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The complete Mobile Hydraulics Catalog from Bosch Rexroth at a glance:

Part 1	Pumps	Axial Piston Pumps, External Gear Pumps, Electrohydraulic Pumps, Gerotor Pumps	RE 90010-01
Part 2	Motors, Gears	Axial Piston Motors, External Gear Motors, Radial Piston Motors, Gears	RE 90010-02
Part 3	Mobile Controls	Control Blocks, Valve Modules, Pilot Control Devices, Power Brake Valves	RE 90010-03
Part 4	Mobile Electronics, Accumulators, Filters	Controllers, Application Software, Tools, Sensors, Displays, Video Cameras, Accumulators, Filters, Oil Measurement Technology	RE 90010-04
Part 5	Compact Hydraulics	Mechanical, Solenoid and Proportional Cartridge Valves, Integrated Circuits	RE 90010-05
Part 6	Compact Hydraulics	Load Holding/Motion Control Valves, Compact Directional Valves, Compact Power Modules	RE 90010-06

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External gear pump Standard-Performance	AZPW	4...22	1x/2x	10090	1261
External gear pump High Performance	AZPB	1...7.1	3x	10088	1297
External gear pump High Performance	AZPF	4...28	1x/2x	10089	1329
External gear pump High Performance	AZPN	20...36	1x/2x	10091	1397
External gear pump High Performance	AZPG	22...100	2x/3x	10093	1421
External gear pump SILENCE	AZPS	4...28	1x/2x	10095	1487
External gear pump SILENCE	AZPT	20...36	2x	10092	1519
External gear pump SILENCE	AZPU	22...63	2x	10098	1541
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Electrohydraulic pumps					
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General

Hydraulic fluids based on mineral oils and related hydrocarbons

Application notes and requirements for Rexroth hydraulic components

Hydraulic fluids

Title	**Hydraulic fluids based on mineral oils and related hydrocarbons**	Environmentally acceptable hydraulic fluids	Fire-resistant, water-free hydraulic fluids	Fire-resistant, water-containing hydraulic fluids
Standard	**DIN 51524**	ISO 15380	ISO 12922	ISO 12922
Data sheets	**RE 90220**	RE 90221	RE 90222	RE 90223 (in preparation)
Classification	**HL HLP HLPD HVLP HLPD and more**	HEPG HEES partially saturated HEES saturated HEPR HETG	HFDR HFDU (ester base) HFDU (glycol base) and more	HFC HFB HFAE HFAS

Contents

1 Basic information

1.1 General instructions

The hydraulic fluid is the common element in any hydraulic component and must be selected very carefully. Quality and cleanliness of the hydraulic fluid are decisive factors for the operational reliability, efficiency and service life of a system.

Hydraulic fluids must conform, be selected and used in accordance with the generally acknowledged rules of technology and safety provisions. Reference is made to the country-specific standards and directives (in Germany the directive of the Employer's Liability Insurance Association BGR 137).

This data sheet includes recommendations and regulations concerning the selection, operation and disposal of hydraulic fluids based on mineral oils and related hydrocarbons in the application of Rexroth hydraulic components.

The individual selection of hydraulic fluid or the choice of classification are the responsibility of the operator.

It is the responsibility of the user to ensure that appropriate measures are taken for safety and health protection and to ensure compliance with statutory regulations. The recommendations of the lubricant manufacturer and the specifications given in the safety data sheet are to be observed when using hydraulic fluid.

This data sheet does not absolve the operator from verifying the conformity and suitability of the respective hydraulic fluid for his system. He is to ensure that the selected fluid meets the minimum requirements of the relevant fluid standard during the whole of the period of use.

Other regulations and legal provisions may also apply. The operator is responsible for their observance, e.g. EU directive 2004/35/EG and their national implementations. In Germany the Water Resources Act (WHG) is also to be observed.

We recommend that you maintain constant, close contact with lubricant manufacturers to support you in the selection, maintenance, care and analyses.

When disposing of used hydraulic fluids, apply the same care as during use.

1.2 Scope

This data sheet must be observed when using hydraulic fluids based on mineral oils and related hydrocarbons in Bosch Rexroth hydraulic components.

Please note that the specifications of this data sheet may be restricted further by the specifications given in the product data sheets for the individual components.

The use of the individual hydraulic fluids in accordance with the intended purpose can be found in the safety data sheets or other product description documents of the lubricant manufacturers. In addition, each use is to be individually considered.

Rexroth hydraulic components may only be operated with hydraulic fluids based on mineral oils and related hydrocarbons according to DIN 51524 if specified in the respective component data sheet or if Rexroth approval for use is furnished.

Notes:
In the market overview RE 90220-01, hydraulic fluid based on mineral oil are described which, according to the information of the lubricant manufacturer, feature the respective parameters of the current requirements standard DIN 51524 and other parameters which are of relevance for suitability in connection with Rexroth components.

These specifications are not checked or monitored by Bosch Rexroth. The list in the market overview does not therefore represent a recommendation on the part of Rexroth or approval of the respective hydraulic fluid for use with Rexroth components and does not release the operator from his responsibility regarding selection of the hydraulic fluid.

Bosch Rexroth will accept no liability for its components for any damage resulting from failure to comply with the notes below.

1.3 Safety instructions

Hydraulic fluids can constitute a risk for persons and the environment. These risks are described in the hydraulic fluid safety data sheets. The operator is to ensure that a current safety data sheet for the hydraulic fluid used is available and that the measures stipulated therein are complied with.

2 Solid particle contamination and cleanliness levels

Solid particle contamination is the major reason for faults occurring in hydraulic systems. It may lead to a number of effects in the hydraulic system. Firstly, single large solid particles may lead directly to a system malfunction, and secondly small particles cause continuous elevated wear.

For hydraulic fluids, the cleanliness level is given as a three-digit numerical code in accordance with ISO 4406. This numerical code denotes the number of particles present in a hydraulic fluid for a defined quantity. Moreover, foreign solid matter is not to exceed a mass of 50 mg/kg (gravimetric examination according to ISO 4405).

In general, compliance with a minimum cleanliness level of 20/18/15 in accordance with ISO 4406 or better is to be maintained in operation. Special servo valves demand improved cleanliness levels of at least 18/16/13. A reduction in cleanliness level by one level means half of the quantity of particles and thus greater cleanliness. Lower numbers in cleanliness levels should always be striven for and extend the service life of hydraulic components. The component with the highest cleanliness requirements determines the required cleanliness of the overall system. Please also observe the specifications in table 1: "Cleanliness levels according to ISO 4406" and in the respective data sheets of the various hydraulic components.

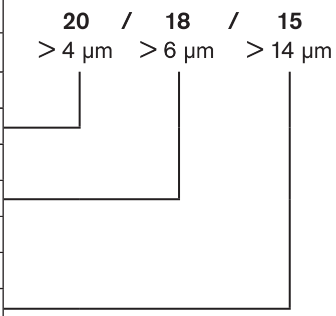
Hydraulic fluids frequently fail to meet these cleanliness requirements on delivery. Careful filtering is therefore required during operation and in particular, during filling in order to ensure the required cleanliness levels. Your lubricant manufacturer can tell you the cleanliness level of hydraulic fluids as delivered. To maintain the required cleanliness level over the operating period, you must use a reservoir breather filter. If the environment is humid, take appropriate measures, such as a breather filter with air drying or permanent off-line water separation.

Note: the specifications of the lubricant manufacturer relating to cleanliness levels are based on the time at which the container concerned is filled and not on the conditions during transport and storage.

Further information about contamination with solid matter and cleanliness levels can be found in brochure RE 08016.

Table 1: Cleanliness levels according to ISO 4406

Particles per 100 ml		Scale number
More than	Up to and including	
8,000,000	16,000,000	24
4,000,000	8,000,000	23
2,000,000	4,000,000	22
1,000,000	2,000,000	21
500,000	1,000,000	20
250,000	500,000	19
130,000	250,000	18
64000	130,000	17
32000	64000	16
16000	32000	15
8000	16000	14
4000	8000	13
2000	4000	12
1000	2000	11
500	1000	10
250	500	9
130	250	8
64	130	7
32	64	6



3 Selection of the hydraulic fluid

The use of hydraulic fluids based on mineral oils for Rexroth hydraulic components is based on compliance with the minimum requirements of DIN 51524.

3.1 Selection criteria for the hydraulic fluid

The specified limit values for all components employed in the hydraulic system, for example viscosity and cleanliness level, must be observed with the hydraulic fluid used, taking into account the specified operating conditions.

Hydraulic fluid suitability depends, amongst others, on the following factors:

3.1.1 Viscosity

Viscosity is a basic property of hydraulic fluids. The permissible viscosity range of complete systems needs to be determined taking account of the permissible viscosity of all components and it is to be observed for each individual component.

The viscosity at operating temperature determines the response characteristics of closed control loops, stability and damping of systems, the efficiency factor and the degree of wear.

We recommend that the optimum operating viscosity range of each component be kept within the permissible temperature range. This usually requires either cooling or heating, or both. The permissible viscosity range and the necessary cleanliness level can be found in the product data sheet for the component concerned.

If the viscosity of a hydraulic fluid used is above the permitted operating viscosity, this will result in increased hydraulic-mechanical losses. In return, there will be lower internal leakage losses. If the pressure level is lower, lubrication gaps may not be filled up, which can lead to increased wear. For hydraulic pumps, the permitted suction pressure may not be reached, which may lead to cavitation damage.

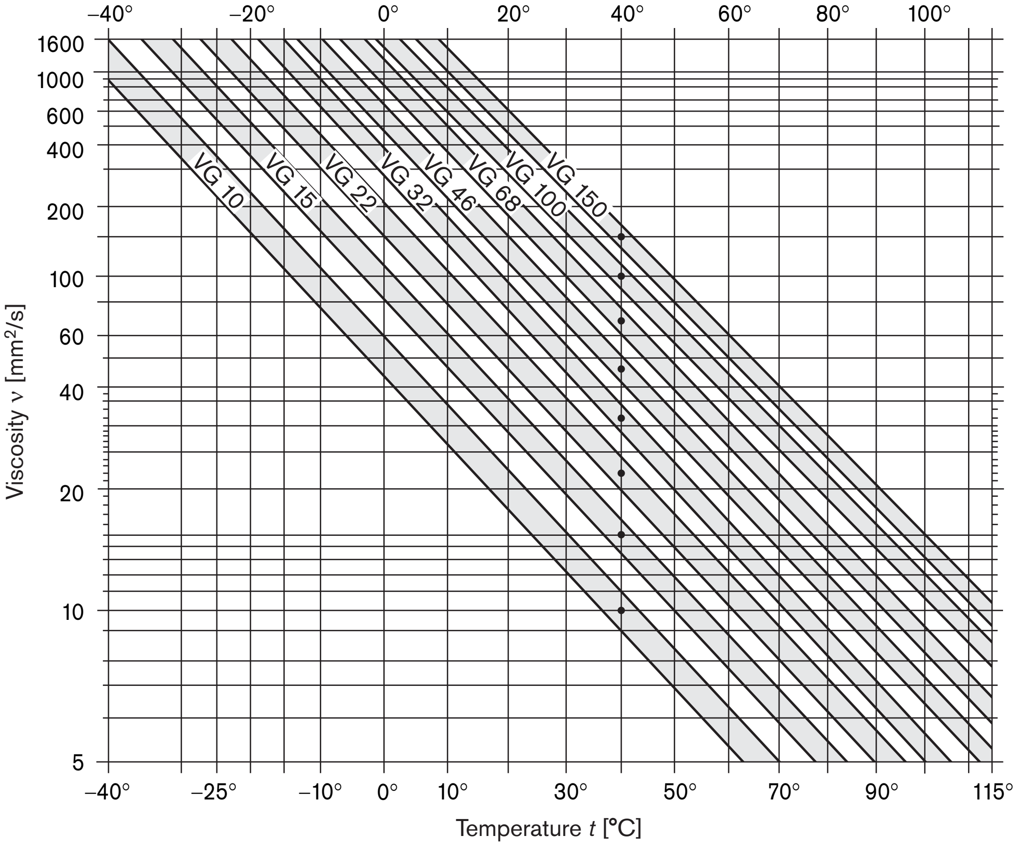
If the viscosity of a hydraulic fluid is below the permitted operating viscosity, increased leakage, wear, susceptibility to contamination and a shorter component life cycle will result.

3.1.2 Viscosity-temperature behavior

For hydraulic fluids, the viscosity temperature behavior (V-T behavior) is of particular importance. Viscosity is characterized in that it drops when the temperature increases and rises when the temperature drops; see Fig. 1 "Viscosity temperature chart for HL, HLP, HLPD (VI 100)". The interrelation between viscosity and temperature is described by the viscosity index (VI).

The viscosity temperature diagram in Fig. 1 is extrapolated in the < 40 °C range. This idealized diagram is for reference purposes only. Measured values can be obtained from your lubricant manufacturer and are to be preferred for design purposes.

Fig. 1: Viscosity-temperature chart for HL, HLP, HLPD (VI 100, double logarithmic representation)



3.1.3 Wear protection capability

Wear protection capability describes the property of hydraulic fluids to prevent or minimize wear within the components. The wear protection capability is described in DIN 51524-2,-3 via test procedures "FZG gear test rig" (ISO 14635-1) and "Mechanical test in the vane pump" (ISO 20763). From ISO VG 32 DIN 51524-2,-3 prescribes a rating of at least 10 (FZG test). At present, the FZG test cannot be applied to viscosity classes < ISO VG 32.

3.1.4 Material compatibility

The hydraulic fluid must not negatively affect the materials used in the components. Compatibility with coatings, seals, hoses, metals and plastics is to be observed in particular. The fluid classifications specified in the respective component data sheets are tested by the manufacturer with regard to material compatibility. Parts and components not supplied by us are to be checked by the user.

Table 2: Known material incompatibilities

Classification	Incompatible with:
HLxx classifications	with EPDM seals
Zinc- and ash/free hydraulic fluids	with bronze-filled PTFE seals

3.1.5 Aging resistance

The way a hydraulic fluid ages depends on the thermal, chemical and mechanical stress to which it is subjected. Aging resistance can be greatly influenced by the chemical composition of the hydraulic fluids.

High fluid temperatures (e.g. over 80 °C) result in a approximate halving of the fluid service life for every 10 °C temperature increase and should therefore by avoided. The halving of the fluid service life results from the application of the Arrhenius equation (see Glossary).

Table 3: Reference values for temperature-dependent aging of the hydraulic fluid

Reservoir temperature	Fluid life cycle
80 °C	100 %
90 °C	50 %
100 °C	25 %

Hydraulic fluids based on mineral oils and related hydrocarbons are tested with 20% water additive during testing of aging resistance according to ISO 4263-1.

The calculated fluid service life is derived from the results of tests in which the long-term characteristics are simulated in a short period of time by applying more arduous conditions (condensed testing). This calculated fluid service life is not to be equated to the fluid service life in real-life applications.

Table 3 is a practical indicator for hydraulic fluids with water content < 0.1%, cf. chapter 4.10. "Water".

3.1.6 Air separation ability (ASA)

The air separation ability (ASA) describes the property of a hydraulic fluid to separate undissolved air. Hydraulic fluids contain approx. 7 to 13 percent by volume of dissolved air (with atmospheric pressure and 50 °C). Hydraulic fluids always contain dissolved air. During operation, dissolved air may be transformed into undissolved air, leading to cavitation damages. Fluid classification, fluid product, reservoir size and design must be coordinated to take into account the dwell time and ASA value of the hydraulic fluid. The air separation capacity depends on the viscosity, temperature, basic fluid and aging.
It cannot be improved by additives.

According to DIN 51524 for instance, an ASA value ≤ 10 minutes is required for viscosity class ISO VG 46, 6 minutes are typical, lower values are preferable.

3.1.7 Demulsifying ability and water solubility

The capacity of a hydraulic fluid to separate water at a defined temperature is known as the demulsifying ability. ISO 6614 defines the demulsifying properties of hydraulic fluids.

For larger systems with permanent monitoring, a demulsifying fluid with good water separation capability (WSC) is recommended. The water can be drained from the bottom of the reservoir. In smaller systems (e.g. in mobile machines), whose fluid is less closely monitored and where water contamination into the hydraulic fluid, for instance through air condensation, cannot be ruled out completely, an HLPD fluid is recommended.

The demulsifying ability up to ISO-VG 100 is given at 54 °C, and at 82 °C for fluids with higher viscosity.

Water emulsifying HLPD hydraulic fluids have no, or a very poor, demulsifying ability.

3.1.8 Filterability

Filterability describes the ability of a hydraulic fluid to pass through a filter, removing solid contaminants. The hydraulic fluids used require a good filterability, not just when new, but also during the whole of their service life. Depending on the basic fluid used and the additives (VI enhancers) there are great differences here.

The filterability is a basic prerequisite for cleanliness, servicing and filtration of hydraulic fluids. Filterability is tested with the new hydraulic fluid and after the addition of 0.2 % water. The underlying standard (ISO 13357-1/-2) stipulates that filterability must have no negative effects on the filters or the hydraulic fluid, see chapter 4 "Hydraulic fluids in operation".

3.1.9 Corrosion protection

Hydraulic fluids should not just prevent corrosion formation on steel components, they must also be compatible with non-ferrous metals and alloys. Corrosion protection tests on different metals and metal alloys are described in DIN 51524. Hydraulic fluids that are not compatible with the materials listed above must not be used, even if they are compliant with ISO 51524.

Rexroth components are usually tested with HLP hydraulic fluids or corrosion protection oils based on mineral oils before they are delivered.

3.1.10 Additivation

The properties described above can be modified with the help of suitable additives. A general distinction is made for fluids between heavy metal-free and heavy metal-containing (generally zinc) additive systems. Both additive systems are most often incompatible with each other. The mixing of these fluids must be avoided even if the mixing ratio is very low. See chapter 4, "Hydraulic fluids in operation".

Increasing additivation generally leads to deteriorated air separation ability (ASA) and water separation capability (WSC) of the hydraulic fluid. According to the present state of knowledge, all hydraulic fluids described in this document, independently of the actual additivation, can be filtered using all filter materials with all known filtration ratings ≥ 1 µm without filtering out effective additives at the same time.

Bosch Rexroth does not prescribe any specific additive system.

3.2 Classification and fields of application

Table 4: Classification and fields of application

Classification	Features	Typical field of application	Notes
HL fluids according to DIN 51524-1 VI = 100	Hydraulic fluids predominantly only with additives for oxidation and corrosion protection, but no specific additives for wear protection in case of mixed friction	HL fluids can be used in hydraulic systems that do not pose any requirements as to wear protection.	HL fluids may be used only for components whose product data sheet specifically allows HL fluids. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. Hydraulic fluids that only comply with the requirements of classes HL and HR in accordance with ISO 11158 without proving that DIN 51524-1 is also met may be used only with written approval of Bosch Rexroth AG. Observe restrictions as to pressure, rotation speed etc.
HLP fluids according to DIN 51524-2 VI = 100	Hydraulic fluid with corrosion, oxidation and verified wear protection additives	HLP fluids are suitable for most fields of application and components provided the temperature and viscosity provisions are observed.	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. For the viscosity classes VG10, VG15 and VG22, DIN 51524 defines no requirements as to wear protection (DIN 51354 part 2 and DIN 51389 part 2). Beyond the requirements of DIN 51524 part 2, we require the same base oil type, identical refining procedure, identical additivation and identical additivation level across all viscosity classes.

Continued on page 8

Table 4: **Classification and fields of application** (continued from page 7)

Classification	**Features**	**Typical field of application**	**Notes**
HVLP fluids according to DIN 51524-3 VI > 140	HLP hydraulic fluid with additional improved viscosity temperature behavior	HVLP fluids are used in systems operated over a wide temperature range.	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. The same notes and restrictions as defined for HLP fluids apply accordingly. The effect on Rexroth components (e.g. compatibility with material seals, wear resistance capacity) may differ when using related hydrocarbons instead of mineral oils, cf. Table 6, line 8. When using HVLP fluids, the viscosity may change on account of the shear of the long-chain VI enhancers. The viscosity index, high at the start, decreases during operation. This needs to be taken into account when selecting the hydraulic fluid. The only value at present that can be used to assess viscosity changes in operation is the result of the test in accordance with DIN 51350 part 6. Please note that there are practical applications that create a much higher shear load on such fluids than can be achieved by this test. Up to VI < 160, we recommend a maximum permitted viscosity drop of 15 %, viscosity at 100 °C. The viscosity limits given by Bosch Rexroth for its components are to be observed for all operating conditions, even after the hydraulic fluids have sheared. HVLP fluids should be used only if required by the temperature ranges of the application.
HLPD fluids according to DIN 51524-2, HVLPD fluids in accordance with DIN 51524-3	HLP and HVLP hydraulic fluid with additional detergent and or dispersant additives	HLPD and HVLPD fluids are used in systems where deposits as well as solid or liquid contamination need to be kept temporarily suspended	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. Some of these fluids are able to absorb significant quantities of water (> 0.1 %). This may have negative implications for the wear protection and the aging properties of the fluid. The wetting ability of these fluids varies largely depending on the product. Therefore it is not correct to say that they are generally all very well able to prevent stick-slip. In individual cases where higher water contamination is to be expected (such as in steelworks or under humid conditions), the use of HLPD/HVLPD fluids cannot be recommended as the emulsified water does not settle in the reservoir but is evaporated in heavily loaded positions. For such cases, we recommend using HLP hydraulic fluids with particularly good demulsifying ability. The water collected at the reservoir bottom is to be drained regularly. If HLPD/HVLPD fluids are used, contamination does not settle. It rather remains suspended and needs to be filtered out or removed by appropriate draining systems. For this reason, the filter area must be increased. HLPD/HVLPD fluids may contain additives that in the long run are incompatible with plastics, elastomers and non-ferrous metals. Furthermore, these additives may lead to the premature clogging of hydraulic filters. Therefore, test the filterability and the selection of the filter material in consultation with the filter manufacturer.

4 Hydraulic fluids in operation

4.1 General

The properties of hydraulic fluids can change continually during storage and operation.

Please note that the fluid standard DIN 51524 merely describes minimum requirements for hydraulic fluids in new condition at the time of filling into the bins. The operator of a hydraulic system must ensure that the hydraulic fluid remains in a utilizable condition throughout its entire period of use.

Deviations from the characteristic values are to be clarified with the lubricant manufacturer, the test labs or Bosch Rexroth.

Please note the following aspects in operation.

4.2 Storage and handling

Hydraulic fluids must be stored correctly in accordance with the instructions of the lubricant manufacturer. Avoid exposing the containers to lengthy periods of direct heat. Containers are to be stored in such a way that the risk of any foreign liquid or solid matter (e.g. water, foreign fluids or dust) ingression into the inside of the container can be ruled out. After taking hydraulic fluids from the containers, these are immediately to be properly resealed.

Recommendation:

- Store containers in a dry, roofed place
- Store barrels on their sides
- Clean reservoir systems and machine reservoirs regularly

4.3 Filling of new systems

Usually, the cleanliness levels of the hydraulic fluids as delivered do not meet the requirements of our components. Hydraulic fluids must be filtered using an appropriate filter system to minimize solid particle contamination and water in the system.

As early as possible during test operation, new systems should be filled with the selected hydraulic fluid so as to reduce the risk of accidentally mixing the fluids (see chapter 4.5 "Mixing and compatibility of different hydraulic fluids"). Changing the hydraulic medium at a later point represents significant additional costs (see following chapter).

4.4 Hydraulic fluid changeover

Changeovers, in particular between hydraulic fluids with heavy metal-free and heavy metal-containing (generally zinc) additives, frequently lead to malfunctions, see chapter 3.1.10 "Additivation".

In the case of changeovers of the fluid in hydraulic systems, it is important to ensure compatibility of the new hydraulic fluid with the remainder of the previous hydraulic fluid. We recommend obtaining a written performance guarantee from the manufacturer or supplier of the new hydraulic fluid. The quantity of old fluid remaining should be minimized. Mixing hydraulic fluids should be avoided, see following chapter.

For information on changing over hydraulic fluids with different classifications please refer to VDMA 24314, VDMA 24569 and ISO 15380 appendix A.

Bosch Rexroth will not accept liability for any damage to its components resulting from inadequate hydraulic fluid changeovers!

4.5 Mixing and compatibility of different hydraulic fluids

If hydraulic fluids from different manufacturers or different types from the same manufacturer are mixed, gelling, silting and deposits may occur. These, in turn, may cause foaming, impaired air separation ability, malfunctions and damage to the hydraulic system.

If the fluid contains more than 2 % of another fluid then it is considered to be a mixture. Exceptions apply for water, see chapter 4.10 "Water".

Mixing with other hydraulic fluids is not generally permitted. This also includes hydraulic fluids with the same classification and from the market overview RE 90220-01. If individual lubricant manufacturers advertise miscibility and/or compatibility, this is entirely the responsibility of the lubricant manufacturer.

Bosch Rexroth customarily tests all components with mineral oil HLP before they are delivered.

Note: With connectible accessory units and mobile filtering systems, there is a considerable risk of non-permitted mixing of the hydraulic fluids!

Rexroth will not accept liability for any damage to its components resulting from mixing hydraulic fluids!

4.6 Re-additivation

Additives added at a later point in time such as colors, wear reducers, VI enhancers or anti-foam additives, may negatively affect the performance properties of the hydraulic fluid and the compatibility with our components and therefore are not permissible.

Rexroth will not accept liability for any damage to its components resulting from re-additivation!

4.7 Foaming behavior

Foam is created by rising air bubbles at the surface of hydraulic fluids in the reservoir. Foam that develops should collapse as quickly as possible.

Common hydraulic fluids in accordance with DIN 51524 are sufficiently inhibited against foam formation in new condition. On account of aging and adsorption onto surfaces, the defoamer concentration may decrease over time, leading to a stable foam.

Defoamers may be re-dosed only after consultation with the lubricant manufacturer and with his written approval.

Defoamers may affect the air separation ability.

4.8 Corrosion

The hydraulic fluid is to guarantee sufficient corrosion protection of components under all operating conditions, even in the event of impermissible water contamination.

During storage and operation, hydraulic fluid based on mineral oils with anti-corrosion additives protect components against water and "acidic" oil degradation products.

4.9 Air

Under atmospheric conditions, the hydraulic fluid contains dissolved air. In the negative pressure range, for instance in the suction pipe of the pump or downstream of control edges, this dissolved air may transform into undissolved air. The undissolved air content represents a risk of cavitation and of the diesel effect. This results in material erosion of components and increased hydraulic fluid aging.

With the correct measures, such as suction pipe and reservoir design, and an appropriate hydraulic fluid, air intake and separation can be positively influenced.

See also chapter 3.1.7 "Air separation ability (ASA)".

4.10 Water

Water contamination in hydraulic fluids can result from direct ingress or indirectly through condensation of water from the air due to temperature variations.

Water in the hydraulic fluid may result in wear or direct failure of hydraulic components. Furthermore, a high water content in the hydraulic fluid negatively affects aging and filterability and increases susceptibility to cavitation.

Undissolved water can be drained from the bottom of the reservoir. Dissolved water can be removed only by using appropriate measures. If the hydraulic system is used in humid conditions, preventive measures need to be taken, such as an air dehumidifier at the reservoir vent. During operation, the water content in all hydraulic fluids, determined according to the "Karl Fischer method" (see chapter 6 "Glossary") for all hydraulic fluids must constantly be kept below 0.1% (1000 ppm). To ensure a long service life of both hydraulic fluids and components, Bosch Rexroth recommends that values below 0.05% (500 ppm) are permanently maintained.

To ensure a long service life for the hydraulic fluids and the components, we recommend that values below 0.05 % (500 ppm) are permanently maintained. Detergent and or dispersant hydraulic fluids (HLPD / HVLPD) are able to absorb (and keep suspended) more water. Prior to using these hydraulic fluids, please contact the lubricant manufacturer.

4.11 Fluid servicing, fluid analysis and filtration

Air, water, operating temperature influences and solid matter contamination will change the performance characteristics of hydraulic fluids and cause them to age.

To preserve the usage properties and ensure a long service life for hydraulic fluid and components, the monitoring of the fluid condition and a filtration adapted to the application requirements (draining and degassing if required) are indispensable.

The effort is higher in the case of unfavorable usage conditions, increased stress for the hydraulic system or high expectations as to availability and service life, see chapter 2 "Solid particle contamination and cleanliness level".

When commissioning a system, please note that the required minimum cleanliness level can frequently be attained only by flushing the system. Due to severe start-up contamination, it may be possible that a fluid and/or filter replacement becomes necessary after a short operating period (< 50 operating hours).

The hydraulic fluid must be replaced in regular intervals and tested by the lubricant manufacturer or recognized, accredited test labs. **We recommend a reference analysis after commissioning.**

The minimum data to be tested for analyses are:

- Viscosity at 40 °C and 100 °C
- Neutralization number NN (acid number AN)
- Water content (Karl-Fischer method)
- Particle measurement with evaluation according to ISO 4406 or mass of solid foreign substances with evaluation to EN 12662
- Element analysis (RFA (EDX) / ICP, specify test method)
- Comparison with new product or available trend analyses
- Assessment / evaluation for further use
- Also recommended: IR spectrum

Compared to the pure unused hydraulic fluid, the changed neutralization number NN (acid number AN) indicates how many aging products are contained in the hydraulic fluid. This value must be kept as low as possible. As soon as the trend analysis notes a significant increase in the acid number, the lubricant manufacturer should be contacted.

In case of warranty, liability or guarantee claims to Bosch Rexroth, service verification and/or the results of fluid analyses are to be provided.

5 Disposal and environmental protection

Hydraulic fluids based on mineral oil and related hydrocarbons are hazardous for the environment. They are subject to a special disposal obligation.

The respective lubricant manufacturers provide specifications on environmentally acceptable handling and storage. Please ensure that spilt or splashed fluids are absorbed with appropriate adsorbents or by a technique that prevents it contaminating water courses, the ground or sewerage systems.

It is also not permitted to mix fluids when disposing of hydraulic fluids. Regulations governing the handing of used oils stipulate that used oils are not to mixed with other products, e.g. substances containing halogen. Non-compliance will increase disposal costs. Comply with the national legal provisions concerning the disposal of the corresponding hydraulic fluid. Comply with the local safety data sheet of the lubricant manufacturer for the country concerned.

6 Other hydraulic fluids based on mineral oil and related hydrocarbons

Table 6: Other hydraulic fluids based on mineral oils and related hydrocarbons

Serial number	Hydraulic fluids	Features / Typical field of application / Notes
1	Hydraulic fluids with classification HL, HM, HV according to ISO 11158	– Can be used without confirmation provided they are listed in the respective product data sheet and are compliant with DIN 51524. Conformity with DIN 51524 must be verified in the technical data sheet of the fluid concerned. For classification see Table 4: "Hydraulic fluid classification". – Fluids **only** classified in accordance with ISO 11158 may be used only with prior written approval of Bosch Rexroth AG.
2	Hydraulic fluids with classification HH, HR, HS, HG according to ISO 11158	– May not be used.
3	Hydraulic fluids with classification HL, HLP, HLPD, HVLP, HVLPD to DIN 51502	– DIN 51502 merely describes how fluids are classified / designated on a national level. – It contains no information on minimum requirements for hydraulic fluids. – Hydraulic fluids standardized according to DIN 51502 can be used without confirmation provided they are listed in the respective product data sheet and are compliant with DIN 51524. Conformity with DIN 51524 must be verified in the technical data sheet of the fluid concerned. For classification see Table 4: "Hydraulic fluid classification".
4	Hydraulic fluids with classification HH, HL, HM, HR, HV, HS, HG according to ISO 6743-4	– ISO 6743-4 merely describes how fluids are classified / designated on an international level. It contains no information on minimum requirements for hydraulic fluids. – Hydraulic fluids standardized according to ISO 6743 -4 can be used without confirmation provided they are listed in the respective product data sheet and are compliant with DIN 51524. Conformity with DIN 51524 must be verified in the technical data sheet of the fluid concerned. For classification see table 4: "Classification and fields of application".
5	Lubricants and regulator fluids for turbines to DIN 51515-1 and -2	– Turbine oils can be used after confirmation and with limited performance data. – They usually offer lower wear protection than mineral oil HLP. Classification of turbine oils to DIN 51515-1 comparable to HL, turbine oils to DIN 51515-2 comparable to HLP. – Particular attention must be paid to material compatibility!
6	Lube oils C, CL, CLP in accordance with DIN 51517	– Lube oils in acc. with DIN 51517 can be used after confirmation and with limited performance data. They are mostly higher-viscosity fluids with low wear protection. Classification: CL similar to HL fluids and CLP similar to HLP fluids. – Particular attention must be paid to material compatibility, specifically with non-ferrous metals!
7	Fluids to be used in pharmaceutical and foodstuff industries, in acc. with FDA / USDA / NSF H1	– There are medical white oils and synthetic hydrocarbons (PAO). – Can only be used after consultation and approval for use in the specific application, even if they are compliant with DIN 51524. – May be used only with FKM seals. – Other fluids used in pharmaceutical and foodstuff industries may be used only after confirmation. – Attention is to be paid to material compatibility in accordance with the applicable food law. **Caution!** Fluids used in pharmaceutical and foodstuff industries should not be confused with environmentally acceptable fluids!

Continued on page 13

Table 6: Other hydraulic fluids based on mineral oils and related hydrocarbons
(continued from page 12)

Serial number	Hydraulic fluids	Features / Typical field of application / Notes
8	Hydraulic fluids of classes HVLP and HVLPD based on related hydrocarbons	– Can only be used after consultation and approval for use in the specific application, even if they are compliant with DIN 51524. – Lower pour point than HLP – Other wetting (polarity)
9	Automatic Transmission Fluids (ATF)	– ATF are operating fluids for automatic gearboxes in vehicles and machines. In special cases, ATFs are also used for certain synchronous gearboxes and hydraulic systems comprising gearboxes. – To be used only after confirmation! – Some of these fluids have poor air separation abilities and modified wear properties. – Check material compatibility and filterability!
10	Multi-purpose oil (MFO) – Industry	– Multi-purpose oils (industry) combine at least two requirements for a fluid, for instance metal machining and hydraulics. – To be used only after confirmation! – Please pay particular attention to air separation ability, modified wear properties and the reduced material life cycle. – Check material compatibility and filterability!
11	Multi-purpose oils (MFO) – Mobil UTTO, STOU	– Multi-purpose oils combine requirements for wet brakes, gearboxes, motor oil (STOU only) and hydraulics. – Fluids of the types: – UTTO (= universal tractor transmission oil) and – STOU (= Super Tractor super tractor universal oil) – To be used only after confirmation! – Please pay particular attention to shear stability, air separation ability and modified wear properties. – Check material compatibility and filterability!
12	Single-grade engine oils 10W, 20W, 30W	– To be used only after confirmation! – Please pay particular attention to the air separation ability and filtering ability.
13	Multi-grade engine oils 0Wx-30Wx	– To be used only after confirmation! – Please pay particular attention to air separation ability, changes in wear protection capability, viscosity changes during operation, material compatibility, dispersant and detergent properties and filterability. **Caution!** Multi-grade engine oils have been adapted to specific requirements in combustion engines and are suitable for use in hydraulic systems only to a limited extent.
14	Motor vehicle transmission oils	– Motor vehicle transmission oil can be used after confirmation and with limited performance data. – Pay particular attention to wear protection, material compatibility, specifically with non-ferrous metals, as well as viscosity!
15	Diesel, test diesel in acc. with DIN 4113	– Diesel / test diesel has poorer wear protection capabilities and a very low viscosity (< 3 mm^2/s). – May be used only with FKM seals – Please note their low flash point! – To be used only after confirmation and with limited performance data!

Continued on page 14

Table 6: Other hydraulic fluids based on mineral oils and related hydrocarbons
(continued from page 13)

Serial number	Hydraulic fluids	Features / Typical field of application / Notes
16	Hydraulic fluids for roller processes	– Hydraulic fluids for roller processes have lower wear protection capabilities than mineral oil HLP and a lower viscosity – Please note their low flash point! – Hydraulic fluids for roller processes with limited performance data can be used only after confirmation.
17	Fluids for power steering, hydro-pneumatic suspension, active chassis etc.	– Can only be used after consultation and approval for use in the specific application, even if they are compliant with DIN 51524. – Please note the low viscosity! – In most cases they have poor water separation capability – Check the material compatibility!

7 Glossary

Additivation
Additives are chemical substances added to the basic fluids to achieve or improve specific properties.

Aging
Hydraulic fluids age due to oxidation (see chapter 3.1.5 "Aging resistance"). Liquid and solid contamination acts as a catalyzer for aging, meaning that it needs to be minimized as far as possible by careful filtration.

API classification
Classification of basic fluids by the **A**merican **P**etroleum **I**nstitute (API) – the largest association representing the US oil and gas industry.

Arrhenius equation
The quantitative relation between reaction rate and temperature is described by an exponential function, the Arrhenius equation. This function is usually visualized within the typical temperature range of the hydraulic system. For a practical example, see chapter 3.1.5 "Aging resistance".

Related hydrocarbons
Related hydrocarbons are hydrocarbon compounds that are not classified as API class 1, 2 or 5.

Basic fluids
In general, a hydraulic fluid is made up of a basic fluid, or base oil, and chemical substances, the so-called additives. The proportion of basic fluid is generally greater than 90%.

Demulsifying
Ability of a fluid to separate water contamination quickly; achieved with careful selection of base oil and additives.

Detergent
Ability of certain additives to emulsify part of the water contamination in the oil or to hold it in suspension until it has evaporated with increasing temperature. Larger water quantities, in contrast (above approx. 2 %), are separated immediately.

Dispersant
Ability of certain additives to keep insoluble liquid and solid contamination in suspension in the fluid.

Diesel effect
If hydraulic fluid that contains air bubbles is compressed quickly, the bubbles are heated to such a degree that a self-ignition of the air-gas mix may occur. The resultant temperature increase may lead to seal damage and increased aging of the hydraulic fluid.

Hydraulic fluids based on mineral oils
Hydraulic fluids based on mineral oils are made from petroleum (crude oil).

ICP (atomic emission spectroscopy)
The ICP procedure can be used to determine various wear metals, contamination types and additives. Practically all elements in the periodic system can be detected with this method.

Karl Fischer method
Method to determine the water content in fluids. Indirect coulometric determination procedure in accordance with DIN EN ISO 12937 in connection with DIN 51777-2. Only the combination of both standards will assure adequately accurate measured values.

Cavitation
Cavitation is the creation of cavities in fluids due to pressure reduction below the saturated vapour pressure and subsequent implosion when the pressure increases. When the cavities implode, extremely high acceleration, temperatures and pressure may occur temporarily, which may damage the component surfaces.

Neutralization number (NN)
The neutralization number (NN) or acid number (AN) specifies the amount of caustic potash required to neutralize the acid contained in one gram of fluid.

Pour point
The lowest temperature at which the fluid still just flows when cooled down under set conditions. The pour point is specified in the lubricant manufacturers' technical data sheets as a reference value for achieving this flow limit.

RFA (wavelength dispersive x-ray fluorescence analysis)
Is a procedure to determine nearly all elements in liquid and solid samples with nearly any composition. This analysis method is suitable for examining additives and contamination, delivering fast results.

Shearing/shear loss
Shearing of molecule chains during operation can change the viscosity of hydraulic fluids with long chain VI enhancers. The initially high viscosity index drops. This needs to be taken into account when selecting the hydraulic fluid.

The only value at present that can be used to assess viscosity changes in operation is the result of the test in accordance with DIN 51350 part -6. Please note that there are practical applications that create a much higher shear load on such hydraulic fluids than can be achieved by this test.

Stick-slip effect (sliding)
Interaction between a resilient mass system involving friction (such as cylinder + oil column + load) and the pressure increase at very low sliding speeds. The static friction of the system is a decisive value here. The lower it is, the lower the speed that can still be maintained without sticking. Depending on the tribologic system, the stick-slip effect may lead to vibrations generated and sometimes also to significant noise emission. In many cases, the effect can be attenuated by replacing the lubricant.

Viscosity
Viscosity is the measure of the internal friction of a fluid to flow. It is defined as the property of a substance to flow under tension. Viscosity is the most important characteristic for describing the load-bearing capacity of a hydraulic fluid.

Kinematic viscosity is the ratio of the dynamic viscosity and the density of the fluid; the unit is mm^2/s. Hydraulic fluids are classified by their kinematic viscosity into ISO viscosity classes. The reference temperature for this is 40 °C.

Viscosity index (VI)
Refers to the viscosity temperature behavior of a fluid.
The lower the change of viscosity in relation the temperature, the higher the VI.

Environmentally acceptable hydraulic fluids

Application notes and requirements for Rexroth hydraulic components

Hydraulic fluids

Title	Hydraulic fluids based on mineral oils and related hydrocarbons	**Environmentally acceptable hydraulic fluids**	Fire-resistant, water-free hydraulic fluids	Fire-resistant, water-containing hydraulic fluids
Standard	DIN 51524	**ISO 15380**	ISO 12922	ISO 12922
Data sheets	RE 90220	**RE 90221**	RE 90222	RE 90223 (in preparation)
Classification	HL HLP HLPD HVLP HLPD and more	**HEPG** **HEES partially saturated** **HEES saturated** **HEPR** **HETG**	HFDR HFDU (ester base) HFDU (glycol base) and more	HFC HFB HFAE HFAS

Contents

1 Basic information

1.1 General instructions

The hydraulic fluid is the common element in any hydraulic component and must be selected very carefully. Quality and cleanliness of the hydraulic fluid are decisive factors for the operational reliability, efficiency and service life of a system.

Hydraulic fluids must conform, be selected and used in accordance with the generally acknowledged rules of technology and safety provisions. Reference is made to the country-specific standards and directives (in Germany the directive of the Employer's Liability Insurance Association BGR 137).

This data sheet includes recommendations and regulations concerning the selection, operation and disposal of environmentally compatible hydraulic fluids in the application of Rexroth hydraulic components.

The individual selection of hydraulic fluid or the choice of classification are the responsibility of the operator.

It is the responsibility of the user to ensure that appropriate measures are taken for safety and health protection and to ensure compliance with statutory regulations. The recommendations of the lubricant manufacturer and the specifications given in the safety data sheet are to be observed when using hydraulic fluid.

This data sheet does not absolve the operator from verifying the conformity and suitability of the respective hydraulic fluid for his system. He is to ensure that the selected fluid meets the minimum requirements of the relevant fluid standard during the whole of the period of use.

Other regulations and legal provisions may also apply. The operator is responsible for their observance, e.g. EU directive 2004/35/EG, 2005/360/EG and their national implementation. In Germany the Water Resources Act (WHG) is also to be observed.

We recommend that you maintain constant, close contact with lubricant manufacturers to support you in the selection, maintenance, care and analyses.

When disposing of used hydraulic fluids, apply the same care as during use.

Environmentally acceptable hydraulic fluids have been used successfully for many years. In some countries, the use of environmentally acceptable hydraulic fluids is already prescribed in ecologically sensitive areas (e.g. forestry, locks, weirs).

Environmentally acceptable hydraulic fluids may only be used in the pharmaceutical and food industry subject to required certification to FDA/USDA/NSF **H1**.

1.2 Environmental compatibility

There is no unambiguous legal definition for environmentally acceptable hydraulic fluids as different testing procedures can be applied for biological degradation and toxicity.

According to ISO 15380 the definition of "environmentally acceptable" is as follows: Humans, animals, plants, air and soil must not be endangered. With regard to hydraulic fluids in an unused condition in the bin this mainly means:

- biological degradation at least 60 %
  (according to ISO 14593 or ISO 9439)
- acute fish toxicity at least 100 mg/l
  (according to ISO 7346-2)
- acute daphnia toxicity at least 100 mg/l
  (according to ISO 5341)
- acute bacteria toxicity at least 100 mg/l
  (according to ISO 8192)

The same amount of care should be taken when handling environmentally acceptable hydraulic fluids as for mineral oils, leakage from the hydraulic system should be avoided. Environmentally acceptable hydraulic fluids are designed so that in the event of accidents and leakage,less permanent environmental damage is caused than by mineral oils, see also chapter 5 "Disposal and environmental protection".

In comparison to mineral oil HLP/HVLP , the biological degradation of environmentally acceptable hydraulic fluids may change fluid aging, see chapter 3.1.5 "Aging resistance", 3.1.6. "Biological degradation" and 4 "Hydraulic fluids in operation".

1.3 Scope

This data sheet must be applied when using environmentally acceptable hydraulic fluids with Rexroth hydraulic components. The specifications of this data sheet may be further restricted by the specification given in the data sheets for the individual components.

The use of the individual environmentally acceptable hydraulic fluids in accordance with the intended purpose can be found in the safety data sheets or other product description documents of the lubricant manufacturers. In addition, each use is to be individually considered.

Rexroth hydraulic components may only be operated with environmentally acceptable hydraulic fluids according to ISO 15380 if specified in the respective component data sheet or if a Rexroth approval for use is furnished.

The manufacturers of hydraulic systems must adjust their systems and operating instructions to the environmentally acceptable hydraulic fluids.

Notes:
In the market overview RE 90221-01, environmentally acceptable hydraulic fluids based on mineral oil are described which, according to the information of the lubricant manufacturer, feature the respective parameters of the current requirements standard ISO 15380 and other parameters which are of relevance for suitability in connection with Rexroth components.

These specifications are not checked or monitored by Bosch Rexroth. The list in the market overview does not therefore represent a recommendation on the part of Rexroth or approval of the respective hydraulic fluid for use with Rexroth components and does not release the operator from his responsibility regarding selection of the hydraulic fluid.

Bosch Rexroth will accept no liability for its components for any damage resulting from failure to comply with the notes below.

1.4 Safety instructions

Hydraulic fluids can constitute a risk for persons and the environment. These risks are described in the hydraulic fluid safety data sheets. The operator is to ensure that a current safety data sheet for the hydraulic fluid used is available and that the measures stipulated therein are complied with.

2 Solid particle contamination and cleanliness levels

Solid particle contamination is the major reason for faults occurring in hydraulic systems. It may lead to a number of effects in the hydraulic system. Firstly, single large solid particles may lead directly to a system malfunction, and secondly small particles cause continuous elevated wear.

For mineral oils, the cleanliness level of environmentally acceptable hydraulic fluids is given as a three-digit numerical code in accordance with ISO 4406. This numerical code denotes the number of particles present in a hydraulic fluid for a defined quantity. Moreover, foreign solid matter is not to exceed a mass of 50 mg/kg (gravimetric examination according to ISO 4405).

In general, compliance with a minimum cleanliness level of 20/18/15 in accordance with ISO 4406 or better is to be maintained in operation. Special servo valves demand improved cleanliness levels of at least 18/16/13. A reduction in cleanliness level by one level means half of the quantity of particles and thus greater cleanliness. Lower numbers in cleanliness levels should always be striven for and extend the service life of hydraulic components. The component with the highest cleanliness requirements determines the required cleanliness of the overall system. Please also observe the specifications in table 1: "Cleanliness levels according to ISO 4406" and in the respective data sheets of the various hydraulic components.

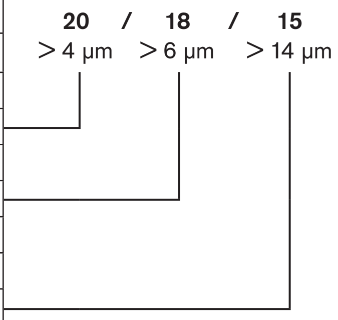
Hydraulic fluids frequently fail to meet these cleanliness requirements on delivery. Careful filtering is therefore required during operation and in particular, during filling in order to ensure the required cleanliness levels. Your lubricant manufacturer can tell you the cleanliness level of hydraulic fluids as delivered. To maintain the required cleanliness level over the operating period, you must use a reservoir breather filter. If the environment is humid, take appropriate measures, such as a breather filter with air drying or permanent off-line water separation.

Note: the specifications of the lubricant manufacturer relating to cleanliness levels are based on the time at which the container concerned is filled and not on the conditions during transport and storage.

Further information about contamination with solid matter and cleanliness levels can be found in brochure RE 08016.

Table 1: Cleanliness levels according to ISO 4406

Particles per 100 ml		Scale number
More than	Up to and including	
8,000,000	16,000,000	24
4,000,000	8,000,000	23
2,000,000	4,000,000	22
1,000,000	2,000,000	21
500,000	1,000,000	20
250,000	500,000	19
130,000	250,000	18
64000	130,000	17
32000	64000	16
16000	32000	15
8000	16000	14
4000	8000	13
2000	4000	12
1000	2000	11
500	1000	10
250	500	9
130	250	8
64	130	7
32	64	6



3 Selection of the hydraulic fluid

Environmentally acceptable hydraulic fluids for Bosch Rexroth hydraulic components are assessed on the basis of their fulfillment of the minimum requirements of ISO 15380.

3.1 Selection criteria for the hydraulic fluid

The specified limit values for all components employed in the hydraulic system, for example viscosity and cleanliness level, must be observed with the hydraulic fluid used, taking into account the specified operating conditions.

Hydraulic fluid suitability depends, amongst others, on the following factors:

3.1.1 Viscosity

Viscosity is a basic property of hydraulic fluids. The permissible viscosity range of complete systems needs to be determined taking account of the permissible viscosity of all components and it is to be observed for each individual component.

The viscosity at operating temperature determines the response characteristics of closed control loops, stability and damping of systems, the efficiency factor and the degree of wear.

We recommend that the optimum operating viscosity range of each component be kept within the permissible temperature range. This usually requires either cooling or heating, or both. The permissible viscosity range and the necessary cleanliness level can be found in the product data sheet for the component concerned.

If the viscosity of a hydraulic fluid used is above the permitted operating viscosity, this will result in increased hydraulic-mechanical losses. In return, there will be lower internal leakage losses. If the pressure level is lower, lubrication gaps may not be filled up, which can lead to increased wear. For hydraulic pumps, the permitted suction pressure may not be reached, which may lead to cavitation damage.

If the viscosity of a hydraulic fluid is below the permitted operating viscosity, increased leakage, wear, susceptibility to contamination and a shorter life cycle will result.

Please ensure that the permissible temperature and viscosity limits are observed for the respective components. This usually requires either cooling or heating, or both.

3.1.2 Viscosity-temperature behavior

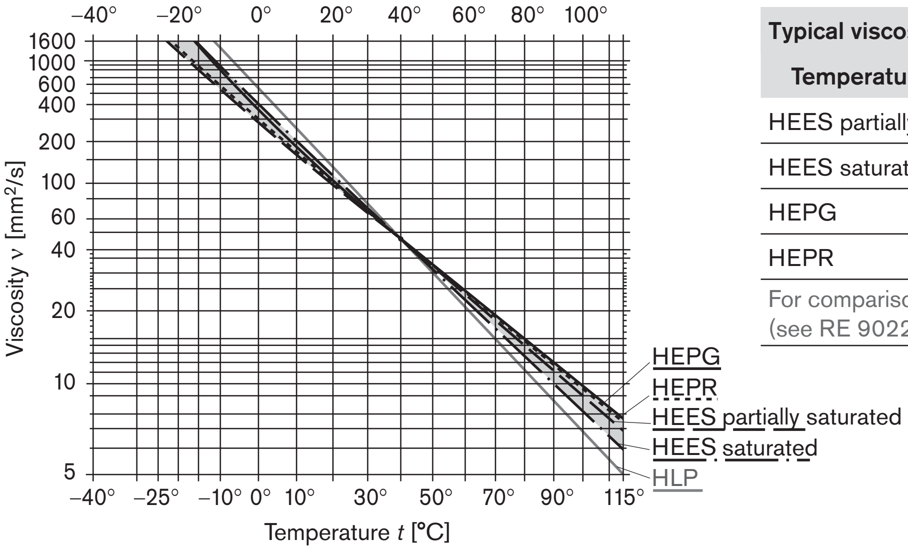
For hydraulic fluids, the viscosity temperature behavior (V-T behavior) is of particular importance. Viscosity is characterized in that it drops when the temperature increases and rises when the temperature drops. The interrelation between viscosity and temperature is described by the viscosity index (VI).

If exposed to the cold for several days, viscosity may rise significantly (HETG and HEES). After heating, the characteristic values as specified on the data sheet are restored. Please ask your lubricant manufacturer for the " Flow capacity after 7 days at low temperature" (ASTM D 2532) of fluid classifications HETG and partially saturated HEES.

All known environmentally acceptable hydraulic fluids have better viscosity temperature behavior than mineral oil HLP and generally feature greater shear stability than HVLP mineral oils. This should be taken into consideration when selecting hydraulic fluid for the required temperature range. A lower viscosity level can frequently be used to save any drive power during a cold start and avoid viscosity being too low at higher temperatures. The required viscosity and temperature limits in the product data sheets are to be observed in all operating conditions.

Depending on the basic fluid types/classes, VI indices can be achieved of 140–220, see Fig. 1: "Examples: V-T diagrams in comparison to HLP (reference values)" and Table 4: "Classification and fields of application of environmentally acceptable hydraulic fluids".

Fig. 1: Examples V-T diagrams in comparison to HLP (reference values, double-logarithmic representation)



Typical viscosity data [mm²/s]			
Temperature	**–20 °C**	**40 °C**	**100 °C**
HEES partially saturated	1250	46	9
HEES saturated	2500	46	8
HEPG	2500	46	10
HEPR	1400	46	10
For comparison HLP (see RE 90220)	4500	46	7

Detailed V-T diagrams may be obtained from your lubricant manufacturer for their specific products.

3.1.3 Wear protection capability

Wear protection capability describes the property of hydraulic fluids to prevent or minimize wear within the components. The wear protection capability is described in ISO 15380 via test procedures"FZG gear test rig" (ISO 14635-1) and "Mechanical test in the vane pump" (ISO 20763). From ISO VG 32, ISO 15380 prescribes a rating of at least 10 (FZG test). At present, the FZG test cannot be applied to viscosity classes < ISO VG 32. The wear protection capability of environmentally acceptable hydraulic fluids in relation to the two test procedures is comparable to that of mineral oil HLP/HVLP.

3.1.4 Material compatibility

The hydraulic fluid must not negatively affect the materials used in the components. Compatibility with coatings, seals, hoses, metals and plastics is to be observed in particular. The fluid classifications specified in the respective component data sheets are tested by the manufacturer with regard to material compatibility. Parts and components not supplied by us are to be checked by the user.

Table 2: Known material incompatibilities

Classification	Incompatible with:
HE... general	One-component color coatings, lead, galvanized zinc coatings, some non-ferrous metals, seals made of NBR. In some cases, the latter show major increases in volume when impermissibly aged hydraulic fluids come into contact with the material. NBR is only permitted by prior consent, please observe the customary seal and tube replacement intervals. Do not use any hydrolysis/susceptible polyurethane qualities. **Note** Please check seals and coatings of control cabinets, outer coatings of hydraulic components and accessories (connectors, cables, control cabinets) for resistance to vapors issuing from hydraulic fluids.
HETG/HEES	Zinc, some non-ferrous alloys with zinc
HEPG	Steel/aluminum tribocontacts, paper filters, polymethylmethacrylate (PMMA), NBR **Note** Check plastics for resistance

The material incompatibilities mentioned here do not automatically result in function problems. However the elements of the materials are found in the hydraulic fluids after use. The biological degradation of hydraulic fluids is negatively influenced.

3.1.5 Aging resistance

The way an environmentally acceptable hydraulic fluids ages depends on the thermal, chemical and mechanical stress to which it is subjected. The influence of water, air, temperature and contamination may be significantly greater than for mineral oils HLP/HVLP. Aging resistance can be greatly influenced by the chemical composition of the hydraulic fluids .

High fluid temperatures (e.g. over 80 °C) result in a approximate halving of the fluid service life for every 10 °C temperature increase and should therefore by avoided. The halving of the fluid service life results from the application of the Arrhenius equation (see Glossary).

Table 3: Reference values for temperature-dependent aging of the hydraulic fluid

Reservoir temperature	Fluid life cycle
80 °C	100 %
90 °C	50 %
100 °C	25 %

A modified aging test (without adding water) is prescribed for fluid classifications HETG and HEES. Hydraulic fluids with HEPG and HEPR classification are subjected to the identical test procedure as mineral oils (with 20 % water added). The calculated fluid service life is derived from the results of tests in which the long-term characteristics are simulated in a short period of time by applying more arduous conditions (condensed testing). This calculated fluid service life is not to be equated to the fluid service life in real-life applications.

Table 3 is a practical indicator for hydraulic fluids with water content < 0.1%, cf. chapter 4.10. "Water".

3.1.6 Biological degradation

Environmentally acceptable hydraulic fluids are ones which degrade biologically much faster than mineral oils. Biological degradation is a biochemical transformation effected by micro-organisms resulting in mineralization. For environmentally acceptable hydraulic fluids that make reference to ISO 15380, biological degradation according to ISO 14593 or ISO 9439 must be verified. 60% minimum degradation is defined as limit value. Proof of biological degradation is furnished for the new, unmixed, ready-formulated hydraulic fluids. Aged or mixed hydraulic fluids are less able to degrade biologically. Biological degradation outside the defined test procedure is subject to a variety of natural influences. The key factors are temperature, humidity, contamination, fluid concentration, type and quantity of micro-organisms. Environmentally acceptable hydraulic fluids require no extended maintenance in comparison to mineral oils, please observe chapter 4 "Hydraulic fluids in operation".

3.1.7 Air separation ability (ASA)

The air separation ability (ASA) describes the property of a hydraulic fluid to separate undissolved air. Hydraulic fluids always contain dissolved air. During operation, dissolved air may be transformed into undissolved air, leading to cavitation damages. Fluid classification, fluid product, reservoir size and design must be coordinated to take into account the dwell time and ASA value of the hydraulic fluid. The air separation capacity depends on the viscosity, temperature, basic fluid and aging. It cannot be improved by additives.

According to ISO 15380, for instance, an ASA value ≤ 10 minutes is required for viscosity class ISO VG 46, 6 minutes are typical, lower values are preferable.

3.1.8 Demulsifying ability and water solubility

The capacity of a hydraulic fluid to separate water at a defined temperature is known as the demulsifying ability. ISO 6614 defines the demulsifying properties of hydraulic fluids.

Fluids classified HETG, HEES and HEPR separate from water. HETG and HEES hydraulic fluids have a different water separation ability to mineral oil HLP/HVLP. At 20 °C, in comparison to mineral oil HLP/HVLP, a multiple (> factor 3) of water can separate in the hydraulic fluid. Water solubility is also more temperature-dependent than for mineral oils. With regard to water solubility, HEPR hydraulic fluids behave like HVLP hydraulic fluids (see RE 90220). In the majority of cases, HEPG-classified fluids HEPG dissolve water completely , see chapter "4.10 Water".

3.1.9 Filterability

Filterability describes the ability of a hydraulic fluid to pass through a filter, removing solid contaminants. The hydraulic fluids used require a good filterability, not just when new, but also during the whole of their service life. Depending on the different basic fluids (glycols, saturated and partially saturated ester oils, hydrocrack oils, polyalpha olefins, triglycerides) and additives (VI enhancers), there are great differences here.

The filterability is a basic prerequisite for cleanliness, servicing and filtration of hydraulic fluids. Rexroth therefore requires the same degree of filterability of environmentally acceptable hydraulic fluids as for mineral oils HLP/HVLP to DIN 51524. As ISO 15380 does not comment on the filterability of hydraulic fluids, filterability comparable to that of mineral oils HLP/HVLP must be requested of lubricant manufacturers.

Filterability is tested with the new hydraulic fluid and after the addition of 0.2 % water. The underlying standard (ISO 13357-1/-2) stipulates that filterability must have no negative effects on the filters or the hydraulic fluid, see chapter 4 "Hydraulic fluids in operation".

3.1.10 Corrosion protection

Hydraulic fluids should not just prevent corrosion formation on steel components, they must also be compatible with non-ferrous metals and alloys. Corrosion protection tests on different metals and metal alloys are described in ISO 15380. Hydraulic fluids that are not compatible with the materials listed above must not be used, even if they are compliant with ISO 15380.

Rexroth components are usually tested with HLP hydraulic fluids or corrosion protection oils based on mineral oils before they are delivered.

3.1.11 Additivation

The properties described above can be modified with the help of suitable additives. Environmentally acceptable hydraulic fluids should never contain heavy metals. According to the present state of knowledge, all hydraulic fluids, regardless of additivation, can be filtered with all customary filter materials in all known filtration ratings (≥ 0.8 μm), without filtering out effective additives at the same time.

Bosch Rexroth does not prescribe any specific additive system.

3.2 Classification and fields of application

Table 4: **Classification and fields of application**

Classification	Features	Typical field of application	Notes
HEPG according to ISO 15380 Density at 15 °C: typically > 0.97 kg/dm³ VI: typical > 170	Basic fluid, glycols	Systems on exposed water courses (locks, weirs, dredgers)	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Very good viscosity/temperature characteristics, shear stability – Resistant to aging – Incompatible with mineral oil (exceptions must be confirmed by the lubricant manufacturer) – Can be water-soluble – Can be mixed with water – Very good wear protection properties – A higher implementation temperature with the same viscosity in comparison to mineral oil is to be expected – Due to the higher density in comparison to HLP, lower suction pressures are to be anticipated for pumps. Reduce the maximum speed as required and optimize suction conditions. – Classified as insignificantly water-endangering (water hazard class WGK 1) – Prior to commissioning, contact the lubricant manufacturer, as the components are tested with mineral oil HLP/corrosion protection oil.
HEES partially saturated according to ISO 15380 Density at 15 °C: typically 0.90–0.93 kg/dm³ VI: typical > 160 Iodine count < 90	Basic fluid: Ester based on renewable raw materials, synthetic esters, mixtures of various esters, mixtures with polyalphaolefines (< 30%)	Suitable for most fields of application and components.	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Preferred use of FKM seals. Please enquire for shaft seal rings and implementation temperatures under −15 °C. – In operation, a higher temperature in comparison to mineral oil HLP/HVLP is to be expected given identical design and viscosity – Limit lower (depending on viscosity class) and upper implementation temperatures (maximum 80 °C due to aging) – Good viscosity/temperature characteristics, shear stability. – Good corrosion protection, if correspondingly additivized – Mostly classed as insignificantly water-endangering (water hazard class WGK 1), in some cases as not water-endangering – High dirt dissolving capacity on fluid changeovers – In unfavorable operating conditions (high water content, high temperature), HEES on ester basis have a tendency to hydrolysis. The acidic organic decomposition products can chemically attack materials and components.

Continued on page 9

Table 4: Classification and fields of application (continued from page 8)

Classification	Features	Typical field of application	Notes
HEES saturated according to ISO 15380 Density at 15 °C: typically 0.90–0.93 kg/dm^3 VI: typical 140–160 Iodine count <15	Basic fluid: Ester based on renewable raw materials, synthetic esters, mixtures of various esters, mixtures with polyalphaolefines (< 30%)	Suitable for most fields of application and components. Saturated HEES should be preferred over partially saturated HEES and HETG for components and systems exposed to high stress levels.	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Preferred use of FKM seals. Please enquire for shaft seal rings and implementation temperatures under –15 °C. – In operation, a higher temperature in comparison to mineral oil HLP/HVLP is to be expected given identical design and viscosity – Good viscosity/temperature characteristics, shear stability – Good corrosion protection, if correspondingly additivized – Mostly classed as insignificantly water-endangering (water hazard class WGK 1), in the case of low viscosity classes (up to ISO VG 32) also classed as not water-endangering – High dirt dissolving capacity on fluid changeovers
HEPR according to ISO 15380 Density at 15 °C: typically 0.87 kg/dm^3 VI : typical 140–160	Basic fluid: synthetically manufactured hydrocarbons (polyalpha olefins PAO) partly mixed with esters (< 30 %)	Suitable for most fields of application and components. HEPR should be preferred over partially saturated HEES and HETG for components and systems exposed to high stress levels.	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Behaves similarly to HVLP- hydraulic fluids, individual products comply with ISO 15380 HEPR and DIN 51524-3 HVLP – Preferred use of FKM seals. Please enquire for shaft seal rings and implementation temperatures under –15 °C. – Good viscosity-temperature behavior – Classified as insignificantly water-endangering (water hazard class WGK 1) **Note:** Note shear stability (see chapter 4.11 "Fluid servicing, fluid analysis and filtration" and chapter 6 "Glossary")
HETG according to ISO 15380 Density at 15 °C: typically 0.90-0.93 kg/dm^3 VI: typical > 200 Iodine count > 90	Basic fluid: vegetable oils and triglycerides	Not recommended for Rexroth components!	Practical requirements are frequently not fulfilled by hydraulic fluids in this classification. Use only permissible after consultation. – Viscosity is not stable over time – Very fast fluid aging, very hydrolysis-susceptible (please observe neutralization number) – Tendency to gumming, gelling and setting. – Limit the lower (depending on viscosity class) and upper implementation temperatures (see chapter 3.1.5) – Only limited material compatibility – Filterability problems at water ingress – High dirt dissolving capacity on fluid changeovers – Mostly classed as not water-endangering

4 Hydraulic fluids in operation

4.1 General

The properties of hydraulic fluids can change continually during storage and operation.

Please note that the fluid standard ISO 15380 merely describes minimum requirements for hydraulic fluids in new condition at the time of filling into the bins. The operator of a hydraulic system must ensure that the hydraulic fluid remains in a utilizable condition throughout its entire period of use.

Deviations from the characteristic values are to be clarified with the lubricant manufacturer, the test labs or Bosch Rexroth.

Bosch Rexroth will accept no liability for damage to its components within the framework of the applicable liability legislation insofar as the latter is due to non-observance of the following instructions.

Please note the following aspects in operation.

4.2 Storage and handling

Hydraulic fluids must be stored correctly in accordance with the instructions of the lubricant manufacturer. Avoid exposing the containers to lengthy periods of direct heat. Containers are to be stored in such a way that the risk of any foreign liquid or solid matter (e.g. water, foreign fluids or dust) ingression into the inside of the container can be ruled out. After taking hydraulic fluids from the containers, these are immediately to be properly resealed.

Recommendation:

- Store containers in a dry, roofed place
- Store barrels on their sides
- Clean reservoir systems and machine reservoirs regularly

4.3 Filling of new systems

Usually, the cleanliness levels of the hydraulic fluids as delivered do not meet the requirements of our components. Hydraulic fluids must be filtered using an appropriate filter system to minimize solid particle contamination and water in the system.

As early as possible during test operation, new systems should be filled with the selected hydraulic fluid so as to reduce the risk of accidentally mixing fluids (see chapter 4.5 "Mixing and compatibility of different hydraulic fluids"). Changing the hydraulic medium at a later point represents significant additional costs (see following chapter).

4.4 Hydraulic fluid changeover

In particular with the changeover from mineral oils to environmentally acceptable hydraulic fluids, but also from one environmentally acceptable hydraulic fluids to another, there may be interference (e.g. incompatibility in the form of gelling, silting, stable foam or reduced filterability or filter blockage).

In the case of changeovers of the fluid in hydraulic systems, it is important to ensure compatibility of the new hydraulic fluid with the remains of the previous hydraulic fluid. Bosch Rexroth recommends obtaining verification of compatibility from the manufacturer or supplier of the new hydraulic fluid. The quantity of old fluid remaining should be minimized. Mixing hydraulic fluids should be avoided, see following chapter.

For information on changing over hydraulic fluids with different classifications, please refer to VDMA 24314, VDMA 24569 and ISO 15380 appendix A.

Bosch Rexroth will not accept liability for any damage to its components resulting from inadequate hydraulic fluid change-overs!

4.5 Mixing and compatibility of different hydraulic fluids

If hydraulic fluids from different manufacturers or different types from the same manufacturer are mixed, gelling, silting and deposits may occur. These, in turn, may cause foaming, impaired air separation ability, malfunctions and damage to the hydraulic system.

If the fluid contains more than 2 % of another fluid then it is considered to be a mixture. Exceptions apply for water, see chapter 4.10 "Water".

Mixing with other hydraulic fluids is not generally permitted. This also includes hydraulic fluids with the same classification and from the market overview RE 90221-01. If individual lubricant manufacturers advertise miscibility and/or compatibility, this is entirely the responsibility of the lubricant manufacturer.

Bosch Rexroth customarily tests all components with mineral oil HLP before they are delivered.

Note: With connectible accessory units and mobile filtering systems, there is a considerable risk of non-permitted mixing of the hydraulic fluids!

Rexroth will not accept liability for any damage to its components resulting from mixing hydraulic fluids!

4.6 Re-additivation

Additives added at a later point in time such as colors, wear reducers, VI enhancers or anti-foam additives, may negatively affect the performance properties of the hydraulic fluid and the compatibility with our components and therefore are not permissible.

Rexroth will not accept liability for any damage to its components resulting from re-additivation!

4.7 Foaming behavior

Foam is created by rising air bubbles at the surface of hydraulic fluids in the reservoir. Foam that develops should collapse as quickly as possible.

Common hydraulic fluids in accordance with ISO 15380 are sufficiently inhibited against foam formation in new condition. On account of aging and adsorption onto surfaces, the defoamer concentration may decrease over time, leading to a stable foam.

Defoamers may be re-dosed only after consultation with the lubricant manufacturer and with his written approval.

Defoamers may affect the air separation ability.

4.8 Corrosion

The hydraulic fluid is to guarantee sufficient corrosion protection of components under all operating conditions, even in the event of impermissible water contamination.

Environmentally acceptable hydraulic fluids are tested for corrosion protection in the same way as mineral oil HLP/HVLP. When used in practice other corrosion mechanisms are revealed in detail and in individual cases, for the most part in contact with non-ferrous and white alloys.

4.9 Air

Under atmospheric conditions the hydraulic fluid contains dissolved air. In the negative pressure range, for instance in the suction pipe of the pump or downstream of control edges, this dissolved air may transform into undissolved air. The undissolved air content represents a risk of cavitation and of the diesel effect. This results in material erosion of components and increased hydraulic fluid aging.

With the correct measures, such as suction pipe and reservoir design, and an appropriate hydraulic fluid, air intake and separation can be positively influenced.

See also chapter 3.1.7 "Air separation ability (ASA)".

4.10 Water

Water contamination in hydraulic fluids can result from direct ingress or indirectly through condensation of water from the air due to temperature variations.

HEPG dissolves water completely. This means that any water that has ingressed into the system cannot be drained off in the sump of the reservoir.

In the case of hydraulic fluids classed HETG, HEES and HEPR undissolved water can be drained off from the reservoir sump, the remaining water content is however too high to ensure that the maximum permissible water limit values are observed in the long term.

Water in the hydraulic fluid can result in wear or direct failure of hydraulic components. Furthermore, a high water content in the hydraulic fluid negatively affects aging and filterability and increases susceptibility to cavitation. During operation, the water content in all hydraulic fluids, determined according to the "Karl Fischer method" (see chapter 6 "Glossary") for all environmentally acceptable hydraulic fluids must constantly be kept below 0.1% (1000 ppm). To ensure a long service life of both hydraulic fluids and components, Bosch Rexroth recommends that values below 0.05% (500 ppm) are permanently maintained.

Due to the higher water solubility (except for HEPR) in comparison to mineral oil HLP/HVLP it is urgently advised that precautions be taken when using environmentally acceptable hydraulic fluids, such as a dehumidifier on the reservoir ventilation.

Water content has an affect particularly in the case of HETG and partially saturated HEES in that it accelerates aging (hydrolysis) of the hydraulic fluid and biological degradation, see chapter 4.11 "Fluid servicing, fluid analysis and filtration".

4.11 Fluid servicing, fluid analysis and filtration

Air, water, operating temperature influences and solid matter contamination will change the performance characteristics of hydraulic fluids and cause them to age.

To preserve the usage properties and ensure a long service life for hydraulic fluid and components, the monitoring of the fluid condition and a filtration adapted to the application requirements (draining and degassing if required) are indispensable.

The effort is higher in the case of unfavorable usage conditions, increased stress for the hydraulic system or high expectations as to availability and service life, see chapter 2 "Solid particle contamination and cleanliness levels".

When commissioning a system, please note that the required minimum cleanliness level can frequently be attained only by flushing the system. Due to severe start-up contamination, it may be possible that a fluid and/or filter replacement becomes necessary after a short operating period ($<$ 50 operating hours).

The hydraulic fluid must be replaced at regular intervals and tested by the lubricant manufacturer or recognized accredited test labs. **We recommend a reference analysis after commissioning.**

The minimum data to be tested for analyses are:

- Viscosity at 40 °C and 100 °C
- Neutralization number NN (acid number AN)
- Water content (Karl-Fischer method)
- Particle measurement with evaluation according to ISO 4406 or mass of solid foreign substances with evaluation to EN 12662
- Element analysis (RFA (EDX) / ICP, specify test method)
- Comparison with new product or available trend analyses
- Assessment / evaluation for further use
- Also recommended: IR spectrum"

Differences in the maintenance and upkeep of environmentally acceptable hydraulic fluids with the corresponding suitability characteristics (as required in market overview RE 90221-01) in comparison to mineral oil HLP/HVLP are not necessary. Attention is however drawn to the note in chapter 1.3.

After changing over hydraulic fluids it is recommended that the filters be replaced again after 50 operating hours as fluid aging products may have detached themselves ("self-cleaning effect").

Compared to the pure unused hydraulic fluid the changed neutralization number NN (acid number AN) indicates how many aging products are contained in the hydraulic fluid. This difference must be kept as low as possible. As soon as the trend analysis notes a significant increase in the values, the lubricant manufacturer should be contacted.

A higher viscosity than that of new materials indicates that the hydraulic fluid has aged. Evaluation by the test lab or lubricant manufacturers is however authoritative, whose recommendation should be urgently observed.

On systems where the possibility of water contamination cannot be completely ruled out (also condensation), it should be ensured via the hydraulic system circuit that fluid aging products are not accumulating in individual areas of the hydraulic system, but are being removed from the system in a controlled manner via the filtration system. This should be ensured via suitable hydraulic circuits (e.g. flushing circuit) or system manufacturer's operating instructions/specifications.

In case of warranty, liability or guarantee claims to Bosch Rexroth, service verification and/or the results of fluid analyses are to be provided.

5 Disposal and environmental protection

All environmentally acceptable hydraulic fluids, are like mineral oil-based hydraulic fluids, subject to special disposal obligations.

The respective lubricant manufacturers provide specifications on environmentally acceptable handling and storage. Please ensure that spilt or splashed fluids are absorbed with appropriate adsorbents or by a technique that prevents it contaminating water courses, the ground or sewerage systems.

It is also not permitted to mix fluids when disposing of hydraulic fluids. Regulations governing the handing of used oils stipulate that used oils are not to mixed with other products, e.g. substances containing halogen. Non-compliance will increase disposal costs. Comply with the national legal provisions concerning the disposal of the corresponding hydraulic fluid. Comply with the local safety data sheet of the lubricant manufacturer for the country concerned.

6 Glossary

Additivation
Additives are chemical substances added to the basic fluids to achieve or improve specific properties.

Aging
Hydraulic fluids age due to oxidation (see chapter 3.1.5 "Aging resistance"). Liquid and solid contamination acts as a catalyzer for aging, meaning that it needs to be minimized as far as possible by careful filtration. Please refer to Hydrolysis.

Arrhenius equation
The quantitative relation between reaction rate and temperature is described by an exponential function, the Arrhenius equation. This function is usually visualized within the typical temperature range of the hydraulic system. For a practical example, see chapter 3.1.5 "Aging resistance".

Basic fluids
In general, a hydraulic fluid is made up of a basic fluid, or base oil, and chemical substances, the so-called additives. The proportion of basic fluid is generally greater than 90%.

Diesel effect
If hydraulic fluid that contains air bubbles is compressed quickly, the bubbles are heated to such a degree that a self-ignition of the air-gas mix may occur. The resultant temperature increase may lead to seal damage and increased aging of the hydraulic fluid.

Saturated esters
Esters differ by the number of C atoms (chain length) and position of the bonds between the C atoms. Saturated esters do not have double/multiple bonds between C atoms and are therefore more resistant to aging than partially saturated esters.

Partially saturated esters
In contrast to saturated esters, partially saturated esters have double/multiple bonds between C atoms. Rexroth defines partially saturated esters as unsaturated bonds and mixtures of esters with unsaturated and saturated bonds. Esters with unsaturated bonds are produced on the basis of renewable raw materials.

Depending on their number and position, these unsaturated bonds between the C atoms are instable. These bonds can detach themselves and form new bonds, thus changing the properties of those liquids (an aging mechanism). One of the underlying requirements for inclusion in the market overview RE 90221-01 is an aging stability characteristic. Attention is however drawn to the note in chapter 1.3.

Hydrolysis
Hydrolysis is the splitting of a chemical bond through the reaction with water under the influence of temperature.

ICP (atomic emission spectroscopy)
The ICP procedure can be used to determine various wear metals, contamination types and additives. Practically all elements in the periodic system can be detected with this method..

Iodine count
The iodine count is a yardstick for the quantity of single and multiple unsaturated bonds between C atoms in the basic fluid. A low iodine count indicates that the hydraulic fluid contains few unsaturated bonds and is thus considerably more resistant to aging than a hydraulic fluid with a high iodine count. A statement about the position at which these multiple bonds are located and about how "stable" they are against influencing factors cannot be derived simply by stating the iodine count.

Karl Fischer method
Method to determine the water content in fluids. Indirect coulometric determination procedure in accordance with DIN EN ISO 12937 in connection with DIN 51777-2. Only the combination of both standards will assure adequately accurate measured values. For hydraulic fluids based on glycol, DIN EN ISO 12937 is to be applied in conjunction with DIN 51777-1.

Cavitation
Cavitation is the creation of cavities in fluids due to pressure reduction below the saturated vapour pressure and subsequent implosion when the pressure increases. When the cavities implode, extremely high acceleration, temperatures and pressure may occur temporarily, which may damage the component surfaces.

Neutralization number (NN)
The neutralization number (NN) or acid number (AN) specifies the amount of caustic potash required to neutralize the acid contained in one gram of fluid.

Pour point
The lowest temperature at which the fluid still just flows when cooled down under set conditions. The pour point is specified in the lubricant manufacturers' technical data sheets as a reference value for achieving this flow limit.

RFA (wavelength dispersive x-ray fluorescence analysis)
Is a procedure to determine nearly all elements in liquid and solid samples with nearly any composition. This analysis method is suitable for examining additives and contamination, delivering fast results.

Shearing/shear loss
Shearing of molecule chains during operation can change the viscosity of hydraulic fluids with long chain VI enhancers. The initially high viscosity index drops. This needs to be taken into account when selecting the hydraulic fluid.

The only value at present that can be used to assess viscosity changes in operation is the result of the test in accordance with DIN 51350 part -6. Please note that there are practical applications that create a much higher shear load on such hydraulic fluids than can be achieved by this test.

Stick-slip
Interaction between a resilient mass system involving friction (such as cylinder + oil column + load) and the pressure increase at very low sliding speeds. The static friction of the system is a decisive value here. The lower it is, the lower the speed that can still be maintained without sticking. Depending on the tribologic system, the stick-slip effect may lead to vibrations generated and sometimes also to significant noise emission. In many cases, the effect can be attenuated by replacing the lubricant.

Viscosity
Viscosity is the measure of the internal friction of a fluid to flow. It is defined as the property of a substance to flow under tension. Viscosity is the most important characteristic for describing the load-bearing capacity of a hydraulic fluid.

Kinematic viscosity is the ratio of the dynamic viscosity and the density of the fluid; the unit is mm²/s. Hydraulic fluids are classified by their kinematic viscosity into ISO viscosity classes. The reference temperature for this is 40 °C.

Viscosity index (VI)
Refers to the viscosity temperature behavior of a fluid. The lower the change of viscosity in relation the temperature, the higher the VI.

Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)

Application notes and requirements for Rexroth hydraulic components

Hydraulic fluids

Title	Hydraulic fluids based on mineral oils and related hydrocarbons	Environmentally acceptable hydraulic fluids	**Fire-resistant, water-free hydraulic fluids**	Fire-resistant, water-containing hydraulic fluids
Standard	DIN 51524	ISO 15380	**ISO 12922**	ISO 12922
Data sheets	RE 90220	RE 90221	**RE 90222**	RE 90223 (in preparation)
Classification	HL HLP HLPD HVLP HLPD and more	HEPG HEES partially saturated HEES saturated HEPR HETG	**HFDR** **HFDU (ester base)** **HFDU (glycol base)** **and more**	HFC HFB HFAE HFAS

Contents

1 Basic information

1.1 General instructions

The hydraulic fluid is the common element in any hydraulic component and must be selected very carefully. Quality and cleanliness of the hydraulic fluid are decisive factors for the operational reliability, efficiency and service life of a system.

Hydraulic fluids must conform, be selected and used in accordance with the generally acknowledged rules of technology and safety provisions. Reference is made to the country-specific standards and directives (in Germany the directive of the Employer's Liability Insurance Association BGR 137).

This data sheet includes recommendations and regulations concerning the selection, operation and disposal of fire-resistant, water-free hydraulic fluids in the application of Rexroth hydraulic components.

The individual selection of hydraulic fluid or the choice of classification are the responsibility of the operator.

It is the responsibility of the user to ensure that appropriate measures are taken for safety and health protection and to ensure compliance with statutory regulations. The recommendations of the lubricant manufacturer and the specifications given in the safety data sheet are to be observed when using hydraulic fluid.

This data sheet does not absolve the operator from verifying the conformity and suitability of the respective hydraulic fluid for his system. He is to ensure that the selected fluid meets the minimum requirements of the relevant hydraulic fluid standard during the whole of the period of use.

The currently valid standard for fire-resistant hydraulic fluids is the ISO 12922. In addition, other, more detailed documents, guidelines, specifications and legislation may also be valid. The operator is responsible for ensuring that such regulations are observed, for example:

- 7th Luxembourg Report: Luxembourg, April 1994, Doc. No. 4746/10/91 EN "Requirements and tests applicable to fire-resistant hydraulic fluids for hydrostatic and hydrokinetic power transmission and control"
- VDMA 24314 (1981-11): "Changing hydraulic fluids – guidelines"
- VDMA 24317 (2005-11): "Fire-resistant hydraulic fluids – minimum technical requirements"
- FM Approval Standard 6930 (2009-04): "Flammability Classification of Industrial Fluids" (only available in English)
- DIN Technical Report CEN/TR 14489 (2006-01): "Selection guidelines for protecting safety, health and the environment"

We recommend that you maintain constant, close contact with lubricant manufacturers to support you in the selection, maintenance, care and analyses.

When disposing of used hydraulic fluids, apply the same care as during use.

1.2 Fire resistance

There is no clear legal definition of fire-resistant hydraulic fluids. There are great differences regarding fire resistance. The selection is the sole responsibility of the system operator with respect to requirements (application, construction and design of the system, hottest source in the system, necessary fire protection).

Different test procedures are applied for evaluating fire resistance.

Fire resistance test procedure according to ISO 12922:

- Ignition properties of spray according to ISO 15029-1 (Spray flame persistence – hollow-cone nozzle method)
- Ignition properties of spray according to ISO 15029-2 (Stabilized flame heat release)
- Wick flame persistence of fluids according to ISO 14935 (average flame persistence)
- Determination of the flammability characteristics of fluids in contact with hot surfaces, ignition process according to ISO 20823 (ignition temperature, flame spread)

In general, fire-resistant hydraulic fluids are distinguished between **water-containing** fire-resistant and **water-free** fire-resistant hydraulic fluids. Water-containing fire-resistant hydraulic fluids are described in RE 90223.

Water-free, fire-resistant hydraulic fluid means hydraulic fluids with a water-proportion of 0.1% by volume ("Karl Fischer method", see chapter 6 "Glossary"), measured at the time of filling in the transport container.

In Europe water-free, fire-resistant hydraulic fluids are not approved for use in underground coal mining. The classification HFDU is no longer included in the VDMA 24317: 2005.

Note
In contrast to water-containing fluids, all water-free, fire-resistant hydraulic fluids have a flash point and a fire point. Specific parameters for flash point and fire point can be found in the technical and/or safety data sheet for the hydraulic fluid concerned.

Just as much care should be taken when working with fire-resistant hydraulic fluids are with other hydraulic fluids, e.g. mineral oils. A leak from the hydraulic system must be avoided. The best and most cost-effective protection against fire and explosion is to prevent leakage with meticulous service, maintenance and care of the hydraulic system.

1.3 Scope

This data sheet must be applied when using water-free, fire-resistant hydraulic fluids with Rexroth hydraulic components. The specifications of this data sheet may be further restricted by the specifications given in data sheets for the individual components concerned.

The use of the individual water-free, fire-resistant hydraulic fluids in accordance with the intended purpose can be found in the safety data sheets or other product description documents of the lubricant manufacturers. In addition, each use is to be individually considered.

Rexroth hydraulic components may only be operated with water-free, fire-resistant hydraulic fluids according to ISO 12922 if specified in the respective component data sheet or if a Rexroth approval for use is furnished.

The manufacturers of hydraulic systems must adjust their systems and operating instructions to the water-free, fire-resistant hydraulic fluids.

Bosch Rexroth will accept no liability for its components for any damage resulting from failure to comply with the notes below.

1.4 Safety instructions

Hydraulic fluids can constitute a risk for persons and the environment. These risks are described in the hydraulic fluid safety data sheets. The operator is to ensure that a current safety data sheet for the hydraulic fluid used is available and that the measures stipulated therein are complied with.

2 Solid particle contamination and cleanliness levels

Solid particle contamination is the major reason for faults occurring in hydraulic systems. It may lead to a number of effects in the hydraulic system. Firstly, single large solid particles may lead directly to a system malfunction, and secondly small particles cause continuous elevated wear.

For mineral oils, the cleanliness level of water-free, fire-resistant hydraulic fluids is given as a three-digit numerical code in accordance with ISO 4406. This numerical code denotes the number of particles present in a hydraulic fluid for a defined quantity. Moreover, foreign solid matter is not to exceed a mass of 50 mg/kg (gravimetric examination according to ISO 4405).

In general, compliance with a minimum cleanliness level of 20/18/15 in accordance with ISO 4406 or better is to be maintained in operation. Special servo valves demand improved cleanliness levels of at least 18/16/13. A reduction in cleanliness level by one level means half of the quantity of particles and thus greater cleanliness. Lower numbers in cleanliness levels should always be striven for and extend the service life of hydraulic components. The component with the highest cleanliness requirements determines the required cleanliness of the overall system. Please also observe the specifications in table 1: "Cleanliness levels according to ISO 4406" and in the respective data sheets of the various hydraulic components.

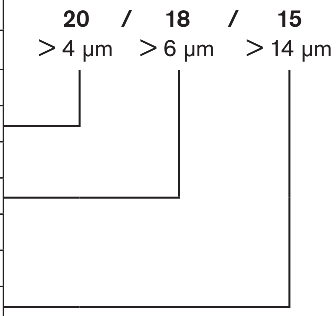
Hydraulic fluids frequently fail to meet these cleanliness requirements on delivery. Careful filtering is therefore required during operation and in particular, during filling in order to ensure the required cleanliness levels. Your lubricant manufacturer can tell you the cleanliness level of hydraulic fluids as delivered. To maintain the required cleanliness level over the operating period, you must use a reservoir breather filter. If the environment is humid, take appropriate measures, such as a breather filter with air drying or permanent off-line water separation.

Note: the specifications of the lubricant manufacturer relating to cleanliness levels are based on the time at which the container concerned is filled and not on the conditions during transport and storage.

Further information about contamination with solid matter and cleanliness levels can be found in brochure RE 08016.

Table 1: Cleanliness levels according to ISO 4406

Particles per 100 ml		Scale number
More than	Up to and including	
8,000,000	16,000,000	24
4,000,000	8,000,000	23
2,000,000	4,000,000	22
1,000,000	2,000,000	21
500,000	1,000,000	20
250,000	500,000	19
130,000	250,000	18
64000	130,000	17
32000	64000	16
16000	32000	15
8000	16000	14
4000	8000	13
2000	4000	12
1000	2000	11
500	1000	10
250	500	9
130	250	8
64	130	7
32	64	6



3 Selection of the hydraulic fluid

Water-free, fire-resistant hydraulic fluids for Bosch Rexroth hydraulic components are assessed on the basis of their fulfillment of the minimum requirements of ISO 12922.

3.1 Selection criteria for the hydraulic fluid

The specified limit values for all components employed in the hydraulic system, for example viscosity and cleanliness level, must be observed with the hydraulic fluid used, taking into account the specified operating conditions.

Hydraulic fluid suitability depends, amongst others, on the following factors:

3.1.1 Viscosity

Viscosity is a basic property of hydraulic fluids. The permissible viscosity range of complete systems needs to be determined taking account of the permissible viscosity of all components and it is to be observed for each individual component.

The viscosity at operating temperature determines the response characteristics of closed control loops, stability and damping of systems, the efficiency factor and the degree of wear.

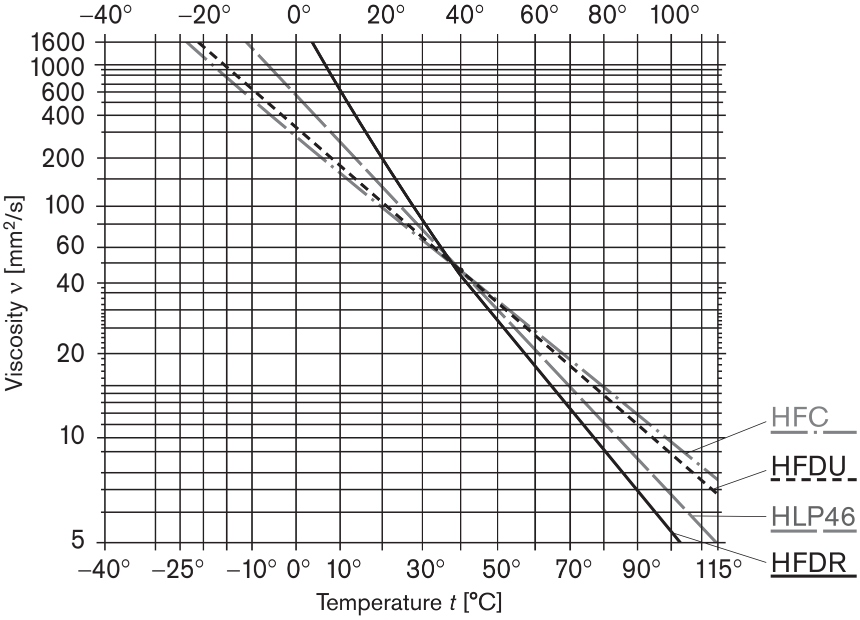
We recommend that the optimum operating viscosity range of each component be kept within the permissible temperature range. This usually requires either cooling or heating, or both. The permissible viscosity range and the necessary cleanliness level can be found in the product data sheet for the component concerned.

If the viscosity of a hydraulic fluid used is above the permitted operating viscosity, this will result in increased hydraulic-mechanical losses. In return, there will be lower internal leakage losses. If the pressure level is lower, lubrication gaps may not be filled up, which can lead to increased wear. For hydraulic pumps, the permitted suction pressure may not be reached, which may lead to cavitation damage.

If the viscosity of a hydraulic fluid is below the permitted operating viscosity, increased leakage, wear, susceptibility to contamination and a shorter component life cycle will result.

Please ensure that the permissible temperature and viscosity limits are observed for the respective components. This usually requires either cooling or heating, or both.

Fig. 1: Examples V-T diagrams for water-free, fire-resistant hydraulic fluids in comparison to HLP and HFC (reference values, double-logarithmic representation)



Typical viscosity data [mm²/s] at temperature	0 °C	40 °C	100 °C
HFDR	2500	43	5,3
HFDU (ester base)	330	46	9,2
HFDU (glycol base)	350	46	8,7
For comparison HLP (see RE 90220)	610	46	7
For comparison HFC (see RE 90223)	280	46	

Detailed V-T diagrams may be obtained from your lubricant manufacturer for their specific products. Descriptions of the individual classifications can be found in chapter 3.2 and in Table 4.

3.1.2 Viscosity-temperature behavior

For hydraulic fluids, the viscosity temperature behavior (V-T behavior) is of particular importance. Viscosity is characterized in that it drops when the temperature increases and rises when the temperature drops. The interrelation between viscosity and temperature is described by the viscosity index (VI).

For cold testing over a period of several days, the viscosity of ester-based HFDU can increase greatly. After heating, the characteristic values as specified on the data sheet are restored. Please ask your lubricant manufacturer for the "Flow capacity after seven days at low temperature" (ASTM D 2532) for the fluid classification ester-based HFDU .

HFDU fluid based on ester and glycol have better viscosity/temperature characteristics than mineral oil HLP (see Fig. 1). This should be taken into consideration when selecting hydraulic fluid for the required temperature range. The viscosity and temperature limits required in the product data sheets are to be observed in all operating conditions.

Note
For ambient temperatures below 0 °C, fire-resistant, **water-containing** hydraulic fluids of classification HFC are to be preferred because they observe the component-related viscosity ranges and because the have better pour points (see RE 90223).

3.1.3 Wear protection capability

Wear protection capability describes the property of hydraulic fluids to prevent or minimize wear within the components. The wear protection capability is described in ISO 12922 via test procedures"FZG gear test rig" (ISO 14635-1) and "Mechanical test in the vane pump" (ISO 20763). The wear protection capability of water-free, fire-resistant hydraulic fluids in relation to the two test procedures is comparable to that of mineral oil HLP/HVLP.

3.1.4 Material compatibility

The hydraulic fluid must not negatively affect the materials used in the components. Compatibility with coatings, seals, hoses, metals and plastics is to be observed in particular. The fluid classifications specified in the respective component data sheets are tested by the manufacturer with regard to material compatibility. Parts and components not supplied by us are to be checked by the user.

Table 2: Known material incompatibilities

Classification	Incompatible with:
HFD in general	Seals, plastics and coatings of control cabinets, outer coatings of hydraulic components and accessory components (connectors, wiring harnesses, control cabinets) are to be tested for stability. **Note:** hydraulic fluid vapors can also lead to incompatibility!
HFDR	Individual component color coating, lead, galvanic zinc-plating, in part non-ferrous metals with zinc, tin and aluminum in a tribological system. Sealing elements made of NBR. In some cases, the latter show major increases in volume when impermissibly aged hydraulic fluids come into contact with the material. Do not use any hydrolysis/susceptible polyurethane qualities.
HFDU based on ester	Single-component color coatings, lead, galvanized zinc coatings, in part non-ferrous metals with zinc, tin, seals made of NBR. In some cases, the latter show major increases in volume when impermissibly aged hydraulic fluids come into contact with the material. Do not use any hydrolysis/susceptible polyurethane qualities.
HFDU based on glycol	Single-component color coatings, steel/aluminum tribocontacts, paper filters, polymethylmethacrylate (PMMA). The compatibility of NBR is to be examined for individual case.

The material incompatibilities mentioned here do not automatically result in function problems. However the elements of the materials are found in the hydraulic fluids after use. The material incompatibilities described here may lead to accelerated aging of the hydraulic fluid and to reduced fire resistance.

3.1.5 Aging resistance

The way a water-free, fire-resistant hydraulic fluid ages depends on the thermal, chemical and mechanical stress to which it is subjected. The influence of water, air, temperature and contamination may be significantly greater than for mineral oils HLP/HVLP. Aging resistance can be greatly influenced by the chemical composition of the hydraulic fluids.

High fluid temperatures (e.g. over 80 °C) result in a approximate halving of the fluid service life for every 10 °C temperature increase and should therefore by avoided. The halving of the fluid service life results from the application of the Arrhenius equation (see Glossary).

Table 3: Reference values for temperature-dependent aging of the hydraulic fluid

Reservoir temperature	Fluid life cycle
80 °C	100 %
90 °C	50 %
100 °C	25 %

A modified aging test (ISO 4263-3 or ASTM D943 – without the addition of water) is specified for fluid classification HFDU. Fluid classification HFDR is described with a special procedure with respect to oxidation stability (EN 14832) and oxidation service life (ISO 4263-3). The calculated fluid service life is derived from the results of tests in which the long-term characteristics are simulated in a short period of time by applying more arduous conditions (condensed testing). This calculated fluid service life is not to be equated to the fluid service life in real-life applications.

Table 3 is a practical indicator for hydraulic fluids with water content $<$ 0.1%, cf. chapter 4.10. "Water".

3.1.6 Environmentally acceptable

HFDU fluids based on ester and glycol are hydraulic fluids which may also be classified as environmentally acceptable. The main criteria for fire-resistant, water-free hydraulic fluids are the leak-free, technically problem-free use and the necessary fire resistance. Environmentally acceptable is merely a supplementary criterion. Notes on environmentally compatible hydraulic fluids can be found in RE 90221.

3.1.7 Air separation ability (ASA)

The air separation ability (ASA) describes the property of a hydraulic fluid to separate undissolved air. Hydraulic fluids always contain dissolved air. During operation, dissolved air may be transformed into undissolved air, leading to cavitation damages. Fluid classification, fluid product, reservoir size and design must be coordinated to take into account the dwell time and ASA value of the hydraulic fluid. The air separation capacity depends on the viscosity, temperature, basic fluid and aging. It cannot be improved by additives.

According to ISO 12922 for instance, an ASA value ≤ 15 minutes is required for viscosity class ISO VG 46, practical values on delivery are $<$ 10 minutes, lower values are preferable.

3.1.8 Demulsifying ability and water solubility

The capacity of a hydraulic fluid to separate water at a defined temperature is known as the demulsifying ability. ISO 6614 defines the demulsifying properties of hydraulic fluids.

The fluid classifications HFDU based on ester and HFDR separate water, but HFD hydraulic fluids have a different water separation ability to mineral oil HLP/HVLP. At 20 °C, in comparison to mineral oil HLP/HVLP, a multiple ($>$ factor 3) of water can separate in the hydraulic fluid. Water solubility is also more temperature-dependent than for mineral oils. The fluid classification HFDU based on glycol usually dissolves water completely, see chapter "4.10 Water".

3.1.9 Filterability

Filterability describes the ability of a hydraulic fluid to pass through a filter, removing solid contaminants. The hydraulic fluids used require a good filterability, not just when new, but also during the whole of their service life. This can differ greatly depending on the different basic fluids (glycols, esters) and additives (VI enhancers, anti-fogging additives).

The filterability is a basic prerequisite for cleanliness, servicing and filtration of hydraulic fluids. Rexroth therefore requires the same degree of filterability of water-free, fire-resistant hydraulic fluids as for mineral oils HLP/HVLP to DIN 51524.
As ISO 12922 does not comment on the filterability of hydraulic fluids, filterability comparable to that of mineral oils HLP/HVLP must be requested of lubricant manufacturers.

Filterability is tested with the new hydraulic fluid and after the addition of 0.2 % water. The underlying standard (ISO 13357-1/-2) stipulates that filterability must have no negative effects on the filters or the hydraulic fluid, see chapter 4 "Hydraulic fluids in operation".

3.1.10 Corrosion protection

Hydraulic fluids should not just prevent corrosion formation on steel components, they must also be compatible with non-ferrous metals and alloys. Corrosion protection tests on different metals and metal alloys are described in ISO 12922.

Rexroth components are usually tested with HLP hydraulic fluids or corrosion protection oils based on mineral oils before they are delivered.

3.1.11 Additivation

The properties described above can be modified with the help of suitable additives.
Bosch Rexroth does not prescribe any specific additive system.

3.2 Classification and fields of application

Table 4: Classification and fields of application

Classification	Features	Typical field of application	Notes
HFDU (glycol-based) according to ISO 12922 Density at 15 °C: typically > 0.97 kg/dm³ VI: typical > 170 The classification "HFDU" is no longer listed in the current standard sheet VDMA 24317.	Base fluid: Glycols	Mobile systems with high thermal loading	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Very good viscosity/temperature characteristics, shear stability – Resistant to aging – Can be water-soluble – Can be mixed with water – Very good wear protection properties – A higher implementation temperature with the same viscosity in comparison to mineral oil is to be expected – Due to the higher density in comparison to HLP, lower suction pressures are to be anticipated for pumps. Reduce the maximum speed as required and optimize suction conditions. – Prior to commissioning, contact the lubricant manufacturer, as the components are tested with mineral oil HLP/corrosion protection oil. – Incompatible with mineral oil (exceptions must be confirmed by the lubricant manufacturer).
HFDU (ester-based) according to ISO 12922 Density at 15 °C: typically 0.90-0.93 kg/dm³ VI: typical > 160 Iodine count < 90 The classification "HFDU" is no longer listed in the current standard sheet VDMA 24317.	Base fluid: Ester based on regenerative raw materials, synthetic ester and mixtures of different esters Because of the fire resistance, HFDU hydraulic fluids based on ester are usually partially saturated esters	Suitable for most fields of application and components.	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Preferred use of FKM seals. Please enquire about shaft seal rings and implementation temperatures under –15 °C. – Note shear stability (see chapter 4.11 "Fluid servicing, fluid analysis and filtration" and chapter 6 "Glossary") – Fire resistance is not stable over time – In operation, a higher temperature in comparison to mineral oil HLP/HVLP is to be expected given identical design and viscosity. Please check ATEX approvals for hydraulic components. – Limit the lower (see chapter 3.1.2) and upper implementation temperatures (see chapter 3.1.5) – Good viscosity-temperature behavior – Usually classified as insignificantly water-endangering (water hazard class WGK 1) – High dirt dissolving capacity on fluid changeovers – In unfavorable operating conditions (high water content, high temperature), HFDU on ester basis have a tendency to hydrolysis. The acidic organic decomposition products can chemically attack materials and components.

Classification	Features	Typical field of application	Notes
HFDR according to ISO 12922 Density at 15 °C: typically 1.1 kg/dm³ VI : typical 140–160	Base fluid: phosphoric acid ester	Turbine control systems	For information on approved components, please refer to the respective product data sheet. For components which have not been approved according to the product data sheet, please consult your Bosch Rexroth sales partner. – Classified as hazardous materials (for transportation and storage) – Hazardous working material – Water-endangering (Water hazard class 2 – WGK2) – Develops toxic vapors in case of fire – Preferred use of FKM, and possibly PTFE seals. Please enquire for shaft seal rings and implementation temperatures under –15 °C. – In operation, a higher temperature in comparison to mineral oil HLP/HVLP is to be expected given identical design and viscosity – Phosphoric acid esters display a tendency to hydrolysis when they come into contact with moisture. Under the influence of water/moisture, they become unstable or form highly aggressive, acidic components which could damage the hydraulic fluid and component beyond repair. – Poor viscosity/temperature characteristics – Due to the higher density in comparison to HLP, lower suction pressures are to be anticipated for pumps. Reduce the maximum speed as required and optimize suction conditions. – In unfavorable operating conditions (high water content, high temperature), HFDR have a tendency to hydrolysis. The acidic inorganic decomposition products chemically attack materials and components.
HFDU (continued)	Based on triglycerides, mineral oils or related hydrocarbons	Not recommended for Rexroth components!	Hydraulic fluids based on polyalphaolefines are not recommended on account of their poor fire resistance. This classification can usually be identified from: density < 0.89; VI < 140 to 160 Hydraulic fluids based on triglycerides are not recommended on account of their aging resistance. This classification can usually be identified from: density > 0.92; VI > 190; iodine count > 90 Consult your lubricant manufacturer or your Bosch Rexroth sales partner if the classification of a hydraulic fluid is not clear.
HFDS HFDT	Based on halogenated hydrocarbons or mixtures with halogenated hydrocarbons	Not approved for Rexroth components!	HFDS and HFDT have not been permitted to be manufactured or used since 1989 for environmental reasons.

4 Hydraulic fluids in operation

4.1 General

The properties of hydraulic fluids can change continually during storage and operation.

Please note that the fluid standard ISO 12922 merely describes minimum requirements for hydraulic fluids in new condition at the time of filling into the bins. The operator of a hydraulic system must ensure that the hydraulic fluid remains in a utilizable condition throughout its entire period of use.

Deviations from the characteristic values are to be clarified with the lubricant manufacturer, the test labs or Bosch Rexroth.

Bosch Rexroth will accept no liability for damage to its components within the framework of the applicable liability legislation insofar as the latter is due to non-observance of the following instructions.

Please note the following aspects in operation.

4.2 Storage and handling

Hydraulic fluids must be stored correctly in accordance with the instructions of the lubricant manufacturer. Avoid exposing the containers to lengthy periods of direct heat. Containers are to be stored in such a way that the risk of any foreign liquid or solid matter (e.g. water, foreign fluids or dust) ingression into the inside of the container can be ruled out. After taking hydraulic fluids from the containers, these are immediately to be properly resealed.

Recommendation:

- Store containers in a dry, roofed place
- Store barrels on their sides
- Clean reservoir systems and machine reservoirs regularly

4.3 Filling of new systems

Usually, the cleanliness levels of the hydraulic fluids as delivered do not meet the requirements of our components. Hydraulic fluids must be filtered using an appropriate filter system to minimize solid particle contamination and water in the system.

As early as possible during test operation, new systems should be filled with the selected hydraulic fluid so as to reduce the risk of accidentally mixing fluids (see chapter 4.5 "Mixing and compatibility of different hydraulic fluids"). Changing the hydraulic medium at a later point represents significant additional costs (see following chapter).

4.4 Hydraulic fluid changeover

Problems may be encountered in particular when changing over from water-containing, fire-resistant hydraulic fluid or mineral oils to water-free, fire-resistant hydraulic fluids (e.g. incompatibilities in the form of gelling, silting, stable foam, reduced filterability or filter blockage). This may also happen when changing products within the same classification.

In the case of changeovers of the fluid in hydraulic systems, it is important to ensure compatibility of the new hydraulic fluid with the remains of the previous hydraulic fluid. Bosch Rexroth recommends obtaining verification of compatibility from the manufacturer or supplier of the new hydraulic fluid. The quantity of old fluid remaining should be minimized. Mixing hydraulic fluids should be avoided, see following chapter.

Information about changing to a hydraulic fluid of a different classification can be found, for example, in VDMA 24314 and in ISO 7745. In addition, the information given in chapter 3.1.4 "Material compatibility" is also to be observed.

Bosch Rexroth will not accept liability for any damage to its components resulting from inadequate hydraulic fluid changeovers!

4.5 Mixing and compatibility of different hydraulic fluids

If hydraulic fluids from different manufacturers or different types from the same manufacturer are mixed, gelling, silting and deposits may occur. These, in turn, may cause foaming, impaired air separation ability, malfunctions and damage to the hydraulic system.

If the fluid contains more than 2 % of another fluid then it is considered to be a mixture. Exceptions apply for water, see chapter 4.10 "Water".

Mixing with other hydraulic fluids is not generally permitted. This includes hydraulic fluids with the same classification. If individual lubricant manufacturers advertise miscibility and/or compatibility, this is entirely the responsibility of the lubricant manufacturer.

Bosch Rexroth customarily tests all components with mineral oil HLP before they are delivered.

Note: With connectible accessory units and mobile filtering systems, there is a considerable risk of non-permitted mixing of the hydraulic fluids!

Rexroth will not accept liability for any damage to its components resulting from mixing hydraulic fluids!

4.6 Re-additivation

Additives added at a later point in time such as colors, wear reducers, VI enhancers or anti-foam additives, may negatively affect the performance properties of the hydraulic fluid and the compatibility with our components and therefore are not permissible.

Rexroth will not accept liability for any damage to its components resulting from re-additivation!

4.7 Foaming behavior

Foam is created by rising air bubbles at the surface of hydraulic fluids in the reservoir. Foam that develops should collapse as quickly as possible.

Common hydraulic fluids in accordance with ISO 12922 are sufficiently inhibited against foam formation in new condition. On account of aging and adsorption onto surfaces, the defoamer concentration may decrease over time, leading to a stable foam.

Defoamers may be re-dosed only after consultation with the lubricant manufacturer and with his written approval.

Defoamers may affect the air separation ability.

4.8 Corrosion

The hydraulic fluid is to guarantee sufficient corrosion protection of components under all operating conditions, even in the event of impermissible water contamination.

Water-free, fire-resistant hydraulic fluids are tested for corrosion protection in the same way as mineral oil HLP/HVLP. When used in practice other corrosion mechanisms are revealed in detail and in individual cases, for the most part in contact with non-ferrous and white alloys.

4.9 Air

Under atmospheric conditions the hydraulic fluid contains dissolved air. In the negative pressure range, for instance in the suction pipe of the pump or downstream of control edges, this dissolved air may transform into undissolved air. The undissolved air content represents a risk of cavitation and of the diesel effect. This results in material erosion of components and increased hydraulic fluid aging.

With the correct measures, such as suction pipe and reservoir design, and an appropriate hydraulic fluid, air intake and separation can be positively influenced.

See also chapter 3.1.7 "Air separation ability (ASA)".

4.10 Water

Water contamination in hydraulic fluids can result from direct ingress or indirectly through condensation of water from the air due to temperature variations.

HFDU hydraulic fluids on glycol basis are water-soluble or can be mixed with water. This means that any water that has ingressed into the system cannot be drained off in the sump of the reservoir.

In the case of HDFU hydraulic fluids on ester basis, undissolved water can be drained off from the reservoir sump, the remaining water content is however too high to ensure that the maximum permissible water limit values are observed in the long term.

With the fluid classification HFDR, the greater density of the ester means that the any water that has ingressed will be on the surface of the hydraulic fluid. This means that any water that has ingressed into the system cannot be drained off in the sump of the reservoir.

Water in the hydraulic fluid can result in wear or direct failure of hydraulic components. Furthermore, a high water content in the hydraulic fluid negatively affects aging and filterability and increases susceptibility to cavitation. During operation, the water content in all hydraulic fluids, determined according to the "Karl Fischer method" (see chapter 6 "Glossary") for all water-free, fire-resistant hydraulic fluids must constantly be kept below 0.1% (1000 ppm). To ensure a long service life of both hydraulic fluids and components, Bosch Rexroth recommends that values below 0.05% (500 ppm) are permanently maintained.

Due to the higher water solubility in comparison to mineral oil HLP/HVLP it is urgently advised that precautions be taken when using water-free, fire-resistant hydraulic fluids, such as a dehumidifier on the reservoir ventilation.

Water content has an affect particularly in the case of HEDU hydraulic fluid on ester basis and HFDR in that it accelerates aging (hydrolysis) of the hydraulic fluid and biological degradation, see chapter 4.11 "Fluid servicing, fluid analysis and filtration".

4.11 Fluid servicing, fluid analysis and filtration

Air, water, operating temperature influences and solid matter contamination will change the performance characteristics of hydraulic fluids and cause them to age.

To preserve the usage properties and ensure a long service life for hydraulic fluid and components, the monitoring of the fluid condition and a filtration adapted to the application requirements (draining and degassing if required) are indispensable.

The effort is higher in the case of unfavorable usage conditions, increased stress for the hydraulic system or high expectations as to availability and service life, see chapter 2 "Solid particle contamination and cleanliness levels".

When commissioning a system, please note that the required minimum cleanliness level can frequently be attained only by flushing the system. Due to severe start-up contamination, it may be possible that a fluid and/or filter replacement becomes necessary after a short operating period (< 50 operating hours).

The hydraulic fluid must be replaced at regular intervals and tested by the lubricant manufacturer or recognized accredited test labs. **We recommend a reference analysis after commissioning.**

The minimum data to be tested for analyses are:

- Viscosity at 40 °C and 100 °C
- Neutralization number NN (acid number AN)
- Water content (Karl-Fischer method)
- Particle measurement with evaluation according to ISO 4406 or mass of solid foreign substances with evaluation to EN 12662
- Element analysis (RFA (EDX) / ICP, specify test method)
- Comparison with new product or available trend analyses
- Assessment / evaluation for further use
- Also recommended: IR spectrum

No differences are needed in the maintenance and care of water-free, fire-resistant hydraulic fluids with the appropriate suitability parameters compared to HLP/HVLP mineral oils. Attention is however drawn to the note in chapter 1.3.

After changing over hydraulic fluids it is recommended that the filters be replaced again after 50 operating hours as fluid aging products may have detached themselves ("self-cleaning effect").

Compared to the pure unused hydraulic fluid the changed neutralization number NN (acid number AN) indicates how many aging products are contained in the hydraulic fluid.
This difference must be kept as small as possible. The lubricant manufacturer should be contacted as soon as the trend analysis notes a significant increase in values.

A higher viscosity than that of new materials indicates that the hydraulic fluid has aged. Evaluation by the test lab or lubricant manufacturers is however authoritative, whose recommendation should be urgently observed.

On systems where the possibility of water contamination cannot be completely ruled out (also condensation), it should be ensured via the hydraulic system circuit that fluid aging products are not accumulating in individual areas of the hydraulic system, but are being removed from the system in a controlled manner via the filtration system. This should be ensured via suitable hydraulic circuits (e.g. flushing circuit) or system manufacturer's operating instructions/specifications.

In case of warranty, liability or guarantee claims to Bosch Rexroth, service verification and/or the results of fluid analyses are to be provided.

5 Disposal and environmental protection

All water-free, fire-resistant hydraulic fluids, are, like mineral oil-based hydraulic fluids, subject to special disposal obligations.

The respective lubricant manufacturers provide specifications on environmentally acceptable handling and storage. Please ensure that spilt or splashed fluids are absorbed with appropriate adsorbents or by a technique that prevents it contaminating water courses, the ground or sewerage systems.

It is also not permitted to mix fluids when disposing of hydraulic fluids. Regulations governing the handing of used oils stipulate that used oils are not to mixed with other products, e.g. substances containing halogen. Non-compliance will increase disposal costs. Comply with the national legal provisions concerning the disposal of the corresponding hydraulic fluid. Comply with the local safety data sheet of the lubricant manufacturer for the country concerned.

6 Glossary

Additivation
Additives are chemical substances added to the basic fluids to achieve or improve specific properties.

Aging
Hydraulic fluids age due to oxidation (see chapter 3.1.5 "Aging resistance"). Liquid and solid contamination acts as a catalyzer for aging, meaning that it needs to be minimized as far as possible by careful filtration. Please refer to Hydrolysis.

Arrhenius equation
The quantitative relation between reaction rate and temperature is described by an exponential function, the Arrhenius equation. This function is usually visualized within the typical temperature range of the hydraulic system. For a practical example, see chapter 3.1.5 "Aging resistance".

Basic fluids
In general, a hydraulic fluid is made up of a basic fluid, or base oil, and chemical substances, the so-called additives. The proportion of basic fluid is generally greater than 90%.

Diesel effect

If hydraulic fluid that contains air bubbles is compressed quickly, the bubbles are heated to such a degree that a self-ignition of the air-gas mix may occur. The resultant temperature increase may lead to seal damage and increased aging of the hydraulic fluid.

Partially saturated esters
In contrast to saturated esters, partially saturated esters have double/multiple bonds between C atoms. Rexroth defines partially saturated esters as unsaturated bonds and mixtures of esters with unsaturated and saturated bonds. Esters with unsaturated bonds are produced on the basis of renewable raw materials.

Depending on their number and position, these unsaturated bonds between the C atoms are instable. These bonds can detach themselves and form new bonds, thus changing the properties of those liquids (an aging mechanism). Attention is however drawn to the note in chapter 1.3.

Hydrolysis
Hydrolysis is the splitting of a chemical bond through the reaction with water under the influence of temperature.

ICP (atomic emission spectroscopy)
The ICP procedure can be used to determine various wear metals, contamination types and additives. Practically all elements in the periodic system can be detected with this method.

Iodine count
The iodine count is a yardstick for the quantity of single and multiple unsaturated bonds between C atoms in the basic fluid. A low iodine count indicates that the hydraulic fluid contains few unsaturated bonds and is thus considerably more resistant to aging than a hydraulic fluid with a high iodine count. A statement about the position at which these multiple bonds are located and about how "stable" they are against influencing factors cannot be derived simply by stating the iodine count.

Karl Fischer method
Method to determine the water content in fluids. Indirect coulometric determination procedure in accordance with DIN EN ISO 12937 in connection with DIN 51777-2. Only the combination of both standards will assure adequately accurate measured values. For hydraulic fluids based on glycol, DIN EN ISO 12937 is to be applied in conjunction with DIN 51777-1.

Cavitation
Cavitation is the creation of cavities in fluids due to pressure reduction below the saturated vapour pressure and subsequent implosion when the pressure increases. When the cavities implode, extremely high acceleration, temperatures and pressure may occur temporarily, which may damage the component surfaces.

Neutralization number (NN)
The neutralization number (NN) or acid number (AN) specifies the amount of caustic potash required to neutralize the acid contained in one gram of fluid.

Pour point
The lowest temperature at which the fluid still just flows when cooled down under set conditions. The pour point is specified in the lubricant manufacturers' technical data sheets as a reference value for achieving this flow limit.

RFA (wavelength dispersive x-ray fluorescence analysis)
Is a procedure to determine nearly all elements in liquid and solid samples with nearly any composition. This analysis method is suitable for examining additives and contamination, delivering fast results.

Shearing/shear loss
Shearing of molecule chains during operation can change the viscosity of hydraulic fluids with long chain VI enhancers and anti-fogging additives. The initially high viscosity index drops. This needs to be taken into account when selecting the hydraulic fluid.

The only value at present that can be used to assess viscosity changes in operation is the result of the test in accordance with DIN 51350 part -6. Please note that there are practical applications that create a much higher shear load on such hydraulic fluids than can be achieved by this test.

Viscosity
Viscosity is the measure of the internal friction of a fluid to flow. It is defined as the property of a substance to flow under tension. Viscosity is the most important characteristic for describing the load-bearing capacity of a hydraulic fluid.

Kinematic viscosity is the ratio of the dynamic viscosity and the density of the fluid; the unit is mm^2/s. Hydraulic fluids are classified by their kinematic viscosity into ISO viscosity classes. The reference temperature for this is 40 °C.

Viscosity index (VI)
Refers to the viscosity temperature behavior of a fluid. The lower the change of viscosity in relation the temperature, the higher the VI.

Fire-resistant hydraulic fluids – water-containing (HFAE, HFAS, HFB, HFC)

Application notes and requirements for Rexroth hydraulic components

Hydraulic fluids

Title	Hydraulic fluids based on mineral oils and related hydrocarbons	Environmentally acceptable hydraulic fluids	Fire-resistant hydraulic fluids – water-free	Fire-resistant hydraulic fluids – water-containing
Standard	DIN 51524	ISO 15380	ISO 12922	ISO 12922
Document	90220	90221	90222 90225[1]	90223 90225[1]
Fluid rating	90235[2] Bosch Rexroth Fluid Rating List 90245[2]			
Classification	HL HLP HVLP and more	HETG HEPG HEES partially saturated HEES saturated HEPR	HFDR HFDU (ester base) HFDU (glycol base) and more	HFAE HFAS HFB HFC and more

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1) Valid for Bosch Rexroth axial piston units

2) Valid for Bosch Rexroth Business Unit “Mobile Applications” – pumps and motors

Contents

1 Basic information

1.1 General instructions

Hydraulic fluid is the common element in any hydraulic system and must be selected very carefully. Quality and cleanliness of the hydraulic fluid are decisive factors for the operational reliability, efficiency, and life cycle of the system. Hydraulic fluids must conform, be selected and used in accordance with the generally acknowledged rules of technology and safety provisions. Reference is made to the country-specific standards and directives (in Germany the directive of the Employer's Liability Insurance Association BGR 137).
This document includes recommendations and regulations concerning the selection, operation, and disposal of water-containing, fire-resistant hydraulic fluids in the application of Rexroth hydraulic components.

The individual selection of hydraulic fluid or the choice of classification are the responsibility of the operator.

It is also the responsibility of the operator to ensure that appropriate measures are taken for safety and health protection and to ensure compliance with statutory regulations. The recommendations of the lubricant manufacturer and the specifications given in the safety data sheet are to be observed when using hydraulic fluid.

This document does not release the operator from verifying the conformity and suitability of the respective hydraulic fluid for his system. The operator of a hydraulic system must ensure that the hydraulic fluid remains fit for purpose throughout its entire period of use.
The currently valid standard for fire-resistant hydraulic fluids is ISO 12922. In addition, even more detailed documents, guidelines, specifications, and laws (the observance of which the operator shall also be responsible) may be valid. This includes, for instance:

a. 90235 - Assessment of hydraulic fluids used in Rexroth hydraulic components (pumps and motors)
b. 7th Luxembourg Report: Luxembourg, April 1994 - Doc. No. 4746/10/91 EN “Requirements and tests applicable to fire-resistant hydraulic fluids used for power transmission and control (hydrostatic and hydrokinetic)”
c. VDMA 24314 (1981-11): “Change of pressure liquids – Directives”
d. VDMA 24317 (2005-11): “Fire-resistant hydraulic fluids - Minimum technical requirements”
e. FM Approval Standard 6930 (2009-04): “Flammability Classification of Industrial Fluids” (only available in English)
f. DIN Technical Report CEN/TR 14489 (2006-01): “Selection guidelines for protecting safety, health, and the environment”
g. BGR 137 - Handling hydraulic fluids (1997-04): German trade association rules health and safety at work.
h. DIN 24320: “Fire-resistant fluids - Hydraulic fluids of categories HFAE and HFAS - Characteristics and requirements”
i. List of hydraulic fluids in the set of regulations for the mining sector (coal mining): http://www.bezregarnsberg.nrw.de/themen/s/schwerentflammbare_hydraulikfluessigkeiten/index.php
j. RAG N 762010 (2012-10): “Fire-resistant hydraulic fluids HFC-E, requirements”
k. RAG N 762011 (2012-09): “Requirements on synthetic, fire-resistant hydraulic fluids (HFA-S and synthetic emulsions)”
l. Ordinance for all mining sectors - ABBergV (1995-10): General Federal Mining Ordinance
m. Occupational Health and Safety Ordinance for Mines (GesBergV) (1991-07): Mining ordinance for the health protection of mineworkers

We recommend that you maintain constant, close contact with lubricant manufacturers to support you in the selection, maintenance, care, and analyses.
When disposing of used hydraulic fluids, apply the same care as during use.

1.2 Fire resistance

There is no clear legal definition of fire-resistant hydraulic fluids. There are great differences regarding fire resistance. Selection is the sole responsibility of the system operator with respect to requirements (application, construction and design of the system, hottest ignition source in the system, required fire protection).

The most important task in determining the fire resistance of hydraulic fluids is to find a test method that reproduces the situation occurring in a specific application. Different test methods are used to assess the fire resistance according to ISO 12922:

- Spray ignition characteristics according to ISO 15029-1 (Spray flame persistence – Hollow-cone nozzle method)
- Spray ignition characteristics according to ISO 15029-2 (Stabilized flame heat release method) Flammability index (RI))
- Wick flame persistence of fluids according to ISO 14935 (average flame persistence)
- Flammability on hot surfaces according to ISO 20823 (ignition temperature, spread of flame)
  The required minimum values for the ignition temperature differ according to ISO 12922:
  HFB: 650 °C, HFC: 600 °C, HFDU: 400 °C, HFDR: 700 °C

In general, fire-resistant hydraulic fluids are distinguished between fire-resistant, **water-free**, and fire-resistant, **water-containing** hydraulic fluids. The fire-resistant, water-free hydraulic fluids are described in Document 90222.

Fire resistant, water-containing hydraulic fluids are normally understood as hydraulic fluids with a proportion greater than 35% by mass of water (according to ISO 12922).

Information

- Only fire-resistant, water-containing hydraulic fluids can currently receive approval from the mining authorities for use in coal mining below ground.
- In contrast to water-free fluids, all fire-resistant, water-containing hydraulic fluids do not have a flash point or combustion point.
- The test conditions for determining the flammability on hot surfaces vary significantly within ISO 12922 between fire-resistant, water-free and fire-resistant, water-containing hydraulic fluids (e.g. different testing temperatures).
- Just as much care should be taken when working with fire-resistant hydraulic fluids as with other hydraulic fluids, e.g. mineral oils. Leakage in the hydraulic system must be prevented. The best and most cost-effective protection against fire and explosion is to prevent leakage with meticulous servicing, and maintenance and care of the hydraulic system.
- If possible, the system should be designed such that fires and explosions cannot arise.

1.3 Scope

This document must be applied when using fire-resistant, water-containing hydraulic fluids in Bosch Rexroth hydraulic components. Please note that the specifications in this document may be further defined by the data sheets for the individual components.

The use of the individual fire-resistant, water-containing hydraulic fluids according to the intended purpose can be found in the safety data sheets or other product description documents of the lubricant manufacturers.

Rexroth hydraulic components may only be operated with fire-resistant, water-containing hydraulic fluids according to ISO 12922 if this is specified in the respective component data sheet or if a Rexroth approval for use is furnished.

The manufacturers of hydraulic systems must adjust their systems and operating instructions to the fire-resistant, water-containing hydraulic fluids.

Bosch Rexroth will accept no liability for its components for any damage resulting from failure to comply with the notes below.

1.4 Safety instructions

Hydraulic fluids can constitute a risk for persons and the environment. These risks are described in the hydraulic fluid safety data sheets. The operator is to ensure that a current safety data sheet for the hydraulic fluid used is available and that the measures stipulated therein are complied with.
See also sub-paragraphs 1.1 b., f., g., j., k., and l.

2 Solid particle contamination and cleanliness levels

Solid particle contamination is the major reason for faults occurring in hydraulic systems. It may lead to a number of effects in the hydraulic system. Firstly, single large solid particles may lead directly to a system malfunction, and secondly small particles cause continuous elevated wear.
For fire-resistant, water-containing hydraulic fluids, the cleanliness level is given as a three-digit numerical code in accordance with ISO 4406. The determination of this is made pursuant to the microscope method according to ISO 4407. The automatic method cannot be applied for fire-resistant, water-containing hydraulic fluids, since oil droplets could be counted as particles, for instance. This numerical code denotes the number of particles present in a hydraulic fluid for a defined quantity. Only particles > 5 µm and > 15 µm are counted here. The specification of the cleanliness level according to ISO 4406 thus only relates to those two particle sizes; for example: “ISO 4406: - / 18 / 15”. The type of measuring method applied must always be specified as well when the cleanliness level is being determined.
ISO 4406 is generally preferred in hydraulics.
Moreover, foreign solid matter is not to exceed a mass of 50 mg/kg (gravimetric examination according to ISO 4405).

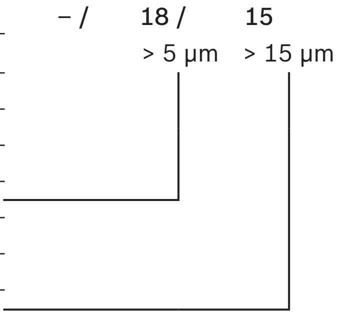
In general, compliance with a minimum cleanliness level of 20/18/15 according to ISO 4406 or better is to be maintained during operation. Special servo valves require better cleanliness levels of at least 18/16/13. An ordinal number lower by one signifies one half of the number of particles, and thus a higher level of cleanliness. Lower numbers in cleanliness levels should always be striven for, and extend the service life of hydraulic components. The component with the highest cleanliness requirements determines the required cleanliness for the overall system. Please also note the information given in Table 1: “Cleanliness levels according to ISO 4406” and in the respective data sheets for the various hydraulic components.
As an option, SAE AS 4059 can be used instead of ISO 4406 if particles above the size of 14 µm are going to be identified. The specification of cleanliness levels using cumulative particle counts is indicated by way of a letter/numerical code, although usually the particle size with the highest code is specified.
Hydraulic fluids frequently fail to meet the cleanliness requirements on delivery (basic contamination in containers). Careful filtering is therefore required during operation and, in particular, during filling in order to ensure the required cleanliness levels in the system. Your lubricant manufacturer can tell you the cleanliness levels of hydraulic fluids as delivered. To maintain the required cleanliness level over the operating period, it is recommended that a tank breather filter be used.

Information
Note: the specifications of the lubricant manufacturer relating to cleanliness levels are based on the time at which the container concerned is filled and not on the conditions during transport and storage.
Further information about solid matter contamination and cleanliness levels can be found in the Bosch Rexroth oil cleanliness booklet R999000239.

Filter inspections and tests can be ordered at Bosch Rexroth as a service using the number R928037504 - Filter inspection - (inspection of used filter cartridges).

Table 1: Cleanliness levels according to ISO 4406 (determination according to ISO 4407)

Particles per 100 ml		Ordinal number
More than	Up to and including	
8,000,000	16,000,000	24
4,000,000	8,000,000	23
2,000,000	4,000,000	22
1,000,000	2,000,000	21
500,000	1,000,000	20
250,000	500,000	19
130,000	250,000	18
64000	130,000	17
32000	64000	16
16000	32000	15
8000	16000	14
4000	8000	13
2000	4000	12
1000	2000	11
500	1000	10
250	500	9
130	250	8
64	130	7
32	64	6



3 Selection of the hydraulic fluid

Fire-resistant, water-containing hydraulic fluids for Bosch Rexroth hydraulic components are assessed on the basis of their fulfillment of the minimum requirements according to ISO 12922.
Based on this, hydraulic fluids can be used that were assessed by Bosch Rexroth according to 90235 (fluid rating).

3.1 Selection criteria for the hydraulic fluid

The specified limit values for all components employed in the hydraulic system, for example required viscosities and cleanliness levels, need to be complied with while observing the specified operating conditions with the hydraulic fluid used. Please refer to the data sheet for the respective Rexroth hydraulic component for the permissible viscosity range, the required cleanliness levels, and the approved operating data.
Hydraulic fluid suitability depends, among other things, on the following factors:

3.1.1 Viscosity

Viscosity is a basic property of hydraulic fluids. The permissible viscosity range of complete systems needs to be determined taking account of the permissible viscosity of all components, and it is to be observed for each individual component.
The viscosity at operating temperature determines the response characteristics of closed control loops, stability and damping of systems, the efficiency factor, and the degree of wear.
We recommend that the optimum operating viscosity range of each component be kept within the permissible temperature range.
If the viscosity of a hydraulic fluid used is above the permitted operating viscosity, this will result in increased hydraulic-mechanical losses. However, internal leakage losses will be fewer. If the pressure level is lower, lubrication gaps may not be filled up, which can lead to increased wear. For hydraulic pumps, the permitted suction pressure may not be reached, which could lead to cavitation damage.
If the viscosity of a hydraulic fluid is below the permitted operating viscosity, increased leakage, wear, susceptibility to contamination, and a shorter life cycle in the components will result.
Please ensure that the permissible temperature and viscosity limits are observed for the respective components. This usually requires either cooling or heating, or both.
The viscosity is influenced by the water content. If water loss occurs during operation owing to temperatures > +40 °C, then the viscosity will increase firstly (mainly in

open systems). If the viscosity drops when the water content is reduced or if it remains the same, then the polymers in the water-glycol mixture are either damaged or sheared.

Fig. 1: Example ν-T-diagram HFA, HFAS concentrated, HFC compared to HFDR, HFDU (ester based) and HLP (reference values, double-logarithmic presentation)

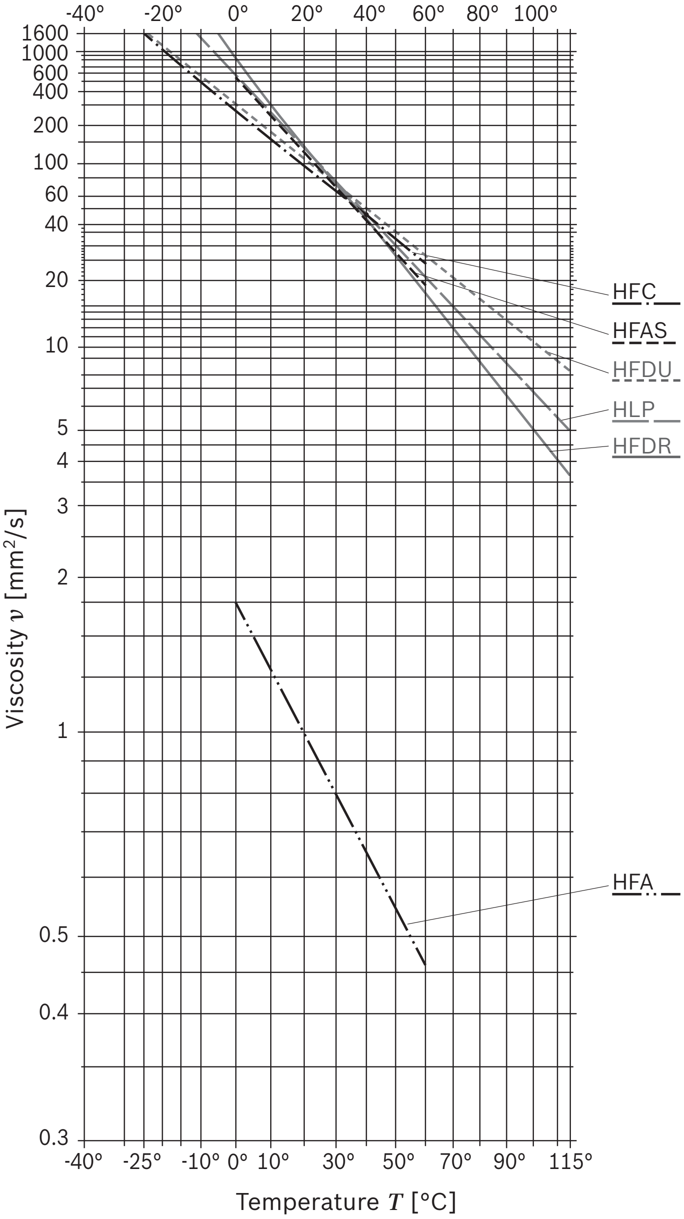


Table 2: Examples of typical viscosity data [mm²/s] in different hydraulic fluids

Temperature	-20 °C	0 °C	40 °C	60 °C	100 °C
HFA	–1)	1.75	0.65	0.47	–2)
HFAS concentrated	–1)	550	42	18.7	–2)
HFC	1183	295	46	24.3	–2)
compare HFDR (see 90222)	(14250)3)	956	43	17.1	(5)3)
compare HFDU (ester based) (see 90222)	1195	310	50	26.5	10.4
compare HLP (see 90220)	(4034)3)	547	46	20.8	(6.9)3)

1) Not applicable (see Pour point)

2) Not applicable (water loss in depressurized reservoir)

3) Observe permissible viscosity range for the respective hydraulic component.

3.1.2 Viscosity temperature behavior

In hydraulic fluids, it is primarily the viscosity temperature behavior (ν-T-behavior) that is of particular importance.
In hydraulic fluids, the viscosity is characterized in that it drops when the temperature increases and rises when the temperature drops. The interrelation between viscosity and temperature is described by the viscosity index (VI).
HFC hydraulic fluids have a better viscosity temperature behavior than HLP mineral oil.
In HFA hydraulic fluids, the dependency of the viscosity on the temperature is negligible.
The differing viscosity temperature behavior needs to be taken into consideration when selecting hydraulic fluid for the required temperature range.
Owing to a high vapor pressure in comparison to a similar HLP mineral oil, the maximum operating temperature when working with fire-resistant, water-containing hydraulic fluids must be limited. Reservoir temperatures above +50 °C must be prevented in open systems, because they can lead to serious water loss and accelerate the aging process in the hydraulic fluid. Furthermore, in HFC hydraulic fluids, water losses that are too high can lead to both an increase in viscosity and to a reduction in the fire-resistant properties.

Information

- The minimum operating temperature for HFA hydraulic fluids is +5 °C.
- HFC hydraulic fluids respond very well at low temperatures and have a lower pour point when compared to HLP mineral oils.

3.1.3 Wear protection capability

Wear protection capability describes the property of hydraulic fluids to prevent or minimize wear within the components.
This is described in ISO 12922 for HFC hydraulic fluids using the following test methods:

- Mechanical testing in the vane pump (ISO 20763), method B (reduced temperature and working pressure when compared to HLP mineral oil)
- Testing in the four-ball apparatus (ISO 20623)
- Testing in the FZG test machine for mechanical stress in the gears (ISO 14635-1), reduced test temperature when compared with HLP mineral oil: in accordance with the 7th Luxembourg Report or ISO 12922 for HFB and HFC at 60 °C.

These test methods cannot be applied for HFA hydraulic fluids.

The test methods and test conditions for fire-resistant, water-containing hydraulic fluids are not comparable to those used for HLP/HVLP mineral oils. This is why the operating data for Rexroth hydraulic components that were optimized for HLP/HVLP mineral oils are (in part) limited.
To some extent, Rexroth hydraulic components specifically developed for fire-resistant, water-containing hydraulic fluids are available without the limitation of operating data (e.g. in 92053, the A4VSO axial piston variable pump for HFC hydraulic fluids).

3.1.4 Material compatibility

The hydraulic fluid must not negatively affect the materials used in the components. Compatibility with coatings, seals, hoses, metals, and plastics is to be observed in particular. The fluid classifications specified in the respective components data sheets are tested by the manufacturer with regard to material compatibility. Parts and components not supplied by us are to be checked by the user.

The material incompatibilities mentioned here do not automatically result in function problems. However the elements of the materials are found in the hydraulic fluid after use. Material incompatibilities may, where applicable, lead to an accelerated aging process in the hydraulic fluid and to increased wear and corrosion of the components.

Table 3: Known incompatibilities of materials

Classification	Incompatible with
Water-containing HF... general	**Seals/plastics/coatings** FKM elastomers are normally not resistant, NBR elastomers are recommended. Seals, plastics, coatings (of control cabinets, too), outer coatings of hydraulic components, and accessory components (connectors, wiring harnesses, control cabinets) are to be tested for stability. Note: hydraulic fluid vapors can also lead to incompatibility! **Coatings on the inside of the reservoir** Single component lacquer (e.g. zinc dust paint) is unstable; the use of stainless steel reservoirs (rustproof steel) is recommended. **Zinc** Zinc and zinc coatings exhibit in the static immersion test only a minimal amount of change in weight. If zinc (e.g. Zn die-cast housings for filters etc.) is attacked even to a minimal extent, then voluminous reaction products are formed (e.g. zinc soaps) that may block the filters, solenoids etc. **Aluminum** Aluminum alloys are not stable in all cases (risk of corrosion with cast aluminum). Above all, it is the simpler properties that get attacked, especially if they come into contact with steel parts. The electrochemical reaction with steel (potential difference approx. 1.23 V) may cause a severe case of aluminum removal. Anodized aluminum is suitable for static loading. Aluminum wrought alloys offer improved stability. **Cadmium/magnesium** Cadmium and magnesium alloys are not compatible. **Lead** Pure lead is noticeably attacked already in the static compatibility test.
HFB	**Seals** Polyurethane (AU) not stable
HFC	**Seals** Polyurethane (AU) not stable **Tin and zinc** Tin and zinc should be avoided in systems using HFC hydraulic fluids. Residual amounts of HLP mineral oils containing zinc and oils used for corrosion protection must be avoided.

3.1.5 Aging resistance

Fire-resistant, water-containing hydraulic fluids are less subject to thermal load than HLP mineral oils, which is why they are substantially less subject to aging.

In HFAE hydraulic fluids, microbial contamination can cause undesirable aging in the hydraulic fluid. Fungal slime, cakes of fungus, and yeasts can clog filters and lines.

3.1.6 Environmental compatibility

Fire-resistant, water-containing hydraulic fluids are hydraulic fluids that can also be environmentally acceptable at the same time. The main criterion for fire-resistant, water-containing hydraulic fluids is the leak-free, technically problem-free application with the necessary fire resistance. Environmental compatibility is merely a supplementary criterion.

You can recognize the environmental compatibility in the technical data sheet for the hydraulic fluid using the reference to:

- DIN Technical Report CEN/TR 14489
- BGR 137
- 7th Luxembourg Report, Part IV “assessment of health hazards” and Part VI “assessment of environmental compatibility”
- Occupational Health and Safety Ordinance for Mines (GesBergV)

Please refer to the safety data sheet of the respective hydraulic fluids for more information on environmental compatibility.

Information on other environmentally acceptable hydraulic fluids can be found (without reference to fire resistance) in Document 90221.

3.1.7 Air separation ability (ASA)

The air separation ability (ASA) describes the property of a hydraulic fluid to separate undissolved air. Hydraulic fluids always contain dissolved air. During operation, dissolved air may be transformed into undissolved air, leading to cavitation damage.

Furthermore, the system behavior can differ due to the higher proportion of undissolved air when compared with HLP mineral oil. According to ISO 12922, a specific value for the air separation ability is not required for the HFAE and HFAS classifications.

The air separation ability for the HFC classification depends on the viscosity, the temperature, basic fluid, and aging. It cannot be improved by additives.

Fluid classification, fluid product, reservoir size and design must be coordinated to take into account the dwell time and ASA value of the hydraulic fluid.

According to ISO 12922 for instance, an ASA value of ≤ 25 minutes is required for HFC in viscosity class ISO VG 46, lower values are preferable.

3.2 Classification and fields of application

Table 4: Classification and fields of application

Classification	Features	Typical field of application	Information
HFAE according to ISO 12922 Density at 15 °C typically 1.00 kg/dm^3 Normal water content ≥ 95% (m/m)	Oil-in-water emulsions Viscosity at 40 °C: max. 5 mm^2/s Appearance: milky to translucent emulsion	Mine support, hydrostatic drives, hydraulic strut extension below ground	Approved for all components that allow “HFAE according to ISO 12922” in the product data sheet for hydraulic fluids. Observe limitations in the operating data for the respective components. - Water-polluting (WGK 1 to 3) - Reservoir temperature +5 °C to +50 °C - Resistance to aging, see chapter 3.1.5 - Owing to the higher density by comparison to HLP, lower intake pressures are to be expected in pumps and, where applicable, the flow must be reduced and the intake conditions optimized (higher cavitation tendency)
HFAS according to ISO 12922 Density at 15 °C typically 1.00 kg/dm^3 Normal water content ≥ 95% (m/m)	Chemical solutions in water Viscosity at 40 °C: max. 5 mm^2/s or thickened variants up to ISO VG 68 Appearance: transparent	Mine support, foundry technology, press hydraulics (example: hydroforming)	Approved for all components that allow “HFAS according to ISO 12922” in the product data sheet for hydraulic fluids. Observe limitations in the operating data for the respective components. - Mineral-oil free - Water-polluting (WGK 1 to 2) - Reservoir temperature +5 °C to +50 °C - Owing to the higher density by comparison to HLP, lower intake pressures are to be expected in pumps and, where applicable, the flow must be reduced and the intake conditions optimized (higher cavitation tendency)
HFB according to ISO 12922 Density at 15 °C typically 0.92 to 1.05 kg/dm^3 Normal water content ≥ 40% (m/m)	Water-in-oil emulsions Viscosity classes: ISO VG 46 up to 100	Mostly in coal mining below ground, primarily in the U.K. (hydrostatic control systems and drives)	Practical requirements are frequently not fulfilled by hydraulic fluids in this classification. As a result of a high mineral oil content up to 60%, they do not meet the limit values for spray ignition characteristics (fire resistance) prescribed in Germany. Observe limitations in the operating data for the respective components. - Water-polluting (WGK 1 to 3) - Reservoir temperature +5 °C to +50 °C - Owing to the higher density by comparison to HLP mineral oil, lower intake pressures are to be expected in pumps and, where applicable, the flow must be reduced and the intake conditions optimized (higher cavitation tendency)
HFC according to ISO 12922 Density at 15 °C typically 1.07 to 1.09 kg/dm^3 VI: typically > 150 Normal water content ≥ 35% (m/m)	Watery polymer solutions Viscosity classes: ISO VG 22 up to 68 Usually ISO VG 46	All application areas where water-free hydraulic fluids are not permitted due to the risk of fire. For example: The steel industry, coking plants, foundries, hardening plants, forming presses, injection molding and pressure die casting machines, mining technology (exception: salt mining)	Approved for all components that allow “HFC according to ISO 12922” in the product data sheet for hydraulic fluids. Observe limitations in the operating data for the respective components. - Categorized as non-/minimally water-polluting (NWG/WGK 1) - Reservoir temperatures -20 °C to +50 °C - Very good viscosity temperature behavior - Owing to the higher density by comparison to HLP mineral oil, lower intake pressures are to be expected in pumps and, where applicable, the flow must be reduced and the intake conditions optimized (higher cavitation tendency). - A reservoir with an inspection port above the fill level is recommended in order to remove floating residual oil.
HFC-E not standardized according to ISO 12922 Density at 15 °C typically 1.07 to 1.14 kg/dm^3 VI: typically > 135 Normal water content 18 to 20% (m/m)	Watery polymer solutions Viscosity classes: ISO VG 46 up to 68 Normally ISO VG 68	Mostly in coal mining below ground, primarily in Germany	- Like HFC, but improved protection against wear and extended temperature range up to 70 °C

4 Hydraulic fluids in operation

4.1 General

The properties of hydraulic fluids can change continually during storage and operation.

Please note that the fluid standard ISO 12922 merely describes minimum requirements for hydraulic fluids in new condition at the time of filling into the delivery containers. The operator of a hydraulic system must ensure that the hydraulic fluid remains fit for purpose throughout its entire period of use.

Deviations from the characteristic values are to be clarified with the lubricant manufacturer, the test labs, or Bosch Rexroth.

Bosch Rexroth will accept no liability for damage to its components within the framework of the applicable liability legislation insofar as the latter is due to non-observance of the following instructions.

Please note the following aspects in operation.

4.2 Storage and handling

Hydraulic fluids must be stored correctly in accordance with the instructions of the lubricant manufacturer. Avoid exposing the containers to lengthy periods of direct heat.

A container is to be stored such that the risk of any foreign liquid or solid matter (e.g. water, foreign fluids, or dust) ingression into the inside of the container can be ruled out.

After taking hydraulic fluids from the containers, these are to be properly resealed immediately. HFAE and HFAS hydraulic fluids are delivered in a concentrated form.

Please observe the hardness (°dH) in order to produce the finished product, lower hardness values should be aimed at (°dH, calcium oxide CaO in ppm).

Recommendation:

- Store containers in a dry, roofed place
- Store HFA containers frost-protected
- Clean reservoir systems and machine reservoirs regularly

Please refer to the respective safety data sheet for the minimum storage duration and storage conditions.

4.3 Filling of new systems

Usually, the cleanliness levels of the hydraulic fluids as delivered do not meet the requirements of our hydraulic components at the company. When filling, hydraulic fluids must be filtered using an appropriate filter system to minimize solid particle contamination in the system.

As early as possible during test operation, new systems should be filled with the selected hydraulic fluid so as to reduce the risk of accidentally mixing the fluids (see chapter 4.5 “Mixing and compatibility of different hydraulic fluids”). Changing the hydraulic medium at a later point represents significant additional costs (see following section).

4.4 Hydraulic fluid changeover

Problems may be encountered in particular when changing over from fire-resistant, water-free hydraulic fluids or mineral oils to fire-resistant, water-containing hydraulic fluids (e.g. incompatibilities in the form of gelling, silting, stable foam, reduced filterability, or filter blockage). This may also happen when changing products within the same classification.

In the case of changeovers of the fluid in hydraulic systems, it is important to ensure compatibility and miscibility of the new hydraulic fluid with the remains of the previous hydraulic fluid from the system.

Bosch Rexroth recommends obtaining verification of compatibility and miscibility from the manufacturer or supplier of the new hydraulic fluid. The remainder quantities of the old fluid need to be minimized. Mixing hydraulic fluids should be avoided; see following section.

Information on changing over hydraulic fluids with different classifications can be found in VDMA 24314 and ISO 7745, among others. Beyond that, please observe chapter 3.1.4 “Material compatibility”.

Bosch Rexroth will not accept liability for any damage to its components resulting from inadequate hydraulic fluid changeovers!

4.5 Mixing and compatibility of different hydraulic fluids

If hydraulic fluids from different manufacturers or different types from the same manufacturer are mixed, gelling, silting, and deposits may occur. These, in turn, may cause foaming, impaired air separation ability, malfunctions, and damage to the hydraulic system.

If the fluid contains more than 2% of another fluid then it is considered to be a mixture.

Mixing with other hydraulic fluids is not generally permitted. This includes hydraulic fluids with the same classification. If individual lubricant manufacturers advertise miscibility and/or compatibility, this is entirely the responsibility of the lubricant manufacturer.

Bosch Rexroth customarily tests all components with HLP mineral oil.

Bosch Rexroth will not accept liability for any damage to its components resulting from mixing hydraulic fluids!

4.6 Re-additivation

Additives added at a later point in time such as colors, wear reducers, VI enhancers or anti-foam additives, may negatively affect the performance properties of the hydraulic fluid and the compatibility with our components, and are not approved.

Bosch Rexroth will not accept liability for any damage to its components resulting from re-additivation!

4.7 Foaming behavior

Foam is created by rising air bubbles at the surface of hydraulic fluids in the reservoir. Foam that develops should collapse as quickly as possible.

The foaming behavior of fire-resistant, water-containing hydraulic fluids is normally worse than in HLP mineral oil.

4.8 Corrosion protection

Water generally has corrosive properties.

Corrosion protection is only possible to a limited extent due to the water content in fire-resistant, water-containing hydraulic fluids, despite the available corrosion protection additives.

Materials made of steel, copper, zinc, aluminum, bronze alloys and brass alloys, as well as combinations of these materials have a higher corrosion tendency.

4.9 Dissolved and undissolved air

Under atmospheric conditions, the hydraulic fluid contains dissolved air. In the negative pressure range, for instance in the suction pipe of the pump or downstream of control edges, this dissolved air may transform into undissolved air. The undissolved air content represents a risk of cavitation. The consequence of this is material erosion on components. With the correct measures, such as suction pipe and reservoir design, and an appropriate hydraulic fluid, air intake and separation can be positively influenced.

See also section 3.1.7 “Air separation ability (ASA)”.

4.10 Fluid servicing, fluid analysis, and filtration

To preserve the usage properties and ensure a long service life for hydraulic fluid and components, both the monitoring of the fluid condition and a filtration adapted to the application requirements are indispensable.

The application of hydraulic system filters with a filtration rate > 200 for 10µm particles (β10(c) > 200 according to ISO 16889) is not recommended for fire-resistant, water-containing hydraulic fluids, since finer filters can break down the chemical composition of the fluid. If finer filters are required despite that, then the fluid manufacturer needs to be consulted before they are used.

β10(c) > 75 according to ISO 16889 is recommended.

The effort is higher in the case of unfavorable usage conditions, increased stress on the hydraulic system or high expectations as to availability and service life, see chapter 2 “Solid particle contamination and cleanliness levels”.

When commissioning a system, please note that the required minimum cleanliness level can frequently be attained only by flushing the system. Due to severe start-up contamination, it may be possible that a fluid and/or filter replacement becomes necessary after a short operating period (< 50 operating hours).

The hydraulic fluid must be replaced at regular intervals and tested by the lubricant manufacturer or recognized, accredited test labs. A reference inspection is recommended both for the unused hydraulic fluid (casks) and after commissioning.

Minimum information in analyses (recommended)

Property or test conditions	Test method	HFAE	HFAS	HFB	HFC
Appearance		●	●	●	●
Water content	HFAE, HFB: ISO 3733 HFAS: ISO 6296; HFC: DIN 51777-1	●	●	●	●
Density at 15 °C	ISO 3675, DIN 51757 incl. supplementary sheet 1	–	–	●	●
pH value at 20 °C	ISO 20843	●	●	–	●
Viscosity at 20 °C, 40 °C, and 50 °C	ISO 3104, DIN 51562-1, ASTM D7042	●	●	●	●
Volume fraction of emulsified concentrate	DIN 51368 in conjunction with DIN 51423-2	●	–	●	–
Foreign oil proportion		●	●	●	●
Cleanliness level	ISO 4406	●	●	●	●
Content of foreign solid matter	ISO 4405	●	●	●	●
Microbial stability with details on bacteria, fungi, yeasts, and germ count		●	●	●	–
Elements	DIN 51399-1	●	●	●	●

Optional information

Property or test conditions	Test method	HFAE	HFAS	HFB	HFC
Reserve alkalinity compared with pH values 3.3 and 5.5		●	●	●	●
Testing in the four-ball apparatus	ISO 20623	–	–	–	●
Air separation ability at 50 °C	ISO 9120	–	–	–	●

Information

- If possible, compare the measurement results with the values of new oil or available trend analyses.
- The test report should include an evaluation / assessment pertaining to the further use of the hydraulic fluid.

When using fire-resistant, water-containing hydraulic fluids, the same servicing and maintenance requirements as applied for HLP/HVLP mineral oil are necessary. However, the scope of the analysis/analysis methods have to be adapted to the fluid properties.
After changing over hydraulic fluids, it is recommended that the filter be replaced again after 50 operating hours as fluid aging products may have detached themselves ("self-cleaning effect").
Fire-resistant, water-containing hydraulic fluids contain alkaline additives. They are used both for the neutralization of contamination and for corrosion protection in the hydraulic system. If the reserve alkalinity drops significantly below the value for the unused hydraulic fluid, there is a chance that fully developed, acidic reaction products can no longer be fully neutralized. The risk of electrochemical corrosion in the system increases, which is why the proportion of corrosion protection inhibitors have to be checked during operation (reserve alkalinity compared with pH values 3.3 and 5.5).

If the water contained has noticeably vaporized, then distilled water or VE water needs to be replenished in order to set the initial viscosity; tap water must never be used. The addition of larger quantities of water should be done slowly and, if possible, in several positions during ongoing operation, so as to prevent the pump from occasionally sucking in pure water, and thus being damaged by that. It is recommended that the corresponding amount of water prior to the addition be mixed with approximately the same amount of HFC fluid, for example.

Ultimately, the evaluation by the test lab or lubricant manufacturers is authoritative. Their recommendation should be urgently observed.
In case of warranty, liability, or guarantee claims to Bosch Rexroth, service verification and/or the results of fluid analyses are to be provided.

5 Disposal and environmental protection

All fire-resistant, water-containing hydraulic fluids, are, like mineral oil-based hydraulic fluids, subject to special disposal obligations.
The respective lubricant manufacturers provide specifications on environmentally friendly handling and storage. Please ensure that spilled or splashed fluids are absorbed with appropriate adsorbents or by a technique that prevents it contaminating water courses, the ground, or sewerage systems.

It is also not permitted to mix fluids when disposing of hydraulic fluids. Regulations governing the handing of used oils stipulate that used oils are not to be mixed with other products. Non-compliance will increase disposal costs.

Both the national legal or regulatory provisions and the information given in the respective safety data sheets (e.g. waste codes) must be observed for the disposal of the relevant hydraulic fluid.

6 Standardization

The information pertaining to the standards listed in this document relates to the respective standard edition currently valid.

7 Glossary

Additivation
Additives are chemical substances added to base fluids in small quantities to achieve or improve specific properties.

Alkaline additives
Hydraulic fluids can produce acids as a result of various aging processes. The hydraulic fluid contains alkaline additives in order to cushion/remove the acidification. These additives bind the acid residue and then become particles that are (can be) filtered out. A statement in regard of alkaline additives still effective is provided, on the one hand, by pH value, but better still is the statement pertaining to the content of free acids. In the alkaline f value range, acidic corrosion is not possible, even if acids are present.

Aging
The aging response in a hydraulic fluid describes the chronological sequence of the oxidative, thermal, and (sometimes) hydrolytic change in selected chemical and physical data under test conditions or in practice.
(See chapter 3.1.5 “Aging resistance”).

Arrhenius equation
The quantitative relation between reaction rate and temperature is described by an exponential function, the Arrhenius equation. This function is usually visualized within the typical temperature range of the hydraulic system.

ICP (optical emission spectrometry)
The ICP procedure can be used to determine various wear metals, contamination types, and additives. Practically all elements in the periodic system can be detected with this method.

Karl Fischer method
Method for determining the proportion of water in water-containing hydraulic fluids: potentiometric method according to DIN 51777-1

Cavitation
Cavitation is the creation of vapor filled cavities (vapor bubbles) in fluids due to insufficient vapor pressure and subsequent implosion when the pressure increases. When the cavities implode, extremely high acceleration, temperatures, and pressures may occur temporarily, which may damage the component surfaces.

Reserve alkalinity
Determining the reserve alkalinity is used for the investigation of the corrosion protection still available. If the determined reserve alkalinity significantly drops below the initial value of the new oil, then acidic contamination can no longer be neutralized, this means that there is a potential threat to the system becoming damaged due to corrosion.

pH value
This is the measurement for the acidic or alkaline character of an aqueous solution or emulsion.

Pour point
This is the lowest temperature at which the fluid still just flows when cooled down under set conditions. The pour point is specified in the lubricant manufacturers' technical data sheets as a reference value for achieving this flow limit.

RFA (energy dispersive or wavelength dispersive X-ray fluorescence analysis)
Is a procedure to determine almost all elements in liquid and solid samples with nearly any composition. This analysis method is suitable for examining additives and contamination, delivering fast results.

VE water
Demineralized water, also known as deionized, fully desalinated water

Viscosity
Viscosity is the measure of the internal friction of a fluid to flow. It is defined as the property of a substance to flow under tension. Viscosity is the most important characteristic for describing the load-bearing capacity of a hydraulic fluid.
Kinematic viscosity is the ratio of the dynamic viscosity and the density of the fluid; the unit is mm^2/s. Hydraulic fluids are categorized in ISO viscosity classes by kinematic viscosity. The reference temperature for this is 40 °C.

Viscosity index (VI)
Refers to the viscosity temperature behavior of a fluid.
The lower the change of viscosity in relation the temperature, the higher the VI.

Axial piston units for operation with fire-resistant hydraulic fluids - water-free and water-containing (HFDR, HFDU, HFA, HFB, HFC)

Application requirements and technical data for axial piston units

Hydraulic fluids

Title	Hydraulic fluids based on mineral oils and related hydrocarbons	Environmentally acceptable hydraulic fluids	Fire-resistant hydraulic fluids – water free	Fire-resistant hydraulic fluids – containing water
Standard	DIN 51524	ISO 15380	ISO 12922	ISO 12922
Document	90220	90221	90222 90225[1]	90223 90225[1]
Fluid rating	90235[2] Bosch Rexroth Fluid Rating List 90245[2]			
Classification	HL HLP HVLP and others	HETG HEPG HEES partially saturated HEES saturated HEPR	HFDR HFDU (ester base) HFDU (glycol base) and others	HFAE HFAS HFB HFC and others

[1] Valid for Bosch Rexroth axial piston units

[2] Valid for Bosch Rexroth Business Unit "Mobile Applications" – pumps and motors

Contents

1 Basic information

In accordance with DIN 51502 and DIN EN ISO 6743-4, fire resistant fluids – hereinafter referred to as HF hydraulic fluids – are divided into four groups A, B, C, D and correspondingly designated HFA, HFB, HFC, HFD. In the designation “HF”, the “H” for “hydraulic fluid” and “F” is for “fire resistant”.

In general, fire-resistant hydraulic fluids are divided into water-free, fire-resistant hydraulic fluids and water-containing, fire-resistant hydraulic fluids. The water-free, fire-resistant hydraulic fluids are described in Rexroth data sheet 90222, the water-containing ones are described in Rexroth data sheet 90223.

Compared with hydraulic fluids based on mineral oils and related hydrocarbons, fire-resistant hydraulic fluids do have other, sometimes disadvantageous, properties. This document is intended to show how these special properties have to be considered in the selection and operation of axial piston units.

For axial piston units which may, in accordance with product data sheet, be operated with fire-resistant hydraulic fluids, note the following:

- The operation with HFA, HFB and HFC hydraulic fluids usually requires a reduction in the permissible pressures and rotational speeds. Depending on the product size or nominal size, a special version of the axial piston unit is needed (version **E**-...).
  However, Rexroth hydraulic components that have been specifically developed for water-containing, fire-resistant hydraulic fluids are available without limitation of operational data (e.g. 92053 axial piston variable pump A4VSO for HFC hydraulic fluids).
- When using hydraulic fluids of the category HFDU (ester base), there are permissible standard values for pressure and rotational speed for these axial piston units just as there are for hydraulic fluids based on mineral oils and related hydrocarbons. For operation with HFDR and HFDU (glycol base), for example, a reduction in the permissible rotational speeds results from the significantly higher density of the fluid.
- Note that for almost all HF hydraulic fluids, due to the higher density compared with hydraulic fluids based on mineral oils, the pressure will not fall below the minimum permissible suction pressure at the pump inlet.
- Additional technical data and required sealing materials for the axial piston units are listed in the table on page 4.

When ordering the axial piston unit, please state in plain text the hydraulic fluid that is to be used.

2 Classification of HF-hydraulic fluids

Classification	**Containing water**					**Water-free**		
	HFAE	**HFAS**	**HFB**	**HFC**	**HFC-E**[3]	**HFDR**	**HFDU**[4] **(Glycol base)**	**HFDU (Ester base)**
Features	Oil-in-water emulsions	Chemical solutions in water	Water-in-oil emulsions	Watery polymer solutions	Watery polymer solutions	Basic fluids	Basic fluids	Basic fluids
						Phosphoric acid ester	Glycols	Ester
Water content [%(m/m)]	≥ 95	≥ 95	≥ 40	≥ 35	≥ 20±2	–	–	–
Reservoir temperature T [°C]	5 to 50	5 to 50	5 to 50	-20 to 50	-20 to 70	80	80	80
Optimal reservoir temperature T_{opt} [°C]	40	40	40	40	40	70	70	70
Bearing service life[1] [%]	10	10	20	100[2] 20	100[2] 20	100	100	100
Cleanliness level acc. to ISO 4406	– / 18 / 15	– / 18 / 15	– / 18 / 15	– / 18 / 15	– / 18 / 15	20 / 18 / 15	20 / 18 / 15	20 / 18 / 15
Filter material	Glass fiber, do not use cellulose (filter paper)					–	–	–
Sealing material	NBR	NBR	NBR	NBR	NBR	FKM	FKM	FKM
Minimum suction pressure Port **S** $p_{s\ min}$ [bar] (operation as a pump, open circuit)	1.0 (abs.)	1.0 (abs.)	1.0 (abs.)	1.0 (abs.)	1.0 (abs.)	1.0 (abs.)	1.0 (abs.)	1.0 (abs.)

Notice

- Sealing material and filter grade is to be agreed upon with the manufacturer of the hydraulic fluid or with Bosch Rexroth Filtration System.
  Link: Bosch Rexroth Filtration System
- Compared to hydraulic fluids based on mineral oils, HFC hydraulic fluids have a very good low-temperature performance, a lower pour point and a lower viscosity-pressure coefficients.
- Bosch Rexroth offers the rating of hydraulic fluids for Rexroth hydraulic components as a service. You can find further information on this in the following data sheet:
  90235: Rating of hydraulic fluids for Rexroth hydraulic components

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[1] Attainable bearing service life based on operation with hydraulic fluids based on mineral oils, according to the specifications of the bearing manufacturer.
Practical application cases show results that are much higher.

[2] Axial piston variable pump A4VSO for HFC hydraulic fluids, see document 92053

[3] Not standardized according to ISO 12922.

[4] Can be water-soluble

3 Technical data for axial piston units operating with HF-hydraulic fluids

Notice

- Maximum permissible rotational speeds
- In the following tables, HFA includes HFAE and HFAS
- Nominal pressure/maximum pressure for HFD corresponds to the specifications for mineral oil; see product data sheet
- For HFDU (ester and glycol) as well as for HFDR, there is no pressure limitation
- For HFDR and HFDU (glycol), the maximum allowable rotational speed must be reduced due to the high density of the hydraulic fluid
- The manufacturer's specifications concerning the suction performance, the temperatures, the working pressures and the rotational speeds are to be strictly adhered to for a long service life of the axial piston unit

3.1 Swashplate pumps for open circuit

Variable pump A4VSO series 1x and series 30
for open circuit (data sheet 92050)

Size			40	71	125	180	250	355	500	750	1000
HFA	Nominal pressure p_N = 140 bar Maximum pressure p_{max} = 160 bar	rpm	1950[1]	1650	1350	1350	1120	1120	1000[1]	900	750
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	2100[1]	1760	1450	1450	1200	1200	1050[1]	960	800
HFC	Nominal pressure p_N = 250 bar Maximum pressure p_{max} = 280 bar	rpm	2100[1]	[2]	[2]	[2]	[2]	[2]	1050[1]	960	800
HFD	HFDR, HFDU (glycol base)	rpm	2100	1760	1450	1450	1200	1200	1050	960	800
	HFDU (ester base)	rpm	2600	2200	1800	1800	1500	1500	1320	1200	1000

Variable pump A4VSO series 1x and series 30 for HFC hydraulic fluids
for open circuit (data sheet 92053)

Size			71	125	180	250	355
HFA			See table above: Variable pump A4VSO series 1x and series 30 Please contact us.				
HFB			See table above, variable pump A4VSO series 1x and series 30 Please contact us.				
HFC	Nominal pressure p_N = 350 bar Maximum pressure p_{max} = 400 bar	rpm	2200[3]	1800[3]	1800[3]	1500[3][4]	1500[3]
HFD			See table above, variable pump A4VSO series 1x and series 30 Please contact us.				

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[1] Version E-A4VSO

[2] See table below, variable pump A4VSO series 1x and series 30 for HFC hydraulic fluids

[3] Version A4VSO-F

[4] Version A4VSO-F2

Fixed pump A4FO series 10, series 3x

for open circuit (data sheet 91455)

Size			16	22	28	40	71	125	180	250	500
HFA	Nominal pressure p_N = 140 bar Maximum pressure p_{max} = 160 bar	rpm	–	–	–	–	1650[1]	1350[1]	1350[1]	1120[1]	1000[1]
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	–	–	–	–	1760[1]	1450[1]	1450[1]	1200[1]	1050[1]
HFC	Nominal pressure p_N = 250 bar Maximum pressure p_{max} = 280 bar	rpm	–	–	–	–	1760[1]	1450[1]	1450[1]	1200[1]	1050[1]
HFD	HFDR, HFDU (glycol base)	rpm	3200	2880	2400	2200	1760	1450	1450	1200	1050
	HFDU (ester base)	rpm	4000	3600	3000	2750	2200	1800	1800	1500	1320

Variable pump A10VO series 31

for open circuit (data sheet 92701)

Size			18[2]	28	45	71	100	140
HFA	not permissible		–	–	–	–	–	–
HFB	not permissible		–	–	–	–	–	–
HFC	not permissible		–	–	–	–	–	–
HFD	HFDR, HFDU (glycol base)	rpm	2650	2400	2100	1760	1600	1450
	HFDU (ester base)	rpm	3300	3000	2600	2200	2000	1800

Variable pump A10VSO series 31

for open circuit (data sheet 92711)

Size			18	28	45	71	100	140
HFA	Nominal pressure p_N = 140 bar Maximum pressure p_{max} = 160 bar	rpm	2450[3]	2250[3]	1950[3]	1650[3]	1500[3]	1350[3]
HFB	Nominal pressure p_N = 140 bar Maximum pressure p_{max} = 160 bar	rpm	2650[3]	2400[3]	2100[3]	1760[3]	1600[3]	1450[3]
HFC	Nominal pressure p_N = 175 bar Maximum pressure p_{max} = 210 bar	rpm	2650[3]	2400[3]	2100[3]	1760[3]	1600[3]	1450[3]
HFD	HFDR, HFDU (glycol base)	rpm	2650	2400	2100	1760	1600	1450
	HFDU (ester base)	rpm	3300	3000	2600	2200	2000	1800

Variable pump A10VO series 32

for open circuit (data sheet 92705)

Size			45	71	100	140
HFA	not permissible		–	–	–	–
HFB	not permissible		–	–	–	–
HFC	not permissible		–	–	–	–
HFD	HFDR, HFDU (glycol base)	rpm	2100	1760	1600	1450
	HFDU (ester base)	rpm	2600	2200	2000	1800

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[1] Version E-A4FO

[2] Version A10VSO

[3] Version E-A10VSO

Variable pump A10VSO series 32
for open circuit (data sheet 92714)

Size			45	71	100	140	180
HFA	not permissible		–	–	–	–	–
HFB	not permissible		–	–	–	–	–
HFC	not permissible		–	–	–	–	–
HFD	HFDR, HFDU (glycol base)	rpm	2100	1760	1600	1450	On request
	HFDU (ester base)	rpm	2600	2200	2000	1800	On request

Variable pump A11VO series 1x
for open circuit (data sheet 92500)

Size			40	60	75	95	130	145	190	260
HFA	not permissible		–	–	–	–	–	–	–	–
HFB	not permissible		–	–	–	–	–	–	–	–
HFC	not permissible		–	–	–	–	–	–	–	–
HFD	HFDR, HFDU (glycol base)	rpm	2400	2200	2050	1900	1700	1700	1700	1450
	HFDU (ester base)	rpm	3000	2700	2550	2350	2100	2100	2100	1800

Variable pump A11VLO series 1x
for open circuit (data sheet 92500)

Size			130	145	190	260
HFA	not permissible		–	–	–	–
HFB	not permissible		–	–	–	–
HFC	not permissible		–	–	–	–
HFD	HFDR, HFDU (glycol base)	rpm	2000	2000	2000	1850
	HFDU (ester base)	rpm	2500	2500	2500	2300

Variable pump A11VO series 41[1)]
for open circuit (data sheet 92510)

Size			280
HFA	not permissible		–
HFB	not permissible		–
HFC	not permissible		–
HFD	HFDR, HFDU (glycol base)	rpm	1450
	HFDU (ester base)	rpm	1800

[1)] Version P

VVariable pump A11VLO series 41[1)]

for open circuit (data sheet 92510)

Size			280
HFA	not permissible		–
HFB	not permissible		–
HFC	not permissible		–
HFD	HFDR, HFDU (glycol base)	rpm	1850
	HFDU (ester base)	rpm	2300

Variable pump A15VO series 11[1)]

for open circuit (data sheet 92800)

Size			280
HFA	not permissible		–
HFB	not permissible		–
HFC	not permissible		–
HFD	HFDR, HFDU (glycol base)	rpm	1450
	HFDU (ester base)	rpm	1800

Variable pump A15VLO series 11[1)]

for open circuit (data sheet 92800)

Size			280
HFA	not permissible		–
HFB	not permissible		–
HFC	not permissible		–
HFD	HFDR, HFDU (glycol base)	rpm	1850
	HFDU (ester base)	rpm	2300

Variable pump A18VO series 11

for open circuit (data sheet 92270)

Size		55	80	107
HFA	not permissible	–	–	–
HFB	not permissible	–	–	–
HFC	not permissible	–	–	–
HFD		For operation with HFD hydraulic fluids, limitations for the technical data and the sealing materials are to be observed. Please contact us.		

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1) Version P

Variable pump A18VLO series 11

for open circuit (data sheet 92280)

Size		80
HFA	not permissible	–
HFB	not permissible	–
HFC	not permissible	–
HFD		For operation with HFD hydraulic fluids, limitations for the technical data and the sealing materials are to be observed. Please contact us.

Variable double pump A20VO series 10

for open circuit (data sheet 93100)

Size			95	190	260	520
HFA	Nominal pressure p_N = 140 bar Maximum pressure p_{max} = 160 bar	rpm	–	–	–	1000
HFB	Nominal pressure p_N = 160(140$^{1)}$) bar Maximum pressure p_{max} = 210(160$^{1)}$) bar	rpm	–	–	–	1000
HFC	Nominal pressure p_N = 250(175$^{1)}$) bar Maximum pressure p_{max} = 280(210$^{1)}$) bar	rpm	–	–	–	1000
HFD	HFDR, HFDU (glycol base)	rpm	1900	2000	1850	1000
	HFDU (ester base)	rpm	2350	2500	2300	1300

3.2 Swashplate pumps for closed circuit

Variable pump A4VSG series 1x and series 30

for closed circuit (data sheet 92100)

Size			40	71	125	180	250	355	500	750	1000
HFA	Nominal pressure p_N = 140 bar Maximum pressure p_{max} = 160 bar	rpm	$2750^{1)2)}$	$2400^{1)2)}$	$1950^{1)2)}$	$1800^{1)2)}$	$1650^{1)2)}$	$1500^{1)2)}$	$1350^{1)2)}$	$1200^{2)}$	$1200^{2)}$
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	$3000^{1)2)}$	$2550^{1)2)}$	$2100^{1)2)}$	$1920^{1)2)}$	$1750^{1)2)}$	$1600^{1)2)}$	$1450^{1)2)}$	$1300^{2)}$	$1300^{2)}$
HFC	Nominal pressure p_N = 250 bar Maximum pressure p_{max} = 280 bar	rpm	$3000^{1)2)}$	$2550^{1)2)}$	$2100^{1)2)}$	$1920^{1)2)}$	$1750^{1)2)}$	$1600^{1)2)}$	$1450^{1)2)}$	$1300^{2)}$	$1300^{2)}$
HFD		rpm	3700	3200	2600	2400	2200	2000	1800	1600	1600

Variable pump A4VG series 32

for closed circuit (data sheet 92003)

Size			28	40	56	71	90	125	180	250
HFA	not permissible		–	–	–	–	–	–	–	–
HFB	not permissible		–	–	–	–	–	–	–	–
HFC	not permissible		–	–	–	–	–	–	–	–
HFD		rpm	4250	4000	3600	3300	3050	2850	2500	2400

1) Bearing flushing at **U** port required!

2) Version E-A4VSG

Variable pump A4VG series 40
for closed circuit (data sheet 92004)

Size			**45**	**65**	**85**	**110**	**145**	**175**	**210**	**280**
HFA	not permissible		–	–	–	–	–	–	–	–
HFB	not permissible		–	–	–	–	–	–	–	–
HFC	not permissible		–	–	–	–	–	–	–	–
HFD			For operation with HFD hydraulic fluids, limitations for the technical data and the sealing materials are to be observed. Please contact us.							

Variable pump A4VTG series 33
for closed circuit (data sheet 92013)

Size			**71**	**90**
HFA	not permissible		–	–
HFB	not permissible		–	–
HFC	not permissible		–	–
HFD			For operation with HFD hydraulic fluids, limitations for the technical data and the sealing materials are to be observed. Please contact us.	

Variable pump A10VG series 10
for closed circuit (data sheet 92750)

Size			**18**	**28**	**45**	**63**
HFA	not permissible		–	–	–	–
HFB	not permissible		–	–	–	–
HFC	not permissible		–	–	–	–
HFD		rpm	5000	4250	3800	3500

Variable double pump A20VG series 11 and A22VG series 11
for closed circuit (data sheet 93220)

Size			**45**
HFA	not permissible		–
HFB	not permissible		–
HFC	not permissible		–
HFD			For operation with HFD hydraulic fluids, limitations for the technical data and the sealing materials are to be observed. Please contact us.

Variable double pump A22VG series 40
for closed circuit (data sheet 93221)

Size		45
HFA	not permissible	–
HFB	not permissible	–
HFC	not permissible	–
HFD		For operation with HFD hydraulic fluids, limitations for the technical data and the sealing materials are to be observed. Please contact us.

Variable double pump A24VG series 10
for closed circuit (data sheet 93240)

Size		45 - 45	65 - 45	65 - 65
HFA	not permissible	–	–	–
HFB	not permissible	–	–	–
HFC	not permissible	–	–	–
HFD		For operation with HFD hydraulic fluids, limitations for the technical data and the sealing materials are to be observed. Please contact us.		

Variable double pump A30VG series 10
for closed circuit (data sheet 93430)

Size		28
HFA	not permissible	–
HFB	not permissible	–
HFC	not permissible	–
HFD		For operation with HFD hydraulic fluids, limitations for the technical data and the sealing materials are to be observed. Please contact us.

3.3 Bent-axis pumps for open circuit

Fixed pump A2FO series 6

for open circuit (data sheet 91401)

Size			**5**	**10**	**12**	**16**	**23**	**28**	**32**	**45**	**56**	**63**	**80**
HFA	not permissible		–	–	–	–	–	–	–	–	–	–	–
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	4500	2520	2520	2520	2000	2000	2000	1800	1600	1600	1440
HFC	Nominal pressure p_N = 200 bar Maximum pressure p_{max} = 250 bar	rpm	4500	2520	2520	2520	2000	2000	2000	1800	1600	1600	1440
HFD	HFDR, HFDU (glycol base)	rpm	4500	2520	2520	2520	2000	2000	2000	1800	1600	1600	1440
	HFDU (ester base)	rpm	5600	3150	3150	3150	2500	2500	2500	2240	2000	2000	1800
Size			**90**	**107**	**125**	**160**	**180**	**200**	**250**	**355**	**500**	**710**	**1000**
HFA	not permissible		–	–	–	–	–	–	–	–	–	–	–
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	1440	1280	1280	1160	1160	1240	1200[1]	1060[1]	950[1]	950[1]	750[1]
HFC	Nominal pressure p_N = 200 bar Maximum pressure p_{max} = 250 bar	rpm	1440	1280	1280	1160	1160	1240	1200[1]	1060[1]	950[1]	950[1]	750[1]
HFD	HFDR, HFDU (glycol base)	rpm	1440	1280	1280	1160	1160	1240	1200[2]	1060[2]	950[2]	950[2]	750[2]
	HFDU (ester base)	rpm	1800	1600	1600	1450	1450	1550	1500[2]	1320[2]	1200[2]	1200[2]	950[2]

Variable pump A7VO series 63

for open circuit (data sheet 92202)

Size			**55**	**80**	**107**	**160**
HFA	not permissible		–	–	–	–
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	2000	1800	1600	1400
HFC	Nominal pressure p_N = 200 bar Maximum pressure p_{max} = 250 bar	rpm	2000	1800	1600	1400
HFD	HFDR, HFDU (glycol base)	rpm	2000	1800	1600	1400
	HFDU (ester base)	rpm	2500	2240	2150	1900

Variable pump A7VLO series 63

for open circuit (data sheet 92203)

Size			**250**	**355**	**500**
HFA	not permissible		–	–	–
HFB	not permissible		–	–	–
HFC	not permissible		–	–	–
HFD	HFDR, HFDU (glycol base)	rpm	1200	1060	950
	HFDU (ester base)	rpm	1500	1320	1200

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[1] Version E-A2FLO

[2] Version A2FLO

Variable double pump A8VO series 6x
for open circuit (data sheet 93010)

Size			55	80	107	140	200
HFA	not permissible		–	–	–	–	–
HFB	not permissible		–	–	–	–	–
HFC	not permissible		–	–	–	–	–
HFD	HFDR, HFDU (glycol base)	rpm	2000	1800	1600	–	–
	HFDU (ester base)	rpm	2500	2240	2150	2100	1950

Fixed pump A17FO series 10
for open circuit (data sheet 91520)

Size		23	32	45	63	80	107
HFA	not permissible	–	–	–	–	–	–
HFB	not permissible	–	–	–	–	–	–
HFC	not permissible	–	–	–	–	–	–
HFD		For operation with HFD hydraulic fluids, limitations for the technical data and the sealing materials are to be observed. Please contact us.					

Fixed pump A17FNO series 10
for open circuit (data sheet 91510)

Size		125
HFA	not permissible	–
HFB	not permissible	–
HFC	not permissible	–
HFD		For operation with HFD hydraulic fluids, limitations for the technical data and the sealing materials are to be observed. Please contact us.

3.4 Swashplate motor

Fixed motor A4FM series 1x and series 3x
for open and closed circuit (data sheet 91120)

Size			22	28	40	56	71	125	250	500
HFA	Nominal pressure p_N = 140 bar Maximum pressure p_{max} = 160 bar	rpm	–	–	–	–	2400[1]	1950[1]	1650[1]	1350[1]
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	–	–	–	–	2550[1]	2100[1]	1750[1]	1450[1]
HFC	Nominal pressure p_N = 250 bar Maximum pressure p_{max} = 280 bar	rpm	–	–	–	–	2550[1]	2100[1]	1750[1]	1450[1]
HFD		rpm	4250	4250	4000	3600	3200	2600	2200	1800

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[1] Version E-A4FM

3.5 Bent-axis motors

Fixed motor A2FM series 6x

for open and closed circuit (data sheet 91001)

Size			10	12	16	23	28	32	45	56	63	80	90
HFA	not permissible		–	–	–	–	–	–	–	–	–	–	–
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	4800	4800	4800	3800	3800	3800	3400	3000	3000	2680	2680
HFC	Nominal pressure p_N = 200 bar Maximum pressure p_{max} = 250 bar	rpm	4800	4800	4800	3800	3800	3800	3400	3000	3000	2680	2680
HFD		rpm	8000	8000	8000	6300	6300	6300	5600	5000	5000	4500	4500

Size			107	125	160	180	200	250	355	500	710	1000
HFA	not permissible		–	–	–	–	–	–	–	–	–	–
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	2400	2400	2100	2100	2200	2150[1)]	1800[1)]	1600[1)]	1280[1)]	1280[1)]
HFC	Nominal pressure p_N = 200 bar Maximum pressure p_{max} = 250 bar	rpm	2400	2400	2100	2100	2200	2150[1)]	1800[1)]	1600[1)]	1280[1)]	1280[1)]
HFD		rpm	4000	4000	3600	3600	2750	2700[2)]	2240[2)]	2000[2)]	1600[2)]	1600[2)]

Fixed motor A2FE series 6x

for open and closed circuit (data sheet 91008)

Size			28	32	45	56	63	80	90	107	125	160	180
HFA	not permissible		–	–	–	–	–	–	–	–	–	–	–
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	3800	3800	3400	3000	3000	2680	2680	2400	2400	2100	2100
HFC	Nominal pressure p_N = 200 bar Maximum pressure p_{max} = 250 bar	rpm	3800	3800	3400	3000	3000	2680	2680	2400	2400	2100	2100
HFD		rpm	6300	6300	5600	5000	5000	4500	4500	4000	4000	3600	3600

Size			250	355
HFA	not permissible		–	–
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	2150[3)]	1800[3)]
HFC	Nominal pressure p_N = 200 bar Maximum pressure p_{max} = 250 bar	rpm	2150[3)]	1800[3)]
HFD		rpm	2700[4)]	2240[4)]

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1) Version E-A2FLM
2) Version A2FLM
3) Version E-A2FLE
4) Version A2FLE

Variable motor A6VM series 63

for open and closed circuit (data sheet 91604)

Size			**28**	**55**	**80**	**107**	**140**	**160**	**200**	**250**	**355**	**500**	**1000**
HFA	not permissible		–	–	–	–	–	–	–	–	–	–	–
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	3700	3000	2600	2300	2200	2100	1900	2150$^{1)}$	1800$^{1)}$	1600$^{1)}$	1280$^{1)}$
HFC	Nominal pressure p_N = 200 bar Maximum pressure p_{max} = 250 bar	rpm	3700	3000	2600	2300	2200	2100	1900	2150$^{1)}$	1800$^{1)}$	1600$^{1)}$	1280$^{1)}$
HFD		rpm	5550	4450	3900	3550	3250	3100	2900	2700$^{2)}$	2240$^{2)}$	2000$^{2)}$	1600$^{2)}$

Variable motor A6VE series 63

for open and closed circuit (data sheet 91606)

Size			**28**	**55**	**80**	**107**	**160**	**250**
HFA	not permissible		–	–	–	–	–	–
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	3700	3000	2600	2300	2100	2150$^{3)}$
HFC	Nominal pressure p_N = 200 bar Maximum pressure p_{max} = 250 bar	rpm	3700	3000	2600	2300	2100	2150$^{3)}$
HFD		rpm	5550	4450	3900	3550	3100	2700$^{4)}$

Variable motor A6VM series 65

for open and closed circuit (data sheet 91607)

Size			**55**	**80**	**107**	**140**	**160**	**200**
HFA	not permissible		–	–	–	–	–	–
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	3000	2600	2300	2200	2100	1900
HFC	Nominal pressure p_N = 200 bar Maximum pressure p_{max} = 250 bar	rpm	3000	2600	2300	2200	2100	1900
HFD		rpm	4450	3900	3550	3250	3100	2900

Variable motor A6VM series 71

for open and closed circuit (data sheet 91610)

Size			**60**	**85**	**115**	**150**	**170**	**215**
HFA	not permissible		–	–	–	–	–	–
HFB	Nominal pressure p_N = 160 bar Maximum pressure p_{max} = 210 bar	rpm	3000	2600	2300	2200	2100	1900
HFC	Nominal pressure p_N = 200 bar Maximum pressure p_{max} = 250 bar	rpm	3000	2600	2300	2200	2100	1900
HFD		rpm	4450	3900	3550	3250	3100	2900

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1) Version E-A6VLM

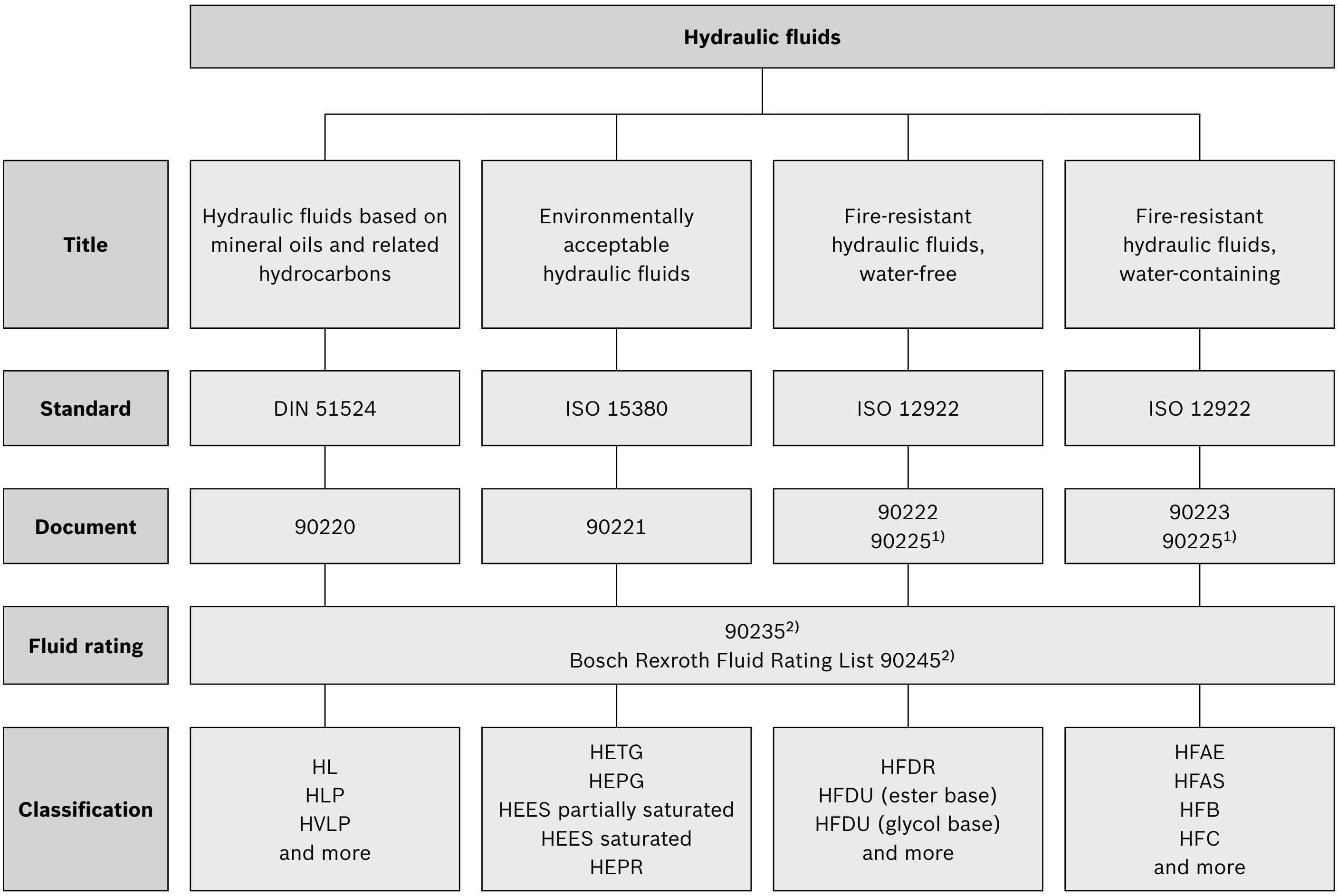
2) Version A6VLM

3) Version E-A6VLE

4) Version A6VLE

Rating of hydraulic fluids for Rexroth hydraulic components (pumps and motors)

Bosch Rexroth offers the rating of hydraulic fluids as service – inclusive assistance and consulting of experienced engineers.



Hydraulic fluids

Title	Hydraulic fluids based on mineral oils and related hydrocarbons	Environmentally acceptable hydraulic fluids	Fire-resistant hydraulic fluids, water-free	Fire-resistant hydraulic fluids, water-containing
Standard	DIN 51524	ISO 15380	ISO 12922	ISO 12922
Document	90220	90221	90222 90225[1]	90223 90225[1]
Fluid rating	90235[2] Bosch Rexroth Fluid Rating List 90245[2]			
Classification	HL HLP HVLP and more	HETG HEPG HEES partially saturated HEES saturated HEPR	HFDR HFDU (ester base) HFDU (glycol base) and more	HFAE HFAS HFB HFC and more

[1] Valid for Bosch Rexroth axial piston units

[2] Valid for Bosch Rexroth Business Unit “Mobile Applications” – pumps and motors

The safe and reliable operation of industrial and mobile equipment is only possible if the hydraulic fluid used is selected with respect to the application. The main tasks of the hydraulic fluid are e.g. transmission of power, lubrication of the components, reduction of friction, corrosion prevention and heat dissipation. Unfortunately the common element “hydraulic fluid” is often disregarded during conceptual design.
Increased requirements on machines and equipment constantly raise the quality requirements on the hydraulic fluid used. For using a suitable hydraulic fluid, adequate knowledge and experience of this are necessary.
Therefore Bosch Rexroth offers the rating of hydraulic fluids for Rexroth hydraulic components as service.
Bosch Rexroth defines hydraulic fluids on the basis of the illustration on page 1. Application notes and requirements for Rexroth hydraulic components can be taken out of the data sheets mentioned in this illlustration on page 1.

1 Description

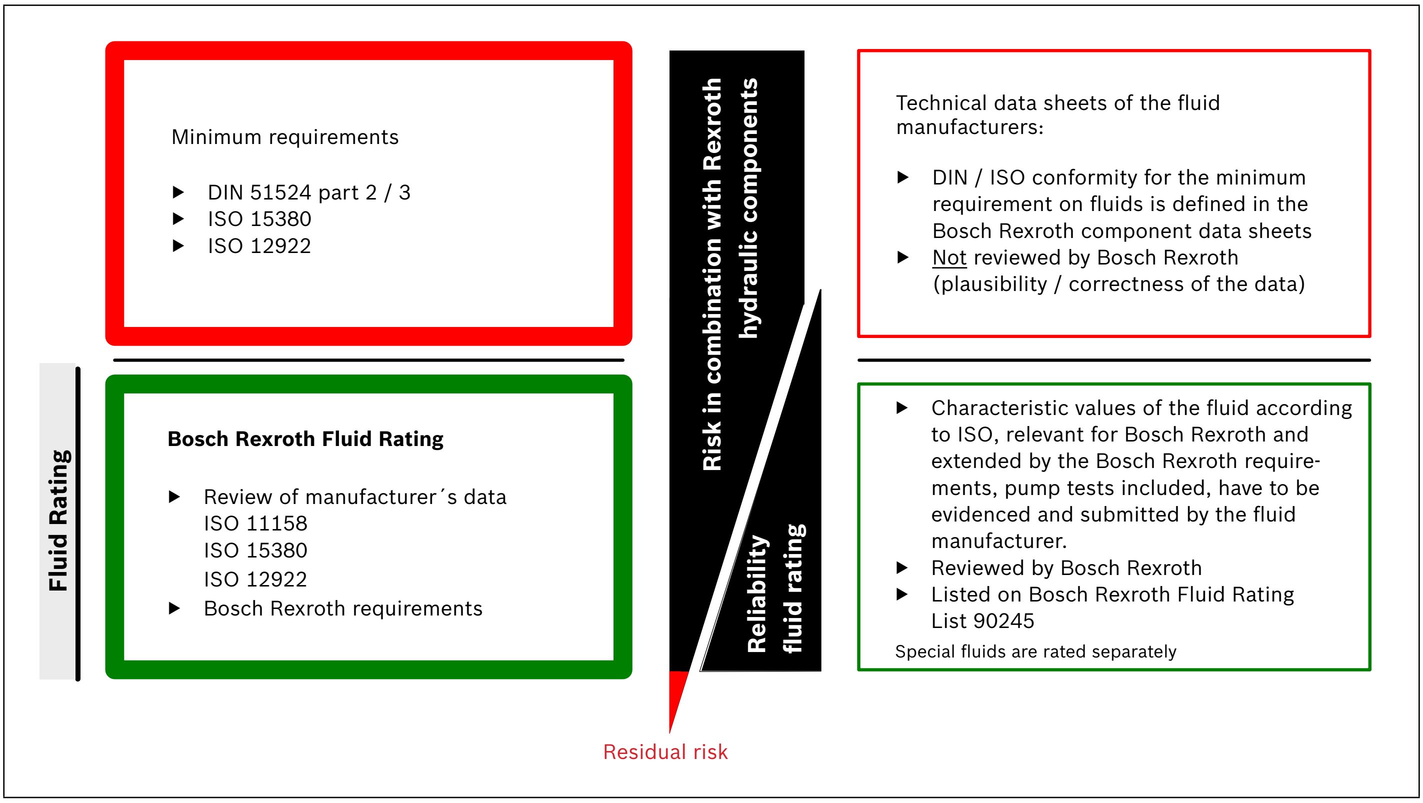
Minimum requirements
At present the standards conformity for the minimum requirement on fluids is defined in our Bosch Rexroth component data sheets. The fluid manufacturers’ technical data sheets have to include that the specific standards are met. The plausibility and correctness of the fluid data are not reviewed by Bosch Rexroth.

Bosch Rexroth Fluid Rating
Fluid data of the manufacturer has to be according to ISO (selected characteristic values of standards) and Bosch Rexroth requirements (tightened values of standards and extended Bosch Rexroth requirements). Bosch Rexroth demands the data to be confirmed in writing. The plausibility and correctness of the fluid data is reviewed by Bosch Rexroth.

The extended Bosch Rexroth requirements are beneath others specific fluid tests, that show suitability of the hydraulic fluid with defined Rexroth components and which are constituents of the respective specification.
Depending on the utilized Rexroth hydraulic components and the oil type, the corresponding fluid test has to be passed prior to the assignment of the Bosch Rexroth fluid rating.
Retention samples (finished oil, base oil) are furthermore saved. The hydraulic fluids that fulfill the Bosch Rexroth Fluid Rating requirements will be listed on the following Bosch Rexroth document.

- ▶ 90245: Bosch Rexroth Fluid Rating List

Note
The Bosch Rexroth Fluid Rating requirements cannot cover all machine and system-dependent conditions (see residual risk on rating scheme on page 3). Only single Rexroth components pumps/motors can be examined in the fluid tests. Bosch Rexroth Fluid Rating does not cover all systems and applications.
Releases for special applications are excluded from the Bosch Rexroth Fluid Rating.
The responsibility for selection of the hydraulic fluid remains with the equipment/machinery operator and the fluid manufacturer.
By means of the requirements contained in the Bosch Rexroth Fluid Rating the risk of using hydraulic fluid in combination with Rexroth hydraulic components can be considerably reduced and the reliability significantly increased.



Minimum requirements

- DIN 51524 part 2 / 3
- ISO 15380
- ISO 12922

Technical data sheets of the fluid manufacturers:

- DIN / ISO conformity for the minimum requirement on fluids is defined in the Bosch Rexroth component data sheets
- Not reviewed by Bosch Rexroth (plausibility / correctness of the data)

Bosch Rexroth Fluid Rating

- Review of manufacturer´s data
  ISO 11158
  ISO 15380
  ISO 12922
- Bosch Rexroth requirements

- Characteristic values of the fluid according to ISO, relevant for Bosch Rexroth and extended by the Bosch Rexroth requirements, pump tests included, have to be evidenced and submitted by the fluid manufacturer.
- Reviewed by Bosch Rexroth
- Listed on Bosch Rexroth Fluid Rating List 90245

Special fluids are rated separately

2 Process

The process of a Fluid Rating includes the following steps:

Fluid Rating Process

Bosch Rexroth Fluid Rating

(BR*	Contacting fluid manufacturer)
FM**	Registration for “Fluid Rating” on website of Bosch Rexroth
BR	Reviewing registration data of the fluid manufacturer for plausibility
BR	Assignation of registration number to fluid manufacturer Activating of fluid manufacturer´s access to download area of “Fluid Rating” on the website of Bosch Rexroth
BR	Information to fluid manufacturer: 1) Registration number (=user name for login in the download area “Fluid Rating“) 2) Activating for download area is done
FM	Download of all documents (conditions, applications) necessary for “Fluid Rating”
FM	Submitting of all documents and retained samples necessary for “Fluid Rating” to Bosch Rexroth
BR	Reviewing of the manufacturer´s data, storing of retained samples
BR	when the requirements are fulfilled - hydraulic fluid will be listed on the Bosch Rexroth Fluid Rating List 90245 → **Fulfilled the requirements of Bosch Rexroth Fluid Rating 90245** validity period: 5 years

*BR: Bosch Rexroth **FM: Fluid Manufacturer

3 Fluid tests

3.1 Requests for Fluid Tests

Two different fluid tests may presently be requested by Bosch Rexroth:

- RFT-APU-CL Rexroth Fluid Test Axial Piston Unit Closed Loop (see **3.2**)
- RFT-APU-OL-HFC Rexroth Fluid Test Axial Piston Unit Open Loop-HFC (see **3.3**)

These tests may be requested independent of the Bosch Rexroth Fluid Rating. They are, however, a permanent specification of the Bosch Rexroth Fluid Rating.
Prior to the request for the Bosch Rexroth Fluid Rating the fluid test, required in the respective specification, has to be terminated positively.

The process of the fluid test includes the following steps:

FM	Request for quotation for fluid test by Bosch Rexroth			
FM	Commissioning of fluid test, submission of further documents and supplying of the fluid for the test			
BR	Implementation of the requested fluid test using defined Rexroth components	**RFT-APU-CL** Rexroth Fluid Test - Axial Piston Unit Closed Loop	**RFT-APU-OL-HFC** Rexroth Fluid Test - Axial Piston Unit Open Loop-HFC	Further fluid tests in preparation

*BR: Bosch Rexroth **FM: Fluid Manufacturer

3.2 Rexroth fluid test RFT-APU-CL

(**R**exroth **F**luid **T**est **A**xial **P**iston **U**nit **C**losed **L**oop)

Fluid test for closed loop applications using a combination of units consisting of a hydraulic pump A4VG045EP and a hydraulic motor A6VM060EP. This fluid test represents the requirements on a hydrostatic transmission.

Features of the fluid test

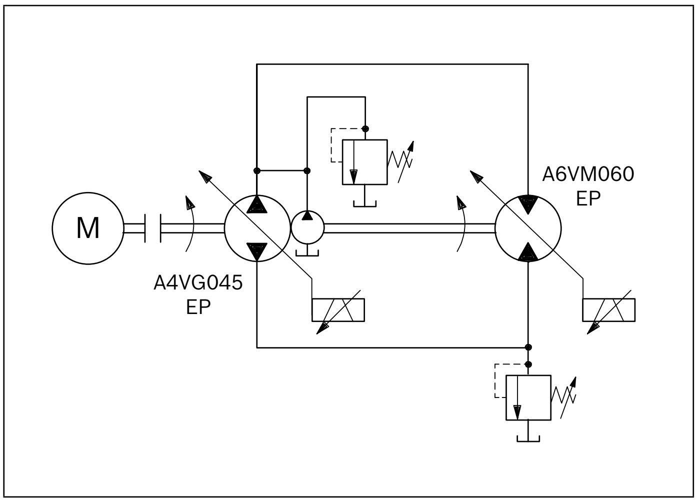
The suitability of the hydraulic fluid is tested at high stress under laboratory conditions. The fluid test consists of a break-in test, swivel cycle test and a corner power test.

Rating criteria

- ▶ Examination of the interaction fluid / component
  - – Measurement of the component weight change respectively dimensional change
  - – Material compatibility
  - – Visual inspection of components /component surfaces
  - – Oil analysis (start of test (SOT), during test, end of test (EOT)
- ▶ Evidence of endurance performance
- ▶ Determination of efficiency (SOT, EOT)

Test bench

▼ Schematical hydraulic circuit diagram of the RFT-APU-CL



Technical data of the test components

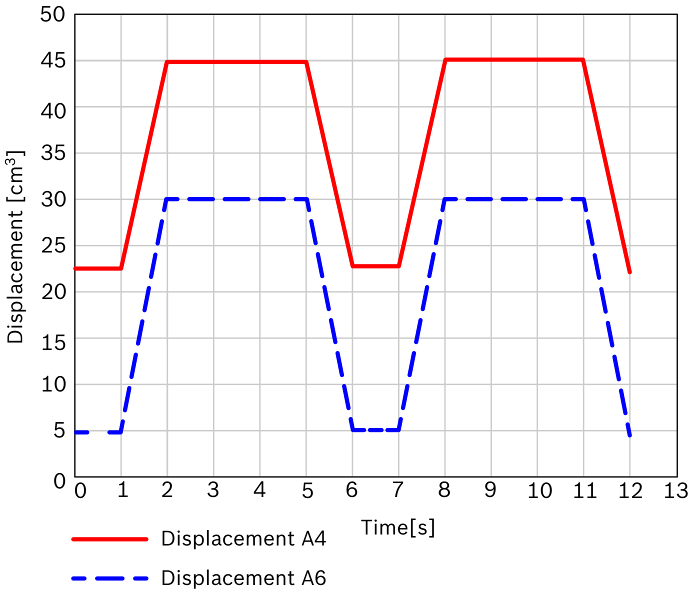
Type	A4VG045 EP	A6VM060 EP
Data sheet	92004	91610
Operation mode	pump	motor
Nominal volume	45 cm^3	62 cm^3
Maximum speed (at $V_{\text{g max}}$)	4300 min^{-1}	4450 min^{-1}
Maximum pressure	500 bar	500 bar
Control	electric (EP)	electric (EP)

Operating data

1. Break-in test	A4VG045 EP	A6VM060 EP
Speed	2000 min^{-1}	2000 min^{-1}
Operating pressure	250 bar	250 bar
Leckage temperature Hydraulic motor		60 °C at port T
Operating time	10 h	10 h

2. Swivel cycle test	A4VG045 EP	A6VM060 EP
Speed	4000 min^{-1}	4000 min^{-1}
Operating pressure	450 bar	450 bar
Leckage temperature Hydraulic motor		100 °C at port T
Operating time	300 h	300 h

▼ Swivel cycle (schematic diagram)



3. Corner power test	A4VG045 EP	A6VM060 EP
Speed	4000 min^{-1}	4000 min^{-1}
Operating pressure	500 bar	500 bar
Leckage temperature Hydraulic motor		100 °C at port T
Operating time	200 h	200 h

3.3 Rexroth fluid test RFT-APU-OL-HFC

(**R**exroth **F**luid **T**est **A**xial **P**iston **U**nit **O**pen **L**oop-**HFC**)

Fluid test for open loop applications using a combination of units consisting of a A4VSO swashplate axial piston combination unit (hydraulic pump and hydraulic motor) as well as an EA10VSO/31 hydraulic pump. This fluid test represents the requirements on applications demanding water-containing, fire-resistant hydraulic fluids of the HFC classification.

Features of the fluid test

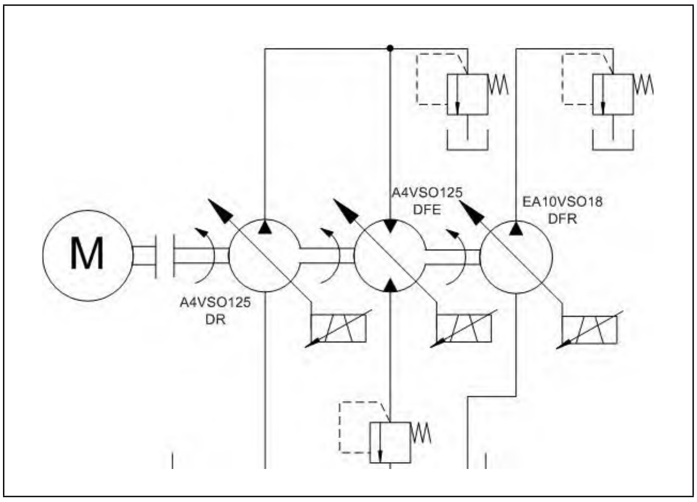
The suitability of the hydraulic fluid is tested at high stress under laboratory conditions. The fluid test consists of a constant and swivel cycle test.

Rating criteria

- Examination of the interaction fluid / component
  - Wear and cavitation behaviour
  - Material compatibility
  - Visual inspection of components /component surfaces
  - Measuring records of functional relevant component surfaces
  - Oil analysis (SOT, during test, EOT)
- Evidence of endurance performance

Test bench

▼ **Schematical hydraulic circuit diagram of the RFT-APU-OL-HFC**



Technical data of the test components

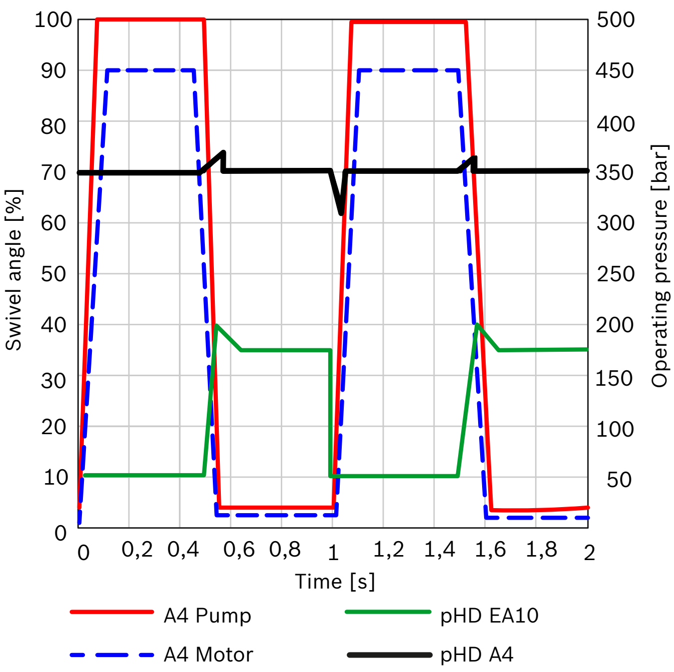
Type	A4VSO125 DR	A4VSO125 DFE	EA10VSO18 DFR/31
Data sheet	92053	92053	92711
Operation mode	pump, self-priming	motor	pump, self-priming
Nominal volume	125 cm^3	125 cm^3	18 cm^3
Maximum speed	2200 min^{-1}	2200 min^{-1}	3300 min^{-1}
Maximum pressure	400 bar	400 bar	350 bar

Operating data

1. Constant test	A4VSO125 DR/DFE	EA10VSO18 DFR/31
Speed	1800 min^{-1}	1800 min^{-1}
Operating pressure	350 bar	175 bar
Displacement	$V_{\text{g max}}/V_{\text{g min}}$	$V_{\text{g max}}/V_{\text{g min}}$
Temperature	50 °C	50 °C
Operating time	100/100 h	100/100 h

2. Swivel cycle test	A4VSO125 DR/DFE	EA10VSO18 DFR/31
Speed	1800 min^{-1}	1800 min^{-1}
Operating pressure	350 bar	50 / 175 bar
Displacement	0,5 sec $V_{\text{g min}}$/ 0,5 sec $V_{\text{g max}}$	0,5 sec $V_{\text{g min}}$/ 0,5 sec $V_{\text{g max}}$
Temperature	50 °C	50 °C
Operating time	800 h	800 h

▼ **Swivel cycle (schematic diagram)**



Axial piston pumps

Fixed pumps, open circuits

Designation	Type	Size	Series	Data sheet	Page
Fixed pump	A2FO	5...1000	6x	91401	97
Fixed pump	A4FO	22...500	10/32	91455	131
Fixed pump	A17FO	23...107	10	91520	159
Fixed pump	A17FNO	125	10	91510	175

Axial Piston Fixed Pump
A2FO

Data sheet

Series 6

Size	Nominal pressure/Maximum pressure
5	315/350 bar
10 to 200	400/450 bar
250 to 1000	350/400 bar

Open circuit

Contents

Features

- Fixed pump with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in an open circuit
- For use in mobile and stationary applications
- The flow is proportional to the drive speed and displacement
- The drive shaft bearings are designed for the bearing service life requirements usually encountered in these areas
- High power density
- Small dimensions
- High total efficiency
- Economical design
- One-piece tapered piston with piston rings for sealing

Ordering code for standard program

	A2F		O		/	6			–	V				
01	02	03	04	05		06	07	08		09	10	11	12	13

Hydraulic fluid

01	Mineral oil and HFD. HFD for sizes 250 to 1000 only in combination with long-life bearings "L" (without code)		
	HFB, HFC hydraulic fluid	Sizes 5 to 200 (without code)	
		Sizes 250 to 1000 (only in combination with long-life bearings "L")	E-

Axial piston unit

02	Bent-axis design, fixed	A2F

Drive shaft bearing		5 to 200	250 to 500	710 to 1000	
03	Standard bearing (without code)	●	●	–	
	Long-life bearing	–	●	●	L

Operating mode

04	Pump, open circuit	O

Sizes (NG)

05 Geometric displacement, see table of values on page 7

5	10	12	16	23	28	32	45	56	63	80	90	107	125	160	180	200	250	355	500	710	1000

Series

06		6

Index

07	NG10 to 180	1
	NG200	3
	NG5 and 250 to 1000	0

Directions of rotation

08	Viewed on drive shaft	clockwise	R
		counter-clockwise	L

Seals

09	FKM (fluor-caoutchouc)	V

Drive shafts		5	10	12	16	23	28	32	45	56	63	80	90	107	125	160	180	200	250 to 1000	
10	Splined shaft DIN 5480	–	●	●	●	●	●	●	–	●	●	●	●	●	●	●	●	●	–	A
		–	●	●	–	●	●	–	●	●	–	●	–	●	–	●	–	–	●	Z
	Parallel keyed shaft DIN 6885	●	●	●	●	●	●	●	–	●	●	●	●	●	●	●	●	●	–	B
		–	●	●	–	●	●	–	●	●	–	●	–	●	–	●	–	–	●	P
	Conical shaft[1]	●	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	C

Mounting flanges			5 to 250	355 to 1000	
11	ISO 3019-2	4-hole	●	–	B
		8-hole	–	●	H

● = Available ❍ = On request – = Not available ▨ = Preferred program

[1] Conical shaft with threaded pin and woodruff key (DIN 6888). The torque must be transmitted via the tapered press fit.

Ordering code for standard program

	A2F		O		/	6			–	V				
01	02	03	04	05		06	07	08		09	10	11	12	13

	Port plates for service lines[2]	**5**	**10 to 16**	**23 to 250**	**355 to 1000**	
12	SAE flange port A/B at side and SAE flange port S at rear	–	–	●	–	**05**
	Threaded port A/B at side and threaded port S at rear	–	●	–	–	**06**
	SAE flange ports A/B and S at rear	–	–	–	●	**11**
	Threaded ports A/B and S at side	●	–	–	–	**07**

	Standard / special version	
13	Standard version (without code)	▨
	Standard version with installation variants, e. g. T ports against standard open or closed	**–Y**
	Special version	**-S**

● = Available ❍ = On request – = Not available ▨ = Preferred program

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[2] Fastening thread or threaded ports, metric

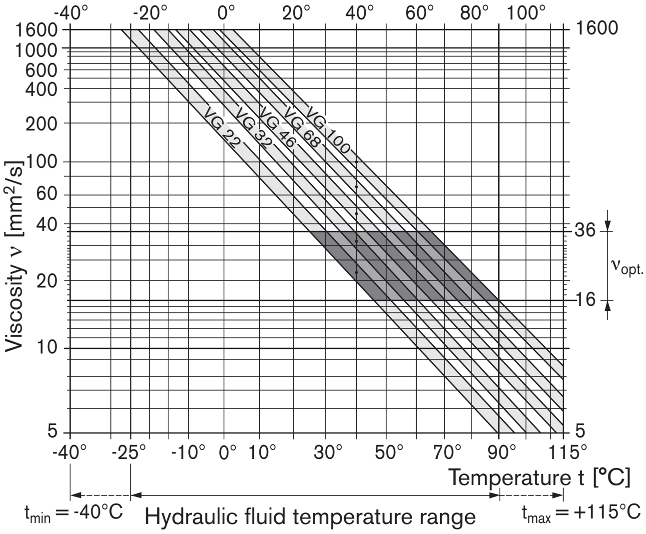
Technical data

Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids), RE 90222 (HFD hydraulic fluids) and RE 90223 (HFA, HFB, HFC hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.

The fixed pump A2FO is not suitable for operation with HFA hydraulic fluid. If HFB, HFC or HFD or environmentally acceptable hydraulic fluids are used, the limitations regarding technical data or other seals must be observed.

Selection diagram



Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature: in an open circuit, the reservoir temperature.

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see shaded area of the selection diagram). We recommended that the higher viscosity class be selected in each case.

Example: At an ambient temperature of X °C, an operating temperature of 60 °C is set in the circuit. In the optimum operating viscosity range ($\nu_{opt.}$, shaded area), this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Note

The case drain temperature, which is affected by pressure and speed, can be higher than the reservoir temperature. At no point of the component may the temperature be higher than 115 °C. The temperature difference specified below is to be taken into account when determining the viscosity in the bearing.

If the above conditions cannot be maintained due to extreme operating parameters, we recommend flushing the case at port U (sizes 250 to 1000).

Viscosity and temperature of hydraulic fluid

	Viscosity [mm²/s]	Temperature	Comment
Transport and storage at ambient temperature		$T_{min} \geq -50$ °C $T_{opt} = +5$ °C to +20 °C	factory preservation: up to 12 months with standard, up to 24 months with long-term
(Cold) start-up¹⁾	$\nu_{max} = 1600$	$T_{St} \geq -40$ °C	$t \leq 3$ min, without load ($p \leq 50$ bar), $n \leq 1000$ rpm (for sizes 5 to 200), $n \leq 0.25 \cdot n_{nom}$ (for sizes 250 to 1000)
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu < 1600$ to 400	T = -40 °C to -25 °C	at $p \leq 0.7 \cdot p_{nom}$, $n \leq 0.5 \cdot n_{nom}$ and $t \leq 15$ min
Operating phase			
Temperature difference		ΔT = approx. 12 K	between hydraulic fluid in the bearing and at port T.
Maximum temperature		115 °C	in the bearing
		103 °C	measured at port T
Continuous operation	$\nu = 400$ to 10 $\nu_{opt} = 36$ to 16	T = -25 °C to +90 °C	measured at port T, no restriction within the permissible data
Short-term operation²⁾	$\nu_{min} \geq 7$	$T_{max} = +103$ °C	measured at port T, $t < 3$ min, $p < 0.3 \cdot p_{nom}$
FKM shaft seal¹⁾		$T \leq +115$ °C	see page 5

1) At temperatures below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C).
2) Sizes 250 to 1000, please contact us.

Technical data

Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

To ensure the functional reliability of the axial piston unit, a gravimetric analysis of the hydraulic fluid is necessary to determine the amount of solid contaminant and to determine the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 is to be maintained.

At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

If the above classes cannot be achieved, please contact us.

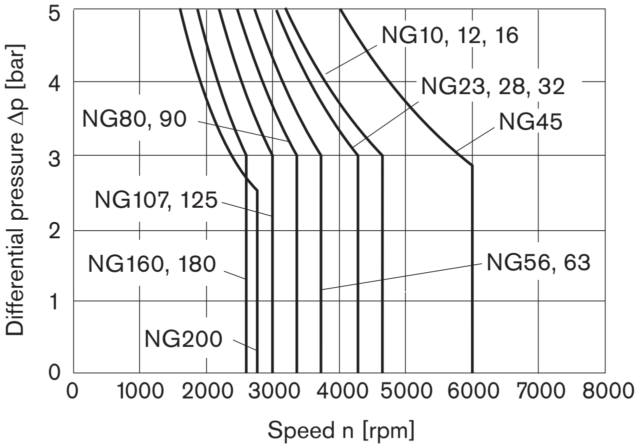
Shaft seal

Permissible pressure loading

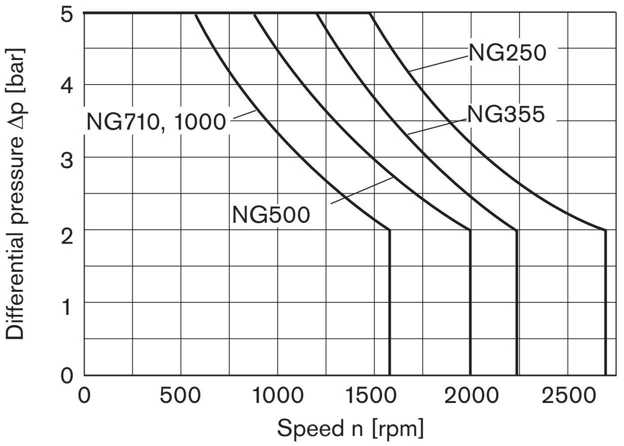
The service life of the shaft seal is influenced by the speed of the axial piston unit and the case drain pressure (case pressure). The mean differential pressure of 2 bar between the case and the ambient pressure may not be enduringly exceeded at normal operating temperature. For a higher differential pressure at reduced speed, see diagram. Momentary pressure spikes ($t < 0.1$ s) of up to 10 bar are permitted. The service life of the shaft seal decreases with an increase in the frequency of pressure spikes.

The case pressure must be equal to or higher than the ambient pressure.

Sizes 10 to 200



Sizes 250 to 1000



The values are valid for an ambient pressure $p_{abs} = 1$ bar.

Temperature range

The FKM shaft seal may be used for case drain temperatures from -25 °C to +115 °C.

Note
For application cases below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C). State NBR shaft seal in plain text when ordering.
Please contact us.

Direction of flow

Direction of rotation, viewed on drive shaft	
clockwise	**counter-clockwise**
S to **B**	**S** to **A**

Long-life bearing

Sizes 250 to 1000
For long service life and use with HF hydraulic fluids. Identical external dimensions as motor with standard bearings. Subsequent conversion to long-life bearings is possible. Bearing and case flushing via port U is recommended.

Flushing flow (recommended)

NG	250	355	500	710	1000
$q_{v\ flush}$ (L/min)	10	16	16	16	16

Technical data

Operating pressure range

(operating with mineral oil)

Pressure at service line port A or B

Size 5

Nominal pressure p_{nom} ________ 315 bar absolute

Maximum pressure p_{max} ________ 350 bar absolute
Single operating period ________ 10 s
Total operating period ________ 300 h

Sizes 10 to 200

Nominal pressure p_{nom} ________ 400 bar absolute

Maximum pressure p_{max} ________ 450 bar absolute
Single operating period ________ 10 s
Total operating period ________ 300 h

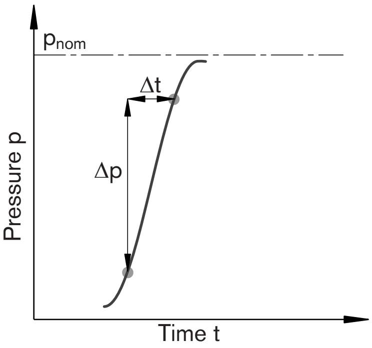
Sizes 250 to 1000

Nominal pressure p_{nom} ________ 350 bar absolute

Maximum pressure p_{max} ________ 400 bar absolute
Single operating period ________ 10 s
Total operating period ________ 300 h

Minimum pressure (high-pressure side) ___ 25 bar absolute

Rate of pressure change $R_{A\ max}$
Without pressure-relief valve ________ 16000 bar/s



Pressure at suction port S (inlet)

Minimum pressure $p_{S\ min}$ ________ 0.8 bar absolute

Maximum pressure $p_{S\ max}$ ________ 30 bar absolute

Note
Values for other hydraulic fluids, please contact us.

Definition

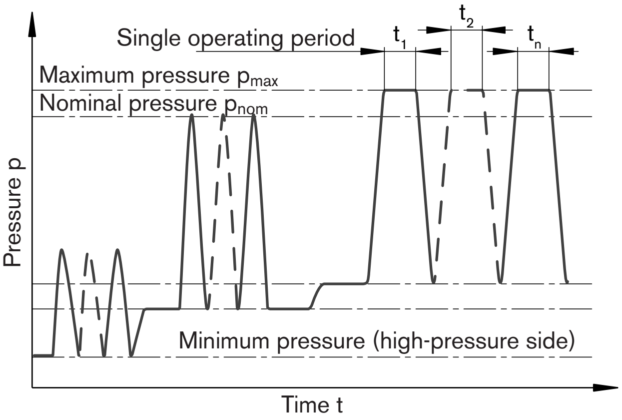
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

Maximum pressure p_{max}
The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.

Minimum pressure (high-pressure side)
Minimum pressure at the high-pressure side (A or B) which is required in order to prevent damage to the axial piston unit.

Minimum pressure (inlet)
Minimum pressure at suction port S (inlet) which is required in order to prevent damage to the axial piston unit. The minimum pressure is dependent on the speed of the axial piston unit (see diagram on page 7).

Rate of pressure change R_A
Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range.



Total operating period = $t_1 + t_2 + \ldots + t_n$

Technical data

Table of values (theoretical values, without efficiency and tolerances; values rounded)

Size		NG		5	10	12	16	23	28	32	45	56	63	80
Displacement geometric, per revolution		V_g	cm^3	4.93	10.3	12	16	22.9	28.1	32	45.6	56.1	63	80.4
Speed maximum[1]		n_{nom}	rpm	5600	3150	3150	3150	2500	2500	2500	2240	2000	2000	1800
		n_{max}[2]	rpm	8000	6000	6000	6000	4750	4750	4750	4250	3750	3750	3350
Flow at n_{nom}		q_V	L/min	27.6	32	38	50	57	70	80	102	112	126	145
Power at	$\Delta p = 350$ bar	P	kW	14.5[4]	19	22	29	33	41	47	60	65	74	84
	$\Delta p = 400$ bar	P	kW	–	22	25	34	38	47	53	68	75	84	96
Torque[3]														
at V_g and	$\Delta p = 350$ bar	T	Nm	24.7[4]	57	67	89	128	157	178	254	313	351	448
	$\Delta p = 400$ bar	T	Nm	–	66	76	102	146	179	204	290	357	401	512
Rotary stiffness		c	kNm/rad	0.63	0.92	1.25	1.59	2.56	2.93	3.12	4.18	5.94	6.25	8.73
Moment of inertia for rotary group		J_{GR}	kgm^2	0.00006	0.0004	0.0004	0.0004	0.0012	0.0012	0.0012	0.0024	0.0042	0.0042	0.0072
Maximum angular acceleration		α	rad/s^2	5000	5000	5000	5000	6500	6500	6500	14600	7500	7500	6000
Case volume		V	L		0.17	0.17	0.17	0.20	0.20	0.20	0.33	0.45	0.45	0.55
Mass (approx.)		m	kg	2.5	6	6	6	9.5	9.5	9.5	13.5	18	18	23

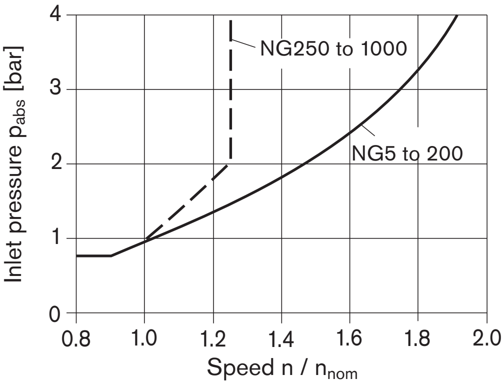
Size		NG		90	107	125	160	180	200	250	355	500	710	1000
Displacement geometric, per revolution		V_g	cm^3	90	106.7	125	160.4	180	200	250	355	500	710	1000
Speed maximum[1]		n_{nom}	rpm	1800	1600	1600	1450	1450	1550	1500	1320	1200	1200	950
		n_{max}[2]	rpm	3350	3000	3000	2650	2650	2750	1800	1600	1500	1500	1200
Flow at n_{nom}		q_V	L/min	162	171	200	233	261	310	375	469	600	852	950
Power at	$\Delta p = 350$ bar	P	kW	95	100	117	136	152	181	219	273	350	497	554
	$\Delta p = 400$ bar	P	kW	108	114	133	155	174	207	–	–	–	–	–
Torque[3]														
at V_g and	$\Delta p = 350$ bar	T	Nm	501	594	696	893	1003	1114	1393	1978	2785	3955	5570
	$\Delta p = 400$ bar	T	Nm	573	679	796	1021	1146	1273	–	–	–	–	–
Rotary stiffness		c	kNm/rad	9.14	11.2	11.9	17.4	18.2	57.3	73.1	96.1	144	270	324
Moment of inertia for rotary group		J_{GR}	kgm^2	0.0072	0.0116	0.0116	0.0220	0.0220	0.0353	0.061	0.102	0,178	0.55	0.55
Maximum angular acceleration		α	rad/s^2	6000	4500	4500	3500	3500	11000	10000	8300	5500	4300	4500
Case volume		V	L	0.55	0.8	0.8	1.1	1.1	2.7	2.5	3.5	4.2	8	8
Mass (approx.)		m	kg	23	32	32	45	45	66	73	110	155	325	336

[1] The values are valid:
- at an absolute pressure $p_{abs} = 1$ bar at suction port S
- for the optimum viscosity range from $\nu_{opt} = 16$ to 36 mm^2/s
- with hydraulic fluid based on mineral oils

[2] Maximum speed (limiting speed) with increased inlet pressure p_{abs} at suction port S, see adjacent diagram.

[3] Torque without radial force, with radial force see page 8

[4] Torque at $\Delta p = 315$ bar



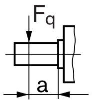
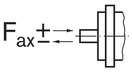
Note

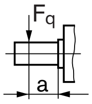
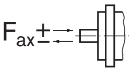
Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, with respect to speed variation, reduced angular acceleration as a function of the frequency and the permissible start up angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.

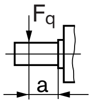
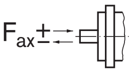
Technical data

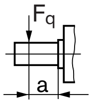
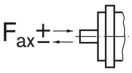
Permissible radial and axial forces of the drive shafts

(splined shaft and parallel keyed shaft)

Size	NG		**5**	**5**3)	**10**	**10**	**12**	**12**	**16**	**23**	**23**
Drive shaft	ø	mm	12	12	20	25	20	25	25	25	30
Maximum radial force1) at distance a (from shaft collar) 	$F_{q\,max}$	kN	1.6	1.6	3.0	3.2	3.0	3.2	3.2	5.7	5.4
	a	mm	12	12	16	16	16	16	16	16	16
with permissible torque	T_{max}	Nm	24.7	24.7	66	66	76	76	102	146	146
≙ permissible pressure Δp	Δp_{perm}	bar	315	315	400	400	400	400	400	400	400
Maximum axial force2) 	$+F_{ax\,max}$	N	180	180	320	320	320	320	320	500	500
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\,perm/bar}$	N/bar	1.5	1.5	3.0	3.0	3.0	3.0	3.0	5.2	5.2

Size	NG		**28**	**28**	**32**	**45**	**56**	**56**4)	**56**	**63**	**80**
Drive shaft	ø	mm	25	30	30	30	30	30	35	35	35
Maximum radial force1) at distance a (from shaft collar) 	$F_{q\,max}$	kN	5.7	5.4	5.4	7.6	9.5	7.8	9.1	9.1	11.6
	a	mm	16	16	16	18	18	18	18	18	20
with permissible torque	T_{max}	Nm	179	179	204	290	357	294	357	401	512
≙ permissible pressure Δp	Δp_{perm}	bar	400	400	400	400	400	330	400	400	400
Maximum axial force2) 	$+F_{ax\,max}$	N	500	500	500	630	800	800	800	800	1000
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\,perm/bar}$	N/bar	5.2	5.2	5.2	7.0	8.7	8.7	8.7	8.7	10.6

Size	NG		**80**4)	**80**	**90**	**107**	**107**	**125**	**160**	**160**	**180**
Drive shaft	ø	mm	35	40	40	40	45	45	45	50	50
Maximum radial force1) at distance a (from shaft collar) 	$F_{q\,max}$	kN	11.1	11.4	11.4	13.6	14.1	14.1	18.1	18.3	18.3
	a	mm	20	20	20	20	20	20	25	25	25
with permissible torque	T_{max}	Nm	488	512	573	679	679	796	1021	1021	1146
≙ permissible pressure Δp	Δp_{perm}	bar	380	400	400	400	400	400	400	400	400
Maximum axial force2) 	$+F_{ax\,max}$	N	1000	1000	1000	1250	1250	1250	1600	1600	1600
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\,perm/bar}$	N/bar	10.6	10.6	10.6	12.9	12.9	12.9	16.7	16.7	16.7

Size	NG		**200**	**250**	**355**	**500**	**710**	**1000**			
Drive shaft	ø	mm	50	50	60	70	90	90			
Maximum radial force1) at distance a (from shaft collar) 	$F_{q\,max}$	kN	20.3	1.26)	1.56)	1.96)	3.06)	2.66)			
	a	mm	25	41	52.5	52.5	67.5	67.5			
with permissible torque	T_{max}	Nm	1273	5)	5)	5)	5)	5)			
≙ permissible pressure Δp	Δp_{perm}	bar	400	5)	5)	5)	5)	5)			
Maximum axial force2) 	$+F_{ax\,max}$	N	1600	2000	2500	3000	4400	4400			
	$-F_{ax\,max}$	N	0	0	0	0	0	0			
Permissible axial force per bar operating pressure	$\pm F_{ax\,perm/bar}$	N/bar	16.7	5)	5)	5)	5)	5)			

1) With intermittent operation

2) Maximum permissible axial force during standstill or when the axial piston unit is operating in non-pressurized condition.

3) Conical shaft with threaded pin and woodruff key (DIN 6888)

4) Restricted technical data only for splined shaft

5) Please contact us.

6) When at a standstill or when axial piston unit operating in non-pressurized conditions. Higher forces are permissible when under pressure, please contact us.

Note

Influence of the direction of the permissible axial force:

$+F_{ax\,max}$ = Increase in service life of bearings

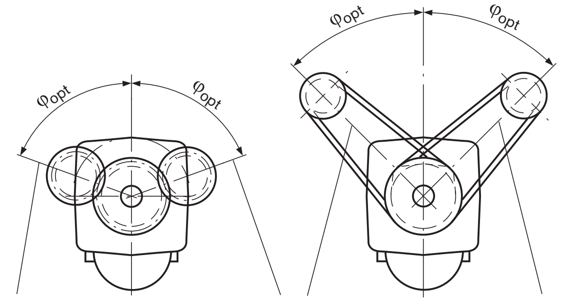
$-F_{ax\,max}$ = Reduction in service life of bearings (avoid)

Technical data

Effect of radial force F_q on the service life of bearings

By selecting a suitable direction of radial force F_q, the load on the bearings, caused by the internal rotary group forces can be reduced, thus optimizing the service life of the bearings. Recommended position of mating gear is dependent on direction of rotation. Examples:

	Toothed gear drive	V-belt output
NG	**$\varphi_{opt.}$**	**$\varphi_{opt.}$**
5 to 180	± 70°	± 45°
200 to 1000	± 45°	± 70°



Clockwise direction of rotation

Pressure at port **B**

Counter-clockwise direction of rotation

Pressure at port **A**

Clockwise direction of rotation

Pressure at port **B**

Determining the operating characteristics

Flow
$$q_v = \frac{V_g \cdot n \cdot \eta_v}{1000} \quad [\text{L/min}]$$

Torque
$$T = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}} \quad [\text{Nm}]$$

Power
$$P = \frac{2\,\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p}{600 \cdot \eta_t} \quad [\text{kW}]$$

V_g = Displacement per revolution in cm^3

Δp = Differential pressure in bar

n = Speed in rpm

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

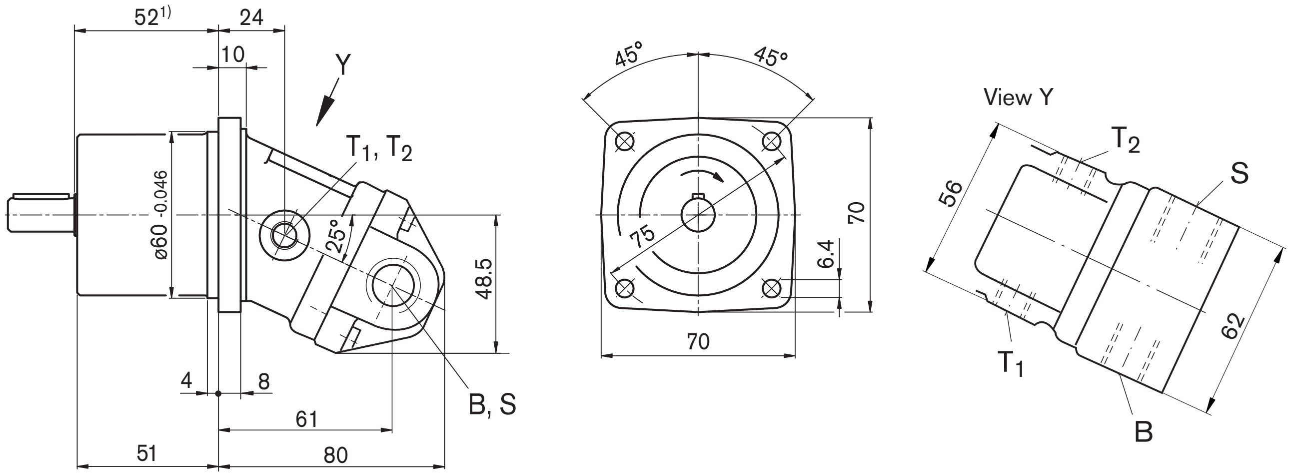
η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

Dimensions size 5

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

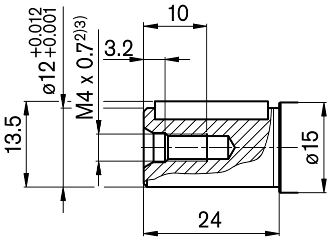
Port plate 07 – Threaded ports A/B and S at side

Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)

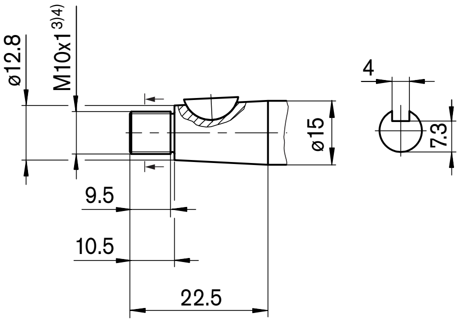


Drive shafts

B Parallel keyed shaft DIN 6885, A4x4x20



C Conical shaft with threaded pin and woodruff key, 3x5 (DIN 6888), (tapering 1:10)



Ports

Designation	Port for	Standard⁶⁾	Size³⁾	Maximum pressure [bar]⁵⁾	State⁷⁾
B (A)	Service line	DIN 3852	M18 x 1.5; 12 deep	350	O
S	Suction line	DIN 3852	M22 x 1.5; 14 deep	30	O
T_1	Drain line	DIN 3852	M10 x 1; 8 deep	3	O
T_2	Drain line	DIN 3852	M10 x 1; 8 deep	3	O

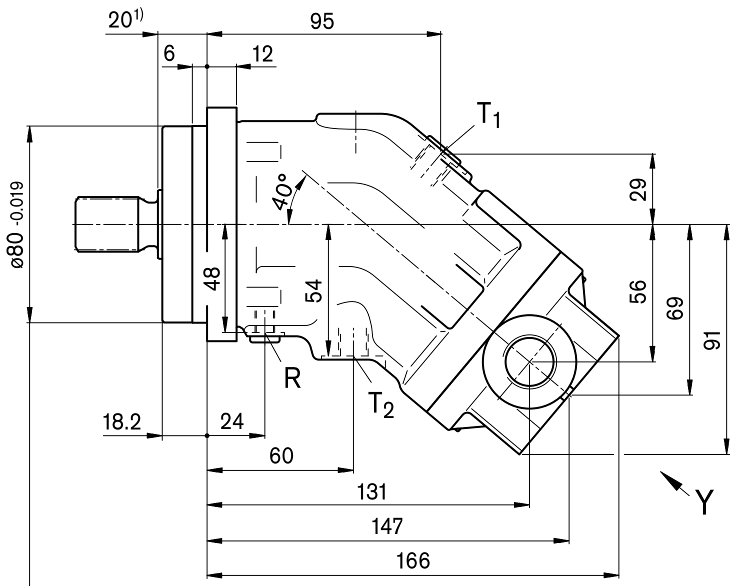
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 34 for the maximum tightening torques.
4) Thread according to DIN 3852, maximum tightening torque: 30 Nm
5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)

Dimensions sizes 10, 12, 16

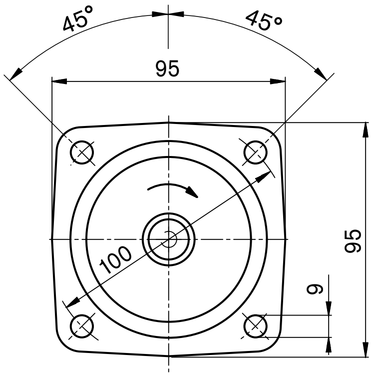
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 06 – Threaded port A/B at side and threaded port S at rear

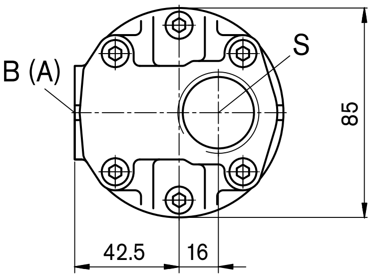
Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)



Flange
similar to ISO 3019-2



View Y



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1) To shaft collar

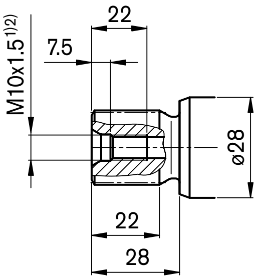
Dimensions sizes 10, 12, 16

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shafts

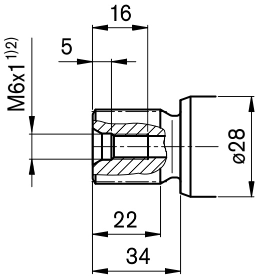
Sizes 10, 12, 16

A Splined shaft DIN 5480
W25x1.25x18x9g



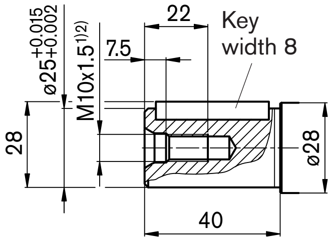
NG10, 12

Z Splined shaft DIN 5480
W20x1.25x14x9g



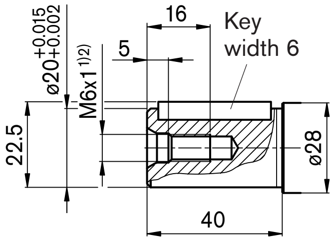
Sizes 10, 12, 16

B Parallel keyed shaft
DIN 6885, AS8x7x32



NG10, 12

P Parallel keyed shaft
DIN 6885, AS6x6x32



Ports

Designation	Port for	Standard[5]	Size[2]	Maximum pressure [bar][3]	State[6]
B (A)	Service line	DIN 3852	M22 x 1.5; 14 deep	450	O
S	Suction line	DIN 3852	M33 x 2; 18 deep	30	O
T_1	Drain line	DIN 3852	M12 x 1.5; 12 deep	3	X[4]
T_2	Drain line	DIN 3852	M12 x 1.5; 12 deep	3	O[4]
R	Air bleed	DIN 3852	M8 x 1; 8 deep	3	X

[1] Center bore according to DIN 332 (thread according to DIN 13)

[2] Observe the general instructions on page 34 for the maximum tightening torques.

[3] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[4] Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 32 and 33).

[5] The spot face can be deeper than specified in the appropriate standard.

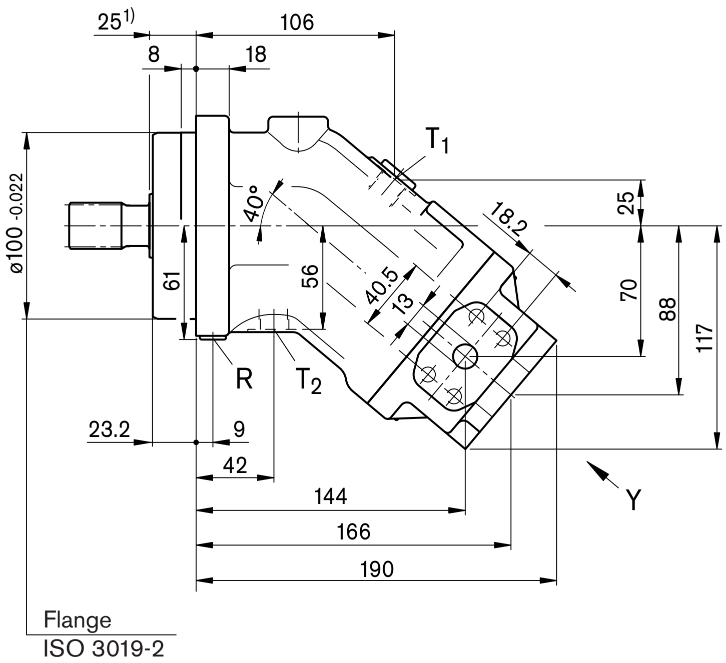
[6] O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

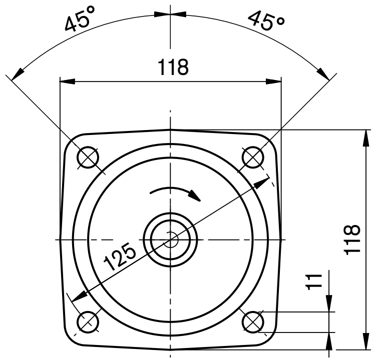
Dimensions sizes 23, 28, 32

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

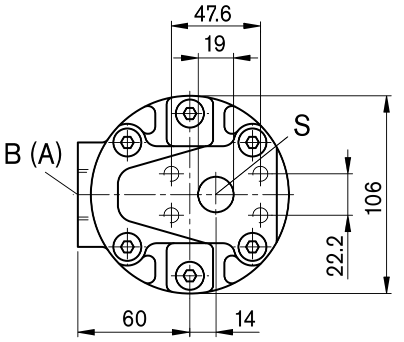
Port plate 05 – SAE flange port A/B at side and SAE flange port S at rear

Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)





View Y



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1) To shaft collar

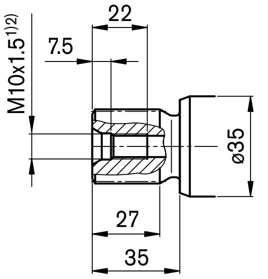
Dimensions sizes 23, 28, 32

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shafts

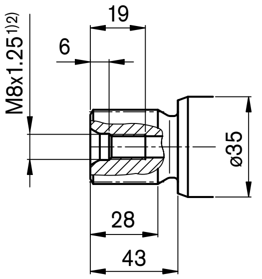
Sizes 23, 28, 32

A Splined shaft DIN 5480 W30x2x14x9g



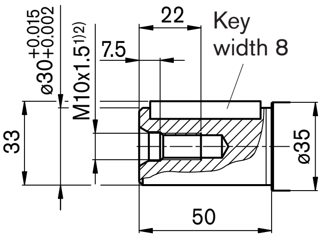
NG23, 28

Z Splined shaft DIN 5480 W25x1.25x18x9g



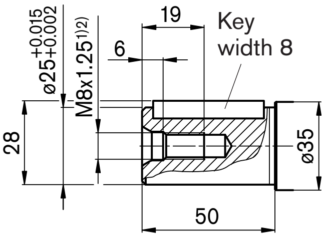
Sizes 23, 28, 32

B Parallel keyed shaft DIN 6885, AS8x7x40



NG23, 28

P Parallel keyed shaft DIN 6885, AS8x7x40



Ports

Designation	Port for	Standard	Size[2]	Maximum pressure [bar][3]	State[7]
B (A)	Service line Fastening thread B/A	SAE J518[5] DIN 13	1/2 in M8 x 1.25; 15 deep	450	O
S	Suction line Fastening thread	SAE J518[5] DIN 13	3/4 in M10 x 1.5; 17 deep	30	O
T_1	Drain line	DIN 3852[6]	M16 x 1.5; 12 deep	3	X[4]
T_2	Drain line	DIN 3852[6]	M16 x 1.5; 12 deep	3	O[4]
R	Air bleed	DIN 3852[6]	M10 x 1; 12 deep	3	X

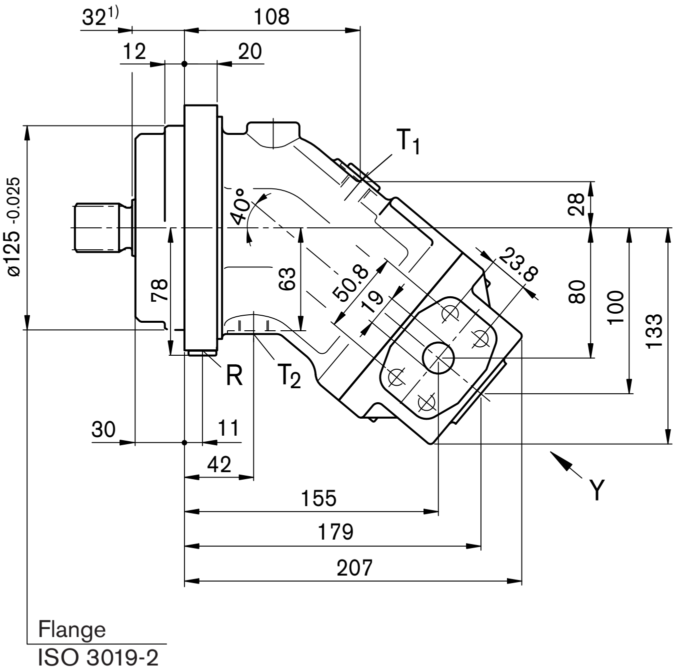
1) Center bore according to DIN 332 (thread according to DIN 13)
2) Observe the general instructions on page 34 for the maximum tightening torques.
3) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 32 and 33).
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

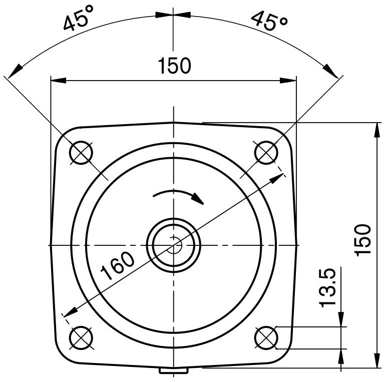
Dimensions size 45

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

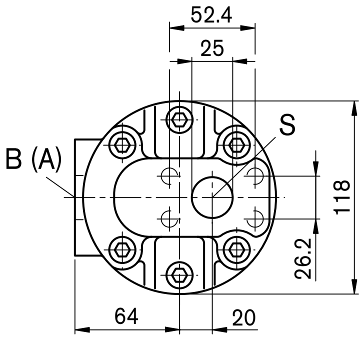
Port plate 05 – SAE flange port A/B at side and SAE flange port S at rear

Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)





View Y



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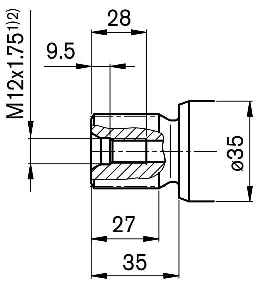
1) To shaft collar

Dimensions size 45

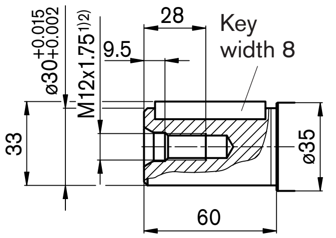
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shafts

Z Splined shaft DIN 5480 W30x2x14x9g



P Parallel keyed shaft DIN 6885, AS8x7x50



Ports

Designation	Port for	Standard	Size[2]	Maximum pressure [bar][3]	State[7]
B (A)	Service line Fastening thread B/A	SAE J518[5] DIN 13	3/4 in M10 x 1.5; 17 deep	450	O
S	Suction line Fastening thread	SAE J518[5] DIN 13	1 in M10 x 1.5; 17 deep	30	O
T_1	Drain line	DIN 3852[6]	M18 x 1.5; 12 deep	3	X[4]
T_2	Drain line	DIN 3852[6]	M18 x 1.5; 12 deep	3	O[4]
R	Air bleed	DIN 3852[6]	M12 x 1.5; 12 deep	3	X

[1] Center bore according to DIN 332 (thread according to DIN 13)

[2] Observe the general instructions on page 34 for the maximum tightening torques.

[3] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[4] Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 32 and 33).

[5] Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

[6] The spot face can be deeper than specified in the appropriate standard.

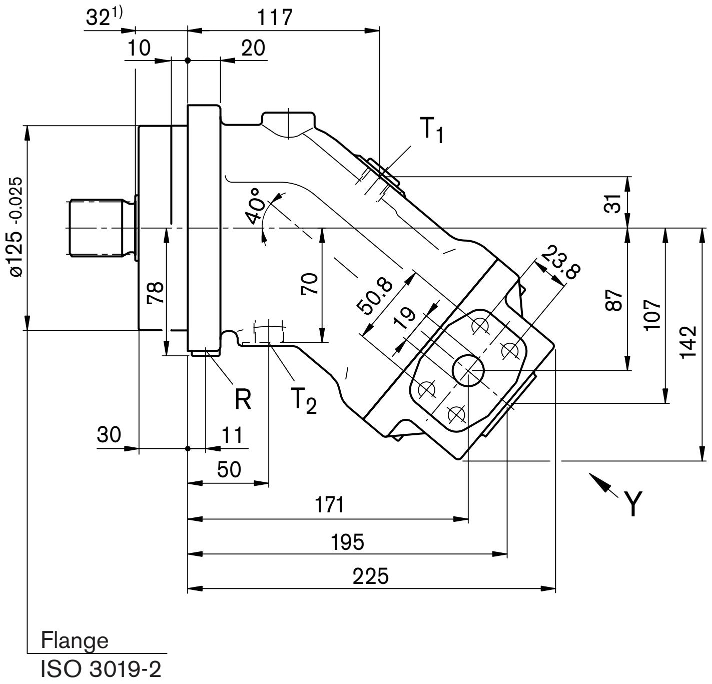
[7] O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

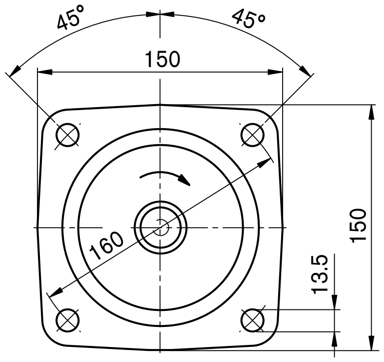
Dimensions sizes 56, 63

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

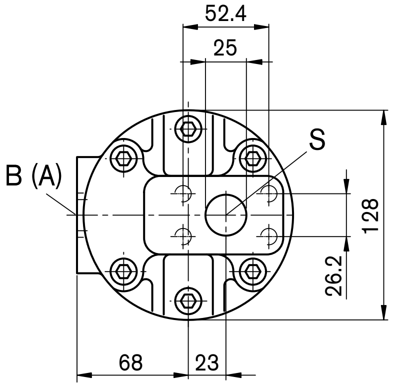
Port plate 05 – SAE flange port A/B at side and SAE flange port S at rear

Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)





View Y



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1) To shaft collar

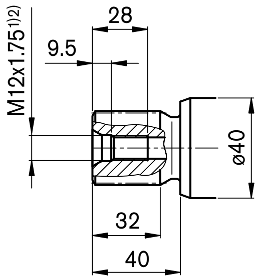
Dimensions sizes 56, 63

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shafts

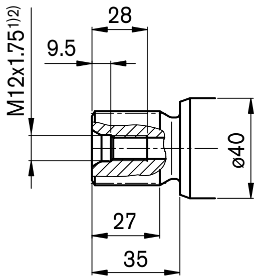
NG56, 63

A Splined shaft DIN 5480
W35x2x16x9g



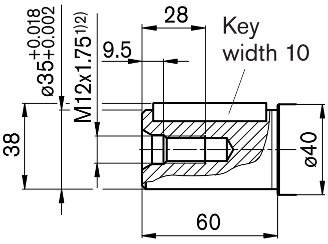
NG56

Z Splined shaft DIN 5480
W30x2x14x9g



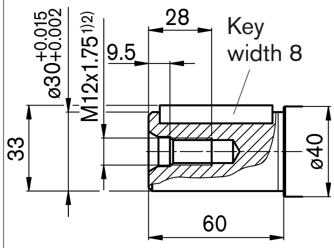
NG56, 63

B Parallel keyed shaft
DIN 6885, AS10x8x50



NG56

P Parallel keyed shaft
DIN 6885, AS8x7x50



Ports

Designation	Port for	Standard	Size[2]	Maximum pressure [bar][3]	State[7]
B (A)	Service line Fastening thread B/A	SAE J518[5] DIN 13	3/4 in M10 x 1.5; 17 deep	450	O
S	Suction line Fastening thread	SAE J518[5] DIN 13	1 in M10 x 1.5; 17 deep	30	O
T_1	Drain line	DIN 3852[6]	M18 x 1.5; 12 deep	3	X[4]
T_2	Drain line	DIN 3852[6]	M18 x 1.5; 12 deep	3	O[4]
R	Air bleed	DIN 3852[6]	M12 x 1.5; 12 deep	3	X

[1] Center bore according to DIN 332 (thread according to DIN 13)

[2] Observe the general instructions on page 34 for the maximum tightening torques.

[3] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[4] Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 32 and 33).

[5] Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

[6] The spot face can be deeper than specified in the appropriate standard.

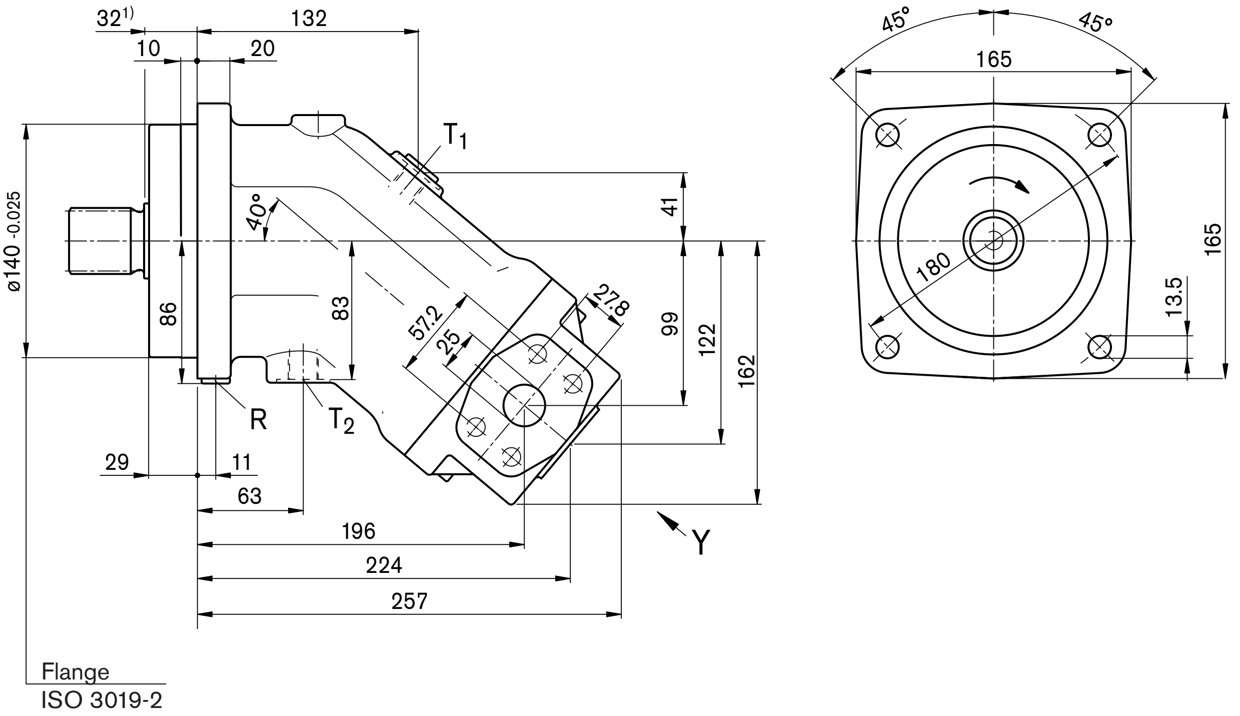
[7] O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

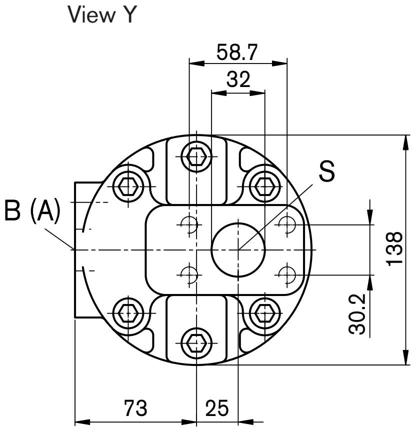
Dimensions sizes 80, 90

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 05 – SAE flange port A/B at side and SAE flange port S at rear

Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)





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1) To shaft collar

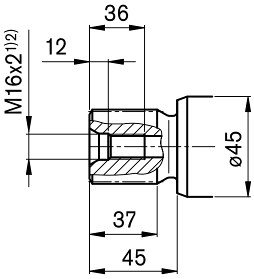
Dimensions sizes 80, 90

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shafts

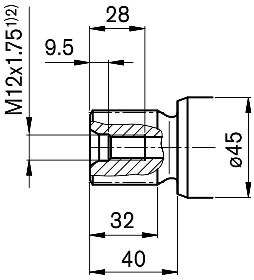
NG80, 90

A Splined shaft DIN 5480
W40x2x18x9g



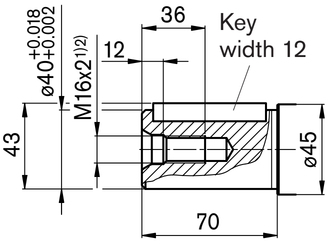
NG80

Z Splined shaft DIN 5480
W35x2x16x9g



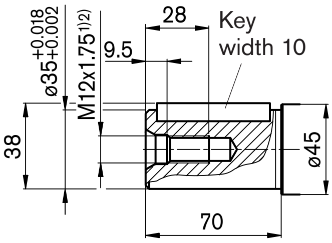
NG80, 90

B Parallel keyed shaft
DIN 6885, AS12x8x56



NG80

P Parallel keyed shaft
DIN 6885, AS10x8x56



Ports

Designation	Port for	Standard	Size[2]	Maximum pressure [bar][3]	State[7]
B (A)	Service line Fastening thread B/A	SAE J518[5] DIN 13	1 in M12 x 1.5; 17 deep	450	O
S	Suction line Fastening thread	SAE J518[5] DIN 13	1 1/4 in M10 x 1.5; 17 deep	30	O
T_1	Drain line	DIN 3852[6]	M18 x 1.5; 12 deep	3	X[4]
T_2	Drain line	DIN 3852[6]	M18 x 1.5; 12 deep	3	O[4]
R	Air bleed	DIN 3852[6]	M12 x 1.5; 12 deep	3	X

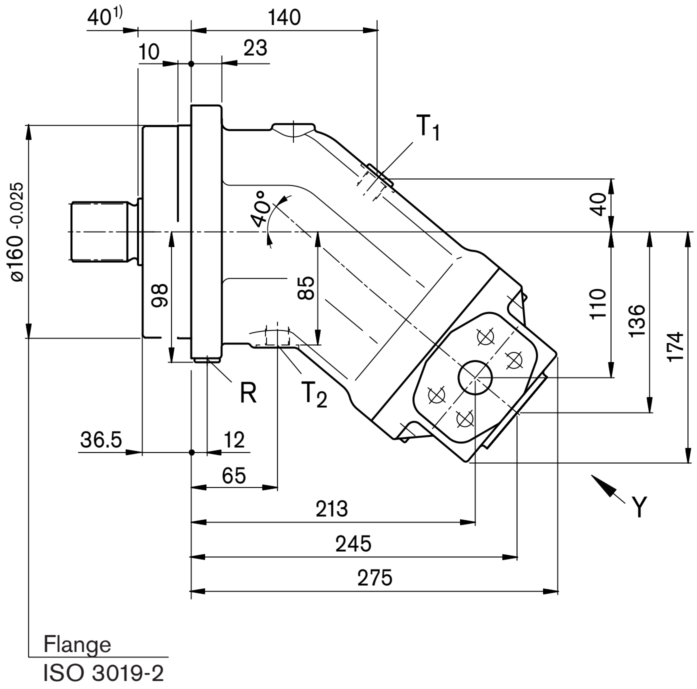
1) Center bore according to DIN 332 (thread according to DIN 13)
2) Observe the general instructions on page 34 for the maximum tightening torques.
3) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 32 and 33).
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
6) The spot face can be deeper than specified in the appropriate standard.
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

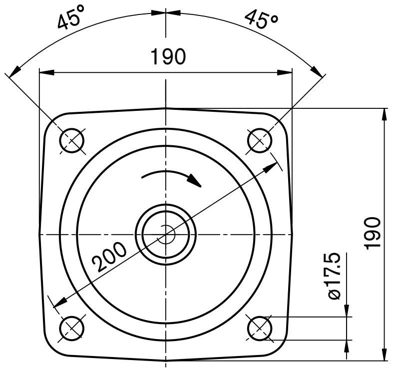
Dimensions sizes 107, 125

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

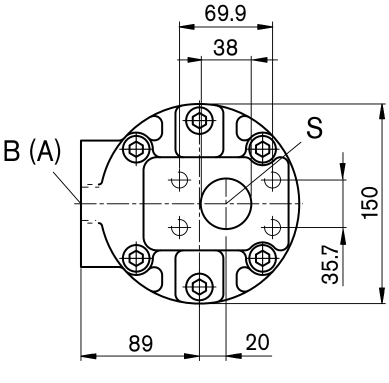
Port plate 05 – SAE flange port A/B at side and SAE flange port S at rear

Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)

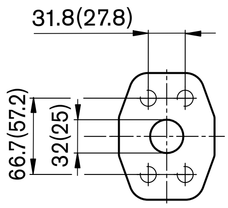




View Y



Detail: port A/B
(dimensions in brackets for size 107)



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1) To shaft collar

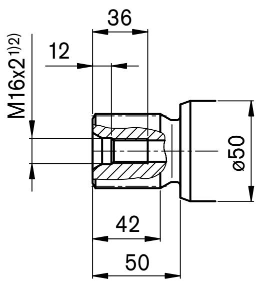
Dimensions sizes 107, 125

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shafts

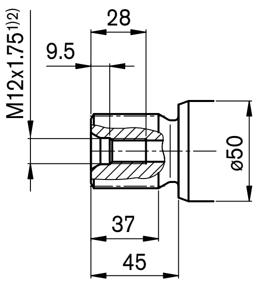
NG107, 125

A Splined shaft DIN 5480 W45x2x21x9g



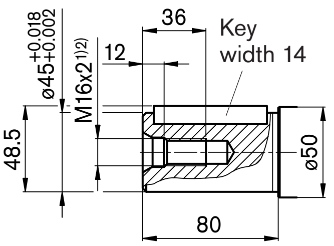
NG107

Z Splined shaft DIN 5480 W40x2x18x9g



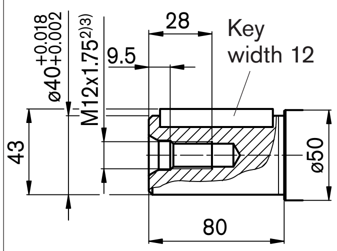
NG107, 125

B Parallel keyed shaft DIN 6885, AS14x9x63



NG107

P Parallel keyed shaft DIN 6885, AS12x8x63



Ports

Designation	Port for	Standard	Size[2)]	Maximum pressure [bar][3)]	State[7)]
B (A)	Service line	SAE J518[5)]	1 in (size 107) 1 1/4 in (size 125)	450	O
	Fastening thread B/A	DIN 13	M12 x 1.75; 17 deep (size 107) M14 x 2; 19 deep (size 125)		
S	Suction line	SAE J5185)	1 1/2 in	30	O
	Fastening thread	DIN 13	M12 x 1.75; 20 deep		
T_1	Drain line	DIN 3852[6)]	M18 x 1.5; 12 deep	3	X[4)]
T_2	Drain line	DIN 3852[6)]	M18 x 1.5; 12 deep	3	O[4)]
R	Air bleed	DIN 3852[6)]	M14 x 1.5; 12 deep	3	X

1) Center bore according to DIN 332 (thread according to DIN 13)

2) Observe the general instructions on page 34 for the maximum tightening torques.

3) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 32 and 33).

5) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

6) The spot face can be deeper than specified in the appropriate standard.

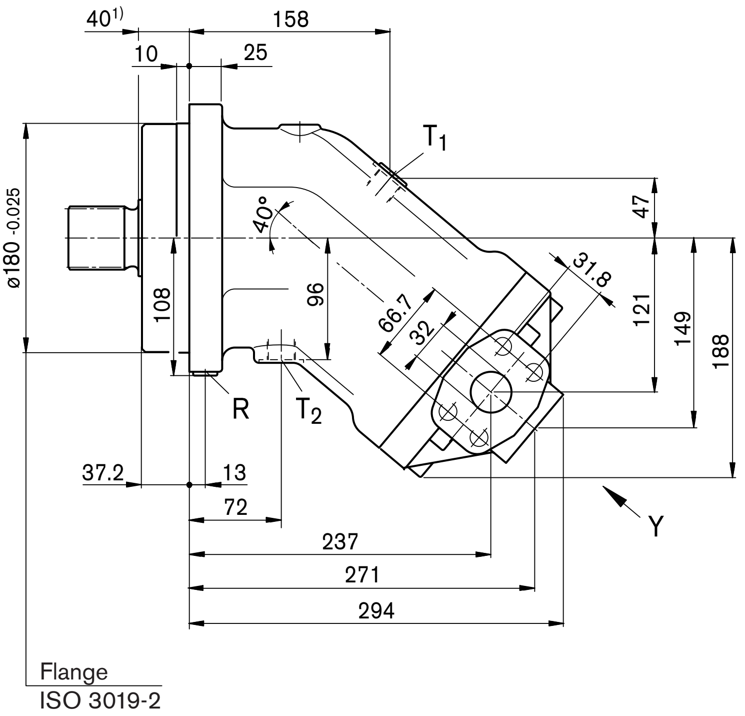
7) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

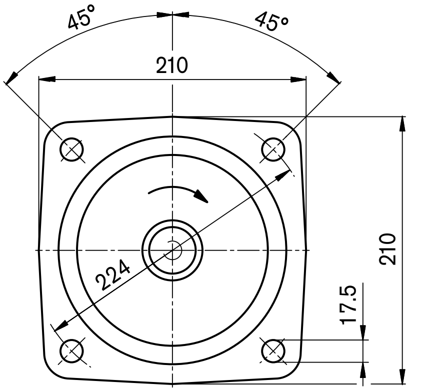
Dimensions sizes 160, 180

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

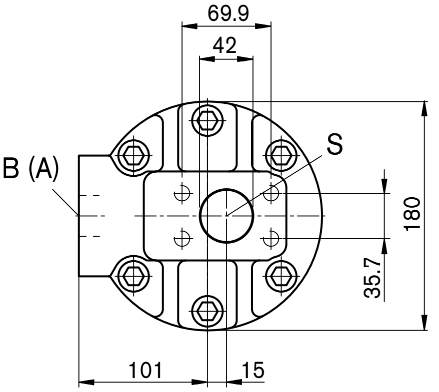
Port plate 05 – SAE flange port A/B at side and SAE flange port S at rear

Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)





View Y



---

1) To shaft collar

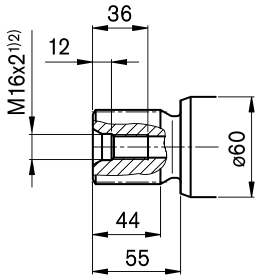
Dimensions sizes 160, 180

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shafts

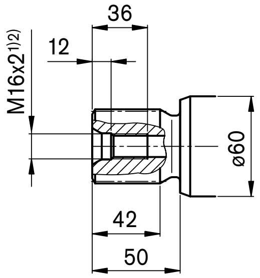
NG160, 180

A Splined shaft DIN 5480 W50x2x24x9g



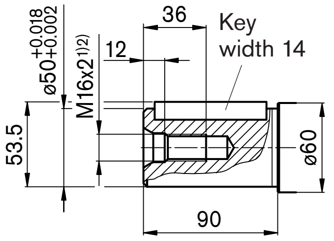
NG160

Z Splined shaft DIN 5480 W45x2x21x9g



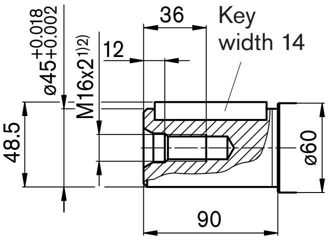
NG160, 180

B Parallel keyed shaft DIN 6885, AS14x9x70



NG160

P Parallel keyed shaft DIN 6885, AS14x9x70



Ports

Designation	Port for	Standard	Size[2]	Maximum pressure [bar][3]	State[7]
B (A)	Service line Fastening thread B/A	SAE J518[5] DIN 13	1 1/4 in M14 x 2; 19 deep	450	O
S	Suction line Fastening thread	SAE J518[5] DIN 13	1 1/2 in M12 x 1.75; 20 deep	30	O
T_1	Drain line	DIN 3852[6]	M22 x 1.5; 14 deep	3	X[4]
T_2	Drain line	DIN 3852[6]	M22 x 1.5; 14 deep	3	O[4]
R	Air bleed	DIN 3852[6]	M14 x 1.5; 12 deep	3	X

[1] Center bore according to DIN 332 (thread according to DIN 13)

[2] Observe the general instructions on page 34 for the maximum tightening torques.

[3] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[4] Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 32 and 33).

[5] Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

[6] The spot face can be deeper than specified in the appropriate standard.

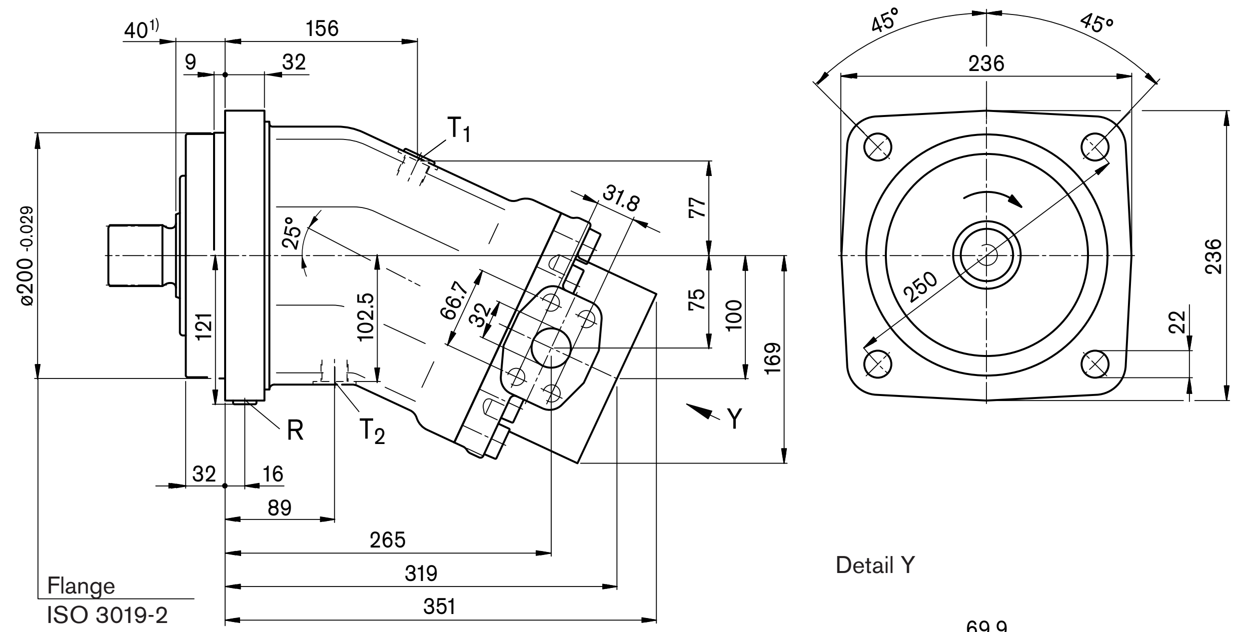
[7] O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 200

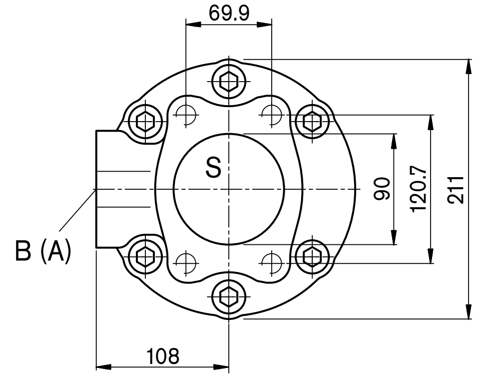
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 05 – SAE flange port A/B at side and SAE flange port S at rear

Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)

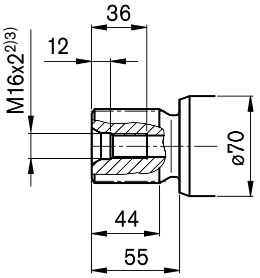


Detail Y

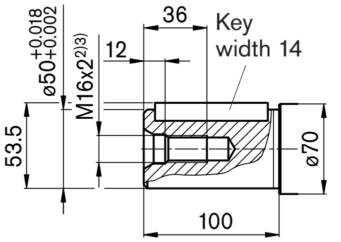


Drive shafts

A Splined shaft DIN 5480 W50x2x24x9g



B Parallel keyed shaft DIN 6885, AS14x9x80



Ports

Designation	Port for	Standard	Size3)	Maximum pressure [bar]4)	State8)
B (A)	Service line Fastening thread B/A	SAE J518 6) DIN 13	1 1/4 in M14 x 2; 19 deep	450	O
S	Suction line Fastening thread	SAE J518 6) DIN 13	3 1/2 in M16 x 2; 24 deep	30	O
T_1	Drain line	DIN 3852 7)	M22 x 1.5; 14 deep	3	X5)
T_2	Drain line	DIN 3852 7)	M22 x 1.5; 14 deep	3	O5)
R	Air bleed	DIN 3852 7)	M14 x 1.5; 12 deep	3	X

1) To shaft collar

2) Center bore according to DIN 332 (thread according to DIN 13)

3) Observe the general instructions on page 34 for the maximum tightening torques.

4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 32 and 33).

6) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

7) The spot face can be deeper than specified in the appropriate standard.

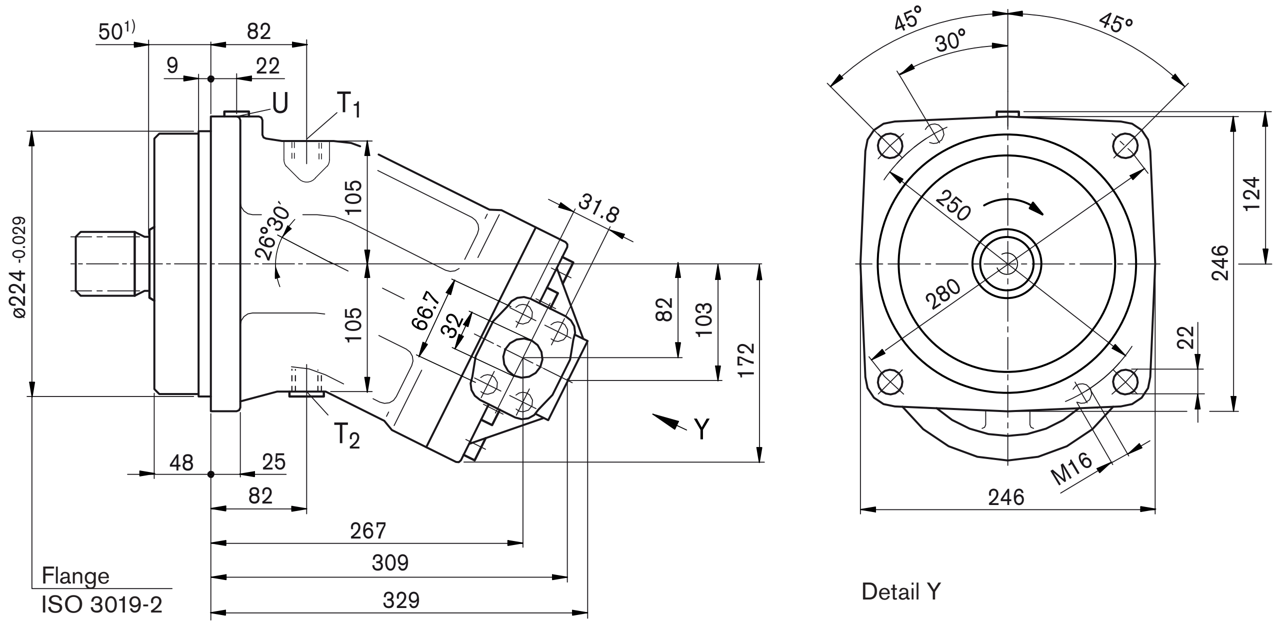
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 250

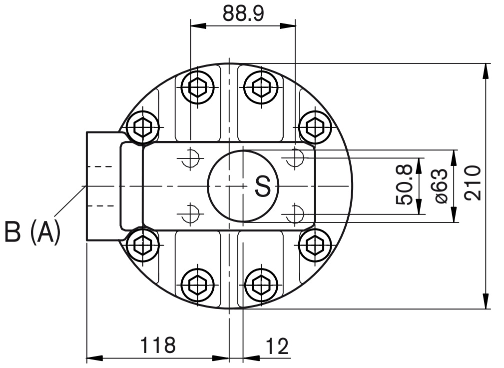
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 05 – SAE flange port A/B at side and SAE flange port S at rear

Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)

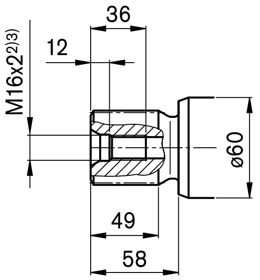


Detail Y

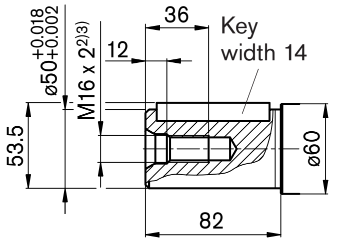


Drive shafts

Z Splined shaft DIN 5480 W50x2x24x9g



P Parallel keyed shaft DIN 6885, AS14x9x80



Ports

Designation	Port for	Standard	Size³⁾	Maximum pressure [bar]⁴⁾	State⁸⁾
B (A)	Service line Fastening thread B/A	SAE J518⁶⁾ DIN 13	1 1/4 in M14 x 2; 19 deep	400	O
S	Suction line Fastening thread	SAE J518⁶⁾ DIN 13	2 1/2 in M12 x 1.75; 17 deep	30	O
T_1	Drain line	DIN 3852⁷⁾	M22 x 1.5; 14 deep	3	O⁵⁾
T_2	Drain line	DIN 3852⁷⁾	M22 x 1.5; 14 deep	3	X⁵⁾
U	Bearing flushing	DIN 3852⁷⁾	M14 x 1.5; 12 deep	3	X

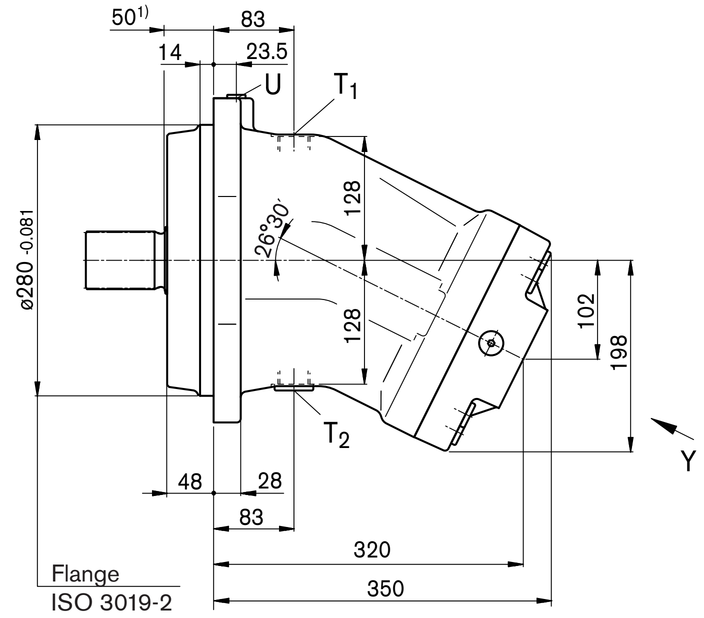
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 34 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 32 and 33).
6) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
7) The spot face can be deeper than specified in the appropriate standard.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

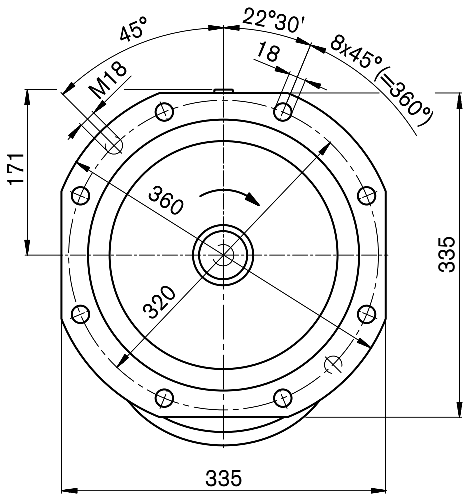
Dimensions size 355

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 11 – SAE flange ports A/B and S at rear

Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)

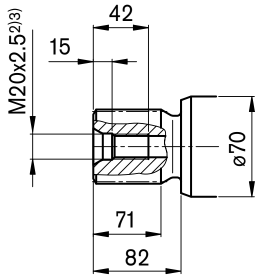




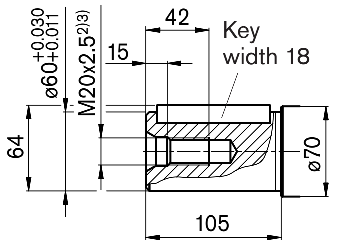
Detail Y

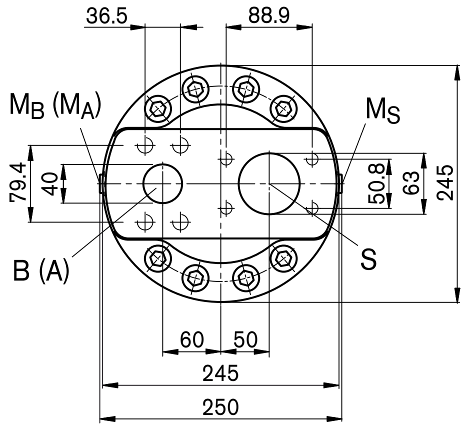
Drive shafts

Z Splined shaft DIN 5480 W60x2x28x9g



P Parallel keyed shaft DIN 6885, AS18x11x100





Ports

Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[8]
B (A)	Service line Fastening thread B/A	SAE J518[6] DIN 13	1 1/2 in M16 x 2; 21 deep	400	O
S	Suction line Fastening thread	SAE J518[6] DIN 13	2 1/2 in M12 x 1.75; 17 deep	30	O
T_1	Drain line	DIN 3852[7]	M33 x 2; 18 deep	3	O[5]
T_2	Drain line	DIN 3852[7]	M33 x 2; 18 deep	3	X[5]
U	Bearing flushing	DIN 3852[7]	M14 x 1.5; 12 deep	3	X
M_A, M_B	Measuring operating pressure	DIN 3852[7]	M14 x 1.5; 12 deep	400	X
M_S	Measuring suction pressure	DIN 3852[7]	M14 x 1.5; 12 deep	30	X

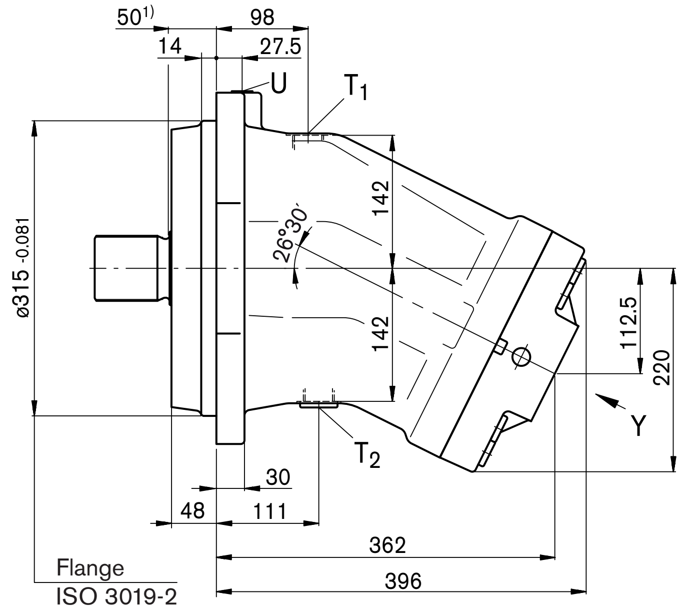
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 34 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 32 and 33).
6) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
7) The spot face can be deeper than specified in the appropriate standard.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

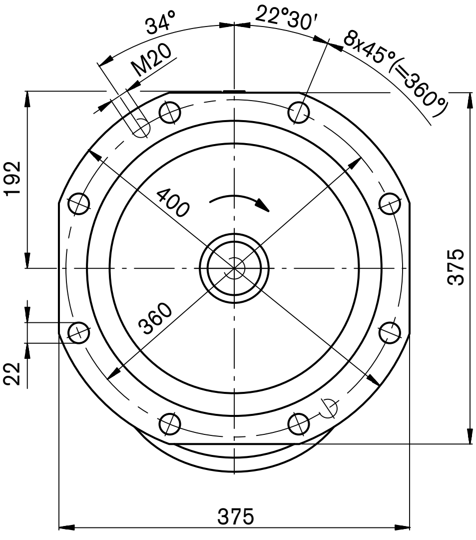
Dimensions size 500

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

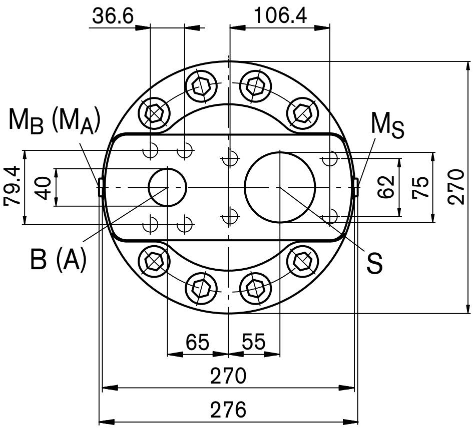
Port plate 11 – SAE flange ports A/B and S at rear

Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)



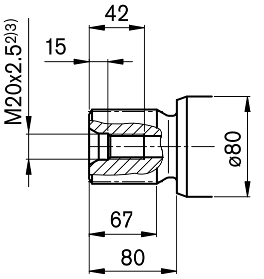


Detail Y

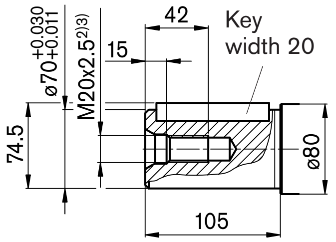


Drive shafts

Z Splined shaft DIN 5480 W70x3x22x9g



P Parallel keyed shaft DIN 6885, AS20x12x100



Ports

Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[8]
B (A)	Service line fastening thread B/A	SAE J518[6] DIN 13	1 1/2 in M16 x 2; 21 deep	400	O
S	Suction line fastening thread	SAE J518[6] DIN 13	3 in M16 x 2; 24 deep	30	O
T_1	Drain line	DIN 3852[7]	M33 x 2; 18 deep	3	O[5]
T_2	Drain line	DIN 3852[7]	M33 x 2; 18 deep	3	X[5]
U	Bearing flushing	DIN 3852[7]	M18 x 1.5; 12 deep	3	X
M_A, M_B	Operating pressure measurement	DIN 3852[7]	M14 x 1.5; 12 deep	400	X
M_S	Suction pressure measurement	DIN 3852[7]	M14 x 1.5; 12 deep	30	X

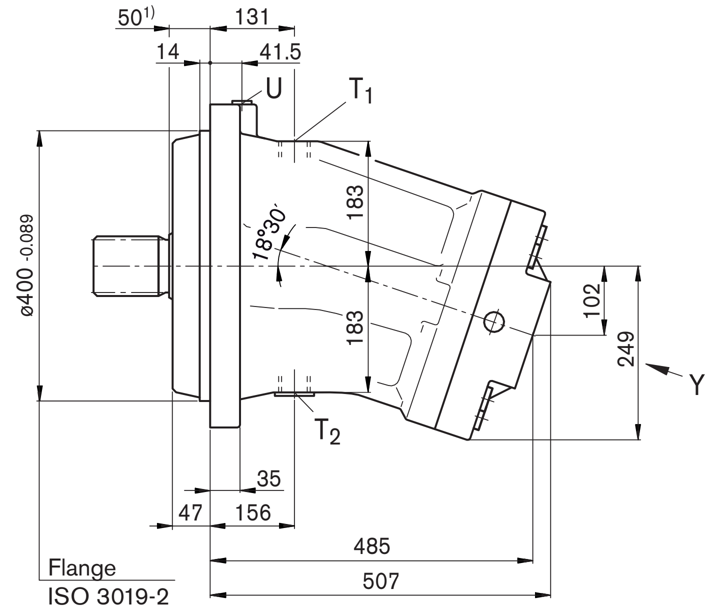
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 34 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 32 and 33).
6) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
7) The spot face can be deeper than specified in the appropriate standard.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

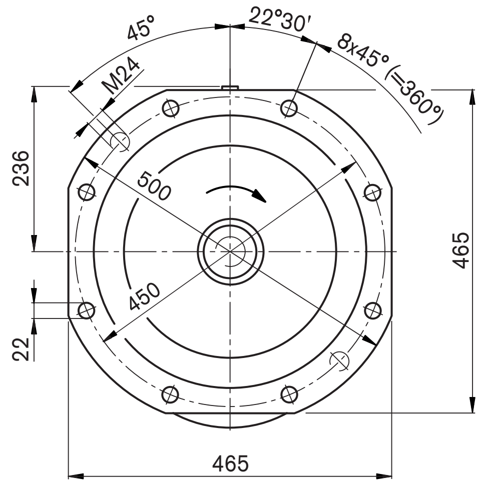
Dimensions size 710

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

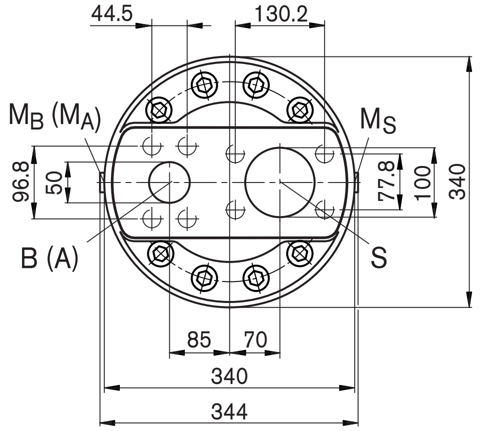
Port plate 11 – SAE flange ports A/B and S at rear

Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)



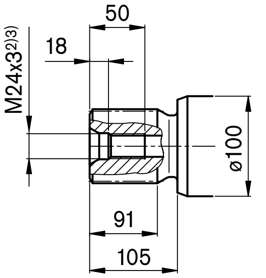


Detail Y

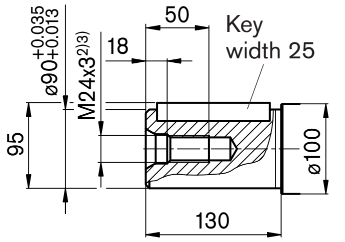


Drive shafts

Z Splined shaft DIN 5480 W90x3x28x9g



P Parallel keyed shaft DIN 6885, AS25x14x125



Ports

Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[8]
B (A)	Service line Fastening thread B/A	SAE J518[6] DIN 13	2 in M20 x 2.5; 30 deep	400	
S	Suction line Fastening thread	SAE J518[6] DIN 13	4 in M16 x 2; 24 deep	30	O
T_1	Drain line	DIN 3852[7]	M42 x 2; 20 deep	3	O[5]
T_2	Drain line	DIN 3852[7]	M42 x 2; 20 deep	3	X[5]
U	Bearing flushing	DIN 3852[7]	M18 x 1.5; 12 deep	3	X
M_A, M_B	Measuring operating pressure	DIN 3852[7]	M14 x 1.5; 12 deep	400	X
M_S	Measuring suction pressure	DIN 3852[7]	M14 x 1.5; 12 deep	30	X

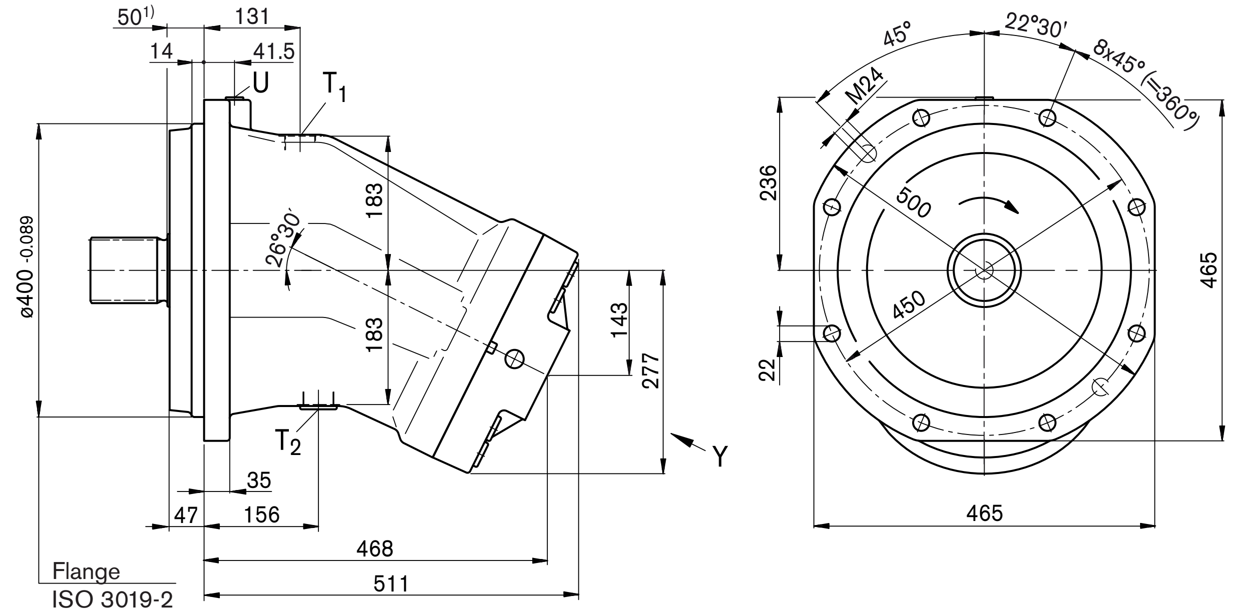
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 34 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 32 and 33).
6) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
7) The spot face can be deeper than specified in the appropriate standard.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 1000

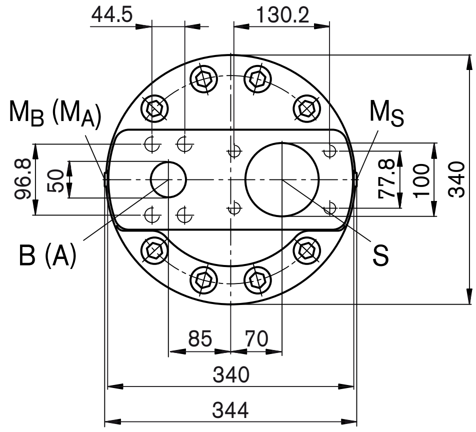
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 11 – SAE flange ports A/B and S at rear

Illustration: cw direction of rotation (on version "ccw direction of rotation" the port plate is rotated through 180°)

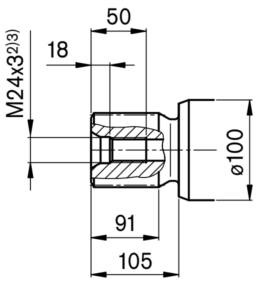


Detail Y

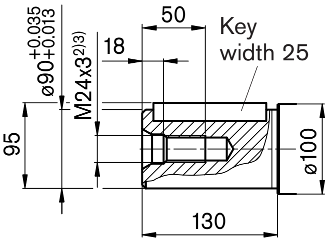


Drive shafts

Z Splined shaft DIN 5480 W90x3x28x9g



P Parallel keyed shaft DIN 6885, AS25x14x125



Ports

Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[8]
B (A)	Service line fastening thread B/A	SAE J518[6] DIN 13	2 in M20 x 2.5; 30 deep	400	
S	Suction line fastening thread	SAE J518[6] DIN 13	4 in M16 x 2; 24 deep	30	O
T_1	Drain line	DIN 3852[7]	M42 x 2; 20 deep	3	O[5]
T_2	Drain line	DIN 3852[7]	M42 x 2; 20 deep	3	X[5]
U	Bearing flushing	DIN 3852[7]	M18 x 1.5; 12 deep	3	X
M_A, M_B	Measuring operating pressure	DIN 3852[7]	M14 x 1.5; 12 deep	400	X
M_S	Measuring suction pressure	DIN 3852[7]	M14 x 1.5; 12 deep	30	X

1) To shaft collar

2) Center bore according to DIN 332 (thread according to DIN 13)

3) Observe the general instructions on page 34 for the maximum tightening torques.

4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 32 and 33).

6) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

7) The spot face can be deeper than specified in the appropriate standard.

8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a relatively long standstill as the axial piston unit may drain back to the reservoir via the hydraulic lines.

Particularly in the installation position "drive shaft upwards" filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The case drain fluid in the motor housing must be directed to the reservoir via the highest available drain port (T_1, T_2).

For combinations of multiple units, make sure that the respective case pressure in each unit is not exceeded. In the event of pressure differences at the drain ports of the units, the shared drain line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation. If this is not possible, separate drain lines must be laid if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction and drain lines must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure; it must not, however, be higher than $h_{S\ max} = 800$ mm. The minimum suction pressure at port S must also not fall below 0.8 bar absolute during operation and during cold start.

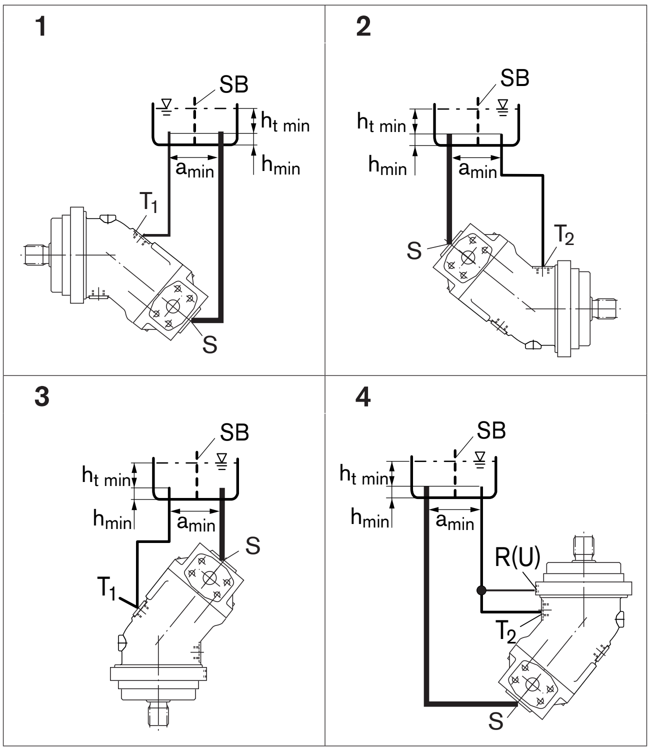
Installation position

See the following examples 1 to 8.
Further installation positions are possible upon request.

Recommended installation positions: 1 and 2.

Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



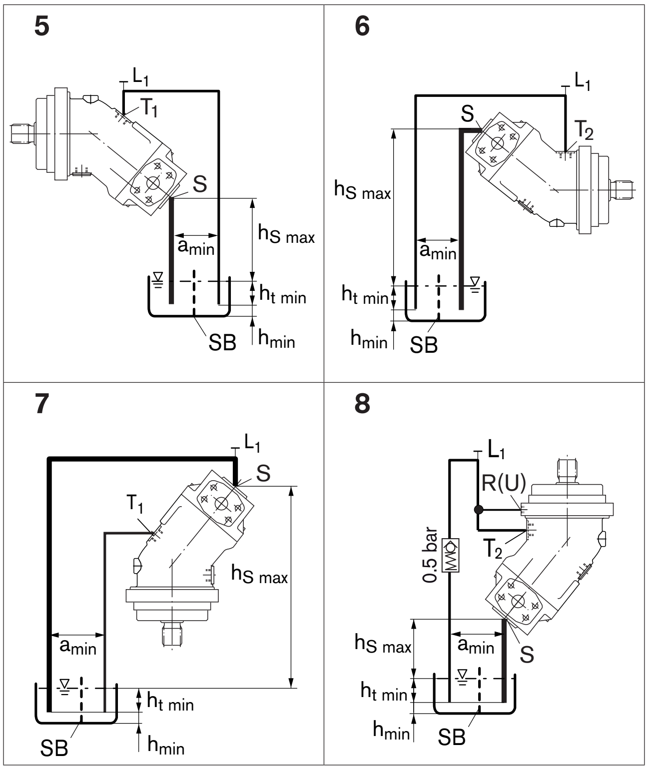
Installation position	Air bleed	Filling
1	–	T_1
2	–	T_2
3	–	T_1
4	R (U)	T_2

Installation instructions

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.

Recommendation for installation position 8 (drive shaft upward): A check valve in the drain line (cracking pressure 0.5 bar) can prevent draining of the pump housing.



Installation position	Air bleed	Filling
5	L_1	T_1 (L_1)
6	L_1	T_2 (L_1)
7	L_1	T_1 (L_1)
8	R (U)	T_2 (L_1)

L_1	Filling / air bleed
R	Air bleed port
U	Bearing flushing / air bleed port
S	Suction port
T_1, T_2	Drain port
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (100 mm)
SB	Baffle (baffle plate)
$h_{S\ max}$	Maximum permissible suction height (800 mm)
a_{min}	When designing the reservoir, ensure adequate space between the suction line and the drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

General instructions

- The pump A2FO is designed to be used in open circuits.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- During and shortly after operation, there is a risk of burns on the axial piston unit. Take appropriate safety measures (e. g. by wearing protective clothing).
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Service line ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The service line ports and function ports can only be used to accommodate hydraulic lines.
- The data and notes contained herein must be adhered to.
- The product is not approved as a component for the safety concept of a general machine according to ISO 13849.
- A pressure-relief valve is to be fitted in the hydraulic system.
- The following tightening torques apply:
  - Fittings:
    Observe the manufacturer's instructions regarding tightening torques of the fittings used.
  - Mounting bolts:
    For mounting bolts with metric ISO thread according to DIN 13 or with thread according to ASME B1.1, we recommend checking the tightening torque in individual cases in accordance with VDI 2230.
  - Female threads in the axial piston unit:
    The maximum permissible tightening torques $M_{G\,max}$ are maximum values for the female threads and must not be exceeded. For values, see the following table.
  - Threaded plugs:
    For the metallic threaded plugs supplied with the axial piston unit, the required tightening torques of threaded plugs M_V apply. For values, see the following table.

Ports **Standard**	**Size of thread**	**Maximum permissible tightening torque of the female threads $M_{G\,max}$**	**Required tightening torque of the threaded plugs M_V**[1]	**WAF hexagon socket in the threaded plugs**
DIN 3852	M8 x 1	10 Nm	7 Nm	3 mm
	M10 x 1	30 Nm	15 Nm[2]	5 mm
	M12 x 1.5	50 Nm	25 Nm[2]	6 mm
	M14 x 1.5	80 Nm	35 Nm	6 mm
	M16 x 1.5	100 Nm	50 Nm	8 mm
	M18 x 1.5	140 Nm	60 Nm	8 mm
	M22 x 1.5	210 Nm	80 Nm	10 mm
	M33 x 2	540 Nm	225 Nm	17 mm
	M42 x 2	720 Nm	360 Nm	22 mm

[1] The tightening torques apply for screws in the "dry" state as received on delivery and in the "lightly oiled" state for installation.

[2] In the "lightly oiled" state, the M_V is reduced to 10 Nm for M10 x 1 and 17 Nm for M12 x 1.5.

Axial piston fixed pump
A4FO

- Sizes 22 and 28
  - Nominal pressure 400 bar
  - Maximum pressure 450 bar
- Sizes 71 to 500
  - Nominal pressure 350 bar
  - Maximum pressure 400 bar

Features

- Fixed pump in axial piston swashplate design for hydrostatic drives in an open circuit
- For use in mobile and stationary applications
- Flow is proportional to the drive speed and displacement.
- High power density
- High total efficiency
- Optimized dimensions for special installation situations
- Excellent suction characteristics
- Low noise level
- Long service life
- Economical design
- Through drive for combining additional pumps

Contents

Type code

01	02	03	04		05	06		07	08	09	10	11
	A4F	**O**		**/**			**–**					

Hydraulic fluid

		022	028	071	125	180	250	500	
01	Mineral oil, HFD hydraulic fluid (no code)	●	●	●	●	●	●	●	
	HFA, HFB, HFC hydraulic fluid	–	–	●	●	●	●	●	**E–**
	High-speed version	–	–	–	–	–	●	●	**H–**

Axial piston unit

02	Swashplate design, fixed displacement	**A4F**

Operating mode

03	Pump, open circuit	**O**

Size (NG)

04	Geometric displacement, see „Technical data“ on page 8	**022**	**028**	**071**	**125**	**180**	**250**	**500**

Series

		022, 028	071	125 to 500	
05	Series 1, index 0	–	●	–	**10**
	Series 3, index 0	–	–	●	**30**
	Series 3, index 2	●	–	–	**32**

Direction of rotation

06	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Sealing material

		022, 028	071 to 500	
07	NBR (nitrile rubber), shaft seal in FKM (fluoroelastomer)	●	–	**N**
		–	●	**P**
	FKM (fluoroelastomer)	–	●	**V**

Drive shaft (permissible input torque, see page 10)

		022	028	071	125	180	250	500	
08	Splined shaft ANSI B92.1a	●	●	–	–	–	–	–	**S**
	Splined shaft DIN 5480	–	–	●	●	●	●	●	**Z**
	Parallel keyed shaft DIN 6885	–	–	●	●	●	●	●	**P**

Mounting flange

		022	028	071	125	180	250	500	
09	SAE J744, 2-hole	●	●	–	–	–	–	–	**C**
	ISO 3019, 4-hole	–	–	●	●	●	●	–	**B**
	ISO 3019, 8-hole	–	–	–	–	–	–	●	**H**

Working port[1)]

		022, 028	071 to 500	
10	SAE pressure and suction port, at side, opposite	●	–	**12**
	SAE pressure and suction port, at side, offset by 90° 2nd pressure port B1 opposite B (plugged with flange plate on delivery)	–	●	**25**

● = Available – = Not available

---

1) Fastening thread, metric

01	02	03	04		05	06		07	08	09	10	11
	A4F	**O**		**/**			**–**					

Through drive (for attachment options, see page 25)

			022	**028**	**071**	**125**	**180**	**250**	**500**	
11	Without through drive		●	●	●	●	●	●	●	**N00**
	With through drive for mounting an axial piston unit or gear pump		●	●	●	–	–	–	●	**K...**
	Universal through drive (can be modified)		–	–	–	●	●	●	–	**U...**
	Flange SAE J744	Hub for splined shaft SAE J744								
	82-2 (A)	5/8 in (16-4)	●	●	●	●	●	●	●	**...01**
	101-2 (B)	7/8 in (22-4)	●	●	–	–	–	–	–	**...02**
	101-2 (B)	7/8 in (22-4)	–	–	●	●	●	●	○	**...68**
	Flange ISO 3019-2 (metric)	Hub for splined shaft SAE J744								
	80, 2-hole	3/4 in (19-4)	–	–	●	●	●	●	○	**...B2**
	100, 2-hole	7/8 in (22-4)	–	–	●	●	●	●	○	**...B3**
	100, 2-hole	1 in (25-4)	–	–	●	●	●	●	○	**...B4**
	125, 2-hole	1 1/4 in (32-4)	–	–	●	●	●	●	○	**...B5**
	125, 2-hole	1 1/2 in (38-4)	–	–	–	●	●	●	○	**...B6**
	180, 4-hole	1 3/4 in (44-4)	–	–	–	–	●	●	●	**...B7**
	Flange ISO 3019-2 (metric)	Hub for splined shaft DIN 5480								
	125, 4-hole	W32×2×14×9g	–	–	●	●	●	●	○	**...31**
	140, 4-hole	W40×2×18×9g	–	–	●	●	●	●	○	**...33**
	160, 4-hole	W50×2×24×9g	–	–	–	●	●	●	●	**...34**
	224, 4-hole	W60×2×28×9g	–	–	–	–	–	●	●	**...35**
	315, 8-hole	W80×3×25×9g	–	–	–	–	–	–	●	**...43**
	With through-drive shaft, without hub, without intermediate flange, closed with cover		–	–	●	●	●	●	●	**...99**

● = Available ○ = On request – = Not available

Notes

- Note the project planning notes on page 28.
- Preservation:
  - Up to 12 months as standard
  - Up to 24 months long-term (state in plain text when ordering)

Hydraulic fluids

The A4FO fixed pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)
- 90223: Fire-resistant, water-containing hydraulic fluids (HFC, HFB, HFAE, HFAS)
  Sizes 22 and 28 are not suitable for operation with HFA, HFB and HFC.

Details regarding the choice of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}, see selection diagram).

Note
At no point of the component may the temperature be higher than 115 °C (sizes 22 and 28) and 90 °C (sizes 71 to 500).
The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

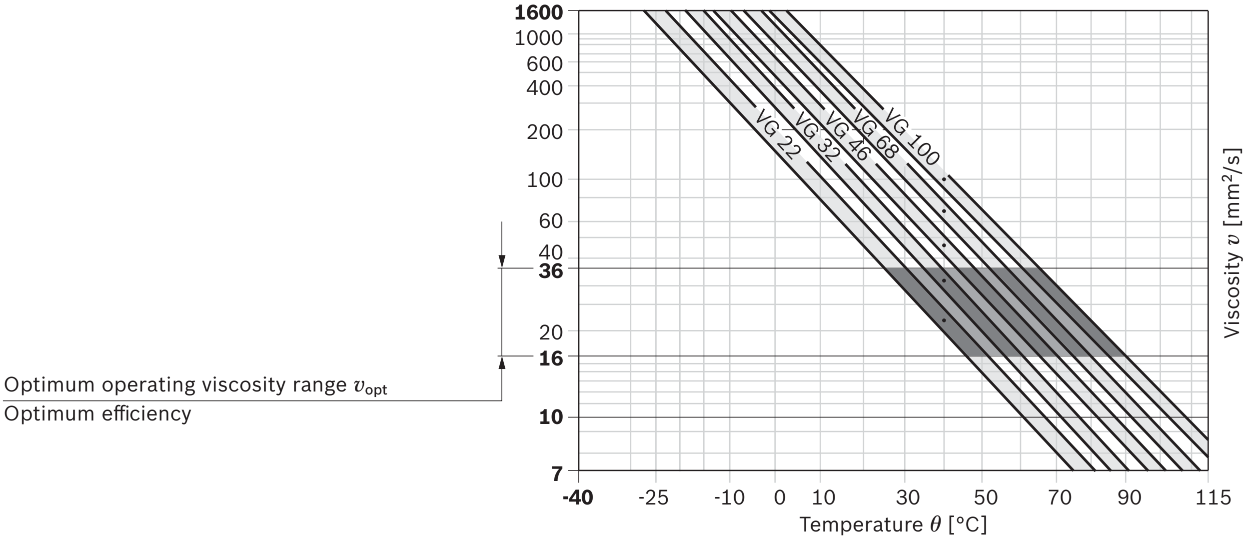
▼ **Sizes 22 and 28**

	Viscosity	Temperature	Comment
Cold start	$\nu_{\text{max}} \leq 1600\ \text{mm}^2/\text{s}$	$\theta_{\text{St}} \geq -40$ °C	$t \leq 3$ min, $n \leq 1000$ rpm, without load $p \leq 50$ bar
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid in the system
Warm-up phase	$\nu_{\text{max}} < 1600$ to $400\ \text{mm}^2/\text{s}$	$\theta = -40$ °C to -25 °C	at $p \leq 0{,}7 \times p_{\text{nom}}$, $n \leq 0{,}5 \times n_{\text{nom}}$ and $t \leq 15$ min
Continuous operation	$\nu = 400$ to $10\ \text{mm}^2/\text{s}$		
		$\theta = -25$ °C to $+110$ °C	measured at port **T_1** or **T_2** Note the permissible temperature range of the shaft seal (ΔT = approx. 5 K between the bearing/shaft seal and port **T_1**/**T_2**)
	$\nu_{\text{opt}} = 36$ to $16\ \text{mm}^2/\text{s}$		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{\text{min}} \geq 7\ \text{mm}^2/\text{s}$		$t < 3$ min, $p < 0{,}3 \times p_{\text{nom}}$

▼ **Sizes 71 to 500**

	Viscosity	Temperature	Comment
Cold start	$\nu_{\text{max}} \leq 1000\ \text{mm}^2/\text{s}$	$\theta_{\text{St}} \geq -40$ °C	$t \leq 3$ min, $n \leq 1000$ rpm, without load $p \leq 50$ bar
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid in the system
Warm-up phase	$\nu_{\text{max}} < 1000$ to $100\ \text{mm}^2/\text{s}$	$\theta = -40$ °C to -25 °C	at $p \leq 0{,}7 \times p_{\text{nom}}$, $n \leq 0{,}5 \times n_{\text{nom}}$ and $t \leq 15$ min
Continuous operation	$\nu = 100$ to $16\ \text{mm}^2/\text{s}$		
		$\theta = -25$ °C to $+90$ °C	measured at port **T** Note the permissible temperature range of the shaft seal
	$\nu_{\text{opt}} = 36$ to $16\ \text{mm}^2/\text{s}$		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{\text{min}} \geq 10\ \text{mm}^2/\text{s}$		$t < 3$ min, $p < 0{,}3 \times p_{\text{nom}}$

▼ **Selection diagram**



Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which in turn increases the service life of the axial piston unit.

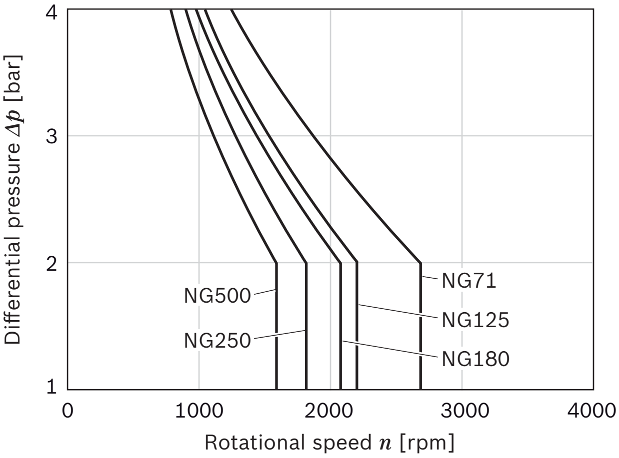
A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.

At very high hydraulic fluid temperatures (90 °C to maximum 110 °C, measured at port **T**, not permitted for sizes 71 to 500), a cleanliness level of at least 19/17/14 in accordance with ISO 4406 is necessary.

Shaft seal

Permissible pressure loading

The service life of the shaft seal is influenced by the speed of the axial piston unit and the leakage pressure in the housing (case pressure). Momentary (t < 0,1 s) pressure peaks of up to 10 bar are allowed. The service life of the shaft seal decreases with increasing frequency of pressure peaks and increasing mean differential pressure.
The case pressure must be equal to or higher than the ambient pressure.

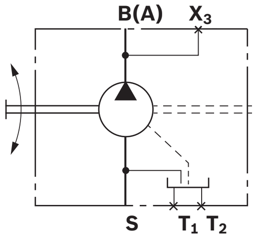


The FKM shaft seal may be used for leakage temperatures from −25 °C to +115 °C.
Sizes 22 and 28: For application cases below −25 °C, an NBR shaft seal is required (permissible temperature range: −40 °C to +90 °C).

Flow direction

Direction of rotation, viewed on drive shaft, sizes 22 and 28	
clockwise	counter-clockwise
S to **B**	**S** to **A**

▼ **Schematic, sizes 22 and 28**

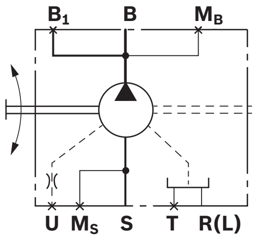


Ports

A, B	Working port
S	Suction port
T_1, T_2	Drain port
X_3	Measuring pressure B (A)

Direction of rotation, viewed on drive shaft, sizes 71 to 500	
clockwise	counter-clockwise
S to **B**	**S** to **B**

▼ **Schematic, sizes 71 to 500**



Ports

B, B_1	Working port
S	Suction port
T	Drain port
R (L)	Filling / air bleeding
M_B	Measuring port working pressure
M_S	Measuring port suction pressure
U	Flushing port

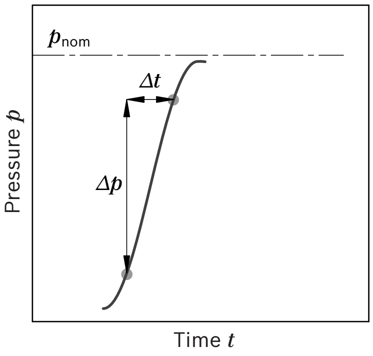
Bearing flushing (sizes 71 to 500)

Please refer to the data sheet 92050 (A4VSO) for operating conditions, flushing quantities and notes on bearing flushing.

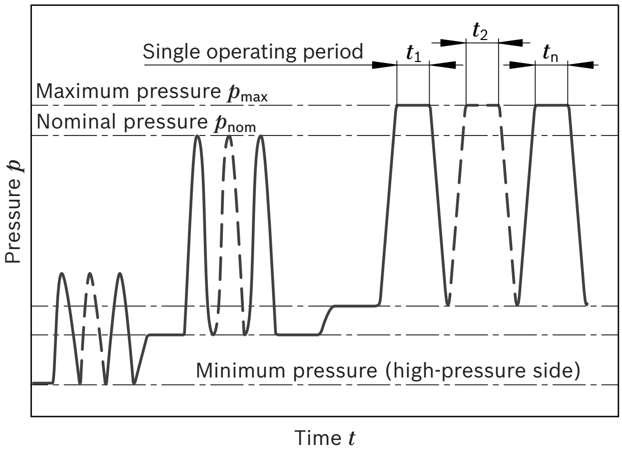
Working pressure range

Pressure at working ports A or B and B_1	**Sizes 22 and 28**	**Sizes 71 to 500**	**Definition**
Nominal pressure p_{nom}	400 bar absolute	350 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	450 bar absolute	400 bar absolute	The maximum pressure corresponds the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	1 s	1 s	
Total operating period	300 h	300 h	
Minimum pressure (high-pressure side)	25 bar absolute	–	Minimum pressure on high-pressure side (**A** or **B** and **B**$_1$) required to prevent damage to the axial piston unit.
Rate of pressure change $R_{A\ max}$	16000 bar/s	16000 bar/s	Maximum permissible rate of pressure build-up and reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)			
Minimum pressure $p_{S\ min}$	0,8 bar absolute	0,8 bar absolute	Minimum pressure at suction port **S** (inlet) that is required in order to avoid damage to the axial piston unit. The minimum pressure depends on the speed of the axial piston unit.
Maximum pressure $p_{S\ max}$	2 bar absolute	30 bar absolute	

▼ **Rate of pressure change $R_{A\ max}$**



▼ **Pressure definition**



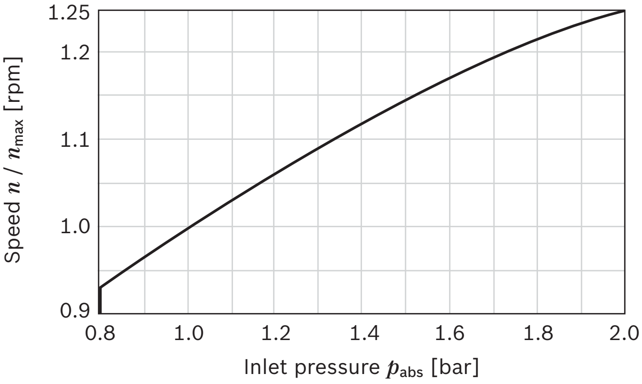
Total operating period = $t_1 + t_2 + ... + t_n$

Note
Working pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical data

Size		NG		22	28	71	125	180	250/H[1]	500/H[1]
Displacement, geometric, per revolution		V_g	cm³	22	28	71	125	180	250	500
Maximum rotational speed[2]		n_{nom}	rpm	3600	3000	2200	1800	1800	1500 / 1900	1320 /1500
Maximum rotational speed[3]		n_{max}	rpm	4500	3750	2700	2200	2100	1800 / 2100	1600 / 1800
Flow	at V_g and n_{nom}	q_v	l/min	79	84	156	225	324	375 / 475	660 / 750
Power	at V_g, n_{nom} and Δp = 400 bar	P	kW	53	56	91[4]	131[4]	189[4]	219 / 277[4]	385 / 438[4]
Torque	at V_g and Δp = 400 bar	T	Nm	140	178	396[4]	696[4]	1003[4]	1393[4]	2785[4]
Rotary stiffness drive shaft	Shaft end **S**	c	kNm/rad	29,9	29,9	–	–	–	–	–
	Shaft end **P**	c	kNm/rad	–	–	146	260	328	527	1145
	Shaft end **Z**	c	kNm/rad	–	–	146	263	332	543	1136
Moment of inertia for rotary group		J_{GR}	kgm²	0,0017	0,0017	0,0121	0,0300	0,055	0,0959	0,3325
Maximum angular acceleration		a	rad/s²	38000	38000	20000	13000	10000	8000	4800
Case volume		V	l	0,3	0,3	2,0	3,0	4,0	7,0	11,0
Weight (approx.)		m	kg	13,5	13,5	34	61	76	120	220

▼ **Maximum permissible speed (speed limit)**



Determining operating characteristics			
Flow	q_v	$= \dfrac{V_g \times n \times \eta_v}{1000}$	[l/min]
Torque	T	$= \dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{mh}}$	[Nm]
Power	P	$= \dfrac{2\,\pi \times T \times n}{60000} = \dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g = Displacement per revolution [cm³]

Δp = Differential pressure [bar]

n = Rotational speed [rpm]

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Total efficiency ($\eta_t = \eta_v \times \eta_{mh}$)

Notes

- ▶ Theoretical values, without efficiency and tolerances; values rounded
- ▶ Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or the destruction of the axial piston unit. Bosch Rexroth recommend testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.

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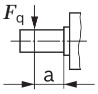
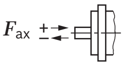
1) H = High-speed version

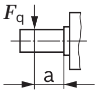
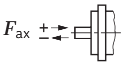
2) The values are valid:
   - – At absolute pressure p_{abs} = 1 bar at suction port **S**
   - – For the optimal viscosity range of ν_{opt} = 36 to 16 mm²/s
   - – For hydraulic fluid based on mineral oils.

3) Maximum speed (speed limit) with increased inlet pressure p_{abs} at suction port **S**, see diagram.

4) At Δp = 350 bar

Permissible radial and axial forces of the drive shaft

Size	NG		22	28
Drive shaft **S** according to ANSI B92.1a		in	7/8	7/8
Maximum radial force at distance a (from shaft collar) 	$F_{q\,max}$	N	2550	2150
	a	mm	16,5	16,5
Maximum axial force 	+ $F_{ax\,max}$	N	1557	1557
	− $F_{ax\,max}$	N	417	417

Size	NG		71	71	125	125	180	180	250	250	500	500
Drive shaft **Z** according to DIN 5480				W40		W50		W50		W60		W80
Drive shaft **P** according to DIN 6885		mm	Ø40		Ø50		Ø50		Ø60		Ø80	
Maximum radial force at distance a (from shaft collar) 	$F_{q\,max}$	N	1200	1200	1600	1600	2000	2000	2000	2000	2500	2500
	a	mm	35	22,5	41	27	41	27	52,5	35	65	45
Maximum axial force 	+ $F_{ax\,max}$	N	800	800	1000	1000	1400	1400	1800	1800	2000	2000
	− $F_{ax\,max}$	N	800	800	1000	1000	1400	1400	1800	1800	2000	2000

Note

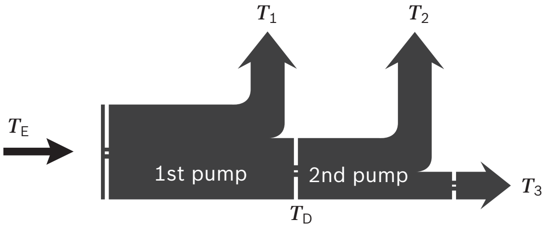
Special requirements apply in the case of belt drive and cardan shaft. Please contact us.

Permissible input and through-drive torques

Size		NG		22	28
Torque at V_g and Δp = 400 bar[1]		T	Nm	140	178
Input torque at drive shaft, maximum[2]					
ANSI B92.1a	S	$T_{E\,max}$	Nm	192	192
				7/8 in	7/8 in
Maximum through-drive torque		$T_{D\,max}$	Nm	192	192

Size		NG		71	125	180	250	500
Torque at V_g and Δp = 350 bar[1]		T	Nm	396	696	1003	1393	2785
Input torque at drive shaft, maximum[2]								
DIN 5480	Z	$T_{E\,max}$	Nm	790	1392	2004	2782	5566
				W40	W50	W50	W60	W80
DIN 6885	P	$T_{E\,max}$	Nm	700	1392	1400	2300	5200
				Ø40	Ø50	Ø50	Ø60	Ø80
Maximum through-drive torque		$T_{D\,max}$	Nm	395	696	1002	1391	2783

▼ **Torque distribution**



Torque at 1st pump	T_1		
Torque at 2nd pump	T_2		
Torque at 3rd pump	T_3		
Input torque	T_E	=	$T_1 + T_2 + T_3$
	T_E	<	$T_{E\,max}$
Through-drive torque	T_D	=	$T_2 + T_3$
	T_D	<	$T_{D\,max}$

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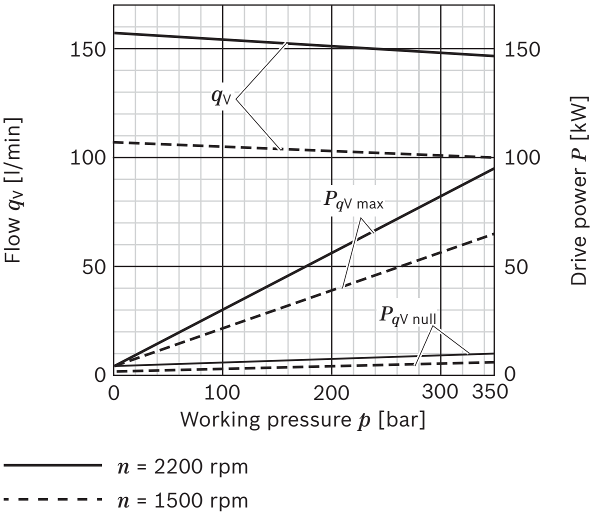
[1] Efficiency not considered

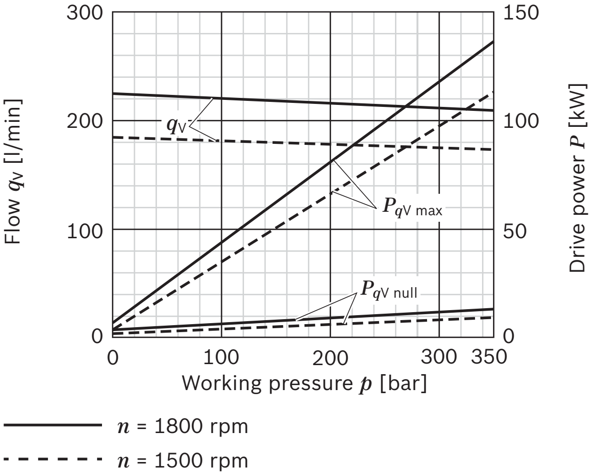
[2] For drive shafts free of radial force

Flow and power

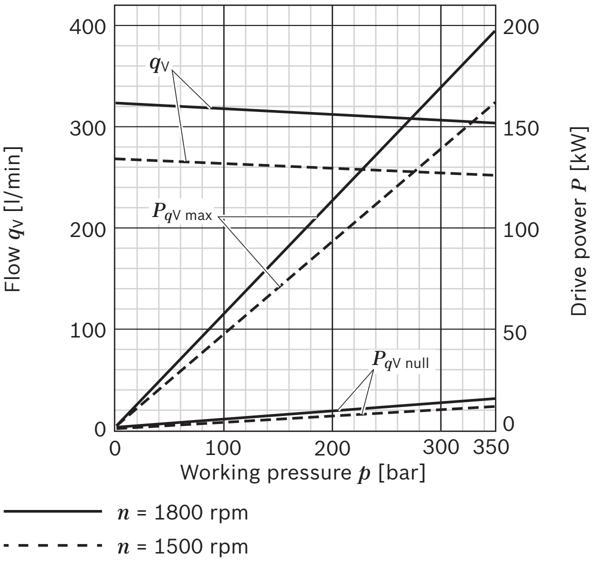
▼ Size 71



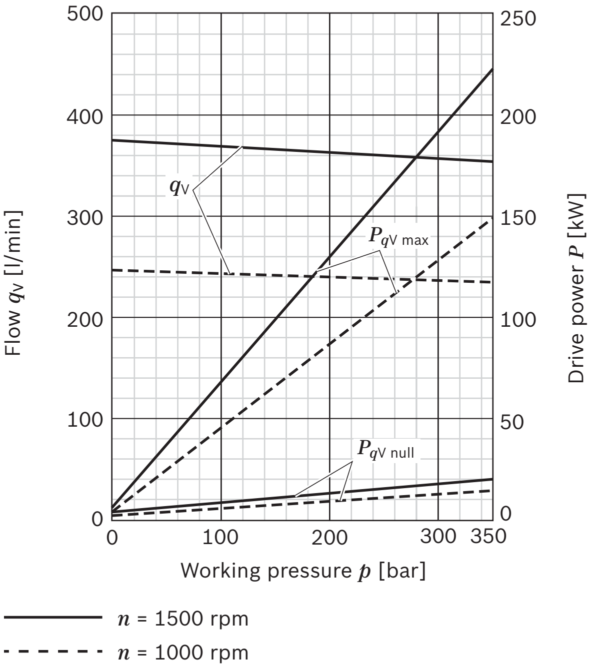
▼ Size 125



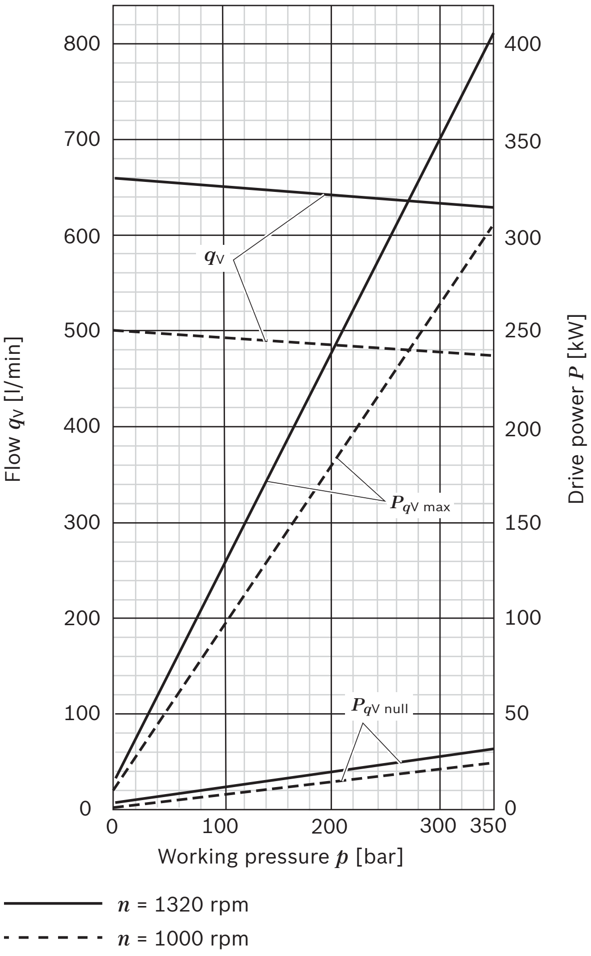
▼ Size 180



▼ Size 250



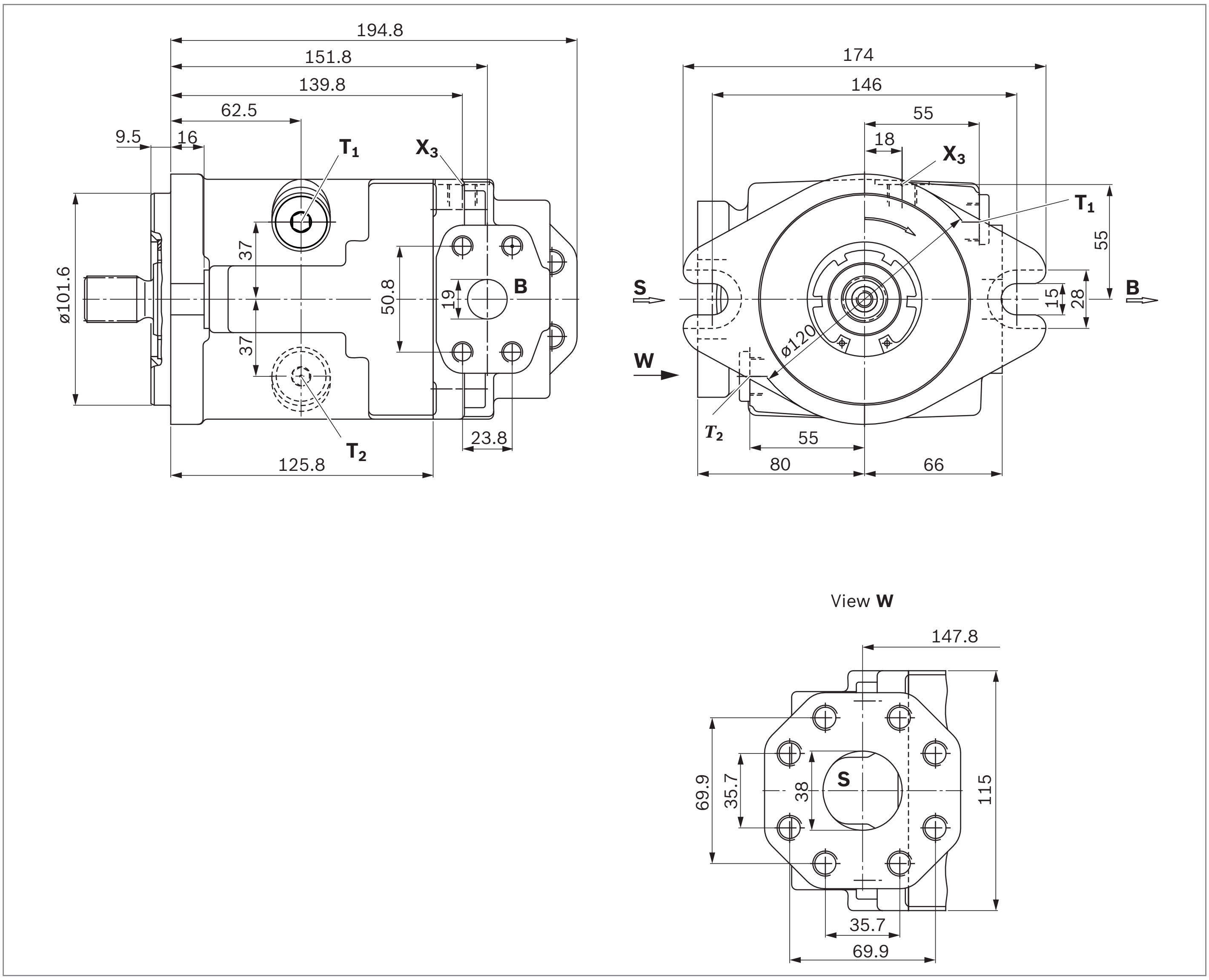
▼ Size 500



Dimensions sizes 22, 28

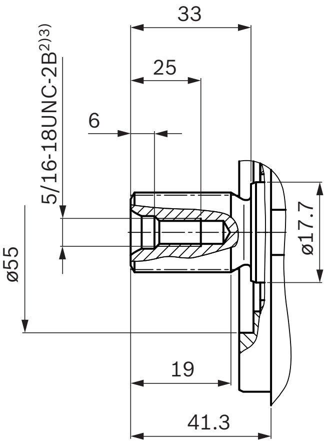
Representation with clockwise direction of rotation

Counter-clockwise drive rotation: Port plate rotated 180°



▼ Splined shaft SAE J744

S – 7/8 in 13T 16/32DP[1]



Ports		Standard	Size[3]	$p_{\text{max abs}}$ [bar][4]	Status
B (A)	Working port (high-pressure series) fastening thread	SAE J518[5] DIN 13	3/4 in M10 × 1,5; 17 deep	450	O
S	Suction port (standard series) fastening thread	SAE J518[5] DIN 13	1 1/2 in M12 × 1,75; 18 deep	35	O
T$_1$	Drain port	DIN 3852[6]	M18 × 1,5; 12 deep	2	X
T$_2$	Drain port	DIN 3852[6]	M18 × 1,5; 12 deep	2	X
X$_3$	Measuring pressure B (A)	DIN 3852[6]	M14 × 1,5; 12 deep	450	X

---

[1] Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Thread according to ASME B1.1

[3] For notes on tightening torques, see instruction manual

[4] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

[5] Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard

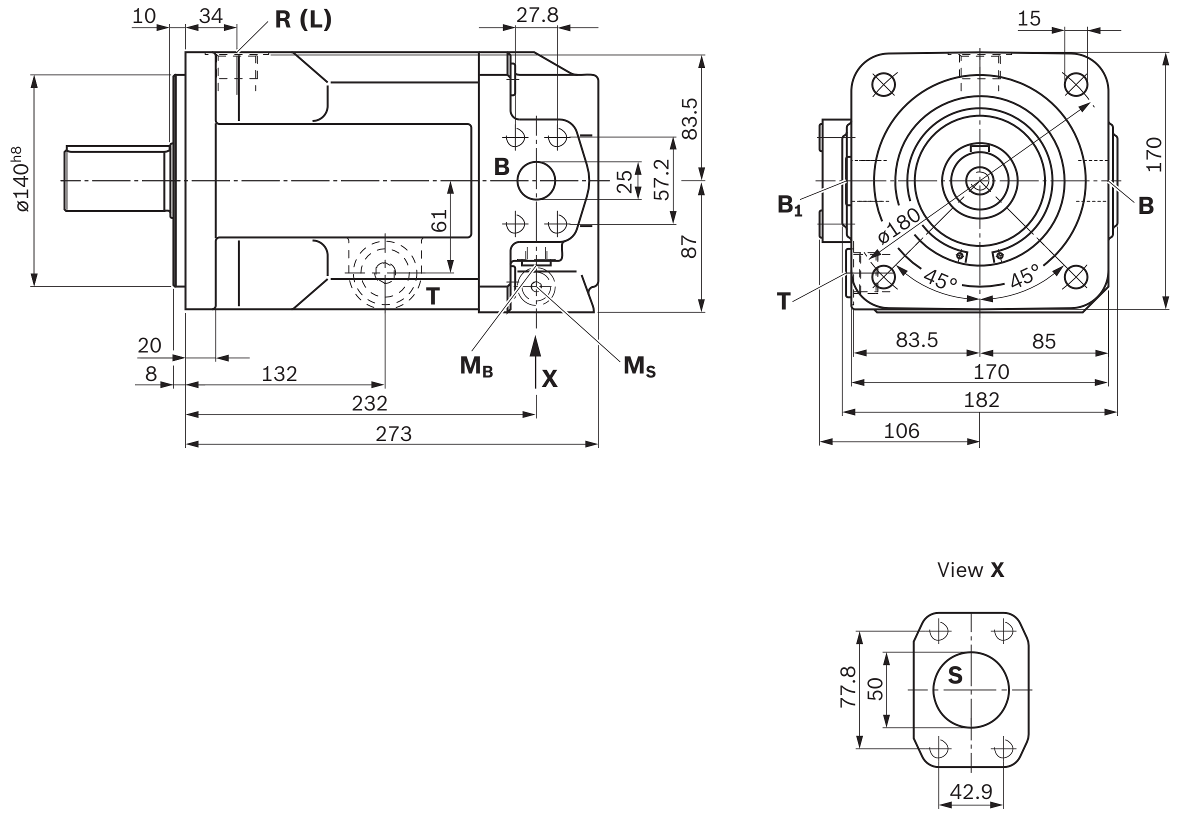
[6] The spot face can be deeper than as specified in the standard

O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

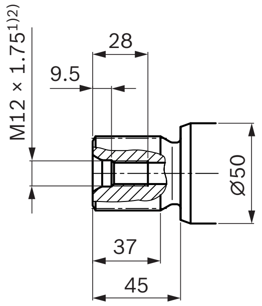
Dimensions size 71

Representation with clockwise and counter-clockwise direction of rotation



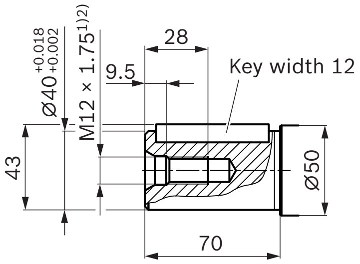
▼ Splined shaft DIN 5480

Z – W40×2×18×9g



▼ Parallel keyed shaft DIN 6885

P – AS12×8×68



Ports		Standard	Size[2)]	$p_{\text{max abs}}$ [bar][3)]	Status
B	Working port (high-pressure series) fastening thread	SAE J518[4)] DIN 13	1 in M12 × 1,75; 17 deep	400	O
B$_1$	2nd working port (high-pressure series) fastening thread	SAE J518[4)] DIN 13	1 in M12 × 1,75; 17 deep	400	X
S	Suction port (standard series) fastening thread	SAE J518[4)] DIN 13	2 in M12 × 1,75; 20 deep	30	O
T	Drain port	DIN 3852[5)]	M27 × 2; 16 deep	4	X
R (L)	Filling / air bleeding (drain port)	DIN 3852[5)]	M27 × 2; 16 deep	4	O
M$_B$	Measuring pressure B	DIN 3852[5)]	M14 × 1,5; 12 deep	400	X
M$_S$	Measuring pressure S	DIN 3852[5)]	M14 × 1,5; 12 deep	30	X

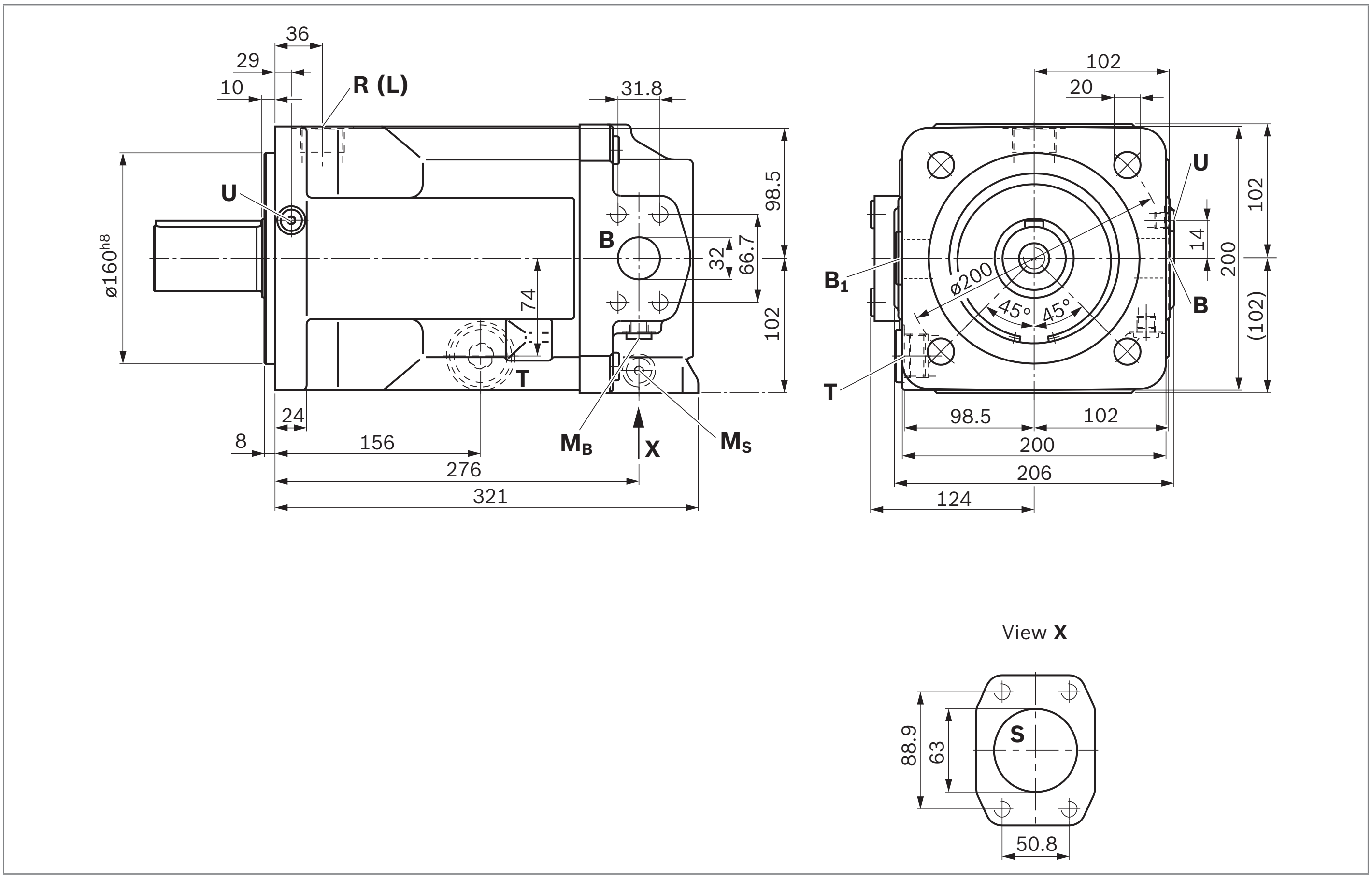
---

1) Center bore according to DIN 332 (thread according to DIN 13)
2) For notes on tightening torques, see instruction manual
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
5) The spot face can be deeper than as specified in the appropriate standard.

O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

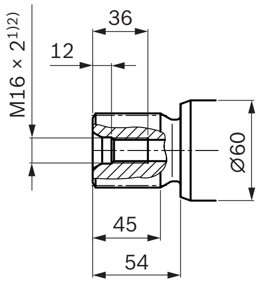
Dimensions size 125

Representation with clockwise and counter-clockwise direction of rotation



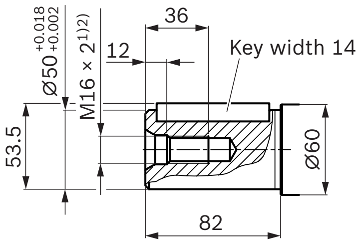
▼ Splined shaft DIN 5480

Z – W50×2×24×9g



▼ Parallel keyed shaft DIN 6885

P – AS14×9×80



Ports		Standard	Size[2)]	$p_{\text{max abs}}$ [bar][3)]	Status
B	Working port (high-pressure series) fastening thread	SAE J518[4)] DIN 13	1 1/4 in M14 × 2; 19 deep	400	O
B_1	2nd working port (high-pressure series) fastening thread	SAE J518[4)] DIN 13	1 1/4 in M14 × 2; 19 deep	400	X
S	Suction port (standard series) fastening thread	SAE J518[4)] DIN 13	2 1/2 in M12 × 1,75; 17 deep	30	O
T	Drain port	DIN 3852[5)]	M33 × 2; 18 deep	4	X
R (L)	Filling / air bleeding (drain port)	DIN 3852[5)]	M33 × 2; 18 deep	4	O
M_B	Measuring pressure B	DIN 3852[5)]	M14 × 1,5; 12 deep	400	X
M_S	Measuring pressure S	DIN 3852[5)]	M14 × 1,5; 12 deep	30	X
U	Bearing flushing	DIN 3852[5)]	M14 × 1,5; 12 deep	10	X

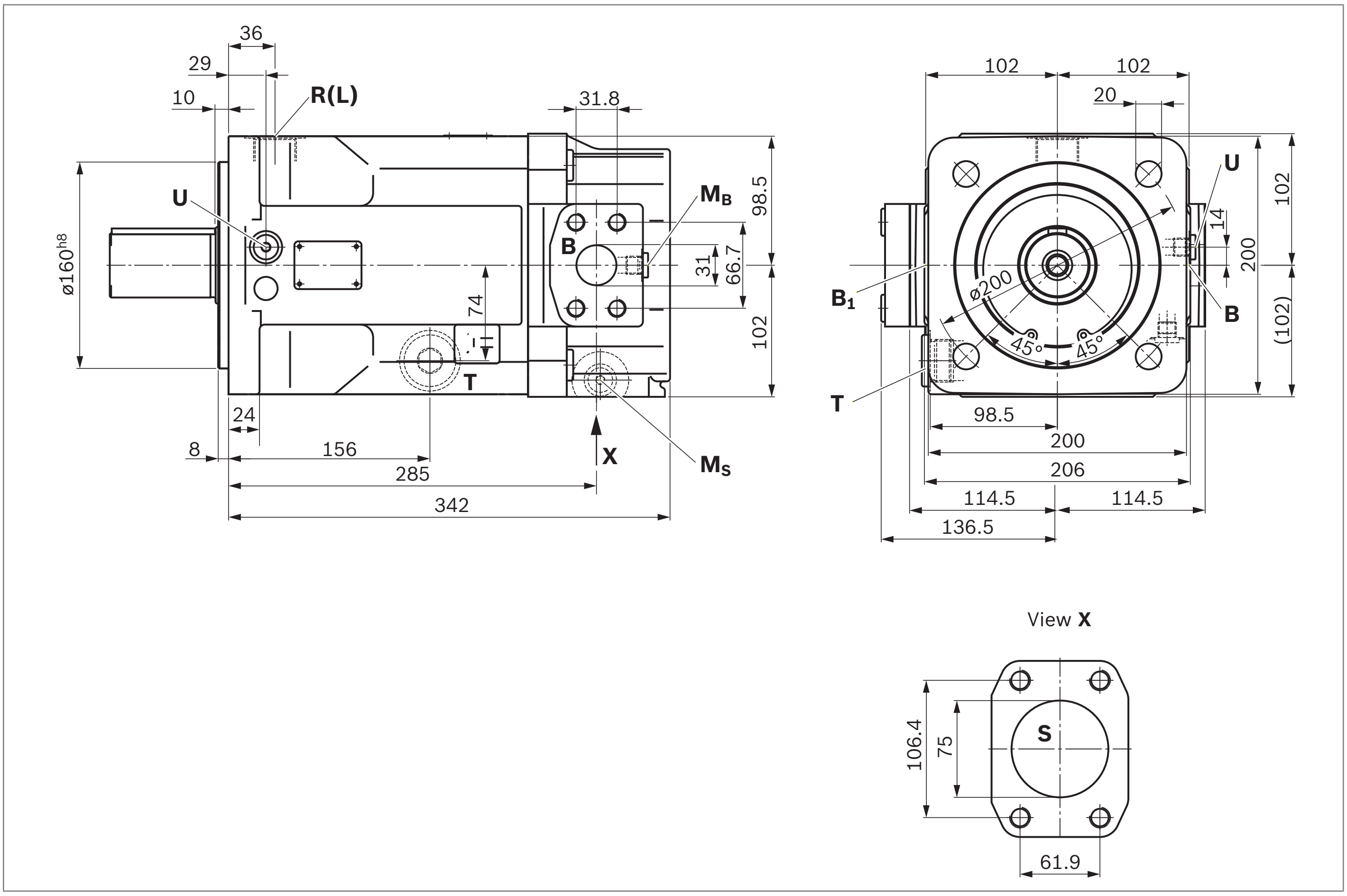
---

1) Center bore according to DIN 332 (thread according to DIN 13)
2) For notes on tightening torques, see instruction manual
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
5) The spot face can be deeper than as specified in the appropriate standard.

O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

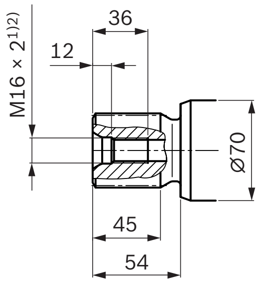
Dimensions size 180

Representation with clockwise and counter-clockwise direction of rotation



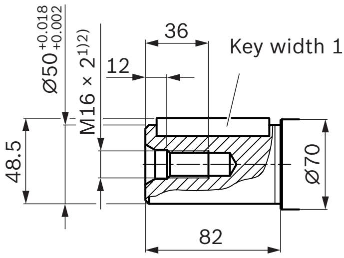
▼ Splined shaft DIN 5480

Z – W50×2×24×9g



▼ Parallel keyed shaft DIN 6885

P – AS14×9×80



Ports		Standard	Size[2)]	$p_{\text{max abs}}$ [bar][3)]	Status
B	Working port (high-pressure series) fastening thread	SAE J518[4)] DIN 13	1 1/4 in M14 × 2; 19 deep	400	O
B₁	2nd working port (high-pressure series) fastening thread	SAE J518[4)] DIN 13	1 1/4 in M14 × 2; 19 deep	400	X
S	Suction port (standard series) fastening thread	SAE J518[4)] DIN 13	3 in M16 × 2; 24 deep	30	O
T	Drain port	DIN 3852[5)]	M33 × 2; 18 deep	4	X
R (L)	Filling / air bleeding (drain port)	DIN 3852[5)]	M33 × 2; 18 deep	4	O
M$_B$	Measuring pressure B	DIN 3852[5)]	M14 × 1,5; 12 deep	400	X
M$_S$	Measuring pressure S	DIN 3852[5)]	M14 × 1,5; 12 deep	30	X
U	Bearing flushing	DIN 3852[5)]	M14 × 1,5; 12 deep	10	X

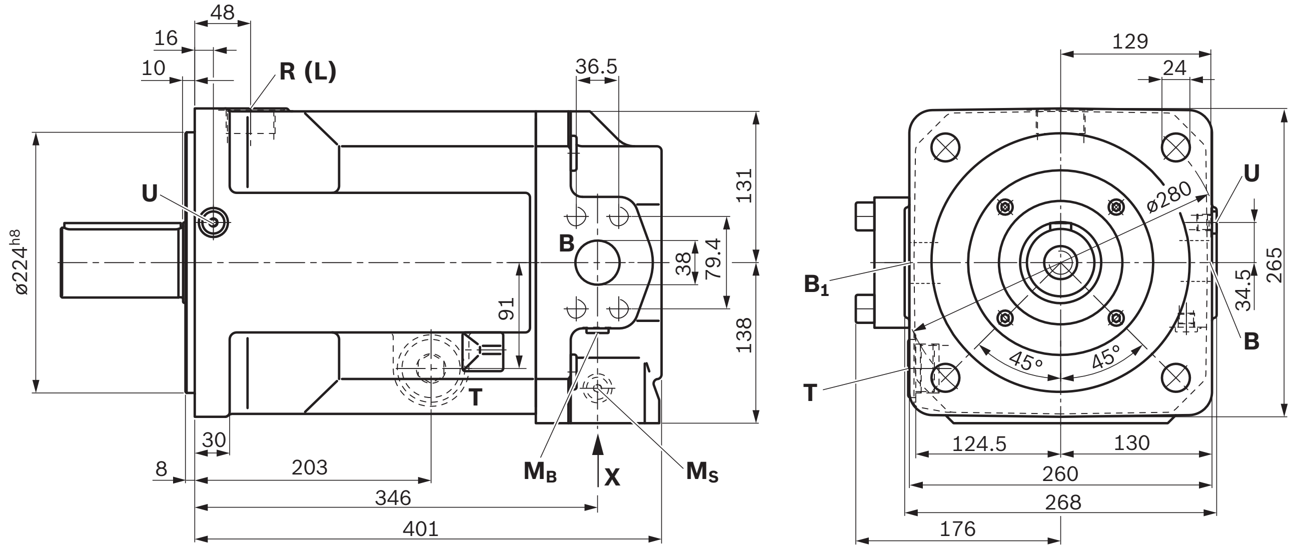
---

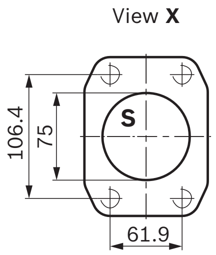
1) Center bore according to DIN 332 (thread according to DIN 13)
2) For notes on tightening torques, see instruction manual
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
5) The spot face can be deeper than as specified in the appropriate standard.

O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions size 250

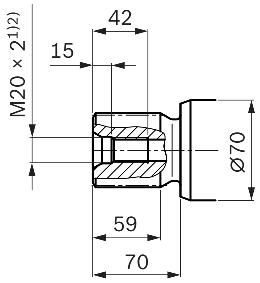
Representation with clockwise and counter-clockwise direction of rotation




View X

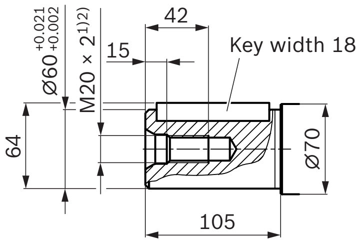
▼ Splined shaft DIN 5480

Z – W60×2×28×9g



▼ Parallel keyed shaft DIN 6885

P – AS18×11×100



Ports		Standard	Size[2)]	$p_{\text{max abs}}$ [bar][3)]	Status
B	Working port (high-pressure series) fastening thread	SAE J518[4)] DIN 13	1 1/2 in M16 × 2; 24 deep	400	O
B_1	2nd working port (high-pressure series) fastening thread	SAE J518[4)] DIN 13	1 1/2 in M16 × 2; 24 deep	400	X
S	Suction port (standard series) fastening thread	SAE J518[4)] DIN 13	3 in M16 × 2; 24 deep	30	O
T	Drain port	DIN 3852[5)]	M42 × 2; 20 deep	4	X
R (L)	Filling / air bleeding (drain port)	DIN 3852[5)]	M42 × 2; 20 deep	4	O
M_B	Measuring pressure B	DIN 3852[5)]	M14 × 1,5; 12 deep	400	X
M_S	Measuring pressure S	DIN 3852[5)]	M14 × 1,5; 12 deep	30	X
U	Bearing flushing	DIN 3852[5)]	M14 × 1,5; 12 deep	10	X

---

1) Center bore according to DIN 332 (thread according to DIN 13)

2) For notes on tightening torques, see instruction manual

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

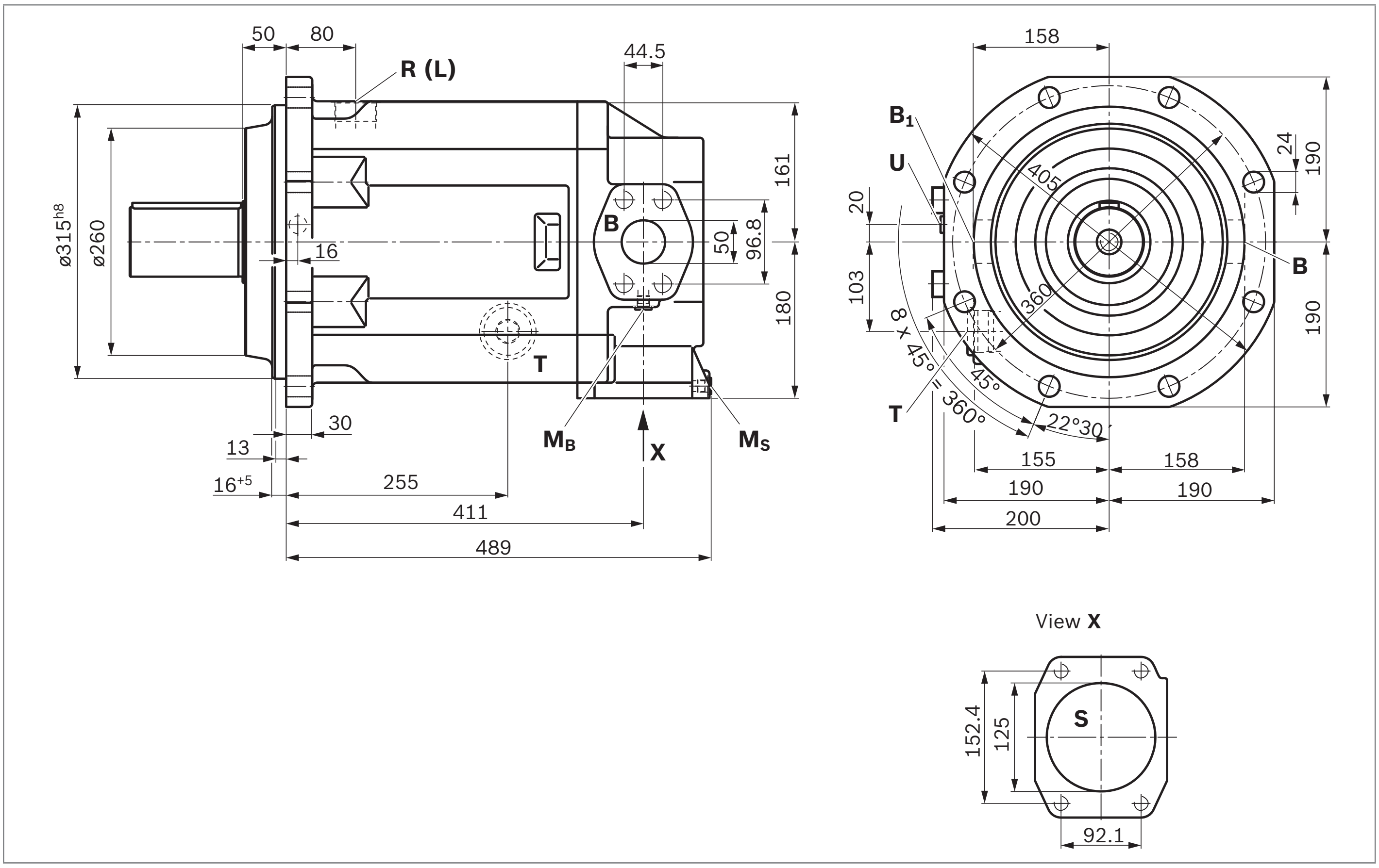
5) The spot face can be deeper than as specified in the appropriate standard.

O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

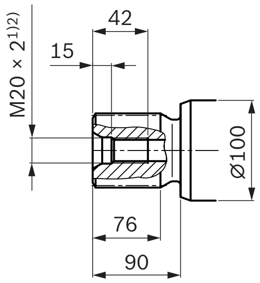
Dimensions size 500

Representation with clockwise and counter-clockwise direction of rotation



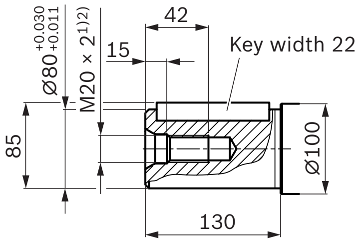
▼ Splined shaft DIN 5480

Z – W80×3×25×9g



▼ Parallel keyed shaft DIN 6885

P – AS22×14×125



Ports		Standard	Size[2)]	$p_{\text{max abs}}$ [bar][3)]	Status
B	Working port (high-pressure series) fastening thread	SAE J518[4)] DIN 13	2 in M20 × 2,5; 24 deep	400	O
B$_1$	2nd working port (high-pressure series) fastening thread	SAE J518[4)] DIN 13	2 in M20 × 2,5; 24 deep	400	X
S	Suction port (standard series) fastening thread	SAE J518[4)] DIN 13	5 in M16 × 2; 23 deep	30	O
T	Drain port	DIN 3852[5)]	M48 × 2; 22 deep	4	X
R (L)	Filling / air bleeding (drain port)	DIN 3852[5)]	M48 × 2; 22 deep	4	O
M$_B$	Measuring pressure B	DIN 3852[5)]	M18 × 1,5; 12 deep	400	X
M$_S$	Measuring pressure S	DIN 3852[5)]	M18 × 1,5; 12 deep	30	X
U	Bearing flushing	DIN 3852[5)]	M18 × 1,5; 12 deep	10	X

---

1) Center bore according to DIN 332 (thread according to DIN 13)

2) For notes on tightening torques, see instruction manual

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

5) The spot face can be deeper than as specified in the appropriate standard.

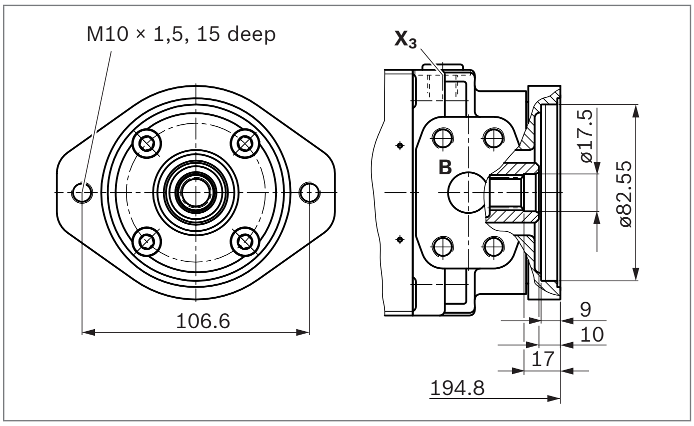
O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

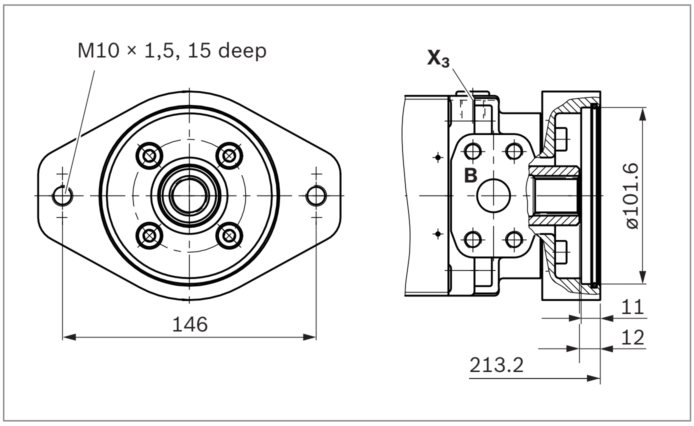
Through drives dimensions

Sizes 22 and 28

▼ K01: Flange 82-2 (A), hub for splined shaft 5/8 in (16-4)

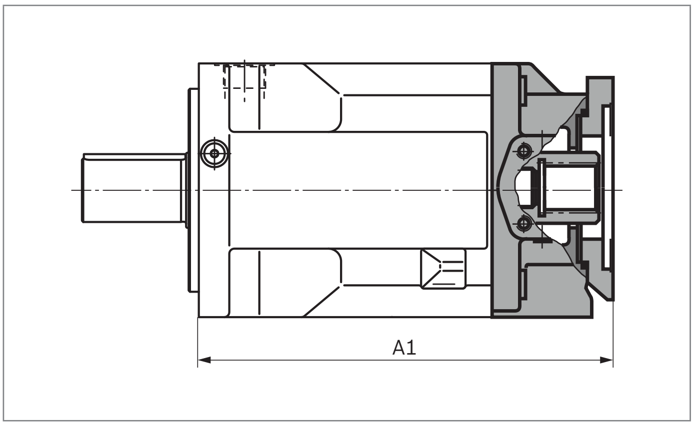


▼ K02: Flange 101-2 (B), hub for splined shaft 7/8 in (22-4)



Sizes 71 to 500

▼ For through drives see data sheet 92050 (A4VSO)



▼ Dimensions for A1

Code	71	125	180	250	500
K/U01	269	335	360	419	○
K/U68	300	335	360	419	○
K/UB2	269	335	360	419	○
K/UB3	269	335	360	419	○
K/UB4	294	335	360	419	○
K/UB5	299	335	360	419	○
K/UB6	–	335	360	419	○
K/UB7	–	–	373	419	500
K/U31	294	335	360	419	○
K/U33	294	335	360	419	○
K/U34	–	335	360	419	475
K/U35	–	–	–	435	511
K/U43	–	–	–	–	560
K/U99	286,5	334	359	419	497

○ = on request

Overview of attachment options

Through drive A4FO[1]			Attachment of 2nd pump				
Flange	**Hub for splined shaft**	**Code**	**A4VSO/G NG (shaft)**	**A4CSG NG (shaft)**	**A10V(S)O/ 31(2) NG (shaft)**	**A10V(S)O/52(3) NG (shaft)**	**External gear pump[2]**
SAE J744							
82-2 (A)	5/8 in	**K01**	–	–	–	–	AZPF
101-2 (B)	7/8 in	**K02, K/U68**	–	–	28 (S)/31	28 (S)	AZPN
ISO 3019-2 (metric)							
80, 2-hole	3/4 in	**K/UB2**	–	–	18 (S)/31	10 (S)	–
100, 2-hole	7/8 in	**K/UB3**	–	–	28 (S)/31	–	–
	1 in	**K/UB4**	–	–	45 (S)/31	–	–
125, 2-hole	1 1/4 in	**K/UB5**	–	–	71 (S)/31	–	–
	1 1/2 in	**K/UB6**	–	–	100 (S)/31	–	–
125, 4-hole	W32×2×14×9g	**K/U31**	40 (Z)	–	–	–	–
140, 4-hole	W40×2×18×9g	**K/U33**	71 (Z)	–	–	–	–
160, 4-hole	W50×2×24×9g	**K/U34**	125 (Z)	–	–	–	–
180, 4-hole	1 3/4 in	**K/UB7**	–	–	140 (S)/31/32	–	–
224, 4-hole	W60×2×28×9g	**K/U35**	250 (Z)	250 (Z)	–	–	–
315, 8-hole	W80×3×25×9g	**K/U43**	500 (Z)	500 (Z)	–	–	–

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1) Additional through drives are available on request

2) Bosch Rexroth recommends special versions of the external gear pumps. Please contact us.

Installation instructions

General

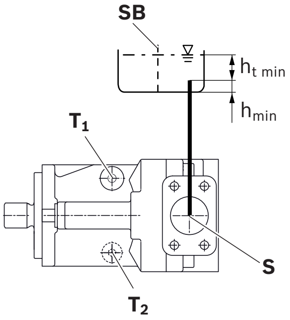
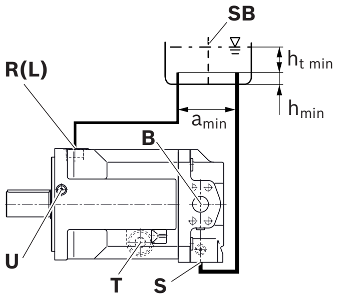
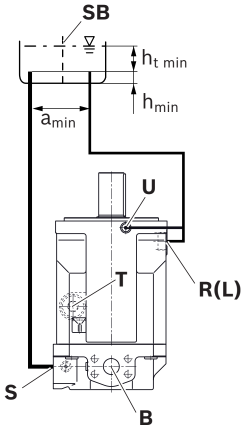
The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.
Particularly in the installation position „drive shaft upwards“, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.
For sizes 22 and 28, the pump housing is internally connected to the suction chamber. A separate drain line from the housing to the reservoir is not needed. A drain line is required for sizes 71 to 500.
If a shared drain line is used for several units, make sure that the relevant case pressure is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operational circumstances, particularly at cold start. If this is not possible, separate drain lines must be laid if necessary.
To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.
In all operating conditions, the suction lines and the drain lines must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\,max}$ = 800 mm. The minimum suction pressure at port **S** must not fall below 0,8 bar absolute during operation either.
When designing the reservoir, ensure that there is adequate spacing between the suction line and the drain line. This minimizes oil turbulence and carries out degassing, which prevents the heated hydraulic fluid from being sucked directly back in again.

Installation position

See the following examples **1** to **8**.
Additional installation positions are available upon request.

Below-reservoir installation (standard)

Below-reservoir installation is when the axial piston unit is installed outside of the reservoir below the minimum fluid level.

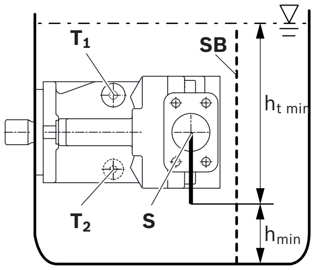
Installation position	Air bleeding	Filling
1 Sizes 22, 28  	Above the highest drain port $\mathbf{T_1}$ or $\mathbf{T_2}$	**S**
2 Sizes 71 to 500  	**R (L)**	**S + R (L)**
3 Sizes 125 to 500  	**R (L), U**	**S + R (L)**

Key, see page 27.

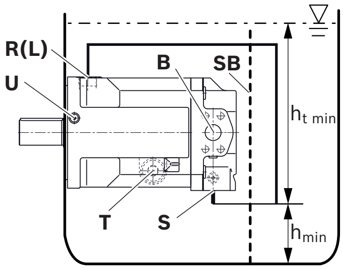
Inside-reservoir installation

Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level. The axial piston unit is completely below the hydraulic fluid.

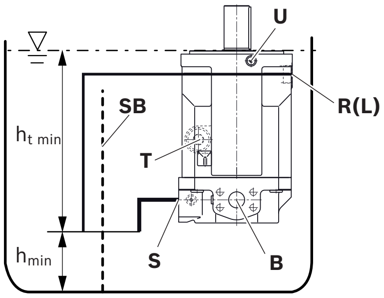
Installation position	Air bleeding	Filling
4 Sizes 22, 28	Above the highest drain port **T_1** or **T_2**	1)



Installation position	Air bleeding	Filling
5 Sizes 71 to 500	via the highest open drain port **R (L)**	1)



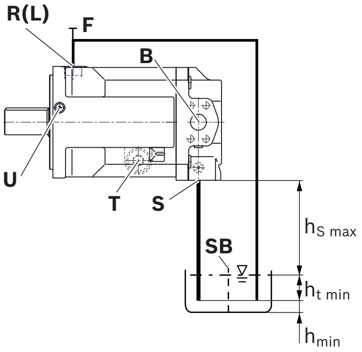
Installation position	Air bleeding	Filling
6 Sizes 125 to 500	via the highest open drain port **R (L)** and the bearing flushing **U**	1)



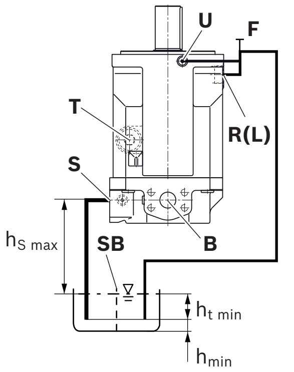
Above-reservoir installation

Above-reservoir installation means the axial piston unit is installed above the minimum fluid level of the reservoir. Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.

Installation position	Air bleeding	Filling
7 Sizes 71 to 500	**F (R (L))**	**F (R (L))**



Installation position	Air bleeding	Filling
8 Sizes 125 to 500	**F (U)**	**F (R (L))**



Key	
T, T_1, T_2	Drain port
R (L)	Filling / air bleeding
F	Filling / air bleeding Note: F is part of the external piping
S	Suction port
SB	Baffle (baffle plate)
U	Flushing port
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (100 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)

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1) With piping: The axial piston unit must be filled before the piping is attached. Without piping: Automatically via all open ports, by position below hydraulic fluid level

Project planning notes

- The A4FO pump is designed to be used in open circuits.
- Project planning, installation and commissioning of the axial piston units requires the involvement of skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual thoroughly and completely. If necessary, request them from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The specified data and notes must be observed.
- Depending on the operating condition of the axial piston unit (working pressure, fluid temperature), the characteristic may shift.
- Not all versions of the product are approved for use in a safety function pursuant to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. MTTF_d) for functional safety.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports can only be used to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit. Take appropriate safety measures (e.g. by wearing protective clothing).

Axial piston fixed pump
A17FO Series 10

- High-pressure pump for use in commercial vehicles
- Sizes 23 to 107
- Nominal pressure/maximum pressure 350/400 bar
- Bent-axis design
- Open circuit

Features
- Flange and shaft designed for direct mounting on the power take-off of commercial vehicles
- Weight-optimized thanks to diecast aluminum housing.
- No case drain line necessary
- Reduced noise
- Straightforward adjustment of direction of drive
- Excellent suction performance
- High total efficiency
- Long service life

Contents

Ordering code

01	02	03		04	05	06	07	08	09	10		11
A17F	**O**		**/**	**10**	**N**	**L**	**W**	**K0**	**E8**	**1**	**–**	

Axial piston unit

01	Bent-axis design, fixed, nominal pressure 350 bar, maximum pressure 400 bar, for commercial vehicles (truck)	**A17F**

Operating mode

02	Pump, open circuit	**O**

Sizes (NG)

03	Geometric displacement, see table of values on page 5	**023**	**032**	**045**	**063**	**080**	**107**

Series

04	Series 1, index 0	**10**

Configuration of port and fastening threads

05	Metric, port threads with profiled sealing ring according to DIN 3852	**N**

Direction of rotation[1]

06	Viewed on drive shaft	counter-clockwise	**L**

Sealing material

07	FKM (fluor-caoutchouc) including the 2 shaft seal rings in FKM	**W**

Mounting flange

08	Special flange ISO 7653-1985 (for trucks)	**K0**

Drive shaft

09	Splined shaft similar to DIN ISO 14 (for trucks)	**E8**

Service line port

10	Threaded ports **A** and **S** at rear	**1**

Standard / special version

11	Standard version	**0**
	Special version	**S**

Note

Note the project planning notes on page 16.

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[1] Changing the direction of rotation see instruction manual 91520-01-B, chapter 6.4.2

Hydraulic fluid

The fixed pump A17FO is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)

The axial piston unit is not suitable for operation with water-containing HF hydraulic fluid.

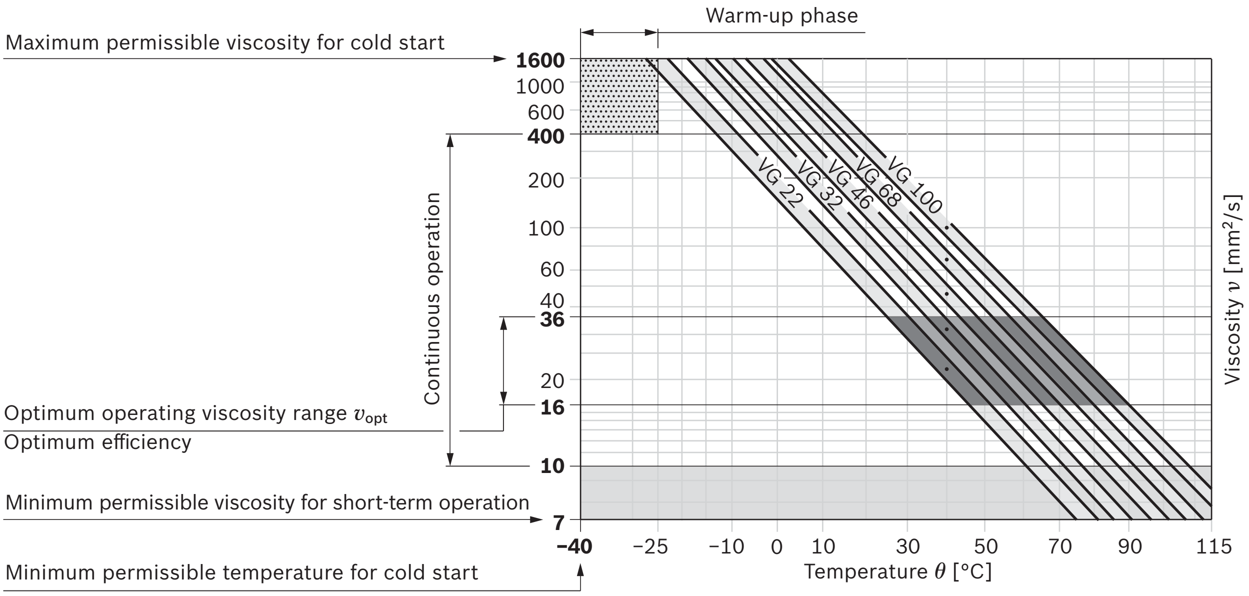
Notes on selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see selection diagram).

Note
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
Please contact us if the above conditions cannot be met due to extreme operating parameters.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \le 1600$ mm²/s	$\theta_{St} \ge -25$ °C[1]	$t \le 3$ min, without load ($p \le 50$ bar), $n \le 1000$ rpm
Permissible temperature difference		$\Delta T \le 25$ K	between axial piston unit and hydraulic fluid in the system
Warm-up phase	$\nu < 1600$ to 400 mm²/s		at $p \le 0.7 \times p_{nom}$, $n \le 0.5 \times n_{nom}$ and $t \le 15$ min
Continuous operation	$\nu = 400$ to 10 mm²/s		this corresponds, for VG 46 for example, to a temperature range of +5 °C to +85 °C (see selection diagram)
		θ = -25 °C to +103 °C	measured at air bleed port **R** observe permissible temperature range of the shaft seal ring[1] (ΔT = approx. 12 K between bearing/shaft seal and port **R**)
	$\nu_{opt} = 36$ to 16 mm²/s		range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \ge 7$ mm²/s		$t < 3$ min, $p < 0.3 \times p_{nom}$

▼ **Selection diagram**



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[1] The FKM shaft seal is permissible for temperatures of –25 °C to +115 °C, please contact us for temperatures below –25 °C.

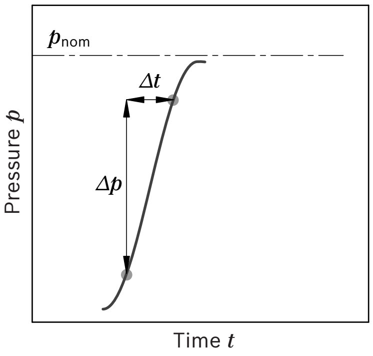
Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.
A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.
At very high hydraulic fluid temperatures (90 °C to maximum 103 °C, measured at air bleed port **R**), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

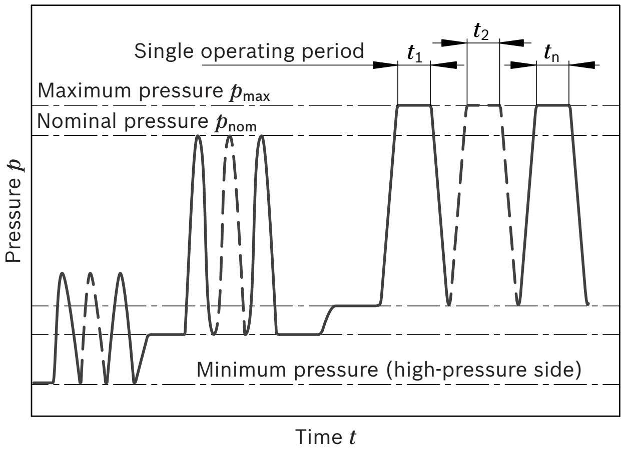
Operating pressure range

Pressure at service line port A (high-pressure side)		**Definition**
Nominal pressure p_{nom}	350 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	400 bar absolute	The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	5 s	
Total operating period	50 h	
Minimum pressure (high-pressure side)	10 bar absolute	Minimum pressure at the high-pressure side (**A**) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{\text{A max}}$	9000 bar/s	Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{\text{S min}}$	0.8 bar absolute	Minimum pressure at suction port **S** (inlet) which is required in order to prevent damage to the axial piston unit. The minimum pressure is dependent on the speed of the axial piston unit.
Maximum pressure $p_{\text{S max}}$	2 bar absolute	

▼ **Rate of pressure change $R_{\text{A max}}$**



▼ **Pressure definition**



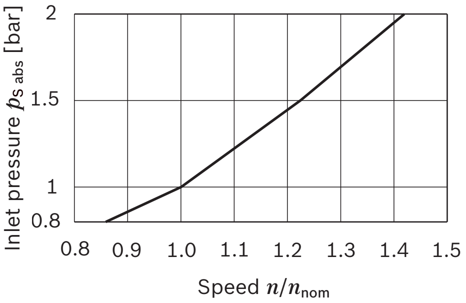
Total operating period = $t_1 + t_2 + \ldots + t_n$

Note
Operating pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical Data

Size		NG		23	32	45	63	80	107
Displacement, geometric, per revolution		V_g	cm³	22.9	32	45.6	63	80.4	106.7
Speed maximum1)		n_{nom}2)	rpm	3050	2750	2650	2200	2150	2000
		n_{max}3)	rpm	4300	3900	3800	3200	3100	2800
Flow	at n_{nom}	q_v	l/min	70	88	121	139	173	213
Power	at n_{nom} and Δp = 350 bar	P	kW	41	51	71	81	101	124
Torque	at Δp = 350 bar	T	Nm	127	178	254	351	448	594
Rotary stiffness		c	kNm/rad	2.56	3.12	4.18	6.25	8.73	11.2
Moment of inertia for rotary group		J_{TW}	kgm²	0.0012	0.0012	0.003	0.0042	0.0072	0.0116
Maximum angular acceleration		α	rad/s²	6500	6500	14600	7500	6000	4500
Case volume		V	l	0.25	0.29	0.4	0.5	0.6	0.75
Mass moment		T_G	Nm	4.7	4.7	8.6	9.9	15.3	20
Mass (approx.)		m	kg	5.9	5.9	8.4	9.3	12.3	15.0

▼ Maximum speed (limiting speed)



Determining the operating characteristics				
Flow	q_v	=	$\dfrac{V_g \times n \times \eta_v}{1000}$	[l/min]
Torque	T	=	$\dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$	[Nm]
Power	P	=	$\dfrac{2\,\pi \times T \times n}{60000} = \dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g	Displacement per revolution [cm³]
Δp	Differential pressure [bar]
n	Speed [rpm]
η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

Note

- ▶ Theoretical values, without efficiency and tolerances; values rounded.
- ▶ Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, such as speed variation, reduced angular acceleration as a function of the frequency and the permissible angular acceleration at start (lower than the maximum angular acceleration) can be found in data sheet 90261.

---

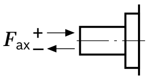
1) The values are applicable:
– for the optimum viscosity range from ν_{opt} = 36 bis 16 mm²/s
– for hydraulic fluids based on mineral oils.

2) The values apply at absolute pressure p_{abs} = 1 bar at suction port **S**

3) Maximum speed (speed limit) with increased inlet pressure p_{abs} at suction port **S** (see diagram).

Operating pressure range

Permissible axial forces of the drive shaft

Size		**NG**		**23**	**32**	**45**	**63**	**80**	**107**
Maximum axial force, at standstill or pressure-free operation		+ $F_{ax\ max}$	N	0	0	0	0	0	0
		− $F_{ax\ max}$	N	24	33	43	53	60	71

Note

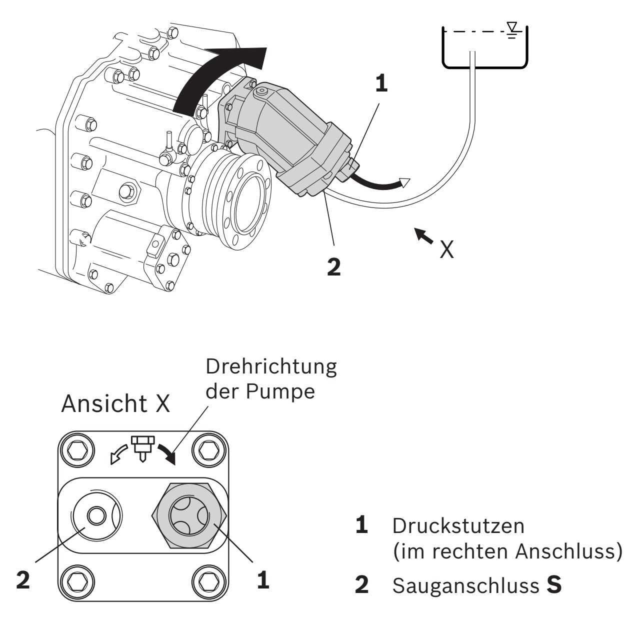
- The values given are maximum values and do not apply to continuous operation.
- The permissible axial force in direction $-F_{ax}$ is to be avoided as the lifetime of the bearing is reduced.
- Radial forces are not permissible.

Direction of rotation

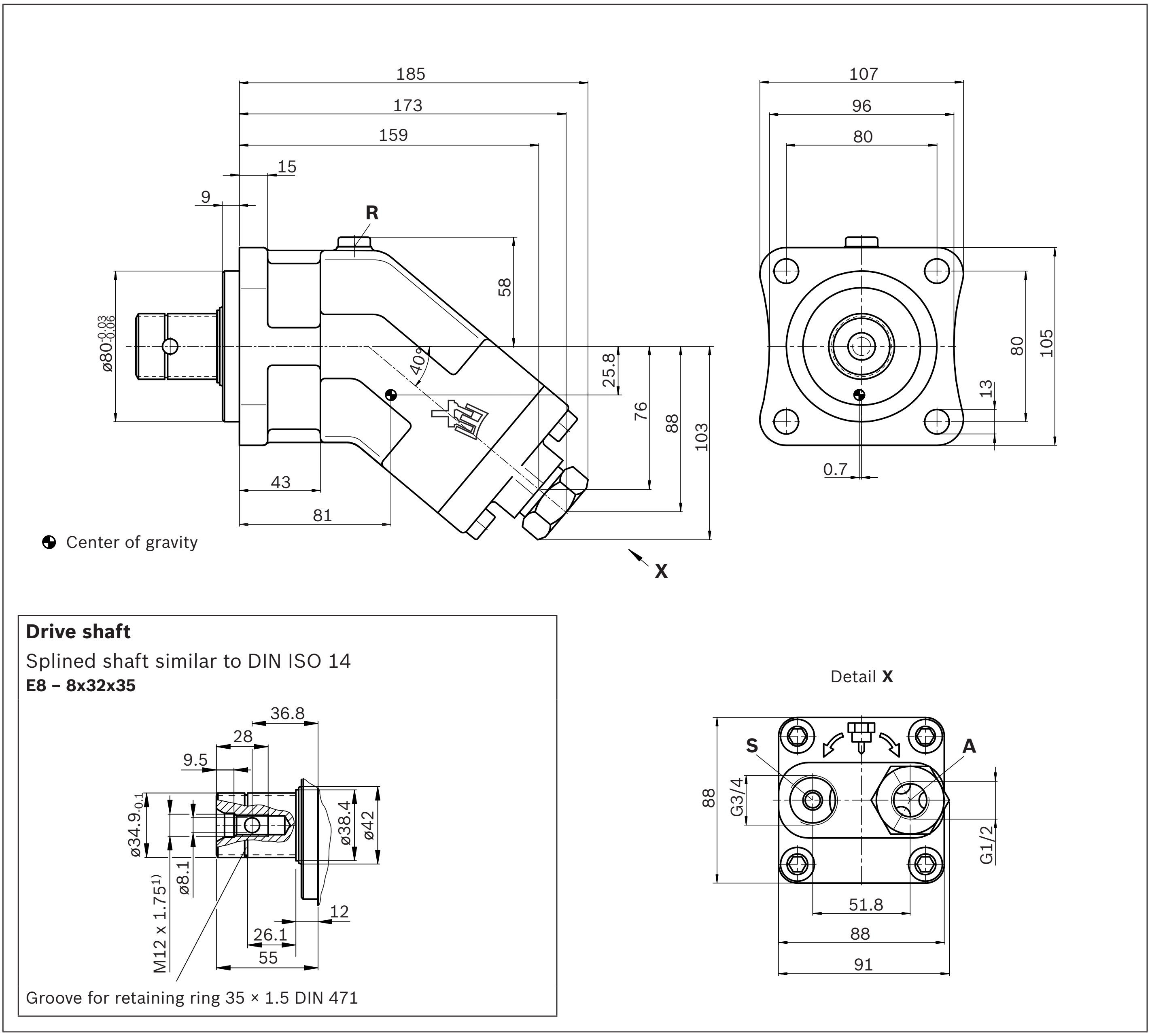
The direction of rotation of the axial piston unit is defined by means of a pressure connection screwed into the service line port and can easily be changed.
By changing the pressure connection, the service line port and the suction port are exchanged. As a result, the permissible drive direction is changed. This is necessary when mounting on a power take-off with counter-clockwise rotation, for example. The procedure for conversion of the pressure nipple can be found in the instruction manual (91520-01-B, chapter 6.4.2 “Direction of rotation and change of direction of rotation”).

Direction of rotation on delivery
On delivery, the pressure connection (**1**) is pre-assembled in the right-hand service line port of the axial piston unit. The permissible drive direction of the pump looking at the drive shaft: counter-clockwise. The power take-off turns clockwise.

Note
The pressure connection is pre-installed upon delivery and must be tightened with the torque stipulated for the appropriate thread size prior to installation (see instruction manual).



Dimensions, sizes 23, 32



Ports		Standard	Size	$p_{\text{max abs}}$ [bar][2]	State[5]
A	Service line port	DIN ISO 228	G1/2; 14 deep	400	O
S	Suction port	DIN ISO 228	G3/4; 16 deep	2	O
R	Air bleed port	DIN 3852[4]	M10 x 1, 8 deep	2	X[3]

---

[1] Center bore according to DIN 332 (thread according to DIN 13)

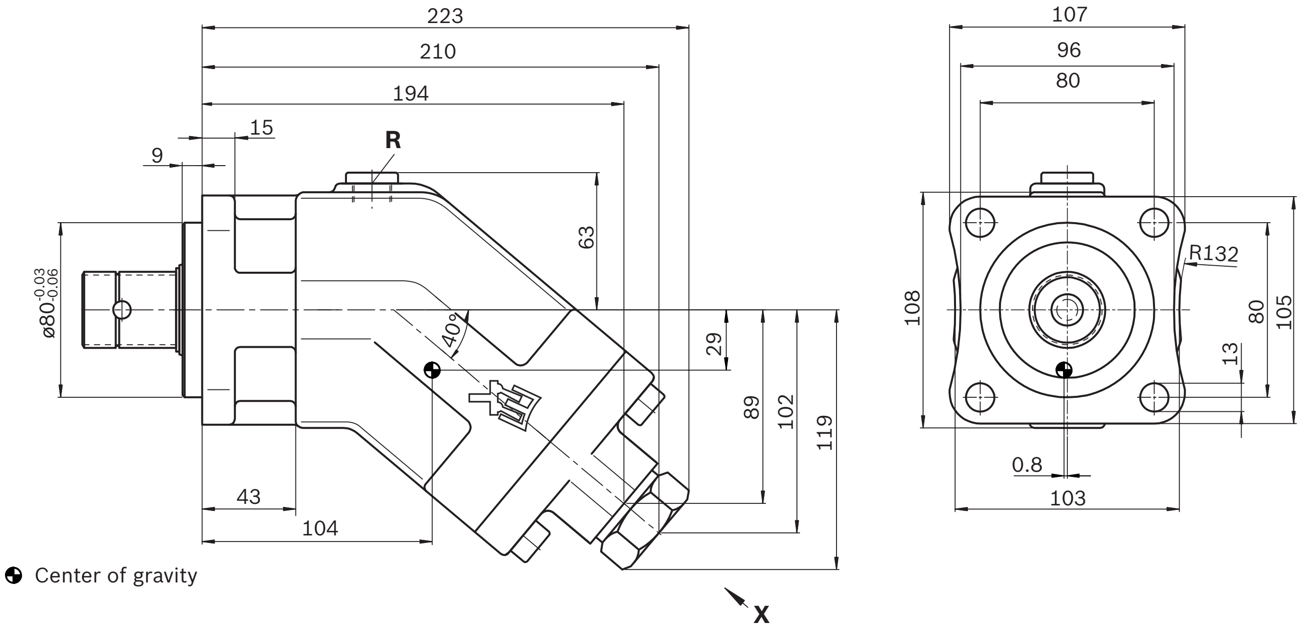
[2] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[3] Only open port **R** for filling and air bleeding.

[4] The spot face can be deeper than as specified in the appropriate standard.

[5] O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

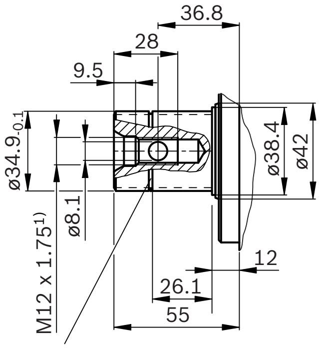
Dimensions, size 45



Drive shaft

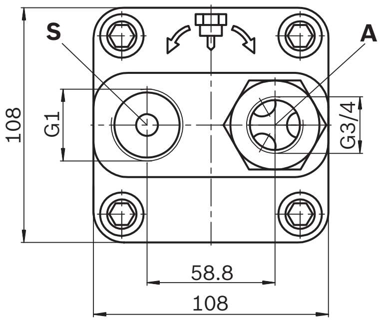
Splined shaft similar to DIN ISO 14

E8 – 8x32x35



Groove for retaining ring 35 × 1.5 DIN 471

Detail **X**



Ports		Standard	Size	$p_{\text{max abs}}$ [bar][2]	State[5]
A	Service line port	DIN ISO 228	G3/4; 16 deep	400	O
S	Suction port	DIN ISO 228	G1; 18 deep	2	O
R	Air bleed port	DIN 3852[4]	M10 x 1, 8 deep	2	X[3]

---

1) Center bore according to DIN 332 (thread according to DIN 13)

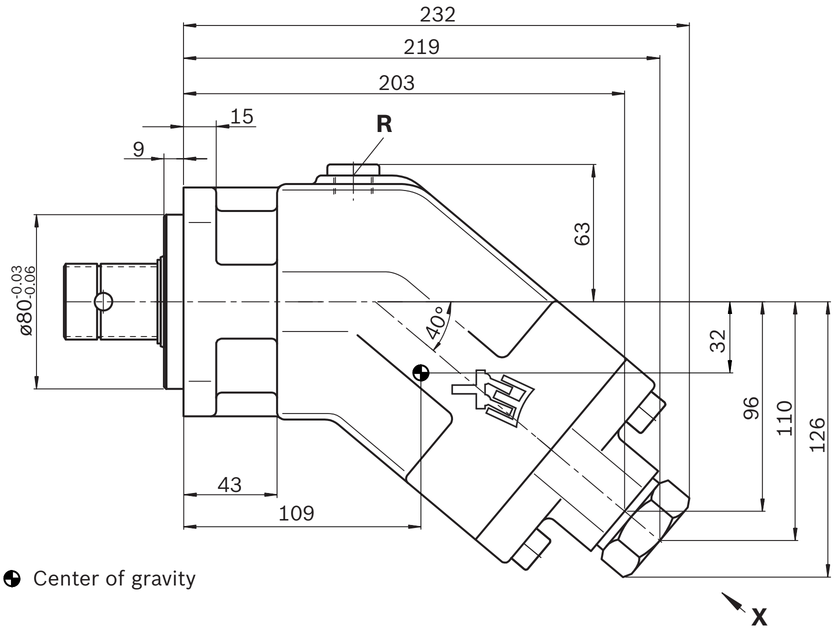
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

3) Only open port **R** for filling and air bleeding.

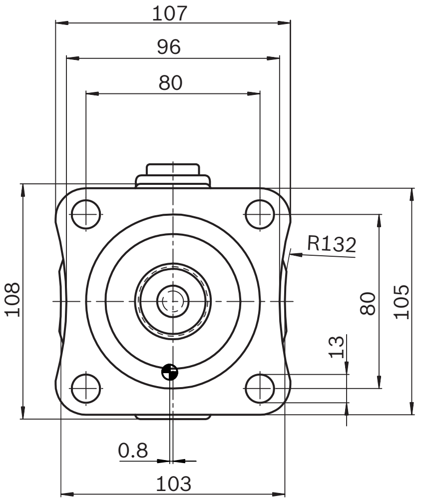
4) The spot face can be deeper than as specified in the appropriate standard.

5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions, size 63



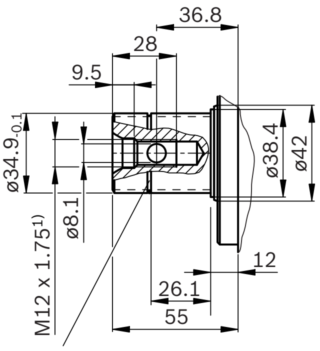
● Center of gravity



Drive shaft

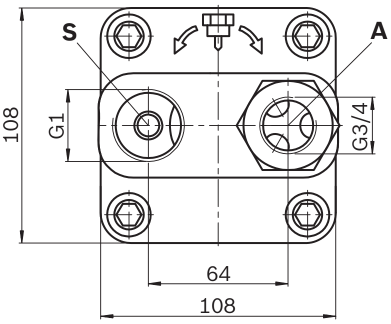
Splined shaft similar to DIN ISO 14

E8 – 8x32x35



Groove for retaining ring 35 × 1.5 DIN 471

Detail **X**



Ports		Standard	Size	$p_{\text{max abs}}$ [bar][2]	State[5]
A	Service line port	DIN ISO 228	G3/4; 16 deep	400	O
S	Suction port	DIN ISO 228	G1; 18 deep	2	O
R	Air bleed port	DIN 3852[4]	M10 x 1, 8 deep	2	X[3]

---

[1] Center bore according to DIN 332 (thread according to DIN 13)

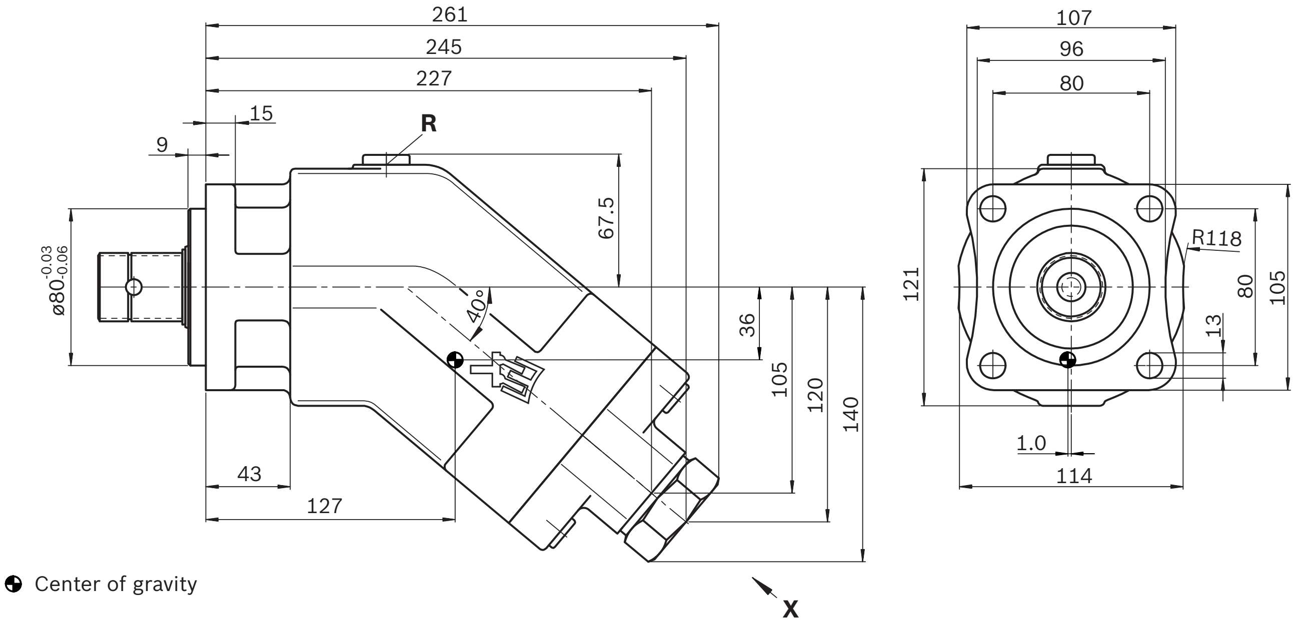
[2] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[3] Only open port **R** for filling and air bleeding.

[4] The spot face can be deeper than as specified in the appropriate standard.

[5] O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

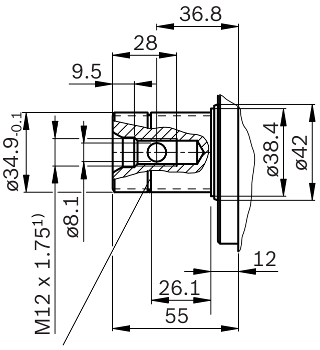
Dimensions, size 80



Drive shaft

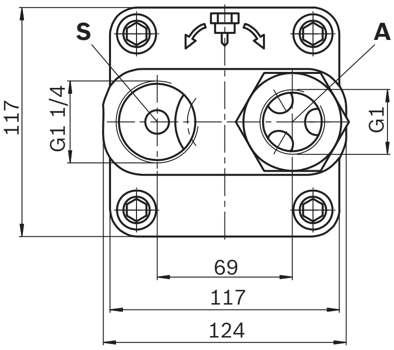
Splined shaft similar to DIN ISO 14

E8 – 8x32x35



Groove for retaining ring 35 × 1.5 DIN 471

Detail **X**



Ports		Standard	Size	$p_{\text{max abs}}$ [bar][2]	State[5]
A	Service line port	DIN ISO 228	G1; 18 deep	400	O
S	Suction port	DIN ISO 228	G1 1/4; 20 deep	2	O
R	Air bleed port	DIN 3852[4]	M10 x 1, 8 deep	2	X[3]

---

1) Center bore according to DIN 332 (thread according to DIN 13)

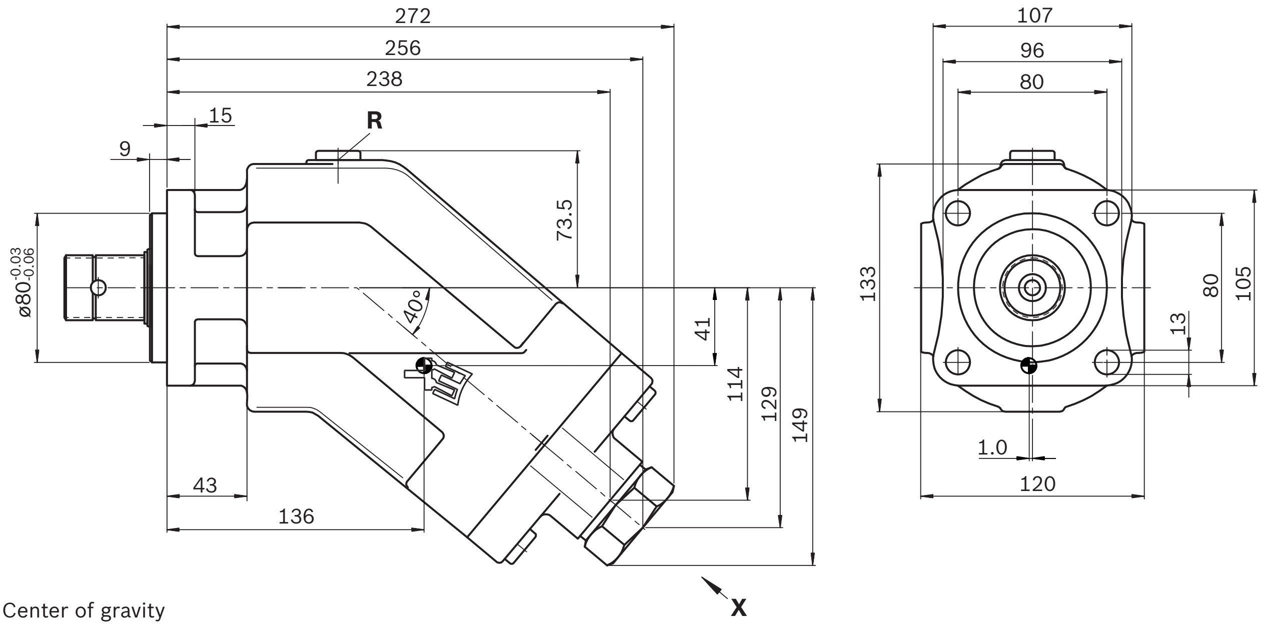
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

3) Only open port **R** for filling and air bleeding.

4) The spot face can be deeper than as specified in the appropriate standard.

5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions, size 107

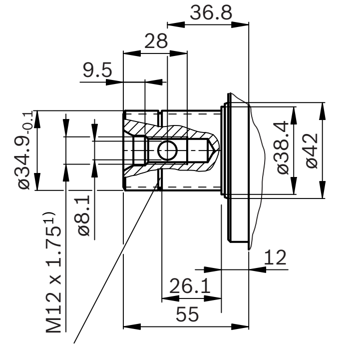


● Center of gravity

Drive shaft

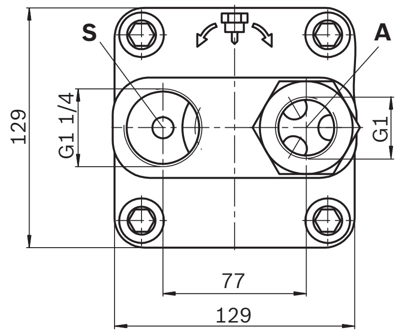
Splined shaft similar to DIN ISO 14

E8 – 8x32x35



Groove for retaining ring 35 × 1.5 DIN 471

Detail **X**



Ports		Standard	Size	$p_{\text{max abs}}$ [bar][2]	State[5]
A	Service line port	DIN ISO 228	G1; 18 deep	400	O
S	Suction port	DIN ISO 228	G1 1/4; 20 deep	2	O
R	Air bleed port	DIN 3852[4]	M10 x 1, 8 deep	2	X[3]

---

1) Center bore according to DIN 332 (thread according to DIN 13)

2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

3) Only open port **R** for filling and air bleeding.

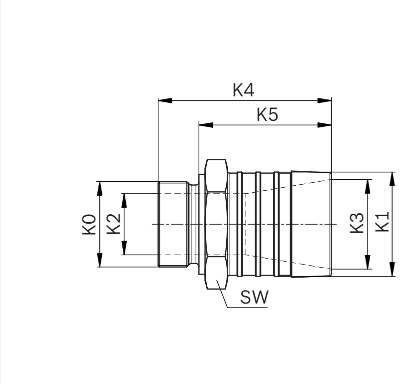
4) The spot face can be deeper than as specified in the appropriate standard.

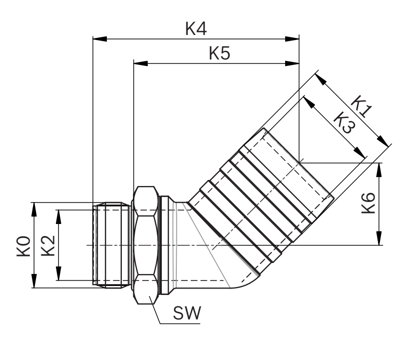
5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

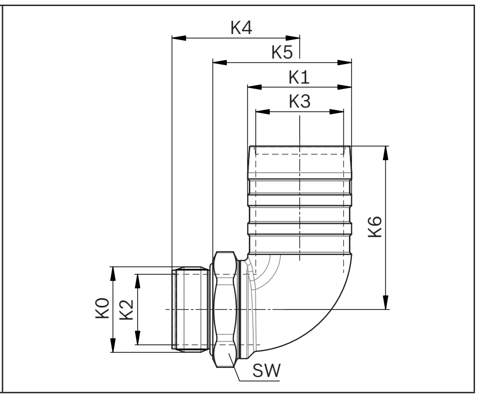
Accessories

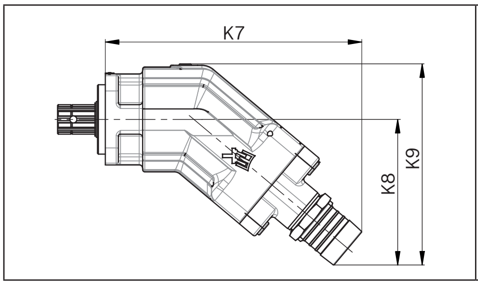
Suction stud

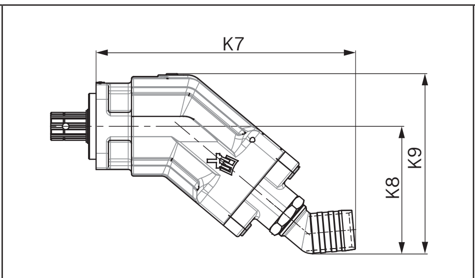
▼ Dimensions

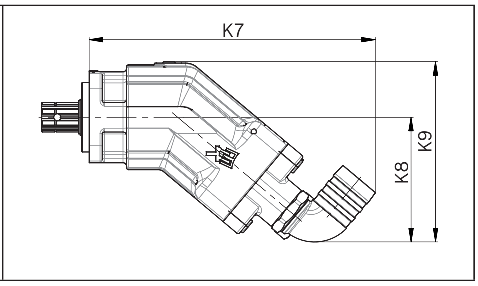












Version	Pump size	Hose nominal width	Material number	Thread K0	K1	K2	K3	K4	K5	K6	K7	K8	K9	SW
Straight	23, 32	1 1/2"	R909831856	G3/4	39	18	33.5	70	54	–	221	132	186	41
	45	1 1/2"	R902600251	G1	39	23.5	33.5	72	54	–	248	139	197	41
	63	1 1/2"		G1	39	23.5	33.5	72	54	–	257	146	204	41
	63	2"	R902602028	G1	51	26	44	82	64	–	268	157	215	55
	80	2"	R902600252	G1 1/4	51	30	44	85	65	–	295	168	232	55
	107	2"		G1 1/4	51	30	44	85	65	–	306	177	245	55
	107	2 1/2"	R902601630	G1 1/4	63	31	54	82	64	–	308	180	248	65
45°	23, 32	1 1/2"	R909831601	G3/4	39	20	31	101	82	43	259	126	180	36
	45	1 1/2"	R909831600	G1	39	26	31	101	82	45	287	132	190	41
	63	1 1/2"		G1	39	26	31	101	82	45	296	139	197	41
	63	2"	R902602029	G1	51	26	43	100	81	44	295	145	203	41
	80	2"	R909831597	G1 1/4	51	34	43	101	81	40	317	156	220	50
	107	2"		G1 1/4	51	34	43	101	81	40	328	165	234	50
	107	2 1/2"	R902601631	G1 1/4	63	35	54	100	81	44	331	169	237	50
90°	23, 32	1 1/2"	R909831602	G3/4	39	20	31	62	43	81	265	117	171	36
	45	1 1/2"	R909831599	G1	39	26	31	64	44	85	296	127	185	41
	63	1 1/2"		G1	39	26	31	64	44	85	305	134	192	41
	63	2"	R902602030	G1	51	26	43	62	42	81	305	138	196	41
	80	2"	R909831598	G1 1/4	51	35	43	63	43	80	330	144	208	50
	107	2"		G1 1/4	51	35	43	63	43	80	341	153	221	50

The suction stud is not included in the scope of delivery and must be ordered separately.

Notes on suction line

- Keep as short and straight as possible, without sharp bend
- Use a supporting ring for plastic hoses
- Use two hose clamps to protect the suction hose against air suction
- Note pressure resistance of suction hose compared to ambient pressure

Replacing seals

The O-rings used as seals to prevent air from entering the suction line are to be replaced after every removal and new installation in order to guarantee complete sealing.

Material number for O-rings:

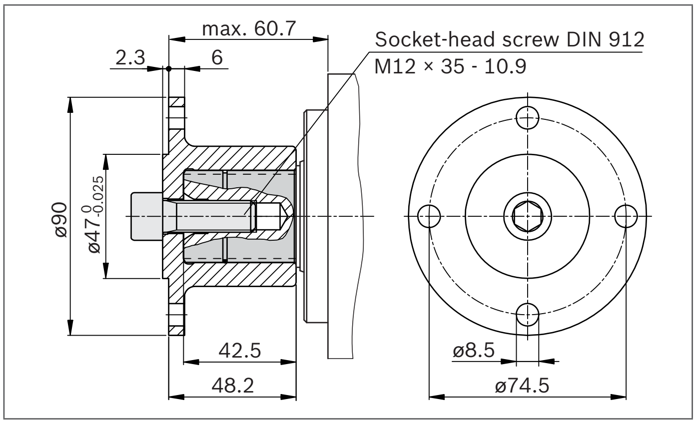
- R909083796: O-ring for suction stud G3/4
- R909083802: O-ring for suction stud G1
- R909083808: O-ring for suction stud G1 1/4

Coupling flange

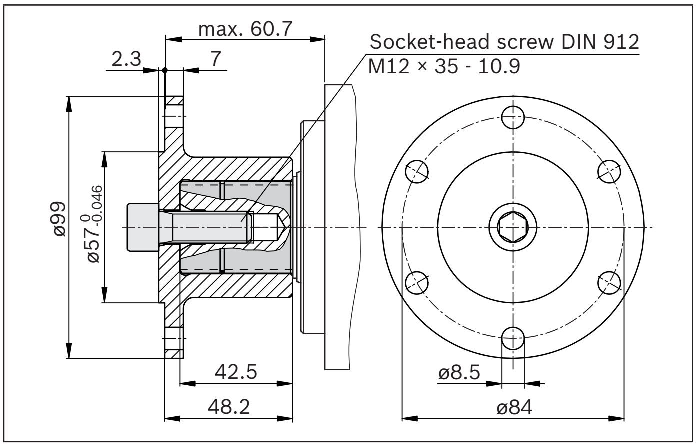
There are special, modified coupling flanges in 4-hole and 6-hole design for the cardan shaft drive.

The coupling flange is not included in the scope of delivery and must be ordered separately.

▼ **4-hole coupling flange, complete – ø 90**
Material number: R902060152



▼ **6-hole coupling flange, complete – ø 100**
Material number: R902060153



Note

- Assembly of the coupling flange is carried out by pulling onto the drive shaft with the aid of the threaded bore in the drive shaft end.
- The coupling flange must be clamped on the drive shaft using a socket-head screw. In addition, permanent lubrication should be applied between the drive shaft and the coupling flange.
- The socket-head screw should be secured in a suitable manner (e.g. gluing with Loctite 276) and tightened with a tightening torque of 130 Nm.
- Sudden axial impact upon the drive shaft will lead to rotary group damage and therefore must be avoided.

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a long standstill as the axial piston unit can empty via the hydraulic lines.

The pump housing is internally connected to the suction chamber. A separate drain line from the housing to the reservoir is not needed.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction line must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\,max}$ = 800 mm. The minimum suction pressure at port **S** must also not fall below 0.8 bar absolute during operation and during cold start.

Installation position

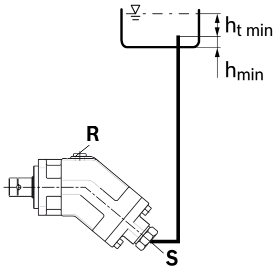
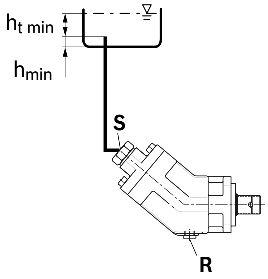
See the following examples **1** to **4**.

Further installation positions are available upon request.

Recommended installation position: **1** and **2**.

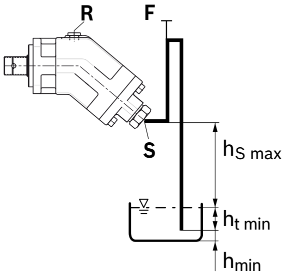
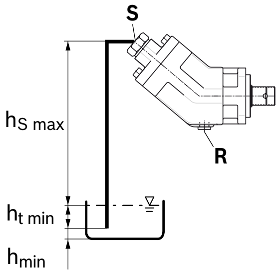
Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.

Installation position		Air bleed	Filling
1		R	S
2		–	S

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. Observe the maximum permissible suction height $h_{S\,max}$ = 800 mm.

Installation position		Air bleed	Filling
3		R	F
4		S	S

Key	
F	Filling/air bleed
R	Air bleed port
S	Suction port
$h_{t\,min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)
$h_{S\,max}$	Maximum permissible suction height (800 mm)

Note

Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

Other related documents

Other pumps with special characteristics and dimensions for use in commercial vehicles can be found in the following data sheets:

- ▶ 91510: Fixed pump A17FNO, 250/300 bar
- ▶ 92270: Variable pump, A18VO 350/400 bar
- ▶ 92280: Variable pump, A18VLO 350/400 bar

Project planning notes

- The A17FO pump is designed to be used in open circuits.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes must be observed.
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Preservation: Our axial piston units are supplied as standard with protection to preserve for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. MTTF_d) for functional safety.
- Be sure to add a pressure relief valve to the hydraulic system.
- Please note the details regarding the tightening torques of port threads and other threaded joints.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The service line ports and function ports can only be used to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).

Axial piston fixed pump
A17FNO Series 10

- Designed for use in commercial vehicles with standard pressure requirements
- Size 125
- Nominal pressure/maximum pressure 250/300 bar
- Bent-axis design
- Open circuit

Features

- Flange and shaft designed for direct mounting on the power take-off of commercial vehicles
- Weight-optimized thanks to diecast aluminum housing.
- No case drain line necessary
- Reduced noise
- Straightforward adjustment of direction of drive
- Excellent suction performance
- High total efficiency
- Long service life

Contents

Ordering code

01	02	03		04	05	06	07	08	09	10		11
A17FN	**O**		**/**	**10**	**N**	**L**	**W**	**K0**	**E8**	**1**	**–**	

Axial piston unit

01	Bent-axis design, fixed, nominal pressure 250 bar, maximum pressure 300 bar, for commercial vehicles (truck)	**A17FN**

Operating mode

02	Pump, open circuit	**O**

Sizes (NG)

03	Geometric displacement, see table of values on page 5	**125**

Series

04	Series 1, index 0	**10**

Configuration of port and fastening threads

05	Metric, port threads with profiled sealing ring according to DIN 3852	**N**

Direction of rotation[1]

06	Viewed on drive shaft	counter-clockwise	**L**

Sealing material

07	FKM (fluor-caoutchouc) including the 2 shaft seal rings in FKM	**W**

Mounting flange

08	Special flange ISO 7653-1985 (for trucks)	**K0**

Drive shaft

09	Splined shaft similar to DIN ISO 14 (for trucks)	**E8**

Service line port

10	Threaded ports **A** and **S** at rear	**1**

Standard / special version

11	Standard version	**0**
	Special version	**S**

Note
Note the project planning notes on page 12.

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[1] Changing the direction of rotation see instruction manual 91520-01-B, chapter 6.4.2

Hydraulic fluid

The A17FNO fixed pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)

The axial piston unit is not suitable for operation with water-containing HF hydraulic fluid.

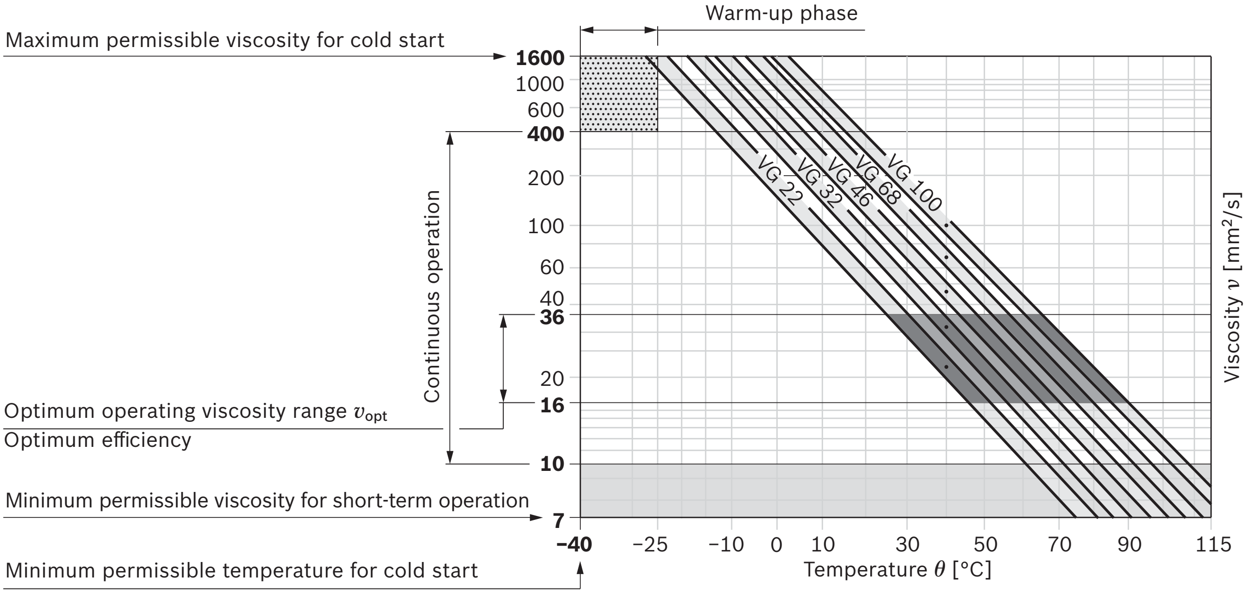
Notes on selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see selection diagram).

Note
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
Please contact us if the above conditions cannot be met due to extreme operating parameters.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \le 1600$ mm²/s	$\theta_{St} \ge -25°C$[1]	$t \le 3$ min, without load ($p \le 50$ bar), $n \le 1000$ rpm
Permissible temperature difference		$\Delta T \le 25$ K	between axial piston unit and hydraulic fluid in the system
Warm-up phase	$\nu < 1600$ to 400 mm²/s		at $p \le 0.7 \times p_{nom}$, $n \le 0.5 \times n_{nom}$ and $t \le 15$ min
Continuous operation	$\nu = 400$ to 10 mm²/s		this corresponds, for VG 46 for example, to a temperature range of +5 °C to +85 °C (see selection diagram)
		θ = -25 °C to +103 °C	measured at air bleed port **R** observe permissible temperature range of the shaft seal ring[1] (ΔT = approx. 12 K between bearing/shaft seal and port **R**)
	ν_{opt} = 36 to 16 mm²/s		range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \ge 7$ mm²/s		$t < 3$ min, $p < 0.3 \times p_{nom}$

▼ **Selection diagram**



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[1] The FKM shaft seal is permissible for temperatures of −25 °C to +115 °C, please contact us for temperatures below −25 °C.

Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

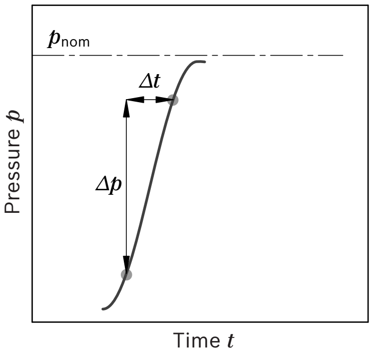
A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.

At very high hydraulic fluid temperatures (90 °C to maximum 103 °C, measured at air bleed port **R**), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

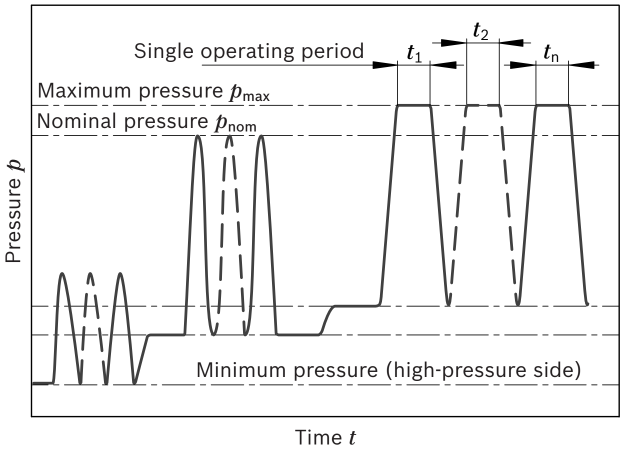
Operating pressure range

Pressure at service line port A (high-pressure side)		**Definition**
Nominal pressure p_{nom}	250 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure $p_{\max}$	300 bar absolute	The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	5 s	
Total operating period	50 h	
Minimum pressure (high-pressure side)	10 bar absolute	Minimum pressure at the high-pressure side (**A**) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{\text{A max}}$	9000 bar/s	Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{\text{S min}}$	0.8 bar absolute	Minimum pressure at suction port **S** (inlet) which is required in order to prevent damage to the axial piston unit. The minimum pressure is dependent on the speed of the axial piston unit.
Maximum pressure $p_{\text{S max}}$	2 bar absolute	

▼ **Rate of pressure change $R_{\text{A max}}$**



▼ **Pressure definition**



Total operating period = $t_1 + t_2 + \ldots + t_n$

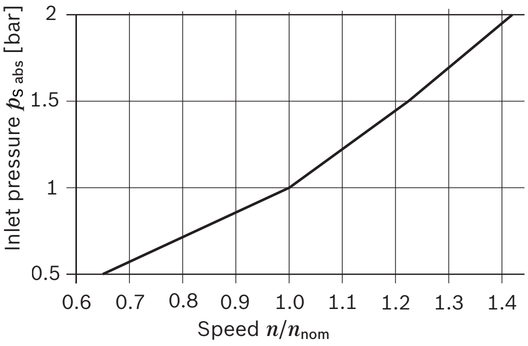
Note

Operating pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical Data

Size		**NG**		**125**
Displacement, geometric, per revolution		V_g	cm³	125
Speed maximum[1)]		n_{nom}[2)]	rpm	1750
		n_{max}[3)]	rpm	2500
Flow	at n_{nom}	q_v	l/min	219
Power	at n_{nom} and Δp = 350 bar	P	kW	91
Torque	at Δp = 350 bar	T	Nm	497
Rotary stiffness		c	kNm/rad	11.9
Moment of inertia for rotary group		J_{TW}	kgm²	0.0016
Maximum angular acceleration		α	rad/s²	4500
Case volume		V	l	0.83
Mass moment		T_G	Nm	20
Mass (approx.)		m	kg	15.0

▼ **Maximum speed (limiting speed)**



Determining the operating characteristics

Flow	q_v	=	$\dfrac{V_g \times n \times \eta_v}{1000}$			[l/min]
Torque	T	=	$\dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$			[Nm]
Power	P	=	$\dfrac{2\,\pi \times T \times n}{60000}$	=	$\dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g	Displacement per revolution [cm³]
Δp	Differential pressure [bar]
n	Speed [rpm]
η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

Note

- ▶ Theoretical values, without efficiency and tolerances; values rounded.
- ▶ Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, such as speed variation, reduced angular acceleration as a function of the frequency and the permissible angular acceleration at start (lower than the maximum angular acceleration) can be found in data sheet 90261.

---

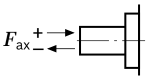
1) The values are applicable:
   – for the optimum viscosity range from ν_{opt} = 36 bis 16 mm²/s
   – for hydraulic fluids based on mineral oils.

2) The values apply at absolute pressure p_{abs} = 1 bar at suction port **S**

3) Maximum speed (speed limit) with increased inlet pressure p_{abs} at suction port **S** (see diagram).

Operating pressure range

Permissible axial forces of the drive shaft

Size		NG		125
Maximum axial force, at standstill or pressure-free operation		+ $F_{ax\ max}$	N	0
		− $F_{ax\ max}$	N	77

Note

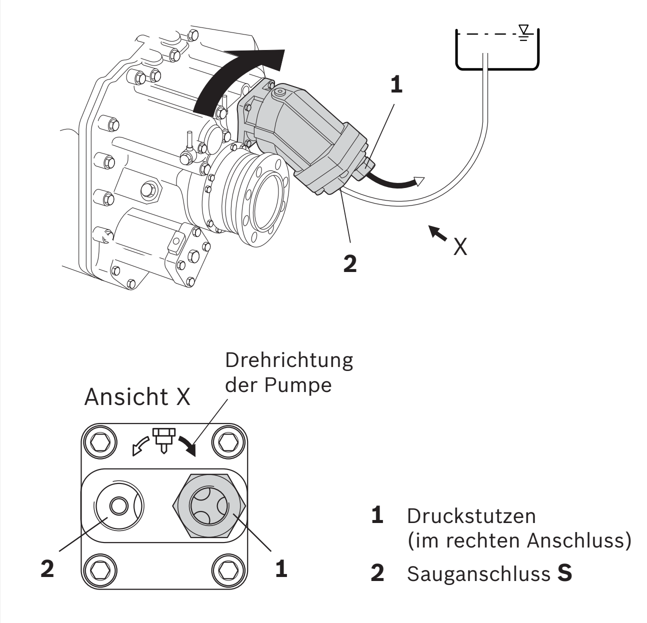
- The values given are maximum values and do not apply to continuous operation.
- The permissible axial force in direction $-F_{ax}$ is to be avoided as the lifetime of the bearing is reduced.
- Radial forces are not permissible.

Direction of rotation

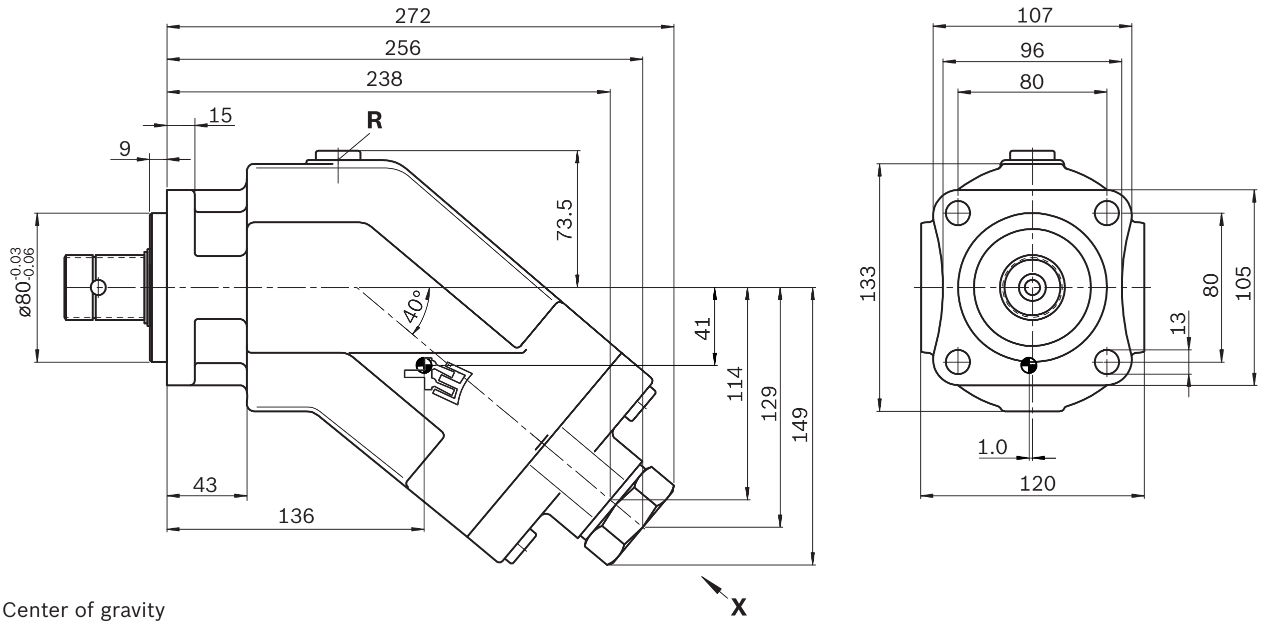
The direction of rotation of the axial piston unit is defined by means of a pressure connection screwed into the service line port and can easily be changed.
By changing the pressure connection, the service line port and the suction port are exchanged. As a result, the permissible drive direction is changed. This is necessary when mounting on a power take-off with counter-clockwise rotation, for example. The procedure for conversion of the pressure nipple can be found in the instruction manual (91520-01-B, chapter 6.4.2 “Direction of rotation and change of direction of rotation”).

Direction of rotation on delivery
On delivery, the pressure connection (**1**) is pre-assembled in the right-hand service line port of the axial piston unit. The permissible drive direction of the pump looking at the drive shaft: counter-clockwise. The power take-off turns clockwise.

Note
The pressure connection is pre-installed upon delivery and must be tightened with the torque stipulated for the appropriate thread size prior to installation (see instruction manual).



Dimensions, size 125

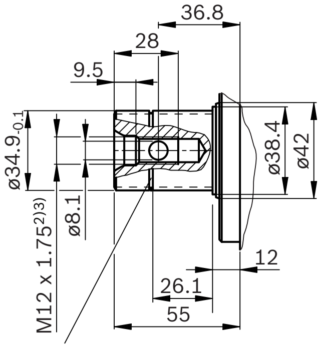


● Center of gravity

Drive shaft

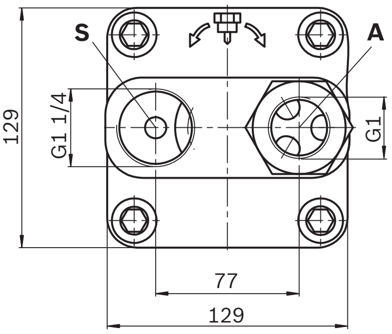
Splined shaft similar to DIN ISO 14

E8 – 8x32x35



Groove for retaining ring 35 × 1.5 DIN 471

Detail **X**



Ports		**Standard**	**Size**	$p_{\text{max abs}}$ **[bar]**[2]	**State**[5]
A	Service line port	DIN ISO 228	G1; 18 deep	300	O
S	Suction port	DIN ISO 228	G1 1/4; 20 deep	2	O
R	Air bleed port	DIN 3852[4]	M10 × 1; 8 deep	2	X[3]

---

1) Center bore according to DIN 332 (thread according to DIN 13)

2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

3) Only open port **R** for filling and air bleeding.

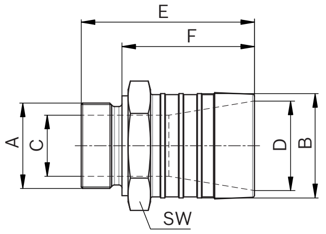
4) The spot face can be deeper than as specified in the appropriate standard.

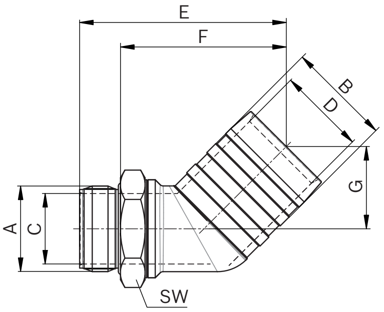
5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

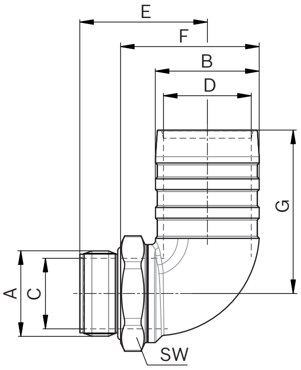
Accessories

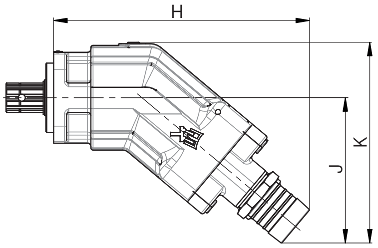
Suction stud

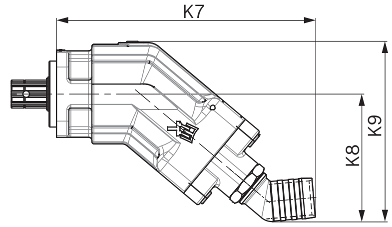
▼ **Dimensions**

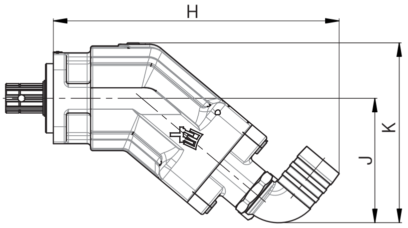












Version	Pump size	Hose nominal width	Material number	Thread K0	K1	K2	K3	K4	K5	K6	K7	K8	K9	SW
Straight	125	2"	R902600252	G1 1/4	51	30	44	85	65	–	306	177	245	55
		2 1/2"	R902601630	G1 1/4	63	31	54	82	64	–	308	180	248	65
45°	125	2"	R909831597	G1 1/4	51	34	43	101	81	40	328	165	234	50
		2 1/2"	R902601631	G1 1/4	63	35	54	100	81	44	331	169	237	50
90°	125	2"	R909831598	G1 1/4	51	35	43	63	43	80	341	153	221	50

The suction stud is not included in the scope of delivery and must be ordered separately.

Notes on suction line

- Keep as short and straight as possible, without sharp bend
- Use a supporting ring for plastic hoses
- Use two hose clamps to protect the suction hose against air suction
- Note pressure resistance of suction hose compared to ambient pressure

Replacing seals

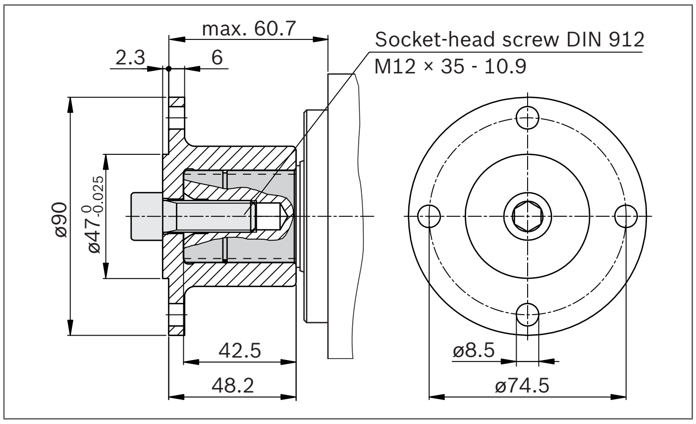
The O-rings used as seals to prevent air from entering the suction line are to be replaced after every removal and new installation in order to guarantee complete sealing.
Material number for O-rings:

- R909083808: O-ring for suction stud G1 1/4

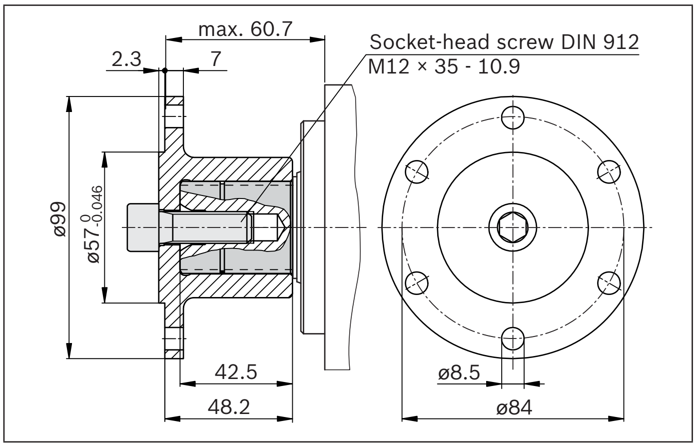
Coupling flange

There are special, modified coupling flanges in 4-hole and 6-hole design for the cardan shaft drive.
The coupling flange is not included in the scope of delivery and must be ordered separately.

▼ **4-hole coupling flange, complete – ø 90**
Material number: R902060152



▼ **6-hole coupling flange, complete – ø 100**
Material number: R902060153



Note

- Assembly of the coupling flange is carried out by pulling onto the drive shaft with the aid of the threaded bore in the drive shaft end.
- The coupling flange must be clamped on the drive shaft using a socket-head screw. In addition, permanent lubrication should be applied between the drive shaft and the coupling flange.
- The socket-head screw should be secured in a suitable manner (e.g. gluing with Loctite 276) and tightened with a tightening torque of 130 Nm.
- Sudden axial impact upon the drive shaft will lead to rotary group damage and therefore must be avoided.

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a long standstill as the axial piston unit can empty via the hydraulic lines.

The pump housing is internally connected to the suction chamber. A separate drain line from the housing to the reservoir is not needed.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction line must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\ max}$ = 800 mm.

The minimum suction pressure at port **S** must not fall below 0.8 bar absolute during operation and during cold start.

Installation position

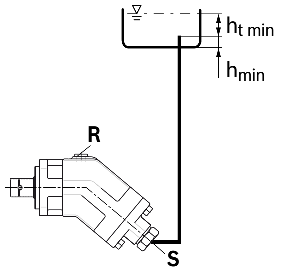
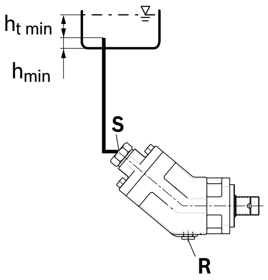
See the following examples **1** to **4**.

Further installation positions are available upon request.

Recommended installation position: **1** and **2**.

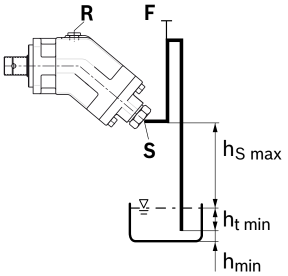
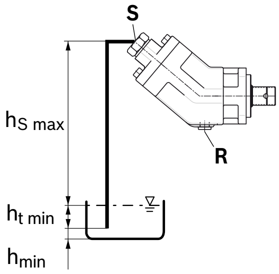
Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.

Installation position	Air bleed	Filling
1 	**R**	**S**
2 	–	**S**

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.

Installation position	Air bleed	Filling
3 	**R**	**F**
4 	**S**	**S**

Key	
F	Filling/air bleed
R	Air bleed port
S	Suction port
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)

Note

Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

Other related documents

Other pumps with special characteristics and dimensions for use in commercial vehicles can be found in the following data sheets:

- 91520: Fixed pump A17FO, 350/400 bar
- 92270: Variable pump, A18VO 350/400 bar
- 92280: Variable pump, A18VLO 350/400 bar

Project planning notes

- The A17FNO pump is designed to be used in open circuits.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes must be observed.
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Preservation: Our axial piston units are supplied as standard with protection to preserve for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. MTTF_d) for functional safety.
- Be sure to add a pressure relief valve to the hydraulic system.
- Please note the details regarding the tightening torques of port threads and other threaded joints.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The service line ports and function ports can only be used to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).

Axial piston pumps

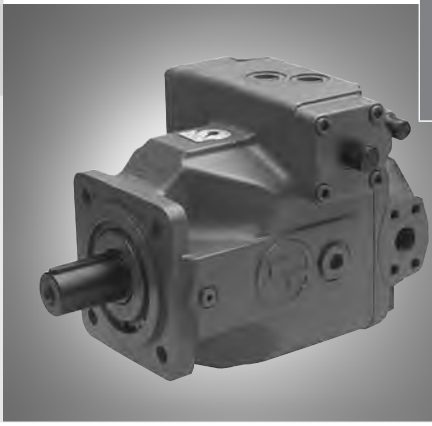
Variable pumps, open circuits

Designation	Type	Size	Series	Data sheet	Page
Variable pump	A4VSO	40...1000	10/11/30	92050	189
Variable pump	A11V(L)O	40...260	10/11	92500	257
Variable pump	A11V(L)O	110...280	40	92510	321
Variable pump	A1VO	18...35	10	92650	389
Variable pump	A10V(S)O	18...140	31	92701	413
Variable pump	A10VO	45...180	32	92705	473
Variable pump	A10VO/5	10...100	52/53	92703	529
Variable pump	A10VNO	28...85	52/53	92735	597
Variable pump A10V(S)O with electro-proportional EF differential pressure control	for A10V(S)O	18...140	3x/5x	92709	633
Variable pump	A7VO	28...160	63	92202	645
Variable pump	A7VO	250...500	63	92203	689
Variable pump	A18VO	55...107	11	92270	741
Variable pump	A18VLO	80	11	92280	765
Variable double pump	A8VO	55...200	6x	93010	781
Variable double pump	A8VO	225	72	93013	821
Variable double pump	A20VO	60...520	10	93100	837
Variable double pump	A28VO	280	10	93110	853

Axial piston variable pump A4VSO

Data sheet

Series 10, 11 and 30
Size 40...1000
Nominal pressure 350 bar
Peak pressure 400 bar
Open circuit



Contents

Features

- Axial piston pump in swash plate design for hydrostatic drives in open circuit operation
- The flow is proportional to the input drive speed and displacement. By adjusting the swash plate angle it is possible to infinitely vary the output flow.
- Excellent suction characteristics
- Low noise level
- Long service life
- Modular design
- Short response times
- Variable through drive options
- Visual swivel angle indicator
- Optional mounting position
- Operation on HF-fluids under reduced operational data possible
  A special version is available for operation with HFC-fluid see data sheet RE 92053

For the descriptions of the control devices see the separate RE data sheets
RE 92056, RE 92060, RE 92064,
RE 92072, RE 92076, RE 92080, RE 92088

Type code for Standard program

	A4VS		**O**			**/**			**–**						
01	02	03	04	05	06		07	08		09	10	11	12	13	14

	Hydraulic fluid / Version	**40**	**71**	**125**	**180**	**250**	**355**	**500**	**750**	**1000**	
01	Mineral oil and HFD-fluids (no code)	●	●	●	●	●	●	●	●	●	
	HFA-, HFB- and HFC-Fluids	●	●	–	–	–	–	●	–	–	**E**
	For operation on HFC-special performance version see RE 92053 (HFA and HFB see RE 90223)			●	●	●	●				
	High-Speed-Version	–	–	–	–	●	●	●	–	–	**H**

	Axial piston unit	
02	Swash plate design, variable	**A4VS**

	Boost pump (Impeller)										
03	without boost pump (no coden)	●	●	●	●	●	●	●	●	●	
	with boost pump (Impeller) only with port plate 25 (service port connections)	–	–	–	–	–	–	–	●	–	**L**

	Type of operation	
04	Pump, open circuit	**O**

	Size	**40**	**71**	**125**	**180**	**250**	**355**	**500**	**750**	**1000**
05	Displacement $V_{g\,max}$ [cm^3]	40	71	125	180	250	355	500	750	1000

	Control devices													
06	Pressure control	(RE 92060)	DR	●	●	●	●	●	●	●	●	●	**DR..**
	Pressure control for parallel operation		DP	●	●	●	●	●	●	●	●	●	**DP..**
	Flow control		FR	●	●	●	●	●	●	–	–	–	**FR..**
	Pressure and flow control		DFR	●	●	●	●	●	●	–	–	–	**DFR..**
	Power control with hyperbolic curve	(RE 92064)	LR	●	●	●	●	●	●	●	●	●	**LR..1)**
	Manual control	(RE 92072)	MA	●	●	●	●	●	●	●	–	–	**MA..**
	Electric motor control		EM	●	●	●	●	●	●	●	–	–	**EM..**
	Hydraulic control, control volume dependent	(RE 92076)	HM	●	●	●	●	●	●	●	●	●	**HM..**
	Hydr. control, with servo/proportional valve		HS	●	●	●	●	●	●	●	●	●	**HS..1)**
	Electronic control		EO	●	●	●	●	●	●	●	●	●	**EO..1)**
	Hydraulic control, pilot pressure dependent	(RE 92080)	HD	●2)	●2)	●	●	●	●	●	●	●	**HD..1)**
	Secundary speed control	(RE 92056)	DS1	●	●	●	●	●	●	●	●	○	**DS1..1)**
	Electro-hydraulic control system DFE1 System solution SYHDFEE	(RE 92088) (RE 30035)		●	●	●	●	●	●	–	–	–	**DFE1..1)**

	Series										
07		●	●	–	–	–	–	–	–	–	**10(11)2)**
		–	–	●	●	●	●	●	●	●	**30**

● available ○ in preparation – not available ▨ = preferred program

1) when operating on HF-fluids, observe the limitations as shown in the relevant data sheets of the control devices and the mounted valves

2) Versions with HD-controls only in series 11

Type code for Standard program

	A4VS		O			/			–						
01	02	03	04	05	06		07	08		09	10	11	12	13	14

Direction of rotation

08	with view on shaft end	right hand	**R**
		left hand	**L**

Seals

		40	71	125	180	250	355	500	750	1000	
09	NBR (Nitrile-rubber), Shaft seal FKM (Fluoro-rubber)	●	●	●	●	●	●	●	●	●	**P**
	FKM (Fluoro-rubber) / for operation on HFD	●	●	●	●	●	●	●	●	●	**V**
	HFC-special performance version see RE 92053	–	–	●	●	●	●	–	–	–	**F**

Shaft end

10	Keyed parallel shaft to DIN 6885	**P**
	Splined shaft to DIN 5480	**Z**

Mounting flange

			40	71	125	180	250	355	500	750	1000	
11	similar to ISO 3019-2 metric	4-hole	●	●	●	●	●	●	–	–	–	**B**
		8-hole	–	–	–	–	–	–	●	●	●	**H**

Service line connections

		40	71	125	180	250	355	500	750	1000	
12	Port B and S: SAE flange on side, 90° offset, metric fixing screws	●	●	●	●	●	●	–	–	–	**13** [1]
	Port B and S: SAE flange on side, 90° offset, metric fixing screws 2. pressure port B_1, opposite B – closed with blanking plate on delivery	●	●	●	●	●	●	●	●	●	**25**

● available ○ in preparation ▨ = preferred program

---

[1] only with through drive code N00 and K..

continuation of type code see page 4

Type code for Standard program

	A4VS		O			/			–						
01	02	03	04	05	06		07	08		09	10	11	12	13	14

	Through drive			40	71	125	180	250	355	500	750	1000	
13	without auxiliary pump, without through drive			●	●	●	●	●	●	●	●	●	**N00**
	with through drive for mounting an axial piston unit, gear or radial piston pump			●	●	–	–	–	–	●	●	●	**K...**
	Universal through drive, can be adapted			–	–	●	●	●	●	–	–	–	**U...**
	Flange	splined shaft coupler [1])	to mount										
	125, 4-hole (ISO[2]))	32x2x14x9g	A4VSO/G 40	●	●	●	●	●	●	●	○	○	**31**
	140, 4-hole (ISO[2]))	40x2x18x9g	A4VSO/G 71	–	●	●	●	●	●	●	●	○	**33**
	160, 4-hole (ISO[2]))	50x2x24x9g	A4VSO/G 125	–	–	●	●	●	●	●	●	○	**34**
	160, 4-hole (ISO[2]))	50x2x24x9g	A4VSO/G 180	–	–	–	●	●	●	●	●	○	**34**
	224, 4-hole (ISO[2]))	60x2x28x9g	A4VSO/G, A4CSG 250	–	–	–	–	●	●	●	●	○	**35**
	224, 4-hole (ISO[2]))	70x3x22x9g	A4VSO/G, A4CSG 355	–	–	–	–	–	●	●	○	○	**77**
	315, 8-hole (ISO[2]))	80x3x25x9g	A4VSO/G, A4CSG 500	–	–	–	–	–	–	●	●	○	**43**
	400, 8-hole (ISO[2]))	90x3x28x9g	A4VSO/G, A4CSG 750	–	–	–	–	–	–	–	●	○	**76**
	400, 8-hole (ISO[2]))	100x3x32x9g	A4VSO/G 1000	–	–	–	–	–	–	–	–	●	**88**
	80, 2-hole (ISO[2]))	3/4in 19-4 (SAE A-B)	A10VSO 10/52, 18/31	○	●	○	○	○	○	○	○	○	**B2**
	100, 2-hole (ISO[2]))	7/8in 22-4 (SAE B)	A10VSO 28/31	●	●	●	●	○	○	○	○	○	**B3**
	100, 2-hole (ISO[2]))	1in 25-4 (SAE B-B)	A10VSO 45/31	●	●	●	●	●	●	●	○	○	**B4**
	125, 2-hole (ISO[2]))	1 1/4in 32-4 (SAE C)	A10VSO 71/31	–	●	●	●	●	●	○	○	○	**B5**
	160, 4-hole (ISO[2]))	1 1/4in 32-4 (SAE C)	A10VSO 71/32	–	○	○	○	●	○	○	○	○	**B8**
	125, 2-hole (ISO[2]))	1 1/2in 38-4(SAE C-C)	A10VSO 100/31	–	–	○	○	○	○	○	○	○	**B6**
	180, 4-hole (ISO[2]))	1 1/2in 38-4 (SAE C-C)	A10VSO 100/32	–	–	○	○	○	○	○	○	○	**B9**
	180, 4-hole (ISO[2]))	1 3/4in 44-4 (SAE D)	A10VSO 140/31/32	–	–	–	●	●	●	●	○	○	**B7**
	82-2 (SAE A)	5/8in 16-4 (SAE A)	AZ-PF-1X-004...022	●	●	●	●	●	●	●	●	○	**01**
	82-2 (SAE A)	3/4in 19-4 (SAE A-B)	A10VSO 10, 18/31/52(3)	●	●	○	○	○	○	○	○	○	**52**
	101-2 (SAE B)	7/8in 22-4 (SAE B)	AZ-PN-1X-020...032, A10VO 28/31/52(3)	●	●	●	●	●	●	●	○	○	**68**
	101-2 (SAE B)	1in 25-4 (SAE B-B)	PGH4, A10VO45/31	●	●	●	●	●	●	●	○	○	**04**
	127-2 (SAE C)	1 1/4in 32-4 (SAE C)	A10VO 71/31	–	●	●	●	●	●	●	○	○	**07**
	127-2 (SAE C)	1 1/2in 38-4 (SAE C-C)	PGH5, A10VO100/31	–	–	●	●	●	●	●	○	○	**24**
	152-4 (SAE D)	1 3/4in 44-4 (SAE D)	A10VO 140/31	–	–	–	●	●	●	●	○	○	**17**
	Ø 63, metr.4-hole	for keyed shaft Ø 25	R4	●	●	○	○	○	○	○	○	○	**57**
	with through drive shaft, without coupler, without adapter flange, closed with cover plate			●	●	●	●	●	●	●	●	●	**99**

	Filtration (only with HS- and DS-control)	
14	without filter	**N**
	Sandwich plate filter (with HS- and DS-control see RE 92076 and RE 92056)	**Z**

[1]) Keyed shaft coupler on K/U 57 through drive

[2]) to ISO 3019-2 metric

Combination pumps

1. Combination pumps consisting of axial piston units – ordering example see page 38; overview mounting options see page 39
2. if delivery with mounted gear or radial piston pump is desired, please consult us.

● available ○ in preparation – not available ▨ = preferred program

Technical data

Hydraulic fluid

For extensive information on the selection of hydraulic fluids and application conditions please consult our data sheets RE 90220 (mineral oils), RE 90221 (ecologically acceptable fluids) and RE 90223 (HF-fluids).

The variable pump A4VSO is suitable for operation on HF-fluids.
(HFA, HFB, and HFC: ***E***A4VSO or A4VSO....***F***
HFD: standard version A4VSO with FKM seals)

However, limitations to the technical data, according to RE 90223 must be observed.

On certain selected HFC-fluids, pump sizes **125...355**, executed in accordance to RE 92053 can be operated with the **same pressures and speeds** as on mineral oil.

On operation with HFA and HFB-fluids, limitations of the technical data must be observed according to RE 90223.
On operation with rolling oil please consult us.

When ordering, please state the fluid to be used.

Operating viscosity range

Within the operating viscosity range between 16...100 mm²/s the units can be operated without limitations of the technical data.
In order to obtain optimum efficiency and service life, we recommend that the operating viscosity (at operating temperature) be selected in the range

ν_{opt} = opt. viscosity range 16...36 mm²/s

referred to tank temperature (open circuit).

Limit of viscosity range

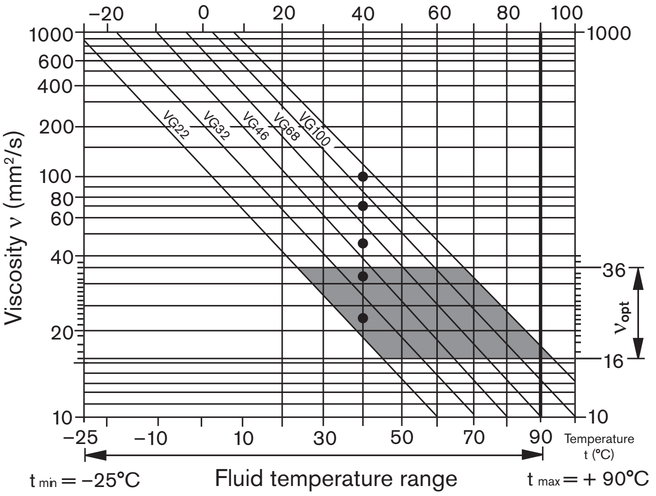
For critical operating conditions the following values apply:

ν_{min} = 10 mm²/s
for short periods ($t < 3$ min)
at max. permissible case drain temperature
$t_{max} = +90°C$.

ν_{max} = 1000 mm²/s
for short periods (on cold start, operating viscosity should be below 100 mm²/sec within 15 minutes)
$t_{min} = -25°C$

For detailed information on operation with low temperatures see RE 90300-03-B.

Selection diagram



Notes on the selection of hydraulic fluid

In order to select the correct fluid, it is necessary to know the operating temperature in the tank (open circuit) in relation to the ambient temperature.

The hydraulic fluid should be selected so that within the operating temperature range, the viscosity lies within the optimum range (ν_{opt}); see shaded section in the selection diagram. We recommend, that the higher viscosity grade is selected in each case.

Temperature range (see selection diagram)

t_{min} = − 25° C
t_{max} = + 90° C

Example: at an ambient temperature of X° C the operating temperature in the tank is 60° C. In the optimum viscosity range (ν_{opt} ; shaded area), this corresponds to grades VG 46 or VG 68; select: VG 68.
Important: The case drain temperature is influenced by pressure and speed and is always higher than the tank temperature. However the max. temperature at any point in the system may not exceed 90° C.

Technical data

Bearing flushing

For the following operating conditions bearing flushing is required for a safe, continuous operation:

- Applications with special fluids (non mineral oils) due to limited lubricity and narrow operating temperature range
- Operation at critical conditions of temperature and viscosity with mineral oil

Flushing is recommended with vertical mounting (drive shaft facing upwards) in order to ensure lubrication of the front bearing and shaft seal.

Flushing is carried out via port „U“, located in the front flange area of the pump. The flushing fluid flows through the front bearing and leaves the pump together with the case drain flow.

Depending on pump size, the following flushing flows are recommended:

Size			40	71	125	180	250
recommended flushing flow	q_{Sp}	L/min	3	4	5	7	10

Size			355	500	750	1000
recommended flushing flow	q_{Sp}	L/min	15	20	30	40

These recommended flushing flows will cause a pressure drop of approx. 2 bar (series 1) and 3 bar (series 3) between the entrance to port„U“ and the pump case (including the pipe fittings).

Notes regarding series 30

When using external bearing flushing the throttle screw at port U must be turned in to the end stop.

Filtration of the fluid (Axial piston unit)

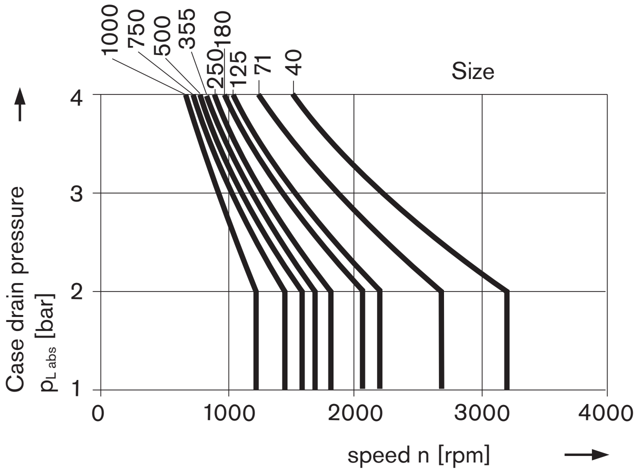
The finer the filtration, the better the achieved cleanliness of the fluid and the longer the life of the axial piston pump.

To ensure a reliable functioning of the axial piston unit, a minimum cleanliness class of

20/18/15 acc. to ISO 4406 is necessary.

Case drain pressure

The permissible case drain pressure (housing pressure) is dependent on the drive speed (see diagram).



Max. case drain pressure (housing pressure)

$p_{L\ abs\ max}$ ________________ 4 bar absolute

These are approximate values; under certain operating conditions a reduction in these values may be necessary.

Direction of flow

S to B.

Technical data

Operating pressure range

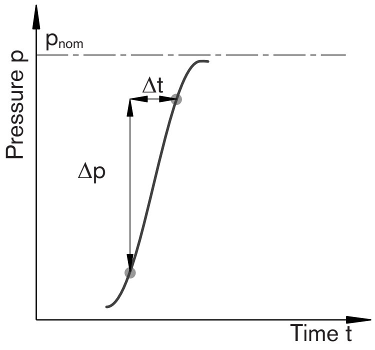
Pressure at service line port (pressure port) B

Nominal pressure p_{nom} 350 bar absolute

Peak pressure p_{max} 400 bar absolute
Total operating period 300 h
Single operating period 1 s

Minimum pressure (high-pressure side) 15 bar
For lower pressures please consult us.

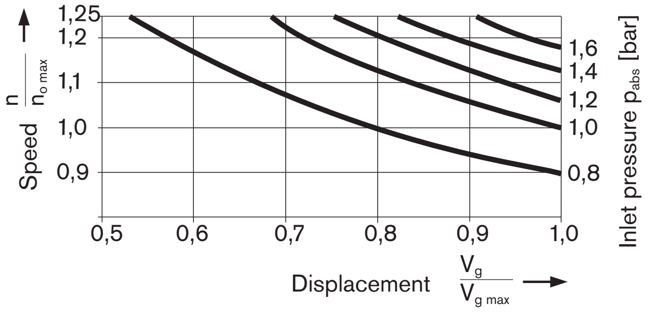
Rate of pressure change R_A 16000 bar/s



Pressure at suction port S (inlet)

Minimum suction pressure $p_{S\,min}$ 0.8 bar absolute
Maximum suction pressure $p_{S\,max}$ 30 bar absolute

Minimum pressure (inlet)
In order to avoid damage to the axial piston unit, a minimum pressure must be ensured at the suction port S (inlet). The minimum pressure is dependent on the speed and displacement of the axial piston unit.



The inlet pressure is the static feed pressure or the minimum dynamic value of the boost pressure.

Please note:
Max. permissible drive speed $n_{o\,max.\,perm.}$ (speed limit) see page 8

Please contact us if these conditions cannot be satisfied.

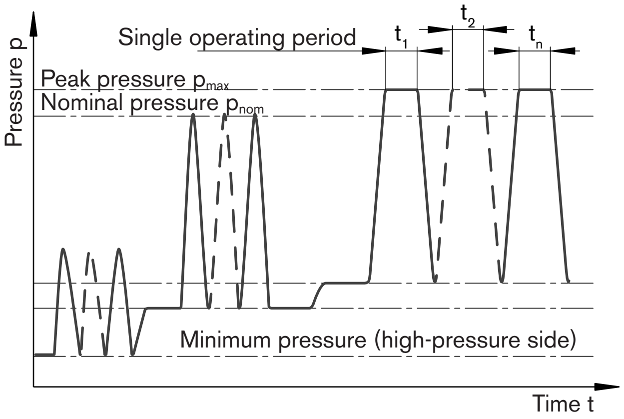
Definition

Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

Peak pressure p_{max}
The peak pressure corresponds the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.

Minimum pressure (high-pressure side)
Minimum pressure on the high-pressure side (B) that is required in order to prevent damage to the axial piston unit.

Rate of pressure change R_A
Maximum permissible rate of pressure build-up and pressure reduction during a pressure change over the entire pressure range.



Total operating period = $t_1 + t_2 + ... + t_n$

Technical data

Table of values (theoretical values, without considering efficiencies and tolerances; values rounded off)

Size			**40**	**71**	**125**	**180**	**250/ H 1)**	**355/ H 1)**	**500/ H 1)**	**750**	**750** with Impeller	**1000**
Displacement	$V_{g\,max}$	cm³	40	71	125	180	250/ 250	355/ 355	500/ 500	750	750	1000
Speed 2) max. at $V_{g\,max}$	$n_{o\,max}$	rpm	2600	2200	1800	1800	1500/ 1900	1500/ 1700	1320/ 1500	1200	1500	1000
max. at $V_g \leq V_{g\,max}$ (speed limit)	$n_{o\,max\,zul.}$	rpm	3200	2700	2200	2100	1800/ 2100	1700/ 1900	1600/ 1800	1500	1500	1200
Flow at $n_{o\,max}$	$q_{vo\,max}$	L/min	104	156	225	324	375/ 475	533/ 604	660/ 750	900	1125	1000
at $n_E = 1500$ rpm	$q_{VE\,max}$	L/min	60	107	186	270	375	533	581 3)	770 3)	1125	–
Power $\Delta p = 350$ bar at $n_{o\,max}$	$P_{o\,max}$	kW	61	91	131	189	219/ 277	311/ 352	385/ 437	525	656	583
at $n_E = 1500$ rpm	$P_{E\,max}$	kW	35	62	109	158	219	311	339 3)	449 3)	656	–
Torque bat $V_{g\,max}$ $\Delta p = 350$ bar	T_{max}	Nm	223	395	696	1002	1391	1976	2783	4174	4174	5565
$\Delta p = 100$ bar	T	Nm	64	113	199	286	398	564	795	1193	1193	1590
Rotary stiffness Shaft end P	c	kNm/rad	80	146	260	328	527	800	1145	1860	1860	2730
Shaft end Z	c	kNm/rad	77	146	263	332	543	770	1136	1812	1812	2845
Moment of inertia rotary group	J_{TW}	kgm²	0,0049	0,0121	0,03	0,055	0,0959	0,19	0,3325	0,66	0,66	1,20
Angular acceleration max. 4)	α	rad/s²	17000	11000	8000	6800	4800	3600	2800	2000	2000	1450
Case volume	V	L	2	2,5	5	4	10	8	14	19	22	27
Weight (with press. contr.) approx.	m	kg	39	53	88	102	184	207	320	460	490	605

1) High-Speed-Version

2) Values are valid with inlet pressure p_{abs} 1 bar at inlet port S, with increased speed up to speed limit please observe diagram, page 7

3) $V_g < V_{g\,max}$

4) – The range of validity lies between zero and the maximum permissible drive speeds.
Valid for external excitation (eg. diesel engine 2- to 8-fold rotary frequency, cardan shaft 2-fold rotary frequency).
– The limiting value is only valid for a single pump.
– The loading capacity of the connecting parts must be considered.

Notes

Exceeding the maximum or falling below the minimum permissible values can lead to a loss of function, a reduction in operational service life or total destruction of the axial piston unit.
The permissible values can be determined through calculation.

Determination of pump size

Flow $$q_V = \frac{V_g \bullet n \bullet \eta_V}{1000} \quad [\text{L/min}]$$

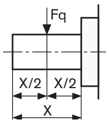
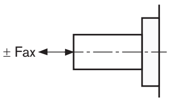
Drive torque $$T = \frac{V_g \bullet \Delta p}{20 \bullet \pi \bullet \eta_{mh}} \quad [\text{Nm}]$$

Power $$P = \frac{2\pi \bullet T \bullet n}{60000} = \frac{q_V \bullet \Delta p}{600 \bullet \eta_t} \quad [\text{kW}]$$

V_g = geometr. displacement per rev. in cm³
Δp = pressure difference in bar
n = speed in rpm
η_V = volumetric efficiency
η_{mh} = mechanical-hydraulic efficiency
η_t = overall efficiency ($\eta_t = \eta_V \bullet \eta_{mh}$)

Technical data

Permissible radial and axial forces on the drive shaft

Size					40	71	125	180	250	355	500	750*	1000
Radial force, max.		at X/2	$F_{q\ max}$	N	1000	1200	1600	2000	2000	2200	2500	3000	3500
Axial force, max.			$\pm F_{ax\ max}$	N	600	800	1000	1400	1800	2000	2000	2200	2200

* also valid for versions with boost pump

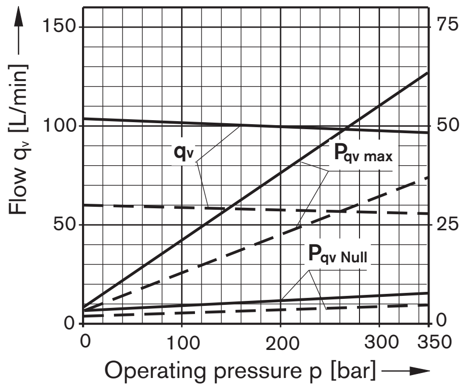
Characteristics

Drive power and flow

(Fluid: Hydraulic oil ISO VG 46 DIN 51519, t = 50°C)

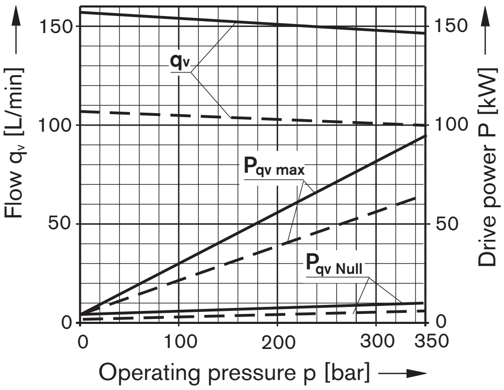
Overall efficiency: $\eta_t = \frac{q_v \cdot p}{P_{q_v\,max} \cdot 600}$ Volumetric efficiency: $\eta_v = \frac{q_v}{q_{v\,theor}}$

Size 40



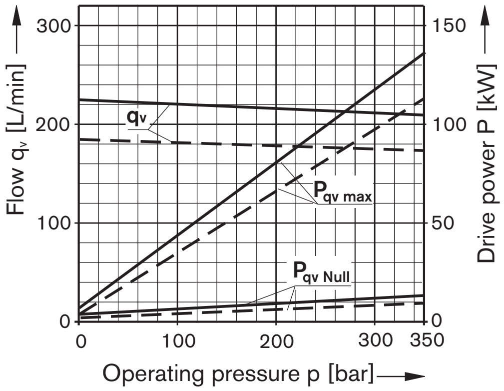
— n = 2600 rpm
- - - n = 1500 rpm

Size 71



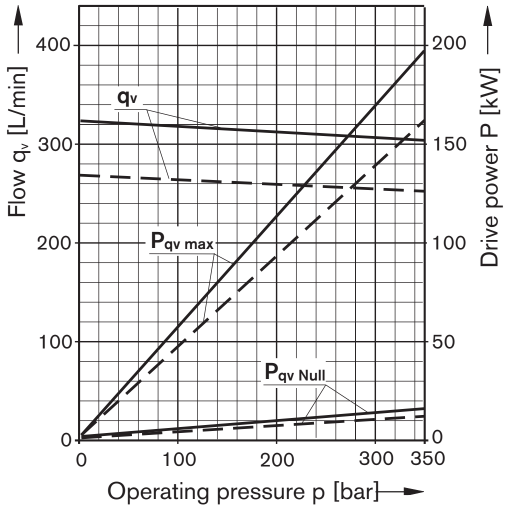
— n = 2200 rpm
- - - n = 1500 rpm

Size 125



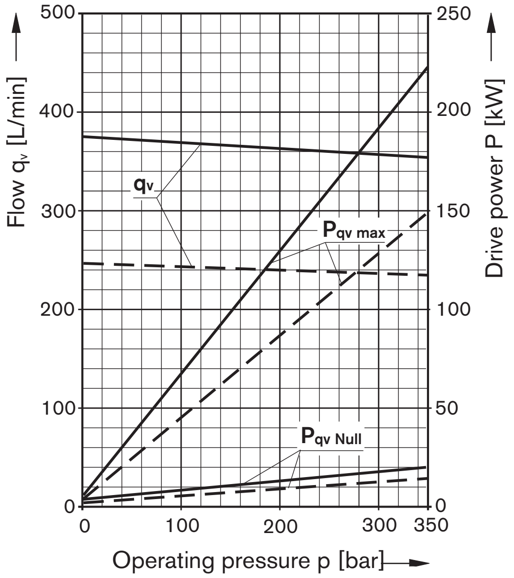
— n = 1800 rpm
- - - n = 1500 rpm

Size 180



— n = 1800 rpm
- - - n = 1500 rpm

Size250



— n = 1500 rpm
- - - n = 1000 rpm

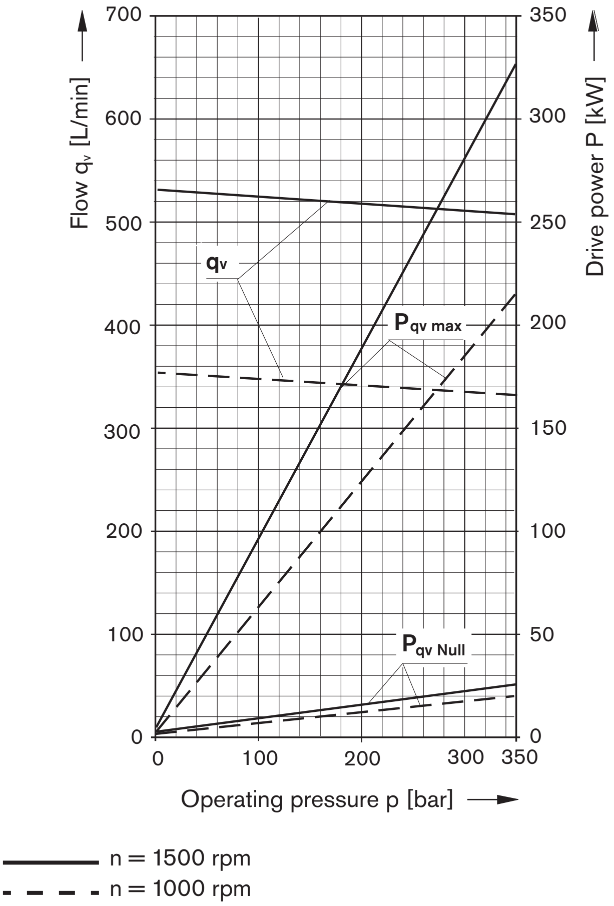
Characteristics

Drive power and flow

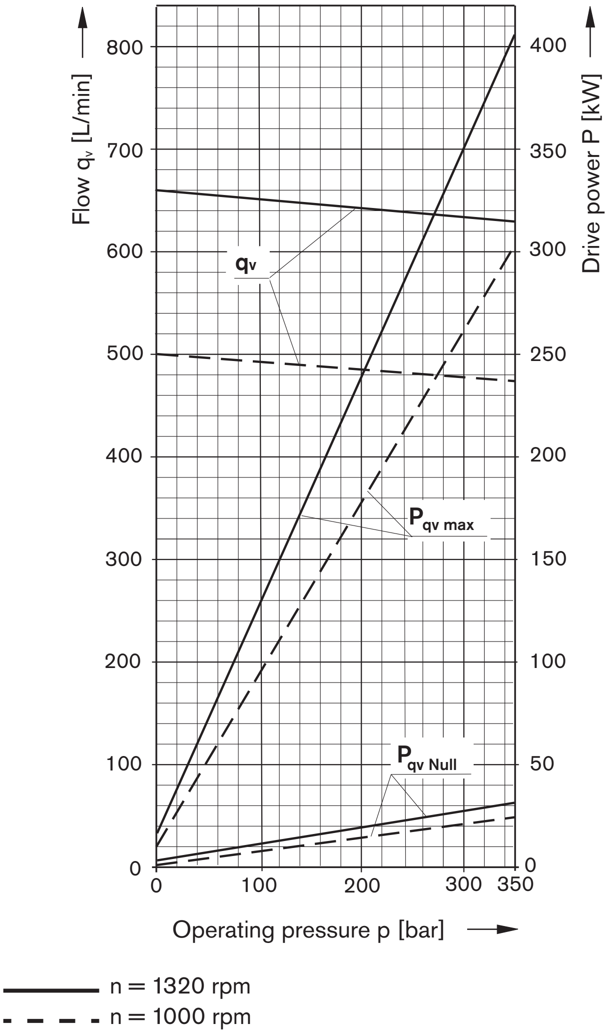
(Fluid: Hydraulic oil ISO VG 46 DIN 51519, t = 50°C)

Overall efficiency: $\eta_t = \dfrac{q_v \cdot p}{P_{q_v\,max} \cdot 600}$ Volumetric efficiency: $\eta_v = \dfrac{q_v}{q_{v\,theor}}$

Size 355



Size 500



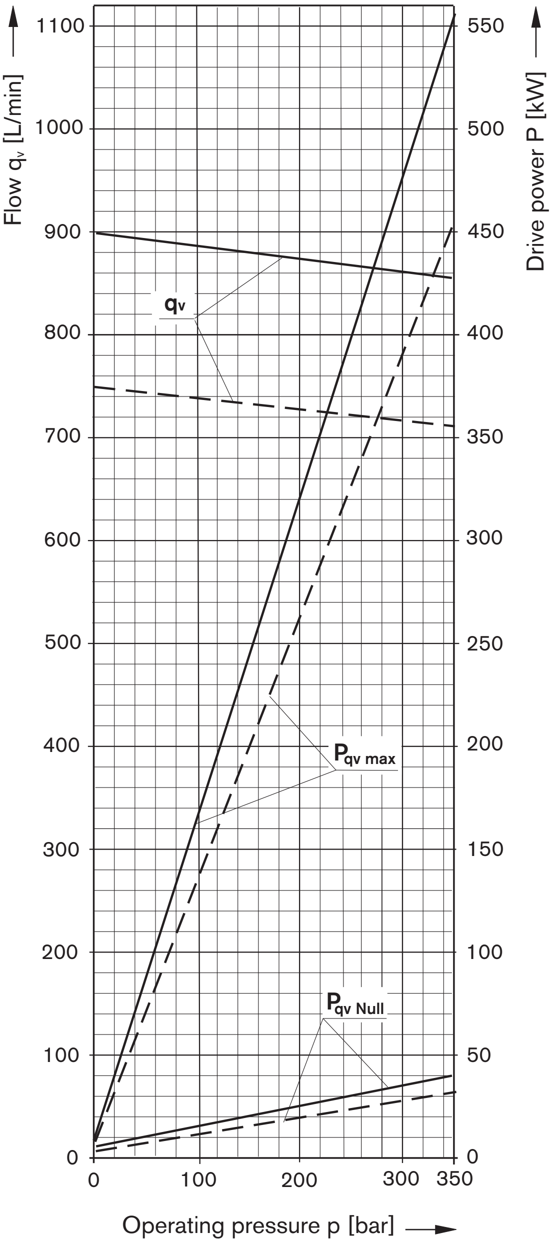
Characteristics

Drive power and flow

(Fluid: Hydraulic oil ISO VG 46 DIN 51519, t = 50°C)

Overall efficiency: $\eta_t = \dfrac{q_v \cdot p}{P_{q_v\,max} \cdot 600}$ Volumetric efficiency: $\eta_v = \dfrac{q_v}{q_{v\,theor}}$

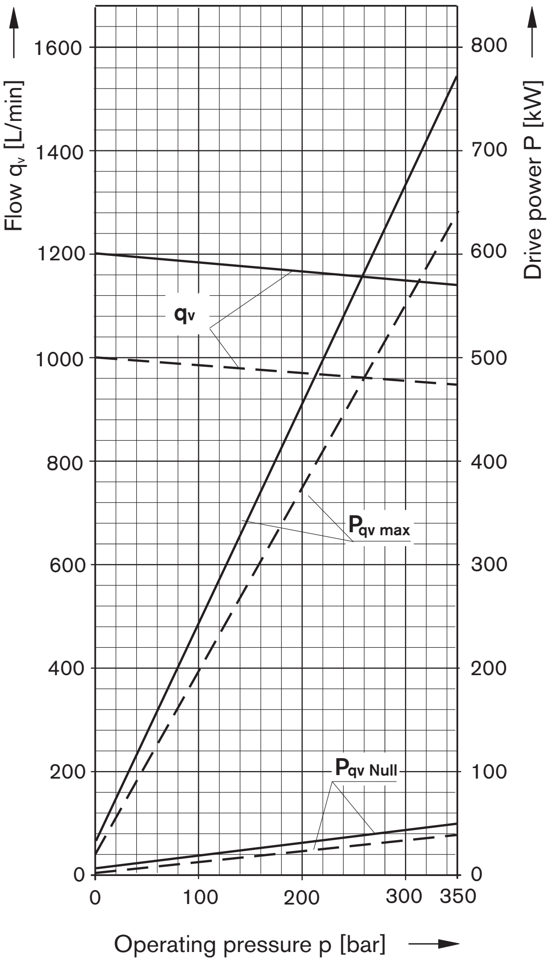
Size 750



n = 1200 rpm

n = 1000 rpm

Size 1000



n = 1200 rpm

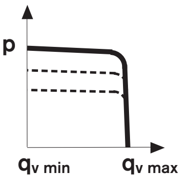
n = 1000 rpm

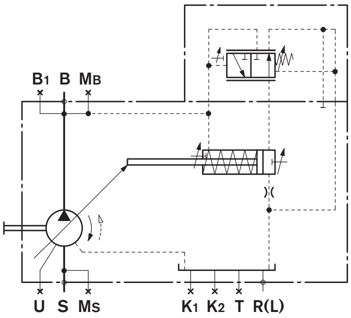
Summary of controls

Pressure control DR **(see RE 92060)**

The DR- pressure control limits the maximum pressure at the pump outlet within the pump's control range. This max. pressure level can be steplessly set at the control valve.
Setting range 20...350 bar

Optional:
Remote control (DRG)

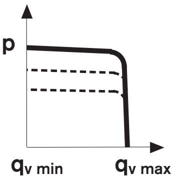




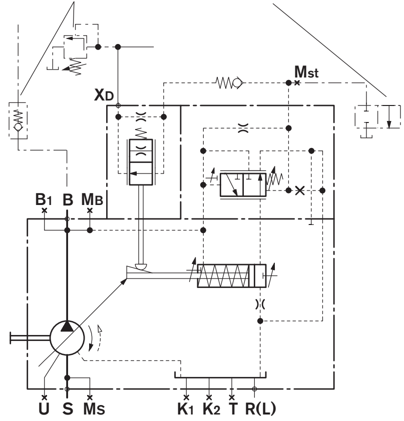
Pressure control for parallel operation DP **(see RE 92060)**

Suitable for pressure control with multiple A4VSO axial piston pumps in parallel operation.

Optional:
Flow control (DPF)



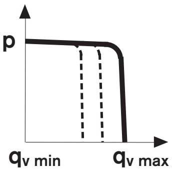
not in scope of supply



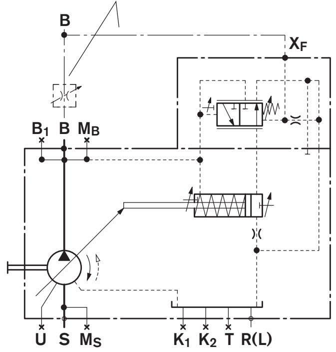
Flow control FR **(see RE 92060)**

Maintains a constant flow in a hydraulic system.

Optional:
Remote pressure control (FRG)
connection between X_F and tank closed
(FR1, FRG1)



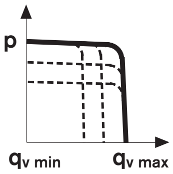
not in scope of supply



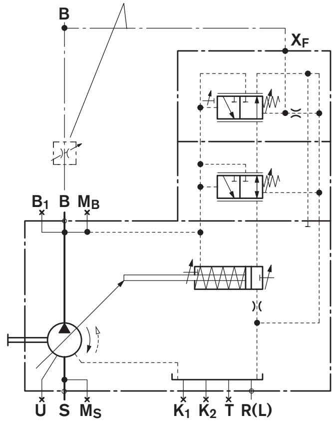
Pressure and flow control DFR **(see RE 92060)**

This control maintains a constant flow from the pump even under varying operating conditions. Overriding this control is a mechanically adjustable pressure control.

Optional:
connection between X_F and tank closed (DFR1)



not in scope of supply

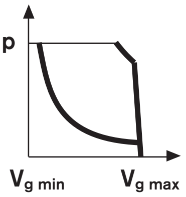


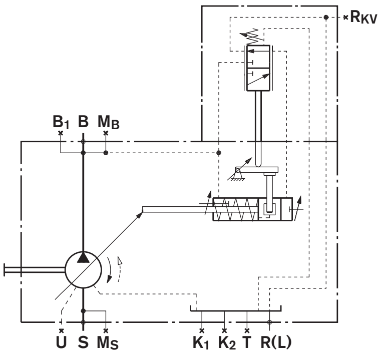
Summary of controls

Power control LR2 with hyperbolic characteristic (see RE 92064)

The hyperbolic power control maintains a constant preset drive power at the same input speed.

Optional:
Pressure control (LR2D), remotely controlled (LR2G);
Flow control (LR2F, LR2S);
Hydraulic stroke limiter (LR2H);
Mechanical stroke limiter (LR2M);
Hydraulic two-point control (LR2Z);
with electric unloading valve for easy start (LR2Y).

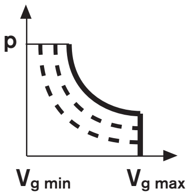


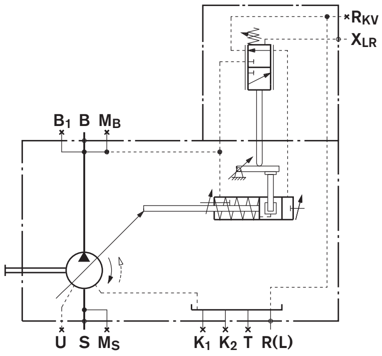


Power control LR3 with remote control of power characteristics (see RE 92064)

This power control maintains a constant preset drive power, with remote control of the power characteristics.

Optional:
Pressure control (LR3D), remotely controlled (LR3G);
Flow control (LR3F, LR3S);
Hydraulic stroke control (LR3H);
Mechanical stroke control (LR3M);
Hydraulic two-point control (LR3Z).
with electric unloading valve for easy start (LR3Y)



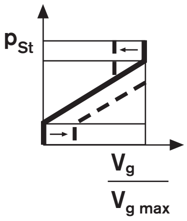


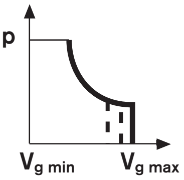
Hydraulic control LR2N and LR3N pilot pressure dependent, initial position $V_{g\,min}$ (see RE 92064)

With overriding power control.

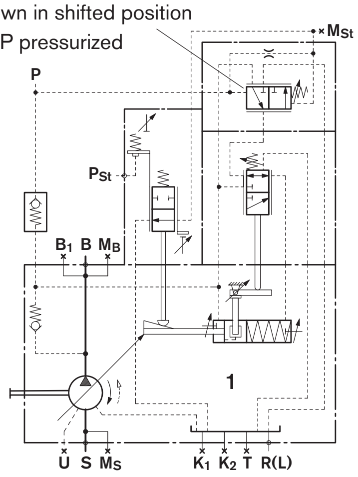
The pump displacement is proportional to a pilot pressure signal in P_{St}.
The additional hyperbolic power control overrides the pilot pressure signal and holds the preset drive power constant.

Optional:
Remote control of power characteristics (LR3N)
Pressure control (LR.DN),
Remote pressure control (LR.GN)
Electric control of pilot pressure signal (LR.NT)





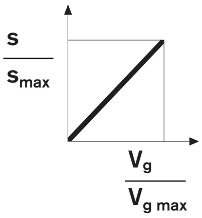
shown in shifted position
i.e. P pressurized

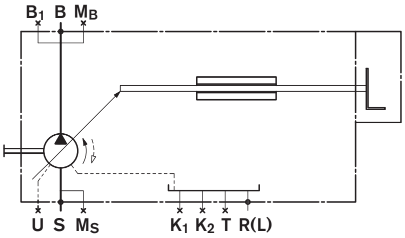


Summary of controls

Manual control MA (see RE 92072)

Stepless adjustment of displacement by means of a handwheel.

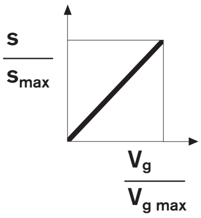


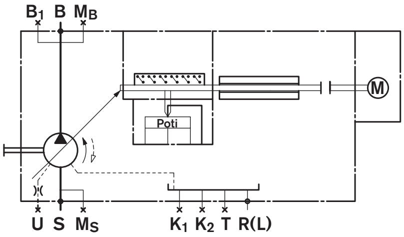


Electric motor control EM (see RE 92072)

Stepless adjustment of displacement via an electric motor.

Various intermediate displacement values can be selected with a programmed sequence control, by means of built on limit switches and an optional potentiometer for feedback signal.

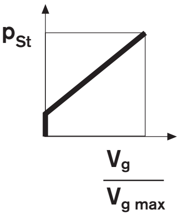


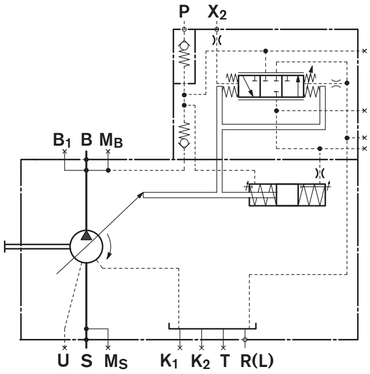


Hydraulic control HD pilot pressure dependent (see RE 92080)

Stepless adjustment of displacement proportional to a pilot pressure signal. The displacement is proportional to the applied pilot pressure (Difference between pilot pressure level and pump case pressure).

Optional:
Pilot pressure curves (HD1, HD2, HD3)
Pressure control (HD.B),
Remote pressure control (HD.GB)
Power control (HD1P)
with electric control of pilot pressure (HD1T)



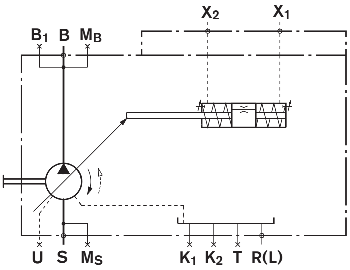


Summary of controls

Hydraulic control HM 1/2, control volume dependent (see RE 92076)

The pump displacement is infinitely variable in relation to the control oil volume in ports X_1 and X_2.

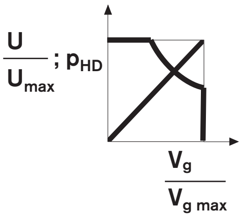
Application:
- 2-point control
- basic control device for servo or proportional valve control

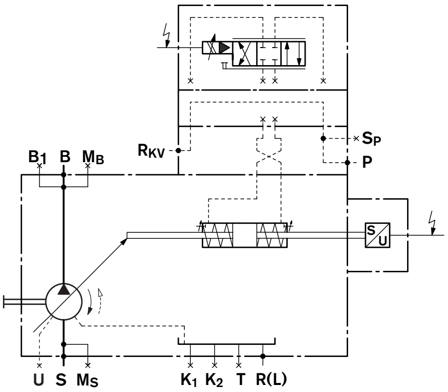


Control system HS, HS4, with servo or proportional valve (see RE 92076)

The stepless displacement control is accomplished by by means of servo or proportional valve with electrical feedback of the swivel angle.
The HS4P-control system is fitted with a built on pressure transducer so that it can be utilized for electrical pressure and power control.

Optional:
Servo valve (HS);
Proportional valve (HS4);
Short circuit valve (HSK, HS4K, HS4KP);
Without valves (HSE, HS4E).
For oil-immersed use (HS4M)

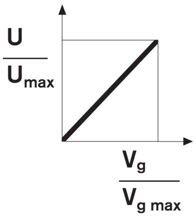


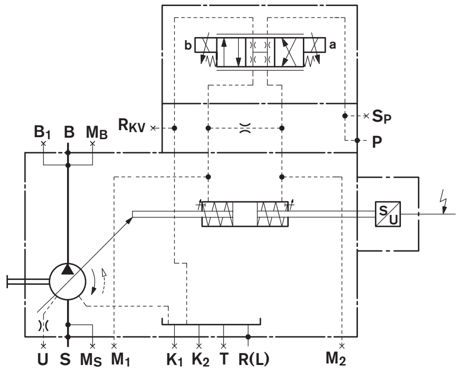


Control system EO1/2 (see RE 92076)

The stepless adjustment of the displacement is accomplished by means of a proportional valve with electrical feedback of the swivel angle.
This control can be utilized as an electric control of displacement.

Optional:
Control pressure range (EO1, EO2)
Short circuit valve (EO1K, EO2K)
Without valves (EO1E, EO2E)

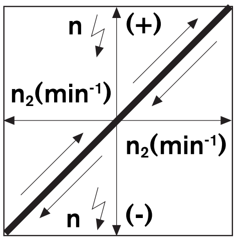


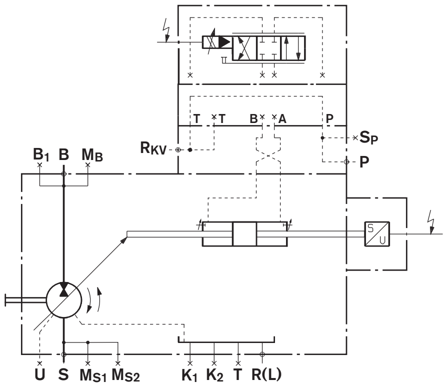


Summary of controls

Speed control DS1, secundary controlled **(see RE 92056)**

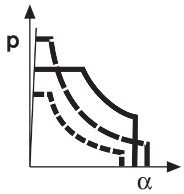
The speed control DS1 controls the secundary unit (motor) in such a manner, that this motor delivers sufficient torque to maintain the required output speed. When connected to a constant pressure system, this torque is proportional to motor displacement and thus also proportional to the swivel angle.

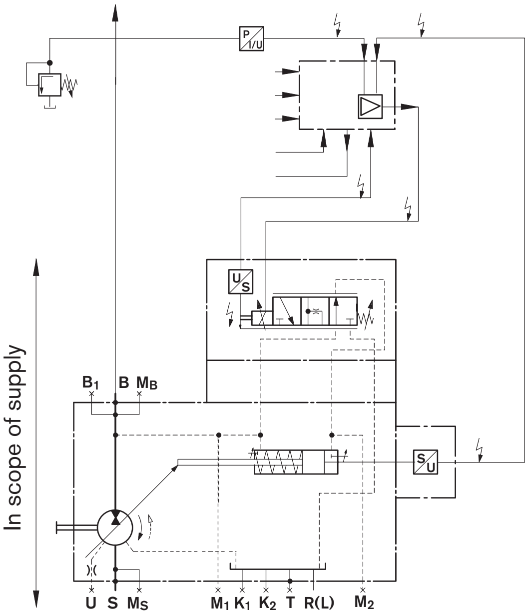




Electro hydraulic control system DFE1 **(see RE 92088)**

The power, pressure and swivel angle control of the variable pump A4VSO...DFE1 is accomplished by means of an electrically controlled proportional valve. A current signal to the proportional valve moves the control piston and determines via an integrated positional transducer the cradle‘s swivel angle and thus the pump flow. When the electric drive motor is switched off and the system is pressureless, the bias spring in the control chamber will swivel the pump to max. displacement ($V_{g\ max}$).



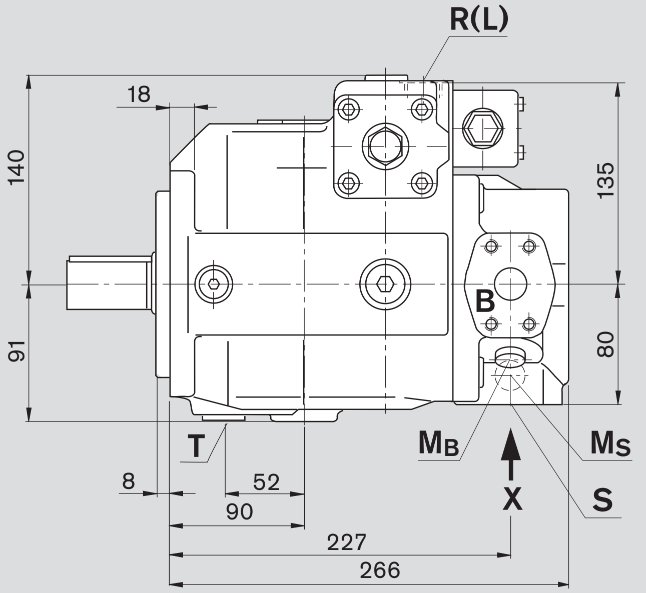


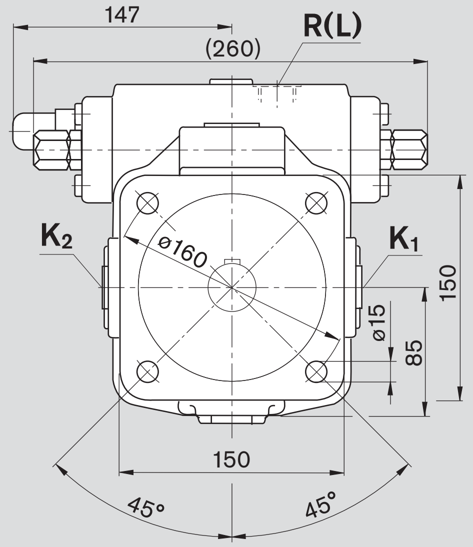
Dimensions, size 40

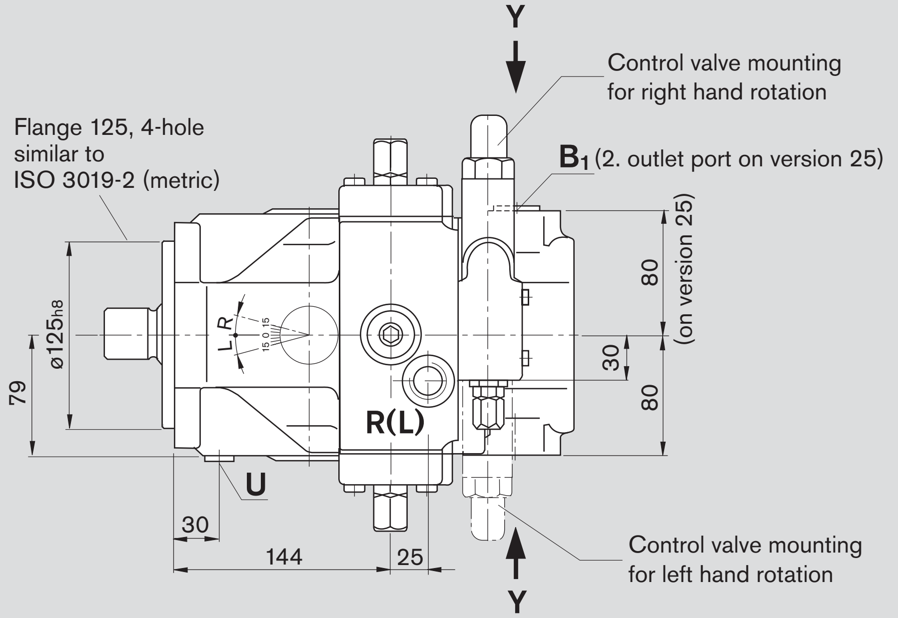
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Series 1

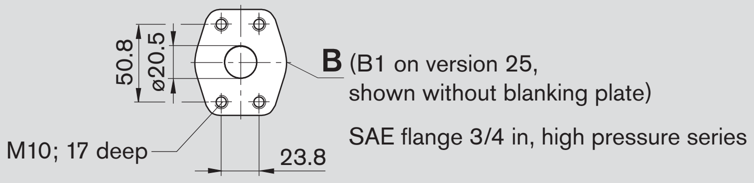
(Example: pressure control; for exact dimensions of the control devices see separate data sheets)



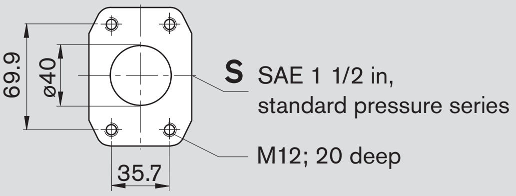




View Y



View X



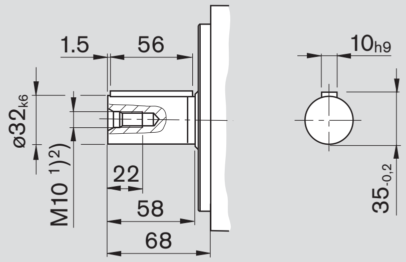
For dimensions of shaft ends and ports see page 19

Dimensions, size 40

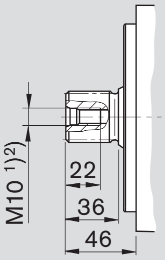
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Shaft ends

P Keyed to DIN 6885
AS10x8x56



Z Splined to DIN 5480
W32x2x14x9g



Ports

				max. tightening torque ²)
S	Suction port (standard pressure series) Fixing thread	SAE J518 ³) DIN 13	1 1/2 in M12x1,75; 20 deep ²)	
K_1, K_2	Flushing port	DIN 3852	M22x1,5;14 deep (plugged)	210 Nm
T	Drain	DIN 3852	M22x1,5;14 deep (plugged)	210 Nm
M_B	Measuring port outlet pressure	DIN 3852	M14x1,5;12 deep (plugged)	80 Nm
M_S	Measuring port suction pressure	DIN 3852	M14x1,5;12 deep (plugged)	80 Nm
R(L)	Fill and bleed (case drain port)	DIN 3852	M22x1,5; 14 deep	210 Nm
U	Flushing port	DIN 3852	M14x1,5;12 deep (plugged)	80 Nm
on version 13				
B	Pressure port (high pressure series) Fixing thread	SAE J518 ³) DIN 13	3/4 in M10x1,5; 17 deep ²)	
B_1	Additional port	DIN 3852	M22x1,5;14 deep (plugged)	210 Nm
on version 25				
B	Pressure port (high pressure series) Fixing thread	SAE J518 ³) DIN 13	3/4 in M10x1,5; 17 deep ²)	
B_1	2. press. port (high pressre series) Fixing thread	SAE J518 ³) DIN 13	3/4 in (closed with blanking plate) M10x1,5; 17 deep ²)	

¹) Center bore to DIN 332 (threaded to DIN 13)

²) for the max. tightening torques please observe the manufacturer's information on the used fittings and the general information on page 68

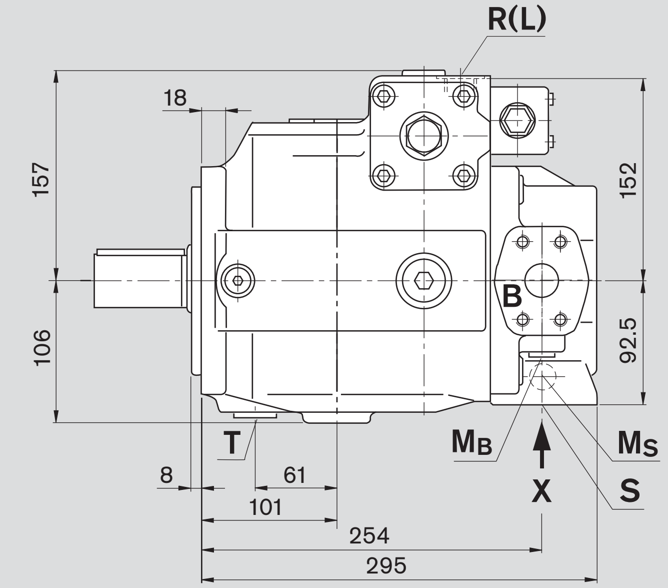
³) Caution: metric thread deviates from standard

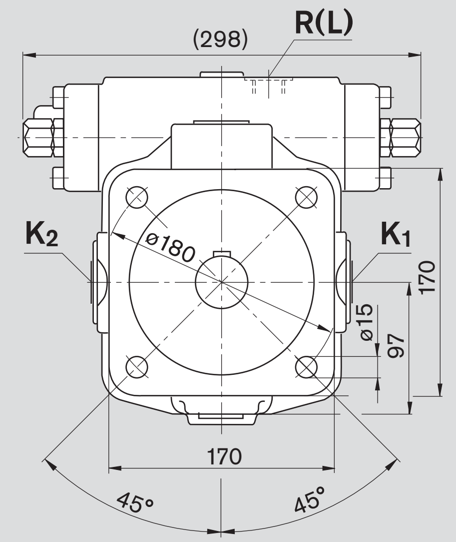
Dimensions, size 71

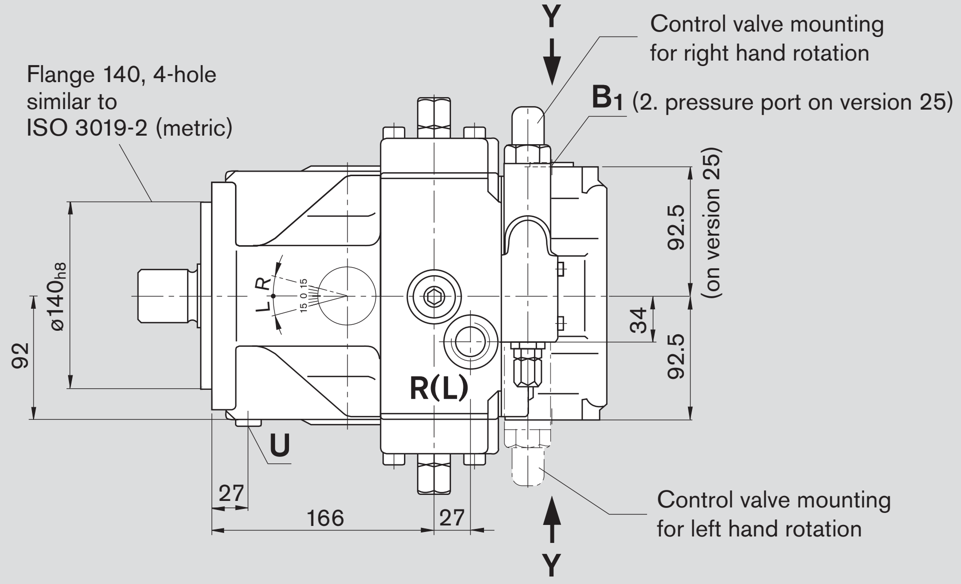
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Series 1

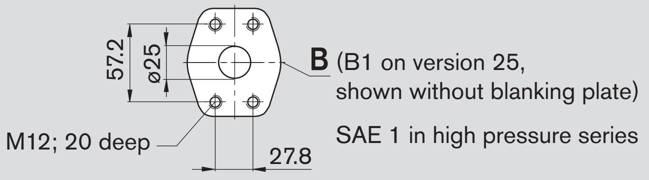
(Example: pressure control; for exact dimensions of control devices see separate data sheets)



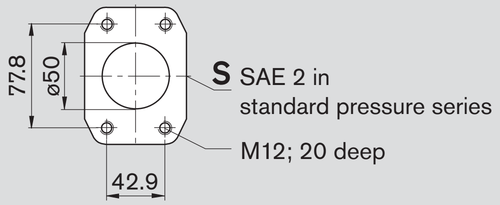




View Y



View X



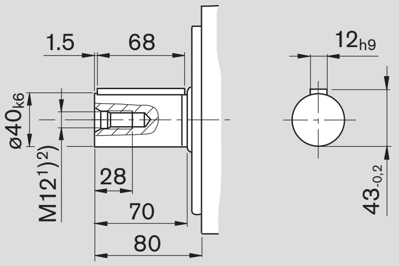
For dimensions of shaft ends or ports see page 21

Dimensions, size 71

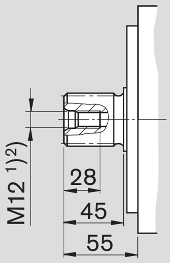
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Shaft ends

P Keyed to DIN 6885
AS12x8x68



Z Splined to DIN 5480
W40x2x18x9g



Ports

				max. tightening torque 2)
S	Suction port (standard pressure series) Fixing thread	SAE J518 3) DIN 13	2 in M12x1,75; 20 deep 2)	
K_1, K_2	Flushing port	DIN 3852	M27x2;16 deep (plugged)	330 Nm
T	Drain	DIN 3852	M27x2;16 deep (plugged)	330 Nm
M_B	Measuring port outlet pressure	DIN 3852	M14x1,5;12 deep (plugged)	80 Nm
M_S	Measuring port suction pressure	DIN 3852	M14x1,5;12 deep (plugged)	80 Nm
R(L)	Fill + air bleed (case drain port)	DIN 3852	M27x2; 16 deep	330 Nm
U	Flushing port	DIN 3852	M14x1,5;12 deep (plugged)	80 Nm
on version 13				
B	Pressure port (high pressure series) Fixing thread	SAE J518 3) DIN 13	1 in M12x1,75; 20 deep 2)	
B_1	Additional port	DIN 3852	M27x2;16 deep (plugged)	330 Nm
on version 25				
B	Pressure port (high pressure series) Fixing thread	SAE J518 3) DIN 13	1 in M12x1,75; 20 deep 2)	
B_1	2. pressure port (high pressure series) Fixing thread	SAE J518 3) DIN 13	1 in (closed with blanking plate) M12x1,75; 20 deep 2)	

1) Center bore to DIN 332 (thread to DIN 13)

2) for the max. tightening torques please observe the manufacturer's information on the used fittings and the general information on page 68

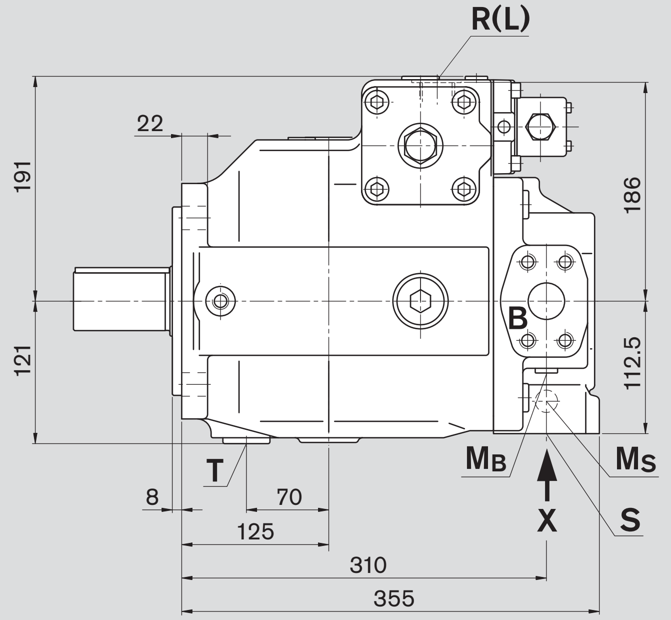
3) Caution: metric thread deviates from standard

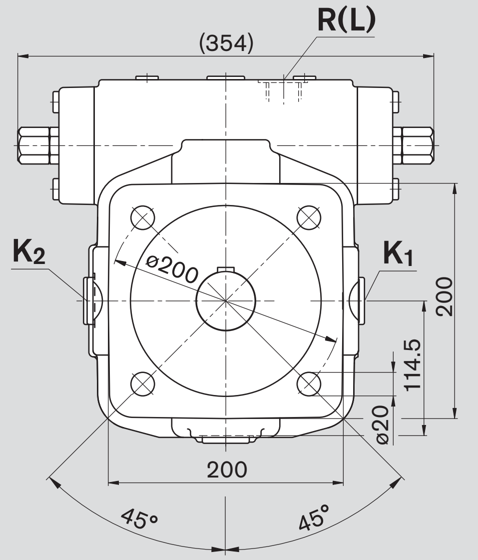
Dimensions, size 125

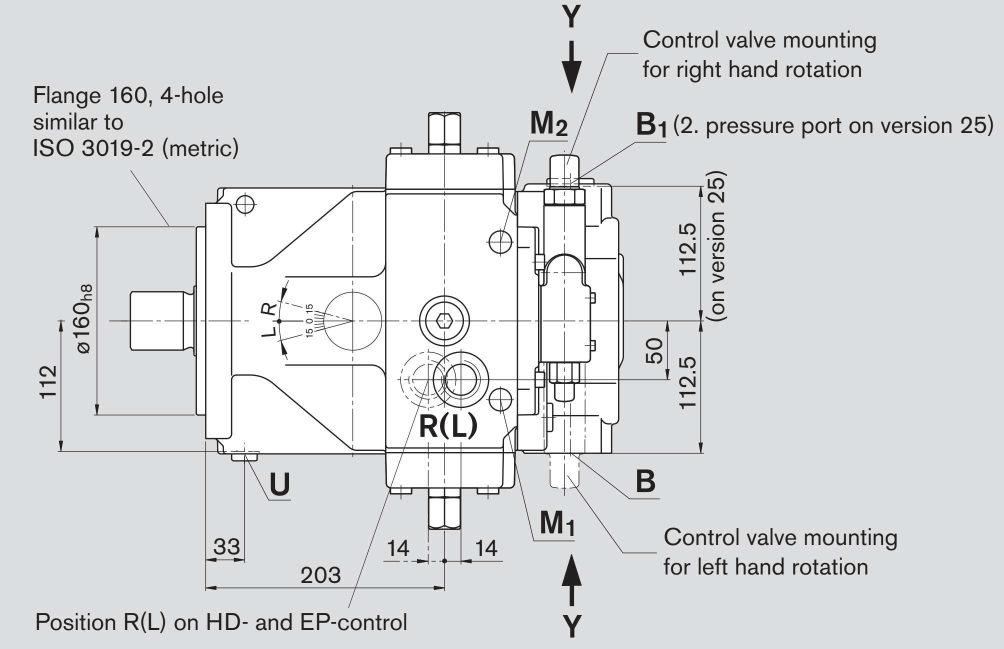
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Series 3

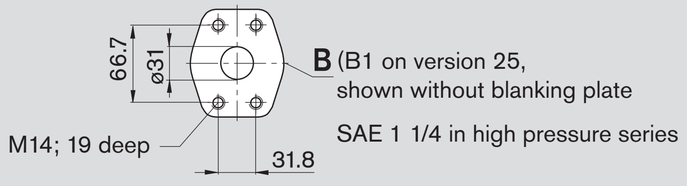
(Example: pressure control; for exact dimensions of control devices see separate data sheets)



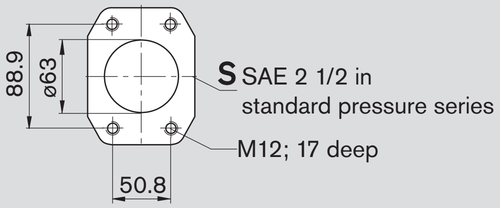




View Y



View X



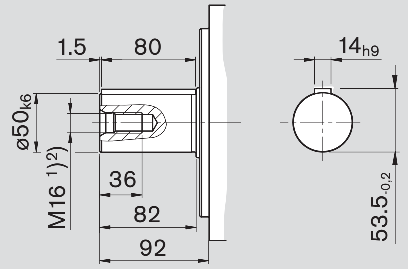
For dimensions of shaft ends and ports see page 23

Dimensions, size 125

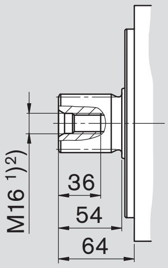
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Shaft ends

P Keyed to DIN 6885
AS14x9x80



Z Splined to DIN 5480
W50x2x24x9g



Ports

				max. tightening torque 2)
S	Suction port (standard pressure series)	SAE J518 3)	2 1/2 in	
	Fixing thread	DIN 13	M12x1,75; 17 deep 2)	
K_1, K_2	Flushing port	DIN 3852	M33x2; 18 deep (plugged)	540 Nm
T	Drain	DIN 3852	M33x2; 18 deep (plugged)	540 Nm
M_B	Measuring port outlet pressure	DIN 3852	M14x1,5; 12 deep (plugged)	80 Nm
M_S	Measuring port suction pressure	DIN 3852	M14x1,5; 12 deep (plugged)	80 Nm
R(L)	Fill + air bleed (case drain port)	DIN 3852	M33x2; 18 deep	540 Nm
U	Flushing port	DIN 3852	M14x1,5; 12 deep (plugged)	80 Nm
M_1, M_2	Measuring port control chamber press.	DIN 3852	M14x1,5; 12 deep (plugged)	80 Nm

on version 13

B	Pressure port (high pressure series)	SAE J518 3)	1 1/4 in	
	Fixing thread	DIN 13	M14x2; 19 deep 2)	
B_1	Additional port	DIN 3852	M33x2; 18 deep (plugged)	540 Nm

on version 25

B	Pressure port (high pressure series)	SAE J518 3)	1 1/4 in
	Fixing thread	DIN 13	M14x2; 19 deep 2)
B_1	2. pressure port (high pressure series)	SAE J518 3)	1 1/4 in (closed with blanking plate)
	Fixing thread	DIN 13	M14x2; 19 deep 2)

1) Center bore to DIN 332 (thread to DIN 13)

2) for the max. tightening torques please observe the manufacturer‘s information on the used fittings and the general information on page 68

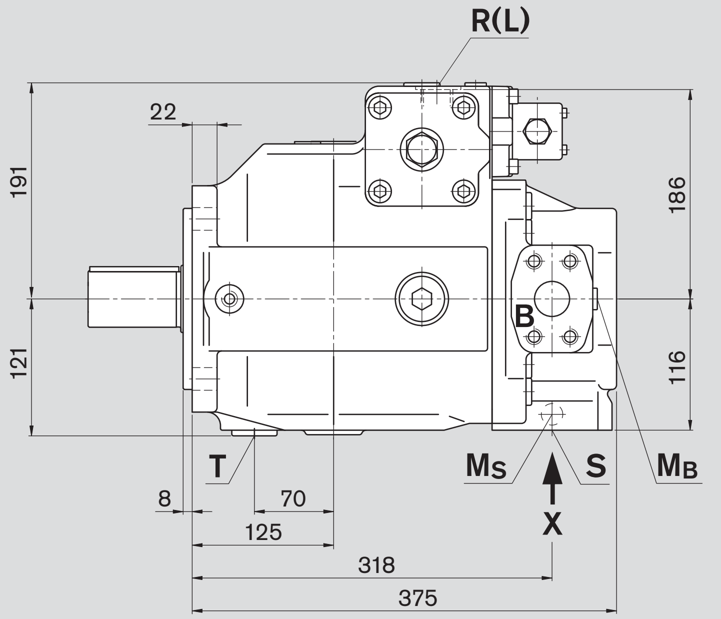
3) Caution: metric thread deviates from standard

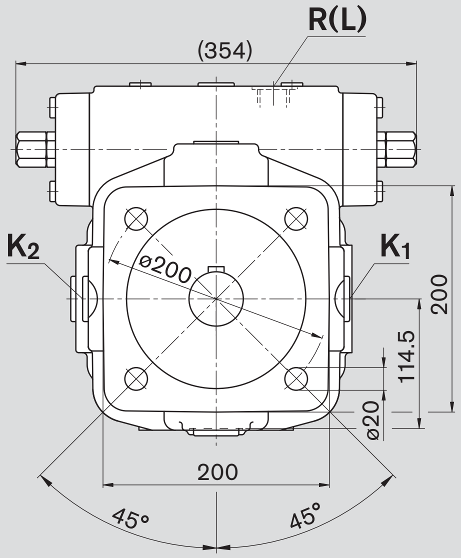
Dimensions, size 180

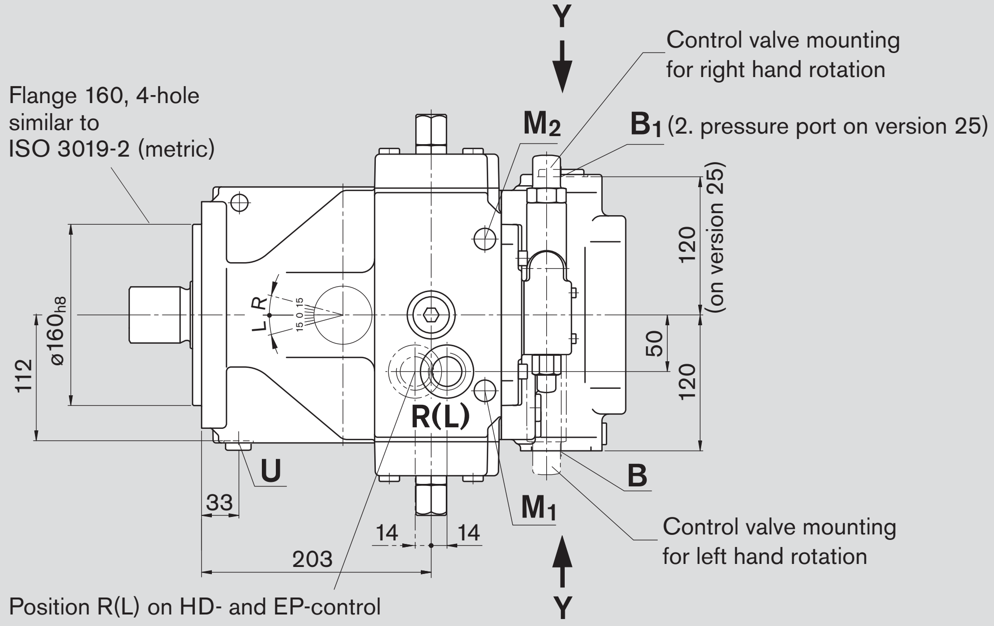
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Series 3

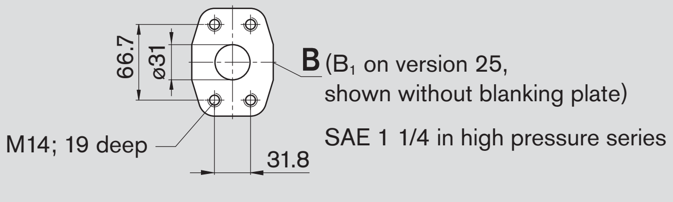
(Example: pressure control; for exact dimensions of control devices see separate data sheets)



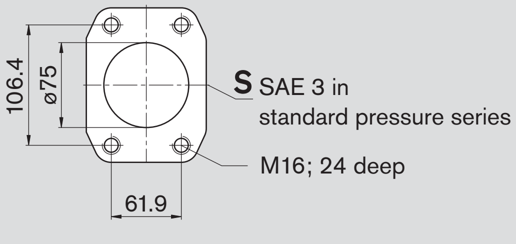




View Y



View X



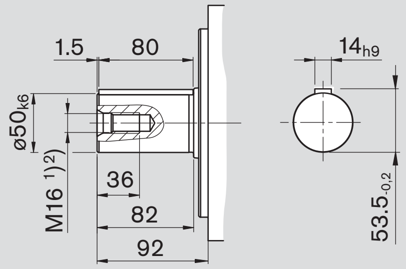
For dimensions of shaft ends and ports see page 25

Dimensions, size 180

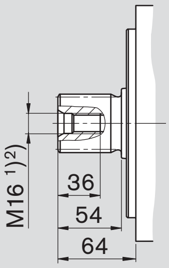
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Shaft ends

P Keyed to DIN 6885
AS14x9x80



Z Splined to DIN 5480
W50x2x24x9g



Ports

				max. tightening torque [2]
S	Suction port (standard pressure series) Fixing thread	SAE J518 [3] DIN 13	3 in M16x2; 24 deep [2]	
K_1, K_2	Flushing port	DIN 3852	M33x2; 18 deep (plugged)	540 Nm
T	Drain	DIN 3852	M33x2; 18 deep (plugged)	540 Nm
M_B	Measuring port outlet pressure	DIN 3852	M14x1,5; 12 deep (plugged)	80 Nm
M_S	Measuring port suction pressure	DIN 3852	M14x1,5; 12 deep (plugged)	80 Nm
R(L)	Fill + air bleed (case drain port)	DIN 3852	M33x2; 18 deep	540 Nm
U	Flushing port	DIN 3852	M14x1,5; 12 deep (plugged)	80 Nm
M_1, M_2	Measuring port control chamber pressure	DIN 3852	M14x1,5; 12 deep (plugged)	80 Nm

on version 13

B	Pressure port (high pressure series) Fixing thread	SAE J518 [3] DIN 13	1 1/4 in deep [2] M14x2; 19 deep [2]	
B_1	Additional port	DIN 3852	M33x2;18 deep (plugged)	540 Nm

on version 25

B	Pressure port (high pressure series) Fixing thread	SAE J518 [3] DIN 13	1 1/4 in M14x2; 19 deep [2]
B_1	2. pressure port (high pressure series) Fixing thread	SAE J518 [3] DIN 13	1 1/4 in (closed with blanking plate) M14x2; 19 deep [2]

[1] Center bore to DIN 332 (thread to DIN 13)

[2] for the max. tightening torques please observe the manufacturer‘s information on the used fittings and the general information on page 68

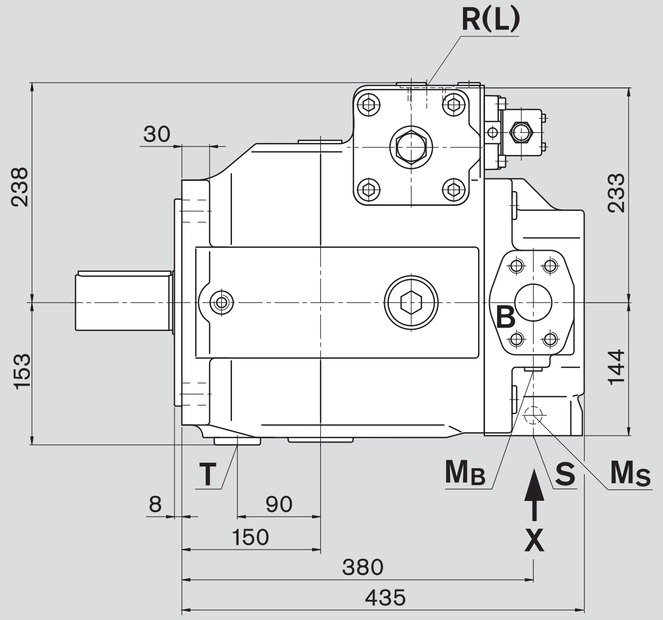
[3] Caution: metric thread deviates from standard

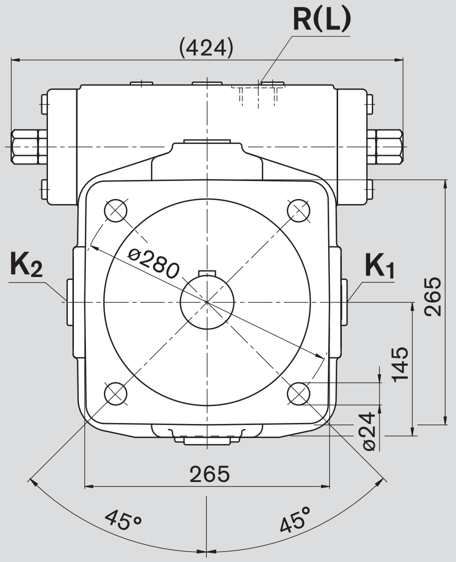
Dimensions, size 250

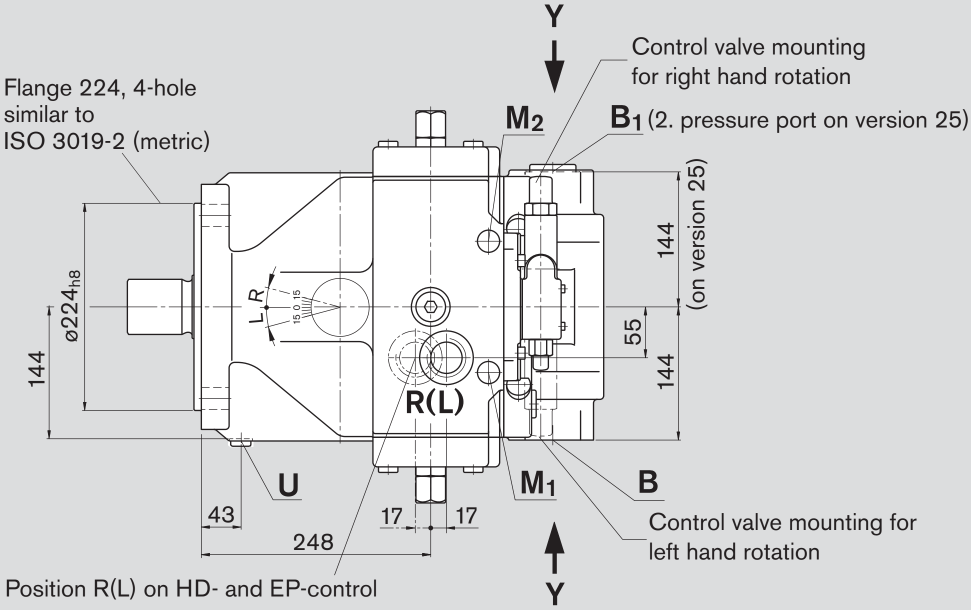
Before finalising your design please request a certified installation drawing. Dimension in mm.

Series 3

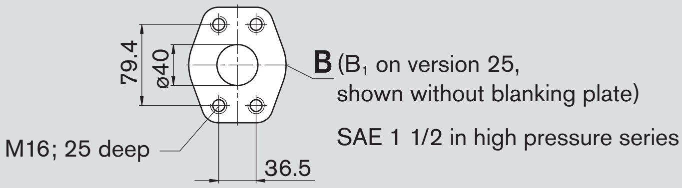
(Example: pressure control; for exact dimensions of control devices see separate data sheets)



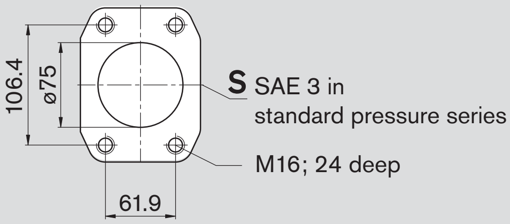




View Y



View X



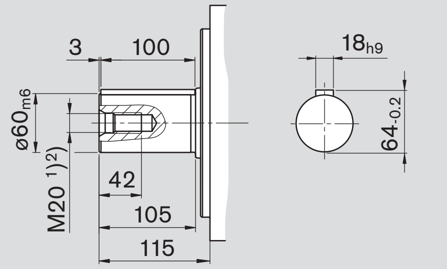
For dimensions on shaft ends and ports see page 27

Dimensions, size 250

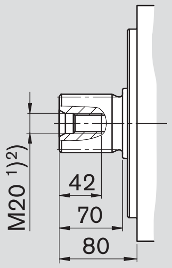
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Shaft ends

P Keyed to DIN 6885
AS18x11x100



Z Splined to DIN 5480
W60x2x28x9g



Ports

				max. tightening torque [2]
S	Suction port (standard pressure series) Fixing thread	SAE J518 [3] DIN 13	3 in M16x2; 24deep [2]	
K_1, K_2	Flushing port	DIN 3852	M42x2; 20 deep (plugged)	720 Nm
T	Drain	DIN 3852	M42x2; 20 deep (plugged)	720 Nm
M_B	Measuring port outlet pressure	DIN 3852	M14x1,5; 12 deep (plugged)	80 Nm
M_S	Measuring port suction pressure	DIN 3852	M14x1,5; 12 deep (plugged)	80 Nm
R(L)	Fill + air bleed (case drain port)	DIN 3852	M42x2; 20 deep	720 Nm
U	Flushing port	DIN 3852	M14x1,5; 12 deep (plugged)	80 Nm
M_1, M_2	Measuring port control chamber pressure	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm

on version 13

B	Pressure port (high pressure series) Fixing thread	SAE J518 [3] DIN 13	1 1/2 in M16x2; 25 deep [2]	
B_1	Additional port	DIN 3852	M42x2; 20 deep (plugged)	720 Nm

on version 25

B	Pressure port (high pressure series) Fixing thread	SAE J518 [3] DIN 13	1 1/2 in M16x2; 25 deep [2]
B_1	2. pressure port (high pressure series) Fixing thread	SAE J518 [3] DIN 13	1 1/2 in (closed with blanking plate) M16x2; 25 deep [2]

[1] Center bore to DIN 332 (thread to DIN 13)

[2] for the max. tightening torques please observe the manufacturer‘s information on the used fittings and the general information on page 68

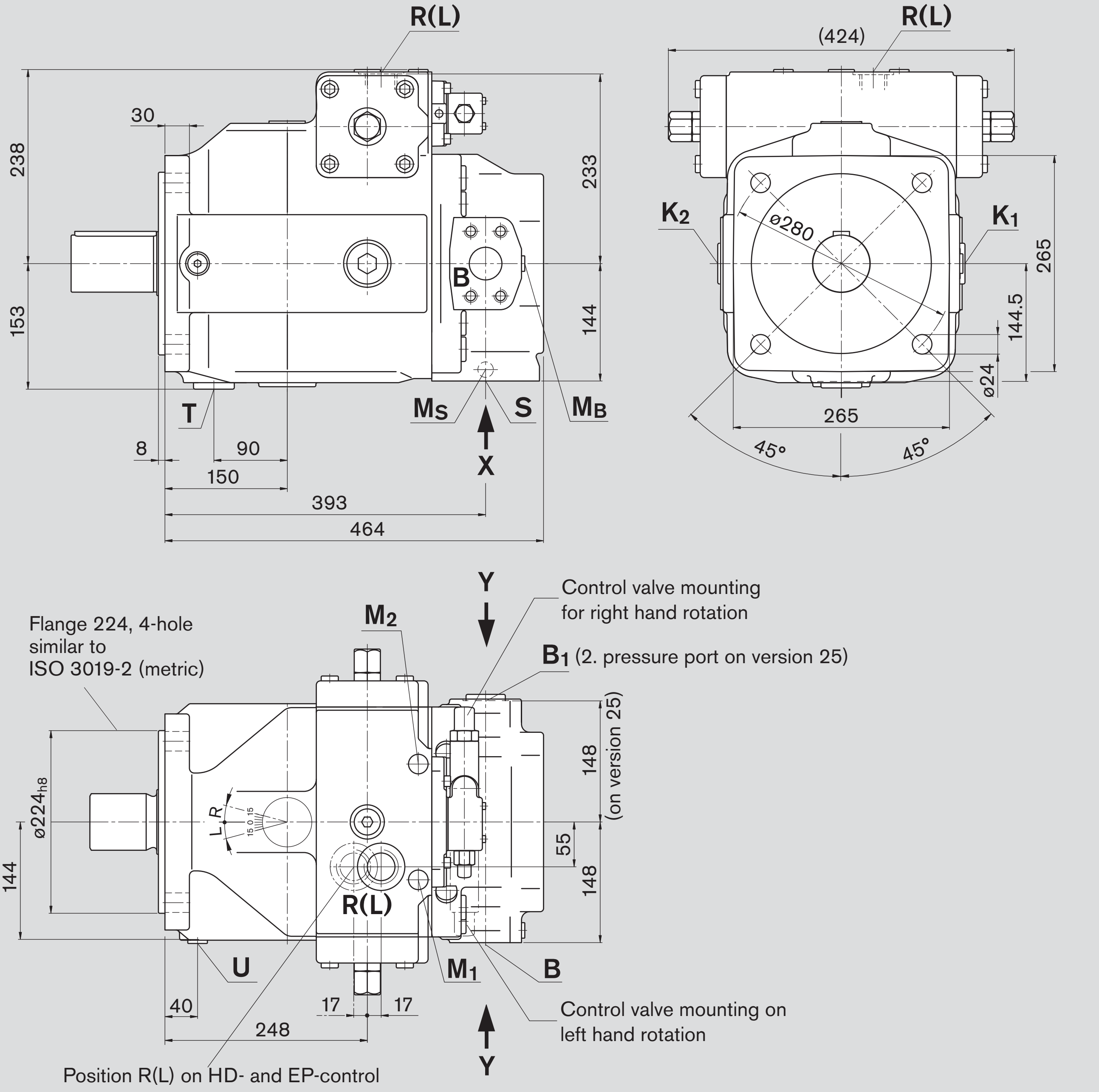
[3] Caution: thread deviates from standard

Dimensions, size 355

Before finalising your design please request a certified installation drawing. Dimensions in mm.

Series 3

(Example: pressure control; for exact dimensions of control devices see separate data sheets)



Control valve mounting for right hand rotation

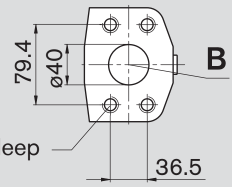
B1 (2. pressure port on version 25)

Flange 224, 4-hole similar to ISO 3019-2 (metric)

Control valve mounting on left hand rotation

Position R(L) on HD- and EP-control

View Y

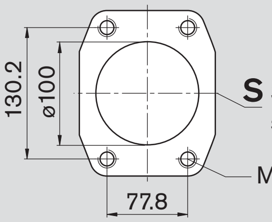


B (B1 on version 25, shown without blanking plate)

SAE 1 1/2 in high pressure series

M16; 25 deep

View X



S SAE 4 in standard pressure series

M16; 21 deep

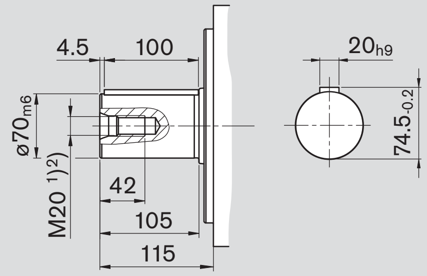
For dimensions of shaft ends and ports see page 29

Dimensions, size 355

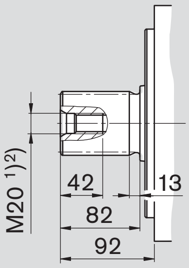
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Shaft ends

P Keyed to DIN 6885
AS20x12x100



Z Splined to DIN 5480
W70x3x22x9g



Ports

				max. tightening torque 2)
S	Suction port (standard pressure series) Fixing thread	SAE J518 3) DIN 13	4 in M16x2; 21 deep 2)	
K_1, K_2	Flushing port	DIN 3852	M42x2; 20 deep (plugged)	720 Nm
T	Drain	DIN 3852	M42x2; 20 deep (plugged)	720 Nm
M_B	Measuring port outlet pressure	DIN 3852	M14x1,5; 12deep (plugged)	80 Nm
M_S	Measuring port suction pressure	DIN 3852	M14x1,5; 12 deep (plugged)	80 Nm
R(L)	Fill + air bleed (case drain port)	DIN 3852	M42x2; 20 deep	720 Nm
U	Flushing port	DIN 3852	M18x1,5;12 deep (plugged)	140 Nm
M_1, M_2	Measuring port control chamber pressure	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm

on version 13

B	Pressure port (high pressure series) Fixing thread	SAE J518 3) DIN 13	1 1/2 in M16x2; 25 deep 2)	
B_1	Additional port	DIN 3852	M42x2; 20 deep (plugged)	720 Nm

on version 25

B	Pressure port (high pressure series) Fixing thread	SAE J518 3) DIN 13	1 1/2 in M16x2; 25 deep2)
B_1	2. pressure port (high pressure series) Fixing thread	SAE J518 3) DIN 13	1 1/2 in (closed with blanking plate) M16x2; 25 deep 2)

1) Center bore to DIN 332 (thread to DIN 13)

2) for the max. tightening torques please observe the manufacturer‘s information on the used fittings and the general information on page 68

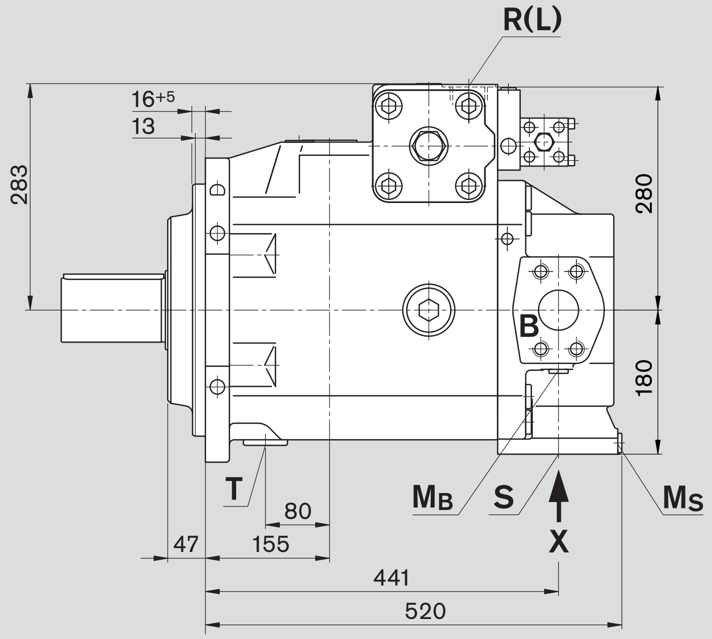
3) Caution: metric thread deviates from standard

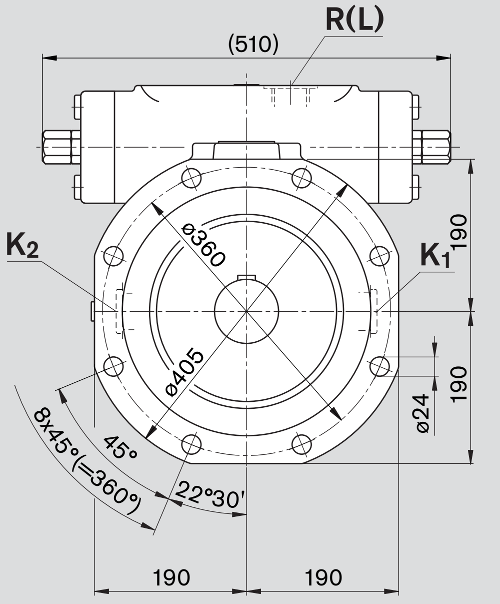
Dimensions, size 500

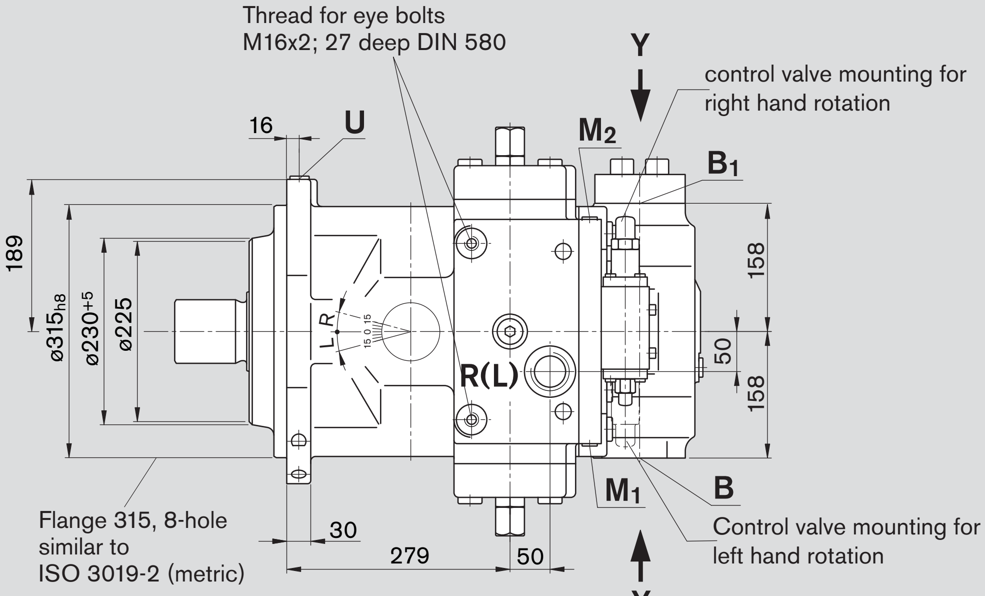
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Series 3

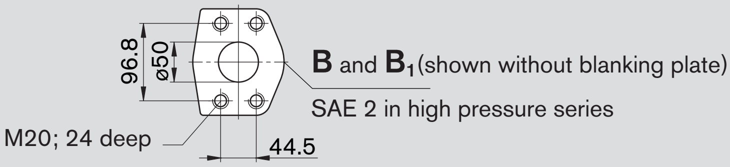
(Example: pressure control; for exact dimensions of control devices see separate data sheets)



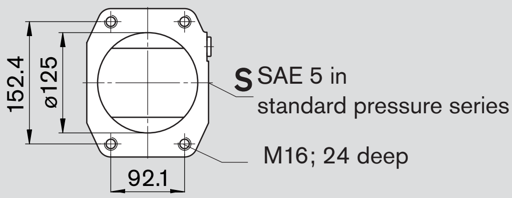




View Y



View X



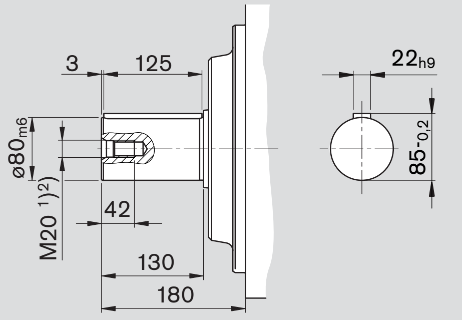
For dimensions of shaft ends and ports see page 31

Dimensions, size 500

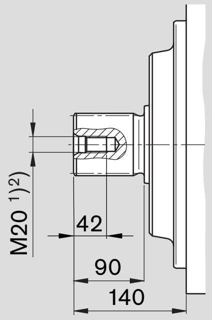
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Shaft ends

P Keyed to DIN 6885
AS22x14x125



Z Splined to DIN 5480
W80x3x25x9g



Ports

				max. tightening torque 2)
S	Suction port (standard pressure series)	SAE J518 3)	5 in	
	Fixing thread	DIN 13	M16x2; 24 deep 2)	
K_1, K_2	Flushing port	DIN 3852	M48x2; 22 deep (plugged)	960 Nm
T	Drain	DIN 3852	M48x2; 22 deep (plugged)	960 Nm
M_B	Measuring port outlet pressure	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
M_S	Measuring port suction pressure	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
R(L)	Fill + air bleed (case drain port)	DIN 3852	M48x2; 22 deep	960 Nm
U	Flushing port	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
M_1, M_2	Measuring port control chamber pressure	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
	or dependent on control device	DIN 3852	M14x1,5; 12 deep (plugged)	80 Nm
B	Pressure port (high pressure series)	SAE J518 3)	2 in	
	Fixing thread	DIN 13	M20x2,5; 24 deep 2)	
B_1	2. pressure port (high pressure series)	SAE J518 3)	2 in (closed with blanking plate)	
	Fixing thread	DIN 13	M20x2,5; 24 deep 2)	

1) Center bore to DIN 332 (thread to DIN 13)

2) for the max. tightening torques please observe the manufacturer's information on the used fittings and the general information on page 68

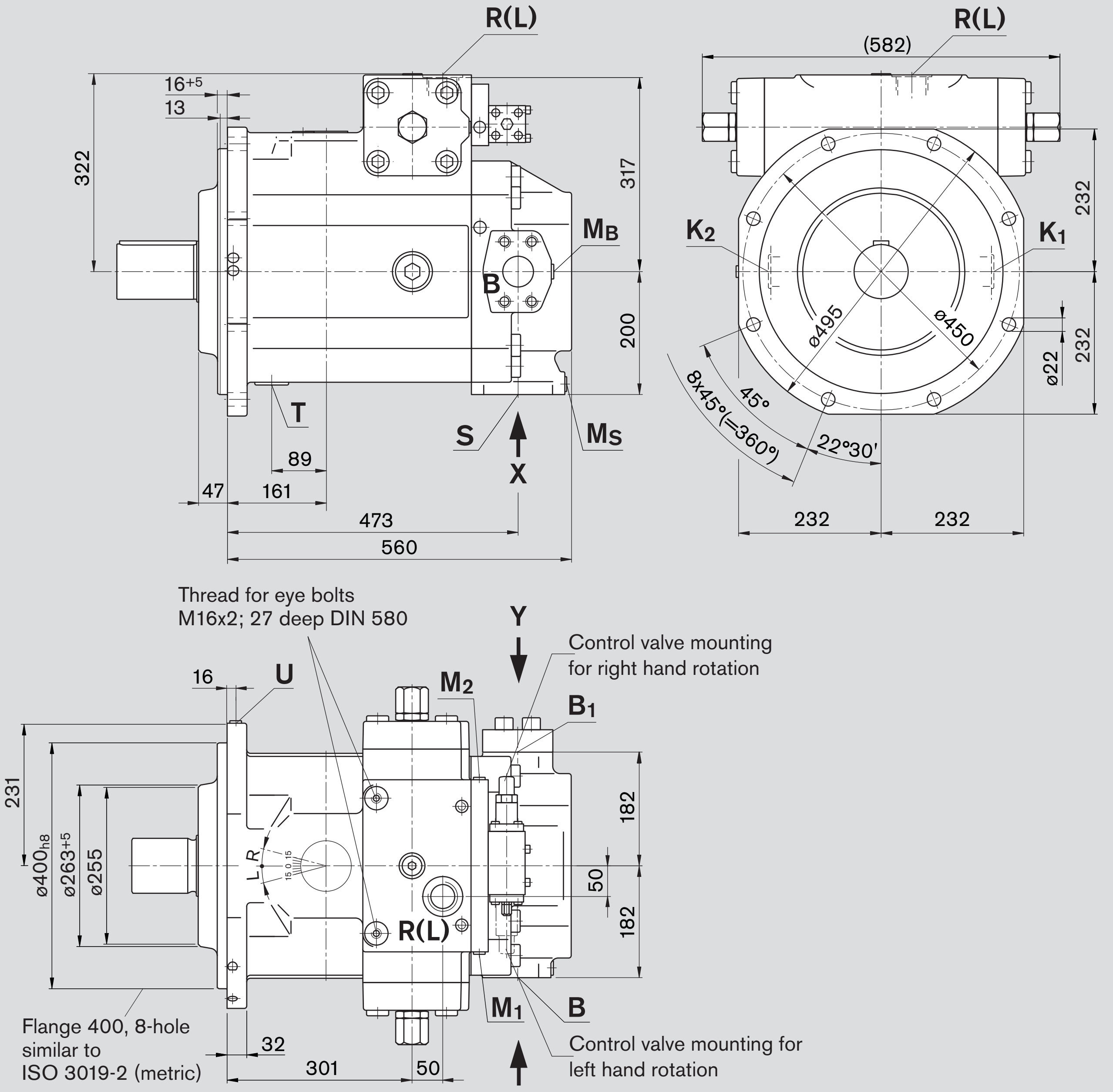
3) Caution: metric thread deviates from standard

Dimensions, size 750

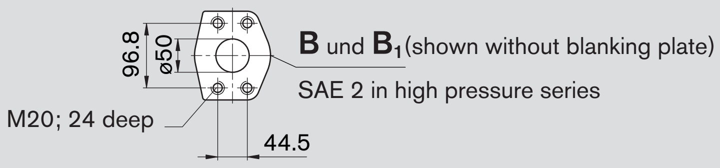
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Series 3

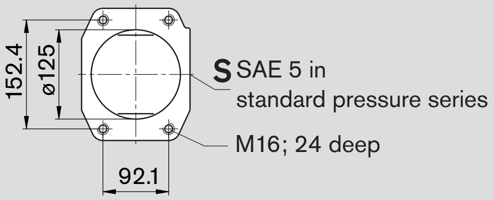
(Example: pressure control; for exact dimensions of control devices see separate dData sheets)



View Y



View X



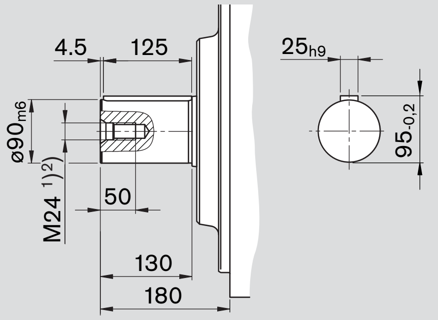
For dimensions of shaft ends and ports see page 33

Dimensions , size 750

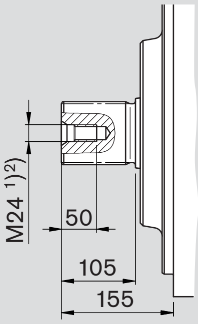
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Shaft ends

P Keyed to DIN 6885
AS25x14x125



Z Splined to DIN 5480
W90x3x28x9g



Ports

				max. tightening torques
S	Suction port (standard pressure series) Fixing thread	SAE J518 3) DIN 13	5 in M16x2; 24 deep 2)	
K_1, K_2	Flushing port	DIN 3852	M48x2; 20 deep (plugged)	960 Nm
T	Drain	DIN 3852	M48x2; 20 deep (plugged)	960 Nm
M_B	Measuring port outlet pressure	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
M_S	Measuring port suction pressure	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
R(L)	Fill + air bleed (case drain port)	DIN 3852	M48x2; 20 deep	960 Nm
U	Flushing port	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
M_1, M_2	Measuring port control chamber press. or dependent on control device	DIN 3852 DIN 3852	M18x1,5; 12 deep (plugged) M14x1,5; 12 deep (plugged)	140 Nm 80 Nm
B	Pressure port (high pressure series) Fixing thread	SAE J518 3) DIN 13	2 in M20x2,5; 24 deep 2)	
B_1	2. pressure port (high pressure series) Fixing thread	SAE J518 3) DIN 13	2 in (closed with blanking plate) M20x2,5; 24 deep 2)	

1) Center bore to DIN 332 (thread to DIN 13)

2) for the max. tightening torques please observe the manufacturer‘s information on the used fittings and the general information on page 68

3) Caution: metric thread deviates from standard

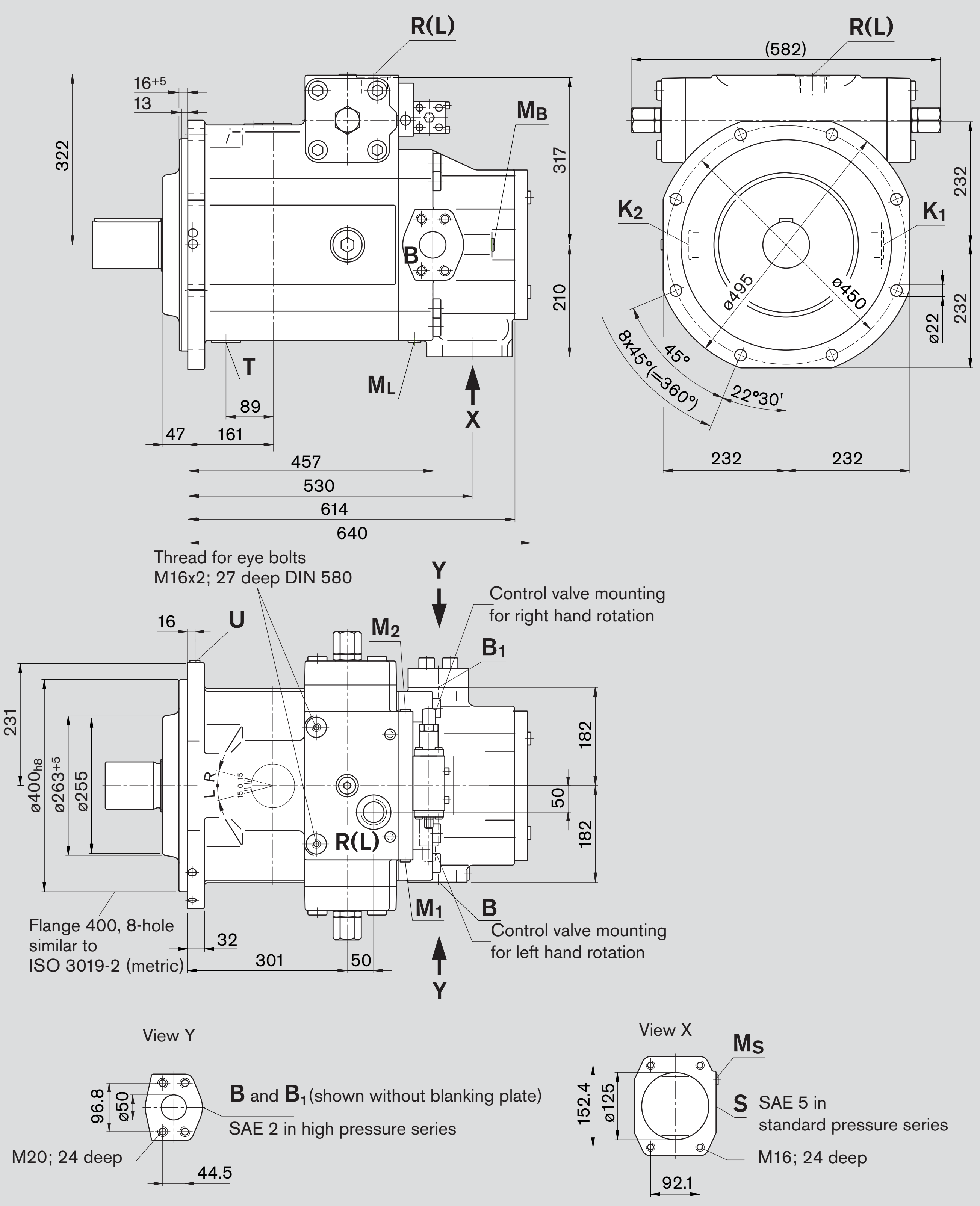
Dimensions, size 750

Before finalising your design please request a certified installation drawing. Dimensions in mm.

with boost pump (Impeller)

Series 3

(Example: pressure control; for exact dimensions of control devices see separate data sheets)



For dimensions of shaft ends and ports see page 35

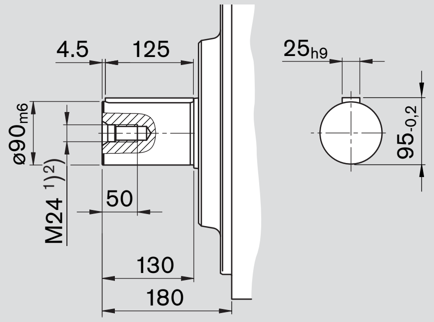
Dimensions, size 750

Before finalising your design please request a certified installation drawing. Dimensions in mm.

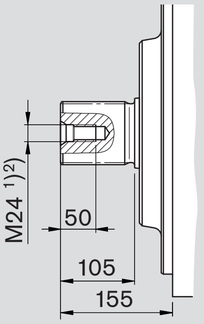
with boost pump (Impeller)

Shaft ends

P Keyed to DIN 6885
AS25x14x125



Z Splined to DIN 5480
W90x3x28x9g



Ports

				max. tightening torque 2)
S	Suction port (standard pressure series) Fixing thread	SAE J518 3) DIN 13	5 in M16x2; 24 deep 2)	
K_1, K_2	Flushing port	DIN 3852	M48x2; 20 deep (plugged)	960 Nm
T	Drain	DIN 3852	M48x2; 20 deep (plugged)	960 Nm
M_B	Measuring port outlet pressure	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
M_S	Measuring port suction pressure	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
M_L	Measuring port boost pressure	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
R(L)	Fill + air bleed (case drain port)	DIN 3852	M48x2; 20 deep	960 Nm
U	Flushing port	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
M_1, M_2	Measuring port control chamber press. or dependent on control device	DIN 3852 DIN 3852	M18x1,5; 12 deep (plugged) M14x1,5; 12 deep (plugged)	140 Nm 80 Nm
B	Pressure port (high pressure series) Fixing thread	SAE J518 3) DIN 13	2 in M20x2,5; 24 deep 2)	
B_1	2. pressure port (high pressure series) Fixing thread	SAE J518 3) DIN 13	2 in (closed with blanking plate) M20x2,5; 24 deep 2)	

1) Center bore to DIN 332 (thread to DIN 13)

2) for the max. tightening torques please observe the manufacturer‘s information on the used fittings and the general information on page 68

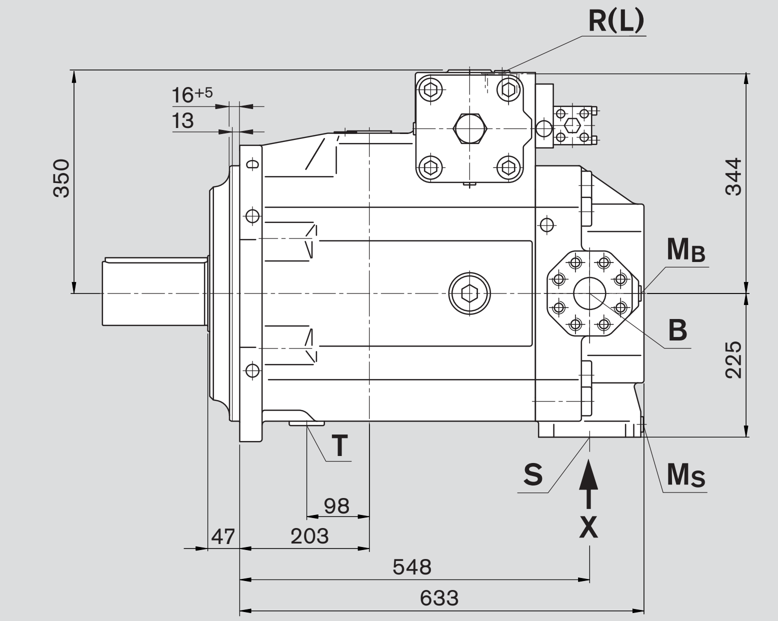
3) Caution: metric thread deviates from standard

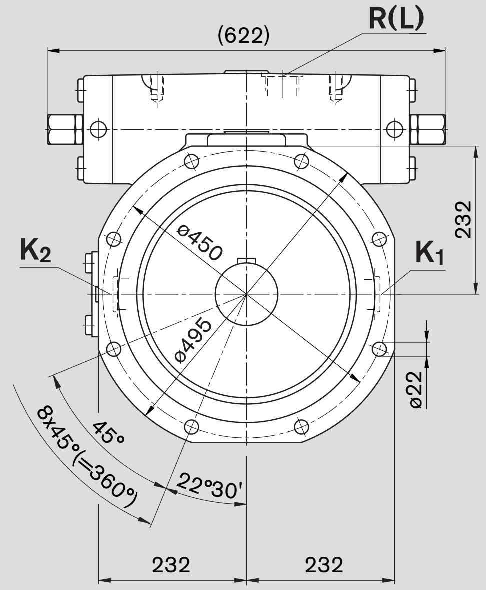
Dimensions, size 1000

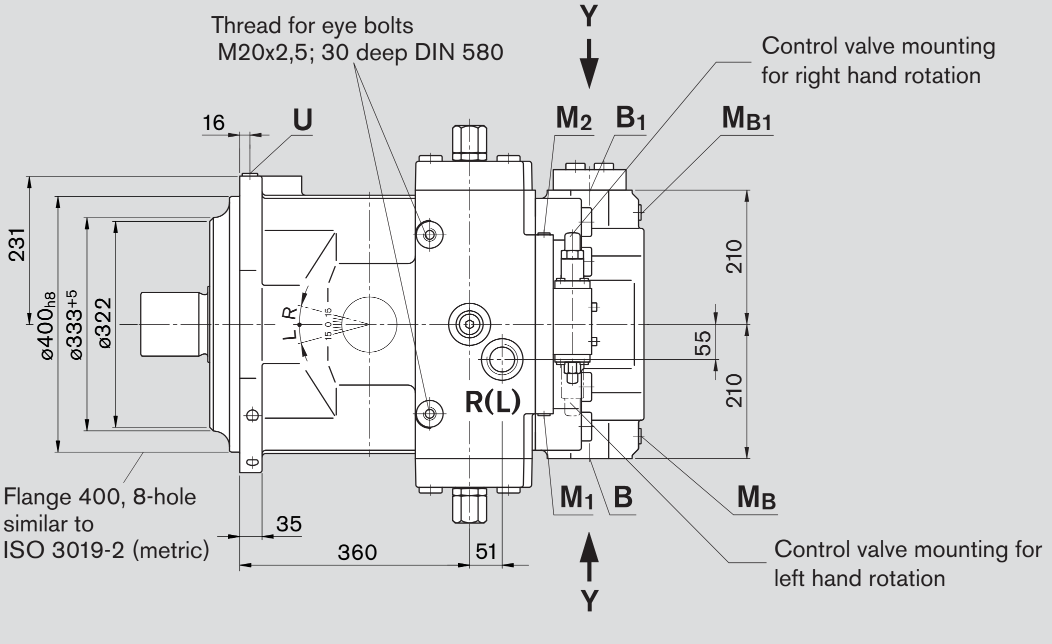
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Series 3

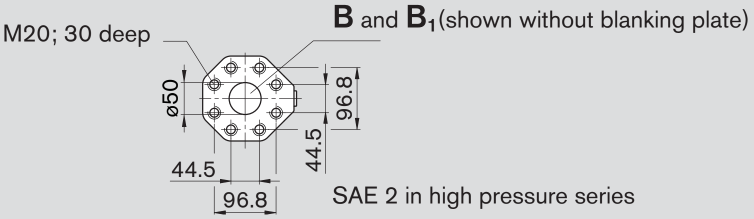
(Example: pressure control; for exact dimensions of control devices see separate data sheets)



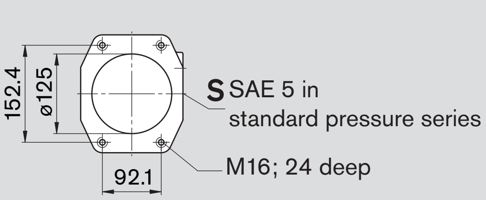




View Y



View X



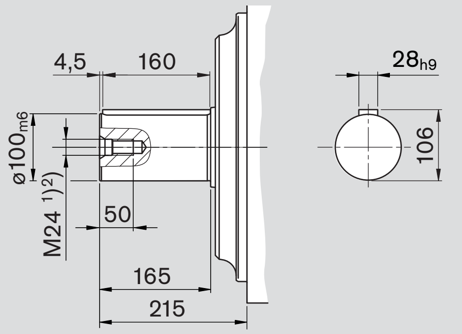
For dimensions of shaft ends and ports see page 37

Dimensions, size 1000

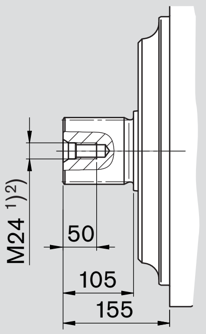
Before finalising your design please request a certified installation drawing. Dimensions in mm.

Shaft ends

P Keyed to DIN 6885
AS28x16x160



Z Splined to DIN 5480
W100x3x32x9g



Ports

				max. tightening torque
S	Suction port (standard pressure series) Fixing thread	SAE J518 3) DIN 13	5 in M16x2; 24 deep 2)	
K_1, K_2	Flushing port	DIN 3852	M48x2; 20 deep (plugged)	960 Nm
T	Drain	DIN 3852	M48x2; 20 deep (plugged)	960 Nm
M_B, M_{B1}	Measuring port outlet pressure	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
M_S	Measuring port suction pressure	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
R(L)	Fill + air bleed (case drain port)	DIN 3852	M48x2; 20 deep	960 Nm
U	Flushing port	DIN 3852	M18x1,5; 12 deep (plugged)	140 Nm
M_1, M_2	Measuring port control chamber press.or dependent on control device	DIN 3852 DIN 3852	M18x1,5; 12 deep (plugged) M14x1,5; 12 deep (plugged)	140 Nm 80 Nm
B	Pressure port (high pressure series) Fixing thread	SAE J518 3) DIN 13	2 in M20x2,5; 30 deep 2)	
B_1	2. pressure port (high pressure series) Fixing thread	SAE J518 3) DIN 13	2 in (closed with blanking plate) M20x2,5; 30 deep 2)	

1) Center bore to DIN 332 (thread to DIN 13)

2) for the max. tightening torques please observe the manufacturer‘s information on the used fittings and the general information on page 68

3) Caution: metric thread deviates from standard

Through drive

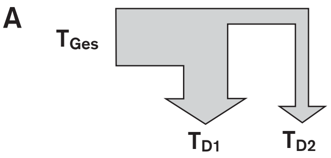
The axial piston unit A4VSO can be equipped with a through drive, as shown in the type code on page 4.
The through drive execution is designated by the code K/U 31...99.

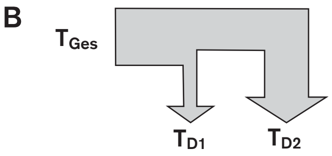
We recommend, that no more than three pumps be coupled together.

Permissible input and through drive torques

Size			40	71	125	180	250	355	500	750	1000
Splined shaft											
Max. perm. total input torque at shaft of pump 1 (Pump 1 + pump 2)	$T_{tot\ max}$	Nm	446	790	1392	2004	2782	3952	5566	8348	11130
A Perm.through drive torque	$T_{D1\ max}$	Nm	223	395	696	1002	1391	1976	2783	4174	5565
	$T_{D2\ max}$	Nm	223	395	696	1002	1391	1976	2783	4174	5565
B Perm. through drive torque	$T_{D1\ max}$	Nm	223	395	696	1002	1391	1976	2783	4174	5565
	$T_{D2\ max}$	Nm	223	395	696	1002	1391	1976	2783	4174	5565
Keyed shaft											
Max. perm. total input torque at shaft of pump 1 (Pump 1 + pump 2)	$T_{tot\ max}$	Nm	380	700	1392	1400	2300	3557	5200	7513	9444
A Perm. through drive torque	$T_{D1\ max}$	Nm	223	395	696	1002	1391	1976	2783	4174	5565
	$T_{D2\ max}$	Nm	157	305	696	398	909	1581	2417	3339	3879
B Perm. through drive torque	$T_{D1\ max}$	Nm	157	305	696	398	909	1581	2417	3339	3879
	$T_{D2\ max}$	Nm	223	395	696	1002	1391	1976	2783	4174	5565

Distribution of torques





Single pump with through drive

If no further pumps are factory-mounted the simple type code is sufficient.

included in this case are:

on all through drives except K/U 99
shaft coupler, mounting screws, seal and if required an adapter flange

on K/U 99
with through drive shaft, without shaft coupler, without adapter flange; unit is closed with pressure tight cover.

Universal through drive

On pump sizes 125...355 all through drives are supplied as universal through drives „U“ .

These have the advantage, that they can be adapted later on.

Simply by exchanging the adapter flange and the shaft coupler it is possible to convert the through drive option.
The conversion sets must be ordered separately, see RE 95581.

Combination pumps

Independent circuits are available for the user when further pumps are built on.

1. If the combination consists of **2 Rexroth axial piston pumps**, and if this must be **factory mounted**, the two individual type codes must be joined by a „+“ .

   Ordering example:
   A4VSO 125 DR / 30 R – PPB13K33 **+** A4VSO 71 DR / 10 R – PZB13N00

2 If a **gear** or a radial piston pump must be **factory mounted** as the second pump please consult us.

Overview of A4VSO through drive options

Through drive - A4VSO			**Mounting option 2. pump**					**Through drive**
Flange	Coupler for splined shaft 6)	Code	A4VSO/G size (shaft)	A4CSG size (shaft)	A10V(S)O/31(2) 5) size (shaft)	A10V(S)O/52(3) size (shaft)	External/internal gear pump	available for size
Flange ISO 3019-2 (metric)								
80, 2-hole	19-4 (3/4in, 11T) 3)	**K/UB2**	–	–	18 (S)/31	10 (S)	–	71
100, 2-hole	22-4 (7/8in, 13T) 3)	**K/UB3**	–	–	28 (S)/31	–	–	40...180
	25-4 (1in, 15T) 3)	**K/UB4**	–	–	45 (S)/31	–	–	40...500
125, 2-hole	32-4 (1 1/4in, 14T) 3)	**K/UB5**	–	–	71 (S)/31	–	–	71...355
	38-4(1 1/2in, 17T) 3)	**UB6**	–	–	100 (S)/31	–	–	in preparation
125, 4-hole	W 32x2x14x9g 2)	**K/U31**	40 (Z)	–	–	–	–	40...500
140, 4-hole	W 40x2x18x9g 2)	**K/U33**	71 (Z)	–	–	–	–	71...750
160, 4-hole	W 50x2x24x9g 2)	**K/U34**	125 (Z)	–	–	–	–	125...750
			180 (Z)	–	–	–	–	180...750
	32-4 (1 1/4in, 14T) 3)	**UB8**	–	–	71 (S)/32	–	–	250
180, 4-hole	44-4 (1 3/4in, 13T) 3)	**K/UB7**	–	–	140 (S)/31/32	–	–	180... 500
	38-4 (1 1/2in, 17T) 3)	**UB9**	–	–	100 (S)/32	–	–	in preparation
224, 4-hole	W 60x2x28x9g 2)	**K/U35**	250 (Z)	250 (Z)	–	–	–	250...750
	W 70x3x22x9g 2)	**K/U77**	355 (Z)	355 (Z)	–	–	–	355, 500
315, 8-hole	W 80x3x25x9g 2)	**K43**	500 (Z)	500 (Z)	–	–	–	500, 750
400, 8-hole	W 90x3x28x9g 2)	**K76**	750 (Z)	750 (Z)	–	–	–	750
	W 100x3x32x9g 2)	**K88**	1000 (Z)	–	–	–	–	1000
Flange SAE J 744 (ISO 3019-1)								
82-2 (A) 1)	16-4 (5/8in, 9T) 3)	**K/U01**	–	–	–	–	AZ-PF-1X-004...022 4)	40...750
	19-4 (3/4in, 11T) 3)	**K/U52**	–	–	18 (S)/31	10, 18 (S)	–	40 u. 71
101-2 (B) 1)	22-4 (7/8in, 13T) 3)	**K/U68**	–	–	28 (S)/31	28 (S)	AZ-PN-1X-020...032 4)	40...500
	25-4 (1in, 15T) 3)	**K/U04**	–	–	45 (S)/31	45 (S)	PGH4	40...500
127-2 (C) 1)	32-4 (1 1/4in, 14T) 3)	**K/U07**	–	–	71 (S)/31	–	–	71...500
	38-4 (1 1/2in, 17T) 3)	**K/U24**	–	–	100 (S)/31	85 (S)	PGH5	125...500
152-4 (D) 1)	44-4 (1 3/4in, 13T) 3)	**K/U17**	–	–	140 (S)/31	–	–	180...500
Dia 63-4, metr.	Keyed dia 25	**K/U57**	–	–	–	–	R4	40 u. 71

1) 2 = 2-hole, 4 = 4-hole

2) to DIN 5480

3) Splined shafts acc. to SAEJ744 OCT83

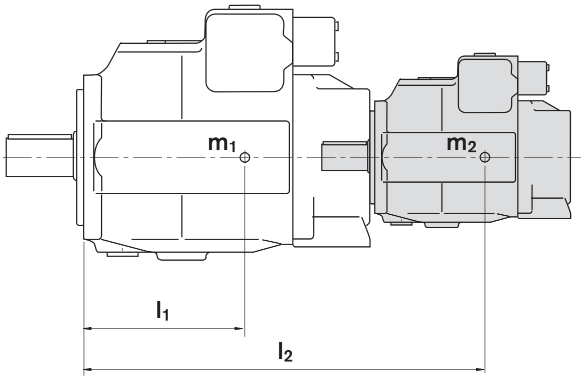
4) Rexroth recommends special executions of the gear pumps. Please consult us.

5) If a through drive for an A10V(S)O with R-shaft is desired, please consult us.

6) Keyed shaft on through drive code K/U57

Permissible mass moment of inertia

referred to the mounting flange of the main pump



m_1, m_2 [kg] Weight of pump

l_1, l_2 [mm] Distance center of gravity

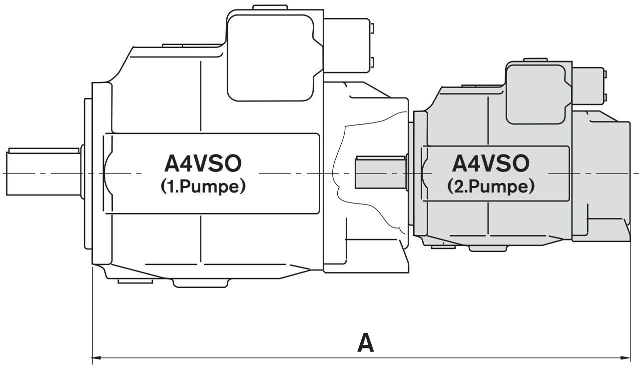
$$T_m = m_1 \bullet l_1 \bullet \frac{1}{102} + m_2 \bullet l_2 \bullet \frac{1}{102} \text{ [Nm]}$$

Size			**40**	**71**	**125**	**180**	**250**	**355**	**500**	**750**	**1000**
Perm. mass moment of inertia	$T_{m\ perm.}$	Nm	1800	2000	4200	4200	9300	9300	15600	19500	19500
Perm. mass moment at dynam. acceleration of 10 g ≙ 98,1 m/sec^2	$T_{m\ perm.}$	Nm	180	200	420	420	930	930	1560	1950	1950
Weight (A4VSO...DR)	*m*	kg	39	53	88	102	184	207	320	460	605
Distance center of gravity	l_1	mm	120	140	170	180	210	220	230	260	290

Dimensions combination pumps

Before finalising your design please request a certified installation drawing. Dimensions in mm.

A4VSO + A4VSO



Overall lenght A

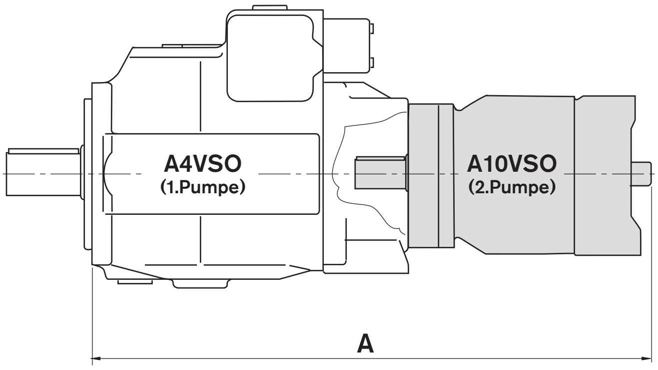
A4VSO	A4VSO..DR..N00 (2. pump)								
(1. pump)	**Size 40**	**Size 71**	**Size 125**	**Size 180**	**Size 250**	**Size 355**	**Size 500**	**size 750**	**Size 1000**
Size 40	554	–	–	–	–	–	–	–	–
Size 71	582	611	–	–	–	–	–	–	–
Size 125	635	664	724	–	–	–	–	–	–
Size 180	659	688	748	768	–	–	–	–	–
Size 250	719	748	808	828	904	–	–	–	–
Size 355	748	777	837	857	933	962	–	–	–
Size 500	771	800	860	880	976	1005	1110	–	–
Size 750	821	850	910	930	1026	1055	1160	1214	–
Size 1000	*	*	*	*	*	*	*	*	1368

* on request

Dimensions combination pumps

Before finalising your design please request a certified installation drawing. Dimensions in mm.

A4VSO + A10VSO



Overall lenght A

A4VSO	A10VSO.../31 (2. pump)					
(1. pump)	Size 18	Size 28	Size 45	Size 71	Size 100	Size 140
Size 40	458	496	514	–	–	–
Size 71	486	497	540	580	–	–
Size 125	564	575	593	628	698	–
Size 180	588	599	617	652	722	744
Size 250	648	659	677	712	782	791
Size 355	*	*	706	741	*	820
Size 500	700	711	729	764	857	868
Size 750	750	761	779	812	907	917
Size 1000	*	*	*	*	*	*

* on request

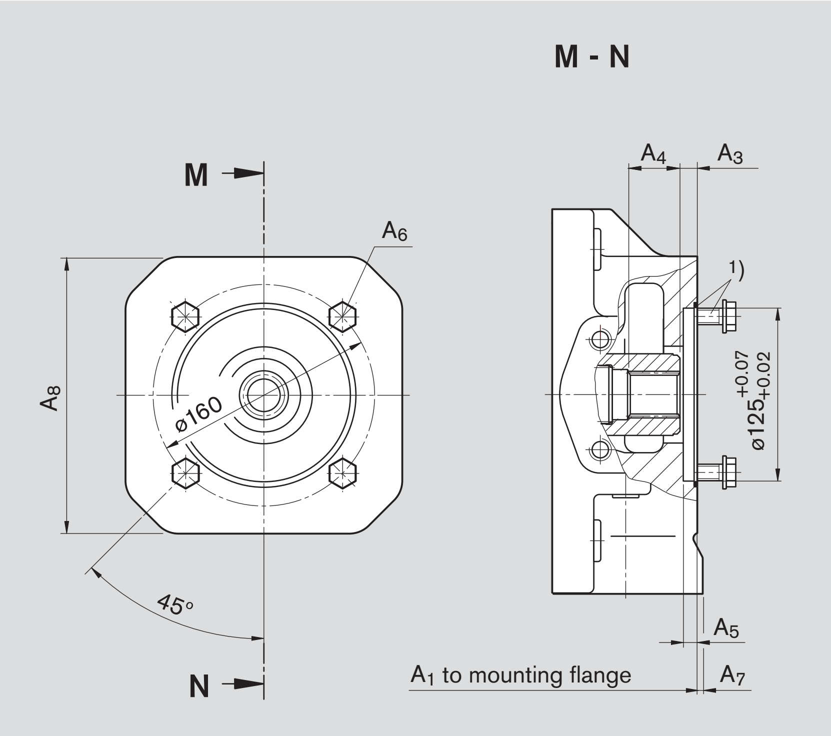
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K31

Flange ISO 3019-2 125, 4-hole
Shaft coupler to DIN 5480 N32x2x14x8H

for mounting an A4VSO/G 40 splined shaft



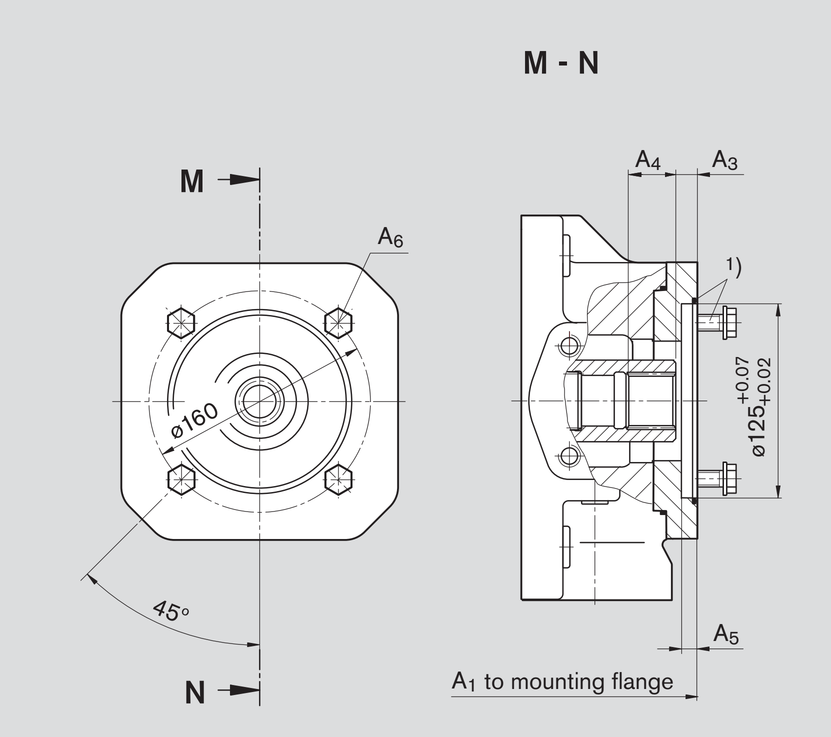
Size	A_1	A_3	A_4	A_5	A_6 [2]
40	288	12,5	40	9	M12
71	316	12,5	33,6	9	M12
500	505	12,5	38,5	9	M12
750	in preparation				
1000	in preparation				

Size	A_7	A_8
40	–	–
71	–	–
500	15	240
750	in preparation	
1000	in preparation	

U31

Flange ISO 3019-2 125, 4-hole
Shaft coupler to DIN 5480 N32x2x14x8H

for mounting an A4VSO/G 40 splined shaft



Size	A_1	A_3	A_4	A_5	A_6 [2]
125	369	12,5	35,6	9	M12
180	393	12,5	35,6	9	M12
250	453	12,5	38	9	M12
355	482	12,5	38	9	M12

---

[1] Mounting screws and O-ring seal are included with supply

[2] Thread to DIN 13, for the max. tightening torques observe the general information on page 68

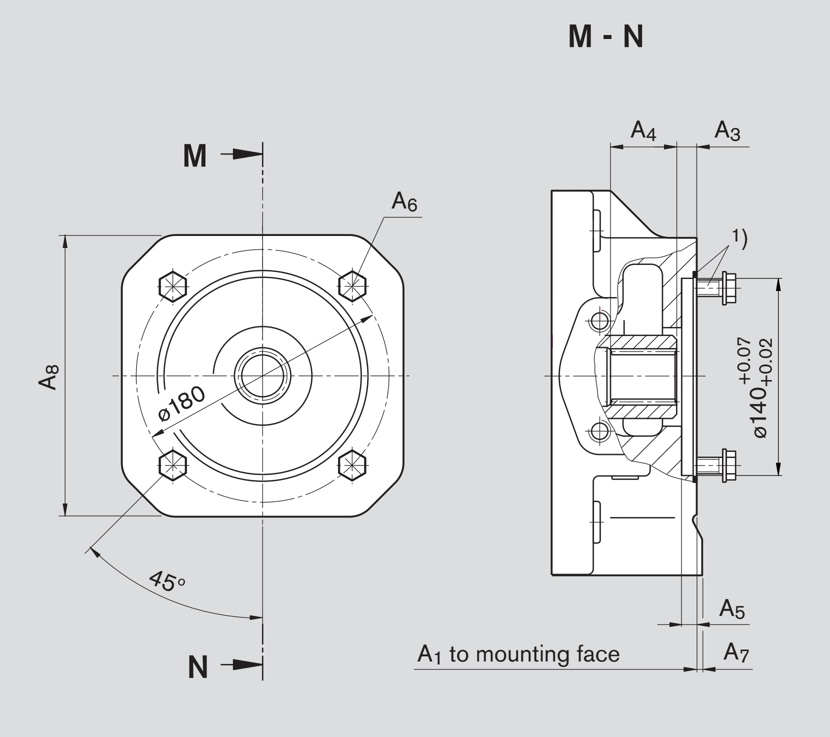
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K33

Flange ISO 3019-2 140, 4-hole
Shaft coupler to DIN 5480 N40x2x18x8H

for mounting an A4VSO/G 71 splined shaft



Size	A_1	A_3	A_4	A_5	A_6 2)
71	316	11,5	42,8	9	M12
500	505	12,5	57	9	M12
750	555	12,5	44,5	9	M12
750 *	in preparation				
1000	in preparation				

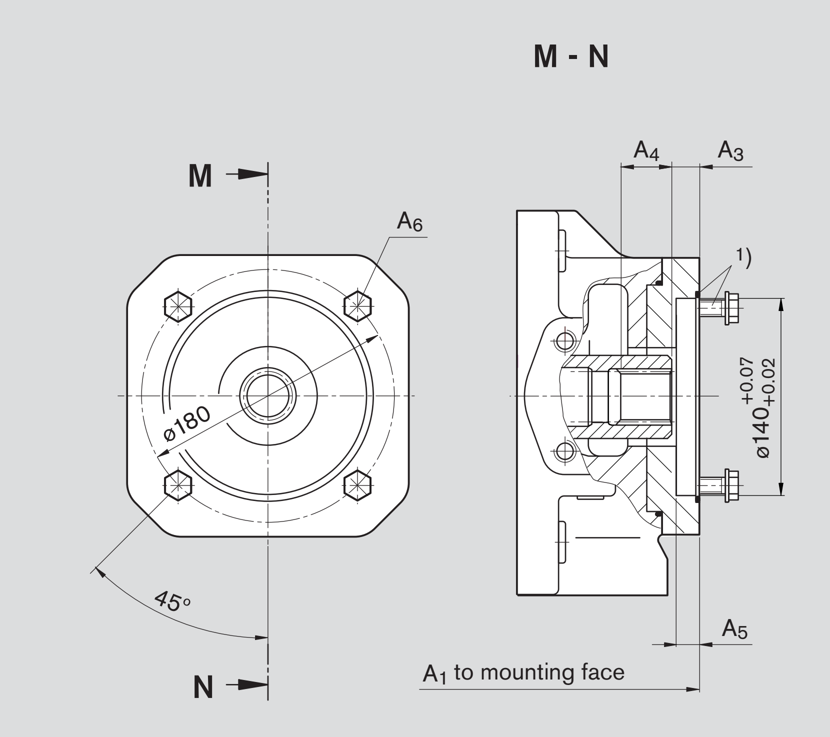
Size	A_7	A_8
71	–	–
500	15	240
750	–	–
750 *	in preparation	
1000	in preparation	

* with boost pump

U33

Flange ISO 3019-2 140, 4-hole
Shaft coupler to DIN 5480 N40x2x18x8H

for mounting an A4VSO/G 71 splined shaft



Size	A_1	A_3	A_4	A_5	A_6 2)
125	369	12,5	43,8	9	M12
180	393	12,5	43,8	9	M12
250	453	12,5	48,9	9	M12
355	482	12,5	48	9	M12

1) Mounting screws and O-ring seal are included with supply
2) Thread to DIN 13, for the max. tightening torques observe the general information on page 68

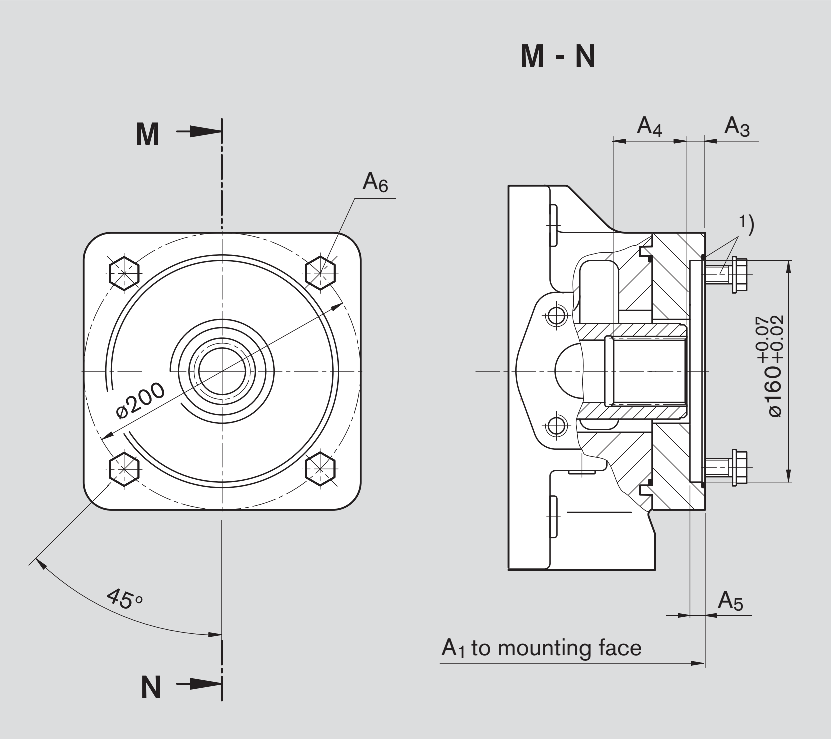
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K34

Flange ISO 3019-2 160, 4-hole
Shaft coupler to DIN 5480 N50x2x24x8H

for mounting an A4VSO/G 125 or 180 splined shaft



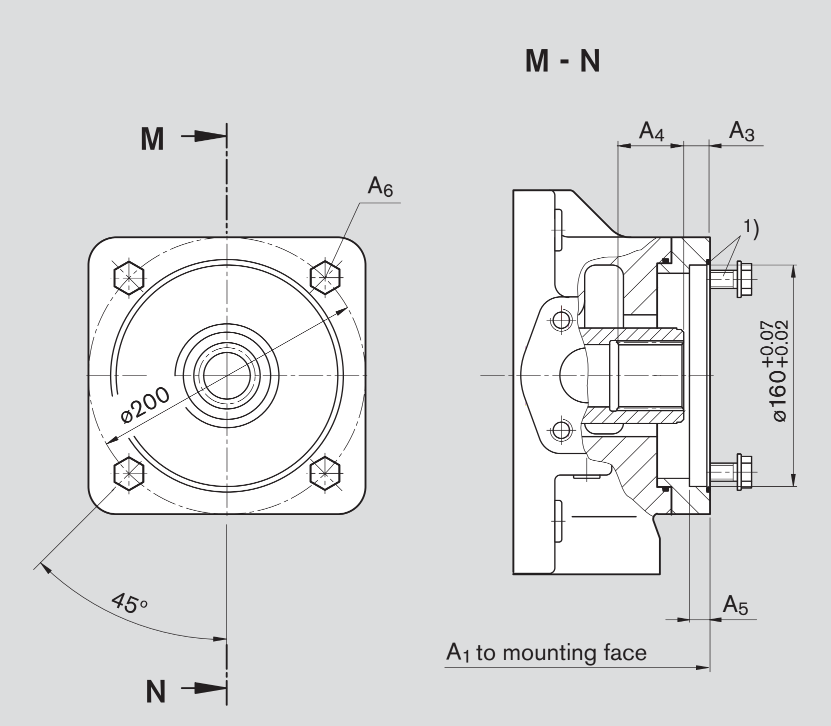
Size	**A₁**	**A₃**	**A₄**	**A₅**	**A₆** ²)
500	505	13,5	54,5	9	M16
750	555	12,5	55,5	9	M16
750 *	in preparation				
1000	in preparation				

* with boost pump

U34

Flange ISO 3019-2 160, 4-hole
Shaft coupler to DIN 5480 N50x2x24x8H

for mounting an A4VSO/G 125 or 180 splined shaft



Size	**A₁**	**A₃**	**A₄**	**A₅**	**A₆** ²)
125	369	12,5	51,6	9	M16
180	393	12,5	51,6	9	M16
250	453	12,5	54	9	M16
355	482	12,5	54	9	M16

---

[1] Mounting screws and O-ring seal are included with supply
[2] Thread to DIN 13, for the max. tightening torques observe the general information on page 68

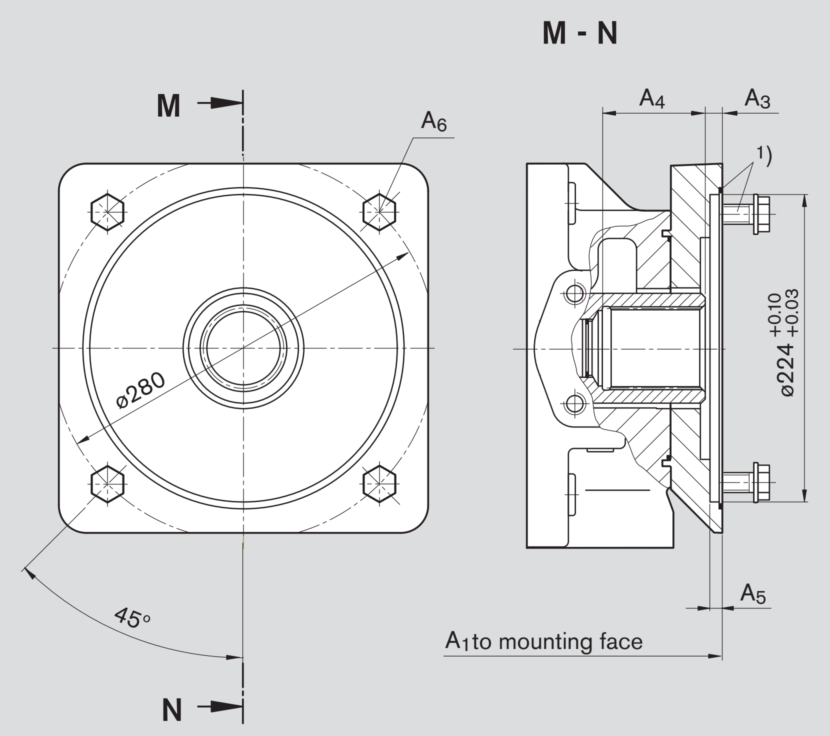
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K35

Flange ISO 3019-2 224, 4-hole
Shaft coupler to DIN 5480 N60x2x28x8H

for mounting an A4VSO/G or A4CSG 250 splined shaft



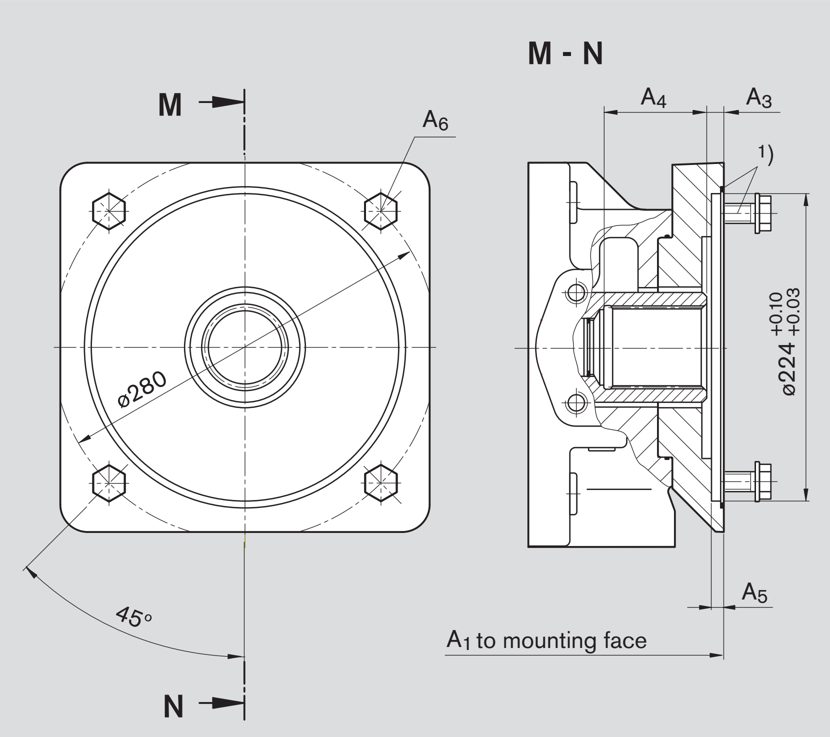
Size	A_1	A_3	A_4	A_5	A_6 2)
500	541	12,5	74	9	M20
750	591	12,5	74	9	M20
750*	in preparation				
1000	in preparation				

* with boost pump

U35

Flange ISO 3019-2 224, 4-hole
Shaft coupler to DIN 5480 N60x2x28x8H

for mounting an A4VSO/G or A4CSG 250 splined shaft



Size	A_1	A_3	A_4	A_5	A_6 2)
250	469	12,5	75	9	M20
355	498	12,5	75	9	M20

---

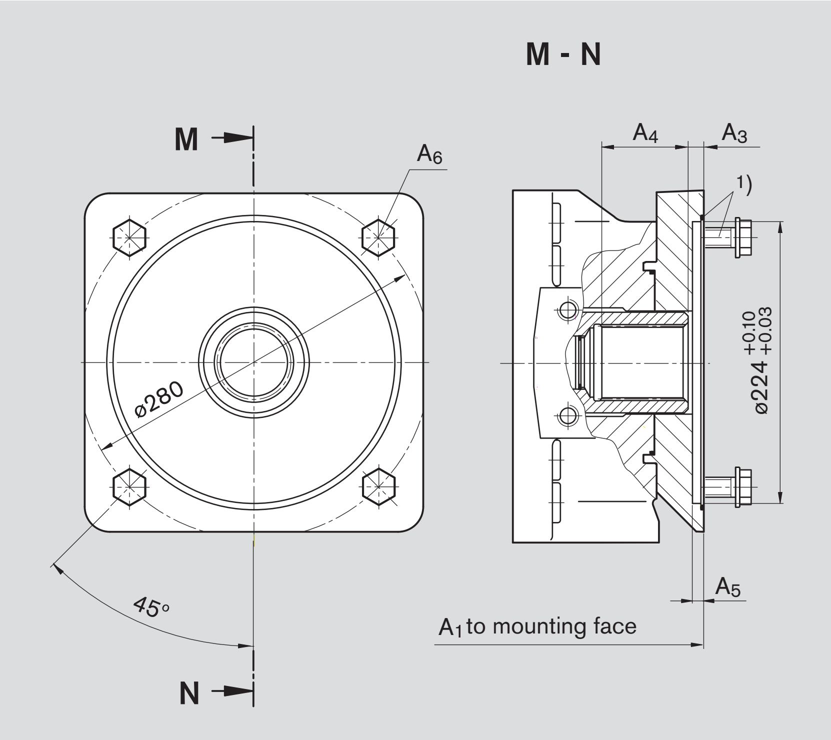
1) Mounting screws and O-ring seal are included with supply
2) Thread to DIN 13, for the max. tightening torques observe the general information on page 68

Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K77 **Flange** ISO 3019-2 224, 4-hole
Shaft coupler to DIN 5480 N70x3x22x8H

for mounting an A4VSO/G or A4CSG 355 splined shaft

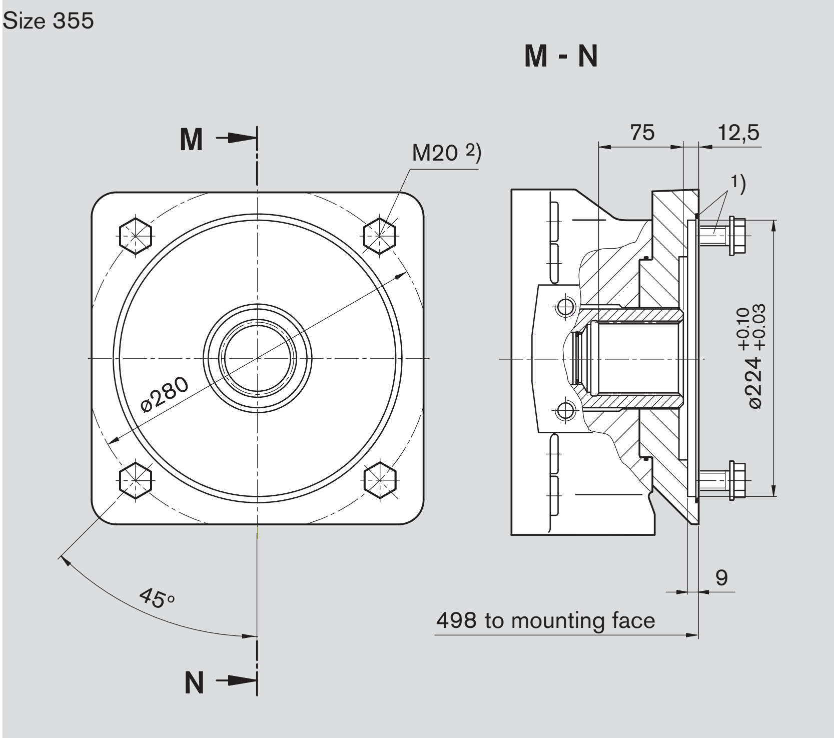


Size	A_1	A_3	A_4	A_5	A_6 2)
500	541	12,5	76	9	M20
750	in preparation				
1000	in preparation				

U77 **Flange** ISO 3019-2 224, 4-hole
Shaft coupler to DIN 5480 N70x3x22x8H

for mounting an A4VSO/G or A4CSG 355 splined shaft

Size 355



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[1]) Mounting screws and O-ring seal are included with supply

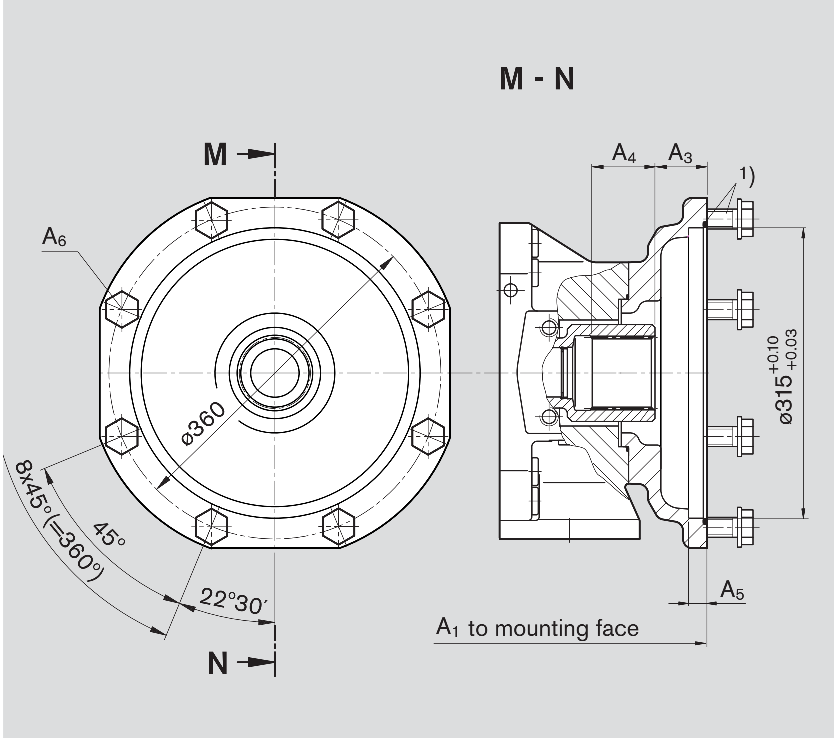
[2]) Thread to DIN 13, for the max. tightening torques observe the general information on page 68

Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K43 **Flange** ISO 3019-2 315, 8-hole
Shaft coupler to DIN 5480 N80x3x25x8H

for mounting an A4VSO/G or A4CSG 500 splined shaft

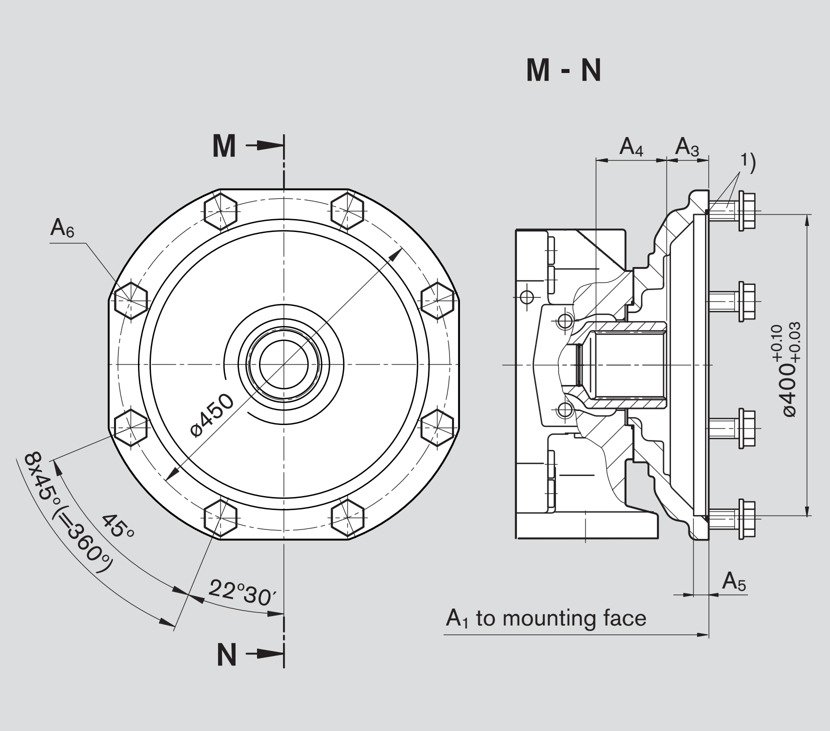


Size	A_1	A_3	A_4	A_5	A_6 2)
500	590	53,5	71,9	19	M20
750	640	53,5	71,9	19	M20
750*	in preparation				
1000	in preparation				

* with boost pump

K76 **Flange** ISO 3019-2 400, 8-hole
Shaft coupler to DIN 5480 N90x3x28x8H

for mounting an A4VSO/G or A4CSG 750 splined shaft



Size	A_1	A_3	A_4	A_5	A_6 2)
750	655	104	53	19	M20
750*	in preparation				
1000	in preparation				

* with boost pump

---

1) Mounting screws and O-ring seal are included with supply

2) Thread to DIN 13, for the max. tightening torques observe the general information on page 68

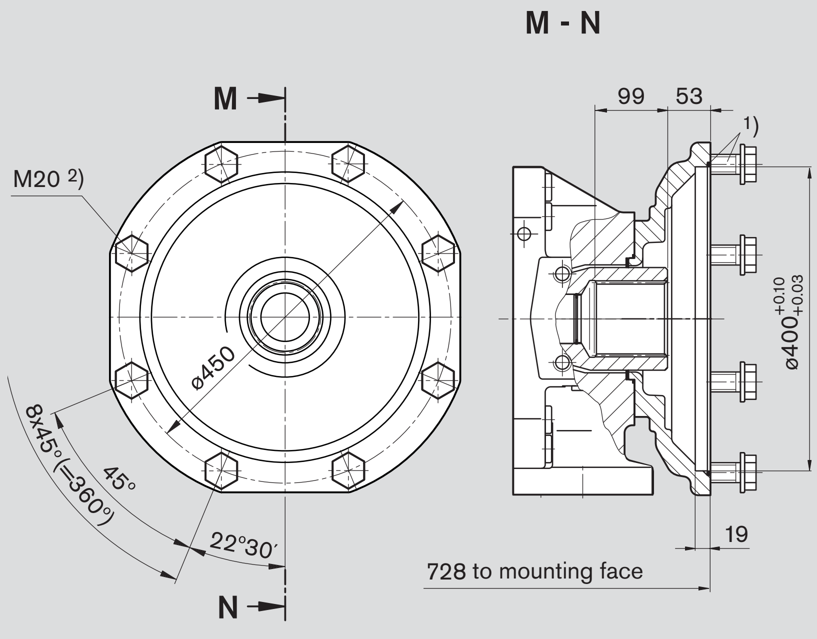
Dimensions through drives

K88

Flange ISO 3019-2 400, 8-hole
Shaft coupler to DIN 5480 N100x3x32x8H

for mounting an A4VSO/G 1000 splined shaft

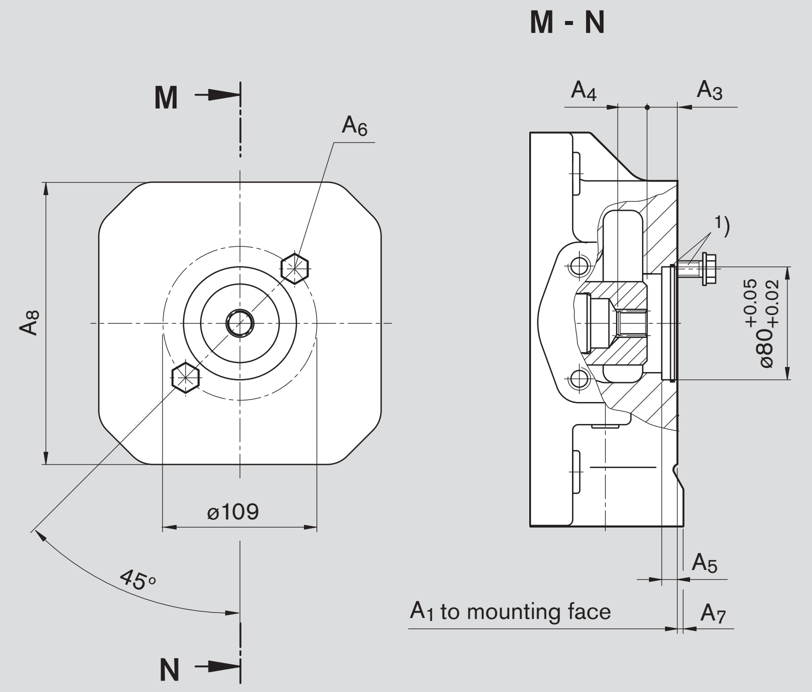
Size 1000



KB2

Flange ISO 3019-2 80, 2-hole
Shaft coupler for splined shaft, 19-4 SAE A-B, 3/4 in, 16/32 DP; 11T [3]

for mounting an A10VSO 18/31 shaft S – see RE 92712 or an
A10VSO 10/52 shaft S – see RE 92703



Size	A_1	A_3	A_4	A_5	A_6 [2]
40	in preparation				
71	291	21,5	19	10	M10
500	in preparation				
750	in preparation				
1000	in preparation				

Size	A_7	A_8
40	in preparation	
71	2	140
500	in preparation	
750	in preparation	
1000	in preparation	

Sizes 125...355 with U-through drive in preparation

[1] Mounting screws and O-ring seal are included with supply
[2] Thread to DIN 13, for the max. tightening torques observe the general information on page 68
[3] To ANSI B92.1a-1976, 30° pressure angle, flat base, flank centering, fit class 5

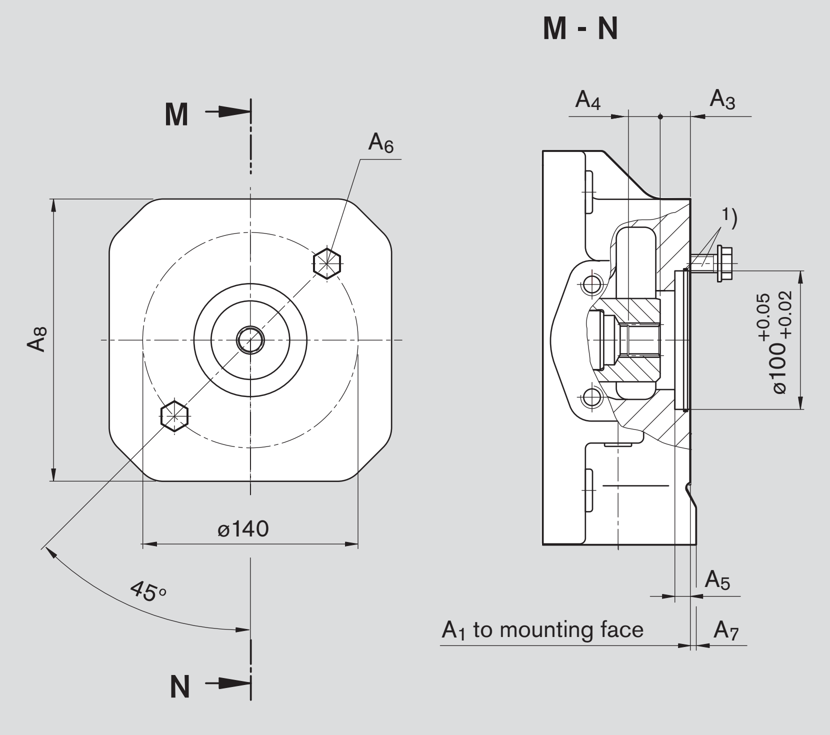
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

KB3

Flange ISO 3019-2 100, 2-hole
Shaft coupler for splined shaft, 22-4 SAE B, 7/8 in, 16/32 DP; 13T [3])

for mounting an A10VSO 28/31 splined shaft S (see RE 92711)



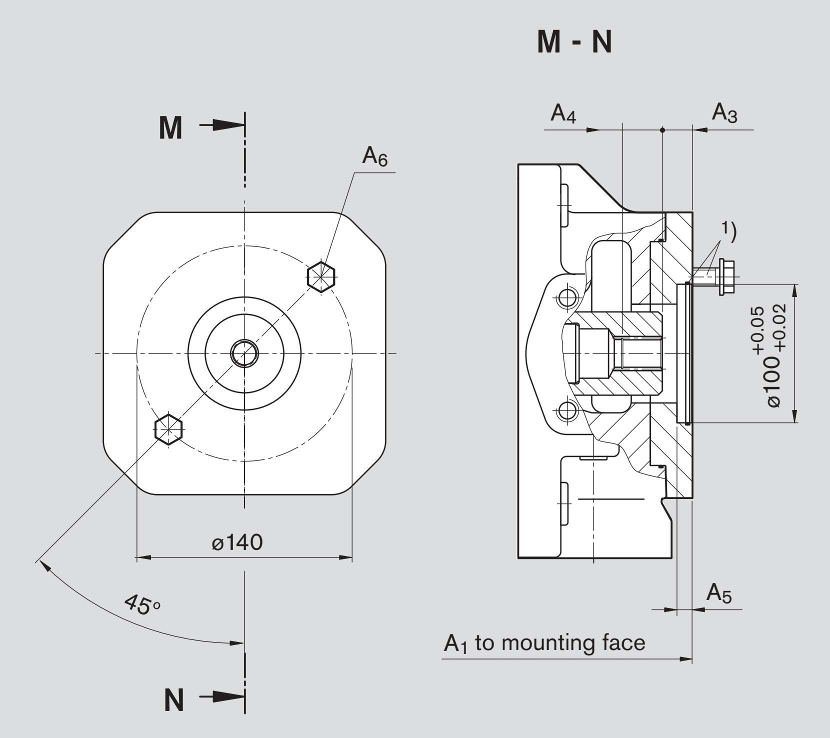
Size	A_1	A_3	A_4	A_5	A_6 [2])
40	290	20,3	23	10	M12
71	291	20,4	23	10	M12
500	in preparation				
750	in preparation				
1000	in preparation				

Size	A_7	A_8
40	–	–
71	2	140
500	in preparation	
750	in preparation	
1000	in preparation	

UB3

Flange ISO 3019-2 100, 2-hole
Shaft coupler for splined shaft, 22-4 SAE B, 7/8 in, 16/32 DP; 13T [3])

for mounting an A10VSO 28/31 splined shaft S (see RE 92711)



Size	A_1	A_3	A_4	A_5	A_6 [2])
125	369	20,5	24,9	10	M12
180	393	20,5	24,9	10	M12
250	in preparation				
355	in preparation				

---

[1]) 2 mounting screws and O-ring seal are included with supply

[2]) Thread to DIN 13, for the max. tightening torques observe the general information on page 68

[3]) To ANSI B92.1a-1976, 30°pressure angle, flat base, flank centering, fit class 5

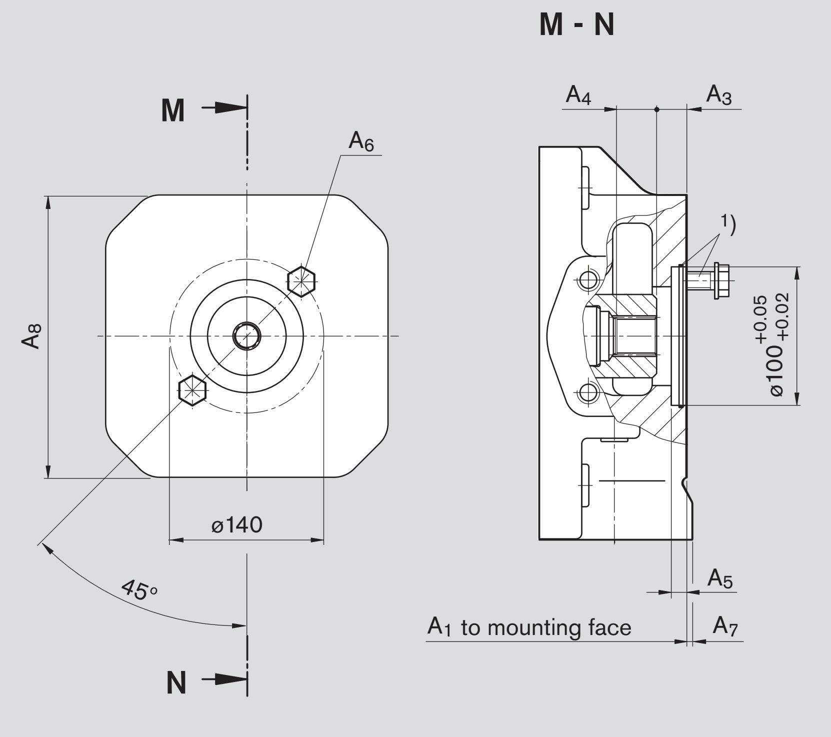
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

KB4

Flange ISO 3019-2 100, 2-hole
Shaft coupler for splined shaft, 25-4 SAE B-B, 1 in, 16/32 DP; 15T 3)

for mounting an A10VSO 45/31 splined shaft S – see RE 92711



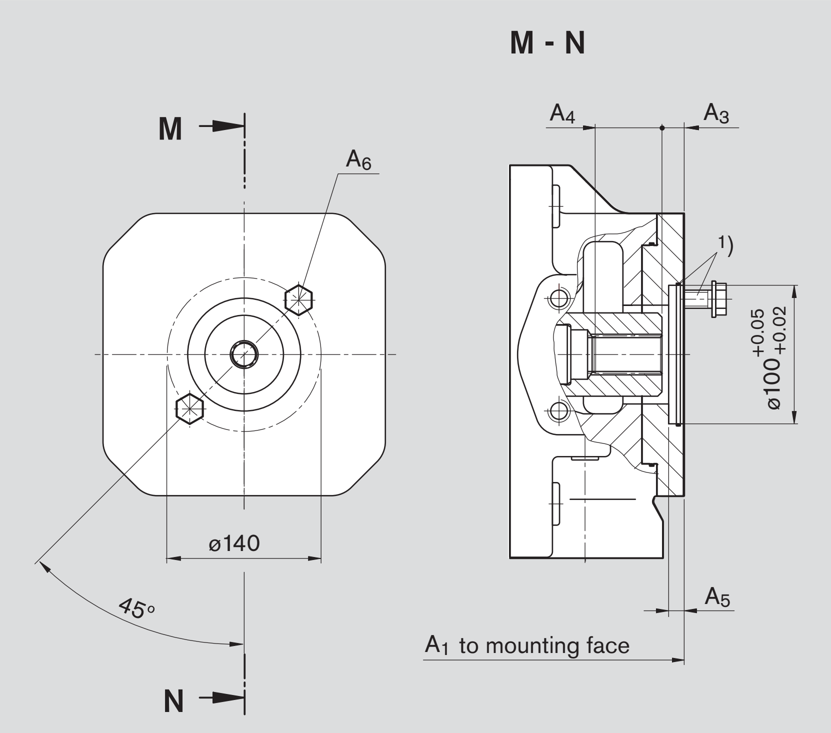
Size	A_1	A_3	A_4	A_5	A_6 2)
40	290	20,8	27,5	10	M12
71	316	20,8	27,5	8	M12
500	505	20,4	28,9	10	M12
750	in preparation				
1000	in preparation				

Size	A_7	A_8
40	–	–
71	–	–
500	15	240
750	in preparation	
1000	in preparation	

UB4

Flange ISO 3019-2 100, 2-hole
Shaft coupler for splined shaft, 25-4 SAE B-B, 1 in, 16/32 DP; 15T 3)

for mounting an A10VSO 45/31 splined shaft S – see RE 92711



Size	A_1	A_3	A_4	A_5	A_6 2)
125	369	18,9	29,5	10	M12
180	393	18,9	29,5	10	M12
250	453	20,9	29,5	10	M12
355	482	20,9	29,5	10	M12

1) 2 mounting screws and O-ring seal are included with supply

2) Thread to DIN 13, for the max. tightening torques observe the general information on page 68

3) To ANSI B92.1a-1976, 30° pressure angle, flat base, flank centering, fit class 5

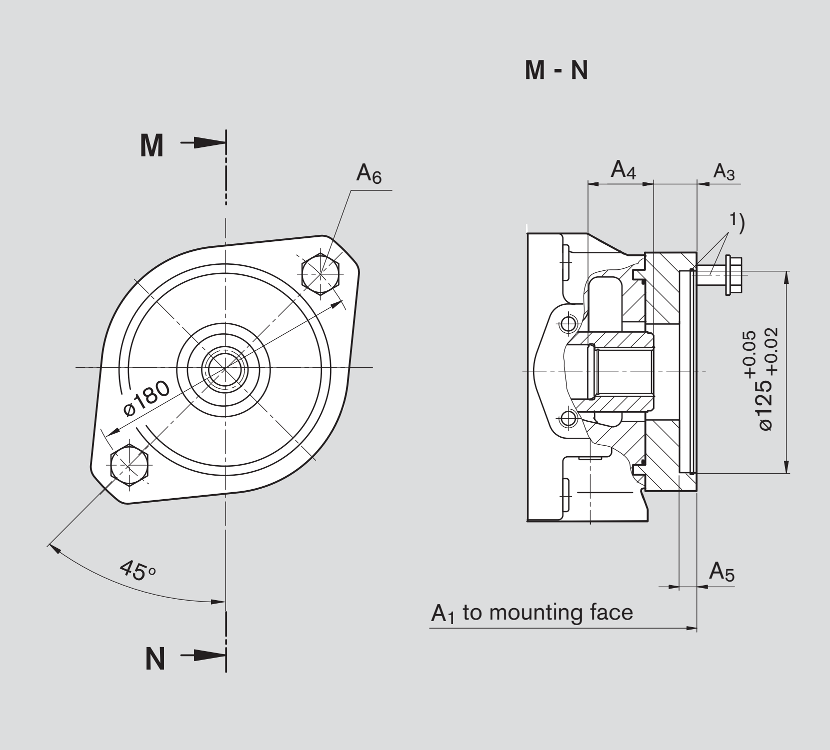
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

KB5

Flange ISO 3019-2 125, 2-hole
Shaft coupler for splined shaft, 32-4 SAE C, 1 1/4 in, 12/24 DP; 14T ³)

for mounting an A10VSO 71/31 splined shaft S (see RE 92711)

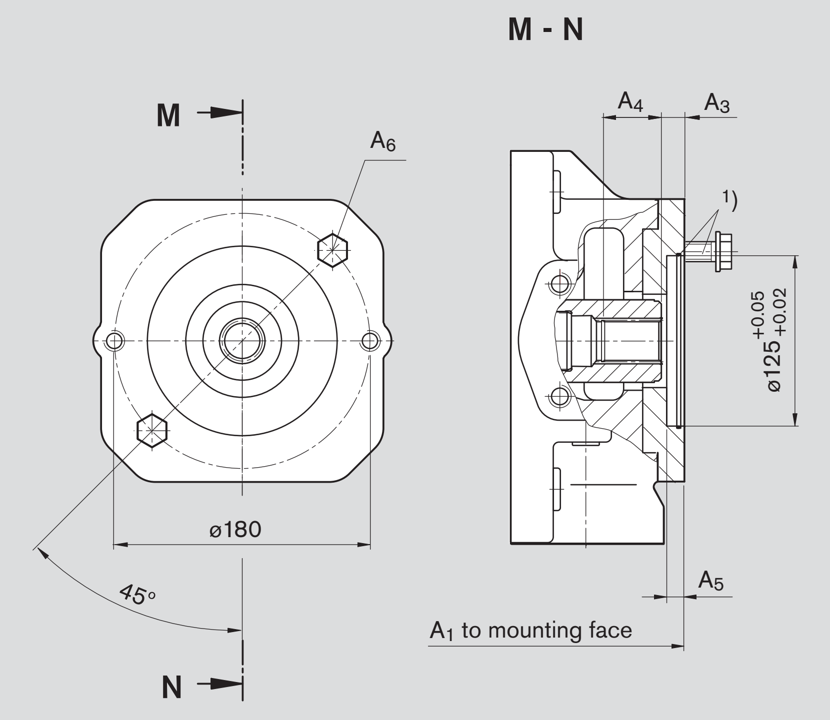


Size	A_1	A_3	A_4	A_5	A_6 ²)
71	321	23	38	10	M20
500	in preparation				
750	in preparation				
1000	in preparation				

UB5

Flange ISO 3019-2 125, 2-hole
Shaft coupler for splined shaft, 32-4 SAE C, 1 1/4 in, 12/24 DP; 14T ³)

for mounting an A10VSO 71/31 splined shaft S (see RE 92711)



Size	A_1	A_3	A_4	A_5	A_6 ²)
125	369	20	38	9	M16
180	393	20	38	9	M16
250	453	20,9	37,9	9	M16
355	482	20,9	37,9	9	M16

¹) 2 mounting screws and O-ring seal are included with supply
²) Thread to DIN 13, for the max. tightening torques observe the general information on page 68
³) To ANSI B92.1a-1976, 30° pressure angle, flat base, flank centering, fit class 5

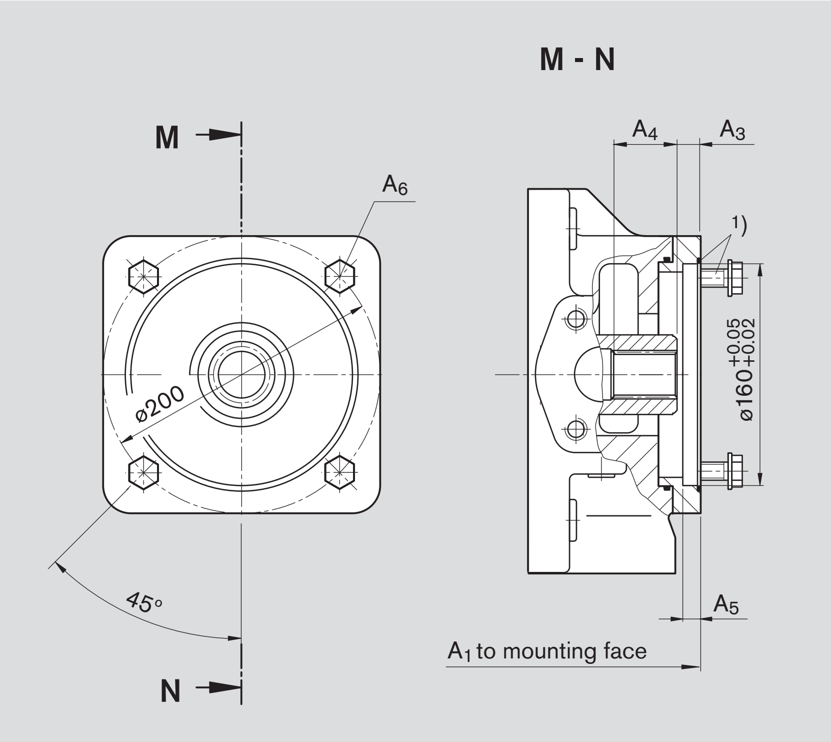
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

UB8

Flange ISO 3019-2 160, 4-hole
Shaft coupler for splined shaft, 32-4 SAE C, 1 1/4 in, 12/24 DP; 14T [3]

for mounting an A10VSO 71/32 splined shaft S (see RE 92714)



Size	A_1	A_3	A_4	A_5	A_6 [2]
125	in preparation				
180	in preparation				
250	453	20,9	38	9	M16
355	in preparation				

---

[1] Mounting screws and O-ring seal are included with supply
[2] Thread to DIN 13, for the max. tightening torques observe the general information on page 68
[3] To ANSI B92.1a-1976, 30° pressure angle, flat base, flank centering, fit class 5

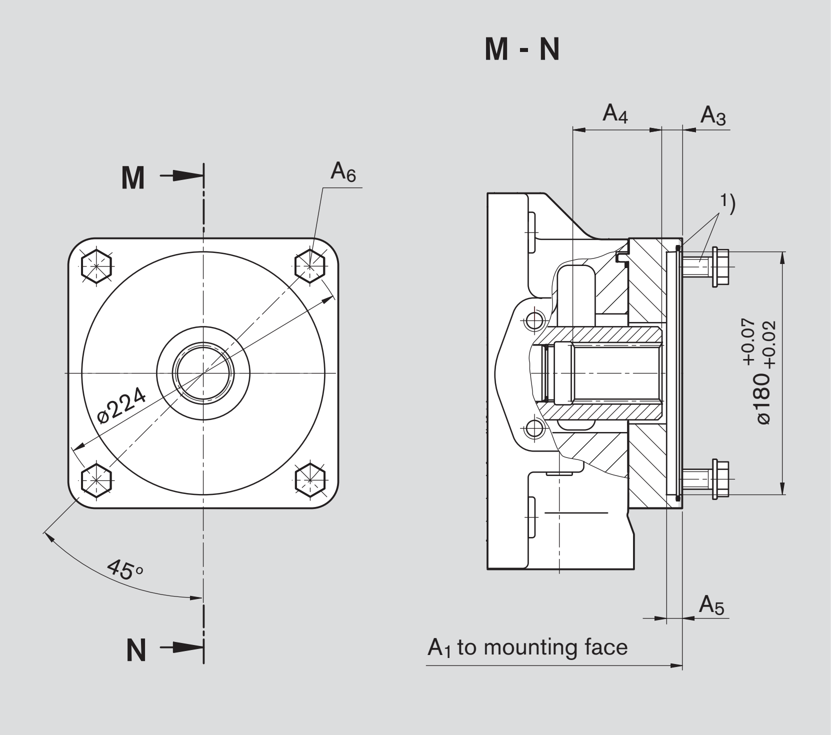
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

KB7

Flange ISO 3019-2 180, 4-hole
Shaft coupler for splined shaft, 44-4 SAE D, 1 3/4 in, 8/16 DP; 13T ³)

for mounting an A10VSO 140/31(32) splined shaft S – see RE 92711 (RE 92714)

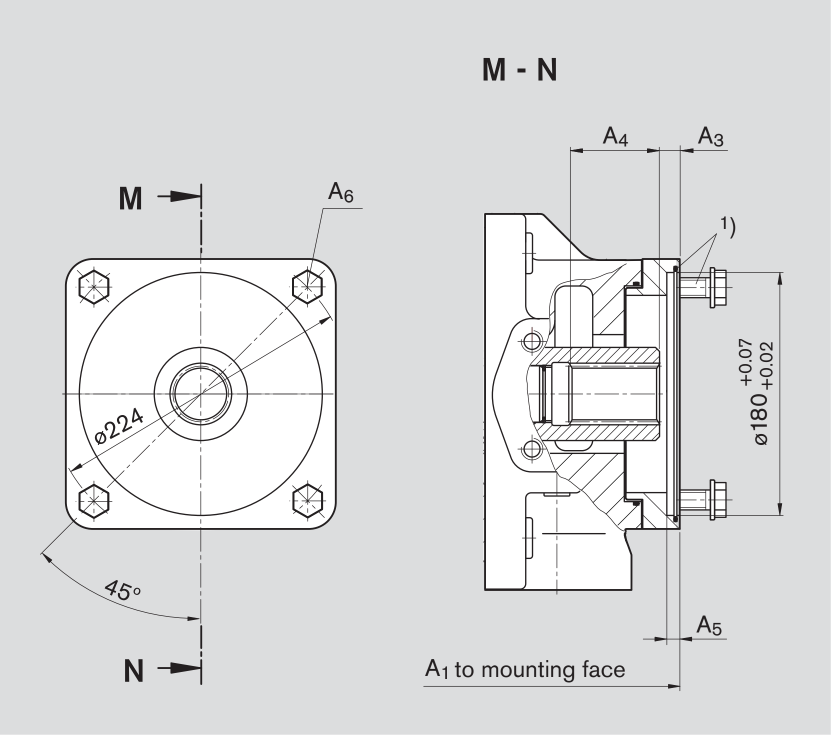


Size	A_1	A_3	A_4	A_5	A_6 ²)
500	530	10,4	63,6	10	M16
750	in preparation				
1000	in preparation				

UB7

Flange ISO 3019-2 180, 4-hole
Shaft coupler for splined shaft, 44-4 SAE D, 1 3/4 in, 8/16 DP; 13T ³)

for mounting an A10VSO 140/31(32) splined shaft S – see RE 92711 (RE 92714)



Size	A_1	A_3	A_4	A_5	A_6 ²)
180	406	10,6	62	9	M16
250	453	10,6	64	9	M16
355	482	10,6	64	9	M16

---

¹) Mounting screws and O-ring seal are included with supply
²) Thread to DIN 13, for the max. tightening torques observe the general information on page 68
³) To ANSI B92.1a-1976, 30° pressure angle, flat base, flank centering, fit class 5

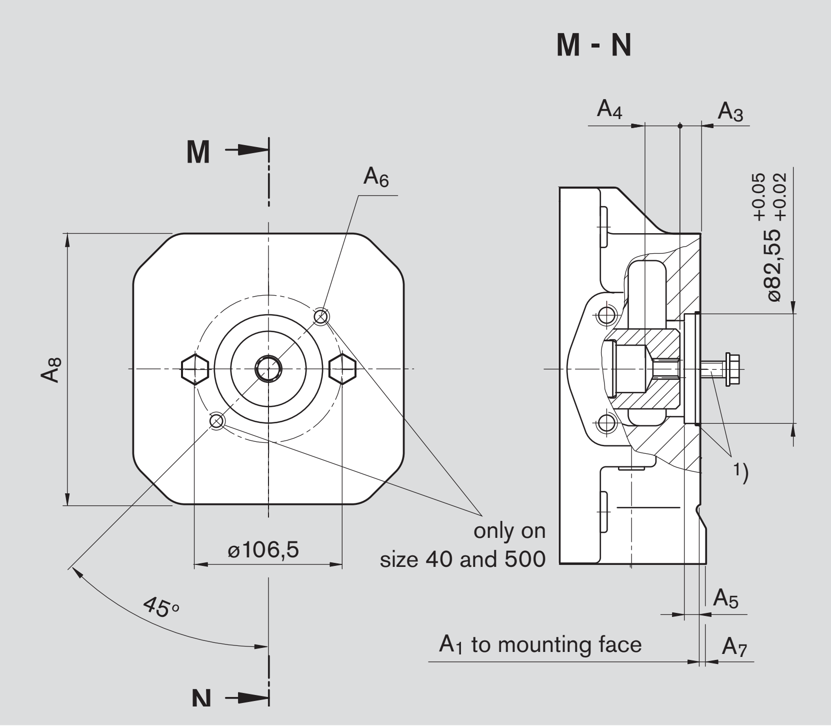
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K01

Flange ISO 3019-1 82-2 (SAE A)
Shaft coupler for splined shaft, 16-4 SAE A, 5/8 in, 16/32 DP; 9T 3)

for mounting an external gear pump AZ-PF-1X-004 ... 022 (see RE 10089)
Rexroth recommends a special execution of the gear pump, please consult us



Size	A_1	A_3	A_4	A_5	A_6 2)
40	263	10,3	25,9	10	M10
71	291	10,3	24,6	10	M10
500	505	10,3	32,7	10	M10
750	555	10,3	32,7	10	M10
750*	in preparation				
1000	in preparation				

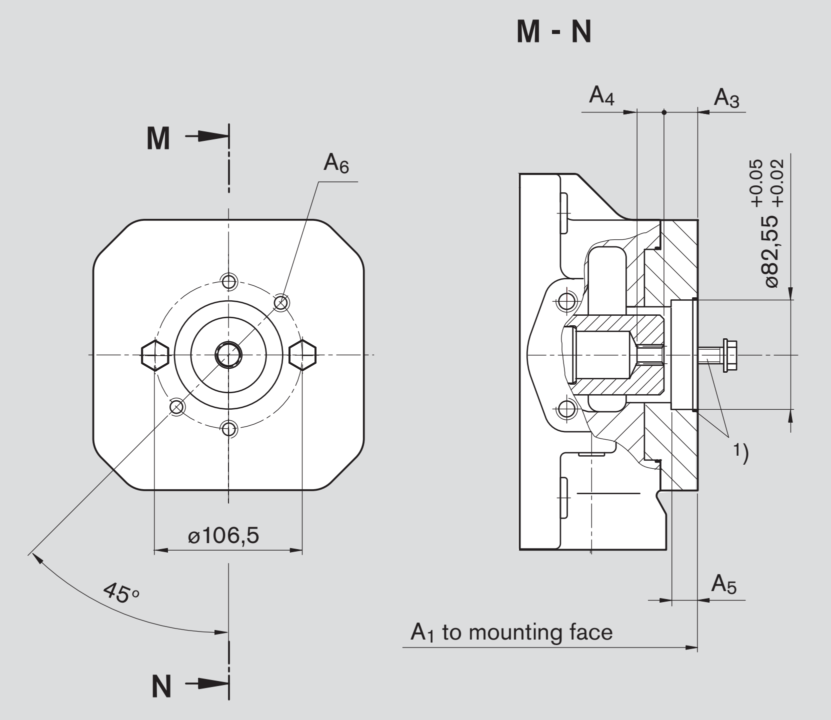
NG	A_7	A_8
40	–	–
71	2	140
500	15	240
750	–	–
750*	in preparation	
1000	in preparation	

* with boost pump

U01

Flange ISO 3019-1 82-2 (SAE A)
Shaft coupler for splined shaft, 16-4 SAE A, 5/8 in, 16/32 DP; 9T 3)

for mounting an external gear pump AZ-PF-1X-004 ... 022 (see RE 10089)
Rexroth recommends a special execution of the gear pump, please consult us



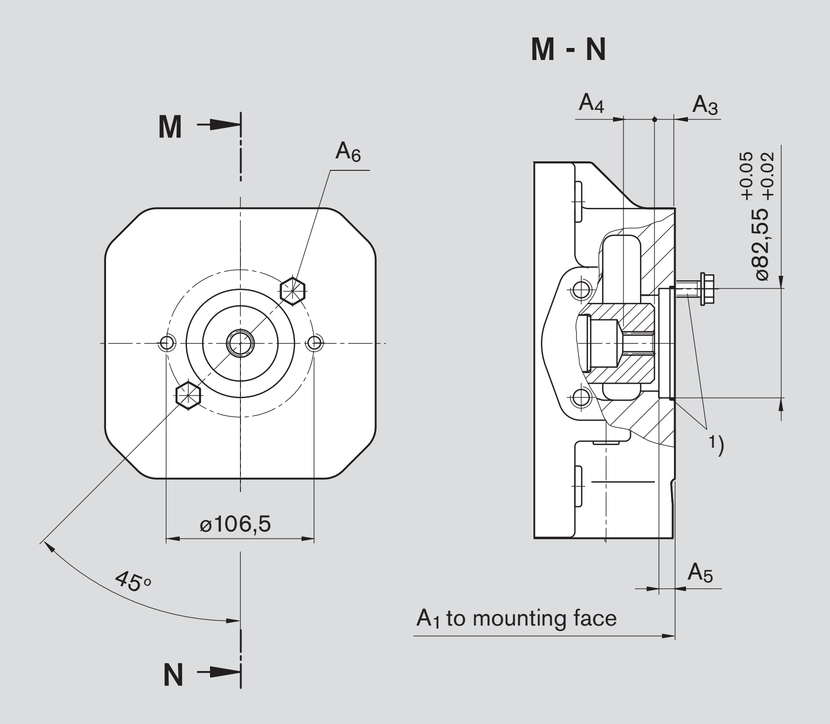
Size	A_1	A_3	A_4	A_5	A_6 2)
125	369	16	19,4	13	M10
180	393	16	19,4	13	M10
250	453	16	19,4	13	M10
355	482	16	19,4	13	M10

1) 2 mounting screws and O-ring seal are included with supply
2) Thread to DIN 13, for the max. tightening torques observe the general information on page 68
3) To ANSI B92.1a-1976, 30° pressure angle, flat base, flank centering, fit class 5

Dimensions through drives

K52 **Flange** ISO 3019-1 82-2 (SAE A)
Shaft coupler for splined shaft, 19-4 SAE A-B, 3/4 in, 16/32 DP; 11T ³)

for mounting an A10VSO 18/31 splined shaft S (see RE 92711) or A10VSO10 or 18/52 splined shaft S (see RE 92703)



Size	A_1	A_3	A_4	A_5	A_6 ²)
40	263	10,5	33,8	10	M10
71	315	10,5	30	10	M10
500	in preparation				
750	in preparation				
1000	in preparation				

Sizes 125...355 with U-through drive in preparation

[1] 2 mounting screws and O-ring seal are included with supply
[2] Thread to DIN 13, for the max. tightening torques observe the general information on page 68
[3] To ANSI B92.1a-1976, 30° pressure angle, flat base, flank centering, fit class 5

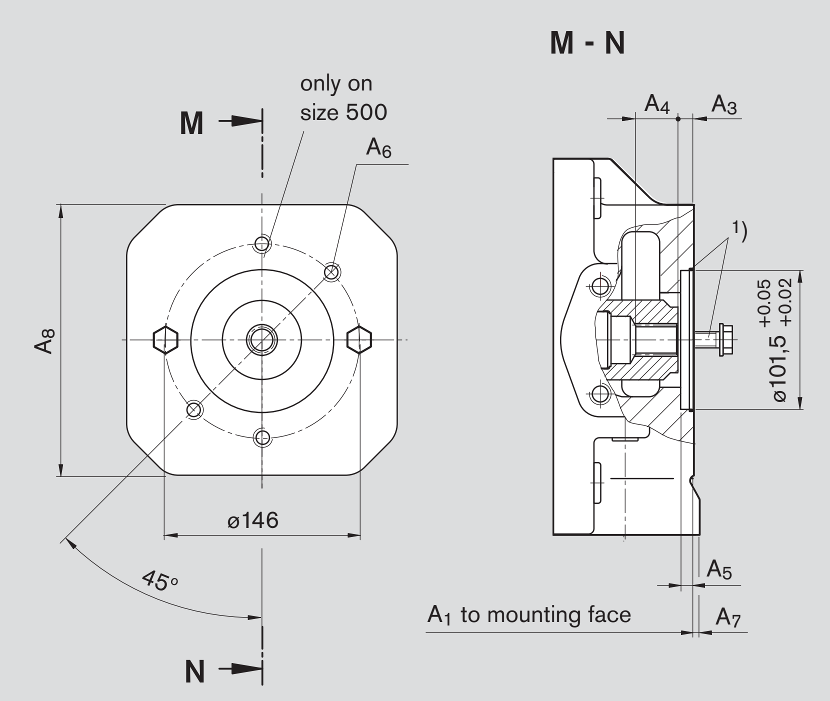
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensionse in mm.

K68

Flange ISO 3019-1 101-2 (SAE B)
Shaft coupler for splined shaft 22-4 SAE B, 7/8 in, 16/32 DP; 13T [3])

for mounting an external gear pump AZ-PN-1X020...032 (see RE 10091 or an A10VO 28/31 and 52(53) splined shaft S (see RE 92701 and 92703)
Rexroth recommends a special excution of the gear pump, please consult us



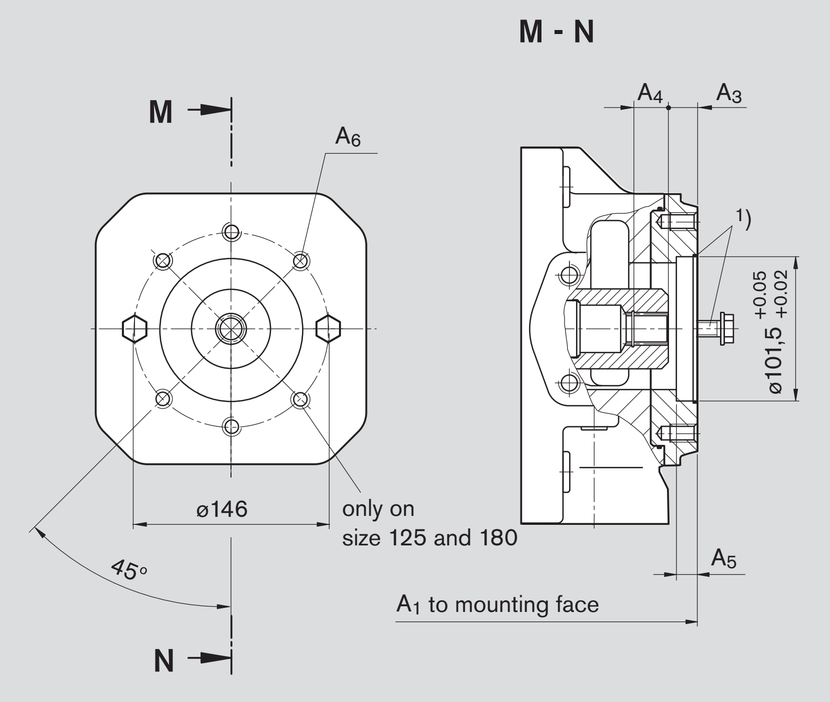
Size	A_1	A_3	A_4	A_5	A_6 2)
40	290	20,4	23,1	10	M12
71	322	10,4	35,1	10	M12
500	505	19,5	25	10	M12
750	in preparation				
1000	in preparation				

Size	A_7	A_8
40	–	–
71	–	–
500	15	240
750	in preparation	
1000	in preparation	

U68

Flange ISO 3019-1 101-2 (SAE B)
Shaft coupler for splined shaft 22-4 SAE B, 7/8 in, 16/32 DP; 13T [3])

for mounting an external gear pump AZ-PN-1X020...032 (see RE 10091 or an A10VO 28/31 and 52(53) splined shaft S (see RE 92701 and 92703)
Rexroth recommends a special execution of the gear pump, please consult us



Size	A_1	A_3	A_4	A_5	A_6 2)
125	369	28	25	13	M12
180	393	28	25	13	M12
250	453	19,5	23,1	13	M12
355	482	19,5	23,1	13	M12

---

[1]) 2 mounting screws and O-ring seal are included with supply
[2]) Thread to DIN 13, for the max. tightening torques observe the general information on page 68
[3]) To ANSI B92.1a-1976, 30° pressure angle, flat base, flank centering, fit class 5

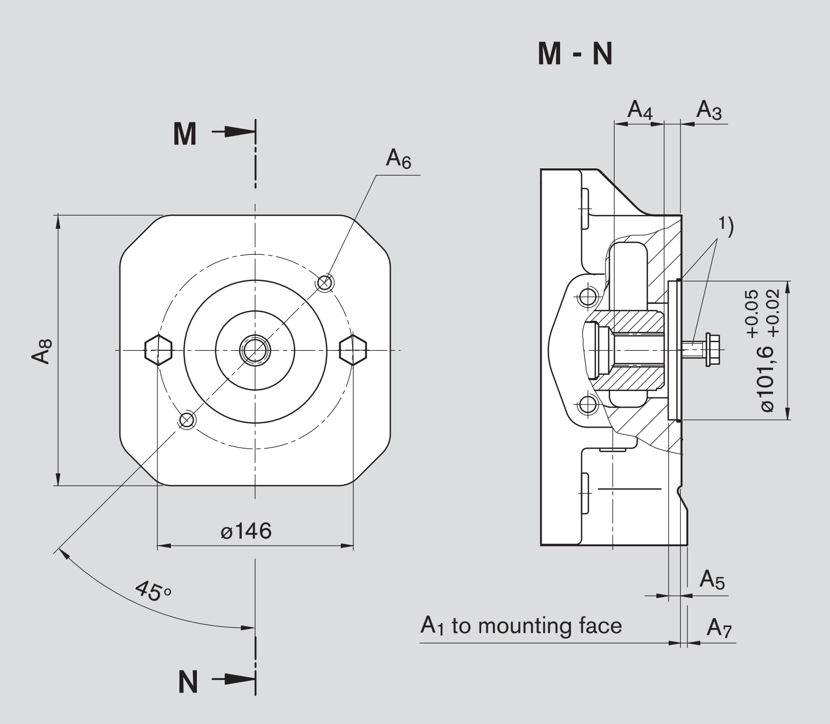
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K04

Flange ISO 3019-1 101-2 (SAE B)
Shaft coupler for splined shaft 25-4 SAE B-B, 1 in, 16/32 DP; 15T ³)

for mounting an A10VO 45/31 and 52 (53) splined shaft S (see RE 92701 and 92703) or an internal gear pump PGH4 (see RE 10223)



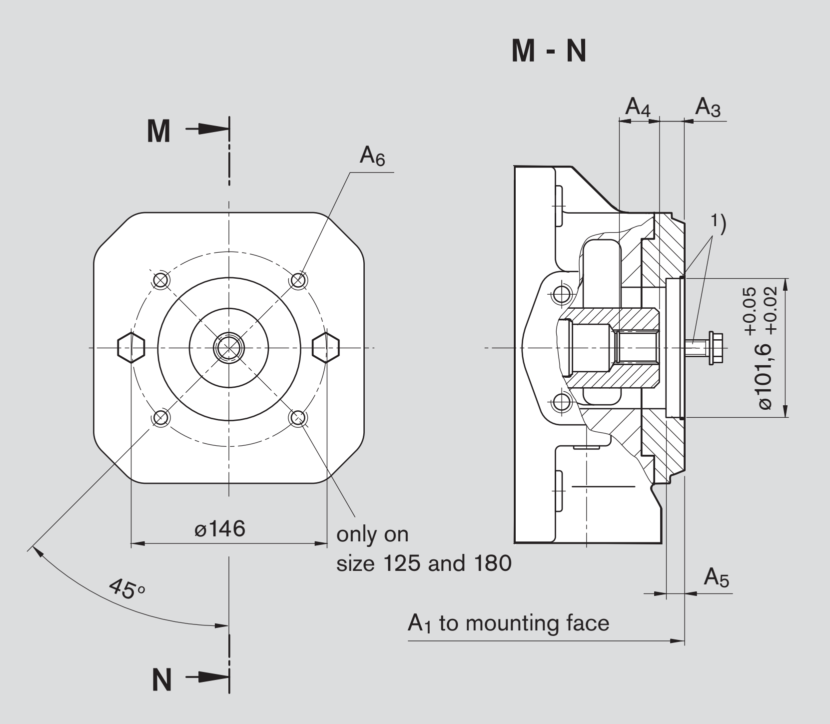
Size	A_1	A_3	A_4	A_5	A_6 ²)
40	290	10,4	37,9	10	M12
71	322	10,3	35,7	10	M12
500	505	10,3	28,9	10	M12
750	in preparation				
1000	in preparation				

Size	A_7	A_8
40	–	–
71	–	–
500	15	240
750	in preparation	
1000	in preparation	

U04

Flange ISO 3019-1 101-2 (SAE B)
Shaft coupler for splined shaft 25-4 SAE B-B, 1 in, 16/32 DP; 15T ³)

for mounting an A10VO 45/31 and 52 (53) splined shaft S (see RE 92701 and 92703) or an internal gear pump PGH4 (see RE 10223)



Size	A_1	A_3	A_4	A_5	A_6 ²)
125	369	18,9	29,4	13	M12
180	393	18,9	29,4	13	M12
250	453	18,9	29,4	13	M12
355	482	18,9	29,4	13	M12

---

¹) 2 mounting screws and O-ring seal are included with supply

²) Thread to DIN 13, for the max. tightening torques observe the general information on page 68

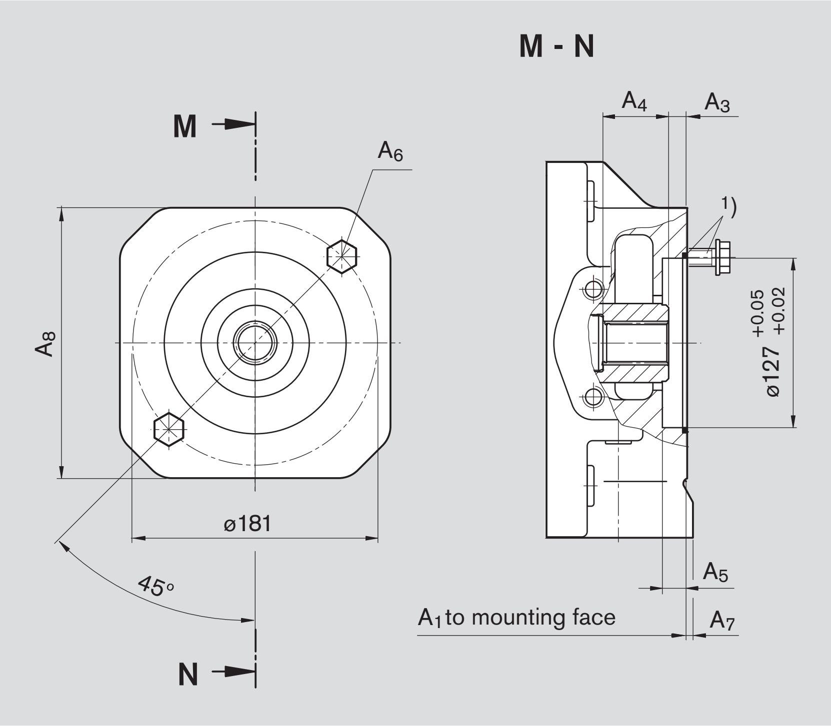
³) To ANSI B92.1a-1976, 30° pressure angle, flat base, flank centering, fit class 5

Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K07 **Flange** ISO 3019-1 127-2 (SAE C)
Shaft coupler for splined shaft 32-4 SAE C, 1 1/4 in, 12/24 DP; 14T [3])

for mounting an A10VO 71/31 splined shaft S (see RE 92701)



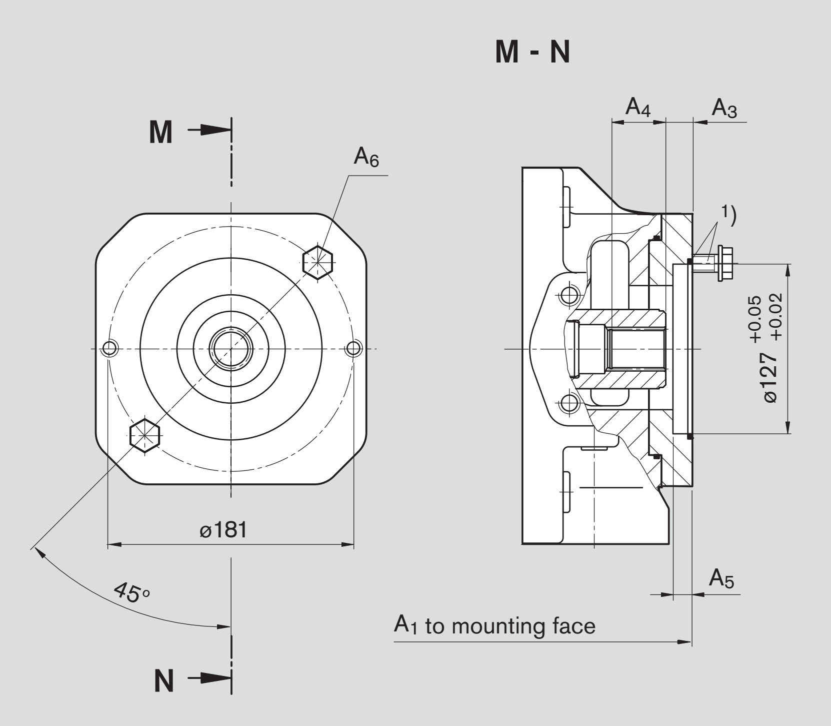
Size	A_1	A_3	A_4	A_5	A_6 [2])
71	321	10,4	47,6	13	M16
500	505	11,3	40,2	13	M16
750	in preparation				
1000	in preparation				

Size	A_7	A_8
71	–	–
500	15	240
750	in preparation	
1000	in preparation	

3

U07 **Flange** ISO 3019-1 127-2 (SAE C)
Shaft coupler for splined shaft 32-4 SAE C, 1 1/4 in, 12/24 DP; 14T [3])

for mounting an A10VO 71/31 splined shaft S (see RE 92701)



Size	A_1	A_3	A_4	A_5	A_6 [2])
125	369	20,9	37,9	13	M16
180	393	20,9	37,9	13	M16
250	453	20,9	37,9	13	M16
355	482	20,9	37,9	13	M16

[1]) 2 mounting screws and O-ring seal are included with supply
[2]) Thread to DIN 13, for the max. tightening torques observe the general information on page 68
[3]) To ANSI B92.1a-1976, 30° pressure angle, flat base, flank centering, fit class 5

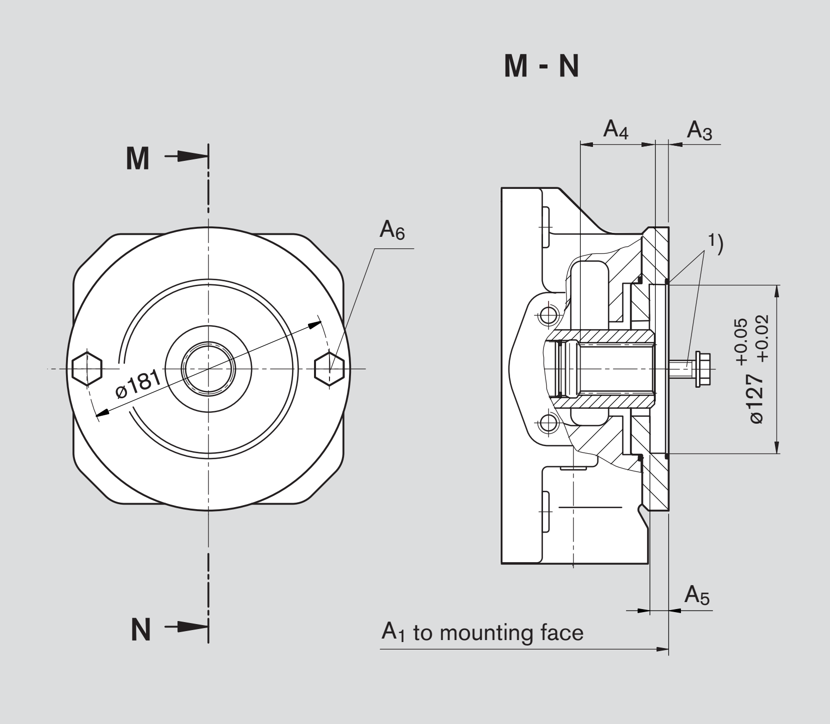
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K24

Flange ISO 3019-1 127-2 (SAE C)
Shaft coupler for splined shaft 38-4 SAE C-C, 1 1/2 in, 12/24 DP; 17T ³)

for mounting an A10VO 100/31 splined shaft S (see RE 92701) or an A10VO 85/52(53) splined shaft S (see RE 92703) or an internal gear pump PGH5 (see RE 10223)

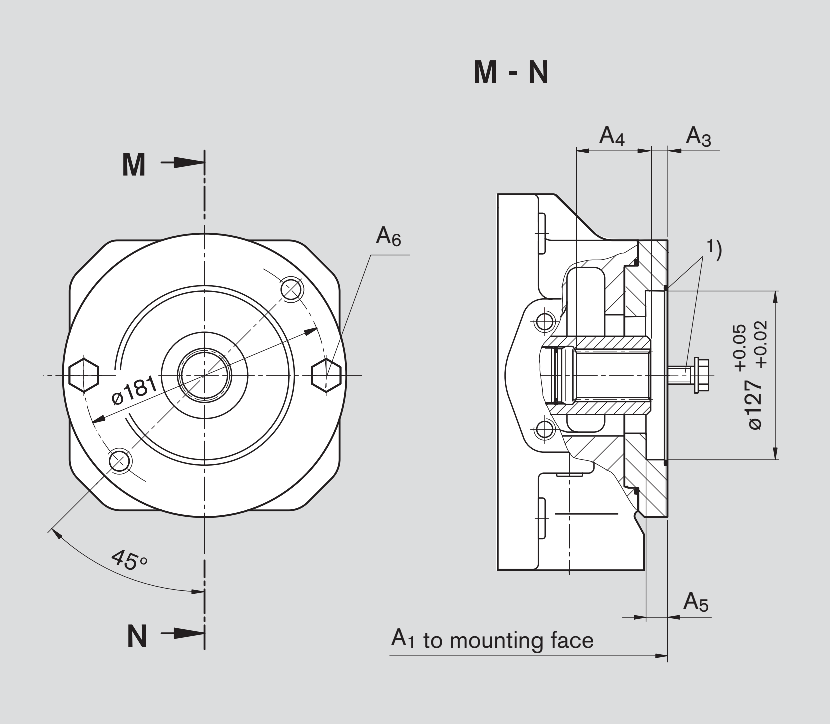


Size	A_1	A_3	A_4	A_5	A_6 ²)
500	505	10,3	56,7	13	M16
750	in preparation				
1000	in preparation				

U24

Flange ISO 3019-1 127-2 (SAE C)
Shaft coupler for splined shaft 38-4 SAE C-C, 1 1/2 in, 12/24 DP; 17T ³)

for mounting an A10VO 100/31 splined shaft S (see RE 92701) or an A10VO 85/52(53) splined shaft S (see RE 92703) or an internal gear pump PGH5 (see RE 10223)



Size	A_1	A_3	A_4	A_5	A_6 ²)
125	369	10,4	50	13	M16
180	393	10,4	50	13	M16
250	453	12,4	55	13	M16
355	482	12,4	55	13	M16

¹) 2 mounting screws and O-ring seal are included with supply
²) Thread to DIN 13, for the max. tightening torques observe the general information on page 68
³) To ANSI B92.1a-1976, 30° pressure angle, flat base, flank centering, fit class 5

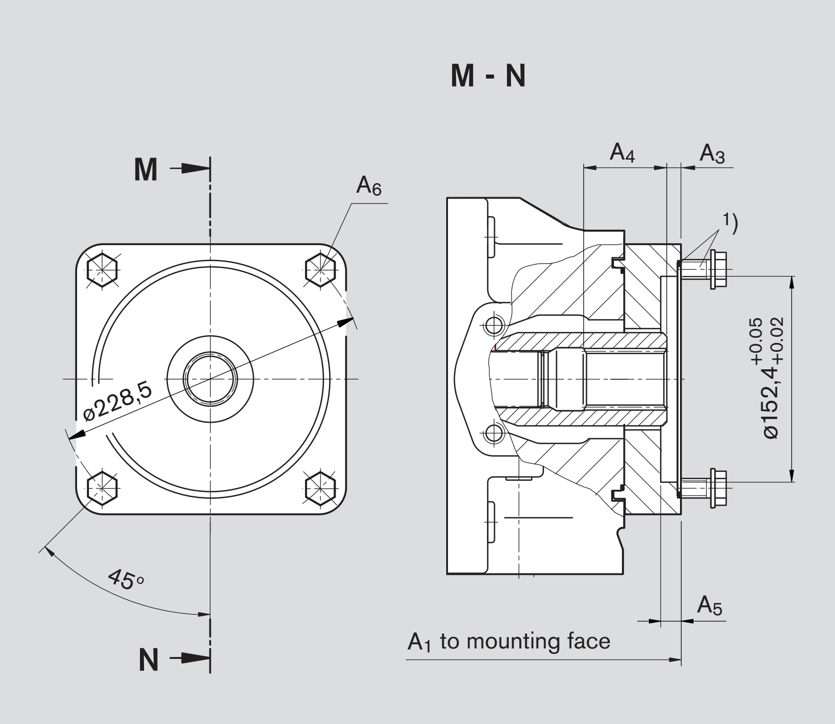
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K17

Flange ISO 3019-1 152-4 (SAE D)
Shaft coupler for splined shaft 44-4 SAE D, 1 3/4 in, 8/16 DP; 13T ³)

for mounting an A10VO 140/31 splined shaft S (see RE 92701)

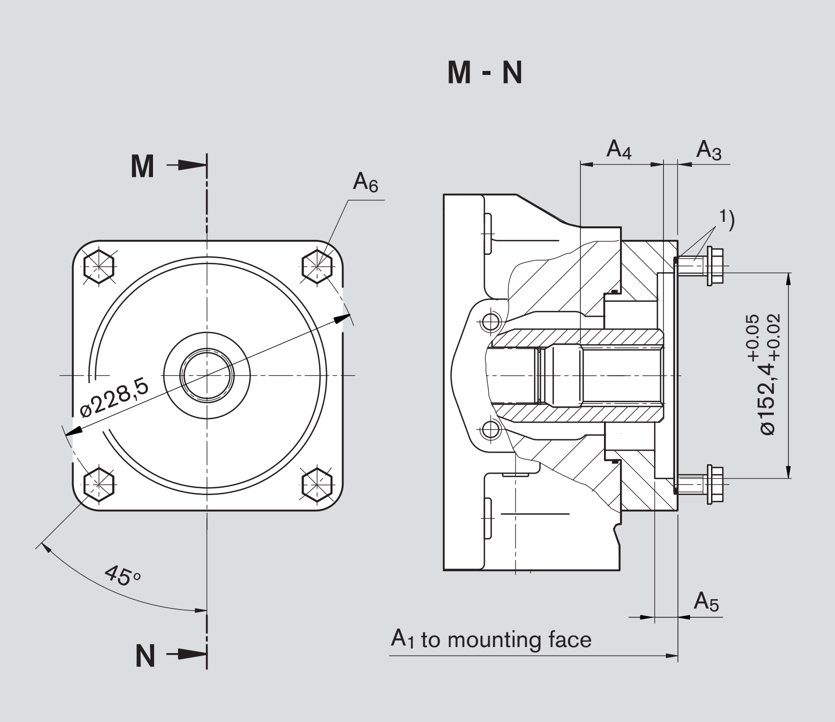


Size	A₁	A₃	A₄	A₅	A₆ ²)
500	505	10,4	59,6	13	M16
750	in preparation				
1000	in preparation				

U17

Flange ISO 3019-1 152-4 (SAE D)
Shaft coupler for splined shaft 44-4 SAE D, 1 3/4 in, 8/16 DP; 13T ³)

for mounting an A10VO 140/31 splined shaft S (see RE 92701)



Size	A₁	A₃	A₄	A₅	A₆ ²)
180	406	10,4	62	13	M16
250	453	10,6	62	13	M16
355	482	10,6	62	13	M16

---

[1]) 2 mounting screws and O-ring seal are included with supply

[2]) Thread to DIN 13, for the max. tightening torques observe the general information on page 68

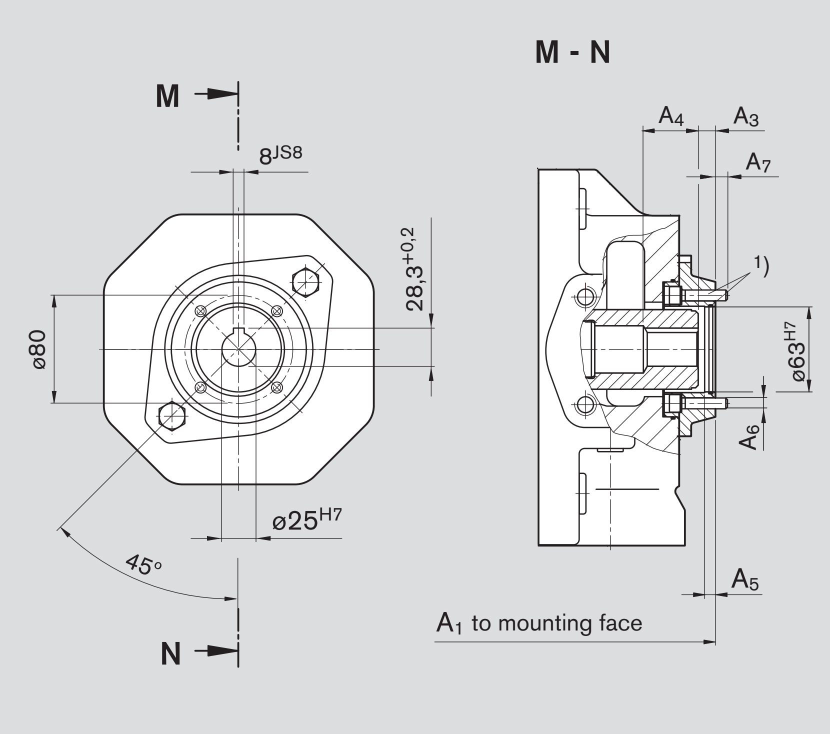
[3]) To ANSI B92.1a-1976, 30° pressure angle, flat base, flank centering, fit class 5

Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K57 **dia. 63 metric**, 4-hole
Shaft coupler for keyed shaft dia. 25

for mounting a radial piston pump R4 (see RE 11263)



Size	A_1	A_3	A_4	A_5	A_6 2)	A_7
40	288	11	56	8	M8	9
71	319	10,9	42	8	M8	9
500	in preparation					
750	in preparation					

Sizes 125...355 with U-through drive in preparation

1) Mounting screws and O-ring seal are included with supply

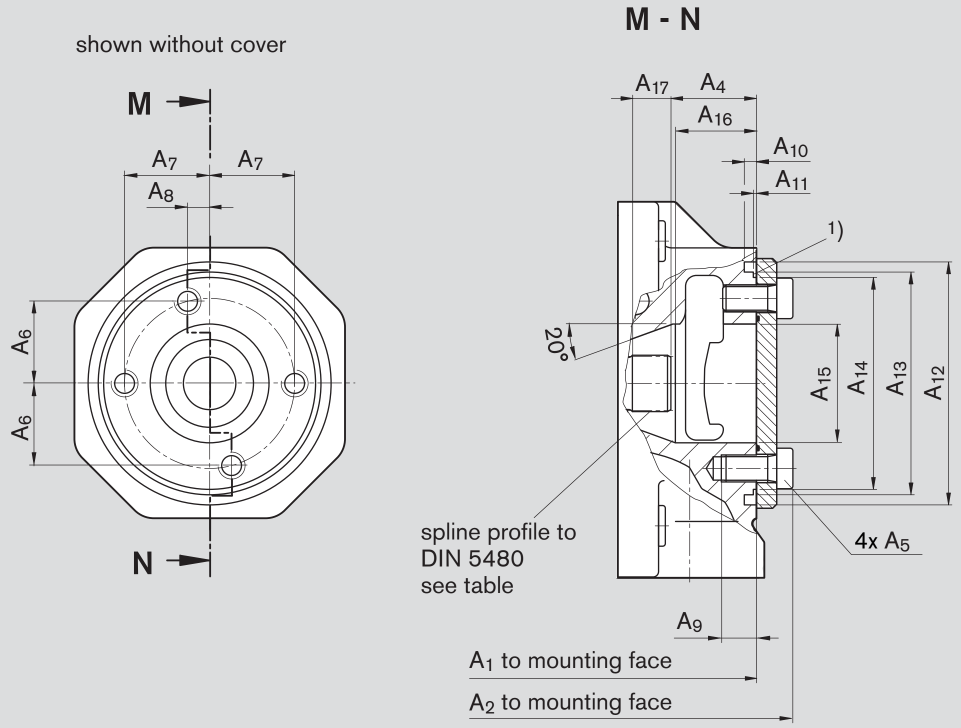
2) Thread to DIN 13, for the max. tightening torques observe the general information on page 68

Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K99 Sizes 40 and 71

with through drive shaft, without shaft coupler, without adapter flange, **closed with pressure tight cover**



depiction shows
size 71

Size Main pump	A_1	A_2	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}	A_{11}	A_{12}	A_{13}
40	263	280	51.3 ±1	M12x25	37 ±0.2	37 ±0.2	0	18	9	$2.3^{+0.1}$	ø118	ø105$_{g6}$
71	291	310	48 ±1	M12x25	42,3 ±0,15	45 ±0,15	15.4 ±0.15	18	9	$2.7^{+0.1}$	ø130	ø116$_{g6}$

Size Main pump	A_{14}	A_{15}	A_{16}	A_{17}	Spline profile to DIN 5480	[1]) **O-Ring** for retrofitting (not in supply)
40	ø97.6$_{-0.4}$	ø52	44	14	W25x1,25x18x9g	99 x 3
71	ø106.4$_{-0.4}$	ø63	38	16	W30x1,25x22x9g	110,72 x 3,53

Sizes 125...1000 see pages 65 and 66

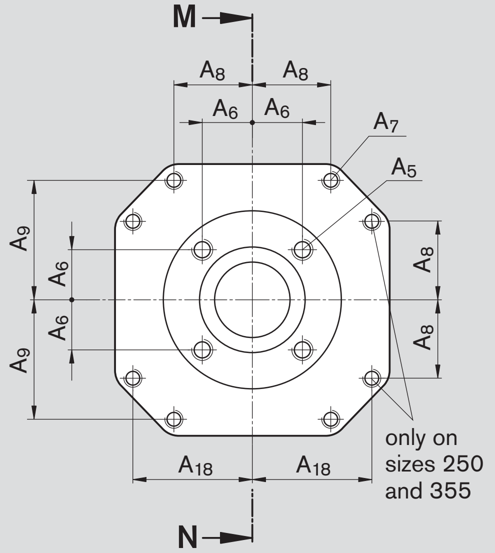
Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

U99 Sizes 125...355

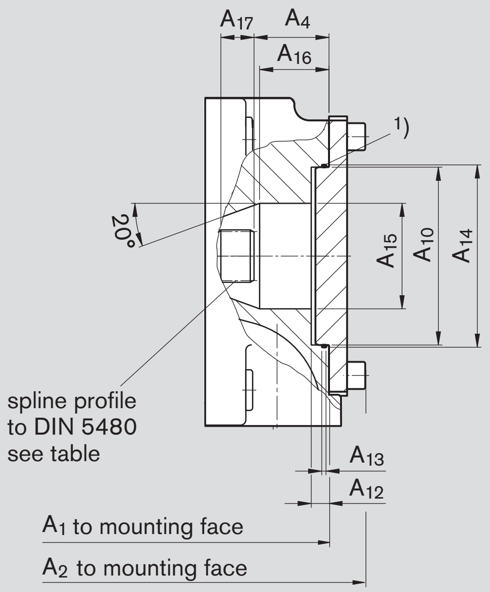
with through drive shaft, without shaft coupler, without adapter flange, **closed with pressure tight cover**

shown without cover



only on sizes 250 and 355

M - N



spline profile to DIN 5480 see table

A1 to mounting face

A2 to mounting face

Size Main pump	A_1	A_2	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}	A_{12}	A_{13}
125	347	368	$49.7^{\pm1}$	M14; 15 deep	$33,2^{+0.15}$	M12; 18 deep	–	$79,2^{+0.15}$	ø118^{H7}	9	$2,8^{+0,2}$
180	371	392	$49.7^{\pm1}$	M14; 15 deep	$33,2^{+0.15}$	M12; 18 deep	–	$79,2^{+0.15}$	ø118^{H7}	9	$2,8^{+0,2}$
250	431	455	$61.4^{\pm1}$	M20; 22 deep	$44,5^{+0.15}$	M10; 15 deep	$58,15^{+0.15}$	$86,2^{+0.15}$	ø160^{H7}	9	$2,8^{+0,2}$
355	460	487	$61.4^{\pm1}$	M20; 22 deep	$44,5^{+0.15}$	M10; 15 deep	$58,15^{+0.15}$	$86,2^{+0.15}$	ø160^{H7}	9	$2,8^{+0,2}$

Size Main pump	A_{14}	A_{15}	A_{16}	A_{17}	A_{18}	Spline profile to DIN 5480	1) **O-Ring** for retrofitting (included in supply)
125	ø$121^{+0.1}$	ø70	46	22	–	W35x1,25x26x9g	118 x 2
180	ø$121^{+0.1}$	ø70	46	25	–	W35x1,25x26x9g	118 x 2
250	ø$163^{+0.1}$	ø87	64	30,5	$86,2^{+0,15}$	W42x1,25x32x9g	160 x 2
355	ø$163^{+0.1}$	ø87	64	34	$86,2^{+0,15}$	W42x1,25x32x9g	160 x 2

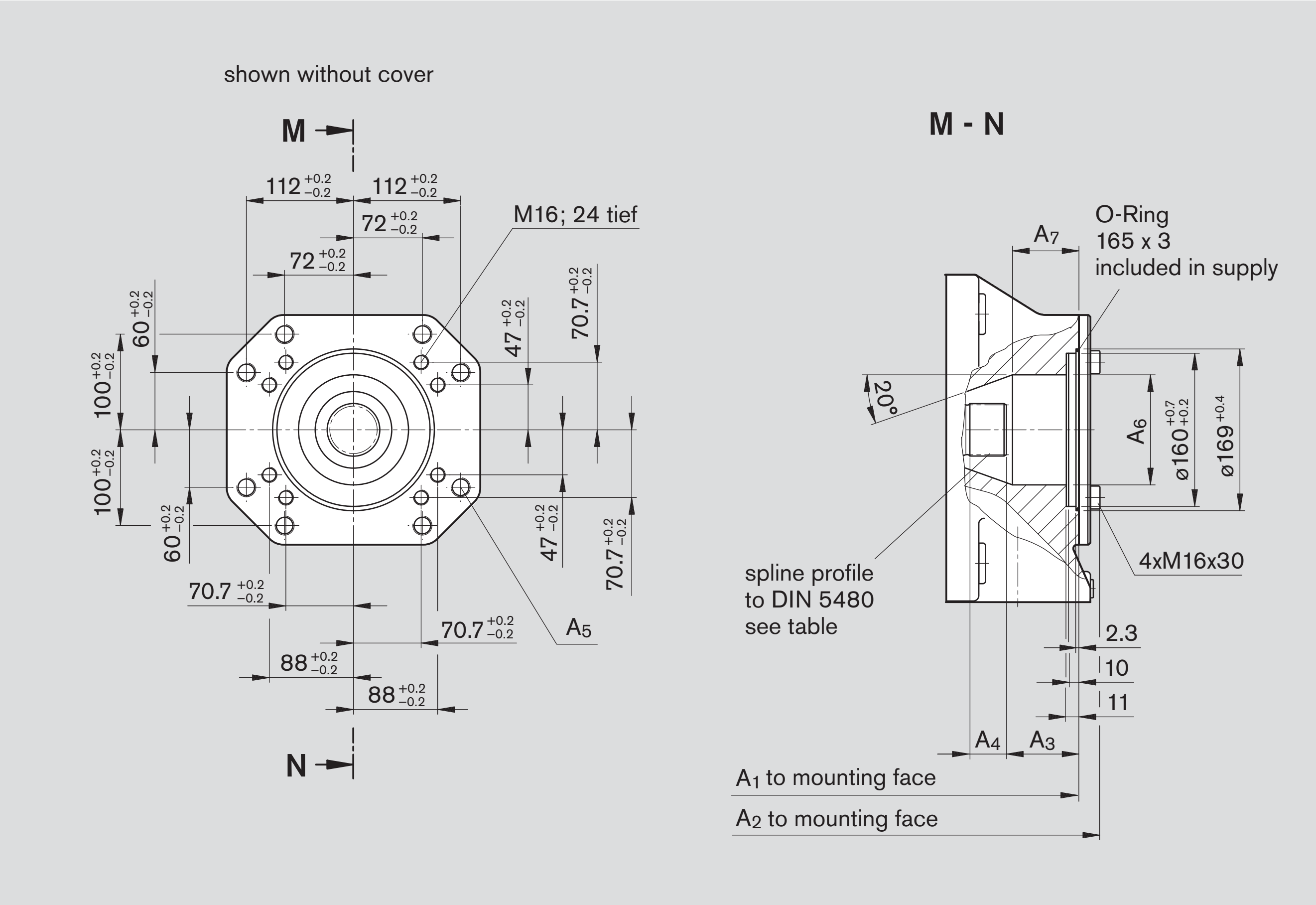
Sizes 500...1000 see page 66

Dimensions through drives

Before finalising your design please request a certified installation drawing. Dimensions in mm.

K99 Sizes 500...1000

with through drive shaft, without shaft coupler, without adapter flange, **closed with pressure tight cover**



Size Main pump	A_1	A_2	A_3	A_4	A_5	A_6	A_7	Spline profile to DIN 5480
500	505	527	73	41	M20; 24 deep	ø115	75	W55x1,25x42x9g
750	555	577	73	41	M20: 24 deep	ø115	75	W55x1,25x42x9g
750*	in preparation							
1000	628	650	77	66,5	M20; 30 deep	ø138	65	W65x1,25x50x9g

* with boost pump

Sizes 40 and 71 see page 64 and sizes 125...355 see page 65

Installation notes

Mounting position:

Optional. The pump case must be filled with fluid during commissioning and remain full when operating.
In order to reduce the operating noise level, all connecting lines (suction, pressure and case drain lines) must be de-coupled from the tank, using flexible elements.
The use of check valves in the case drain line must be avoided. The case drain line must be returned directly to tank without a reduction in cross section.
Exceptions maybe possible, please consult us first.

1. **Vertical installation** (shaft end pointing upwards)
   With a vertical installation, bearing flushing is recommended to provide lubrication for the front bearing, see page 6.

   The following installation conditions must be taken into account:

1.1 Installation into the reservoir

a) When the minimum fluid level is equal to or above the pump mounting flange area: ports »R/L«, »T« and »S« open (see fig. 1).

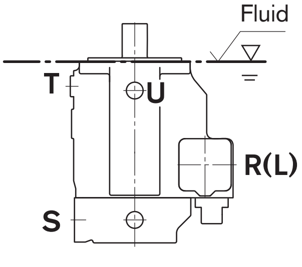


Fig. 1

b) When the minimum fluid level is below the mounting flange area: ports»R/L«,»T« und possibly »S« must be piped as shown in fig. 2. Also observe the conditions as shown in point 1.2.

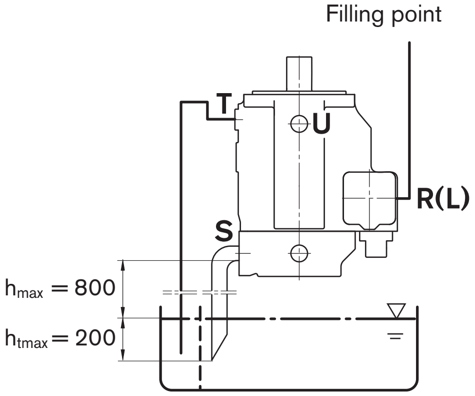


Fig. 2

1.2 Installation outside the reservoir

Before installation, fill the pump housing with the pump in a horizontal position.
Pipe port »T« to tank, »R/L« plugged.
Filling in mounted condition: fill via »R« and bleed via»T«, afterwards plug port»R«.
Conditions: A minimum pump inlet pressure (suction pressure) of 0,8 bar abs. is necessary. Avoid mounting above the reservoir in order to reduce the noise level.

2. **Horizontal installation**
   The highest situated of the ports»T«,»K_1«, »K_2« or »R/L« must be used for filling/bleeding and subsequently to connect the case drain line.

2.1 Installation inside the reservoir

a) When the minimum fluid level is equal to or lies above the upper edge of the pump: case drain port and suction port »S« open (see fig. 3).

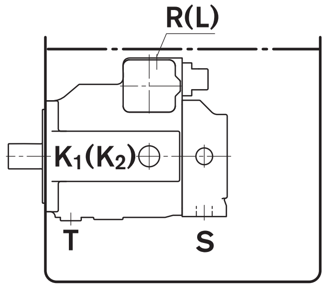


Fig. 3

b) When the minimum fluid level lies below the upper edge of the pump: case drain port and possibly port »S« must be piped, see fig. 4. Observe conditions as shown in point 1.2.

Fill pump housing prior to commissioning.

2.2 Installation outside the reservoir

Fill the pump housing before commissioning.
a) Mounting above the reservoir see fig. 4.
Observe conditions as shown in point 1.2.
b) Mounting below the reservoir
Case drain port and port »S« must be piped (see fig. 5).

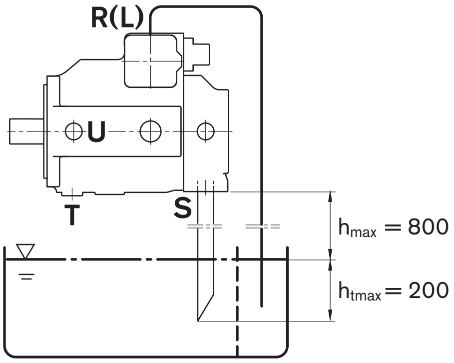


Fig. 4

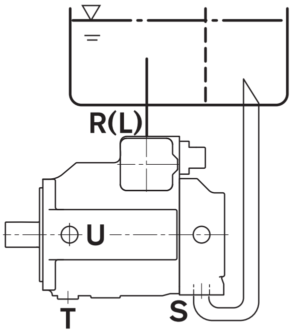


Fig. 5

Notes

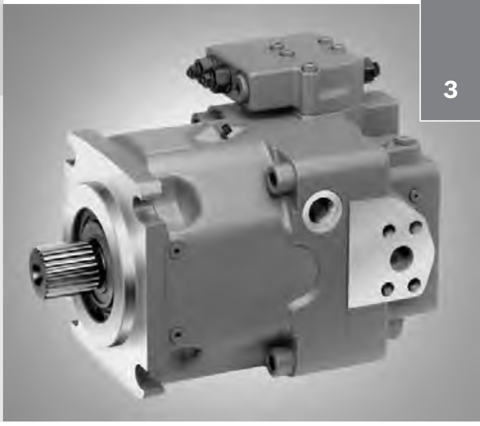
General information

- The pump A4VSO was designed for operation in open loop circuits.
- Systems design, installation and commissioning requires trained technicians or tradesmen.
- All hydraulic ports can only be used for the fastening of hydraulic service lines.
- Tightening torques:
    - All tightening torques mentioned in this data sheet are maximum values and may not be exceeded (Maximum values for the female threads in the castings).
      Please comply with the manufacturer's information regarding the max. permissible tightening torques for the used fittings.
    - For fastening screws to DIN 13 we recommend to check the permissible tightening torque in each individual case acc. to VDI 2230 issue 2003.
- During and shortly after operation of a pump the housing and especially a solenoid can be extremely hot. Take suitable safety measures (e.g. wear protective clothing).
- All given data and information has to be adhered to.

Axial Piston Variable Pump A11VO

Data sheet

Series 1
Size NG40 to 260
Nominal pressure 350 bar
Maximum pressure 400 bar
Open circuit



Contents

Features

- Variable axial piston pump of swashplate design for hydrostatic drives in open circuit hydraulic system.
- Designed primarily for use in mobile applications.
- The pump operates under self-priming conditions, with tank pressurization, or with an optional built-in charge pump (impeller).
- A comprehensive range of control options is available matching any application requirement.
- Power control option is externally adjustable, even when the pump is running.
- The through drive is suitable for adding gear pumps and axial piston pumps up to the same, i.e. 100% through drive.
- The output flow is proportional to the drive speed and infinitely variable between $q_{V\ max}$ and $q_{V\ min} = 0$.

Ordering Code / Standard Program

A11V		**O**			**/**	**1**			**–**	**N**							
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15	16

Axial piston unit

01	Swashplate design, variable, nominal pressure 350 bar, maximum pressure 400 bar	**A11V**

Charge pump (impeller)

		40	60	75	95	130	145	190	260	
02	without charge pump (no code)	●	●	●	●	●	●	●	●	
	with charge pump	–	–	–	–	●	●	●	●	**L**

Operation

03	Pump, open circuit	**O**

Size

04	≈ Displacement $V_{g\ max}$ in cm^3	**40**	**60**	**75**	**95**	**130**	**145**	**190**	**260**

Control unit

									40	60	75	95	130	145	190	260	
05	Power control			LR					●	●	●	●	●	●	●	●	**LR**
	with override	cross sensing	negative	LR		C			●	●	●	●	●	●	●	●	**LR .C**
		high-pressure related	negative	LR3					●	●	●	●	●	●	●	●	**LR3**
		pilot-pressure related	negative	LG1					●	●	●	●	●	●	●	●	**LG1**
			positive	LG2					●	●	●	●	●	●	●	●	**LG2**
		electric U = 12 V	negative	LE1					○	○	○	●	●	●	●	●	**LE1**
		U = 24 V	negative	LE2					○	●	●	●	●	●	●	●	**LE2**
	with pressure cut-off				D				●	●	●	●	●	●	●	●	**L . D. .**
		hydraulic, 2-stage			E				●	●	●	●	●	●	●	●	**L . E. .**
		hydraulic, remote controlled					G		●	●	●	●	●	●	●	●	**L . . G.**
	with load sensing							S	●	●	●	●	●	●	●	●	**L . . .S**
		electric, prop. override, 24 V						S2	○	○	○	●	●	●	●	●	**L . . .S2**
		hydraulic, prop. override						S5	○	○	○	●	●	●	●	●	**L . . .S5**
	with stroke limiter	negative characteristic	Δp = 25 bar					H1	●	●	●	●	●	●	●	●	**L . . .H1**
			Δp = 10 bar					H5	●	●	●	●	●	●	●	●	**L . . .H5**
		positive characteristic	Δp = 25 bar					H2	●	●	●	●	●	●	●	●	**L . . .H2**
			Δp = 10 bar					H6	●	●	●	●	●	●	●	●	**L . . .H6**
			U = 12 V					U1	●	●	●	●	●	●	●	●	**L . . .U1**
			U = 24 V					U2	●	●	●	●	●	●	●	●	**L . . .U2**
	Pressure control			DR					●	●	●	●	●	●	●	●	**DR**
		with load sensing		DRS					●	●	●	●	●	●	●	●	**DRS**
		remote controlled		DRG					●	●	●	●	●	●	●	●	**DRG**
		for parallel operation		DRL					●	●	●	●	●	●	●	●	**DRL**
	Hydraulic control,		Δp = 10 bar	HD1					●	●	●	●	●	●	●	●	**HD1**
	pilot-pressure related	(positive characteristic)	Δp = 25 bar	HD2					●	●	●	●	●	●	●	●	**HD2**
		with pressure cut-off			D				●	●	●	●	●	●	●	●	**HD.D**
		with pressure cut-off, remote controlled			G				○	●	○	○	○	○	●	●	**HD. G**
	Electric control		U = 12 V	EP1					●	●	●	●	●	●	●	●	**EP1**
	with proportional solenoid	(positive characteristic)	U = 24 V	EP2					●	●	●	●	●	●	●	●	**EP2**
		with pressure cut-off			D				●	●	●	●	●	●	●	●	**EP. D**
		with pressure cut-off, remote control			G				●	●	●	●	●	●	●	●	**EP. G**

In case of controls with several additional functions, observe the order of the columns, only one option per column is possible (e.g. LRDCH2). The following combinations are not available for the power control: LRDS2, LRDS5, L...GS, L...GS2, L...GS5, L...EC and the combination L...DG in conjunction with the stroke limiters H1, H2, H5, H6, U1 and U2.

Ordering Code / Standard Program

A11V		O			/	1			–	N							
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15	16

Series

06		**1**

Index

07		Size 40 ... 130	**0**
		Size 145 ... 260	**1**

Direction of rotation

08	Viewed from shaft end	clockwise	**R**
		counter-clockwise	**L**

Seals

09	NBR (nitrile-caoutchouc), shaft seal ring in FKM (fluor-caoutchouc)	**N**

Shaft end (see page 8 for permissible input and through drive torques)

			40	60	75	95	130	145	190	260	
10	Splined shaft DIN 5480 for single and combination pump		●	●	●	●	●	●	●	●	**Z**
	Parallel keyed shaft DIN 6885		●	●	●	●	●	●	●	●	**P**
	Splined shaft ANSI B92.1a–1976	for single pump	●	●	●	●	●	●	●	●	**S**
		for combination pump	●	●	●	–[1]	–[1]	–[1]	●	●	**T**

Mounting flange

		40	60	75	95	130	145	190	260	
11	SAE J744 – 2-hole	●	●	–	–	–	–	–	–	**C**
	SAE J744 – 4-hole	–	–	●	●	●	●	●	●	**D**
	SAE J617 [2] (SAE 3)	–	–	–	●	●	●	●	–	**G**

Service line ports

		40	60	75	95	130	145	190	260	
12	Pressure and suction port SAE, at side, opposite side (with metric fastening threads)	●	●	●	●	●	●	●	●	**12**

Through drive (see page 58 for attachments)

						40	60	75	95	130	145	190	260	
13	Flange SAE J744 [3]		Coupler for splined shaft											
	–		–			●	●	●	●	●	●	●	●	**N00**
	82-2	(A)	5/8in	9T 16/32DP	(A)	●	●	●	●	●	●	●	●	**K01**
			3/4in	11T 16/32DP	(A-B)	○	●	○	●	●	●	○	○	**K52**
	101-2	(B)	7/8in	13T 16/32DP	(B)	●	●	●	●	●	●	●	●	**K02**
			1 in	15T 16/32DP	(B-B)	●	●	●	●	●	●	●	●	**K04**
			W35	2x30x16x9g		●	●	●	●	●	●	●	●	**K79**
	127-2	(C) [4]	1 1/4in	14T 12/24DP	(C)	–	●	●	●	●	●	●	●	**K07**
			1 1/2in	17T 12/24DP	(C-C)	–	–	–	●	●	●	●	●	**K24**
			W30	2x30x14x9g		–	●	●	●	●	●	●	●	**K80**
			W35	2x30x16x9g		–	●	●	●	●	●	●	●	**K61**
	152-4	(D)	1 1/4in	14T 12/24DP	(C)	–	–	●	●	●	●	●	●	**K86**
			1 3/4in	13T 8/16DP	(D)	–	–	–	–	●	●	●	●	**K17**
			W40	2x30x18x9g		–	–	●	●	●	●	●	●	**K81**
			W45	2x30x21x9g		–	–	–	●	●	●	●	●	**K82**
			W50	2x30x24x9g		–	–	–	–	●	●	●	●	**K83**
	165-4	(E)	1 3/4in	13T 8/16DP	(D)	–	–	–	–	–	–	●	●	**K72**
			W50	2x30x24x9g		–	–	–	–	–	–	●	●	**K84**
			W60	2x30x28x9g		–	–	–	–	–	–	–	●	**K67**

Ordering Code / Standard Program

A11V		O			/	1			–	N							
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15	16

Swivel angle indicator (page 59)

		40	60	75	95	130	145	190	260	
14	without swivel angle indicator (no symbol)	●	●	●	●	●	●	●	●	
	with optical swivel angle indicator	●	–	●	●	●	●	●	●	**V**
	with electric swivel angle sensor	●	–	●	●	●	●	●	●	**R**

Connector for solenoids (page 60)

		40	60	75	95	130	145	190	260	
15	DEUTSCH connector molded, 2-pin – without suppressor diode	●	●	●	●	●	●	●	●	**P**

Standard / special version

16	Standard version	without symbol	
		combined with attachment part or attachment pump	**-K**
	Special version		**-S**
		combined with attachment part or attachment pump	**-SK**

[1] **S**-shaft suitable for combination pump!

[2] To fit the flywheel case of the combustion engine

[3] 2 ≙ 2-hole; 4 ≙ 4-hole

[4] Size 190 and 260 with 2 + 4-hole flange

● = available ❍ = on request – = not available ▨ = preferred program

Technical Data

Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids) and RE 90223 (HF hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and operating conditions.

The variable pump A11VO is not suitable for operating with HFA, HFB and HFC. If HFD or environmentally acceptable hydraulic fluids are being used, the limitations regarding technical data and seals mentioned in RE 90221 and RE 90223 must be observed.

When ordering, please indicate the used hydraulic fluid.

Operating viscosity range

For optimum efficiency and service life, select an operating viscosity (at operating temperature) within the optimum range of

ν_{opt} = optimum operating viscosity 16 to 36 mm^2/s

depending on the tank temperature (open circuit).

Limits of viscosity range

The limiting values for viscosity are as follows:

ν_{min} = 5 mm^2/s
Short-term ($t < 3$ min)
At max. perm. temperature of $t_{max} = +115$°C.

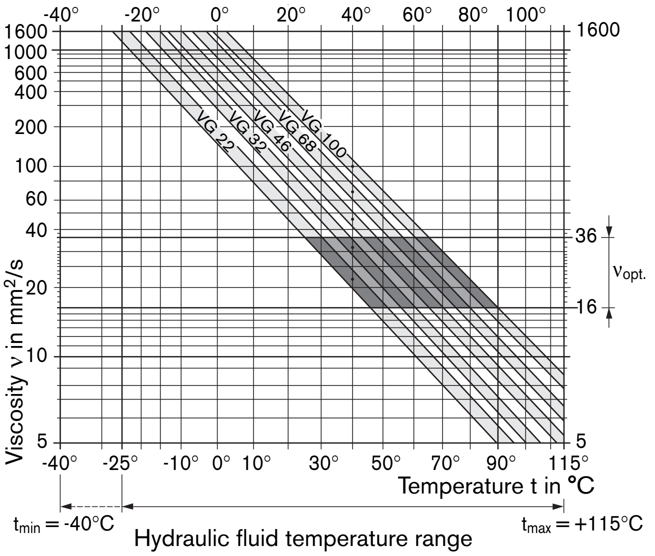
ν_{max} = 1600 mm^2/s
Short-term ($t < 3$ min)
At cold start ($p \leq 30$ bar, $n \leq 1000$ rpm, $t_{min} = -40$°C).
Only for starting up without load. Optimum operating viscosity must be reached within approx. 15 minutes.

Note that the maximum hydraulic fluid temperature of 115°C must not be exceeded locally either (e.g. in the bearing area). The temperature in the bearing area is – depending on pressure and speed – up to 5 K higher than the average case drain temperature.

Special measures are necessary in the temperature range from -40°C and -25°C (cold start phase), please contact us.

For detailed information about use at low temperatures, see RE 90300-03-B.

Selection diagram



Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature: in an open circuit the tank temperature.

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range ($\nu_{opt.}$) – see the shaded area of the selection diagram. We recommended that the higher viscosity class be selected in each case.

Example: At an ambient temperature of X°C an operating temperature of 60°C is set. In the optimum operating viscosity range (ν_{opt}; shaded area) this corresponds to the viscosity classes VG 46 and VG 68; to be selected: VG 68.

Please note:
The case drain temperature, which is affected by pressure and speed, is always higher than the tank temperature. At no point in the system may the temperature be higher than 115°C.

If the above conditions cannot be maintained due to extreme operating parameters, please contact us.

Filtration

The finer the filtration, the higher the cleanliness level of the hydraulic fluid and the longer the service life of the axial piston unit.

To ensure functional reliability of the axial piston unit, the hydraulic fluid must have a claenliness level of at least

20/18/15 according to ISO 4406.

At very high hydraulic fluid temperatures (90°C to max. 115°C, not permitted for sizes 250 to 1000) at least cleanliness level

19/17/14 according to ISO 4406 is required.

If the above classes cannot be observed, please contact us.

Technical Data

Operating pressure range

Inlet

Absolute pressure at port S (suction port)
Version *without* charge pump

$p_{abs\ min}$ ________ 0.8 bar
$p_{abs\ max}$ ________ 30 bar

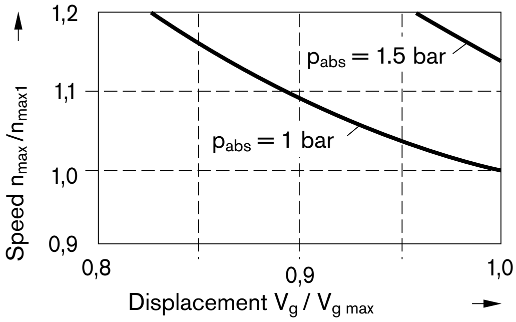
If the pressure is > 5 bar, please ask.

Version *with* charge pump

$p_{abs\ min}$ ________ 0.6 bar
$p_{abs\ max}$ ________ 2 bar

Maximum permissible speed (speed limit)

Permissible speed by increasing the inlet pressure p_{abs} at the suction port S or at $V_g \leq V_{g\ max}$



Outlet

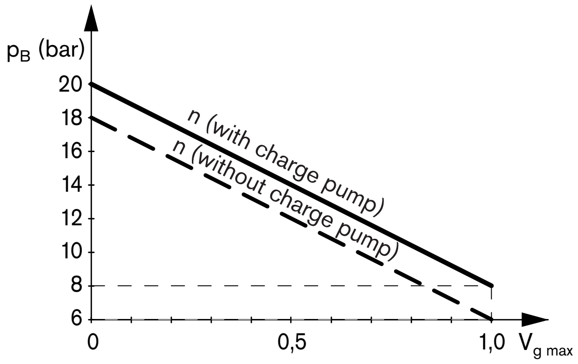
Pressure at port A or B

Nominal pressure p_N ________ 350 bar
Maximum pressure p_{max} ________ 400 bar

Nominal pressure:	Max. design pressure at which fatigue strength is ensured.
Maximum pressure:	Max. operating pressure which is permissible for short-term (t < 1s).

Minimum operating pressure

A minimum operating pressure $p_{B\ min}$ is required in the pump service line depending on the speed, the swivel angle and the displacement (see diagram).



Case drain pressure

The case drain pressure at the ports T_1 and T_2 may be a maximum of 1.2 bar higher than the inlet pressure at the port S but not higher than

$p_{L\ abs.\ max}$ ________ 2 bar.

An unrestricted, full size case drain line directly to tank is required.

Temperature range of the shaft seal ring

The FKM shaft seal ring is permissible for case drain temperatures of -25°C to +115°C.

Note:
For applications below -25°C, an NBR shaft seal ring is necessary (permissible temperature range: -40°C to +90°C).
State NBR shaft seal ring in clear text in the order.

Flushing the case

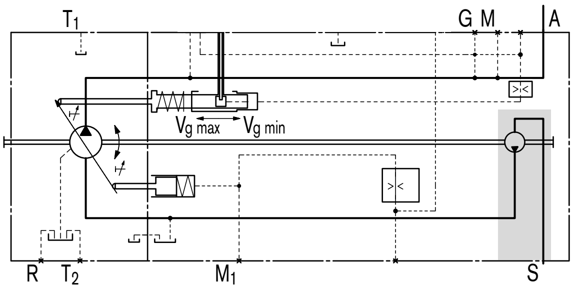
If a variable pump with control unit **EP, HD, DR** or stroke limiter (**H., U.**,) is operated over a long period (t > 10 min) with flow zero or operating pressure < 15 bar, flushing of the case via ports "T_1", "T_2" or "R" is necessary.

Size	**40**	**60**	**75**	**95**	**130**	**145**	**190**	**260**
$q_{V\ flush}$(l/min)	2	3	3	4	4	4	5	6

Flushing the case is unnecessary in versions with charge pump (A11VLO), since a part of the charge flow is directed to the case.

Charge pump (impeller)

The charge pump is a circulating pump with which the A11VLO (size 130...260) is filled and therefore can be operated at higher speeds. This also simplifies cold starting at low temperatures and high viscosity of the hydraulic fluid. Tank charging is therefore unnecessary in most cases. A tank pressure of a max. 2 bar is permissible with charge pump.



Technical Data

Table of values (theoretical values, without efficiency and tolerances; values rounded)

Size	**A11VO**		**40**	**60**	**75**	**95**	**130**	**145**	**190**	**260**
Displacement	$V_{g\,max}$	cm³	42	58.5	74	93.5	130	145	193	260
	$V_{g\,min}$	cm³	0	0	0	0	0	0	0	0
Speed										
maximum at $V_{g\,max}$ 1)	n_{max}	rpm	3000	2700	2550	2350	2100	2200	2100	1800
maximum at $V_g \leq V_{g\,max}$ 3)	n_{max1}	rpm	3500	3250	3000	2780	2500	2500	2100	2300
Flow at n_{max} and $V_{g\,max}$	$q_{v\,max}$	l/min	126	158	189	220	273	319	405	468
Power at $q_{v\,max}$ and $\Delta p = 350$ bar	P_{max}	kW	74	92	110	128	159	186	236	273
Torque at $V_{g\,max}$ and $\Delta p = 350$ bar	T_{max}	Nm	234	326	412	521	724	808	1075	1448
Rotary stiffness	Z shaft	Nm/rad	88894	102440	145836	199601	302495	302495	346190	686465
	P shaft	Nm/rad	87467	107888	143104	196435	312403	312403	383292	653835
	S shaft	Nm/rad	58347	86308	101921	173704	236861	236861	259773	352009
	T shaft	Nm/rad	74476	102440	125603	–	–	–	301928	567115
Moment of inertia for rotary group	J_{TW}	kgm²	0.0048	0.0082	0.0115	0.0173	0.0318	0.0341	0.055	0.0878
Angular acceleration, max. 4)										
	α	rad/s²	22000	17500	15000	13000	10500	9000	6800	4800
Filling capacity	V	l	1.1	1.35	1.85	2.1	2.9	2.9	3.8	4.6
Mass (approx.)	m	kg	32	40	45	53	66	76	95	125

Size	**A11VLO (with charge pump)**		**130**	**145**	**190**	**260**
Displacement	$V_{g\,max}$	cm³	130	145	193	260
	$V_{g\,min}$	cm³	0	0	0	0
Speed						
maximum at $V_{g\,max}$ 2)	n_{max}	rpm	2500	2500	2500	2300
maximum at $V_g \leq V_{g\,max}$ 3)	n_{max1}	rpm	2500	2500	2500	2300
Flow at n_{max} and $V_{g\,max}$	$q_{v\,max}$	l/min	325	363	483	598
Power at $q_{v\,max}$ and $\Delta p = 350$ bar	P_{max}	kW	190	211	281	349
Torque at $V_{g\,max}$ and $\Delta p = 350$ bar	T_{max}	Nm	724	808	1075	1448
Rotary stiffness	Z shaft	Nm/rad	302495	302495	346190	686465
	P shaft	Nm/rad	312403	312403	383292	653835
	S shaft	Nm/rad	236861	236861	259773	352009
	T shaft	Nm/rad	–	–	301928	567115
Moment of inertia for rotary group	J_{TR}	kgm²	0.0337	0.036	0.0577	0.0895
Angular acceleration, max. 4)						
	α	rad/s²	10500	9000	6800	4800
Filling capacity	V	l	2.9	2.9	3.8	4.6
Mass (approx.)	m	kg	72	73	104	138

1) The values apply at absolute pressure (p_{abs}) 1 bar at the suction port S and mineral hydraulic fluid.

2) The values apply at absolute pressure (p_{abs}) of at least 0.8 bar at the suction port S and mineral hydraulic fluid.

3) The values apply at $V_g \leq V_{g\,max}$ or in case of an increase in the inlet pressure p_{abs} at the suction port S (see diagram page 6)

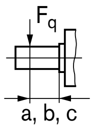
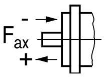
4) – The area of validity is situated between 0 and the maximum permissible speed.
It applies for external stimuli (e.g. engine 2-8 times rotary frequency, cardan shaft twice the rotary frequency).
– The limit value applies for a single pump only.
– The loading on the connection parts has to be considered.

Caution:
Exceeding the permissible limit values could cause a loss of function, reduced service life or the destruction of the axial piston unit. The permissible values can be determined by calculation.

Technical Data

Permissible radial and axial loading on drive shaft

The values stated are maximum data and not permissible for continuous operation

Size			Size	40	60	75	95	130	145	190	260
Radial force, max. at distance a, b, c (from shaft collar)		$F_{q\,max}$	N	3600	5000	6300	8000	11000	11000	16925	22000
		a	mm	17.5	17.5	20	20	22.5	22.5	26	29
		$F_{q\,max}$	N	2891	4046	4950	6334	8594	8594	13225	16809
		B	mm	30	30	35	35	40	40	46	50
		$F_{q\,max}$	N	2416	3398	4077	5242	7051	7051	10850	13600
		c	mm	42.5	42.5	50	50	57.5	57.5	66	71
Axial force, max.		$\pm F_{ax\,max}$	N	1500	2200	2750	3500	4800	4800	6000	4150

Permissible input and through drive torques

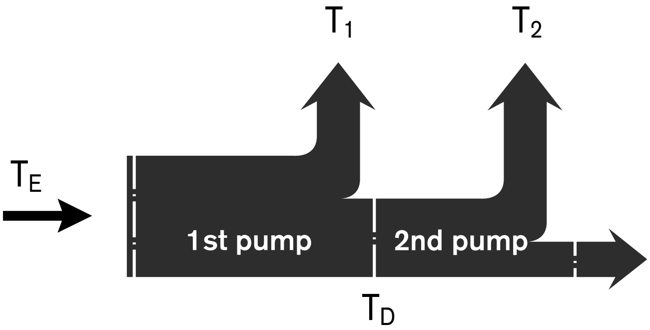
Size		Size	40	60	75	95	130	145	190	260
Torque (at $V_{g\,max}$ and $\Delta p = 350$ bar 1))	T_{max}	Nm	234	326	412	521	724	808	1075	1448
Input torque, max. 2)										
at shaft end P	$T_{E\,perm.}$	Nm	468	648	824	1044	1448	1448	2226	2787
Shaft key DIN 6885			ø32	ø35	ø40	ø45	ø50	ø50	ø55	ø60
at Z shaft end	$T_{E\,perm.}$	Nm	912	912	1460	2190	3140	3140	3140	5780
DIN 5480			W35	W35	W40	W45	W50	W50	W50	W60
at S shaft end	$T_{E\,perm.}$	Nm	314	602	602	1640	1640	1640	1640	1640
ANSI B92.1a-1976 (SAE J744)			1 in	1 1/4 in	1 1/4 in	1 3/4 in	1 3/4 in	1 3/4 in	1 3/4 in	1 3/4 in
at T shaft end	$T_{E\,perm.}$	Nm	602	970	970	–	–	–	2670	4070
ANSI B92.1a-1976 (SAE J744)			1 1/4 in	1 3/8 in	1 3/8 in	–	–	–	2 in	2 1/4 in
Through drive torque, max. 3)	$T_{D\,perm.}$	Nm	314	521	660	822	1110	1110	1760	2065

1) Efficiency not considered

2) For drive shafts with no radial force

3) Observe max. input torque for shaft **S**!

Torque distribution



Determining the nominal value

Flow $$q_v = \frac{V_g \bullet n \bullet \eta_v}{1000} \quad \text{l/min}$$

Torque $$T = \frac{V_g \bullet \Delta p}{20 \bullet \pi \bullet \eta_{mh}} \quad \text{Nm}$$

Power $$P = \frac{2\,\pi \bullet T \bullet n}{60{,}000} = \frac{q_v \bullet \Delta p}{600 \bullet \eta_t} \quad \text{kW}$$

V_g = Displacement per revolution in cm^3

Δp = Differential pressure in bar

n = Speed in rpm

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Overall efficiency ($n_t = n_v \bullet n_{mh}$)

LR – Power Control

The power control regulates the displacement of the pump depending on the operating pressure so that a given drive power is not exceeded at constant drive speed.

$p_B \cdot V_g = \text{constant}$

p_B = operating pressure

V_g = displacement

The precise control with a hyperbolic control characteristic, provides an optimum utilization of available power.

The operating pressure acts on a rocker via a measuring piston. An externally adjustable spring force counteracts this, it determines the power setting.

If the operating pressure exceeds the set spring force, the control valve is actuated by the rocker, the pump swivels back (direction $V_{g\,min}$). The lever length at the rocker is shortened and the operating pressure can increase at the same rate as the displacement decreases without the drive powers being exceeded ($p_B \cdot V_g$ = constant).

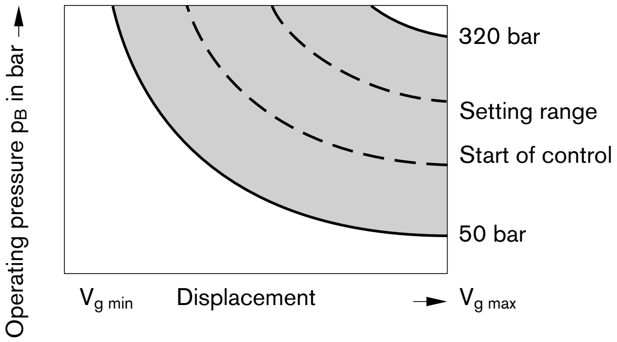
The hydraulic output power (characteristic LR) is influenced by the efficiency of the pump.

State in clear text in the order:

- drive power P in kW
- drive speed n in rpm
- max. flow $q_{V\,max}$ in l/min

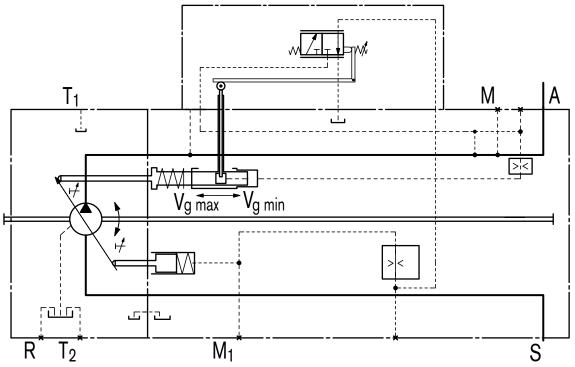
After clarifying the details a power diagram can be created by our computer.

Characteristic LR

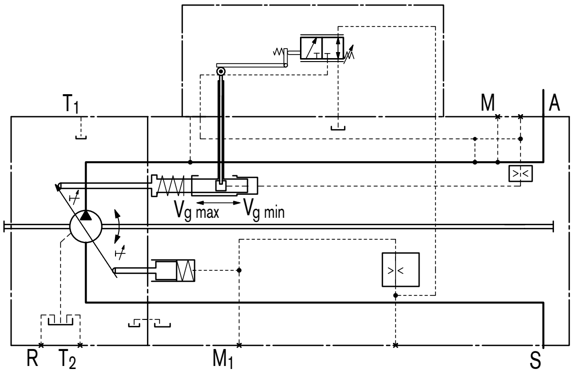


Circuit diagram LR

Size 40 ... 145



Size 190 ... 260



LR – Power Control

LRC Override with cross sensing

Cross sensing control is a summation power control system, whereby the total power, of both the A11VO and of a same size A11VO power controlled pump mounted onto the through drive, are kept constant.

If a pump is operating at pressures below the start of the control curve setting, then the surplus power not required, in a critical case up to 100%, becomes available to the other pump. Total power is thus divided between two systems as demand requires.

Any power being limited by means of pressure cut-off or other override functions is not taken into account.

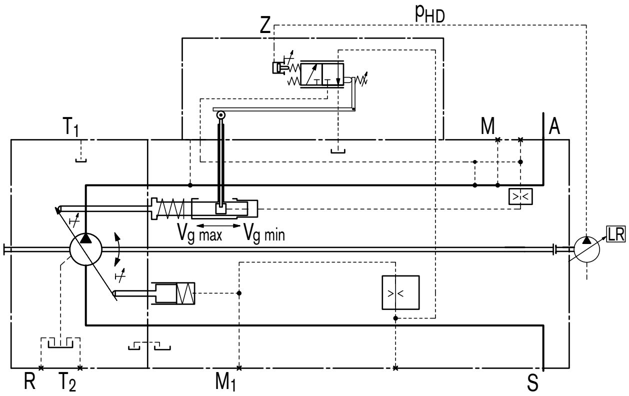
Half side cross sensing function

When using the LRC control on the 1st pump (A11VO) and a power-controlled pump without cross sensing attached to the through drive, the power required for the 2nd pump is deducted from the setting of the 1st pump. The 2nd pump has priority in the total power setting.

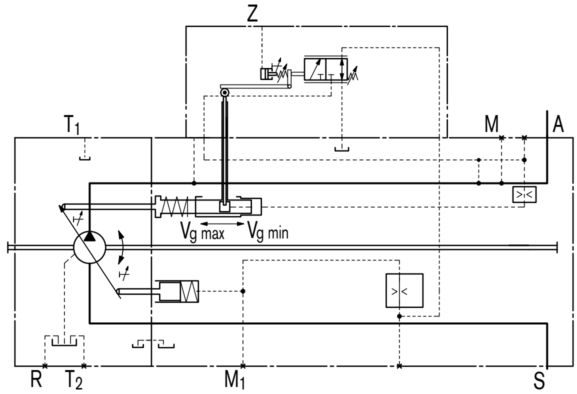
The size and start of control of the power control of the 2nd pump must be specified for rating the control of the 1st pump.

Circuit diagram LRC

Size 40 ... 145



Size 190 ... 260



LR3 High-pressure related override

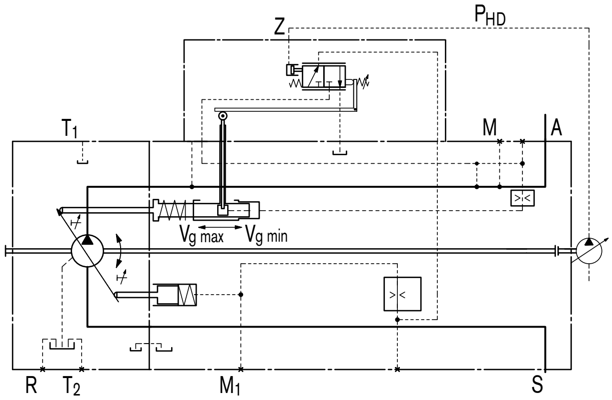
The high-pressure related power override is a total power control in which the power control setting is piloted by the load pressure of an attached fixed pump (port Z).

As a result the A11VO can be set to 100% of the total drive power. The power setting of the A11VO is reduced proportional to the load-dependent rise in operating pressure of the fixed pump. The fixed pump has priority in the total power setting.

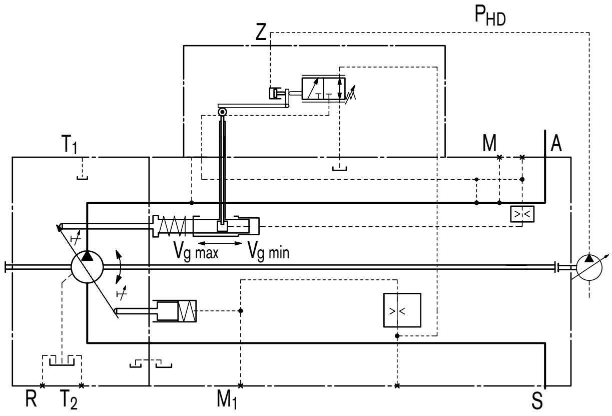
The measuring area of the power reduction pilot piston is designed as a function of the size of the fixed pump.

Circuit diagram LR3

Size 40 ... 145



Size 190 ... 260



LR – Power Control

LG1/2 Pilot-pressure related override

This power control works by overriding the control setting with an external pilot pressure signal. This pilot pressure acts on the adjustment spring of the power regulator via port Z.

The mechanically adjusted basic setting can be hydraulically adjusted by means of different pilot pressure settings, enabling different power mode settings.

If the pilot pressure signal is then adjusted by means of an external power limiting control, the total hydraulic power consumption of all users can be adapted to the available drive power from the engine.

The pilot pressure used for power control is generated by an external control element that is not a component part of the A11VO (e.g. see also data sheet RE 95310, Electronic Load Limiting Control, LLC).

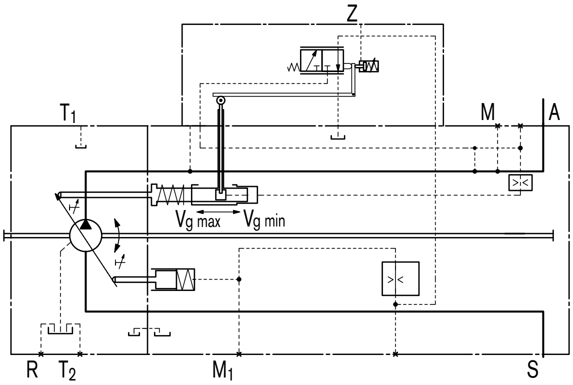
LG1 Negative power override

Power control with negative override, LG1: the force resulting from the pilot pressure is acting against the mechanical adjustment spring of the power control.

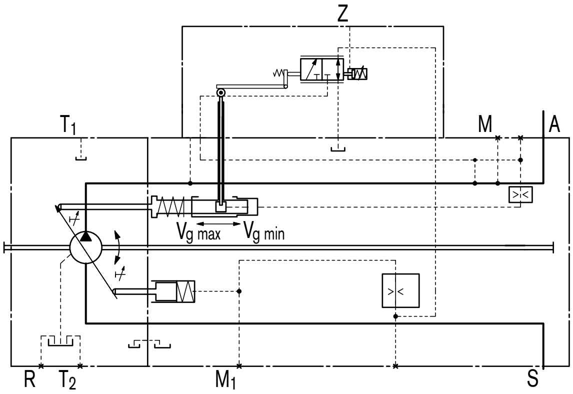
Increasing the pilot pressure reduces the power setting.

Circuit diagram LG1

Size 40 ... 145



Size 190 ... 260



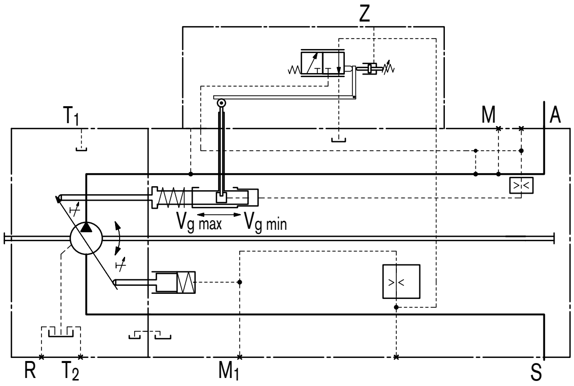
LG2 Positive power override

Power control with positive override, LG2: the force resulting from the pilot pressure is additive the mechanical adjustment spring of the power control.

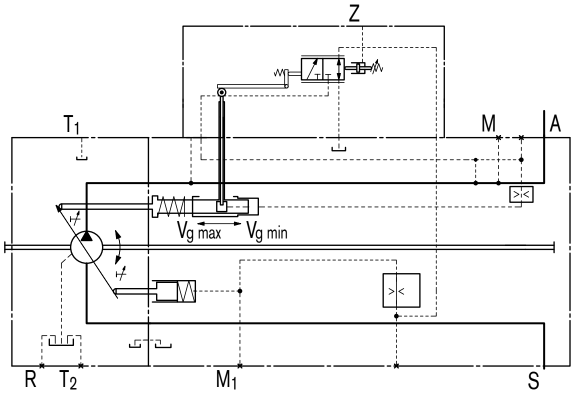
An increase in pilot pressure increases the power output.

Circuit diagram LG2

Size 40 ... 145



Size 190 ... 260



LE1/2 Electric override (negative)

Contrary to hydraulic power control override, the basic power setting is reduced by an electric pilot current applied to a proportional solenoid. The resulting force is acting against the mechanical power control adjustment spring.

The mechanically adjusted basic power setting can be varied by means of different control current settings.

Increase in current = decrease in power

If the pilot current signal is adjusted by a load limiting control the power consumption of all actuators will be reduced to match the available power from the diesel engine.

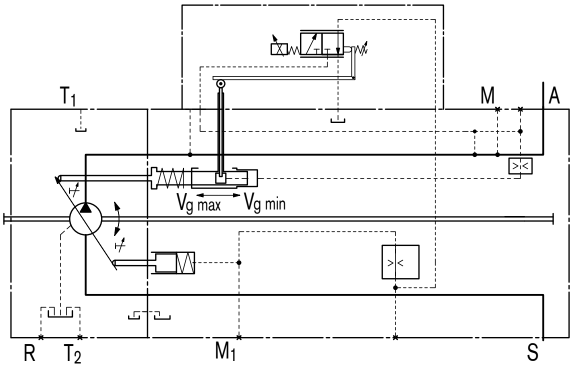
A 12V (LE1) or 24V (LE2) supply is required for the control of the proportion solenoid.

Technical data - Solenoids

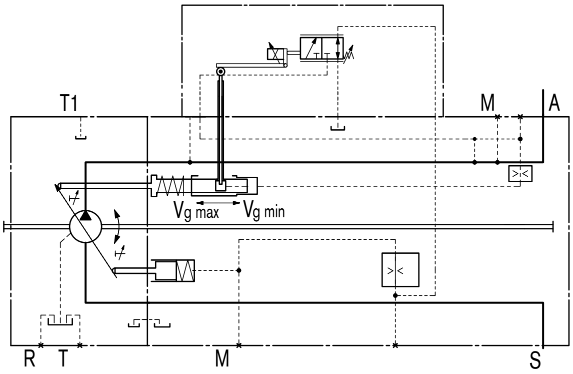
	LE1	LE2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control	400 mA	200 mA
End of control	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20°C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Actuated time	100 %	100 %
Type of protection	see connector version, page 60	

Circuit diagram LE1/2

Size 40 ... 145

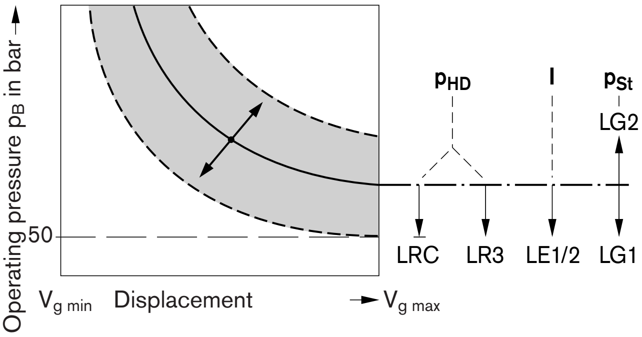


Size 190 ... 260



Overview of power overrides

Effect of power overrides at rising pressure or current



LR – Power Control

LRD Power control with pressure cut-off

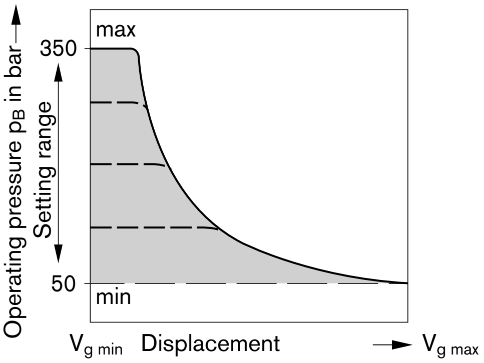
The pressure cut-off corresponds to a pressure control which adjusts the pump displacement back to $V_{g\,min}$, when the pressure setting is reached.

This function overrides the power control, i.e. below the preset pressure value, the power function is effective.

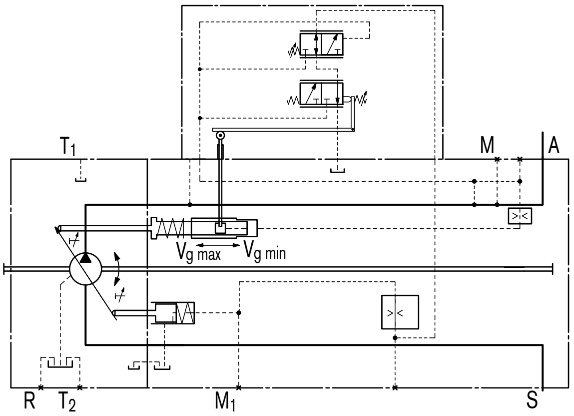
The pressure cut-off function is integrated into the pump control module and is preset to a specified value at the factory.

Setting range from 50 to 350 bar

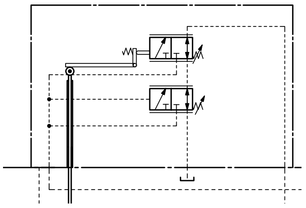
Characteristic LRD



Circuit diagram LRD
Size 40...145



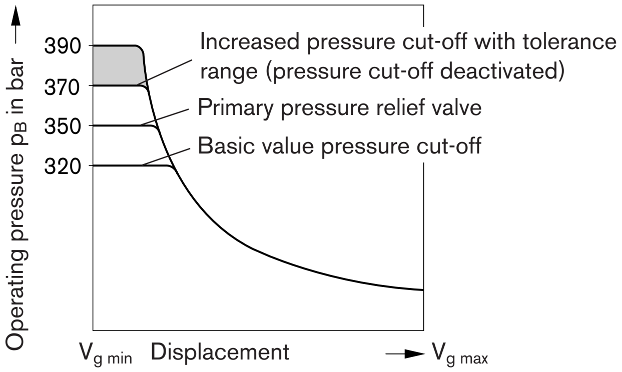
Size 190...260



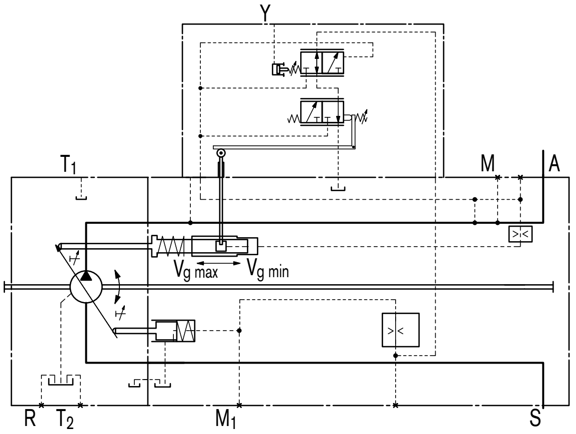
LRE Power control with pressure cut-off, 2-stage

By connecting an external pilot pressure to port Y, the basic value of the pressure cut-off can be increased by 50 $^{+20}$ bar and a 2nd pressure setting implemented.
This value is usually above the primary pressure relief valve setting and therefore disables the pressure cut-off function.
The pressure signal at port Y must be between 20 and 50 bar.

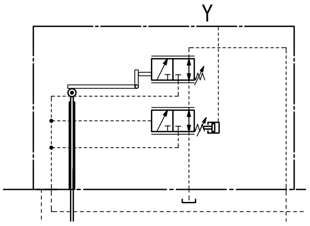
Characteristic LRE



Circuit diagram LRE
Size 40...145



Size 190...260



LRG Power control with pressure cut-off, hydraulically remote controlled

See page 21 for description and characteristic (pressure control remote controlled, DRG)

LRDS Power control with pressure cut-off and load sensing

The load sensing control is a flow control option that operates as a function of the load pressure to regulate the pump displacement to match the actuator flow requirement.

The flow depends here on the cross section of the external sensing orifice (1) fitted between the pump outlet and the actuator. The flow is independent of the load pressure below the power curve and the pressure cut-off setting and within the control range of the pump.

The sensing orifice is usually a separately arranged load sensing directional valve (control block). The position of the directional valve piston determines the opening cross section of the sensing orifice and thus the flow of the pump.

The load sensing control compares pressure before and after the sensing orifice and maintains the pressure drop across the orifice (differential pressure Δp) and with it the pump flow constant.

If the differential pressure Δp increases at the sensing orifice, the pump is swivelled back (towards $V_{g\,min}$), and, if the differential pressure Δp decreases, the pump is swivelled out (towards $V_{g\,max}$) until the pressure drop across the sensing orifice in the valve is restored.

$\Delta p_{orifice} = p_{pump} - p_{actuator}$

The setting range for Δp is between 14 bar and 25 bar.

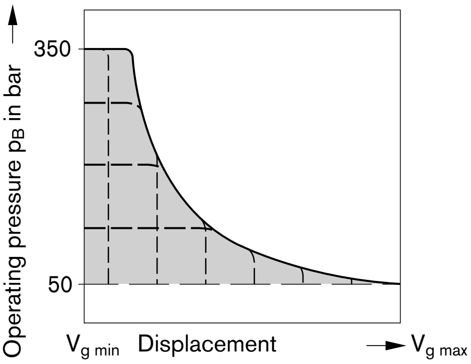
The standard differential pressure setting is 18 bar. (Please state in clear text when ordering).

The stand-by pressure in zero stroke operation (sensing orifice plugged) is slightly above the Δp setting.

In a standard LS system the pressure cut-off is integrated in the pump control. In a LUDV (flow sharing) system the pressure cut-off is integrated in the LUDV control block.

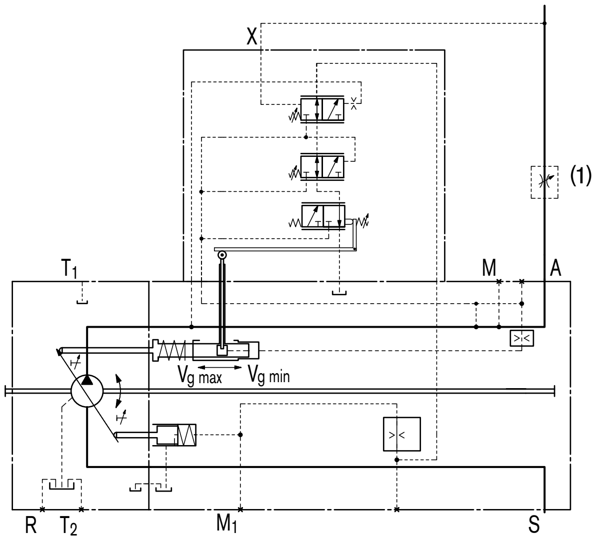
(1) The sensing orifice (control block) is not included in the pump supply.

Characteristic LRDS

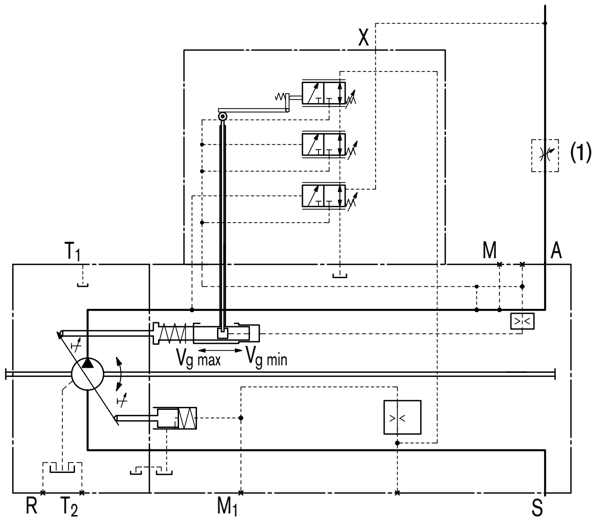


Circuit diagram LRDS

Size 40 ... 145



Size 190 ... 260



LR – Power Control

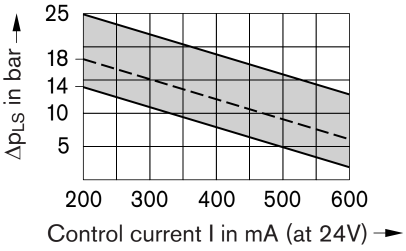
LRS2 Power control with load sensing, electric override

This control option adds a proportional solenoid to override to the mechanically set load sensing pressure. The pressure differential change is proportional to the solenoid current.

Increasing current = smaller Δp-setting

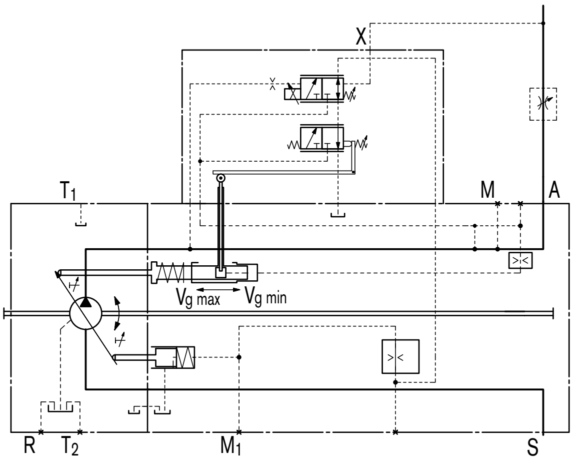
See following characteristic for details (example). Please consult us during the project planning phase.
For solenoid specification, see page 12 (LE2)

Characteristic LRS2

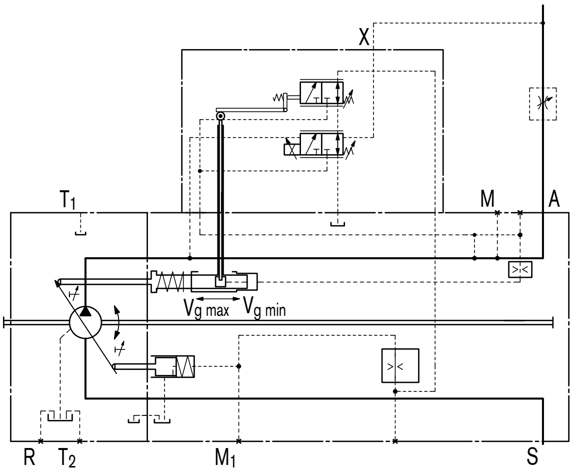


Circuit diagram LRS2

Size 40 ... 145



Size 190 ... 260



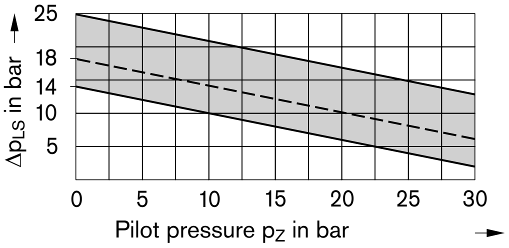
LRS5 Power control with load sensing, hydraulic override

This control option adds an external proportional pilot pressure signal (to port Z) to override the mechanically set load sensing pressure.

Increasing pilot pressure = smaller Δp-setting

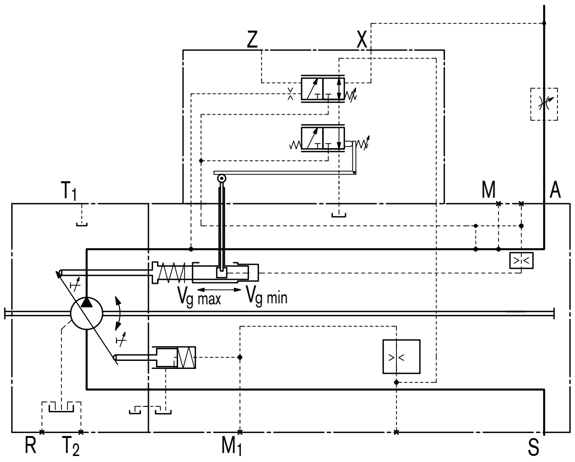
See following characteristic for details (example). Please consult us during the project planning phase.

Characteristic LRS5

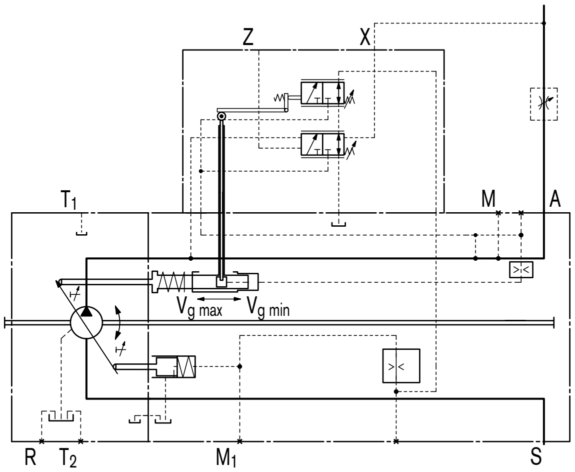


Circuit diagram LRS5

Size 40 ... 145



Size 190 ... 260



LR… Power control with stroke limiter

The stroke limiter can be used to vary or limit the displacement of the pump continuously over the whole control range. The displacement is set in LRH with the pilot pressure p_{St} (max. 40 bar) applied to port Y or in LRU by the control current applied to the proportional solenoid. A DC current of 12V (U1) or 24V (U2) is required to control the proportional solenoid.

The power control overrides the stoke limiter control, i.e. below the hyperbolic power characteristic, the displacement is controlled by the control current or pilot pressure. When exceeding the power characteristic with a set flow or load pressure, the power control overrides and reduces the displacement following the hyperbolic characteristic.

To permit operation of the pump displacement control from its starting position $V_{g\,max}$ to $V_{g\,min}$, a minimum control pressure of 30 bar is required for the electric stroke limiter LRU1/2 and the hydraulic stroke limiter LRH2/6.

The required control pressure is taken either from the load pressure, or from the externally applied control pressure at the G port.

To ensure functioning of the stroke limiter even at low operating pressure, port G must be supplied with external control pressure of approx. 30 bar.

Note:
If no external control pressure is connected at G, the shuttle valve must be removed.

Note

The spring return feature in the controller is not a safety device

The spool valve inside the controller can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).

LR – Power Control

LRH1/5 Hydraulic stroke limiter (negative characteristic)

Control from $V_{g\,max}$ to $V_{g\,min}$

With increasing pilot pressure the pump swivels to a smaller displacement.

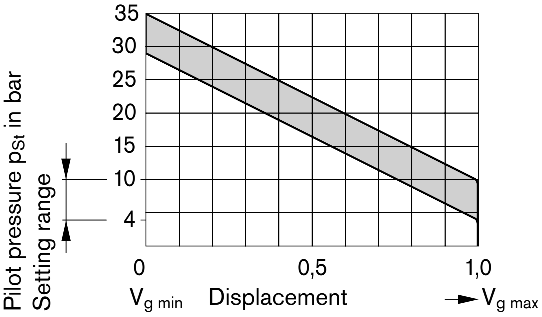
Start of control (at $V_{g\,max}$), can be set _______ from 4 – 10 bar

State start of control in clear text in the order.

Starting position without control signal (pilot pressure): $V_{g\,max}$

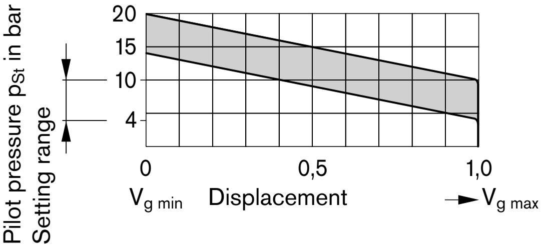
Characteristic H1

Increase in pilot pressure ($V_{g\,max}$ – $V_{g\,min}$) ________Δp = 25 bar



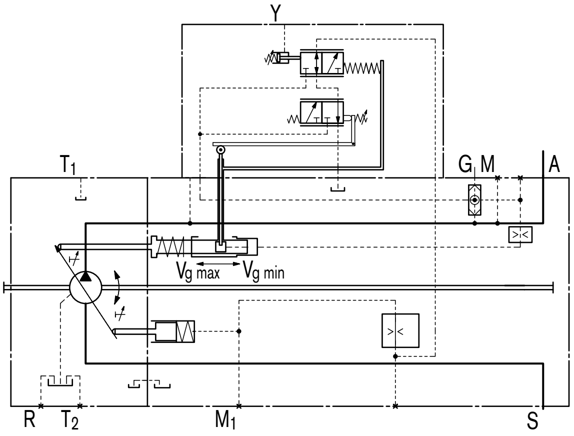
Characteristic H5

Increase in pilot pressure ($V_{g\,max}$ – $V_{g\,min}$) ________Δp = 10 bar

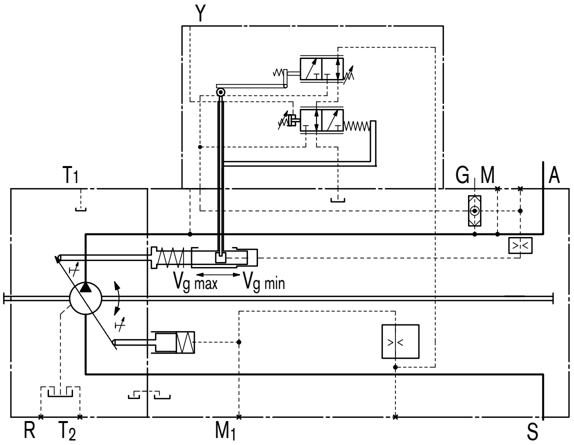


Circuit diagram LRH1/5

Size 40 ... 145



Size 190 ... 260



LRH2/6 Hydraulic stroke limiter (positive characteristic)

Control from $V_{g\,min}$ to $V_{g\,max}$

With increasing pilot pressure the pump swivels to a higher displacement.

Start of control (at $V_{g\,min}$), can be set ________ from 4–10 bar

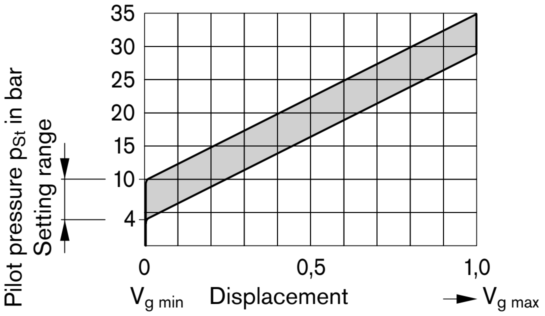
State start of control in clear text in the order.

Starting position without control signal (pilot pressure):

- at operating pressure and external control pressure < 30 bar: $V_{g\,max}$
- at operating pressure or external control pressure > 30 bar: $V_{g\,min}$

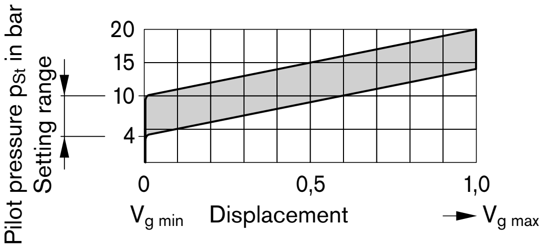
Characteristic H2

Increase in pilot pressure ($V_{g\,min}$ – $V_{g\,max}$) _______ $\Delta p = 25$ bar



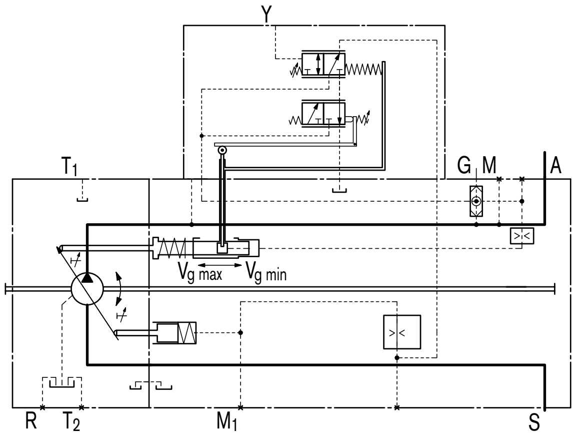
Characteristic H6

Increase in pilot pressure ($V_{g\,min}$ – $V_{g\,max}$) _______ $\Delta p = 10$ bar



Circuit diagram LRH2/6

Size 40 ... 145



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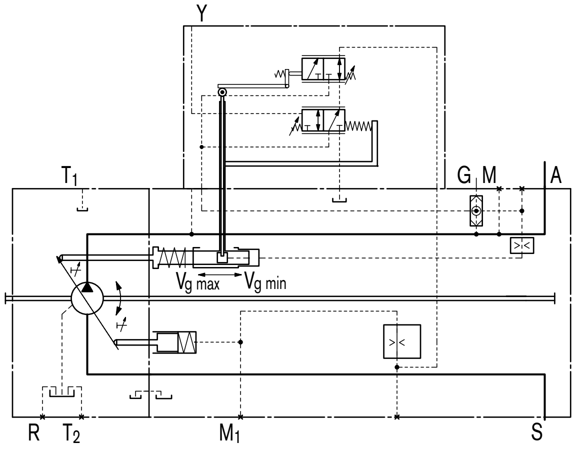


LR – Power Control

LRU1/2 Electric stroke limiter (positive characteristic)

Control from $V_{g\,min}$ to $V_{g\,max}$

With increasing control current the pump swivels to a higher displacement.

Technical data - solenoids

	LRU1	LRU2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control at $V_{g\,max}$	400 mA	200 mA
End of control at $V_{g\,min}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20°C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Actuated time	100 %	100 %
Type of protection	see connector version, page 60	

Starting position without control signal (control current):

- at operating pressure and external control pressure < 30 bar: $V_{g\,max}$
- at operating pressure or external control pressure > 30 bar: $V_{g\,min}$

The following electronic controllers and amplifiers are available for actuating the proportional solenoids:

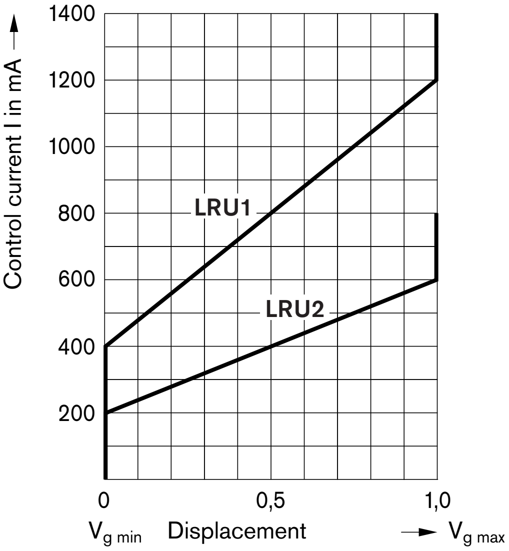
- BODAS controller RC

Series 20	RE 95200
Series 21	RE 95201
Series 22	RE 95202
Series 30	RE 95203

  and application software

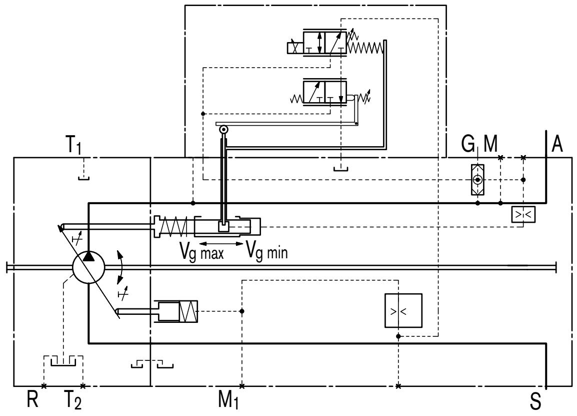
- Analog amplifier RA ____________ RE 95230

Characteristic LRU1/2



Circuit diagram LRU1/2

Size 40 ... 145



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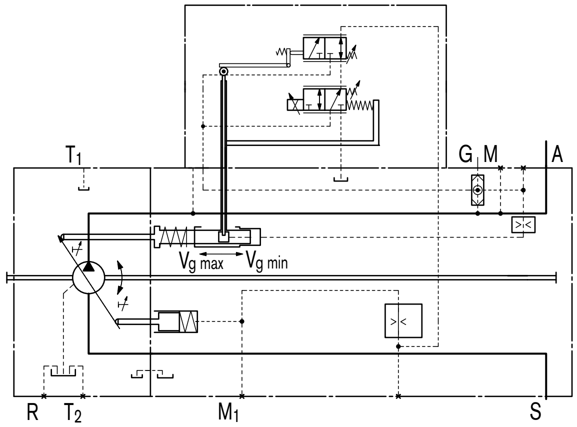


DR – Pressure Control

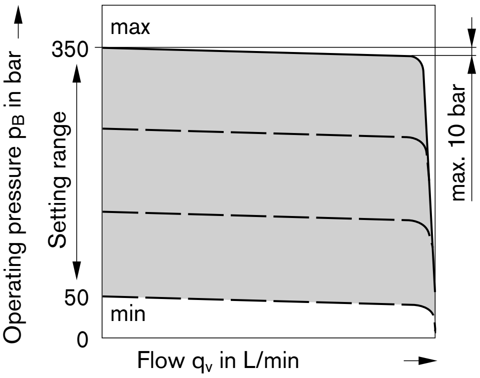
DR Pressure control

The pressure control keeps the pressure in a hydraulic system constant within its control range even under varying flow conditions. The variable pump only moves as much hydraulic fluid as is required by the actuators. If the operating pressure exceeds the setpoint set at the integral pressure control valve, the pump displacement is automatically swivelled back until the pressure deviation is corrected.

Starting position in depressurized state: $V_{g\ max}$

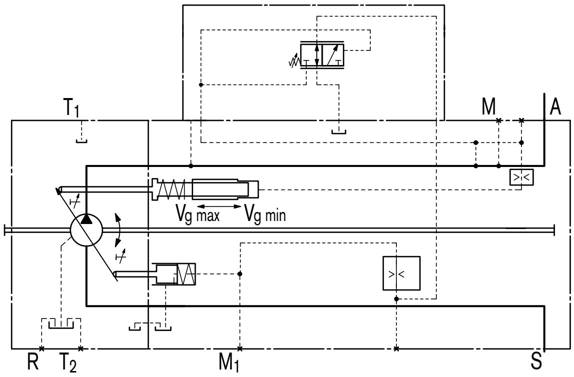
Setting range from 50 to 350 bar.

Characteristic: DR



Circuit diagram DR

Size 40 ... 145



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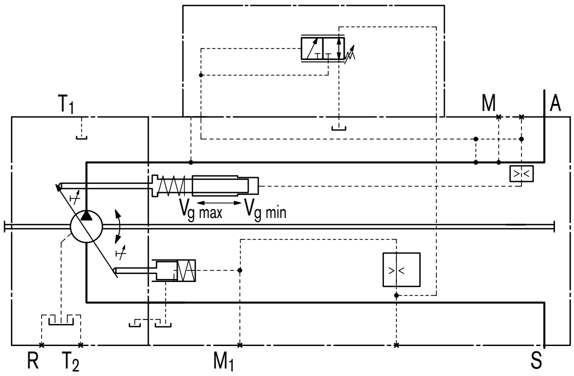


DR – Pressure Control

DRS Pressure control with load sensing

The load sensing control is a flow control option that operates as a function of the load pressure to regulate the pump displacement to match the actuator flow requirement.

The flow depends here on the cross section of the external sensing orifice (1) fitted between the pump outlet and the actuator. The flow is independent of the load pressure below the pressure cut-off setting and within the control range of the pump.

The sensing orifice is usually a separately arranged load sensing directional valve (control block). The position of the directional valve piston determines the opening cross section of the sensing orifice and thus the flow of the pump.

The load sensing control compares pressure before and after the sensing orifice and maintains the pressure drop across the orifice (differential pressure Δp) and with it the pump flow constant.

If the differential pressure Δp increases at the sensing orifice, the pump is swivelled back (towards $V_{g\,min}$), and, if the differential pressure Δp decreases, the pump is swivelled out (towards $V_{g\,max}$) until the pressure drop across the sensing orifice in the valve is restored.

$\Delta p_{orifice} = p_{pump} - p_{actuator}$

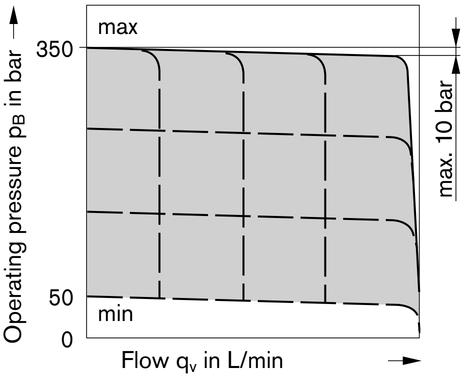
The setting range for Δp is between 14 bar and 25 bar.

The standard differential pressure setting is 18 bar. (Please state in clear text when ordering).

The stand-by pressure in zero stroke operation (sensing orifice plugged) is slightly above the Δp setting.

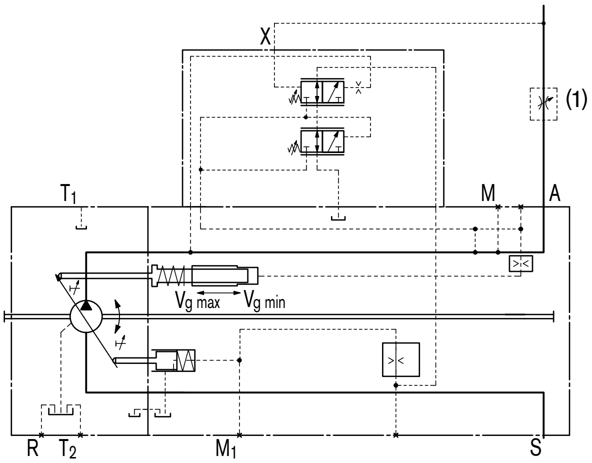
(1) The sensing orifice (control block) is not included in the pump supply.

Characteristic: DRS

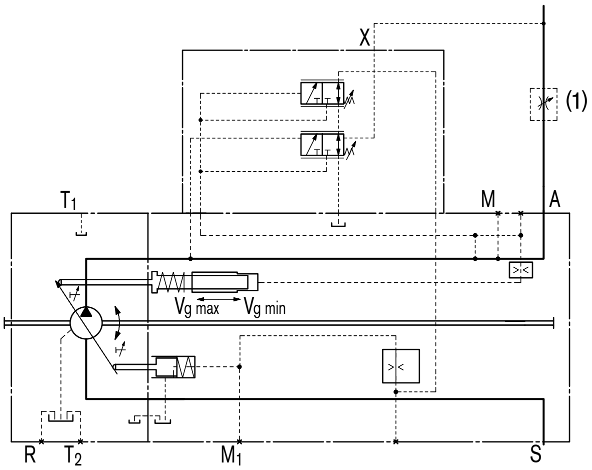


Circuit diagram DRS

Size 40 ... 145



Size 190 ... 260



DR – Pressure Control

DRG Pressure control, remote controlled

The remote control pressure cut-off regulator permits the adjustment of the pressure setting by a remotely installed pressure relief valve (1). Pilot flow for this valve is provide by a fixed orifice in the control module.

Setting range from 50 to 350 bar.

In addition the pump can be unloaded into a standby pressure condition by an externally installed 2/2-way directional valve (2).

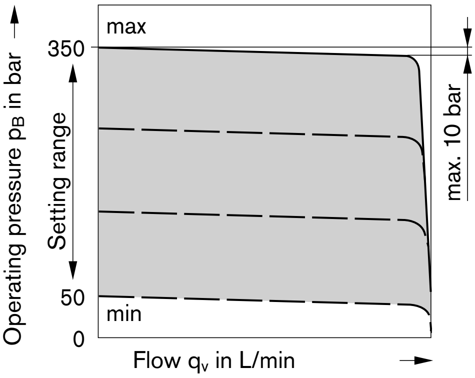
Both functions can be used individually or in combination (see circuit diagram).

The external valves are not included in the pump supply.

As a separate pressure relief valve (1) we recommend:

DBDH 6 (manual control), see RE 25402

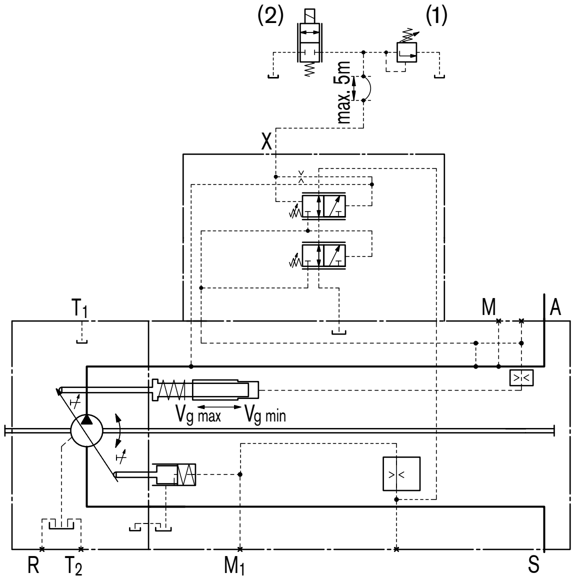
Characteristic: DRG



Note: The remote controlled pressure cut-off is also possible in combination with LR, HD and EP.

Circuit diagram DRG

Size 40 ... 145



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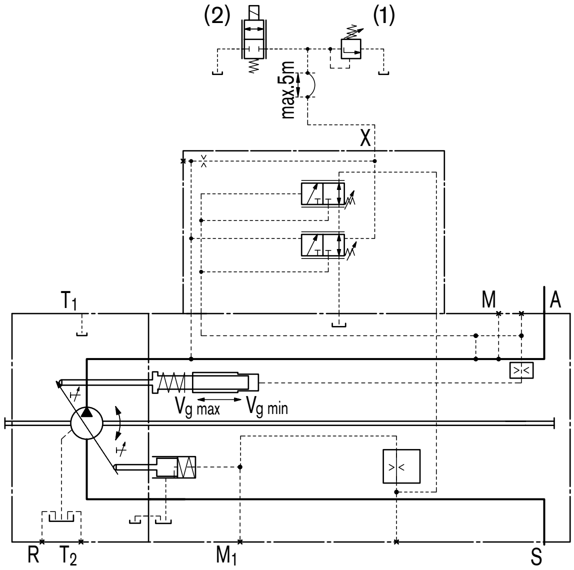


DR – Pressure Control

DRL Pressure control for parallel operation

The pressure control DRL is suitable for pressure control of several axial piston pumps A11VO in parallel operation pumping into a common pressure header.

The parallel pressure control has a pressure rise characteristic of approx. 15 bar from $q_{v\ max}$ to $q_{v\ min}$. The pump regulates therefore to a pressure dependent swive angle. This results in stable control behavior, without the need of "staging" the individual pump compensators.

With the externally installed pressure relief valve (1) the nominal pressure setting of all pumps connected to the system is adjusted to the same value.

Setting range from 50 to 350 bar.

Each pump can be individually unloaded from the system by a separately installed 3/2-way directional valve (2).

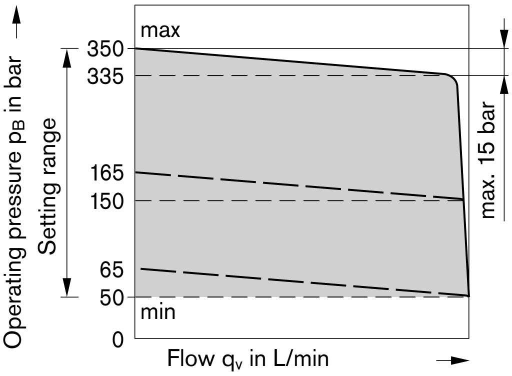
The check valves (3) in the service line (port A) or control line (port X) must be provided generally.

The external valves are not included in the pump supply.

As a separate pressure relief valve (1) we recommend:

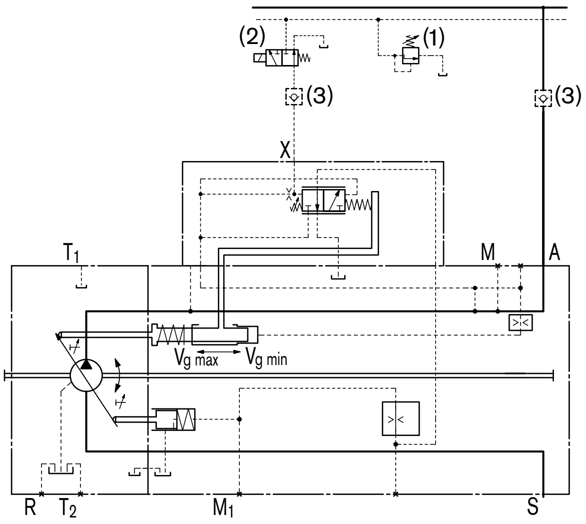
DBDH 6 (manual control), see RE 25402

Characteristic DRL



Circuit diagram DRL

Size 40 ... 145



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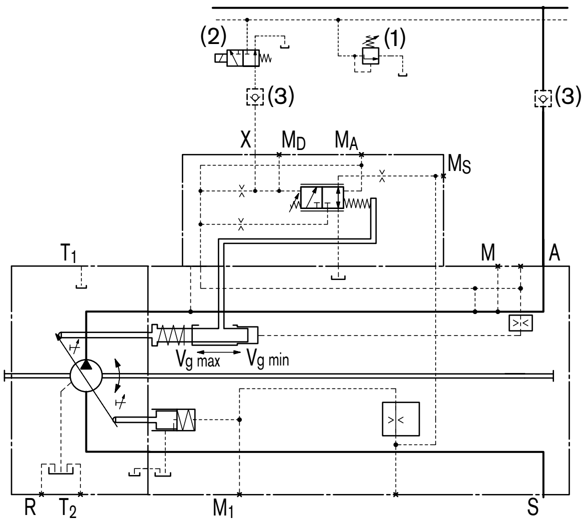


HD – Hydraulic Control, Pilot-Pressure Related

With the pilot-pressure related control the pump displacement is adjusted in proportion to the pilot pressure applied to port Y. Maximum permissible pilot pressure $p_{St\,max} = 40$ bar

Control from $V_{g\,min}$ to $V_{g\,max}$.

With increasing pilot pressure the pump swivels to a higher displacement.

Start of control (at $V_{g\,min}$), can be set ________ from 4–10 bar

State start of control in clear text in the order.

Starting position without control signal (pilot pressure):

- at operating pressure and external control pressure < 30 bar: $V_{g\,max}$
- at operating pressure or external control pressure > 30 bar: $V_{g\,min}$

A control pressure of 30 bar is required to swivel the pump from its starting position $V_{g\,max}$ to $V_{g\,min}$.

The required control pressure is taken either from the load pressure, or from the externally applied control pressure at the G port.

To ensure the control even at low operating pressure < 30 bar the port G must be supplied with an external control pressure of approx. 30 bar.

Note:
If no external control pressure is connected at G, the shuttle valve must be removed.

Note

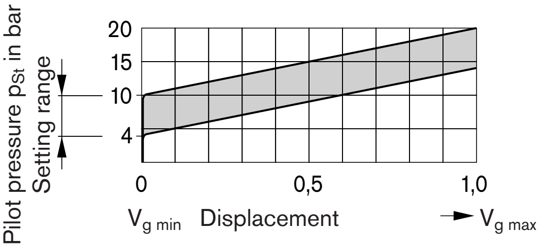
The spring return feature in the controller is not a safety device

The spool valve inside the controller can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).

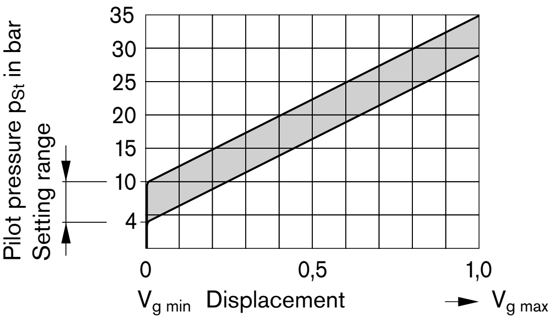
Characteristic HD1

Increase in pilot pressure $V_{g\,min}$ to $V_{g\,max}$_________ $\Delta p = 10$ bar



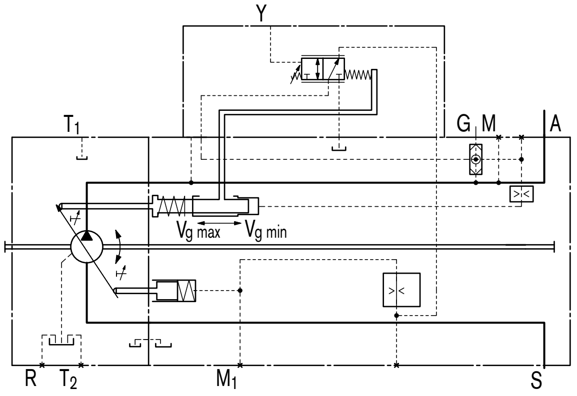
Characteristic HD2

Increase in pilot pressure $V_{g\,min}$ to $V_{g\,max}$_________ $\Delta p = 25$ bar



Circuit diagram HD

Size 40 ... 260



HD – Hydraulic Control, Pilot-Pressure Related

HD.D Hydraulic control with pressure cut-off

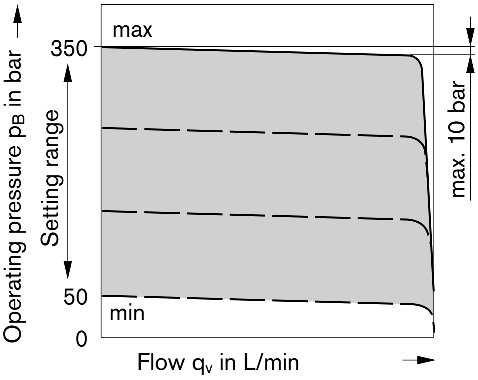
The pressure cut-off corresponds to a pressure control which adjusts the pump displacement back to $V_{g\,min}$ when the pressure setting is reached.

This function overrides the HD control, i.e. the pilot-pressure related displacement control is functional below the pressure setting.

The pressure cut-off function is integrated into the pump control module and is preset to a specified value at the factory.

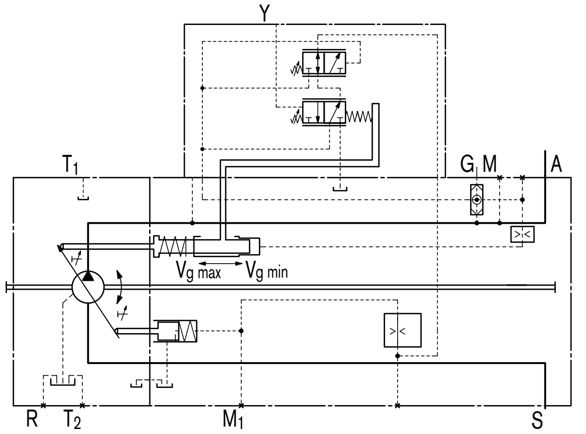
Setting range from 50 to 350 bar.

Pressure cut-off characteristic D



Circuit diagram HD.D

Size 40 ... 145



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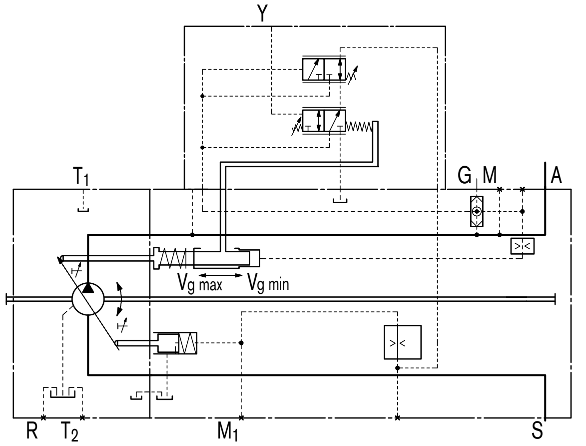


EP – Electric Control with Proportional Solenoid

With the electric control with proportional solenoid, the pump displacement is adjusted proportionally to the solenoid current, resulting in a magnetic control force, acting directly onto the control spool that pilots the pump control piston.

Control from $V_{g\,min}$ to $V_{g\,max}$

With increasing control current the pump swivels to a higher displacement.

Starting position wthout control signal (control current):

- at operating pressure and external control pressure $<$ 30 bar: $V_{g\,max}$
- at operating pressure or external control pressure $>$ 30 bar: $V_{g\,min}$

A control pressure of 30 bar is required to swivel the pump from its starting position $V_{g\,max}$ to $V_{g\,min}$.

The required control pressure is taken either from the load pressure, or from the externally applied control pressure at port G.
To ensure the control even at low operating pressure $<$ 30 bar the port G must be supplied with an external control pressure of approx. 30 bar.

Note:
If no external control pressure is connected at G, the shuttle valve must be removed.

Note:
Install pump with EP control in the oil tank only when using mineral hydraulic oils and an oil temperature in the tank of max. 80°C.

The following electronic control units and amplifiers are available for actuating the proportional solenoids:

– BODAS controller RC	
Series 20	RD 95200
Series 21	RD 95201
Series 22	RD 95202
Series 30	RD 95203
and application software	
– Analog amplifier RA	RE 95230

Technical data, solenoid at EP1, EP2

	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control at $V_{g\,min}$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20°C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Actuated time	100 %	100 %
Type of protection	see connector version, page 60	

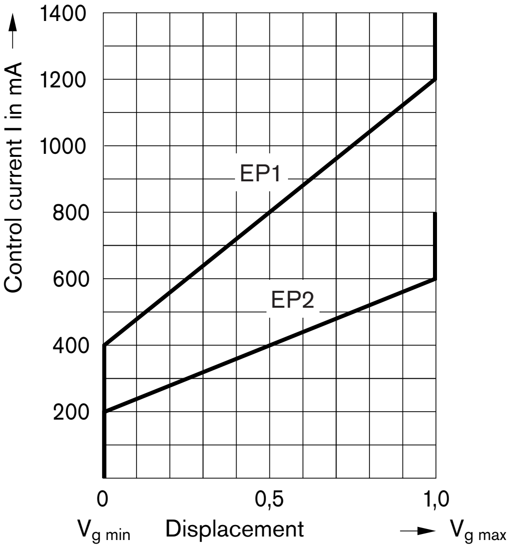
Note

The spring return feature in the controller is not a safety device

The spool valve inside the controller can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

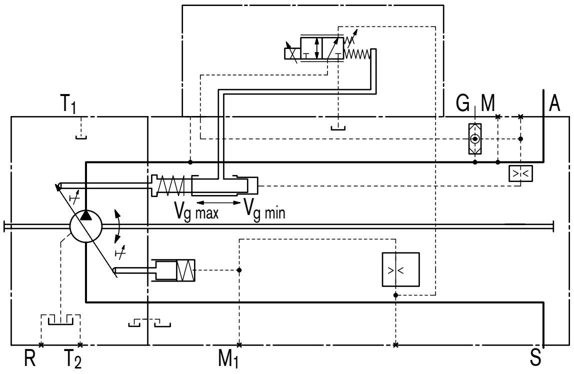
Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).

Characteristic EP1/2



Circuit diagram EP1/2

Size 40 ... 260



EP – Electric Control with Proportional Solenoid

EP.D Electric control with pressure cut-off

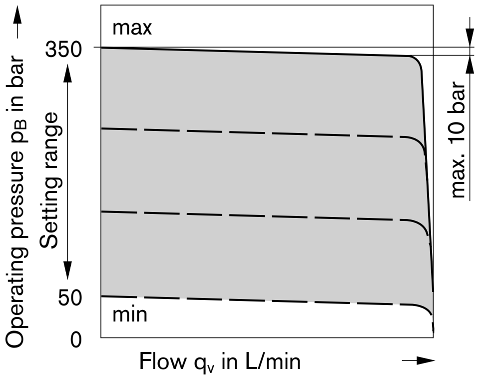
The pressure cut-off corresponds to a pressure control which adjusts the pump displacement back to $V_{g\,min}$ when the pressure setting is reached.

This function overrides the EP control, i.e. the control current related displacement control is functional below the pressure setting.

The valve for the pressure cut-off is integrated in the control case and is set to a fixed specified pressure value at the factory.

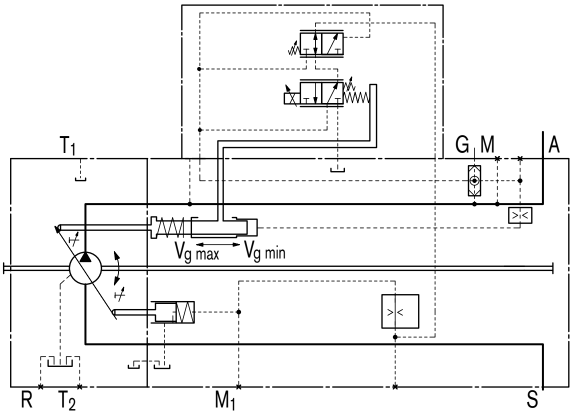
Setting range from 50 to 350 bar

Pressure cut-off characteristic D



Circuit diagram EP.D

Size 40 ... 145



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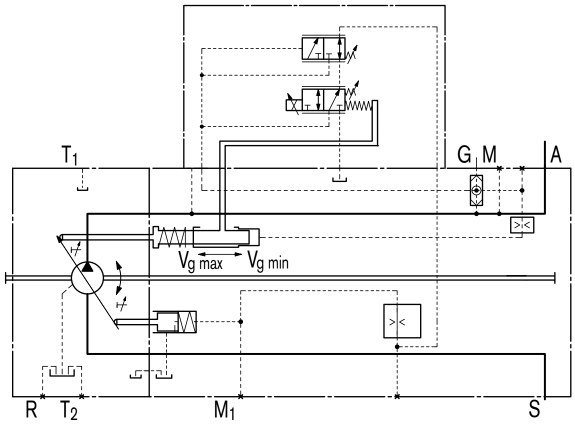
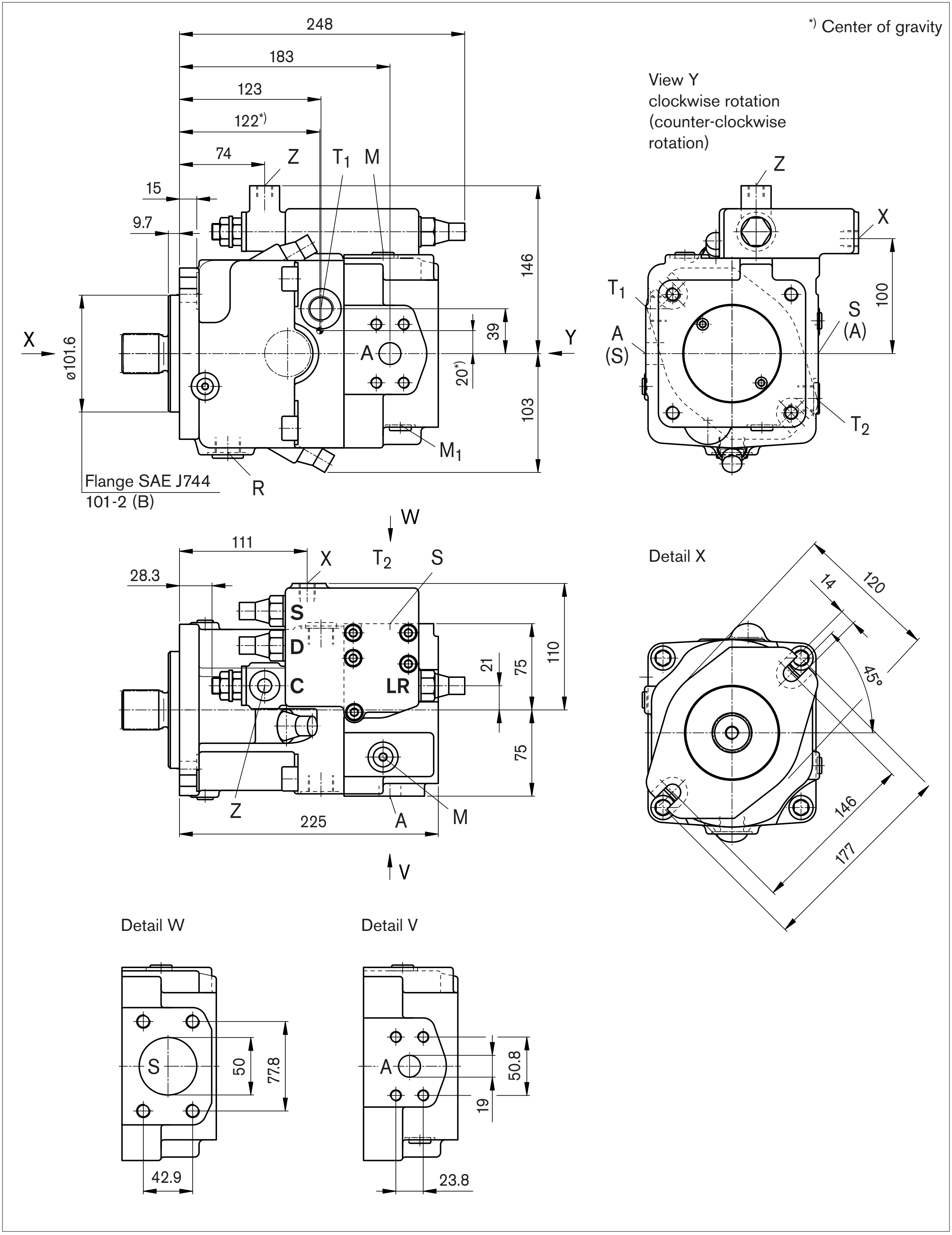


Dimensions, Size 40

Before finalizing your design, please request a certified drawing. Dimensions in mm.

LRDCS

Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

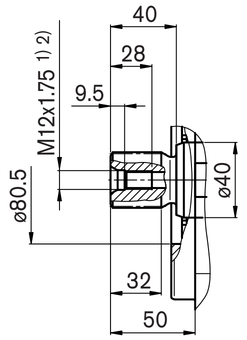


Dimensions, Size 40

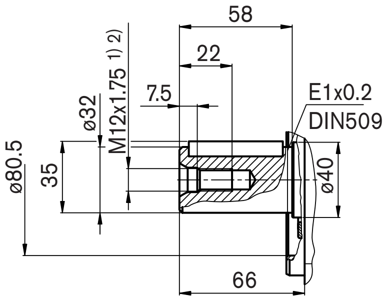
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

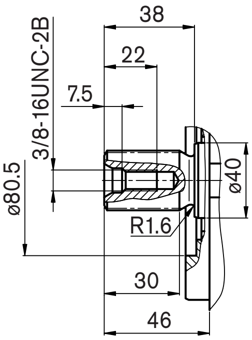
Z Splined shaft DIN 5480
W35x2x30x16x9g



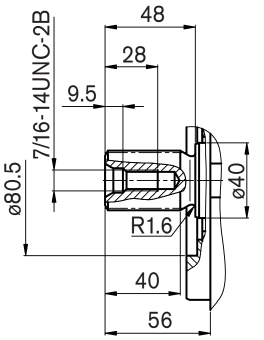
P Parallel keyed shaft DIN 6885,
AS10x8x56



S Splined shaft SAE J744
1 in 15T 16/32 [3]



T Splined shaft SAE J744
1 1/4 in 14T 12/24DP [3]



Ports

Designation	Function	Standard	Size[2]		Max. pressure (bar) [4]	State
A	Service line port Fixing thread	SAE J518 DIN 13	3/4 in M10x1.5;	 16 deep	400	O
S	Suction port Fixing thread	SAE J518 DIN 13	2 in M12x1.75;	 17 deep	30	O
T_1, T_2	Tank port	DIN 3852	M22x1.5;	14 deep	10	[5]
R	Air bleed	DIN 3852	M22x1.5;	14 deep	10	X
M_1	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

[1] Center bore according to DIN 332 (thread acc. to DIN 13)

[2] For max. tightening torque, please refer to general notes on page 64

[3] ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

[4] Depending on adjustment data and operating pressure

[5] Depending on installation position, T1 or T2 must be connected (see also page 61)

O = Open, must be connected (closed on delivery)

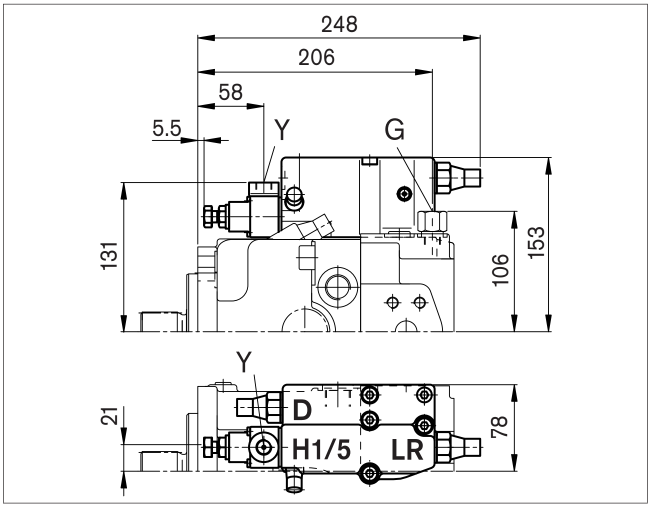
X = Closed (in normal operation)

Dimensions, Size 40

Before finalizing your design, please request a certified drawing. Dimensions in mm.

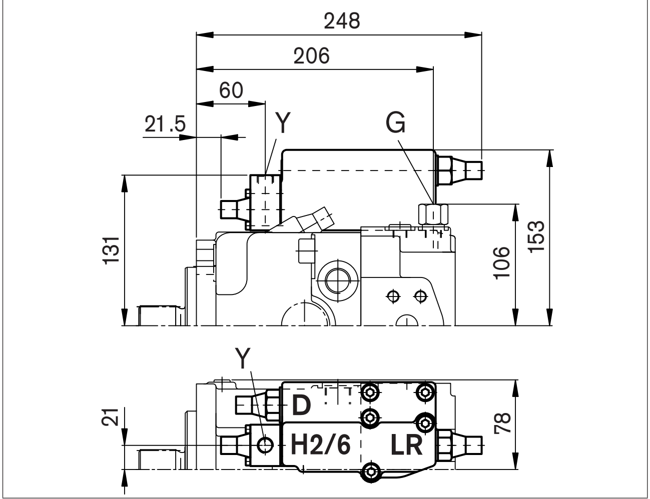
LRDH1/LRDH5

Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



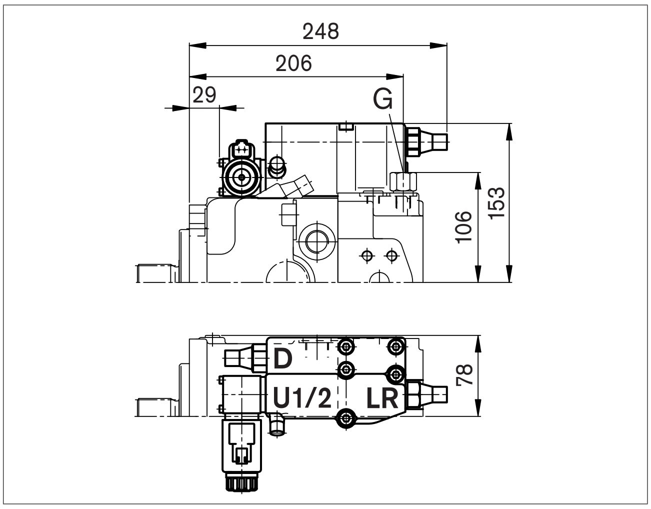
LRDH2/LRDH6

Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



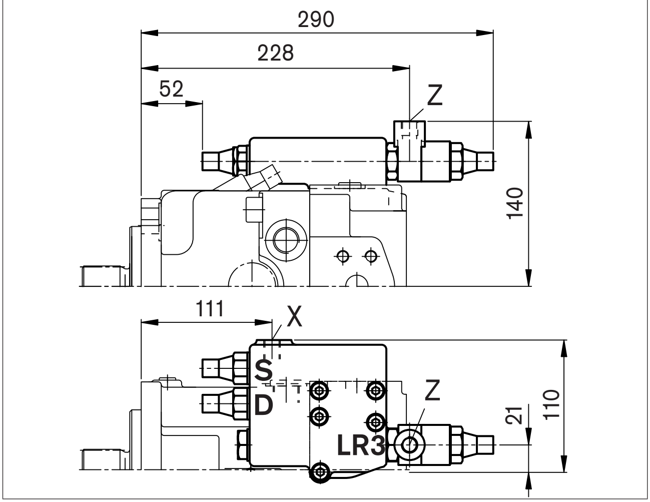
LRDU1/LRDU2

Power control with pressure cut-off and electric stroke limiter (positive characteristic)



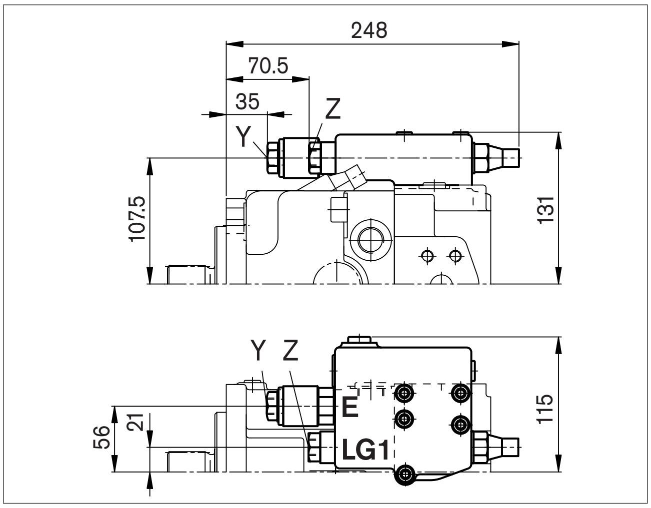
LR3DS

Power control with high-pressure related override, pressure cut-off and load sensing control



LG1E

Power control with pilot-pressure related override (negative) and 2-stage pressure cut-off



LG2E

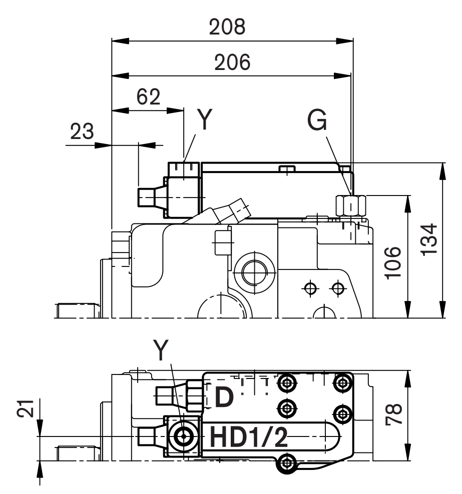
Power control with pilot-pressure related override (positive) and 2-stage pressure cut-off

Dimensions, Size 40

Before finalizing your design, please request a certified drawing. Dimensions in mm.

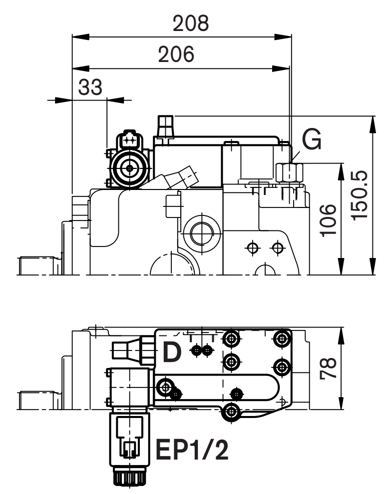
HD1D/HD2D

Hydraulic control, pilot-pressure related with pressure cut-off



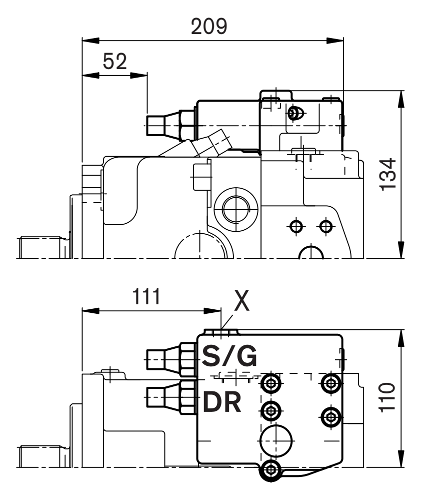
EP1D/EP2D

Electric control with proportional solenoid and pressure cut-off



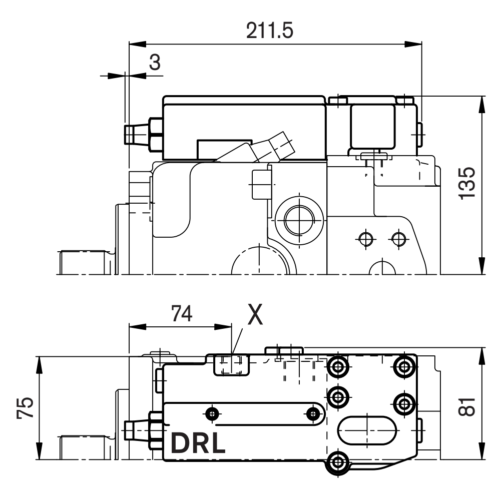
DRS/DRG

Pressure control with load sensing control
Pressure control remote controlled



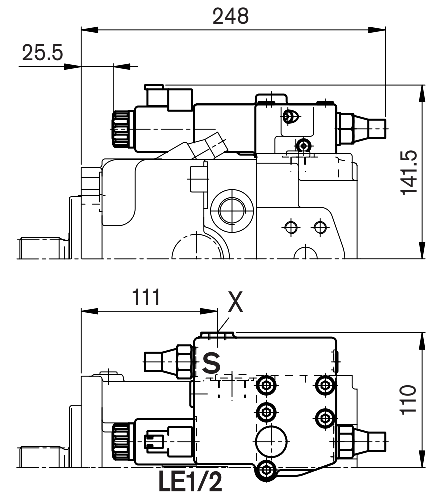
DRL

Pressure control for parallel operation



LE1S/LE2S

Power control with electric override (negative) and load sensing control



LE2S2/LE1S5/LE2S5

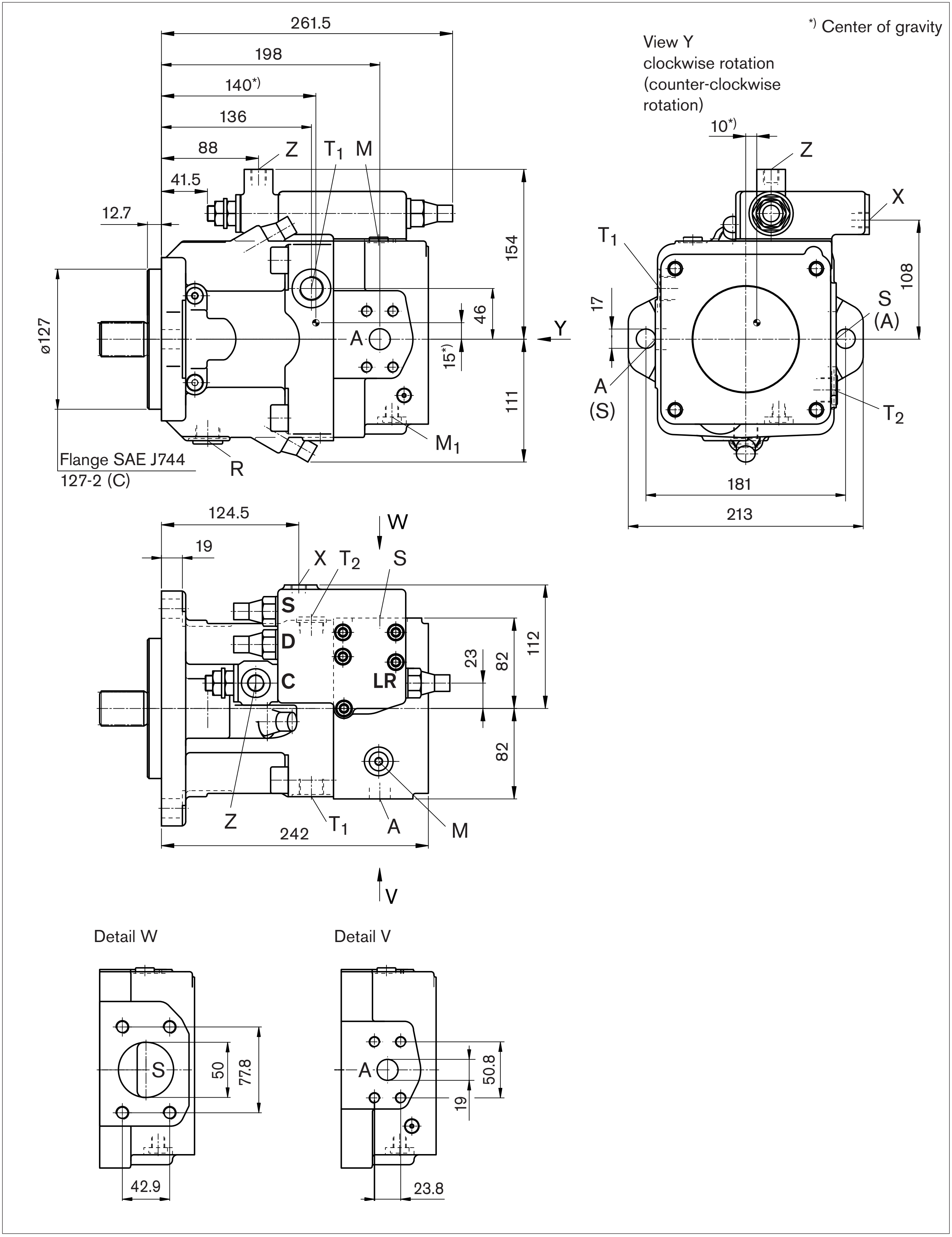
Power control with electric override (negative) and load sensing control, override

Dimensions, Size 60

Before finalizing your design, please request a certified drawing. Dimensions in mm.

LRDCS

Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

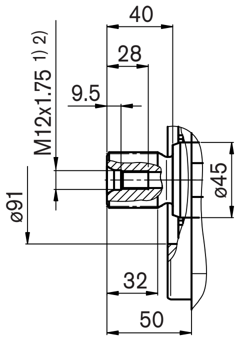


Dimensions, Size 60

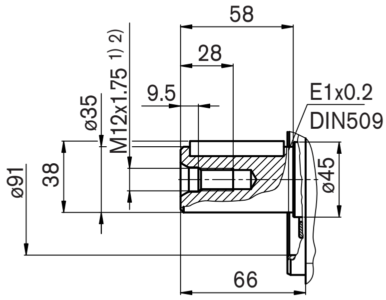
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

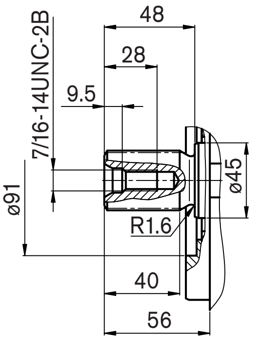
Z Splined shaft DIN 5480
W35x2x30x16x9g



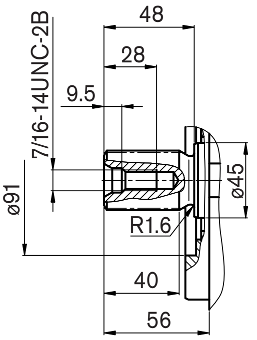
P Parallel keyed shaft DIN 6885,
AS10x8x56



S Splined shaft SAE J744
1 1/4 in 14T 12/24DP 3)



T Splined shaft SAE J744
1 3/8 in 21T 16/32DP 3)



Ports

Designation	Function	Standard	Size 2)		Max. pressure (bar) 4)	State
A	Service line port Fixing thread	SAE J518 DIN 13	3/4 in M10x1.5;	 17 deep	400	O
S	Suction port Fixing thread	SAE J518 DIN 13	2 in M12x1.75;	 20 deep	30	O
T$_1$, T$_2$	Tank port	DIN 3852	M22x1.5;	14 deep	10	5)
R	Air bleed	DIN 3852	M22x1.5;	14 deep	10	X
M$_1$	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

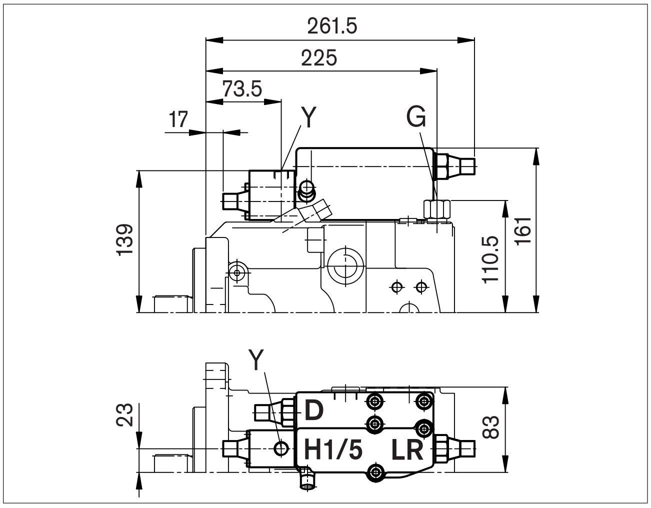
1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For max. tightening torque, please refer to general notes on page 64
3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T1 or T2 must be connected (see also page 61)
O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

Dimensions, Size 60

Before finalizing your design, please request a certified drawing. Dimensions in mm.

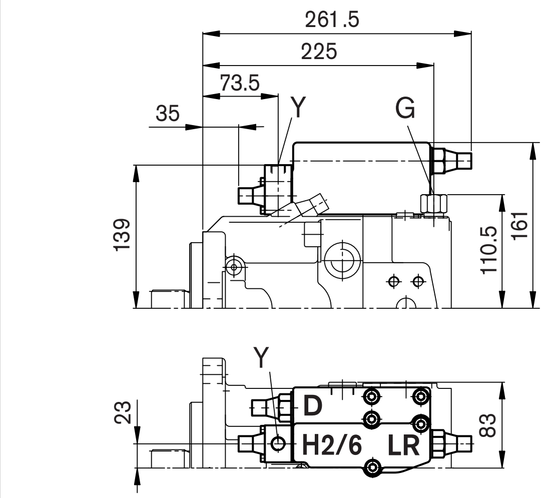
LRDH1/LRDH5

Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



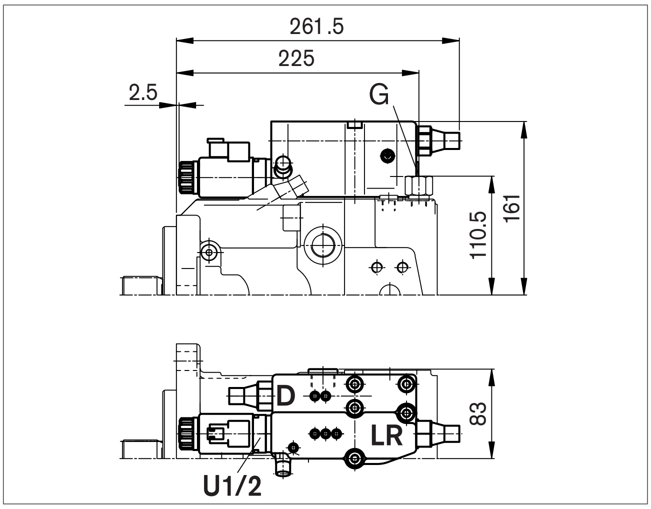
LRDH2/LRDH6

Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



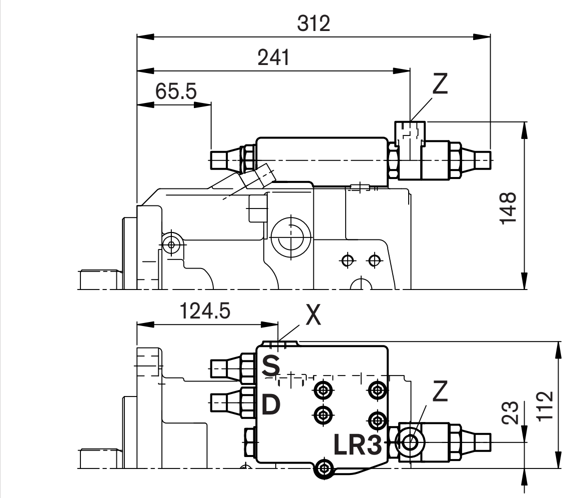
LRDU1/LRDU2

Power control with pressure cut-off and electric stroke limiter (positive characteristic)



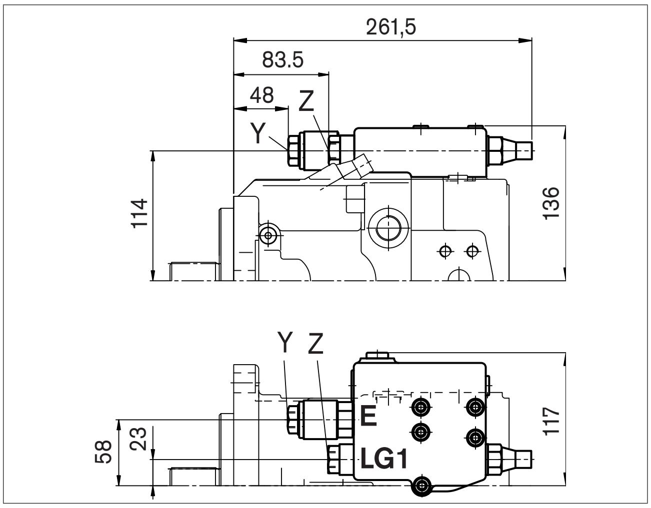
LR3DS

Power control with high-pressure related override, pressure cut-off and load sensing control



LG1E

Power control with pilot-pressure related override (negative) and 2-stage pressure cut-off



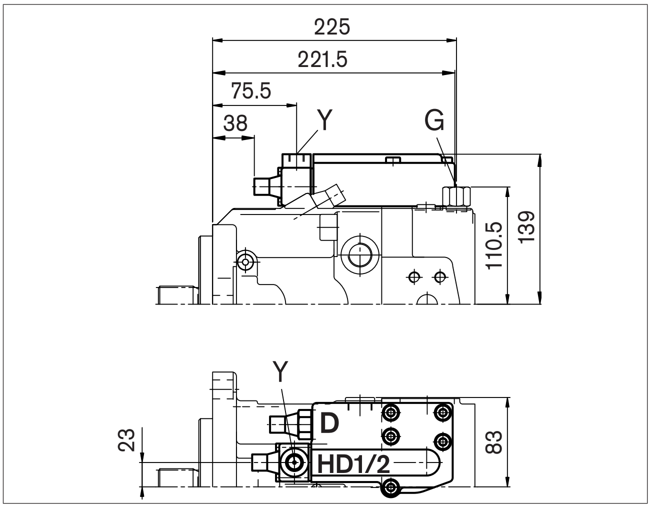
LG2E

Power control with pilot-pressure related override (positive) and 2-stage pressure cut-off

Dimensions, Size 60

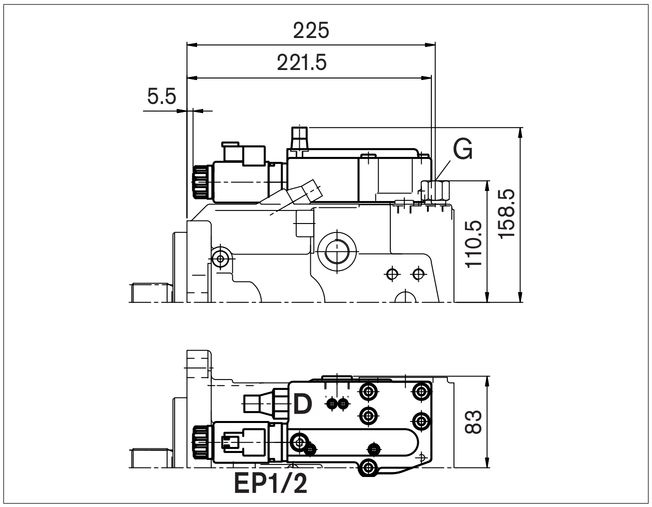
HD1D/HD2D

Hydraulic control, pilot-pressure related with pressure cut-off



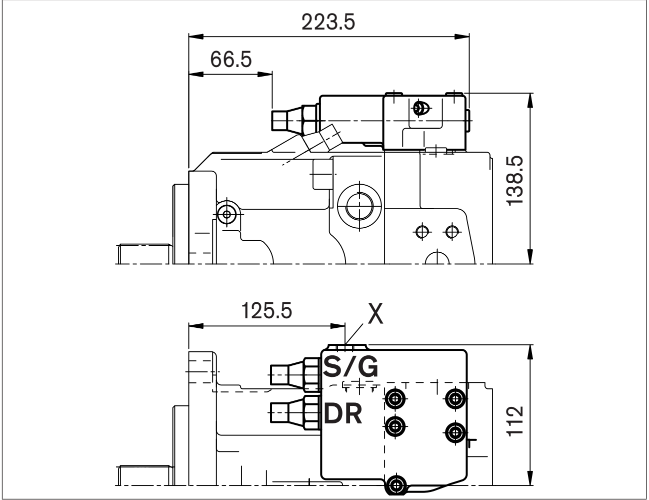
EP1D/EP2D

Electric control with proportional solenoid and pressure cut-off



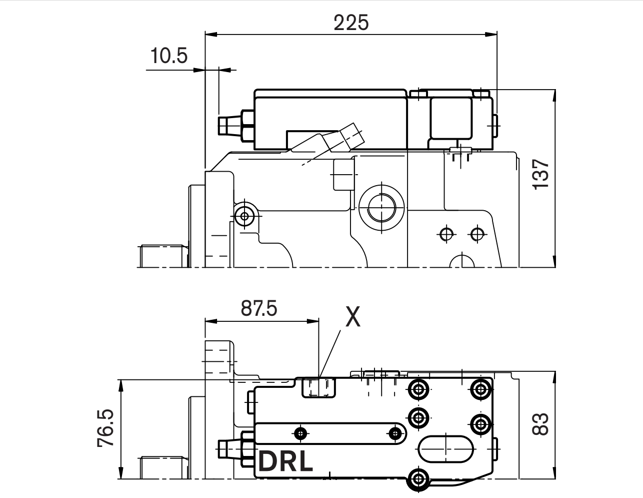
DRS/DRG

Pressure control with load sensing control
Pressure control remote controlled



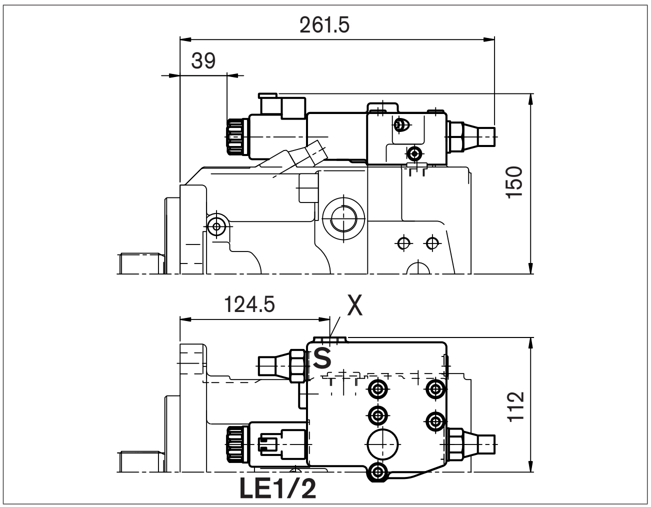
DRL

Pressure control for parallel operation



LE1S/LE2S

Power control with electric override (negative) and load sensing control



LE2S2/LE1S5/LE2S5

Power control with electric override (negative) and load sensing control, override

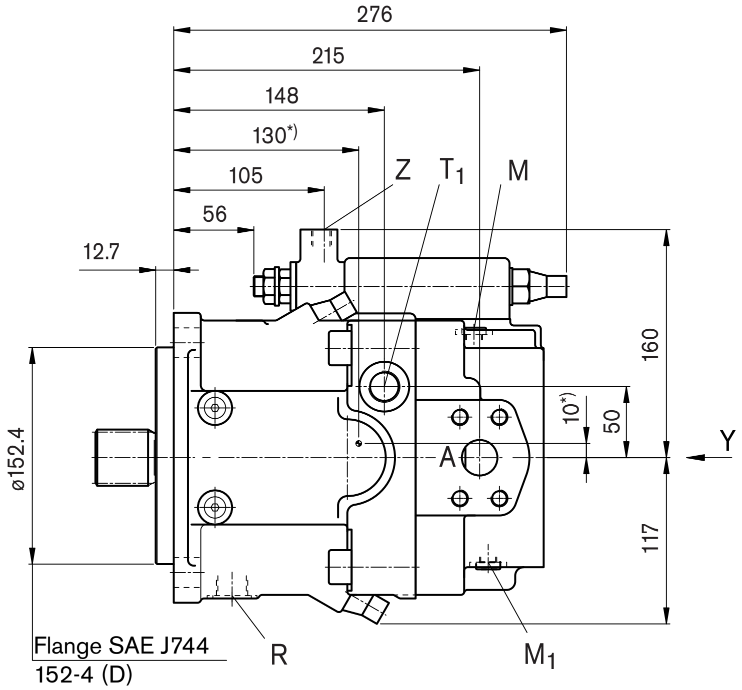
Dimensions, Size 75

Before finalizing your design, please request a certified drawing. Dimensions in mm.

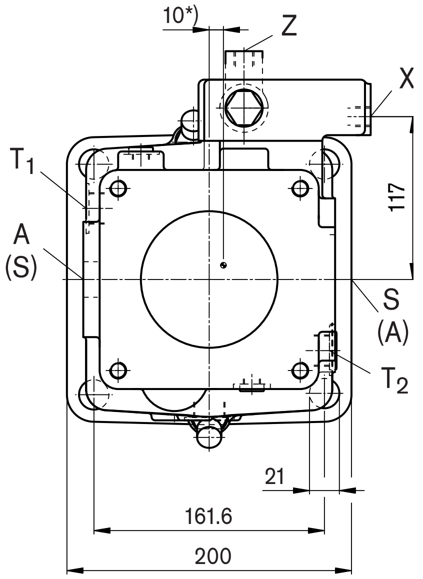
LRDCS

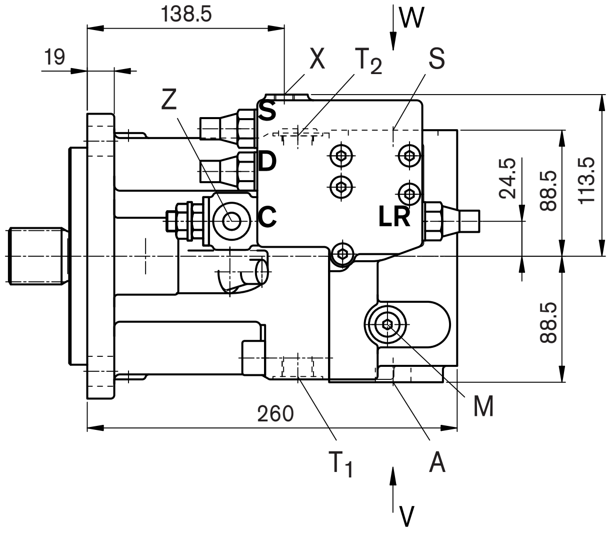
Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

*) Center of gravity

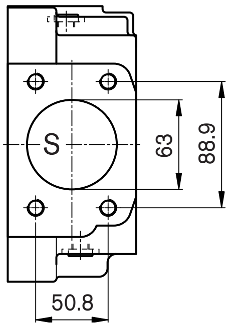


View Y
clockwise rotation
(counter-clockwise
rotation)

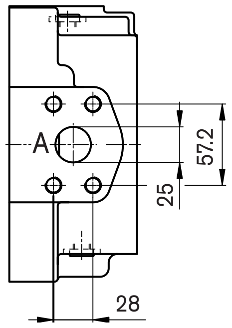




Detail W



Detail V

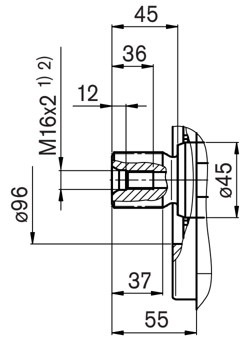


Dimensions, Size 75

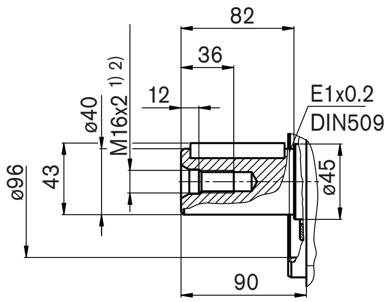
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

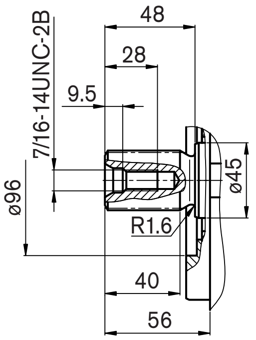
Z Splined shaft DIN 5480
W40x2x30x18x9g



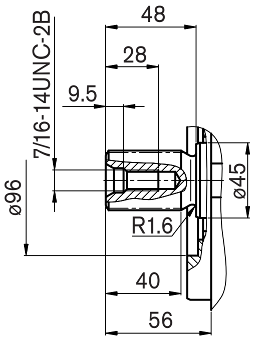
P Parallel keyed shaft DIN 6885
AS12x8x80



S Splined shaft SAE J744
1 1/4 in 14T 12/24DP 3)



T Splined shaft SAE J744
1 3/8 in 21T 16/32DP 3)



Ports

Designation	Function	Standard	Size 2)		Max. pressure (bar) 4)	State
A	Service line port Fixing thread	SAE J518 DIN 13	1 in M12x1.75;	 17 deep	400	O
S	Suction port Fixing thread	SAE J518 DIN 13	2 1/2in M12x1.75;	 17 deep	30	O
T$_1$, T$_2$	Tank port	DIN 3852	M22x1.5;	14 deep	10	5)
R	Air bleed	DIN 3852	M22x1.5;	14 deep	10	X
M$_1$	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

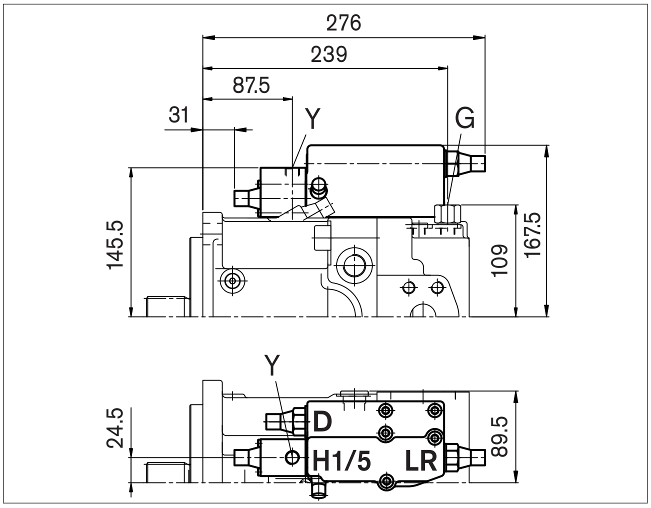
1) Center bore according to DIN 332 (thread acc. to DIN 13)
2) For max. tightening torque, please refer to general notes on page 64
3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
4) Depending on adjustment data and operating pressure
5) Depending on installation position, T1 or T2 must be connected (see also page 61)
O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

Dimensions, Size 75

Before finalizing your design, please request a certified drawing. Dimensions in mm.

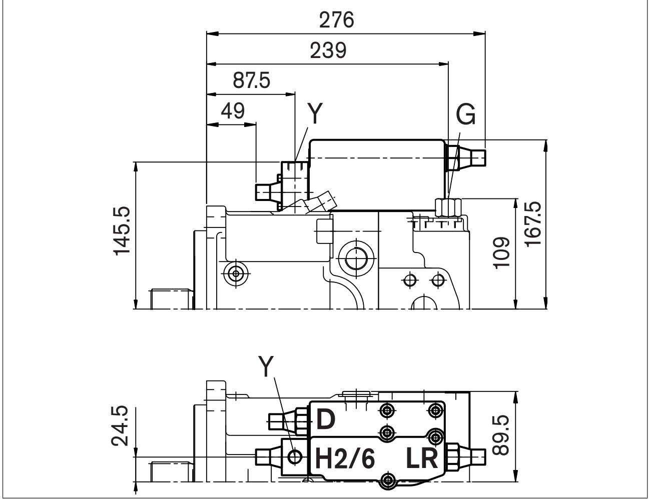
LRDH1/LRDH5

Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



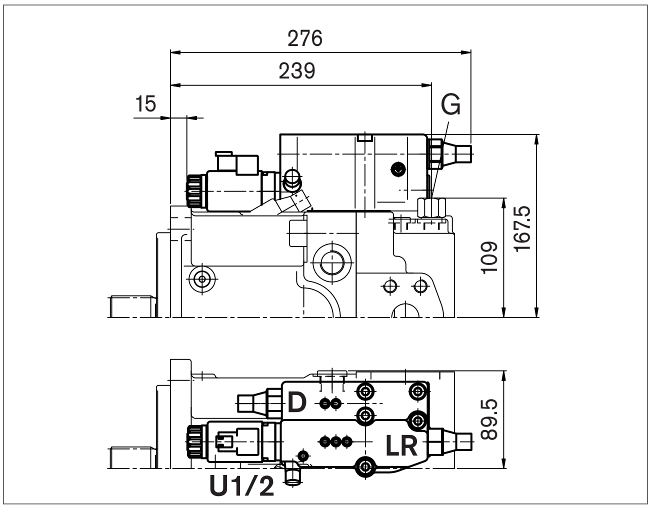
LRDH2/LRDH6

Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



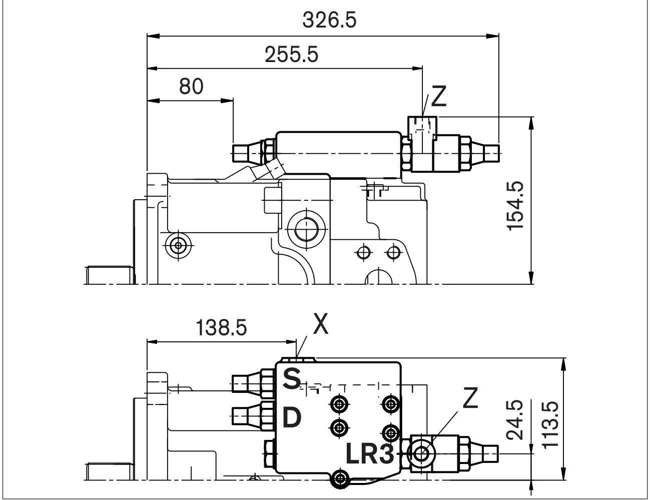
LRDU1/LRDU2

Power control with pressure cut-off and electric stroke limiter (positive characteristic)



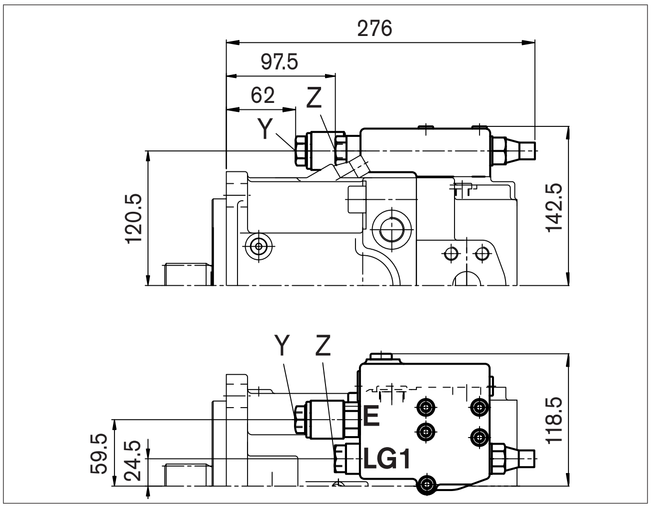
LR3DS

Power control with high-pressure related override, pressure cut-off and load sensing control



LG1E

Power control with pilot-pressure related override (negative) and 2-stage pressure cut-off



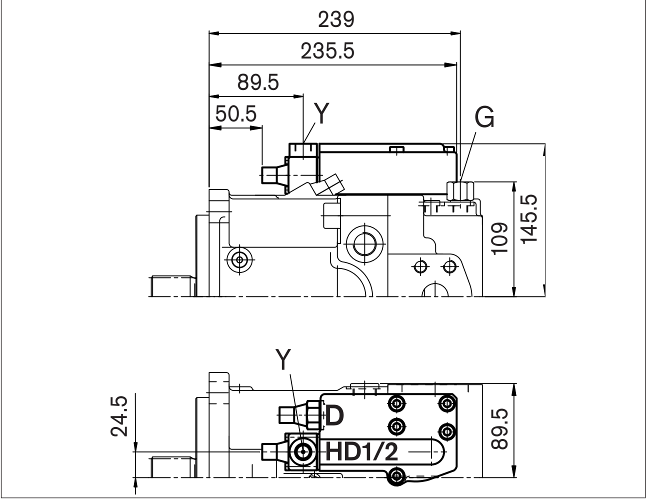
LG2E

Power control with pilot-pressure related override (positive) and 2-stage pressure cut-off

Before finalizing your design, please request a certified drawing. Dimensions in mm.

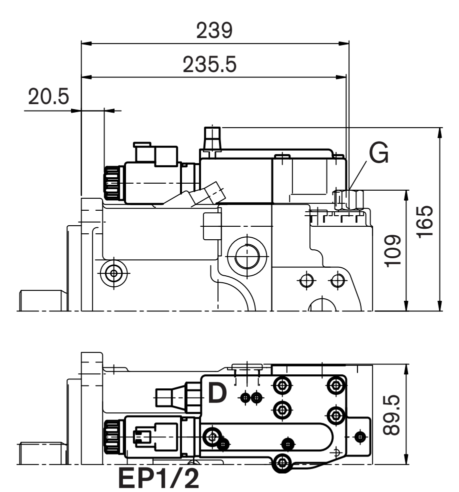
HD1D/HD2D

Hydraulic control, pilot-pressure related with pressure cut-off



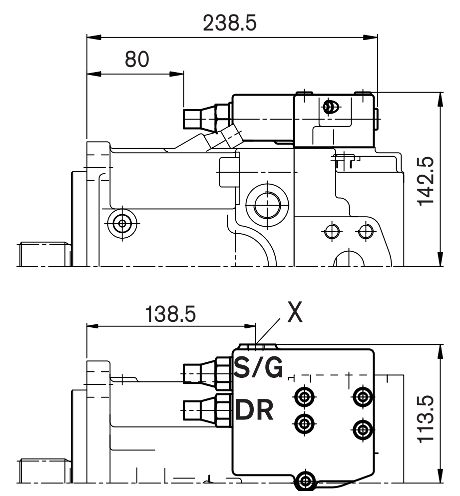
EP1D/EP2D

Electric control with proportional solenoid and pressure cut-off



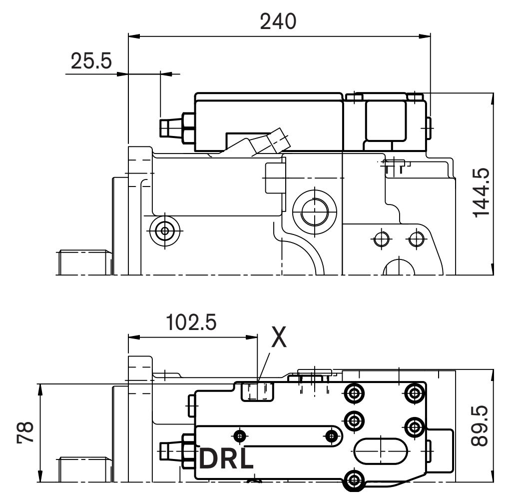
DRS/DRG

Pressure control with load sensing control
Pressure control remote controlled



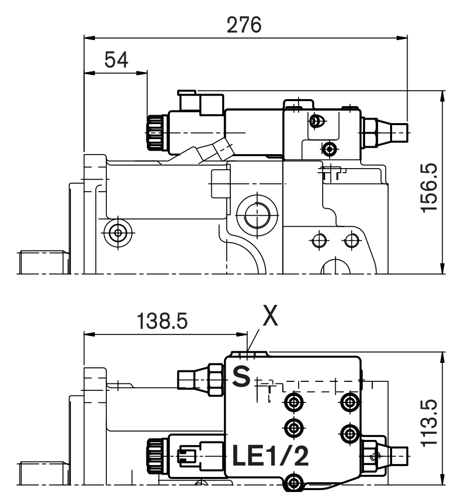
DRL

Pressure control for parallel operation



LE1S/LE2S

Power control with electric override (negative) and load sensing control



LE2S2/LE1S5/LE2S5

Power control with electric override (negative) and load sensing control, override

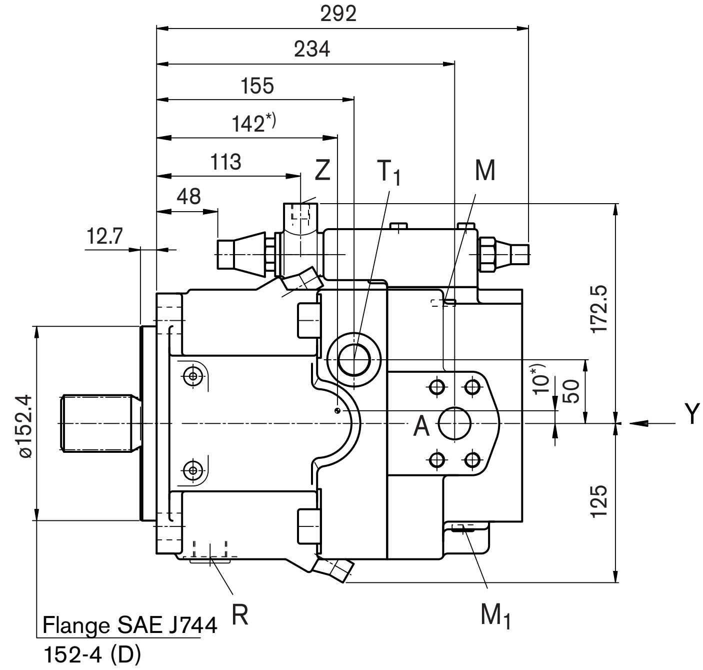
Dimensions, Size 95

Before finalizing your design, please request a certified drawing. Dimensions in mm.

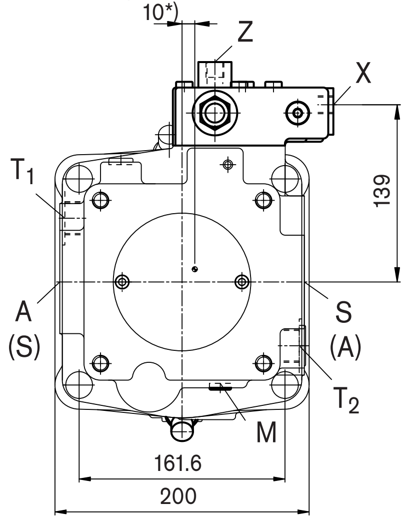
LRDCS

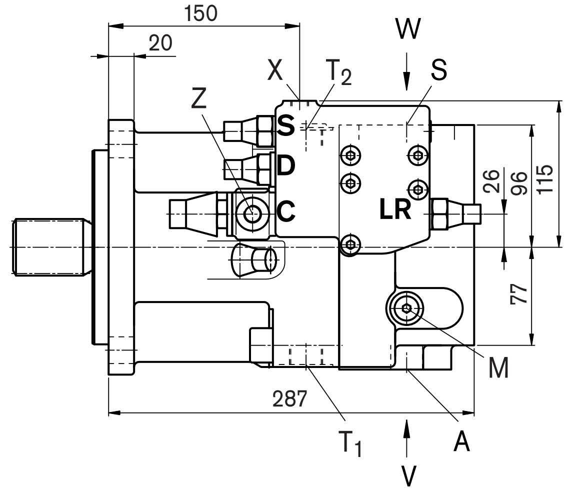
Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

*) Center of gravity

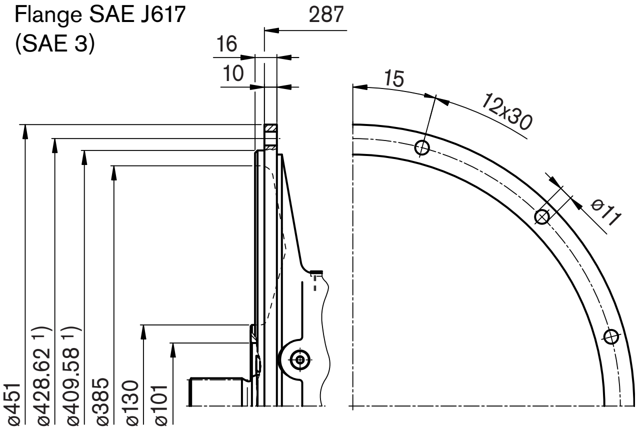


View Y
clockwise rotation
(counter-clockwise
rotation)

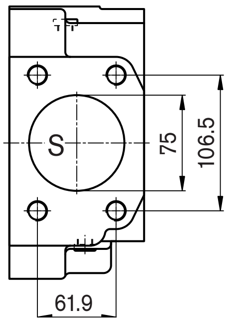




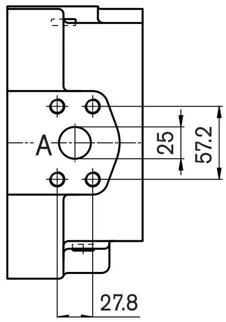
Flange SAE J617
(SAE 3)



Detail W



Detail V



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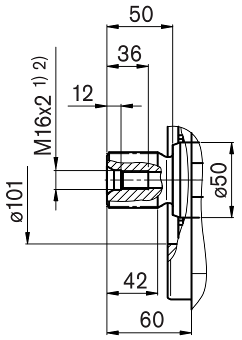
[1] Dimensions according to SAE J617-No. 3, for connection to the flywheel case of the combustion engine

Dimensions, Size 95

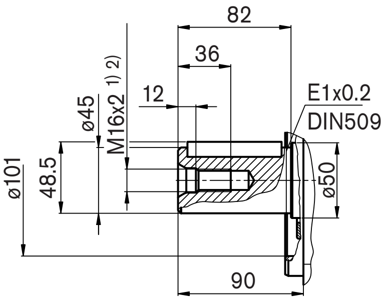
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

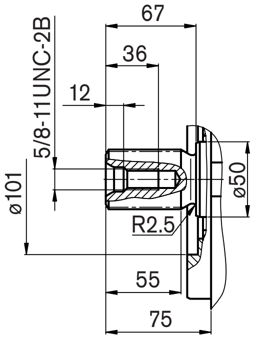
Z Splined shaft DIN 5480
W45x2x30x21x9g



P Parallel keyed shaft DIN 6885 –
AS14x9x80



S Splined shaft SAE J744
1 3/4 in 13T 8/16DP [3]



Ports

Designation	Function	Standard	Size[2]		Max. pressure (bar) [4]	State
A	Service line port Fixing thread	SAE J518 DIN 13	1 in M12x1.75;	 17 deep	400	O
S	Suction port Fixing thread	SAE J518 DIN 13	3 in M16x2;	 24 deep	30	O
T$_1$, T$_2$	Tank port	DIN 3852	M26x1.5;	16 deep	10	[5]
R	Air bleed	DIN 3852	M26x1.5;	16 deep	10	X
M$_1$	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

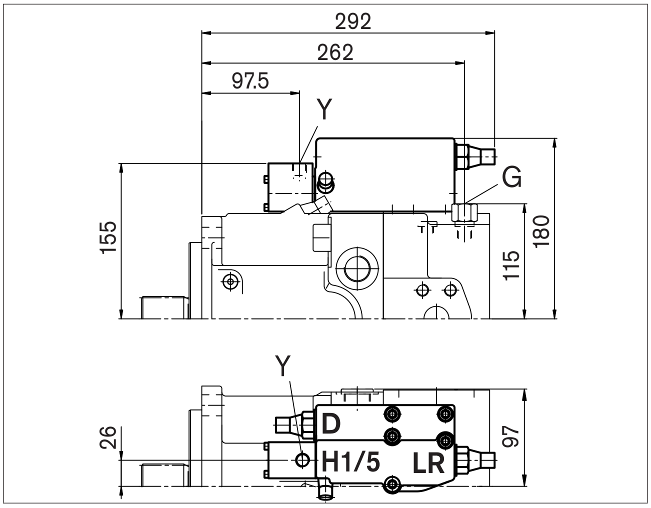
[1] Center bore according to DIN 332 (thread acc. to DIN 13)
[2] For max. tightening torque, please refer to general notes on page 64
[3] ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
[4] Depending on adjustment data and operating pressure
[5] Depending on installation position, T1 or T2 must be connected (see also page 61)
O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

Dimensions, Size 95

Before finalizing your design, please request a certified drawing. Dimensions in mm.

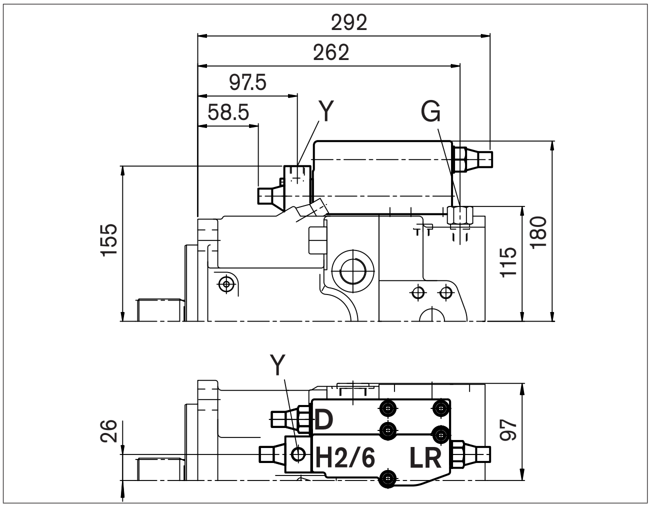
LRDH1/LRDH5

Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



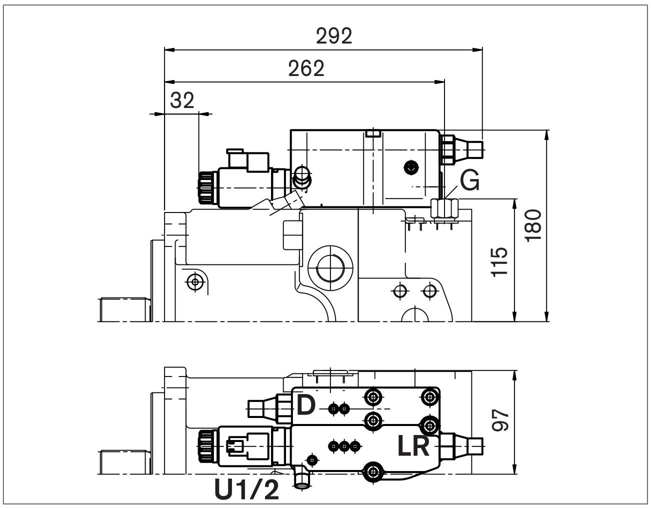
LRDH2/LRDH6

Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



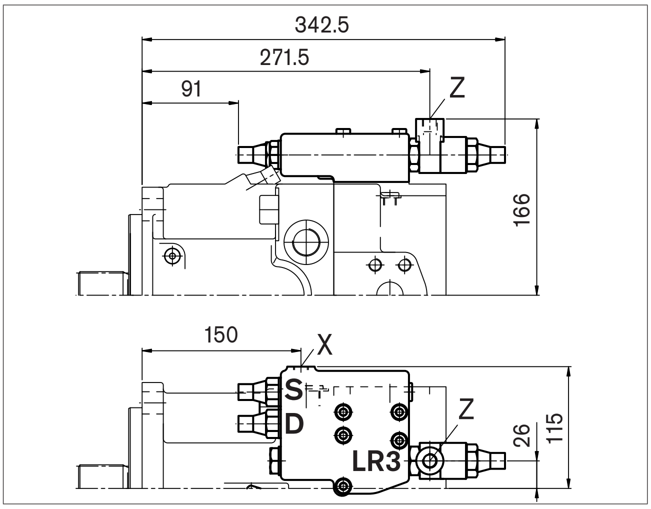
LRDU1/LRDU2

Power control with pressure cut-off and electric stroke limiter (positive characteristic)



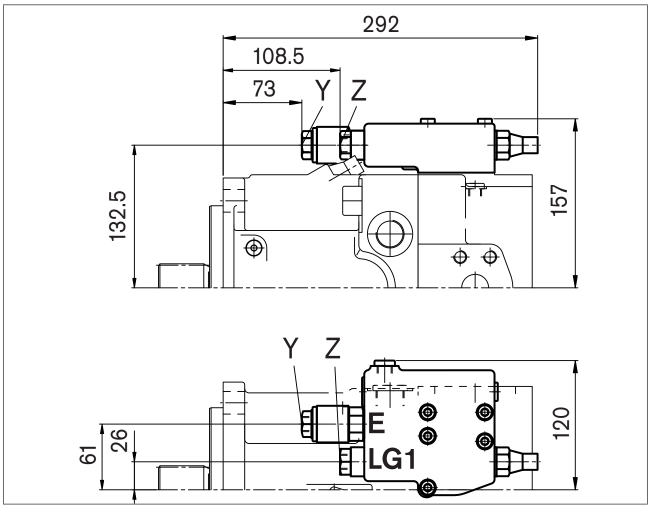
LR3DS

Power control with high-pressure related override, pressure cut-off and load sensing control



LG1E

Power control with pilot-pressure related override (negative) and 2-stage pressure cut-off



LG2E

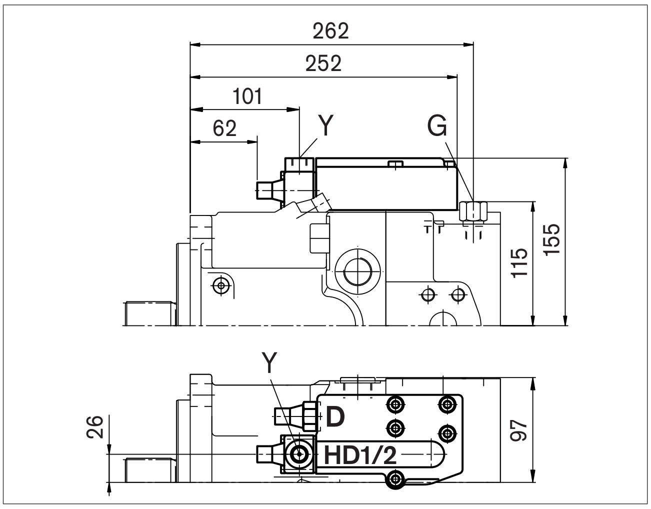
Power control with pilot-pressure related override (positive) and 2-stage pressure cut-off

Dimensions, Size 95

Before finalizing your design, please request a certified drawing. Dimensions in mm.

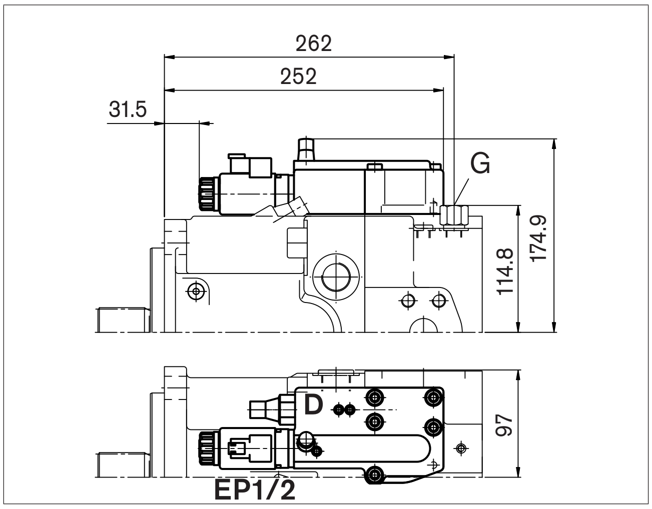
HD1D/HD2D

Hydraulic control, pilot-pressure related with pressure cut-off



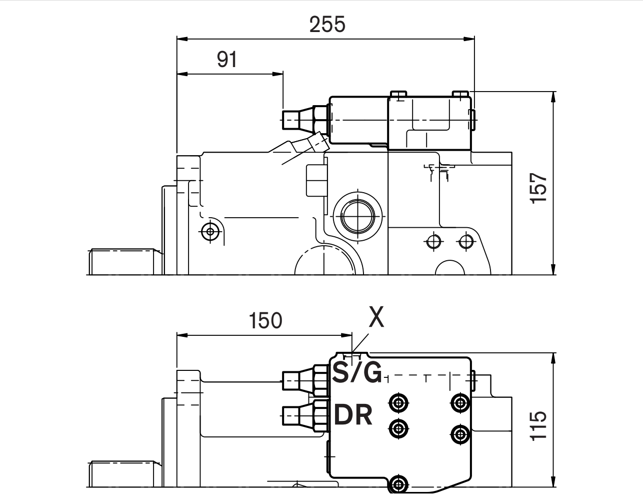
EP1D/EP2D

Electric control with proportional solenoid and pressure cut-off



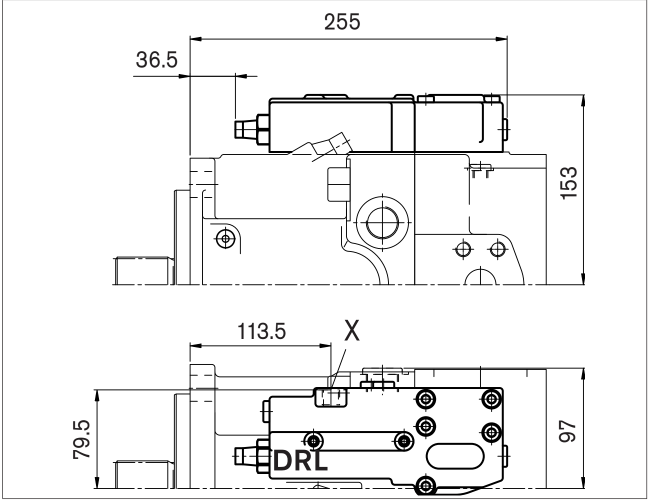
DRS/DRG

Pressure control with load sensing control
Pressure control remote controlled



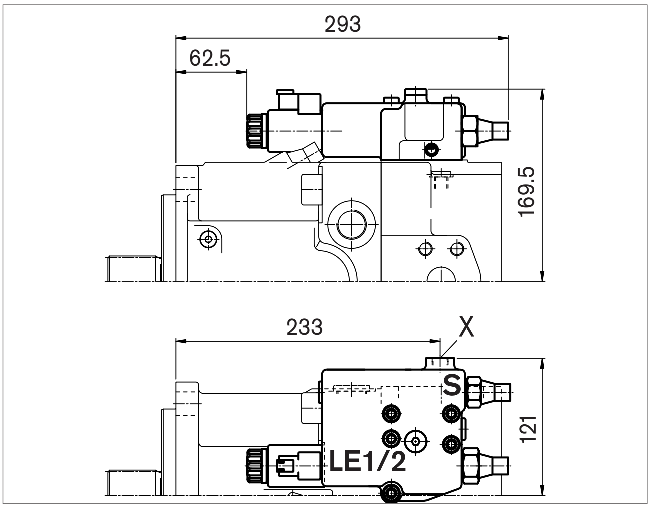
DRL

Pressure control for parallel operation



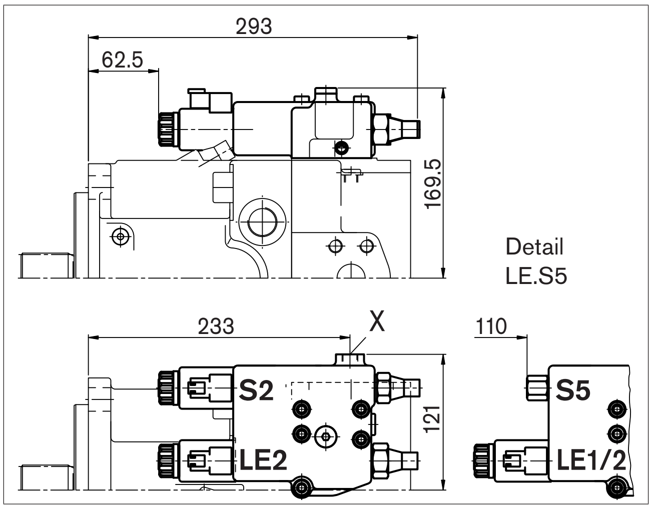
LE1S/LE2S

Power control with electric override (negative) and load sensing control



LE2S2/LE1S5/LE2S5

Power control with electric override (negative) and load sensing control, override

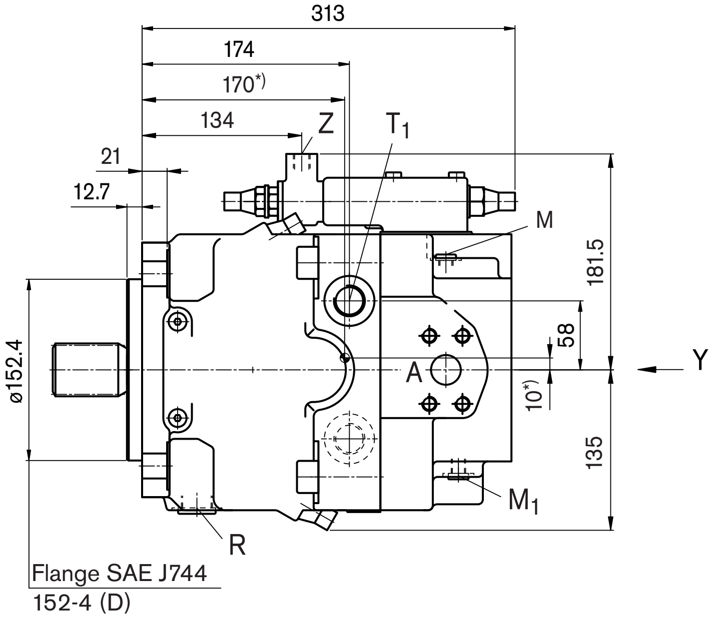


Dimensions, Size 130/145

Before finalizing your design, please request a certified drawing. Dimensions in mm.

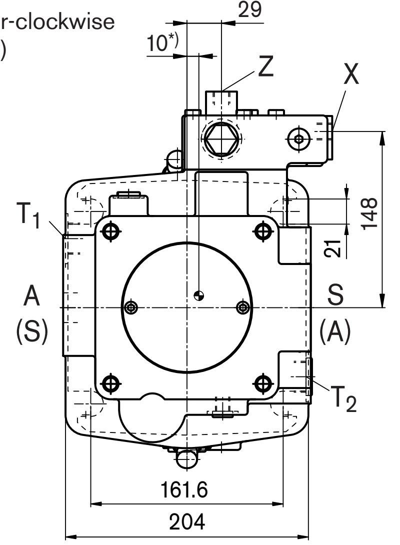
LRDCS

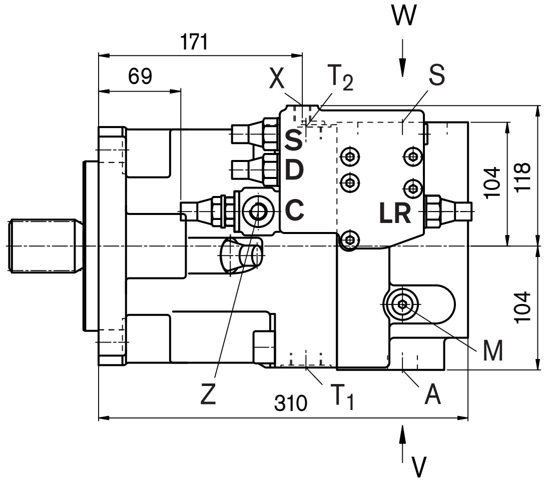
Power control LR with pressure cut-off D, cross sensing control C and load sensing control S



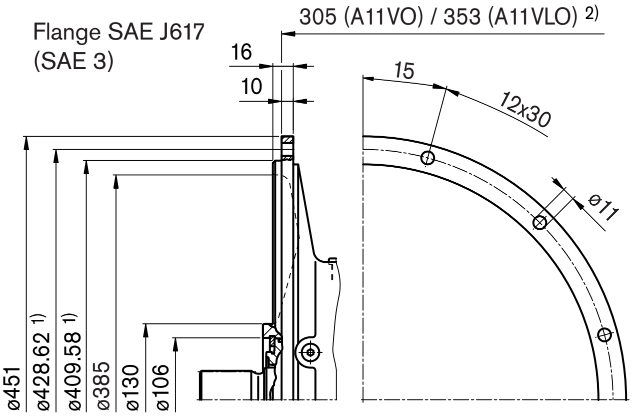
View Y
clockwise rotation
(counter-clockwise rotation)

*) Center of gravity

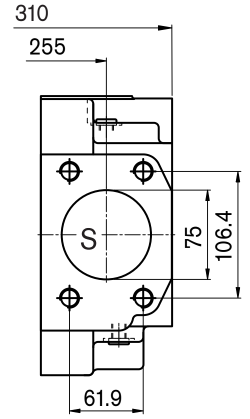




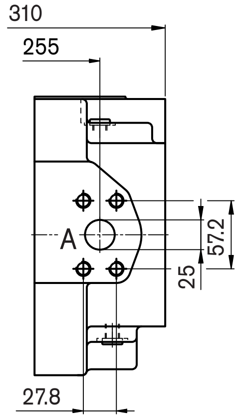
Flange SAE J617
(SAE 3)



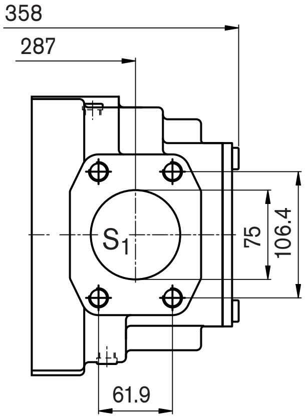
without charge pump
Detail W



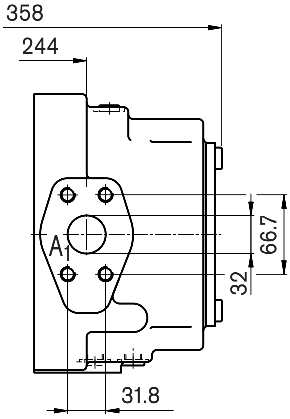
Detail V



with charge pump
Detail W



Detail V



[1] Dimensions according to SAE J617-No. 3, for connection to the flywheel case of the combustion engine

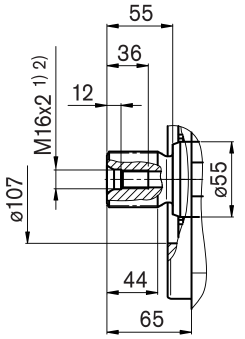
[2] The case or length dimension with flange SAE 3 is 5 mm shorter than the standard case.

Dimensions, Size 130/145

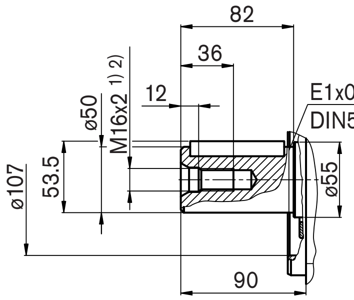
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

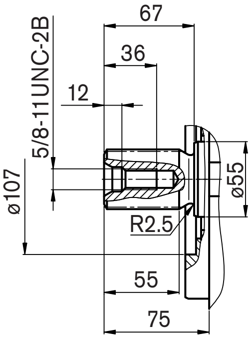
Z Splined shaft DIN 5480
W50x2x30x24x9g



P Parallel keyed shaft DIN 6885,
AS14x9x80



S Splined shaft SAE J744
1 3/4 in 13T 8/16DP 3)



Ports

Designation	Function	Standard	Size 2)		Max. pressure (bar) 4)	State
A	Service line port Fixing thread	SAE J518 DIN 13	1 in M12x1.75;	 17 deep	400	O
A₁	Service line port Fixing thread	SAE J518 DIN 13	1 1/4 in M14x2;	 19 deep	400	O
S, S₁	Suction port Fixing thread	SAE J518 DIN 13	3 in M16x2;	 24 deep	30 2 6)	O
T₁, T₂	Tank port	DIN 3852	M26x1.5;	16 deep	10	5)
R	Air bleed	DIN 3852	M26x1.5;	16 deep	10	X
M₁	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

1) Center bore according to DIN 332 (thread acc. to DIN 13)

2) For max. tightening torque, please refer to general notes on page 64

3) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

4) Depending on adjustment data and operating pressure

5) Depending on installation position, T1 or T2 must be connected (see also page 61)

6) with charge pump

O = Open, must be connected (closed on delivery)

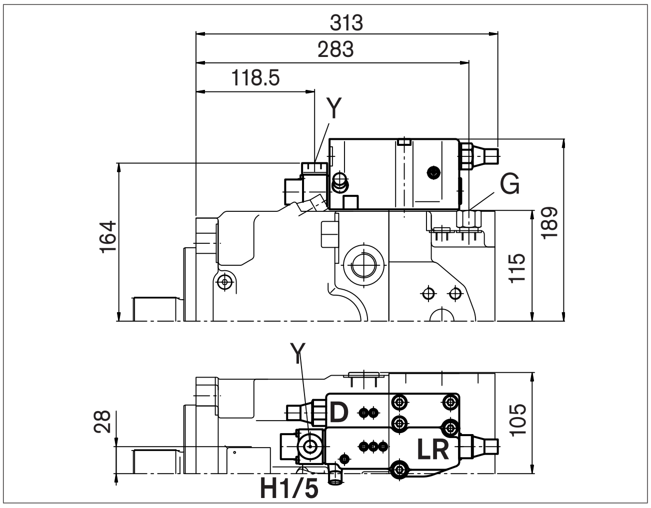
X = Closed (in normal operation)

Dimensions, Size 130/145

Before finalizing your design, please request a certified drawing. Dimensions in mm.

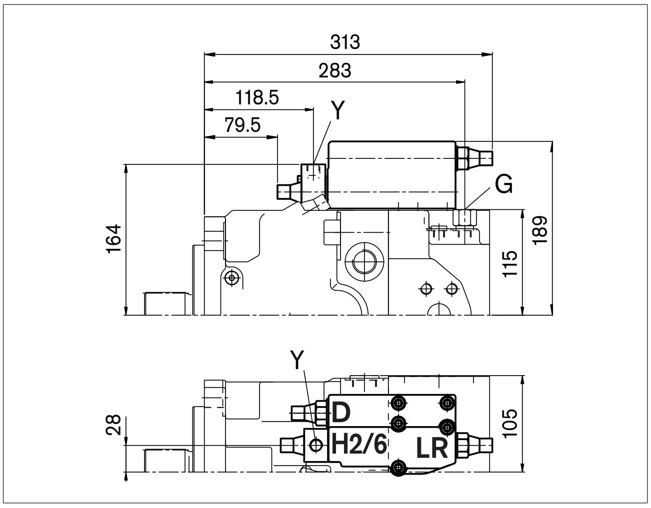
LRDH1/LRDH5

Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



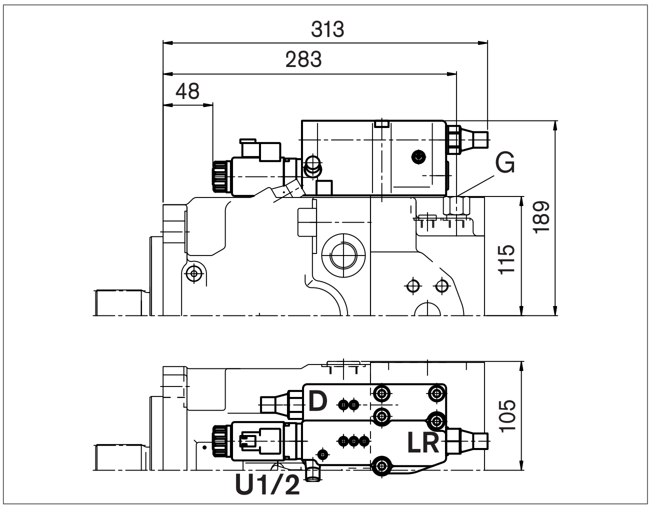
LRDH2/LRDH6

Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



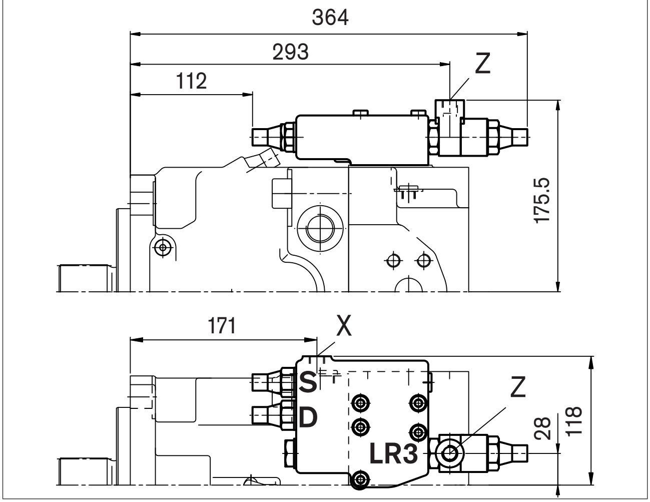
LRDU1/LRDU2

Power control with pressure cut-off and electric stroke limiter (positive characteristic)



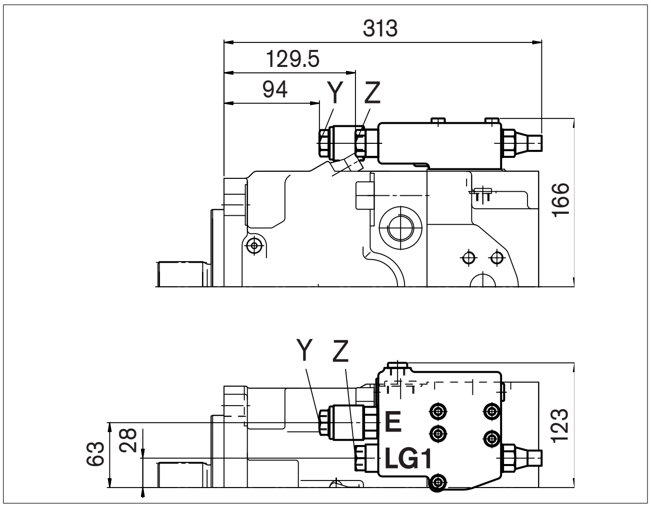
LR3DS

Power control with high-pressure related override, pressure cut-off and load sensing control



LG1E

Power control with pilot-pressure related override (negative) and 2-stage pressure cut-off



LG2E

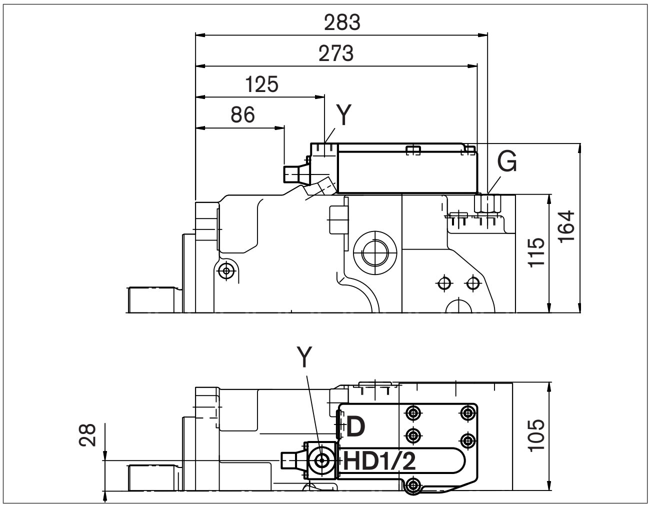
Power control with pilot-pressure related override (positive) and 2-stage pressure cut-off

Dimensions, Size 130/145

Before finalizing your design, please request a certified drawing. Dimensions in mm.

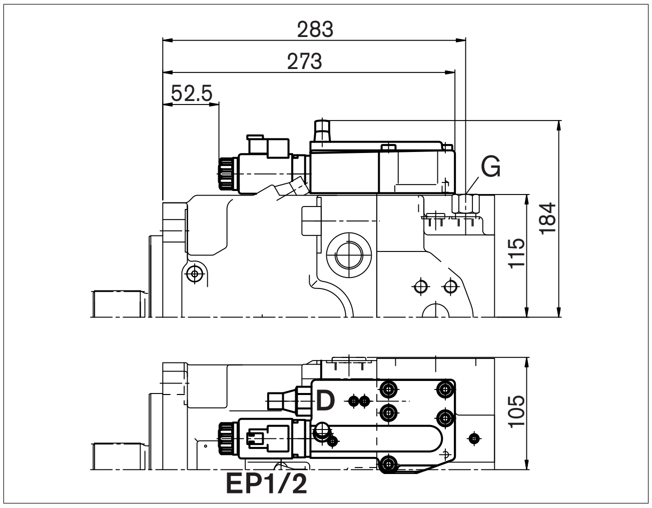
HD1D/HD2D

Hydraulic control, pilot-pressure related with pressure cut-off



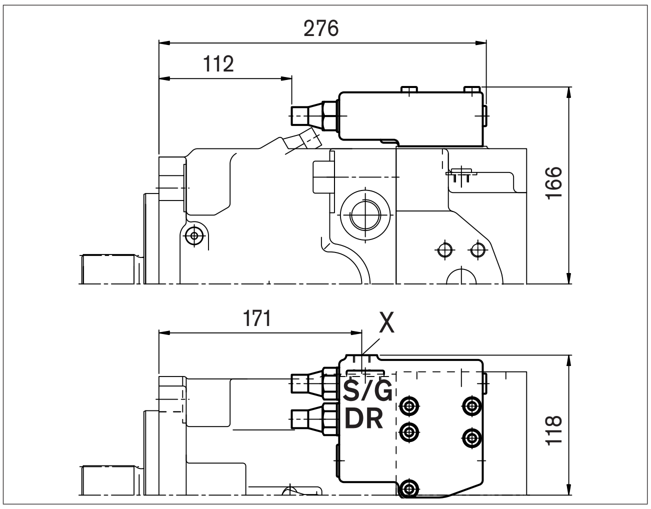
EP1D/EP2D

Electric control with proportional solenoid and pressure cut-off



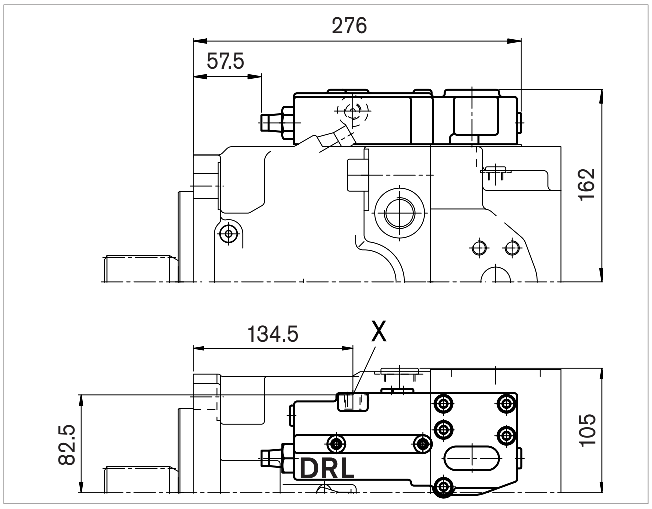
DRS/DRG

Pressure control with load sensing control
Pressure control remote controlled



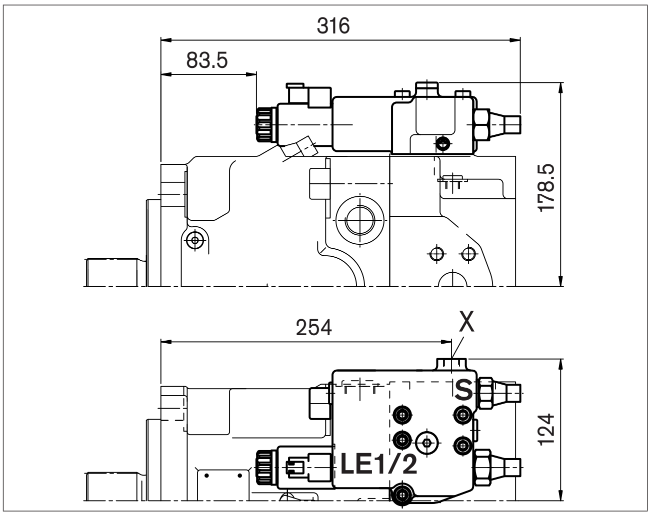
DRL

Pressure control for parallel operation



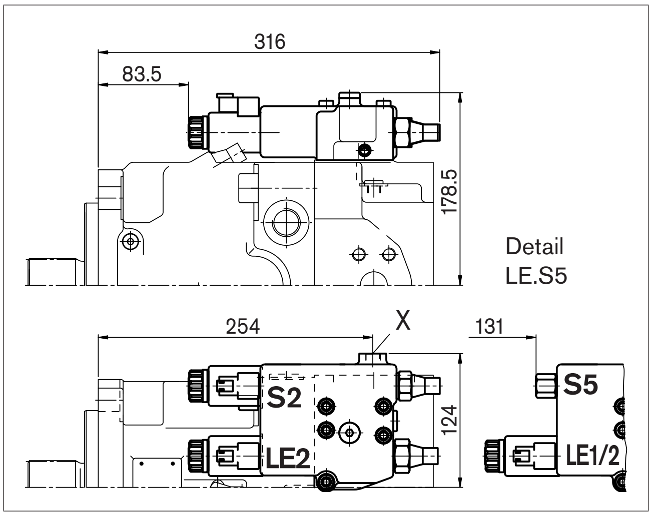
LE1S/LE2S

Power control with electric override (negative) and load sensing control



LE2S2/LE1S5/LE2S5

Power control with electric override (negative) and load sensing control, override



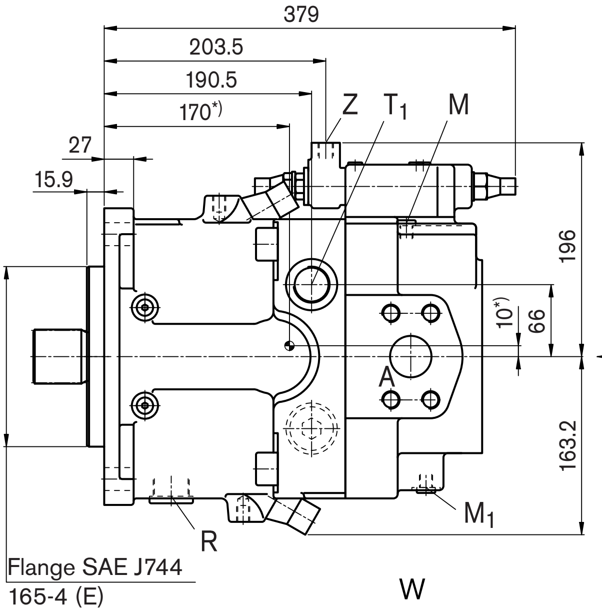
Dimensions, Size 190

Before finalizing your design, please request a certified drawing. Dimensions in mm.

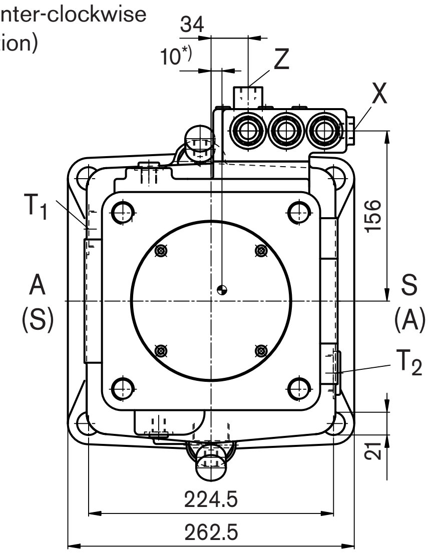
LRDCS

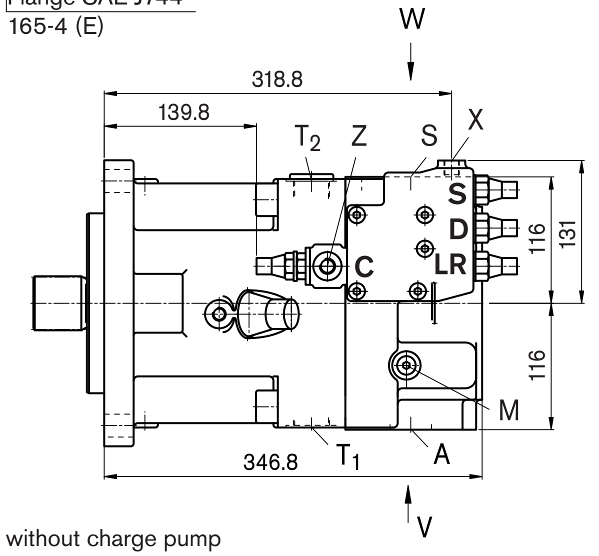
Power control LR with pressure cut-off D, cross sensing control C and load sensing control S

*) Center of gravity

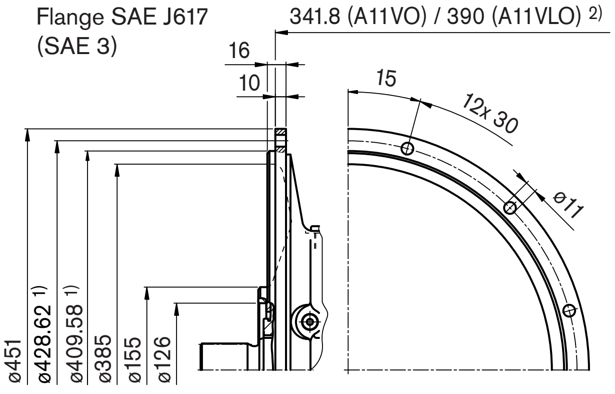


View Y
clockwise rotation
(counter-clockwise
rotation)

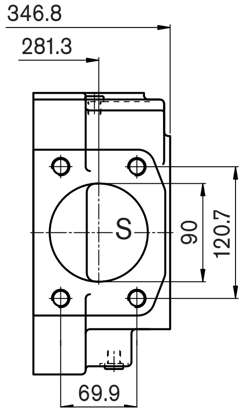




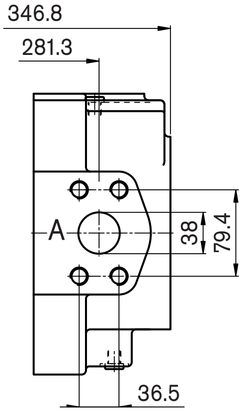
Flange SAE J617
(SAE 3)



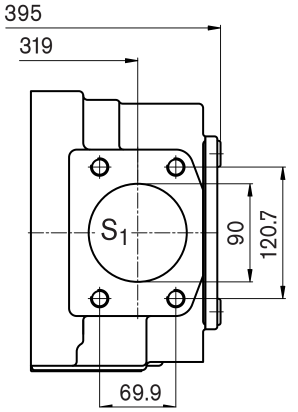
without charge pump
Detail W



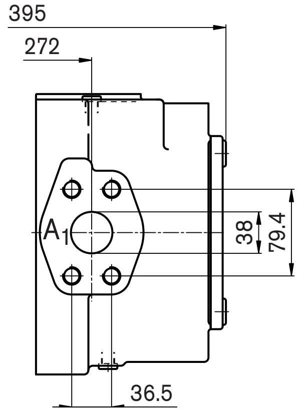
Detail V



with charge pump
Detail W



Detail V



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[1] Dimensions according to SAE J617-No. 3, for connection to the flywheel case of the combustion engine

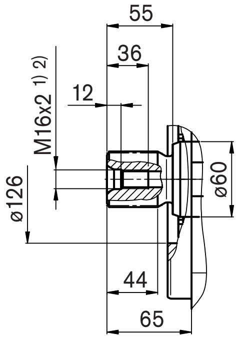
[2] The case or length dimension with flange SAE 3 is 5 mm shorter than the standard case.

Dimensions, Size 190

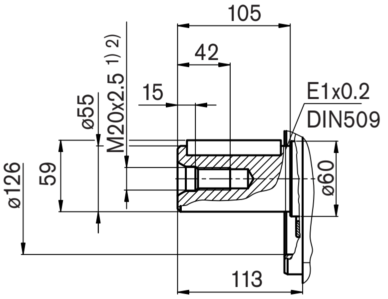
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

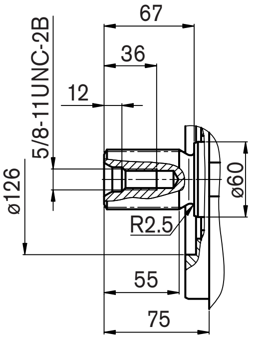
Z Splined shaft DIN 5480
W50x2x30x24x9g



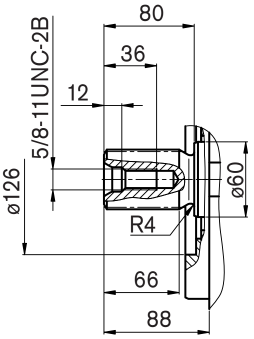
P Parallel keyed shaft DIN 6885,
AS16x10x100



S Splined shaft SAE J744
1 3/4 in 13T 8/16DP [3]



T Splined shaft SAE J744
2 in 15T 8/16DP [3]



Ports

Designation	Function	Standard	Size[2]		Max. pressure (bar) [4]	State
A, A_1	Service line port Fixing thread	SAE J518 DIN 13	1 1/2 in M16x2;	 21 deep	400	O
S, S_1	Suction port Fixing thread	SAE J518 DIN 13	3 1/2 in M16x2;	 24 deep	30 2[6]	O
T_1, T_2	Tank port	DIN 3852	M33x2;	18 deep	10	[5]
R	Air bleed	DIN 3852	M33x2;	18 deep	10	X
M_1	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

[1] Center bore according to DIN 332 (thread acc. to DIN 13)
[2] For max. tightening torque, please refer to general notes on page 64
[3] ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
[4] Depending on adjustment data and operating pressure
[5] Depending on installation position, T1 or T2 must be connected (see also page 61)
[6] with charge pump

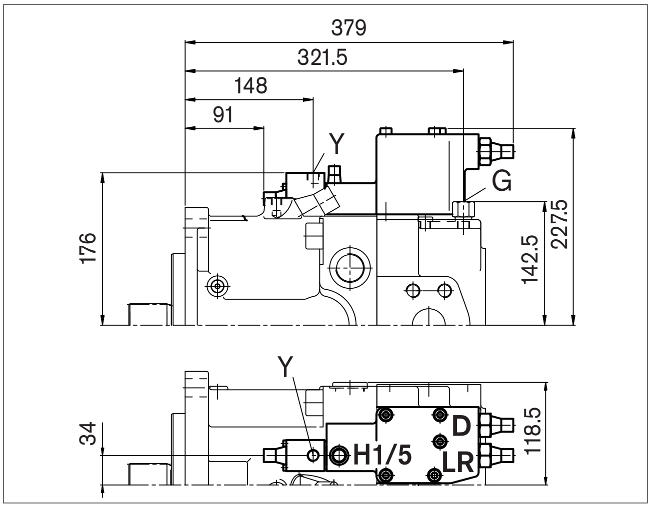
O = Open, must be connected (closed on delivery)
X = Closed (in normal operation)

Dimensions, Size 190

Before finalizing your design, please request a certified drawing. Dimensions in mm.

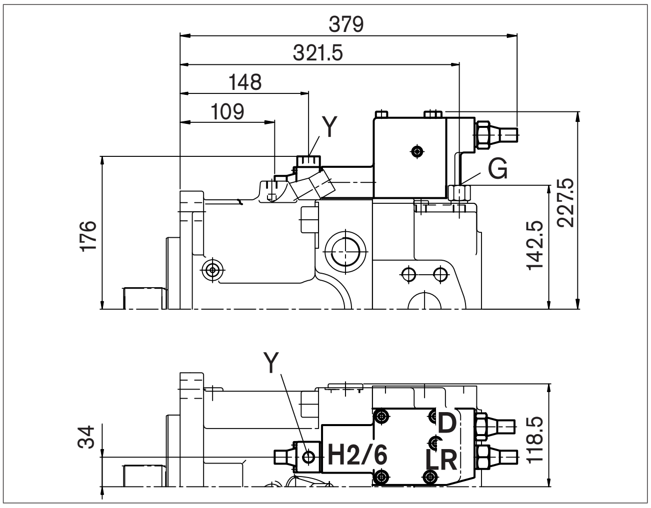
LRDH1/LRDH5

Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



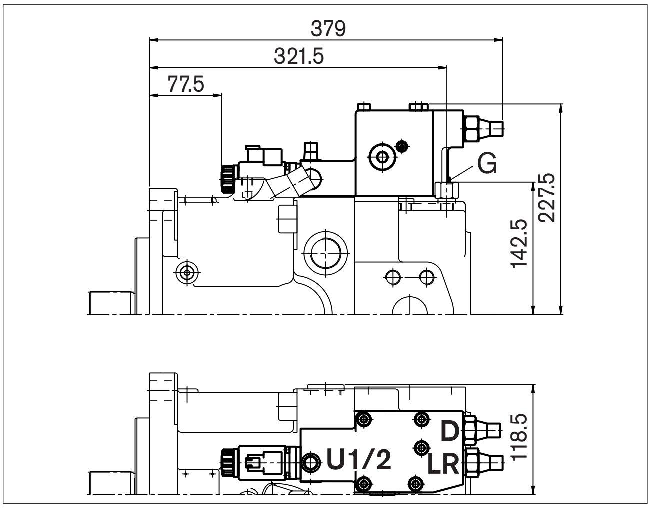
LRDH2/LRDH6

Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



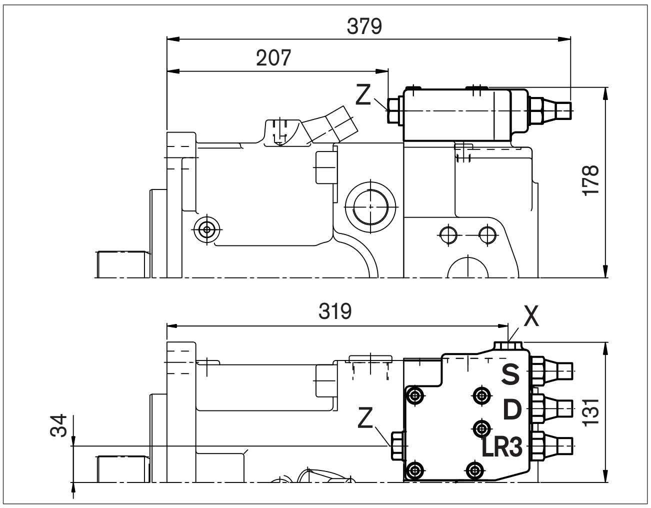
LRDU1/LRDU2

Power control with pressure cut-off and electric stroke limiter (positive characteristic)



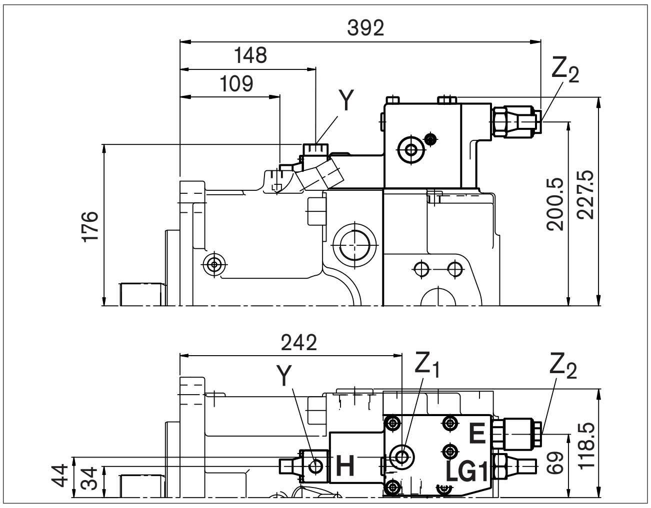
LR3DS

Power control with high-pressure related override, pressure cut-off and load sensing control



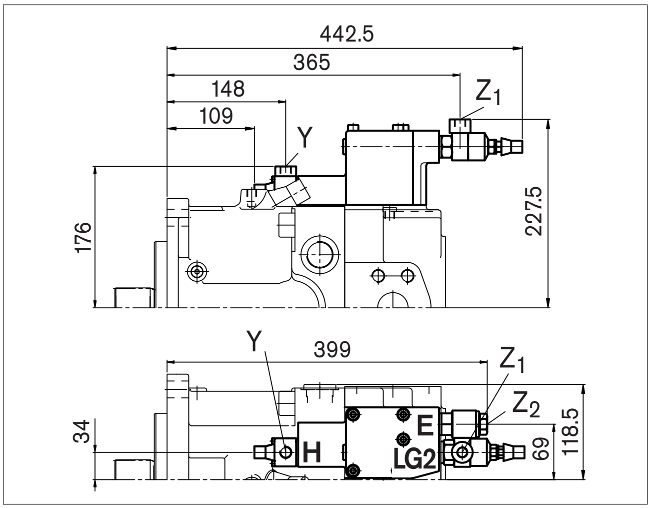
LG1EH

Power control with pilot-pressure related override (neg.), 2-stage pressure cut-off and hydr. stroke limiter



LG2EH

Power control with pilot-pressure related override (pos.), 2-stage pressure cut-off and hydr. stroke limiter

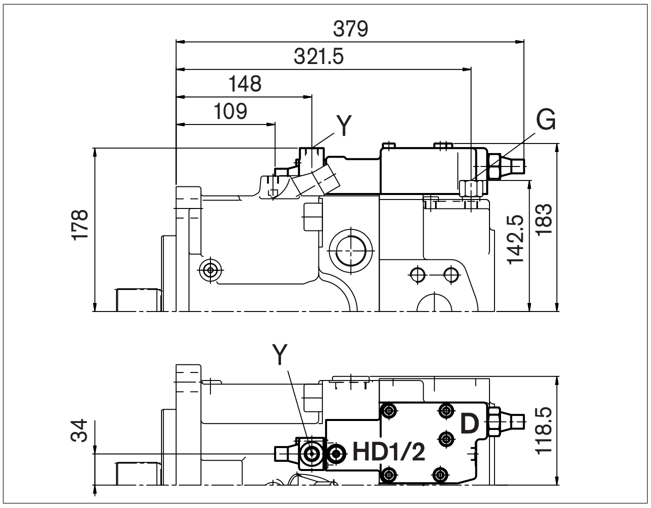


Dimensions, Size 190

Before finalizing your design, please request a certified drawing. Dimensions in mm.

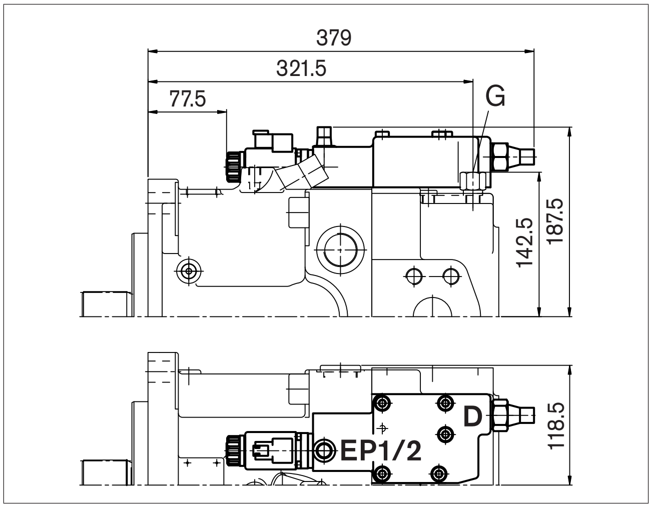
HD1D/HD2D

Hydraulic control, pilot-pressure related with pressure cut-off



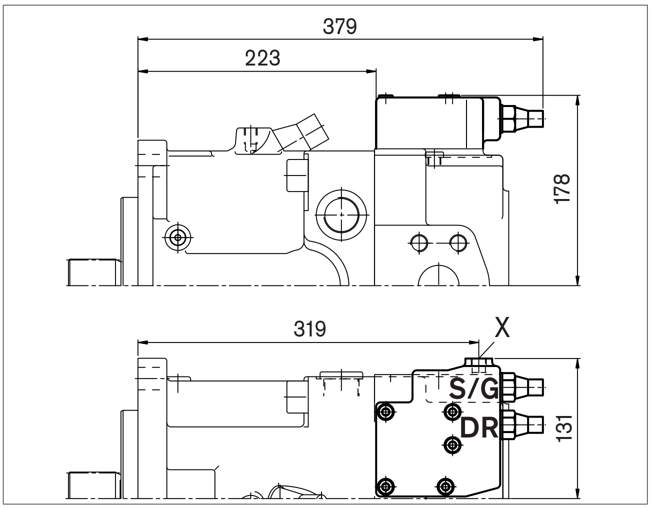
EP1D/EP2D

Electric control with proportional solenoid and pressure cut-off



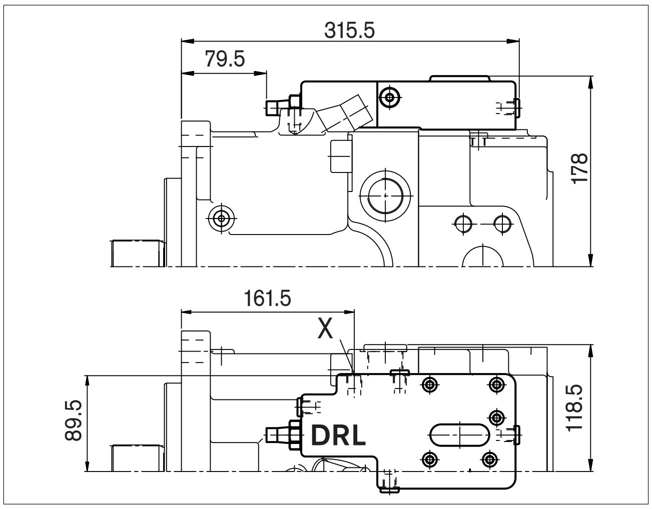
DRS/DRG

Pressure control with load sensing control
Pressure control remote controlled



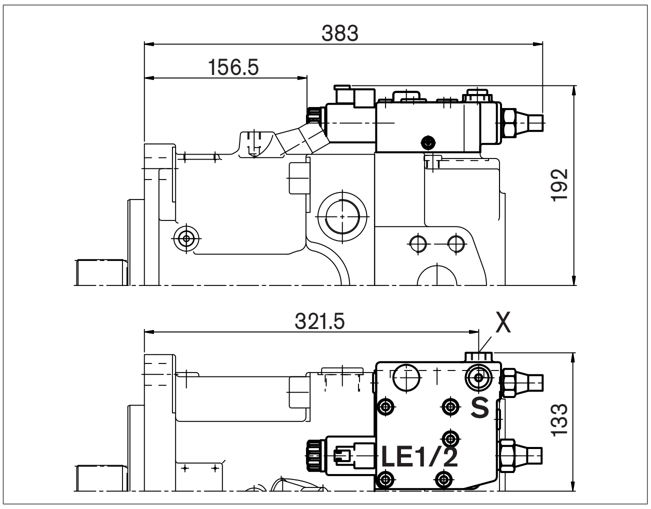
DRL

Pressure control for parallel operation



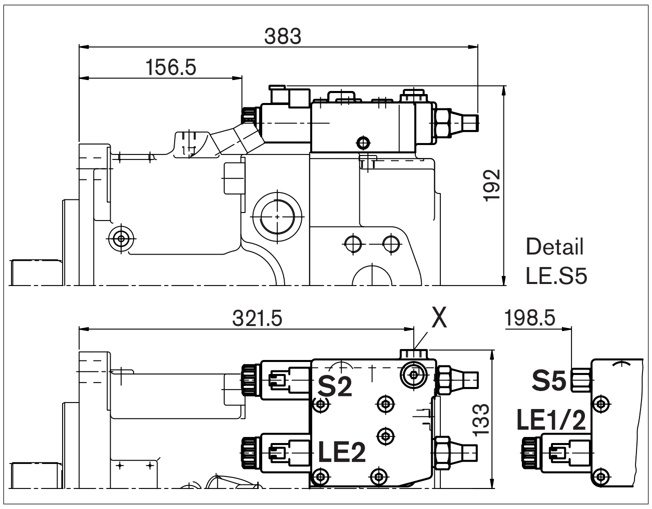
LE1S/LE2S

Power control with electric override (negative) and load sensing control



LE2S2/LE1S5/LE2S5

Power control with electric override (negative) and load sensing control, override

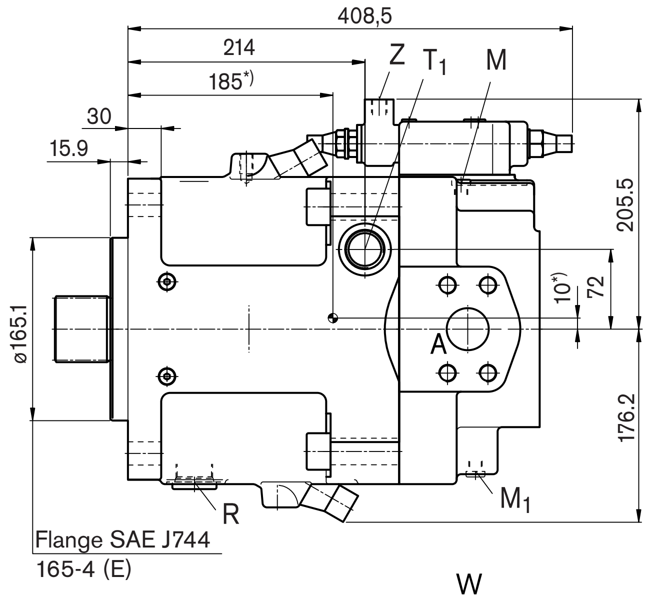


Dimensions, Size 260

Before finalizing your design, please request a certified drawing. Dimensions in mm.

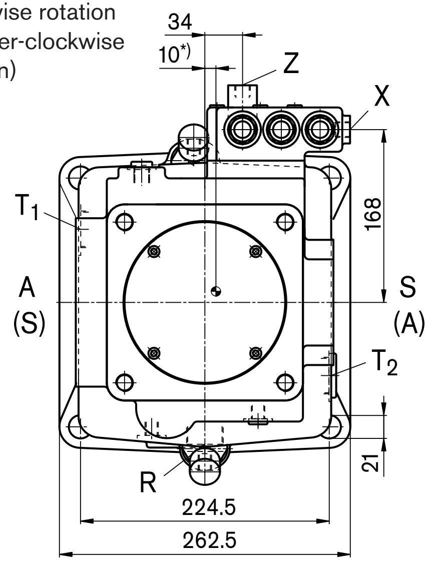
LRDCS

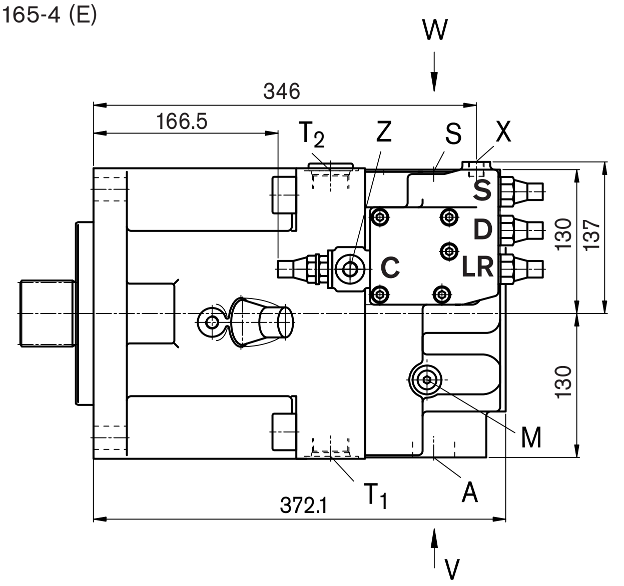
Power control LR with pressure cut-off D, cross sensing control C and load sensing control S



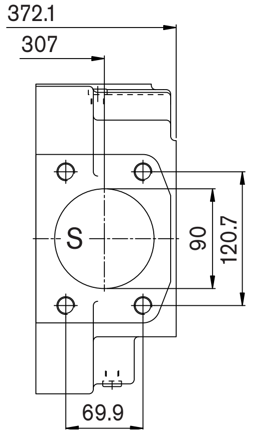
View Y
clockwise rotation
(counter-clockwise
rotation)

*) Center of gravity

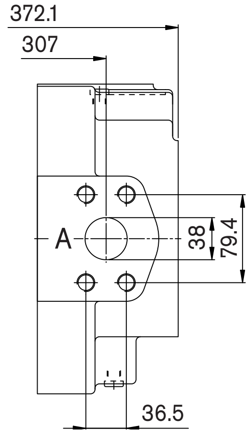




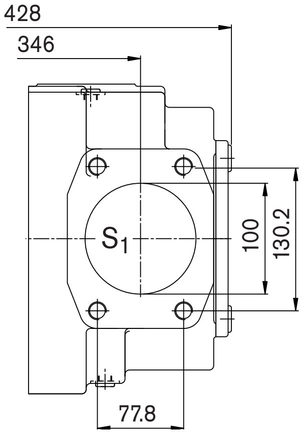
without charge pump
Detail W



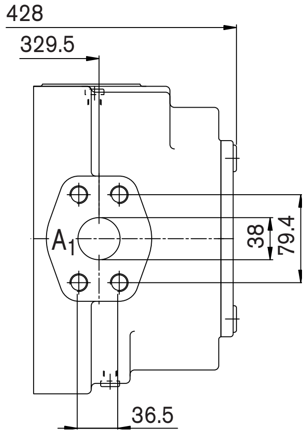
Detail V



with charge pump
Detail W



Detail V

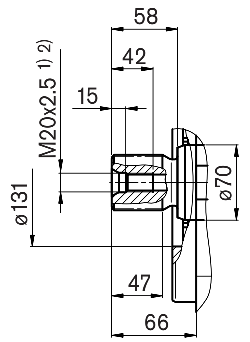


Dimensions, Size 260

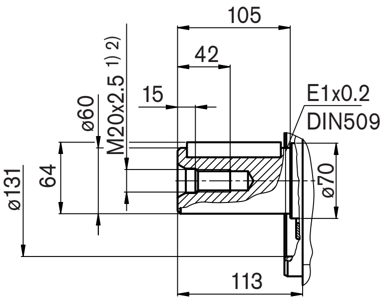
Before finalizing your design, please request a certified drawing. Dimensions in mm.

Shaft ends

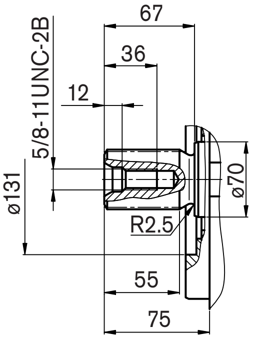
Z Splined shaft DIN 5480
W60x2x30x28x9g



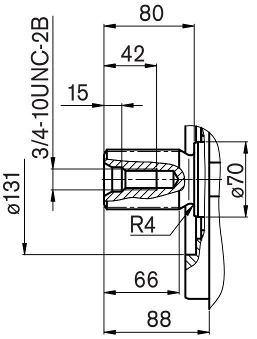
P Parallel keyed shaft DIN 6885,
AS18x11x100



S Splined shaft SAE J744
1 3/4 in 13T 8/16DP [3]



T Splined shaft SAE J744
2 1/4 in 17T 8/16DP [3]



Ports

Designation	Function	Standard	Size[2]		Max. pressure (bar) [4]	State
A, A_1	Service line port Fixing thread	SAE J518 DIN 13	1 1/2 in M16x2;	 21 deep	400	O
S	Suction port Fixing thread	SAE J518 DIN 13	3 1/2 in M16x2;	 24 deep	30	O
S_1	Suction port Fixing thread	SAE J518 DIN 13	4 in M16x2;	 21 deep	2[6]	O
T_1, T_2	Tank port	DIN 3852	M33x2;	16 deep	10	[5]
R	Air bleed	DIN 3852	M33x2;	16 deep	10	X
M_1	Measurement point, positioning chamber	DIN 3852	M12x1.5;	12 deep	400	X
M	Measurement point, service line port	DIN 3852	M12x1.5;	12 deep	400	X
X	Pilot pressure port in version with load sensing (S) and remote controlled pressure cut-off (G)	DIN 3852	M14x1.5	12 deep	400	O
Y	Pilot pressure port in version with stroke limiter (H...), 2-stage pressure cut-off (E) and HD	DIN 3852	M14x1.5;	12 deep	40	O
Z	Pilot pressure port in version with cross sensing (C) and power override (LR3) power override (LG1)	DIN 3852	M14x1.5;	12 deep	 400 40	O
G	Port for control pressure (controller) in version with stroke limiter (H.., U2), HD and EP with screw union GE10 - PLM (otherwise closed)	DIN 3852	M14x1.5;	12 deep	40	O

[1] Center bore according to DIN 332 (thread acc. to DIN 13)

[2] For max. tightening torque, please refer to general notes on page 64

[3] ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

[4] Depending on adjustment data and operating pressure

[5] Depending on installation position, T1 or T2 must be connected (see also page 61)

[6] with charge pump

O = Open, must be connected (closed on delivery)

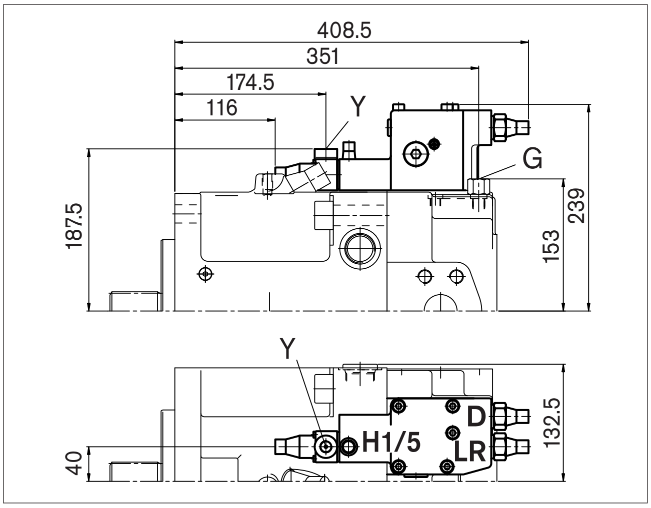
X = Closed (in normal operation)

Dimensions, Size 260

Before finalizing your design, please request a certified drawing. Dimensions in mm.

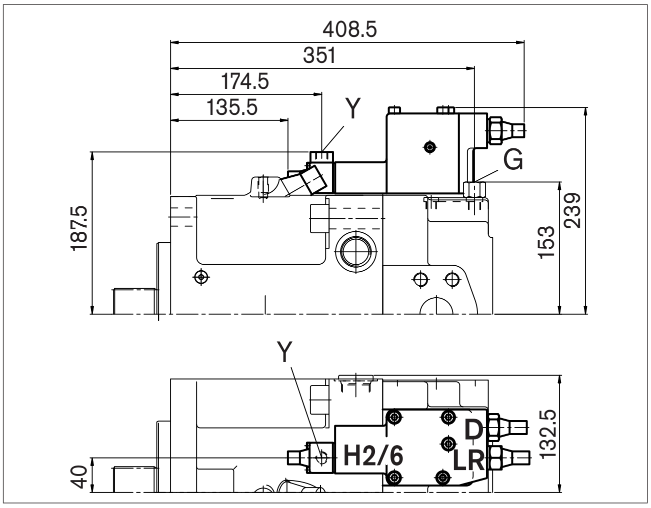
LRDH1/LRDH5

Power control with pressure cut-off and hydraulic stroke limiter (negative characteristic)



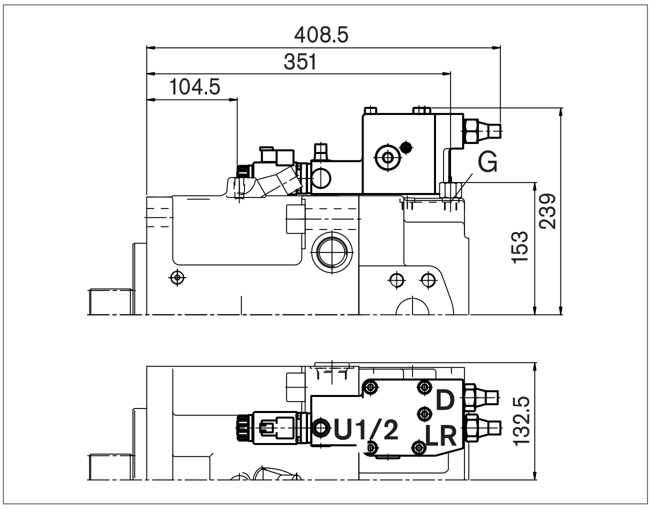
LRDH2/LRDH6

Power control with pressure cut-off and hydraulic stroke limiter (positive characteristic)



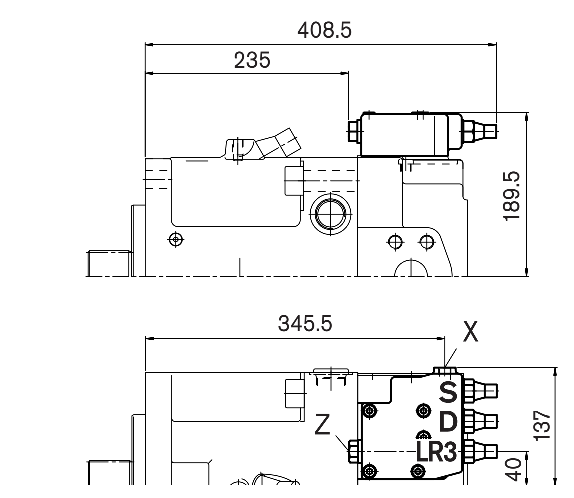
LRDU1/LRDU2

Power control with pressure cut-off and electric stroke limiter (positive characteristic)



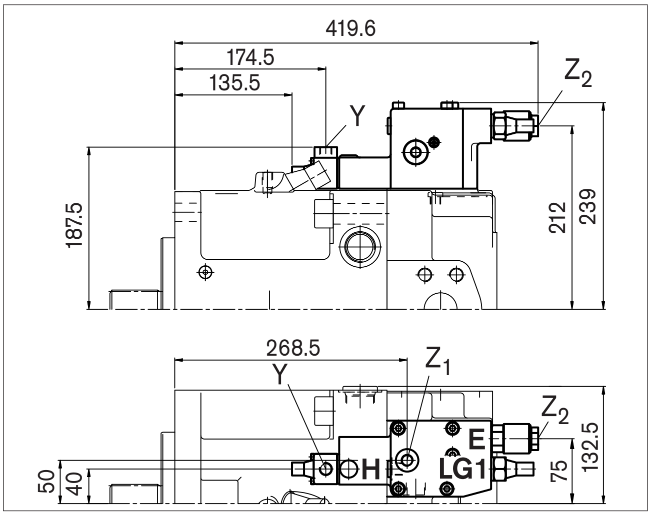
LR3DS

Power control with high-pressure related override, pressure cut-off and load sensing control



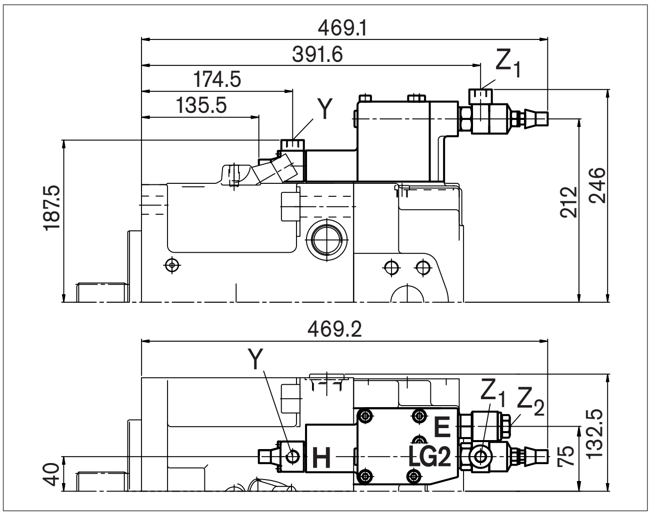
LG1EH

Power control with pilot-pressure related override (neg.), 2-stage pressure cut-off and hydr. stroke limiter



LG2EH

Power control with pilot-pressure related override (pos.), 2-stage pressure cut-off and hydr. stroke limiter

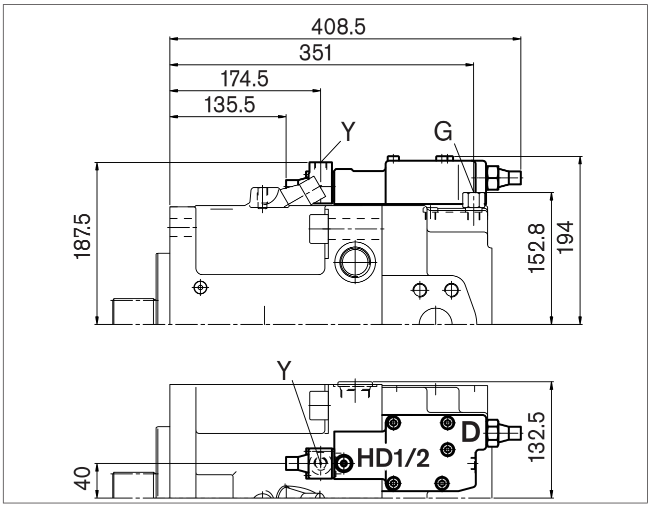


Dimensions, Size 260

Before finalizing your design, please request a certified drawing. Dimensions in mm.

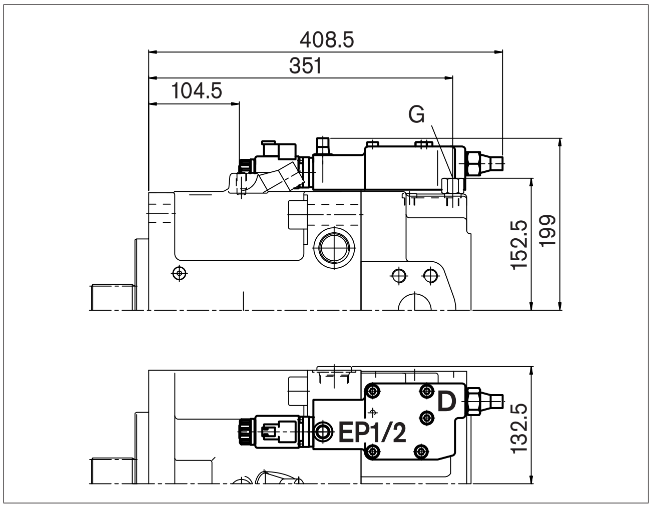
HD1D/HD2D

Hydraulic control, pilot-pressure related with pressure cut-off



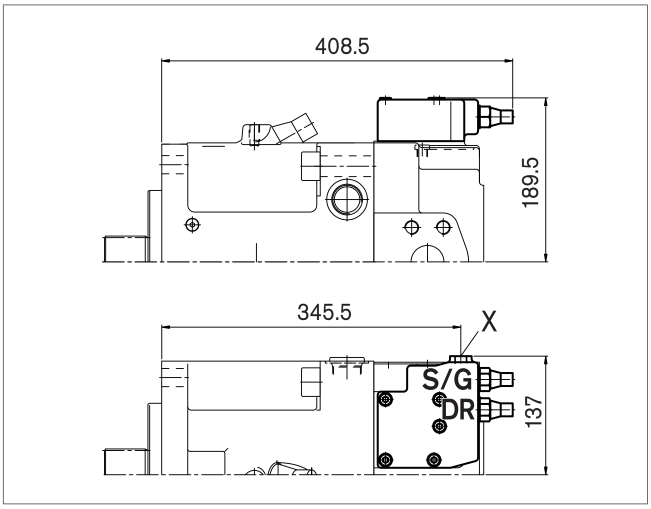
EP1D/EP2D

Electric control with proportional solenoid and pressure cut-off



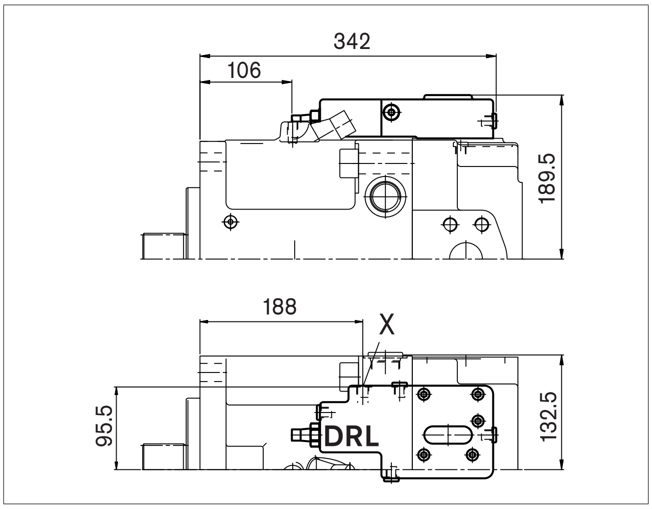
DRS/DRG

Pressure control with load sensing control
Pressure control remote controlled



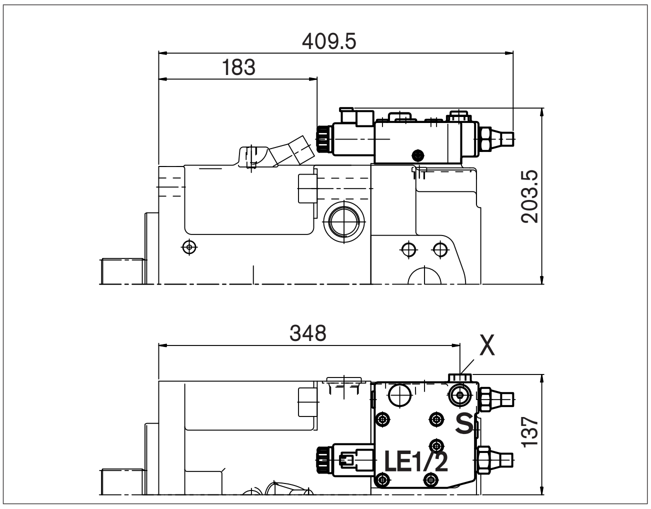
DRL

Pressure control for parallel operation



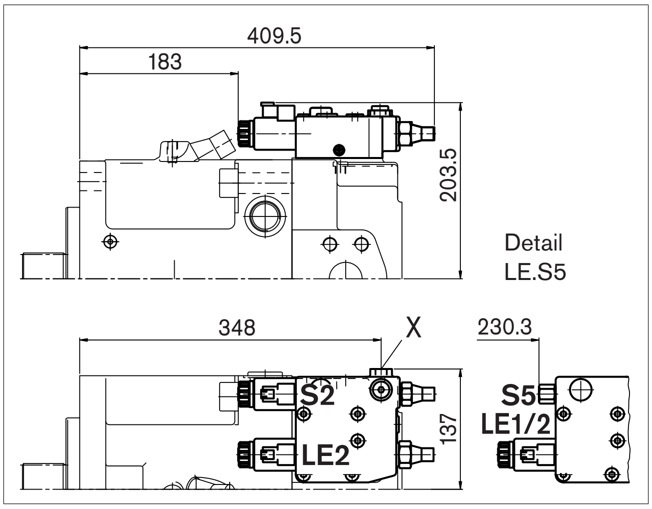
LE1S/LE2S

Power control with electric override (negative) and load sensing control



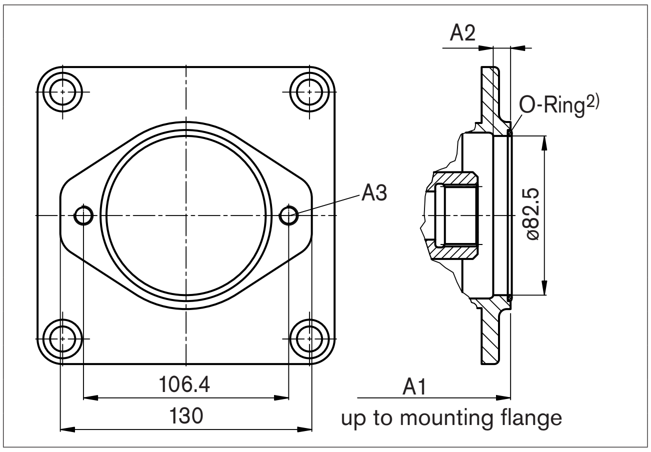
LE2S2/LE1S5/LE2S5

Power control with electric override (negative) and load sensing control, override



Through Drive Dimensions

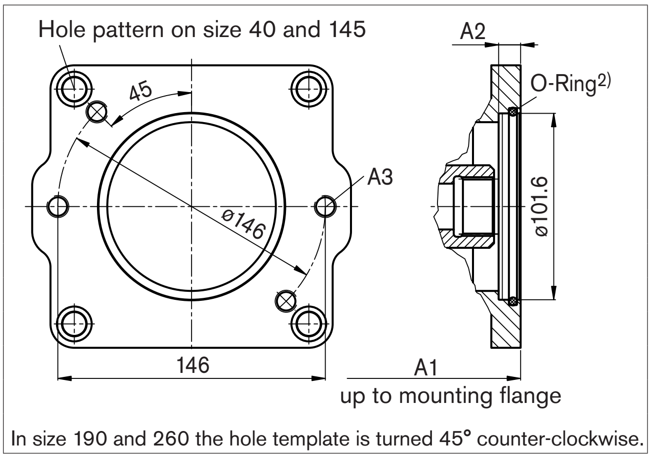
Flange SAE J744 **–** 82-2 (A) **Coupler** for splined shaft acc. to ANSI B92.1a-1976 5/8 in 9T 16/32 DP[1] (SAE J744 – 16-4 (A) **K01**
3/4 in 11T 16/32 DP[1] (SAE J744 – 19-4 (A-B)) **K52**



	A1		A2	A3[3]
Size	**K01**	**K52**		
40	240	240	8	M10x1.5; 15 deep
60	257	257	–	M10x1.5; 15 deep
75	275	275	–	M10x1.5; 15 deep
95	306	306	–	M10x1.5; 12.5 deep
130/145	329	329	–	M10x1.5; 12.5 deep
130/145*	363	363	–	M10x1.5; 12.5 deep
190	359.8	359.8	–	M10x1.5; 13 deep
190*	394	394	–	M10x1.5; 13 deep
260	385	385	–	M10x1.5; 13 deep
260*	427.3	427.3	–	M10x1.5; 13 deep

*) Version with charge pump

Flange SAE J744 **–** 101-2 (B) **Coupler** for splined shaft acc. to ANSI B92.1a-1976 7/8 in 13T 16/32 DP[1] (SAE J744 **–** 22-4 (B)) **K02**
1 in 15T 16/32 DP[1] (SAE J744 – 25-4 (B-B)) **K04**
Coupler for splined shaft acc. to DIN 5480 W35x2x30x16x9g **K79**

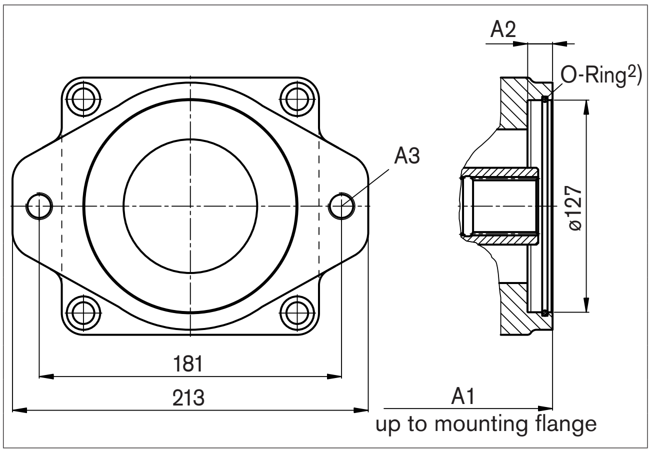


In size 190 and 260 the hole template is turned 45° counter-clockwise.

	A1			A2	A3[3]
Size	**K02**	**K04**	**K79**		
40	244	244		10	M12x1.75; 19 deep
60	261	261	261	10	M12x1.75; 19 deep
75	279	279		10	M12x1.75; 19 deep
95	303	303	303	10	M12x1.75; 16 deep
130/145	326	326	326	10	M12x1.75; 16 deep
130/145*	360	360	360	10	M12x1.75; 16 deep
190	371.8	369.8	361.8	–	M12x1.75; 15 deep
190*	404	404	394	–	M12x1.75; 15 deep
260	395	395	395	–	M12x1.75; 15 deep
260*	437.5	437.5	437.5	–	M12x1.75; 15 deep

*) Version with charge pump

Flange SAE J744 **–** 127-2 (C) **Coupler** for splined shaft acc. to ANSI B92.1a-1976 1 1/4 in 14T 12/24 DP[1] (SAE J744 – 32-4 (C)) **K07**
1 1/2 in 17T 12/24 DP[1] (SAE J744 – 38-4 (C-C)) **K24**
Coupler for splined shaft acc. to DIN 5480 W30x2x30x14x9g **K80**
W35x2x30x16x9g **K61**



	A1				A2	A3[3]
Size	**K07**	**K24**	**K80**	**K61**		
60	272	–	265	265	13	M16x2; 20 deep
75	290	–	283	283	13	M16x2; 20 deep
95	318	318	318	318	13	M16x2; 16 deep
130/145	330	330	330	330	13	M16x2; 20 deep
130/145*	364	364	364	364	13	M16x2; 20 deep

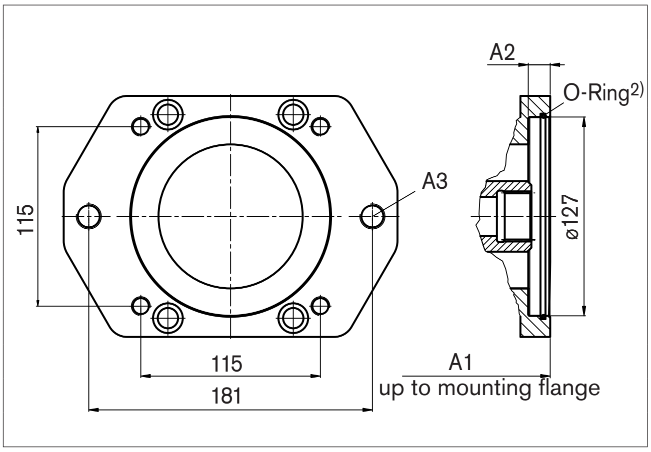
*) Version with charge pump

Note:
The mounting flange may be turned through 90°. Standard position as illustrated. Please state in clear text if required.

[1] 30° pressure angle, flat root, side fit, tolerance class 5
[2] O-ring included in the delivery contents
[3] DIN 13, for max. tightening torque, please refer to general notes on page 64

Through Drive Dimensions

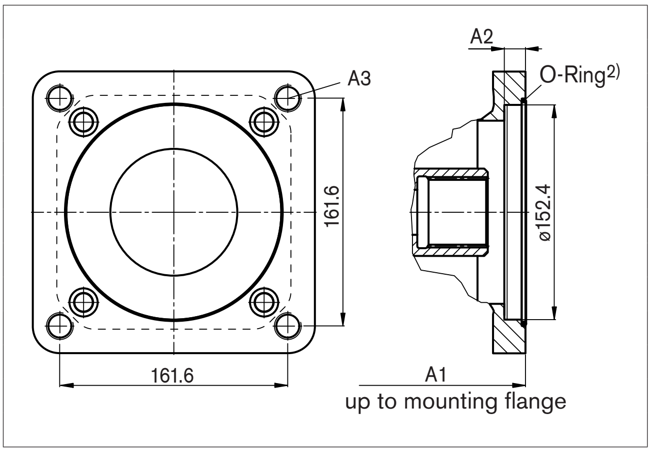
Flange SAE J744–127-2+4 (A) **Coupler** for splined shaft acc. to ANSI B92.1a-19761 1/4 in 14T 12/24 DP1) (SAE J744 – 32-4 (C) **K07**
1 1/2 in 17T 12/24 DP1) (SAE J744 – 38-4 (C-C)) **K24**
Coupler for splined shaft acc. to DIN 5480 W30x2x30x14x9g **K80**
W35x2x30x16x9g **K61**



	A1				A2	A3 3)
Size	**K07**	**K24**	**K80**	**K61**		
190	367.8	367.8	367.8	367.8	13	M16x2; 19 deep
190*	400	400	400	400	13	M16x2; 19 deep
260	391.5	391.5	391.5	391.5	13	M16x2; 19 deep
260*	433.5	433.5	433.5	433.5	13	M16x2; 19 deep

*) Version with charge pump

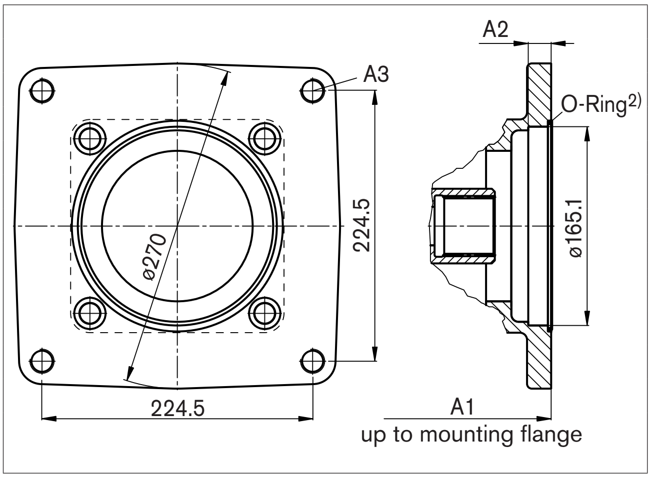
Flange SAE J744 – 152-4 (D) **Coupler** for splined shaft acc. to ANSI B92.1a-1976 1 1/4 in 14T 12/24 DP1) (SAE J744 – 32-4 (C)) **K86**
1 3/4 in 13T 8/16 DP1) (SAE J744 – 44-4 (D)) **K17**
Coupler for splined shaft acc. to DIN 5480 W40x2x30x18x9g **K81**
W45x2x30x21x9g **K82**
W50x2x30x24x9g **K83**



	A1					A2	A3 3)
Size	**K86**	**K17**	**K81**	**K82**	**K83**		
75	290	–	290	–	–	13	M20x2.5; 28 deep
95	317	327	317	317	–	30	M20x2.5; 25 deep
130/145	340	350	340	340	340	30	M20x2.5; 25 deep
130/145*	374	384	374	374	374	30	M20x2.5; 25 deep
190	392	392	392	392	392	13	M20x2.5; 22 deep
190*	424	424	424	424	424	13	M20x2.5; 22 deep
260	417	417	417	417	417	13	M20x2.5; 22 deep
260*	459	459	459	459	459	13	M20x2.5; 22 deep

*) Version with charge pump

Flange SAE J744 – 101-2 (E) **Coupler** for splined shaft acc. to ANSI B92.1a-1976 1 3/4 in 13T 16/32 DP1) (SAE J744 – 32-4 (C)) **K72**
Coupler for splined shaft acc. to DIN 5480 W50x2x30x24x9g) **K84**
W60x2x30x28x9g **K67**



	A1			A2	A3 3)
Size	**K72**	**K84**	**K67**		
190	376.8	376.8	–	19	M20x2.5; 20 deep
190*	409	409	–	19	M20x2.5; 20 deep
260	417	400	400	19	M20x2.5; 20 deep
260*	459	442.5	442.5	19	M20x2.5; 20 deep

*) Version with charge pump

Note:
The mounting flange may be turned through 90°. Standard position as illustrated. Please state in clear text if required.

1) 30° pressure angle, flat root, side fit, tolerance class 5
2) O-ring included in the delivery contents
3) DIN 13, for max. tightening torque, please refer to general notes on page 64

Overview of Attachments for A11V(L)O

Through drive	A11VO		Attachment – 2nd pump							Through drive
Flange	Coupler for splined shaft	Code	A11VO Size (shaft)	A10V(S)O/31 Size (shaft)	A10V(S) O/53 Size (shaft)	A4FO Size (shaft)	A4VG Size (shaft)	A10VG Size (shaft)	External gear pump	available for size
82-2 (A)	5/8 in	K01	–	18 (U)	10 (U)	–	–	–	Frame size F Size 4-22 1)	40...260
	3/4 in	K52	–	18 (S)	10 (S)	–	–	–	–	40...260
101-2 (B)	7/8 in	K02	–	28 (S, R) 45 (U)	28 (S, R) 45 (U, W)	16, 22, 28 (S)	–	18 (S)	Frame size N Size 20-32 1) Frame size G Size 38-45 1)	40...260
	1 in	K04	40 (S)	45 (S, R)	45 (S, R) 60 (U, W)	–	28 (S)	28, 45 (S)	–	40...260
	W35	K79	40 (Z)	–	–	–	–	–	–	40...260
127-2 (C)	1 1/4 in	K07	60 (S)	71 (S, R) 100 (U)	60 (S) 2) 85 (U)	–	40, 56, 71 (S)	63 (S)	–	60...260
	1 1/2 in	K24	–	100 (S)	85 (S)	–	–	–	–	95...260
	W30	K80	–	–	–	–	40, 56 (Z)	–	–	60...260
	W35	K61	60 (Z)	–	–	–	40, 56 (A) 71 (Z)	–	–	60...260
152-4 (D)	1 1/4 in	K86	75 (S)	–	–	–	–	–	–	75...260
	1 3/4 in	K17	95, 130, 145 (S)	140 (S)	–	–	90, 125 (S)	–	–	130...260
	W40	K81	75 (Z)	–	–	–	125 (Z)	–	–	75...260
	W45	K82	95 (Z)	–	–	–	90, 125 (A)	–	–	95...260
	W50	K83	130, 145 (Z)	–	–	–	–	–	–	130...260
165-4 (E)	1 3/4 in	K72	190, 260 (S)	–	–	–	180, 250 (S)	–	–	190...260
	W50	K84	190 (Z)	–	–	–	180 (Z)	–	–	190...260
	W60	K67	260 (Z)	–	–	–	–	–	–	260

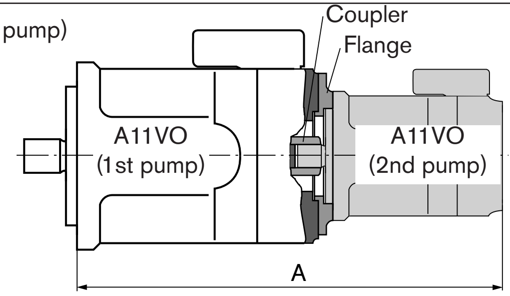
[1] Rexroth recommends special versions of the gear pumps. Please ask.
[2] Only A10VO with 4-hole mounting flange can be mounted to A11V(L)O 190 and 260.

Combination Pumps A11VO + A11VO

Total length A 1)

A11VO	2nd pump									
1st pump	Size 40	Size 60	Size 75	Size 95	Size 130/145	Size 130/145 2)	Size 190	Size 190 2)	Size 260	Size 260 2)
Size 40	–	–	–	–	–	–	–	–	–	–
Size 60	490	507	–	–	–	–	–	–	–	–
Size 75	–	525	550	–	–	–	–	–	–	–
Size 95	528	560	577	604	–	–	–	–	–	–
Size 130/145	551	572	600	627	650	698	–	–	–	–
Size 130/145 2)	585	606	634	661	684	732	–	–	–	–
Size 190	586.8	609.8	652	679	702	750	723.6	772.3	–	–
Size 190 2)	619	642	684	711	734	782	755.8	804.5	–	–
Size 260	620	633.5	677	704	727	775	746.8	795.5	772	828
Size 260 2)	662.5	675.5	719	746	769	817	789.3	838	814.5	870.5

[1] When using the Z shaft (splined shaft DIN 5480) for the attached pump (2nd pump)
[2] Version with charge pump



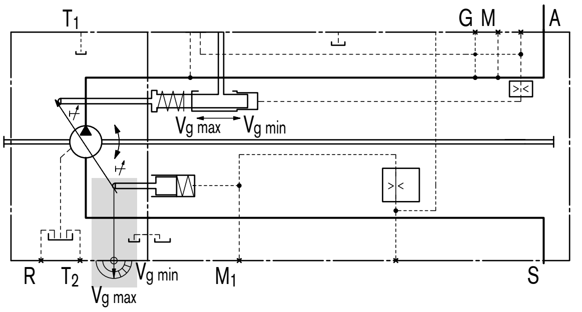
When ordering combination pumps, the type designations of the 1st and 2nd pumps must be connected by a "+".
Ordering code 1st pump + Ordering code 2nd pump

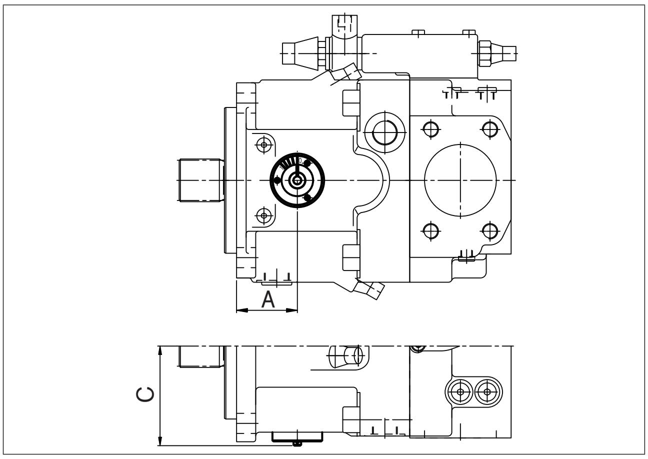
Ordering example:
A11VO130LRDS/10R-NZD12K61 + A11VO60LRDS/10R-NZC12N00

Swivel Angle Indicator

Optical swivel angle indicator, V

With the optical swivel angle indicator, a mechanical pointer on the side of the pump case displays the position of the swivel angle of the pump.



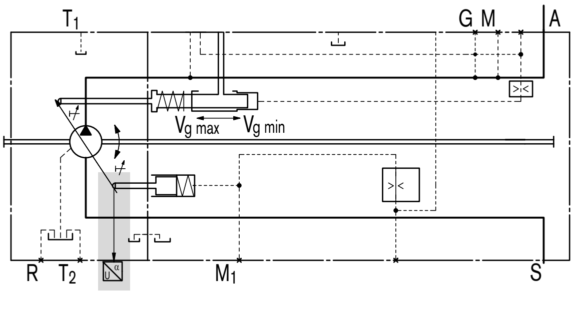


Size	A	C
40	50.5	84.0
60	not available	
75	60.7	97.0
95	63,5	104.0
130	70.9	112.0
190	87.6	123.5
260	87.6	137.0

Electric swivel angle sensor, R

With the electric swivel angle indicator the swivel position of the pump is measured by an electric swivel angle sensor. It has a robust, sealed case and integrated electronics designed for automotive applications.

As an output the Hall effect swivel angle sensor supplies a voltage signal proportional to the swivel angle (see technical parameters).



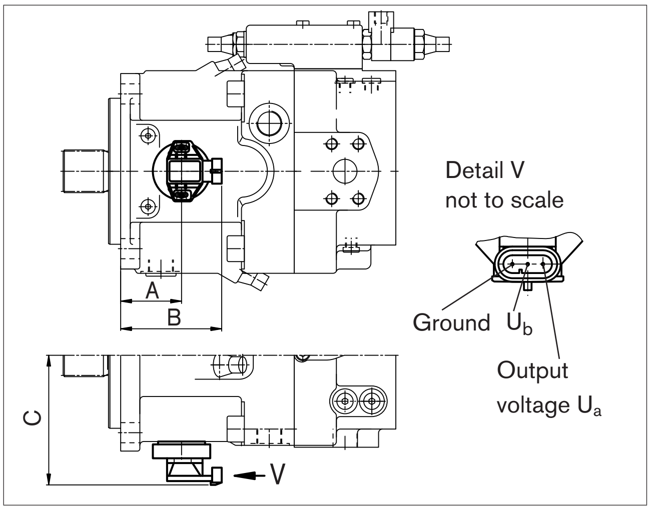
Parameters		
Supply voltage U_b	10...30 V DC	
Output voltage U_a	2.5 V ($V_{g\ min}$)	4.5 V ($V_{g\ max}$)
Reverse-connect protection	Short-circuit-proof	
EMC stability	Details on request	
Operating temperature range	-40°C...+125°C	
Vibration resistance Sinusoidal vibration EN 60068-2-6	10 *g* / 5...2000 Hz	
Shock resistance: Continuous shock IEC 68-2-29	*25 g*	
Resistance to salt spray DIN 50021-SS	96 h	
Type of protection DIN/EN 60529	IP67 and IP69K	
Case material	synthetic material	

Mating connector

AMP Superseal 1.5; 3-pin,
Rexroth mat. no. R902602132

Consisting of:	AMP no.
– 1 female connector case, 3-pin	282087-1
– 3 single wire seals, yellow	281934-2
– 3 female connector contacts 1.8–3.3 mm	283025-1

The mating connector is not included in the delivery contents. This can be delivered by Rexroth on request.



Size	A	B	C
40	50.5	88.5	118.3
60	not available		
75	60.7	98.7	131.3
95	63.5	101.5	138.3
130	70.9	108.9	146.3
190	87.6	125.6	157.8
260	87.6	125.6	171.3

Connector for Solenoids

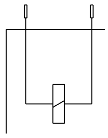
DEUTSCH DT04-2P-EP04, 2-pin

molded, without bidirectional suppressor diode
(standard) ______________________________ **P**

Type of protection according to DIN/EN 60529:
IP67 and IP69K

Circuit diagram symbol

without bidirectional
suppressor diode

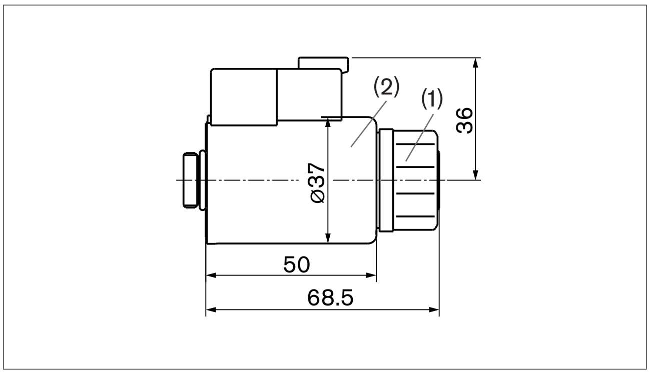


Mating connector

DEUTSCH DT06-2S-EP04
Rexroth mat. no. R902601804

Consisting of:	DT designation
– 1 case	DT06-2S-EP04
– 1 wedge	W2S
– 2 female connectors	0462-201-16141

The mating connector is not included in the delivery contents. This can be delivered by Rexroth on request.



Note for round solenoids:

The position of the connector can be changed by turning the solenoid body.

Proceed as follows:

- 1. Loosen fixing nut (1)
- 2. Turn the solenoid body (2) to the desired position.
- 3. Tighten the fixing nut
  Tightening torque of fixing nut: 5^{+1} Nm
  (width across the flats WAF 26, 12kt DIN 3124)

Installation Notes

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This is also to be observed following a relatively long standstill as the system may empty via the hydraulic lines.

The case drain in the case interior must be directed to the tank via the highest tank port (T_1, T_2). The minimum suction pressure at port S must not fall below 0.8 bar absolute (without charge pump) or 0.6 bar (with charge pump).

In all operational conditions, the suction line and case drain line must flow into the tank below the minimum fluid level.

Installation position

See examples below. Additional installation positions are available upon request.

Below-tank installation (standard)

Pump below the minimum fluid level of the tank.

Recommended installation positions: 1 and 2.

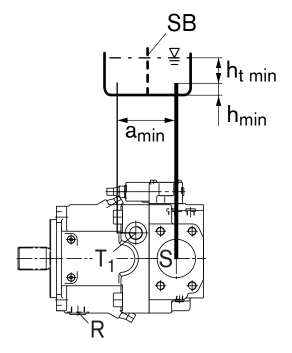
Above-tank installation

Pump above the minimum fluid level of the tank.

Observe the maximum permissible suction height $h_{s\ max} = 800$ mm.

The version A11VLO (with charge pump) is not designed for installation above the tank.
Recommendation for installation position 7 (shaft up): A check valve in the case drain line (opening pressure 0.5 bar) can prevent the case interior from draining.
For control options with pressure control, displacement limiters, HD and EP control, the minimum displacement setting must be $V_g \geq 5\%\ V_{g\ max}$.

1



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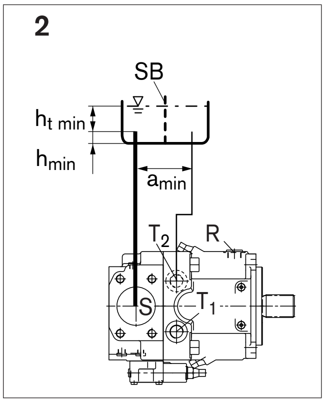

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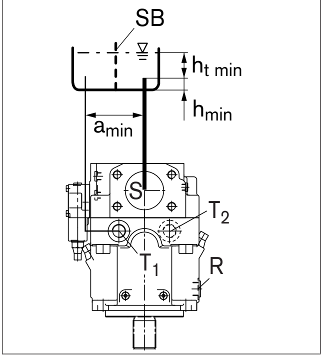

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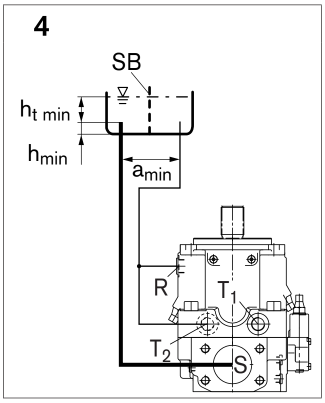

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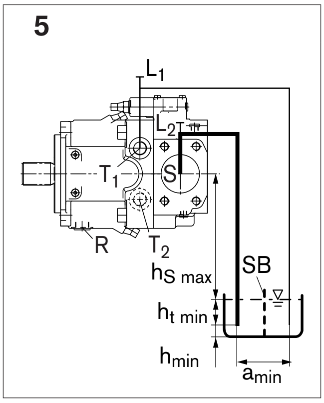

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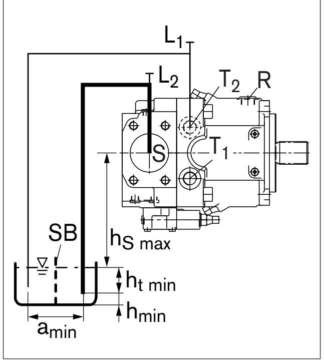

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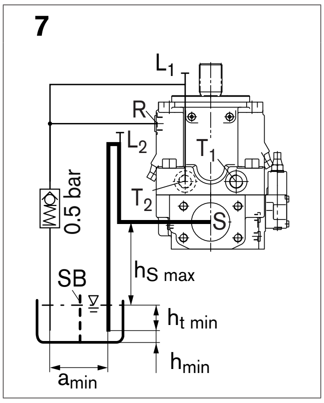


$h_{s\ max} = 800$ mm, $h_{t\ min} = 200$ mm, $h_{min} = 100$ mm, SB = Silencer plate (baffle plate)

When designing the tank, ensure adequate space a_{min} between the suction line and the case drain line to prevent the heated, returned fluid from being directly drawn back out.

Installation position	Air bleeding	Filling
1	T_1	$S + T_1$
2	R	$S + T_2$
3	T_1/T_2	$S + T_1/T_2$
4	R	$S + T_1/T_2$

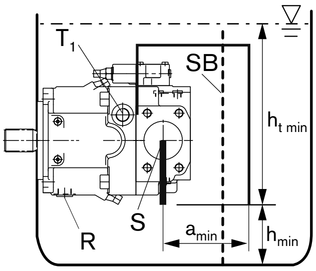
Installation position	Air bleeding	Filling
5	$L_1 + L_2$	L_2 (S) + L_1 (T_1)
6	R + L_2	L_2 (S) + L_1 (T_2)
7	$L_1 + L_2$	L_2 (S) + L_1 (T_1/T_2)

Installation Notes

Tank installation

Pump below the minimum fluid level in the tank.

8



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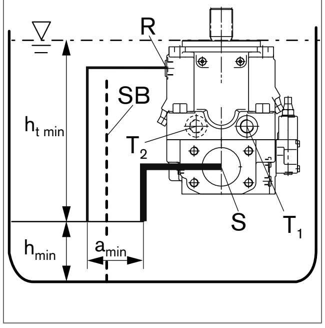

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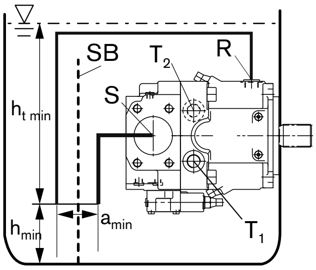

$h_{s\ max} = 800$ mm, $h_{t\ min} = 200$ mm, $h_{min} = 100$ mm,
SB = Silencer plate (baffle plate)

When designing the tank, ensure adequate space a_{min} between the suction line and the case drain line to prevent the heated, returned fluid from being directly drawn back out.

Installation position	Air bleeding	Filling
8	T_1	automatically via all open T_1, T_2, R and S ports, though position below the hyraulic fluid level
9	R	
10	R	

Notice

General Notes

- The A11VO pump is designed to be used in open circuits.
- Project planning, assembly and commissioning of the axial piston unit require the involvement of qualified personnel.
- The service line ports and function ports are only designed to accommodate hydraulic lines.
- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e. g. by wearing protective clothing).
- Depending on the operational state of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Pressure ports:
  The ports and fixing threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
- The data and notes contained herein must be adhered to.
- The following tightening torques apply:
  - Threaded hole for axial piston unit:
    The maximum permissible tightening torques $M_{G\,max}$ are maximum values for the threaded holes and must not be exceeded. For values, see the following table.
  - Fittings:
    Observe the manufacturer's instruction regarding the tightening torques of the used fittings.
  - Fixing screws:
    For fixing screws according to DIN 13, we recommend checking the tightening torque individually according to VDI 2230.
  - Locking screws:
    For the metal locking screws supplied with the axial piston unit, the required tightening torques of locking screws M_V apply. For values, see the following table.
- The product is not approved as a component for the safety concept of a general machine according to DIN EN ISO 13849.

Thread size		**Max. permissible tightening torque of the screw thread M_{Gmax}**	**Required tightening torque for locking screws M_V**	**WAF Hexagon socket**
M12x1.5	DIN 3852	50 Nm	25 Nm	6 mm
M14x1.5	DIN 3852	80 Nm	35 Nm	6 mm
M22x1.5	DIN 3852	210 Nm	80 Nm	10 mm
M26x1.5	DIN 3852	230 Nm	120 Nm	12 mm
M33x2	DIN 3852	540 Nm	310 Nm	17 mm

Axial piston variable pump
A11V(L)O Series 40

- Sizes 110 to 280
- Nominal pressure 350 bar (5100 psi)
- Maximum pressure 420 bar (6100 psi)
- Open circuit

Features

- Variable pump with axial piston rotary group in swashplate design for hydrostatic drives in open circuit.
- For use preferably in mobile applications
- Flow is proportional to the drive speed and displacement.
- The flow can be infinitely varied by adjusting the swashplate angle.
- The pump can work either self-priming or with a charge pump.
- Special control devices program for mobile applications, with different control and regulation functions.
- The universal through drive is suitable for adding gear pumps and axial piston pumps up to the same size, i.e. 100% through drive.
- Compact design
- High efficiency
- High power density
- Low noise level

Content

Ordering code

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A11V										**/**	**40**						**1**			**0**	**–**	

Axial piston unit

01	Variable swashplate design, nominal pressure 350 bar (5100 psi), maximum pressure 420 bar (6100 psi)	**A11V**

Operating mode

			110	**145**	**175**	**210**	**280**	
02	Pump, open circuit	without charge pump	●	●	●	●	●	**O**
		with charge pump	–	●	●	●	●	**LO**

Size (NG)

03	Geometric displacement	cm^3	**110**	**145**	**175**	**210**	**280**
	See the table of values, page 8	in^3	**6.71**	**8.85**	**10.68**	**12.81**	**17.09**

Control devices: basic controller[1]

					110	**145**	**175**	**210**	**280**	
04	Power controller	fixed setting			●	●	●	●	●	**LR**
		override electric-proportional	negative control	U = 12 V	●	●	●	●	●	**L3**
				U = 24 V	●	●	●	●	●	**L4**
		hydraulic-proportional,	negative control		●	●	●	●	●	**L5**
			positive control		●	●	●	●	●	**L6**
	Summation power controller	override hydraulic proportional, high pressure	negative control	with stop	●	●	●	●	●	**CR**
				without stop	●	●	●	●	●	**PR**
	Stroke control[2]	electric-proportional	positive control	U = 12 V	●	●	●	●	●	**E1**
				U = 24 V	●	●	●	●	●	**E2**
		hydraulic-proportional, control pressure	negative control	Δp = 25 bar (365 psi)	●	●	●	●	●	**H3**
			positive control		●	●	●	●	●	**H4**
	Pressure control with one-side swiveling	fixed setting			●	●	●	●	●	**DR**
		remote controlled hydraulically	positive control		●	●	●	●	●	**DG**
		electric-proportional with integrated pilot valve for external pilot pressure supply	positive control	U = 24 V	○	○	○	○	○	**D2**[3]
	Pressure control with two-side swiveling	electric-proportional with integrated pilot valve for external pilot pressure supply	positive control	U = 24 V	○	○	○	○	○	**M2**[3]

Additional control: Pressure control

				110	**145**	**175**	**210**	**280**	
05	Without additional control (without symbol)			●	●	●	●	●	
	Pressure control with one-side swiveling	fixed setting		●	●	●	●	●	**DR**
		remote controlled hydraulically	positive control	●	●	●	●	●	**DG**

Additional control: stroke control or unloading

					110	**145**	**175**	**210**	**280**	
06	Without additional control (without symbol)				●	●	●	●	●	
	Stroke control[4]	electric-proportional	positive control	U = 12 V	●	●	●	●	●	**E1**
				U = 24 V	●	●	●	●	●	**E2**
		hydraulic-proportional, control pressure	negative control	Δp = 25 bar (365 psi)	●	●	●	●	●	**H3**
			positive control		●	●	●	●	●	**H4**

Additional control: load sensing

		110	**145**	**175**	**210**	**280**	
07	Without additional control (without symbol)	●	●	●	●	●	
	Load sensing, internal pump pressure, fixed setting	●	●	●	●	●	**S0**

● = Available ○ = On request – = Not available

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[1] The basic controller (04) can be combined with at most two additional controllers (05, 06, 07)

[2] The stroke control systems can be combined with either pressure controllers or load sensing controllers. A combination of all three controllers is not possible.

[3] Not combinable with other controllers

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A11V										**/**	**40**						**1**			**0**	**–**	

Depressurized basic position and external control pressure supply

		110	145	175	210	280	
08	Maximum swivel angle ($V_{g\ max}$)						
	Without external control pressure supply (standard for power and pressure controllers)	●	●	●	●	●	**A**
	With external control pressure supply (integrated shuttle valve, standard for negative stroke control)	●	●	●	●	●	**B**
	Minimum swivel angle ($V_{g\ min}$)						
	With external control pressure supply (integrated shuttle valve, standard for positive stroke control)	●	●	●	●	●	**C**

Connectors for solenoids[4]

		110	145	175	210	280	
09	Without connector (without solenoid, only for hydraulic control)	●	●	●	●	●	**0**
	DEUTSCH - molded connector, 2-pin, without suppressor diode	●	●	●	●	●	**P**
	AMP connector (Junior-Timer), 2-pin (only for D2/M2 controller)	○	○	○	○	○	**S**

Swivel angle sensor

			110	145	175	210	280	
10	Without swivel angle sensor		●	●	●	●	●	**0**
	With electric swivel angle sensor[5] as per data sheet 95150	Power supply 5 V DC	●	●	●	●	●	**B**
		Power supply 8 V – 32 V DC	●	●	●	●	●	**K**

Series

11	Series 4, index 0	**40**

Configuration of port and fastening threads

12	Metric, all fastening threads according to DIN 13, all port threads with O-ring seal according to ISO 6149	**M**
	ANSI, all fastening threads according to ASME B1.1, all port threads with O-ring seal according to ISO 11926	**A**

Direction of rotation

			110	145	175	210	280	
13	Viewed on drive shaft	clockwise	●	●	●	●	●	**R**
		counter-clockwise	●	●	●	●	●	**L**

Sealing material

		110	145	175	210	280	
14	FKM (fluor-caoutchouc)	●	●	●	●	●	**V**

Mounting flange

			110	145	175	210	280	
15	SAE J744	152-4	●	●	–	–	–	**D4**
		165-4	–	–	●	●	●	**E4**
	SAE J617	409-12	○	●	●	●	–	**G3**

Drive shaft (permissible input torque, see page 11)

			110	145	175	210	280	
16	Splined shaft ANSI B92.1a	1 3/4 in 13T 8/16 DP	●	●	●	●	–	**T1**
		2 in 15T 8/16 DP	–	●	●	●	–	**T2**
		2 1/4 in 17T 8/16 DP	–	–	–	–	●	**T3**
	Splined shaft DIN 5480	W45x2x21x9g	●	–	–	–	–	**A1**
		W50x2x24x9g	–	●	●	●	–	**A2**
		W60x2x28x9g	–	–	–	–	●	**A4**

Working port

17	SAE flange port A, at side (45° right), SAE flange port S at bottom	**1**

Rotary group version

		110	145	175	210	280	
18	Noise-optimized for n = 1500/1800 rpm, version without charge pump	●	●	●	●	●	**E**
	Version with charge pump	–	●	●	●	●	**S**

● = Available ○ = On request – = Not available

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[4] Connectors for other electric components may deviate

[5] Please contact us if the swivel angle sensor is used for control

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21
A11V										**/**	**40**						**1**			**0**	**–**	

Through drives (for attachment options, see page 61)

19	Flange SAE J744			Hub for splined shaft[1]								
	Diameter	Attachment[2]	Designation	Diameter		Designation	**110**	**145**	**175**	**210**	**280**	
	82-2 (A)	⁘	A3	5/8 in	9T 16/32DP	S2	●	●	●	●	●	**A3S2**
				3/4 in	11T 16/32DP	S3	○	○	●	●	●	**A3S3**
	101-2 (B)	⁘	B3	7/8 in	13T 16/32DP	S4	●	●	●	●	●	**B3S4**
				1 in	15T 16/32DP	S5	●	●	●	●	●	**B3S5**
		⋰	B5	7/8 in	13T 16/32DP	S4	●	●	●	●	●	**B5S4**
				1 in	15T 16/32DP	S5	○	○	●	●	○	**B5S5**
	127-2 (C)	⁘	C3	1 1/4 in	14T 12/24DP	S7	○	○	●	●	●	**C3S7**
				1 1/2 in	17T 12/24DP	S9	○	○	●	●	●	**C3S9**
		⋰	C5	1 1/4 in	14T 12/24DP	S7	○	–	●	●	●	**C5S7**
	127-4 (C)	⌘	C4	1 1/4 in	14T 12/24DP	S7	●	●	●	●	○	**C4S7**
				1 3/8 in	21T 16/32 DP	V8	○	○	○	○	○	**C4V8**
	152-4 (D)	⌘	D4	1 1/4 in	14T 12/24DP	S7	○	○	○	○	○	**D4S7**
				1 3/8 in	21T 16/32 DP	V8	○	○	○	○	○	**D4V8**
				1 3/4 in	13T 8/16DP	T1	●	●	●	●	●	**D4T1**
	165-4 (E)	⌘	E4	1 3/4 in	13T 8/16DP	T1	–	–	●	●	●	**E4T1**
				2 in	15T 8/16DP	T2	–	–	●	●	●	**E4T2**
				2 1/4 in	17T 8/16DP	T3	–	–	–	–	●	**E4T3**
				W60x2x28x9g[3]		A4	–	–	–	–	●	**E4A4**
	Prepared for through drive, with pressure-proof plugged cover (also see data sheet 95581)						●	●	●	●	●	**U000**

Pressure sensors and other sensors

20	Without sensor	**0**

Standard/special version

21	Standard version	**0**
	Special version	**S**

● = Available ○ = On request – = Not available

Note

- ▶ Note the project planning notes on page 66.
- ▶ In addition to the ordering code, please specify the relevant technical data when placing your order.

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[1] According to ANSI B92.1a

[2] Mounting bores pattern viewed from through drive with control at top

[3] Hub N60x2x28x8H according to DIN 5480

Hydraulic fluids

The A11V(L)O variable pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)

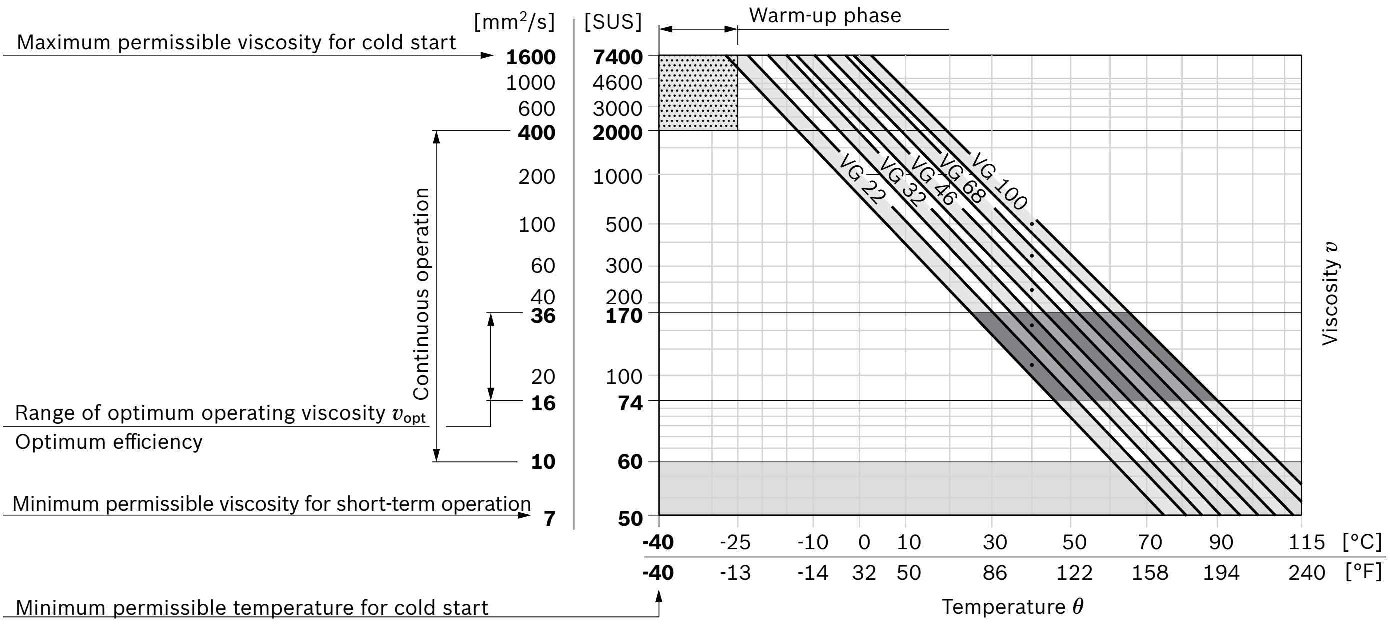
Notes on selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see selection diagram).

Notice
At no point of the component may the temperature be higher than 115 °C (240 °F). The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start/ Warm-up phase	ν = 1600 to 400 mm²/s (ν < 7400 to 1850 SUS)	θ = −40 °C to −25 °C (θ = −40 °F to −13 °F)	At low load (20 bar ≤ p 50 bar) n ≤ 1000 rpm
Permissible temperature difference		$\Delta T \leq$ 25 K (45 °F)	between axial piston unit and hydraulic fluid
Standard operating conditions and continuous operation at ν_{opt}	ν = 400 to 10 mm²/s (ν = 1850 to 60 SUS)	θ = −25 °C to +110 °C (θ = −13 °F to +230 °F)	This corresponds, for example on the VG 46, to a temperature range of +5 °C (41 °F) to +85 °C (185 °F) (see selection diagram) measured at port **T** observe the permissible temperature range of the shaft seal ring (ΔT = about 5 K (9 °F) between bearing/shaft seal ring and port **T**)
	ν_{opt} = 36 to 16 mm²/s (ν_{opt} = 170 to 74 SUS)	θ = −25 °C to +110 °C (θ = −13 °F to +230 °F)	optimal operating viscosity and efficiency measured at port **T**
Short-term operation	$\nu_{min} \geq$ 7 mm²/s (50 SUS)		t < 3 min, p < 0.3 × p_{nom}

▼ **Selection diagram**



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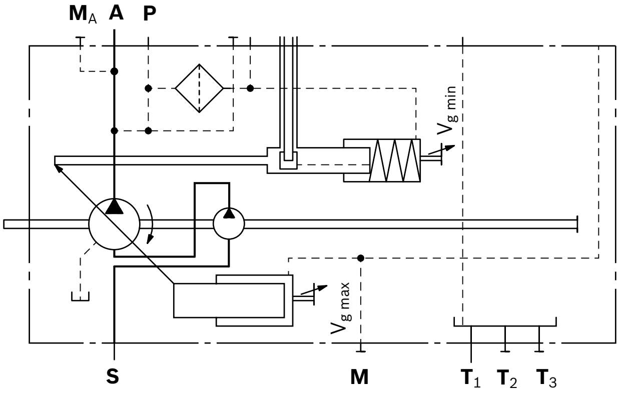
1) At temperatures below −25 °C (−13 °F) an NBR shaft seal is required (permissible temperature range −40 °C to +90 °C (−40 °F to +195 °F)), please contact us (ordering code 14, letter K).

Filtration of the hydraulic fluid
Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.
A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.
At very high hydraulic fluid temperatures (90 °C (195 °F) to maximum 115 °C (240 °F)), a cleanliness class of at least 19/17/14 according to ISO 4406 is necessary.
Please contact us if the above classes cannot be observed.

Charge pump (impeller)

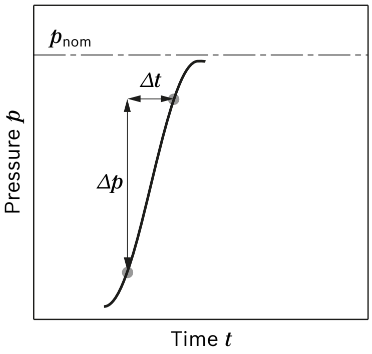
The charge pump is a circulating pump with which the A11VLO is filled and therefore can be operated at higher speeds. This also simplifies cold starting at low temperatures and high viscosity of the hydraulic fluid. Externally increasing the inlet pressure is therefore unnecessary in most cases. Charging the reservoir with compressed air is not permissible.



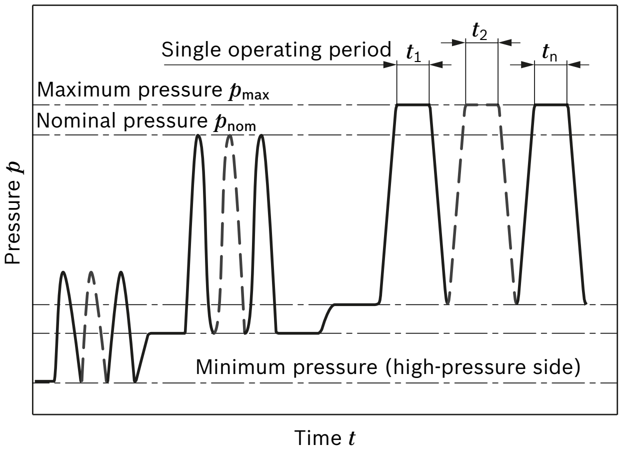
Operating pressure range

Pressure at working line port A		**Definition**
Nominal pressure p_{nom}	350 bar (5100 psi)	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	420 bar (6100 psi)	The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure $p_{\text{A abs}}$ (High-pressure side)		Minimum pressure at the high-pressure side (**A**) which is required in order to prevent damage to the axial piston unit. The minimum pressure depends on the rotational speed and the swivel angle (see diagram).
Rate of pressure change $R_{\text{A max}}$	16000 bar/s (232000 psi/s)	Maximum permissible rate of pressure build-up and reduction during a pressure change across the entire pressure range.
Pressure at suction port S (inlet)		
Version without charge pump		Minimum pressure at suction port **S** (inlet) that is required in order to avoid damage to the axial piston unit. The minimum pressure depends on the speed and displacement of the axial piston unit.
Minimum pressure $p_{\text{S min}}$	≥ 0.8 bar (12 psi) absolute	
Maximum pressure $p_{\text{S max}}$	≤ 30 bar (435 psi)	
Version with charge pump		
Minimum pressure $p_{\text{S min}}$	≥ 0.7 bar (10.5 psi) absolute	
Maximum pressure $p_{\text{S max}}$	≤ 2 bar (30 psi) absolute	
Case pressure at port T_1, T_2, T_3		
Maximum static pressure $p_{\text{L max}}$	3 bar (45 psi)	Maximum 1.2 bar (18 psi) higher than inlet pressure at port **S**, but not higher than $p_{\text{L max}}$. A case drain line to the reservoir is required.
Pressure peaks $p_{\text{L peak}}$	6 bar (90 psi)	t< 0.1s

▼ **Rate of pressure change $R_{\text{A max}}$**

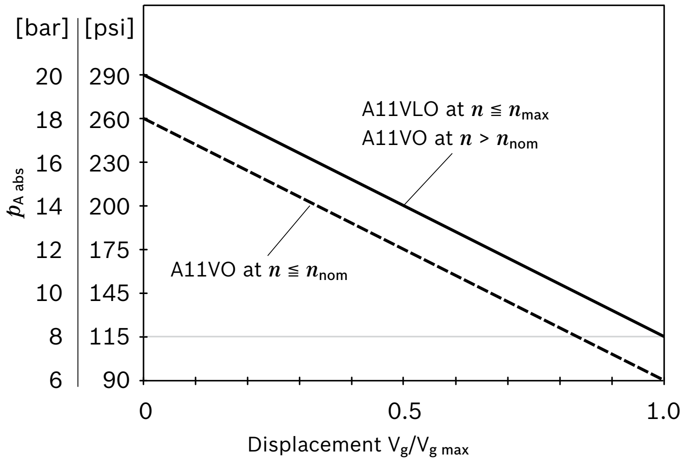


▼ **Pressure definition**



Total operating period = $t_1 + t_2 + \ldots + t_n$

▼ **Minimum pressure (high-pressure side)**



Notice

Operating pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical data

Without charge pump (A11VO)

Size			NG		110	145	175	210	280
Displacement, geometric, per revolution			$V_{g\ max}$	cm³	110.0	145.0	175.0	210.0	280.0
				in³	6.71	8.85	10.68	12.81	17.09
			$V_{g\ min}$	cm³	0	0	0	0	0
				in³	0	0	0	0	0
Speed maximum[1]	at $V_{g\ max}$[2]		n_{nom}	rpm	2400	2300	2150	2100	1800
	at $V_g \leq V_{g\ max}$[3]		n_{max}	rpm	2800	2600	2500	2500	2300
Flow	at n_{nom} and $V_{g\ max}$		q_v	l/min	264	334	376	441	504
				gpm	70	88	99	117	133
Power	at n_{nom}, $V_{g\ max}$ and Δp = 350 bar (5100 psi)		P	kW	154	195	219	257	294
				hp	207	261	294	345	394
Torque	at $V_{g\ max}$ and Δp = 350 bar (5100 psi)[2]		T	Nm	613	808	975	1170	1560
				lb-ft	452	596	719	863	1151
Rotary stiffness of drive shaft	1 3/4 in 13T 8/16 DP	T1	c	kNm/rad	–	235	243	254	–
				lb-ft/rad	–	173327	179227	187340	–
	2 in 15T 8/16 DP	T2	c	kNm/rad	–	286	298	314	–
				lb-ft/rad	–	210942	219794	231595	–
	2 1/4 in 17T 8/16 DP	T3	c	kNm/rad	–	–	–	–	519
				lb-ft/rad	–	–	–	–	382795
	W45x2x21x9g	A1	c	kNm/rad	242	–	–	–	–
				lb-ft/rad	178489	–	–	–	–
	W50x2x24x9g	A2	c	kNm/rad	–	334	357	381	–
				lb-ft/rad	–	246345	263309	281011	–
	W60x2x28x9g	A4	c	kNm/rad	–	–	–	–	645
				lb-ft/rad	–	–	–	–	475727
Moment of inertia for rotary group			J_{TW}	kgm²	0.022	0.035	0.045	0.06	0.097
				lb-ft²	0.5221	0.8306	1.0679	1.4238	2.3019
Maximum angular acceleration[4]			α	rad/s²	7465	6298	5609	5014	4200
Case volume			V	l	2.2	2.7	3.6	4	6.5
				gal	0.58	0.71	0.95	1.06	1.72
Weight (without through drive) about			m	kg	64	79	97	111	143
				lbs	141	174	214	245	315

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[1] The values are applicable:
  - for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s (170 to 74 SUS)
  - with hydraulic fluid based on mineral oils

[2] The values apply at absolute pressure p_{abs} = 1 bar (15 psi) at suction port **S**.

[3] Maximum rotational speed (rotational speed limit) in the case of increasing the inlet pressure p_{abs} at suction port **S** and $V_g < V_{g\ max}$, see diagram on page 10.

[4] The data are valid for values between the minimum required and maximum permissible rotational speed. Valid for external excitation (e.g. diesel engine 2 to 8 times rotary frequency; cardan shaft twice the rotary frequency). The limit value is only valid for a single pump. The load capacity of the connecting parts must be considered.

With charge pump (A11VLO)

Size			NG		145	175	210	280
Displacement, geometric, per revolution			$V_{g\ max}$	cm³	145.0	175.0	210.0	280.0
				in³	8.85	10.68	12.81	17.09
			$V_{g\ min}$	cm³	0	0	0	0
				in³	0	0	0	0
Speed maximum[1]	at $V_{g\ max}$[2]		n_{nom}	rpm	2600	2500	2500	2300
	at $V_g \leq V_{g\ max}$[3]		n_{max}	rpm	2600	2500	2500	2300
Flow	at n_{nom} and $V_{g\ max}$		q_v	l/min	377	438	525	644
				gpm	100	116	139	170
Power	at n_{nom}, $V_{g\ max}$ and Δp = 350 bar (5100 psi)		P	kW	220	255	306	376
				hp	295	342	410	504
Torque	at $V_{g\ max}$ and Δp = 350 bar (5100 psi)[2]		T	Nm	808	975	1170	1560
				lb-ft	596	719	863	1151
Rotary stiffness of drive shaft	1 3/4 in 13T 8/16 DP	T1	c	kNm/rad	235	243	254	–
				lb-ft/rad	173327	179227	187340	–
	2 in 15T 8/16 DP	T2	c	kNm/rad	286	298	314	–
				lb-ft/rad	210942	219794	231595	–
	2 1/4 in 17T 8/16 DP	T3	c	kNm/rad	–	–	–	519
				lb-ft/rad	–	–	–	382795
	W50x2x24x9g	A2	c	kNm/rad	334	357	381	–
				lb-ft/rad	246345	263309	281011	–
	W60x2x28x9g	A4	c	kNm/rad	–	–	–	645
				lb-ft/rad	–	–	–	475727
Moment of inertia for rotary group			J_{TW}	kgm²	0.035	0.047	0.063	0.097
				lb-ft²	0.8306	1.0679	1.4238	2.3019
Maximum angular acceleration[4]			α	rad/s²	6298	5609	5014	4200
Case volume			V	l	2.9	3.6	3.7	5.6
				gpm	0.77	0.95	0.98	1.48
Weight (without through drive) about			m	kg	92	110	125	148
				lbs	203	243	276	326

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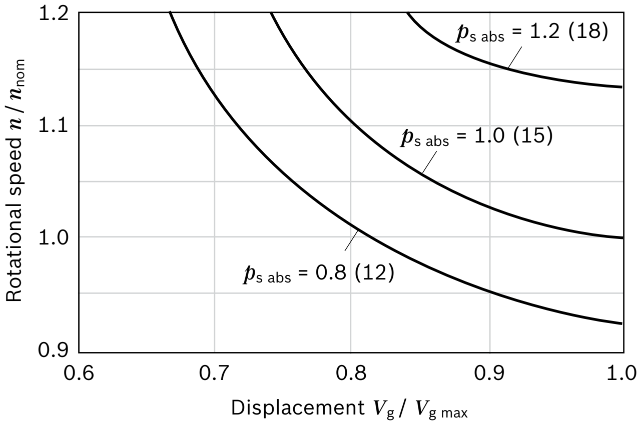
[1] The values are applicable:
  - for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s (170 to 74 SUS)
  - with hydraulic fluid based on mineral oils

[2] The values apply at absolute pressure p_{abs} = 1 bar (15 psi) at suction port **S**.

[3] Maximum rotational speed (rotational speed limit) in the case of increasing the inlet pressure p_{abs} at suction port **S** and $V_g < V_{g\ max}$, see diagram on page 10.

[4] The data are valid for values between the minimum required and maximum permissible rotational speed. Valid for external excitation (e.g. diesel engine 2 to 8 times rotary frequency; cardan shaft twice the rotary frequency). The limit value is only valid for a single pump. The load capacity of the connecting parts must be considered.

▼ **Maximum permissible rotational speed (rotational speed limit)**
($p_{S\,abs}$ = inlet pressure [bar (psi)])



Determining the operating characteristics		
Flow	$q_v = \frac{V_g \times n \times \eta_v}{1000}$	[l/min]
	$q_v = \frac{V_g \times n \times \eta_v}{231}$	[gpm]
Torque	$T = \frac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$	[Nm]
	$T = \frac{V_g \times \Delta p}{24 \times \pi \times \eta_{hm}}$	[lb-ft]
Power	$P = \frac{2\,\pi \times T \times n}{60000} = \frac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]
	$P = \frac{2\,\pi \times T \times n}{33000} = \frac{q_v \times \Delta p}{1714 \times \eta_t}$	[hp]

Key

V_g = Displacement per revolution [cm^3 (in^3)]

Δp = Differential pressure [bar (psi)]

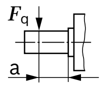
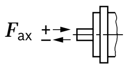
n = Rotational speed [rpm]

η_v = Volumetric efficiency

η_{hm} = Hydraulic-mechanical efficiency

η_t = Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

Permissible radial and axial forces of the drive shafts

Size	**NG**		**110**	**110**	**145**	**145**	**145**	**175**	**175**	**175**	**210**	**210**	**210**	**280**	**280**
Drive shaft			1 3/4 in	W45	1 3/4 in	2 in	W50	1 3/4 in	2 in	W50	1 3/4 in	2 in	W50	2 1/4 in	W60
Maximum radial force at distance a (from shaft collar)	$F_{q\,max}$	N	8000	8000	11000	11000	11000	12300	12300	14000	16925	16925	17000	18000	23600
		lb	1798	1798	2473	2473	2473	2765	2765	3147	3805	3805	3822	4046	5305
	a	mm	33.5	25	33.5	40	27.5	33.5	40	27	33.5	40	27	40	29
		in	1.32	0.98	1.32	1.57	1.08	1.32	1.57	1.06	1.32	1.57	1.06	1.57	1.14
Maximum axial force	+ $F_{ax\,max}$	N	1200	1200	1350	1350	1350	1400	1400	1400	1450	1450	1450	1800	1800
		lb	270	270	304	304	304	315	315	315	326	326	326	405	405
	− $F_{ax\,max}$	N	500	500	600	600	600	650	650	650	700	700	700	850	850
		lb	112	112	135	135	135	146	146	146	157	157	157	191	191

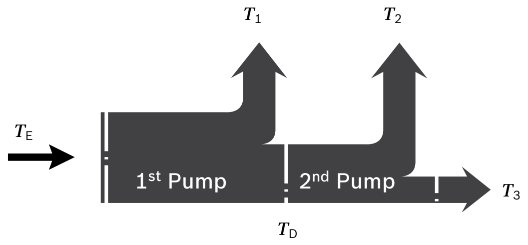
Note

- ▶ Theoretical values, without efficiency and tolerances; values rounded
- ▶ Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. We recommend testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.
- ▶ Special requirements apply in the case of belt drives. Please contact us.

Permissible input and through-drive torques

Size			NG		110	145	175	210	280
Torque at $V_{g\,max}$ and Δp = 350 bar (5100 psi)[1]			T_{max}	Nm	610	808	975	1170	1560
				lb-ft	452	596	719	863	1151
Input torque at drive shaft, maximum[2]									
	T1	1 3/4 in	$T_{E\,max}$	Nm	1640	1640	1640	1640	–
				lb-ft	1210	1210	1210	1210	–
	T2	2 in	$T_{E\,max}$	Nm	–	2670	2670	2670	–
				lb-ft	–	1969	1969	1969	–
	T3	2 1/4 in	$T_{E\,max}$	Nm	–	–	–	–	4380
				lb-ft	–	–	–	–	3231
	A1	W45	$T_{E\,max}$	Nm	2190	–	–	–	–
				lb-ft		–	–	–	–
	A2	W50	$T_{E\,max}$	Nm	–	3140	3140	3140	–
				lb-ft	–	2316	2316	2316	–
	A4	W60	$T_{E\,max}$	Nm	–	–	–	–	5780
				lb-ft	–	–	–	–	4263
Maximum through-drive torque			$T_{D\,max}$	Nm	960	1110	1340	1915	2225
				lb-ft	708	819	988	1412	1641

▼ **Distribution of the torques**



Torque at 1st pump	T_1		
Torque at 2nd pump	T_2		
Torque at 3rd pump	T_3		
Input torque	T_E	=	$T_1 + T_2 + T_3$
	T_E	<	$T_{E\,max}$
Through-drive torque	T_D	=	$T_2 + T_3$
	T_D	<	$T_{D\,max}$

External control pressure supply (ordering code digit 08 B and C)

Control systems with external control pressure supply need a flow appropriate to the adjustment time and size.

Size	Maximum flow [l/min (gpm)]
110	10 (2.64)
145	13 (3.43)
175	14 (3.70)
210	17 (4.49)
280	22 (5.81)

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[1] Efficiency not considered

[2] For drive shafts free of radial force

Power controller

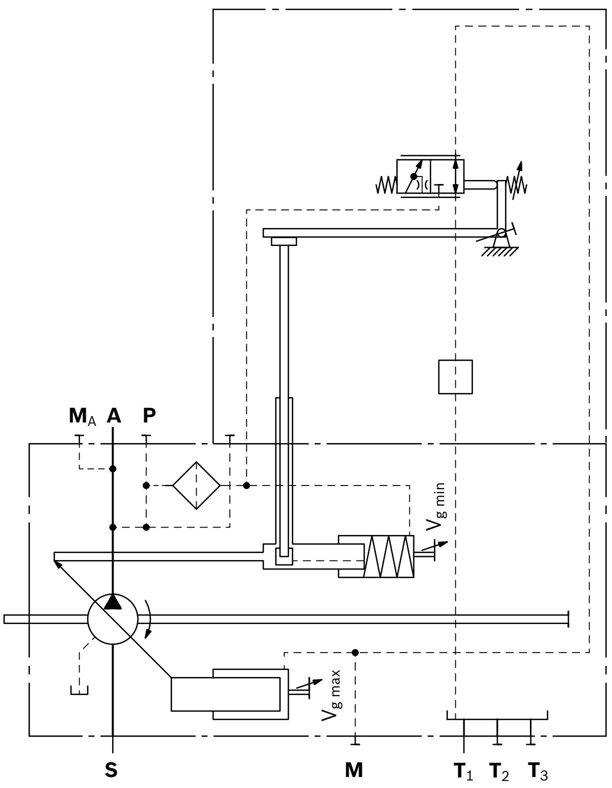
LR – Power controller, fixed setting

The power controller regulates the displacement of the pump depending on the operating pressure so that a given drive power is not exceeded at constant drive speed.
The precise control with a hyperbolic control characteristic, provides an optimum utilization of available power.
The operating pressure acts on a rocker via a measuring piston moved together with the control. An externally adjustable spring force counteracts this, it determines the power setting. The depressurized basic position is $V_{g\,max}$.
If the operating pressure exceeds the set spring force, the control valve will be actuated by the rocker and the pump will swivel back from the basic setting $V_{g\,max}$ toward $V_{g\,min}$.
Here, the leverage at the rocker may be shortened and the operating pressure may rise in the same relation as the displacement is reduced ($p_B \times V_g$ = constant; p_B = operating pressure; V_g = displacement).
The hydraulic output power (characteristic LR) is influenced by the efficiency of the pump.
Setting range for beginning of control 50 bar (725 psi) to 350 bar (5100 psi).
When ordering, state in plain text:

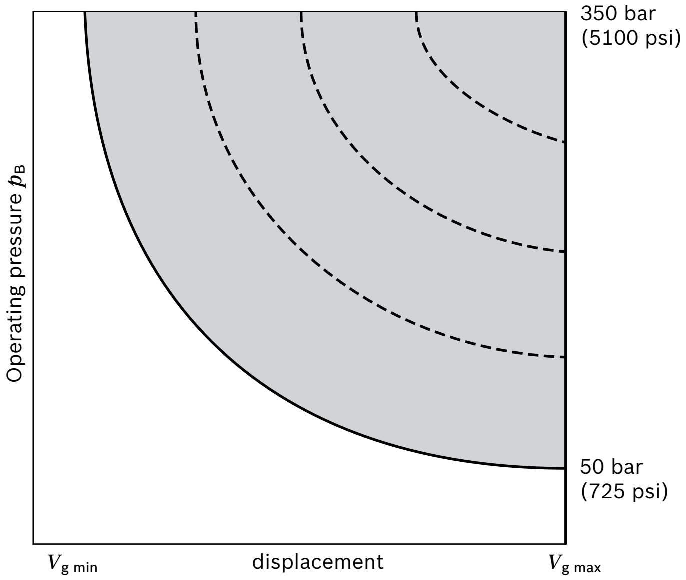
- Drive power P [kW]
- Drive speed n [rpm]
- Maximum flow $q_{V\,max}$ [l/min]

Please contact us if you need a power diagram.

▼ **Circuit diagram LR**



▼ **Characteristic LR**



L3/L4 – Power controller, electric-proportional override (negative control)

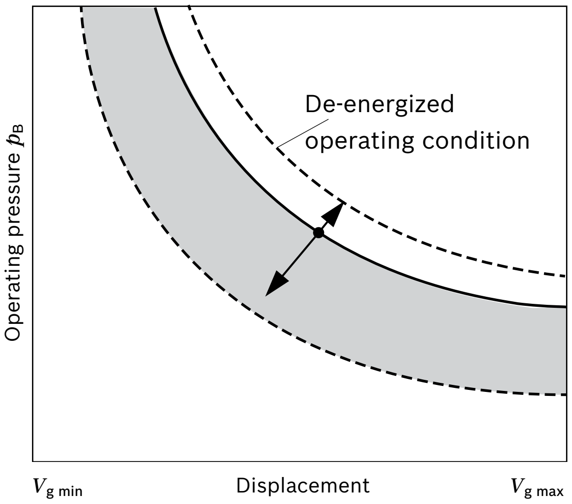
A control current acts against the adjustment spring of the power controller via a proportional solenoid.
The mechanically adjusted basic power setting can be reduced by means of different control current settings.
Increasing control current = reduced power.
If the pilot control signal is variably controlled via a load limiting control, the power draw of all consumers is adjusted to the power draw possible for the diesel engine (e.g. electronic load limiting control LLC (data sheet 95310) in BODAS controller RC2-2).

Technical data, solenoid	**L3**	**L4**
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Beginning of control	400 mA	200 mA
End of control	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C (68 °F))	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100%	100%
Type of protection: see connector version page 63		

When ordering, state in plain text:

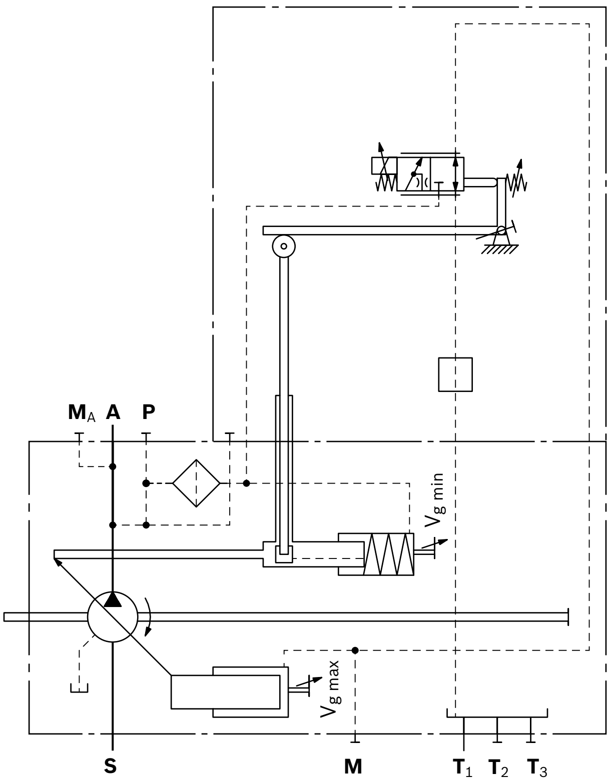
- Drive power P [kW (hp)] at beginning of control
- Drive speed n [rpm]
- Maximum flow $q_{\text{V max}}$ [l/min (gpm)]

▼ Effect of power override through current increase or de-energized operating condition



Notice
In operating condition **L3** de-energized (jump 400 to 0 mA): Power increase by a factor of 2 of the table values.
In operating condition **L4** de-energized (jump 200 to 0 mA): Power increase by a factor of 1 of the table values.

▼ Circuit diagram L3/L4



Reduction of power by control current to the proportional solenoids with **L3**[1)]

Power reduction/control current [kW (hp)/100 mA]

	Speed [rpm]		
Size	**1000**	**1500**	**1800**
110	6.1 (8.2)	9.2 (12.3)	11.0 (14.7)
145	7.4 (9.9)	11.1 (14.9)	13.3 (17.8)
175	8.4 (11.3)	12.6 (16.9)	15.1 (20.2)
210	9.4 (12.6)	14.1 (18.9)	16.9 (22.7)
280	11.4 (15.3)	17.1 (22.9)	20.5 (27.5)

Reduction of power by control current to the proportional solenoids with **L4**[1)]

Power reduction/control current [kW (hp)/100 mA]

	Speed [rpm]		
Size	**1000**	**1500**	**1800**
110	12.3 (16.5)	18.5 (24.8)	22.1 (29.6)
145	14.8 (19.8)	22.2 (29.8)	26.6 (35.7)
175	16.8 (22.5)	25.2 (33.8)	30.2 (40.5)
210	18.9 (25.3)	28.4 (38.1)	34.0 (45.6)
280	22.9 (30.7)	34.4 (46.1)	41.2 (55.3)

---

1) Values in the tables are reference points. Determination of the exact power override on request.

L5 – Power controller, hydraulic-proportional override (negative control)

A pilot pressure acts against the adjustment spring of the power controller via a valve.
The mechanically adjusted basic power setting can be reduced by means of different pilot pressure settings.
Increasing pilot pressure = reduced power.

- Maximum permissible pilot pressure $p_{St\ max}$ = 100 bar (1450 psi)

If the pilot pressure signal is adjusted by a load limiting control, the power reduction of all consumers is reduced to match the available power from the diesel engine.
Reduction of power by pilot pressure at port **L5**

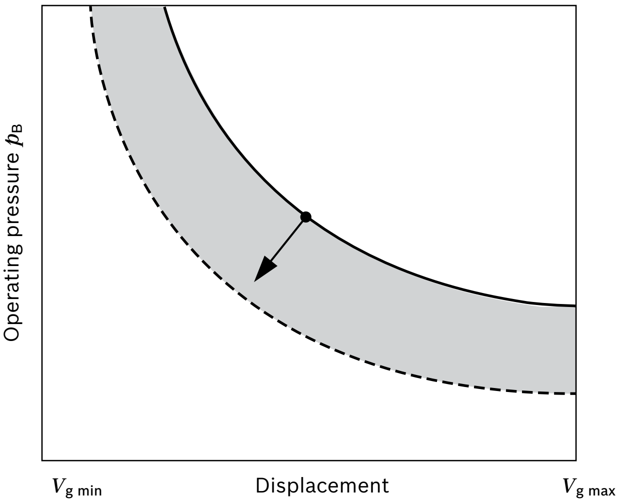
Power reduction/control current [kW (hp)/bar (psi)]

	Speed [rpm]		
Size	**1000**	**1500**	**1800**
110	2.3 (3.1)	3.5 (4.7)	4.1 (5.5)
145	2.8 (3.8)	4.2 (5.6)	5.0 (6.7)
175	3.2 (4.3)	4.8 (6.4)	5.8 (7.8)
210	3.6 (4.8)	5.4 (5.9)	6.5 (8.7)
280	4.4 (5.9)	6.6 (8.9)	7.9 (10.6)

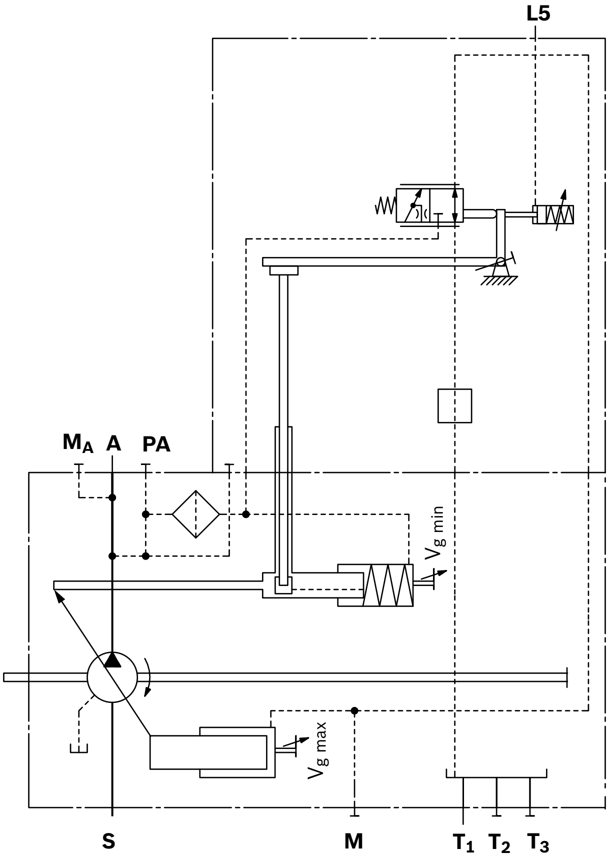
Values in the tables are reference points. Determination of the exact power override on request.
When ordering, state in plain text:

- Drive power P [kW (hp)] at a pilot pressure of p_{st} in **L5** of 5 bar (75 psi)
- Drive speed n [rpm]
- Maximum flow $q_{V\ max}$ [l/min (gpm)]

▼ **Effect of power override through pilot pressure increase**



▼ **Circuit diagram L5**



L6 – Power controller, hydraulic-proportional override (positive control)

A pilot pressure acts together with the adjustment spring of the power controller via a valve.
The mechanically adjusted basic power setting can be increased by means of different pilot pressure settings.
Increasing pilot pressure = increased power.

- Maximum permissible pilot pressure
  $p_{St\ max}$ = 100 bar (1450 psi)

If the pilot pressure signal is adjusted by a load limiting control, the power increase of all consumers is increased to match the available power from the diesel engine.
Power increase by pilot pressure at port **L6**

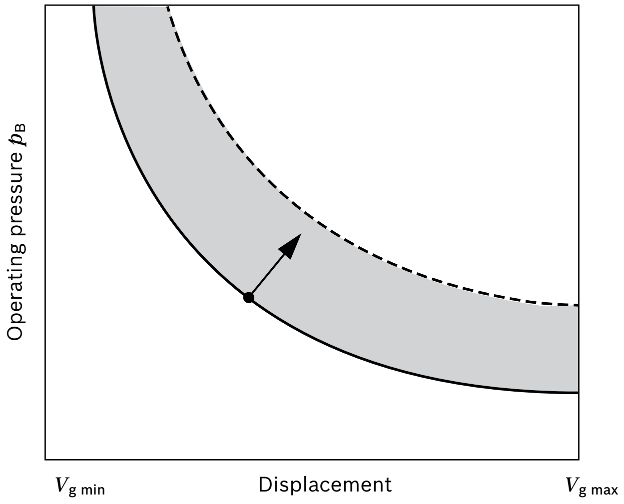
Power increase/pilot pressure [kW (hp)/bar (psi)]

	Speed [rpm]		
Size	**1000**	**1500**	**1800**
110	2.4 (3.2)	3.6 (4.8)	4.3 (5.8)
145	2.9 (3.9)	4.3 (5.8)	5.2 (7.0)
175	3.3 (4.4)	4.9 (6.6)	5.9 (7.9)
210	3.7 (5.0)	5.6 (7.5)	6.7 (9.0)
280	4.5 (6.0)	6.8 (9.1)	8.1 (10.9)

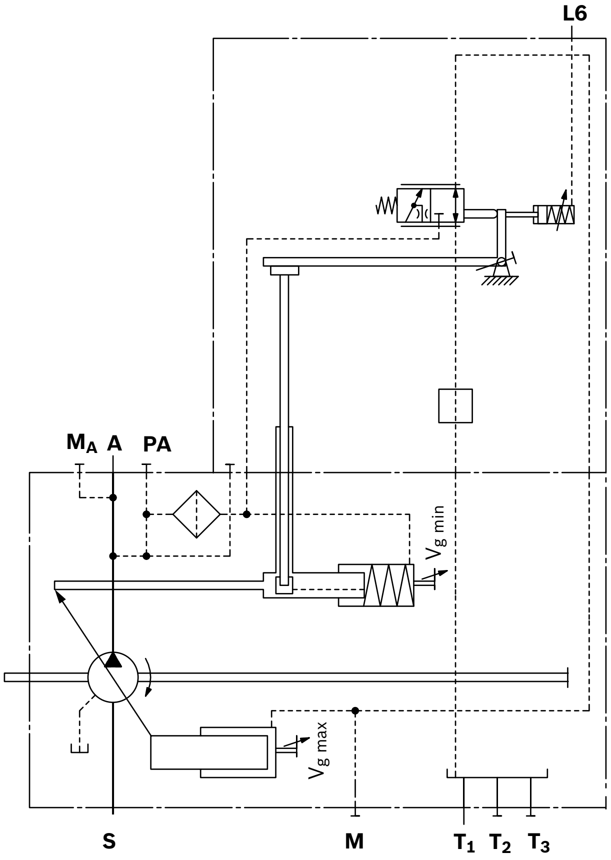
Values in the tables are reference points. Determination of the exact power override on request.
When ordering, state in plain text:

- Drive power P [kW (hp)] at a pilot pressure of p_{st} in **L6** of 5 bar (75 psi)
- Drive speed n [rpm]
- Maximum flow $q_{V\ max}$ [l/min (gpm)]

▼ **Effect of power override through pilot pressure increase**



▼ **Circuit diagram L6**

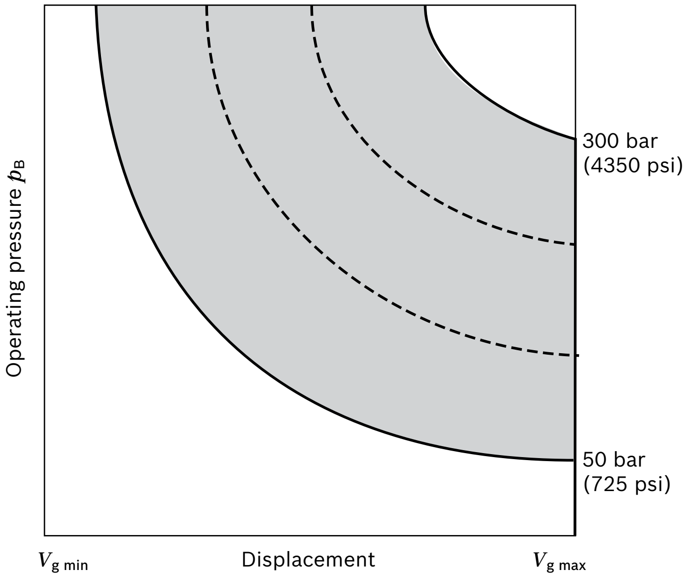


CR – Summation hp-control of two power-controlled pumps, high-pressure-related override (with stop)

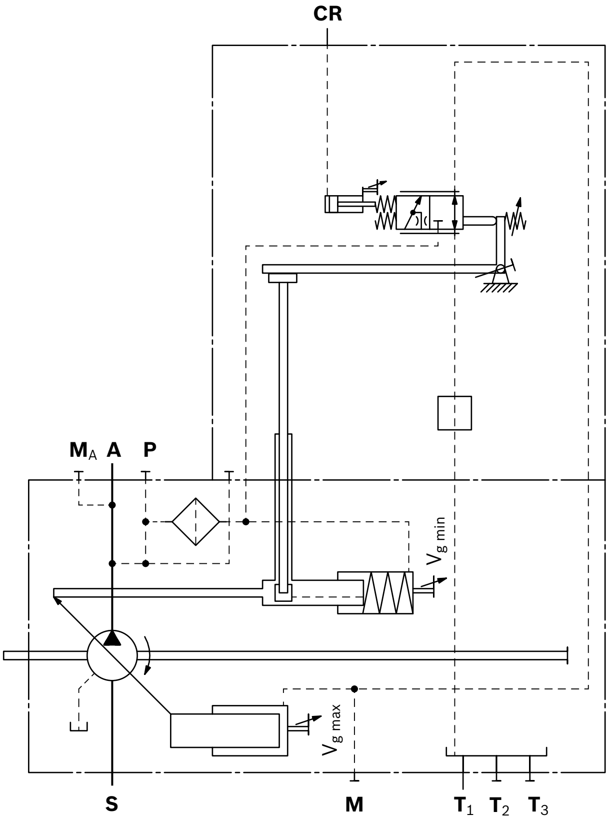
With two pumps of the same size working in different circuits, the CR controller limits the overall power.
The CR works like the normal LR with a fixed maximum power setting along the power hyperbola. The high-pressure-related override reduces the power setpoint in dependence on the operating pressure of the other pump. That happens proportionally below the beginning of control and is blocked by a stop when the minimum power is reached.
Here, the **CR** port of the one pump has to be connected to the $\mathbf{M}_A$ port of the other pump.
The maximum power of the first pump is reached when the second pump is working at idle when depressurized. When defining the maximum power, the idle power of the second pump has to be taken into account.
The minimum power of each pump is reached when both pumps are working at high pressure. The minimum power usually equates to 50% of the total power.
Power that is released by the pressure control or other overrides remains unconsidered.
Setting range for beginning of control 50 bar (725 psi) to 300 bar (4350 psi).
When ordering, please specify separately for each pump:

- Maximum drive power P_{max} [kW (hp)]
- Minimum drive power P_{min} [kW (hp)]
- Drive speed n [rpm]
- Maximum flow $q_{V\,\text{max}}$ [l/min (gpm)]

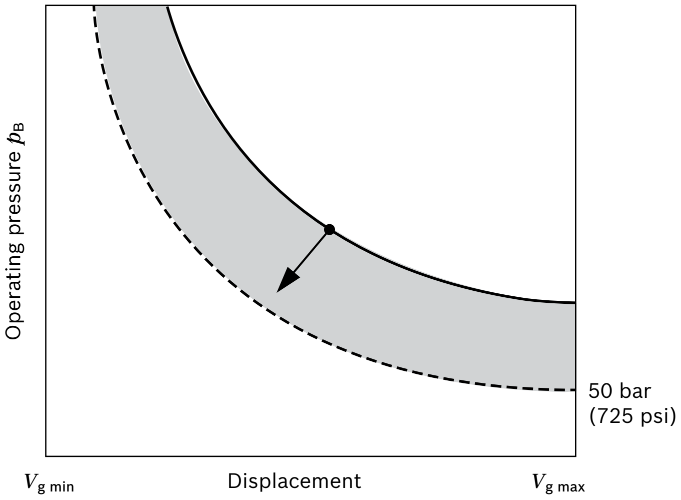
▼ **Characteristic CR**



▼ **Circuit diagram CR**



▼ **Effect of power override of a pump with increasing pressure in the 2nd pump**

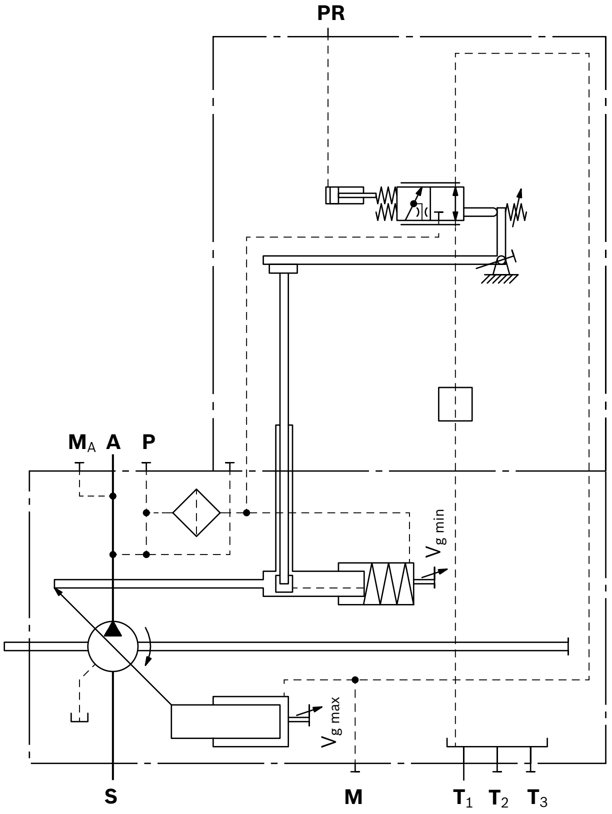


PR – Summation hp-control of two power-controlled pump and a constant pump

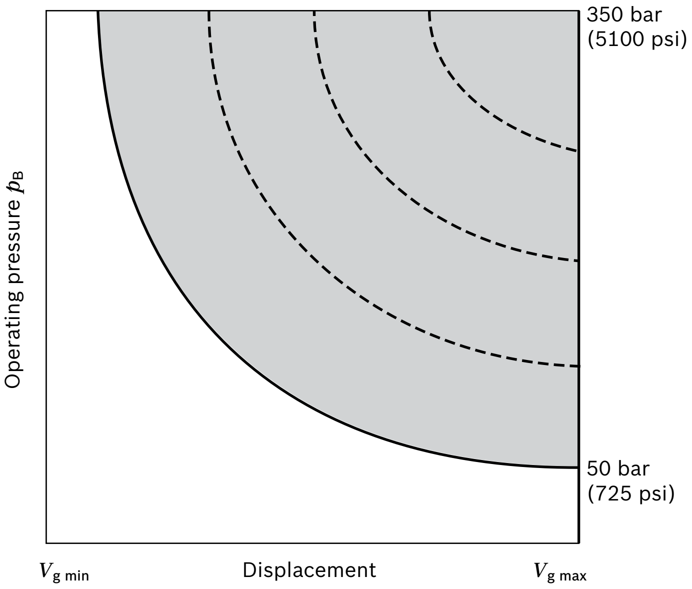
Together with the mounted fixed pump, the PR controller on an A11V(L)O effects a limitation of the overall power. The PR works like the normal LR with a fixed maximum power setting along the power hyperbola. The high-pressure-dependent override reduces the power specification in proportion to the operating pressure of the fixed pump. Here, port **PR** of the A11V(L)O must be connected to the operating pressure of the fixed pump. The power of the controlled pump can then be reduced to zero in a borderline case.
The maximum power of the controlled pump is reached when the fixed pump works at idle when depressurized. When defining the maximum power, the idle power of the fixed pump has to be taken into account.
Power that is released by the pressure control or other overrides remains unconsidered.
Setting range for beginning of control 50 bar (725 psi) to 350 bar (5100 psi).
When ordering, state in plain text:

- Maximum drive power P_{max} [kW (hp)]
- Drive speed n [rpm]
- Maximum flow $q_{\text{V max}}$ [l/min (gpm)]
- Size of the fixed pump

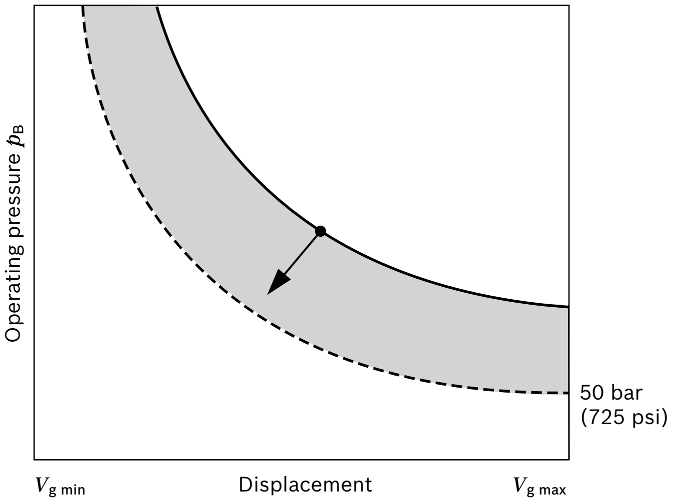
▼ **Circuit diagram PR**



▼ **Characteristic PR**



▼ **Effect of power override of a pump with increasing pressure in the 2nd pump**



Stroke control

E1/E2 – Stroke control, electric, proportional (positive control)

With the electrical stroke limiter with proportional solenoid, the pump displacement is steplessly adjusted in proportion to the current via the magnetic force.

Basic position without pilot signal is $V_{g\,min}$. Mechanically depressurized basic position is $V_{g\,min}$ (see ordering code position 08, letter C).

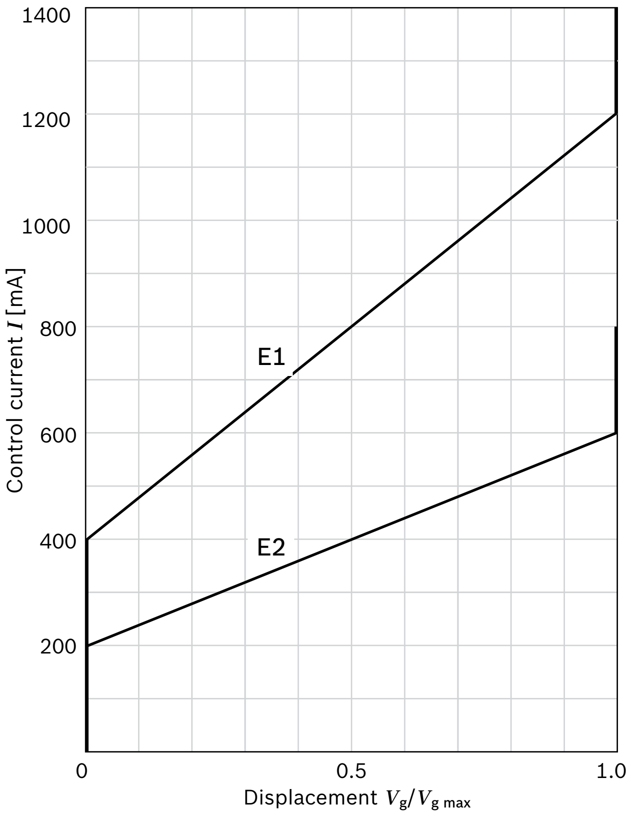
With increasing control current the pump swivels to a higher displacement (from $V_{g\,min}$ to $V_{g\,max}$).

The necessary control fluid is taken from the operating pressure or the external control pressure applied to port **P**. If the pump is to be adjusted from the basic position $V_{g\,min}$ or from a low operating pressure, port **P** must be supplied with an external control pressure of at least 30 bar (435 psi), maximum 50 bar (725 psi).

Notice

If there is no external control pressure applied to **P**, the version “Maximum swivel angle ($V_{g\,max}$), without external control pressure supply” must be ordered (see ordering code position 08, A).

▼ **Characteristic E1/E2**



Various BODAS controllers with application software and amplifiers are available for controlling the proportional solenoids.

- RC series 30, data sheet 95204
- RC series 30, data sheet 95205

Technical data, solenoid	E1	E2
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at $V_{g\,min}$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA[1]	600 mA[2]
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C (68 °F))	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100%	100%
Type of protection: see connector version page 63		

When ordering, state in plain text:

- Drive speed n [rpm]
- Maximum flow $q_{V\,max}$ [l/min (gpm)]
- Minimum flow $q_{V\,min}$ [l/min (gpm)]

See circuit diagram on page 19

Notice!

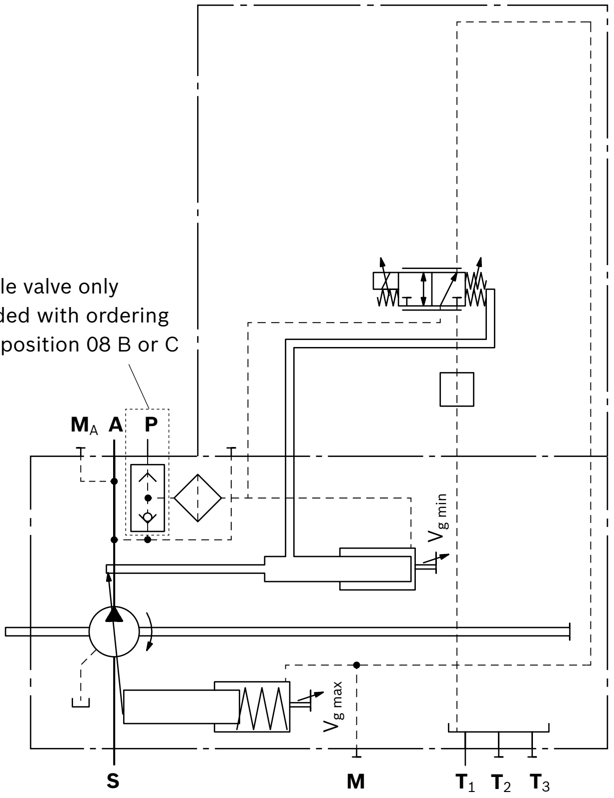
The spring feedback in the controller is not a security device. The controller can stick in an undefined position due to internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the flow of the axial piston unit will no longer respond correctly to the operator's commands. Check whether the application on your machine requires additional safety measures, in order to bring the driven consumer into a safe position (immediate stop). If necessary, make sure that these are properly implemented.

---

[1] Because of the control hysteresis, a control current of up to 1300 mA may be required for the $V_{g\,max}$ position.

[2] Because of the control hysteresis, a control current of up to 650 mA may be required for the $V_{g\,max}$ position.

▼ Circuit diagram E1/E2



Shuttle valve only included with ordering code position 08 B or C

H3 – Stroke control, hydraulic-proportional, pilot pressure (negative control)

With pilot-pressure-related control, the pump displacement is adjusted in proportion to the pilot pressure applied at port **H3**.

Basic position without pilot signal is $V_{g\,max}$. Mechanically depressurized basic position is $V_{g\,max}$ (see ordering code position 08, letter B).

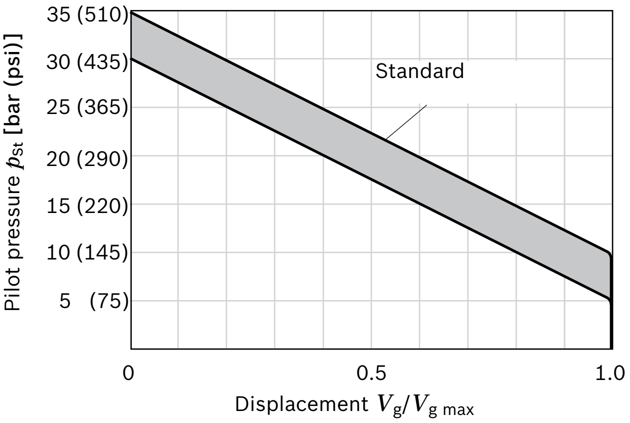
- Adjustment from $V_{g\,max}$ to $V_{g\,min}$; with increasing pilot pressure, the pump swivels to a smaller displacement.
- Setting range for beginning of control (at $V_{g\,max}$) 5 bar (75 psi) to 10 bar (145 psi), standard is 10 bar (145 psi). State beginning of control in plain text in the order.
- Maximum permissible pilot pressure $p_{St\,max}$ = 100 bar (1450 psi)

The necessary control fluid is taken from the operating pressure or the external control pressure applied to port **P**. If the pump is to be adjusted from the basic position $V_{g\,min}$ or from a low operating pressure, port **P** must be supplied with an external control pressure of at least 30 bar (435 psi), maximum 50 bar (725 psi).

Notice

If no external control pressure is applied to **P**, the version "Maximum swivel angle ($V_{g\,max}$), without external control pressure supply" is to be ordered (see ordering code position 08, letter A).

▼ **Characteristic H3 (negative)**

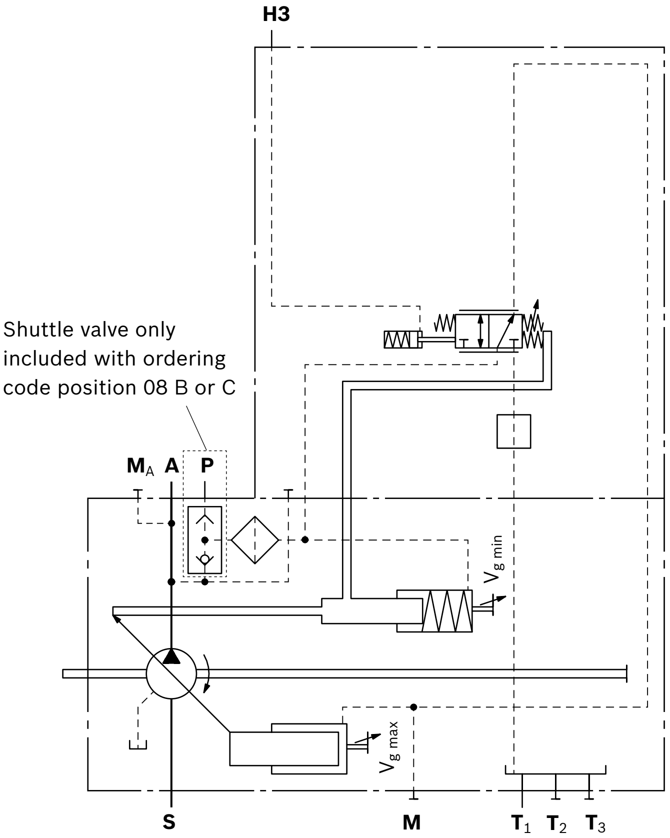


Increase in pilot pressure $V_{g\,max}$ to $V_{g\,min}$: Δp = 25 bar (365 psi)

When ordering, state in plain text:

- Beginning of control [bar (psi)] at $V_{g\,max}$

▼ **Circuit diagram H3**



Shuttle valve only included with ordering code position 08 B or C

H4 – Stroke control, hydraulic-proportional, pilot pressure (positive control)

With pilot-pressure-related control, the pump displacement is adjusted in proportion to the pilot pressure applied at port **H4**.

Basic position without pilot signal is $V_{g\,min}$. Mechanically depressurized basic position is $V_{g\,min}$ (see ordering code position 08, letter C).

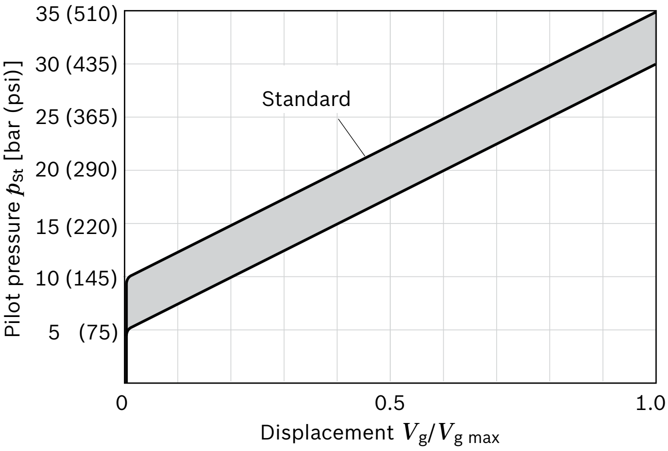
- Adjustment from $V_{g\,min}$ to $V_{g\,max}$; with increasing pilot pressure the pump swivels to a larger displacement.
- Setting range for beginning of control (at $V_{g\,min}$) 5 bar (75 psi) to 10 bar (145 psi), standard is 10 bar (145 psi). State beginning of control in plain text in the order.
- Maximum permissible pilot pressure $p_{St\,max}$ = 100 bar (1450 psi)

The necessary control fluid is taken from the operating pressure or the external control pressure applied to port **P**. If the pump is to be adjusted from the basic position $V_{g\,min}$ or from a low operating pressure, port **P** must be supplied with an external control pressure of at least 30 bar (435 psi), maximum 50 bar (725 psi).

Notice

If no external control pressure is applied to **P**, the version "Maximum swivel angle ($V_{g\,max}$), without external control pressure supply" is to be ordered (see ordering code position 08, letter A).

▼ **Characteristic H4 (positive)**

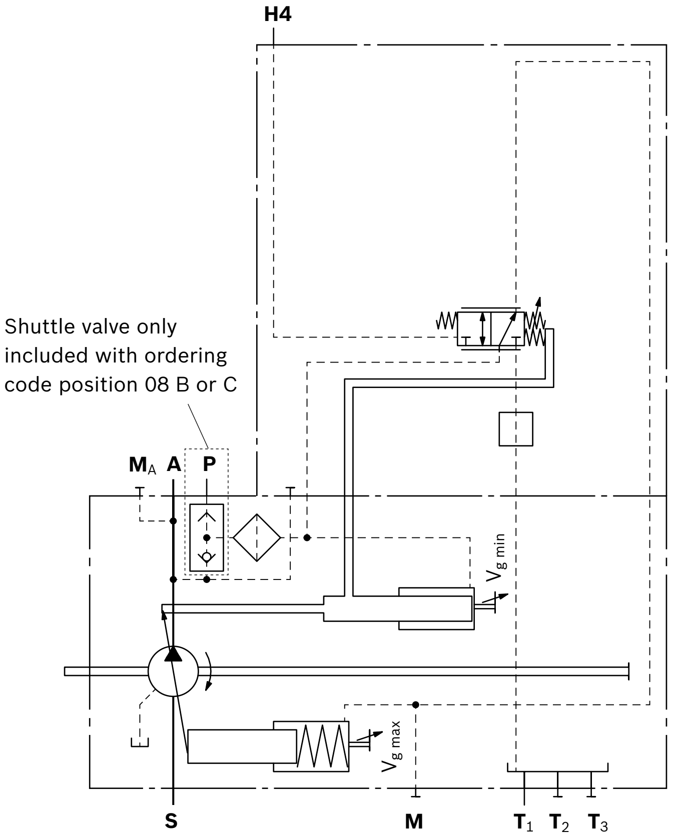


Increase in pilot pressure $V_{g\,min}$ to $V_{g\,max}$: Δp = 25 bar (365 psi)

When ordering, state in plain text:

- Beginning of control [bar (psi)] at $V_{g\,min}$

▼ **Circuit diagram H4**



Shuttle valve only included with ordering code position 08 B or C

Notice!

The spring feedback in the controller is not a security device. The controller can stick in an undefined position due to internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the flow of the axial piston unit will no longer respond correctly to the operator's commands. Check whether the application on your machine requires additional safety measures, in order to bring the driven consumer into a safe position (immediate stop). If necessary, make sure that these are properly implemented.

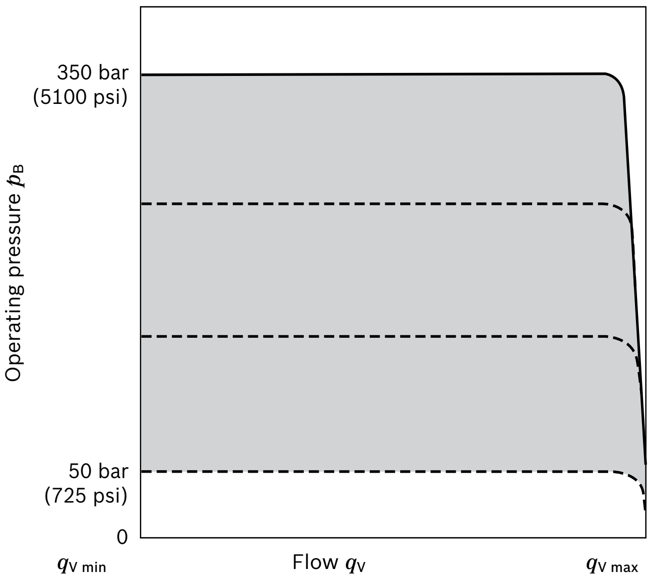
Pressure control

DR – Pressure controller with one-sided swiveling, fixed setting

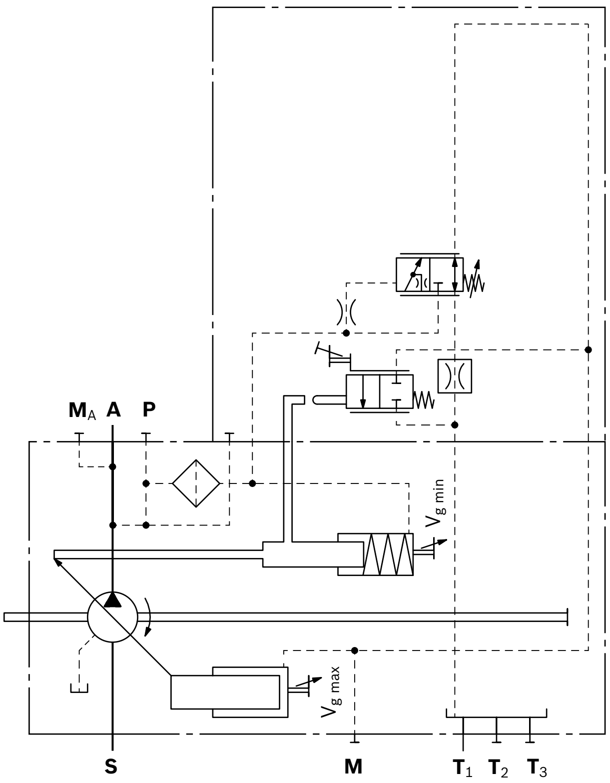
The pressure controller limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only supplies as much hydraulic fluid as is required by the consumers. If the operating pressure exceeds the pressure setting at the pressure valve, the pump will regulate to a smaller displacement to reduce the control differential.

- Initial position in depressurized state: $V_{g\ max}$
- Setting range for beginning of control 50 bar (725 psi) to 350 bar (5100 psi), 350 bar (5100 psi) is standard.

▼ **Characteristic curve DR**



▼ **Circuit diagram DR**



Hydraulic $V_{g\ min}$ stop

The hydraulic $V_{g\ min}$ stop opens the valve outlet to the case drain chamber when a minimum position is reached, damping the controller and reducing overshoot. This can cause a connection from high pressure or external control pressure via the controller and the hydraulic $V_{g\ min}$ stop to the case drain chamber.

When ordering, state in plain text:

- Pressure setting p [bar (psi)] at pressure controller DR

DRS0 – Pressure control with load sensing

The load sensing controller works as a load-pressure controlled flow controller and adjusts the displacement of the pump to the volume required by the consumer.

The flow of the pump is then dependent on the cross section of the external metering orifice (**1**), which is located between the pump and the consumer. Below the setting of the pressure controller and within the control range of the pump, the flow is not dependent on the load pressure.

The metering orifice is usually a separately located load sensing directional valve (control block). The position of the directional valve spool determines the opening cross-section of the metering orifice and thus the flow of the pump.

The load sensing controller compares pressure before and after the sensing orifice and keeps the pressure drop (differential pressure Δp) across the orifice – and therefore the flow – constant.

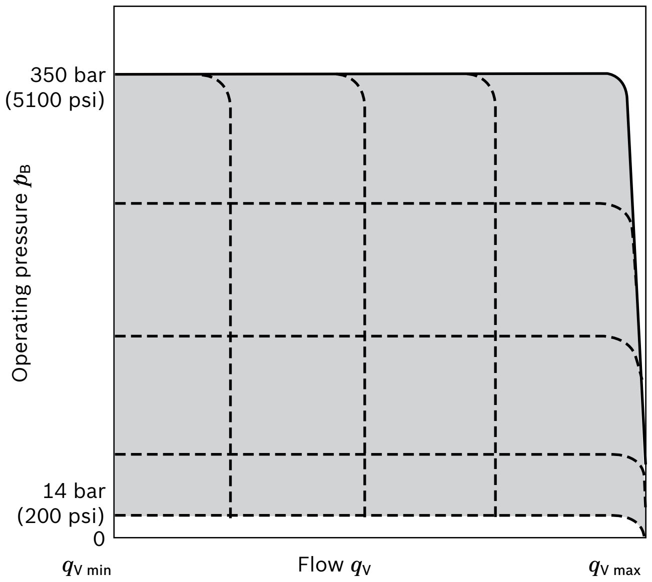
If the differential pressure Δp at the measuring orifice rises, the pump is swiveled back (toward $V_{\text{g min}}$). If the differential pressure Δp drops, the pump is swiveled out (toward $V_{\text{g max}}$) until equilibrium at the measuring orifice is restored.

$\Delta p_{\text{measuring orifice}} = p_{\text{pump}} - p_{\text{consumer}}$

- Setting range for Δp 14 bar (200 psi) to 30 bar (435 psi) (please state in plain text)
- Standard adjustment 14 bar (200 psi)

The stand-by pressure in zero stroke operation (metering orifice closed) is slightly higher than the Δp setting.

▼ **Characteristic DRS0**



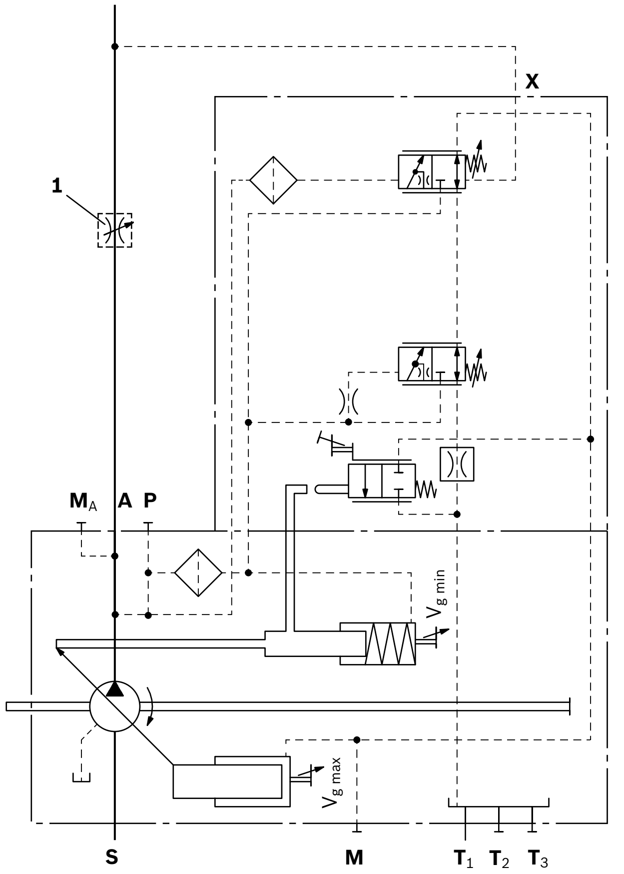
Hydraulic $V_{\text{g min}}$ stop

The hydraulic $V_{\text{g min}}$ stop opens the valve outlet to the case drain chamber when a minimum position is reached, damping the controller and reducing overshoot. This can cause a connection from high pressure or external control pressure via the controller and the hydraulic $V_{\text{g min}}$ stop to the case drain chamber.

When ordering, state in plain text:

- Pressure setting p [bar (psi)] at pressure controller DR
- Differential pressure Δp [bar (psi)] at load sensing controller S0

▼ **Circuit diagram DRS0**



1 The metering orifice (control block) is not included in the scope of delivery.

DG – Pressure control with one-sided deflection, hydraulically remote controlled (positive control)

The remote controlled pressure control has a fixed-setting Δp value. A separately connected pressure relief valve at port **X** (**1**) enables the pressure control to be remotely controlled.

- Setting range Δp 14 bar (200 psi) to 25 bar (365 psi)
- Recommended value 20 bar (290 psi) (standard)
- Control volume at **X**: about 1.6 l/min (0.42 gpm) (static) at Δp 20 bar (290 psi)

In addition a separately configured 2/2 directional valve (**2**) can be operated to start the pump with low operating pressure (standby pressure).

Both functions can be used individually or in combination (see circuit diagram).

The external valves are not included in the scope of supply.

As a separate pressure relief valve (**1**) we recommend:

- For DBD.6, see data sheet 25402

Hydraulic $V_{g\,min}$ stop

The hydraulic $V_{g\,min}$ stop opens the valve outlet to the case drain chamber when a minimum position is reached, damping the controller and reducing overshoot. This can cause a connection from high pressure or external control pressure via the controller and the hydraulic $V_{g\,min}$ stop to the case drain chamber.

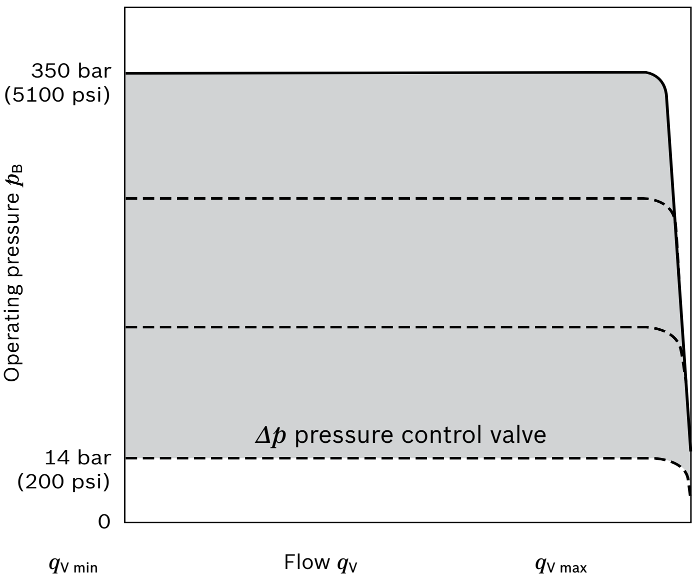
- Operating pressure p in bar (psi) (test pressure for DG)
- Differential pressure Δp in bar (psi)
- Drive speed n in rpm
- Maximum flow qV_{max} in l/min (gpm)

Note about setting of the remote control pressure control: The setting value for the external pressure relief valve plus the differential pressure value at the pressure control valve determines the level of pressure control.

Example:

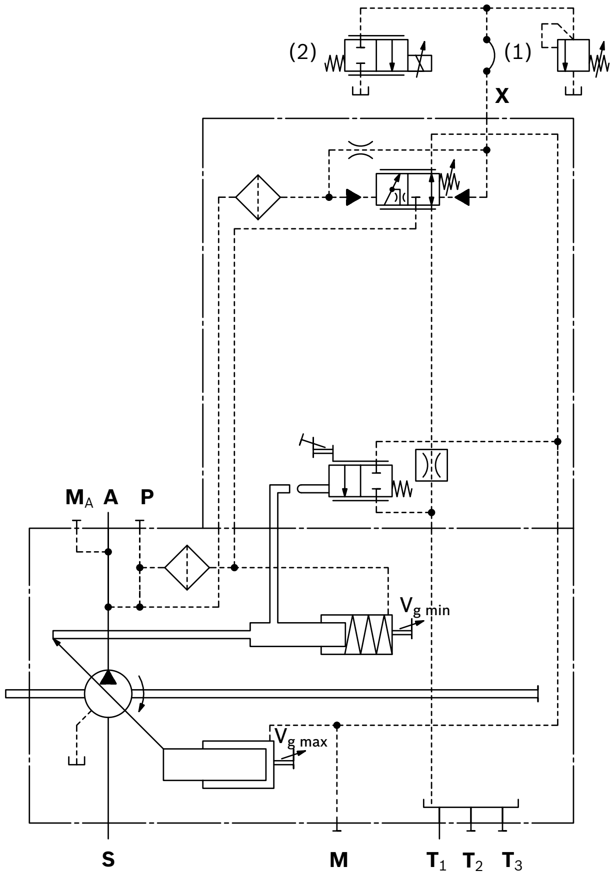
▶ external pressure relief valve	330 bar (4800 psi)
▶ Differential pressure at pressure control valve	20 bar (290 psi)
▶ resulting pressure control with	330 + 20 = 350 bar (4810 + 290 = 5100 psi)

▼ **Characteristic DG**



For function and description of pressure control DR, see page 22

▼ **Circuit diagram DG**



1 Pressure-relief valve (not included in the scope of supply)

2 2/2 directional valve (not included in the scope of supply)

D2 – Proportional pressure control with one-side swiveling, electric override (M2 with two-side swiveling) (positive control)

The pressure controller keeps the pressure in a hydraulic system constant within its control range even under varying flow conditions. The variable pump only supplies as much hydraulic fluid as is required by the consumers.
If the operating pressure exceeds the setting at the integrated pressure control valve, the pump is automatically swiveled back to reduce the control differential.

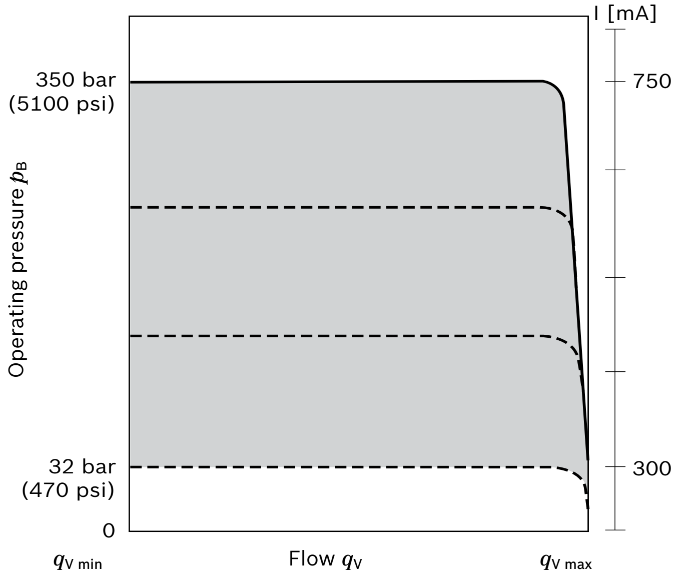
- Initial position in depressurized state: $V_{g\ max}$
- Pressure controller basic setting: 32 bar (470 psi)/300 mA

The basic setting of the pressure controller can be overridden. The pressure control value is proportional to the electrical current acting on the solenoids of the pressure reducing valve.

- Pressure setting overridden:
  32 bar (470 psi)/300 mA to 350 bar (5100 psi)/750 mA
- Auxiliary pressure for controlling D2 at port **Y**:
  p_{min} = 40 bar; p_{max} = 50 bar.
  Port **X** acts solely as a measuring port (p_{max} 50 bar). Pressurization leads to an impermissible increase in pressure.

Notice
Applying current above the limit of 750 mA to the proportional solenoid results in an impermissible increase in pressure.
Make sure that currents above the permissible limit are not applied to the proportional solenoid.

▼ **Characteristic D2**

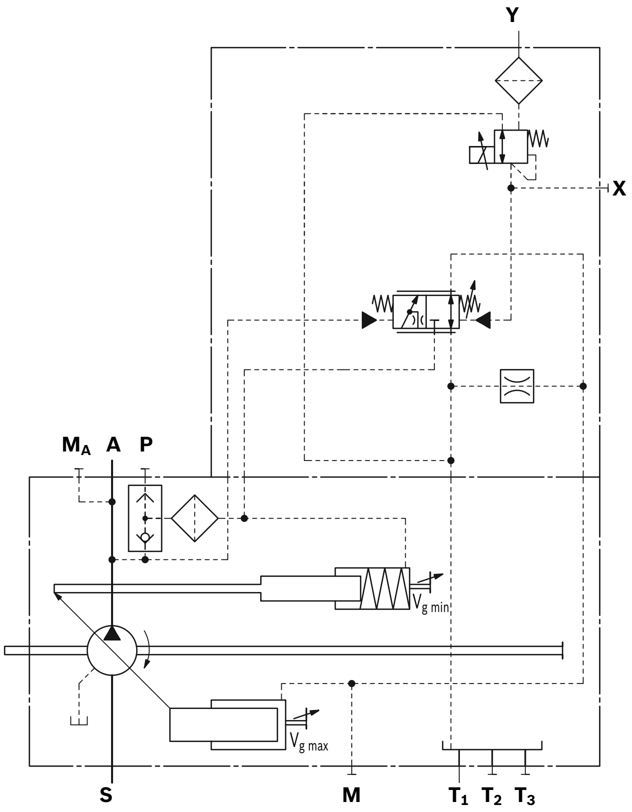


Technical data, solenoid	D2	D2
Voltage	24 V	24 V
Control current		
Beginning of control at $V_{g\ min}$		300 mA
End of control at $V_{g\ max}$		750 mA
Current limit	750 mA	750 mA
Nominal resistance (at 20 °C (68 °F))	12 Ω	12 Ω
Dither frequency	200 Hz	200 Hz
Duty cycle	100%	100 %
Type of protection: see connector version page 63		

The following electronic controllers and amplifiers are available for controlling the proportional solenoids:

BODAS RC controllers Series	Data sheet
20	95200
21	95201
22	95202
30	95203
and application software	95230
Analog amplifier RA	95230

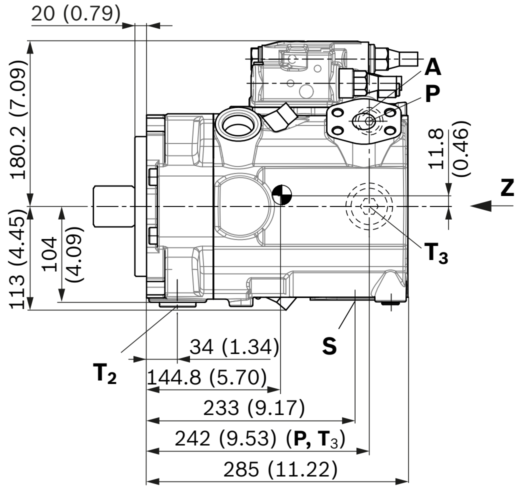
▼ **Circuit diagram D2**

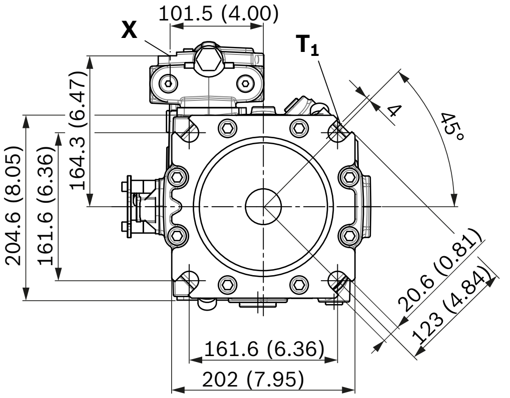


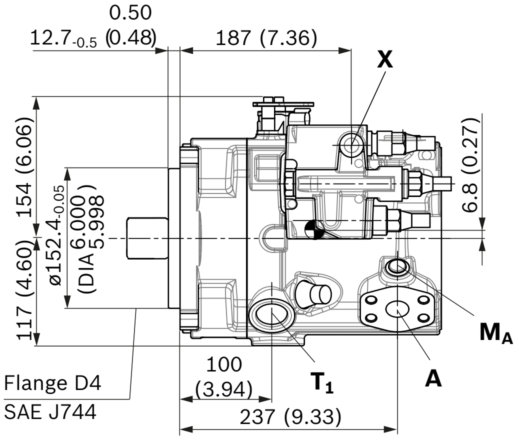
Dimensions size 110

LRDRS0 – Power controller with pressure controller, load sensing and with electric swivel angle sensor

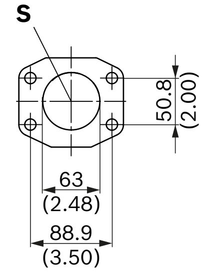
Without charge pump, clockwise rotation



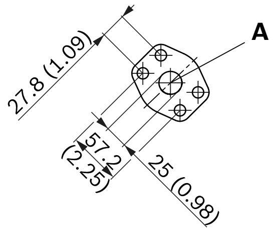


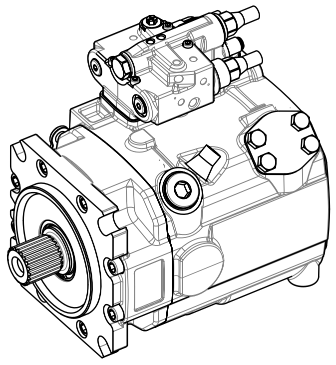


Detail X

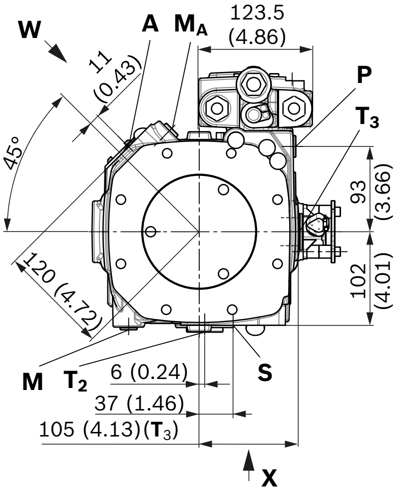


Detail W





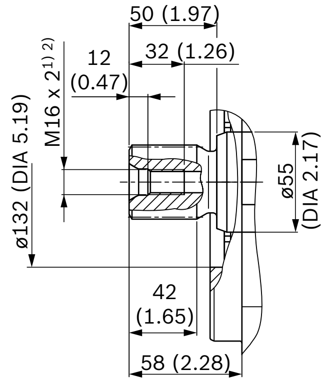
Detail Z



◐ Center of gravity

▼ Splined shaft DIN 5480

A1 – W45x2x21x9g



Ports – version “M” metric		Standard	Size[2]	$p_{\text{max abs}}$ [bar (psi)][3]	State[7]
A	Service line Fastening thread	SAE J518[4] DIN 13	1 in M12 × 1.75; 18 deep	420 (6100)	O
S	Suction port (without charge pump) Fastening thread	SAE J518[4] DIN 13	2 1/2 in M12 × 1.75; 18 deep	30 (435)	O
T_1	Drain port	ISO 6149[5]	M33 × 2; 19 deep	10 (145)	O[6]
T_2	Drain port	ISO 6149[5]	M33 × 2; 19 deep	10 (145)	X[6]
T_3	Drain port	ISO 6149[5]	M33 × 2; 19 deep	10 (145)	X[6]
CR	Pilot signal (CR only)	ISO 6149	M14 × 1.5; 11.5 deep	420 (6100)	O
PR	Pilot signal (PR only)	ISO 6149	M14 × 1.5; 11.5 deep	420 (6100)	O
H3, **H4**	Pilot signal (H3 and H4 only)	ISO 6149	M14 × 1.5; 11.5 deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	**ISO 6149**	M14 × 1.5; 11.5 deep	100 (1450)	O
X	Pilot signal (S0 and DG only)	ISO 6149[5]	M14 × 1.5; 11.5 deep	420 (6100)	O
M	Measuring, control pressure	ISO 6149[5]	M14 × 1.5; 12 deep	420 (6100)	X
M_A	Measuring, pressure A	ISO 6149[5]	M14 × 1.5; 12 deep	420 (6100)	X
P	External control pressure (Ordering code position 8 version B or C = with external control pressure supply)	ISO 6149[5]	M14 × 1.5; 11.5 deep	50 (725)	O
	Port **P** is without function (Ordering code position 8 version A = without external control pressure supply)	ISO 6149[5]	M18 × 1.5; 14.5 deep	420 (6100)	X

---

1) Center bore according to DIN 332 (thread according to DIN 13)

2) Observe the instructions in the operating instructions concerning the maximum tightening torques.

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Metric fastening thread is a deviation from standard.

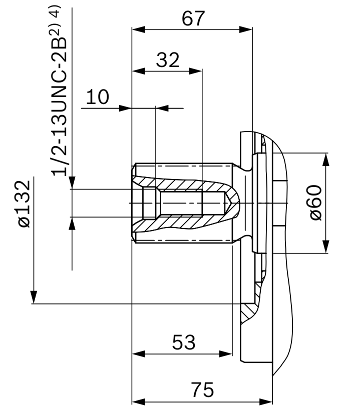
5) The countersink can be deeper than as specified in the standard.

6) Depending on installation position, T_1, T_2 or T_3 must be connected (see also Installation instructions on pages 64 and 65).

7) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

▼ Splined shaft SAE J744

T1 – 1 3/4 in 13T 8/16 DP[1]



Ports – version “A” SAE		**Standard**	**Size**[3]	$p_{\text{max abs}}$ **[bar (psi)]**[4]	**State**[7]
A	Service line Fastening thread	SAE J518 ASME B1.1	1 in 7/16-14UNC-2B; 19 (0.75) deep	420 (6100)	O
S	Suction port (without charge pump) Fastening thread	SAE J518 ASME B1.1	2 1/2 in 1/2-13UNC-2B; 19 (0.75) deep	30 (435)	O
T_1	Drain port	ISO 11926[5]	1 5/16UNF-2B; 20 (0.79) deep	10 (145)	O[6]
T_2	Drain port	ISO 11926[5]	1 5/16UNF-2B; 20 (0.79) deep	10 (145)	X[6]
T_3	Drain port	ISO 11926[5]	1 5/16UNF-2B; 20 (0.79) deep	10 (145)	X[6]
CR	Pilot signal (CR only)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	O
PR	Pilot signal (PR only)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	O
H3, **H4**	Pilot signal (H3 and H4 only)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	**ISO 11926**	9/16-18 UNF-2B; 13 (0.51) deep	100 (1450)	O
X	Pilot signal (S0 and DG only)	ISO 11926[5]	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	O
M	Measuring, control pressure	ISO 11926[5]	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	X
M_A	Measuring, pressure A	ISO 11926[5]	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	X
P	External control pressure (Ordering code position 8 version B or C = with external control pressure supply)	ISO 11926[5]	9/16-18 UNF-2B; 13 (0.51) deep	50 (725)	O
	Port **P** is without function (Ordering code position 8 version A = without external control pressure supply)	ISO 11926[5]	3/4-16 UNF-2B; 12.6 (0.50) deep	420 (6100)	X

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Centering bore according to ASME B1.1

3) Observe the instructions in the operating instructions concerning the maximum tightening torques.

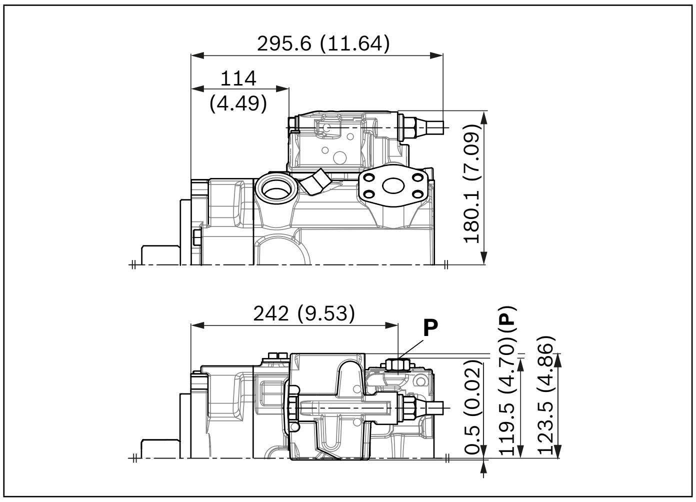
4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

5) The countersink can be deeper than as specified in the standard.

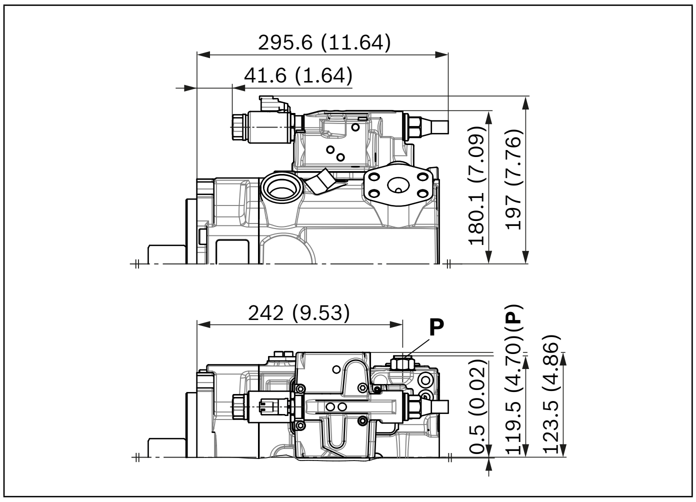
6) Depending on installation position, T_1, T_2 or T_3 must be connected (see also Installation instructions on pages 64 and 65).

7) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

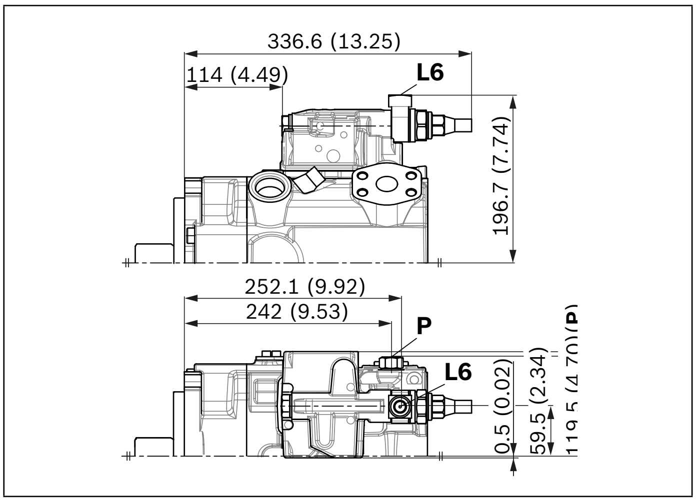
▼ **LR** – Power controller, fixed setting



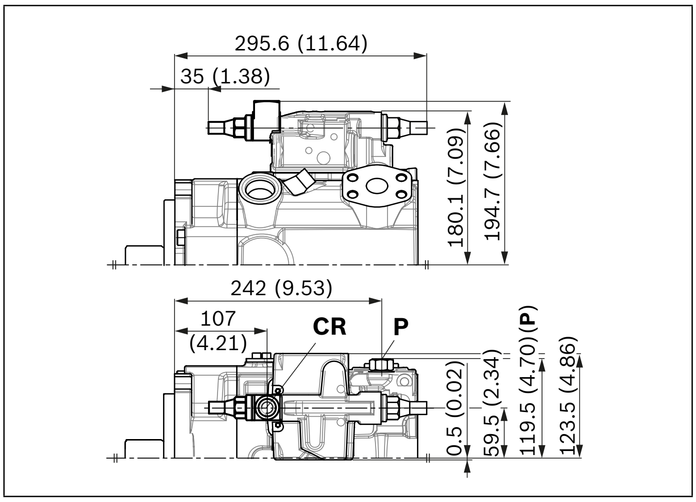
▼ **L3/L4** – Power controller, electric-proportional override



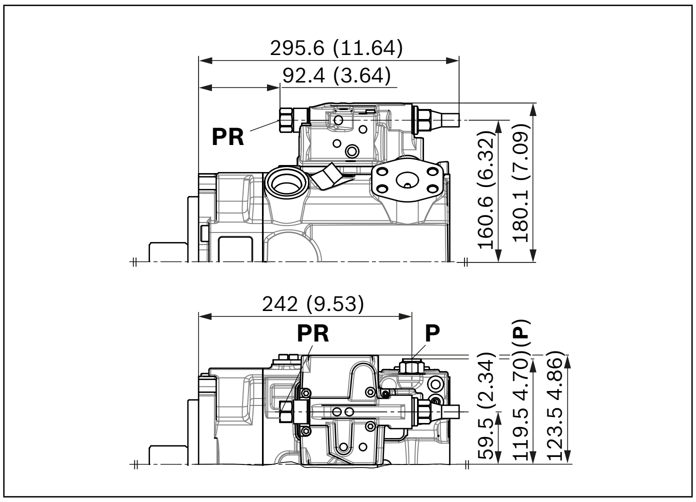
▼ **L5/L6** – Power controller, hydraulic-proportional override



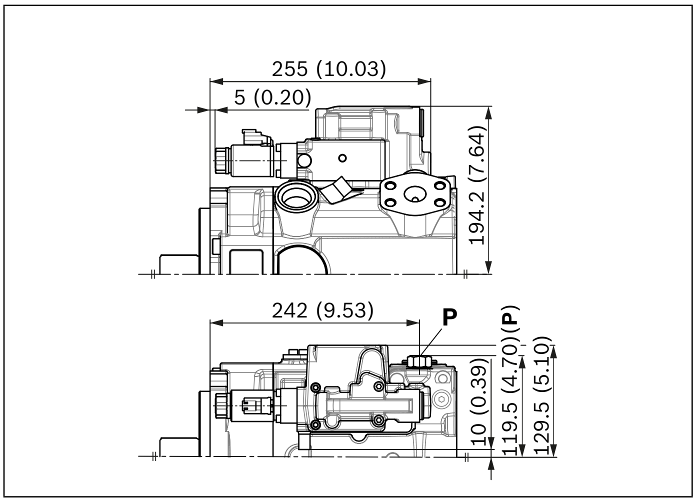
▼ **CR** – Power controller, hydraulic-proportional override, high pressure, with stop



▼ **PR** – Power controller, hydraulic-proportional override, high pressure, without stop



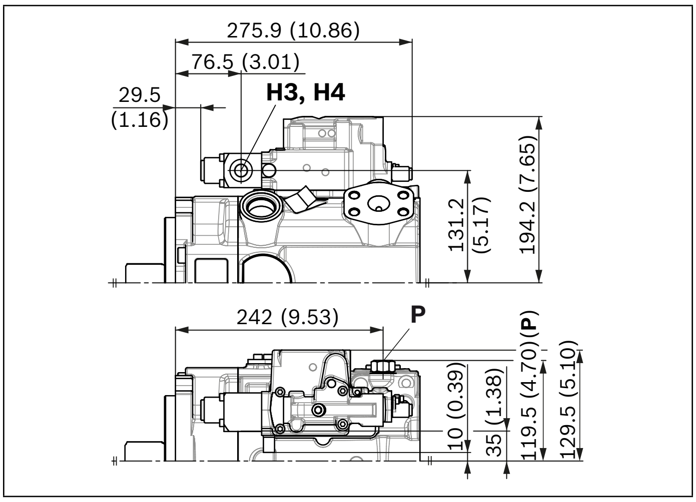
▼ **E1/E2** – Stroke control electric-proportional



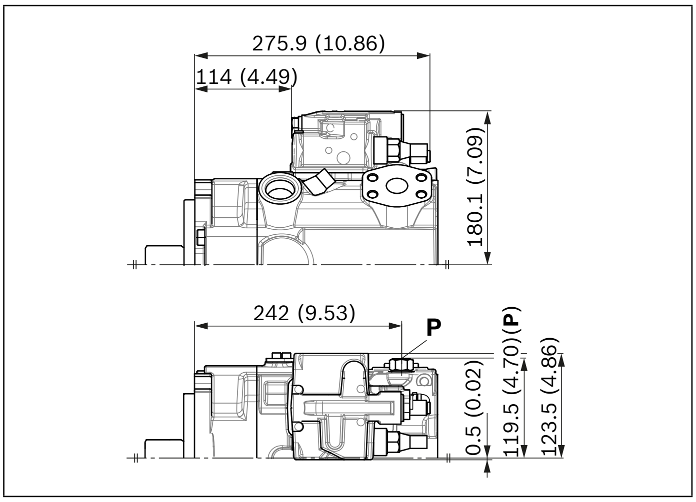
Notice

All controllers described with shuttle valve in **P** (some contrary to standard according to ordering code position 08)

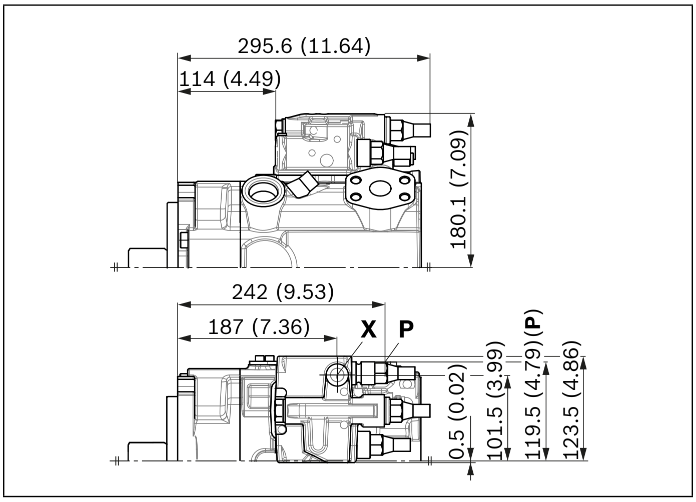
▼ **H3/H4** – Stroke control, hydraulic-proportional, pilot pressure



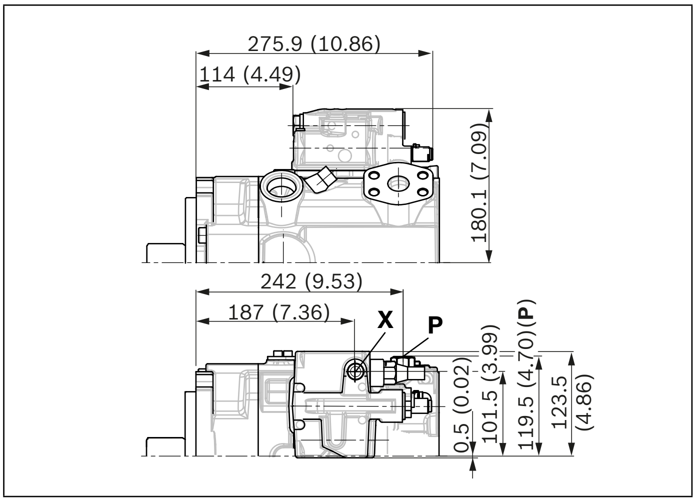
▼ **DR** – Pressure controller, fixed setting



▼ **LRDRS0** – Power controller with pressure controller and load sensing, fixed setting



▼ **DG** – Pressure controller, hydraulic, remote controlled



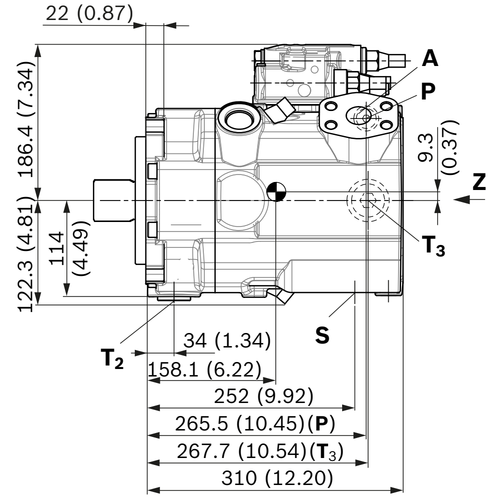
Notice

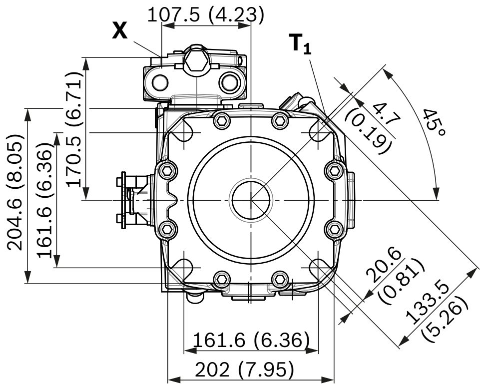
All controllers described with shuttle valve in **P** (some contrary to standard as per ordering code position 08)

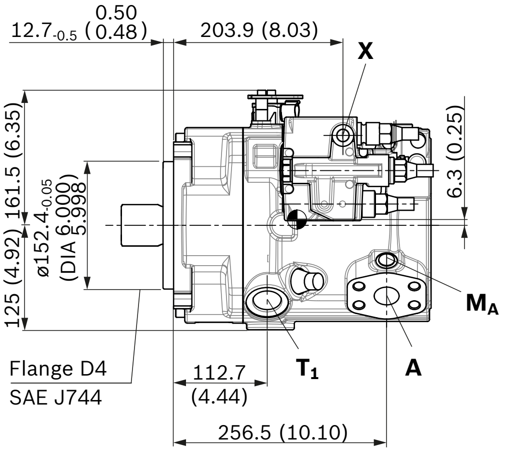
Dimensions size 145

LRDRS0 – Power controller with pressure controller, load sensing and with electric swivel angle sensor

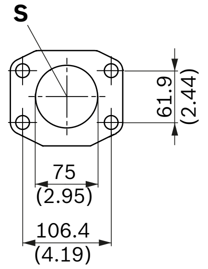
Without charge pump, clockwise rotation



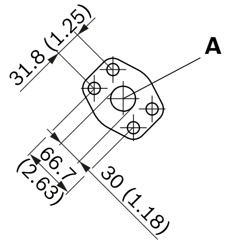


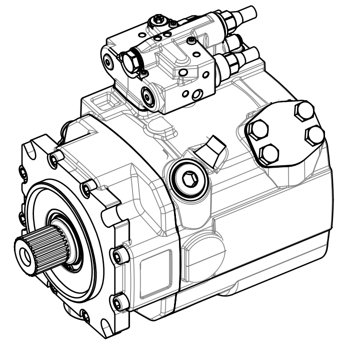


Detail X

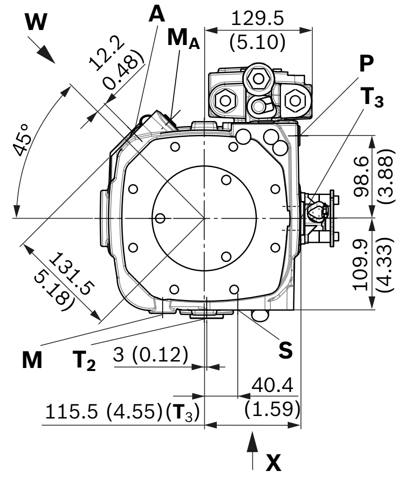


Detail W





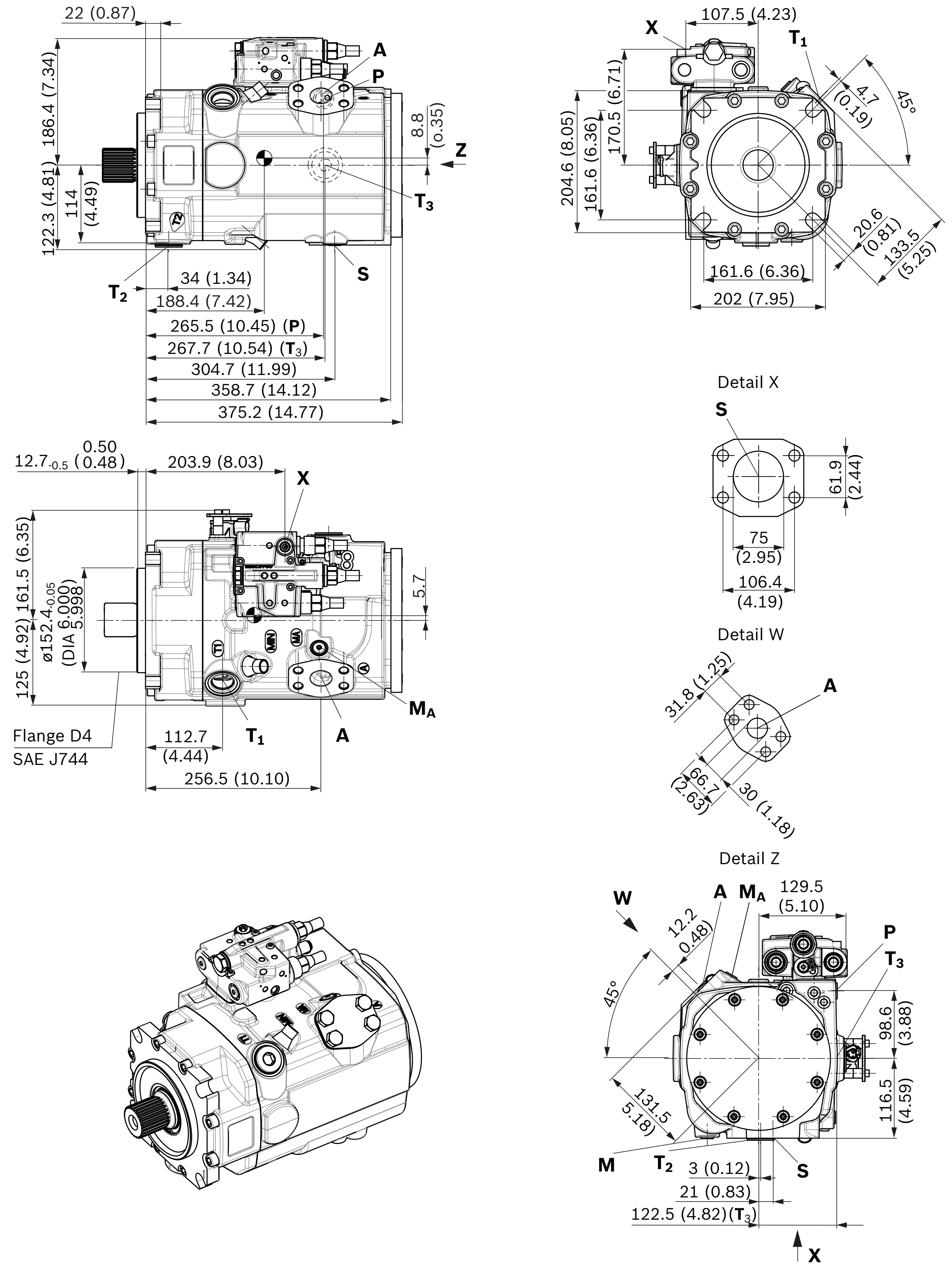
Detail Z



◐ Center of gravity

LRDRS0 – Power controller with pressure controller, load sensing and with electric swivel angle sensor

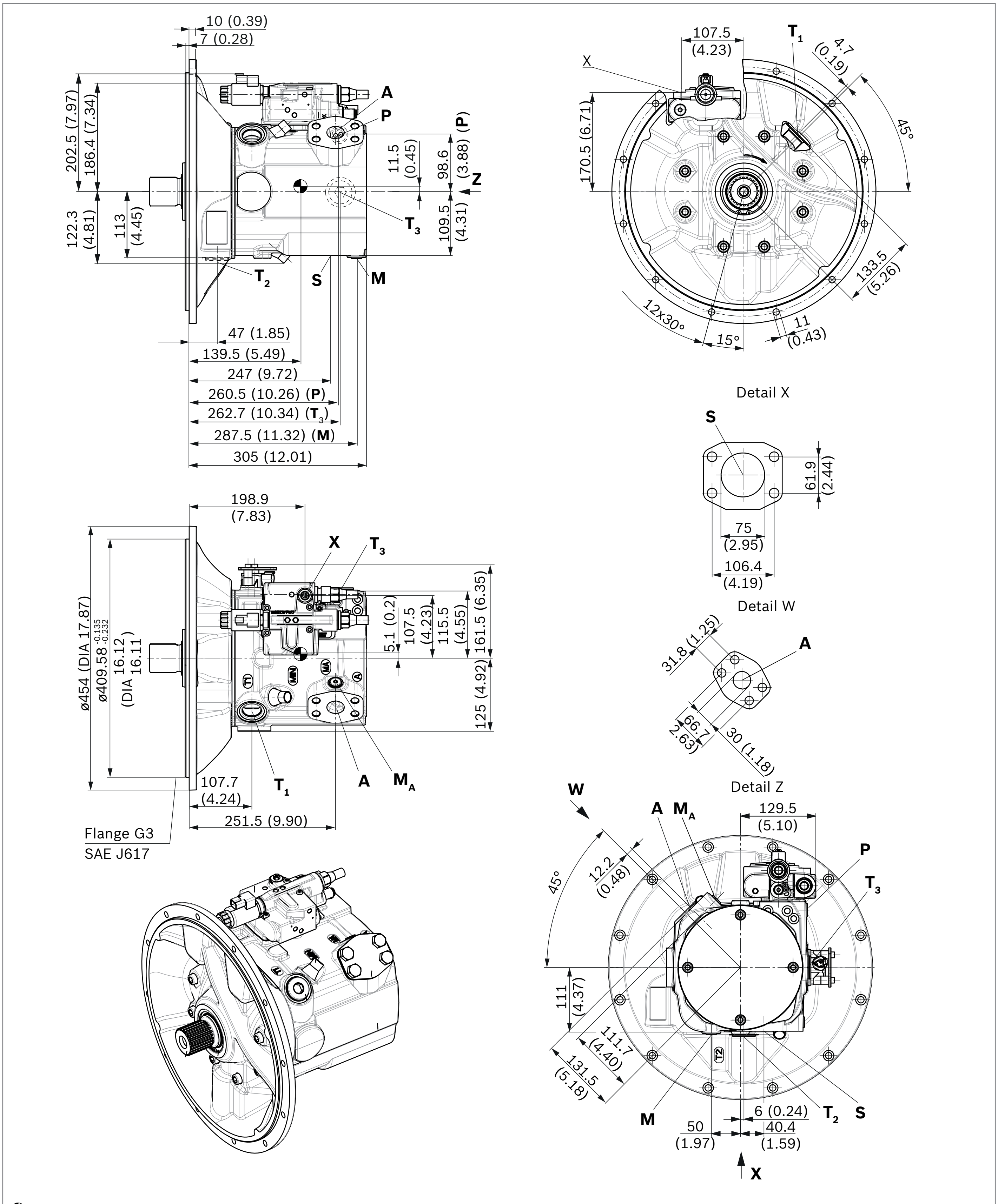
With charge pump, clockwise rotation



◐Center of gravity

L4S0 – Power controller electrically proportional, load sensing and with electric swivel angle sensor

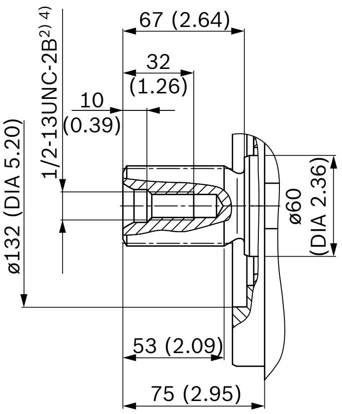
Mounting flange G3 according to SAE J617; 409-12; without charge pump



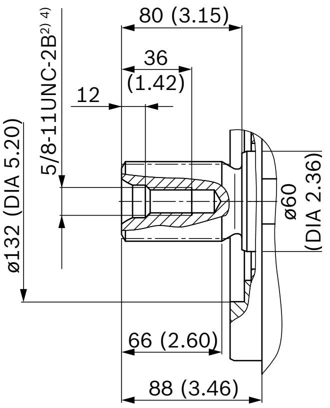
◐Center of gravity

▼ Splined shaft SAE J744

T1 – 1 3/4 in 13T 8/16DP[1]

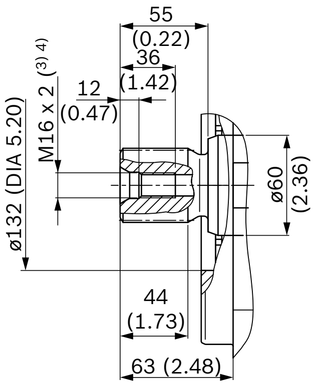


T2 – 2 in 15T 8/16 DP[1]



▼ Splined shaft DIN 5480

A2 – W50x2x24x9g



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1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Center bore according to DIN 332 (thread according to DIN 13)

4) Observe the instructions in the operating instructions concerning the maximum tightening torques.

Ports – version “M” metric		**Standard**	**Size**[4]	**$p_{\text{max abs}}$ [bar (psi)]**[5]	**State**[9]
A	Service line Fastening thread	SAE J518[6] DIN 13	1 1/4 in M14 × 2; 22 (0.87) deep	420 (6100)	O
S	Suction port (without charge pump) Fastening thread	SAE J518[6] DIN 13	3 in M16 × 2; 24 (0.94) deep	30 (435)	O
S	Suction port (with charge pump) Fastening thread	SAE J518[6] DIN 13	3 in M16 × 2; 24 (0.94) deep	2 (30)	O
T$_1$	Drain port	ISO 6149[7]	M33 × 2; 19 (0.75) deep	10 (145)	O[8]
T$_2$	Drain port	ISO 6149[7]	M33 × 2; 19 (0.75) deep	10 (145)	X[8]
T$_3$	Drain port	ISO 6149[7]	M33 × 2; 19 (0.75) deep	10 (145)	X[8]
CR	Pilot signal (CR only)	ISO 6149	M14 × 1.5; 11.5 (0.45) deep	420 (6100)	O
PR	Pilot signal (PR only)	ISO 6149	M14 × 1.5; 11.5 (0.45) deep	420 (6100)	O
H3, **H4**	Pilot signal (H3 and H4 only)	ISO 6149	M14 × 1.5; 11.5 (0.45) deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	**ISO 6149**	M14 × 1.5; 11.5 (0.45) deep	100 (1450)	O
X	Pilot signal (S0 and DG only)	ISO 6149[7]	M14 × 1.5; 11.5 (0.45) deep	420 (6100)	O
M	Measuring, control pressure	ISO 6149[7]	M14 × 1.5; 12 (0.47) deep	420 (6100)	X
M$_A$	Measuring, pressure A	ISO 6149[7]	M14 × 1.5; 12 (0.47) deep	420 (6100)	X
P	External control pressure (Ordering code position 8 version B or C = with external control pressure supply)	ISO 6149[7]	M14 × 1.5; 11.5 (0.45) deep	50 (725)	O
	Port **P** is without function (Ordering code position 8 version A = without external control pressure supply)	ISO 6149[7]	M18 x 1.5; 14.5 (0.57) deep	420 (6100)	X

Ports – version “A” SAE		**Standard**	**Size**[4]	**$p_{\text{max abs}}$ [bar (psi)]**[5]	**State**[9]
A	Service line Fastening thread	SAE J518 ASME B1.1	1 1/4 in 1/2-13 UNC-2B; 19 (0.75) deep	420 (6100)	O
S	Suction port (without charge pump) Fastening thread	SAE J518 ASME B1.1	3 in 5/8-11 UNC-2B; 24 (0.94) deep	30 (435)	O
S	Suction port (with charge pump) Fastening thread	SAE J518 ASME B1.1	3 in 5/8-11 UNC-2B; 24 (0.94) deep	2 (30)	O
T$_1$	Drain port	ISO 11926[7]	1 5/16 UNF-2B; 20 (0.79) deep	10 (145)	O[8]
T$_2$	Drain port	ISO 11926[7]	1 5/16 UNF-2B; 20 (0.79) deep	10 (145)	X[8]
T$_3$	Drain port	ISO 11926[7]	1 5/16 UNF-2B; 20 (0.79) deep	10 (145)	X[8]
CR	Pilot signal (CR only)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	O
PR	Pilot signal (PR only)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	O
H3, **H4**	Pilot signal (H3 and H4 only)	ISO 11926	9/16-18 UNF-2B; 13 (0.51) deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	**ISO 11926**	9/16-18 UNF-2B; 13 (0.51) deep	100 (1450)	O
X	Pilot signal (S0 and DG only)	ISO 11926[7]	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	O
M	Measuring, control pressure	ISO 11926[7]	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	X
M$_A$	Measuring, pressure A	ISO 11926[7]	9/16-18 UNF-2B; 13 (0.51) deep	420 (6100)	X
P	External control pressure (Ordering code position 8 version B or C = with external control pressure supply)	ISO 11926[7]	9/16-18 UNF-2B; 13 (0.51) deep	50 (725)	O
	Port **P** is without function (Ordering code position 8 version A = without external control pressure supply)	ISO 11926[7]	3/4-16 UNF-2B; 12.6 (0.50) deep	420 (6100)	X

---

[5] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

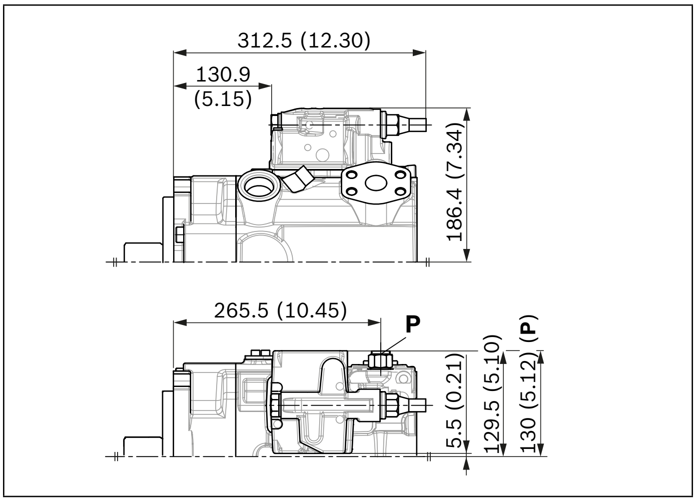
[6] Metric fastening thread is a deviation from standard.

[7] The countersink can be deeper than as specified in the standard.

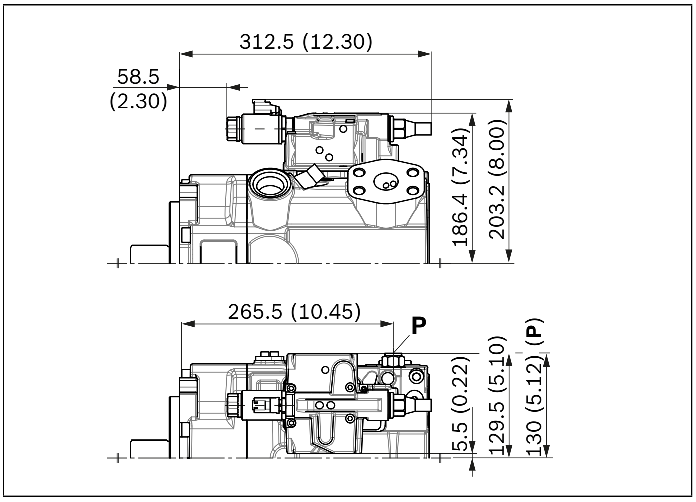
[8] Depending on installation position, T$_1$, T$_2$ or T$_3$ must be connected (see also Installation instructions on pages 64 and 65).

[9] O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

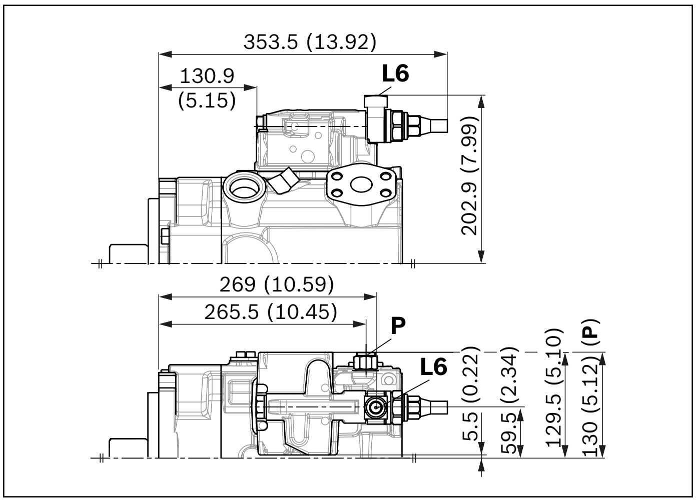
- ▼ **LR** – Power controller, fixed setting



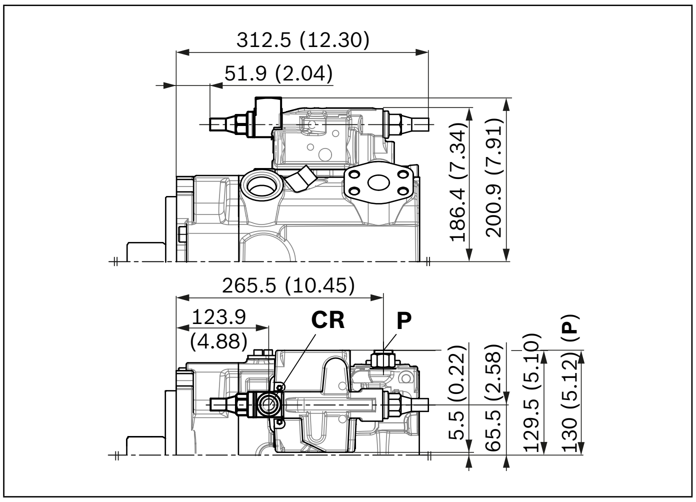
- ▼ **L3/L4** – Power controller, electric-proportional override



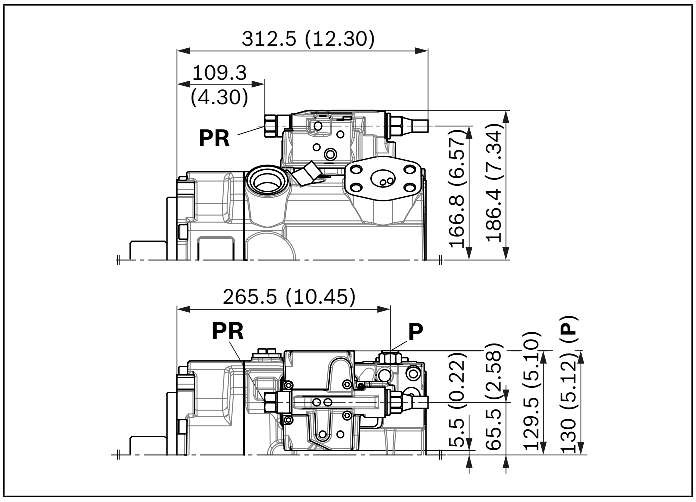
- ▼ **L5/L6** – Power controller, hydraulic override



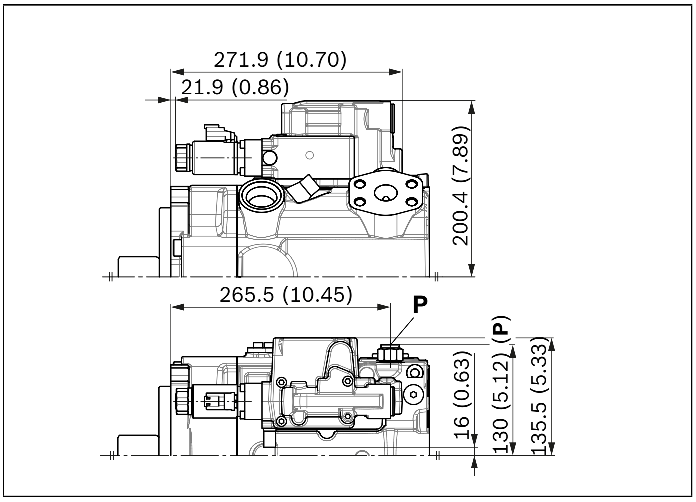
- ▼ **CR** – Power controller, hydraulic-proportional override, high pressure, with stop



- ▼ **PR** – Power controller, hydraulic-proportional override, high pressure, without stop



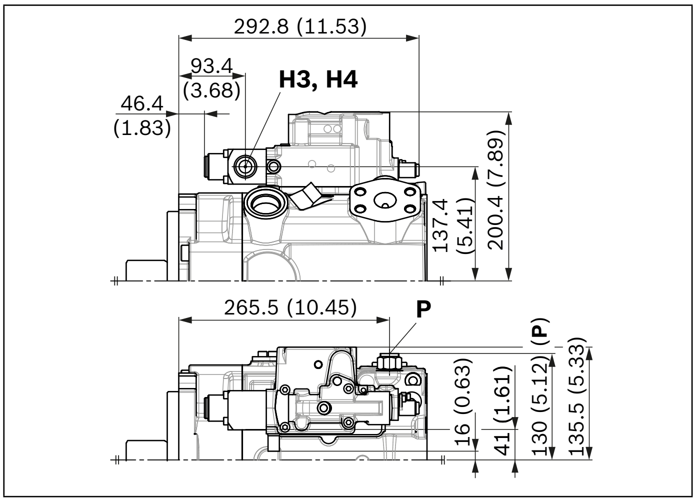
- ▼ **E1/E2** – Stroke control electric-proportional



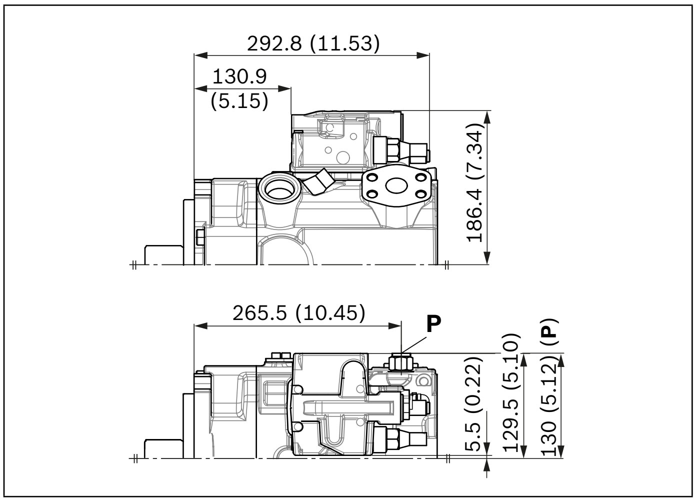
Notice

All controllers described with shuttle valve in **P** (some contrary to standard as per ordering code position 08)

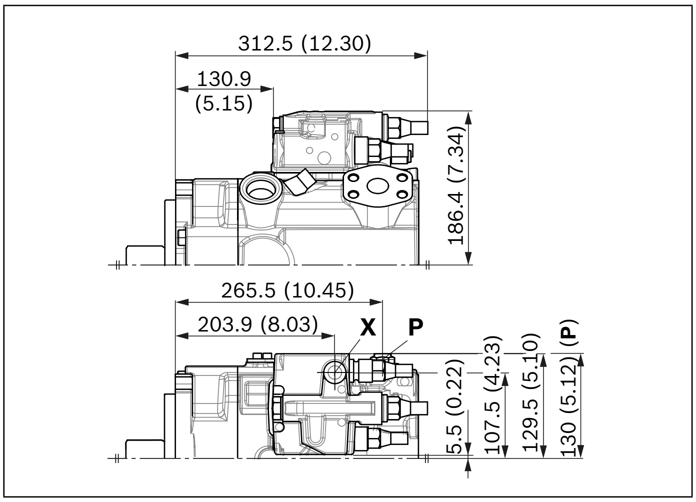
▼ **H3/H4** – Stroke control, hydraulic-proportional, pilot pressure



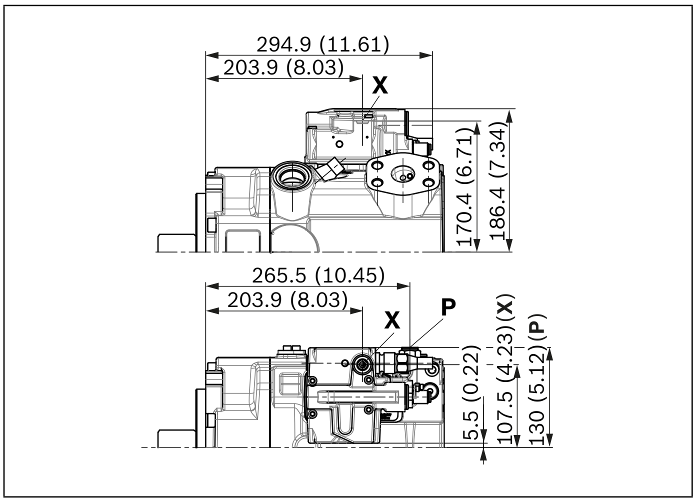
▼ **DR** – Pressure controller, fixed setting



▼ **LRDRS0** – Power controller with pressure controller and load sensing, fixed setting



▼ **DG** – Pressure controller, hydraulic, remote controlled



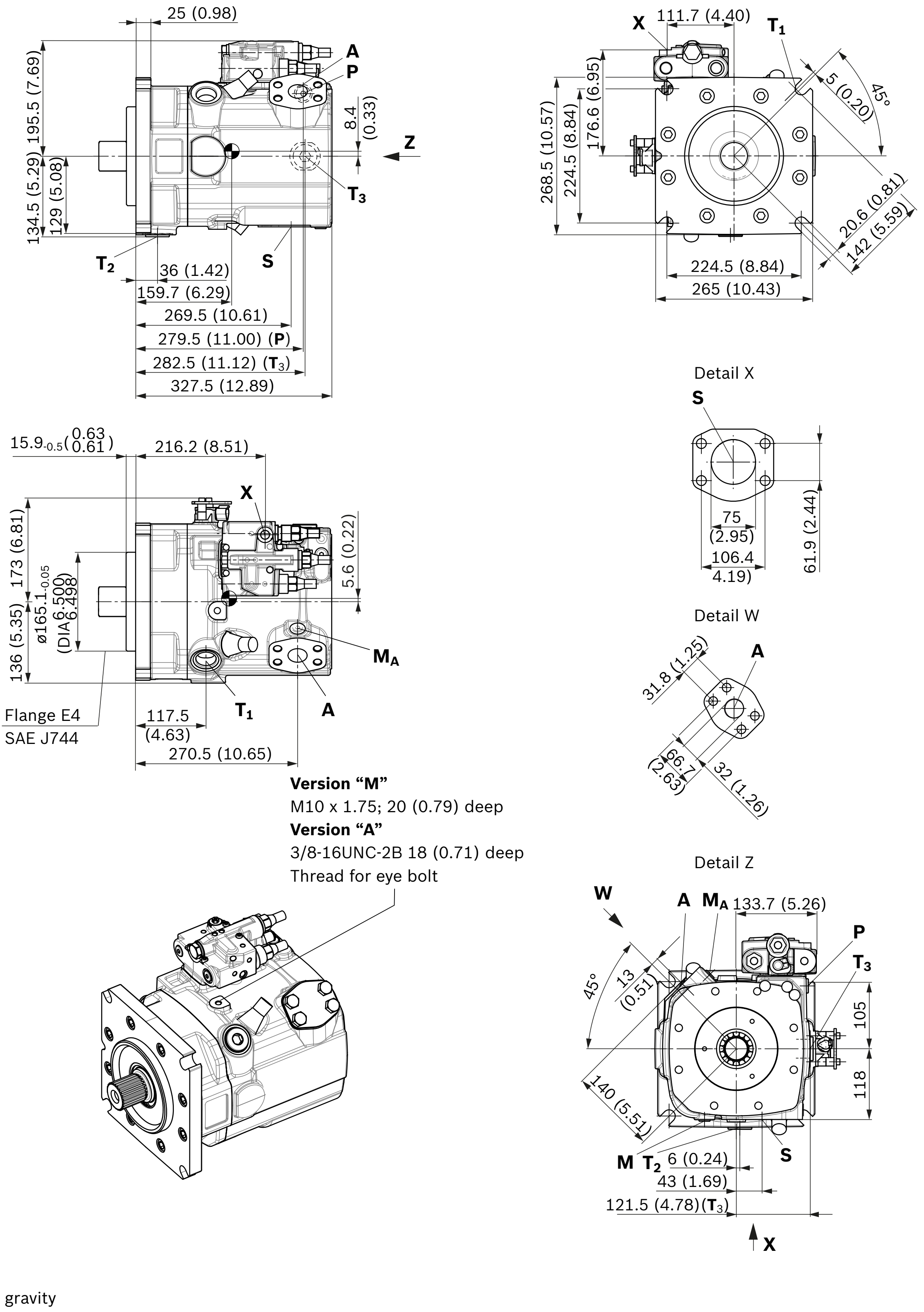
Notice

All controllers described with shuttle valve in **P** (some contrary to standard as per ordering code position 08)

Dimensions size 175

LRDRS0 – Power controller with pressure controller, load sensing and with electric swivel angle sensor

Without charge pump, clockwise rotation

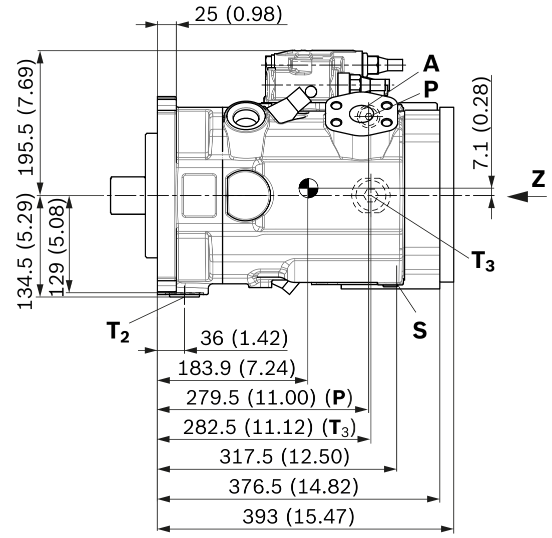


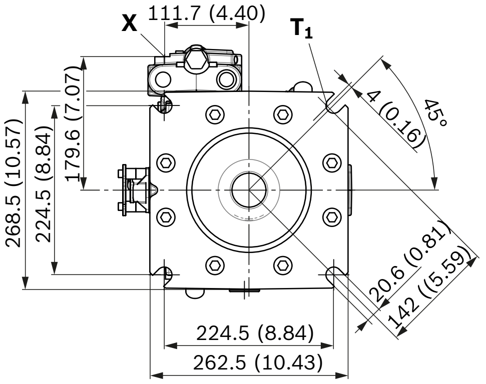
Version "M"
M10 x 1.75; 20 (0.79) deep
Version "A"
3/8-16UNC-2B 18 (0.71) deep
Thread for eye bolt

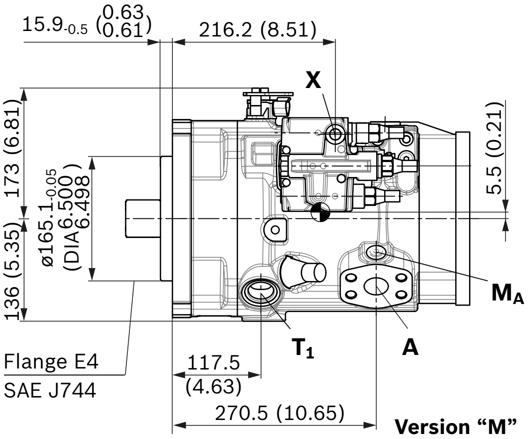
● Center of gravity

LRDRS0 – Power controller with pressure controller, load sensing and with electric swivel angle sensor

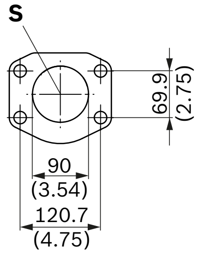
With charge pump, clockwise rotation



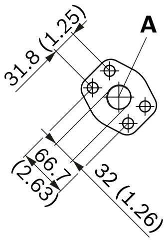




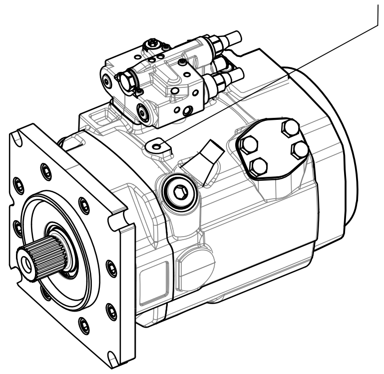
Detail X



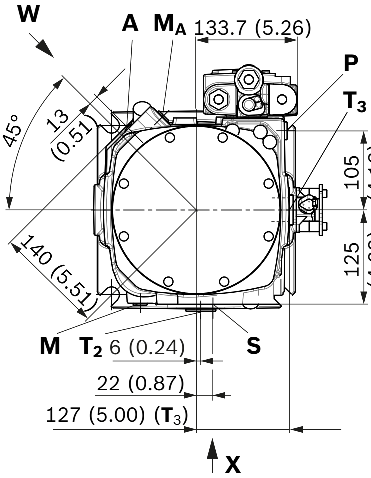
Detail W



Version "M"
M10 x 1.75; 20 (0.79) deep
Version "A"
3/8-16UNC-2B 18 (0.71) deep
Thread for eye bolt



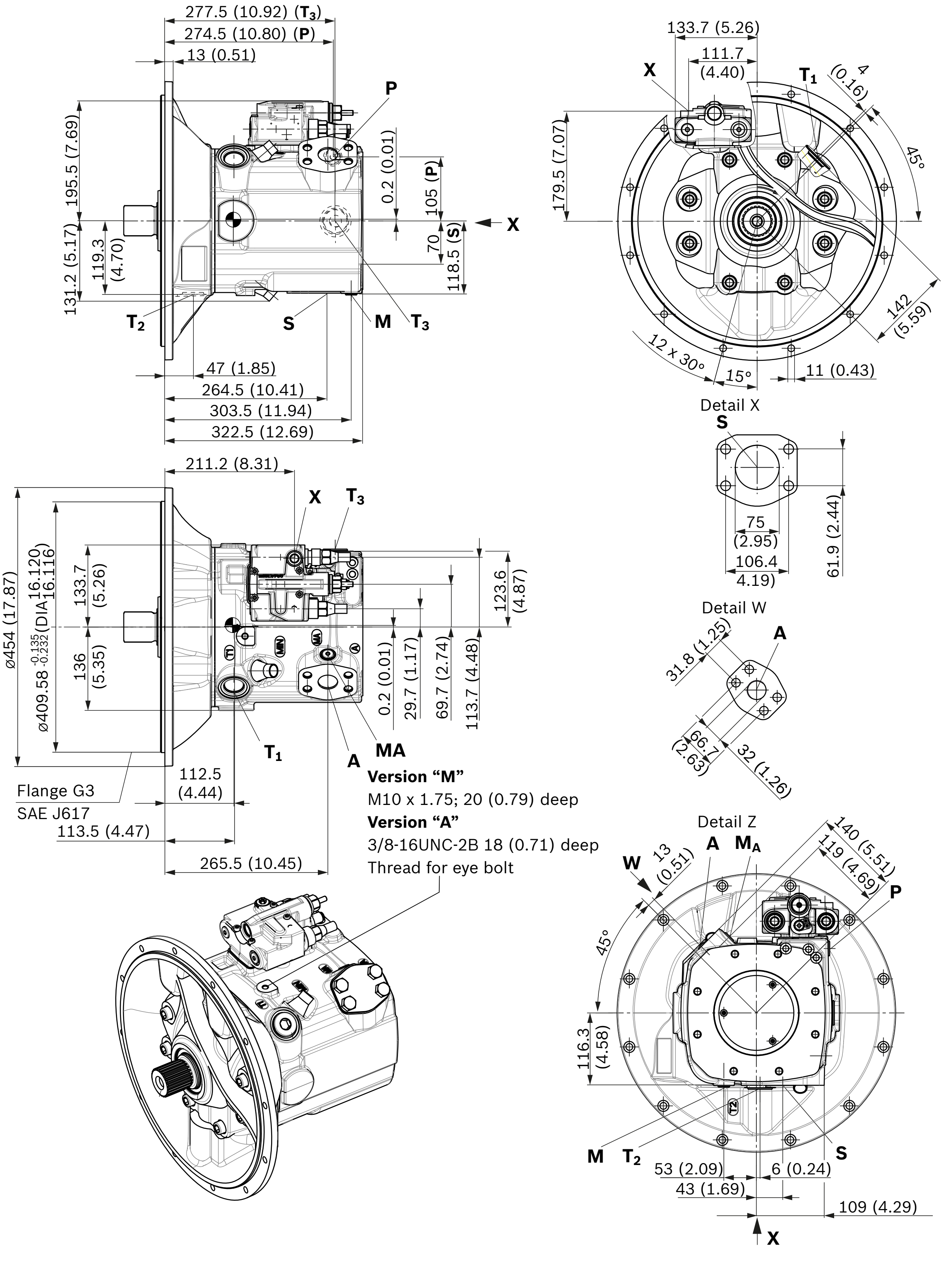
Detail Z



● Center of gravity

LRDRS0 – Power controller with pressure controller, load sensing and without electric swivel angle sensor

Mounting flange G3 according to SAE J617; 409-12; without charge pump

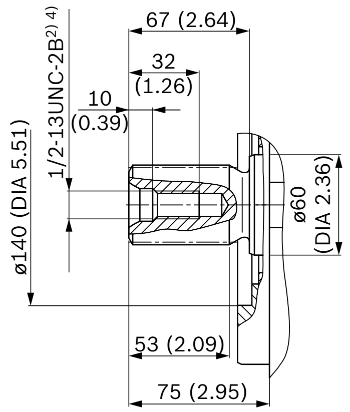


Version “M”
M10 x 1.75; 20 (0.79) deep
Version “A”
3/8-16UNC-2B 18 (0.71) deep
Thread for eye bolt

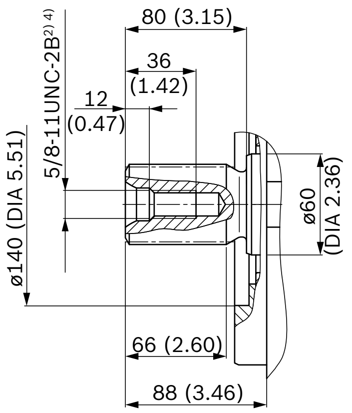
◐ Center of gravity

▼ Splined shaft SAE J744

T1 – 1 3/4 in 13T 8/16DP[1)]

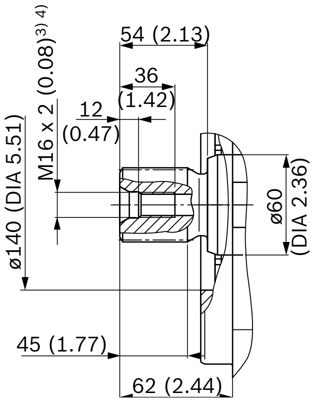


T2 – 2 in 15T 8/16DP[1)]



▼ Splined shaft DIN 5480

A2 – W50x2x24x9g



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1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Center bore according to DIN 332 (thread according to DIN 13)

4) Observe the instructions in the operating instructions concerning the maximum tightening torques.

Ports – version "M" metric		Standard	Size[4]	$p_{\text{max abs}}$ [bar (psi)][5]	State[9]
A	Service line Fastening thread	SAE J518[6] DIN 13	1 1/4 in M14 × 2; 22 (0.87) deep	420 (6100)	O
S	Suction port (without charge pump) Fastening thread	SAE J518[6] DIN 13	3 in M16 × 2; 24 (0.94) deep	30 (435)	O
S	Suction port (with charge pump) Fastening thread	SAE J518[6] DIN 13	3 1/2 in M16 × 2; 24 (0.94) deep	2 (30)	O O
$\mathbf{T_1}$	Drain port	ISO 6149[7]	M33 × 2; 19 (0.75) deep	10 (145)	O[8]
$\mathbf{T_2}$	Drain port	ISO 6149[7]	M33 × 2; 19 (0.75) deep	10 (145)	X[8]
$\mathbf{T_3}$	Drain port	ISO 6149[7]	M33 × 2; 19 (0.75) deep	420 (6100)	X[8]
CR	Pilot signal (CR only)	ISO 6149	M14 × 1.5; 11.5 (0.45) deep	100 (1450)	O
PR	Pilot signal (PR only)	ISO 6149	M14 × 1.5; 11.5 (0.45) deep	100 (1450)	O
H3, **H4**	Pilot signal (H3 and H4 only)	ISO 6149	M14 × 1.5; 11.5 (0.45) deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	**ISO 6149**	M14 × 1.5; 11.5 (0.45) deep	100 (1450)	O
X	Pilot signal (S0 and DG only)	ISO 6149[7]	M14 × 1.5; 11.5 (0.45) deep	420 (6100)	O
M	Measuring, control pressure	ISO 6149[7]	M14 × 1.5; 12 (0.47) deep	420 (6100)	X
$\mathbf{M_A}$	Measuring, pressure A	ISO 6149[7]	M14 × 1.5; 12 (0.47) deep	420 (6100)	X
P	External control pressure (ordering code position 8 version B or C = with external control pressure supply)	ISO 6149[7]	M14 × 1.5; 11.5 (0.45) deep	50 (725)	O
	Port **P** is without function (Ordering code position 8 version A = without external control pressure supply)	ISO 6149[7]	M18 x 1.5; 14.5 (0.57) deep	420 (6100)	X

Ports – version "A" SAE		Standard	Size[4]	$p_{\text{max abs}}$ [bar (psi)][5]	State[9]
A	Service line Fastening thread	SAE J518 ASME B1.1	1 1/4 in 1/2-13UNC-2B; 19 (0.75) deep	420 (6100)	O
S	Suction port (without charge pump) Fastening thread	SAE J518 ASME B1.1	3 in 5/8-11UNC-2B; 24 (0.94) deep	30 (435)	O
S	Suction port (with charge pump) Fastening thread	SAE J518 ASME B1.1	3 1/2 in 5/8-11UNC-2B; 24 (0.94) deep	2 (30)	O O
$\mathbf{T_1}$	Drain port	ISO 11926[7]	1 5/16UNF-2B; 20 (0.79) deep	10 (145)	O[8]
$\mathbf{T_2}$	Drain port	ISO 11926[7]	1 5/16UNF-2B; 20 (0.79) deep	10 (145)	X[8]
$\mathbf{T_3}$	Drain port	ISO 11926[7]	1 5/16UNF-2B; 20 (0.79) deep	420 (6100)	X[8]
CR	Pilot signal (CR only)	ISO 11926	9/16-18UNF-2B; 13 (0.51) deep	100 (1450)	O
PR	Pilot signal (PR only)	ISO 11926	9/16-18UNF-2B; 13 (0.51) deep	100 (1450)	O
H3, **H4**	Pilot signal (H3 and H4 only)	ISO 11926	9/16-18UNF-2B; 13 (0.51) deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	**ISO 11926**	9/16-18UNF-2B; 13 (0.51) deep	100 (1450)	O
X	Pilot signal (S0 and DG only)	ISO 11926[7]	9/16-18UNF-2B; 13 (0.51) deep	420 (6100)	O
M	Measuring, control pressure	ISO 11926[7]	9/16-18UNF-2B; 13 (0.51) deep	420 (6100)	X
$\mathbf{M_A}$	Measuring, pressure A	ISO 11926[7]	9/16-18UNF-2B; 13 (0.51) deep	420 (6100)	X
P	External control pressure (Ordering code position 8 version B or C = with external control pressure supply)	ISO 11926[7]	9/16-18UNF-2B; 13 (0.51) deep	50 (725)	O
	Port **P** is without function (Ordering code position 8 version A = without external control pressure supply)	ISO 11926[7]	3/4-16UNF-2B; 12.6 (0.50) deep	420 (6100)	X

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[5] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

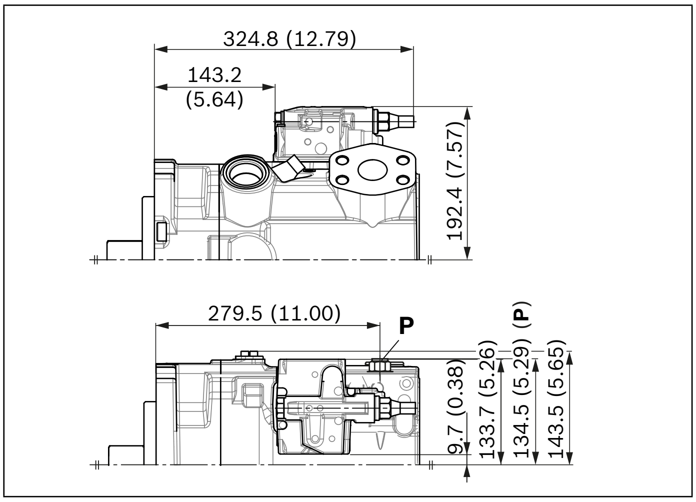
[6] Metric fastening thread is a deviation from standard.

[7] The countersink can be deeper than as specified in the standard.

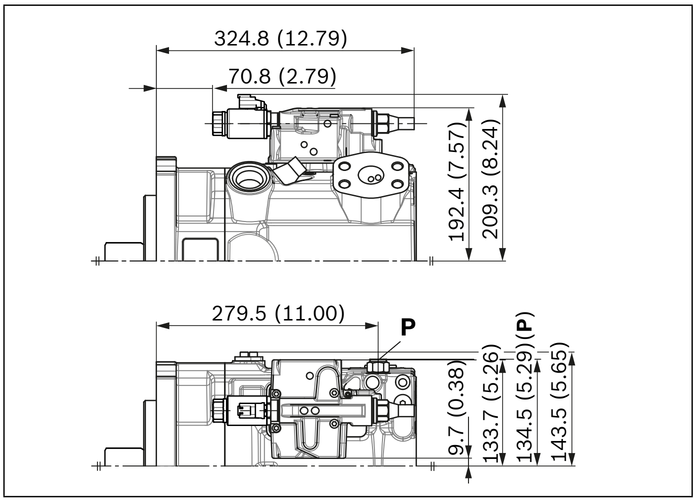
[8] Depending on installation position, T_1, T_2 or T_3 must be connected (see also Installation instructions on pages 64 and 65).

[9] O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

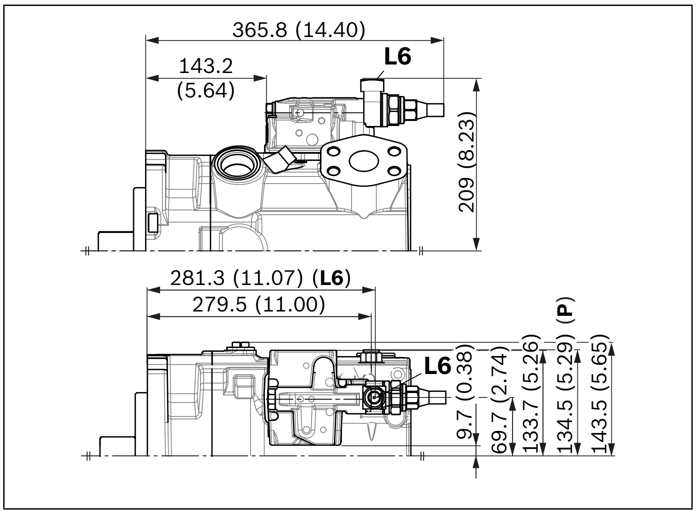
▼ **LR** – Power controller, fixed setting



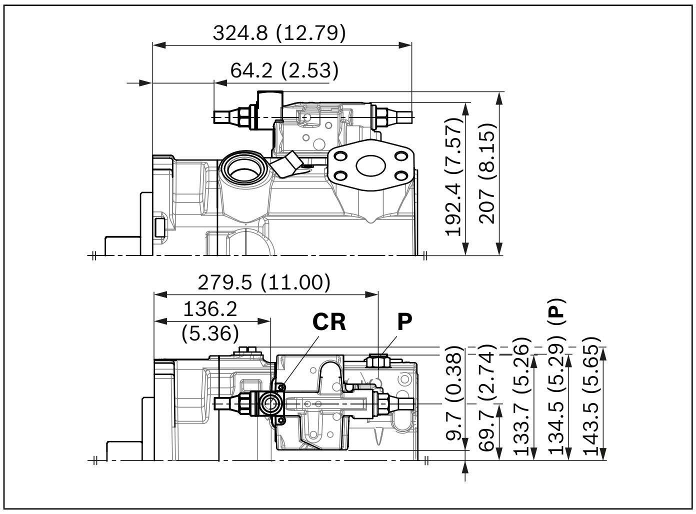
▼ **L3/L4** – Power controller, electric-proportional override



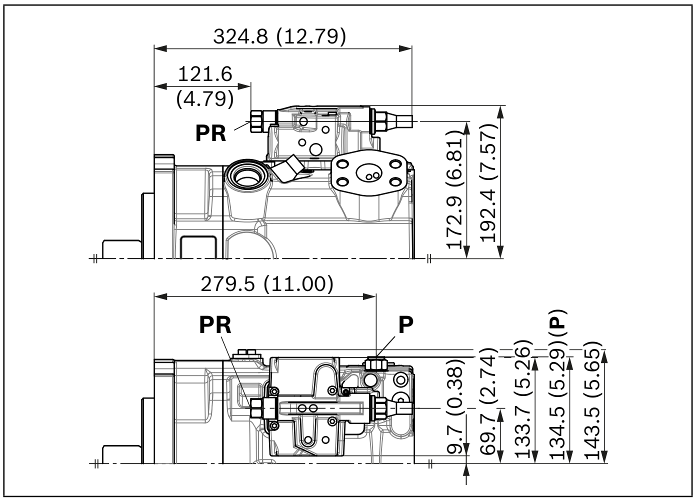
▼ **L5/L6** – Power controller, hydraulic override



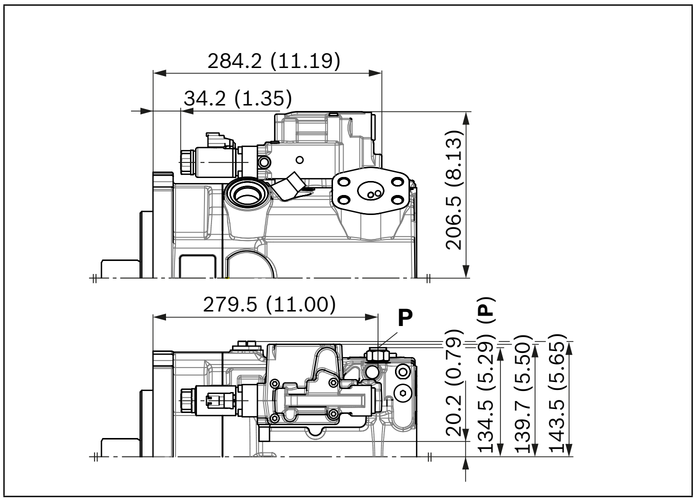
▼ **CR** – Power controller, hydraulic-proportional override, high pressure, with stop



▼ **PR** – Power controller, hydraulic-proportional override, high pressure, without stop



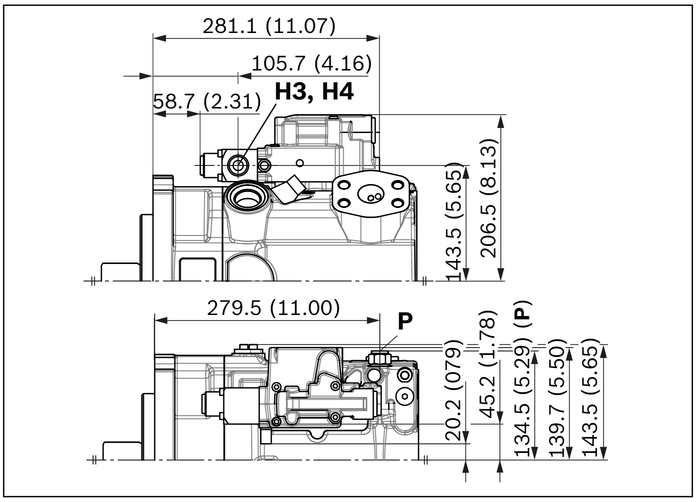
▼ **E1/E2** – Stroke control electric-proportional



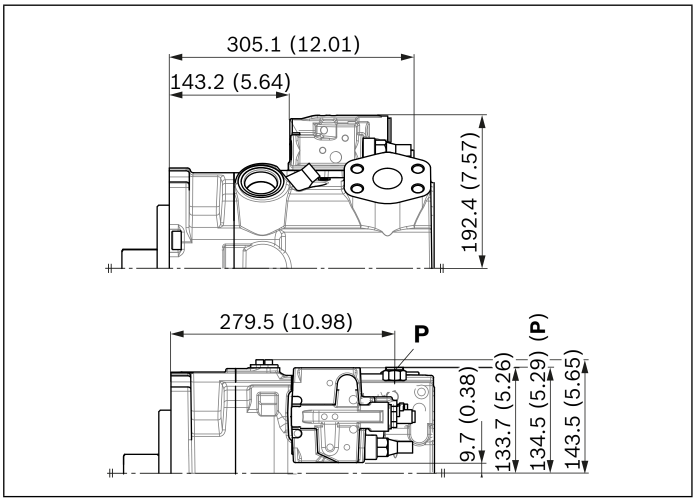
Notice

All controllers described with shuttle valve in **P** (some contrary to standard as per ordering code position 08)

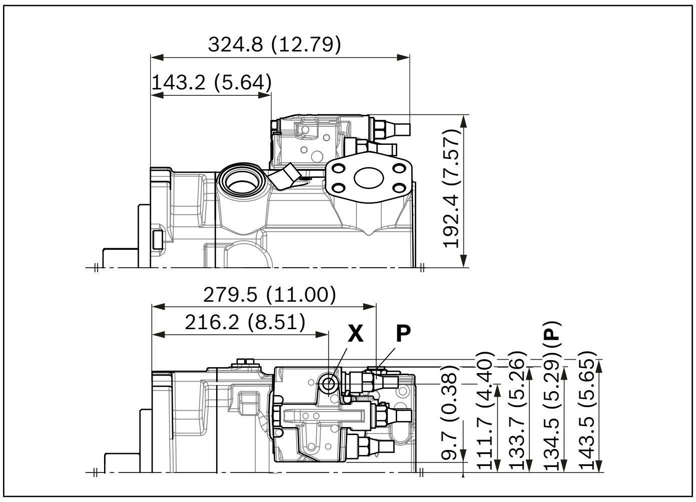
▼ **H3/H4** – Stroke control, hydraulic-proportional, pilot pressure



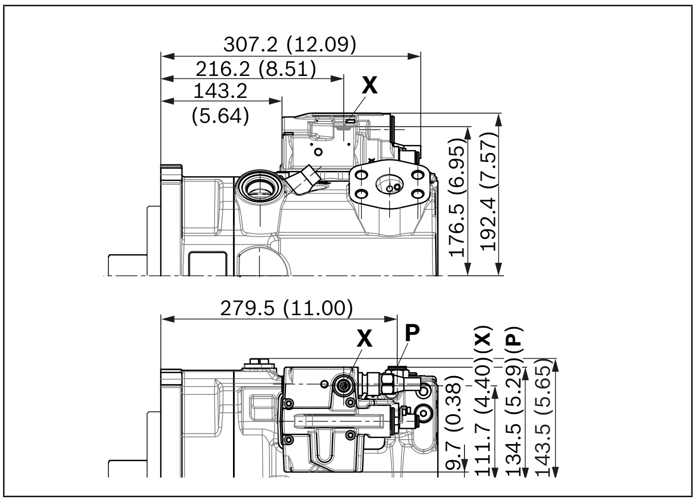
▼ **DR** – Pressure controller, fixed setting



▼ **LRDRS0** – Power controller with pressure controller and load sensing, fixed setting



▼ **DG** – Pressure controller, hydraulic, remote controlled



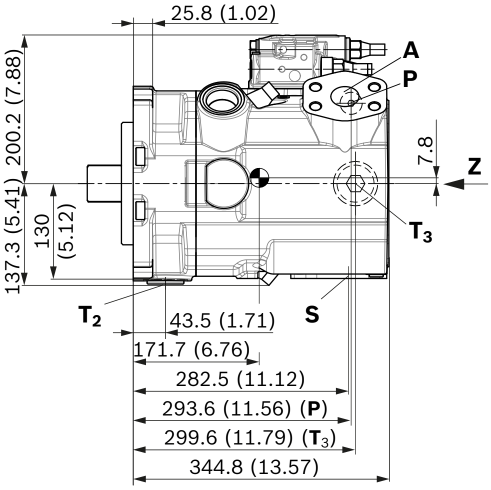
Notice

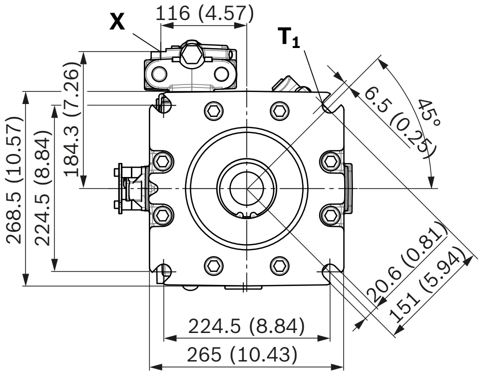
All controllers described with shuttle valve in **P** (some contrary to standard as per ordering code position 08)

Dimensions size 210

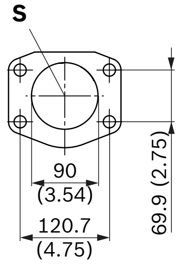
LRDRS0 – Power controller with pressure controller, load sensing and with electric swivel angle sensor

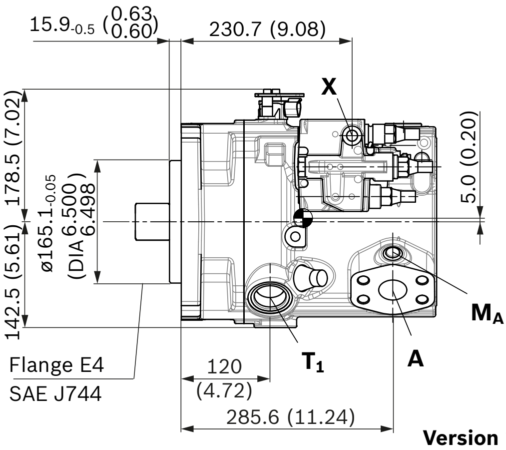
Without charge pump, clockwise rotation



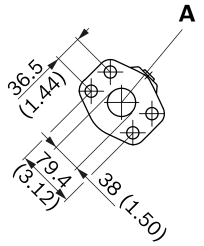


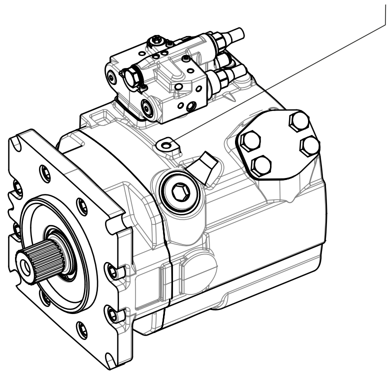
Detail X





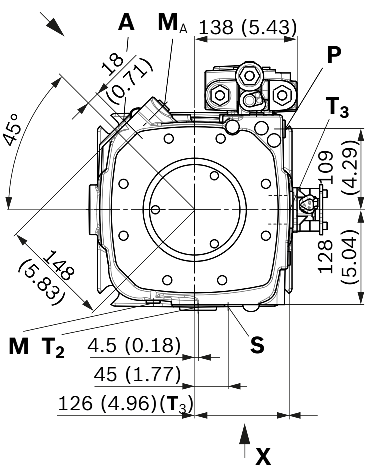
Detail W





Version "M"
M12 x 1.75; 22 (0.87) deep
Version "A"
1/2-13UNC-2B; 22 (0.87) deep
Thread for eye bolt

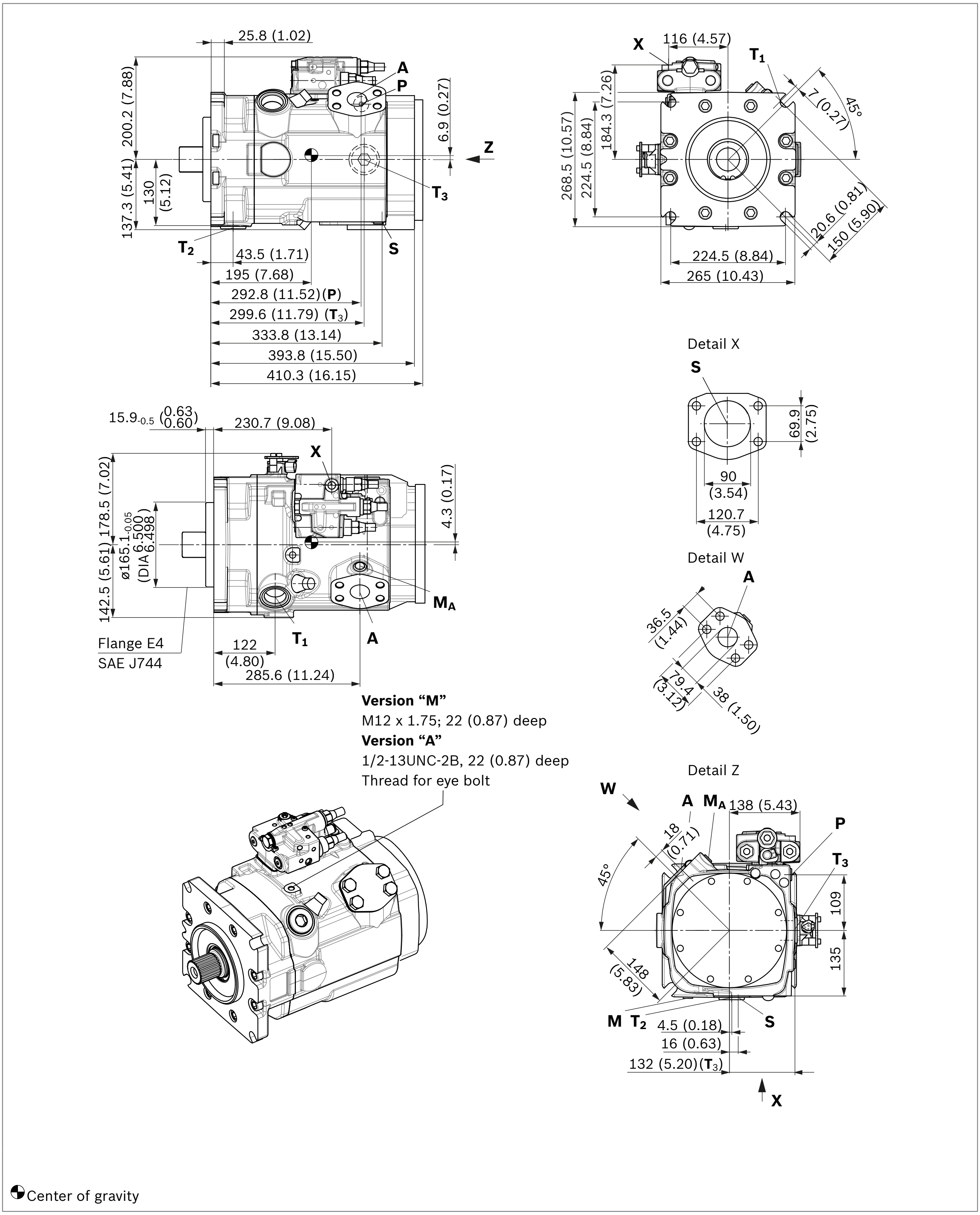
Detail Z



◐Center of gravity

LRDRS0 – Power controller with pressure controller, load sensing and with electric swivel angle sensor

With charge pump, clockwise rotation

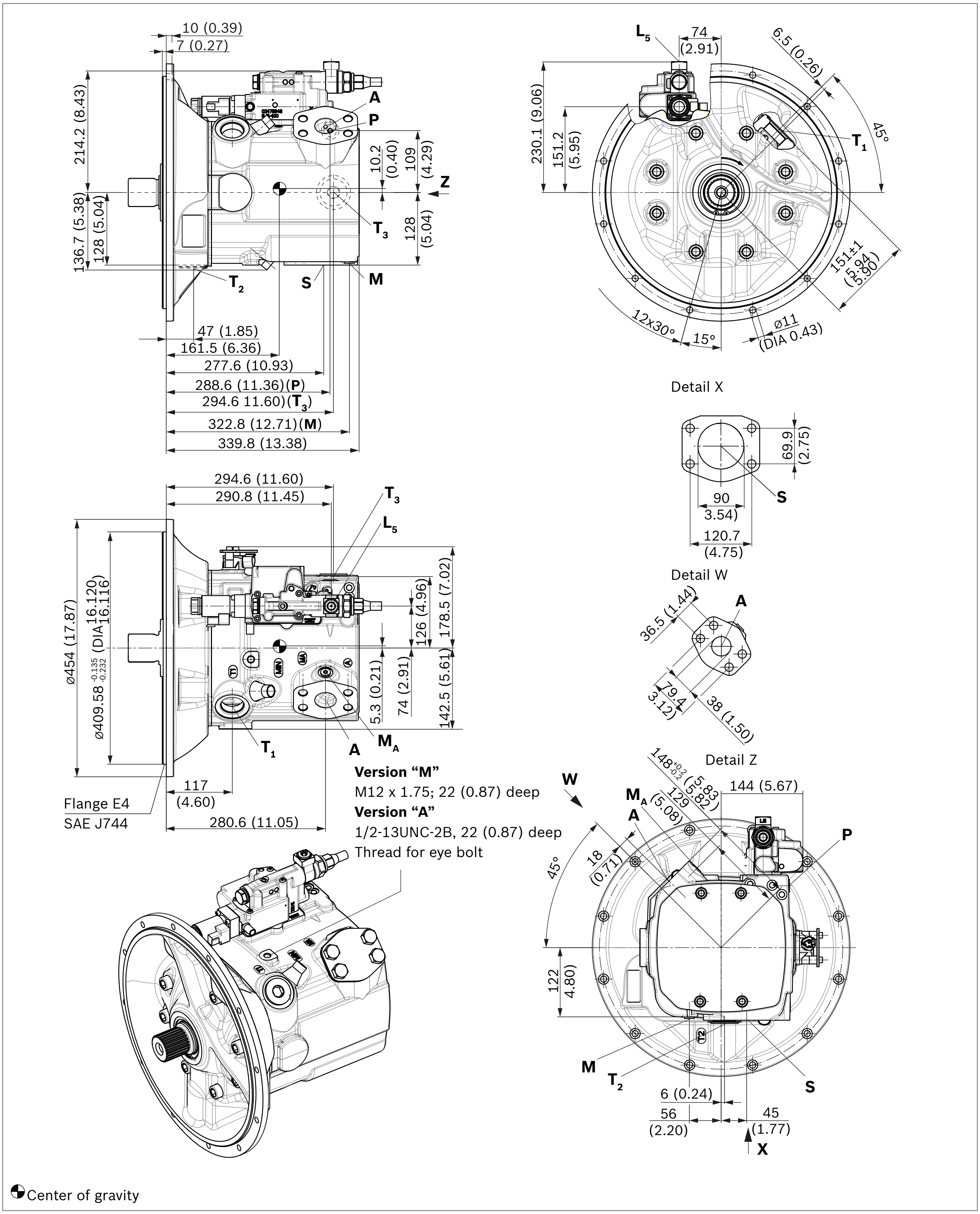


Version "M"
M12 x 1.75; 22 (0.87) deep
Version "A"
1/2-13UNC-2B, 22 (0.87) deep
Thread for eye bolt

● Center of gravity

L5E2 – Power controller with pressure controller, load sensing and with electric swivel angle sensor

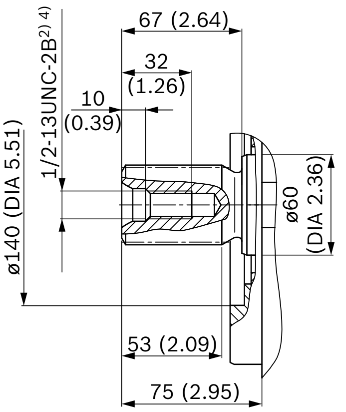
Mounting flange G3 according to SAE J617; 409-12; without charge pump



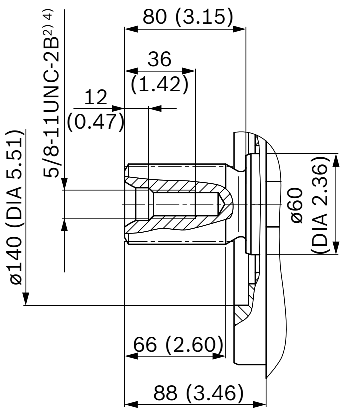
Version "M"
M12 x 1.75; 22 (0.87) deep
Version "A"
1/2-13UNC-2B, 22 (0.87) deep
Thread for eye bolt

▼ Splined shaft SAE J744

T1 – 1 3/4 in 13T 8/16DP[1)]

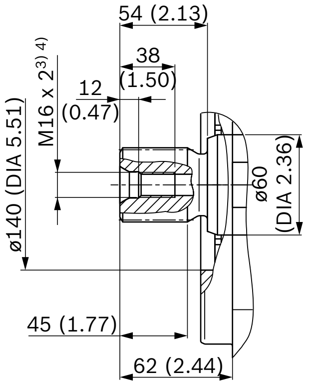


T2 – 2 in 15T 8/16DP[1)]



▼ Splined shaft DIN 5480

A2 – W50x2x24x9g



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1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Center bore according to DIN 332 (thread according to DIN 13)

4) Observe the instructions in the operating instructions concerning the maximum tightening torques.

Ports – version “M” metric		**Standard**	**Size**[4]	$p_{\text{max abs}}$ **[bar (psi)]**[5]	**State**[9]
A	Service line Fastening thread	SAE J518[6] DIN 13	1 1/2 in M16 x 2; 24 (0.94) deep	420 (6100)	O
S	Suction port (without charge pump) Fastening thread	SAE J518[6] DIN 13	3 1/2 in M16 x 2; 24 (0.94) deep	30 (435)	O
S	Suction port (with charge pump) Fastening thread	SAE J518[6] DIN 13	3 1/2 in M16 x 2; 24 (0.94) deep	2 (30)	O
$\mathbf{T_1}$	Drain port	ISO 6149[7]	M42 x 2; 19.5 (0.77) deep	10 (145)	O[8]
$\mathbf{T_2}$	Drain port	ISO 6149[7]	M42 x 2; 19.5 (0.77) deep	10 (145)	X[8]
$\mathbf{T_3}$	Drain port	ISO 6149[7]	M42 x 2; 19.5 (0.77) deep	10 (145)	X[8]
CR	Pilot signal (CR only)	ISO 6149	M14 x 1.5; 11.5 (0.45) deep	420 (6100)	O
PR	Pilot signal (PR only)	ISO 6149	M14 x 1.5; 11.5 (0.45) deep	420 (6100)	O
H3, **H4**	Pilot signal (H3 and H4 only)	ISO 6149	M14 x 1.5; 11.5 (0.45) deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	**ISO 6149**	M14 x 1.5; 11.5 (0.45) deep	100 (1450)	O
X	Pilot signal (S0 and DG only)	ISO 6149[7]	M14 x 1.5; 11.5 (0.45) deep	420 (6100)	O
M	Measuring, control pressure	ISO 6149[7]	M14 x 1.5; 12 (0.47) deep	420 (6100)	X
$\mathbf{M_A}$	Measuring, pressure A	ISO 6149[7]	M14 x 1.5; 12 (0.47) deep	420 (6100)	X
P	External control pressure (Ordering code position 8 version B or C = with external control pressure supply)	ISO 6149[7]	M14 x 1.5; 11.5 (0.45) deep	50 (725)	O
	Port **P** is without function (Ordering code position 8 version A = without external control pressure supply)	ISO 6149[7]	M18 x 1.5; 14.5 deep	420 (6100)	X

Ports – version “A” SAE		**Standard**	**Size**[4]	$p_{\text{max abs}}$ **[bar (psi)]**[5]	**State**[9]
A	Service line Fastening thread	SAE J518 ASME B1.1	1 1/2 in 5/8-11UNC-2B; 30 (1.18) deep	420 (6100)	O
S	Suction port (without charge pump) Fastening thread	SAE J518 ASME B1.1	3 1/2 in 5/8-11UNC-2B; 30 (1.18) deep	30 (435)	O
S	Suction port (with charge pump) Fastening thread	SAE J518[4] ASME B1.1	3 1/2 in 5/8-11UNC-2B; 30 (1.18) deep	2 (30)	O
$\mathbf{T_1}$	Drain port	ISO 11926[7]	1 5/8-12UNF-2B; 20 (0.79) deep	10 (145)	O[8]
$\mathbf{T_2}$	Drain port	ISO 11926[7]	1 5/8-12UNF-2B; 20 (0.79) deep	10 (145)	X[8]
$\mathbf{T_3}$	Drain port	ISO 11926[7]	1 5/8-12UNF-2B; 20 (0.79) deep	10 (145)	X[8]
CR	Pilot signal (CR only)	ISO 11926	9/16-18UNF-2B; 13 (0.51) deep	420 (6100)	O
PR	Pilot signal (PR only)	ISO 11926	9/16-18UNF-2B; 13 (0.51) deep	420 (6100)	O
H3, **H4**	Pilot signal (H3 and H4 only)	ISO 11926	9/16-18UNF-2B; 13 (0.51) deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	**ISO 11926**	9/16-18UNF-2B; 13 (0.51) deep	100 (1450)	O
X	Pilot signal (S0 and DG only)	ISO 11926[7]	9/16-18UNF-2B; 13 (0.51) deep	420 (6100)	O
M	Measuring, control pressure	ISO 11926[7]	9/16-18UNF-2B; 13 (0.51) deep	420 (6100)	X
$\mathbf{M_A}$	Measuring, pressure A	ISO 11926[7]	9/16-18UNF-2B; 13 (0.51) deep	420 (6100)	X
P	External control pressure (Ordering code position 8 version B or C = with external control pressure supply)	ISO 11926[7]	9/16-18UNF-2B; 13 (0.51) deep	50 (725)	O
	Port **P** is without function (Ordering code position 8 version A = without external control pressure supply)	ISO 11926[7]	3/4-16UNF-2B; 12.6 (0.50) deep	420 (6100)	X

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[5] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

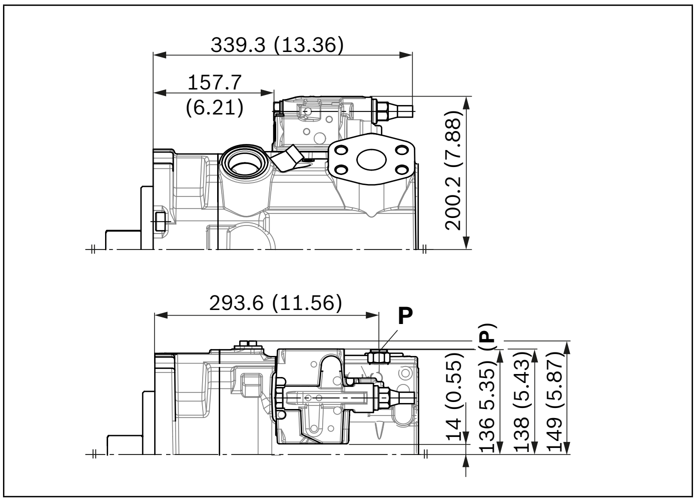
[6] Metric fastening thread is a deviation from standard.

[7] The countersink can be deeper than as specified in the standard.

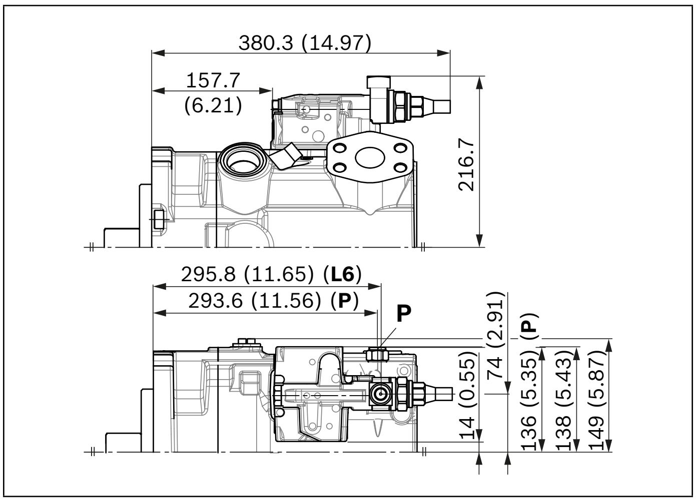
[8] Depending on installation position, T_1, T_2 or T_3 must be connected (see also Installation instructions on pages 64 and 65).

[9] O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

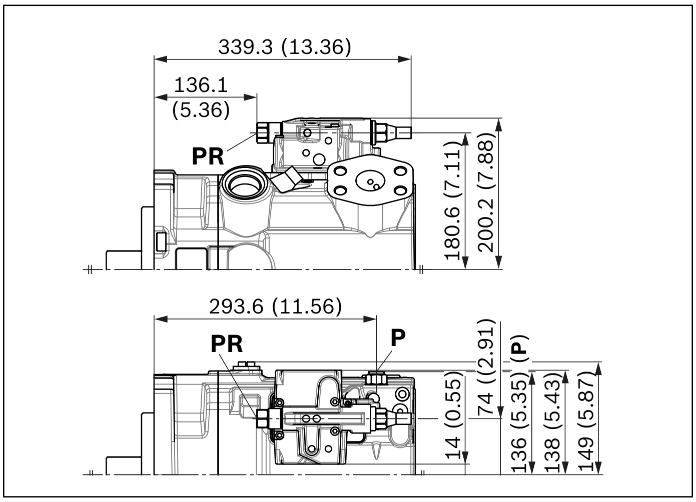
▼ **LR** – Power controller, fixed setting



▼ **L5/L6** – Power controller, hydraulic override



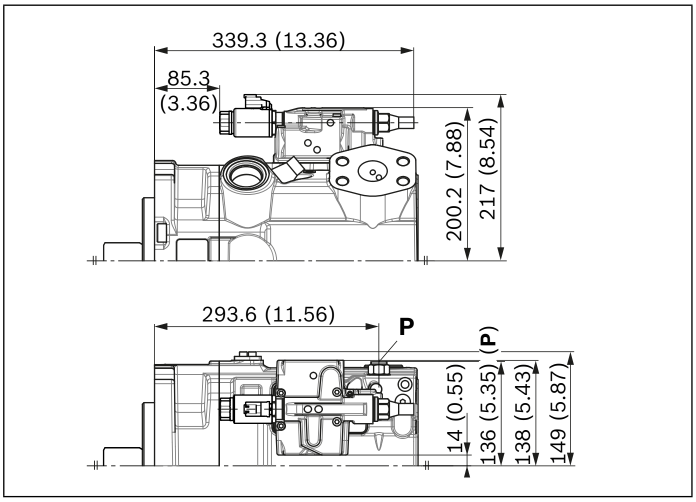
▼ **PR** – Power controller, hydraulic-proportional override, high pressure, without stop



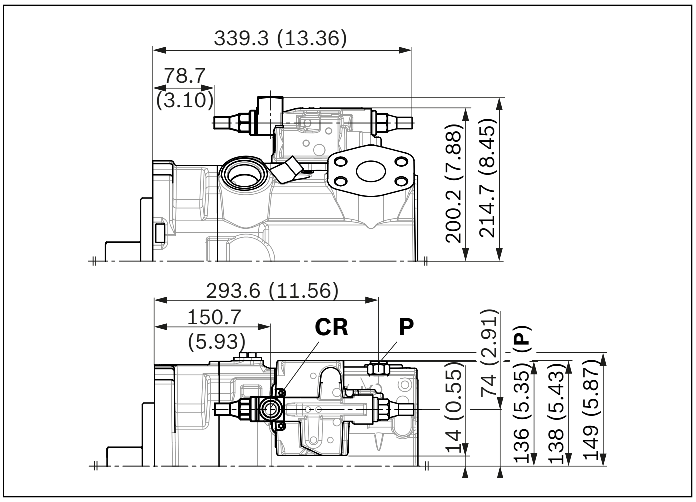
Notice

All controllers described with shuttle valve in **P** (some contrary to standard as per ordering code position 08)

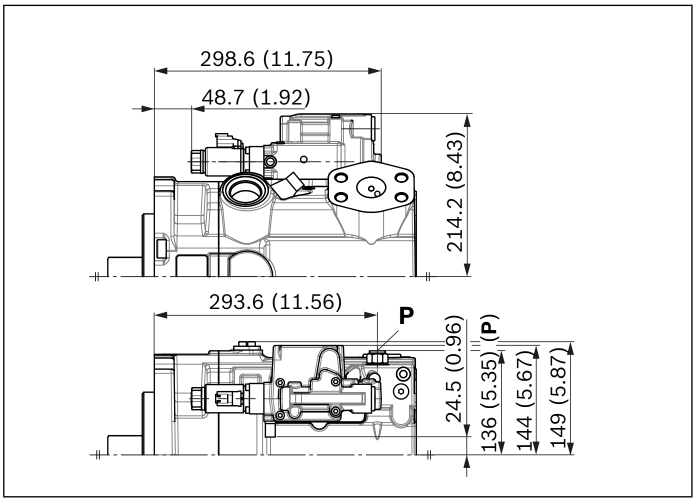
▼ **L3/L4** – Power controller, electric-proportional override



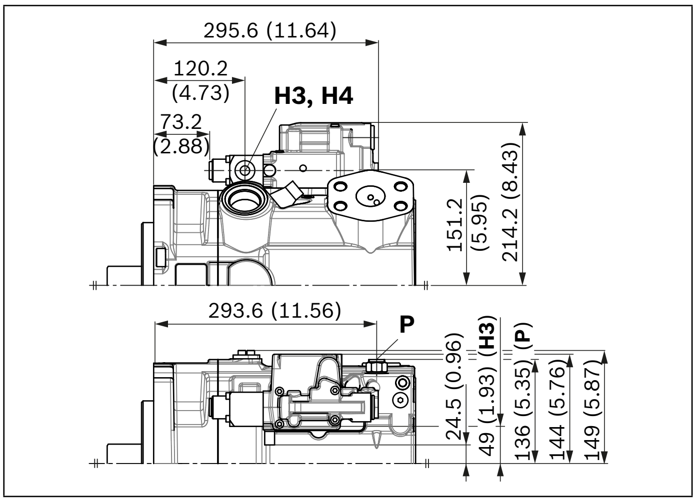
▼ **CR** – Power controller, hydraulic-proportional override, high pressure, with stop



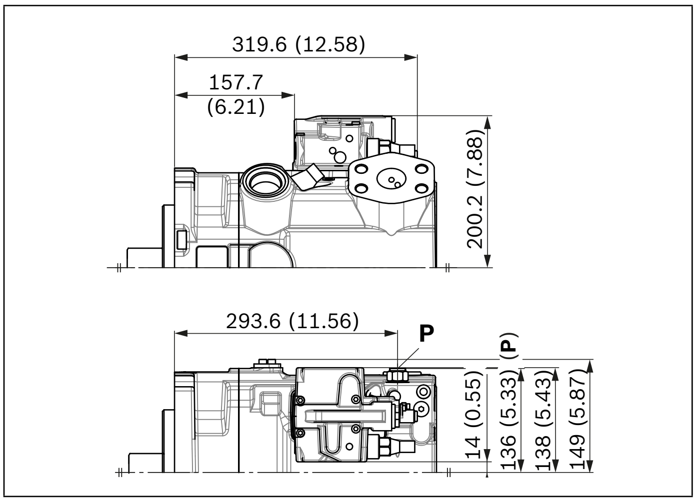
▼ **E1/E2** – Stroke control electric-proportional



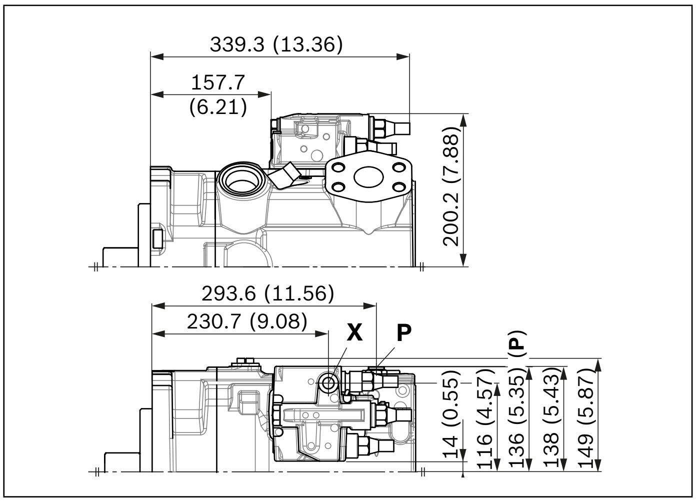
▼ **H3/H4** – Stroke control, hydraulic-proportional, pilot pressure



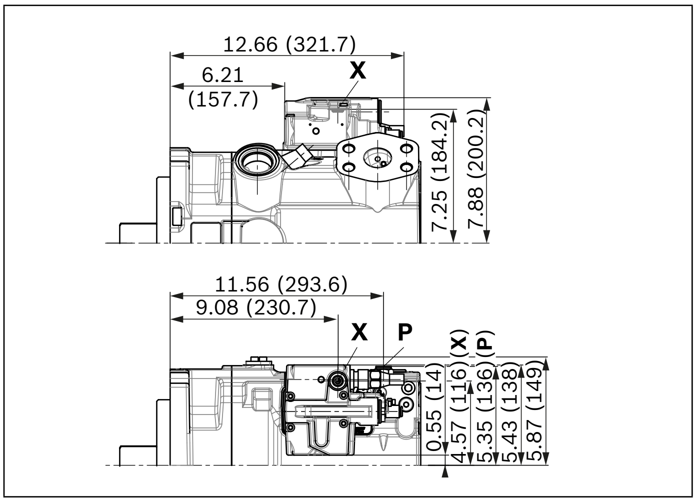
▼ **DR** – Pressure controller, fixed setting



▼ **LRDRS0** – Power controller with pressure controller and load sensing, fixed setting



▼ **DG** – Pressure controller, hydraulic, remote controlled



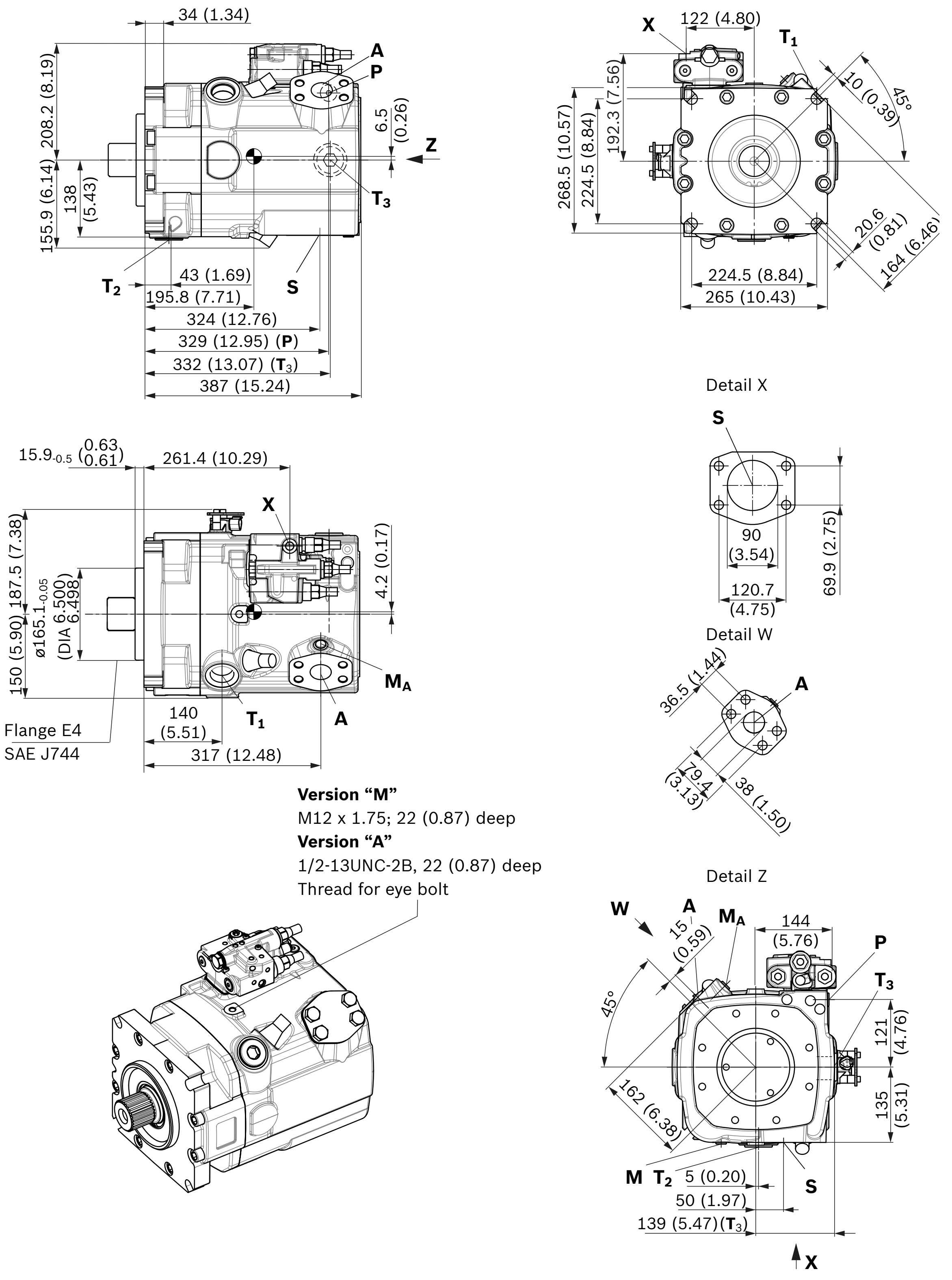
Notice

All controllers described with shuttle valve in **P** (some contrary to standard as per ordering code position 08)

Dimensions size 280

LRDRS0 – Power controller with pressure controller, load sensing and with electric swivel angle sensor

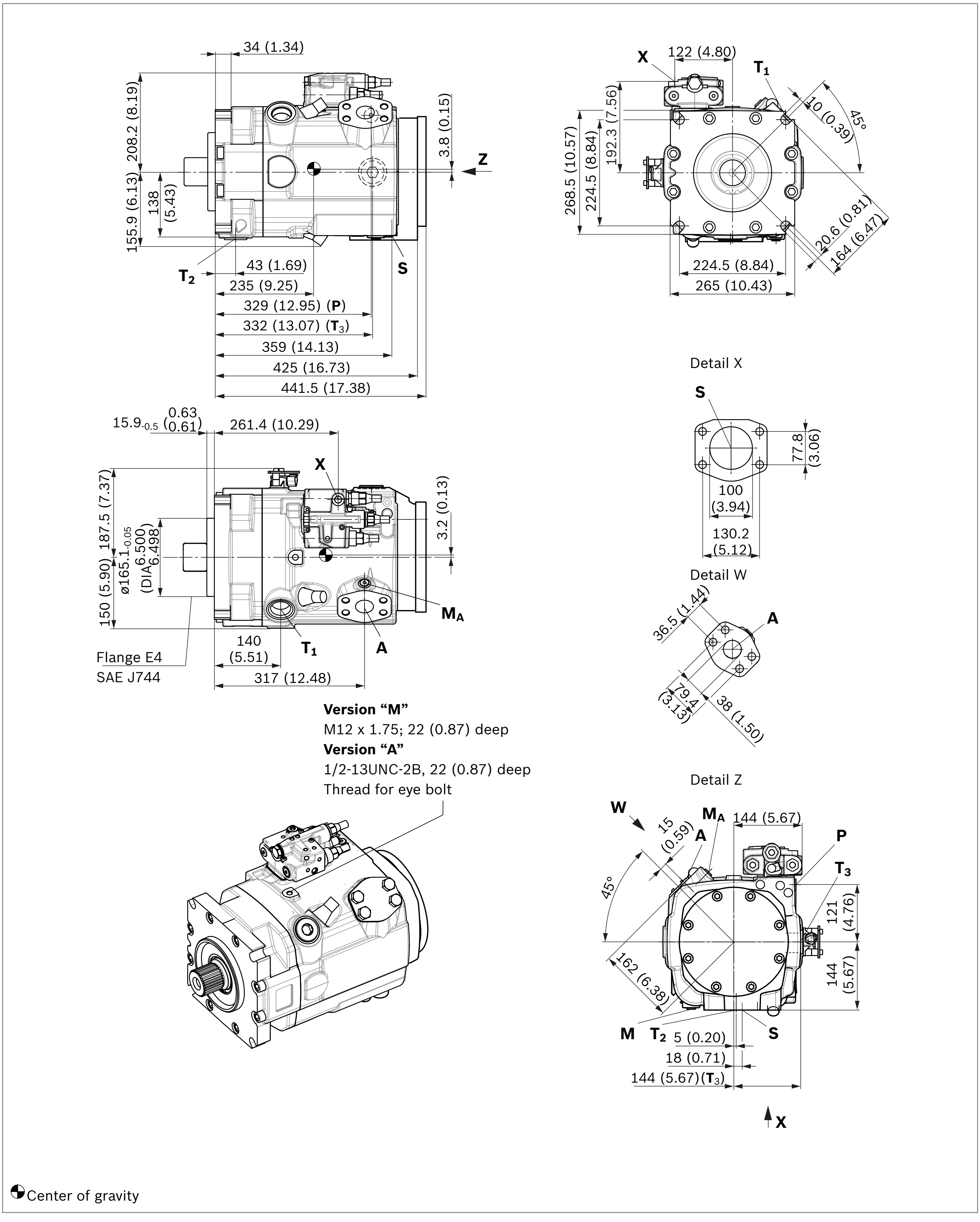
Without charge pump, clockwise rotation



◐ Center of gravity

LRDRS0 – Power controller with pressure controller, load sensing and with electric swivel angle sensor

With charge pump, clockwise rotation

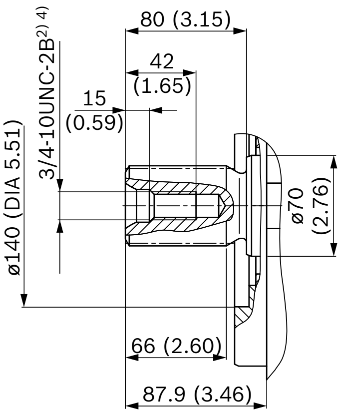


Version "M"
M12 x 1.75; 22 (0.87) deep
Version "A"
1/2-13UNC-2B, 22 (0.87) deep
Thread for eye bolt

Center of gravity

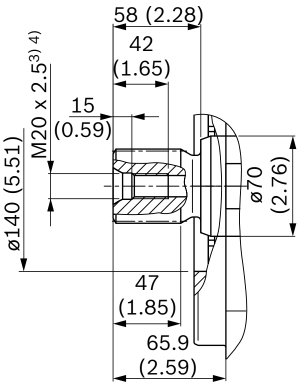
▼ **Splined shaft SAE J744**

T3 – 2 1/4 in 17T 8/16DP[1]



▼ **Splined shaft DIN 5480**

A4 – W60x2x28x9g



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1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Center bore according to DIN 332 (thread according to DIN 13)

4) Observe the instructions in the operating instructions concerning the maximum tightening torques.

Ports – version “M” metric		Standard	Size$^{1)}$	$p_{\text{max abs}}$ [bar (psi)]$^{2)}$	State$^{6)}$
A	Service line Fastening thread	SAE J518$^{3)}$ DIN 13	1 1/2 in M16 x 2; 24 (0.94) deep	420 (6100)	O
S	Suction port (without charge pump) Fastening thread	SAE J518$^{3)}$ DIN 13	3 1/2 in M16 x 2; 24 (0.94) deep	30 (435)	O
S	Suction port (with charge pump) Fastening thread	SAE J518$^{3)}$ DIN 13	4 in M16 x 2; 24 (0.94) deep	2 (30)	O
T_1	Drain port	ISO 6149$^{4)}$	M42 x 2; 19.5 (0.77) deep	10 (145)	O$^{5)}$
T_2	Drain port	ISO 6149$^{4)}$	M42 x 2; 19.5 (0.77) deep	10 (145)	X$^{5)}$
T_3	Drain port	ISO 6149$^{4)}$	M42 x 2; 19.5 (0.77) deep	10 (145)	X$^{5)}$
CR	Pilot signal (CR only)	ISO 6149	M14 x 1.5; 11.5 (0.45) deep	420 (6100)	O
PR	Pilot signal (PR only)	ISO 6149	M14 x 1.5; 11.5 (0.45) deep	420 (6100)	O
H3, **H4**	Pilot signal (H3 and H4 only)	ISO 6149	M14 x 1.5; 11.5 (0.45) deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	**ISO 6149**	M14 x 1.5; 11.5 (0.45) deep	100 (1450)	O
X	Pilot signal (S0 and DG only)	ISO 6149$^{4)}$	M14 x 1.5; 11.5 (0.45) deep	420 (6100)	O
M	Measuring, control pressure	ISO 6149$^{4)}$	M14 x 1.5; 12 (0.47) deep	420 (6100)	X
M_A	Measuring, pressure A	ISO 6149$^{4)}$	M14 x 1.5; 12 (0.47) deep	420 (6100)	X
P	External control pressure (ordering code position 8 version B or C = with external control pressure supply)	ISO 6149$^{4)}$	M14 x 1.5; 11.5 (0.45) deep	50 (725)	O
	Port **P** is without function (Ordering code position 8 version A = without external control pressure supply)	ISO 6149$^{4)}$	M18 x 1.5; 14.5 0.57) deep	420 (6100)	X

Ports – version “A” SAE		Standard	Size$^{1)}$	$p_{\text{max abs}}$ [bar (psi)]$^{2)}$	State$^{6)}$
A	Service line Fastening thread	SAE J518 ASME B1.1	1 1/2 in 5/8-11UNC-2B; 35$^{7)}$ (1.38) deep	420 (6100)	O
S	Suction port (without charge pump) Fastening thread	SAE J518 ASME B1.1	3 1/2 in 5/8-11UNC-2B; 35$^{7)}$ (1.38) deep	30 (435)	O
S	Suction port (with charge pump) Fastening thread	SAE J518 ASME B1.1	3 1/2 in 5/8-11UNC-2B; 35$^{7)}$ (1.38) deep	2 (30)	O
T_1	Drain port	ISO 11926$^{4)}$	1 5/8UN-2B; 20 (0.79) deep	10 (145)	O$^{5)}$
T_2	Drain port	ISO 11926$^{4)}$	1 5/8UN-2B; 20 (0.79) deep	10 (145)	X$^{5)}$
T_3	Drain port	ISO 11926$^{4)}$	1 5/8UN-2B; 20 (0.79) deep	10 (145)	X$^{5)}$
CR	Pilot signal (CR only)	ISO 11926	9/16-18UNF-2B; 13 (0.51) deep	420 (6100)	O
PR	Pilot signal (PR only)	ISO 11926	9/16-18UNF-2B; 13 (0.51) deep	420 (6100)	O
H3, **H4**	Pilot signal (H3 and H4 only)	ISO 11926	9/16-18UNF-2B; 13 (0.51) deep	100 (1450)	O
L5, L6	Override power controller (only with L5 and L6)	**ISO 11926**	9/16-18UNF-2B; 13 (0.51) deep	100 (1450)	O
X	Pilot signal (S0 and DG only)	ISO 11926$^{4)}$	9/16-18UNF-2B; 13 (0.51) deep	420 (6100)	O
M	Measuring, control pressure	ISO 11926$^{4)}$	9/16-18UNF-2B; 13 (0.51) deep	420 (6100)	X
M_A	Measuring, pressure A	ISO 11926$^{4)}$	9/16-18UNF-2B; 13 (0.51) deep	420 (6100)	X
P	External control pressure (Ordering code position 8 version B or C = with external control pressure supply)	ISO 11926$^{4)}$	9/16-18UNF-2B; 13 (0.51) deep	50 (725)	O
	Port **P** is without function (Ordering code position 8 version A = without external control pressure supply)	ISO 11926$^{4)}$	3/4-16UNF-2B; 12.6 (0.50) deep	420 (6100)	X

1) Observe the instructions in the operating instructions concerning the maximum tightening torques.

2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

3) Metric fastening thread is a deviation from standard.

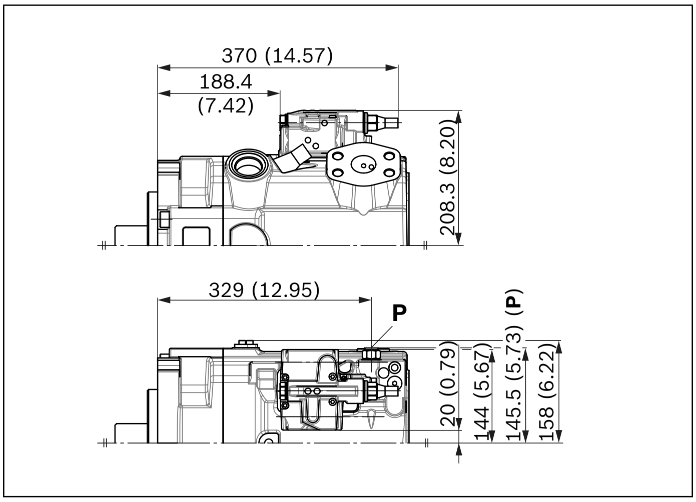
4) The countersink can be deeper than as specified in the standard.

5) Depending on installation position, T_1, T_2 or T_3 must be connected (see also Installation instructions on pages 64 and 65).

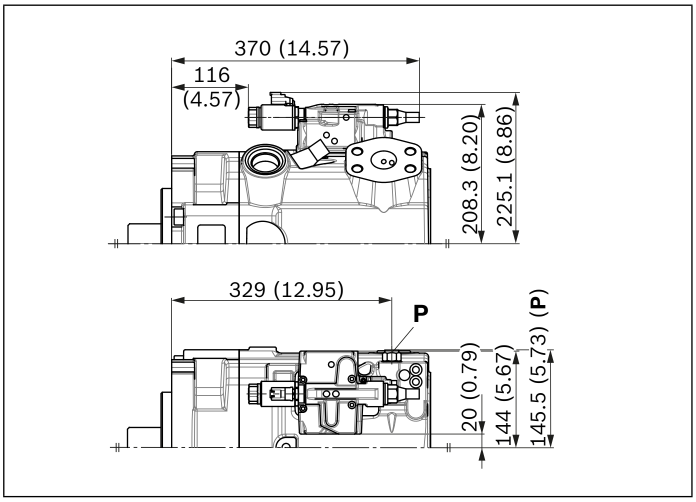
6) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

7) The thread depth is 30 mm (1.18 in) for the left pump direction of rotation

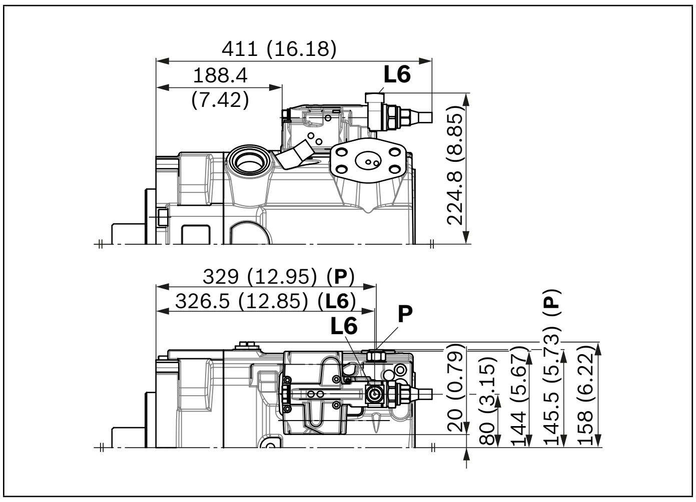
▼ **LR** – Power controller, fixed setting



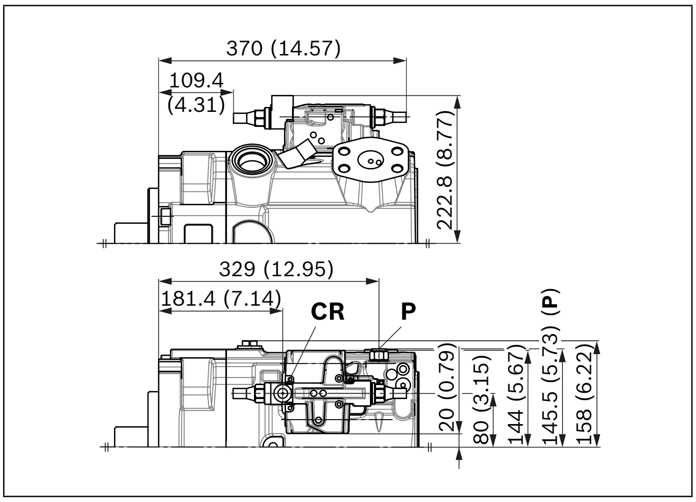
▼ **L3/L4** – Power controller, electric-proportional override



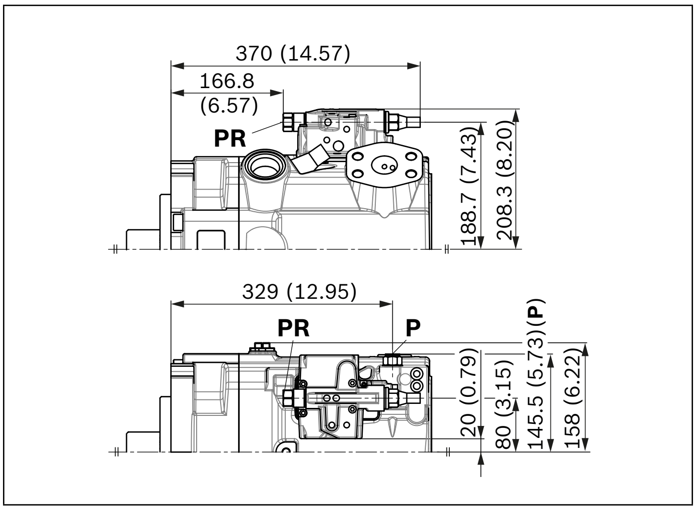
▼ **L5/L6** – Power controller, hydraulic override



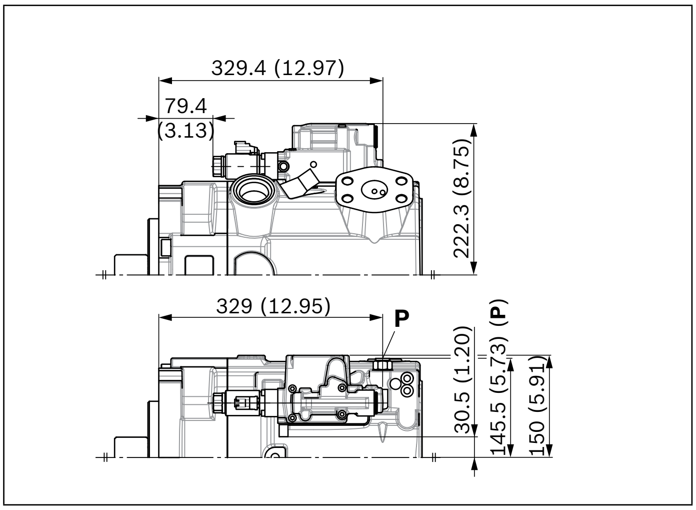
▼ **CR** – Power controller, hydraulic-proportional override, high pressure, with stop



▼ **PR** – Power controller, hydraulic-proportional override, high pressure, without stop



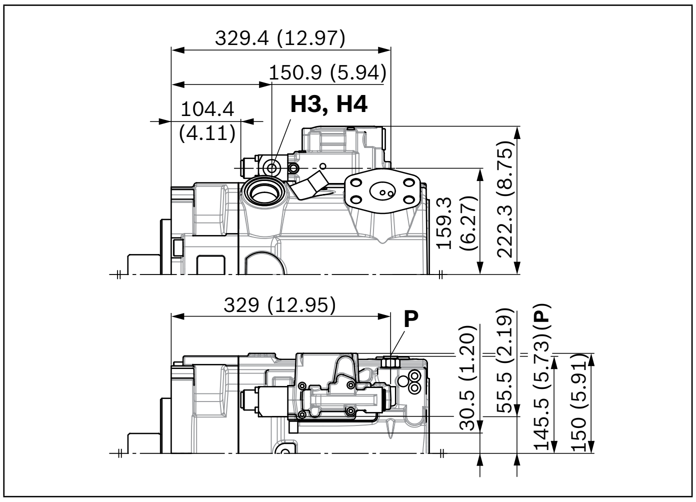
▼ **E1/E2** – Stroke control electric-proportional



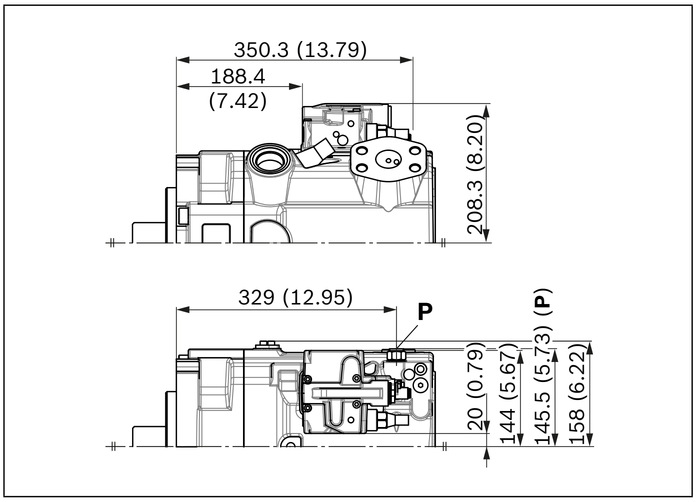
Notice

All controllers described with shuttle valve in **P** (some contrary to standard as per ordering code position 08)

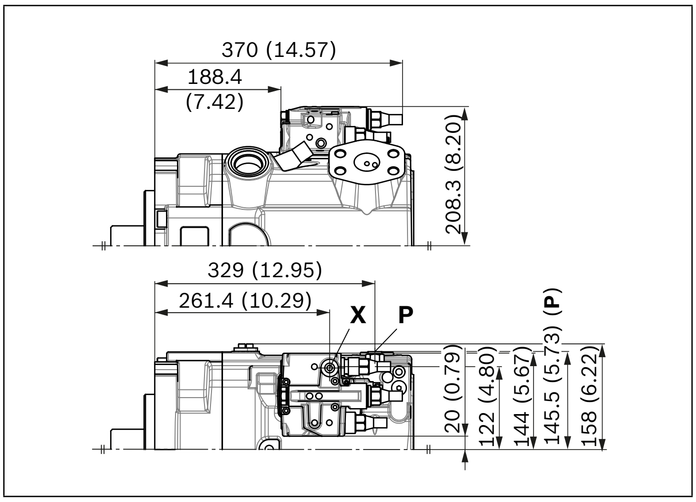
▼ **H3/H4** – Stroke control, hydraulic-proportional, pilot pressure



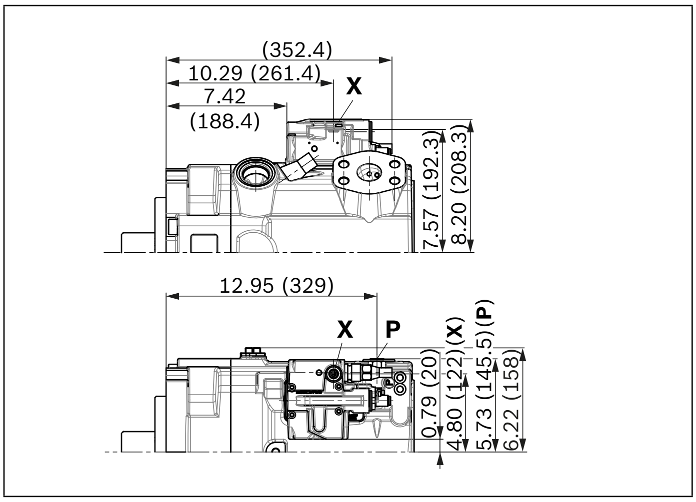
▼ **DR** – Pressure controller, fixed setting



▼ **LRDRS0** – Power controller with pressure controller and load sensing, fixed setting



▼ **DG** – Pressure controller, hydraulic, remote controlled



Notice

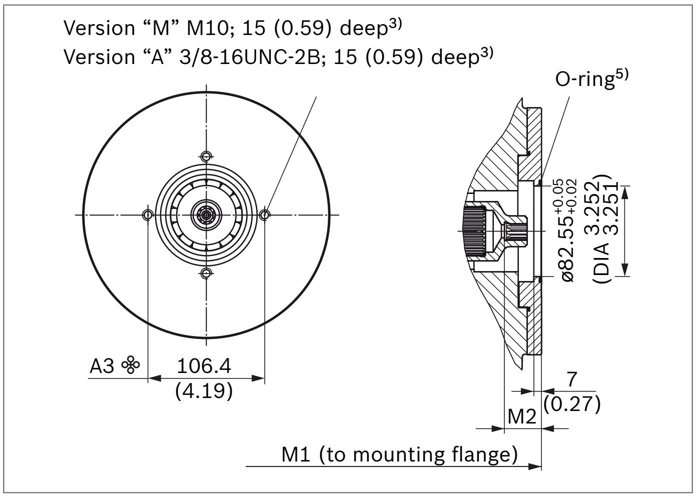
All controllers described with shuttle valve in **P** (some contrary to standard as per ordering code position 08)

Dimensions, through drives

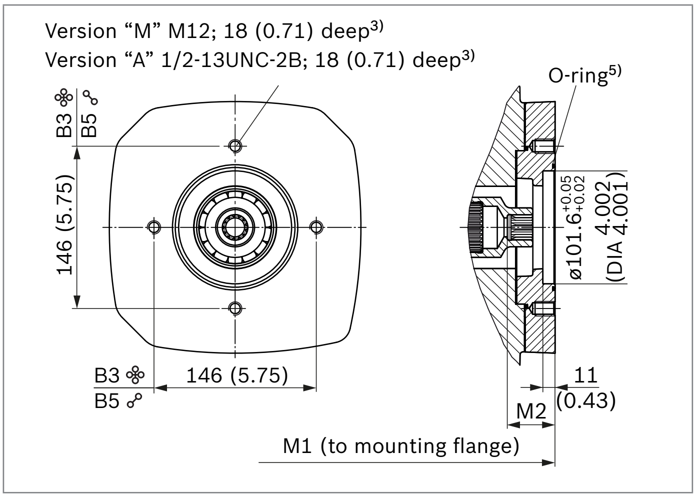
Flange SAE J744			Hub for splined shaft[1]			Availability over sizes					Code
Diameter	Attachment[2]	Designation	Diameter		Designation	110	145	175	210	280	
82-2 (A)	✣	A3	5/8 in	9T 16/32DP	S2	●	●	●	●	●	A3S2
			3/4 in	11T 16/32DP	S3	○	○	●	●	●	A3S3
101-2 (B)	✣	B3	7/8 in	13T 16/32DP	S4	●	●	●	●	●	B3S4
			1 in	15T 16/32DP	S5	●	●	●	●	●	B3S5
	⚯	B5	7/8 in	13T 16/32DP	S4	●	●	●	●	●	B5S4
			1 in	15T 16/32DP	S5	○	○	●	●	○	B5S5

● = Available ○ = On request

▼ 82-2 (A)



▼ 101-2 (B)



A3S2	NG	M1	M2
without charge pump	110	301 (11.85)	34 (1.39)
	145	326 (12.83)	40 (1.57)
	175	340.5 (13.41)	33.8 (1.33)
	210	357.8 (14.09)	33.8 (1.33)
	280	400 (15.75)	33.8 (1.33)
with charge pump	145	374.7 (14.75)	40 (1.57)
	175	389.5 (15.33)	33.8 (1.33)
	210	406.8 (16.02)	33.8 (1.33)
	280	438 (17.24)	33.8 (1.33)

A3S3	NG	M1	M2
without charge pump	175	340.5 (13.41)	40 (1.57)
	210	357.8 (14.09)	40 (1.57)
	280	400 (15.75)	40 (1.57)
with charge pump	175	389.5 (15.33)	40 (1.57)
	210	406.8 (16.02)	40 (1.57)
	280	438 (17.24)	40 (1.57)

B3S4, B5S4	NG	M1	M2
without charge pump	110	312 (12.28)	43 (1.69)
	145	337 (13.27)	43 (1.69)
	175	355 (13.97)	43 (1.69)
	210	372.3 (14.65)	43 (1.69)
	280	414.5 (16.31)	43 (1.69)
with charge pump	145	385.7 (15.19)	43 (1.69)
	175	404 (15.90)	43 (1.69)
	210	421.3 (16.58)	43 (1.69)
	280	452.5 (17.81)	43 (1.69)

B3S4, B3S5	NG	M1	M2
without charge pump	110	312 (12.28)	48 (1.89)
	145	337 (13.27)	48 (1.89)
	175	355 (13.97)	48 (1.89)
	210	372.3 (14.65)	48 (1.89)
	280	414.5 (16.31)	48 (1.89)
with charge pump	145	385.7 (15.18)	48 (1.89)
	175	404 (15.90)	48 (1.89)
	210	421.3 (16.58)	48 (1.89)
	280	452.5 (17.81)	48 (1.89)

---

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Mounting bores pattern viewed from through drive with control at top

3) Thread according to DIN 13, observe the general instructions on page 66 for the maximum tightening torques.

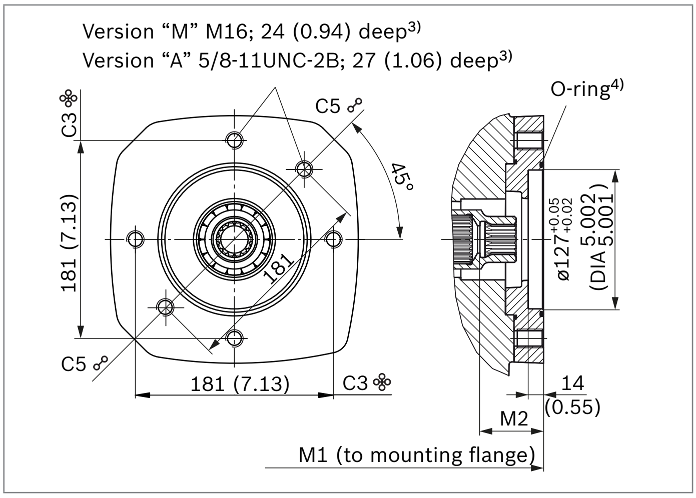
4) Thread according to ASME B1.1, observe the general instructions on page 66 for the maximum tightening torques.

5) O-ring included in the scope of delivery

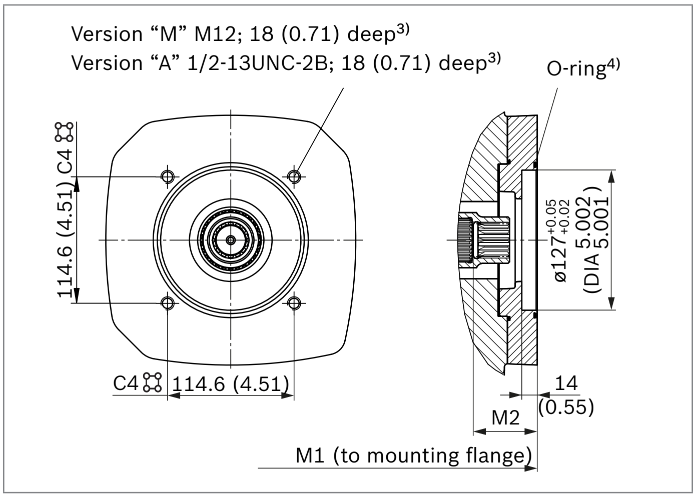
Flange SAE J744			Hub for splined shaft[1]		Availability over sizes					Code
Diameter	Attachment[2]	Designation	Diameter	Designation	110	145	175	210	280	
127-2 (C)	✣	C3	1 1/4 in 14T 12/24DP	S7	●	●	●	●	●	C3S7
			1 1/2 in 17T 12/24DP	S9	○	○	●	●	●	C3S9
	⚯	C5	1 1/4 in 14 12/24DP	S7	○	–	●	●	●	C5S7
127-4 (C)	⌘	C4	1 1/4 in 14T 12/24DP	S7	●	●	●	●	○	C4S7

● = Available ○ = On request

▼ **127-2 (C)**



▼ **127-4 (C)**



C3S7	NG	M1	M2
without charge pump	110	323 (12.72)	58 (2.28)
	145	348 (13.70)	58 (2.28)
	175	354.5 (13.96)	58.1 (2.29)
	210	371.8 (14.64)	58.1 (2.29)
	280	414 (16.30)	58.1 (2.29)
with charge pump	145	396.7 (15.62)	58 (2.28)
	175	403.5 (15.89)	58.1 (2.29)
	210	420.8 (16.57)	58.1 (2.29)
	280	452 (17.80)	58.1 (2.29)

C3S9	NG	M1	M2
without charge pump	175	359.5 (14.15)	64 (2.52)
	210	376.8 (14.83)	64 (2.52)
	280	414 (16.30)	63.8 (2.51)
with charge pump	175	408.5 (16.08)	64 (2.52)
	210	425.8 (16.76)	64 (2.52)
	280	452 (17.80)	63.8 (2.51)

C5S7	NG	M1	M2
without charge pump	175	354.5 (13.96)	58 (2.28)
	210	371.8 (14.64)	58 (2.28)
	280	414 (16.30)	58 (2.28)
with charge pump	175	403.5 (15.89)	58 (2.28)
	210	420.8 (16.57)	58 (2.28)
	280	452 (17.80)	58 (2.28)

C4S7	NG	M1	M2
without charge pump	110	323 (12.72)	58 (2.28)
	145	348 (13.70)	58 (2.28)
	175	354.5 (13.96)	58 (2.28)
	210	371.8 (14.64)	58 (2.28)
with charge pump	145	396.7 (15.62)	58 (2.28)
	175	403.5 (15.89)	58 (2.28)
	210	420.8 (16.57)	58 (2.28)

---

[1] According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Mounting bores pattern viewed from through drive with control at top

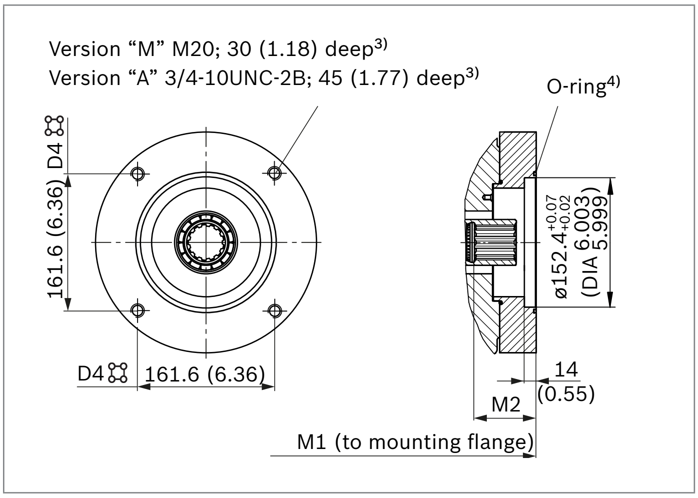
[3] Thread according to DIN 13, observe the general instructions on page 66 for the maximum tightening torques.

[4] O-ring included in the scope of delivery

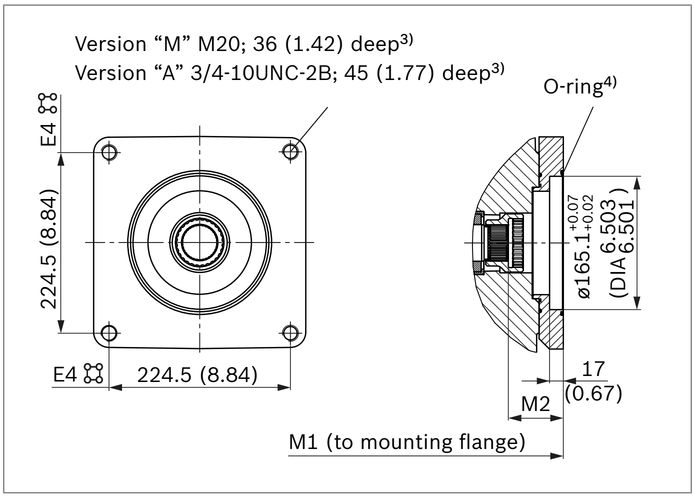
Flange SAE J744			Hub for splined shaft[1]			Availability over sizes					Code
Diameter	Attachment[2]	Designation	Diameter		Designation	110	145	175	210	280	
152-4 (D)	⌘	D4	1 3/4 in	13T 8/16DP	T1	●	●	●	●	●	D4T1
165-4 (E)	⌘	E4	1 3/4 in	13T 8/16DP	T1	–	–	●	●	●	E4T1
			2 in	15T 8/16DP	T2	–	–	●	●	●	E4T2
			2 1/4 in	17T 8/16DP	T3	–	–	–	–	●	E4T3
			W60x2x28x9g[5]		A4	–	–	–	–	●	E4A4

● = Available ○ = On request

▼ 152-4 (D)



▼ 165-4 (E)



D4T1	NG	M1	M2
without charge pump	110	336 (13.23)	77 (3.03)
	145	361 (14.21)	76.8 (3.02)
	175	372.5 (14.67)	76.8 (3.02)
	210	389.8 (15.35)	76.8 (3.02)
	280	432 (17.01)	77 (3.03)
with charge pump	145	409.7 (16.13)	76.8 (3.02)
	175	421.5 (16.59)	76.8 (3.02)
	210	438.8 (17.28)	76.8 (3.02)
	280	470 (18.50)	77 (3.03)

E4T1	NG	M1	M2
without charge pump	175	355 (13.98)	77 (3.03)
	210	389.8 (15.35)	77 (3.03)
	280	432 (17.00)	77 (3.03)
with charge pump	175	421.5 (16.59)	77 (3.03)
	210	438.8 (17.27)	77 (3.03)
	280	470 (18.50)	77 (3.03)

E4T2	NG	M1	M2
without charge pump	175	385.5 (15.18)	90 (3.54)
	210	402.8 (15.86)	90 (3.54)
	280	445 (17.52)	90 (3.54)
with charge pump	175	434.5 (17.11)	90 (3.54)
	210	451.8 (17.79)	90 (3.54)
	280	483 (19.02)	90 (3.54)

E4T3	NG	M1	M2
without charge pump	280	445 (17.52)	90 (3.54)
with charge pump	280	483 (19.02)	90 (3.54)

E4A4	NG	M1	M2
without charge pump	280	423 (16.65)	68 (2.68)
with charge pump	280	461 (18.15)	68 (2.68)

---

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Mounting bores pattern viewed from through drive with control at top

3) Thread according to DIN 13, observe the general instructions on page 66 for the maximum tightening torques.

4) O-ring included in the scope of delivery

5) Hub N60x2x28x8H according to DIN 5480

Overview of mounting options

Through drive[1]			**Attachment options – 2nd pump**						
Flange	**Hub for splined shaft**	**Code**	**A11VO/40 NG (shaft)**	**A10VO/31 NG (shaft)**	**A10VO/32 NG (shaft)**	**A4VG/32 NG (shaft)**	**A4VG/40 NG (shaft)**	**A10VO/52 and 53 NG (shaft)**	**External gear**
82-2 (A)	5/8 in	A3S2	–	18 (U)	–	–	–	10, 18 (U)	Series F[2]
	3/4 in	A3S3		18 (S, R)				10 (S), 18 (S, R)	
101-2 (B)	7/8 in	B_S4	–	28 (S, R); 45 (U, W)	–	–	–	28 (R, S); 45 (U, W)	Series N[2]
	1 in	B_S5	–	45 (R, S)	–	28 (S)	–	45 (R, S); 60, 63 (U, W)	PGH4
127-2 (C)	1 1/4 in	C_S7	–	71 (R, S); 100 (U, W)	71 (R) (S)	40, 56, 71 (S)	45, 65 (S7)	85, 100 (U, W)	–
	1 1/2 in	C3S9	–	100 (S)	100 (S)	–	45, 65 (S9)	85, 100 (S)	PGH5
	1 1/4 in	C5S7		71 (S, R) 100 (U, W)	71 (S, R) 100 (U, W)			85, 100 (U, W)	
127-4 (C)	1 1/4 in	C4S7	–	–	71 (R) (S)	–	65 (S7)	60, 63 (R, S) 85 (U, W)	–
	1 3/8 in	C4V8	–	–	–	–	85, 110 (V8)	–	–
152-4 (D)	1 1/4 in	D4S7	–	–	100 (U,W)	90 (U)	–	–	–
	1 3/8 in	D4V8	–	–	–	–	85, 110 (V8)	–	–
	1 3/4 in	D4T1	110, 145 (T1)	140 (S)	140 (S)	90, 125 (S)	145 (T1)	–	–
165-4 (E)	1 3/4 in	E4T1	–	–	–	180, 250 (S)	145, 175 (T1)	–	–
	2 in	E4T2	175, 210 (T2)	–	–	–	145 (T2)	–	–
	2 1/4 in	E4T3	280 (T3)	–	–	180, 250 (T)	175 (T3)	–	–
	W60	E4A4	280 (A4)	–	–	–	–	–	–

---

1) Additional through drives are available on request

2) Bosch Rexroth recommends special versions of the external gear pumps. Please contact us.

Combination pumps A11V(L)O + A11V(L)O

Total length A

A11VO (1st pump)	**A11VO (2nd pump)**						**A11VLO (2nd pump)**				
	NG110	**NG145**	**NG175**	**NG210**	**NG280**	**NG280**	**NG145**	**NG175**	**NG210**	**NG280**	**NG280**
	D4T1	**D4T1**	**E4T2**	**E4T2**	**E4A4**	**E4T3**	**D4T1**	**E4T2**	**E4T2**	**E4A4**	**E4T3**
NG110	621 (24.45)	–	–	–	–	–	–	–	–	–	–
NG145	646 (25.43)	671 (26.42)	–	–	–	–	736.2 (28.98)	–	–	–	–
NG175	657.5 (25.89)	682.5 (26.87)	713 (28.07)	–	–	–	747.7 (29.44)	780 (30.71)	–	–	–
NG210	674.8 (26.57)	699.8 (27.55)	730.3 (28.75)	747.6 (29.43)	–	–	765 (30.12)	797.3 (31.00)	814.6 (32.07)	–	–
NG280	717 (28.23)	742 (29.21)	772.5 (30.41)	789.8 (31.09)	810 (31.90)	832 (32.76)	807.2 (31.78)	839.5 (33.05)	856.8 (33.73)	866 (34.09)	888 (34.96)

A11VLO (1st pump)	**A11VO (2nd pump)**						**A11VLO (2nd pump)**				
	NG110	**NG145**	**NG175**	**NG210**	**NG280**	**NG280**	**NG145**	**NG175**	**NG210**	**NG280**	**NG280**
	D4T1	**D4T1**	**E4T2**	**E4T2**	**E4A4**	**E4T3**	**D4T1**	**E4T2**	**E4T2**	**E4A4**	**E4T3**
NG 145	694.7 (27.35)	719.7 (28.33)	–	–	–	–	784.9 (30.90)	–	–	–	–
NG175	706.5 (27.81)	731.5 (28.80)	762 (30.00)	–	–	–	796.7 (31.37)	829 (32.64)	–	–	–
NG210	723.8 (28.50)	748.8 (29.48)	779.3 (30.68)	796.6 (31.36)	–	–	814 (32.05)	846.3 (33.32)	863.6 (34.00)	–	–
NG280	755 (29.72)	780 (30.71)	810.5 (31.91)	827.8 (32.59)	848 (33.39)	870 (34.25)	845.2 (33.28)	877.5 (34.55)	894.8 (35.23)	904 (35.59)	926 (36.46)

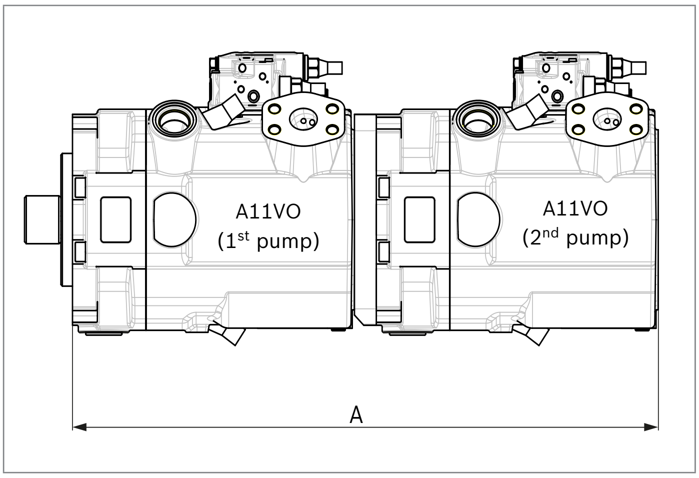
By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes. When ordering combination pumps, the type designations of the 1st and 2nd pumps must be linked by a "**+**".

Order example:

A11VO280LRDRA00/40M(A)RVE4A41SE4A40-0+

A11VO280LRDRA00/40M(A)RVE4A41SU0000-0

A tandem pump consisting of two equal sizes is permissible without additional supports assuming that the dynamic mass acceleration does not exceed maximum 10 g (= 98.1 m/s²). For combination pumps consisting of more than two pumps, the mounting flange must be rated for the permissible mass torque.



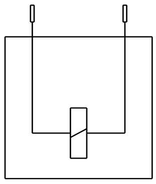
Connector for solenoids

DEUTSCH DT04-2P-EP04

Molded, 2-pin, without bidirectional suppressor diode, with mating connector mounted, results in the following type of protection:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)

▼ **Switching symbol**



▼ **Mating connector DEUTSCH DT06-2S-EP04**

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).

Notice

If necessary, you can change the position of the connector by turning the solenoid.
The procedure is defined in the instruction manual.

AMP Junior-Timer, 2-pin

Type of protection:

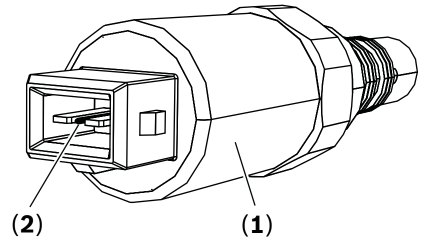
- IP69K (DIN 40050-9)

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R901022127); see also data sheet 08006.

- Outer diameter of conductor 2.2 mm (0.09 in) to 3.0 mm (0.12 in)

Manual override

When power supply to the vehicle is interrupted, maximum operating pressure can be established by means of a manual override so that the vehicle can be driven under its own power from a danger zone.



To activate the manual override:

- Unplug the electrical connector from the pressure reducing valve (1).
- Using a pointed tool, press both PINs (2) in up to the stop.
  Both PINs must remain in the depressed position!

Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.

Particularly in the installation position “drive shaft upwards”, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The case drain fluid in the pump housing must be directed to the reservoir via the highest available drain port (**T**$_1$, **T**$_2$, **T**$_3$).

For combination pumps, the leakage must be drained off at each pump.

If a shared drain line is used for several units, make sure that the respective case pressure is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operating conditions, specifically on cold start. If this is not possible, separate drain lines must be laid if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction line and drain line must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\ max}$ = 800 mm (31.50 in). The minimum suction pressure at port **S** must also not fall below 0.8 bar (12 psi) absolute (without charge pump) or 0.7 bar (11 psi) absolute (with charge pump) during operation and during a cold start.

When designing the reservoir, ensure adequate distance between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Notice

In certain installation positions, an influence on the control characteristic can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristic curves and changes in response time.

Installation position

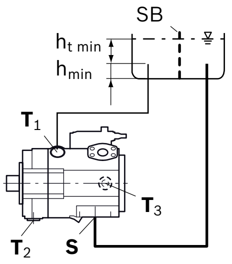
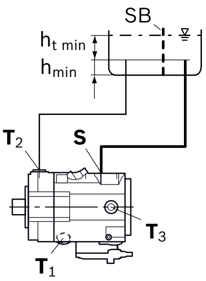
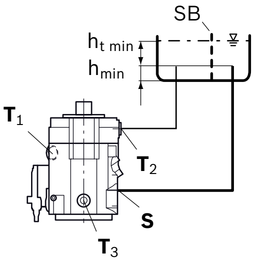
See the following examples **1** to **9**.

Further installation positions are available upon request.

Recommended installation position: **1** and **2**

Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir and below the minimum fluid level of the reservoir.

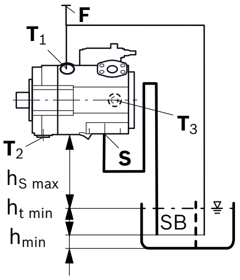
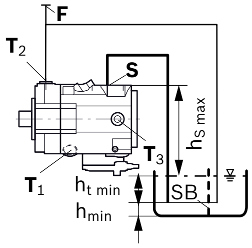
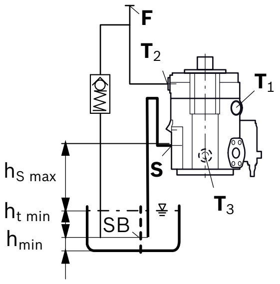
Installation position		Air bleed	Filling
1		**T**$_1$	**S** + **T**$_1$
2		**T**$_2$	**S** + **T**$_2$
3		**T**$_2$	**S** + **T**$_2$

Key	
L	Filling / air bleeding
S	Suction port
T	Drain port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm (7.87 in))
h_{min}	Minimum required distance to reservoir bottom (100 mm (3.94 in))
$h_{ES\ min}$	Minimum necessary height required to protect the axial piston unit from draining (25 mm (1 in))
$h_{S\ max}$	Maximum permissible suction height (800 mm (31.50 in))

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. To prevent the axial piston unit from draining, a height difference $h_{ES\ min}$ of at least 25 mm (1 in) at port **T**$_2$ is required in position 6. Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm (31.50 in).

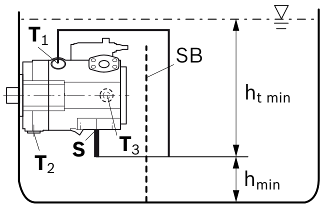
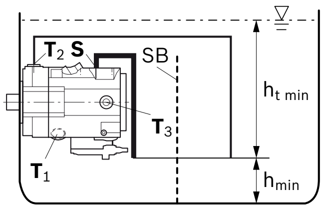
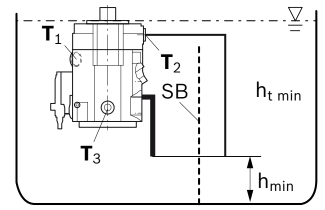
The above-reservoir installation is not permitted for units with charge pump (A11V**L**O).

<table>
<tr><th>Installation position</th><th></th><th>Air bleed</th><th>Filling</th></tr>
<tr><td>4</td><td> </td><td>F</td><td>T₁ (F)</td></tr>
<tr><td>5</td><td> </td><td>F</td><td>T₂ (F)</td></tr>
<tr><td>6</td><td> </td><td>F</td><td>T₂ (F)</td></tr>
</table>

Inside-reservoir installation

Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level. The axial piston unit is completely below the hydraulic fluid. If the minimum fluid level is equal to or below the upper edge of the pump, see chapter "**Above-reservoir installation**".

Axial piston units with electric components (e.g. electric controls, sensors) must not be installed in a reservoir below the fluid level.

<table>
<tr><th>Installation position</th><th></th><th>Air bleed</th><th>Filling</th></tr>
<tr><td>7</td><td> </td><td>Via the highest available port T₁</td><td>Automatically via the open port T₁ due to the position under the hydraulic fluid level</td></tr>
<tr><td>8</td><td> </td><td>Via the highest available port T₂</td><td>Automatically via the open port T₂ due to the position under the hydraulic fluid level</td></tr>
<tr><td>9</td><td> </td><td>Via the highest available port T₂</td><td>Automatically via the open port T₂ due to the position under the hydraulic fluid level</td></tr>
</table>

Notice

Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

Project planning notes

- The A11V(L)O axial piston variable pump is designed to be used in open circuits.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes contained herein must be observed.
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic curve may shift.
- The characteristic curve may also shift due to the dither frequency or control electronics.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all versions of the product are approved for use in a safety function pursuant to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference.
  Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- Pressure controllers are not safeguards against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports are only intended to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of getting burnt on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve pistons) can, under certain circumstances get blocked in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filter) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.

Axial piston variable pump
A1VO Series 10

- For load-sensing-systems in smaller working machines
- Sizes 18, 28, 35
- Nominal pressure 250 bar
- Maximum pressure 280 bar
- Open circuit

Characteristics

- Variable pump with axial piston rotary group of swashplate design for hydrostatic drives in open circuit
- Flow is proportional to the drive speed and displacement.
- The flow can be infinitely varied by controlling the swashplate angle.
- Significant fuel savings of up to 15% compared to fixed systems
- Optimized efficiency, though same power at less fuel consumption
- Increased service life compared to gear pumps
- Compact design by integrated controller
- A wide range of highly adaptable control devices for all important applications
- Low noise
- High power density
- Excellent suction characteristics
- High flexibility due to interchangeable through drive adapter

Contents

Ordering code

01	02	03	04	05	06	07	08		09	10	11	12	13	14	15	16	17		18
A1V	**O**				**2**		**0**	**/**	**10**			**V**					**00**	**–**	**0**

Axial piston unit

01	Variable swashplate design, nominal pressure 250 bar, maximum pressure 280 bar	**A1V**

Operating mode

02	Pump, open circuit	**O**

Size (NG)

03	Geometric displacement, see “Technical data” on page 7	**018**	**028**	**035**

Control device

				018	**028**	**035**	
04	Pressure controller	Setting range 100 to 250 bar		●	●	●	**DR**
		with load sensing		●	●	●	**DRS0**
		Setting range 20 to 100 bar		●	●	●	**DN**
		with load sensing		●	●	●	**DNS0**
		with override, electric-proportional, negative control	U = 12 V	●	●	●	**D3**
			U = 24 V	●	●	●	**D4**

Controller design and mounting

05	Built-on (only possible at control valve D3 and D4)	●	●	●	**A**
	Cartridge (only possible at control valve DR, DRS0, DN and DNS0)	●	●	●	**C**

Setting

06	Adjustable	**2**

Connector for solenoids[1] (see page 21)

07	Without connector (without solenoid, only for hydraulic control)	●	●	●	**0**
	DEUTSCH - molded connector, 2-pin, without suppressor diode	●	●	●	**P**

Additional function

08	Without additional function	**0**

Series

09	Series 1, index 0	**10**

Design of ports and fastening threads

10	ANSI, port threads with O-ring seal according to ISO 11926, metric fastening thread on through drive version	●	●	●	**B**
	ISO, port threads with O-ring seal according to ISO 6149, metric fastening thread on through drive version	●	●	●	**M**

Direction of rotation

11	Viewed on drive shaft	clockwise	●	●	●	**R**
		counter-clockwise	●	●	●	**L**

Sealing material

12	FKM (fluoroelastomer)	**V**

Mounting flanges

13	SAE J744	82-2	●	●	–	**A2**
		101-2	●	●	●	**B2**

---

[1] Connectors for other electric components may differ

01	02	03	04	05	06	07	08		09	10	11	12	13	14	15	16	17		18
A1V	**O**				**2**		**0**	**/**	**10**			**V**					**00**	**–**	**0**

Drive shaft (permissible input torque, see page 8)

			018	028	035	
14	Splined shaft ANSI B92.1a (Bosch Rexroth recomendet in case of through drive to use the next biggest drive shaft)	3/4 in 11T 16/32DP	●	●	–	**S3**
		7/8 in 13T 16/32 DP[2]	●	●	●	**S4**
		1 in 15T 16/32DP	–	–	●	**S5**

Service line port

		018	028	035	
15	Threaded ports B and S on opposite sides	●	●	●	**1**
	Threaded ports B and S at rear; not for through drive	●	●	○	**9**

Through drives (for attachment options, see page 19)

16	Flange SAE J744			Hub for splined shaft[3]						
	Diameter	Attachment[4]	Designation	Diameter		Designation	018	028	035	
	Without through drive						●	●	●	**0000**
	82-2 (A)	o-o	A2	5/8 in	9T 16/32 DP	S2	●	●	●	**A2S2**
				3/4 in	11T 16/32 DP	S3	●	●	●	**A2S3**
				7/8 in	13T 16/32 DP	S4	●	●	●	**A2S4**
	101-2 (B)	o-o	B2	7/8 in	13T 16/32 DP	S4	●	●	●	**B2S4**
				1 in	15T 16/32 DP	S5	–	–	●	**B2S5**

Reduction of geometric displacement

17	Without reduction	**00**

Standard / special version

18	Standard version	**0**

● = Available ○ = On request – = Not available

Notes

Note the project planning notes on page 24.

---

[2] For size 35, not for through drive

[3] According to ANSI B92.1a

[4] Mounting drillings pattern viewed on through drive, with service line port B on right.

Hydraulic fluids

The A1VO variable pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons

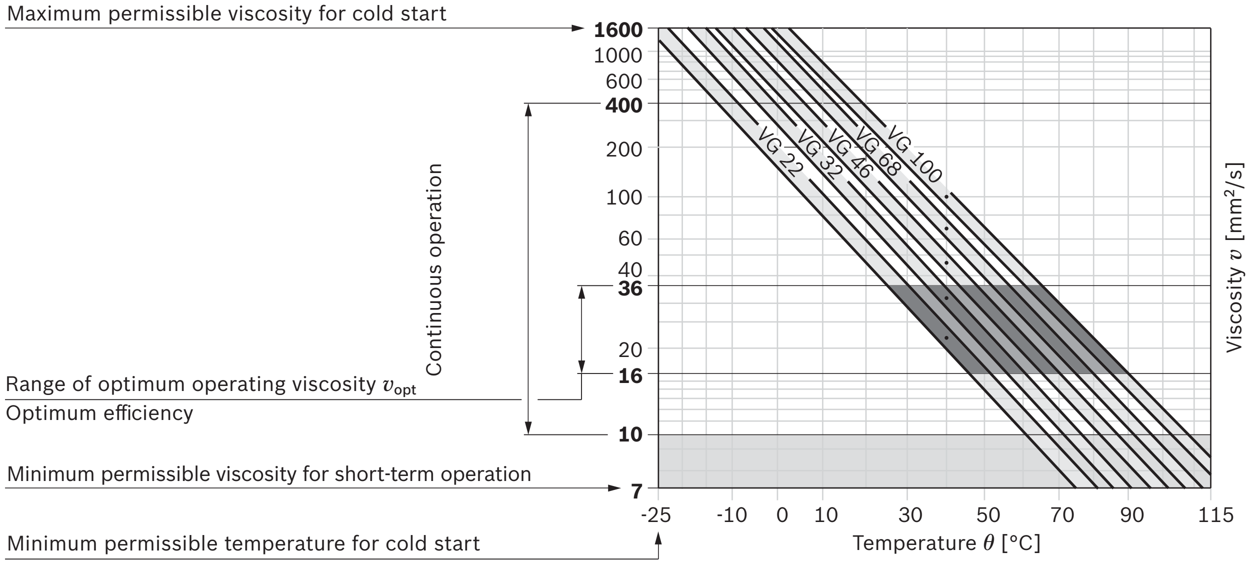
Details regarding the selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}, see selection diagram).

Note
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \leq 1600$ mm²/s	$\theta_{St} \geq -25$ °C	$t \leq 3$ min, without load (20 bar $\leq p \leq$ 50 bar), $n \leq 1000$ RPM
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu <$ 1600 to 400 mm²/s	$\theta = -25$ °C	at $p \leq 0.7 \cdot p_{nom}$, $n \leq 0.5 \cdot n_{nom}$ and $t \leq 15$ min
Continuous operation	$\nu =$ 400 to 10 mm²/s		This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram)
		$\theta = -25$ °C to +90 °C	Note the permissible temperature range of the shaft seal measured at port **L** (ΔT = approx. 5 K between the bearing/shaft seal and port **L**)
	ν_{opt} = 36 to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \geq 7$ mm²/s		$t < 1$ min, $p < 0.3 \cdot p_{nom}$

▼ **Selection diagram**



Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit. In order to guarantee the functional reliability of the axial piston unit it is necessary to carry out a gravimetric evaluation of the hydraulic fluid to determine the particle contamination and the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 must be maintained.
At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), at least cleanliness level 19/17/14 according to ISO 4406 is necessary.
Please contact us if the above classes cannot be observed.

Shaft seal

The FKM shaft seal ring may be used for leakage temperatures from -25 °C to +115 °C.

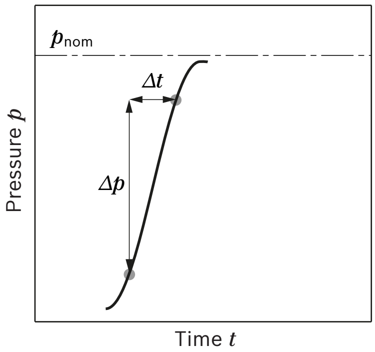
Note

For the temperature range below -25 °C, the values in the table on page 4 are to be observed.

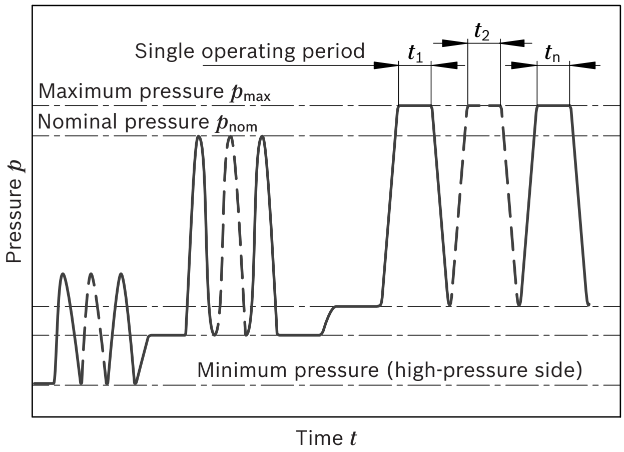
Working pressure range

Pressure at service line port B		Definition
Nominal pressure p_{nom}	250 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	280 bar	The maximum pressure corresponds the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period (maximum number of cycles: approx. 1 million).
Single operating period	0.05 s	
Total operating period	14 h	
Minimum pressure $p_{B\ abs}$ (high-pressure side)	14 bar[1]	Minimum pressure on the high-pressure side (**B**) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{A\ max}$	16000 bar/s	Maximum permissible rate of pressure build-up and reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{S\ min}$	0.8 bar absolute	Minimum pressure at suction port **S** (inlet) that is required in order to avoid damage to the axial piston unit. The minimum pressure depends on the speed and displacement of the axial piston unit.
Maximum pressure $p_{S\ max}$	5 bar absolute	
Leakage pressure at port L_1, L_2		
Maximum pressure $p_{L\ max}$	2 bar absolute	Maximum 0.5 bar higher than inlet pressure at port **S**, but not higher than $p_{L\ max}$.

▼ **Rate of pressure change $R_{A\ max}$**



▼ **Pressure definition**



Total operating period = $t_1 + t_2 + \ldots + t_n$

Note
Working pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

---

[1] Please contact us about lower pressures

Technical data

Size			NG		018	028	035
Displacement, geometric, per revolution			$V_{g\ max}$	cm³	18	28	35
			$V_{g\ min}$	cm³	0	0	0
Maximum rotational speed[1)2)]	at $V_{g\ max}$		n_{nom}	rpm	3300	3200	3000
Flow	at n_{nom} and $V_{g\ max}$		q_v	l/min	59	89	105
Power	at n_{nom}, $V_{g\ max}$ and Δp = 250 bar		P	kW	25	37	44
Torque	at $V_{g\ max}$ and Δp = 250 bar		T	Nm	72	111	139
Rotary stiffness of drive shaft	3/4 in 11T 16/32DP	S3	c	kNm/rad	9.78	9.78	–
	7/8 in 13T 16/32 DP	S4	c	kNm/rad	12.88	12.88	18.6
	1 in 15T 16/32DP	S5	c	kNm/rad	–	–	22.9
Moment of inertia for rotary group			J_{TW}	kgm²	0.000686	0.00737	0.00159
Maximum angular acceleration[5)]			α	rad/s²	6800	5500	5000
Case volume			V	l	0.5	0.5	0.6
Weight (**without** through drive) approx.			m	kg	12.3	12.3	18.4
Weight (**with** through drive) approx.			m	kg	13.5	13.5	19.8

Determining operating characteristics

Flow	q_v	$= \dfrac{V_g \times n \times \eta_v}{1000}$	[l/min]
Torque	T	$= \dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$	[Nm]
Power	P	$= \dfrac{2\,\pi \times T \times n}{60000} = \dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g	Displacement per revolution [cm³]
Δp	Differential pressure [bar]
n	Rotational speed [rpm]
η_v	Volumetric efficiency
η_{hm}	Hydraulic mechanical efficiency
η_t	Total efficiency ($\eta_t = \eta_v \bullet \eta_{hm}$)

Note

- Theoretical values, without efficiency and tolerances; values rounded.
- Exceeding the maximum or falling below the minimum permissible values can lead to a loss of function, a reduction in operational service life or total destruction of the axial piston unit. Bosch Rexroth recommend testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.

---

1) The values are valid:
   - For the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s
   - For hydraulic fluid based on mineral oils
   - For a pressure $p_{suction}$ ≥ 1 bar absolute at suction port **S**.

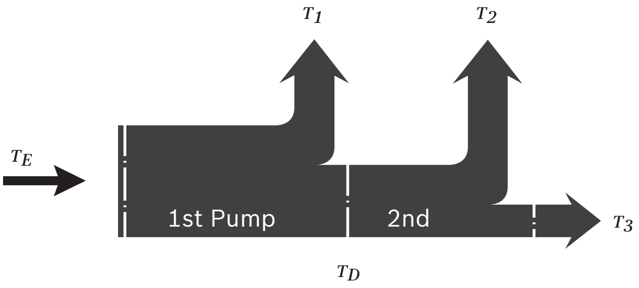
2) For a pressure $p_{suction}$ < 1 bar at suction port **S**, please contact us.

3) The data are valid at values between the minimum required and maximum permissible speed. Valid for external excitation (e.g., diesel engine 2 to 8 times rotary frequency; cardan shaft twice the rotary frequency). The limit value is only valid for a single pump. The load capacity of the connection parts must be considered.

Permissible input and through-drive torques

Size					018	028	035
Torque at $V_{g\,max}$ and Δp = 250 bar[1]			T_{max}	Nm	72	111	139
Input torque at drive shaft, maximum[2]							
	S3	3/4 in	$T_{E\,max}$	Nm	143	143	–
	S4	7/8 in	$T_{E\,max}$	Nm	198	198	198
	S5	1 in	$T_{E\,max}$	Nm	–	–	319
Through-drive torque, maximum[1]			$T_{D\,max}$	Nm			
	S3	3/4 in	$T_{D\,max}$	Nm	87	87	–
	S4	7/8 in	$T_{D\,max}$	Nm	87	87	139
	S5	1 in	$T_{D\,max}$	Nm	–	–	139

▼ Torque distribution



Torque at 1st Pump	T_1		
Torque at 2nd Pump	T_2		
Torque at 3rd Pump	T_3		
Input torque	T_E	=	$T_1 + T_2 + T_3$
	T_E	<	$T_{E\,max}$
Through-drive torque	T_D	=	$T_2 + T_3$
	T_D	<	$T_{D\,max}$

Note
For axial and/or radial loading (pinion, v-belt), please contact us!

---

[1] Efficiency not considered

[2] For drive shafts free of radial force

DR/DN pressure controller

The pressure controller limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only supplies as much hydraulic fluid as is required by the consumers. If the operating pressure exceeds the pressure setting at the pressure valve, the pump will regulate to a smaller displacement to reduce the control differential.

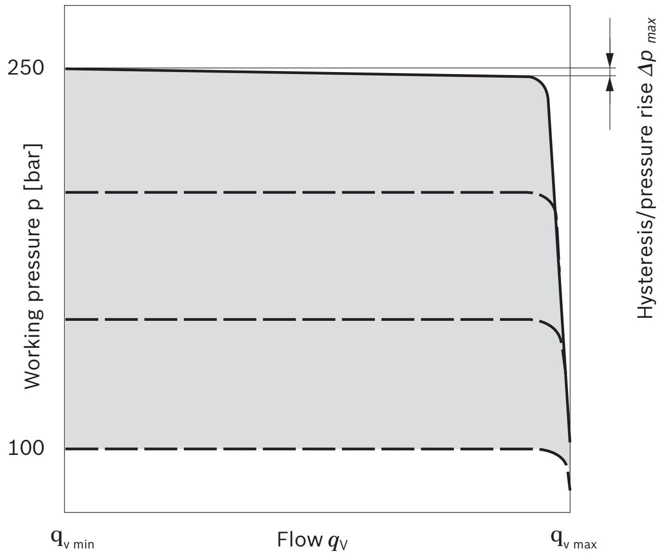
- Basic position in depressurized state: $V_{g\ max}$.
- **DR**

  Setting range [1] for pressure control 100 to 250 bar.
  Standard 250 bar

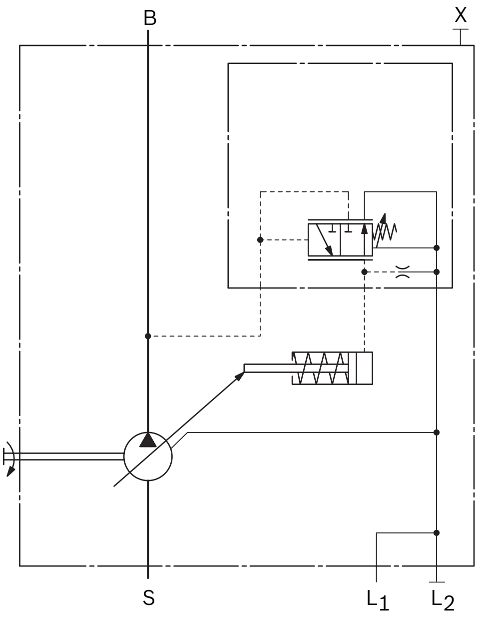
  DN

  Setting range[1] for pressure control 20 to 100 bar.
  Standard is 100 bar

▼ Characteristic curve DR



▼ Schematic DR



Controller data

NG	18	28	35
Hysteresis and repeat precision Δp	Maximum 5 bar		
Pilot fluid consumption	Approx. 3 l/min max.		

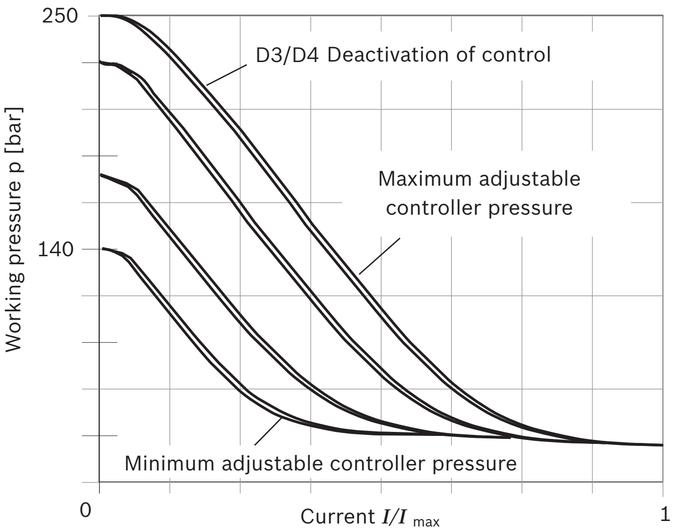
---

[1] In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. Lower values on request

D3/D4 – Pressure controller with override

With electric pressure adjustment using a proportional solenoid, the high pressure can be freely adjusted depending on the solenoid current. When the load pressure is changed at the consumer, the pump flow volume is adjusted so that the specified pressure is achieved again. If the solenoid current drops below the beginning of control, the unit will go to the set maximum pressure.
The same thing applies if the pilot signal is lost.

▼ **Current-pressure characteristic curve (negative characteristic curve)**



Characteristic curve measured with pump in zero stroke.
Further information on request.

DRS0/DNSO – Pressure controller with load sensing

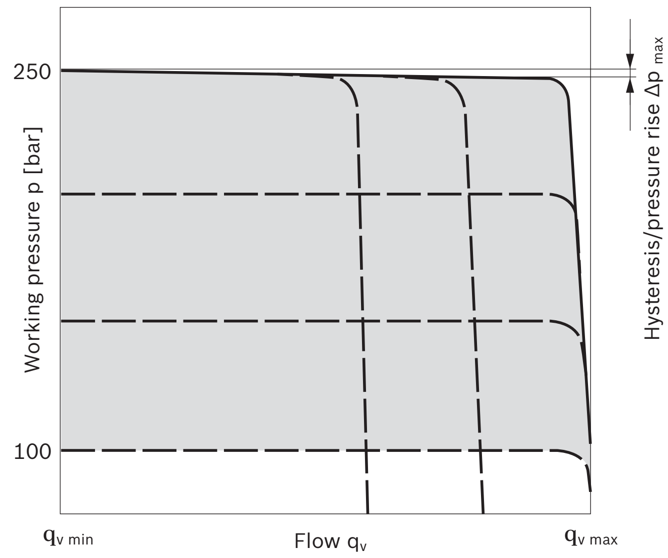
In addition to the pressure controller function (DR), the load-sensing controller works as a flow controller that operates as a function of the load pressure to regulate the pump displacement to match the consumer flow requirement. The load sensing controller compares pressure before and after the metering orifice and keeps the pressure drop (differential pressure Δp) across the orifice – and therefore the flow – constant.
The swiveling in due to the pressure or flow controller will always take priority.

- **DRS0**
  Setting range [1] for pressure control 100 to 250 bar.
- **DNS0**
  Setting range [1] for pressure control 20 to 100 bar.

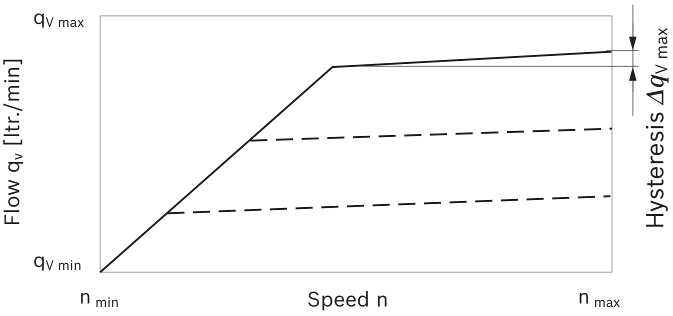
Note

The DRS0/DNSO version has no connection from **X** to the reservoir, which means that the LS relief has to be incorporated into the system.

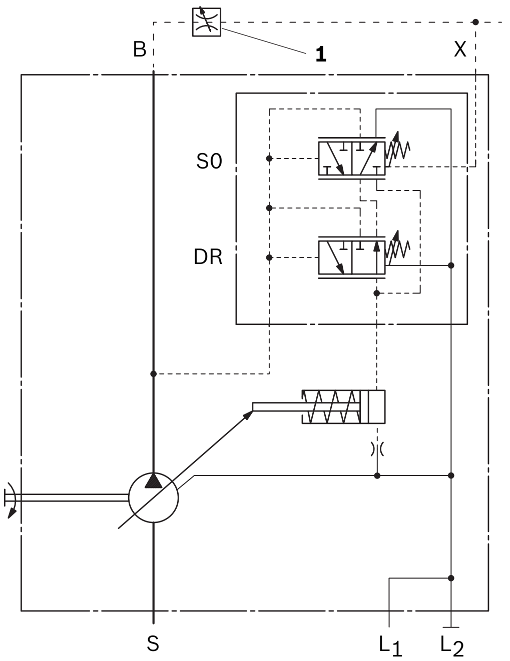
▼ **Characteristic curve DRS0**



▼ **Characteristic curve at variable speed**



▼ **Schematic DRS0**



1 The metering orifice (control block) is not included in the scope of delivery.

Differential pressure Δp

Standard setting: 14 bar. If another setting is required, please state in clear text.

Control data

For data for the pressure controller DR, please refer to page 9. Maximum flow differential (hysteresis and increase) measured at drive speed n = 1500 rpm and t_{fluid} = 50 °C

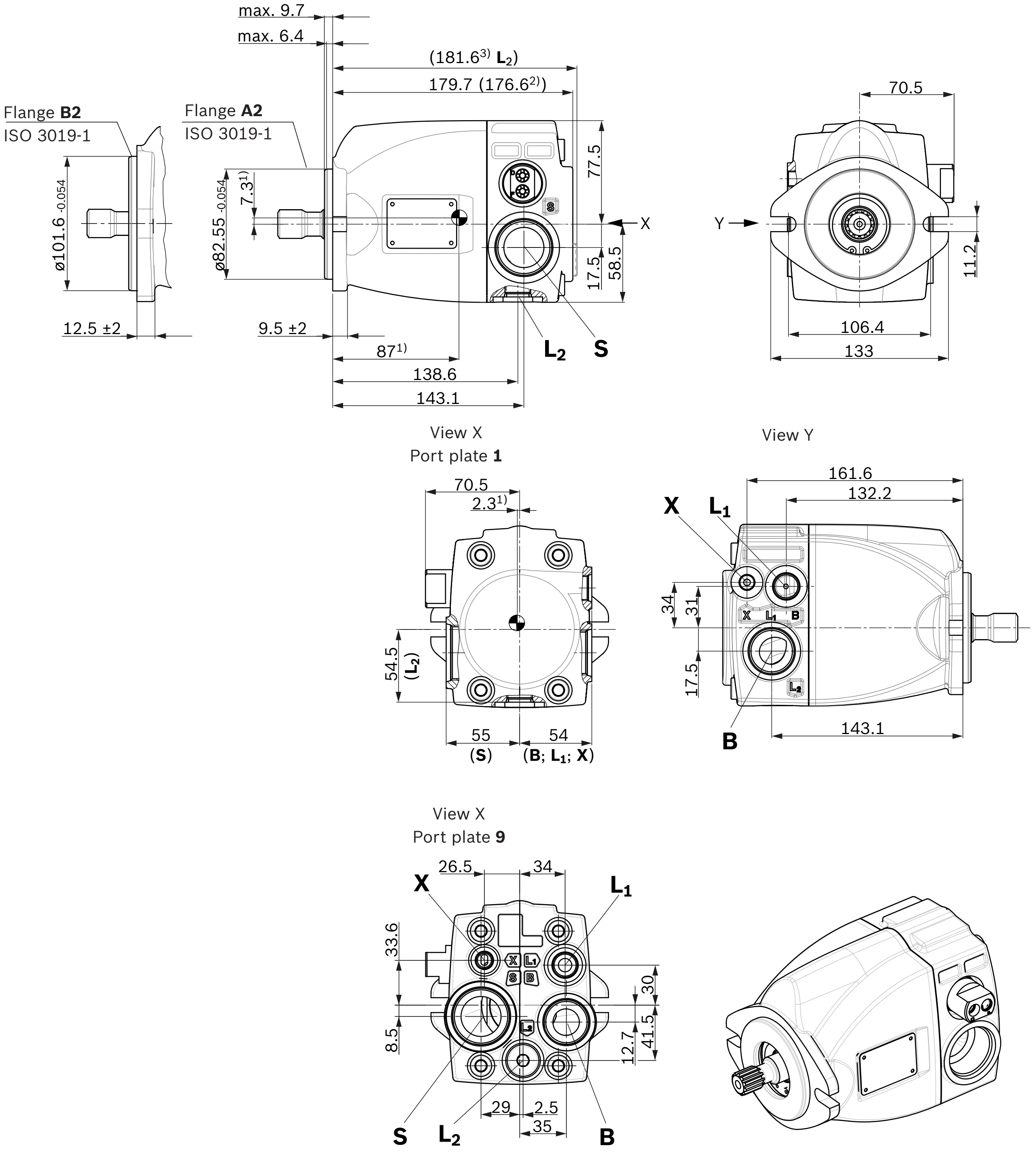
NG	18	28	35
Volume flow difference $\Delta q_{V\ max}$		3 l/min	
Maximum control fluid consumptionapprox.		4 l/min	

---

1) In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. Lower values on request

Dimensions size 18 and size 28

DR, DN – Pressure controller / DRS0, DNS0 – Pressure control with load sensing, clockwise rotation



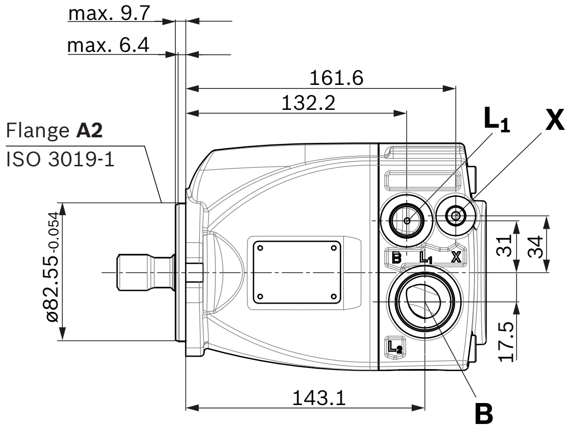
1) Center of gravity

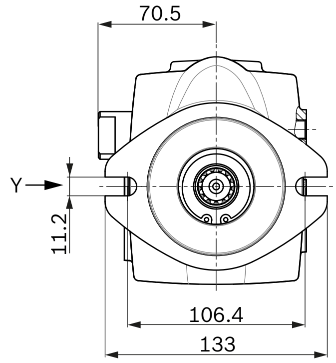
2) Connection surfaces **S**, **B**, **X**, **L**$_1$ and **L**$_2$ with port plate 9

3) Only at port plate 9 and L$_2$ closed

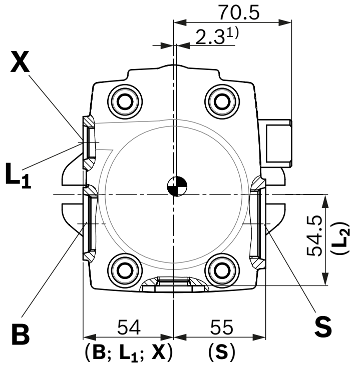
Dimensions size 18 and size 28

DR, DN – Pressure controller / DRS0, DNS0 – Pressure control with load sensing, counter clockwise rotation

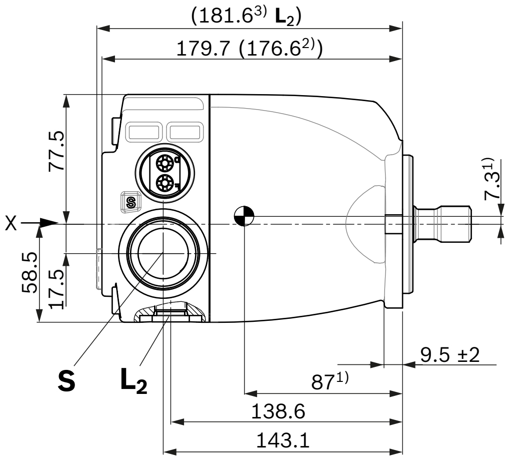




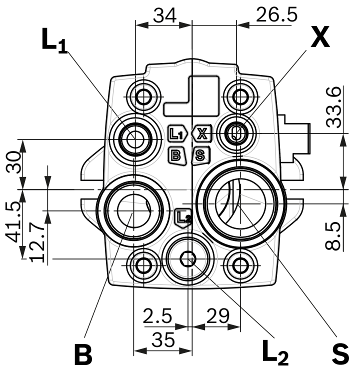
View X
Port plate **1**



View Y



View X
Port plate **9**

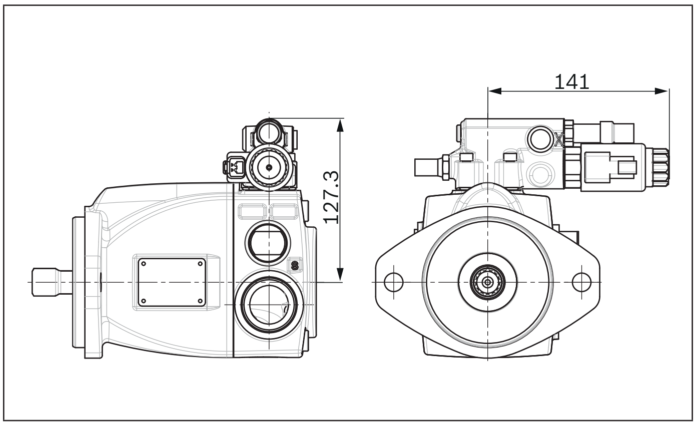


[1] Center of gravity

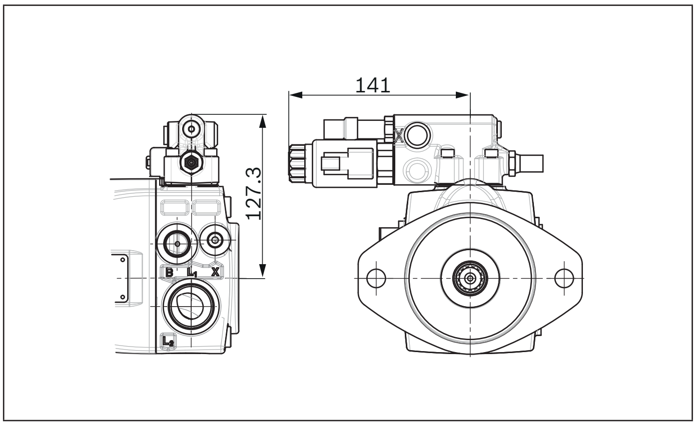
[2] Connection surfaces **S**, **B**, **X**, **L**$_1$ and **L**$_2$ with port plate 9

[3] Only at port plate 9 and L$_2$ closed

▼ **D3/D4 Pressure controller with override, electric-proportional, negative control; cw**

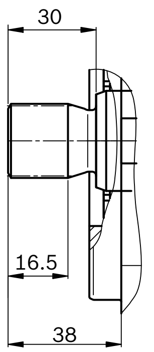


▼ **D3/D4 Pressure controller with override, electric-proportional, negative control; ccw**



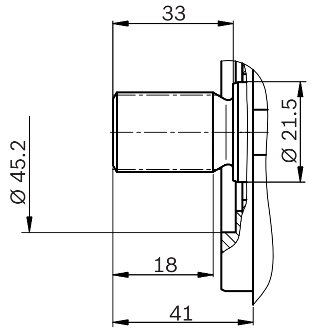
▼ **Spline shaftSAE J744**

S3 – 3/4 in 11T 16/32DP[1)]



▼ **Spline shaft SAE J744**

S4 – 7/8 in 13T 16/32DP[1)]



Ports and fastening threads version "B"

Ports		Standard[4)]	Size[3)]	$p_{max\ abs}$ [bar][5)]	State[8)]
B	Service line port	ISO 11926	1 5/16-12UN-2B; 20 tief	280	O
S	Suction port	ISO 11926	1 5/8-12UN-2B; 20 tief	5	O
L_1	Case drain port	ISO 11926	3/4-16UNF-2B; 15 tief	10	O[6)]
L_2	Case drain port	ISO 11926	3/4-16UNF-2B; 15 tief	10	X[6)]
X	Pilot signal	ISO 11926	7/16-20UNF-2B; 12 tief	280	O[7)]

Ports and fastening threads version "M"

Ports		Standard[4)]	Size[3)]	$p_{max\ abs}$ [bar][5)]	State[8)]
B	Service line port	ISO 6149	M33 × 2; 20 deep	280	O
S	Suction port	ISO 6149	M42 × 2; 20 deep	5	O
L_1	Case drain port	ISO 6149	M18 × 1.5; 13 deep	10	O[6)]
L_2	Case drain port	ISO 6149	M18 × 1.5; 13 deep	10	X[6)]
X	Pilot signal	ISO 6149	M12 × 1.5; 12 deep	280	O[7)]

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Observe the instructions in the operating instructions concerning the maximum tightening torques.

4) The spot face can be deeper than specified in the standard.

5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

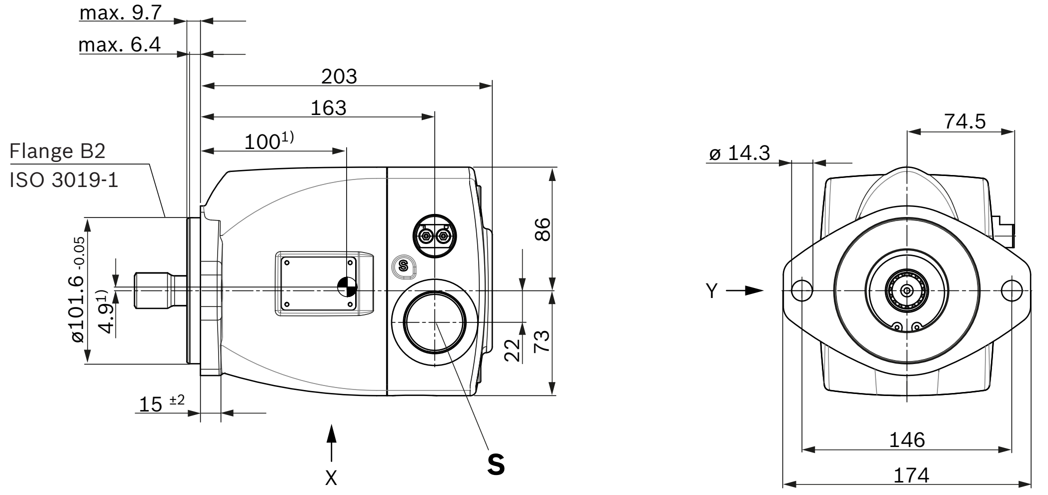
6) Depending on the installation position, **L_1** or **L_2** must be connected (see also the installation instructions on page 22).

7) Only if an S0 controller is present.

8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

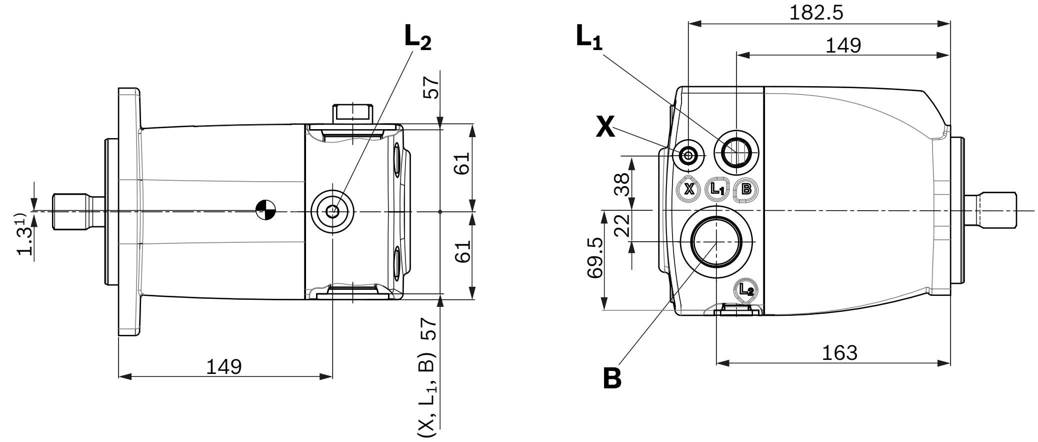
Dimensions, size 35

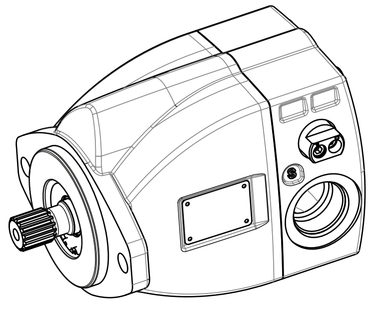
DR, DN – Pressure controller / DRS0, DNS0 – Pressure control with load sensing, clockwise rotation



View X

View Y





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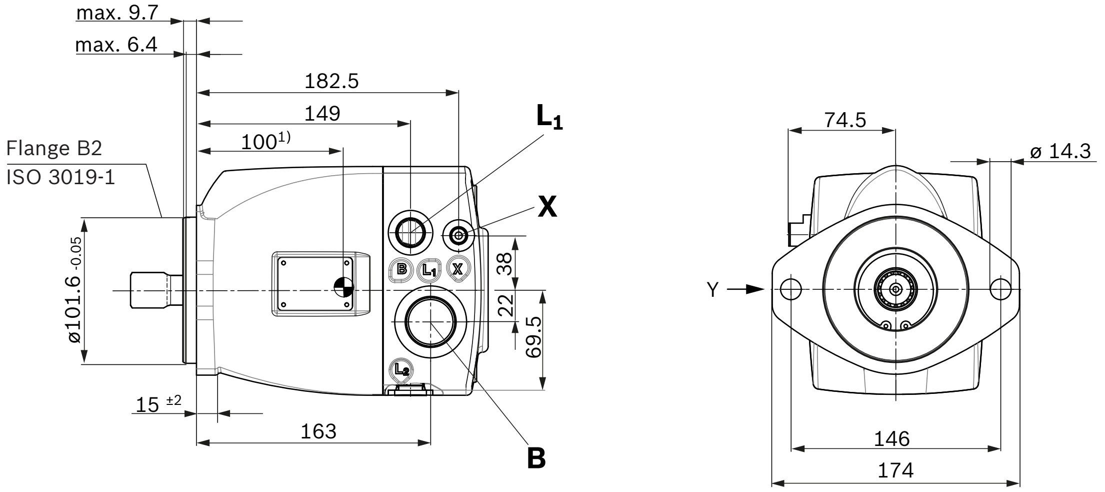
1) Center of gravity

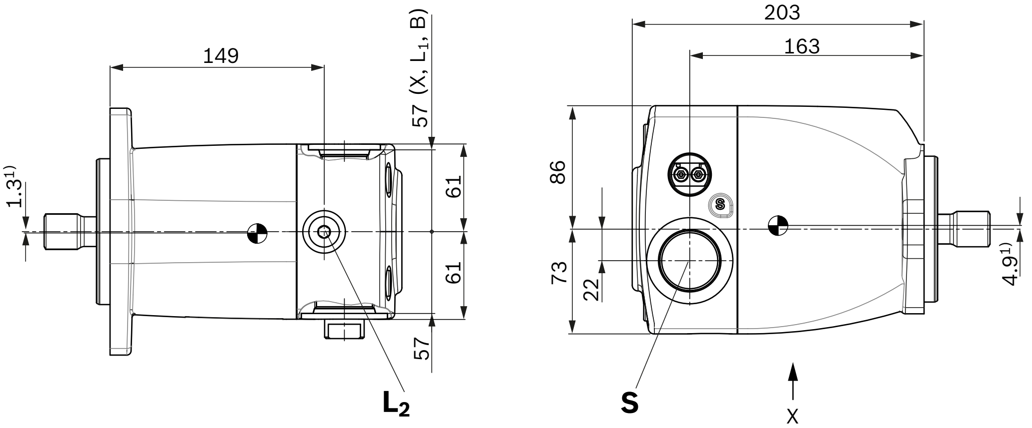
Dimensions, size 35

DR, DN – Pressure controller / DRS0, DNS0 – Pressure control with load sensing, counter clockwise rotation



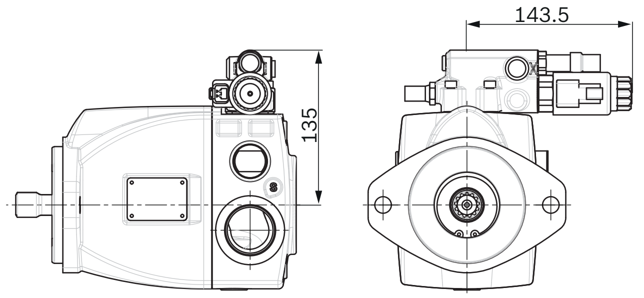
View X

View Y

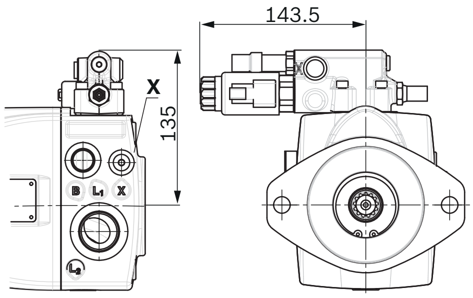


[1] Center of gravity

▼ D3/D4 Pressure controller with override, electric-proportional, negative control; cw

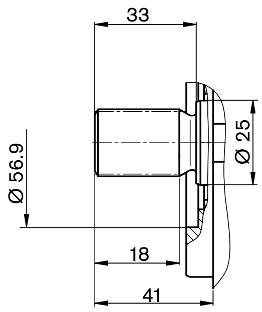


▼ D3/D4 Pressure controller with override, electric-proportional, negative control; ccw

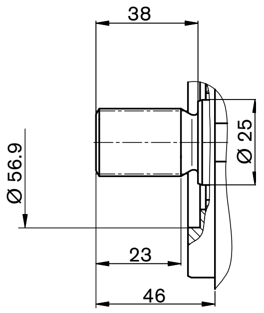


▼ Splined shaft SAE J744

S4 – 7/8 in 13T 16/32DP[1]



S5 – 1 in 15T 16/32DP[1]



Ports and fastening threads version "B"

Ports		Standard[4]	Size[3]	$p_{max\ abs}$ [bar][5]	State[8]
B	Service line port	ISO 11926	1 5/16-12UN-2B; 20 deep	280	O
S	Suction port	ISO 11926	1 5/8-12UN-2B; 20 deep	5	O
$\mathbf{L_1}$	Case drain port	ISO 11926	3/4-16UNF-2B; 15 deep	10	O[6]
$\mathbf{L_2}$	Case drain port	ISO 11926	3/4-16UNF-2B; 15 deep	10	X[6]
X	Pilot signal	ISO 11926	7/16-20UNF-2B; 12 deep	280	O[7]

Ports and fastening threads version "M"

Ports		Standard[4]	Size[3]	$p_{max\ abs}$ [bar][5]	State[8]
B	Service line port	ISO 6149	M33 × 2; 20 deep	280	O
S	Suction port	ISO 6149	M42 × 2; 20 deep	5	O
$\mathbf{L_1}$	Case drain port	ISO 6149	M18 × 1.5; 13 deep	10	O[6]
$\mathbf{L_2}$	Case drain port	ISO 6149	M18 × 1.5; 13 deep	10	X[6]
X	Pilot signal	ISO 6149	M12 × 1.5; 12 deep	280	O[7]

Note

With all the ports – in particular when connecting port **S** – use the stud ends provided for the standard with the corresponding width across flats. Please contact us about larger widths across flats.

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Observe the instructions in the operating instructions concerning the maximum tightening torques.

4) The spot face can be deeper than specified in the standard.

5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

6) Depending on the installation position, $\mathbf{L_1}$ or $\mathbf{L_2}$ must be connected (see also the installation instructions on page 22).

7) Only if an S0 controller is present.

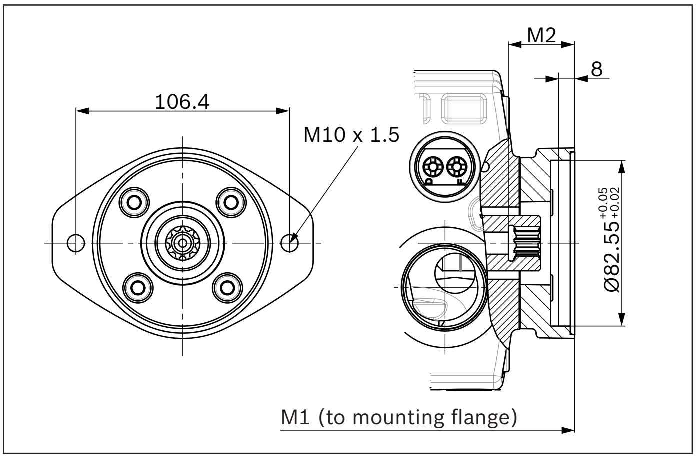
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Through drives dimensions

Flange SAE J744			Hub for splined shaft[1)]			Availability NG			Code
Diameter	Attachment[2)]	Designation	Diameter		Designation	018	028	035	
82-2 (A)	o-o	A2	5/8 in	9T 16/32 DP	S2	●	○	●	A2S2
			3/4 in	11T 16/32 DP	S3	●	○	●	A2S3
			7/8 in	13T 16/32 DP	S4	●	○	●	A2S4
101-2 (B)	o-o	B2	7/8 in	13T 16/32 DP	S4	●	○	●	B2S4
			1 in	15T 16/32 DP	S5	–	–	●	B2S5

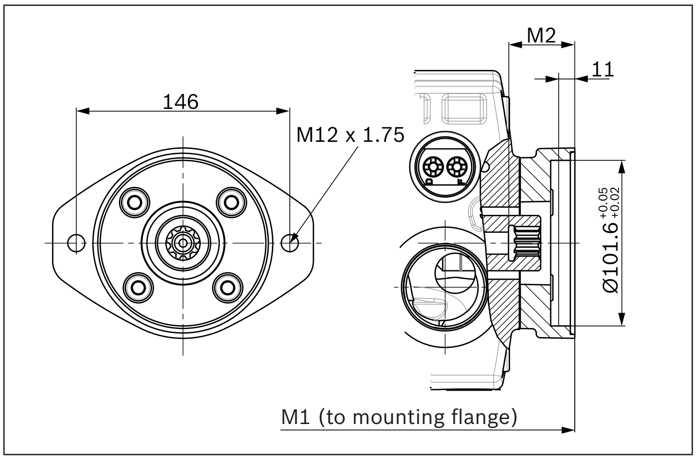
● = Available ○ = On request – = Not available

▼ **82-2 (A)**



Short code	NG	M1	M2
A2S2	018	203.2	32
	028	203.2	32
	035	227.6	32
A2S3	018	203.2	38
	028	203.2	38
	035	227.6	38
A2S4	018	203.2	41
	028	203.2	41
	035	227.6	41

▼ **101-2 (B)**



Short code	NG	M1	M2
B2S4	018	203.2	41
	028	203.2	41
	035	227.6	41
B2S5	035	227.6	46

---

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Mounting drillings pattern viewed on through drive, with service line port B on right.

3) Continuous thread according to DIN 13; observe the instructions in the operating instructions concerning the maximum tightening torques.

Overview of attachment options

Through drive[1]			**Fitting options – 2nd pump**						
Flange	**Hub for splined shaft**	**Short code**	**A1VO/10 NG (shaft)**	**A4VG/32 NG (shaft)**	**A10VG/10 NG (shaft)**	**A10VO/52/53 NG (shaft)**	**A10VNO/52/53 NG (shaft)**	**A10V(S)O/31 NG (shaft)**	**External gear pump**
82-2 (A)	3/4 in	A2S3	18, 28 (S3)	–	–	10 (S), 18 (S, R)	28 (R)	18 (S, R)	–
	7/8 in	A2S4	18, 28 (S4)	–	–	–	–	–	–
101-2 (B)	7/8 in	B2S4	18, 28 (S4) 35 (S4)	–	18 (S)	28 (S, R)	–	28 (S, R)	Series N Series G
	1 in	B2S5	35 (S5)	28 (S)	28 (S)	–	–	–	–

---

[1] Additional through drives are available on request

Combination pumps A1VO + A1VO

Total length A

A1VO (1st pump)	A1VO (2nd pump)		
	NG18	NG28	NG35
NG18	383	–	–
NG28	383	383	–
NG35	410	410	431

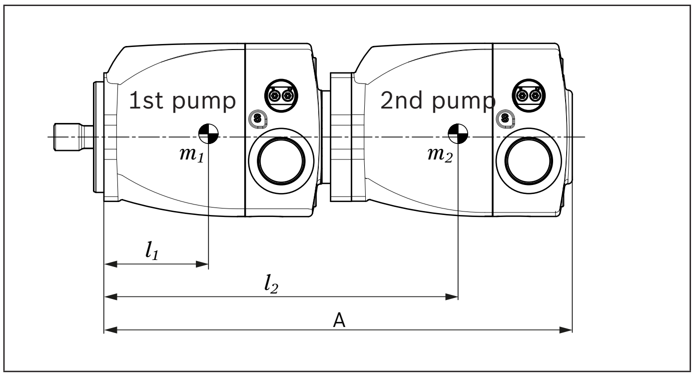
By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes. When ordering combination pumps, the type designations of the 1st and 2nd pump must be linked by a “**+**”.

Order example:

A1VO035DRS0C200/10BRVB2S51B2S500-0+
A1VO035DRS0C200/10BRVB2S51000000-0

It is permissible to use a combination of two single pumps of the same size (tandem pump), considering a dynamic mass acceleration of maximum 10 g (= 98.1 m/s^2) without additional support brackets.

For combination pumps consisting of more than two pumps, the mounting flange must be rated for the permissible mass torque.



m_1, m_2	Weight of pump	[kg]
$l_1, l_2,$	Distance, center of gravity	[mm]

$$T_m = (m_1 \times l_1 + m_2 \times l_2) \times \frac{1}{102} \quad \text{[Nm]}$$

Permissible mass moment of inertia

Size				18	28	35
	static	T_m	Nm	500	500	890
	dynamic at 10 g (98.1 m/s^2)	T_m	Nm	50	50	89
Weight **without** through-drive		m	kg	12.3	12.3	18.4
Weight **with** through-drive				13.5	13.5	19.8
Distance, center of gravity **without** through drive		l_1	mm	87	87	100
Distance, center of gravity **with** through drive		l_1	mm	97	97	108

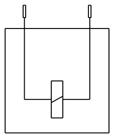
Connector for solenoids

DEUTSCH DT04-2P

Molded connector, 2-pin, without bidirectional suppressor diode
There is the following type of protection with mounted mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)

▼ Circuit symbol



▼ Mating connector DEUTSCH DT06-2S-EP04

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery.
This can be supplied by Bosch Rexroth on request (material number R902601804).

Notice

If necessary, you can change the position of the connector by turning the solenoid.
The procedure is defined in the instruction manual.

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a relatively long standstill as the axial piston unit may drain back to the reservoir via the hydraulic lines.

Particularly with the “drive shaft up/down” installation position, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The leakage in the pump housing must be discharged to the reservoir via the highest available drain port (**L_1**, **L_2**).

For combinations of multiple units, the case drain fluid must be drained off at each pump.

If a shared drain line is used for several units, make sure that the respective case pressure is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operational circumstances, particularly at cold start. If this is not possible, separate drain lines must be laid if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction lines and the drain lines must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\ max}$ = 800 mm. The minimum suction pressure at port **S** must also not fall below 0.8 bar absolute during operation and during cold start.

When designing the reservoir, ensure adequate distance between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Note

In certain installation positions, an influence on the control characteristic curves can be expected. Gravity, dead weight and case pressure can cause minor shifts in characteristics and changes in response time.

For key, see page Page 23

Installation position

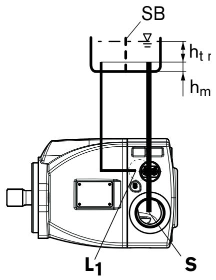
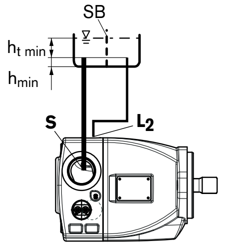
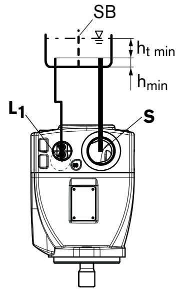
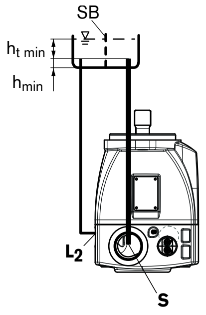
See examples **1** to **11** below.

Additional installation positions are available upon request.

Recommended installation position: **1** and **2**

Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.

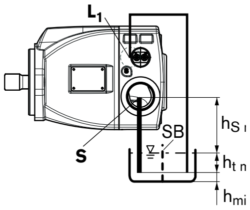
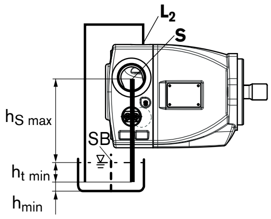
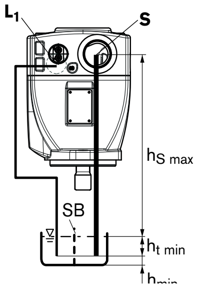
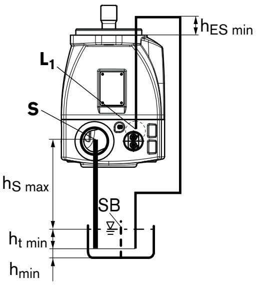
Installation position	Air bleeding	Filling
1 	**L_1**	**L_1**
2 	**L_2**	**L_2**
3 	**L_1** or **L_2**	**L_1** or **L_2**
4[1] 	**L_1** or **L_2**	**L_1** or **L_2**

---

[1] Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

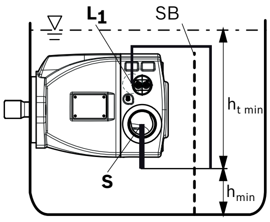
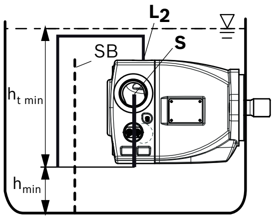
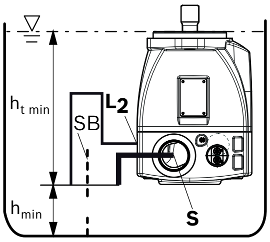
Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. To prevent the axial piston unit from draining in position 8, the height difference $h_{ES\ min}$ must be at least 25 mm. Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.

Installation position	Air bleeding	Filling
5 	L_1	L_1
6 	L_2	L_2
7 	L_1	L_1
8[1] 	L_1	L_1

Inside-reservoir installation

Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level. The axial piston unit is completely below the hydraulic fluid. If the minimum fluid level is equal to or below the upper edge of the pump, see chapter **"Above-reservoir installation"**. Axial piston units with electrical components (e.g., electric control, sensors) may not be installed in a reservoir below the fluid level.

Installation position	Air bleeding	Filling
9 	Via the highest available port **L_1**	Automatically via the open port **L_1** due to the position under the hydraulic fluid level
10 	Via the highest available port **L_2**	Automatically via the open port **L_2** due to the position below the hydraulic fluid level
11[1] 		

Key	
L_1, L_2	Filling / air bleeding
S	Suction port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (100 mm)
$h_{ES\ min}$	Minimum necessary height needed to protect the axial piston unit from draining (25 mm).
$h_{S\ max}$	Maximum permissible suction height (800 mm)

---

[1] Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

Project planning notes

- The A1VO variable pump is designed to be used in an open circuit.
- The project planning, installation and commissioning of the axial piston unit require the involvement of qualified skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, request it from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The specified data and notes must be observed.
- Depending on the operating condition of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation times apply under optimal storage conditions, details of these conditions can be found in the data sheet 90312 or the instruction manual.
- Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference.
  Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- Pressure controllers is no safeguard from pressure overload. A pressure relief valve must be provided in the hydraulic system.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports can only be used to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control and regulation systems (e.g. valve spools) may in certain circumstances become stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid, abrasion or residual dirt from components). As a result, the hydraulic fluid flow or build-up of torque of the axial piston unit will no longer respond correctly to the operator's commands. Even the use of different filter cartridges (external or internal inlet filter) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.

Axial piston variable pump
A10V(S)O Series 31

- Size 18 (A10VSO)
- Sizes 28 to 140 (A10VO)
- Nominal pressure 280 bar
- Maximum pressure 350 bar
- Open circuit

Features

- Variable pump with axial piston rotary group in swashplate design for hydrostatic drives in open circuit.
- The flow is proportional to the drive speed and displacement.
- The flow can be infinitely varied by adjusting the swashplate angle.
- 2 drain ports
- Excellent suction performance
- Low noise level
- Long service life
- Favorable power/weight ratio
- Versatile controller range
- Short control time
- The through drive is suitable for adding gear pumps and axial piston pumps up to the same size, i.e., 100% through drive.

Contents

Type code

01	02	03	04	05		06	07		08	09	10	11	12	13
	A10V(S)	**O**			**/**	**31**		**–**	**V**					

Version

		18	28	45	71	88	100	140	
01	Standard version (without code)	●	●	●	●	●	●	●	
	High-speed version (external dimensions are the same as the standard version)	–	–	●	●	–	●	●	**H**

Axial piston unit

		18	28	45	71	88	100	140	
02	Swashplate design, variable, nominal pressure 280 bar, maximum pressure 350 bar	●	–	–	–	–	–	–	**A10VS**
		–	●	●	●	●	●	●	**A10V**

Operating mode

03	Pump, open circuit	**O**

Size (NG)

04	Geometric displacement, see table of values on pages 6 and 7	**18**	**28**	**45**	**71**	**88**	**100**	**140**

Control device

					18	28	45	71	88	100	140	
05	Two-point control, direct operated				●	●	●	●	●	●	●	**DG**
	Pressure controller	hydraulic			●	●	●	●	●	●	●	**DR**
	with flow controller	hydraulic	X-T open		●	●	●	●	●	●	●	**DFR**
			X-T plugged with flushing function		●	●	●	●	●	●	●	**DFR1**
			X-T plugged without flushing function		●	●	●	●	●	●	●	**DRSC**
	with flow and differential pressure control, electrically variable				●	●	●	●	●	●	●	**EF**[1]
	with pressure cut-off	hydraulic	remote controlled		●	●	●	●	●	●	●	**DRG**
		electrical	negative control	U = 12 V	●	●	●	●	●	●	●	**ED71**
				U = 24 V	●	●	●	●	●	●	●	**ED72**
		electrical	positive control	U = 12 V	●	●	●	●	●	●	●	**ER71**
				U = 24 V	●	●	●	●	●	●	●	**ER72**
	Pressure-flow power control				–	●	●	●	●	●	●	**DFLR**

Series

06	Series 3, index 1	**31**

Direction of rotation

07	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Sealing material

08	FKM (fluoroelastomer)	**V**

Drive shaft

			18	28	45	71	88	100	140	
09	Splined shaft ANSI B92.1a	standard shaft	●	●	●	●	●	●	●	**S**
		similar to shaft “S” however for higher input torque	●	●	●	●	●	–	–	**R**
		reduced diameter, limited suitability for through drive (see table of values, page 9)	●	●	●	●	●	●	○	**U**
		same as “U”, higher torque; limited suitability for through drive (see table of values, page 9)	–	●	●	●	●	●	●	**W**

Mounting flange

			18	28	45	71	88	100	140	
10	ISO 3019-1 (SAE)	2-hole	●	●	●	●	●	●	●	**C**
		4-hole	–	–	–	–	–	–	●	**D**

---

[1] See data sheet 92709

01	02	03	04	05		06	07		08	09	10	11	12	13
	A10V(S)	**O**			**/**	**31**		**–**	**V**					

Working port

				18	28	45	71	88	100	140	
11	SAE flange ports according to J518 Working ports **metric**	Fastening thread **metric**; rear	not for through drive	–	●	●	–	–	●	●	**11**
				–	–	–	●	●	–	–	**41**
		Fastening thread **metric**; lateral top bottom	for through drive	●	●	●	–	–	●	●	**12**
				–	–	–	●	●	–	–	**42**
	SAE flange ports according to J518 Working ports **UNF**	Fastening thread **UNF**; rear	not for through drive	–	●	●	–	–	●	●	**61**
				–	–	–	●	●	–	–	**91**
		Fastening thread **UNF**; lateral top bottom	for through drive	●	●	●	–	–	●	●	**62**
				–	–	–	●	●	–	–	**92**

Through drive (for mounting options, see page 53)

				18	28	45	71	88	100	140	
12	Flange ISO 3019-1 Diameter	Hub for splined shaft[2] Diameter									
	without through drive			●	●	●	●	●	●	●	**N00**
	82-2 (A)	5/8 in	9T 16/32DP	●	●	●	●	●	●	●	**K01**
		3/4 in	11T 16/32DP	●	●	●	●	●	●	●	**K52**
	101-2 (B)	7/8 in	13T 16/32DP	–	●	●	●	●	●	●	**K68**
		1 in	15T 16/32DP	–	–	●	●	●	●	●	**K04**
	127-2 (C)	1 1/4 in	14T 12/24DP	–	–	–	●	●	●	●	**K07**
		1 1/2 in	17T 12/24DP	–	–	–	–	–	●	●	**K24**
	152-4 (D)	1 3/4 in	13T 8/16DP	–	–	–	–	–	–	●	**K17**[4]

Connectors for solenoids[3]

		18	28	45	71	88	100	140	
13	Without connector (without solenoid, with hydraulic control only, without code)	●	●	●	●	●	●	●	
	DEUTSCH - molded connector, 2-pin, without suppressor diode	●	●	●	●	●	●	●	**P**

● = Available ○ = On request – = Not available

Notice

- ▶ Note the project planning notes on page 59.
- ▶ In addition to the type code, please specify the relevant technical data when placing your order.

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[2] Hub for splined shaft according to ANSI B92.1a

[3] Connectors for other electric components can deviate.

[4] Only with mounting flange D

Hydraulic fluids

The A10V(S)O variable pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: HFD hydraulic fluids (for permissible technical data, see data sheet 90225)

Notes on selection of hydraulic fluid

The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see selection diagram).

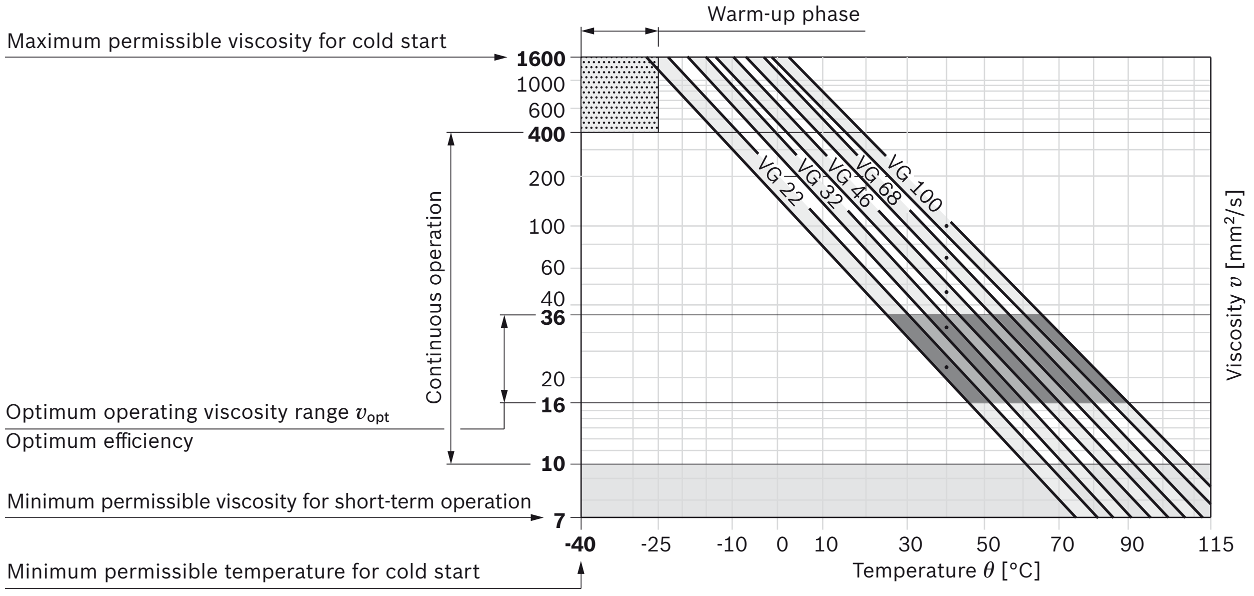
Notice

At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \leq 1600$ mm²/s	$\theta_{St} \geq -40$ °C	$t \leq 1$ min, without load ($p \leq 30$ bar), $n \leq 1000$ rpm
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu < 1600$ to 400 mm²/s	$\theta = -40$ °C to -25 °C	Note the detailed information on operation with low temperatures, see data sheet 90300-03-B
Continuous operation	$\nu = 400$ to 10 mm²/s		this corresponds, for VG 46 for example, to a temperature range of +5 °C to +85 °C (see selection diagram)
		$\theta = -25$ °C to +110 °C	measured at port **L**, $\mathbf{L_1}$ observe the permissible temperature range of the shaft seal (ΔT = approx. 5 K between the bearing/shaft seal and port **L**, $\mathbf{L_1}$)
	$\nu_{opt} = 36$ to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \geq 7$ mm²/s		$t < 1$ min, $p < 0.3 \cdot p_{nom}$

▼ **Selection diagram**



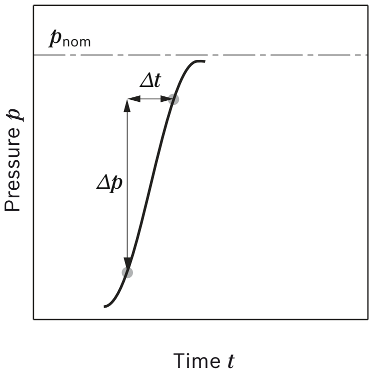
Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.
A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.
At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), cleanliness level 19/17/14 according to at least ISO 4406 is necessary.
Please contact us if the above classes cannot be observed.

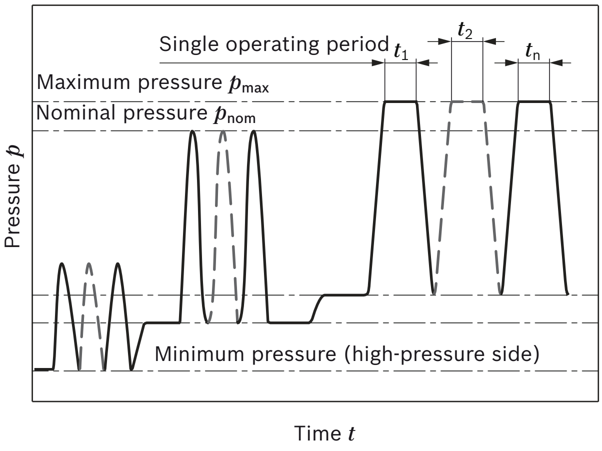
Working pressure range

Pressure at working port B		**Definition**
Nominal pressure p_{nom}	280 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	350 bar	The maximum pressure corresponds to the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	2 ms	
Total operating period	300 h	
Minimum pressure $p_{B\,abs}$ (high-pressure side)	10 bar[1]	Minimum pressure on the high-pressure side (**B**) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{A\,max}$	16000 bar/s	Maximum permissible speed of pressure build-up and reduction during a pressure change across the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{S\,min}$ Standard	0.8 bar absolute	Minimum pressure at suction port **S** (inlet) that is required in order to avoid damage to the axial piston unit. The minimum pressure depends on the rotational speed and displacement of the axial piston unit.
Maximum pressure $p_{S\,max}$	10 bar absolute[2]	
Leakage pressure at port L, L_1		
Maximum pressure $p_{L\,max}$	2 bar absolute[2]	Maximum 0.5 bar higher than inlet pressure at port **S**, but not higher than $p_{L\,max}$. A case drain line to the reservoir is required.

▼ **Rate of pressure change $R_{A\,max}$**



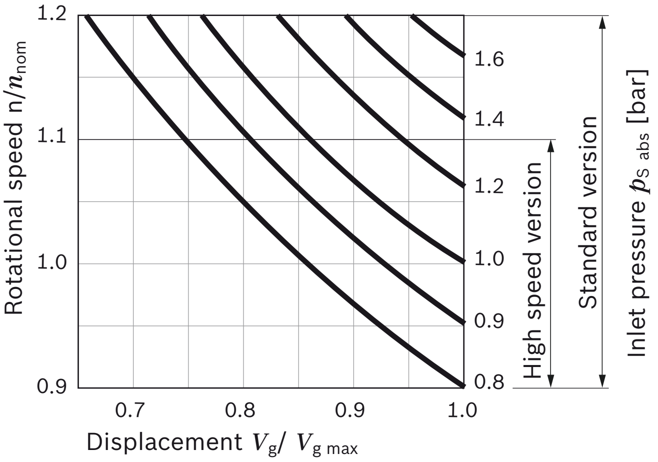
▼ **Pressure definition**



Total operating period = $t_1 + t_2 + \ldots + t_n$

Notice
Working pressure range valid when using hydraulic fluids based on mineral oils. Please contact us for values for other hydraulic fluids.

Minimum permissible inlet pressure at suction port S with speed increase
In order to avoid damage to the pump (cavitation), a minimum inlet pressure must be guaranteed at suction port **S**. The minimum inlet pressure level depends on the rotational speed and the displacement of the variable pump.



During continuous operation in overspeed over n_{nom}, a reduction in operational service life is to be expected due to cavitation erosion.

---

1) Lower pressure is time-dependent, please contact us
2) Other values on request

Technical data, standard unit

Size		**NG**		**18**	**28**	**45**	**71**	**88**	**100**	**140**
Displacement, geometric, per revolution		$V_{g\,max}$	cm³	18	28	45	71	88	100	140
Rotational speed maximum[1]	at $V_{g\,max}$	n_{nom}	rpm	3300	3000	2600	2200	2100	2000	1800
	at $V_g < V_{g\,max}$[2]	$n_{max\,perm}$	rpm	3900	3600	3100	2600	2500	2400	2100
Flow	at n_{nom} and $V_{g\,max}$	$q_{v\,max}$	l/min	59	84	117	156	185	200	252
	at n_E= 1500 rpm and $V_{g\,max}$	$q_{vE\,max}$	l/min	27	42	68	107	132	150	210
Power at Δp = 280 bar	at n_{nom}, $V_{g\,max}$	P_{max}	kW	28	39	55	73	86	93	118
	at n_E= 1500 rpm and $V_{g\,max}$	$P_{E\,max}$	kW	12.6	20	32	50	62	70	98
Torque at $V_{g\,max}$ and	Δp = 280 bar	T_{max}	Nm	80	125	200	316	392	445	623
	Δp = 100 bar	T	Nm	30	45	72	113	140	159	223
Rotary stiffness of drive shaft	S	c	Nm/rad	11087	22317	37500	71884	71884	121142	169437
	R	c	Nm/rad	14850	26360	41025	76545	76545	–	–
	U	c	Nm/rad	8090	16695	30077	52779	52779	91093	–
	W	c	Nm/rad	–	19898	34463	57460	57460	101847	165594
Moment of inertia for rotary group		J_{TW}	kgm²	0.00093	0.0017	0.0033	0.0083	0.0083	0.0167	0.0242
Maximum angular acceleration[3]		α	rad/s²	6800	5500	4000	2900	2600	2400	2000
Case volume		V	l	0.4	0.7	1.0	1.6	1.6	2.2	3.0
Weight **without** through drive (approx.)		m	kg	12.9	18	23.5	35.2	35.2	49.5	65.4
Weight **with** through drive (approx.)				13.8	19.3	25.1	38	38	55.4	74.4

Determining the operating characteristics			
Flow	$q_v = \dfrac{V_g \times n \times \eta_v}{1000}$		[l/min]
Torque	$T = \dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{mh}}$		[Nm]
Power	$P = \dfrac{2\,\pi \times T \times n}{60000}$	$= \dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g	Displacement per revolution [cm³]
Δp	Differential pressure [bar]
n	Rotational speed [rpm]
η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

Notice

- ▶ Theoretical values, without efficiency and tolerances; values rounded
- ▶ Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommends checking the load by means of test or calculation / simulation and comparison with the permissible values.

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[1] The values are applicable:
- – At absolute pressure p_{abs} = 1 bar at suction port **S**
- – For the optimal viscosity range of ν_{opt} = 36 to 16 mm²/s
- – For hydraulic fluid based on mineral oils

[2] For a speed increase up to $n_{max\,perm}$, please observe the diagram on page 6.

[3] The data are valid for values between the minimum required and maximum permissible rotational speed. It applies for external stimuli (e. g. diesel engine 2 to 8 times rotary frequency, Cardan shaft twice the rotary frequency). The limit value is only valid for a single pump. The load capacity of the connecting parts must be considered.

Technical data, high-speed version

Size		NG		45	71	100	140
Displacement, geometric, per revolution		$V_{g\,max}$	cm³	45	71	100	140
Rotational speed maximum[1]	at $V_{g\,max}$	n_{nom}	rpm	3000	2550	2300	2050
	at $V_g < V_{g\,max}$[2]	$n_{max\,perm}$	rpm	3300	2800	2500	2200
Flow	at n_{nom} and $V_{g\,max}$	$q_{v\,max}$	l/min	135	178	230	287
Power	at n_{nom}, $V_{g\,max}$ and Δp = 280 bar	P_{max}	kW	63	83	107	134
Torque	Δp = 280 bar	T_{max}	Nm	200	316	445	623
at $V_{g\,max}$ and	Δp = 100 bar	T	Nm	72	113	159	223
Rotary stiffness of drive shaft	S	c	Nm/rad	37500	71884	121142	169537
	R	c	Nm/rad	41025	76545	–	–
	U	c	Nm/rad	30077	52779	91093	–
	W	c	Nm/rad	34463	57460	101847	165594
Moment of inertia for rotary group		J_{TW}	kgm²	0.0033	0.0083	0.0167	0.0242
Maximum angular acceleration[3]		α	rad/s²	4000	2900	2400	2000
Case volume		V	l	1.0	1.6	2.2	3.0
Weight **without** through drive (approx.)		m	kg	23.5	35.2	49.5	65.4
Weight **with** through drive (approx.)				25.1	38	55.4	74.4

Notice

- ▶ Theoretical values, without efficiency and tolerances; values rounded
- ▶ Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommends checking the load by means of test or calculation / simulation and comparison with the permissible values.

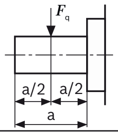
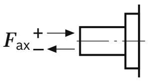
---

[1] The values are applicable:
  - At absolute pressure p_{abs} = 1 bar at suction port **S**
  - For the optimal viscosity range of ν_{opt} = 36 to 16 mm²/s
  - For hydraulic fluid based on mineral oils

[2] For a speed increase up to $n_{max\,perm}$, please observe the diagram on page 6.

[3] The data are valid for values between the minimum required and maximum permissible rotational speed. It applies for external stimuli (e. g. diesel engine 2 to 8 times rotary frequency, Cardan shaft twice the rotary frequency). The limit value is only valid for a single pump. The load capacity of the connecting parts must be considered.

Permissible radial and axial forces of the drive shafts

Size		NG		18	28	45	71	88	100	140
Maximum radial force at a/2		$F_{q\,max}$	N	350	1200	1500	1900	1900	2300	2800
Maximum axial force		$\pm F_{ax\,max}$	N	700	1000	1500	2400	2400	4000	4800

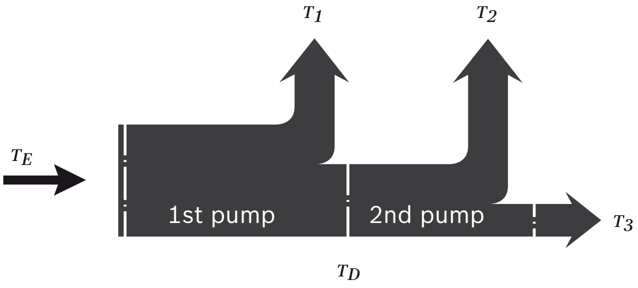
Notice

- The values given are maximum values and do not apply to continuous operation.
  For drives with radial loading (pinion, V-belt drives), please contact us!

Permissible input and through-drive torques

Size				18	28	45	71	88	100	140
Torque at $V_{g\,max}$ and Δp = 280 bar[1]		T_{max}	Nm	80	125	200	316	392	445	623
Maximum input torque at drive shaft[2]										
	S	$T_{E\,max}$	Nm	124	198	319	626	626	1104	1620
		Ø	in	3/4	7/8	1	1 1/4	1 1/4	1 1/2	1 3/4
	R	$T_{E\,max}$	Nm	160	250	400	644	644	–	–
		Ø	in	3/4	7/8	1	1 1/4	1 1/4	–	–
	U	$T_{E\,max}$	Nm	59	105	188	300	300	595	–
		Ø	in	5/8	3/4	7/8	1	1	1 1/4	–
	W	$T_{E\,max}$	Nm	–	140	220	394	394	636	1220
		Ø	in	–	3/4	7/8	1	1	1 1/4	1 1/2
Maximum through-drive torque										
	S	$T_{D\,max}$	Nm	108	160	319	492	492	778	1266
	R	$T_{D\,max}$	Nm	120	176	365	548	548	–	–
	U	$T_{D\,max}$	Nm	59	105	188	300	300	595	–
	W	$T_{D\,max}$	Nm	–	140	220	394	394	636	1220

▼ **Distribution of torques**



Torque at 1st pump	T_1		
Torque at 2nd pump	T_2		
Torque at 3rd pump	T_3		
Input torque	T_E	=	$T_1 + T_2 + T_3$
	T_E	<	$T_{E\,max}$
Through-drive torque	T_D	=	$T_2 + T_3$
	T_D	<	$T_{D\,max}$

---

[1] Efficiency not considered

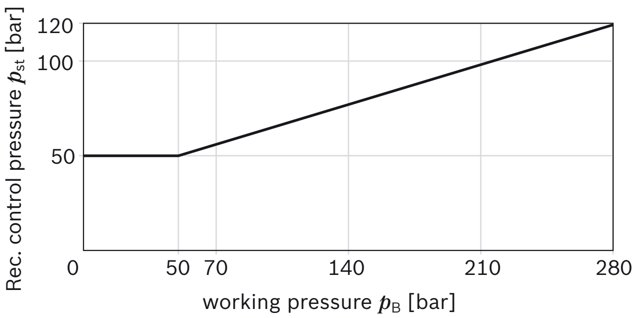
[2] For drive shafts with no radial force

DG – Two-point control, direct operated

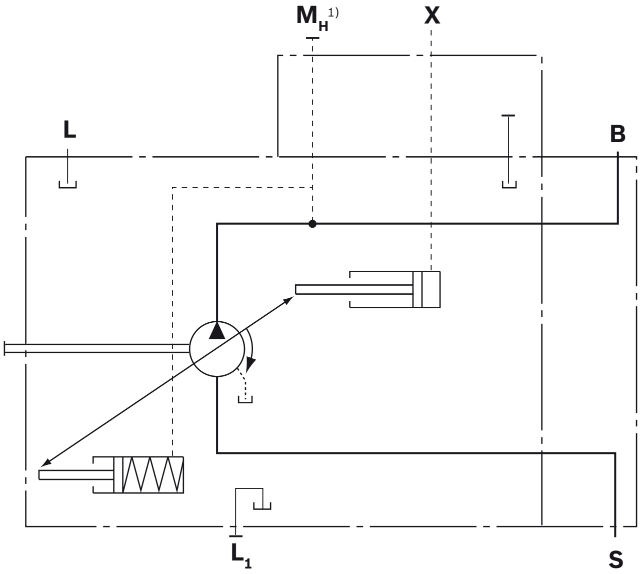
The variable pump can be set to a minimum swivel angle by connecting an external control pressure to port **X.**
This will supply control fluid directly to the stroking piston; a minimum control pressure of $p_{st} \geq 50$ bar is required.
The variable pump can only be switched between $V_{g\,max}$ or $V_{g\,min}$.
Please note that the required control pressure at port **X** is directly dependent on the actual working pressure p_B in port **B**. (See control pressure characteristic).
The maximum permissible control pressure is 280 bar.

Control pressure p_{st} in **X** = 0 bar ≙ $V_{g\,max}$
Control pressure p_{st} in **X** ≥ 50 bar ≙ $V_{g\,min}$

▼ **Control pressure characteristic curve**



▼ **Circuit diagram**



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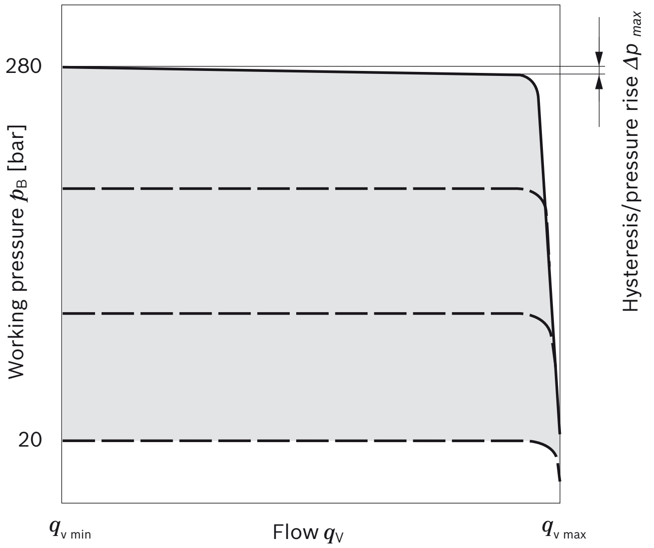
1) Only size 140

DR – Pressure controller

The pressure controller limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only supplies as much hydraulic fluid as is required by the consumers. If the working pressure exceeds the pressure command value at the pressure valve, the pump will regulate to a smaller displacement to reduce the control differential.

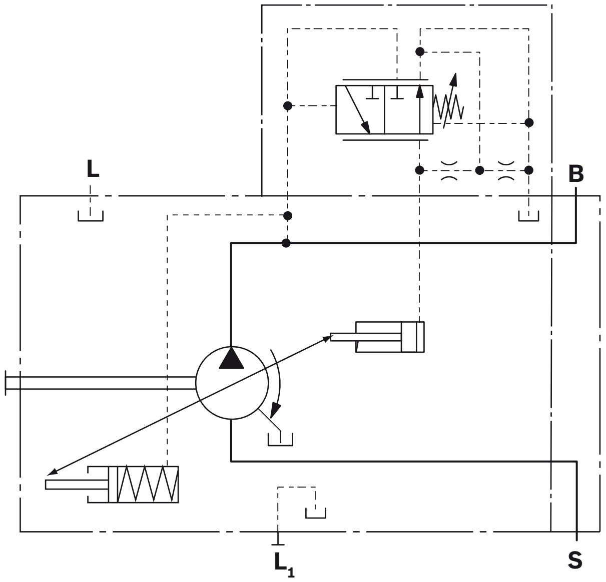
- Initial position in depressurized state: $V_{g\,max}$.
- Setting range[1] for pressure control 20 to 280 bar. Standard is 280 bar.

▼ **Characteristic curve**

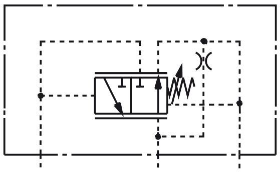


Characteristic curve valid at n_1 = 1500 rpm and θ_{fluid} = 50 °C.

▼ **Circuit diagram, sizes 18 to 100**



▼ **Circuit diagram, size 140**



Controller data

NG		18	28	45	71	88	100	140
Pressure increase	Δp [bar]	4	4	6	8	9	10	12
Hysteresis and repeatability	Δp [bar]	maximum 3						
Control fluid consumption	[l/min]	maximum approx. 3						

---

[1] In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.

DRG – Pressure controller, remote controlled

For the remote controlled pressure controller, the LS pressure limitation is performed using a separately arranged pressure relief valve. Therefore any pressure control value under the pressure set on the pressure controller can be regulated. Pressure controller DR see page 11.
A pressure relief valve is externally piped up to port **X** for remote control. This relief valve is not included in the scope of delivery of the DRG control.
When there is differential pressure Δp at the control valve and with the standard setting on the remote controlled pressure cut-off of 20 bar, the amount of control fluid at the port is **X** approx. 1.5 l/min. If a different setting (range 10 to 22 bar) is required, please state in plain text.
As a separate pressure relief valve (**1**) we recommend:

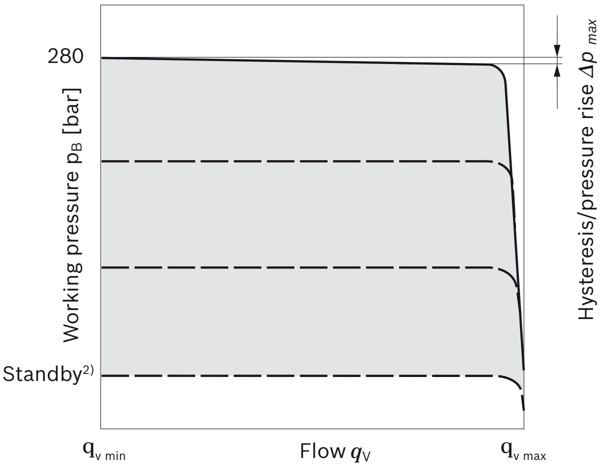
- a direct operated hydraulic or electric proportional one, suitable for the control fluid mentioned above.

The max. length of piping should not exceed 2 m.

- Basic position in depressurized state: $V_{g\ max}$.
- Setting range[1] for pressure control 20 to 280 bar **(3).** Standard is 280 bar.
- Setting range for differential pressure 10 - 22 bar(**2**) Standard is 20 bar.

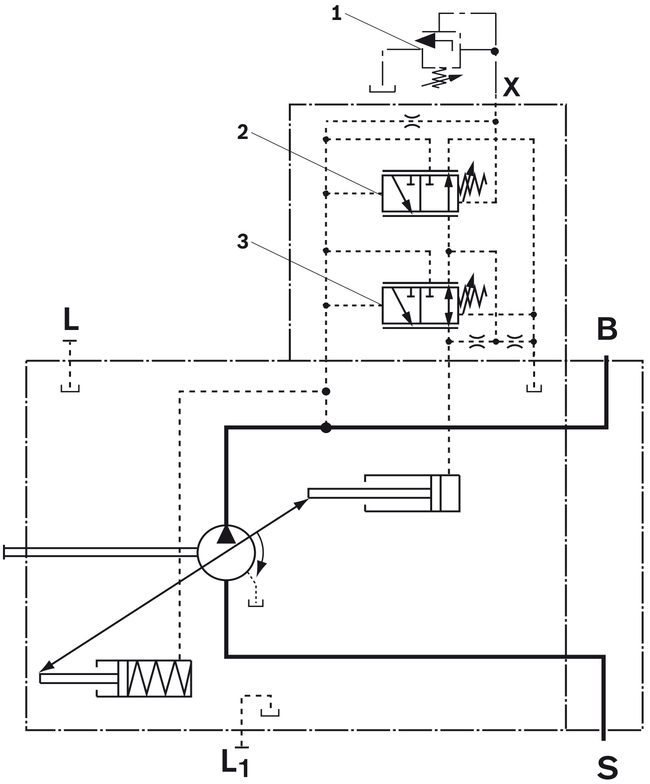
Unloading port **X** to the reservoir results in a zero stroke (standby) pressure which is approx. 1 to 2 bar higher than the defined differential pressure Δp, however system influences are not taken into account.

▼ Characteristic curve DRG



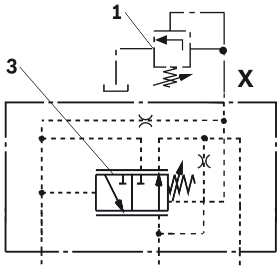
Characteristic curve valid for n_1 = 1500 rpm and t_{fluid} = 50 °C.

▼ Circuit diagram DRG nominal size 18 to 100



1 The separate pressure relief valve and the line are not included in the scope of delivery.
2 Remote controlled pressure cut-off (**G**).
3 Pressure controller (**DR**)

▼ Circuit diagram, size 140



Controller data

NG		18	28	45	71	88	100	140
Pressure increase	Δp [bar]	4	4	6	8	9	10	12
Hysteresis and repeatability	Δp [bar]	maximum 3						
Control fluid consumption	[l/min]	maximum approx. 4.5						

---

[1] In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.
[2] Zero stroke from pressure setting Δp on controller (**2**)

DFR / DFR1 / DRSC – Pressure and flow controller

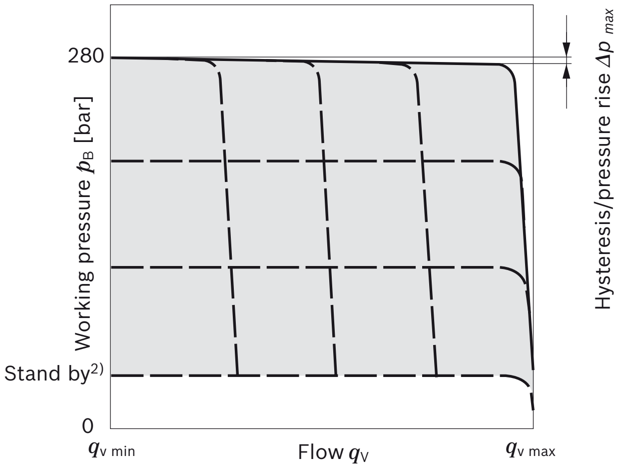
In addition to the pressure controller function (see page 11), a variable orifice (e.g. directional valve) is used to adjust the differential pressure upstream and downstream of the orifice. This is used to control the pump flow. The pump flow is equal to the actual hydraulic fluid quantity required by the consumer. With all controller combinations, the V_g reduction has priority.

- Basic position in depressurized state: $V_{g\,max}$.
- Setting range[1)] to 280 bar
  standard is 280 bar.
- DR pressure controller data see page 11

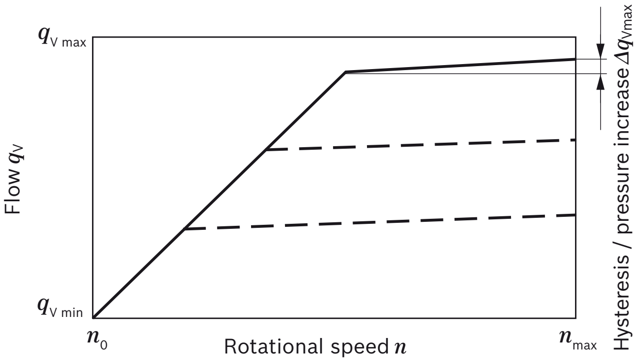
Notice

- The DFR1 and DRSC versions have no unloading between **X** and the reservoir. Unloading the LS-pilot line must be possible in the valve system. Because of the flushing function of the flow controller in the DRS control valve, sufficient unloading of the **X**-line must also be provided. If this unloading of the **X** line does not have to be guaranteed, the DRSC control valve must be used.

▼ Characteristic curve

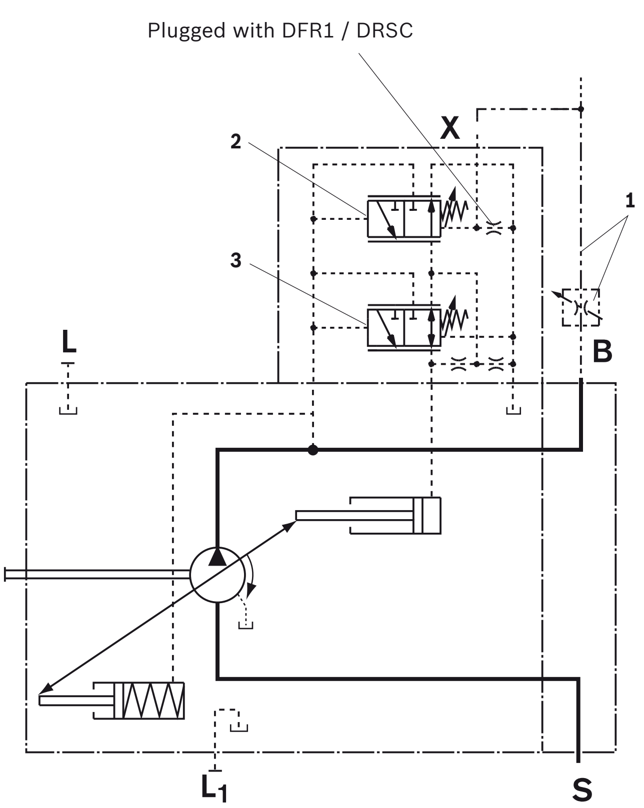


▼ Characteristic curve at variable rotational speed

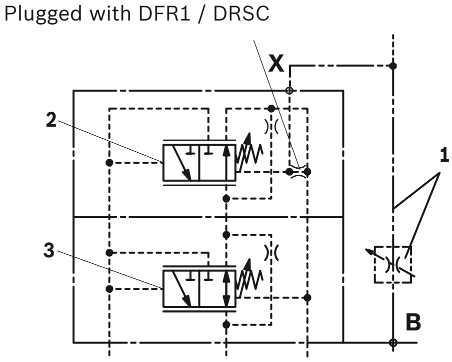


Characteristic curve valid at n_1 = 1500 rpm and θ_{fluid} = 50 °C.

▼ Circuit diagram DFR size 18 to 100



▼ Circuit diagram, size 140



1 The metering orifice (control block) and the line is not included in the scope of delivery.
2 Pressure and flow controller (**FR**).
3 Pressure controller (**DR**)

For further information see page 14

---

1) In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded.
The range of possible settings at the valve is higher.

2) Zero stroke from pressure setting Δp on controller (**2**)

Differential pressure Δ*p*:

- Standard setting: 14 bar
  If another setting is required, please state in plain text.
- Setting range: 14 bar to 22 bar

Unloading port **X** to the reservoir results in a zero stroke (standby) pressure which is approx. 1 to 2 bar higher than the defined differential pressure Δp, however, system influences are not taken into account.

Controller data

DR pressure controller data see page 11.

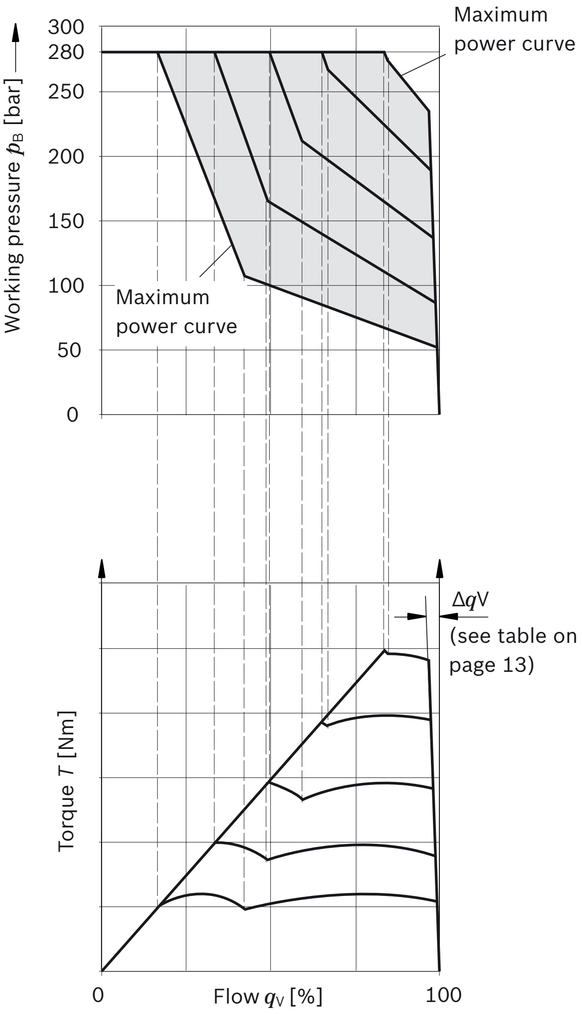
Maximum flow deviation measured at drive speed n = 1500 rpm.

NG		**18**	**28**	**45**	**71**	**88**	**100**	**140**
Flow deviation	$\Delta q_{V\,max}$ [l/min]	0.9	1.0	1.8	2.8	3.4	4.0	6.0
Hysteresis and repeatability	Δp [bar]	maximum 4						
Control fluid consumption	[l/min]	maximum approx. 3 to 4.5 (DFR) maximum approx. 3 (DFR1/DRSC)						

DFLR – Pressure, flow and power control

Pressure controller equipped like DR(G), see page 11 (12).
Flow controller equipped like DFR, DFR1, see page 13.
In order to achieve a constant drive torque with varying working pressures, the swivel angle and with it the output flow from the axial piston pump is varied so that the product of flow and pressure remains constant.
Flow controller is possible below the power control curve.

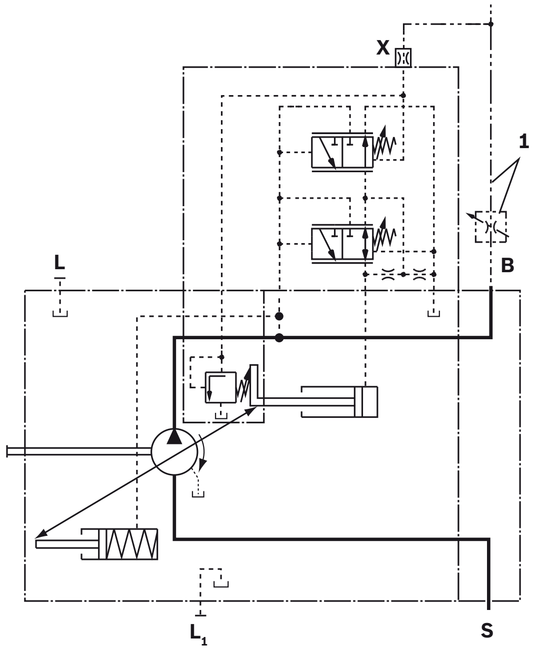
▼ **Characteristic curve and torque characteristic**



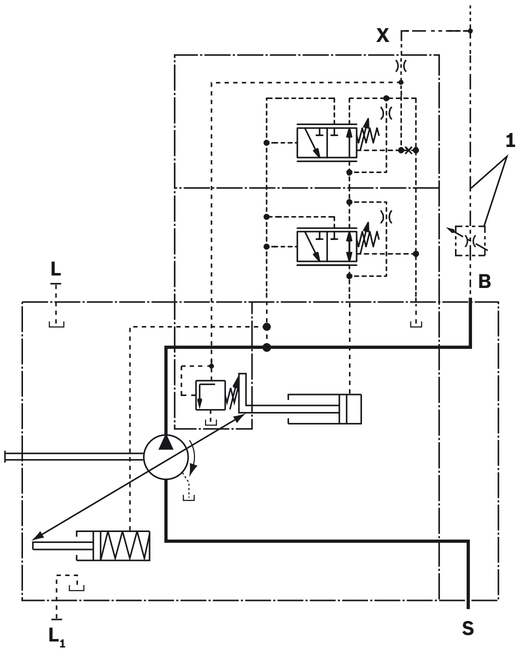
Beginning of control 50 bar

When ordering please state the power characteristics to be set at the factory in plain text, e.g. 20 kW at 1500 rpm.

▼ **Circuit diagram, sizes 28 to 100**



▼ **Circuit diagram, size 140**



1 The metering orifice (control block) and the line is not included in the scope of delivery.

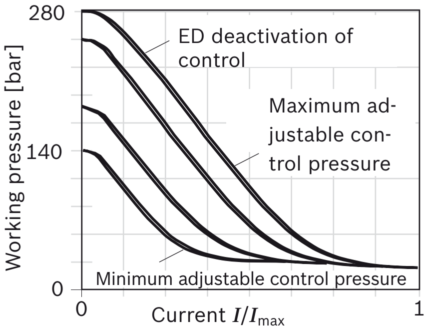
Controller data

- ▶ For technical data of pressure controller DR see page 11.
- ▶ For technical data of flow controller FR see page 14.
- ▶ Control fluid consumption approx. 5.5 l/min max.

ED – Electro-hydraulic pressure control

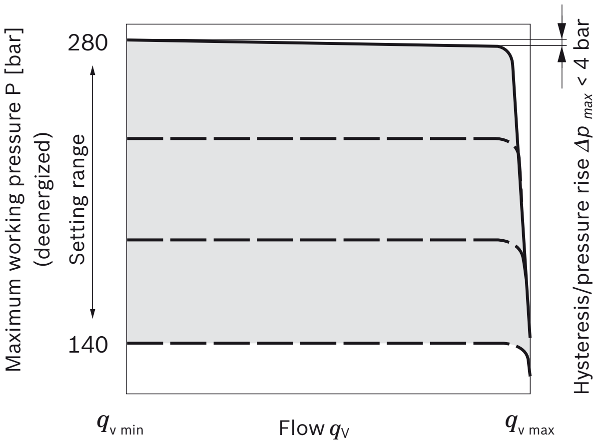
The ED valve is set to a certain pressure by a specified variable solenoid current.
With changes on the consumer (load pressure), this causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.
The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.
As the solenoid current signal drops towards zero, the pressure will be limited to p_{max} by an adjustable hydraulic pressure cut-off (secure fail safe function in case of power failure, e.g. for fan speed control). The response time characteristic curve of the ED control was optimized for the use as a fan drive system.
When ordering, specify the type of application in plain text.

▼ **Static current-pressure characteristic curve ED**
(negative characteristic curve measured with pump in zero stroke)



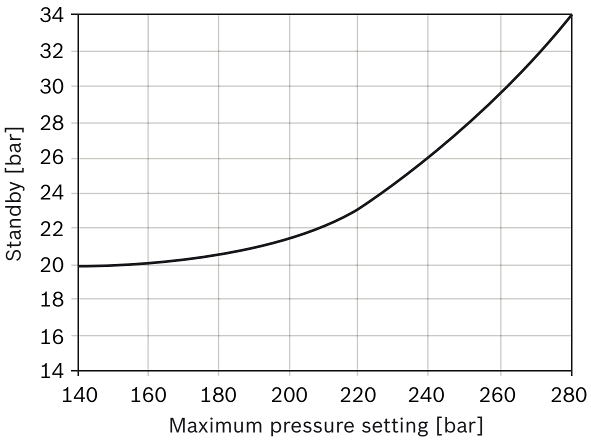
Hysteresis static < 3 bar.

▼ **Flow-pressure characteristic curve**

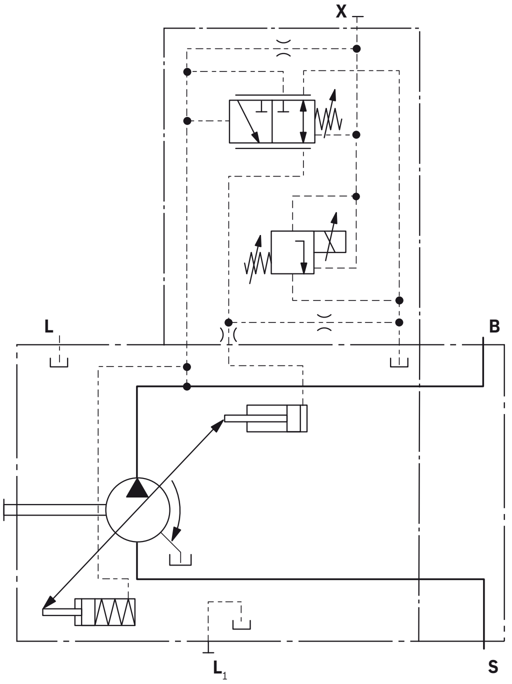


Characteristic curves valid at n_1 = 1500 rpm and t_{fluid} = 50 °C.
Control fluid consumption: 3 to 4.5 l/min.
For standby standard setting, see diagram on right, other values on request.

▼ **Influence of the pressure setting on standby (maximally energized)**



▼ **Circuit diagram ED71/ED72**

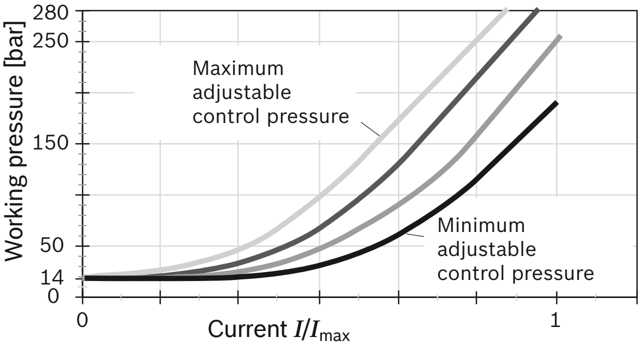


Technical data, solenoid	ED71	ED72
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at p_{max}	100 mA	50 mA
Start of control at p_{min}	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Duty cycle	100%	100%
Electronic controls and type of protection, see page 55		
Operating temperature range at valve -20 °C to +115 °C		

ER – Electro-hydraulic pressure control

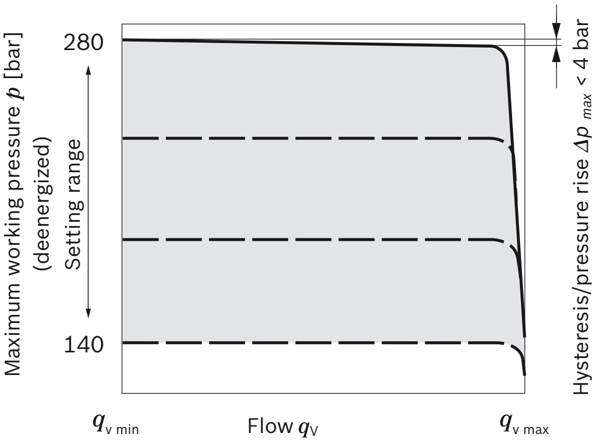
The ER valve is set to a certain pressure by a specified variable solenoid current.
When a change is made at the consumer (load pressure), the position of the control spool will shift.
This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.
The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.
As the solenoid current signal drops towards zero, the pressure will be limited to p_{min} (stand by).

▼ Current-pressure characteristic curve
(positive characteristic curve measured with pump in zero stroke)



Hysteresis static < 3 bar.

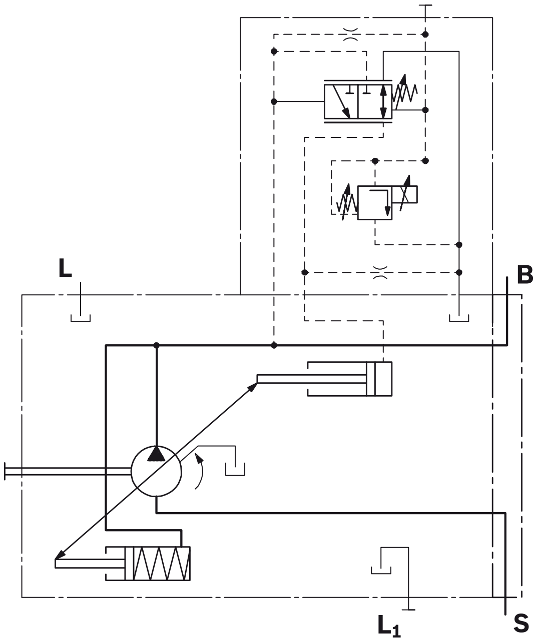
▼ Flow-pressure characteristic curve



Characteristic curve valid at n_1 = 1500 rpm and θ_{fluid} = 50 °C.

- ▶ Control fluid consumption: 3 to 4.5 l/min.
- ▶ Standby standard setting 14 bar. Other values on request.
- ▶ Influence of pressure setting on stand-by ± 2 bar.

▼ Circuit diagram



Technical data, solenoid	ER71	ER72
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at p_{min}	100 mA	50 mA
End of control at p_{max}	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Duty cycle	100%	100%
Electronic controls and type of protection, see page 55		
Operating temperature range at valve -20 °C to +115 °C		

Project planning note!
Excessive current levels (I > 1200 mA at 12 V or I > 600 mA at 24 V) to the ER solenoid can result in undesired pressure increases which can lead to pump or system damage. Therefore:

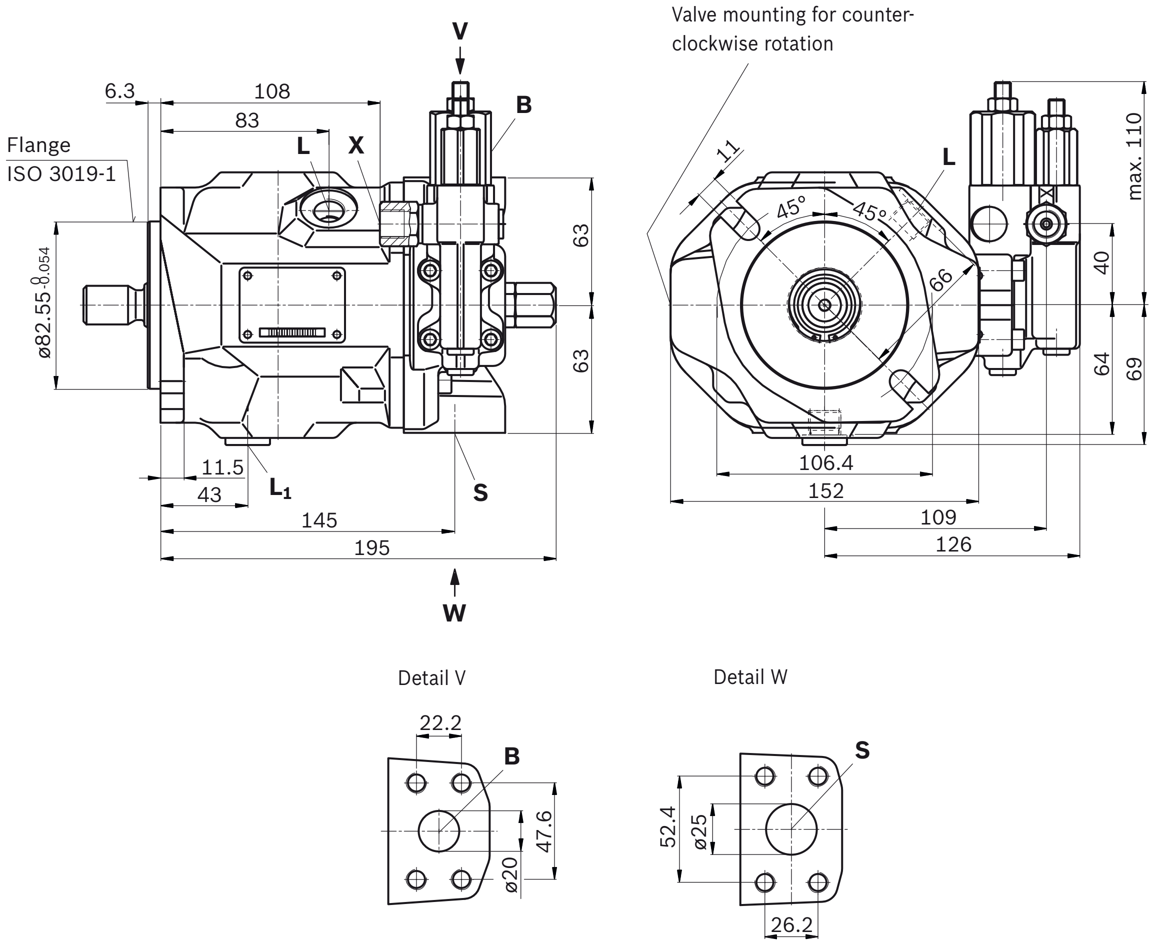
- ▶ Use I_{max} current limiter solenoids.
- ▶ An intermediate plate pressure controller can be used to protect the pump in the event of overflow.

An accessory kit with intermediate plate pressure controller can be ordered from Bosch Rexroth under part number R902490825.

Dimensions, size 18

DFR / DFR1 / DRSC – Pressure and flow control, hydraulic; clockwise rotation, version: Ports metric

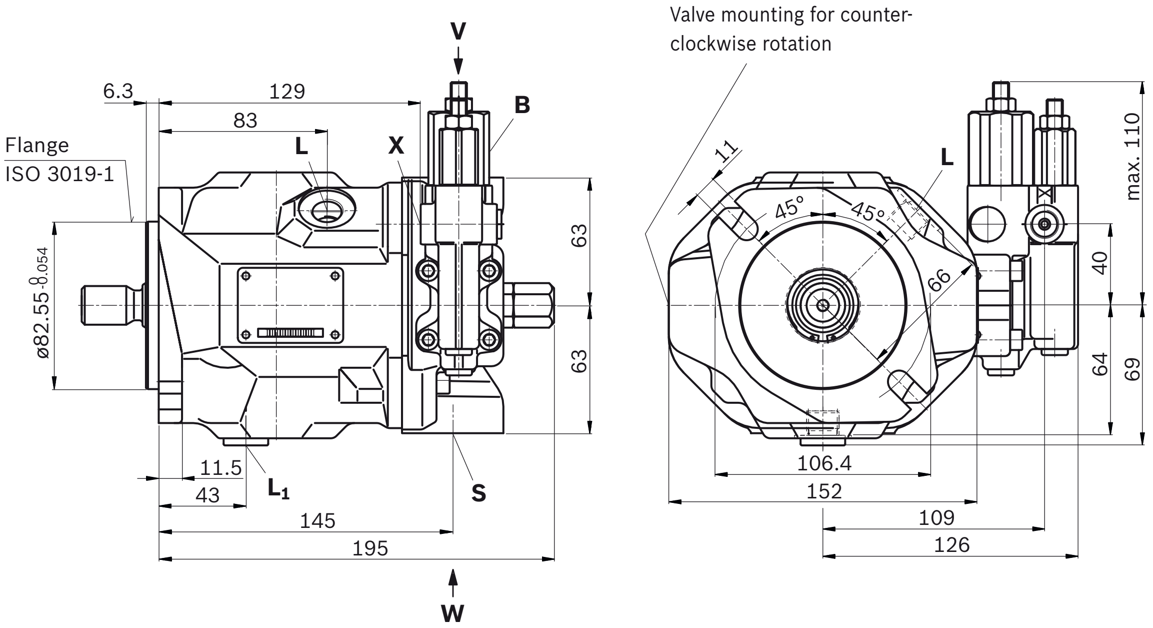
▼ **Port plate 12**



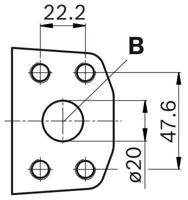
Dimensions, size 18

DFR / DFR1 / DRSC – Pressure and flow control, hydraulic; clockwise rotation, version: SAE ports

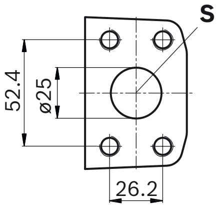
▼ **Port plate 62**



Detail V

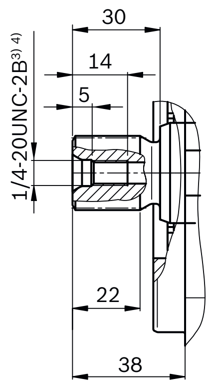


Detail W



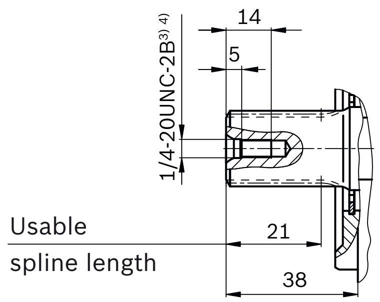
▼ Splined shaft 3/4 in (SAE J744)

S – 11T 16/32DP[1]



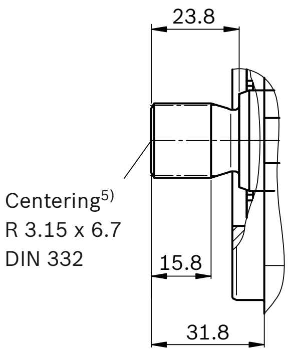
▼ Splined shaft 3/4 in (SAE J744)

R – 11T 16/32DP[1][2]



▼ Splined shaft 5/8 in (SAE J744)

U – 9T 16/32DP[1]



Ports - version metric port plate 12		**Standard**	**Size**[4]	$p_{\text{max abs}}$ **[bar]**[6]	**State**[10]
B	Working port (standard pressure series) Fastening thread	SAE J518[7] DIN 13	3/4 in M10 × 1.5; 17 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[7] DIN 13	1 in M10 × 1.5; 17 deep	10	O
L	Drain port	DIN 3852[8]	M16 × 1.5; 12 deep	2	O[9]
L_1	Drain port	DIN 3852[8]	M16 × 1.5; 12 deep	2	X[9]
X	Pilot pressure	DIN 3852	M14 × 1.5; 12 deep	350	O
X	Pilot pressure with DG-control	DIN ISO 228	G1/4 in; 12 deep	350	O

Ports - version SAE port plate 62		**Standard**	**Size**[4]	$p_{\text{max abs}}$ **[bar]**[6]	**State**[10]
B	Working port (standard pressure series) Fastening thread	SAE J518 ASME B1.1	3/4 in 3/8-16 UNC-2B; 20 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518 ASME B1.1	1 in 3/8-16 UNC-2B; 20 deep	10	O
L	Drain port	ISO 11926[8]	9/16-18 UNF-2B; 12 deep	2	O[9]
L_1	Drain port	ISO 11926[8]	9/16-18 UNF-2B; 12 deep	2	X[9]
X	Pilot pressure	ISO 11926	7/16-20 UNF-2B; 11.5 deep	350	O
X	Pilot pressure with DG-control	DIN ISO 228	G1/4 in; 12 deep	350	O

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1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) For notes on tightening torques, see the instruction manual

5) Coupling axially secured, e.g. with a clamp coupling or radially mounted clamping screw

6) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

7) Metric fastening thread is a deviation from standard.

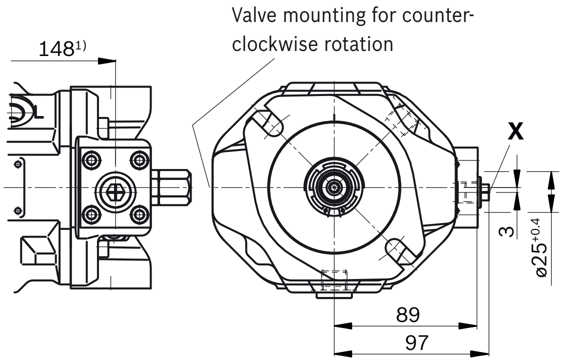
8) The countersink can be deeper than as specified in the standard.

9) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 56).

10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

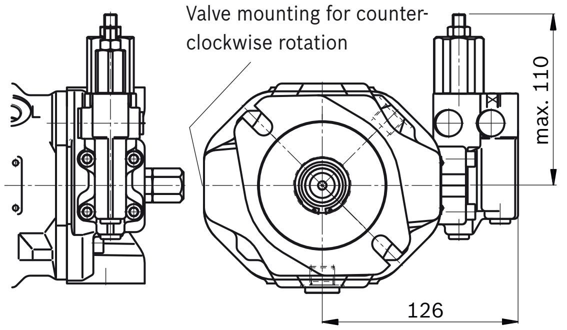
▼ DG – Two-point control, direct operated

Port plate 12 (62)



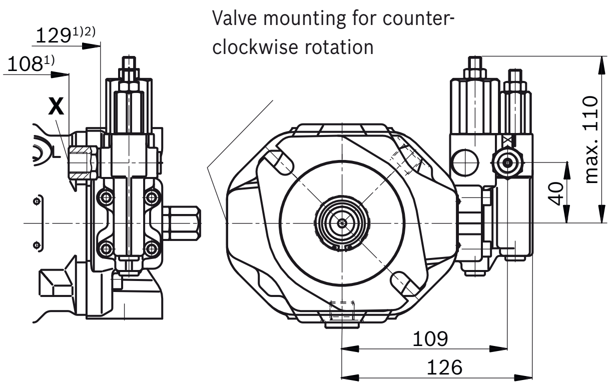
▼ DR – Pressure controller

Port plate 12 (62)



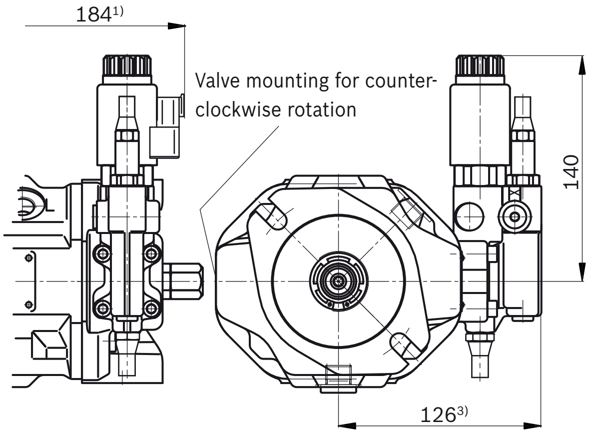
▼ DRG – Pressure controller, remote controlled

Port plate 12 (62)



▼ ED7.,ER7. – Electro-hydraulic pressure control

Port plate 12 (62)



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1) To flange surface

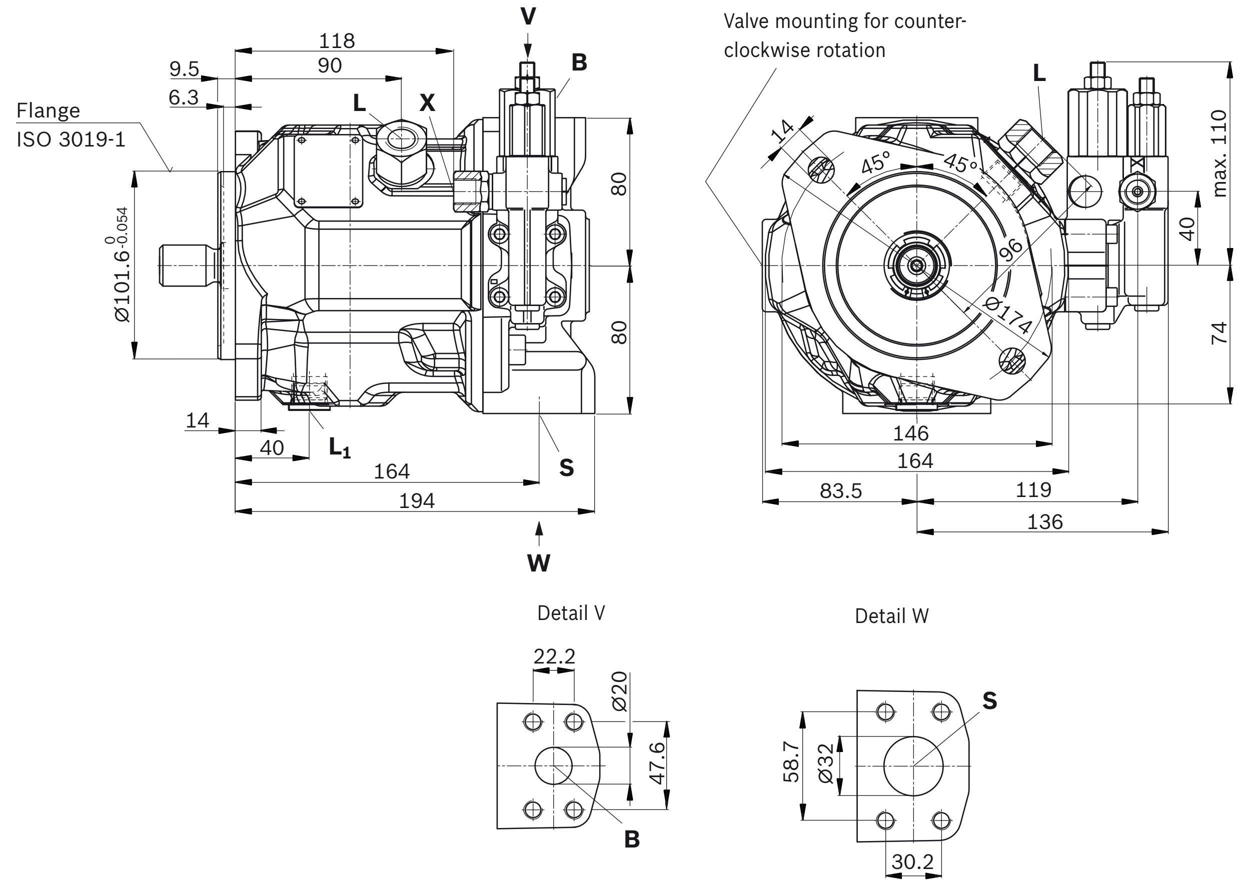
2) For version port plates 62

3) ER7.: 161 mm if using an intermediate plate pressure controller

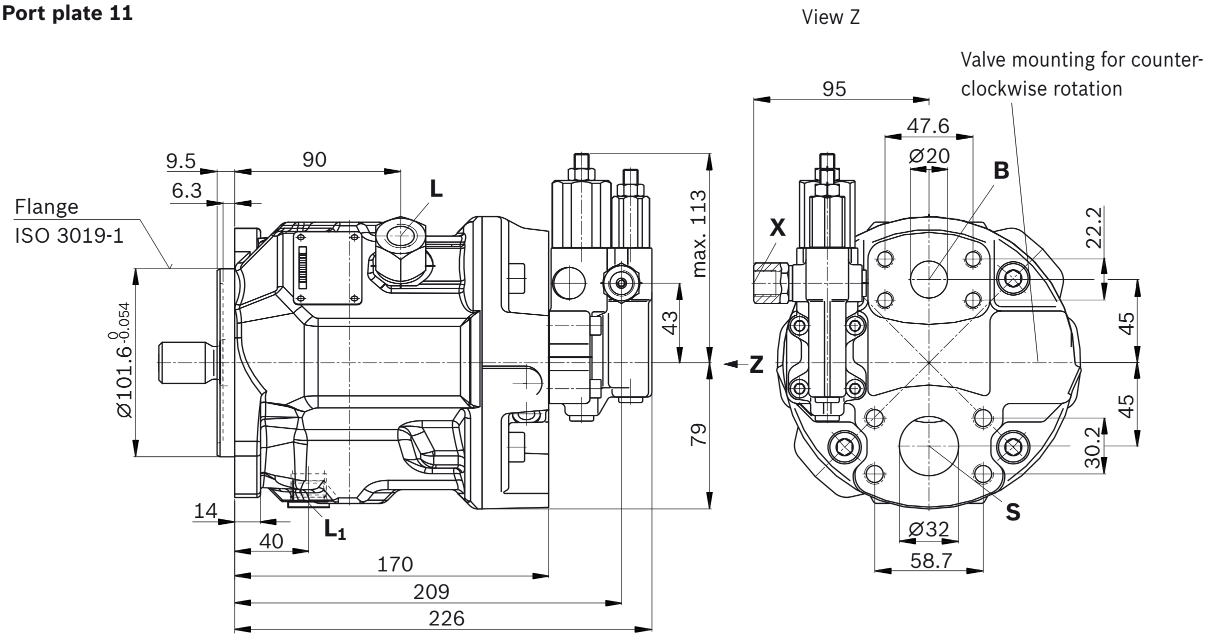
Dimensions, size 28

DFR / DFR1 / DRSC – Pressure and flow control, hydraulic; clockwise rotation, version: Ports metric

▼ **Port plate 12**



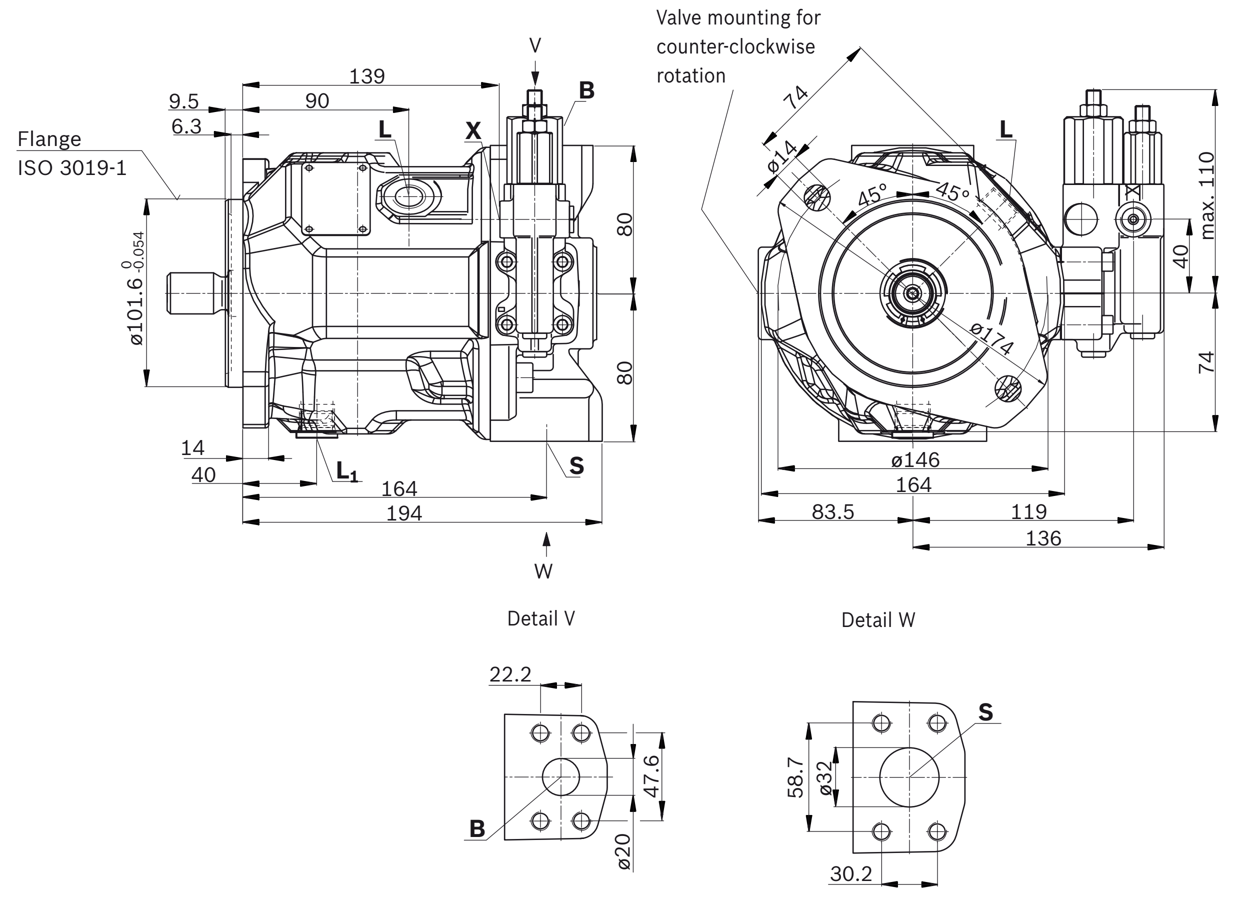
▼ **Port plate 11**



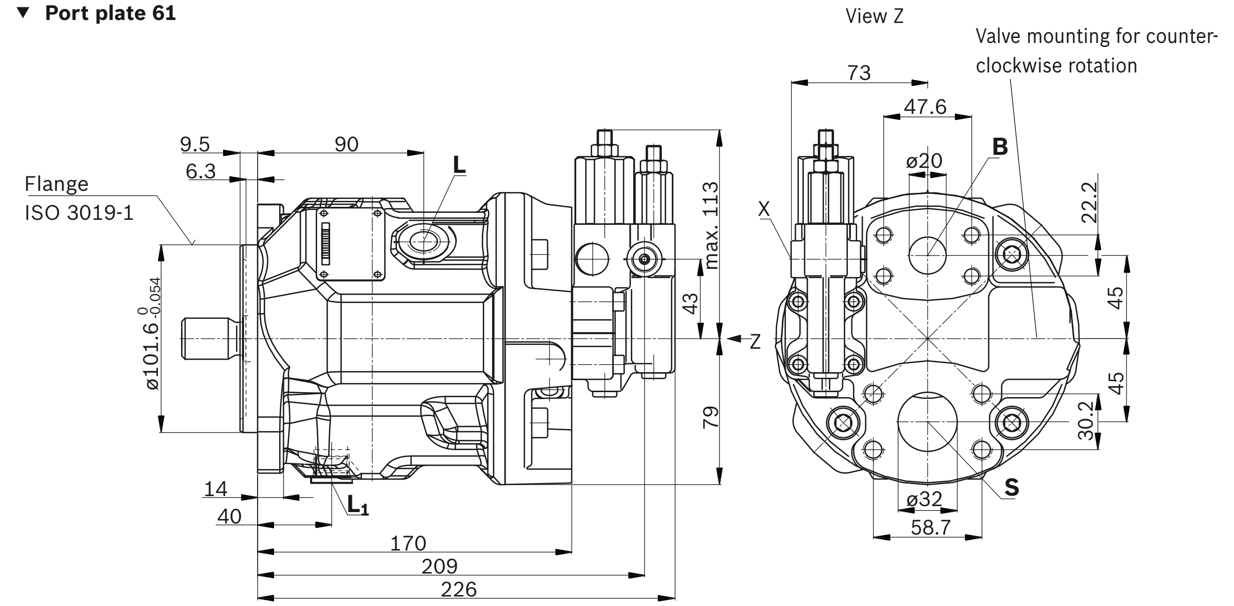
Dimensions, size 28

DFR / DFR1 / DRSC – Pressure and flow control, hydraulic; clockwise rotation, version: SAE ports

▼ **Port plate 62**

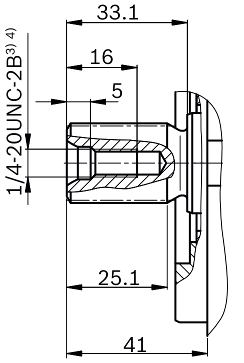


▼ **Port plate 61**



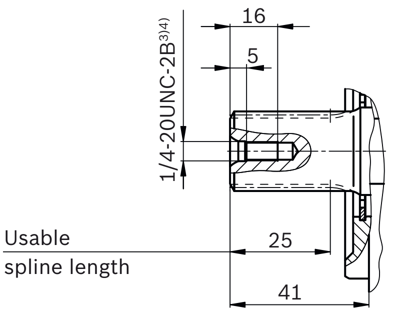
▼ **Splined shaft 7/8 in (SAE J744)**

S – 13T 16/32DP[1)]



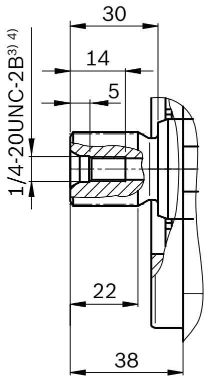
▼ **Splined shaft 7/8 in (SAE J744)**

R – 13T 16/32DP[1)2)]



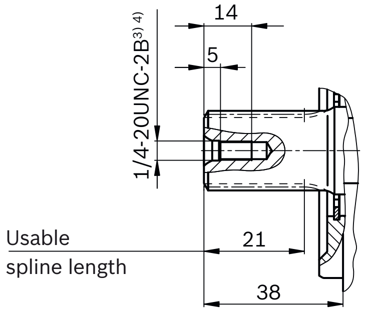
▼ **Splined shaft 3/4 in (SAE J744)**

U – 11T 16/32DP[1)]



▼ **Splined shaft 3/4 in (SAE J744)**

W – 11T 16/32DP[1)2)]



Ports - version metric port plate 11/12		**Standard**	**Size**[4)]	$p_{\text{max abs}}$ **[bar]**[5)]	**State**[9)]
B	Working port (standard pressure series) Fastening thread	SAE J518[6)] DIN 13	3/4 in M10 × 1.5; 17 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6)] DIN 13	1 1/4 in M10 × 1.5; 17 deep	10	O
L	Drain port	DIN 3852[7)]	M18 × 1.5; 12 deep	2	O[8)]
L_1	Drain port	ISO 11926[7)]	3/4-16 UNF-2B; 14 deep	2	X[8)]
X	Pilot pressure	DIN 3852	M14 × 1.5; 12 deep	350	O
X	Pilot pressure with DG-control	DIN ISO 228	G1/4 in; 12 deep	350	O

Ports - version SAE port plate 61/62		**Standard**	**Size**[4)]	$p_{\text{max abs}}$ **[bar]**[5)]	**State**[9)]
B	Working port (standard pressure series) Fastening thread	SAE J518 ASME B1.1	3/4 in 3/8-16 UNC-2B; 20 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518 ASME B1.1	1 1/4 in 7/16-14 UNC-2B; 24 deep	10	O
L	Drain port	ISO 11926[7)]	3/4-16 UNF-2B; 14 deep	2	O[8)]
L_1	Drain port	ISO 11926[7)]	3/4-16 UNF-2B; 14 deep	2	X[8)]
X	Pilot pressure	ISO 11926	7/16-20 UNC-2B; 11.5 deep	350	O
X	Pilot pressure with DG-control	DIN ISO 228	G1/4 in; 12 deep	350	O

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1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) For notes on tightening torques, see the instruction manual

5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

6) Metric fastening thread is a deviation from standard.

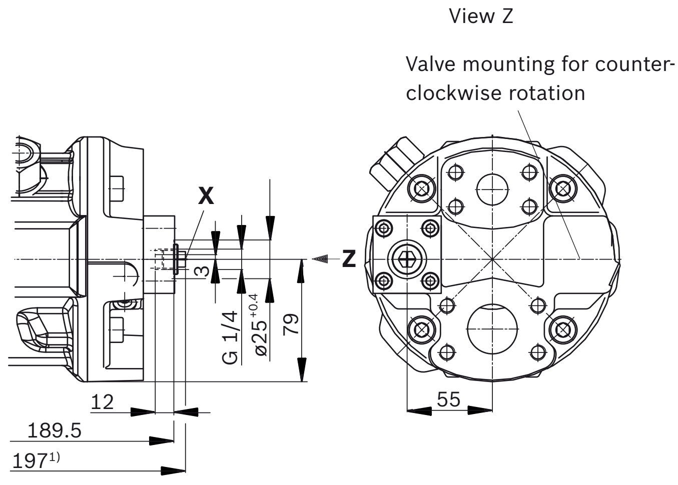
7) The countersink can be deeper than as specified in the standard.

8) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 56).

9) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

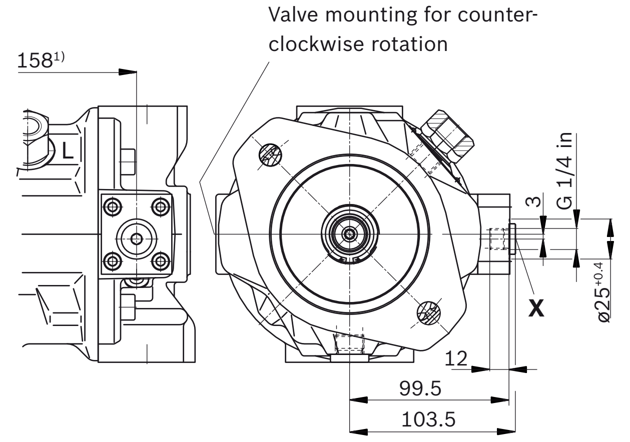
▼ DG – Two-point control, direct operated

Port plate 11 (61)



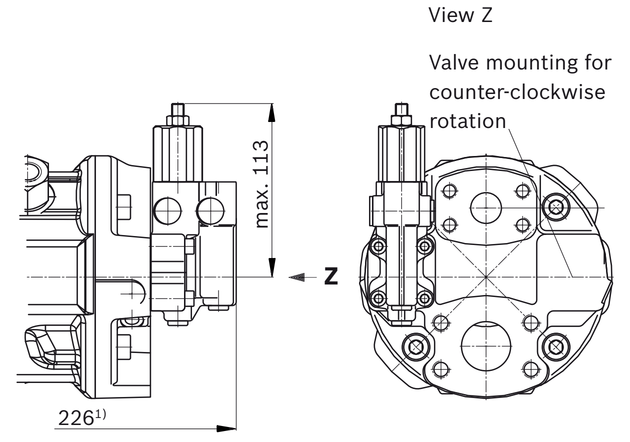
▼ DG – Two-point control, direct operated

Port plate 12 (62)



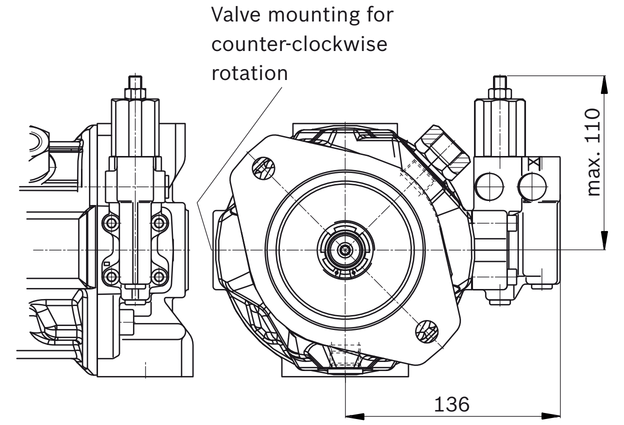
▼ DR – Pressure controller

Port plate 11 (61)



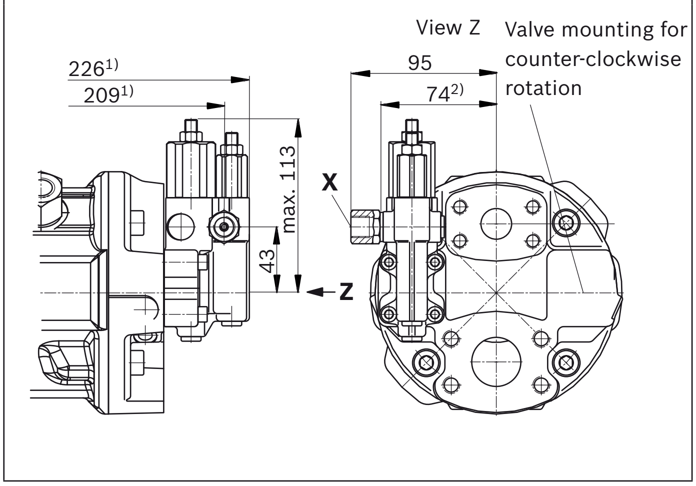
▼ DR – Pressure controller

Port plate 12 (62)



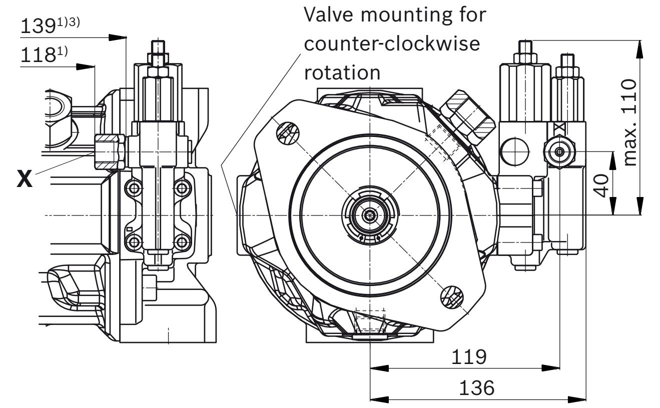
▼ DRG – Pressure controller, remote controlled

Port plate 11 (61)



▼ DRG – Pressure controller, remote controlled

Port plate 12 (62)



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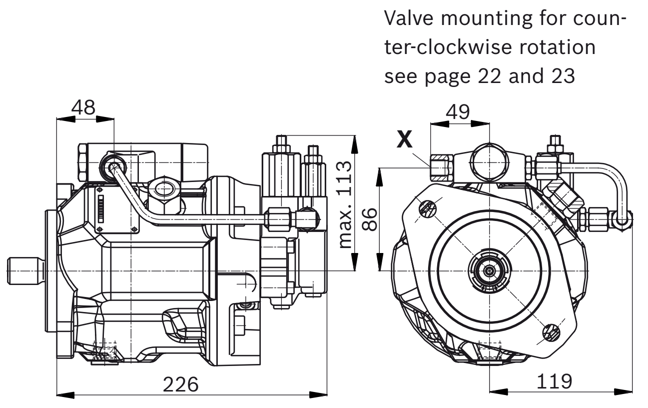
1) To flange surface

2) For version port plate 61

3) For version port plate 62

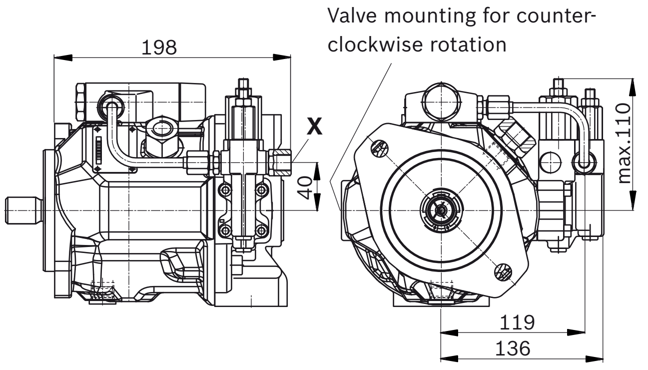
▼ DFLR – Pressure, flow and power controller

Port plate 11 (61)



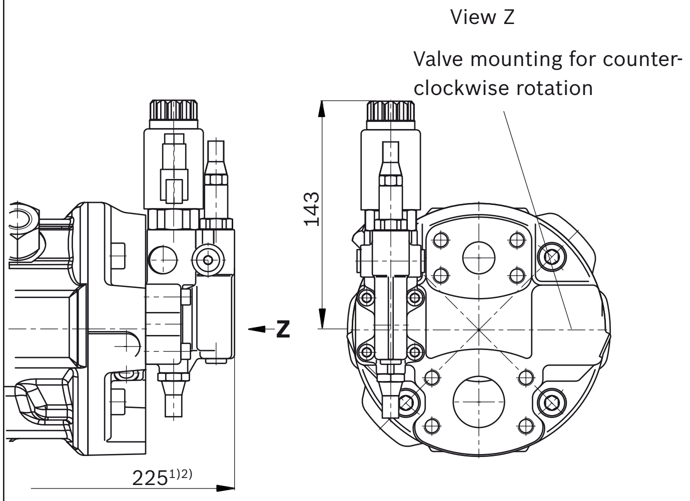
▼ DFLR – Pressure, flow and power controller

Port plate 12 (62)



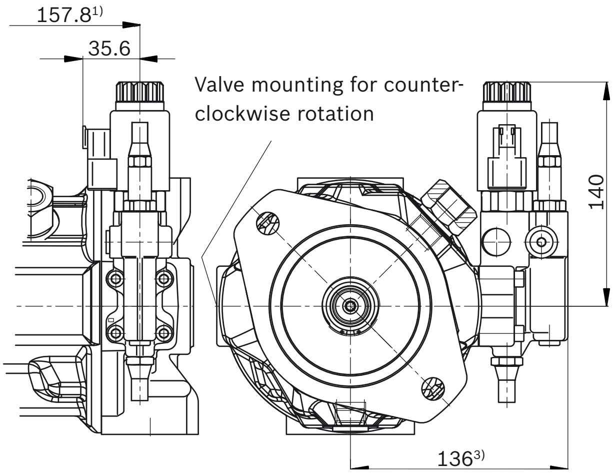
▼ ED7. / ER7. – Electro-hydraulic pressure control

Port plate 11 (61)



▼ ED7. / ER7. – Electro-hydraulic pressure control

Port plate 12 (62)



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1) To flange surface

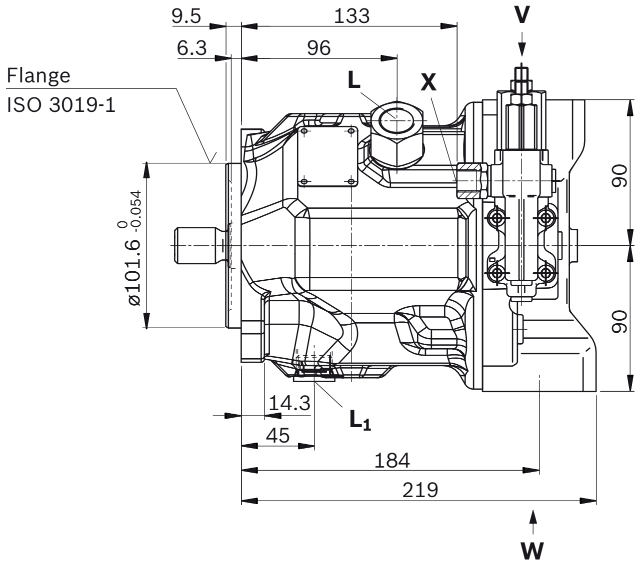
2) ER7.: 260 mm if using an intermediate plate pressure controller

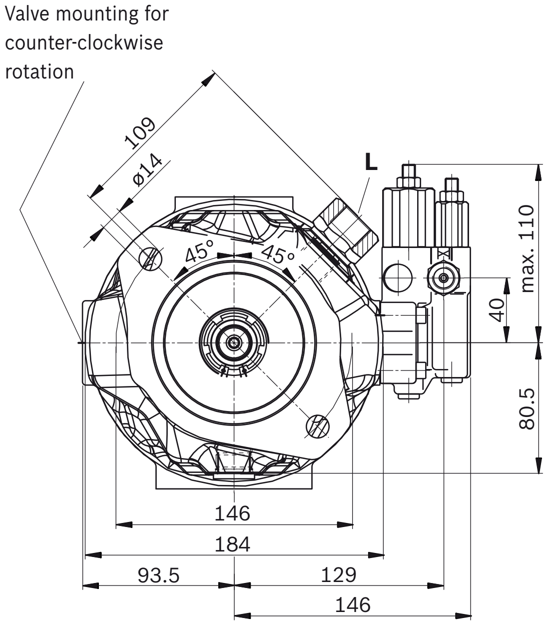
3) ER7.: 171 mm if using an intermediate plate pressure controller

Dimensions, size 45

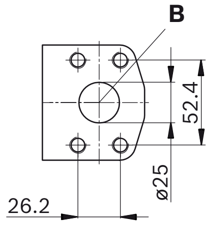
DFR / DFR1 / DRSC – Pressure and flow control, hydraulic; clockwise rotation, version: Ports metric

▼ **Port plate 12**

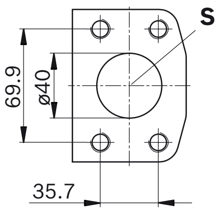




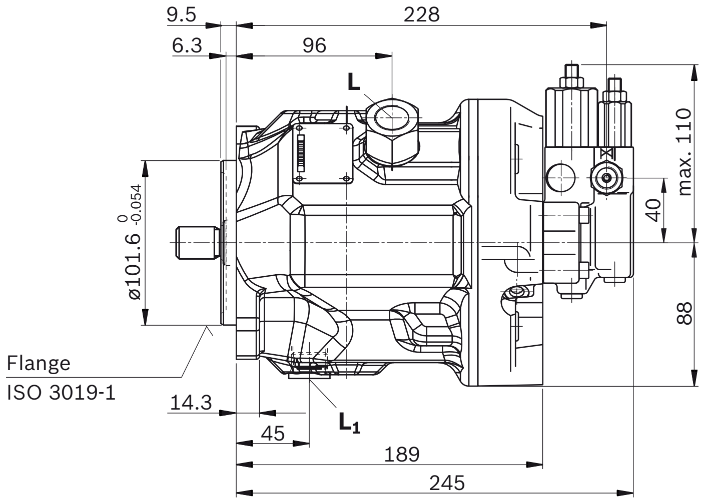
Detail V



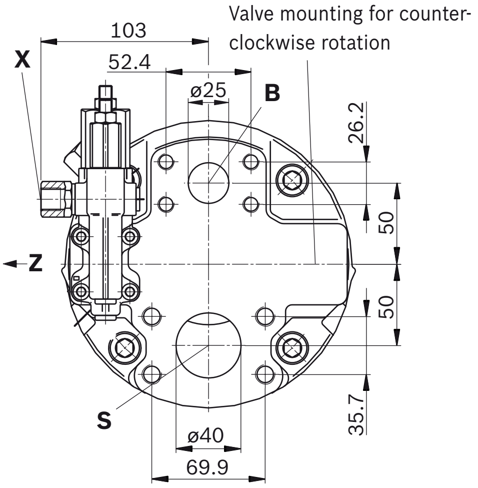
Detail W



▼ **Port plate 11**



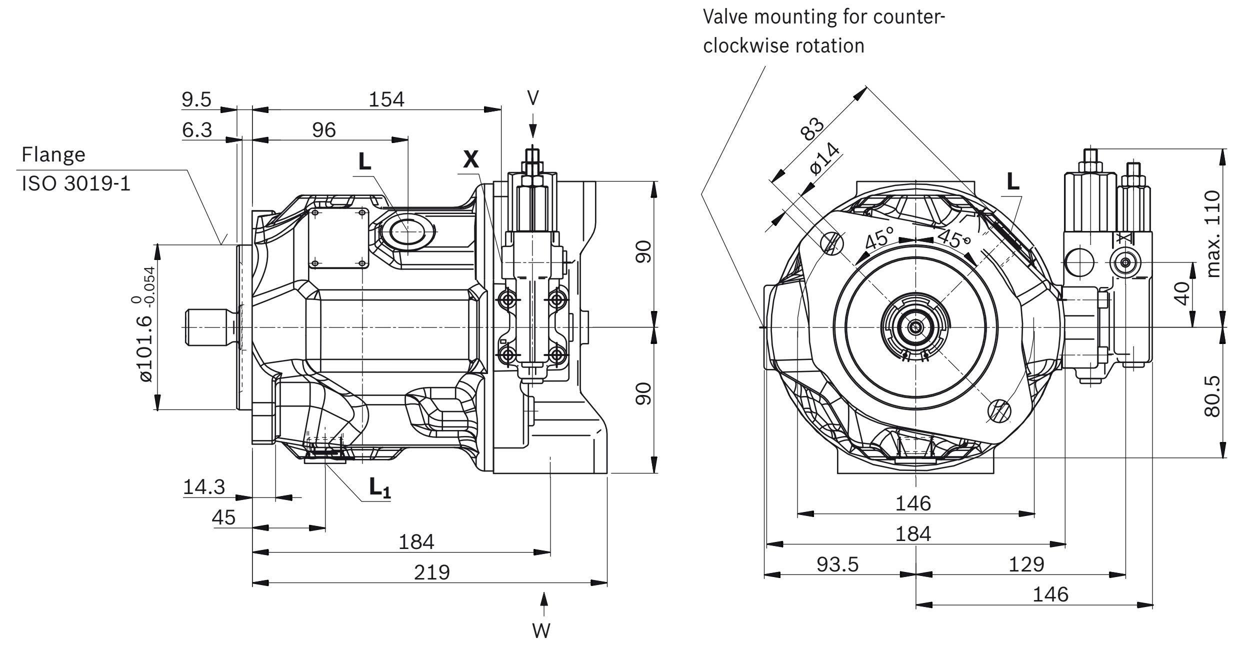
View Z



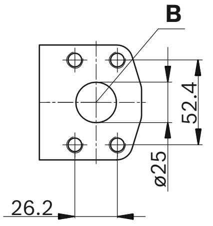
Dimensions, size 45

DFR / DFR1 / DRSC – Pressure and flow control, hydraulic; clockwise rotation, version: SAE ports

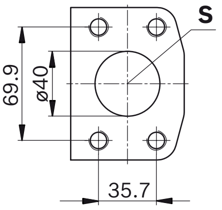
▼ **Port plate 62**



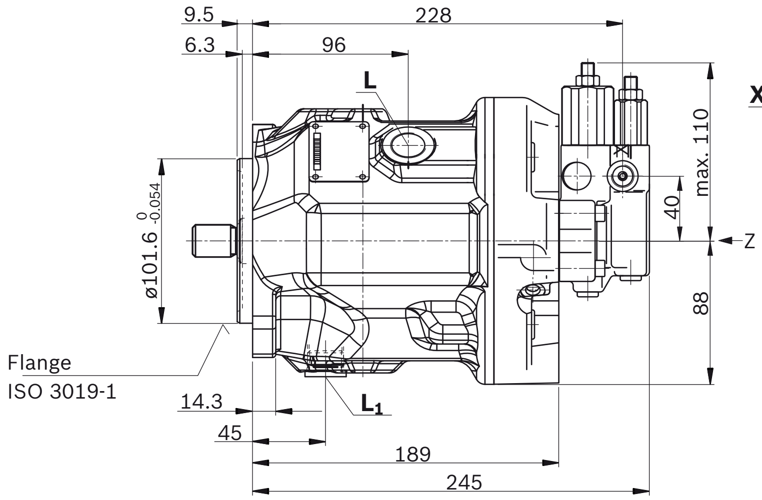
Detail V



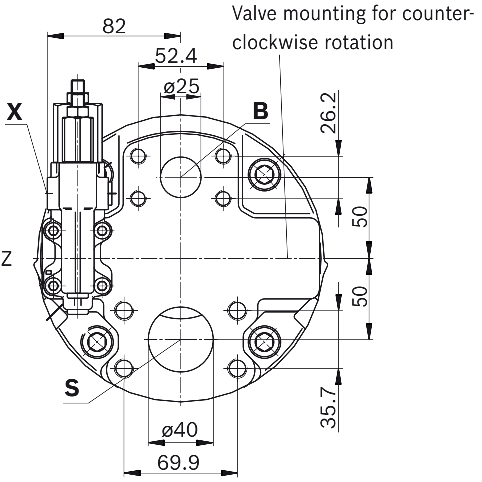
Detail W



▼ **Port plate 61**

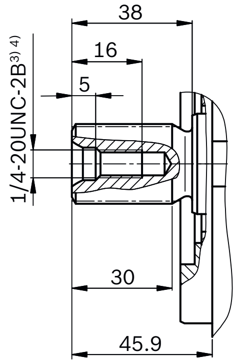


View Z



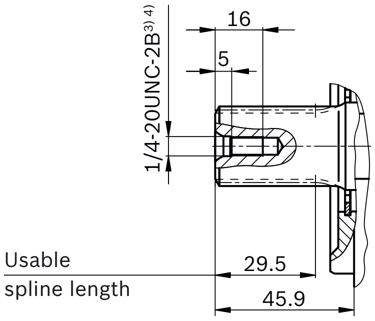
▼ Splined shaft 1 in (SAE J744)

S – 15T 16/32DP1)



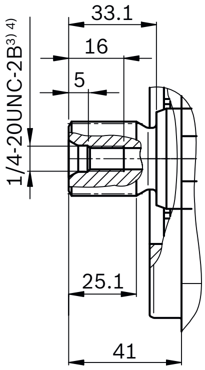
▼ Splined shaft 1 in (SAE J744)

R – 15T 16/32DP1)2)



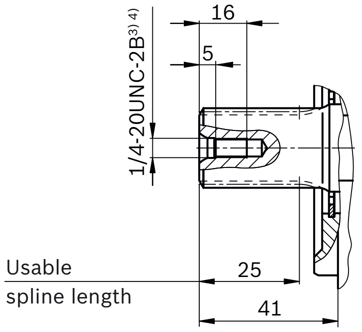
▼ Splined shaft 7/8 in (SAE J744)

U – 13T 16/32DP1)



▼ Splined shaft 7/8 in (SAE J744)

W – 13T 16/32DP1)2)



Ports - version metric port plate 11/12		**Standard**	**Size**4)	$p_{\text{max abs}}$ **[bar]**5)	**State**9)
B	Working port (standard pressure series) Fastening thread	SAE J5186) DIN 13	1 in M10 × 1.5; 17 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J5186) DIN 13	1 1/2 in M12 × 1.75; 20 deep	10	O
L	Drain port	DIN 38527)	M22 × 1.5; 14 deep	2	O8)
$\mathbf{L_1}$	Drain port	ISO 119267)	7/8-14 UNF-2B; 16 deep	2	X8)
X	Pilot pressure	DIN 3852	M14 × 1.5; 12 deep	350	O
X	Pilot pressure with DG-control	DIN ISO 228	G1/4 in; 12 deep	350	O

Ports - version SAE port plate 61/62		**Standard**	**Size**4)	$p_{\text{max abs}}$ **[bar]**5)	**State**9)
B	Working port (standard pressure series) Fastening thread	SAE J518 ASME B1.1	1 in 3/8-16 UNC-2B; 17 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518 ASME B1.1	1 1/2 in 1/2-13 UNC-2B; 20 deep	10	O
L	Drain port	ISO 119267)	7/8-14 UNF-2B; 16 deep	2	O8)
$\mathbf{L_1}$	Drain port	ISO 119267)	7/8-14 UNF-2B; 16 deep	2	X8)
X	Pilot pressure	ISO 11926	7/16-20 UNF-2B; 11.5 deep	350	O
X	Pilot pressure with DG-control	DIN ISO 228	G1/4 in; 12 deep	350	O

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) For notes on tightening torques, see the instruction manual

5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

6) Metric fastening thread is a deviation from standard.

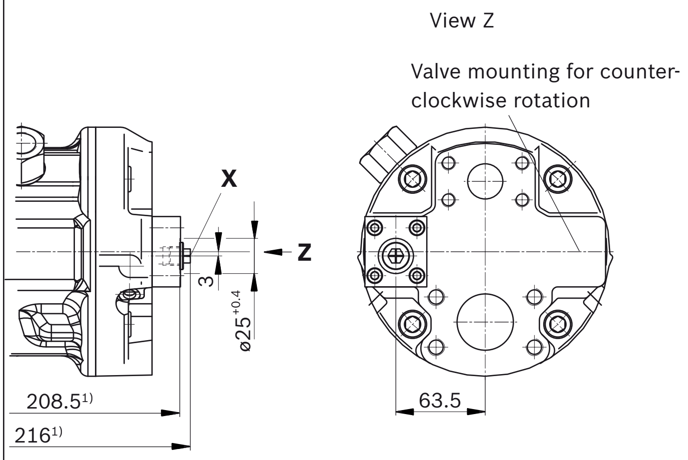
7) The countersink can be deeper than as specified in the standard.

8) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 56).

9) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

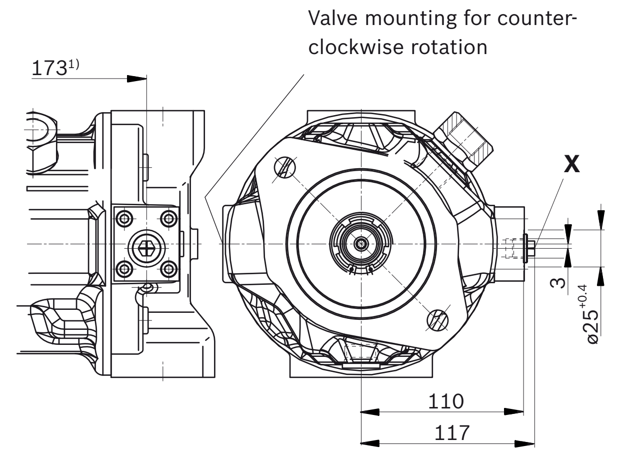
▼ DG – Two-point control, direct operated

Port plate 11 (61)



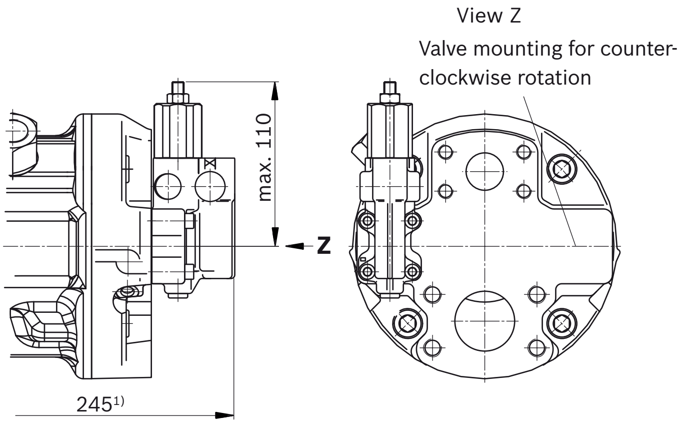
▼ DG – Two-point control, direct operated

Port plate 12 (62)



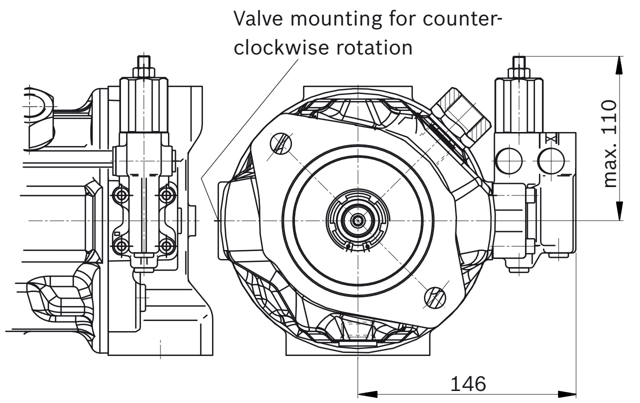
▼ DR – Pressure controller

Port plate 11 (61)



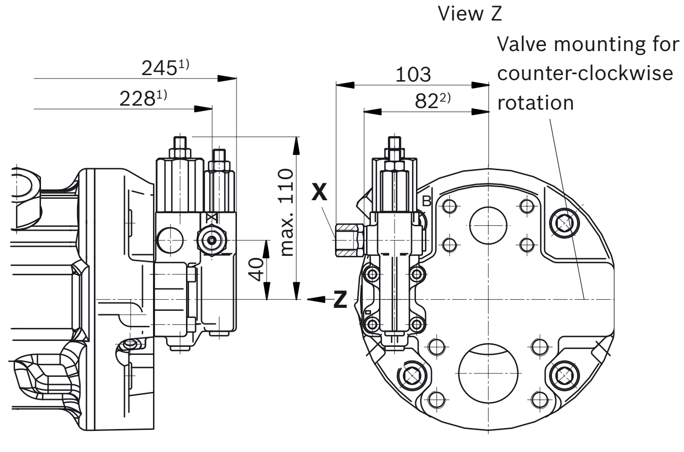
▼ DR – Pressure controller

Port plate 12 (62)



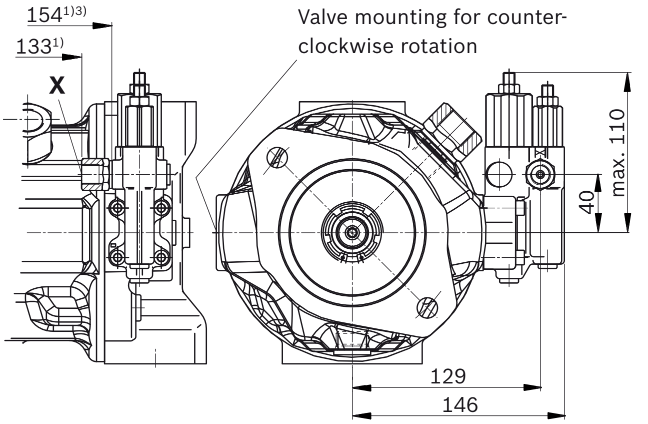
▼ DRG – Pressure controller, remote controlled

Port plate 11 (61)



▼ DRG – Pressure controller, remote controlled

Port plate 12 (62)



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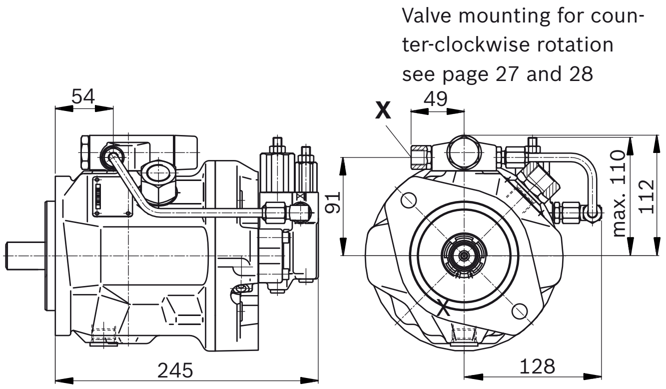
1) To flange surface

2) For version port plate 61

3) For version port plate 62

▼ DFLR – Pressure, flow and power controller

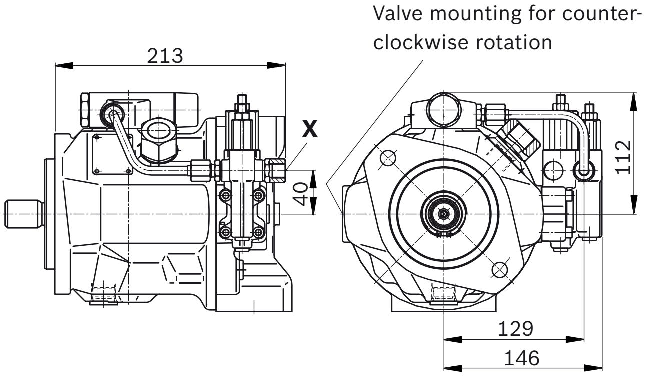
Port plate 11 (61)



Valve mounting for counter-clockwise rotation see page 27 and 28

▼ DFLR – Pressure, flow and power controller

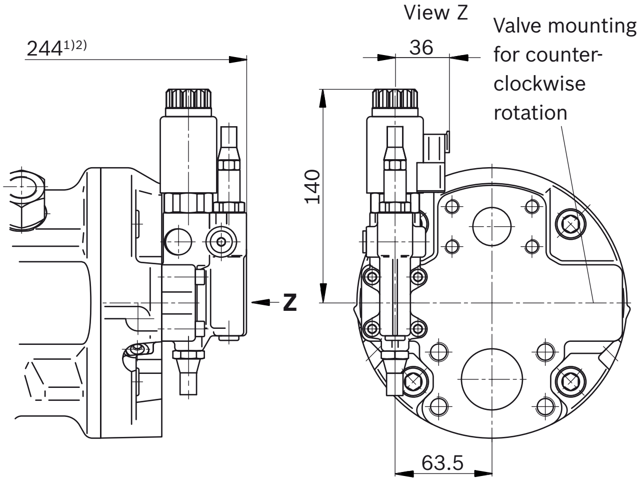
Port plate 12 (62)



Valve mounting for counter-clockwise rotation

▼ ED7. / ER7. – Electro-hydraulic pressure control

Port plate 11 (61)

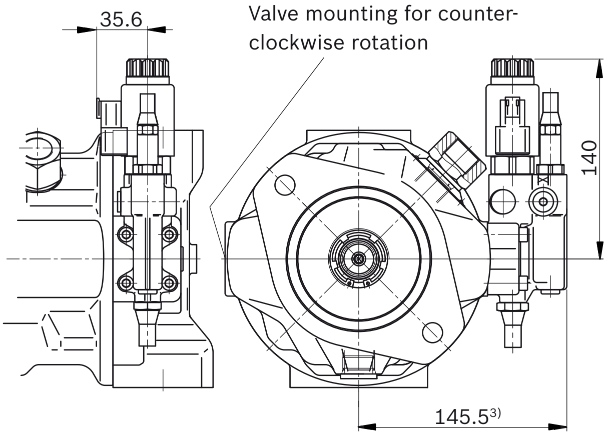


View Z

Valve mounting for counter-clockwise rotation

▼ ED7. / ER7. – Electro-hydraulic pressure control

Port plate 12 (62)



Valve mounting for counter-clockwise rotation

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[1] To flange surface

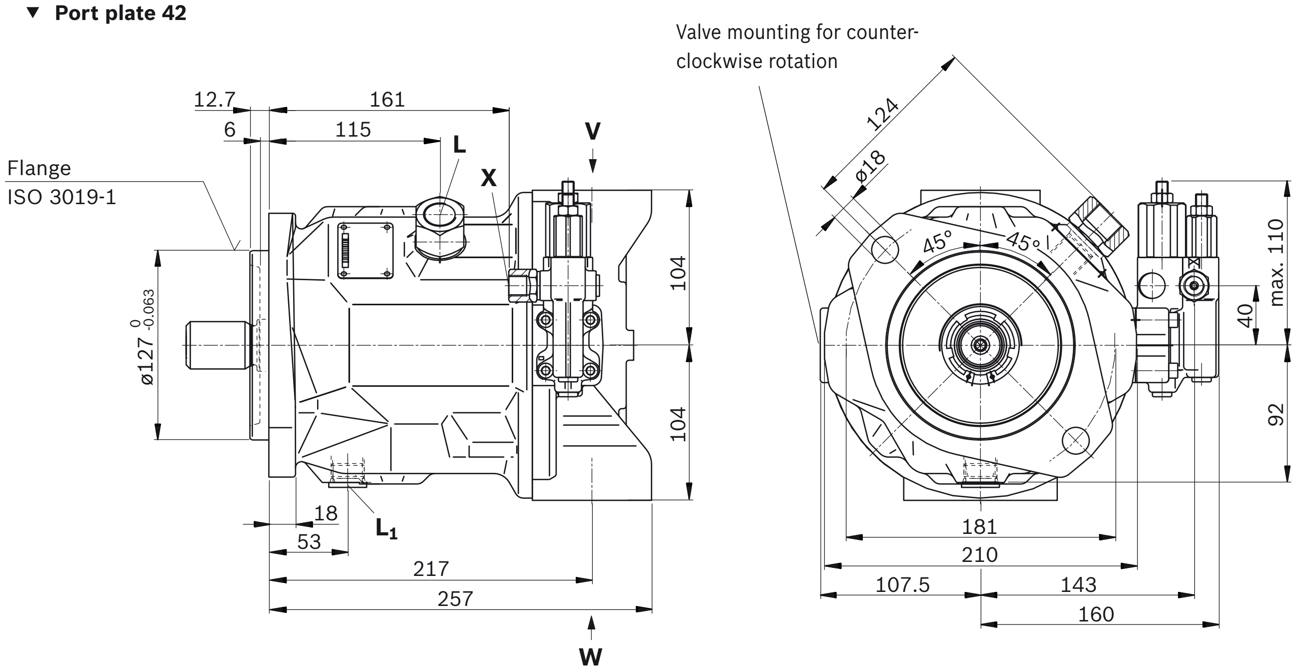
[2] ER7.: 279 mm if using an intermediate plate pressure controller

[3] ER7.: 180.9 mm if using an intermediate plate pressure controller

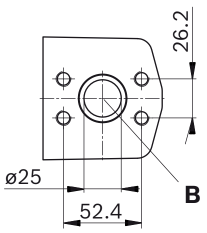
Dimensions sizes 71 and 88

DFR / DFR1 / DRSC – Pressure and flow control, hydraulic; clockwise rotation, version: Ports metric

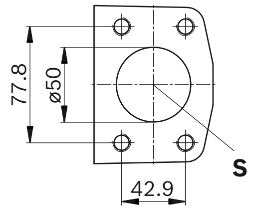
▼ **Port plate 42**



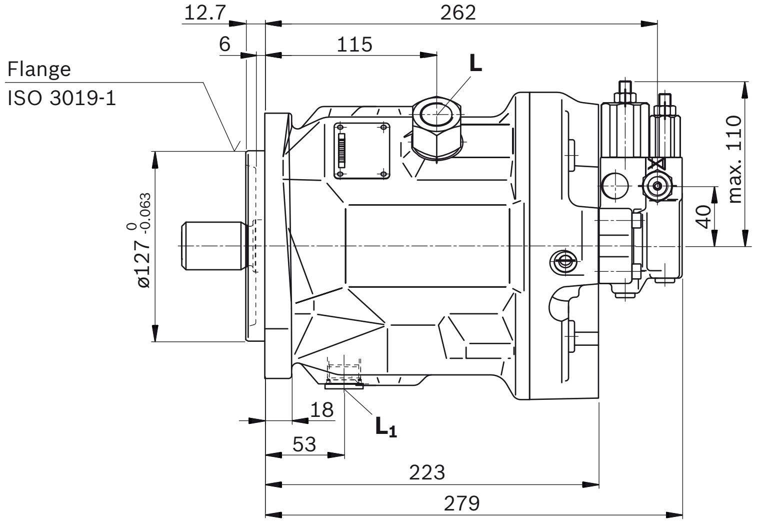
Detail V



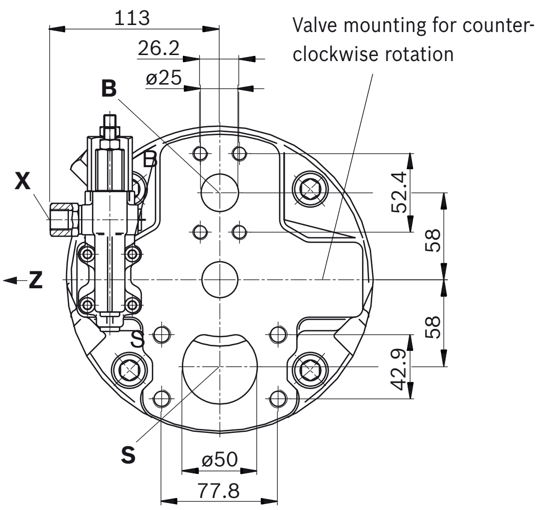
Detail W



▼ **Port plate 41**



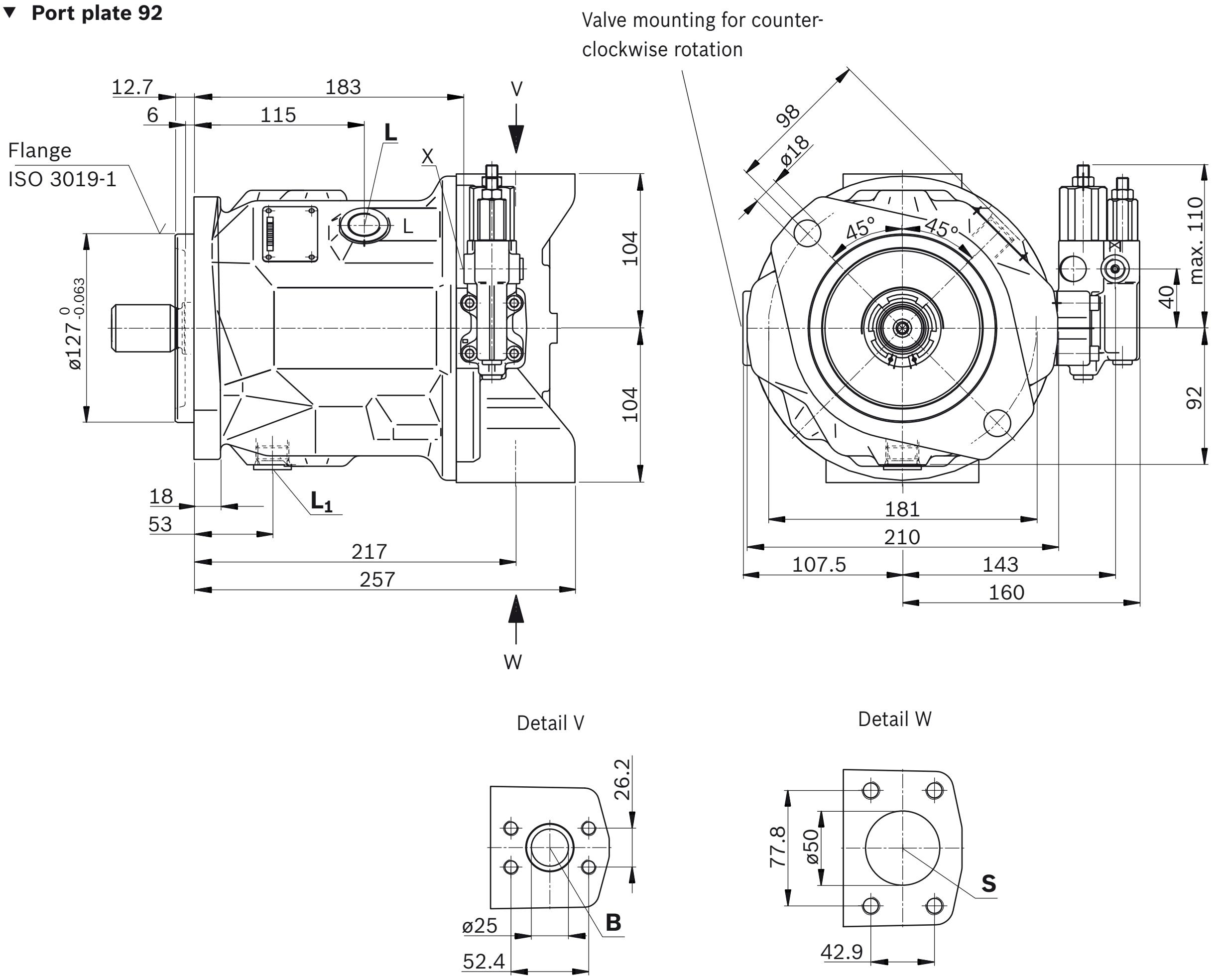
View Z



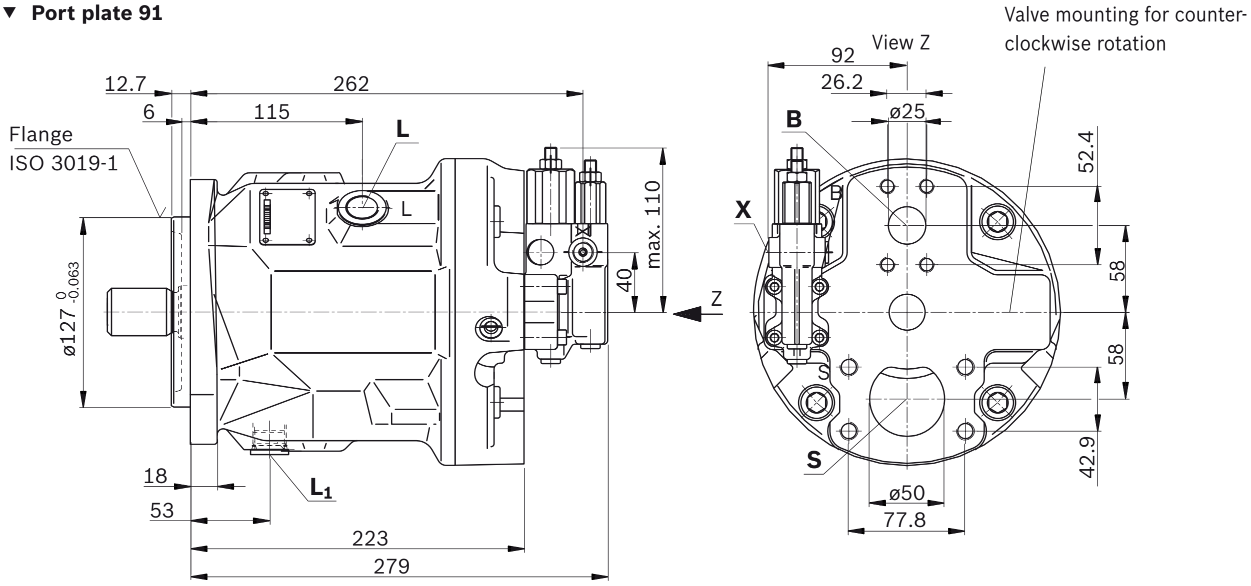
Dimensions sizes 71 and 88

DFR / DFR1 / DRSC – Pressure and flow control, hydraulic; clockwise rotation, version: SAE ports

▼ **Port plate 92**

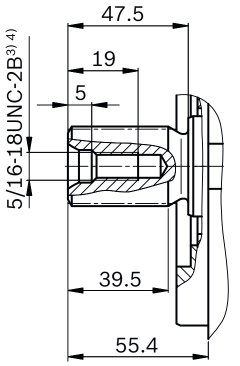


▼ **Port plate 91**



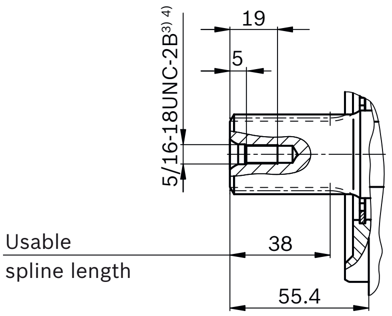
▼ Splined shaft 1 1/4 in (SAE J744)

S – 14T 12/24DP[1]



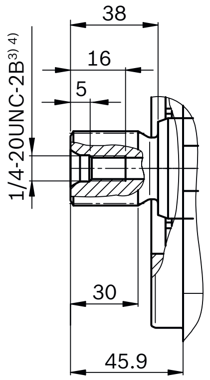
▼ Splined shaft 1 1/4 in (SAE J744)

R – 14T 12/24DP[1)2)]



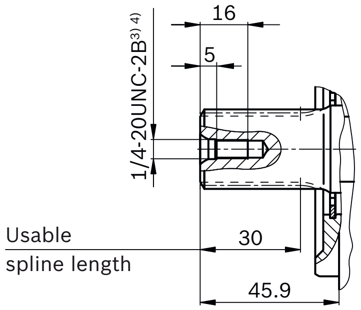
▼ Splined shaft 1 in (SAE J744)

U – 15T 16/32DP[1]



▼ Splined shaft 1 in (SAE J744)

W – 15T 16/32DP[1)2)]



Ports - version metric port plate 41/42		Standard	Size[4]	$p_{\text{max abs}}$ [bar][5]	State[9]
B	Working port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	1 in M10 × 1.5; 17 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	2 in M12 × 1.75; 20 deep	10	O
L	Drain port	DIN 3852[7]	M22 × 1.5; 14 deep	2	O[8]
L_1	Drain port	ISO 11926[7]	7/8-14 UNF-2B; 16 deep	2	X[8]
X	Pilot pressure	DIN 3852	M14 × 1.5; 12 deep	350	O
X	Pilot pressure with DG-control	DIN ISO 228	G1/4 in; 12 deep	350	O

Ports - version SAE port plate 91/92		Standard	Size[4]	$p_{\text{max abs}}$ [bar][5]	State[9]
B	Working port (standard pressure series) Fastening thread	SAE J518 ASME B1.1	1 in 3/8-16 UNC-2B; 18 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518 ASME B1.1	2 in 1/2-13UNC-2B; 22 deep	10	O
L	Drain port	ISO 11926[7]	7/8-14 UNF-2B; 16 deep	2	O[8]
L_1	Drain port	ISO 11926[7]	7/8-14 UNF-2B; 16 deep	2	X[8]
X	Pilot pressure	ISO 11926	7/16-20 UNF-2B; 11.5 deep	350	O
X	Pilot pressure with DG-control	DIN ISO 228	G1/4 in; 12 deep	350	O

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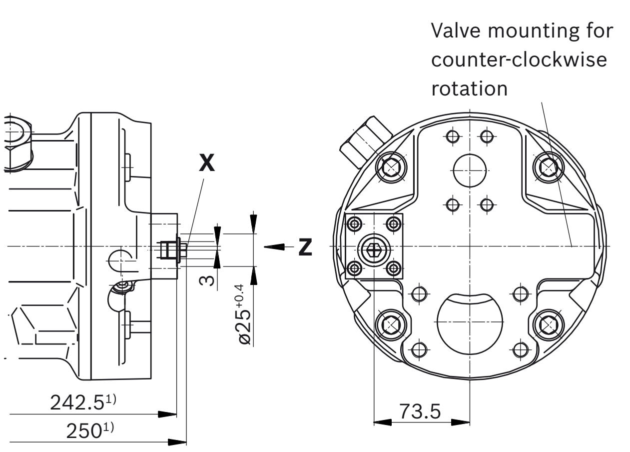
1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.
3) Thread according to ASME B1.1
4) For notes on tightening torques, see the instruction manual
5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
6) Metric fastening thread is a deviation from standard.
7) The countersink can be deeper than as specified in the standard.
8) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 56).
9) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

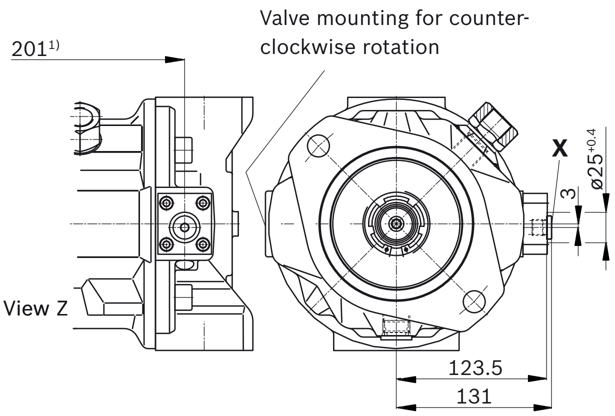
▼ DG – Two-point control, direct operated

Port plate 41 (91)



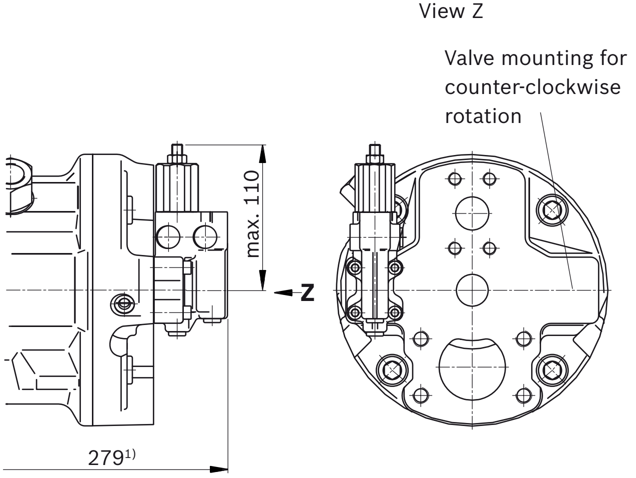
▼ DG – Two-point control, direct operated

Port plate 42 (92)



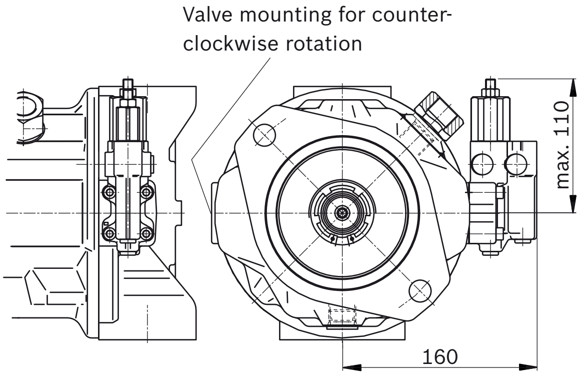
▼ DR – Pressure controller

Port plate 41 (91)



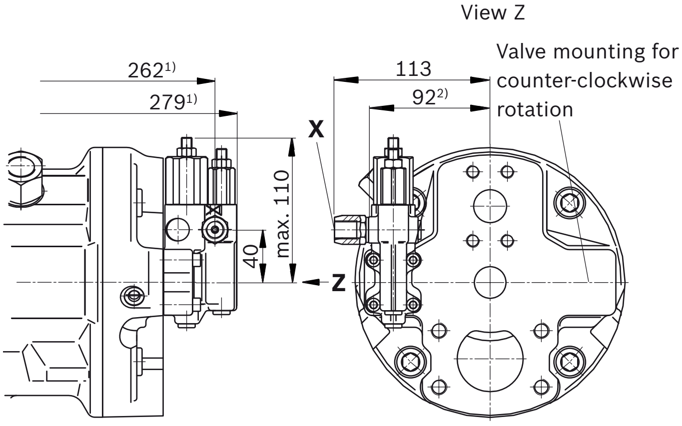
▼ DR – Pressure controller

Port plate 42 (92)



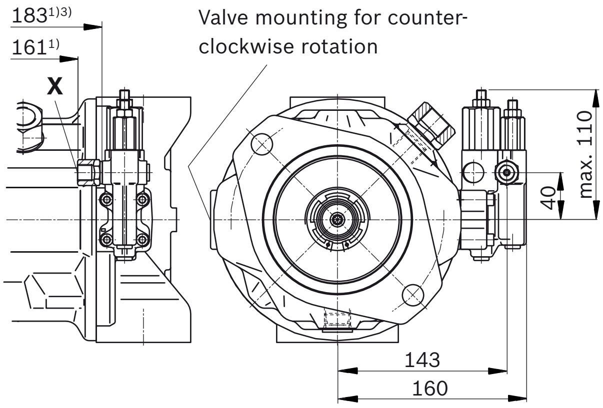
▼ DRG – Pressure controller, remote controlled

Port plate 41 (91)



▼ DRG – Pressure controller, remote controlled

Port plate 42 (92)



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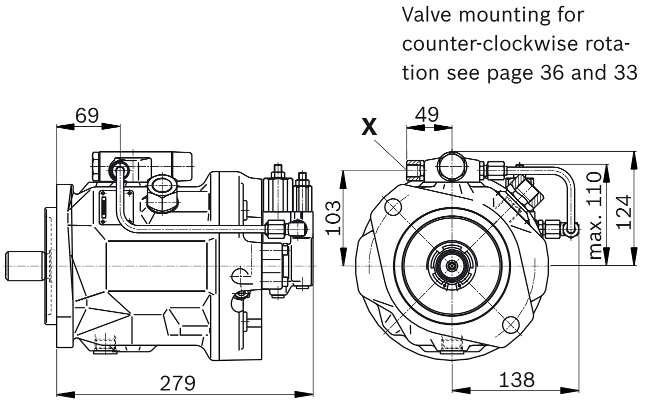
1) To flange surface

2) For version port plate 91

3) For version port plate 92

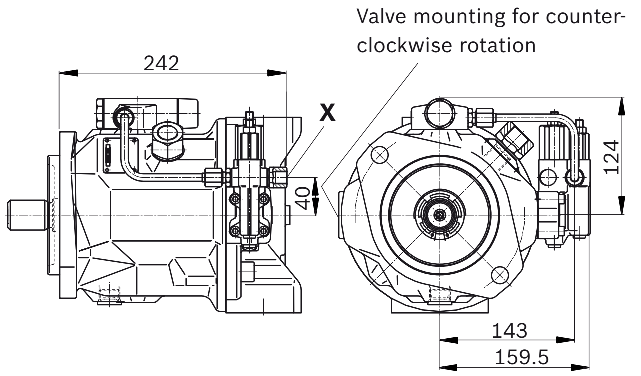
▼ DFLR – Pressure, flow and power controller

Port plate 41 (91)



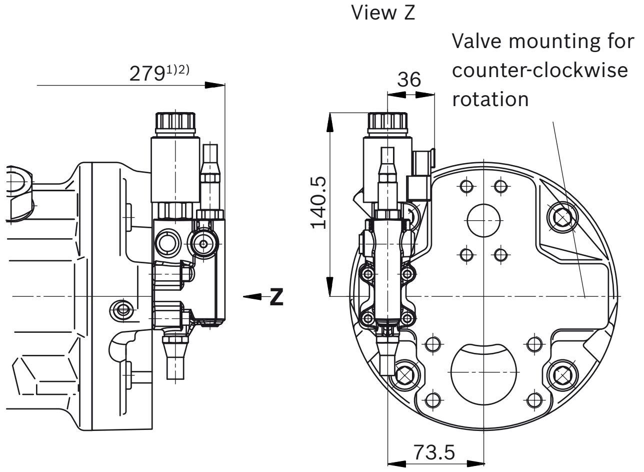
▼ DFLR – Pressure, flow and power controller

Port plate 42 (92)



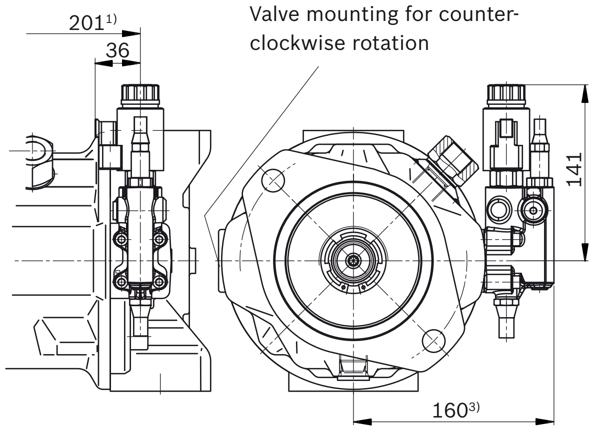
▼ ED7. / ER7. – Electro-hydraulic pressure control

Port plate 41 (91)



▼ ED7. / ER7. – Electro-hydraulic pressure control

Port plate 42 (92)



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1) To flange surface

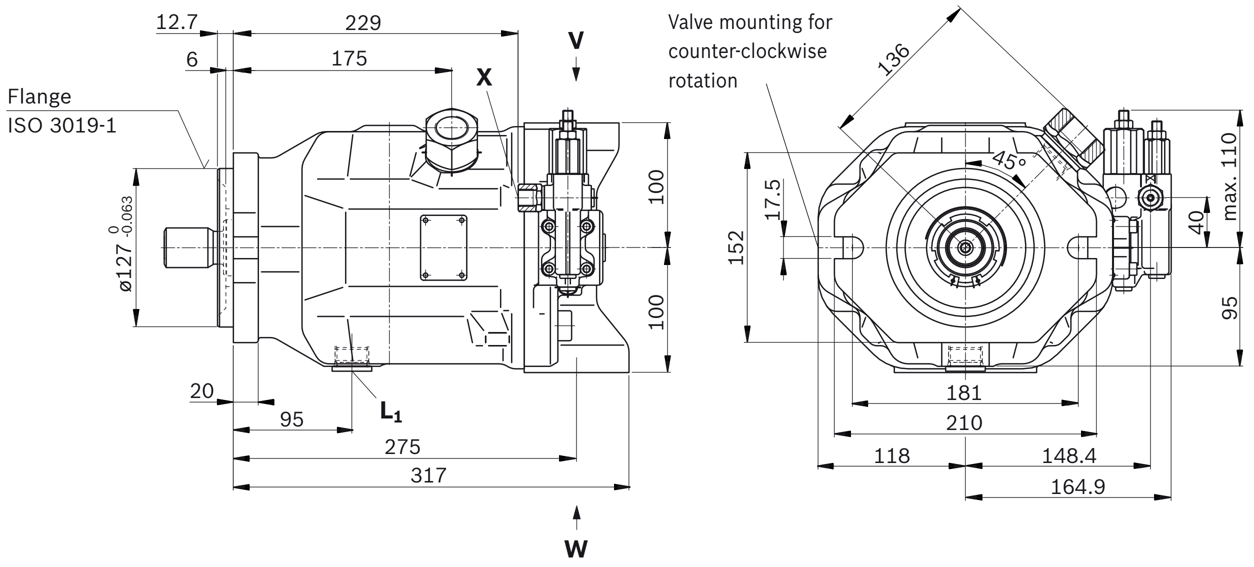
2) ER7.: 314 mm if using an intermediate plate pressure controller

3) ER7.: 195 mm if using an intermediate plate pressure controller

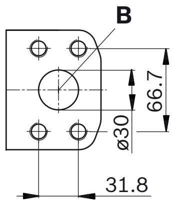
Dimensions, size 100

DFR / DFR1 / DRSC – Pressure and flow control, hydraulic; clockwise rotation, version: Ports metric

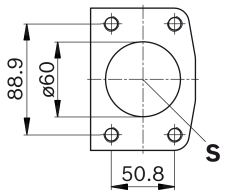
▼ **Port plate 12**



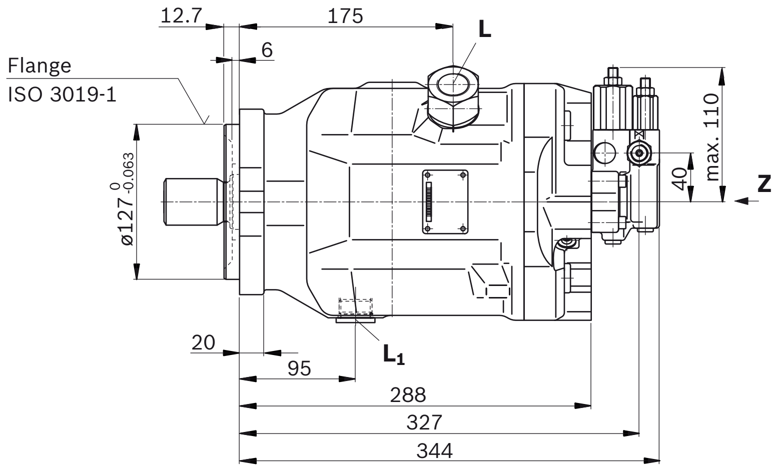
Detail V



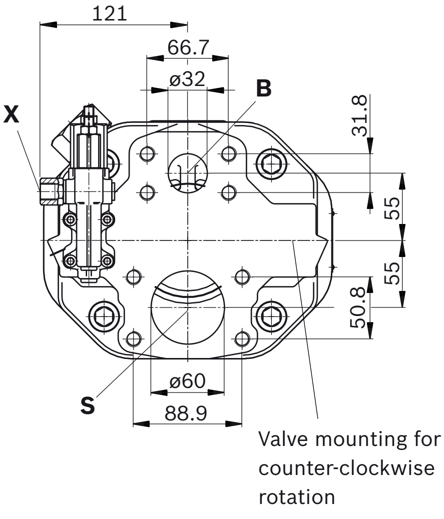
Detail W



▼ **Port plate 11**



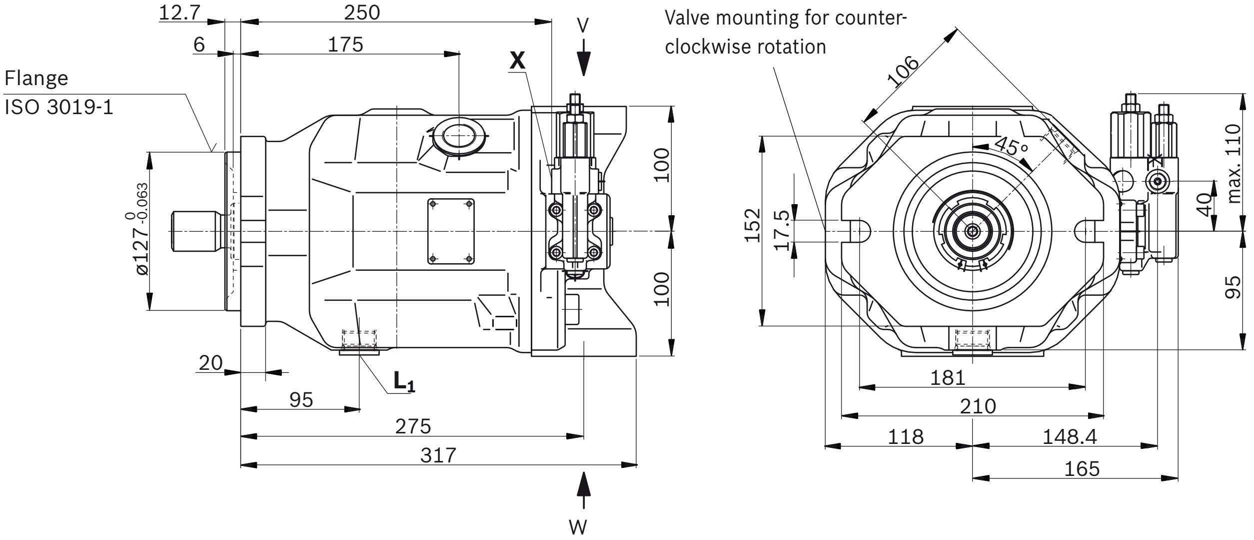
View Z



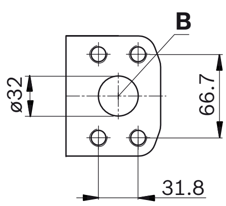
Dimensions, size 100

DFR / DFR1 / DRSC – Pressure and flow control, hydraulic; clockwise rotation, version: SAE ports

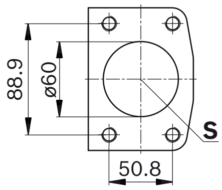
▼ **Port plate 62**



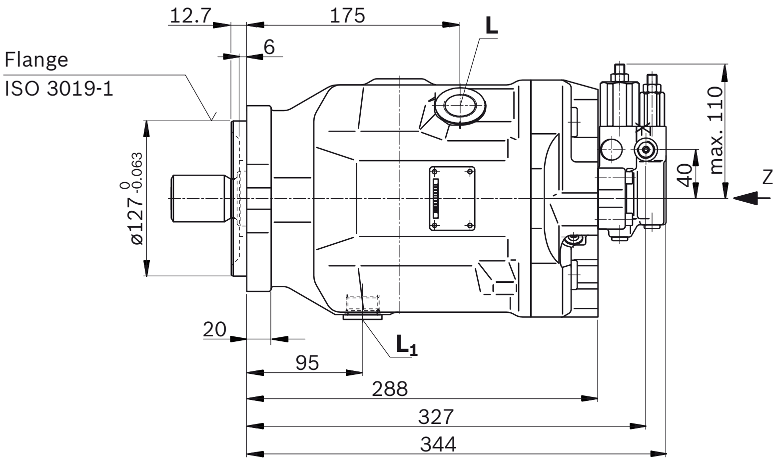
Detail V



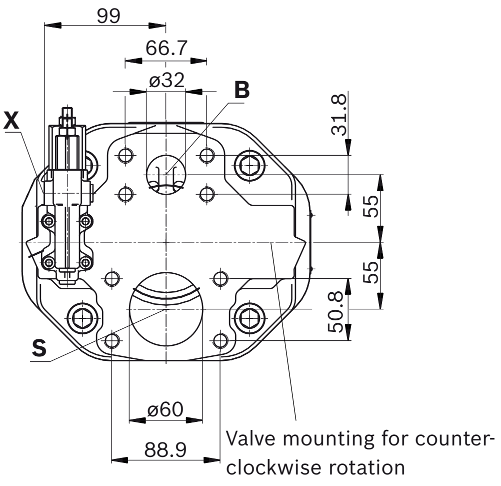
Detail W



▼ **Port plate 61**

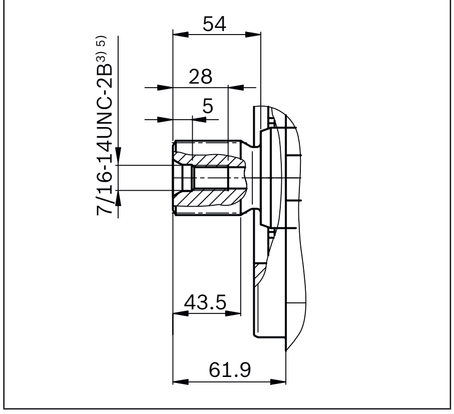


View Z



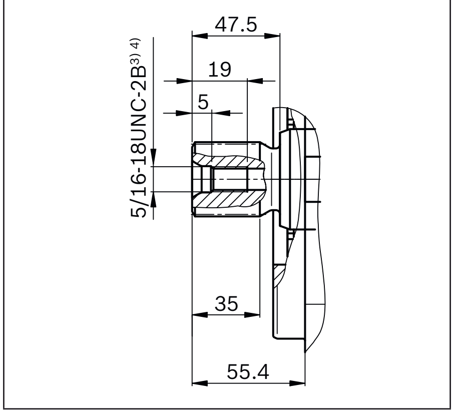
▼ Splined shaft 1 1/2 in (SAE J744)

S – 17T 12/24DP$^{1)}$



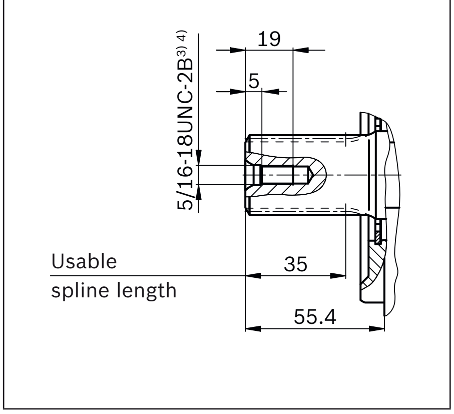
▼ Splined shaft 1 1/4 in (SAE J744)

U – 14T 12/24DP$^{1)}$



▼ Splined shaft 1 1/4 in (SAE J744)

W – 14T 12/24DP$^{1)2)}$



Ports - version metric port plate 11/12		**Standard**	**Size**$^{4)}$	$p_{\text{max abs}}$ **[bar]**$^{5)}$	**State**$^{9)}$
B	Working port (high-pressure series)	SAE J518$^{6)}$	1 1/4 in	350	O
	Fastening thread	DIN 13	M14 × 2; 19 deep		
S	Suction port (standard pressure series)	SAE J518$^{6)}$	2 1/2 in	10	O
	Fastening thread	DIN 13	M12 × 1.75; 17 deep		
L	Drain port	DIN 3852$^{7)}$	M27 × 2; 16 deep	2	O$^{8)}$
L_1	Drain port	ISO 11926$^{7)}$	1 1/16-12 UNF-2B; 18 deep	2	X$^{8)}$
X	Pilot pressure	DIN 3852	M14 × 1.5; 12 deep	350	O
X	Pilot pressure with DG-control	DIN ISO 228	G1/4 in; 12 deep	350	O

Ports - version SAE port plate 61/62		**Standard**	**Size**$^{4)}$	$p_{\text{max abs}}$ **[bar]**$^{5)}$	**State**$^{9)}$
B	Working port (high-pressure series)	SAE J518	1 1/4 in	350	O
	Fastening thread	ASME B1.1	1/2-13 UNC-2B; 19 deep		
S	Suction port (standard pressure series)	SAE J518	2 1/2 in	10	O
	Fastening thread	ASME B1.1	1/2-13 UNC-2B; 22 deep		
L	Drain port	ISO 11926$^{7)}$	1 1/16-12 UNF-2B; 18 deep	2	O$^{8)}$
L_1	Drain port	ISO 11926$^{7)}$	1 1/16-12 UNF-2B; 18 deep	2	X$^{8)}$
X	Pilot pressure	ISO 11926	7/16-20 UNF-2B; 11.5 deep	350	O
X	Pilot pressure with DG-control	DIN ISO 228	G1/4 in; 12 deep	350	O

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) For notes on tightening torques, see the instruction manual

5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

6) Metric fastening thread is a deviation from standard.

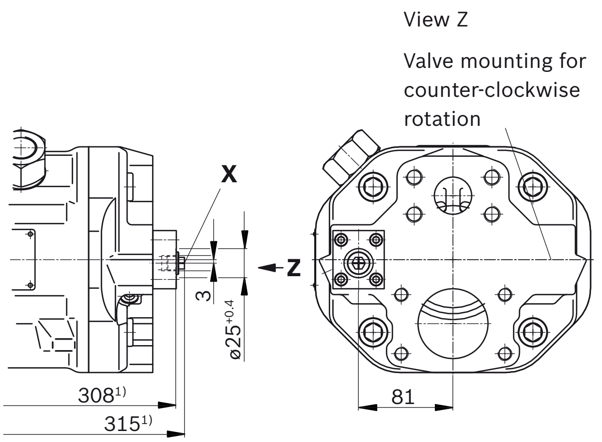
7) The countersink can be deeper than as specified in the standard.

8) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 56).

9) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

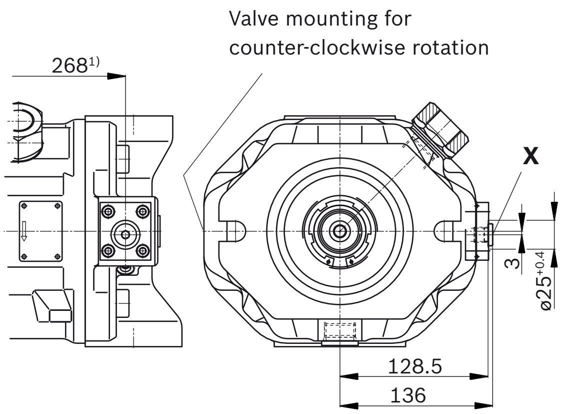
▼ DG – Two-point control, direct operated

Port plate 11 (61)



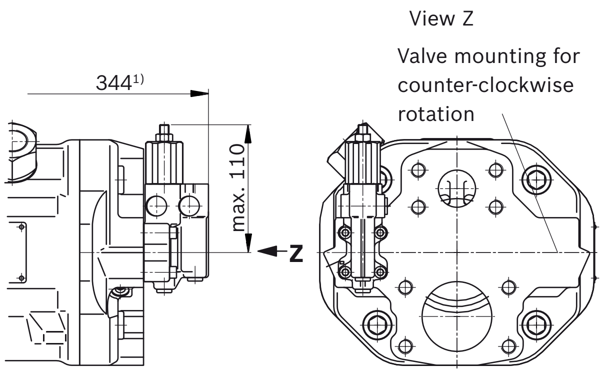
▼ DG – Two-point control, direct operated

Port plate 12 (62)



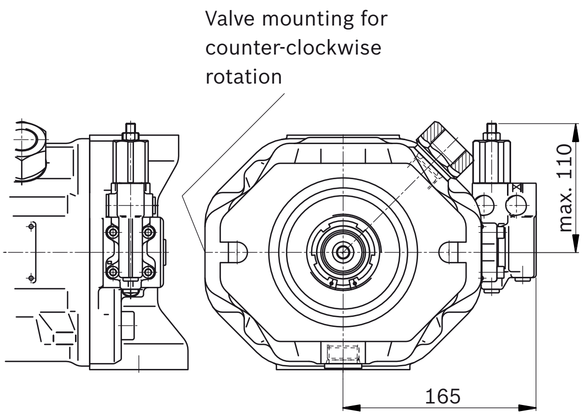
▼ DR – Pressure controller

Port plate 11 (61)



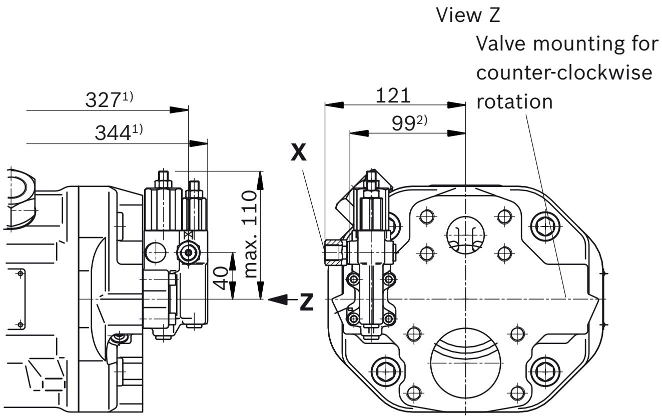
▼ DR – Pressure controller

Port plate 12 (62)



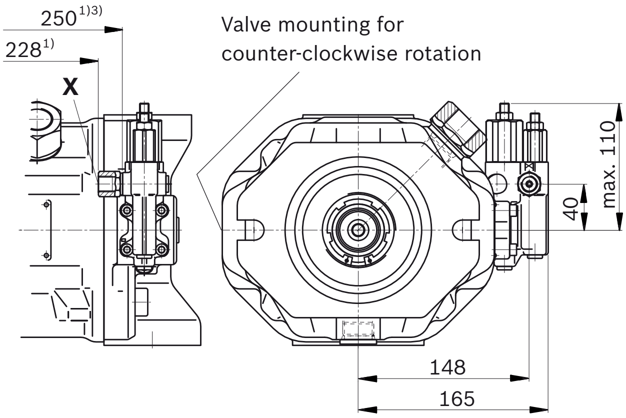
▼ DRG – Pressure controller, remote controlled

Port plate 11 (61)



▼ DRG – Pressure controller, remote controlled

Port plate 12 (62)



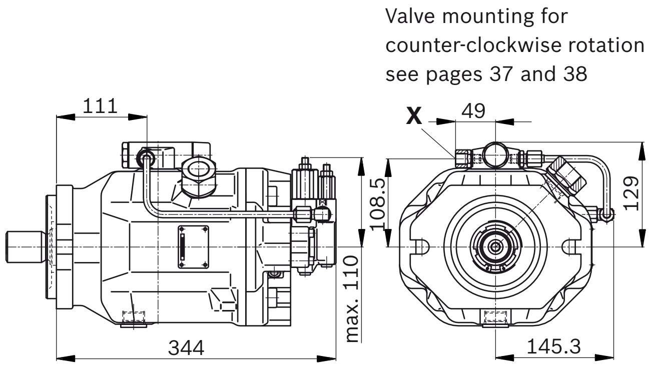
1) To flange surface

2) For version port plate 61

3) For version port plate 62

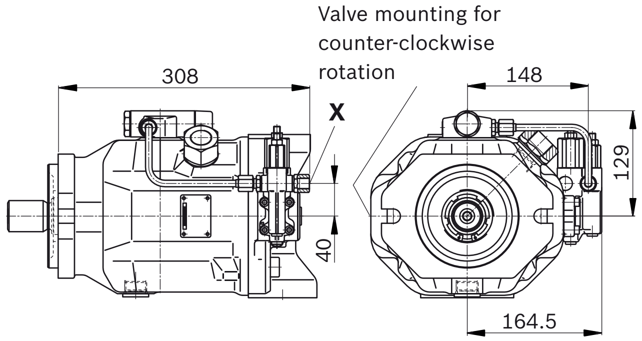
▼ **DFLR – Pressure, flow and power controller**

Port plate 11 (61)



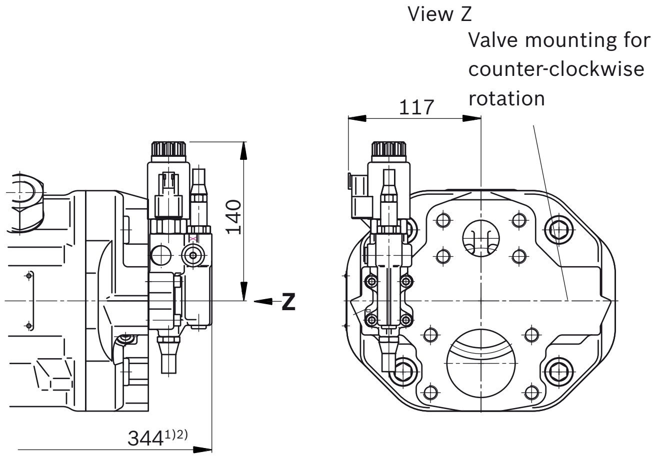
▼ **DFLR – Pressure, flow and power controller**

Port plate 12 (62)



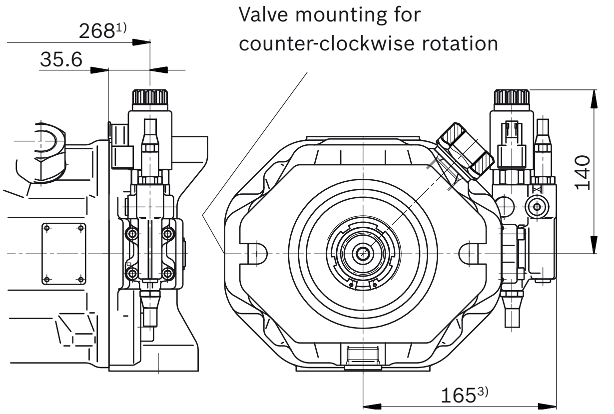
▼ **ED7. / ER7. – Electro-hydraulic pressure control**

Port plate 11 (61)



▼ **ED7. / ER7. – Electro-hydraulic pressure control**

Port plate 12 (62)



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1) To flange surface

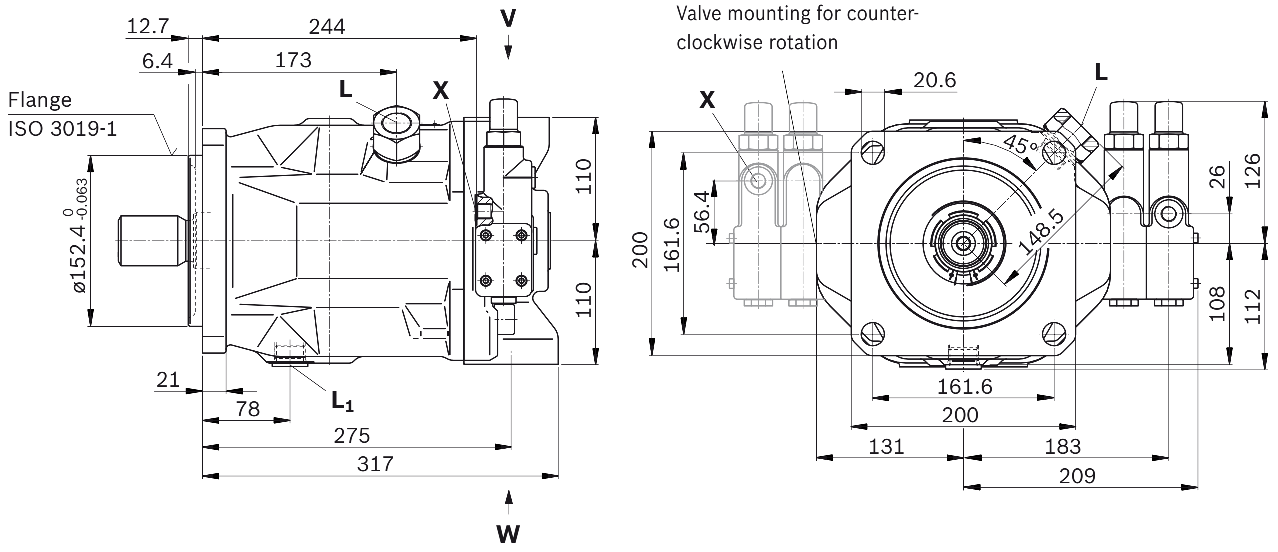
2) ER7.: 379 mm if using an intermediate plate pressure controller

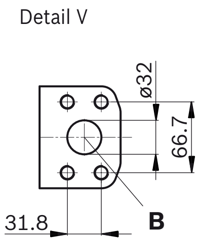
3) ER7.: 200 mm if using an intermediate plate pressure controller

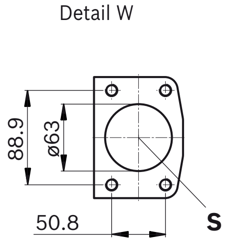
Dimensions, size 140

DFR / DFR1 / DRSC – Pressure and flow control, hydraulic, clockwise rotation, mounting flange D, version metric

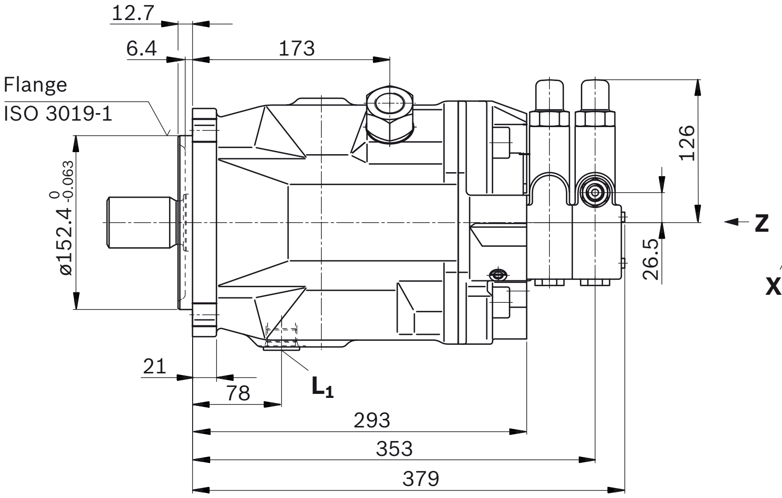
▼ **Port plate 12**

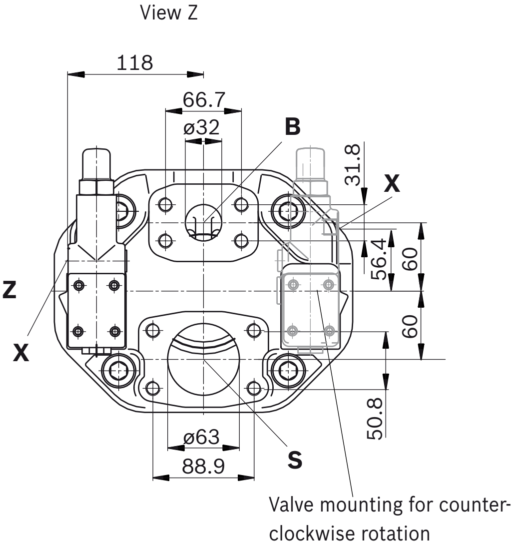






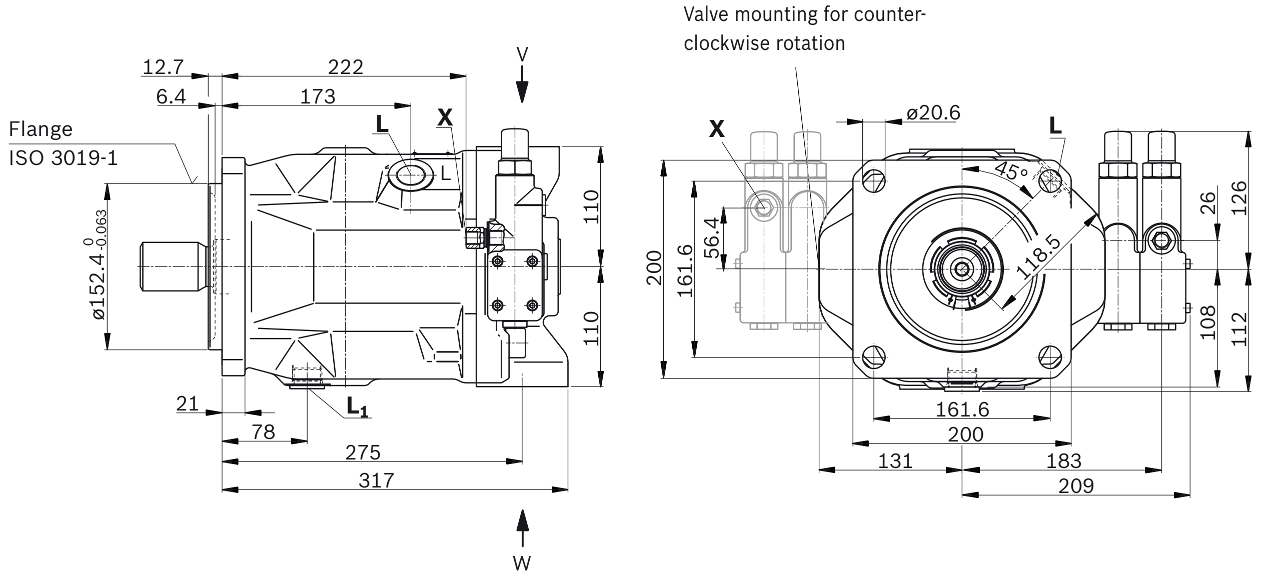
▼ **Port plate 11**



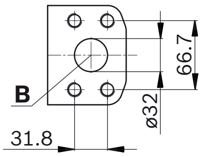


DFR / DFR1 / DRSC – Pressure and flow control, hydraulic, clockwise rotation, mounting flange D, version SAE

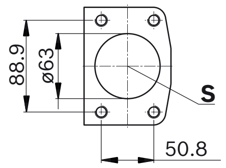
▼ Port plate 62



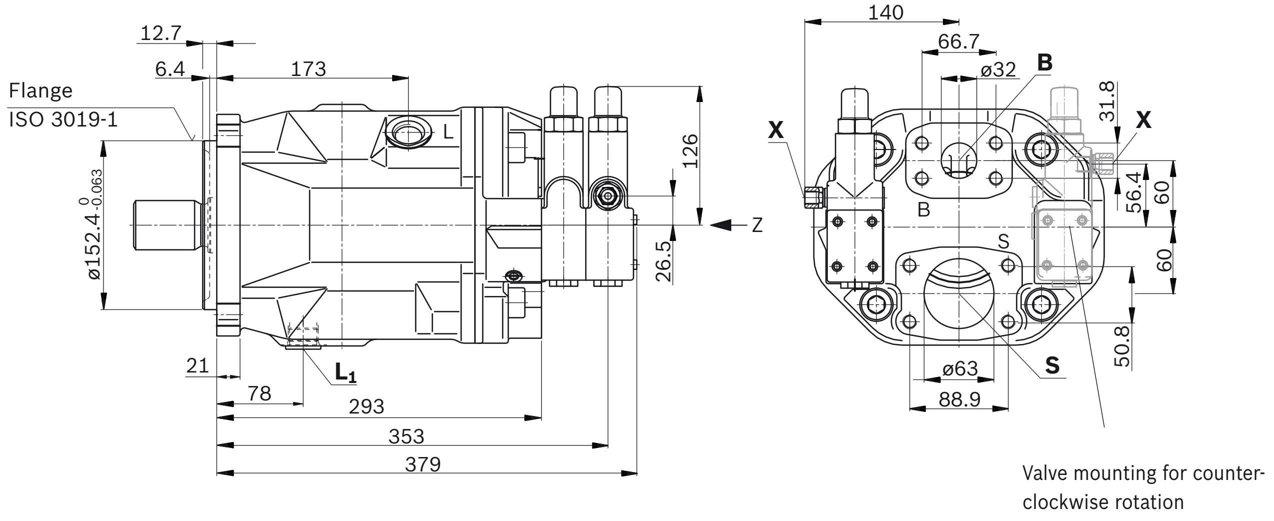
Detail V



Detail W

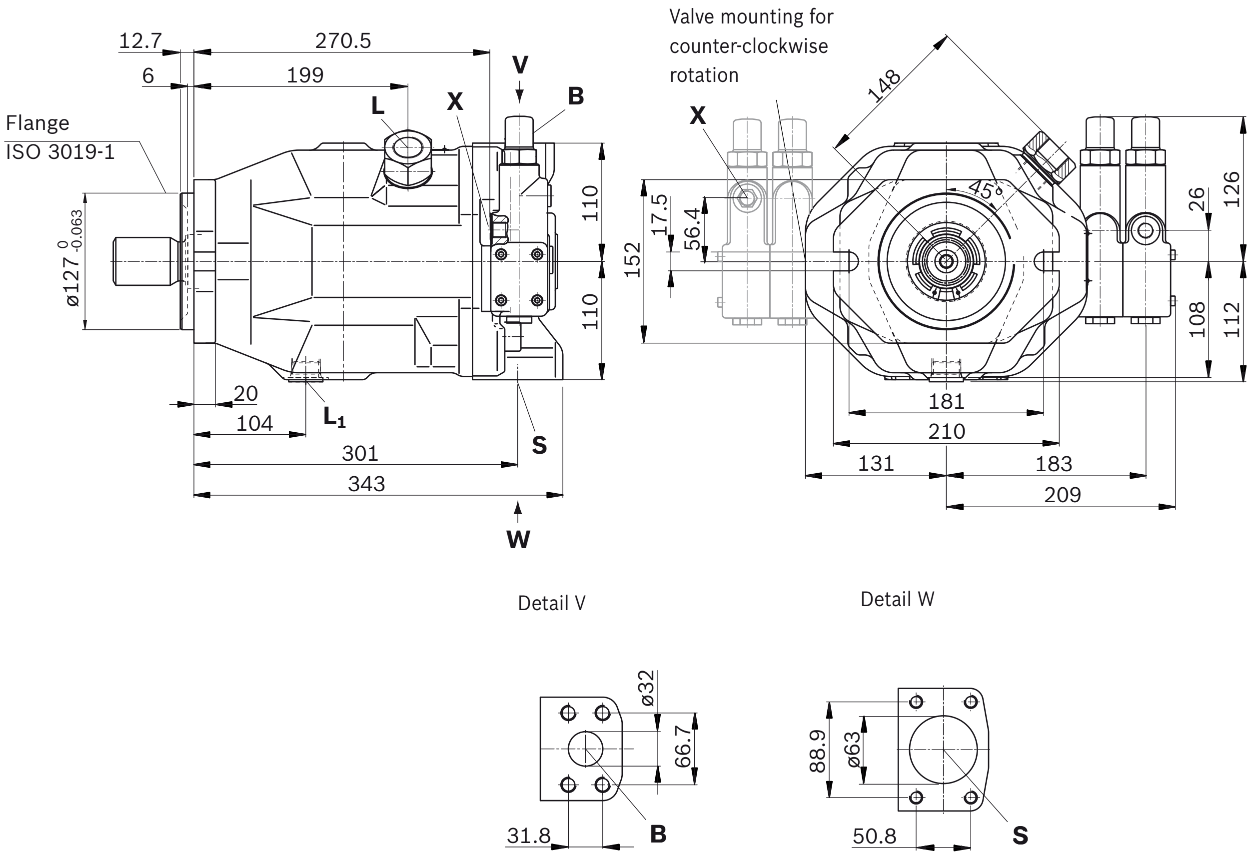


▼ Port plate 61

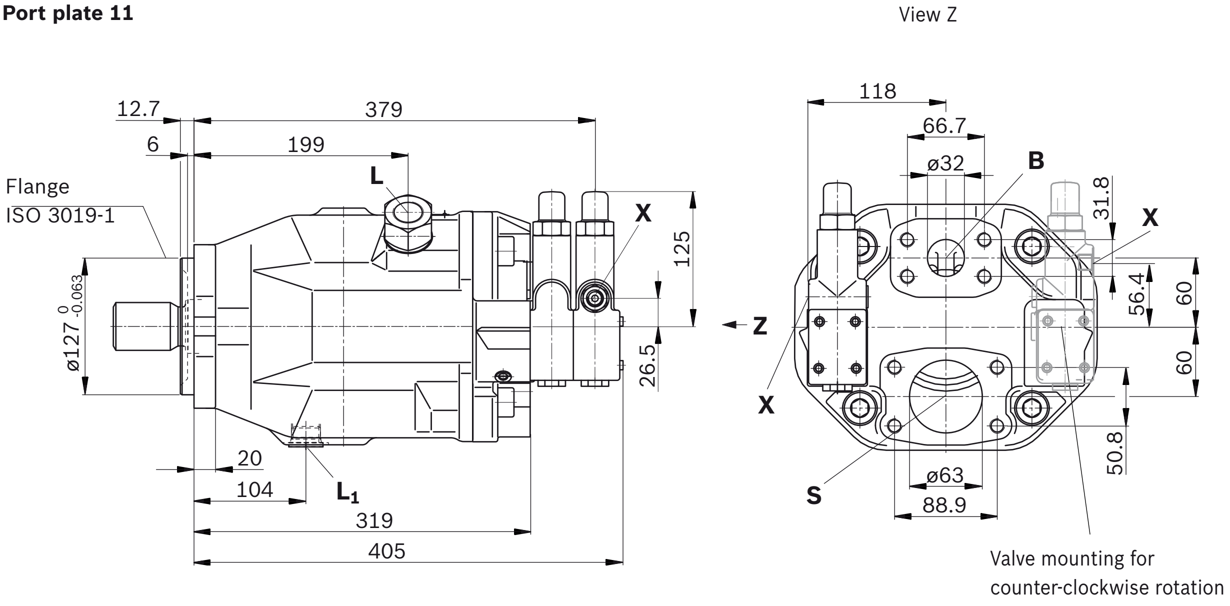


DFR / DFR1 / DRSC – Pressure and flow control, hydraulic, clockwise rotation, mounting flange C, version metric

▼ **Port plate 12**

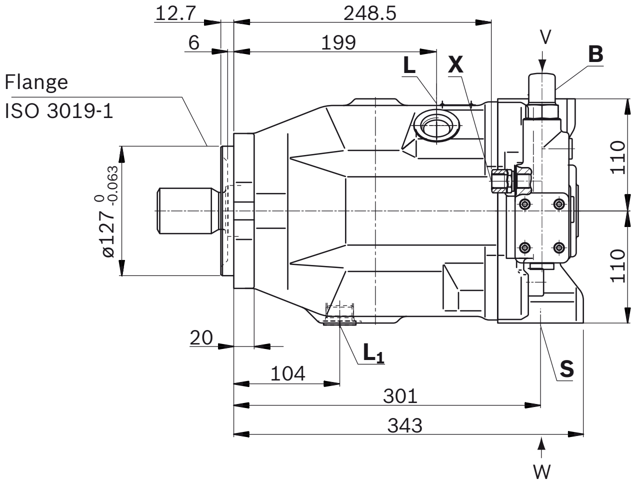


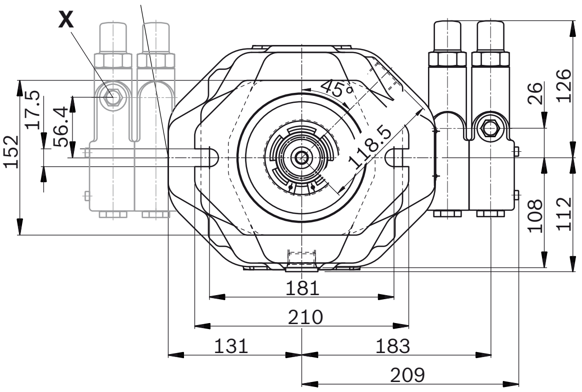
▼ **Port plate 11**



DFR / DFR1 / DRSC – Pressure and flow control, hydraulic, clockwise rotation, mounting flange C, version SAE

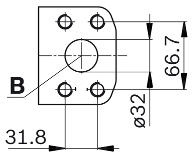
▼ Port plate 62



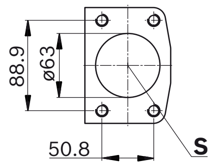


Valve mounting for counter-clockwise rotation

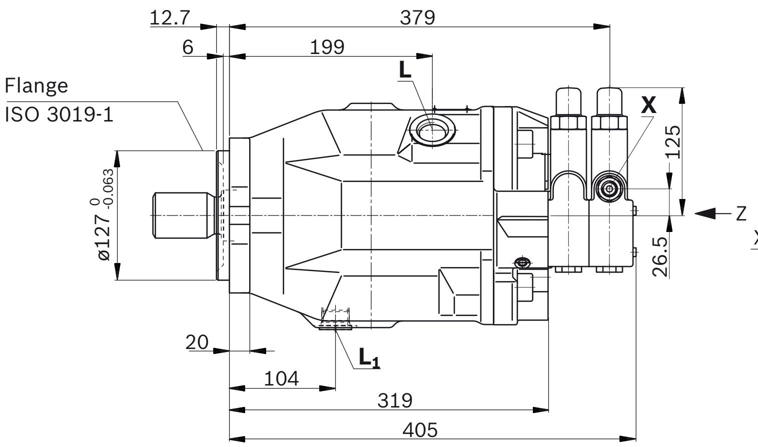
Detail V



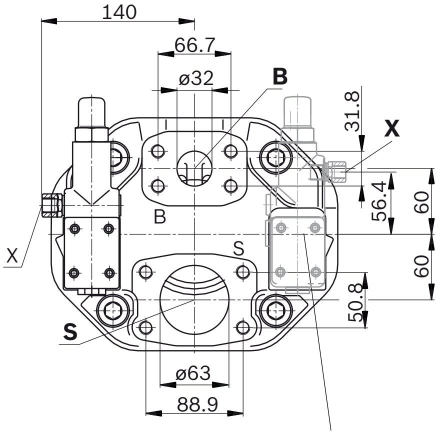
Detail W



▼ Port plate 61



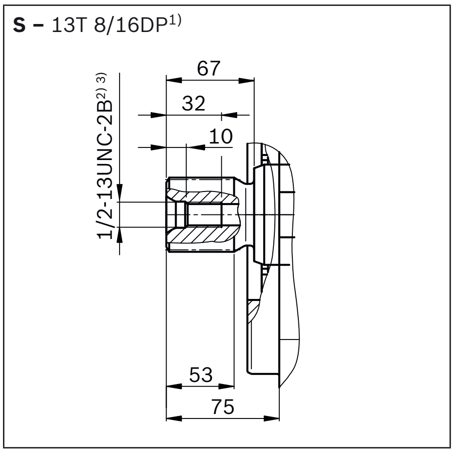
View Z



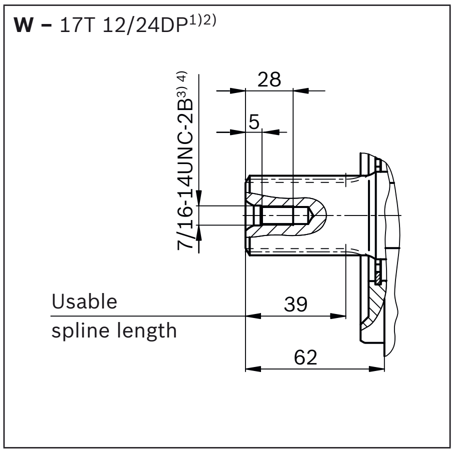
Valve mounting for counter-clockwise rotation

3

▼ Splined shaft 1 3/4 in (SAE J744)



▼ Splined shaft 1 1/2 in (SAE J744)



Ports - version metric port plate 11/12		Standard	Size[3]	$p_{\text{max abs}}$ [bar][4]	State[8]
B	Working port (high-pressure series) Fastening thread	SAE J518[5] DIN 13	1 1/4 in M14 × 2; 19 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[5] DIN 13	2 1/2 in M12 × 1.75; 17 deep	10	O
L	Drain port	DIN 3852[6]	M27 × 2; 16 deep	2	O[7]
L_1	Drain port	ISO 11926[6]	1 1/16-12 UNF-2B; 18 deep	2	X[7]
X	Pilot pressure	DIN 3852[6]	M14 × 1.5; 12 deep	350	O
X	Pilot pressure with DG-control	DIN 3852	M14 × 1.5; 12 deep	350	O
M_H	High pressure measurement (only with control DG)	DIN 3852	M14 × 1.5; 12 deep	350	X

Ports - version SAE port plate 61/62		Standard	Size[3]	$p_{\text{max abs}}$ [bar][4]	State[8]
B	Working port (high-pressure series) Fastening thread	SAE J518 ASME B1.1	1 1/4 in 1/2-13 UNC-2B; 24 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518 ASME B1.1	2 1/2 in 1/2-13 UNC-2B; 24 deep	10	O
L	Drain port	ISO 11926[6]	1 1/16-12 UNF-2B; 18 deep	2	O[7]
L_1	Drain port	ISO 11926[6]	1 1/16-12 UNF-2B; 18 deep	2	X[7]
X	Pilot pressure	ISO 11926	9/16-18 UNF-2B; 13 deep	350	O
X	Pilot pressure with DG-control	DIN 3852	M14 × 1.5; 12 deep	350	O
M_H	High pressure measurement (only with control DG)	DIN 3852	M14 × 1.5; 12 deep	350	X

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) For notes on tightening torques, see the instruction manual

4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

5) Metric fastening thread is a deviation from standard.

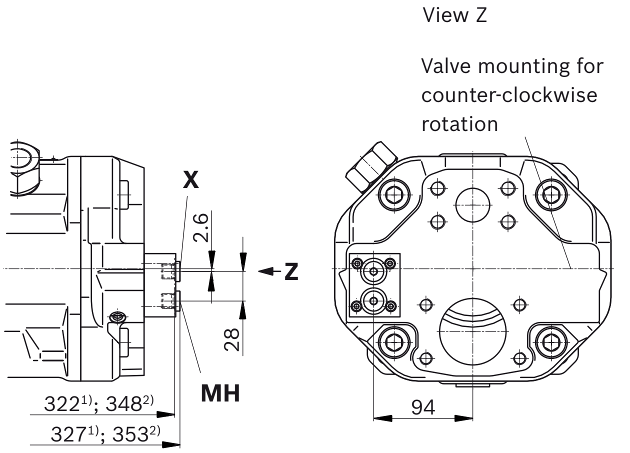
6) The countersink can be deeper than as specified in the standard.

7) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 56).

8) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

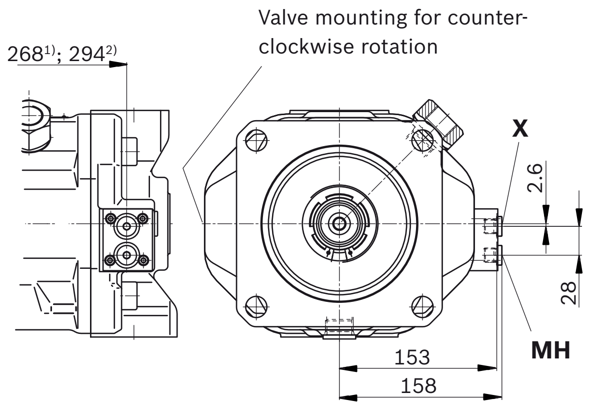
▼ **DG – Two-point control, direct operated**

Port plate 11 (61)



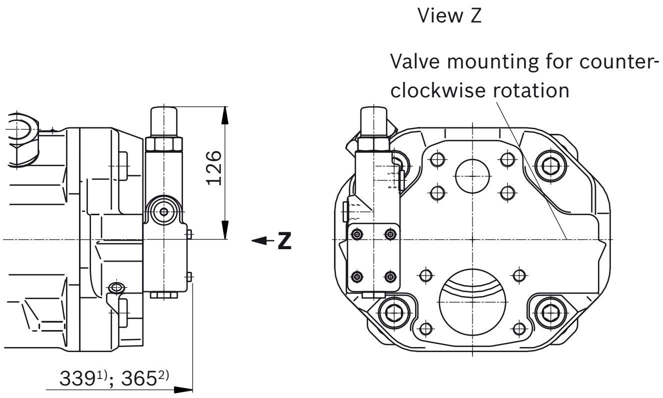
▼ **DG – Two-point control, direct operated**

Port plate 12 (62)



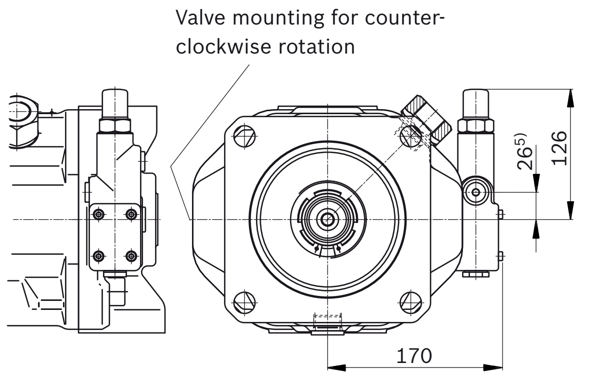
▼ **DR – Pressure controller**

Port plate 11 (61)



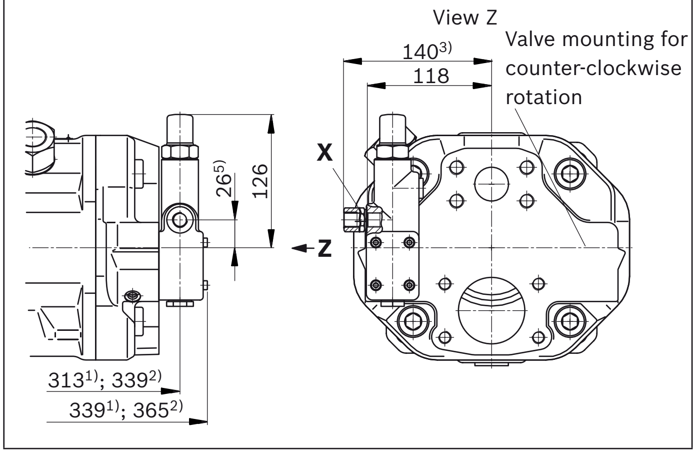
▼ **DR – Pressure controller**

Port plate 12 (62)



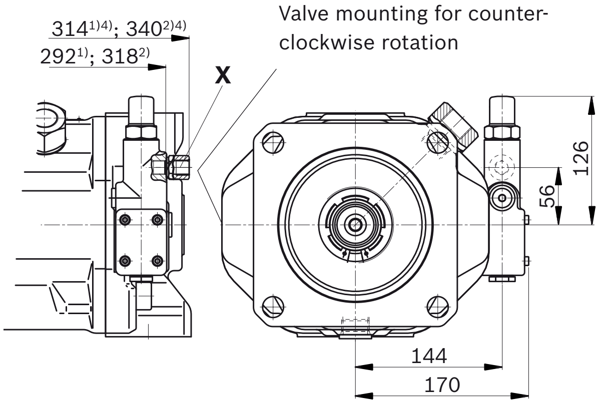
▼ **DRG – Pressure controller, remote controlled**

Port plate 11 (61)



▼ **DRG – Pressure controller, remote controlled**

Port plate 12 (62)



1) To flange surface and housing with D flange

2) To flange surface and housing with C flange

3) For version port plate 61

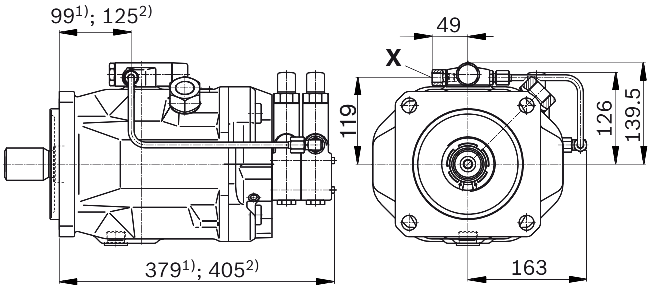
4) For version port plate 62

5) 56 mm with counter-clockwise rotation

▼ DFLR – Pressure, flow and power controller

Port plate 11 (61)

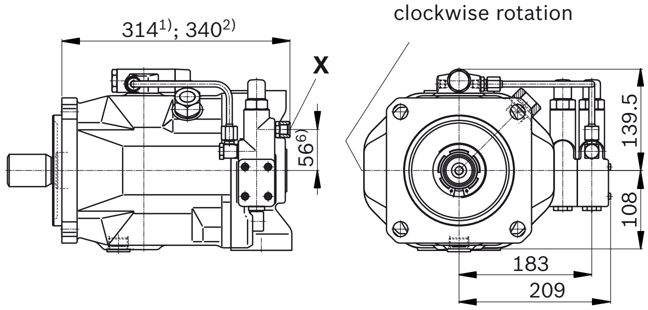
Valve mounting for counter-clockwise rotation see pages 42 and 43



▼ DFLR – Pressure, flow and power controller

Port plate 12 (62)

Valve mounting for counter-clockwise rotation

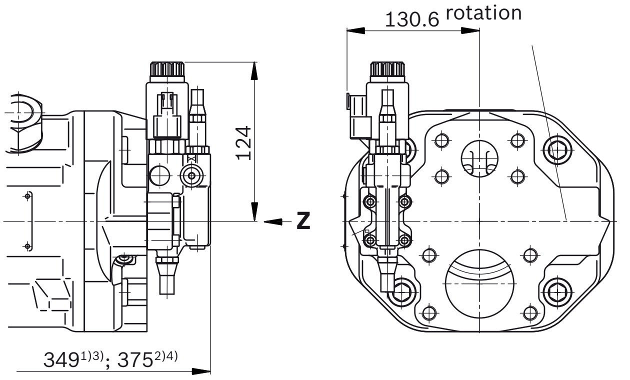


▼ ED7. / ER7. – Electro-hydraulic pressure control

Port plate 11 (61)

View Z

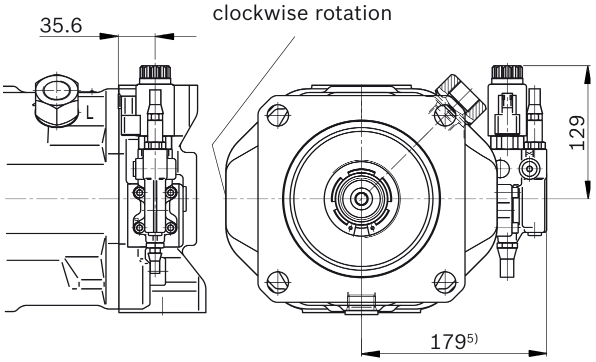
Valve mounting for counter-clockwise rotation



▼ ED7. / ER7. – Electro-hydraulic pressure control

Port plate 12 (62)

Valve mounting for counter-clockwise rotation



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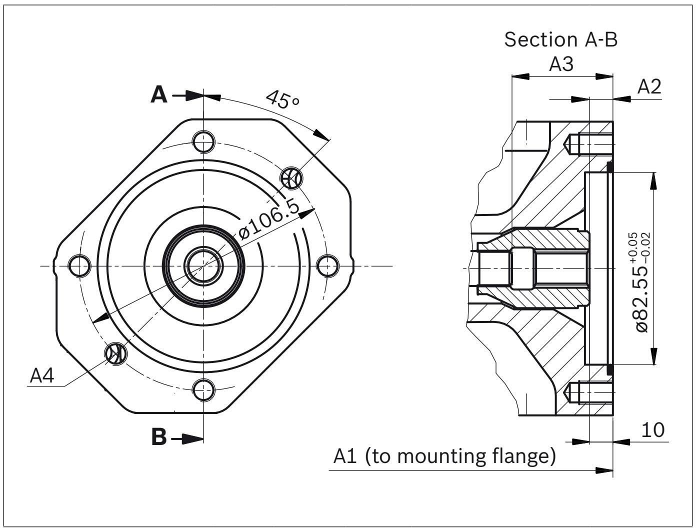
1) To flange surface and housing with D flange
2) To flange surface and housing with C flange
3) ER7.: 384 mm if using an intermediate plate pressure controller
4) ER7.: 410 mm if using an intermediate plate pressure controller
5) ER7.: 214 mm if using an intermediate plate pressure controller
6) 26 mm with counter-clockwise rotation

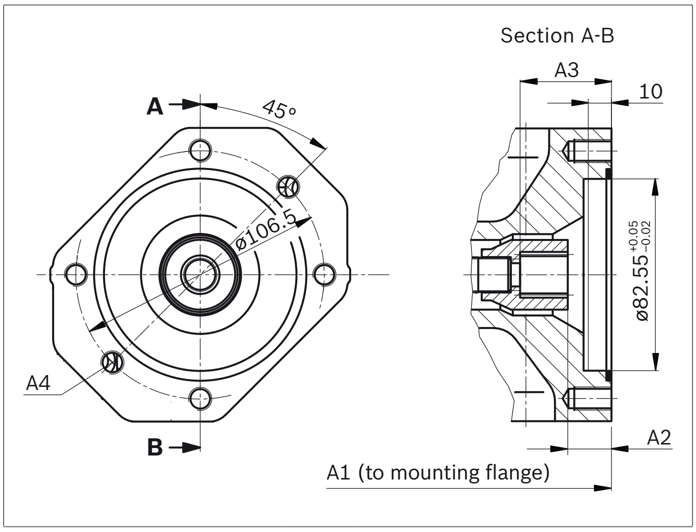
Dimensions, through drive

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability over sizes							Code
Diameter	**Symbol**	**Diameter**		**18**	**28**	**45**	**71**	**88**	**100**	**140**	
82-2 (A)	⚯, ⚯, ⚯	5/8 in	9T 16/32DP	●	●	●	●	●	●	●	K01
		3/4 in	11T 16/32DP	●	●	●	●	●	●	●	K52

● = Available – = Not available

▼ **82-2**





K01 (SAE J744 16-4 (A))	NG	A1	A2	A3	A4[2]
	18	182	10	43.3	M10×1.5; 14.5 deep
	28	204	10	33.7	M10×1.5; 16 deep
	45	229	10.7	53.4	M10×1.5; 16 deep
	71	267	11.8	61.3	M10×1.5; 20 deep
	88	267	11.8	61.3	M10×1.5; 20 deep
	100	338	10.5	65	M10×1.5; 16 deep
	140	350[3] 376[4]	10.8	77.3	M10×1.5; 16 deep

K52 (SAE J744 19-4 (A-B))	NG	A1	A2	A3	A4[2]
	18	182	18.8	38.7	M10×1.5; 14.5 deep
	28	204	18.8	38.7	M10×1.5; 16 deep
	45	229	18.9	38.7	M10×1.5; 16 deep
	71	267	21.3	41.4	M10×1.5; 20 deep
	88	267	21.3	41.4	M10×1.5; 20 deep
	100	338	19	38.9	M10×1.5; 16 deep
	140	350[3] 376[4]	18.9	38.6	M10×1.5; 16 deep

---

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to DIN 13, see instruction manual for maximum tightening torques.

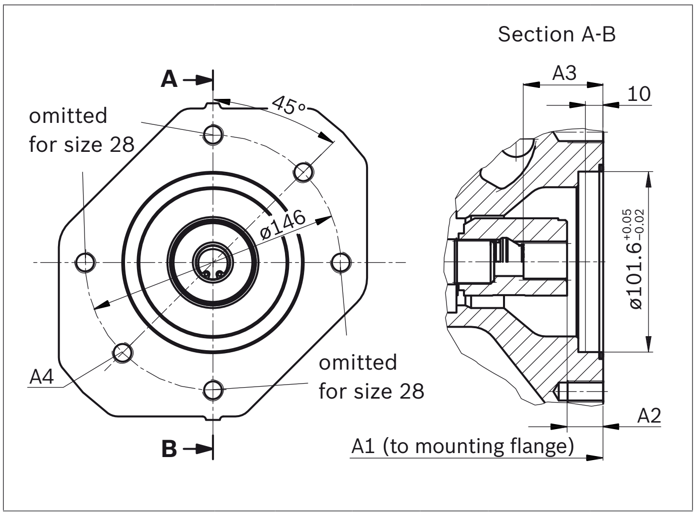
3) Housing with D flange

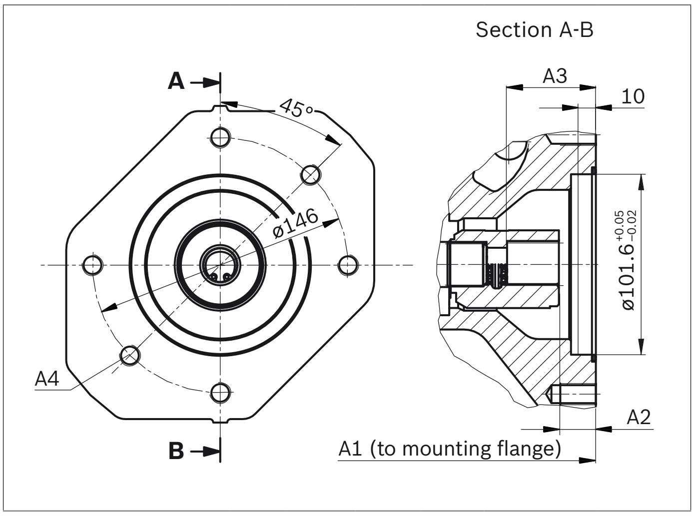
4) Housing with C flange

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability over sizes							Code
Diameter	Symbol	Diameter		18	28	45	71	88	100	140	
101-2 (B)	8, ∘°, ∘∘	7/8 in	13T 16/32DP	–	●	●	●	●	●	●	K68
		1 in	15T 16/32DP	–	–	●	●	●	●	●	K04

● = Available – = Not available

▼ **101-2**





K68 (SAE J744 22-4 (B))	NG	A1	A2	A3	A4[2]
	28	204	17.8	41.7	M12×1.75;[3]
	45	229	17.9	41.7	M12×1.75; 18 deep
	71	267	20.3	44.7	M12×1.75; 20 deep
	88	267	20.3	44.7	M12×1.75; 20 deep
	100	338	18	41.9	M12×1.75; 20 deep
	140	350[4] 376[5]	17.8	41.6	M12×1.75; 20 deep

K04 (SAE J744 25-4 (B-B))	NG	A1	A2	A3	A4[2]
	45	229	18.4	46.7	M12×1.75; 18 deep
	71	267	20.8	49.1	M12×1.75; 20 deep
	88	267	20.8	49.1	M12×1.75; 20 deep
	100	338	18.2	46.6	M12×1.75; 20 deep
	140	350[4] 376[5]	18.3	45.9	M12×1.75; 20 deep

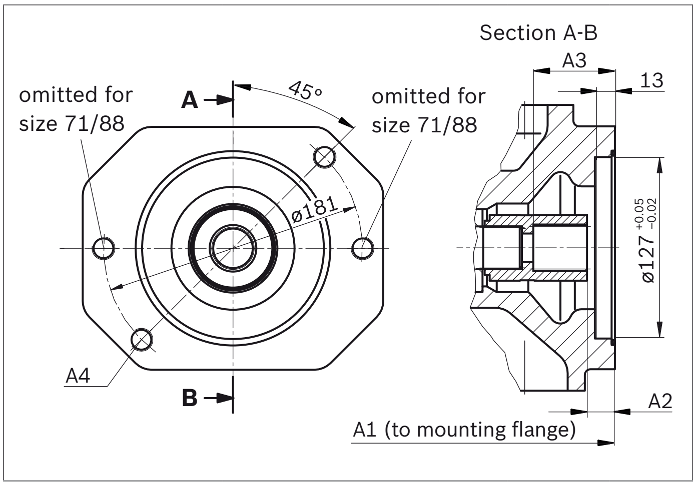
---

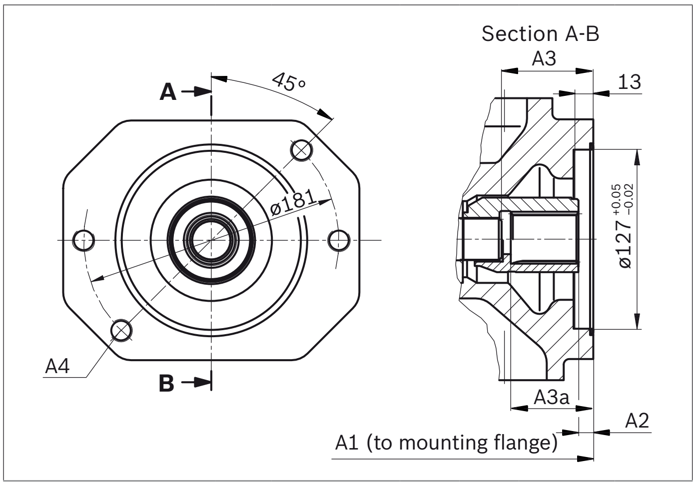
1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to DIN 13, see instruction manual for maximum tightening torques.
3) Continuous
4) Housing with D flange
5) Housing with C flange

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability over sizes							Code
Diameter	Symbol	Diameter		18	28	45	71	88	100	140	
127-2 (C)	∘°, ∘∘	1 1/4 in	14T 12/24DP	–	–	–	●	●	●	●	K07
		1 1/2 in	17T 12/24DP	–	–	–	–	–	●	●	K24

● = Available – = Not available

▼ **127-2**





K07 (SAE J744 32-4 (C))	NG	A1	A2	A3	A4[2]
	71	267	21.8	58.6	M16×2;[3]
	88	267	21.8	58.6	M16×2;[3]
	100	338	19.5	56.4	M16×2;[3]
	140	350[4] 376[5]	19.3	56.1	M16×2; 24 deep

K24 (SAE J744 38-4 (C-C))	NG	A1	A2	A3	A3a	A4[2]
	100	338	9.9	65	–	M16×2;[3]
	140	350[4] 376[5]	9.7	–	69.1	M16×2; 24 deep

---

[1] According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Thread according to DIN 13, see instruction manual for maximum tightening torques.

[3] Continuous

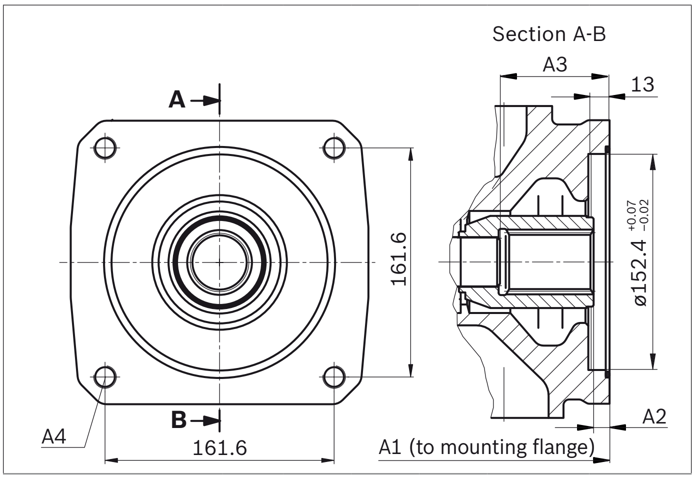
[4] Housing with D flange

[5] Housing with C flange

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability over sizes						Code
Diameter	**Symbol**	**Diameter**		**18**	**28**	**45**	**71 /88**	**100**	**140**	
152-4 (D)	⁘	1 3/4 in	13T 8/16DP	–	–	–	–	–	●	K17

● = Available – = Not available

▼ 152-4



K17 (SAE J744 44-4 (D))	**NG**	**A1**	**A2**	**A3**	**A4**[2]
	140	350	11	77.3	M16×2;[3]

Only available with housing with mounting flange D.

---

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to DIN 13, see instruction manual for maximum tightening torques.

3) Continuous

Overview of mounting options

SAE – mounting flange

Through drive[4]			**Mounting options – 2nd pump**			
Flange ISO 3019-1	**Hub for splined shaft**	**Code**	**A10V(S)O/31 NG (shaft)**	**A10V(S)O/5x NG (shaft)**	**External gear pump design (size)**	**Through drive available for size**
82-2 (A)	5/8 in	K01	18 (U)	10 (U), 18 (U)	Series F	18 to 140
	3/4 in	K52	18 (S, R)	10 (S) 18 (S, R)	–	18 to 140
101-2 (B)	7/8 in	K68	28 (S, R) 45 (U, W)[1]	28 (S, R) 45 (U, W)[1]	Series N/G	28 to 140
	1 in	K04	45 (S, R) –	45 (S, R) 60, 63, 72 (U, W)[2]	–	45 to 140
127-2 (C)	1 1/4 in	K07	71 (S, R) 88 (S, R) 100 (U, W)[3]	85 (U, W)[3] 100 (U,W)	–	71 to 140
	1 1/2 in	K24	100 (S)	85 (S) 100 (S)	–	100 to 140
152-4 (4-hole D)	1 3/4 in	K17	140 (S)	–	–	140

---

[1] Not for main pump NG28 with K68

[2] Not for main pump NG45 with K04

[3] Not for main pump NG71 and NG88 with K07

Combination pumps A10VO + A10VO

By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes. When ordering combination pumps, the type designations of the 1st and 2nd pumps must be linked by a "**+**".

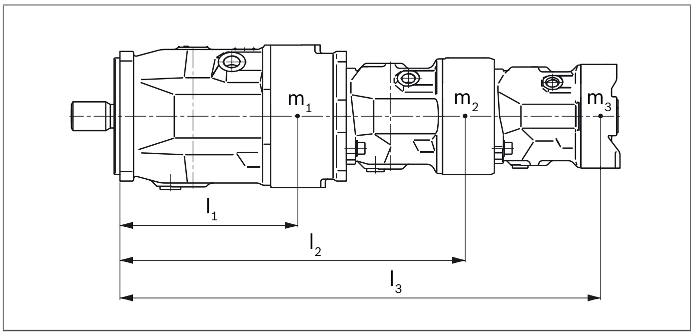
Order example:
A10VO100DFR1/31R-VSC12K04+
A10VO45DFR/31R-VSC12N00

If no further pumps are to be mounted at the factory, the simple type designation is sufficient.

It is permissible to use a combination of two single pumps of the same nominal size (tandem pump) considering a dynamic mass acceleration of maximum 10 g (= 98.1 m/s^2) without additional support brackets.

Each through drive is plugged with a **non-pressure-resistant** cover. Before commissioning the units, they must therefore be equipped with a pressure-resistant cover. Through drives can also be ordered with pressure-resistant covers. Please specify in plain text.

For combination pumps consisting of more than two pumps, the mounting flange must be rated for the permissible mass torque (please contact us).



m_1, m_2, m_3	Weight of pump	[kg]
l_1, l_2, l_3	Distance, center of gravity	[mm]

$$T_m = (m_1 \times l_1 + m_2 \times l_2 + m_3 \times l_3) \times \frac{1}{102} \quad \text{[Nm]}$$

Permissible mass moment of inertia

Size			18	28	45	71	88	100	140	
static	T_m	Nm	500	880	1370	2160	2160	3000	4500[1]	3000[2]
dynamic at 10 g (98.1 m/s^2)	T_m	Nm	50	88	137	216	216	300	450[1]	300[2]
Weight **without** through drive and N00 Weight **with** through drive and K..	m	kg	12.9 13.8	18 19.3	23.5 25.1	35.2 38	35.2 38	49.5 55.4	65.4 74.4	
Distance, center of gravity **without** through drive N00	l_1	mm	92	100	113	127	127	161	159	
Distance, center of gravity **with** through drive K..	l_1	mm	98	107	120	137	137	178	180	

---

[1] 4-hole flange (D)
[2] 2-hole flange (C)

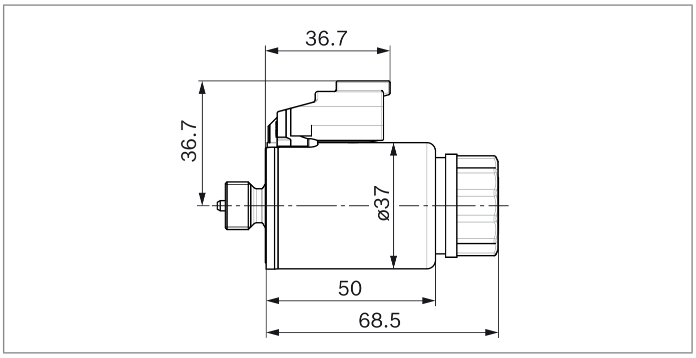
Connector for solenoids

DEUTSCH DT04-2P

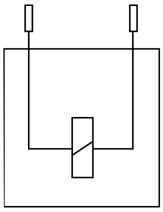
Molded connector, 2-pin, without bidirectional suppressor diode **P**

There is the following type of protection with mounted mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)



▼ Switching symbol



Notice

- If necessary, you can change the position of the connector by turning the solenoid.
- The procedure is defined in the instruction manual.

▼ Mating connector DEUTSCH DT06-2S-EP04

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery.

This can be supplied by Bosch Rexroth on request (material number R902601804).

Electronic controls

Control	Electronics function	Electronics		Further information
Electric pressure control	Controlled power outlet	RA	analog	95230
		RC4-5/30	digital	95205

Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.
Particularly with the “drive shaft up/down” installation position, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.
The leakage in the housing area must be discharged to the reservoir via the highest available tank port (**L**, **L_1**).

If a shared drain line is used for several units, make sure that the respective case pressure is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operating conditions, specifically on cold start. If this is not possible, separate reservoir lines must be laid as required.
To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.
In all operating conditions, the suction lines and the drain lines must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\,max}$ = 800 mm. The minimum suction pressure at port **S** must also not fall below 0.8 bar absolute during operation and during cold start.
When designing the reservoir, ensure adequate distance between the suction line and the drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Notice

In certain installation positions, an influence on the control or closed loop control can be expected. Gravity, dead weight and case pressure can cause minor characteristic shifts and changes in response time.

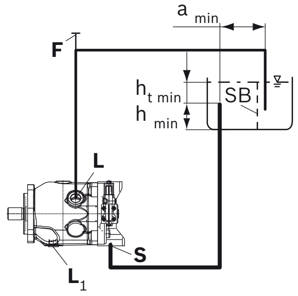
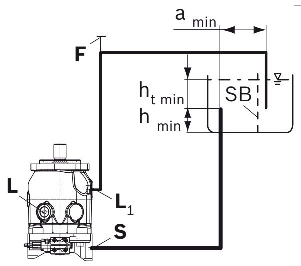
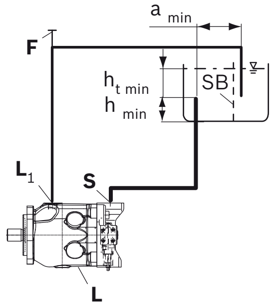
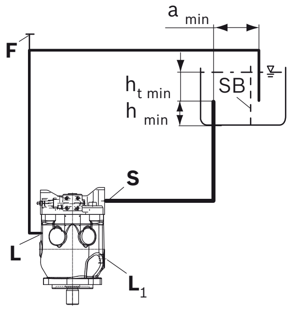
Key, see page 58.

Installation position

See the following examples **1** to **12**.
Further installation positions are available upon request.
Recommended installation position: **1** and **3**

Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir and below the minimum fluid level of the reservoir.

Installation position	Air bleed	Filling
1  	**F**	**L (F)**
2[1]  	**F**	**L_1 (F)**
3  	**F**	**L_1 (F)**
4[1]  	**F**	**L (F)**

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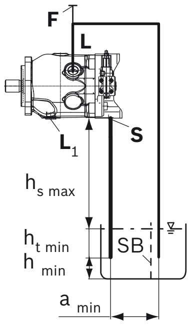
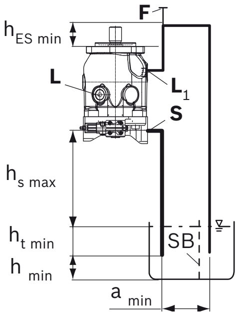
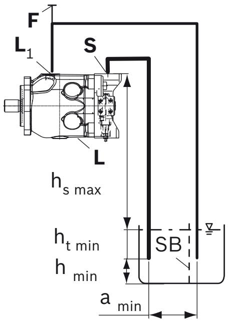
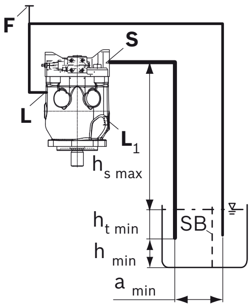
[1] Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. To prevent the axial piston unit from draining in position 6, the height difference $h_{ES\,min}$ must be at least 25 mm.

Observe the maximum permissible suction height $h_{S\,max}$ = 800 mm.

A check valve in the drain line is only permissible in individual cases. Consult us for approval.

Installation position	Air bleed	Filling
5  	**F**	**L (F)**
6 1)  	**F**	**L_1 (F)**
7  	**F**	**L_1 (F)**
8 1)  	**F**	**L (F)**

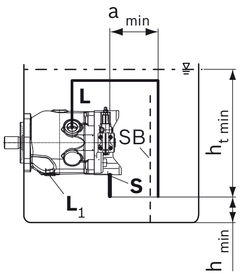
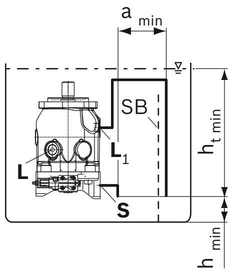
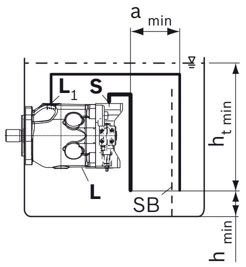
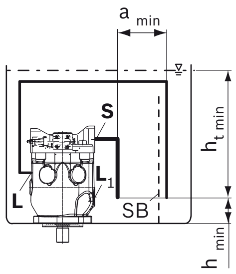
Key, see page 58.

Inside-reservoir installation

Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level. The axial piston unit is completely below the hydraulic fluid.

If the minimum fluid level is equal to or below the upper edge of the pump, see chapter “Above-reservoir installation”.

Axial piston units with electrical components (e.g., electric control, sensors) may not be installed in a reservoir below the fluid level.

Installation position	Air bleed	Filling
9  	Via the highest available port **L**	Automatically via the open port **L** or **L_1** due to the position under the hydraulic fluid level
10  	Via the highest available port **L_1**	Automatically via the open port **L**, **L_1** due to the position under the hydraulic fluid level
11  	Via the highest available port **L_1**	Automatically via the open port **S**, **L** or **L_1** due to the position under the hydraulic fluid level
12  	Via the highest available port **L**	Automatically via the open port **S**, **L** or **L_1** due to the position under the hydraulic fluid level

---

1) Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

Key	
F	Filling / air bleeding
S	Suction port
L; L_1	Drain port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)
$h_{ES\ min}$	Minimum necessary height required to protect the axial piston unit from draining (25 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)
a_{min}	When designing the reservoir, ensure adequate distance between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Notice

Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

Project planning notes

- The A10V(S)O axial piston variable pump is designed to be used in open circuit.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes contained herein must be observed.
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all versions of the product are approved for use in a safety function pursuant to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference.
  Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- Pressure controllers are not protection against overpressure. A pressure relief valve is to be provided for the hydraulic system.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports are only intended to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of getting burnt on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve pistons) can, under certain circumstances get stuck in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filter) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.

Axial piston variable pump
A10VO Series 32

- Optimized medium pressure pump for powerful machines
- Sizes 45 to 180
- Nominal pressure 280 bar
- Maximum pressure 350 bar
- Open circuit

Features
- Variable pump with axial piston rotary group of swashplate design for hydrostatic drives in open circuit
- Flow is proportional to the drive speed and displacement.
- The flow can be infinitely varied by adjusting the swashplate angle.
- Hydrostatic unloading of the cradle bearings
- Port for measurement sensor on high pressure port for size 180 or port plate 22 and 32
- Low noise level
- Increased functional reliability
- High efficiency
- Favorable power/weight ratio
- Universal through drive for Only size 180
- Optional pulsation damping

Contents

Ordering code

01	02	03	04		05	06		07	08	09	10	11	12
A10V	**O**			**/**	**32**		**–**	**V**					

Axial piston unit

01	Swashplate design, variable, nominal pressure 280 bar, maximum pressure 350 bar	**A10V**

Operating mode

02	Pump, open circuit	**O**

Sizes (NG) and **Control devices**

						045	071	100	140	180	
03	Geometric displacement, see “Technical data” on page 7					**045**	**071**	**100**	**140**	**180**	
04	Pressure controller	Hydraulic				●	●	●	●	●	**DR**
	with flow controller	Hydraulic	X-T open			●	●	●	●	●	**DRF**
			X-T plugged	with flushing function		●	●	●	●	●	**DRS**
			X-T plugged	without flushing function		●	●	●	●	●	**DRSC**
	Pressure cut-off	Hydraulic	remotely controlled			●	●	●	●	●	**DRG**
		electrical	negative control		U = 12 V	●	●	●	●	●	**ED71**
					U = 24 V	●	●	●	●	●	**ED72**
		electrical	positive control		U = 12 V	●	●	●	●	●	**ER71**[1]
					U = 24 V	●	●	●	●	●	**ER72**[1]
	Differential pressure control	electrical	negative control	see data sheet 92709		●	●	●	●	○	**EF.**
	Power controller with										
	Pressure cut-off	Hydraulic	Beginning of control	to	50 bar	●	●	●	●	●	**LA5D**
				from	51 to 90 bar	●	●	●	●	●	**LA6D**
					91 to 160 bar	●	●	●	●	●	**LA7D**
					161 to 240 bar	●	●	●	●	●	**LA8D**
				above	240 bar	●	●	●	●	●	**LA9D**
	Pressure cut-off and flow control	Hydraulic	Beginning of control	see LA.D		●	●	●	●	●	**LA.DS**
	Remote-controlled pressure cut-off	Hydraulic	Beginning of control	see LA.D		●	●	●	●	●	**LA.DG**
	Separate flow control	Hydraulic	Beginning of control	see LA.D		●	●	●	●	●	**LA.S**

Series

05	Series 3, index 2	**32**

Directions of rotation

06	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Seal

07	FKM (fluoroelastomer)	**V**

Drive shaft

			045	071	100	140	180	
08	Splined shaft	standard shaft	●	●	●	●	●	**S**
	ANSI B92.1a	similar to shaft “S” however for higher input torque	●	●	–	–	–	**R**
		reduced diameter, limited suitability for through drive (see table of values, page 8)	●	●	●	●	–	**U**
		same as shaft “U”, but for higher torque, limited suitability for through drive (see table of values, page 8)	○	○	●	●	●	**W**

---

1) Comply with project planning notes on page 16

01	02	03	04		05	06		07	08	09	10	11	12
A10V	**O**			**/**	**32**		**–**	**V**					

Mounting flange

			045	071	100	140	180	
09	ISO 3019-1 (SAE)	SAE C; 2-hole	●	●	●	●	–	**C**
		SAE C; 4-hole	●	●	●	●	●	**D**
		SAE D; 4-hole	–	●	–	–	–	**U**

Working port

			045	071	100	140	180	
10	SAE flange port (Port plates and through drive assignment, see position 11)	rear, metric fastening thread (not for through drive)	●	●	●	●	●	**11**
		at top, at bottom, on opposite side, metric fastening thread	●	●	●	●	–	**12**
		at top, at bottom, on opposite side, metric fastening thread with universal through drive U..; **without** pulsation damping	○	○	○	○	●	**22**[1]
		at top, at bottom, on opposite side, metric fastening thread with universal through drive U..; **with** pulsation damping	○	○	○	○	●	**32**[1]

Through drive (for mounting options, see page 48)

11	Flange ISO 3019-1 Diameter	Attachment[4]	Hub for splined shaft[2] Diameter		045	071	100	140	180	
	without through drive	(**Only for port plates 11 and 12**)			●	●	●	●	●	**N00**
	82-2 (A)	8 ☍ ⚯	5/8 in	9T 16/32DP	●	●	●	●	–	**K01**
			3/4 in	11T 16/32DP	●	●	●	●	–	**K52**
	101-2 (B)	8 ☍ ⚯	7/8 in	13T 16/32DP	●	●	●	●	–	**K68**
			1 in	15T 16/32DP	●	●	●	●	–	**K04**
	127-2 (C)	☍ ⚯	1 1/4 in	14T 12/24DP	–	●	●	●	–	**K07**
			1 1/2 in	17T12/24DP	–	–	●	●	–	**K24**
	127-4 (C)	⌘	1 1/4 in	14T 12/24DP	–	○	●	●	–	**K15**
	152-4 (D)	⌘	1 3/4 in	13T 8/16DP	–	–	–	●	–	**K17**
	without through drive	(**Only possible with port plates 22 and 32**)[3]			○	○	○	○	●	**U00**
	82-2 (A)	8 ☍ ⚯	5/8 in	9T 16/32DP	○	○	○	○	●	**U01**
			3/4 in	11T 16/32DP	○	○	○	○	●	**U52**
	101-2 (B)	8 ☍ ⚯	7/8 in	13T 16/32DP	○	○	○	○	●	**U68**
			1 in	15T 16/32DP	○	○	○	○	●	**U04**
	127-2 (C)	8 ☍ ⚯	1 1/4 in	14T 12/24DP	–	○	○	○	●	**U07**
			1 1/2 in	17T 12/24DP	–	–	○	○	●	**U24**
	127-4 (C)	⌘	1 in	15T 16/32DP	○	○	○	○	○	**UE2**
			1 1/4 in	14T 12/24DP	–	–	○	○	●	**U15**
	152-4 (D)	⌘	1 3/4 in	13T 8/16DP	–	–	–	○	●	**U17**

Connectors for solenoids[5]

12	Without connector (without solenoid, with hydraulic control only, without code)	
	DEUTSCH molded connector, 2-pin – without suppressor diode	**P**

● = Available ○ = On request – = Not available

Notes

- ▶ Note the project planning notes on page 54!
- ▶ In addition to the type code, please specify the relevant technical data when placing your order.

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[1] Only with mounting flange (ordering code position 09) D or U

[2] According to ANSI B92.1a (splined shafts according to SAE J744)

[3] With through-drive shaft, without hub, without intermediate flange, closed on a functionally reliable basis with cover. For mounting kits, see data sheet 95581.

[4] Mounting through bores pattern viewed from through drive with control at top.

[5] Connectors for other electric components may deviate.

Hydraulic fluids

The A10VO variable pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: HFD hydraulic fluids (for permissible technical data, see data sheet 90225.)

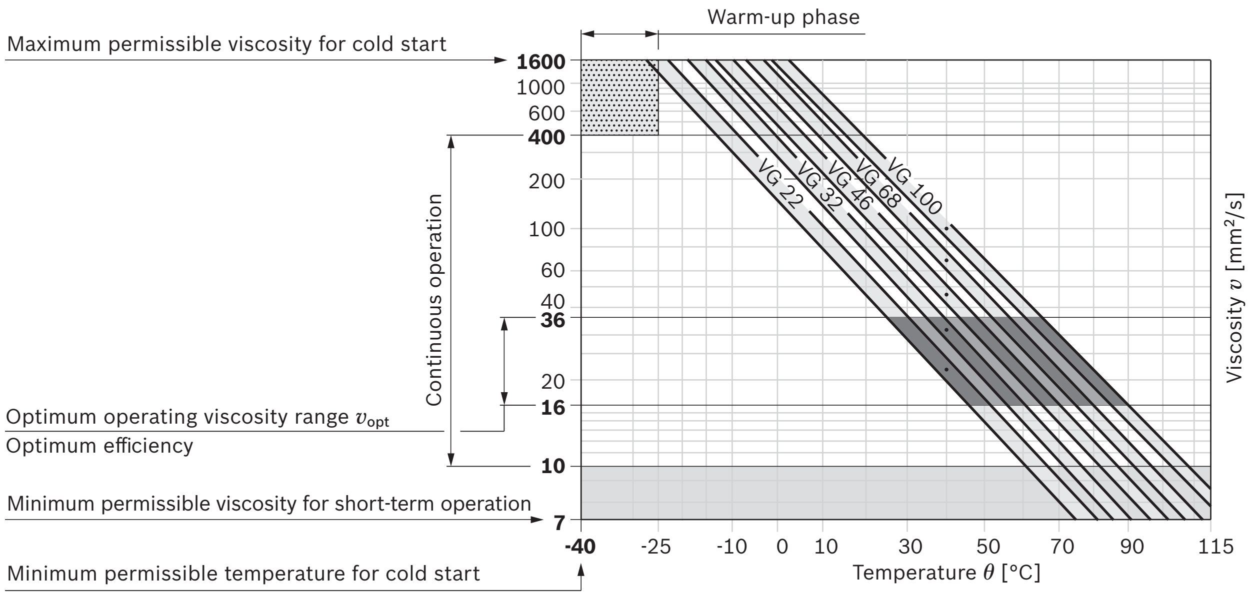
Notes on selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see selection diagram).

Notice
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \leq 1600$ mm²/s	$\theta_{St} \geq -40$ °C	$t \leq 1$ min, without load ($p \leq 30$ bar), $n \leq 1000$ rpm
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu < 1600$ to 400 mm²/s	$\theta = -40$ °C to -25 °C	Note the detailed information on operation with low temperatures, see data sheet 90300-03-B.
Continuous operation	$\nu = 400$ to 10 mm²/s		this corresponds, for VG 46 for example, to a temperature range of +5 °C to +85 °C (see selection diagram)
		$\theta = -25$ °C to +110 °C	measured at port **L**, **L₁** Observe the permissible temperature range of the shaft seal (ΔT = approx. 5 K between the bearing/shaft seal and port **L**, **L₁**)
	$\nu_{opt} = 36$ to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \geq 7$ mm²/s		$t < 1$ min, $p < 0.3 \cdot p_{nom}$

▼ **Selection diagram**



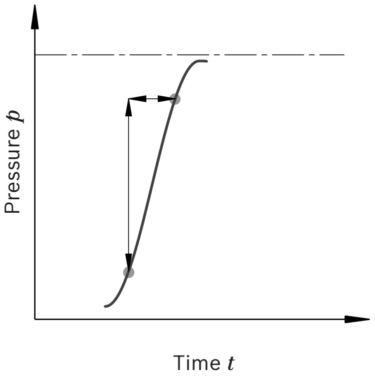
Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.
A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.
At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), cleanliness level 19/17/14 according to at least ISO 4406 is necessary.
Please contact us if the above classes cannot be observed.

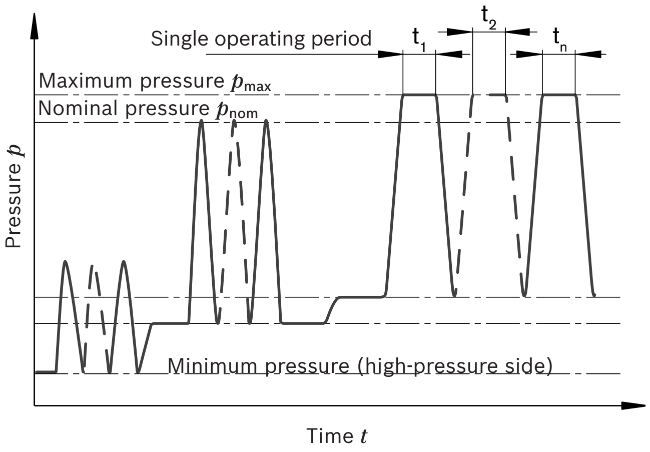
Working pressure range

Pressure at working port B			**Definition**
Nominal pressure p_{nom}		280 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}		350 bar	The maximum pressure corresponds to the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period		2 ms	
Total operating period		300 h	
Minimum pressure (high-pressure side)		10 bar[1]	Minimum pressure on the high-pressure side (**B**) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{\text{A max}}$		16000 bar/s	Maximum permissible pressure build-up and reduction speed during a pressure change across the entire pressure range.
Pressure at suction port S (inlet)			
Minimum pressure $p_{\text{S min}}$	NG 45 to 100 at 1800 rpm	0.8 bar absolute	Minimum pressure at suction port **S** (inlet) that is required in order to avoid damage to the axial piston unit. The minimum pressure depends on the rotational speed and displacement of the axial piston unit.
	NG 140 to 180 at 1800 rpm	1.0 bar absolute	
Maximum pressure $p_{\text{S max}}$		10 bar[2]	
Case pressure at port L_1, L_2			
Maximum pressure $p_{\text{L max}}$		2 bar[2] absolute	Maximum 0.5 bar higher than inlet pressure at port **S**, but not higher than $p_{\text{L max}}$. A case drain line to the reservoir is required.

▼ **Rate of pressure change $R_{\text{A max}}$**



▼ **Pressure definition**



Total operating period = $t_1 + t_2 + \ldots + t_n$

Notice
Working pressure range valid when using hydraulic fluids based on mineral oils. Please contact us for values for other hydraulic fluids.

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[1] Lower pressure is time-dependent, please contact us

[2] Other values on request

Technical data

Size		NG		045	071	100	140	180
Displacement, geometric, per revolution		$V_{g\ max}$	cm³	45	71.1	100	140	180
Maximum rotational speed[1)2)]	at $V_{g\ max}$	n_{nom}	rpm	3000	2550	2300	2200	1800
Flow	at n_{nom} and $V_{g\ max}$	q_v	l/min	135	181	230	308	324
Power	at n_{nom}, $V_{g\ max}$ and Δp = 280 bar	P	kW	63	85	107	144	151
Torque	at $V_{g\ max}$ and Δp = 280 bar	T	Nm	200	317	446	624	802
	at $V_{g\ max}$ and Δp = 100 bar	T	Nm	72	113	159	223	286
Rotary stiffness of drive shaft	S	c	Nm/rad	37500	71884	121142	169537	171107
	R	c	Nm/rad	41025	76545	–	–	–
	U	c	Nm/rad	30077	52779	91093	on request	–
	W	c	Nm/rad	34463	57460	101847	165594	–
Moment of inertia for rotary group		J_{TW}	kgm²	0.0035	0.0087	0.0167	0.0242	0,033
Maximum angular acceleration[3)]		α	rad/s²	4000	2900	2400	2000	2000
Case volume		V	L	1.0	1.6	2.2	3.0	2.7
Weight (11N00 and 12N00 without through drive) approx.		m	kg	25.8	40.4	56.4	70.5	75.2
Weight (12Kxx) approx.		m	kg	27.4	43.3	62.6	79.5	–
Weight (22Uxx/32Uxx) approx.		m	kg	32.6	51.8	76	90.2	89.4

Determining the operating characteristics			
Flow	$q_v = \dfrac{V_g \times n \times \eta_v}{1000}$		[l/min]
Torque	$T = \dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$		[Nm]
Power	$P = \dfrac{2\ \pi \times T \times n}{60000}$	$= \dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g	Displacement per revolution [cm³]
Δp	Differential pressure [bar]
n	Rotational speed [rpm]
η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

Notice

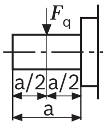
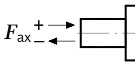
- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommend testing the load by means of experiment or calculation/simulation and comparison with the permissible values.

[1)] The values are applicable:
  – to the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s
  – to hydraulic fluid based on mineral oils

[2)] The values apply at absolute pressure p_{abs} = 1.0 bar at suction port **S**.

[3)] The data are valid for values between the minimum required and maximum permissible rotational speed. Valid for external excitation (e.g. diesel engine 2 to 8 times rotary frequency, cardan shaft twice the rotary frequency). The limit value is only valid for a single pump. The load capacity of the connecting parts must be considered.

Permissible radial and axial forces on the drive shaft

Size		NG		45	71	100	140	180
Maximum radial force at a/2		$F_{q\ max}$	N	1500	1900	2300	2800	2300
Maximum axial force		$\pm F_{ax\ max}$	N	1500	2400	4000	4800	800

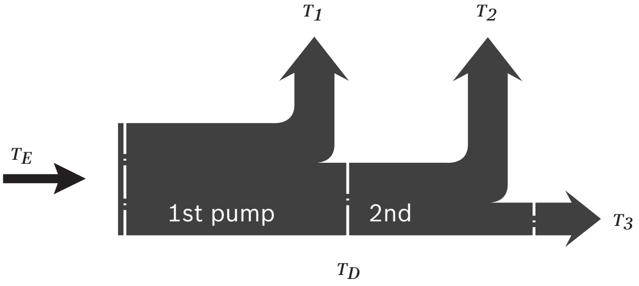
Notice

- For drives with radial loading (pinion, V-belt), please contact us!
- The values given are maximum values and do not apply to continuous operation.

Permissible input and through-drive torques

Size				45	71	100	140	180
Torque at $V_{g\ max}$ and Δp = 280 bar[1]		T_{max}	Nm	200	316	446	624	802
Input torque at drive shaft, maximum[2]								
	S	$T_{E\ max}$	Nm	319	626	1104	1620	1834
		Ø	in	1	1 1/4	1 1/2	1 3/4	1 3/4
	R	$T_{E\ max}$	Nm	400	644	–	–	–
		Ø	in	1	1 1/4	–	–	–
	U	$T_{E\ max}$	Nm	188	300	595	on request	–
		Ø	in	7 /8	1	1 1/4	1 1/2	–
	W	$T_{E\ max}$	Nm	–	394	636	1220	1488
		Ø	in	–	1	1 1/4	1 1/2	1 1/2
Maximum through-drive torque								
	S	$T_{D\ max}$	Nm	319	492	778	1266	1266
	R	$T_{D\ max}$	Nm	365	548	–	–	–
	U	$T_{D\ max}$	Nm	188	–	595	on request	–
	W	$T_{D\ max}$	Nm	–	–	636	1220	1266

▼ **Distribution of torques**



Torque at 1st pump	T_1		
Torque at 2nd pump	T_2		
Torque at 3rd pump	T_3		
Input torque	T_E	=	$T_1 + T_2 + T_3$
	T_E	<	$T_{E\ max}$
Through-drive torque	T_D	=	$T_2 + T_3$
	T_D	<	$T_{D\ max}$

---

1) Efficiency not considered

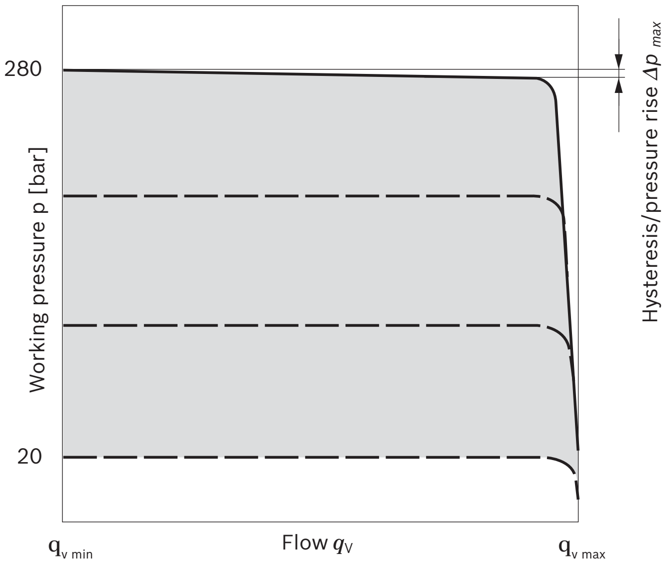
2) For drive shafts with no radial force

DR – Pressure controller

The pressure controller limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only supplies as much hydraulic fluid as is required by the consumers. If the working pressure exceeds the pressure command value at the pressure valve, the pump will regulate to a smaller displacement to reduce the control differential.

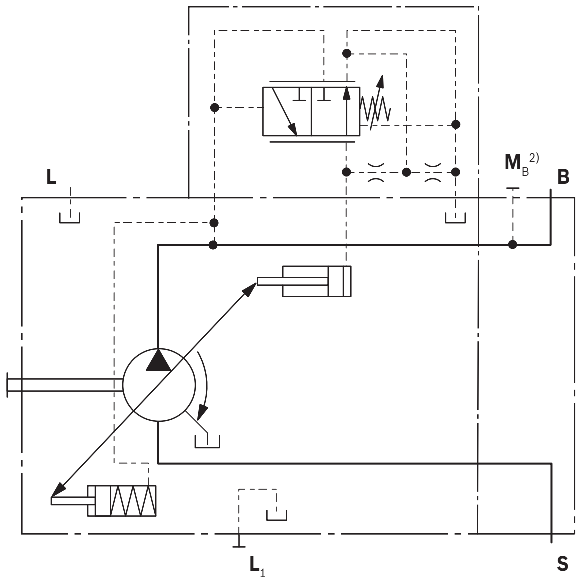
- Basic position in depressurized state: $V_{g\ max}$.
- Setting range[1] for pressure control 20 to 280 bar. Standard is 280 bar.

▼ Characteristic curve DR



Characteristic curve valid at n_1 = 1500 rpm and θ_{fluid} = 50 °C.

▼ Circuit diagram DR



Controller data

Size		45	71	100	140	180
Pressure rise, maximum	Δp [bar]	6	8	10	12	14
Hysteresis and repeatability	Δp [bar]	maximum 3				
Control fluid consumption	[l/min]	maximum approx. 3				

---

[1] In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded.
The range of possible settings at the valve is higher.

[2] Only with port plates 22 and 32

DRG – Pressure controller, remotely controlled

For the remote-controlled pressure controller, the LS pressure limitation is performed using a separately arranged pressure relief valve. Therefore any pressure control value under the pressure set on the pressure controller can be regulated. Pressure controller DR see page 9.

A pressure relief valve is externally piped to port **X** for remote control. This relief valve is not included in the scope of delivery of the DRG control.

When there is differential pressure Δp at the control valve and with the standard setting on the remote-controlled pressure cut-off of 20 bar, the amount of control fluid at the port is **X** approx. 1.5 l/min. If a different setting (range 10 to 22 bar) is required, please state in plain text.

As a separate pressure relief valve (**1**) we recommend:

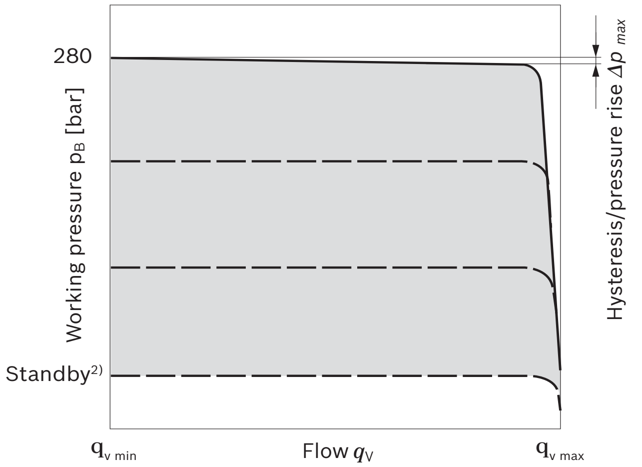
- A directly controlled, hydraulic or electric proportional one, suitable for the control fluid mentioned above.

The max. length of piping should not exceed 2 m.

- Basic position in depressurized state: $V_{g\ max}$.
- Setting range[1] for pressure control 20 to 280 bar **(3).** Standard is 280 bar.
- Setting range for differential pressure 10 - 22 bar(**2**) Standard is 20 bar.

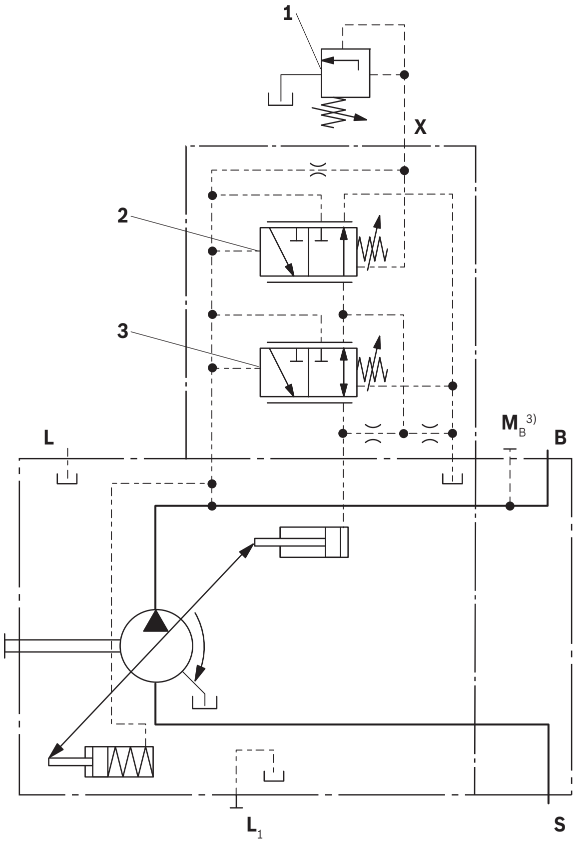
Unloading port **X** to the reservoir results in a zero stroke (standby) pressure which is approx. 1 to 2 bar higher than the defined differential pressure Δp, however system influences are not taken into account.

▼ Characteristic curve DRG



Characteristic curve valid for n_1 = 1500 rpm and θ_{fluid} = 50 °C.

▼ Circuit diagram DRG



1 The separate pressure relief valve and the line are not included in the scope of delivery.

2 Remote-controlled pressure cut-off (**G**).

3 Pressure controller (**DR**)

Controller data

Size		45	71	100	140	180
Pressure rise, maximum	Δp [bar]	6	8	10	12	14
Hysteresis and repeatability	Δp [bar]	maximum 3				
Control fluid consumption	[l/min]	maximum approx. 4.5				

---

[1] In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.

[2] Zero stroke from pressure setting Δp on controller (**2**)

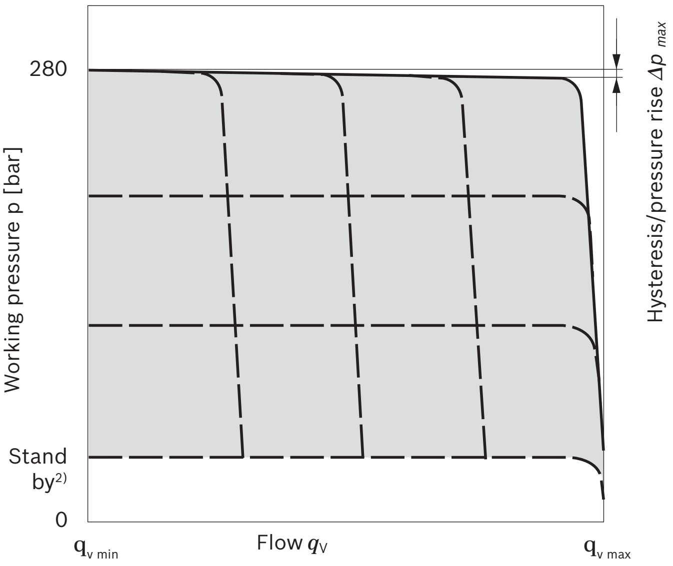
[3] Only with port plates 22 and 32

DRF/DRS/DRSC – Pressure and flow control

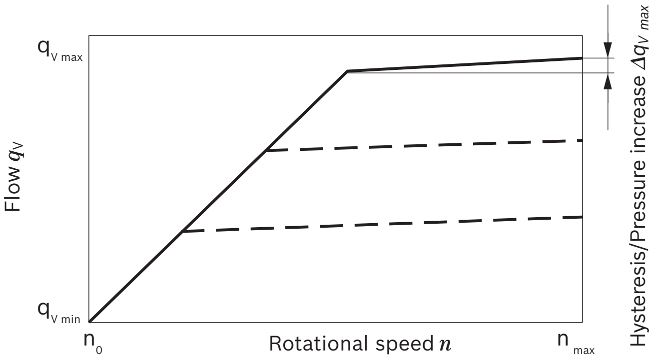
In addition to the pressure controller function (see page 9), an adjustable orifice (e.g. directional valve) is used to adjust the differential pressure upstream and downstream of the orifice. This is used to control the pump flow. The pump flow is equal to the actual hydraulic fluid quantity required by the consumer. With all controller combinations, the V_g reduction has priority.

- Basic position in depressurized state: $V_{g\,max}$.
- Setting range[1] to 280 bar.
  Standard is 280 bar
- DR pressure controller data see page 9

▼ **Characteristic curve DRF/DRS/DRSC**

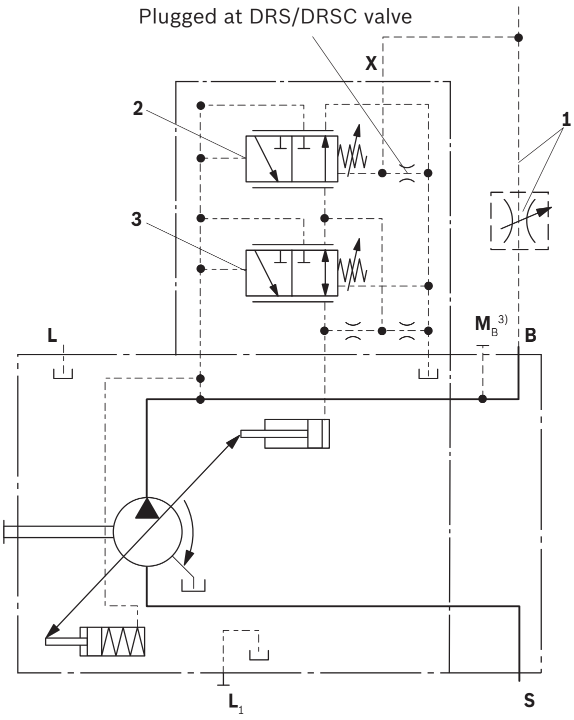


▼ **Characteristic curve at variable rotational speed**



Characteristic curves valid at n_1 = 1500 rpm and θ_{fluid} = 50 °C.

▼ **Circuit diagram DRF**



1 The metering orifice (control block) and the line are not included in the scope of delivery.

2 Pressure and flow controller (**FR**).

3 Pressure controller (**DR**)

Note

The DRS and DRSC valve versions have no pilot line between **X** and the reservoir.

Unloading the LS-pilot line must be possible in the valve system.

Because of the flushing function sufficient unloading of the flow controller in DRS control valve **X**-line must also be provided.

If this pilot line of the **X** line does not have to be guaranteed, the DRSC control valve must be used.

For further information see page 12

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1) In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded.
The range of possible settings at the valve is higher.

2) Zero stroke from differential pressure setting Δp on controller (**2**)

3) Only with port plates 22 and 32

Differential pressure Δp

- Standard setting: 14 bar
  If another setting is required, please state in clear text.
- Setting range: 14 to 22 bar

Unloading port **X** to the reservoir results in a zero stroke (standby) pressure which is approx. 1 to 2 bar higher than the defined differential pressure Δp, however system influences are not taken into account.

Controller data

DR pressure controller data see page 9.
Maximum flow deviation measured at drive speed n = 1500 rpm.

NG		**45**	**71**	**100**	**140**	**180**
Flow deviation	$\Delta q_{V\,max}$ [l/min]	1.8	2.8	4.0	6.0	8.0
Hysteresis and repeatability	Δp [bar]	maximum 3				
Control fluid consumption	l/min	maximum approx. 3 to 4.5 (DRF) maximum approx. 3 (DRS/DRSC)				

LA... – Pressure, flow and power controller

Pressure controller equipped as DR(G), see page 9 (10).
Equipment of the flow controller like DRS, see page 11.
In order to achieve a constant drive torque with varying working pressures, the swivel angle and with it the output flow from the axial piston pump is varied so that the product of flow and pressure remains constant. Flow controller is possible below the power control curve.

When ordering please state the power characteristics to be set at the factory in plain text, e.g. 20 kW at 1500 rpm.

Controller data

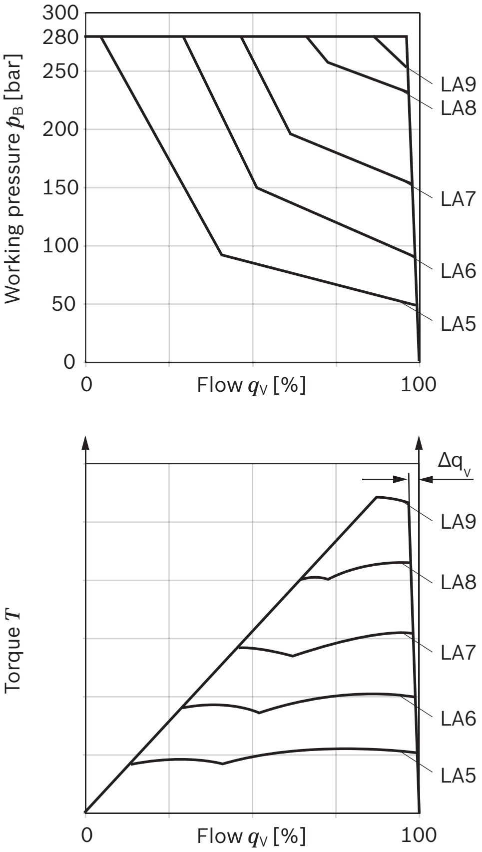
- For technical data of pressure controller DR see page 9.
- For technical data of flow controller FR see page 11.
- Control fluid consumption max. approx. 5.5 l/min

Beginning of control	Torque T [Nm] for size 45	71	100	140	180	Ordering code
up to 50 bar	up to 42.0	up to 67.0	up to 94.0	up to 132.0	up to 167.0	**LA5**
51 to 90 bar	42.1 × 76.0	67.1 × 121.0	94.1 × 169.0	132.1 × 237.0	167.1 × 302.0	**LA6**
91 to 160 bar	76.1 × 134.0	121.1 × 213.0	169.1 × 299.0	237.1 × 418.0	302.1 × 540.0	**LA7**
161 to 240 bar	134.1 × 202.0	213.1 × 319.0	299.1 × 449.0	418.1 × 629.0	540.1 × 810.0	**LA8**
over 240 bar	over 202.1	over 319.1	over 449.1	over 629.1	over 810.1	**LA9**

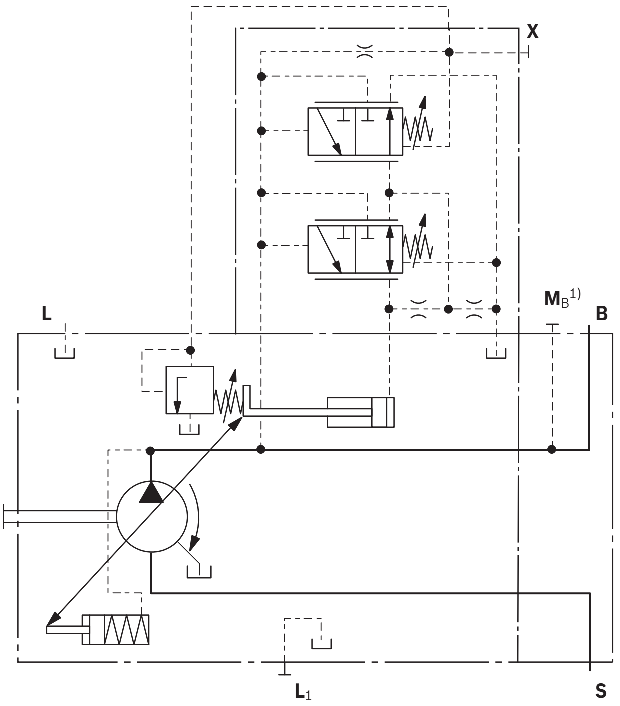
Conversion of the torque values in power [kW]

$P = \frac{T}{6.4}$ [kW] (at 1500 rpm) or $P = \frac{2\pi \times T \times n}{60000}$ [kW] (For rotational speeds, see table on page 7)

▼ **Characteristic curve LA**

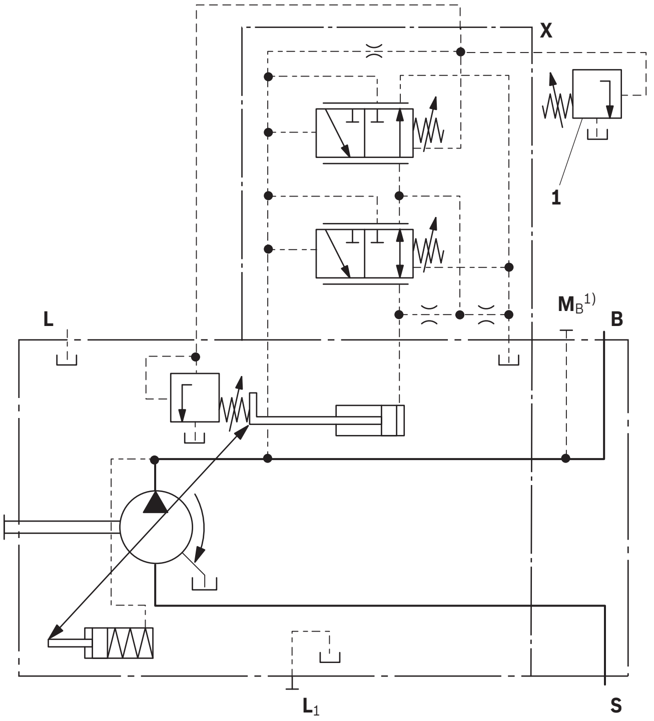


▼ **Circuit diagram LA.D** with pressure cut-off
(for further combination options with LA.. see page 14)

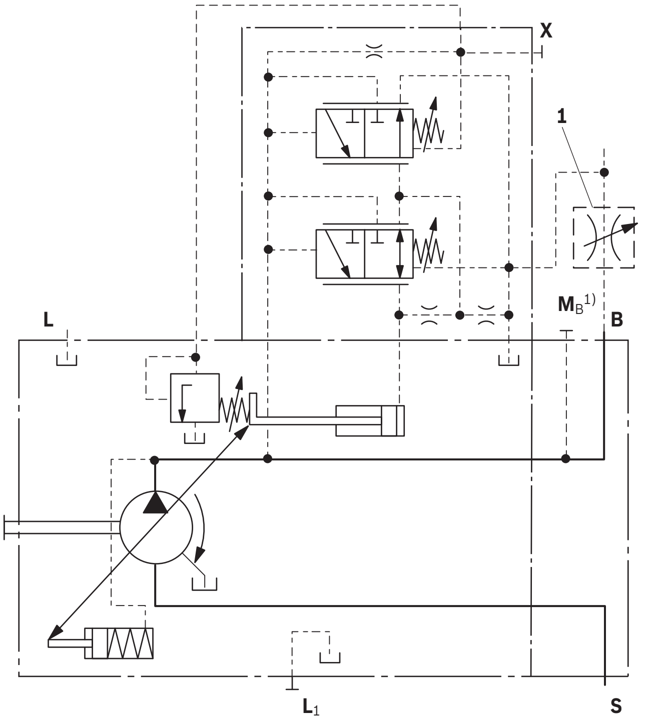


LA... – Variations

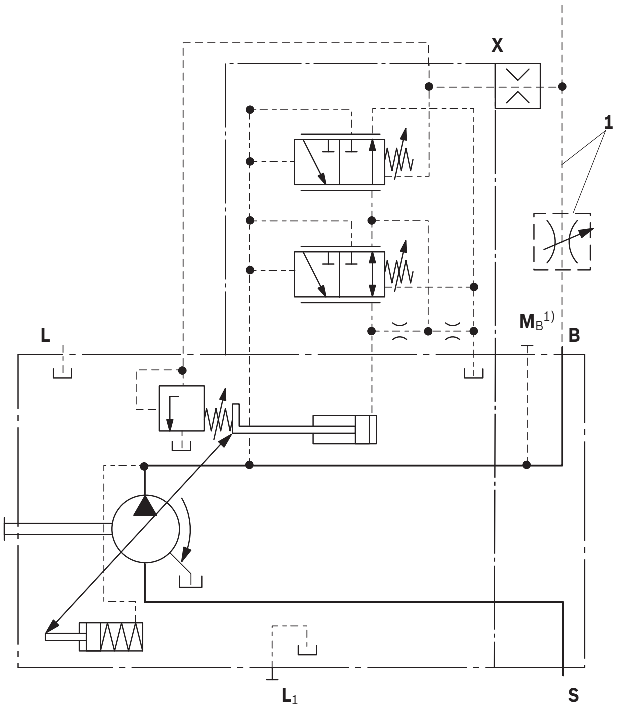
▼ **Circuit diagram LA.DG** with pressure cut-off, remotely controlled



▼ **Circuit diagram LA.S** with separate flow control



▼ **Circuit diagram LA.DS**



1 The metering orifice and the pressure relief valve and line are not included in the scope of delivery.

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1) Only with port plates 22 and 32

ED – Electro-hydraulic pressure control

The ED valve is set to a certain pressure by a specified variable solenoid current.

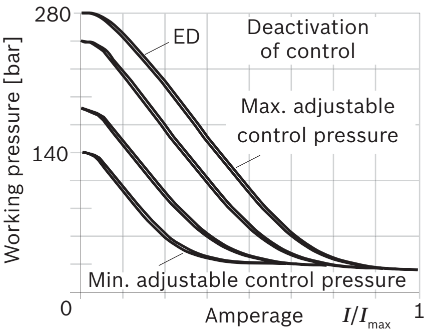
When changing the consumer (load pressure), this causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.

The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.

As the solenoid current signal drops towards zero, the pressure will be limited to p_{max} by an adjustable hydraulic pressure cut-off (secure fail safe function in case of power failure, e.g. for fan speed control). The response time characteristic curve of the ED control was optimized for the use as a fan drive system.

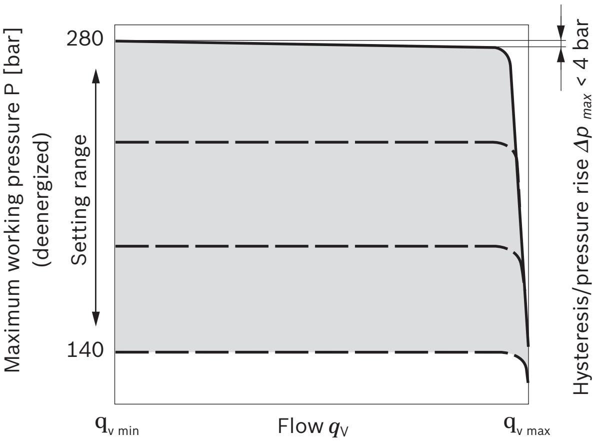
When ordering, specify the type of application in plain text.

▼ Static current-pressure characteristic curve ED
(negative characteristic curve measured with pump in zero stroke)



Hysteresis static < 3 bar.

▼ Flow-pressure characteristic curve

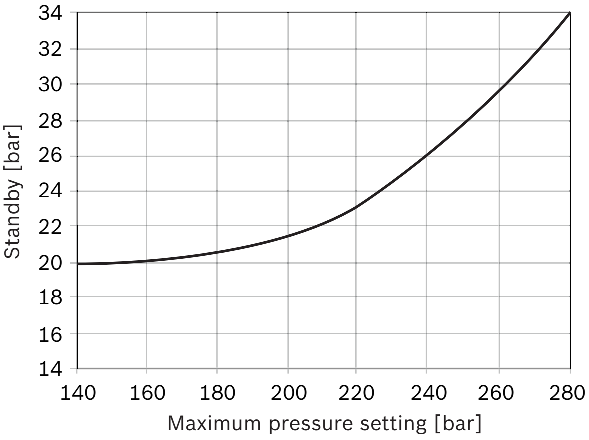


Characteristic curves valid at n_1 = 1500 rpm and θ_{fluid} = 50 °C.

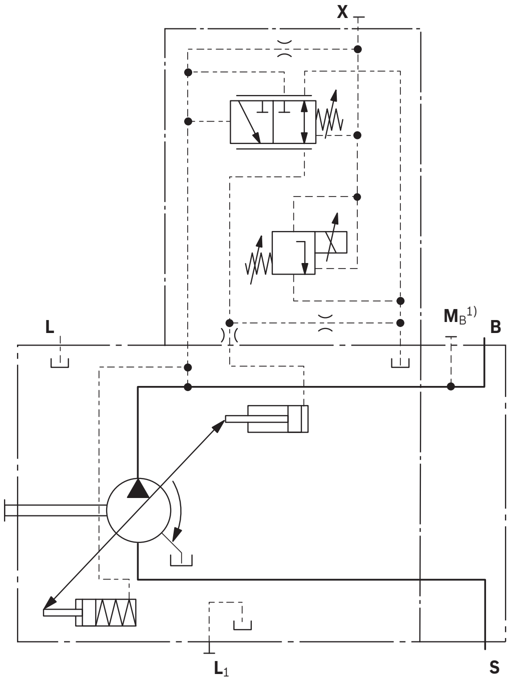
Control fluid consumption: 3 to 4.5 l/min.

For standby standard setting, see diagram on right, other values on request.

▼ Influence of the pressure setting on standby (maximally energized)



▼ Circuit diagram ED71/ED72



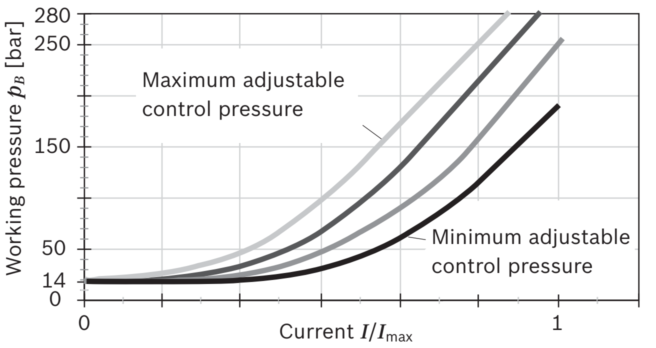
Technical data, solenoid	ED71	ED72
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control at p_{max}	100 mA	50 mA
End of control at p_{min}	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Duty cycle	100 %	100 %
Controls and type of protection: see connector version page 50		
Operating temperature range at valve -20 °C to +115 °C		

1) Only with port plates 22 and 32

ER – Electro-hydraulic pressure control

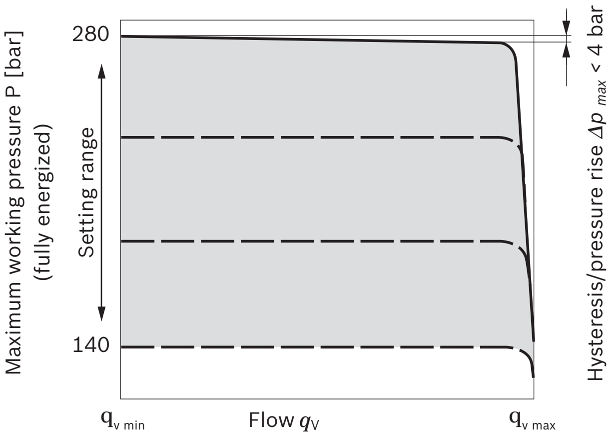
The ER valve is set to a certain pressure by a specified variable solenoid current.
When a change is made at the consumer (load pressure), the position of the control spool will shift.
This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.
The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.
As the solenoid current signal drops towards zero, the pressure will be limited to p_{min} (stand by).

▼ **Static current-pressure characteristic curve ER**
(positive characteristic curve measured with pump in zero stroke)



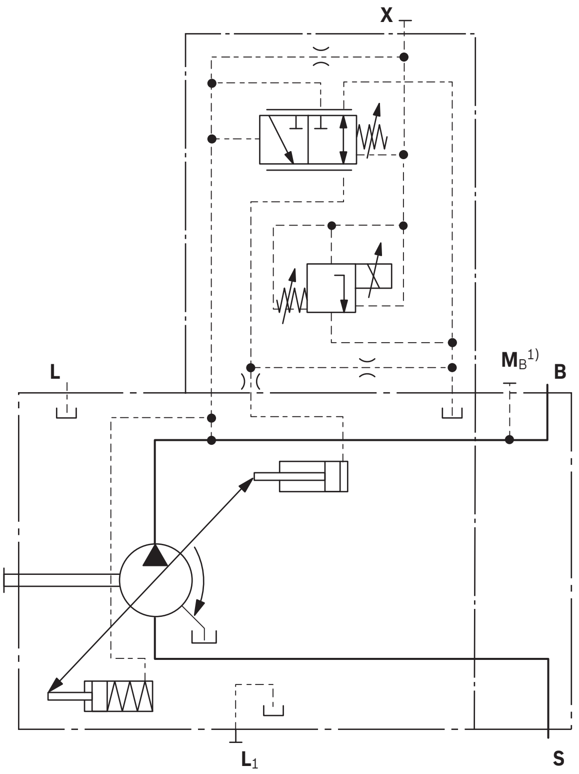
Hysteresis static current-pressure characteristic curve < 3 bar.

▼ **Flow-pressure characteristic curve**



Characteristic curves valid at n_1 = 1500 rpm and θ_{fluid} = 50 °C.
Control fluid consumption: 3 to 4.5 l/min.
Standby standard 14 bar. Other values on request.
Influence of pressure setting on stand-by ±2 bar.

▼ **Circuit diagram ER71/ER72**



Technical data, solenoid	ED71	ED72
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of control at p_{min}	100 mA	50 mA
End of control at p_{max}	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Duty cycle	100 %	100 %
Controls and type of protection: see connector version page 50		
Operating temperature range at valve -20 °C to +115 °C		

Project planning note!
Excessive current levels (I > 1200 mA at 12 V or I > 600 mA at 24 V) to the ER solenoid can result in undesired pressure increases which can lead to pump or system damage. Therefore:

- Use I_{max} current limiter solenoids.
- An intermediate plate pressure controller can be used to protect the pump in the event of overflow.

An accessory kit with intermediate plate pressure controller can be ordered from Bosch Rexroth under part number R902490825.

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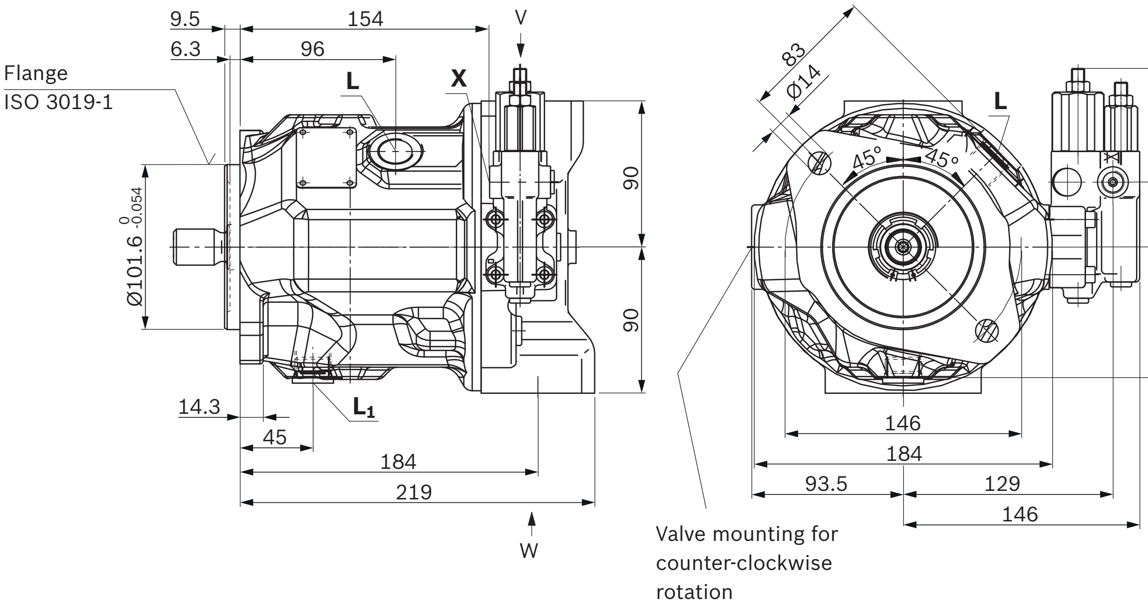
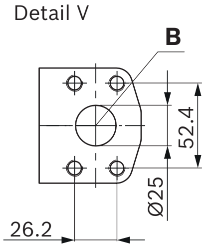
1) Only with port plates 22 and 32

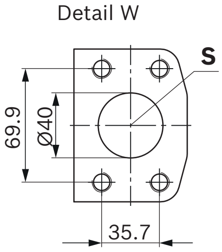
Dimensions size 45

DRF, DRS, DRSC – Pressure and flow control, port plate 11 and 12; mounting flange C (SAE-B; 101-2)

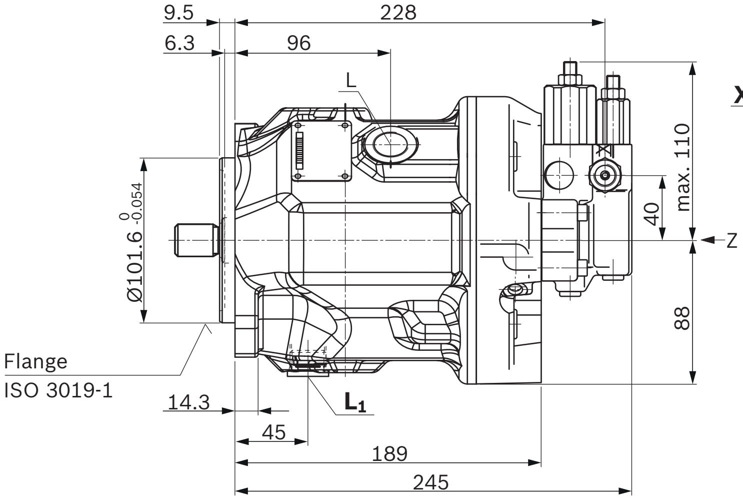
▼ **Port plate 12**

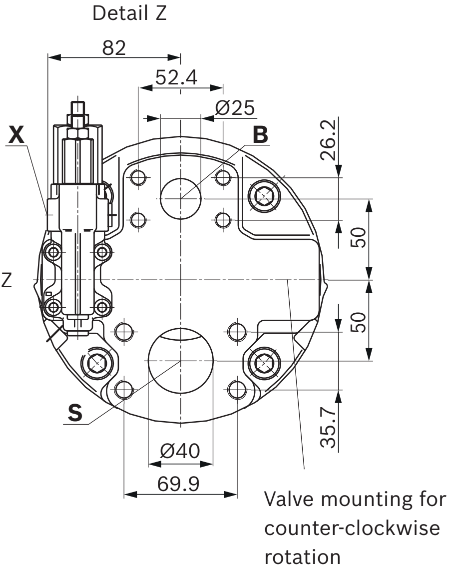






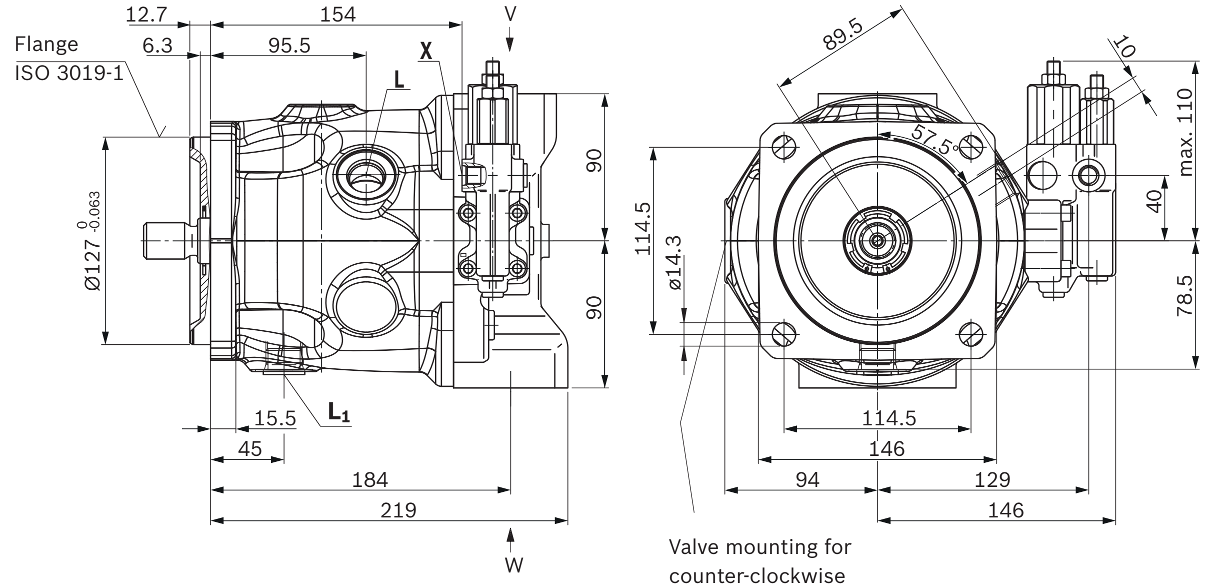
▼ **Port plate 11**





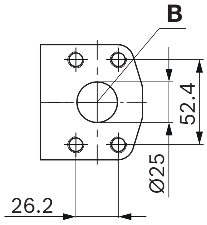
DRF, DRS, DRSC – Pressure and flow control, port plate 11 and 12; mounting flange D (SAE-C; 127-4)

▼ **Port plate 12**

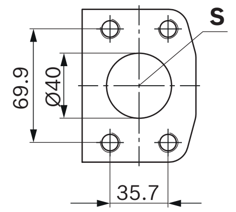


Valve mounting for
counter-clockwise
rotation

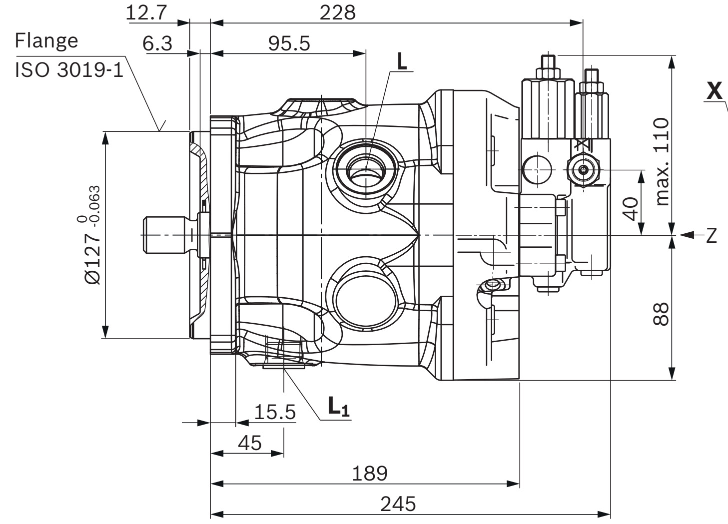
Detail V



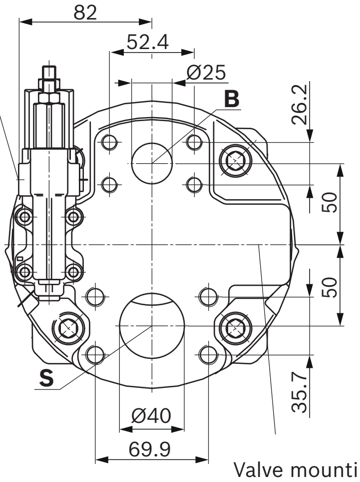
Detail W



▼ **Port plate 11**



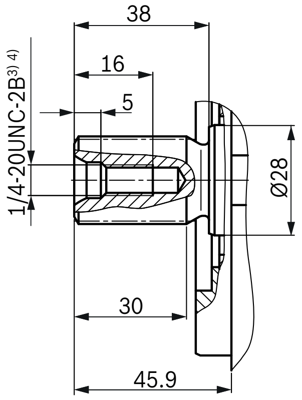
Detail Z



Valve mounting for
counter-clockwise
rotation

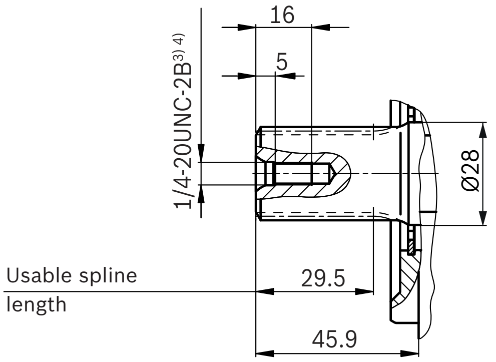
▼ Splined shaft 1 in (SAE J744)

S – 15T 16/32DP[1]



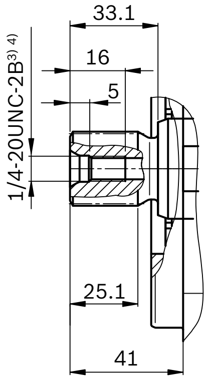
▼ Splined shaft 1 in (SAE J744)

R – 15T 16/32DP[1)2)]



▼ Splined shaft 7/8 in (SAE J744)

U – 13T 16/32DP[1]



Ports		Standard	Size[4]	$p_{\max}$ [bar][5]	State[9]
B	Working port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	1 in M10 x 1.5, 17 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	1 1/2 in M12 x 1.75; 20 deep	10	O
L	Drain port	ISO 11926[7]	7/8-14UNF-2B; 13 deep	2	O[8]
L_1	Drain port	ISO 11926[7]	7/8-14UNF-2B; 13 deep	2	X[8]
X	Pilot pressure	ISO 11926	7/16-20 UNF-2A; 12 deep	350	O
M_B	Measuring pressure **B**	DIN 3852-2[7]	G 1/4 in; 12 deep	350	X

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) For notes on tightening torques, see the instruction manual.

5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

6) Metric fastening thread is a deviation from standard.

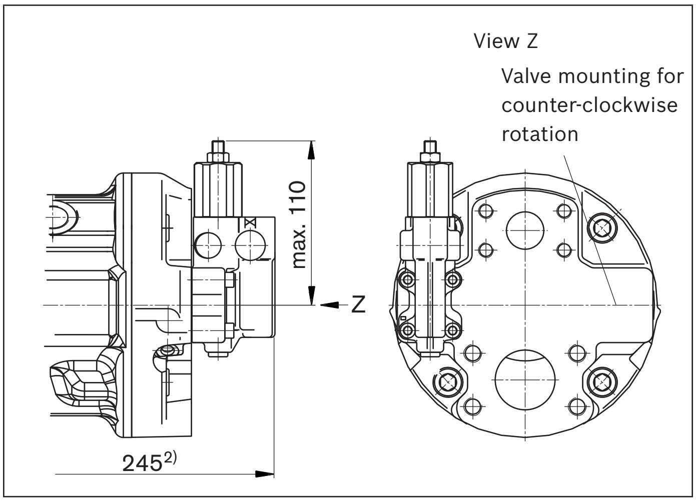
7) The countersink can be deeper than as specified in the standard.

8) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 51).

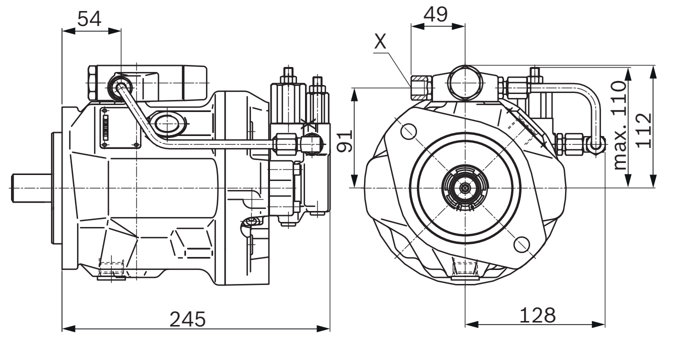
9) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

Port plate 11

▼ DR – Pressure controller

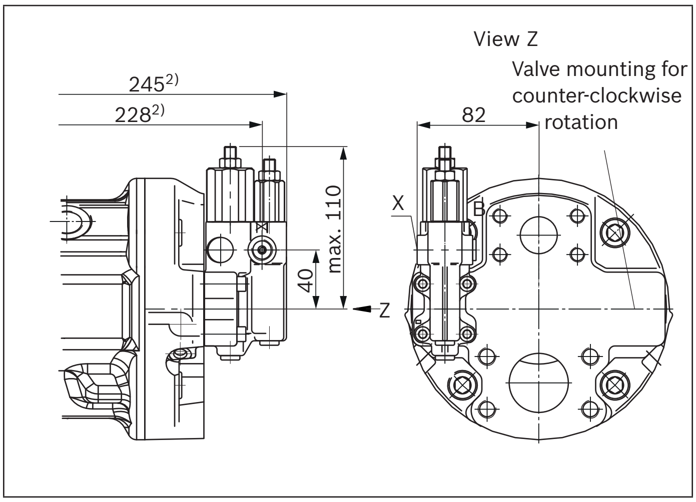


▼ LA.DS – Pressure, flow and power controller

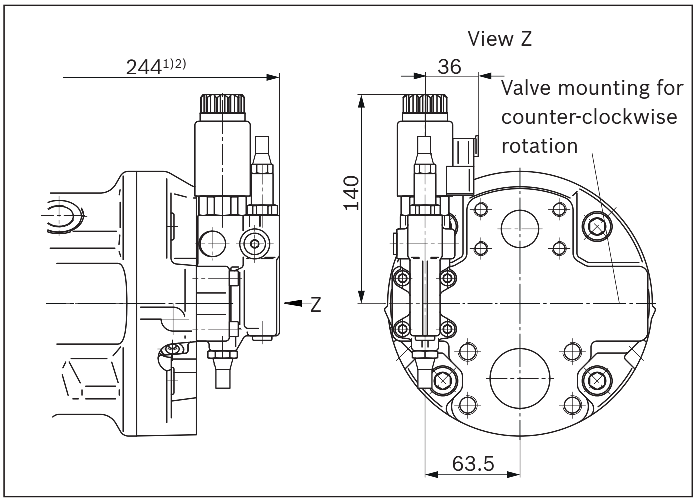


Valve mounting for counter-clockwise rotation see page 17 and 18

▼ DRG – Pressure controller, remotely controlled



▼ ED7./ER7. – Pressure controller, electrical



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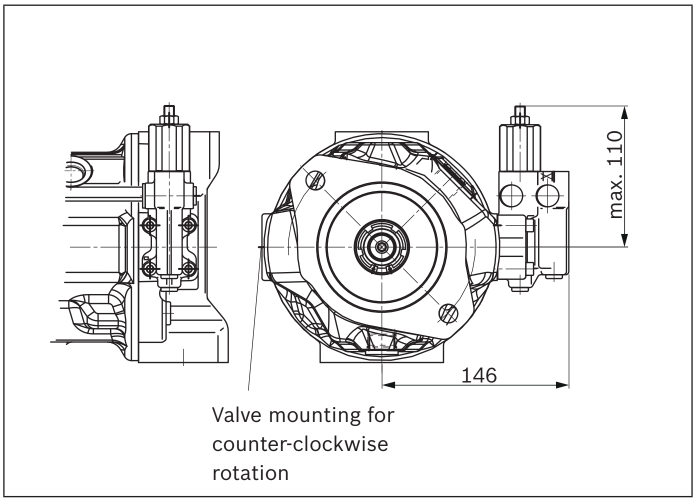
1) ER7. 279 mm if using an intermediate plate pressure controller

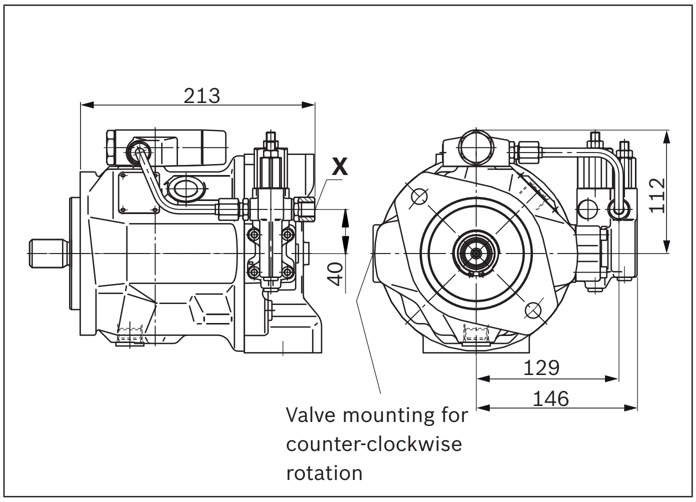
2) To mounting flange

Port plate 12

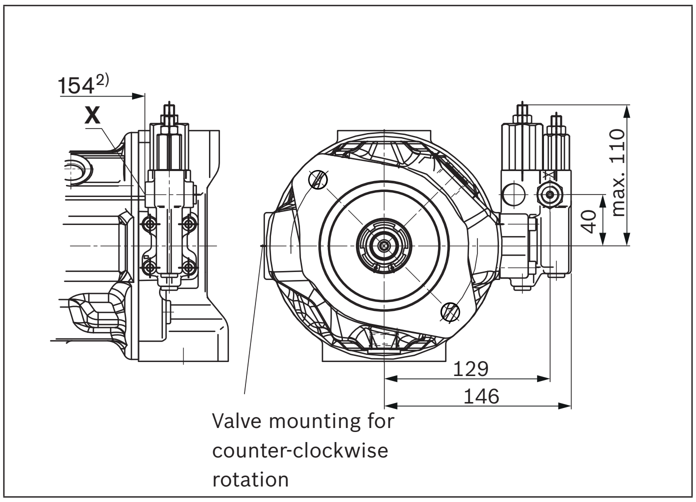
▼ **DR – Pressure controller**



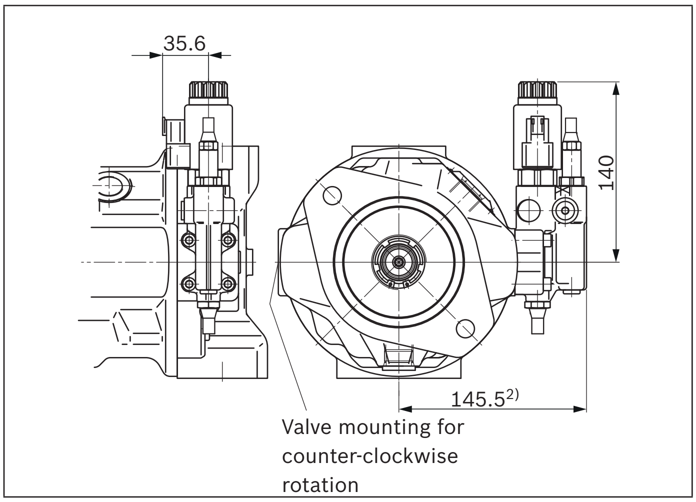
▼ **LA.DS – Pressure, flow and power controller**



▼ **DRG – Pressure controller, remotely controlled**



▼ **ED7./ER7. – Pressure controller, electrical**



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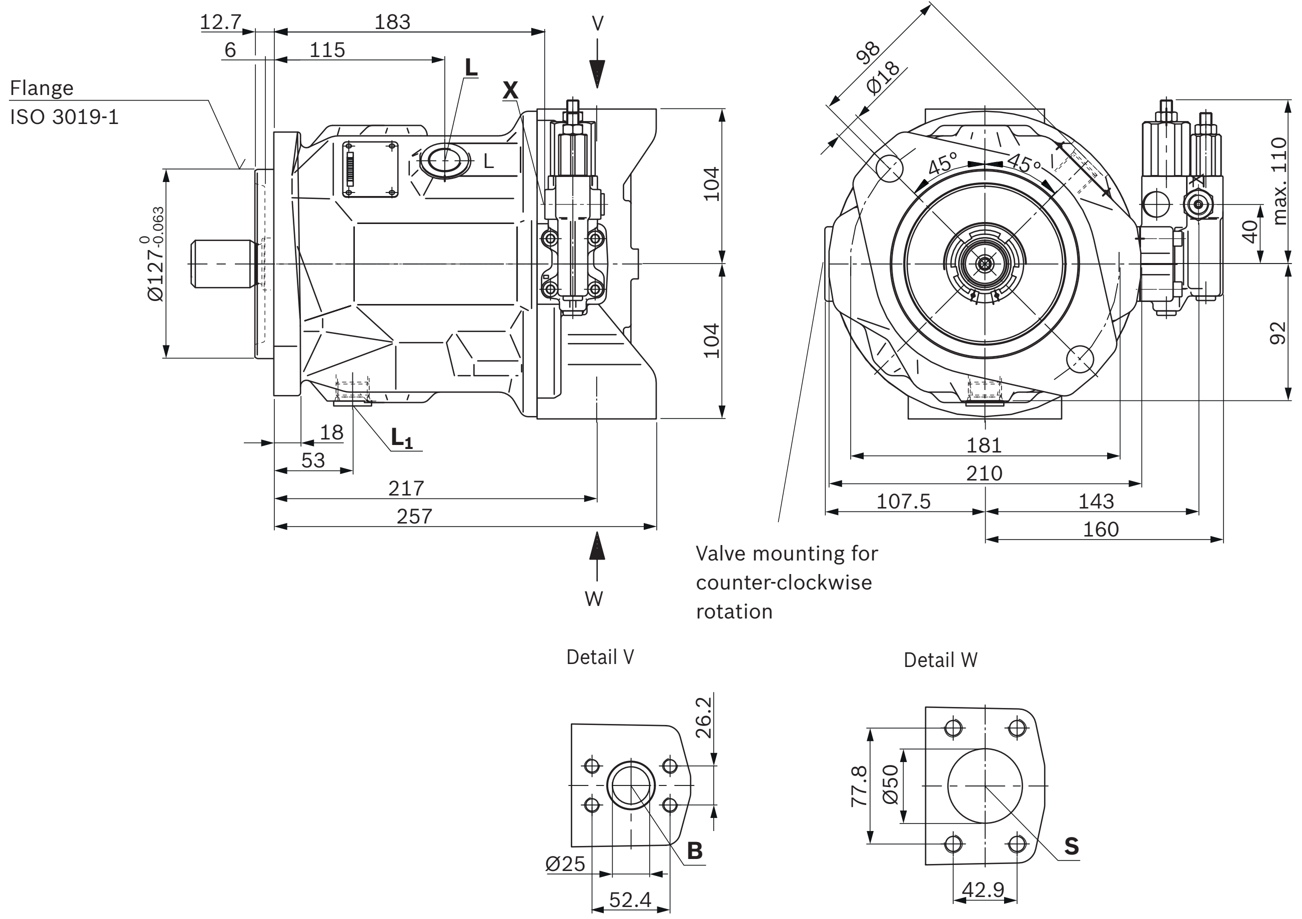
1) ER7. 180.5 mm if using an intermediate plate pressure controller

2) To mounting flange

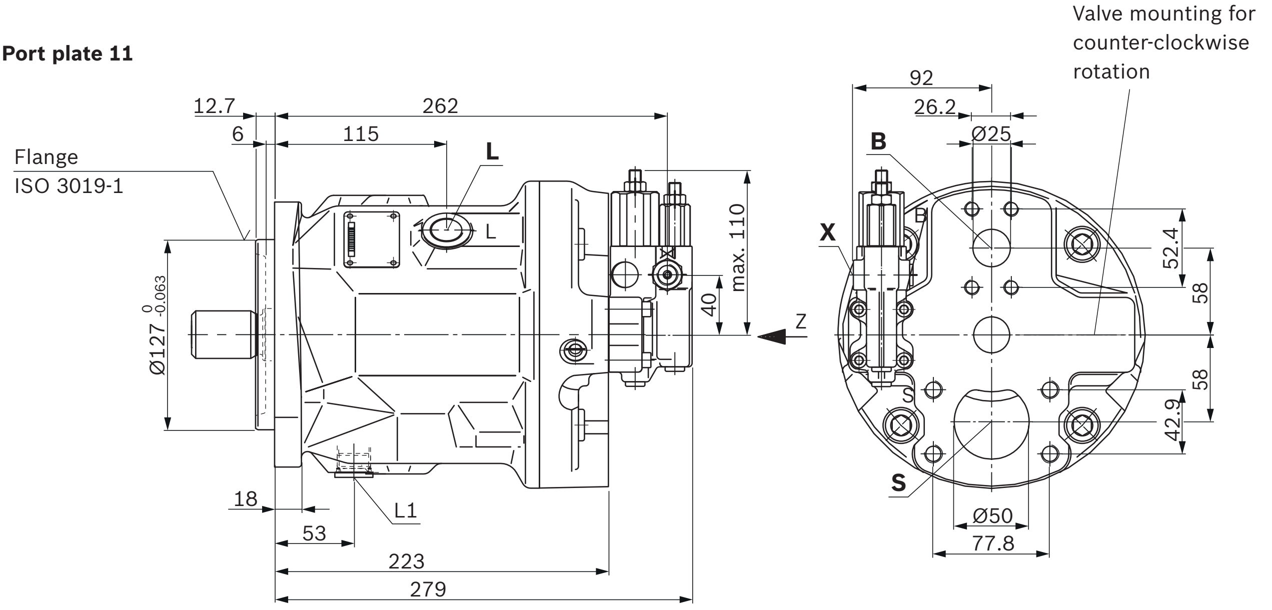
Dimensions size 71

DRF, DRS, DRSC – Pressure and flow control, port plate 11 and 12; mounting flange C (SAE-C; 127-2)

▼ **Port plate 12**

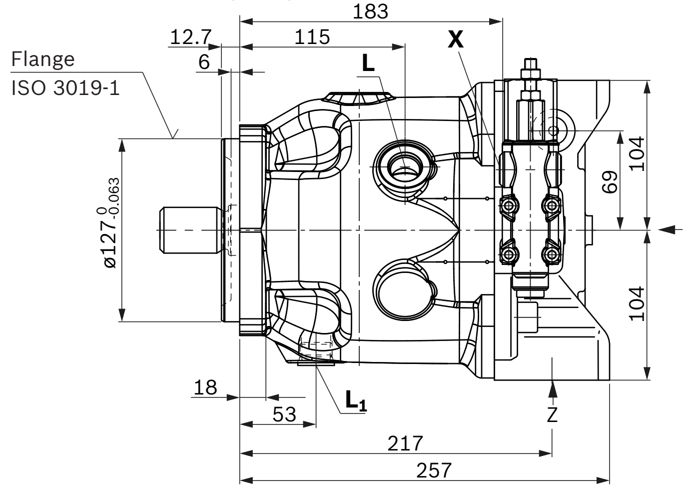


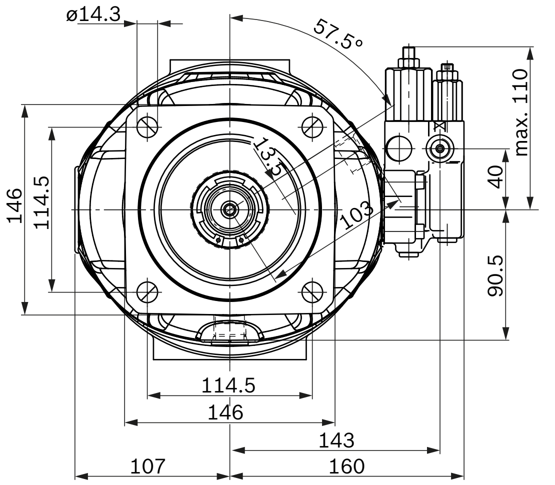
▼ **Port plate 11**

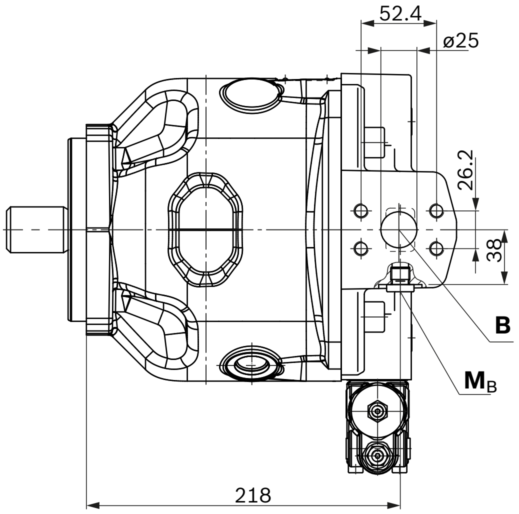


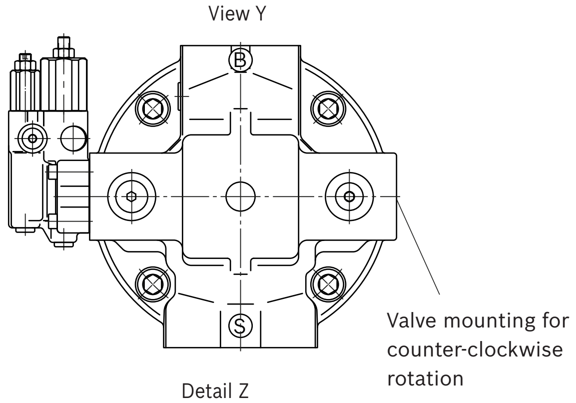
DRF, DRS, DRSC – Pressure and flow control, port plate 12; mounting flange D (SAE-C; 127-4) and U (SAE-D; 152-4)

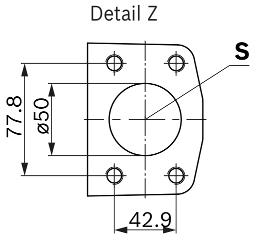
▼ **Port plate 12; mounting flange D**



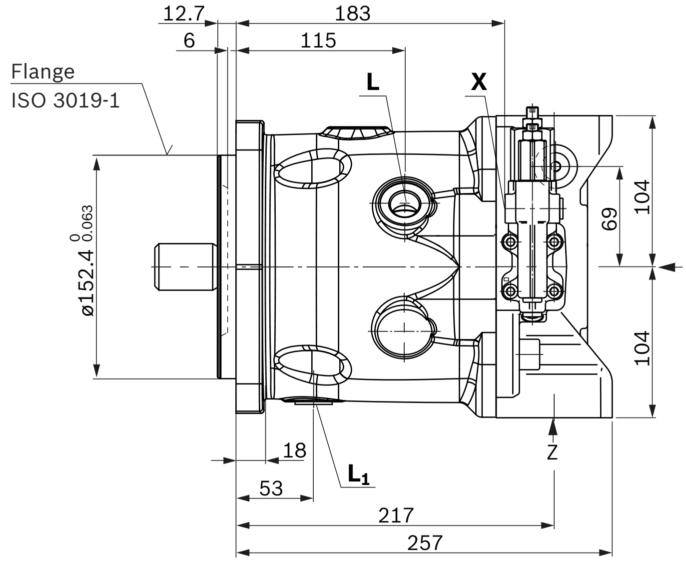


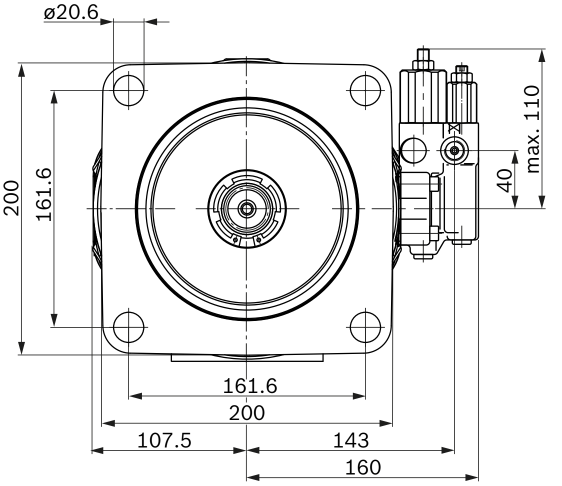






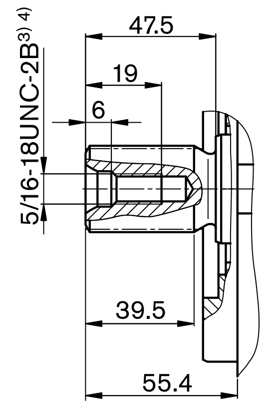
▼ **Port plate 12; mounting flange U**





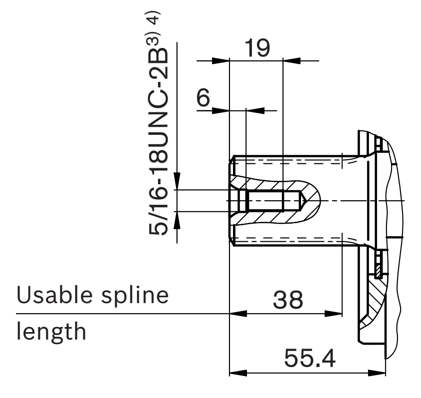
▼ **Splined shaft 1 1/4 in (SAE J744)**

S – 14T 12/24DP[1)]



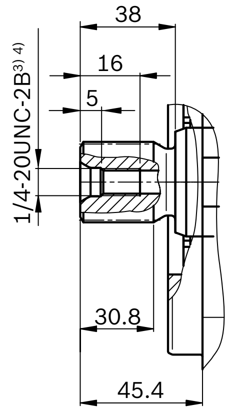
▼ **Splined shaft 1 1/4 in (SAE J744)**

R – 14T 12/24DP[1)2)]



▼ **Splined shaft 1 in (SAE J744)**

U – 15T 16/32DP[1)]



Ports		**Standard**	**Size**[4)]	$p_{\text{max abs}}$ **[bar]**[5)]	**State**[9)]
B	Working port (standard pressure series) Fastening thread	SAE J518[6)] DIN 13	1 in M10 x 1.5, 17 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6)] DIN 13	2 in M12 x 1.75; 20 deep	10	O
L	Drain port	ISO 11926[7)]	7/8-14 UNF-2B; 12 deep	2	O[8)]
L_1	Drain port	ISO 11926[7)]	7/8-14 UNF-2B; 12 deep	2	X[8)]
X	Pilot pressure	ISO 11926	7/16-20 UNF-2B; 12 deep	350	O
M_B	Measuring pressure B	DIN 3852-2[7)]	G 1/4 in; 12 deep	350	X

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) For notes on tightening torques, see the instruction manual.

5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

6) Metric fastening thread is a deviation from standard.

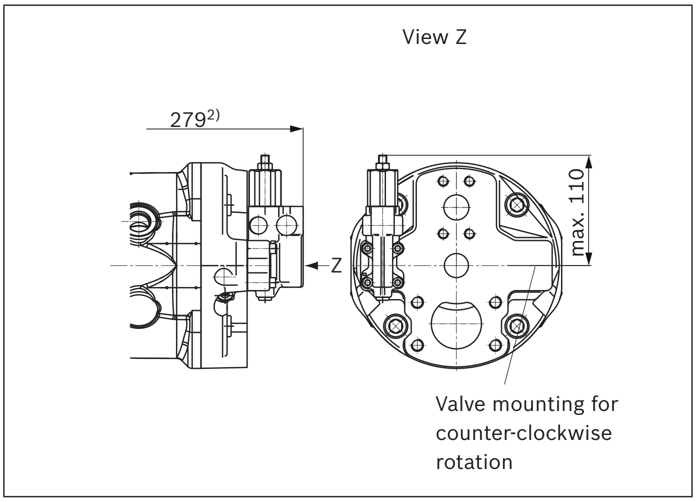
7) The countersink can be deeper than as specified in the standard.

8) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 51).

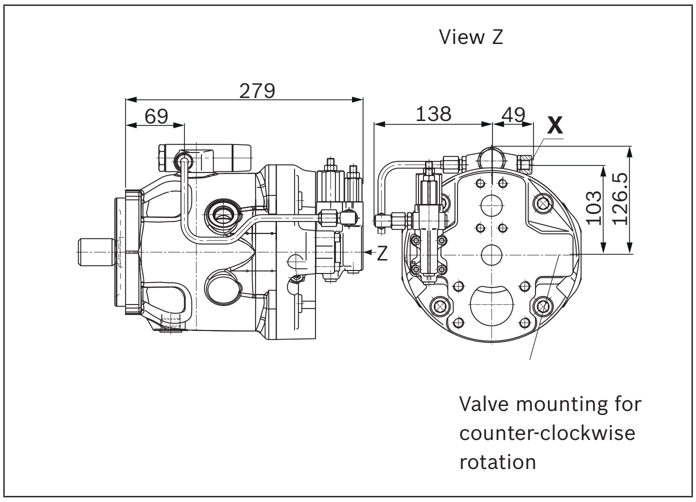
9) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

Port plate 11

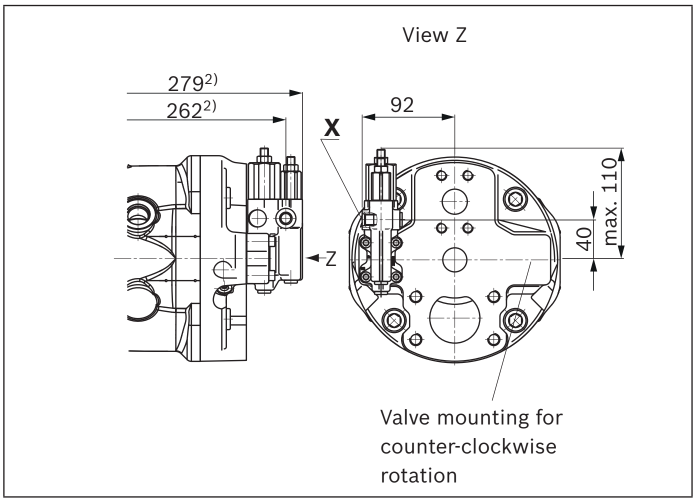
▼ DR – Pressure controller



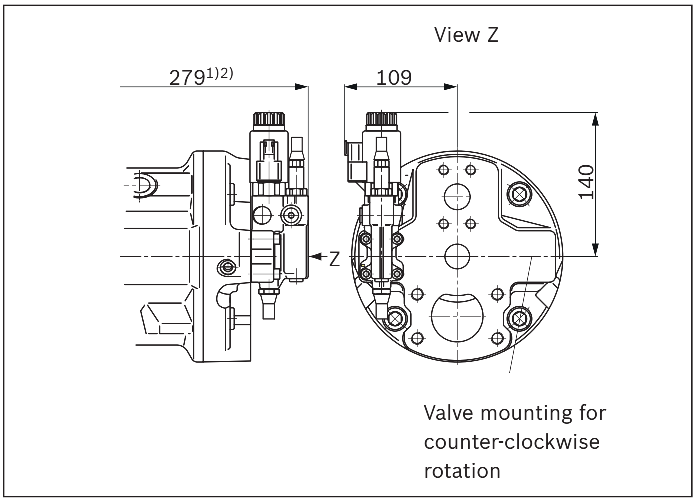
▼ LA.DS – Pressure, flow and power controller



▼ DRG – Pressure controller, remotely controlled



▼ ED7./ER7. – Pressure controller, electrical



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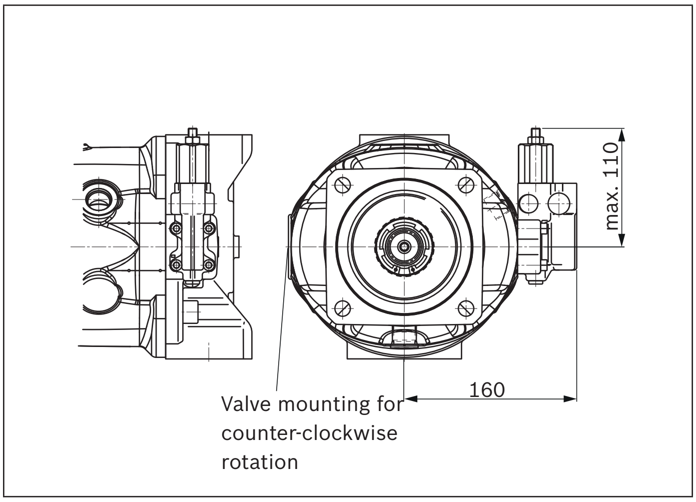
1) ER7. 314 mm if using an intermediate plate pressure controller

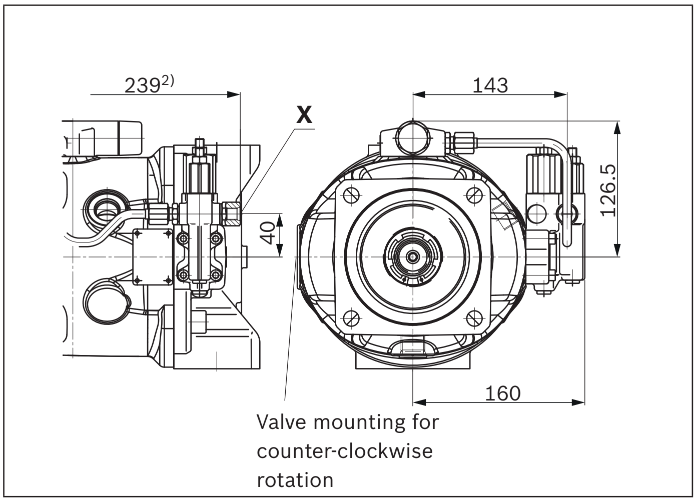
2) To mounting flange

Port plate 12

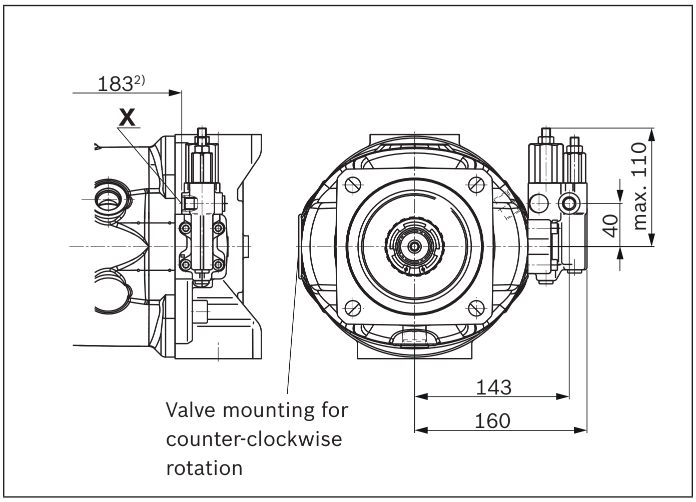
▼ DR – Pressure controller



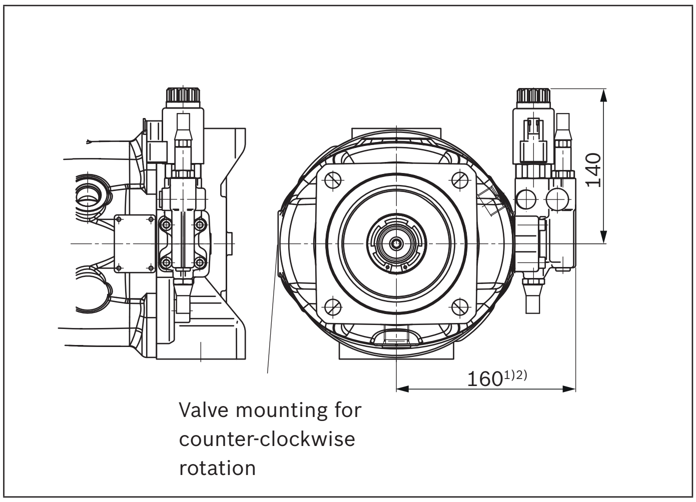
▼ LA.DS – Pressure, flow and power controller



▼ DRG – Pressure controller, remotely controlled



▼ ED7./ER7. – Pressure controller, electrical



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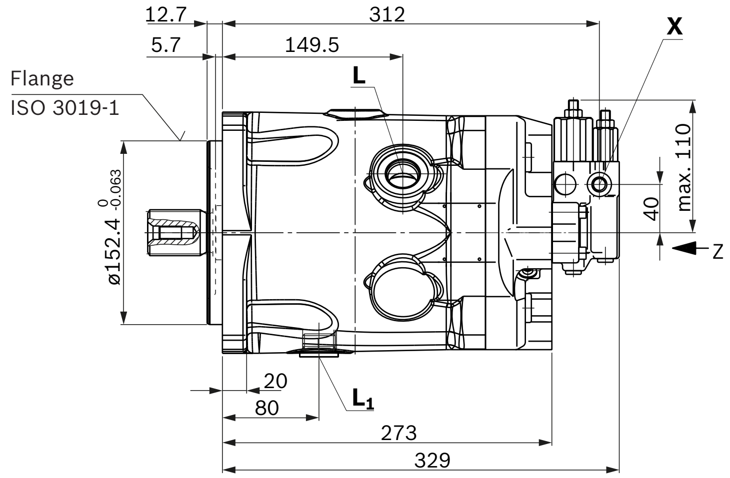
1) ER7. 195 mm if using an intermediate plate pressure controller

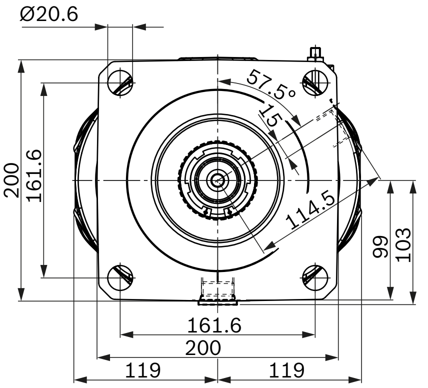
2) To mounting flange

Dimensions size 100

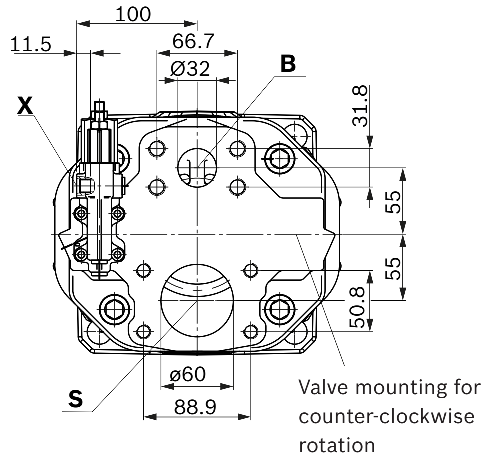
DRF, DRS, DRSC – Pressure and flow control, port plate 11, 12; mounting flange C (SAE-C; 127-2), D (SAE-D; 152-4)

▼ **Port plate 11; mounting flange D**

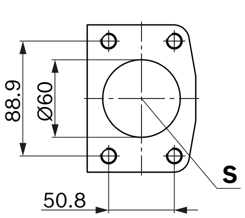




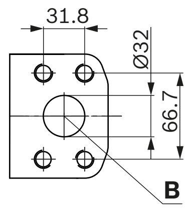
View Z



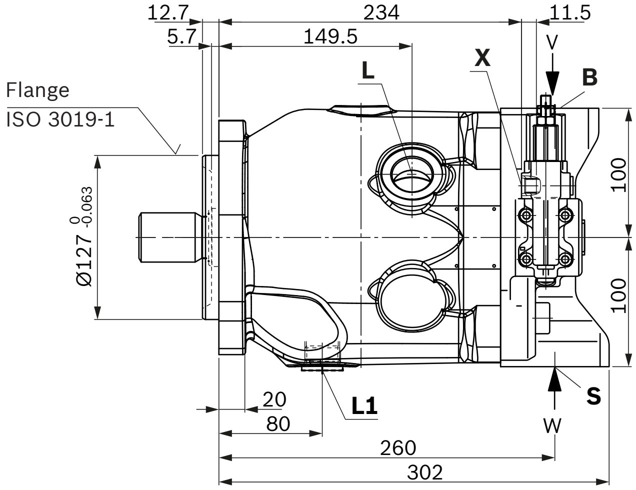
Detail W

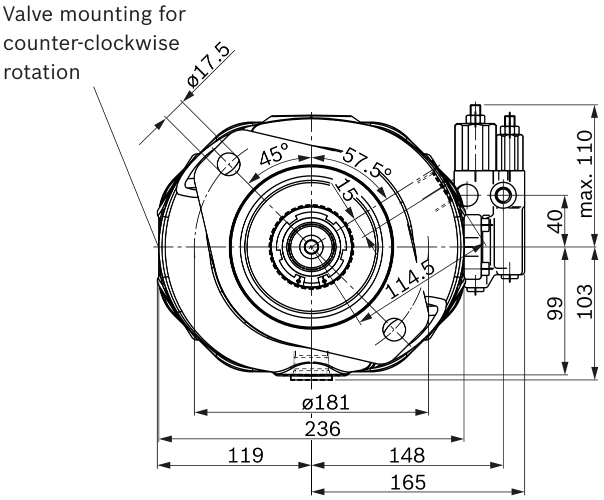


Detail V



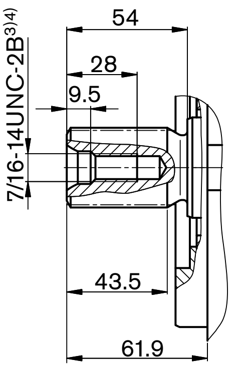
▼ **Port plate 12; mounting flange C**





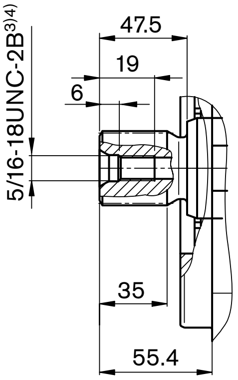
▼ Splined shaft 1 1/2 in (SAE J744)

S – 17T 12/24DP[1]



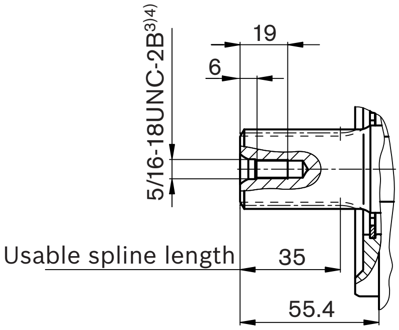
▼ Splined shaft 1 1/4 in (SAE J744)

U – 14T 12/24DP[1]



▼ Splined shaft 1 1/4 in (SAE J744)

W – 14T 12/24DP[1][2]



Ports		**Standard**	**Size**[4]	$p_{\max\ \text{abs}}$ **[bar]**[5]	**State**[9]
B	Working port (high-pressure series) Fastening thread	SAE J518[6] DIN 13	1 1/4 in M14 x 2; 19 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	2 1/2 in M12 x 1.75; 17 deep	10	O
L	Drain port	ISO 11926[7]	1 1/16-12 UNF-2B; 15 deep	2	O[8]
L_1	Drain port	ISO 11926[7]	1 1/16-12 UNF-2B; 15 deep	2	X[8]
X	Pilot pressure	ISO 11926	7/16-20 UNF; 12 deep	350	O
M_B	Measuring pressure B	DIN 3852-2[7]	G 1/4 in; 12 deep	350	X

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) For notes on tightening torques, see the instruction manual.

5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

6) Metric fastening thread is a deviation from standard.

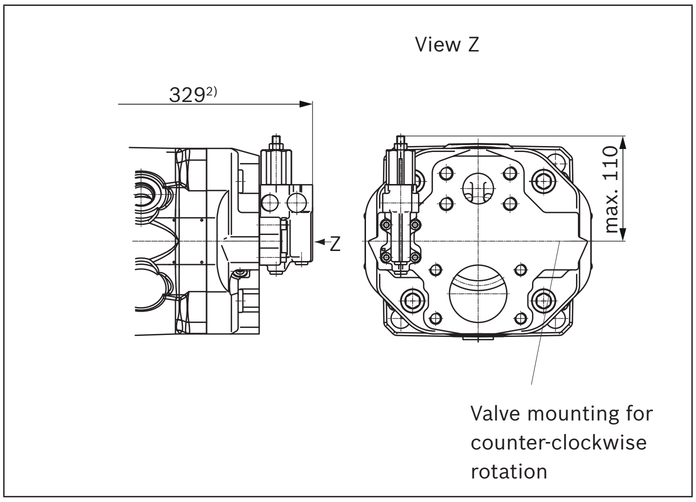
7) The countersink can be deeper than as specified in the standard.

8) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 51).

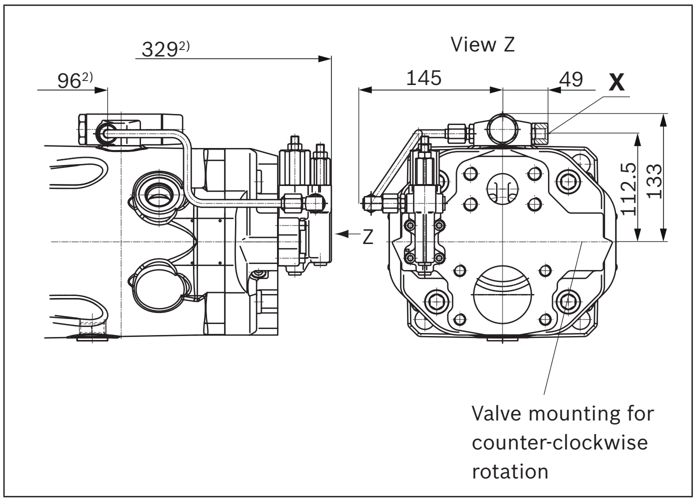
9) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

Port plate 11

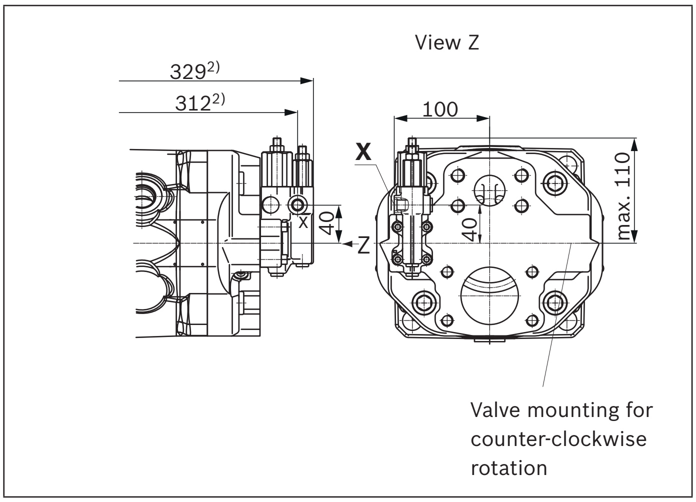
▼ DR – Pressure controller



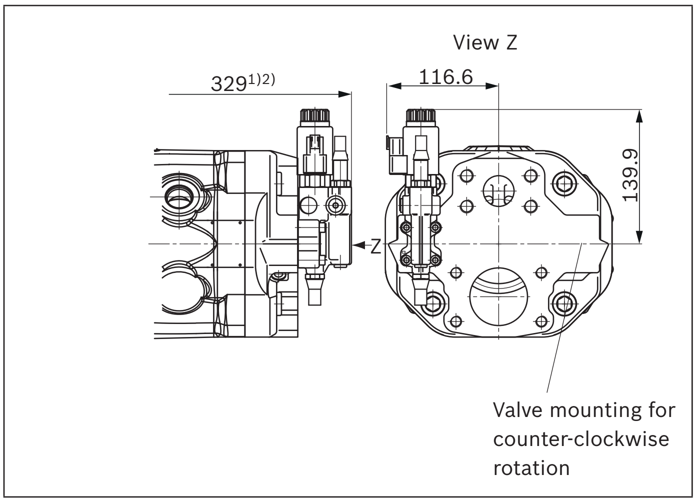
▼ LA.DS – Pressure, flow and power controller



▼ DRG – Pressure controller, remotely controlled



▼ ED7./ER7. – Pressure controller, electrical



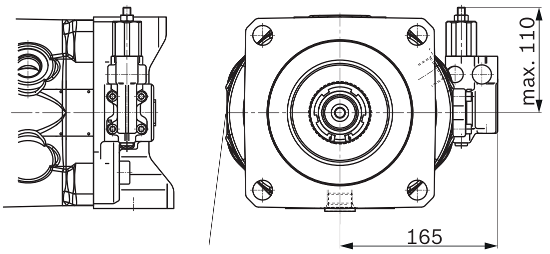
---

1) ER7. 364 mm if using an intermediate plate pressure controller

2) To mounting flange

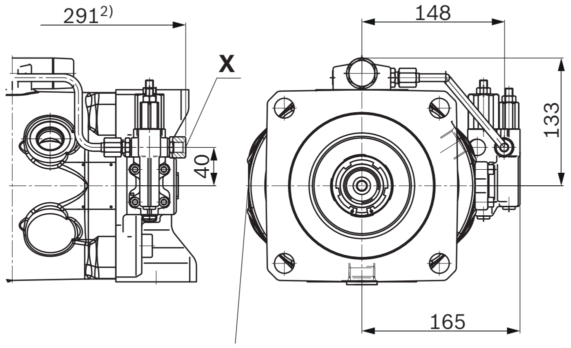
Port plate 12

▼ DR – Pressure controller



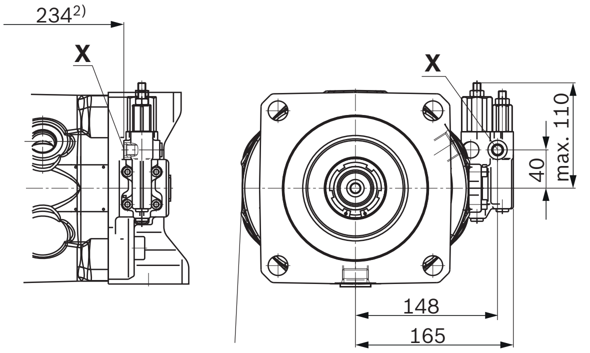
Valve mounting for
counter-clockwise
rotation

▼ LA.DS – Pressure, flow and power controller



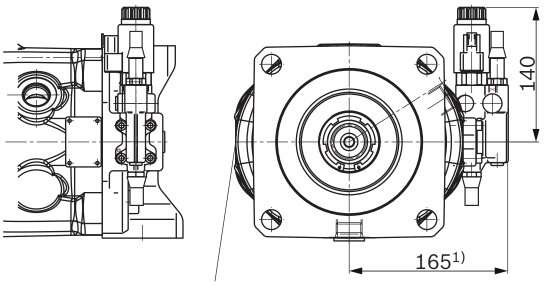
Valve mounting for
counter-clockwise
rotation

▼ DRG – Pressure controller, remotely controlled



Valve mounting for
counter-clockwise
rotation

▼ ED7./ER7. – Pressure controller, electrical



Valve mounting for
counter-clockwise
rotation

---

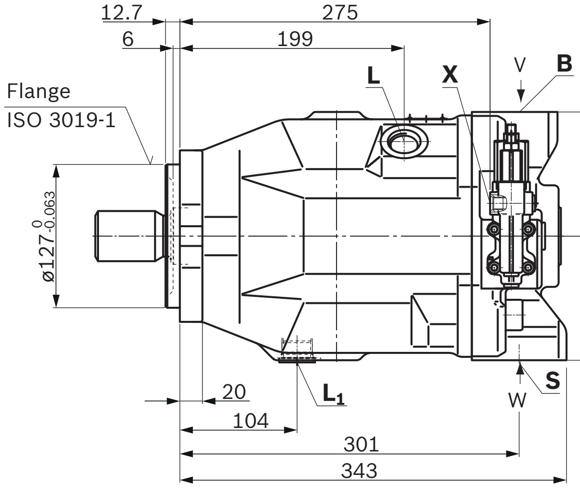
1) ER7. 200 mm if using an intermediate plate pressure controller

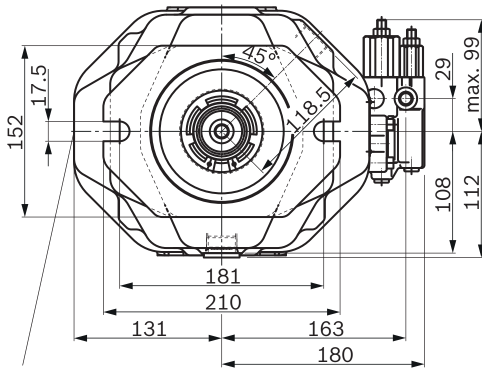
2) To mounting flange

Dimensions size 140

DRF, DRS, DRSC – Pressure and flow control, port plate 11 and 12; mounting flange C (SAE-C; 127-2)

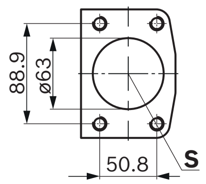
▼ Port plate 12; mounting flange C



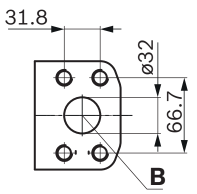


Valve mounting for
counter-clockwise
rotation

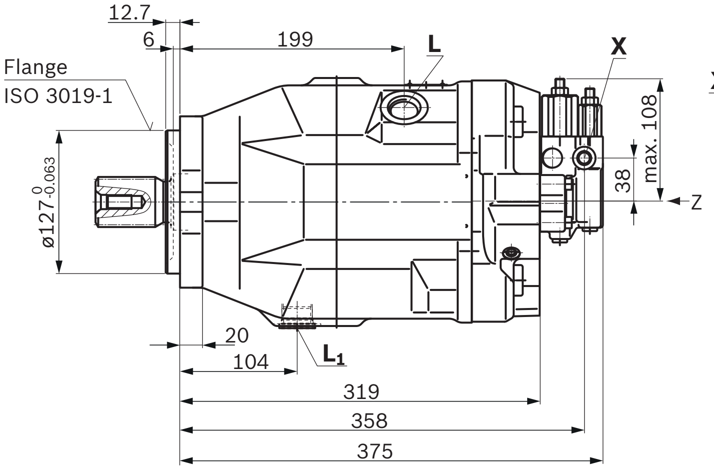
Detail W

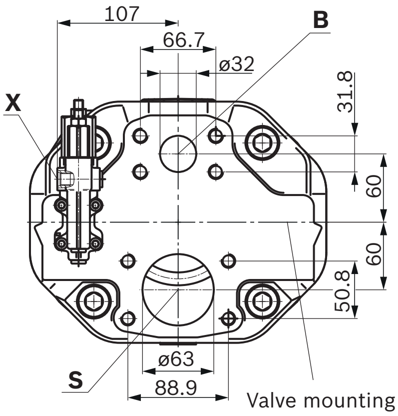


Detail V



▼ Port plate 11; mounting flange C

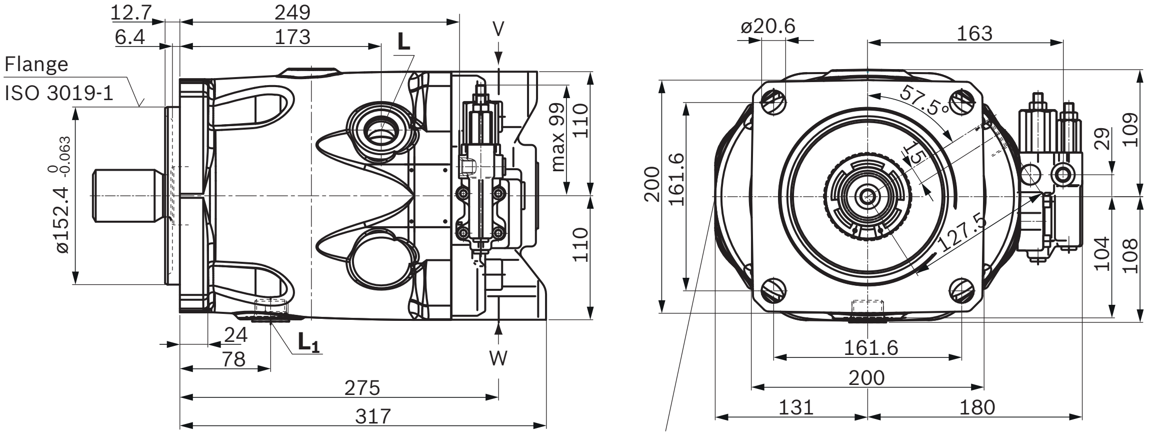




Valve mounting for
counter-clockwise
rotation

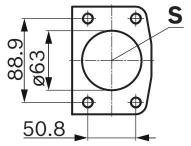
DRF, DRS, DRSC – Pressure and flow control, port plate 11 and 12; mounting flange D (SAE-D; 152-4)

▼ **Port plate 12; mounting flange D**

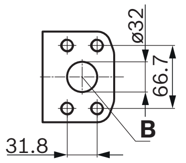


Valve mounting for counter-clockwise rotation

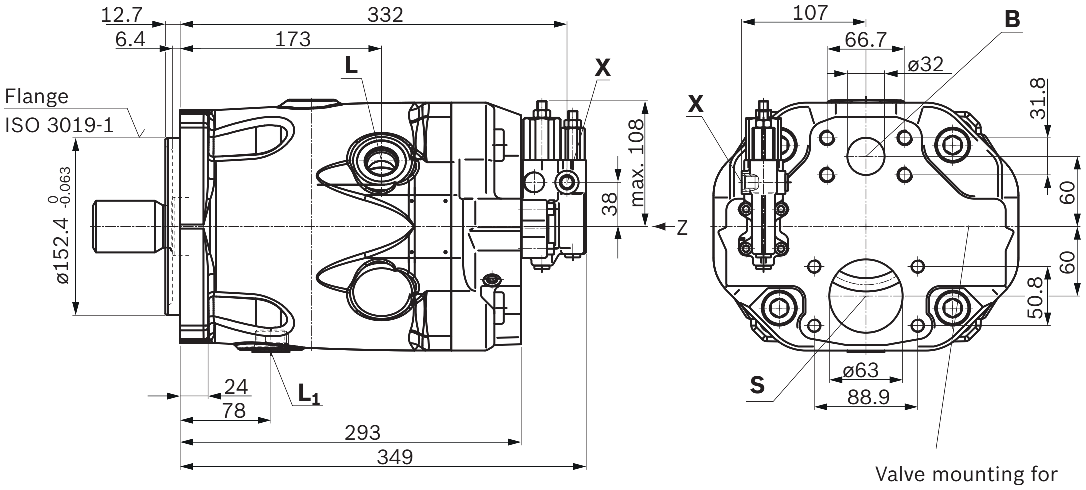
Detail W



Detail V



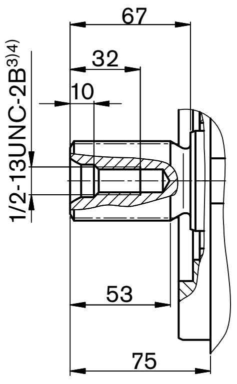
▼ **Port plate 11; mounting flange D**



Valve mounting for counter-clockwise rotation

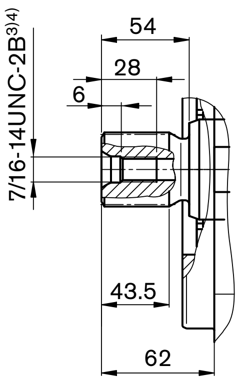
▼ Splined shaft 1 3/4 in SAE J744

S – 13T 8/16DP[1]



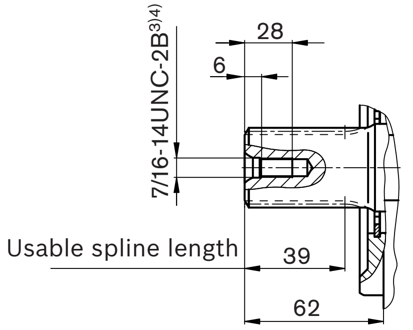
▼ Splined shaft 1 1/2 in SAE J744

U – 17T 12/24DP[1]



▼ Splined shaft 1 1/2 in SAE J744

W – 17T 12/24DP[1][2]



Ports		Standard	Size[4]	$p_{\text{max abs}}$ **[bar]**[5]	State[9]
B	Working port (high-pressure series) Fastening thread	SAE J518[6] DIN 13	1 1/4 in M14 x 2; 19 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	2 1/2 in M12 x 1.75; 17 deep	10	O
L	Drain port	ISO 11926[7]	1 1/16-12 UNF-2B; 15 deep	2	O[8]
L_1	Drain port	ISO 11926[7]	1 1/16-12 UNF-2B; 15 deep	2	X[8]
X	Pilot pressure	ISO 11926	7/16-20 UNF-2B; 12 deep	350	O
M_B	Measuring pressure B	DIN 3852-2[7]	G 1/4 in; 12 deep	350	X

---

[1] Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

[3] Thread according to ASME B1.1

[4] For notes on tightening torques, see the instruction manual

[5] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

[6] Metric fastening thread is a deviation from standard.

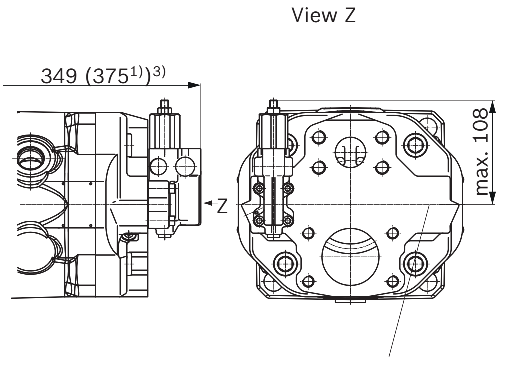
[7] The countersink can be deeper than as specified in the standard.

[8] Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 51).

[9] O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

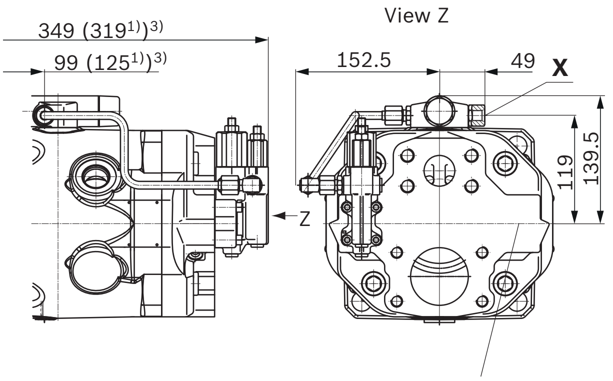
Port plate 11

▼ DR – Pressure controller; mounting flange D



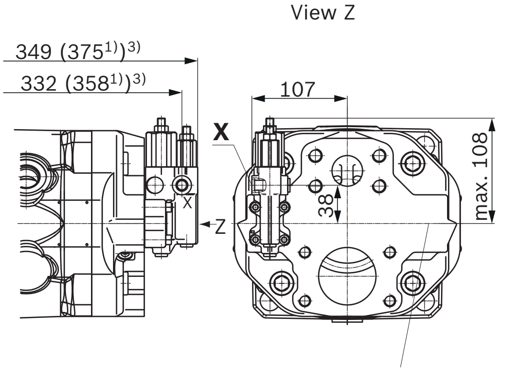
Valve mounting for counter-clockwise rotation

▼ LA.DS – Pressure, flow and power controller; mounting flange D



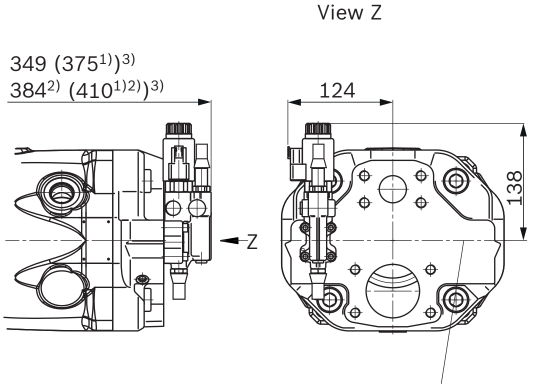
Valve mounting for counter-clockwise rotation

▼ DRG – Pressure controller, remotely controlled; mounting flange D



Valve mounting for counter-clockwise rotation

▼ ED7./ER7. – Pressure controller, electric; mounting flange D



Valve mounting for counter-clockwise rotation

---

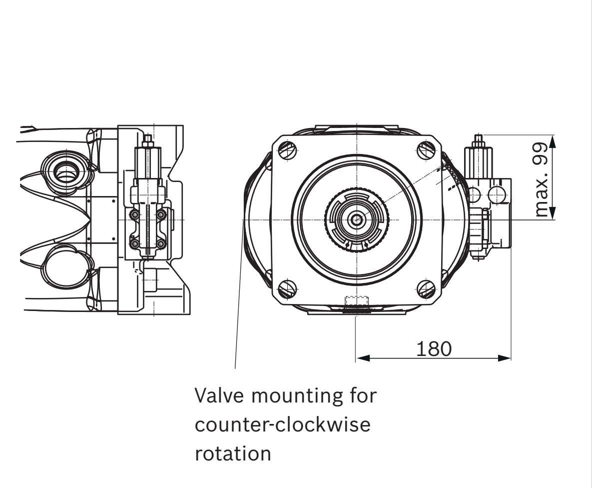
[1] Dimension of mounting flange C

[2] ER7. If using an intermediate plate pressure controller

[3] To mounting flange

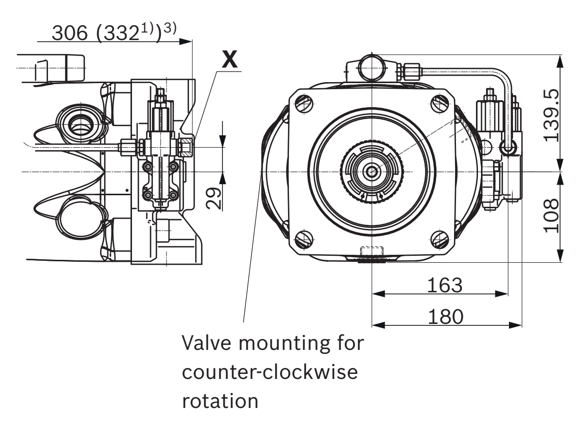
Port plate 12

▼ DR – Pressure controller; mounting flange D



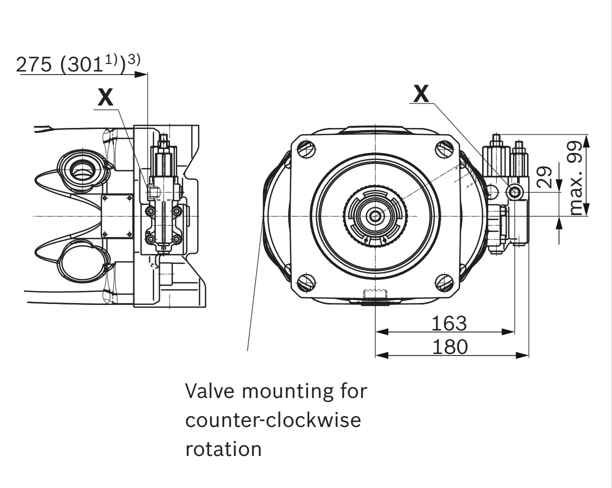
Valve mounting for counter-clockwise rotation

▼ LA.DS – Pressure, flow and power controller; mounting flange D



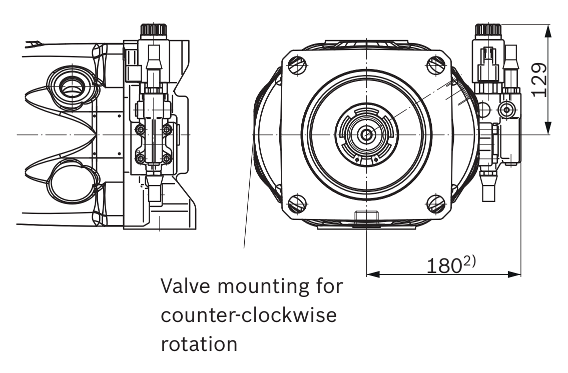
Valve mounting for counter-clockwise rotation

▼ DRG – Pressure controller, remotely controlled; mounting flange D



Valve mounting for counter-clockwise rotation

▼ ED7./ER7. – Pressure controller, electric; mounting flange D



Valve mounting for counter-clockwise rotation

---

1) Dimension of mounting flange C

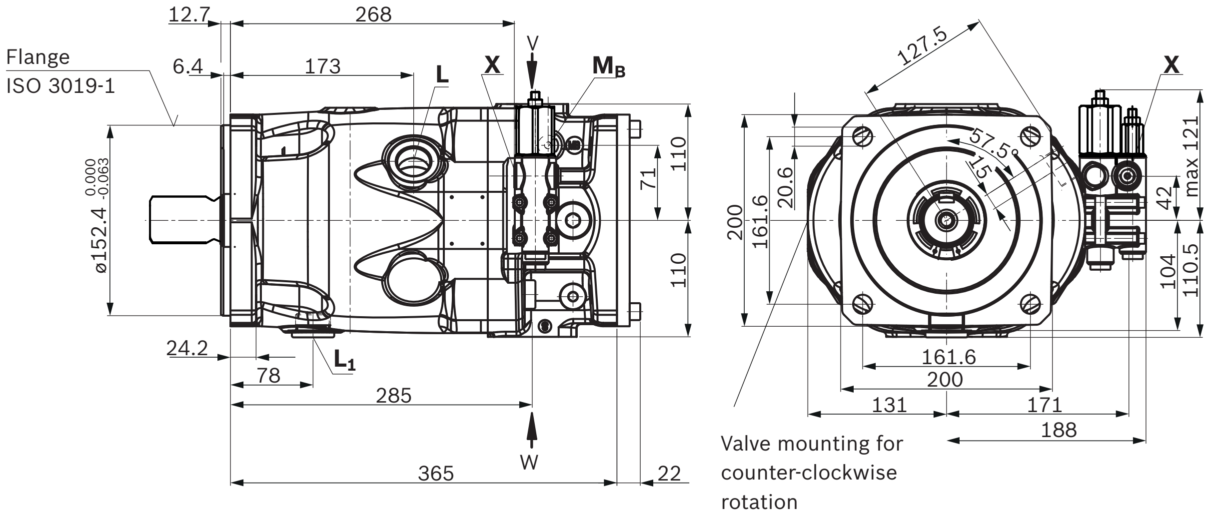
2) ER7. 215 mm if using an intermediate plate pressure controller

3) To mounting flange

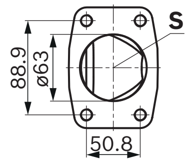
Dimensions size 180

DRF, DRS, DRSC – Pressure and flow control, port plate 11, 22 and 32; mounting flange D (SAE-D; 152-4)

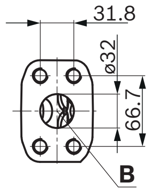
▼ **Port plate 22 and 32**



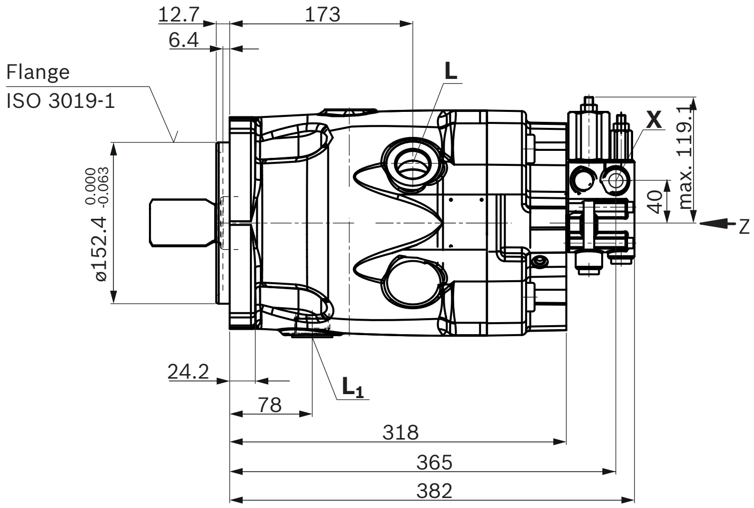
Detail W



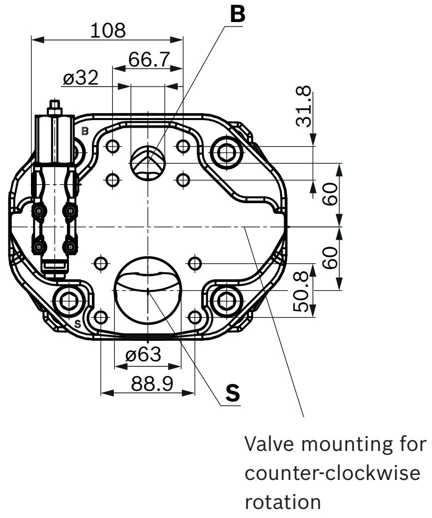
Detail X



▼ **Port plate 11**

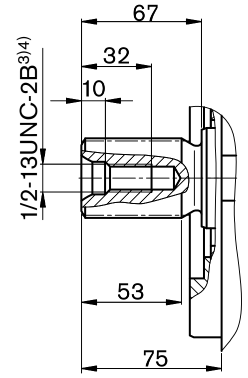


View Z



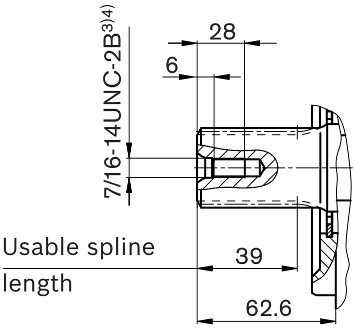
▼ Splined shaft 1 3/4 in SAE J744

S – 13T 8/16DP[1]



▼ Splined shaft 1 1/2 in SAE J744

W – 17T 12/24DP[1][2]



Ports		Standard	Size[4]	$p_{\text{max abs}}$ **[bar]**[5]	State[9]
B	Working port (high-pressure series) Fastening thread	SAE J518[6] DIN 13	1 1/4 in M14 x 2; 19 deep	350	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	2 1/2 in M12 x 1.75; 17 deep	10	O
L	Drain port	ISO 11926[7]	1 5/16-12 UN-2B; 15 deep	2	O[8]
L$_1$	Drain port	ISO 11926[7]	1 5/16-12 UN-2B; 15 deep	2	X[8]
X	Pilot pressure	ISO 11926	7/16-20 UNF-2B; 12 deep	350	O
M$_B$	Measuring pressure B	DIN 3852-2[7]	G 1/4 in; 12 deep	350	X

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) For notes on tightening torques, see the instruction manual

5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

6) Metric fastening thread is a deviation from standard.

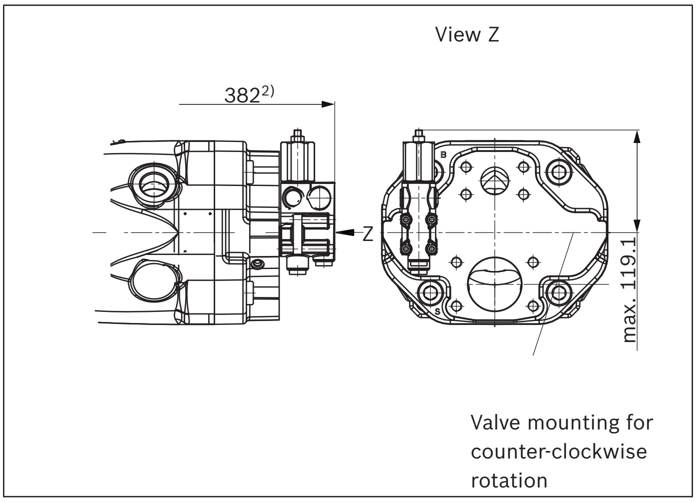
7) The countersink can be deeper than as specified in the standard.

8) Depending on the installation position, L or L$_1$ must be connected (also see installation instructions starting on page 51).

9) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

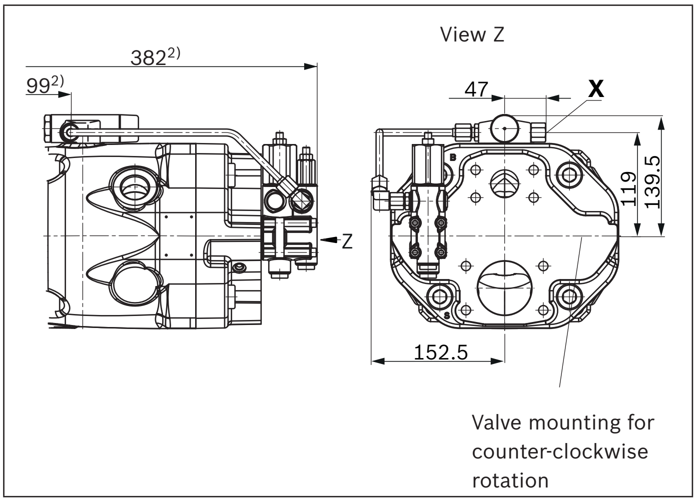
Port plate 11

▼ DR – Pressure controller



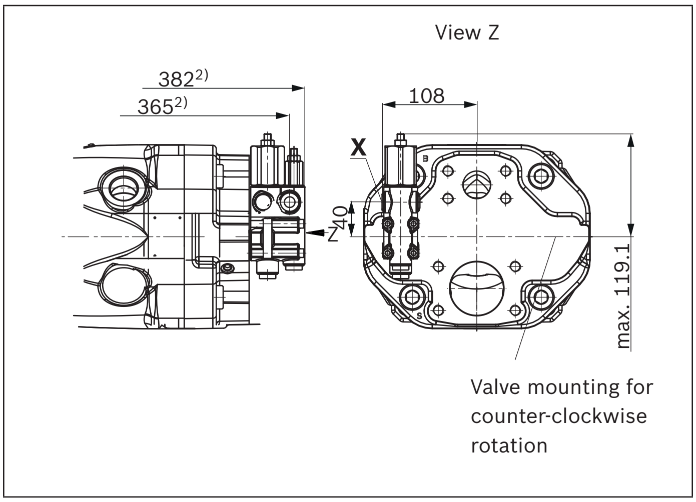
Valve mounting for counter-clockwise rotation

▼ LA.DS – Pressure, flow and power controller



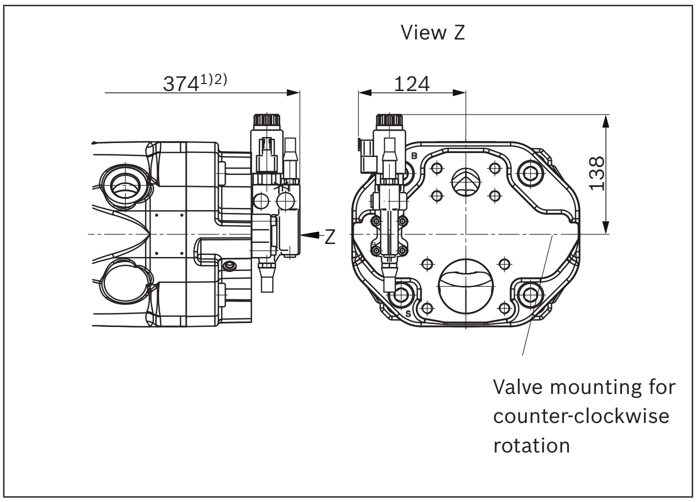
Valve mounting for counter-clockwise rotation

▼ DRG – Pressure controller, remotely controlled



Valve mounting for counter-clockwise rotation

▼ ED7./ER7. – Pressure controller, electrical



Valve mounting for counter-clockwise rotation

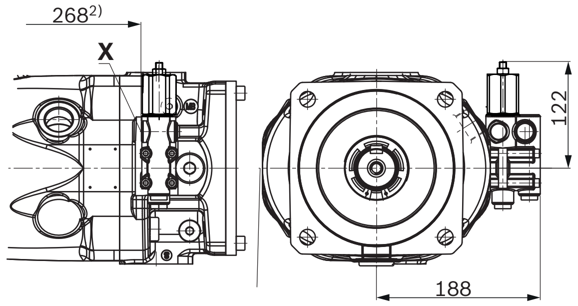
---

1) ER7. 409 mm if using an intermediate plate pressure controller

2) To mounting flange

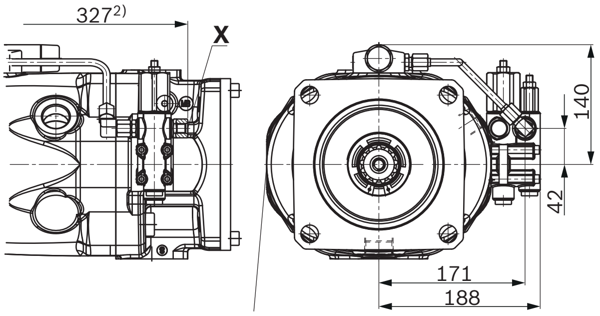
Port plate 22 and 32

▼ DR – Pressure controller



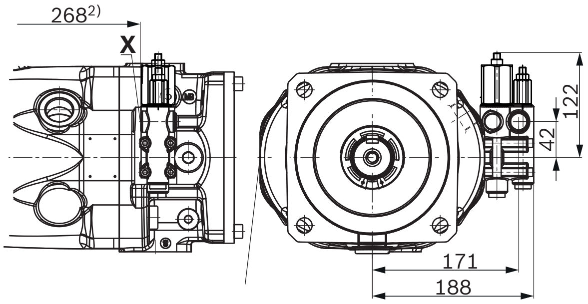
Valve mounting for
counter-clockwise
rotation

▼ LA.DS – Pressure, flow and power controller



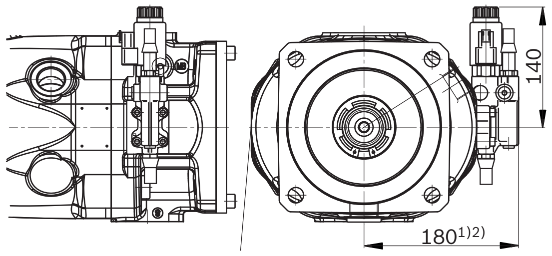
Valve mounting for
counter-clockwise
rotation

▼ DRG – Pressure controller, remotely controlled



Valve mounting for
counter-clockwise
rotation

▼ ED7./ER7. – Pressure controller, electrical



Valve mounting for
counter-clockwise
rotation

---

1) ER7. 215 mm if using an intermediate plate pressure controller

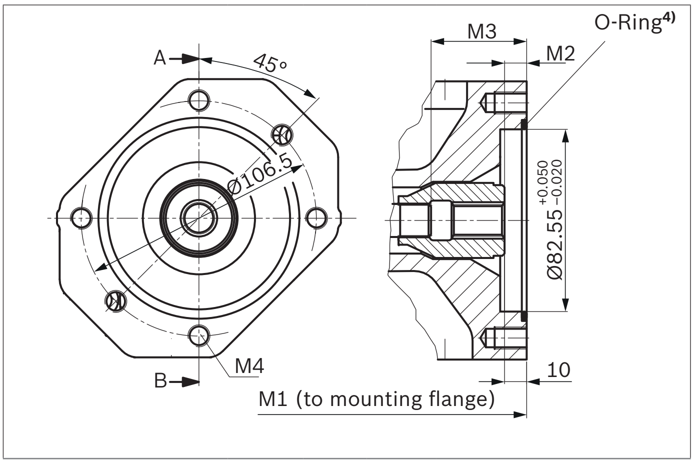
2) To mounting flange

Dimensions, through drives

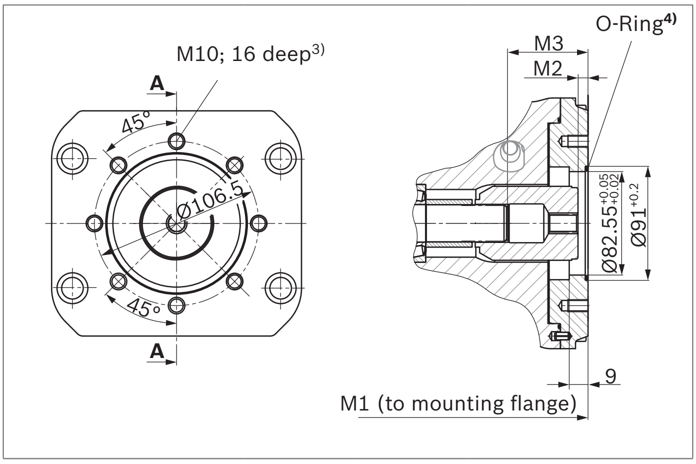
Flange ISO 3019-1 (SAE J744)		**Hub for splined shaft**[1]		**Availability over sizes**					**Code**
Diameter	**Attachment**[2]	**Diameter**		**45**	**71**	**100**	**140**	**180**	
82-2 (A)	⚬|⚬, ⚬/⚬, ⚬–⚬	5/8 in	9T 16/32DP	●	●	●	●	–	K01
	⚬|⚬, ⚬/⚬, ⚬–⚬	5/8 in	9T 16/32DP	○	○	○	○	●	U01

● = Available ○ = On request – = Not available

▼ 82-2 (A)



▼ 82-2 (A)



K01 (SAE J744 16-4 (A))	**NG**	**M1**	**M2**	**M3**	**M4**
	45	229	10.7	53.4	M10 × 1.5; 16 deep
	71	267	11.8	61.3	M10 × 1.5; 20 deep
	100	338	10.5	65	M10 × 1.5; 16 deep
	140[5]	350	10.8	77.3	M10 × 1.5; 16 deep
	140[6]	376			

U01 (SAE J744 16-4 (A))	**NG**	**M1**	**M2**	**M3**
	180	387	On request	

---

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Mounting through bores pattern viewed from through drive with control at top

3) Thread according to DIN 13, observe the instructions in the instruction manual for the maximum tightening torques.

4) O-ring included in the scope of delivery

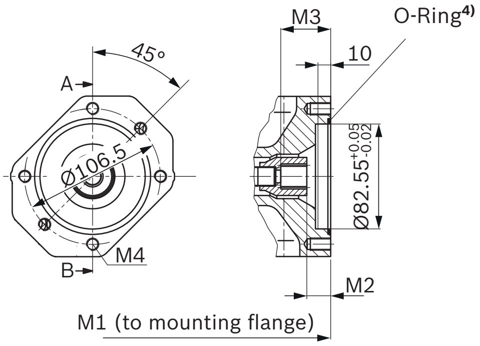
5) With D-flange

6) With C-flange

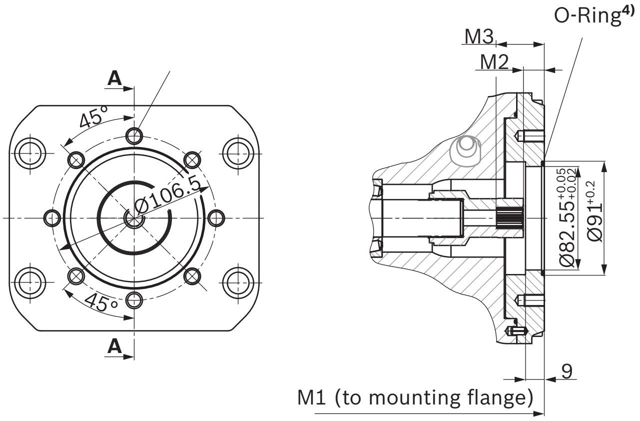
Flange ISO 3019-1 (SAE J744)		Hub for splined shaft[1]		Availability over sizes					Code
Diameter	Attachment[2]	Diameter		45	71	100	140	180	
82-2 (A)	o|o, o/o, o–o	3/4 in	11T 16/32DP	●	●	●	●	–	K52
	o|o, o/o, o–o	3/4 in	11T 16/32DP	○	○	○	○	●	U52

● = Available ○ = On request – = Not available

▼ 82-2 (A)



▼ 82-2 (A)



K52 (SAE J744 19-4 (A-B))	NG	M1	M2	M3	M4
	45	229	18.9	38.7	M10 × 1.5; 16 deep
	71	267	21.3	41.4	M10 × 1.5; 20 deep
	100	338	19	38.9	M10 × 1.5; 16 deep
	140[5]	350	18.9	38.6	M10 × 1.5; 16 deep
	140[6]	376			

U52 SAE J744 19-4 (A-B))	NG	M1	M2	M3
	180	387	On request	

---

[1] Hub for splined shaft according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Mounting through bores pattern viewed from through drive with control at top

[3] Thread according to DIN 13, observe the instructions in the instruction manual for the maximum tightening torques.

[4] O-ring included in the scope of delivery

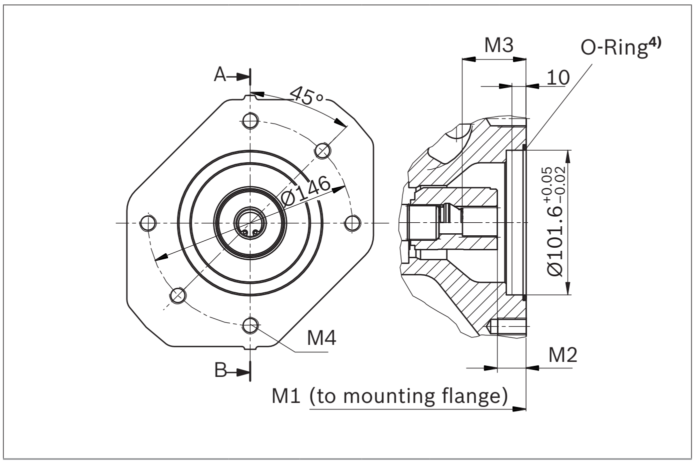
[5] With D-flange

[6] With C-flange

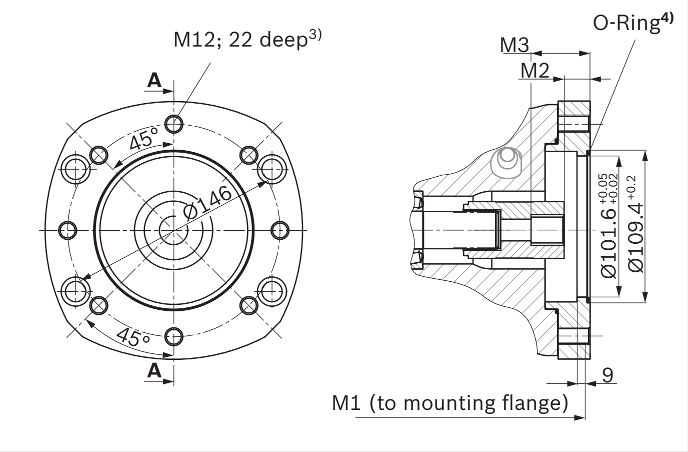
Flange ISO 3019-2 (metric)		Hub for splined shaft[1)]		Availability over sizes					Code
Diameter	**Attachment**[2)]	**Diameter**		**45**	**71**	**100**	**140**	**180**	
101-2 (B)	8, ∘°, ∘∘	7/8 in	13T 16/32DP	●	●	●	●	–	K68
	8, ∘°, ∘∘	7/8 in	13T 16/32DP	○	○	○	○	●	U68

● = Available ○ = On request – = Not available

▼ 101-2



▼ 101-2



K68 (SAE J744 22-4) (B))	NG	M1	M2	M3	M4
	45	229	17.9	41.7	M12 × 1.75; 18 deep
	71	267	20.3	44.1	M12 × 1.75; 20 deep
	100	338	18	41.9	M12 × 1.75; 20 deep
	140[5)]	350	17.8	41.6	M12 × 1.75; 20 deep
	140[6)]	376			

U68 (SAE J744 22-4) (B))	NG	M1	M2	M3
	180	387	18.6	42.4

---

1) Hub for splined shaft according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Mounting through bores pattern viewed from through drive with control at top

3) Thread according to DIN 13, observe the instructions in the instruction manual for the maximum tightening torques.

4) O-ring included in the scope of delivery

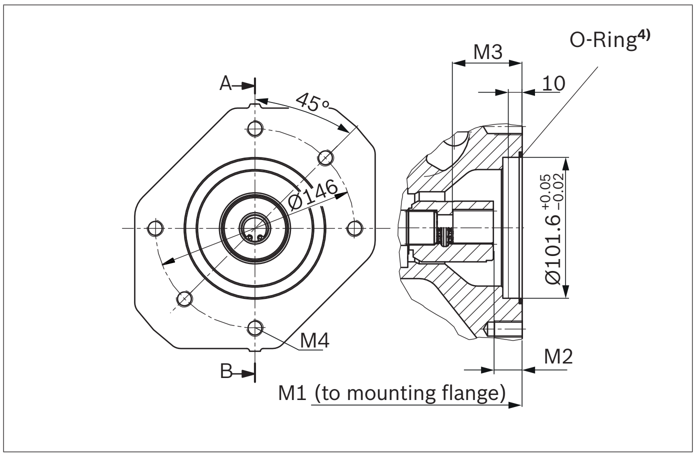
5) With D-flange

6) With C-flange

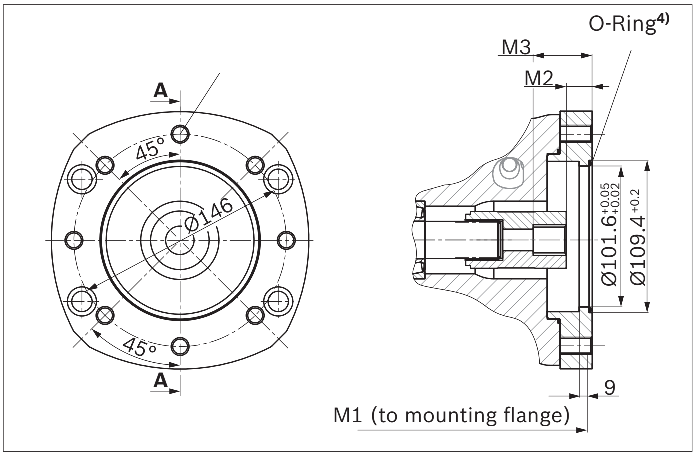
Flange ISO 3019-1 (SAE J744)		Splined shaft[1]		Availability over sizes					Code
Diameter	**Attachment[2]**	**Diameter**		**45**	**71**	**100**	**140**	**180**	
101-2 (B)	o|o, o/o, o-o	1 in	15T 16/32DP	●	●	●	●	-	K04
	o|o, o/o, o-o	1 in	15T 16/32DP	○	○	○	○	●	U04

● = Available ○ = On request – = Not available

▼ **101-2 (B)**



▼ **101-2 (B)**



K04 (SAE J744 25-4 (B-B))	**NG**	**M1**	**M2**	**M3**	**M4**
	45	229	18.4	46.7	M12 × 1.75; 18 deep
	71	267	20.8	49.1	M12 × 1.75; 20 deep
	100	338	18.2	46.6	M12 × 1.75; 20 deep
	140[5]	350	18.3	45.9	M12 × 1.75; 20 deep
	140[6]	376			

U04 (SAE J744 25-4 (B-B))	**NG**	**M1**	**M2**	**M3**
	180	387	On request	

---

1) Hub for splined shaft according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Mounting through bores pattern viewed from through drive with control at top

3) Thread according to DIN 13, observe the instructions in the instruction manual for the maximum tightening torques.

4) O-ring included in the scope of delivery

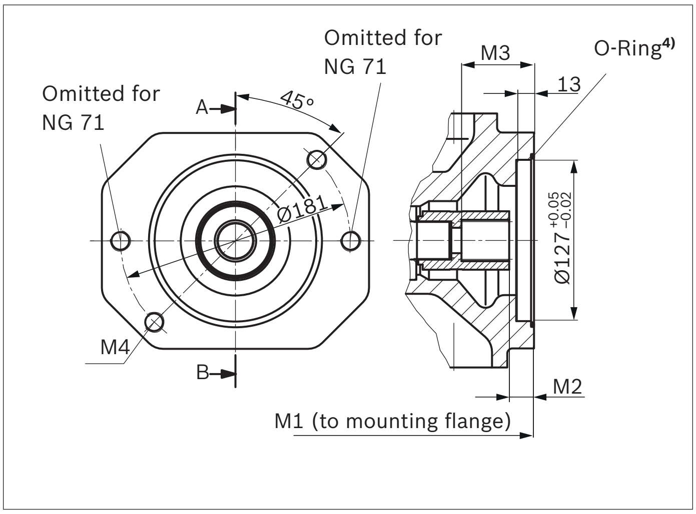
5) With D-flange

6) With C-flange

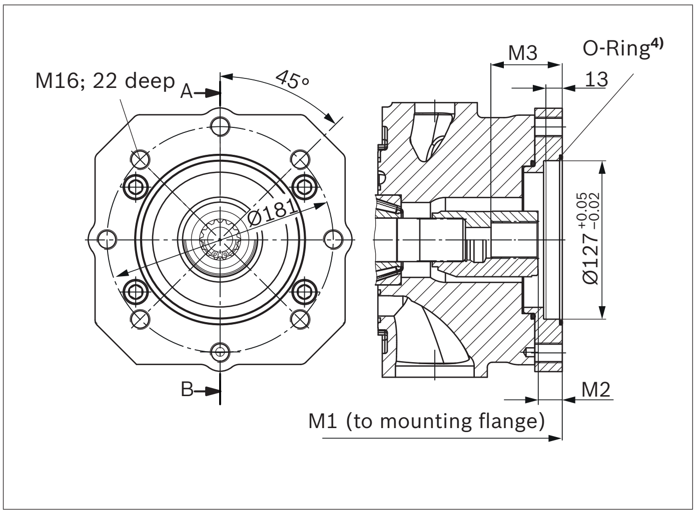
Flange ISO 3019-1 (SAE J744)		Splined shaft[1)]		Availability over sizes					Code
Diameter	**Attachment**[2)]	**Diameter**		**45**	**71**	**100**	**140**	**180**	
127-2 (C)	∘⁄∘, ∘–∘	1 1/4 in	14T 12/24DP	–	●	●	●	–	K07
	∘|∘, ∘⁄∘, ∘–∘	1 1/4 in	14T 12/24DP	–	○	○	○	●	U07

● = Available ○ = On request – = Not available

▼ **127-2 (C)**



▼ **127-2 (C)**



K07 (SAE J744 32-4 (C))	**NG**	**M1**	**M2**	**M3**	**M4**[3)]
	71	267	21.8	58.6	M16 × 2; continuous
	100	338	19.5	56.4	M16 × 2; continuous
	140[5)]	350	19.3	56.1	M16 × 2; 24 deep
	140[6)]	376			

U07 (SAE J744 32-4 (C))	**NG**	**M1**	**M2**	**M3**
	180	387	18.9	56.1

---

1) Hub for splined shaft according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Mounting through bores pattern viewed from through drive with control at top

3) Thread according to DIN 13, observe the instructions in the instruction manual for the maximum tightening torques.

4) O-ring included in the scope of delivery

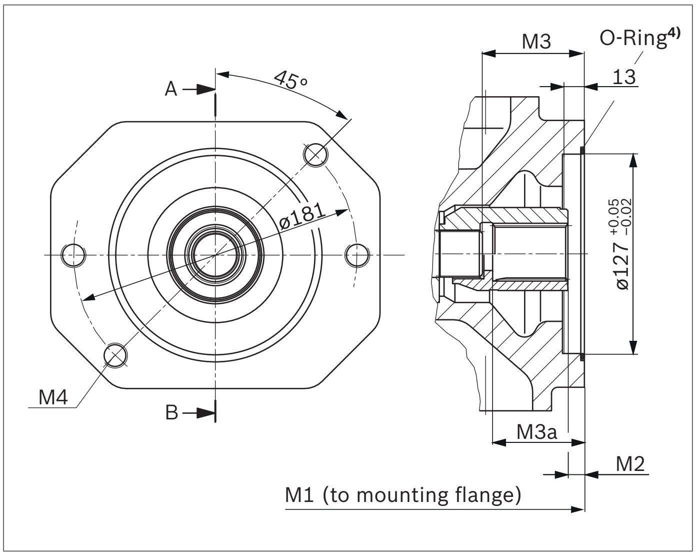
5) With D-flange

6) With C-flange

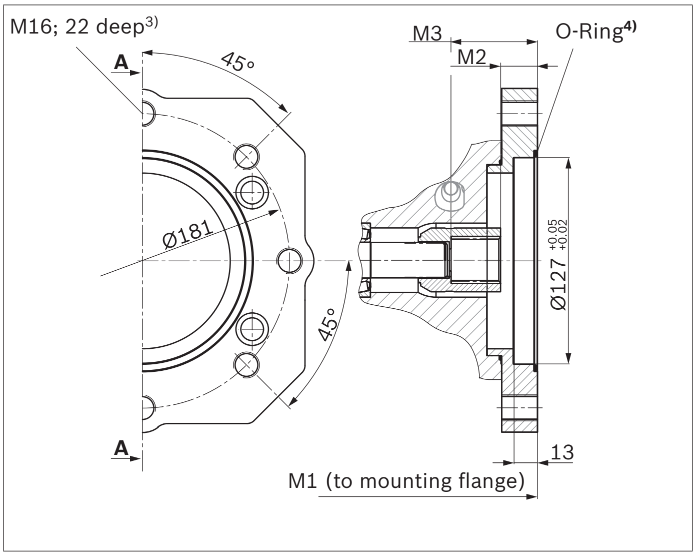
Flange ISO 3019-1 (SAE J744) Diameter	Attachment[2)]	Splined shaft[1)] Diameter		Availability over sizes 45	71	100	140	180	Code
127-2 (C)	ₒ°, ∘∘	1 1/2 in	17T 12/24DP	–	–	●	●	–	K24
	8, ₒ°, ∘∘	1 1/2 in	17T 12/24DP	–	–	○	○	●	U24

● = Available ○ = On request – = Not available

▼ **127-2 (C)**



▼ **127-2 (C)**



K24 (SAE J744 38-4 (C-C))	NG	M1	M2	M3	M3a	M4[3)]
	100	323	9.9	65	–	M16 × 2; continuous
	140[5)]	350	9.7	–	69.1	M16 × 2; 24 deep
	140[6)]	376				

U24 (SAE J744 38-4 (C-C))	NG	M1	M2	M3
	180	387	9.9	62.3

[1)] Hub for splined shaft according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2)] Mounting through bores pattern viewed from through drive with control at top

[3)] Thread according to DIN 13, observe the instructions in the instruction manual for the maximum tightening torques.

[4)] O-ring included in the scope of delivery

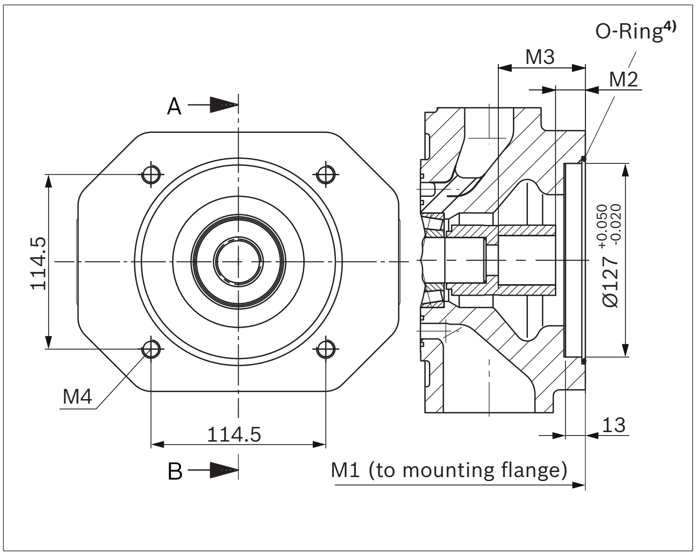
[5)] With D-flange

[6)] With C-flange

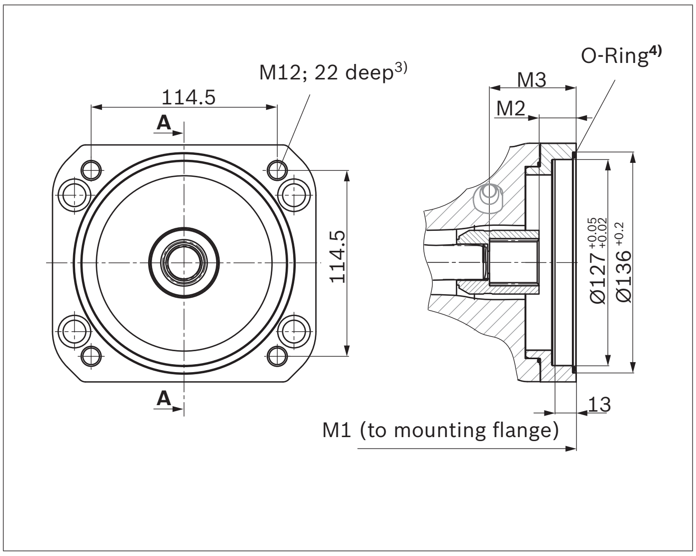
Flange ISO 3019-1 (SAE J744)		Splined shaft[1]		Availability over sizes					Code
Diameter	Attachment[2]	Diameter		45	71	100	140	180	
127-4 (C)	⛶	1 1/4 in	14T 12/24DP	–	○	●	●	–	K15
		1 1/4 in	14T 12/24DP	–	–	○	○	●	U15

● = Available ○ = On request – = Not available

▼ **127-4 (C)**



▼ **127-4 (C)**



K15 (SAE J744 32-4 (C))	NG	M1	M2	M3	M4[3]
	100	338	17.9	56.5	M12 × 1.75; 22 deep
	140	350	17.9	56.5	M12 × 1.75; 22 deep

U15 (SAE J744 32-4 (C))	NG	M1	M2	M3
	180	387	20	57

---

1) Hub for splined shaft according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Mounting through bores pattern viewed from through drive with control at top

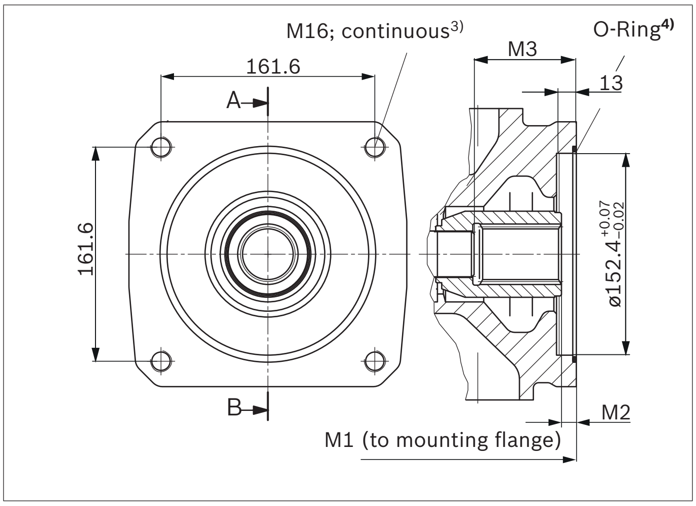
3) Thread according to DIN 13, observe the instructions in the instruction manual for the maximum tightening torques.

4) O-ring included in the scope of delivery

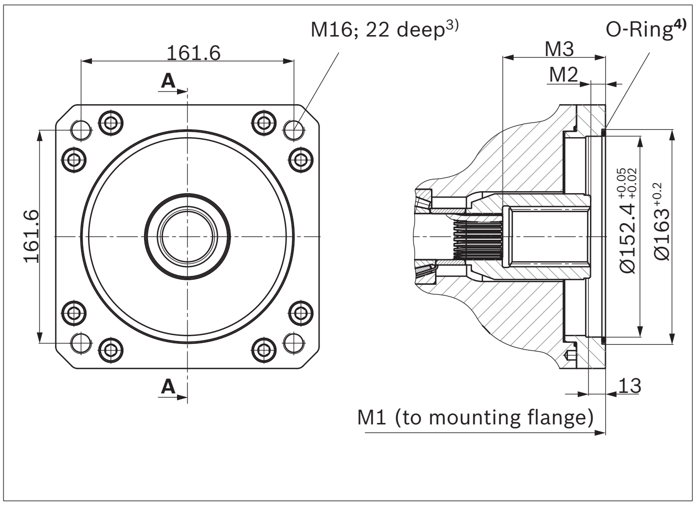
Flange ISO 3019-1 (SAE J744)		Splined shaft[1]		Availability over sizes					Code
Diameter	Attachment[2]	Diameter		45	71	100	140	180	
152-4 (D)	⁘	1 3/4 in	13T 8/16DP	–	–	–	●	–	K17
		1 3/4 in	13T 8/16DP	–	–	–	○	●	U17

● = Available ○ = On request – = Not available

▼ **152-4 (D)**



▼ **152-4 (D)**



K17 152-4 (D)	NG	M1	M2	M3
	140	350	11	77.3

U17 152-4 (D)	NG	M1	M2	M3
	180	387	10.8	78.1

---

1) Hub for splined shaft according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Mounting through bores pattern viewed from through drive with control at top

3) Thread according to DIN 13, observe the instructions in the instruction manual for the maximum tightening torques.

4) O-ring included in the scope of delivery

Overview of mounting options

Through drive			Mounting options – 2nd pump		
Flange (SAE) ISO 3019-1	**Hub for splined shaft**	**Code**[1]	**A10VO/31 and 32 NG (shaft)**	**A10VO/52 and 53 NG (shaft)**	**External gear pump**
82-2 (A)	5/8 in	(K)(U)01	18 (U)/31	10 (U), 18 (U)	Design F
	3/4 in	(K)(U)52	18 (S, R)/31	10 (S) 18 (S, R)	
101-2 (B)	7/8 in	(K)(U)68	28 (S, R)/31	28 (S, R)	Design N/G
	1 in	(K)(U)04	45 (S, R)	45 (S, R)	–
127-2 (C)	1 1/4 in	(K)(U)07	71 (S, R)	85 (U,W)	–
	1 1/2 in	(K)(U)24	100 (S)	85 (S), 100 (S)	–
127-4 (C)	1 in	UE2	45 (S, R)/32	60, 63, 72 (U, W)	–
	1 1/4 in	(K)(U)15	71 (S, R)/32	63 (S, R), 72 (S, R)	–
152-4 (D)	1 3/4 in	(K)(U)17	140 (S); 180 (S)/32	–	–

Mounting flange C, D and U (see order item 09 in the ordering code) and port plate with a K.. or U.. Through drive (see or items 10 and 11 in the ordering code) directly connected by the static and dynamic loading when installed.
The following table shows the version to be selected:

Mounting flange	**C**	**D**	**U**
Port plate	12	22 /32	22 /32
Through drive	K..	U..	U..

---

[1] 1st Pump only with mounting flanges D or U for Uxx through drives (for more information, see also ordering code on page 3).

Combination pumps A10VO + A10VO

By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes. When ordering combination pumps, the type designations of the 1st and 2nd pumps must be linked by a "**+**".

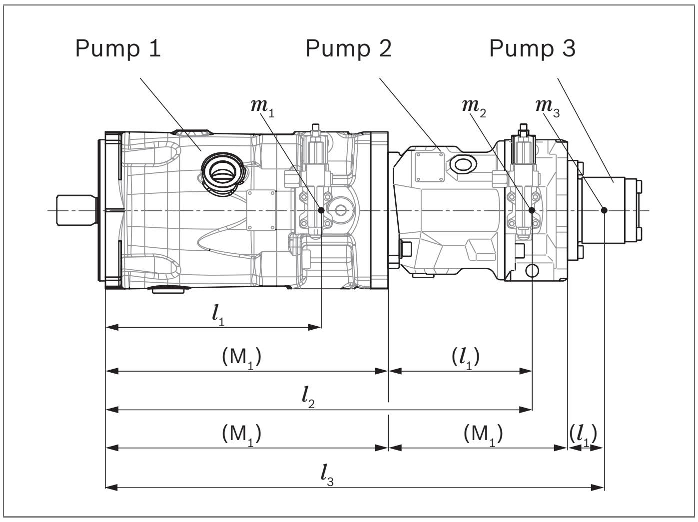
Order example:
A10VO100DR/32R-VSC12K07+
A10VO71DR/32R-VSC12N00

It is permissible to use a combination of two single pumps of the same nominal size (tandem pump) considering a dynamic mass acceleration of maximum 10 *g* (= 98.1 m/s^2) without additional support brackets.

For combination pumps consisting of more than two pumps, the mounting flange must be rated for the permissible mass torque (please consult us).

The "K.." through drives are plugged with a **non-pressure-resistant** cover. Before commissioning the units, they must therefore be equipped with pressure-resistant covers. Through drives can also be ordered with pressure-resistant covers, please state in plain text.

The "U.." through drives are equipped with a flexible, universal through drive (without hub and intermediate flange) and a pressure-resistant cover. This enables the utilization of various through drive options without any machining of the port plate. Details of the necessary adapter parts can be found in data sheet RE 95581.



m_1, m_2, m_3	Weight of pump	[kg]
l_1, l_2, l_3	Distance, center of gravity	[mm]

$$T_m = (m_1 \bullet l_1 + m_2 \bullet l_2 + m_3 \bullet l_3) \bullet \frac{1}{102} \quad [\text{Nm}]$$

Calculation for multiple pumps

l_1 = Distance, center of gravity, front pump (value from "Permissible mass moment of inertia" table)

l_2 = Dimension "M1" from through drive drawings (page 40 to 47) + l_1 of the 2nd pump

l_3 = Dimension "M1" from through drive drawings (page 40 to 47) of the 1st pump + "M1" of the 2nd pump + l_1 of the 3rd pump

Permissible mass moment of inertia

NG			45	71	100	140	180
for 4-hole flange							
static	T_m	Nm	3000	3000	4500	4500	4500
dynamic at 10 *g* (98.1 m/s^2)	T_m	Nm	300	300	450	450	450
for 2-hole flange							
static	T_m	Nm	1370	2160	3000	3000[1]	–
dynamic at 10 *g* (98.1 m/s^2)	T_m	Nm	137	216	300	300[1]	–
Weight with port plate 11/12N00 and mounting flange C	m	kg	25.8	40.4	56.4	70.5	75.2
Weight with port plate 12K.. and mounting flange C	m	kg	27.4	43.3	62.6	79.5	–
Weight with port plate 22(32)U00 and mounting flange D or U	m	kg	32.6	51.8	76	90.2	89.4
Distance, center of gr avity at 11/12N00	l_1	mm	108	120	138	158	159
Distance, center of gravity at 12Kxx	l_1	mm	115	129	153	177	–
Distance, center of gravity at 22/32Uxx	l_1	mm	135	153	184	196	190

Please also pay attention to the installation information on page 53.

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[1] Pump combinations permissible only max. as double pump up to the same size.

Connector for solenoids

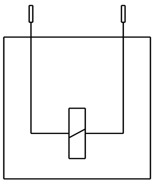
DEUTSCH DT04-2P

Molded connector, 2-pin, without bidirectional suppressor diode

The following type of protection ensues with an installed mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)

▼ **Switching symbol**



▼ **Mating connector DEUTSCH DT06-2S-EP04**

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).

Notice

If necessary, you can change the position of the connector by turning the solenoid.

The procedure is defined in the instruction manual.

Electronic controls

Control	Electronics function	Electronics		Data sheet
Electric pressure control	Controlled power outlet	RA	analog	95230
		RC4-5/30	digital	95205

Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be considered with a long-term standstill.

Particularly with the “drive shaft up/down” installation position, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The leakage in the housing area must be discharged to the reservoir via the highest available tank port (**L**, **L_1**).

If a shared drain line is used for several units, make sure that the respective case pressure is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operating conditions, specifically on cold start. If this is not possible, separate drain lines must be laid if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction lines and the drain lines must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\,max}$ = 800 mm. The minimum suction pressure at port **S** (see the technical data on page 6) must not be fallen short of during operation and at cold starting either.

When designing the reservoir, ensure adequate distance between the suction line and the drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Key	
L, L_1 (F)	Filling / air bleeding
S	Suction port
L, L_1	Drain port
SB	Baffle (baffle plate)
$h_{t\,min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)
$h_{ES\,min}$	Minimum necessary height required to protect the axial piston unit from draining (25 mm)
$h_{S\,max}$	Maximum permissible suction height (800 mm)

Installation position

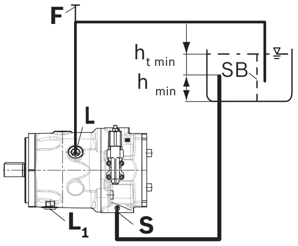
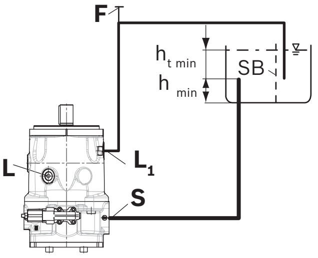
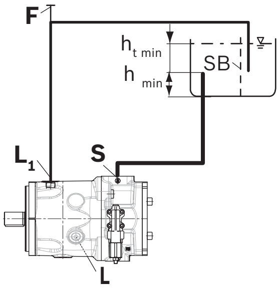
See the following examples **1** to **9**.

Further installation positions are available upon request.

Recommended installation position: **1** and **3**

Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir and below the minimum fluid level of the reservoir.

Installation position	Air bleed	Filling
1 	**F**	**F (L)**
2[1] 	**F**	**F (L_1)**
3 	**F**	**F (L_1)**

Notice

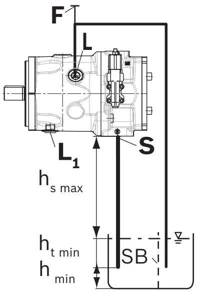
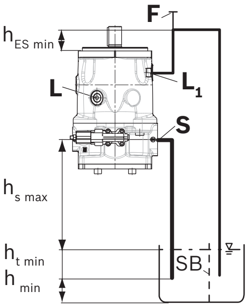
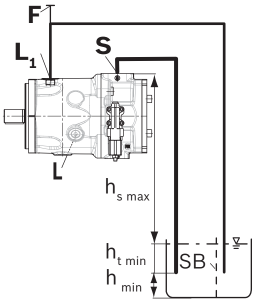
Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

---

[1] Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

Above-reservoir installation

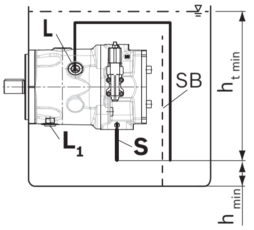
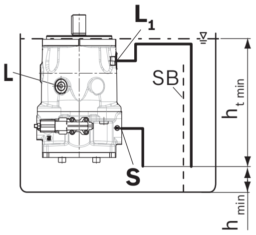
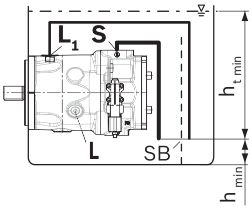
Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. To prevent the axial piston unit from draining in position 5, the height difference $h_{ES\ min}$ must be at least 25 mm. Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.

Installation position	Air bleed	Filling
4 	**F**	**F (L)**
5[1] 	**F**	**F (L_1)**
6 	**F**	**F (L_1)**

A check valve in the drain line is only permissible in individual cases. Consult us for approval.

Inside-reservoir installation

Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level. The axial piston unit is completely below the hydraulic fluid. If the minimum fluid level is equal to or below the upper edge of the pump, see chapter **"Above-reservoir installation"**. Axial piston units with electrical components (e.g., electric control, sensors) may not be installed in a reservoir below the fluid level.

Installation position	Air bleed	Filling
7 	Over the highest tank port **L**	Automatically via the open port **L** or **L_1** due to the position under the hydraulic fluid level
8[1] 	Over the highest tank port **L_1**	
9 	Over the highest tank port **L_1**	

For key, see page 51.

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[1] Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

Assembly note

Due to the compact design of the housing, socket-head screws with a hexagon socket must be used to attach the axial piston pump. Please observe the maximum permissible surface pressure according to VDI 2230.

Apart from this, you should take into account the information regarding tightening torques in the instruction manual.

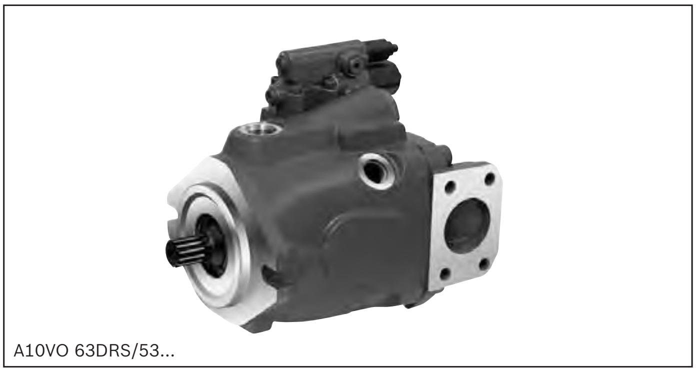
Project planning notes

- The A10VO axial piston variable pump is designed to be used in open circuit.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes contained herein must be observed.
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all versions of the product are approved for use in a safety function pursuant to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference.
  Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- Pressure controllers are not protection against overpressure. A pressure relief valve is to be provided for the hydraulic system.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports are only intended to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of getting burnt on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve spools) can, under certain circumstances get blocked in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filter) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must check whether additional measures are required on the machine for the relevant application in order to bring the driven consumer into a safe position (e.g. safe stop) and ensure any measures are properly implemented.

Axial piston variable pump
A10VO series 52 and 53


A10VO 63DRS/53...

- Sizes 10 to 100
- Nominal pressure 250 bar
- Maximum pressure 315 bar
- Open circuit

Features

- Variable pump with axial piston rotary group in swashplate design for hydrostatic drives in open circuit.
- The flow is proportional to the drive speed and the displacement.
- The flow can be infinitely varied by adjusting the swashplate angle.
- Stable bearing for long service life
- High permissible drive speed
- Favorable power-to-weight ratio – compact dimensions
- Low noise
- Excellent suction characteristics
- Electro-hydraulic pressure control
- Power control
- Electro-proportional swivel angle control
- Short response times

Inhalt

Ordering code series 52

01	02	03	04		05	06		07	08	09	10	11	12
A10V(S)	**O**			**/**	**52**		**–**	**V**					

Axial piston unit

		10	28	45	60	85	
01	Swashplate design, variable, nominal pressure 250 bar, maximum pressure 315 bar	●	–	–	–	–	**A10VS**
		–	●	●	●	●	**A10V**

Operation mode

02	Pump, open circuit	**O**

Size (NG)

03	Geometric displacement, see table of values on page 10	**10**	**28**	**45**	**60**	**85**

Control devices

						10	28	45	60	85	
04	Pressure control	hydraulic				●	●	●	●	●	**DR**
	with flow controller	hydraulic	X-T open			●	●	●	●	●	**DFR**
			X-T plugged	with flushing function		●	●	●	●	●	**DFR1**
				without flushing function		–	●	●	●	●	**DRSC**
	with pressure cut-off	hydraulic	remotely operated			●	●	●	●	●	**DRG**
		electric	negative control		U = 12 V	–	●	●	●	●	**ED71**
					U = 24 V	–	●	●	●	●	**ED72**
		electric	positive control		U = 12 V	–	●	●	●	●	**ER71**
					U = 24 V	–	●	●	●	●	**ER72**
	Differential pressure control		electric control (negative control)			–	○	○	○	●	**EF..**[1]

Series

		10	28	45	60	85	
05	Series 5, Index 2	●	●	●	●	●	**52**

Direction of rotation

06	View on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Sealing material

07	FKM (fluor-caoutchouc)	**V**

Drive shaft

			10	28	45	60	85	
08	splined shaft	standard shaft	●	●	●	●	●	**S**
	ANSI B92.1a	similar to shaft "S" however for higher input torque	–	●	●	●	●	**R**
		reduced diameter, limited suitability for through drive	●	●	●	●	●	**U**
		similar to shaft "U", however for higher torque	–	●	●	●	●	**W**
	Parallel keyed shaft DIN 6885 limited suitability for through drive		●	–	–	–	–	**P**

Mounting flange

			10	28	45	60	85	
09	ISO 3019-2 (ISO)	2-hole	●	–	–	–	–	**A**
	ISO 3019-1 (SAE)	2-hole	●	●	●	●	●	**C**
		4-hole	–	–	–	●	–	**D**

Note

- Observe the engineering notes regarding each control device

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[1] See data sheet 92709 for precise specification

01	02	03	04		05	06		07	08	09	10	11	12
A10V(S)	**O**			**/**	**52**		**–**	**V**					

Working port

				10	28	45	60	85	
10	SAE flange port fastening thread, metric	rear	not for through drive	–	●	●	●	●	**11**
		at side, opposite	for through drive	–	●	●	●	●	**12**
		at side, offset 90°	not for through drive; available only for counter-clockwise direction of rotation	–	–	●	–	–	**13**
	Threaded port, metric	rear	not for through drive	●	–	–	–	–	**14**

Through drive (for attachment options, see page 59)

				10	28	45	60	85	
11	Flange ISO 3019-1 Diameter	Hub for splined shaft[1)] Diameter							
	without through drive			●	●	●	●	●	**N00**
	82-2 (A)	5/8 in	9T 16/32DP	–	●	●	●	●	**K01**
		3/4 in	11T 16/32DP	–	●	●	●	●	**K52**
	101-2 (B)	7/8 in	13T 16/32DP	–	●	●	●	●	**K68**
		1 in	15T 16/32DP	–	–	●	●	●	**K04**
	127-4 (C)	1 1/4 in	14T 12/24DP	–	–	–	●	●	**K15**
		1 1/2 in	17T 12/24DP	–	–	–	–	●	**K16**
	127-2 (C)	1 1/4 in	14T12/24DP	–	–	–	–	●	**K07**
		1 1/2 in	17T 12/24DP	–	–	–	–	●	**K24**

Connector for solenoids

		10	28	45	60	85	
12	Without connector (without solenoid, with hydraulic control only, without code)	●	●	●	●	●	
	DEUTSCH – molded connector, 2-pin – without suppressor diode (for electric controls)	–	●	●	●	●	**P**

● = Available ○ = On request – = Not available

Note

- ▶ Note the project planning notes on page 65.
- ▶ In addition to the ordering code, please specify the relevant technical data when placing your order.

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1) According to ANSI B92.1a

Ordering code series 53

01	02	03	04		05	06		07	08	09	10	11	12
A10V	**O**			**/**	**53**		**–**	**V**					

Axial piston unit

		18	28	45	63	72	85	100	
01	Swashplate design, variable, nominal pressure 250 bar, maximum pressure 315 bar	●	●	●	●	●	●	●	**A10V**

Operation mode

02	Pump, open circuit	**O**

Size (NG)

03	Geometric displacement, see table of values on page 10	**18**	**28**	**45**	**63**	**72**	**85**	**100**

Control devices

							18	28	45	63	72	85	100	
04	Pressure control		hydraulic				●	●	●	●	●	●	●	**DR**
		with flow controller	hydraulic	X-T open			●	●	●	●	●	●	●	**DRF**
				X-T plugged	with flushing function		●	●	●	●	●	●	●	**DRS**
					without flushing function		●	●	●	●	●	●	●	**DRSC**
		with pressure cut-off	hydraulic	remotely operated			●	●	●	●	●	●	●	**DRG**
			electric	negative control		*U* = 12 V	●	●	●	●	●	●	●	**ED71**
						U = 24 V	●	●	●	●	●	●	●	**ED72**
			electric	positive control		*U* = 12 V	●	●	●	●	●	●	●	**ER71**
						U = 24 V	●	●	●	●	●	●	●	**ER72**
	Differential pressure control			electric control (negative control)			○	○	○	○	○	●	●	**EF..**[1]
	Power control with pressure cut-off		hydraulic	start of control	from	10 to 35 bar	●	●	●	●	●	●	●	**LA5D**
						36 to 70 bar	●	●	●	●	●	●	●	**LA6D**
						71 to 105 bar	●	●	●	●	●	●	●	**LA7D**
						106 to 140 bar	●	●	●	●	●	●	●	**LA8D**
						141 to 230 bar	●	●	●	●	●	●	●	**LA9D**
		remotely operated	hydraulic	start of control	see LA.D		●	●	●	●	●	●	●	**LA.DG**
		flow control, X-T plugged	hydraulic	start of control	see LA.D		●	●	●	●	●	●	●	**LA.DS**
			electrically overridable (negative control)	start of control	see LA.D		●	●	●	●	●	●	●	**LA.S**
	Electro-proportional control			positive control										
		with pressure control				*U* = 12 V	●	●	●	●	●	●	●	**EP1D**
						U = 24 V	●	●	●	●	●	●	●	**EP2D**
		with pressure and flow control (load-sensing)		X-T open		*U* = 12 V	●	●	●	●	●	●	●	**EP1DF**
						U = 24 V	●	●	●	●	●	●	●	**EP2DF**
		with pressure and flow control (load-sensing)		X-T plugged		*U* = 12 V	●	●	●	●	●	●	●	**EP1DS**
						U = 24 V	●	●	●	●	●	●	●	**EP2DS**
		with electro-hydraulic pressure control				*U* = 12 V	●	●	●	●	●	●	●	**EP1ED**
						U = 24 V	●	●	●	●	●	●	●	**EP2ED**

Note
- ▶ Observe the engineering notes regarding each control device

---

[1] See data sheet 92709 for precise specification

01	02	03	04		05	06		07	08	09	10	11	12
A10V	**O**			**/**	**53**		**–**	**V**					

					18	28	45	63	72	85	100	
04	Electro-proportional control	positive control										
	with pressure control		*U* = 12 V		●	●	●	●	●	●	●	**EK1D**
			U = 24 V		●	●	●	●	●	●	●	**EK2D**
	pressure and flow control with controller cut-off (load sensing)	X-T open	*U* = 12 V		●	●	●	●	●	●	●	**EK1DF**
			U = 24 V		●	●	●	●	●	●	●	**EK2DF**
	pressure and flow control with controller cut-off (load sensing)	X-T plugged	*U* = 12 V		●	●	●	●	●	●	●	**EK1DS**
			U = 24 V		●	●	●	●	●	●	●	**EK2DS**
	electro-hydraulic pressure control with controller cut-off		*U* = 12 V		●	●	●	●	●	●	●	**EK1ED**
			U = 24 V		●	●	●	●	●	●	●	**EK2ED**

Series

		18	28	45	63	72	85	100	
05	Series 5, index 3	●	●	●	●	●	●	●	**53**

Direction of rotation

06	View on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Sealing material

07	FKM (fluor-caoutchouc)	**V**

Drive shaft

			18	28	45	63	72	85	100	
08	Splined shaft	standard shaft	●	●	●	●	●	●	●	**S**
	ANSI B92.1a	similar to shaft "S" however for higher input torque	●	●	●	●	●	●	–	**R**
		reduced diameter, limited suitability for through drive	●	●	●	●	●	●	●	**U**
		similar to shaft "U", however for higher torque	–	●	●	●	●	●	●	**W**

Mounting flange

			18	28	45	63	72	85	100	
09	ISO 3019-1 (SAE)	2-hole	●	●	●	●	●	●	●	**C**
		4-hole	–	–	–	●	●	●	●	**D**

Working port

				18	28	45	63	72	85	100	
10	SAE flange port fastening thread, metric	rear	not for through drive	●	●	●	●	●	●	●	**11**
		at side, opposite	for through drive	●	●	●	●	●	●	●	**12**
		at side, offset 90°	not for through drive; available only for counter-clockwise direction of rotation	–	–	●	–	–	–	–	**13**

01	02	03	04		05	06		07	08	09	10	11	12
A10V	**O**			**/**	**53**		**–**	**V**					

Through drive (for attachment options, see page 59)

11	Flange ISO 3019-1 Diameter	Hub for splined shaft[2)] Diameter		**18**	**28**	**45**	**63**	**72**	**85**	**100**	
	without through drive			●	●	●	●	●	●	●	**N00**
	82-2 (A)	5/8 in	9T 16/32DP	●	●	●	●	●	●	●	**K01**
		3/4 in	11T 16/32DP	●	●	●	●	●	●	●	**K52**
	101-2 (B)	7/8 in	13T 16/32DP	–	●	●	●	●	●	●	**K68**
		1 in	15T 16/32DP	–	–	●	●	●	●	●	**K04**
	127-4 (C)	1 1/4 in	14T 12/24DP	–	–	–	●	●	●	●	**K15**
		1 1/2 in	17T 12/24DP	–	–	–	–	–	●	●	**K16**
	127-2 (C)	1 1/4 in	14T12/24DP	–	–	–	–	–	●	●	**K07**
		1 1/2 in	17T 12/24DP	–	–	–	–	–	●	●	**K24**

Connector for solenoids

12		18	28	45	63	72	85	100	
	Without connector (without solenoid, with hydraulic control only, without code)	●	●	●	●	●	●	●	
	DEUTSCH – molded connector, 2-pin – without suppressor diode (for electric controls)	●	●	●	●	●	●	●	**P**

● = Available ○ = On request – = Not available

Note

- ▶ Note the project planning notes on page 65.
- ▶ In addition to the ordering code, please specify the relevant technical data when placing your order.

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2) According to ANSI B92.1a

Hydraulic fluids

The A10VO variable pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids

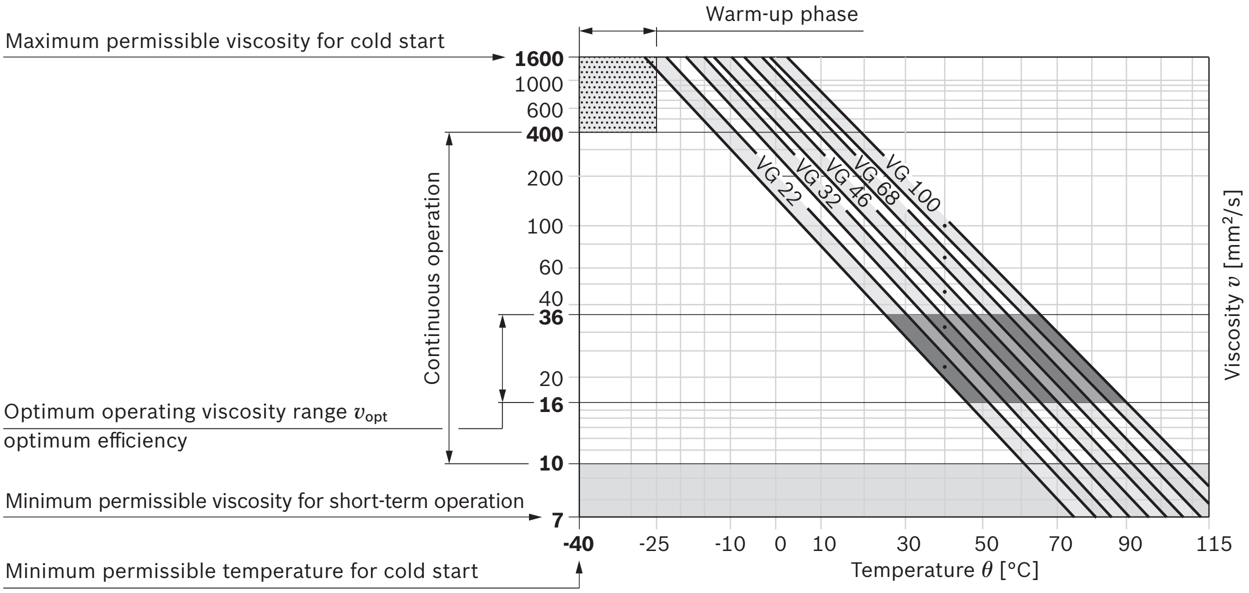
Notes on selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see selection diagram).

Note
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \leq 1600$ mm²/s	$\theta_{St} \geq -40$ °C	$t \leq 1$ min, without load ($p \leq 30$ bar), $n \leq 1000$ rpm
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu < 1600$ to 400 mm²/s	$\theta = -40$ °C to -25 °C	Note the detailed information on operation with low temperatures, see data sheet 90300-03-B.
Continuous operation	$\nu = 400$ to 10 mm²/s		This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram page 7)
		$\theta = -25$ °C to +110 °C	measured at port **L** Observe the permissible temperature range of the shaft seal (ΔT = approx. 5 K between the bearing/shaft seal and port **L**)
	$\nu_{opt} = 36$ to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \geq 7$ mm²/s		$t < 1$ min, $p < 0.3 \cdot p_{nom}$

▼ **Selection diagram**



Ordering code series 53

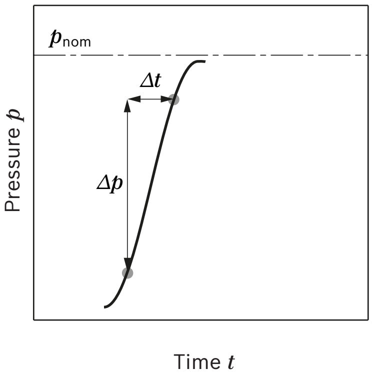
Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.
A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.
At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), cleanliness level 19/17/14 according to at least ISO 4406 is necessary.
Please contact us if the above classes cannot be observed.

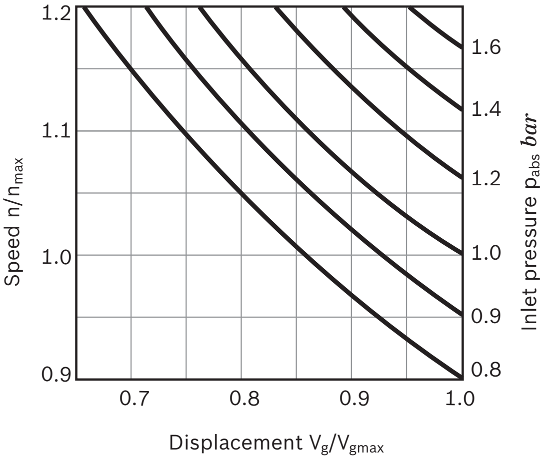
Operating pressure range

Pressure at working port B		**Definition**
Nominal pressure p_{nom}	250 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	315 bar absolute	The maximum pressure corresponds the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	2.5 ms	
Total operating period	300 h	
Minimum pressure $p_{\text{B abs}}$ (high pressure side)	10 bar absolute	Minimum pressure on the high-pressure side (**B**) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{\text{A max}}$	16000 bar/s	Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{\text{S min}}$ Standard	0.8 bar absolute	Minimum pressure at suction port **S** (inlet) that is required in order to avoid damage to the axial piston unit. The minimum pressure depends on the speed and displacement of the axial piston unit.
Maximum pressure $p_{\text{S max}}$	5 bar absolute	
Case drain pressure at port L_1, L_2		
Maximum pressure $p_{\text{L max}}$	2 bar absolute	Maximum 0.5 bar higher than inlet pressure at port **S**, but not higher than $p_{\text{L max}}$. A case drain line to the reservoir is required.

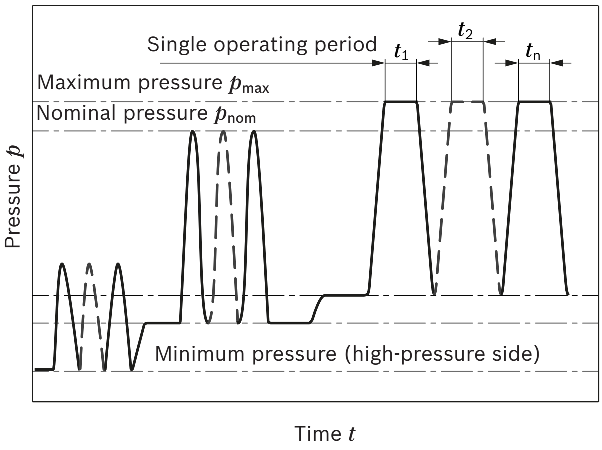
▼ **Rate of pressure change $R_{\text{A max}}$**



▼ **Maximum permissible speed (limit speed)**
Permissible speed by increasing inlet pressure p_{abs} at suction opening **S** or at $V_g \le V_{gmax}$



▼ **Pressure definition**



Total operating period = $t_1 + t_2 + ... + t_n$

Note
Operating pressure range valid when using hydraulic fluids based on mineral oils. Please contact us for values for other hydraulic fluids.

Technical data

Size		NG		10	18	28	45	60 [1]	63 [2]	72	85	100
Displacement, geometric, per revolution		$V_{g\,max}$	cm³	10.5	18	28	45	60	63	72	85	100
Speed maximum[3]	at $V_{g\,max}$	n_{nom}	rpm	3600	3300	3000	2600 [4]	2700	2600	2600	2500	2300
	at $V_g < V_{g\,max}$	$n_{max\,perm}$	rpm	4320	3960	3600	3120	3140	3140	3140	3000	2500
Flow	at n_{nom} and $V_{g\,max}$	q_v	l/min	37	59	84	117	162	163	187	212	230
	at n_E = 1500 rpm	q_{vE}	l/min	15	27	42	68	90	95	108	128	150
Power	at n_{nom}, $V_{g\,max}$ and Δp = 250 bar	P	kW	16	25	35	49	65	68	77	89	96
	at n_E = 1500 rpm	P_E	kW	7	11	18	28	37	39	45	53	62
Torque	at $V_{g\,max}$ and Δp = 250 bar	T	Nm	42	71	111	179	238	250	286	338	398
	at $V_{g\,max}$ and Δp = 100 bar	T	Nm	17	29	45	72	95	100	114	135	159
Rotary stiffness of drive shaft	S	c	Nm/rad	9200	11000	22300	37500	65500	65500	65500	143000	143000
	R	c	Nm/rad	–	14800	26300	41000	69400	69400	69400	152900	–
	U	c	Nm/rad	6800	8000	16700	30000	49200	49200	49200	102900	102900
	W	c	Nm/rad	–	–	19900	34400	54000	54000	54000	117900	117900
	P	c	Nm/rad	10700	–	–	–	–	–	–	–	–
Moment of inertia for rotary group		J_{TW}	kgm²	0.0006	0.0009	0.0017	0,003	0.0056	0.0056	0.0056	0,012	0,012
Maximum angular acceleration[5]		α	rad/s²	8000	6800	5500	4000	3300	3300	3300	2700	2700
Case volume		V	l	0.2	0.25	0.3	0.5	0.8	0.8	0.8	1	1
Weight **without** through drive (approx.)		m	kg	8	11.5	15	18	22	22	22	36	36
Weight **with** through drive (approx.)				–	13	18	24	28	28	28	45	45

Determining the operating characteristics			
Flow	q_v	$= \dfrac{V_g \times n \times \eta_v}{1000}$	[l/min]
Torque	T	$= \dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$	[Nm]
Power	P	$= \dfrac{2\,\pi \times T \times n}{60000} = \dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g	Displacement per revolution [cm³]
Δp	Differential pressure [bar]
n	Rotational speed [rpm]
η_v	Volumetric efficiency
η_{hm}	Mechanical-hydraulic efficiency
η_t	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

Note

- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommends testing the load by means of experiment or calculation / simulation and comparison with the permissible values.

---

1) Only series 52

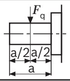
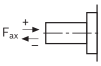
2) Only series 53

3) The values are applicable:
   - At absolute pressure p_{abs} = 1 bar at suction port **S**
   - For the optimal viscosity range of ν_{opt} = 36 to 16 mm²/s
   - For hydraulic fluid based on mineral oils

4) Please contact us regarding higher speeds

5) The scope of application lies between the minimum necessary and the maximum permissible drive speeds. It applies for external stimuli (e. g. engine 2 to 8 times rotary frequency, Cardan shaft twice the rotary frequency). The limit value is only valid for a single pump. The load capacity of the connecting parts must be considered.

Permissible radial and axial forces on the drive shaft

Size		NG		10	18	28	45	60/63	72	85	100
Maximum radial force at a/2		$F_{q\,max}$	N	250	350	1200	1500	1700	1500	2000	2000
Maximum axial force		$\pm F_{ax\,max}$	N	400	700	1000	1500	2000	1500	3000	3000

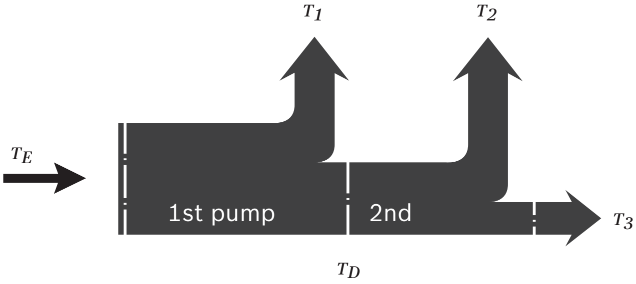
Note

- The values given are maximum values and do not apply to continuous operation. For drives with radial loading (pinion, V-belt drives), please contact us!

Permissible input and through drive torques

Size				10	18	28	45	60/63	72	85	100
Torque at $V_{g\,max}$ and Δp = 250 bar[1]		T_{max}	Nm	42	71	111	179	250	321	338	398
Input torque at drive shaft, maximum[2]											
	S	$T_{E\,max}$	Nm	126	124	198	319	630	630	1157	1104
		Ø	in	3/4	3/4	7/8	1	1 1/4	1 1/4	1 1/2	1 1/2
	R	$T_{E\,max}$	Nm	–	160	250	400	650	650	1215	–
		Ø	in	–	3/4	7/8	1	1 1/4	1 1/4	1 1/2	–
	U	$T_{E\,max}$	Nm	60	59	105	188	306	306	628	595
		Ø	in	5/8	5/8	3/4	7/8	1	1	1 1/4	1 1/4
	W	$T_{E\,max}$	Nm	–	–	140	220	396	383	650	636
		Ø	in	–	–	3/4	7/8	1	1	1 1/4	1 1/4
	P	$T_{E\,max}$	Nm	90	–	–	–	–	–	–	–
		Ø	mm	18	–	–	–	–	–	–	–
Maximum through-drive torque											
	S	$T_{D\,max}$	Nm	–	108	160	319	484	484	698	778
	R	$T_{D\,max}$	Nm	–	120	176	365	484	484	698	–
	U	$T_{D\,max}$	Nm	–	59	105	188	306	306	628	595
	W	$T_{D\,max}$	Nm	–	–	140	220	396	383	650	636

▼ **Distribution of torques**



Torque at 1st pump	T_1		
Torque at 2nd pump	T_2		
Torque at 3rd pump	T_3		
Input torque	T_E	=	$T_1 + T_2 + T_3$
	T_E	<	$T_{E\,max}$
Through-drive torque	T_D	=	$T_2 + T_3$
	T_D	<	$T_{D\,max}$

---

1) Efficiency not considered

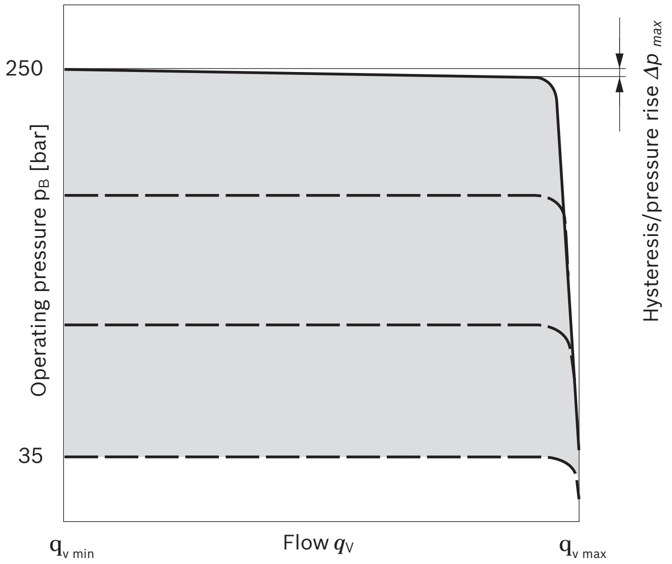
2) For drive shafts with no radial force

DR – Pressure control

The pressure controller limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only supplies as much hydraulic fluid as is required by the consumers. If the operating pressure exceeds the pressure setting at the pressure valve, the pump will regulate to a smaller displacement to reduce the control differential.

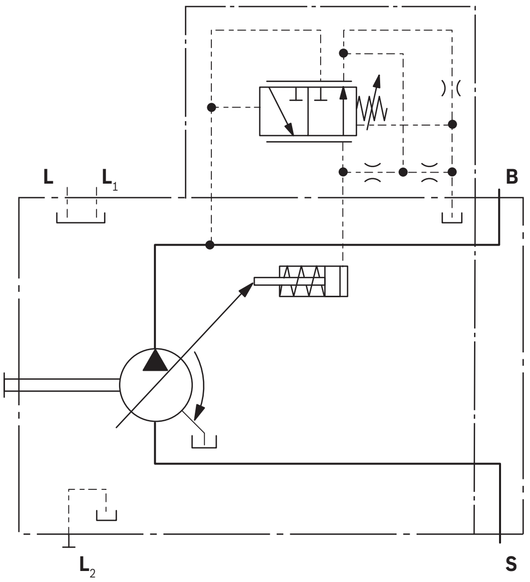
- Basic position in depressurized state: $V_{g\ max}$.
- Setting range[1] for pressure control 35 to 250 bar. Standard is 250 bar.

▼ **Characteristic curve DR**



Characteristic curve valid for n_1 = 1500 rpm and t_{fluid} = 50 °C.

▼ **Circuit diagram DR**



Controller data

Size		10	18	28	45	60 63	72	85	100
Pressure increase	Δp [bar]	6	6	6	6	8	8	12	14
Hysteresis and repeatability	Δp [bar]	maximum 3							
Control fluid consumption	l/min	maximum approx. 3							

---

[1] In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.

DRG – Pressure control, remotely operated

For the remote-controlled pressure control, the LS pressure limitation is performed using a separately arranged pressure relief valve. Therefore any pressure control value under the pressure set on the pressure controller can be regulated. Pressure controller DR see page 12.
A pressure relief valve is externally piped to port **X** for remote setting of pressure below the setting of the DR control valve spool. This relief valve is not included in the scope of delivery of the DRG control.
When there is differential pressure Δp at the control valve and with the standard setting on the remote-controlled pressure cut-off of 20 bar, the amount of control fluid at the connection is **X** approx. 1.5 l/min. If a different setting (range 10 to 22 bar) is required, please state in plain text.
As a separate pressure relief valve (**1**) we recommend:

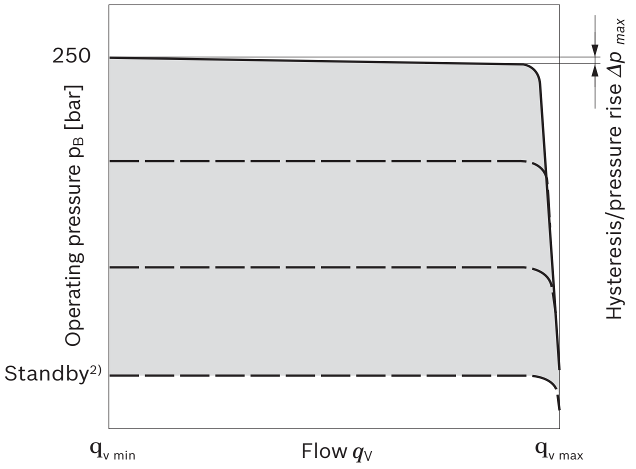
- a directly controlled, hydraulic or electric proportional one, suitable for the control fluid mentioned above.

The max. length of piping should not exceed 2 m.

- Basic position in depressurized state: $V_{g\ max}$.
- Setting range$^{1)}$ for pressure control 35 to 250 bar (**3**). Standard is 250 bar.
- Setting range for differential pressure 10 to 22 bar (**2**) Standard is 20 bar.

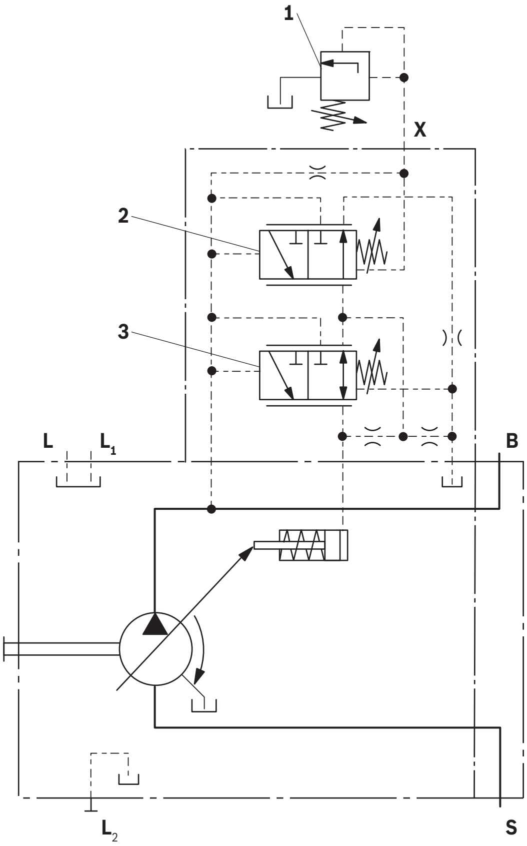
Unloading port **X** to the reservoir results in a zero stroke (standby) pressure which is approx. 1 to 2 bar higher than the defined differential pressure Δp, however system influences are not taken into account.

▼ **Characteristic curve DRG**



Characteristic curve valid for n_1 = 1500 rpm and t_{fluid} = 50 °C.

▼ **Circuit diagram DRG**



1 The separate pressure relief valve and the line are not included in the scope of delivery.

2 Remote-controlled pressure cut-off (**G**).

3 Pressure controller (**DR**)

Controller data

Size		10	18	28	45	60 63	72	85	100
Pressure increase	Δp [bar]	6	6	6	6	8	8	12	14
Hysteresis and repeatability	Δp [bar]	maximum 3							
Control fluid consumption	l/min	maximum approx. 4.5							

---

1) In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.

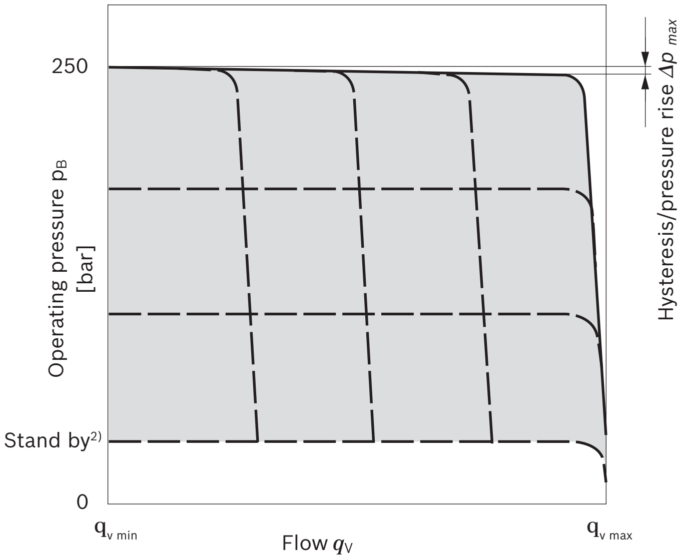
2) Zero stroke from pressure setting Δp on controller (**2**)

DRF (DFR) / DRS (DFR1) / DRSC– Pressure and flow control

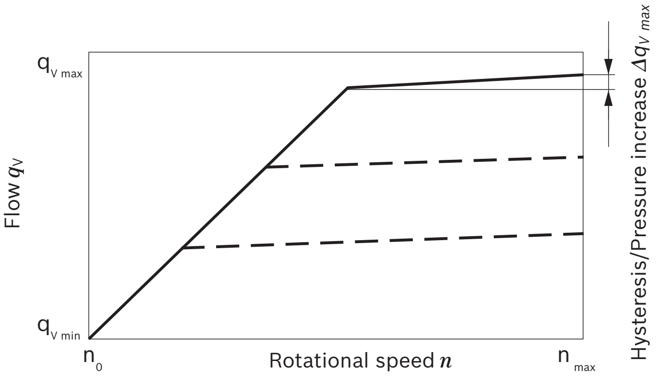
In addition to the pressure controller function (see page 12), a variable orifice (e.g. directional valve) is used to adjust the differential pressure upstream and downstream of the orifice. This is used to control the pump flow. The pump flow is equal to the actual hydraulic fluid quantity required by the consumer. With all controller combinations, the V_g reduction has priority.

- Basic position in depressurized state: $V_{g\ max}$.
- Setting range[1] to 250 bar.
- DR pressure controller data see page 12

▼ Characteristic curve DRF (DFR) / DRS (DFR1) / DRSC



▼ Characteristic curve at variable speed

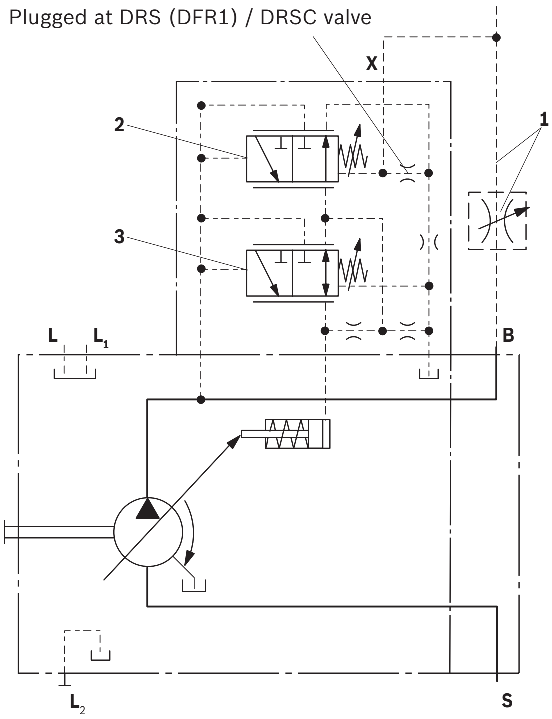


Characteristic curves valid for n_1 = 1500 rpm and t_{fluid} = 50 °C.

Possible connections at port **B**
(not included in the delivery contents)

LS mobile control blocks	Data sheets
M4-12	64276
M4-15	64283
LUDV mobile control blocks	
M6-15	64284
M7-22	64295

▼ Circuit diagram DRF (DFR)



1 The metering orifice (control block) and the line is not included in the delivery contents.
2 Pressure and flow controller (**FR**).
3 Pressure controller (**DR**)

Note

The DRS and (DFR1) and DRSC valve versions have no pilot line between **X** and the reservoir.

Unloading the LS-pilot line must be possible in the valve system.

Because of the flushing function sufficient unloading of the flow control in DRS (DFR1) control valve **X**-line must also be provided.

If this pilot line of the **X** line does not have to be guaranteed, the DRSC control valve must be used.

For further information see page 15

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[1] In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.

[2] Zero stroke from differential pressure setting Δp on controller **(2)**

Differential pressure Δp:

- Standard setting: 14 bar
  If another setting is required, please state in clear text.
- Adjustment range: 14 to 22 bar

Unloading port **X** to the reservoir results in a zero stroke (standby) pressure which is approx. 1 to 2 bar higher than the defined differential pressure Δp, however system influences are not taken into account.

Controller data

- DR pressure controller data see page 12.
- Maximum flow deviation measured at drive speed n = 1500 rpm.

Size		10	18	28	45	60 63	72	85	100
Flow deviation	Δq_{vmax} [l/min]	0.5	0.9	1.0	1.8	2.5	2.5	3.1	3.1
Hysteresis; repeatability	Δp [bar]	maximum 3							
Control fluid consumption	l/min	maximum approx. 3 to 4.5 (DRF (DFR)) maximum approx. 3 (DRS (DFR1) / DRSC)							

LA... – Pressure, flow and power controller

Pressure control equipped as DR(G), see page 12 (13). Equipment of the flow control like DRS (DFR1), see page 14.

In order to achieve a constant drive torque with varying operating pressures, the swivel angle and with it the volume flow from the axial piston pump is varied so that the product of flow and pressure remains constant. Flow controller is possible below the power control curve. When ordering please state the power characteristics to be set ex works in clear text, e.g. 20 kW at 1500 rpm.

Controller data

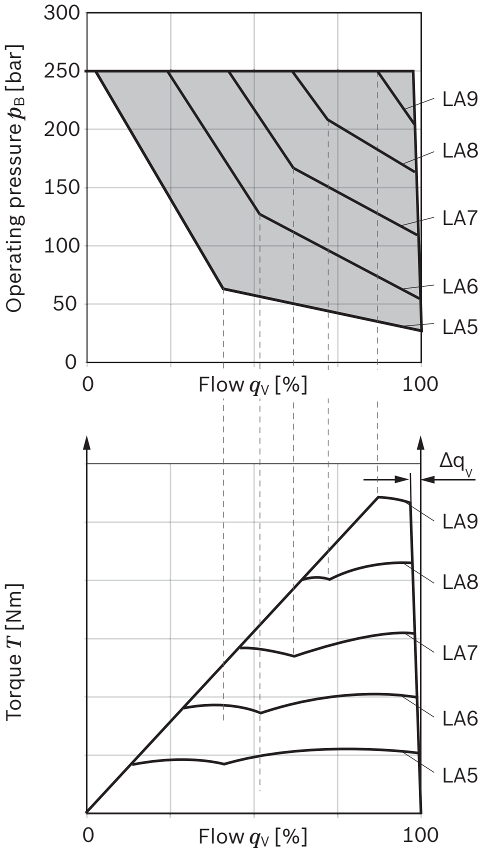
- Pressure controller DR see page 12.
- Pressure and flow controller DR see page 14.
- See data sheet 92709 for electric override LA.S
- Control fluid consumption max. approx. 5.5 l/min

	Torque T [Nm] for size							
Start of control	**18**	**28**	**45**	**63**	**72**	**85**	**100**	**Order code**
10 to 35 bar	3.8 – 12.1	6 – 19	10 – 30	15 – 43	17 – 49.2	20 – 57	24 – 68	**LA5**
36 to 70	12.2 – 23.3	19.1 – 36	30.1 – 59	43.1 – 83	49.3 – 94.9	57.1 – 112	68.1 – 132	**LA6**
71 to 105	23.4 – 33.7	36.1 – 52	59.1 – 84	83.1 – 119	95.0 – 136.0	112.1 – 160	132.1 – 189	**LA7**
106 to 140	33.8 – 45	52.1 – 70	84.1 – 112	119.1 – 157	136.1 – 179.4	160.1 – 212	189.1 – 249	**LA8**
141 – 230	45.1 – 74.8	70.1 – 117	112.1 – 189	157.1 – 264	179.5 – 301.7	212.1 – 357	249.1 – 419	**LA9**

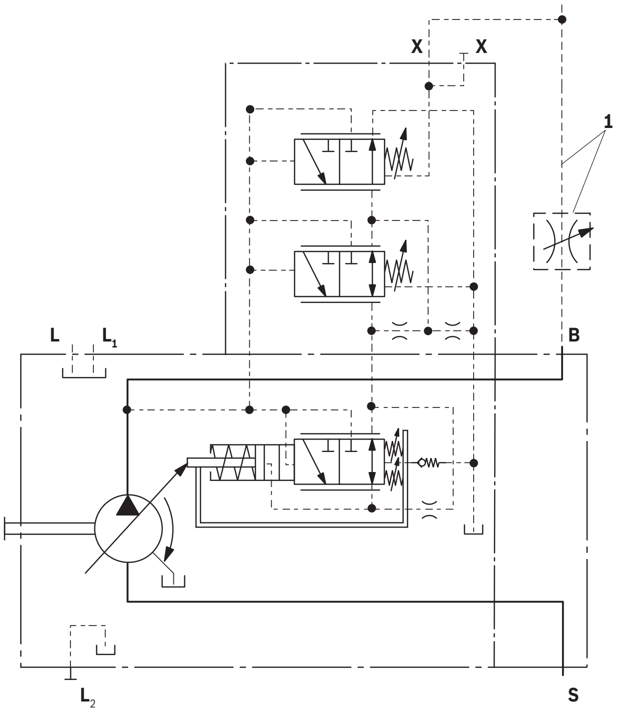
Conversion of the torque values in power [kW]

$$P = \frac{T}{6.4} \text{ [kW] (at 1500 rpm)} \quad \text{or} \quad P = \frac{2 \times T \times n}{60000} \text{ [kW] (For rotational speeds see page 10)}$$

▼ Characteristic curve LA.DS



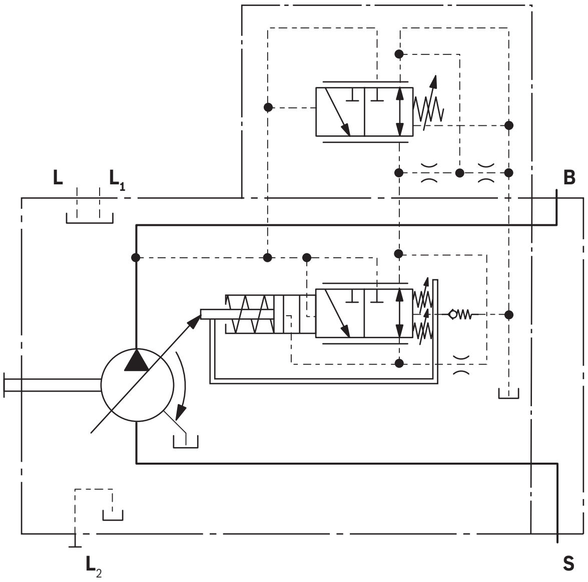
▼ Circuit diagram LA.DS
(for further combination options with LA.. see page 17)



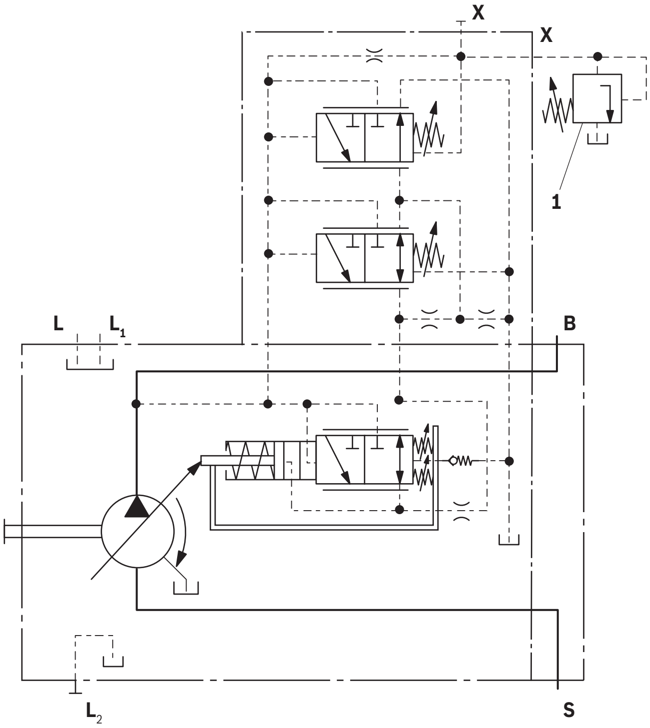
1 The metering orifice (control block) and the line is not included in the delivery contents.

LA... – Variations

▼ **Circuit diagram LA.D** with pressure cut-off

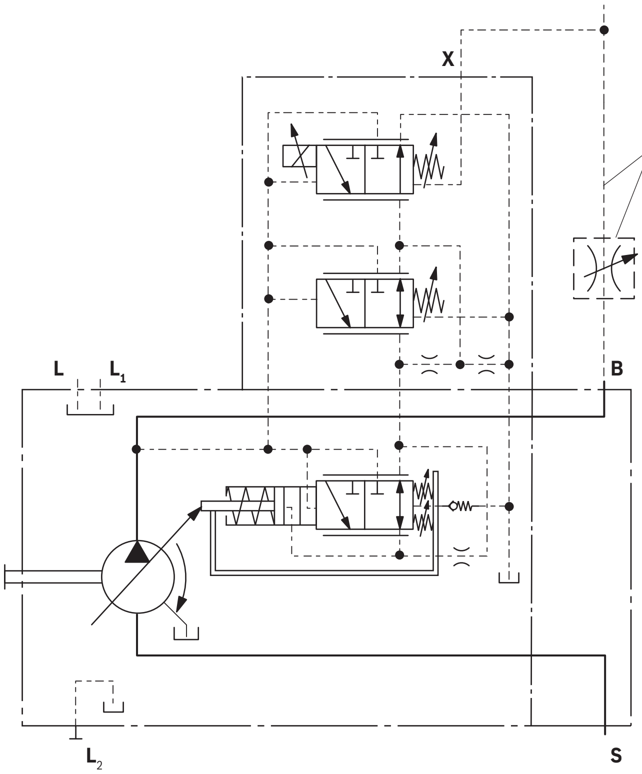


▼ **Circuit diagram LA.DG** with pressure cut-off, remotely operated



1 The pressure relief valve and the line are not included in the scope of delivery.

▼ **Circuit diagram LA.S** with separate flow control



1 The sensing orifice (control block) and the line is not included in the delivery contents.

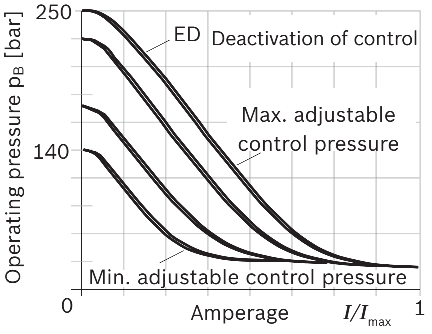
Controller data

▶ See data sheet 92709 for electric override LA.S

ED – Electro-hydraulic pressure control

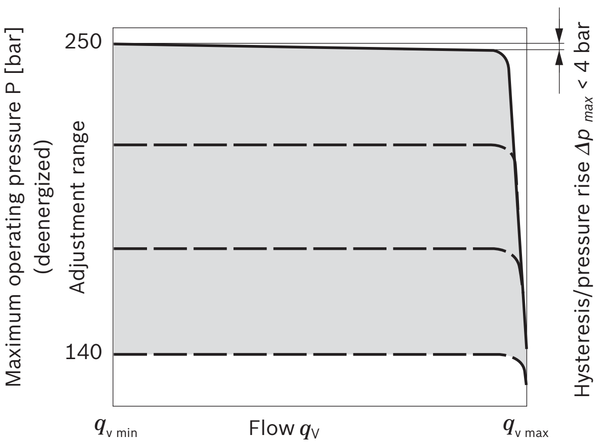
The ED valve is set to a certain pressure by a specified variable solenoid current.
When changing the consumer (load pressure), this causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.
The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.
As the solenoid current signal drops towards zero, the pressure will be limited to p_{max} by an adjustable hydraulic pressure cut-off (secure fail safe function in case of a loss of power, e.g. for fan drives). The response time characteristic curve of the ED-control was optimized for the use as a fan drive system. When ordering, specify the type of application in clear text.

▼ **Static current-pressure characteristic curve ED**
(negative characteristic curve measured with pump in zero stroke)



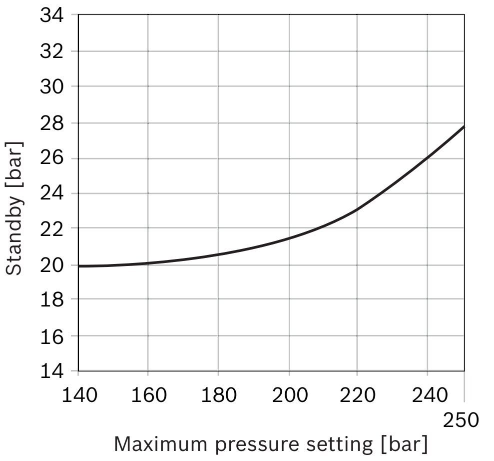
- ▶ Hysteresis static < 3 bar.

▼ **Flow-pressure characteristic curve**

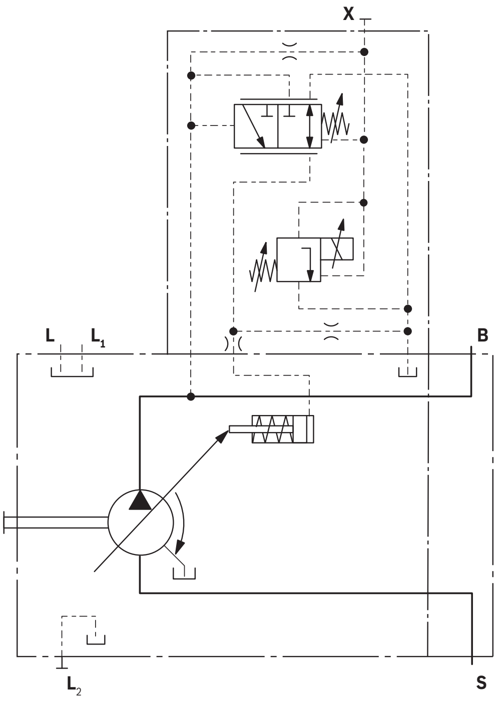


- ▶ Characteristic curves valid for n_1 = 1500 rpm and t_{fluid} = 50 °C.
- ▶ Control fluid consumption: 3 to 4.5 l/min.
- ▶ For standby standard setting, see the following diagram, other values on request.

▼ **Influence of the pressure setting on standby (maximally energized)**



▼ **Circuit diagram ED71/ED72**



Technical data, solenoid	ED71	ED72
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at p_{max}	100 mA	50 mA
End of control at p_{min}	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Duty cycle	100%	100%
Type of protection: see connector version page 61		
Operating temperature range at valve -20 °C to +115 °C		

ER – Electro-hydraulic pressure control

The ER valve is set to a certain pressure by a specified variable solenoid current.

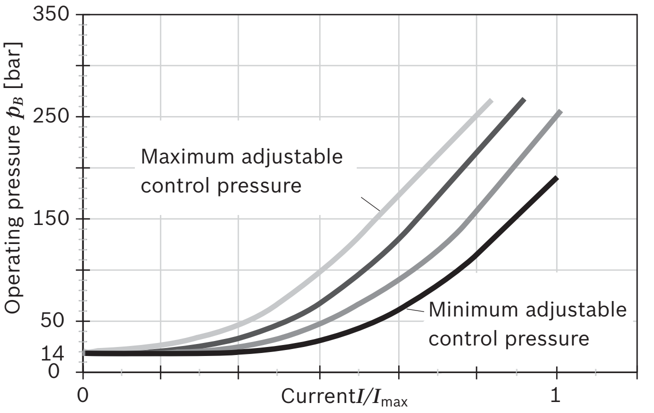
When changing the consumer (load pressure), this causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.

The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.

As the solenoid current signal drops towards zero, the pressure will be limited to $p$min (stand by).

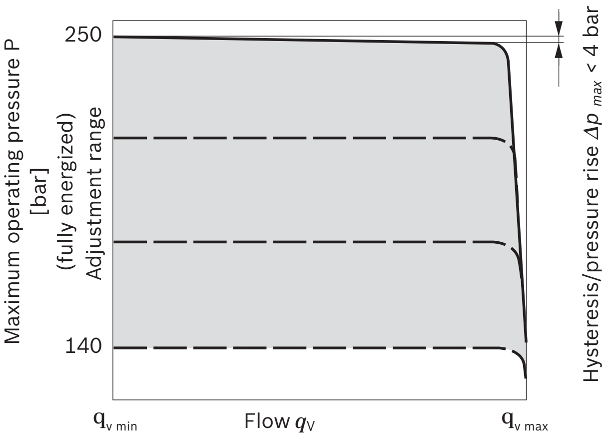
Observe project planning notes.

▼ **Static current-pressure characteristic curve ER**
(positive characteristic curve measured with pump in zero stroke)



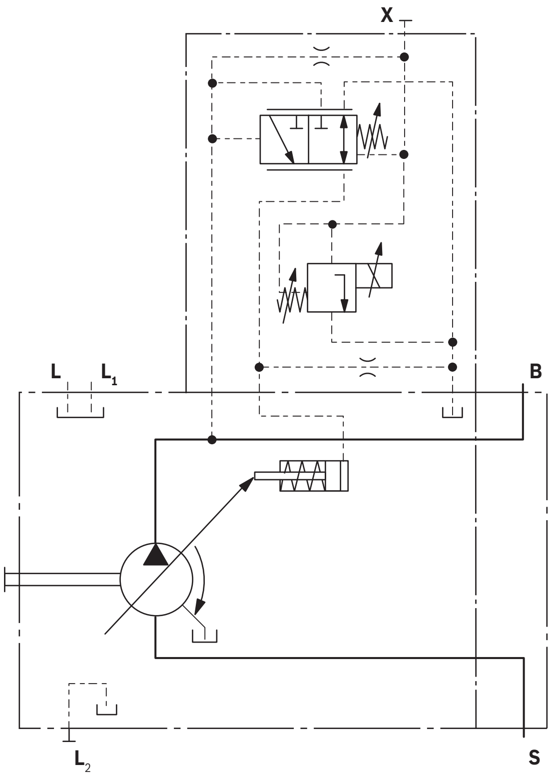
▶ Hysteresis static current-pressure characteristic curve < 3 bar.

▼ **Flow-pressure characteristic curve**



- ▶ Characteristic curves valid for n_1 = 1500 rpm and t_{fluid} = 50 °C.
- ▶ Control fluid consumption: 3 to 4.5 l/min.
- ▶ Standby standard 14 bar. Other values on request.
- ▶ Influence of pressure setting on stand-by ±2 bar.

▼ **Circuit diagram ER71/ER72**



Technical data, solenoid	ER71	ER72
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at p_{min}	100 mA	50 mA
End of control at p_{max}	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Duty cycle	100%	100%
Type of protection: see connector version page 61		
Operating temperature range at valve -20 °C to +115 °C		

Project planning note!

Excessive current levels (I > 1200 mA at 12 V or I > 600 mA at 24 V) to the ER solenoid can result in undesired pressure increases which can lead to pump or system damage.

Therefore:

- ▶ Use I_{max} current limiter solenoids.
- ▶ A sandwich plate pressure reducing valve can be used to protect the pump in the event of overflow.

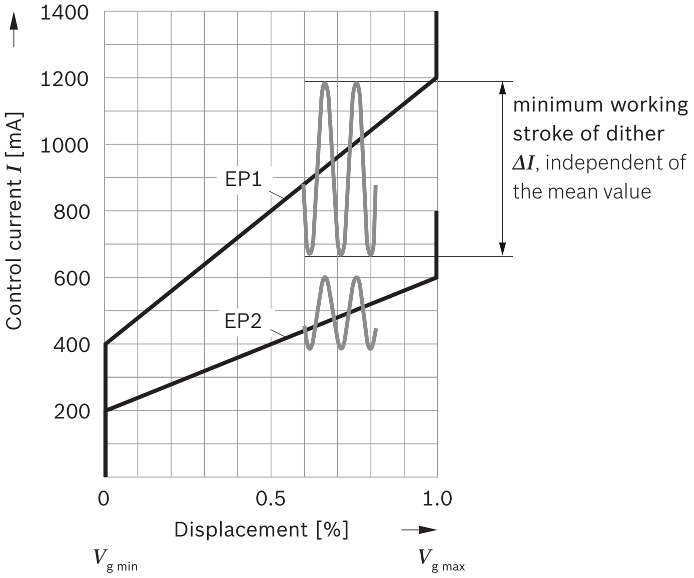
An accessory kit with intermediate plate pressure controller can be ordered from Bosch Rexroth under part number R902490825.

EP – Electro-proportional control

Electro-proportional control makes a stepless and reproducible setting of the pump displacement possible directly via the swashplate. The control force of the control piston is applied by a proportional solenoid. The control is proportional to the current (for start of control, see table right).
In a depressurized state, the pump is swiveled to its initial position ($V_{g\,max}$) by an adjusting spring. If the operating pressure exceeds a limit value of approx. 4 bar, the pump starts to swivel from $V_{g\,max}$ to $V_{g\,min}$ without control by the solenoid (control current < start of control). With a minimum swivel angle $V_{g\,min}$ and de-energized EP solenoids, a minimum pressure of 10 bar must be maintained, or alternatively a minimum amount of 5 % of the displacement.
A PWM signal is used to control the solenoid.

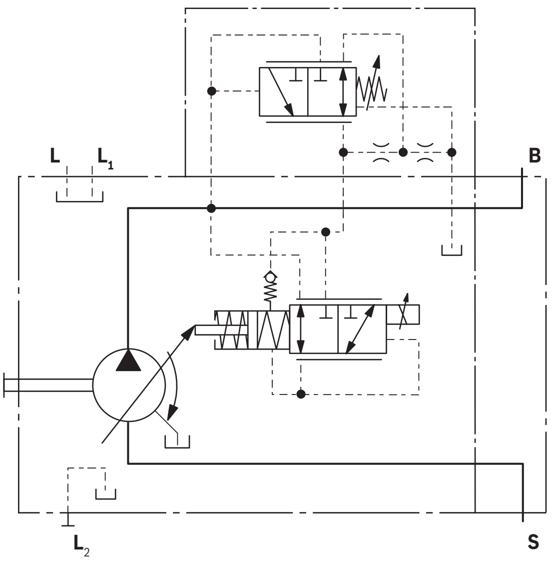
EP.D: The pressure control regulates the pump displacement back to $V_{g\,min}$ after the set target pressure has been reached. A minimum operating pressure of 14 bar is needed for safe and reproducible control. The necessary control fluid is taken from the high pressure.

▼ **Characteristic curve EP1/2**



- ▶ Hysteresis static current-displacement characteristic curve < 5%.

▼ **Circuit diagram EP.D**



Technical data, solenoid	EP1	EP2
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at $V_{g\,min}$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA	600 mA
Minimum working stroke of the dither within the control range[1]	352 mA	176 mA
Dither frequency	100 to 200 Hz	100 to 200 Hz
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Duty cycle	100%	100%
Type of protection: see connector version page 61		
Operating temperature range at valve -20 °C to +115 °C		

Note
We recommend the valve with flushing function for the EP.D control variant. Please contact us.

---

[1] ΔI = 44% of the current difference within the control range, regardless of the mean value of the current

EK – Electro-proportional control with controller cut-off

Variant EK... is based completely on the variant EP... (see page 20).

In addition to the electro-proportional control function, a controller cut-off is integrated in the electric characteristic curve. The pump then swivels to $V_{g\,max}$ if the pilot signal is lost (e.g., cable break) and then works with the DRF settings if necessary (see page 12). The controller cut-off is only intended for short-term use and not for permanent use if the control signal is lost. If the control signal is lost, the pump swivel times are increased by the EK valve.

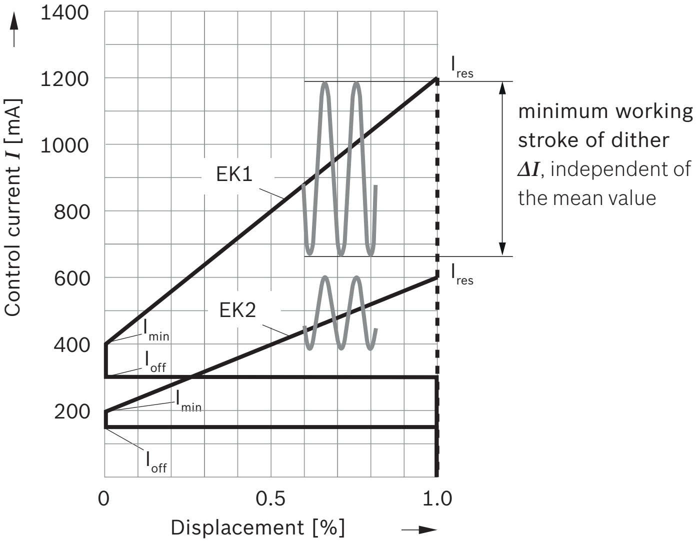
A PWM signal is used to control the solenoid.

Note

A minimum operating pressure of 50 bar is needed for safe and reproducible electro-proportional control with controller cut-off. For lower pressures, a pilot signal of > 500 mA (EK2) or > 1000 mA (EK1) is required in order to avoid undesired controller cut-off. The necessary control fluid is taken from the high pressure.

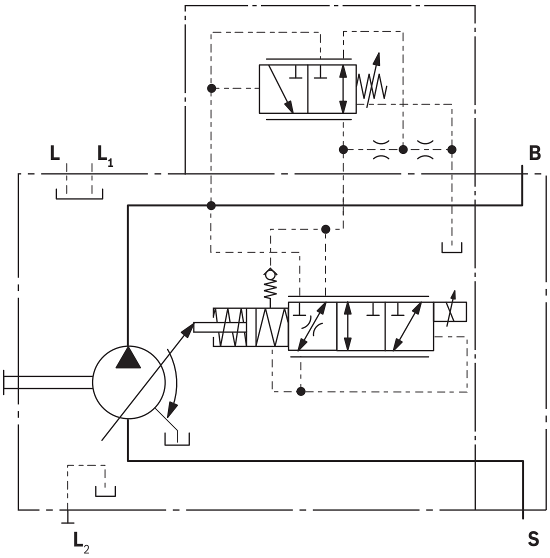
In the $V_{g\,max}$ the spring force of the return spring is maximum. To overcome the force of this spring, the solenoid must be subjected to excessive current (I_{res}).

▼ **Characteristic EK1/2**



- Hysteresis static current-displacement characteristic curve < 5%.
- For changes in current, ramp times of > 200 ms must be observed.

▼ **Circuit diagram EK.D**



Technical data, solenoid	EK1	EK2
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at $V_{g\,min}$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA	600 mA
Minimum working stroke of the dither within the control range[1]	352 mA	176 mA
Dither frequency	100 to 200 Hz	100 to 200 Hz
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Duty cycle	100%	100%
Type of protection: see connector version page 61		
Operating temperature range at valve -20 °C to +115 °C		

	EK1	EK2
I_{min} [mA]	400	200
I_{max} [mA]	1200	600
I_{off} [mA]	< 300	< 150
I_{res} [mA]	> 1200	> 600

Note

We recommend the valve with flushing function for the EK.D control variant. Please contact us.

---

[1] ΔI = 44% of the current difference within the control range, regardless of the mean value of the current

EP(K).DF / EP(K).DS / EP(K) – with pressure and flow control

A hydraulic pressure flow control is superimposed on the electro-proportional control.

The pressure control regulates the pump displacement infinitely varied back to $V_{\text{g min}}$ after the set target pressure has been reached.

This function is super-imposed on the EP or EK control, i.e. the control-current dependent EP or EK function is executed below the target pressure.

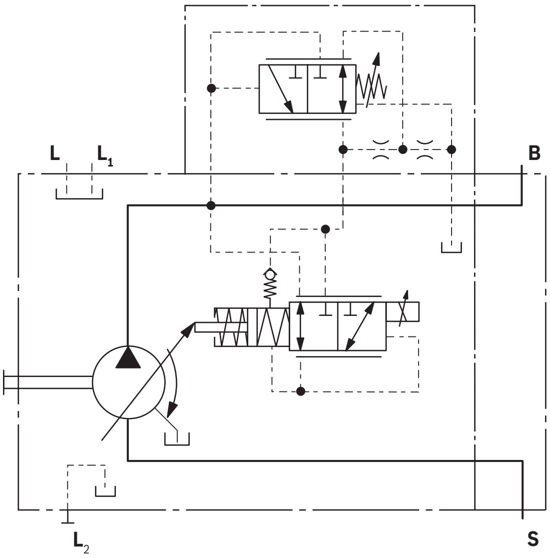
For the adjustment range of the pressure flow control, see page 12 to 15.

With all controller combinations, the V_g reduction has priority.

With flow control, the pump flow can be influenced in addition to pressure control. The pump flow is thus equal to the actual amount of hydraulic fluid required by the consumer. This is achieved using the differential pressure at the consumer (e.g. orifice).

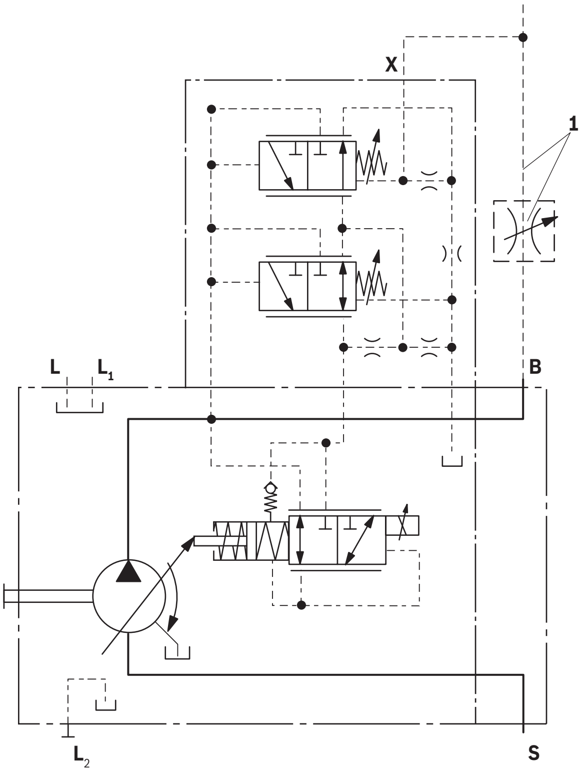
The EP.DS or EK.DS version has no connection between X and the reservoir (load sensing). Please refer to the notes on page 14.

▼ **Circuit diagram EP.D**

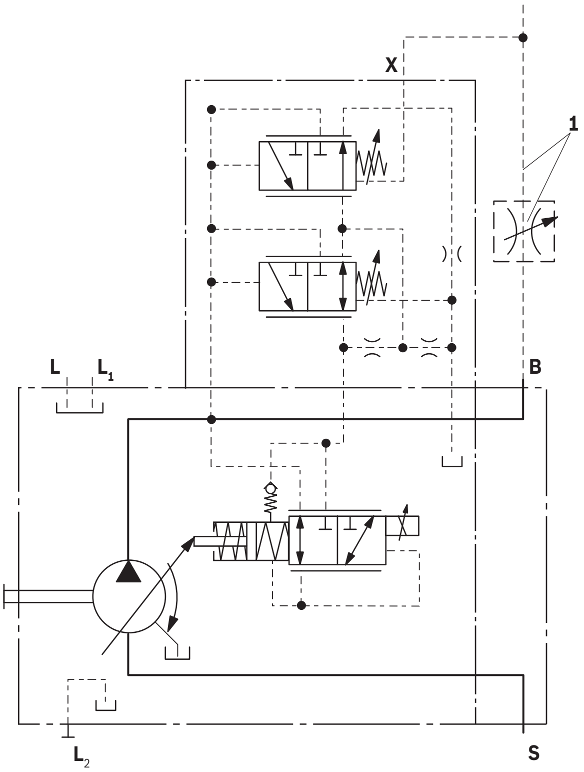


1 The sensing orifice (control block) and the line is not included in the delivery contents.

▼ **Circuit diagram EP.DF**



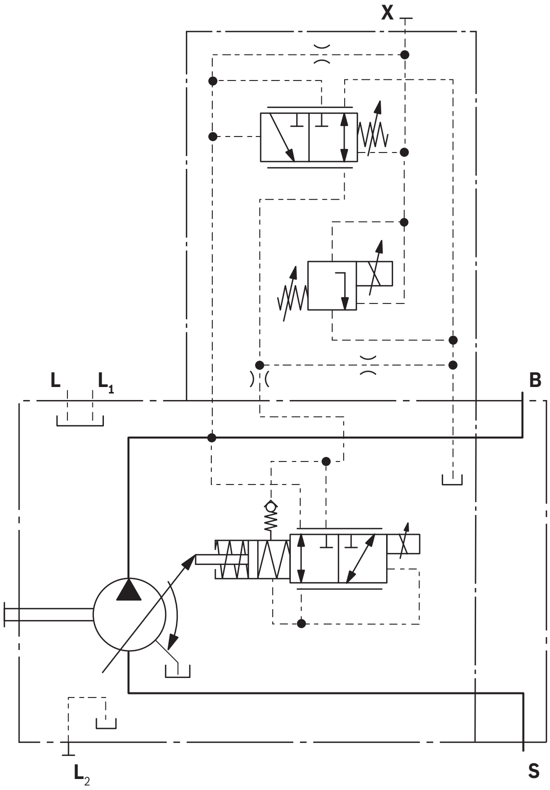
▼ **Circuit diagram EP.DS**



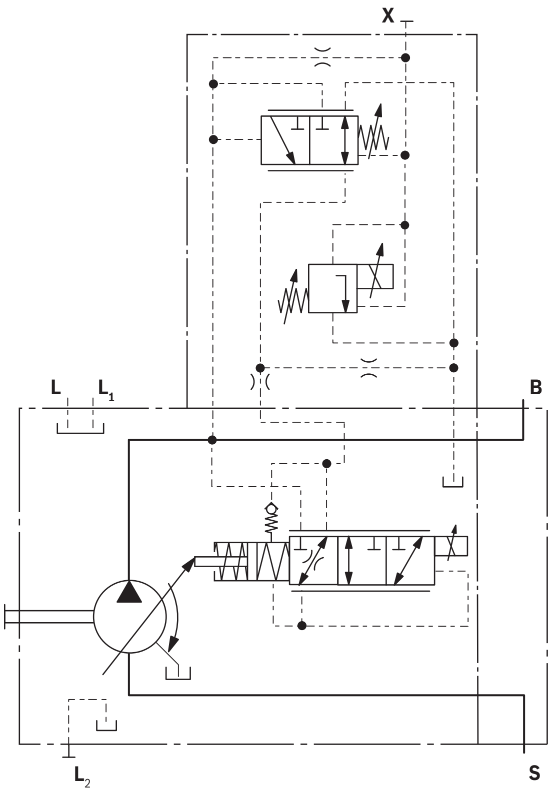
EP.ED / EK.ED – with electro-hydraulic pressure control

The ED valve is set to a certain pressure by a specified variable solenoid current.
When changing the consumer (load pressure), this causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.
The pump thus only delivers as much hydraulic fluid as the consumers can take. The pressure can be set steplessly by the solenoid current.
As the solenoid current signal drops towards zero, the pressure will be limited to $p_{\max}$ by an adjustable hydraulic pressure cut-off (negative characteristic curve, e.g. for fan drives). A PWM signal is used to control the solenoid.
For further information and technical data of the solenoids for ED(ER) control please refer to pages 18 to 21.

▼ **Circuit diagram EP.ED**

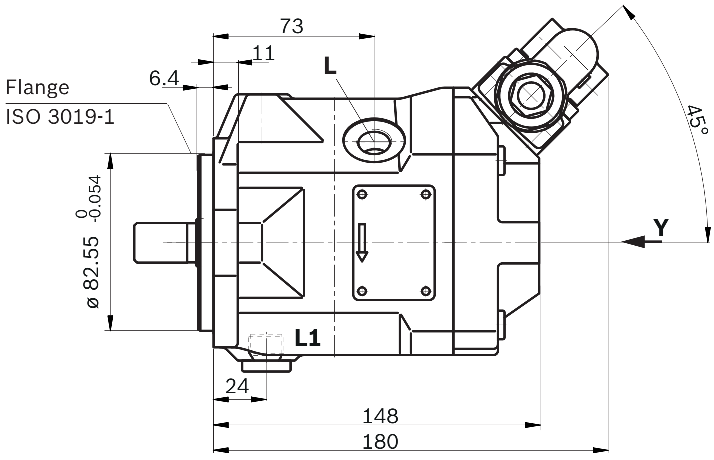


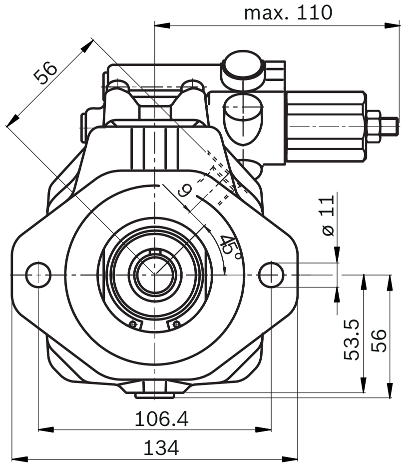
▼ **Circuit diagram EK.ED**



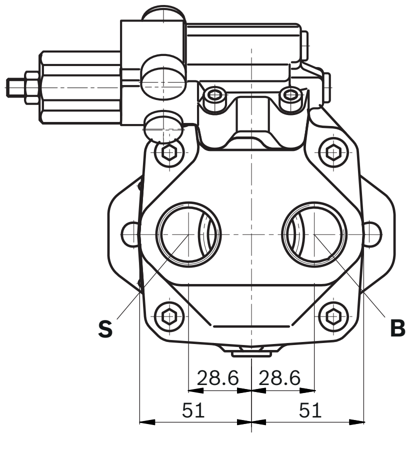
Dimensions size 10

DR – Pressure controller; mounting flange C version SAE; series 52

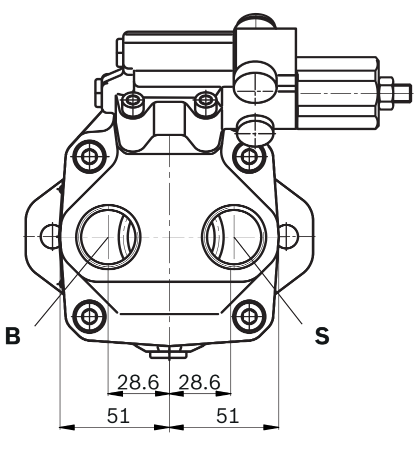




▼ **View Y**
Valve mounting
for clockwise
rotation

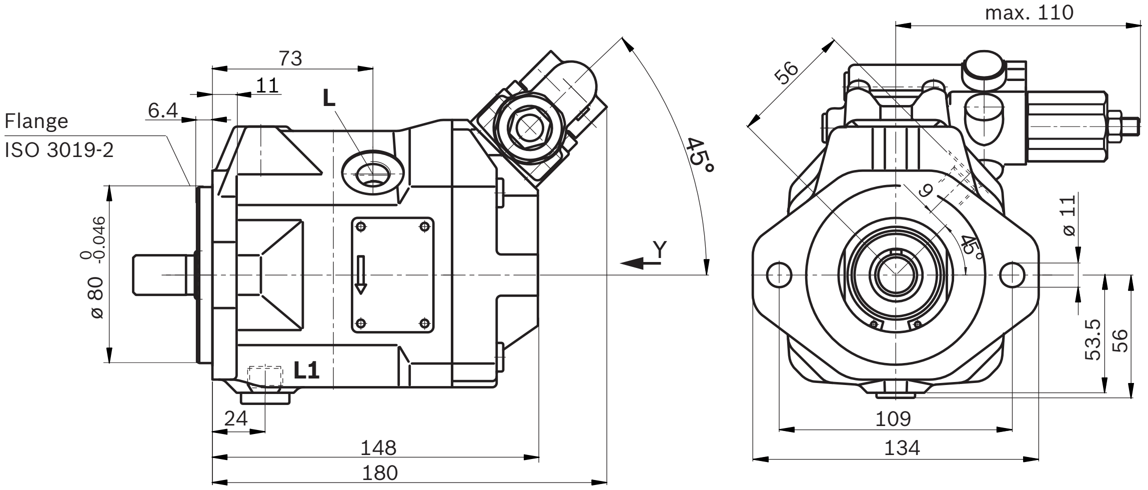


▼ **View Y**
Valve mounting for
counter-clockwise
rotation

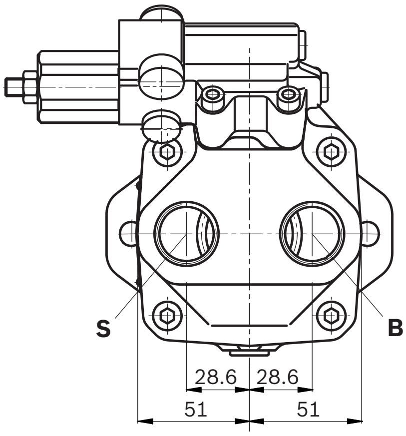


Dimensions size 10

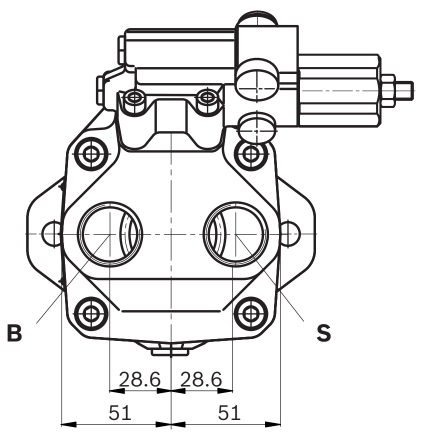
DR – Pressure controller; mounting flange A metric; series 52



▼ **View Y**
Valve mounting
for clockwise
rotation

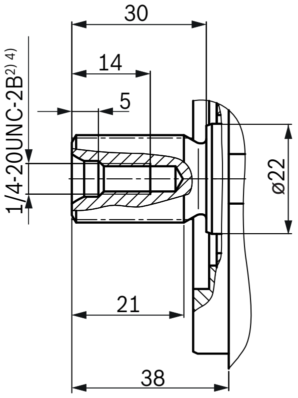


▼ **View Y**
Valve mounting for
counter-clockwise
rotation



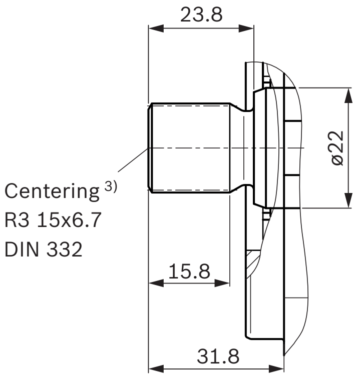
▼ Splined shaft 3/4 in (SAE J744)

S – 11T 16/32DP[1]



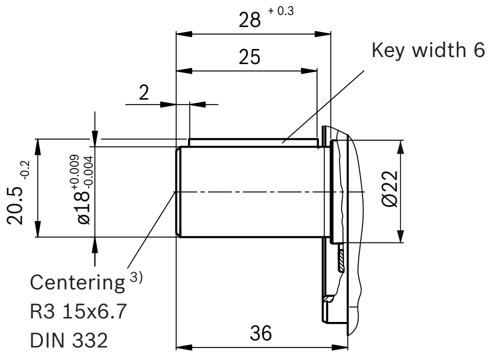
▼ Splined shaft 5/8 in (SAE J744)

U – 9T 16/32DP[1]



▼ Parallel keyed shaft DIN 6885

P – A6x6x25



Ports		**Standard**	**Size**[4]	$p_{\text{max abs}}$ **[bar]**[5]	**State**[8]
B	Working port	DIN 3852	M27 × 2; 16 deep	315	O
S	Suction port	DIN 3852	M27 × 2; 16 deep	5	O
Ports at mounting flange A metric					
L	Drain port	DIN 3852[6]	M16 × 1.5; 12 deep	2	O[7]
L₁	Drain port	DIN 3852[6]	M16 × 1.5; 12 deep	2	X[7]
X with adapter	Control pressure	DIN 3852	M14 × 1.5; 12 deep	315	O
Ports at mounting flange C SAE					
L	Drain port	DIN 11926[6]	9/16-18UNF-2B; 10 deep	2	O[7]
L₁	Drain port	DIN 11926[6]	9/16-18UNF-2B; 10 deep	2	X[7]
X without adapter	Control pressure	DIN 11926	7/16-20UNF-2B; 11.5 deep	315	O

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Coupling axially secured, e.g. with a clamp coupling or radially mounted clamping screw

4) Observe the instructions in the operating instructions concerning the maximum tightening torques.

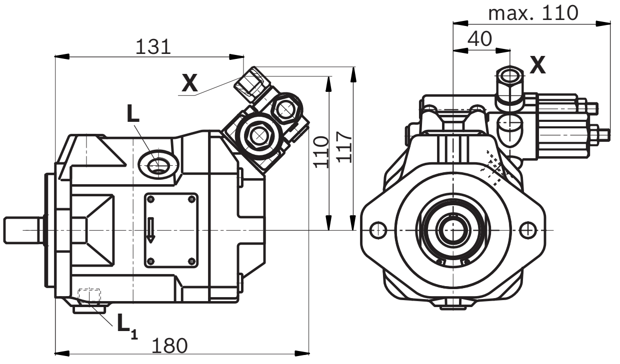
5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

6) The spot face can be deeper than as specified in the standard.

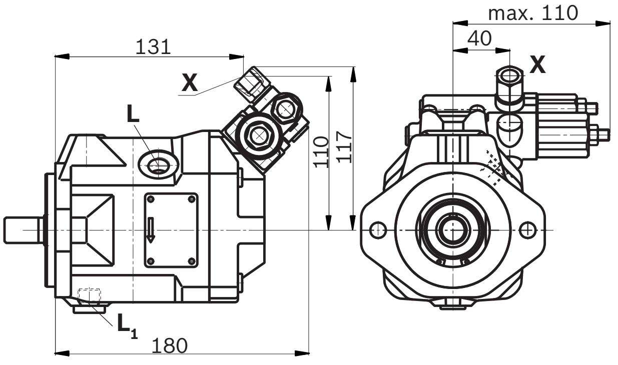
7) Depending on the installation position, **L** or **L₁** must be connected (also see installation instructions starting on page 62).

8) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

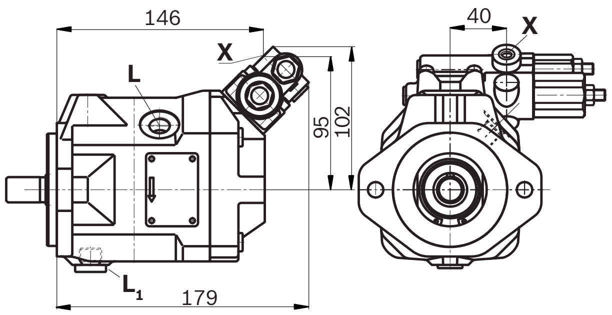
▼ DRG – Pressure control, remotely operated (metric)[1]



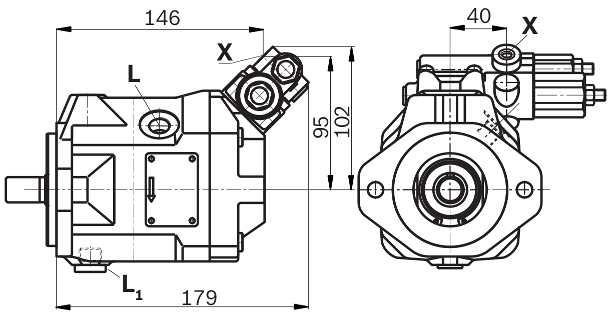
▼ DFR/DFR1 – Pressure, flow control (metric)[1]



▼ DRG – Pressure control, remotely operated (SAE)[1]



▼ DFR/DFR1 – Pressure, flow control (SAE)[1]



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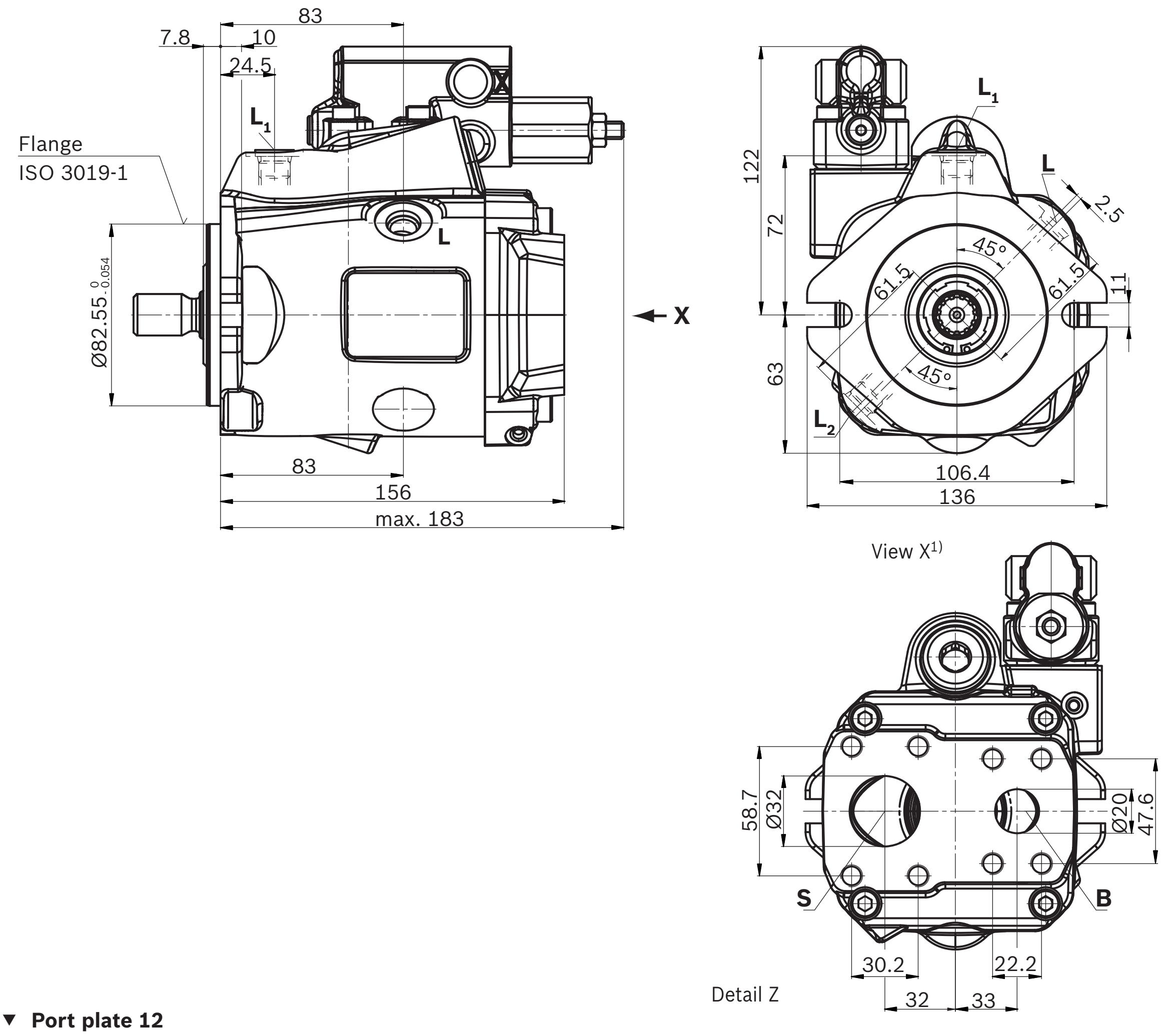
[1] Valve mounting for clockwise or counter-clockwise rotation see page 11 and 12

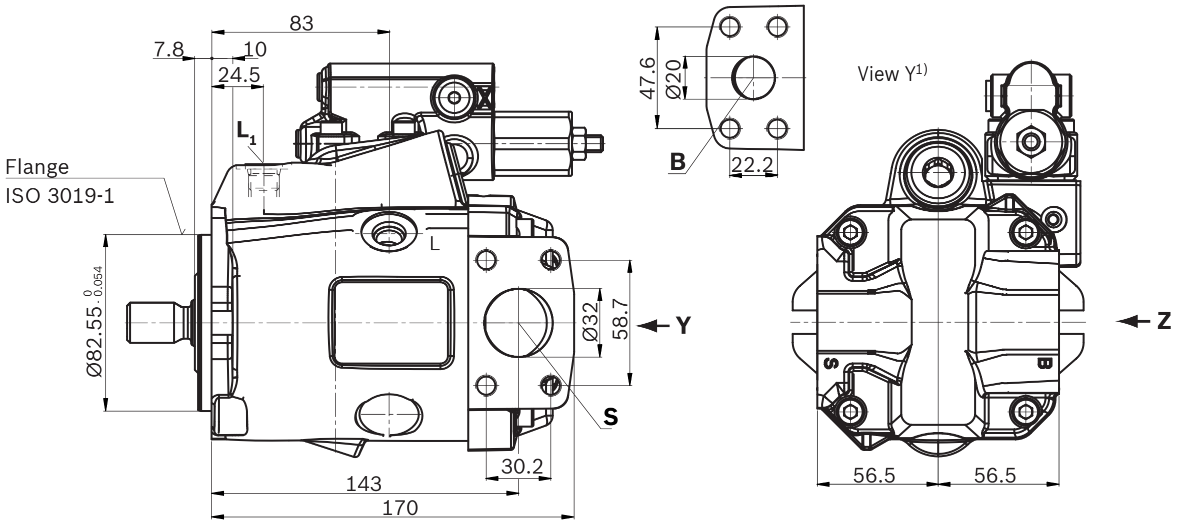
Dimensions size 18

DR – Hydraulic pressure controller, clockwise rotation, series 53

▼ **Port plate 11**



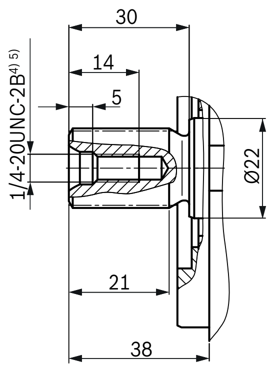
▼ **Port plate 12**



1) Dimensions of working ports turned through 180° for counter-clockwise rotation

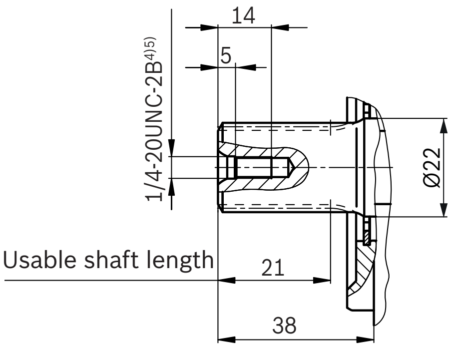
▼ Splined shaft 3/4 in (SAE J744)

S – 11T 16/32DP[1]



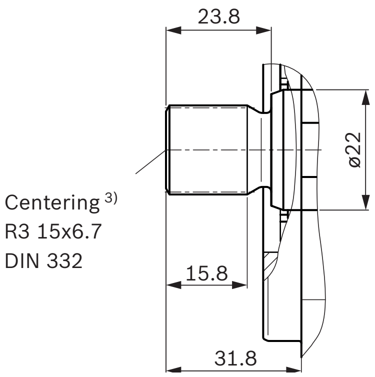
▼ Splined shaft 3/4 in (SAE J744)

R – 11T 16/32DP[1)2)]



▼ Splined shaft 5/8 in (SAE J744)

U – 9T 16/32DP[1]



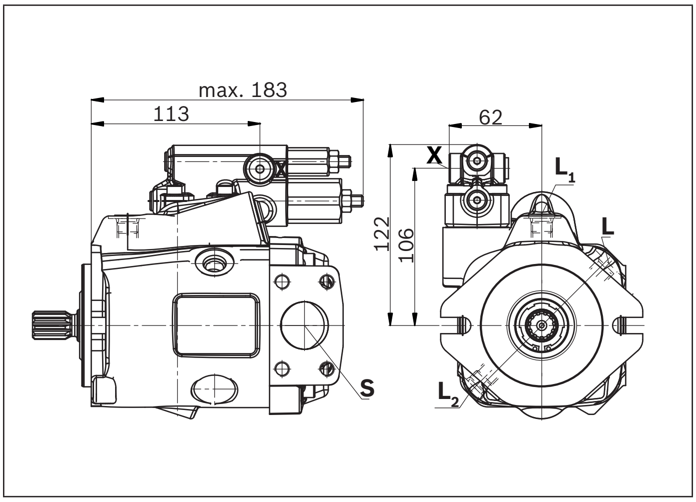
3

Ports		Standard	Size[5]	$p_{\text{max abs}}$ [bar][6]	State[11]
B	Working port (Standard pressure series) Fastening thread	SAE J518[7] DIN 13	3/4 in M10 × 1.5; 17 deep	315	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[7] DIN 13	1 1/4 in M10 × 1.5; 17 deep	5	O
L	Drain port	DIN 11926[8]	3/4-16UNF-2B; 12 deep	2	O[9]
L_1, L_2[10]	Drain port	DIN 11926[8]	3/4-16UNF-2B; 12 deep	2	X[9]
X	Control pressure	DIN 11926	7/16-20UNF-2A; 11.5 deep	315	O

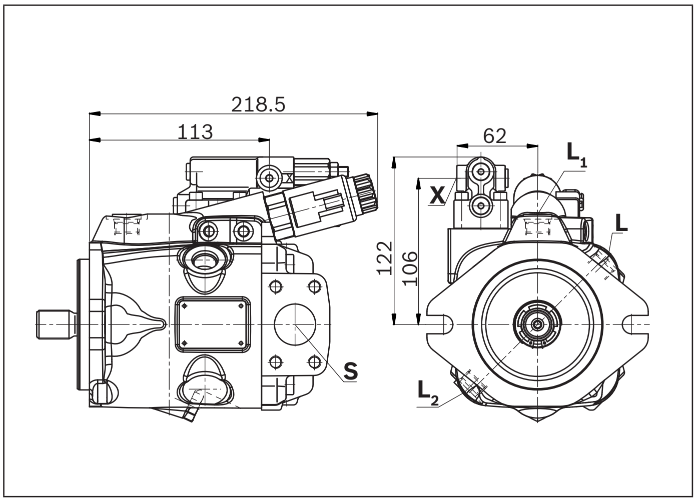
---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.
3) Center bore according to DIN 332
4) Thread according to ASME B1.1
5) Observe the instructions in the operating instructions concerning the maximum tightening torques.
6) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
7) Metric fastening thread is a deviation from standard.
8) The spot face can be deeper than as specified in the standard.
9) Depending on the installation position, **L**, **L_1** or **L_2** must be connected (also see installation instructions starting on page 62).
10) Only series 53
11) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

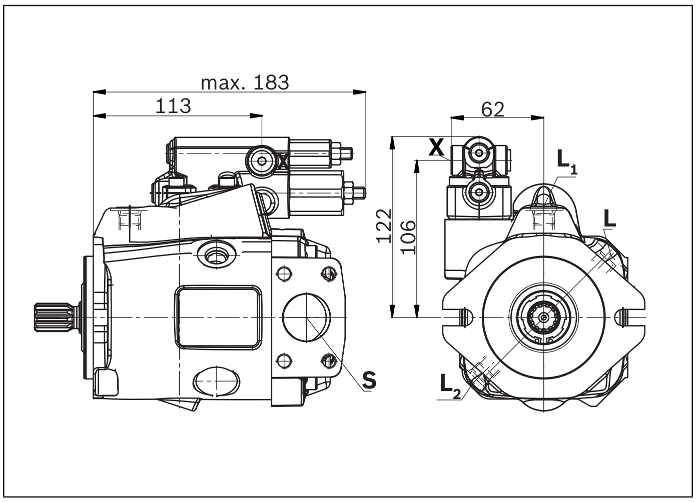
▼ DRG – Pressure controller, remote controlled, series 53



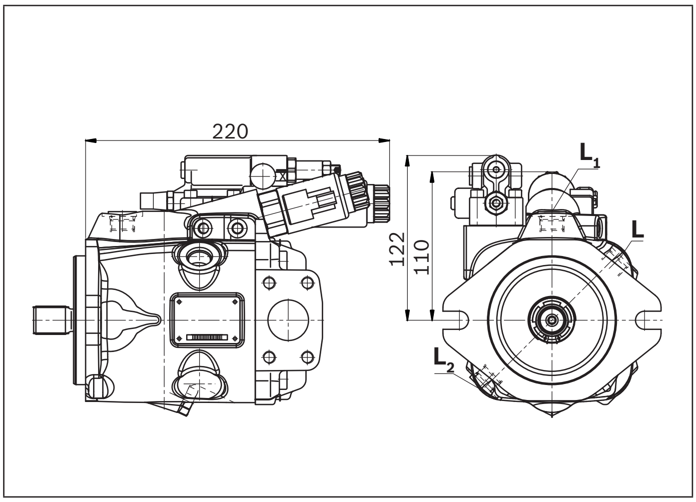
▼ EP.D. / EK.D. – Electro-proportional control, series 53



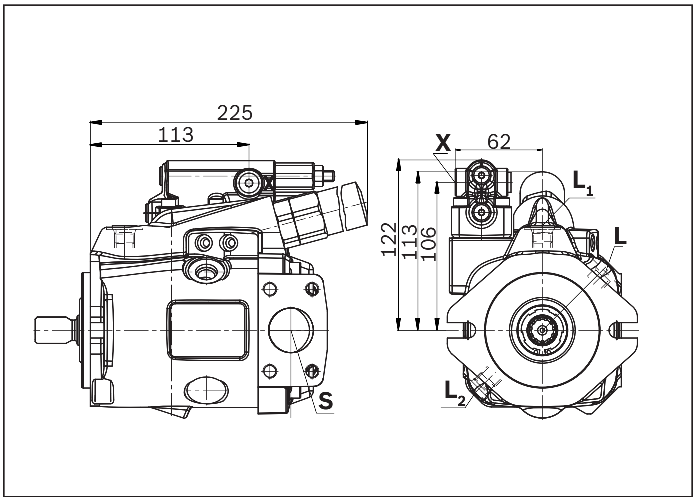
▼ DRF/DRS/DRSC – Pressure and flow control, series 53



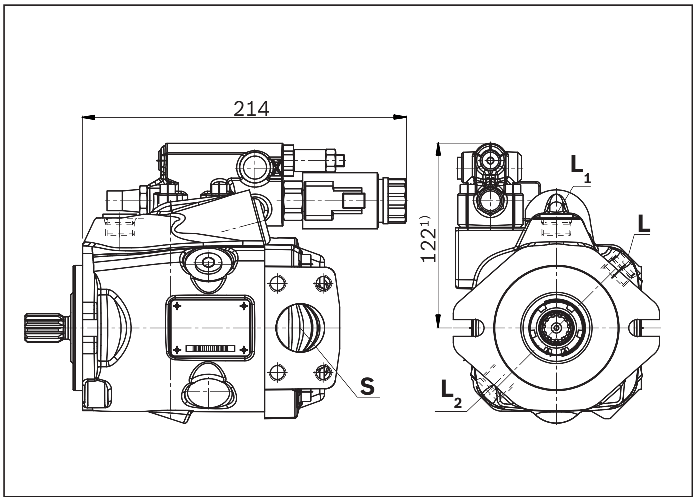
▼ EP.ED. / EK.ED. – Electro-prop. control, series 53



▼ LA.D. – Pressure, flow and power control, series 53



▼ ED7. / ER7. – Electro-prop. Pressure control, series 53



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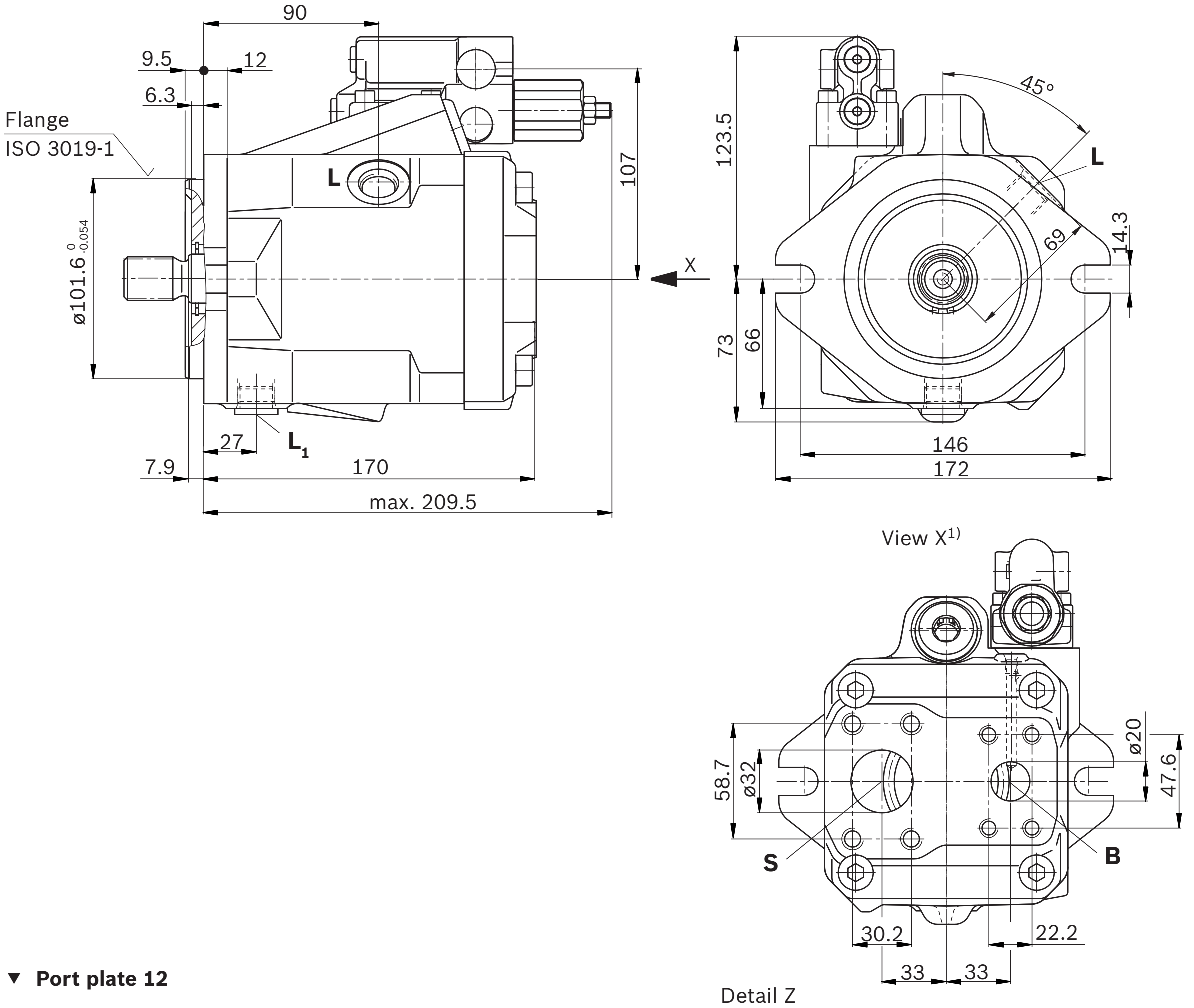
[1] ER7.: 157 mm if using an intermediate plate pressure controller

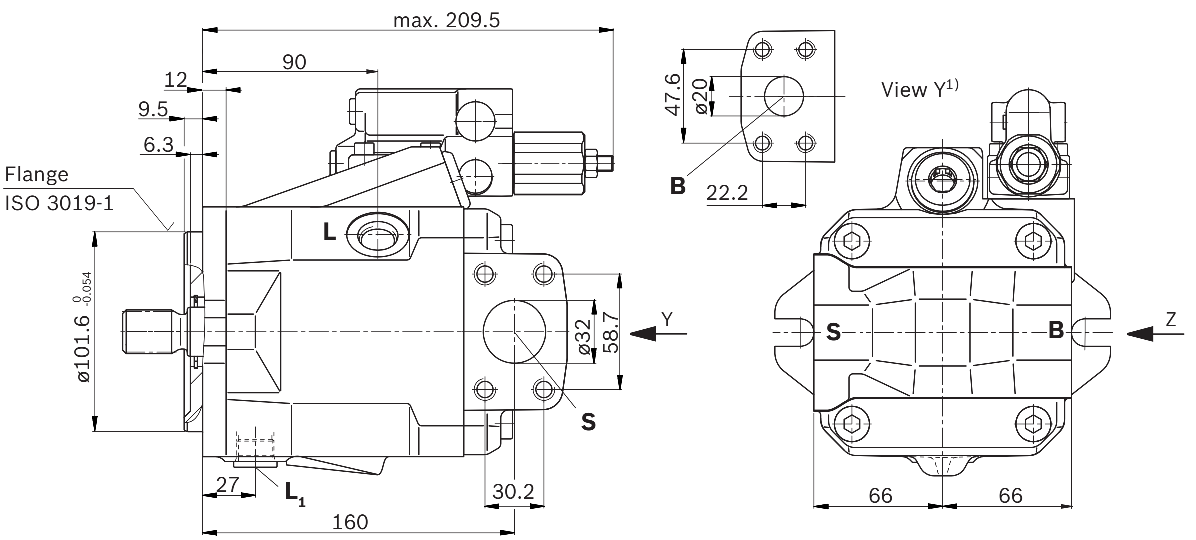
Dimensions size 28

DR – Hydraulic pressure controller, clockwise rotation, series 52 2)

▼ **Port plate 11**



▼ **Port plate 12**

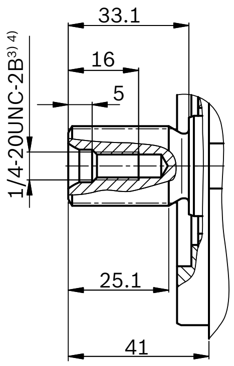


1) Dimensions of working ports turned through 180° for counter-clockwise rotation

2) Primary dimensions for pump apply to series 52 and 53

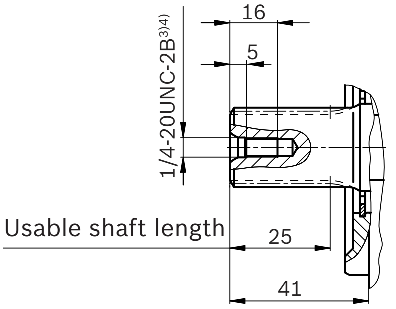
▼ Splined shaft 7/8 in (SAE J744)

S – 13T 16/32DP[1]



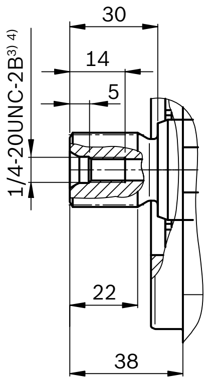
▼ Splined shaft 7/8 in (SAE J744)

R – 13T 16/32DP[1][2]



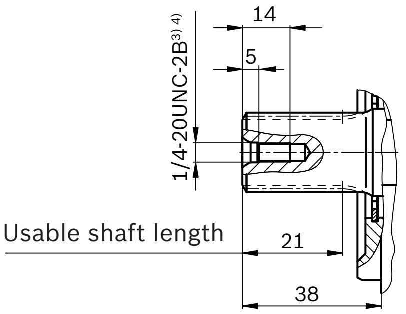
▼ Splined shaft 3/4 in (SAE J744)

U – 11T 16/32DP[1]



▼ Splined shaft 3/4 in (SAE J744)

W – 11T 16/32DP[1][2]



Ports		Standard	Size[4]	$p_{\text{max abs}}$ [bar][5]	State[10]
B	Working port (Standard pressure series) Fastening thread	SAE J518[6] DIN 13	3/4 in M10 × 1.5; 17 deep	315	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	1 1/4 in M10 × 1.5; 17 deep	5	O
L	Drain port	ISO 11926[7]	3/4-16UNF-2B; 12 deep	2	O[8]
L₁, **L₂**[9]	Drain port	ISO 11926[7]	3/4-16UNF-2B; 12 deep	2	X[8]
X	Control pressure	ISO 11926	7/16-20UNF-2B; 11.5 deep	315	O

---

[1] Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

[3] Thread according to ASME B1.1

[4] Observe the instructions in the operating instructions concerning the maximum tightening torques.

[5] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[6] Metric fastening thread is a deviation from standard.

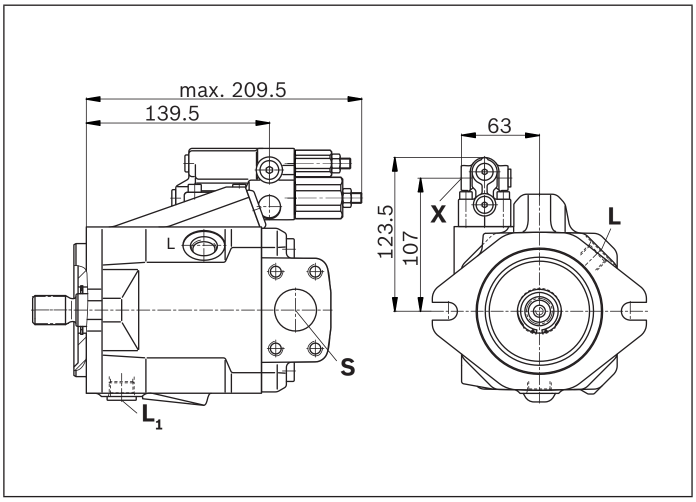
[7] The spot face can be deeper than as specified in the standard.

[8] Depending on the installation position, **L**, **L**$_1$ or **L**$_2$ must be connected (also see installation instructions starting on page 62).

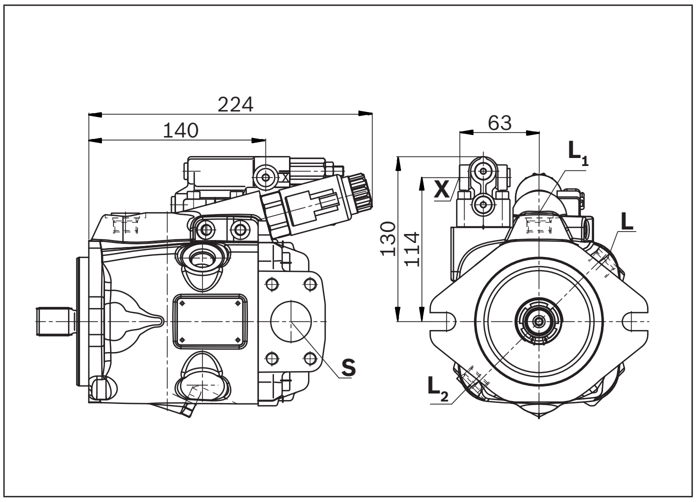
[9] Only for series 53

[10] O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

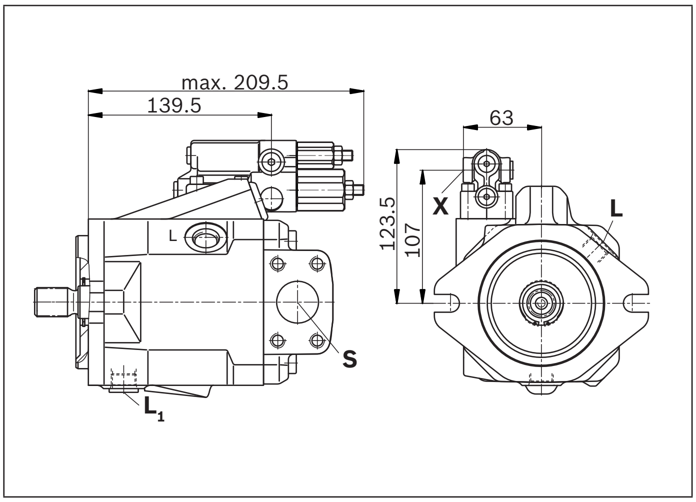
▼ DRG – Pressure controller, remote controlled, series 52 (53)



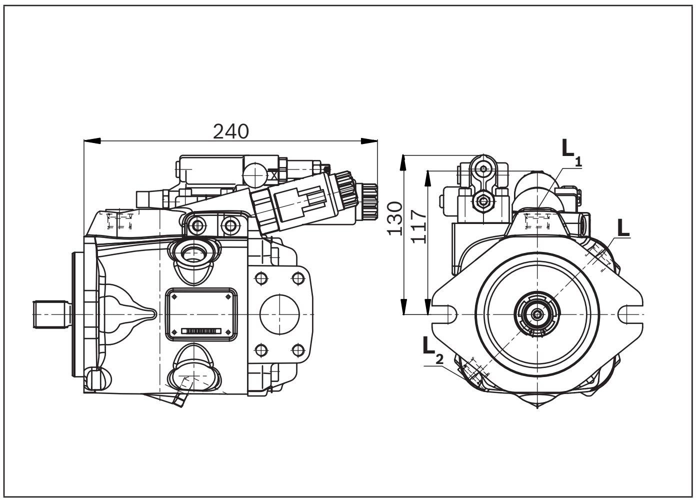
▼ EP.D. / EK.D. – Electro-proportional control, series 53



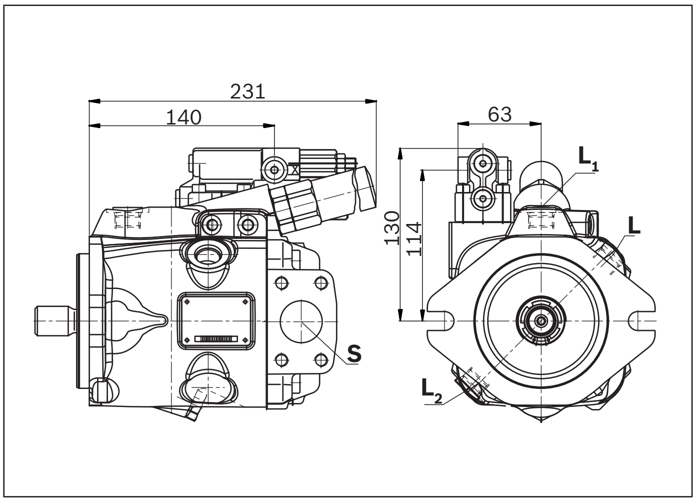
▼ DFR/DFR1/DRSC – Pressure and flow control, series 52 (53)



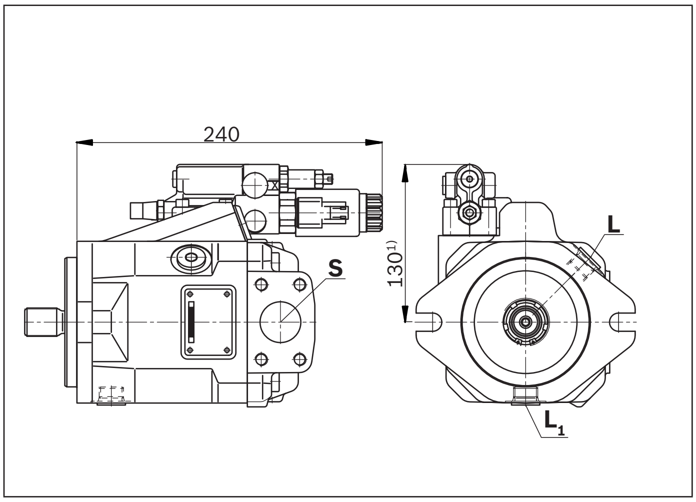
▼ EP.ED. / EK.ED. – Electro-proportional control, series 53



▼ LA.D. – Pressure, flow and power control, series 53



▼ ED7. / ER7. – Electro-prop. Pressure control, series 52 (53)



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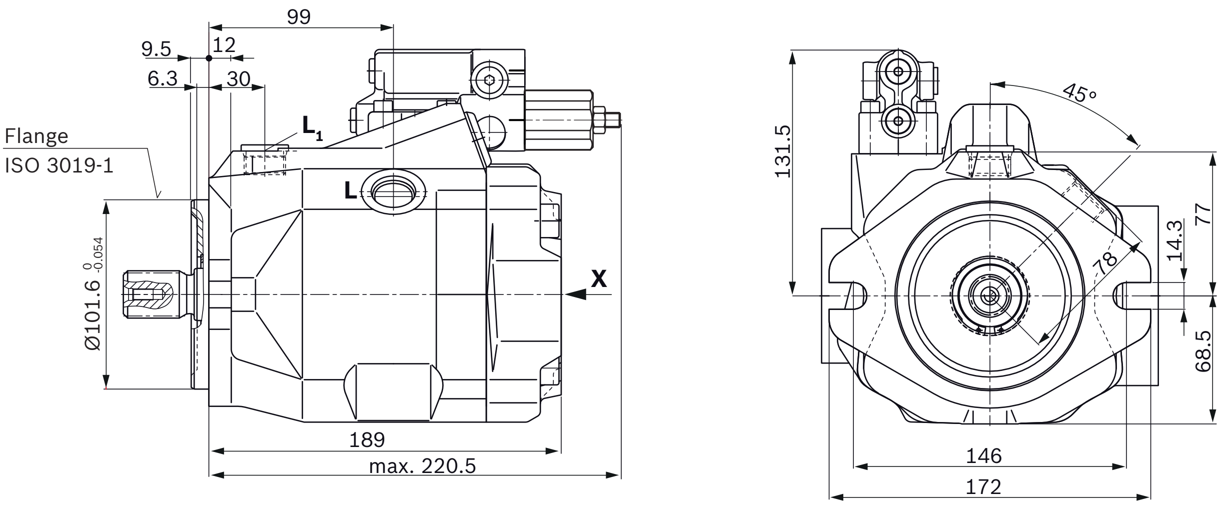
1) ER7.: 159 mm if using an intermediate plate pressure controller

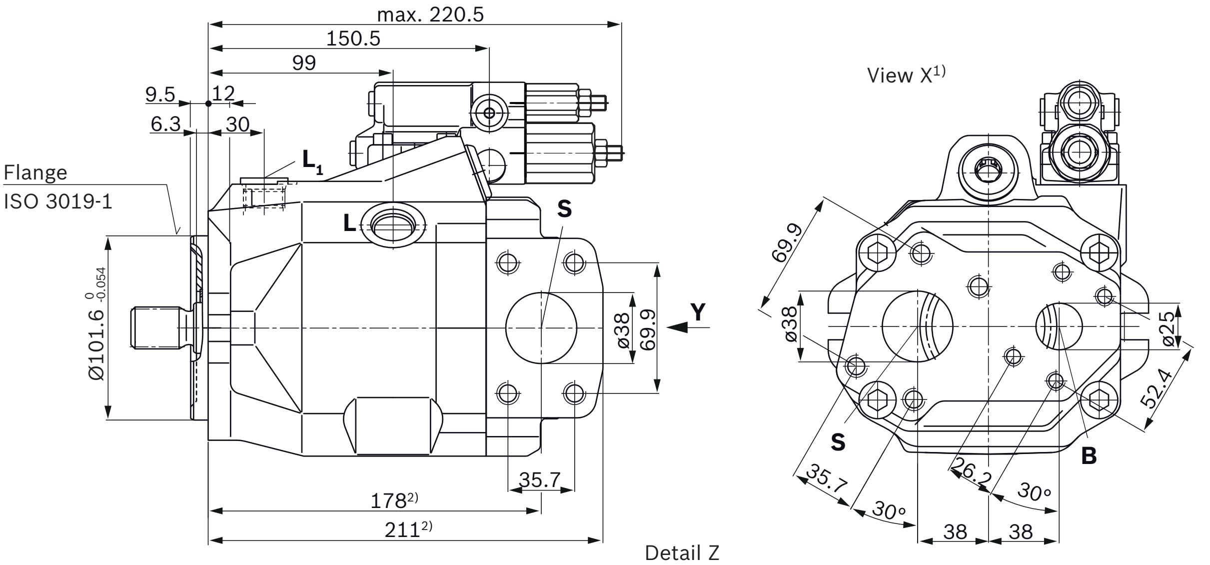
Dimensions size 45

DR – Hydraulic pressure controller, clockwise rotation, series 52[3)]

▼ **Port plate 11**

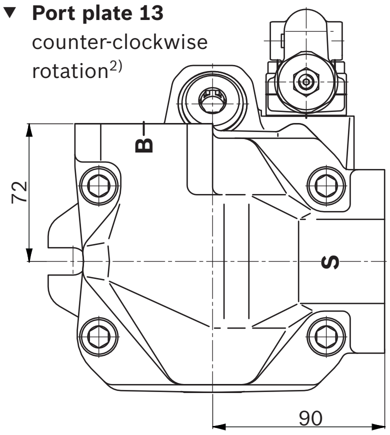


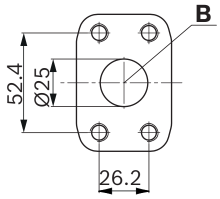
▼ **Port plate 12**

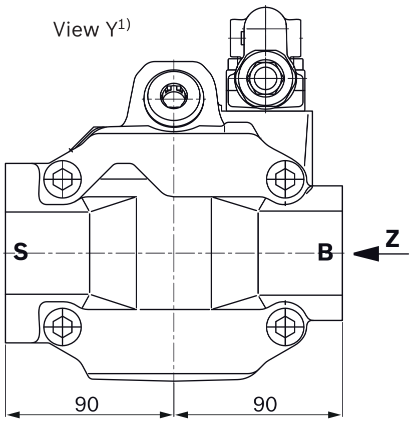


Detail Z

▼ **Port plate 13**
counter-clockwise
rotation[2)]







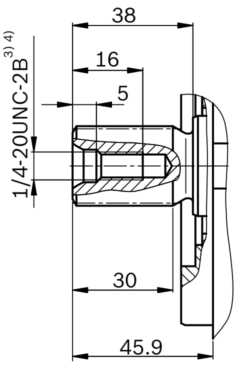
[1)] Dimensions of working ports turned through 180° for counter-clockwise rotation

[2)] For dimensions of working ports S and B for port plate 13, please refer to port plate 12, footnote 2).

[3)] Primary dimensions for pump apply to series 52 and 53

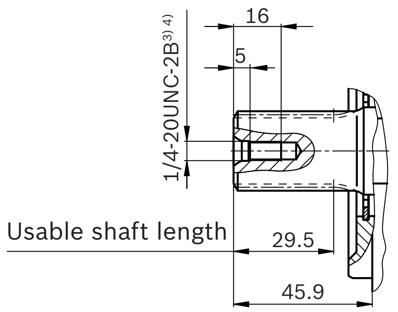
▼ Splined shaft 1 in SAE J744

S – 15T 16/32DP[1]



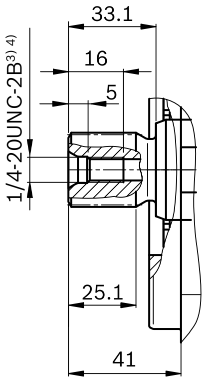
▼ Splined shaft 1 in SAE J744

R – 15T 16/32DP[1)2)]



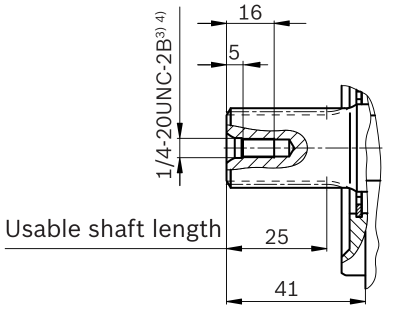
▼ Splined shaft 7/8 in SAE J744

U – 13T 16/32DP[1]



▼ Splined shaft 7/8 in SAE J744

W – 13T 16/32DP[1]



Ports		Standard	Size[4]	$p_{\text{max abs}}$ [bar][5]	State[10]
B	Working port (Standard pressure series) Fastening thread	SAE J518[6] DIN 13	1 in M10 × 1.5; 17 deep	315	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	1 1/2 in M12 × 1.75; 20 deep	5	O
L	Drain port	ISO 11926[7]	7/8-14UNF-2B; 13 deep	2	O[8]
L₁, **L₂**[9]	Drain port	ISO 11926[7]	7/8-14UNF-2B; 13 deep	2	X[8]
X	Control pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	315	O

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) Observe the instructions in the operating instructions concerning the maximum tightening torques.

5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

6) Metric fastening thread is a deviation from standard.

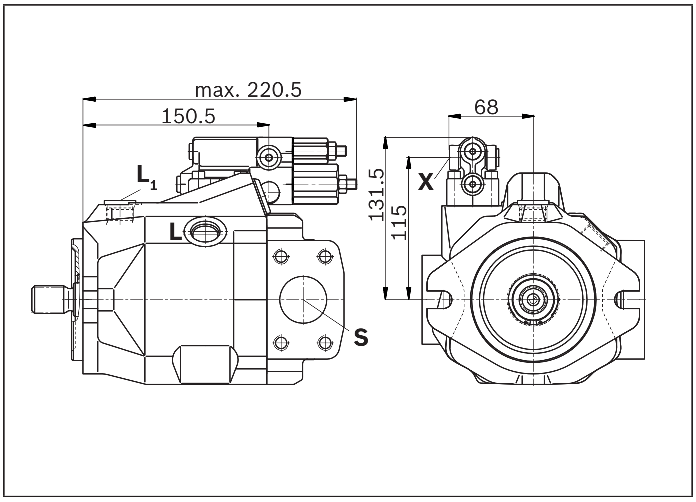
7) The spot face can be deeper than as specified in the standard.

8) Depending on the installation position, **L**, **L**$_1$ or **L**$_2$ must be connected (also see installation instructions starting on page 62).

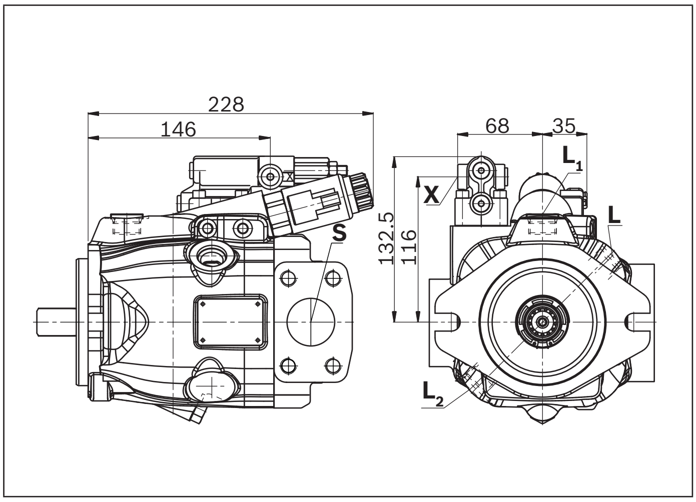
9) Only series 53

10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

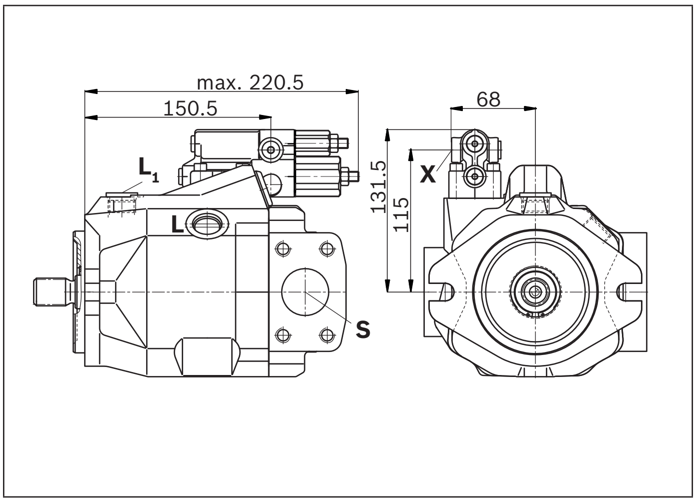
▼ DRG – Pressure controller, remote controlled, series 52 (53)



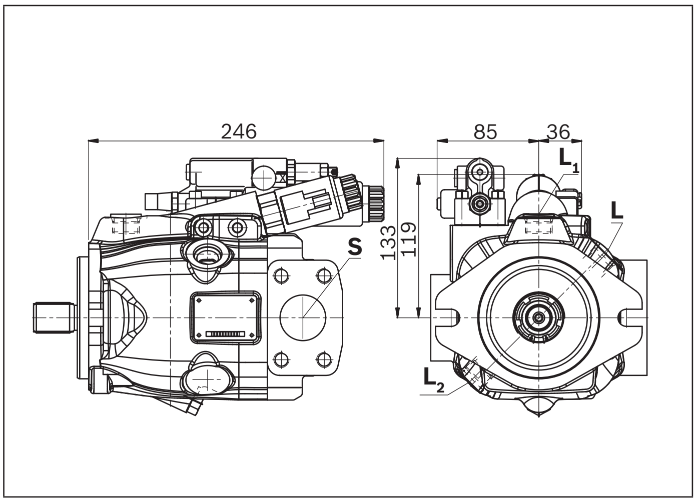
▼ EP.D. / EK.D. – Electro-proportional control, series 53



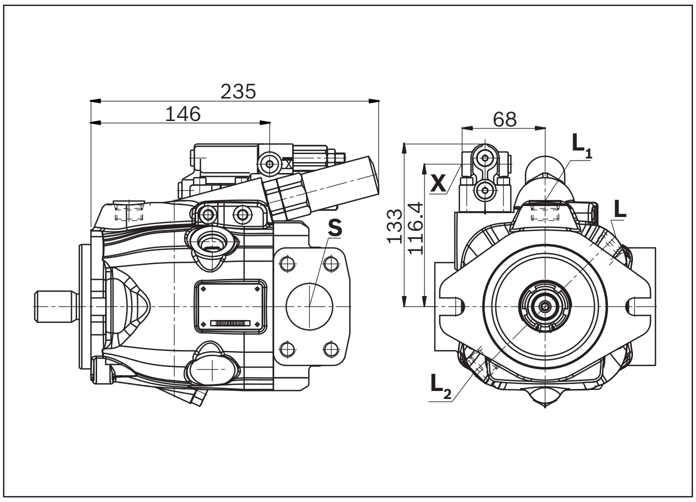
▼ DFR/DFR1/DRSC – Pressure and flow control, series 52 (53)



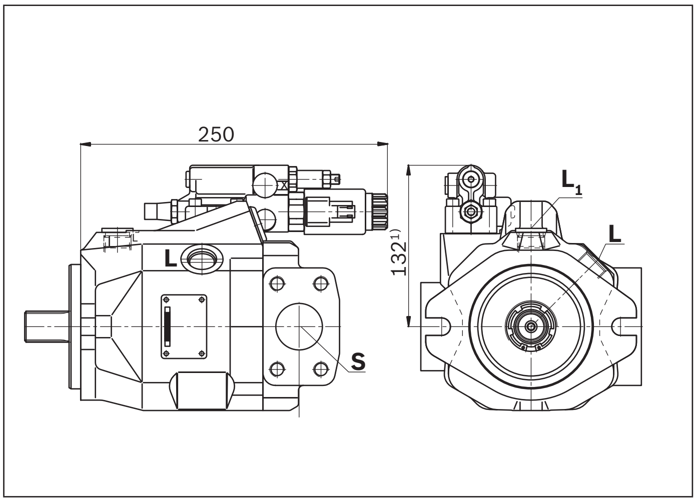
▼ EP.ED. / EK.ED. – Electro-prop. control, series 53



▼ LA.D. – Pressure, flow and power control, series 53



▼ ED7. / ER7. – Electro-prop. Pressure control, series 52



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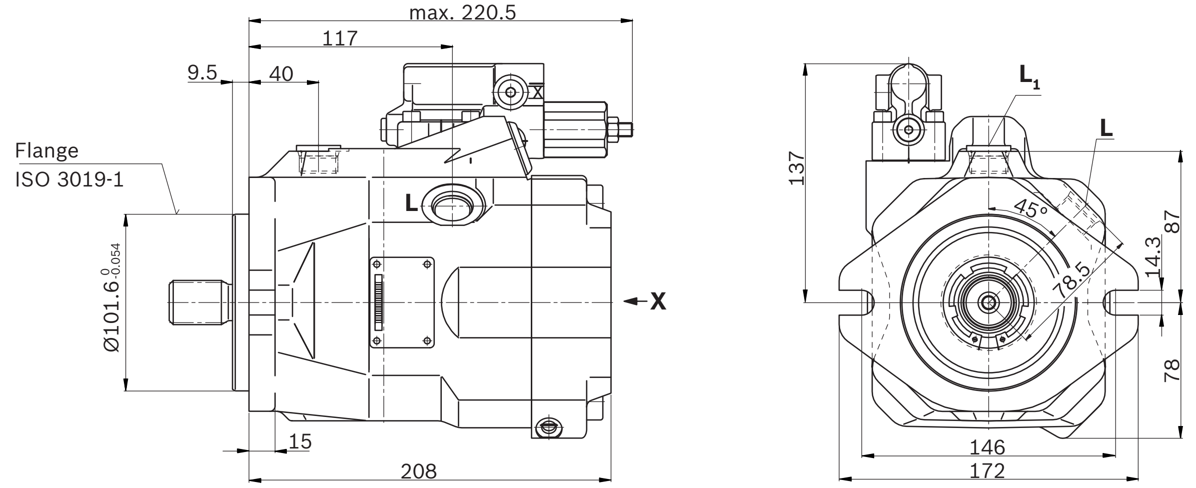
[1] ER7.: 167 mm if using an intermediate plate pressure controller

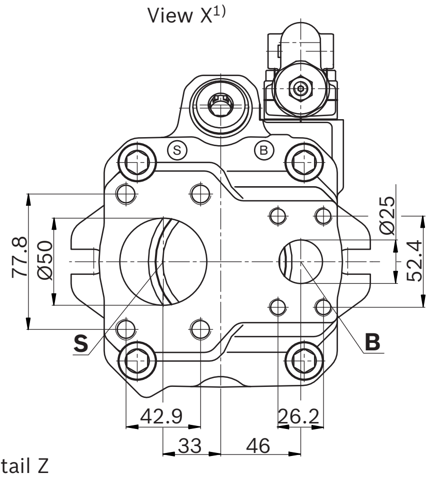
Dimensions size 60

DR – Hydraulic pressure controller, clockwise rotation, mounting flange C series 52

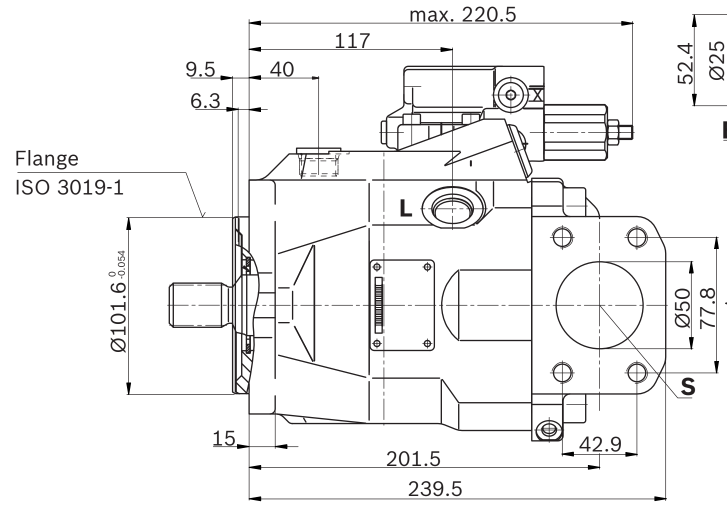
▼ Port plate 11



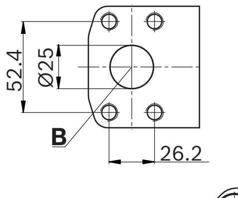
View X¹⁾



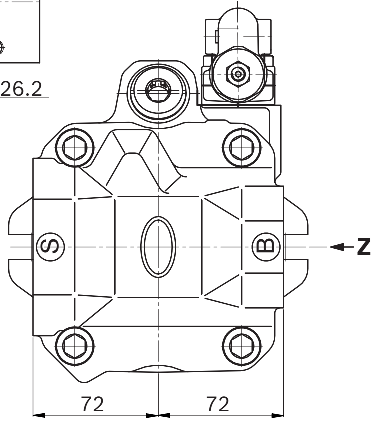
▼ Port plate 12



Detail Z



View Y¹⁾



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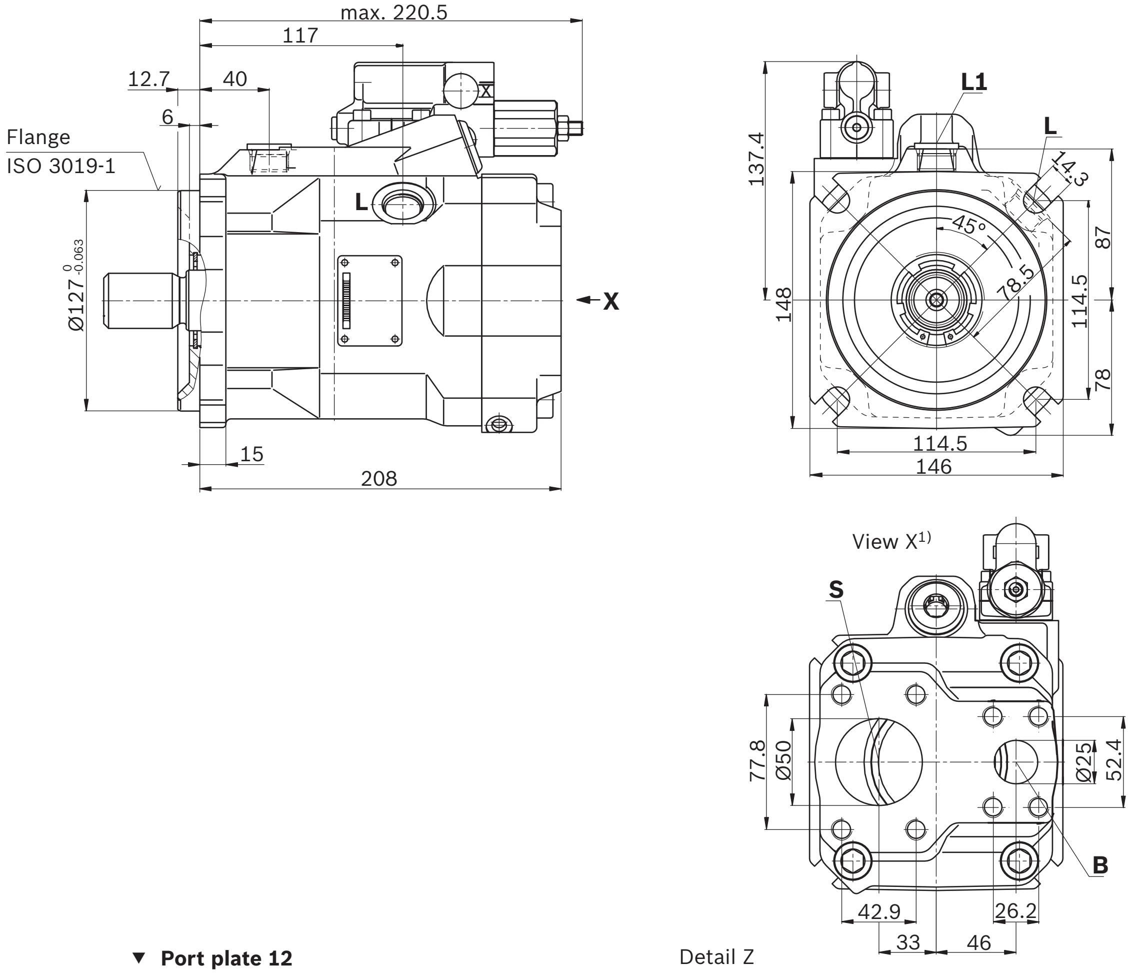
1) Dimensions of working ports turned through 180° for counter-clockwise rotation

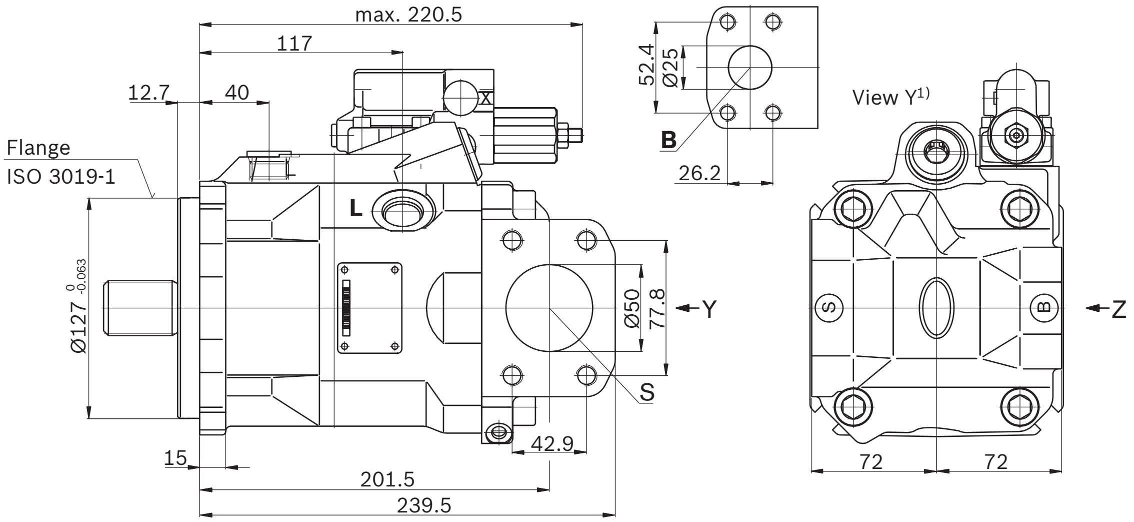
Dimensions size 60

DR – Hydraulic pressure controller, clockwise rotation, mounting flange D series 52

▼ **Port plate 11**



▼ **Port plate 12**



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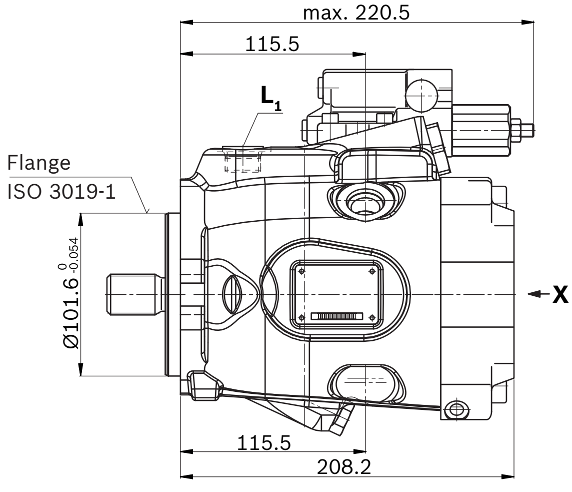
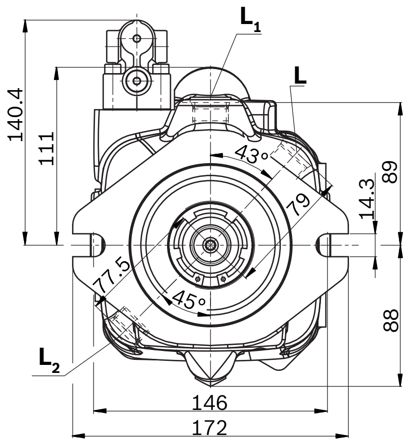
1) Dimensions of working ports turned through 180° for counter-clockwise rotation

Dimensions size 63

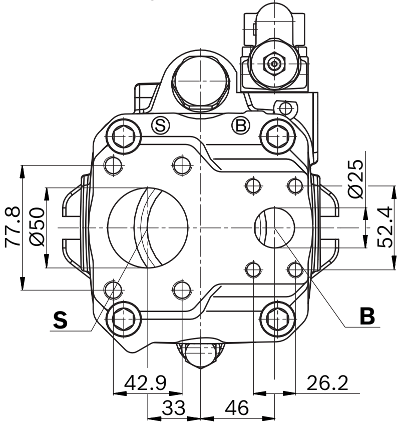
DR – Hydraulic pressure controller, clockwise rotation, mounting flange C series 53

▼ Port plate 11

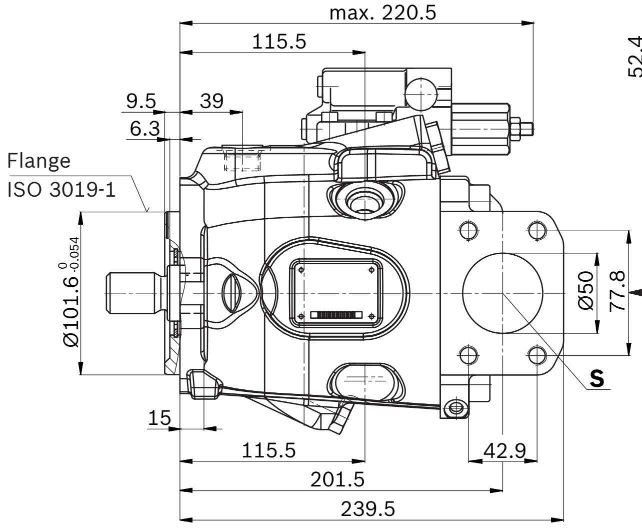




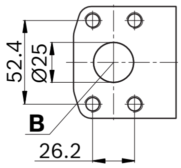
View X1)



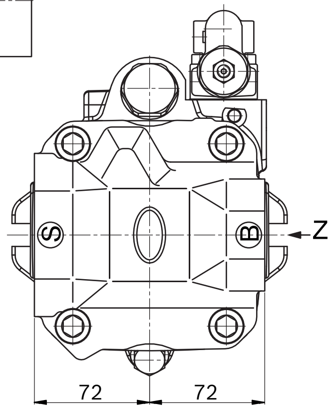
▼ Port plate 12



Detail Z



View Y1)

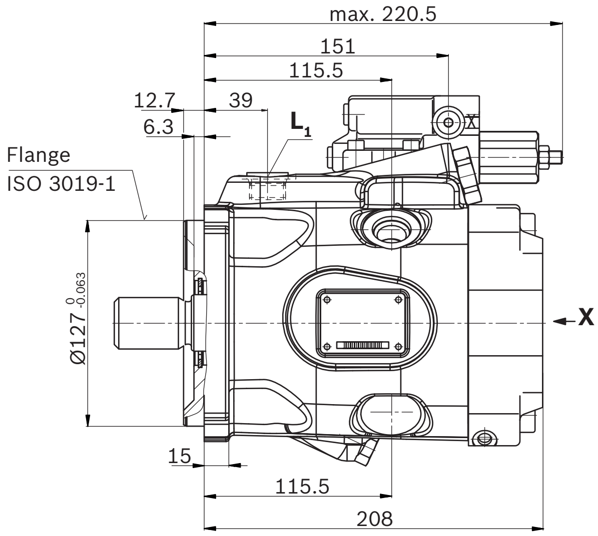


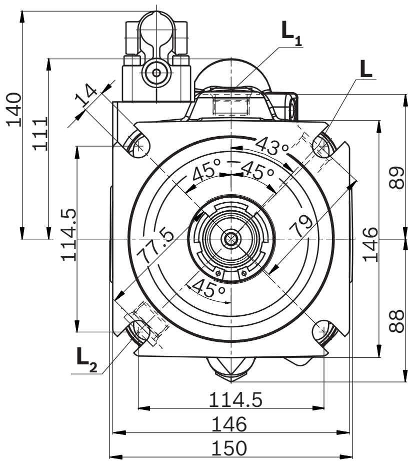
1) Dimensions of working ports turned through 180° for counter-clockwise rotation

Dimensions size 63

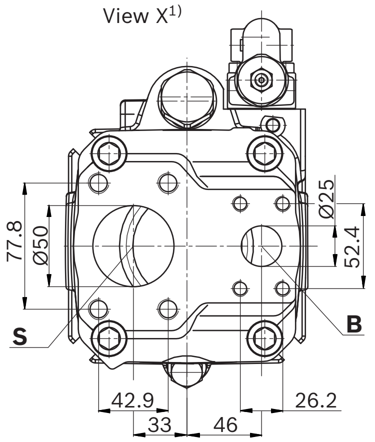
DR – Hydraulic pressure controller, clockwise rotation, mounting flange D series 53

▼ Port plate 11

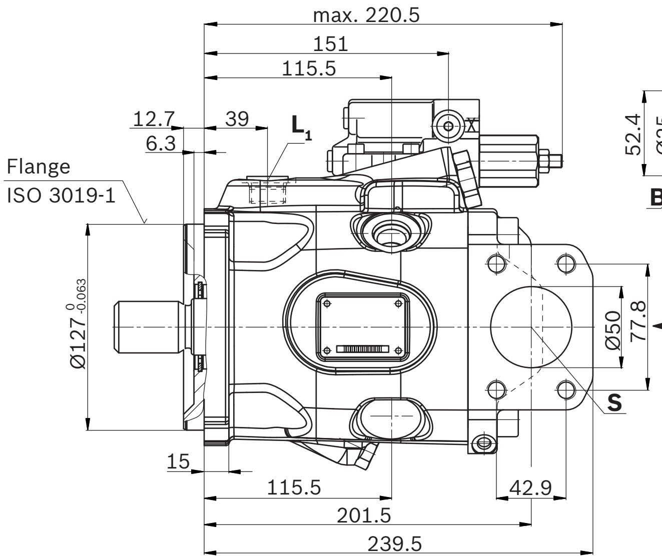




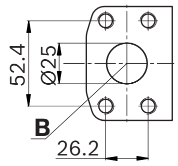
View X¹⁾



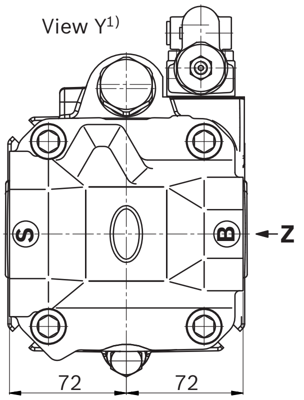
▼ Port plate 12



Detail Z



View Y¹⁾



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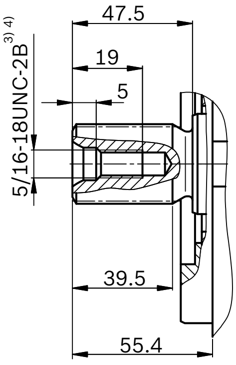
1) Dimensions of working ports turned through 180° for counter-clockwise rotation

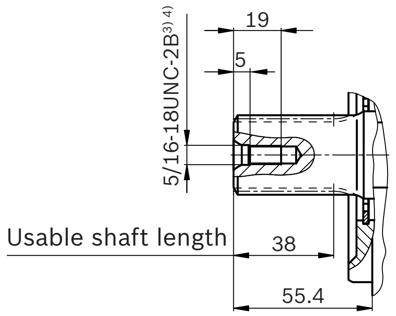
▼ Splined shaft 1 1/4 in SAE J744

S – 14T 12/24DP[1]



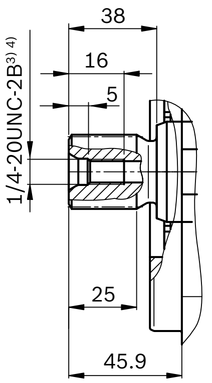
▼ Splined shaft 1 1/4 in SAE J744

R – 14T 12/24DP[1)2)]



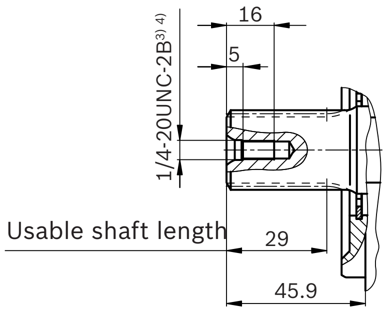
▼ Splined shaft 1 in SAE J744

U – 15T 16/32DP[1]



▼ Splined shaft 1 in SAE J744

W – 15T 16/32DP[1]

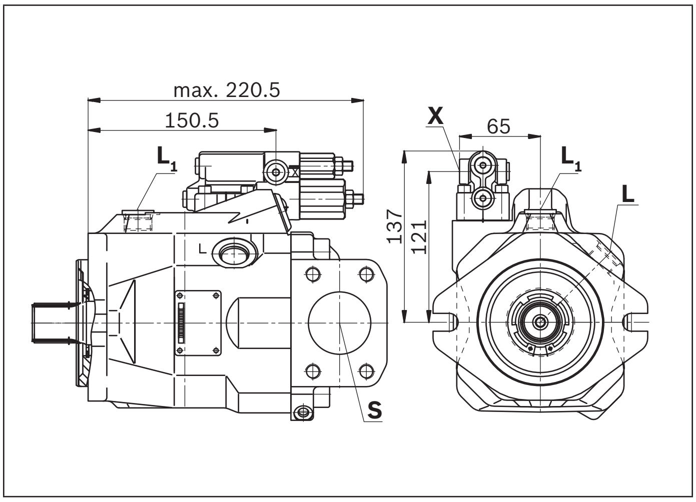


Ports		**Standard**	**Size**[4]	$p_{\text{max abs}}$ **[bar]**[5]	**State**[10]
B	Working port (Standard pressure series) Fastening thread	SAE J518[6] DIN 13	1 in M10 × 1.5; 17 deep	315	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	2 in M12 × 1.75; 20 deep	5	O
L	Drain port	ISO 11926[7]	7/8-14UNF-2B; 13 deep	2	O[8]
$\mathbf{L_1}$, $\mathbf{L_2}$[9]	Drain port	ISO 11926[7]	7/8-14UNF-2B; 13 deep	2	X[8]
X	Control pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	315	O

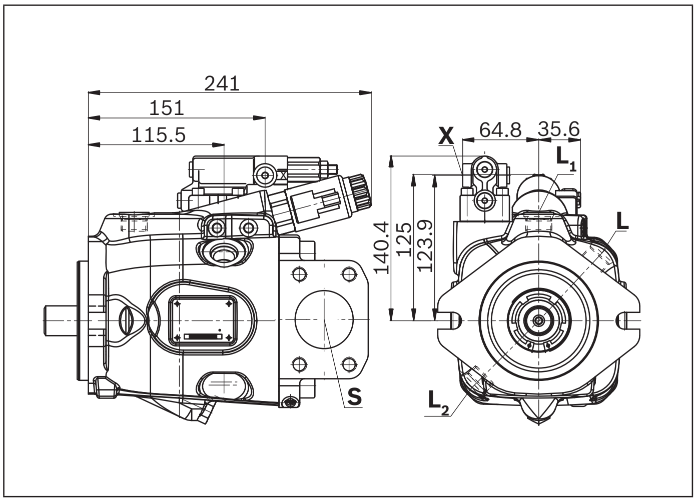
---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.
3) Thread according to ASME B1.1
4) Observe the instructions in the operating instructions concerning the maximum tightening torques.
5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
6) Metric fastening thread is a deviation from standard.
7) The spot face can be deeper than as specified in the standard.
8) Depending on the installation position, **L**, $\mathbf{L_1}$ or $\mathbf{L_2}$ must be connected (also see installation instructions starting on page 62).
9) Only series 53
10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

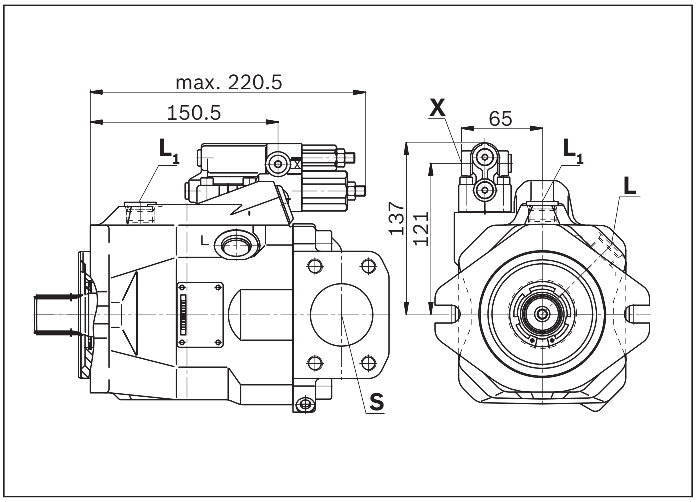
▼ **DRG – Pressure controller, remote controlled, series 53 (52)**



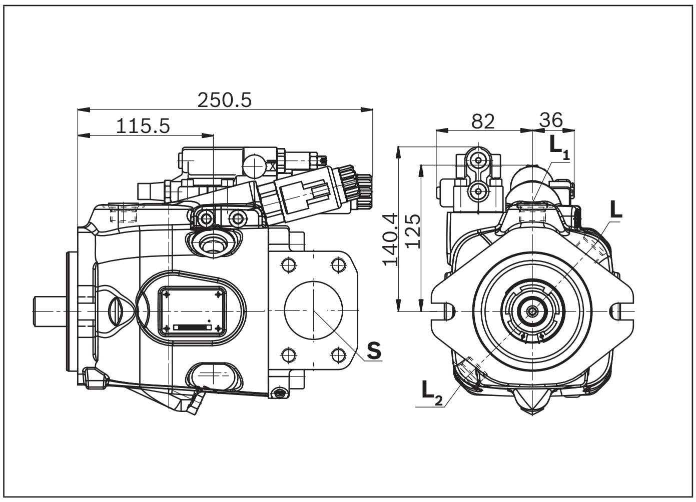
▼ **EP.D. / EK.D. – Electro-proportional control, series 53**



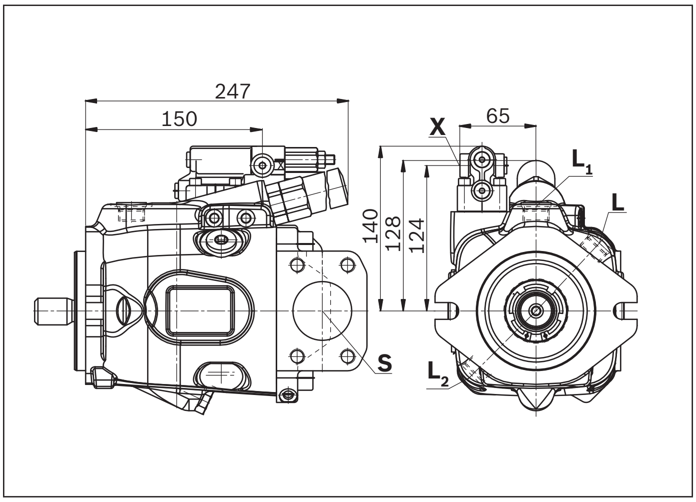
▼ **DFR/DFR1/DRSC – Pressure and flow control, series 53 (52)**



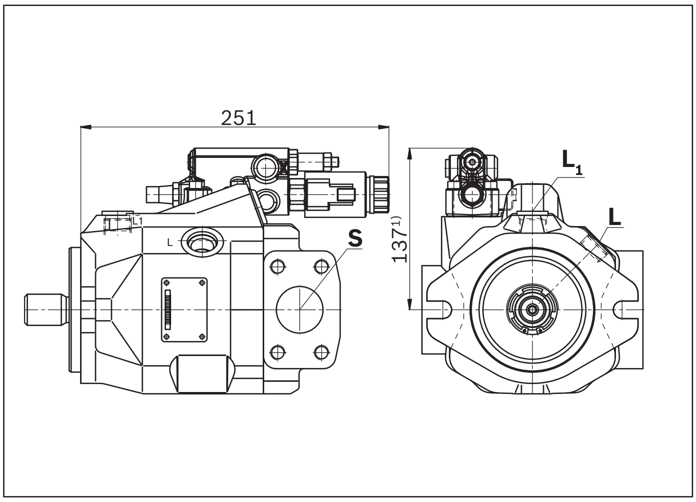
▼ **EP.ED. / EK.ED. – Electro-prop. control, series 53**



▼ **LA.D. – Pressure, flow and power control, series 53**



▼ **ED7. / ER7. – Electro-prop. Pressure control, series 53 (52)**



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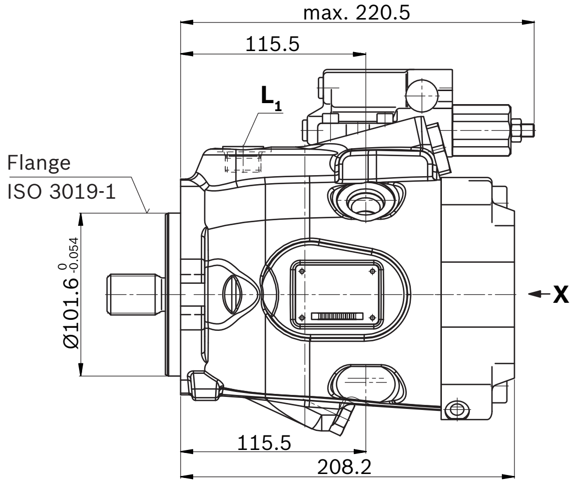
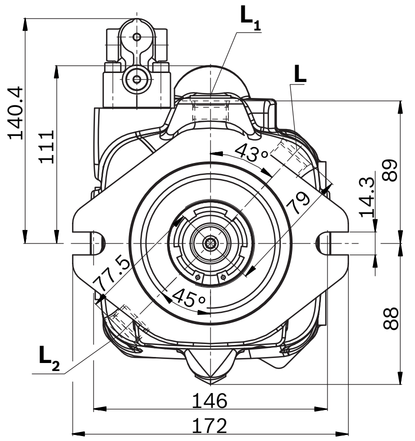
[1] ER7.: 172 mm if using an intermediate plate pressure controller

Dimensions size 72

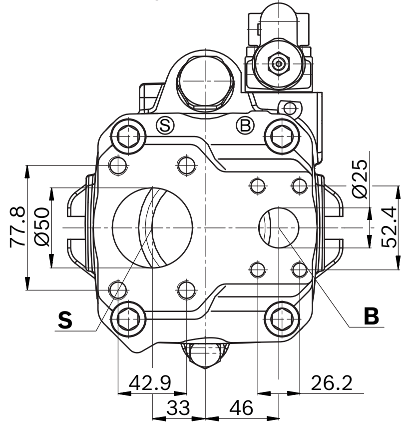
DR – Hydraulic pressure controller, clockwise rotation, mounting flange C series 53

▼ **Port plate 11**

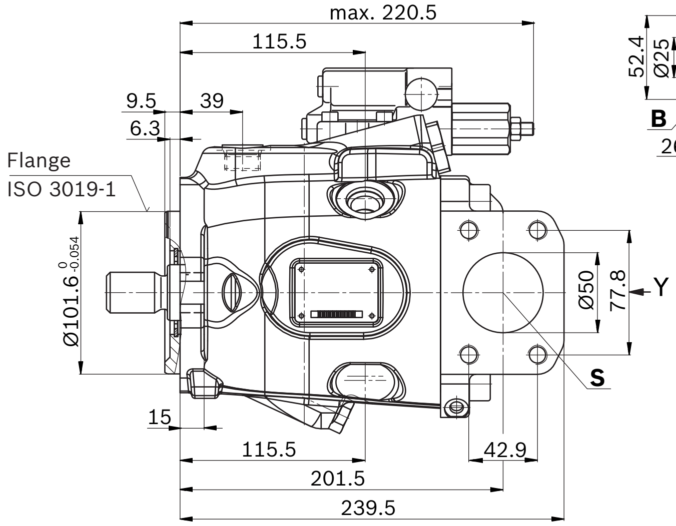




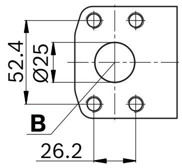
View X1)



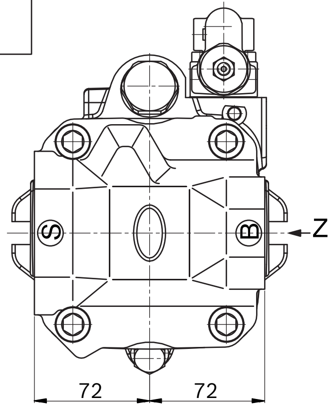
▼ **Port plate 12**



Detail Z



View Y1)



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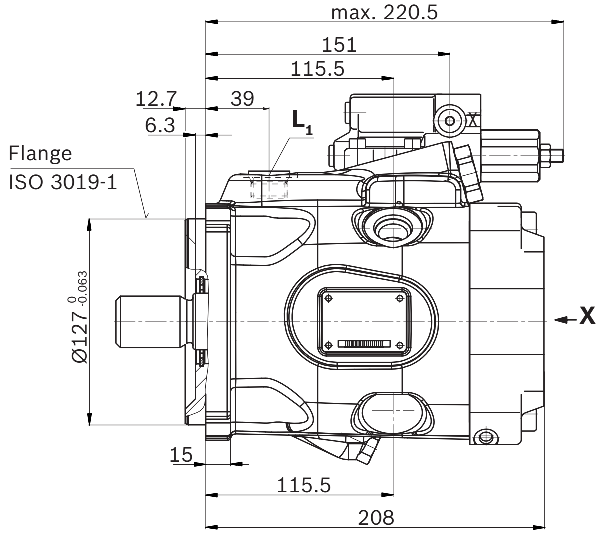
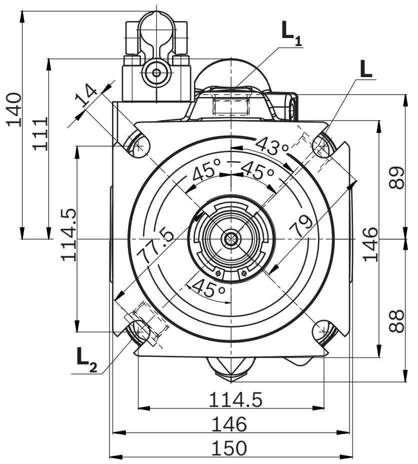
1) Dimensions of working ports turned through 180° for counter-clockwise rotation

Dimensions size 72

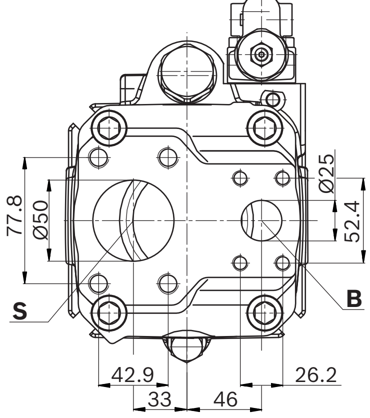
DR – Hydraulic pressure controller, clockwise rotation, mounting flange D series 53

▼ **Port plate 11**

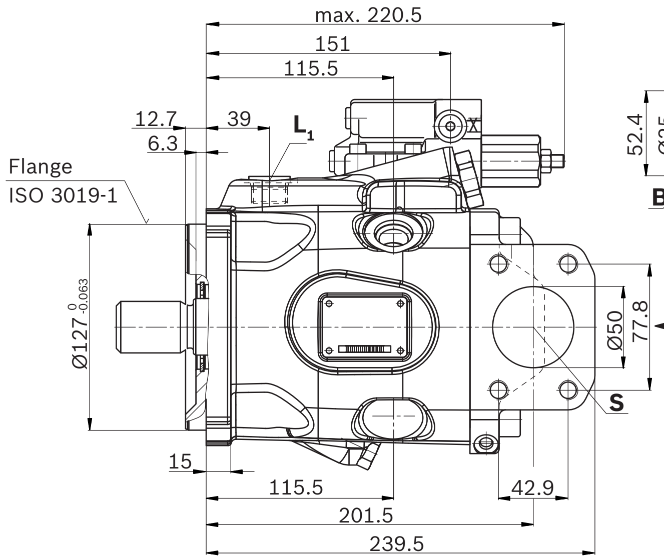




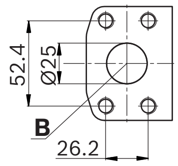
View X1)



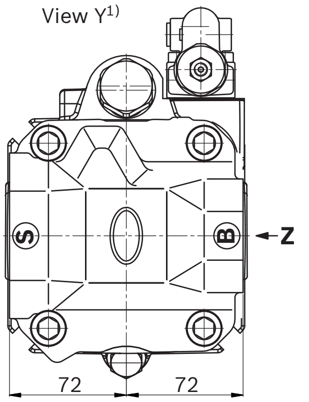
▼ **Port plate 12**



Detail Z



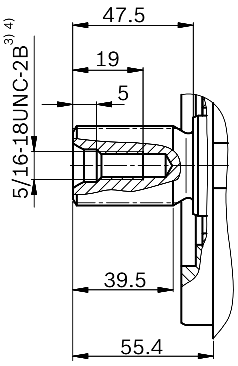
View Y1)



1) Dimensions of working ports turned through 180° for counter-clockwise rotation

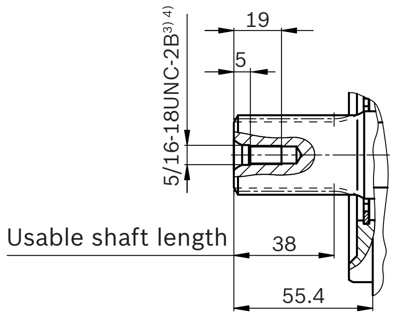
▼ Splined shaft 1 1/4 in SAE J744

S – 14T 12/24DP[1]



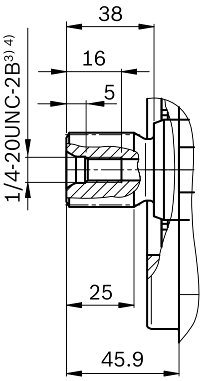
▼ Splined shaft 1 1/4 in SAE J744

R – 14T 12/24DP[1][2]



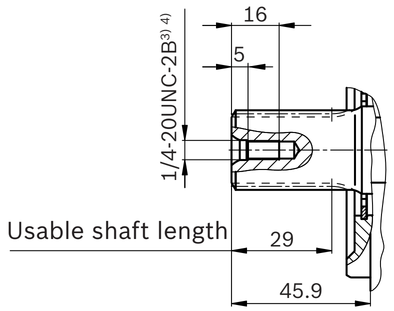
▼ Splined shaft 1 in SAE J744

U – 15T 16/32DP[1]



▼ Splined shaft 1 in SAE J744

W – 15T 16/32DP[1]



Ports		Standard	Size[4]	$p_{\text{max abs}}$ [bar][5]	State[10]
B	Working port (Standard pressure series) Fastening thread	SAE J518[6] DIN 13	1 in M10 × 1.5; 17 deep	315	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	2 in M12 × 1.75; 20 deep	5	O
L	Drain port	ISO 11926[7]	7/8-14UNF-2B; 13 deep	2	O[8]
L$_1$, **L**$_2$[9]	Drain port	ISO 11926[7]	7/8-14UNF-2B; 13 deep	2	X[8]
X	Control pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	315	O

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) Observe the instructions in the operating instructions concerning the maximum tightening torques.

5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

6) Metric fastening thread is a deviation from standard.

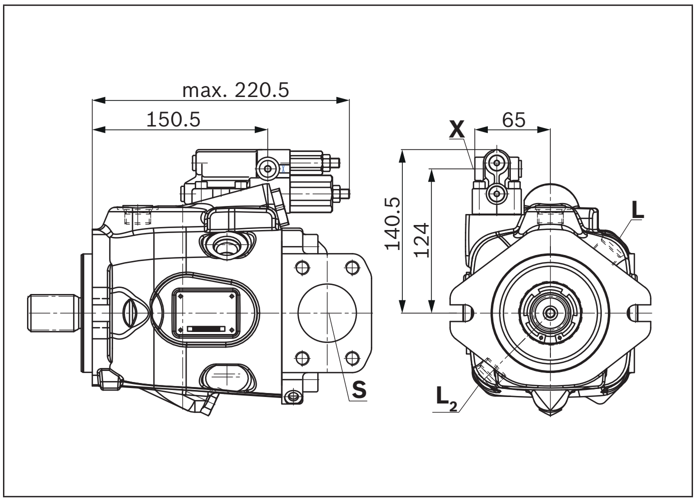
7) The spot face can be deeper than as specified in the standard.

8) Depending on the installation position, **L**, **L**$_1$ or **L**$_2$ must be connected (also see installation instructions starting on page 62).

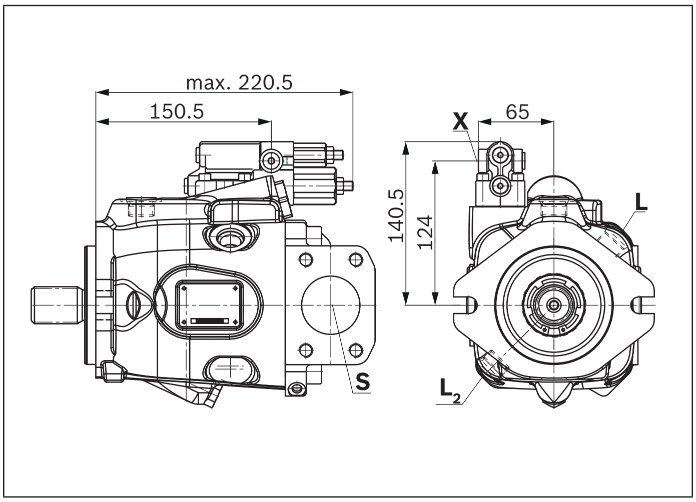
9) Only series 53

10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

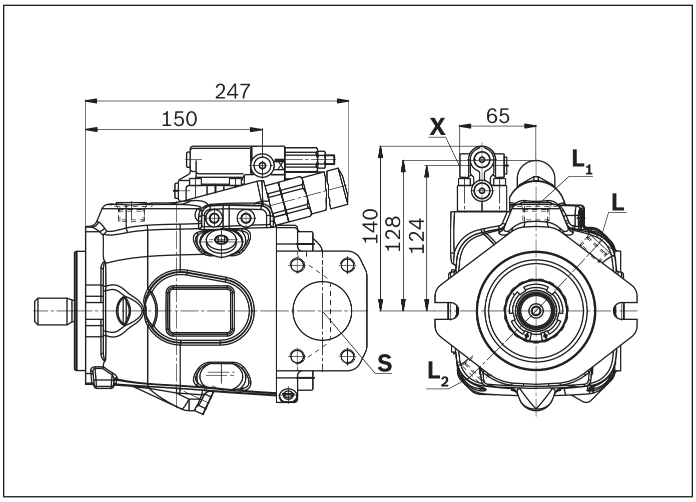
▼ DRG – Pressure controller, remote controlled, series 53



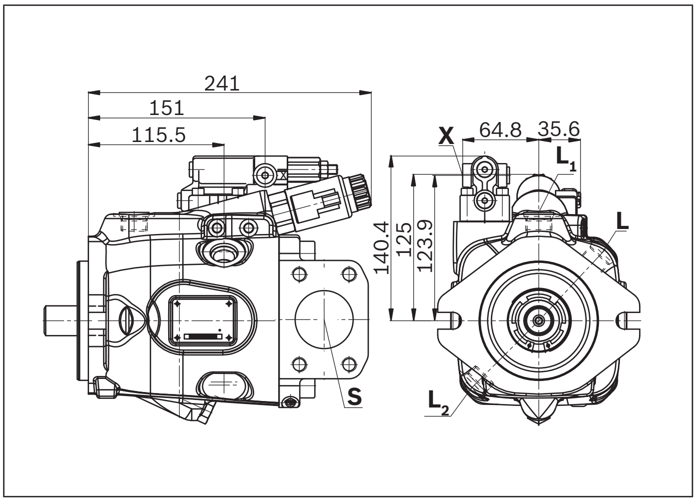
▼ DRF/DRS/DRSC – Pressure and flow control, series 53



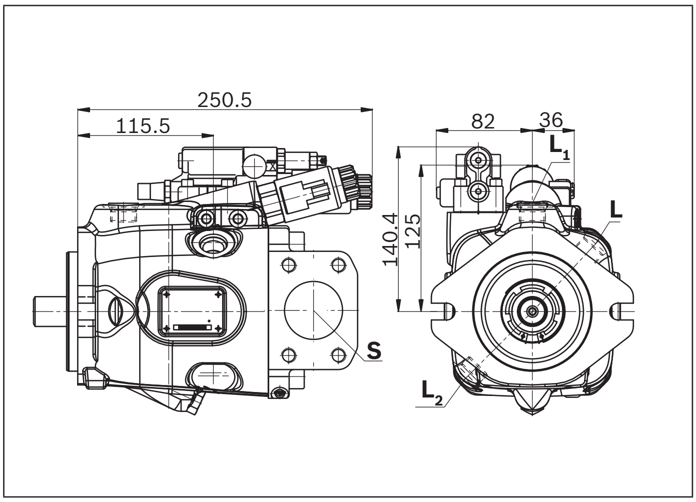
▼ LA.D. – Pressure, flow and power control, series 53



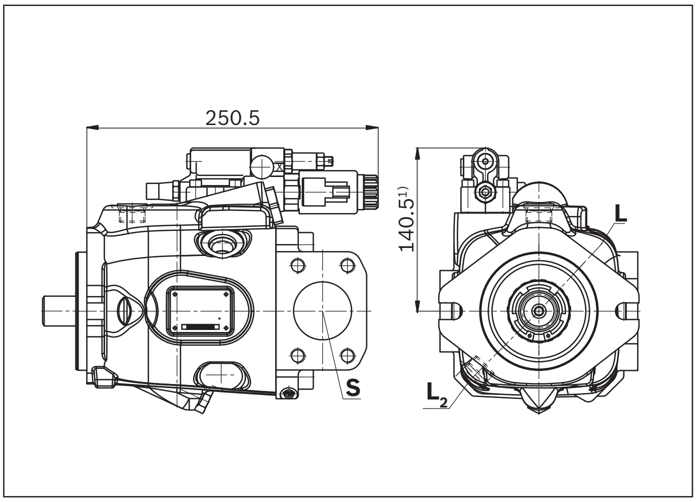
▼ EP.D. / EK.D. – Electro-proportional control, series 53



▼ EP.ED. / EK.ED. – Electro-prop. control, series 53



▼ ED7. / ER7. – Electro-prop. Pressure control, series 53



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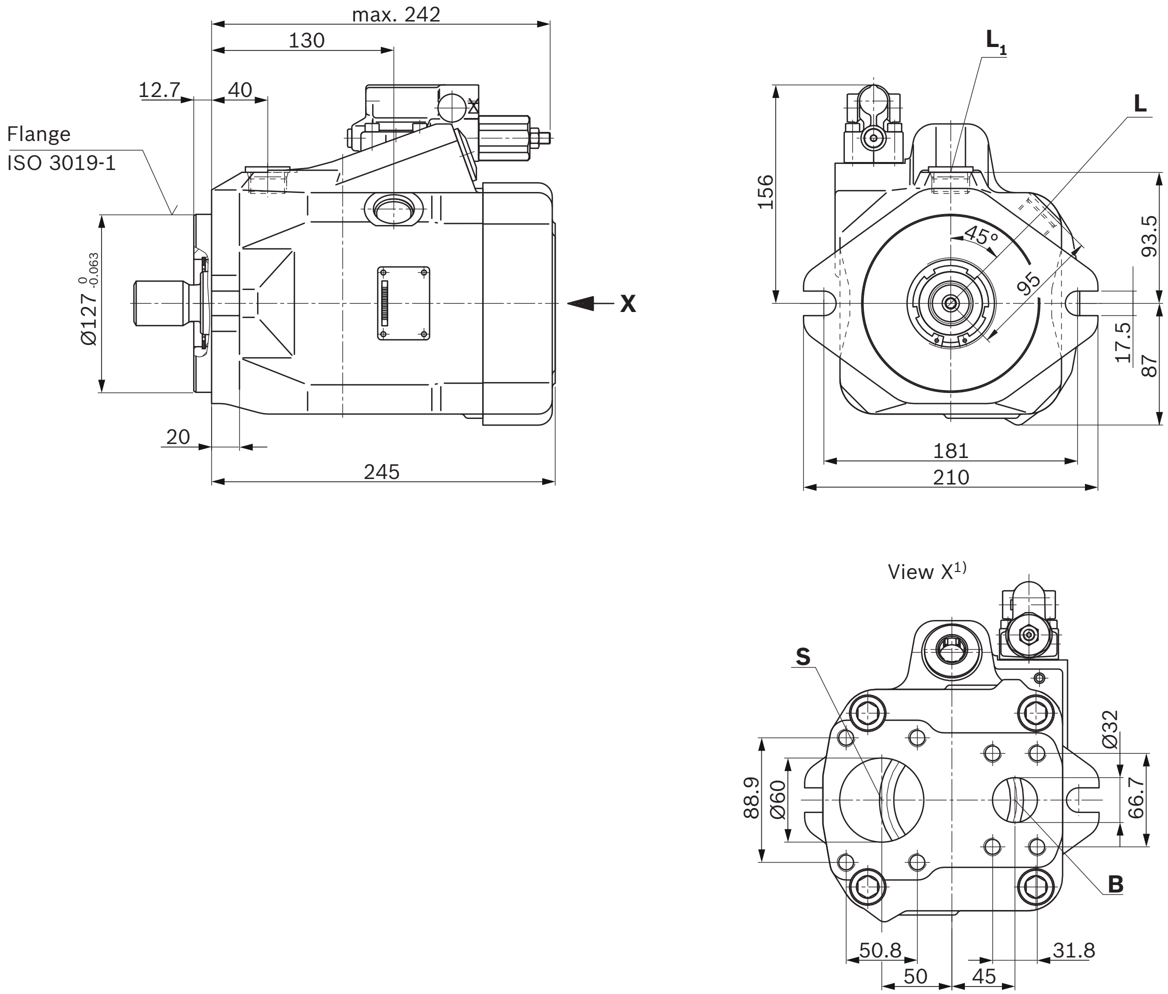
1) ER7.: 175.5 mm if using an intermediate plate pressure controller

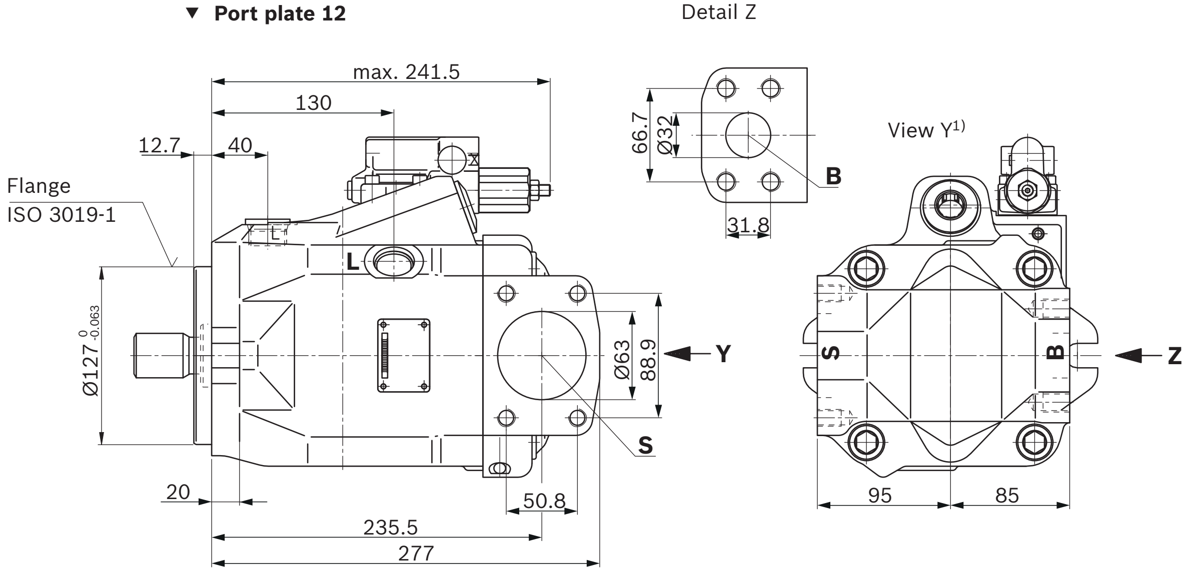
Dimensions size 85

DR – Hydraulic pressure controller, clockwise rotation, mounting flange C series 52

▼ **Port plate 11**



▼ **Port plate 12**

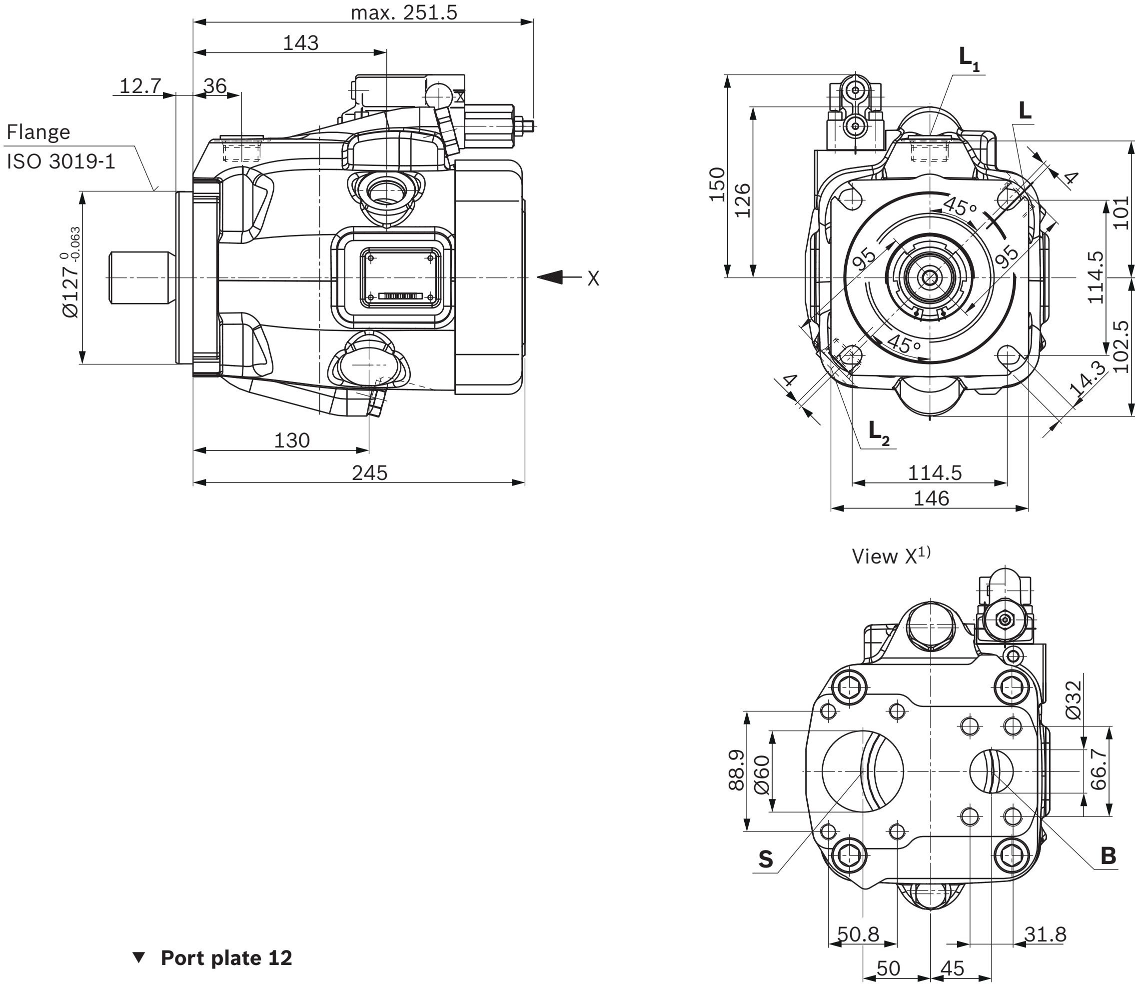


1) Dimensions of working ports turned through 180° for counter-clockwise rotation

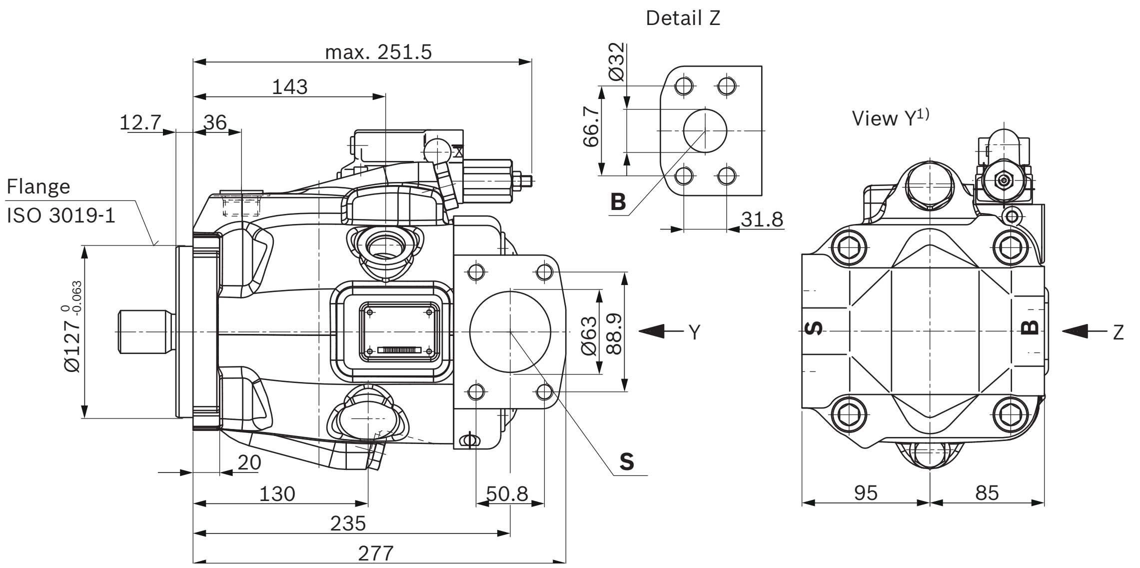
Dimensions size 85

DR – Hydraulic pressure controller, clockwise rotation, mounting flange D series 53

▼ **Port plate 11**



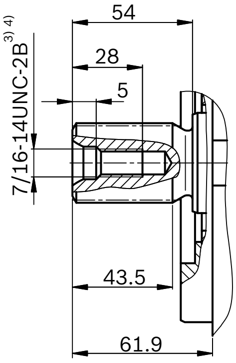
▼ **Port plate 12**



1) Dimensions of working ports turned through 180° for counter-clockwise rotation

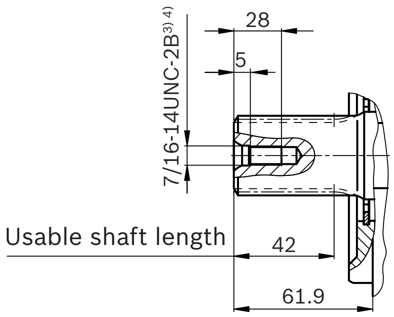
▼ Splined shaft 1 1/2 in SAE J744

S – 17T 12/24DP[1]



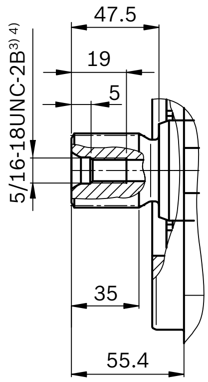
▼ Splined shaft 1 1/2 in SAE J744

R – 17T 12/24DP[1]



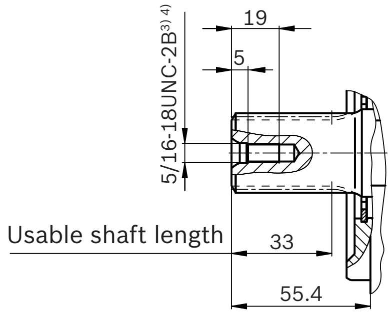
▼ Splined shaft 1 1/4 in SAE J744

U – 14T 12/24DP[1]



▼ Splined shaft 1 1/4 in SAE J744

W – 14T 12/24DP[1]



Ports		Standard	Size[4]	$p_{\max\ abs}$ **[bar]**[5]	State[10]
B	Working port (high-pressure series) Fastening thread	SAE J518[6] DIN 13	1 1/4 in M14 × 2; 19 deep	315	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	2 1/2 in M12 × 1.75; 17 deep	5	O
L	Drain port	ISO 11926[7]	1 1/16-12UNF-2B; 15 deep	2	O[8]
L$_1$, L$_2$[9]	Drain port	ISO 11926[7]	1 1/16-12UNF-2B; 15 deep	2	X[8]
X	Control pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	315	O

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) Observe the instructions in the operating instructions concerning the maximum tightening torques.

5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

6) Metric fastening thread is a deviation from standard.

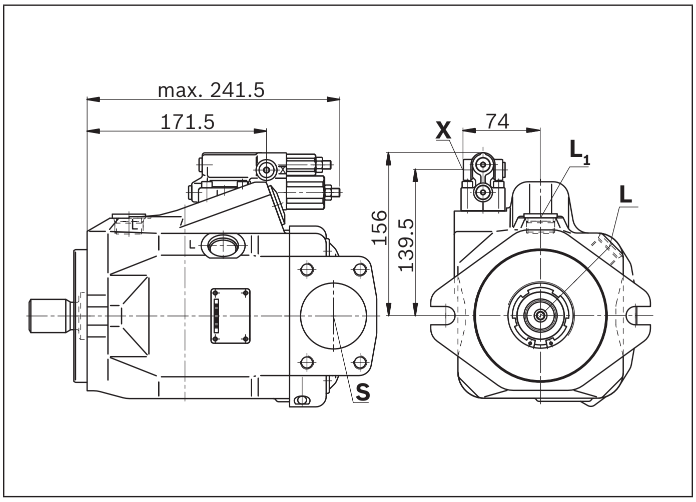
7) The spot face can be deeper than as specified in the standard.

8) Depending on the installation position, **L**, **L$_1$** or **L$_2$** must be connected (also see installation instructions starting on page 62).

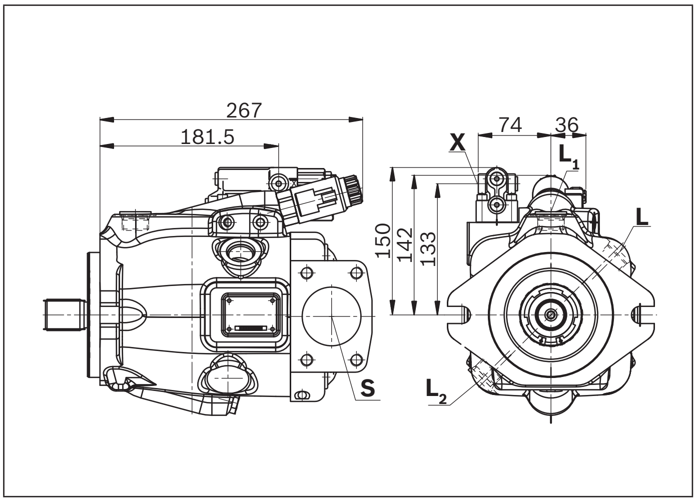
9) Only series 53

10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

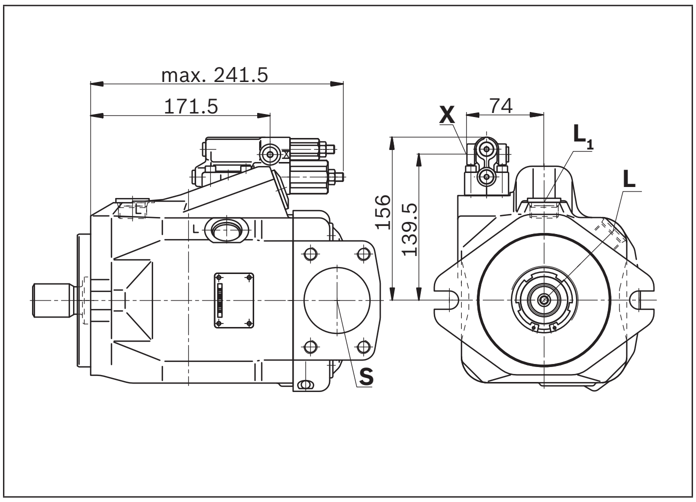
▼ DRG – Pressure controller, remote controlled, series 52 (53)



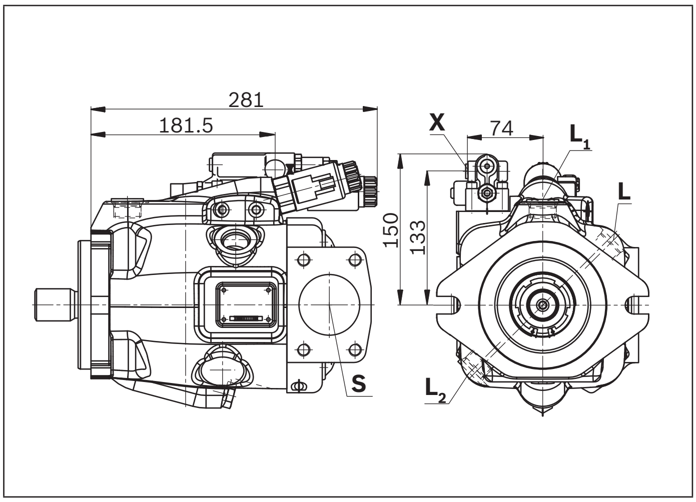
▼ EP.D. / EK.D. – Electro-proportional control, series 53



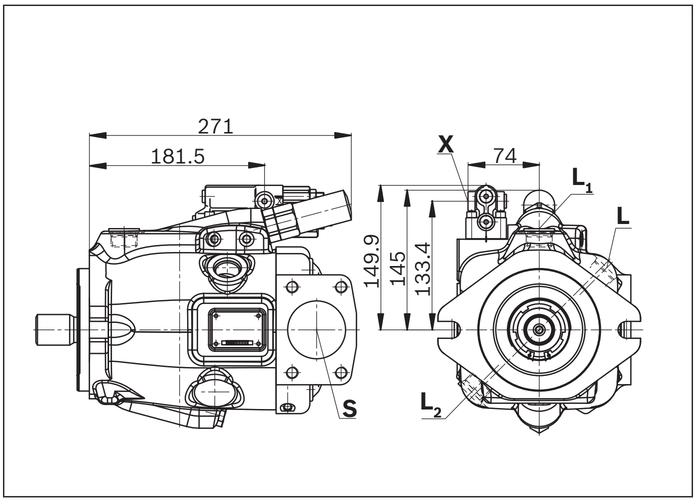
▼ DRF/DRS/DRSC – Pressure and flow control, series 52 (53)



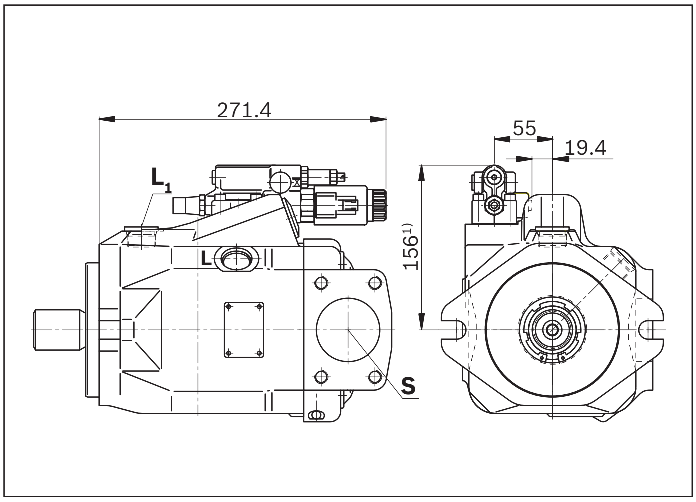
▼ EP.ED. / EK.ED. – Electro-prop. control, series 53



▼ LA.D. – Pressure, flow and power control, series 53



▼ ED7. / ER7. – Electro-prop. Pressure control, series 52 (53)



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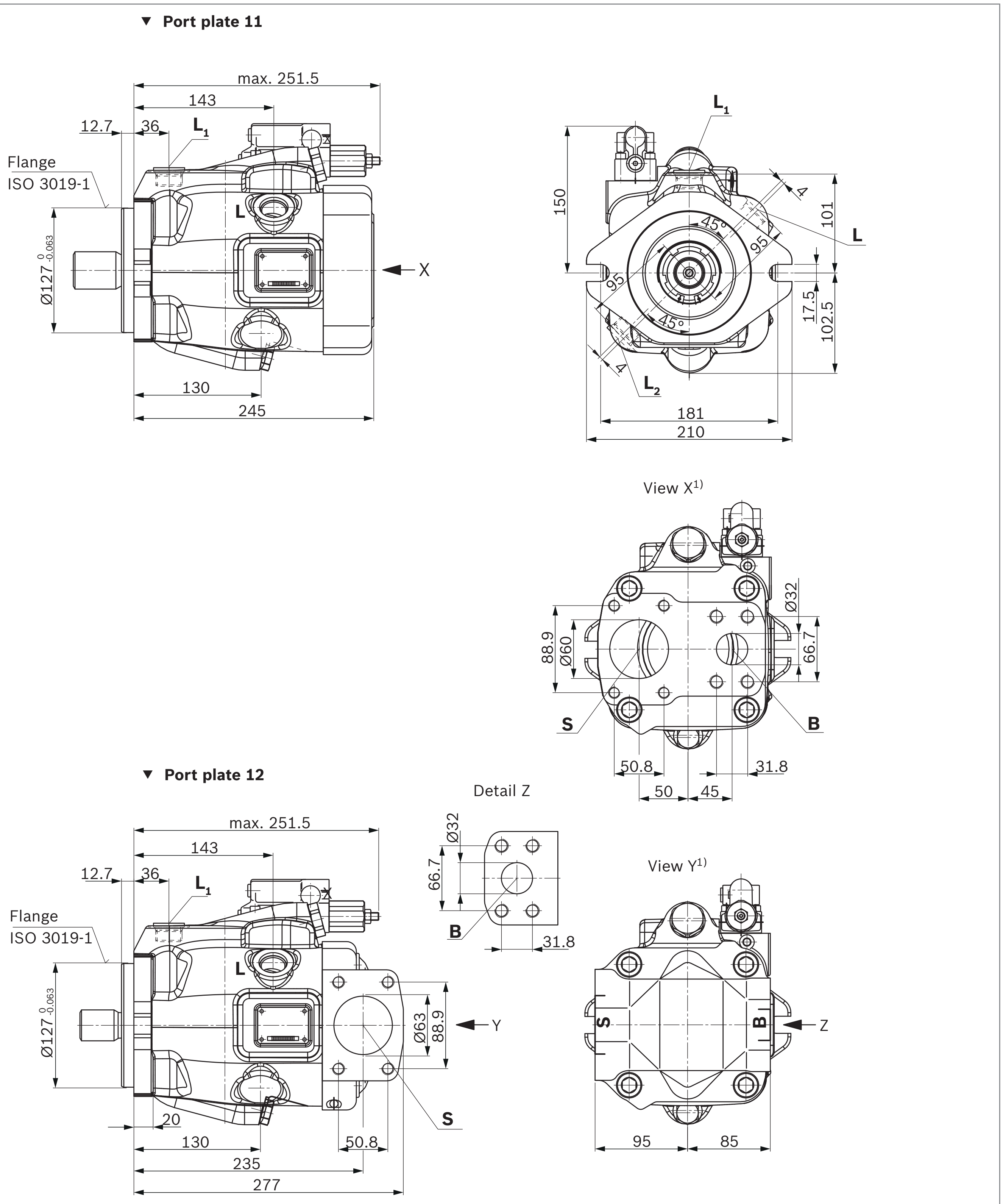
1) ER7.: 191 mm if using an intermediate plate pressure controller

Dimensions size 100

DR – Hydraulic pressure controller, clockwise rotation, mounting flange C series 53

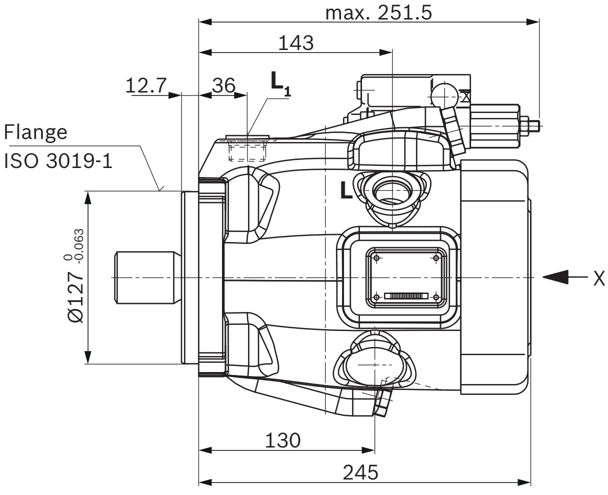


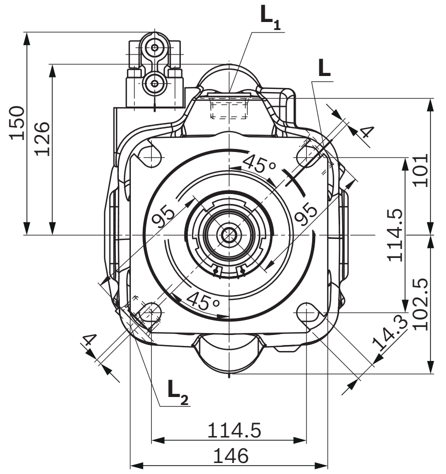
1) Dimensions of working ports turned through 180° for counter-clockwise rotation

Dimensions size 100

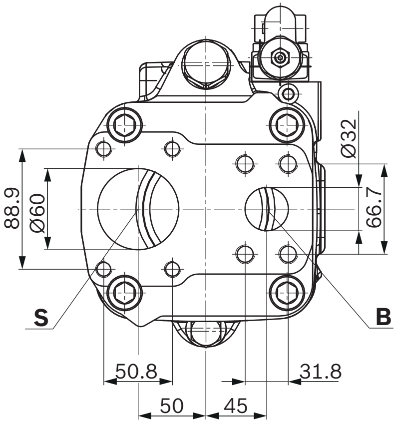
DR – Hydraulic pressure controller, clockwise rotation, mounting flange D series 53

▼ **Port plate 11**



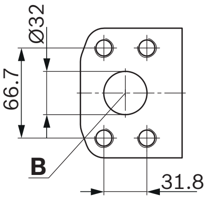


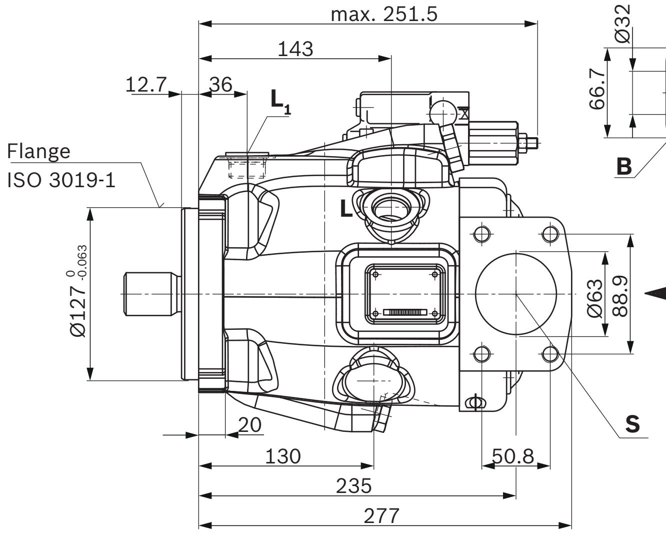
View X1)



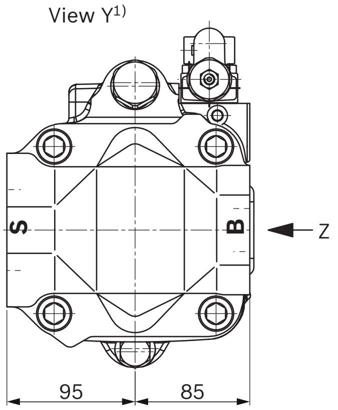
▼ **Port plate 12**

Detail Z





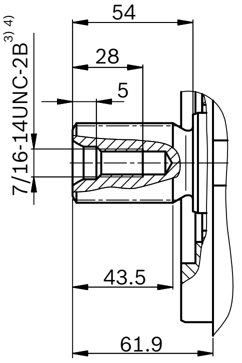
View Y1)



1) Dimensions of working ports turned through 180° for counter-clockwise rotation

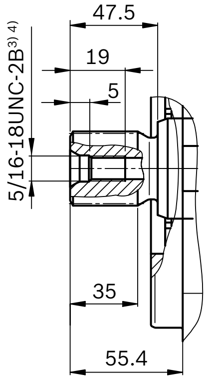
▼ Splined shaft 1 1/2 in SAE J744

S – 17T 12/24DP1)



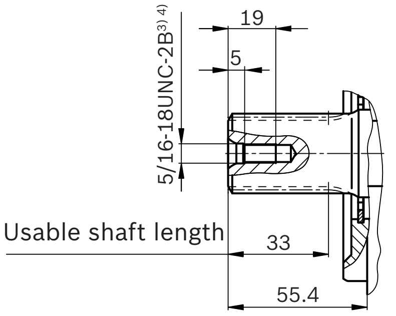
▼ Splined shaft 1 1/4 in SAE J744

U – 14T 12/24DP1)



▼ Splined shaft 1 1/4 in SAE J744

W – 14T 12/24DP1)



Ports		Standard	Size4)	$p_{\text{max abs}}$ [bar]5)	State10)
B	Working port (high-pressure series) Fastening thread	SAE J5186) DIN 13	1 1/4 in M14 × 2; 19 deep	315	O
S	Suction port (standard pressure series) Fastening thread	SAE J5186) DIN 13	2 1/2 in M12 × 1.75; 17 deep	5	O
L	Drain port	ISO 119267)	1 1/16-12UNF-2B; 15 deep	2	O8)
L_1, $L_2$9)	Drain port	ISO 119267)	1 1/16-12UNF-2B; 15 deep	2	X8)
X	Control pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	315	O

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) Observe the instructions in the operating instructions concerning the maximum tightening torques.

5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

6) Metric fastening thread is a deviation from standard.

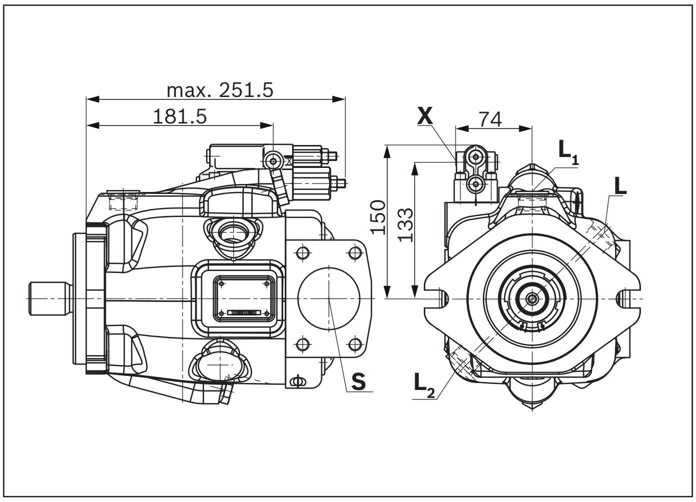
7) The spot face can be deeper than as specified in the standard.

8) Depending on the installation position, **L**, **L_1** or **L_2** must be connected (also see installation instructions starting on page 62).

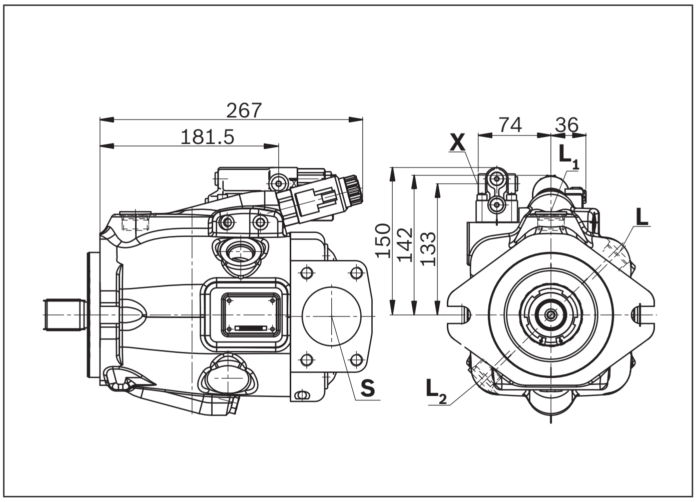
9) Only series 53

10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

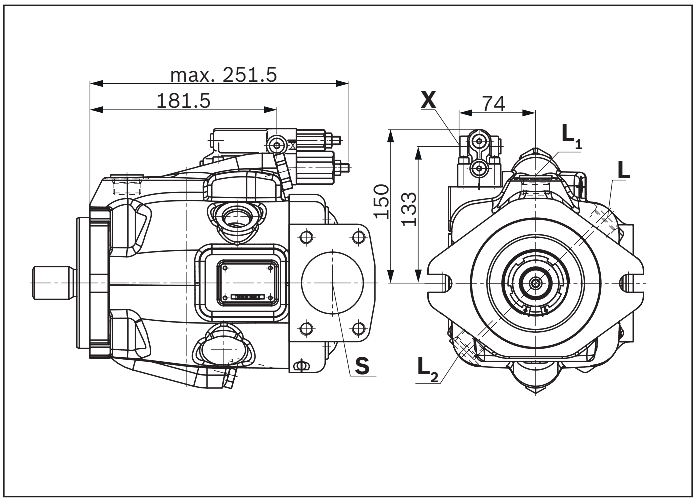
▼ DRG – Pressure controller, remote controlled, series 53



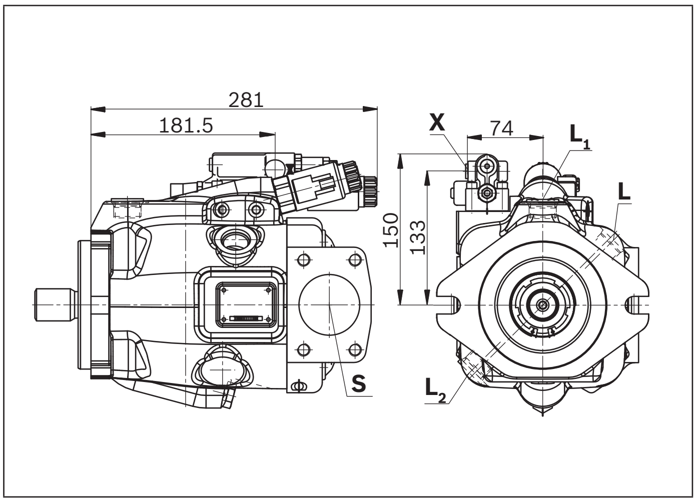
▼ EP.D. / EK.D. – Electro-proportional control, series 53



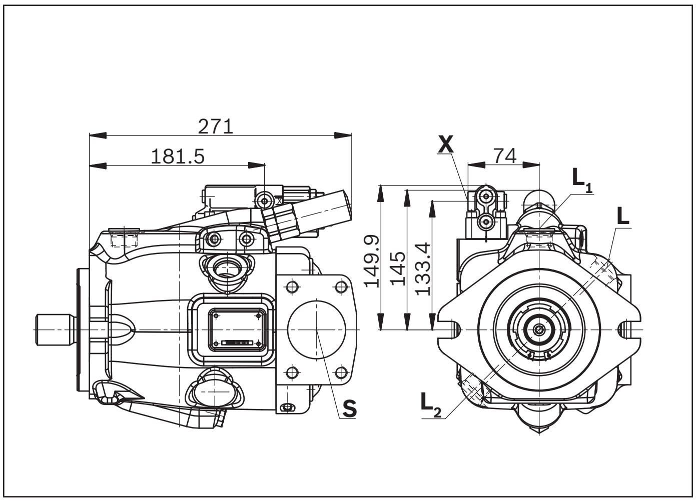
▼ DRF/DRS/DRSC – Pressure and flow control, series 53



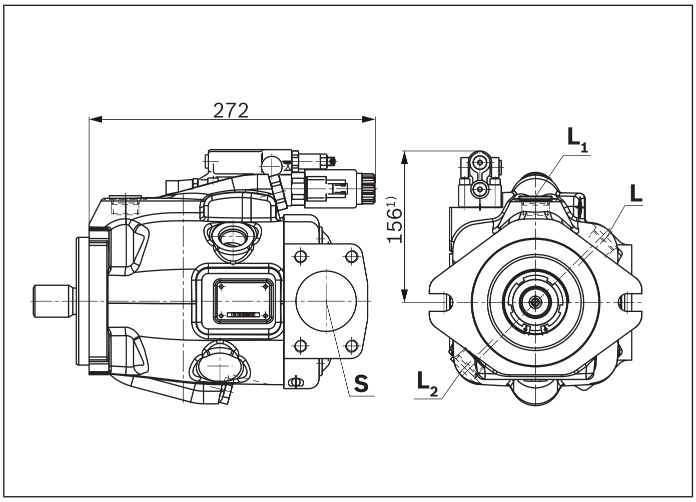
▼ EP.ED. / EK.ED. – Electro-prop. control, series 53



▼ LA.D. – Pressure, flow and power control, series 53



▼ ED7. / ER7. – Electro-prop. Pressure control, series 53



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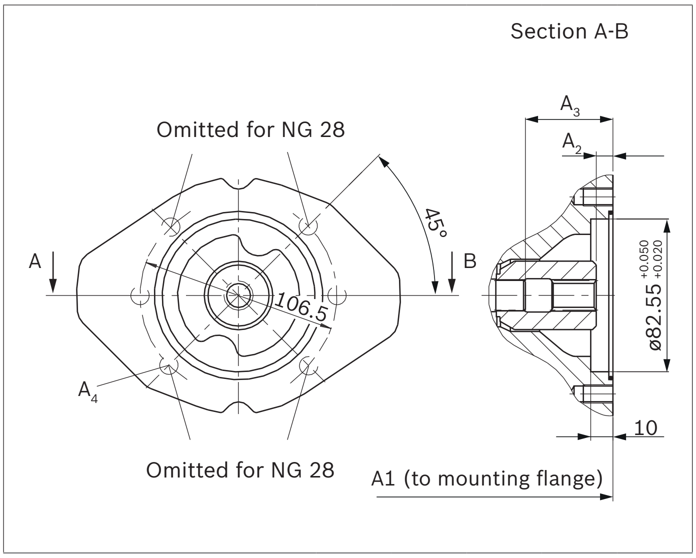
1) ER7.: 191 mm if using an intermediate plate pressure controller

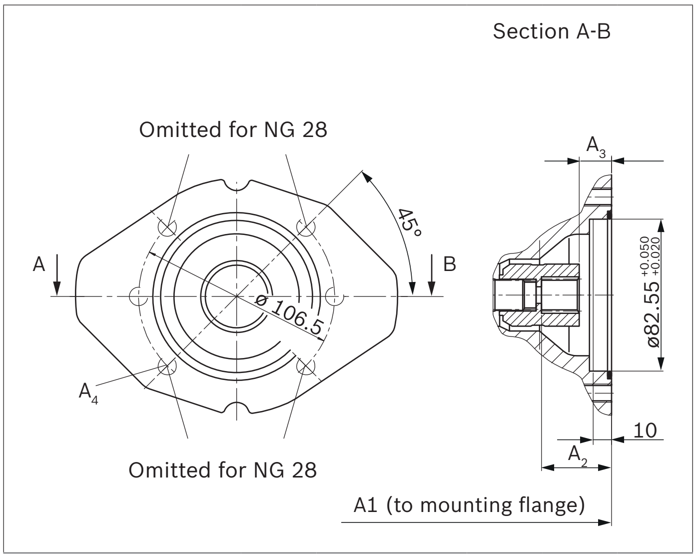
Dimensions through drive

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability over sizes							Code
Diameter	**Attachment**[2]	**Diameter**		**18**	**28**	**45**	**60/63**	**72**	**85**	**100**	
82-2 (A)	∘°, ∘∘	5/8 in	9T 16/32DP	●	●	●	●	●	●	●	K01
		3/4 in	11T 16/32DP	●	●	●	●	●	●	●	K52

● = Available ○ = On request

▼ **82/-2**





K01 (SAE J744 16-4 (A))	**NG**	**A1**	**A2**	**A3**	**A4**[3]
	18	182	9.3	43.3	M10×1.5; 14.5 deep
	28	204	9.9	47	M10×1.5; 16 deep
	45	229	10.7	53	M10×1.5; 16 deep
	60 63	255	9.5	59	M10×1.5; 16 deep
	72	255	9.5	59	M10×1.5; 16 deep
	85	302	13.4	68	M10×1.5; 20 deep
	100	302	13.4	68	M10×1.5; 20 deep

K52 (SAE J744 19-4 (A-B))	**NG**	**A1**	**A2**	**A3**	**A4**[3]
	18	182	39	18.8	M10×1.5; 14.5 deep
	28	204	39.3	18.8	M10×1.5; 16 deep
	45	229	39.4	18.9	M10×1.5; 16 deep
	60 63	255	39.4	18.9	M10×1.5; 16 deep
	72	255	39.4	18.9	M10×1.5; 16 deep
	85	302	44.1	23.6	M10×1.5; 20 deep
	100	302	44.1	23.6	M10×1.5; 20 deep

---

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

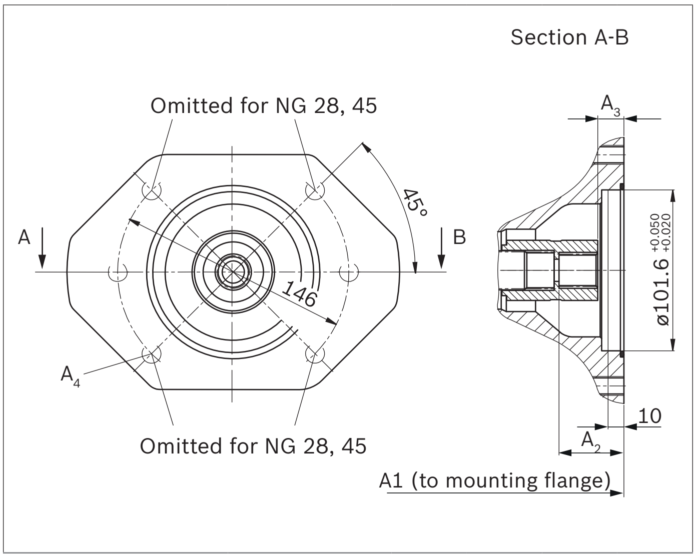
2) Mounting bores pattern viewed from through drive with control at top

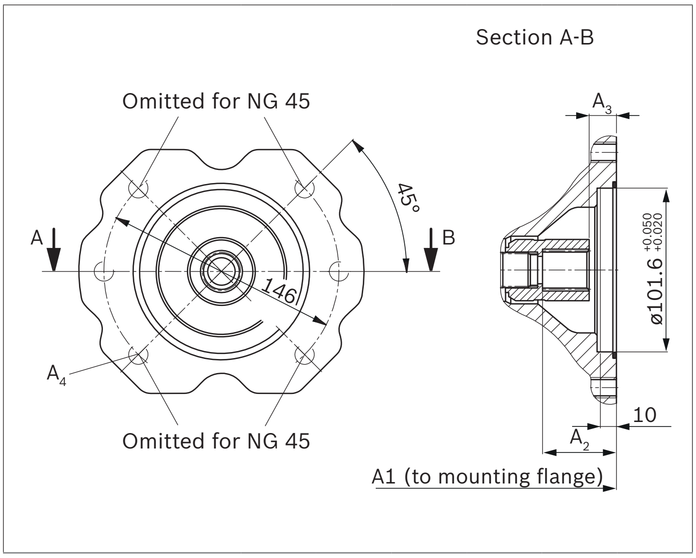
3) Thread according to DIN 13, observe the instructions in the instruction manual for the maximum tightening torques.

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability over sizes							Code
Diameter	**Attachment**[2]	**Diameter**		**18**	**28**	**45**	**60/63**	**72**	**85**	**100**	
101-2 (B)	o⁄o, o–o	7/8 in	13T 16/32DP	–	●	●	●	●	●	●	K68
		1 in	15T 16/32DP	–	–	●	●	●	●	●	K04

● = Available ○ = On request

▼ **101/-2**





K68 (SAE J744 22-4 (B))	**NG**	**A1**	**A2**	**A3**	**A4**[3]
	28	204	42.3	17.8	M12×1.75; 18 deep
	45	229	42.4	17.9	M12×1.75; 18 deep
	60 63	255	42.4	17.9	M12×1.75; 18 deep
	72	255	42.4	17.9	M12×1.75; 18 deep
	85	302	46.5	22	M12×1.75; 20 deep
	100	302	46.5	22	M12×1.75; 20 deep

K04 (SAE J744 25-4 (B-B))	**NG**	**A1**	**A2**	**A3**	**A4**[3]
	45	229	47.9	18.9	M12×1.75; 18 deep
	60 63	255	47.4	18.4	M12×1.75; 18 deep
	72	255	47.4	18.4	M12×1.75; 18 deep
	85	302	51.2	22.2	M12×1.75; 20 deep
	100	302	51.2	22.2	M12×1.75; 20 deep

---

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

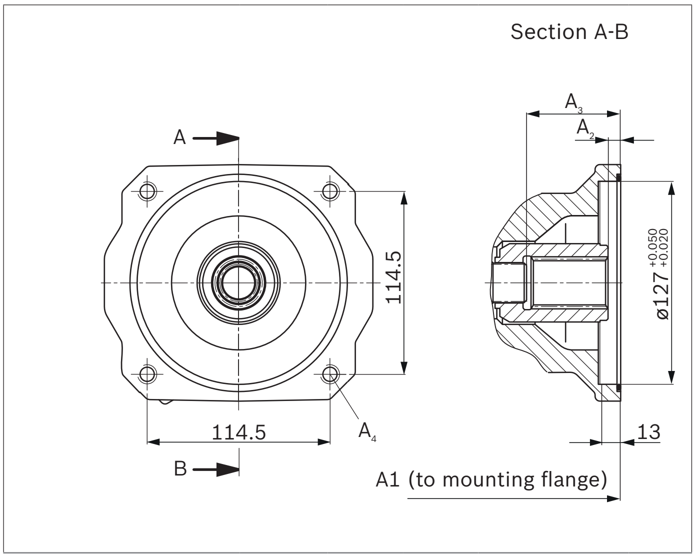
2) Mounting bores pattern viewed from through drive with control at top

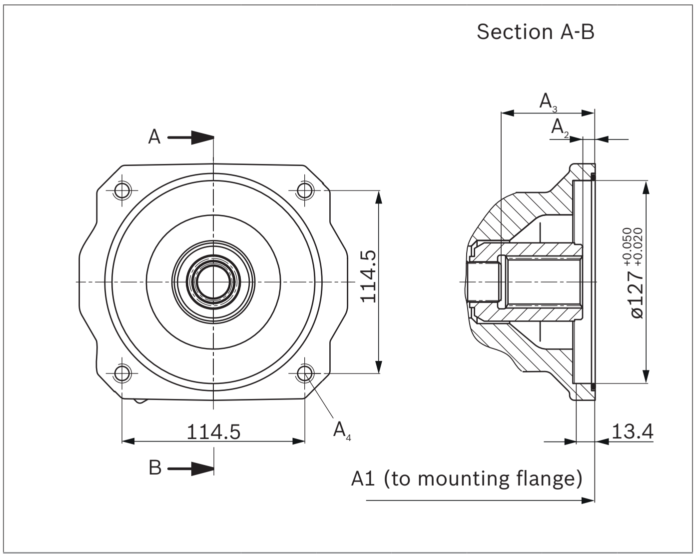
3) Thread according to DIN 13, observe the instructions in the instruction manual for the maximum tightening torques.

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability over sizes							Code
Diameter	**Attachment**[2]	**Diameter**		**18**	**28**	**45**	**60/63**	**72**	**85**	**100**	
127-4 (C)	⌘	1 1/4 in	14T 12/24DP	–	–	–	●	●	●	●	K15
		1 1/2 in	17T 12/24DP	–	–	–	–	–	●	●	K16

● = Available ○ = On request

▼ 127/-4





K15 (SAE J744 32-4 (C))	NG	A1	A2	A3	A4[3]
	60/63	255	8	59	M12×1.75; 16 deep
	72	255	8	59	M12×1.75; 16 deep
	85	301.5	13	67.9	M12×1.75; through
	100	301.5	13	67.9	M12×1.75; through

K16 (SAE J744 32-4 (C))	NG	A1	A2	A3	A4[3]
	85	301.5	13	67.9	M12×1.75; through
	100	301.5	13	67.9	M12×1.75; through

---

[1] According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

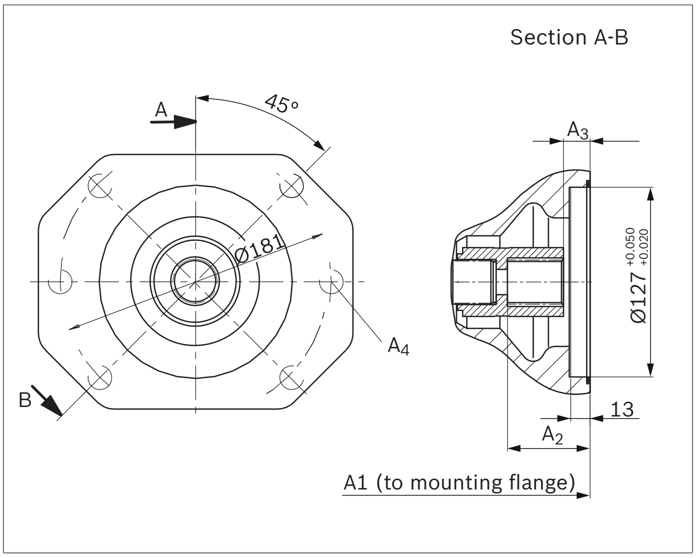
[2] Mounting bores pattern viewed from through drive with control at top

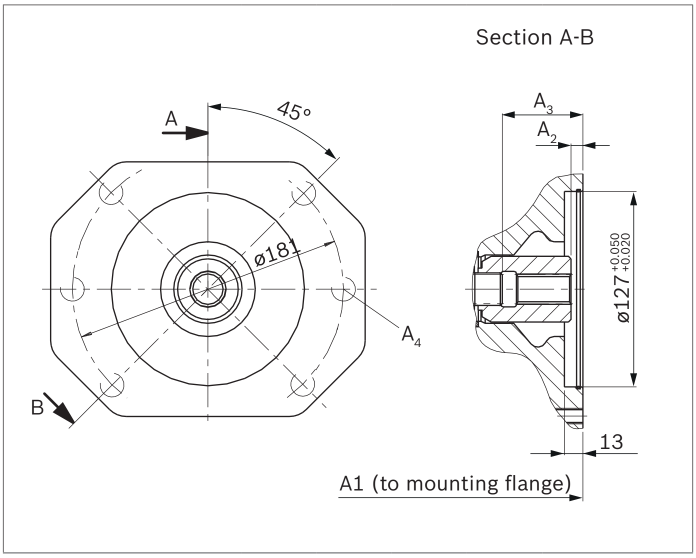
[3] Thread according to DIN 13, observe the instructions in the instruction manual for the maximum tightening torques.

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability over sizes							Code
Diameter	Attachment[2]	**Diameter**		**18**	**28**	**45**	**60/63**	**72**	**85**	**100**	
127-2 (B)	∘°, ∘-∘	1 1/4 in	14T 12/24DP	–	–	–	–	–	●	●	K07
		1 1/2 in	17T 12/24DP	–	–	–	–	–	●	●	K24

● = Available ○ = On request

▼ 127/-2





K07 (SAE J744 32-4 (C))	NG	A1	A2	A3	A4[3]
	85	301.5	13	67.9	M16×2; 24 deep
	100	301.5	13	67.9	M16×2; 24 deep

K24 (SAE J744 38-4 (C-C))	NG	A1	A2	A3	A4[3]
	85	302	8	68	M16×2; 24 deep
	100	302	8	68	M16×2; 24 deep

---

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Mounting bores pattern viewed from through drive with control at top

3) Thread according to DIN 13, observe the instructions in the instruction manual for the maximum tightening torques.

Overview of attachment options

Through drive			Attachment options – 2nd pump			
Flange ISO 3019-1	**Hub for splined shaft**	**Code**	**A10V(S)O/5x NG (shaft)**	**A10VO/31 NG (shaft)**	**A1VO/10 NG (shaft)**	**External gear**
82-2 (A)	5/8 in	K01	10 (U), 18 (U)	18 (U)	18 (S2)	AZPF
	3/4 in	K52	10 (S), 18 (S, R)	18 (S, R)	18 (S3)	
101-2 (B)	7/8 in	K68	28 (S, R) 45 (U, W)[1]	28 (S, R) 45 (U,W)	35 (S4)	AZPN/AZPG
	1 in	K04	45 (S, R) 60, 63 (U, W)[2] 72 (U, W)[2]	45 (S, R)	35 (S5)	–
127-4 (C)	1 1/4 in	K15	60, 63 (S, R) 72 (S, R)	–	–	–
	1 1/2 in	K16	85 (S) 100 (S)	–	–	–
127-2 (C)	1 1/4 in	K07	85 (U,W) 100 (U,W)	71 (S, R)	–	PGH5
	1 1/2 in	K24	85 (S) 100 (S)	–	–	–

---

[1] Not for NG28 with K68

[2] Not for NG45 with K04

Combination pumps A10VO + A10VO

By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes. When ordering combination pumps, the type designations of the 1st and 2nd pump must be linked by a "**+**".

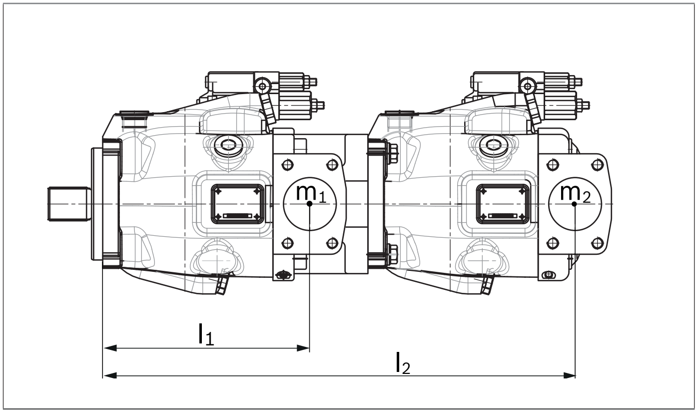
Order example:

A10VO85DRS/53R-VSC12K04+

A10VO45DRF/53R-VSC11N00

It is permissible to use a combination of two single pumps of the same nominal size (tandem pump) considering a dynamic mass acceleration of maximum 10 *g* (= 98.1 m/s^2) without additional support brackets.

For combination pumps consisting of more than two pumps, the mounting flange must be rated for the permissible mass torque (please consult us).



m_1, m_2, m_3	Weight of pump	[kg]
l_1, l_2, l_3	Distance, center of gravity	[mm]

$$T_m = (m_1 \times l_1 + m_2 \times l_2 + m_3 \times l_3) \times \frac{1}{102} \quad \text{[Nm]}$$

Permissible mass moment of inertia

NG			10	18	28	45	60/63	72	85	100
static	T_m	Nm	–	–	890	900	1370	1370	3080	3080
dynamic at 10 *g* (98.1 m/s^2)	T_m	Nm	–	–	89	90	137	137	308	308
Weight with through-drive plate	m	kg	–	13	18	24	28	28	45	45
Weight without through-drive plate (e.g. 2nd pump)			8	11.5	15	18	22	22	36	36
Distance, center of gravity **without** through drive	l_1	mm	–	78	85	96	105	105	122	122
Distance, center of gravity **with** through drive	l_1	mm	–	87	99	115	127	127	150	150

Connector for solenoids

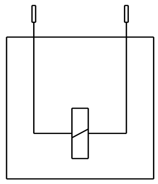
DEUTSCH DT04-2P-EP04

Molded connector, 2-pin, without bidirectional suppressor diode

The following type of protection ensues with a mounted mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)

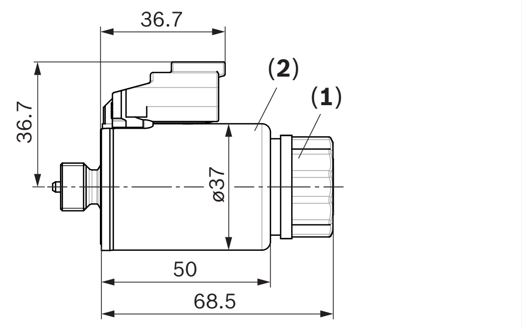
▼ **Circuit diagram symbol**



▼ **Mating connector DEUTSCH DT06-2S-EP04**

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).



Changing plug position

If necessary, you can change the position of the connector by turning the solenoid.

To do this, proceed as follows:

- Loosen the mounting nut (**1**) of the solenoid. To do this, turn the mounting nut (**1**) one revolution counter-clockwise.
- Turn the solenoid body (**2**) to the desired orientation.
- Re-tighten the mounting nut.
  Tightening torque: 5+1 Nm.
  (WAF 26, 12-sided DIN 3124)

On delivery, the position of the connector may differ from that shown in the brochure or drawing.

Electronic controls

Control	Electronics function	Electronics		Data sheet
Electric pressure control	Controlled power outlet	RA	analog	95230
		RC4-5/30	digital	95205

Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.

Particularly with the "drive shaft up/down" installation position, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The case drain fluid in the pump housing must be directed to the reservoir via the highest available drain port (**L**, $\mathbf{L_1}$[2], $\mathbf{L_2}$[3]).

For combinations of multiple units, the case drain fluid must be drained off at each pump. If a shared reservoir line is used for several units, make sure that the case pressure in each pump is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operational circumstances, particularly at cold start. If this is not possible, separate drain lines must be laid if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction line and drain line must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\,max}$ = 800 mm. The minimum suction pressure at port **S** must also not fall below 0.8 bar absolute during operation and during cold start.

When designing the reservoir, ensure adequate distance between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Note

In certain installation positions, an influence on the control characteristic can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristic curves and changes in response time.

For key, see page 64.

Installation position

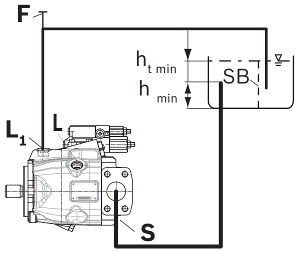
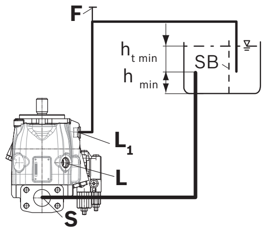
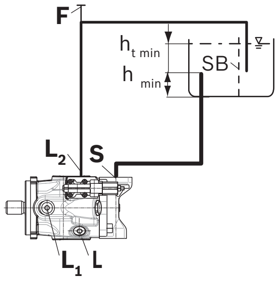
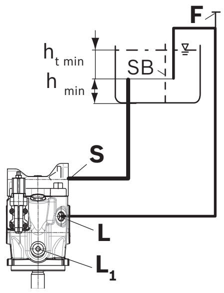
See the following examples **1** to **12**.

Additional installation positions are possible upon request.

Recommended installation position: **1** and **3**

Below-reservoir installation (standard)

Below-reservoir installation is when the axial piston unit is installed outside of the reservoir and below the minimum fluid level.

Installation position	Air bleeding	Filling
1 [2]  	**F**	**S** + **L** or $\mathbf{L_1}$
2 [1]  	**F**	**S** + $\mathbf{L_1}$
3 [3]  	**F**	**S** + **L** or $\mathbf{L_1}$
4  	**F**	**S** + **L** or $\mathbf{L_1}$

---

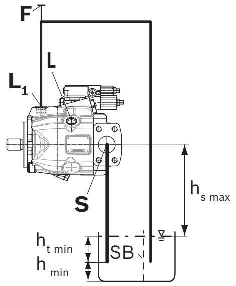
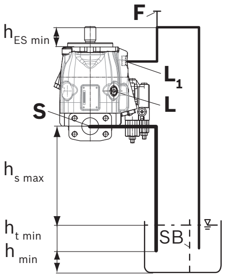
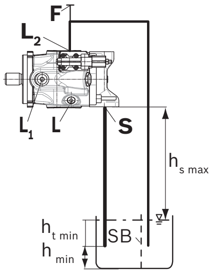
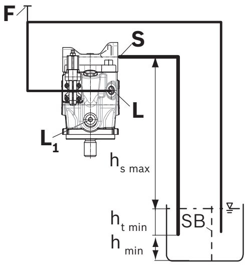
[1] Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

[2] For NG10 and NG28 series 52, $\mathbf{L_1}$ is opposite, L must then be connected if necessary.

[3] Only series 53

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. To prevent the axial piston unit from draining, a height difference $h_{ES\ min}$ of at least 25 mm is required in position 6 Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.

Installation position	Air bleeding	Filling
5 [2] 	**F**	**L_1** or **L**
6 [1)2)] 	**F**	**L_1**
7 [3] 	**F**	**L_2**
8 [1] 	**F**	**S** or **L**

A check valve in the case drain line is only permissible in individual cases. Consult us for approval.

For key, see page 64.

---

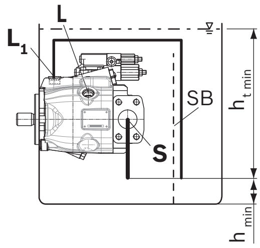
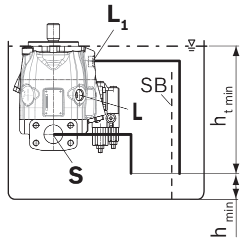
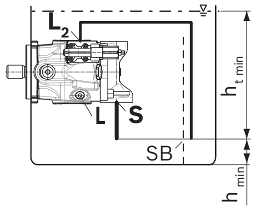
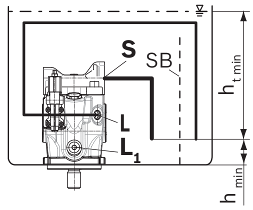
1) Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

2) For NG10 and NG28 series 52, **L_1** is opposite, **L** must then be connected if necessary.

3) Only series 53

Reservoir installation

Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level. The axial piston unit is completely below the hydraulic fluid.
If the minimum fluid level is equal to or below the upper edge of the pump, see chapter "Above-reservoir installation".
Axial piston units with electric components (e.g. electric controls, sensors) must not be installed in a reservoir below the fluid level.

Installation position	Air bleeding	Filling
9 [2] 	Via the highest available port **L**	Automatically via the open port **L** or $\mathbf{L_1}$ due to the position under the hydraulic fluid level
10 	Via the highest available port $\mathbf{L_1}$	Automatically via the open port **L**, $\mathbf{L_1}$ or **S** due to the position under the hydraulic fluid level
11 [3] 		
12 	Via the highest available port **L**	Automatically via the open port **L**, $\mathbf{L_1}$ or **S** due to the position under the hydraulic fluid level

Key and assembly note

Key	
F	Filling / air bleeding
S	Suction port
L; $\mathbf{L_1}$	Drain port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)
$h_{ES\ min}$	Minimum necessary height required to protect the axial piston unit from draining (25 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)

Note

Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

---

1) Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

2) For NG10 and NG28 series 52, $\mathbf{L_1}$ is opposite, **L** must then be connected if necessary.

3) Only series 53

Project planning notes

- The A10VO axial piston variable pump is designed to be used in open circuit.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, request it from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes must be observed.
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Preservation: Our axial piston units are supplied as standard with protection to preserve for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $\mathrm{MTTF_d}$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference.
  Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- Pressure controllers are not safeguards against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the intended operating conditions (pressure, flow, hydraulic fluid, temperature) with allowance for the necessary safety margins.
  - The working ports and function ports can only be used to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve spools) can, under certain circumstances, get blocked in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the flow of hydraulic fluid and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filter) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.

Axial piston variable pump
A10VNO series 52 and 53

A10VNO series 52

A10VNO series 53

- Size 28 to 85
- Nominal pressure 210 bar
- Maximum pressure 250 bar
- open circuit

Features

- Variable axial piston pump of swashplate design for hydrostatic drives in open circuits.
- The flow is proportional to the drive speed and the displacement.
- The flow can be infinitely varied by adjusting the swashplate angle.
- Stable storage for long service life
- High, permissible drive speed
- Favorable power-to-weight ratio – compact dimensions
- Low noise
- Excellent suction characteristics
- Electro-hydraulic pressure control
- Short response times

Contents

Ordering code

01	02	03	04		05	06		07	08	09	10	11	12
A10VN	**O**			**/**	**5x**		**–**	**V**					

Axial piston unit

		28	45	63	85	
01	Variable swashplate design, nominal pressure 210 bar, maximum pressure 250 bar	●	●	●	●	**A10VN**

Operating mode

02	Pump, open circuit	**O**

Size (NG)

03	Geometric displacement, see table of values on page 7	**28**	**45**	**63**	**85**

Control device

					28	45	63	85	
04	Pressure control	hydraulic			●	●	●	●	**DR**
	with flow control	hydraulic	X-T open		●	●	●	●	**DRF**
			X-T plugged	with flushing function	●	●	●	●	**DRS**
				without flushing function	●	●	●	●	**DRSC**
	pressure cut-off	hydraulic	remotely operated		●	●	●	●	**DRG**
		electrical	negative control	U = 12 V	●	●	●	●	**ED71**
				U = 24 V	●	●	●	●	**ED72**

Series

		28	45	63	85	
05	Series 5, index 2	–	●	●	–	**52**
	Series 5, index 3	●	–	–	●	**53**

Direction of rotation

06	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Sealing material

07	FKM (fluor-caoutchouc)	**V**

Drive shaft

			28	45	63	85	
08	Splined shaft	Standard shaft	●	●	●	●	**S**
	ANSI B92.1a	similar to shaft "S" however for higher input torque	●	●	●	●	**R**

Mounting flanges

			28	45	63	85	
09	ISO 3019-1 (SAE)	2-hole	●	●	●	●	**C**
		4-hole	–	–	–	●	**D**

Working port

				28	45	63	85	
10	SAE flange port fastening thread, metric	rear	not for through drive	●	●	●	●	**11**
		at side, opposite	for through drive	●	●	●	●	**12**

01	02	03	04		05	06		07	08	09	10	11	12
A10VN	**O**			**/**	**5x**		**–**	**V**					

Through drive (for fitting options, see page 29)

	Flange ISO 3019-1 diameter	Hub for splined shaft[1] diameter		**28**	**45**	**63**	**85**	
11	without through drive			●	●	●	●	**N00**
	82-2 (A)	5/8 in	9T 16/32DP	●	●	●	●	**K01**
		3/4 in	11T 16/32DP	●	●	●	●	**K52**
	101-2 (B)	7/8 in	13T 16/32DP	–	●	●	●	**K68**
		1 in	15T 16/32DP	–	–	●	●	**K04**

Connector for solenoids

		28	45	63	85	
12	DEUTSCH – molded connector, 2-pin – without suppressor diode (for electric controls)	●	●	●	●	**P**

● = Available ○ = On request – = Not available

Information

- ▶ Note the project planning notes on page 36.
- ▶ Preservation:
  - – Up to 12 months as standard
  - – Up to 24 months long-term (state in plain text when ordering)

---

1) According to ANSI B92.1a

Hydraulic fluids

The A10VNO variable pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids

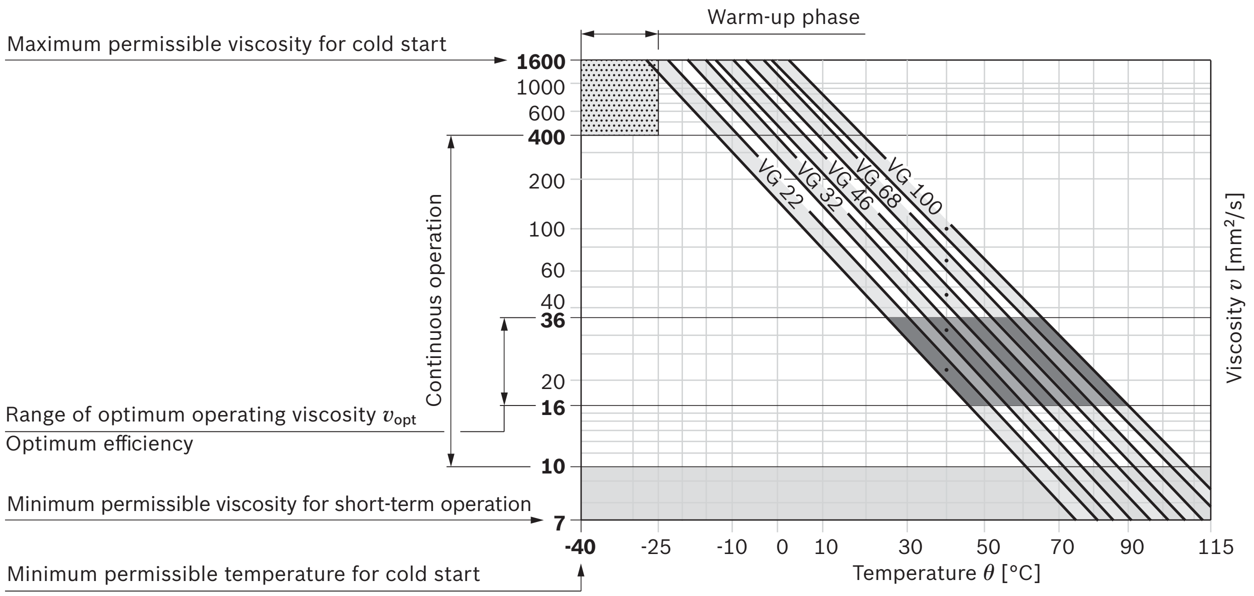
Details regarding the selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}, see selection diagram).

Note
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \leq 1600$ mm²/s	$\theta_{St} \geq -40$ °C	$t \leq 1$ min, without load ($p \leq 30$ bar), $n \leq 1000$ rpm
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu < 1600$ to 400 mm²/s	$\theta = -40$ °C to -25 °C	Note the detailed information on operation with low temperatures, see data sheet 90300-03-B.
Continuous operation	$\nu = 400$ to 10 mm²/s		This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram page 4)
		$\theta = -25$ °C to +110 °C	measured at port **L** observe permissible temperature range of the shaft seal ring (ΔT = approx. 5 K between bearing/shaft seal and port **L**)
	$\nu_{opt} = 36$ to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \geq 7$ mm²/s		$t < 1$ min, $p < 0.3 \cdot p_{nom}$

▼ **Selection diagram**



Filtration of the hydraulic fluid

The finer the filtration, the better the hydraulic fluid cleanliness level, and the longer the service life of the axial piston unit.

A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.

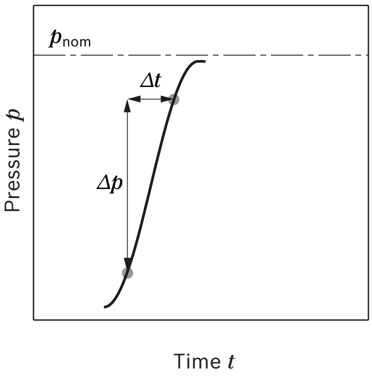
At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), at least cleanliness level 19/17/14 according to ISO 4406 is necessary.

Please contact us if the above classes cannot be observed.

Operating pressure range

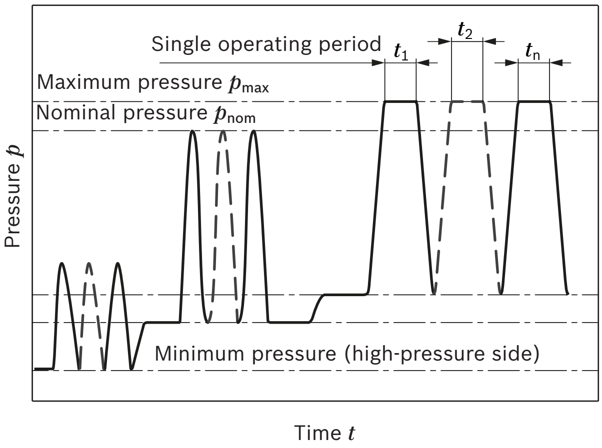
Pressure at working port B		**Definition**
Nominal pressure p_{nom}	210 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	250 bar absolute	The maximum pressure corresponds the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	2.5 ms	
Total operating period	300 h	
Minimum pressure $p_{\text{B abs}}$ (high pressure side)	10 bar absolute	Minimum pressure on the high-pressure side (**B**) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{\text{A max}}$	16000 bar/s	Maximum permissible rate of pressure build-up and reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{\text{S min}}$ Standard	0.8 bar absolute	Minimum pressure at suction port **S** (inlet) that is required in order to avoid damage to the axial piston unit. The minimum pressure depends on the speed and displacement of the axial piston unit.
Maximum pressure $p_{\text{S max}}$	5 bar absolute	
Leakage pressure at port L_1, L_2		
Maximum pressure $p_{\text{L max}}$	2 bar absolute	Maximum 0.5 bar higher than inlet pressure at port **S**, but not higher than $p_{\text{L max}}$. A case drain line to the reservoir is required.

▼ **Rate of pressure change $R_{\text{A max}}$**



Note
Operating pressure range valid when using hydraulic fluids based on mineral oils. Please contact us for values for other hydraulic fluids.

▼ **Pressure definition**



Total operating period = $t_1 + t_2 + \ldots + t_n$

Technical data

Size		NG		28	45	63	85
Displacement, geometric, per revolution		$V_{g\ max}$	cm³	28	45	63	85
Maximum rotational speed[1]	At $V_{g\ max}$	n_{nom}	rpm	3200	2900	2700	2700
Flow	at n_{nom} and $V_{g\ max}$	q_v	l/min	90	131	170	230
Power	at n_{nom}, $V_{g\ max}$ and Δp = 210 bar	P	kW	31	46	59	80
Torque	at $V_{g\ max}$ and Δp = 210 bar	T	Nm	94	150	210	284
Rotary stiffness drive shaft	S	c	Nm/rad	11000	22300	37500	65500
	R	c	Nm/rad	14800	26500	40500	69400
Moment of inertia for rotary group		J_{GR}	kgm²	0.00093	0.0017	0.0033	0.0056
Maximum angular acceleration[2]		α	rad/s²	6800	4900	3500	2500
Case volume		V	l	0.25	0.3	0.5	0.8
Weight **without** through drive (approx.)		m	kg	11.5	15	18	22
Weight **with** through drive (approx.)				13	18	24	28

Determining the operating characteristics			
Flow	q_v	$= \dfrac{V_g \times n \times \eta_v}{1000}$	[l/min]
Torque	T	$= \dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{mh}}$	[Nm]
Power	P	$= \dfrac{2\,\pi \times T \times n}{60000} = \dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g = Displacement per revolution [cm³]

Δp = Differential pressure [bar]

n = Rotational speed [rpm]

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Total efficiency ($\eta_t = \eta_v \times \eta_{mh}$)

Note

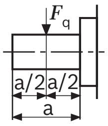
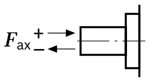
- Theoretical values, without efficiency and tolerances; values rounded.
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or the destruction of the axial piston unit. We recommend testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.

---

[1] The values are valid:
- At absolute pressure p_{abs} = 1 bar at suction port **S**
- For the optimal viscosity range of ν_{opt} = 36 to 16 mm²/s
- For hydraulic fluid based on mineral oils

[2] The scope of application lies between the minimum necessary and the maximum permissible drive speeds. It applies for external stimuli (e. g. engine 2 to 8 times rotary frequency, Cardan shaft twice the rotary frequency). The limiting value is only valid for a single pump. The load capacity of the connection parts must be considered.

Permissible radial and axial forces of the drive shaft

Size		NG		28	45	63	85
Maximum radial force at a/2		$F_{q\,max}$	N	150	650	1000	1350
Maximum axial force		$\pm F_{ax\,max}$	N	400	650	1000	1350

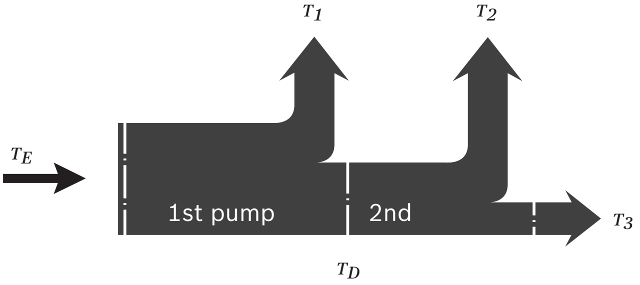
Note

- The values given are maximum values and do not apply to continuous operation. For drives with radial loading (pinion, V-belt drives), please contact us!

Permissible input and through-drive torques

Size				28	45	63	85
Torque at $V_{g\,max}$ and Δp = 210 bar[1]		T_{max}	Nm	94	150	210	284
Input torque at drive shaft, maximum[2]							
	S	$T_{E\,max}$	Nm	124	198	319	630
		Ø	in	3/4	7/8	1	1 1/4
	R	$T_{E\,max}$	Nm	160	250	400	650
		Ø	in	3/4	7/8	1	1 1/4
Maximum through-drive torque							
	S	$T_{D\,max}$	Nm	108	160	319	484
	R	$T_{D\,max}$	Nm	120	176	365	484

▼ **Torque distribution**



Torque at 1st pump	T_1		
Torque at 2nd pump	T_2		
Torque at 3rd pump	T_3		
Input torque	T_E	=	$T_1 + T_2 + T_3$
	T_E	<	$T_{E\,max}$
Through-drive torque	T_D	=	$T_2 + T_3$
	T_D	<	$T_{D\,max}$

---

1) Efficiency not considered

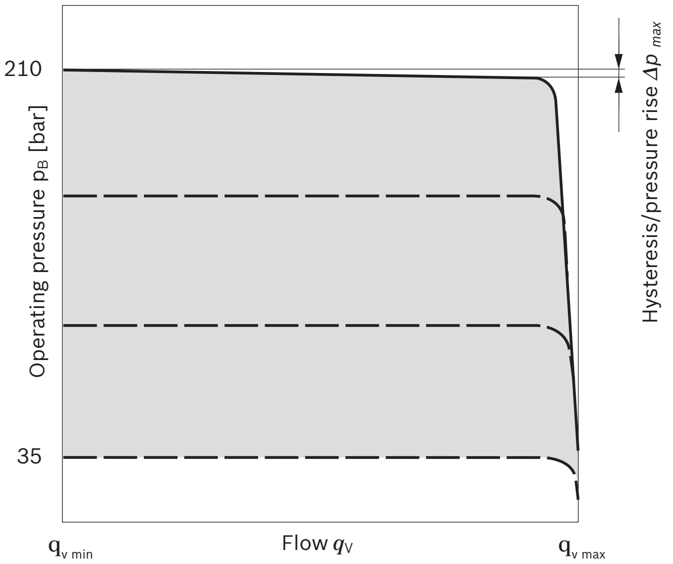
2) For drive shafts with no radial force

DR – Pressure control

The pressure control limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only supplies as much hydraulic fluid as is required by the consumers. If the operating pressure exceeds the pressure setting at the pressure valve, the pump will regulate to a smaller displacement to reduce the control differential.

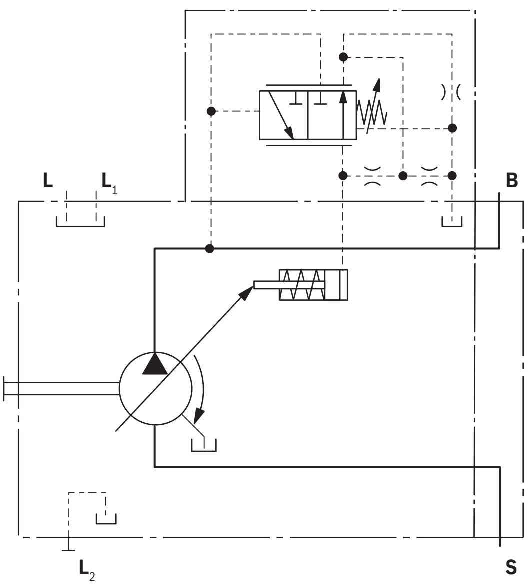
- Basic position in depressurized state: $V_{g\,max}$.
- Setting range[1] for pressure control 35 to 210 bar. Standard is 210 bar.

▼ Characteristic curve DR



Characteristic curve valid at n_1 = 1500 rpm and θ_{fluid} = 50 °C.

▼ Schematic DR



Controller data

NG		28	45	63	85
Pressure increase	Δp [bar]	6	6	6	8
Hysteresis and repeat precision	Δp [bar]	maximum 4			
Pilot fluid consumption	[l/min]	maximum approx. 3			

---

[1] In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.

DRG – Pressure control remotely operated

For the remote-controlled pressure control, the target pressure can be set using a separately arranged pressure relief valve. Pressure control DR see page 9.

A pressure relief valve can be externally piped to port **X** for remote setting of pressure below the setting of the DR control valve spool. This relief valve is not included in the scope of supply of the pump.

The differential pressure at the DRG control valve is set as standard to 20 bar. At port **X** the amount of control fluid is about 1.5 l/min. If a different setting (range 10 to 22 bar) is required, please state in plain text.

As a separate pressure relief valve, we recommend:

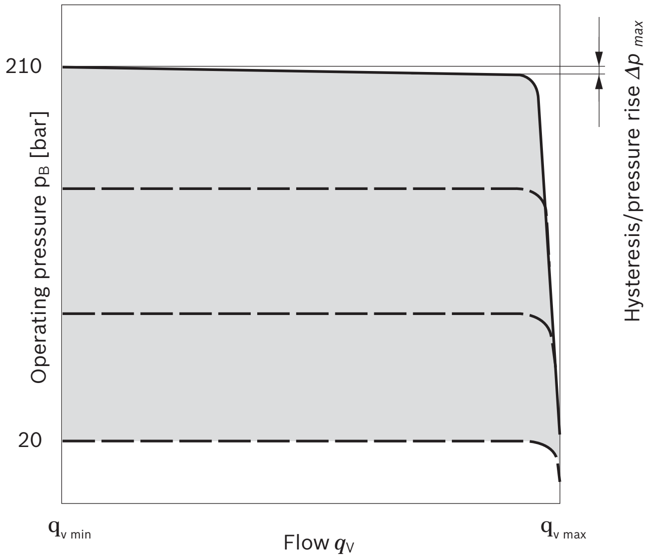
DBDH 6 (hydraulic) to RE 25402 or

DBETR-SO 381 with orifice Ø 0.8 mm in P (electric) to RE 29166.

The max. length of piping should not exceed 2 m.

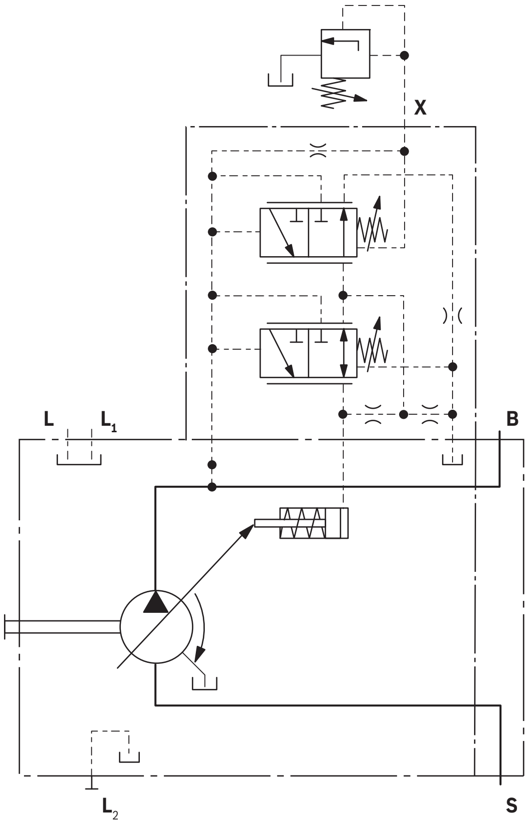
- Basic position in depressurized state: $V_{g\ max}$.
- Setting range[1] for pressure control 20 to 210 bar. Standard is 210 bar.

▼ **Characteristic curve DRG**



Characteristic curve valid at n_1 = 1500 rpm and θ_{fluid} = 50 °C.

▼ **Schematic DRG**



Controller data

NG		28	45	63	85
Pressure increase	Δp [bar]	6	6	6	8
Hysteresis and repeat precision	Δp [bar]	maximum 4			
Pilot fluid consumption	l/min	maximum approx. 4.5			

---

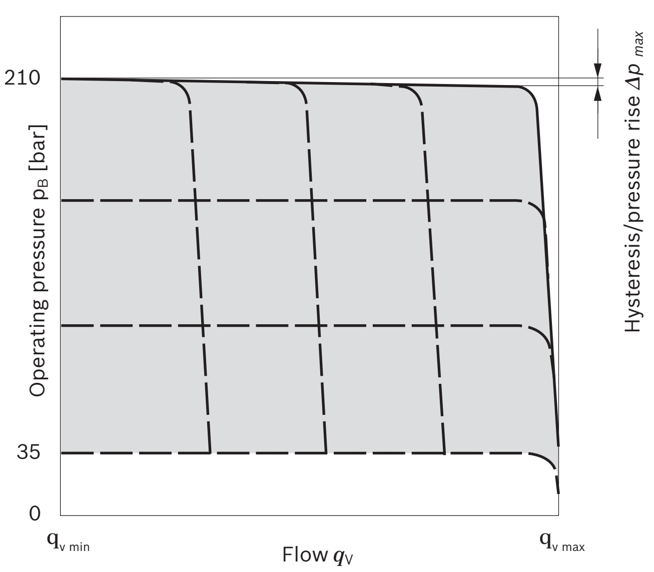
[1] In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.

DRF/DRS/DRSC – Pressure and flow control

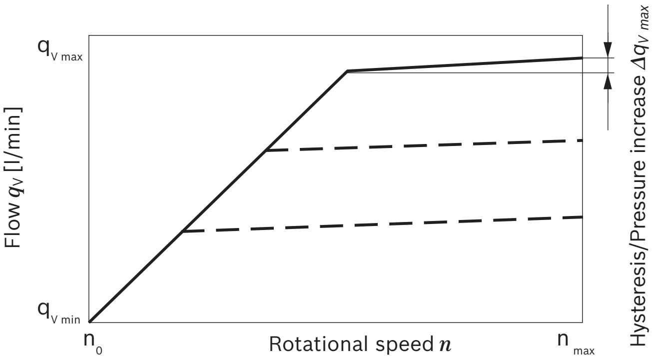
In addition to the pressure control function (see page 9), a variable orifice (e.g. directional valve) is used to adjust the differential pressure upstream and downstream of the orifice. This is used to control the pump flow. The pump flow is equal to the actual required flow by the consumer, regardless of changing pressure levels.
The pressure control overrides the flow control function.

- Basic position in depressurized state: $V_{g\ max}$.
- Setting range[1] for pressure control 35 to 210 bar. Standard is 210 bar.

▼ **Characteristic curve DRF/DRS/DRSC**



▼ **Characteristic curve at variable speed**

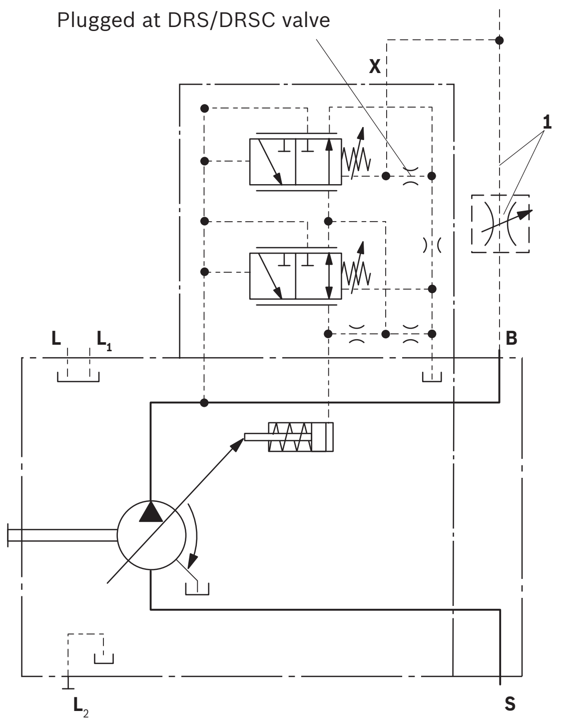


Characteristic curve valid at n_1 = 1500 rpm and θ_{fluid} = 50 °C.

Possible connections at port **B** (not included in the delivery contents)

LS mobile control blocks	Data sheets
M4-12	64276
M4-15	64283
LUDV mobile control blocks	
M6-15	64284
M7-22	64295

▼ **Schematic DG**



1 The sensing orifice (control block) and the line is not included in the delivery contents.

Note
The DRS and DRSC valve versions have no pilot line between **X** and the reservoir.
Unloading the LS-pilot line must be possible in the valve system.
Because of the flushing function sufficient unloading of the flow control in DRS control valve **X**-line must also be provided.
If this pilot line of the **X** line does not have to be guaranteed, the DRSC control valve must be used.

For further information see page 12

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[1] In order to prevent damage to the pump and the system, the permissible setting range must not be exceeded. The range of possible settings at the valve is higher.

Differential pressure Δ*p*:

- Standard setting: 14 to 22 bar.

If another setting is required, please state in clear text.

Relieving the load on port **X** to the reservoir results in a zero stroke ("standby") pressure which lies about 1 to 2 bar higher than the differential pressure Δ*p*.

No account is taken of system influences.

Controller data

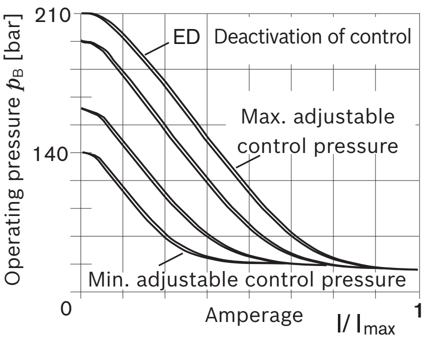
- DR Pressure control data see page 9.
- Maximum flow deviation measured at drive speed n = 1500 rpm.

NG		28	45	63	85
Flow deviation	Δq_{vmax} [l/min]	0.9	1.0	1.8	2.5
Hysteresis; repeat precision	Δp [bar]	maximum 4			
Pilot fluid consumption	[l/min]	maximum approx. 3 to 4.5 (DRF) maximum approx. 3 (DRS / DRSC)			

ED – Electro-hydraulic pressure control

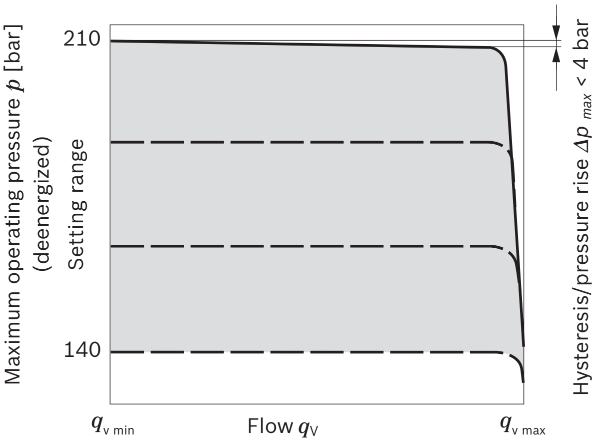
The ED valve is set to a certain pressure by a specified variable solenoid current.
When a change is made at the consumer (load pressure), the position of the control piston will shift.
This causes an increase or decrease in the pump swivel angle (flow) in order to maintain the electrically set pressure level.
The pump thus only delivers as much hydraulic fluid as the consumers can take. The desired pressure level can be set steplessly by varying the solenoid current.
As the solenoid current signal drops towards zero, the pressure will be limited to p_{max} by an adjustable hydraulic pressure cut-off (secure fail safe function in case of a loss of power, e.g. for fan drives). The response time characteristic curve of the ED-control was optimized for the use as a fan drive system.
When ordering, specify the type of application in clear text.

▼ **Static current-pressure characteristic curve ED**
(negative characteristic curve measured with pump in zero stroke)



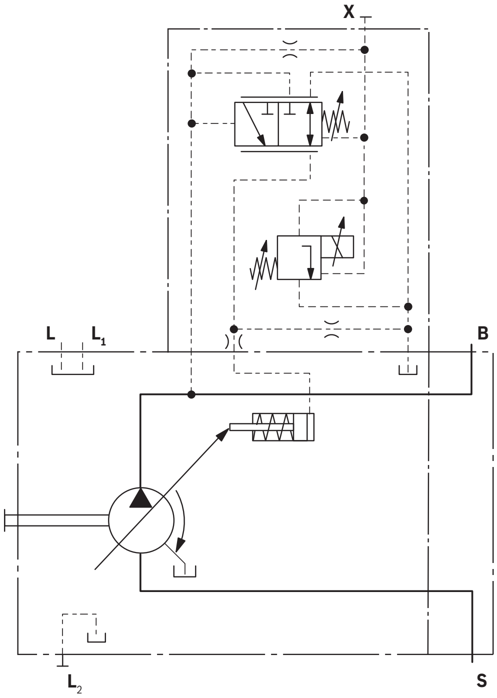
- Hysteresis static < 3 bar.

▼ **Flow-pressure characteristic curve**



- Characteristic curve valid at n_1 = 1500 rpm and θ_{fluid} = 50 °C.
- Pilot fluid consumption: 3 to 4.5 l/min.
- Standby standard setting 23 bar. Other values on request.

▼ **Schematic ED71/ED72**



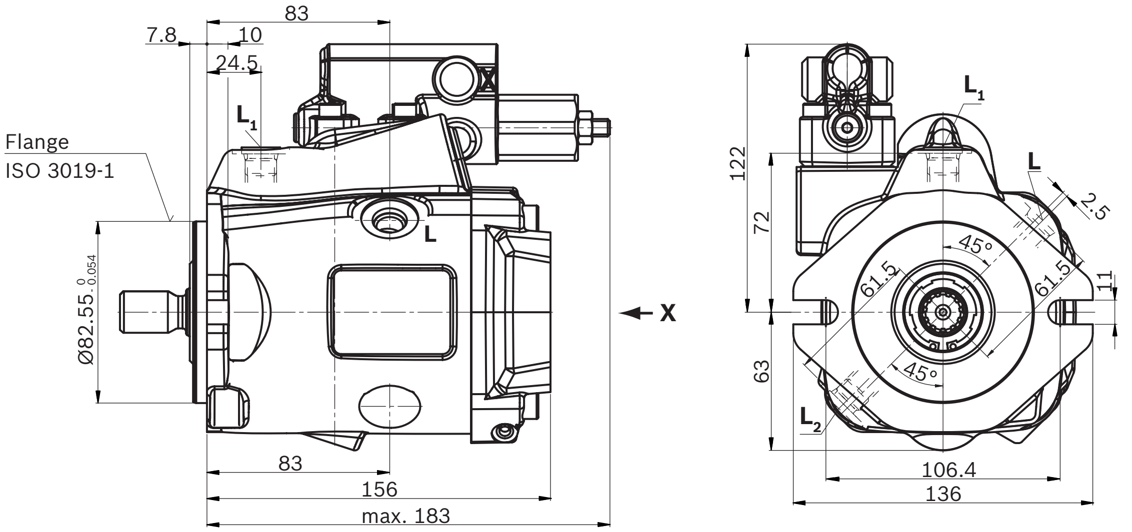
Technical data, solenoid	ED71	ED72
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at p_{min}	100 mA	50 mA
End of control at p_{max}	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Duty cycle	100%	100%
Type of protection: see connector version page 31		
Operating temperature range at valve -20 °C to +115 °C		

210 bar is the standard nominal pressure, higher pressures for fan drive application on request. You will also find more information about fan systems in application brochure 98065.

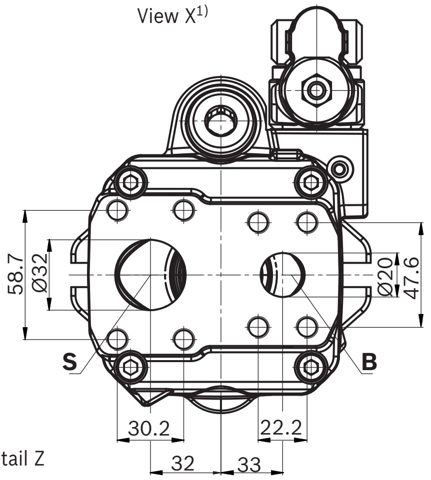
Dimensions, Size 28

DR – Hydraulic pressure controller; clockwise rotation, series 53

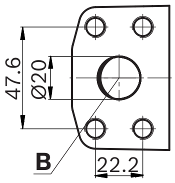
▼ Port plate 11



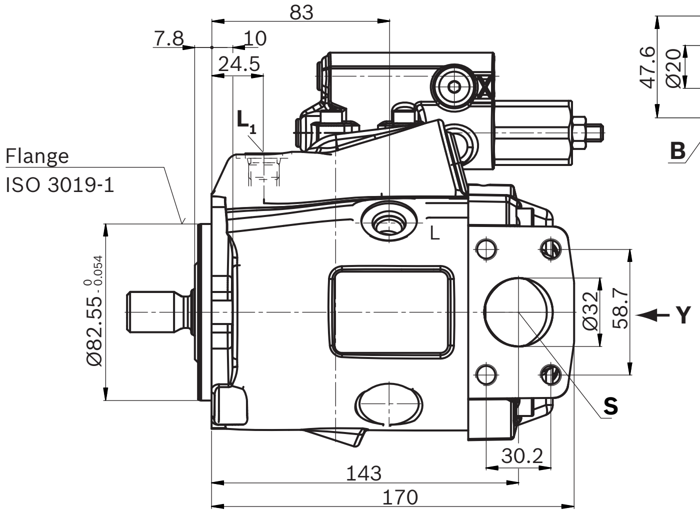
View X1)



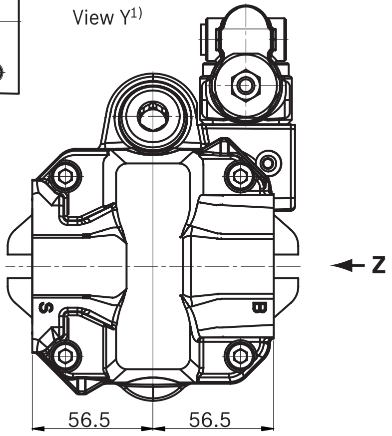
Detail Z



▼ Port plate 12



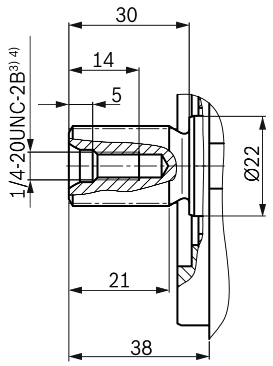
View Y1)



1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

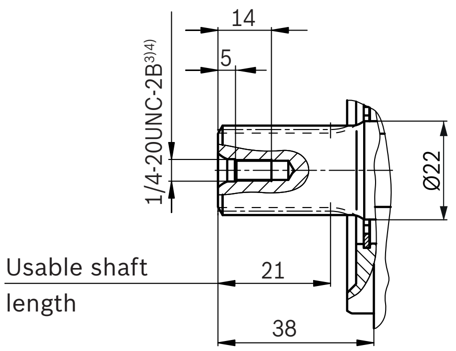
▼ Splined shaft 3/4 in (SAE J744)

S – 11T 16/32DP[1)]



▼ Splined shaft 3/4 in (SAE J744)

R – 11T 16/32DP[1)2)]



Ports		**Standard**	**Size**[4)]	$p_{\text{max abs}}$ **[bar]**[5)]	**Condition**[9)]
B	Working line port (Standard pressure series) Fastening thread	SAE J518[6)] DIN 13	3/4 in M10 × 1.5; 17 deep	250	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6)] DIN 13	1 1/4 in M10 × 1.5; 17 deep	5	O
L	Case drain port	DIN 11926[7)]	3/4-16UNF-2B; 12 deep	2	O[8)]
L_1, L_2	Case drain port	DIN 11926[7)]	3/4-16UNF-2B; 12 deep	2	X[8)]
X	Control pressure	DIN 11926	7/16-20UNF-2A; 11.5 deep	250	O

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1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

3) Thread according to ASME B1.1

4) Observe the general instructions on page 36 concerning the maximum tightening torques.

5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

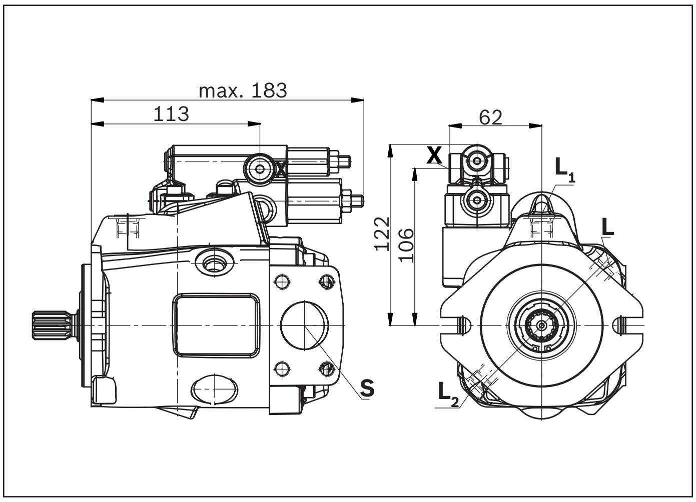
6) Metric fixing thread differing from standard

7) The spot face can be deeper than as specified in the standard.

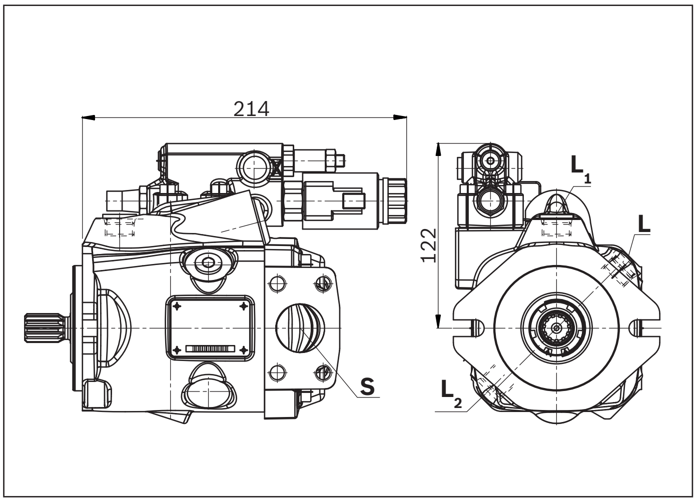
8) Depending on the installation position, L, L_1 or L_2 must be connected (also see installation instructions starting on page 32).

9) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

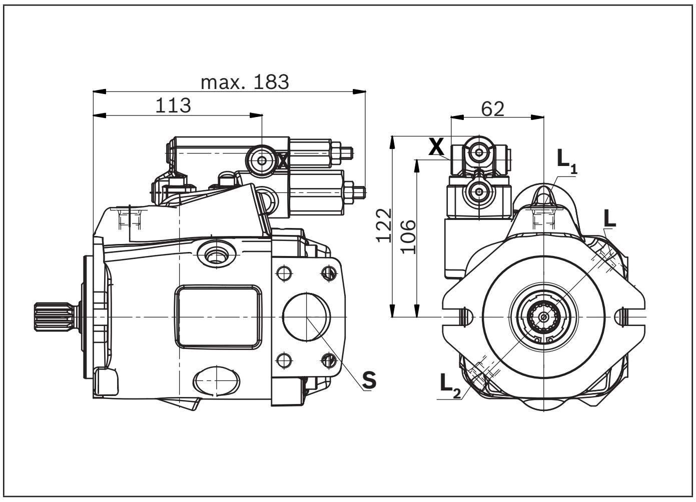
▼ DRG – Pressure controller, remote controlled, series 53



▼ ED7. – Electro-prop. Pressure control, series 53



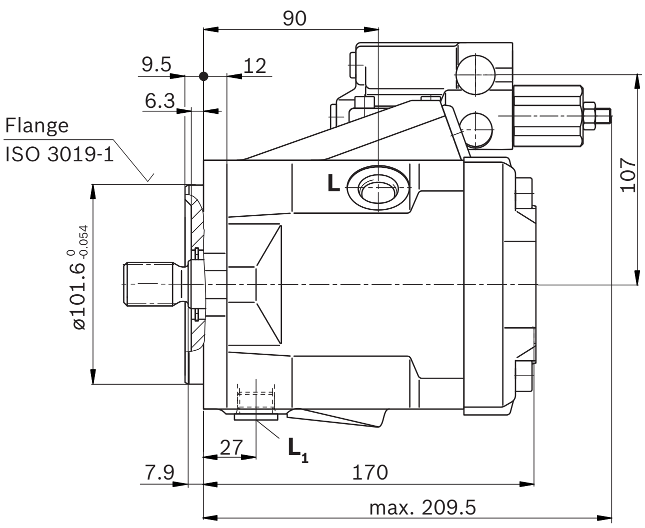
▼ DRF/DRS/DRSC – Pressure and flow control, series 53

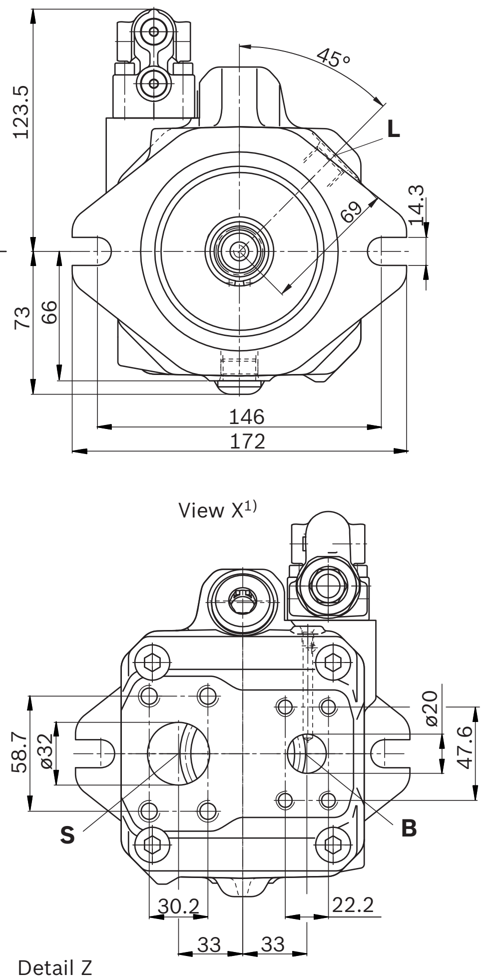


Dimensions, Size 45

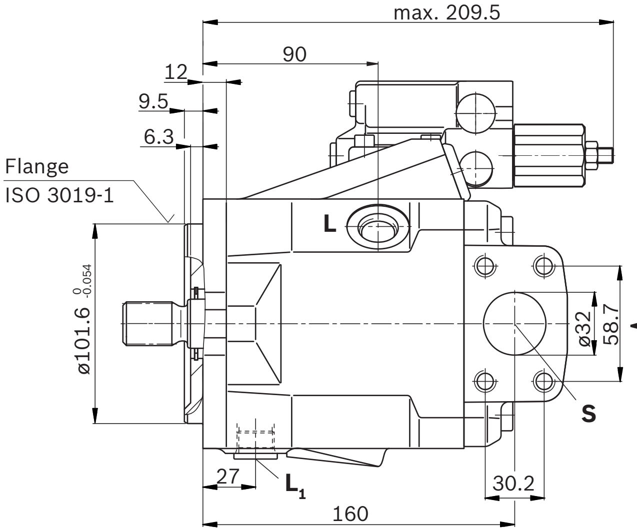
DR – Hydraulic pressure controller; clockwise rotation, series 52

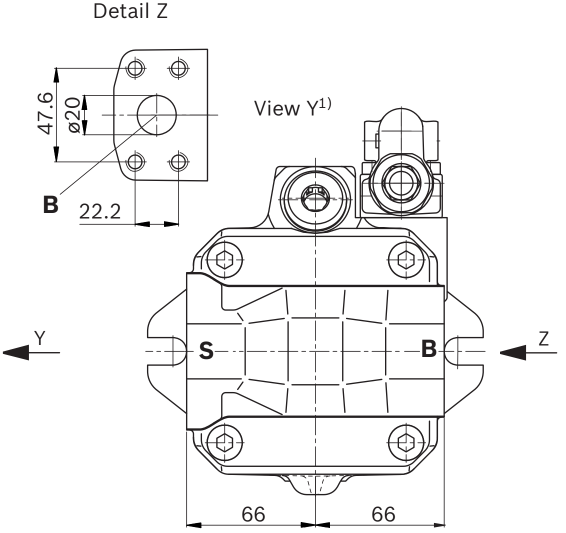
▼ **Port plate 11**





▼ **Port plate 12**

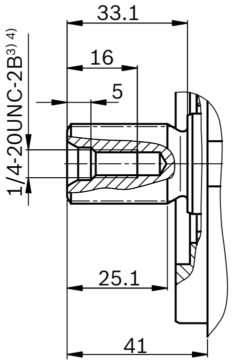




[1] Dimensions of service line ports turned through 180° for counter-clockwise rotation

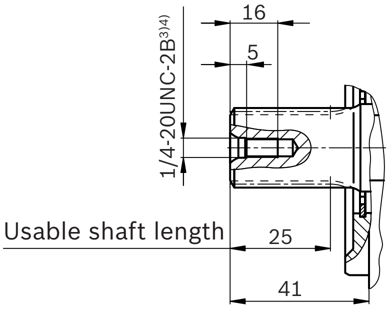
▼ Splined shaft 7/8 in (SAE J744)

S – 13T 16/32DP[1)]



▼ Splined shaft 7/8 in (SAE J744)

R – 13T 16/32DP[1)2)]

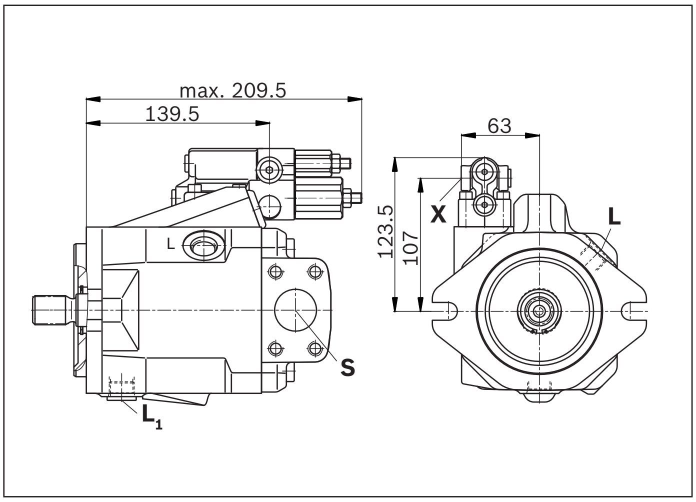


Ports		Standard	Size[4)]	$p_{\text{max abs}}$ [bar][5)]	Condition[9)]
B	Service line port (Standard pressure series) Fixing thread	SAE J518[6)] DIN 13	3/4 in M10 × 1.5; 17 deep	250	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6)] DIN 13	1 1/4 in M10 × 1.5; 17 deep	5	O
L	Case drain port	ISO 11926[7)]	3/4-16UNF-2B; 12 deep	2	O[8)]
L_1	Case drain port	ISO 11926[7)]	3/4-16UNF-2B; 12 deep	2	X[8)]
X	Control pressure	ISO 11926	7/16-20UNF-2B; 11.5 deep	250	O

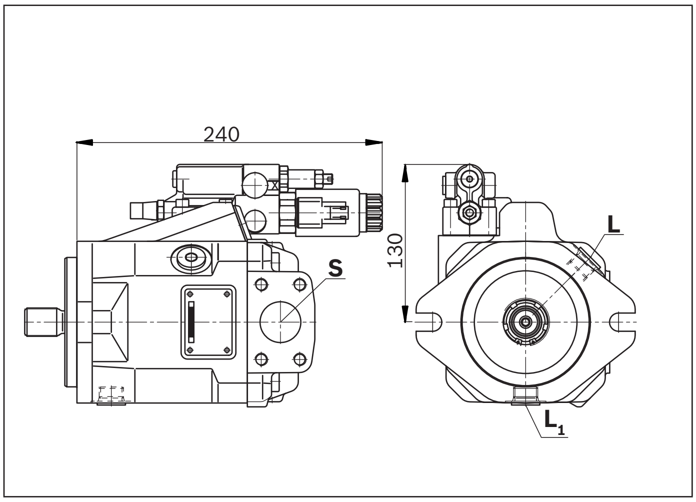
---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.
3) Thread according to ASME B1.1
4) Observe the general instructions on page 36 concerning the maximum tightening torques.
5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
6) Metric fixing thread differing from standard
7) The spot face can be deeper than as specified in the standard.
8) Depending on the installation position, L or L_1 must be connected (also see installation instructions starting on page 32).
9) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

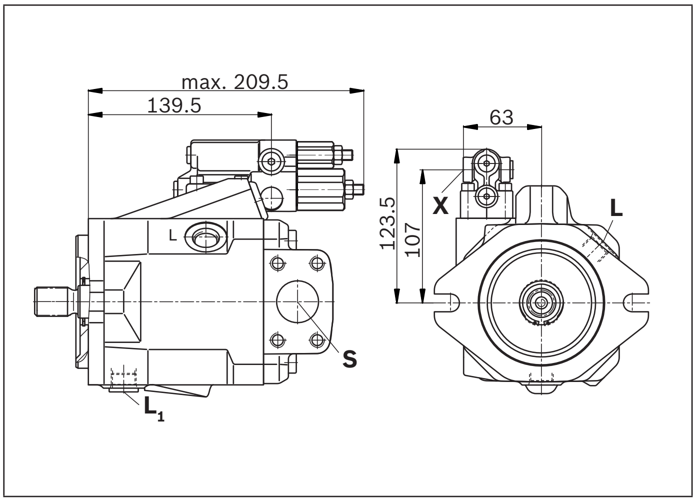
▼ DRG – Pressure controller, remote controlled, series 52



▼ ED7. – Electro-prop. Pressure control, series 52



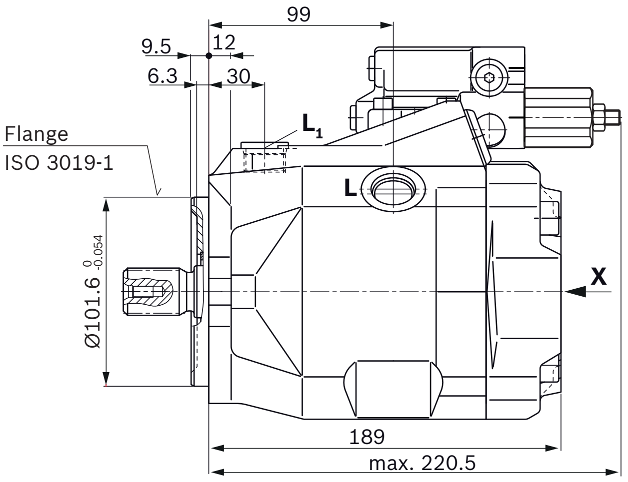
▼ DRF/DRS/DRSC – Pressure and flow control, series 52

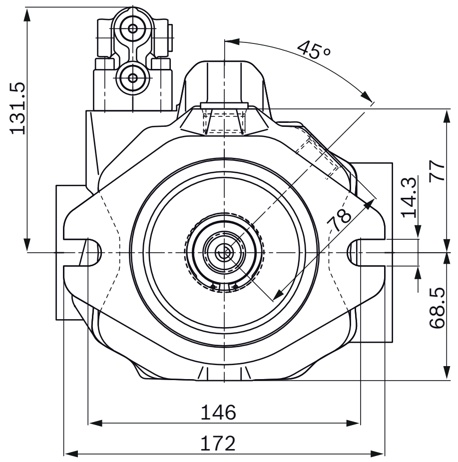


Dimensions, Size 63

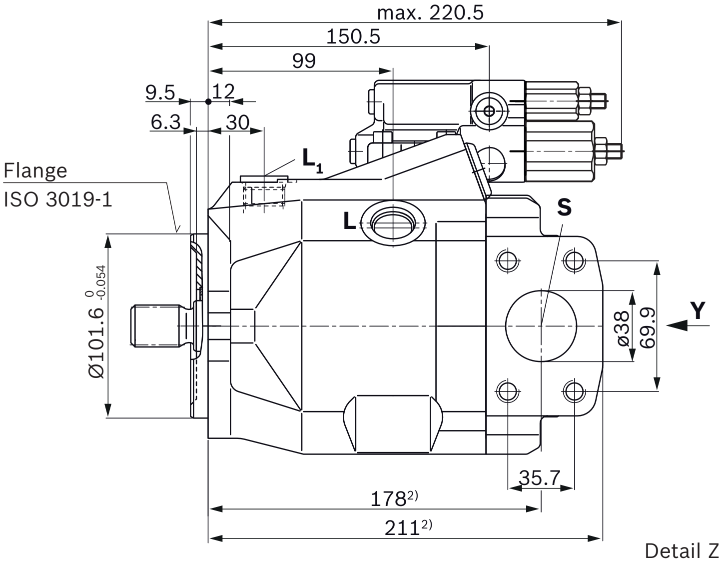
DR – Hydraulic pressure controller; clockwise rotation, series 52

▼ Port plate 11

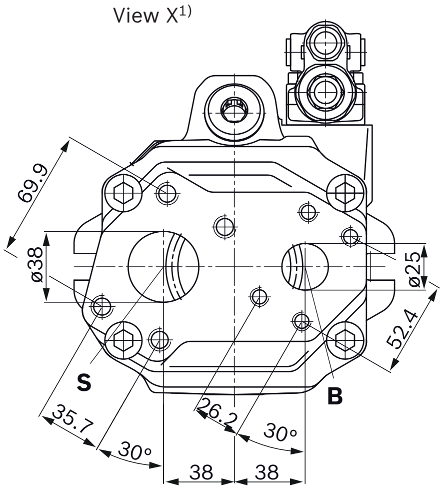




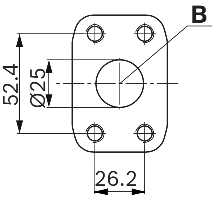
▼ Port plate 12



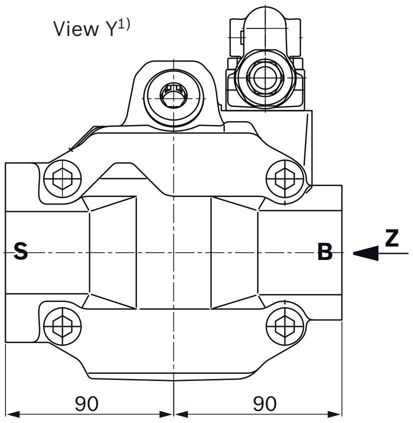
View X1)



Detail Z



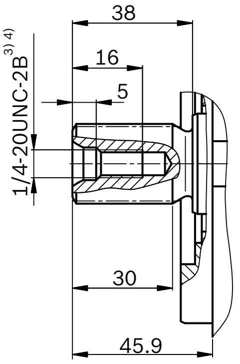
View Y1)



1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

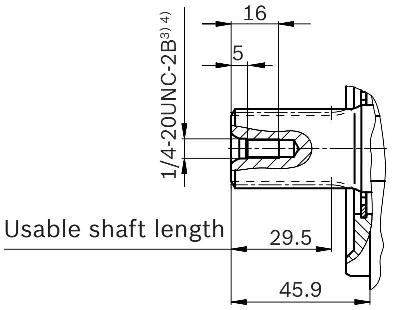
▼ Splined shaft 1 in SAE J744

S – 15T 16/32DP[1]



▼ Splined shaft 1 in SAE J744

R – 15T 16/32DP[1)2)]

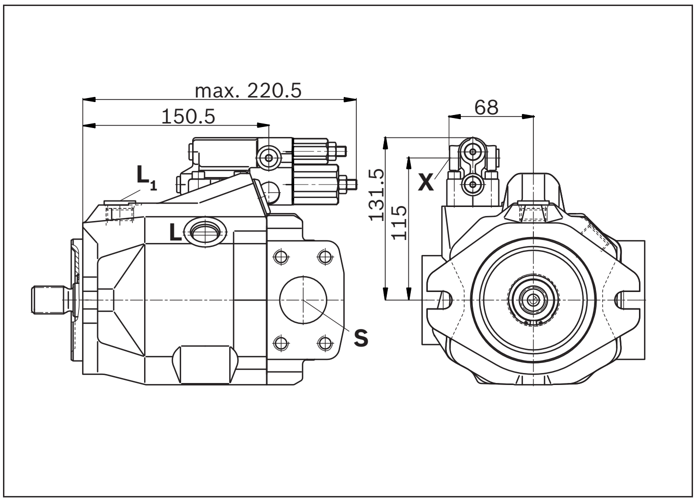


Ports		Standard	Size[4]	$p_{\text{max abs}}$ [bar][5]	Condition[9]
B	Working line port (Standard pressure series) Fastening thread	SAE J518[6] DIN 13	1 in M10 × 1.5; 17 deep	250	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	1 1/2 in M12 × 1.75; 20 deep	5	O
L	Case drain port	ISO 11926[7]	7/8-14UNF-2B; 13 deep	2	O[8]
L$_{1,}$	Case drain port	ISO 11926[7]	7/8-14UNF-2B; 13 deep	2	X[8]
X	Control pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	250	O

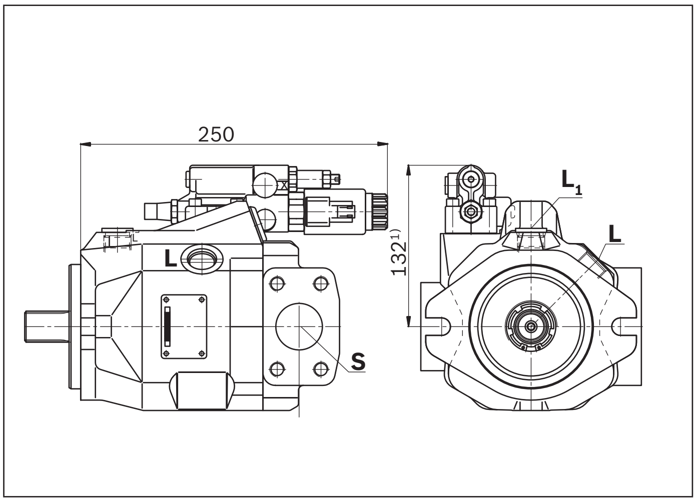
---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Splines according to ANSI B92.1a, run out of spline is a deviation from standard.
3) Thread according to ASME B1.1
4) Observe the general instructions on page 36 concerning the maximum tightening torques.
5) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
6) Metric fixing thread differing from standard
7) The spot face can be deeper than as specified in the standard.
8) Depending on the installation position, L, L_1 or L_2 must be connected (also see installation instructions starting on page 32).
9) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

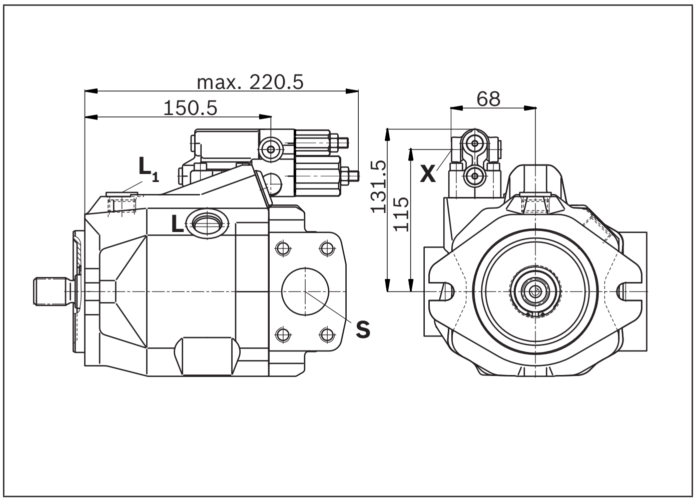
▼ DRG – Pressure controller, remote controlled, series 52



▼ ED7. / ER7. – Electro-prop. Pressure control, series 52



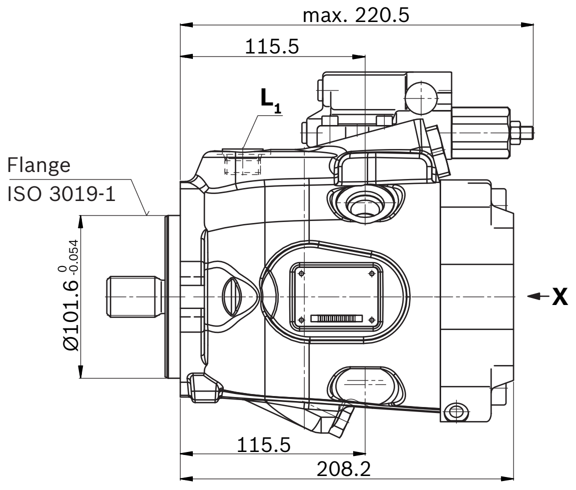
▼ DRF/DRS/DRSC – Pressure and flow control, series 52

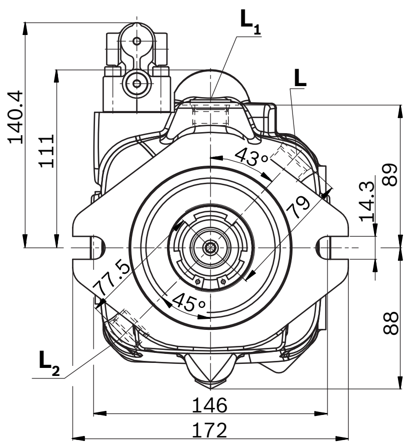


Dimensions, Size 85

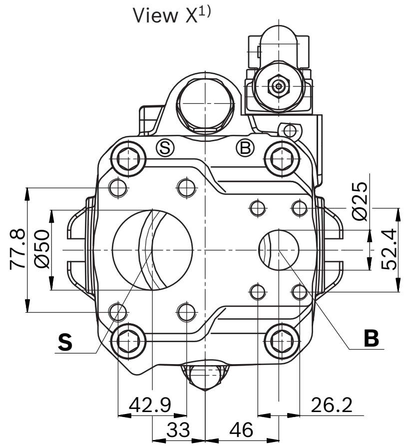
DR – Hydraulic pressure controller; clockwise rotation, mounting flange C series 53

▼ **Port plate 11**



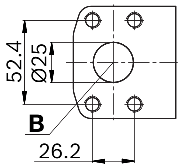


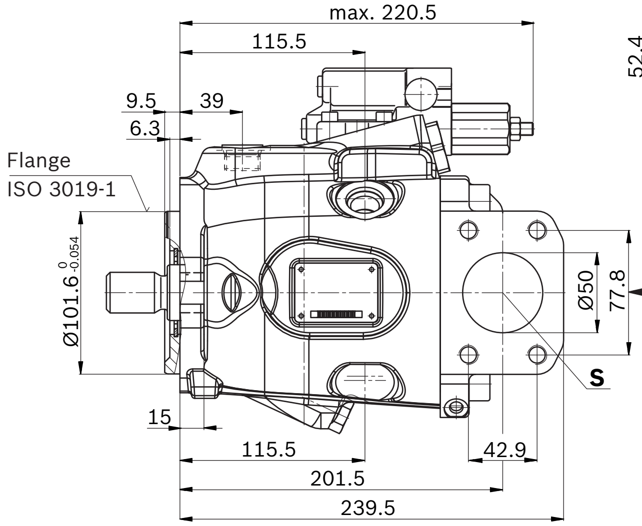
View X1)



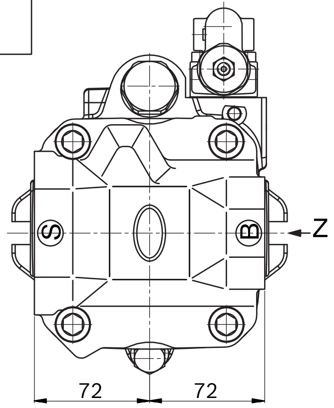
▼ **Port plate 12**

Detail Z





View Y1)

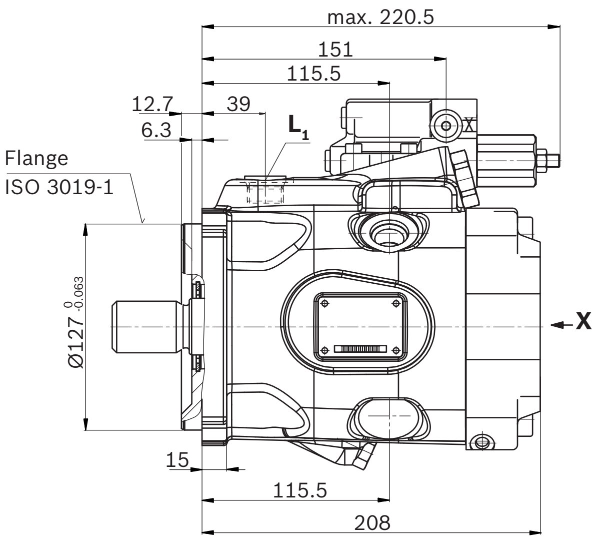


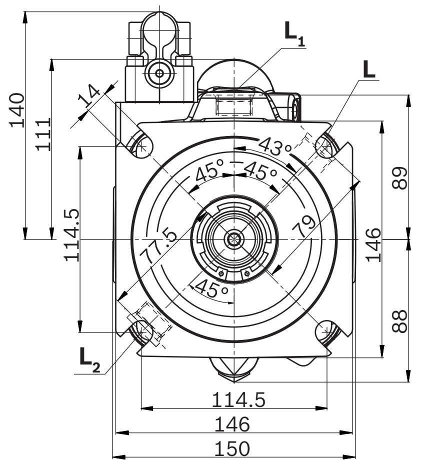
1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

Dimensions, Size 85

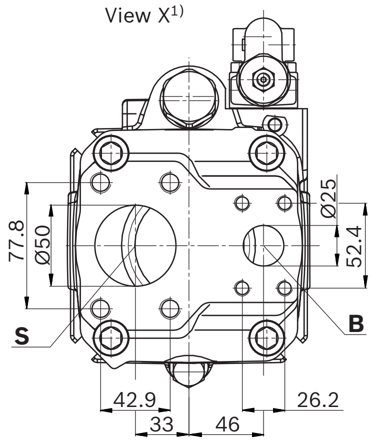
DR – Hydraulic pressure controller; clockwise rotation, mounting flange D series 53

▼ **Port plate 11**

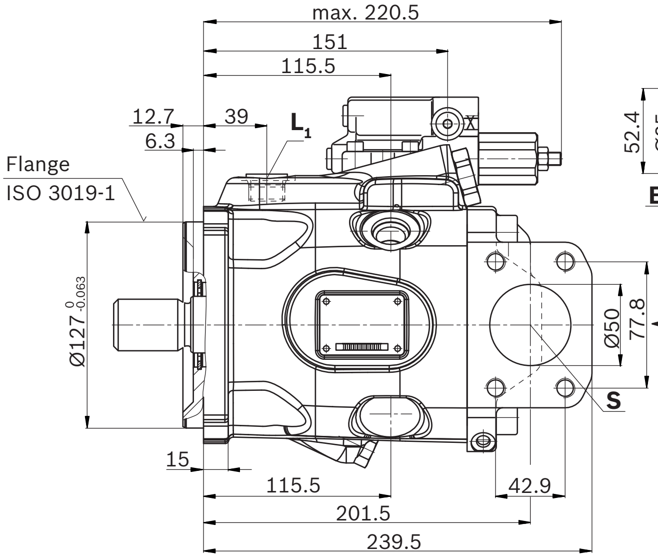




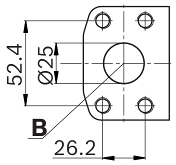
View X1)



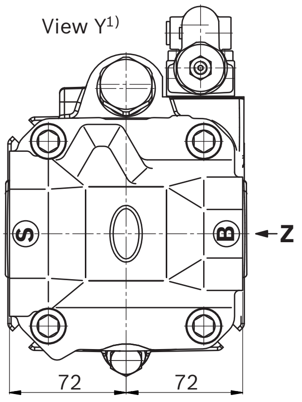
▼ **Port plate 12**



Detail Z



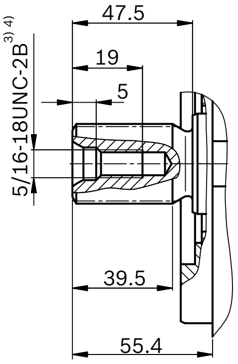
View Y1)



1) Dimensions of service line ports turned through 180° for counter-clockwise rotation

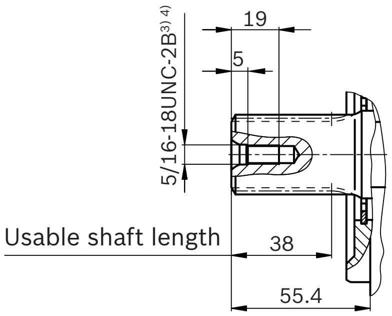
▼ Splined shaft 1 1/4 in SAE J744

S – 14T 12/24DP[1]



▼ Splined shaft 1 1/4 in SAE J744

R – 14T 12/24DP[1)2)]



Ports		Standard	Size[4]	$p_{\text{max abs}}$ [bar][5]	Condition[9]
B	Working line port (Standard pressure series) Fastening thread	SAE J518[6] DIN 13	1 in M10 × 1.5; 17 deep	250	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[6] DIN 13	2 in M12 × 1.75; 20 deep	5	O
L	Case drain port	ISO 11926[7]	7/8-14UNF-2B; 13 deep	2	O[8]
L_1, L_2	Case drain port	ISO 11926[7]	7/8-14UNF-2B; 13 deep	2	X[8]
X	Control pressure	ISO 11926	7/16-20UNF-2A; 11.5 deep	250	O

---

[1] Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Splines according to ANSI B92.1a, run out of spline is a deviation from standard.

[3] Thread according to ASME B1.1

[4] Observe the general instructions on page 36 concerning the maximum tightening torques.

[5] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

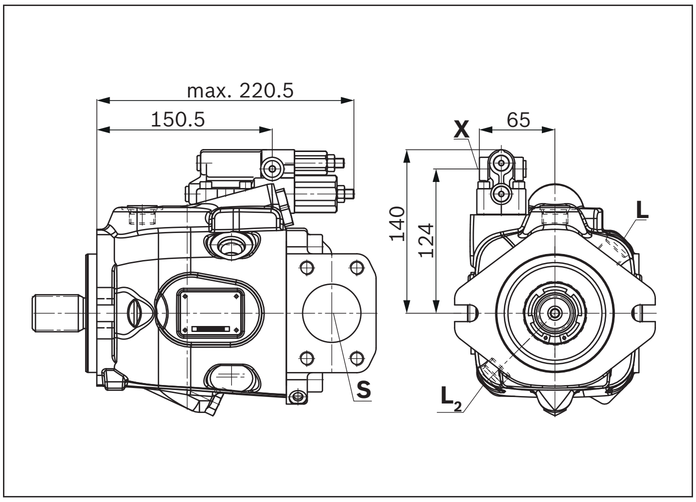
[6] Metric fixing thread differing from standard

[7] The spot face can be deeper than as specified in the standard.

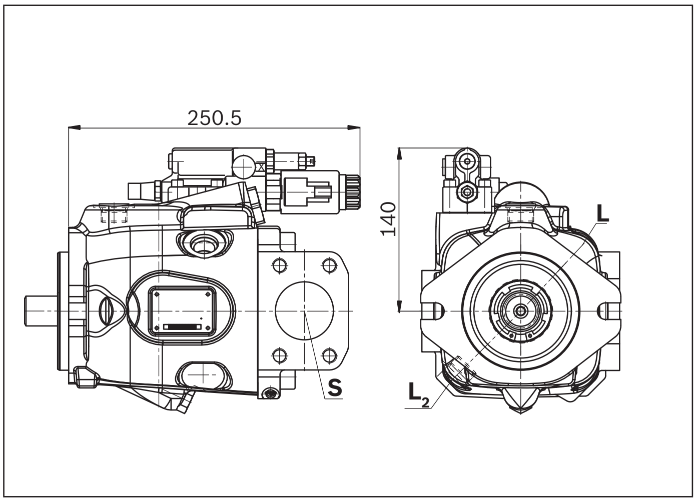
[8] Depending on the installation position, L, L_1 or L_2 must be connected (also see installation instructions starting on page 32).

[9] O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

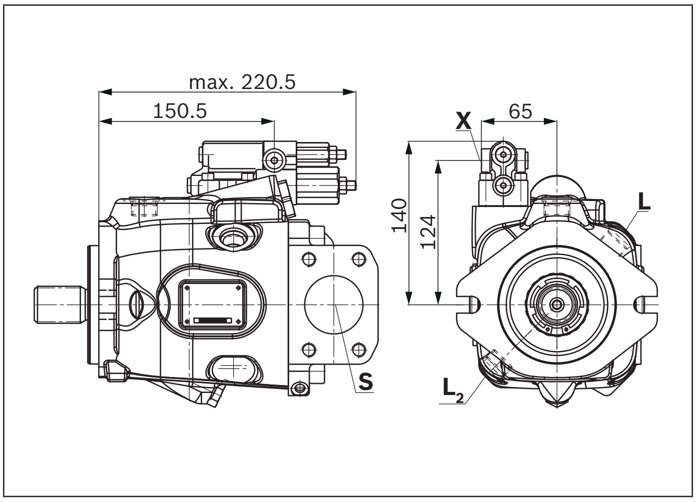
▼ DRG – Pressure controller, remote controlled, series 53



▼ ED7. – Electro-prop. Pressure control, series 53



▼ DRF/DRS/DRSC – Pressure and flow control, series 53

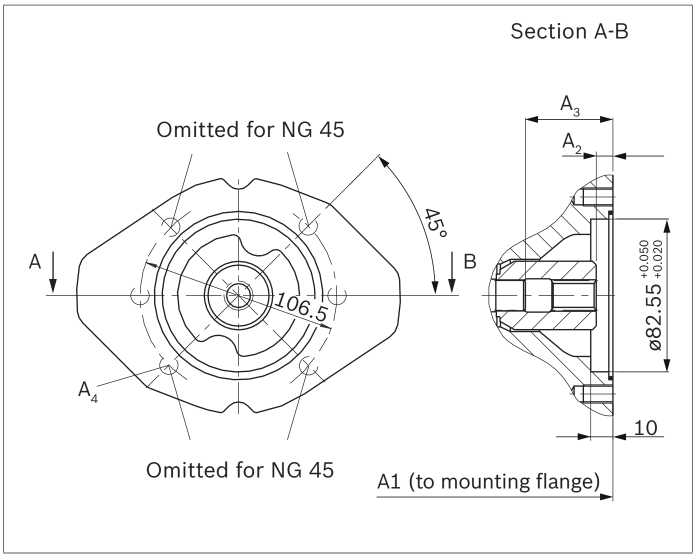


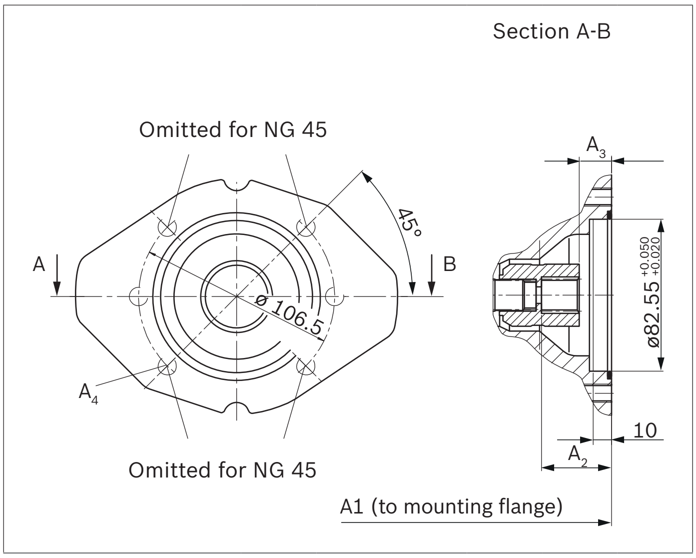
Dimensions through drive

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability over sizes				Code
diameter	**Symbol**[2]	**diameter**		**28**	**45**	**63**	**85**	
82-2 (A)	∘°, ∘∘	5/8 in	9T 16/32DP	●	●	●	●	K01
		3/4 in	11T 16/32DP	●	●	●	●	K52

● = Available ○ = On request

▼ 82-2





K01 (SAE J744 16-4 (A))	NG	A1	A2	A3	A4[3]
	28	182	9.3	43.3	M10×1.5; 14.5 deep
	45	204	9.9	47	M10×1.5; 16 deep
	63	229	10.7	53	M10×1.5; 16 deep
	85	255	9.5	59	M10×1.5; 16 deep

K52 (SAE J744 19-4 (A-B))	NG	A1	A2	A3	A4[3]
	28	182	39	18.8	M10×1.5; 14.5 deep
	45	204	39.3	18.8	M10×1.5; 16 deep
	63	229	39.4	18.9	M10×1.5; 16 deep
	85	255	39.4	18.9	M10×1.5; 16 deep

---

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

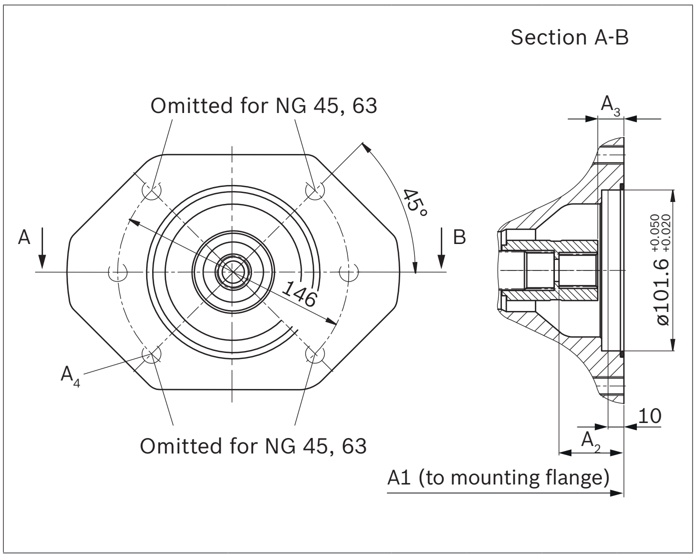
2) Mounting bores pattern viewed from through drive with control at top

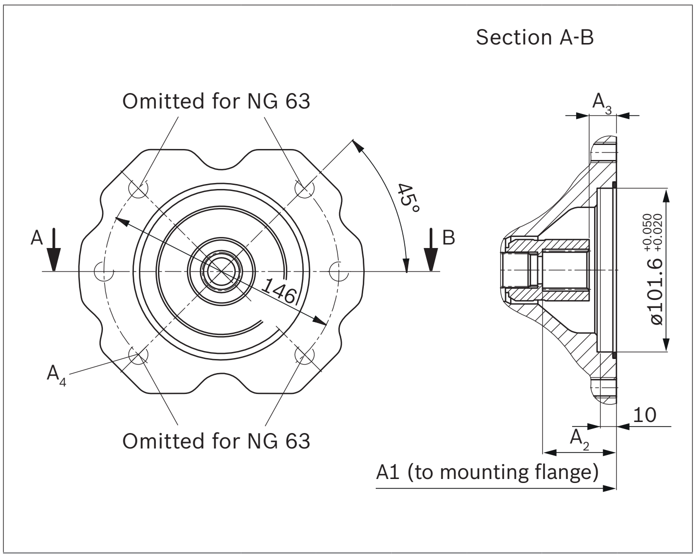
3) Thread according to DIN 13, observe the general instructions on page 54 for the maximum tightening torques.

Flange ISO 3019-1 (SAE)		Hub for splined shaft[1]		Availability over sizes				Code
diameter	**Symbol[2]**	**diameter**		**28**	**45**	**63**	**85**	
101-2 (B)	°°, ○○	7/8 in	13T 16/32DP	–	●	●	●	K68
		1 in	15T 16/32DP	–	–	●	●	K04

● = Available ○ = On request

▼ 101-2





K68 (SAE J744 22-4 (B))	**NG**	**A1**	**A2**	**A3**	**A4[3]**
	45	204	42.3	17.8	M12×1.75; 18 deep
	63	229	42.4	17.9	M12×1.75; 18 deep
	85	255	42.4	17.9	M12×1.75; 18 deep

K04 (SAE J744 25-4 (B-B))	**NG**	**A1**	**A2**	**A3**	**A4[3]**
	63	229	47.9	18.9	M12×1.75; 18 deep
	85	255	47.4	18.4	M12×1.75; 18 deep

---

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Mounting bores pattern viewed from through drive with control at top

3) Thread according to DIN 13, observe the general instructions on page 54 for the maximum tightening torques.

Overview of attachment options

Through drive			Attachment of 2nd pump			
Flange ISO 3019-1	**Hub for splined shaft**	**Short code**	**A10VNO/5x NG (shaft)**	**A10V(S)O/5x NG (shaft)**	**A1VO/10 NG (shaft)**	**External gear**
82-2 (A)	5/8 in	K01	–	10 (U), 18 (U)	18 (S2)	Series F
	3/4 in	K52	28 (S, R)	10 (S) 18 (S, R)	18 (S3)	
101-2 (B)	7/8 in	K68	45 (S, R)	28 (S, R) 45 (U, W)[1]	35 (S4)	Series N/G
	1 in	K04	63 (S, R)	45 (S, R) 60, 63 (U, W)[2] 72 (U, W)[2]	35 (S5)	–

---

[1] Not for NG28 with K68

[2] Not for NG63 with K04

Combination pumps A10VNO + A10VNO

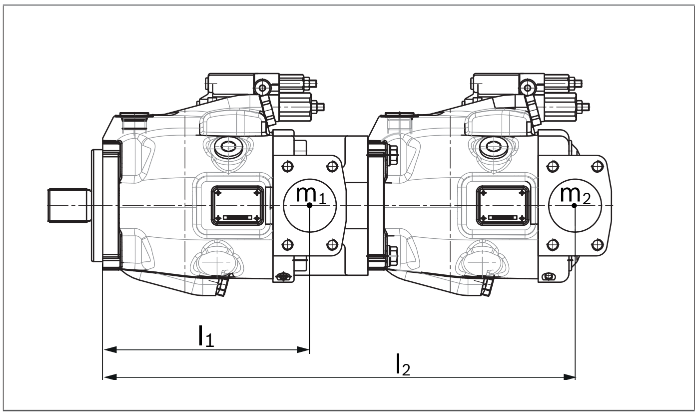
By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes. When ordering combination pumps, the type designations of the 1st and 2nd pump must be linked by a "**+**".

Order example:

A10VNO63DRS/53R-VSC12K04+
A10VNO45DRF/53R-VSC11N00

It is permissible to use a combination of two single pumps of the same nominal size (tandem pump) considering a dynamic mass acceleration of maximum 10 *g* (= 98.1 m/s^2) without additional support brackets.

For combination pumps consisting of more than two pumps, the mounting flange must be rated for the permissible mass torque (please consult us).



m_1, m_2, m_3	Weight of pump	[kg]
l_1, l_2, l_3	Distance, center of gravity	[mm]

$$T_m = (m_1 \times l_1 + m_2 \times l_2 + m_3 \times l_3) \times \frac{1}{102} \quad \text{[Nm]}$$

Permissible mass moment of inertia

Size				28	45	63	85
	static	T_m	Nm	–	890	900	1370
	dynamic at 10 *g* (98.1 m/s^2)	T_m	Nm	–	89	90	137
Weight with through-drive plate		m	kg	13	18	24	28
Weight without through-drive plate (e.g. 2nd pump)				11.5	15	18	22
Distance, center of gravity **without** through drive		l_1	mm	78	85	96	105
Distance, center of gravity **with** through drive		l_1	mm	87	99	115	127

Connector for solenoids

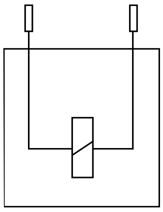
DEUTSCH DT04-2P-EP04

Molded connector, 2-pin, without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)

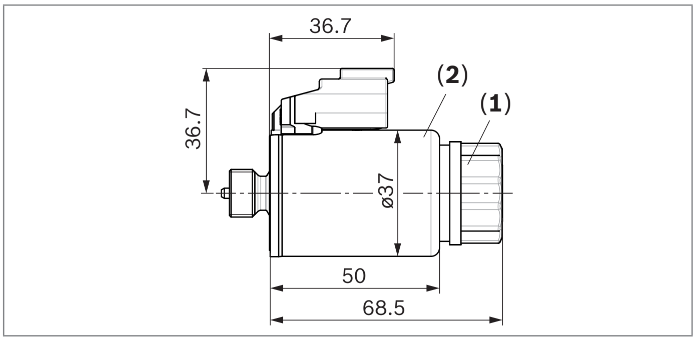
▼ Circuit symbol



▼ Mating connector DEUTSCH DT06-2S-EP04

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).



Changing plug position

If necessary, you can change the connector orientation by turning the solenoid housing.

To do this, proceed as follows:

- Loosen the mounting nut (**1**) of the solenoid. To do this, turn the mounting nut (**1**) one turn counter-clockwise.
- Turn the solenoid body (**2**) to the desired orientation.
- Retighten the mounting nut.
  Tightening torque: 5^{+1} Nm.
  (WAF 26, 12-sided DIN 3124)

On delivery, the position of the connector may differ from that shown in the brochure or drawing.

Electronic controls

Control	Electronics function	electronics		Further information
Electric pressure control	Controlled power outlet	RA	analog	95230
		RC4-5/30 1)	Digital	95205

Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.

Particularly with the "drive shaft up/down" installation position, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The case drain in the case interior must be directed to the reservoir via the highest available drain port (**L**, **L_1**[2], **L_2**[3]).

If a shared drain line is used for several units, make sure that the relevant case pressure is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operational circumstances, particularly at cold start. If this is not possible, separate reservoir lines must be laid as required.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction lines and the drain lines must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\ max}$ = 800 mm. The minimum suction pressure at port **S** must also not fall below 0.8 bar absolute during operation and during cold start.

When designing the reservoir, ensure that there is sufficient distance

between the suction line and the drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Note

In certain installation conditions, an influence on the control characteristic curves can be expected. Gravity, dead weight and case pressure can cause minor shifts in characteristics and changes in response time.

For key, see page 34.

Installation position

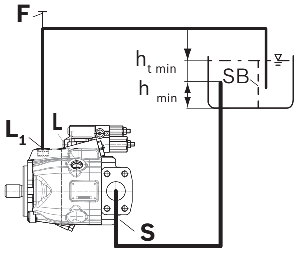
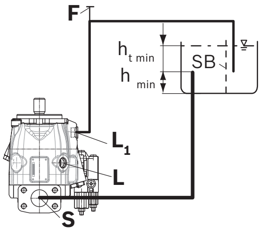
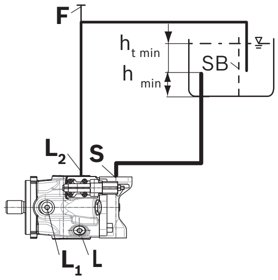
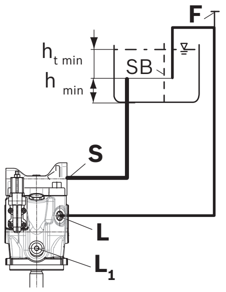
See the following examples **1** to **12**.

Additional installation positions are available upon request.

Recommended installation position: **1** and **3**

Below-reservoir installation (standard)

Below-reservoir installation is when the axial piston unit is installed outside of the reservoir below the minimum fluid level.

Installation position	Air bleeding	Filling
1[2] 	**F**	**S** + **L** or **L_1**
2[1] 	**F**	**S** + **L_1**
3[3] 	**F**	**S** + **L** or **L_1**
4 	**F**	**S** + **L** or **L_1**

---

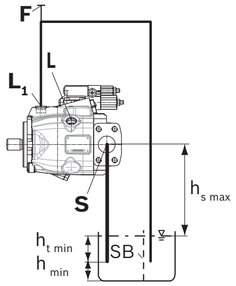
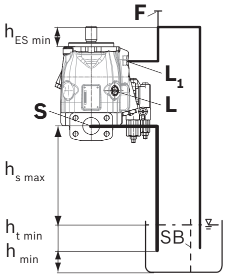
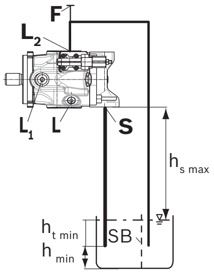
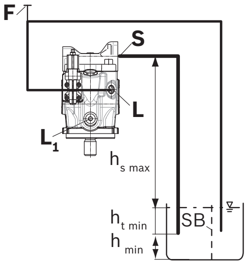
[1] Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

[2] For NG45 and NG63 series 52, **L_1** is opposite, L must then be connected if necessary.

[3] Only series 53

Above-reservoir installation

Above-reservoir installation means the axial piston unit is installed above the minimum fluid level of the reservoir. To prevent the axial piston unit from draining in position 6, the height difference $h_{ES\,min}$ must be at least 25 mm. Observe the maximum permissible suction height $h_{S\,max}$ = 800 mm.

Installation position	Air bleeding	Filling
5[2)] 	**F**	**L_1** or **L**
6[1)2)] 	**F**	**L_1**
7[3)] 	**F**	**L_2**
8[1)] 	**F**	**S** or **L**

A check valve in the drain line is only permissible in individual cases. Consult us for approval.

For key, see page 34.

---

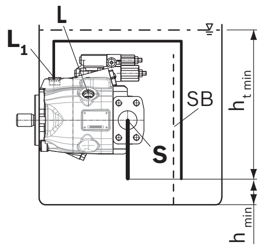
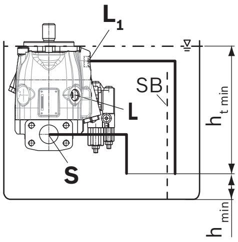
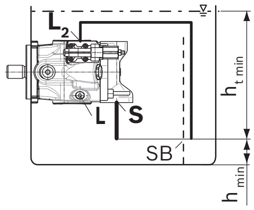
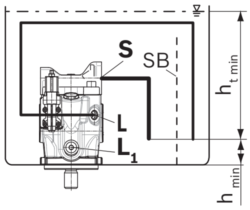
1) Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

2) For NG45 and NG63 series 52, **L_1** is opposite, **L** must then be connected if necessary.

3) Only series 53

Tank installation

Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level. The axial piston unit is completely below the hydraulic fluid. If the minimum fluid level is equal to or below the upper edge of the pump, see chapter "Above-reservoir installation". Axial piston units with electrical components (e.g., electric control, sensors) may not be installed in a reservoir below the fluid level.

Installation position	Air bleeding	Filling
9[2] 	Via the highest available port **L**	Automatically via the open port **L** or **L_1** due to the position under the hydraulic fluid level
10 	Via the highest available port **L_1**	Automatically via the open port **L**, **L_1** or **S** due to the position under the hydraulic fluid level
11[3] 		
12 	Via the highest available port **L**	Automatically via the open port **L**, **L_1** or **S** due to the position under the hydraulic fluid level

Key and assembly note

Key	
F	Filling / air bleeding
S	Suction port
L; L_1; L_2	Tank port
SB	Baffle (baffle plate)
$h_{t\,min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to tank base (100 mm)
$h_{ES\,min}$	Minimum necessary height needed to protect the axial piston unit from draining (25 mm).
$h_{S\,max}$	Maximum permissible suction height (800 mm)

Note

Port **F** is part of the external piping and must be provided by the customer to make filling and air bleeding easier.

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[1] Because complete air bleeding and filling are not possible in this position, the pump should be air bled and filled in a horizontal position before installation.

[2] For NG45 and NG63 series 52, **L_1** is opposite, **L** must then be connected if necessary.

[3] Only series 53

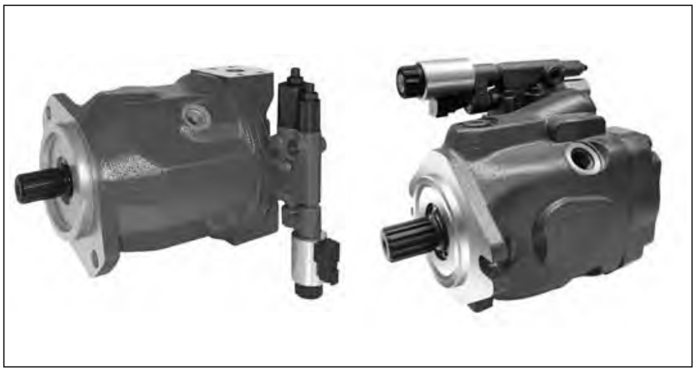
Project planning notes

- The A10VNO pump is designed to be used in open circuits.
- Project planning, installation and commissioning of the axial piston units requires the involvement of skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual thoroughly and completely. If necessary, request them from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The specified data and notes must be observed.
- Pressure controllers are not backups against pressure overload. A separate pressure relief valve is to be provided in the hydraulic system.
- Depending on the operating condition of the axial piston unit (operating pressure, fluid temperature), the characteristic curve may shift.
- Not all versions of the product are approved for use in a safety function pursuant to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. MTTF_d) for functional safety.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports can only be used to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control and regulation systems (e.g. valve spools) may in certain circumstances become stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid, abrasion or residual dirt from components). As a result, the hydraulic fluid flow or build-up of torque of the axial piston unit will no longer respond correctly to the operator's commands. Even the use of different filter cartridges (external or internal inlet filter) will not rule out a fault but merely minimize the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.

Axial piston variable pump A10V(S)O, A10VO Series 3x and 5x with electro-proportional EF differential pressure control



Series 31 and 32
- Sizes 18 to 180
- Nominal pressure/maximum pressure 280 / 350 bar
- Open circuit

Series 52 and 53
- Sizes 18 to 100
- Nominal pressure/maximum pressure 250 / 315 bar
- Open circuit

Features
- Electro-proportional differential pressure control by a current signal
- High precision
- Safe function in the event of a power failure, e.g. supply of braking and steering systems
- Use of standard proportional amplifiers possible
- Compact design

Application possibilities
- Variations in the fine control
- Control of the maximum flow
- Use for electronic load limiting control

Further information on the relevant products can be found in the data sheets:

A10V(S)O series 31	92701
A10VO series 32	92705
A10VO series 52/53	92703

Inhalt

Ordering code A10V(S)O series 31 (see also data sheet 92701)

01	02	03	04	05		06	07		08	09	10	11	12	13
	A10V(S)	**O**			**/**	**31**		**–**						**P**

Version

		18	28	45	71	100	140	
01	Standard version (without code)	●	●	●	●	●	●	
	High-speed version	–	–	●	●	●	●	**H**

Axial piston unit

		18	28	45	71	100	140	
02	Variable swashplate design, nominal pressure 280 bar, maximum pressure 350 bar	–	●	●	●	●	●	**A10V**
		●	–	–	–	–	–	**A10VS**

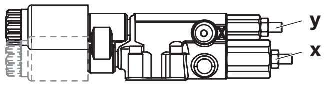
Operating mode

03	Pump, open circuit	**O**

Size (NG)

04	Geometric displacement	**18**	**28**	**45**	**71**	**100**	**140**

Control device



					18	28	45	71	100	140	Controller axis	x	y
05	Differential pressure control, electrically variable, negative characteristic curve										**EF.**		
			Δ*p* shifting Controller axis **y**	U = 12 V	●	●	●	●	●	●	**EF1**		
				U = 24 V	●	●	●	●	●	●	**EF2**		
			Δ*p* shifting Controller axis **x**	U = 12 V	●	●	●	●	●	●	**EF6**		
				U = 24 V	●	●	●	●	●	●	**EF7**		
	Possible controller combinations1)												
	Controller axis **x**		Controller axis **y**										
	Pressure controller1)		Flow controller	X-T plugged **without** flushing function	●	●	●	●	●	●	**EF.1)**	**D**	**C**
				X-T open **without** flushing function	●	●	●	●	●	●	**EF.1)**	**D**	**F**
	Flow control	X-T plugged **with** flushing function	Pressure controller remote controlled	X-T plugged **without** flushing function	●	●	●	●	●	●	**EF.**	**S**	**G**
		X-T open **without** flushing function			●	●	●	●	●	●	**EF.**	**F**	**G**

Series

		18	28	45	71	100	140	
06	Series 3, index 1							**31**

All other ordering code information for position 07 to 10 and 12 can be found in the data sheets 92701

Port plate		**Position**	**Fastening thread**		18	28	45	71	100	140	
11	Flange ports according to SAE J518	rear	metric	not for through drive	●	●	●	–	●	●	**11**
					–	–	–	●	–	–	**41**
			SAE		●	●	●	–	●	●	**61**
					–	–	–	●	–	–	**91**
		on the side opposite, top, bottom	metric		●	●	●	–	●	●	**12**
					–	–	–	●	–	–	**42**
			SAE		●	●	●	–	●	●	**62**
					–	–	–	●	–	–	**92**

Connector for solenoids

13	DEUTSCH molded connector, 2-pin, without suppressor diode	**P**

● = Available ○ = On request – = Not available

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1) For controller combinations with pressure controller, differential pressure control can only take place in controller axis “y”. This is only possible with the combinations with EF1 and EF2.

Ordering code A10VO series 32 (see also data sheet 92705)

01	02	03	04		05	06		07	08	09	10	11	12
A10V	**O**			**/**	**32**		**–**						**P**

Axial piston unit

		45	71	100	140	180	
01	Variable swashplate design, nominal pressure 280 bar, maximum pressure 350 bar						**A10V**

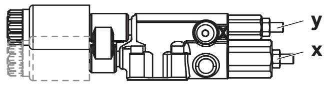
Operating mode

02	Pump, open circuit	**O**

Size (NG)

03	Geometric displacement	**45**	**71**	**100**	**140**	**180**

Control device



				45	71	100	140	180	Controller axis	x	y
04	Differential pressure control, electrically variable, negative characteristic curve								**EF.**		
		Δ*p* shifting controller axis **y**	U = 12 V	●	●	●	●	○	**EF1**		
			U = 24 V	●	●	●	●	○	**EF2**		
		Δ*p* shifting Controller axis **x**	U = 12 V	●	●	●	●	○	**EF6**		
			U = 24 V	●	●	●	●	○	**EF7**		
	Possible controller combinations[1]										
	Controller axis **x**	Controller axis **y**									
	Pressure controller[1]	Flow controller	X-T plugged **without** flushing function	●	●	●	●	○	**EF.[1]**	**D**	**C**
			X-T open **without** flushing function	●	●	●	●	○	**EF.[1]**	**D**	**F**
	Flow control – X-T plugged **with** flushing function	Pressure controller remote controlled	X-T plugged **without** flushing function	●	●	●	●	○	**EF.**	**S**	**G**
	Flow control – X-T open **without** flushing function			●	●	●	●	○	**EF.**	**F**	**G**

Series

		45	71	100	140	180	
05	Series 3, index 2						**32**

All other ordering code information for position 06 to 09 and 11 can be found in the data sheets 92705

Port plate		**Position**	**Fastening thread**		45	71	100	140	180	
10	Flange ports according to SAE J518	rear	metric	not for through drive	●	●	●	●	●	**11**
		at side opposite top, bottom	metric		●	●	●	●	–	**12**
			metric		–	–	–	–	●	**22**

Connector for solenoids

12	DEUTSCH molded connector, 2-pin, without suppressor diode	**P**

● = Available ○ = On request – = Not available

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[1] For controller combinations with pressure controller, differential pressure control can only take place in controller axis "y".
This is only possible with the combinations with EF1 and EF2.

Ordering code A10VO series 5x (see also data sheet 92703)

01	02	03	04		05	06		07	08	09	10	11	12
A10V	**O**			**/**	**5x**		**–**						**P**

Axial piston unit

		18	28	45	60	63	72	85	100	
01	Variable swashplate design, nominal pressure 250 bar, maximum pressure 315 bar	●	●	●	●	●	●	●	●	**A10V**

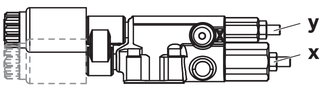
Operating mode

02	Pump, open circuit	**O**

Size (NG)

03	Geometric displacement	**18**	**28**	**45**	**60**	**63**	**72**	**85**	**100**

Control device

												Controller axis	x	y
04	Differential pressure control, electrically variable, negative characteristic curve											**EF.**		
		Δ*p* shifting Controller axis **y**	U = 12 V	○	○	○	○	○	○	●	●	**EF1**		
			U = 24 V	○	○	○	○	○	○	●	●	**EF2**		
		Δ*p* shifting Controller axis **x**	U = 12 V	○	○	○	○	○	○	●	●	**EF6**		
			U = 24 V	○	○	○	○	○	○	●	●	**EF7**		
	Possible controller combinations1)													
	Controller axis **x**	Controller axis **y**												
	Pressure controller1)	Flow controller	X-T plugged **without** flushing function	○	○	○	○	○	○	●	●	**EF.1)**	**D**	**C**
			X-T open **without** flushing function	○	○	○	○	○	○	●	●	**EF.1)**	**D**	**F**
	Flow controller X-T plugged **with** flushing function	Pressure controller remote controlled	X-T plugged **without** flushing function	○	○	○	○	○	○	●	●	**EF.**	**S**	**G**
	X-T open **without** flushing function			○	○	○	○	○	○	●	●	**EF.**	**F**	**G**

Series

		18	28	45	60	63	72	85	100	
05	Series 5, index 2	–	●	●	●	–	–	●	–	**52**
	Series 5, index 3	●	●	●	–	●	●	●	●	**53**

All other ordering code information for position 06 to 11 can be found in the data sheets 92703

Connector for solenoids

12	DEUTSCH molded connector, 2-pin, without suppressor diode	**P**

● = Available ○ = On request – = Not available

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1) For controller combinations with pressure controller, differential pressure control can only take place in controller axis "y". This is only possible with the combinations with EF1 and EF2.

EF – differential pressure control, electrically variable

The differential pressure control is based on a pressure flow controller.

In combination with a pressure controller, it limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only supplies as much hydraulic fluid as is required by the consumers.

In combination with a remote controlled pressure controller DG, LS pressure limitation takes place via a separate pressure relief valve. More information can be found in data sheets 92701, 92703 and 92705.

In addition to the function of the pressure controller, a differential pressure is tapped off via an adjustable orifice (e.g. directional valve) which regulates the flow of the pump before and after the orifice. The pump flow is equal to the actual hydraulic fluid quantity required by the consumer.

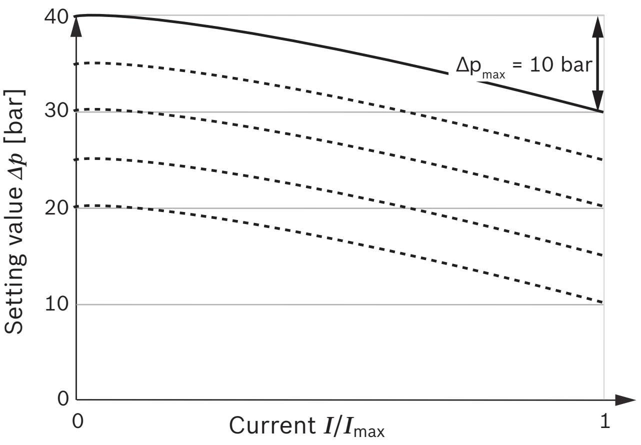
With all controller combinations, the V_g reduction has priority.

- Basic position in depressurized state: $V_{g\,max}$.
- Setting range for pressure control series 3x
  25 to 280 bar.
  Standard is 280 bar.
- Setting range for pressure control series 5x
  35 to 250 bar.
  Standard is 250 bar.

The electrically variable differential pressure control can be used to reduce the differential pressure by a maximum of 10 bar. A PWM signal is used to control the electrically variable controller (solenoid).

- Setting range for differential pressure control:
  20 to 40 bar.
  Standard is 24 bar.
  If another setting is required, please state in plain text.

▼ **Characteristic curve EF**



Unloading port **X** to the reservoir and with de-energized solenoid results in a zero stroke (“standby”) pressure which is about 1 to 2 bar higher than the defined differential pressure Δp. Other system influences are not taken into account.

Technical data, solenoids	EF1../EF6..	EF2../EF7..
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Start of adjustment Δp_{max}	0 mA	0 mA
End of adjustment Δp_{min}	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 to 200 Hz	100 to 200 Hz
Minimum working stroke of the dither within the control range[1]	352 mA	176 mA
Duty cycle	100 %	100 %
Operating temperature range	-20 °C to +115 °C	
Type of protection: see connector version page 10		

Project planning note

For a maximally energized valve, a minimum differential pressure Δp of 10 bar must be present.

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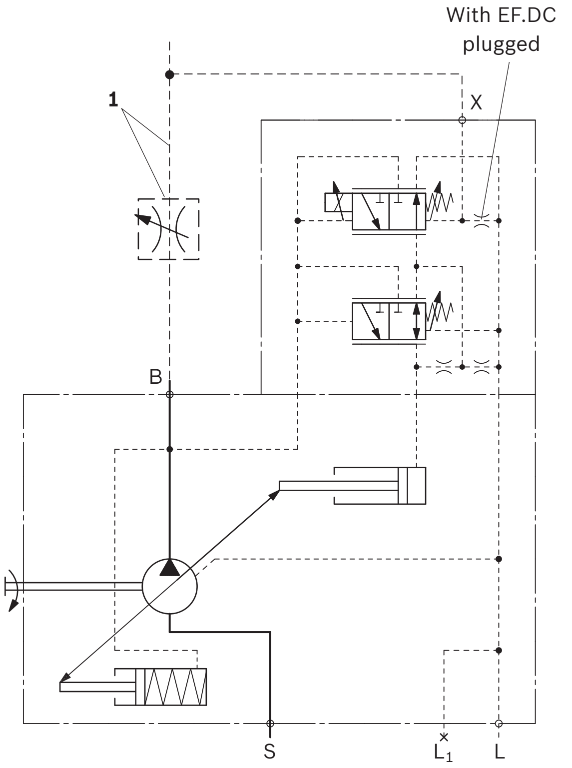
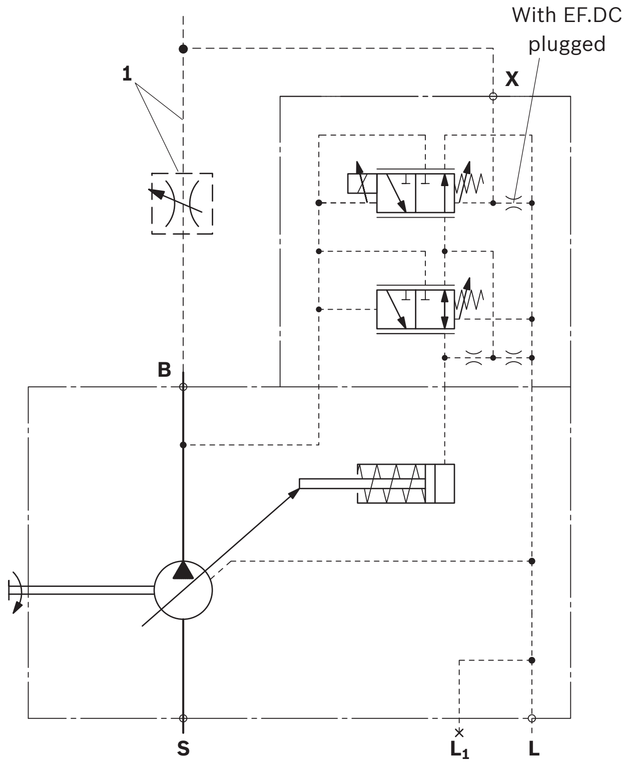
[1] ΔI = 44 % of the current difference within the control range, regardless of the mean value of the current

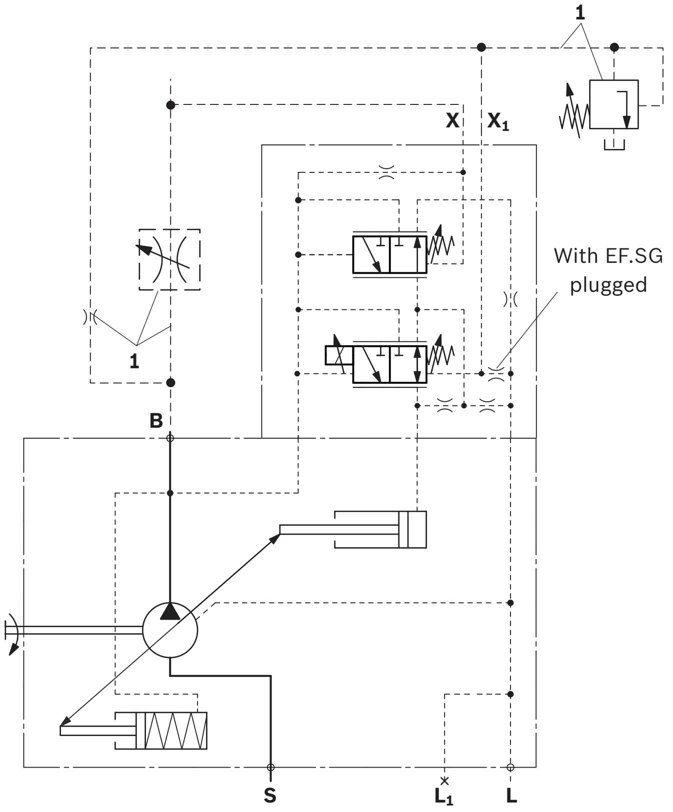
▼ Circuit diagram EF.DF series 3x



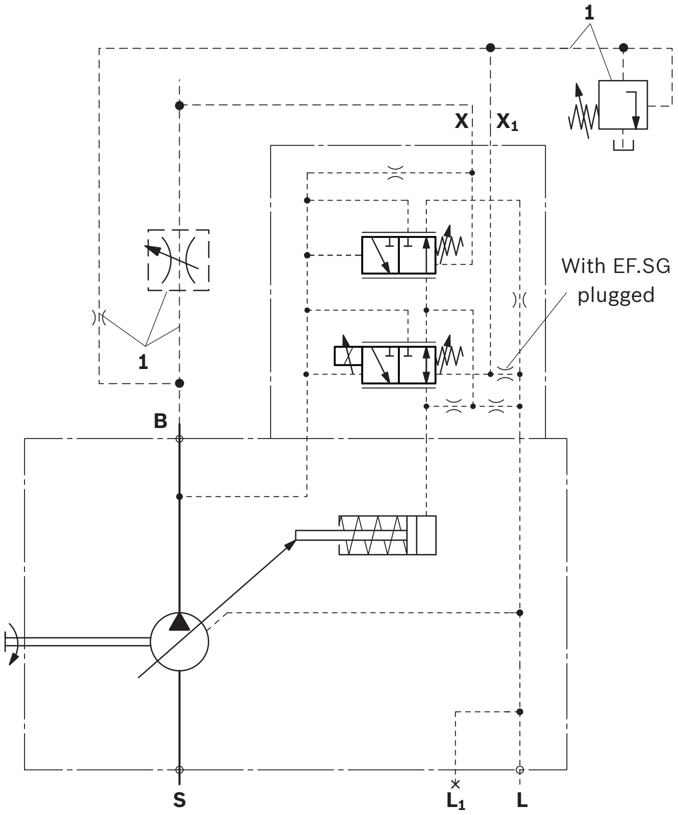
▼ Circuit diagram EF.DF series 5x



▼ Circuit diagram EF.FG series 3x



▼ Circuit diagram EF.FG series 5x



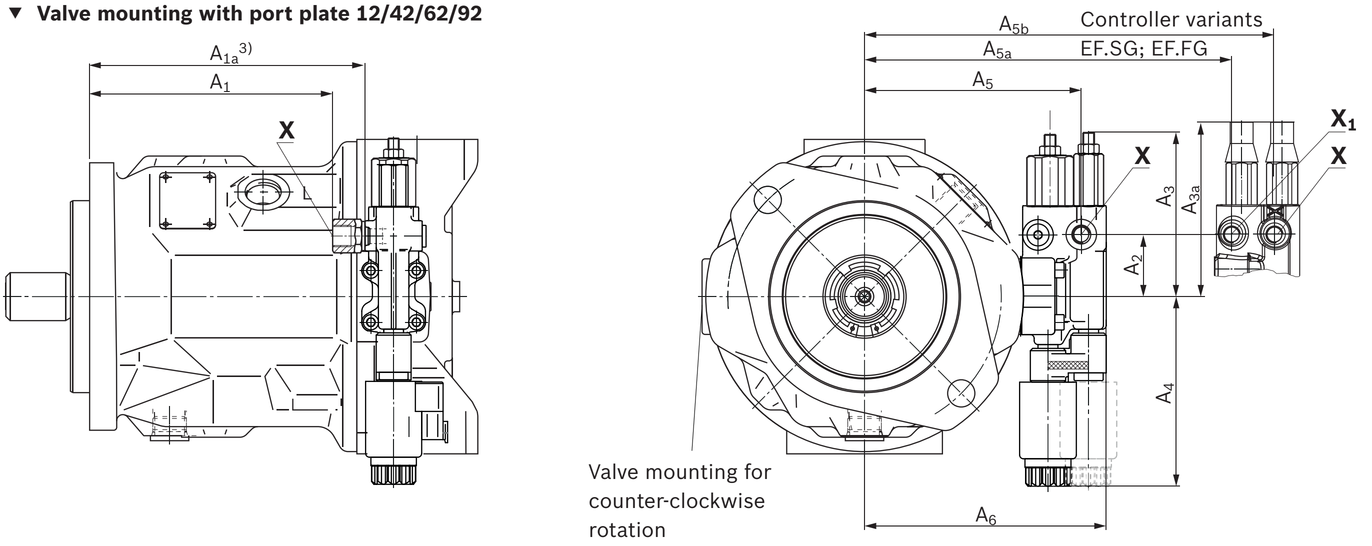
1 The metering orifice (control block) or pressure relief valve and the line is not included in the scope of delivery.

For ports, see Connection table series 31 and Connection table series 52/53 on page 9.

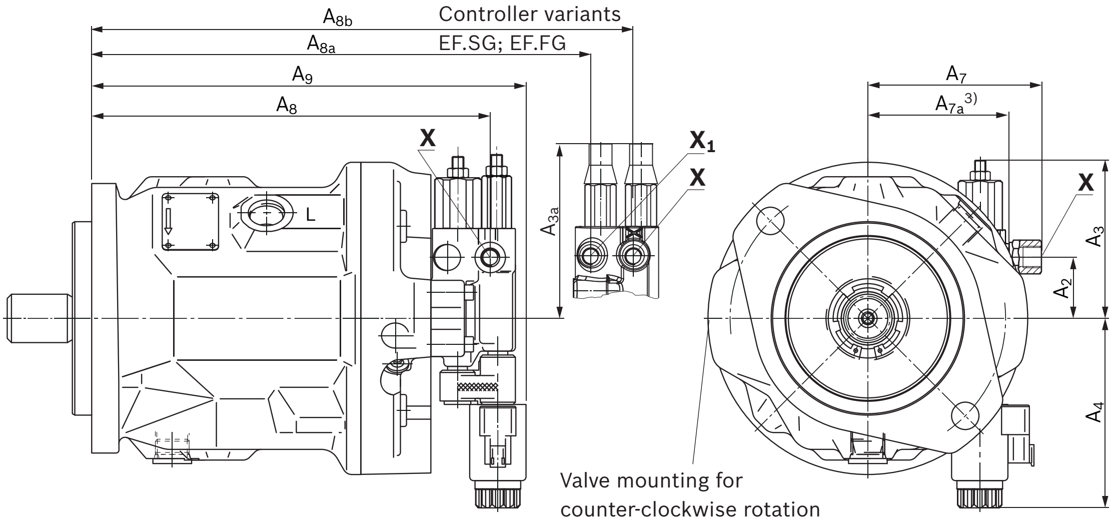
Dimensions A10 V(S)O series 31 and 32

Clockwise rotation (main dimensions of the variable pump and the technical data, see data sheet 92701, 92705)

▼ **Valve mounting with port plate 12/42/62/92**



▼ **Valve mounting with port plate 11/41/61/91**



Size	A_1	A_{1a}[3]	A_2	A_3	A_{3a}	A_4	A_5	A_{5a}	A_{5b}	A_6	A_7	A_{7a}[3]	A_8	A_{8a}	A_{8b}	A_9
18	108	129	40	110	113	124	109	81	109	133	–	–	–	–	–	–
28	118	139	40	110	113	124	119	91	119	142	95	74	209	181	209	232
45	133	154	40	110	113	124	129	101	129	153	103	82	228	200	228	251
71	161	182	40	110	113	124	143	115	143	167	114	93	262	234	262	285
100	229	250	40	110	113	124	148	120	148	172	121	100	327	299	327	350
140[1]	233	254	29	99	102	136	163	135	163	187	on request					
140[2]	206	227	29	99	102	136	163	135	163	187						

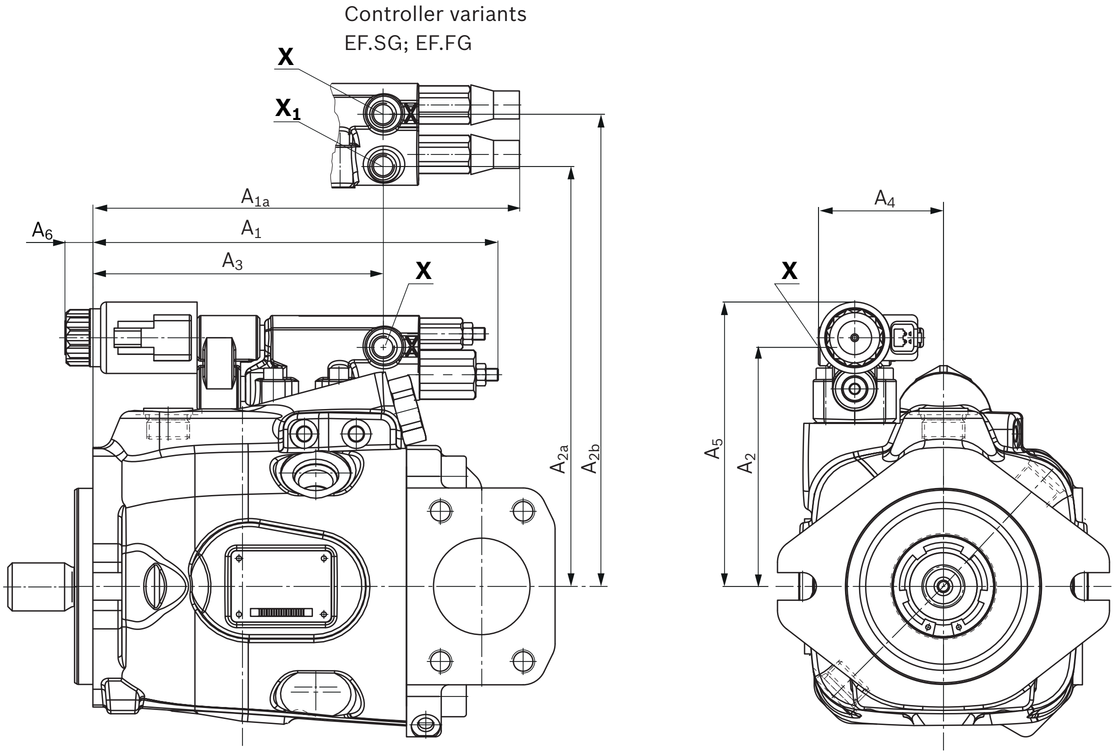
For ports, see Connection table series 31 and 32 on page 9.

---

1) Dimensions of mounting flange C
2) Dimensions of mounting flange D
3) At port plates 61, 91 or 62, 92 series 31 see data sheet 92701.

Dimensions A10 VO series 52 and 53

Clockwise rotation (main dimensions of the variable pump and the technical data, see data sheet 92703)



Size	A_1	A_{1a}	A_2	A_{2a}	A_{2b}	A_3	A_4	A_5	A_6
18	on request								
28									
45									
60									
63									
72									
85[1]	241.5	245	139.5	111.5	139.5	171.5	74	163	–
85[2]	251.5	255	139.5	111.5	139.5	181.5	74	163	–
100	251.5	255	133	105	133	181.5	74	157	–

For ports, see Connection table series 52/53 on page 9.

---

[1] Dimensions of mounting flange C

[2] Dimensions of mounting flange D

Connection table series 31

Ports version metric		**Standard**	**Size**	$p_{\text{max abs}}$ **[bar]**[2]	**State**
B	Working port (high-pressure series) Fastening thread[1]	SAE J518[3] DIN 13	See data sheet 92701	350	O
S	Suction port (standard pressure series) Fastening thread[1]	SAE J518[3] DIN 13		10	O
L	Drain port	DIN 3852		2	O[5]
$\mathbf{L_1}$	Drain port	ISO 11926[4]		2	X[5]
X	Pilot pressure controller axis y	DIN 3852	M14 × 1.5; 12 deep	350	O
$\mathbf{X_1}$	Pilot pressure controller axis x	DIN 3852	M14 × 1.5; 12 deep	350	O

Ports version SAE		**Standard**	**Size**	$p_{\text{max abs}}$ **[bar]**[2]	**State**
B	Working port (high-pressure series) Fastening thread[1]	SAE J518 ASME B1.1	See data sheet 92701	350	O
S	Suction port (standard pressure series) Fastening thread[1]	SAE J518 ASME B1.1		10	O
L	Drain port	ISO 11926[4]		2	O[5]
$\mathbf{L_1}$	Drain port	ISO 11926[4]		2	X[5]
X	Pilot pressure controller axis y	ISO 11926[4]	7/16-14UNC-2B; 11.5 deep	350	O
$\mathbf{X_1}$	Pilot pressure controller axis x	ISO 11926[4]	7/16-14UNC-2B; 11.5 deep	350	O

Port plate assignment metric/SAE see Ordering code A10V(S)O series 31 (see also data sheet 92701) and position 11 on page 2

Connection table series 32

Ports		**Standard**	**Size**	$p_{\text{max abs}}$ **[bar]**[2]	**State**
B	Working port (high-pressure series) Fastening thread[1]	SAE J518[3] DIN 13	See data sheet 92705	350	O
S	Suction port (standard pressure series) Fastening thread[1]	SAE J518[3] DIN 13		10	O
L	Drain port	ISO 11926[4]		2	O[5]
$\mathbf{L_1}$	Drain port	ISO 11926[4]		2	X[5]
X	Pilot pressure controller axis y	ISO 11926[4]	7/16-14UNC-2B; 11.5 deep	350	O
$\mathbf{X_1}$	Pilot pressure controller axis x	ISO 11926[4]	7/16-14UNC-2B; 11.5 deep	350	O

Connection table series 52/53

Ports		**Standard**	**Size**	$p_{\text{max abs}}$ **[bar]**[2]	**State**
B	Working port (high-pressure series) Fastening thread[1]	SAE J518[3] DIN 13	See data sheet 92703	315	O
S	Suction port (standard pressure series) Fastening thread[1]	SAE J518[3] DIN 13		5	O
L	Drain port	ISO 11926[4]		2	O[5]
$\mathbf{L_1}$, $\mathbf{L_2}$[6]	Drain port	ISO 11926[4]		2	X[5]
X	Pilot pressure controller axis y	ISO 11926	7/16-20UNF-2B; 11.5 deep	315	O
$\mathbf{X_1}$	Pilot pressure controller axis x	ISO 11926	7/16-20UNF-2B; 11.5 deep	315	O

[1] Observe the instructions in the operating instructions concerning the maximum tightening torques.

[2] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[3] Metric fastening thread is a deviation from standard.

[4] The spot face can be deeper than as specified in the standard.

[5] Depending on the installation position, **L**, $\mathbf{L_1}$ or $\mathbf{L_2}$ must be connected (please refer to installation instructions in the relevant data sheets).

[6] Only series 53

[7] O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

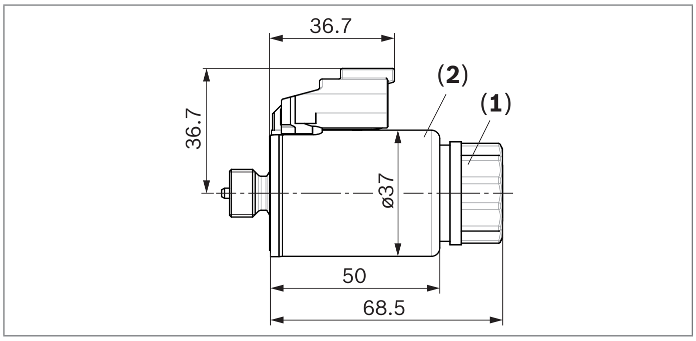
Connector for solenoids

DEUTSCH DT04-2P-EP04

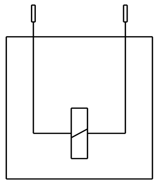
Molded connector, 2-pin, without bidirectional suppressor diode

The following type of protection ensues with a mounted mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)



▼ Switching symbol



▼ Mating connector DEUTSCH DT06-2S-EP04

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).

Note

- If necessary, you can change the position of the connector by turning the solenoid.
- The procedure is defined in the general operating instructions 90300-B.

Electronic controls

Control	Electronics function	Electronics		Data sheet
Electric pressure control	Controlled power outlet	RA	analog	95230
		RC4-5/30	digital	95205

Project planning notes

- The axial piston variable pump A10V(S)O with EF control is designed to be used in open circuit.
- The project planning, installation and commissioning of the axial piston unit require the involvement of qualified skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, request it from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes must be observed.
- Depending on the operating condition of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Preservation: Our axial piston units are supplied as standard with protection to preserve them for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference.
  Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- Pressure controllers are not safeguards against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- Working ports:
  - The ports and fastening threads are designed for the specified peak pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports can only be used to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control and regulation systems (e.g. valve spools) may in certain circumstances become stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid, abrasion or residual dirt from components). As a result, the hydraulic fluid flow or torque build-up of the axial piston unit will no longer respond correctly to the operator's commands. Even the use of different filter cartridges (external or internal inlet filter) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must check whether additional measures on the machine are required for the relevant application in order to bring the powered load into a safe position (e.g. safe stop) and ensure all appropriate measures are taken.

Axial piston variable pump
A7VO Series 63

- Sizes 28 to 160
- Nominal pressure 350 bar
- Maximum pressure 400 bar
- Open circuit

Characteristics

- Variable pump with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open circuit
- For use in mobile and stationary applications
- Flow is proportional to the drive speed and displacement.
- The flow can be steplessly changed by adjusting the bent axis.
- Wide selection of control devices
- Compact, robust pump with a long service life

Contents

Ordering code

01	02	03	04		05	06		07	08	09	10	11	12	13
A7V	**O**			**/**	**63**		**–**	**V**		**B**	**01**			

Axial piston unit

01	Bent-axis design, variable, nominal pressure 350 bar, maximum pressure 400 bar	**A7V**

Operating mode

02	Pump, open circuit	**O**

Size (NG)

03	Geometric displacement V_g (cm^3), see “Technical data” on page 7	**28**	**55**	**80**	**107**	**160**
	For sizes 250, 355 and 500, see data sheet 92203					

Control device

				28	55	80	107	160	
04	Power controller without power override			●	●	●	●	●	**LR**
	with pressure cut-off			●	●	●	●	●	**LRD**
	with stroke limiter	negative control	Δp = 25 bar	–	●	●	●	●	**LRH1**
	with pressure cut-off and stroke limiter	negative control	Δp = 25 bar	–	●	●	●	●	**LRDH1**
	with pressure cut-off and load sensing			–	●	●	●	●	**LRDS**
	Power controller with hydraulically proportional power override (only available for clockwise rotation and with port plate 02)								
	with load sensing			–	●	●	–	–	**LA1S**
	with load sensing and hydraulically proportional LS-override			–	●	●	–	–	**LA1S5**
	Pressure controller			●	●	●	●	●	**DR**
	remotely controlled			●	●	●	●	●	**DRG**
	with load sensing			–	●	●	●	●	**DRS**
	Proportional control hydraulic	Positive control	Δp = 10 bar	●	●	●	●	●	**HD1**
	with pressure cut-off, remotely controlled	Positive control	Δp = 10 bar	●	●	●	●	●	**HD1G**
	Proportional control electrical	Positive control	U = 24 V	●	●	●	●	●	**EP2**

Series

05	Series 6, index 3	**63**

Direction of rotation

			28 to 160	
06	Viewed on drive shaft	clockwise	●	**R**
		counter-clockwise	●	**L**

Sealing material

07	FKM (fluoroelastomer)	**V**

Drive shaft

		28 to 160	
08	Splined shaft DIN 5480	●	**Z**
	Parallel keyed shaft according to DIN 6885	●	**P**

Mounting flange

09	ISO 3019-2; 4-hole	**B**

Port plate for working lines

10	SAE flange ports A and S at rear (metric fastening thread)	**01**
	SAE flange ports A and S at side (available for power controllers LA1S and LA1S5 only, metric fastening thread)	**02**

● = Available – = Not available ▨ = Preferred program

01	02	03	04		05	06		07	08	09	10	11	12	13
A7V	**O**			**/**	**63**		**–**	**V**		**B**	**01**			

Connector for solenoids[1] (see page 40)

11	Without connector (without solenoid, with hydraulic control only; without code)	
	DEUTSCH molded connector, 2-pin – without suppressor diode	**P**

Standard / special version

12	Standard version (without code)	
	Special version	**-S**

● = Available – = Not available ▨ = Preferred program

Notes

- Note the project planning notes on page 42!
- Preservation:
  - Up to 12 months as standard
  - Up to 24 months long-term (state in plain text when ordering)

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[1] Connectors for other electric components may differ

Hydraulic fluids

The A7VO variable pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)
- 90223: Fire-resistant, water-containing hydraulic fluids (HFC, HFB, HFAE, HFAS)

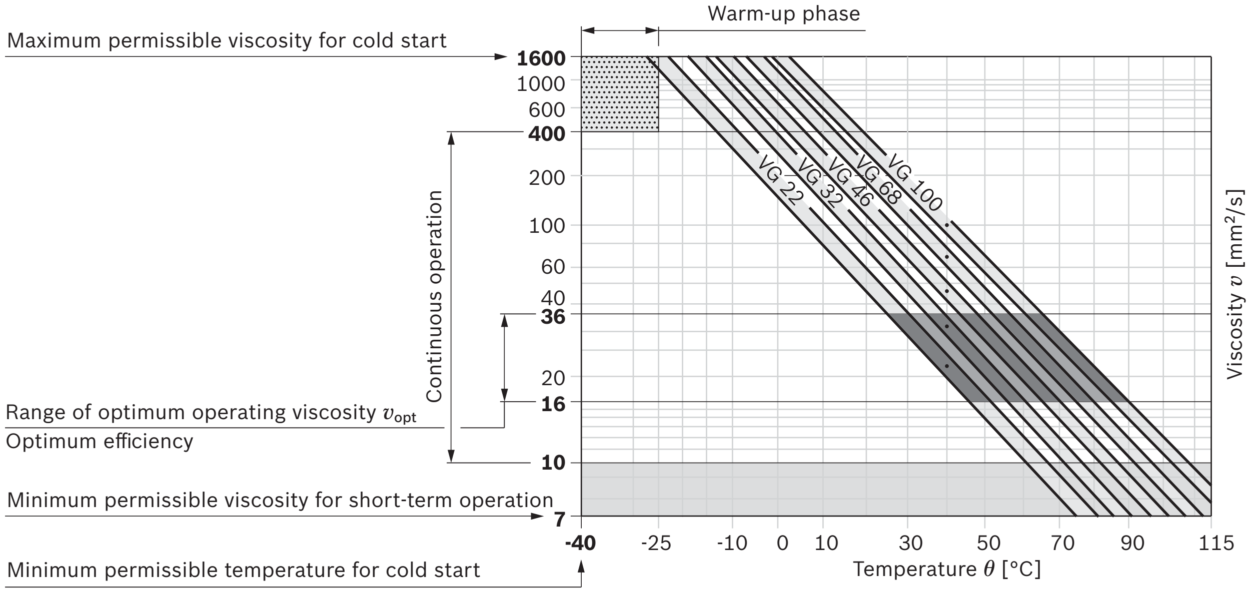
Details regarding the selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}, see selection diagram).

Note
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If it is not possible to maintain the conditions above due to extreme operating parameters, we recommend flushing the case at port **U.**

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \le 1600$ mm²/s	$\theta_{St} \ge -40$ °C	$t \le 3$ min, $n \le 1000$ rpm, without load $p \le 50$ bar
Permissible temperature difference		$\Delta T \le 25$ K	between axial piston unit and hydraulic fluid in the system
Warm-up phase	$\nu < 1600$ to 400 mm²/s	$\theta = -40$ °C to -25 °C	at $p \le 0.7 \times p_{nom}$, $n \le 0.5 \times n_{nom}$ and $t \le 15$ min
Continuous operation	$\nu = 400$ to 10 mm²/s		This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram)
		$\theta = -25$ °C to +103 °C	measured at port **R**$_1$/**R**$_2$ Note the permissible temperature range of the shaft seal (ΔT = approx. 12 K between the bearing/shaft seal and port **R**$_1$/**R**$_2$)
	$\nu_{opt} = 36$ to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \ge 7$ mm²/s		$t < 3$ min, $p < 0.3 \times p_{nom}$

▼ **Selection diagram**



Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which in turn increases the service life of the axial piston unit.
A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.
At very high hydraulic fluid temperatures (90 °C to maximum 103 °C, measured at port $\mathbf{R}_1$/$\mathbf{R}_2$) a cleanliness level is necessary of at least 19/17/14 according to ISO 4406.

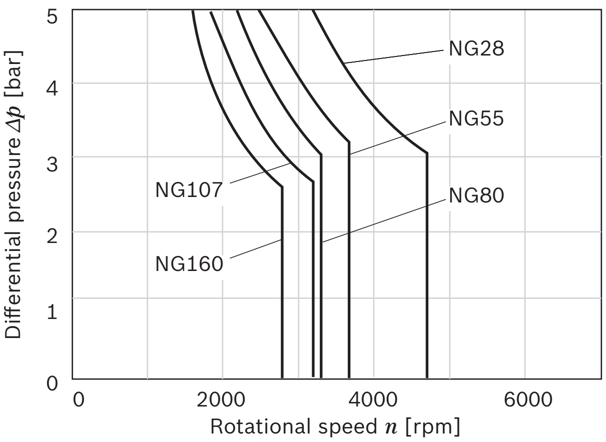
Leakage

The case interior is connected to the suction chamber. A separate case drain line from the case to the reservoir is therefore not required (both **R** ports are plugged).
Exception: For versions with pressure controller or pressure cut-off, a drain line is needed to relieve port $\mathbf{T}_1$ to the reservoir.

Shaft seal ring

Permissible pressure loading

The service life of the shaft seal is influenced by the speed of the axial piston unit and the leakage pressure in the housing (case pressure). Momentary pressure spikes (t < 0.1 s) up to 10 bar are allowed. The service life of the shaft seal decreases with increasing frequency of pressure spikes and increasing mean differential pressure.
The case pressure must be equal to or higher than the ambient pressure.



The FKM shaft seal ring may be used for leakage temperatures from -25 °C to +115 °C. For application cases below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C).

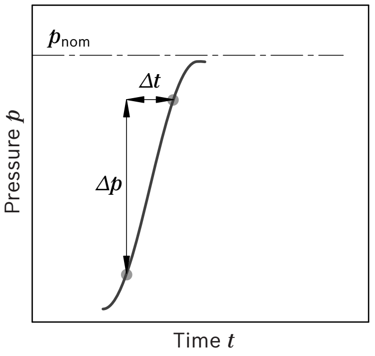
Flow direction

Direction of rotation, viewed on drive shaft	
clockwise	counter-clockwise
S to **B**	**S** to **A**

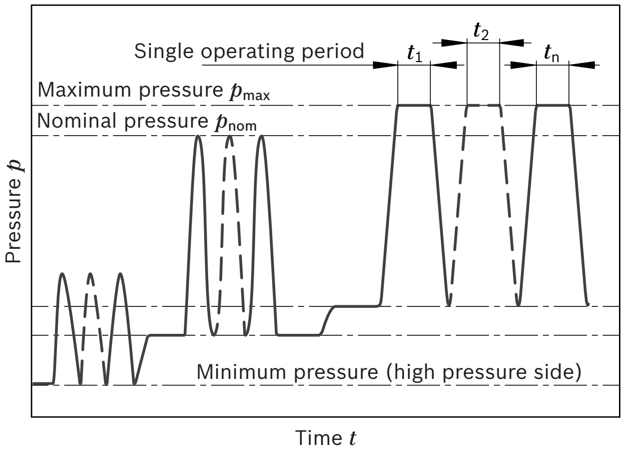
Operating pressure range

Pressure at working port A or B (high-pressure side)		**Definition**
Nominal pressure p_{nom}	350 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	400 bar absolute	The maximum pressure corresponds the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure (high-pressure side)	10 bar absolute	Minimum pressure on high-pressure side (**A** or **B**) required to prevent damage to the axial piston unit.
Rate of pressure change $R_{\text{A max}}$	16000 bar/s	Maximum permissible rate of pressure build-up and reduction during a pressure change over the entire pressure range.
Pressure at suction port S (Inlet)		
Minimum pressure $p_{\text{S min}}$	0.8 bar absolute	Minimum pressure at suction port **S** (inlet) that is required to avoid damage to the axial piston unit. The minimum required pressure is dependent on the speed and displacement of the axial piston unit (see diagram on page 7).
Maximum pressure $p_{\text{S max}}$	2 bar absolute	

▼ **Rate of pressure change $R_{\text{A max}}$**



▼ **Pressure definition**



Total operating period = $t_1 + t_2 + \ldots + t_n$

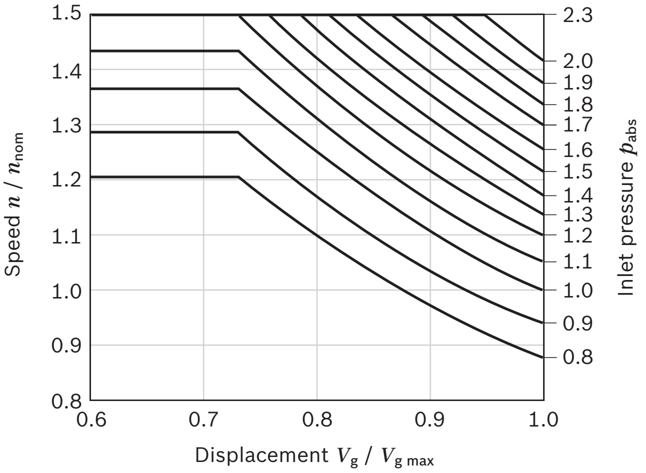
Note

Operating pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical data

Size		NG		28	55	80	107	160
Displacement, geometric, per revolution		$V_{g\,max}$	cm³	28.1	54.8	80	107	160
Maximum rotational speed[1)]	At $V_{g\,max}$	n_{nom}	rpm	3150	2500	2240	2150	1900
	At $V_g < 0.74 \times V_{g\,max}$	n_{max1}	rpm	4250	3400	3000	2900	2560
Maximum rotational speed[2)]		n_{max2}	rpm	4750	3750	3350	3200	2850
Flow	At $V_{g\,max}$ and n_{nom}	q_v	l/min	89	137	179	230	304
Power	At $V_{g\,max}$, n_{nom} and Δp = 350 bar	P	kW	52	80	105	134	177
Torque	At $V_{g\,max}$ and Δp = 350 bar	T	Nm	156	305	446	596	891
Rotary stiffness	$V_{g\,max}$ to $V_g/2$	c_{min}	kNm/rad	5	10	16	21	36
	$V_g/2$ to 0 (interpolated)	c_{max}	kNm/rad	16	32	49	67	104
Moment of inertia rotary group		J_{GR}	kgm²	0.0042	0.0042	0.0080	0.0127	0.0253
Maximum angular acceleration		α	rad/s²	35900	31600	24200	19200	15300
Case volume		V	l	0.5	0.75	1.2	1.5	2.4
Weight (approx.)		m	kg	17	25	40	49	71

▼ **Maximum permissible speed (limit speed)**



Determining operating characteristics

Flow	$q_v = \dfrac{V_g \times n \times \eta_v}{1000}$		[l/min]
Torque	$T = \dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{mh}}$		[Nm]
Power	$P = \dfrac{2\,\pi \times T \times n}{60000}$	$= \dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g = Displacement per revolution [cm³]

Δp = Differential pressure [bar]

n = Rotational speed [rpm]

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Total efficiency ($\eta_t = \eta_v \times \eta_{mh}$)

Notes

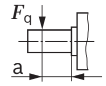
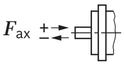
- ▶ Theoretical values, without efficiency and tolerances; values rounded
- ▶ Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, such as speed variation, reduced angular acceleration as a function of the frequency and the permissible angular acceleration at start (lower than the maximum angular acceleration) can be found in data sheet 90261.

---

1) The values are valid:
  - At absolute pressure p_{abs} = 1 bar at suction port **S**
  - For the optimal viscosity range of ν_{opt} = 36 to 16 mm²/s
  - For hydraulic fluid based on mineral oils.

2) Maximum rotational speed (speed limit) for increased inlet pressure p_{abs} at suction port **S** and $V_g < V_{g\,max}$, see diagram.

Permissible radial and axial forces of the drive shaft

Size		NG		28	55	80	107	160
Drive shaft		Ø	mm	25	30	35	40	45
Maximum radial force1) at distance a (from shaft collar)		$F_{q\,max}$	N	6436	7581	10266	13758	18278
		a	mm	14.0	17.5	20.0	22.5	25.0
Maximum torque at $F_{q\,max}$		$T_{q\,max}$	Nm	179	281	444	681	1019
Maximum differential pressure at $V_{g\,max}$ and $F_{q\,max}$		$\Delta p_{q\,max}$	bar	400	322	349	400	400
Maximum axial force at standstill or pressure-free operation		$+ F_{ax\,max}$	N	0	0	0	0	0
		$- F_{ax\,max}$	N	315	500	710	900	11250
Permissible axial force per bar operating pressure		$+ F_{ax\,perm}$/bar	N/bar	4.6	7.5	9.6	11.3	15.1

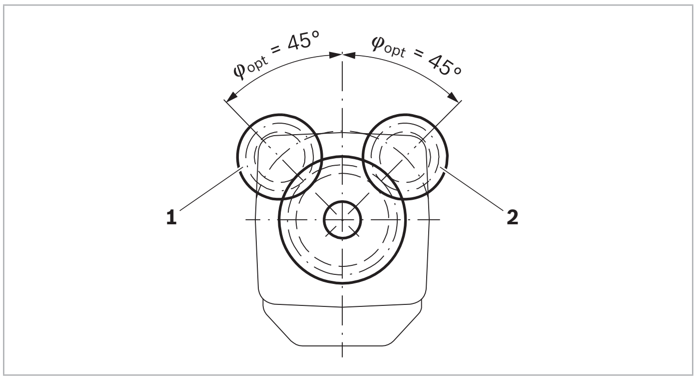
Effect of radialforce F_q on the service life of bearings

By selecting a suitable direction of radial force F_q, the load on the bearings, caused by the internal rotary group forces can be reduced, thus optimizing the service life of the bearings. Recommended position of mating gear is dependent on direction of rotation. Example:

Note

- The permissible axial force in direction $-F_{ax}$ is to be avoided, because thereby the bearing life is reduced.
- Special requirements apply in the case of belt drives. Please contact us.

▼ **Gear drive**



1 “Clockwise” rotation, pressure at port **B**
2 “Counter-clockwise” rotation, pressure at port **A**

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1) With intermittent operation

LR – Power controller without power override

The power controller regulates the displacement of the pump depending on the operating pressure so that a given drive power is not exceeded at constant drive speed.
The precise control with a hyperbolic control characteristic, provides an optimum utilization of available power.
The operating pressure acts on a rocker via a measuring spool which moves with the control. An externally adjustable spring force counteracts this, it determines the power setting.
If the operating pressure exceeds the set spring force, the control valve is actuated by the rocker and the pump swivels back from the initial position $V_{g\,max}$ toward $V_{g\,min}$. When doing this, the lever length at the rocker shortens and the operating pressure may rise in the same proportion as the displacement reduces without the drive power being exceeded ($p_B \times V_g$ = constant; p_B = operating pressure; V_g = displacement).
When depressurized, the pump is swiveled to its initial position to $V_{g\,max}$ by a return spring.
The hydraulic output power (characteristic **LR**) is influenced by the efficiency of the pump.

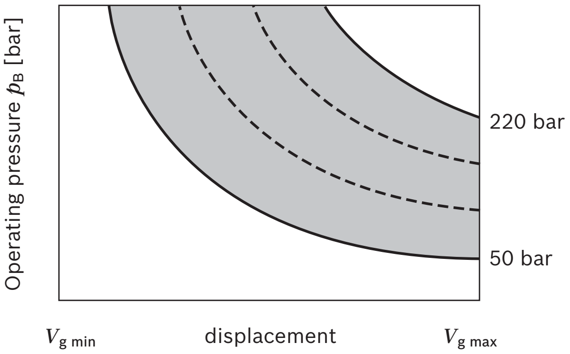
- Beginning of control, setting range 50 to 220 bar

When ordering, state in plain text:

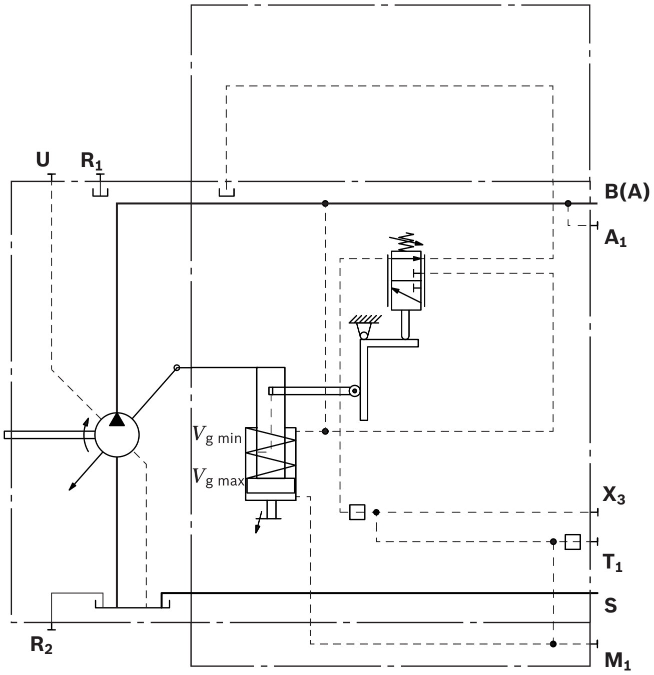
- Drive power P [kW]
- Drive speed n [rpm]
- Maximum flow $q_{v\,max}$ [l/min]

Please contact us if you need a power diagram.

▼ **Characteristic curve LR**



▼ **Schematic LR**



LRD – Power controller with pressure cut-off

The pressure cut-off is a pressure control which adjusts the displacement of the pump back to $V_{g\,min}$ after reaching the set pressure command value.

This function overrides the power controller, i.e. the power control function is executed below the pressure command value.

Pressure cut-off is preset to a pressure command value at the factory.

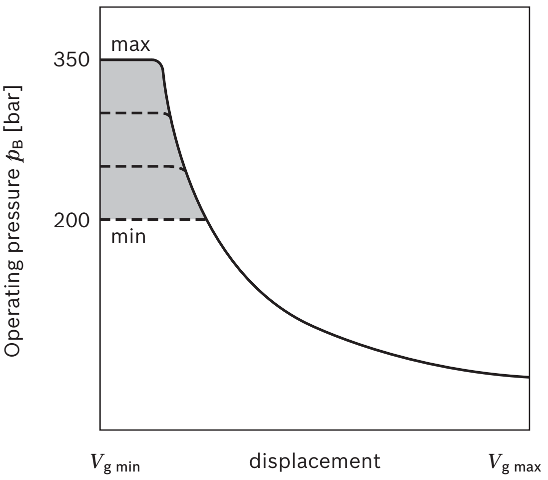
- Setting range 200 to 350 bar
  When ordering, state the setting in plain text.

Notes

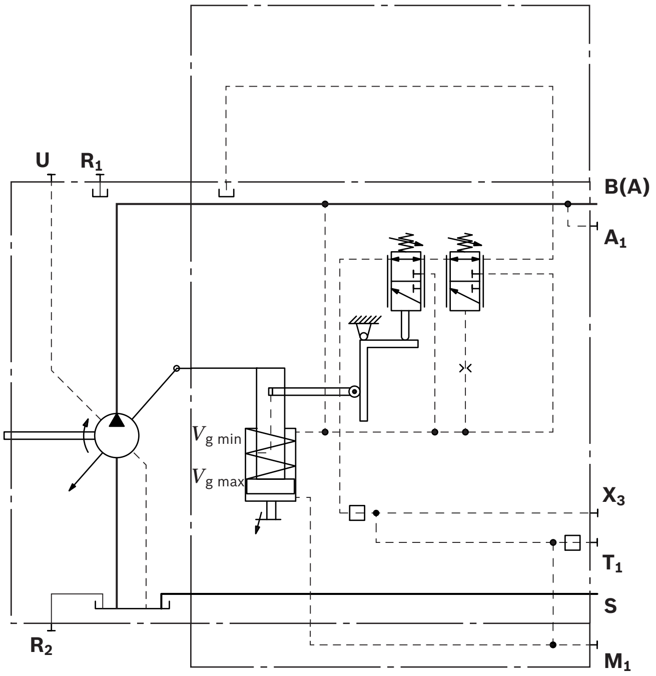
- The pressure setting of the pressure cut-off must be at least a factor of 5 higher than the beginning of control of power control.
  Example:
  - Beginning of control of the power controller: 50 bar
  - Minimum setting of pressure cut-off:
    5 × 50 = 250 bar

  Higher settings of the pressure cut-off are always possible.
- For versions with pressure cut-off, a drain line is needed from port **T₁** to the reservoir.
  When port **T₁** is plugged and t_{tank} ≤ 50 °C, this results in a permissible pressure cut-off of ≤ 2 min.
- Any pressure-relief valve included in the system to limit the maximum pressure must have its start of opening at least 20 bar above the pressure cut-off setting.

▼ **Characteristic curve LRD**



▼ **Schematic LRD**



LR... – Power controller with stroke limiter

Due to the hydraulic stroke limiter, it is possible to change or limit the displacement of the pump continuously across the entire control range. The displacement is set proportionally using the pilot pressure p_{St} applied to port **X**$_1$ (maximum of 40 bar).

The power control overrides the hydraulic stroke limiter, i.e. below the power characteristic (hyperbolic characteristic), the displacement is controlled in dependence on the pilot pressure. If the set flow or operating pressure exceeds the power control characteristic, the power control overrides and reduces the displacement along the hyperbolic characteristic.

A control pressure of 40 bar is needed to swivel the pump from its initial position $V_{g\,max}$ to $V_{g\,min}$.

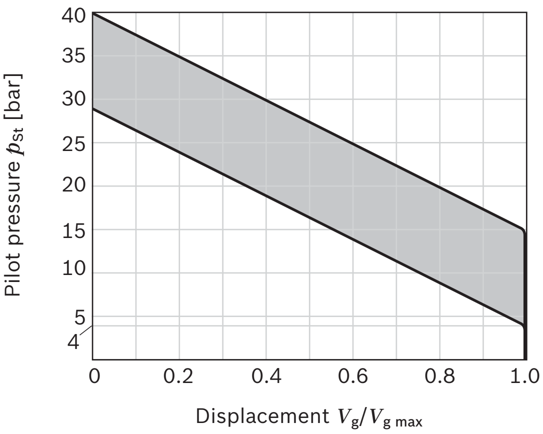
The necessary control power is taken from the operating pressure or the external control pressure applied to port **Y**$_3$.

To ensure that the stroke limiter functions at a low operating pressure of < 40 bar, port **Y**$_3$ must be supplied with an external control pressure of about 40 bar.

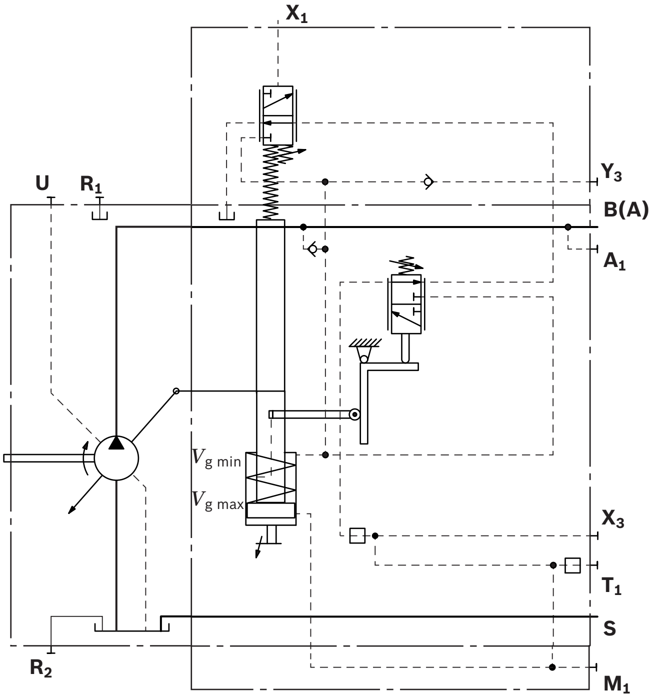
LRH1 – Hydraulic stroke limiter (negative control)

- Control from $V_{g\,max}$ to $V_{g\,min}$
  As the pilot pressure increases, the pump swivels to a smaller displacement.
- Start of control (at $V_{g\,max}$) can be set to 4 to 15 bar
  When ordering, state the start of control in plain text.
- Initial position without pilot signal (pilot pressure): $V_{g\,max}$

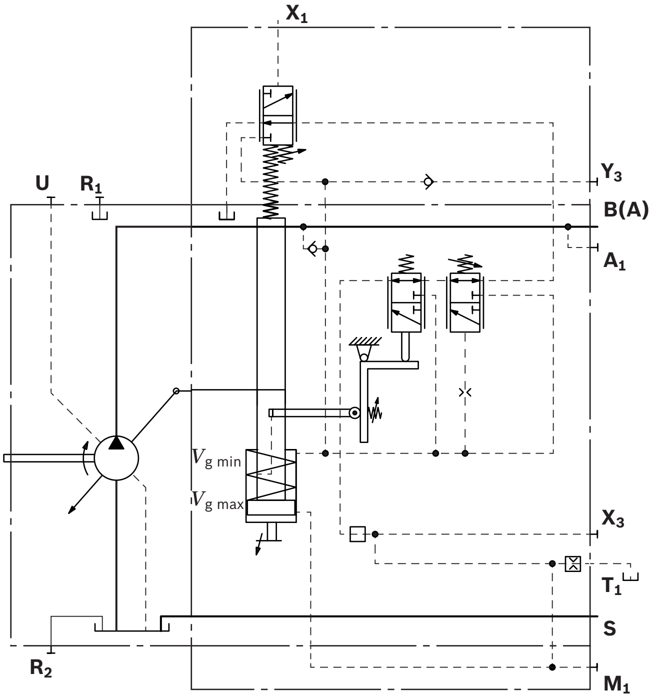
▼ **Characteristic curve LRH1**
control pressure increase ($V_{g\,max} - V_{g\,min}$) Δp = 25 bar



▼ **Schematic LRH1**



▼ **Schematic LRDH1**



LRDS – Power control with pressure cut-off and load sensing

The load sensing controller works as a load-pressure controlled flow controller and adjusts the displacement of the pump to the volume required by the consumer. The flow of the pump is then dependent on the cross section of the external measuring orifice (**1**), which is located between the pump and the consumer. Below the power curve and the setting of the pressure cut-off and within the control range of the pump, the flow is independent of the load pressure.

The measuring orifice is usually a separately located load sensing directional valve (control block). The position of the directional valve spool determines the opening cross-section of the measuring orifice and thus the flow of the pump.

The load sensing controller compares pressure before and after the orifice and keeps the pressure drop (differential pressure Δp) across the orifice – and therefore the flow – constant.

If the differential pressure Δp at the measuring orifice rises, the pump is swiveled back (toward $V_{g\,min}$). If the differential pressure Δp drops, the pump is swiveled out (toward $V_{g\,max}$) until equilibrium at the measuring orifice is restored.

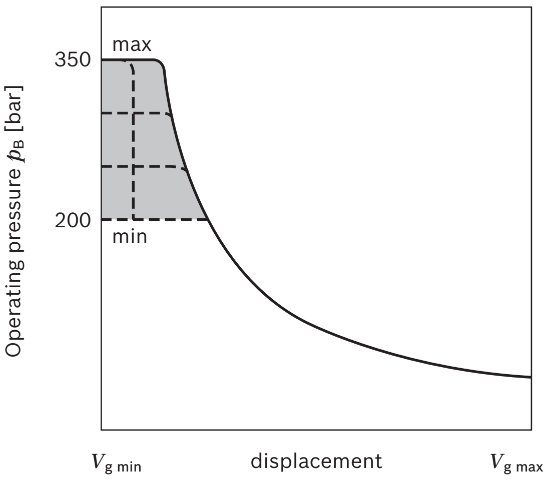
$\Delta p_{\text{measuring orifice}} = p_{\text{pump}} - p_{\text{consumer}}$

- Setting range for Δp 14 to 25 bar
- Default setting 18 bar
  When ordering, state the setting in plain text.

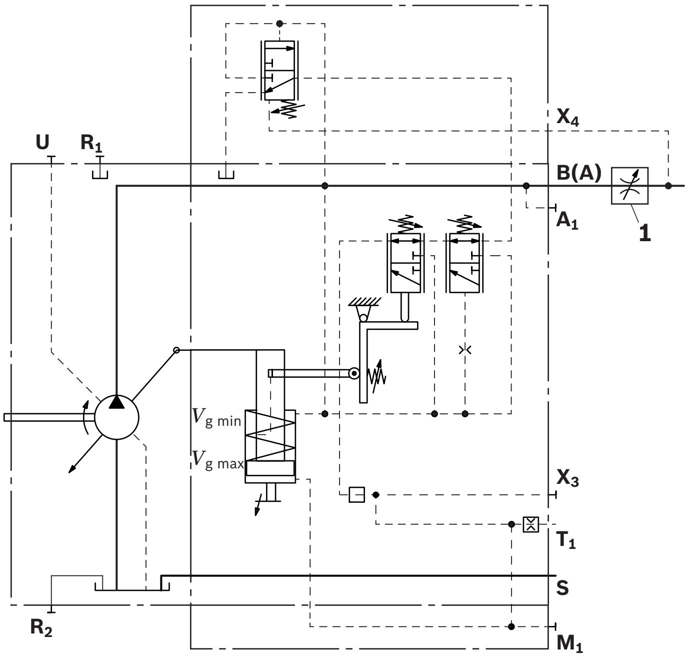
The stand-by pressure in zero-stroke mode (metering orifice closed) is slightly higher than the Δp setting.

In an LUDV system, the pressure cut-off is integrated in the flow sharing control block (LUDV).

▼ **Characteristic curve LRDS**



▼ **Schematic LRDS**



The measuring orifice (control block) (**1**) is not included in the scope of delivery.

LA1 – Power controller with hydraulically proportional power override

The power controller regulates the displacement of the pump depending on the operating pressure so that a given drive power is not exceeded at constant drive speed.

The hyperbolic power curve is approximated with two measuring springs. The operating pressure acts on the measurement area of a differential piston against the measuring springs and an externally adjustable spring force which determines the power setting.

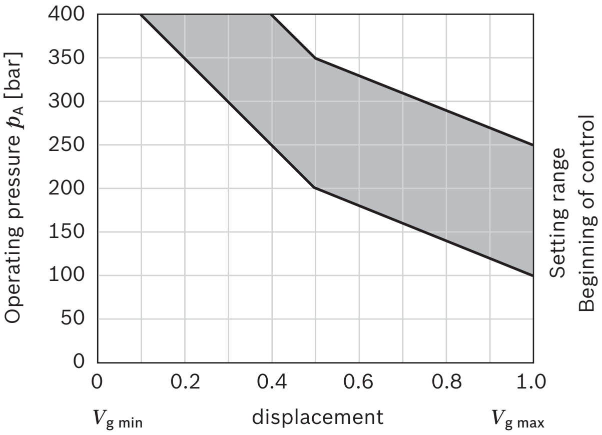
If the sum of the hydraulic forces exceeds the forces of the springs, the control oil is fed to the stroking piston, which swivels the pump back to reduce the flow.

In a depressurized state, the pump is swiveled to its initial position to $V_{g\,max}$ by a return spring.

By connecting an external pilot pressure at port $\mathbf{X_3}$, it is possible to override the power control proportionally.

Increasing pilot pressure = reduced power.

▼ **Characteristic curve LA1**



The hydraulic output power (characteristic curve) is affected by the efficiency.

When ordering, state in plain text:

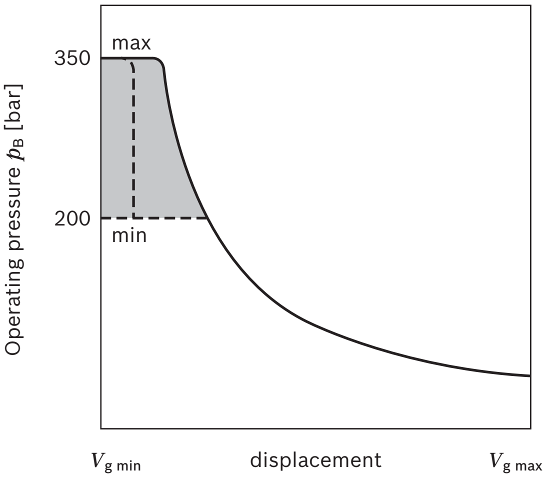
- Drive power P [kW]
- Drive speed n [rpm]
- Maximum volume flow $q_{V\,max}$ [l/min]

Please contact us if you need a power diagram.

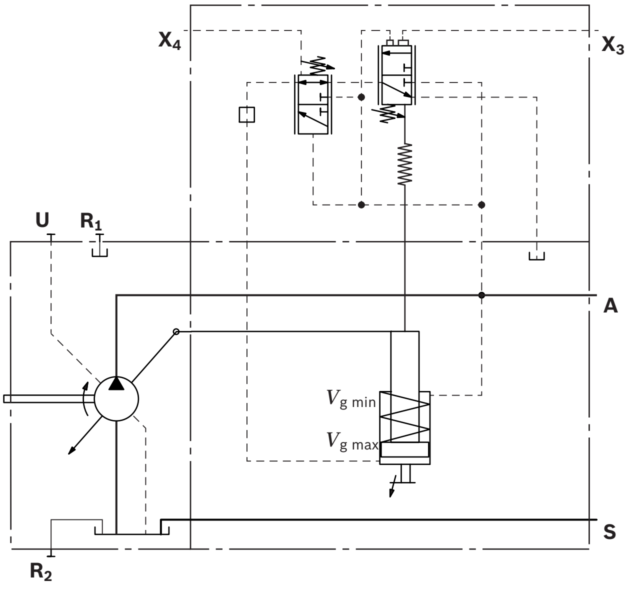
LA1S – Power controller with load sensing

For description of load sensing, see page 12.

▼ **Characteristic curve LA1S**



▼ **Schematic LA1S**



LA1S5 – Power controller with load sensing and hydraulically proportional LS-override

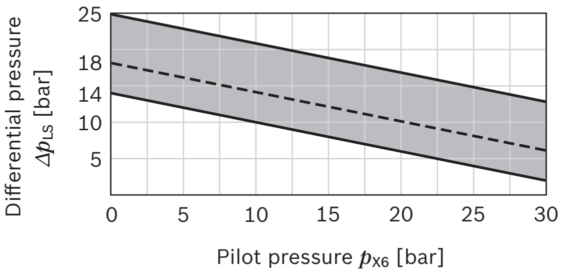
By connecting an external pilot pressure at port **X**$_6$, it is possible to override proportionally the differential pressure Δp of the load sensing control.

Increasing pilot pressure = lower Δp setting.

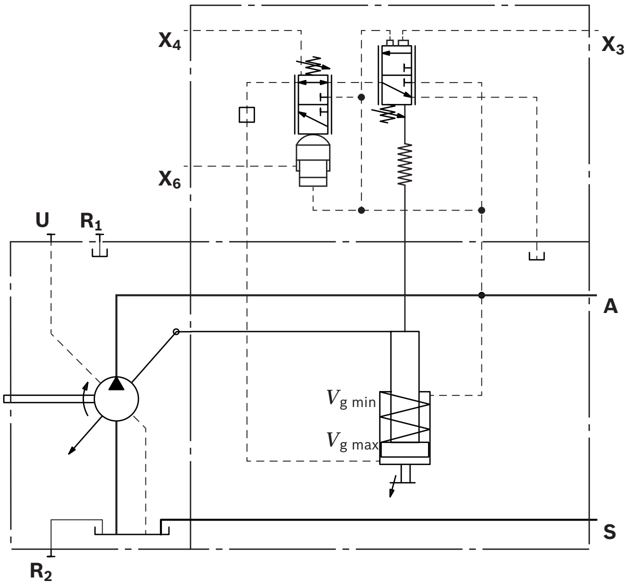
An example of this is shown in the characteristic curve below.

Please consult us before carrying out project planning.

▼ **Characteristic curve LA1S5**



▼ **Schematic LA1S5**



DR – Pressure controller

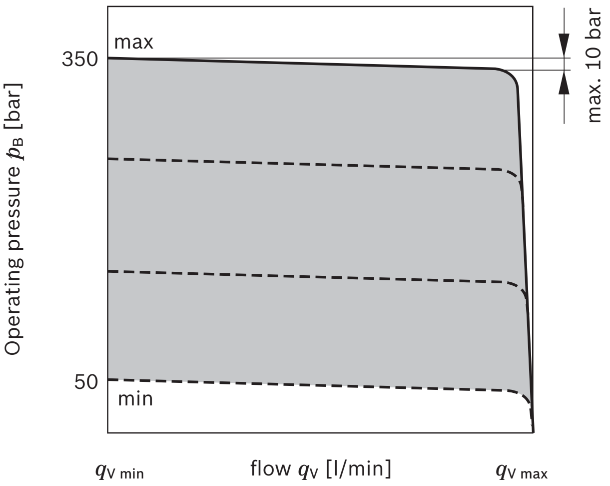
The pressure control limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only delivers as much hydraulic fluid as is required by the consumers. If the operating pressure exceeds the setpoint value set at the integrated pressure valve, the pump control will shift toward a smaller displacement and the control deviation will decrease. When depressurized, the pump is swiveled to its initial position $V_{g\,max}$ by an adjustment spring.

- Setting range of pressure control 50 to 350 bar
  When ordering, state the setting in plain text.

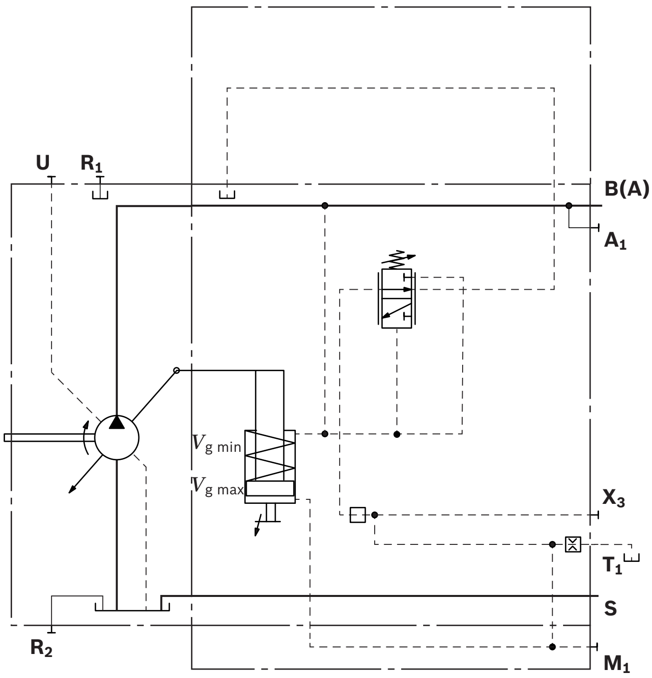
Notes

- For versions with controller **DR,** a drain line is needed from port $\mathbf{T_1}$ to the reservoir.
- Any pressure-relief valve included in the system to limit the maximum pressure must be set to a cracking pressure at least 20 bar above the controller setting.

▼ **Characteristic curve DR**

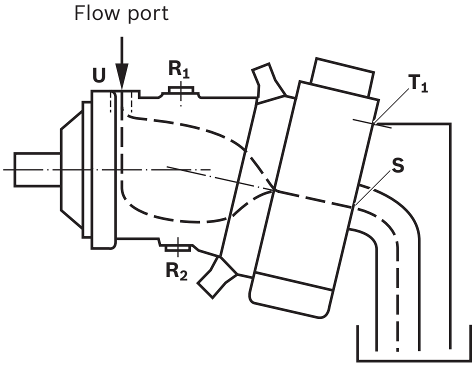


▼ **Schematic DR**



Zero-stroke operation

The standard pump unit is designed for intermittent constant pressure operation. Short-term zero-stroke operation (< 1 min.) is permissible up to an operating pressure p_{max} = 315 bar at a reservoir temperature of ≤ 50 °C. In the case of longer zero-stroke operation (> 1 min), bearing flushing should be carried out via flushing port **U**.



Flushing flow (recommended)

NG		28	55	80	107	160
$q_{V\,flush}$	l/min	3	4	6	8	12

Temperature of flushing fluid ≤ reservoir temperature

DRG – Pressure controller, remotely controlled

A separate sequence valve with port plate provides the pressure control function. The valve is arranged separate from the pump; in this connection, you should not exceed the single line length of 5 m. The valve is supplied with high pressure from port **A**$_1$ of the pump. The system feeds back via port **X**$_3$ the control power of the valve into the pump; the valve adjusts the pump back to $V_{\text{g min}}$. Note that ports **T** of the sequence valve and **T**$_1$ of the pump are returned to the reservoir (cooler).

- Setting range of pressure control 50 to 315 bar
  When ordering, state the setting in plain text.

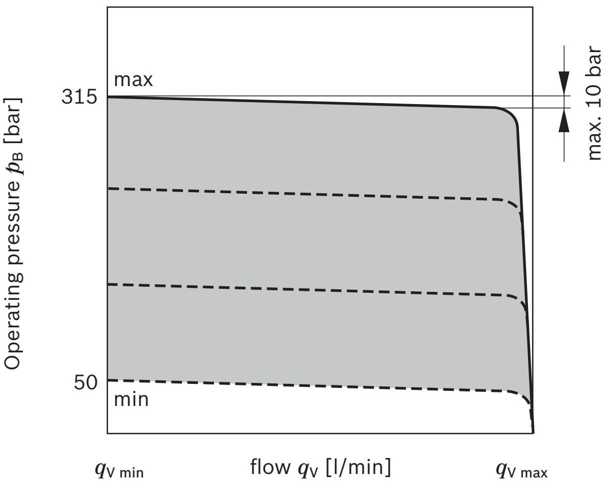
Notes

- For versions with controller **DRG,** a drain line is needed from port **T**$_1$ to the reservoir.
- Any pressure-relief valve included in the system to limit the max. pressure must be set to a cracking pressure at least 20 bar above the controller setting.

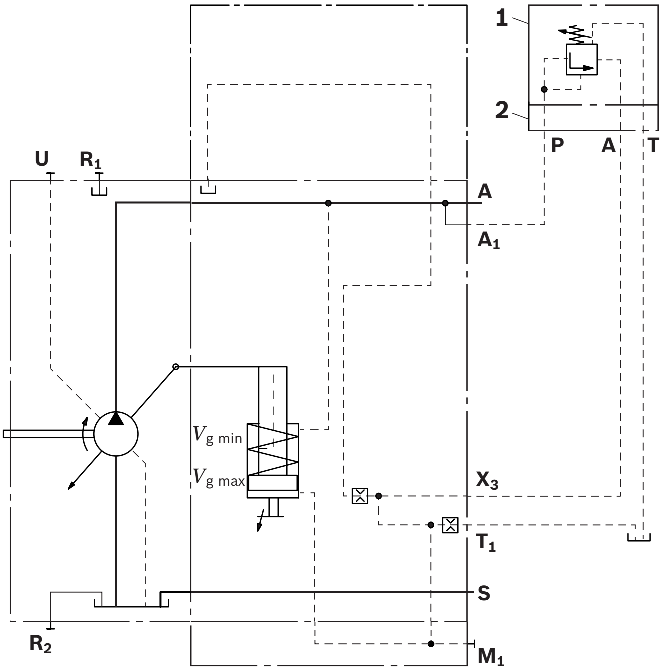
You must order the sequence valve and the port plate separately.

- Sequence valve (**1**): DZ5DP2-1X/315YMSO21
  (Material number R900495604)
- Port plate (**2**): G 115/1
  (Material number R900424379)

▼ **Characteristic curve DRG**



▼ **Schematic DRG**



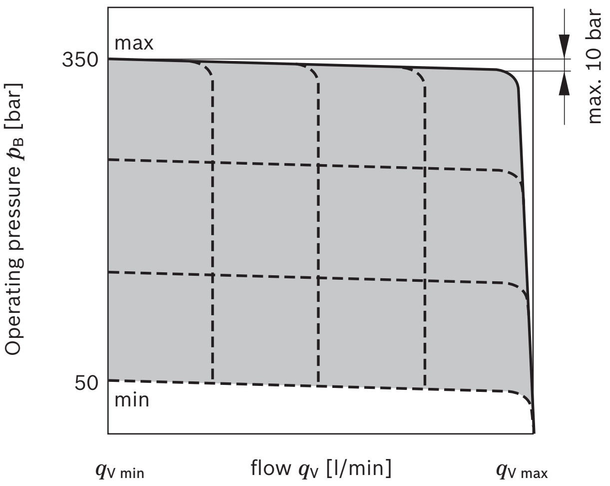
DRS – Pressure controller with load sensing

For description of load sensing, see page 12.

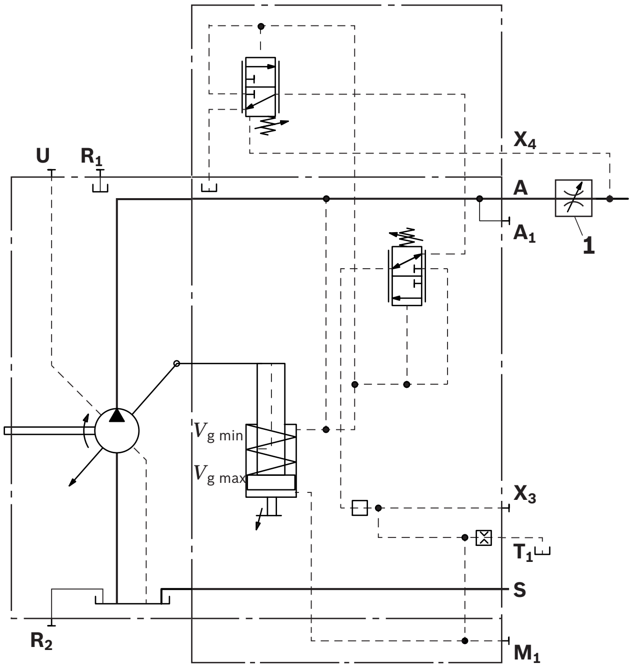
Notes

- For versions with controller **DRS,** a drain line is needed from port **T**$_1$ to the reservoir.
- The pressure controller overrides the load-sensing controller, i.e. the load-sensing function operates below the set pressure.

▼ **Characteristic curve DRS**



▼ **Schematic DRS**



The measuring orifice (control block) (**1**) is not included in the scope of delivery.

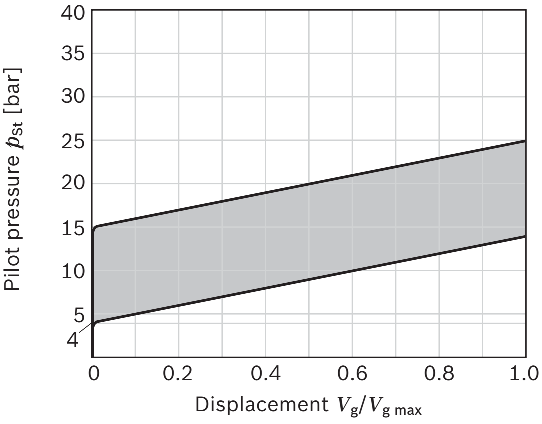
HD – Proportional hydraulic control

The proportional hydraulic control provides continuous control of the displacement. Control is carried out proportional to the pilot pressure applied at port **X**$_1$.

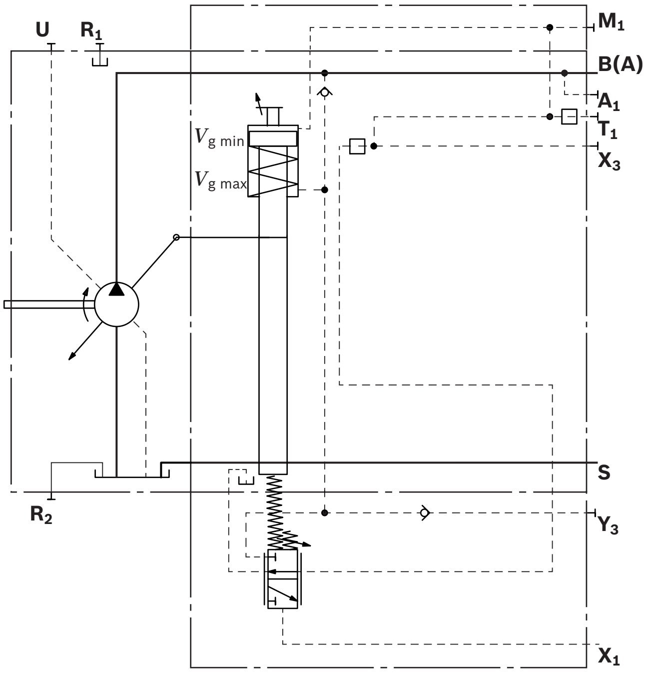
- Maximum permissible pilot pressure p_{St} = 40 bar
- Control from $V_{g\,min}$ to $V_{g\,max}$ (positive control)
  As the pilot pressure increases, the pump swivels to a larger displacement.
- Start of control (at $V_{g\,min}$) can be set to 4 to 15 bar
  When ordering, state the start of control in plain text.

A control pressure of 40 bar is needed to swivel the pump from its initial position $V_{g\,min}$ to $V_{g\,max}$.
The necessary control power is taken from the operating pressure or the external control pressure applied to port **Y**$_3$.
To ensure that control is guaranteed at a low operating pressure of < 40 bar too, port **Y**$_3$ must be supplied with an external control pressure of about 40 bar.

▼ **Characteristic curve HD1 positive control**
increase in control pressure ($V_{g\,min}$ – $V_{g\,max}$) Δp = 10 bar



▼ **Schematic HD**



HD1G – Proportional hydraulic control with pressure cut-off, remotely controlled

A separate sequence valve with port plate provides the pressure cut-off function. The valve is arranged separate from the pump; in this connection, you should not exceed the single line length of 5 m. The valve is supplied with high pressure from port **A**$_1$ of the pump. The system feeds back via port **X**$_3$ the control power of the pump into the valve and at port **A** of the sequence valve's port plate diverts it into the reservoir; if the set pressure command value is exceeded, this adjusts the pump back to $V_{g\ min}$.

- Pressure cut-off setting range 50 to 315 bar
  When ordering, state the pressure cut-off setting in plain text.

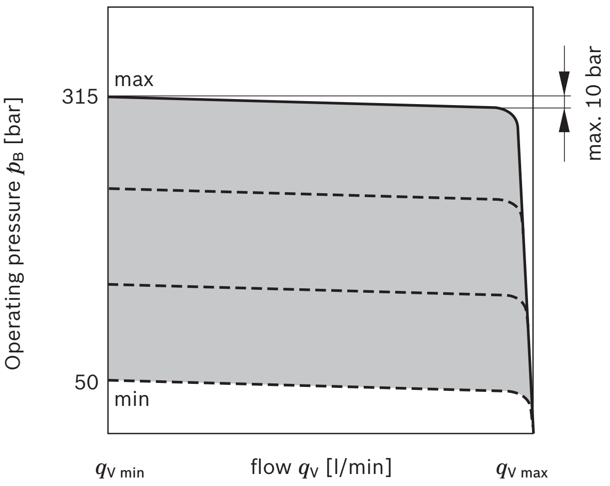
Notes

- Port **A** from the sequence valve must be returned to the reservoir (cooler).
- Any pressure-relief valve included in the system to limit the max. pressure must be set to a cracking pressure at least 20 bar above the controller setting.

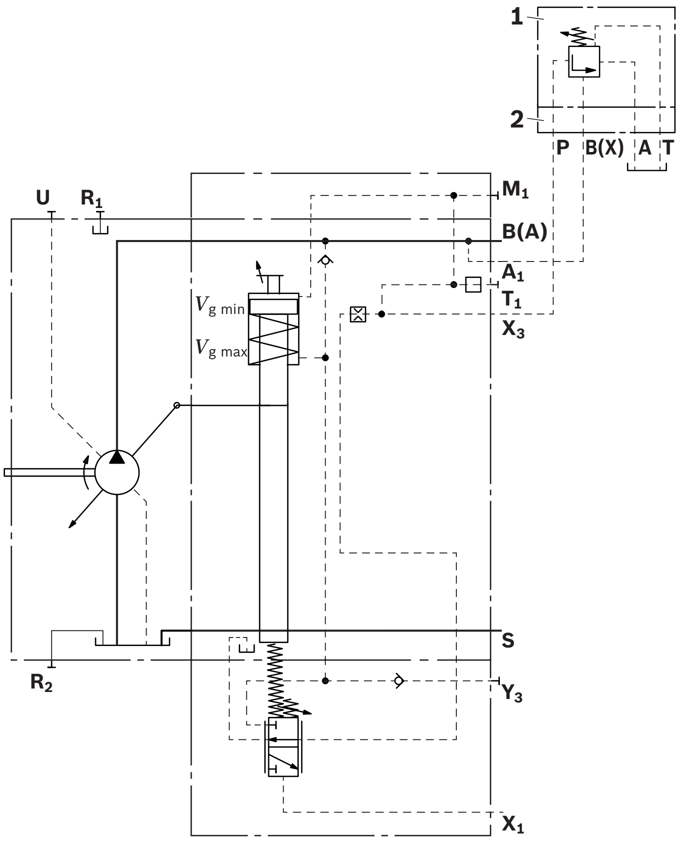
You must order the sequence valve and the port plate separately.

- Sequence valve (**1**): DZ5DP2-1X/315XYMSO20 (Material number R900490554)
- Port plate (**2**): G 115/1 (Material number R900424379)

▼ **Characteristic curve HD1G positive control**



▼ **Schematic HD1G**



EP – Proportional electric control

The proportional electric control, type EP, provides continuous control of the displacement. Control is proportional to the electric control current applied to the solenoid.

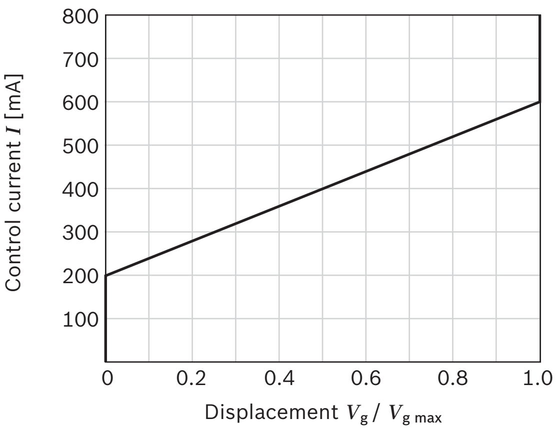
- Control from $V_{g\,min}$ to $V_{g\,max}$ (positive control)
  As the pilot pressure increases, the pump swivels to a larger displacement.

A control pressure of 40 bar is needed to swivel the pump from its initial position $V_{g\,min}$ to $V_{g\,max}$.
The necessary control power is taken from the operating pressure or the external control pressure applied to port **Y**$_3$.
To ensure that control is guaranteed at a low operating pressure of < 40 bar too, port **Y**$_3$ must be supplied with an external control pressure of about 40 bar.

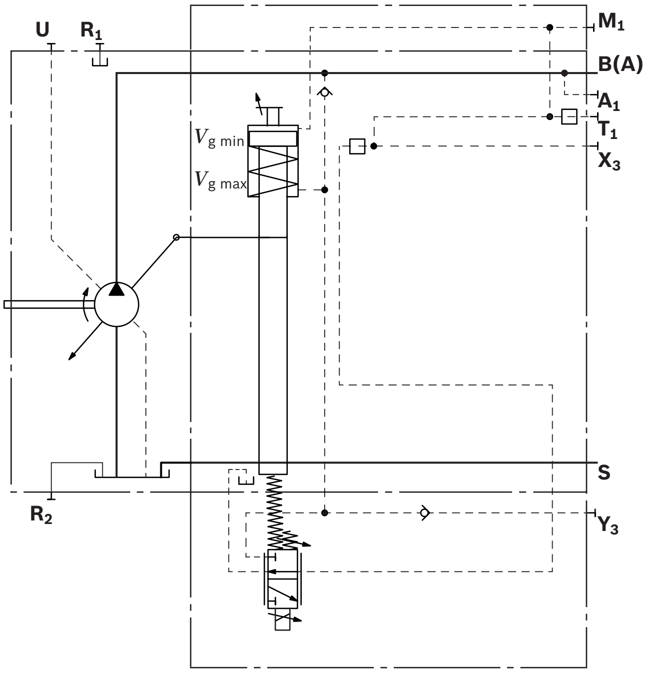
Various BODAS controllers with application software and amplifiers are available for controlling the proportional solenoids.

Technical data, solenoid	EP2
Voltage	24 V (±20%)
Control current	
Start of control	200 mA
End of control	600 mA
Current limit	0.77 A
Nominal resistance (at 20 °C)	22.7 Ω
Dither frequency	100 Hz
Duty cycle	100%
Type of protection: see connector version page 40	

▼ **Characteristic curve EP2 positive control**



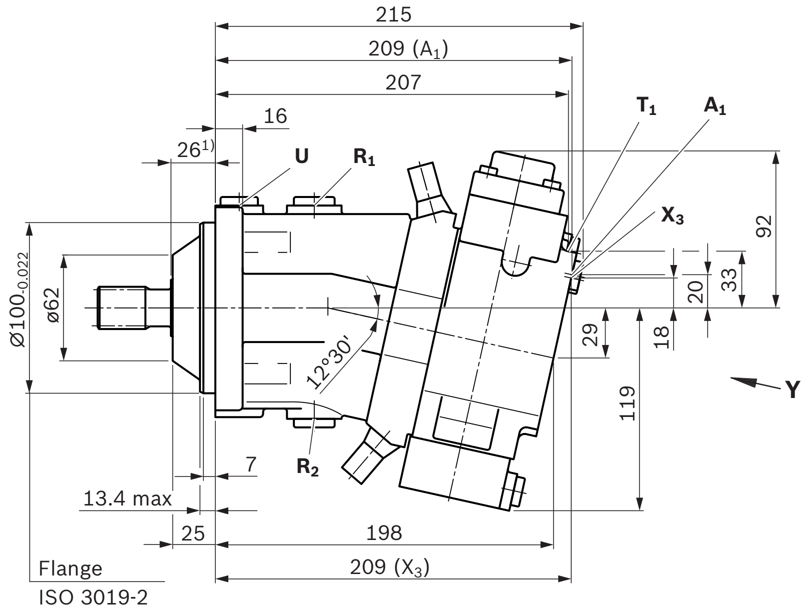
▼ **Schematic EP2**

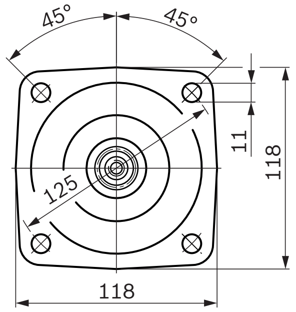


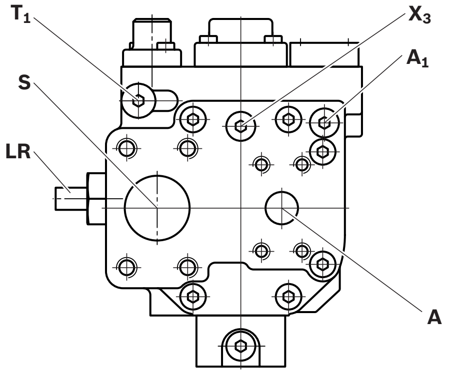
Dimensions, size 28

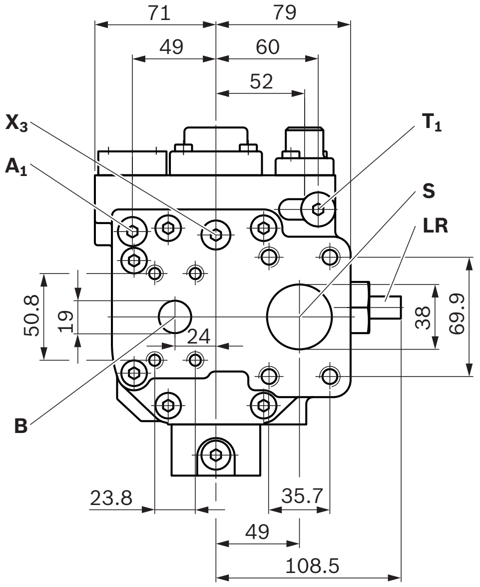
LR – Power controller without power override

All of the variants of the controllers on page 23 are shown for the clockwise direction of input rotation (view **Y**)





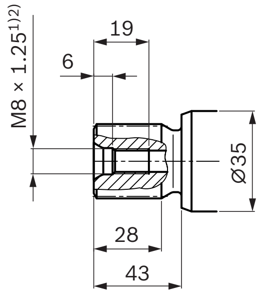

View **Y**
Counter-clockwise rotation


View **Y**
Clockwise rotation

1) To shaft collar

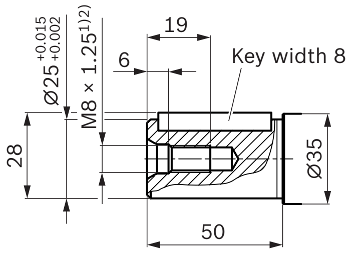
▼ Splined shaft DIN 5480

Z – W25×1.25×18×9g



▼ Parallel keyed shaft DIN 6885

P – AS8×7×40



Ports		Standard	Size[2]	$p_{\text{max abs}}$ [bar][3]	Status
A (B)	Working port (high-pressure series) fastening thread	SAE J518[4] DIN 13	3/4 in M10 × 1.5; 17 deep	400	O
S	Suction port (standard series) fastening thread	SAE J518[4] DIN 13	1 1/2 in M12 × 1.75; 20 deep	2	O
U	Bearing flushing	DIN 3852[5]	M16 × 1.5; 12 deep	2	X
R_1, R_2	Air bleed	DIN 3852[5]	M18 × 1.5; 12 deep	2	X
A_1	Measuring high pressure	DIN 3852[5]	M12 × 1.5; 12 deep	400	X
T_1	Control fluid drain	DIN 3852[5]	M12 × 1.5; 12 deep	400	X[6]
X_3	Override	DIN 3852[5]	M12 × 1.5; 12 deep	400	X
Y_3	External control pressure	DIN 3852[5]	M14 × 1.5; 12 deep	40	X
X_1	Pilot pressure	DIN 3852[5]	M14 × 1.5; 12 deep	40	O
M_1	Control pressure measurement	DIN 3852[5]	M12 × 1.5; 12 deep	400	X

---

1) Center bore according to DIN 332 (thread according to DIN 13)

2) For notes on tightening torques, see instruction manual.

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

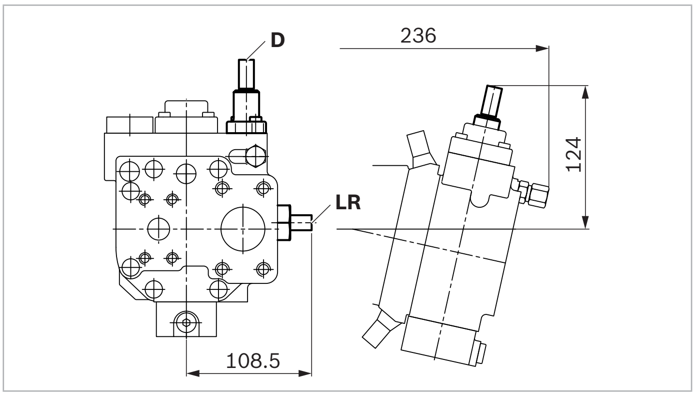
5) The spot face can be deeper than specified in the appropriate standard.

6) For versions with a pressure controller or pressure cut-off, a drain line is needed to relieve port **T_1** to the reservoir.

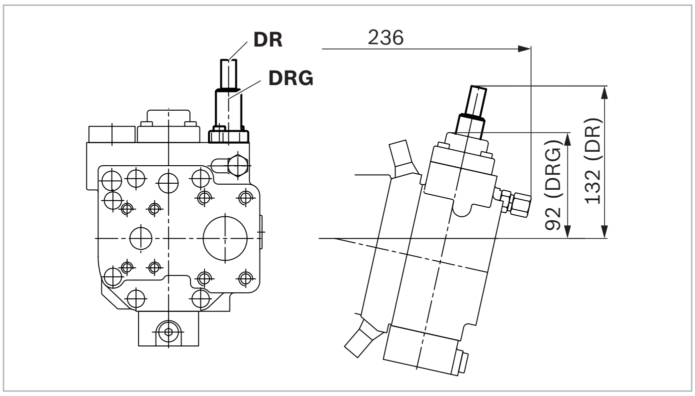
O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

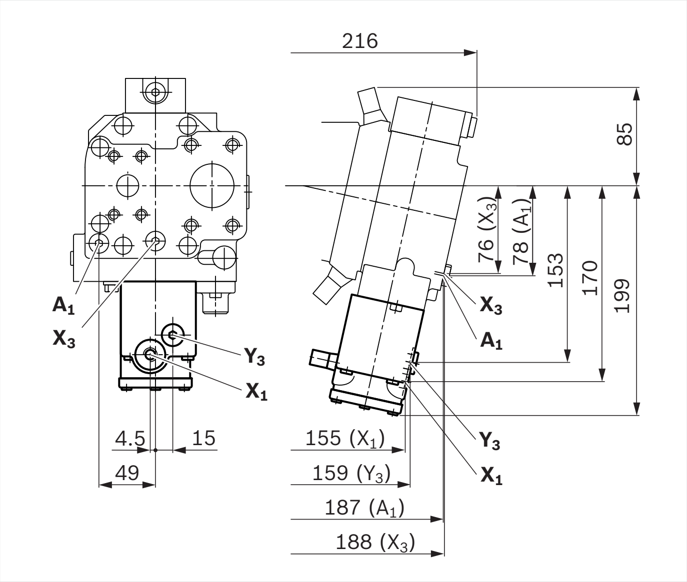
▼ **LRD** – Power controller with pressure cut-off



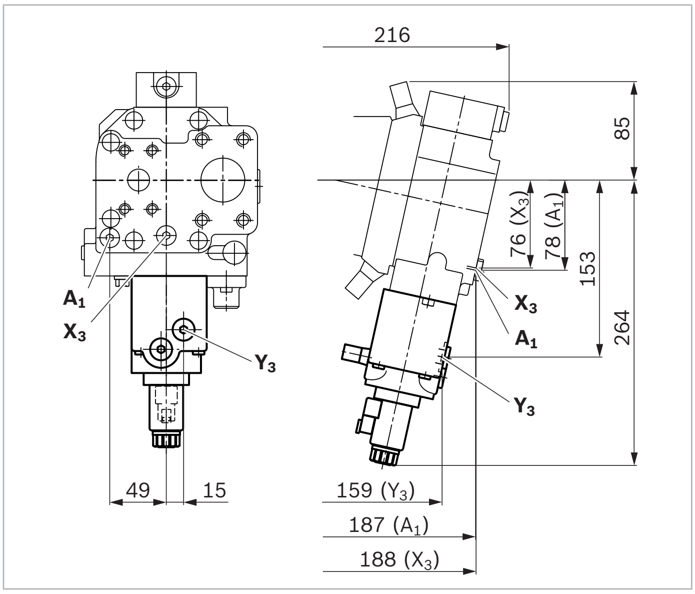
▼ **DR/DRG** – Pressure controller/pressure controller remotely controlled



▼ **HD1, HD1G** – Proportional hydraulic control , positive control, and variant with pressure cut-off, remotely controlled



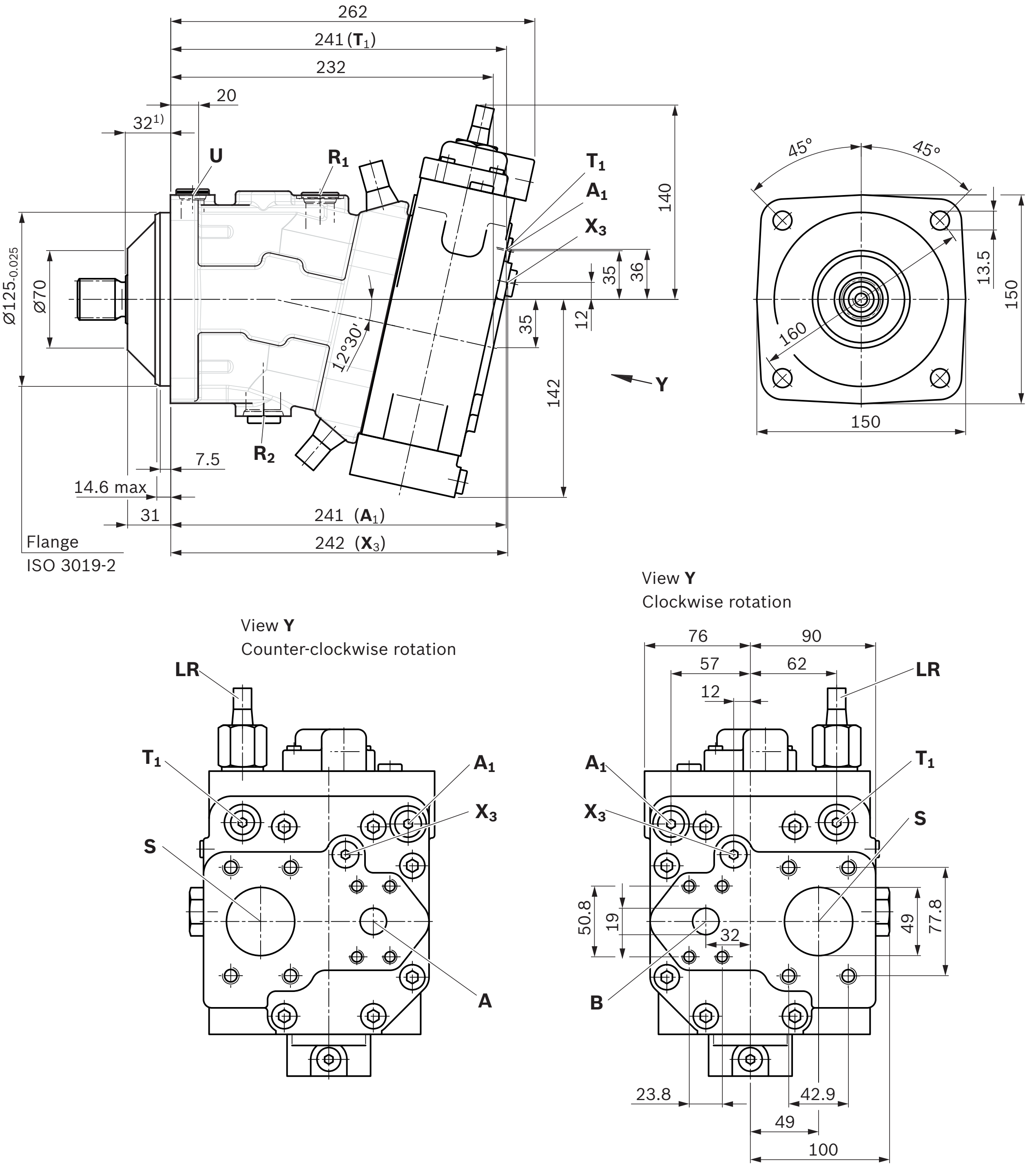
▼ **EP2** – Proportional control electric, positive control



Dimensions, size 55

LR – Power controller without power override

All of the variants of the controllers on pages 26 and 27 are shown for the clockwise direction of input rotation (view **Y**)



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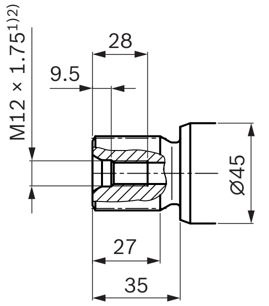
1) To shaft collar

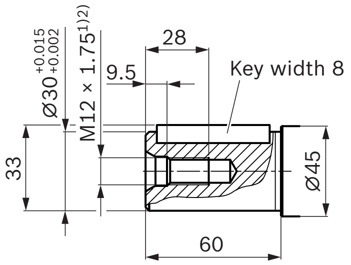
▼ Splined shaft DIN 5480

Z – W30×2×14×9g



▼ Parallel keyed shaft DIN 6885

P – AS8×7×50



Ports		Standard	Size[2]	$p_{\text{max abs}}$ [bar][3]	Status
A (B)	Working port (high-pressure series) fastening thread	SAE J518[4] DIN 13	3/4 in M10 x 1.5; 17 deep	400	O
S	Suction port (standard series) fastening thread	SAE J518[4] DIN 13	2 in M12 × 1.75; 20 deep[2]	2	O
U	Bearing flushing	DIN 3852[5]	M18 × 1.5; 12 deep	2	X
R_1, R_2	Air bleed	DIN 3852[5]	M18 × 1.5; 12 deep	2	X
R_1	Air bleed (LA1S only.)	DIN 3852[5]	M22 × 1.5; 15.5 deep	2	X
R_2	Air bleed (LA1S only.)	DIN 3852[5]	M27 × 2; 19 deep	2	X
A_1	Measuring high pressure	DIN 3852[5]	M14 × 1.5; 12 deep	400	X
T_1	Control fluid drain	DIN 3852[5]	M12 × 1.5; 12 deep	400	X[6]
X_3	Override	DIN 3852[5]	M14 × 1.5; 12 deep	400	X
Y_3	External control pressure	DIN 3852[5]	M14 × 1.5; 12 deep	40	X
X_1	Pilot pressure	DIN 3852[5]	M14 × 1.5; 12 deep	40	O
X_4	Load pressure	DIN 3852[5]	M14 × 1.5; 12 deep	400	O
M_1	Control pressure measurement	DIN 3852[5]	M12 × 1.5; 12 deep	400	X

---

1) Center bore according to DIN 332 (thread according to DIN 13)

2) For notes on tightening torques, see instruction manual.

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

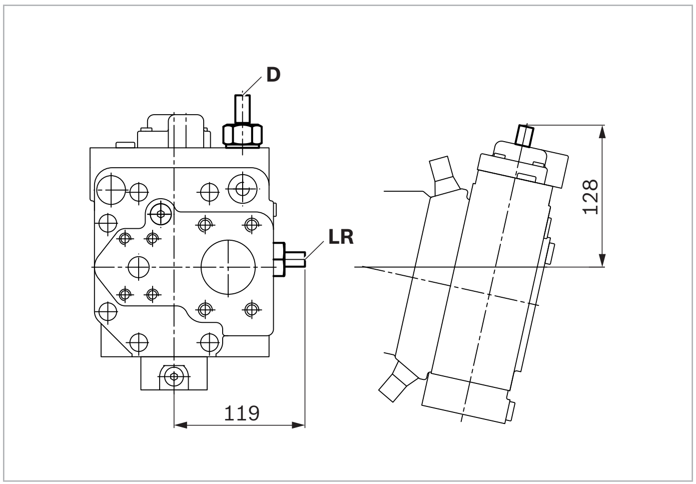
5) The spot face can be deeper than specified in the appropriate standard.

6) For versions with a pressure controller or pressure cut-off, a drain line is needed to relieve port **T_1** to the reservoir.

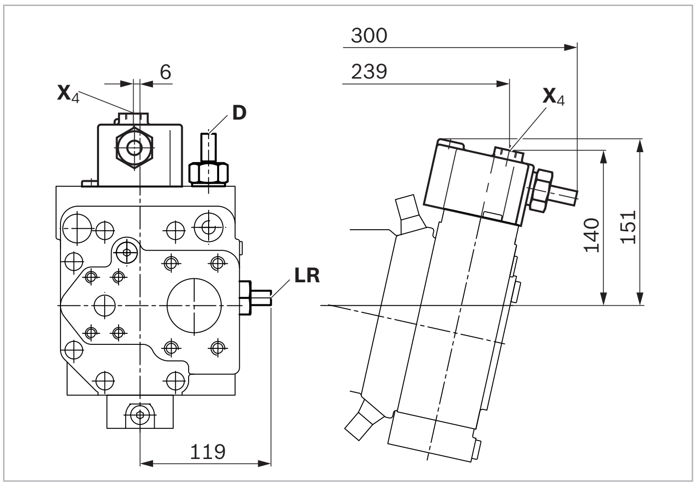
O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

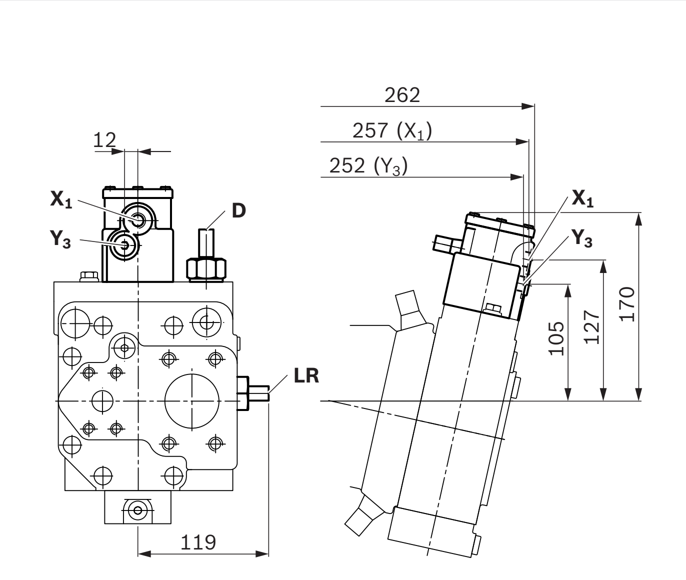
▼ **LRD** – Power controller with pressure cut-off



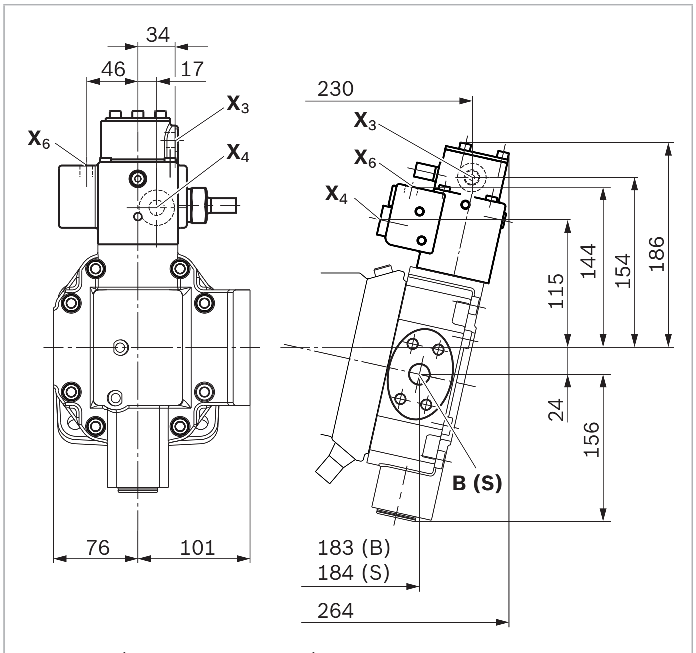
▼ **LRDS** – Power control with pressure cut-off and load sensing



▼ **LRDH1** – Power control with pressure cut-off and stroke limiter

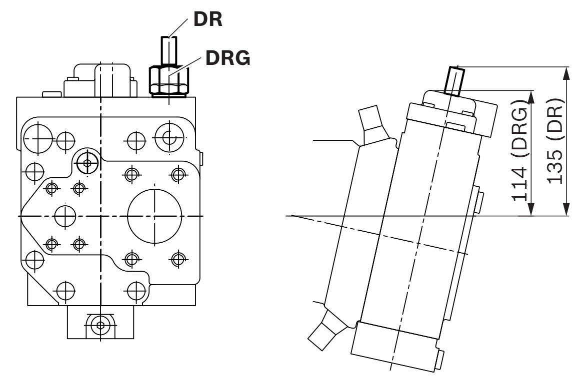


▼ **LA1S** – Power control with load sensing,
LA1S5 – Power control with load sensing and hydraulically proportional LS-override

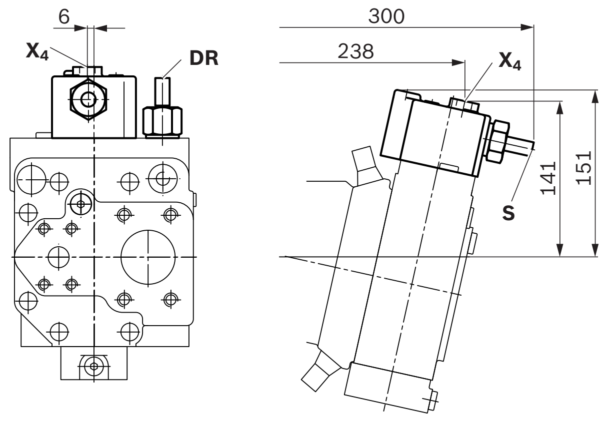


Port **X**$_6$ with version LA1S5 only

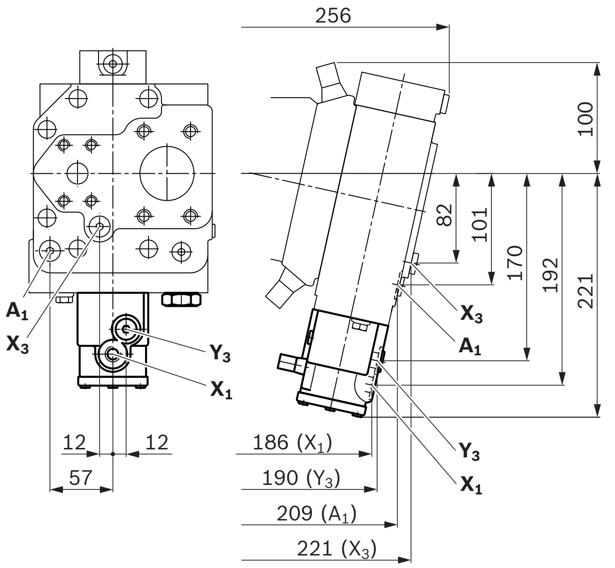
▼ DR/DRG – Pressure controller/pressure controller remotely controlled



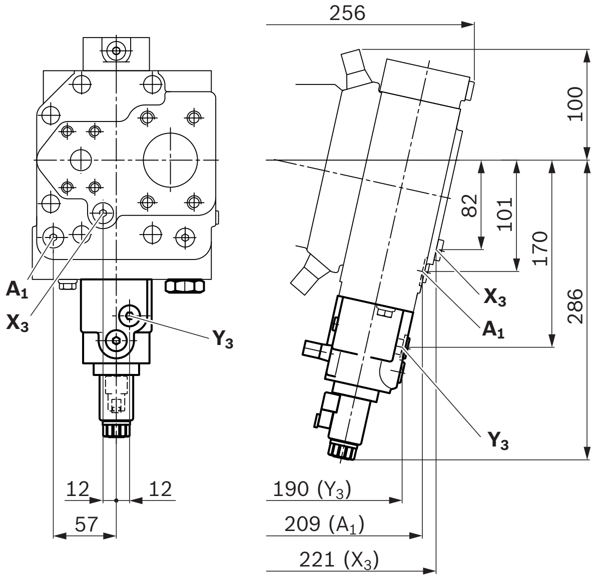
▼ DRS – Pressure controller with load sensing



▼ HD1, HD1G – Proportional hydraulic control , positive control, and variant with pressure cut-off, remotely controlled



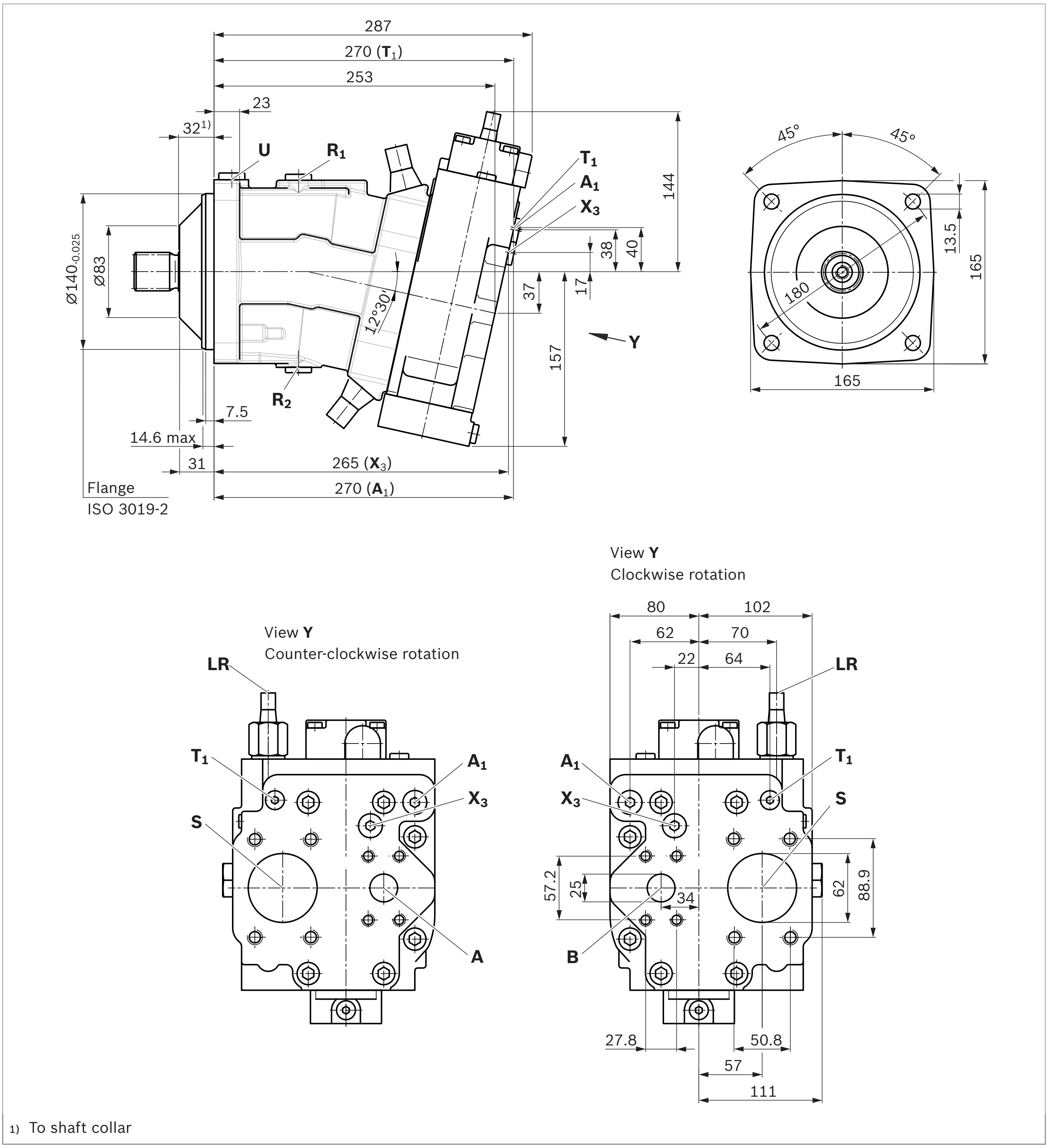
▼ EP2 – Proportional control electric, positive control



Dimensions, size 80

LR – Power controller without power override

All of the variants of the controllers on pages 30 and 31 are shown for the clockwise direction of input rotation (view **Y**)



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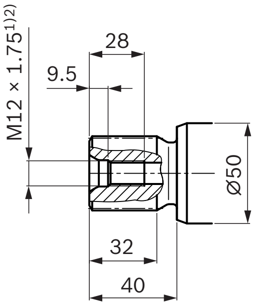
1) To shaft collar

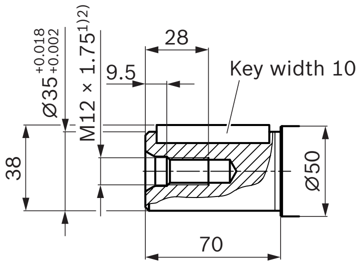
▼ Splined shaft DIN 5480

Z – W35×2×16×9g



▼ Parallel keyed shaft DIN 6885

P – AS10×8×56



Ports		Standard	Size[2]	$p_{\text{max abs}}$ [bar][3]	Status
A (B)	Working port (high-pressure series) fastening thread	SAE J518[4] DIN 13	1 in M12 × 1.75; 17 deep	400	O
S	Suction port (standard series) fastening thread	SAE J518[4] DIN 13	2 1/2 in M12 × 1.75; 17 deep	2	O
U	Bearing flushing	DIN 3852[5]	M18 × 1.5; 12 deep	2	X
R_1, R_2	Air bleed	DIN 3852[5]	M18 × 1.5; 12 deep	2	X
R_1	Air bleed (LA1S only.)	DIN 3852[5]	M22 × 1.5; 15.5 deep	2	X
R_2	Air bleed (LA1S only.)	DIN 3852[5]	M27 × 2; 19 deep	2	X
A_1	Measuring high pressure	DIN 3852[5]	M16 × 1.5; 12 deep	400	X
T_1	Control fluid drain	DIN 3852[5]	M12 × 1.5; 12 deep	400	X[6]
X_3	Override	DIN 3852[5]	M16 × 1.5; 12 deep	400	X
Y_3	External control pressure	DIN 3852[5]	M14 × 1.5; 12 deep	40	X
X_1	Pilot pressure	DIN 3852[5]	M14 × 1.5; 12 deep	40	O
X_4	Load pressure	DIN 3852[5]	M14 × 1.5; 12 deep	400	O
M_1	Control pressure measurement	DIN 3852[5]	M12 × 1.5; 12 deep	400	X

---

[1] Center bore according to DIN 332 (thread according to DIN 13)

[2] For notes on tightening torques, see instruction manual.

[3] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

[4] Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

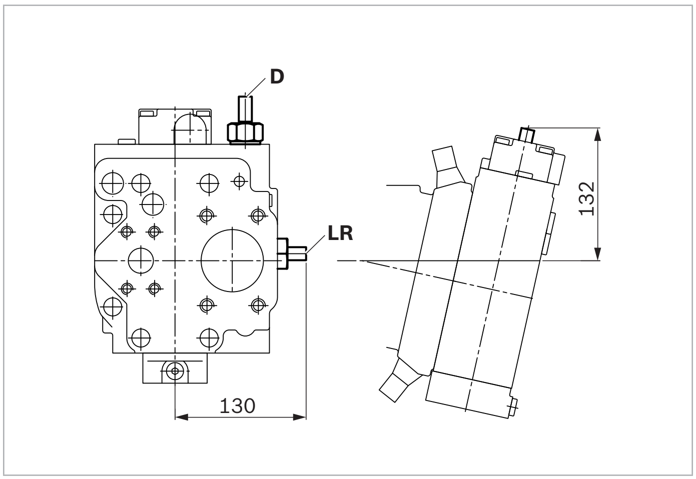
[5] The spot face can be deeper than specified in the appropriate standard.

[6] For versions with a pressure controller or pressure cut-off, a drain line is needed to relieve port T_1 to the reservoir.

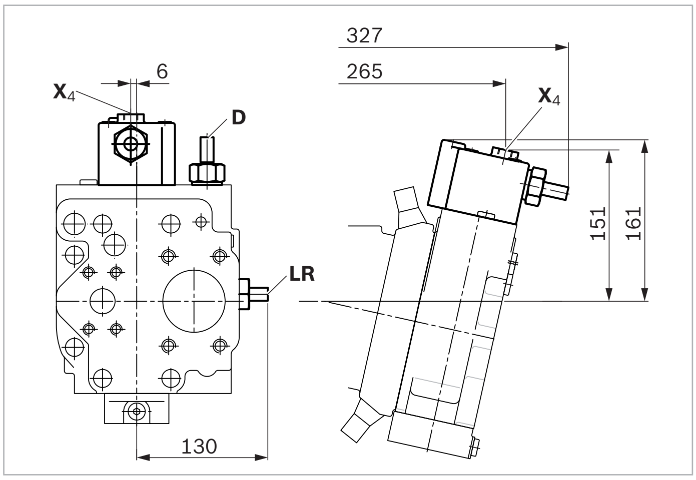
O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

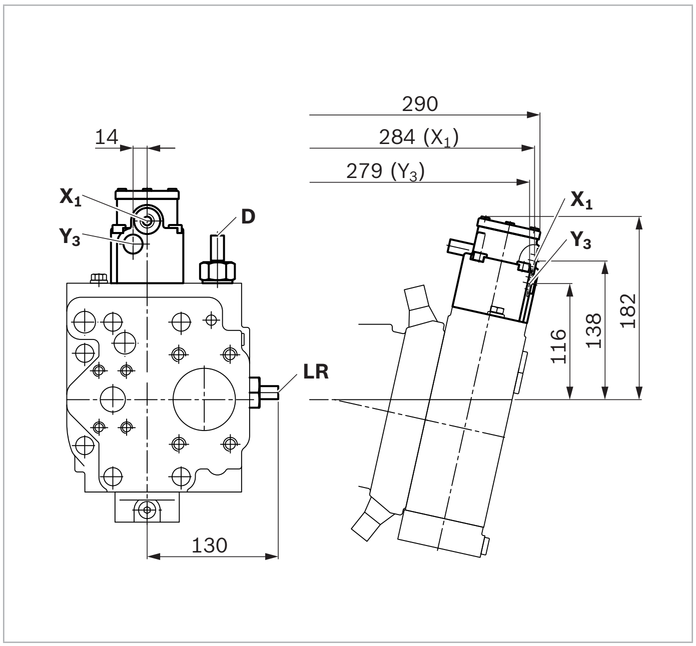
▼ **LRD** – Power controller with pressure cut-off



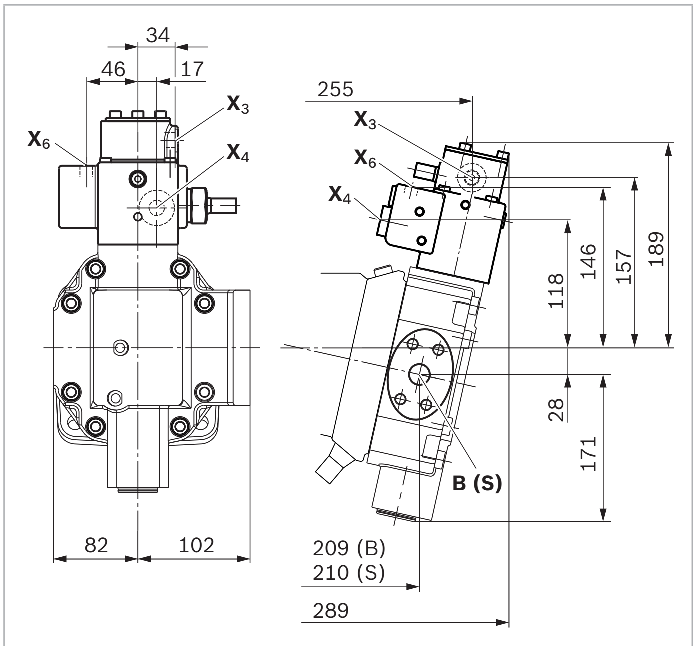
▼ **LRDS** – Power control with pressure cut-off and load sensing



▼ **LRDH1** – Power control with pressure cut-off and stroke limiter

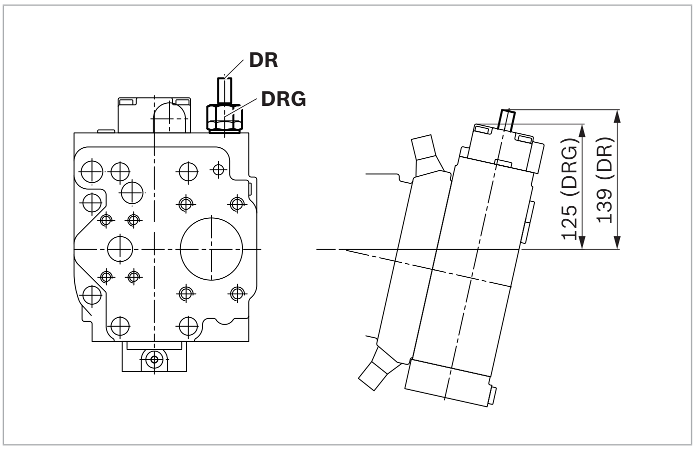


▼ **LA1S** – Power control with load sensing,
LA1S5 – Power control with load sensing, can be overridden on a hydraulically proportional basis

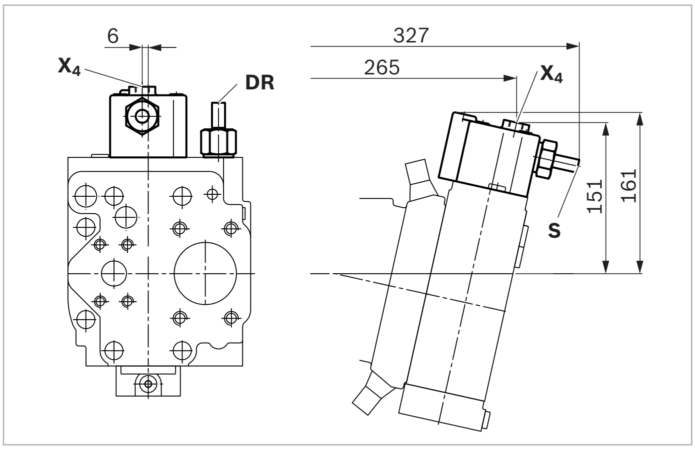


Port X_6 with version LA1S5 only

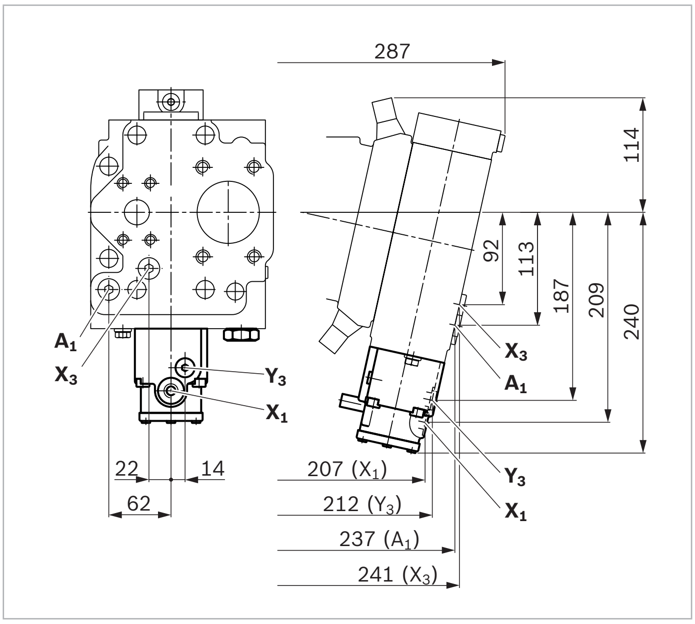
▼ **DR/DRG** – Pressure controller/pressure controller remotely controlled



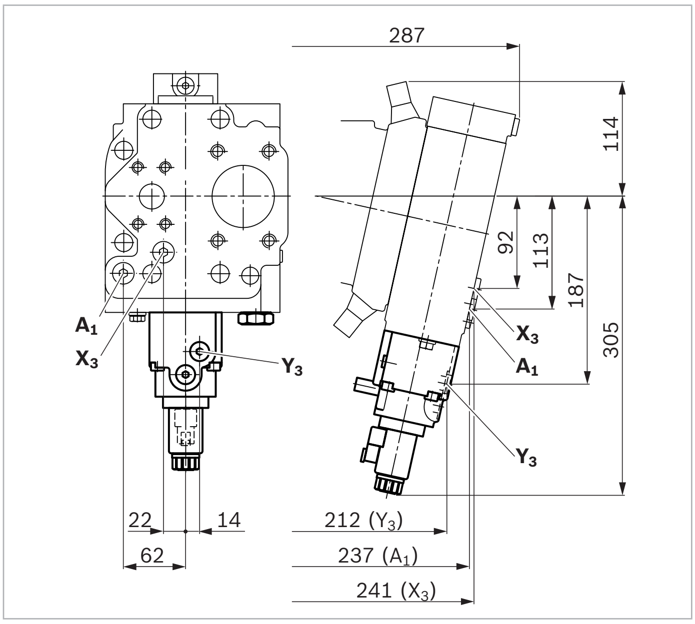
▼ **DRS** – Pressure controller with load sensing



▼ **HD1, HD1G** – Proportional hydraulic control , positive control, and variant with pressure cut-off, remotely controlled



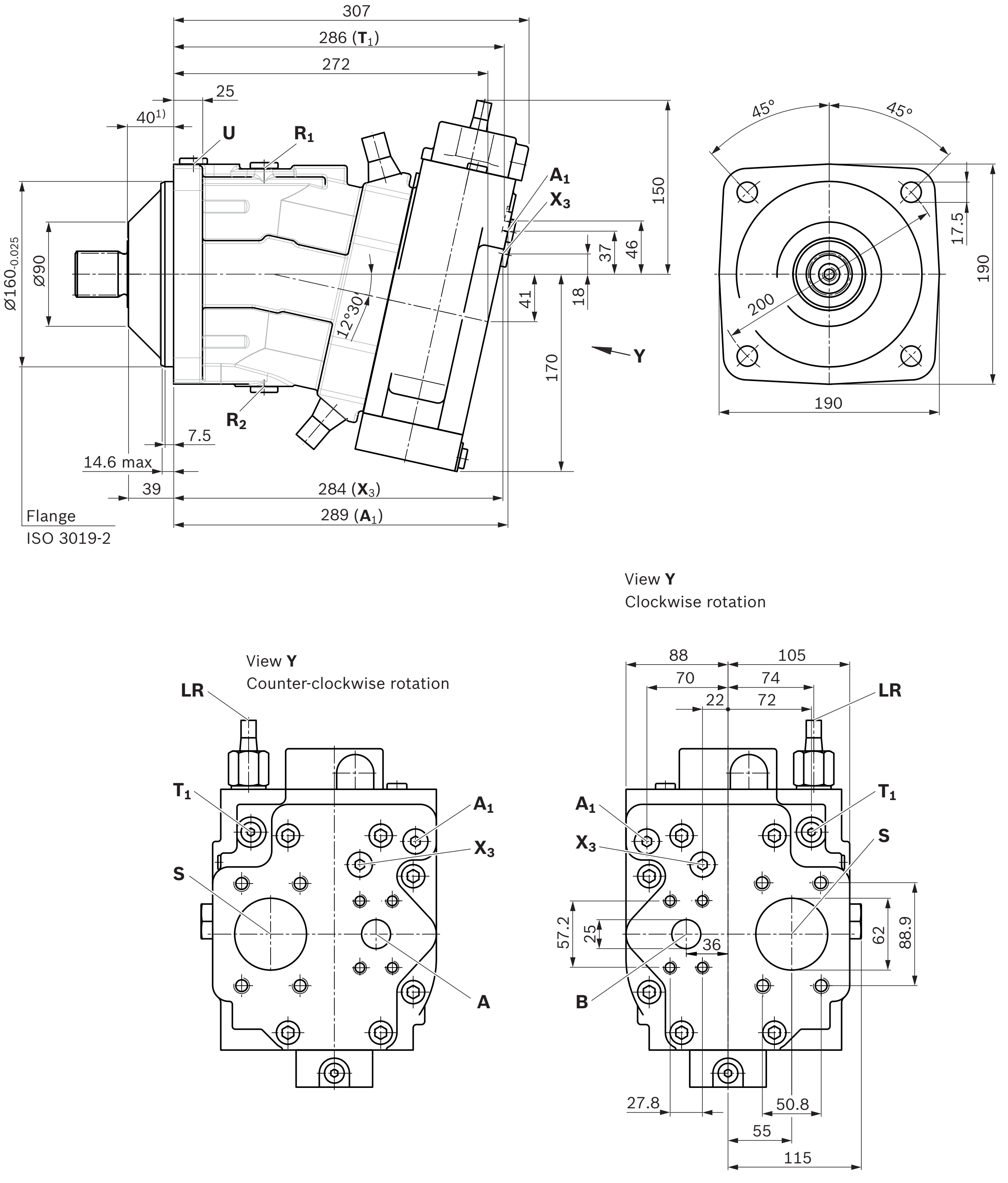
▼ **EP2** – Proportional control electric, positive control



Dimensions, size 107

LR – Power controller without power override

All of the variants of the controllers on pages 34 and 35 are shown for the clockwise direction of input rotation (view **Y**)



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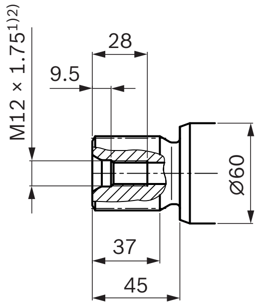
1) To shaft collar

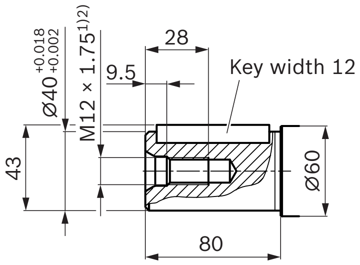
▼ Splined shaft DIN 5480

Z - W40×2×18×9g



▼ Parallel keyed shaft DIN 6885

P - AS12×8×63



Ports		Standard	Size[2]	$p_{\max\ abs}$ [bar][3]	Status
A (B)	Working port (high-pressure series) fastening thread	SAE J518[4] DIN 13	1 in M12 × 1.75; 17 deep	400	O
S	Suction port (standard series) fastening thread	SAE J518[4] DIN 13	2 1/2 in M12 × 1.75; 17 deep	2	O
U	Bearing flushing	DIN 3852[5]	M18 × 1.5; 12 deep	2	X
R_1, R_2	Air bleed	DIN 3852[5]	M18 × 1.5; 12 deep	2	X
A_1	Measuring high pressure	DIN 3852[5]	M16 × 1.5; 12 deep	400	X
T_1	Control fluid drain	DIN 3852[5]	M12 × 1.5; 12 deep	400	X[6]
X_3	Override	DIN 3852[5]	M16 × 1.5; 12 deep	400	X
Y_3	External control pressure	DIN 3852[5]	M14 × 1.5; 12 deep	40	X
X_1	Pilot pressure	DIN 3852[5]	M14 × 1.5; 12 deep	40	O
X_4	Load pressure	DIN 3852[5]	M14 × 1.5; 12 deep	400	O
M_1	Control pressure measurement	DIN 3852[5]	M12 × 1.5; 12 deep	400	X

---

[1] Center bore according to DIN 332 (thread according to DIN 13)

[2] For notes on tightening torques, see instruction manual.

[3] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

[4] Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

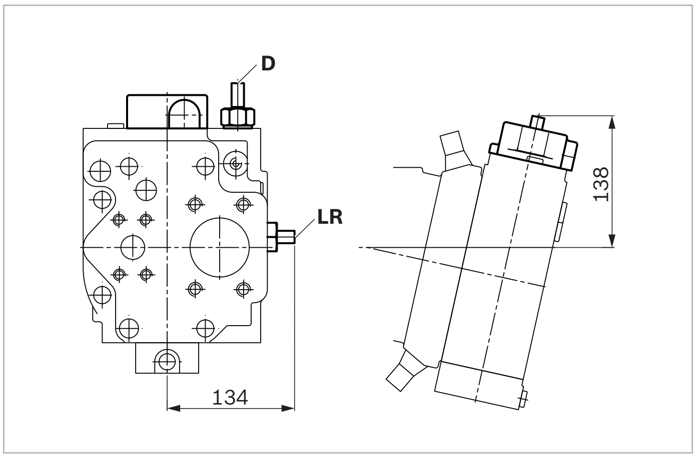
[5] The spot face can be deeper than specified in the appropriate standard.

[6] For versions with a pressure controller or pressure cut-off, a drain line is needed to relieve port **T_1** to the reservoir.

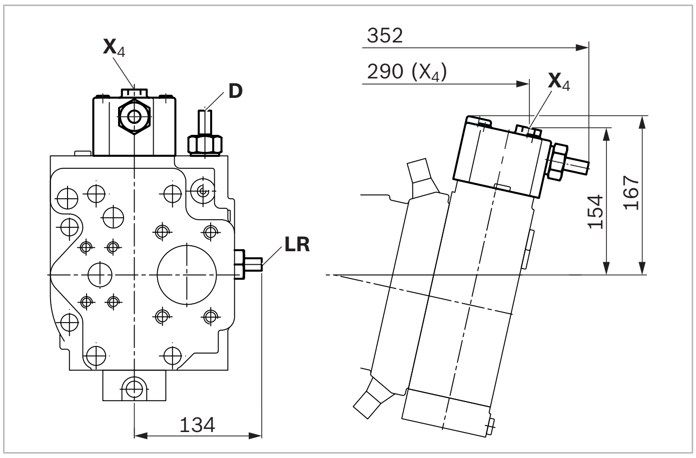
O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

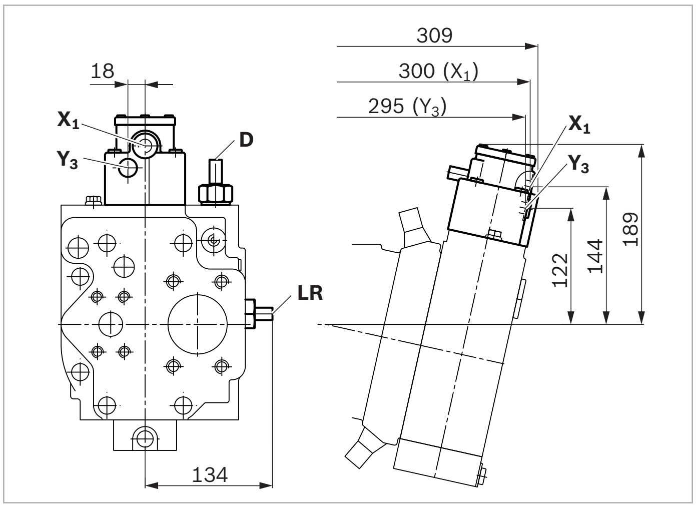
▼ **LRD** – Power controller with pressure cut-off



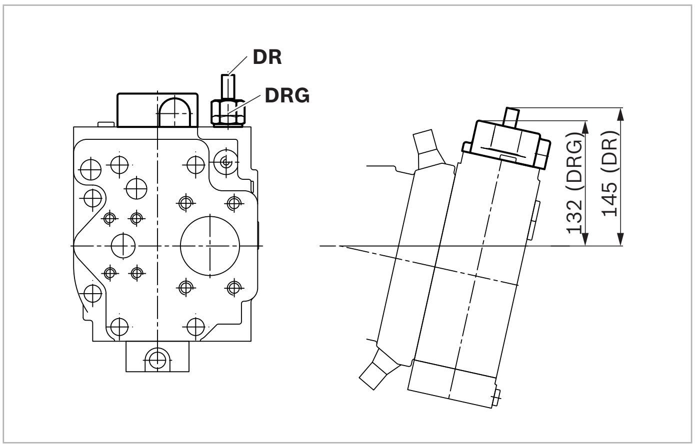
▼ **LRDS** – Power control with pressure cut-off and load sensing



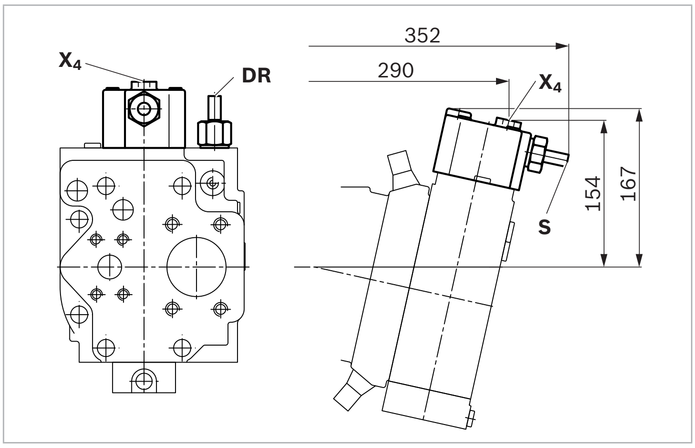
▼ **LRDH1** – Power control with pressure cut-off and stroke limiter



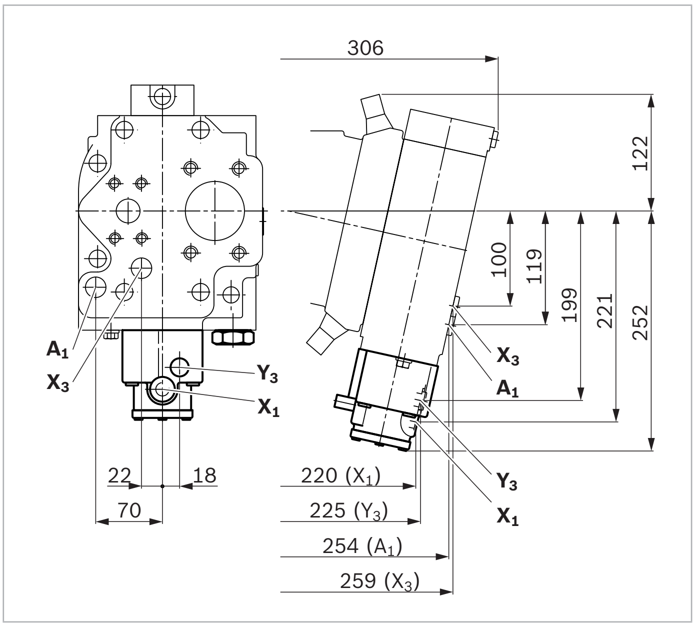
▼ **DR/DRG** – Pressure controller/pressure controller remotely controlled



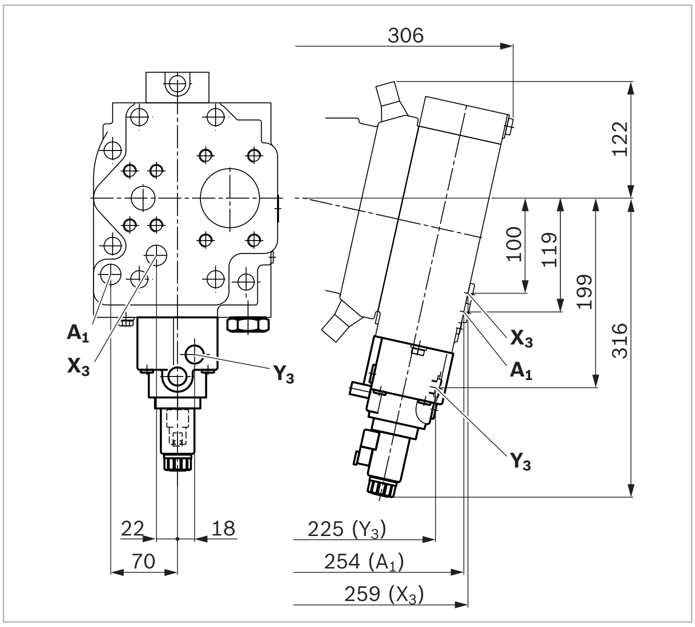
▼ **DRS** – Pressure controller with load sensing



▼ **HD1, HD1G** – Proportional hydraulic control , positive control, and variant with pressure cut-off, remotely controlled



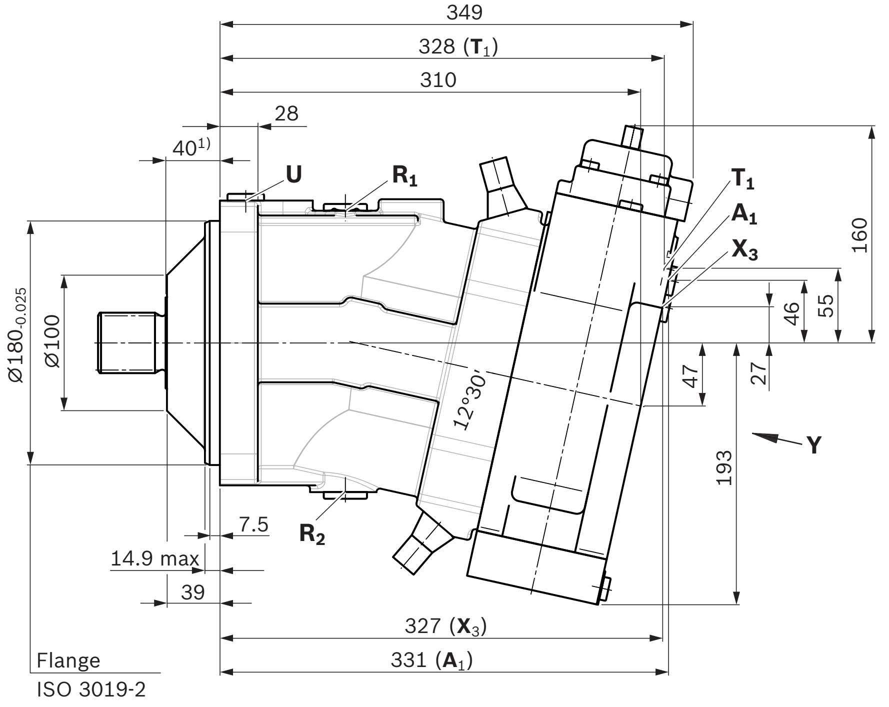
▼ **EP2** – Proportional control electric, positive control

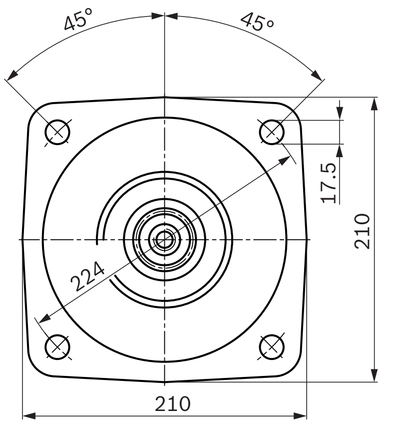


Dimensions, size 160

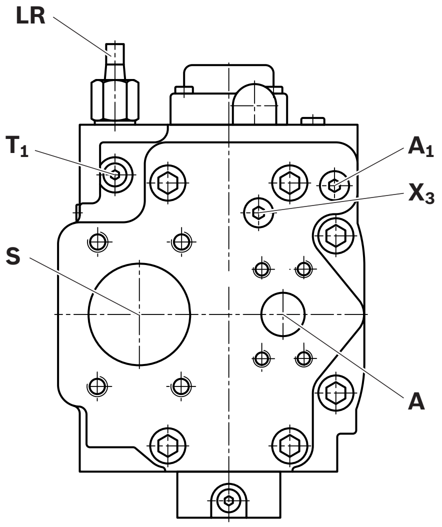
LR – Power controller without power override

All of the variants of the controllers on pages 38 and 39 are shown for the clockwise direction of input rotation (view **Y**)

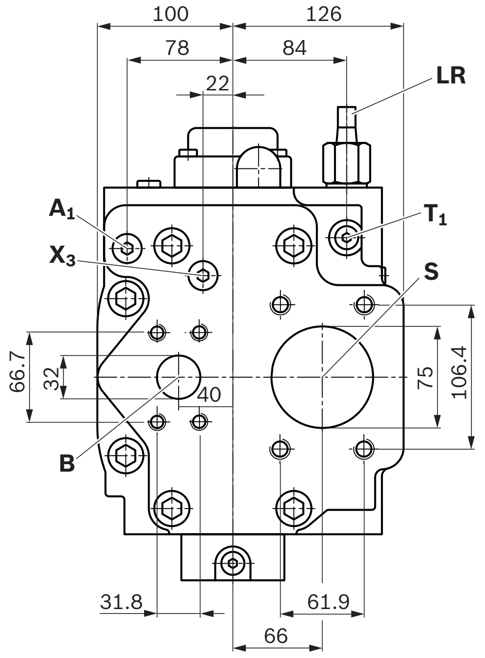




View **Y**
Counter-clockwise rotation



View **Y**
Clockwise rotation



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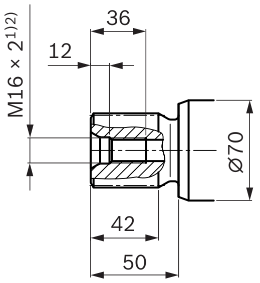
1) To shaft collar

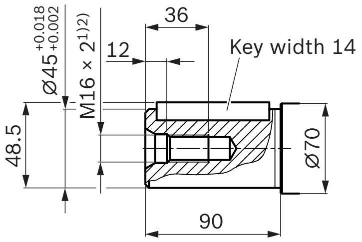
▼ Splined shaft DIN 5480

Z – W45×2×21×9g



▼ Parallel keyed shaft DIN 6885

P – AS14×9×70



Ports		Standard	Size[2]	$p_{\text{max abs}}$ [bar][3]	Status
A (B)	Working port (high-pressure series) fastening thread	SAE J518[4] DIN 13	1 1/4 in M14 × 1.5; 19 deep	400	O
S	Suction port (standard series) fastening thread	SAE J518[4] DIN 13	3 in M16 × 1.5; 24 deep	2	O
U	Bearing flushing	DIN 3852[5]	M22 × 1.5; 14 deep	2	X
R$_1$, **R$_2$**	Air bleed	DIN 3852[5]	M26 × 1.5; 16 deep	2	X
A$_1$	Measuring high pressure	DIN 3852[5]	M16 × 1.5; 12 deep	400	X
T$_1$	Control fluid drain	DIN 3852[5]	M12 × 1.5; 12 deep	400	X[6]
X$_3$	Override	DIN 3852[5]	M16 × 1.5; 12 deep	400	X
Y$_3$	External control pressure	DIN 3852[5]	M14 × 1.5; 12 deep	40	X
X$_1$	Pilot pressure	DIN 3852[5]	M14 × 1.5; 12 deep	40	O
X$_4$	Load pressure	DIN 3852[5]	M14 × 1.5; 12 deep	400	O
M$_1$	Control pressure measurement	DIN 3852[5]	M12 × 1.5; 12 deep	400	X

---

1) Center bore according to DIN 332 (thread according to DIN 13)

2) For notes on tightening torques, see instruction manual.

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

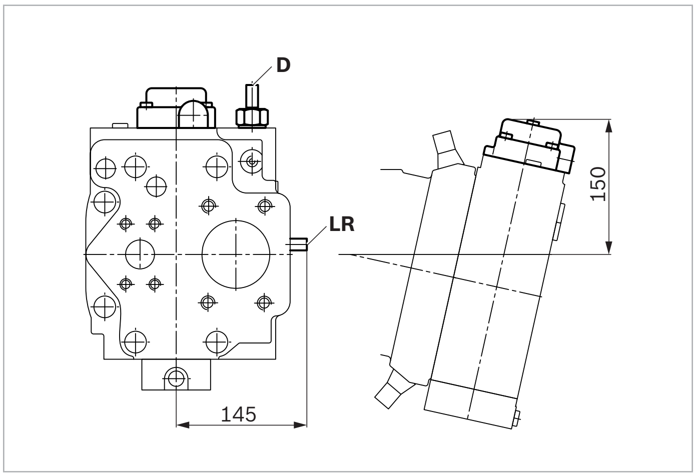
5) The spot face can be deeper than specified in the appropriate standard.

6) For versions with a pressure controller or pressure cut-off, a drain line is needed to relieve port **T$_1$** to the reservoir.

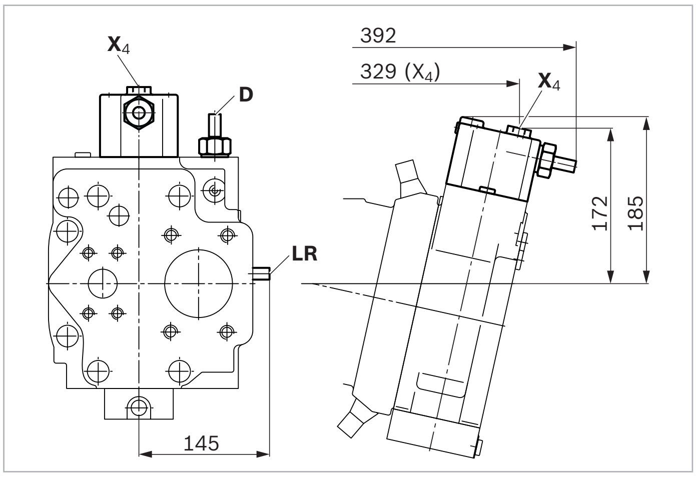
O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

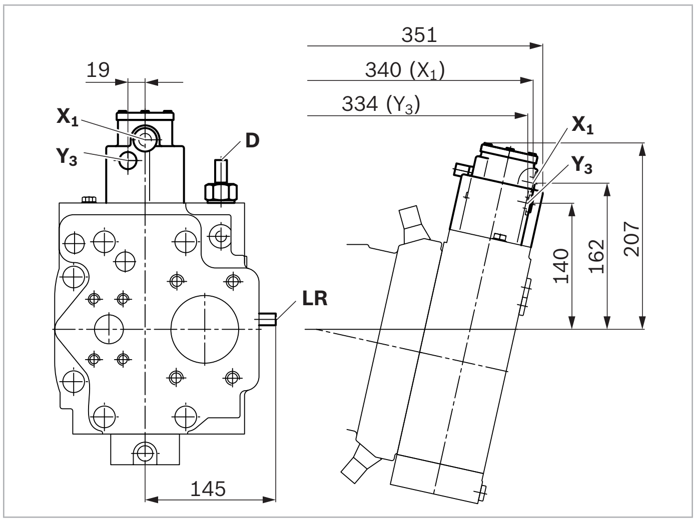
▼ **LRD** – Power controller with pressure cut-off



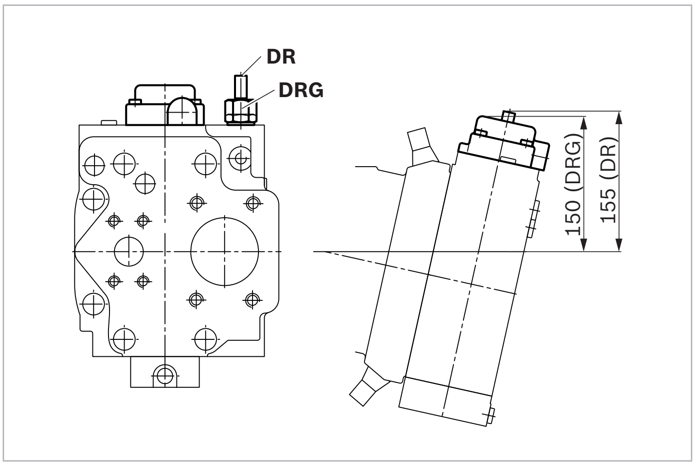
▼ **LRDS** – Power control with pressure cut-off and load sensing



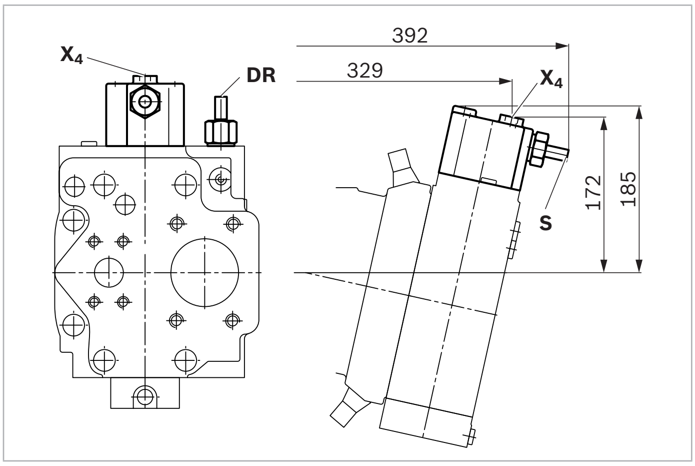
▼ **LRDH1** – Power control with pressure cut-off and stroke limiter



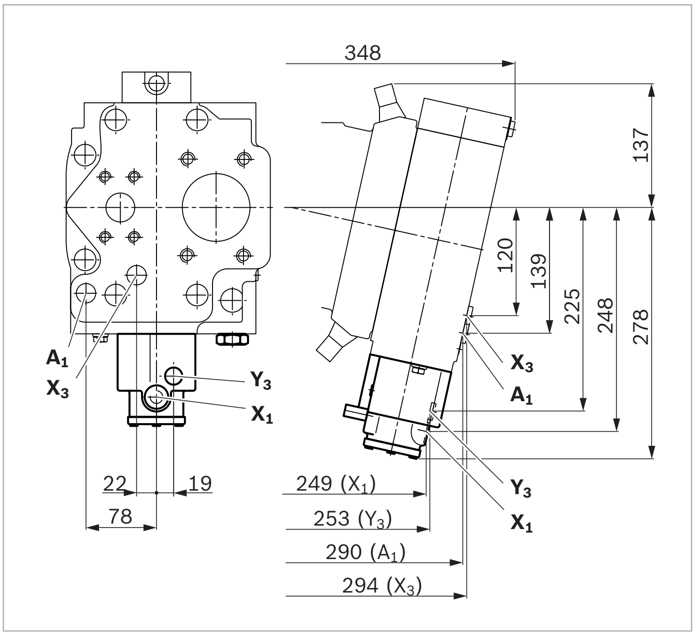
▼ **DR/DRG** – Pressure controller/pressure controller remotely controlled



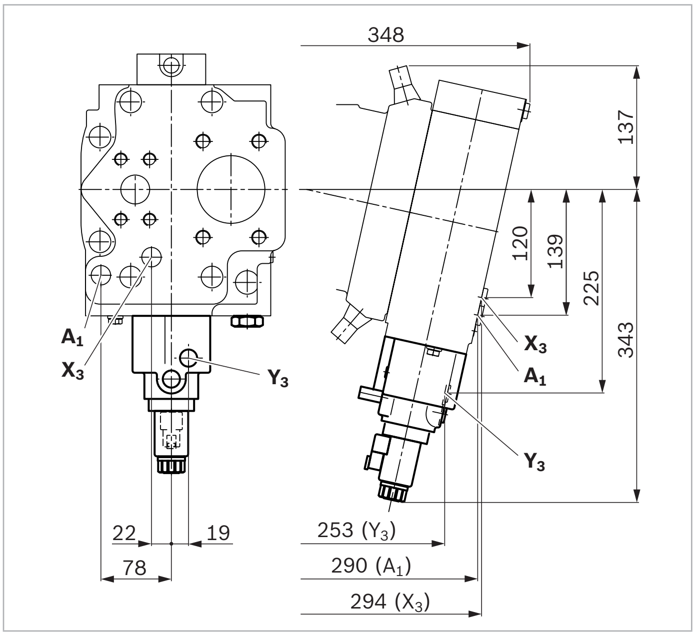
▼ **DRS** – Pressure controller with load sensing



▼ **HD1, HD1G** – Proportional hydraulic control , positive control, and variant with pressure cut-off, remotely controlled



▼ **EP2** – Proportional control electric, positive control



Connector for solenoids

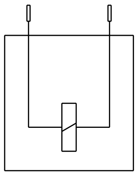
DEUTSCH DT04-2P-EP04

Molded connector, 2-pin, without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)

▼ Circuit symbol



▼ Mating connector DEUTSCH DT06-2S-EP04

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery.

This can be supplied by Bosch Rexroth on request (material number R902601804).

Note

If necessary, you can change the connector orientation by turning the solenoid housing.

The procedure can be taken from the instruction manual.

Installation instructions

General

At commissioning and during operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a long standstill as the axial piston unit can empty via the hydraulic lines.

Particularly in the installation position "drive shaft upwards", filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The pump housing is internally connected to the suction chamber. A separate drain line from the case to the reservoir is not needed. Exception: For versions with pressure controller or pressure cut-off, a drain line is needed to relieve port **T_1** to the reservoir.

To achieve favorable noise values, decouple all connecting lines using elastic elements.

In all operating conditions, the suction line and the drain line must flow into the reservoir below the minimum fluid level. The minimum suction pressure at port **S** must not fall below 0.8 bar absolute during operation either.

When designing the reservoir, ensure that there is adequate spacing between the suction line and the drain line. This minimizes oil turbulence and carries out degassing, which prevents the heated hydraulic fluid from being sucked directly back in again.

Notes

- Axial piston units with electric components (e.g. electric controls, sensors) must not be installed in a reservoir below the fluid level.
- In certain installation conditions, an influence on the control characteristic curves can be expected. Gravity, dead weight and case pressure can cause minor shifts in characteristics and changes in response time.

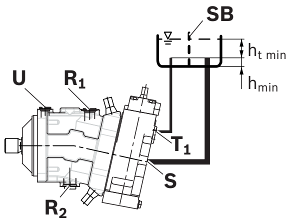
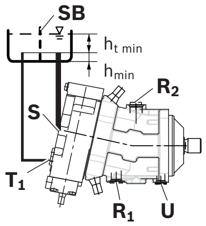
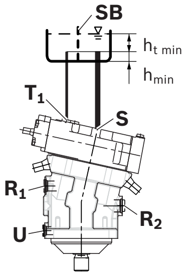
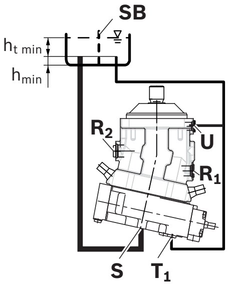
Key	
R_1/R_2	Air bleed port
U	Bearing flushing
S	Suction port
T_1	Control fluid drain
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir base (100 mm)
SB	Baffle (baffle plate)

Installation position

See the following examples **1** to **4**.

Additional installation positions are available upon request.

Recommended installation position: **1** and **2**.

Installation position	Air bleeding	Filling
1 	**R_1**	**S**
2 	**R_2**	**S**
3 	**T_1**	**S**
4 	**U**	**S**

Project planning notes

- The A7VO pump is designed to be used in open circuits.
- Project planning, installation and commissioning of the axial piston units requires the involvement of skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual thoroughly and completely. If necessary, request them from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The specified data and notes must be observed.
- Pressure controllers are no protection from pressure overload. A separate pressure relief valve is to be provided in the hydraulic system.
- Depending on the operating condition of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Not all versions of the product are approved for use in a safety function pursuant to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. MTTF_d) for functional safety.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports can only be used to accommodate hydraulic lines.

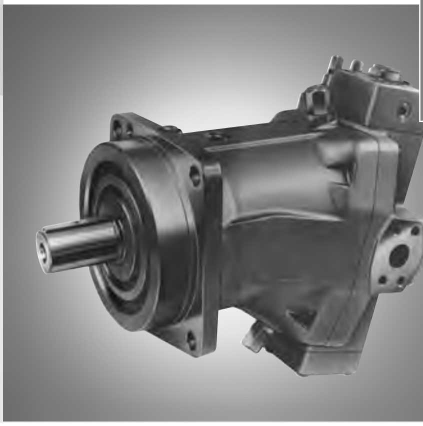
Safety instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control and regulation systems (e.g. valve spools) may in certain circumstances become stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid, abrasion or residual dirt from components). As a result, the hydraulic fluid flow or build-up of torque of the axial piston unit will no longer respond correctly to the operator's commands. Even the use of different filter cartridges (external or internal inlet filter) will not rule out a fault but merely minimize the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.

Axial piston variable pump
A7VO

Data sheet

Series 63
Sizes NG250 to 500
Nominal pressure 350 bar
Peak pressure 400 bar
Open circuit



Contents

Features

- Variable axial piston pump with tapered piston rotary group in bent axis design for hydrostatic drives in open circuits
- For operation in mobile and industrial applications
- The flow is proportional to the drive speed and the displacement and steplessly variable from $q_{v\,max}$ to $q_{v\,min} = 0$
- Wide range of controls and adjustment devices
- Compact, robust bearing system for long service life
- Available with Long Life bearings for special fluids and extreme service life requirements
- Pressure control is standard
- Optical or electric swivel angle indicator available

Type code for standard program

	A7V		**O**			**/**	**63**		**–**	**V**				
01	02	03	04	05	06		07	08		09	10	11	12	13

Fluid / Version

		250	355	500	
01	Mineral oil and HFD. HFD only in conjunction with Long-Life-Lagerung „L“ (no code)	●	●	●	
	For operation on HFC, special high performance version A4VSO...F see RE 92053	●	●	–	
	High-Speed-Version (only mineral oil)	●	–	–	**H** [1]

Axial piston unit

02	Bent axis design, variable, nominal pressure 350 bar, peak pressure 400 bar	**A7V**

Drive shaft bearings

		250	355	500	
03	Mechanical bearings (no code)	●	●	●	
	Long-Life-bearings	●	●	●	**L**

Type of operation

04	Pump, open circuit	**O**

Size

05	Displacement $V_{g\,max}$ [cm³]	**250**	**355**	**500**
	NG28 to160 see RE 92202			

Control devices

			250	355	500	
06	Pressure control		●	●	●	**DR**
	Pressure control, remotely adjustable		●	●	●	**DRG**
	Power control					
	with integrated pressure control (fixed setting)		●	●	●	**LRD**
	hydraulic stroke limiter initial position $V_{g\,max}$	Δp = 10 bar	●	●	●	**LRDH1**
		Δp = 25 bar	●	●	●	**LRDH2**
		Δp = 35 bar	●	●	●	**LRDH3**
	hydraulic stroke limiter initial position $V_{g\,min}$	Δp = 10 bar	●	●	●	**LRDN1**
		Δp = 25 bar	●	●	●	**LRDN2**
		Δp = 35 bar	●	●	●	**LRDN3**
	with pressure control remotely adjustable		●	●	●	**LRG**
	hydraulic stroke limiter initial position $V_{g\,max}$	Δp = 10 bar	●	●	●	**LRGH1**
		Δp = 25 bar	●	●	●	**LRGH2**
		Δp = 35 bar	●	●	●	**LRGH3**
	hydraulic stroke limiter initial position $V_{g\,min}$	Δp = 10 bar	●	●	●	**LRGN1**
		Δp = 25 bar	●	●	●	**LRGN2**
		Δp = 35 bar	●	●	●	**LRGN3**
	Hydraulic control, pilot pressure dependent,					
	with integrated pressure control (fixed setting)	Δp = 10 bar	●	●	●	**HD1D**
		Δp = 25 bar	●	●	●	**HD2D**
		Δp = 35 bar	●	●	●	**HD3D**
	with pressure control, remotely adjustable	Δp = 10 bar	●	●	●	**HD1G**
		Δp = 25 bar	●	●	●	**HD2G**
		Δp = 35 bar	●	●	●	**HD3G**
	Hydraulic control, with electric proportional valve [2]					
	with integrated pressure control (fixed setting)	Control voltage 12 V	●	●	●	**EP1D**
		Control voltage 24 V	●	●	●	**EP2D**
	with pressure control, remotely adjustable	Control voltage 12 V	●	●	●	**EP1G**
		control voltage 24 V	●	●	●	**EP2G**

[1] recommended for new projects

[2] for operation on HFD-fluids please observe RE 29181 (proportional pressure reducing valve type DRE4K)

Type code for standard program

	A7V		**O**			**/**	**63**		**–**	**V**				
01	02	03	04	05	06		07	08		09	10	11	12	13

	Series		**250**	**355**	**500**	
07	Series 6, Index 3		●	●	●	**63**

	Direction of rotation		**250**	**355**	**500**	
08	with view on drive shaft	clockwise	● ▨	● ▨	● ▨	**R**
		counter clockwise	●	●	●	**L**

	Seals		**250**	**355**	**500**	
09	FKM (Fluoro-rubber)		●	●	●	**V**

	Drive shaft		**250**	**355**	**500**	
10	Splined shaft to DIN 5480		●	●	●	**Z**
	Keyed parallel shaft to DIN 6885		● ▨	● ▨	● ▨	**P**

	Mounting flange		**250**	**355**	**500**	
11	Similar to ISO 3019-2	4-hole	●	–	–	**B**
		8-hole	–	●	●	**H**

	Service line connections		**250**	**355**	**500**	
12	SAE-flanged port B or A, at rear (metric fixing bolts) SAE flanged port S, at rear(metric fixing bolts)		●	●	●	**01**
	SAE- flanged ports B or A, on opposite side (metric fixing bolts) SAE- flanged port S, on opposite side (metric fixing bolts)		● ▨	● ▨	● ▨	**02**

	Swivel angle indicator		**250**	**355**	**500**	
13	Without swivel angle indicator (no code)		● ▨	● ▨	● ▨	
	With optical swivel angle indicator		●	●	●	**V**
	With electric swivel angle indicator		●	●	●	**E**

Note

Exact value for $V_{g\,min}$ and $V_{g\,max}$ (displacement) must be stated in clear text when ordering ($V_{g\,min}$ ......cm³/rev., $V_{g\,max}$ .....cm³/rev.)

Setting range $V_{g\,min}$: 0 to $0.2 \cdot V_{g\,max}$
$V_{g\,max}$: $V_{g\,max}$ down to $0.8 \cdot V_{g\,max}$

● = Available – = Not available ▨ = Preferred program

Technical data

Hydraulic fluid

For extensive information on the selection of hydraulic fluids and application conditions please consult our data sheets RE 90220 (mineral oils), RE 90221 (ecologically acceptable fluids) and RE 90223 (HF-fluids).

The variable pump A7VO is not suitable for operation on HFA fluids. When operating on HFD or ecologically acceptable fluids, limitations to the technical data and seals according to RE 90223 and RE 90221 must be observed.

For the sizes 250 and 355 with **operation on HFC-fluids**, the **A4VSO..*F*** must be used. For certain selected HFC fluids the same pressures and speeds are permissible as for operation on mineral oil. See RE 92053.

When ordering, state the fluid to be used in clear text.

Operating viscosity range

In order to obtain optimum efficiency and service life, we recommend that the operating viscosity (at operating temperature) be selected in the range

ν_{opt} = opt. viscosity range 16...36 mm^2/s

referred to tank temperature (open circuit).

Limit of viscosity range

For critical operating conditions the following values apply:

ν_{min} = 10 mm^2/s
for short periods ($t < 3$ min)
at max. permissible case drain temperature
$t_{max} = +90$°C.

ν_{max} = 1000 mm^2/s
for short periods (on cold start maximum operating viscosity of 100 mm^2/s should be reached within 15 min)
$t_{min} = -25$°C

Note, that the maximum fluid temperature of 90°C may not be exceeded at any point (e.g. around the bearings). The fluid temperature in the bearing area is influenced by drive speed and pressure, and is typically 12 K higher than the average case drain temperature.

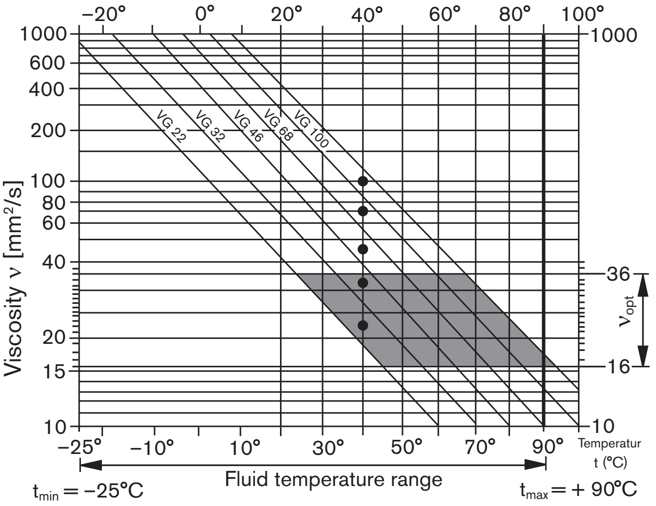
Temperature range

(see selection diagram)

$t_{min} = -25$°C
$t_{max} = +90$°C

For detailed information on operation with low temperatures see RE 90300-03-B.

Selection diagram



Notes on the selection of hydraulic fluids

In order to select the correct fluid, it is necessary to know the operating temperature in the tank (open circuit) in relation to the ambient temperature.

The hydraulic fluid should be selected so that within the operating temperature range, the viscosity lies within the optimum range (ν_{opt}) see shaded section in the selection diagram. We recommend, that the higher viscosity grade is selected in each case.

Example: at an ambient temperature of X° C the operating temperature in the tank is 60° C. In the optimum viscosity range (ν_{opt} ; shaded area), this corresponds to grades VG 46 or VG 68; select: VG 68.

Important:
The case drain temperature is influenced by pressure and speed and is always higher than the tank temperature. However the max. temperature at any point in the system may not exceed 90° C.

If the above conditions cannot be met, due to extreme operating parameters we recommend a housing flushing via port U.

Filtration

The finer the filtration, the better the achieved cleanliness of the fluid and the longer the life of the axial piston pump.

To ensure a reliable functioning of the axial piston unit, a minimum cleanliness class of

20/18/15 acc. to ISO 4406 is necessary.

.

Technical data

Operating pressure range

Depending on the operating fluid, limitations may apply, see the chapter on hydraulic fluids, page 4.

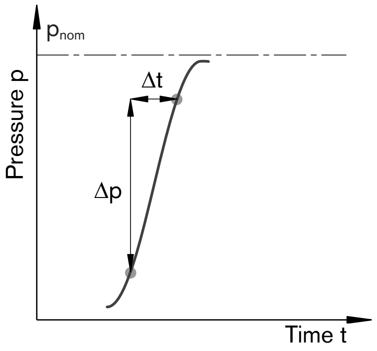
Pressure at the outlet ports (pressure ports) A or B

Nominal pressure p_{nom} ________ 350 bar absolute

Peak pressure p_{max} ________ 400 bar absolute
Total operating period ________ 300 h
Individual operating period ________ 1 s

Minimum pressure (in pump outlet) ________ 10 bar
For a lower pressure, please consult us.

Rate of pressure change R_A ________ 16000 bar/s

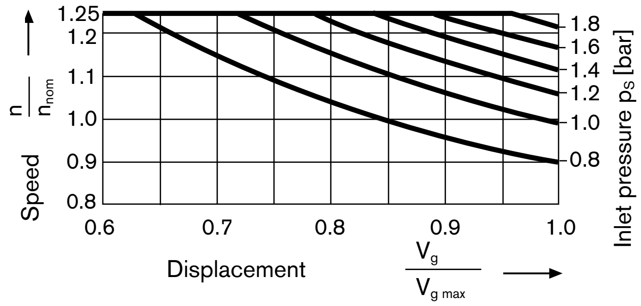


Under pulsating load conditions above 315 bar we recommend the use of a splined shaft (to DIN 5480).

Pressure at the inlet port S (Suction)

Minimum inlet pressure $p_{S\ min}$ ________ 0.8 bar absolute
Maximum inlet pressure $p_{S\ max}$ ________ 8 bar absolute

Minimum inlet pressure
In order to avoid damage to the axial piston pump a certain minimum inlet pressure at the pump's suction port S is necessary This minimum inlet pressure is dependent on the drive speed and the displacement of the axial piston unit.



Note

- Maximum speed n_{max}
  (Speed limit, see table of values, page 8)
- Minimum and maximum pressure at port S
- Permissible values for the shaft seal
  (see diagram on page 7)

An increase in inlet pressure results in a higher control begin of the **LR**-control curve as well as a rise of the LR.**H**- and LR.**N**-pilot pressure characteristics.
Factory setting of the control begin is done at an inlet pressure p_S=1 bar absolute.
Exact details of the shifts in the control curves on request.

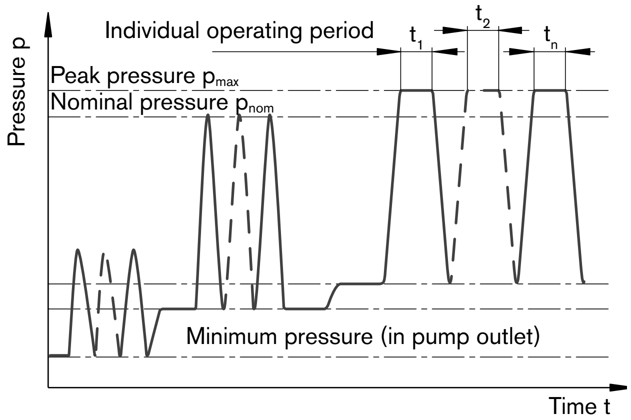
Definition

Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

Peak pressure p_{max}
The peak pressure corresponds to the maximum pressure within the individual operating period. The total of the individual operating periods must not exceed the total operating period.

Minimum pressure (in pump outlet)
Minimum pressure in the pump outlet side (port A or B) that is required in order to prevent damage to the axial piston unit.

Rate of pressure change R_A
Maximum permissible pressure build-up and pressure reduction speed with a pressure change over the entire pressure range.



Total operating period = $t_1 + t_2 + ... + t_n$

Direction of flow

Direction of rotation, with view on shaft end clockwise	 counter clockwise
S to **B**	**S** to **A**

Technical data

Long-Life-Bearings (L)

For long service life requirements and when using HFD-fluids. Identical external dimensions as units with standard bearings. A retroactive conversion to Long-Life Bearings is possible. It is recommended, that the bearings and housing be flushed via port U.

Bearing flushing

Flushing flows (recommended)

NG	250	355	500
q_{flow} (L/min)	10	16	16

Operation in standby (in pressure control mode)

Operation in standby, without external flushing via port U is only permissible for short periods:

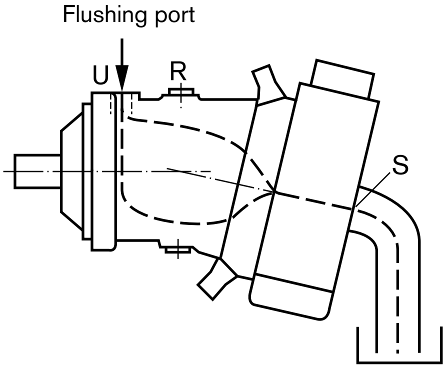
A7VO maximum	15 min at 200 bar 3 min at 350 bar
HA7VO maximum	5 min at 200 bar 1 min at 350 bar

For other pressure levels information on request

Influence of drive speed can be neglected

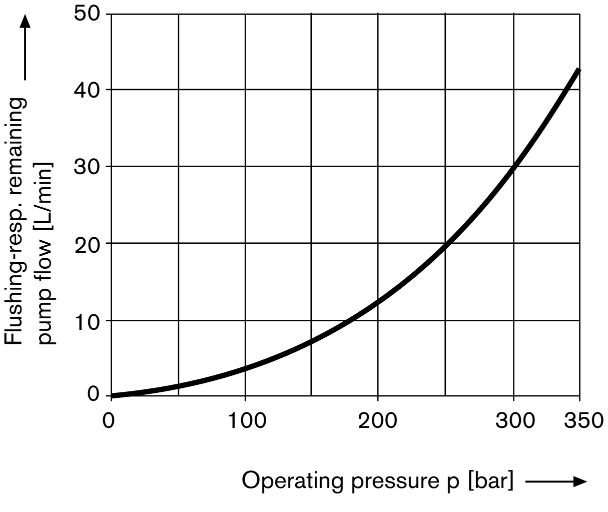
At tank temperature ≤ 50° C

For longer periods of standby operation it is necessary to implement housing flushing vie port U.



Flushing flows for A7VO same as bearing flushing

Flushing flows HA7VO (High-Speed-version)



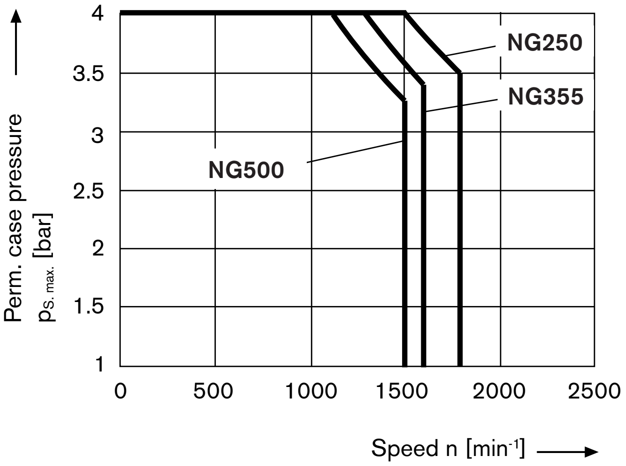
Technical data

Shaft seal FKM (Fluoro-rubber)

Permissible case pressure

The service life of the shaft seal is influenced by pump drive speed and case pressure. It is recommended not to exceed the continuous averaged case pressure of 3 bar abs. (max. perm. case pressure 4 bar abs. at reduced speed, see diagram).

The case pressure must be equal to or higher than the external pressure on the shaft seal (in case of the standard version). For the High-Speed-version please consult us.



Special operating conditions may make it necessary to restrict these values .

Important:

- maximum permissible drive speed of variable pump (see table of values, page 8)
- max. permissible case pressure $p_{S\,max}$ ______________ 4 bar
- an increase in case pressure results in a higher control begin of the **HD**- and **DR**- controls.

  Exact details of the shift in control characteristics on request.

  Factory setting of the control begin at $p_S = 1$ bar.

Temperature range

The FKM shaft seal is suitable for case temperatures of -25° C to +90°C.

Technical data

Table of values (theoretical values, without considering η_{mh} and η_v; values rounded off)

Size		**NG**		**250**		**355**	**500**
		High-Speed-Version			**250H**		
Displacement		$V_{g\,max}$[1]	cm³	250	250	355	500
		$V_{g\,min}$[1]	cm³	0	0	0	0
Speed maximum [2][4]	at $V_{g\,max}$	n_{nom}	rpm	1500	1800	1320	1200
Speed maximum [3][4]	at $V_g \leq V_{g\,max}$	n_{max}	rpm	1800	–	1600	1500
Maximum flow [4]	at n_{nom} ($V_{g\,max}$)	$q_{v\,max\,nom}$	L /min	375	450	469	600
Maximum power [4]	at $q_{v\,nom}$ and $\Delta p = 350$ bar	P_{nom}	kW	219	262	273	350
Torque [4]	at $V_{g\,max}$ and $\Delta p = 350$ bar (continuous operation)	T_{max}	Nm	1391	1391	1978	2785
Rotary stiffness	$V_{g\,max}$ to $0.5 \cdot V_{g\,max}$	c_{min}	Nm/rad	59500	59500	74800	115000
	$0.5 \cdot V_{g\,max}$ to $0_{(interpolated)}$	c_{max}	Nm/rad	181000	181000	262000	391000
Moment of inertia rotary group		J_{TW}	kgm²	0.061	0.061	0.102	0.178
Angular acceleration maximum		α	rad/s²	10000	10000	8300	5500
Case volume		V	L	3	3	5	7
Weight approx.		m	kg	102	102	173	234

[1] Standard setting for limitation of the swivel angle. If another setting is required, please state in clear text.
Setting range $V_{g\,max}$: $V_{g\,max}$ to $0.8 \cdot V_{g\,max}$
$V_{g\,min}$: 0 to $0.2 \cdot V_{g\,max}$

[2] Nominal speed in self priming operation with an absolute pressure (p_S) of 1 bar at inlet port S and mineral oil with a density of 0,88 kg/L

[3] The values apply for $V_g \leq V_{g\,max}$ or an increase in inlet pressure p_S at the inlet port S (see diagram page 5)

[4] Depending on the type of fluid, restrictions may be necessary, see chapter hydraulic fluids page 4

Important

Exceeding the maximum or falling below the minimum permissible values can lead to a loss of function, a reduction in operational service life or total destruction of the axial piston unit. More details on limiting values for speed fluctuations, reduction in angular acceleration dependent on the frequency and the permissible starting angular acceleration (below the maximum angular acceleration) can be found in data sheet RE 90261.

Determination of size

Flow
$$q_V = \frac{V_g \cdot n \cdot \eta_V}{1000} \quad \text{[L/min]}$$

Drive torque
$$T = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}} \quad \text{[Nm]}$$

Power
$$P = \frac{2\pi \cdot T \cdot n}{60000} = \frac{q_V \cdot \Delta p}{600 \cdot \eta_t} \quad \text{[kW]}$$

V_g = Geometr. displacement per revolution in cm³

Δp = Differential pressure in bar

n = Speed in rpm

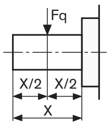
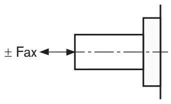
η_V = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Overall efficiency ($\eta_t = \eta_V \cdot \eta_{mh}$)

Technical data

Permissible radial and axial forces on the drive shaft

Size		NG		250	355	500
Radial force, maximum [1] (at $p_{A,B} = 1$ bar)		$F_{q\,max}$	N	1200	1500	1900
Axial force, maximum [2] (at $p_{A,B} = 1$ bar)		$+ F_{ax\,max}$	N	4000	5000	6250
		$- F_{ax\,max}$	N	1200	1500	1900

[1] When at standstill or pressureless circulation of the axial piston unit. Under pressurized condition higher forces are permissible, please consult us

[2] Maximum permissible axial force at standstill or pressureless circulation of the axial piston unit

Regarding the permissible axial force, the direction of the force must be taken into consideration:

$- F_{ax\,max}$ = increase of bearing life

$+ F_{ax\,max}$ = decrease of bearing life

Influence of the radial force F_q on the bearing life

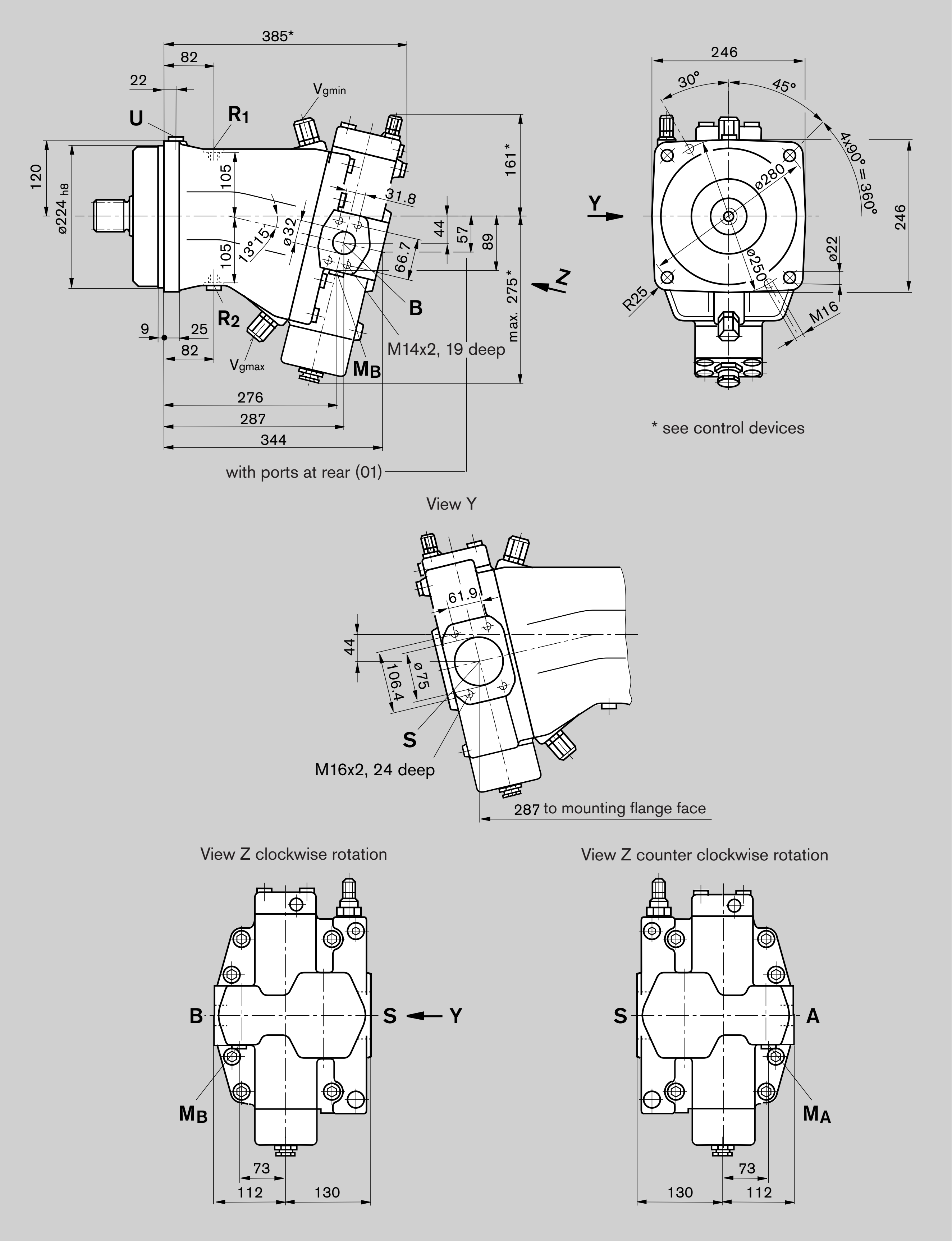
Through a favourable direction of the actuating radial force F_q,the internal load on the bearings can be compensated for and in this manner an optimum on bearing life can be obtained, please consult us.

Dimensions size 250

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Ports A (B) and S on opposite sides (02), clockwise rotation

(without control devices)

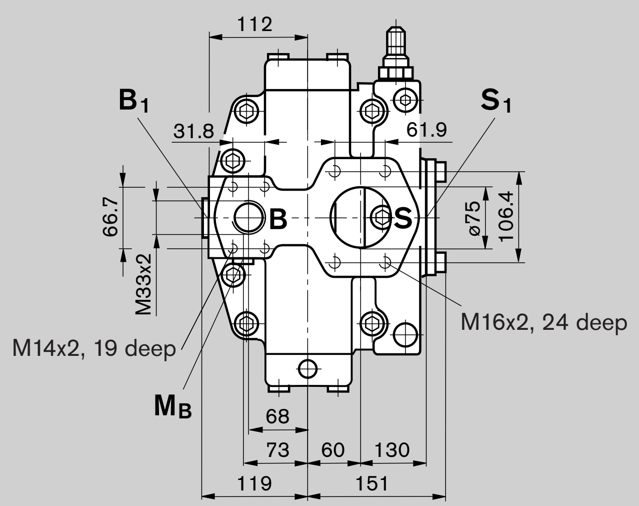


Dimensions size 250

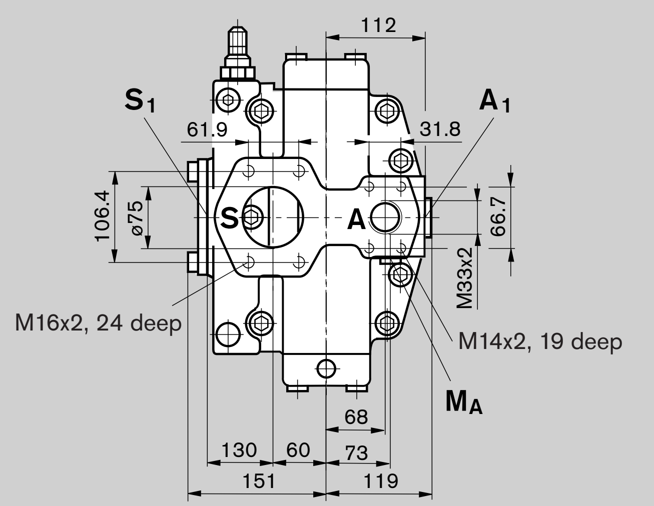
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Ports A (B) and S at rear (01)

View Z clockwise rotation

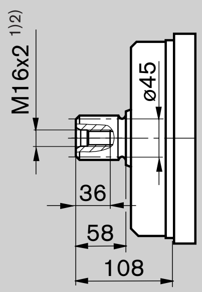


View Z counter clockwise rotation

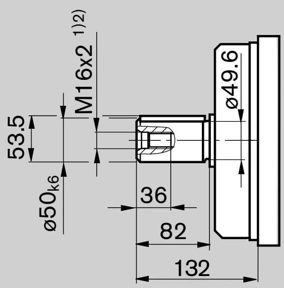


Drive shafts

Z Splined shaft DIN 5480
W50x2x24x9g



P Parallel keyed shaft
DIN 6885, AS14x9x80



[1] Centering bore to DIN 332 (Thread to DIN 13)

Ports

Designation	Port for	Standard	Size[2]	Peak pressure [bar][3]	State
A, (B)	Pressure outlet (high pressure range) Fixing thread	SAE J518[4] DIN 13	1 1/4in M14x2; 19 deep	400	O
S	Suction (standard pressure range) Fixing thread	SAE J518[4] DIN 13	3 in M16x2; 24 deep	7	O
U	Flushing	DIN 3852	M14x1.5; 12 deep	3	X
R_1	Case drain	DIN 3852	M22x1.5; 14 deep	3	O
R_2	Case drain	DIN 3852	M22x1.5; 14 deep	3	X
M_A, M_B	Measuring pressure A, B	DIN 3852	M14x1.5; 12 deep	400	X

[2] For the max. tightening torques the general information on page 52 must be observed

[3] Depending on the application, momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices and fittings.

[4] Only dimensions to SAE J518

O = Must be connected (closed on delivery)

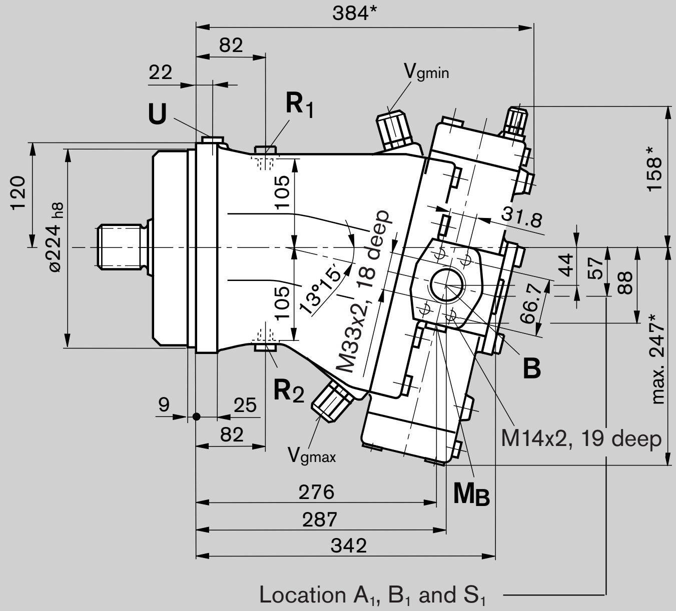
X = Plugged (in normal operation)

Dimensions size 250 High-Speed-Version

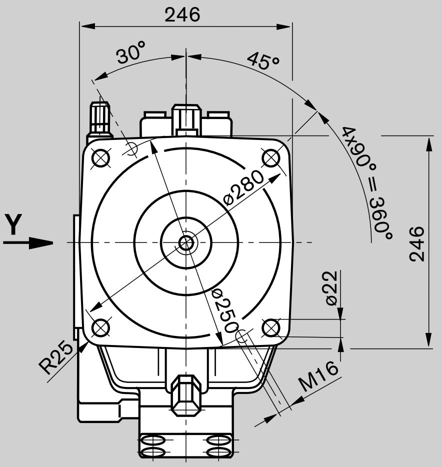
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Ports A (B) and S on opposite sides (02), clockwise rotation

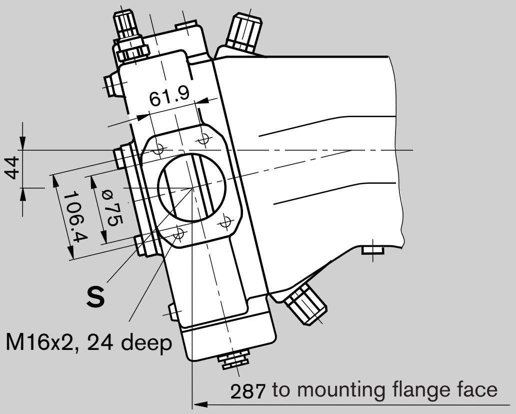
(without control devices)



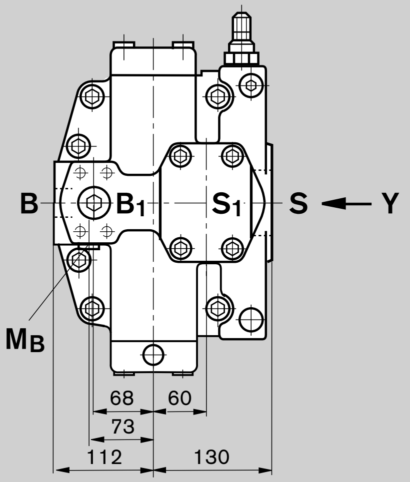
Location A_1, B_1 and S_1



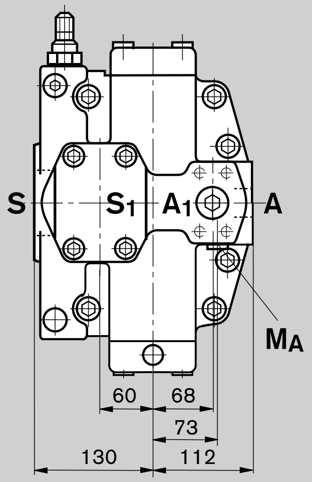
* see control devices



View Z clockwise rotation



View Z counter clockwise rotation

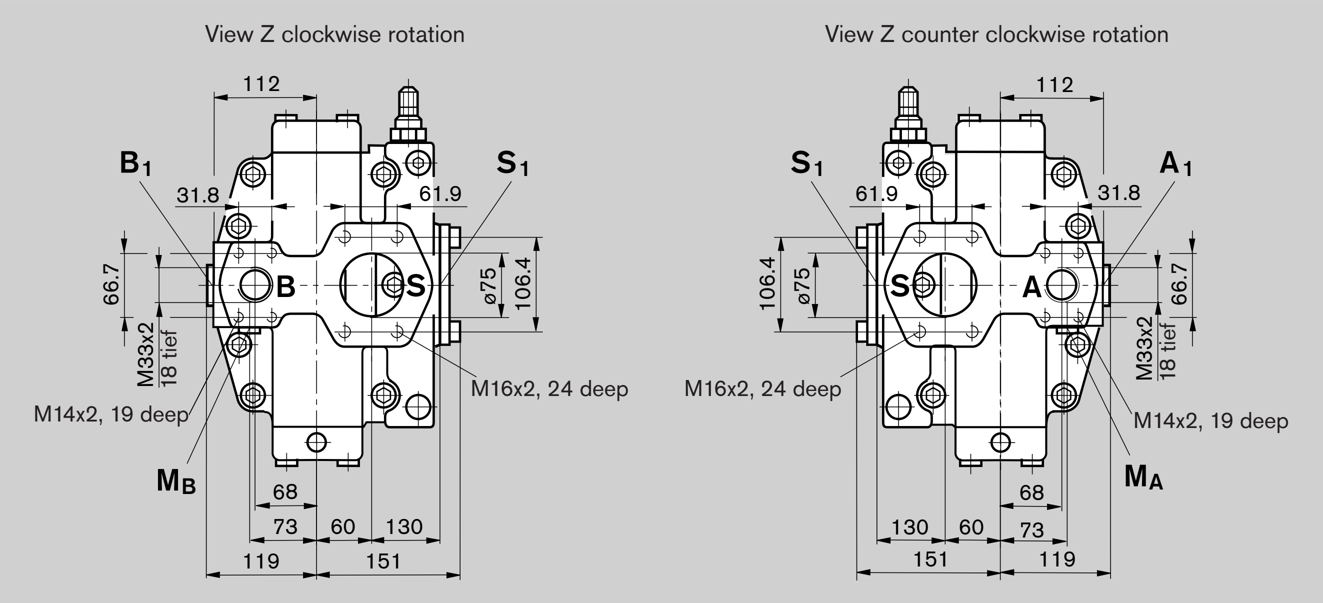


Ports A_1, B_1 and S_1 closed pressure tight with plug or flange plate, Dimensions like A, B and S

Dimensions size 250 High-Speed-Version

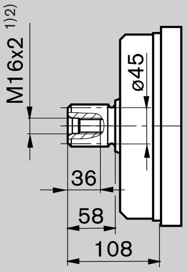
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Ports A (B) and S at rear (01)

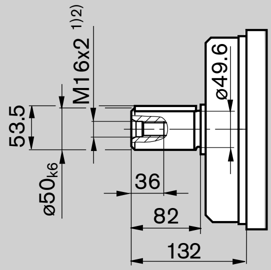


Drive shafts

Z Splined shaft DIN 5480
W50x2x24x9g



P Parellel keyed shaft
DIN 6885, AS14x9x80



[1] Centering bore to DIN 332 (Thread to DIN 13)

Ports

Designation	Port for	Standard	Size[2]	Peak pressure [bar][3]	State
A, (B)	Pressure outlet (high pressure series) Fixing thread	SAE J518[4] DIN 13	1 1/4in M14x2; 19 deep	400	O
A_1, (B_1)	2. Pressure outlet (high pressure series) Fixing thread	SAE J518[4] DIN 13	1 1/4in M14x2; 19 deep	400	X [5]
S	Suction (standard pressure series) Fixing thread	SAE J518[4] DIN 13	3 in M16x2; 24 deep	3[6]	O
S_1	2. Suction (standard pressure series) Fixing thread	SAE J518[4] DIN 13	3 in M16x2; 24 deep	3[6]	X[7]
U	Flushing	DIN 3852	M14x1.5; 12 deep	3	X
R_1, R_2	Case drain	DIN 3852	M22x1.5; 14 deep	3	X[8]
M_A, M_B	Measuring outlet pressure A, B	DIN 3852	M14x1.5; 12 deep	400	X

[2] For the max. tightening torques the general information on page 52 must be observed

[3] Depending on the application momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices and fittings.

[4] Only dimensions to SAE J518

[5] Closed pressure tight with plug M33x2

[6] Note: suction chamber and leakage chamber are connected inside pump housing, observe permissible pressure load on shaft seal, see page 7

[7] Closed pressure tight with flange plate

[8] Both ports are plugged. Leakage chamber is connected with suction chamber. Separate case drain line to tank is not necessary.

O = Must be connected (closed on delivery)

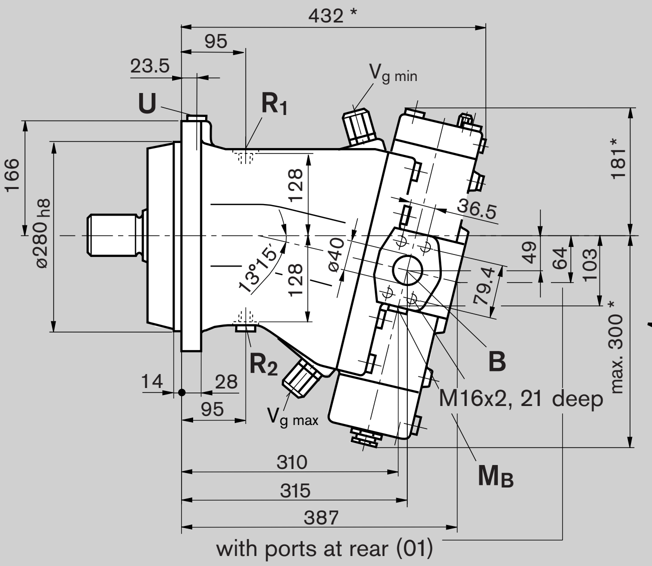
X = Plugged (in normal operation)

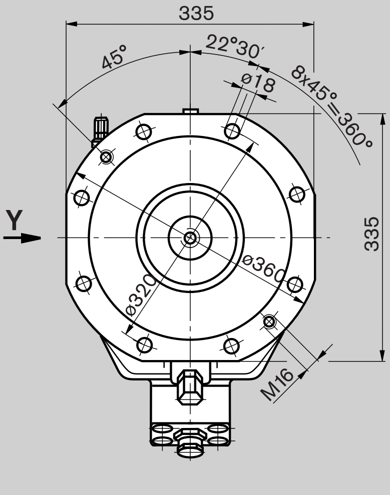
Dimensions size 355

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Ports A (B) and S on opposite sides (02), clockwise rotation

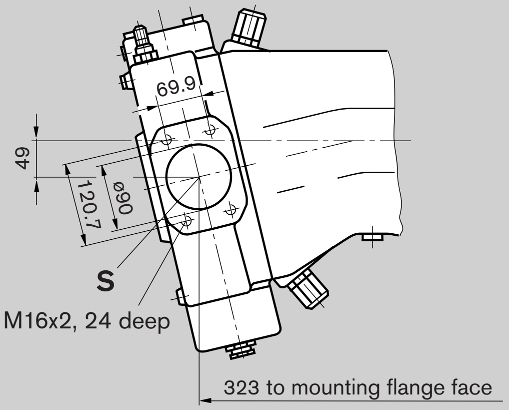
(without control devices)



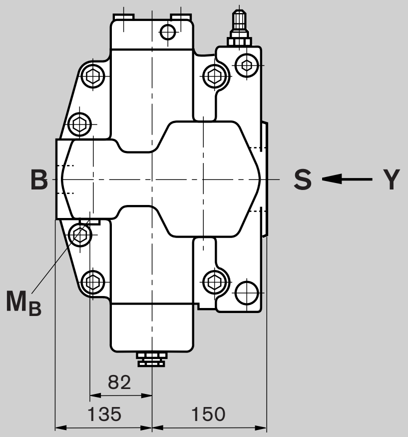


* see control devices

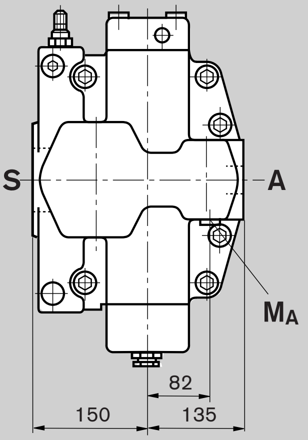
View Y



View Z clockwise rotation



View Z counter clockwise rotation

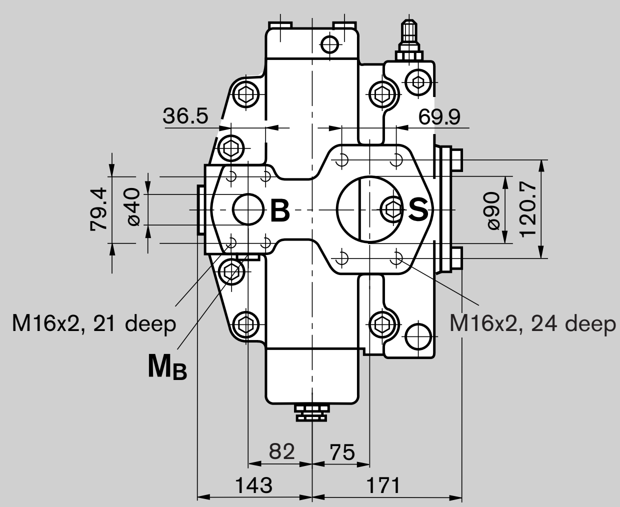


Dimensions size 355

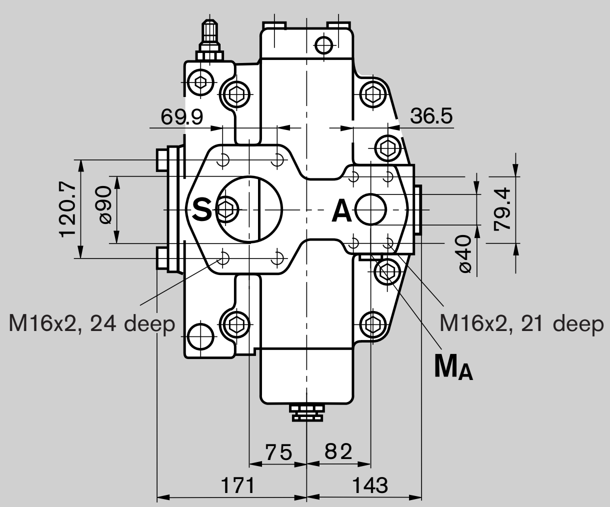
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Ports A (B) and S at rear (01)

View Z clockwise rotation

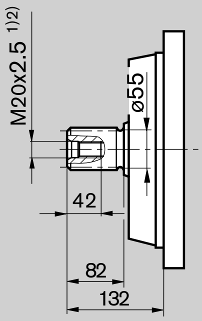


View Z counter clockwise rotation

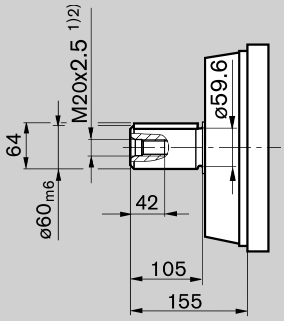


Drive shafts

Z Splined shaft DIN 5480
W60x2x28x9g



P Parallel keyed shaft
DIN 6885, AS18x11x100



[1] Centering bore to DIN 332 (Thread to DIN 13)

Ports

Designation	Port for	Standard	Size[2]	Peak pressure [bar][3]	State
A, (B)	Pressure outlet (high pressure range) Fixing thread	SAE J518[4] DIN 13	1 1/2in M16x2; 21 deep	400	O
S	Suction (standard pressure range) Fixing thread	SAE J518[4]) DIN 13	3 1/2 in M16x2; 24 deep	7	O
U	Flushing	DIN 3852	M14x1.5; 12 deep	3	X
R_1	Case drain	DIN 3852	M33x2; 18 deep	3	O
R_2	Case drain	DIN 3852	M33x2; 18 deep	3	X
M_A, M_B	Measuring outlet pressure A, B	DIN 3852	M14x1.5; 12 deep	400	X

[2] For the max. tightening torques the general information on page 52 must be observed

[3] Depending on the application momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices and fittings.

[4] Only dimensions to SAE J518

O = Must be connected (closed on delivery)

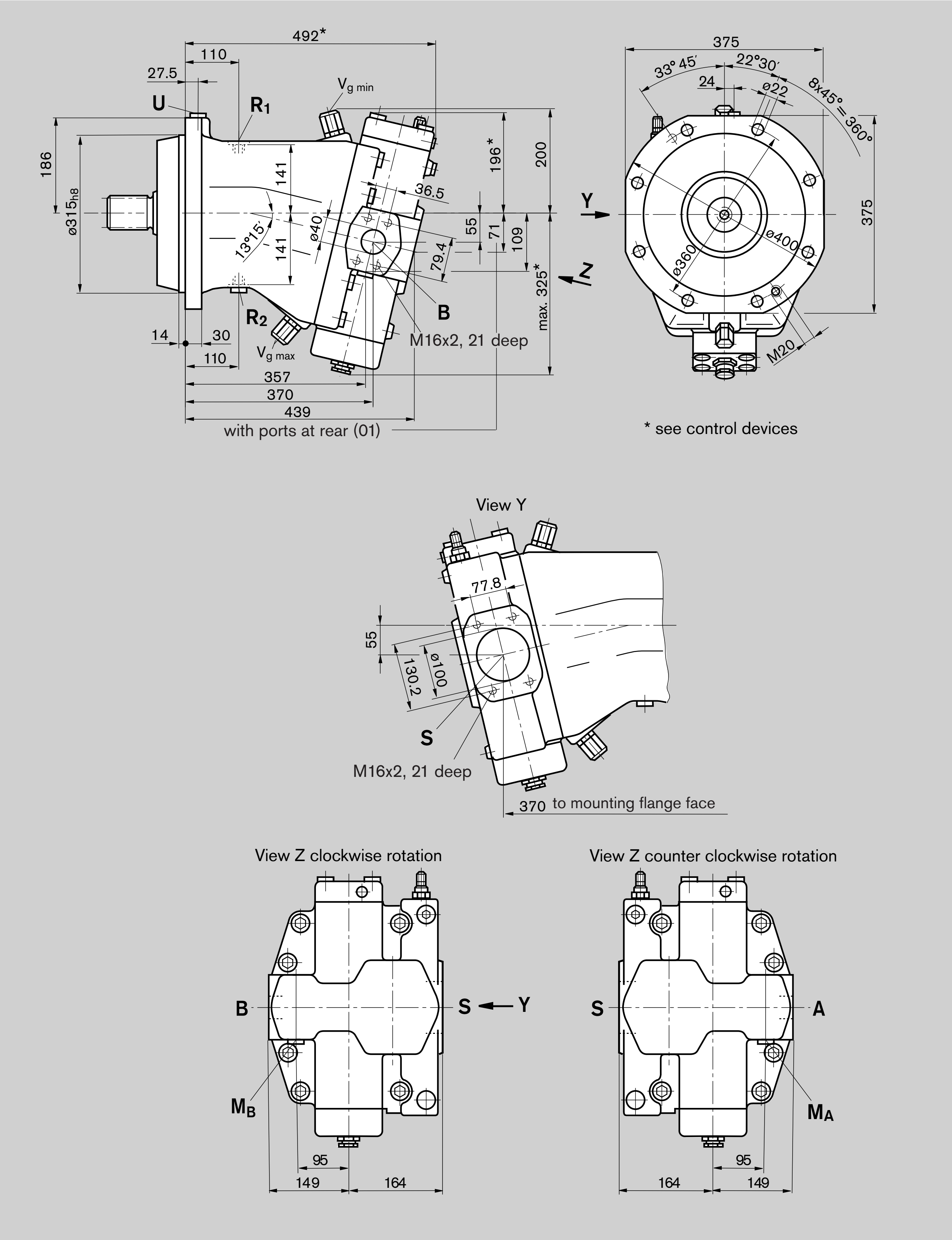
X = Plugged (in normal operation)

Dimensions size 500

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Ports A (B) and S on opposite sides (02), clockwise rotation

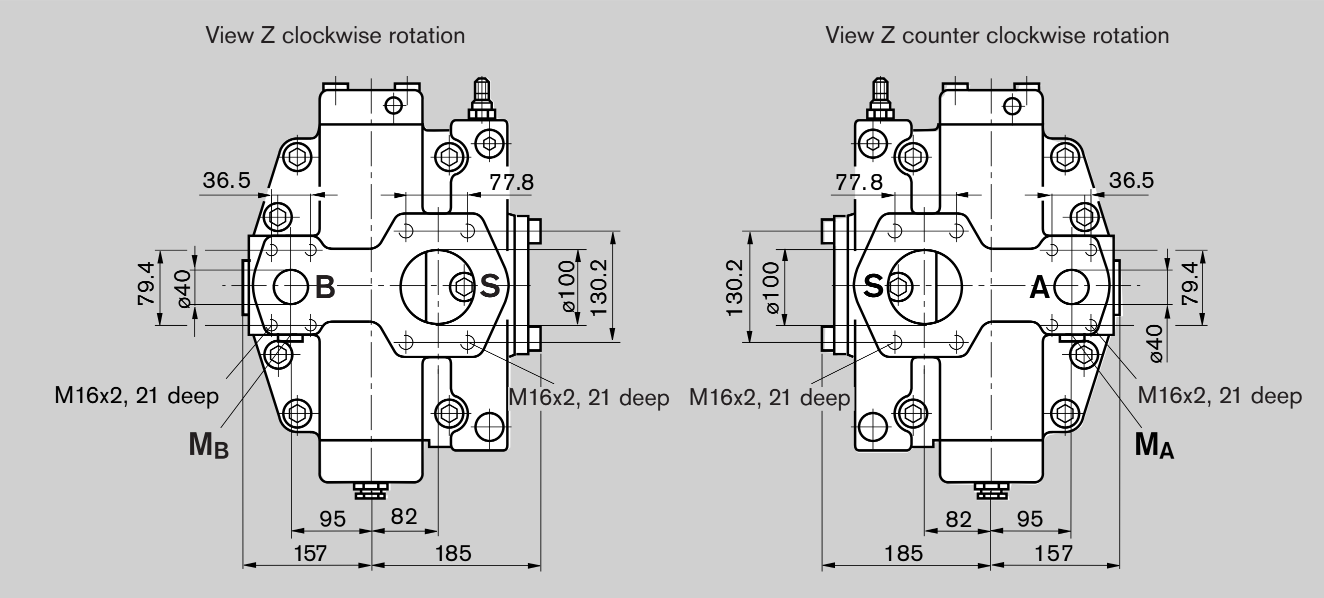
(without control devices)



Dimensions size 500

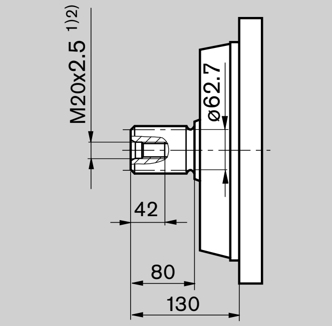
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Ports A (B) and S at rear (01)

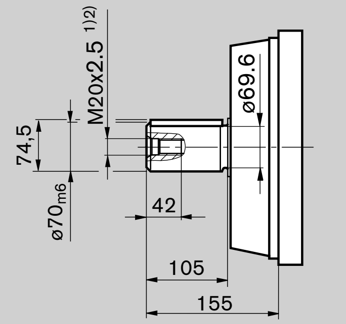


Drive shafts

Z Splined shaft DIN 5480
W70x3x22x9g



P Parallel keyed shaft
DIN 6885, AS20x12x100



[1] Centering bore to DIN 332 (Thread to DIN 13)

Ports

Designation	Port for	Standard	Size[2]	Peak pressure [bar][3]	State
A, (B)	Pressure outlet (high pressure range) Fixing thread	SAE J518[4] DIN 13	1 1/2in M16x2, 21 deep	400	O
S	Suction (standard pressure range) Fixing thread	SAE J518[4] DIN 13	4 in M16x2, 21 deep	7	O
U	Flushing	DIN 3852	M18x1.5; 12 deep	3	X
R_1	Case drain	DIN 3852	M33x2; 18 deep	3	O
R_2	Case drain	DIN 3852	M33x2; 18 deep	3	X
M_A, M_B	Measuring outlet pressure A, B	DIN 3852	M14x1.5; 12 deep	400	X

[2] For the max. tightening torques the general information on page 52 must be observed

[3] Depending on the application momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices and fittings.

[4] Only dimensions to SAE J518

O = Must be connected (closed on delivery)

X = Plugged (in normal operation)

DR Pressure control

Initial position: $V_{g\,max}$ in pressureless condition

The pressure control limits the maximum pump output pressure within the control range of the pump. This max. pressure level can be set at the integrated control valve. When reaching this preset level, the pump destrokes and supplies only the amount of flow as needed by the users (actuators).

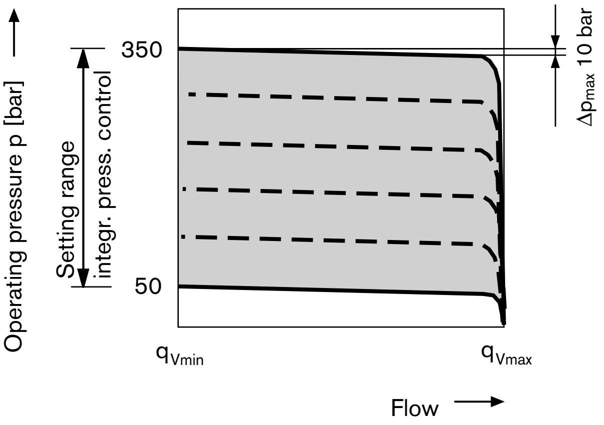
Setting range of the pressure control _______50 to 350 bar
Standard setting is 350 bar.

If another setting is required please state in clear text.

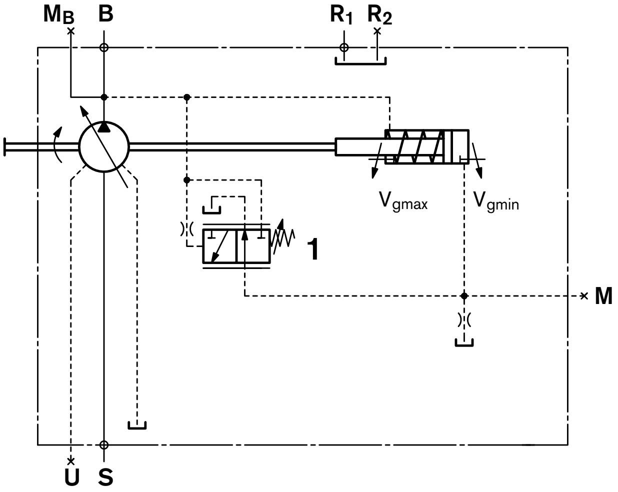
Important

- A recommended main line relief valve in the system to safeguard against excessive pressure spikes must have a cracking pressure at least 20 bar above the DR control setting.
- The control begin and the DR-control characteristic is influenced by housing pressure. An increase in housing pressure results in a higher control begin and thus a parallel shifting of the control curve (see page 7).
- Operation in standby see page 6.

Characteristic



Schematic



Sub assemblies

1 Integrated pressure control valve

Ports for

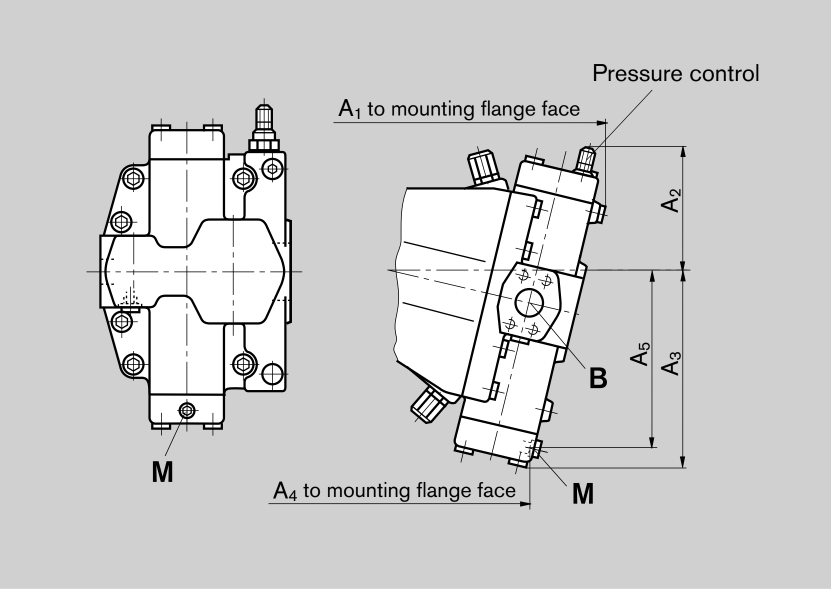
M Measuring pressure on control piston (plugged)

Dimensions DR

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

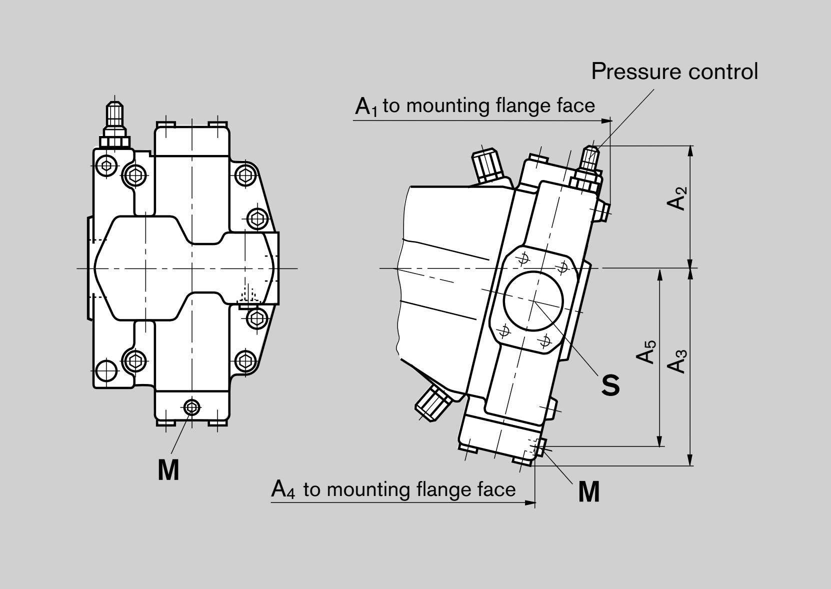
For general dimensions see pages 10 to 17

Clockwise rotation



NG	A_1	A_2	A_3	A_4	A_5
250	385	161	248	297	227
355	430	175	279	333	257
500	490	200	306	382	284

Counter clockwise rotation



Ports

Designation	Port for	Standard	Size[2]	Peak pressure [bar][3]	State
M	Measuring pressure on control piston	DIN 3852	M14x1.5; 12 deep	400	X

[2] For the max. tightening torques the general information on page 52 must be observed

[3] Depending on the application momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices and fittings.

X = Plugged (in normal operation)

DRG Pressure control remotely adjustable

Initial position: $V_{g\,max}$ in pressureless condition

In order to obtain a remote adjustment of the pressure control level a separate pilot pressure relief (item 2) valve must be connected to port X_3. This relief valve is not included in the supply of the DRG control.

Setting range of the pressure control ________50 to 350 bar

The spring force on the pressure compensator spool causes a differential pressure between pump output pressure and pressure at X_3 (as soon as the relief valve opens and the pressure control function takes place). Standard setting of this differential pressure 25 bar.

As long as the the pressure is below the set pressure of the relief valve, the pressures on both sides of the pressure compensator spool are equal and the additional spring force keeps this spool in a shifted position (Spool in equilibrium).

As soon as the set pressure of the relief valve is reached, this valve will start to open and the pilot flow will result in a differential pressure over the compensator spool, which causes this spool to shift and brings the pump to a smaller displacement. $V_{g\,min}$.

The differential pressure at the pressure compensator spool (item 1) is normally set at 25 bar, which results in a pilot flow at X_3 of approx. 2 L/min.
In case another setting (range 14 to 50 bar) is required, please state in clear text when ordering.

As a seperate pilot relief valve we recommend:

DBD 6 (hydraulic) see RE 25402

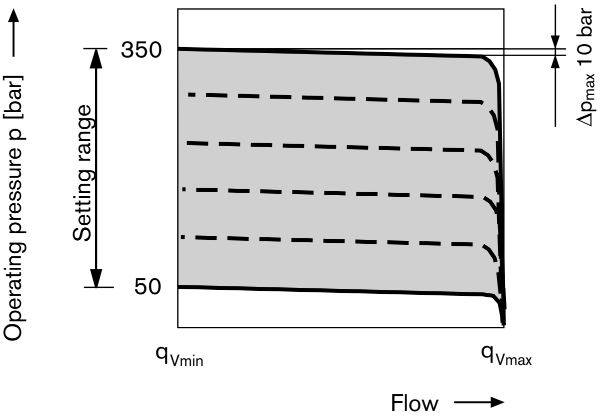
DBETR-SO 437 with dampened spool
(electric) see RE 29166

The max. line lenght should not exceed 2 m.

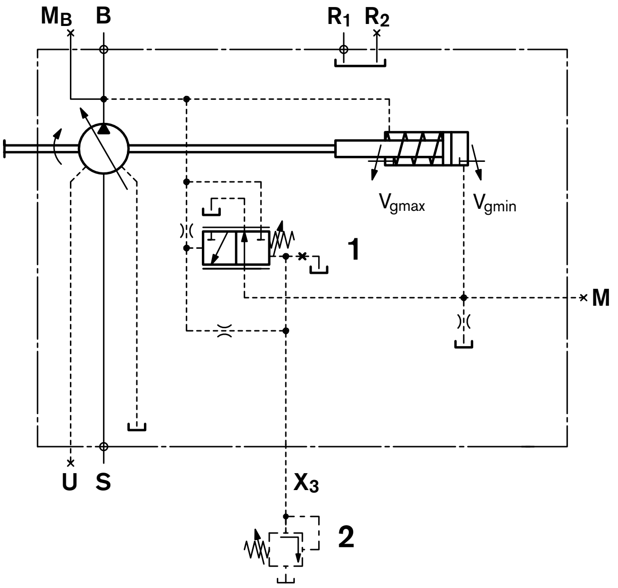
Note

- The beginning of control and the DRG control characteristic are influenced by housing pressure. An increase in housing pressure results in a higher beginning of control (see page 7) and thus a parallel shift of the control characteristic.
- Standby operation see page 6.

Characteristic



Schematic



Sub assemblies

1	Integrated pressure compensator
2	Separate pilot pressure relief valve (not in scope of supply)

Ports for

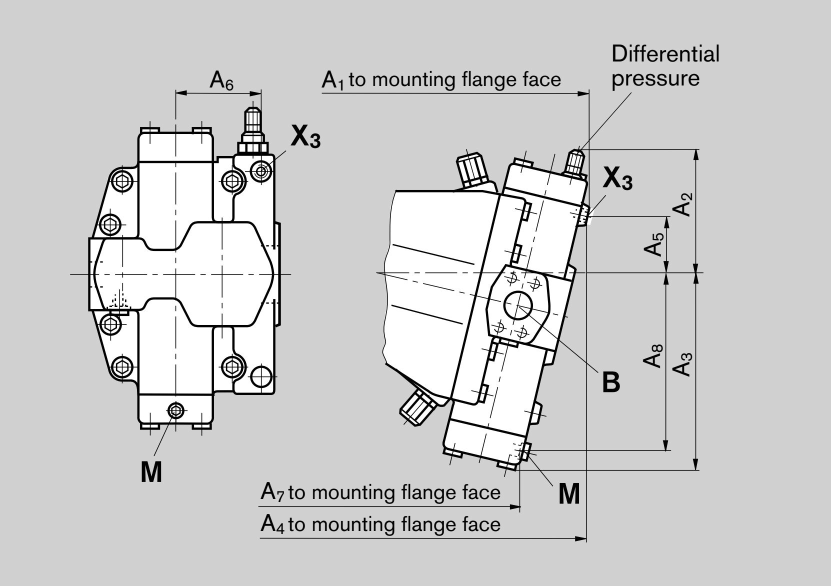
X_3	Separate pressure relief valve
M	Measuring pressure on control piston (plugged)

Dimensions DRG

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

General dimensions see page 10 to 17

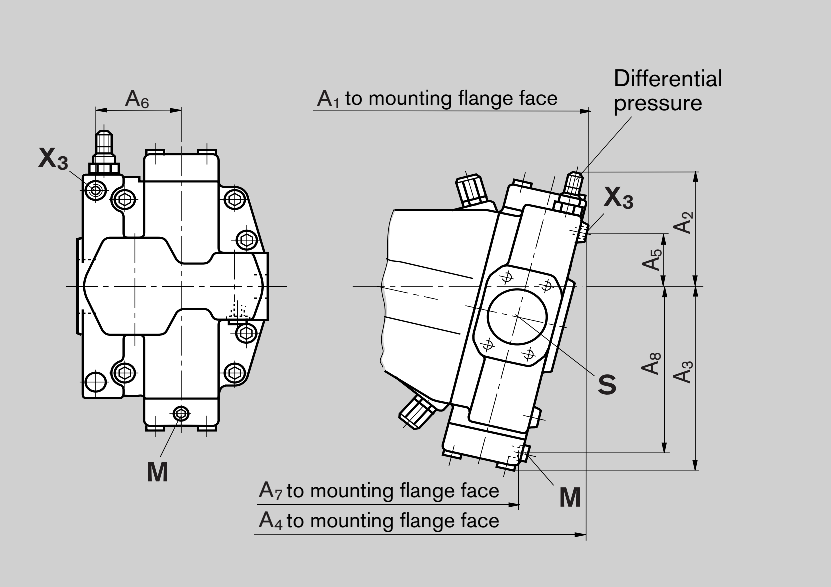
Clockwise rotation



NG	A_1	A_2	A_3	A_4	A_5
250	385	161	248	380	74
355	430	175	279	425	82
500	490	200	306	483	96

NG	A_6	A_7	A_8
250	112	297	227
355	131	333	257
500	142	382	284

Counter clockwise rotation



Ports

Designation	Ports for	Standard	Size[2]	Peak pressure [bar][3]	State
X_3	Separate pressure relief valve	DIN 3852	M14x1.5; 12 deep	400	O
M	Measuring pressure on control piston	DIN 3852	M14x1.5; 12 deep	400	X

[2] For the max. tightening torques the general information on 52 must be observed

[3] Depending on the application momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices or fittings.

O = Must be connected (closed on delivery)

X = Plugged (in normal operation)

LRD Power control with integrated pressure control

Initial position: $V_{g\,max}$ in pressureless condition

Power control

The power control adjusts the pump displacement in relation to the operating pressure in such a manner, that a given drive power at constant drive speed is not exceeded .

$$p_B \cdot V_g = \text{constant (drive power)}$$

p_B = operating pressure; V_g = displacement

This precise control along the hyperbolic control characteristic permits an optimum utilisation of drive power.

The operating pressure acts on a lever mechanism via the measuring spool in the displacement control piston. It is offset by the externally set spring force which acts on the pilot valve and determines the power setting.

When the operating pressure exceeds the set spring force, the power control pilot valve is actuated via the lever mechanism and the pump swivel towards a smaller displacement $V_{g\,min}$. This in turn reduces the effective moment on the lever mechanism and the operating pressure can increase in the same ratio by which the pump output flow is reduced, without exceeding the installed drive power ($p_B \cdot V_g$ = constant).

Setting range for the control begin of the power control from________________________________50 to 300 bar.

Note

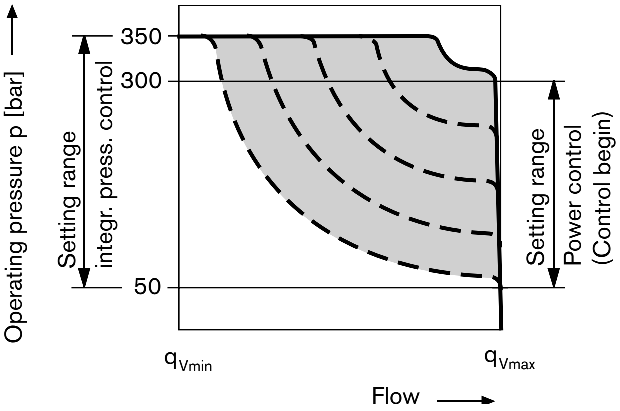
- The control begin and the LR-power control characteristic are influenced by pump inlet pressure. An increase in pump inlet pressure results in a higher control begin (see page 5) and thus a parallel shift of the control characteristic.
- The hydraulic output power (LR-characteristic) is influenced by pump efficiency

When ordering please state in clear text:

- Drive power P in kW
- Drive speed n in rpm
- Maximum flow $q_{v\,max}$ in L/min

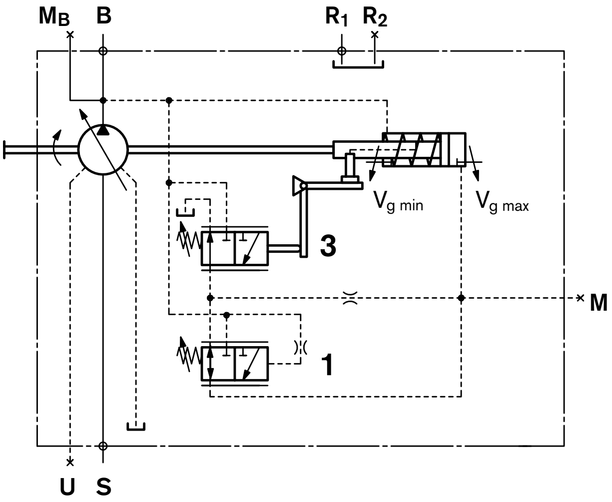
The integrated pressure control is standard and overrides the power control, description see page 24

Characteristic



Schematic

Power control with integrated pressure control



Sub assemblies

1 Pressure control

3 Power control

Port for

M Measuring pressure on control piston (plugged)

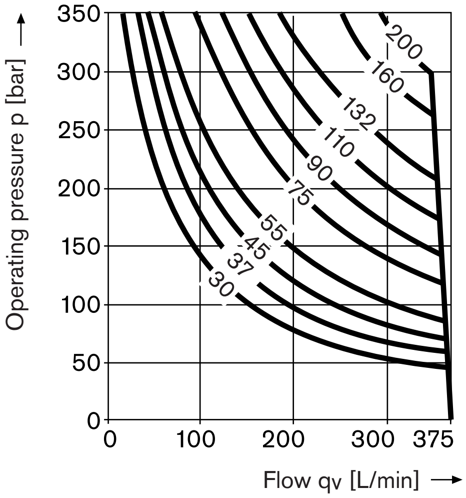
Dimensions see page 25

LRD Power control with integrated pressure control

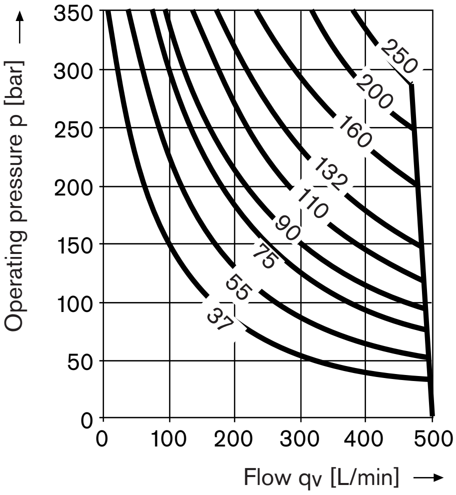
Initial position $V_{g\,max}$

Power control characteristics in kW

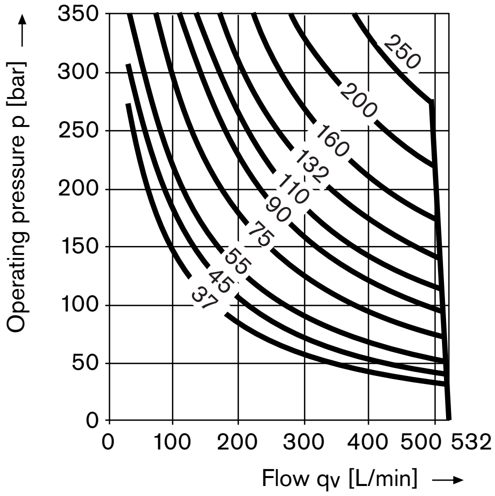
NG 250
at 1500 rpm



NG 500
at 1000 rpm



NG 355
at 1500 rpm



LRD with integrated pressure control

Initial position: $V_{g\ max}$ in pressureless condition

The pressure control is overriding the power control.

It protects the pump against excessive pressure and consequential damage.

The pressure control valve is integrated into the port plate and can be set externally.

Upon reaching the set pressure level the pump will destroke towards lower displacement.

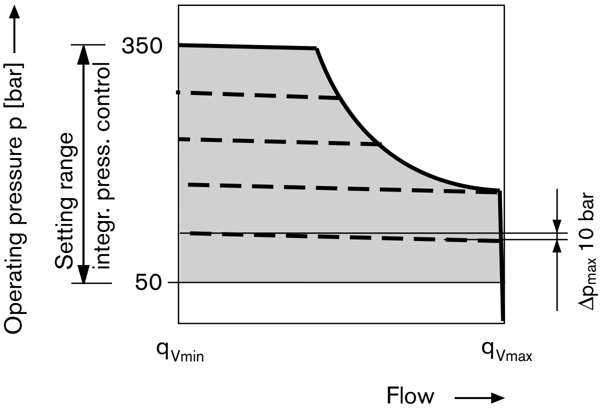
Setting range of the pressure control_______ 50 to 350 bar
Standard setting: 350 bar.

If another setting is required please state in clear text.

Note

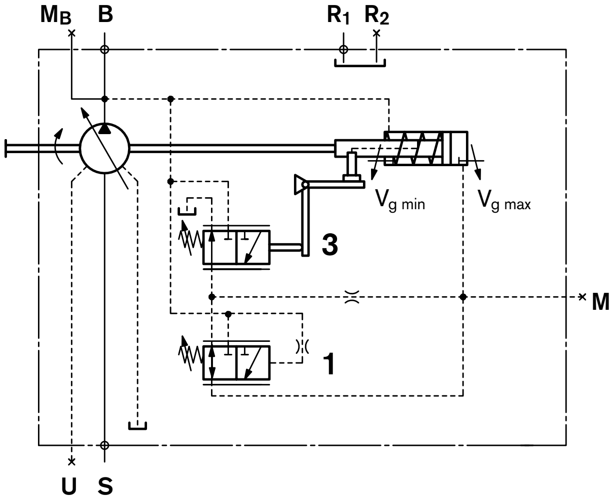
- A recommended main line relief valve in the system to safeguard against excessive pressure spikes must have a cracking pressure at least 20 bar above the pressure control setting.
- The control begin and the pressure control characteristic are influenced by housing pressure. An increase in housing pressure results in a higher control begin (see page 7) and thus a parallel shift of the characteristic.
- Standby operation see page 6.

Characteristic



Schematic

Power control with integrated pressure control



Sub assemblies

1	Pressure control
3	Power control

Port for

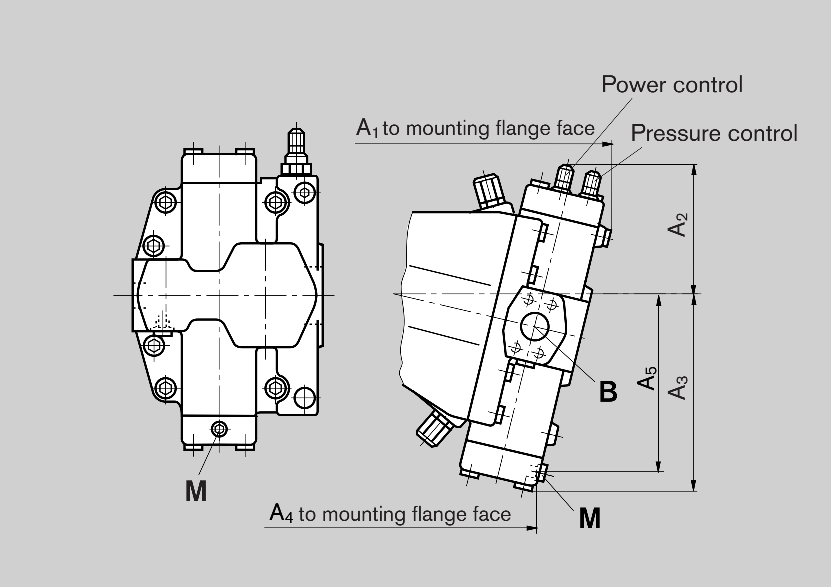
M	Measuring pressure on control piston (plugged)

Dimensions LRD

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

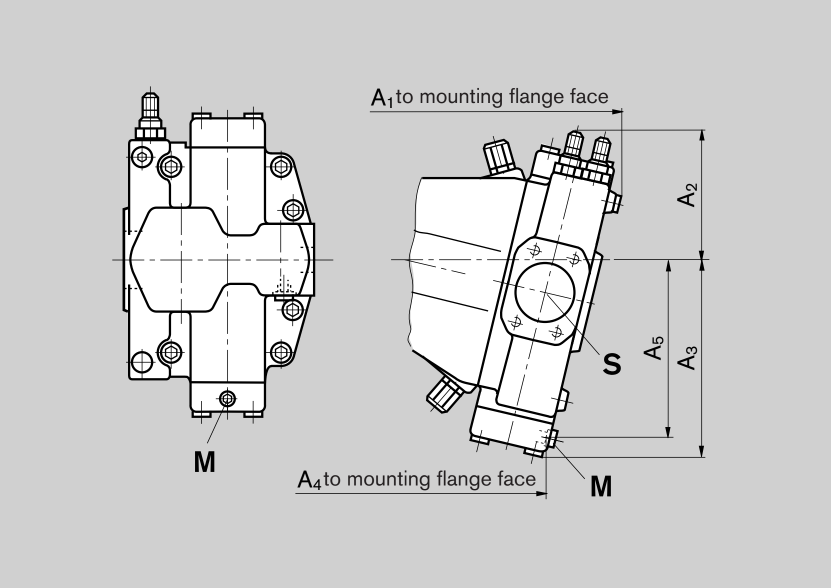
General dimensions see page 10 to 17

Clockwise rotation



NG	A_1	A_2	A_3	A_4	A_5
250	385	170	248	297	227
355	430	175	279	333	257
500	490	200	306	382	284

Counter clockwise rotation



Ports

Designation	Port for	Standard	Size[2]	Peak pressure [bar][3]	State
M	Measuring pressure on control piston	DIN 3852	M14x1.5; 12 deep	400	X

[2] For the max. tightening torques the general information on page 52 must be ovserved

[3] Depending on the application momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices and fittings.

X = Plugged (in normal operation)

LRG with remotely adjustable pressure control

Initial position: $V_{g\,max}$ in pressureless condition

The remotely adjustable pressure control overrides the power control.

In order to obtain a remote adjustment of the pressure control level a separate pilot pressure relief (item 2) valve must be connected to port X_3. This relief valve is not included in the supply of the DRG control.

Setting range of the pressure control _________50 to 350 bar

The spring force on the pressure compensator spool causes a differential pressure between pump output pressure and pressure at X_3 (as soon as the relief valve opens and the pressure control function takes place). Standard setting of this differential pressure 25 bar.

As long as the the pressure is below the set pressure of the relief valve, the pressures on both sides of the pressure compensator spool are equal and the additional spring force keeps this spool in a shifted position (Spool in equilibrium).

As soon as the set pressure of the relief valve is reached, this valve will start to open and the pilot flow will result in a differential pressure over the compensator spool, which causes this spool to shift and brings the pump to a smaller displacement $V_{g\,min}$.

Upon reaching the set pressure control level (set pressure at pilot relief valve plus differential pressure at pressure control compensator) the pump will go over to the pressure control mode.

The differential pressure at the pressure compensator spool (item 1) is normally set at 25 bar, which results in a pilot flow at X_3 of approx. 2 L/min.
In case another setting (range 14 to 50 bar) is required, please state in clear text when ordering.

As a seperate pilot relief valve we recommend:

DBD 6 (hydraulic) see RE 25402

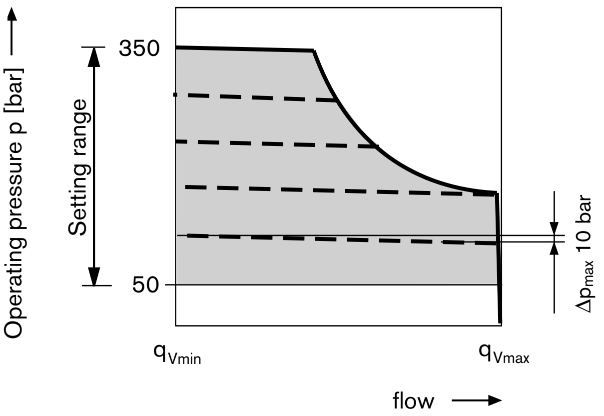
DBETR-SO 437 with dampened spool
(electric) see RE 29166

The max. line lenght should not exceed 2 m.

Note

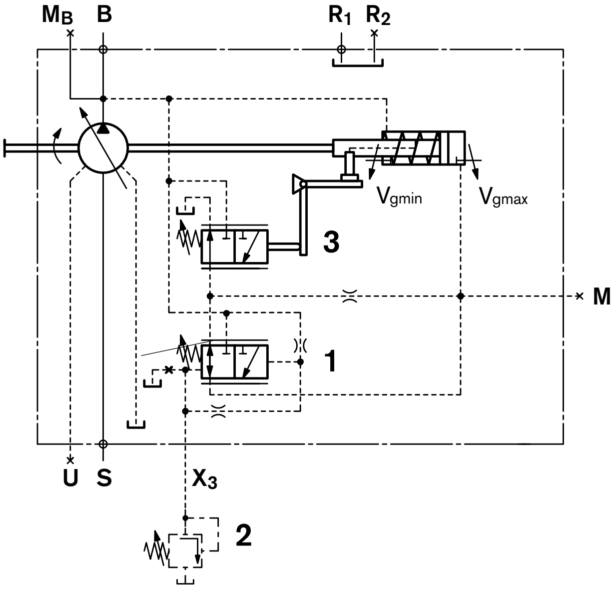
- The beginning of control and the DRG control characteristic are influenced by housing pressure. An increase in housing pressure results in a higher beginning of control (see page 7) and thus a parallel shift of the control characteristic.
- Standby operation see page 6.

Characteristic



Schematic

Power control with remotely adjustable pressure control



Sub assemblies

1	Integrated pressure control compensator
2	Separate pressure relief valve (not in scope of supply)
3	Power control

Ports for

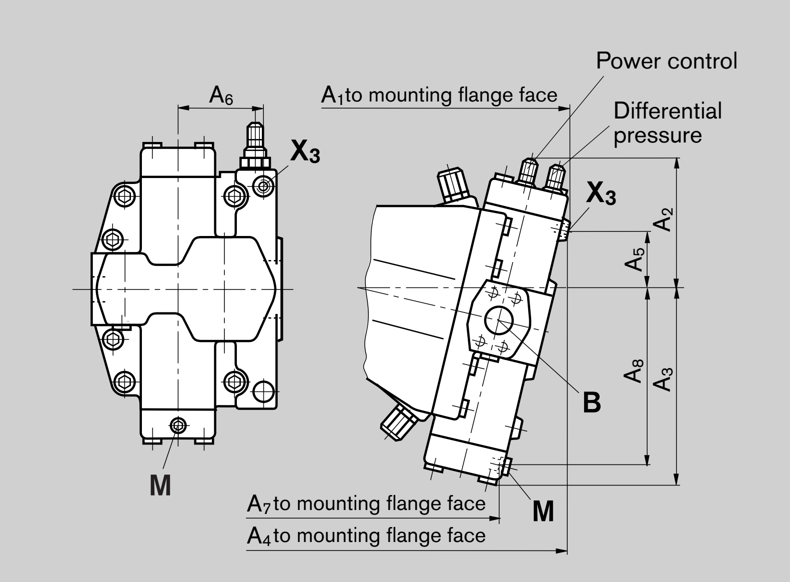
X_3	Separate pressure relief valve
M	Measuring pressure on control piston (plugged)

Dimensions LRG

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

General dimensions see page 10 to 17

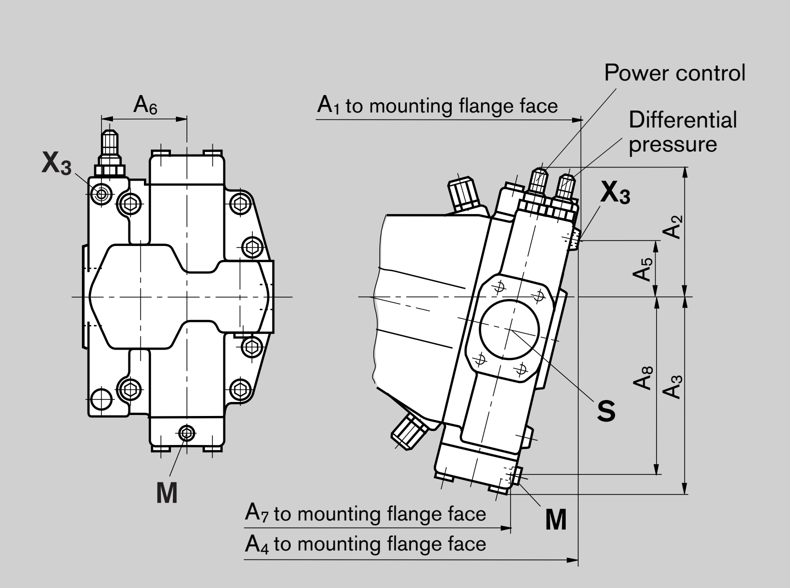
Clockwise rotation



NG	A_1	A_2	A_3	A_4	A_5
250	385	170	248	380	74
355	430	175	279	425	82
500	490	200	306	483	96

NG	A_6	A_7	A_8
250	112	297	227
355	131	333	257
500	142	382	284

Counter clockwise rotation



Ports

Designation	Ports for	Standard	Size[2)]	Peak pressure [bar][3)]	State
X_3	Separate pressure relief valve	DIN 3852	M14x1.5; 12 deep	400	O
M	Measuring pressure on control piston	DIN 3852	M14x1.5; 12 deep	400	X

[2)] For the max. tightening torques the general information on 52 must be observed

[3)] Depending on the application momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices or fittings.

O = Must be connected (closed on delivery)

X = Plugged (in normal operation)

LRDH with hydraulic stroke limitation

Initial position: $V_{g\,max}$ in pressureless condition

The hydraulic stroke limitation is used for infinite adjustment of the displacement from $V_{g\,max}$ bis $V_{g\,min}$.

It is overridden by the power control.

The displacement is set by the pilot pressure applied at port X_1

Maximum permissible pilot pressure ____________ 100 bar

The hydraulic stroke limitation takes the required control pressure from the pump output pressure. It must be noted, that the pump operating pressure must be at least 40 bar.

If the pressure is lower, the pump must be supplied with an external control pressure of at least 40 bar into port X_2.

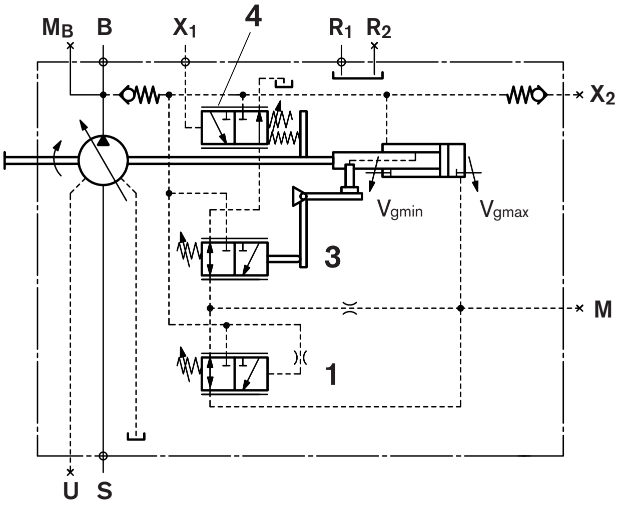
The control begin is adjustable.
Control begin (bar), please state in clear test when ordering.

Note

- The control begin and the LRDH-control characteristic are influenced by pump inlet pressure. An increase in pump inlet pressure results in a higher control begin (see page 5) and thus a parallel shift of the control characteristic.

Schematic

Power control with integrated pressure control and hydraulic stroke limitation H



Sub assemblies

1	Pressure control
3	Power control
4	Hydraulic stroke limitation H

Ports for

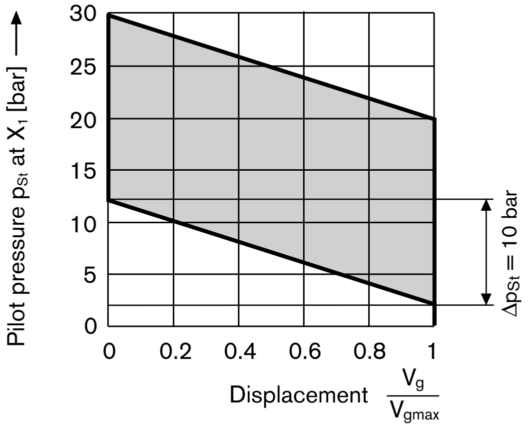
X_1	Pilot pressure
X_2	External control pressure (plugged)
M	Measuring pressure on control piston(plugged)

Dimensions see page 30

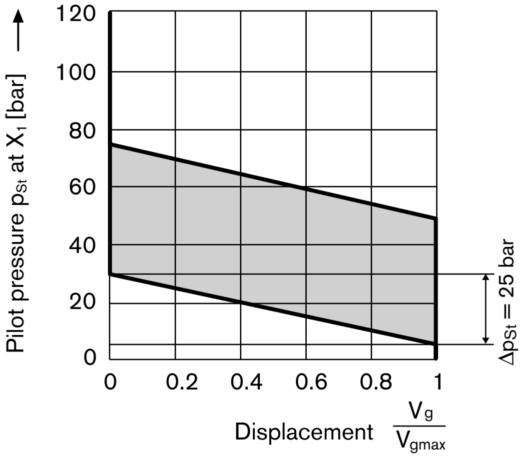
LRDH with hydraulic stroke limitation

Characteristics

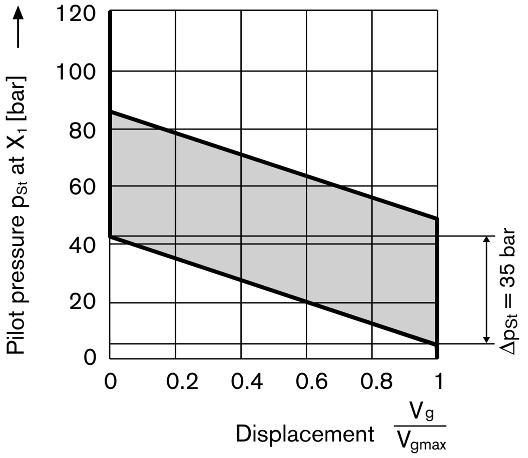
H1 Δp_{St} for hydraulic stroke limitation ____ 10 bar
Control begin adjustable ____ 2 to 20 bar
Standard setting of control begin ____ 5 bar



H2 Δp_{St} for hydraulic stroke limitation ____ 25 bar
Control begin adjustable ____ 5 to 50 bar
Standard setting of control begin ____ 10 bar



H3 Δp_{St} for hydraulic stroke limitation ____ 35 bar
Control begin adjustable ____ 7 to 50 bar
Standard setting of control begin ____ 10 bar

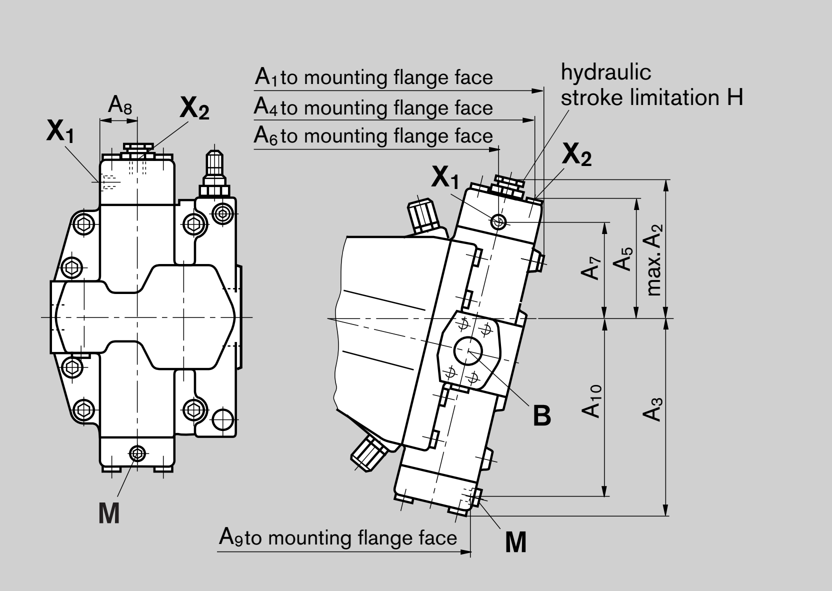


Dimensions LRDH

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

General dimensions see page 10 to 17

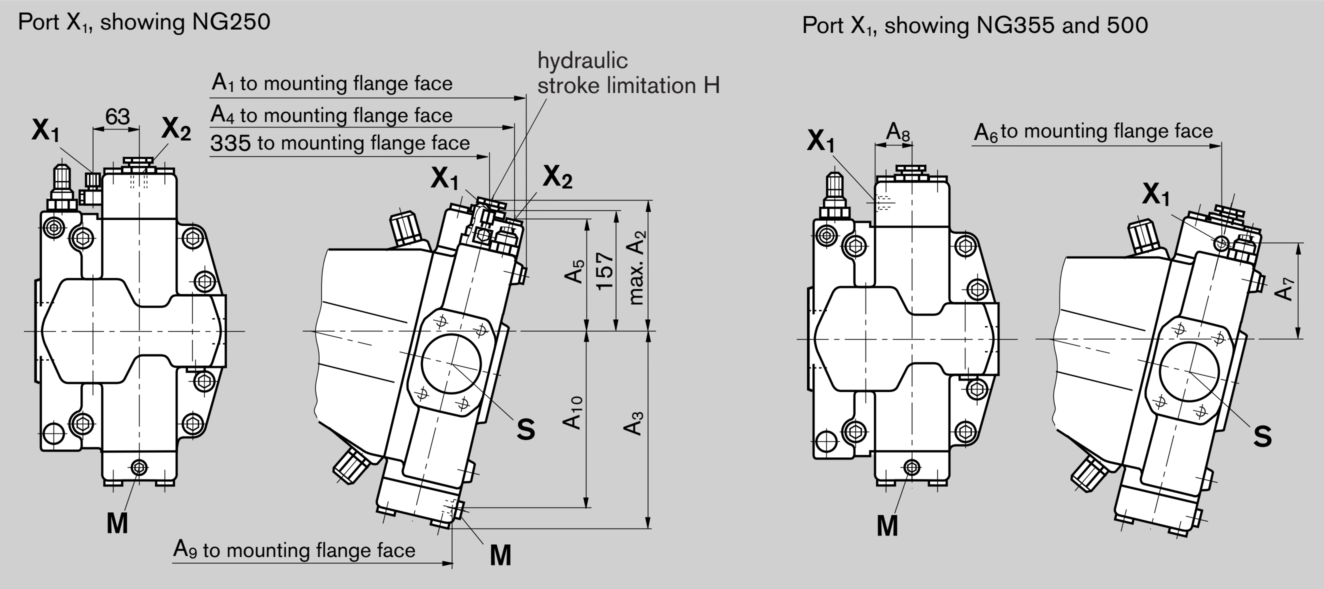
Clockwise rotation



NG	A_1	A_2	A_3	A_4	A_5
250	385	188	248	370	144
355	432	203	279	416	157
500	490	215	306	470	169

NG	A_6	A_7	A_8	A_9	A_{10}
250	327	123	49	297	227
355	366	137	54	333	257
500	417	148	61.5	382	284

Counter clockwise rotation


Port X_1, showing NG250

Port X_1, showing NG355 and 500

Ports

Designation	Ports for	Standard	Size[2]	Peak pressure [bar][3]	State
X_1	Pilot pressure	DIN 3852	M14x1.5; 12 deep	100	O
X_2	External control pressure	DIN 3852 DIN 3852	M14x1.5; 12 deep (NG250 a. 355) M18x1.5; 12 deep (NG500)	400 400	X X
M	Measuring pressure on control piston	DIN 3852	M14x1.5; 12 deep	400	X

[2] For the max. tightening torques the general information on 52 must be observed

[3] Depending on the application momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices or fittings.

O = Must be connected (closed on delivery)

X = Plugged (in normal operation)

LRDN with hydraulic stroke limitation

Initial position: $V_{g\,min}$ in pressureless condition

The hydraulic stroke limitation is used for infinite adjustment of the displacement from $V_{g\,min}$ to $V_{g\,max}$.

It is overridden by the power control.

Displacement is set by the pilot pressure applied at port X_1.

Maximum permissible pilot pressure p______________100 bar

A minimum pressure of 40 bar is required for hydraulic stroke limitation. The necessary control fluid is taken from the pump outlet pressure side.

An external control pressure is not required when the operating pressure $>$ 40 bar and $V_{g\,min} > 0$. In this case the port X_2 must be plugged prior to commissioning. Otherwise an external control pressure source of at least 40 bar must be connected to port X_2.

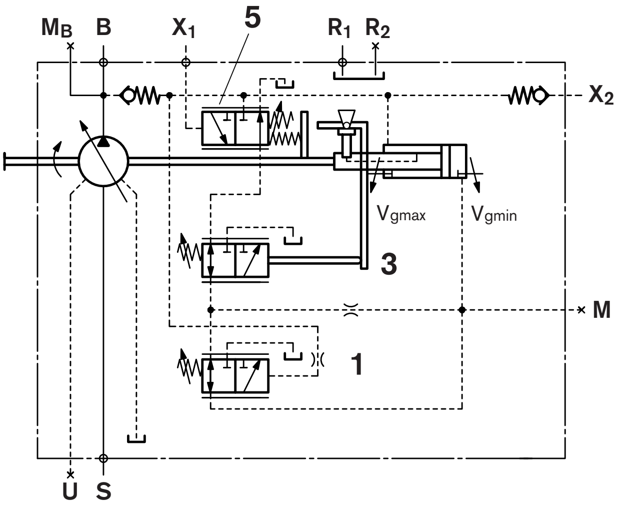
The control begin is adjustable.
Control begin (bar), please state in clear text when ordering.

Note

- The control begin and the LRDN-control characteristic are influenced by pump inlet pressure. An increase in pump inlet pressure results in a higher control begin (see page 5) and thus a parallel shift of the control characteristic.

Schematic

Power control with integrated pressure control and hydraulic stroke limitation N



Sub assemblies

1	Pressure control
3	Power control
5	Hydraulic stroke limitation N

Ports for

X_1	Pilot pressure
X_2	External control pressure
M	Measuring of pressure on control piston (plugged)

Dimensions see page 33

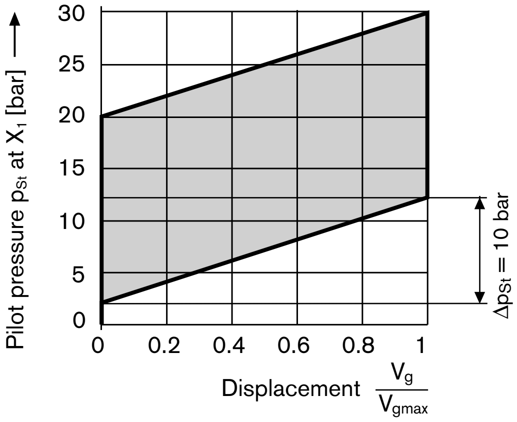
LRDN with hydraulic stroke limitation

Characteristics

N1 Δp_{St} for hydraulic stroke limitation ________ 10 bar

Control begin adjustable ________ 2 to 20 bar

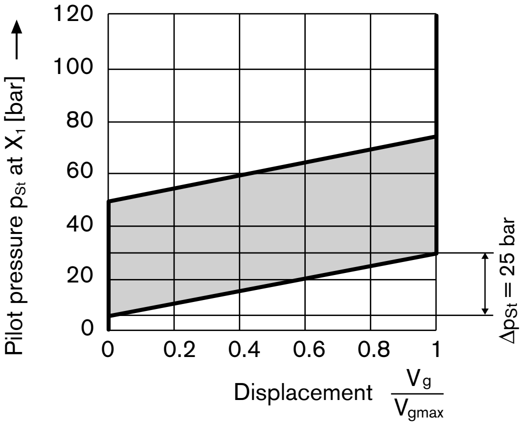
Standard setting of control begin ________ 5 bar



N2 Δp_{St} for hydraulic stroke limitation ________ 25 bar

Control begin adjustable ________ 5 to 50 bar

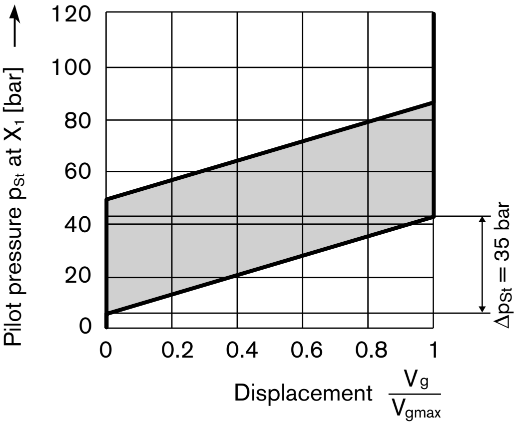
Standard setting of control begin ________ 10 bar



N3 Δp_{St} for hydraulic stroke limitation ________ 35 bar

Control begin adjustable ________ 7 to 50 bar

Standard setting of control begin ________ 10 bar

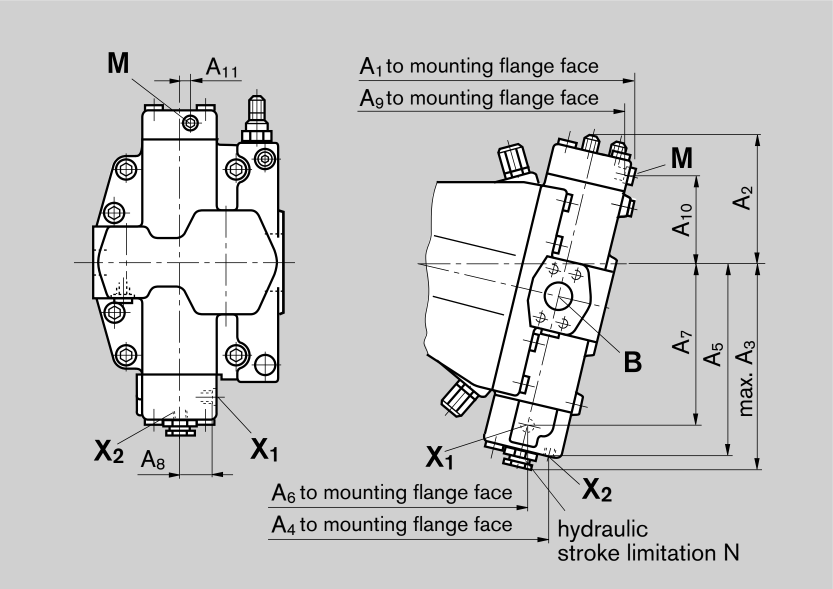


Dimensions LRDN

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

General dimensions see page 10 to 17

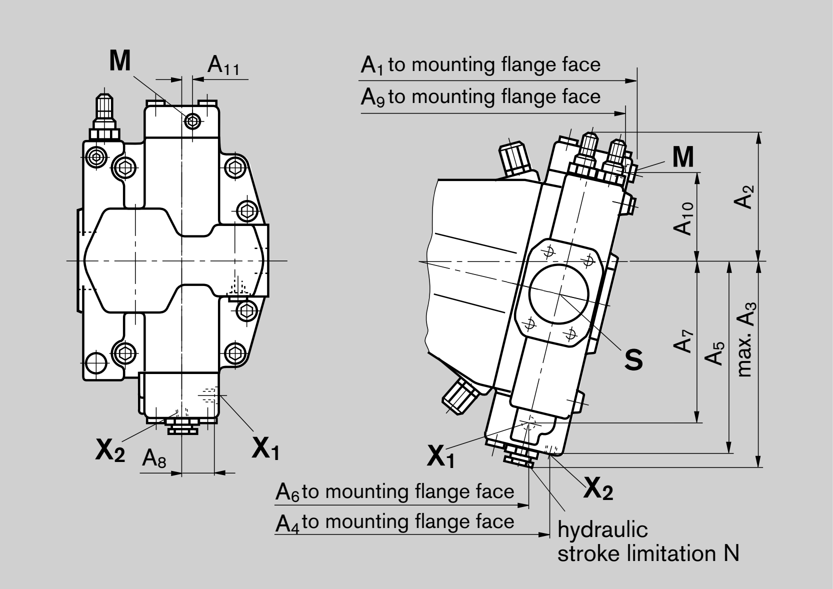
Clockwise rotation



NG	A_1	A_2	A_3	A_4	A_5	A_6
250	385	170	275	276	248	248
355	430	175	300	315	275	278
500	492	200	325	359	300	322

NG	A_7	A_8	A_9	A_{10}	A_{11}
250	210	49	377	116	14
355	234	54	425	132	20
500	258	61.5	483	144	20

Counter clockwise rotation



Ports

Designation	Ports for	Standard	Size[2]	Peak pressure [bar][3]	State
X_1	Pilot pressure	DIN 3852	M14x1.5; 12 deep	100	O
X_2	External control pressure	DIN 3852 DIN 3852	M14x1.5; 12 deep (NG250 a. 355) M18x1.5; 12 deep (NG500)	400 400	O [4] O [4]
M	Measuring pressure on control piston	DIN 3852	M14x1.5; 12 deep	400	X

[2] For the max. tightening torques the general information on page 52 must be observed

[3] Depending on the application momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices and fittings.

[4] If no external control pressure is connected, port X_2 must be plugged

O = Must be connected (closed on delivery)

X = Plugged (in normal operation)

HD.D Hydraulic control, pilot pressure dependent

Initial position: $V_{g\,min}$ in pressureless condition

The hydraulic pilot pressure dependent control enables an infinite adjustment of the pump displacement in accordance with the applied pilot pressure signal. The displacement setting is proportional to the pilot pressure in port X_1.

A minimum control pressure of 40 bar is required. The necessary control fluid is taken from the pump outlet pressure side.

An external control pressure is not required when the operating pressure > 40 bar and $V_{g\,min} > 0$. In this case the port X_2 must be plugged prior to commissioning. Otherwise an external control pressure of at least 40 bar must be connected to port X_2.

Maximum permissible pilot pressure p_{St} ____________ 100 bar

The control begin is adjustable.
Control begin (bar), please state in clear text when ordering.

Note

- The beginning of control and the HD control characteristic are influenced by housing pressure. An increase in housing pressure results in a higher beginning of control (see page 7) and thus a parallel shift of the control characteristic.

Integrated pressure control is standard. Description see page 37

Note

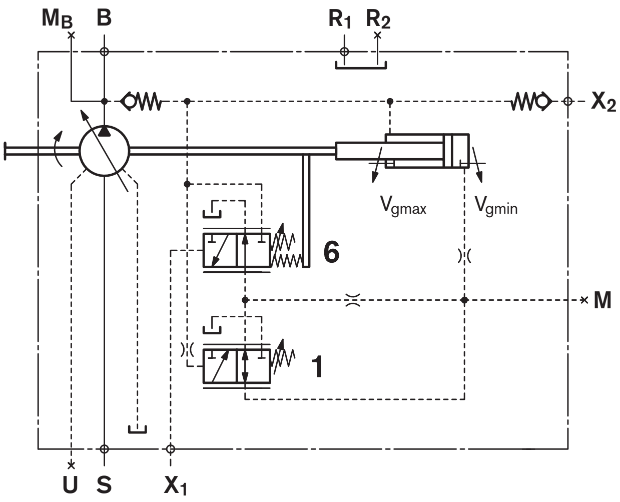
The spring return feature in the control unit is not a safety device

The spool valve inside the control unit can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).

Schematic

Hydraulic control, pilot pressure dependent with integrated pressure control



Sub assemblies

1	Pressure control
6	HD-pilot valve

Ports for

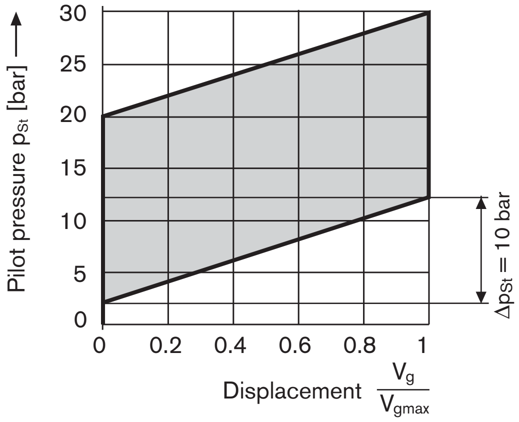
X_1	Pilot pressure
X_2	External control pressure
M	Measuring pressure on control piston

Dimensions see page 36

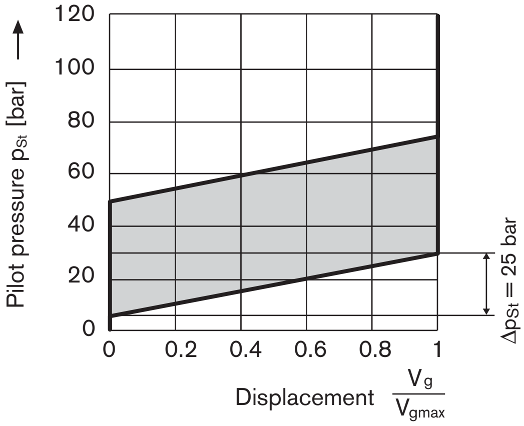
HD.D Hydraulic control, pilot pressure dependent

Characteristics

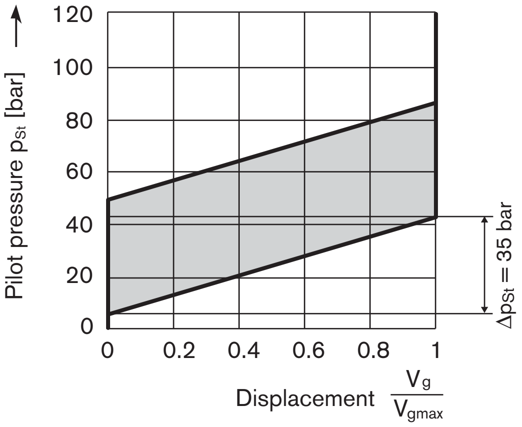
HD1D Δp_{St} ________ 10 bar
Control begin adjustable ________ 2 to 20 bar
Standard setting of control begin ________ 5 bar



HD2D Δp_{St} ________ 25 bar
Control begin adjustable ________ 5 to 50 bar
Standard setting of control begin ________ 10 bar



HD3D Δp_{St} ________ 35 bar
Control begin adjustable ________ 7 to 50 bar
Standard setting of control begin ________ 10 bar

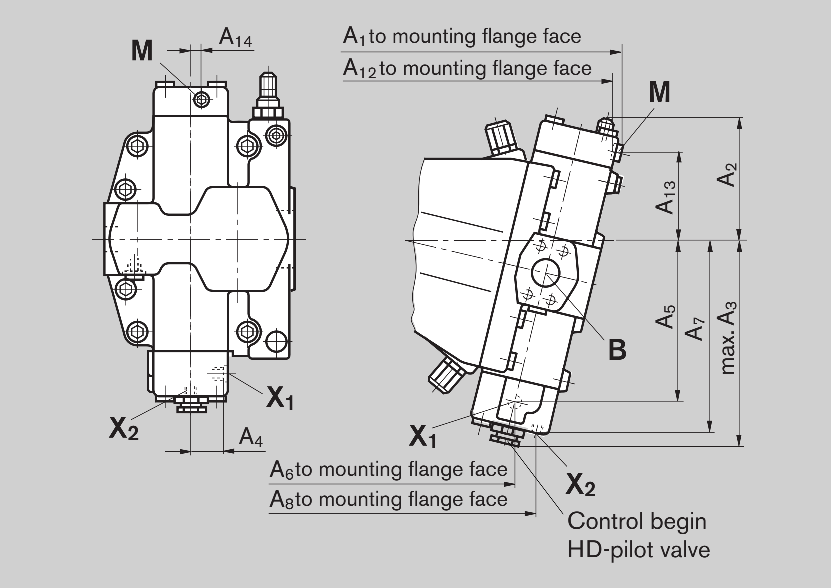


Dimensions **HD.D**

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

General dimensions see page 10 to 17

Clockwise rotation

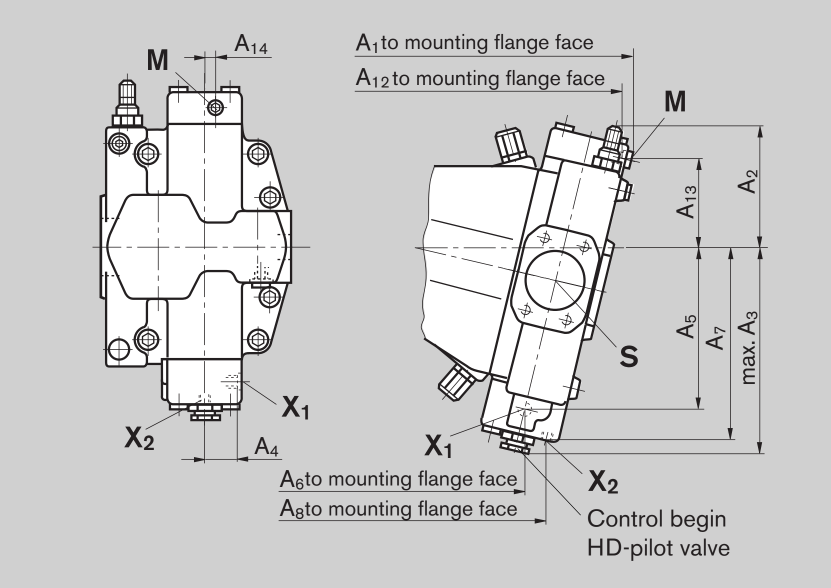


NG	A_1	A_2	A_3	A_4	A_5
250	385	161	275	49	210
355	432	181	300	54	234
500	492	200	325	61.5	258

NG	A_6	A_7	A_8
250	248	248	276
355	278	275	315
500	322	300	359

NG	A_{12}	A_{13}	A_{14}
250	377	116	14
355	425	132	20
500	483	144	20

Counter clockwise rotation



Ports

Designation	Port for	Standard	Size[2]	Peak pressure [bar][3]	State
X_1	Pilot pressure	DIN 3852	M14x1.5; 12 deep	100	O
X_2	External control pressure	DIN 3852	M14x1.5; 12 deep (NG250 a. 355)	400	O [4]
		DIN 3852	M18x1.5; 12 deep (NG500)	400	O [4]
M	Measuring pressure on control piston	DIN 3852	M14x1.5; 12 deep	400	X

[2] For the max. tightening torques the general information on page 52 must be observed

[3] Depending on the application momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices and fittings.

[4] If no external control pressure is connected, port X_2 must be plugged

O = Must be connected (closed on delivery)

X = Plugged (in normal operation)

HD.D with integrated pressure control

Initial position: $V_{g\,min}$ in pressureless condition

The pressure control overrides the HD-function i.e. below the setting of the pressure control the HD-function can be operated

It protects the pump against excessive pressure and subsequential damage.

The pressure control valve is integrated into the port plate and can be set externally.

Upon reaching the set pressure control level the pump will swivel towards a lower displacement.

Setting range of the pressure control _______ 50 to 350 bar
Standard setting at 350 bar.

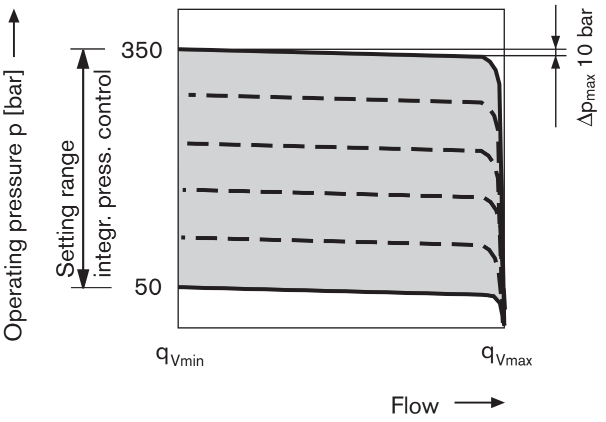
If a different setting is required, please state in clear text.

A recommended main line relief valve in the system to safeguard against excessive pressure spikes must have a cracking pressure at least 20 bar above the pressure control setting.

Note

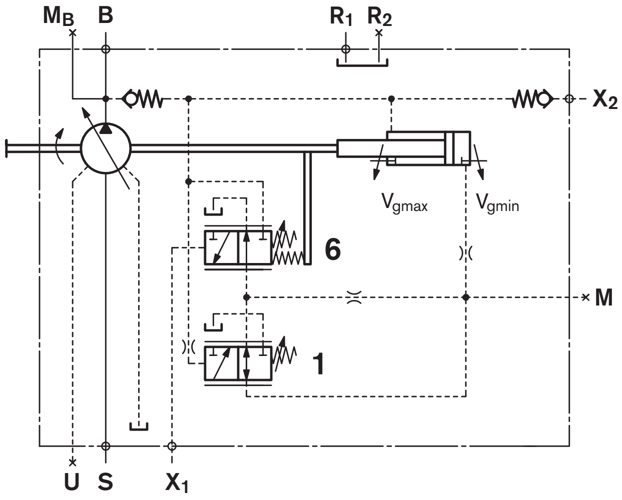
- The beginning of control and the pressure control characteristic are influenced by housing pressure. An increase in housing pressure results in a higher beginning of control (see page 7) and thus a parallel shift of the control characteristic
- Standby operation see page 6.

Characteristic



Schematic

Hydraulic control, pilot pressure dependent with integrated pressure control



Sub assemblies

1 Pressure control

6 HD-Pilot valve

Ports for

X_1 Pilot pressure

X_2 External control pressure

M Measuring pressure on control piston (plugged)

Dimensions see page 39

HD.G with remotely adjustable pressure control

Initial position: $V_{g\,min}$ in pressureless condition

The pressure control overrides the HD function.

In order to obtain a remote adjustment of the pressure control level a separate pilot pressure relief (item 2) valve must be connected to port X_3. This relief valve is not included in the supply of the DRG control.

Setting range of the pressure control ________50 to 350 bar

The spring force on the pressure compensator spool causes a differential pressure between pump output pressure and pressure at X_3 (as soon as the relief valve opens and the pressure control function takes place). Standard setting of this differential pressure 25 bar.

As long as the the pressure is below the set pressure of the relief valve, the pressures on both sides of the pressure compensator spool are equal and the additional spring force keeps this spool in a shifted position (Spool in equilibrium).

As soon as the set pressure of the relief valve is reached, this valve will start to open and the pilot flow will result in a differential pressure over the compensator spool, which causes this spool to shift and brings the pump to a smaller displacement $V_{g\,min}$.

Upon reaching the set pressure control level (set pressure at pilot relief valve plus differential pressure at pressure control compensator) the pump will go over to the pressure control mode.

The differential pressure at the pressure compensator spool (item 1) is normally set at 25 bar, which results in a pilot flow at X_3 of approx. 2 L/min.
In case another setting (range 14 to 50 bar) is required, please state in clear text when ordering.

As a seperate pilot relief valve we recommend:

DBD 6 (hydraulic) see RE 25402

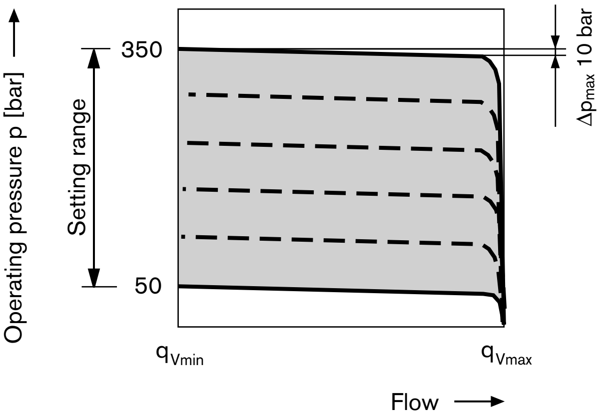
DBETR-SO 437 with dampened spool
(electric) see RE 29166

The max. line lenght should not exceed 2 m.

Note

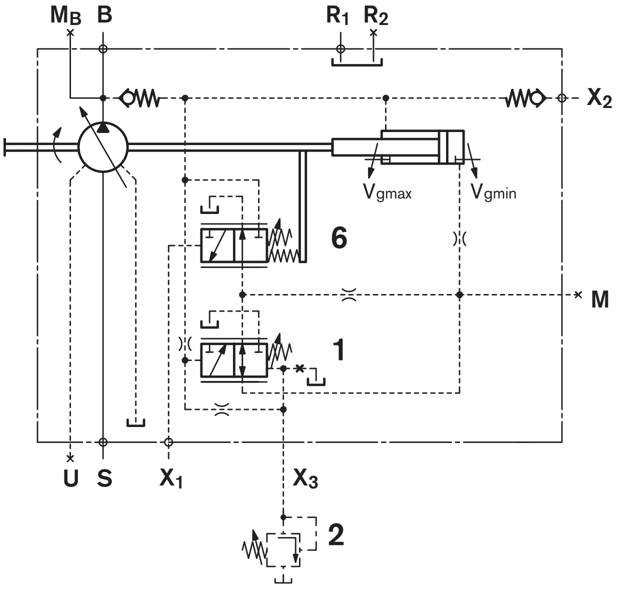
- The beginning of control and the pressure control characteristic are influenced by housing pressure. An increase in housing pressure results in a higher beginning of control (see page 7) and thus a parallel shift of the control characteristic.
- Standby operation see page 6.

Characteristic



Schematic

Hydraulic control, pilot pressure dependent with integrated pressure control



Sub assemblies

1	Integrated pressure control compensator
2	Separate pressure relief valve (not in scope of supply)
6	HD-pilot valve

Ports for

X_1	Pilot pressure
X_2	External control pressure
X_3	Separate pressure relief valve (for HDG)
M	Measuring of pressure on control piston (plugged)

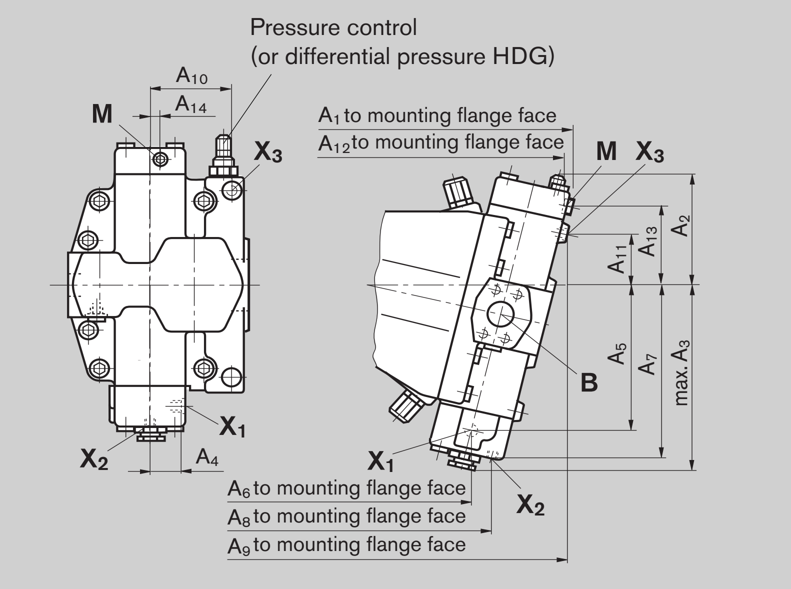
Dimensions see page 39

Dimensions HD.D and HD.G

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

General dimensions see page 10 to 17

Clockwise rotation

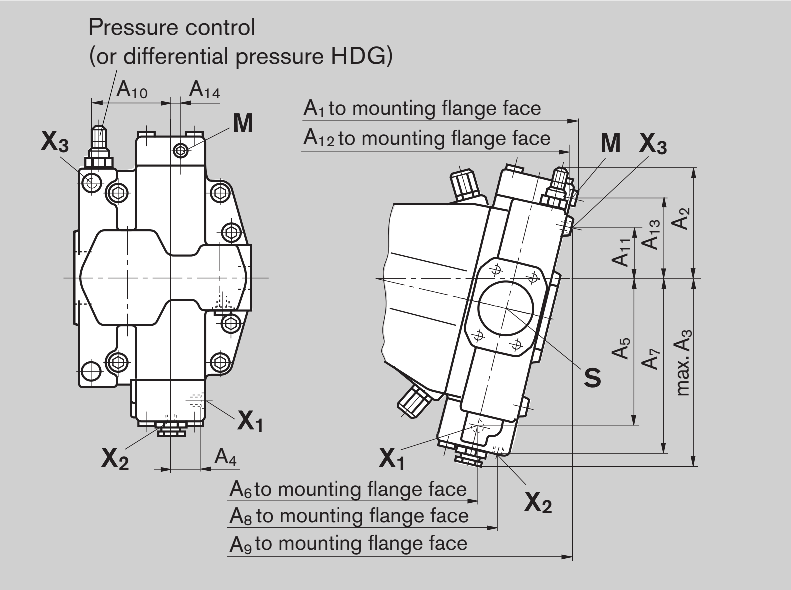


NG	A_1	A_2	A_3	A_4	A_5
250	385	161	275	49	210
355	432	181	300	54	234
500	492	200	325	61.5	258

NG	A_6	A_7	A_8	A_9	A_{10}
250	248	248	276	380	112
355	278	275	315	425	131
500	322	300	359	483	142

NG	A_{11}	A_{12}	A_{13}	A_{14}
250	74	377	116	14
355	82	425	132	20
500	96	483	144	20

Counter clockwise rotation



Ports

Designation	Port for	Standard	Size[2]	Peak pressure [bar][3]	State
X_1	Pilot pressure	DIN 3852	M14x1.5; 12 deep	100	O
X_2	External control pressure	DIN 3852 DIN 3852	M14x1.5; 12 deep (NG250 a. 355) M18x1.5; 12 deep (NG500)	400 400	O [4] O [4]
X_3 (for HDG)	Separate pressure relief valve	DIN 3852	M14x1.5; 12 deep	400	O
M	Measuring of pressure on control piston	DIN 3852	M14x1.5; 12 deep	400	X

[2] For the max. tightening torques the general information on page 52 must be observed

[3] Depending on the application momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices and fittings.

[4] If no external control pressure is connected, port X_2 must be plugged

O = Must be connected (closed on delivery)

X = Plugged (in normal operation)

EP.D Electric control with proportional valve

Initial position: $V_{g\,min}$ in pressureless condition

The electro-hydraulic control with proportional valve enables a stepless adjustment of the pump displacement dependent on an electric current signal.

The displacement is proportional to the current signal to the solenoid of a proportional pressure reducing valve DRE4K (see RE 29181), i.e. an increasing current signal results in an increasing displacement.

A minimum control pressure of 40 bar is required. The necessary control fluid is taken from the pump outlet pressure side.

An external control pressure is not required when the operating pressure > 40 bar and $V_{g\,min} > 0$. In this case the port X_2 must be plugged prior to commissioning. Otherwise an external control pressure of at least 40 bar must be connected to port X_2.

A pilot pressure of 30 bar is required at port P to actuate the proportional valve DRE4K.

Pilot pressure at port P

Required p_{min}	30 bar
p_{max}	100 bar

Important

- For operation on HF-fluids please observe the information in RE 29181
  (Proportional-pressure reducing valve Type DRE4K).
- The beginning of control and the pressure control characteristic are influenced by housing pressure. An increase in housing pressure results in a higher beginning of control (see page 7) and thus a parallel shift of the control characteristic.
- Type of protection proportional valve to IP65

Note

The spring return feature in the control unit is not a safety device

The spool valve inside the control unit can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).

Technical data proportional-press. reducing valve

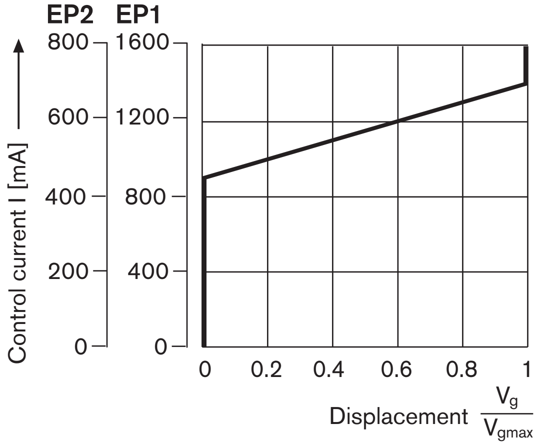
	EP1	EP2
Operating valtage (DC)	12V(±20%)	24V (±20%)
Control current		
Control begin at $V_{g\,min}$	900 mA	450 mA
Control end at $V_{g\,max}$	1400 mA	700 mA
Current limit	2,2 A	1,0 A
Nom. resistance (at 20°C)	2,4 Ω	12 Ω
Duty cycle	100 %	100 %
Type of protection (HIRSCHMANN) to DIN EN 60529	IP65	IP65

Various amplifiers for control of the proportional valve are available in the Rexroth program, see RE 29181.

Integrated pressure control EP.D is standard and overrides the EP function. Description see page 43.

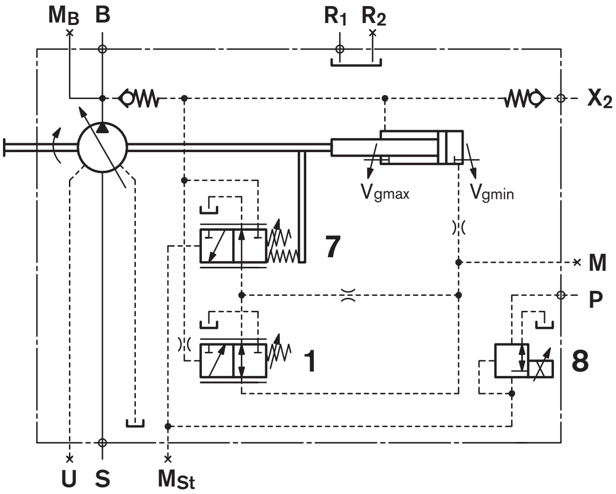
EP.D Electric control with proportional valve

Characteristic



Schematic

Electric control with proportional pressure reducing valve



Sub assemblies

1	Pressure control
7	Pilot valve
8	Proportional pressure reducing valve (see RE 29181) incl. conductor box (Hirschmann plug without suppressor diode) see page 50

Ports for

P	Pilot pressure
X_2	External control pressure
M	Measuring pressure on control piston (plugged)
M_{St}	Measuring pilot pressure (plugged)

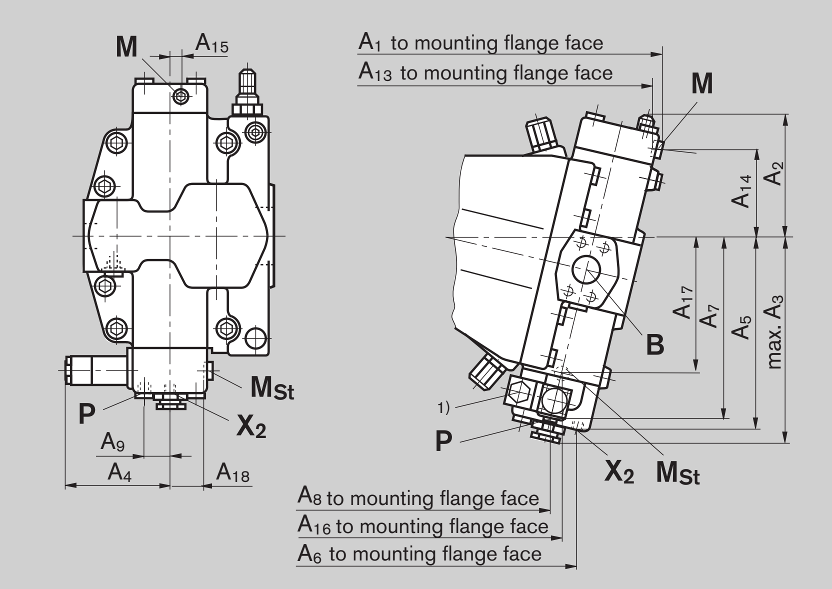
Dimensions see page 42

Dimensions EP.D

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

General dimensions see page 10 to 17

Clockwise rotation



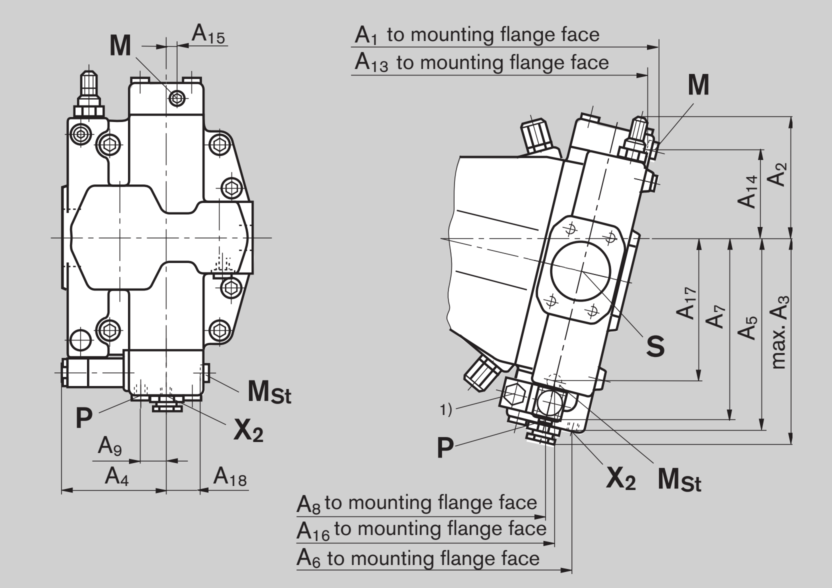
NG	A_1	A_2	A_3	A_4	A_5	A_6
250	385	161	275	115	248	276
355	432	181	300	116	275	315
500	492	200	325	123	300	359

NG	A_7	A_8	A_9	A_{10}	A_{11}	A_{12}
250	238	241	36	112	380	74
355	268	286	36	131	425	82
500	294	328	43	142	483	96

NG	A_{13}	A_{14}	A_{15}	A_{16}	A_{17}	A_{18}
250	377	116	14	248	210	49
355	425	132	20	278	234	54
500	483	144	20	322	258	61.5

[1] Cable connection M16x1.5 for cable diameter 4.5 to 10 mm
Plug description and dimensions see page 50

Counter clockwise rotation



Ports

Designation	Port for	Standard	Size[2]	Peak pressure [bar][3]	State
P	Pilot pressure for proportional valve	DIN 3852	M14x1.5; 12 deep	100	O
X_2	External control pressure	DIN 3852	M14x1.5; 12 deep (NG250 a. 355)	400	O [4]
		DIN 3852	M18x1.5; 12 deep (NG500)	400	O [4]
M	Measuring pressure on control piston	DIN 3852	M14x1.5; 12 deep	400	X
M_{St}	Measuring pilot pressure	DIN 3852	M14x1.5; 12 deep	100	X

[2] For the max. tightening torques the general information on page 52 must be observed

[3] Depending on the application momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices and fittings.

[4] If no external control pressure is connected, port X_2 must be plugged

O = Must be connected (closed on delivery)

X = Plugged (in normal operation)

EP.D with integrated pressure control

Initial position: $V_{g\,min}$ in pressureless condition

The pressure control overrides the EP-function i.e. below the setting of the pressure control the EP-function can be operated.

It protects the pump against excessive pressure and subsequential damage.

The pressure control valve is integrated into the port plate and can be set externally.

Upon reaching the set pressure control level the pump will swivel towards a lower displacement.

Setting range of the pressure control______ 50 to 350 bar
Standard setting at 350 bar.

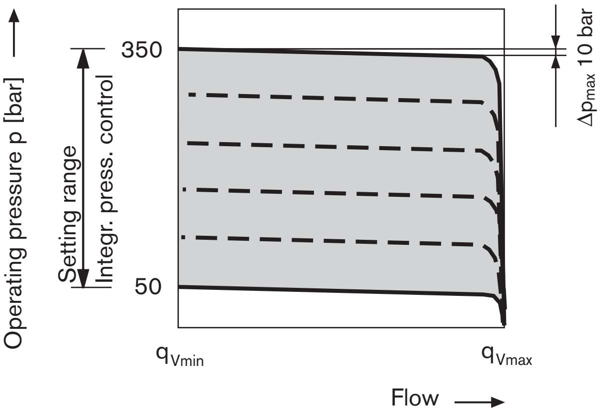
If a different setting is required, please state in clear text.

A recommended main line relief valve in the system to safeguard against excessive pressure spikes must have a cracking pressure at least 20 bar above the pressure control setting.

Note

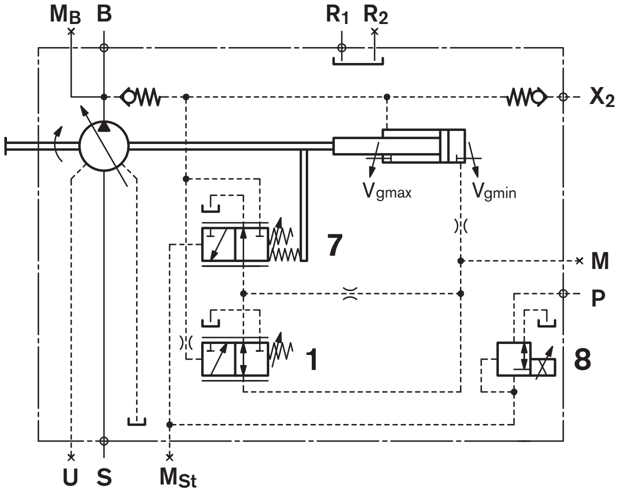
- The beginning of control and the pressure control characteristic are influenced by housing pressure. An increase in housing pressure results in a higher beginning of control (see page 7) and thus a parallel shift of the control characteristic
- Standby operation see page 6.

Characteristic



Schematic

Electric control with proportional pressure reducing valve



Sub assemblies

1	Pressure control
7	Pilot valve
8	Proportional pressure reducing valve incl. conductor box (Hirschmann plug without suppressor diode) see page 46

Ports for

P	Pilot pressure
X_2	External control pressure
M	Measuring pressure on control piston (plugged)
M_{St}	Measuring pilot pressure (plugged)

Dimensions see page 45

EP.G with remotely adjustable pressure control

Initial position: $V_{g\,min}$ in pressureless condition

The pressure control overrides the EP- function.

In order to obtain a remote adjustment of the pressure control level a separate pilot pressure relief (item 2) valve must be connected to port X_3. This relief valve must be ordered separately to the DRG control.

Setting range of the pressure control _________50 to 350 bar

The spring force on the pressure compensator spool causes a differential pressure between pump output pressure and pressure at X_3 (as soon as the relief valve opens and the pressure control function takes place). Standard setting of this differential pressure 25 bar.

As long as the the pressure is below the set pressure of the relief valve, the pressures on both sides of the pressure compensator spool are equal and the additional spring force keeps this spool in a shifted position (Spool in equilibrium).

As soon as the set pressure of the relief valve is reached, this valve will start to open and the pilot flow will result in a differential pressure over the compensator spool, which causes this spool to shift and brings the pump to a smaller displacement $V_{g\,min}$.

Upon reaching the set pressure control level (set pressure at pilot relief valve plus differential pressure at pressure control compensator) the pump will go over to the pressure control mode.

The differential pressure at the pressure compensator spool (item 1) is normally set at 25 bar, which results in a pilot flow at X_3 of approx. 2 L/min.
In case another setting (range 14 to 50 bar) is required, please state in clear text when ordering.

As a seperate pilot relief valve we recommend:

DBD 6 (hydraulic) see RE 25402

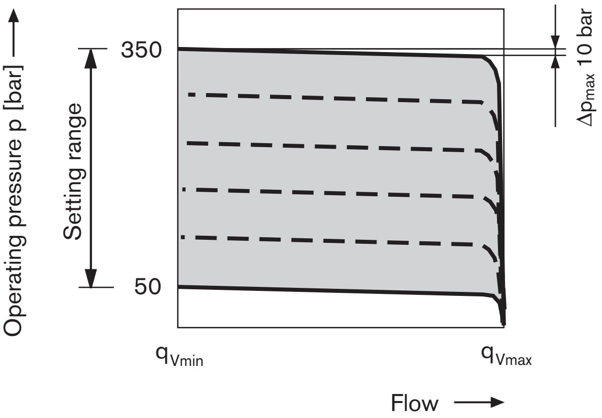
DBETR-SO 437 with dampened spool
(electric) see RE 29166

The max. line lenght should not exceed 2 m.

Note

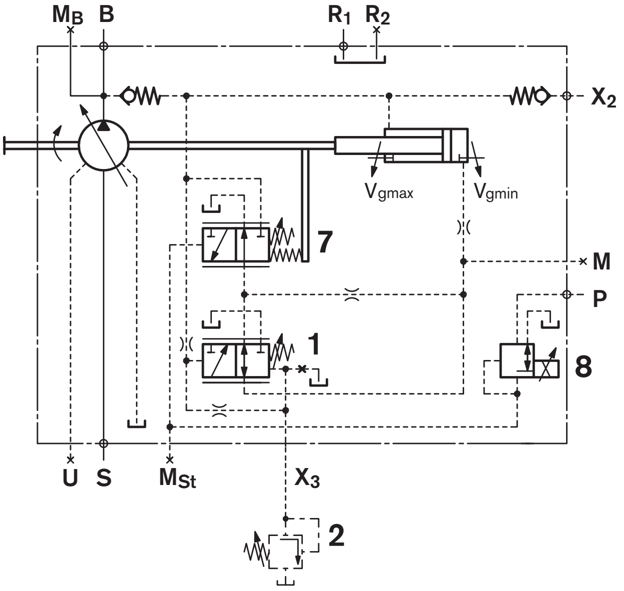
- The beginning of control and the pressure control characteristic are influenced by housing pressure. An increase in housing pressure results in a higher beginning of control (see page 7) and thus a parallel shift of the control characteristic.
- Standby operation see page 6.

Characteristic



Schematic

Electric control with proportional pressure reducing valve and remotely adjustable pressure control



Sub assemblies

1	Integrated pressure control compensator
2	Separate pressure relief valve (not in scope of supply)
7	Pilot valve
8	Proportional pressure reducing valve

Ports for

P	Pilot pressure for proportional valve
X_2	External control pressure
X_3	Separate pressure relief valve (EPG)
M	Measuring pressure on control piston (plugged)
M_{St}	Measuring pilot pressure (plugged)

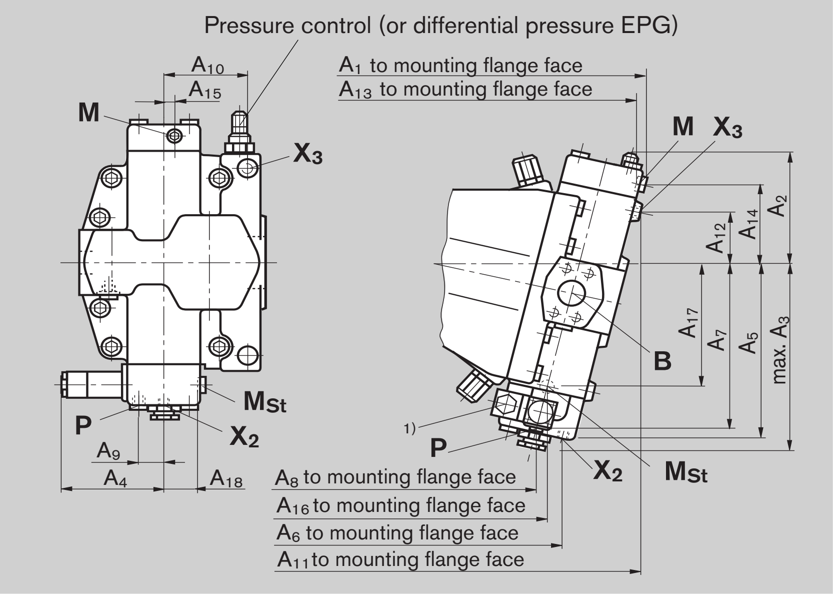
Dimensions see page 45

Dimensions EP.D and EP.G

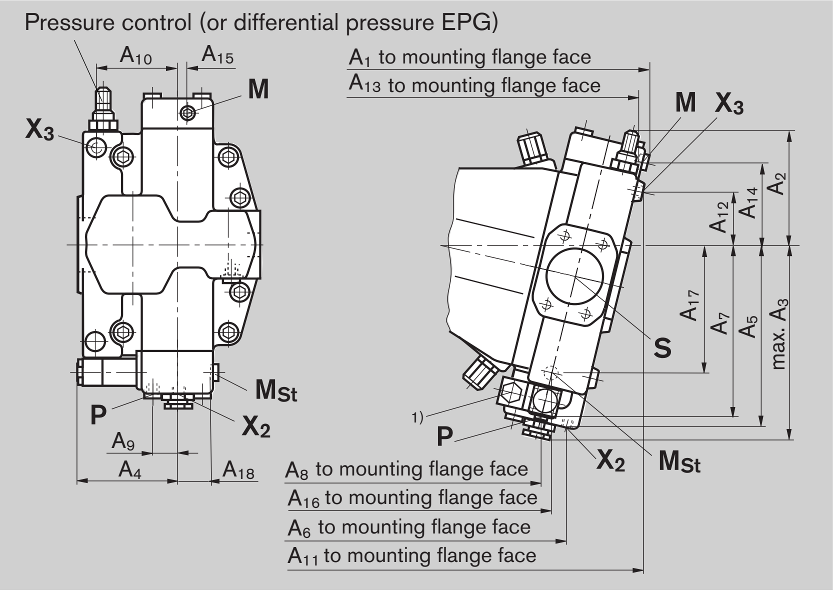
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

General dimensions see page 10 to 17

Clockwise rotation



Counter clockwise rotation



NG	A_1	A_2	A_3	A_4	A_5	A_6
250	385	161	275	115	248	276
355	432	181	300	116	275	315
500	492	200	325	123	300	359

NG	A_7	A_8	A_9	A_{10}	A_{11}	A_{12}
250	238	241	36	112	380	74
355	268	286	36	131	425	82
500	294	328	43	142	483	96

NG	A_{13}	A_{14}	A_{15}	A_{16}	A_{17}	A_{18}
250	377	116	14	248	210	49
355	425	132	20	278	234	54
500	483	144	20	322	258	61.5

[1] Cable connection M16x1.5 for cable diameter 4.5 to 10 mm
Plug description and dimensions see page 50

Ports

Designation	Port for	Standard	Size[2]	Peak pressure [bar][3]	State
P	Pilot pressure for proportional valve	DIN 3852	M14x1.5; 12 deep	100	O
X_2	External control pressure	DIN 3852 DIN 3852	M14x1.5; 12 deep (NG250 a. 355) M18x1.5; 12 deep (NG500)	400 400	O O
X_3 (for EPG)	Separate pressure relief valve	DIN 3852	M14x1.5; 12 deep	400	O
M	Measuring pressure on control piston	DIN 3852	M14x1.5; 12 deep	400	X
M_{St}	Measuring pilot pressure	DIN 3852	M14x1.5; 12 deep	100	X

[2] For the max. tightening torques the general information on page 52 must be observed

[3] Depending on the application momentary pressure spikes can occur. Take this into consideration when selecting the measuring devices and fittings.

[4] If no external control pressure is connected, port X_2 must be plugged

O = Must be connected (closed on delivery)

X = Plugged (in normal operation)

Visual swivel angle indicator

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

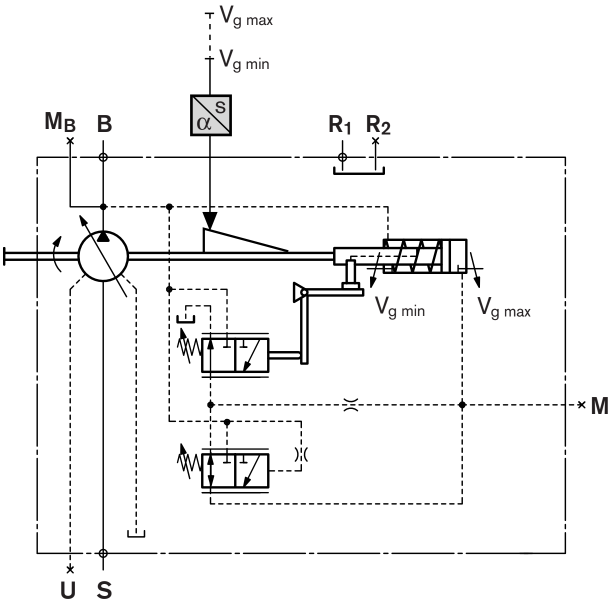
The swivel angle is indicated by a pin at the side of the port plate (the cap nut must be removed).

The protruding lenght of the pin varies in accordance with the position of the lens plate.

The pump is at zero if the pin is flush with the port plate.

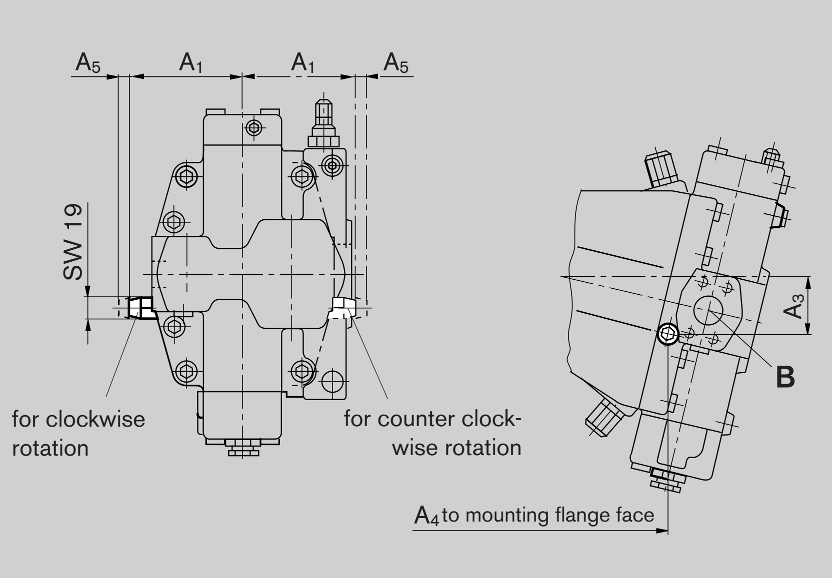
The lenght of the pin is approx. 8 mm when swivelled to max. angle $\mathbf{V_{g\,max}}$.

Schematic example LRD – intial position $V_{g\,max}$



Dimensions

General dimensions see page 10 to 17



NG	A_1	A_3	A_4	A_5*
250	136.5	73	238	11
355	159.5	84	266	11
500	172.5	89	309	11

* Dimension to remove the cap nut

Electric swivel angle indicator

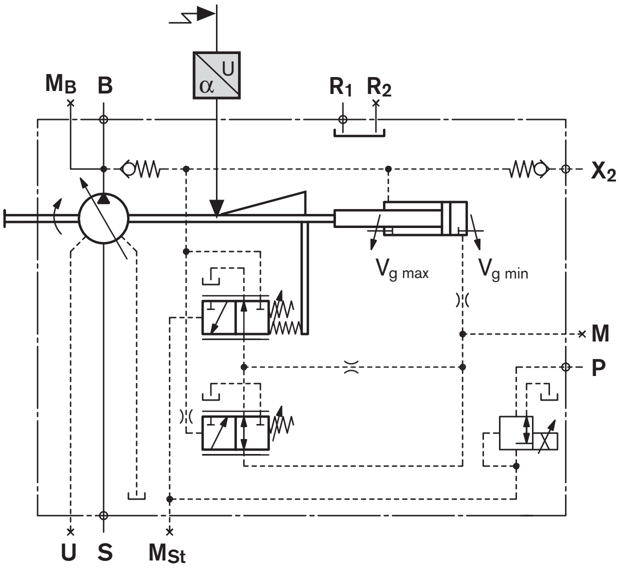
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

In this case the pump swivel angle is indicated via an inductive position transducer.

It converts the displacement of the control device into an electrical signal This signal can be used to feed the value of swivel angle to an amplifier card for example.

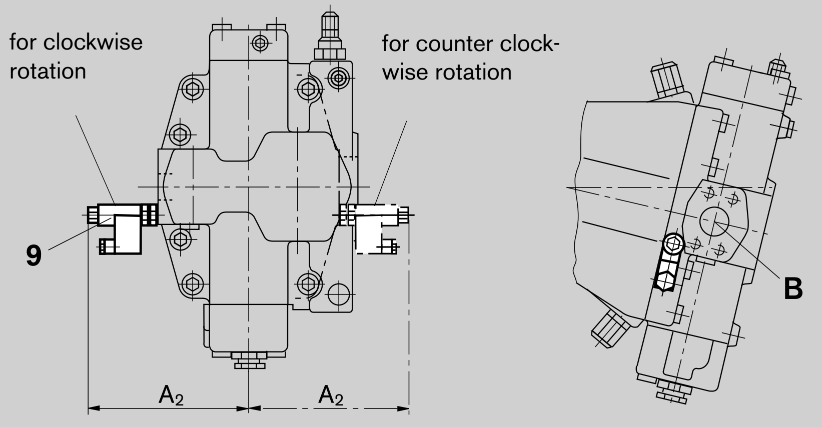
Inductive transducer Type IW9 – 03 – 01

Schematic example EPD – intial position $V_{g\ min}$



Dimensions

General dimensions see page10 to 17



NG	A_2
250	182
355	205
500	218

Sub assemblies

9 Inductive transducer IW9-03-01
with conductor box (mating plug) Hirschmann plug without suppressore diode,
with cable connection M16x1.5 for cable diameter 4.5 to 10 mm
Plug description and dimensions see page 50

Installation instructions standard version

General

During commissioning and operation the axial piston unit must be full with fluid at all times and must be deaerated. This is also important after prolonged periods of standstill since the system can empty itself via the hydraulic lines

The leakage fluid in the housing must be drained to tank via the highest positioned case drain port.

Under all operating conditions the case drain line and the suction line inside the reservoir must be below the minimum fluid level

The minimum inlet pressure at port S may not fall below 0.8 bar absolute.

Installation position

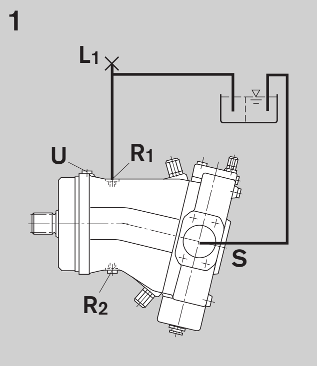
See examples below. Further installation positions are possible, please consult us.

Mounting below the reservoir (standard)

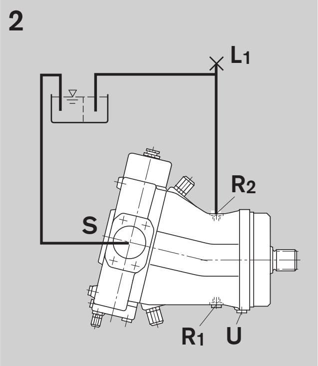
Pump below the minimum reservoir fluid level

Recommemded installation position: 1 and 2

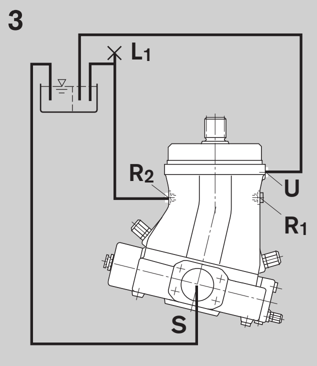
1



2



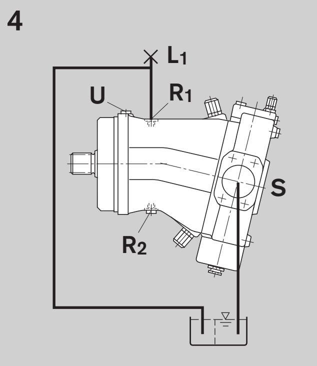
3



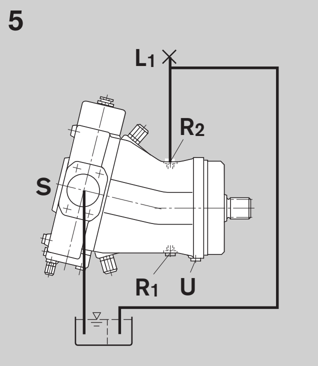
Installation position	Deaerate	Filling
1	–	R_1 (L_1)
2	–	R_2 (L_1)
3	U	R_2 (L_1)

Mounting above the reservoir

4



5



Installation position	Deaerate	Filling
4	–	R_1 (L_1)
5	–	R_2 (L_1)

Installation instructions High-Speed-version

General

During commissioning and operation the axial piston unit must be full with fluid at all times and must be deaerated. This is also important after prolonged periods of standstill since the system can empty itself via the hydraulic lines

The leakage chamber and suction chamber are connected inside the pump housing. A case drain line to tank is not necessary.

The suction line inside the reservoir must end up below the minimum fluid level under all operating conditions.
The minimum inlet pressure at port S may not fall below 0.8 bar absolute.

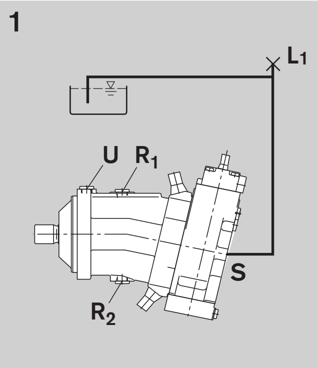
Installation position

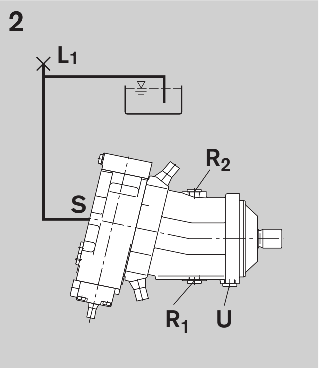
See examples below. Further installation positions are possible, please consult us

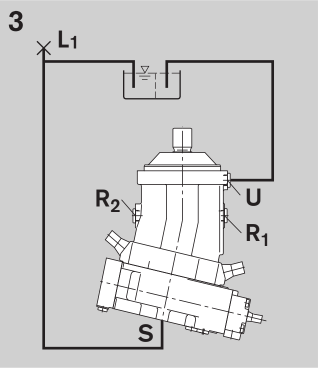
Mounting below the reservoir (standard)

Pump below the minimum reservoir fluid level

Recommended installation position: 1 and 2.







Installation position	Deaerate	Filling
1	R_1	S (L_1)
2	R_2	S (L_1)
3	U	S (L_1)

Plug

On EP-control and electric swivel angle indicator E

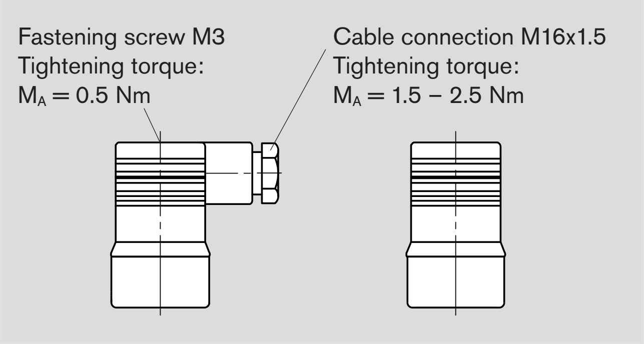
HIRSCHMANN DIN EN 175 301-803-A /ISO 4400

Without bi-directional suppressor diode

Type of protection to DIN/EN 60529: IP65

The sealing ring in the cable connection is suitable for a cable diameter of 4.5 mm to 10 mm.

The HIRSCHMANN-plug is included in the delivery of the pump.



Notes

Safety information

– The pump A7VO was designed for operation in open loop circuits

– Systems design, installation and commissioning requires trained technicians or tradesmen.

– All hydraulic ports can only be used for the fastening of hydraulic service lines.

– During and shortly after operation of a pump the housing and especially a solenoid can be extremely hot, avoid being burned; take suitable safety measures (wear protective clothing).

– Dependent on the operating conditions of the axial piston pump (operating pressure, fluid temperature) deviations in the performance curves can occur.

– Pressure ports:
All materials and port threads are selected and designed in such a manner, that they can withstand the peak pressures.
The machine and system manufacturer must ensure, that all connecting elements and hydraulic lines are suitable for the actual operating conditions (pressures, flow, fluid, temperature) in accordance with the necessary safety factors.

– All given data and information must be adhered to..

– The product has not been released as a component in the safety concept of a total machine system acc. to DIN EN ISO 13849.

– The following tightening torques are valid:

  - Female threads in the axial piston unit:
  the maximum permissible tightening torques M_{GMax} are maximum values for the female threads in the pump casting and may not be exceeded. For values see table below. -

  - Fittings:
  please comply with the manufacturer‘s information regarding the max. permissible tightening torques for the used fittings.

  - Fastening bolts:
  for fastening bolts to DIN 13 we recommend to check the permissible tightening torques in each individual case to VDI 2230.

  - Plugs:
  for the metal plugs, supplied with the axial piston unit the following min. required tightening torques M_V apply (see table)

Port thread size		**Max. perm. tightening torque in female threads $M_{G\,max}$**	**Required tightening torque of plugs or fittings M_V**	**Across the flats in Allan screws**
M14x1.5	DIN 3852	80 Nm	35 Nm	6 mm
M18x1.5	DIN 3852	140 Nm	60 Nm	8 mm
M22x1.5	DIN 3852	210 Nm	80 Nm	10 mm
M33x2	DIN 3852	540 Nm	225 Nm	17 mm

Axial piston variable pump A18VO series 11

- High-pressure pump for use in commercial vehicles
- Sizes 55 to 107
- Nominal pressure 350 bar
- Maximum pressure 400 bar
- Open circuit

Features

- Variable pump with axial tapered piston rotary group in bent-axis design with special properties and dimensions for use in commercial vehicles.
- Flow is proportional to the drive speed and displacement.
- The flow can be infinitely varied by adjusting the swivel angle.
- Favorable power/weight ratio, small dimensions, optimum efficiency and economic design
- High self-suction capability
- Flange and shaft designed for direct mounting on the power take-off of commercial vehicles
- Low noise level

Contents

Type code

01	02	03	04	05	06		07	08	09	10	11	12	13	14		15
A18V	**O**				**0**	**/**	**11**	**N**		**W**	**K0**				**–**	

Axial piston unit

01	Bent-axis design, variable, nominal pressure 350 bar, maximum pressure 400 bar, for commercial vehicles (trucks)	**A18V**

Operating mode

02	Pump, open circuit	**O**

Size (NG)

03	Geometric displacement, see table of values on page 6	**055**	**080**	**107**

Control devices

				055	**080**	**107**	
04	Pressure controller with load sensing			●	●	●	**DRS**
	Proportional control, electric	positive control	U = 12 V	●	●	●	**EP1**
			U = 24 V	●	●	●	**EP2**
		negative control	U = 12 V	–	–	●	**EP5**
			U = 24 V	–	–	●	**EP6**

Connector for solenoids

05	Without connector (without solenoid, only for hydraulic control)	**0**
	DEUTSCH molded connector, 2-pin – without suppressor diode	**P**

Auxiliary functions 1

06	Without auxiliary functions	**0**

Series

07	Series 1, index 1	**11**

Design of ports and fastening threads

08	Metric, connecting thread with profiled sealing ring according to DIN 3852	**N**

Direction of rotation

09	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Sealing material

10	FKM (fluoroelastomer) including the two shaft seals made of FKM	**W**

Mounting flange

11	Special flange ISO 7653-1985 (for trucks)	**K0**

Drive shaft

12	Splined shaft similar to DIN ISO 14 (for trucks)	**E8**

Working port

13	Threaded ports **A** and **S** at rear	**1**
	Threaded ports **A** and **S** at rear, with mounted suction adapter	**2**

Speed sensor

		055	**080**	**107**	
14	Without speed sensor	●	●	●	**0**
	DSA speed sensor mounted[1]	–	●	–	**V**
	DSM speed sensor mounted[1]	–	●	–	**M**

---

[1] Specify type key of sensor in accordance with data sheet 95133 (DSA) and/or 95132 (DSM) separately and observe the requirements for the electronics

01	02	03	04	05	06		07	08	09	10	11	12	13	14		15
A18V	**O**				**0**	**/**	**11**	**N**		**W**	**K0**				**–**	

Standard / special version

15	Standard version	**0**
	Standard version with installation variants, e. g. thread adapter mounted on the **X** port	**Y**
	Special version	**S**

● = Available – = Not available

Note

Note the project planning notes on page 24.

Hydraulic fluid

The A18VO variable pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)

Variable pump A18VO is not suitable for operation with water-containing HF hydraulic fluids.

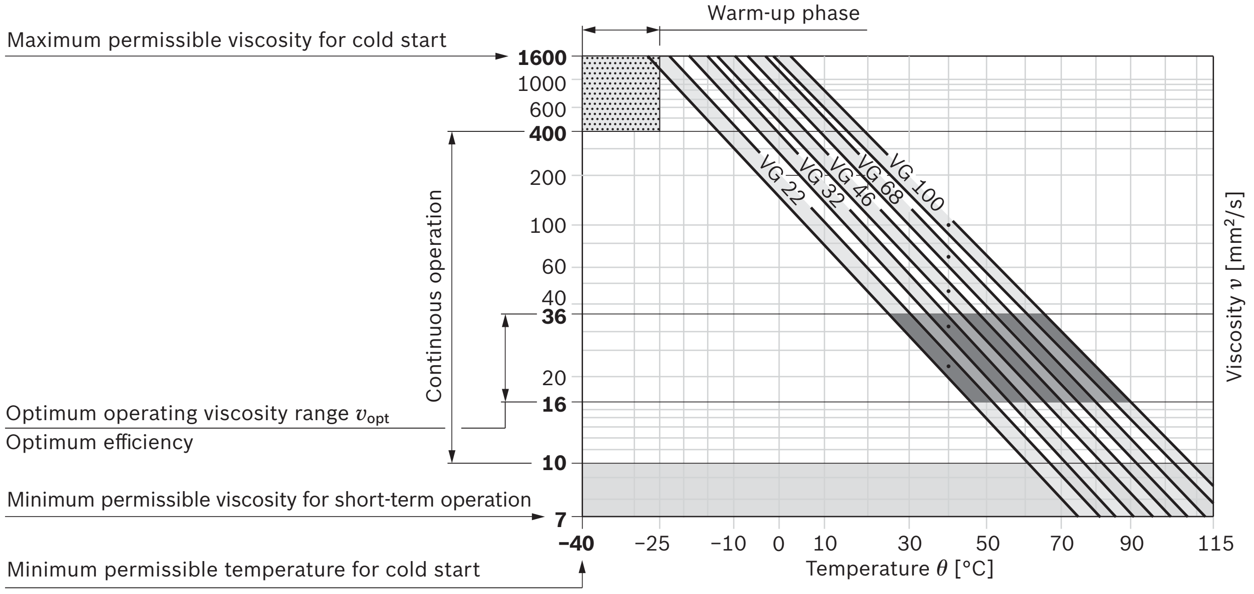
Details regarding the selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}, see selection diagram).

Note
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
Please contact us if the above conditions cannot be met due to extreme operating parameters.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \leq 1600$ mm²/s	$\theta_{St} \geq -40$ °C[1]	$t \leq 3$ min, without load ($p \leq 50$ bar), $n \leq 1000$ rpm
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid in the system
Warm-up phase	$\nu = 1600$ to 400 mm²/s	$\theta = -40$ °C to -25 °C	at $p \leq 0.7 \times p_{nom}$, $n \leq 0.5 \times n_{nom}$ and $t \leq 15$ min
Continuous operation	$\nu = 400$ to 10 mm²/s		This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram)
		$\theta = -25$ °C to $+103$ °C	measured at air bleed port **R** Note the permissible temperature range of the shaft seal[1] (ΔT = approx. 12 K between the bearing/shaft seal and port **R**)
	$\nu_{opt} = 36$ to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \geq 7$ mm²/s		$t < 3$ min, $p < 0.3 \times p_{nom}$

▼ **Selection diagram**



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[1] The FKM shaft seal is permissible for temperatures of −25 °C to +115 °C, please contact us for temperatures below −25 °C.

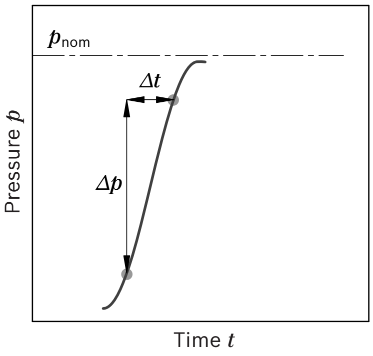
Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.
A cleanliness level of at least 20/18/15 according to ISO 4406 is to be adhered to.
At very high hydraulic fluid temperatures (90 °C to maximum 103 °C, measured at air bleed port **R**), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

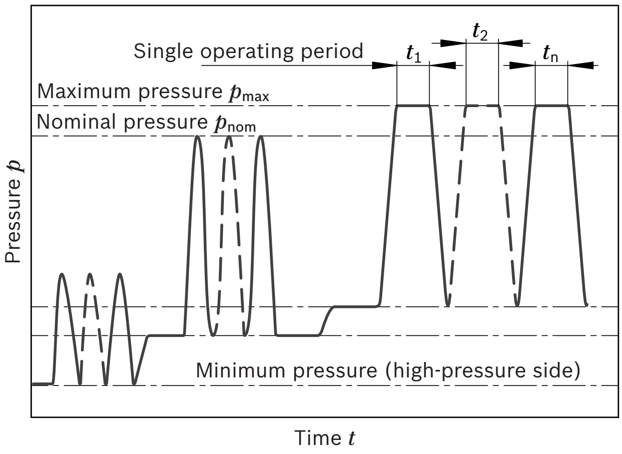
Working pressure range

Pressure at working port A (high-pressure side)		**Definition**
Nominal pressure p_{nom}	350 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	400 bar absolute	The maximum pressure corresponds the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	5 s	
Total operating period	50 h	
Minimum pressure (high-pressure side)	10 bar absolute	Minimum pressure on high-pressure side (**A**) required to prevent damage to the axial piston unit.
Rate of pressure change $R_{\text{A max}}$	9000 bar/s	Maximum permissible rate of pressure build-up and reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{\text{S min}}$	0.8 bar absolute	Minimum pressure at suction port **S** (inlet) that is required to avoid damage to the axial piston unit. The minimum required pressure is dependent on the speed and displacement of the axial piston unit (see diagram on page 6).
Maximum pressure $p_{\text{S max}}$	2 bar absolute	

▼ **Rate of pressure change $R_{\text{A max}}$**



▼ **Pressure definition**



Total operating period = $t_1 + t_2 + \ldots + t_n$

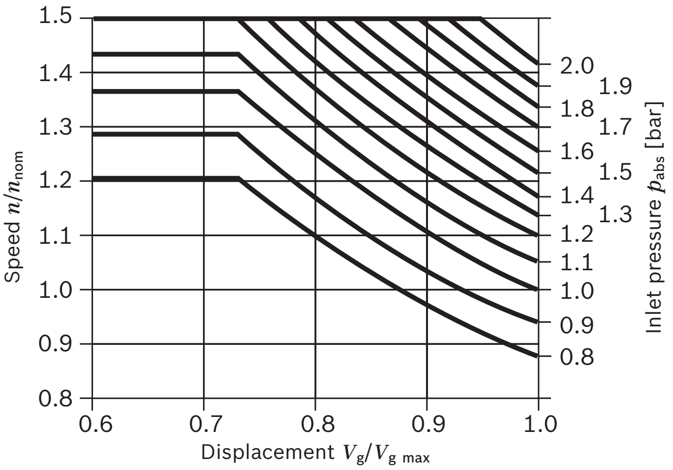
Note

Working pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical data

Size		NG		55	80	107
Displacement, geometric, per revolution		$V_{g\ max}$	cm³	54.8	80	107
Maximum rotational speed[1]	at $V_{g\ max}$	n_{nom}	rpm	2500	2240	2150
	at $V_g < 0.74 \times V_{g\ max}$	n_{max1}	rpm	3400	3000	2900
Maximum rotational speed[2]		n_{max2}	rpm	3750	3350	3200
Flow	at n_{nom} and $V_{g\ max}$	q_v	l/min	137	179	230
Power	at n_{nom}, $V_{g\ max}$ and Δp = 350 bar	P	kW	80	105	134
Torque	at $V_{g\ max}$ and Δp = 350 bar	T	Nm	305	446	596
Rotary stiffness	$V_{g\ max}$ to $0.5 \times V_{g\ max}$	c_{min}	Nm/rad	10594	15911	21469
	$0.5 \times V_{g\ max}$ to 0 (interpolated)	c_{max}	Nm/rad	32103	48971	67666
Moment of inertia for rotary group		J_{TW}	kgm²	0.0034	0.0066	0.0109
Maximum angular acceleration		α	rad/s²	31600	24200	19200
Case volume		V	l	0.6	0.8	1.2
Mass moment		T_G	Nm	21	32	41
Weight (approx.)		m	kg	16	21	25

▼ **Maximum speed (speed limit)**



Determining operating characteristics					
Flow	q_v	=	$\frac{V_g \times n \times \eta_v}{1000}$		[l/min]
Torque	T	=	$\frac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$		[Nm]
Power	P	=	$\frac{2\ \pi \times T \times n}{60000}$	= $\frac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g	Displacement per revolution [cm³]
Δp	Differential pressure [bar]
n	Rotational speed [rpm]
η_v	Volumetric efficiency
η_{hm}	Hydraulic mechanical efficiency
η_t	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

Note

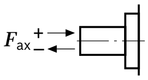
- ▶ Theoretical values, without efficiency and tolerances; values rounded.
- ▶ Exceeding the maximum or falling below the minimum permissible values can lead to a loss of function, a reduction in operational service life or total destruction of the axial piston unit. Other permissible limit values, such as speed variation, reduced angular acceleration as a function of the frequency and the permissible angular acceleration at start (lower than the maximum angular acceleration) can be found in data sheet 90261.

---

1) The values are valid:
   - – At absolute pressure p_{abs} = 1 bar at suction port **S**
   - – For the optimal viscosity range of ν_{opt} = 36 to 16 mm²/s
   - – For hydraulic fluid based on mineral oils.

2) Maximum rotational speed (speed limit) for increased inlet pressure p_{abs} at suction port **S** and $V_g < V_{g\ max}$, see diagram.

Permissible axial forces of the drive shaft

Size		NG		55	80	107
Maximum axial force at standstill or pressure-free operation		+ $F_{ax\ max}$	N	0	0	0
		− $F_{ax\ max}$	N	66	86	103

Note

- The values given are maximum values and do not apply to continuous operation.
- The permissible axial force in direction $-F_{ax}$ is to be avoided as the lifetime of the bearing is reduced.
- Radial forces are not permissible.

DRS – Pressure controller with load sensing

Function of the pressure controller

The pressure controller limits the maximum pressure at the pump output within the control range of the pump. The variable pump only delivers as much hydraulic fluid as the consumers actually need. If the operating pressure exceeds the setpoint value set at the pressure valve, the pump will regulate to a smaller displacement to reduce the control differential.

When depressurized, the pump is swiveled to its initial position $V_{g\,max}$ by an adjustment spring.

- Setting range for pressure control 100 to 400 bar
- Standard setting 350 bar

Note

- Any pressure-relief valve included in the system to limit the maximum pressure must have its start of opening at least 20 bar above the pressure controller setting.
- The pressure controller overrides the load-sensing controller, i.e. the load-sensing function operates below the set pressure.
- To ensure thermal stability, a drain line from port **T** to the reservoir is generally required (not needed for EP control).

When ordering, state in clear text:

- Pressure controller setting
- Δp setting for load sensing function

Unless otherwise specified, the pump will be delivered with standard settings.

Zero-stroke operation

The standard version is designed for intermittent constant pressure operation. Short-term zero-stroke operation (< 1 min) is permissible up to an operating pressure of p_{nom} = 350 bar at a reservoir temperature of ≤ 50 °C.

Load-sensing function

The load sensing controller works as a load-pressure controlled flow controller and adjusts the displacement of the pump to the volume required by the consumer.

The flow of the pump is then dependent on the cross section of the external metering orifice (**1**), which is located between the pump and the consumer. Below the setting of the pressure controller and within the control range of the pump, the flow is not dependent on the load pressure.

The metering orifice is usually a separately located load sensing directional valve (control block). The position of the directional valve spool determines the opening cross-section of the metering orifice and thus the flow of the pump.

The load sensing controller compares the pressure before the metering orifice with that after the orifice and maintains the pressure drop encountered here (differential pressure Δp) and thus the flow constant.

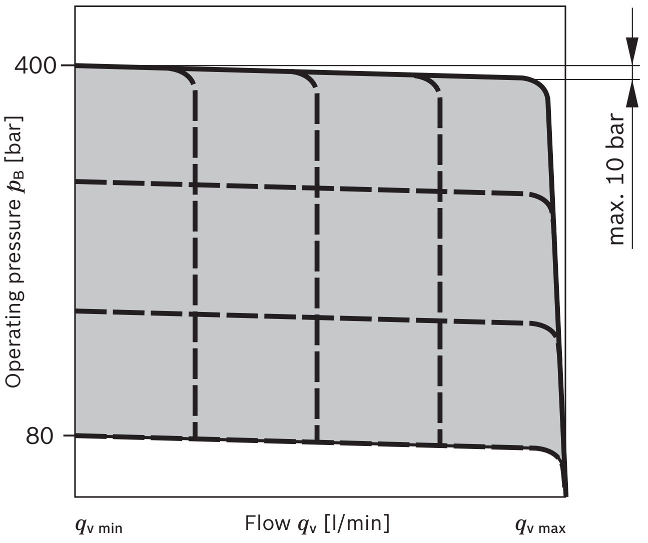
If the differential pressure Δp at the metering orifice rises, the pump is swiveled back (toward $V_{g\,min}$). If the differential pressure Δp drops, the pump is swiveled out (toward $V_{g\,max}$) until equilibrium at the metering orifice is restored.

$\Delta p_{\text{Metering orifice}} = p_{\text{Pump}} - p_{\text{Consumer}}$

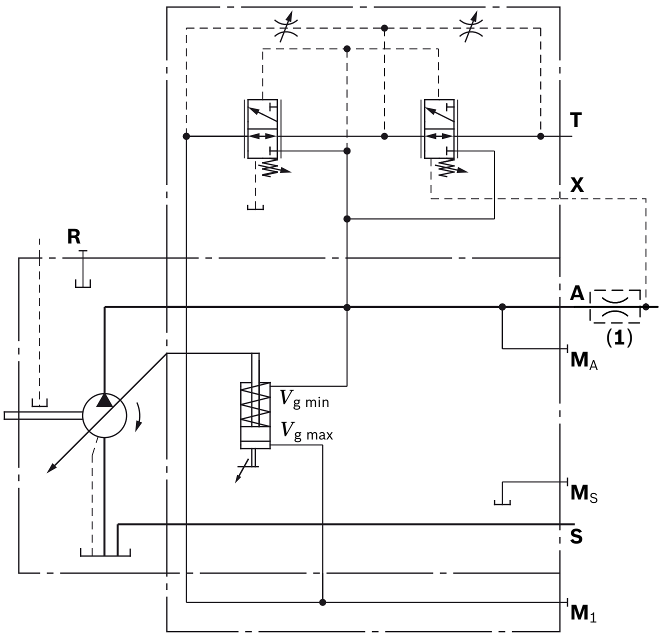
- Setting range for Δp 19 to 40 bar
- Standard setting 30 bar

The stand-by pressure in zero-stroke mode (metering orifice closed) is slightly higher than the Δp setting.

▼ **Characteristic curve DRS**



▼ **Circuit diagram DRS**



The metering orifice (control block) (**1**) is not included in the scope of delivery.

EP – Proportional control, electric

The electric proportional control provides infinite control of the displacement. Control is proportional to the electric control current applied to the solenoid.

EP1, EP2 – Positive control

Adjustment from $V_{g\,min}$ to $V_{g\,max}$

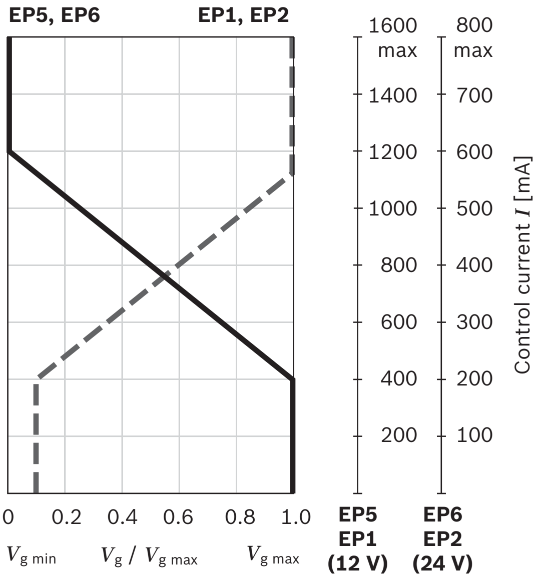
With increasing control current, the pump swivels to a larger displacement. A control pressure is needed to swivel the pump from its initial position $V_{g\,min}$ to $V_{g\,max}$. The control power required is drawn from the working pressure. To enable a pressure to be built up, a residual volume of approx. 10% of $V_{g\,max}$ is a fixed setting.

EP5, EP6 – Negative control

Adjustment from $V_{g\,max}$ to $V_{g\,min}$

With increasing control current, the pump swivels to a smaller displacement. The control power required is drawn from the working pressure.

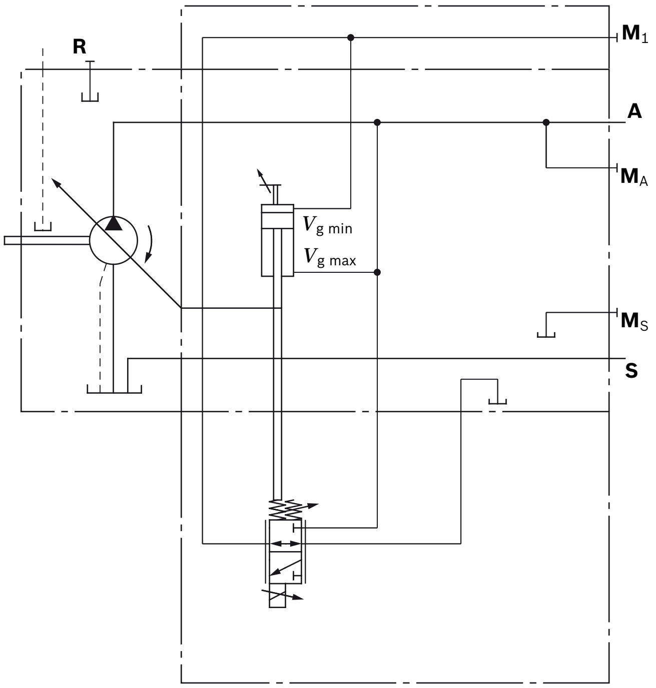
▼ **Characteristic curve EP**



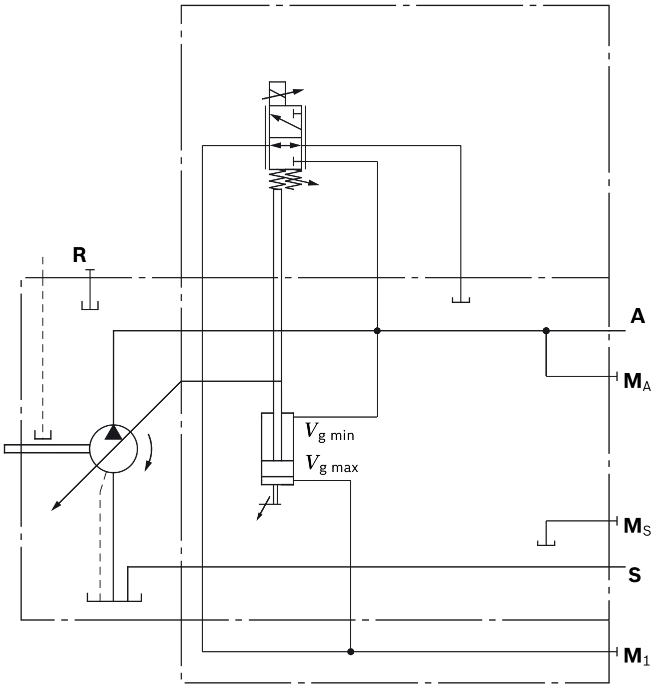
Technical data, solenoid	EP1, EP5	EP2, EP6
Voltage	12 V (± 20%)	24 V (± 20%)
Control current		
Start of control	400 mA	200 mA
End of control	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100%	100%
Type of protection: see connector version page 19		

Various BODAS controllers with application software and amplifiers are available for controlling the proportional solenoids.

▼ Circuit diagram EP1, EP2

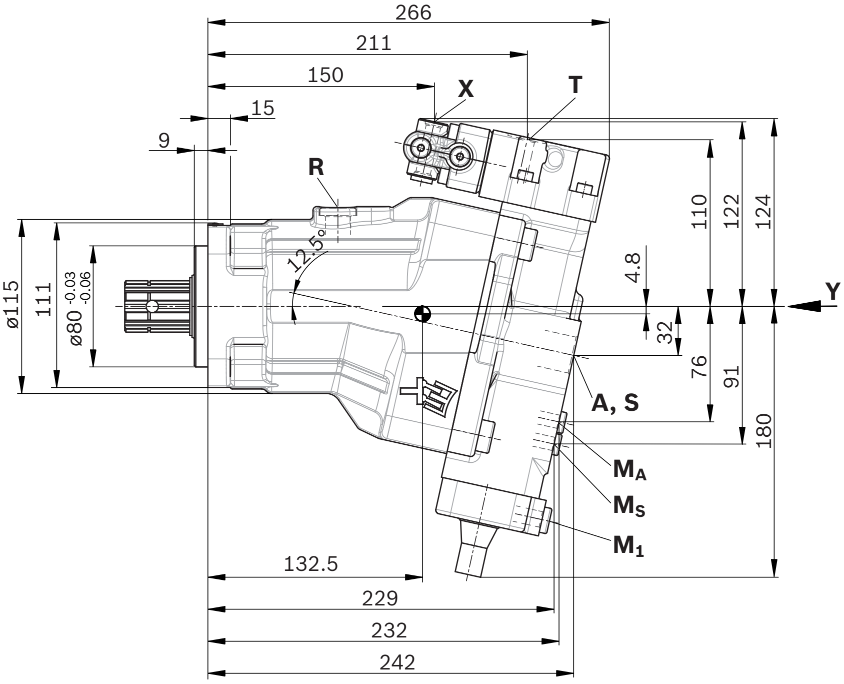


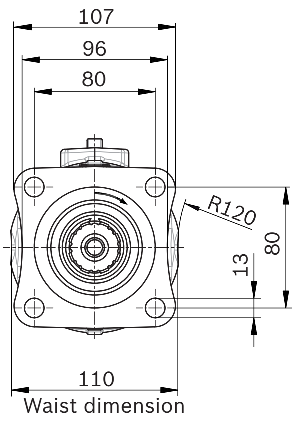
▼ Circuit diagram EP5, EP6

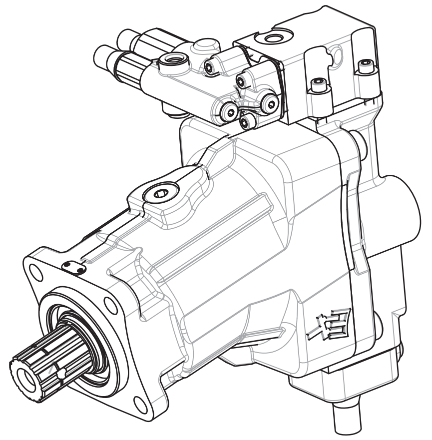


Dimensions, size 55

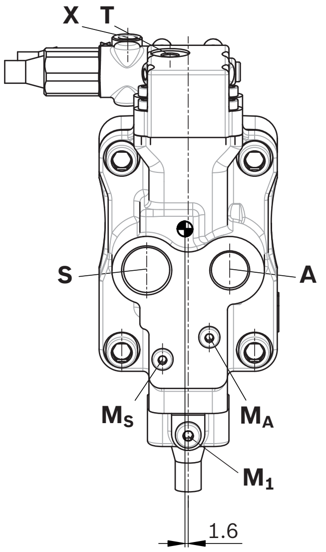
DRS – Pressure controller with load sensing



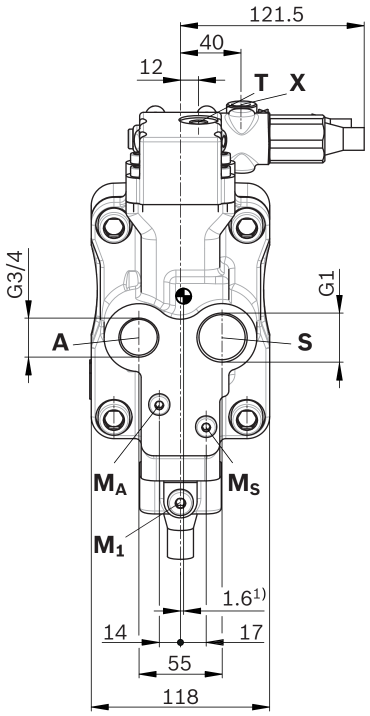




View **Y**
Counter-clockwise rotation

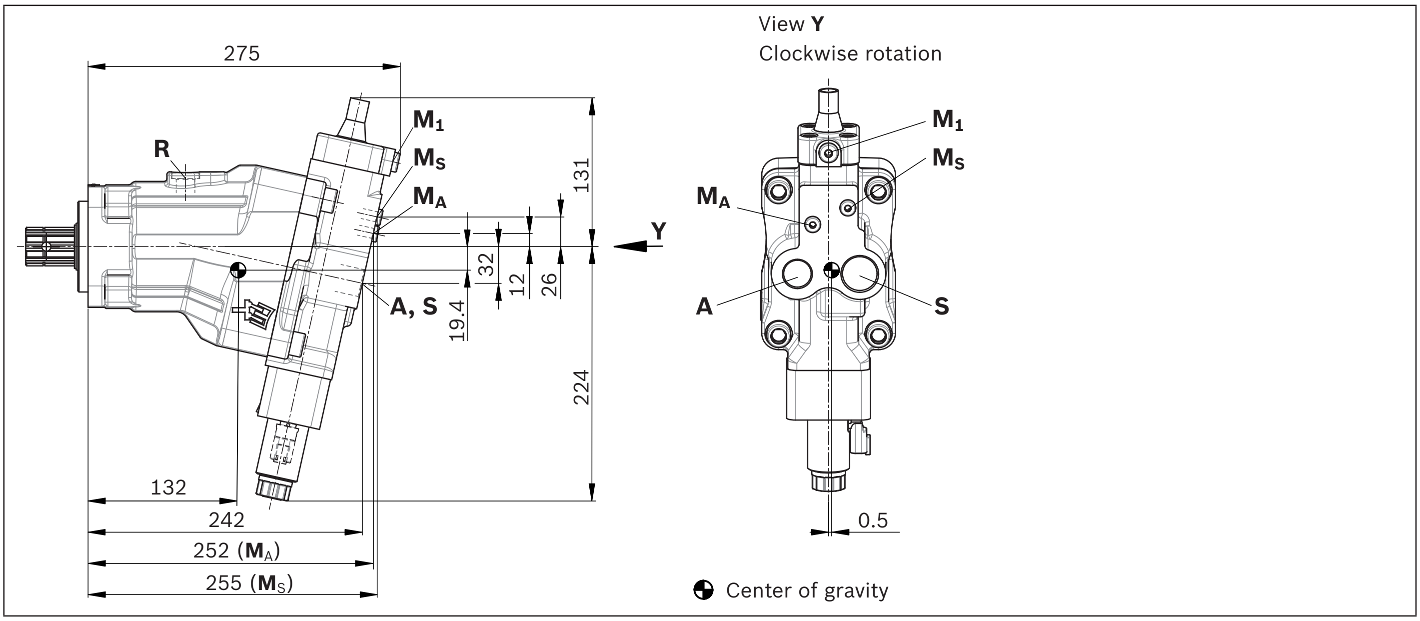


View **Y**
Clockwise rotation

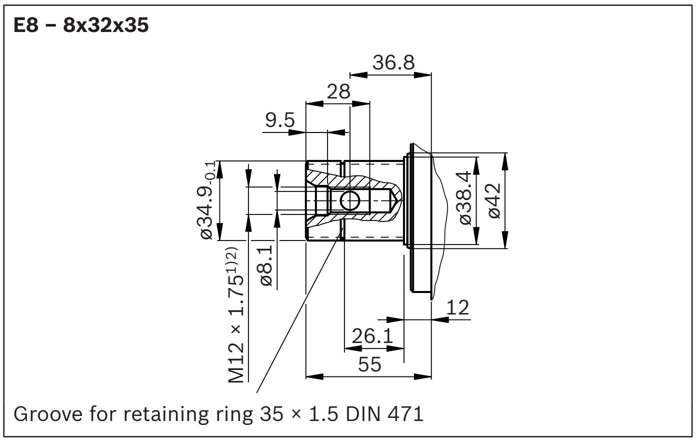


◐ Center of gravity

EP1, EP2 – Proportional electric control, positive control



▼ Splined shaft similar to DIN ISO 14


E8 – 8x32x35

Groove for retaining ring 35 × 1.5 DIN 471

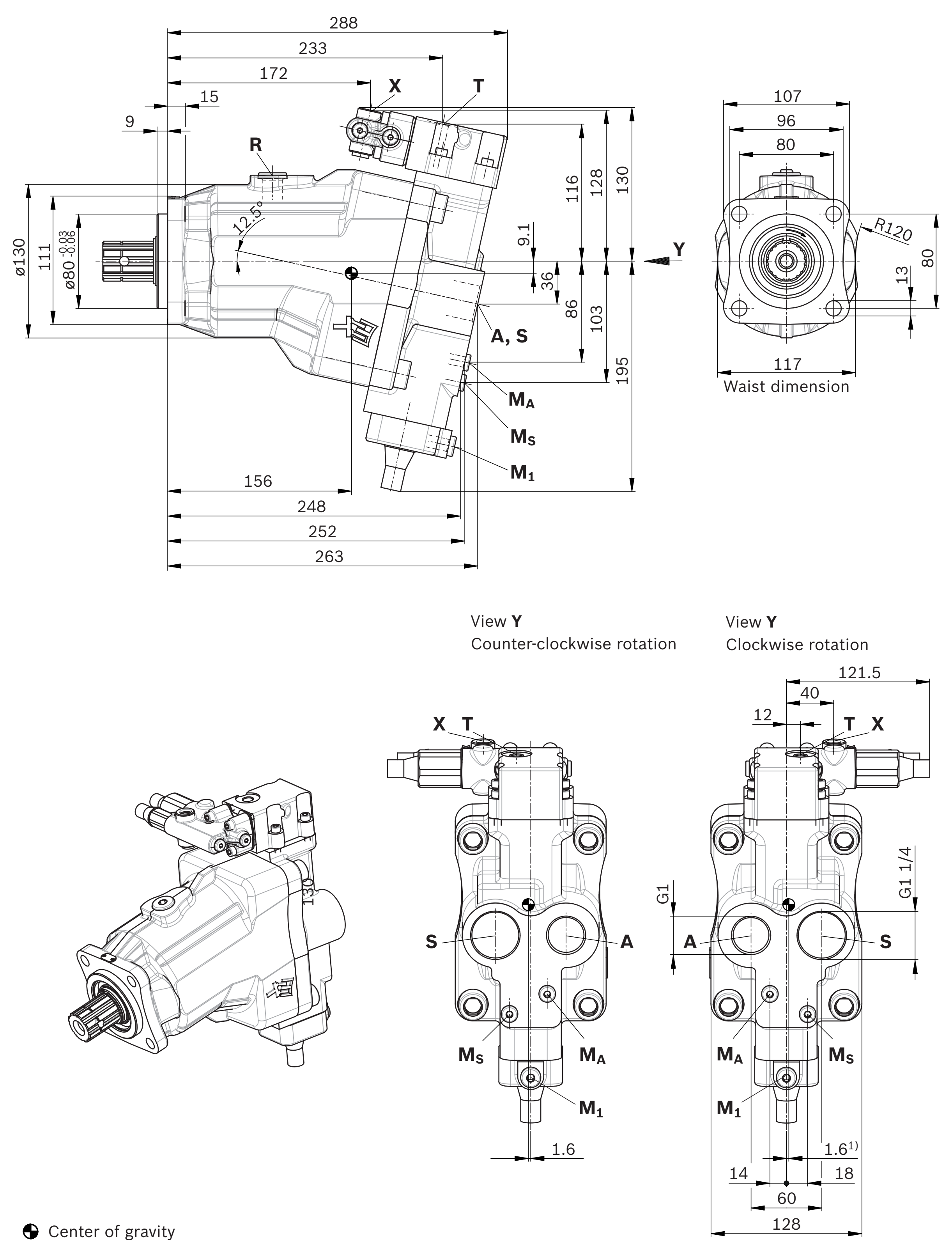
Ports		Standard	Size[2]	$p_{\max\,\text{abs}}$ [bar][3]	State[6]
A	Working port	DIN ISO 228	G3/4; 16 deep	400	O
S	Suction port	DIN ISO 228	G1; 18 deep	2	O
T	Drain port (DRS only)	DIN 3852[5]	M12 × 1.5; 12 deep	2	O
M$_A$	Measuring port, high pressure	DIN 3852[5]	M10 × 1; 8 deep	400	X
M$_S$	Measuring port, suction pressure	DIN 3852[5]	M10 × 1; 8 deep	2	X
M$_1$	Measuring port, stroking chamber	DIN 3852[5]	M12 × 1.5; 12 deep	400	X
R	Air bleed port	DIN 3852[5]	M18 × 1.5; 12 deep	2	X[4]
X	Load pressure port (DRS only)	ISO 11926[5]	7/16-20UNF-2B; 11.5 deep	400	O

---

1) Center bore according to DIN 332 (thread according to DIN 13)
2) For notes on tightening torques, see instruction manual
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) Only open port **R** for filling and air bleeding.
5) The spot face can be deeper than as specified in the standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions, size 80

DRS – Pressure controller with load sensing

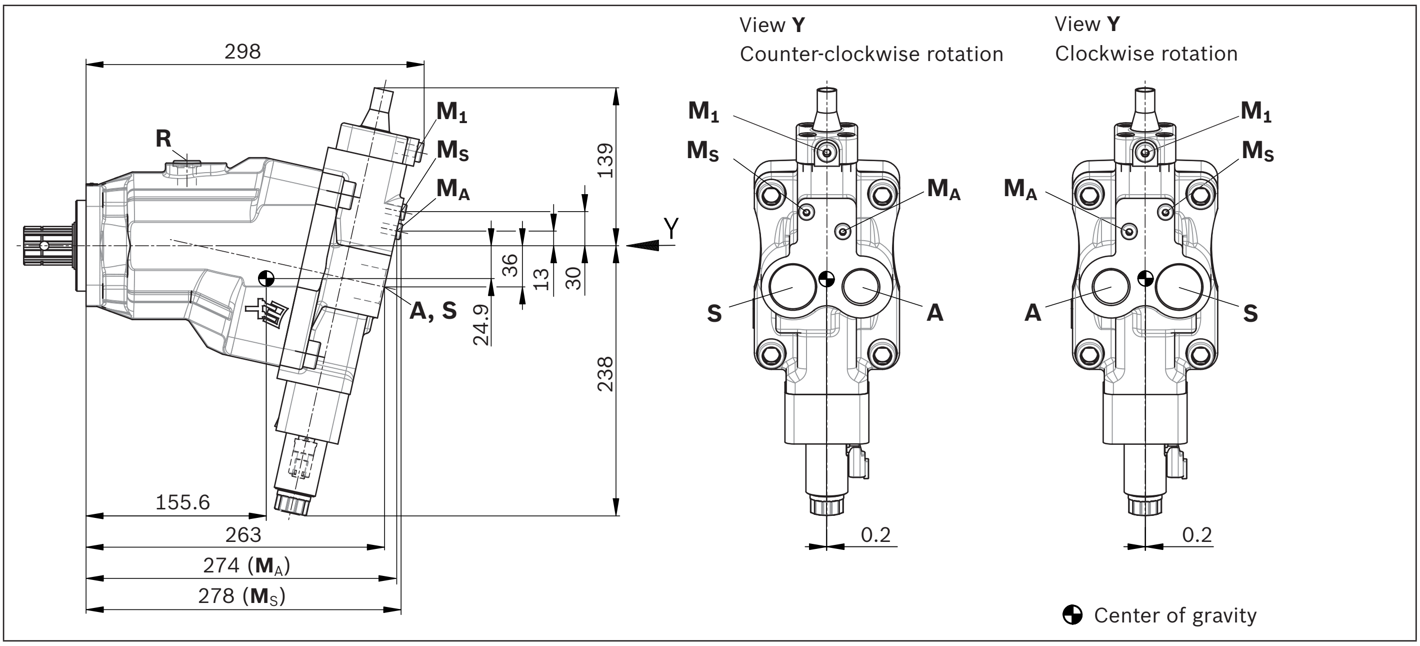


View **Y**
Counter-clockwise rotation

View **Y**
Clockwise rotation

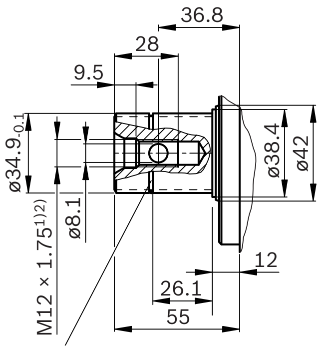
● Center of gravity

EP1, EP2 – Proportional electric control, positive control



▼ **Splined shaft similar to DIN ISO 14**

E8 – 8x32x35



Groove for retaining ring 35 × 1.5 DIN 471

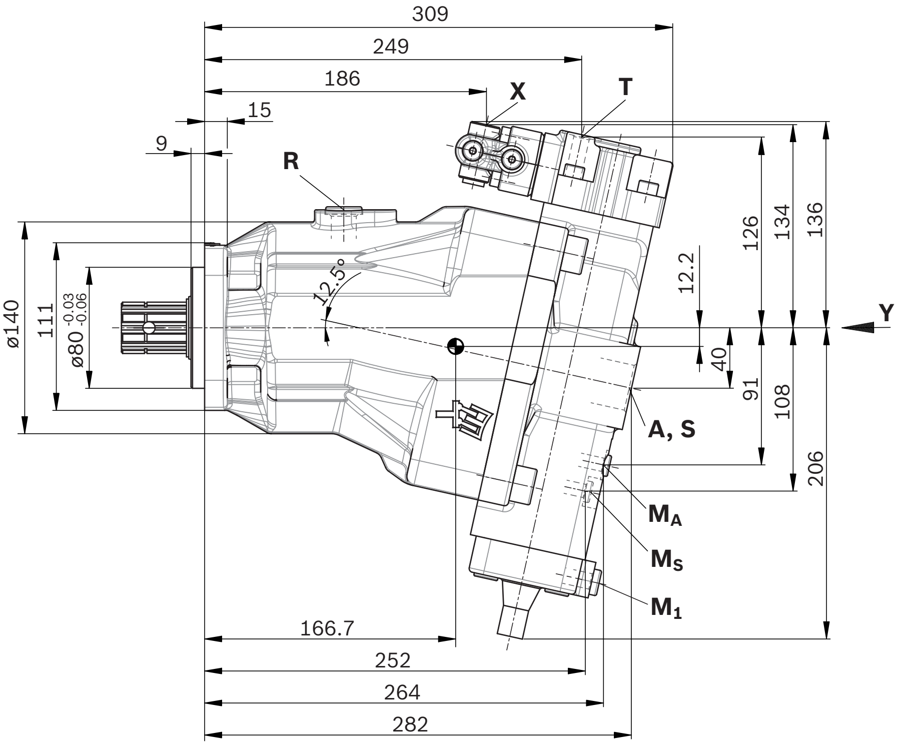
Ports		**Standard**	**Size**$^{2)}$	$p_{\text{max abs}}$ **[bar]**$^{3)}$	**State**$^{6)}$
A	Working port	DIN ISO 228	G1; 18 deep	400	O
S	Suction port	DIN ISO 228	G1 1/4; 20 deep	2	O
T	Drain port (DRS only)	DIN 3852$^{5)}$	M12 × 1.5; 12 deep	2	O
$\mathbf{M}_A$	Measuring port, high pressure	DIN 3852$^{5)}$	M10 × 1; 8 deep	400	X
$\mathbf{M}_S$	Measuring port, suction pressure	DIN 3852$^{5)}$	M10 × 1; 8 deep	2	X
$\mathbf{M}_1$	Measuring port, stroking chamber	DIN 3852$^{5)}$	M12 × 1.5; 12 deep	400	X
R	Air bleed port	DIN 3852$^{5)}$	M18 × 1.5; 12 deep	2	X$^{4)}$
X	Load pressure port (DRS only)	ISO 11926$^{5)}$	7/16-20UNF-2B; 11.5 deep	400	O

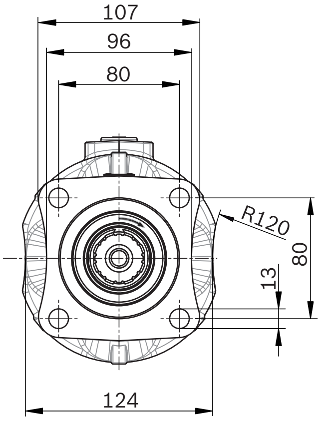
---

1) Center bore according to DIN 332 (thread according to DIN 13)
2) For notes on tightening torques, see instruction manual
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) Only open port **R** for filling and air bleeding.
5) The spot face can be deeper than as specified in the standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

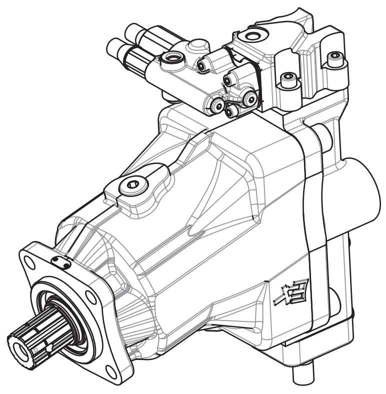
Dimensions, size 107

DRS – Pressure controller with load sensing

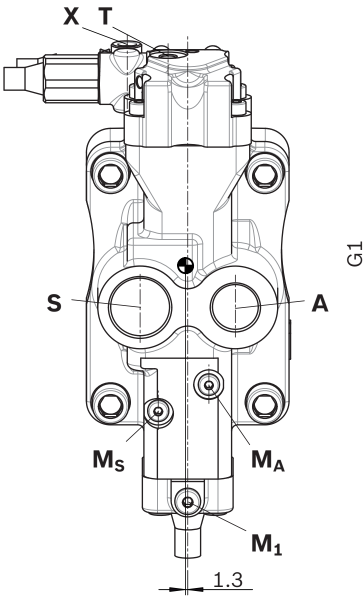




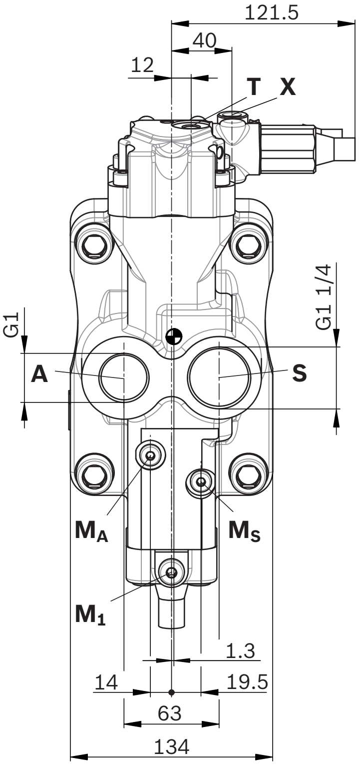
Waist dimension



View **Y**
Counter-clockwise rotation

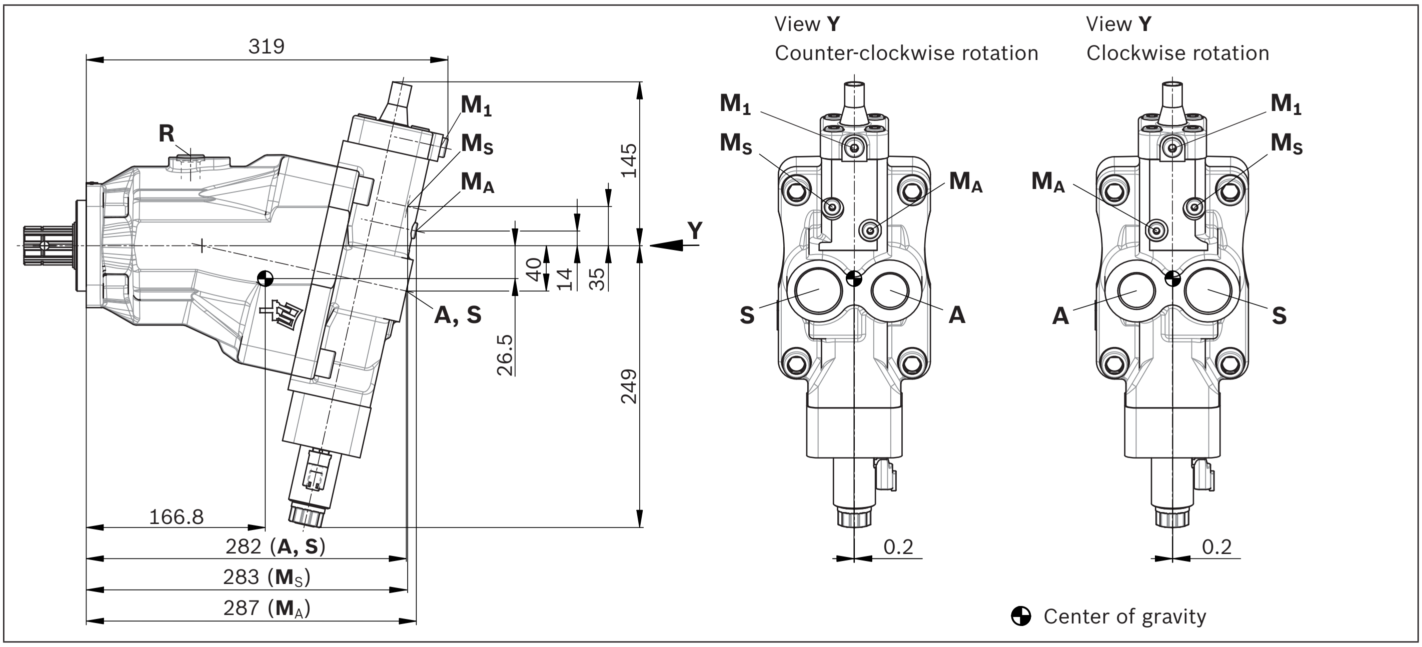


View **Y**
Clockwise rotation

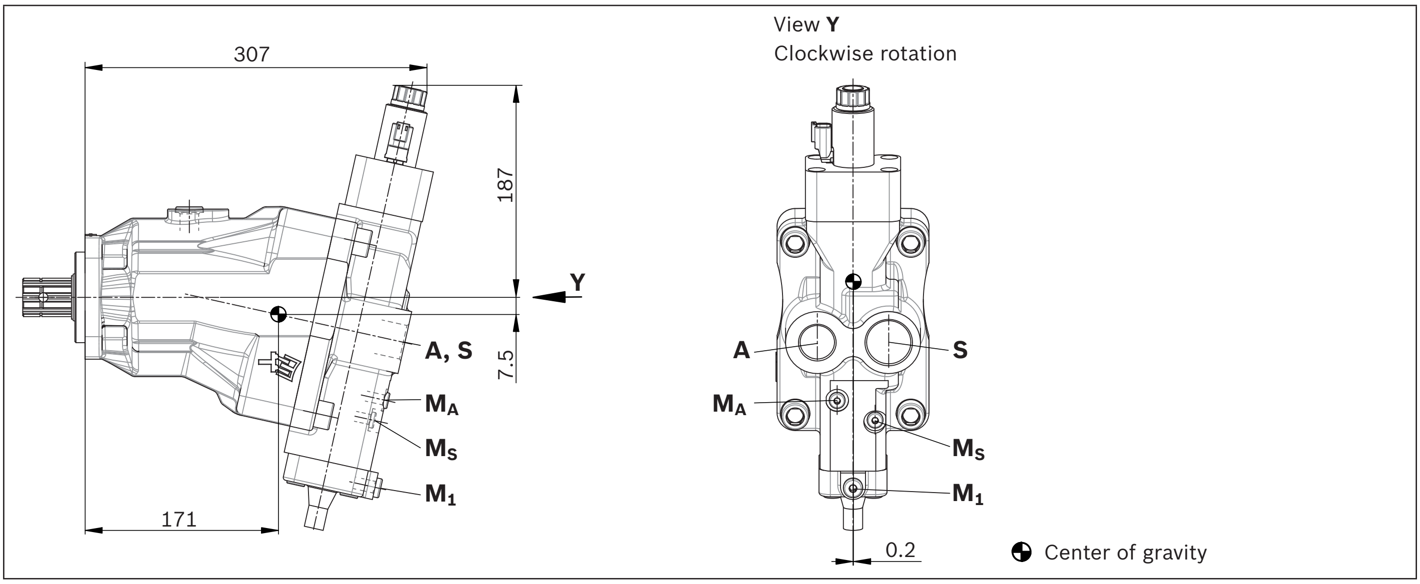


● Center of gravity

EP1, EP2 – Proportional electric control, positive control

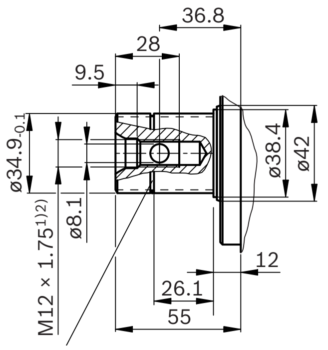


EP5, EP6 – Proportional electric control, negative control



▼ Splined shaft similar to DIN ISO 14

E8 – 8x32x35



Groove for retaining ring 35 × 1.5 DIN 471

Ports		Standard	Size[2]	$p_{\text{max abs}}$ [bar][3]	State[6]
A	Working port	DIN ISO 228	G1; 18 deep	400	O
S	Suction port	DIN ISO 228	G1 1/4; 20 deep	2	O
T	Drain port (DRS only)	DIN 3852[5]	M12 × 1.5; 12 deep	2	O
M_A	Measuring port, high pressure	DIN 3852[5]	M10 × 1; 8 deep	400	X
M_S	Measuring port, suction pressure	DIN 3852[5]	M10 × 1; 8 deep	2	X
M_1	Measuring port, stroking chamber	DIN 3852[5]	M12 × 1.5; 12 deep	400	X
R	Air bleed port	DIN 3852[5]	M18 × 1.5; 12 deep	2	X[4]
X	Load pressure port (DRS only)	ISO 11926[5]	7/16-20UNF-2B; 11.5 deep	400	O

---

1) Center bore according to DIN 332 (thread according to DIN 13)
2) For notes on tightening torques, see instruction manual
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) Only open port **R** for filling and air bleeding.
5) The spot face can be deeper than as specified in the standard.
6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Connector for solenoids

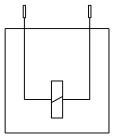
DEUTSCH DT04-2P-EP04

Molded connector, 2-pin, without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)

▼ **Circuit symbol**



▼ **Mating connector DEUTSCH DT06-2S-EP04**

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).

Note

- If necessary, you can change the connector orientation by turning the solenoid housing.
- The procedure can be taken from the instruction manual.

Speed sensors DSA and DSM

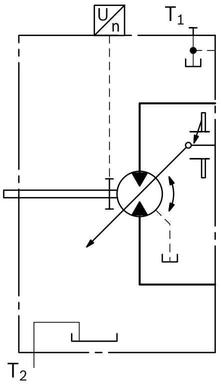
A signal proportional to pump speed can be generated with the fitted DSA/DSM speed sensor. The DSA/DSM sensor registers the speed and direction of rotation.

Type code, technical data, dimensions and details on the connector, plus safety instructions about the sensor can be found in the relevant data sheet 95133 (DSA) and 95132 (DSM).

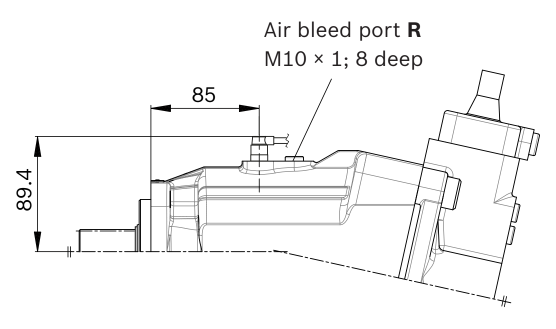
The sensor is mounted on the port provided for this purpose with a mounting bolt.

Size	80
Number of teeth	21

▼ **Circuit diagram**



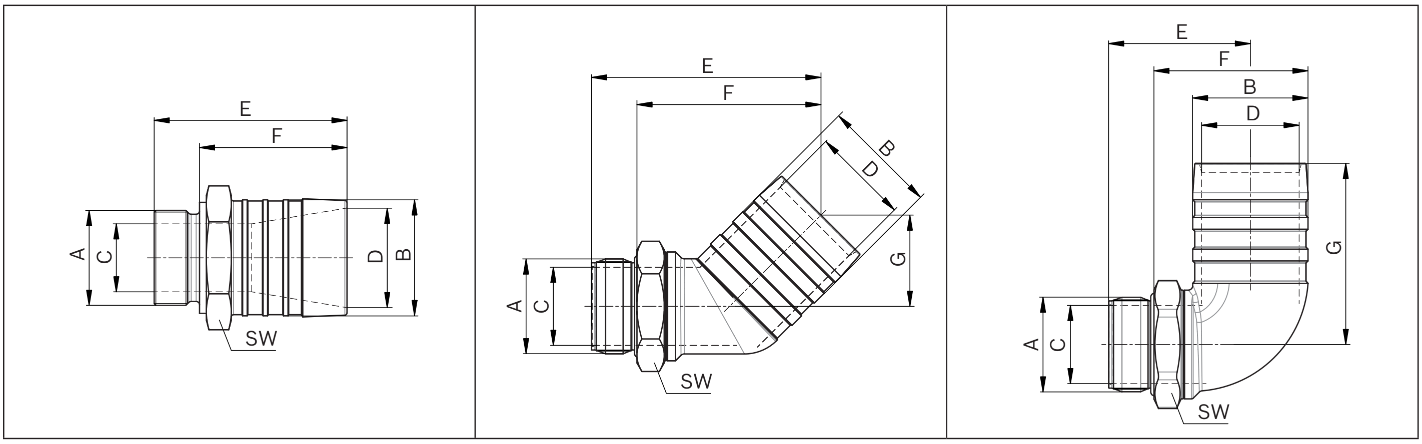
Dimensions

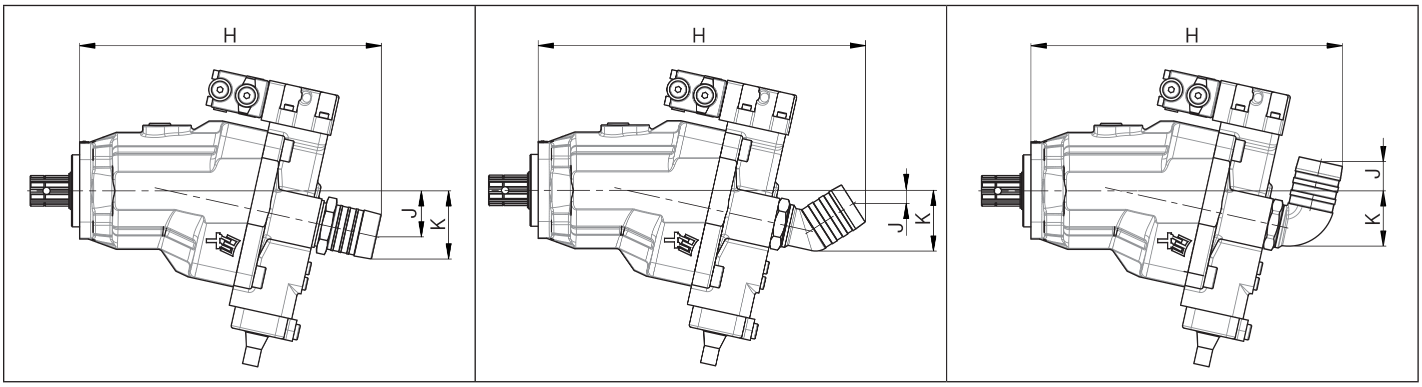


Accessories

Suction adapter

▼ Dimensions





Axial piston unit		Suction adapter												
NG	Port S	Inner Ø		Version	Material number									
	A	B [in]	B [mm]			ø C	ø D	E	F	G	WAF	H	J	K
55	G1	1 1/2	39	Straight	R902600251	23.5	33.5	72	54	–	41	301	44	63
55	G1	2	51		R902602028	26	44	82	64	–	55	312	47	70
80	G1 1/4	2	51		R902600252	30	44	85	65	–	55	335	51	76
107												354	55	79
107	G1 1/4	2 1/2	63		R902601630	31	54	82	64	–	65	354	54	79
55	G1	1 1/2	39	45°	R909831600	26	31	101	82	45	41	342	7	59
55	G1	2	51		R902602029	26	43	100	81	44	41	344	7	61
80	G1 1/4	2	51		R909831597	34	43	101	81	40	50	364	15	68
107												383	18	71
107	G1 1/4	2 1/2	63		R902601631	35	54	100	81	44	50	387	14	74
55	G1	1 1/2	39	90°	R909831599	26	31	64	44	85	41	321	41	56
55	G1	2	51		R902602030	26	43	62	42	81	41	324	38	58
80	G1 1/4	2	51		R909831598	35	43	63	43	80	50	346	33	66
107												365	29	70

When ordering, quote the material number of the version required

Notes on suction line

- Keep as short and straight as possible, without sharp bend
- Use a supporting ring for plastic hoses
- Use two hose clamps to protect the suction hose against air suction
- Note pressure resistance of suction hose compared to ambient pressure

Replacing seals

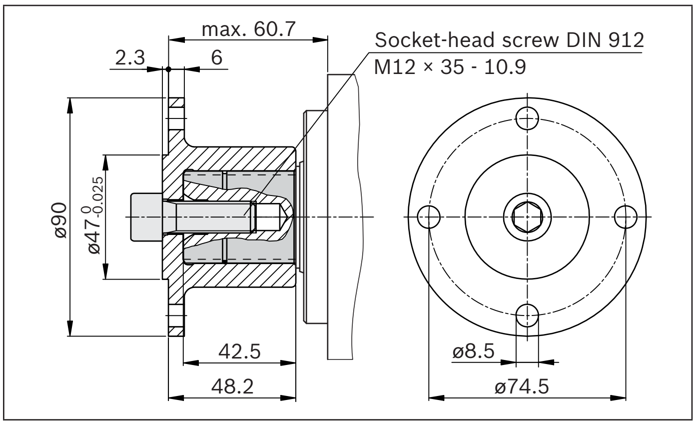
The O-rings used as seals to prevent air from entering the suction line are to be replaced after every removal and new installation in order to guarantee complete sealing.
Material number for O-rings:

- R909083802: O-ring for suction adapter G1
- R909083808: O-ring for suction adapter G1 1/4

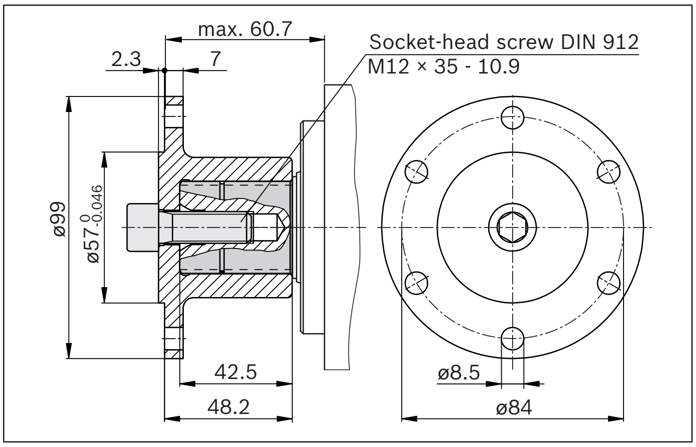
Coupling flange

There are special, modified coupling flanges in 4-hole and 6-hole design for the cardan shaft drive.
The coupling flange is not included in the scope of delivery and must be ordered separately.

▼ **4-hole coupling flange, complete – ø 90**
Material number: R902060152



▼ **6-hole coupling flange, complete – ø 100**
Material number: R902060153



Note

- Assembly of the coupling flange is carried out by pulling onto the drive shaft with the aid of the threaded bore in the drive shaft end.
- The coupling flange must be clamped on the drive shaft using a socket-head screw. In addition, permanent lubrication should be applied between the drive shaft and the coupling flange.
- The socket-head screw should be secured in a suitable manner (e.g. gluing with Loctite 276) and tightened with a tightening torque of 130 Nm.
- Sudden axial impact upon the drive shaft will lead to rotary group damage and therefore must be avoided at all costs.

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a long standstill as the axial piston unit can empty via the hydraulic lines.

The pump housing is internally connected to the suction chamber. A separate drain line from the housing to the reservoir is not needed. Exception: To ensure thermal stability, a drain line from port **T** to the reservoir is generally required with the DRS controller.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction line and drain line must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\ max}$ = 800 mm. The minimum suction pressure at port **S** must not fall below 0.8 bar absolute during both operation and during cold start.

When designing the reservoir, ensure that there is adequate spacing between the suction line and the drain line. This minimizes oil turbulence and carries out degassing, which prevents the heated hydraulic fluid from being sucked directly back in again.

Key	
F	Filling/air bleeding
R	Air bleed port
S	Suction port
T	Drain port (DRS only)
M_S	Measuring port, suction pressure
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)

Note

Port **F** is part of the external piping and must be provided by the customer to make filling and air bleeding easier.

Installation position

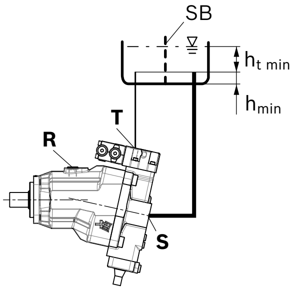
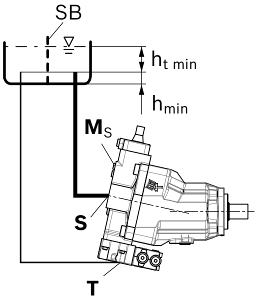
See the following examples **1** to **4**.

Additional installation positions are available upon request.

Recommended installation position: **1** and **2**.

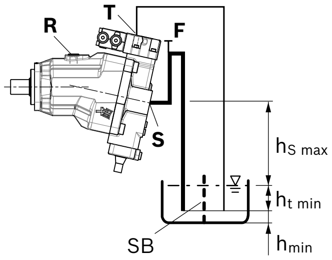
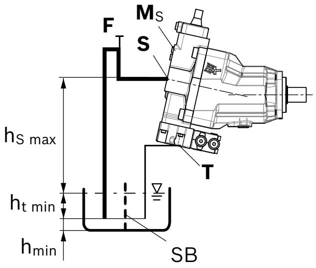
Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.

Installation position		Air bleeding	Filling
1		**R**	**S**
2		**M_S**	**S**

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.

Installation position		Air bleeding	Filling
3		**R**	**F**
4		**M_S**	**F**

Other related documents

Other pumps with special properties and dimensions for use in commercial vehicles can be found in the following data sheets:

- 91510: Fixed pump A17FNO, 250/300 bar
- 91520: Fixed pump A17FO, 350/400 bar
- 92280: Variable pump, A18VLO 350/400 bar

Project planning notes

- The A18VO pump is designed to be used in open circuits.
- The project planning, installation and commissioning of the axial piston unit require the involvement of qualified skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, request it from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The specified data and notes must be observed.
- Depending on the operating condition of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation times apply under optimal storage conditions, details of these conditions can be found in the data sheet 90312 or the instruction manual.
- Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference. Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- Pressure controllers are not safeguards against pressure overload. A pressure relief valve is to be provided in the hydraulic system.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports can only be used to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control and regulation systems (e.g. valve spools) may in certain circumstances become stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid, abrasion or residual dirt from components). As a result, the hydraulic fluid flow or build-up of torque of the axial piston unit will no longer respond correctly to the operator's commands. Even the use of different filter cartridges (external or internal inlet filter) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.

Axial Piston Variable Pump
A18VLO Series 11

- Size 80
- Nominal pressure 350 bar
- Maximum pressure 400 bar
- For commercial vehicles
- Open circuit

Features

- Variable pump with axial tapered piston rotary group of bent-axis design with special characteristics and dimensions for use in commercial vehicles
- The flow is proportional to the drive speed and displacement.
- The flow can be infinitely varied by adjusting the bent-axis angle.
- Favorable power-to-weight ratio, compact dimensions, optimum efficiency, economical design
- High self-suction capability
- Flange and shaft designed for direct mounting on the power take-off of commercial vehicles
- Low noise levels
- Increased pressure (350/400 bar) compared to standard pump A17VO
- Increased service life through use of long-life bearings

Contents

Ordering code

01	02	03	04	05	06		07	08	09	10	11	12	13	14		15
A18V	**LO**	**080**	**DRS**	**0**	**E**	**/**	**11**	**N**		**W**	**K0**			**0**	**–**	

Axial piston unit

01	Bent-axis design, variable, nominal pressure 350 bar, maximum pressure 400 bar, for commercial vehicles (trucks)	**A18V**

Operating mode

02	Pump, Open circuit, with long-life bearings	**LO**

Sizes (NG)

03	Geometric displacement, see table of values on page 6	**080**

Control devices

04	Pressure controller with load sensing	**DRS**

Additional functions 1

05	Without additional functions	**0**

Additional functions 2

06	DRS controller with external pump measuring pressure port and mechanically adjustable $V_{g\,\text{min}}$ stop	**E**

Series

07	Series 1, index 1	**11**

Configuration of ports and fastening threads

08	Metric, port threads with profiled sealing ring according to DIN 3852	**N**

Directions of rotation

09	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Seals

10	FKM (fluor-caoutchouc) including the 2 shaft seal rings in FKM	**W**

Mounting flange

11	Special flange ISO 7653-1985 (for trucks)	**K0**

Drive shaft

12	Splined shaft similar to DIN ISO 14 (for trucks)	**E8**
	Splined shaft E8 with coupling flange	**C8**

Port plate for service lines

13	Threaded ports A and S at rear	**1**
	Threaded ports A and S at rear, with suction stud mounted in S	**2**

Additional functions 3

14	Without additional functions	**0**

Standard / special version

15	Standard version	**0**
	Special version	**S**

Technical data

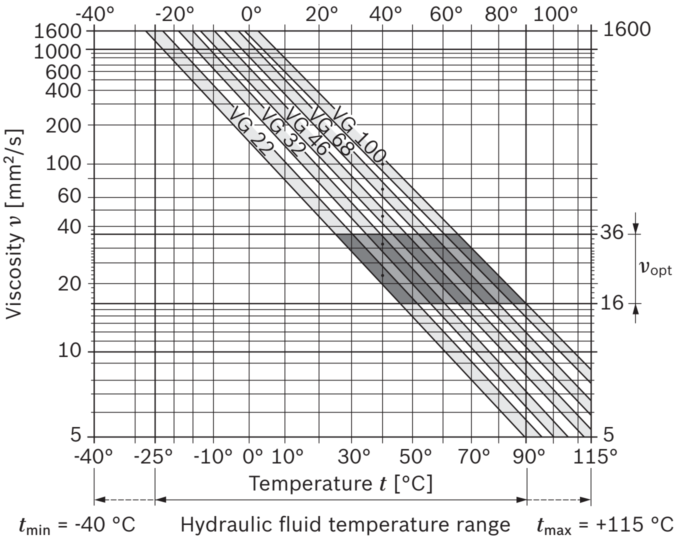
Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil) and RE 90221 (environmentally acceptable hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.
If environmentally acceptable hydraulic fluids are used, the limitations regarding technical data or other seals must be observed. Please contact us.

Note

Variable pump A18VLO is not suitable for operation with water-containing HF hydraulic fluid.

▼ **Selection diagram**



Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature: in an open circuit the reservoir temperature.
The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see shaded area of the selection diagram). We recommended that the higher viscosity class be selected in each case.
Example: At an ambient temperature of X °C, an operating temperature of 60 °C is set in the circuit. In the optimum operating viscosity range (ν_{opt}, shaded area), this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Note

The case drain temperature, which is affected by pressure and speed, can be higher than the reservoir temperature. At no point of the component may the temperature be higher than 115 °C. The temperature difference specified below is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact us.

Viscosity and temperature of hydraulic fluid

	Viscosity [mm^2/s]	Temperature	Comment
Transport and storage at ambient temperature		$T_{min} \geq -40$ °C $T_{opt} = +5$ °C to $+20$ °C	factory preservation: up to 12 months with standard, up to 24 months with long-term
(Cold) start-up	$\nu_{max} = 1600$	$T_{St} \geq -40$ °C	$t \leq 3$ min, without load ($p \leq 50$ bar), $n \leq 1000$ rpm
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu < 1600$ to 400	$T = -40$ °C to -25 °C	at $p \leq 0.7 \cdot p_{nom}$, $n \leq 0.5 \cdot n_{nom}$ and $t \leq 15$ min
Operating phase			
Temperature difference		ΔT = approx. 12 K	between hydraulic fluid in the bearing and at port R
Maximum temperature		115 °C	in the bearing
		103 °C	measured at port R
Continuous operation	$\nu = 400$ to 10 $\nu_{opt} = 36$ to 16	$T = -25$ °C to $+90$ °C	measured at port R, no restriction within the permissible data
Short-term operation	$\nu_{min} \geq 7$	$T_{max} = +103$ °C	measured at port R, $t < 3$ min, $p < 0.3 \cdot p_{nom}$
Shaft seal FKM		$T \leq +115$ °C	see page 4

Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

To ensure the functional reliability of the axial piston unit, a gravimetric analysis of the hydraulic fluid is necessary to determine the amount of solid contaminant and to determine the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 is to be maintained.

At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

If the above classes cannot be achieved, please contact us.

Case drain fluid

The case drain chamber is connected to the suction chamber. A case drain line from the case to the reservoir is not required (port "R" is plugged).

On versions with DRS control, a case drain line for discharge from port "T" to the reservoir is absolutely essential.

Shaft seal

The FKM shaft seal may be used for case drain temperatures from -25 °C to +115 °C.

Note

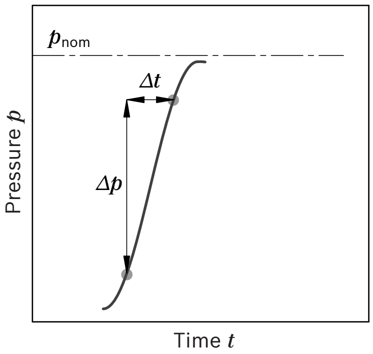
For the temperature range below -25 °C, the values in the table on page 3 are to be observed.

Operating pressure range

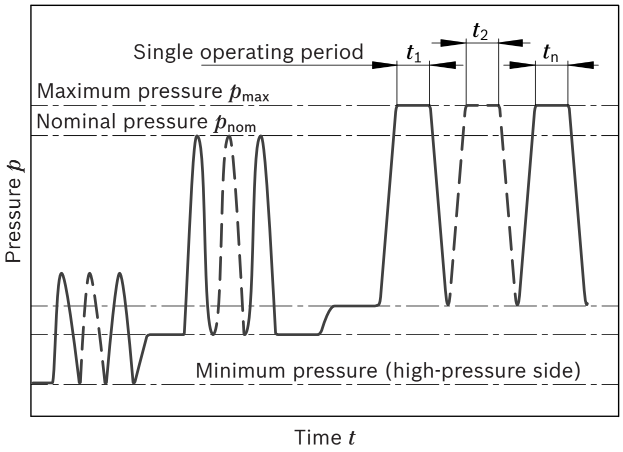
Valid when using hydraulic fluids based on mineral oils

Pressure at service line port A		Definition
Nominal pressure p_{nom}	350 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	400 bar absolute	The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	5 s	
Total operating period	50 h	
Minimum pressure (high-pressure side)	10 bar absolute	Minimum pressure at the high-pressure side (A) which is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{A\ max}$	9000 bar/s	Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{S\ min}$	0.8 bar absolute	Minimum pressure at suction port S (inlet) which is required in order to prevent damage to the axial piston unit. The minimum pressure is dependent on the speed and displacement of the axial piston unit.
Maximum pressure $p_{S\ max}$	2 bar absolute	

▼ **Rate of pressure change $R_{A\ max}$**



▼ **Pressure definition**



Total operating period = $t_1 + t_2 + \ldots + t_n$

Note

Values for other hydraulic fluids, please contact us.

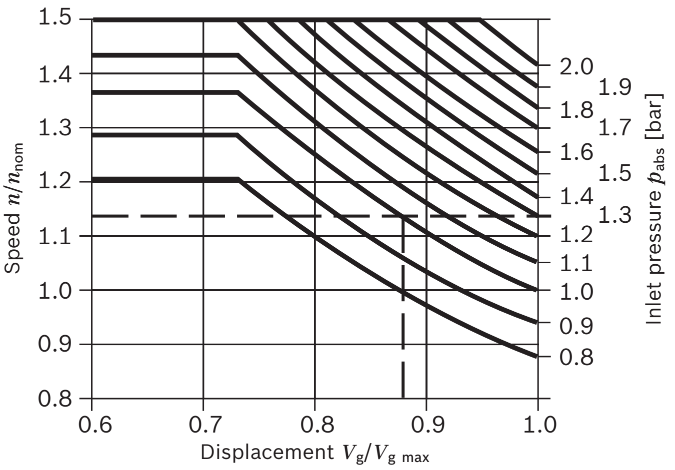
Table of values

Theoretical values, without efficiency and tolerances; values rounded

Size		NG		80
Displacement geometric, per revolution		$V_{g\ max}$	cm³	80
Speed maximum[1]	at $V_{g\ max}$	n_{nom}	rpm	2240
	at $V_g < 0.74 \cdot V_{g\ max}$	n_{max1}	rpm	3000
Speed maximum[2]		n_{max2}	rpm	3350
Flow	at n_{nom} and $V_{g\ max}$	q_v	L/min	179
Power	at n_{nom}, $V_{g\ max}$ and Δp = 350 bar	P	kW	105
Torque	at $V_{g\ max}$ and Δp = 350 bar	T	Nm	446
Rotary stiffness	$V_{g\ max}$ to $0.5 \cdot V_{g\ max}$	c_{min}	Nm/rad	15911
	$0.5 \cdot V_{g\ max}$ bis $0_{(interpolated)}$	c_{max}	Nm/rad	48971
Moment of inertia for rotary group		J_{GR}	kgm²	0.0066
Maximum angular acceleration		α	rad/s²	24200
Case volume		V	L	0.8
Mass moment		T_G	Nm	38
Mass (approx.)		m	kg	24.4

[1] The values are valid:
- at an absolute pressure p_{abs} = 1 bar at suction port S
- for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s
- with hydraulic fluid based on mineral oils

[2] Maximum rotational speed (limit speed) for increased inlet pressure p_{abs} at suction port S and $V_g < V_{g\ max}$, see the following diagram.



Note

Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, with respect to speed variation, reduced angular acceleration as a function of the frequency and the permissible start up angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.

Determining the operating characteristics

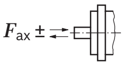
Formulas		
Flow	$q_v = \dfrac{V_g \cdot n \cdot \eta_v}{1000}$	[L/min]
Torque	$T = \dfrac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}}$	[Nm]
Power	$P = \dfrac{2\,\pi \cdot T \cdot n}{60000} = \dfrac{q_v \cdot \Delta p}{600 \cdot \eta_t}$	[kW]

Key

V_g = Displacement per revolution in cm³
Δp = Differential pressure in bar
n = Speed in rpm
η_v = Volumetric efficiency
η_{mh} = Mechanical-hydraulic efficiency
η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

Permissible axial forces of the drive shaft

The values given are maximum values and do not apply to continuous operation. For drives with radial loading (pinion, V-belt drives), please contact us!

Size		NG		80
When standstill or when axial piston unit operating in non-pressurized conditions		$\pm F_{\text{ax max}}$	N	0
Permissible axial force per bar operating pressure		$+ F_{\text{ax max}}$	N/bar	86
		$- F_{\text{ax max}}$	N/bar	0

Note

Influence of the direction of the permissible axial force:

$+ F_{\text{ax max}}$ = Increase in service life of bearings

$- F_{\text{ax max}}$ = Reduction in service life of bearings (avoid)

DRS – Pressure control with load sensing

Function of the pressure controller

The pressure controller limits the maximum pressure at the pump outlet within the control range of the pump. The variable pump only delivers as much hydraulic fluid as the consumers actually need. If the operating pressure exceeds the pressure setpoint set at the integrated pressure valve, the pump will regulate to a smaller displacement to reduce the control deviation.

In a non-pressurized state, the pump is swiveled to its initial position to $V_{g\,max}$ by a return spring.

- Setting range for pressure control: 80 to 400 bar
- Standard setting: 350 bar

Note

A pressure-relief valve is provided to limit the maximum pressure in the system. This must be at least 20 bar above the control setting at the start of opening.

The pressure controller overrides the load sensing controller, i.e. the load sensing function operates below the set pressure.

Load sensing function

The load sensing controller works as a load-pressure controlled flow compensator and adjusts the displacement of the pump to the volume required by the consumer.

The flow of the pump is then dependent on the cross section of the external metering orifice (1), which is located between the pump and the consumer. Below the setting of the pressure control and within the control range of the pump, the flow is not dependent on the load pressure.

As a rule, the metering orifice is a separately located load sensing directional valve (control block). The position of the directional valve piston determines the opening cross section of the metering orifice and thus the flow of the pump.

The load sensing controller compares the pressure before the metering orifice with that after the orifice and maintains the pressure drop encountered here (differential pressure Δp) and thus the flow constant.

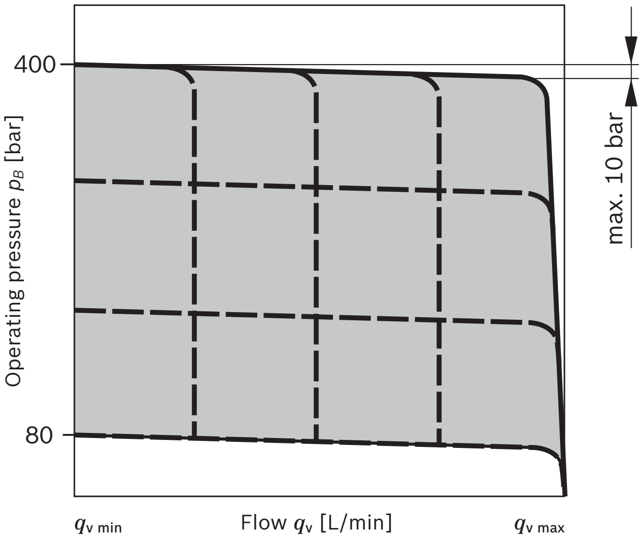
If the differential pressure Δp at the metering orifice rises, the pump is swiveled back (toward $V_{g\,min}$). If the differential pressure Δp drops, the pump is swiveled out (toward $V_{g\,max}$) until equilibrium at the metering orifice is restored.

$\Delta p_{\text{Metering orifice}} = p_{\text{Pump}} - p_{\text{Consumer}}$

- Setting range for Δp 19 to 40 bar
- Standard setting: 30 bar

The stand-by pressure in zero-stroke mode (metering orifice closed) is slightly higher than the Δp setting.

▼ **Characteristic DRS**

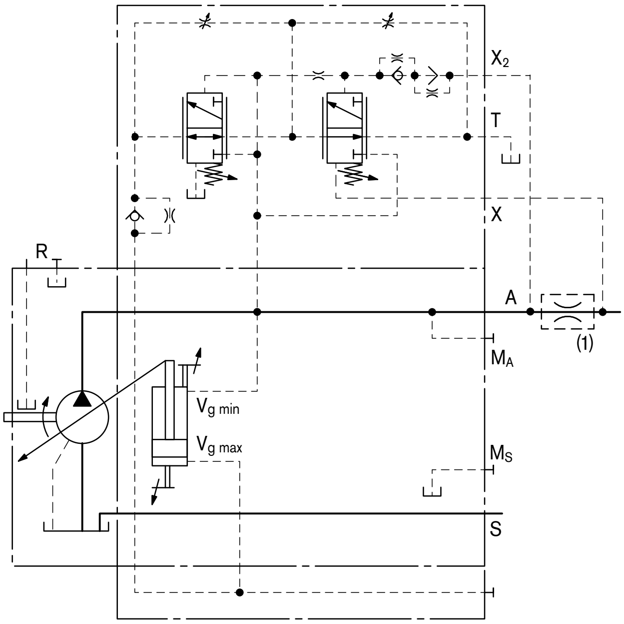


DRS.E

With external pump measuring pressure port

With the standard DRS controller, the internal pump pressure at the LS piston is compared to the load pressure from the X port. With the DRS.E controller, the pressure from the inlet line to the valve block is led via a separate external line to port X_2 where it is compared to the load pressure at the LS piston. For partial flow quantities, this results in better system efficiency.

▼ **Schematic DRS.E**



(1) The sensing orifice (control block) is not included in the delivery contents.

Zero-stroke mode

The standard version is designed for intermittent, constant-pressure operation. Short-term (< 1 min), zero-stroke operation is permissible up to an operating pressure p_{nom} = 350 bar with reservoir temperature ≤ 50 °C.

Note

To ensure thermal stability, a case drain line from port "T" to the reservoir is generally required with the DRS controller.

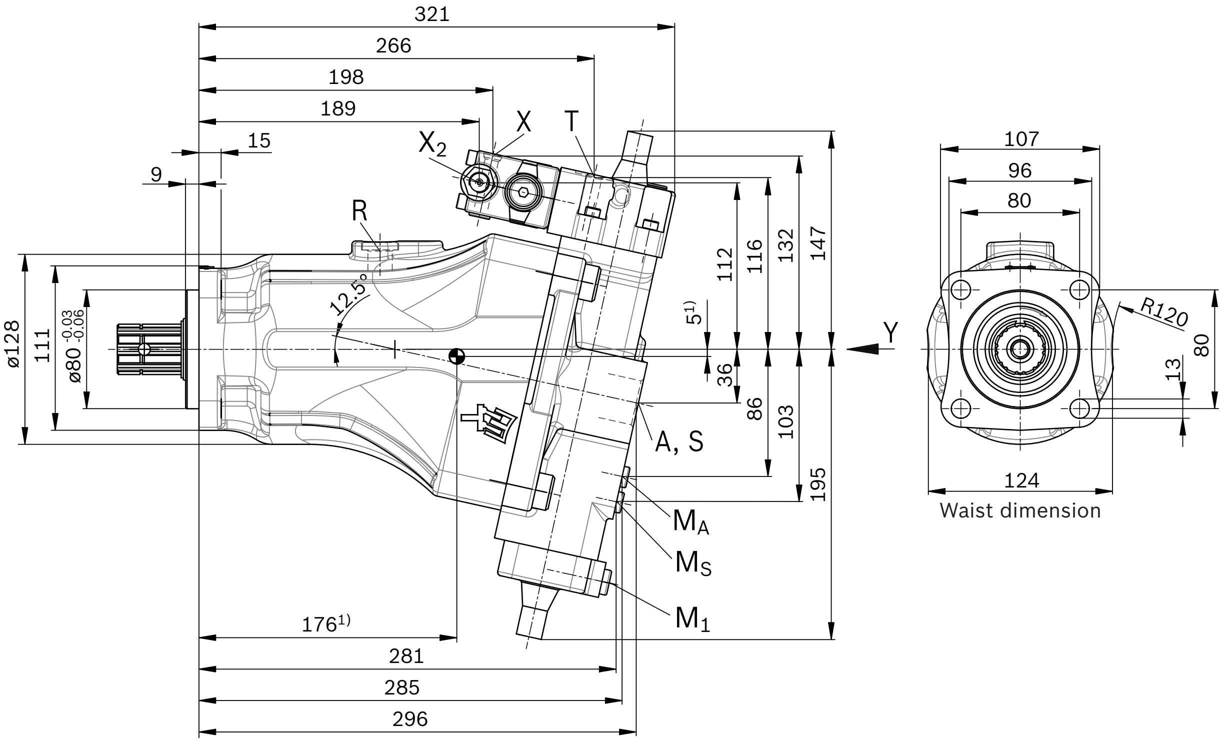
When ordering, please state in plain text:

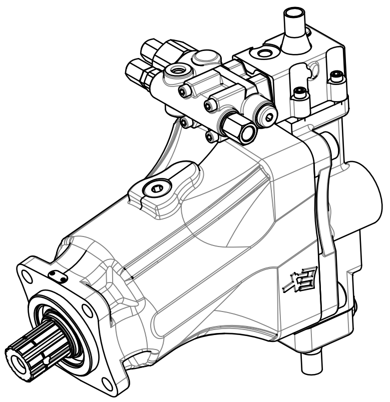
- Pressure control setting
- Δp setting for load sensing function

If these details are missing from the order, the pump will be delivered with the standard setting, see page 8.

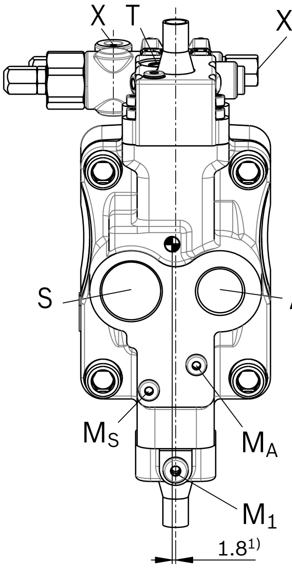
Dimensions size 80

DRS – Pressure controller with load sensing

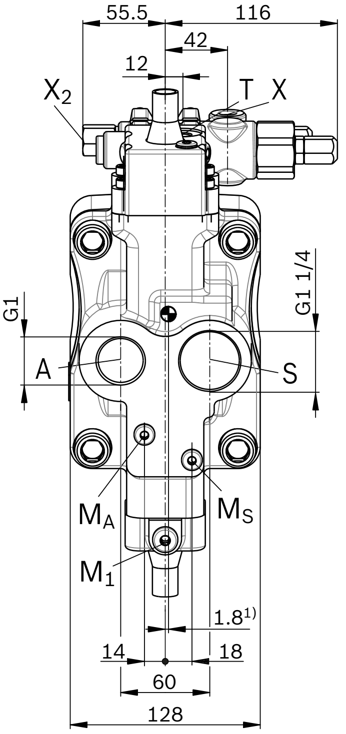




View Y
Counter-clockwise rotation



View Y
Clockwise rotation

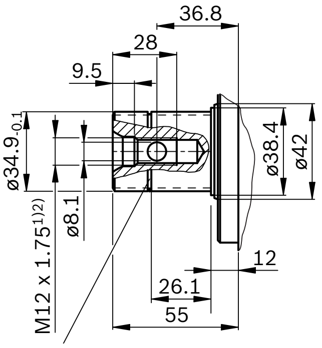


[1] Center of gravity

Drive shaft

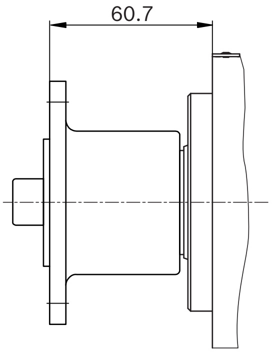
Splined shaft similar to DIN ISO 14 ...with coupling flange

E8 – 8x32x35



Groove for retaining ring
35 x 1.5 DIN 471

C8



Ports

Designation	Port for	Standard	Size[2]	Maximum pressure [bar][3]	State[6]
A	Service line	DIN ISO 228	G1; 18 deep	400	O
S	Suction line	DIN ISO 228	G1 1/4; 20 deep	2	O
T	Drain line (DRS only)	DIN 3852[5]	M12 x 1.5; 12 deep	2	O
M_A	Measuring pressure A	DIN 3852[5]	M10 x 1; 8 deep	400	X
M_S	Measuring suction pressure	DIN 3852[5]	M10 x 1; 8 deep	2	X
M_1	Measuring stroking chamber	DIN 3852[5]	M12 x 1.5; 12 deep	400	X
R	Air bleed	DIN 3852[5]	M18 x 1.5; 12 deep	2	X[4]
X	Load pressure (load sensing)	ISO 11926[5]	7/16-20UNF-2B; 11.5 deep	400	O
X_2	Pump working pressure	DIN 3852[5]	M14 x 1.5; 12 deep	400	O

1) Center bore according to DIN 332 (thread according to DIN 13)

2) Observe the general instructions on page 16 for the maximum tightening torques.

3) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

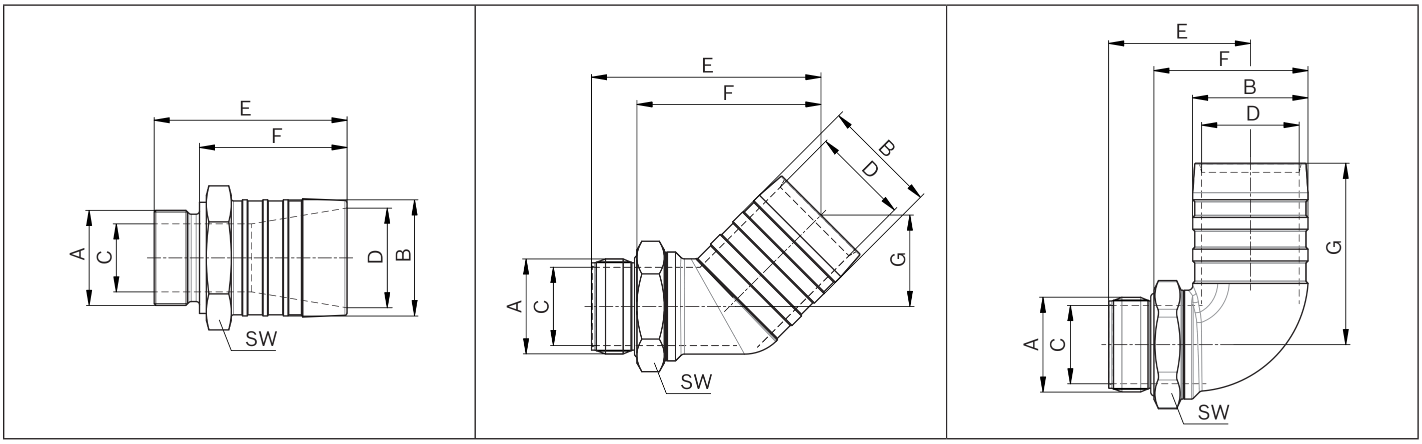
4) Only open port R for filling and air bleed.

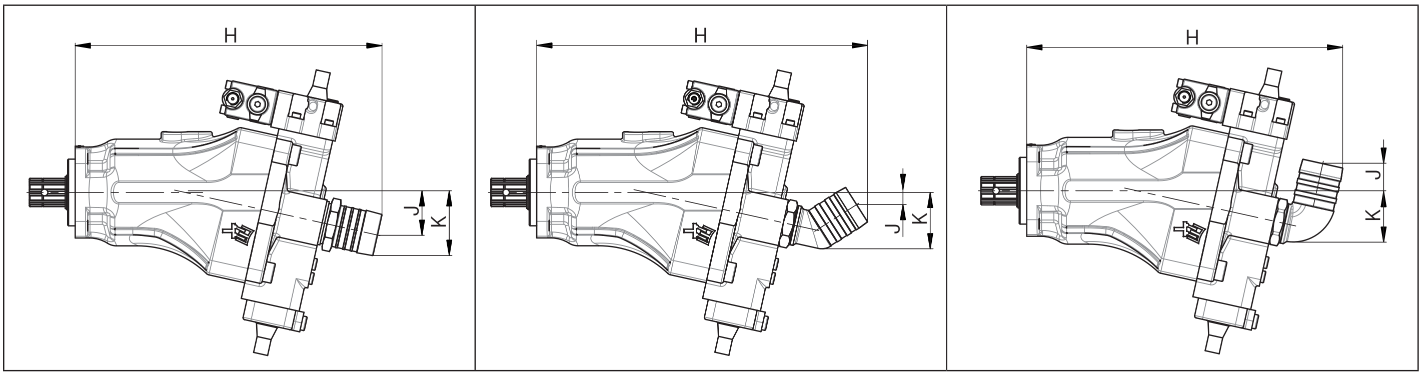
5) The spot face can be deeper than specified in the appropriate standard.

6) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Suction stud

Dimensions





Axial piston unit		Suction stud												
NG	Port S	Inner Ø		Version	Material number									
	A	B [in]	B [mm]			ØC	ØD	E	F	G	SW	H	J	K
80	G1 1/4	2	51	Straight	R902600252	30	44	85	65	–	55	368	51	76
				45°	R909831597	34	43	101	81	40	50	397	15	68
				90°	R909831598	35	43	63	43	80	50	379	33	66

Notes on suction line

- Keep as short and straight as possible, without bend
- Use a supporting ring for plastic hoses
- Use two hose clamps to protect the suction hose against air suction
- Note pressure resistance of suction hose compared to ambient pressure

Replacing seals

The O-rings used as seals to prevent air from entering the suction line are to be replaced after every removal and new installation in order to guarantee complete sealing.

Material number for O-rings:

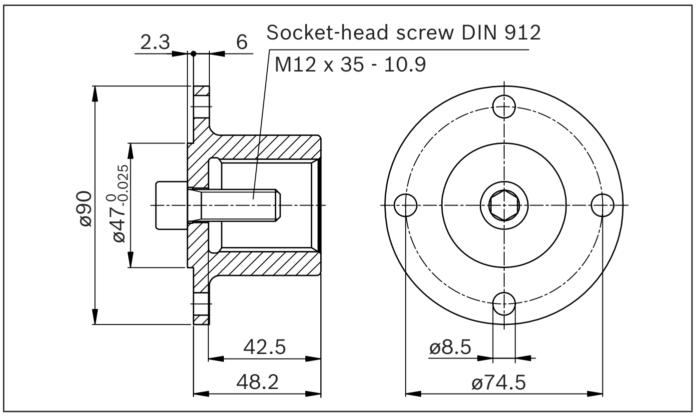
- R902083808: O-ring for suction stud G1 1/4

Coupling flange

There are specially modified coupling flanges in 4-hole and 6-hole designs for the cardan-shaft drive.

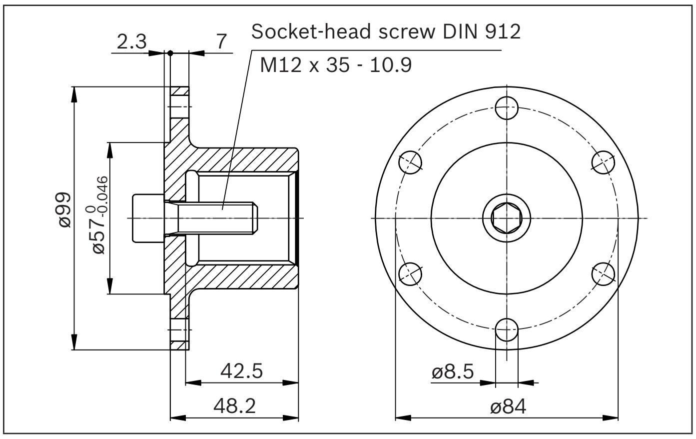
4-hole coupling flange, complete – Ø90

Material number: R902060152



6-hole coupling flange, complete – Ø100

Material number: R902060153



Note

The coupling flange is installed by screwing it onto the drive shaft with the help of the threaded bore in the end of the drive shaft.

The coupling flange must be glued onto the splined drive shaft with Loctite 574 and clamped (= 130 Nm).

Sudden or abrupt forces acting on the drive shaft could lead to damage to the rotary group and must therefor be avoided.

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a relatively long standstill as the axial piston unit may drain back to the reservoir via the hydraulic lines.

The case drain chamber is internally connected to the suction chamber. A case drain line from the case to the reservoir is not required. However, to ensure thermal stability, a case drain line from port "T" to the reservoir is generally required with the DRS.E controller.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction and case drain lines must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure; it must not, however, be higher than $h_{S\ max}$ = 800 mm. The minimum suction pressure at port S must also not fall below 0.8 bar absolute during operation and during cold start.

Installation position

See the following examples 1 to 4.

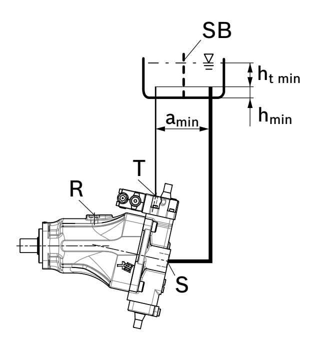
Further installation positions are available upon request.

Recommended installation position: 1 and 2.

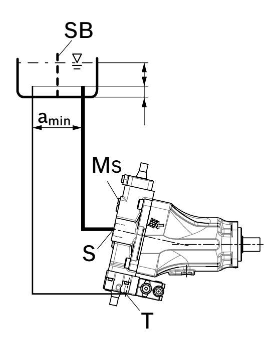
Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.

1



2

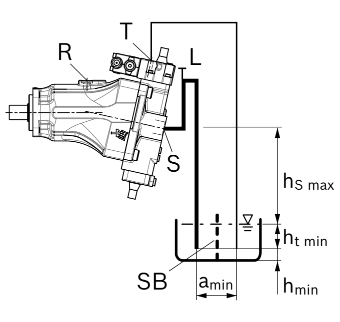


Installation position	Air bleed	Filling
1	R	S
2	M_S	S

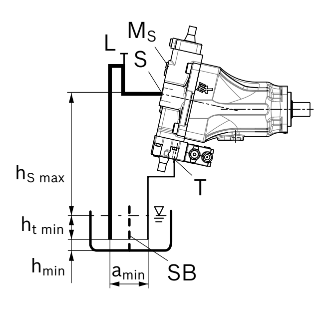
Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.

3



4



Installation position	Air bleed	Filling
3	R	L
4	M_S	L

Key	
L	Filling / air bleed
R	Air bleed port
S	Suction port
T	Drain port (DRS only)
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (100 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)
M_S	Measuring port suction pressure
a_{min}	When designing the reservoir, ensure adequate space between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Other related documents

Other pumps with special characteristics and dimensions for use in commercial vehicles can be found in the following data sheets:

- RE 91510: Fixed pump A17FNO, 250/300 bar
- RE 91520: Fixed pump A17FO, 300/350 bar
- RE 91540: 2-circuit fixed pump A18FDO, 350/400 bar
- RE 92260: Variable pump A17VO, 300/350 bar
- RE 92270: Variable pump A18VO, 350/400 bar

General instructions

- The pump A18VLO is designed to be used in open circuits.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e. g. by wearing protective clothing).
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Service line ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The service line ports and function ports can only be used to accommodate hydraulic lines.
- The data and notes contained herein must be adhered to.
- Before finalizing your design, request a binding installation drawing.
- The product is not approved as a component for the safety concept of a general machine according to ISO 13849.
- Pressure controls are not backups against pressure overload. A pressure-relief valve is to be provided in the hydraulic system.
- The following tightening torques apply:
  - Fittings:
    Observe the manufacturer's instructions regarding the tightening torques of the fittings used.
  - Mounting bolts:
    For mounting bolts with metric ISO threads according to DIN 13, we recommend checking the tightening torque in individual cases in accordance with VDI 2230.
  - Female threads in the axial piston unit:
    The maximum permissible tightening torques $M_{G\,max}$ are maximum values of the female threads and must not be exceeded. For values, see the following table.
  - Threaded plugs:
    For the metallic threaded plugs supplied with the axial piston unit, the required tightening torques of threaded plugs M_V apply. For values, see the following table.

Ports Standard	Size of thread	Maximum permissible tightening torque of the female threads $M_{G\,max}$	Required tightening torque of the threaded plugs M_V	WAF Hexagon socket of the threaded plugs
DIN 3852[1]	M10 x 1	30 Nm	15 Nm[2]	5 mm
	M12 x 1.5	50 Nm	25 Nm[2]	6 mm
	M14 x 1.5	80 Nm	35 Nm	6 mm
	M18 x 1.5	66 Nm	60 Nm	8 mm
ISO 11926	7/16-20UNF-2B	40 Nm	15 Nm	3/16 in
DIN ISO 228	G1	480 Nm	–	–
	G1 1/4	720 Nm	–	–

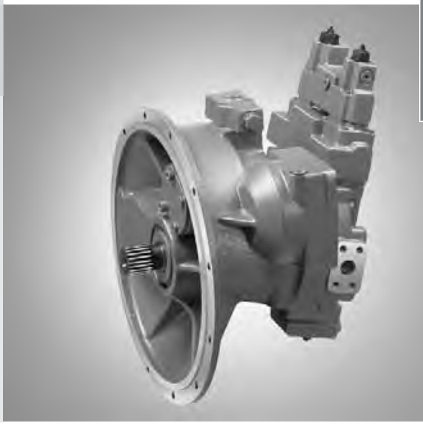
1) The tightening torques apply for screws in the "dry" state as received on delivery and in the "lightly oiled" state for installation.

2) In the “lightly oiled” condition, the M_V is reduced to 10 Nm for M10 x 1 and to 17 Nm for M12 x 1.5.

Axial Piston Variable Double Pump A8VO

Data sheet

Series 61 / 63
Sizes 55...200
Nominal pressure 350 bar
Peak pressure 400 bar
for open circuit



Contents

Features

- Variable double pump with two axial tapered piston rotary groups of bent-axis design for hydrostatic drives in open circuits
- The flow is proportional to the input speed and to the displacement, and is infinitely variable from $q_{V\,max}$ to $q_{V\,min} = 0$
- The pump is suitable for direct mounting on the flywheel case in diesel engines
- One common suction port for auxiliary pump and both circuits
- A wide range of control instruments is available for different control and regulating functions
- Individual power controller
- Integrated auxiliary pump with pressure-relief valve, optionally with additional pressure-reduction valve
- Power take-off for mounting axial piston and gear pumps
- Excellent power to weight ratio
- Long service life

Ordering Code / Standard Program

A8V	O			/		R	1	–	N	Z		05				
01	02	03	04		05	06	07		08	09	10	11	12	13	14	15

Axial piston unit

01	Bent-axis design, variable	**A8V**

Operation mode

02	Double pump (parallel construction), for open circuits	**O**

Size

03	≈ Displacement $V_{g\ max}$ in cm^3, per rotary group	**55**	**80**	**107**	**140**	**200**

	Control device	**55**	**80**	**107**	**140**	**200**	
04	Individual power controller without power override						
	with hydraulic stroke limiter, positive control and external pilot pressure supply	●	○	●	○	○	**LA0H2**
	with load sensing	–	–	○	○	○	**LA0S**
	with hydraulic power coupling	●	●	●	○	–	**LA0K**
	and load sensing	–	○	○	●	○	**LA0KS**
	and hydraulic stroke limiter, negative control	○	○	○	○	○	**LA0KH1**
	hydraulic stroke limiter, positive control and external pilot pressure supply	●	●	●	●	●	**LA0KH2**
	hydraulic stroke limiter, negative control and external pilot pressure supply	○	○	●	●	●	**LA0KH3**
	Individual power controller with power override by pilot pressure						
	with hydraulic stroke limiter, positive control and external pilot pressure supply	●	●	●	●	●	**LA1H2**
	with load sensing	–	–	●	●	●	**LA1S**
	with hydraulic power coupling	○	○	○	○	–	**LA1K**
	and load sensing	–	○	●	●	●	**LA1KS**
	and hydraulic stroke limiter, negative control	●	●	●	●	●	**LA1KH1**
	hydraulic stroke limiter, positive control and external pilot pressure supply	●	●	●	●	●	**LA1KH2**
	hydraulic stroke limiter, negative control and external pilot pressure supply	○	○	○	○	○	**LA1KH3**
	Electric control with prop. solenoid (positive control) U = 24V	–	–	●	●	–	**EP2**

	Series	**55**	**80**	**107**	**140**	**200**	
05	Series 6; Index 1, 3	●	–	–	–	–	**61**
		–	●	●	●	●	**63**

Direction of rotation

06	viewed from shaft end: clockwise	**R**

Gear ratio (n_{input} / $n_{rotary\ groups}$)

07	i = 1	**1**

Seals

08	NBR (nitrile-caoutchouc), shaft seal ring in FKM (fluor-caoutchouc)	**N**

Shaft end

09	Splined shaft, DIN 5480	**Z**

	Mounting flange	**55**	**80**	**107**	**140**	**200**[1]	
10	To fit flywheel case (conforming to SAE J617) of internal combustion engine (hole diameter for fixing ø11 mm)	●	●	●	●	–	**G**
		–	–	–	–	●	**N**

[1]) Hole diam. 11 mm for new projects only (previous types with short code G and hole diam. 14 mm)

Ordering Code / Standard Program

A8V	O			/		R	1	–	N	Z		05				
01	02	03	04		05	06	07		08	09	10	11	12	13	14	15

Service line port

11	SAE flange ports A1 and A2 at side, opposite (metric fixing thread) SAE flange port S at rear (metric fixing thread)	**05**

Auxiliary pump

			55	80	107	140	200	
12	without integrated auxiliary pump	without power take-off (PTO)	●	●	●	●	●	**K00**
		with power take-off (PTO)	●	●	●	●	●	**K...**
	with integrated auxiliary pump,	without power take-off (PTO)	●	●	●	●	●	**F00**
		with power take-off (PTO)	●	●	●	●	●	**F...**

Power take-off [1] [2]

	Flange SAE J744 [3]	Hub for splined shaft [4]				55	80	107	140	200	
12	82-2 (A)	5/8in	9T	16/32DP	(A)	●	●	●	●	●	**...01**
	101-2 (B)	7/8in	13T	16/32DP	(B)	●	●	●	●	●	**...02**
		1in	15T	16/32DP	(B-B)	●	●	●	●	●	**...04**
	127-2 (C)	1 1/4in	14T	12/24DP	(C)	❍	●	●	●	●	**...07**
	152-4 (D)	1 1/4in	14T	12/24DP	(C)	–	–	–	❍	●	**...86**
		1 3/4in	13T	8/16DP	(D)	–	–	–	●	●	**...17**

Valves

		K..	F..	
13	Without valves (only for versions **without** auxiliary pump, K..)	●	–	**0**
	With pressure-relief valve (only for versions **with** auxiliary pump, F..)	–	●	**1**
	With pressure-relief and pressure-reduction valve, (only for versions **with** auxiliary pump, F..). U = 24V	–	●	**4**

Connector for solenoids (only for EP)

		55	80	107	140	200	
14	DEUTSCH connector molded, 2-pin, without suppressor diode	–	–	●	●	–	**P**

Standard / special version

15	Standard version	(without code)	
		combined with attachment part or attachment pump	**-K**
	Special version		**-S**
		combined with attachment part or attachment pump	**-SK**

[1] Note installation conditions (see pages 32/33)

[2] Other PTOs on request

[3] 2 = 2-hole; 4 = 4-hole

[4] Hub for splined shaft according to ANSI B92.1a-1976 (splined shafts assigned according to SAE J744, see pages 32/33)

● = available   ❍ = on request   – = not available

Technical Data

Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids) and RE 90223 (HF hydraulic fluids) for detailed information regarding the choice of hydraulic fluids and application conditions.

The A8VO variable double pump is not suitable for operation with HFA. If HFB, HFC and HFD or environmentally acceptable hydraulic fluids are being used, the limitations regarding technical data and seals mentioned in RE 90221 and RE 90223 must be observed.

When ordering, please indicate the used hydraulic fluid.

Operating viscosity range

We recommend that a viscosity (at operating temperature) for optimum efficiency and service life purposes of

ν_{opt} = optimum operating viscosity 16 to 36 mm^2/s

be chosen, taken the tank temperature (open circuits) into account.

Limits of viscosity range

The following values apply in extreme cases:

$\nu_{min} = 5\ mm^2/s$
short-term ($t < 3$ min)
at max. perm. temperature of $t_{max} = +115°C$.

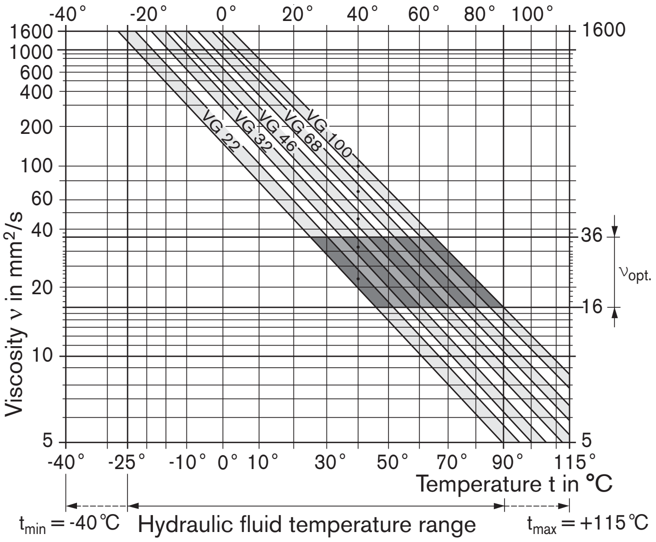
$\nu_{max} = 1600\ mm^2/s$,
short-term ($t < 3$ min)
at cold start ($p \leq 30$ bar, $n \leq 1000$ rpm, $t_{min} = -40°C$).
Only for starting up without load. Optimum operating viscosity must be reached within approx. 15 minutes.

Note that the maximum hydraulic fluid temperature of 115°C must not be exceeded locally either (e.g. in the bearing area). The temperature in the bearing area is – depending on pressure and speed – up to 12 K higher than the average case drain temperature.

Special measures are necessary in the temperature range from -40°C to -25°C (cold start phase); please contact us.

For detailed information about use at low temperatures, see RE 90300-03-B.

Selection diagram



Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature, in an open circuit the tank temperature.

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range ($\nu_{opt.}$) - the shaded area of the selection diagram. We recommended that the higher viscosity class be selected in each case.

Example: At an ambient temperature of X°C, an operating temperature of 60°C is set. In the optimum viscosity range ($\nu_{opt.}$, shaded area) this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Note:
The case drain temperature, which is affected by pressure and speed, is always higher than the tank temperature. At no point in the system may the temperature be higher than 115°C.

If the above conditions cannot be maintained due to extreme operating parameters, please contact us.

Filtration

The finer the filtration, the higher the cleanliness level of the hydraulic fluid and the longer the service life of the axial piston unit.

To ensure functional reliability of the axial piston unit, the hydraulic fluid must have a claenliness level of at least

20/18/15 according to ISO 4406.

At very high hydraulic fluid temperatures (90°C to max. 115°C) at least cleanliness level

19/17/14 according to ISO 4406 is required.

If the above classes cannot be observed, please contact us.

Technical Data

Operating pressure range

Input

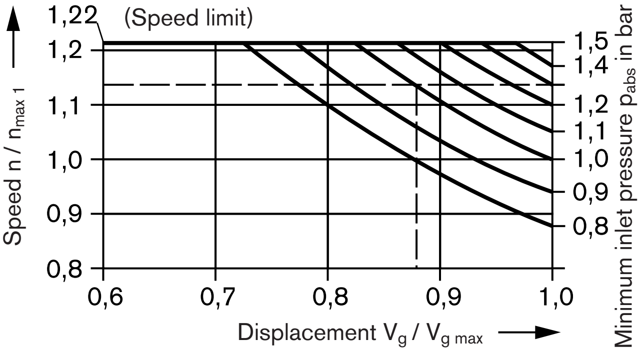
Pressure on port S
The minimum permissible inlet pressure depends on the input speed. The following limit values must not be exceeded or undercut.

$p_{abs\ min}$ ______________________________ 0.8 bar

The max. pressure $p_{abs\ max}$ is also dependent on the speed (see following diagram).

Minimum permissible inlet pressure at suction port S with increased speed

In order to avoid damage to the pump (cavitation), a minimum inlet pressure at the suction port must be assured. The minimum inlet pressure is depends on the speed and the displacement of the variable pump.



Example:

Given: Size 80, input speed 2560 rpm

Required: Necessary minimum inlet pressure p_{abs} at suction port S

Solution: Speed ratio $\frac{n}{n_{max\ 1}} = \frac{2560}{2240} = 1.14$

results in a minimum inlet pressure of $p_{abs} = 1.3$ bar at full swivel angle ($V_{g\ max}$).

If a free inlet flow can only be achieved at e.g. $p_{abs} = 1$ bar, the displacement must be reduced to $0.88 \cdot V_{g\ max}$.

Note:

- Max. speed n_{max} (speed limit, see page 6)
- Min. and max. permissible pressure at port S.
- Permissible values for the shaft seal ring

Output

Pressure on port A_1 or A_2
(pressure data according to DIN 24312)

Nominal pressure p_N ______________________ 350 bar

Peak pressure p_{max} ______________________ 400 bar

Nominal pressure:	Max. design pressure at which fatigue strength is ensured.
Peak pressure:	Max. operating pressure which is permissible for short-term ($t < 1$ s).

Case drain fluid

The case drain chamber is connected to the suction and gear chambers. A case drain line to the tank is not required. Note the special feature of size 200 for flushing fluid.

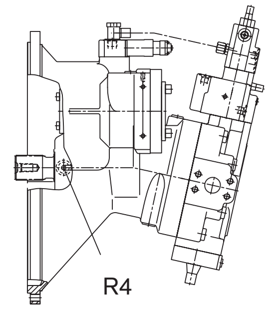
External flushing fluid connection

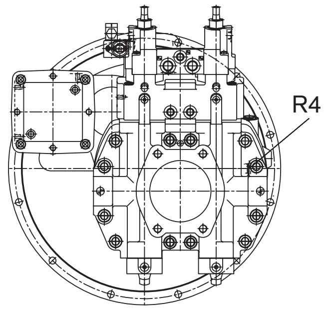
All A8VO variable double pumps in **size 200 always** require an external flushing fluid connection from the R4 port to the tank, to ensure cooling and lubrication of the bearing sets.

This line should have an internal diameter ≥ 15 mm.

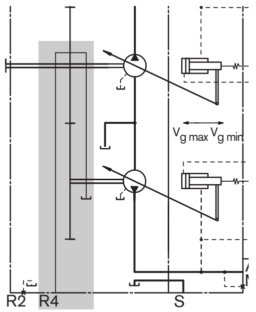
Note:

The tank level must be higher than the position of the R4 port (see page 37).





Circuit diagram with R4 port



Temperature range of shaft seal ring

The FKM shaft seal ring is permissible for case drain temperatures of -40°C to +115°C.

Auxiliary pump

Max. permissible pressure p_{max} ________________ 40 bar

The pressure-relief valve installed to protect the integrated auxiliary pump has a fixed setting of 30 bar.

Input

Via flexible coupling.

Technical Data

Table of values (theoretical values, without efficiencies and tolerances; values rounded)

Size				**55**	**80**	**107**	**140**	**200**
Displacement		$V_{g\ max}$	cm³	2 x 54.8	2 x 80	2 x 107	2 x 140	2 x 200
		$V_{g\ min}$	cm³	0	0	0	0	0
Gear ratio $i = n_{input}/n_{rotary\ groups}$				1.0	1.0	1.0	1.0	1.0
Input speed	at $V_{g\ max}$ ¹⁾	$n_{max\ 1}$	rpm	2500	2240	2150	2100	1950
	at $V_g \leq V_{g\ max}$ ²⁾	n_{max}	rpm	3000	2750	2450	2450	2250
Flow	at n_{max} and $V_{g\ max}$	$q_{v\ max}$	L/min	2 x 137	2 x 179	2 x 230	2 x 294	2 x 390
Power at n_{max}, V_{gmax} and Δp=350 bar		P_{max}	kW	160	209	268	294 ³⁾	325 ³⁾
Input torque at $V_{g\ max}$ and Δp=350 bar		T_{max}	Nm	611	891	1192	1337 ³⁾	1592 ³⁾
Rotary stiffness (single rotary group) ⁵⁾ $V_{g\ max}$ to $0{,}5 \cdot V_{g\ max}$		c_{TW}	Nm/rad	11213	17985	25565	41408	39505
$0{,}5 \cdot V_{g\ max}$ to $0_{(interpolated)}$		c_{TW}	Nm/rad	41442	67666	89381	146677	156876
Moment of inertia for rotary group with power take-off, without attachment pump		J_{TW}	kgm²	0.0161	0.0209	0.0345	0.0581	0.0849
without power take-off (PTO)		J_{TW}	kgm²	0.0126	0.0173	0.0288	0.0500	0.0750
Angular acceleration (single rotary group) ⁵⁾		α	rad/s²	25800	21800	17100	7500	11000
Mass approx.		m	kg	82	90	116	146	180
Variation: with integrated auxiliary pump, F00, F.. ⁴⁾								
Displacement with integrated auxiliary pump		$V_{g\ max}$	cm³	8.6	8.6	8.6 (10.7)⁴⁾	10.7	11 (19)⁴⁾
Effective displacement		$V_{g\ max/eff}$	cm³	9.7	9.7	11 (13.7)	12.7	13.6 (23.6)
Gear ratio $i = n_{input}/n_{aux.\ pump}$				0.887	0.887	0.780	0.843	0.804
Variation: with power take-offs, K.., F..								
Max. torque at PTO		T_{max}	Nm	250	350	380	450	650
Gear ratio $i = n_{input}/n_{PTO}$				1.0	1.0	1.0	1.0	0.804

¹⁾ The values shown are valid for absolute pressure (p_{abs}) of 1 bar at suction port S and for operation with mineral fluids with a specific mass of 0.88kg/L.

²⁾ The values shown are valid for $V_g \leq V_{g\ max}$ or for an increase in the inlet pressure p_{abs} at the suction port S (see page 5).

³⁾ Observe max. permissible torque!

⁴⁾ (...) = Available on request!

⁵⁾ **Caution:** Exceeding the permissible limit values may result in a loss of function, a reduction in service life or in the destruction of the axial piston unit.
Other permissible limit values with respect to speed variation, reduced angular acceleration as a function of the frequency and the permissible startup angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.

Calculation of nominal size

Flow $$q_v = \frac{V_g \cdot n \cdot \eta_v}{1000}$$ in L/min

Torque $$T = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}}$$ in Nm

Power $$P = \frac{2\pi \cdot T \cdot n}{60\,000} = \frac{q_V \cdot \Delta p}{600 \cdot \eta_t}$$ in kW

V_g = Displacement per revolution in cm³
Δp = Differential pressure in bar
N = Speed in rpm
η_v = Volumetric efficiency
η_{mh} = Mechanical-hydraulic efficiency
η_t = Overall efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

LA0, LA1 - Individual Power Controller

On the variable double pump with individual power controller LA0/LA1, the two rotary groups are not mechanically coupled, i.e. each rotary group is fitted with a separate power controller.

The power controller controls the displacement of the pump depending on the operating pressure so that a defined input power is not exceeded.

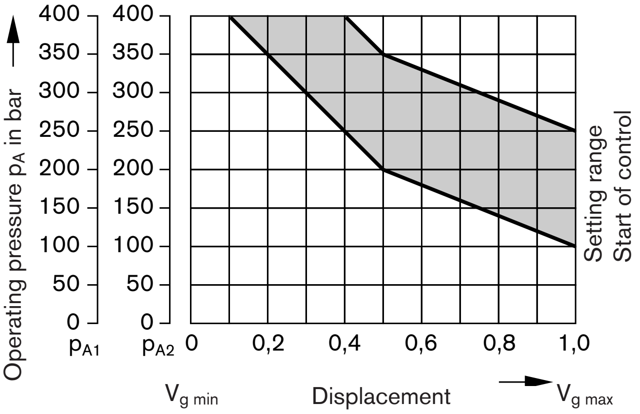
The power setting is adjusted individually for each control and can be different; each pump can be set to 100% input power.

The hyperbolic power characteristic is approximated using two measuring springs. The operating pressure acts on the measuring surfaces of a differential piston against the measuring springs and an externally adjustable spring force, which determines the power setting.

If the sum of the hydraulic forces exceeds the spring forces, control fluid is supplied to the control piston, which swivels the pump back to reduce the flow.

When not under pressure, the pump is swiveled back to its initial position at $V_{g\ max}$ by a return spring.

Characteristic: LA0; LA1



The hydraulic output power (characteristic) is influenced by the efficiency of the double pump.

Please state in clear text when ordering:

- Application: e.g. excavator
- Input power P in kW
- Input speed n in rpm
- Max. flow $q_{V\ max}$ in L/min
- Max. operating pressure (primary pressure valve setting)

After clarifying the details, a power diagram can be created by our computer.

LA0

Individual power controller without power override

LA1

Individual power controller with power override by pilot pressure

An external pilot pressure is applied to the third measuring surface of the differential piston (port X_3), thus enabling the set power to be reduced (negative power override).

The mechanically set basic power can be varied using different pilot pressures. This means that different power settings are possible.

If the pilot pressure signal is variably controlled by a load-limiting control, the sum of the hydraulic powers is equal to the input power. The pilot pressure for the power override is generated by an external control element or by the mounted pressure-reduction valve (see page 36).
The electric signal for controlling the pressure-reduction valve must be generated by an external electronic controller. The BODAS controllers RC (RE 95 200) in conjunction with the LLC software (see RE 95 310) are available for this purpose

- BODAS controller RC

Series 20	RE 95200
Series 21	RE 95201
Series 22	RE 95202
Series 30	RE 95203

Note:
If there is no power override, port X_3 to the tank should be depressurized.

LA0, LA1 - Individual Power Controller

LA0H; LA1H

Individual power controller with hydraulic stroke limiter

The hydraulic stroke limiter enables the displacement to be infinitely varied or limited across the entire control range of $V_{g\ max}$ to $V_{g\ min}$.

The displacement is set by the pilot pressure p_{St} applied at port X_1 (max. 40 bar).

The hydraulic stroke limiter is overridden by the power controller, i.e. below the power controller characteristic, the displacement is adjusted depending on the pilot pressure. If the set flow or the operating pressure is such that the power controller characteristic is exceeded, the power controller overrides the stroke limiter and reduces the displacement along the spring characteristic.

Note: The H1/H2/H3 characteristic curve is influenced by the design of the power controller!

LA0H1/3; LA1H1/3

Hydraulic stroke limiter (negative control)

Control range from $V_{g\ max}$ to $V_{g\ min}$.

With increasing pilot pressure the pump swivels to a smaller displacement.

Start of control (at $V_{g\ max}$) adjustable ______ from 4 – 15 bar

Note: The start of control depends on the power controller setting.

Please specify start of control in clear text when ordering.
Initial position in depressurized state: $V_{g\ max}$

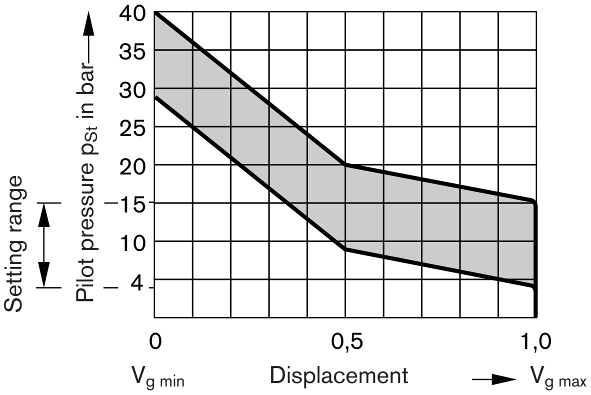
Note for H1:

A pressure ≥ 30 bar is necessary for control. The required control fluid is taken from the high-pressure line.
When using negative control directional valves, the control pressure is supplied from the negative control system via the high-pressure line.

Note for H3:

A pressure ≥ 30 bar is necessary for control. The required control pressure is taken from the high-pressure line or the external control pressure applied at port Y_3 (≥ 30 bar).
When using standard open-center directional valves, this control must be carried out with the external control pressure supply.

Characteristic: LA0H1/3; LA1H1/3
pilot pressure increase ($V_{g\ max} - V_{g\ min}$)____ Δp = approx. 25 bar



LA0H2; LA1H2

Hydraulic stroke limiter and external pilot pressure supply (positive control)

Control range from $V_{g\ min}$ to $V_{g\ max}$.

With increasing pilot pressure the pump swivels to a larger displacement.

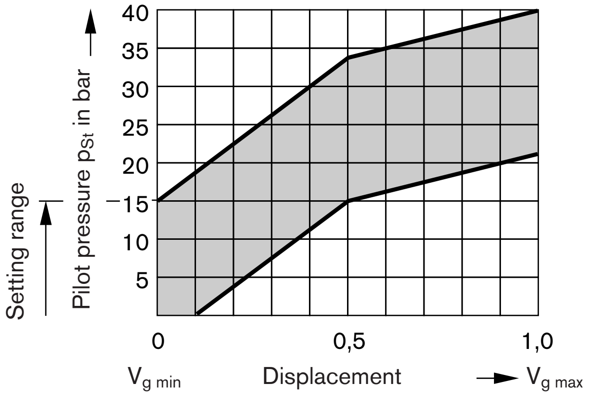
Start of control (at $V_{g\ min}$) adjustable__________ 0 to 15 bar
Please specify start of control in clear text when ordering.

Initial position in depressurized state: $V_{g\ max}$

To control from $V_{g\ max}$ to $V_{g\ min}$ a pressure ≥ 30 bar is required. The required fluid is taken from the high-pressure line or the external control pressure applied at port Y_3 (≥ 30 bar) (pilot pressure < start of control).

Characteristic: LA0/1H2

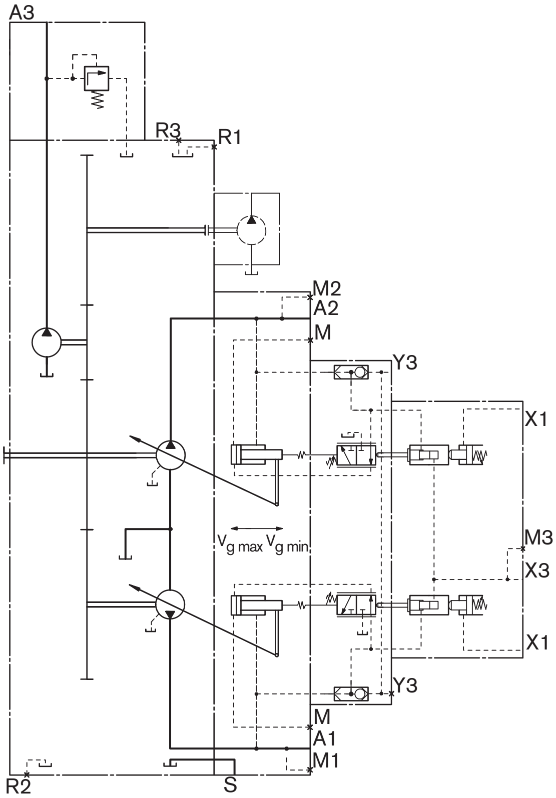
Pilot pressure increase ($V_{g\ min} - V_{g\ max}$) ____ Δp = approx. 25 bar



Note: If port Y_3 is present (H2 + H3), it must always be connected to an external control pressure. If there is no external control pressure supply, this connection to the tank must be depressurized.

LA0, LA1 - Individual Power Controller

Circuit diagram: LA1H2



LA0K; LA1K

Individual power controller with hydraulic coupling

The hydraulic coupling of the two individual controller provides the function of a summation power control. However, the two rotary groups are coupled hydraulically, not mechanically.

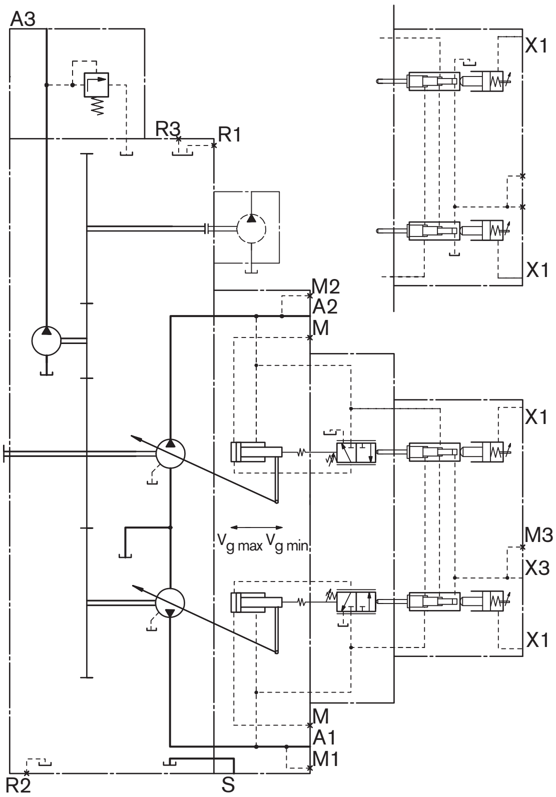
The operating pressures of the two circuits each act on the differential pistons in the two individual controls, causing both rotary groups to swivel out and back together.

If one pump is working at less than 50% of the total input power, the remaining power can be transferred to the other pump, up to a limit of 100% of the total input power.

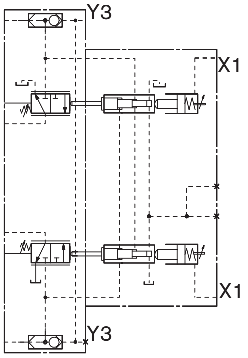
With the additional H1/H3 hydraulic stroke limiter function, each rotary group can be independently swiveled back to a smaller V_g than is currently specified by the power control.

Circuit diagram: LA1KH1

Circuit diagram module for LA0KH1



Circuit diagram module for LA0KH3



LA0, LA1 - Individual Power Controller

LA0S; LA1S, LA0KS, LA1KS

Individual power controller with load sensing

The load-sensing controller is a flow control option that operates as a function of the load pressure to regulate the pump displacement to match the consumer flow requirement.

The flow depends here on the cross section of the external measuring orifice (1) fitted between the pump and the consumer. The flow is independent of the load pressure below the power characteristic and within the control range of the pump.

The measuring orifice is usually a separately arranged load sensing directional valve (control block). The position of the directional valve piston determines the opening cross section of the measuring orifice and thus the flow of the pump.

The load-sensing controller compares pressure before and after the measuring orifice and maintains the pressure drop (differential pressure Δp) and thus the flow constant.

If the differential pressure Δp on the measuring orifice increases, the pump is swiveled back towards $V_{g\ min}$ and, if the Δp decreases, the pump is swiveled out towards $V_{g\ max}$ until equilibrium in the valve is restored.

$\Delta p_{\text{measuring orifice}} = p_{\text{pump}} - p_{\text{consumer}}$

Setting range for Δp ________________________ 14 - 25 bar

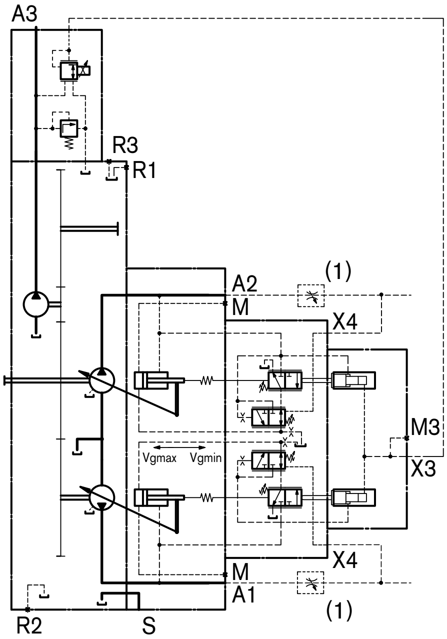
Standard setting ______________________________ 18 bar
(please state in clear text).

The stand-by pressure in zero stroke operation (measuring orifice plugged) is slightly above the Δp setting.

In an LUDV (flow sharing) system, the pressure cut-off is integrated in the LUDV valve block.

(1) The measuring orifice (control block) is not included in supply.

Circuit diagram: LA1S



EP Electric Control with Proportional Solenoids

With the electric control with proportional solenoid, the pump displacement is adjusted proportionally and steplessly to the current by means of the magnetic force.

Control from $V_{g\,min}$ to $V_{g\,max}$

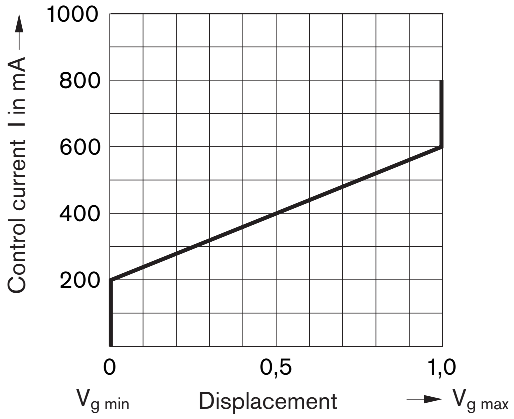
With increasing control current the pump swivels to a larger displacement.

Initial position without control signal (control current): $V_{g\,min}$

The required control pressure is taken either from the operating pressure or from the externally applied control pressure at port Y_3.

To ensure the control even at low operating pressure < 30 bar, the port Y_3 must be supplied with an external control pressure of approx. 30 bar.

Characteristic: EP2



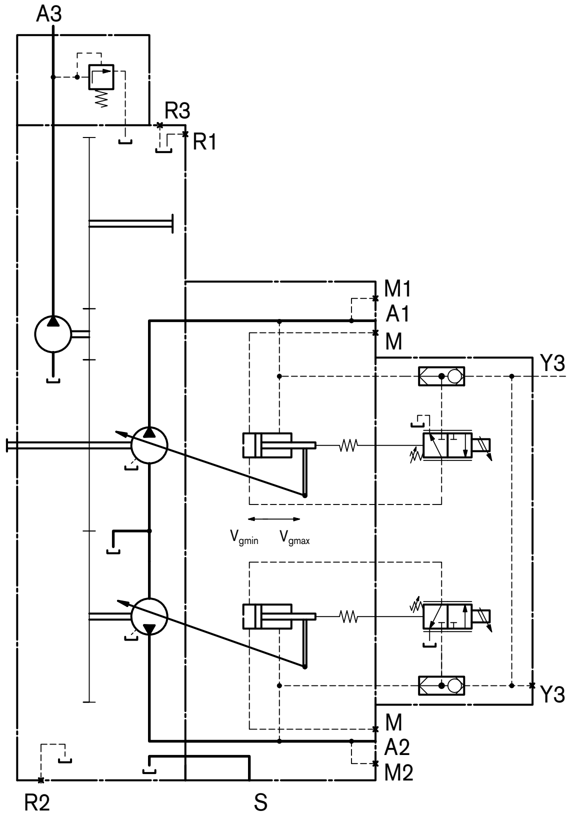
Note on load sensing "S" and electric control "EP":
When operated at $V_{g\,min}$ (> 5min), the hydraulic fluid in the case can become heated to an impermissible temperature. Please contact us.

Solenoid technical data	EP2
Voltage	24 V (±20%)
Control current	
Start of control at V_g 0	200 mA
End of control at $V_{g\,max}$	600 mA
Limiting current	0.77 A
Nominal resistance (at 20°C)	22.7 Ω
Dither frequency	100 Hz
Actuated time	100%
Type of protection according to DIN/EN 60529	IP67 and IP69K

The following electronic controllers and amplifiers are available for controlling the proportional solenoids

– BODAS controller RC	
Series 20	RE 95200
Series 21	RE 95201
Series 22	RE 95202
Series 30	RE 95203
and application software	
– Analog amplifier RA	RE 95230

Circuit diagram: EP2

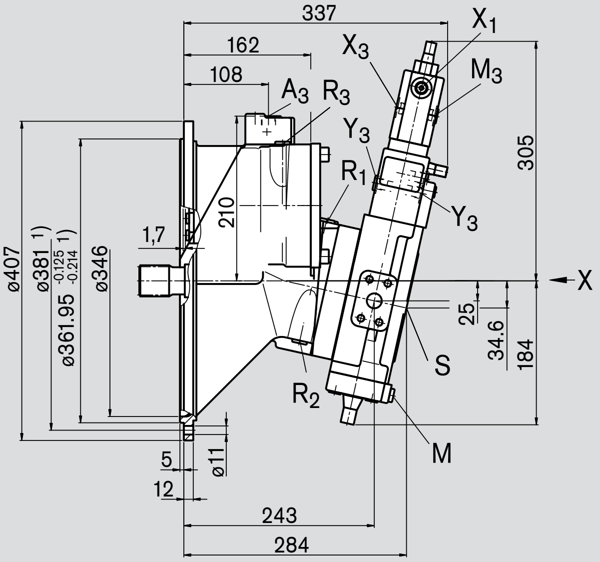


Unit Dimensions, Size 55

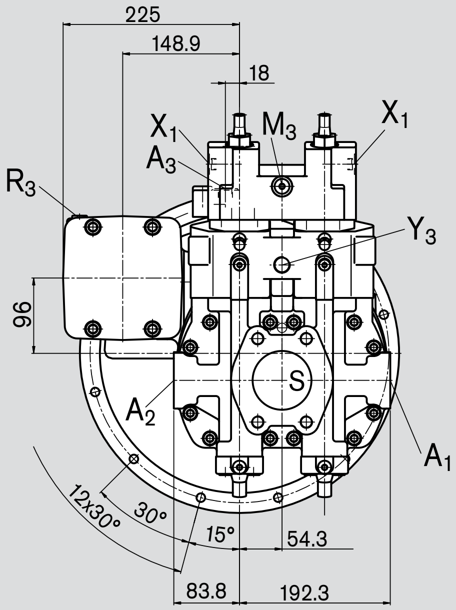
Before finalizing your design, please request a binding installation drawing. Dimensions in mm

LA0KH1/H3, LA1KH1/H3

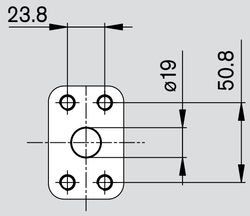
Individual power controller with hydraulic coupling and hydraulic stroke limiter (negative control)



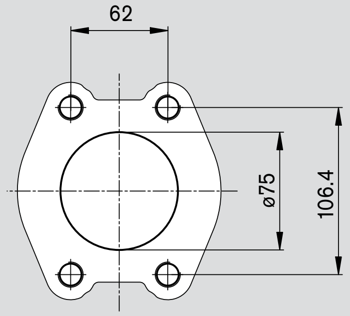
View X



Detail of A_1, A_2
(2:1)



Detail of S
(2:1)



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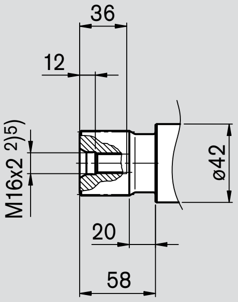
[1]) Dimensions according to SAE J617-No. 4, for connection to flywheel case in internal combustion engine.

Unit Dimensions, Size 55

Shaft end

Z Splined shaft DIN 5480 W40x2x30x18x9g



Ports

A_1, A_2	Service line ports (high-pressure series)	SAE J518	3/4in	
	Fixing thread	DIN 13	M10x1.5; 17 deep 5)	
S	Suction port (standard series)	SAE J518	3in	
	Fixing thread	DIN 13	M16x2; 21 deep 5)	
A_3	Service line port (auxiliary pump)	DIN 3852	M18x1.5; 12 deep	140 Nm 5)
R_1, R_3	Air bleed port 6)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
R_2	Fluid drain 6)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
M	Gauge port for control pressure 6)	DIN 3852	M12x1.5; 12 deep	50 Nm 5)
M_3	Gauge port for power override 3) 6)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
X_1	Pilot pressure port for hydraulic stroke limiter	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
X_3	Pilot pressure port for power override 3)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
Y_3	External control pressure port 4) 7)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)

2) Center bore according to DIN 332 (thread according to DIN 13)

3) On the LA0 version, the port has no function

4) Only for versions LA...H2 and LA...H3

5) Please observe the general notes for the max. tightening torques on page 40.

6) Plugged

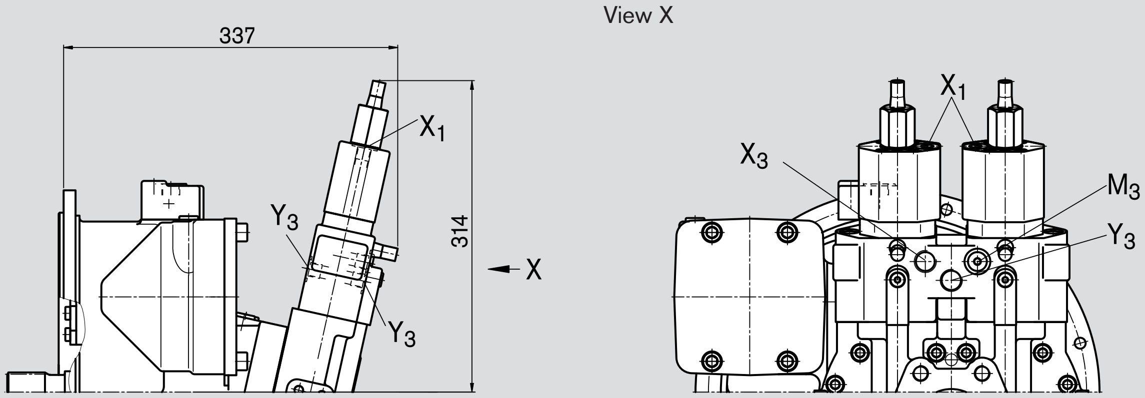
7) 1x plugged, 1x open

Unit Dimensions, Size 55

Before finalizing your design, please request a binding installation drawing. Dimensions in mm

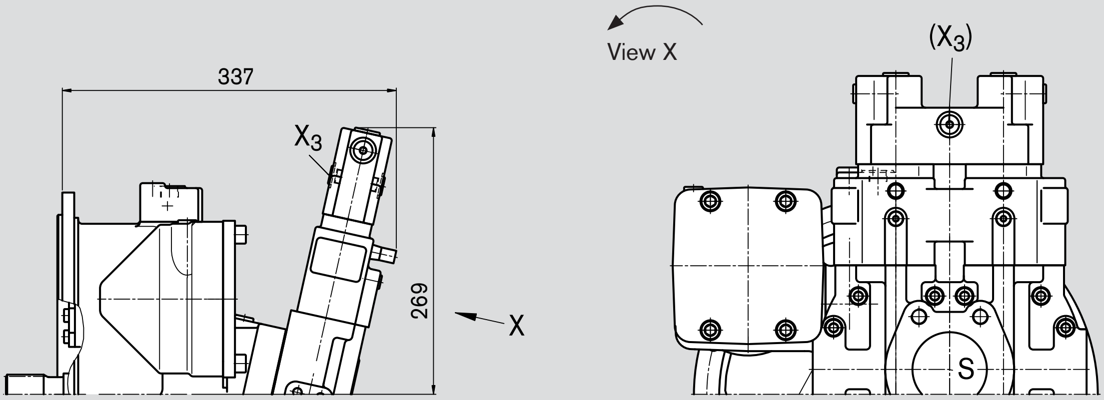
LA0H2, LA1H2

Individual power controller with hydraulic stroke limiter and external pilot pressure supply (positive control)



LA0K, LA1K

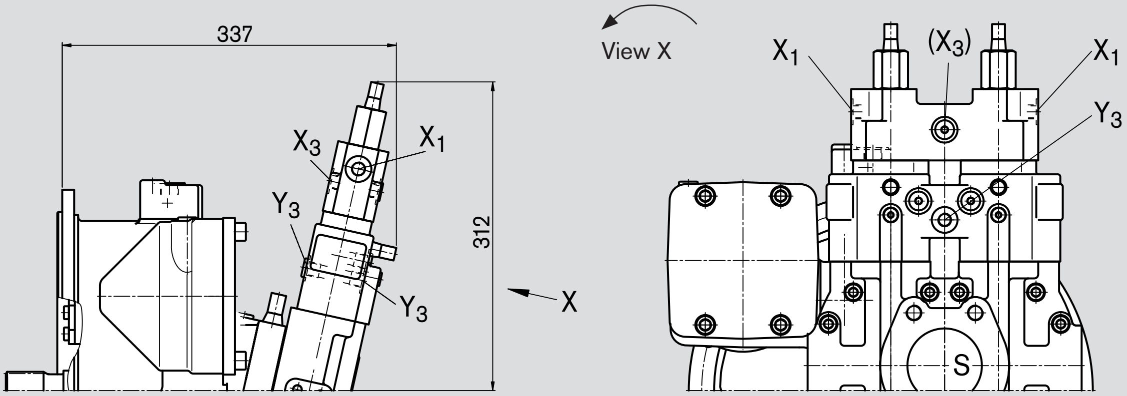
Individual power controller with hydraulic power coupling



Unit Dimensions, Size 55

LA0KH2, LA1KH2

Individual power controller with hydraulic power coupling, hydraulic stroke limiter and external pilot pressure supply (positive control)

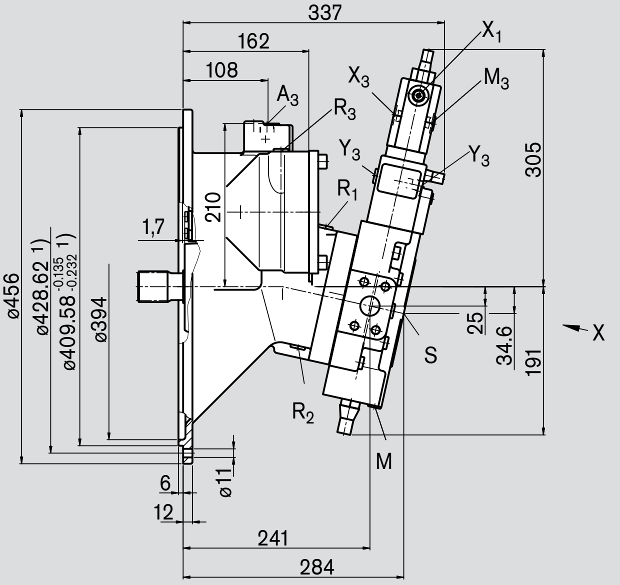


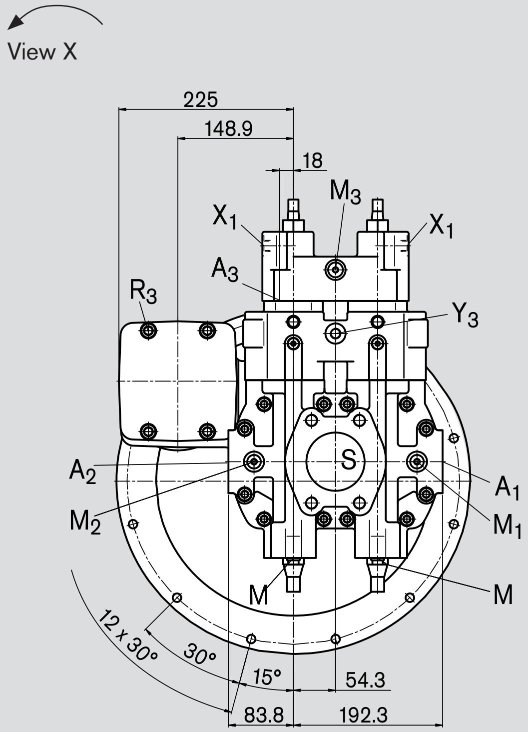
Unit Dimensions, Size 80

Before finalizing your design, please request a binding installation drawing. Dimensions in mm

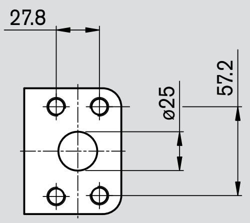
LA0KH1/H3, LA1KH1/H3

Individual power controller with hydraulic coupling and hydraulic stroke limiter (negative control)

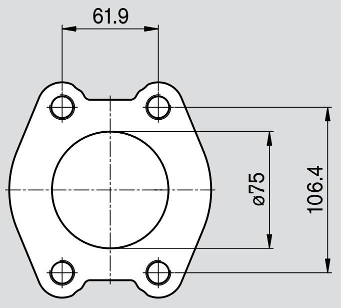




Detail of A_1, A_2
(2:1)



Detail of S
(2:1)



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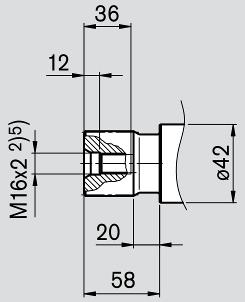
1) Dimensions according to SAE J617-No. 3, for connection to flywheel case in internal combustion engine.

Unit Dimensions, Size 80

Shaft end

Z Splined shaft DIN 5480 W40x2x30x18x9g



Ports

A_1, A_2	Service line ports (high-pressure series)	SAE J518	1in	
	Fixing thread	DIN 13	M12x1.75; 17 deep 5)	
S	Suction port (standard series)	SAE J518	3in	
	Fixing thread	DIN 13	M16x2; 21 deep 5)	
A_3	Service line port (auxiliary pump)	DIN 3852	M18x1.5; 12 deep	140 Nm 5)
R_1, R_3	Air bleed port 6)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
R_2	Fluid drain 6)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
M	Gauge port for control pressure 6)	DIN 3852	M12x1.5; 12 deep	50 Nm 5)
M_1, M_2	Gauge port for high-pressure 6)	ISO11926	9/16-18UNF-2B;12 deep	80 Nm 5)
M_3	Gauge port for power override 3) 6)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
X_1	Pilot pressure port for hydraulic stroke limiter	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
X_3	Pilot pressure port for power override 3)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
X_4	Pilot pressure port for load sensing	DIN 3852	M14x1.5;12 deep	80 Nm 5)
Y_3	External control pressure port 4) 7)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)

2) Center bore according to DIN 332 (thread according to DIN 13)

3) On the LA0 version, the port has no function

4) Only for versions LA...H2 and LA...H3

5) Please observe the general notes for the max. tightening torques on page 40.

6) Plugged

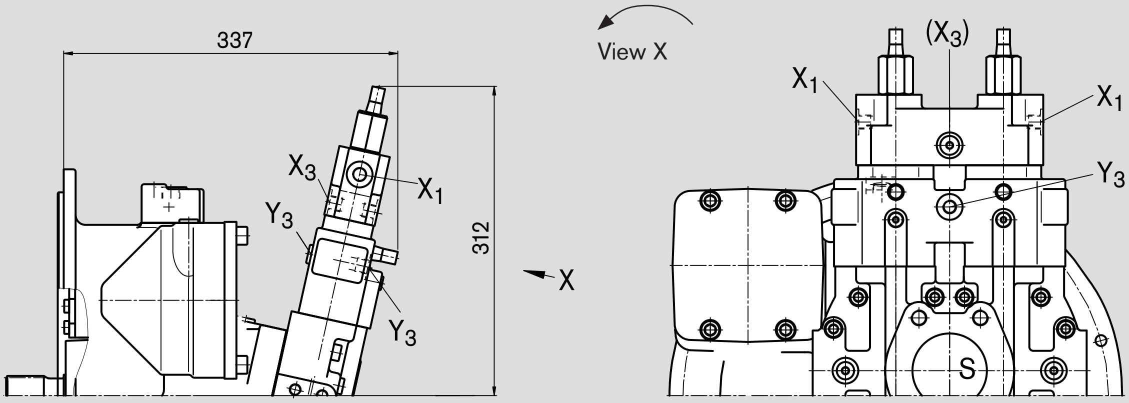
7) 1x plugged, 1x open

Unit Dimensions, Size 80

Before finalizing your design, please request a binding installation drawing. Dimensions in mm

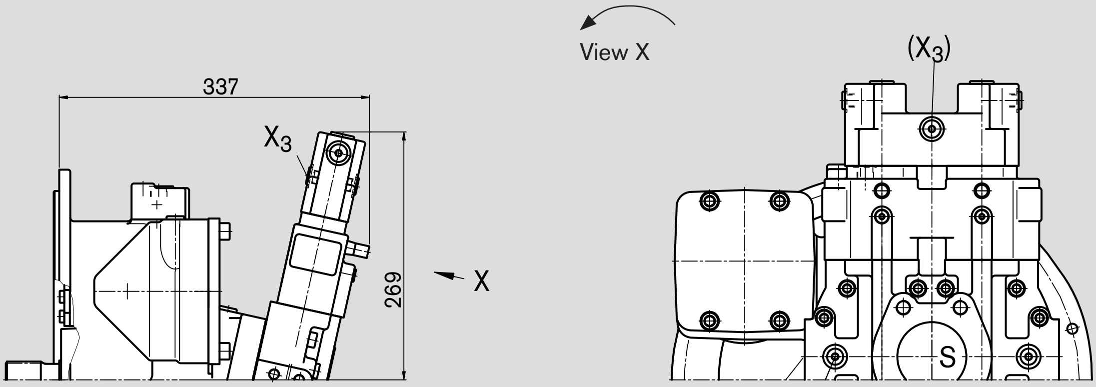
LA0H2, LA1H2

Individual power controller with hydraulic stroke limiter and external pilot pressure supply (positive control)



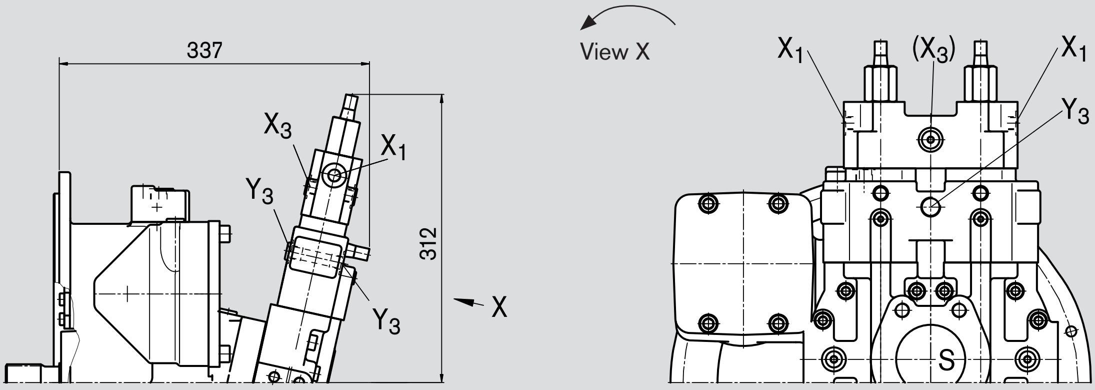
LA0K, LA1K

Individual power controller with hydraulic power coupling



LA0KH2, LA1KH2

Individual power controller with hydraulic power coupling, hydraulic stroke limiter and external pilot pressure supply (positive control)

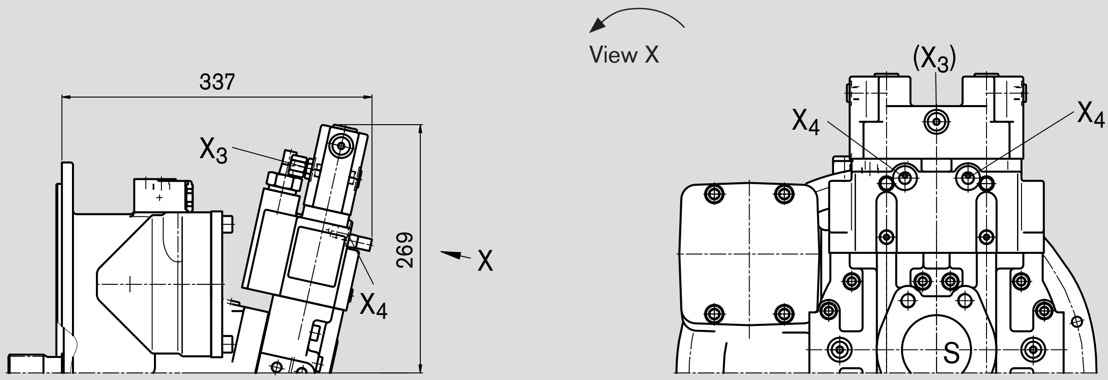


Unit Dimensions, Size 80

Before finalizing your design, please request a binding installation drawing. Dimensions in mm

LA0KS, LA1KS

Individual power controller with hydraulic power coupling and load sensing

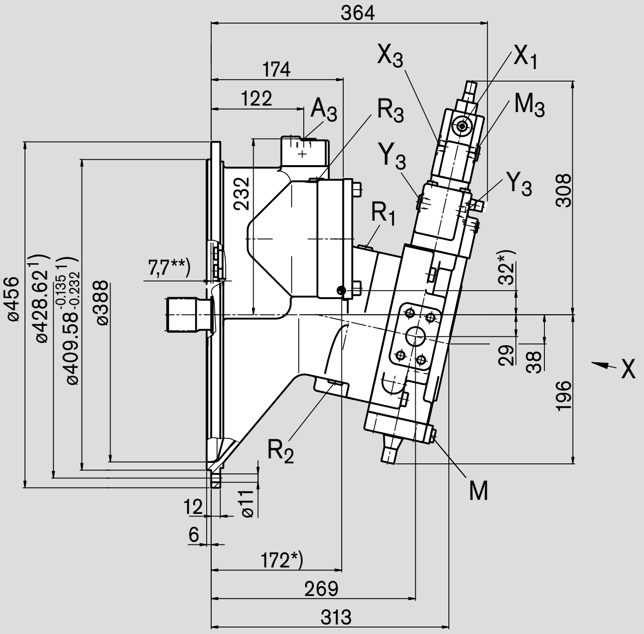


Unit Dimensions, Size 107

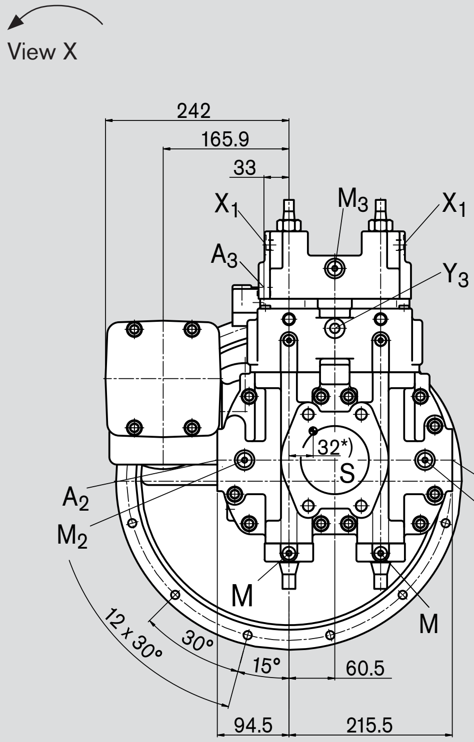
Before finalizing your design, please request a binding installation drawing. Dimensions in mm

LA0KH1/H3, LA1KH1/H3

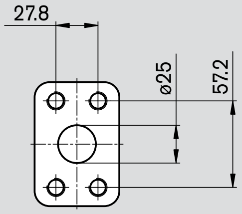
Individual power controller with hydraulic coupling and hydraulic stroke limiter (negative control)



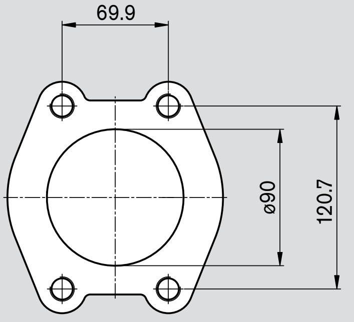
View X



Detail of A_1, A_2
(2:1)



Detail of S
(2:1)



*) Center of gravity

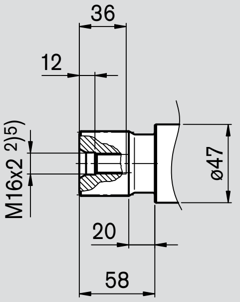
**) with auxiliary pump 10.7 cm^3 = 4.7 mm

1) Dimensions according to SAE J617-No. 3, for connection to flywheel case in internal combustion engine.

Unit Dimensions, Size 107

Shaft end

Z Splined shaft DIN 5480 W45x2x30x21x9g



Ports

A_1, A_2	Service line ports (high-pressure series)	SAE J518	1in	
	Fixing thread	DIN 13	M12x1.75; 17 deep 5)	
S	Suction port (standard series)	SAE J518	3 1/2in	
	Fixing thread	DIN 13	M16x2; 21 deep 5)	
A_3	Service line port (auxiliary pump)	DIN 3852	M18x1.5; 12 deep	140 Nm 5)
R_1, R_3	Air bleed port 6)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
R_2	Fluid drain 6)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
M	Gauge port for control pressure 6)	DIN 3852	M12x1.5; 12 deep	50 Nm 5)
M_1, M_2	Gauge ports for high-pressure 6)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
M_3	Gauge port for power override 3) 6)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
X_1	Pilot pressure port for hydraulic stroke limiter	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
X_3	Pilot pressure port for power override 3)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
X_4	Pilot pressure port for load sensing	DIN 3852	M14x1.5; 12 deep	80 Nm 5)
Y_3	External control pressure port 4) 7)	DIN 3852	M14x1.5; 12 deep	80 Nm 5)

2) Center bore according to DIN 332 (thread according to DIN 13)

3) On the LA0 version, the port has no function

4) Only for versions LA...H2 and LA...H3

5) Please observe the general notes for the max. tightening torques on page 40.

6) Plugged

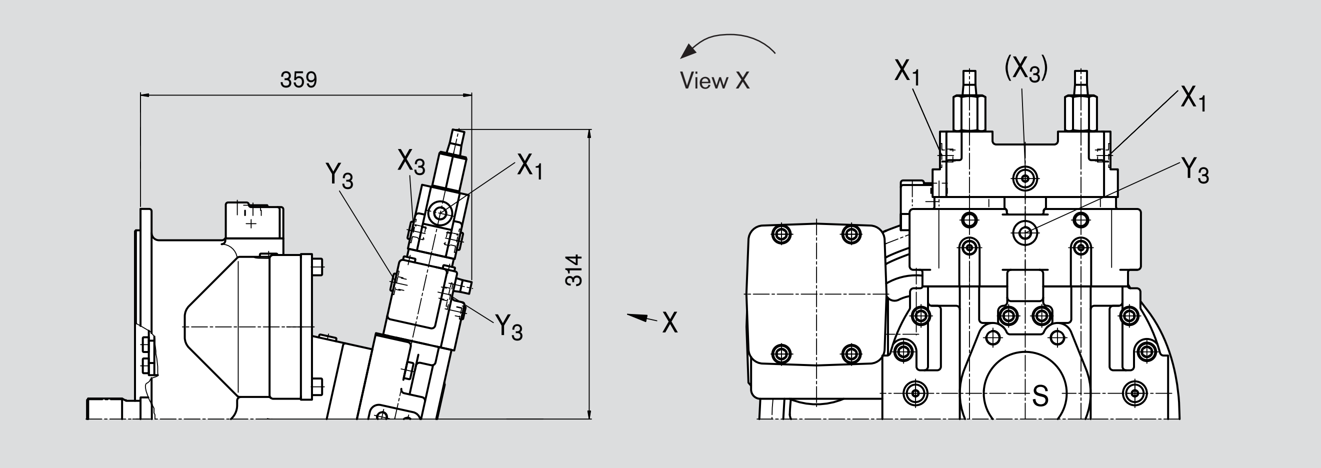
7) 1x plugged, 1x open

Unit Dimensions, Size 107

Before finalizing your design, please request a binding installation drawing. Dimensions in mm

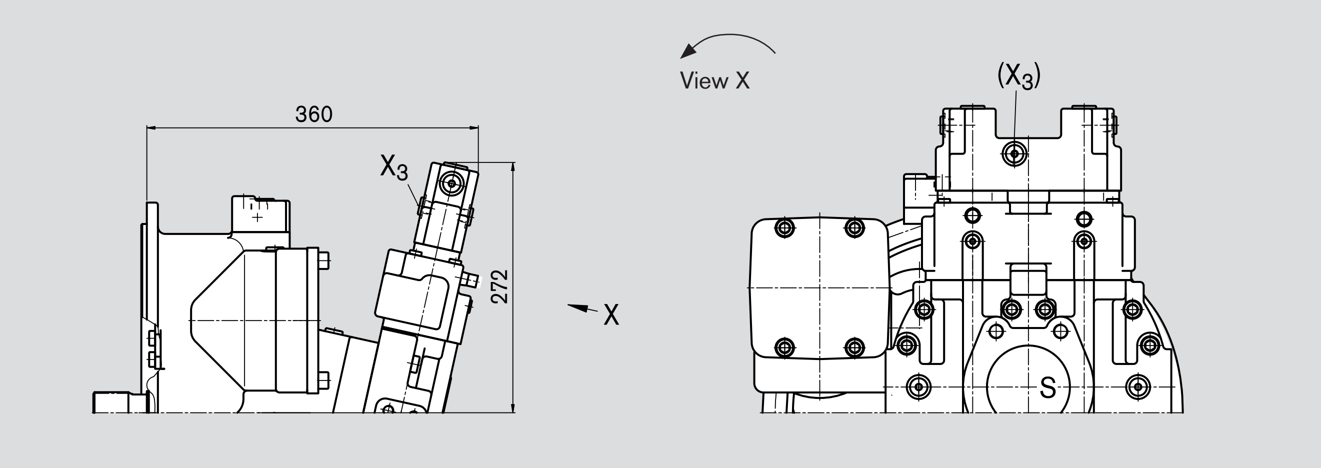
LA0H2, LA1H2

Individual power controller with hydraulic stroke limiter and external pilot pressure supply (positive control)



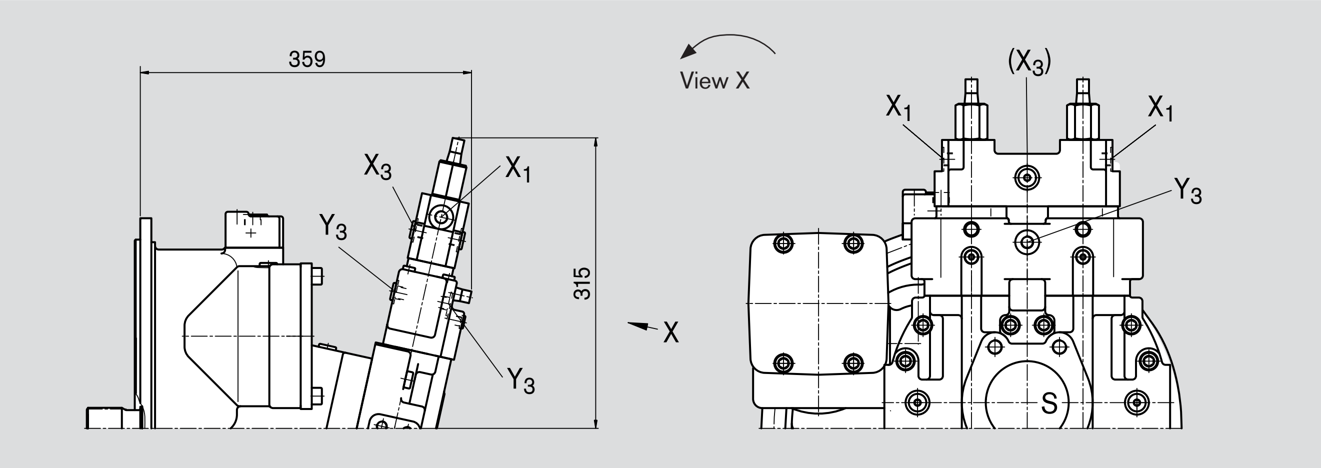
LA0K, LA1K

Individual power controller with hydraulic power coupling



LA0KH2, LA1KH2

Individual power controller with hydraulic power coupling, hydraulic stroke limiter and external pilot pressure supply (positive control)

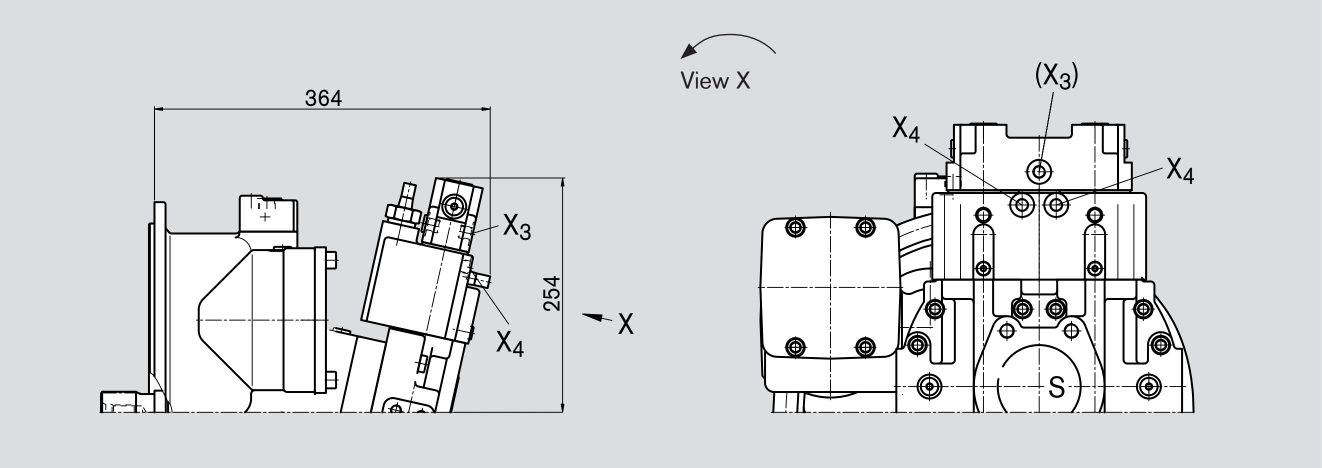


Unit Dimensions, Size 107

Before finalizing your design, please request a binding installation drawing. Dimensions in mm

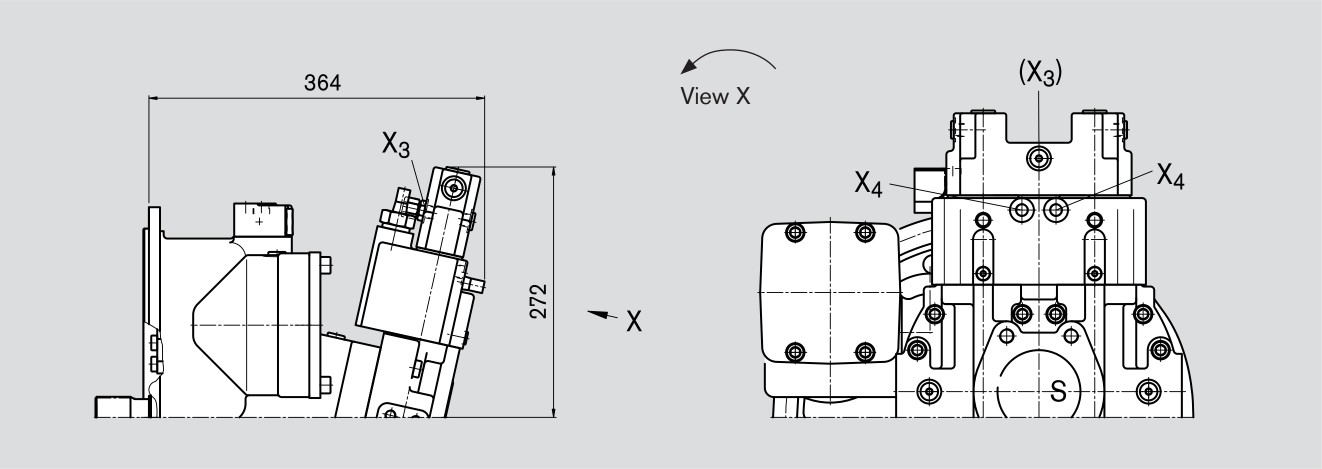
LA0S, LA1S

Individual power controller with load sensing



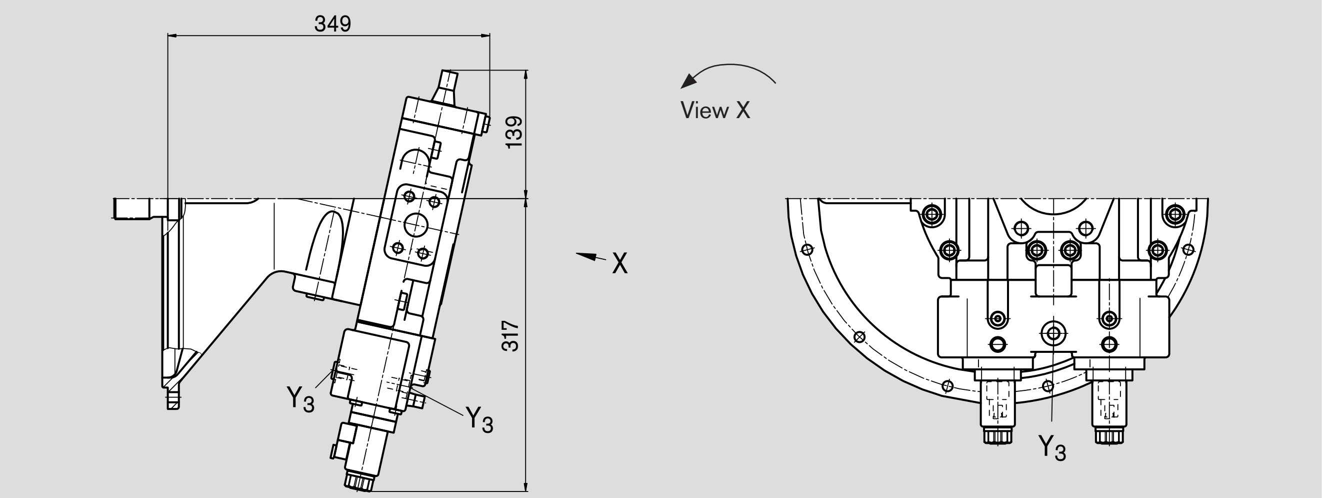
LA0KS, LA1KS

Individual power controller with hydraulic power coupling and load sensing



EP2

Electric control with proportional solenoid (positive control)

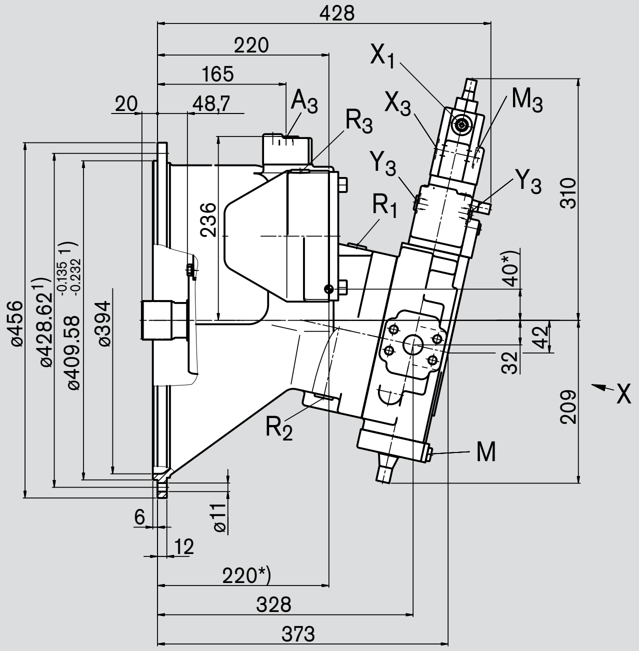


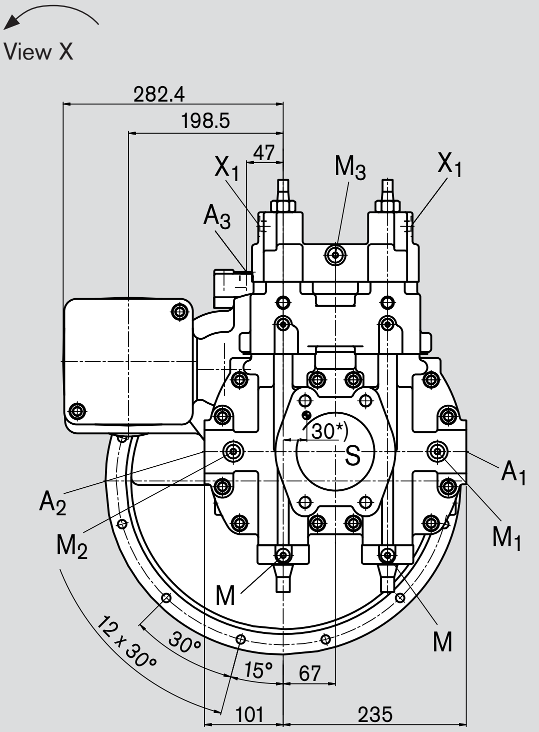
Unit Dimensions, Size 140

Before finalizing your design, please request a binding installation drawing. Dimensions in mm

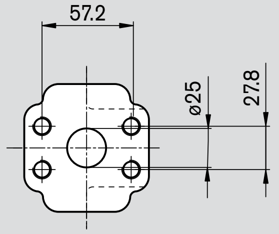
LA0KH1/H3, LA1KH1/H3

Individual power controller with hydraulic coupling and hydraulic stroke limiter (negative control)

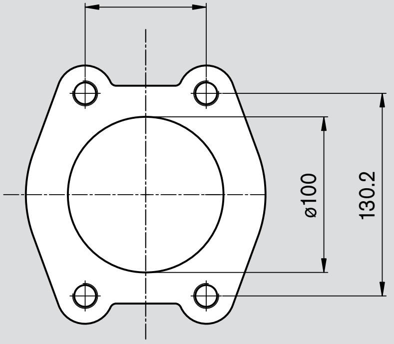




Detail of A₁, A₂
(2:1)



Detail of S
(2:1)



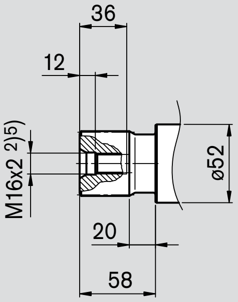
*) Center of gravity

[1] Dimensions according to SAE J617-No. 3, for connection to flywheel case in internal combustion engine.

Unit Dimensions, Size 140

Shaft end

Z Splined shaft DIN 5480 W50x2x30x24x9g



Ports

A_1, A_2	Service line ports (high-pressure series)	SAE J518	1in	
	Fixing thread	DIN 13	M12x1,75; 17 deep [5]	
S	Suction port (standard series)	SAE J518	4in	
	Fixing thread	DIN 13	M16x2; 21 deep [5]	
A_3	Service line port (auxiliary pump)	DIN 3852	M18x1.5; 12 deep	140 Nm [5]
R_1, R_3	Air bleed port [6]	DIN 3852	M18x1.5; 12 deep	140 Nm [5]
R_2	Fluid drain [6]	DIN 3852	M18x1.5; 12 deep	140 Nm [5]
M	Gauge port for control pressure [6]	DIN 3852	M12x1.5; 12 deep	50 Nm [5]
M_1, M_2	Gauge port for high-pressure [6]	ISO11926	9/16-18UNF-2B;12 deep	80 Nm [5]
M_3	Gauge port for power override [3] [6]	DIN 3852	M14x1.5; 12 deep	80 Nm [5]
X_1	Pilot pressure port for hydraulic stroke limiter	DIN 3852	M14x1.5; 12 deep	80 Nm [5]
X_3	Pilot pressure port for power override [3]	DIN 3852	M14x1.5; 12 deep	80 Nm [5]
X_4	Pilot pressure port for load sensing	DIN 3852	M14x1.5;12 deep	80 Nm [5]
Y_3	External control pressure port [4] [7]	DIN 3852	M14x1.5; 12 deep	80 Nm [5]

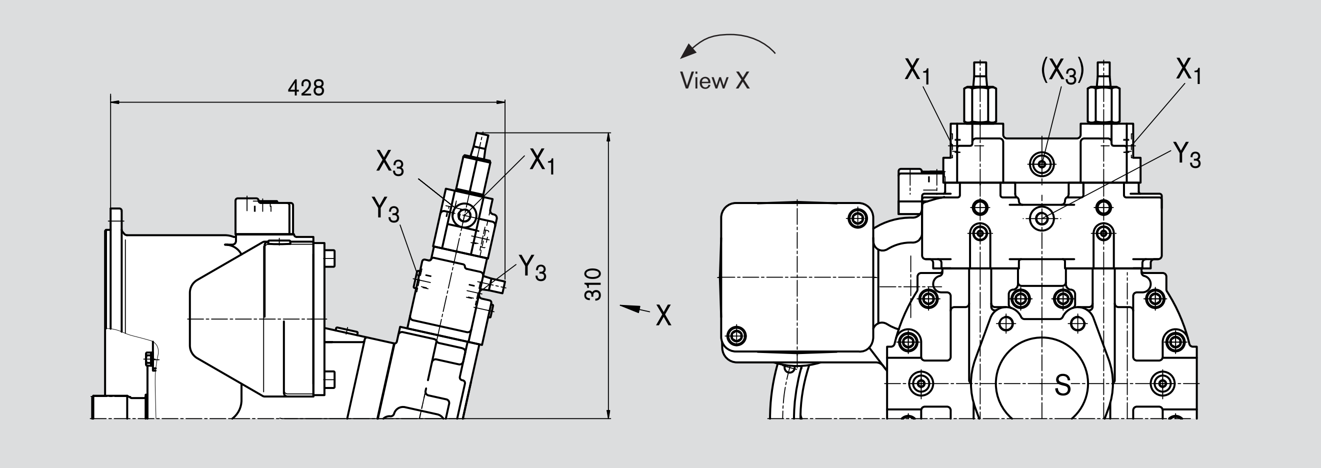
[2] Center bore according to DIN 332 (thread according to DIN 13)
[3] On the LA0 version, the port has no function
[4] Only for versions LA...H2 and LA...H3
[5] Please observe the general notes for the max. tightening torques on page 40.
[6] Plugged
[7] 1x plugged, 1x open

Unit Dimensions, Size 140

Before finalizing your design, please request a binding installation drawing. Dimensions in mm

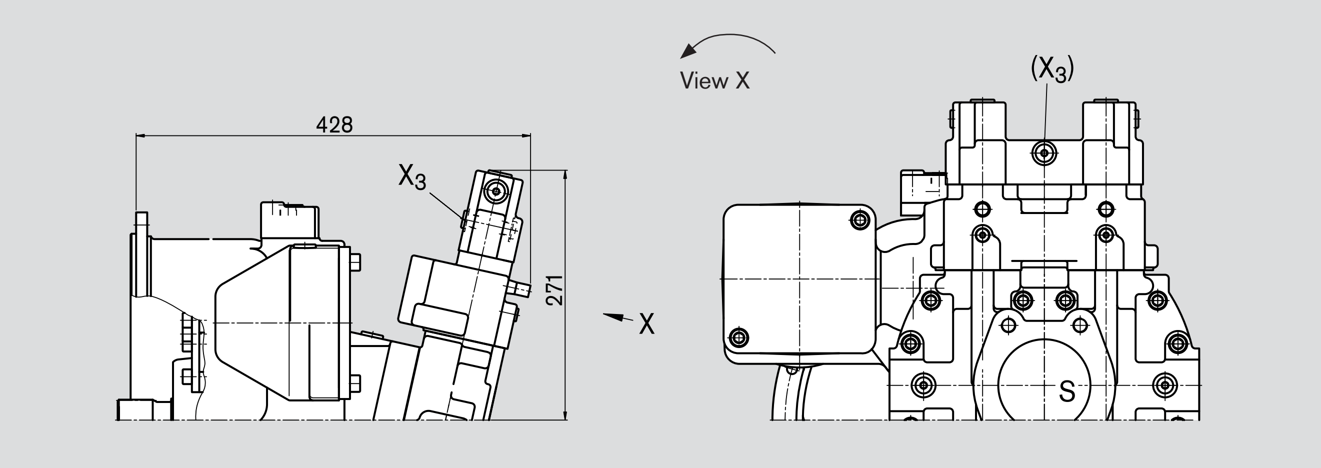
LA0H2, LA1H2

Individual power controller with hydraulic stroke limiter and external pilot pressure supply (positive control)



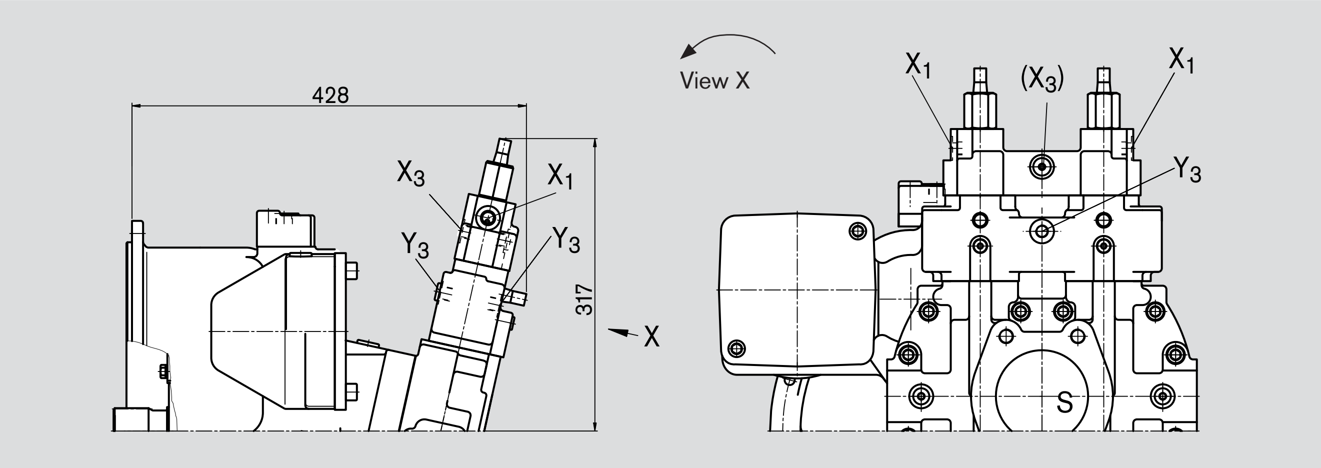
LA0K, LA1K

Individual power controller with hydraulic power coupling



LA0KH2, LA1KH2

Individual power controller with hydraulic power coupling, hydraulic stroke limiter and external pilot pressure supply (positive control)

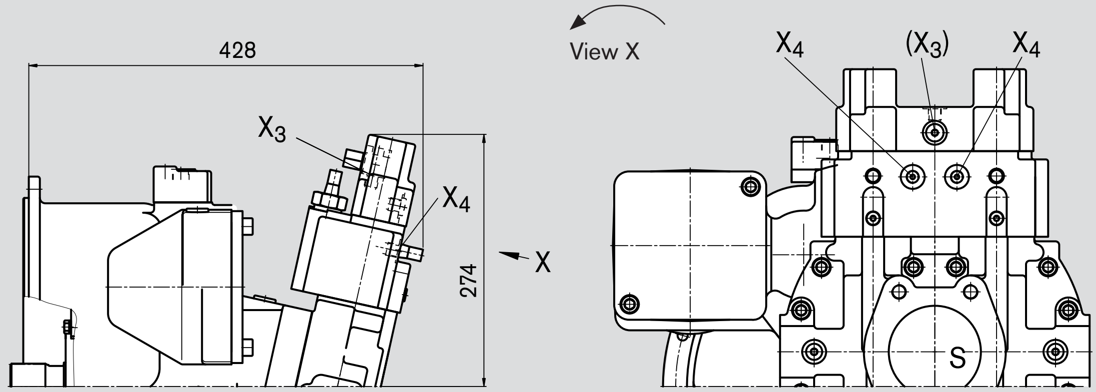


Unit Dimensions, Size 140

Before finalizing your design, please request a binding installation drawing. Dimensions in mm

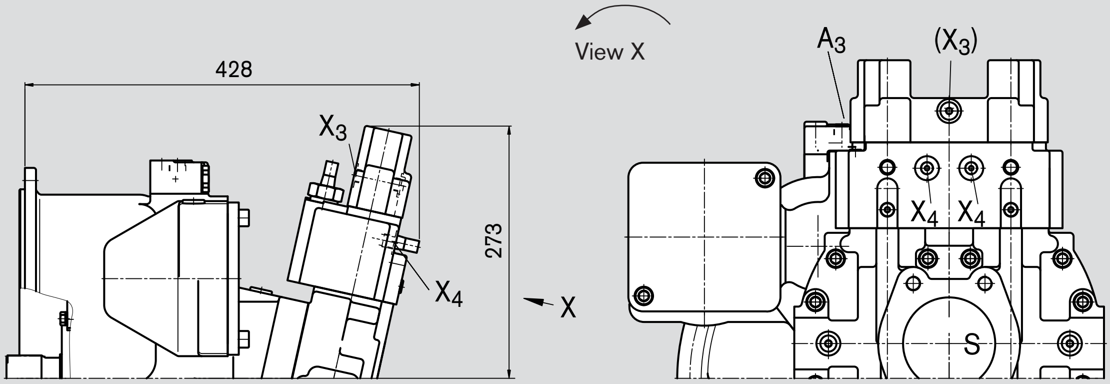
LA0S, LA1S

Individual power controller with load sensing



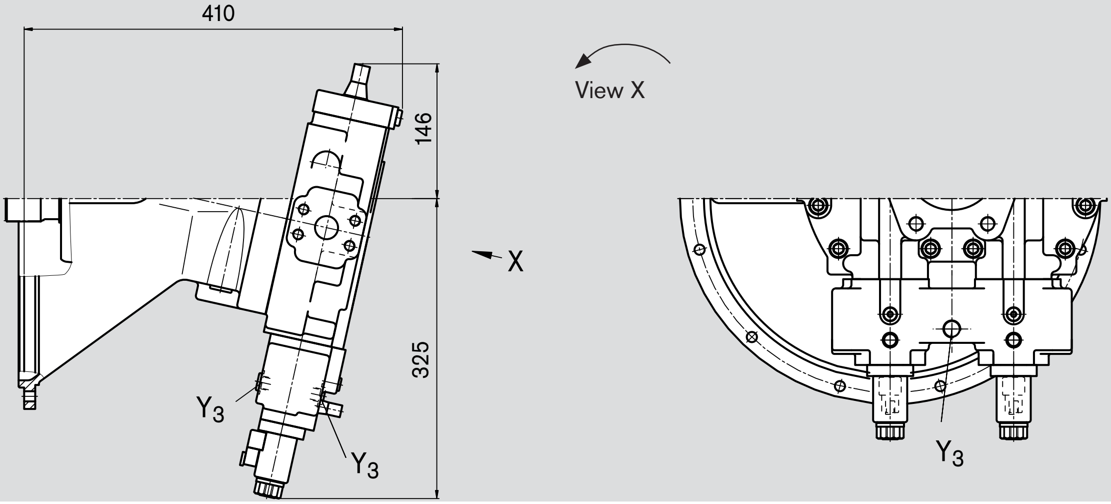
LA0KS, LA1KS

Individual power controller with hydraulic power coupling and load sensing



EP2

Electric control with proportional solenoid (positive control)

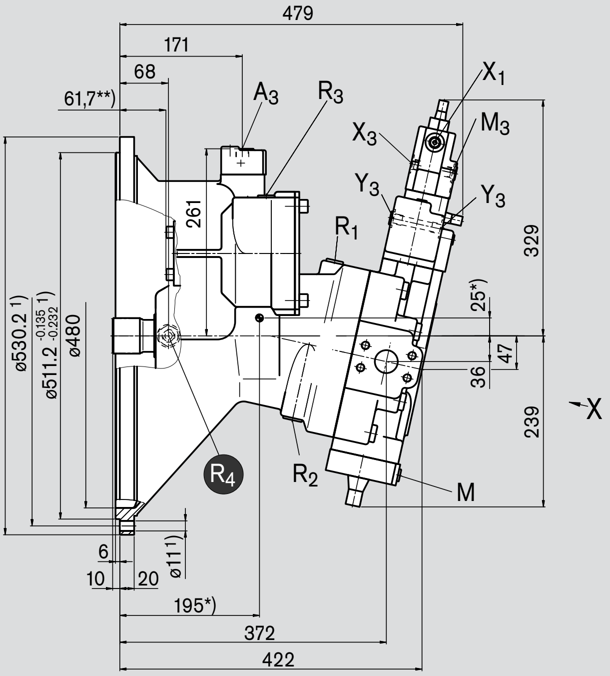


Unit Dimensions, Size 200

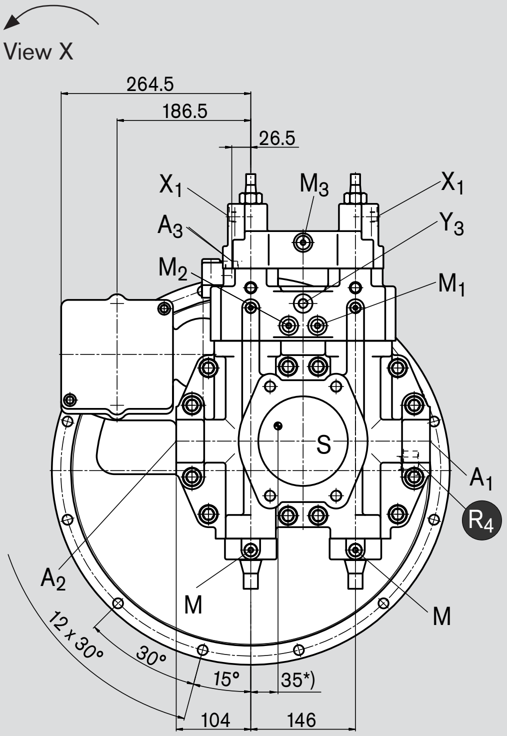
Before finalizing your design, please request a binding installation drawing. Dimensions in mm

LA0KH1/H3, LA1KH1/H3

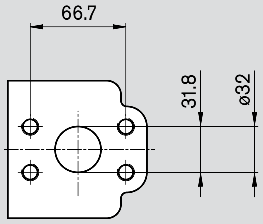
Individual power controller with hydraulic coupling and hydraulic stroke limiter (negative control)



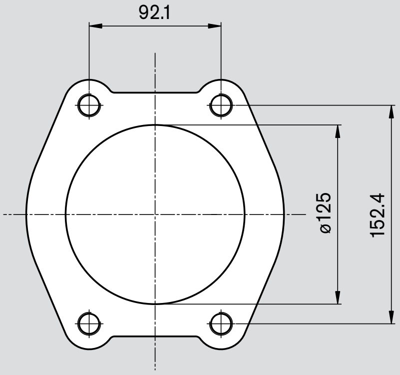
View X



Detail of A1, A2
(2:1)



Detail of S
(2:1)



R4 –Must be connected to tank to ensure cooling and lubrication of bearing sets.

*) Center of gravity

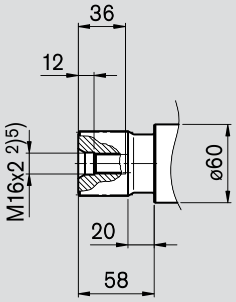
**) with auxiliary pump 19 cm^3 = 48.3

[1] Dimensions according to SAE J617-No. 1, for connection to flywheel case in internal combustion engine, hole diam. 11 mm for new projects only (previous types with short code G and hole diam. 14 mm)

Unit Dimensions, Size 200

Shaft end

Z Splined shaft DIN 5480 W50x2x30x24x9g



Ports

A_1, A_2	Service line ports (high-pressure series)	SAE J518	1 1/4in	
	Fixing thread	DIN 13	M12x1.75; 19 deep ⁵)	
S	Suction port (standard series)	SAE J518	5in	
	Fixing thread	DIN 13	M16x2; 23 deep ⁵)	
A_3	Service line port (auxiliary pump)	DIN 3852	M18x1.5; 12 deep	140 Nm ⁵)
R_1, R_3	Air bleed port ⁶)	DIN 3852	M22x1.5; 12 deep	210 Nm ⁵)
R_2	Fluid drain ⁶)	DIN 3852	M22x1.5; 12 deep	210 Nm ⁵)
R_4	Flushing fluid port ⁶)	DIN 3852	M18x1.5; 12 deep	140 Nm ⁵)
M	Gauge port for control pressure ⁶)	DIN 3852	M12x1.5; 12 deep	50 Nm ⁵)
M_1, M_2	Gauge port for high-pressure ⁶)	ISO11926	9/16-18UNF-2B;12 deep	80 Nm ⁵)
M_3	Gauge port for power override ³) ⁶)	DIN 3852	M14x1.5; 12 deep	80 Nm ⁵)
X_1	Pilot pressure port for hydraulic stroke limiter	DIN 3852	M14x1.5; 12 deep	80 Nm ⁵)
X_3	Pilot pressure port for power override ³)	DIN 3852	M14x1.5; 12 deep	80 Nm ⁵)
X_4	Pilot pressure port for load sensing	DIN 3852	M14x1.5;12 deep	80 Nm ⁵)
Y_3	External control pressure port ⁴) ⁷)	DIN 3852	M14x1.5; 12 deep	80 Nm ⁵)

²) Center bore according to DIN 332 (thread according to DIN 13)

³) On the LA0 version, the port has no function

⁴) Only for versions LA...H2 and LA...H3

⁵) Please observe the general notes for the max. tightening torques on page 40.

⁶) Plugged

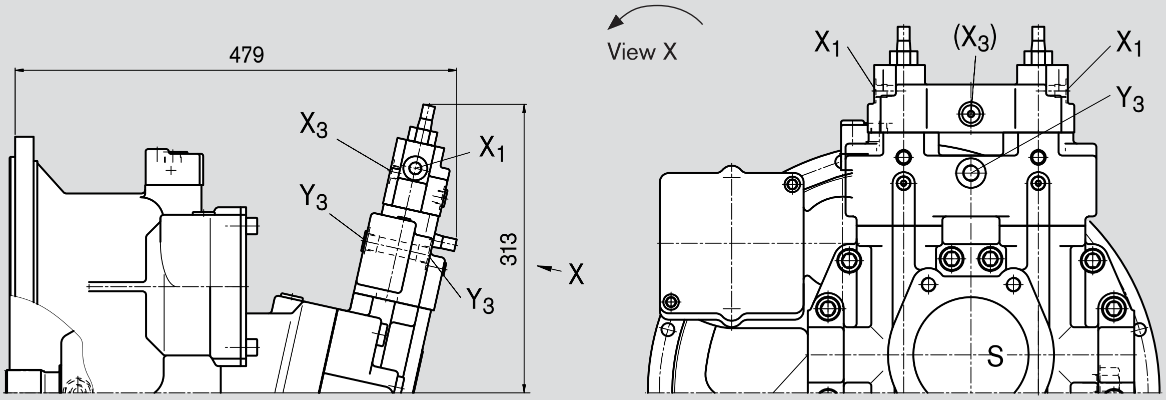
⁷) 1x plugged, 1x open

Unit Dimensions, Size 200

Before finalizing your design, please request a binding installation drawing. Dimensions in mm

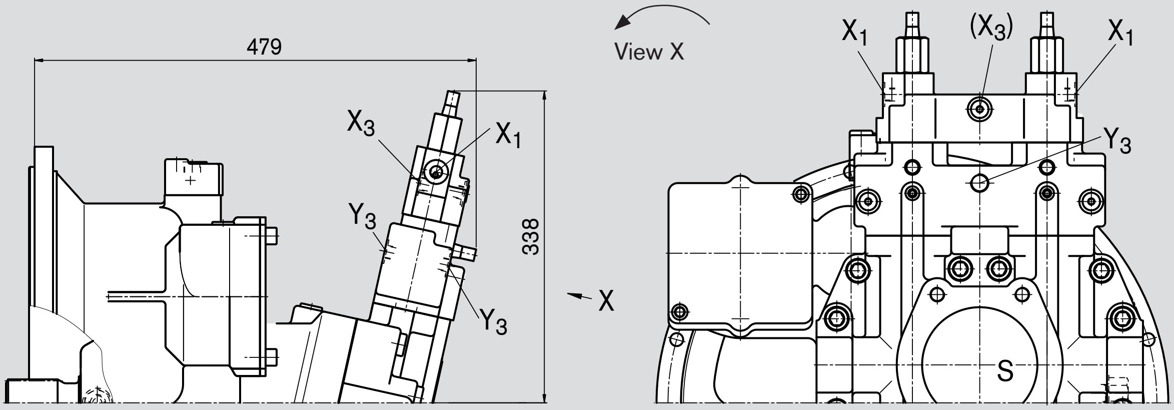
LA0H2, LA1H2

Individual power controller with hydraulic stroke limiter and external pilot pressure supply (positive control)



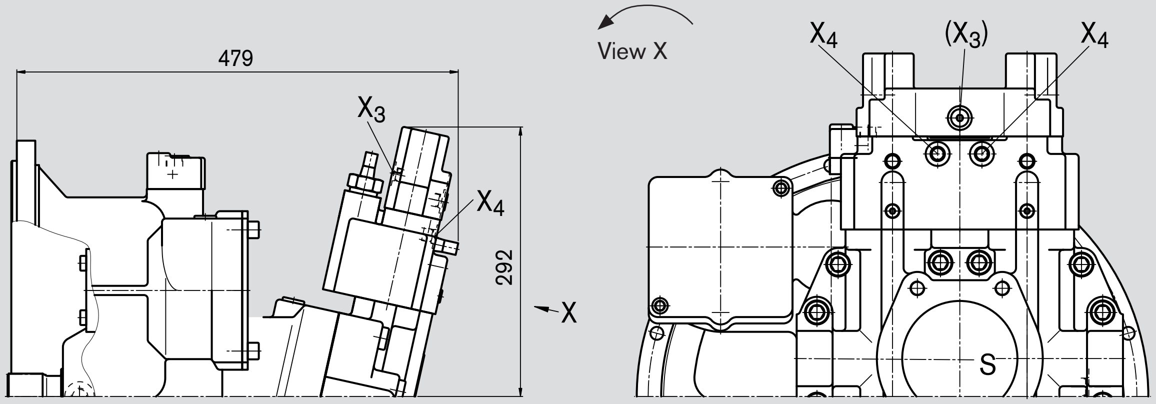
LA0KH2, LA1KH2

Individual power controller with hydraulic power coupling, hydraulic stroke limiter and external pilot pressure supply (positive control)



LA0S, LA1S

Individual power controller with load sensing

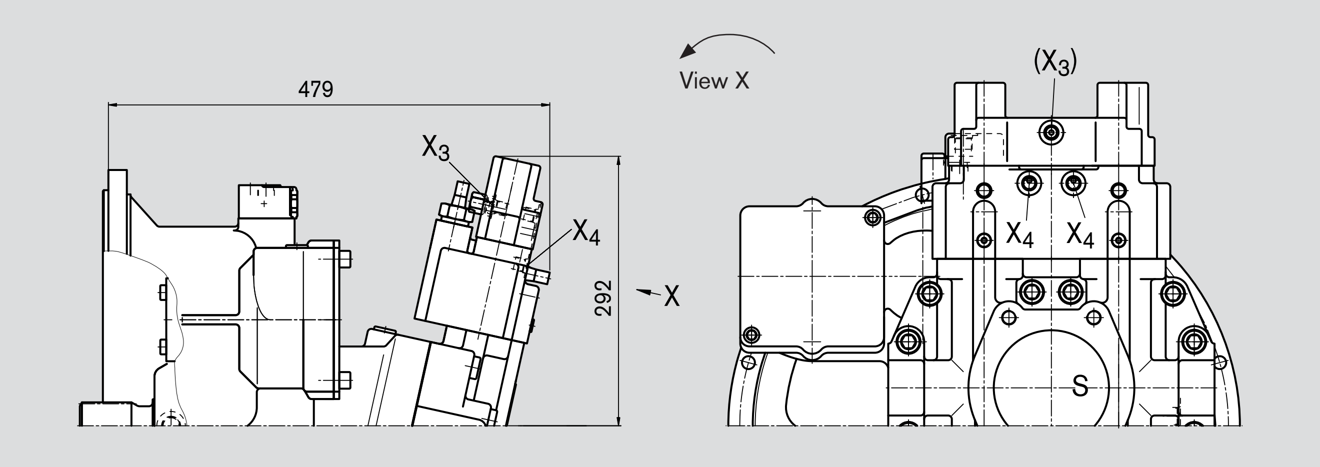


Unit Dimensions, Size 200

Before finalizing your design, please request a binding installation drawing. Dimensions in mm

LA0KS, LA1KS

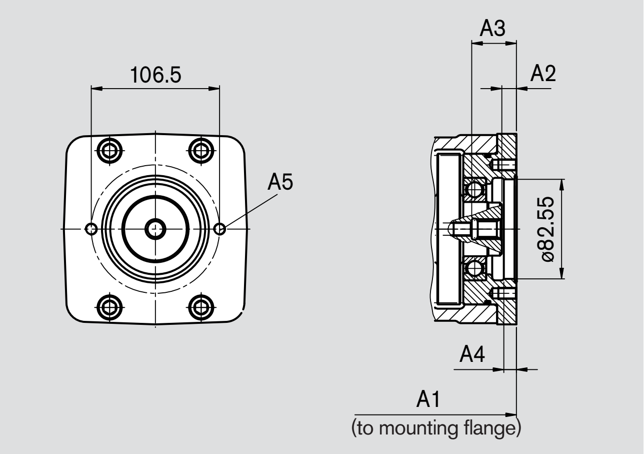
Individual power controller with hydraulic power coupling and load sensing



Power Take-off Dimensions

Before finalizing your design, please request a binding installation drawing. Dimensions in mm

K01/F01 Flange SAE J744 – 82-2 (A)
Hub for splined shaft according to ANSI B92.1a-1976 5/8in 9T 16/32DP [1] (SAE J744 – 16-4 (A))



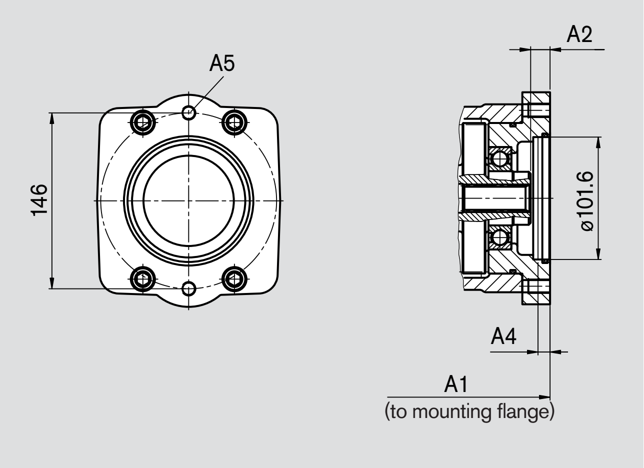
Size	A1	A2	A3	A4	A5 [2]
55	178	10.1	35.1	10.5	M10x1.5;15 deep
80	178	10.1	35.1	10.5	M10x1.5;15 deep
107	190	12.1	37.1	10.5	M10x1.5;15 deep
140	232	11.1	36.1	10.1	M10x1.5;14 deep
200	260	12	37	10.2	M10x1.5;15 deep

Note related to the position of the fixing threads:

Standard position is shown. Further positions of the fixing threads available on request.
Please specify in clear text.

K02/F02 Flange SAE J744 – 101-2 **(B)**
Hub for splined shaft according to ANSI B92.1a-1976 7/8in 13T 16/32DP [1] (SAE J744 – 22-4 (**B**))

K04/F04 Flange SAE J744 – 101-2 **(B)**
Hub for splined shaft according to ANSI B92.1a-1976 1in 15T 16/32DP [1] (SAE J744 – 25-4 (**B-B**))



K02/F02, K04/F04

Size	A1	A2	A4	A5 [2]
55	185	13.1	10	M12x1.75;18 deep
80	185	13.1	10	M12x1.75;18 deep
107	197	16.1	10	M12x1.75;18 deep
140	243	15.1	12.1	M12x1.75;18 deep
200	262.5	14.5	10.4	M12x1.75;18 deep

Note related to the position of the fixing threads:

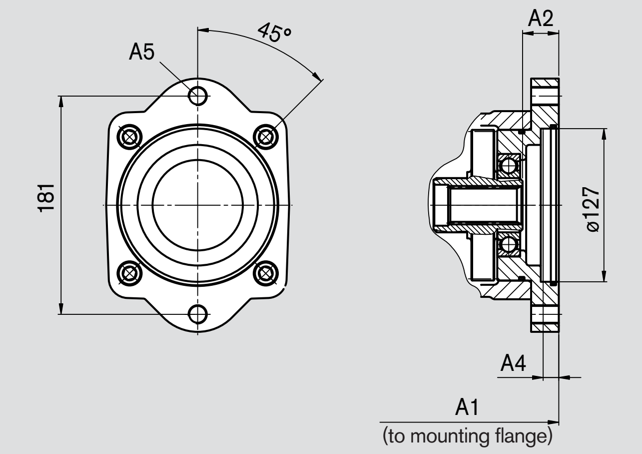
Standard position is shown. Further positions of the fixing threads available on request.
Please specify in clear text.

---

[1] 30° pressure angle, flat root, side fit, tolerance class 5
[2] Thread according to DIN13, please observe the general notes for the max. tightening torques on page 40.

Power Take-off Dimensions

K07/F07 Flange SAE J744 – 127-2 **(C)**
Hub for splined shaft according to ANSI B92.1a-1976 1 1/4in 14T 12/24DP [1] (SAE J744 – 32-4 (**C**))



Size	A1	A2	A3	A4	A5 [2]
55					
80	185	16.1	59.1 [3]	13	M16x2
107	197	30.1	–	13	M16x2
140	243	15.1	–	13	M16x2
200	267.5	19.5	–	11	M16x2

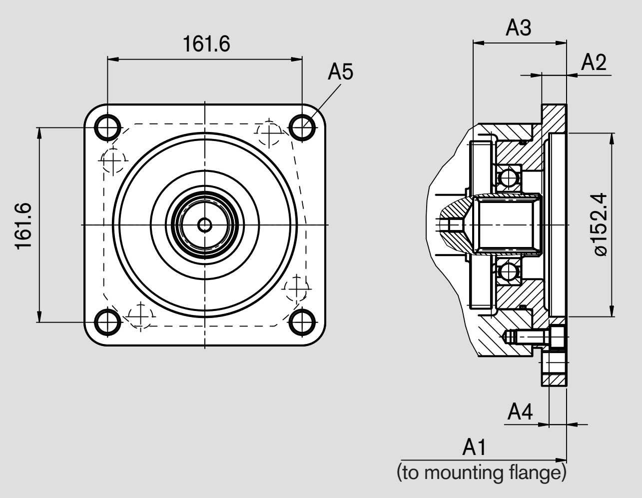
[3] Illustration as for K01

Note related to the position of the fixing threads:

Standard position is shown. Further positions of the fixing threads available on request.
Please specify in clear text.

K86/F86 Flange SAE J744 – 152-4 **(D)**
Hub for splined shaft according to ANSI B92.1a-1976 1 1/4in 14T 12/24DP [1] (SAE J744 – 32-4 (**C**))

K17/F17 Flange SAE J744 – 152-4 **(D)**
Hub for splined shaft according to ANSI B92.1a-1976 1 3/4in 13T 8/16DP [1] (SAE J744 – 44-4 (**D**))



K86/F86, K17/F17

Size	A1	A2	A3	A4	A5 [2]
140	248.5	20.6	77.6	14.5	M20x2.5
200	267.5	19.5	76.5	14.5	M20x2.5

---

[1] 30° pressure angle, flat root, side fit, tolerance class 5

[2] Thread according to DIN13, please observe the general notes for the max. tightening torques on page 40.

Overview of Attachments

			Attachment for 2nd pump						
Flange	Hub for splined shaft	Short code K.../F...	A4FO Size (Shaft)	A4VG Size (Shaft)	A10VG Size (Shaft)	A10VO/31 Size (Shaft)	A10VO/53 Size (Shaft)	A11VO Size (Shaft)	External gear pump
Power take-off – A8VO55/80									
82-2 (A)	5/8in	**01**	–	–	–	–	–	–	Size F Sizes 4-22 1)
101-2 (B)	7/8in	**02**	16, 22, 28 (S)	–	18 (S)	28 (S, R)	28 (S, R) 45 (U, W)	–	Size N Sizes 20-32 1) Size G Sizes 38-45 1)
	1in	**04**	–	28 (S)	28,45 (S)	–	45 (S, R) 60 (U, W)	40 (S)	–
127-2 (C)	1 1/4in	**07**	–	40, 56, (S)	–	–	60 (S)	60 (S) 2)	–
Power take-off – A8VO107									
82-2 (A)	5/8in	**01**	–	–	–	–	–	–	Size F Sizes 4-22 1)
101-2 (B)	7/8in	**02**	16, 22, 28 (S)	–	18 (S)	28 (S, R) 45 (U)	28 (S, R) 45 (U, W)	–	Size N Sizes 20-32 1) Size G Sizes 38-45 1)
	1in	**04**	–	28 (S)	28,45 (S)	45 (S, R)	45 (S, R) 60 (U, W)	40 (S)	–
127-2 (C)	1 1/4in	**07**	–	40, 56, 71 (S)	–	–	60 (S)	60 (S)	–
Power take-off – A8VO140									
82-2 (A)	5/8in	**01**	–	–	–	–	–	–	Size F Sizes 4-22 1)
101-2 (B)	7/8in	**02**	16, 22, 28 (S)	–	18 (S)	28 (S, R) 45 (U)	28 (S, R) 45 (U, W)	–	Size N Sizes 20-32 1) Size G Sizes 38-45 1)
	1in	**04**	–	28 (S)	28,45 (S)	45 (S, R)	45 (S, R) 60 (U, W)	40 (S)	–
127-2 (C)	1 1/4in	**07**	–	40, 56, 71 (S)	63 (S)	71 (S, R) 100 (U)	60 (S) 85 (U)	60(S)	–
152-4 (D)	1 1/4in	**86**	–	–	–	–	–	75 (S)	–
	1 3/4in	**17**	–	90 (S)	–	140 (S)	–	95 (S)	–
Power take-off – A8VO200									
82-2 (A)	5/8in	**01**	–	–	–	–	–	–	Size F Sizes 4-22 1)
101-2 (B)	7/8in	**02**	16, 22, 28 (S)	–	18 (S)	28 (S, R) 45 (U)	28 (S, R) 45 (U, W)	–	Size N Sizes 20-32 1) Size G Sizes 38-45 1)
	1in	**04**	–	28 (S)	28,45 (S)	45 (S, R)	45 (S, R) 60 (U, W)	40 (S)	–
127-2 (C)	1 1/4in	**07**	–	40, 56, 71 (S)	–	71 (S, R) 100 (U)	60 (S) 85 (U)	60 (S)	–
152-4 (D)	1 1/4in	**86**	–	–	–	–	–	75 (S)	–
	1 3/4in	**17**	–	90, 125 (S)	–	140 (S)	–	95, 130 (S)	–

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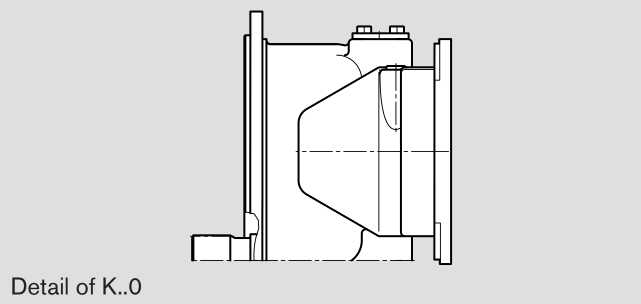
1) Rexroth recommends special gear pump versions. Please contact us.

2) For mounting the A11VO size 60, side threaded ports for A_1 and A_2 are required. Please contact us.

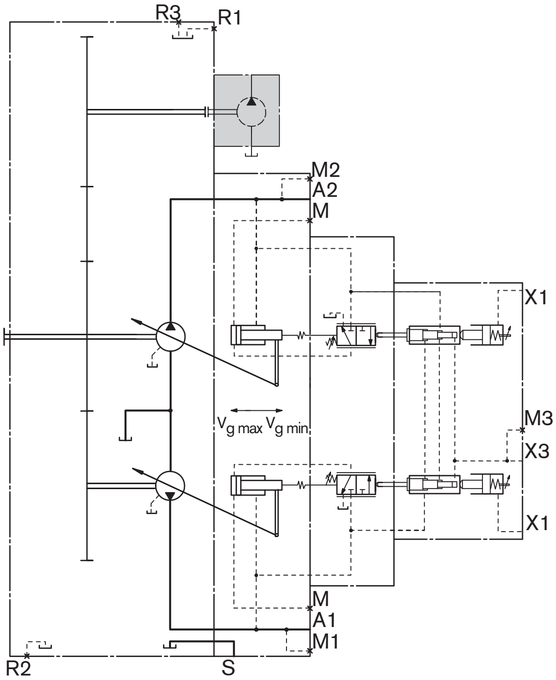
Power Take-off, Auxiliary Pump and Valves

Variation:

with power take-off, without integrated auxiliary pump, K..0

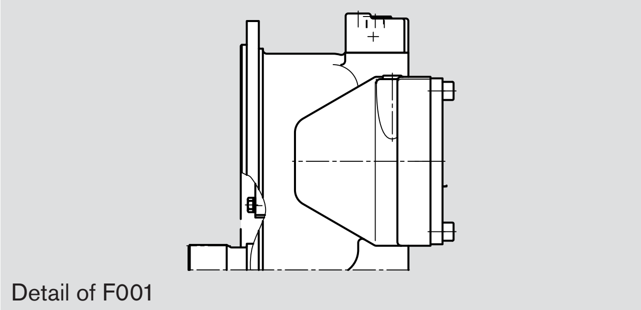

Detail of K..0

For technical data, see table of values on page 6.
For mounting on PTO:
Axial piston pumps and gear pumps

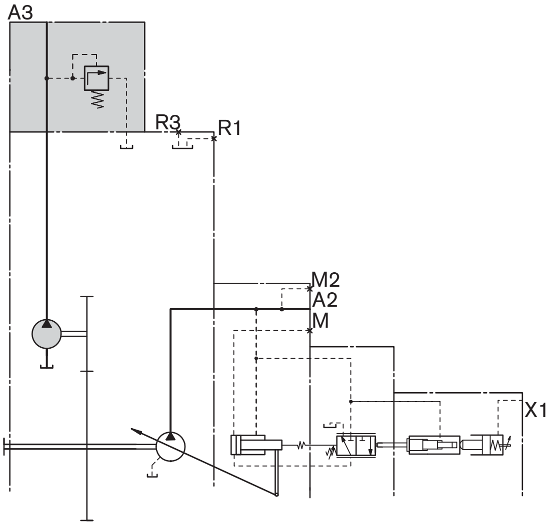


Variation:

without power take-off, with integrated auxiliary pump (pilot fluid pump) and pressure-relief valve, F001

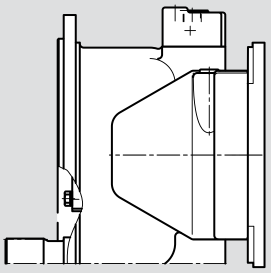

Detail of F001

For technical data, see table of values on page 6.
The pressure-relief valve installed to protect the integrated auxiliary pump has a fixed setting of 30 bar.



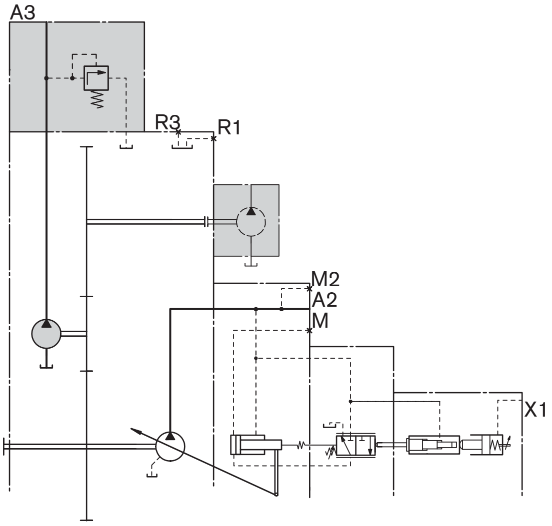
Power Take-off, Auxiliary Pump and Valves

Variation:
with power take-off, with integrated auxiliary pump (pilot fluid pump) and pressure-relief valve, F..1

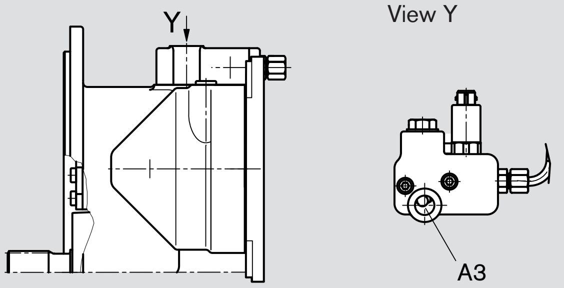


Detail for F..1

For technical data, see table of values on page 6.
The pressure-relief valve installed to protect the integrated auxiliary pump has a fixed setting of 30 bar.
For mounting on PTO:
Axial piston pumps and gear pumps



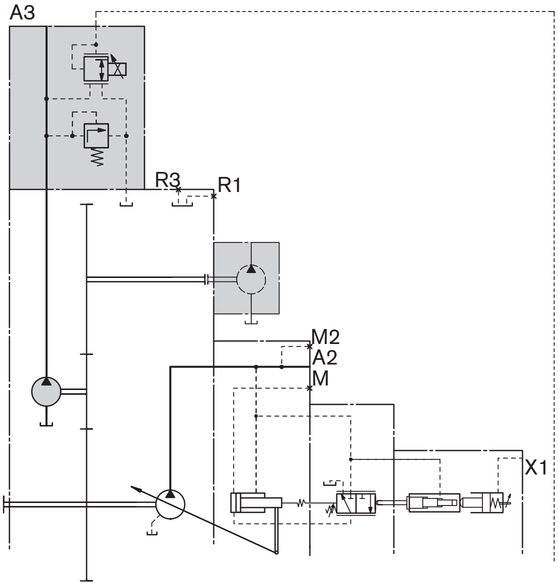
Variation:
with power take-off, with integrated auxiliary pump (pilot fluid pump), with pressure-relief and pressure-reduction valves, F..4



Detail for F..4

For technical data, see table of values on page 6.
The pressure-relief valve installed to protect the integrated auxiliary pump has a fixed setting of 30 bar. An electrically controlled pressure-reduction valve can be used to override the power setting (load-limiting control).

Pressure-reduction valve control voltage:
F..4 ➔ 24V DC
Recommended frequency ➔ >100Hz
For mounting on PTO:
Axial piston pumps and gear pumps



Connector for Solenoids (only for EP)

DEUTSCH DT04-2P-EP04, 2-pin

Molded, without bi-directional suppressor diode
(standard) ____________________ **P**

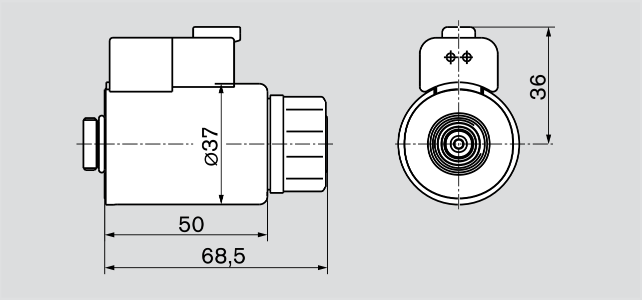
Type of protection according to DIN/EN 60529: IP67 and IP69K

Mating connector

DEUTSCH DT06-2S-EP04
Rexroth Mat. No. R902601804

consisting of:	DT designation
– 1 case	DT06-2S-EP04
– 1 wedge	W2S
– 2 sockets	0462-201-16141

The mating connector is not included in supply.
This can be supplied by Rexroth on request.



Note for round solenoids:

The position of the connector can be changed by turning the solenoid body.

The following procedure is to be observed:

1. Loosen the fixing nut (1)
2. Turn the solenoid body (2) to the desired position
3. Tighten the fixing nut
   Tightening torque of fixing nut: 5^{+1} Nm
   (width across flats WAF26, 12-sided DIN 3124)

Installation Notes

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This is also to be observed following a relatively long standstill as the system may empty via the hydraulic lines.

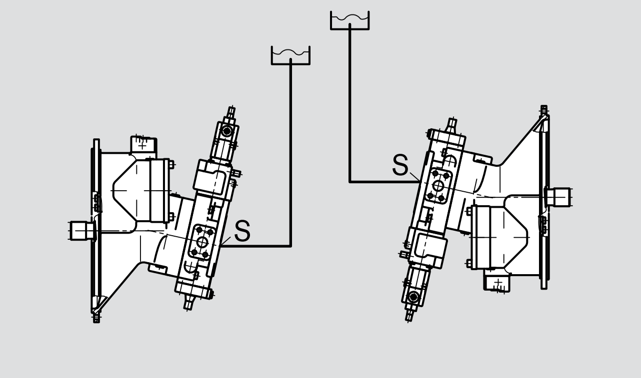
The case drain chamber is internally connected to the suction chamber. A case drain line to the tank is not required.
Note the special feature of size 200 for flushing fluid. (Port R4)
In all operational states, the suction line must flow into the tank below the minimum fluid level.
The minimum suction pressure at port S must not fall below of 0.8 bar absolute.

Installation position

Shaft horizontal.

Below-tank installation

Below-tank installation is when the pump is fitted below the minimum fluid level in the tank.

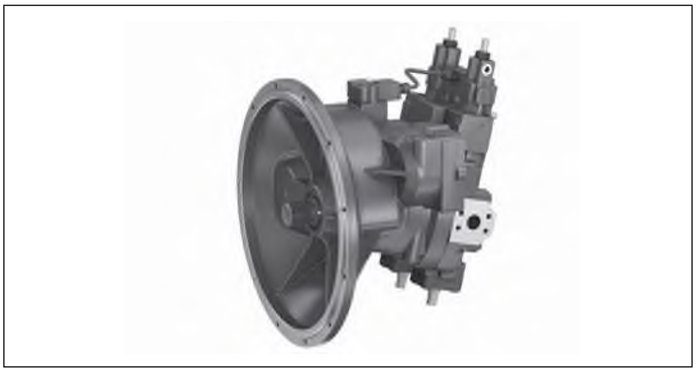


Notice

General Notes

- The A8VO pump is designed to be used in open circuits.
- Project planning, assembly and commissioning of the pump require the involvement of qualified personnel.
- The service line ports and function ports are only designed for mounting hydraulic lines.
- During and shortly after operation, there is a risk of burns on the pump and especially on the solenoids. Take suitable safety precautions, e.g. wear protective clothing.
- There may be shifts in the characteristic depending on the operating state of the pump (operating pressure, fluid temperature).
- Tightening torques:
  - The tightening torques specified in this data sheet are maximum values and must not be exceeded (maximum values for screw thread).
    Manufacturer's instruction for the max. permissible tightening torques of the used armatures must be observed!
  - For DIN 13 fixing screws we recommend checking the tightening torque individually according to VDI 2230 Edition 2003.
- The data and information contained herein must be adhered to.

Axial piston variable double pump
A8VO225 Series 72



- Size 225
- Nominal pressure 380 bar
- Maximum pressure 420 bar
- Open circuit

Features

- Variable double pump with two axial tapered piston rotary groups with bent-axis design for open-circuit hydrostatic drives
- Flow is proportional to drive speed and displacement
- Adjusting the swashplate rotary group enables the volume flow to be steplessly varied
- The pump is suitable for direct attachment to the flywheel case of a diesel engine
- A common suction port for both circuits and the auxiliary pump
- Integrated auxiliary pump with pressure-relief valve
- Power take-off variants for attachment of axial piston and gear pumps
- Very favorable power-to-weight ratio
- Long service life

Contents

Ordering code

01	02	03	04	05		06	07	08		09	10	11	12	13	14	15	16		17
A8V	**O**	**225**		**0**	**/**	**72**	**M**	**R**	**–**	**N**	**1**	**G1**	**A2**	**5**				**–**	

Axial piston unit

01	Bent-axis design, variable, nominal pressure 380 bar, maximum pressure 420 bar	**A8V**

Operating mode

02	Double pump (parallel design), open circuit	**O**

Size (NG)

03	Geometrical displacement per rotary group, see Technical data on page 6	**225**

Control devices

04	Individual power controller with pilot pressure power override, with hydraulic power coupling and hydraulic lift limitation	Negative control	**LA1KH1**
		Positive control, external pilot pressure supply	**LA1KH2**

Swivel angle indicator

05	Without swivel angle indicator	**0**

Series

06	Series 7, index 2	**72**

Configuration of ports and fastening threads

07	Metric, port threads with O-ring seal according to ISO 6149	**M**

Direction of rotation

08	Viewed on drive shaft, right	**R**

Sealing material

09	NBR (nitrile rubber), FKM (fluoroelastomer)	**N**

Transmission ratio (n_{drive} / $n_{\text{rotary groups}}$)

10	$i = 1$	**1**

Mounting flange

11	Suitable for the flywheel case (acc. to SAE J617) of the combustion engine	**G1**

Drive shaft

12	Splined shaft DIN 5480	**A2**

Service line ports

13	SAE flange ports **A**$_1$ and **A**$_2$ on opposite sides (metric fastening thread) SAE flange port **S** at rear (metric fastening thread)	**5**

Auxiliary pump

14	Without integrated auxiliary pump		**U**
	With integrated auxiliary pump	Standard	**F**
		Large	**B**

01	02	03	04	05		06	07	08		09	10	11	12	13	14	15	16		17
A8V	**O**	**225**		**0**	**/**	**72**	**M**	**R**	**–**	**N**	**1**	**G1**	**A2**	**5**				**–**	

Power take-offs

15	Without power take-off	**0000**

Valves

16	Without valves (only for the version **without** auxiliary pump, U)	**0**
	With pressure-relief valve (only for versions **with** auxiliary pump, F)	**A**
	With pressure limitation and pressure reducing valve, U = 24 V (only for versions with auxiliary pump, F)	**C**

Standard / special version

17	Standard version	**0**
	Standard version with installation variants, e. g. T ports against standard open or closed	**Y**
	Special version	**S**

Note

Preservation:

- up to 12 months as standard
- up to 24 months long-term
  (state in plain text when ordering)

Hydraulic fluids

The A8VO variable double pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: environmentally acceptable hydraulic fluids
- 90222: fire-resistant, water-free hydraulic fluids (HFDR/HFDU)

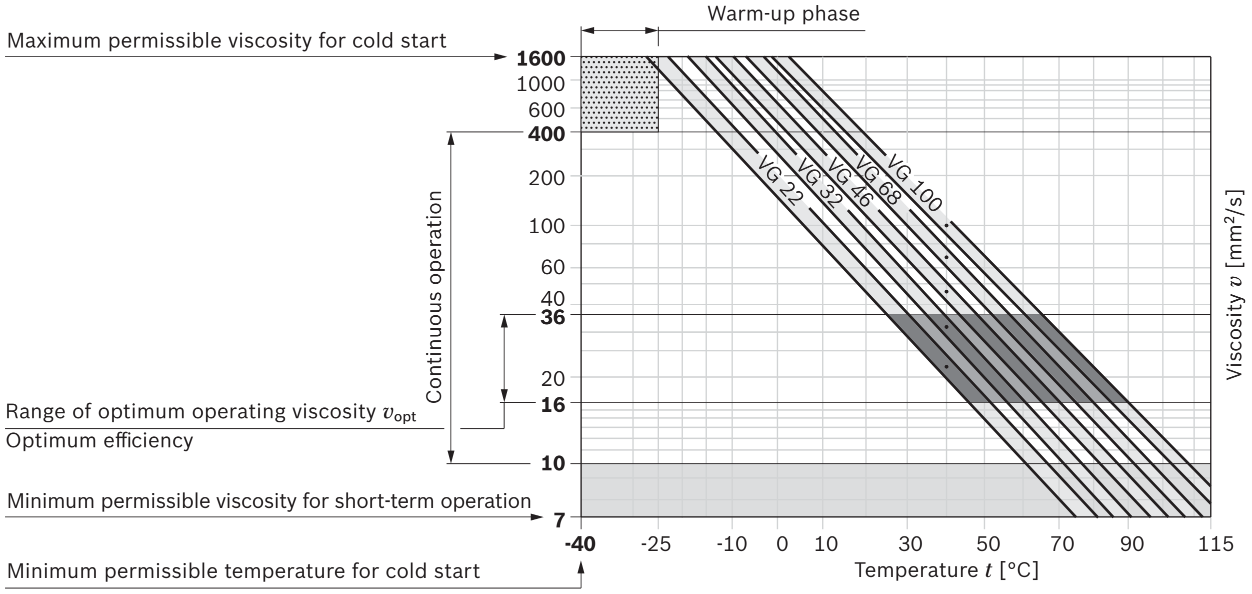
Details regarding the selection of hydraulic fluid
The hydraulic fluid should be chosen such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see selection diagram).

Note
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \leq 1600\ mm^2/s$	$\theta_{St} \geq -40\ °C$	$t \leq 3$ min, $n \leq 1000$ rpm, without load $p \leq 50$ bar
Permissible temperature difference		$\Delta T \leq 25\ K$	between axial piston unit and hydraulic fluid in system
Warm-up phase	$\nu <$ 1600 to 400 mm^2/s	$\theta =$ -40 °C to -25 °C	At $p \leq 0.7 \cdot p_{nom}$, $n \leq 0.5 \cdot n_{nom}$ and $t \leq 15$ min
Continuous operation	$\nu =$ 400 to 10 mm^2/s		This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram)
		$\theta =$ -25 °C to +103 °C	measured at port **R** Note the permissible temperature range of the shaft seal (ΔT = approx. 12 K between the bearing/shaft seal and port **R**)
	$\nu_{opt} =$ 36 to 16 mm^2/s		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \geq$ 7 mm^2/s		$t < 3$ min, $p < 0.3 \cdot p_{nom}$

▼ **Selection diagram**



Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.

At very high hydraulic fluid temperatures (90 °C to maximum 103 °C, measured at port **R**), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

Shaft seal

The FKM shaft seal ring may be used for case drain temperatures from -25 °C to +115 °C. For application cases below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C).

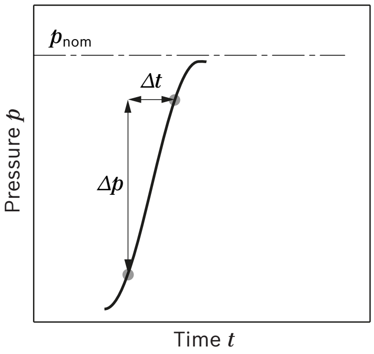
Drive

Via elastic coupling.

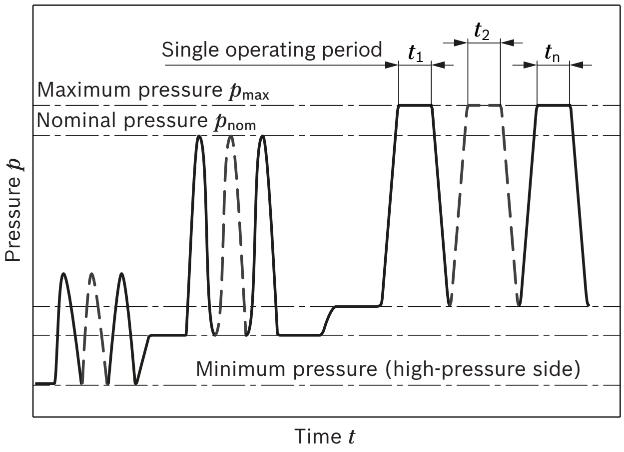
Operating pressure range

Pressure at service line port A$_1$ or A$_2$		**Definition**
Nominal pressure p_{nom}	380 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	420 bar absolute	The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure (high-pressure side)	25 bar absolute	Minimum pressure on the high-pressure side (**A$_1$** and **A$_2$**) that is required in order to prevent damage to the axial piston unit.
Rate of pressure change $R_{A\ max}$	9000 bar/s	Maximum permissible rate of pressure build-up and reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{S\ min}$	0.8 bar absolute	Minimum pressure at suction port **S** (inlet) that is required in order to avoid damage to the axial piston unit. The minimum pressure depends on the speed and displacement of the axial piston unit.
Maximum pressure $p_{S\ max}$	1.5 bar absolute	
Auxiliary pump		
Maximum pressure p_{max}	40 bar absolute	

▼ **Rate of pressure change $R_{A\ max}$**



▼ **Pressure definition**



Total operating period = $t_1 + t_2 + ... + t_n$

Note
- ▶ Valid when using hydraulic fluids based on mineral oils
- ▶ Values for other hydraulic fluids, please contact us.

Formulas		
Flow	$q_\text{v} = \dfrac{V_\text{g} \cdot n \cdot \eta_\text{v}}{1000}$	[l/min]
Torque	$T = \dfrac{V_\text{g} \cdot \Delta p}{20 \cdot \pi \cdot \eta_\text{mh}}$	[Nm]
Power	$P = \dfrac{2\,\pi \cdot T \cdot n}{60000} = \dfrac{q_\text{v} \cdot \Delta p}{600 \cdot \eta_\text{t}}$	[kW]

Key

V_g = Displacement per revolution [cm^3]

Δp = Differential pressure [bar]

n = Rotational speed [rpm]

η_v = Volumetric efficiency

η_mh = Mechanical-hydraulic efficiency

η_t = Total efficiency ($\eta_\text{t} = \eta_\text{v} \cdot \eta_\text{mh}$)

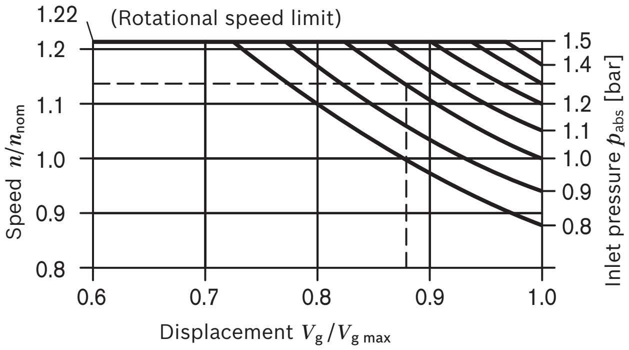
Note

- Theoretical values, without efficiency levels and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, such as speed variation, reduced angular acceleration as a function of the frequency and the permissible angular acceleration at start (lower than the maximum angular acceleration) can be found in data sheet 90261.
- Transport and storage
  $\theta_\text{min} \geq -50$ °C, $\theta_\text{opt} = +5$ °C to +20 °C

Technical data

Size		**NG**		**225**
Displacement geometric, per revolution		$V_\text{g max}$	cm^3	2 x 224.6
		$V_\text{g min}$	cm^3	0
Transmission ratio $i = n_\text{drive}/n_\text{rotary groups}$				1.0
Maximum rotational speed	at $V_\text{g max}$[1]	n_nom	rpm	2050
	at $V_\text{g} < 0.74 \cdot V_\text{g max}$[2]	n_max	rpm	2300
Flow	at n_nom and $V_\text{g max}$	q_v	l/min	2 x 460
Power	At n_nom, $V_\text{g max}$ and Δp = 250 bar	P	kW	384
Torque	at $V_\text{g max}$ and Δp = 250 bar (both pumps)	T[3]	Nm	1788
Rotary stiffness of individual rotary group	$V_\text{g max}$ to $0.5 \cdot V_\text{g max}$	c_min	Nm/rad	72995
	$0.5 \cdot V_\text{g max}$ bis $0_\text{(interpolated)}$	c_max	Nm/rad	318679
Moment of inertia for rotary group	with power take-off, without attachment pump	J_TW	kgm^2	0.0879
	without power take-off	J_TW	kgm^2	0.0708
Angular acceleration of individual rotary group		α	rad/s^2	10000
Weight (approx.)		m	kg	194
Variation: with integrated auxiliary pump, F0000, F..				
Displacement with integrated auxiliary pump		$V_\text{g max}$	cm^3	11 (19)
Displacement effective		$V_\text{g max}$	cm^3	13.6 (23.6)
Transmission ratio $i = n_\text{drive}/n_\text{auxiliary pump}$				0.804
Variation: with power take-offs, U...., F....				
Maximum torque at power take-off		$T_\text{T3 max}$	Nm	800
Transmission ratio $i = n_\text{drive}/n_\text{auxiliary pump}$				0.804

▼ Maximum permissible speed (speed limit)



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1) The values are applicable:
– at absolute pressure p_abs = 1 bar at suction port **S**
– for the optimal viscosity range of ν_opt = 36 to 16 mm^2/s
– for hydraulic fluid based on mineral oils

2) Maximum rotational speed (limit speed) for increased inlet pressure p_abs at suction port **S** and $V_\text{g} < V_\text{g max}$, see diagram.

3) Input torque T is the sum of the individual torques of rotary group 1 (T_T1), rotary group 2 (T_T2) and power take-off (T_T3)
– T_T1 = Torque of rotary group 1 (V_g, Δp)
– T_T2 = Torque of rotary group 2 (V_g, Δp)
– T_T3 = Torque of power take-off
– Condition for all operating conditions: $T_\text{T1} + T_\text{T2} + T_\text{T3} \leq T$

Individual power control

The two rotary groups of the variable double pump mit individual power controller LA1 are not mechanically coupled, i.e. each rotary group is equipped with a separate power controller.

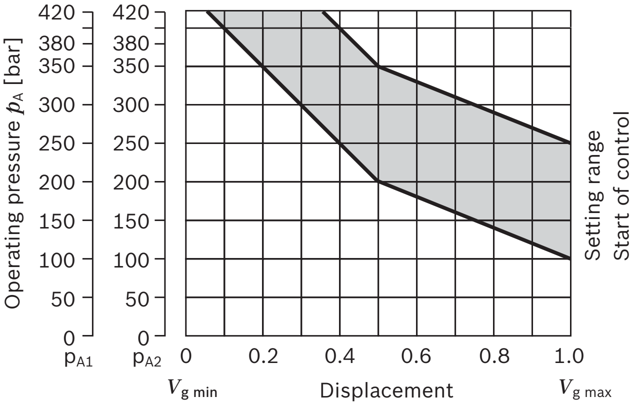
The power control regulates the displacement of the pump depending on the operating pressure so that a given drive power is not exceeded.

Power is set individually for each controller and may differ, whereby each pump can be set to 100% drive power.

The hyperbolic power curve is approximated with two mass springs. The operating pressure acts on the measurement area of a differential piston against the mass springs and of a spring force that can be varied from the outside, which determines the power setting.

If the sum of the hydraulic forces exceeds the forces of the springs, the control fluid is fed to the stroking piston, swiveling the pump back and setting it to a smaller volume flow. In a depressurized state, the pump is swiveled to its initial position to $V_{g\,max}$ by a return spring.

▼ **Characteristic LA1**



The hydraulic output power (characteristic LR) is influenced by the efficiency of the double pump.

When ordering, state in plain text:

- Application: e.g. excavator
- Drive power P [kW]
- Drive speed n [rpm]
- Maximum volume flow $q_{V\,max}$ [l/min]
- Maximum working pressure (primary pressure valve setting)

After clarifying the details a power diagram can be created by our computer.

LA1

Individual power controller with power override through pilot pressure

The third measuring area of the differential piston is charged with an external pilot pressure (port $\mathbf{X}_3$, allowing the set power to be reduced (negative power override).

The mechanically adjusted basic setting can be hydraulically adjusted by means of different pilot pressure settings. This makes different power setting possible.

If the pilot pressure signal is variably controlled via a load limiting control, the sum of the hydraulic powers equals the drive power. The pilot pressure for power override is generated by an external control element or by the mounted pressure reducing valve (see page 13).

The electric signal for controlling the pressure reducing valve must be generated in an external control electronic circuit. Various BODAS controllers RC in conjunction with LLC software are available for this purpose.

Note!

If there is no power override, port $\mathbf{X}_3$ to the reservoir must be relieved.

LA1K

Individual power controller mit hydraulic coupling

The hydraulic coupling of the two individual controllers is the result of the accumulated power control function. However, the two rotary groups are not coupled mechanically, but rather hydraulically.

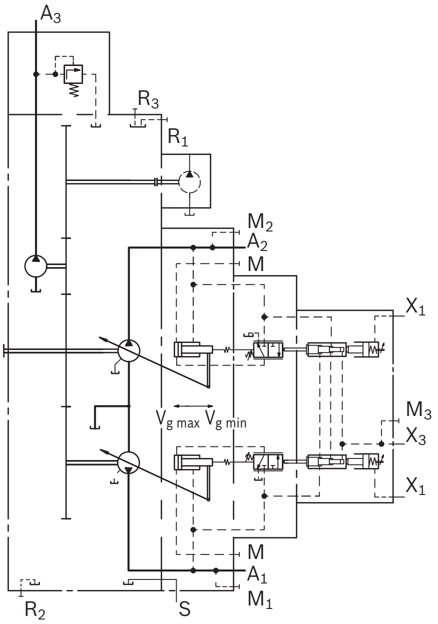
The operating pressures of the two circuits each act on the differential piston of the two individual controllers, swiveling the two rotary groups out and back together.

If one pump is working with less than 50% of the total drive power, the power that is set free can be additionally transmitted to the other pump, in borderline cases up to 100% of the total drive power.

Note

With the additional function hydraulic stroke limiter, each rotary group can be swiveled back independently of a smaller V_g than that currently specified by the power control.

▼ **Schematic LA1KH1**



LA1H

Individual power controller with hydraulic stroke limiter

The hydraulic stroke limiter allows the displacement to be steplessly varied or limited over the entire adjustment range of $V_{g\,max}$ to $V_{g\,min}$.

The displacement is set by a pilot pressure p_{st} applied to port **X**$_1$ (maximal 40 bar).

The power control overrides the hydraulic stroke limiter control, i.e. below the power characteristic, the displacement is controlled by the pilot pressure. If the set flow or operating pressure exceeds the power characteristic, the power control overrides and reduces the displacement following the spring characteristic.

Instructions

The H1/H2 characteristic is influenced by the design of the power controller!

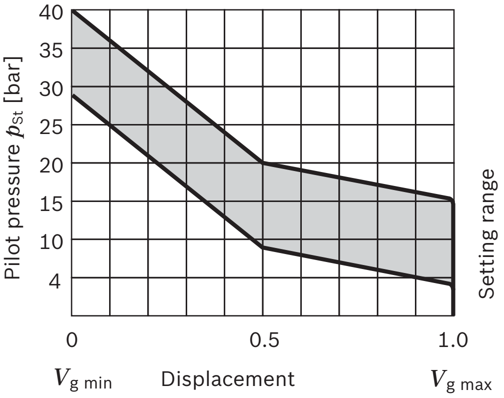
LA1H1

Hydraulic stroke limiter (negative control)

- Control from $V_{g\,max}$ to $V_{g\,min}$.
  With increasing pilot pressure the pump swivels to a smaller displacement.
- Start of control (at $V_{g\,max}$), adjustable of 4 to 15 bar.
  Start of control depends on the setting of the power controller. State start of control in clear text in the order.
- Initial position in depressurized state: $V_{g\,max}$

▼ **Characteristic LA1H1**

Pilot pressure increase ($V_{g\,max}$ to $V_{g\,min}$) Δp = approx. 25 bar



Note

A pressure of ≥ 30 bar is needed for control. The necessary positioning fluid is taken from the high-pressure line. If negative control directional valves are used, control pressure supply from the negative control system is ensured via the high-pressure line

LA1H2

Hydraulic stroke limiter and external pilot pressure supply (positive control)

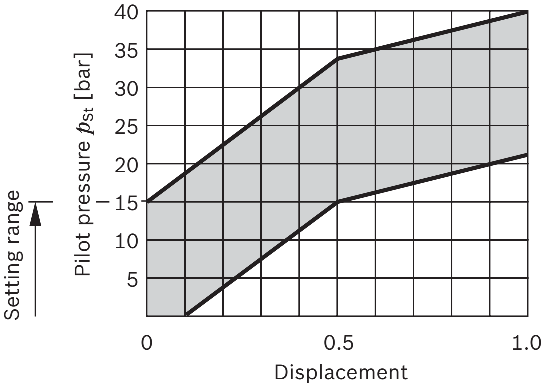
- Control from $V_{g\,min}$ to $V_{g\,max}$.
  With increasing pilot pressure the pump swivels to a higher displacement.
- Start of control (at $V_{g\,min}$), adjustable of 0 to 15 bar.
  State start of control in clear text in the order.
- Initial position in depressurized state: $V_{g\,max}$

Note

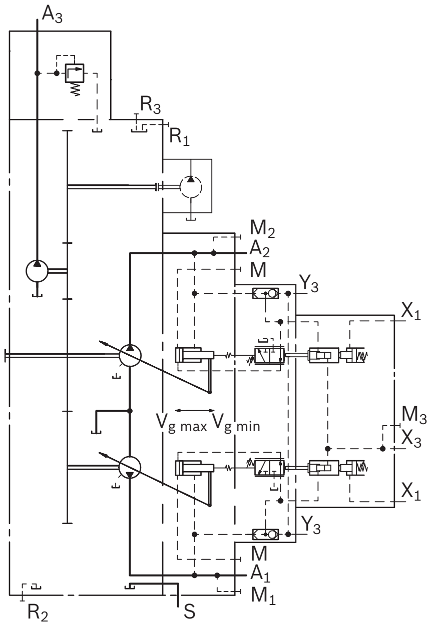
- To adjust from $V_{g\,max}$ to $V_{g\,min}$, a pressure of ≥ 30 bar is needed. The necessary control power is taken from the high pressure or the remote control pressure (≥ 30 bar) acting on port **Y**$_3$
  (pilot pressure < start of control).
- If there is a **Y**$_3$ port (H2) this must always be connected to a remote control pressure. Without a remote control pressure supply, this port to the reservoir must be relieved.

▼ Characteristic LA1H2

Pilot pressure increase ($V_{g\,min}$ – $V_{g\,max}$) Δp = approx. 25 bar

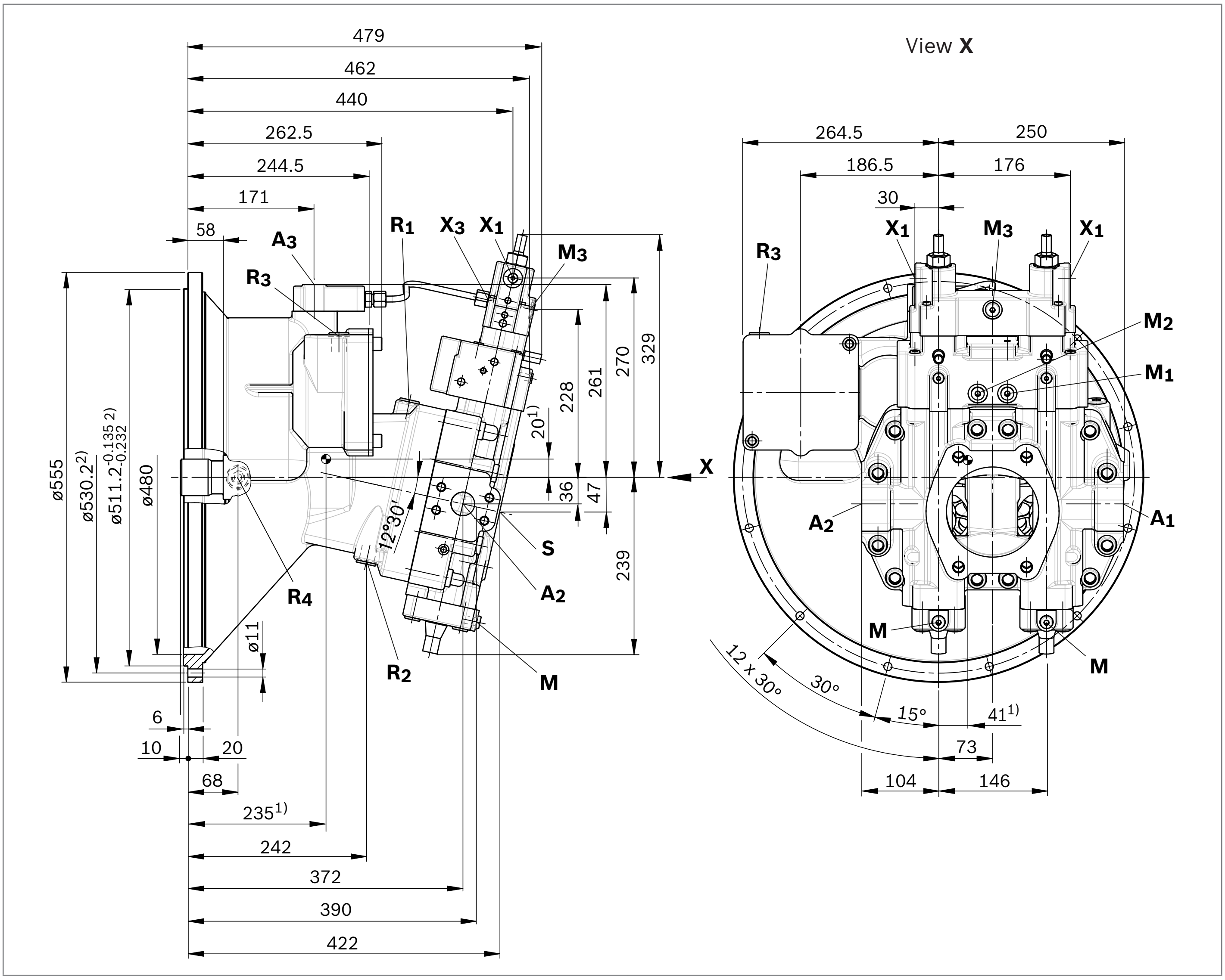


▼ Schematic LA1H2

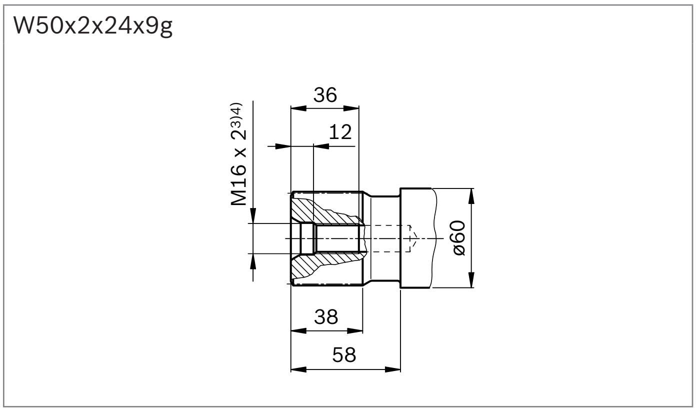


Dimensions size 225

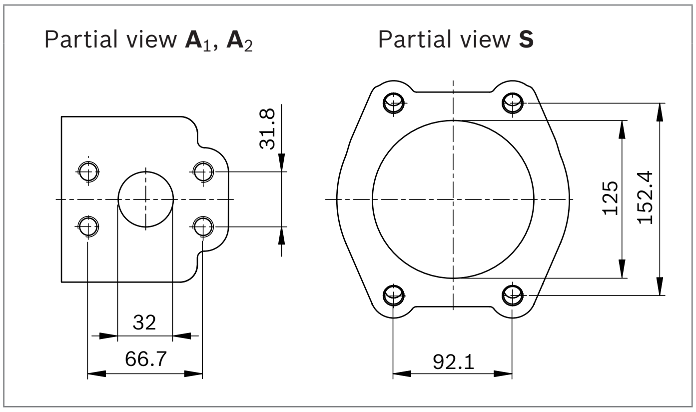
LA1KH1 – Individual power controller, negative control



▼ **Splined shaft DIN 5480**

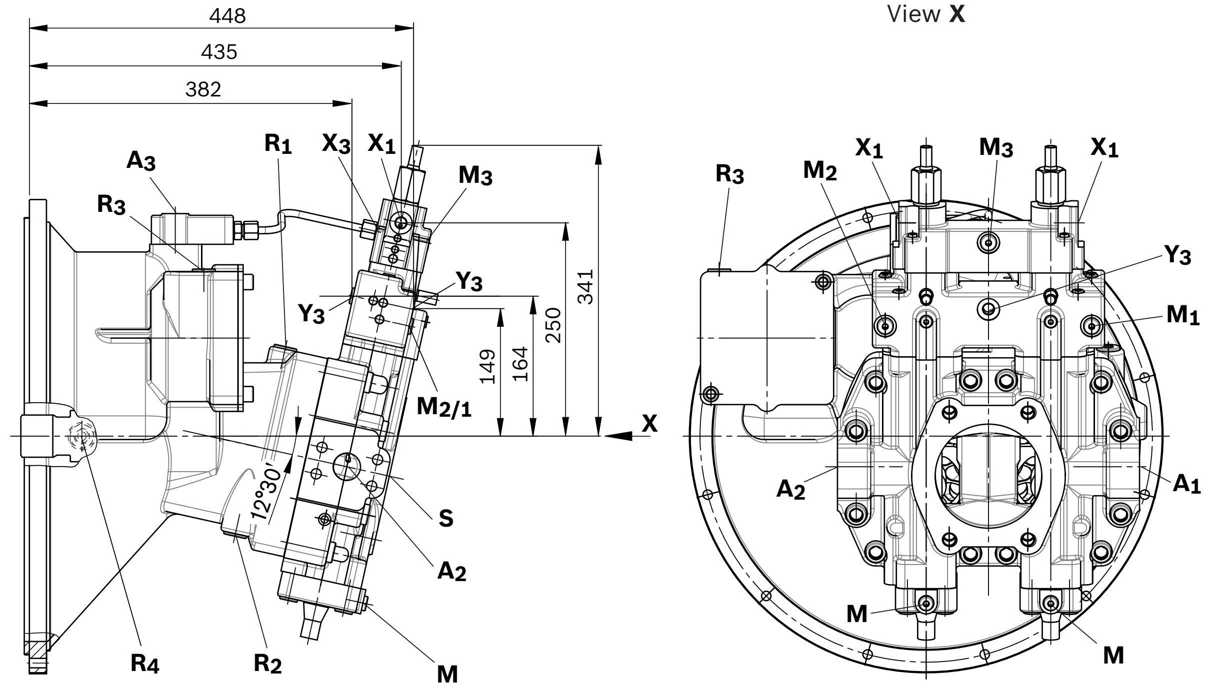


▼ **Partial views**



1) Center of gravity
2) Dimensions according to SAE J617-No. 1, for connection to the flywheel case of the combustion engine
3) Center bore according to DIN 332 (thread according to DIN 13)
4) Observe the general instructions on page 15 for the maximum tightening torques.

LA1KH2 – Individual power controller, negative control

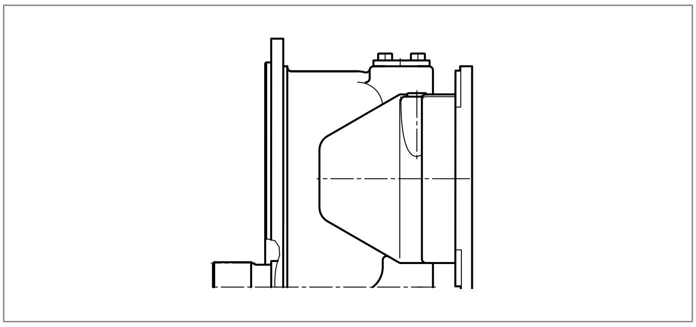


Ports		Standard	Size[1]	$p_{max\ abs}$ [bar][2]	Status[6]
A_1, A_2	Service line port (high-pressure series) Fastening thread	SAE J518[3] DIN 13	1 1/4 in M12 x 1.75; 19 deep	420	O
S	Suction port (standard pressure series) Fastening thread	SAE J518[3] DIN 13	5 in M16 x 2; 23 deep	1.5	O
A_3	Service line port for auxiliary pump	DIN 3852[4]	M18 x 1.5; 12 deep	40	O
R_1, R_3	Air bleed	DIN 3852[4]	M22 x 1.5; 12 deep	1.5	X
R_2	Oil drain	DIN 3852[4]	M22 x 1.5; 12 deep	1.5	X
R_4	Flow port	ISO 11926[4]	3/4-16 UNF-2B; 12 deep	1.5	O
M	Measurement of stroking chamber pressure	DIN 3852[4]	M12 x 1.5; 12 deep	420	X
M_1	Pressure measurement **A_1**	DIN 3852[4]	M14 x 1.5; 12 deep	420	X
M_2	Pressure measurement **A_2**	DIN 3852[4]	M14 x 1.5; 12 deep	420	X
M_3	Power override measurement	DIN 3852[4]	M14 x 1.5; 12 deep	40	X
X_1	Stroke limiter pilot pressure	DIN 3852[4]	M14 x 1.5; 12 deep	40	O
X_3	Power override pilot pressure	DIN 3852[4]	M14 x 1.5; 12 deep	40	P
Y_3	Auxiliary pressure[5]	DIN 3852[4]	M14 x 1.5; 12 deep	40	O

[1] Observe the general instructions on page 15 for the maximum tightening torques.
[2] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
[3] Metric fastening thread, deviating from standard.
[4] The spot face can be deeper than specified in the appropriate standard.
[5] Only with version LA...H2
[6] O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)
P = Piped

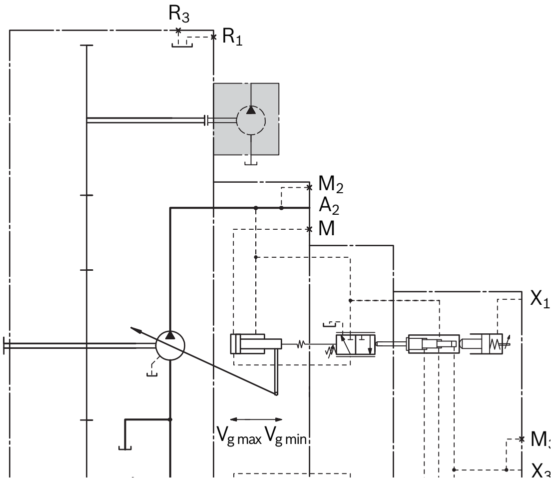
Power take-offs, auxiliary pump and valves

with power take-off, without integrated auxiliary pump, U....0

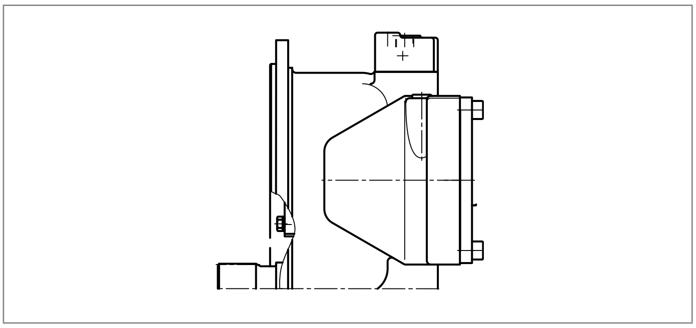


- Technical data, see page 6.
- Attachable to the power take-off: axial piston pumps and gear pumps.

▼ Schematic

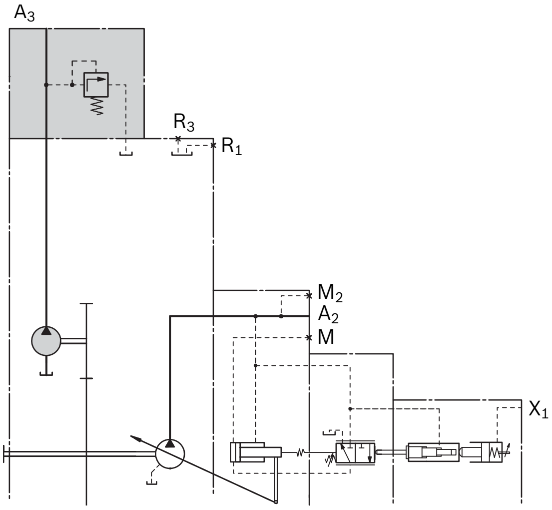


Without power take-off, with integrated auxiliary pump (control fluid pump) and pressure-relief valve, F0000A

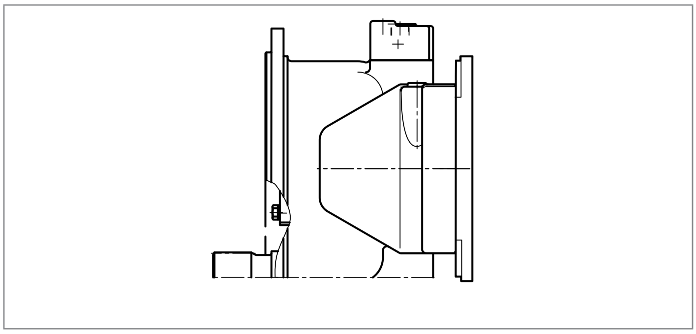


- Technical data, see page 6.
- The pressure-relief valve installed as a pressure safeguard for the integrated auxiliary pump is permanently set at a value of 30 bar.

▼ Schematic

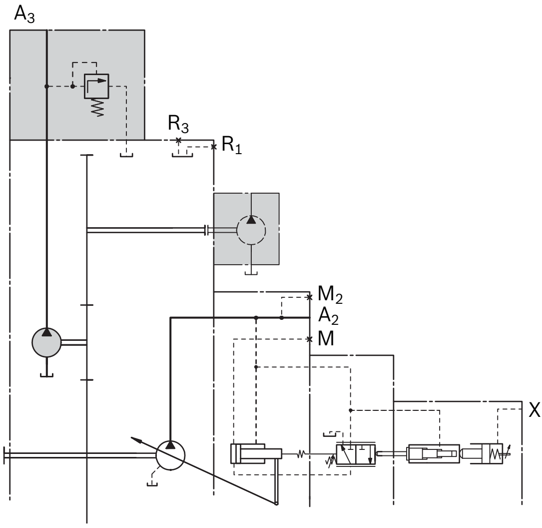


With power take-off, mit integrated auxiliary pump (pilot fluid pump) and pressure-relief valve, F....A



- Technical data, see page 6.
- The pressure-relief valve installed as a pressure safeguard for the integrated auxiliary pump is permanently set at a value of 30 bar.
- Attachable to the power take-off:
  axial piston pumps and gear pumps

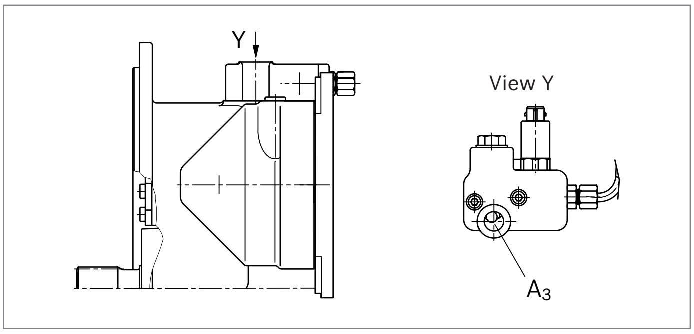
▼ **Schematic**



Pressure reducing valve

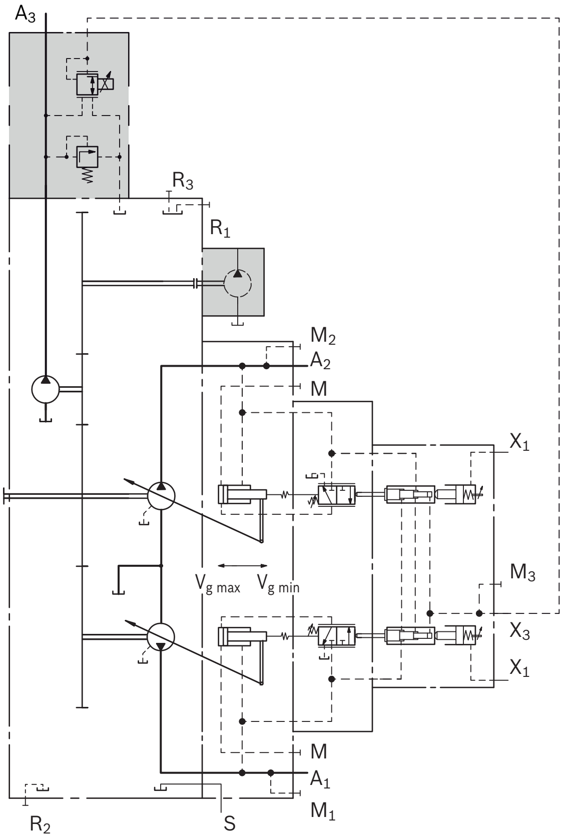
- Control voltage: 24 V DC
- Recommended frequency: ≥150 Hz
- Connector AMP Junior Timer, 2-pin,
  type of protection according to DIN 40050-9: IP69k
- Mating connector
  The mating connector is not included in the delivery contents. This can be supplied by Bosch Rexroth on request.
  - Material number R901022127
  - Please refer to data sheet 08006.
  - Conductor outer diameter 2.2 to 3.0 mm

With power take-off, mit integrated auxiliary pump (pilot fluid pump), mit pressure limitation valve and pressure reducing valve, F....C



- Technical data, see page 6.
- The pressure-relief valve installed as a pressure safeguard for the integrated auxiliary pump is permanently set at a value of 30 bar.
- An electrically variable pressure reducing valve can be used, for example to override the power setting (load limiting control) (see below).
- Can be fitted to the power take-off:
  axial piston pump and gear pump

▼ **Schematic**



Installation instructions

General

The axial piston unit and in particular the pressure reducing valve must be completely filled with hydraulic fluid and air-bled before electrical connections are made. This must also observed following a relatively long standstill as the axial piston unit may drain back to the reservoir via the hydraulic lines.

In all operating conditions, the suction and drain lines must flow into the reservoir below the minimum fluid level. The minimum suction pressure at port **S** must not exceed 0.8 bar absolute during operation, even after a cold start.

When designing the reservoir, ensure adequate space between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Installation position

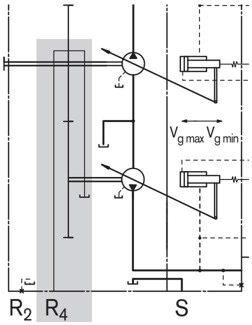
See the following examples 1 and 2.

External connection for flush oil

A8VO variable double pumps of **nominal size 225 must have** an external connection from port **R_4** to the reservoir. Flush oil for cooling and lubrication of the bearings is drawn via this port **R_4**.

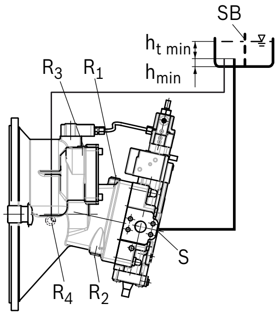
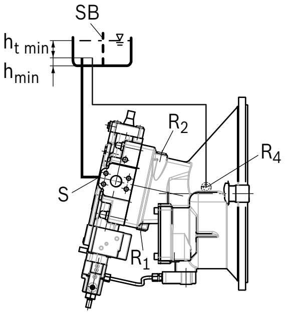
The internal diameter of this line shall be ≥ 15mm.

▼ **Schematic with port R_4**



Below-reservoir installation

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.

Installation position	Air bleed	Filling
1 	**R_1 + R_3**	**S** + **R_4**
2 	**R_2**	**S** + **R_4**

Key	
R_1, R_3	Port for air bleeding
R_2	Port for oil draining
R_4	Flow port
S	Suction port
SB	Baffle (baffle plate)
$h_{t\,min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)

General instructions

- The A8VO pump is designed to be used in open circuits.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of skilled person.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e. g. by wearing protective clothing).
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Service line ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The service line ports and function ports can only be used to accommodate hydraulic lines.
- The data and notes contained herein must be adhered to.
- Before finalizing your design, request a binding installation drawing.
- Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Pressure controls are not backups against pressure overload. A separate pressure-relief valve is to be provided in the hydraulic system.
- The following tightening torques apply:
  - Fittings:
    Observe the manufacturer's specifications regarding the tightening torques of the fittings used.
  - Mounting bolts:
    For mounting bolts with metric ISO threads according to DIN 13, we recommend checking the tightening torque individually according to VDI 2230.
  - Female thread of the axial piston unit:
    The maximum permissible tightening torques $M_{G\,max}$ are maximum values of the female threads and must not be exceeded. For values, see the following table.
  - Threaded plugs:
    For the metallic threaded plugs supplied with the axial piston unit, the required tightening torques of threaded plugs M_V apply. For values, see the following table.

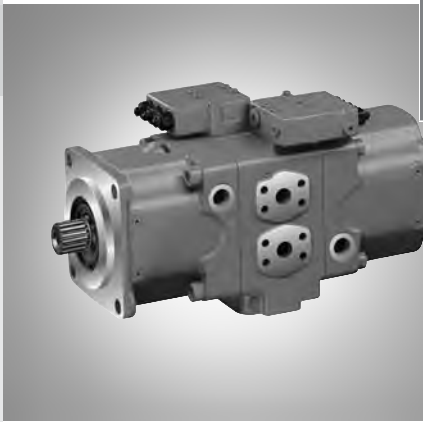
Ports **Standard**	**Thread size**	**Maximum permissible tightening torque of the female threads $M_{G\,max}$**	**Required tightening torque of the threaded plugs M_V**	**WAF hexagon socket for the threaded plugs**
DIN 3852[1]	M12 x 1.5	50 Nm	25 Nm[2]	6 mm
	M14 x 1.5	80 Nm	35 Nm	6 mm
	M18 x 1.5	140 Nm	60 Nm	8 mm
	M22 x 1.5	210 Nm	80 Nm	10 mm
ISO 11926	3/4-16 UNF-2B	160 Nm	70 Nm	5/16 in

[1] The tightening torques apply for screws in the "dry" state as received on delivery and in the "lightly oiled" state for installation.

[2] In the “lightly oiled” state, the M_V is reduced to 17 Nm for M12 x 1.5.

Axial Piston
Variable Double Pump A20VO

Technical data sheet



Series 1

Sizes	Nominal pressure/ Peak pressure
60	250/315 bar
95...520	350/400 bar

for open circuits

Contents

Features

- Variable pump with two axial piston rotary groups in swash-plate design for use in open circuit hydrostatic drives
- For use in mobile and stationary applications
- The pump consists of proven components from the A11VO (RE 92500), A10VO/53 (RE 92703) or A4VSO (RE 92050) variable pumps
- The pump operates under self-priming condition, with tank pressurisation or with charge pump (sizes 190...260)
- A wide variety of controls are available
- Setting of the constant power control is possible via external adjustments, even when the unit is operating (only with power contol).
- The pump is available with a through drive to mount a gear pump or a second axial piston pump
- Output flow is proportional to drive speed and pump displacement and is steplessly variable between maximum and zero displacement

Ordering Code / Standard Program

A20V		O			/	10		–					
01	02	03	04	05		06	07		08	09	10	11	12

Axial piston unit

01	Swashplate design, variable (Back to back - design)	A20V

Charge pump (impeller)

		60	95	190	260	520	
02	without charge pump (no code)	●	●	–	–	●	
	with charge pump	–	–	●	●	–	L

Operation

03	Double pump, open circuit	O

Size

04	≈ Displacement $V_{g\,max}$ in cm^3 (per rotary group)	60	95	190	260	520

Control devices

		60	95	190	260	520	
05	see RE 92703 (A10VO/53)	●	–	–	–	–	
	see RE 92500 (A11VO)	–	●	●	●	–	
	see RE 92050 (A4VSO) and RE 92060, RE 92064, RE 92076	–	–	–	–	●	

Series

06	Series 1, Index 0	10

Direction of rotation

07	viewed on shaft end	clockwise	R
		counter-clockwise	L

Seals

08	NBR (nitril-caoutchouc), shaft seal ring in FKM (fluor-caoutchouc)	●	●	●	●	–	N
	FKM (fluor-caoutchouc)	–	–	–	–	●	V

Shaft end

		60	95	190	260	520	
10	Splined shaft DIN 5480	–	●	●	●	●	Z
	Splined shaft, ANSI B92.1a-1976	●	●	–	–	–	S
		–	–	●	●	–	T
	Parallel keyed shaft, DIN 6885	–	–	–	–	●	P

Mounting flange

		60	95	190	260	520	
09	SAE J744 – 4-hole	●	●	●	●	–	D
	To fit flywheel housing (conformin to SAE J617) of internal combustion engine (details on request)	–	●	●	–	–	G
	ISO 3019-2 – 8-hole	–	–	–	–	●	H

Service line ports

		60	95	190	260	520	
11	Two service line ports and one scution port at site, opposite (fastening thread metric)	●	●	●	●	–	24
	At the site two service line ports each, opposite and one suction port displaced by 90° (fastening thread metric)	–	–	–	–	●	26

Boost pump and through drive[1]

				60	95	190	260	520	
12	without boost pump, without through drive			●	●	●	●	–	N00
	without boost pump, with through drive								
	Flange SAE J744	Splined shaft hub							
	82-2 (A)	5/8 in	9T 16/32DP (A)	❍	❍	❍	❍	–	K01
	127-2 (C)	1 1/4in	14T 12/24DP (C)	–	–	–	–	●	K07
	with through drive shaft, without hub, without intermediate flange, closed by a cover			–	–	–	–	●	K99

● = available ❍ = available on request – = not available

[1] Please contact us

Technical Data

Table of values (theoretical values, without efficiencies η_{mh} and η_v; values rounded)

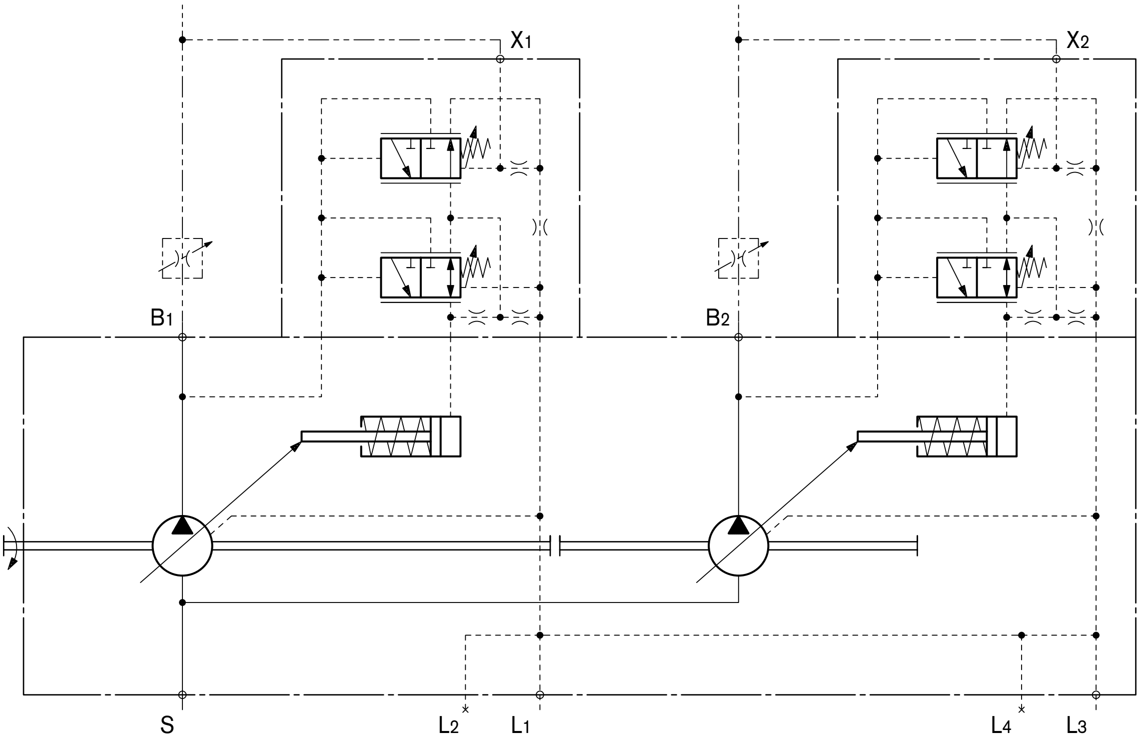
Size	*without* **charge pump**		**60**	**95**			**520**
	with **charge pump**				**190**	**260**	
Displacement	$V_{g\,max}$	cm^3	60	93,8	192,7	260	520
(per rotary group)	$V_{g\,min}$	cm^3	0	0	0	0	0
Speed maximal [1] at $V_{g\,max}$	n_{max}	min^{-1}	2700	2350	2500 [2]	2300 [2]	1450
Speed max. [3] at $V_g \le V_{g\,max}$	n_{max}	min^{-1}	3200	2780	2500	2300	1720
Flow at n_{max} and $V_{g\,max}$	$q_{v\,max}$	L/min	2x162	2x220	2x482	2x598	2x754
Power at $q_{V\,max}$ and $\Delta p = 350$ bar	P_{max}	kW	135[4]	257	562	698	880
Torque at $V_{g\,max}$ at long-term ($\Delta p = 350$ bar)	T_{max}	Nm	477 [4]	1045	2147	2897	5793
max. perm., short term ($\Delta p = 400$ bar)	T_{max}	Nm	602 [4]	1194	2454	3310	6621
Moment of inertia (of the rotating parts)	J	kgm^2	0,0113	0,0346	0,0604	0,0912	0,696
Mass approx.	m	kg	44				640

[1] The values are quoted for an absolute pressure (p_{abs}) of 1 bar at suction port S and mineral operating fluid.
[2] The values are quoted for an absolute pressure (p_{abs}) of at least 0.8 bar at suction port S and mineral operating fluid.
[3] The values are quoted for $V_g < V_{g\,max}$ or increase of the input pressure p_{abs} at suction port S.
[4] $\Delta p = 250$ bar (long-term operation) or rather 315 bar (short term).

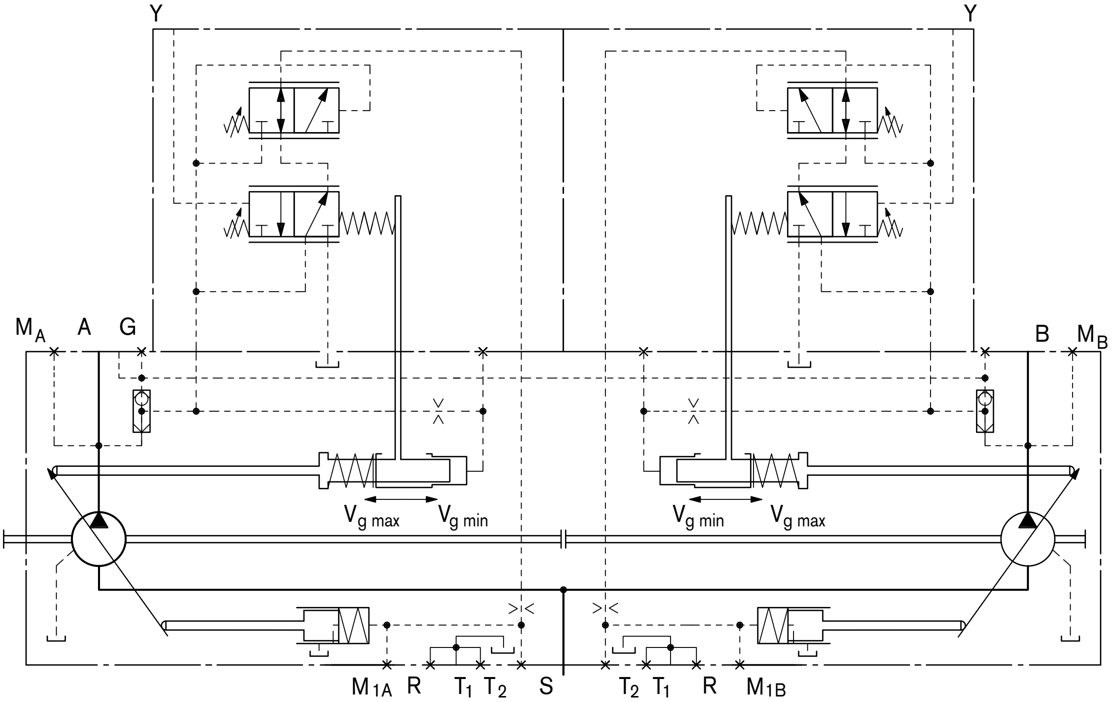
Through Drive

Please contact us.

Example circuit diagram Size 60: DFR

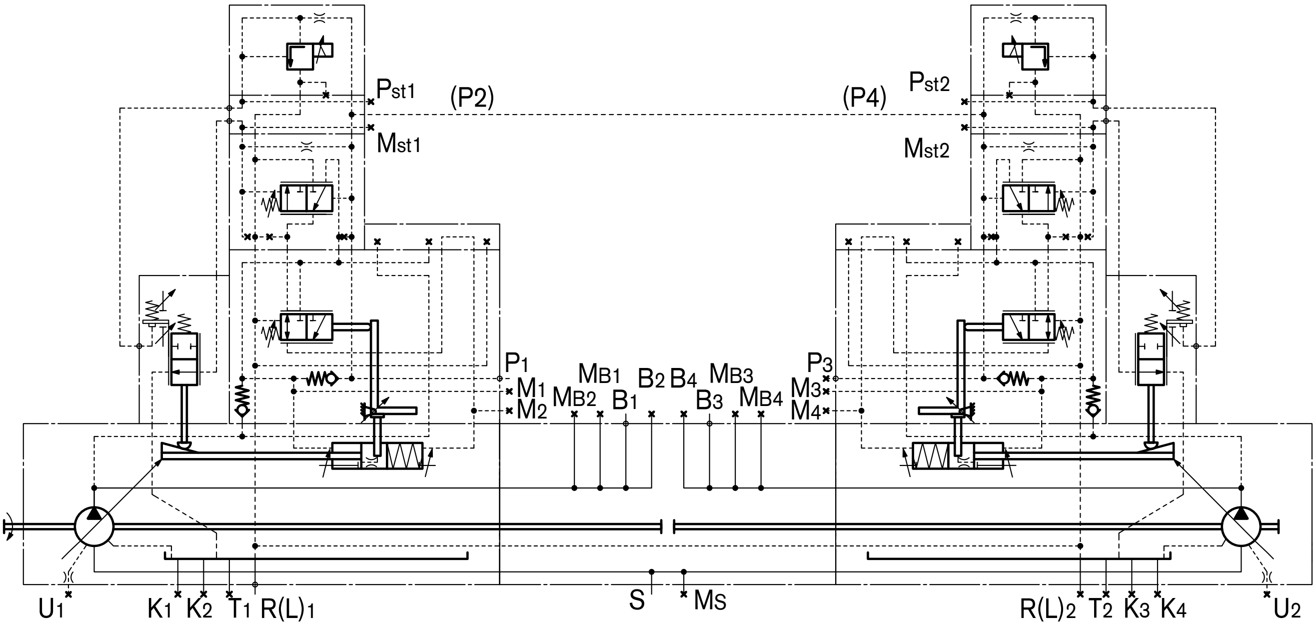


Example circuit diagram Size 95...260: HD1D



Control Devices

Example circuit diagram Size 520: LR2DN



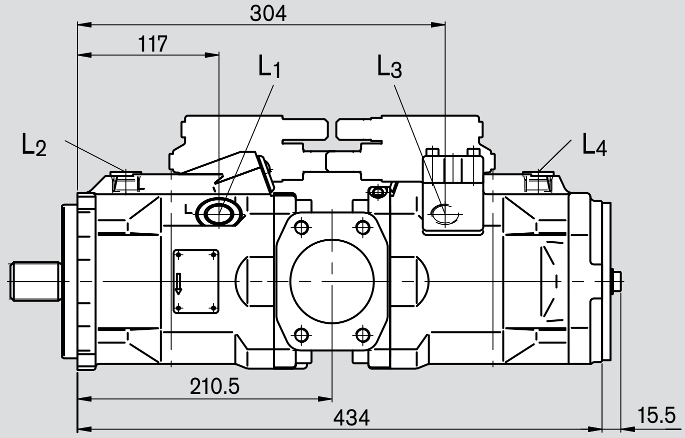
Further technical datas as soon as control devices see

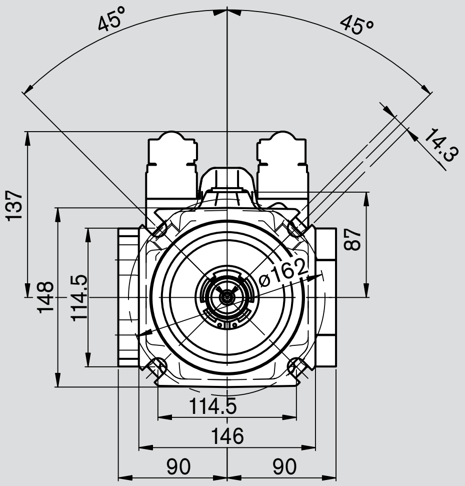
for size 60	RE 95703 (A10VO/53)
for sizes 95 ... 260	RE 92500 (A11VO)
for size 520	RE 92050 (A4VSO), RE 92060, RE 92064, RE 92076

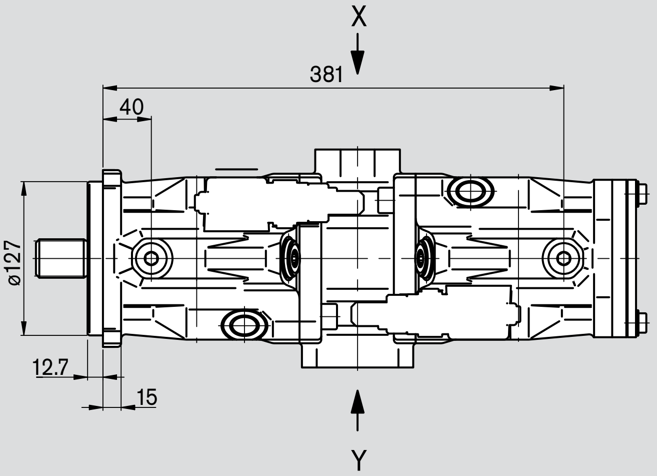
Unit Dimensions, Size 60

Before finalizing your design, please request a approved installation drawing.
Dimensions in mm

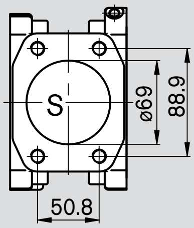
For controller selection see RE 92703 (A10VO/53)



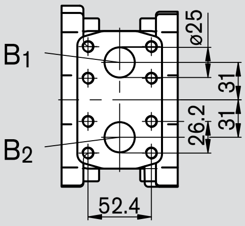




View Z



View Y

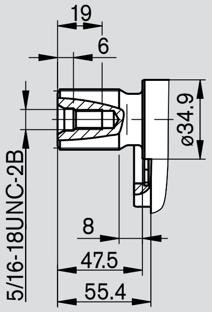


Unit Dimensions, Size 60

Before finalizing your design, please request a approved installation drawing.
Dimensions in mm

Shaft end

S Splined shaft
1 1/4in 14T 12/24DP [1]
(SAE J744 – 32-4 (C))



Ports

B_1, B_2	Service ports (High pressure series)	SAE J518	1in	
	Fastening thread	DIN 13	M10x1,5; 17 deep [2]	
S	Suction port	SAE J518	2 1/2 in	
	Fastening thread	DIN 13	M12x1,75; 20 deep [2]	
$L_{1,2,3,4}$	Case drain	DIN 3852	7/8-14UNF-2B	240 Nm [2]

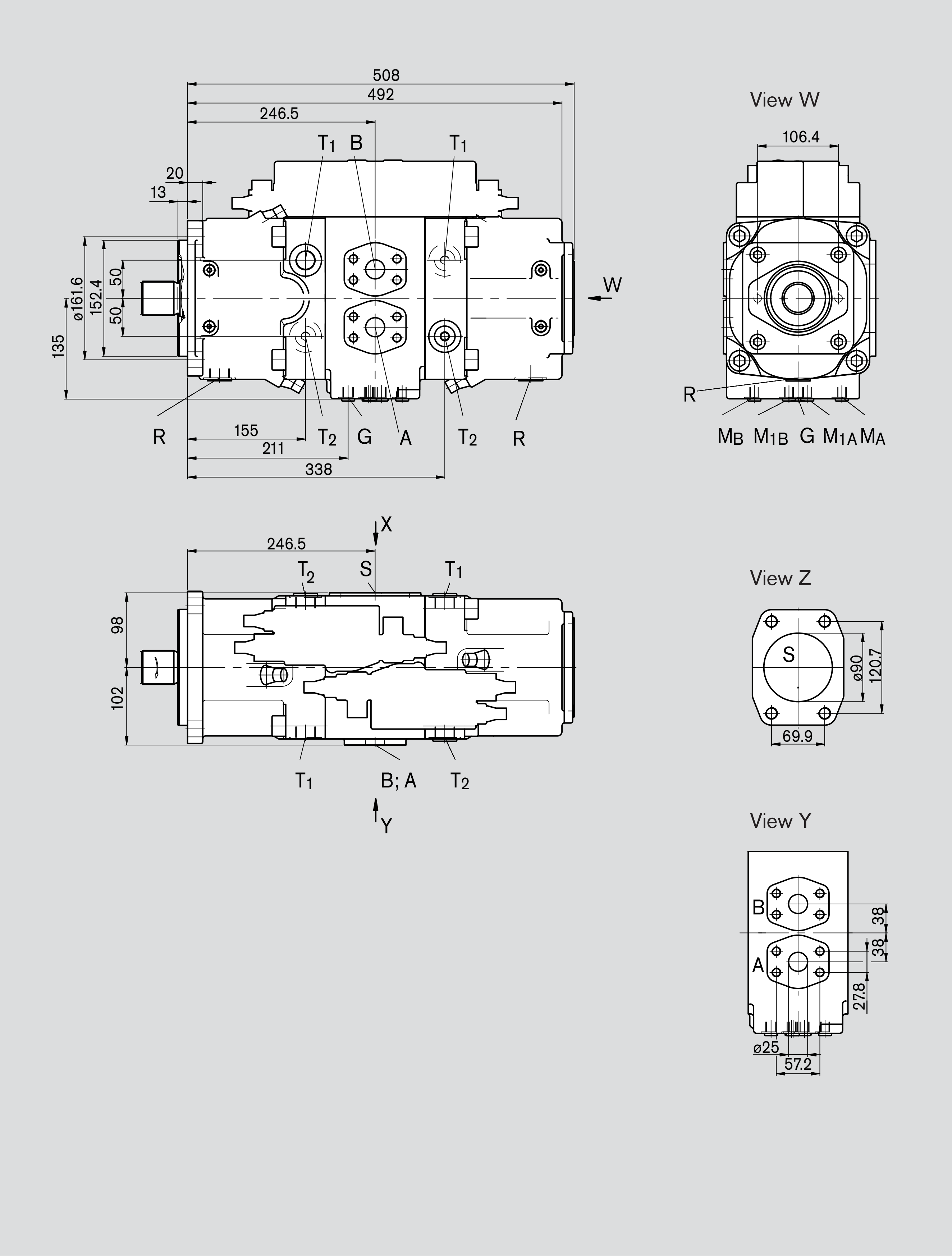
[1] ANSI B92.1a-1976, pressure angle 30°, flat rood, side fit, tolerance class 5

[2] please observe the general notes for the max. tightening torques on page 16

Unit Dimensions, Size 95

Before finalizing your design, please request a approved installation drawing.
Dimensions in mm

For controller selection see RE92500 (A11VO)

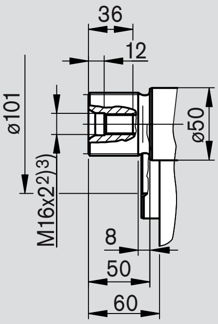


Unit Dimensions, Size 95

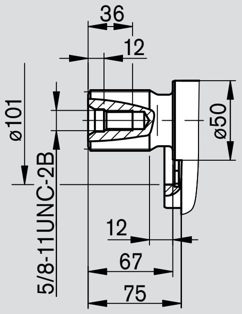
Before finalizing your design, please request a approved installation drawing.
Dimensions in mm

Shaft ends

Z Splined shaft DIN 5480
W45x2x30x21x9g



S Splined shaft
1 3/4in 13T 8/16DP [1]
(SAE J744 – 44-4 (D))



Ports

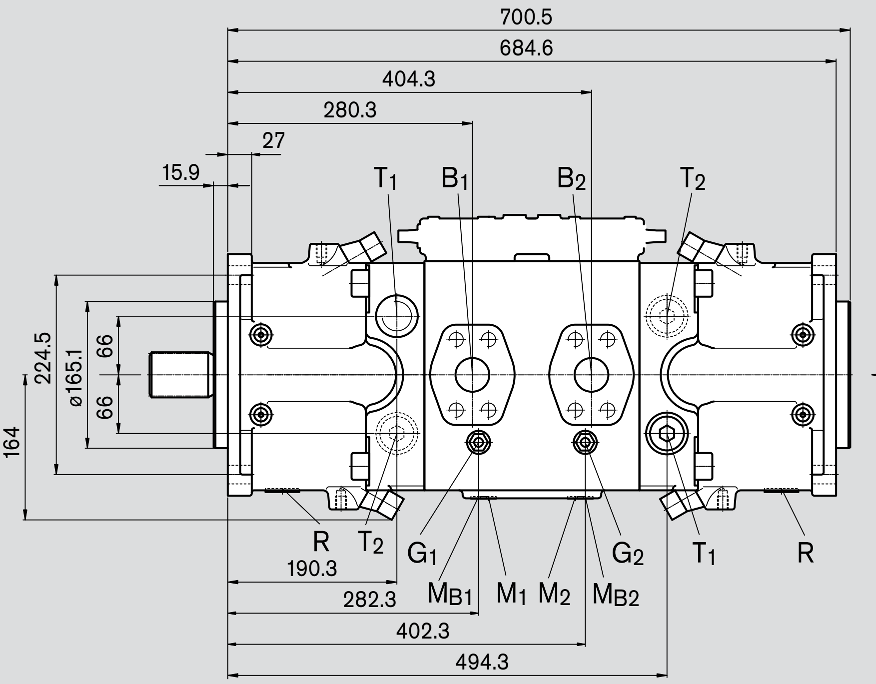
A, B	Service ports (High pressure series)	SAE J518	1in	
	Fastening threads	DIN 13	M12x1,75; 17 deep [3]	
S	Suction port (standard series)	SAE J518	3 1/2 in	
	Fastening threads	DIN 13	M16x2; 24 deep [3]	
T_1, T_2	Case drain	DIN3852	M26x1,5; 14 deep	230 Nm [3]
M_A, M_B	Gauge point positioning chamber	DIN3852	M12x1,5; 12 deep	50 Nm [3]
M_{A1}, M_{B1}	Gauge point for service port	DIN3852	M12x1,5; 12 deep	50 Nm [3]
R	Air bleed, drain port	DIN3852	M26x1,5; 14 deep	230 Nm [3]
G	Control pressure port (controller) [4]	DIN3852	M14x1,5; 12 deep	80 Nm [3]

[1] ANSI B92.1a-1976, pressure angle 30°, flat rood, side fit, tolerance class 5
[2] Center bore according to DIN 332 (thread according to DIN13)
[3] please observe the general notes for the max. tightening torques on page 16
[4] At design with stroke limiter (H..., U2), HD and EP with fitting GE10-PLM (in other case is port G plugged)

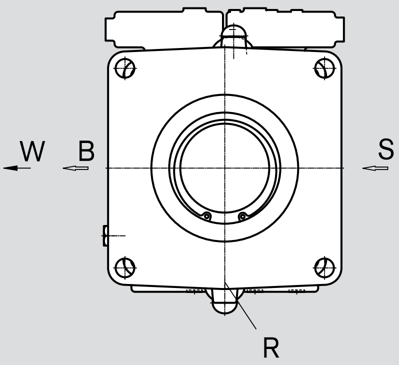
Unit Dimensions, Size 190 (with impeller)

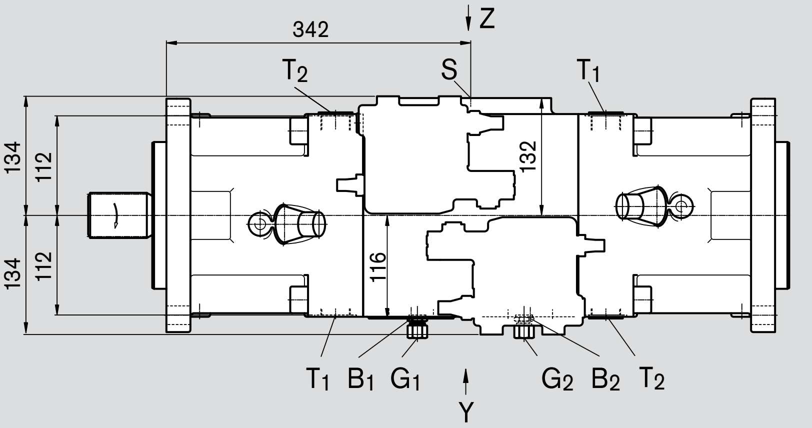
Before finalizing your design, please request a approved installation drawing.
Dimensions in mm

For controller selection see RE92500 (A11VO)

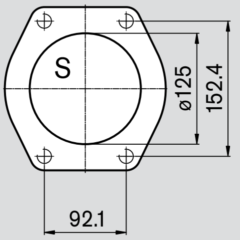


View W

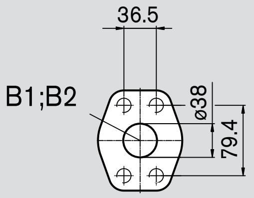




View Z



View Y

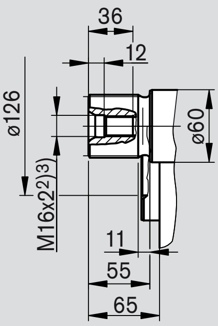


Unit Dimensions, Size 190 (with impeller)

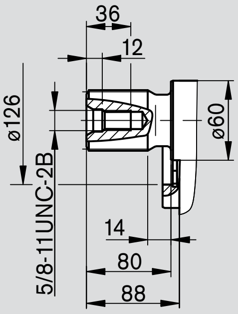
Before finalizing your design, please request a approved installation drawing.
Dimensions in mm

Shaft ends

Z Splined shaft DIN 5480
W50x2x30x24x9g



T Splined shaft
2in 15T 8/16DP [1]
(SAE J744 – 50-4 (F))



Connections

B_1, B_2	Service ports (High pressure series)	SAE J518	1 1/2 in	
	Fastening threads	DIN 13	M16x2; 21 deep	
S	Suction port (standard series)	SAE J518	5 in	
	Fastening threads	DIN 13	M16x2; 23 deep	
T_1, T_2	Case drain	DIN3852	M33x2; 18 deep	540 Nm [4]
M_1, M_2	Gauge point positioning chamber	DIN3852	M12x1,5; 12 deep	50 Nm [4]
M_{B1}, M_{B2}	Gauge point for service port	DIN3852	M12x1,5; 12 deep	50 Nm [4]
R	Air bleed, drain port	DIN3852	M33x2; 16 deep	540 Nm [4]
G_1, G_2	Control pressure port (controller) [4]	DIN3852	M14x1,5; 12 deep	80 Nm [4]

[1] ANSI B92.1a-1976, pressure angle 30°, flat rood, side fit, tolerance class 5

[2] Center bore according to DIN 332 (thread according to DIN13)

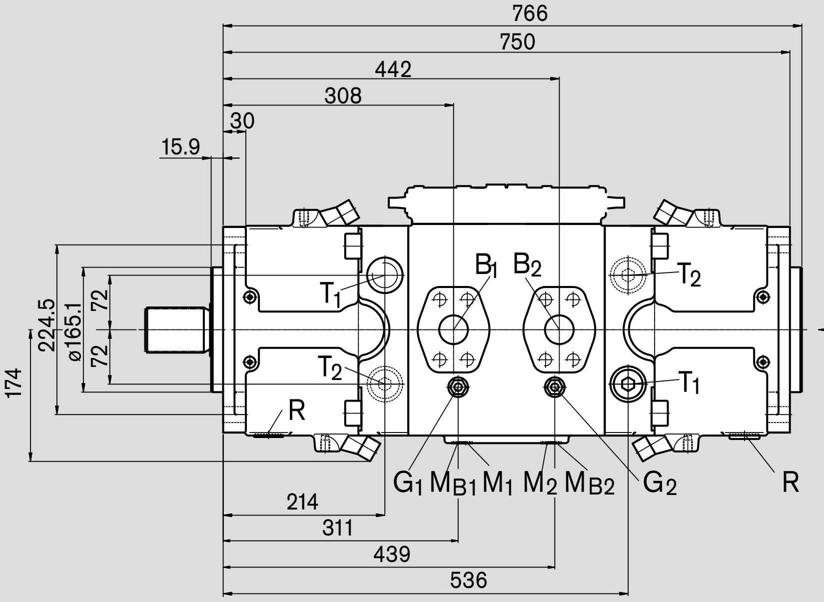
[3] please observe the general notes for the max. tightening torques on page 16

[4] At design with stroke limiter (H..., U2), HD and EP with fitting GE10-PLM (in other case is port G plugged)

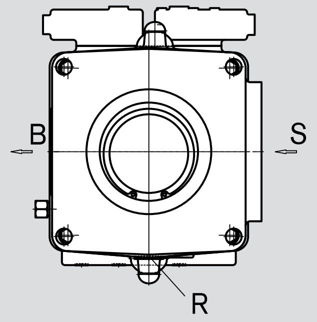
Unit Dimensions, Size 260 (with impeller)

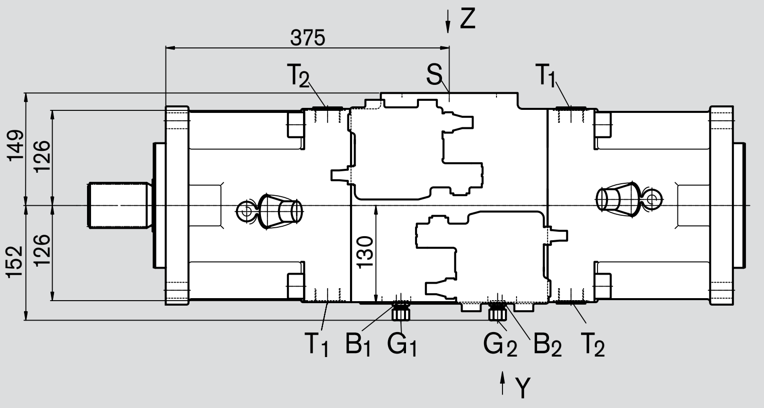
Before finalizing your design, please request a approved installation drawing. Dimensions in mm

For controller selection see RE92500 (A11VO)

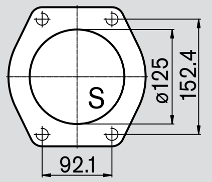


View W

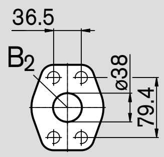




View Z



View Y

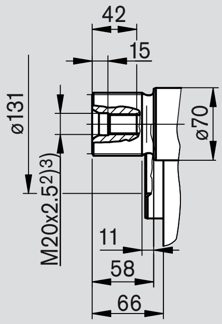


Unit Dimensions, Size 260 (with impeller)

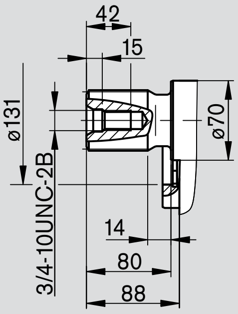
Before finalizing your design, please
request a approved installation drawing.
Dimensions in mm

Shaft ends

Z Splined shaft DIN 5480
W60x2x30x28x9g



T Splined shaft
2 1/4in 17T 8/16DP 1)



Connections

B_1, B_2	Service ports (High pressure series)	SAE J518	1 1/2 in	
	Fastening threads	DIN 13	M16x2; 21 deep 3)	
S	Suction port (standard series)	SAE J518	5 in	
	Fastening threads	DIN 13	M16x2; 23 deep 3)	
T_1, T_2	Case drain	DIN3852	M33x2; 18 deep	540 Nm 3)
M_1, M_2	Gauge point positioning chamber	DIN3852	M12x1,5; 12 deep	50 Nm 3)
M_{B1}, M_{B2}	Gauge point for service port	DIN3852	M12x1,5; 12 deep	50 Nm 3)
R	Air bleed, drain port	DIN3852	M33x2; 16 deep	540 Nm 3)
G_1, G_2	Control pressure port (controller) 3)	DIN3852	M14x1,5; 12 deep	80 Nm 3)

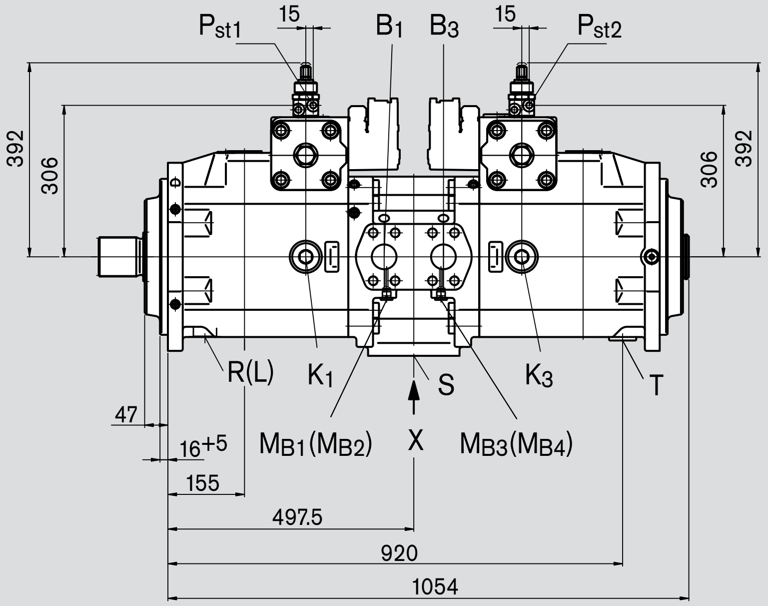
1) ANSI B92.1a-1976, pressure angle 30°, flat rood, side fit, tolerance class 5
2) Center bore according to DIN 332 (thread according to DIN13)
3) please observe the general notes for the max. tightening torques on page 16
4) At design with stroke limiter (H..., U2), HD and EP with fitting GE10-PLM (in other case is port G plugged)

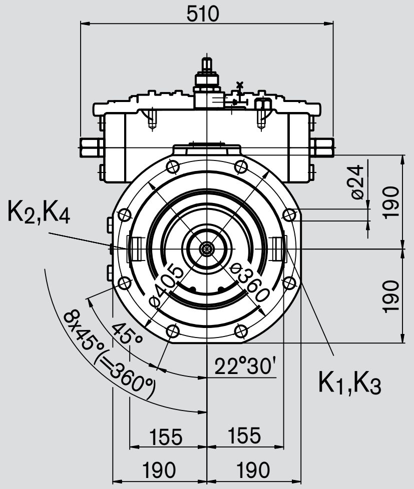
Unit Dimensions, Size 520

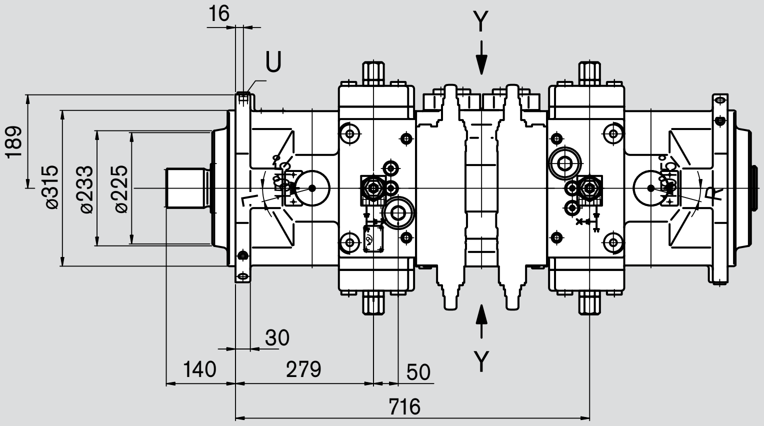
Before finalizing your design, please request a approved installation drawing.
Dimensions in mm

For controller selection see RE92064 (A4VS)

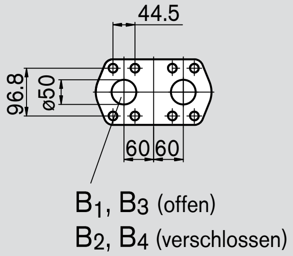
Picture for counter-clockwise



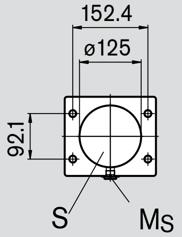




View Z



View Y

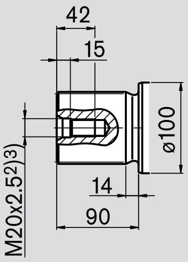


Unit Dimensions, Size 520

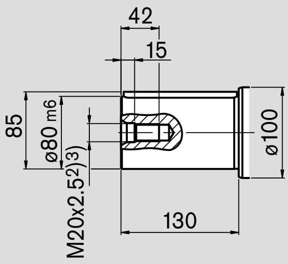
Before finalizing your design, please request a approved installation drawing.
Dimensions in mm

Shaft ends

Z Splined shaft DIN 5480 W80x3x30x25x9g



P Parallel keyed shaft DIN 6885



Connections

B_1 - B_4	Service line ports (High pressure series)	SAE J518	2 in	
	Fastening threads	DIN 13	M20x2,5; 24 deep 3)	
S	Suction port (standard series)	SAE J518	5 in	
	Fastening threads	DIN 13	M16x2; 24 deep 3)	
K_1 - K_4	Flush ports		M48x2; 22 deep	960 Nm 3)
M_{B1}, M_{B4}	Gauge point for operating pressure	DIN3852	M18x1,5; 12 deep	140 Nm 3)
M_S	Gauge point for suction port	DIN3852	M18x1,5; 12 deep	140 Nm 3)
P_{st1}, P_{st2}	Pilot pressure port		M14x1,5; 12 deep	80 Nm 3)
R (L)	Air bleed, drain port	DIN3852	M48x2; 22 deep	960 Nm 3)
T	Case drain	DIN3852	M48x2; 22 deep	960 Nm 3)
U	Flush port	DIN3852	M18x1,5; 12 deep	140 Nm 3)

1) ANSI B92.1a-1976, pressure angle 30°, flat rood, side fit, tolerance class 5

2) Center bore according to DIN 332 (thread according to DIN13)

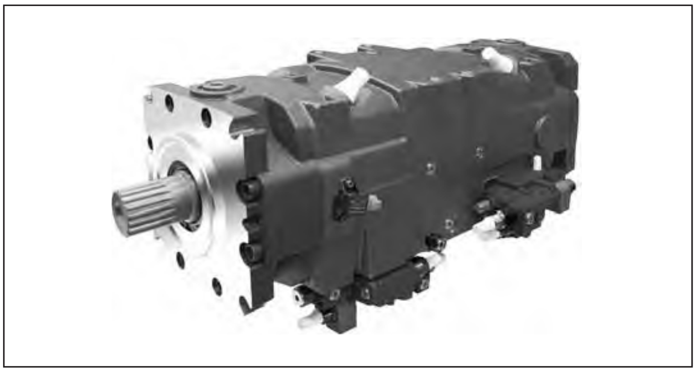
3) please observe the general notes for the max. tightening torques on page 16

4) At design with stroke limiter (H1) with fitting GE10-PLM (in other case is port G plugged)

General Notes

- The pump A20VO is designed to be used in open circuits.
- Project planning, assembly and commissioning of the pump require the invovement of trained personnel.
- The working and functional ports are only designed to accommadate hydraulic piping.
- There is a danger of burns from the pump and especially the solenoids during and shortly after operation. Suitable safety precautions, e.g. protective clothing plan.
- The characteristic curve may shift depending on the operating status (operating pressure, fluid temperature) of the pump.
- Tightening torques:
  - The tightening torques specified in this data sheet are maximum values and may not be exceeded (maximum value for screw thread). Manufacturer specifications for the max. permissible tightening torques of the used fittings must be observed!
  - For DIN 13 fastening screws we recommend checking the tightening torque individually according to VDI 2230 Edition 2003.
- The data and information contained herein must be adhered to.

Axial piston variable double pump
A28VLO Series 10



- Sizes 280
- Nominal pressure 350 bar
- Maximum pressure 420 bar
- Open circuit

Features

- Variable axial piston double pump of swashplate design for hydrostatic drives in open circuit.
- For use preferably in mobile applications
- Flow is proportional to the drive speed and displacement.
- The flow can be infinitely varied by adjusting the swashplate angle.
- One suction port, two pressure ports.
- Special control devices program for mobile applications, with different control and regulation functions.
- Compact design
- High efficiency
- High power density
- Low noise level

Contents

Ordering code

01	02	03	04	05	06	07	08	09	10	11		12	13	14	15	16	17	18	19	20	21		22
A28V	LO	280									/	10		R	V	E4		1	K0	0000	0	–	

Axial piston unit

01	Double pump, variable swashplate design	A28V

Operation mode

			280	
02	Pump, open circuit	with charge pump	●	LO

Sizes (NG)

03	Geometric displacement, see “Technical data” on page 8	280

Pump 1: control devices: basic controller

The basic controller can be combined with at most two additional controllers (05, 06, 07)

04	Single power control	fixed setting			●	LR
	override	electric-proportional	negative control	U = 12 V	●	L3
				U = 24 V	●	L4
		hydraulic-proportional,	negative control		●	L5
			positive control		●	L6
	Summation power controller	override hydraulic-proportional, high pressure	negative control	with stop	●	CR
		Combination of CR and L5 = C5			●	C5
	Pressure control with one-side swiveling	fixed setting			●	DR
		electric-proportional with integrated pilot valve for external pilot pressure supply	positive control	U = 24 V	○	D2[2]
	Stroke control[1]	override electric-proportional	positive control	U = 12 V	●	E1
				U = 24 V	●	E2

Pump 1: Additional control: Pressure controller

05	Without additional control (without symbol)	●	
	with one-side swiveling, fixed setting	●	DR

Pump 1: additional control for basic controller L4 and CR[1]: stroke control or unloading

06	Without additional control (without symbol)				●	
	Stroke control	override electric-proportional	positive control	U = 12 V	●	E1
				U = 24 V	●	E2
	Stroke control	hydraulic-proportional, control pressure	negative control	Δp = 20 bar	●	H3
			positive control		●	H4
		hydraulic-proportional, control pressure	negative control	Δp = 35 bar	●	H5
			positive control		●	H6

Pump 1: Additional control: load sensing

07	Without additional control (without symbol)	●	
	Load sensing, internal pump pressure, fixed setting	●	S0

Pump 2: control combination

08	Identical with pump 1	●	1
	Various controls, please contact us	●	2

---

[1] The stroke control systems can be combined with either pressure controllers or load sensing controllers. A combination of all three controllers is not possible

[2] Not combinable with other controllers

01	02	03	04	05	06	07	08	09	10	11		12	13	14	15	16	17	18	19	20	21		22
A28V	**LO**	**280**									**/**	**10**		**R**	**V**	**E4**		**1**	**K0**	**0000**	**0**	**–**	

Depressurized basic position and external control pressure supply

			280	
09	Maximum swivel angle ($V_{g\ max}$)			
		Without external control pressure supply (standard for power and pressure controllers)	●	**A**
		With external control pressure supply (integrated shuttle valve, standard for negative stroke control)	●	**B**
	Minimum swivel angle ($V_{g\ min}$)			
		With external control pressure supply (integrated shuttle valve, standard for positive stroke control)	●	**C**

Connector for solenoids[3] (see page 29)

10	Without connector (only for hydraulic controls)	●	**0**
	DEUTSCH connector	●	**P**
	AMP connector (Junior-Timer), 2-pin (only for D2 controller)	○	**S**

Swivel angle indicator

11	Without optical swivel angle indicator		●	**0**
	With electric swivel angle sensor[4] as per data sheet 95150	Power supply 5 V DC	●	**B**
		Power supply 8 V - 32 V DC	●	**K**

Series

12	Series 1, Index 0	**10**

Configuration of port and fastening threads

13	ANSI, all fastening threads according to ASME B1.1, all port threads with O-ring seal according to ISO 11926	○	**A**
	Metric, all fastening threads according to DIN 13, all port threads with O-ring seal according to ISO 6149	●	**M**

Direction of rotation

14	With view on drive shaft	clockwise	**R**

Sealing material

15	FKM (fluor-caoutchouc)	**V**

Mounting flanges

16	SAE J744	165-4	●	**E4**

Drive shaft

17	Splined shaft ANSI B92.1a	2 1/4 in 17T 8/16DP	●	**T3**
	Splined shaft DIN 5480	W60x2x28x9g	●	**A4**

● = Available ○ = On request – = Not available

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[3] Connectors for other electric components may deviate

[4] Please contact us if the swivel angle sensor is used for control

01	02	03	04	05	06	07	08	09	10	11		12	13	14	15	16	17	18	19	20	21		22
A28V	**LO**	**280**									**/**	**10**		**R**	**V**	**E4**		**1**	**K0**	**0000**	**0**	**–**	

Service line port

		280	
18	SAE service line port **A**, **B** at side, SAE-suction port **S** at bottom	●	**1**

Control fluid pump and pressure relief valve

19	Without integrated control oil pump, without pressure-relief valve	●	**K0**

Through drive

20	Without through drive[5]	●	**0000**

Speed sensor

21	Without	●	**0**

Standard/special version

22	Standard version	**0**
	Special version	**S**

Note

- ▶ Note the project planning notes on page 32.
- ▶ In addition to the ordering code, please specify the relevant technical data when placing your order.

● = Available ○ = On request – = Not available

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[5] With through drive on request

Hydraulic fluids

The A28V(L)O variable pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)

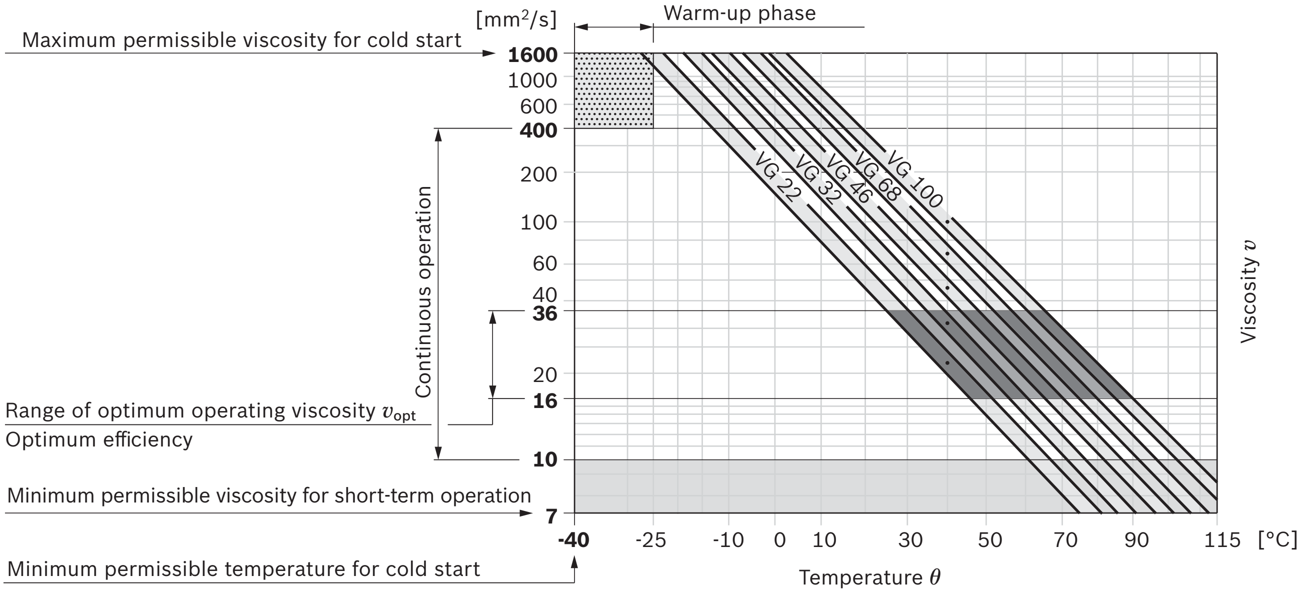
Notes on selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see selection diagram).

Note
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \leq 1600$ mm²/s	$\theta_{St} \geq -40$ °C[1]	$t \leq 3$ min, without load (20 bar $\leq p \leq$ 50 bar, $n \leq$ 1000 rpm
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu <$ 1600 to 400 mm²/s	θ = -40 °C to −25 °C	at $p \leq 0.7 \times p_{nom}$, $n \leq 0.5 \times n_{nom}$ and $t \leq 15$ min
Continuous operation	ν = 400 to 10 mm²/s		This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram)
		θ = −25 °C to +110 °C	measured at port **T** Note the permissible temperature range of the shaft seal (ΔT = approx. 5 K between bearing/shaft seal and port **T**)
	ν_{opt} = 36 to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \geq 7$ mm²/s		$t <$ 3 min, $p < 0.3 \times p_{nom}$

▼ **Selection diagram**



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[1] At temperatures below −25 °C, an NBR shaft seal is required (permissible temperature range −40 °C bis +90 °C)

Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

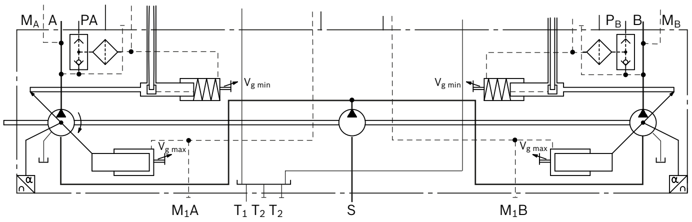
In order to guarantee the functional reliability of the axial piston unit it is necessary to carry out a gravimetric evaluation of the hydraulic fluid to determine the particle contamination and the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 must be maintained.

At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), a cleanliness class of at least 19/17/14 according to ISO 4406 is necessary.

Please contact us if the above classes cannot be observed.

Charge pump (impeller)

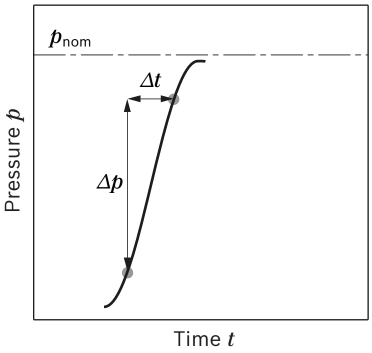
The charge pump is a circulating pump with which the A28VLO 280 is filled and therefore can be operated at higher speeds. This also simplifies cold starting at low temperatures and high viscosity of the hydraulic fluid. Externally increasing the inlet pressure is therefore unnecessary in most cases. Charging the reservoir with compressed air is not permissible.



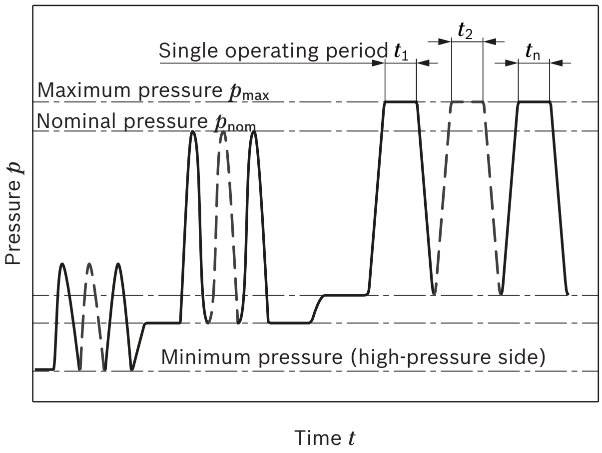
Operating pressure range

Pressure at working line port A		**Definition**
Nominal pressure p_{nom}	350 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	420 bar	The maximum pressure corresponds to the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure $p_{A\ abs}$ (high-pressure side)	15 bar	Minimum pressure on the high-pressure side (**A**) which is required in order to prevent damage to the axial piston unit. The minimum pressure depends on the rotational speed and the swivel angle (see diagram).
Rate of pressure change $R_{A\ max}$	16000 bar/s	Maximum permissible rate of pressure build-up and pressure reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{S\ min}$	≥ 0.7 bar absolute	Minimum pressure at suction port **S** (inlet) that is required in order to avoid damage to the axial piston unit. The minimum pressure depends on the speed and displacement of the axial piston unit.
Maximum pressure $p_{S\ max}$	≤ 2 bar absolute	
Drain pressure at port T_1, T_2, T_3		
Maximum pressure $p_{L\ max}$	4 bar	Maximum 1.2 bar higher than inlet pressure at port **S**, but not higher than $p_{L\ max.}$ A case drain line to the reservoir is required.
Peak Pressure $p_{L\ peak}$	7 bar	t< 0.1 s

▼ **Rate of pressure change $R_{A\ max}$**



▼ **Pressure definition**



Total operating period = $t_1 + t_2 + ... + t_n$

Note
Operating pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical data

With charge pump (A28VLO)

Size		NG		280
Displacement, geometric, per revolution by rotary group		$V_{g\,max}$	cm³	280
		$V_{g\,min}$	cm³	0
Maximum rotational speed[1]	at $V_{g\,max}$[2]	n_{nom}	rpm	1900
	at $V_g \leq V_{g\,max}$[3]	n_{max}	rpm	1900
Flow	at n_{nom} and $V_{g\,max}$	q_v	L/min	2 x 532
Power	at n_{nom}, $V_{g\,max}$ and Δp = 350 bar	P	kW	2 x 310
Torque	at $V_{g\,max}$ and Δp = 350 bar[2]	T	Nm	2 x 1560
Rotary stiffness drive shaft	2 1/4 in 17T 8/16DP T3	c	kNm/rad	519
	W60x2x28x9g A4	c	kNm/rad	645
Moment of inertia rotary group		J_{TW}	kgm²	0.198
Maximum angular acceleration[4]		α	rad/s²	4200
Case volume		V	L	9.5
Weight (without through drive) approx.		m	kg	305

Determining the operating characteristics		
Flow	$q_v = \dfrac{V_g \times n \times \eta_v}{1000}$	[l/min]
Torque	$T = \dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$	[Nm]
Power	$P = \dfrac{2\,\pi \times T \times n}{60000} = \dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g = Displacement per revolution [cm³]

Δp = Differential pressure [bar]

n = Rotational speed [rpm]

η_v = Volumetric efficiency

η_{hm} = Hydraulic mechanical efficiency

η_t = Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

---

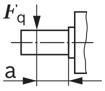
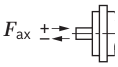
[1] The values are applicable:
  - for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s
  - with hydraulic fluid on the basis of mineral oils

[2] The values apply at absolute pressure p_{abs} = 1 bar at suction port **S**.

[3] Maximum rotational speed (rotational speed limit) in the case of increasing the inletpressure p_{abs} at suction port **S** and $V_g < V_{g\,max}$.

[4] The data are valid for values between the minimum required and maximum permissible speed. Valid for external excitation (e. g. diesel engine 2 to 8 times rotary frequency; cardan shaft twice the rotary frequency). The limiting value is only valid for a single pump. The load capacity of the connection parts must be considered.

Permissible radial and axial forces of the drive shafts

Size		NG		280	280
Drive shaft				2 1/4	W60
Maximum radial force at distance a (from shaft collar)		$F_{q\ max}$	N	18000	23600
		a	mm	40	29
Maximum axial force		$+F_{ax\ max}$	N	1800	1800
		$-F_{ax\ max}$	N	850	850

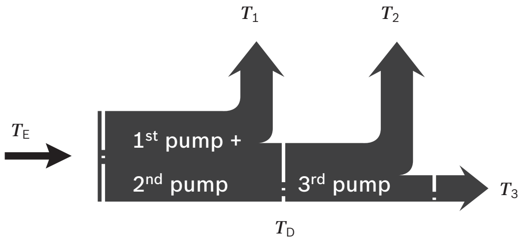
Note

- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. We recommend testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.
- Special requirements apply in the case of belt drives. Please contact us.

Permissible input torques

Size			NG		280
Torque at $V_{g\,max}$ and Δp = 350 bar[1]			T_{max}	Nm	3120
Input torque at drive shaft, maximum[2]					
	T3	2 1/4 in	$T_{E\,max}$	Nm	4380
	A4	W60	$T_{E\,max}$	Nm	5780
Maximum through-drive torque			$T_{D\,max}$	Nm	–

▼ Distribution of torques



Torque at 1st pump + 2nd pump	T_1		
Torque at 3rd pump	T_2		
Torque at 4th pump	T_3		
Input torque	T_E	=	$T_1 + T_2 + T_3$
	T_E	<	$T_{E\,max}$
Through-drive torque	T_D	=	$T_2 + T_3$
	T_D	<	$T_{D\,max}$

---

[1] Efficiency not considered

[2] For drive shafts free of radial force

Power control

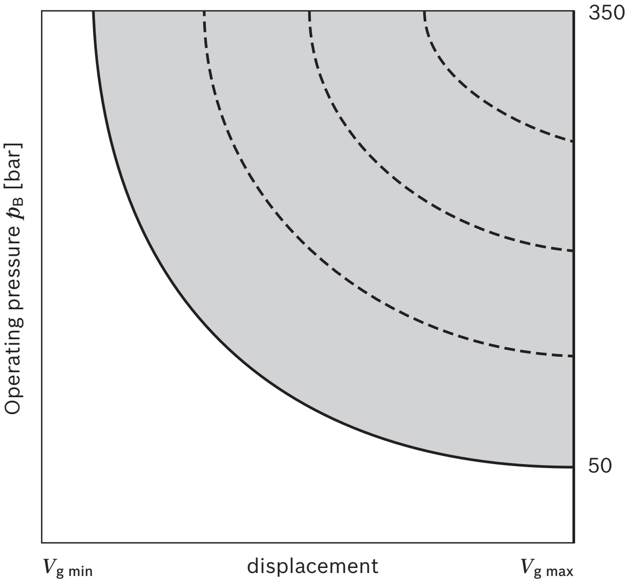
LR – Power controller, fixed setting

The power controller regulates the displacement of the pump depending on the operating pressure so that a given drive power is not exceeded at constant drive speed.
The precise control with a hyperbolic control characteristic, provides an optimum utilization of available power.
The operating pressure acts on a rocker via a measuring piston moved together with the control. An externally adjustable spring force counteracts this, it determines the power setting. The depressurized basic position is $V_{g\,max}$.
If the operating pressure exceeds the set spring force, the control valve will be actuated by the rocker and the pump will swivel back from the basic setting $V_{g\,max}$ toward $V_{g\,min}$.
Here, the leverage at the rocker may be shortened and the operating pressure may rise in the same relation as the displacement is reduced ($p_B \times V_g$ = constant; p_B = operating pressure; V_g = displacement).
The hydraulic output power (characteristic LR) is influenced by the efficiency of the pump.
Setting range for beginning of control 50 to 350 bar
When ordering, state in plain text:

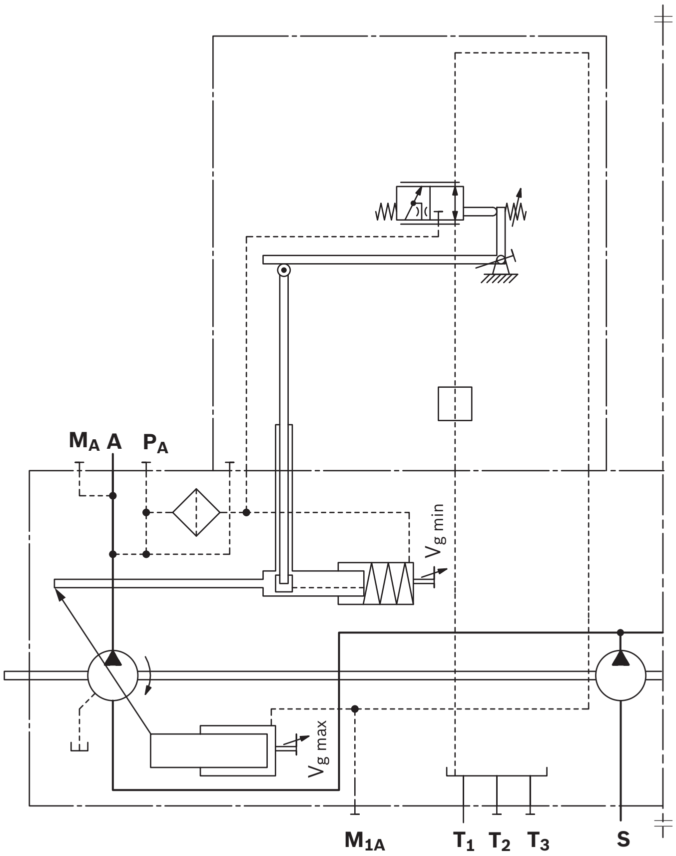
- Drive power P [kW]
- Drive speed n [rpm]
- Maximum flow $q_{V\,max}$ [l/min]

Please contact us if you need a power diagram.

▼ Characteristic LR



▼ Circuit diagram LR



Illustrated for purposes of clarity, only pump A

L3/L4 – Power controller, electric-proportional override (negative control)

A control current acts against the adjustment spring of the power control via a proportional solenoid.

The mechanically adjusted basic power setting can be reduced by means of different control current settings.

Increasing control current = reduced power.

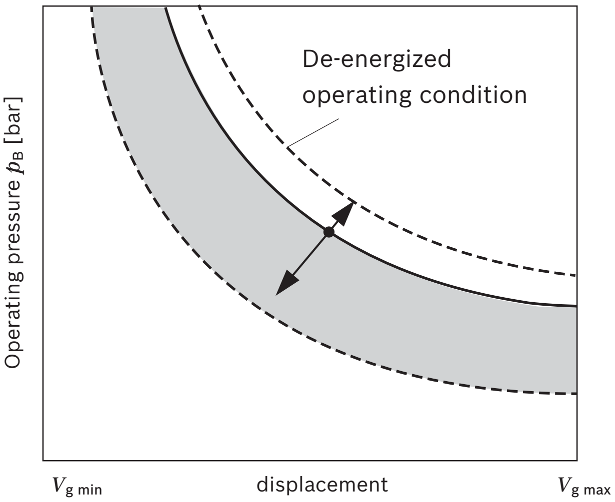
If the pilot control signal is variably controlled via a load limiting control, the power draw of all consumers is adjusted to the power draw possible for the diesel engine (e.g. electronic load limiting control LLC (data sheet 95310) in BODAS controller RC2-2).

Technical data, solenoid	**L3**	**L4**
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Beginning of control	400 mA	200 mA
End of control	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100%	100%
Type of protection: see connector version page 29		

When ordering, state in plain text:

- Drive power P [kW] at beginning of control
- Control current I [mA] at drive power P [kW]
- Drive speed n [rpm]
- Maximum flow $q_{V\,max}$ [l/min]

▼ **Effect of power override through current increase**

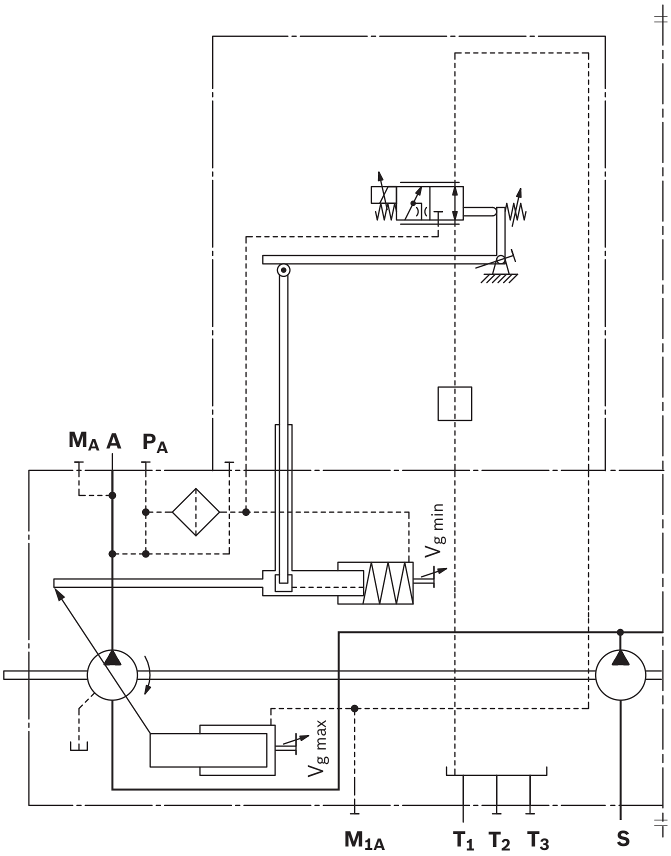


Note

In operating condition **L3** de-energized (jump 400 to 0 mA): Power increase by a factor of 2 of the table values.

In operating condition **L4** de-energized (jump 200 to 0 mA): Power increase by a factor of 1 of the table values.

Circuit diagram L4



Illustrated for purposes of clarity, only pump A

Reduction of power by control current to the proportional solenoids with **L3**[1)]

Power reduction/control current [kW /100 mA]

	Rotational speed [rpm]		
Size	**1000**	**1500**	**1800**
280	11.4	17.1	20.5

Reduction of power by control current to the proportional solenoids with **L4**[1)]

Power reduction/control current [kW/100 mA]

	Rotational speed [rpm]		
Size	**1000**	**1500**	**1800**
280	22.9	34.4	41.2

---

1) Values in the tables are reference points. Determination of the exact power override on request.

L5 – Power controller, hydraulic-proportional override (negative control)

A pilot pressure acts against the adjustment spring of the power control via a valve.

The mechanically adjusted basic power setting can be reduced by means of different pilot pressure settings.

Increasing pilot pressure = reduced power.

- Maximum permissible pilot pressure $p_{St\ max}$ = 100 bar

If the pilot pressure signal is adjusted by a load limiting control, the power reduction of all consumers is reduced to match the available power from the diesel engine.

Reduction of power by pilot pressure at port **L5**

Power reduction/pilot pressure [kW/bar]

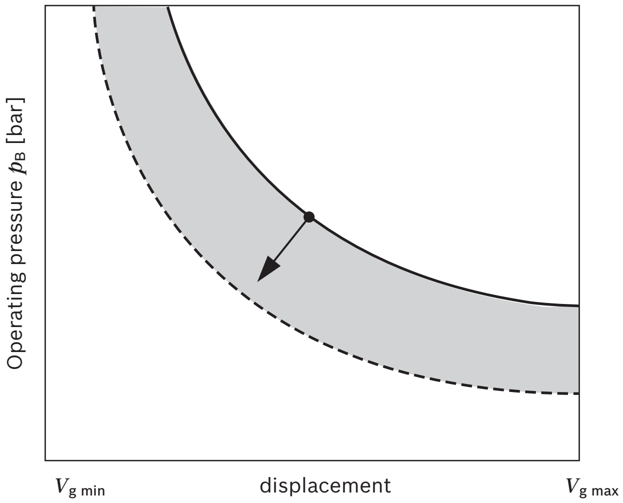
	Rotational speed [rpm]		
Size	**1000**	**1500**	**1800**
280	4.4	6.6	7.9

Values in the tables are reference points. Determination of the exact power override on request.

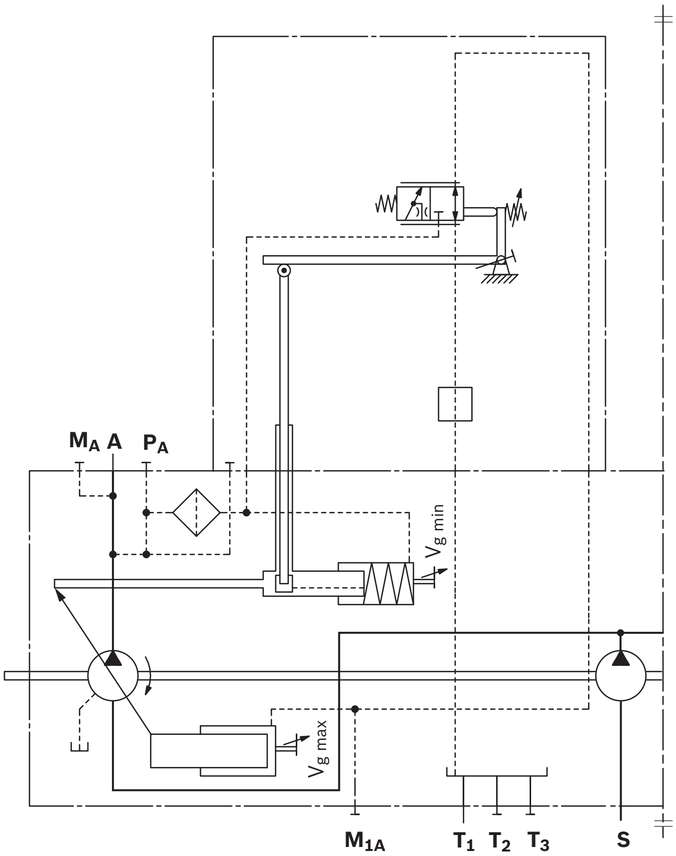
When ordering, state in plain text:

- Drive power P [kW] at beginning of control
- Pilot pressure p_{st} [bar] in **L5** at drive power P [kW]
- Drive speed n [rpm]
- Maximum flow $q_{V\ max}$ [l/min]

▼ **Effect of power override through pilot pressure increase**



▼ **Circuit diagram L5**



Illustrated for purposes of clarity, only pump A

Change in beginning of control in bar when pilot pressure is changed from minimum to maximum.

The factor pilot pressure to beginning of control is 1:7.

CR – Summation hp-control of two power-controlled pumps, high-pressure-related override (with stop)

With two pumps of the same size working in different circuits, the CR controller limits the overall power.

The CR works like the normal LR with a fixed maximum power setting along the power hyperbola. The high-pressure-related override reduces the power setpoint in dependence on the operating pressure of the other pump. That happens proportionally below the beginning of control and is blocked by a stop when the minimum power is reached. Here, the **CR** port of the one pump has to be connected to the **M**$_A$ port of the other pump.

The maximum power of the first pump is reached when the second pump is working at idle when depressurized. When defining the maximum power, the idle power of the second pump has to be taken into account.

The minimum power of each pump is reached when both pumps are working at high pressure. The minimum power usually equates to 50% of the total power.

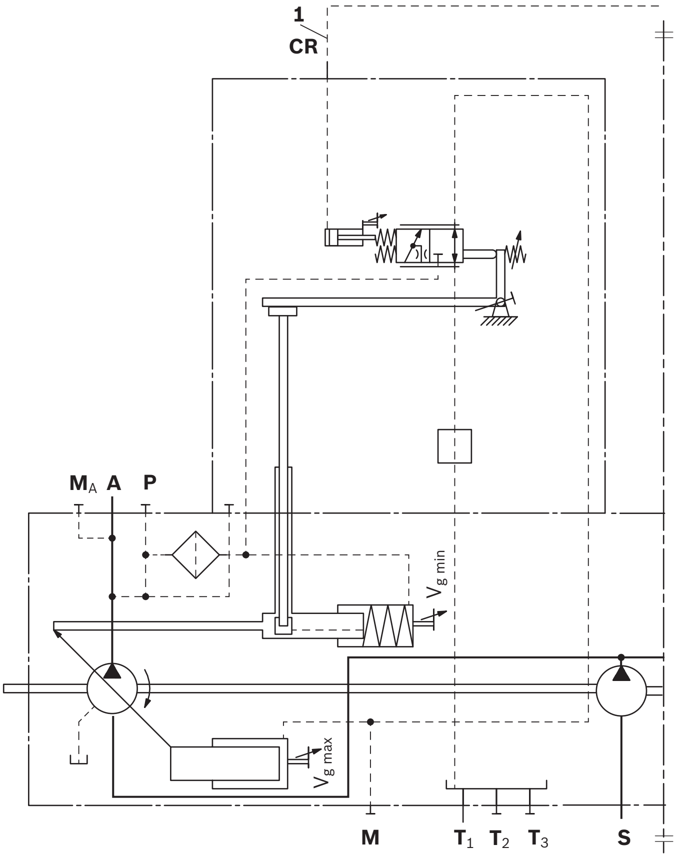
Power that is released by the pressure control or other overrides remains unconsidered.

Setting range for beginning of control is 50 bar to 300 bar.

When ordering, please specify separately for each pump:

- Maximum drive power P_{max} [kW]
- Minimum drive power P_{min} [kW]
- Drive speed n [rpm]
- Maximum flow $q_{V\,max}$ [l/min]

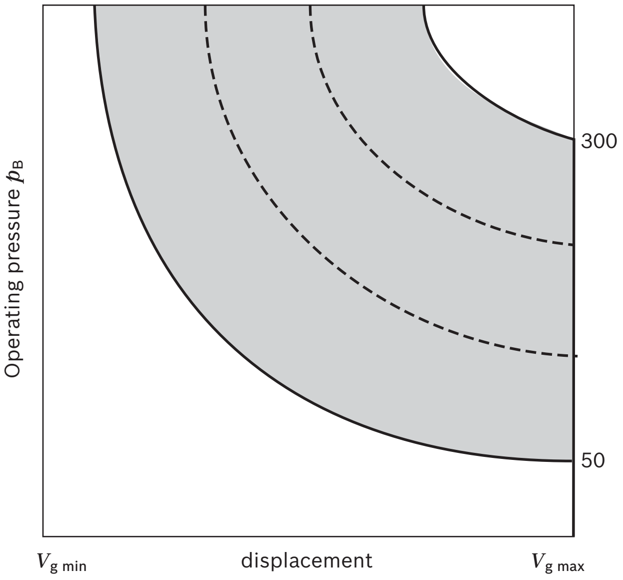
▼ **Circuit diagram CR**



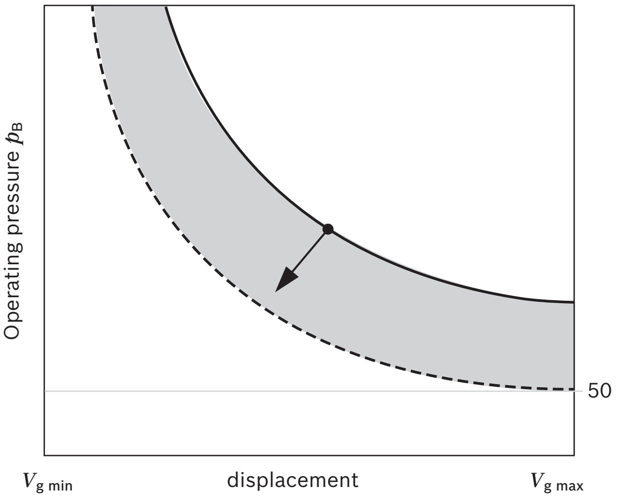
1 Piping is not included in the scope of delivery.

Illustrated for purposes of clarity, only pump A

▼ **Characteristic CR**



▼ **Effect of power override of a pump with increasing pressure in the 2nd pump**



H3 – Stroke control, hydraulic-proportional, pilot pressure (negative control)

With pilot-pressure-related control, the pump displacement is adjusted in proportion to the pilot pressure applied at port **H3**.

Basic position without pilot signal is $V_{g\ max}$. Mechanically depressurized basic position is $V_{g\ max}$ (see ordering code digit 09, letter B).

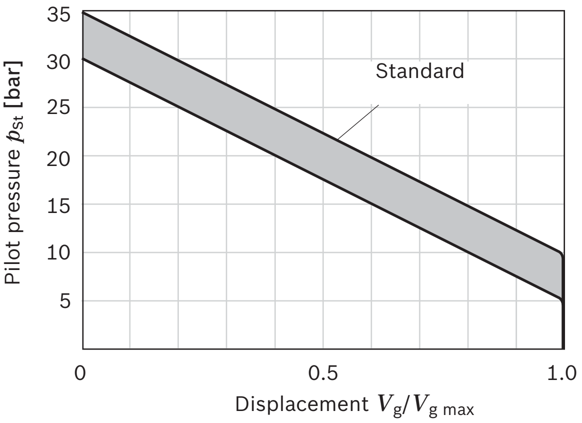
- Adjustment from $V_{g\ max}$ to $V_{g\ min}$
  With increasing pilot pressure, the pump swivels to a smaller displacement.
- Setting range for beginning of control (at $V_{g\ max}$)
  5 bar to 10 bar, standard is 10 bar. State beginning of control in plain text in the order.
- Maximum permissible pilot pressure $p_{St\ max}$ = 100 bar

The necessary control fluid is taken from the operating pressure or the external control pressure applied to port **P**. If the pump is to be adjusted from the basic position $V_{g\ min}$ or from a low operating pressure, port **P** must be supplied with an external control pressure of at least 30 bar, maximum 50 bar.

Note

If no external control pressure is applied to **P**, the version "Maximum swivel angle ($V_{g\ max}$), without external control pressure supply" is to be ordered (see ordering code 09, letter A).

▼ **Characteristic H3 (negative)**

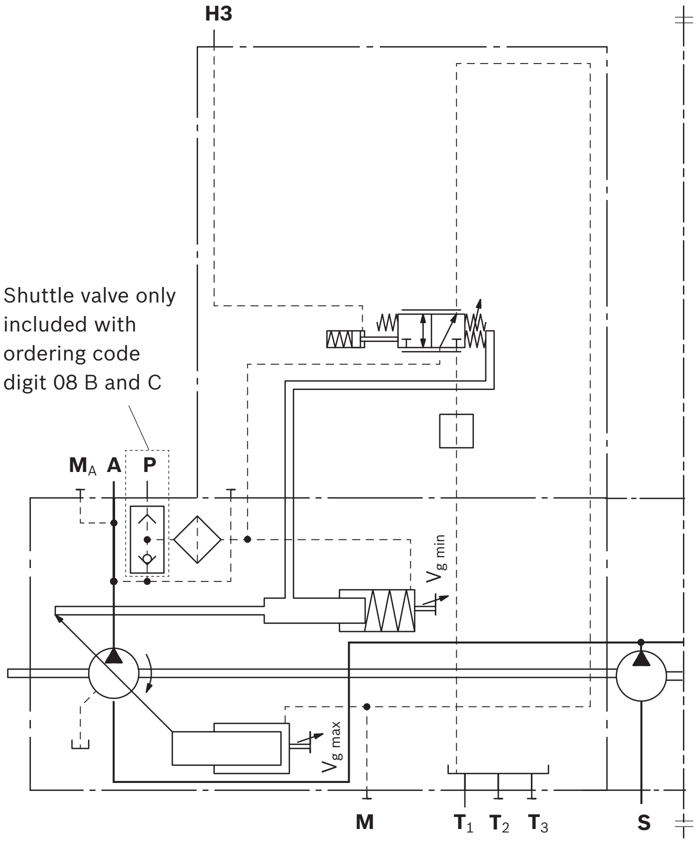


Increase in pilot pressure $V_{g\ max}$ to $V_{g\ min}$: Δp = 25 bar

When ordering, state in plain text:

- Beginning of control [bar] at $V_{g\ max}$

▼ **Circuit diagram H3**



Illustrated for purposes of clarity, only pump A

H5 – Stroke control, hydraulic-proportional, pilot pressure (negative control)

With pilot-pressure-related control, the pump displacement is adjusted in proportion to the pilot pressure applied at port **H5**.

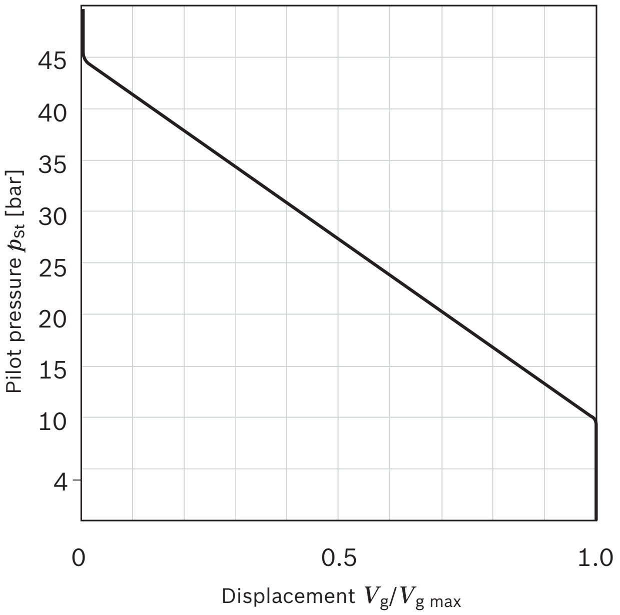
Basic position without pilot signal is $V_{g\,max}$, which includes the mechanically depressurized basic position $V_{g\,max}$ (see ordering code digit 08).

- Maximum permissible pilot pressure $p_{St\,max}$ = 100 bar
- Adjustment from $V_{g\,max}$ to $V_{g\,min}$
  With increasing pilot pressure, the pump swivels to a smaller displacement.
- Beginning of control (at $V_{g\,max}$) 10 bar

The necessary control power is taken from the operating pressure or the external control pressure applied to port **P**. If the pump is to be adjusted at low operating pressure, port **P** must have an external control pressure supply of at least 30 bar, maximum 50 bar.

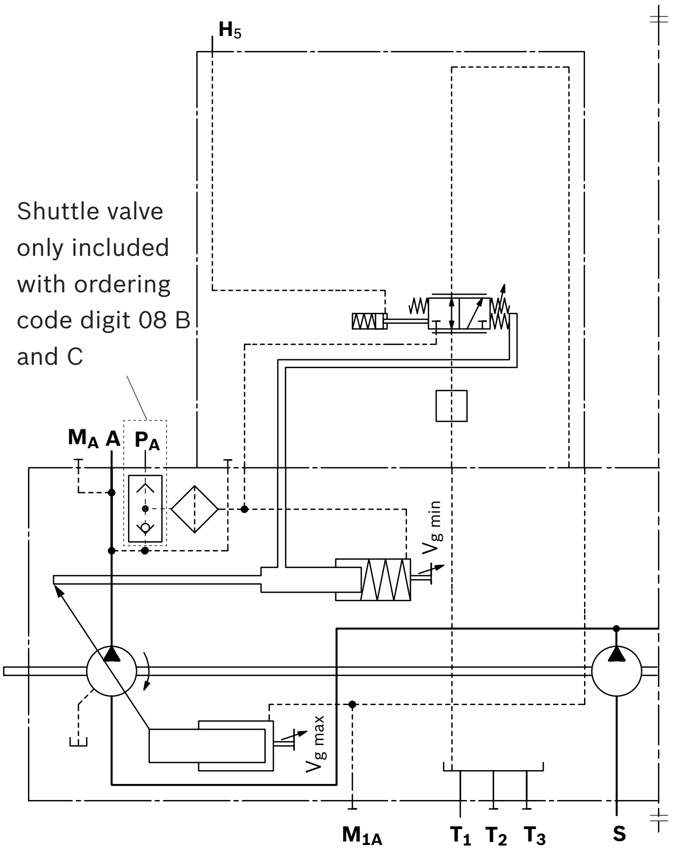
Note
If no external control pressure is applied to **P**, the version "Maximum swivel angle ($V_{g\,max}$), without external control pressure supply" is to be ordered (see ordering code digit 08, A).

▼ **Characteristic H5 (negative)**



Increase in pilot pressure $V_{g\,max}$ to $V_{g\,min}$: Δp = 35 bar

▼ **Circuit diagram H5**



Illustrated for purposes of clarity, only pump A

H6 – Stroke control, hydraulic-proportional, pilot pressure (positive control)

With pilot-pressure-related control, the pump displacement is adjusted in proportion to the pilot pressure applied at port **H6**.

Basic position without pilot signal is $V_{g\,min}$, which includes the mechanically depressurized basic position $V_{g\,min}$ (see ordering code digit 08).

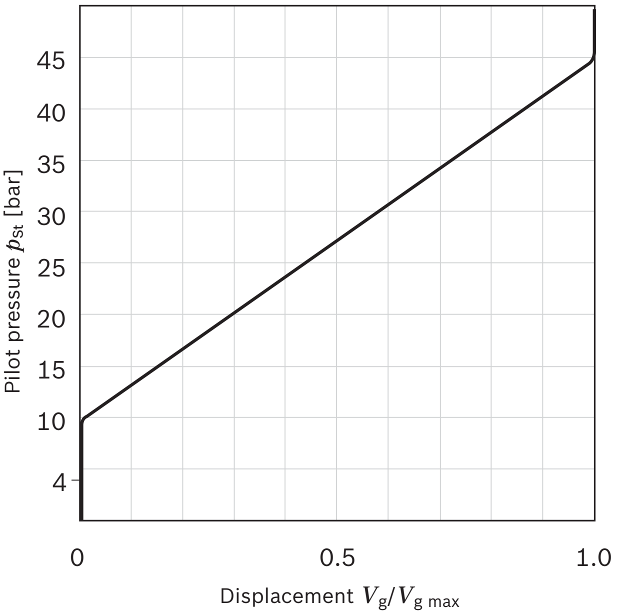
- Maximum permissible pilot pressure $p_{St\,max}$ = 100 bar
- Adjustment from $V_{g\,min}$ to $V_{g\,max}$
  With increasing pilot pressure the pump swivels to a larger displacement.
- Beginning of control (at $V_{g\,min}$) 10 bar.

The necessary control power is taken from the operating pressure or the external control pressure applied to port **P**. If the pump is to be adjusted from the zero basic setting or from a low operating pressure, port **P** must be supplied with an external control pressure of at least 30 bar, maximum 50 bar.

Note

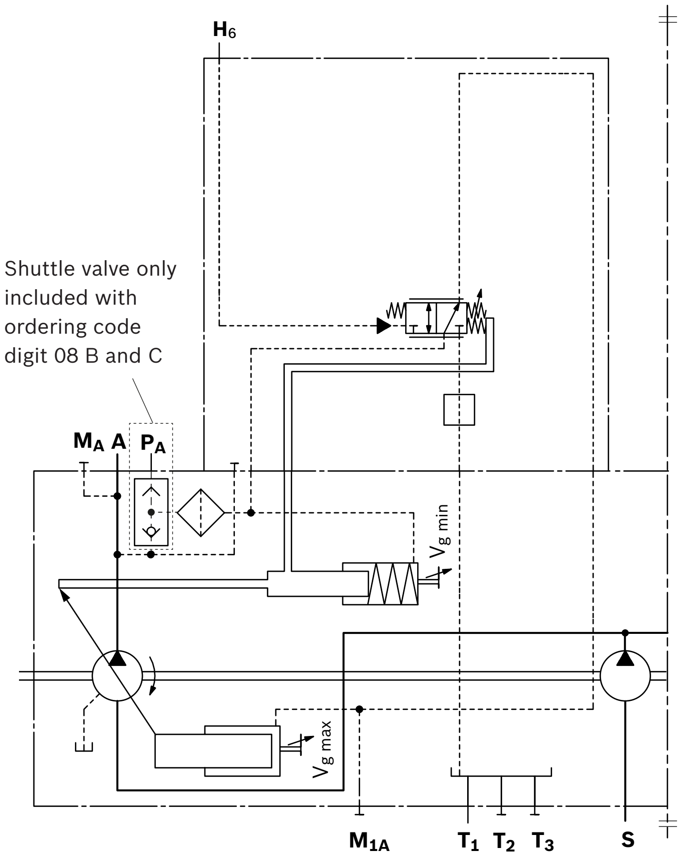
If no external control pressure is applied to **P**, the version “Maximum swivel angle ($V_{g\,max}$), without external control pressure supply” is to be ordered (see ordering code digit 08, A).

▼ **Characteristic H6 (positive)**



Increase in pilot pressure $V_{g\,min}$ to $V_{g\,max}$: Δp = 35 bar

▼ **Circuit diagram H6**



Illustrated for purposes of clarity, only pump A

Stroke control

E1/E2 – Stroke control, electric, proportional (positive control)

With the electrical stroke limiter with proportional solenoid, the pump displacement is steplessly adjusted in proportion to the current via the magnetic force. Basic position without pilot signal is $V_{g\,min}$, which includes the mechanically depressurized basic position $V_{g\,min}$ (see ordering code digit 08).

With increasing control current the pump swivels to a higher displacement (from $V_{g\,min}$ to $V_{g\,max}$).

The necessary control fluid is taken from the operating pressure or the external control pressure applied to port **P**.

If the pump is to be adjusted from the basic position $V_{g\,min}$ or from a low operating pressure, port **P** must be supplied with an external control pressure of at least 30 bar, maximum 50 bar.

Note

If there is no external control pressure applied to **P**, the version “Maximum swivel angle ($V_{g\,max}$), without external control pressure supply” must be ordered (see ordering code digit 08, A).

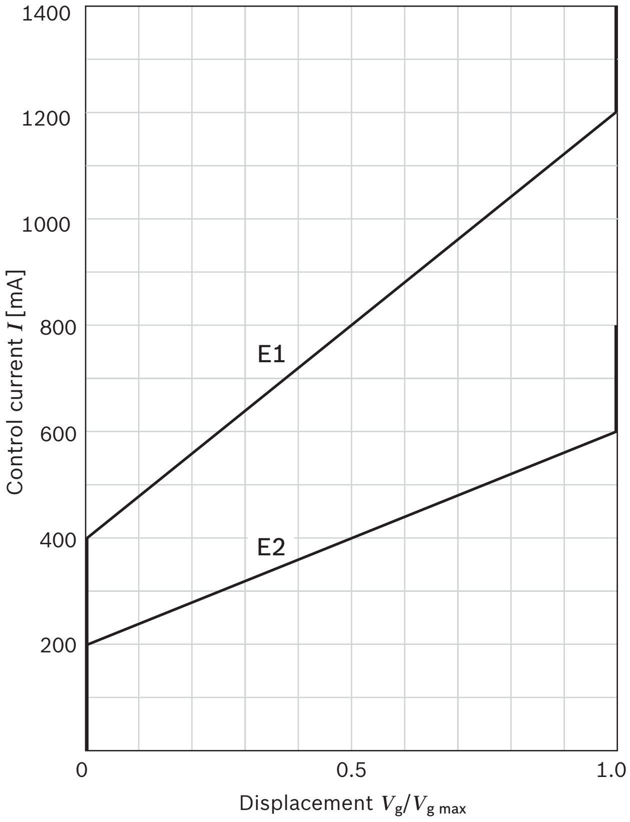
BODAS RC controllers with application software and analog amplifier RA are available for controlling the proportional solenoids.

Technical data, solenoid	E1	E2
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Beginning of control at $V_{g\,min}$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA[1]	600 mA[2]
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100%	100%
Type of protection: see connector version page 29		

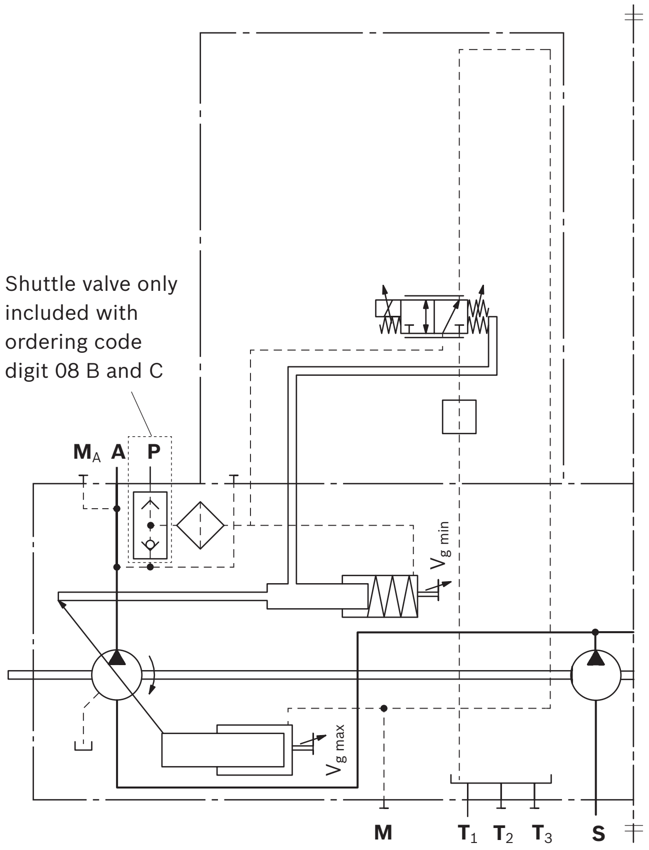
When ordering, state in plain text:

- Drive speed n [rpm]
- Maximum flow $q_{V\,max}$ [l/min]
- Minimum flow $q_{V\,min}$ [l/min]

▼ **Characteristic E1/E2**



▼ **Circuit diagram E1/E2**



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1) Because of the control hysteresis, a control current of up to 1300 mA may be required for the $V_{g\,max}$ position.

2) Because of the control hysteresis, a control current of up to 650 mA may be required for the $V_{g\,max}$ position.

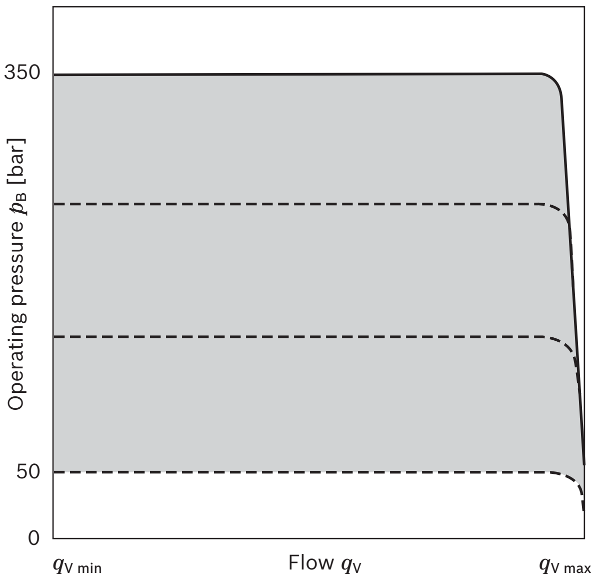
Pressure controller

DR – Pressure controller with one-sided swiveling, fixed setting

The pressure controller limits the maximum pressure at the pump outlet within the control range of the variable pump. The variable pump only supplies as much hydraulic fluid as is required by the consumers. If the operating pressure exceeds the pressure setting at the pressure valve, the pump will regulate to a smaller displacement to reduce the control differential.

- Initial position in depressurized state: $V_{g\ max}$
- Setting range for pressure control: 50 to 350 bar.

▼ **Characteristic DR**



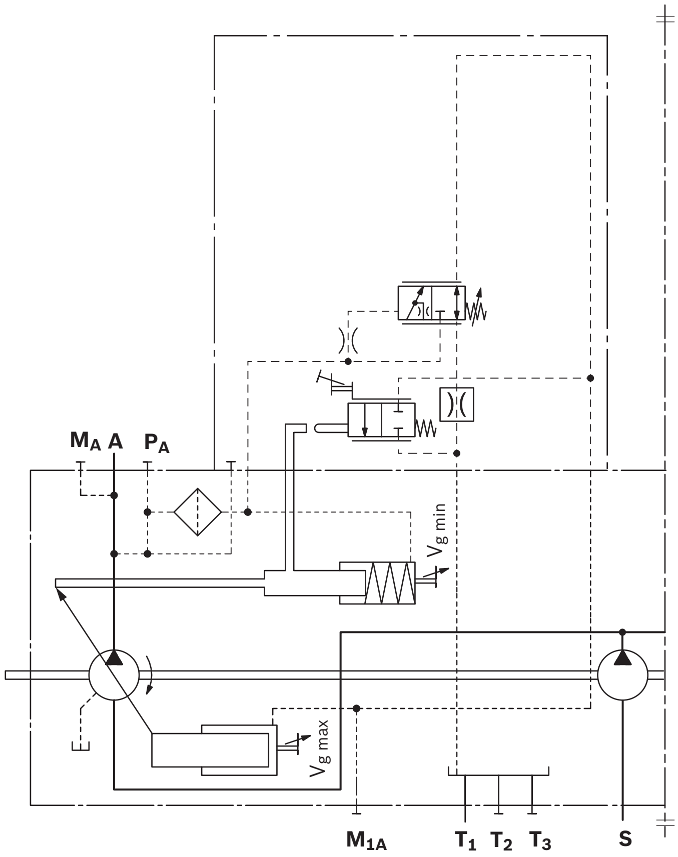
Hydraulic $V_{g\ min}$ stop

The hydraulic $V_{g\ min}$ stop opens the valve outlet to the case drain chamber when a minimum position is reached, damping the controller and reducing overshoot. This can cause a connection from high pressure or external control pressure via the controller and the hydraulic $V_{g\ min}$ stop to the case drain chamber.

When ordering, state in plain text:

- Pressure setting p [bar] at pressure controller DR

▼ **Circuit diagram DR**



Illustrated for purposes of clarity, only pump A

D2 – Proportional pressure control with one-side swiveling, electric override (M2 with two-side swiveling) (positive control)

The pressure controller keeps the pressure in a hydraulic system constant within its control range even under varying flow conditions. The variable pump only supplies as much hydraulic fluid as is required by the consumers.
If the operating pressure exceeds the setting at the integrated pressure control valve, the pump is automatically swiveled back to reduce the control differential.

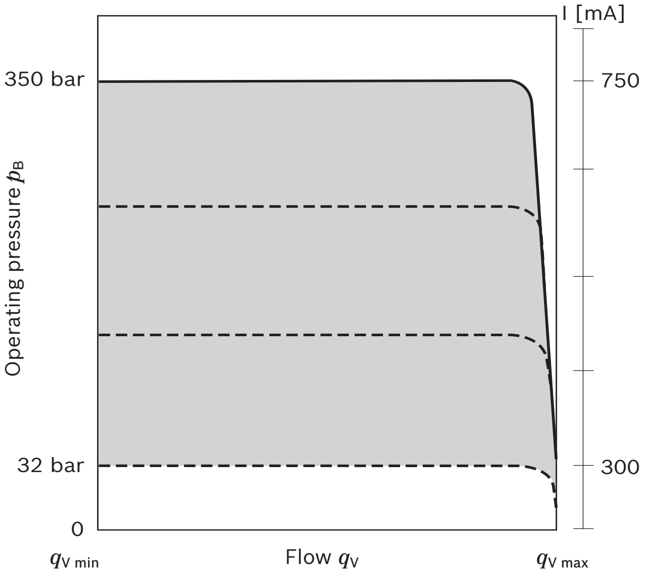
- Initial position in depressurized state: $V_{\text{g max}}$
- Pressure controller basic setting: 32 bar/300 mA

The basic setting of the pressure controller can be overridden. The pressure control value is proportional to the electrical current acting on the solenoids of the pressure reducing valve.

- Pressure setting overridden:
  32 bar/300 mA to 350 bar/750 mA
- Auxiliary pressure for controlling D2 at port **Y**:
  p_{min} = 40 bar; p_{max} = 50 bar.
  Port **X** acts solely as a measuring port (p_{max} 50 bar). Pressurization leads to an impermissible increase in pressure.

Notice
Applying current above the limit of 750 mA to the proportional solenoid results in an impermissible increase in pressure.
Make sure that currents above the permissible limit are not applied to the proportional solenoid.

▼ Characteristic D2

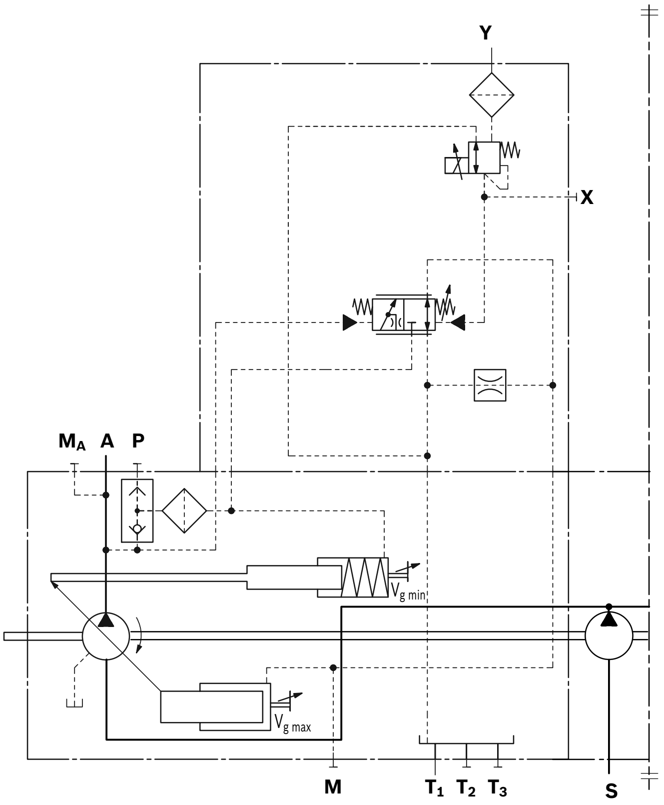


Technical data, solenoid	D2	D2
Voltage	24 V	24 V
Control current		
Beginning of control at $V_{\text{g min}}$		300 mA
End of control at $V_{\text{g max}}$		750 mA
Current limit	750 mA	750 mA
Nominal resistance (at 20 °C (68 °F))	12 Ω	12 Ω
Dither frequency	200 Hz	200 Hz
Duty cycle	100%	100 %
Type of protection: see connector version page 63		

The following electronic controllers and amplifiers are available for controlling the proportional solenoids:

BODAS RC controllers Series	Data sheet
20	95200
21	95201
22	95202
30	95203
and application software	95230
Analog amplifier RA	95230

▼ Circuit diagram D2



DRS0 – Pressure control with load sensing

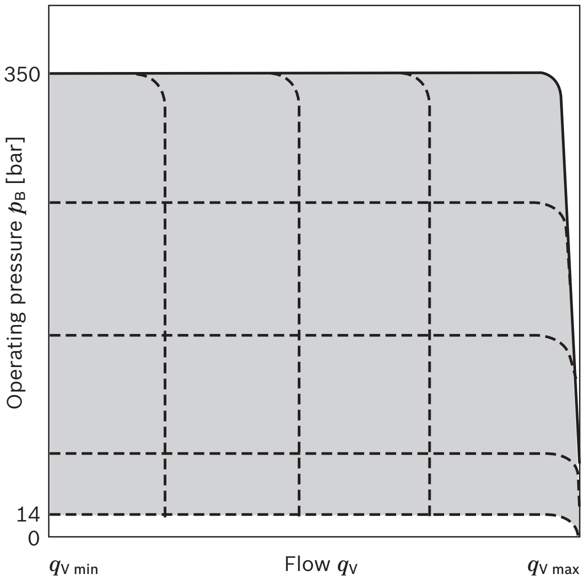
The load sensing controller works as a load-pressure controlled flow controller and adjusts the displacement of the pump to the volume required by the consumer.
The flow of the pump is then dependent on the cross section of the external metering orifice (**1**), which is located between the pump and the consumer. Below the setting of the pressure controller and within the control range of the pump, the flow is not dependent on the load pressure.
The metering orifice is usually a separately located load sensing directional valve (control block). The position of the directional valve spool determines the opening cross-section of the metering orifice and thus the flow of the pump.
The load sensing controller compares pressure before and after the sensing orifice and keeps the pressure drop (differential pressure Δp) across the orifice – and therefore the flow – constant.
If the differential pressure Δp at the metering orifice rises, the pump is swiveled back (toward $V_{g\ min}$). If the differential pressure Δp drops, the pump is swiveled out (toward $V_{g\ max}$) until equilibrium at the metering orifice is restored.

$$\Delta p_{\text{measuring orifice}} = p_{\text{pump}} - p_{\text{consumer}}$$

- Setting range for Δp 14 to 30 bar (please state in plain text)
- Standard adjustment 14 bar

The stand-by pressure in zero stroke operation (metering orifice closed) is slightly higher than the Δp-setting.

▼ **Characteristic DRS0**



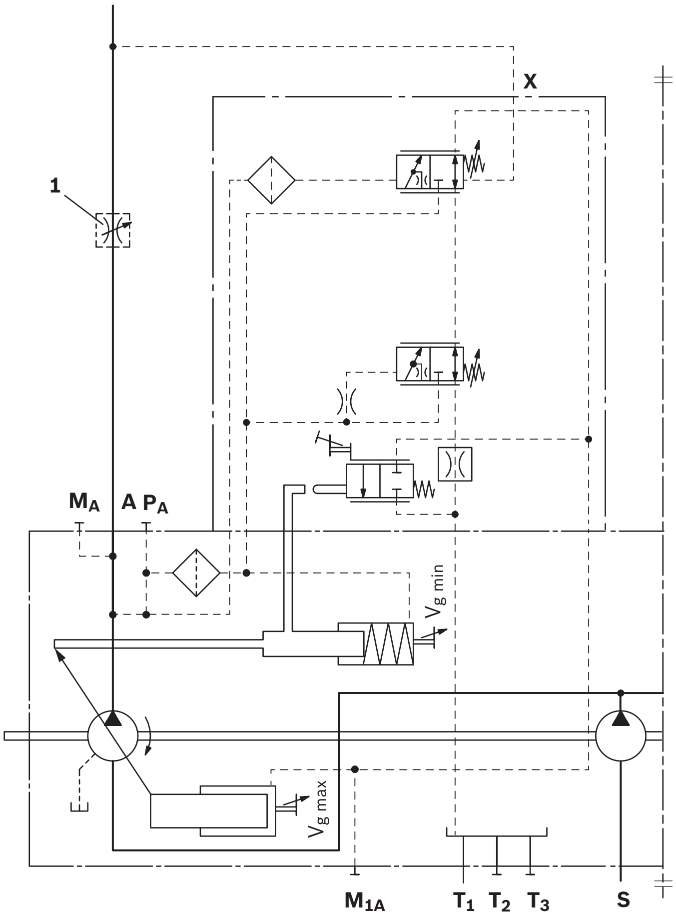
Hydraulic $V_{g\ min}$ stop

The hydraulic $V_{g\ min}$ stop opens the valve outlet to the case drain chamber when a minimum position is reached, damping the controller and reducing overshoot. This can cause a connection from high pressure or external control pressure via the controller and the hydraulic $V_{g\ min}$ stop to the case drain chamber.

When ordering, state in plain text:

- Pressure setting p [bar] at pressure controller DR
- Differential pressure Δp [bar] at load sensing controller S0

▼ **Circuit diagram DRS0**



Illustrated for purposes of clarity, only pump A

1 The measuring orifice (control block) is not included in the scope of delivery.

C5H3 – Cross-sensing control with power-controlled double pumps, stroke control, hydraulic-proportional, pilot-pressure related

The method of function is made up of controllers L5 and CR to C5.

For the operation, refer to chapters “L5 – Power controller, hydraulic-proportional override (negative control)” on page 13 and “CR – Summation hp-control of two power-controlled pumps, high-pressure-related override (with stop)” on page 14.

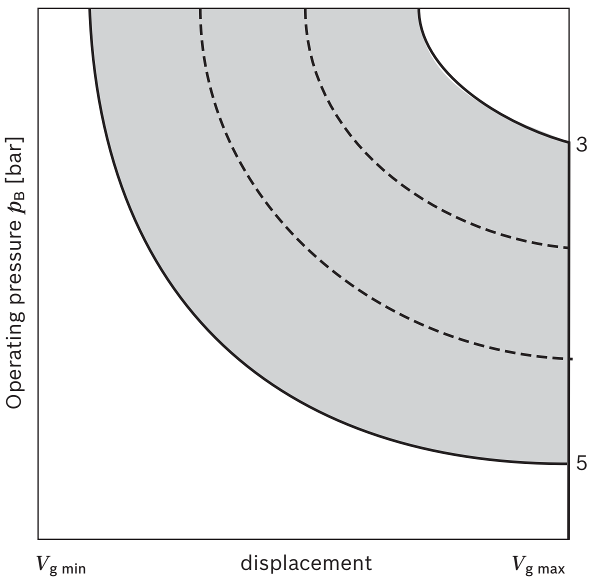
The function of H3 controller “H3 – Stroke control, hydraulic-proportional, pilot pressure (negative control)” can be found on page 15.

Setting range for beginning of control 50 to 300 bar

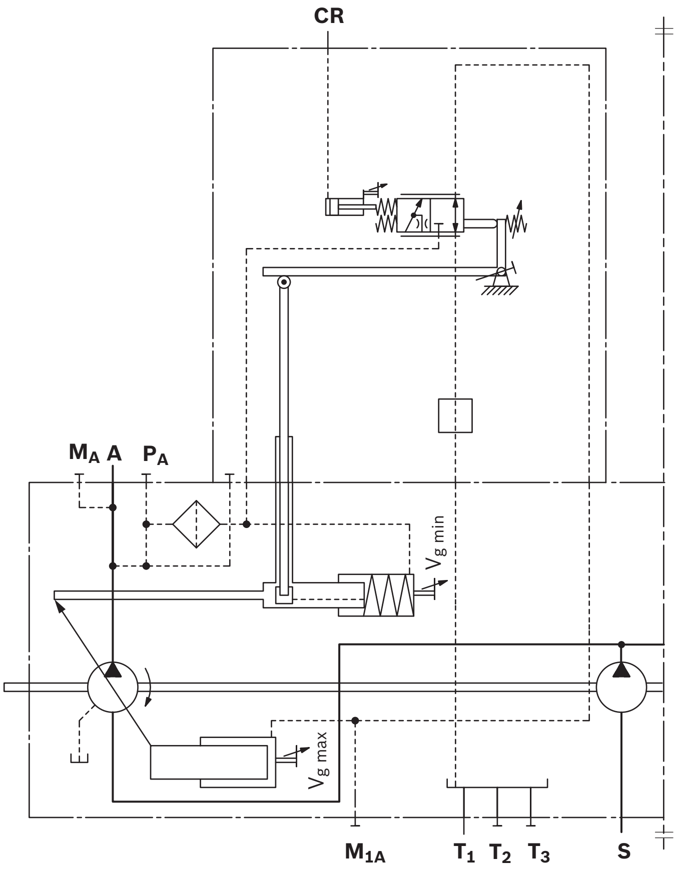
When ordering, please specify:

- Maximum drive power P_{max} [kW]
- Minimum drive power P_{min} [kW]
- Drive speed n [rpm]
- Maximum flow $q_{\text{V max}}$ [L/min]

▼ **Characteristic CR**

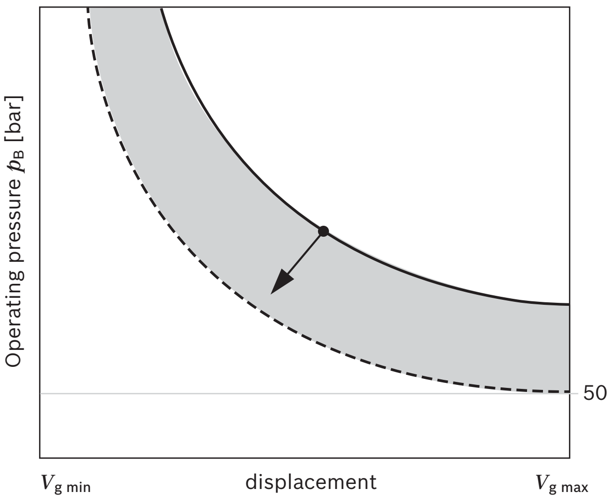


▼ **Circuit diagram CR**



Illustrated for purposes of clarity, only pump A

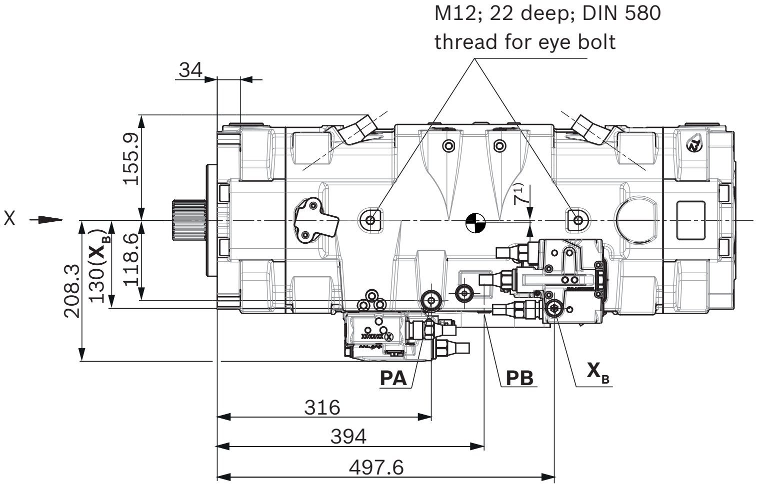
▼ **Effect of power override of a pump with increasing pressure in the 2nd pump**

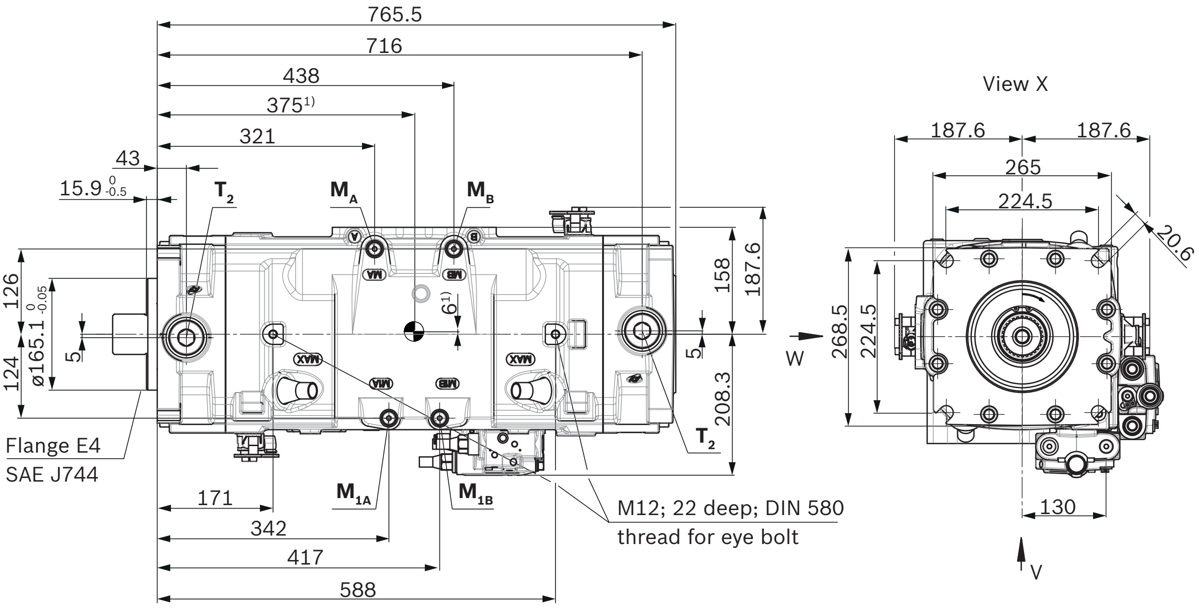


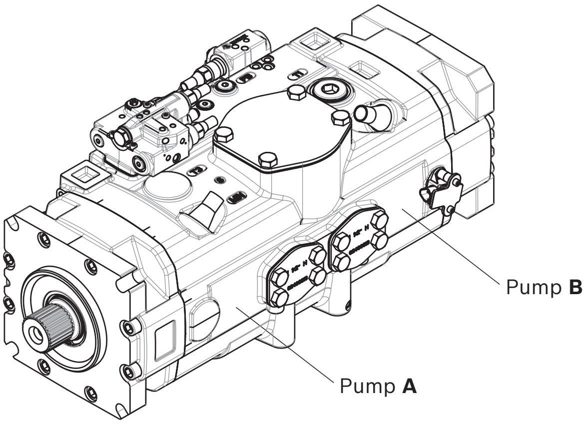
Dimensions, size 280

LRDRS0 – Power controller with pressure controller, load sensing and with electric swivel angle sensor (Part 1/2)

Clockwise rotation







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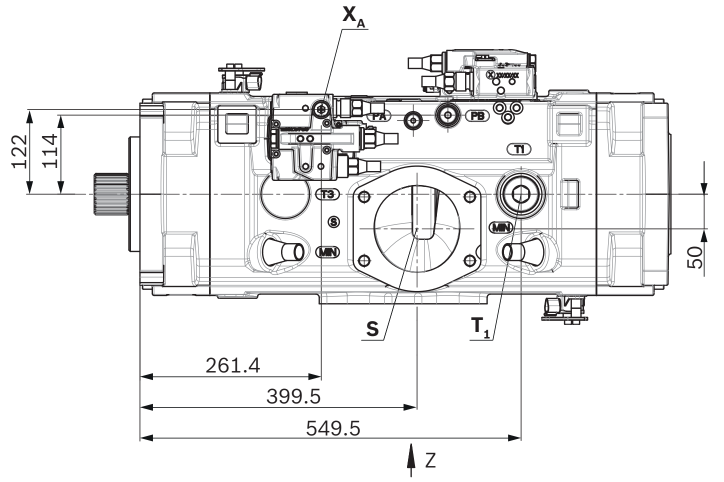
1) Center of gravity

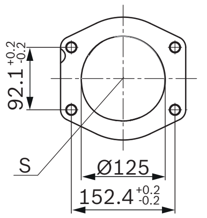
LRDRS0 – Power controller with pressure controller, load sensing and with electric swivel angle sensor (Part 2/2)

Clockwise rotation

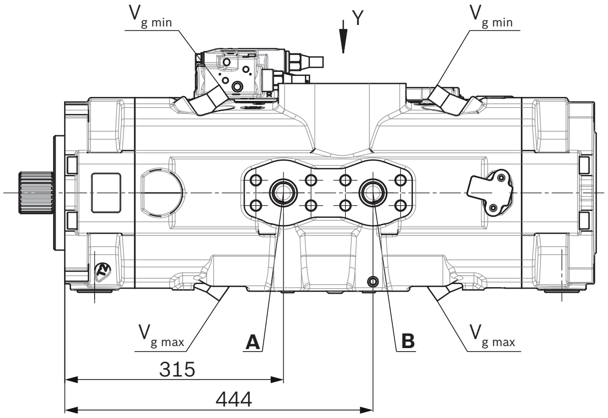
View V



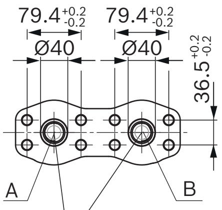
Detail Y



View W



Detail Z



Maximum inner diameter of the mounted compression flange may not exceed Ø 36 mm.

Additional information about ports and shaft ends can be found on page 25

SAE–version

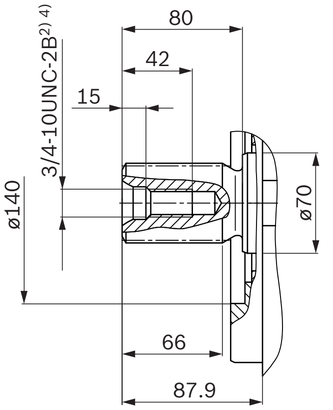
Ports			Standard	Size[2]	$p_{\text{max abs}}$ [bar][7]	State[9]	
Pump A	**Pump B**					Pump A	Pump B
A	**B**	Service line port Fastening thread	SAE J518[5] ASME B1.1	1 1/2 in 5/8-11UNC-2B; 35 deep	420	O	O
S		Suction port Fastening thread	SAE J518[5] ASME B1.1	5 in 5/8-11UNC-2B; 35 deep	30	O	
$\mathbf{T}_1$	–	Drain port	ISO 11926[6]	1 5/8; 19.5 deep	10	X[8]	–
$\mathbf{T}_2$	$\mathbf{T}_2$	Drain port	ISO 11926[6]	1 5/8; 19.5 deep	10	O[8]	O[8]
CR	**CR**	Pilot signal (only at CR)	ISO 11926	9/16-18UNF-2B; 13 deep	420	O	O
H.	**H.**	Pilot signal (only at H3, H4, H5, H6)	ISO 11926	9/16-18UNF-2B; 13 deep	100	O	O
L.	**L.**	Override power control (only at L3, L4. L5, L6)	ISO 11926	9/16-18UNF-2B; 13 deep	100	O	O
$\mathbf{M}_{1A}$	$\mathbf{M}_{1B}$	Measuring, control pressure	ISO 11926[6]	9/16-18UNF-2B; 13 deep	420	X	X
$\mathbf{M}_A$	$\mathbf{M}_B$	Measuring, operating pressure A, B	ISO 11926[6]	9/16-18UNF-2B; 13 deep	420	X	X
$\mathbf{P}_A$	$\mathbf{P}_B$	External control pressure (Ordering code digit 9 version B or C = with external control pressure supply)	ISO 11926[6]	9/16-18UNF-2B; 13 deep	50	O	O
		Port **P** is without function (Ordering code digit 9 version A = without external control pressure supply)	ISO 11926[5]	3/4-16UNF-2B; 12.5 deep	420	X	X

Metric version

Ports			Standard	Size[2]	$p_{\text{max abs}}$ [bar][7]	State[9]	
Pump A	**Pump B**					Pump A	Pump B
A	**B**	Service line port Fastening thread	SAE J518[5] DIN 13	1 1/2 in M16 x 2; 24 deep	420	O	O
S		Suction port Fastening thread	SAE J518[5] DIN 13	5 in M16 x 2; 24 deep	30	O	
$\mathbf{T}_1$	–	Drain port	ISO 6149[6]	M42 x 2; 19.5 deep	10	X[8]	–
$\mathbf{T}_2$	$\mathbf{T}_2$	Drain port	ISO 6149[6]	M42 x 2; 19.5 deep	10	O[8]	O[8]
CR	**CR**	Pilot signal (only at CR)	ISO 6149	M14 x 1.5; 11.5 deep	420	O	O
H.	**H.**	Pilot signal (only at H3, H4, H5, H6)	ISO 6149	M14 x 1.5; 11.5 deep	100	O	O
L.	**L.**	Override power control (only at L3, L4, L5, L6)	ISO 6149	M14 x 1.5; 11.5 deep	100	O	O
$\mathbf{M}_{1A}$	$\mathbf{M}_{1B}$	Measuring, control pressure	ISO 6149[6]	M14 x 1.5; 12 deep	420	X	X
$\mathbf{M}_A$	$\mathbf{M}_B$	Measuring, operating pressure A, B	ISO 6149[6]	M14 x 1.5; 12 deep	420	X	X
$\mathbf{P}_A$	$\mathbf{P}_B$	External control pressure (Ordering code digit 9 version B or C = with external control pressure supply)	ISO 6149[6]	M14 x 1.5; 11.5 deep	50	O	O
		Port **P** is without function (Ordering code digit 9 version A = without external control pressure supply)	ISO 6149[6]	M18 x 1.5; 14.5 deep	420	X	X

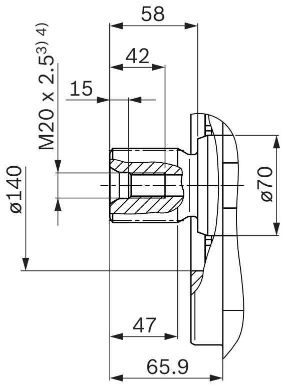
▼ Splined shaft SAE J744

T3 – 2 1/4 in 17T 8/16DP[1]



▼ Splined shaft DIN 5480

A4 – W60x2x28x9



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1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Centering bore according to DIN 332 (thread according to DIN 13)

4) Observe the general instructions on page 32 concerning the maximum tightening torques.

5) Metric fixing thread is a deviation from standard.

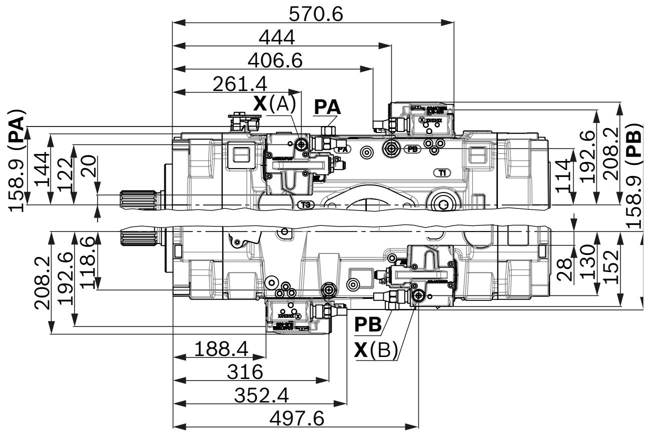
6) The spot face can be deeper than as specified in the standard

7) Depending on the application, momentary pressure peaks may occur. Keep this in mind when selecting measuring devices and fittings.

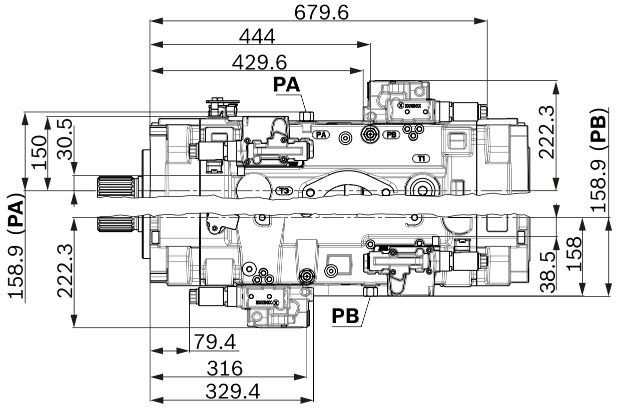
8) Depending on installation position, T_1, T_2 or T_3 must be connected (see also Installation instructions on pages 30 and 31).

9) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

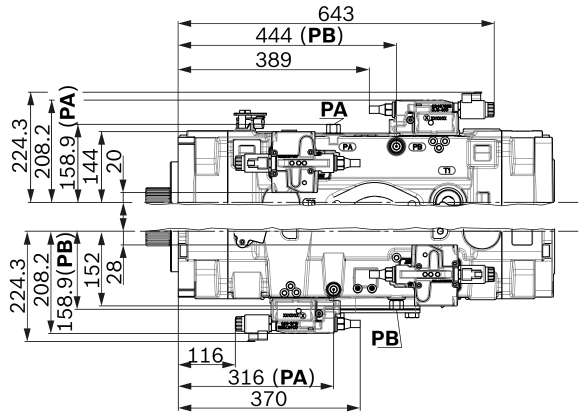
▼ xxS0 – Additional controller; Load sensing, internal pump pressure, fixed setting



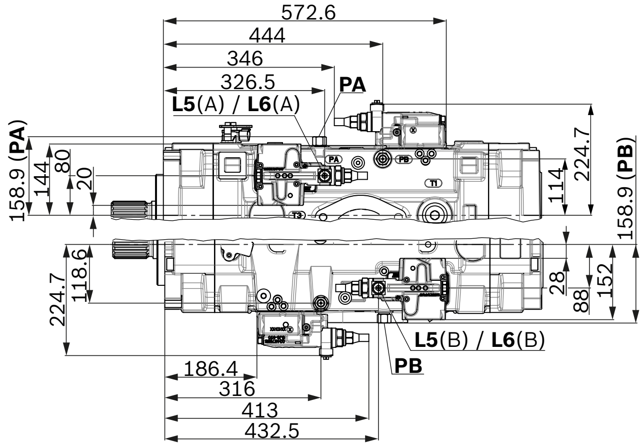
▼ E1/E2 – Stroke control electric-proportional



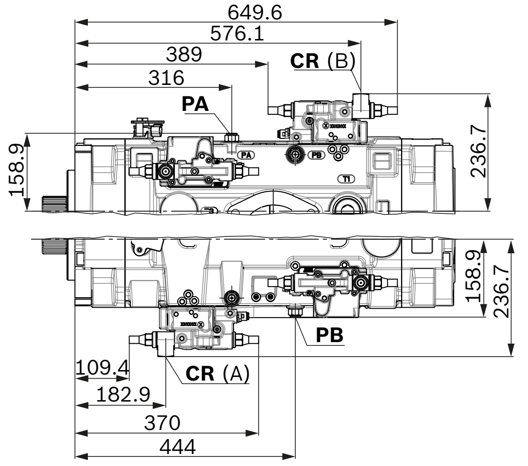
▼ L3/L4 – Power controller, electric-proportional override



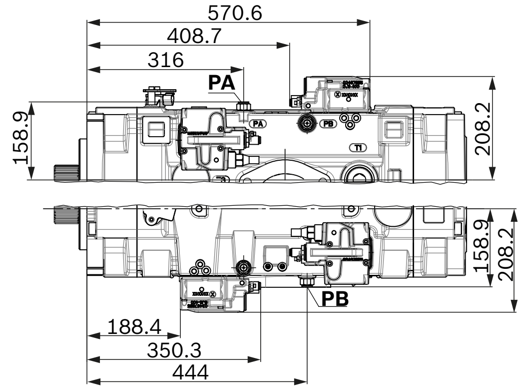
▼ L5/L6 – Power controller, hydraulic-proportional override



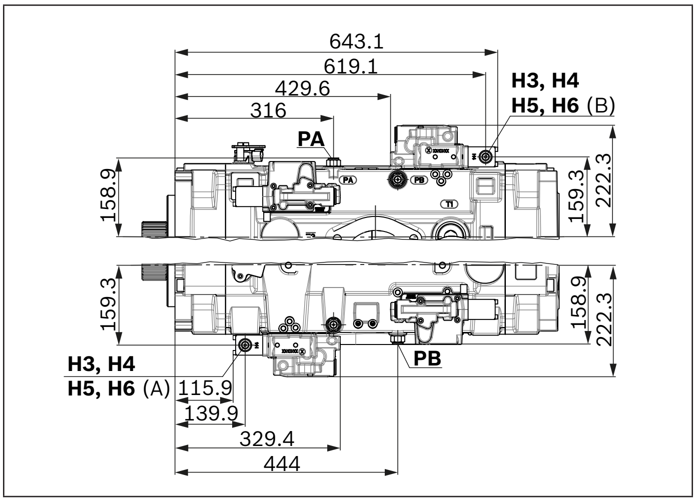
▼ CR – Power controller, hydraulic-proportional override, high pressure, with stop



▼ DR – Pressure controller



▼ **H3/H4/H5/H6 – Stroke control, hydraulic-proportional, pilot pressure**



Connector for solenoids

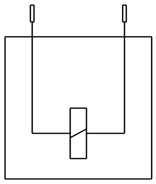
DEUTSCH DT04-2P-EP04

Molded connector, 2-pin, without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)

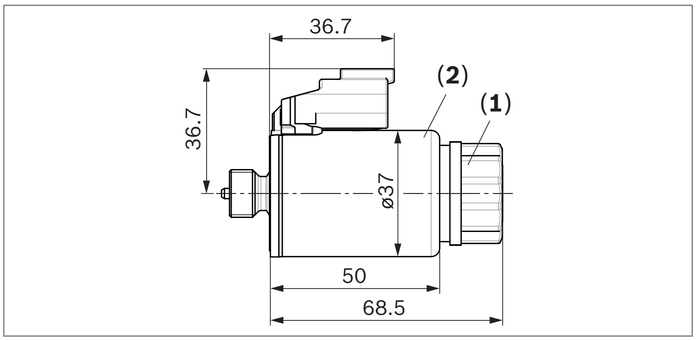
▼ **Circuit diagram symbol**



▼ **Mating connector DEUTSCH DT06-2S-EP04**

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).



Changing connector orientation

If necessary, you can change the position of the connector by turning the solenoid.

To do this, proceed as follows:

- Loosen the mounting nut (**1**) of the solenoid.
  To do this, turn the mounting nut (**1**) one revolution counter-clockwise.
- Turn the solenoid body (**2**) to the desired orientation.
- Re-tighten the mounting nut.
  Tightening torque: 5+1 Nm.
  (WAF 26, 12-sided DIN 3124)

On delivery, the position of the connector may differ from that shown in the brochure or drawing.

AMP Junior-Timer, 2-pin

Type of protection:

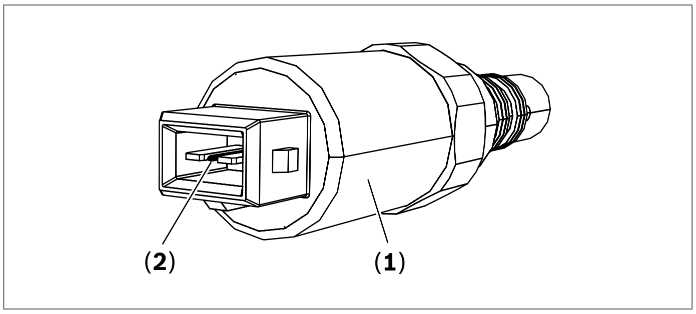
- IP69K (DIN 40050-9)

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R901022127); see also data sheet 08006.

- Outer diameter of conductor 2.2 mm to 3.0 mm

Manual override

When power supply to the vehicle is interrupted, maximum operating pressure can be established by means of a manual override so that the vehicle can be driven under its own power from a danger zone.



To activate the manual override:

- Unplug the electrical connector from the pressure reducing valve (**1**).
- Using a pointed tool, press both PINs (**2**) in up to the stop.
  Both PINs must remain in the depressed position!

Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.

Particularly in the installation position “drive shaft upwards”, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The case drain fluid in the case interior must be directed to the reservoir via the highest drain port (**T_1**, **T_2**, **T_3**).

For combinations of multiple units, the case drain fluid must be drained off at each pump. If a shared drain line is used for this purpose, make sure that the case pressure in each pump is not exceeded. In the event of pressure differences at the drain ports of the units, the shared drain line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation. If this is not possible, separate drain lines must be laid if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction line and drain line must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\ max}$ = 800 mm. The minimum suction pressure at port **S** must also not fall below 0.8 bar absolute (without charge pump) or 0.7 bar absolute (with charge pump) during operation and during a cold start.

When designing the reservoir, ensure adequate distance between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Note

In certain installation positions, an influence on the control characteristic curves can be expected. Gravity, dead weight and case pressure can cause minor characteristic shifts and changes in response time.

Installation position

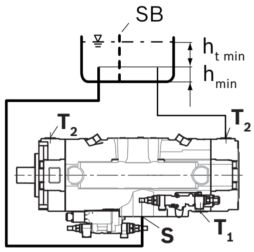
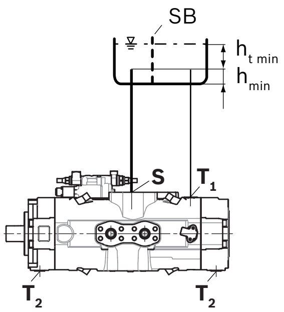
See examples **1** to **6** below.

Further installation positions are available upon request.

Recommended installation position: **1** and **2**

Below-reservoir installation (standard)

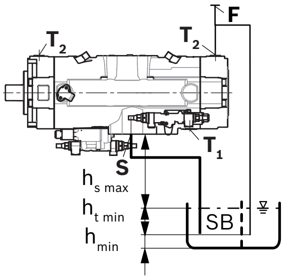
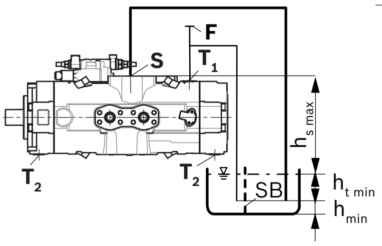
Below-reservoir installation is when the axial piston unit is installed outside of the reservoir and below the minimum fluid level.

Installation position	Air bleeding	Filling
1 	**T_2**	**S + T_2**
2 	**T_1**	**S + T_1**

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. To prevent the axial piston unit from draining, a height difference $h_{ES\ min}$ of at least 25 mm at port T_2 is required in position 6. Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.

Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

Installation position	Air bleeding	Filling
3 	**F**	T_2 (**F**)
4 	**S** (**F**)	T_1 (**F**)

Key	
F	Filling / air bleeding
S	Suction port
T	Drain port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir base (100 mm)
$h_{ES\ min}$	Minimum necessary height required to protect the axial piston unit from draining (25 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)

Inside-reservoir installation

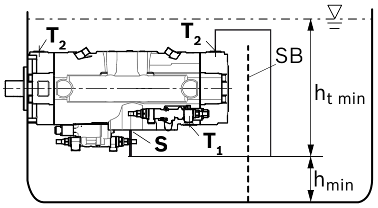
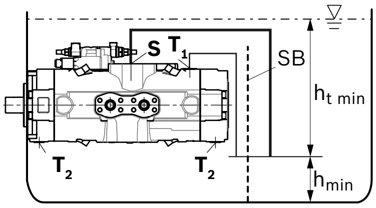
Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level.

The axial piston unit is completely below the hydraulic fluid.

If the minimum fluid level is equal to or below the upper edge of the pump, see chapter **“Above-reservoir installation”**.

Axial piston units with electrical components (e.g., electric control, sensors) may not be installed in a reservoir below the fluid level.

Exception: Installation of the pump with E2/E6 control only with HIRSCHMANN connector and if mineral hydraulic fluids are used and the fluid temperature in the reservoir does not exceed 80 °C

Installation position	Air bleeding	Filling
5 	via the highest available port T_2	**automatically via the open port T_2 due to position below hydraulic fluid level**
6 	via the highest available port T_1	**automatically via the open port T_1 due to position below hydraulic fluid level**

Note

Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

Project planning notes

- The A28V(L)O variable pump is designed to be used in open circuits.
- Project planning, installation and commissioning of the axial piston units requires the involvement of skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, request it from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The data and notes contained herein must be adhered to.
- Depending on the operating condition of the axial piston unit (operating pressure, fluid temperature), the characteristic curve may shift.
- The characteristic curve may also shift due to the dither frequency or control electronics.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation times apply under optimal storage conditions, details of these conditions can be found in the data sheet 90312 or the instruction manual.
- Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. MTTF_d) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference.
  Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- Pressure controllers are not safeguards against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- Service line ports:
  - The ports and fixing threads are designed for the specified peak pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The service line ports and function ports can only be used to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of burning on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve spools) can, under certain circumstances, get blocked in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the flow of hydraulic fluid and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filter) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.

Axial piston pumps

Variable pumps, closed circuits

Designation	Type	Size	Series	Data sheet	Page
Variable pump	A4VG	28...125	32	92003	887
Variable pump	A4VG	110...280	40	92004	959
Variable pump	A4VTG	71...90	33	92013	1031
Variable pump	A10VG	18...63	10	92750	1055
Variable pump	A4CSG	250...750		92105	1099
Variable double pump	A22VG	45	40	93221	1135
Variable double pump	A24VG	45...125	10	93240	1161
2-Circuit Axial Piston Variable Pump	A30VG	28		93430	1199

Axial piston variable pump A4VG Series 32

Europe

- High-pressure pump for applications in a closed circuit
- Size 28 to 125
- Nominal pressure 400 bar
- Maximum pressure 450 bar
- Closed circuit

Features

- Integrated auxiliary pump for boost and pilot oil supply
- Flow direction changes smoothly when the swashplate is moved through the neutral position
- High-pressure relief valves with integrated boost function
- With adjustable pressure cut-off as standard
- Boost-pressure relief valve
- Through drive for mounting of further pumps up to same nominal size
- Large variety of controls
- Swashplate design

Contents

Type code

01	02	03	04	05	06	07	08	09		10	11		12	13	14	15	16	17	18	19	20	21	22
A4V	G			D					/	32		–	N										

Axial piston unit

01	Swashplate design, variable, nominal pressure 400 bar, maximum pressure 450 bar	**A4V**

Operating mode

02	Pump, closed circuit	**G**

Size (NG)

03	Geometric displacement, see “Technical data” on page 8	**28**	**40**	**56**	**71**	**90**	**125**

Control device

				28	**40**	**56**	**71**	**90**	**125**	
04	Without control module			●	●	●	●	●	●	**NV**
	Proportional control, hydraulic	Pilot-pressure related p = 6 to 18 bar		●	●	●	●	●	●	**HD3**
		Mechanical servo		●	●	▨ ●	▨ ●	●	●	**HW**
	Proportional control, electric		U = 12 V	●	▨ ●	▨ ●	▨ ●	▨ ●	▨ ●	**EP3**
			U = 24 V	●	●	●	●	▨ ●	▨ ●	**EP4**
	Two-point control, electric		U = 12 V	●	●	●	●	●	●	**EZ1**
			U = 24 V	●	●	●	●	●	●	**EZ2**
	Automatic control, speed related		U = 12 V	▨ ●	▨ ●	▨ ●	▨ ●	●	●	**DA1**
			U = 24 V	●	●	●	●	▨ ●	●	**DA2**
	Hydraulic control, direct operated			●	●	●	●	●	●	**DG**
	Electric control, direct operated, two pressure reducing valves		U = 12 V	●	●	●	●	–	–	**ET5**
			U = 24 V	●	●	●	●	–	–	**ET6**

Pressure cut-off

05	Pressure cut-off (standard)	**D**

Neutral position switch

06	Without neutral position switch (without code)	▨ ●	
	Neutral position switch (for HW control only)	●	**L**

Mechanical stroke limiter

07	Without mechanical stroke limiter (without code)	▨ ●	
	Mechanical stroke limiter, externally adjustable	●	**M**

Stroking chamber pressure port

08	Without stroking chamber pressure port $\mathbf{X}_3$, $\mathbf{X}_4$ (without code)	▨ ●	
	Stroking chamber pressure port $\mathbf{X}_3$, $\mathbf{X}_4$	●	**T**

DA control valve

			NV	**HD**	**HW**	**DG**	**DA**	**EP**	**EZ**	
09	Without DA control valve		▨ ●	▨ ●	▨ ●	▨ ●	–	▨ ●	▨ ●	**1**
	DA control valve, fixed setting		–	●	●	●	▨ ●	●	–	**2**
	DA control valve, mechanically adjustable with position lever	direction of actuation, clockwise	–	●	●	●	●	●	–	**3R**
		direction of actuation, counter-clockwise	–	●	●	●	●	●	–	**3L**
	DA control valve, fixed setting, ports for pilot control device		–	●	●	–	●	●	–	**7**
	DA control valve, fixed setting and brake inch valve mounted, control with brake fluid	based on mineral oil	–	–	–	–	●	–	–	**8**

● = Available ○ = On request – = Not available ▨ = Preferred program

01	02	03	04	05	06	07	08	09		10	11		12	13	14	15	16	17	18	19	20	21	22
A4V	**G**			**D**					**/**	**32**		–	**N**										

Series

10	Series 3, index 2	**32**

Direction of rotation

11	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Sealing material

12	NBR (nitrile rubber), shaft seal in FKM (fluoroelastomer)	**N**

Drive shaft			28	40	56	71	90	125	
13	Splined shaft DIN 5480	for single pump	●	●	●	●	●	●	**Z**
		for combination pump – 1st pump	–[1]	●	●	●	●	●	**A**
	Splined shaft ANSI B92.1a	for single pump	●	●	●	●	●	●	**S**
		for combination pump – 1st pump	–[2]	–[2]	●	●	–[2]	●	**T**
		only for combination pump – 2nd pump	–	●	–	–	●	–	**U**

Mounting flange			28	40	56	71	90	125	
14	SAE J744	2-hole	●	●	●	–	–	–	**C**
		2+4-hole	–	–	–	●	●	●	**F**

Working port			28	40	56	71	90	125	
15	SAE working port **A** and **B**, top and bottom	Suction port **S** bottom	–	●	●	●	●	●	**02**
	SAE working port **A** and **B**, top and bottom	Suction port **S** top	–	●	●	○	○	○	**03**
	SAE working port **A** and **B**, same side right[3]	Suction port **S** bottom	●	–	–	–	–	–	**10**
	SAE working port **A** and **B**, same side left[3]	Suction port **S** bottom	–	–	–	●	○	●	
	SAE working port **A** and **B**, same side right[3]	Suction port **S** top	–	–	–	○	○	○	**13**
	SAE working port **A** and **B**, same side left[3]	Suction port **S** top	●	–	●	–	–	–	

Boost pump

16	Without integrated boost pump	without through drive	**N**
		with through drive	**K**
	Integrated boost pump	with and without through drive	**F**

Through drive			28	40	56	71	90	125	
17	Without through drive, versions N and F (no. 16) only		●	●	●	●	●	●	**00**
	Flange SAE J744[4]	Hub for splined shaft							
	82-2 (A)	5/8 in 9T 16/32DP[5]	●	●	●	●	●	●	**01**
	101-2 (B)	7/8 in 13T 16/32DP[5]	●	●	●	●	●	●	**02**
		1 in 15T 16/32DP[5]	●	●	●	●	●	●	**04**
	127-2 (C)[6]	1 in 15T 16/32DP[5]	–	●	–	–	–	–	**09**
		1 1/4 in 14T 12/24DP[5]	–	–	●	●	●	●	**07**
	152-2/4 (D)	W35 2×16×9 g[7]	–	–	–	–	●	–	**73**
		1 3/4 in 13T 8/16DP[5]	–	–	–	–	–	●	**69**

● = Available ○ = On request – = Not available ▨ = Preferred program

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[1] Standard for combination pump – 1st pump: Shaft Z

[2] Standard for combination pump – 1st pump: Shaft S

[3] Only possible without attachment filter

[4] 2 = 2-hole; 4 = 4-hole

[5] Hub for splined shaft to ANSI B92.1a

[6] NG90 to 125 with additional 4-hole-flange (127-4)

[7] Hub for splined shaft according to DIN 5480.

01	02	03	04	05	06	07	08	09		10	11		12	13	14	15	16	17	18	19	20	21	22
A4V	**G**			**D**					**/**	**32**		–	**N**										

High-pressure relief valve

		Setting range Δp		28	40	56	71	90	125	
18	High pressure relief valve, pilot operated	100 to 420 bar	with bypass	–	–	–	●	●	●	**1**
	High-pressure relief valve, direct operated, fixed setting	250 to 420 bar	without bypass	●	●	●	–	–	–	**3**
			with bypass	●	●	●	–	–	–	**5**
		100 to 250 bar	without bypass	●	●	●	–	–	–	**4**
			with bypass	●	●	●	–	–	–	**6**

Filtration boost circuit/external boost pressure supply

		28	40	56	71	90	125	
19	Filtration in the boost pump suction line	●	●	●	●	●	●	**S**
	Filtration in the boost pump pressure line Ports for external boost circuit filtration ($\mathbf{F}_e$ and $\mathbf{F}_a$)	●	●	●	●	●	●	**D**
	Attachment filter with cold start valve	–	●	●	●	●	●	**F**
	Attachment filter with cold start valve and visual contamination indicator	–	●	●	●	●	●	**P**
	Attachment filter with cold start valve and electric contamination indicator	–	●	●	●	●	●	**B**
	External boost pressure supply (version without integrated boost pump - N00, K...)	●	●	●	●	●	●	**E**

Swivel angle sensor

20	Without swivel angle sensor (without code)	●	
	Electric swivel angle sensor[8]	●	**R**

Connector for solenoids[9]

21	Without connector (without code), only for purely hydraulic control		●	
	DEUTSCH molded connector, 2-pin	without suppressor diode	●	**P**
		with suppressor diode (only for EZ and DA)	●	**Q**

Standard / special version

22	Standard version	without code	
		combined with attachment part or attachment pump	**-K**
	Special version		**-S**
		combined with attachment part or attachment pump	**-SK**

● = Available ○ = On request – = Not available ▨ = Preferred program

Notice

- ▶ Note the project planning notes on page 70.
- ▶ In addition to the type code, please specify the relevant technical data when placing your order.

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[8] Please contact us if the swivel angle sensor is used for control

[9] Connectors for other electric components may deviate

Hydraulic fluids

The A4VG variable pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)
- 90225: Axial piston units for operation with water-free and water-containing fire-resistant hydraulic fluids (HFDR, HFDU, HFAE, HFAS, HFB, HFC).

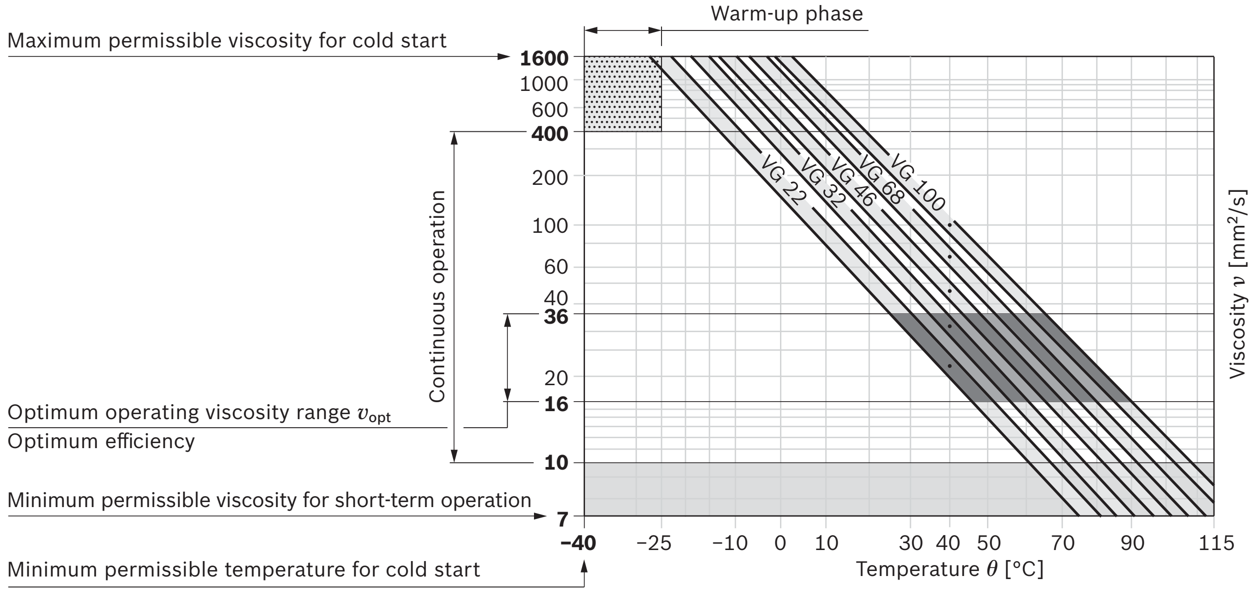
Notes on selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see selection diagram).

Notice
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
Please contact us if the above conditions cannot be met due to extreme operating parameters.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \leq 1600$ mm²/s	$\theta_{St} \geq -40$ °C	$t \leq 3$ min, $n \leq 1000$ min^{-1}, without load $p \leq 50$ bar
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid in the system
Warm-up phase	ν = 1600 to 400 mm²/s	θ = −40 °C to −25 °C	at $p \leq 0.7 \times p_{nom}$, $n \leq 0.5 \times n_{nom}$ and $t \leq 15$ min
Continuous operation	ν = 400 to 10 mm²/s		this corresponds, for VG 46 for example, to a temperature range of +5 °C to +85 °C (see selection diagram below)
		θ = −25 °C to +110 °C	measured at port **T** Observe the permissible temperature range of the shaft seal (ΔT = approx. 5 K between bearing/shaft seal and port **T**)
	ν_{opt} = 36 to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \geq 7$ mm²/s		$t < 3$ min, $p < 0.3 \times p_{nom}$

▼ **Selection diagram**



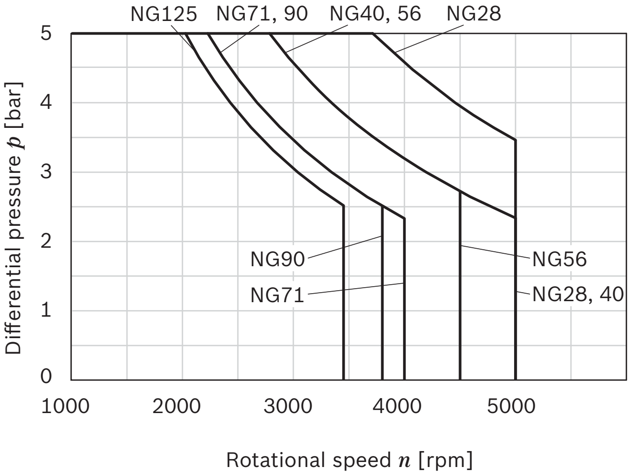
Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.
A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.
Depending on the system and the application, for the A4VG we recommend: Filter elements $\beta_{20} \geq 100$.
At very high hydraulic fluid temperatures (90 °C to maximum 110 °C, measured at port T), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

Shaft seal

Permissible pressure loading

The service life of the shaft seal is influenced by the speed of the axial piston unit and the leakage pressure in the housing (case pressure). Momentary (t < 0.1 s) pressure peaks of up to 10 bar are allowed. The service life of the shaft seal decreases with increasing frequency of pressure peaks and increasing mean differential pressure.
The case pressure must be higher than the ambient pressure.

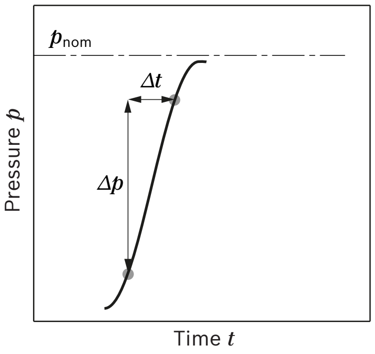


The FKM shaft seal ring may be used for leakage temperatures from −25 °C to +115 °C. For application cases below −25 °C, an NBR shaft seal is required (permissible temperature range: −40 °C to +90 °C).

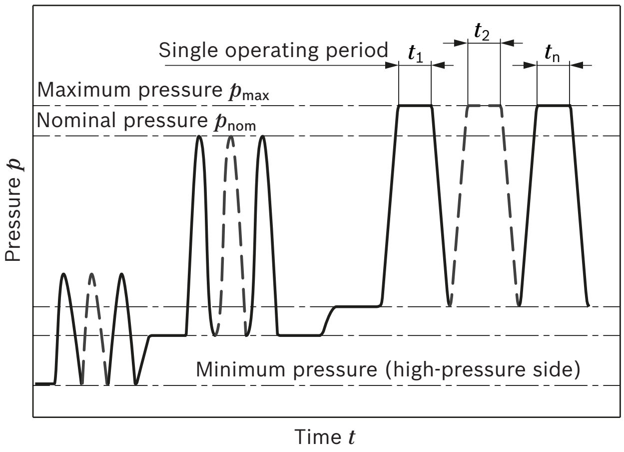
Working pressure range

Pressure at working port A or B		**Definition**
Nominal pressure p_{nom}	400 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	450 bar	The maximum pressure corresponds to the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure (high-pressure side)	25 bar	Minimum pressure at the high-pressure side (**A** or **B**) which is required to prevent damage to the axial piston unit.
Minimum pressure (low-pressure side)	10 bar above case pressure	Minimum pressure at the low-pressure side (**A** or **B**) which is required to prevent damage to the axial piston unit.
Rate of pressure change $R_{\text{A max}}$	9000 bar/s	Maximum permissible rate of pressure build-up and reduction during a pressure change across the entire pressure range.
Boost pump		
Nominal pressure $p_{\text{Sp nom}}$	25 bar	
Maximum pressure $p_{\text{Sp max}}$	40 bar	
Pressure at suction port **S** (inlet)		
Continuous $p_{\text{S min}}$ ($\nu \leq 30\ \text{mm}^2/\text{s}$)	≥ 0.8 bar absolute	
Momentary, during cold start ($t < 3$ min)	≥ 0.5 bar absolute	
Maximum pressure $p_{\text{S max}}$	≤ 5 bar absolute	
Control pressure		
Minimum control pressure $p_{\text{St min}}$		To ensure the function of the control, a minimum control pressure $p_{\text{St min}}$ at n = 2000 rpm is necessary depending on the rotational speed and working pressure
Controls EP, HD, HW	20 bar above case pressure	
Controls DA, DG, EZ, ET	25 bar above case pressure	

▼ **Rate of pressure change $R_{\text{A max}}$**



▼ **Pressure definition**



Total operating period = $t_1 + t_2 + \ldots + t_n$

Notice

Working pressure range valid when using hydraulic fluids based on mineral oils. Please contact us for values for other hydraulic fluids.

Technical data

Size			**NG**		**28**	**40**	**56**	**71**	**90**	**125**
Displacement, geometric, per revolution										
	variable pump		$V_{g\,max}$	cm³	28	40	56	71	90	125
	boost pump (at p = 20 bar)		$V_{g\,Sp}$	cm³	6.1	8.6	11.6	19.6	19.6	28.3
Rotational speed[1]	maximum at $V_{g\,max}$		n_{nom}	rpm	4250	4000	3600	3300	3050	2850
	limited, maximum[2]		n_{max1}	rpm	4500	4200	3900	3600	3300	3250
	intermittent, maximum[3]		n_{max2}	rpm	5000	5000	4500	4100	3800	3450
	minimum		n_{min}	rpm	500	500	500	500	500	500
Flow	at n_{nom} and $V_{g\,max}$		q_v	l/min	119	160	202	234	275	356
Power[4]	at n_{nom}, $V_{g\,max}$ and Δp = 400 bar		P	kW	79	107	134	156	183	238
Torque[4]	at $V_{g\,max}$ and	Δp = 400 bar	T	Nm	178	255	357	452	573	796
		Δp = 100 bar	T	Nm	45	64	89	113	143	199
Rotary stiffness of drive shaft		S	c	kNm/rad	31.4	69	80.8	98.8	158.1	218.3
		T	c	kNm/rad	–	–	95	120.9	–	252.1
		A	c	kNm/rad	–	79.6	95.8	142.4	176.8	256.5
		Z	c	kNm/rad	32.8	67.5	78.8	122.8	137	223.7
		U	c	kNm/rad	–	50.8	–	–	107.6	–
Moment of inertia for rotary group			J_{TW}	kgm²	0.0022	0.0038	0.0066	0.0097	0.0149	0.0232
Maximum angular acceleration[5]			α	rad/s²	38000	30000	24000	21000	18000	14000
Case volume			V	l	0.9	1.1	1.5	1.3	1.5	2.1
Weight (without through drive) approx.			m	kg	29	31	38	50	60	80

Notice

- ▶ Theoretical values, without efficiency and tolerances; values rounded
- ▶ Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommend testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.

Determining the operating characteristics			
Flow	q_v	$= \dfrac{V_g \times n \times \eta_v}{1000}$	[l/min]
Torque	T	$= \dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$	[Nm]
Power	P	$= \dfrac{2\,\pi \times T \times n}{60000} = \dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g	Displacement per revolution [cm³]
Δp	Differential pressure [bar]
n	Rotational speed [rpm]
η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

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1) The values are applicable:
   - – for the optimum viscosity range from n_{opt} = 36 to 16 mm²/s
   - – for hydraulic fluid based on mineral oils (for HF hydraulic fluids, observe the technical data in 90225)

2) Valid at half corner power (e.g. at $V_{g\,max}$ and $p_N/2$)

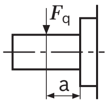
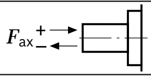
3) Valid at Δp = 70 to 150 bar or Δp < 300 bar and t < 0.1 s

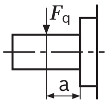
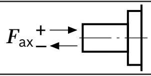
4) Without boost pump

5) The data are valid for values between the minimum required and maximum permissible rotational speed.
Valid for external excitation (e.g. diesel engine 2 to 8 times rotary frequency, cardan shaft twice the rotary frequency).
The limit value is only valid for a single pump.
The load capacity of the connecting parts must be considered.

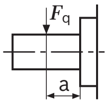
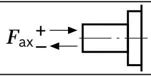
Permissible radial and axial forces on the drive shaft

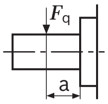
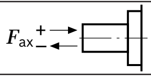
▼ Splined shaft DIN 5480

Size		NG		28	40	40	56	56	71
Drive shaft				W25	W30	W35	W30	W35	W35
Maximum radial force at distance a (from shaft collar)		$F_{q\ max}$	N	3030	3608	3092	5051	4329	5489
		a	mm	17.5	17.5	20	17.5	20	20
Maximum axial force		+ $F_{ax\ max}$	N	1557	2120	2120	2910	2910	4242
		− $F_{ax\ max}$	N	417	880	880	1490	1490	2758

Size		NG		71	90	90	125	125
Drive shaft				W40	W35	W45	W40	W45
Maximum radial force at distance a (from shaft collar)		$F_{q\ max}$	N	4803	6957	5411	8455	7516
		a	mm	22.5	20	25	22.5	25
Maximum axial force		+ $F_{ax\ max}$	N	4242	4330	4330	6053	6053
		− $F_{ax\ max}$	N	2758	2670	2670	3547	3547

▼ Splined shaft ANSI B92.1a

Size		NG		28	40	40	56	56	71
Drive shaft			in	1	1	1 1/4	1 1/4	1 3/8	1 1/4
Maximum radial force at distance a (from shaft collar)		$F_{q\ max}$	N	2983	4261	3409	4772	4338	6050
		a	mm	19	19	24	24	24	24
Maximum axial force		+ $F_{ax\ max}$	N	1557	2120	2120	2910	2910	4242
		− $F_{ax\ max}$	N	417	880	880	1490	1490	2758

Size		NG		71	90	90	125	125
Drive shaft			in	1 3/8	1 1/4	1 3/4	1 3/4	2
Maximum radial force at distance a (from shaft collar)		$F_{q\ max}$	N	5500	7670	5478	7609	6658
		a	mm	24	24	33.5	33.5	40
Maximum axial force		+ $F_{ax\ max}$	N	4242	4330	4330	6053	6053
		− $F_{ax\ max}$	N	2758	2670	2670	3547	3547

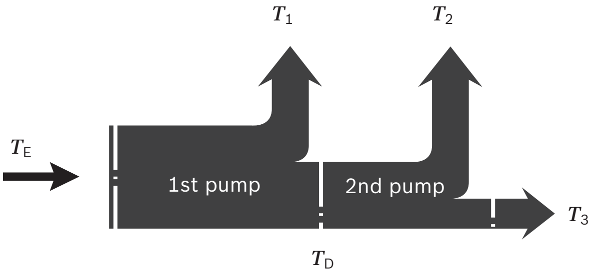
Notice

- ▶ The axial and radial forces generally influence the service life of the bearings.
- ▶ Special requirements apply in the case of belt drive and cardan shaft. Please contact us.

Permissible input and through-drive torques

Size		NG		28	40	56	71	90	125
Torque at $V_{g\,max}$ and Δp = 400 bar[1]		T	Nm	178	255	357	452	573	796
Maximum input torque at drive shaft[2]									
DIN 5480	Z	$T_{E\,max}$	Nm	352	522	522	912	912	1460
				W25	W30	W30	W35	W35	W40
	A	$T_{E\,max}$	Nm	–	912	912	1460	2190	2190
					W35	W35	W40	W45	W45
ANSI B92.1a (SAE J744)	S	$T_{E\,max}$	Nm	314	602	602	602	1640	1640
			in	1	1 1/4	1 1/4	1 1/4	1 3/4	1 3/4
	T	$T_{E\,max}$	Nm	–	–	970	970	–	2670
			in	–	–	1 3/8	1 3/8	–	2
	U[3]	$T_{E\,max}$	Nm	–	314	–	–	602	–
			in	–	1	–	–	1 1/4	–
Maximum through-drive torque[4]		$T_{D\,max}$	Nm	231	314	521	660	822	1110

▼ **Distribution of torques**



Torque at 1st pump	T_1		
Torque at 2nd pump	T_2		
Torque at 3rd pump	T_3		
Input torque	T_E	=	$T_1 + T_2 + T_3$
	T_E	<	$T_{E\,max}$
Through-drive torque	T_D	=	$T_2 + T_3$
	T_D	<	$T_{D\,max}$

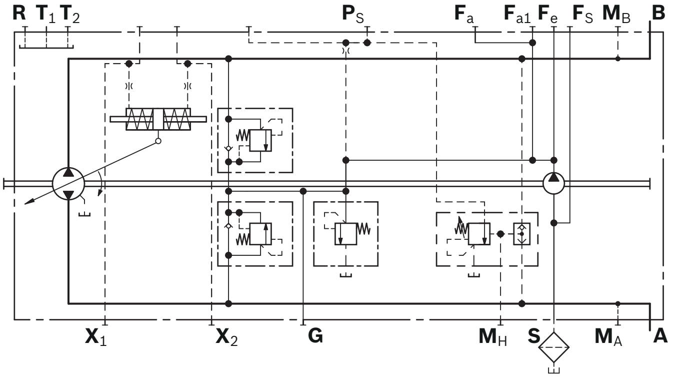
---

1) Efficiency not considered
2) For drive shafts free of radial force
3) Shaft “U” is only permitted as drive shaft on the 2nd pump on a combination pump of the same size.
4) Note maximum input torque for shaft S!

NV – Version without control module

The mounting surface for the control module is machined and sealed with the standard seal for control modules and a cover plate. This version is ready for retrofitting to control modules (HD, HW, EP, EZ). When used directly for “DA” control and in combinations with “DA” control, the appropriate adjustments must be made to the spring assembly of the adjustment cylinder and control plate.

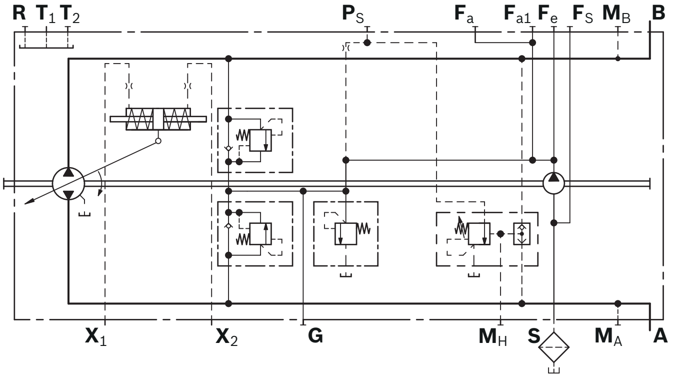
▼ **Standard version**[1)]



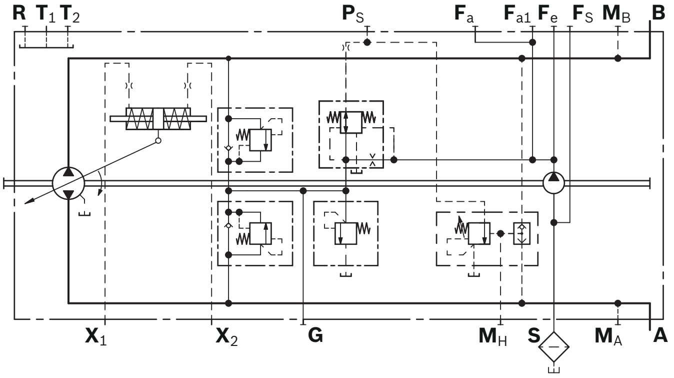
DG – Hydraulic control, direct operated

With the direct operated hydraulic control (DG), the output flow of the pump is controlled by a hydraulic control pressure, applied directly to the stroking piston through either port $\mathbf{X_1}$ or $\mathbf{X_2}$.
Flow direction is determined by which control pressure port is pressurized (refer to table below).
Pump displacement is infinitely variable and proportional to the applied control pressure, but is also influenced by system pressure and pump drive speed.
In order to use the optional built-in pressure cut-off, port $\mathbf{P_S}$ must be used as the control pressure source for the selected control module.
See page 56 for a functional description of the pressure cut-off.
Maximum permissible control pressure: 40 bar
Use of the DG control requires a review of the engine and vehicle parameters to ensure that the pump is set up correctly. We recommend that all DG applications be reviewed by a Bosch Rexroth application engineer.
If the pump is also equipped with a DA control valve (see page 19), automotive operation is possible for travel drives.

▼ **Standard version**[1)]



▼ **Version with DA control valve**[1)]



Correlation of direction of rotation, control and flow direction								
Direction of rotation	clockwise				counter-clockwise			
Size	28 to 56		71 to 125		28 to 56		71 to 125	
Control pressure	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$
Flow direction	**A to B**	**B to A**	**B to A**	**A to B**	**B to A**	**A to B**	**A to B**	**B to A**
Working pressure	$\mathbf{M_B}$	$\mathbf{M_A}$	$\mathbf{M_A}$	$\mathbf{M_B}$	$\mathbf{M_A}$	$\mathbf{M_B}$	$\mathbf{M_B}$	$\mathbf{M_A}$

[1)] Size 28 without port $\mathbf{F_{a1}}$ and $\mathbf{F_S}$

HD – Proportional control, hydraulic, pilot-pressure related

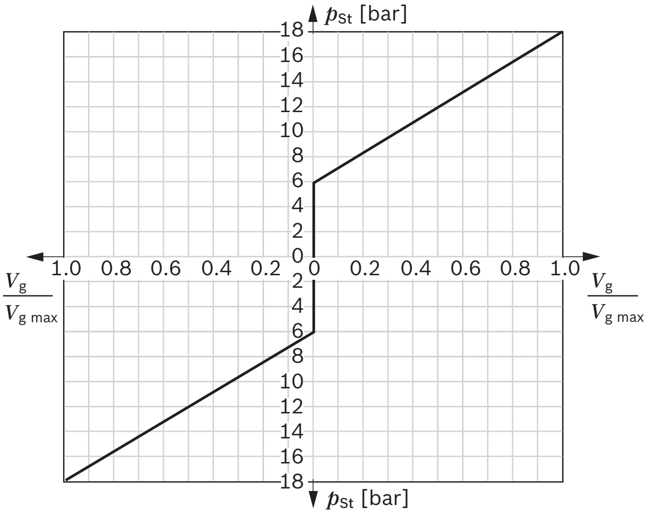
The output flow of the pump is infinitely variable between 0 and 100%, proportional to the difference in pilot pressure applied to the two pilot pressure ports (**Y**$_1$ and **Y**$_2$).

The pilot signal, coming from an external source, is a pressure signal. Flow is negligible, as the pilot signal acts only on the control spool of the control valve.

This control spool then directs control oil into and out of the stroking cylinder to adjust pump displacement as required.

A feedback lever connected to the stroking piston maintains the pump flow for any given pilot signal within the control range.

If the pump is also equipped with a DA control valve (see page 19), automotive operation is possible for travel drives.

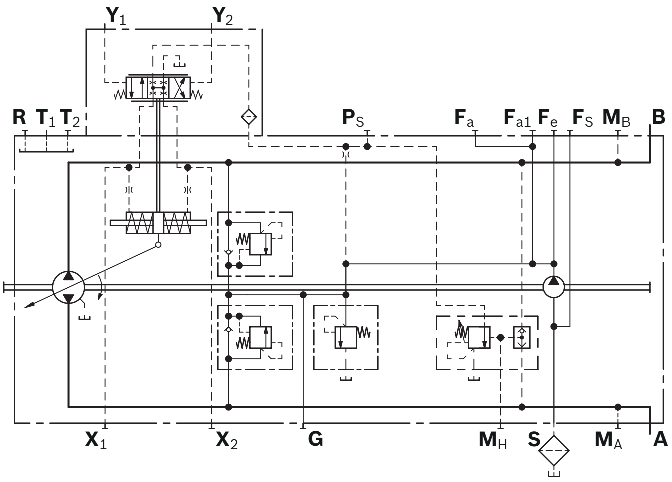


- V_g = Displacement at p_{St}
  $V_{g\,max}$ = Displacement at p_{St} = 18 bar
- Pilot signal p_{St} = 6 to 18 bar (at port **Y**$_1$, **Y**$_2$)
- Start of control at 6 bar
- End of control at 18 bar (maximum displacement $V_{g\,max}$)

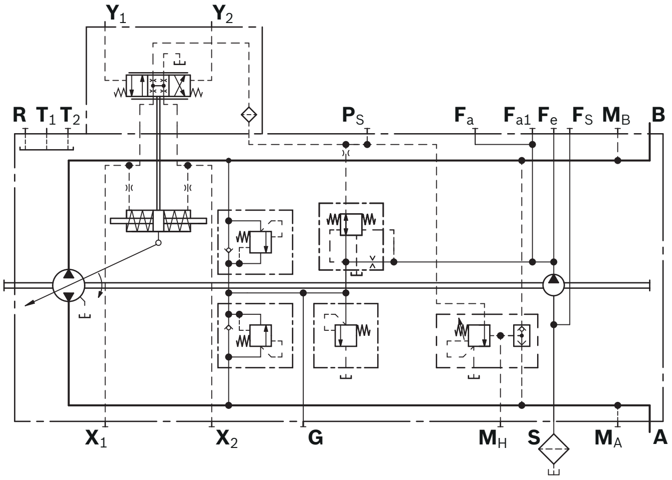
Notice

In the neutral position, the HD control module must be vented to reservoir via the external pilot control device.

▼ **Standard version**[1)]



▼ **Version with DA control valve**[1)]



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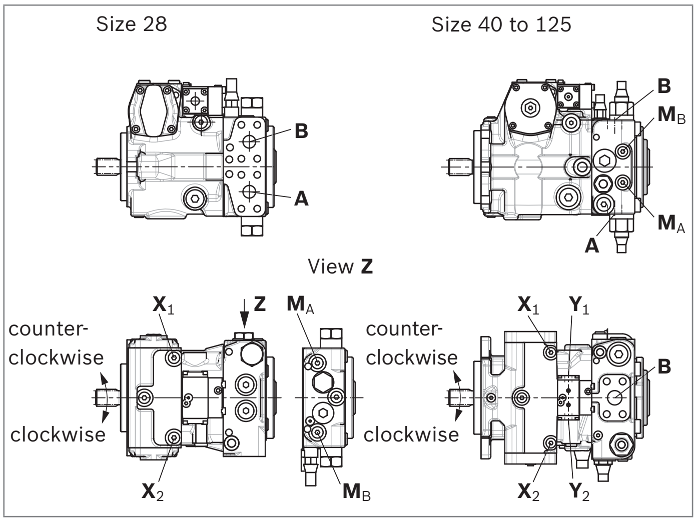
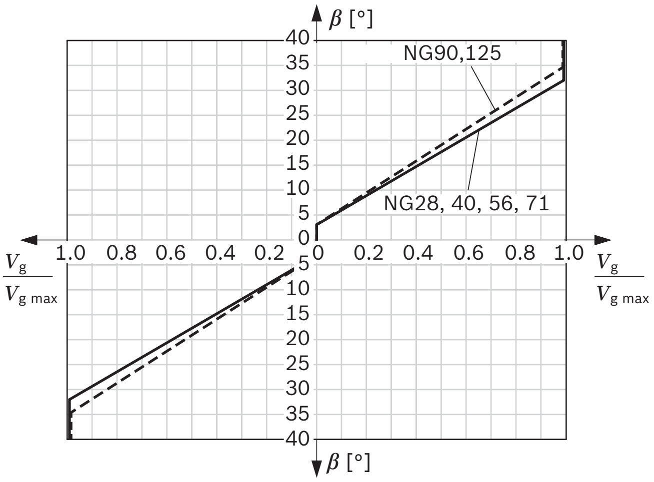
1) Size 28 without port **F**$_{a1}$ and **F**$_S$

Correlation of direction of rotation, control and flow direction								
Direction of rotation	clockwise				counter-clockwise			
Size	28 to 56		71 to 125		28 to 56		71 to 125	
Pilot signal	$\mathbf{Y_1}$	$\mathbf{Y_2}$	$\mathbf{Y_1}$	$\mathbf{Y_2}$	$\mathbf{Y_1}$	$\mathbf{Y_2}$	$\mathbf{Y_1}$	$\mathbf{Y_2}$
Control pressure	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$
Flow direction	**A** to **B**	**B** to **A**	**B** to **A**	**A** to **B**	**B** to **A**	**A** to **B**	**A** to **B**	**B** to **A**
Working pressure	$\mathbf{M_B}$	$\mathbf{M_A}$	$\mathbf{M_A}$	$\mathbf{M_B}$	$\mathbf{M_A}$	$\mathbf{M_B}$	$\mathbf{M_B}$	$\mathbf{M_A}$



HW – Proportional control, hydraulic, mechanical servo

The output flow of the pump is infinitely variable between 0 and 100%, proportional to the swivel angle of the control lever.
A feedback lever connected to the stroking piston maintains the pump flow for any given position of the control lever.
If the pump is also equipped with a DA control valve (see page 19), automotive operation is possible for travel drives.



Swivel angle β at the control lever for pump displacement change:

- Start of control at β = ±3°
- End of control at β (max. displacement $V_{g\,max}$)
  - Size 28 to 71 at ±32°
  - Size 90 to 125 at ±34.5°
- Rotational limit β of the control lever (internal) ±38°

The maximum required torque at the lever is 170 Ncm. To prevent damage to the HW control module, a positive mechanical stop of 36.5° ± 1 must be provided for the HW control lever on the customer side.

Notice

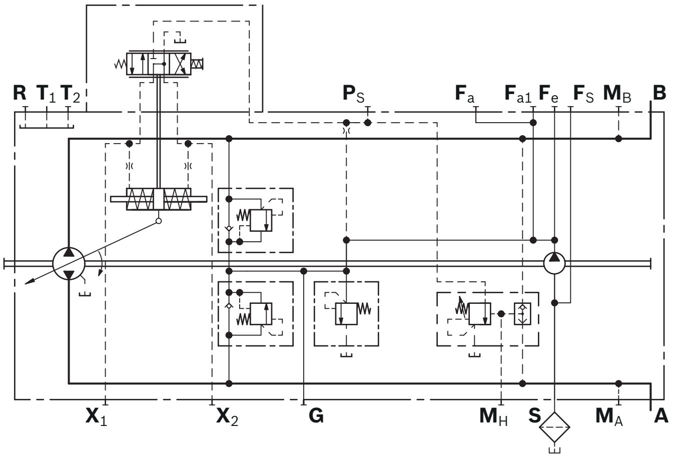
- Spring centering enables the pump, depending on pressure and speed, to move automatically to the neutral position (V_g = 0) as soon as there is no longer any torque on the control lever of the HW control module.
- If necessary, the position of the lever can be changed. The procedure is defined in the instruction manual.
- On delivery, the position of the lever may differ from that shown in the drawing.

Option: Neutral position switch

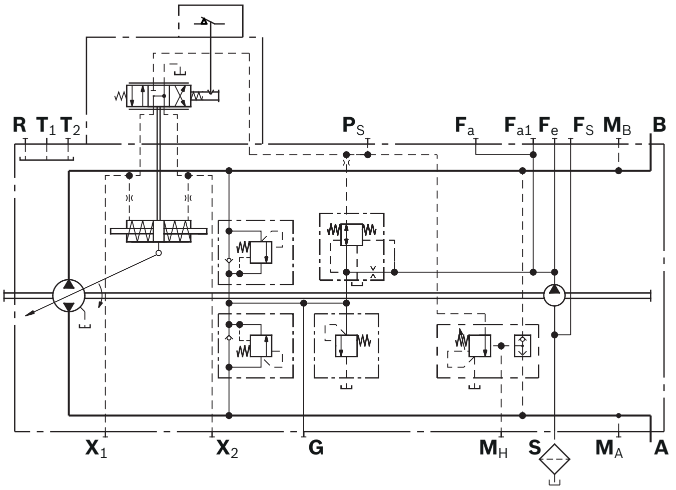
The switch contact in the neutral position switch is closed when the control lever on the HW control module is in its neutral position. The switch opens when the control lever is moved out of the central position in either direction. Thus, the neutral position switch provides a monitoring function for drive units that require the pump to be in the neutral position during certain operating conditions (e.g. starting diesel engines).

Technical Data	
Load capacity	20 A (continuous), without switching operations
Switching capacity	15 A / 32 V (resistive load)
	4 A / 32 V (inductive load)
Connector version	DEUTSCH DT04-2P-EP04 (mating connector, see page 64)

▼ **Standard version**[1)]



▼ **Version with DA control valve and neutral position switch**[1)]



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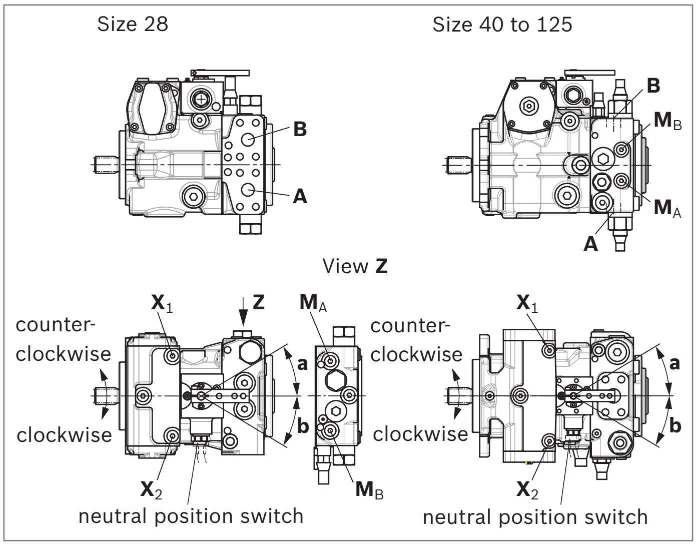
1) Size 28 without port $\mathbf{F}_{a1}$ and $\mathbf{F}_S$

Correlation of direction of rotation, control and flow direction

Direction of rotation	clockwise				counter-clockwise			
Size	28 to 56		71 to 125		28 to 56		71 to 125	
Lever direction	**a**	**b**	**a**	**b**	**a**	**b**	**a**	**b**
Control pressure	$\mathbf{X}_2$	$\mathbf{X}_1$	$\mathbf{X}_2$	$\mathbf{X}_1$	$\mathbf{X}_2$	$\mathbf{X}_1$	$\mathbf{X}_2$	$\mathbf{X}_1$
Flow direction	**B** to **A**	**A** to **B**	**A** to **B**	**B** to **A**	**A** to **B**	**B** to **A**	**B** to **A**	**A** to **B**
Working pressure	$\mathbf{M}_A$	$\mathbf{M}_B$	$\mathbf{M}_B$	$\mathbf{M}_A$	$\mathbf{M}_B$	$\mathbf{M}_A$	$\mathbf{M}_A$	$\mathbf{M}_B$



EP – Proportional control, electric

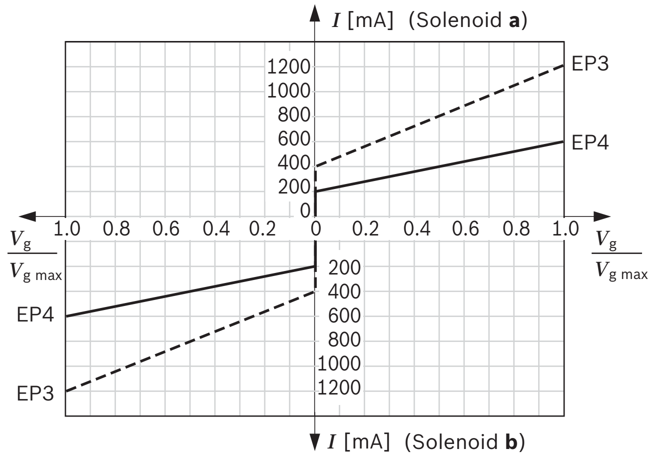
The output flow of the pump is infinitely variable between 0 and 100%, proportional to the electrical current supplied to solenoid **a** or **b**.

The electrical energy is converted into a force acting on the control spool.

This control spool then directs control oil into and out of the stroking cylinder to adjust pump displacement as required.

A feedback lever connected to the stroking piston maintains the pump flow for any given current within the control range.

If the pump is also equipped with a DA control valve (see page 19), automotive operation is possible for travel drives.



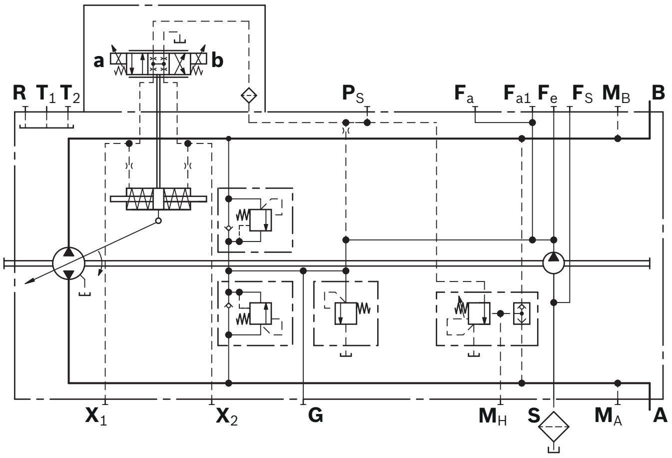
Notice

The proportional solenoids do not have manual override. Proportional solenoids with manual override and spring return are available on request.

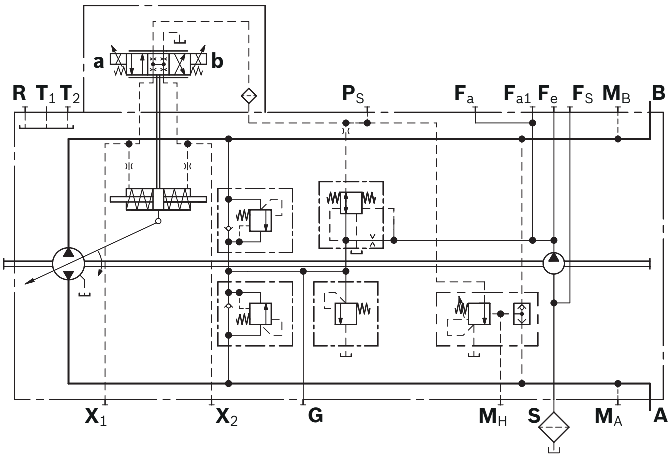
Technical data, solenoid	EP3	EP4
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at $V_g = 0$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither		
Frequency	100 Hz	100 Hz
Minimum oscillation range[1]	240 mA	120 mA
Duty cycle	100%	100%
Type of protection: see connector version page 64		

Various BODAS controllers with application software and amplifiers are available for controlling the proportional solenoids.

▼ **Standard version**[2]



▼ **Version with DA control valve**[2]



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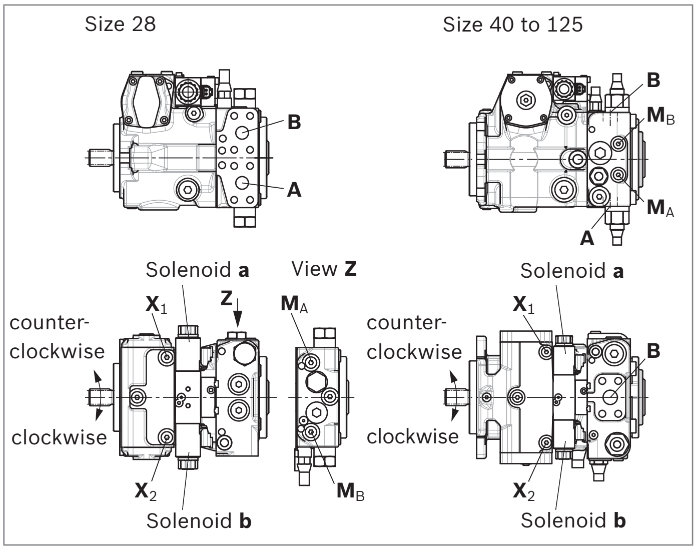
[1] Minimum required oscillation range of the control current $\Delta I_{p\text{-}p}$ (peak to peak) within the respective control range (start of control to end of control)

[2] Size 28 without port $\mathbf{F}_{a1}$ and $\mathbf{F}_S$

Correlation of direction of rotation, control and flow direction								
Direction of rotation	clockwise				counter-clockwise			
Size	28 to 56		71 to 125		28 to 56		71 to 125	
Actuation of solenoid	**a**	**b**	**a**	**b**	**a**	**b**	**a**	**b**
Control pressure	$\mathbf{X}_1$	$\mathbf{X}_2$	$\mathbf{X}_1$	$\mathbf{X}_2$	$\mathbf{X}_1$	$\mathbf{X}_2$	$\mathbf{X}_1$	$\mathbf{X}_2$
Flow direction	**A** to **B**	**B** to **A**	**B** to **A**	**A** to **B**	**B** to **A**	**A** to **B**	**A** to **B**	**B** to **A**
Working pressure	$\mathbf{M}_B$	$\mathbf{M}_A$	$\mathbf{M}_A$	$\mathbf{M}_B$	$\mathbf{M}_A$	$\mathbf{M}_B$	$\mathbf{M}_B$	$\mathbf{M}_A$



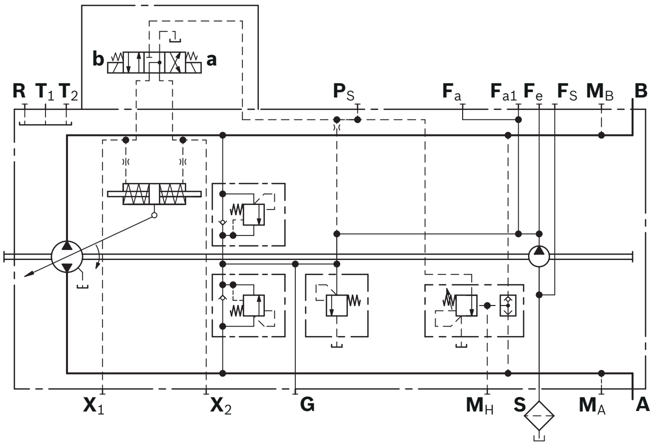
EZ – Two-point control, electric

By actuating either switching solenoid **a** or **b**, internal control pressure is applied directly to the stroking piston and the pump swivels to maximum displacement. The EZ control enables pump flow to be switched between $V_g = 0$ and $V_{g\,max}$.

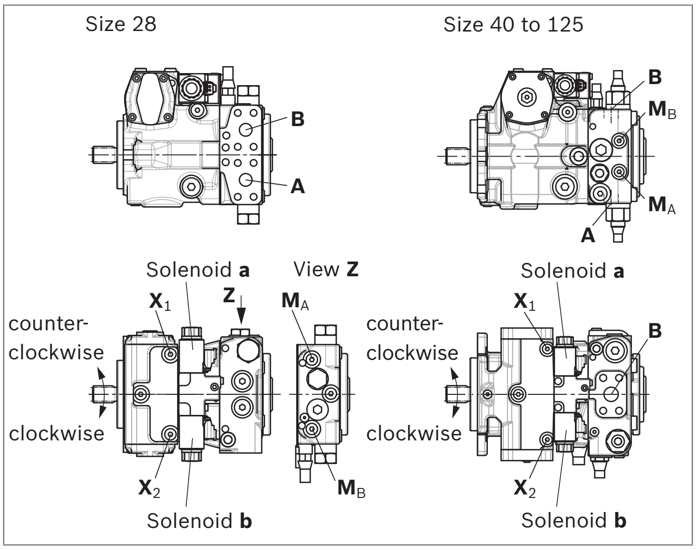
Flow direction is determined by which solenoid is energized.

Technical data, solenoid	EZ1	EZ2
Voltage	12 V (±20%)	24 V (±20%)
Neutral position $V_g = 0$	de-energized	de-energized
Position $V_{g\,max}$	energized	energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum active current required	1.32 A	0.67 A
Duty cycle	100%	100%
Type of protection: see connector version page 64		

▼ **Standard version**1)



Correlation of direction of rotation, control and flow direction								
Direction of rotation	clockwise				counter-clockwise			
Size	28 to 56		71 to 125		28 to 56		71 to 125	
Actuation of solenoid	**a**	**b**	**a**	**b**	**a**	**b**	**a**	**b**
Control pressure	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$
Flow direction	**B to A**	**A to B**	**A to B**	**B to A**	**A to B**	**B to A**	**B to A**	**A to B**
Working pressure	$\mathbf{M_A}$	$\mathbf{M_B}$	$\mathbf{M_B}$	$\mathbf{M_A}$	$\mathbf{M_B}$	$\mathbf{M_A}$	$\mathbf{M_A}$	$\mathbf{M_B}$



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1) Size 28 without port $\mathbf{F}_{a1}$ and $\mathbf{F}_S$

DA – Automatic control, speed related

The DA closed loop control is an engine speed-dependent system for travel drives. The built-in DA control valve generates a pilot pressure that is proportional to pump (engine) drive speed. This pilot pressure is directed to the stroking cylinder of the pump by an electromagnetically actuated 4/3-way directional valve. The pump displacement is infinitely variable in each flow direction and is influenced by both pump drive speed and system pressure. The flow direction (e.g. machine moving forward or backward) is determined by either solenoid **a** or **b** being activated.
Increasing the pump drive speed generates a higher pilot pressure from the DA control valve, with a subsequent increase in pump flow.
Depending on the selected pump operating characteristics, increasing system pressure (e.g. machine load) causes the pump to swivel back towards a smaller displacement. An overload protection for the engine (against stalling) is achieved by combining this pressure-dependent reduction in pump stroke with a reduction in pilot pressure as the engine speed drops.
Any additional power requirement, e.g. for hydraulic functions from attachments, could cause the engine speed to drop further. This will cause a further reduction in pilot pressure and thus of the pump displacement. Automatic power distribution and full exploitation of the available power are achieved in this way, both for the travel drive and for the implement hydraulics, with priority given to the implement hydraulics.
Various override options are available for DA control function to allow controlled operation of the implement hydraulics with high rpm at reduced vehicle speed.
The DA control valve can also be used in pumps with EP, DG, HW and HD control modules to protect the combustion engine against overload.

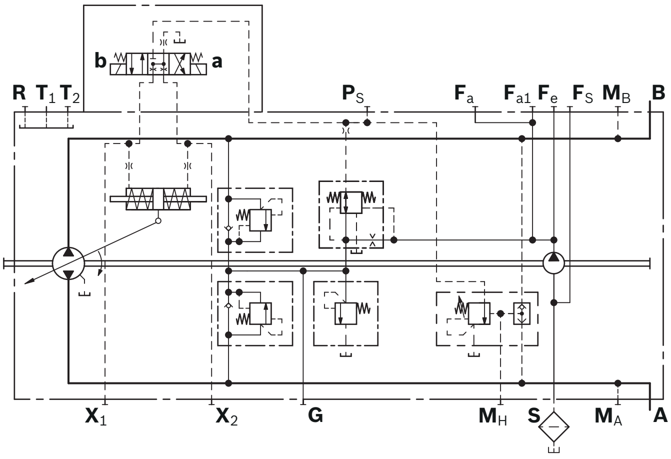
Notice
DA closed loop control is only suitable for certain types of travel drive systems and requires review of the engine and vehicle parameters to ensure that the pump is used correctly and that machine operation is safe and efficient.
We recommend that all DA applications be reviewed by a Bosch Rexroth application engineer.

Technical data, solenoid	DA1	DA2
Voltage	12 V (±20%)	24 V (±20%)
Neutral position $V_g = 0$	de-energized	de-energized
Position $V_{g\ max}$	energized	energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required active current	1.32 A	0.67 A
Duty cycle	100%	100%
Type of protection: see connector version page 64		

DA..2 – DA control valve, fixed setting

Pilot pressure is generated in relation to drive speed.

▼ **DA control valve, fixed setting, DA**1D**2**/**DA**2D**2**[1)]



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1) Size 28 without port $\mathbf{F}_{a1}$ and $\mathbf{F}_S$

DA..3 – DA control valve, mechanically adjustable with position lever

Pilot pressure is generated in relation to drive speed.
Any reduction of pilot pressure possible, independently of drive speed, through mechanical actuation of the position lever (inch function).
The maximum permissible actuation torque at the position lever is $T_{\max}$ = 4 Nm.
Maximum angle of rotation 70°, lever position: any.

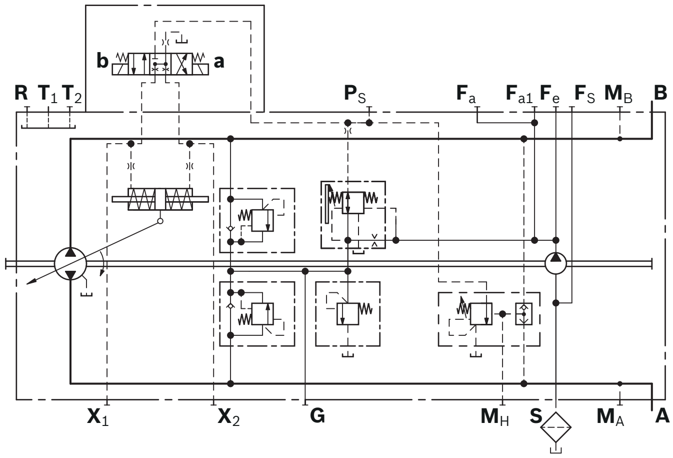
DA..3R

Direction of actuation of the position lever: clockwise

DA..3L

Direction of actuation of the position lever: counter-clockwise

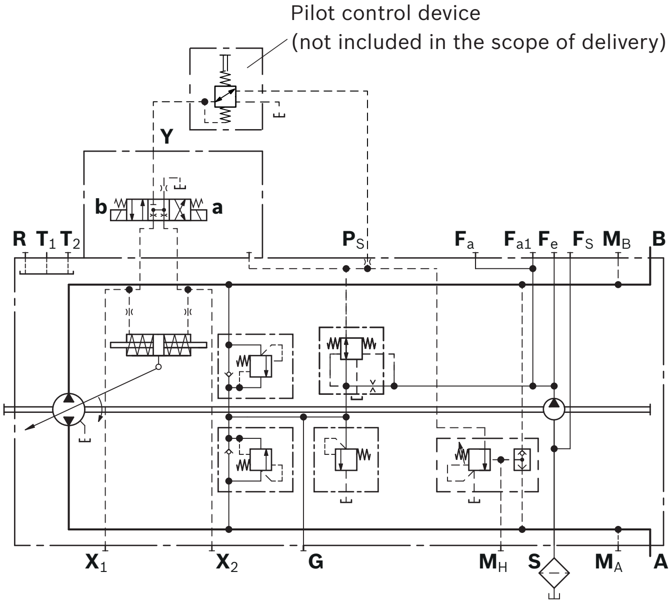
▼ **Circuit diagram DA**1D**3/DA**2D**3**1)



DA..7 – DA control valve, fixed setting, ports for pilot control device as inch valve

Any reduction of the pilot pressure possible, independent of the drive speed is achieved by the mechanical actuation of the pilot control device.
The pilot control device is installed separately from the pump (for example in the driver's cabin) and connected to the pump by two hydraulic control lines via ports **P**$_{S}$ and **Y**.
A suitable pilot control device must be ordered separately and is not included in the scope of delivery.
Note: Rotary inch valves, see page 65.

▼ **Circuit diagram DA**1D**7/DA**2D**7**1)



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1) Size 28 without port **F**$_{a1}$ and **F**$_{S}$

DA..8 – DA control valve, fixed setting and brake inch valve mounted

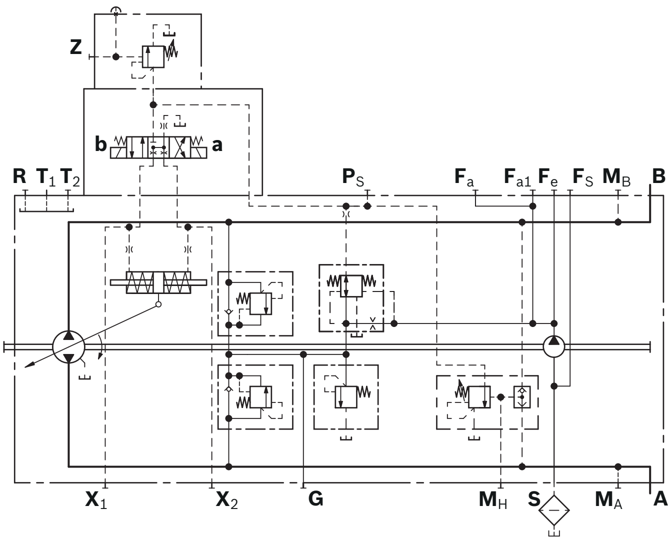
Only for pumps with DA control module

- Version with throttle valve size 28, 40, 56, 71
- Version with pressure reducing valve size 90, 125

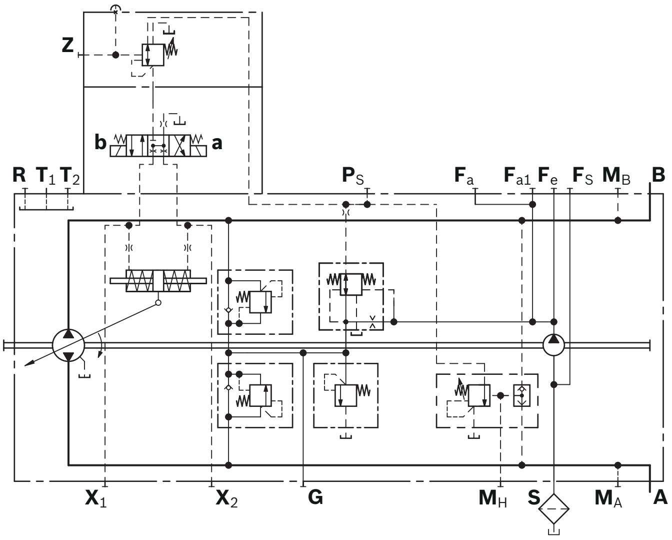
Permits reduction of the pilot pressure, independently of the drive speed via hydraulic control (port **Z**).

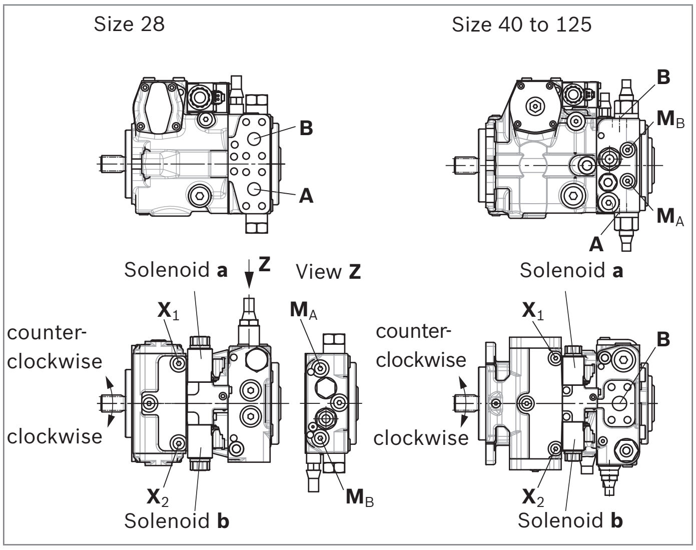
Control at port **Z** by means of brake fluid based on mineral oil.

▼ **Circuit diagram DA**1D**8/DA**2D**8 with throttle valve**[1]



▼ **Circuit diagram DA**1D**8/DA**2D**8 with pressure reducing valve**[1]





Correlation of direction of rotation, control and flow direction								
Direction of rotation	clockwise				counter-clockwise			
Size	28 to 56		71 to 125		28 to 56		71 to 125	
Actuation of solenoid	**a**	**b**	**a**	**b**	**a**	**b**	**a**	**b**
Control pressure	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$
Flow direction	**B to A**	**A to B**	**A to B**	**B to A**	**A to B**	**B to A**	**B to A**	**A to B**
Working pressure	$\mathbf{M_A}$	$\mathbf{M_B}$	$\mathbf{M_B}$	$\mathbf{M_A}$	$\mathbf{M_B}$	$\mathbf{M_A}$	$\mathbf{M_A}$	$\mathbf{M_B}$

---

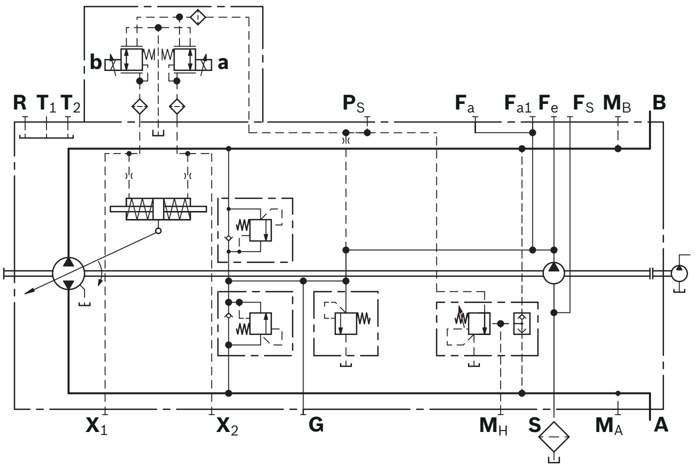
[1] Size 28 without port $\mathbf{F_{a1}}$ and $\mathbf{F_S}$

ET – Electric control, direct operated

The output flow of the pump is infinitely variable between 0 to 100%. Depending on the preselected current **I** at solenoids **a** and **b** of the pressure reducing valves, the stroking cylinder of the pump is proportionally supplied with control pressure. The two control pressures $\mathbf{X_1}$ and $\mathbf{X_2}$ can be controlled independently. The pump displacement that arises at a certain control current is dependent on the speed and working pressure of the pump. A different flow direction is associated with each pressure reducing valve. Maximum permissible control pressure $\mathbf{P_S}$: 40 bar.

Technical data, solenoid	ET5	ET6
Voltage	12 V (±20%)	24 V (±20%)
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither		
Frequency	100 Hz	100 Hz
Minimum oscillation range[1]	240 mA	120 mA
Duty cycle	100%	100%
Type of protection: see connector version page 64		

▼ **Standard version**[1]



Correlation of direction of rotation, control and flow direction								
Direction of rotation	clockwise				counter-clockwise			
Size	28 to 56		71		28 to 56		71	
Actuation of solenoid	**a**	**b**	**a**	**b**	**a**	**b**	**a**	**b**
Control pressure	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$
Flow direction	**B to A**	**A to B**	**A to B**	**B to A**	**A to B**	**B to A**	**B to A**	**A to B**
Working pressure	$\mathbf{M_A}$	$\mathbf{M_B}$	$\mathbf{M_B}$	$\mathbf{M_A}$	$\mathbf{M_B}$	$\mathbf{M_A}$	$\mathbf{M_A}$	$\mathbf{M_B}$

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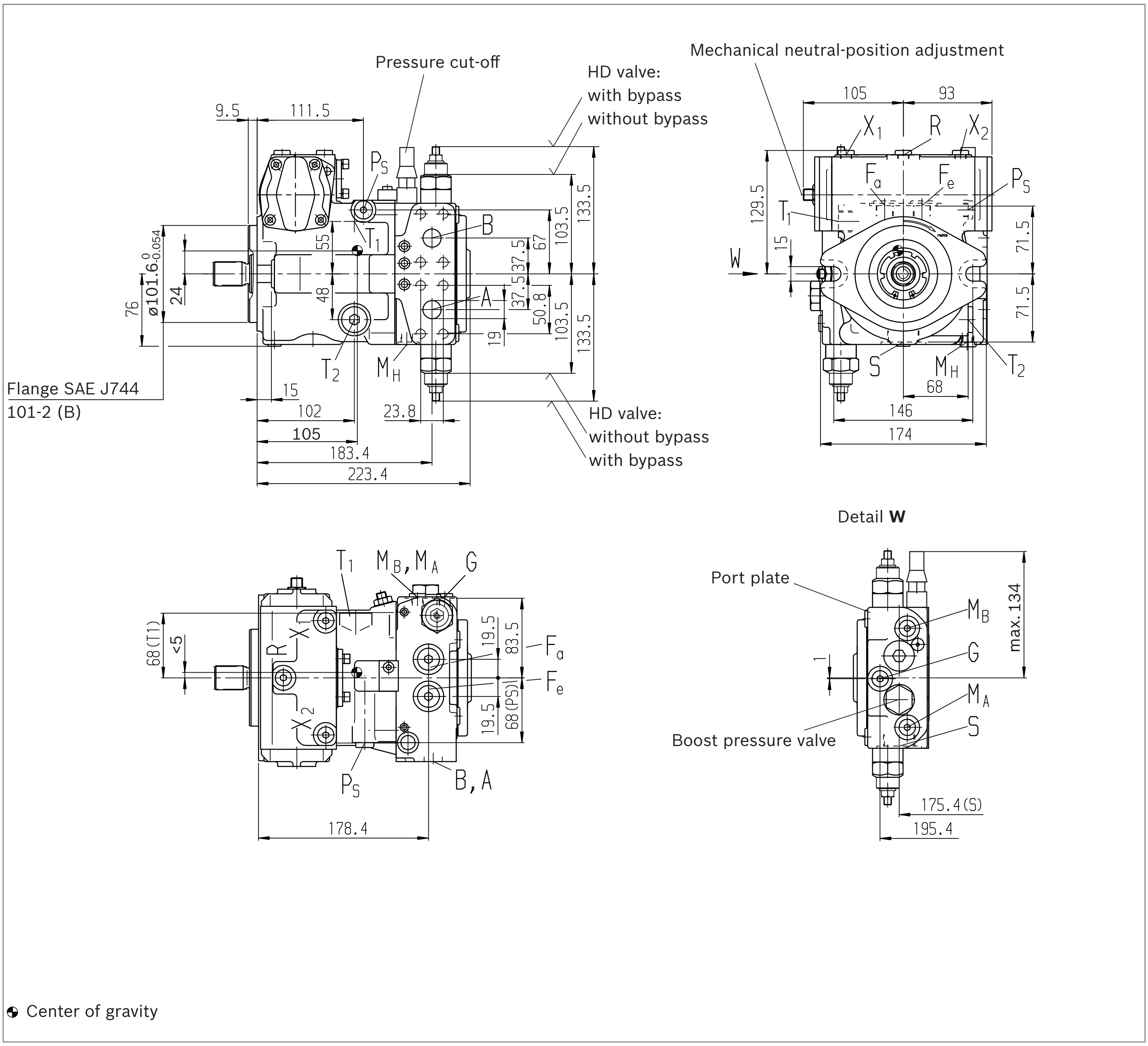
[1] Size 28 without port $\mathbf{F_{a1}}$ and $\mathbf{F_S}$

Dimensions, size 28

NV – Version without control module

Standard: SAE working port **A** and **B**, same side right, suction port **S** bottom (10)

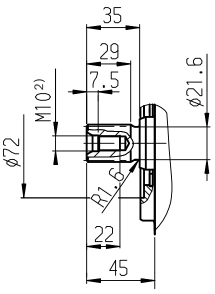


Notice

Option: SAE working port **A** and **B**, same side left, suction port **S** top (13): Port plate 10 rotated through 180°, installation drawing on request

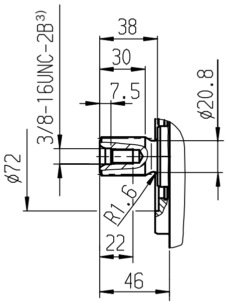
▼ **Splined shaft DIN 5480**

Z – W25×1.25×18×9 g



▼ **Splined shaft ANSI B92.1a**

S – 1 in 15T 16/32DP[1]



Ports		Standard	Size	$p_{\max}$ [bar][4]	State[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	3/4 in M10 × 1.5; 17 deep	450	O
S	Suction port	DIN 3852[8]	M33 × 2; 18 deep	5	O[6]
T$_1$	Drain port	DIN 3852[8]	M22 × 1.5; 14 deep	3	O[7]
T$_2$	Drain port	DIN 3852[8]	M22 × 1.5; 14 deep	3	X[7]
R	Air bleed port	DIN 3852[8]	M12 × 1.5; 12 deep	3	X
X$_1$, X$_2$	Control pressure port (upstream of orifice)	DIN 3852[8]	M12 × 1.5; 12 deep	40	X
X$_1$, X$_2$	Control pressure port (upstream of orifice, DG only)	DIN 3852[8]	M12 × 1.5; 12 deep	40	O
X$_3$, X$_4$[9]	Stroking chamber pressure port	DIN 3852[8]	M12 × 1.5; 12 deep	40	X
G	Boost pressure port inlet	DIN 3852[8]	M12 × 1.5; 12 deep	40	X
P$_S$	Pilot pressure port	DIN 3852[8]	M14 × 1.5; 12 deep	40	X
P$_S$	Pilot pressure port (DA..7 only)	DIN 3852[8]	M14 × 1.5; 12 deep	40	O
Y	Pilot pressure port outlet (DA..7 only)	DIN 3852[8]	M14 × 1.5; 12 deep	40	O
M$_A$, M$_B$	Measuring port pressure A, B	DIN 3852[8]	M12 × 1.5; 12 deep	450	X
M$_H$	Measuring port, high pressure	DIN 3852[8]	M12 × 1.5; 12 deep	450	X
F$_a$	Boost pressure port inlet	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
F$_e$	Boost pressure port outlet	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
Y$_1$, Y$_2$	Pilot pressure port (pilot signal HD only)	DIN 3852[8]	M14 × 1.5; 12 deep	40	O
Z	Pilot pressure port (inch signal DA..8 only)	DIN 3852[8]	M10 × 1; 8 deep	40	X

---

[1] Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Center bore according to DIN 332 (thread according to DIN 13)

[3] Thread according to ASME B1.1

[4] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

[5] Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

[6] Plugged at external boost pressure supply.

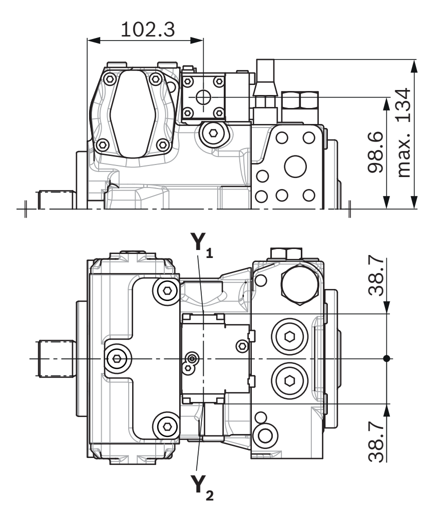
[7] Depending on installation position, **T$_1$** or **T$_2$** must be connected (see also installation instructions on page 67).

[8] The countersink can be deeper than as specified in the standard.

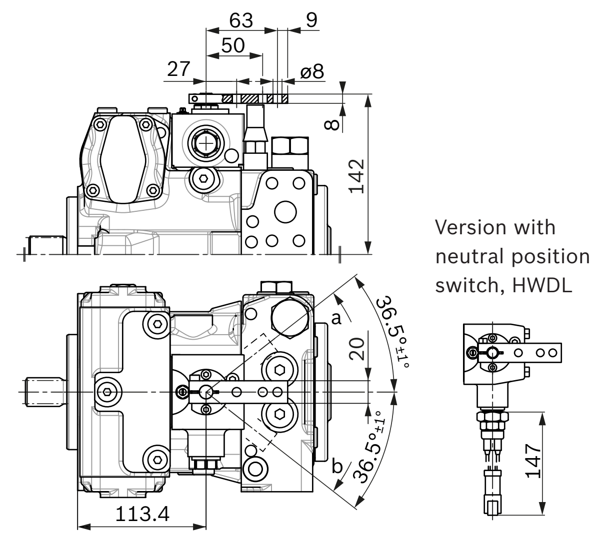
[9] Optional, see page 58

[10] O = Must be connected (plugged when delivered)
X = Plugged (observe installation instructions)

▼ **HD** – Proportional control, hydraulic, pilot-pressure related

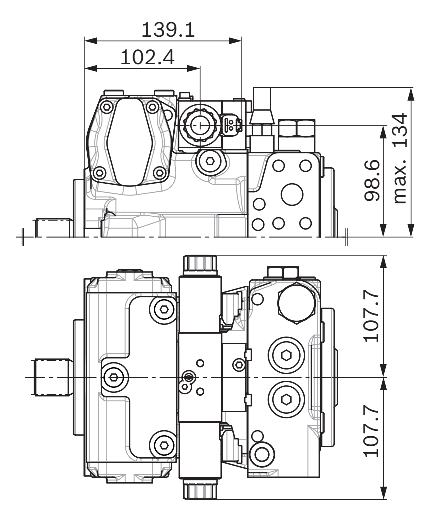


▼ **HW** – Proportional control, hydraulic, mechanical servo

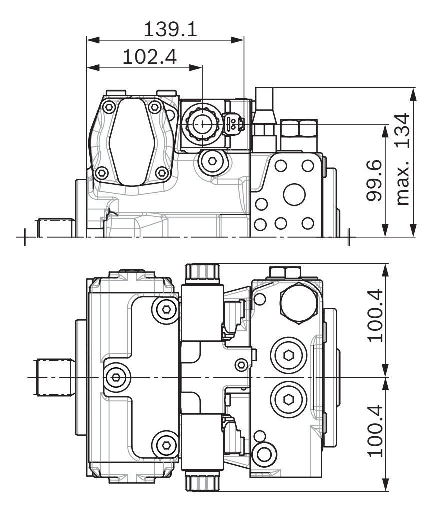


Version with
neutral position
switch, HWDL

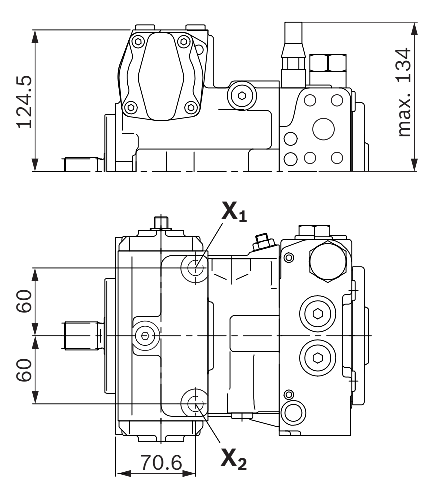
▼ **EP** – Proportional control, electric



▼ **EZ** – Two-point control, electric

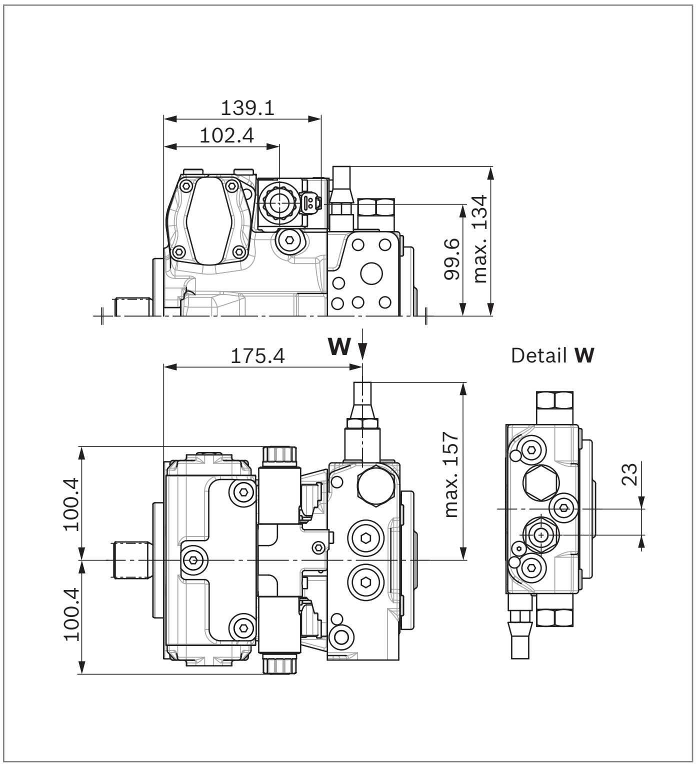


▼ **DG** – Hydraulic control, direct operated

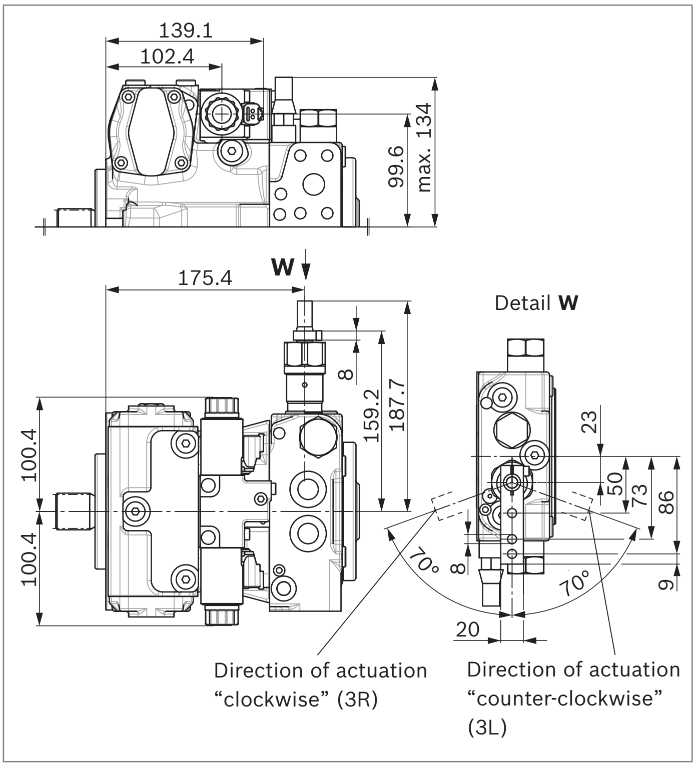


DA control valve

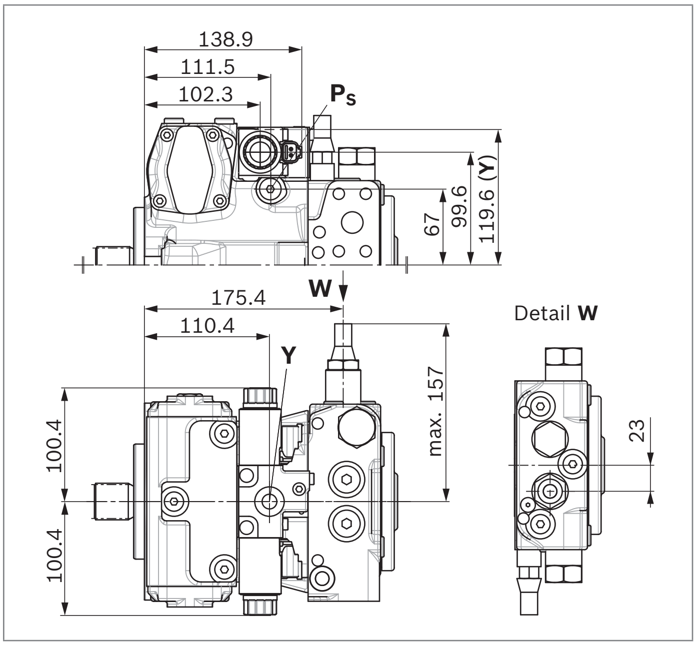
▼ **DA..2** – fixed setting



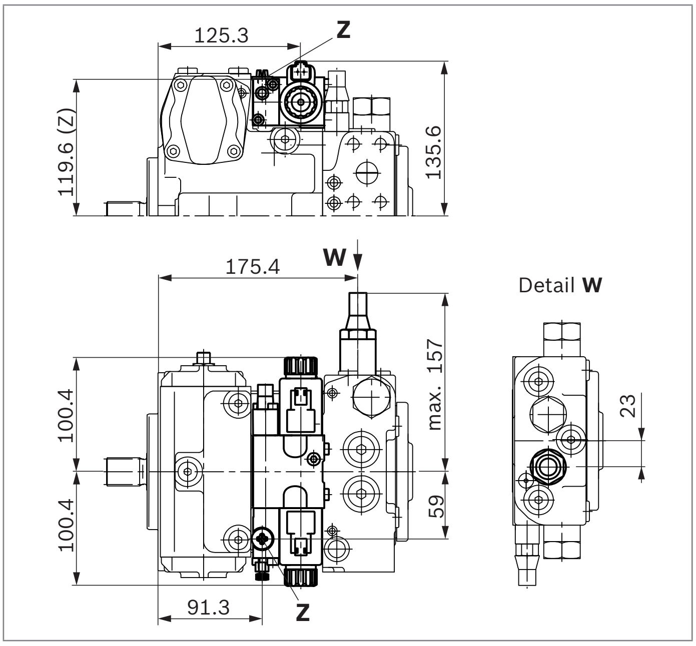
▼ **DA..3** – Mechanically adjustable with position lever



▼ **DA..7** – Fixed setting and ports for pilot control device



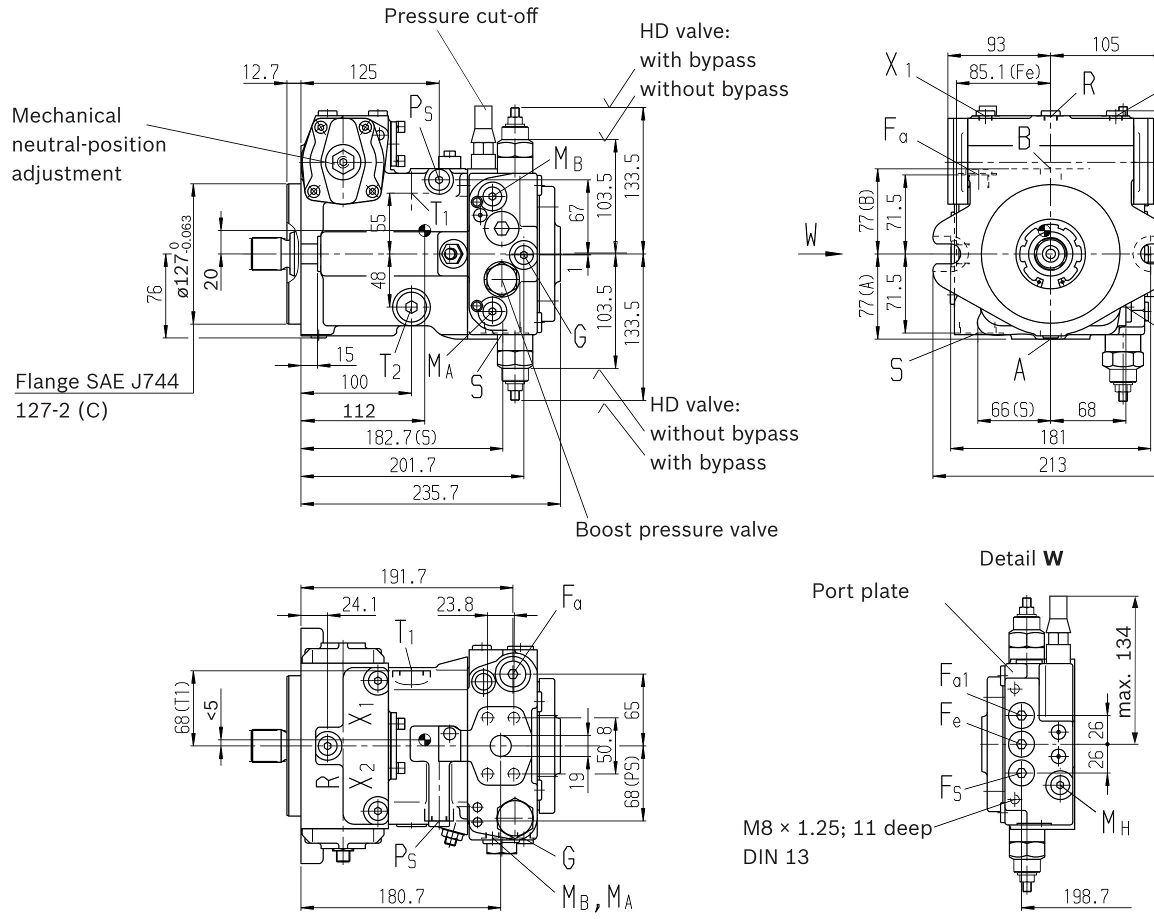
▼ **DA..8** – Fixed setting and inch valve mounted



Dimensions, size 40

NV – Version without control module

Standard: SAE working port **A** and **B** top and bottom, suction port **S** bottom (02)



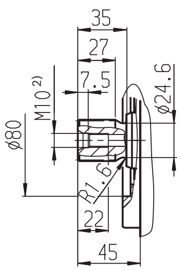
◐ Center of gravity

Notice

Option: SAE working port **A** and **B** top and bottom, suction port **S** top (03), port plate (02) rotated through 180°, installation drawing on request

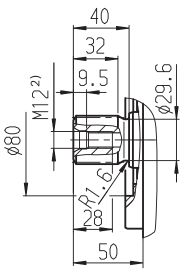
▼ Splined shaft DIN 5480

Z – W30×2×14×9 g



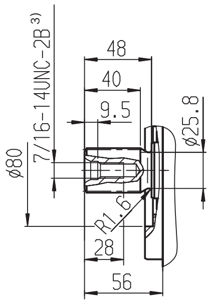
▼ Splined shaft DIN 5480

A – W35×2×16×9 g



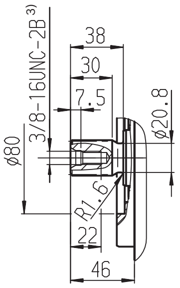
▼ Splined shaft ANSI B92.1a

S – 1 1/4 in 14T 12/24DP[1]



▼ Splined shaft ANSI B92.1a

U – 1 in 15T 16/32DP[1]



Ports		Standard	Size	p_{max} [bar][4]	State[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	3/4 in M10 × 1.5; 17 deep	450	O
S	Suction port	DIN 3852[8]	M33 × 2; 18 deep	5	O[6]
T_1	Drain port	DIN 3852[8]	M22 × 1.5; 14 deep	3	O[7]
T_2	Drain port	DIN 3852[8]	M22 × 1.5; 14 deep	3	X[7]
R	Air bleed port	DIN 3852[8]	M12 × 1.5; 12 deep	3	X
X_1, X_2	Control pressure port (upstream of orifice)	DIN 3852[8]	M12 × 1.5; 12 deep	40	X
X_1, X_2	Control pressure port (upstream of orifice, DG only)	DIN 3852[8]	M12 × 1.5; 12 deep	40	O
X_3, X_4[9]	Stroking chamber pressure port	DIN 3852[8]	M12 × 1.5; 12 deep	40	X
G	Boost pressure port inlet	DIN 3852[8]	M12 × 1.5; 12 deep	40	X
P_S	Pilot pressure port	DIN 3852[8]	M14 × 1.5; 12 deep	40	X
P_S	Pilot pressure port (DA..7 only)	DIN 3852[8]	M14 × 1.5; 12 deep	40	O
Y	Pilot pressure port outlet (DA..7 only)	DIN 3852[8]	M14 × 1.5; 12 deep	40	O
M_A, M_B	Measuring port pressure A, B	DIN 3852[8]	M12 × 1.5; 12 deep	450	X
M_H	Measuring port, high pressure	DIN 3852[8]	M12 × 1.5; 12 deep	450	X
F_a	Boost pressure port inlet	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
F_{a1}	Boost pressure port inlet (attachment filter)	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
F_e	Boost pressure port outlet	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
F_S	Line from filter to suction port (cold start)	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
Y_1, Y_2	Pilot pressure port (pilot signal HD only)	DIN 3852[8]	M14 × 1.5; 12 deep	40	O
Z	Pilot pressure port (inch signal DA..8 only)	DIN 3852[8]	M10 × 1; 8 deep	40	X

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Center bore according to DIN 332 (thread according to DIN 13)

3) Thread according to ASME B1.1

4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

5) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

6) Plugged at external boost pressure supply.

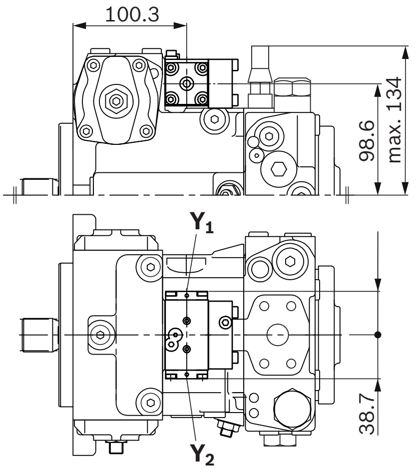
7) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 67).

8) The countersink can be deeper than as specified in the standard.

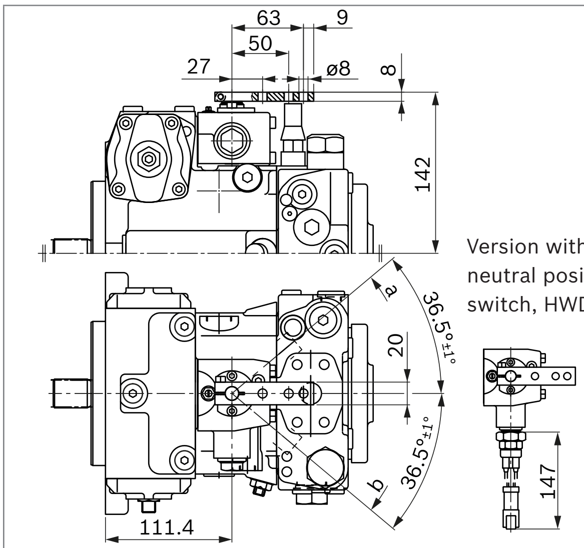
9) Optional, see page 58

10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

▼ **HD** – Proportional control, hydraulic, pilot-pressure related

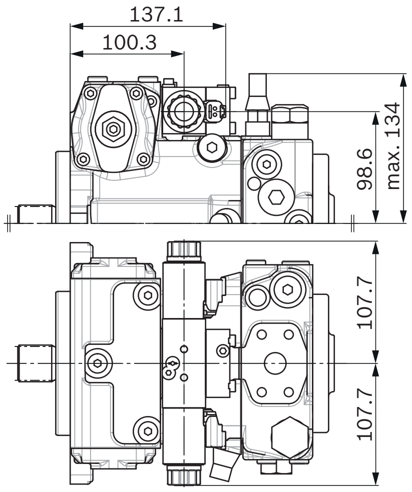


▼ **HW** – Proportional control, hydraulic, mechanical servo

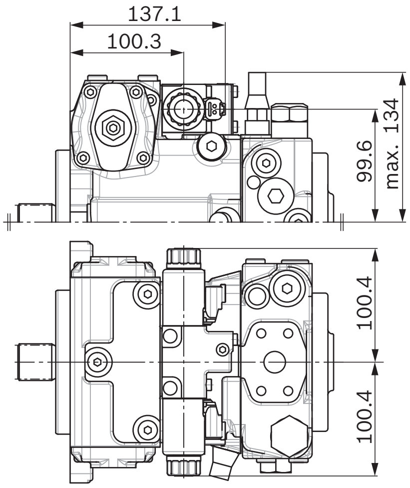


Version with neutral position switch, HWDL

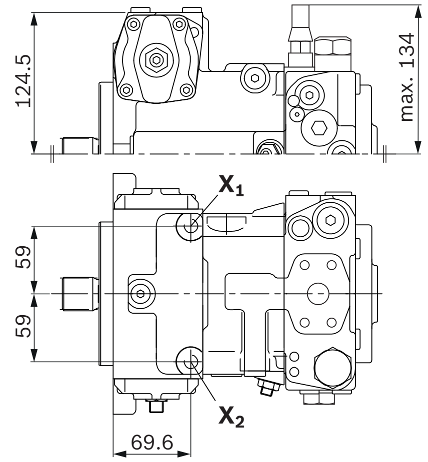
▼ **EP** – Proportional control, electric



▼ **EZ** – Two-point control, electric

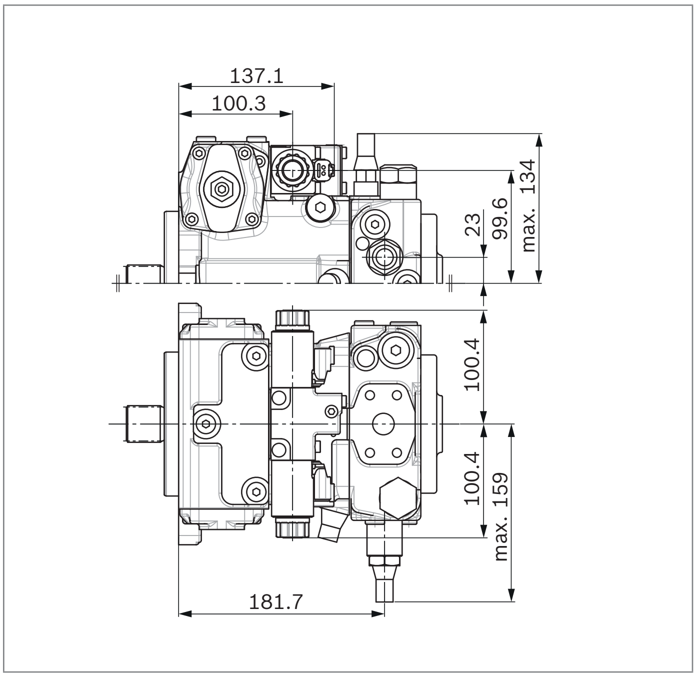


▼ **DG** – Hydraulic control, direct operated

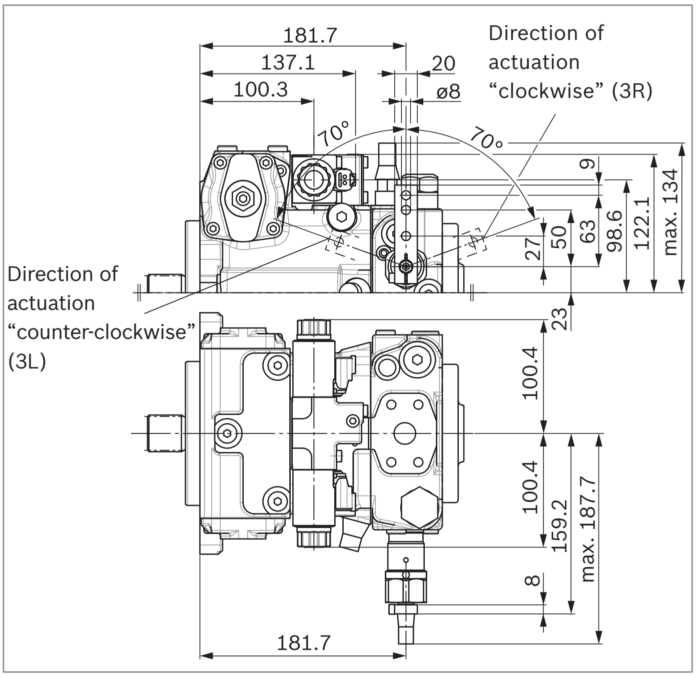


DA control valve

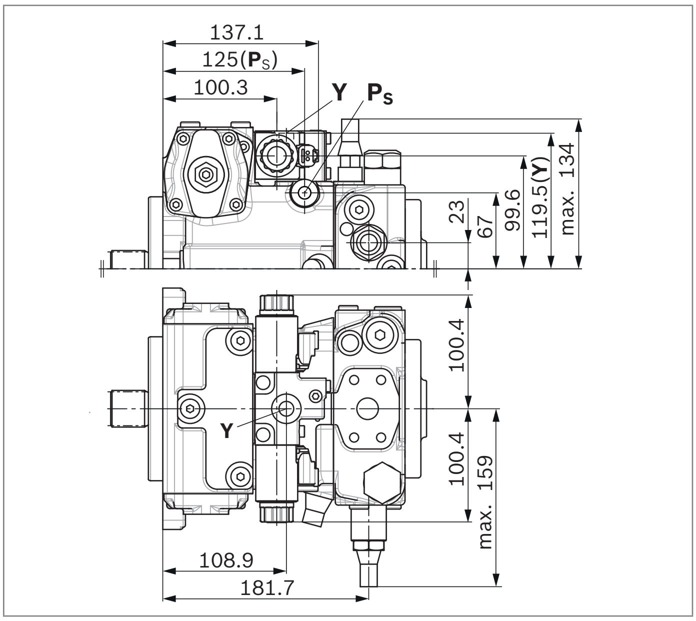
▼ **DA..2** – Fixed setting



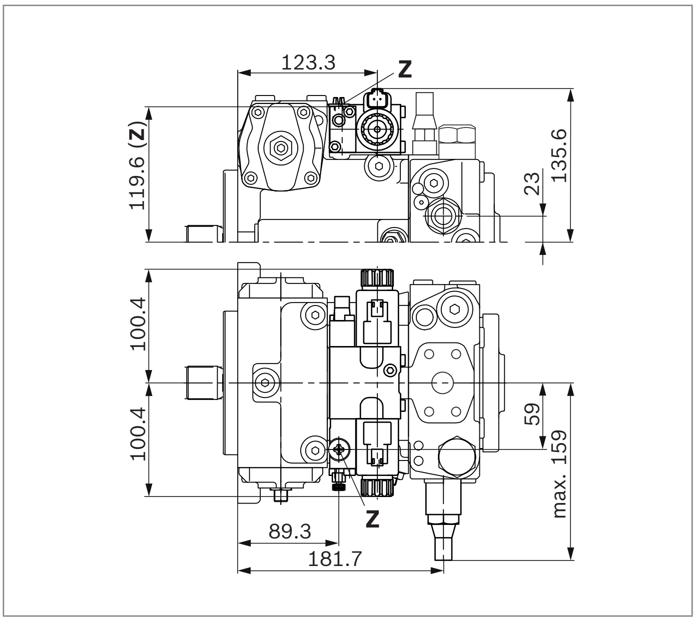
▼ **DA..3** – Mechanically adjustable with position lever



▼ **DA..7** – Fixed setting and ports for pilot control device



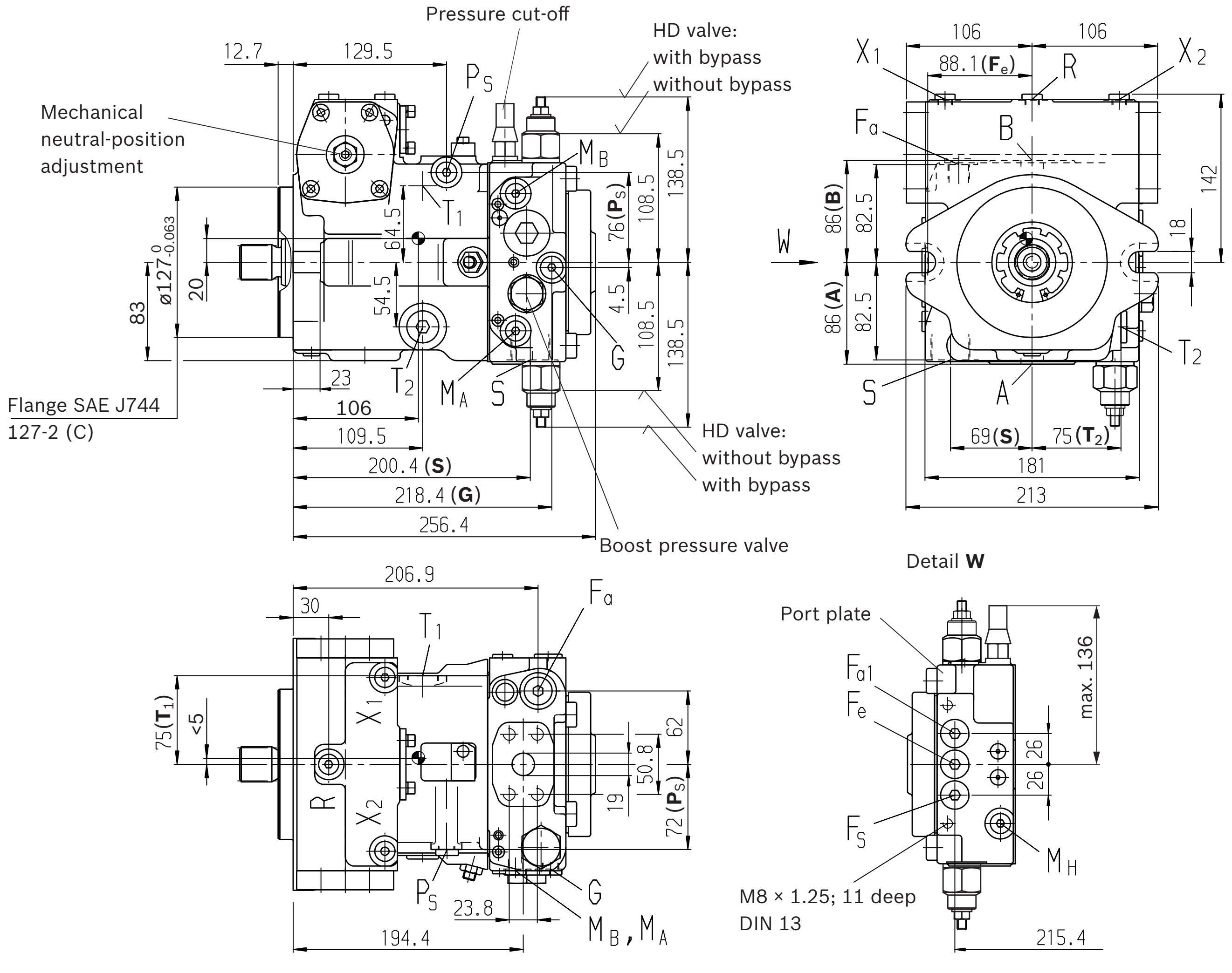
▼ **DA..8** – Fixed setting and inch valve mounted



Dimensions, size 56

NV – Version without control module

Standard: SAE working port **A** and **B** top and bottom, suction port **S** bottom (02)



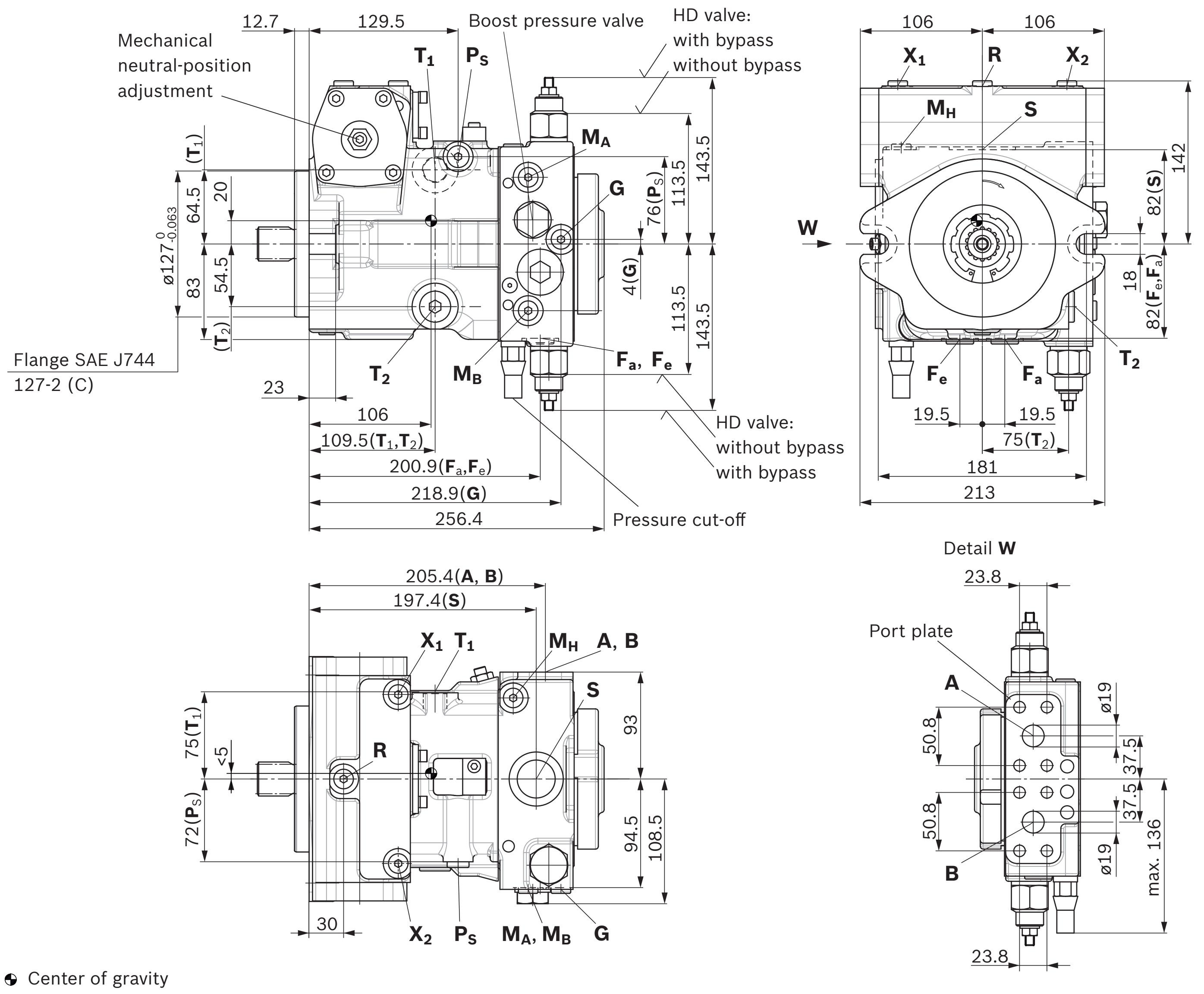
◐ Center of gravity

Notice

Option: SAE working port **A** and **B** top and bottom, suction port **S** top (03), port plate (02) rotated through 180°, installation drawing on request

NV – Version without control module

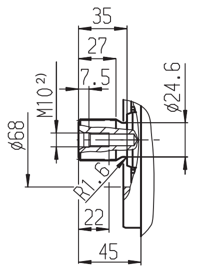
Option: SAE working port **A** and **B**, same side left, suction port **S** top (13)



◐ Center of gravity

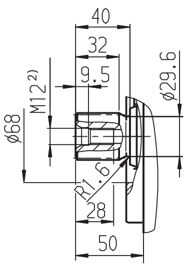
▼ **Splined shaft DIN 5480**

Z – W30×2×14×9 g



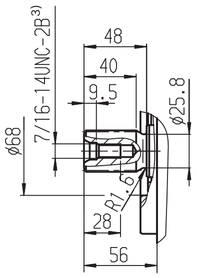
▼ **Splined shaft DIN 5480**

A – W35×2×16×9 g



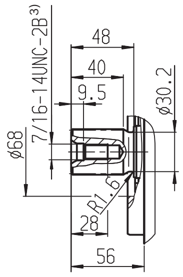
▼ **Splined shaft ANSI B92.1a**

S – 1 1/4 in 14T 12/24DP[1]



▼ **Splined shaft ANSI B92.1a**

T – 1 3/8 in 21T 16/32DP[1]



Ports		Standard	Size	p_{max} [bar][4]	State[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	3/4 in M10 × 1.5; 17 deep	450	O
S	Suction port	DIN 3852[8]	M33 × 2; 18 deep	5	O[6]
T_1	Drain port	DIN 3852[8]	M22 × 1.5; 14 deep	3	O[7]
T_2	Drain port	DIN 3852[8]	M22 × 1.5; 14 deep	3	X[7]
R	Air bleed port	DIN 3852[8]	M12 × 1.5; 12 deep	3	X
X_1, X_2	Control pressure port (upstream of orifice)	DIN 3852[8]	M12 × 1.5; 12 deep	40	X
X_1, X_2	Control pressure port (upstream of orifice, DG only)	DIN 3852[8]	M12 × 1.5; 12 deep	40	O
X_3, X_4[9]	Stroking chamber pressure port	DIN 3852[8]	M12 × 1.5; 12 deep	40	X
G	Boost pressure port inlet	DIN 3852[8]	M14 × 1.5; 12 deep	40	X
P_S	Pilot pressure port	DIN 3852[8]	M14 × 1.5; 12 deep	40	X
P_S	Pilot pressure port (DA..7 only)	DIN 3852[8]	M14 × 1.5; 12 deep	40	O
Y	Pilot pressure port outlet (DA..7 only)	DIN 3852[8]	M14 × 1.5; 12 deep	40	O
M_A, M_B	Measuring port pressure A, B	DIN 3852[8]	M12 × 1.5; 12 deep	450	X
M_H	Measuring port, high pressure	DIN 3852[8]	M12 × 1.5; 12 deep	450	X
F_a	Boost pressure port inlet	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
F_{a1}	Boost pressure port inlet (attachment filter)	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
F_e	Boost pressure port outlet	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
F_S	Line from filter to suction port (cold start)	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
Y_1, Y_2	Pilot pressure port (pilot signal HD only)	DIN 3852[8]	M14 × 1.5; 12 deep	40	O
Z	Pilot pressure port (inch signal DA..8 only)	DIN 3852[8]	M10 × 1; 8 deep	40	X

---

[1] Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Center bore according to DIN 332 (thread according to DIN 13)

[3] Thread according to ASME B1.1

[4] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

[5] Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

[6] Plugged at external boost pressure supply.

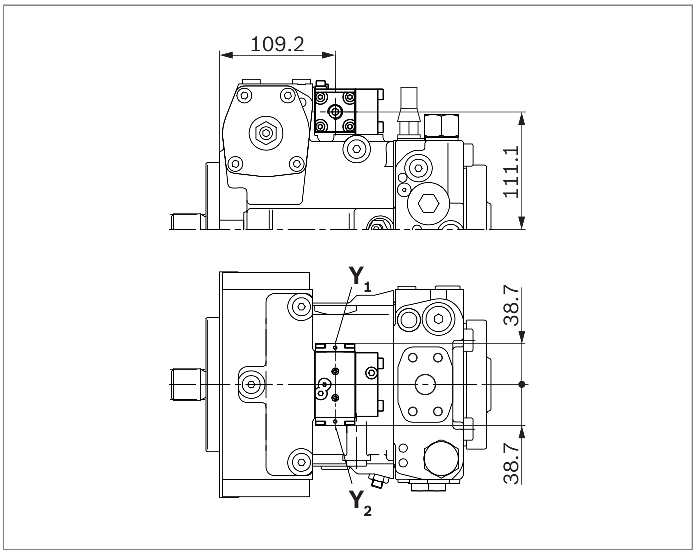
[7] Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 67).

[8] The countersink can be deeper than as specified in the standard.

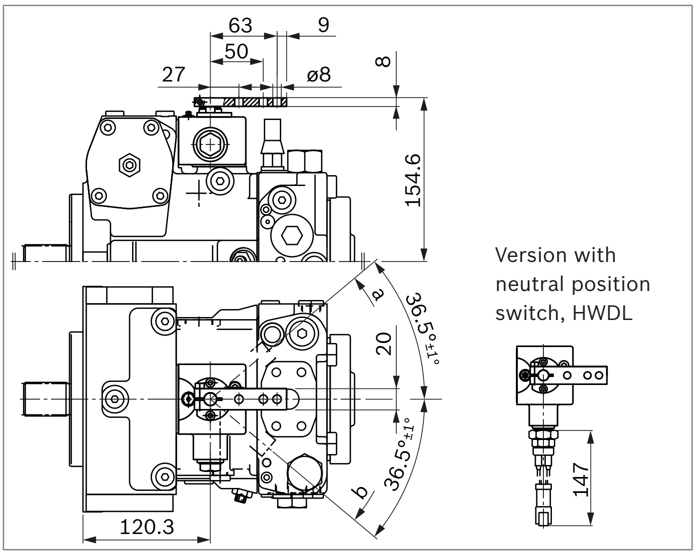
[9] Optional, see page 58

[10] O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

▼ **HD** – Proportional control, hydraulic, pilot-pressure related

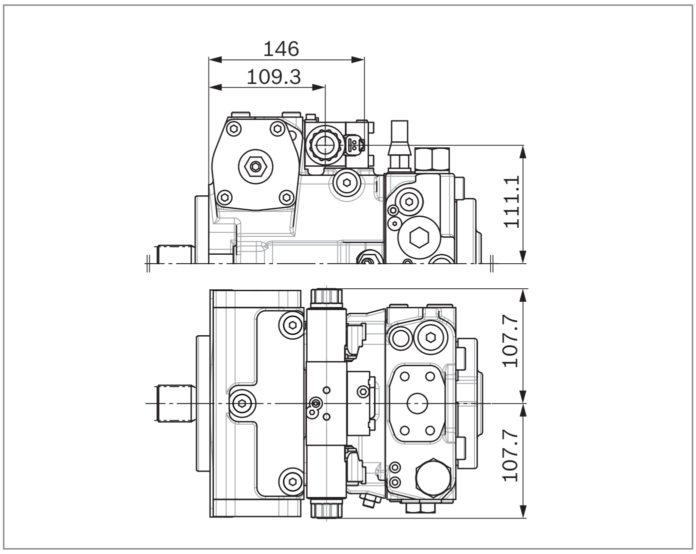


▼ **HW** – Proportional control, hydraulic, mechanical servo

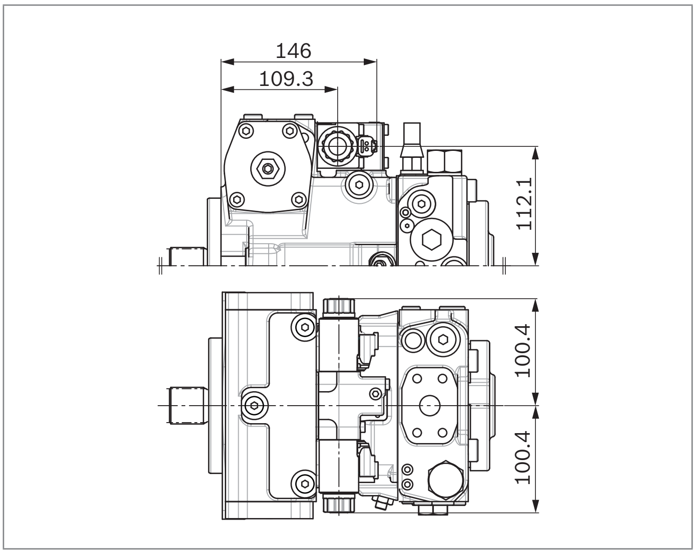


Version with
neutral position
switch, HWDL

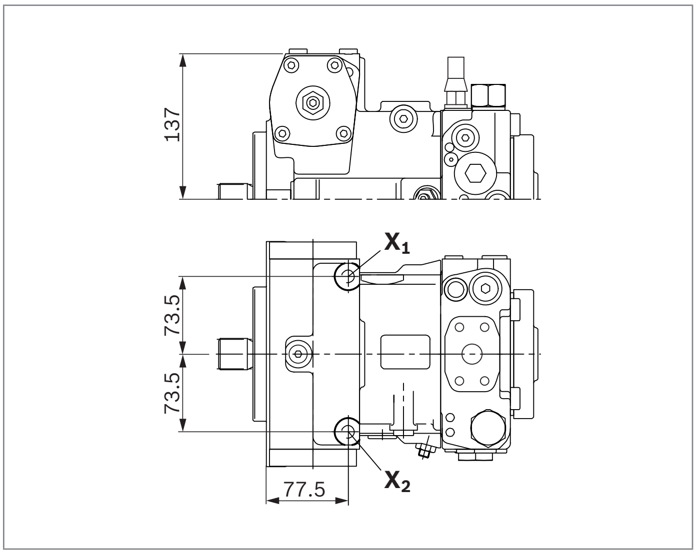
▼ **EP** – Proportional control, electric



▼ **EZ** – Two-point control, electric

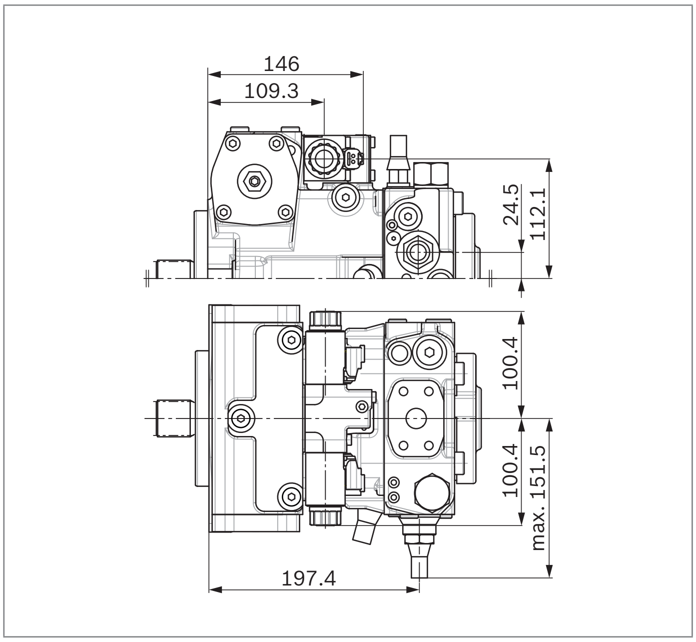


▼ **DG** – Hydraulic control, direct operated

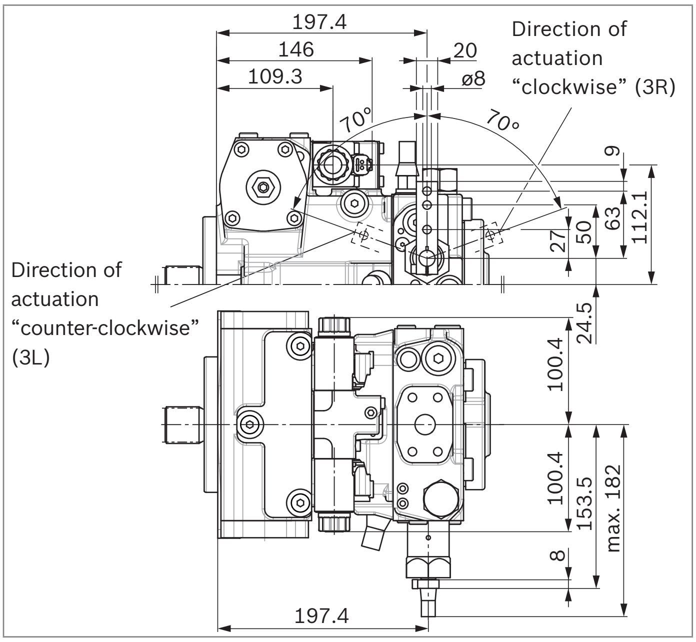


DA control valve

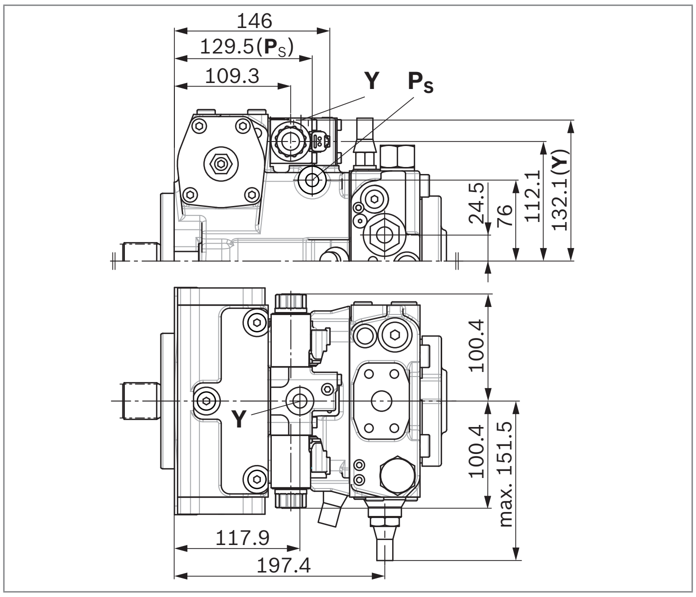
▼ **DA..2** – Fixed setting



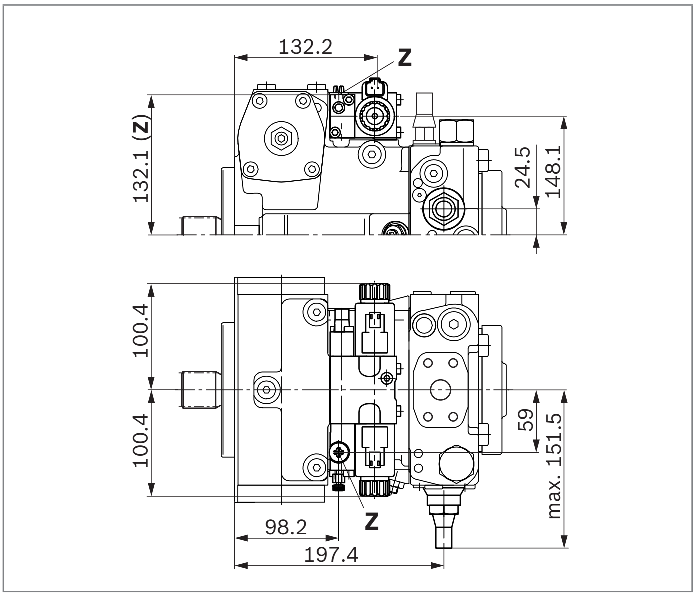
▼ **DA..3** – Mechanically adjustable with position lever



▼ **DA..7** – Fixed setting and ports for pilot control device



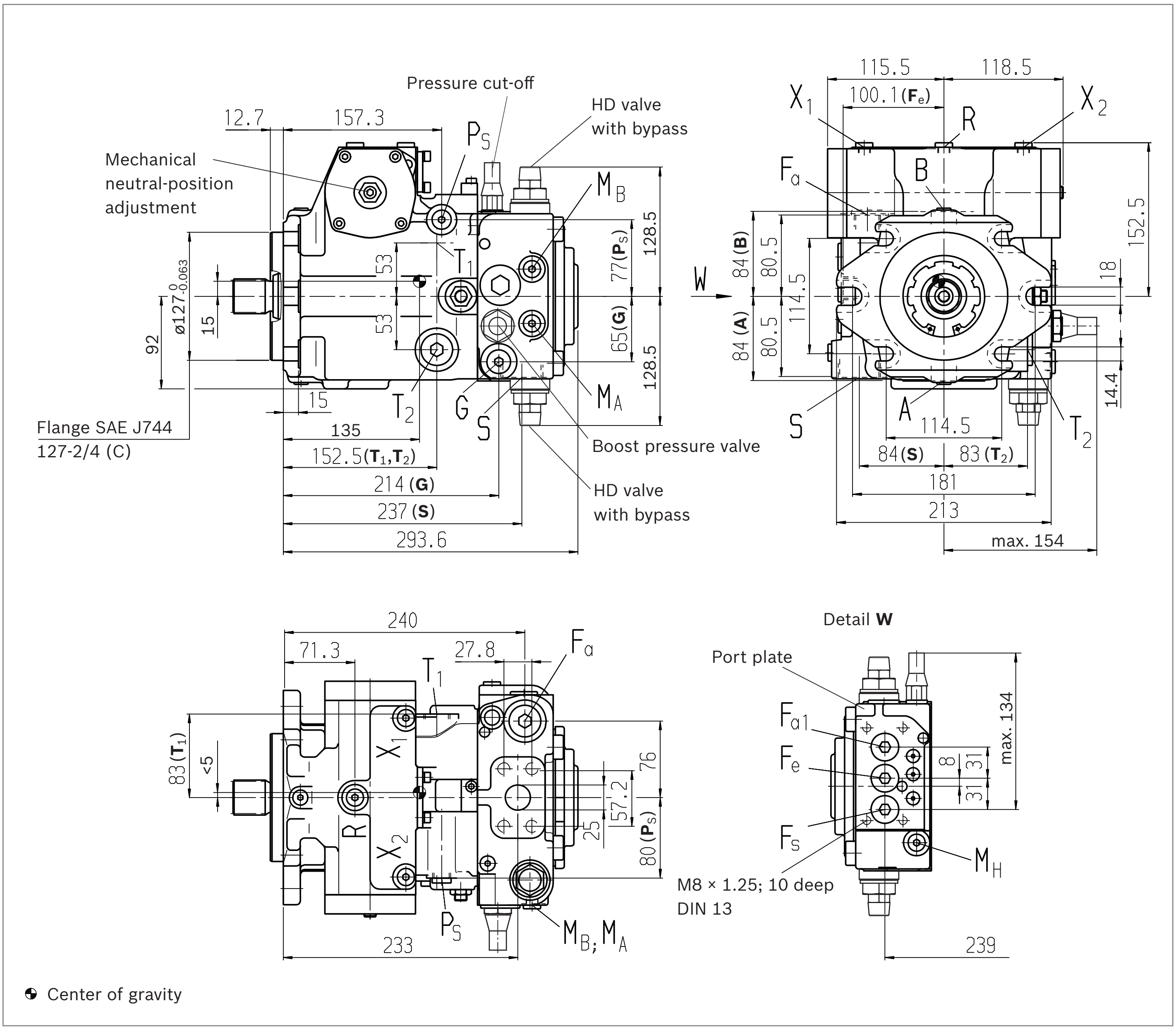
▼ **DA..8** – Fixed setting and inch valve mounted



Dimensions, size 71

NV – Version without control module

Standard: SAE working port **A** and **B** top and bottom, suction port **S** bottom (02)

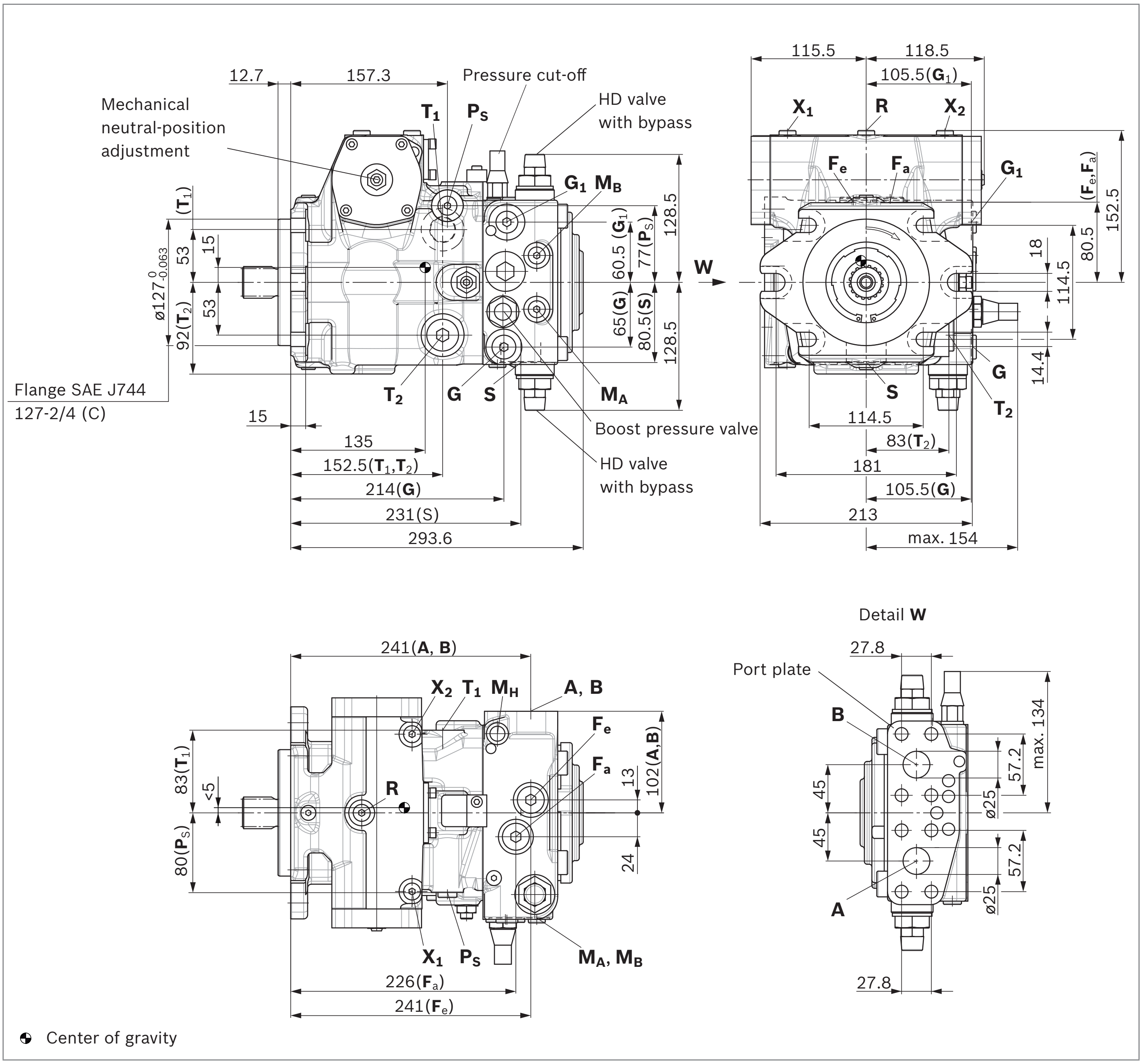


Notice

Option: SAE working port **A** and **B** top and bottom, suction port **S** top (03). Port plate (02) rotated through 180°, installation drawing on request

NV – Version without control module

Standard: SAE working port **A** and **B**, same side left, suction port **S** bottom (10)

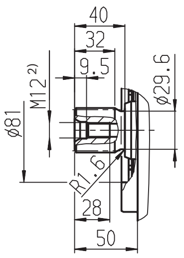
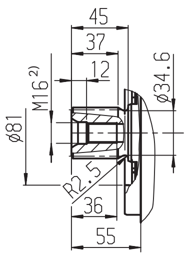
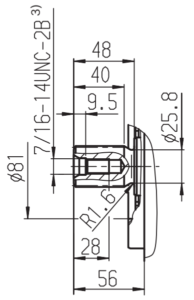
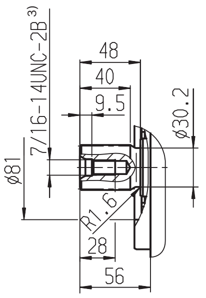


◆ Center of gravity

Notice

Option: SAE working port **A** and **B**, same side right, suction port **S** top (13), installation drawing on request

4

▼ **Splined shaft DIN 5480**	▼ **Splined shaft DIN 5480**	▼ **Splined shaft ANSI B92.1a**	▼ **Splined shaft ANSI B92.1a**
Z – W35×2×16×9 g 	**A – W40×2×18×9 g** 	**S – 1 1/4 in 14T 12/24DP**[1] 	**T – 1 3/8 in 21T 16/32DP**[1] 

Ports		**Standard**	**Size**	$p_{\max}$ **[bar]**[4]	**State**[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	1 in M12 × 1.75; 17 deep	450	O
S	Suction port	DIN 3852[8]	M42 × 2; 20 deep	5	O[6]
$\mathbf{T}_1$	Drain port	DIN 3852[8]	M26 × 1.5; 16 deep	3	O[7]
$\mathbf{T}_2$	Drain port	DIN 3852[8]	M26 × 1.5; 16 deep	3	X[7]
R	Air bleed port	DIN 3852[8]	M12 × 1.5; 12 deep	3	X
$\mathbf{X}_1$, $\mathbf{X}_2$	Control pressure port (upstream of orifice)	DIN 3852[8]	M12 × 1.5; 12 deep	40	X
$\mathbf{X}_1$, $\mathbf{X}_2$	Control pressure port (upstream of orifice, DG only)	DIN 3852[8]	M12 × 1.5; 12 deep	40	O
$\mathbf{X}_3$, $\mathbf{X}_4$[9]	Stroking chamber pressure port	DIN 3852[8]	M12 × 1.5; 12 deep	40	X
G	Boost pressure port inlet	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
$\mathbf{P}_S$	Pilot pressure port	DIN 3852[8]	M14 × 1.5; 12 deep	40	X
$\mathbf{P}_S$	Pilot pressure port (DA..7 only)	DIN 3852[8]	M14 × 1.5; 12 deep	40	O
Y	Pilot pressure port outlet (DA..7 only)	DIN 3852[8]	M14 × 1.5; 12 deep	40	O
$\mathbf{M}_A$, $\mathbf{M}_B$	Measuring port pressure A, B	DIN 3852[8]	M12 × 1.5; 12 deep	450	X
$\mathbf{M}_H$	Measuring port, high pressure	DIN 3852[8]	M12 × 1.5; 12 deep	450	X
$\mathbf{F}_a$	Boost pressure port inlet	DIN 3852[8]	M26 × 1.5; 16 deep	40	X
$\mathbf{F}_{a1}$	Boost pressure port inlet (attachment filter)	DIN 3852[8]	M22 × 1.5; 14 deep	40	X
$\mathbf{F}_e$	Boost pressure port outlet	DIN 3852[8]	M22 × 1.5; 14 deep	40	X
$\mathbf{F}_S$	Line from filter to suction port (cold start)	DIN 3852[8]	M22 × 1.5; 14 deep	40	X
$\mathbf{Y}_1$, $\mathbf{Y}_2$	Pilot pressure port (pilot signal HD only)	DIN 3852[8]	M14 × 1.5; 8 deep	40	O
Z	Pilot pressure port (inch signal DA..8 only)	DIN 3852[8]	M10 × 1; 12 deep	40	X

---

[1] Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Center bore according to DIN 332 (thread according to DIN 13)

[3] Thread according to ASME B1.1

[4] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

[5] Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

[6] Plugged at external boost pressure supply.

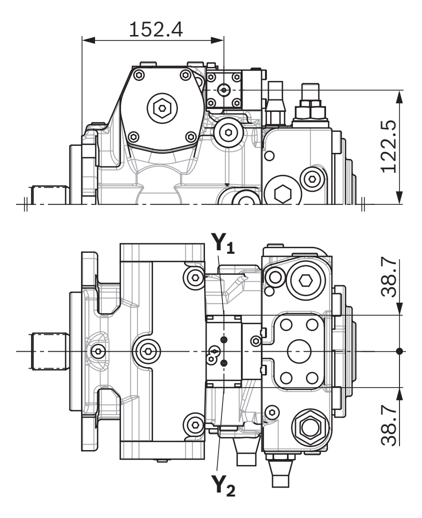
[7] Depending on installation position, $\mathbf{T}_1$ or $\mathbf{T}_2$ must be connected (see also installation instructions on page 67).

[8] The countersink can be deeper than as specified in the standard.

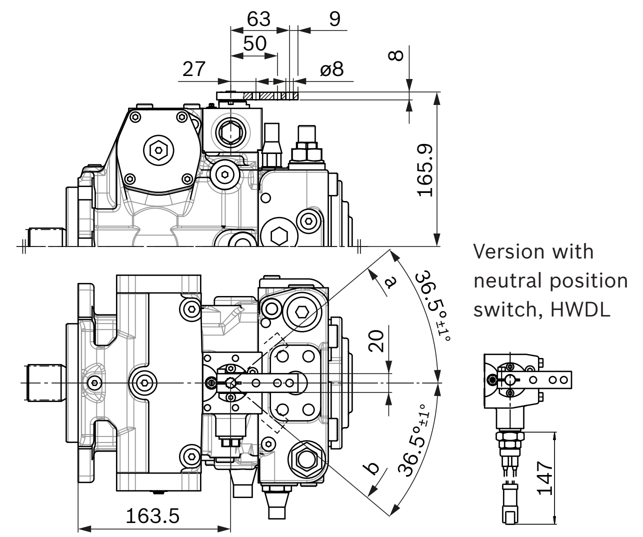
[9] Optional, see page 58

[10] O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

▼ **HD** – Proportional control, hydraulic, pilot-pressure related

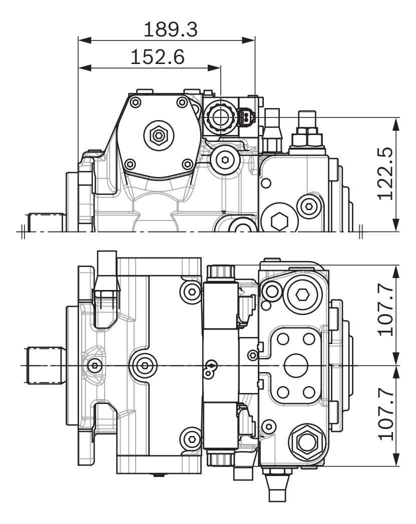


▼ **HW** – Proportional control, hydraulic, mechanical servo

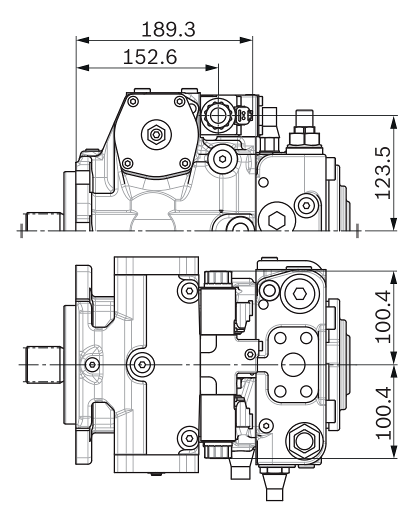


Version with
neutral position
switch, HWDL

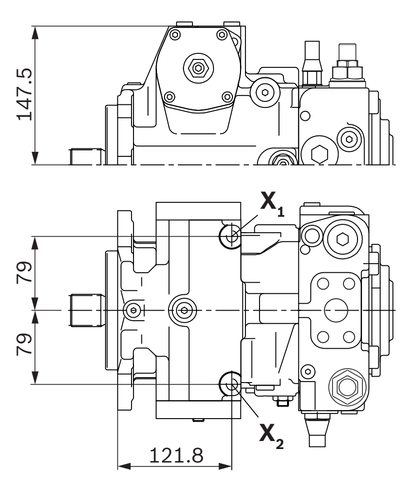
▼ **EP** – Proportional control, electric



▼ **EZ** – Two-point control, electric

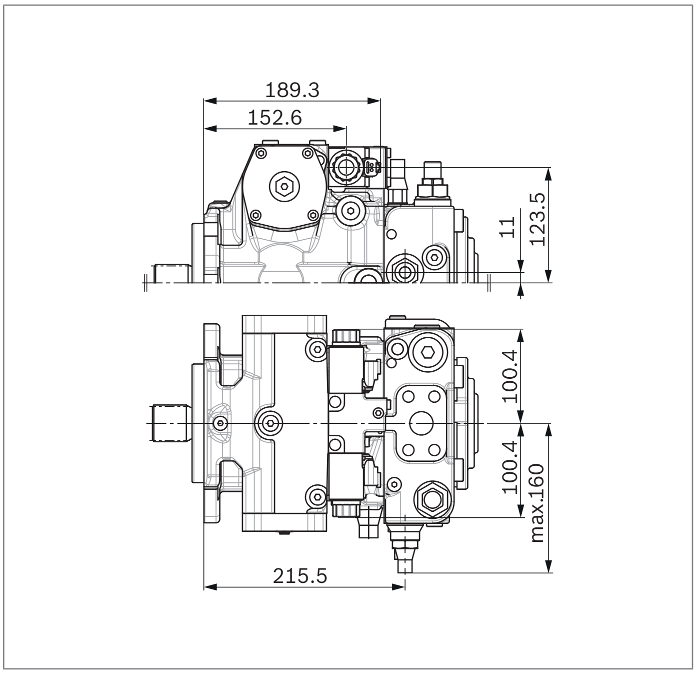


▼ **DG** – Hydraulic control, direct operated

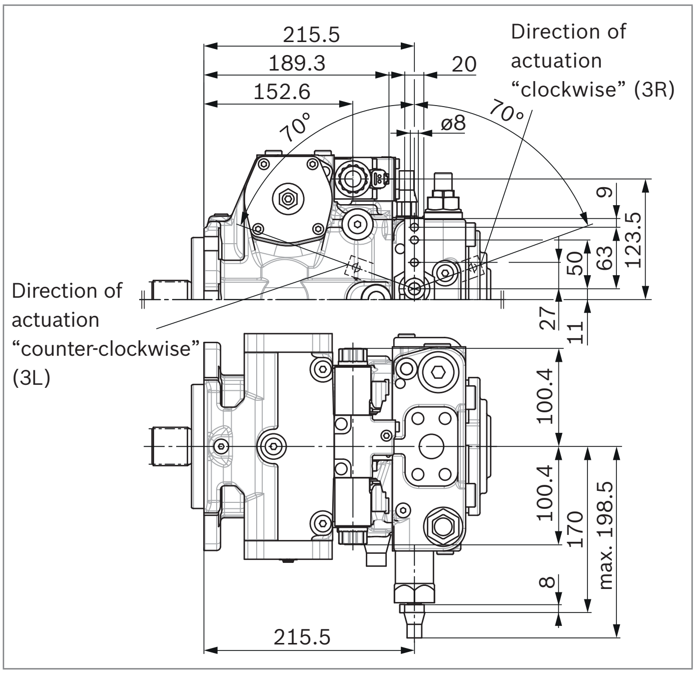


DA control valve

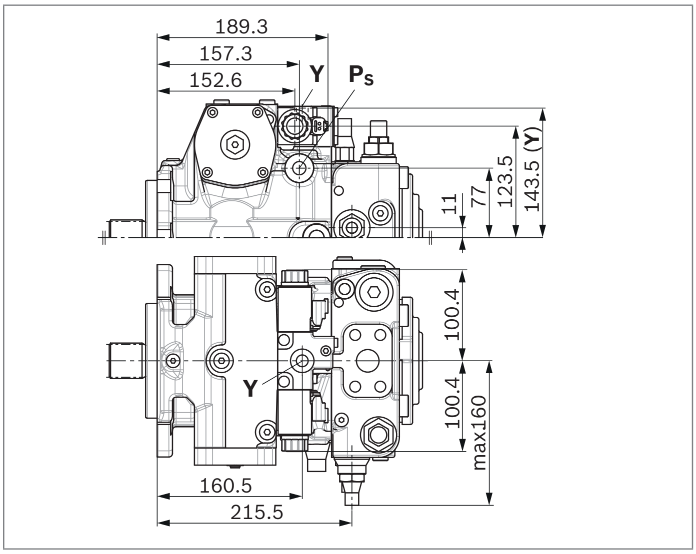
▼ **DA..2** – Fixed setting



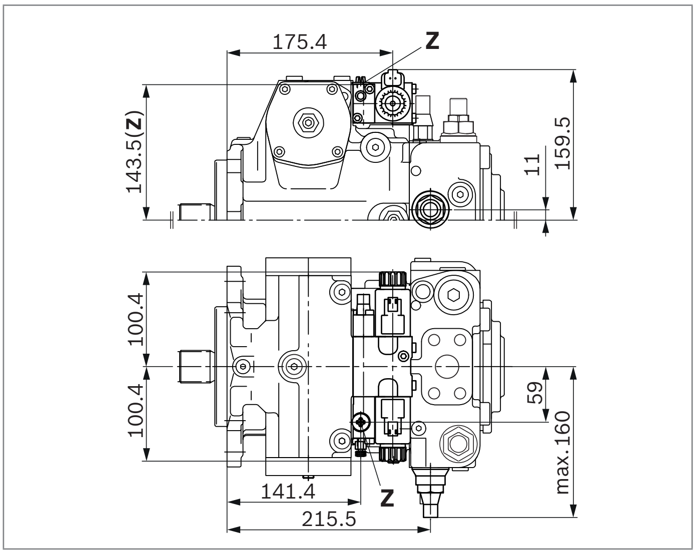
▼ **DA..3** – Mechanically adjustable with position lever



▼ **DA..7** – Fixed setting and ports for pilot control device



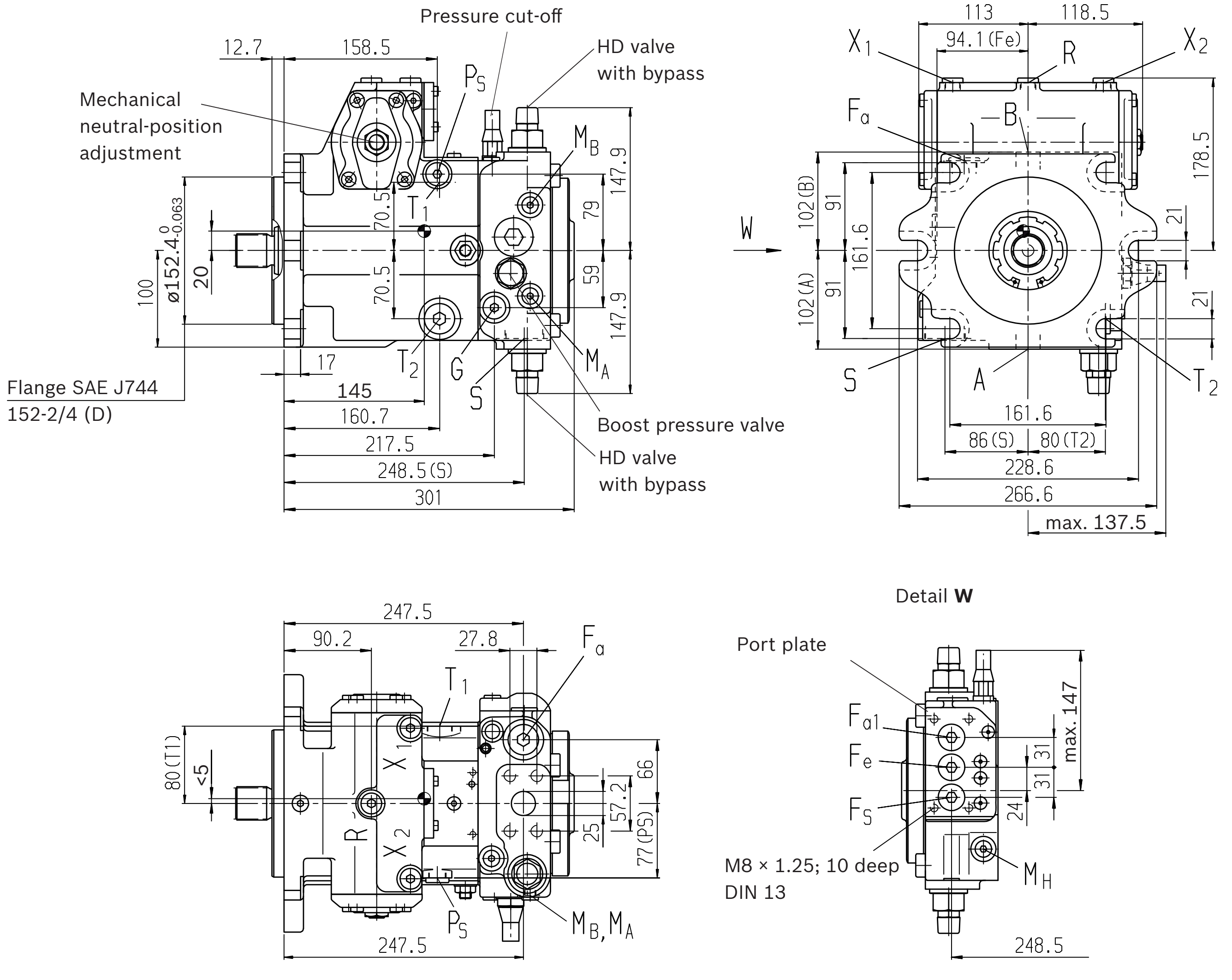
▼ **DA..8** – Fixed setting and inch valve mounted



Dimensions, size 90

NV – Version without control module

Standard: SAE working port **A** and **B** top and bottom, suction port **S** bottom (02)



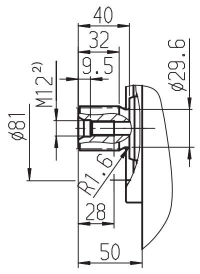
◒ Center of gravity

Notice

Option: SAE working port **A** and **B** top and bottom, suction port **S** top (03). Port plate (02) rotated through 180°, installation drawing on request

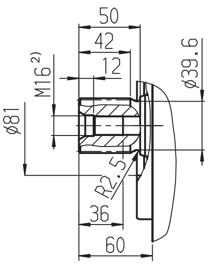
▼ Splined shaft DIN 5480

Z – W35×2×16×9 g



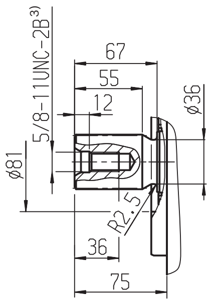
▼ Splined shaft DIN 5480

A – W45×2×21×9 g



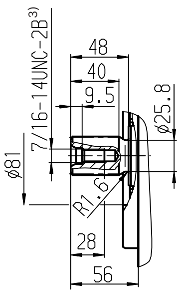
▼ Splined shaft ANSI B92.1a

S – 1 3/4 in 13T 8/16DP[1]



▼ Splined shaft ANSI B92.1a

U – 1 1/4 in 14T 12/24DP[1]



Ports		Standard	Size	p_{max} [bar][4]	State[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	1 in M12 × 1.75; 17 deep	450	O
S	Suction port	DIN 3852[8]	M42 × 2; 20 deep	5	O[6]
T_1	Drain port	DIN 3852[8]	M26 × 1.5; 16 deep	3	O[7]
T_2	Drain port	DIN 3852[8]	M26 × 1.5; 16 deep	3	X[7]
R	Air bleed port	DIN 3852[8]	M16 × 1.5; 12 deep	3	X
X_1, X_2	Control pressure port (upstream of orifice)	DIN 3852[8]	M16 × 1.5; 12 deep	40	X
X_1, X_2	Control pressure port (upstream of orifice, DG only)	DIN 3852[8]	M16 × 1.5; 12 deep	40	O
X_3, X_4[9]	Stroking chamber pressure port	DIN 3852[8]	M12 × 1.5; 12 deep	40	X
G	Boost pressure port inlet	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
P_S	Pilot pressure port	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
P_S	Pilot pressure port (DA..7 only)	DIN 3852[8]	M18 × 1.5; 12 deep	40	O
Y	Pilot pressure port outlet (DA..7 only)	DIN 3852[8]	M18 × 1.5; 12 deep	40	O
M_A, M_B	Measuring port pressure A, B	DIN 3852[8]	M12 × 1.5; 12 deep	450	X
M_H	Measuring port, high pressure	DIN 3852[8]	M12 × 1.5; 12 deep	450	X
F_a	Boost pressure port inlet	DIN 3852[8]	M26 × 1.5; 16 deep	40	X
F_{a1}	Boost pressure port inlet (attachment filter)	DIN 3852[8]	M22 × 1.5; 14 deep	40	X
F_e	Boost pressure port outlet	DIN 3852[8]	M22 × 1.5; 14 deep	40	X
F_S	Line from filter to suction port (cold start)	DIN 3852[8]	M22 × 1.5; 14 deep	40	X
Y_1, Y_2	Pilot pressure port (pilot signal HD only)	DIN 3852[8]	M14 × 1.5; 12 deep	40	O
Z	Pilot pressure port (inch signal DA..8 only)	DIN 3852[8]	M10 × 1; 8 deep	40	X

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Center bore according to DIN 332 (thread according to DIN 13)

3) Thread according to ASME B1.1

4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

5) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

6) Plugged at external boost pressure supply.

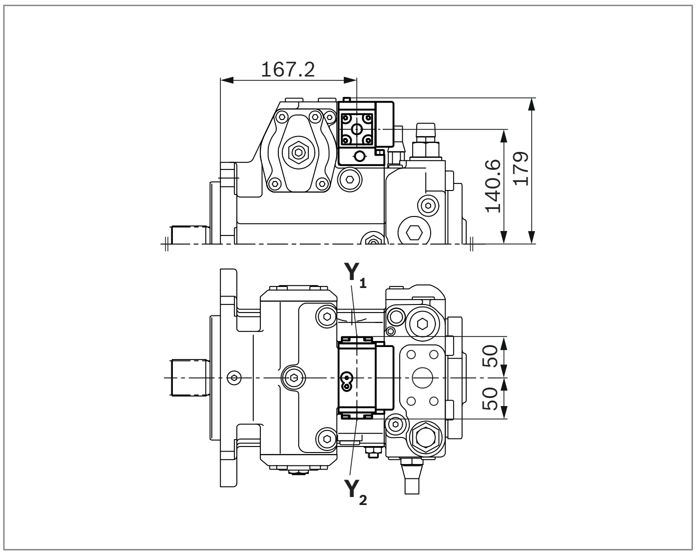
7) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 67).

8) The countersink can be deeper than as specified in the standard.

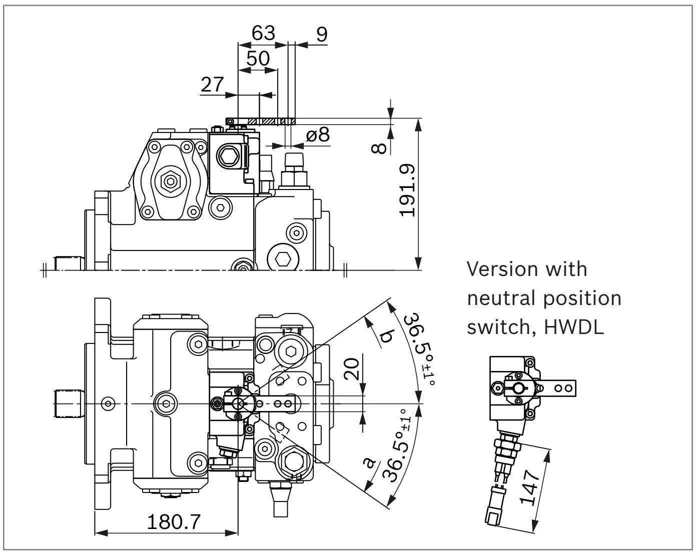
9) Optional, see page 58

10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

▼ **HD** – Proportional control, hydraulic, pilot-pressure related

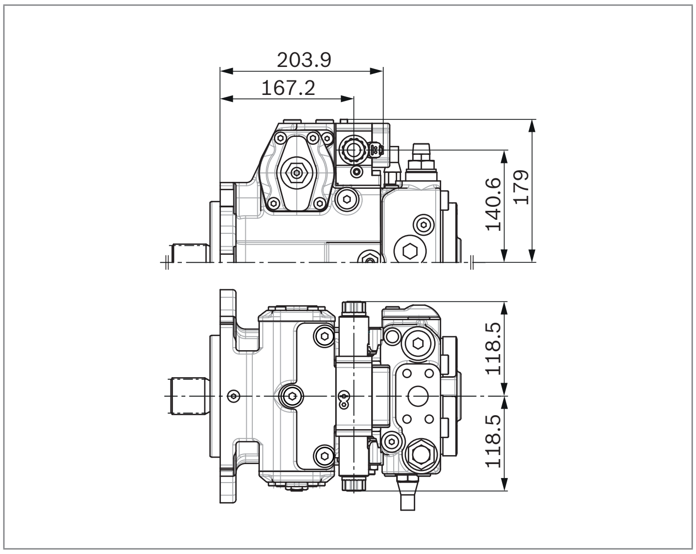


▼ **HW** – Proportional control, hydraulic, mechanical servo

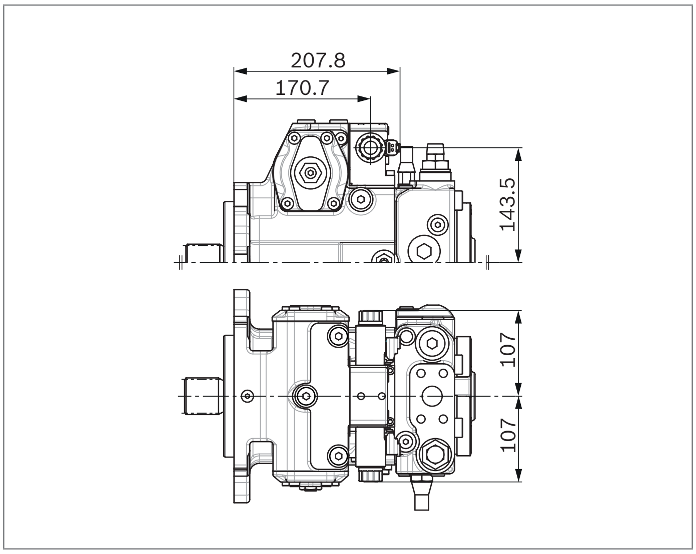


Version with neutral position switch, HWDL

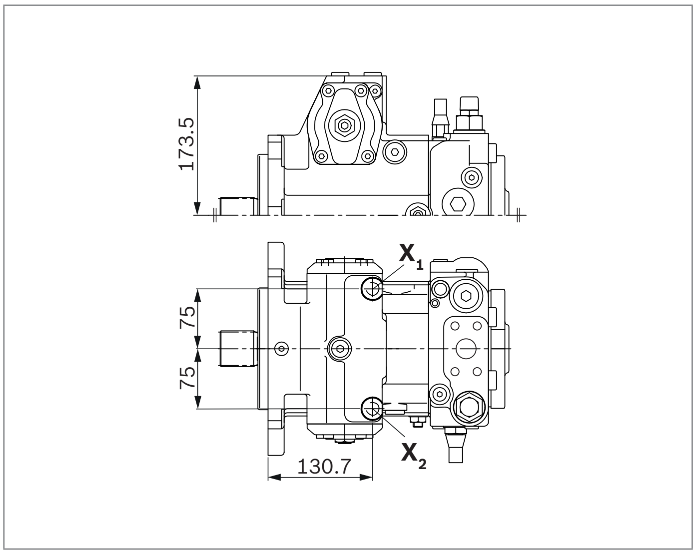
▼ **EP** – Proportional control, electric



▼ **EZ** – Two-point control, electric

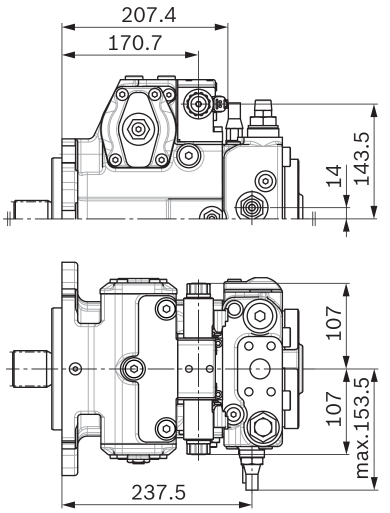


▼ **DG** – Hydraulic control, direct operated

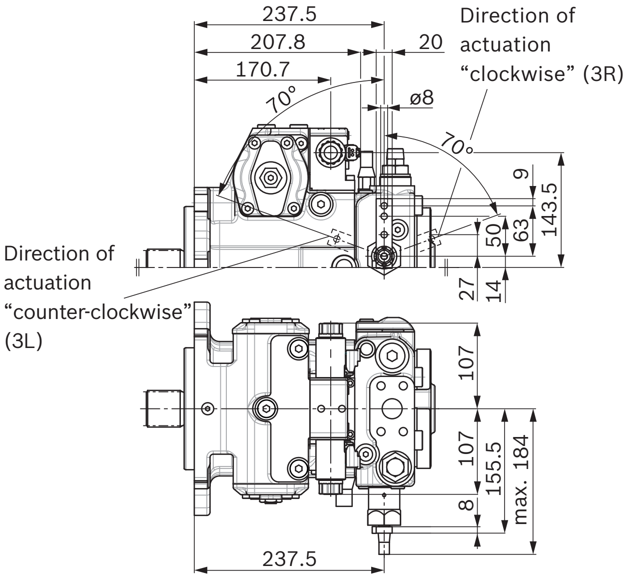


DA control valve

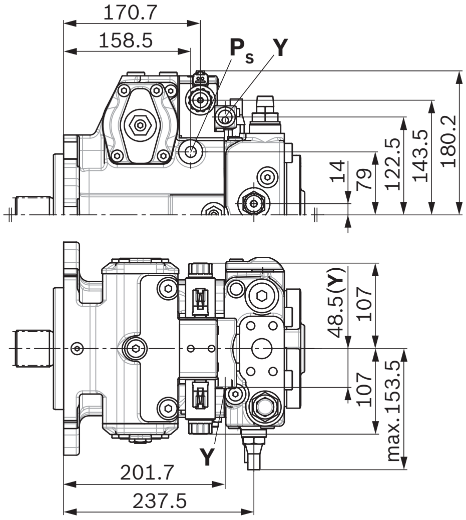
▼ **DA..2** – Fixed setting



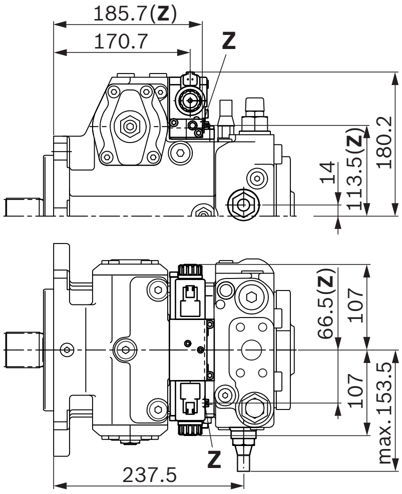
▼ **DA..3** – Mechanically adjustable with position lever



▼ **DA..7** – Fixed setting and ports for pilot control device



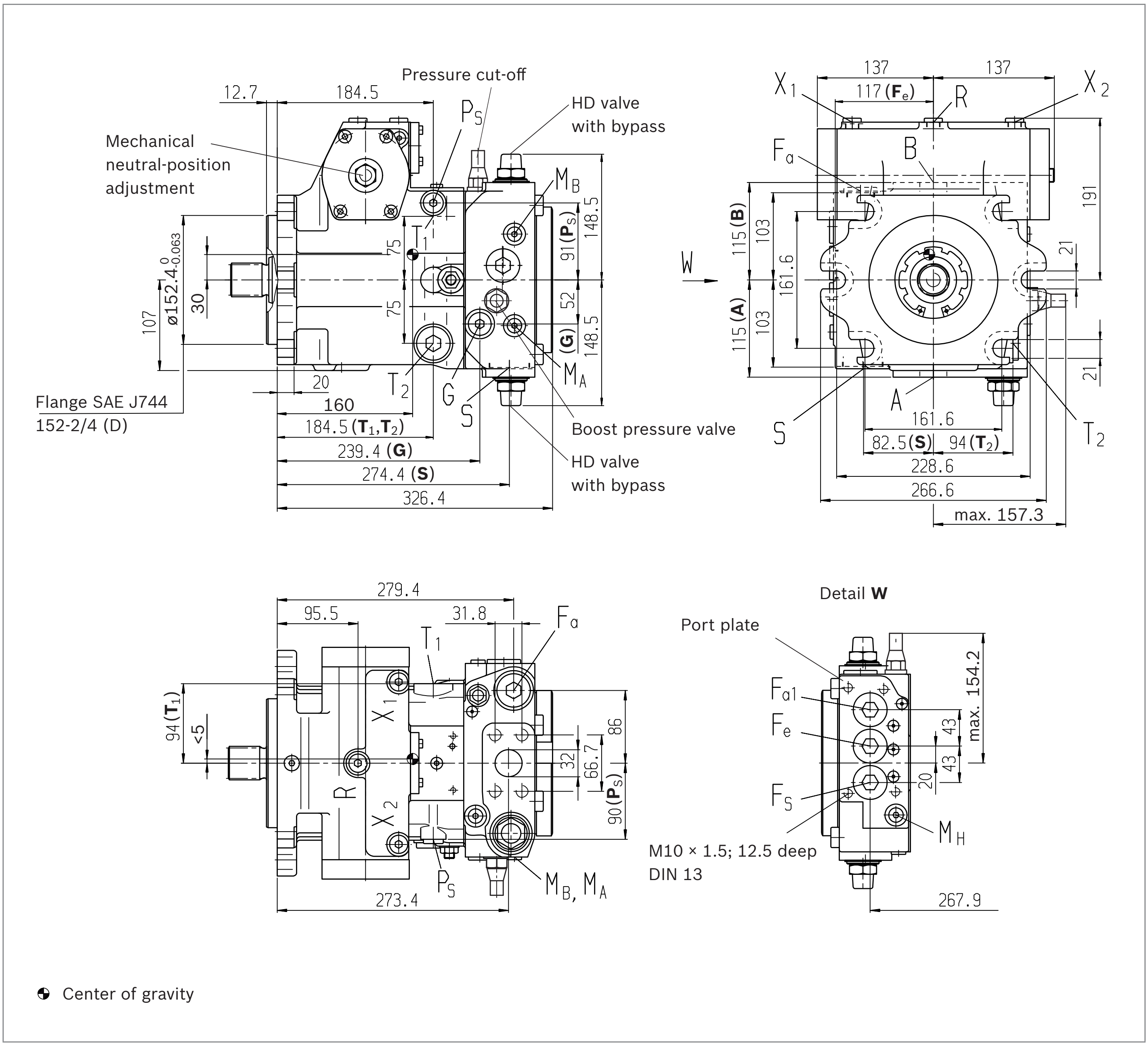
▼ **DA..8** – Fixed setting and inch valve mounted



Dimensions, size 125

NV – Version without control module

Standard: SAE working port **A** and **B** top and bottom, suction port **S** bottom (02)

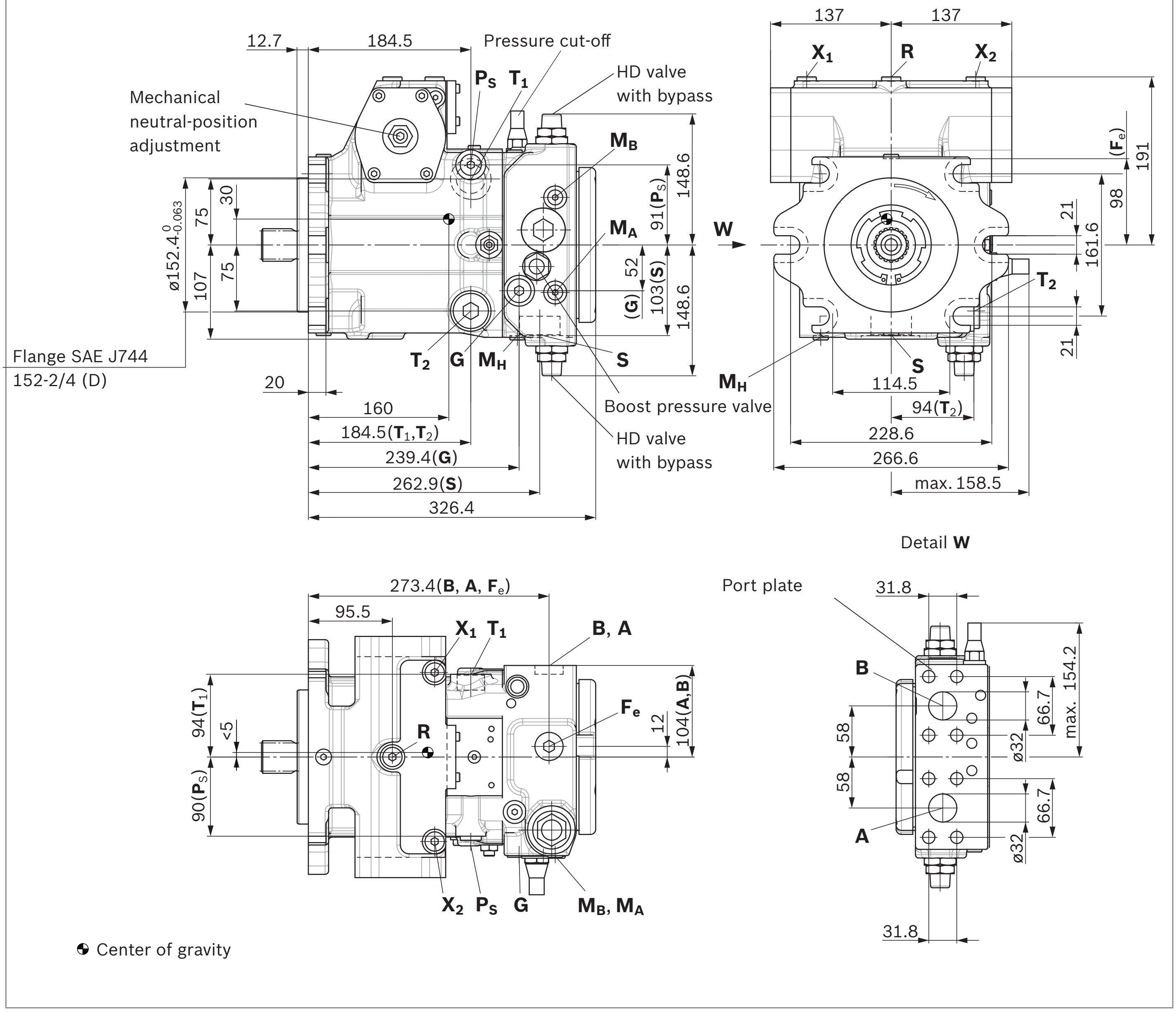


Notice

Option: SAE working port **A** and **B** top and bottom, suction port **S** top (03). Port plate (02) rotated through 180°, installation drawing on request

NV – Version without control module

Standard: SAE working port **A** and **B**, same side left, suction port **S** bottom (10)

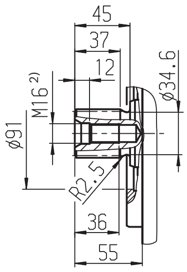


Notice

Option: SAE working port **A** and **B**, same side right, suction port **S** top (13), installation drawing on request

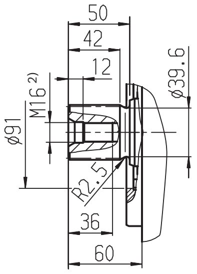
▼ Splined shaft DIN 5480

Z – W40×2×18×9 g



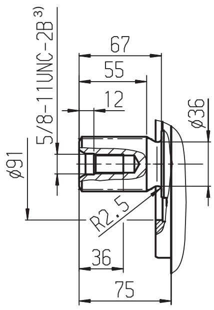
▼ Splined shaft DIN 5480

A – W45×2×21×9 g



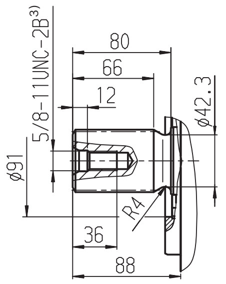
▼ Splined shaft ANSI B92.1a

S – 1 3/4 in 13T 8/16DP[1]



▼ Splined shaft ANSI B92.1a

T – 2 in 15T 8/16DP[1]

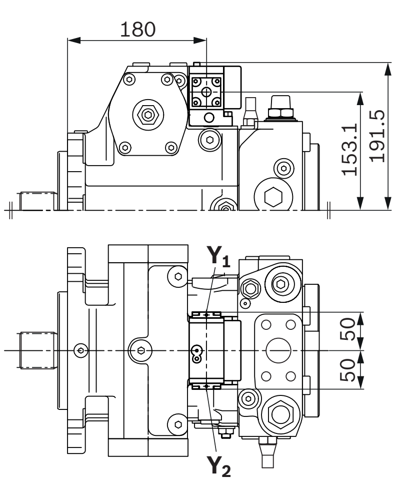


Ports		Standard	Size	p_{max} [bar][4]	State[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	1 1/4 in M14 × 2; 19 deep	450	O
S	Suction port	DIN 3852[8]	M48 × 2; 22 deep	5	O[6]
T_1	Drain port	DIN 3852[8]	M33 × 2; 18 deep	3	O[7]
T_2	Drain port	DIN 3852[8]	M33 × 2; 18 deep	3	X[7]
R	Air bleed port	DIN 3852[8]	M16 × 1.5; 12 deep	3	X
X_1, X_2	Control pressure port (upstream of orifice)	DIN 3852[8]	M16 × 1.5; 12 deep	40	X
X_1, X_2	Control pressure port (upstream of orifice, DG only)	DIN 3852[8]	M16 × 1.5; 12 deep	40	O
X_3, X_4[9]	Stroking chamber pressure port	DIN 3852[8]	M12 × 1.5; 12 deep	40	X
G	Boost pressure port inlet	DIN 3852[8]	M22 × 1.5; 12 deep	40	X
P_S	Pilot pressure port	DIN 3852[8]	M18 × 1.5; 12 deep	40	X
P_S	Pilot pressure port (DA..7 only)	DIN 3852[8]	M18 × 1.5; 12 deep	40	O
Y	Pilot pressure port outlet (DA..7 only)	DIN 3852[8]	M18 × 1.5; 12 deep	40	O
M_A, M_B	Measuring port pressure A, B	DIN 3852[8]	M12 × 1.5; 12 deep	450	X
M_H	Measuring port, high pressure	DIN 3852[8]	M12 × 1.5; 12 deep	450	X
F_a	Boost pressure port inlet	DIN 3852[8]	M33 × 2; 18 deep	40	X
F_{a1}	Boost pressure port inlet (attachment filter)	DIN 3852[8]	M33 × 2; 18 deep	40	X
F_e	Boost pressure port outlet	DIN 3852[8]	M33 × 2; 18 deep	40	X
F_S	Line from filter to suction port (cold start)	DIN 3852[8]	M33 × 2; 18 deep	40	X
Y_1, Y_2	Pilot pressure port (pilot signal HD only)	DIN 3852[8]	M14 × 1.5; 12 deep	40	O
Z	Pilot pressure port (inch signal DA..8 only)	DIN 3852[8]	M10 × 1; 8 deep	40	X

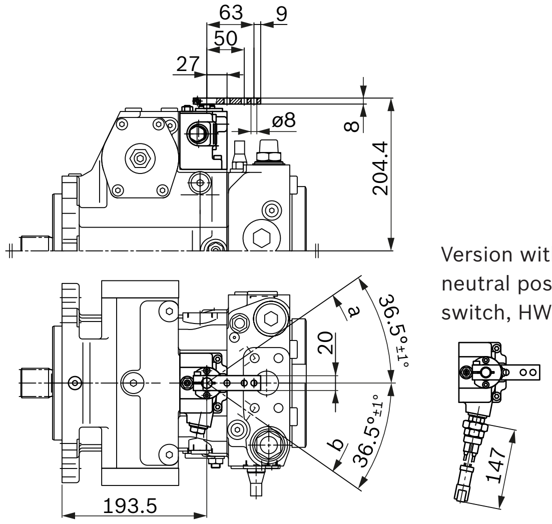
---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Thread according to ASME B1.1
4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
5) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.
6) Plugged at external boost pressure supply.
7) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 67).
8) The countersink can be deeper than as specified in the standard.
9) Optional, see page 58
10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

▼ **HD** – Proportional control, hydraulic, pilot-pressure related

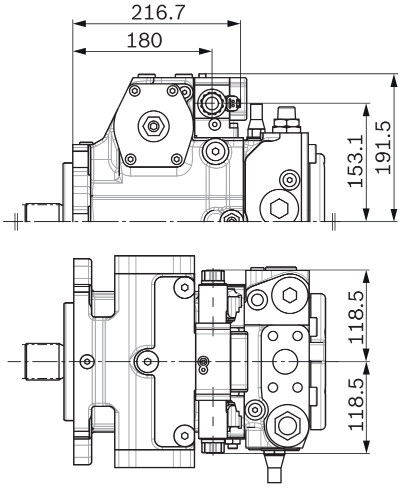


▼ **HW** – Proportional control, hydraulic, mechanical servo

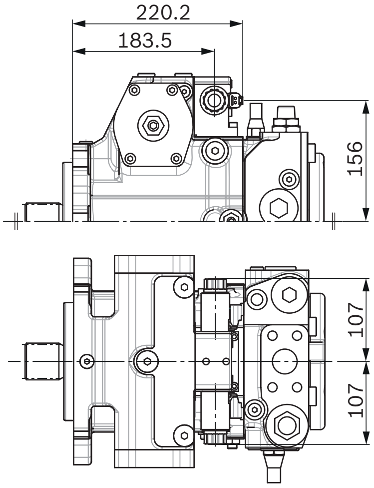


Version with neutral position switch, HWDL

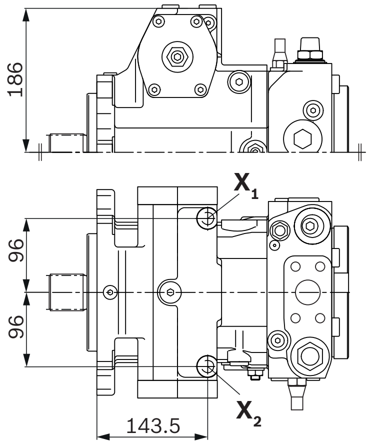
▼ **EP** – Proportional control, electric



▼ **EZ** – Two-point control, electric

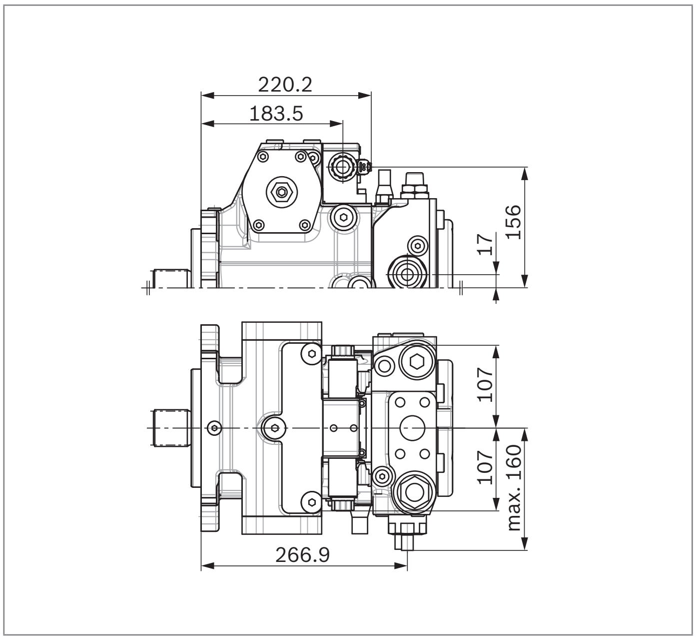


▼ **DG** – Hydraulic control, direct operated

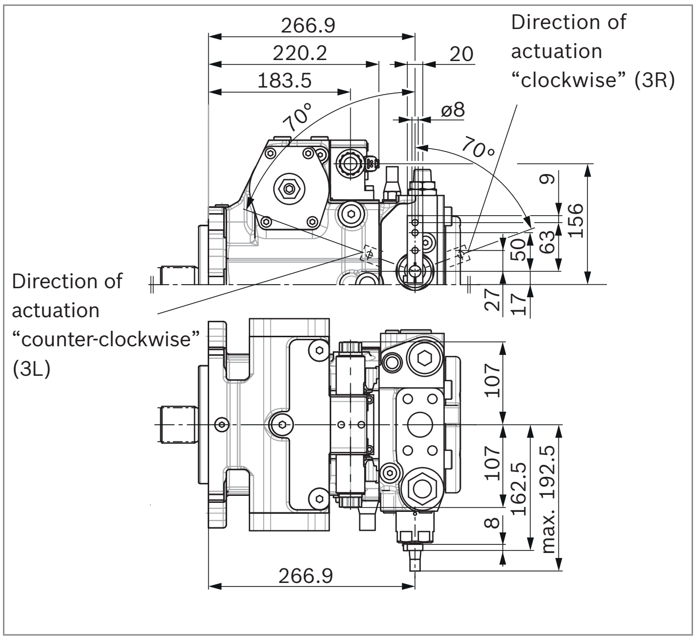


DA control valve

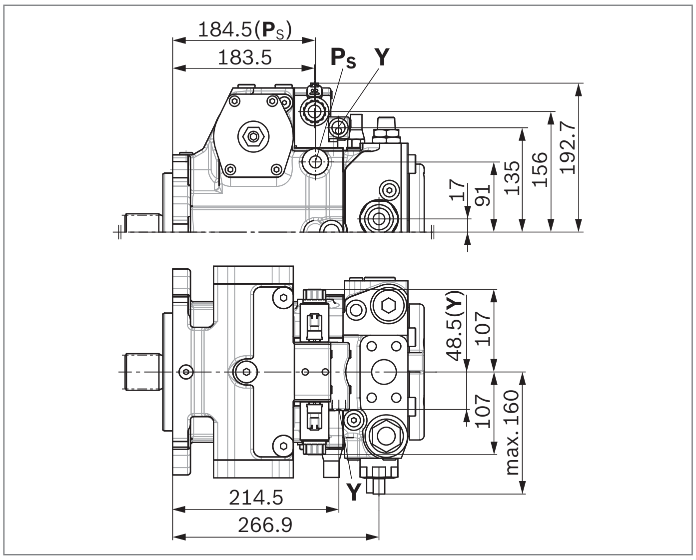
▼ **DA..2** – Fixed setting



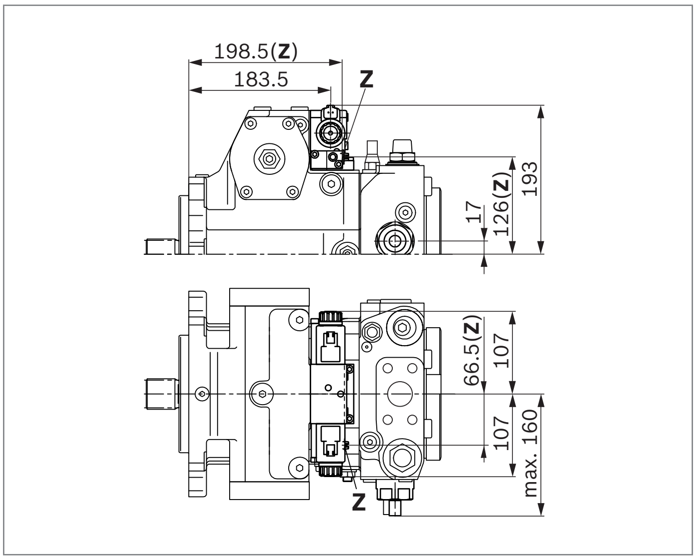
▼ **DA..3** – Mechanically adjustable with position lever



▼ **DA..7** – Fixed setting and ports for pilot control device



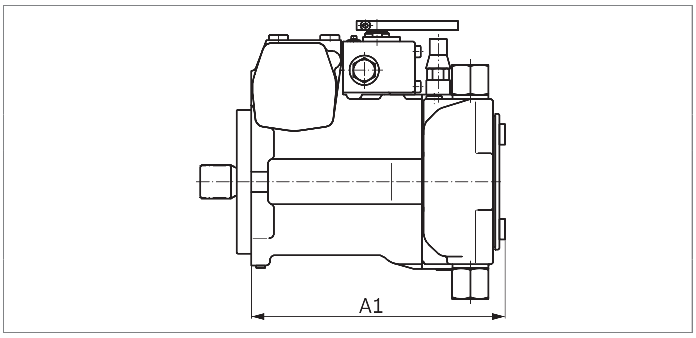
▼ **DA..8** – Fixed setting and inch valve mounted



Dimensions, through drive

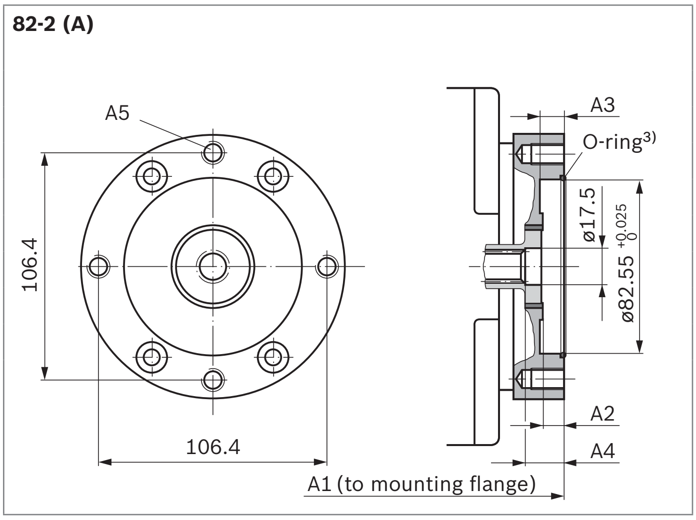
Flange SAE J744	Hub for splined shaft1)	28	40	56	71	90	125	Code
Without through drive		●	●	●	●	●	●	**00**
82-2 (A)	5/8 in 9T 16/32DP	●	●	●	●	●	●	**01**

▼ **N00 –** without boost pump, without through drive / **F00** – with boost pump, without through drive



NG	A1 (N00)	A1 (F00)
28	213.9	223.4
40	220.2	235.7
56	239.4	256.4
71	279.1	293.6
90	287	301
125	320.9	326.4

▼ **F01/K01**4)



NG	A1 (F01)	A1 (K01)	A2	A3	A4
28	227.9	227.9	7.5	7.5	14.5
40	239.7	234.2	9	9	18
56	261.4	254.9	10	10	18
71	297.6	297.6	9	10	17
90	304	304	9	8	–
125	330.9	330.9	10.5	9	–
NG			**A5**2)		
28 to 125			M10 × 1.5; 15 deep		

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to DIN 13

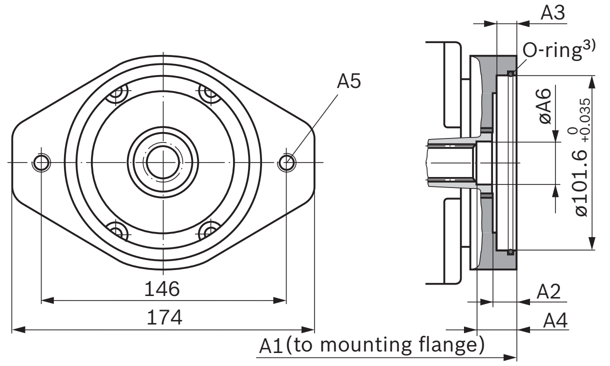
3) O-ring included in the scope of delivery

4) The illustration shows the 2-hole version. Please state in plain text whether the 2-hole horizontal or the 2-hole vertical version is used.

Flange SAE J744	Hub for splined shaft[1]	28	40	56	71	90	125	Code
101-2 (B)	7/8 in 13T 16/32DP	●	●	●	●	●	●	02
	1 in 15T 16/32DP	●	●	●	●	●	●	04
127-2 (C)	1 in 15T 16/32DP	–	●	–	–	–	–	09

▼ **F02/K02; F04/K04**[4]

101-2 (B)

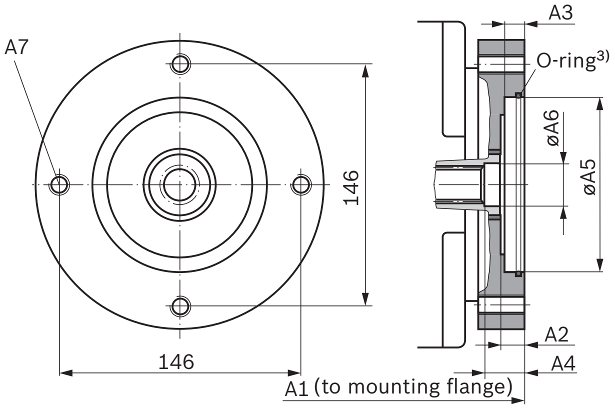


NG	A1	A2	A3	A4 (02)	A4 (04)	A5[2]
28	230.4	9.7	9.7	16.2	13.7	M12 × 1.75; 19 deep
40	240.7	11	11[5]	17	16	M12 × 1.75; 19 deep
56	262.4	12	11	19.5	18.5	M12 × 1.75; 19 deep

	øA6
F02 / K02	24
F04 / K04	27

▼ **F02/K02; F04/K04**[4]

101-2 (B)



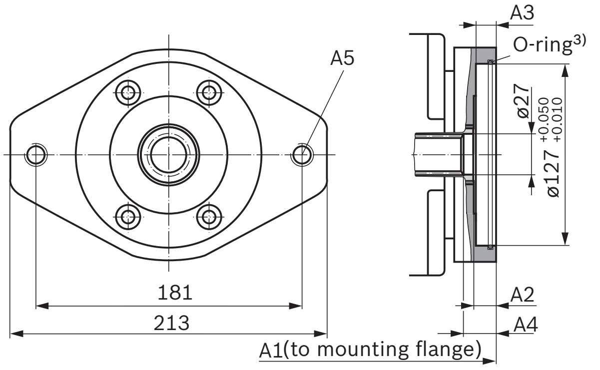
NG	A1	A2	A3	A4 (02)	A4 (04)	ØA5	(K)	(F)
71	300.6	13	9.8	17	15.5	101.6	$^{+0.035}_{0}$	$^{+0.035}_{0}$
90	305	9	11	17	15	101.6	$^{+0.035}_{0}$	$^{+0.022}_{0}$
125	330.9	10	11	17	16.5	101.6	$^{+0.025}_{0}$	$^{+0.025}_{0}$

NG	A7[2]
71, 90	M12 × 1.75; 21 deep
125	M12 × 1.75; 18 deep

	øA6
F02 / K02	24
F04 / K04	27

▼ **F09/K09**

127-2 (C)



NG	A1	A2	A3	A4
40	244.7	14	14	19.5

NG	A5[2]
40	M16 × 2; 20 deep

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to DIN 13

3) O-ring included in the scope of delivery

4) The illustration shows the 2-hole version. Please state in plain text whether the 2-hole horizontal or the 2-hole vertical version is used.

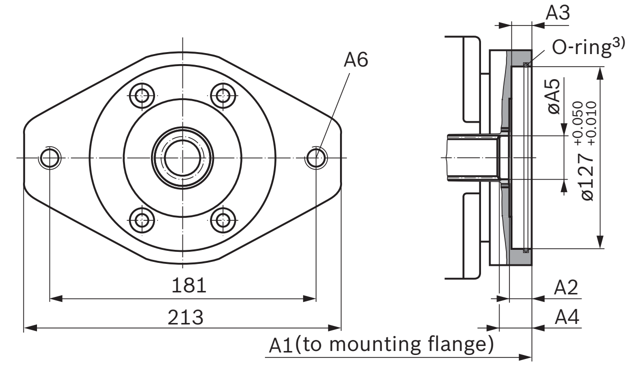
5) For F04/K04 9.7 mm

Dimensions, through drive

Flange SAE J744	Hub for splined shaft	28	40	56	71	90	125	Code
127-2 (C)	1 1/4 in 14T 12/24DP 1)	–	–	●	●	●	●	**07**
152-2/4 (D)	W35 2×16×9 g (according to DIN 5480)	–	–	–	–	●	–	**73**
	1 3/4 in 13T 8/16DP 1)	–	–	–	–	–	●	**69**

▼ **F07/K07 4)**

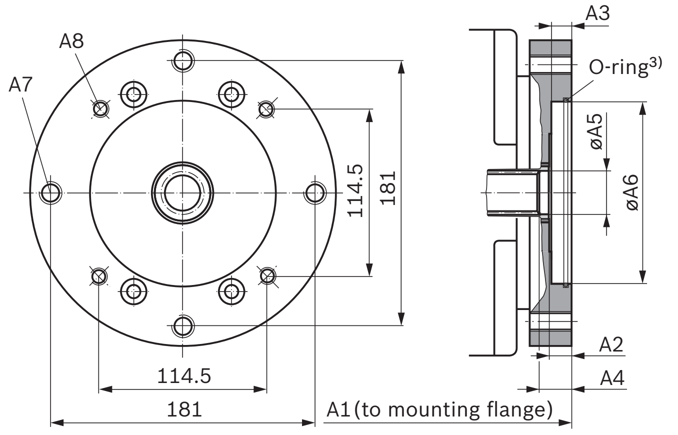
127-2 (C) 5)



NG	A1	A2	A3	A4	øA5	A6 2)
56	266.4	15	14	17.5	32.7	M16 × 2; 20 deep
71	303.6	15	13.5	20	33.5	M16 × 2; 24 deep

▼ **F07/K07 4)**

127-2 (C) 5)

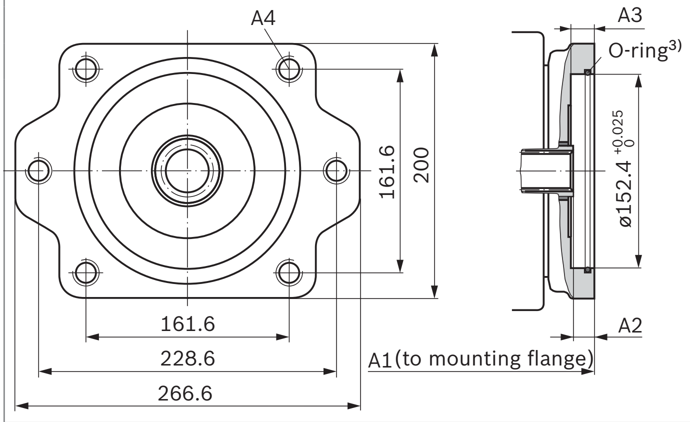


NG	A1	A2	A3	A4	øA5	øA6
90	309	13	14	20.5	33.5	127 +0.025 0
125	335.9	15	15.5	22.5	33.5	127 +0.025 0

NG	A7 2)	A8 2)
90, 125	M16 × 2; 23 deep	M12 × 1.75; 18 deep

▼ **F73/K73; F69/K69 6)**

152-2/4 (D)



NG	A1	A2	A3	A4 2)
90	309	12	14	M20 × 2.5; 20 deep
125	343.9	18	14	M20 × 2.5; 20 deep

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to DIN 13

3) O-ring included in the scope of delivery

4) The illustration shows the 4- and the 2-hole version. Please state in plain text whether the 4-hole, the 2-hole horizontal or the 2-hole vertical version is used.

5) NG90 to 125 with additional 4-hole-flange (127-4)

6) The illustration shows the 4+2-hole version. Please state in plain text whether the 2-hole, the 4-hole or the 4+2-hole vertical version is used.

Overview of mounting options

Through drive[1]			**Mounting option – 2. pump**					
Flange	**Hub for splined shaft**	**Code**	**A4VG/32 NG (shaft)**	**A10V(S)O/3X NG (shaft)**	**A10V(S)O/5X NG (shaft)**	**A11VO/1 NG (shaft)**	**A10VG NG (shaft)**	**External gear pump[2]**
82-2 (A)	5/8 in	**F/K01**	–	18 (U)	10, 18 (U)	–	–	AZPF NG4 to 22
101-2 (B)	7/8 in	**F/K02**	–	28 (S) 45 (U)	28 (S) 45 (U)	–	18 (S)	AZPN NG20 to 36 AZPG NG32 to 50
	1 in	**F/K04**	28 (S)	45 (S)	45 (S) 60, 63, 72 (U)	40 (S)	28 (S) 45 (S)	–
127-2 (C)[3]	1 in	**F/K09**	40 (U)	71 (U)	60, 63, 71 (U)	–	–	–
	1 1/4 in	**F/K07**	40, 56, 71 (S)	71 (S) 100 (U)	60, 63, 71 (S) 85, 100 (U)	60 (S)	63 (S)	–
152-2/4 (D)	W35	**F/K73**	90 (Z)	–	–	–	–	–
	1 3/4 in	**F/K69**	90, 125 (S)	140 (S)	–	95, 130, 145 (S)	–	–

---

1) Availability of the individual sizes, see type code on page 3.

2) Bosch Rexroth recommends special versions of the gear pumps. Please contact us.

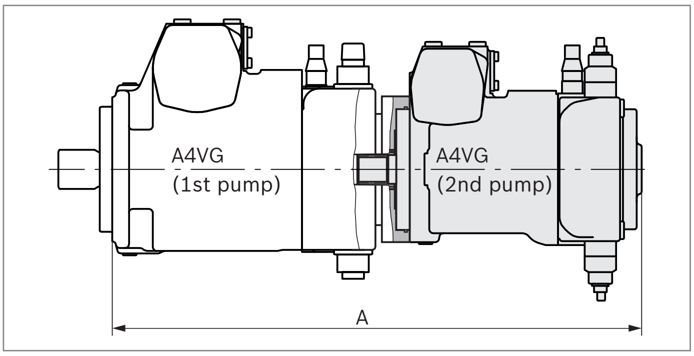
3) A10VO/5X with 4-hole flange attachable only to A4VG NG90 to 125

Combination pumps A4VG + A4VG

Total length A

A4VG	A4VG 2. Pump[1]					
1st pump	**NG28**	**NG40**	**NG56**	**NG71**	**NG90**	**NG125**
NG28	453.8	–	–	–	–	–
NG40	464.1	480.4	–	–	–	–
NG56	485.8	502.1	522.8	–	–	–
NG71	524.0	539.3	560.0	597.2	–	–
NG90	528.4	544.7	565.4	602.6	610.0	–
NG125	554.3	571.6	592.3	629.5	644.9	670.3

By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes.
When ordering combination pumps, the type designations of the 1st and 2nd pumps must be linked by a “**+**”.
Order example:
A4VG56EP3D1/32R-NAC02F073SP + A4VG56EP3D1/32R-NSC02F003SP
A tandem pump, with two pumps of equal size, is permissible without additional supports, assuming that the dynamic acceleration does not exceed maximum 10 *g* (= 98.1 m/s^2).
From size 71 upward, we recommend using the 4-hole mounting flange.
For combination pumps consisting of more than two pumps, the mounting flange must be rated for the permissible moment of inertia, please contact us.



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[1] 2nd pump without through drive and with boost pump, F00

High-pressure relief valves

The two high-pressure relief valves protect the hydrostatic transmission (pump and motor) from overloading. They limit the maximum pressure in the respective high-pressure line and serve simultaneously as boost valves.
High-pressure relief valves are not working valves and are only suitable for pressure peaks or high rates of pressure change.

Setting ranges

High-pressure relief valve, direct operated (NG28 to 56)	**Differential pressure setting Δp_{HD}**
Valve setting range **3**, **5** Δp 250 to 420 bar (see type code)	420 bar
	400 bar
	360 bar
	340 bar
	320 bar
	300 bar
	270 bar
	250 bar
Valve setting range **4**, **6** Δp 100 to 250 bar (see type code)	250 bar
	230 bar
	200 bar
	150 bar
	100 bar

High-pressure relief valve, pilot operated (NG71 to 125)	**Differential pressure setting Δp_{HD}**
Valve setting range **1** Δp 100 to 420 bar (see type code)	420 bar
	400 bar
	360 bar
	340 bar
	320 bar
	300 bar
	270 bar
	250 bar
	230 bar
	200 bar
	150 bar
	100 bar

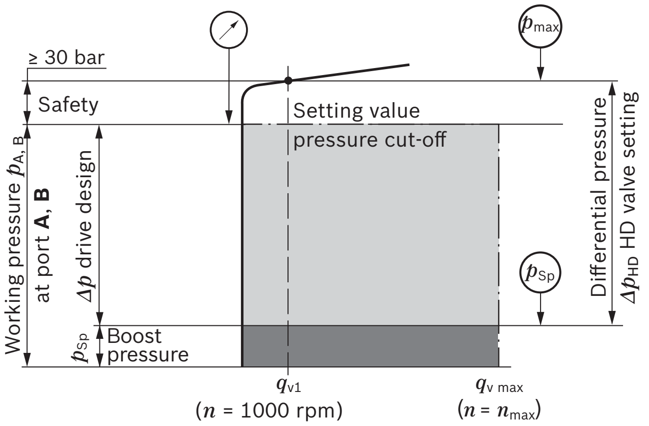
Settings on high-pressure relief valve A and B	
Differential pressure setting	Δp_{HD} = ... bar
Cracking pressure of the HD valve (at $q_{V\,1}$) ($p_{max} = \Delta p_{HD} + p_{Sp}$)	p_{max} = ... bar

- ▶ The valve settings are made at n = 1000 rpm and at $V_{g\,max}$ ($q_{v\,1}$). There may be deviations in the cracking pressures with other operating parameters.
- ▶ When ordering, state differential pressure setting in plain text.

▼ Example

Working pressure		**Boost pressure**		**Safety**		**Differential pressure**
$p_{A,B}$ 400 bar	–	p_{Sp} 30 bar	+	30 bar	=	Δp_{HD} **400 bar**

▼ Setting diagram



Bypass function

A connection between the two high-pressure channels **A** and **B** can be established using the bypass valve (e.g. for machine towing).

- ▶ **Towing speed**
  The maximum towing speed is dependent on the gear ratio in the vehicle and must be calculated by the vehicle manufacturer. The corresponding flow of q_v = 30 l/min may not be exceeded.
- ▶ **Towing distance**
  The vehicle may only be towed out of the immediate danger zone.

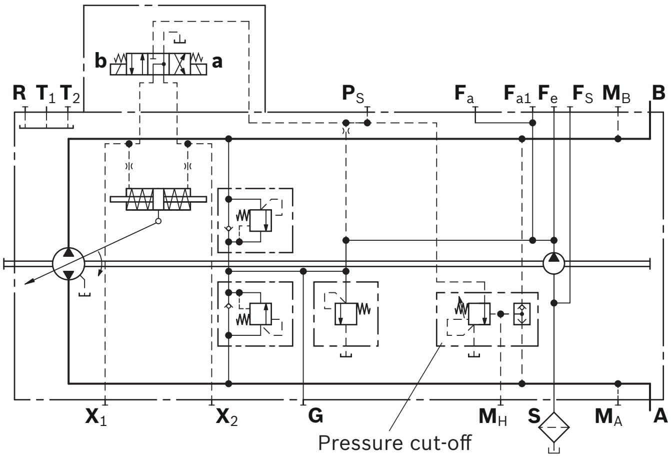
For further information on the bypass function, see the instruction manual.

Notice
The bypass function and the pilot-operated high pressure relief valves (size 71 to 125) are not illustrated in the circuit diagrams.

Pressure cut-off

The pressure cut-off is a pressure control which, after reaching the set pressure, adjusts the displacement of the pump back to $V_{g\ min}$.
This valve prevents the operation of the high-pressure relief valves when accelerating or decelerating.
The high-pressure relief valves protect against the pressure peaks which occur during fast swiveling of the swashplate and limit the maximum pressure in the system.
The setting range of the pressure cut-off may be anywhere within the entire working pressure range. However, it must be set 30 bar lower than the setting value of the high-pressure relief valves (see setting diagram, page 55).
Please state the setting value of the pressure cut-off in plain text when ordering.

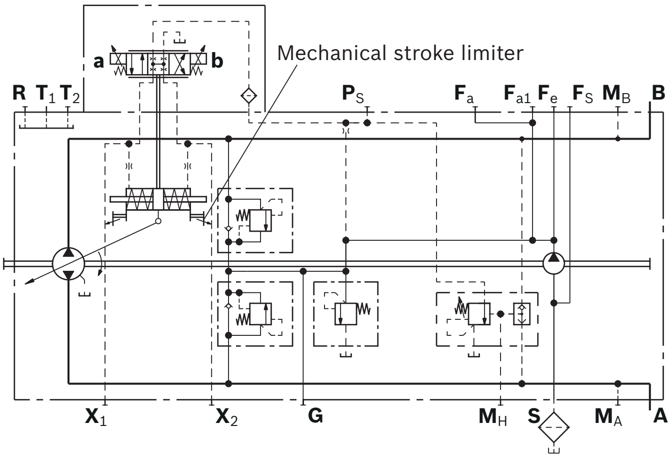
▼ **Circuit diagram with pressure cut-off**
Example: Two-point electric control, EZ1D/EZ2D



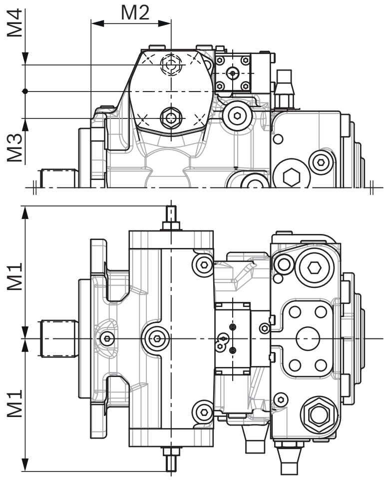
Mechanical stroke limiter

The mechanical stroke limiter is an auxiliary function allowing the maximum displacement of the pump to be steplessly reduced, regardless of the control module used.
By means of two threaded pins, the stroke of the stroking piston and thus the maximum swivel angle of the pump can be limited.

▼ **Circuit diagram**[1)]



Dimensions



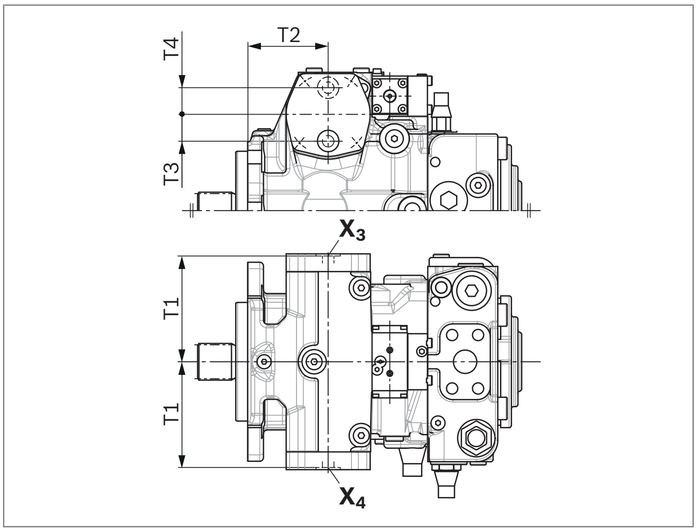
NG	M1 max	M2	M3	M4
28	110.6	40.1	24	–
40	110.6	38.1	24	
56	130.5	44	25.5	–
71	135.4	86.3	–	28.5
90	147	95.7	31.5	–
125	173.7	104.5	–	35.5

---

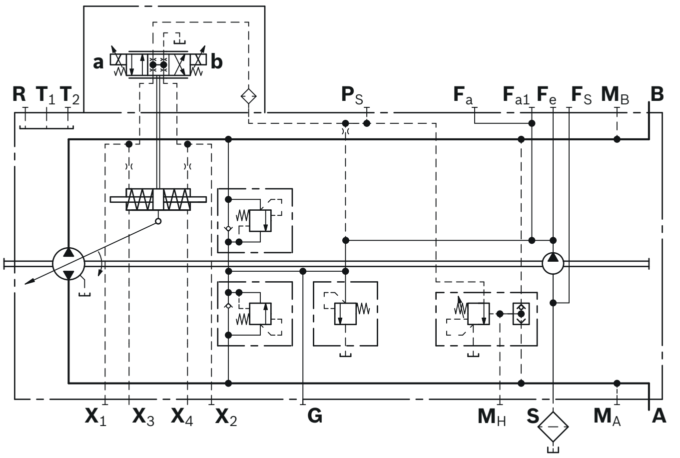
1) Size 28 without port $\mathbf{F}_{a1}$ and $\mathbf{F}_S$

Stroking chamber pressure port X_3 and X_4

Dimensions



▼ Circuit diagram[1]



NG	T1	T2	T3	T4
28	92	40.1	–	24
40	92	38.1	–	24
56	104.5	44	–	25
71	113.5	86.3	28	–
90	111.5	95.7	–	30
125	136	104.5	34	–

Ports		Standard[2]	Size	p_{max} [bar][3]	State[4]
X_3, X_4	Stroking chamber pressure port	DIN 3852	M12 × 1.5; 12 deep	40	X

---

[1] Size 28 without port **F_{a1}** and **F_S**

[2] The countersink can be deeper than as specified in the standard.

[3] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

[4] X = Plugged (in normal operation)

Filtration in the boost pump suction line

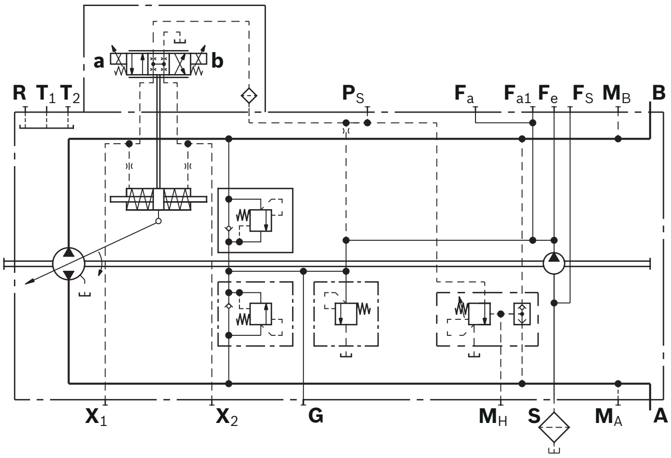
Version S

Filter version	Suction filter without bypass
Recommendation	With contamination indicator
Recommended flow resistance at filter element	
At $\nu = 30\ \text{mm}^2/\text{s}$, $n = n_{\text{max}}$	$\Delta p \leq 0.1$ bar
At $\nu = 1000\ \text{mm}^2/\text{s}$, $n = n_{\text{max}}$	$\Delta p \leq 0.3$ bar
Pressure at suction port S	
Continuous $p_{\text{S min}}$ ($\nu \leq 30\ \text{mm}^2/\text{s}$)	≥ 0.8 bar absolute
Short-term, at a cold start ($t < 3$ min)	≥ 0.5 bar absolute
Maximum pressure $p_{\text{S max}}$	≤ 5 bar absolute

Use of version S is preferred.

The suction filter is not included in the scope of delivery.

▼ **Circuit diagram**



Filtration in the boost pump pressure line

Version D

Ports for external boost circuit filtration

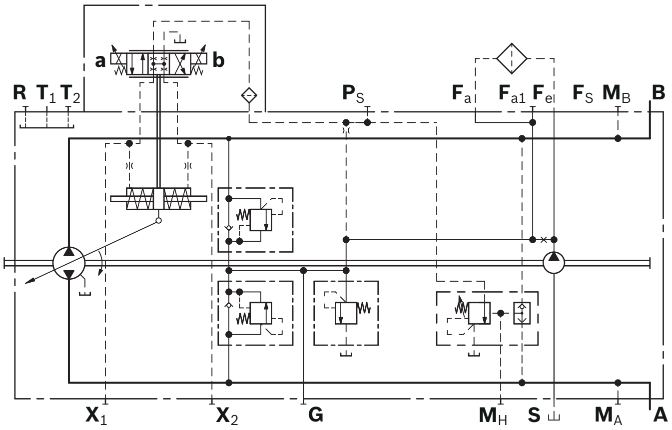
Ports	
Boost pressure inlet	Port **F_a**
Boost pressure outlet	Port **F_e**
Filter version	**Boost pressure filter without bypass**
Recommendation	With contamination indicator
Filter arrangement	**Separate in the pressure line (inline filter)**
Permissible flow resistance at filter element[1]	
At $\nu = 30\ \text{mm}^2/\text{s}$	$\Delta p \leq 1$ bar
For cold start	$\Delta p \leq 3$ bar

Notice

- ▶ Filters with a bypass **not recommended**, (exception DG, see below). Please contact us for applications with a bypass.
- ▶ On versions with DG control (with pilot pressure not from a boost circuit), a filter **with** a bypass and **with** a contamination indicator must be used.

The boost pressure filter is not included in the scope of delivery.

▼ **Circuit diagram**



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[1] Valid for entire speed range n_{min} to n_{max}

Filtration in the boost pump pressure line

Version F[3)]

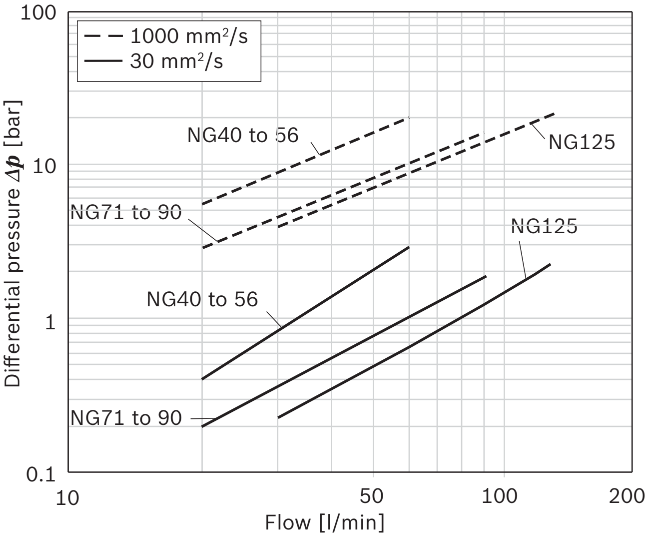
Attachment filter with cold start valve

Filter version	Attachment filter without bypass
Recommendation	Version with contamination indicator, see P, B (differential pressure Δp = 5 bar)
Filter grade (absolute)	20 µm
Filter material	Glass fiber
Pressure rating	100 bar
Filter arrangement	Mounted on pump

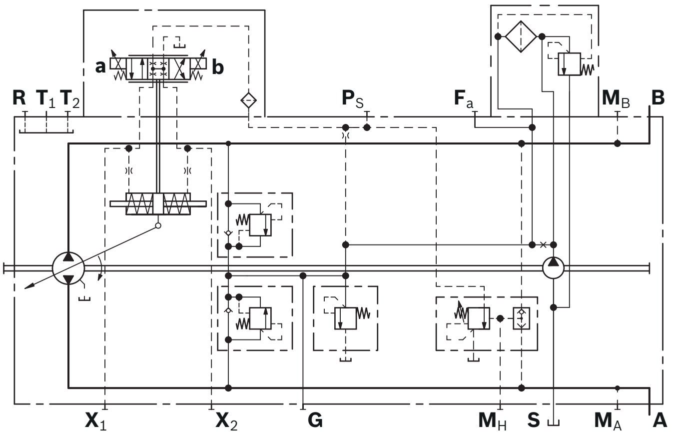
The attachment filter is equipped with a cold start valve and thereby protects the pump from damage. The valve opens at flow resistance of $\Delta p \geq 6$ bar.

▼ Filter characteristics

Differential pressure/flow characteristics to ISO 3968 (valid for clean filter element).



▼ Circuit diagram



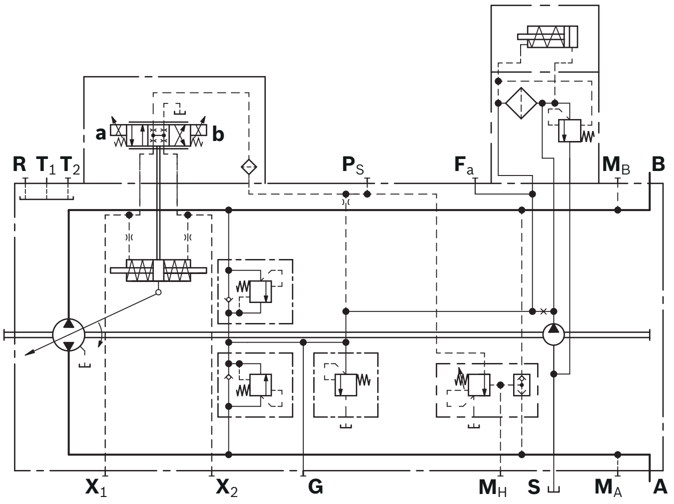
Version P[1)]

Attachment filter with cold start valve and visual contamination indicator

Filtration similar to version F, however with additional visual contamination indicator.

Technical data	
Display type	Green/red window
Differential pressure (switching pressure)	Δp = 5 bar

▼ Circuit diagram



[1)] Valid for entire speed range $n_{\text{min}} - n_{\text{max}}$

[2)] Thread according to DIN 3852;
The countersink may be deeper than specified in the standard.

[3)] To protect the filter element against electrostatic charge, the hydraulic fluid must have a minimum conductivity of 300 pS/m on versions with attachment filter F, P and B. Please contact us if this value cannot be observed.

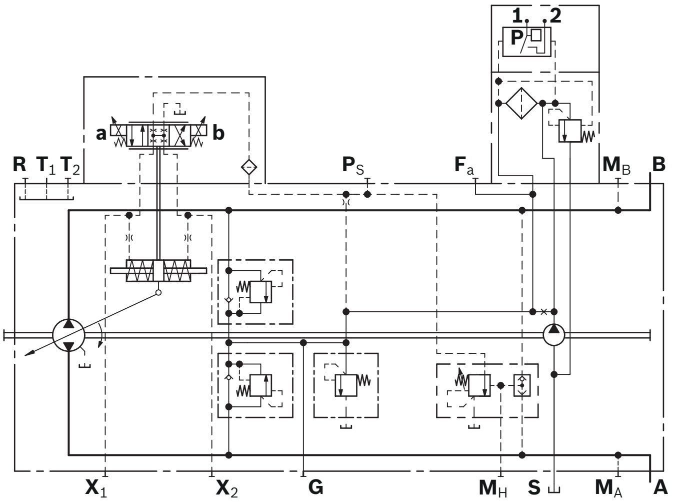
Version B[1)]

Attachment filter with cold start valve and electric contamination indicator

Filtration similar to version F, however with additional electric contamination indicator.

Technical data		
Display type	Electrical	
Connector version (mating connector, see page 64)	DEUTSCH DT04-2P-EP04	
Differential pressure (switching pressure)	Δp = 5 bar	
Maximum switching capacity	12 V DC	24 W
	24 V DC	48 W
Type of protection IP67	DIN EN 60529	

▼ **Circuit diagram**

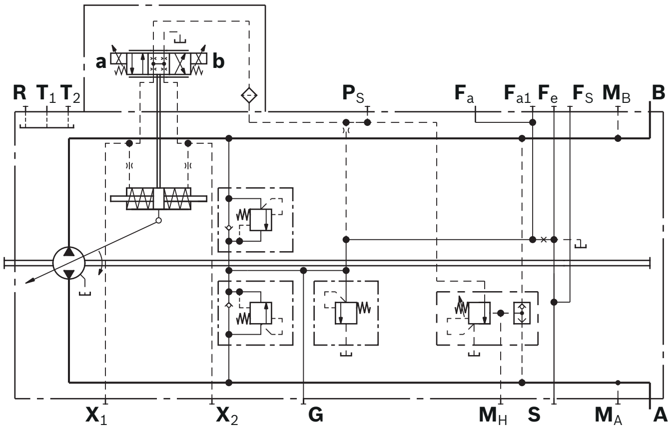


External boost pressure supply

Version E

This variation should be used in versions without integrated boost pump (**N** and **K**).
Port **S** is plugged.
The boost pressure supply comes from port **F**$_a$.
The filter should be installed separately on port **F**$_a$ before the boost pressure supply.
To ensure the functional reliability, maintain the required cleanliness level for the boost fluid fed in at port **F**$_a$ (see page 6).

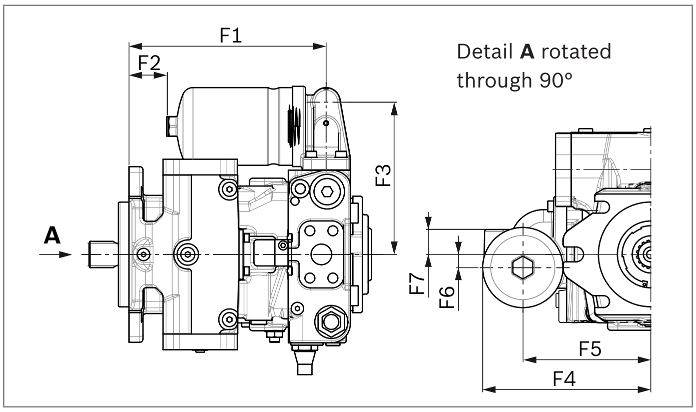
▼ **Circuit diagram**



[1)] To protect the filter element against electrostatic charge buildup, the hydraulic fluid must have a minimum conductivity of 300 pS/m on versions with attachment filter F, P and B. Please contact us if this value cannot be observed.

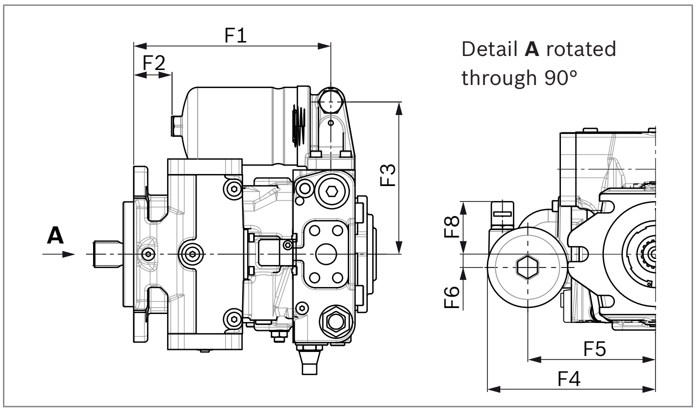
Dimensions with filter fitted

▼ **Version F**
Attachment filter with cold start valve

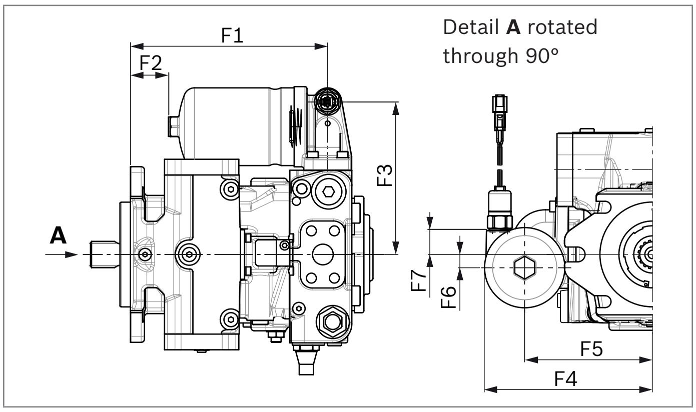


NG	F1	F2	F3	F4	F5	F6	F7	F8
40	201.7	47.7	160	175	135	0	42	78.5
56	218.4	64.4	163	178	138	0	42	78.5
71	239	46.5	185	203.5	155	16	29	65.5
90	248.5	56	179	197.5	149	0	45	81.5
125	235.9	59.4	201	219.5	171	0	53	89.5

▼ **Version P**
Attachment filter with cold start valve and visual contamination indicator



▼ **Version B**
Attachment filter with cold start valve and electric contamination indicator



Swivel angle sensor

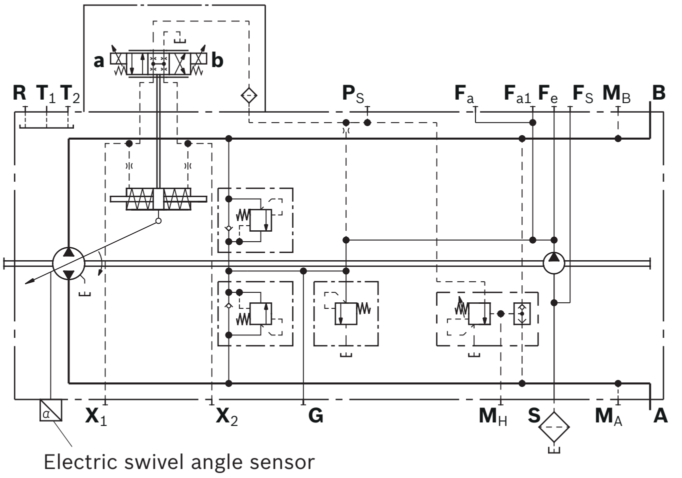
The swivel angle sensor is used to detect the swivel angle of axial piston units and thus the displacement using a Hall-effect based sensor IC. The determined measurement value is converted into an analog signal.
Please contact us if the swivel angle sensor is used for control.

Characteristics			
Supply voltage U_b	10 to 30 V DC		
Output voltage U_a	0.5 V ($V_{g\,max}$)	2.5 V ($V_{g\,0}$)	4.5 V ($V_{g\,max}$)
Reverse polarity protection	Short-circuit resistant		
EMC resistance	Details on request		
Operating temperature range	-40 °C to +115 °C		
Vibration resistance, sinusoidal vibration EN 60068-2-6	10 g / 5 to 2000 Hz		
Shock resistance: continuous shock IEC 68-2-29	25 g		
Salt spray resistance (DIN 50 021-SS)	96 h		
Type of protection with installed mating connector	IP67 – DIN/EN 60529 IP69K – DIN 40050-9		
Housing material	Plastic		
Connector version	AMP Super Seal 1.5		

Output voltage

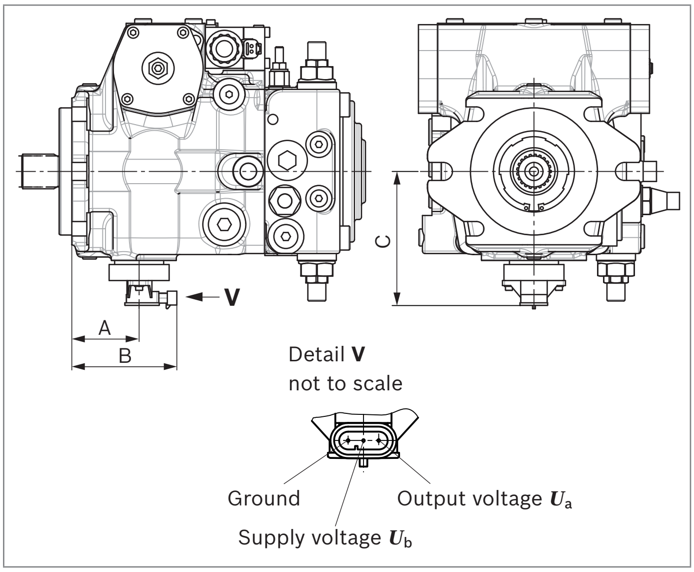
Direction of rotation	Flow direction	Working pressure	Output voltage at $V_{g\,0}$	Output voltage at $V_{g\,max}$
clockwise	**A** to **B**	**M**$_B$	2.5 V	4.5 V
	B to **A**	**M**$_A$	2.5 V	0.5 V
counter-clockwise	**B** to **A**	**M**$_A$	2.5 V	4.5 V
	A to **B**	**M**$_B$	2.5 V	0.5 V

▼ Circuit diagram



Electric swivel angle sensor

Dimensions



Detail **V**
not to scale

NG	A	B	C
28	56.6	94	119
40	58.6	96	119
56	60.5	97.5	128.5
71	71.6	108.6	137.5
90	70.7	107.7	145.5
125	78	115	152.5

Mating connector AMP Superseal 1.5; 3-pin

Consisting of	AMP No.
1 socket housing, 3-pin	282087-1
3 single-wire seals, yellow	281934-2
3 socket contacts 1.8 - 3.3 mm	183025-1

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902602132).

Notice
It is not possible to retrofit existing units with a swivel angle sensor.

Connector for solenoids

DEUTSCH DT04-2P-EP04

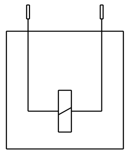
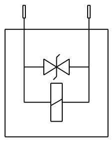
- **P**: Molded, 2-pin, without bidirectional suppressor diode (standard).
- **Q**: Molded, 2-pin, with bidirectional suppressor diode (only for switching solenoids on control module EZ and DA)

The following type of protection ensues with the installed mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)

The protection circuit with bidirectional suppressor diode is needed to limit overvoltages. Overvoltages are caused by switching off the current with switches, relay contacts or by disconnecting the mating connector while voltage is applied.

▼ **Switching symbol**

Without bidirectional suppressor diode	**With** bidirectional suppressor diode
	

▼ **Mating connector DEUTSCH DT06-2S-EP04**

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).

Notice

- If necessary, you can change the position of the connector by turning the solenoid.
- The procedure is defined in the instruction manual.

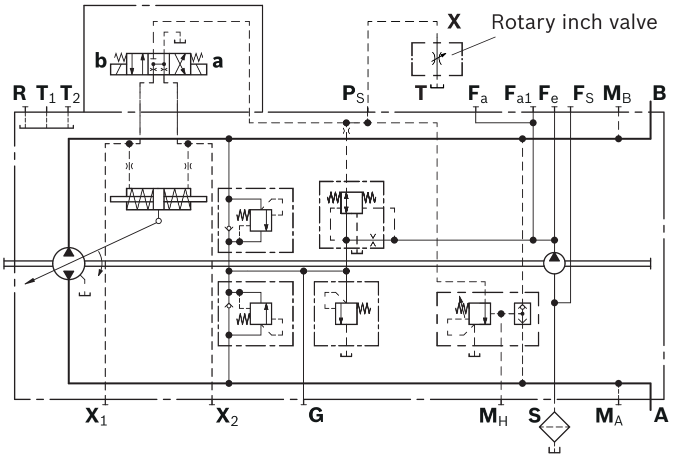
Rotary inch valve

Any reduction of the pilot pressure possible, independently of the drive speed, through mechanical actuation of the position lever. Maximum angle of rotation 90°, lever position: any.
The valve is arranged separately from the pump and is connected to the pump by a hydraulic control line via port **P**$_S$ (maximum line length: approx. 2 m).
The rotary inch valve must be ordered separately.

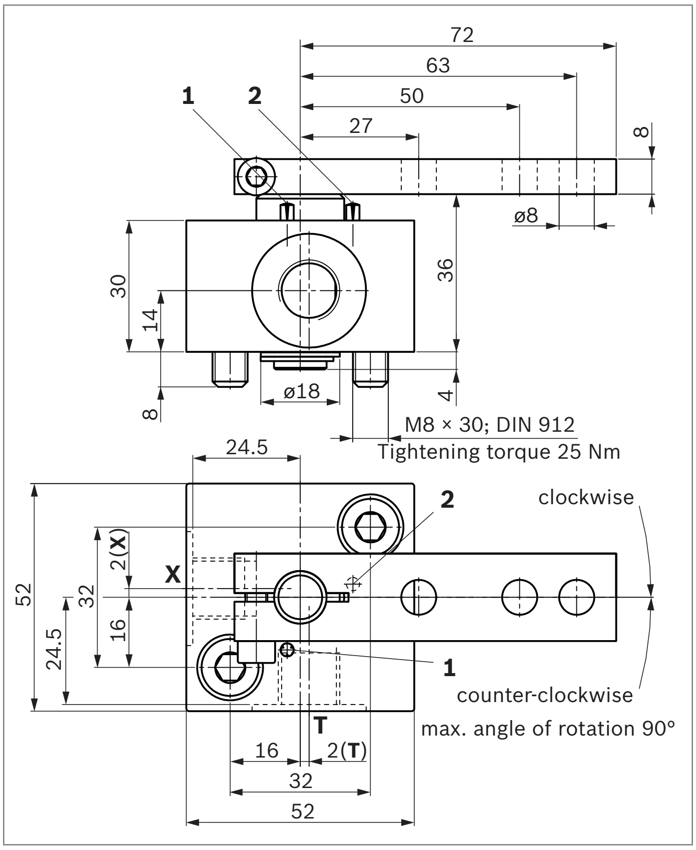
NG	Material number	Direction of actuation of the position lever	Throttle cross-section ⌀
28, 40, 56, 71, 90	R902048734	Clockwise	4.6
	R902048735	Counter-clockwise	4.6
	R902070172	Clockwise	2.7
	R902066994	Counter-clockwise	2.7
125	R902048740	Clockwise	4.7
	R902048741	Counter-clockwise	4.7

Notice
The rotary inch valve can be used regardless of the control module.

▼ **Circuit diagram:**
Hydraulic control, speed-related,
DA with separately attached rotary inch valve



Dimensions



Notice
Limitation **1** and **2** are function stops for inching. They are not to be used as a mechanical limitation within the system. We recommend limiting the angle of rotation to 85° within the system.

Ports		Standard[1]	Size	p_{max} [bar][2]	State[3]
X	Pilot pressure port	DIN 3852	M14 x 1.5; 12 deep	40	O
T	Drain port	DIN 3852	M14 x 1.5; 12 deep	3	O

1) The countersink can be deeper than as specified in the standard.
2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
3) O = Must be connected (plugged on delivery)

Installation dimensions for coupling assembly

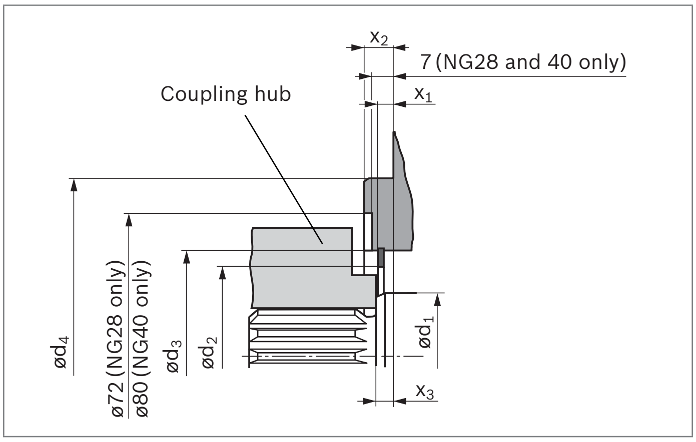
To ensure that rotating components (coupling hub on drive shaft) and fixed components (housing, snap ring) do not come into contact with each other, the installation conditions described here must be observed. This depends on the pump size and the splined shaft.

SAE splined shaft (spline according to ANSI B92.1a)

Splined shaft **S** or **T**

The outer diameter of the coupling hub must be smaller than the inner diameter of the snap ring (dimension d_2) in the area near the drive shaft collar (dimension $x_2 - x_3$).

Observe diameter of relief on sizes 28 and 40.

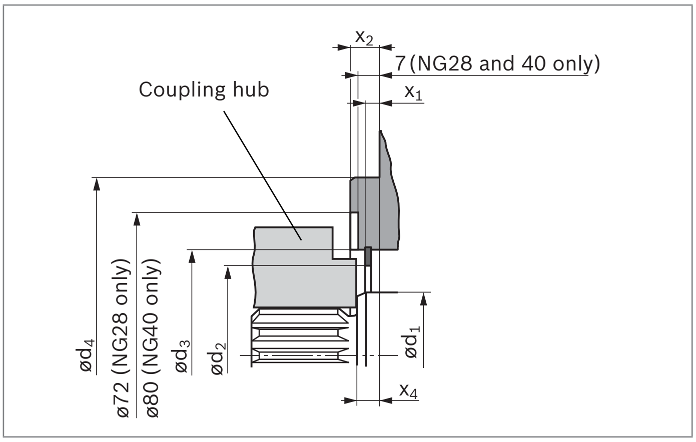


DIN splined shaft (spline according to DIN 5480)

Splined shaft **Z** or **A**

The outer diameter of the coupling hub must be smaller than the case diameter d_3 in the area near the drive shaft collar (dimension $x_2 - x_4$).

Observe diameter of relief on sizes 28 and 40.



NG	ød_1	ø$d_{2\ min}$	ød_3	ød_4	x_1	x_2	x_3	x_4
28	35	43.4	55±0.1	101.6	$3.3^{+0.2}$	$9.5_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$
40	40	51.4	63±0.1	127	$4.3^{+0.2}$	$12.7_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$
56	40	54.4	68±0.1	127	$7.0^{+0.2}$	$12.7_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$
71	45	66.5	81±0.1	127	$7.0^{+0.2}$	$12.7_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$
90	50	66.5	81±0.1	152.4	$6.8^{+0.2}$	$12.7_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$
125	55	76.3	91±0.1	152.4	$7.0^{+0.2}$	$12.7_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$

Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.
Particularly in the installation position “drive shaft upwards”, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.
The leakage in the housing area must be directed to the reservoir via the highest drain port (**T**$_1$, **T**$_2$). For combination pumps, the leakage must be drained off at each pump.
If a shared drain line is used for several units, make sure that the respective case pressure is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operating conditions, specifically on cold start. If this is not possible, separate drain lines must be laid if necessary.
To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.
Under all operating conditions, the suction line and drain line must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\ max}$ = 800 mm.
The suction pressure at port **S** must also not fall below the minimum value of 0.8 bar absolute during operation (cold start 0.5 bar absolute).

Installation position

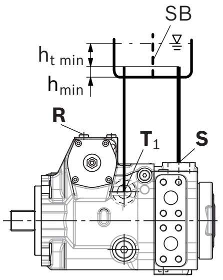
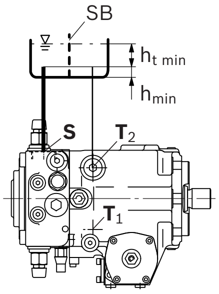
See the following examples 1 to 12.
Further installation positions are available upon request.
Recommended installation position: 1 and 2.

Notice

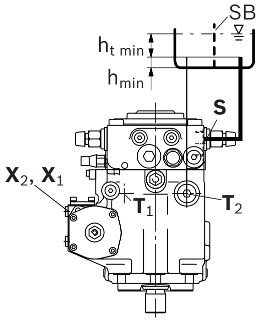
- Size 71 to 125
  For installation position “drive shaft upward”, an **R**$_1$ port is needed (special version).
- If filling the stroking chambers via **X**$_1$ to **X**$_4$ is not possible in the final installation position, then this must take place before installation, e. g. in installation position 2.
- To prevent unexpected actuation and damage, the stroking chambers must be air bled via the ports **X**$_1$, **X**$_2$, or **X**$_3$, **X**$_4$ depending on the installation position.
- In certain installation positions, an influence on the control characteristic can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristic curves and changes in response time.

Below-reservoir installation (standard)

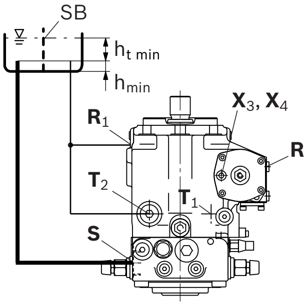
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir and below the minimum fluid level of the reservoir.

Installation position	Air bleeding the housing	Air bleeding the stroking chamber	Filling
1	**R**	**X**$_1$, **X**$_2$	**S** + **T**$_1$ + **X**$_1$ + **X**$_2$
			
2	–	–	**S** + **T**$_2$
			

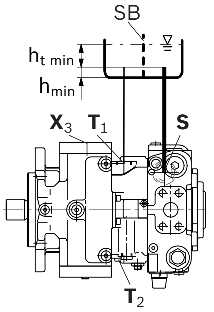
Installation position	Air bleeding the housing	Air bleeding the stroking chamber	Filling
3	–	**X**$_1$, **X**$_2$	**S** + **T**$_2$ + **X**$_1$ + **X**$_2$



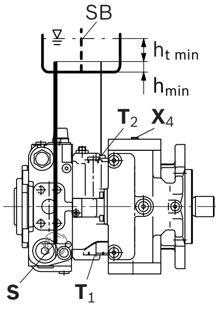
4	**R**$_1$	**X**$_3$, **X**$_4$	**S** + **T**$_2$ + **X**$_3$ + **X**$_4$



5	–	**X**$_3$	**S** + **T**$_1$ + **X**$_3$



6	–	**X**$_4$	**S** + **T**$_2$ + **X**$_4$

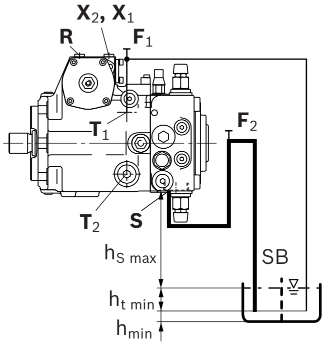


Above-reservoir installation

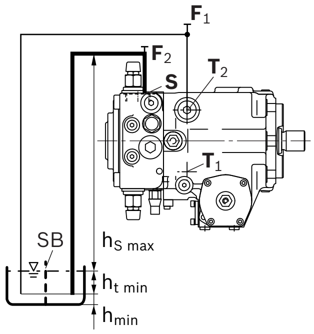
Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.

Recommendation for installation position 10 (drive shaft upward): A check valve in the drain line (cracking pressure 0.5 bar) can prevent the housing area from draining.

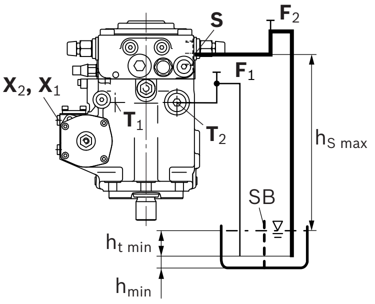
Installation position	Air bleeding the housing	Air bleeding the stroking chamber	Filling
7	**F**$_2$ + **R**	**X**$_1$, **X**$_2$	**F**$_1$ + **F**$_2$ + **X**$_1$ + **X**$_2$

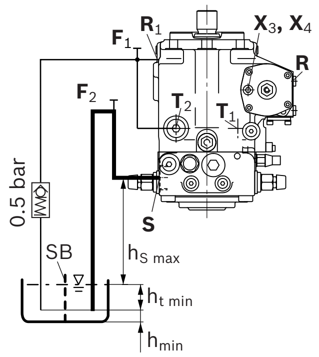
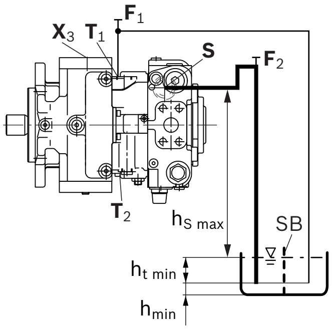
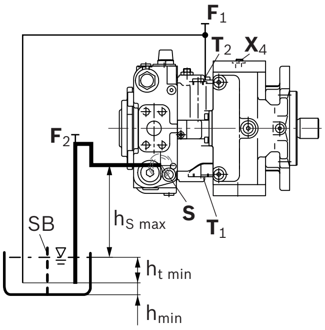


8	**F**$_2$ (**S**) + **F**$_1$ (**T**$_2$)	–	**F**$_2$ (**S**) + **F**$_1$ (**T**$_2$)



9	**F**$_2$ (**S**) + **F**$_1$ (**T**$_2$)	**X**$_1$, **X**$_2$	**F**$_2$ (**S**) + **F**$_1$ (**T**$_2$) + **X**$_1$ + **X**$_2$



Installation position	Air bleeding the housing	Air bleeding the stroking chamber	Filling
10	$\mathbf{F}_2$ + $\mathbf{R}_1$	$\mathbf{X}_3$, $\mathbf{X}_4$	$\mathbf{F}_1$ + $\mathbf{F}_2$ + $\mathbf{X}_3$ + $\mathbf{X}_4$
			
11	$\mathbf{F}_2$ (**S**) + $\mathbf{F}_1$ ($\mathbf{T}_1$)	$\mathbf{X}_3$	$\mathbf{F}_2$ (**S**) + $\mathbf{F}_1$ ($\mathbf{T}_1$) + $\mathbf{X}_3$
			
12	$\mathbf{F}_2$ (**S**) + $\mathbf{F}_1$ ($\mathbf{T}_2$)	$\mathbf{X}_4$	$\mathbf{F}_2$ (**S**) + $\mathbf{F}_1$ ($\mathbf{T}_2$) + $\mathbf{X}_4$
			

Key	
$\mathbf{F}_1$, $\mathbf{F}_2$	Filling / air bleeding
R	Air bleed port
$\mathbf{R}_1$	Air bleed port (special version)
S	Suction port
$\mathbf{T}_1$, $\mathbf{T}_2$	Drain port
$\mathbf{X}_1$, $\mathbf{X}_2$	Control pressure port
$\mathbf{X}_3$, $\mathbf{X}_4$	Stroking chamber pressure port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)

Notice

Ports $\mathbf{F}_1$ and $\mathbf{F}_2$ are part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

Project planning notes

- The pump A4VG is designed to be used in closed circuit.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes contained herein must be observed.
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all versions of the product are approved for use in a safety function according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference.
  Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- The pressure cut-off is not a safeguard against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- Please note the details regarding the tightening torques of port threads and other threaded joints in the instruction manual.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports are only intended to accommodate hydraulic lines.

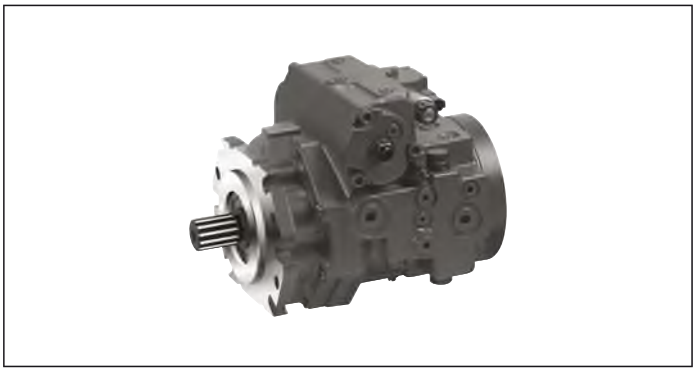
Safety instructions

- During and shortly after operation, there is a risk of getting burnt on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve spools) can, under certain circumstances get blocked in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filter) will not rule out a fault but merely reduce the risk.

  The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.
- Moving parts in high-pressure relief valves may in certain circumstances become stuck in an undefined position due to contamination (e.g. impure hydraulic fluid). This can result in restriction or loss of the load holding function in lifting winches.

  The machine/system manufacturer must check whether additional measures are required on the machine for the relevant application in order to keep the load in a safe position and ensure they are properly implemented.

Axial piston variable pump
A4VG Series 40



- High-pressure pump for applications in a closed circuit up to 500 bar
- Size 110...280
- Nominal pressure 450 bar
- Maximum pressure 500 bar
- Closed circuit

Features

- High power density owing to a very high pressure level
- Integrated auxiliary pump for boost and pilot oil supply
- Flow direction changes smoothly when the swashplate is moved through the neutral position
- High-pressure relief valves with integrated boost function
- With adjustable pressure cut-off as standard
- Boost-pressure relief valve
- Through drive for mounting of further pumps up to same nominal size
- High total efficiency
- Large variety of controls
- Swashplate design

Contents

Type code

01	02	03	04	05	06	07	08	09		10	11	12	13	14	15	16	17	18	19	20	21	22		23
A4V	**G**								**/**	**40**	**M**		**N**						**A**		**0**		**–**	

Axial piston unit

01	Swashplate design, variable, nominal pressure 450 bar, maximum pressure 500 bar	**A4V**

Operating mode

02	Pump, closed circuit	**G**

Size (NG)

03	Geometric displacement, see “Technical data” on page 9	**110**	**125**	**145**	**175**	**210**	**280**

Control device

					110	**125**	**145**	**175**	**210**	**280**	
04	Proportional control, hydraulic	pilot-pressure related p = 6 to 18 bar			–	○	○	○	○	○	**HP1**
		mechanical servo, hexagon shaft with lever, free position			–	●	●	●	●	●	**HW2**
			with neutral position switch		–	●	●	●	●	●	**HW8**
	Hydraulic control, direct operated				–	●	●	●	●	●	**HT1**
	Automatic control, speed related			U = 12 V	●	●	●	●	●	●	**DA1**
				U = 24 V	●	●	●	●	●	●	**DA2**
	Proportional control, electric			U = 12 V	●	●	●	●	●	●	**EP1**
				U = 24 V	●	●	●	●	●	●	**EP2**
		with manual override and spring return		U = 12 V	●	●	●	●	●	●	**EP3**
				U = 24 V	●	●	●	●	●	●	**EP4**
	Two-point control, electric			U = 12 V	●	●	●	●	●	●	**EZ1**
				U = 24 V	●	●	●	●	●	●	**EZ2**
	Electric control, direct operated, 4/3-way directional valve, one pressure reducing valve (DRE)			U = 12 V	●	●	●	●	○	○	**EV1**
				U = 24 V	●	●	●	●	○	○	**EV2**
	Electric control, direct operated, two pressure reducing valves (DRE)			U = 12 V	●	●	●	●	○	○	**ET5**
				U = 24 V	●	●	●	●	○	○	**ET6**

Pressure cut-off

05	Without pressure cut-off	without bypass	**0**
		with bypass	**C**
	Pressure cut-off, with bypass (not for HT)	Fixed setting, hydraulic, mechanical	**D**

Connector for solenoids[1]

06	Without connector (only for purely hydraulic control)	**0**
	DEUTSCH molded connector, 2-pin – without suppressor diode	**P**

Swivel angle sensor

07	Without swivel angle sensor	**0**
	Electric swivel angle sensor (DWS20-1, 3-pin)[2]	**R**

● = Available ○ = On request – = Not available ▨ = Preferred program

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[1] Connectors for other electric components may deviate.

[2] Please contact us if the swivel angle sensor is used for control

01	02	03	04	05	06	07	08	09		10	11	12	13	14	15	16	17	18	19	20	21	22		23
A4V	**G**								**/**	**40**	**M**		**N**						**A**		**0**		**–**	

Additional function

08	Without additional function		**0**
	Mechanical stroke limiter, externally adjustable		**M**
	Stroking chamber pressure port **X**$_3$, **X**$_4$		**T**
	Mechanical stroke limiter and stroking chamber pressure port **X**$_3$, **X**$_4$		**B**
	Neutral valve U = 12 V[3]		**N**
		and mechanical stroke limiter, externally adjustable	**P**
		and ports **X**$_3$, **X**$_4$ for stroking chamber pressure	**R**
		and mechanical stroke limiter and ports **X**$_3$, **X**$_4$	**S**
	Neutral valve U = 24 V[3]		**U**
		and mechanical stroke limiter, externally adjustable	**V**
		and ports **X**$_3$, **X**$_4$ for stroking chamber pressure	**W**
		and mechanical stroke limiter and ports **X**$_3$, **X**$_4$	**Y**

DA control valve

			HP	**HW**	**HT**	**DA**	**EP**	**EZ**	**EV**	
09	Without DA control valve		●	●	●	–	●	●	●	**0**
	DA control valve, fixed setting		●	●	●	●	●	–	–	**1**
	DA control valve, mechanically adjustable with position lever	direction of actuation, clockwise	●	●	●	●	●	–	–	**2**
		direction of actuation, counter-clockwise	●	●	●	●	●	–	–	**3**
	DA control valve, fixed setting and brake inch valve mounted, control with brake fluid	based on mineral oil	–	–	–	●	–	–	–	**5**
	DA control valve, fixed setting, ports for pilot control device		●	●	●	●	●	–	–	**6**

Series

10	Series 4, index 0	**40**

Configuration of port and fastening threads

11	Metric, ISO 6149 with O-ring seal	**M**

Direction of rotation

12	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Sealing material

13	NBR (nitrile rubber), shaft seal in FKM (fluoroelastomer)	**N**

Mounting flange

			110	**125**	**145**	**175**	**210**	**280**	
14	SAE J744	127-2/4	●	●	–	–	–	–	**C6**
		152-2/4	●	●	●	●	–	–	**D6**
		165-4	○	–	–	●	●	●	**E4**

Drive shaft

				110	**125**	**145**	**175**	**210**	**280**	
15	Splined shaft ANSI B92.1a–1976	1 3/8 in	21T 16/32DP	●	–	–	–	–	–	**V8**
		1 3/4 in	13T 8/16DP	●	●	●	●	–	–	**T1**
		2 in	15T 8/16DP	●	●	●	–	●	●	**T2**
		2 1/4 in	17T 8/16DP	–	–	●	●	●	●	**T3**
	Splined shaft DIN 5480	W40×2×18×9		●	–	–	–	–	–	**Z9**
		W45×2×21×9		●	●	●	●	●	–	**A1**
		W50×2×24×9		–	–	●	●	–	–	**A2**
		W55×2×26×9		–	–	–	–	●	●	**A3**

● = Available ○ = On request – = Not available ▨ = Preferred program

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[3] Cannot be combined with EV or brake inch valve

4

01	02	03	04	05	06	07	08	09		10	11	12	13	14	15	16	17	18	19	20	21	22		23
A4V	**G**								**/**	**40**	**M**		**N**						**A**		**0**		**–**	

Working port

16	SAE working port **A** and **B**, on left side (45° left)	**1**
	SAE working port **A** and **B**, on right side (45° right)[4]	**2**

Boost pump and rotary group configuration

			110	125	145	175	210	280	
17	Standard rotary group	Boost pump integrated, through drive convertible	●	●	●	●	●	●	**F**
		without boost pump, through drive convertible	●	●	●	●	●	●	**U**
	High-speed rotary group	Boost pump integrated, through drive convertible	●	–	●	●	–	–	**V**
		without boost pump, through drive convertible	●	–	●	●	–	–	**W**

Through drive[5]

	Flange SAE J744 Diameter	Mounting[7]	Code	Hub for splined shaft[6] Diameter		Code	110	125	145	175	210	280	
18	Without through drive						●	●	●	●	●	●	**0000**
	82-2 (A)	⦂	A1	5/8 in	9T 16/32DP	S2	●	–	●	●	–	○	**A1S2**
			A1	3/4 in	11T 16/32DP	S3	●	–	●	●	●	●	**A1S3**
		⚯	A2	5/8 in	9T 16/32DP	S2	●	●	●	●	○	●	**A2S2**
			A2	3/4 in	11T 16/32DP	S3	●	–	●	●	●	●	**A2S3**
	101-2 (B)	⦂	B1	7/8 in	13T 16/32DP	S4	●	●	●	●	●	●	**B1S4**
			B1	1 in	15T 16/32DP	S5	●	–	●	●	●	●	**B1S5**
		⚯	B2	7/8 in	13T 16/32DP	S4	●	●	●	●	●	●	**B2S4**
			B2	1 in	15T 16/32DP	S5	●	–	●	●	○	○	**B2S5**
		☍	B5	7/8 in	13T 16/32DP	S4	●	–	●	○	○	○	**B5S4**
			B5	1 in	15T 16/32DP	S5	○	–	●	○	●	●	**B5S5**
	101-4 (B)	⌘	B4	7/8 in	13T 16/32DP	S4	○	–	●	○	●	○	**B4S4**
			B4	1 in	15T 16/32DP	S5	●	–	●	○	○	○	**B4S5**
	127-2 (C)	⦂	C1	1 in	15T 16/32DP	S5	–	–	○	–	–	–	**C1S5**
			C1	1 1/4 in	14T 12/24DP	S7	●	–	●	○	○	○	**C1S7**
		⚯	C2	1 1/4 in	14T 12/24DP	S7	●	●	●	●	●	●	**C2S7**
			C2	1 3/8 in	21T 16/32DP	V8	○	–	●	●	–	–	**C2V8**
			C2	1 3/4 in	13T 8/16DP	T1	–	–	●	●	–	–	**C2T1**
		☍	C5	1 1/4 in	14T 12/24DP	S7	●	–	●	○	○	○	**C5S7**
	127-4 (C)	⌘	C4	1 1/4 in	14T 12/24DP	S7	●	–	●	●	○	●	**C4S7**
			C4	1 3/8 in	21T 16/32DP	V8	●	●	–	–	–	–	**C4V8**
	152-4 (D)	⌘	D4	1 3/4 in	13T 8/16DP	T1	–	–	●	●	●	●	**D4T1**
	165-4 (E)	⌘	E4	1 3/4 in	13T 8/16DP	T1	–	–	–	●	●	–	**E4T1**
				2 in	15T 8/16DP	T2	–	–	–	–	●	●	**E4T2**

● = Available ○ = On request – = Not available ▨ = Preferred program

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[4] Only possible without attachment filter.

[5] Specifications for version with integrated boost pump, please contact us for version without boost pump

[6] Hub for splined shaft according to ANSI B92.1a-1976 (drive shaft allocation according to SAE J744)

[7] Mounting hole pattern viewed on through drive

01	02	03	04	05	06	07	08	09		10	11	12	13	14	15	16	17	18	19	20	21	22		23
A4V	**G**								**/**	**40**	**M**		**N**						**A**		**0**		**–**	

High-pressure relief valve

19	High-pressure relief valve, direct operated, fixed setting, with low-pressure relief valve, fixed setting	**A**

Filtration boost circuit/external boost pressure supply

20	Filtration in the boost pump suction line	**S**
	Filtration in the boost pump pressure line	**D**
	Ports for external boost circuit filtration (**F_e** and **F_a**)	
	Attachment filter with cold start valve[8]	**F**
	Attachment filter[8] with cold start valve and electric contamination indicator – DEUTSCH connector	**B**
	External boost pressure supply (on version without integrated boost pump)	**E**

Pressure sensor

21	Without pressure sensor	**0**

Other sensors

22	Without sensor	**0**
	Speed sensor DSM, DSA[9]	**V**

Standard / special version

22	Standard version	**0**
	Standard version with installation variants, e.g. **T** ports against standard open or closed	**Y**
	Special version	**S**

● = Available ○ = On request **–** = Not available ▨ = Preferred program

Notice

- ▶ Note the project planning notes on page 71!
- ▶ In addition to the type code, please specify the relevant technical data when placing your order.

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[8] Only available for working ports located on left

[9] Specify type code of sensor acc. to data sheet (DSM - 95132, DSA 95133) separately and observe the requirements on the electronics

Hydraulic fluid

The A4VG variable pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)
- 90225: Axial piston units for operation with water-free and water-containing fire-resistant hydraulic fluids (HFDR, HFDU, HFAE, HFAS, HFB, HFC).

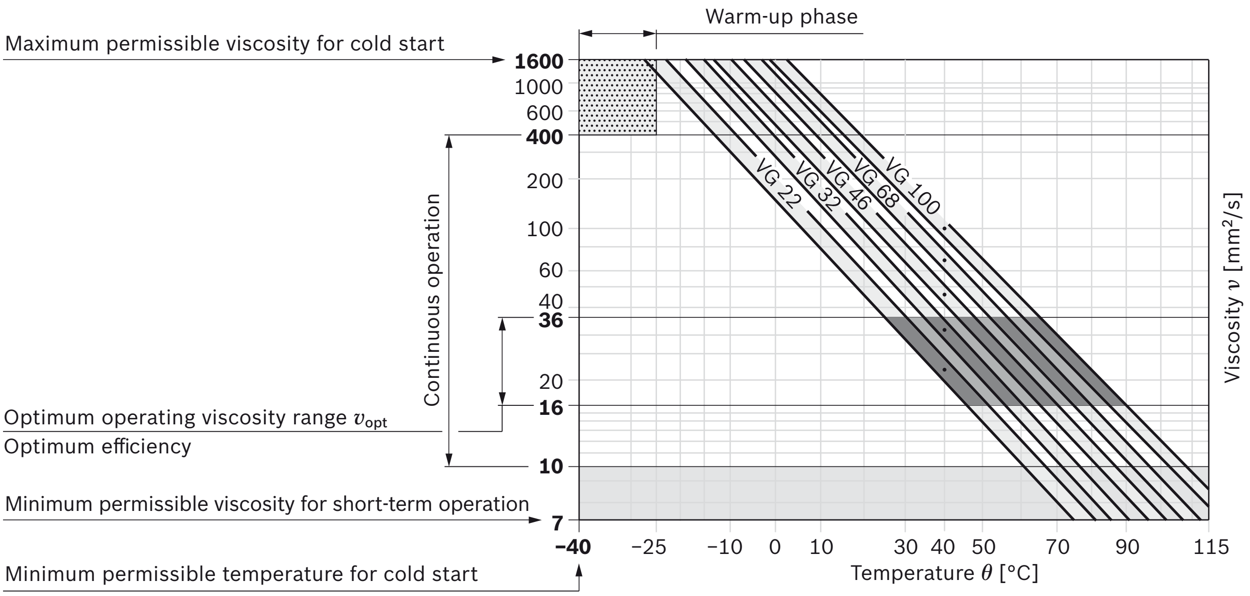
Notes on selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see selection diagram).

Notice
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
Please contact us if the above conditions cannot be met due to extreme operating parameters.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \le 1600$ mm²/s	$\theta_{St} \ge -40$ °C	$t \le 3$ min, $n \le 1000$ min^{-1}, without load $p \le 50$ bar
Permissible temperature difference		$\Delta T \le 25$ K	between axial piston unit and hydraulic fluid in the system
Warm-up phase	ν = 1600 to 400 mm²/s	θ = −40 °C to −25 °C	at $p \le 0.7 \times p_{nom}$, $n \le 0.5 \times n_{nom}$ and $t \le 15$ min
Continuous operation	ν = 400 to 10 mm²/s		this corresponds, for VG 46 for example, to a temperature range of +5 °C to +85 °C (see selection diagram)
		θ = -25 °C to +110 °C	measured at port **T** Observe the permissible temperature range of the shaft seal (ΔT = approx. 5 K between bearing/shaft seal and port **T**)
	ν_{opt} = 36 to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \ge 7$ mm²/s		$t < 3$ min, $p < 0.3 \times p_{nom}$

▼ **Selection diagram**



Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.

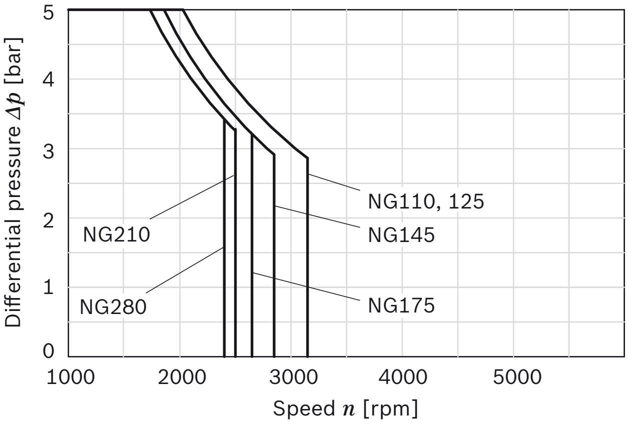
Depending on the system and the application, for the A4VG we recommend: Filter elements $\beta_{20} \geq 100$.

At very high hydraulic fluid temperatures (90 °C to maximum 110 °C, measured at port **T**), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

Shaft seal

Permissible pressure loading

The service life of the shaft seal is influenced by the rotational speed of the axial piston unit and the leakage pressure in the housing (case pressure). Momentary (t < 0.1 s) pressure peaks of up to 10 bar are allowed. The service life of the shaft seal decreases with increasing frequency of pressure peaks and increasing mean differential pressure. The case pressure must be higher than the ambient pressure.

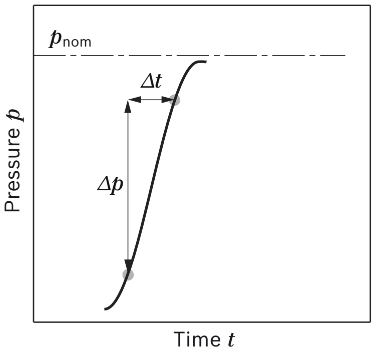


The FKM shaft seal ring may be used for leakage temperatures from −25 °C to +115 °C. For application cases below −25 °C, an NBR shaft seal is required (permissible temperature range: −40 °C to +90 °C).

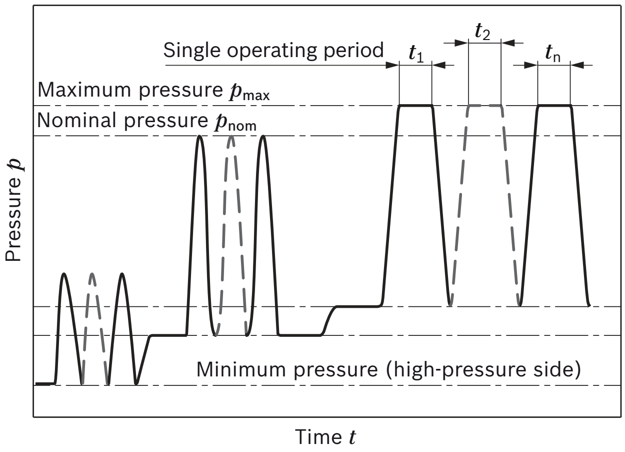
Working pressure range

Pressure at working port A or B		Definition
Nominal pressure p_{nom}	450 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	500 bar	The maximum pressure corresponds to the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure (high-pressure side)	25 bar	Minimum pressure at the high-pressure side (**A** or **B**) which is required to prevent damage to the axial piston unit.
Minimum pressure (low-pressure side)	10 bar above case pressure	Minimum pressure at the low-pressure side (**A** or **B**) which is required to prevent damage to the axial piston unit.
Rate of pressure change $R_{\text{A max}}$	9000 bar/s	Maximum permissible speed of pressure build-up and reduction during a pressure change across the entire pressure range.
Boost pump		
Nominal pressure $p_{\text{Sp nom}}$	25 bar	
Maximum pressure $p_{\text{Sp max}}$	40 bar	
Pressure at suction port **S** (inlet)		
Continuous $p_{\text{S min}}$ ($\nu \leq 30$ mm²/s)	≥0.8 bar absolute	
Short-term, at a cold start ($t < 3$ min)	≥0.5 bar absolute	
Maximum pressure $p_{\text{S max}}$	≤5 bar absolute	
Control pressure		
Minimum control pressure $p_{\text{St min}}$		To ensure the function of the control, a minimum control pressure $p_{\text{St min}}$ at n = 2000 rpm is necessary depending on the rotational speed and working pressure
Controls HP, HW, EP	20 bar above case pressure	
Controls HT, DA, EV, EZ, ET	25 bar above case pressure	

▼ **Rate of pressure change $R_{\text{A max}}$**



▼ **Pressure definition**



Total operating period = $t_1 + t_2 + \ldots + t_n$

Notice

Working pressure range valid when using hydraulic fluids based on mineral oils. Please contact us for values for other hydraulic fluids.

Technical data

Size		NG		110	125	145	175	210	280
Displacement, geometric, per revolution									
	variable pump	$V_{g\ max}$	cm³	110.4	125	145.3	175.4	210.6	280.3
	boost pump (at p = 20 bar)	$V_{g\ Sp}$	cm³	24.5	31	32	39	46	60
Torque[2]	at $V_{g\ max}$ and Δp = 430 bar	T	Nm	756	856	994	1200	1441	1918
	Δp = 100 bar	T	Nm	176	200	231	279	335	446
Rotary stiffness of drive shaft	V8	c	kNm/rad	173	–	–	–	–	–
	T1	c	kNm/rad	214	193	248	266	–	–
	T2	c	kNm/rad	246	219	293	–	394	411
	T3	c	kNm/rad	–	–	340	374	483	510
	Z9	c	kNm/rad	219	–	–	–	–	–
	A1	c	kNm/rad	251	222	300	326	407	–
	A2	c	kNm/rad	–	–	326	357	–	–
	A3	c	kNm/rad	–	–	–	–	516	546
Moment of inertia for rotary group		J_{TW}	kgm²	0.0218	0.0232	0.0330	0.0570	0.0632	0.0975
Maximum angular acceleration[3]		α	rad/s²	14500	13000	12000	10000	8000	5000
Case volume		V	l	2.5	2.3	3.3	3.1	4.9	5.4
Weight (without through drive) approx.		m	kg	88	84	106	115	152	160
Standard rotary group									
Rotational speed[1]	maximum at $V_{g\ max}$	$n_{nom\ S}$	rpm	3150	3000	2850	2650	2500	2400
	at $\Delta p \geq 40$ bar (t < 15 s)	$n_{max\ 40}$	rpm	3350	3150	3000	2800	2650	2550
	minimum	n_{min}	rpm	500	500	500	500	500	500
Flow	at n_{nom} and $V_{g\ max}$	q_v	l/min	348	375	414	465	527	673
Power[2]	at n_{nom}, $V_{g\ max}$ and Δp = 430 bar	P	kW	249	269	297	333	377	482
High-speed rotary group									
Rotational speed[1]	maximum at $V_{g\ max}$	$n_{nom\ H}$	rpm	3400	–	3050	3000	–	–
	at $\Delta p \geq 40$ bar (t < 15 s)	$n_{max\ 40}$	rpm	3600	–	3200	3100	–	–
	minimum	n_{min}	rpm	500	–	500	500	–	–
Flow	at n_{nom} and $V_{g\ max}$	q_v	l/min	375	–	443	526	–	–
Power[2]	at n_{nom}, $V_{g\ max}$ and Δp = 430 bar	P	kW	269	–	318	377	–	–

Notice

- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommend testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.

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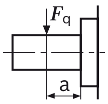
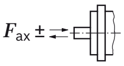
[1] The values are applicable:
  - for the optimum viscosity range from n_{opt} = 36 to 16 mm²/s
  - for hydraulic fluid based on mineral oils (for HF hydraulic fluids, observe the technical data in 90225)

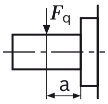
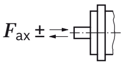
[2] Without boost pump

[3] The data are valid for values between the minimum required and maximum permissible rotational speed.
Valid for external excitation (e.g. diesel engine 2 to 8 times rotary frequency, cardan shaft twice the rotary frequency).
The limit value is only valid for a single pump.
The load capacity of the connecting parts must be considered.

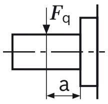
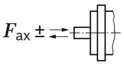
Permissible radial and axial forces of the drive shafts

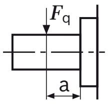
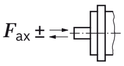
▼ **Splined shaft ANSI B92.1a**

Size		NG		110	110	110	125	125	145	145
Drive shaft			in	1 3/8	1 3/4	2	1 3/4	2	1 3/4	2
Maximum radial force at distance a (from shaft collar)		$F_{q\,max}$	N	9524	7483	6548	6500	5800	9241	8086
		a	mm	24	33.5	40	33.5	40	33.5	40
Maximum axial force		$+F_{ax\,max}$	N	6305	6305	6305	6411	6411	6763	6763
		$-F_{ax\,max}$	N	4095	4095	4095	3989	3989	4437	4437

Size		NG		145	175	175	210	210	280	280
Drive shaft			in	2 1/4	1 3/4	2 1/4	2	2 1/4	2	2 1/4
Maximum radial force at distance a (from shaft collar)		$F_{q\,max}$	N	8086	4800	4400	11185	10059	14562	13256
		a	mm	40	33.5	40	40	40	40	40
Maximum axial force		$+F_{ax\,max}$	N	6763	7252	7252	7760	7760	8450	8450
		$-F_{ax\,max}$	N	4437	4748	4748	5040	5040	5150	5150

▼ **Splined shaft DIN 5480**

Size		NG		110	110	125	145	145	175	175
Drive shaft				W40	W45	W45	W45	W50	W45	W50
Maximum radial force at distance a (from shaft collar)		$F_{q\,max}$	N	11000	10500	7200	9000	8500	5500	5000
		a	mm	22.5	25	25	25	27.5	25	27.5
Maximum axial force		$+F_{ax\,max}$	N	6305	6305	6411	6763	6763	7252	7252
		$-F_{ax\,max}$	N	4095	4095	3989	4437	4437	4748	4748

Size		NG		210	210	280
Drive shaft				W45	W55	W55
Maximum radial force at distance a (from shaft collar)		$F_{q\,max}$	N	13500	12500	14500
		a	mm	25	29	29
Maximum axial force		$+F_{ax\,max}$	N	7760	7760	8450
		$-F_{ax\,max}$	N	5040	5040	5150

Determining the operating characteristics			
Flow	$q_v = \dfrac{V_g \times n \times \eta_v}{1000}$		[l/min]
Torque	$T = \dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$		[Nm]
Power	$P = \dfrac{2\,\pi \times T \times n}{60000}$	$= \dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g	Displacement per revolution [cm^3]
Δp	Differential pressure [bar]
n	Rotational speed [rpm]
η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

Notice

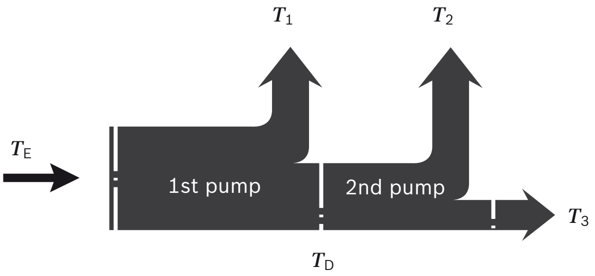
▶ The axial and radial forces generally influence the service life of the bearings.

▶ Special requirements apply in the case of belt drive and cardan shaft. Please contact us.

Permissible input and through-drive torques

Size			NG		110	125	145	175	210	280
Torque at $V_{g\,max}$ and Δp = 430 bar[1]			T	Nm	756	856	994	1200	1441	1918
Maximum input torque at drive shaft[2]										
ANSI B92.1a–1976	**V8**	1 3/8 in	$T_{E\,max}$	Nm	970	–	–	–	–	–
	T1	1 3/4 in	$T_{E\,max}$	Nm	1640	1640	1640	1640	–	–
	T2	2 in	$T_{E\,max}$	Nm	2670	2670	2670	–	2670	2670
	T3	2 1/4 in	$T_{E\,max}$	Nm	–	–	4070	4070	4070	4070
DIN 5480	**Z9**	W40	$T_{E\,max}$	Nm	On request	–	–	–	–	–
	A1	W45	$T_{E\,max}$	Nm	2190	2190	2190	2190	2190	–
	A2	W50	$T_{E\,max}$	Nm	–	–	3140	3140	–	–
	A3	W55	$T_{E\,max}$	Nm	–	–	–	–	4350	4350
Maximum through-drive torque			$T_{D\,max}$	Nm	934	1110	1110	1760	2641	2641

▼ **Distribution of torques**



Torque at 1st pump	T_1		
Torque at 2nd pump	T_2		
Torque at 3rd pump	T_3		
Input torque	T_E	=	$T_1 + T_2 + T_3$
	T_E	<	$T_{E\,max}$
Through-drive torque	T_D	=	$T_2 + T_3$
	T_D	<	$T_{D\,max}$

---

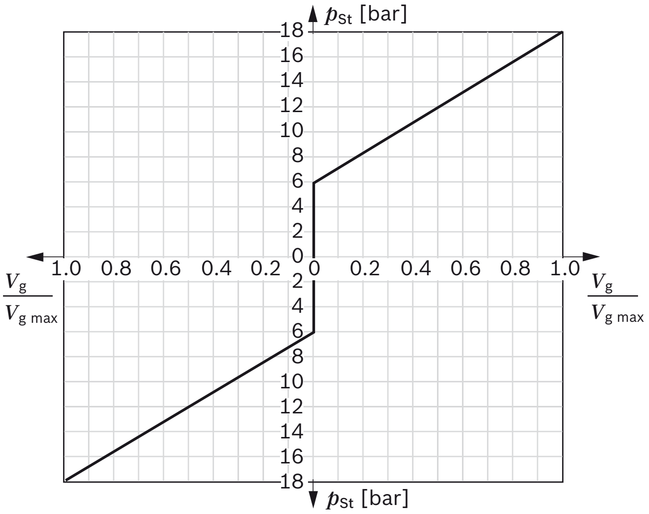
1) Efficiency not considered

2) For drive shafts free of radial force

HP – Proportional control, hydraulic, pilot-pressure related

The output flow of the pump is infinitely variable between 0 and 100%, proportional to the difference in pilot pressure applied to the two pilot pressure ports (**Y_1** and **Y_2**).
The pilot signal, coming from an external source, is a pressure signal. Flow is negligible, as the pilot signal acts only on the control spool of the control valve.
This control spool then directs control oil into and out of the stroking cylinder to adjust pump displacement as required.
A feedback lever connected to the stroking piston maintains the pump flow for any given pilot signal within the control range.

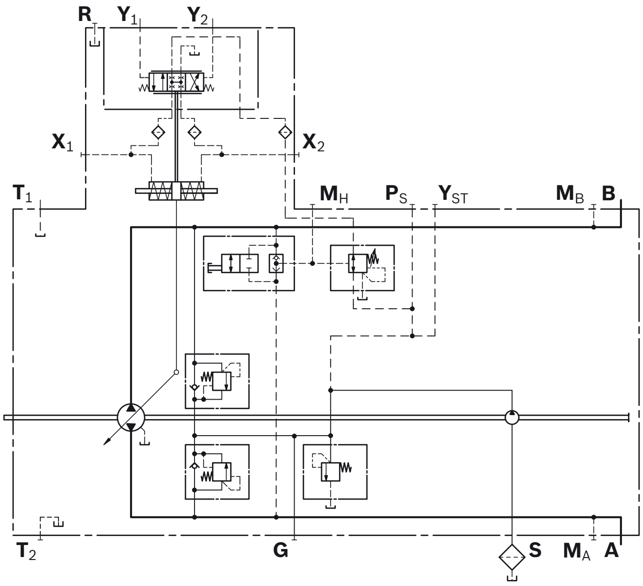
If the pump is also equipped with a DA control valve (see page 16), automotive operation is possible for travel drives.

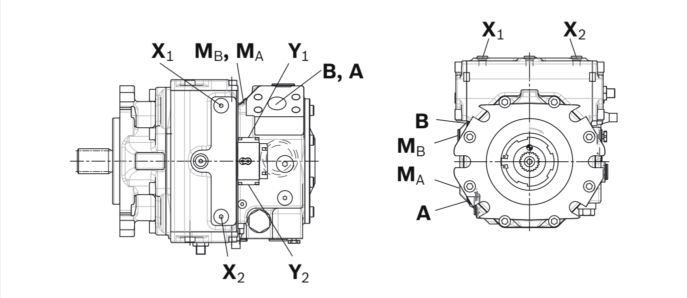


- V_g = Displacement at p_{St}
  $V_{g\,max}$ = Displacement at p_{St} = 18 bar
- Pilot signal p_{St} = 6 to 18 bar (at port **Y_1**, **Y_2**)
- Start of control at 6 bar
- End of control at 18 bar (maximum displacement $V_{g\,max}$)

Notice
In the neutral position, the HP control module must be vented to reservoir via the external pilot control device.

Standard version



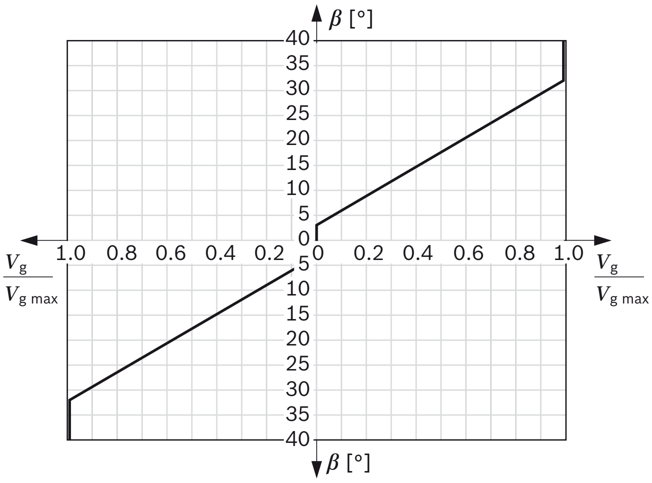


Correlation of direction of rotation, control and flow direction				
Direction of rotation	clockwise		counter-clockwise	
Pilot signal	**Y_1**	**Y_2**	**Y_1**	**Y_2**
Control pressure	**X_1**	**X_2**	**X_1**	**X_2**
Flow direction	**B to A**	**A to B**	**A to B**	**B to A**
Working pressure	**M_A**	**M_B**	**M_B**	**M_A**

HW – Proportional control, hydraulic, mechanical servo

The output flow of the pump is infinitely variable between 0 and 100%, proportional to the swivel angle of the control lever.
A feedback lever connected to the stroking piston maintains the pump flow for any given position of the control lever.

If the pump is also equipped with a DA control valve (see page 16), automotive operation is possible for travel drives.



Swivel angle β at the control lever for pump displacement change:

- Start of control at $\beta = \pm3°$
- End of control at β (maximum displacement $V_{g\,max}$) at ±32°
- Rotational limit β of the control lever (internal) ±38°

The maximum required torque at the lever is 170 Ncm. To prevent damage to the HW control module, a positive mechanical stop of 36.5°±1 must be provided for the HW control lever on the customer side.

Notice

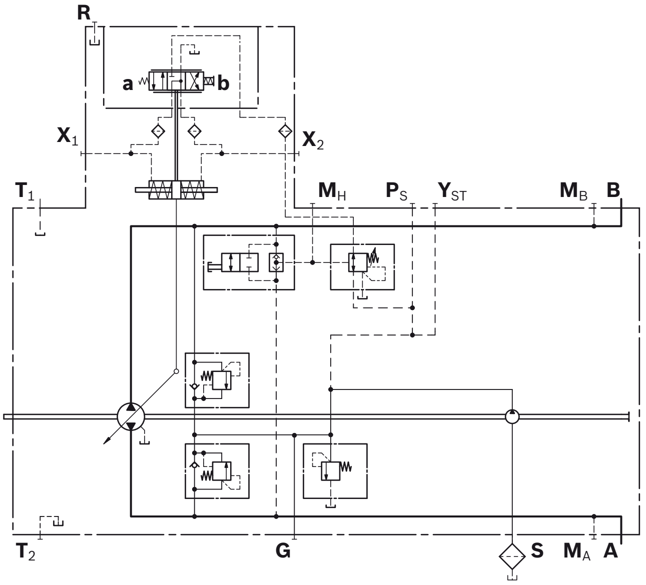
- Spring centering enables the pump, depending on pressure and speed, to move automatically to the neutral position ($V_g = 0$) as soon as there is no longer any torque on the control lever of the HW control module.
- If necessary, the position of the lever can be changed. The procedure is defined in the instruction manual.
- On delivery, the position of the lever may differ from that shown in the drawing.

Option: Neutral position switch

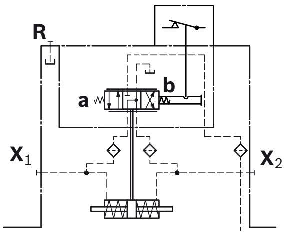
The switch contact in the neutral position switch is closed when the control lever on the HW control module is in its neutral position. The switch opens when the control lever is moved out of the central position in either direction. Thus, the neutral position switch provides a monitoring function for drive units that require the pump to be in the neutral position during certain operating conditions (e.g. starting diesel engines).

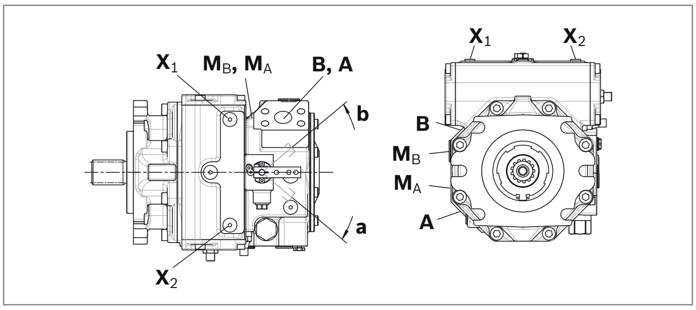
Technical data	
Load capacity	20 A (continuous), without switching operations
Switching capacity	15 A / 32 V (resistive load)
	4 A / 32 V (inductive load)
Connector version	DEUTSCH DT04-2P-EP04 (mating connector, see page 65)

▼ **Standard version**



▼ **Version with neutral position switch**





Correlation of direction of rotation, control and flow direction				
Direction of rotation	clockwise		counter-clockwise	
Lever direction	**a**	**b**	**a**	**b**
Control pressure	X_1	X_2	X_1	X_2
Flow direction	**B** to **A**	**A** to **B**	**A** to **B**	**B** to **A**
Working pressure	M_A	M_B	M_B	M_A

HT – Hydraulic control, direct operated

With the direct operated hydraulic control, the output flow of the pump is controlled by a hydraulic control pressure, applied directly to the stroking piston through either port **X**$_1$ or **X**$_2$.

Flow direction is determined by which control pressure port is pressurized (refer to table below).

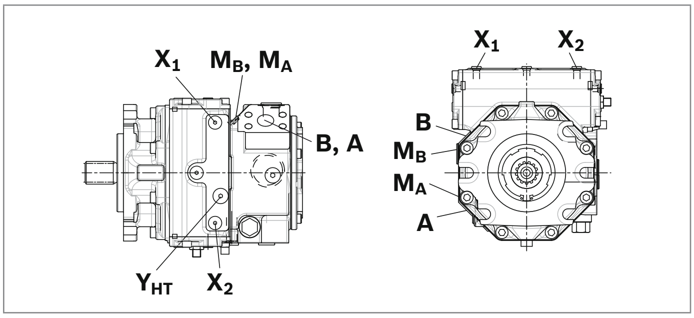
Pump displacement is infinitely variable and proportional to the applied control pressure, but is also influenced by system pressure and pump drive speed.

In order to use the optional built-in pressure cut-off, port **Y**$_{HT}$ must be used as the control pressure source for the selected control module. See page 56 for a functional description of the pressure cut-off.

Maximum permissible control pressure: 40 bar

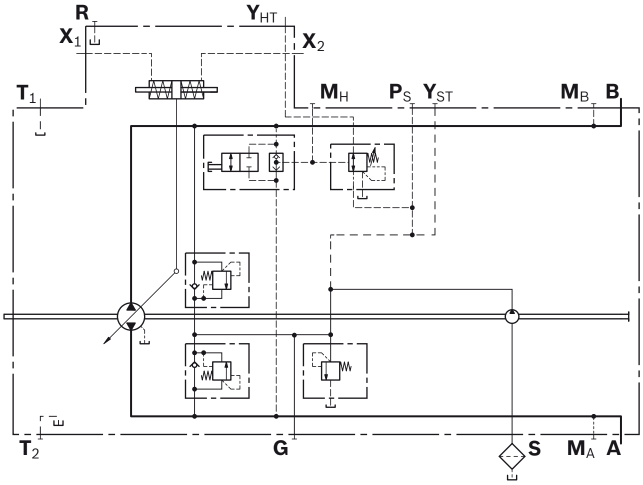
Use of the HT control requires a review of the engine and vehicle parameters to ensure that the pump is set up correctly. We recommend that all HT applications be reviewed by a Bosch Rexroth application engineer.

If the pump is also equipped with a DA control valve (see page 16), automotive operation is possible for travel drives.



Correlation of direction of rotation, control and flow direction				
Direction of rotation	clockwise		counter-clockwise	
Control pressure	**X**$_1$	**X**$_2$	**X**$_1$	**X**$_2$
Flow direction	**B** to **A**	**A** to **B**	**A** to **B**	**B** to **A**
Working pressure	**M**$_A$	**M**$_B$	**M**$_B$	**M**$_A$

▼ **Circuit diagram**



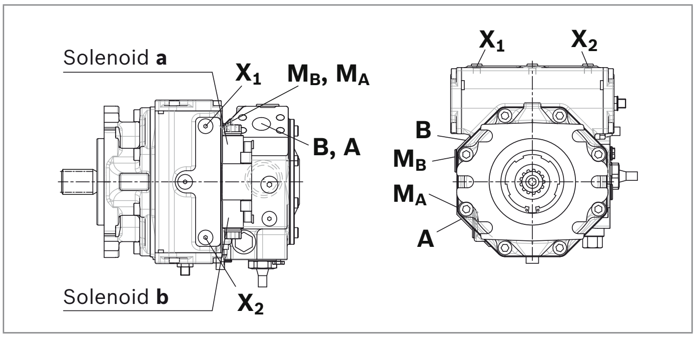
DA – Automatic control, speed related

The DA closed loop control is an engine speed-dependent system for travel drives. The built-in DA control valve generates a pilot pressure that is proportional to pump (engine) drive speed. This pilot pressure is directed to the stroking cylinder of the pump by an electromagnetically actuated 4/3-way directional valve. The pump displacement is infinitely variable in each flow direction and is influenced by both pump drive speed and system pressure. The flow direction (e.g. machine moving forward or backward) is determined by either solenoid **a** or **b** being activated.
Increasing the pump drive speed generates a higher pilot pressure from the DA control valve, with a subsequent increase in pump flow.
Depending on the selected pump operating characteristics, increasing system pressure (e.g. machine load) causes the pump to swivel back towards a smaller displacement. An overload protection for the engine (against stalling) is achieved by combining this pressure-dependent reduction in pump stroke with a reduction in pilot pressure as the engine speed drops.
Any additional power requirement, e.g. for hydraulic functions from attachments, could cause the engine speed to drop further. This will cause a further reduction in pilot pressure and thus of the pump displacement. Automatic power distribution and full exploitation of the available power are achieved in this way, both for the travel drive and for the implement hydraulics, with priority given to the implement hydraulics.
Various override options are available for DA control function to allow controlled operation of the implement hydraulics with high rpm at reduced travel speed.
The DA control valve can also be used in pumps with HP, HW, HT, DA and EP control modules to protect the combustion engine against overload.

Notice

- Our Sales department will provide you detailed information. Use our computer program to work out the input design that meets your needs. All DA applications must be approved by a Bosch Rexroth application engineer.
- DA closed loop control is only suitable for certain types of travel drive systems and requires review of the engine and vehicle parameters to ensure that the pump is used correctly and that machine operation is safe and efficient. We recommend that all DA applications be reviewed by a Bosch Rexroth application engineer.

Technical data, solenoid	DA1	DA2
Voltage	12 V (±20%)	24 V (±20%)
Neutral position $V_g = 0$	de-energized	de-energized
Position $V_{g\ max}$	Current switched on	Current switched on
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum active current required	1.32 A	0.67 A
Duty cycle	100%	100%
Type of protection: see connector version page 65		

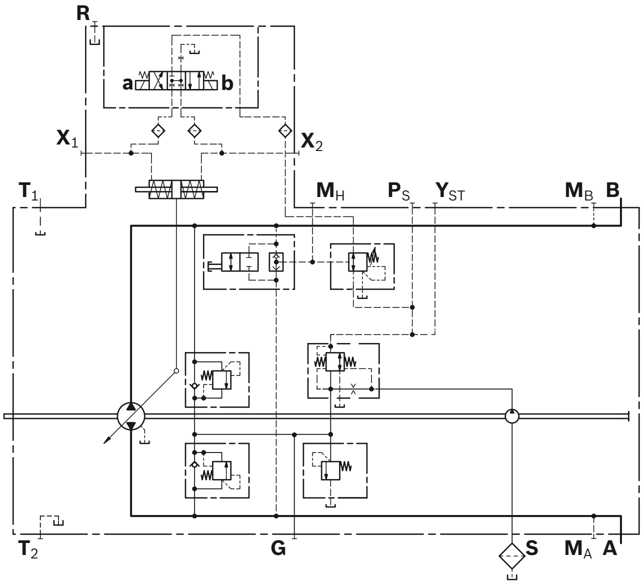


Correlation of direction of rotation, control and flow direction				
Direction of rotation	clockwise		counter-clockwise	
Actuation of solenoid	**a**	**b**	**a**	**b**
Control pressure	X_2	X_1	X_2	X_1
Flow direction	**A** to **B**	**B** to **A**	**B** to **A**	**A** to **B**
Working pressure	M_B	M_A	M_A	M_B

DA..1 – DA control valve, fixed setting

Pilot pressure is generated in relation to drive speed.

▼ **Circuit diagram**



DA..2, DA..3 – DA control valve, mechanically adjustable with position lever

Pilot pressure is generated in relation to drive speed.
Any reduction of pilot pressure possible, independently of drive speed, through mechanical actuation of the position lever (inch function).
The maximum permissible actuation torque at the position lever is $T_{\max}$ = 4 Nm.
Maximum angle of rotation 70°, lever position: any.

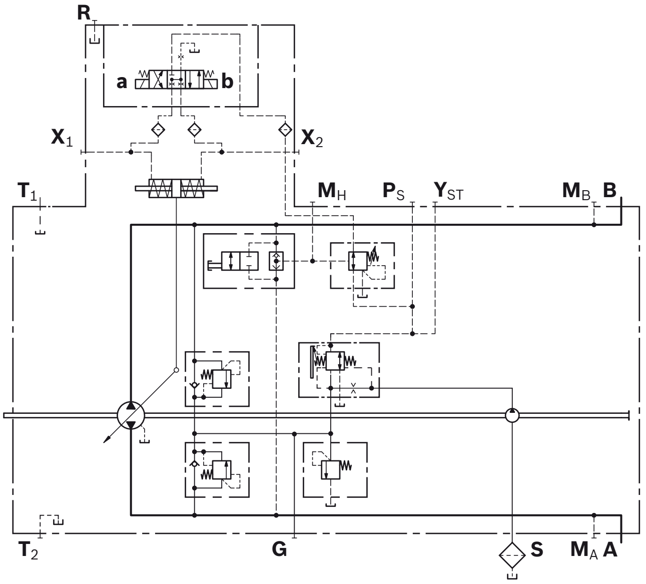
DA..2

Direction of actuation of the position lever: clockwise

DA..3

Direction of actuation of the position lever:
counter-clockwise

▼ **Circuit diagram**



DA..5 – DA control valve, fixed setting and brake inch valve mounted

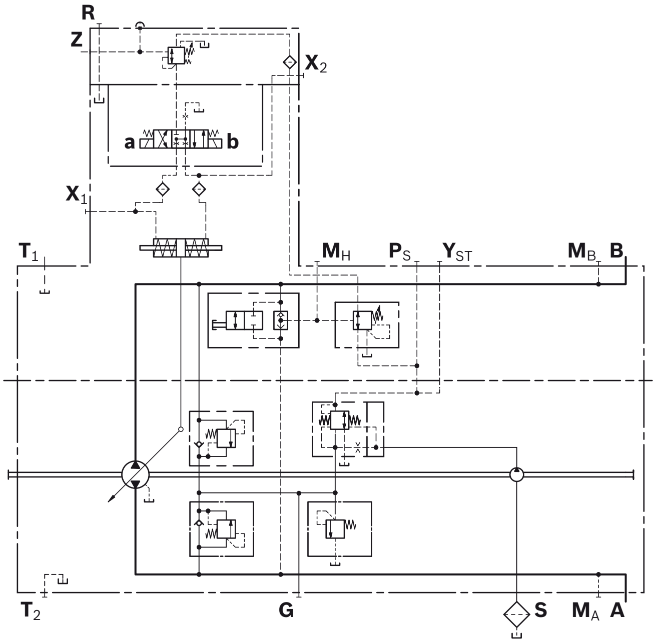
Only for pumps with DA control module.

Version with pressure reducing valve.

Permits reduction of the pilot pressure, independently of the drive speed via hydraulic control (port **Z**).

Control at port **Z** by means of brake fluid based on mineral oil.

▼ **Circuit diagram**



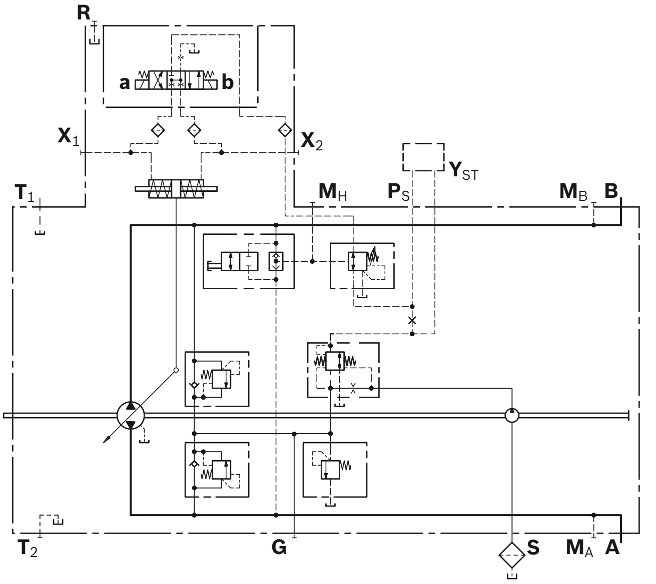
DA..6 – DA control valve, fixed setting, ports for pilot control device as inch valve

Any reduction of the pilot pressure possible, independent of the drive speed is achieved by the mechanical actuation of the pilot control device.

The pilot control device is installed separately from the pump (for example in the driver's cabin) and connected to the pump by two hydraulic control lines via ports **P**$_S$ and **Y**$_{ST}$.

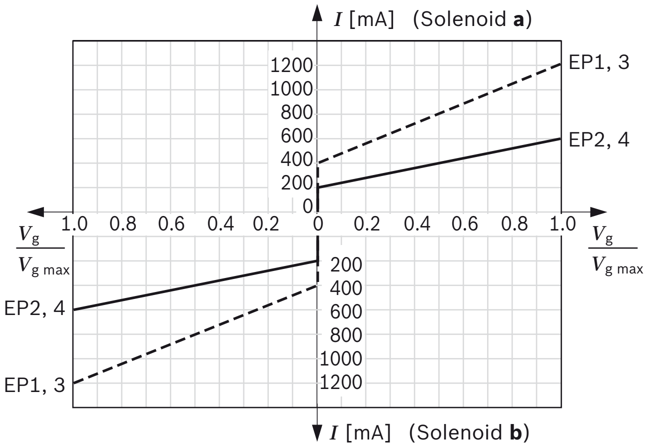
A suitable pilot control device must be ordered separately and is not included in the scope of delivery.

▼ **Circuit diagram**



EP – Proportional control, electric

The output flow of the pump is infinitely variable between 0 and 100%, proportional to the electrical current supplied to solenoid **a** or **b**.
The electrical energy is converted into a force acting on the control spool.
This control spool then directs control oil into and out of the stroking cylinder to adjust pump displacement as required.
A feedback lever connected to the stroking piston maintains the pump flow for any given current within the control range.
If the pump is also equipped with a DA control valve (see page 16), automotive operation is possible for travel drives.

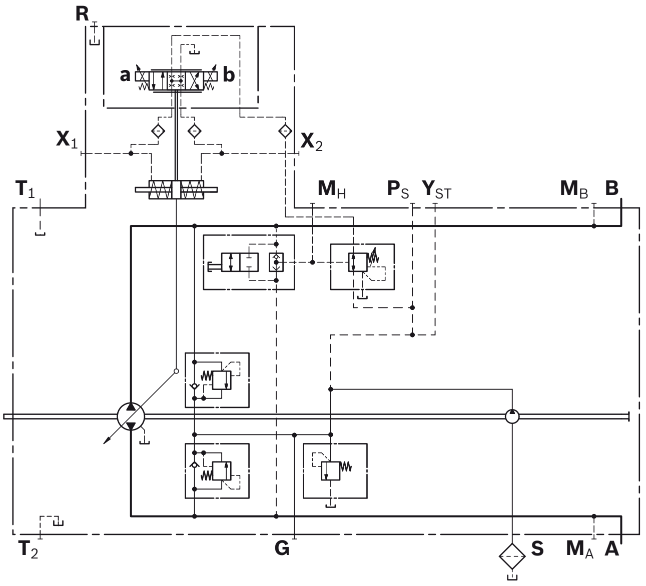


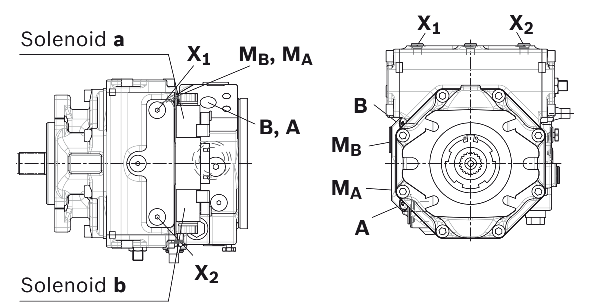
Notice
The proportional solenoids in version EP1/EP2 do not have manual override. Proportional solenoids with manual override and spring return are available on request (version EP3/EP4).

Technical data, solenoid	EP1, 3	EP2, 4
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Start of control at $V_g = 0$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA	600 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither		
Frequency	100 Hz	100 Hz
minimum oscillation range[1]	240 mA	120 mA
Duty cycle	100%	100%
Type of protection: see connector version page 65		

Various BODAS controllers with application software and amplifiers are available for controlling the proportional solenoids.

▼ **Circuit diagram**





Correlation of direction of rotation, control and flow direction				
Direction of rotation	clockwise		counter-clockwise	
Actuation of solenoid	**a**	**b**	**a**	**b**
Control pressure	**X$_1$**	**X$_2$**	**X$_1$**	**X$_2$**
Flow direction	**B to A**	**A to B**	**A to B**	**B to A**
Working pressure	**M$_A$**	**M$_B$**	**M$_B$**	**M$_A$**

---

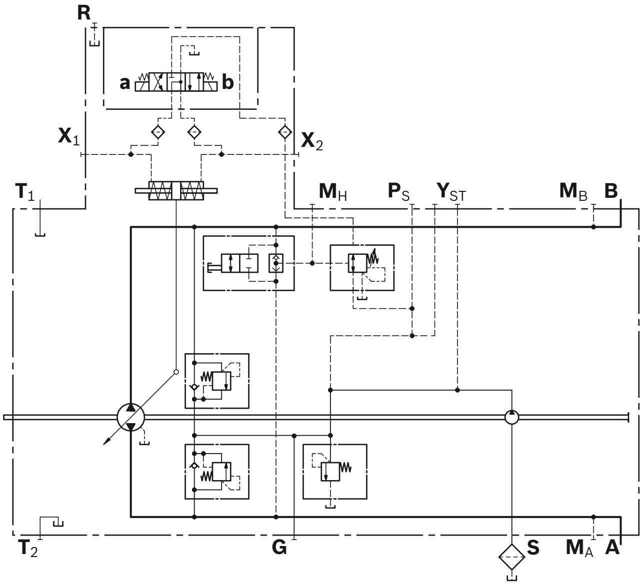
[1] Minimum required oscillation range of the control current $\Delta I_{p\text{-}p}$ (peak to peak) within the respective control range (start of control to end of control)

EZ – Two-point control, electric

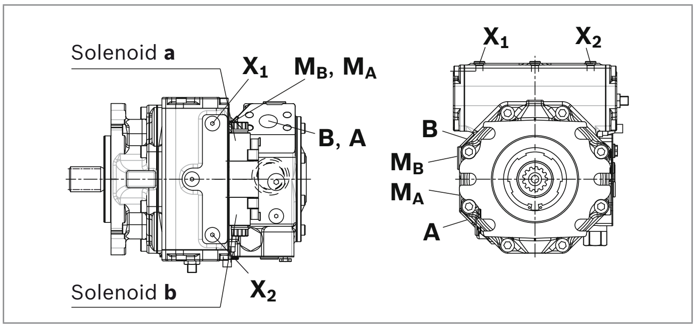
By actuating either switching solenoid **a** or **b**, internal control pressure is applied directly to the stroking piston and the pump swivels to maximum displacement. The EZ control enables pump flow to be switched between $V_g = 0$ and $V_{g\,max}$.
Flow direction is determined by which solenoid is energized.

Technical data, solenoid	EZ1	EZ2
Voltage	12 V (±20%)	24 V (±20%)
Neutral position $V_g = 0$	de-energized	de-energized
Position $V_{g\,max}$	Current switched on	Current switched on
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum active current required	1.32 A	0.67 A
Duty cycle	100%	100%
Type of protection: see connector version page 65		

▼ Circuit diagram



Correlation of direction of rotation, control and flow direction				
Direction of rotation	clockwise		counter-clockwise	
Actuation of solenoid	**a**	**b**	**a**	**b**
Control pressure	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$
Flow direction	**A to B**	**B to A**	**B to A**	**A to B**
Working pressure	$\mathbf{M_B}$	$\mathbf{M_A}$	$\mathbf{M_A}$	$\mathbf{M_B}$



EV – Electric control, direct operated

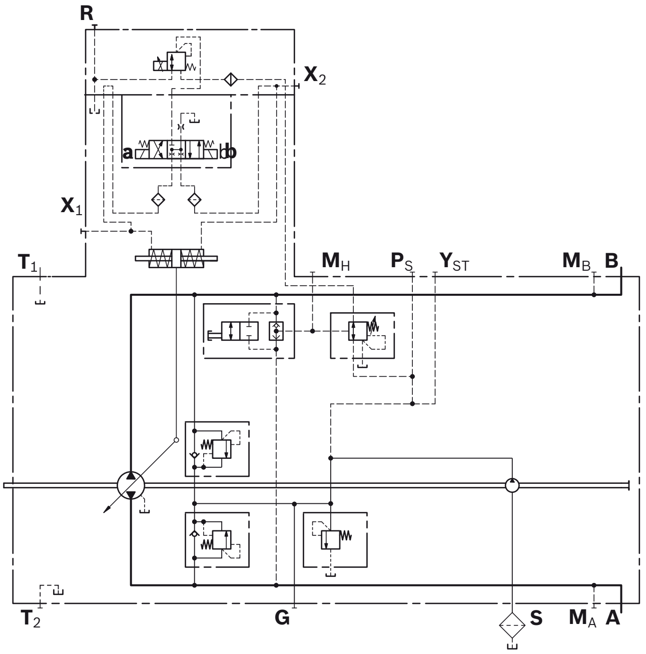
With the direct operated electric control (EV), the output flow of the pump is infinitely variable between 0 and 100%, controlled by the control pressure of the pressure reducing valve. This control pressure level is proportional to the electric current, applied to the solenoid of the pressure reducing valve. This control pressure is then connected directly to the stroking cylinder of the pump by energizing either switching solenoid **a** or **b** on the EV control module, which determines the direction of the pump flow.
The resulting pump displacement at a certain control pressure is also influenced by pump drive speed and working pressure.

Technical data, pressure reducing valve	**EV1**	**EV2**
Voltage	12 V	24 V
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Dither		
Frequency	100 Hz	100 Hz
minimum oscillation range[1]	240 mA	120 mA
Duty cycle	100%	100%
Type of protection: see connector version page 65		

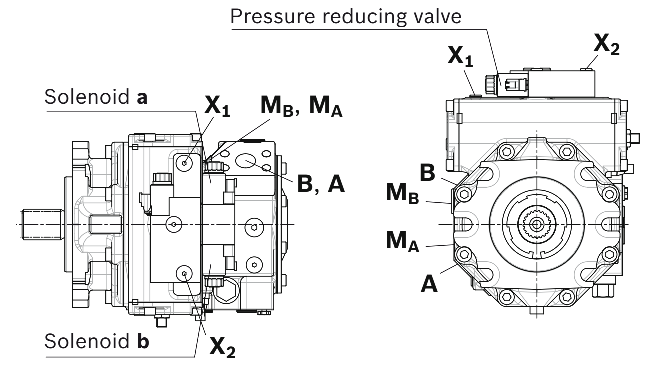
Various BODAS controllers with application software and amplifiers are available for controlling the proportional solenoids.

Technical data, solenoid	**EV1**	**EV2**
Voltage	12 V (±20%)	24 V (±20%)
Neutral position $V_g = 0$	de-energized	de-energized
Position $V_{g\ max}$	Current switched on	Current switched on
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum active current required	1.32 A	0.67 A
Duty cycle	100%	100%
Type of protection: see connector version page 65		

▼ **Circuit diagram**



Correlation of direction of rotation, control and flow direction				
Direction of rotation	clockwise		counter-clockwise	
Actuation of solenoid	**a**	**b**	**a**	**b**
Control pressure	$\mathbf{X_2}$	$\mathbf{X_1}$	$\mathbf{X_2}$	$\mathbf{X_1}$
Flow direction	**A** to **B**	**B** to **A**	**B** to **A**	**A** to **B**
Working pressure	$\mathbf{M_B}$	$\mathbf{M_A}$	$\mathbf{M_A}$	$\mathbf{M_B}$



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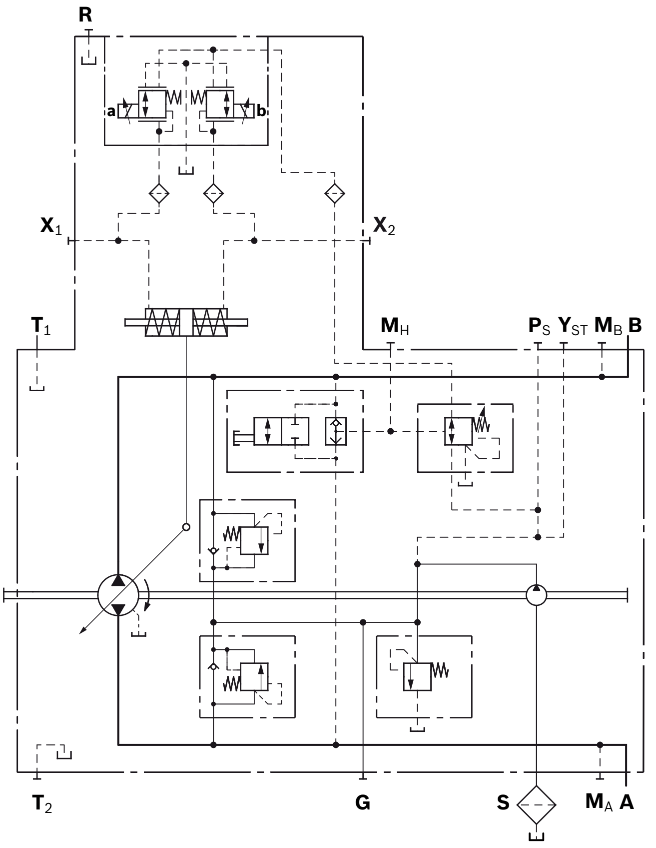
[1] Minimum required oscillation range of the control current $\Delta I_{p\text{-}p}$ (peak to peak) within the respective control range (start of control to end of control)

ET – Electric control, direct operated

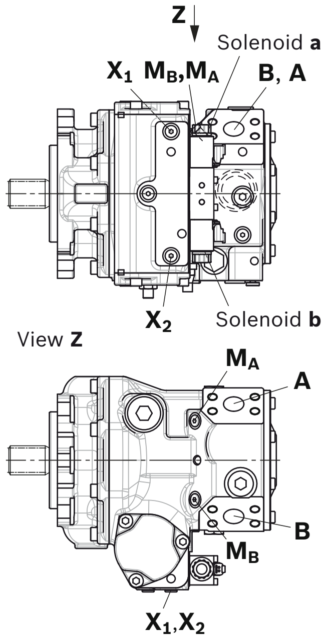
The output flow of the pump is infinitely variable between 0 and 100%. Depending on the preselected current I at solenoids **a** and **b** of the pressure reducing valves, the stroking cylinder of the pump is proportionally supplied with control pressure. The pump displacement that arises at a certain control current is dependent on the speed and working pressure of the pump. A different flow direction is associated with each pressure reducing valve. Maximum permissible control pressure: 40 bar.

Technical data, solenoid	**ET5**	**ET6**
Voltage	12 V (±20%)	24 V (±20%)
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither		
Frequency	100 Hz	100 Hz
minimum oscillation range[1]	240 mA	120 mA
Duty cycle	100%	100%
Type of protection: see connector version page 65		

▼ **Circuit diagram**



Correlation of direction of rotation, control and flow direction				
Direction of rotation	clockwise		counter-clockwise	
Actuation of solenoid	**a**	**b**	**a**	**b**
Control pressure (in $\mathbf{X}_3$, $\mathbf{X}_4$ optional)	$\mathbf{X}_1$ $\mathbf{X}_3$	$\mathbf{X}_2$ $\mathbf{X}_4$	$\mathbf{X}_1$ $\mathbf{X}_3$	$\mathbf{X}_2$ $\mathbf{X}_4$
Flow direction	**B** to **A**	**A** to **B**	**A** to **B**	**B** to **A**
Working pressure	$\mathbf{M}_A$	$\mathbf{M}_B$	$\mathbf{M}_B$	$\mathbf{M}_A$



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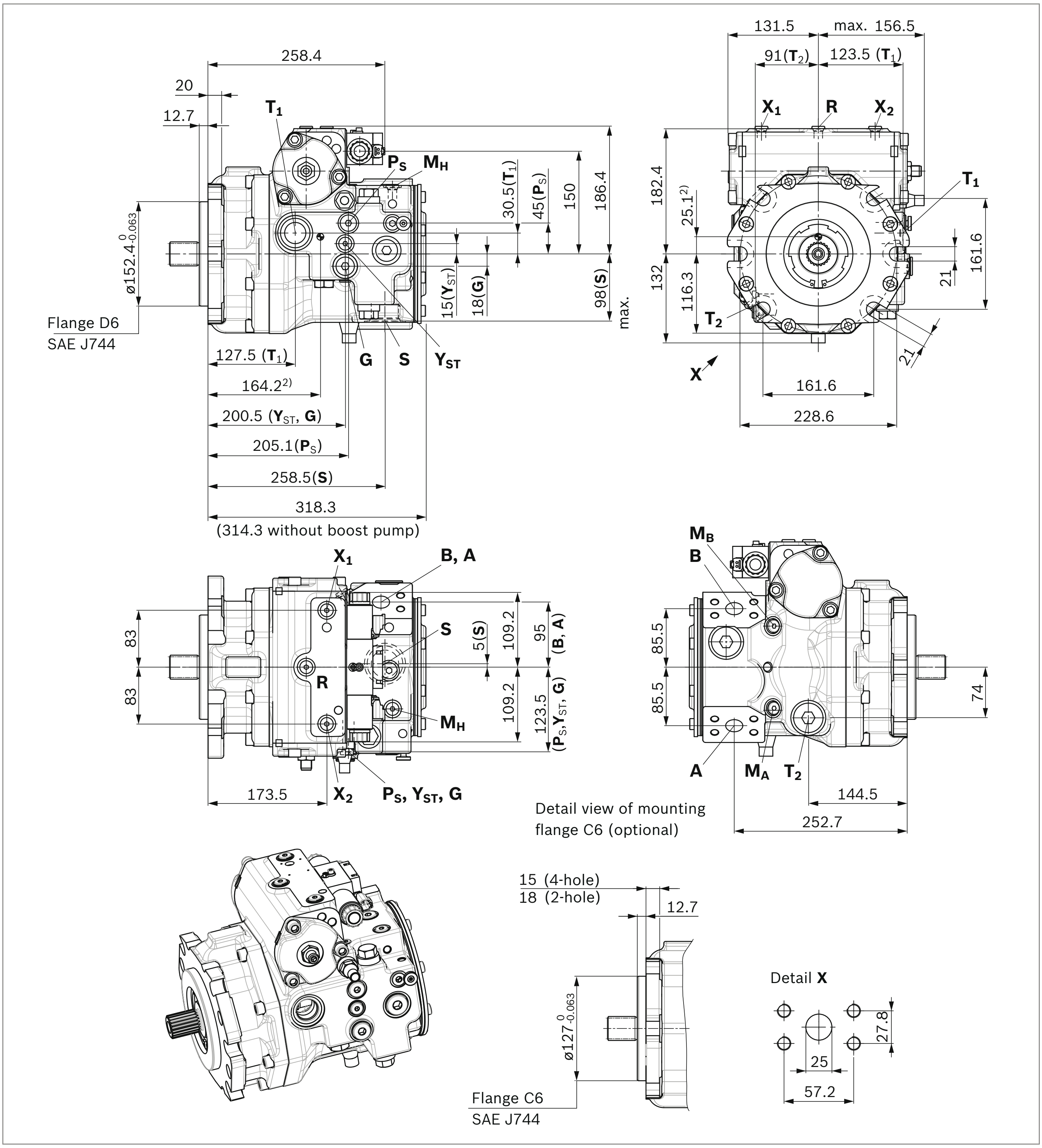
[1] Minimum required oscillation range of the control current $\Delta I_{p\text{-}p}$ (peak to peak) within the respective control range (start of control to end of control)

Dimensions, size 110

EP – Proportional control, electric

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)[1]



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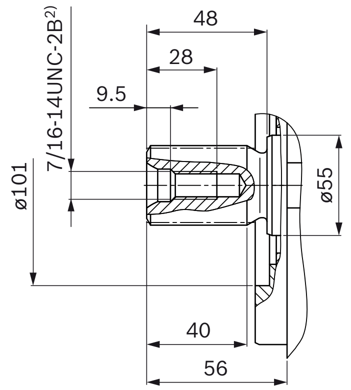
1) For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

2) Center of gravity

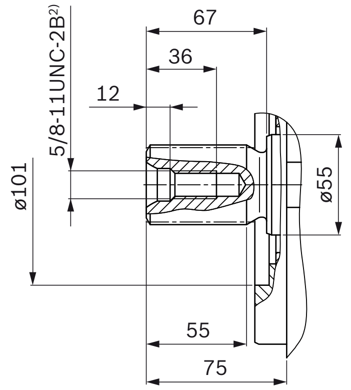
▼ **Splined shaft ANSI B92.1a–1976**

V8 – 1 3/8 in 21T 16/32DP[1)]



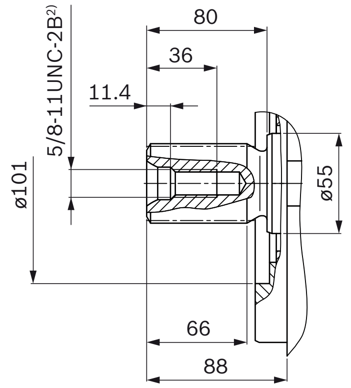
▼ **Splined shaft ANSI B92.1a**

T1 – 1 3/4 in 13T 8/16DP[1)]



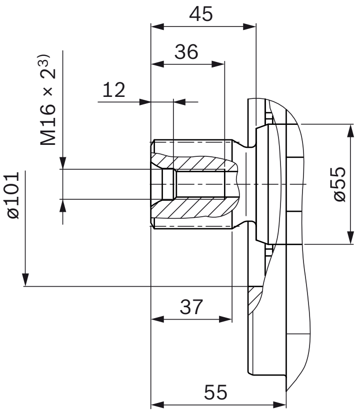
▼ **Splined shaft ANSI B92.1a**

T2 – 2 in 15T 8/16DP[1)]



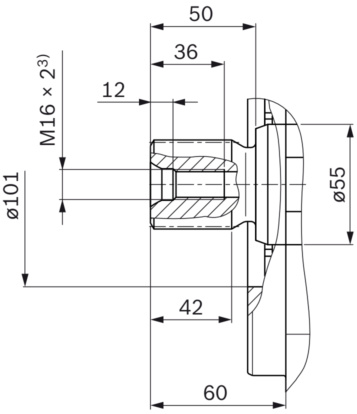
▼ **Splined shaft DIN 5480**

Z9 – W40×2×18×9



▼ **Splined shaft DIN 5480**

A1 – W45×2×21×9



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1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Center bore according to DIN 332 (thread according to DIN 13)

Ports		**Standard**	**Size**	$p_{\text{max abs}}$ **[bar]**[4]	**State**[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	1 in M12 × 1.75; 17 deep	500	O
S	Suction port	ISO 6149[8]	M42 × 2; 19.5 deep	5	O[6]
$\mathbf{T_1}$	Drain port	ISO 6149[8]	M33 × 2; 19 deep	3	O[7]
$\mathbf{T_2}$	Drain port	ISO 6149[8]	M33 × 2; 19 deep	3	X[7]
R	Air bleed port	ISO 6149[8]	M14 × 1.5; 11.5 deep	3	X
$\mathbf{X_1}$, $\mathbf{X_2}$	Control pressure port (upstream of orifice)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
$\mathbf{X_1}$, $\mathbf{X_2}$	Control pressure port (upstream of orifice, HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{X_3}$, $\mathbf{X_4}$[9]	Stroking chamber pressure port	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
G	Boost pressure port inlet	ISO 6149[8]	M22 × 1.5; 15.5 deep	40	X
$\mathbf{P_S}$	Pilot pressure port inlet	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	X
$\mathbf{P_S}$	Pilot pressure port inlet (DA..6 only)	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	O
$\mathbf{Y_{ST}}$	Pilot pressure port outlet	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
$\mathbf{Y_{ST}}$	Pilot pressure port outlet (DA..6 only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{Y_{HT}}$	Pilot pressure port outlet (HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{M_A}$, $\mathbf{M_B}$	Measuring port pressure A, B	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
$\mathbf{M_H}$	Measuring port, high pressure	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
$\mathbf{Y_1}$, $\mathbf{Y_2}$	Pilot pressure port (pilot signal HP only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
Z	Pilot pressure port (inch signal DA..5 only)	ISO 6149[8]	M10 × 1; 8 deep	40	O

---

[4] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

[5] Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

[6] Plugged for external boost pressure supply.

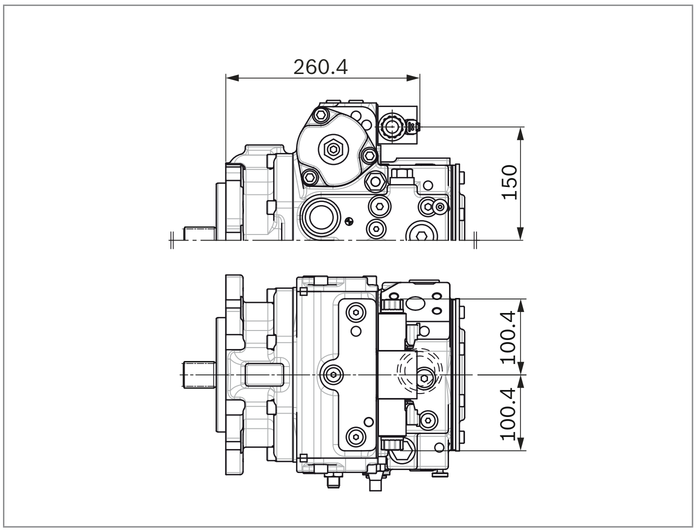
[7] Depending on installation position, $\mathbf{T_1}$ or $\mathbf{T_2}$ must be connected (see also installation instructions on page 68).

[8] The countersink can be deeper than as specified in the standard.

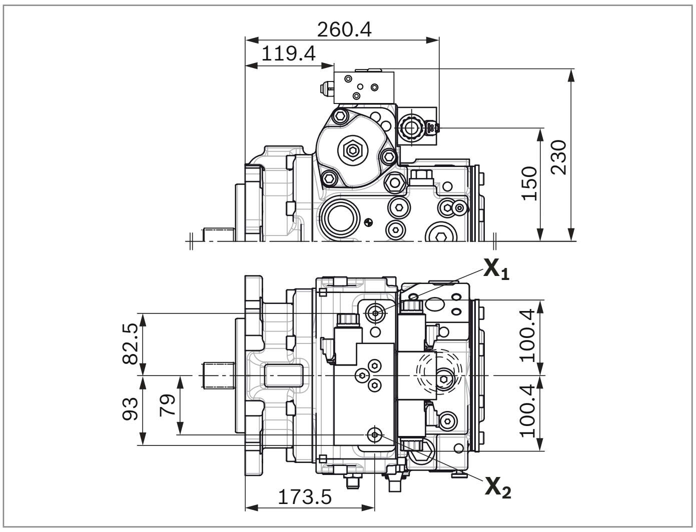
[9] Optional, see page 59

[10] O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

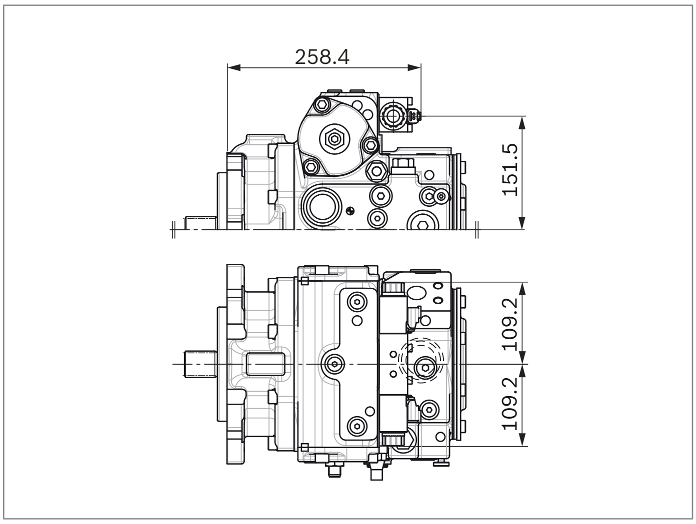
▼ **EZ** – Two-point control, electric



▼ **EV** – Electric control, direct operated, 4/3-way directional valve, one DRE

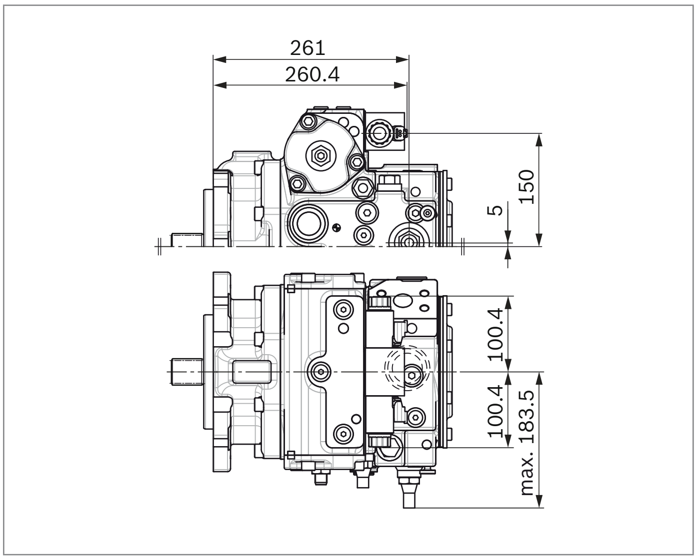


▼ **ET** – Electric control, direct operated, two DRE

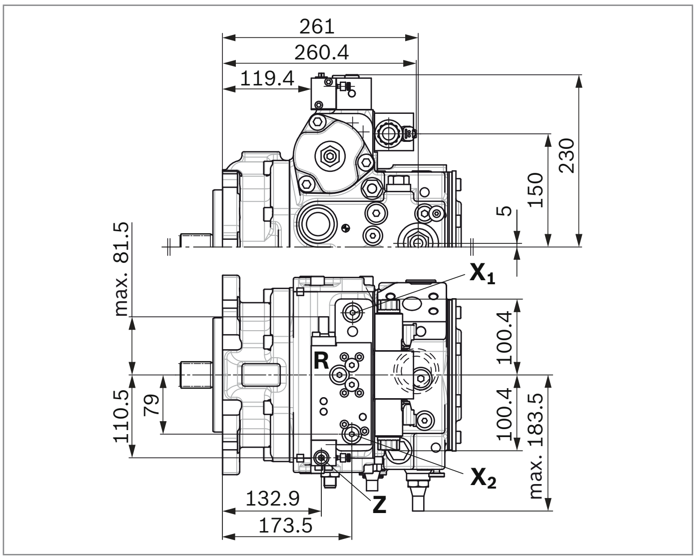


DA control valve

▼ **DA..1 – fixed setting**



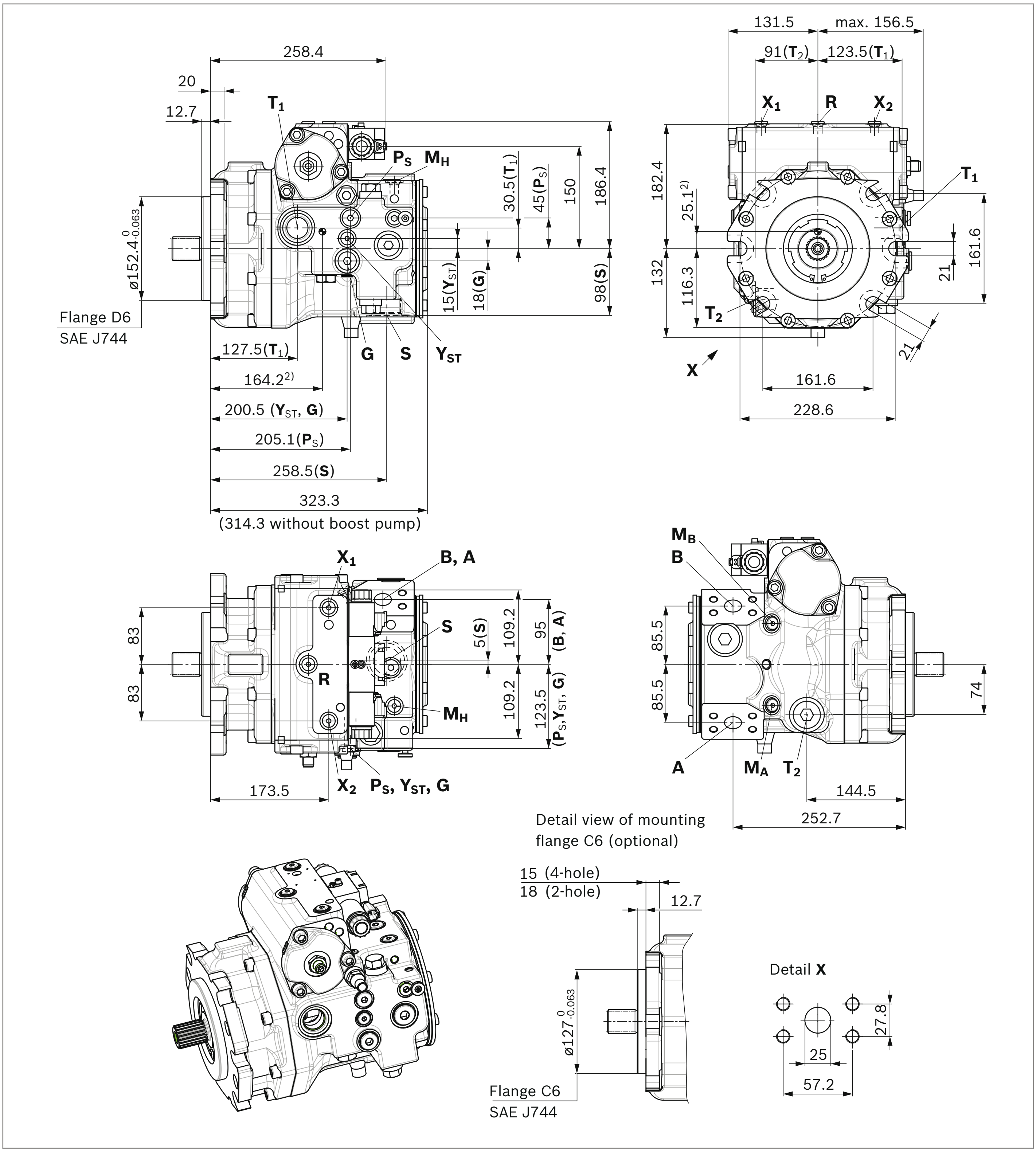
▼ **DA..5 –** fixed setting and inch valve mounted



Dimensions, size 125

EP – Proportional control, electric

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)[1]



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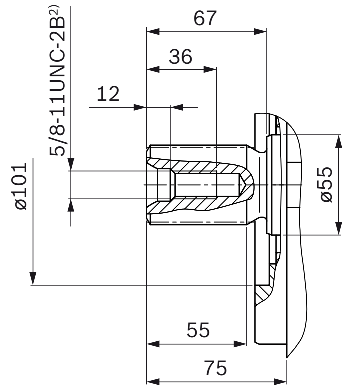
[1] For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

[2] Center of gravity

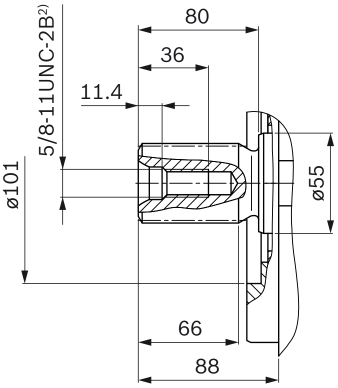
▼ **Splined shaft ANSI B92.1a**

T1 – 1 3/4 in 13T 8/16DP[1]



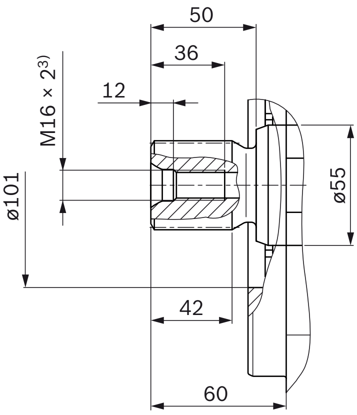
▼ **Splined shaft ANSI B92.1a**

T2 – 2 in 15T 8/16DP[1]



▼ **Splined shaft DIN 5480**

A1 – W45×2×21×9



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[1] Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Thread according to ASME B1.1

[3] Center bore according to DIN 332 (thread according to DIN 13)

Ports		**Standard**	**Size**	$p_{\text{max abs}}$ **[bar]**[4]	**State**[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	1 in M12 × 1.75; 17 deep	500	O
S	Suction port	ISO 6149[8]	M42 × 2; 19.5 deep	5	O[6]
$\mathbf{T}_1$	Drain port	ISO 6149[8]	M33 × 2; 19 deep	3	O[7]
$\mathbf{T}_2$	Drain port	ISO 6149[8]	M33 × 2; 19 deep	3	X[7]
R	Air bleed port	ISO 6149[8]	M14 × 1.5; 11.5 deep	3	X
$\mathbf{X}_1$, $\mathbf{X}_2$	Control pressure port (upstream of orifice)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
$\mathbf{X}_1$, $\mathbf{X}_2$	Control pressure port (upstream of orifice, HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{X}_3$, $\mathbf{X}_4$[9]	Stroking chamber pressure port	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
G	Boost pressure port inlet	ISO 6149[8]	M22 × 1.5; 15.5 deep	40	X
$\mathbf{P}_S$	Pilot pressure port inlet	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	X
$\mathbf{P}_S$	Pilot pressure port inlet (DA..6 only)	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	O
$\mathbf{Y}_{ST}$	Pilot pressure port outlet	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
$\mathbf{Y}_{ST}$	Pilot pressure port outlet (DA..6 only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{Y}_{HT}$	Pilot pressure port outlet (HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{M}_A$, $\mathbf{M}_B$	Measuring port pressure A, B	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
$\mathbf{M}_H$	Measuring port, high pressure	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
$\mathbf{Y}_1$, $\mathbf{Y}_2$	Pilot pressure port (pilot signal HP only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
Z	Pilot pressure port (inch signal DA..5 only)	ISO 6149[8]	M10 × 1; 8 deep	40	O

---

[4] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

[5] Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

[6] Plugged for external boost pressure supply.

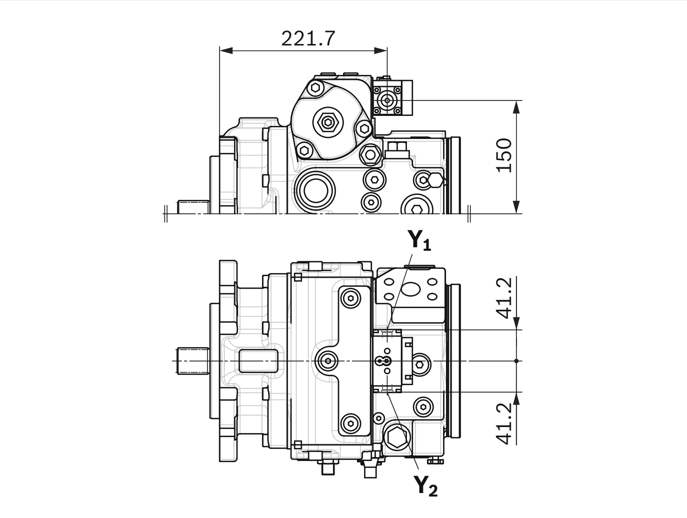
[7] Depending on installation position, $\mathbf{T}_1$ or $\mathbf{T}_2$ must be connected (see also installation instructions on page 68).

[8] The countersink can be deeper than as specified in the standard.

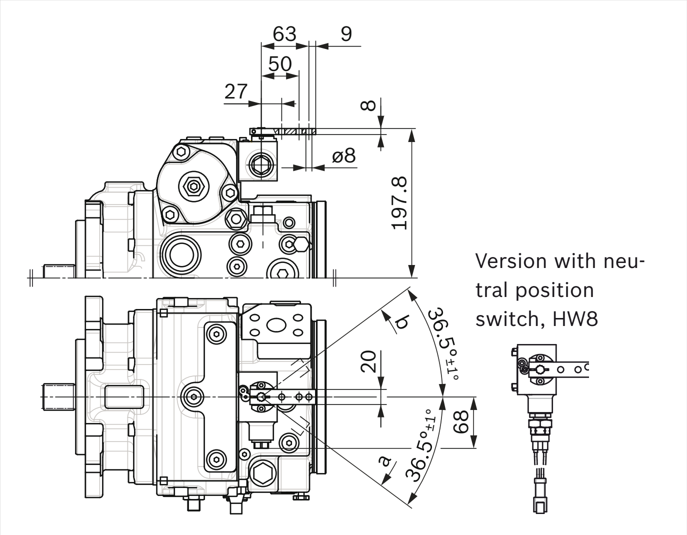
[9] Optional, see page 59

[10] O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

▼ **HP** – Proportional control, hydraulic, pilot-pressure related

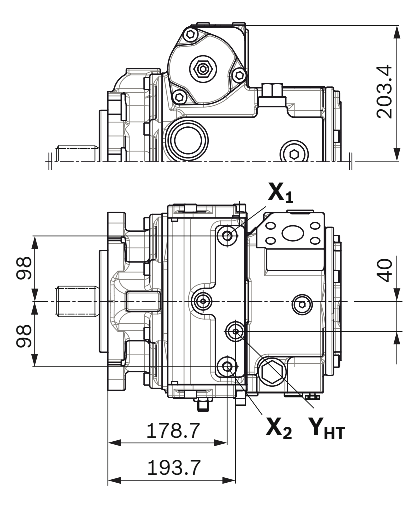


▼ **HW** – Proportional control, hydraulic, mechanical servo

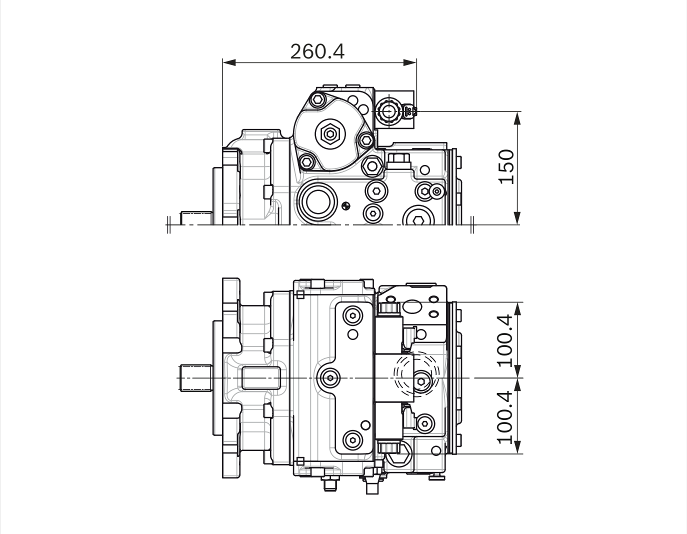


Version with neutral position switch, HW8

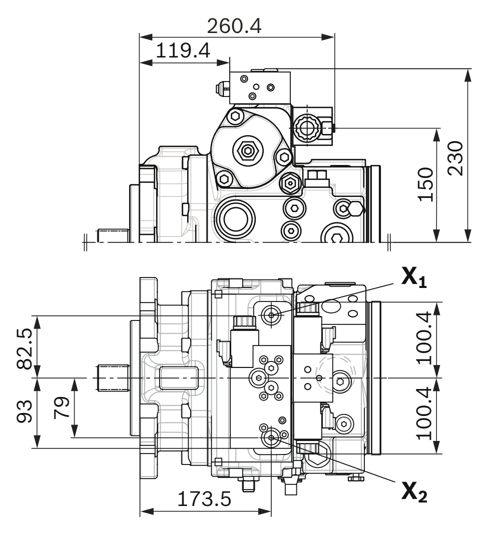
▼ **HT** – Hydraulic control, direct operated



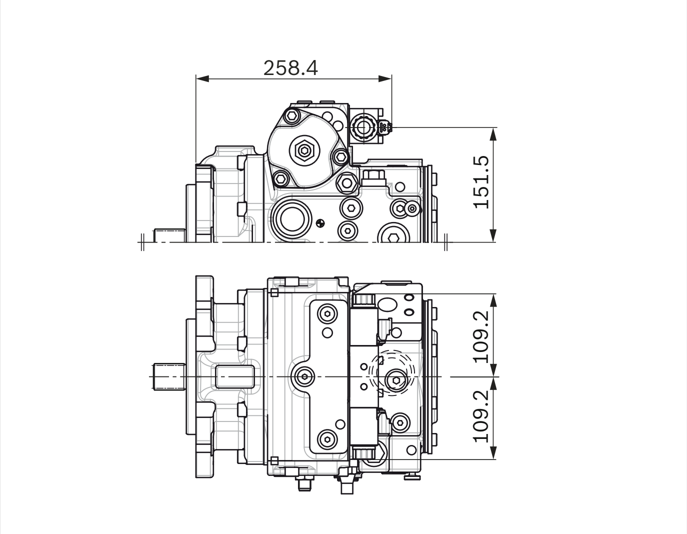
▼ **EZ** – Two-point control, electric



▼ **EV** – Electric control, direct operated, 4/3-way directional valve, one DRE

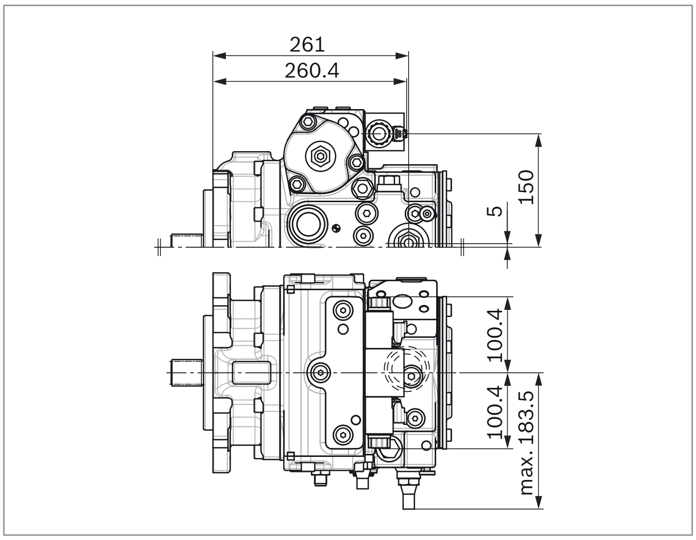


▼ **ET** – Electric control, direct operated, two DRE



DA control valve

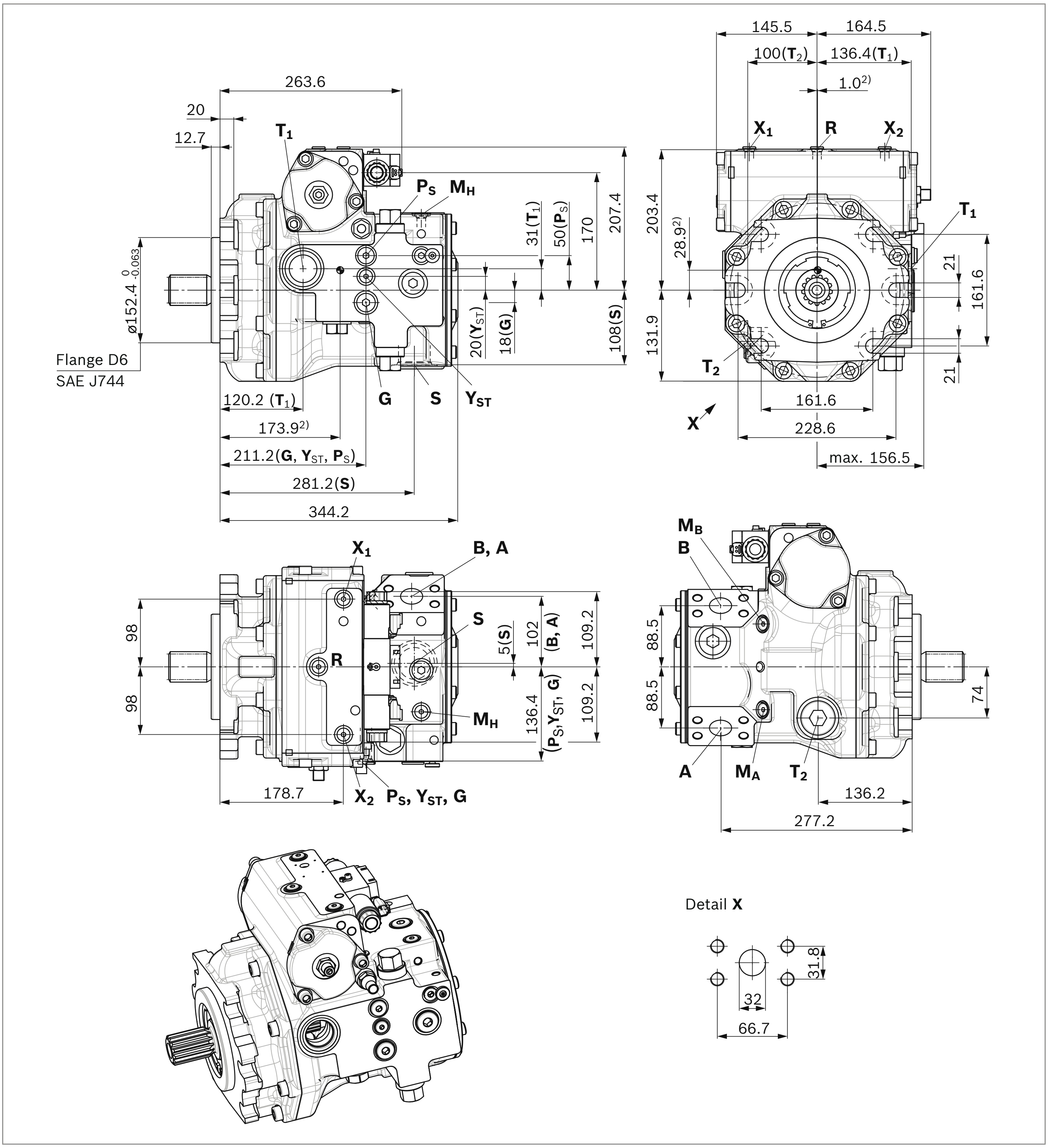
▼ **DA..1** – fixed setting



Dimensions, size 145

EP – Proportional control, electric

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)[1]



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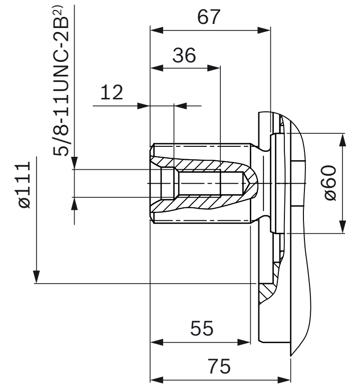
1) For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

2) Center of gravity

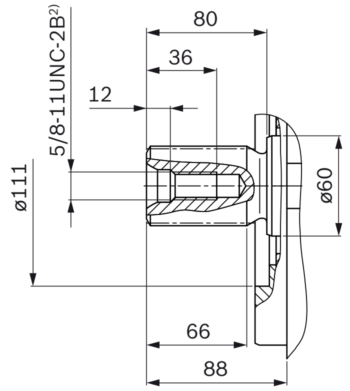
▼ Splined shaft ANSI B92.1a

T1 – 1 3/4 in 13T 8/16DP[1]



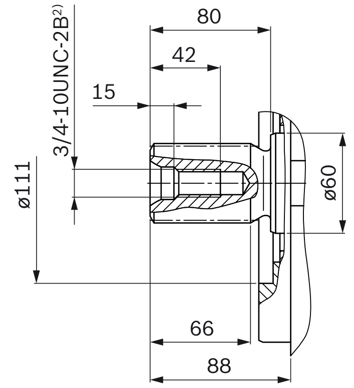
▼ Splined shaft ANSI B92.1a

T2 – 2 in 15T 8/16DP[1]



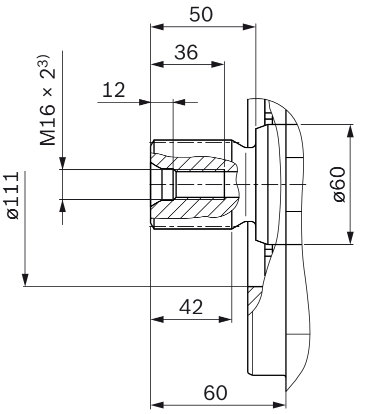
▼ Splined shaft ANSI B92.1a

T3 – 2 1/4 in 17T 8/16DP[1]



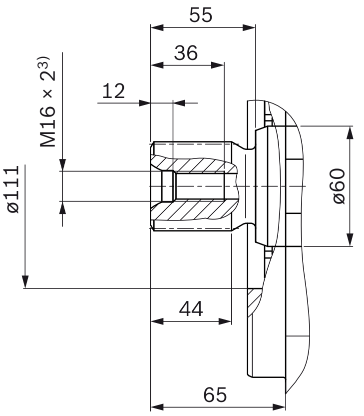
▼ Splined shaft DIN 5480

A1 – W45×2×21×9



▼ Splined shaft DIN 5480

A2 – W50×2×24×9



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1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Center bore according to DIN 332 (thread according to DIN 13)

Ports		Standard	Size	$p_{\text{max abs}}$ **[bar]**[4]	State[10]
A, B	Working port	SAEJ518[5]	1 1/4 in	500	O
	Fastening thread	DIN 13	M14 × 2; 19 deep		
S	Suction port	ISO 6149[8]	M48 × 2; 22 deep	5	O[6]
$\mathbf{T_1}$	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	O[7]
$\mathbf{T_2}$	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	X[7]
R	Air bleed port	ISO 6149[8]	M14 × 1.5; 11.5 deep	3	X
$\mathbf{X_1}$, $\mathbf{X_2}$	Control pressure port (upstream of orifice)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
$\mathbf{X_1}$, $\mathbf{X_2}$	Control pressure port (upstream of orifice, HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{X_3}$, $\mathbf{X_4}$[9]	Stroking chamber pressure port	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
G	Boost pressure port inlet	ISO 6149[8]	M22 × 1.5; 15.5 deep	40	X
$\mathbf{P_S}$	Pilot pressure port inlet	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	X
$\mathbf{P_S}$	Pilot pressure port inlet (DA..6 only)	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	O
$\mathbf{Y_{ST}}$	Pilot pressure port outlet	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
$\mathbf{Y_{ST}}$	Pilot pressure port outlet (DA..6 only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{Y_{HT}}$	Pilot pressure port outlet (HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{M_A}$, $\mathbf{M_B}$	Measuring port pressure A, B	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
$\mathbf{M_H}$	Measuring port, high pressure	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
$\mathbf{Y_1}$, $\mathbf{Y_2}$	Pilot pressure port (pilot signal HP only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
Z	Pilot pressure port (inch signal DA..5 only)	ISO 6149[8]	M10 × 1; 8 deep	40	O

---

[4] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

[5] Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

[6] Plugged for external boost pressure supply.

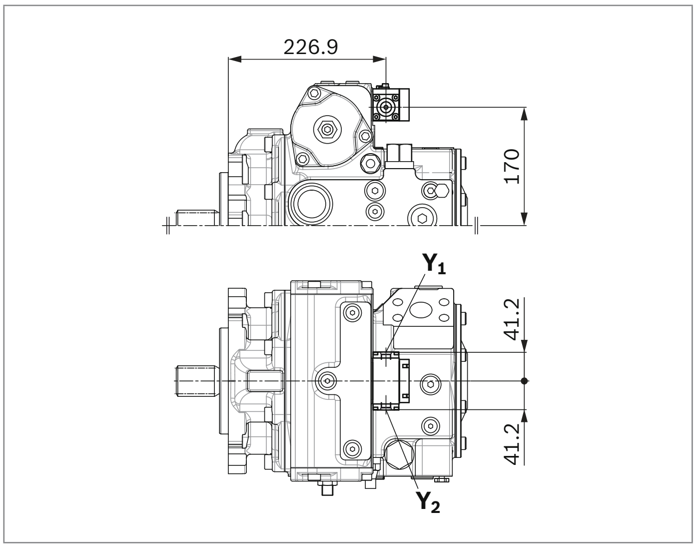
[7] Depending on installation position, $\mathbf{T_1}$ or $\mathbf{T_2}$ must be connected (see also installation instructions on page 68).

[8] The countersink can be deeper than as specified in the standard.

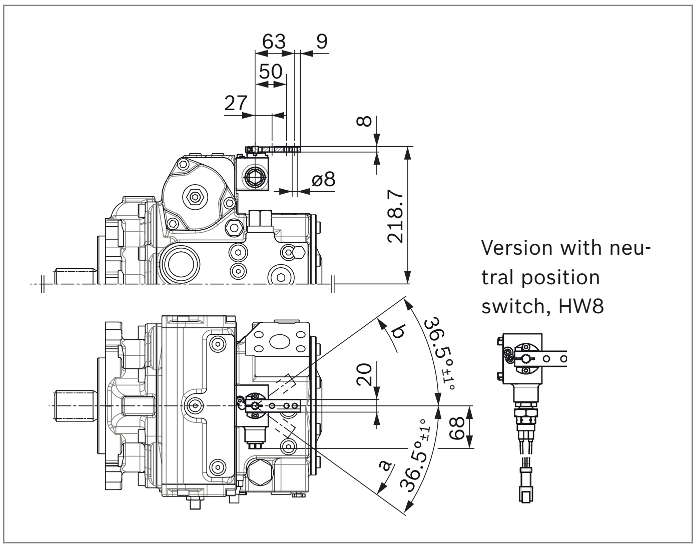
[9] Optional, see page 59

[10] O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

▼ **HP** – Proportional control, hydraulic, pilot-pressure related

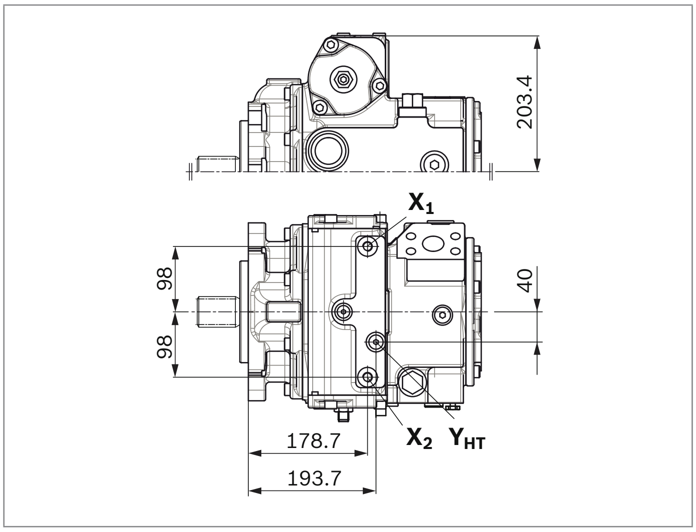


▼ **HW** – Proportional control, hydraulic, mechanical servo

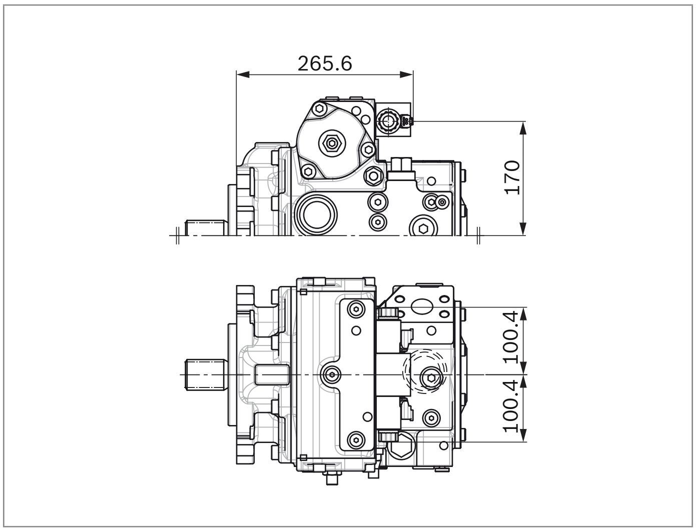


Version with neutral position switch, HW8

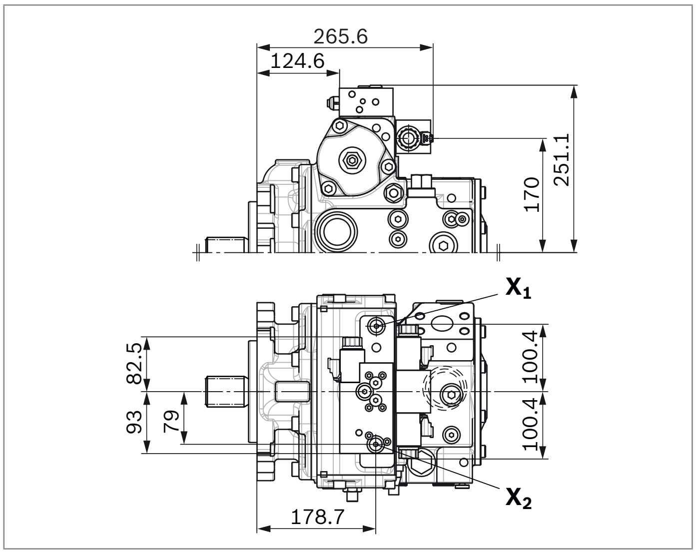
▼ **HT** – Hydraulic control, direct operated



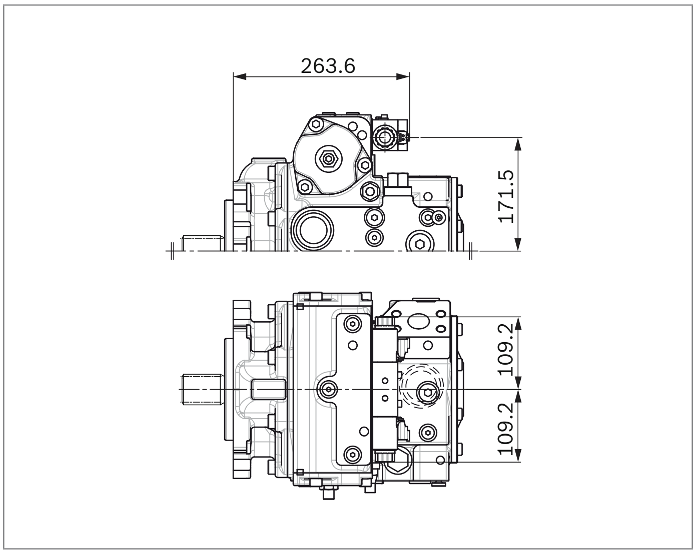
▼ **EZ** – Two-point control, electric



▼ **EV** – Electric control, direct operated, 4/3-way directional valve, one DRE

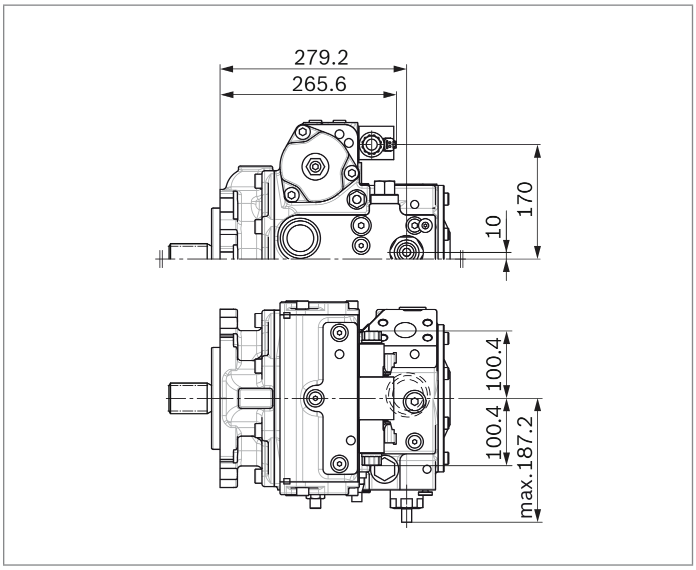


▼ **ET** – Electric control, direct operated, two DRE

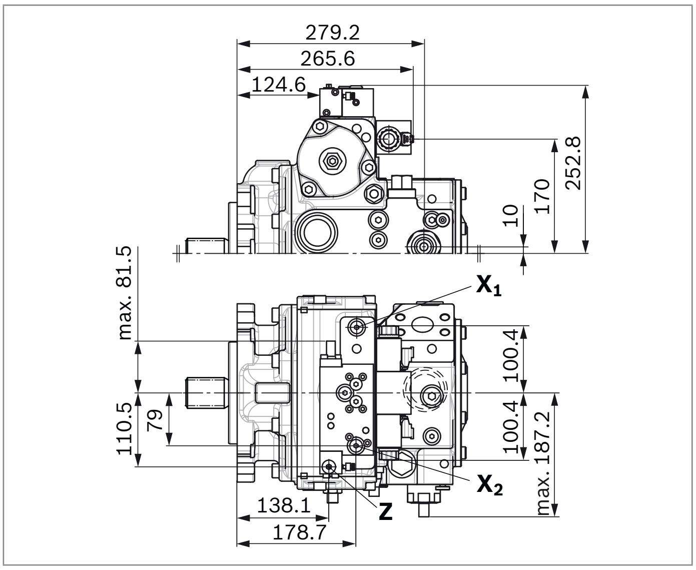


DA control valve

▼ **Version 1** – fixed setting



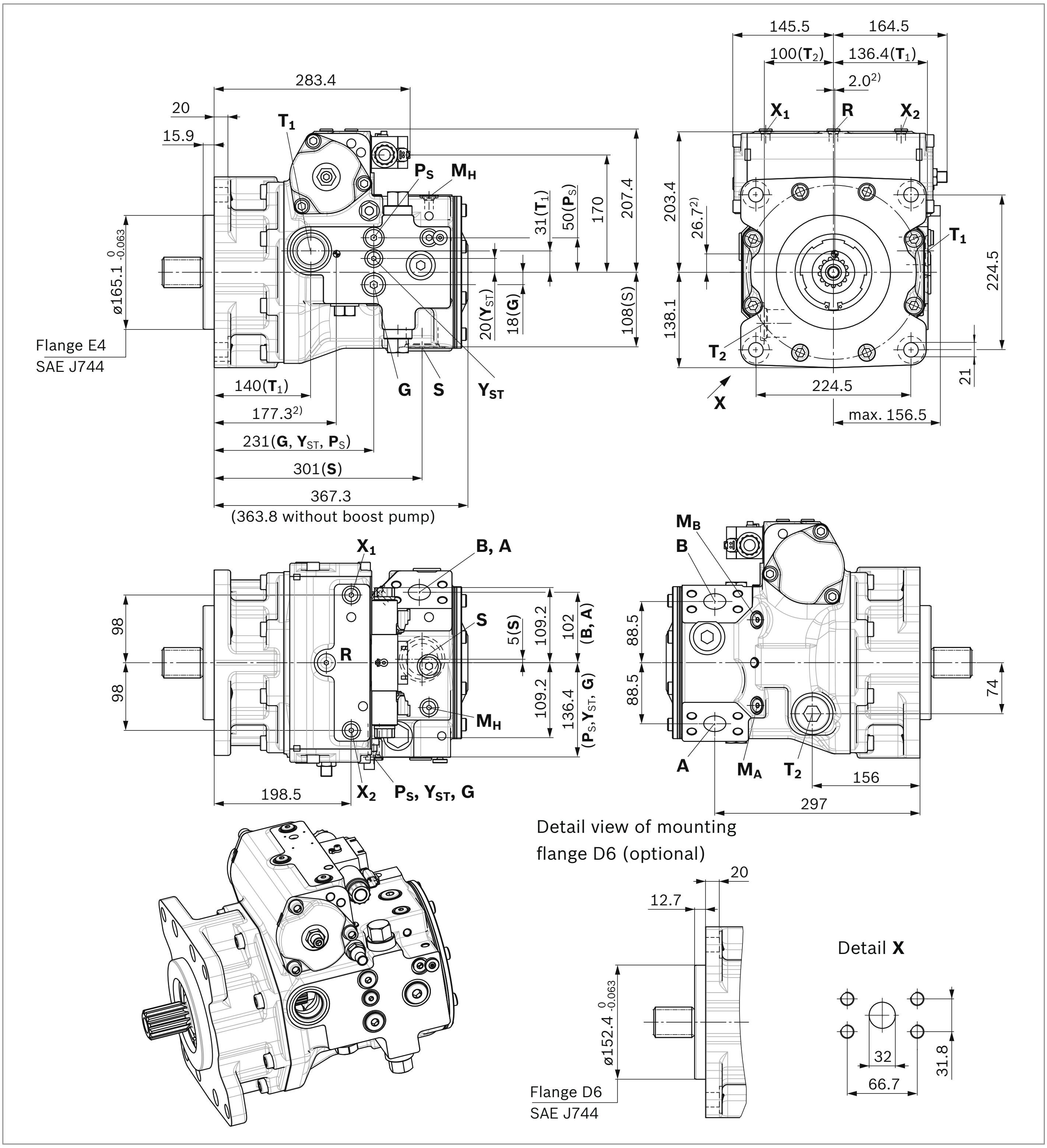
▼ **Version 5** – fixed setting and inch valve mounted



Dimensions, size 175

EP – Proportional control, electric

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)[1]



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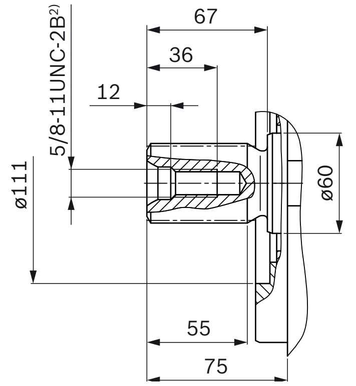
1) For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

2) Center of gravity

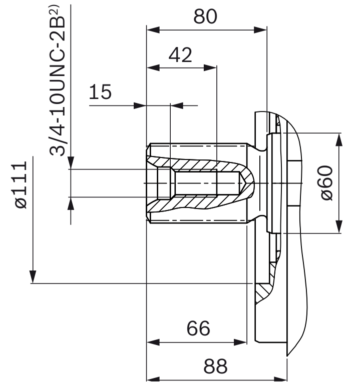
▼ **Splined shaft ANSI B92.1a**

T1 – 1 3/4 in 13T 8/16DP[1]



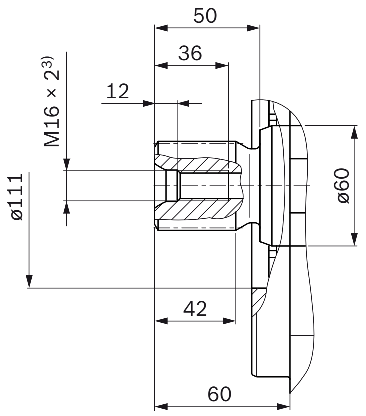
▼ **Splined shaft ANSI B92.1a**

T3 – 2 1/4 in 17T 8/16DP[1]



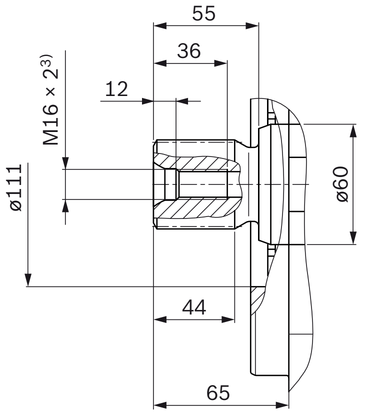
▼ **Splined shaft DIN 5480**

A1 – W45×2×21×9



▼ **Splined shaft DIN 5480**

A2 – W50×2×24×9



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1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) Center bore according to DIN 332 (thread according to DIN 13)

Ports		Standard	Size	$p_{\max\,\mathrm{abs}}$ [bar][4]	State[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	1 1/4 in M14 × 2; 19 deep	500	O
S	Suction port	ISO 6149[8]	M48 × 2; 22 deep	5	O[6]
$\mathbf{T}_1$	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	O[7]
$\mathbf{T}_2$	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	X[7]
R	Air bleed port	ISO 6149[8]	M14 × 1.5; 11.5 deep	3	X
$\mathbf{X}_1$, $\mathbf{X}_2$	Control pressure port (upstream of orifice)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
$\mathbf{X}_1$, $\mathbf{X}_2$	Control pressure port (upstream of orifice, HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{X}_3$, $\mathbf{X}_4$[9]	Stroking chamber pressure port	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
G	Boost pressure port inlet	ISO 6149[8]	M22 × 1.5; 15.5 deep	40	X
$\mathbf{P}_\mathrm{S}$	Pilot pressure port inlet	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	X
$\mathbf{P}_\mathrm{S}$	Pilot pressure port inlet (DA..6 only)	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	O
$\mathbf{Y}_\mathrm{ST}$	Pilot pressure port outlet	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
$\mathbf{Y}_\mathrm{ST}$	Pilot pressure port outlet (DA..6 only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{Y}_\mathrm{HT}$	Pilot pressure port outlet (HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
$\mathbf{M}_\mathrm{A}$, $\mathbf{M}_\mathrm{B}$	Measuring port pressure A, B	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
$\mathbf{M}_\mathrm{H}$	Measuring port, high pressure	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
$\mathbf{Y}_1$, $\mathbf{Y}_2$	Pilot pressure port (pilot signal HP only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
Z	Pilot pressure port (inch signal DA..5 only)	ISO 6149[8]	M10 × 1; 8 deep	40	O

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[4] Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

[5] Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

[6] Plugged for external boost pressure supply.

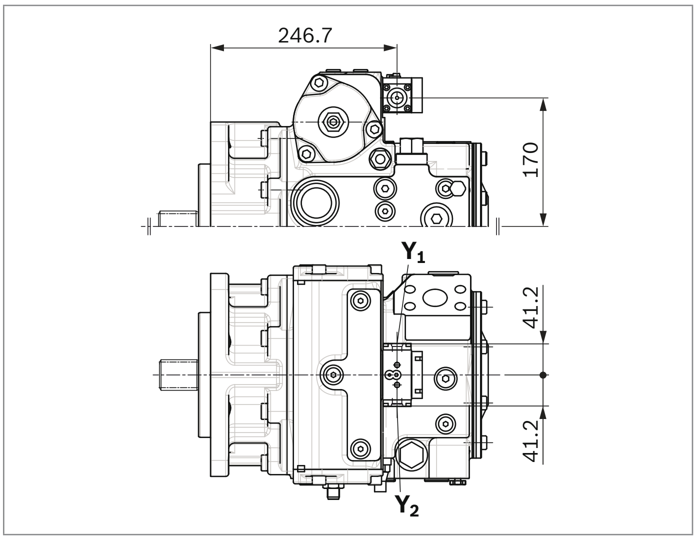
[7] Depending on installation position, $\mathbf{T}_1$ or $\mathbf{T}_2$ must be connected (see also installation instructions on page 68).

[8] The countersink can be deeper than as specified in the standard.

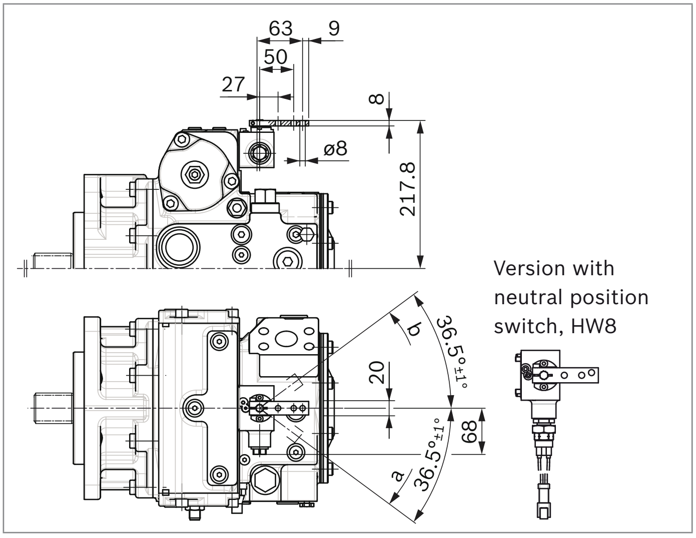
[9] Optional, see page 59

[10] O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

▼ **HP** – Proportional control, hydraulic, pilot-pressure related

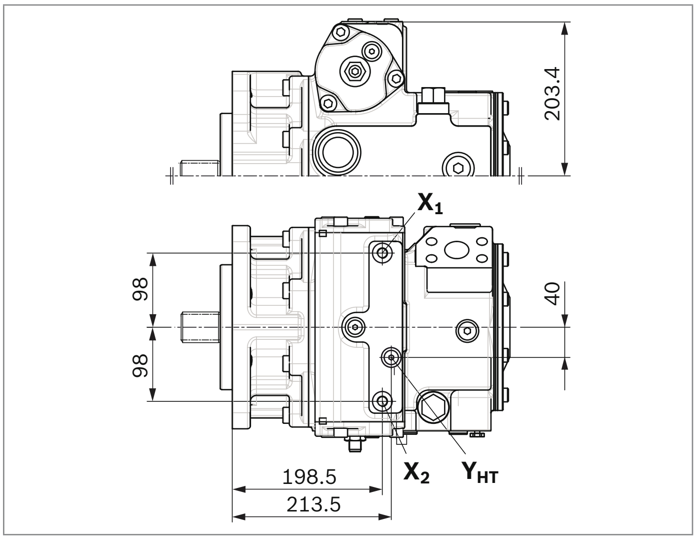


▼ **HW** – Proportional control, hydraulic, mechanical servo

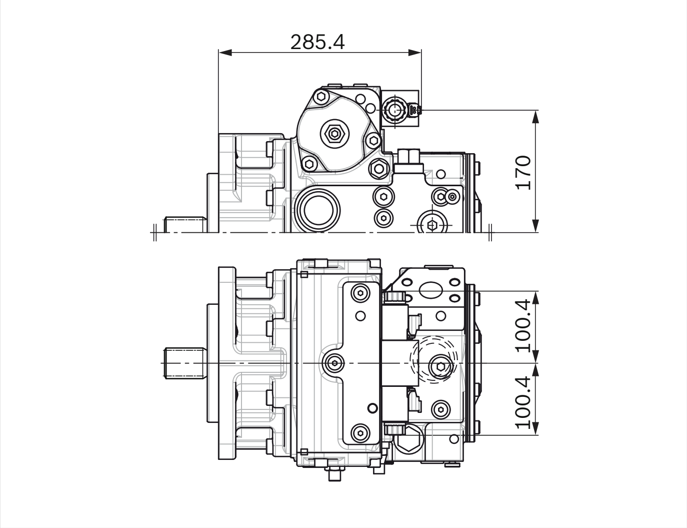


Version with neutral position switch, HW8

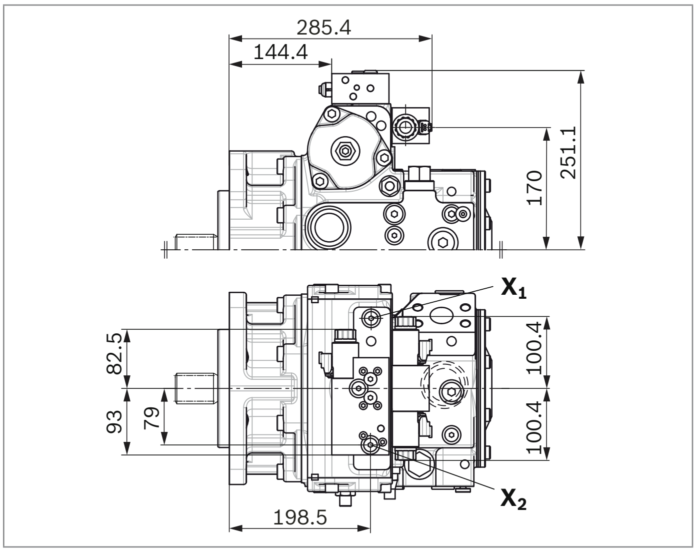
▼ **HT** – Hydraulic control, direct operated



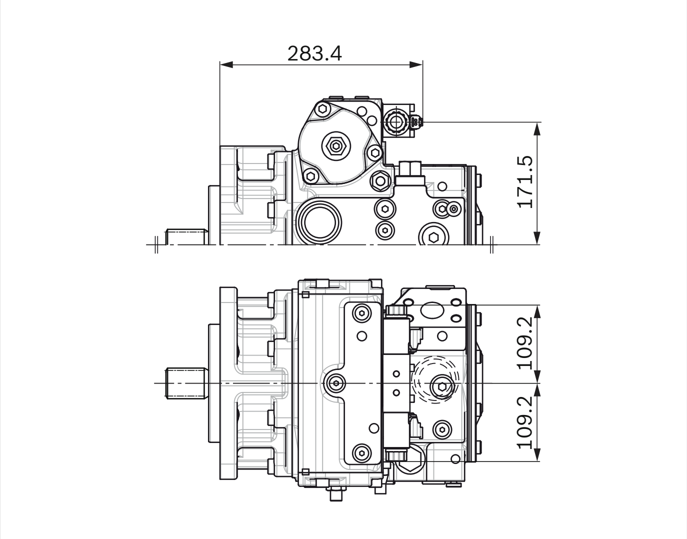
▼ **EZ** – Two-point control, electric



▼ **EV** – Electric control, direct operated, 4/3-way directional valve, one DRE

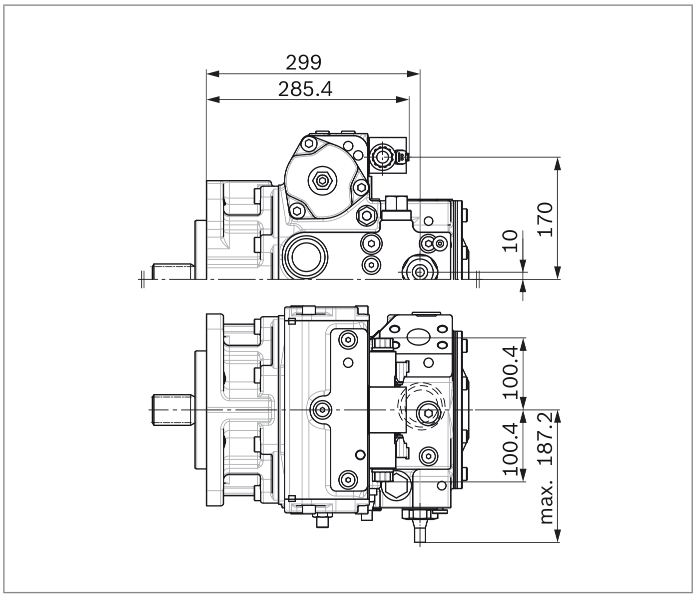


▼ **ET** – Electric control, direct operated, two DRE

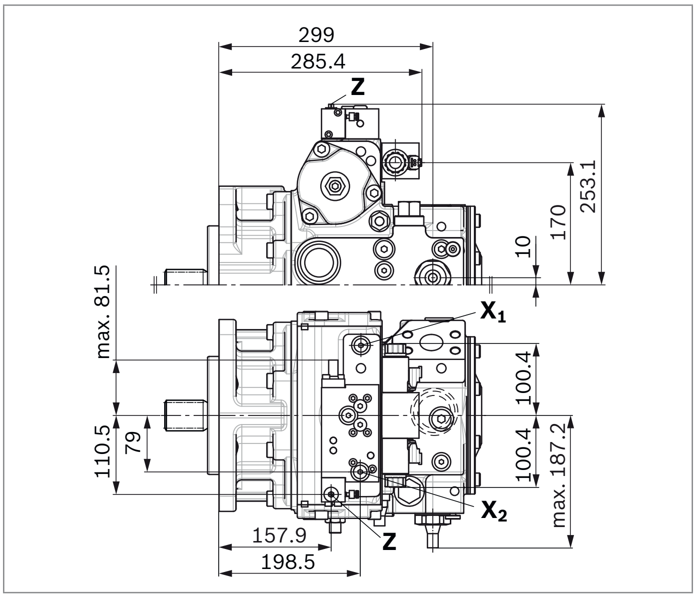


DA control valve

▼ **Version 1** – fixed setting



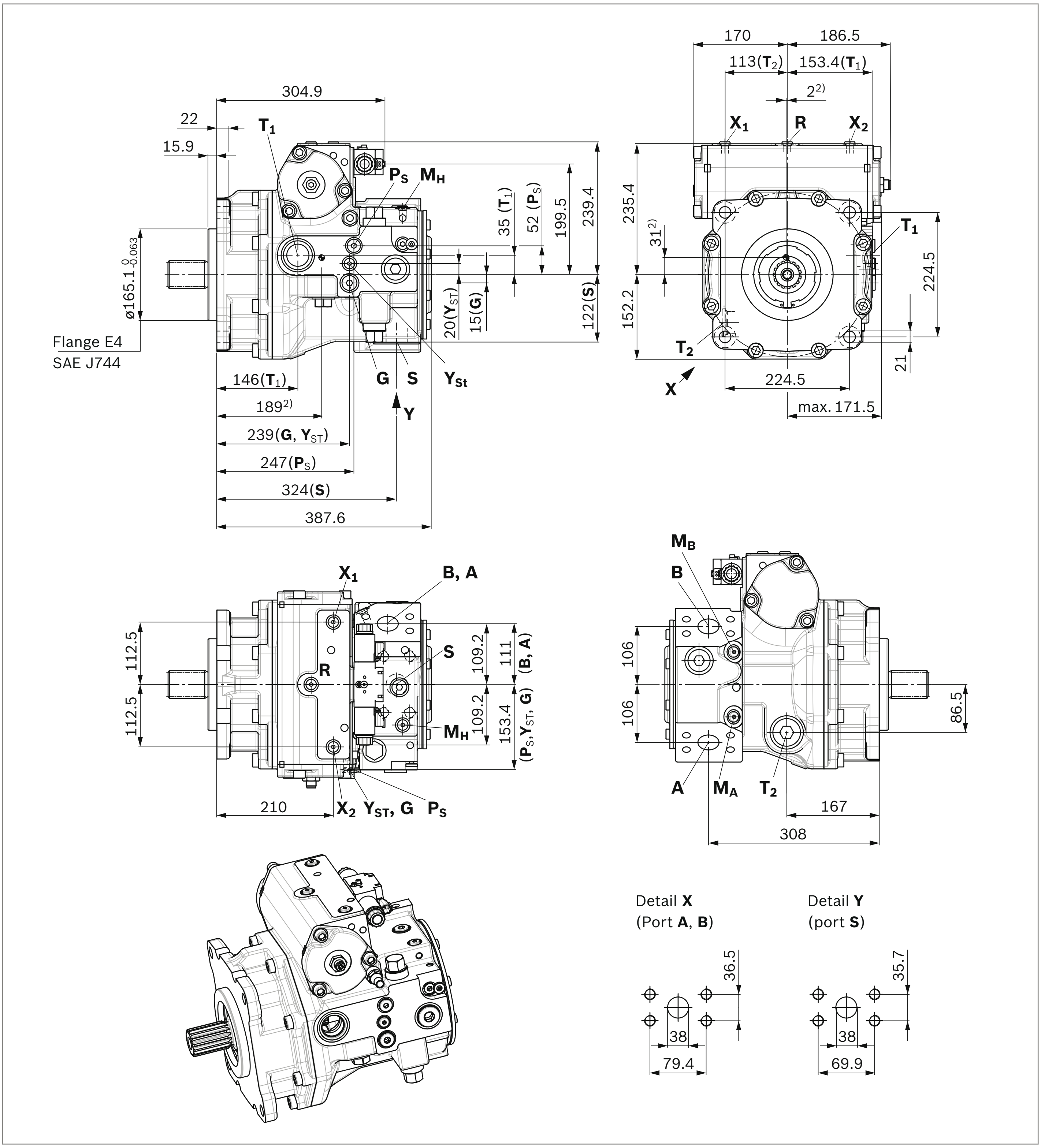
▼ **Version 5** – fixed setting and inch valve mounted



Dimensions, size 210

EP – Proportional control, electric

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)[1]



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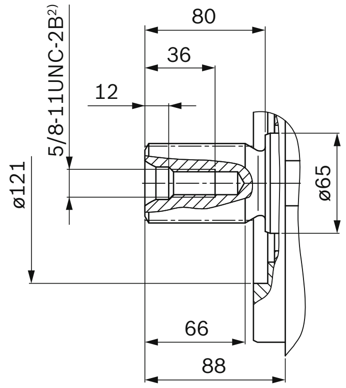
[1] For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

[2] Center of gravity

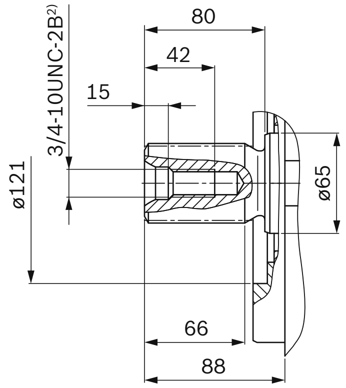
▼ Splined shaft ANSI B92.1a

T2 – 2 in 15T 8/16DP[1]



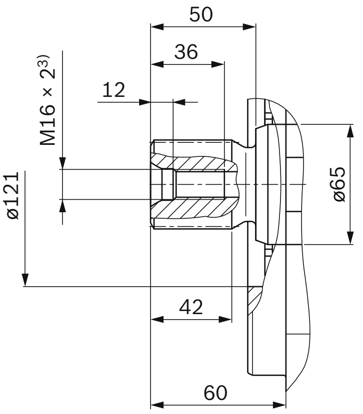
▼ Splined shaft ANSI B92.1a

T3 – 2 1/4 in 17T 8/16DP[1]



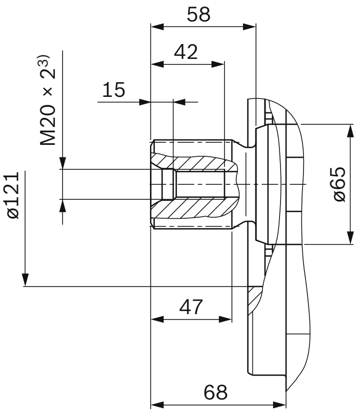
▼ Splined shaft DIN 5480

A1 – W45×2×21×9



▼ Splined shaft DIN 5480

A3 – W55×2×26×9



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[1] Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Thread according to ASME B1.1

[3] Center bore according to DIN 332 (thread according to DIN 13)

Ports		Standard	Size	$p_{\text{max abs}}$ **[bar]** 5)	**State** 11)
A, B	Working port Fastening thread	SAEJ518 5) DIN 13	1 1/2 in M16 × 2; 21 deep	500	O
S	Suction port Fastening thread	SAEJ518 5) DIN 13	1 1/2 in M12 × 1.75; 20 deep	5	O 7)
T$_1$	Drain port	ISO 6149 8)	M42 × 2; 19.5 deep	3	O 8)
T$_2$	Drain port	ISO 6149 8)	M42 × 2; 19.5 deep	3	X 8)
R	Air bleed port	ISO 6149 8)	M14 × 1.5; 11.5 deep	3	X
X$_1$, **X**$_2$	Control pressure port (upstream of orifice)	ISO 6149 8)	M14 × 1.5; 11.5 deep	40	X
X$_1$, **X**$_2$	Control pressure port (upstream of orifice, HT only)	ISO 6149 8)	M14 × 1.5; 11.5 deep	40	O
X$_3$, **X**$_4$ 9)	Stroking chamber pressure port	ISO 6149 8)	M14 × 1.5; 11.5 deep	40	X
G	Boost pressure port inlet	ISO 6149 8)	M22 × 1.5; 15.5 deep	40	X
P$_S$	Pilot pressure port inlet	ISO 6149 8)	M18 × 1.5; 14.5 deep	40	X
P$_S$	Pilot pressure port inlet (DA..6 only)	ISO 6149 8)	M18 × 1.5; 14.5 deep	40	O
Y$_{ST}$	Pilot pressure port outlet	ISO 6149 8)	M14 × 1.5; 11.5 deep	40	X
Y$_{ST}$	Pilot pressure port outlet (DA..6 only)	ISO 6149 8)	M14 × 1.5; 11.5 deep	40	O
Y$_{HT}$	Pilot pressure port outlet (HT only)	ISO 6149 8)	M14 × 1.5; 11.5 deep	40	O
M$_A$, **M**$_B$	Measuring port pressure A, B	ISO 6149 8)	M14 × 1.5; 11.5 deep	500	X
M$_H$	Measuring port, high pressure	ISO 6149 8)	M14 × 1.5; 11.5 deep	500	X
Y$_1$, **Y**$_2$	Pilot pressure port (pilot signal HP only)	ISO 6149 8)	M14 × 1.5; 11.5 deep	40	O
Z	Pilot pressure port (inch signal DA..5 only)	ISO 6149 8)	M10 × 1; 8 deep	40	O

---

4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

5) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

6) Plugged for external boost pressure supply.

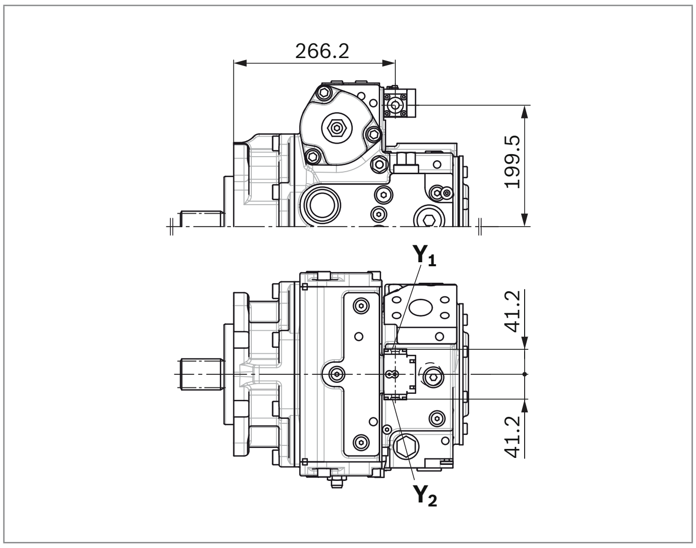
7) Depending on installation position, **T**$_1$ or **T**$_2$ must be connected (see also installation instructions on page 68).

8) The countersink can be deeper than as specified in the standard.

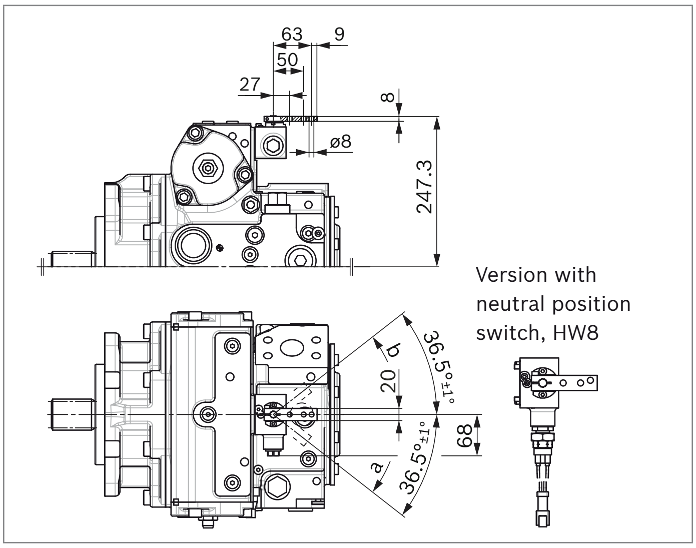
9) Optional, see page 59

10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

▼ **HP** – Proportional control, hydraulic, pilot-pressure related

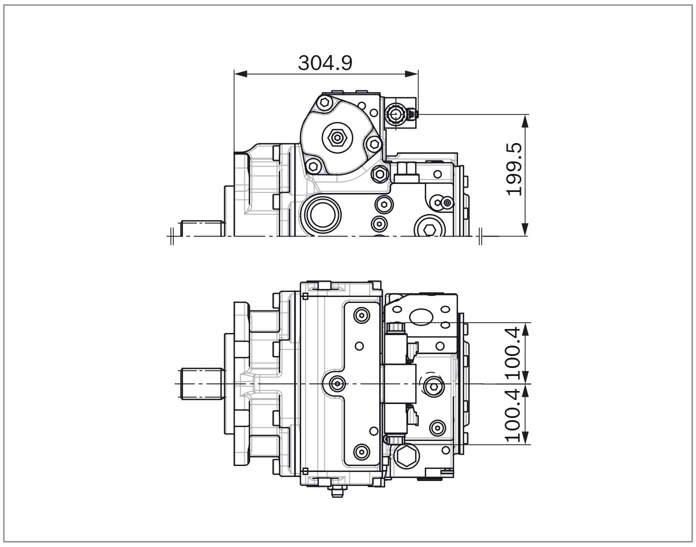


▼ **HW** – Proportional control, hydraulic, mechanical servo



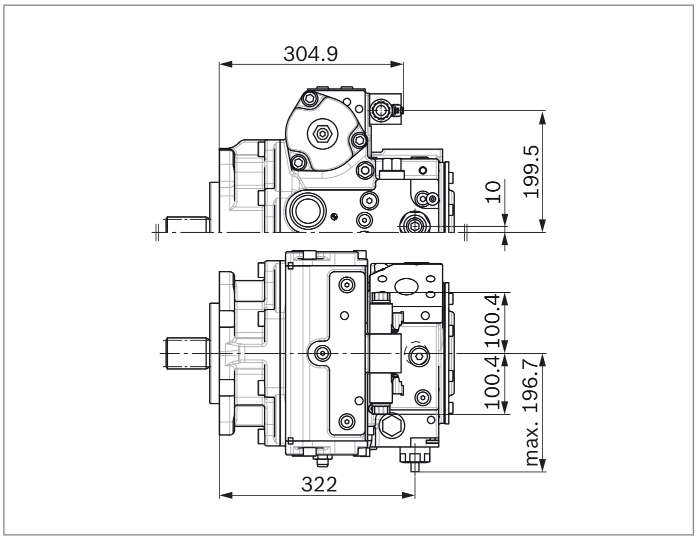
Version with
neutral position
switch, HW8

▼ **EZ** – Two-point control, electric



DA control valve

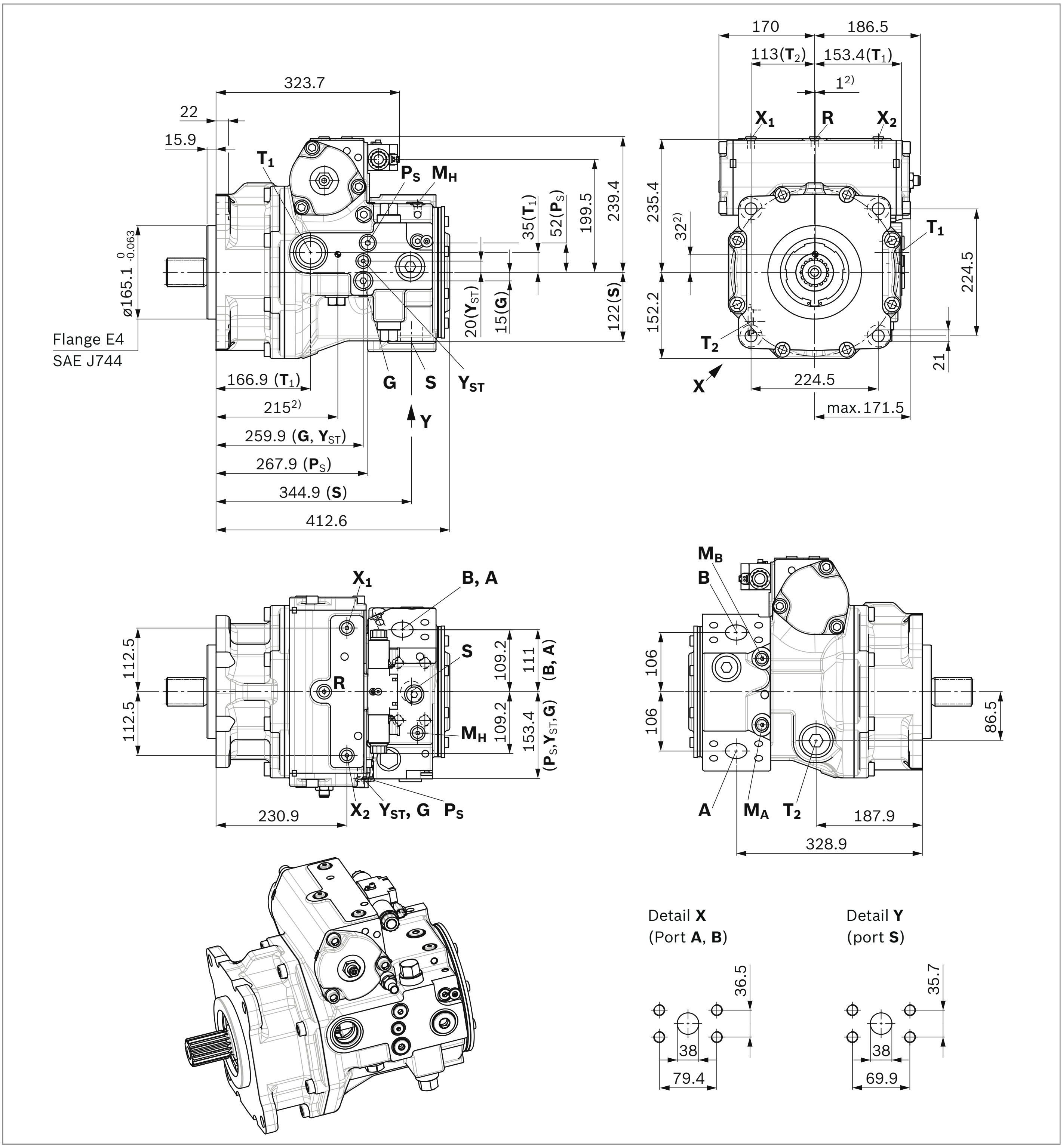
▼ **DA..1 – fixed setting**



Dimensions, size 280

EP – Proportional control, electric

SAE working ports **A** and **B**, on left side 45° (viewed on drive shaft)[1]



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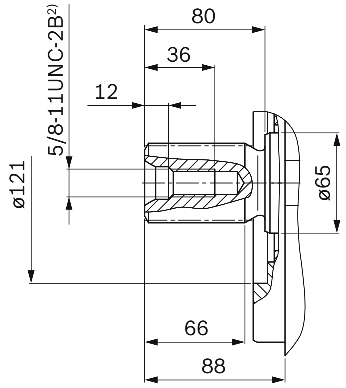
[1] For SAE working ports **A** and **B**, 45° right (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

[2] Center of gravity

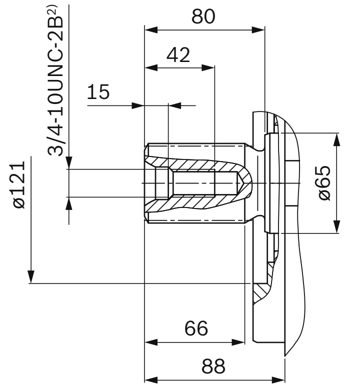
▼ Splined shaft ANSI B92.1a

T2 – 2 in 15T 8/16DP[1]



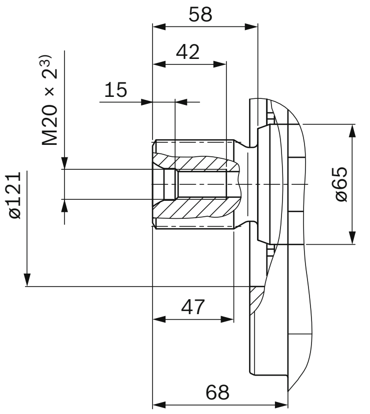
▼ Splined shaft ANSI B92.1a

T3 – 2 1/4 in 17T 8/16DP[1]



▼ Splined shaft DIN 5480

A3 – W55×2×26×9



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[1] Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Thread according to ASME B1.1

[3] Center bore according to DIN 332 (thread according to DIN 13)

Dimensions, size 280

Ports		Standard	Size	$p_{\text{max abs}}$ [bar][4]	State[10]
A, B	Working port Fastening thread	SAEJ518[5] DIN 13	1 1/2 in M16 × 2; 21 deep	500	O
S	Suction port fastening thread	SAEJ518[5] DIN 13	1 1/2 in M12 × 1.75; 20 deep	5	O[6]
T_1	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	O[7]
T_2	Drain port	ISO 6149[8]	M42 × 2; 19.5 deep	3	X[7]
R	Air bleed port	ISO 6149[8]	M14 × 1.5; 11.5 deep	3	X
X_1, X_2	Control pressure port (upstream of orifice)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
X_1, X_2	Control pressure port (upstream of orifice, HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
X_3, X_4[9]	Stroking chamber pressure port	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
G	Boost pressure port inlet	ISO 6149[8]	M22 × 1.5; 15.5 deep	40	X
P_S	Pilot pressure port inlet	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	X
P_S	Pilot pressure port inlet (DA..6 only)	ISO 6149[8]	M18 × 1.5; 14.5 deep	40	O
Y_{ST}	Pilot pressure port outlet	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	X
Y_{ST}	Pilot pressure port outlet (DA..6 only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
Y_{HT}	Pilot pressure port outlet (HT only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
M_A, M_B	Measuring port pressure A, B	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
M_H	Measuring port, high pressure	ISO 6149[8]	M14 × 1.5; 11.5 deep	500	X
Y_1, Y_2	Pilot pressure port (pilot signal HP only)	ISO 6149[8]	M14 × 1.5; 11.5 deep	40	O
Z	Pilot pressure port (inch signal DA..5 only)	ISO 6149[8]	M10 × 1; 8 deep	40	O

---

4) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

5) Only dimensions according to SAE J518, metric fastening thread is a deviation from the standard.

6) Plugged for external boost pressure supply.

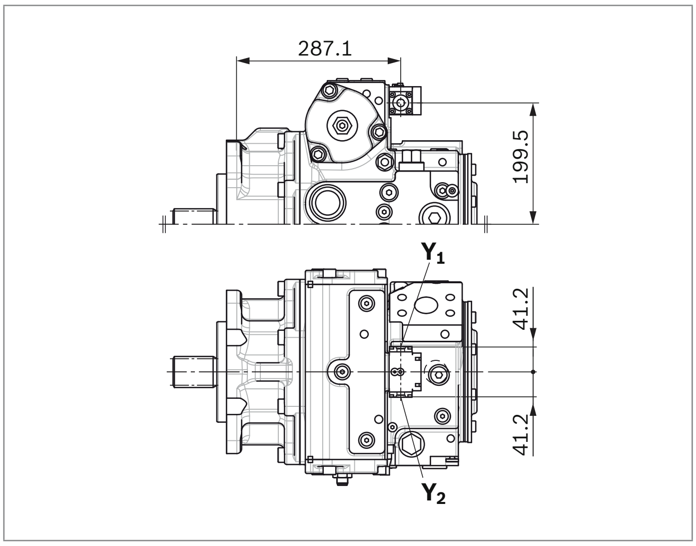
7) Depending on installation position, **T_1** or **T_2** must be connected (see also installation instructions on page 68).

8) The countersink can be deeper than as specified in the standard.

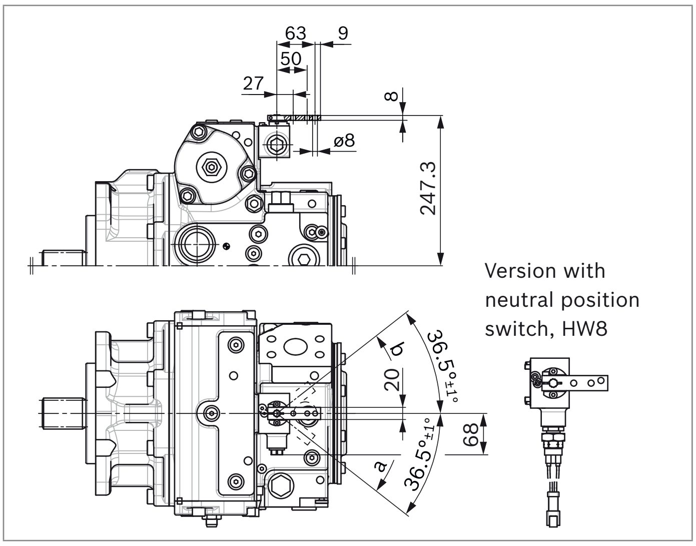
9) Optional, see page 59

10) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

▼ **HP** – Proportional control, hydraulic, pilot-pressure related

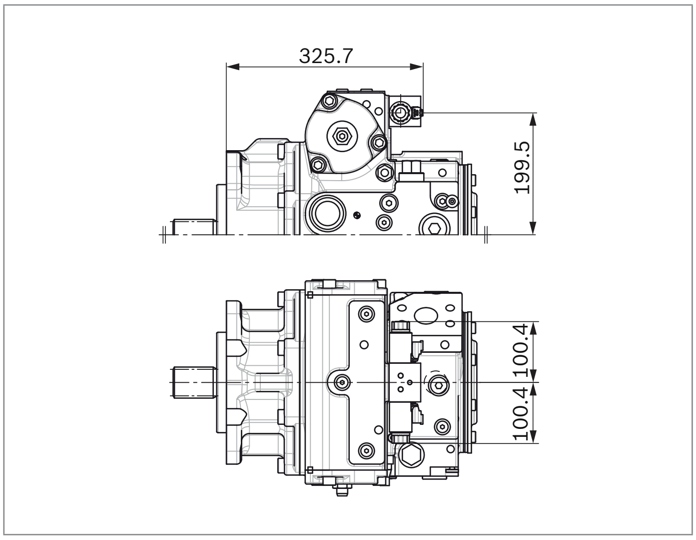


▼ **HW** – Proportional control, hydraulic, mechanical servo



Version with
neutral position
switch, HW8

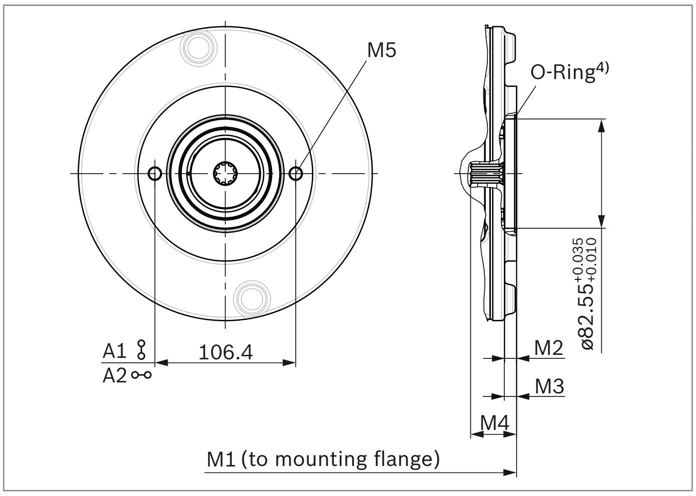
▼ **EZ** – Two-point control, electric



Dimensions, through drive

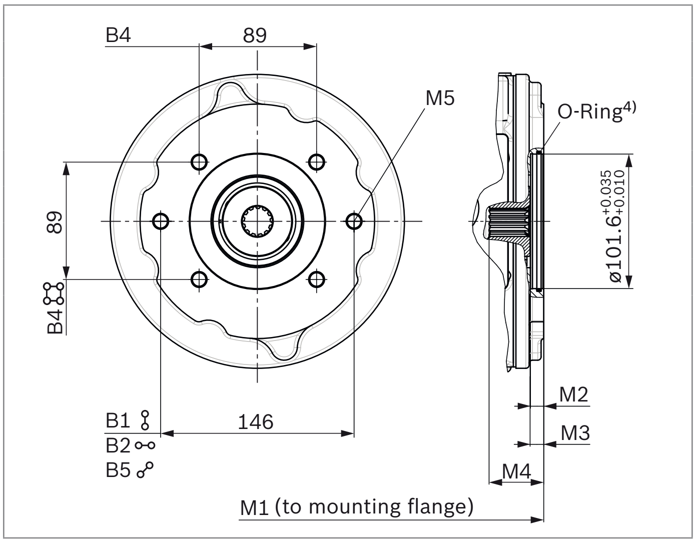
Flange SAE J744[1]			Hub for splined shaft[2]									
Diameter	**Mounting[3]**	**Code**	**Diameter**		**Code**	**110**	**125**	**145**	**175**	**210**	**280**	
82-2 (A)	8	A1	5/8 in	9T 16/32DP	S2	●	–	●	●	–	○	**A1S2**
		A1	3/4 in	11T 16/32DP	S3	●	–	●	●	●	●	**A1S3**
	⚯	A2	5/8 in	9T 16/32DP	S2	●	●	●	●	○	●	**A2S2**
		A2	3/4 in	11T 16/32DP	S3	●	–	●	●	●	●	**A2S3**
101-2 (B)	8	B1	7/8 in	13T 16/32DP	S4	●	●	●	●	●	●	**B1S4**
		B1	1 in	15T 16/32DP	S5	●	–	●	●	●	●	**B1S5**
	⚯	B2	7/8 in	13T 16/32DP	S4	●	●	●	●	●	●	**B2S4**
		B2	1 in	15T 16/32DP	S5	●	–	●	●	○	○	**B2S5**
	☍	B5	7/8 in	13T 16/32DP	S4	●	–	●	○	○	○	**B5S4**
		B5	1 in	15T 16/32DP	S5	○	–	●	○	●	●	**B5S5**
101-4 (B)	⁘	B4	7/8 in	13T 16/32DP	S4	○	–	●	○	●	○	**B4S4**
		B4	1 in	15T 16/32DP	S5	●	–	●	○	○	○	**B4S5**

▼ **82-2**



NG	M1[5]	M2	M3	M4	M5[6]
110	324.3	9	9.4	34.6	M10 × 1.5; 13 deep
125	328.3	9	10	35	
145	346.2	9	9.3	34.7	
175	369.3	9	9.1	33.4	
210	389.6	9	7.3	33	
280	415.6	9.7	9.4	34.1	

▼ **101-2, 101-4**



NG	M1[5]	M2	M3	M4	M5[6]
110	327.3	9	9.4	34.6	M12 × 1.75; 16 deep
125	331.1	10	11	48	
145	349.2	9	9.3	34.7	
175	372.3	9	9.1	33.4	
210	392.6	On request			M12 × 1.75; 13 deep
280	418.6	On request			M12 × 1.75; 13 deep

---

[1] The through-drive shaft is only supplied with the fastening thread corresponding to the ordering code designation.

[2] Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[3] Mounting hole pattern viewed on through drive with control at top

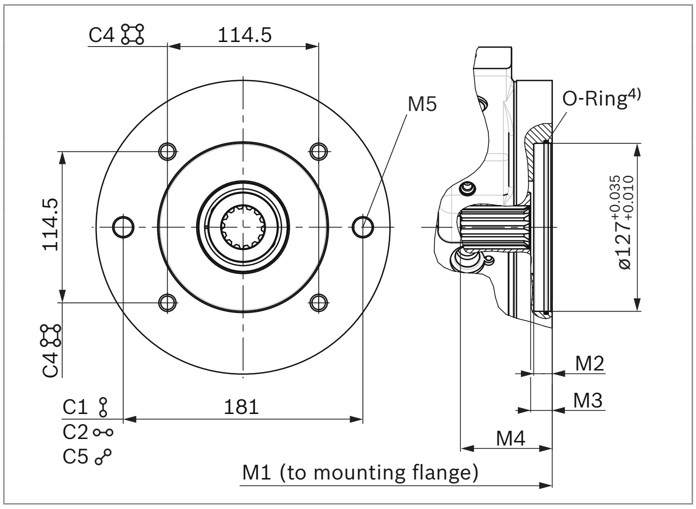
[4] O-ring included in the scope of delivery

[5] Installation length M1 is valid for standard mounting flange (with integrated boost pump)

[6] Thread according to DIN 13

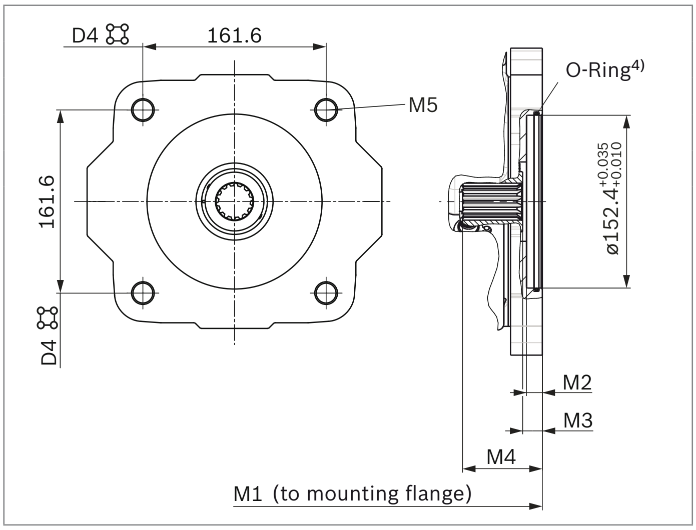
Flange SAE J744[1]			Hub for splined shaft[2]									
Diameter	Mounting[3]	Code	Diameter		Code	110	125	145	175	210	280	
127-2 (C)	⁚	C1	1 in	15T 16/32DP	S5	–	–	○	–	–	–	**C1S5**
		C1	1 1/4 in	14T 12/24DP	S7	●	–	●	○	○	○	**C1S7**
	‥	C2	1 1/4 in	14T 12/24DP	S7	●	●	●	●	●	●	**C2S7**
		C2	1 3/8 in	21T 16/32DP	V8	○	–	●	●	–	–	**C2V8**
		C2	1 3/4 in	13T 8/16DP	T1	–	–	●	●	–	–	**C2T1**
	⋰	C5	1 1/4 in	14T 12/24DP	S7	●	–	●	○	○	○	**C5S7**
127-4 (C)	⸬	C4	1 1/4 in	14T 12/24DP	S7	●	–	●	●	○	●	**C4S7**
		C4	1 3/8 in	21T 16/32DP	V8	●	●	–	–	–	–	**C4V8**
152-4 (D)	⸬	D4	1 3/4 in	13T 8/16DP	T1	–	–	●	●	●	●	**D4T1**

▼ 127-2, 127-2/4



NG	M1[5]	M2	M3	M4	M5[6] 2-hole	M5[6] 4-hole
110	333.3	14	16.9	58.2	M16 × 2; 21 deep	M12 × 1.75; 19 deep
125	On request					
145	355.2	14	16.3	69.6	M16 × 2; 21 deep	M12 × 1.75; 19 deep
175	378.3	14	16.3	62.7		
210	403.7	27	14.2	56.4		
280	424.6	27	14.4	58.6		

▼ 152-4



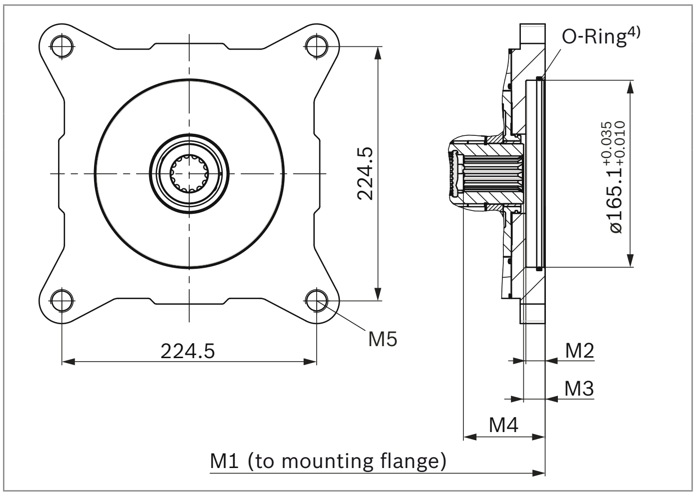
NG	M1[5]	M2	M3	M4	M5[6]
145	356.2	14	10	74.4	M20 × 2.5; 22 deep
175	379.3	14	17.8	76.3	
210	411.6	26	14.3	78.8	
280	432.5	26	14.5	84	

---

1) The through-drive shaft is only supplied with the fastening thread corresponding to the ordering code designation.
2) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
3) Mounting hole pattern viewed on through drive with control at top
4) O-ring included in the scope of delivery
5) Installation length M1 is valid for standard mounting flange (with integrated boost pump)
6) Thread according to DIN 13

Flange SAE J744[1]			Hub for splined shaft[2]									
Diameter	**Mounting**[3]	**Code**	**Diameter**		**Code**	**110**	**125**	**145**	**175**	**210**	**280**	
165-4 (E)	⌘	E4	1 3/4 in	13T 8/16DP	T1	–	–	–	●	●	–	**E4T1**
			2 in	15T 8/16DP	T2	–	–	–	–	●	●	**E4T2**

▼ **165-4**



NG	M1[5]	M2	M3	M4	M5[6]
175	381	17	19.4	77.9	M20 × 2.5; 22 deep
210	407.3	On request			M20 × 2.5; 27 deep
280	447.3	On request			M20 × 2.5; 22 deep

---

1) The through-drive shaft is only supplied with the fastening thread corresponding to the ordering code designation.
2) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
3) Mounting hole pattern viewed on through drive with control at top
4) O-ring included in the scope of delivery
5) Installation length M1 is valid for standard mounting flange (with integrated boost pump)
6) Thread according to DIN 13

Overview of mounting options

Through drive[1]			**Mounting option – 2nd pump**						
Flange	**Hub for splined shaft**	**Code**	**A4VG/40 NG (shaft)**	**A4VG/32 NG (shaft)**	**A10VG NG (shaft)**	**A10VO/3x NG (shaft)**	**A10V(S)O/5x NG (shaft)**	**A11VO/1 NG (shaft)**	**External gear pump**[2]
82-2 (A)	5/8 in	**A_S2**	–	–	–	18 (U)	10, 18 (U)	–	AZPF NG4 to 22
	3/4 in	**A_S3**	–	–	–	18 (S)	10, 18 (S)	–	
101-2 (B)	7/8 in	**B_S4**	–	–	18 (S)	28 (S) 45 (U)	28 (S) 45 (U)	–	AZPN NG20 to 36 AZPG NG32 to 50
	1 in	**B_S5**	–	28 (S)	28, 45 (S)	45 (S)	45 (S) 60, 63, 72 (U)	40 (S)	–
101-4 (B)	7/8 in	**B4S4**	–	–	–	–	–	–	
	1 in	**B4S5**	–	–	–	–	–	–	
127-2 (C)	1 in	**C1S5**	–	40 (U)	–	71 (U)	–	–	–
	1 1/4 in	**C_S7**	–	40, 56, 71 (S)	63 (S)	71 (S) 100 (U)	85, 100 (U)	40 (S)	–
	1 3/8 in	**C2V8**	110 (V8)	56, 71 (T)	63 (T)	–	–	40 (T)	
	1 3/4 in	**C2T1**	110, 125 (T1)	–	–	–	–	–	
127-4 (C)	1 1/4 in	**C4S7**	–	–	–	–	60, 63, 72 (S) 85, 100 (U)	–	
	1 3/8 in	**C4V8**	110 (V8)	–	–	–	–	–	
152-4 (D)	1 3/4 in	**D4T1**	110, 125, 145, 175 (T1)	90, 125 (S)	–	140, 180 (S)	–	95, 130, 145 (S)	–
165-4 (E)	1 3/4 in	**E4T1**	175 (T1)	180 (S)	–	–	–	190, 260 (S)	–
	2 in	**E4T2**	210, 280 (T2)	–	–	–	–	190 (T)	

---

1) Availability of the individual sizes, see type code on page 4.

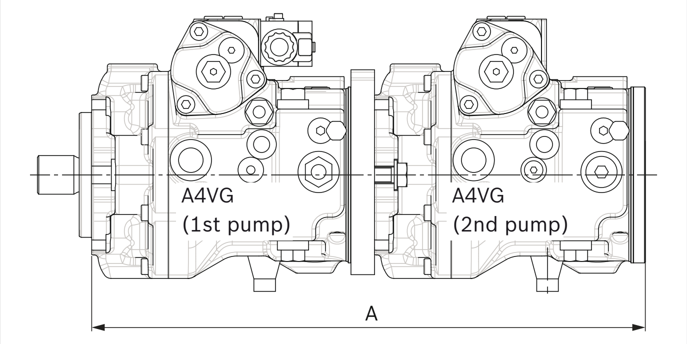
2) Bosch Rexroth recommends special versions of the gear pumps. Please contact us.

Combination pumps A4VG + A4VG

Total length A[1] with standard mounting flange

A4VG	A4VG 2. Pump[2]					
1st pump	**NG110**	**NG125**	**NG145**	**NG175**	**NG210**	**NG280**
NG110	652.6				–	–
NG125	On request	On request			–	–
NG145	674.5	On request	700.4		–	–
NG175	697.6	On request	723.5	748.3	–	–
NG210	729.9	On request	755.8	On request	807.9	–
NG280	755.9	On request	781.8	On request	On request	On request

By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes.
When ordering combination pumps, the type designations of the 1st and 2nd pumps must be linked by a “**+**”.
Order example:
A4VG145EP1DP000/40MRNC6S71FC2S7AS00-0 +
A4VG110EP1DP000/40MRNC2S71F0000AS00-0
A tandem pump, with two pumps of equal size, is permissible without additional supports, assuming that the dynamic acceleration does not exceed maximum 10 g (= 98.1 m/s^2).
We recommend using the 4-hole mounting flanges.
For combination pumps consisting of more than two pumps, the mounting flange must be rated for the permissible moment of inertia, please contact us.



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[1] Overall length is valid for standard mounting flange and integrated boost pump.

[2] 2nd pump without through drive and with boost pump, F0000/V0000

High-pressure relief valves

The two high-pressure relief valves protect the hydrostatic transmission (pump and motor) from overloading. They limit the maximum pressure in the respective high-pressure line and serve simultaneously as boost valves.
High-pressure relief valves are not working valves and are only suitable for pressure peaks or high rates of pressure change.

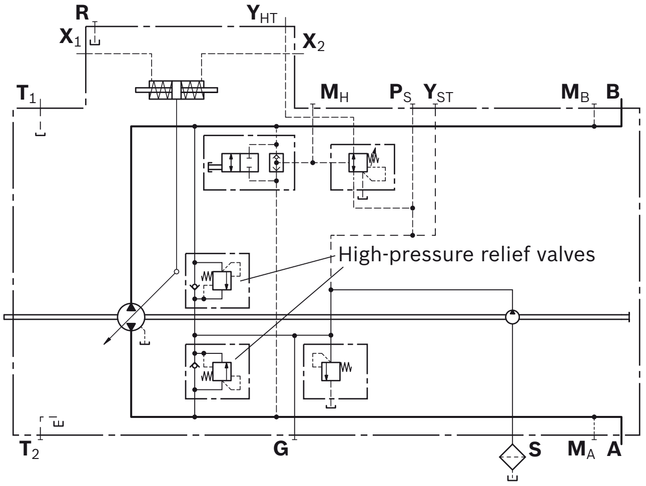
Setting ranges

High-pressure relief valve A and B	Differential pressure setting Δp_{HD}
Preferred values	400 bar
	410 bar
	420 bar
	430 bar
	440 bar
	450 bar
	460 bar
	470 bar
Optional values	300 bar
	320 bar
	340 bar
	360 bar
	380 bar

Settings on high-pressure relief valve A and B	
Differential pressure setting	Δp_{HD} = ... bar
Cracking pressure of the HD valve (at $q_{V\,1}$) ($p_{max} = \Delta p_{HD} + p_{Sp}$)	p_{max} = ... bar

- ▶ The valve settings are made at n = 1000 rpm and at $V_{g\,max}$ ($q_{v\,1}$). There may be deviations in the cracking pressures with other operating parameters.
- ▶ When ordering, state differential pressure setting in plain text.

▼ Circuit diagram

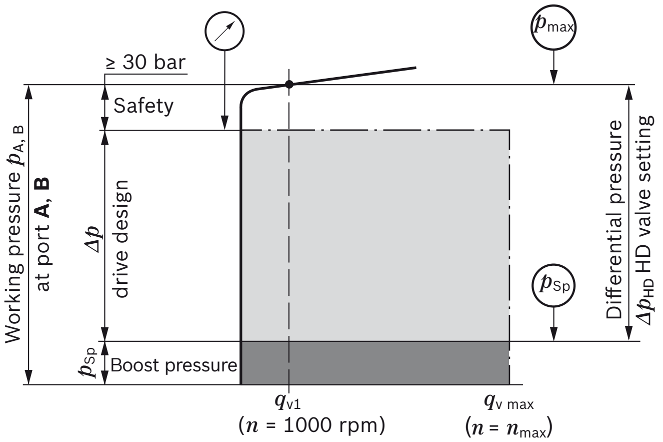


High-pressure relief valve without pressure cut-off

▼ Example

Working pressure		Boost pressure		Differential pressure
$p_{A,B}$		p_{Sp}		Δp_{HD}
450 bar	–	20 bar	=	**430 bar**

▼ Setting diagram

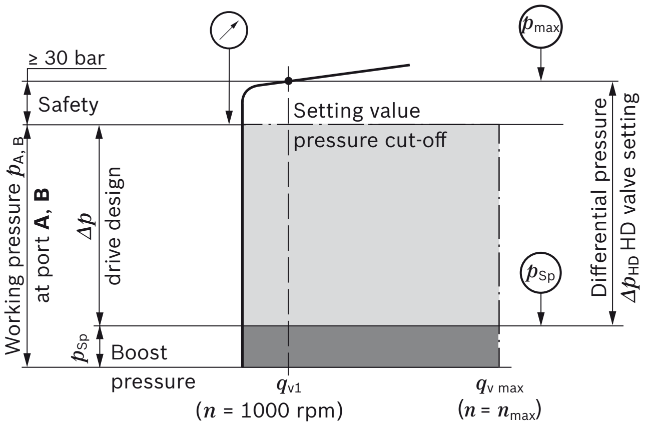


High-pressure relief valve with pressure cut-off

▼ Example

Working pressure		Boost pressure		Safety		Differential pressure
$p_{A,B}$		p_{Sp}				Δp_{HD}
450 bar	–	20 bar	+	30 bar	=	**400 bar**

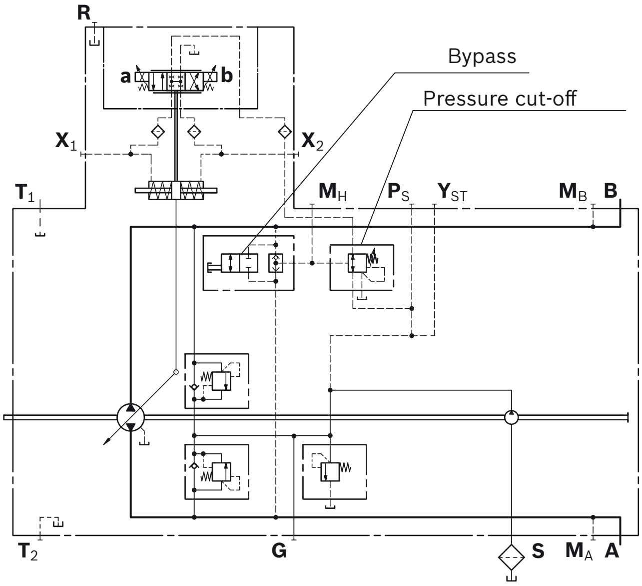
▼ Setting diagram



Pressure cut-off

The pressure cut-off is a pressure control which, after reaching the set pressure, adjusts the displacement of the pump back to $V_{g\,min}$.
This valve prevents the operation of the high-pressure relief valves when accelerating or decelerating.
The high-pressure relief valves protect against the pressure peaks which occur during fast swiveling of the swashplate and limit the maximum pressure in the system.
The setting range of the pressure cut-off may be anywhere within the entire working pressure range. However, it must be set 30 bar lower than the setting value of the high-pressure relief valves (see setting diagram, page 55).
Please state the setting value of the pressure cut-off in plain text when ordering.

▼ **Circuit diagram with pressure cut-off**
Example: electric control, EP_D



Bypass function

A connection between the two high-pressure channels **A** and **B** can be established using the bypass valve (e.g. for machine towing).

Towing speed
The maximum towing speed is dependent on the gear ratio in the vehicle and must be calculated by the vehicle manufacturer. The corresponding flow of q_V = 30 l/min may not be exceeded.

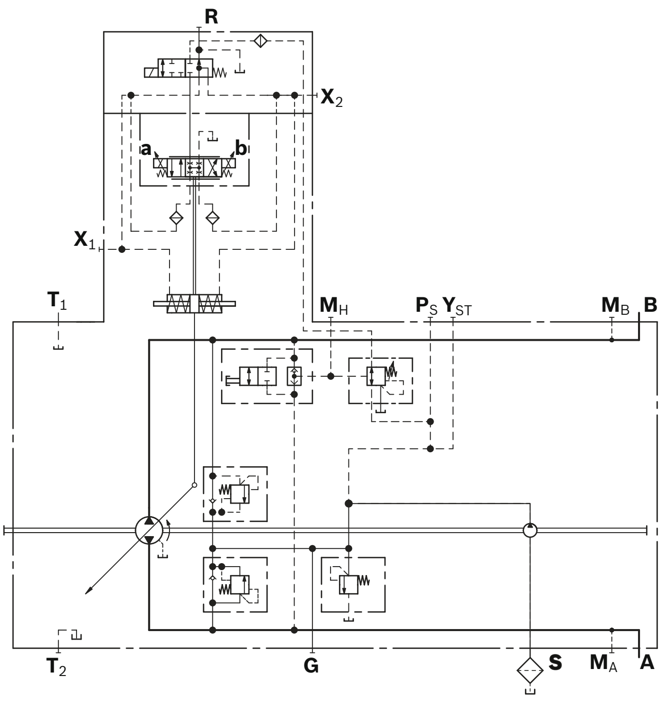
Towing distance
The vehicle may only be towed out of the immediate danger zone.

Neutral valve

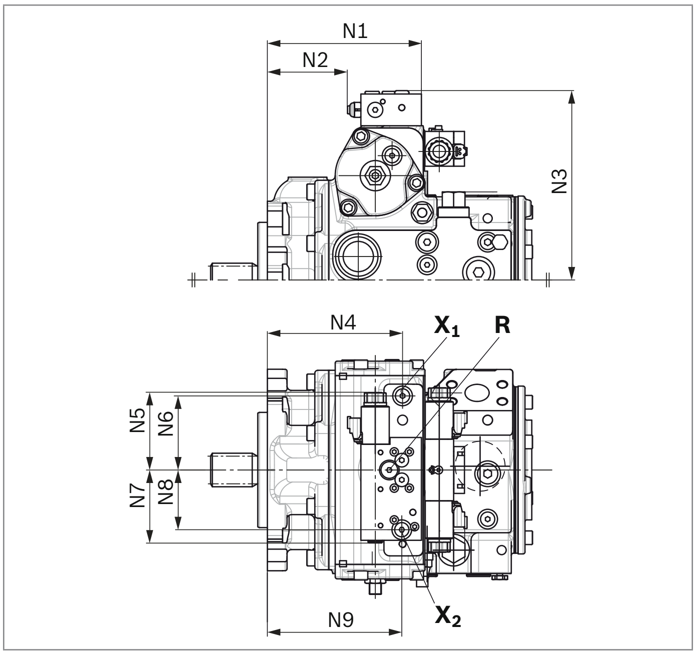
Actuation of the switching solenoid enables pilot pressure through-flow into the control device of the pump. The pump can be swiveled out. When the solenoid is de-energized, this connection is interrupted and simultaneously the two stroking chambers are connected to each other and relieved to the pump housing. This ensures the pump is torque-free.
The return swivel times can be specifically and precisely adapted to the respective customer application. A second capability for deactivation and therefore making the pump torque-free is therefore realized when the neutral valve is used in safety-critical applications.

Technical data		
Voltage	12 V (±20%)	24 V (±20%)
Neutral position $V_g = 0$	de-energized	de-energized
Position $V_{g\ max}$	Current switched on	Current switched on
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum active current required	1.2 A	0.6 A
Duty cycle	100%	100%
Type of protection: see connector version page 65		

▼ Circuit diagram



Dimensions

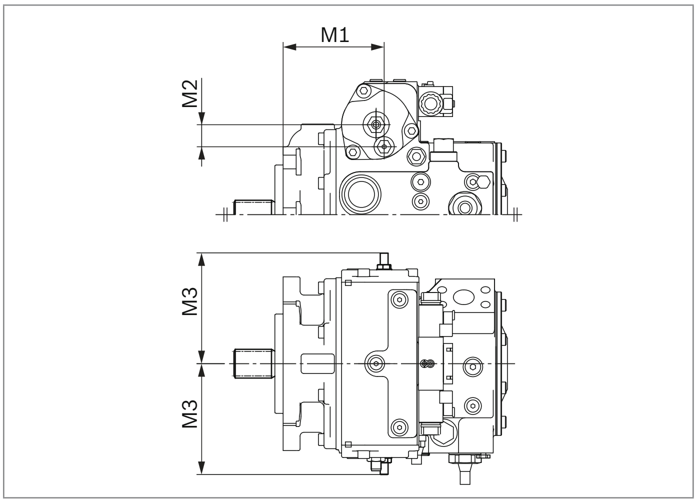


NG	110	125	145	175	210	280
N1	198.4	198.4	203.6	223.4	237.9	258.8
N2	100.7	100.7	105.9	125.7	140.2	161.1
N3	229.8	229.8	250.5	250.5	283	283
N4	173.5	173.5	178.7	198.5	210	230.9
N5	102.5	102.5	102.5	102.5	102.5	102.5
N6	83	83	98	98	112.5	112.5
N7	96.5	96.5	96.5	96.5	96.5	96.5
N8	79	79	79	79	79	79
N9	172.5	172.5	177.7	197.5	212	232.9

Mechanical stroke limiter

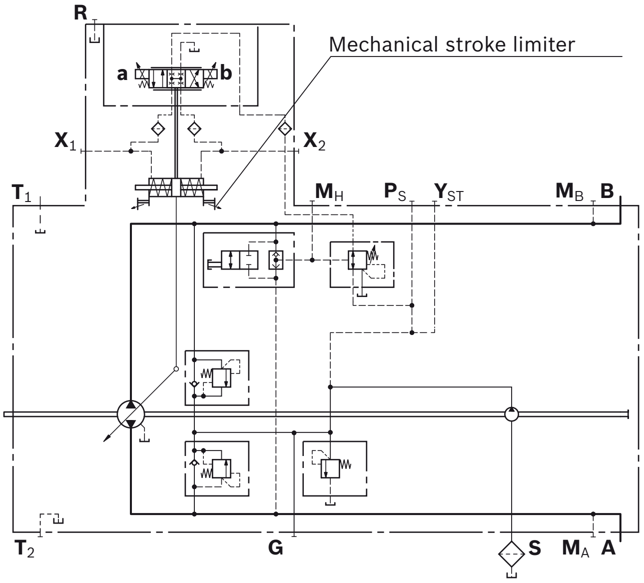
The mechanical stroke limiter is an auxiliary function allowing the maximum displacement of the pump to be steplessly reduced, regardless of the control module used.
By means of two threaded pins, the stroke of the stroking piston and thus the maximum swivel angle of the pump can be limited.

Dimensions



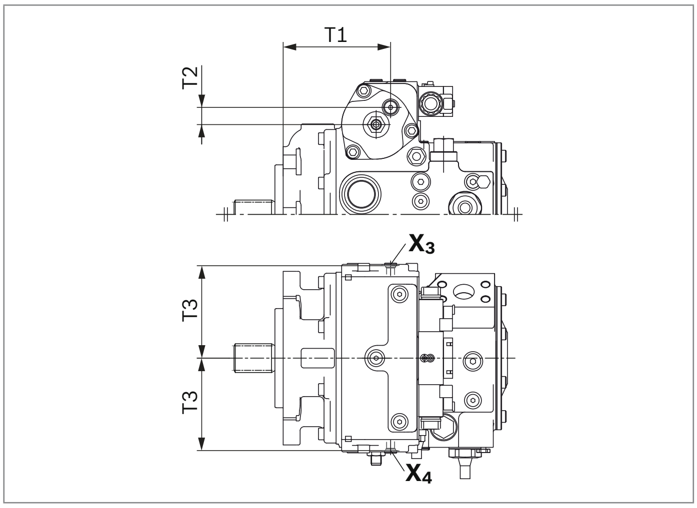
NG	M1	M2	M3
110	153.6	27.7	157.3
125	153.6	27.7	157.3
145	155	33.8	170.1
175	174.8	33.8	170.1
210	183.9	38.1	199.6
280	204.7	38.1	199.6

▼ **Circuit diagram**



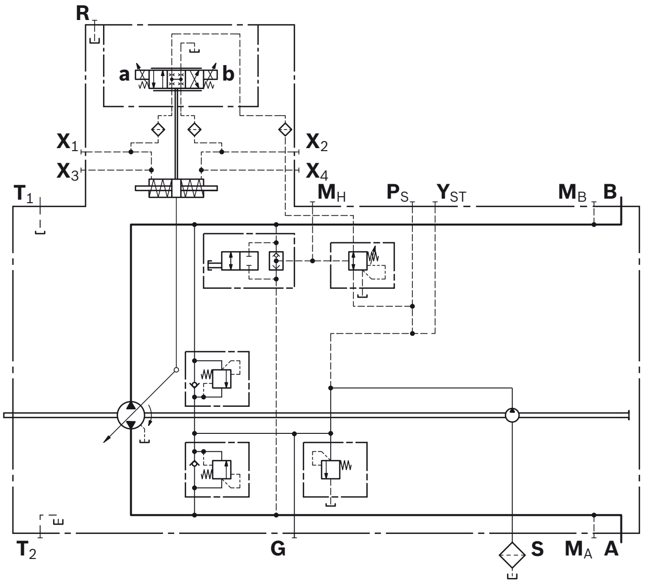
Stroking chamber pressure port X_3 and X_4

Dimensions



NG	T1	T2	T3
110	161.8	21.8	128
125	161.8	21.8	128
145	164.9	26.4	142
175	184.7	26.4	142
210	195.7	30.6	166
280	216.6	30.6	166

▼ **Circuit diagram**



Ports		Standard[1]	Size	p_{max} [bar][2]	State[3]
X_3, X_4	Stroking chamber pressure port	ISO 6149	M14 × 1.5; 11.5 deep	40	X

---

1) The countersink can be deeper than as specified in the standard.
2) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
3) X = Plugged (in normal operation)

Filtration in the boost pump suction line

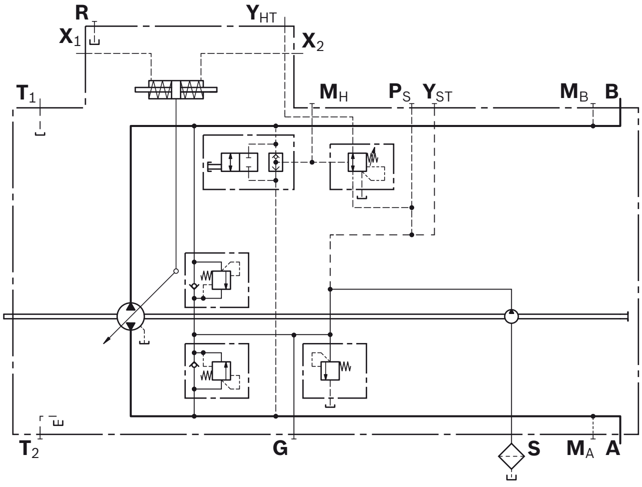
Version S

Filter version	Suction filter without bypass
Recommendation	With contamination indicator
Recommended flow resistance at filter element	
At ν = 30 mm²/s, $n = n_{\text{max}}$	$\Delta p \leq 0.1$ bar
At ν = 1000 mm²/s, $n = n_{\text{max}}$	$\Delta p \leq 0.3$ bar
Pressure at suction port S	
Continuous $p_{\text{S min}}$ ($\nu \leq 30$ mm²/s)	≥ 0.8 bar absolute
Short-term, at a cold start (t < 3 min)	≥ 0.5 bar absolute
Maximum pressure $p_{\text{S max}}$	≤ 5 bar absolute

Use of version S is preferred.

The suction filter is not included in the scope of delivery.

▼ **Circuit diagram**



Filtration in the boost pump pressure line

Version D

Ports for external boost circuit filtration

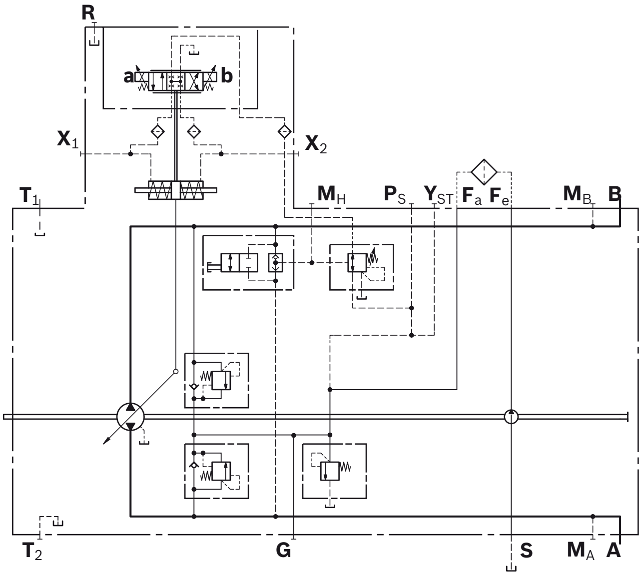
Ports	
Boost pressure inlet	Port $\mathbf{F_a}$
Boost pressure outlet	Port $\mathbf{F_e}$
Filter version	**Boost pressure filter without bypass**
Recommendation	With contamination indicator
Filter arrangement	**Separate in the pressure line (inline filter)**
Permissible flow resistance at filter element[1]	
At ν = 30 mm²/s	$\Delta p \leq 1$ bar
For cold start	$\Delta p \leq 3$ bar

Notice

- ▶ Filters with a bypass **not recommended**, (exception HT, see below). Please contact us for applications with a bypass.
- ▶ On versions with HT control (with pilot pressure not from a boost circuit), a filter **with** a bypass and **with** a contamination indicator must be used.

The boost pressure filter is not included in the scope of delivery.

▼ **Circuit diagram**



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[1] Valid for entire speed range $n_{\text{min}} - n_{\text{max}}$

Version F[1]

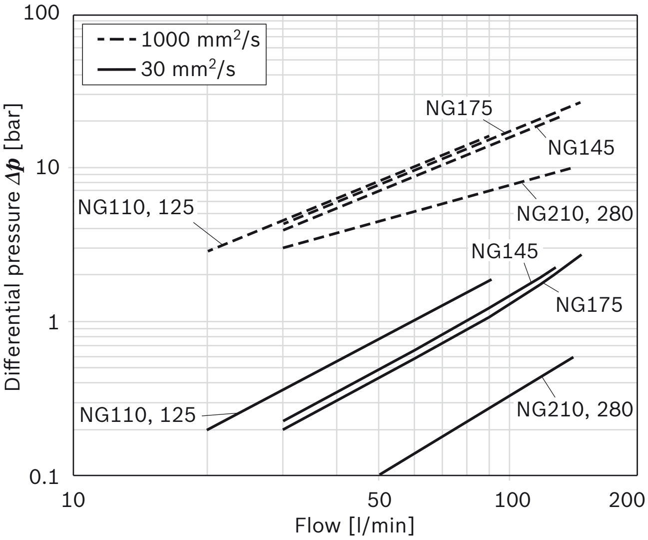
Attachment filter with cold start valve

Filter version	Attachment filter without bypass
Recommendation	Version with contamination indicator, see B (differential pressure Δp = 5 bar)
Filter grade (absolute)	20 µm
Filter material	Glass fiber
Pressure rating	100 bar
Filter arrangement	Mounted on pump

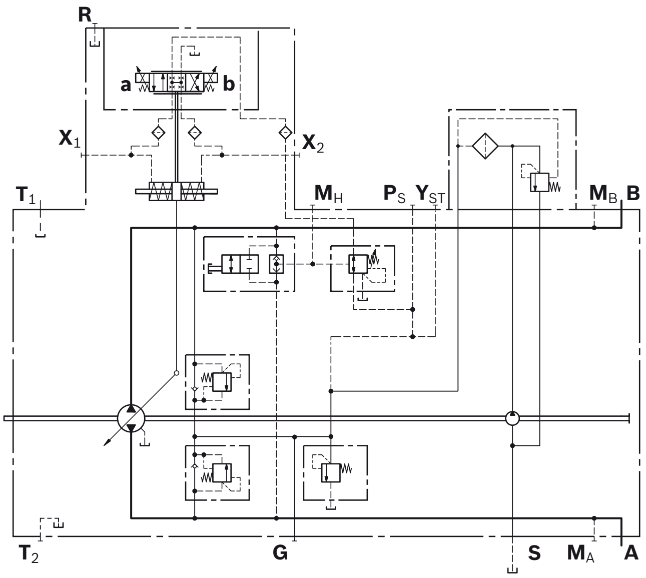
The attachment filter is equipped with a cold start valve and thereby protects the pump from damage. The valve opens at flow resistance of $\Delta p \geq 6$ bar.

▼ **Filter characteristics**

Differential pressure/flow characteristics to ISO 3968 (valid for clean filter element).



▼ **Circuit diagram**



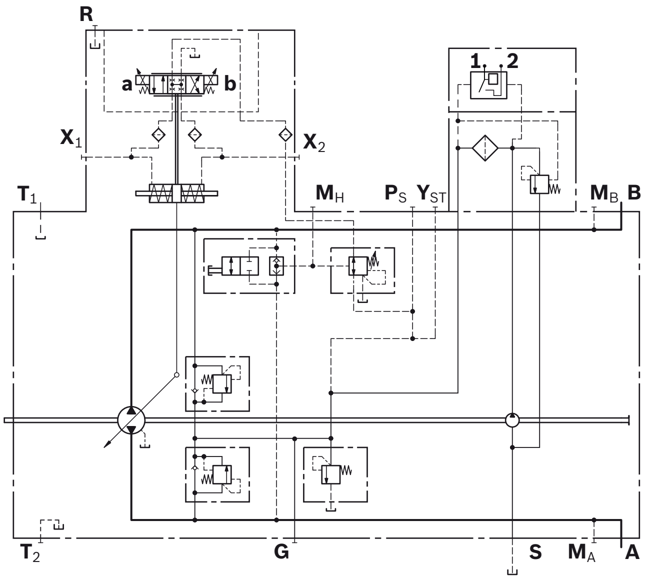
Version B[1]

Attachment filter with cold start valve and electric contamination indicator

Filtration similar to version F, however with additional electric contamination indicator.

Technical data		
Display type	electrical	
Connector version (mating connector, see page 65)	DEUTSCH DT04-2P-EP04	
Differential pressure (switching pressure)	Δp = 5 bar	
Maximum switching capacity	12 V DC	24 W
	24 V DC	48 W
Type of protection IP67	DIN EN 60529	

▼ **Circuit diagram**



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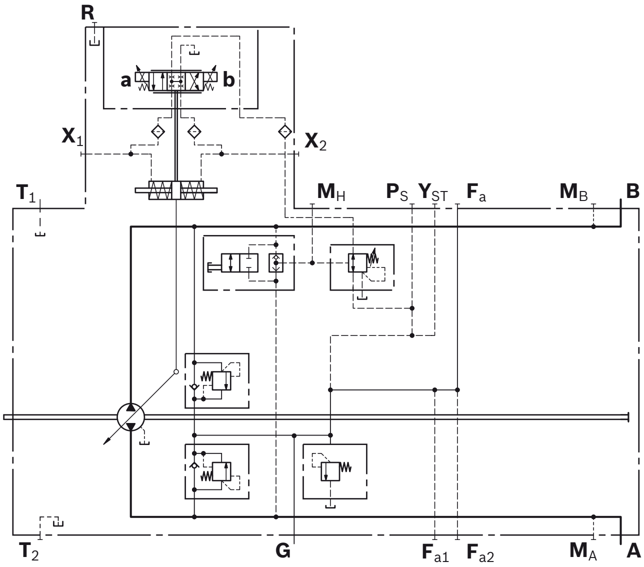
[1] If using the filter versions F and B, make sure that a hydraulic fluid with a minimum electrical conductance of 300 pS/m is used. Please contact us if this value cannot be observed.

External boost pressure supply

Version E

This variant should be used in versions without integrated boost pump (**U**).
Port **S** is plugged.
The boost pressure supply comes from port **G**.
The filter should be installed separately on port **G** before the boost pressure supply.
To ensure the functional reliability, maintain the required cleanliness level for the boost fluid fed in at port **G** (see page 7).

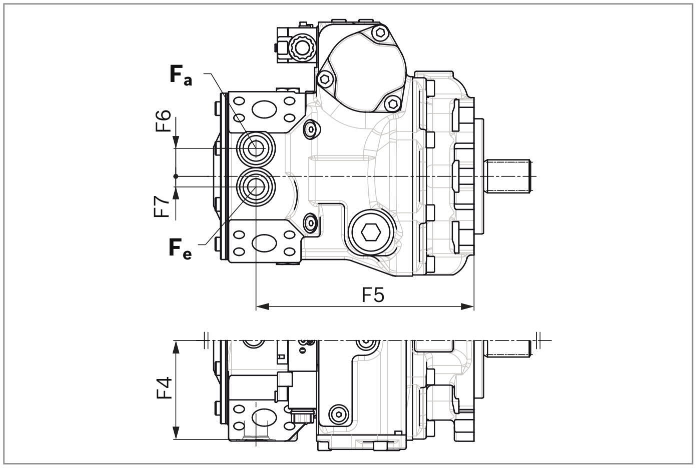
▼ **Circuit diagram**



Dimensions with mounted filter

▼ **Version D**

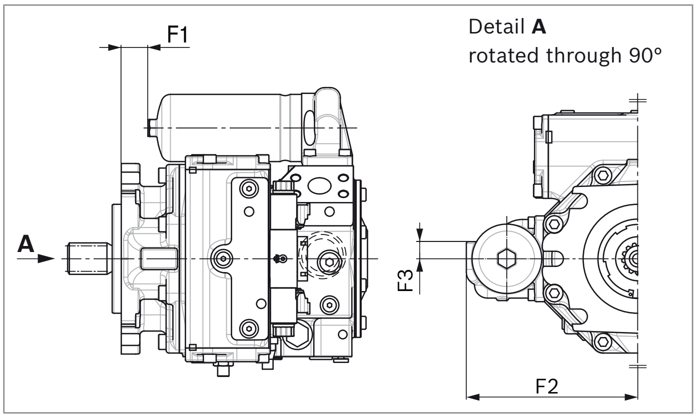
Ports for external boost circuit filtration



NG	F1	F2	F3	F4	F5	F6	F7	F_a, F_e[1]
110	76.5	229.5	22	121	264.5	37	14	M33 ×2; 19 deep According to ISO6149
125	76.5	229.5	22	121	264.5	37	14	
145	37.2	239.5	22	131	288.2	37	14	
175	57	239.5	22	131	308	37	14	
210	69	266.5	22	146.3	325	43	10	
280	89.9	266.5	22	146.3	345.9	43	10	

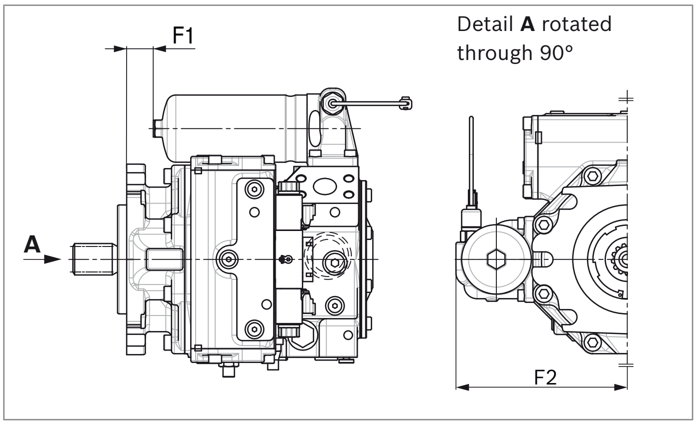
▼ **Version F**

Attachment filter without contamination indicator



▼ **Version B**

Attachment filter with cold start valve and electric contamination indicator



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[1] The countersink can be deeper than as specified in the standard.

Swivel angle sensor

The swivel angle sensor is used to detect the swivel angle of axial piston units and thus the displacement using a Hall-effect based sensor IC. The determined measurement value is converted into an analog signal.
Please contact us if the swivel angle sensor is used for control.

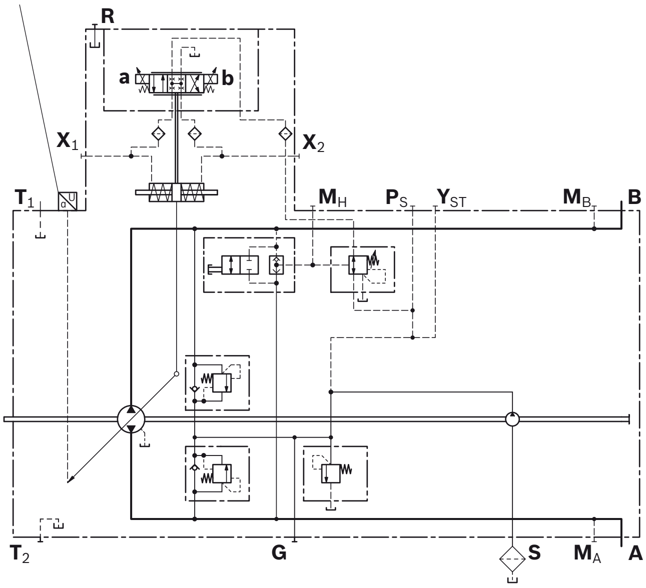
Characteristics			
Supply voltage U_b	10 to 30 V DC		
Output voltage U_a	1 V ($V_{\text{g max}}$)	2.5 V ($V_{\text{g 0}}$)	4 V ($V_{\text{g max}}$)
Reverse polarity protection	Short-circuit resistant		
EMC resistance	Details on request		
Operating temperature range	-40 °C to +115 °C		
Vibration resistance sinusoidal vibration EN 60068-2-6	10 g / 5 to 2000 Hz		
Shock resistance: continuous shock IEC 68-2-29	25 g		
Salt spray resistance (DIN 50 021-SS)	96 h		
Type of protection with installed mating connector	IP67 – DIN EN 60529 IP69K – DIN 40050-9		
Housing material	Plastic		

Output voltage

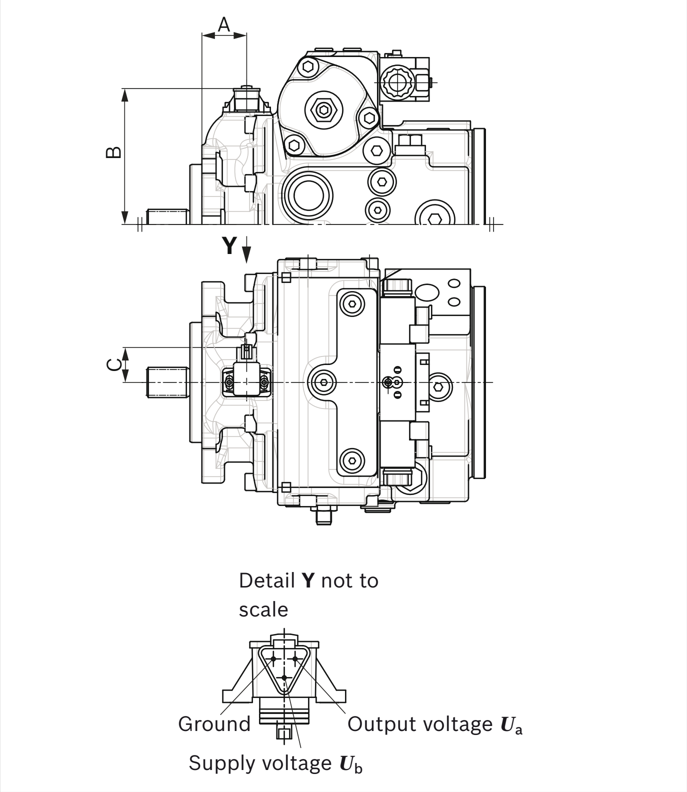
Direction of rotation[1]	Flow direction	Working pressure	Output voltage at $V_{\text{g 0}}$
Clockwise	**B** to **A**	$\mathbf{M}_\text{A}$	>2.5 V
	A to **B**	$\mathbf{M}_\text{B}$	<2.5 V
Counter-clockwise	**A** to **B**	$\mathbf{M}_\text{B}$	>2.5 V
	B to **A**	$\mathbf{M}_\text{A}$	<2.5 V

▼ **Circuit diagram**

Electric swivel angle sensor



Dimensions



Detail **Y** not to scale

NG	A	B	C
110	51.5	148.8	37
125	51.5	148.8	37
145	53.1	160.8	37
175	64.4	160.8	37
210	69	173.8	37
280	75.1	173.8	37

Mating connector DEUTSCH DT06-3S-EP04

Consisting of	DT designation
1 housing	DT06-3S-EP04
1 wedge	W3S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902603524).

Notice

It is not possible to retrofit existing units with a swivel angle sensor.

---

[1] For flow direction, see controls

Connector for solenoids

DEUTSCH DT04-2P-EP04

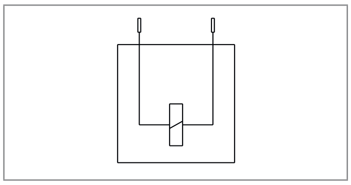
Molded, 2-pin, without bidirectional suppressor diode (standard).

The following type of protection ensues with an installed mating connector:

▶ IP67 (DIN EN 60529) and

▶ IP69K (DIN 40050-9)

▼ **Switching symbol**



▼ **Mating connector DEUTSCH DT06-2S-EP04**

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).

Notice

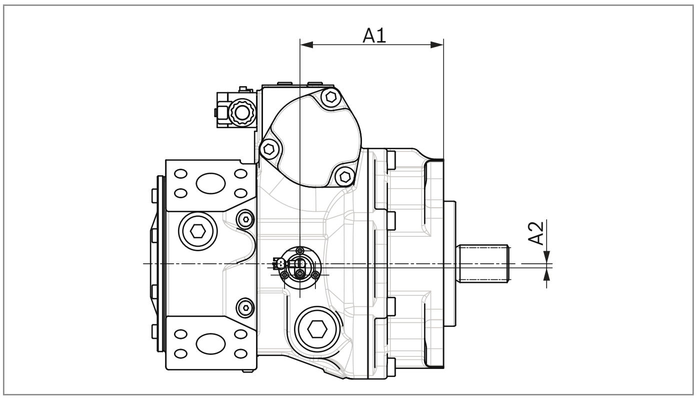
▶ If necessary, you can change the position of the connector by turning the solenoid.

▶ The procedure is defined in the instruction manual.

Speed sensor

With the speed sensor DSA/DSM mounted, a signal proportional to pump speed can be generated. The DSA/DSM sensor measures the speed and direction of rotation. Type code, technical data, dimensions and details on the connector, plus safety instructions about the sensor can be found in the relevant data sheet 95133 – DSA or 95132 – DSM. The sensor is mounted on the port provided for this purpose with a mounting bolt.

Dimensions

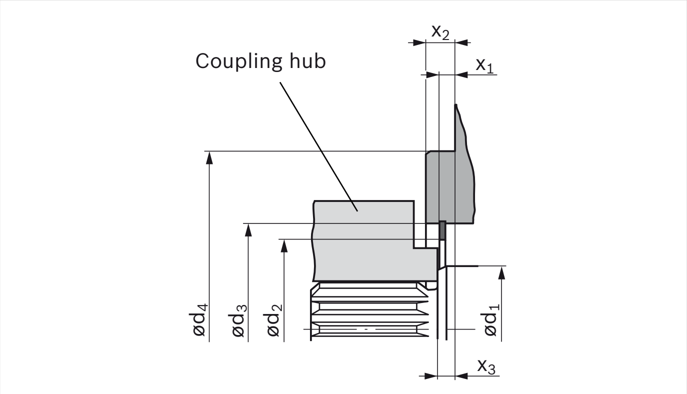


NG	110	125	145	175	210	280
A1	161.5	161.5	181.2	201.0	190	210.9
A2	5.5	5.5	5.5	5.5	5.5	5.5
Number of teeth	53	On request	58	61	64	71

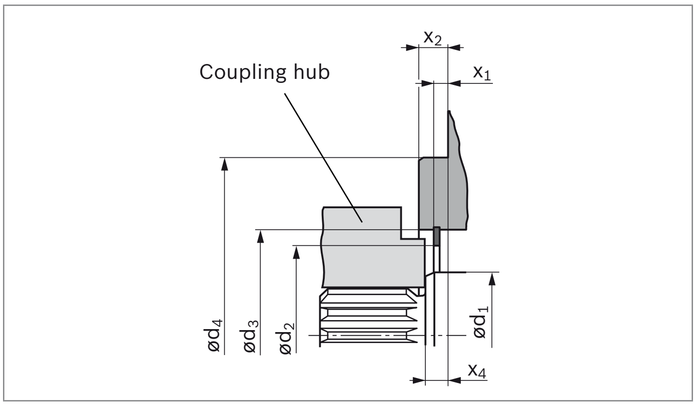
Installation dimensions for coupling assembly

To ensure that rotating components (coupling hub) and fixed components (housing, snap ring) do not come into contact with each other, the installation conditions described here must be observed. This depends on the pump size and the splined shaft.

SAE splined shaft (spline according to ANSI B92.1a)
Splined shaft **V** or **T**
The outer diameter of the coupling hub must be smaller than the inner diameter of the snap ring (dimension d_2) in the area near the drive shaft collar (dimension $x_2 - x_3$).



DIN splined shaft (spline according to DIN 5480)
Splined shaft **Z** or **A**
The outer diameter of the coupling hub must be smaller than the case diameter d_3 in the area near the drive shaft collar (dimension $x_2 - x_4$).



NG	Mounting flange	ød_1	ø$d_{2\ min}$	ød_3	ød_4	x_1	x_2	x_3	x_4
110	127-2/4	55	74.4	101±0.1	$127\ ^{0}_{-0,063}$	4.0	$12.7_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$
	152-2/4	55	74.4	101±0.1	$152.4\ ^{0}_{-0,063}$	6.0	$12.7_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$
125	127-2/4	55	74.4	101±0.1	$127\ ^{0}_{-0,063}$	4.0	$12.7_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$
	152-2/4	55	74.4	101±0.1	$152.4\ ^{0}_{-0,063}$	6.0	$12.7_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$
145	152-2/4	60	84.4	111±0.1	$152.4\ ^{0}_{-0,063}$	7.4	$12.7_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$
175	152-2/4	60	84.4	111±0.1	$152.4\ ^{0}_{-0,063}$	7.0	$12.7_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$
	165-4	60	84.4	111±0.1	$165.1\ ^{0}_{-0,063}$	7.0	$15.9_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$
210	165-4	65	94.4	121±0.1	$165.1\ ^{0}_{-0,063}$	5.5	$15.9_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$
280	165-4	65	94.4	121±0.1	$165.1\ ^{0}_{-0,063}$	7.0	$15.9_{-0.5}$	$8^{+0.9}_{-0.6}$	$10^{+0.9}_{-0.6}$

Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.

Particularly in the installation position “drive shaft upwards”, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.

The leakage in the housing area must be directed to the reservoir via the highest drain port (**T**$_1$, **T**$_2$).

For combination pumps, the leakage must be drained off at each pump.

If a shared drain line is used for several units, make sure that the respective case pressure is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operating conditions, specifically on cold start. If this is not possible, separate drain lines must be laid if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

Under all operating conditions, the suction line and drain line must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\ max}$ = 800 mm.

The suction pressure at port **S** must also not fall below the minimum value of 0.8 bar absolute during operation (cold start 0.5 bar absolute).

Installation position

See the following examples 1 to 12.

Further installation positions are available upon request.

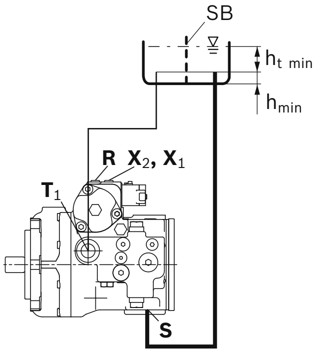
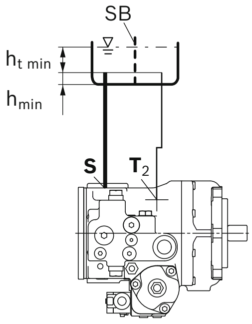
Recommended installation position: 1 and 2.

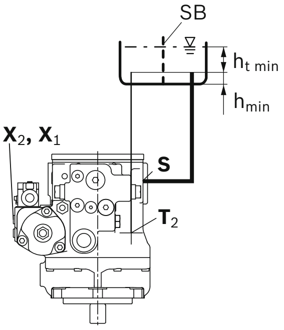
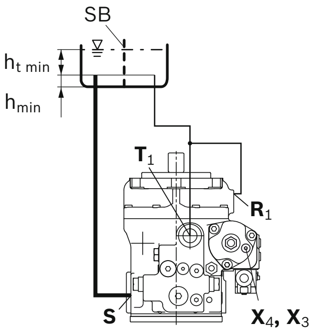
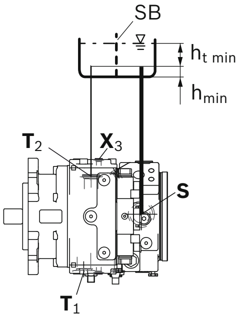
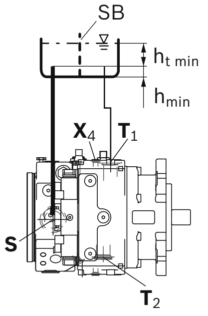
Notice

- If filling the stroking chambers via **X**$_1$ to **X**$_4$ is not possible in the final installation position, then this must take place before installation, e.g. in installation position 2.
- To prevent unexpected actuation and damage, the stroking chambers must be air bled via the ports **X**$_1$, **X**$_2$, or **X**$_3$, **X**$_4$ depending on the installation position.
- In certain installation positions, an influence on the control or closed loop control can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristic curves and changes in response time.

Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir and below the minimum fluid level of the reservoir.

Installation position	Air bleeding the housing	Air bleeding the stroking chamber	Filling
1	**R**	**X**$_1$, **X**$_2$	**S** + **T**$_1$ + **X**$_1$ + **X**$_2$
			
2	–	–	**S** + **T**$_2$
			

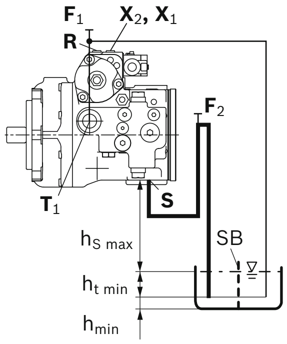
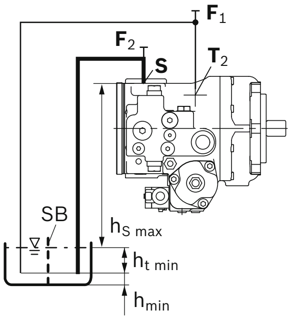
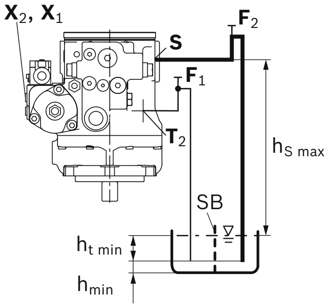
Installation position	Air bleeding the housing	Air bleeding the stroking chamber	Filling
3	–	$\mathbf{X}_1$, $\mathbf{X}_2$	$\mathbf{S} + \mathbf{T}_2 + \mathbf{X}_1 + \mathbf{X}_2$
 			
4	$\mathbf{R}_1$	$\mathbf{X}_3$, $\mathbf{X}_4$	$\mathbf{S} + \mathbf{T}_1 + \mathbf{X}_3 + \mathbf{X}_4$
 			
5	–	$\mathbf{X}_3$	$\mathbf{S} + \mathbf{T}_2 + \mathbf{X}_3$
 			
6	–	$\mathbf{X}_4$	$\mathbf{S} + \mathbf{T}_1 + \mathbf{X}_4$
 			

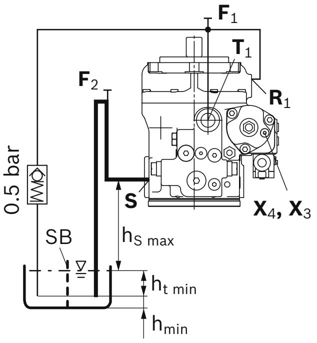
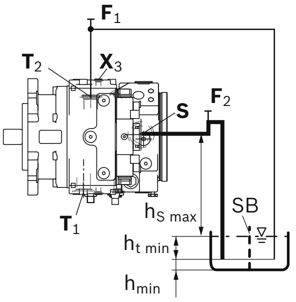
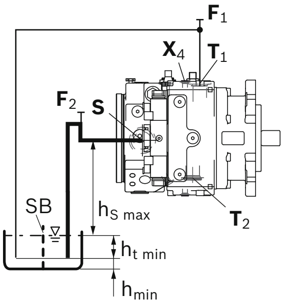
Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.

Observe the maximum permissible suction height $h_{S\,max}$ = 800 mm.

Recommendation for installation position 10 (drive shaft upward): A check valve in the drain line (cracking pressure 0.5 bar) can prevent the housing area from draining.

Installation position	Air bleeding the housing	Air bleeding the stroking chamber	Filling
7	$\mathbf{F}_2 + \mathbf{R}$	$\mathbf{X}_1$, $\mathbf{X}_2$	$\mathbf{F}_1 + \mathbf{F}_2 + \mathbf{X}_1 + \mathbf{X}_2$
 			
8	$\mathbf{F}_2$ (**S**) + $\mathbf{F}_1$ ($\mathbf{T}_2$)	–	$\mathbf{F}_2$ (**S**) + $\mathbf{F}_1$ ($\mathbf{T}_2$)
 			
9	$\mathbf{F}_2$ (**S**) + $\mathbf{F}_1$ ($\mathbf{T}_2$)	$\mathbf{X}_1$, $\mathbf{X}_2$	$\mathbf{F}_2$ (**S**) + $\mathbf{F}_1$ ($\mathbf{T}_2$) + $\mathbf{X}_1 + \mathbf{X}_2$
 			

Installation position	Air bleeding the housing	Air bleeding the stroking chamber	Filling
10	$F_2 + R_1$	X_3, X_4	$F_1 + F_2 + X_3 + X_4$
			
11	F_2 (S) + F_1 (T_2)	X_3	F_2 (S) + F_1 (T_2) + X_3
			
12	F_2 (S) + F_1 (T_1)	X_4	F_2 (S) + F_1 (T_1) + X_4
			

Key	
F_1, F_2	Filling / air bleeding
R	Air bleed port
S	Suction port
T_1, T_2	Drain port
X_1, X_2	Control pressure port
X_3, X_4	Stroking chamber pressure port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)

Notice

Ports **F_1** and **F_2** are part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

Project planning notes

- The pump A4VG is designed to be used in closed circuit.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes contained herein must be observed.
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or the instruction manual.
- Not all versions of the product are approved for use in a safety function according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference.
  Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- The pressure cut-off is not a safeguard against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- Please note the details regarding the tightening torques of port threads and other threaded joints in the instruction manual.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports are only intended to accommodate hydraulic lines.

Safety instructions

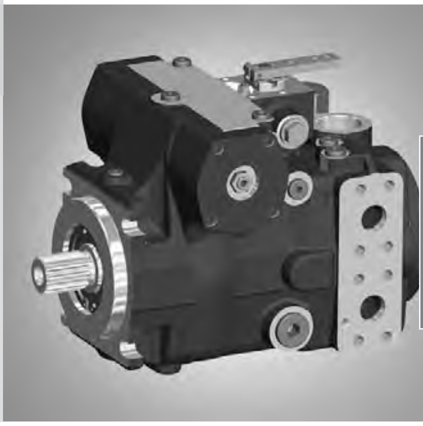
- During and shortly after operation, there is a risk of getting burnt on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve spools) can, under certain circumstances get stuck in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filtration) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.
- Moving parts in high-pressure relief valves may in certain circumstances become stuck in an undefined position due to contamination (e.g. impure hydraulic fluid). This can result in restriction or loss of the load holding function in lifting winches.

  The machine/system manufacturer must check whether additional measures are required on the machine for the relevant application in order to keep the load in a safe position and ensure they are properly implemented.

Axial Piston Variable Pump
A4VTG

Data sheet

Series 33
Sizes NG71, 90
Nominal pressure 400 bar
Maximum pressure 450 bar
Closed circuit
For the drum drive in mobile concrete mixers



Inhalt

Features

- Variable axial piston pump of swashplate design for hydrostatic drives in closed circuit
- The flow is proportional to the drive speed and displacement.
- The flow increases as the angle of the swashplate is adjusted from zero to its maximum value.
- Flow direction changes smoothly when the swashplate is moved through the neutral position.
- Two pressure-relief valves are provided on the high pressure ports to protect the hydrostatic transmission (pump and motor) from overload.
- The high-pressure relief valves also function as boost valves.
- The integrated boost pump acts as a feed pump and control pressure supply.
- The maximum boost pressure is limited by a built-in boost pressure-relief valve.

Ordering code for standard program

A4VT	**G**					**/**	**33**	**M**		**N**	**C4**			**F**		**A**	**S**	
01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16	17	18

Axial piston unit

01	Swashplate design, variable, nominal pressure 400 bar, maximum pressure 450 bar, mobile concrete mixers	**A4VT**

Operation mode

02	Pump, closed circuit	**G**

Size

03	Displacement $V_{g\,max}$ in cm^3	**071**	**090**

Control device

			071	**090**	
04	Proportional control hydraulic, mechanical servo, hexagon shaft with lever to the rear		●	●	**HW1**[1]
	Proportional control electric, with emergency actuation and spring return	U = 12 V DC	●	●	**EP3**
		U = 24 V DC	●	●	**EP4**

Connector for solenoids[2]

		071	**090**	
05	Without	●	●	**0**
	DEUTSCH - molded connector, 2-pin – without suppressor diode	●	●	**P**

Auxiliary functions

		071	**090**	
06	Without	●	●	**0**
	With mechanical stroke limiter, externally adjustable	●	●	**M**
	With ports X_3, X_4 for stroking chamber pressure	●	●	**T**
	With mechanical stroke limiter and ports X_3, X_4	●	●	**B**

Series

07	Series 3, Index 3	**33**

Version of port and fixing threads

08	Metric	**M**

Direction of rotation

09	Viewed from drive shaft	clockwise	**R**
		counter-clockwise	**L**

Seals

10	NBR (nitrile-caoutchouc), shaft seal ring in FKM (fluor-caoutchouc)	**N**

Mounting flange

11	SAE J744, 127-4	**C4**

Drive shaft

				071	**090**	
12	Splined shaft ANSI B92.1a–1976	1 3/8 in 21T 16/32DP	without coupling flange	●	–	**V8**
			with coupling flange	●	–	**C8**
		1 1/2 in 23T 16/32DP	without coupling flange	–	●	**V9**
			with coupling flange	–	●	**C9**

Service line ports

				071	**090**	
13	SAE flange port A and B on same side	left	Suction port S at bottom	❍	❍	**1**
		right	Suction port S at top	●	●	**2**

● = Available ❍ = On request – = Not available

[1] Mounting position of the lever not specified on delivery, to be aligned by the customer

[2] Connectors for other electric components can deviate.

Ordering code for standard program

A4VT	G					/	33	M		N	C4			F		A	S	
01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16	17	18

Boost pump

14	With integrated boost pump	**F**

Through drive

	Flange SAE J744	Mounting variant		Coupling for splined shaft1)				
	Diameter	Symbol	Designation	Diameter	Designation	**071**	**090**	
15	Without					●	●	**0000**
	82-2	⚯	A2	5/8 in 9T 16/32DP	S2	●	●	**A2S2**
	101-2	⚯	B2	7/8 in 13T 16/32DP	S4	●	●	**B2S4**

High-pressure valves

16	With high-pressure relief valve, direct controlled	**A**

Filtration boost circuit

17	Filtration in the boost pump suction line	**S**

Standard / special version

18	Standard version		**-0**
		combined with attachment part or attachment pump	**-K**
	Special version		**-S**
		combined with attachment part or attachment pump	**-T**

Note

Short designation X refers to a special version not covered by the ordering code.

● = Available ❍ = On request – = Not available

3) Coupling for splined shaft acc. ANSI B92.1a-1976

Technical data

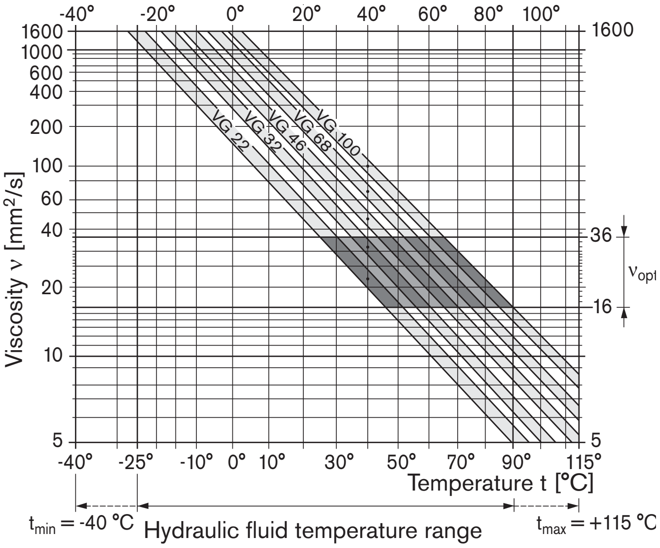
Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil) and RE 90221 (environmentally acceptable hydraulic fluids) for detailed information regarding the choice of hydraulic fluids and application conditions.

The A4VTG variable pump is not suitable for operation with HFA, HFB and HFC. If HFD or environmentally acceptable hydraulic fluids are being used, the limitations regarding technical data and seals must be observed.
Please contact us.

When ordering, indicate the hydraulic fluid that is to be used.

Selection diagram



Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature: in a closed circuit the circuit temperature.

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}), see shaded area of the selection diagram. We recommended that the higher viscosity class be selected in each case.

Example: At an ambient temperature of X °C, an operating temperature of 60 °C is set in the circuit. In the optimum operating viscosity range ($\nu_{opt.}$shaded area), this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Note
The case drain temperature, which is affected by pressure and speed, is always higher than the circuit temperature. At no point of the component may the temperature be higher than 115 °C, however. The temperature difference specified below is to be taken into account when determining the viscosity in the bearing.

If the above conditions cannot be maintained due to extreme operating parameters, please contact us.

Viscosity and temperature

	Viscosity [mm^2/s]	Temperature	Comment
Storage		$T_{min} \geq -50$ °C $T_{opt} = +5$ °C to +20 °C	up to 12 months with standard factory conservation up to 24 months with long-term factory conservation
(Cold) start-up[1]	$\nu_{max} = 1600$	$T_{St} \geq -40$ °C	$t \leq 3$ min, without load ($p \leq 50$ bar), $n \leq 1000$ rpm
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu < 1600$ to 400	T = -40 °C to -25 °C	at p_{nom}, 0.5 • n_{nom} and $t \leq 15$ min
Operating phase			
Temperature difference		ΔT = approx. 5 K	The temperature of the hydraulic fluid in the bearing is (depending on pressure and speed) approx. 5 K higher than that of the case drain fluid at port T.
Continuous operation	$\nu = 400$ to 10 $\nu_{opt} = 16$ to 36	T = -25 °C to +90 °C	no restriction within the permissible data
Short-term operation	$\nu_{min} = < 10$ to 5	$T_{max} = +115$ °C	$t < 3$ min, $p < 0.3$ • p_{nom}
Shaft seal ring FKM[1]		$T \leq +115$ °C	see page 5

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[1] At temperatures below -25 °C, an NBR shaft seal ring is required (permissible temperature range: -40 °C to +90 °C)

Technical data

Filtration of the hydraulic fluid

Filtration improves the cleanliness level of the hydraulic fluid, which, in turn, increases the service life of the axial piston unit.

To ensure the functional reliability of the axial piston unit, a gravimetric evaluation is necessary for the hydraulic fluid to determine the amount of contamination by solid matter and to determine the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 is to be maintained.

Depending on the system and the application, for the A4VTG, we recommend

Filter cartridges $\beta_{20} \geq 100$.

With an increasing differential pressure at the filter cartridges, the β-value must not deteriorate.

At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

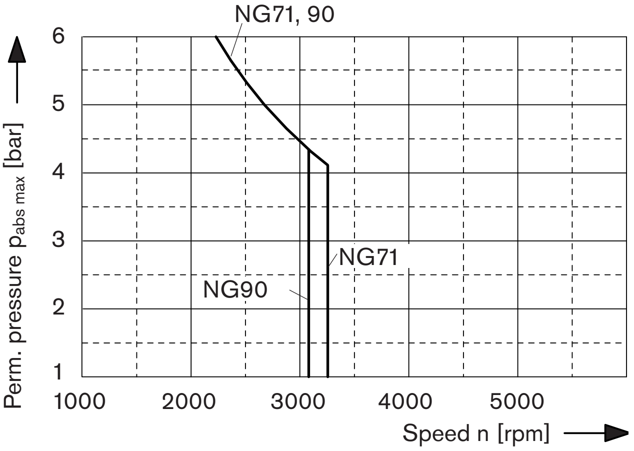
If the above classes cannot be achieved, please contact us. For notes on filtration types, see page 16.

Shaft seal ring

Permissible pressure loading

The service life of the shaft seal ring is affected by the speed of the pump and the case drain pressure. It is recommended that the average, continuous case drain pressure 3 bar absolute at operating temperature not be exceeded (maximum permissible case drain pressure 6 bar absolute at reduced speed, see diagram). Short-term ($t < 0.1$ s) pressure spikes of up to 10 bar absolute are permitted. The service life of the shaft seal ring decreases with an increase in the frequency of pressure spikes.

The case pressure must be equal to or greater than the external pressure on the shaft seal ring.



Temperature range

The FKM shaft seal ring may be used for case drain temperatures from -25 °C to +115 °C.

Note
For application cases below -25 °C, an NBR shaft seal ring is necessary (permissible temperature range: -40 °C to +90 °C). State NBR shaft seal ring in plain text when ordering.
Please contact us.

Technical data

Operating pressure range

Pressure at service line port A or B

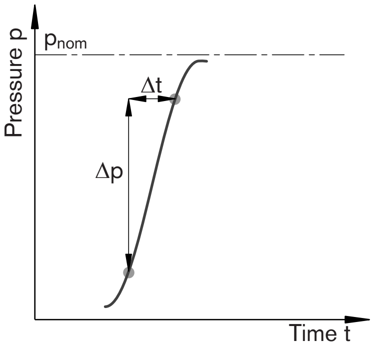
Nominal pressure p_{nom} ________ 400 bar absolute

Maximum pressure p_{max} ________ 450 bar absolute
Single operating period ________ 10 s
Total operating period ________ 300 h

Minimum pressure (high-pressure side) ________ 25 bar

Minimum pressure (inlet) ________ 10 bar
(boost pressure setting must be higher depending on system)

Rate of pressure change $R_{A\ max}$ ________ 9000 bar/s



Boost pump

Pressure at suction port S
Duration $p_{S\ min}$ ($\nu \leq 30\ mm^2/s$) ________ ≥ 0.8 bar absolute
at cold starts, short-term (t < 3 min) ________ ≥ 0.5 bar absolute
Maximum $p_{S\ max}$ ________ ≤ 5 bar absolute

Standard adjustment p_{Sp} (at n = 1500 rpm) ________ 22 bar

Nominal pressure $p_{Sp\ nom}$ ________ 30 bar
Maximum pressure $p_{Sp\ max}$ ________ 40 bar

Control pressure
To ensure the function of the control, the following control pressure is required depending on the speed and operating pressure (measurement point, port P_S):

For controls EP and HW
Minimum control pressure $p_{St\ min}$ (at n = 1500 rpm) ___ 22 bar

Definition

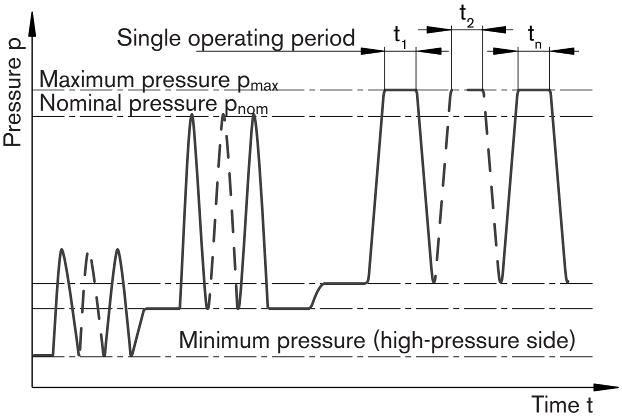
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

Maximum pressure p_{max}
The maximum pressure corresponds the maximum operating pressure within the single operating period. The sum of the single operating period must not exceed the total operating period.

Minimum pressure (high-pressure side)
Minimum pressure on the high-pressure side (A or B) that is required in order to prevent damage to the axial piston unit.

Minimum pressure (inlet)
Minimum pressure in inlet (A or B) that is required in order to prevent damage to the axial piston unit.

Rate of pressure change R_A
Maximum permissible rate of pressure build-up and pressure reduction during a pressure change over the entire pressure range.



Total operating period = $t_1 + t_2 + ... + t_n$

Technical data

Table of values (theoretical values, without efficiency levels and tolerances; values rounded)

Size			**NG**		**71**	**90**
Displacement	variable pump		$V_{g\ max}$	cm^3	71	90
	boost pump (at $p = 20$ bar)		$V_{g\ Sp}$	cm^3	20.5	27
Speed	at $V_{g\ max}$		n_{nom}	rpm	3300	3050
	minimum		n_{min}	rpm	500	500
Flow	at $n_{nom\ H}$ and $V_{g\ max}$		$q_{v\ max}$	l/min	234	275
Power[1)]	at $n_{nom\ H}$, $V_{g\ max}$	$\Delta p = 400$ bar	P_{max}	kW	156	183
Torque[1)]	at $V_{g\ max}$ and	$\Delta p = 400$ bar	T_{max}	Nm	452	573
		$\Delta p = 100$ bar	T	Nm	113	143
Rotary stiffness	drive shaft V8		c	Nm/rad	120900	–
	drive shaft V9		c	Nm/rad	–	150896
Moment of inertia for rotary group			J_{GR}	kgm^2	0.0097	0.0149
Maximum angular acceleration[2)]			α	rad/s^2	21000	18000
Filling capacity			V	L	1.3	1.2
Mass approx. (without through drive)			m	kg	51	53

1) Without boost pump

2) The area of validity lies between the minimum required and maximum permissible speed.
It applies for external stimuli (e. g. engine 2 to 8 times rotary frequency, cardan shaft twice the rotary frequency).
The limit value applies for a single pump only.
The load capacity of the connection parts must be considered.

Note

Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. We recommend testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.

Determining the size

Flow $$q_v = \frac{V_g \cdot n \cdot \eta_v}{1000} \quad [\text{L/min}]$$

Torque $$T = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}} \quad [\text{Nm}]$$

Power $$P = \frac{2\,\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p}{600 \cdot \eta_t} \quad [\text{kW}]$$

V_g = Displacement per revolution in cm^3

Δp = Differential pressure in bar

n = Speed in rpm

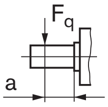
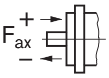
η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

Technical data

Permissible radial and axial loading on drive shaft

Size		NG		71	90
Drive shaft			in	1 3/8	1 1/2
Radial force maximum at distance a (from shaft collar)		$F_{q\ max}$ a	N mm	5600 24	7100 24
Axial force maximum		$+F_{ax\ max}$	N	4242	4330
		$-F_{ax\ max}$	N	2758	2670

Note

Special requirements apply in the case of belt drives. Please contact us.

Force-transfer direction of the permissible axial force:

$+ F_{ax\ max}$ = Increase in service life of bearings

$- F_{ax\ max}$ = Reduction in service life of bearings (avoid)

Permissible input and through-drive torques

Size			NG		71	90
Torque at $V_{g\ max}$ and $\Delta p = 400$ bar)[1]			T_{max}	Nm	452	573
Input torque at drive shaft, maximum[2]	**V8**	1 3/8 in	$T_{E\ max}$	Nm	970	–
	V9	1 1/2 in	$T_{E\ max}$	Nm	–	1305
Maximum through-drive torque			$T_{D\ max}$	Nm	250	250

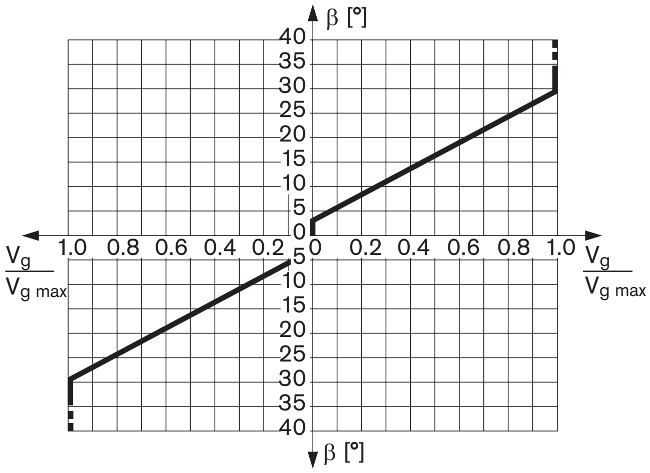
[1] Efficiency not considered

[2] For drive shafts with no radial force

HW – Proportional control hydraulic, mechanical servo

The output flow of the pump can be steplessly varied in the range between 0 to 100 %, proportional to the rotation of the control lever between 0° and ±29°.

A feedback lever connected to the stroke piston maintains the pump flow for any given position of the control lever between 0° and 29°.



Swivel angle β at the control lever for deflection:

Start of control at β = 3°

End of control at β = 29° (maximum displacement $V_{g\,max}$)

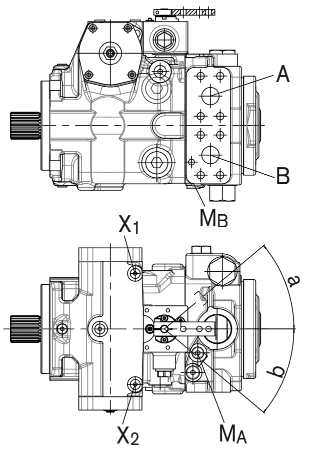
Mechanical stop for β: ±40°

The maximum required torque at the lever is 170 Ncm. To prevent damage to the HW control unit, a positive mechanical stop must be provided for the HW control lever.

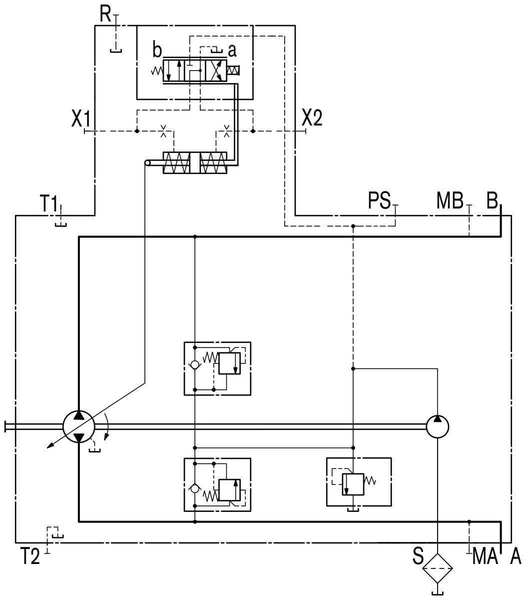
Note
Spring centering enables the pump, depending on pressure and speed, to move automatically to the neutral position ($V_g = 0$) as soon as there is no longer any torque on the control lever of the HW control unit (regardless of deflection angle).

Assignment
Direction of rotation - Control - Flow direction

Direction of rotation		Lever direction	Control pressure	Flow direction	Operating pressure
Direction of rotation	clock-wise	a	X_2	B to A	M_A
		b	X_1	A to B	M_B
	counter-clockwise	a	X_2	A to B	M_B
		b	X_1	B to A	M_A



Circuit diagram

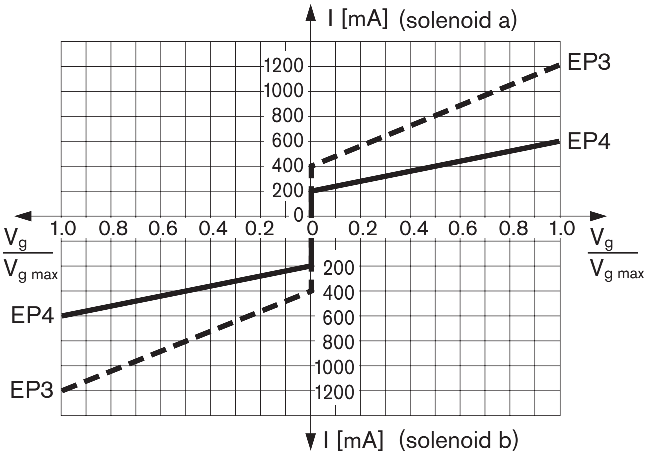


EP – Proportional control electric

The output flow of the pump can be steplessly varied in the range between 0 to 100 %, proportional to the electrical current supplied to solenoid a or b.

The electrical energy is converted into a force acting on the control piston. This control piston then directs control hydraulic fluid into and out of the stroke cylinder to adjust pump displacement as required.

A feedback lever connected to the stroke piston maintains the pump flow for any given current within the control range.



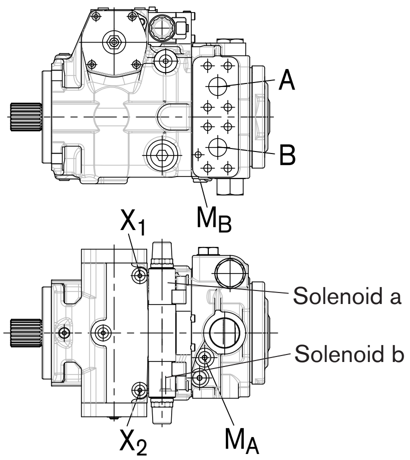
Technical data, solenoid	EP3	EP4
Voltage	12 V (±20 %)	24 V (±20 %)
Start of control at $V_{g\,0}$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Actuated time	100 %	100 %
Type of protection see connector design, page 20		

The following electronic controllers and amplifiers are available for controlling the proportional solenoids:

- BODAS controller RC
  Series 20 _____________________________ RE 95200
  Series 21 _____________________________ RE 95201
  Series 22 _____________________________ RE 95202
  Series 30 _____________________________ RE 95203
  and application software
- Analog amplifier RA ______________________ RE 95230

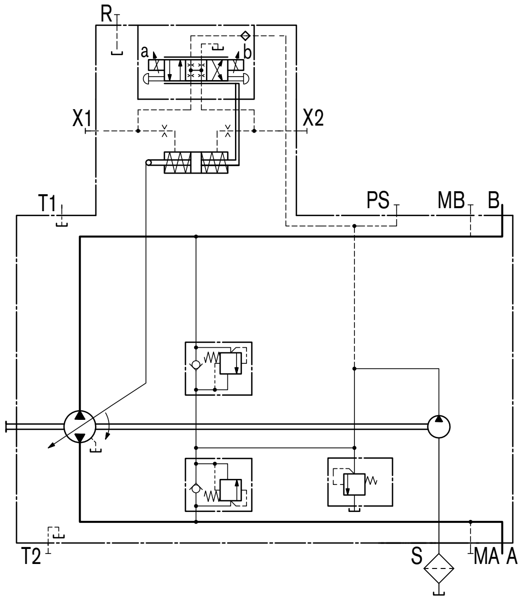
Assignment
Direction of rotation – Control – Flow direction

Direction of rotation		Actuation of solenoid	Control pressure	Flow direction	Operating pressure
	clockwise	b	X_2	B to A	M_A
		a	X_1	A to B	M_B
	counter-clockwise	b	X_2	A to B	M_B
		a	X_1	B to A	M_A



EP – Proportional control electric

Circuit diagram



Note

The spring return feature in the control unit is not a safety device

The spool valve inside the control unit can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e. g. immediate stop).

Dimensions size 71

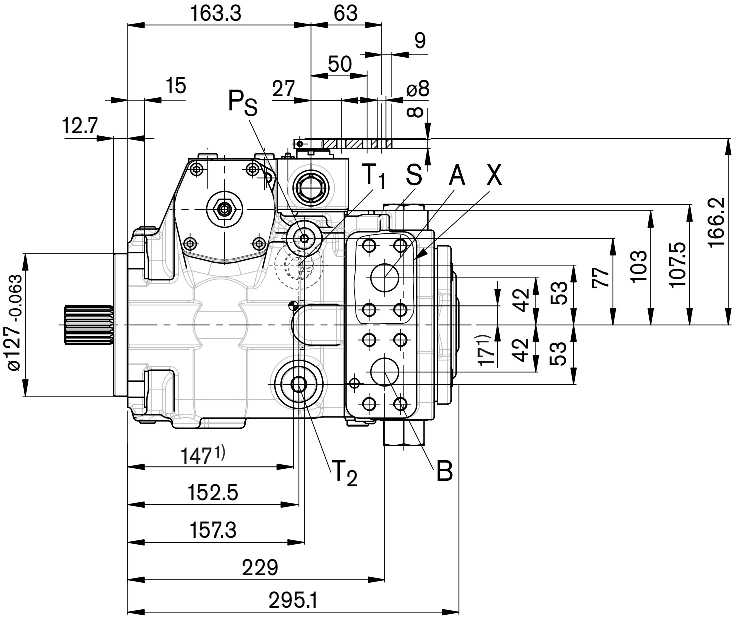
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

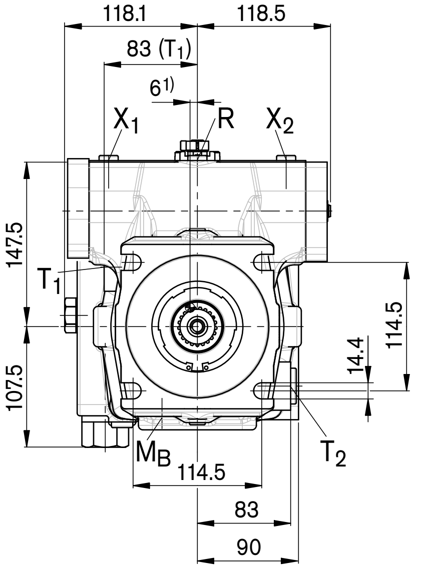
HW – Proportional control hydraulic, mechanical servo

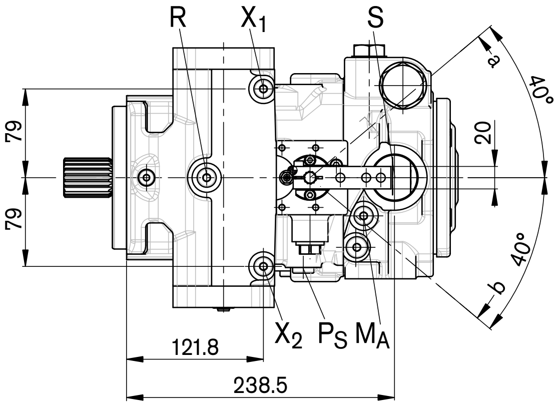
Standard: suction port S at top (02)

Option: suction port S at bottom (01): port plate turned through 180°

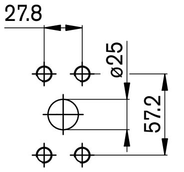
[1] Center of gravity

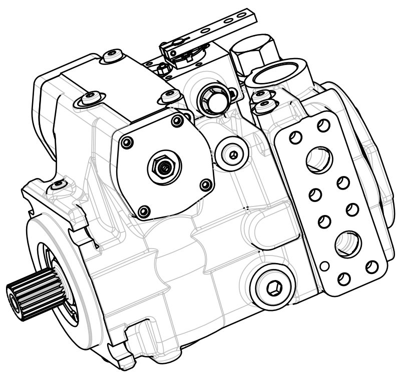






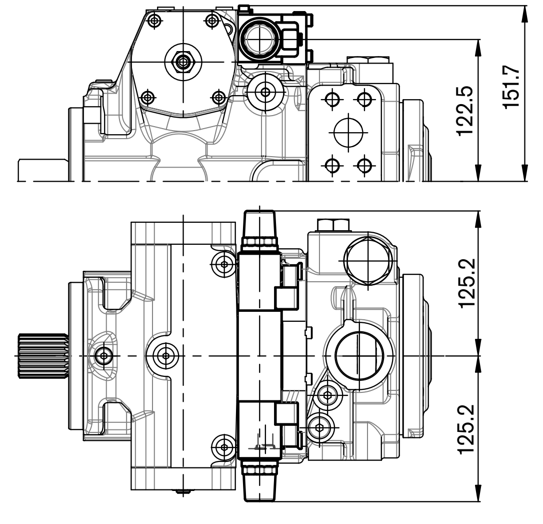
Detail X
Port A/B





Note
Mounting position of the lever not specified on delivery, to be aligned by the customer

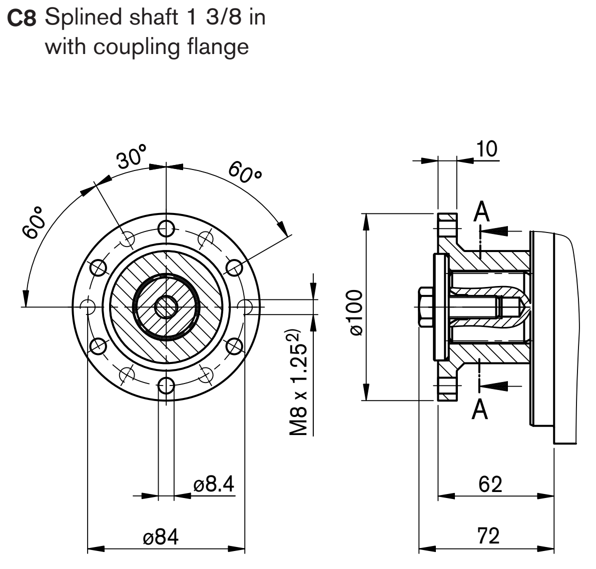
EP – Proportional control electric

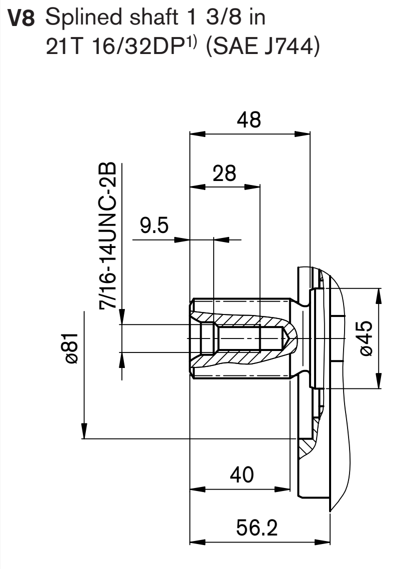


Dimensions size 71

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shaft





Ports

Designation	Port for	Standard	Size[2)]	Maximum pressure [bar][3)]	State
A, B	Service line	SAE J518[4)]	1 in	450	O
	Fixing thread A/B	DIN 13	M12 x 1.75; 17 deep		
S	Suction	DIN 3852	M42 x 2; 20 deep	5	O
T_1	Tank	DIN 3852	M26 x 1.5; 16 deep	3	O[5)]
T_2	Tank	DIN 3852	M26 x 1.5; 16 deep	3	X[5)]
R	Air bleed	DIN 3852	M12 x 1.5; 12 deep	3	X
X_1, X_2	Control pressure (upstream of orifice)	DIN 3852	M12 x 1.5; 12 deep	40	X
X_3, X_4[6)]	Stroking chamber pressure	DIN 3852	M12 x 1.5; 12 deep	40	X
P_S	Pilot pressure, inlet	DIN 3852	M14 x 1.5; 12 deep	40	X
M_A, M_B	Measuring pressure A, B	DIN 3852	M12 x 1.5; 12 deep	450	X

1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

2) Observe the general instructions on page 24 for the maximum tightening torques.

3) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518

5) Depending on installation position, T_1 or T_2 must be connected (see also page 22).

6) Optional, see page 18

O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

Dimensions size 90

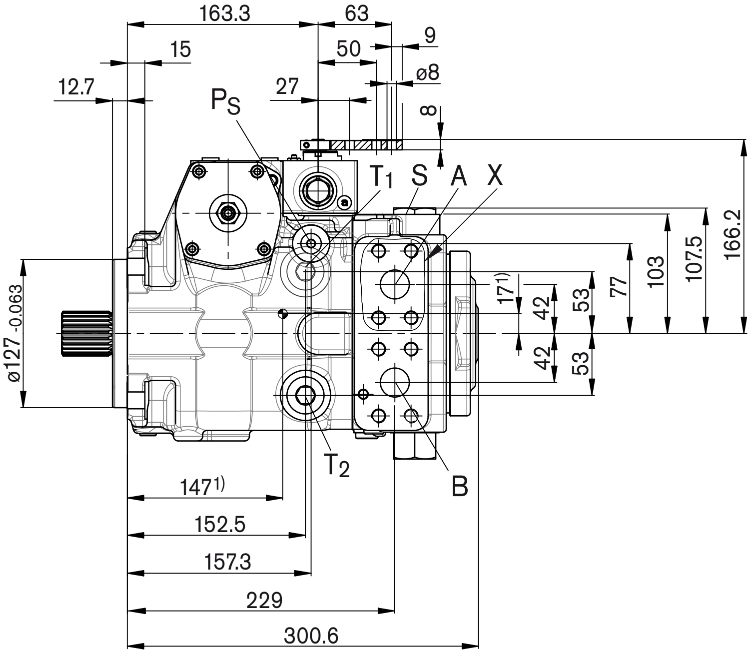
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

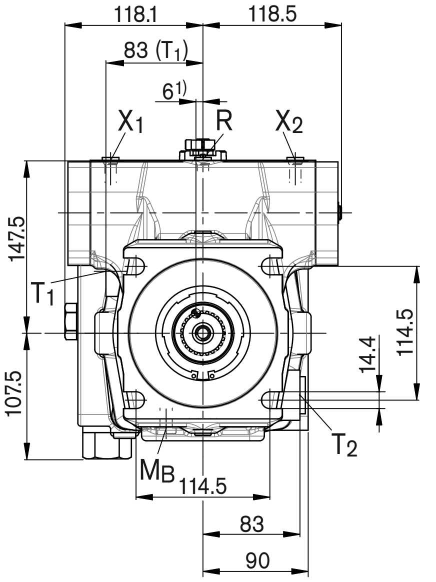
HW – Proportional control hydraulic, mechanical servo

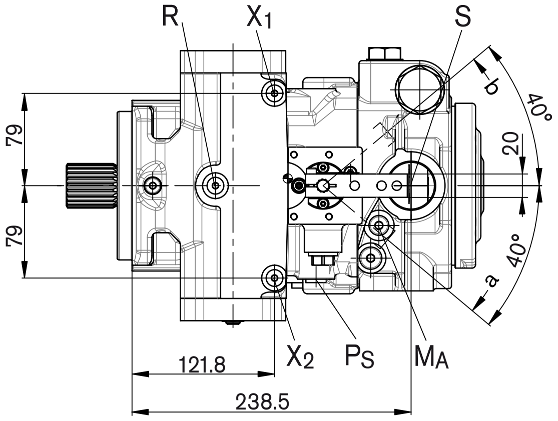
Standard: suction port S at top (02)

Option: suction port S at bottom (01): port plate turned through 180°

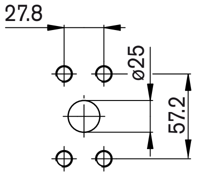
1) Center of gravity

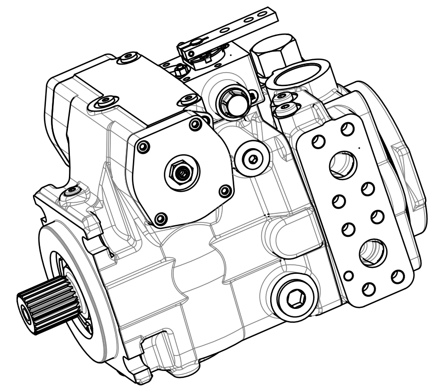






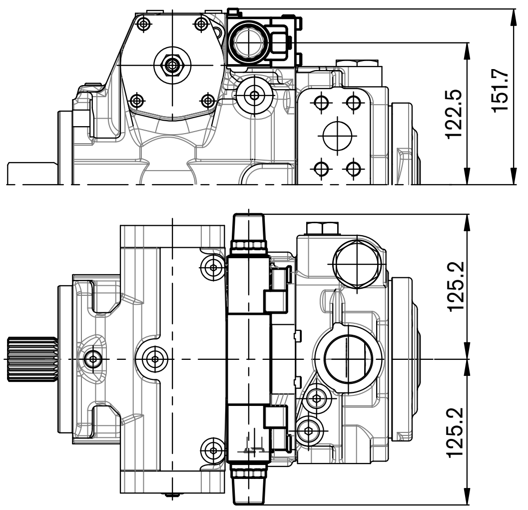
Detail X
Port A/B





Note
Mounting position of the lever not specified on delivery, to be aligned by the customer

EP – Proportional control electric

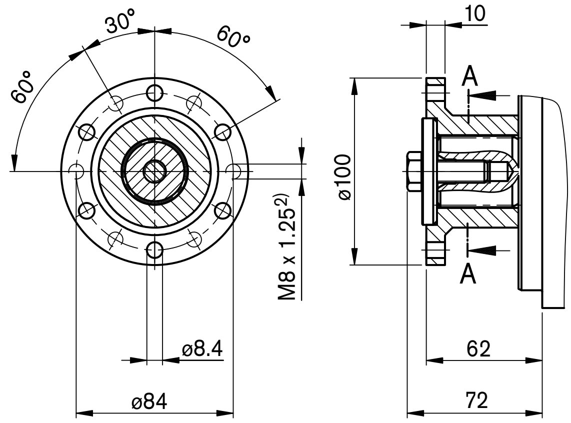


Dimensions size 90

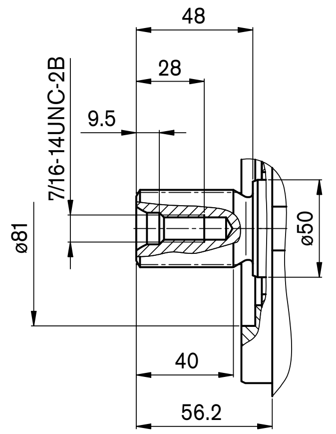
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shaft

C9 Splined shaft 1 1/2 in with coupling flange



V9 Splined shaft 1 1/2 in 23T 16/32DP1) (SAE J744)



Ports

Designation	Port for	Standard	Size2)	Maximum pressure [bar]3)	State
A, B	Service line	SAE J5184)	1 in	450	O
	Fixing thread A/B	DIN 13	M12 x 1.75; 17 deep		
S	Suction	DIN 3852	M42 x 2; 20 deep	5	O
T_1	Tank	DIN 3852	M26 x 1.5; 16 deep	3	O5)
T_2	Tank	DIN 3852	M26 x 1.5; 16 deep	3	X5)
R	Air bleed	DIN 3852	M12 x 1.5; 12 deep	3	X
X_1, X_2	Control pressure (upstream of orifice)	DIN 3852	M12 x 1.5; 12 deep	40	X
X_3, $X_4$6)	Stroking chamber pressure	DIN 3852	M12 x 1.5; 12 deep	40	X
P_S	Pilot pressure, inlet	DIN 3852	M14 x 1.5; 12 deep	40	X
M_A, M_B	Measuring pressure A, B	DIN 3852	M12 x 1.5; 12 deep	450	X

1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

2) Observe the general instructions on page 24 for the maximum tightening torques.

3) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518

5) Depending on installation position, T_1 or T_2 must be connected (see also page 22).

6) Optional, see page 18

O = Must be connected (plugged on delivery)

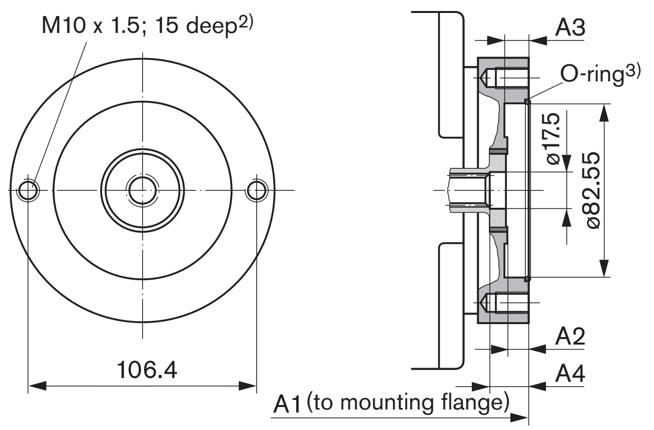
X = Plugged (in normal operation)

Through drive dimensions

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

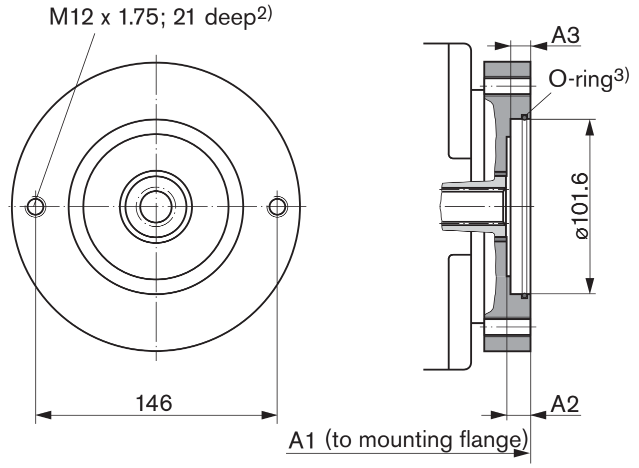
Flange SAE J744			Coupling for splined shaft[1]				
	Mounting variant						
Diameter	Symbol	Designation	Diameter	Designation	**071**	**090**	
Without					●	●	**0000**
82-2	⚯	A2	5/8 in 9T 16/32DP	S2	●	●	**A2S2**
101-2	⚯	B2	7/8 in 13T 16/32DP	S4	●	●	**B2S4**

82-2



NG	A1	A2	A3	A4
71	300.1	9	10	19.8
90	305.6	9	10	19.8

101-2



NG	A1	A2	A3
71	305.1	12	9.8
90	310.6	12	9.8

---

1) Coupling for splined shaft according to ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to DIN 13, observe the general instructions on page 24 for the maximum tightening torques.
3) O-ring included in the delivery contents

Overview of attachments

Through drive			**Attachment – 2nd pump**			
Flange	Coupling for splined shaft	Short code	A10VG NG (shaft)	A10VO/31 NG (shaft)	A10VO/53 NG (shaft)	External gear pump
82-2 (A)	5/8 in	**A2S2**	–	18 (U)	10 (U)	Size F NG4 to 22[1]
101-2 (B)	7/8 in	**B2S4**	18 (S)	28 (S,R) 45 (U,W)	28 (S,R) 45 (U,W)	Size N NG20 to 32[1] Size G NG38 to 45[1]

[1] Rexroth recommends special versions of the gear pumps. Please contact us.

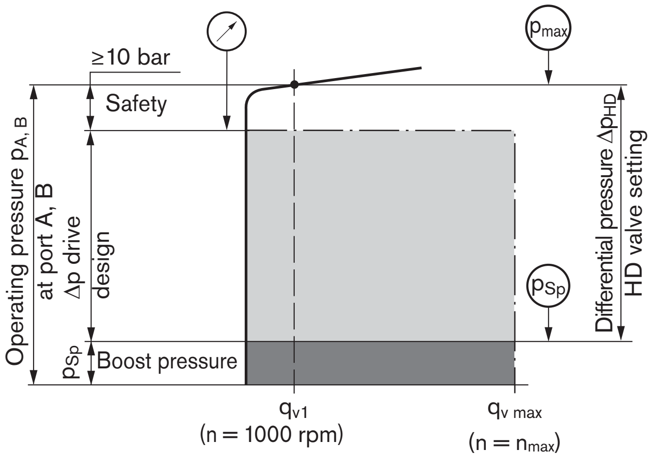
High-pressure relief valves

The two high-pressure relief valves protect the hydrostatic transmission (pump and motor) from overload. They limit the maximum pressure in the respective high-pressure line and serve simultaneously as boost valves.

Standard adjustment Δp_{HD} ____________________ 400 bar

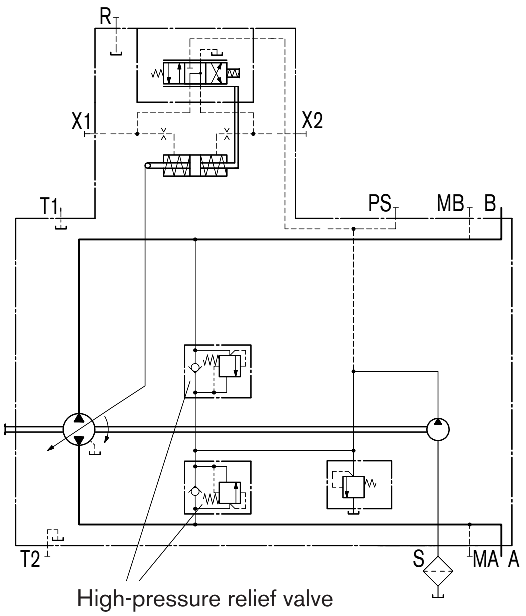
Please contact us regarding other pressure settings.

Setting diagram



Note
The valve settings are made at **n = 1000 rpm** and at **$V_{g\ max}$ ($q_{v\ 1}$)**. There may be deviations in the opening pressures with other operating parameters.

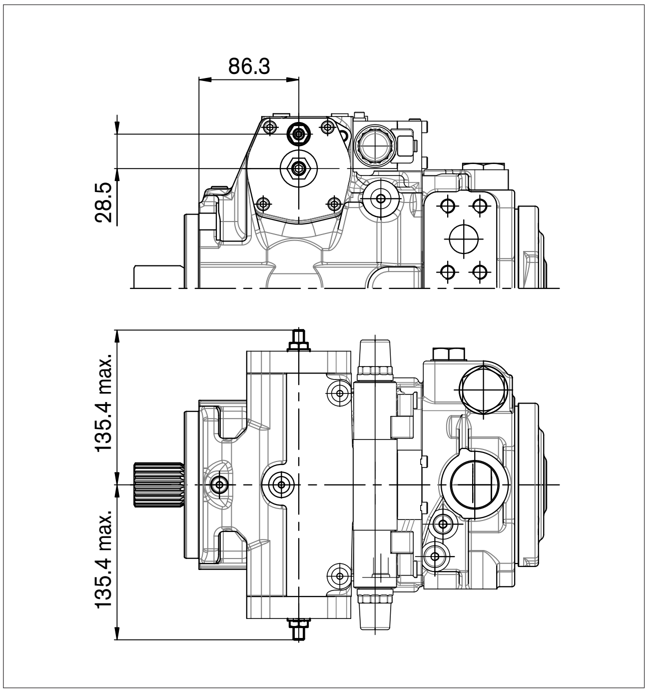
Circuit diagram



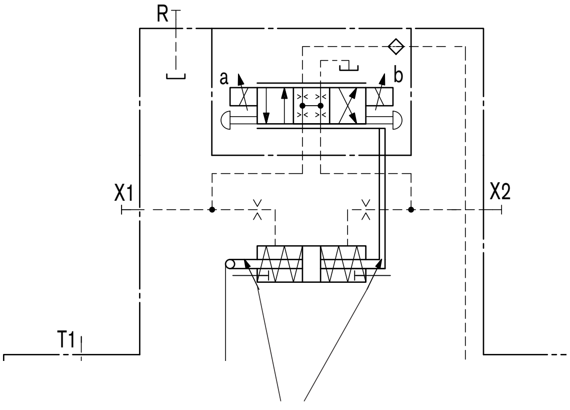
Mechanical stroke limiter

The mechanical stroke limiter is an auxiliary function allowing the maximum displacement of the pump to be steplessly reduced, regardless of the control unit used.

The stroke of the stroke cylinder and hence the maximum swivel angle of the pump are limited by means of two adjusting screws.

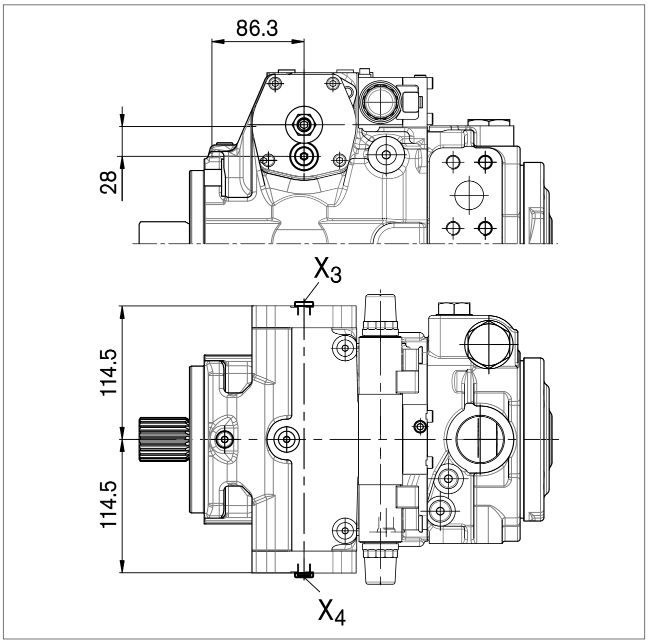


Circuit diagram

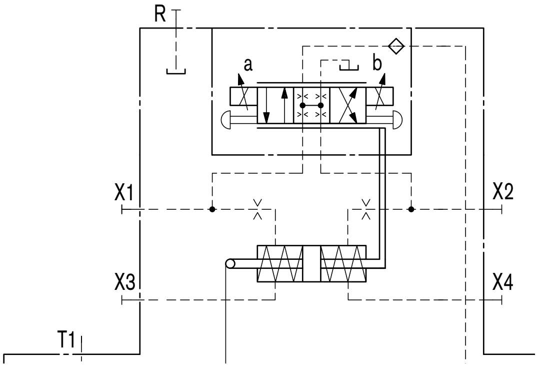


Mechanical stroke limiter

Ports X_3 and X_4 for stroking chamber pressure



Circuit diagram



Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State
X_3, X_4	Stroking chamber pressure	DIN 3852	M12 x 1.5; 12 deep	40	X

[1] Observe the general instructions on page 24 for the maximum tightening torques.

[2] Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Filtration boost circuit

Version S
Filtration in the suction line of the boost pump

Filter type ____________________ **filter without** bypass

Recommendation __________ **with** contamination indicator

Flow resistance at the filter cartridge:

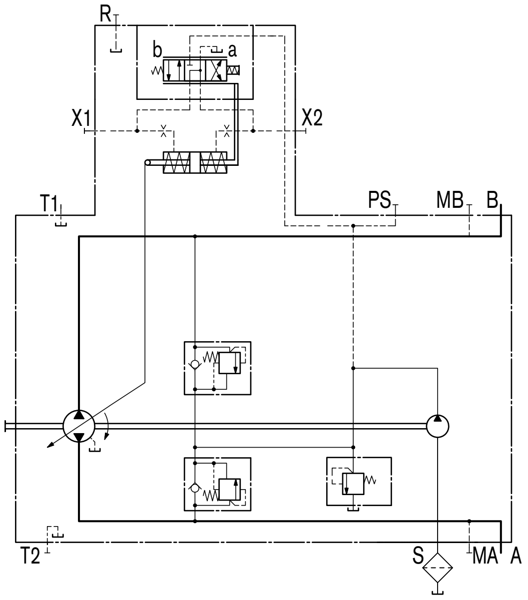
With $\nu = 30\ \text{mm}^2/\text{s}$, $n = n_{max}$ ______________ $\Delta p \leq 0.1$ bar
With $\nu = 1000\ \text{mm}^2/\text{s}$, $n = n_{max}$ ____________ $\Delta p \leq 0.3$ bar

Pressure at port S of the boost pump

Suction pressure $p_{S\ min}$ ($\nu \leq 30\ \text{mm}^2/\text{s}$) ___ ≥ 0.8 bar absolute
At cold start short-term ($t < 3$ min) ______ ≥ 0.5 bar absolute
Suction pressure $p_{S\ max}$ ______________ ≤ 5 bar absolute

The filter is not included in the delivery contents.

Circuit diagram



Connector for solenoids

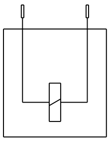
DEUTSCH DT04-2P-EP04, 2-pin

Molded, without bidirectional suppressor diode ____________ P

Type of protection according to DIN/EN 60529:
IP67 and IP69K

Circuit symbol

Without bidirectional suppressor diode



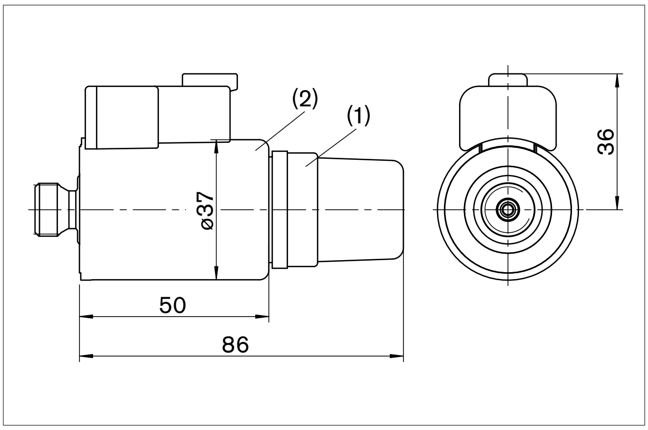
Mating connector

DEUTSCH DT06-2S-EP04
Rexroth Mat. No. R902601804

Consisting of:	DT designation
– 1 case	DT06-2S-EP04
– 1 wedge	W2S
– 2 female connectors	0462-201-16141

The mating connector is not included in the delivery contents. This can be supplied by Rexroth on request.

Solenoid with emergency actuation and spring return



Note
Manual override (emergency actuation) can be applied in the event of a malfunction in the electrical system.
Not approved for continuous operation!

Changing connector position

If necessary, you can change the position of the connector by turning the solenoid.

To do this, proceed as follows:

1. Loosen the fixing nut (1) of the solenoid. To do this, turn the fixing nut (1) one turn counter-clockwise.
2. Turn the solenoid body (2) to the desired position.
3. Retighten the fixing nut. Tightening torque of the fixing nut: 5 +1 Nm (WAF 26, 12-sided DIN 3124)

On delivery, the position of the connector may differ from that shown in the brochure or drawing.

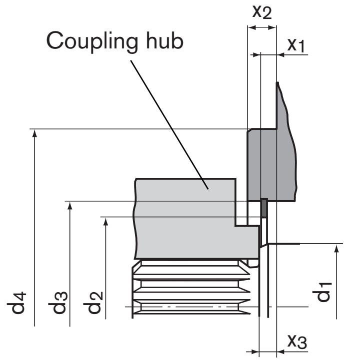
Installation situation for coupling assembly

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

To ensure that rotating components (coupling hub) and fixed components (case, retaining ring) do not come into contact with each other, the installation conditions described here must be observed. This depends on the size and the splined shaft.

SAE splined shaft (spline according to ANSI B92.1a-1976)

- Drive shaft V8, V9
  The outer diameter of the coupling hub must be smaller than the inner diameter of the retaining ring $\mathbf{d_2}$ in the area near the drive shaft collar (dimension $x_2 - x_3$).
- Drive shaft with mounted coupling flange C8, C9
  The depicted installation conditions are already taken into account by Rexroth.



Size	Mounting flange	ød$_1$	ød$_{2\ min}$	ød$_3$	ød$_4$	x$_1$	x$_2$	x$_3$
71	127-4	45	66.5	81 ±0.1	127	$7.0^{+0.2}$	$12.7^{-0.5}$	$8^{+0.9}_{-0.6}$
90	127-4	50	66.5	81 ±0.1	127	$7.0^{+0.2}$	$12.7^{-0.5}$	$8^{+0.9}_{-0.6}$

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This is also to be observed following a relatively long standstill as the system may empty via the hydraulic lines.

The case drain fluid in the case interior must be directed to the tank via the highest tank port (T_1, T_2). The minimum suction pressure at port S must not fall below 0.8 bar absolute (cold start 0.5 bar absolute).

In all operational states, the suction line and tank line must flow into the tank below the minimum fluid level.

Installation position

See examples below. Additional installation positions are available upon request.

Recommended installation positions: 1 and 2.

Below-tank installation (standard)

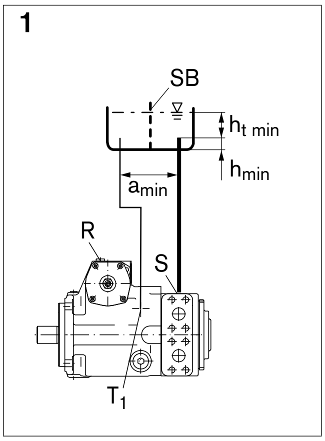
Pump below minimum fluid level of the tank.

Above-tank installation

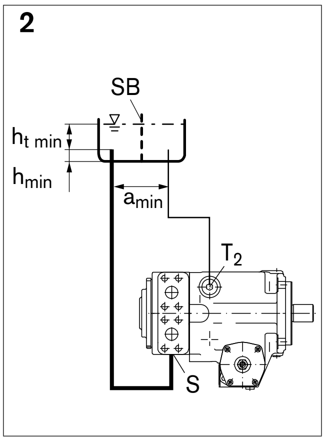
Pump above minimum fluid level of the tank.

Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.

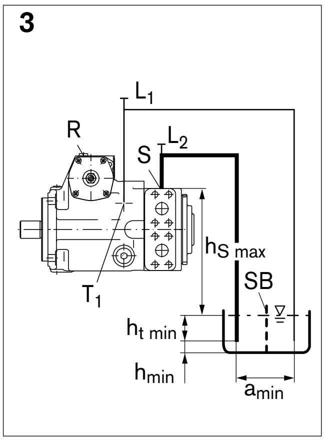
1



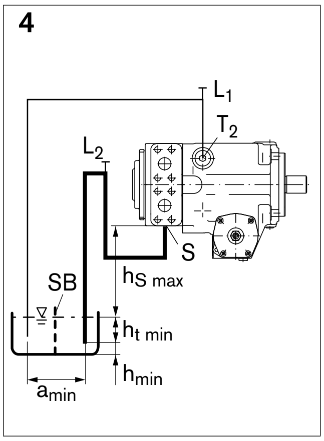
2



3



4



$h_{S\ max}$ = 800 mm, $h_{t\ min}$ = 200 mm, h_{min} = 100 mm, SB = baffle (baffle plate)

When designing the reservoir, ensure adequate distance a_{min} between the suction line and the case drain line to prevent the heated, return flow from being drawn directly back into the suction line.

Installation position	Air bleed	Filling
1	R	S + T_1
2	–	S + T_2

Installation position	Air bleed	Filling
3	L_2 (S) + R	L_2 (S) + L_1
4	L_2 + L_1 (T_2)	L_2 + L_1 (T_2)

Notes

General instructions

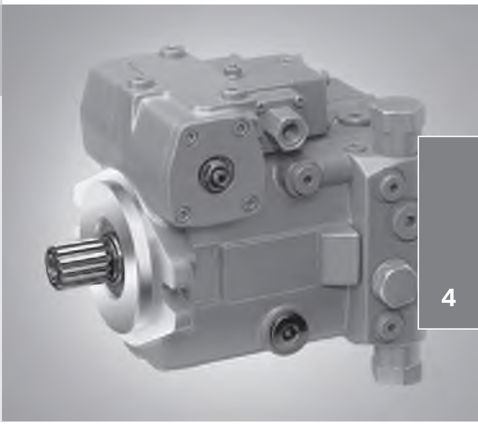
- The A4VTG pump is designed to be used in a closed circuit.
- Project planning, assembly and commissioning of the axial piston unit require the involvement of qualified personnel.
- The service line ports and function ports are only designed to accommodate hydraulic lines.
- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e. g. by wearing protective clothing).
- Depending on the operational state of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Pressure ports:
  The ports and fixing threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
- The data and notes contained herein must be adhered to.
- The following tightening torques apply:
  - Threaded hole for axial piston unit:
    The maximum permissible tightening torques $M_{G\ max}$ are maximum values for the threaded holes and must not be exceeded. For values, see the following table.
  - Fittings:
    Observe the manufacturer's instruction regarding the tightening torques of the used fittings.
  - Fixing screws:
    For fixing screws according to DIN 13, we recommend checking the tightening torque individually according to VDI 2230.
  - Locking screws:
    For the metal locking screws supplied with the axial piston unit, the required tightening torques of locking screws M_V apply. For values, see the following table.
- The product is not approved as a component for the safety concept of a general machine according to DIN EN ISO 13849.

Threaded port sizes		**Maximum permissible tightening torque of the threaded holes $M_{G\ max}$**	**Required tightening torque of the locking screws M_V**	**WAF hexagon socket for the locking screws**
M12 x 1.5	DIN 3852	50 Nm	25 Nm	6 mm
M14 x 1.5	DIN 3852	80 Nm	35 Nm	6 mm
M26 x 1.5	DIN 3852	230 Nm	120 Nm	12 mm
M42 x 2	DIN 3852	720 Nm	360 Nm	22 mm

Axial Piston Variable Pump
A10VG

Data sheet

Series 10
Sizes 18...63
Nominal pressure 300 bar
Peak pressure 350 bar
Closed circuit



Contents

Features

- Variable axial piston pump of swashplate design for hydrostatic closed circuit transmission
- Flow is proportional to drive speed and displacement and is infinitely variable
- Output flow increases with the swivel angle of the swashplate from 0 to its maximum value
- Flow direction changes smoothly when the swashplate is moved through the neutral position
- A wide range of highly adaptable control devices is available for different control and regulating functions
- The pump is equipped with two pressure-relief valves on the high pressure ports to protect the hydrostatic transmission (pump and motor) from overload
- The high-pressure relief valves also function as boost valves
- The integrated boost pump acts as a feed and control oil pump
- The maximum boost pressure is limited by a built-in boost pressure relief valve

Ordering Code / Standard Program

A10V	G								/	10		–	N		C							
01	02	03	04	05	06	07	08	09		10	11		12	13	14	15	16	17	18	19	20	21

Axial piston unit

01	Variable swashplate design, nominal pressure 300 bar, peak pressure 350 bar	A10V

Operation mode

02	Pump in closed circuit	G

Size

03	≈ Displacement $V_{g\ max}$ in cm^3	18	28	45	63

Control device

				18	28	45	63	
	Mechanical pivot control			●	–	–	–	MD
04	Hydraulic control	pilot-pressure related, with supply filtration		●	●	●	●	HD3
		mechanical servo		●	●	●	●	HW
		direct operated		●	●	●	●	DG
		speed related	U = 12 V DC	–	●	●	●	DA1
		(Description DA control valve in Pos. 09)	U = 24 V DC	–	●	●	●	DA2
	Electric control	with proportional solenoid, with supply filtration	U = 12 V DC	●	●	●	●	EP3
			U = 24 V DC	●	●	●	●	EP4
		with switching solenoid	U = 12 V DC	●	●	●	●	EZ1
			U = 24 V DC	●	●	●	●	EZ2

Pressure cut-off

		18	28	45	63	
05	Without pressure cut-off (not for DA, without code)	●	●	●	●	
	With pressure cut-off	–	●	●	●	D

Neutral position switch (only for HW)

		18	28	45	63	
06	Without neutral position switch (without code)	●	●	●	●	
	With neutral position switch (with DEUTSCH connector)	●	●	●	●	L

Mechanical stroke limiter

		18	28	45	63	
07	Without mechanical stroke limiter (without code)	●	●	●	●	
	With mechanical stroke limiter, external variable	●	●	●	●	M

Spring centering of neutral position (only MD)

		18	28	45	63	
08	Without spring centering of neutral position (without code)	●	–	–	–	
	With spring centering of neutral position	●	–	–	–	N

Ordering Code / Standard Program

A10V	G								/	10		–	N		C							
01	02	03	04	05	06	07	08	09		10	11		12	13	14	15	16	17	18	19	20	21

DA control valve (only for size 28-63)

			HD	HW	DG	DA	EP	EZ	
09	Without DA control valve		●	●	●	–	●	●	1
	With DA control valve, fixed setting		●	●	●	●	●	–	2
	With DA control valve, mech. adjustable with position lever	Actuating direction - clockwise	●	●	●	●	●	–	3R
		Actuating direction - counterclockwise	●	●	●	●	●	–	3L
	With DA control valve, fixed setting and hydraulic inch valve mounted, control with brake fluid according to ISO 4925, **no** mineral oil		–	–	–	●	–	–	4
	With DA control valve, fixed setting and ports for pilot control device		●	●	●	●	●	–	7
	With DA control valve, fixed setting and hydraulic inch valve mounted, control with brake fluid based on mineral oil		–	–	–	●	–	–	8

Series

10	Series 1, Index 0	10

Direction of rotation

11	Viewed from shaft end	clockwise	R
		counterclockwise	L

Seals

12	NBR (nitrile-caoutchouc), shaft seal ring in FKM (fluor-caoutchouc)	N

Shaft end (permissible input torque see page 8)

			18	28	45	63	
13	Splined shaft ANSI B92.1a-1976	for single pump	●	●	●	●	S
		for combination pump	–	–	●	●	T

Mounting flange

14	SAE J744 – 2-bolt	C

Service line ports (metric fixing thread)

		18	28	45	63	
15	SAE flange ports A/B, same side left, suction port S bottom	–	●	●	●	10
	A/B threaded ports, same side right, suction port S bottom	●	–	–	–	16

Boost pump

			18	28	45	63	
16	Without integrated boost pump	without through drive	●	●	●	●	N00
		with through drive	●	●	●	●	K..
	With integrated boost pump	without through drive	●	●	●	●	F00
		with through drive	●	●	●	●	F..

Through drive (mounting options, see page 36)

				18	28	45	63	
	Flange SAE J744 1)	Hub for splined shaft						
17	82-2 (A)	5/8 in	9T 16/32DP 2)	●	●	●	●	.01
	101-2 (B)	7/8 in	13T 16/32DP 2)	●	●	●	●	.02
		1 in	15T 16/32DP 2)	–	●	●	●	.04
	127-2 (C)	1 1/4 in	14T 12/24DP 2)	–	–	–	●	.07

Ordering Code / Standard Program

A10V	**G**								**/**	**10**		**–**	**N**		**C**							
01	02	03	04	05	06	07	08	09		10	11		12	13	14	15	16	17	18	19	20	21

	Valves	setting range Δp		**18**	**28**	**45**	**63**	
18	With high-pressure relief valve, direct operated, (fixed setting)	250...320 bar	without bypass	●	●	●	●	**3**
			with bypass	●	●	●	●	**5**
		100...250 bar	without bypass	●	●	●	●	**4**
			with bypass	●	●	●	●	**6**

	Filtration	**18**	**28**	**45**	**63**	
19	Filtration in the suction line of boost pump (filter not included in supply)	●	●	●	●	**S**
	Filtration in the pressure line of boost pump, ports for external boost circuit filtration, (F_e and G (F_a))	–	● 3)	● 3)	●	**D**
	External supply (version without integral boost pump - N00. K...)	●	●	●	●	**E**

	Connector for solenoids (only for EP, EZ and DA)		**18**	**28**	**45**	**63**	
20	DEUTSCH connector molded, 2-pin	without suppressor diode	●	●	●	●	**P**
		with suppressor diode (only for EZ and DA)	❍	❍	❍	❍	**Q**

	Standard / special version		
21	Standard version	without code	
		combined with attachment part or attachment pump	**-K**
	Special version		**-S**
		combined with attachment part or attachment pump	**-SK**

1) 2 = 2-bolt

2) Hub for splined shaft acc. to ANSI B92.1a-1976 (splined shaft assignment acc. to SAE J744, see page 34-35)

3) Pressure filtration is not possible in conjunction with DA control valve

● = available ❍ = on request – = not available

▨ = preferred program

Technical Data

Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids) and RE 90223 (HF hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.

The variable pump A10VG is unsuitable for operation with HFA, HFB and HFC. If HFD or environmentally acceptable hydraulic fluids are being used, the limitations regarding technical data and seals mentioned in RE 90221 and RE 90223 must be observed.

When ordering, please indicate the used hydraulic fluid.

Operating viscosity range

For optimum efficiency and service life, select an operating viscosity (at operating temperature) within the optimum range of

ν_{opt} = opt. operating viscosity 16...36 mm^2/s

depending on the circuit temperature (closed circuit).

Limits of viscosity range

The limiting values for viscosity are as follows:

$\nu_{min} =$ 5 mm^2/s
short term ($t < 3$ min)
at max. perm. temperature of $t_{max} = +115$ °C.

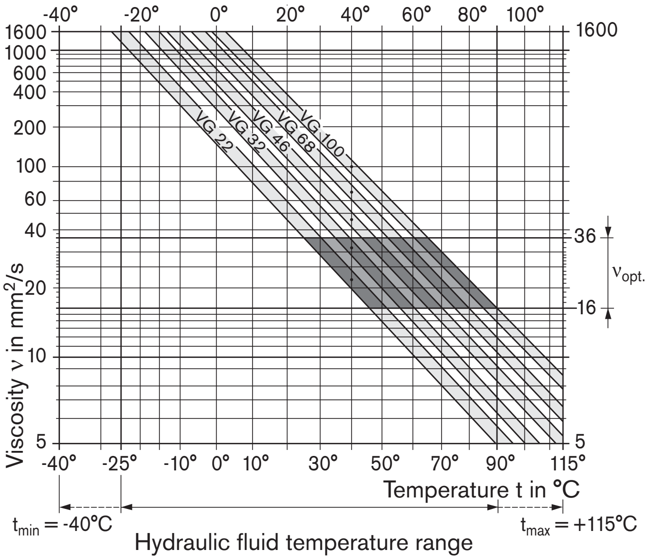
$\nu_{max} =$ 1600 mm^2/s
short term ($t < 3$ min)
at cold start ($p \leq 30$ bar, $n \leq 1000$ rpm, $t_{min} = -40$ °C).
Only for starting up without load. Optimum operating viscosity must be reached within approx. 15 minutes.

Note that the maximum hydraulic fluid temperature of 115 °C must not be exceeded locally either (e.g. in the bearing area). The temperature in the bearing area is - depending on pressure and speed - up to 5 K higher than the average case drain temperature.

Special measures are necessary in the temperature range from -40 °C to -25 °C (cold start phase), please contact us.

For detailed information about use at low temperatures, see RE 90300-03-B.

Selection diagram



Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature: in a closed circuit the circuit temperature.

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}) - the shaded area of the selection diagram. We recommended that the higher viscosity class be selected in each case.
Example: At an ambient temperature of X °C an operating temperature of 60 °C is set. In the optimum operating viscosity range (ν_{opt}; shaded area) this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Please note: The case drain temperature, which is affected by pressure and speed, is always higher than the circuit temperature. At no point in the system may the temperature be higher than 115 °C.

If the above conditions cannot be maintained due to extreme operating parameters, please consult us.

Technical Data

Filtration

The finer the filtration, the higher the cleanliness level of the hydraulic fluid and the longer the service life of the axial piston unit.

To ensure functional reliability of the axial piston unit the hydraulic fluid must have a cleanliness level of at least

20/18/15 according to ISO 4406.

Depending on the system and the application, for the A10VG, we recommend

Filter elements $\beta_{20} \geq 100$

With a rising differential pressure at the filter elements, the β-value must not deteriorate.

At very high hydraulic fluid temperatures (90 °C to max. 115 °C) at least cleanliness level

19/17/14 according to ISO 4406 is required.

If the above classes cannot be observed, please contact us. For notes on filtration types, see page 38.

Operating pressure range

Input

Variable pump (with external supply, E):

For control EP, EZ, HW and HD
boost pressure (at n = 2000 rpm) p_{Sp} ______________ 18 bar

For control DA, DG
boost pressure (at n = 2000 rpm) p_{Sp} ______________ 25 bar

Boost pump:
suction pressure $p_{s\ min}$ ($\nu \leq 30\ mm^2/s$) _____ ≥ 0.8 bar absolute
at cold start short term ($t < 3$ min) _________ ≥ 0.5 bar absolute

Output

Variable pump:
pressure at port A or B

Nominal pressure p_N ____________________________ 300 bar
Peak pressure p_{max} ____________________________ 350 bar

Boost pump:
peak pressure $p_{sp\ max}$ size 18______________ 25 bar
peak pressure $p_{sp\ max}$ size 28, 45, 63______________ 40 bar

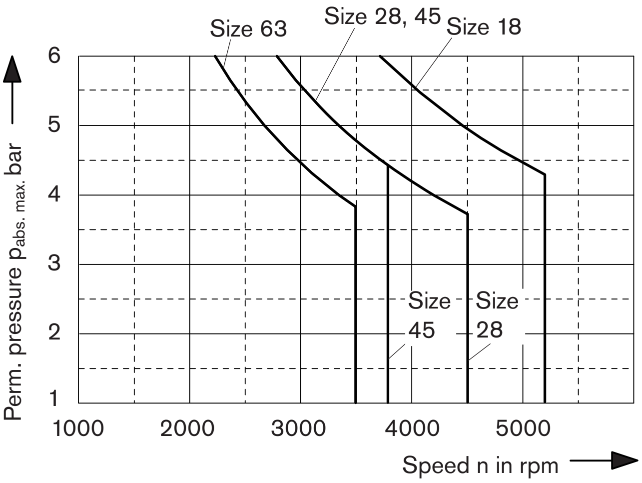
Nominal pressure:	Max. design pressure at which fatigue strength is ensured.
Peak pressure:	Max. operating pressure which is permissible for short term (t<1s).

Shaft seal ring

Permissible pressure loading

The service life of the shaft seal ring is affected by the speed of the pump and the case drain pressure. It is recommended that the average, continuous case drain pressure at operating temperature 3 bar absolute not be exceeded (max. permissible case drain pressure 6 bar absolute at reduced speed, see diagram). Short term ($t < 0.1$ s) pressure spikes of up to 10 bar absolute are permitted. The service life of the shaft seal ring decreases with an increase in the frequency of pressure spikes.

The case pressure must be equal to or greater than the external pressure on the shaft seal ring.



Temperature range

The FKM shaft seal ring is permissible for case temperatures of -25 °C to +115 °C.

Note:
For application cases below -25 °C, an NBR shaft seal ring is necessary (permissible temperature range: -40 °C to +90 °C). Please state NBR shaft seal ring in plain text when ordering. Please contact us.

Technical Data

Table of values (theoretical values, without efficiencies and tolerances; values rounded)

Size				**18**	**28**	**45**	**63**
Displacement							
variable pump		$V_{g\ max}$	cm^3	18	28	46	63
boost pump (at p = 20 bar)		$V_{g\ Sp}$	cm^3	5.5	6.1	8.6	14.9
Speed							
maximum at $V_{g\ max}$		$n_{max\ continuous}$	rpm	4000	3900	3300	3000
limited maximum [1]		$n_{max\ limited}$	rpm	4850	4200	3550	3250
intermittent maximum [2]		$n_{max\ interm.}$	rpm	5200	4500	3800	3500
minimum		n_{min}	rpm	500	500	500	500
Flow							
at $n_{max\ continuous}$ and $V_{g\ max}$		$q_{v\ max}$	l/min	72	109	152	189
Power [3]							
at $n_{max\ continuous}$ and $V_{g\ max}$	$\Delta p = 300$ bar	P_{max}	kW	36	54.6	75.9	94.5
Torque [3]							
at $V_{g\ max}$	$\Delta p = 300$ bar	T_{max}	Nm	86	134	220	301
	$\Delta p = 100$ bar	T	Nm	28.6	44.6	73.2	100.3
Rotary stiffness	Shaft end S	c	Nm/rad	20284	32143	53404	78370
	Shaft end T	c	Nm/rad	–	–	73804	92368
Moment of inertia for rotary group		J_{RG}	kgm^2	0.00093	0.0017	0.0033	0.0056
Angular acceleration, max. [4]		α	rad/s^2	6800	5500	4000	3300
Filling capacity		V	L	0.45	0.64	0.75	1.1
Mass approx. (without through drive)		m	kg	14(18) [5]	25	27	39

[1] Restricted maximum speed: – at half corner power (e.g. at $V_{g\ max}$ and p_N /2)
[2] Intermittent maximum speed: – at high idle speed
– at overspeed: $\Delta p = 70...150$ bar and $V_{g\ max}$
– at reversing peaks: $\Delta p < 300$ bar and $t < 0.1$ s.
[3] Without boost pump
[4] – The area of validity is situated between the minimum required and maximum permissible speed.
It applies for external stimuli (e.g. engine 2-8 times rotary frequency, cardan shaft twice the rotary frequency).

– The limit value applies for a single pump only.

– The load capacity of the connection parts has to be considered.

[5] 14kg: MD control, 18kg: HD control

Caution: Exceeding the permissible limit values may result in a loss of function, a reduction in service life or in the destruction of the axial piston unit.
A calculation can be performed to determine the permissible values.

Determining the size

Flow
$$q_v = \frac{V_g \bullet n \bullet \eta_v}{1000} \quad \text{l/min}$$

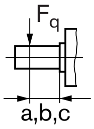
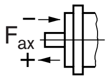
Torque
$$T = \frac{V_g \bullet \Delta p}{20 \bullet \pi \bullet \eta_{mh}} \quad \text{Nm}$$

Power
$$P = \frac{2\,\pi \bullet T \bullet n}{60000} = \frac{q_v \bullet \Delta p}{600 \bullet \eta_t} \quad \text{kW}$$

V_g = displacement volume per revolution in cm^3
Δp = differential pressure in bar
n = speed in rpm
η_v = volumetric efficiency
η_{mh} = mechanical-hydraulic efficiency
η_t = total efficiency

Technical Data

Permissible axial and radial loading on drive shaft

Size			18	28	45	63
Radial force, max. at distance (from shaft collar)	$F_{q\ max}$	N	1300	2500	3600	5000
	a	mm	16.5	17.5	17.5	17.5
	$F_{q\ max}$	N	1000	2000	2891	4046
	b	mm	29	30	30	30
	$F_{q\ max}$	N	880	1700	2416	3398
	c	mm	41.5	42.5	42.5	42.5
Axial force, max. 		N	973	987	1500	2200

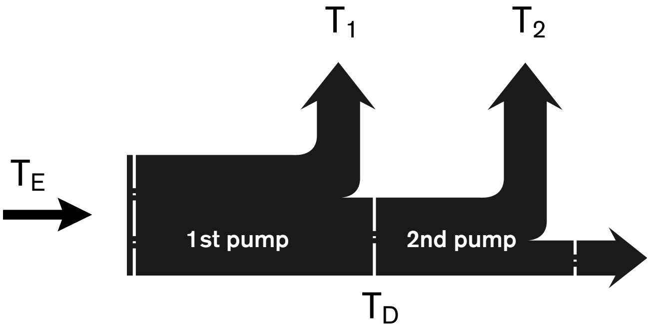
Note: special requirements apply in the case of belt drives. Please contact us.

Permissible input and through-drive torques

Size			18	28	45	63
Torque (at $V_{g\ max}$ and $\Delta p = 300$ bar) ¹)	T_{max}	Nm	86	134	220	301
Input torque, max. ²)						
at shaft end S	$T_{E\ perm.}$	Nm	192	314	314	602
ANSI B92.1a-1976 (SAE J744)			7/8 in	1 in	1 in	1 1/4 in
at shaft end T	$T_{E\ perm.}$	Nm	–	–	602	970
ANSI B92.1a-1976 (SAE J744)					1 1/4 in	1 3/8 in
Through-drive torque, max.	$T_{D\ perm.}$	Nm	112	220	314	439

¹) Efficiency not considered
²) For drive shafts with no radial force

Torque distribution



High-Pressure Relief Valves

Setting ranges

High-pressure relief valve, direct operated	Differential pressure setting Δp_{HP}
Setting range for valve **3, 5** Δp 250 - 320 bar (refer to ordering code)	320 bar
	300 bar [1]
	270 bar
Setting range for valve **4, 6** Δp 100 - 250 bar (refer to ordering code)	250 bar
	230 bar
	200 bar [1]
	150 bar
	100 bar

[1] Standard differential pressure setting. The valves will be set to this value if the differential pressure is not specified on ordering.

Please state in plain text when ordering:
(only the Δp_{HP} values shown in the table are possible)

High-pressure relief valve A

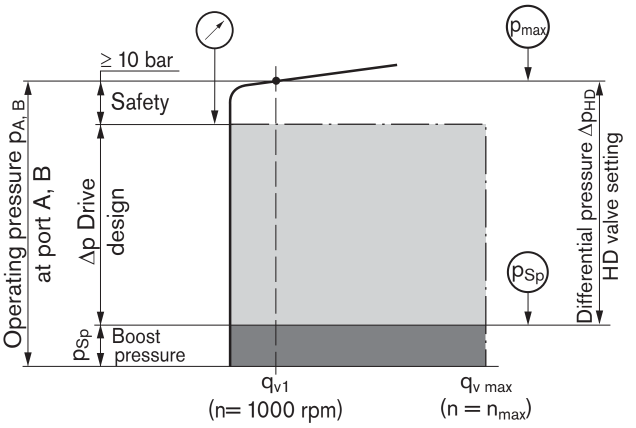
Differential pressure setting: Δp_{HD} = ... bar
opening pressure of the HD valve (at $q_{V\,1}$): p_{max} = ... bar
($p_{max} = \Delta p_{HD} + p_{Sp}$)

High-pressure relief valve B

Differential pressure setting: Δp_{HD} = ... bar
opening pressure of the HD valve (at $q_{V\,1}$): p_{max} = ... bar
($p_{max} = \Delta p_{HD} + p_{Sp}$)

Setting diagram

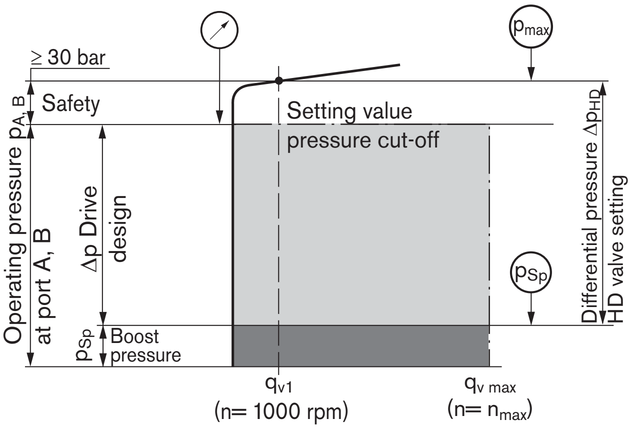
Version without pressure cut-off



Example: boost pressure 20 bar; operating pressure 290 bar

Operating pressure $p_{A,B}$ - boost pressure p_{Sp} = differential pressure Δp_{HD}
290 bar - 20 bar = **270 bar**

Version with pressure cut-off



Example: boost pressure 20 bar; operating pressure 290 bar

Operating pressure $p_{A,B}$ - boost pressure p_{Sp} + safety = differential pressure Δp_{HD}
290 bar - 20 bar + 30 bar = **300 bar**

Note: valve is set at
n = 1000 rpm and $V_{g\,max}$ ($q_{v\,1}$)

Bypass function

The bypass function can only be used for short periods with reduced displacement, e.g. to tow a vehicle out of an immediate danger zone.

Note:
The bypass function is not shown in these circuit diagrams.

Pressure Cut-Off, D

The pressure cut-off corresponds to a pressure regulation which, after reaching the set pressure, adjusts the displacement of the pump to $V_{g\ min}$.

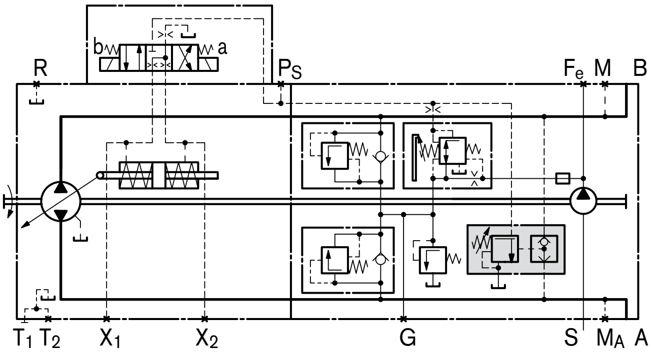
This valve prevents the operation of the high-pressure relief valves when accelerating or decelerating.

Both the pressure peaks occurring when the swashplate is swiveled rapidly and also the maximum pressure in the system are safeguarded by the high-pressure relief valves.

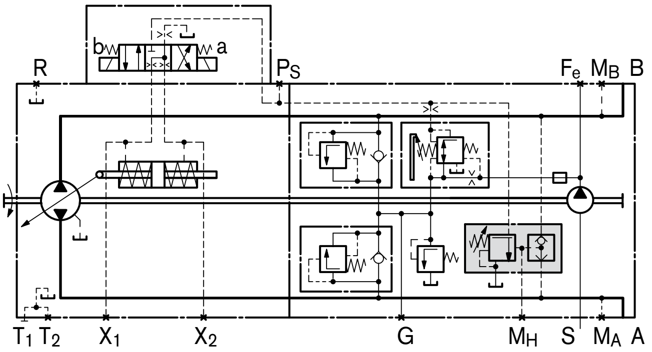
The setting range of the pressure cut-off may be anywhere within the entire operating pressure range. However, it must be set 30 bar lower than the setting of the high-pressure relief valves (see setting diagram, page 9).

Please state the setting value of the pressure cut-off in plain text when ordering.

Circuit diagram with pressure cut-off
Hydraulic control, speed related, DA.D3
Size 28 and 45



Size 63



DG - Hydraulic Control, Direct Operated

With the Direct Operated Hydraulic Control (DG), pump displacement is controlled by a hydraulic control pressure applied directly to the stroke cylinder through either the X_1 or X_2 port. In this way, the swashplate and thus the displacement is switchable from $V_g = 0$ to $V_{g\ max}$. Each direction of through put flow is assigned to a port.

Pilot pressure 0 bar ≙ position $V_g = 0$

The required pilot pressure for position $V_{g\ max}$ depends on operating pressure and speed.

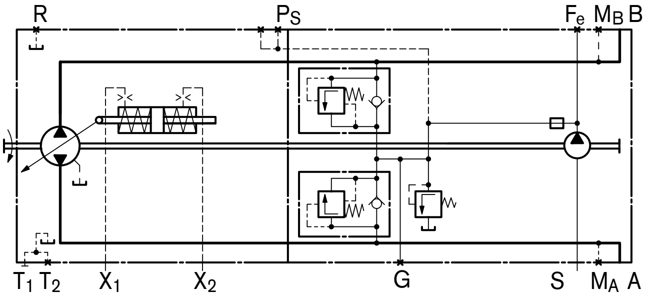
Max. permissible pilot pressure 40 bar

For project planning, please consult us.

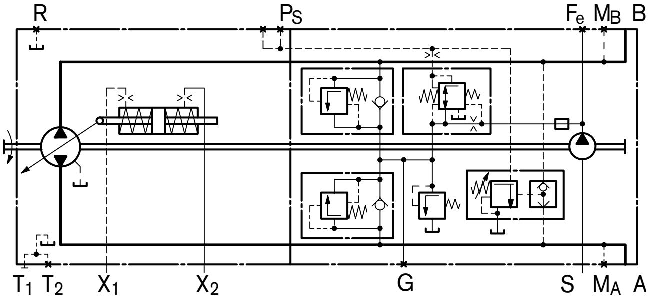
The pressure cut-off and the DA control valve only become effective if the pilot control device used for controlling the DG control is supplied from port P_S.

Assignment of direction of rotation – control – direction of through put flow
refer to HD control, page 12 (control pressure X_1; X_2).

Standard version

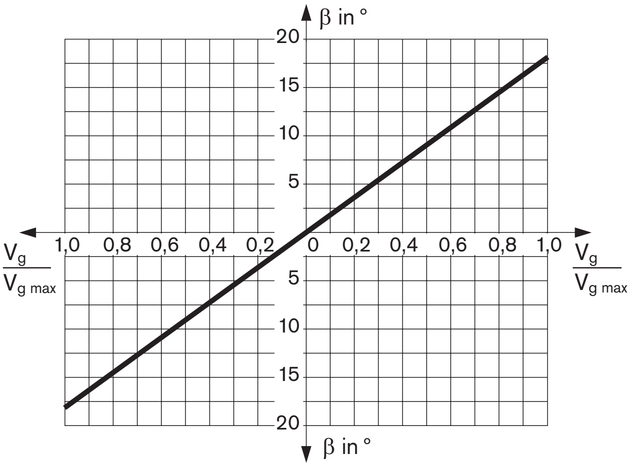


Version with DA control valve and pressure cut-off



MD - Mechanical Pivot Control (Size 18 only)

The swashplate is adjusted directly and thus the displacement of the pump is continuously varied depending on the position of the pivot. A swivel direction of the pivot is assigned to each flow direction.



Swivel angle β at the control lever for deflection:

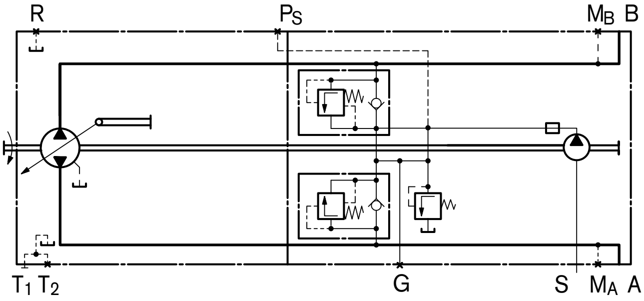
Start of control at β = 0°

End of control at β = 17.79° (max. displacement $V_{g\,max}$)

The required actuating torque is independent of the operating pressure, speed, displacement, design of the control plate and its torsion.

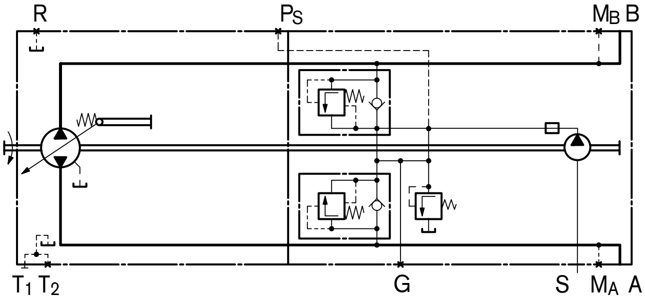
Higher operating pressure	➔	higher actuating torque
Higher speed	➔	higher actuating torque
Larger displacement	➔	lower actuating torque

Standard version (MD)



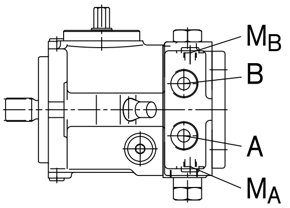
Variation: Spring neutral position centering (MDN)

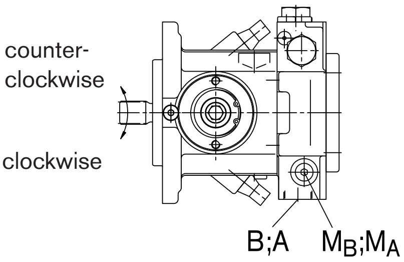
Spring neutral position centering automatically sets the pump to swivel angle 0 as soon as there is no actuating torque at the pivot pin.



Assignment
Direction of through put flow - Control - Direction of through put flow

Direction of rotation		Lever direction	Through put flow	Operating pressure
cw		a	B to A	M_A
		b	A to B	M_B
ccw		a	A to B	M_B
		b	B to A	M_A

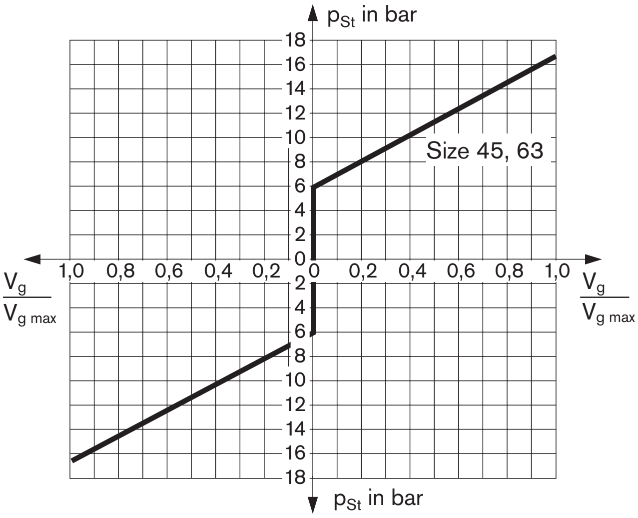




HD - Hydraulic Control, Pilot-Pressure Related

Depending on the pressure difference of the pilot pressure p_{St} in the two control lines (ports Y_1 and Y_2), the stroke cylinder of the pump is supplied with control pressure via the HD control unit. Thus, the swashplate – and, therefore, the displacement – to be infinitely adjustable. A different through put flow direction is associated with each control line.

If the pump is also equipped with a DA control valve (see page 15), automotive operation is possible for travel drives.



Size			18	28	45	63
Start of control ($V_{g\,0}$)	p_{St}	bar	6	6	6	6
End of control ($V_{g\,max}$)	p_{St}	bar	15.7	16	16.7	16.7

p_{St} : pilot pressure at port Y_1, Y_2

Please note:
The external control device must vent the Y_1 and Y_2 ports to tank pressure in neutral.

Note

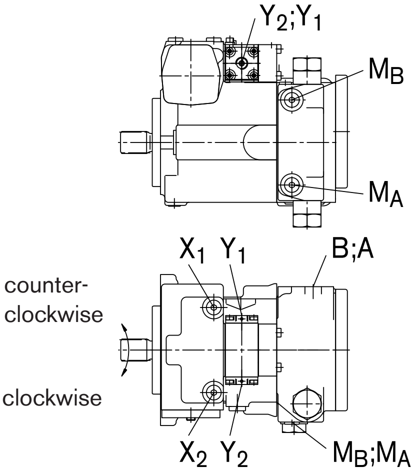
The spring return feature in the control unit is not a safety device

The spool valve inside the control unit can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

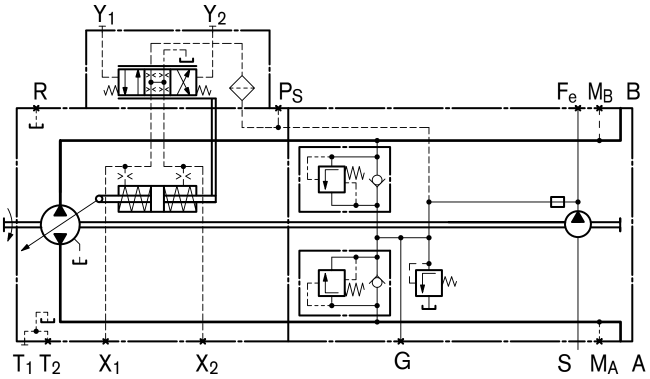
Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).

Assignment
Direction of rotation - Control - Direction of through put flow

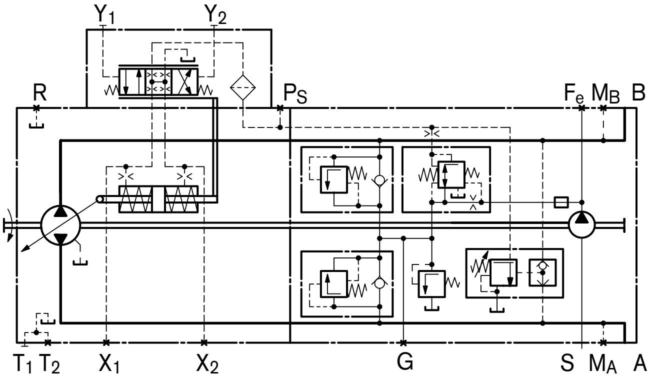
Direction of rotation		Pilot pressure	Control pressure	Through put flow	Operating pressure
Direction of rotation	cw	Y_1	X_1	A to B	M_B
		Y_2	X_2	B to A	M_A
	ccw	Y_1	X_1	B to A	M_A
		Y_2	X_2	A to B	M_B



Standard version



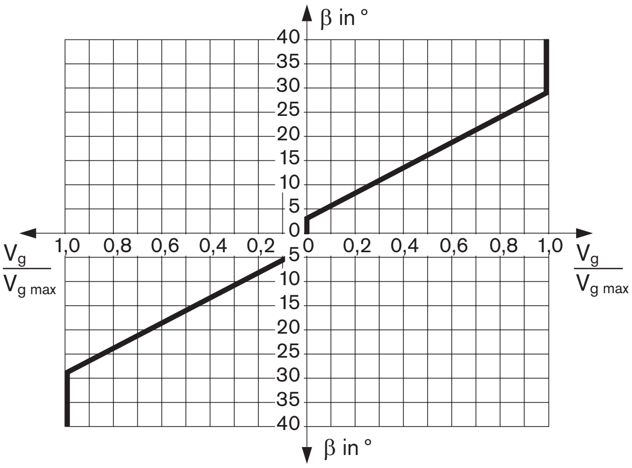
Version with DA control valve and pressure cut-off



HW - Hydraulic Control, Mechanical Servo

Depending on the actuation direction a or b of the control lever, the stroke cylinder of the pump is supplied with control pressure via the HW control unit. Thus, the swashplate – and, therefore, the displacement – to be infinitely adjustable. A different through put flow direction is associated with each direction of control lever actuation.

If the pump is also equipped with a DA control valve (see page 15), automotive operation is possible for travel drives.



Swivel angle β at the control lever for deflection:

Start of control at $\beta = 3°$

End of control at $\beta = 29°$ (max. displacement $V_{g\ max}$)

Mech. stop: ±40°

The maximum required torque at the lever is 170 Ncm. To prevent damage to the HW control module a positive mechanical stop must be provided for the HW control linkage.

Note:
Spring centering enables the pump to move automatically into neutral position ($V_g = 0$) as soon as there is no longer any torque on the control lever of the HW control unit (regardless of deflection angle).

Variation: Neutral position switch, L

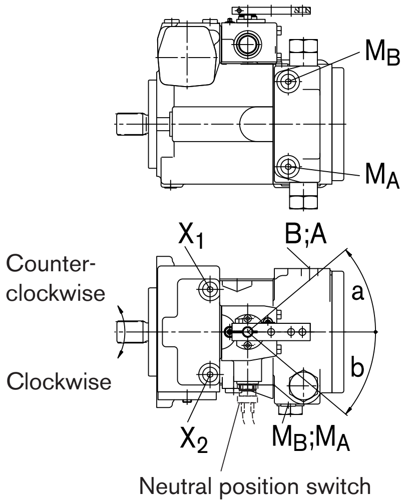
The switch contact in the neutral position switch is closed when the control lever on the HW control unit is in its neutral position. The switch opens if the control lever is moved out of neutral in either direction.

The neutral position switch provides a safety function for drive units that require zero flow under certain operating conditions (e.g. starting engine).

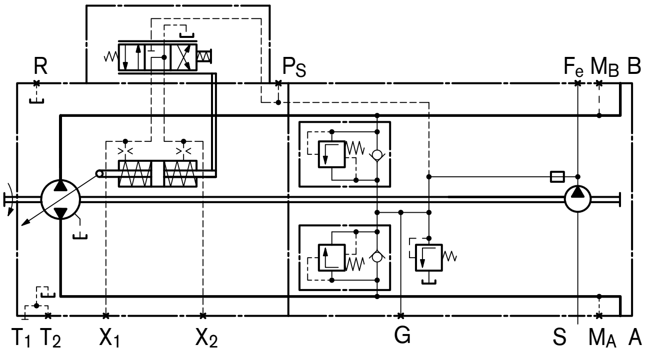
Technical data of neutral position switch	
Load capacity	20 A (continuous), without switching operating
Switching capacity	15 A / 32 V (ohm´s load)
	4 A / 32 V (inductive load)
Connector version	DEUTSCH connector DT04-2P-EP04 (mating connector see page 39)

Assignment
Direction of rotation - Control - Direction of through put flow

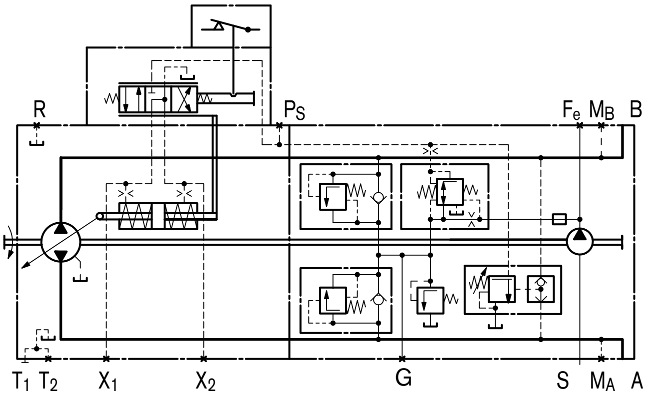
		Lever direction	Control pressure	Through put flow	Operating pressure
Direction of rotation	**cw**	a	X_2	B to A	M_A
		b	X_1	A to B	M_B
	ccw	a	X_2	A to B	M_B
		b	X_1	B to A	M_A



Standard version



Version with DA control valve, neutral position switch and pressure cut-off



DA - Hydraulic Control, Speed Related

The DA control is an engine speed-dependent, or automotive, type control system. The built-in DA regulating cartridge generates a pilot pressure that is proportional to pump (engine) drive speed. This pilot pressure is directed to the positioning cylinder of the pump by a solenoid actuated 4/3 way directional valve. Pump displacement is infinitely variable in each direction of flow, and is influenced by both pump drive speed and discharge pressure. Flow direction (i.e. machine forward or reverse) is controlled by energizing solenoid a or b.

Increasing pump drive speed generates a higher pilot pressure from the DA cartridge, with a subsequent increase in pump flow and/or pressure.

Dependent on the selected pump operating characteristics, increasing system pressure (i.e. machine load) causes the pump to swivel back towards a smaller displacement. Engine overload (anti-stall) protection is achieved by the combination of this pressure-related pump de-stroking, and the reduction of pilot pressure as the engine speed drops.

Any additional power requirement, such as implement hydraulics, may result in further engine pull down. This causes a further reduction in pilot pressure and therefore pump displacement. Automatic power division and full utilization of available power is thus achived for both the vehicle transmission and the implement hydraulics, with priority given to the implement hydraulics.

To provide controllable reduced vehicle speed operation when high engine speeds are required for fast implement hydraulics, various inching options are available.

The DA regulating cartridge can also be used in pumps with conventional control devices, such as EP, HW or HD, to provide an engine anti-stall function, or as a combination of automotive and displacement control functions.

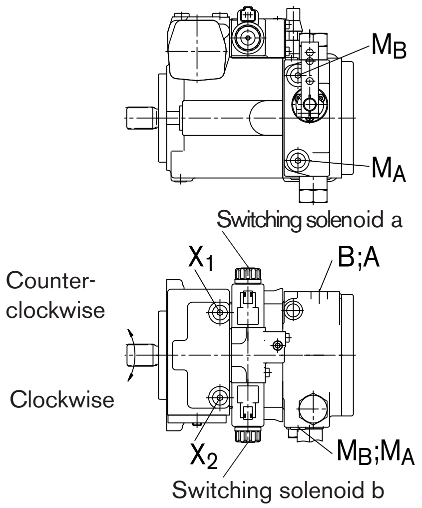
Application of the DA control is only appropriate on certain types of vehicle drive systems, and requires a review of the engine and vehicle parameters to ensure proper application of the pump, and safe and efficient machine operation. All DA applications must therefore be reviewed by a Rexroth Application Engineer.

Solenoid technical data	**DA1**	**DA2**
Voltage	12 V DC (±20 %)	24 V DC (±20 %)
Neutral position $V_{g\,0}$	de-energized	de-energized
Position $V_{g\,max}$	current energized	current energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Current required, minimum effective	1.32 A	0.67 A
Actuated time	100 %	100 %
Type of protection	see range of connectors on page 39	

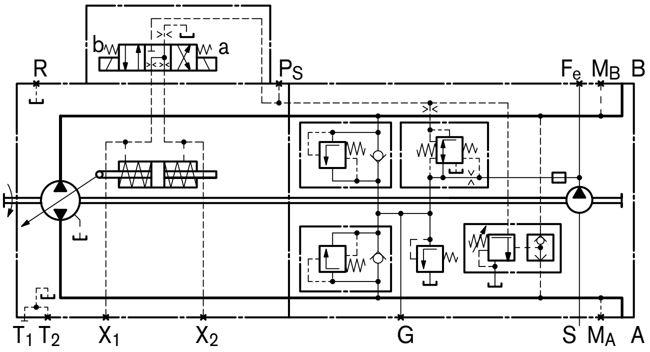
Standard: switching solenoid without manual emergency operation.
On request: manual emergency operation with spring reset available.

Assignment
Direction of rotation - Control - Direction of through put flow

		Actuation of solenoid	Control pressure	Through put flow	Operating pressure
Direction of rotation	**cw**	a	X_2	B to A	M_A
		b	X_1	A to B	M_B
	ccw	a	X_2	A to B	M_B
		b	X_1	B to A	M_A



Hydraulic control, speed related,
DA control valve, fixed setting, DA1D2/DA2D2



DA - Hydraulic Control, Speed Related

Function and control of DA control Valves

DA control valve, fixed setting (2)

Pilot pressure is generated in relation to drive speed. When ordering, please state in plain text: Start of control (set at factory).

DA control valve, mechanically adjustable with position lever, (3)

Pilot pressure is generated in relation to drive speed. When ordering, please state in plain text: Start of control (set at factory).

Pilot pressure may be reduced, independently of drive speed, through mechanical operation of the position lever (inch function).

Max. perm. operating torque at the position lever____$T_{max} = 4$ Nm

Max. angle of rotation 70°, lever position: any.

Variation 3R ____ actuating direction of the position lever
- clockwise

Variation 3L ____ actuating direction of the position lever
- counterclockwise

DA control valve, fixed setting and hydraulic inch valve mounted, (4, 8)

(only for pumps with DA control unit)

Permits the pilot pressure to be reduced independently of the drive speed via hydraulic control (port Z).

Variation 4:
Control at port Z by means of brake fluid according to ISO 4925 (**no** mineral oil) from the vehicle braking system (hydraulically linked with the service brake).

Variation 8:
Control at port Z by means of brake fluid based on mineral oil.

DA control valve with fixed setting, ports for pilot control device as inch valve (7)

Any reduction of pilot pressure, independent from the drive speed through the mechanical operation of the pilot control device.

The pilot control device is installed separately from the pump (for example in the driver's cabin) and connected with the pump by 2 hydraulic control lines via ports P_S and Y.

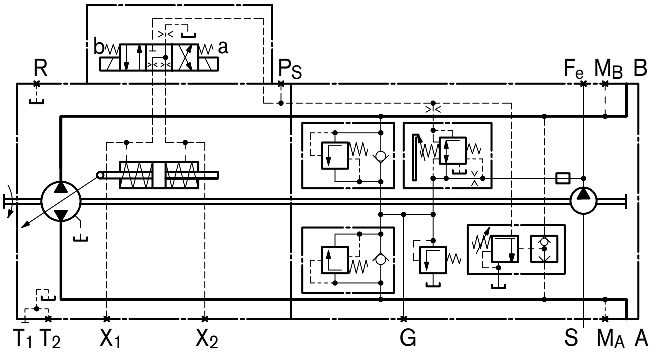
A suitable pilot control device must be ordered separately and is not included in supply.

Note: see page 40 for rotary inch valves.

Circuit diagrams:

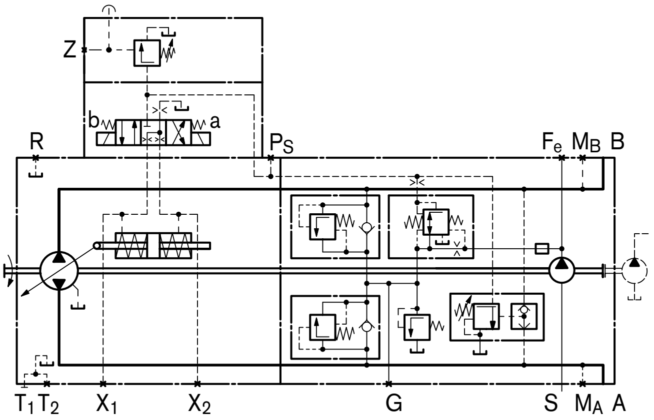
DA1D3/DA2D3

Hydraulic control, speed related, DA control valve, mech. adjustable with position lever



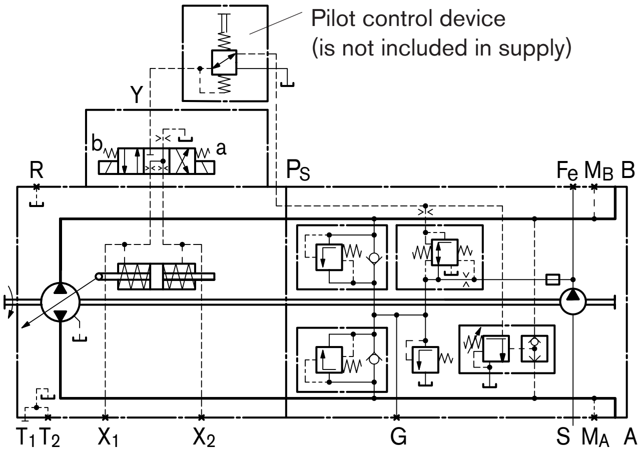
DA1D4/DA2D4

Hydraulic control, speed related,
DA control valve, fixed setting, with hydraulic inch valve



DA1D7/DA2D7

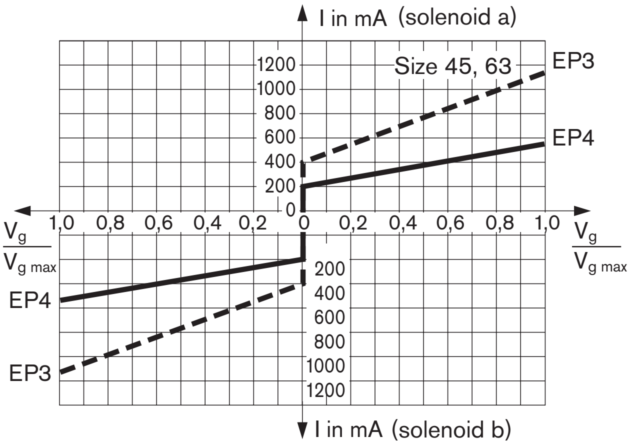
Hydraulic control, speed related, DA
DA control valve, fixed setting, with separately installed pilot control device as inch valve


Pilot control device
(is not included in supply)

EP - Electric Control, With Proportional Solenoid

Depending on the preselected current I at the two proportional solenoids (a and b), the stroke cylinder of the pump is supplied with control pressure via the EP control unit. Thus, the swashplate – and, therefore, the displacement – to be infinitely adjustable. One direction of through put flow is assigned to each proportional solenoid.

If the pump is also equipped with a DA control valve (see page 15), automotive operation is possible for travel drives.



Control current					
EP3	**Size**	**18**	**28**	**45**	**63**
Start of control	mA	400	400	400	400
End of control	mA	1050	1060	1115	1115
EP4	**Size**	**18**	**28**	**45**	**63**
Start of control	mA	200	200	200	200
End of control	mA	525	530	560	560

Solenoid technical data	EP3	EP4
Voltage	12 V DC (±20 %)	24 V DC (±20 %)
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Actuated time	100 %	100 %
Type of protection	see range of connectors on page 39	

– BODAS controller RC
series 20 ______________________________ RE 95200
series 21 ______________________________ RE 95201
series 22 ______________________________ RE 95202
aeries 30 ______________________________ RE 95203
and application software

– Analog amplifier RA ______________________ RE 95230

Note

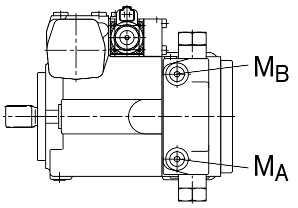
The spring return feature in the control unit is not a safety device

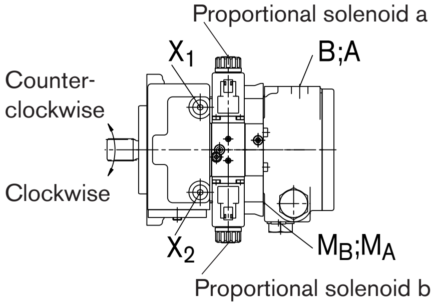
The spool valve inside the control unit can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e.g. immediate stop).

Assignment
Direction of rotation - Control - Direction of through put flow

Direction of rotation		Actuation of solenoid	Control pressure	Through put flow	Operating pressure
	cw	a	X_1	A to B	M_B
		b	X_2	B to A	M_A
	ccw	a	X_1	B to A	M_A
		b	X_2	A to B	M_B

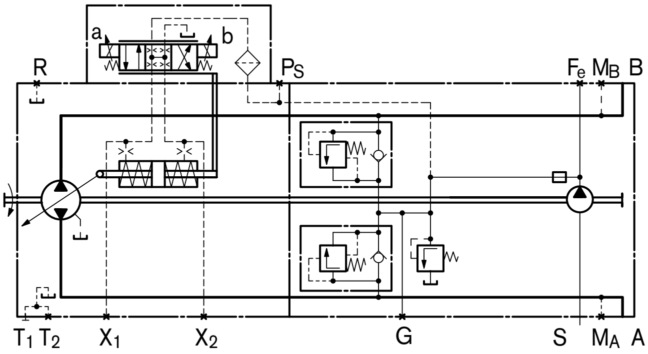




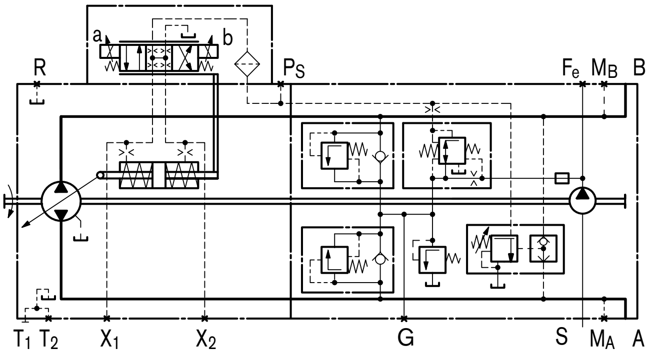
Standard: proportional solenoid without manual emergency operation.
On request: manual emergency operation with spring reset available.

EP - Electric Control, With Proportional Solenoid

Standard version



Version with DA control valve and pressure cut-off



EZ - Electric Two-Position Control, With Switching Solenoid

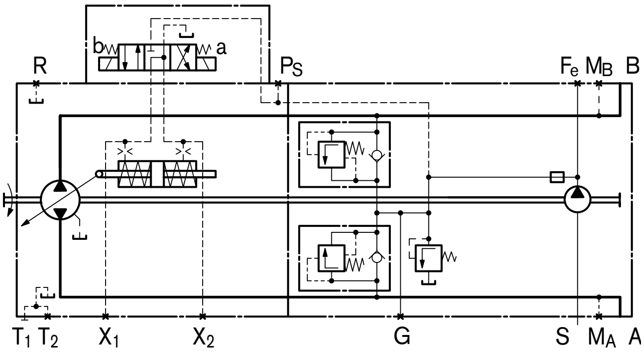
By energizing or de-energizing a control current to either switching solenoid a or b, the stroke cylinders of the pump are supplied with control pressure by the EZ control unit. In this way, the swashplate and thus the displacement is switchable without intermediate settings from $V_g = 0$ to $V_{g\ max}$. Each direction of through put flow is assigned to a switching solenoid.

Solenoid technical data	**EZ1**	**EZ2**
Voltage	12 V DC (±20 %)	24 V DC (±20 %)
Neutral position $V_g = 0$	de-energized	de-energized
Position $V_{g\ max}$	current energized	current energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Current required, minimum effective	1.32 A	0.67 A
Actuated time	100 %	100 %
Type of protection	see range of connectors on page 39	

Standard: switching solenoid without manual emergency operation.
On request: manual emergency operation with spring reset available.

Assignment direction of rotation - Control - Direction of through put flow DA control see page 14.

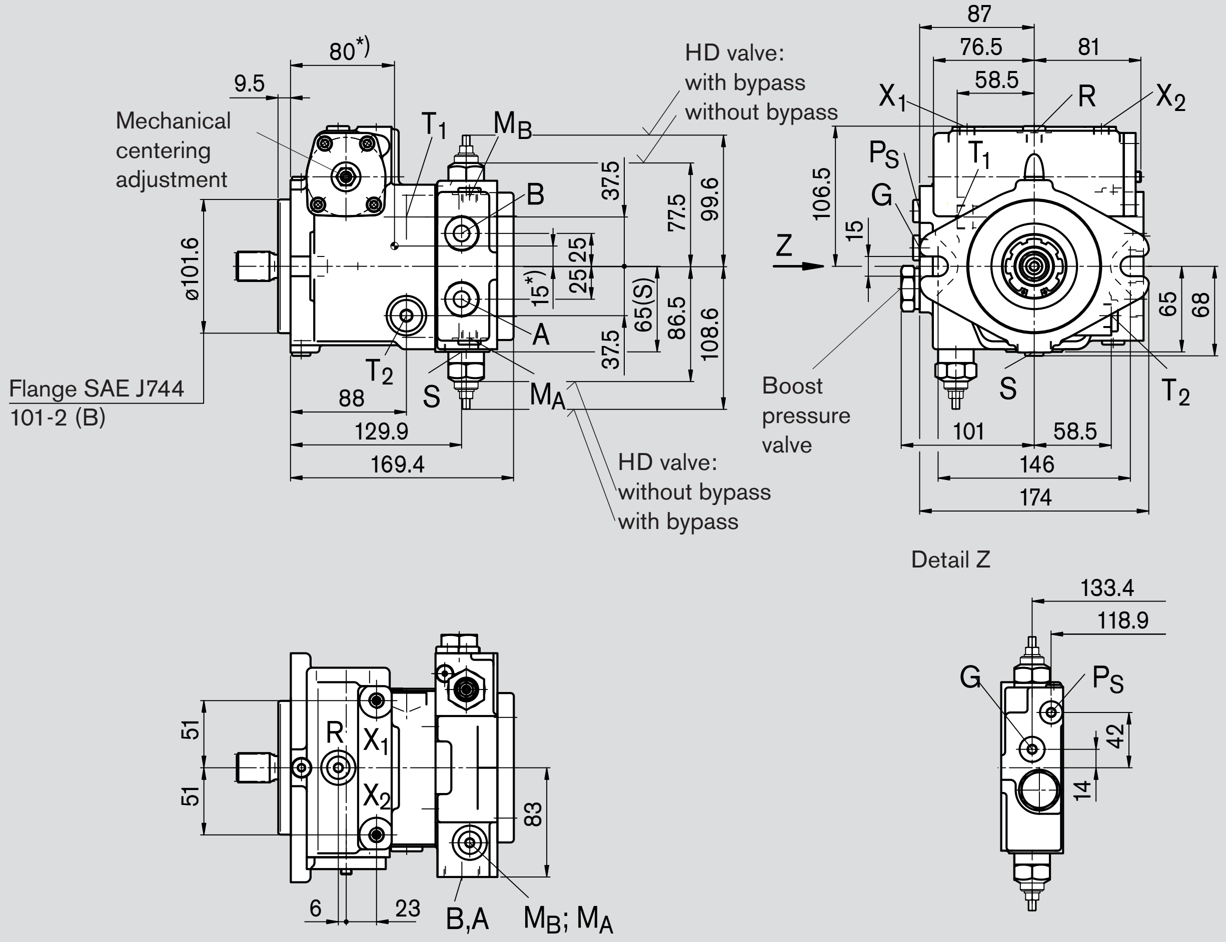
Standard version



Unit Dimensions, Size 18

Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

Hydraulic control, direct operated, DG



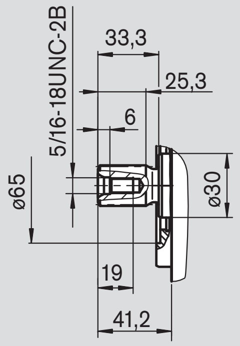
*) Center of gravity

Unit Dimensions, Size 18

Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

Shaft end

S Splined shaft 7/8in
13T 16/32DP 1)
(SAE J744 – 22-4 (B))



Ports

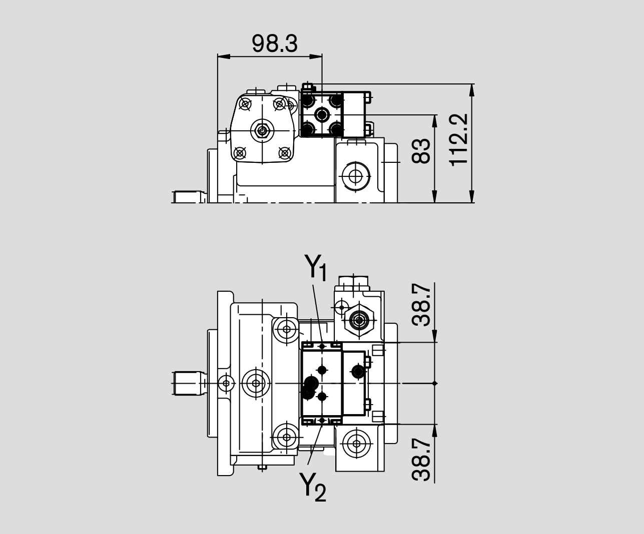
A, B	service line ports	DIN 3852	M27x2; 16 deep	330 Nm 2)
T_1	case drain or fill	DIN 3852	M18x1.5; 12 deep	140 Nm 2)
T_2	case drain 3)	DIN 3852	M18x1.5; 12 deep	140 Nm 2)
M_A, M_B	pressure gauge - operating pressure A, B 3)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
R	air bleed 3)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
S	boost suction port	DIN 3852	M26x1.5; 16 deep	230 Nm 2)
X_1, X_2	ports for control pressure (before orifice) 3)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
G	pressure port for auxiliary circuit 3)	DIN 3852	M14x1.5; 12 deep	80 Nm 2)
P_S	control pressure supply 3)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
Y_1, Y_2	remote control ports (only HD)	DIN 3852	M14x1.5; 12 deep	80 Nm 2)

1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Please observe the general notes for the max. tightening torques on page 44
3) Plugged

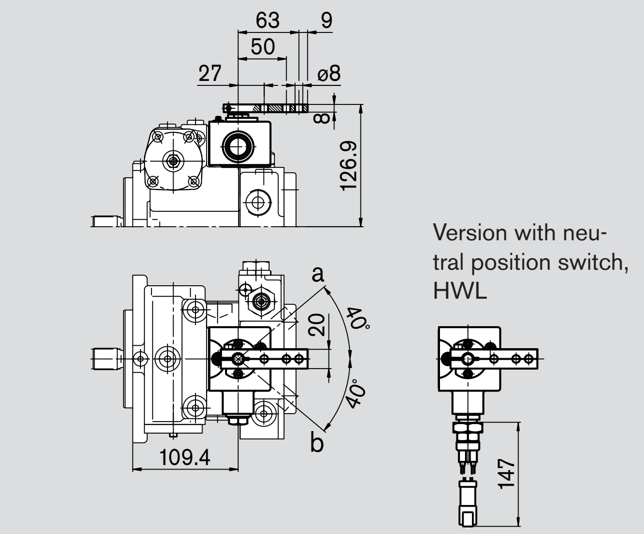
Unit Dimensions, Size 18

Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

Hydraulic control, pilot-pressure related, HD

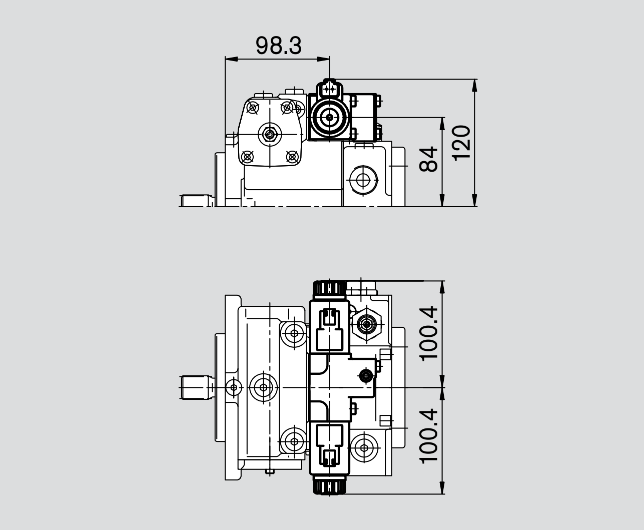


Hydraulic control, mechanical servo, HW

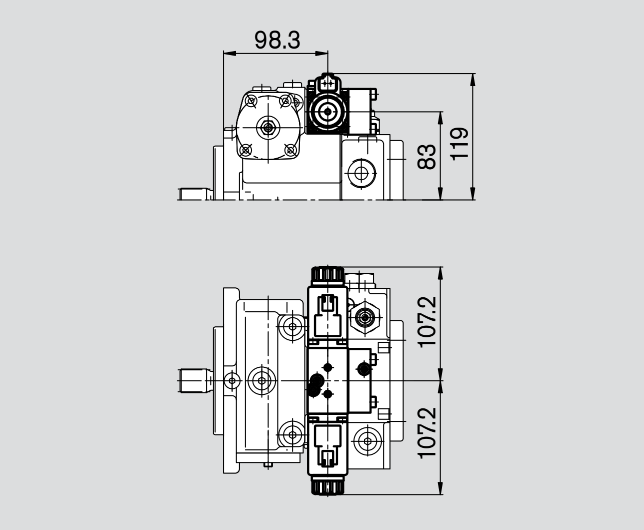


Version with neutral position switch, HWL

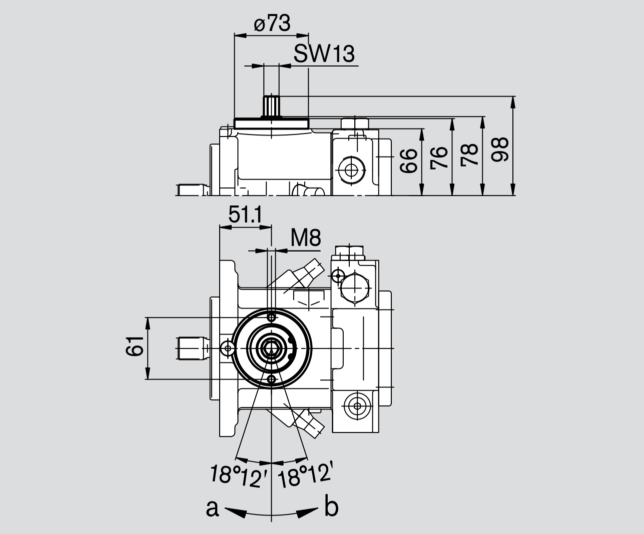
Electric two-position control with switching solenoid, EZ



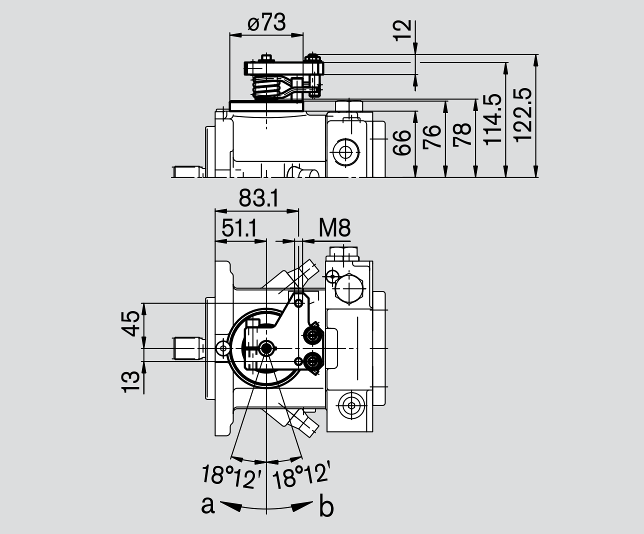
Electric control with proportional solenoid, EP



Mechanical pivot control, MD



Mechanical pivot control, spring neutral position centering, MDN

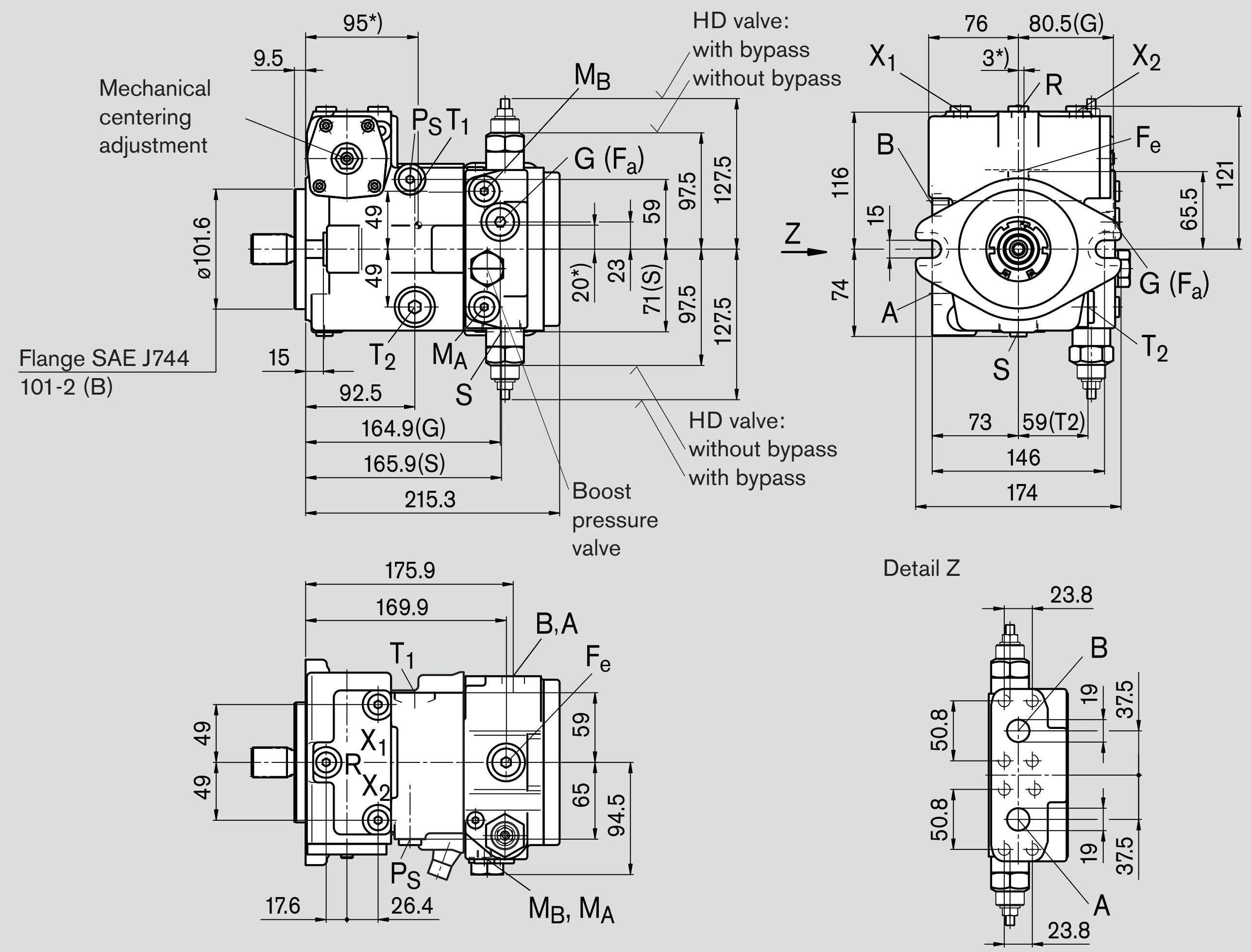


4

Unit Dimensions, Size 28

Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

Hydraulic control, direct operated, DG



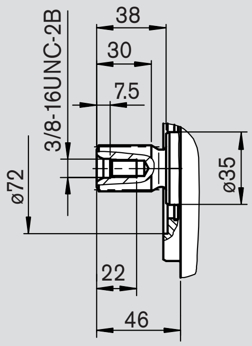
*) Center of gravity

Unit Dimensions, Size 28

Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

Shaft end

S Splined shaft 1in
15T 16/32DP 1)
(SAE J744 – 25-4 (B-B))



Ports

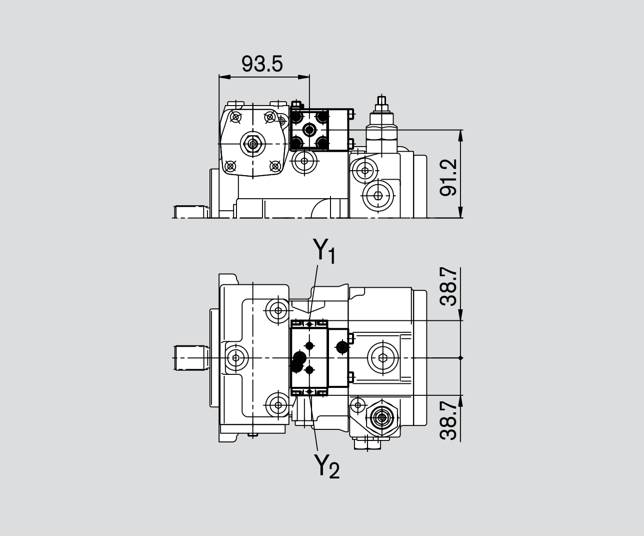
A, B	service line ports (high-pressure series)	SAE J518	3/4 in	
	fixing thread A/B	DIN 13	M10x1.5; 17 deep 2)	
T_1	case drain or fill	DIN 3852	M22x1.5; 14 deep	210 Nm 2)
T_2	case drain 3)	DIN 3852	M22x1.5; 14 deep	210 Nm 2)
M_A, M_B	pressure gauge - operating pressure A, B 3)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
R	air bleed 3)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
S	boost suction port	DIN 3852	M33x2; 18 deep	540 Nm 2)
X_1, X_2	ports for control pressure (before orifice) 3)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
G (F_a)	pressure port for auxiliary circuits 3) (without control cartridge)	DIN 3852	M18x1.5; 12 deep	140 Nm 2)
P_S	control pressure supply, boost pressure 3)	DIN 3852	M14x1.5; 12 deep	80 Nm 2)
F_e	filter input 3)	DIN 3852	M18x1.5; 12 deep	140 Nm 2)
Y_1, Y_2	remote control ports (only HD)	DIN 3852	M14x1.5; 12 deep	80 Nm 2)
Z	pilot pressure port (only DA4/8) 3)	DIN 3852	M10x1; 8 deep	30 Nm 2)
Y	pilot pressure port (only DA7)	DIN 3852	M14x1.5; 12 deep	80 Nm 2)

1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Please observe the general notes for the max. tightening torques on page 44
3) Plugged

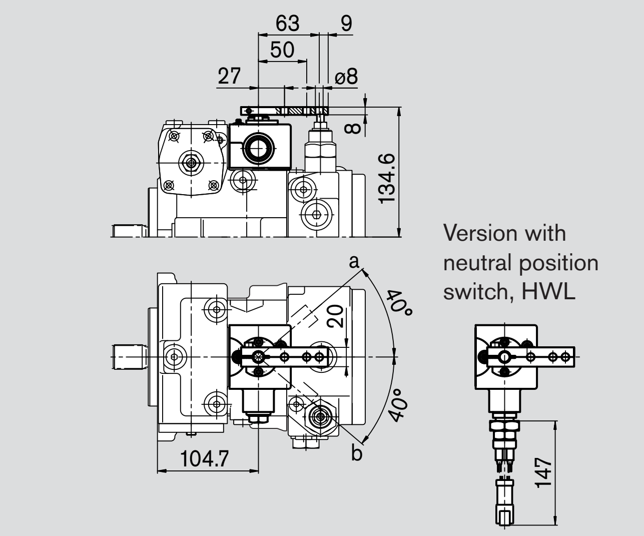
Unit Dimensions, Size 28

Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

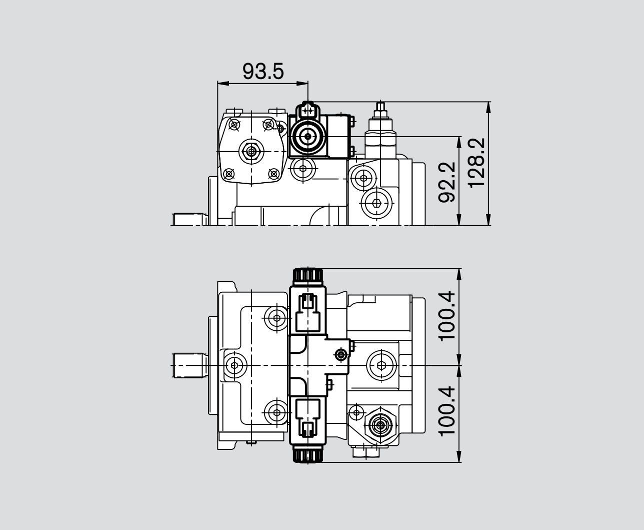
Hydraulic control, pilot-pressure related, HD



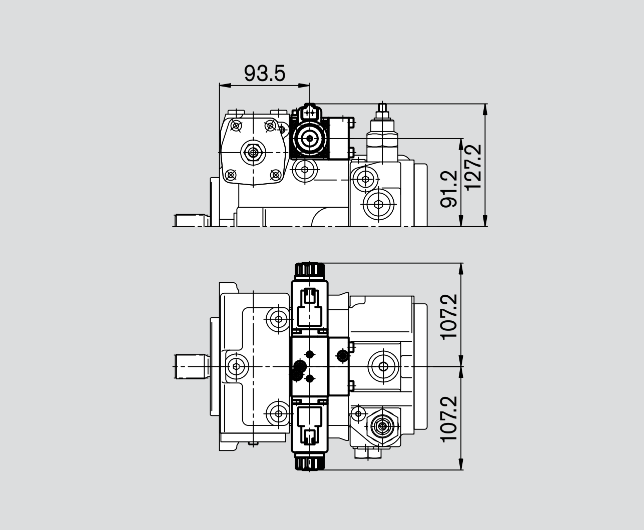
Hydraulic control, mechanical servo, HW



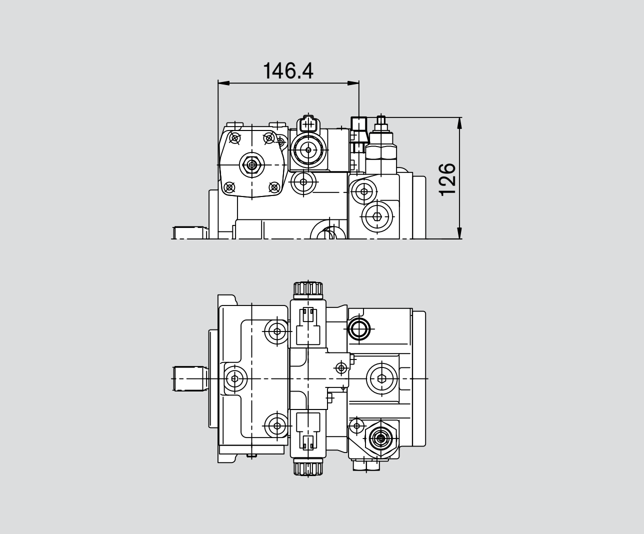
Electric two-position control with switching solenoid, EZ



Electric control with proportional solenoid, EP



Pressure cut-off, D

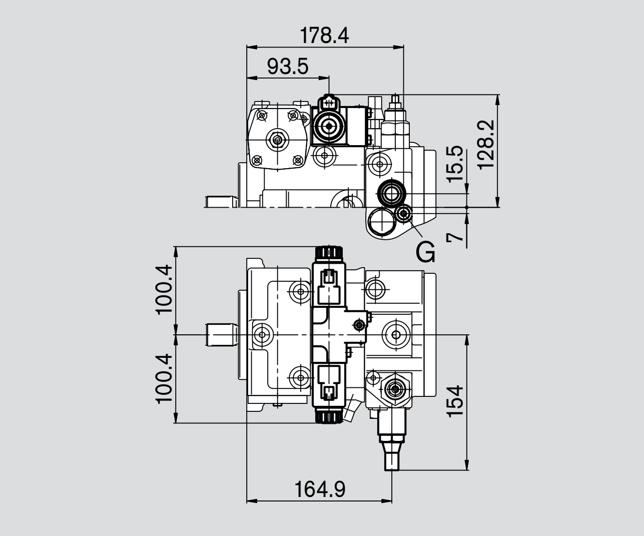


Unit Dimensions, Size 28

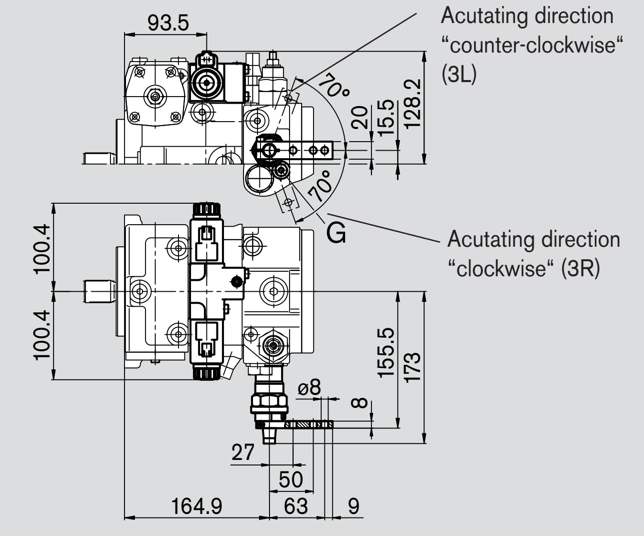
Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

Hydraulic control, speed related, DA

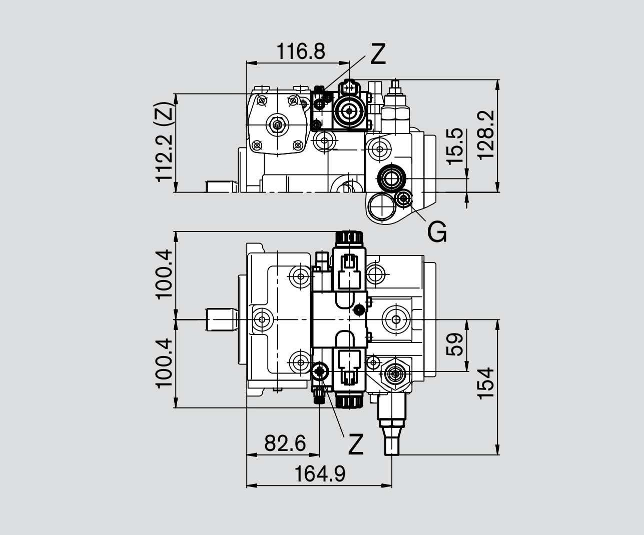
Control valve, fixed setting, DA2



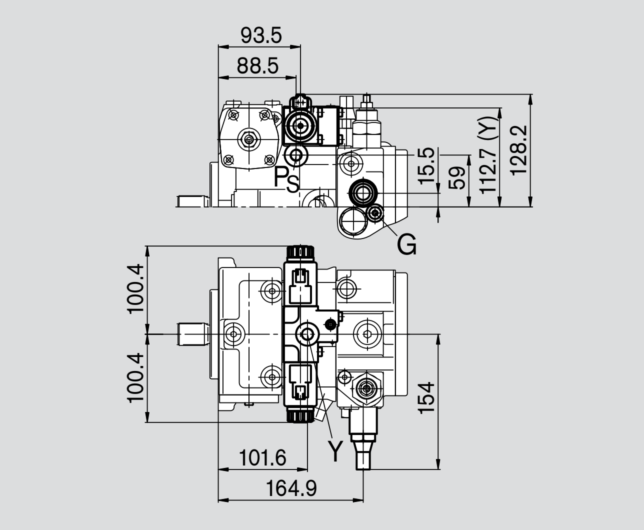
Control valve, mech. adjustable with position lever, DA3



Control valve, fixed setting and hydraulic inch valve mounted, DA4/DA8



Control valve, fixed setting and ports for pilot control device DA7



Important:
Position and size of port G on version with DA control valve

G	DIN 3852	M10x1; 8 deep	30 Nm [1]

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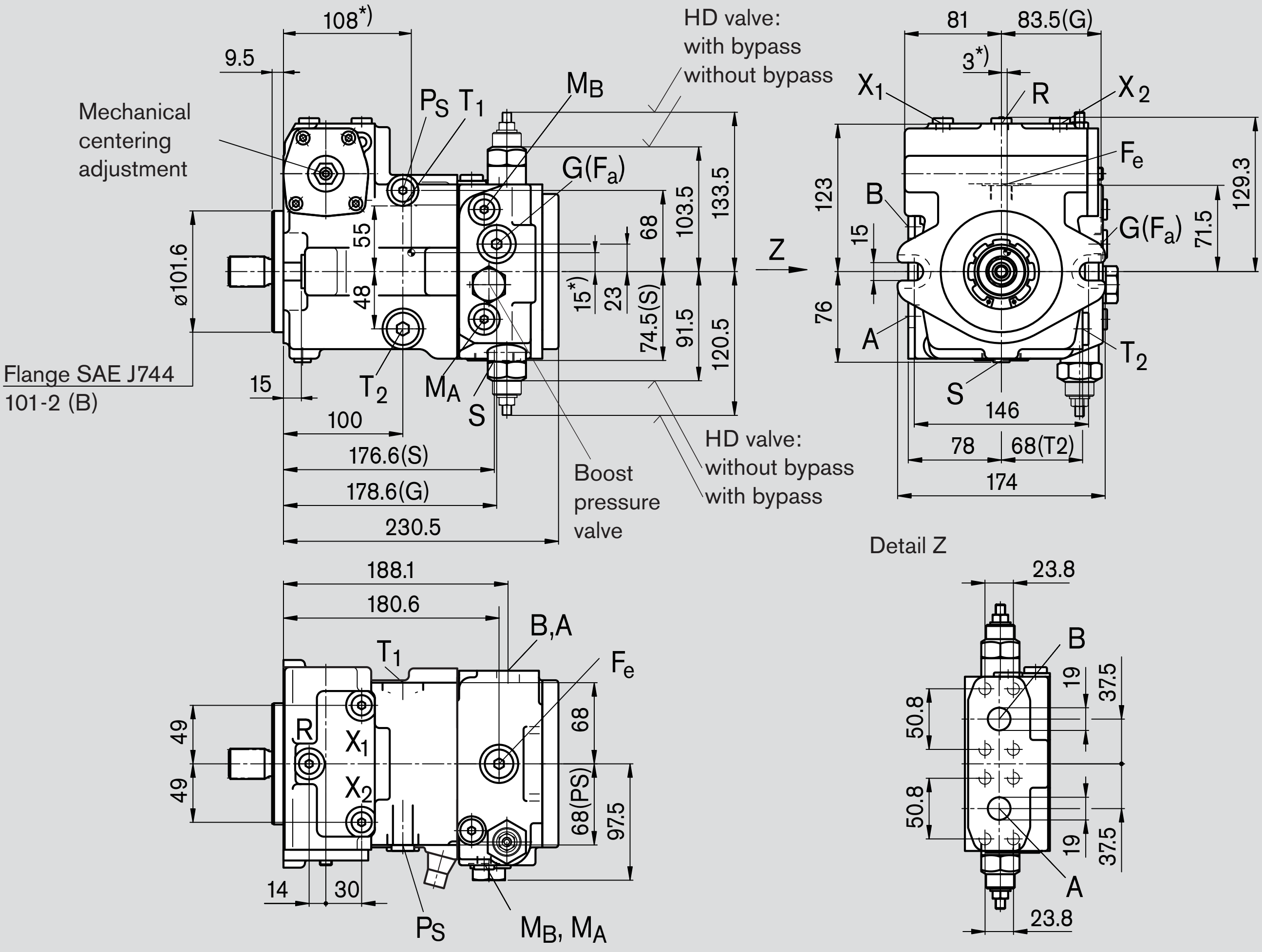
[1] Please observe the general notes for the max. tightening torques on page 44

Unit Dimensions, Size 45

Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

Hydraulic control, direct operated, DG



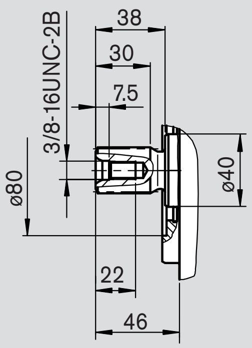
*) Center of gravity

Unit Dimensions, Size 45

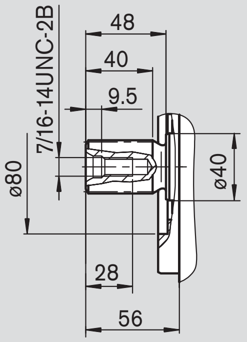
Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

Shaft ends

S Splined shaft 1in
15T 16/32DP 1)
(SAE J744 – 25-4 (B-B))



T Splined shaft 1 1/4in
14T 12/24DP 1)
(SAE J744 – 32-4 (C))



Ports

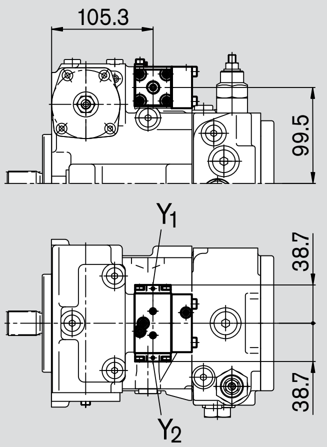
A, B	service line ports (high-pressure series)	SAE J518	3/4 in	
	fixing thread A/B	DIN 13	M10x1.5; 17 deep 2)	
T_1	case drain or fill	DIN 3852	M22x1.5; 14 deep	210 Nm 2)
T_2	case drain 3)	DIN 3852	M22x1.5; 14 deep	210 Nm 2)
M_A, M_B	pressure gauge - operating pressure A, B 3)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
R	air bleed 3)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
S	boost suction port	DIN 3852	M33x2; 18 deep	540 Nm 2)
X_1, X_2	ports for control pressure (before orifice) 3)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
G (F_a)	pressure port for auxiliary circuits 3)	DIN 3852	M18x1.5; 12 deep	140 Nm 2)
P_S	control pressure supply, boost pressure 3)	DIN 3852	M14x1.5; 12 deep	80 Nm 2)
F_e	filter input 3)	DIN 3852	M18x1.5; 12 deep	140 Nm 2)
Y_1, Y_2	remote control ports (only HD)	DIN 3852	M14x1.5; 12 deep	80 Nm 2)
Z	pilot pressure port (only DA4/8) 3)	DIN 3852	M10x1; 8 deep	30 Nm 2)
Y	pilot pressure port (only DA7)	DIN 3852	M14x1.5; 12 deep	80 Nm 2)

1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Please observe the general notes for the max. tightening torques on page 44
3) Plugged

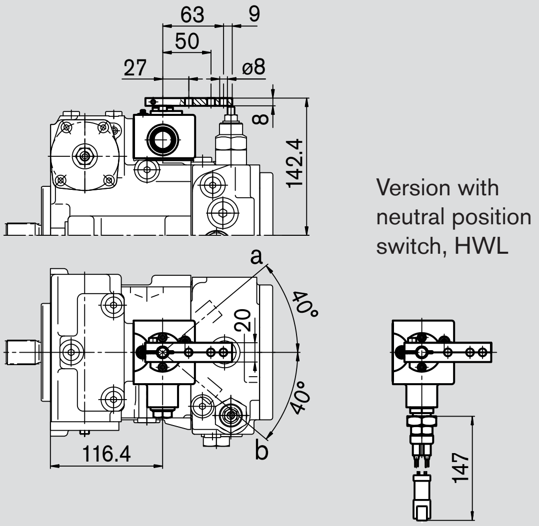
Unit Dimensions, Size 45

Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

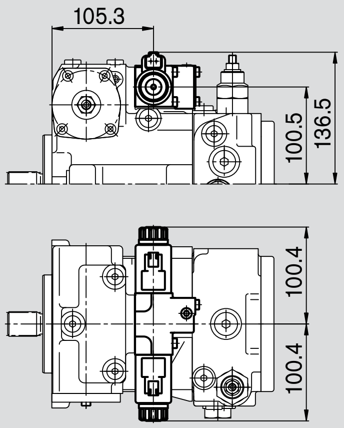
Hydraulic control, pilot-pressure related, HD



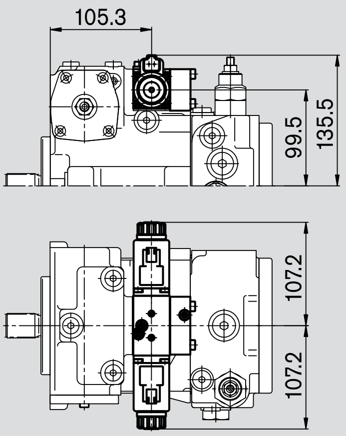
Hydraulic control, mechanical servo, HW



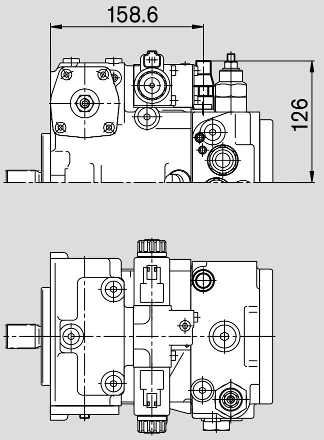
Electric two-position control with switching solenoid, EZ



Electric control with proportional solenoid, EP



Pressure cut-off, D

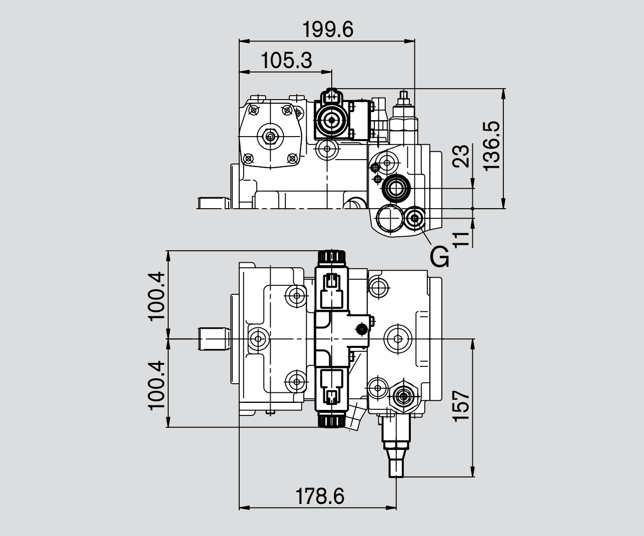


Unit Dimensions, Size 45

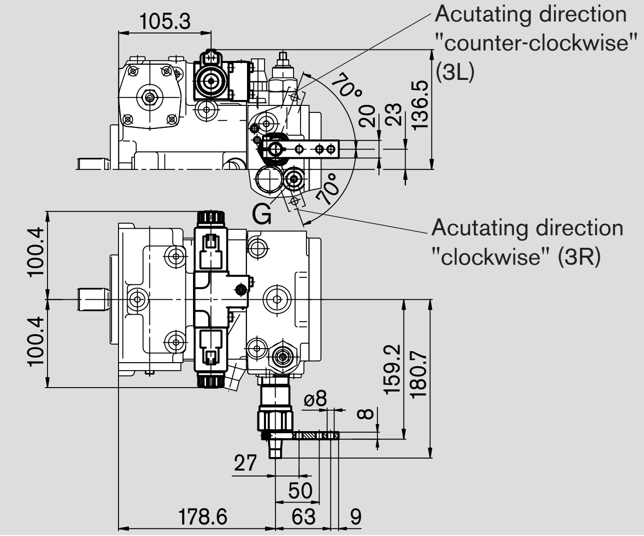
Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

Hydraulic control, speed related, DA

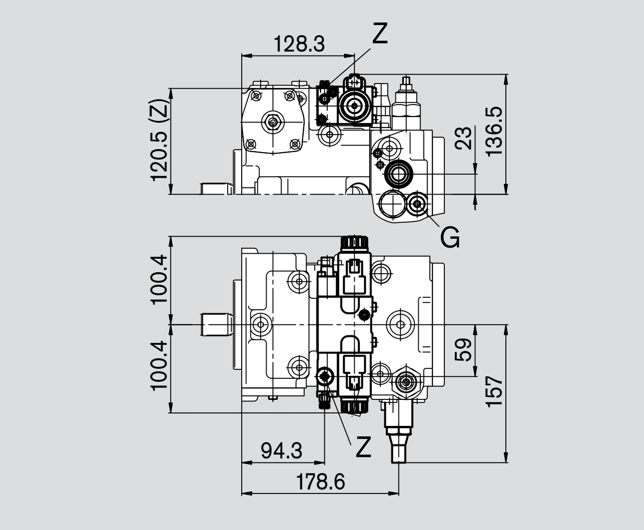
Control valve, fixed setting, DA2



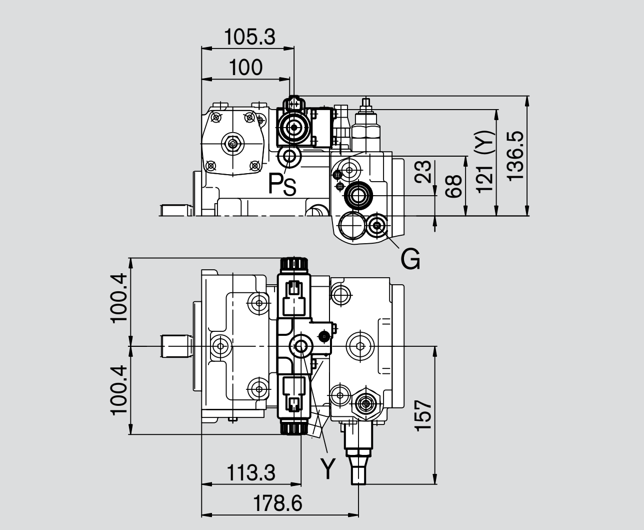
Control valve, mech. adjustable with position lever, DA3



Control valve, fixed setting and hydraulic inch valve mounted, DA4/DA8



Control valve, fixed setting and ports for pilot control device DA7



Important:

Position and size of port G on version with DA control valve

G	DIN 3852	M12x1.5; 12 deep	50 Nm 1)

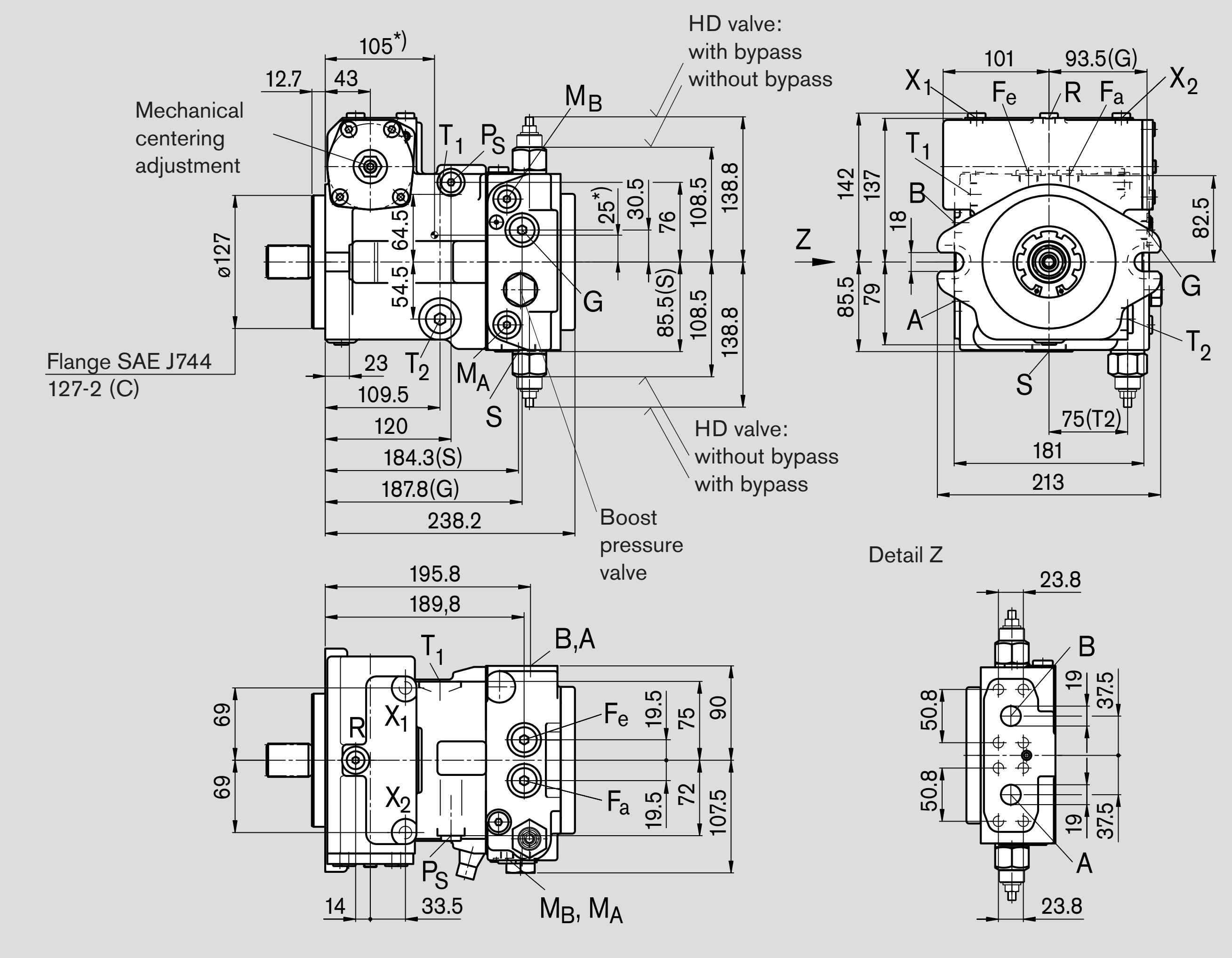
---

1) Please observe the general notes for the max. tightening torques on page 44

Unit Dimensions, Size 63

Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

Hydraulic control, direct operated, DG



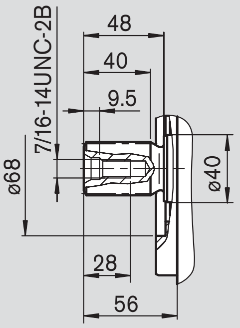
*) Center of gravity

Unit Dimensions, Size 63

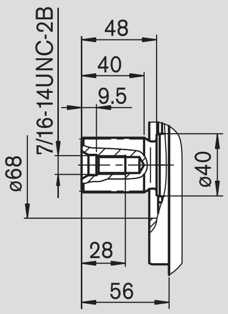
Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

Shaft ends

S Splined shaft 1 1/4in
14T 12/24DP 1)
(SAE J744 – 32-4 (C))



T Splined shaft 1 3/8in
21T 16/32DP 1)



Ports

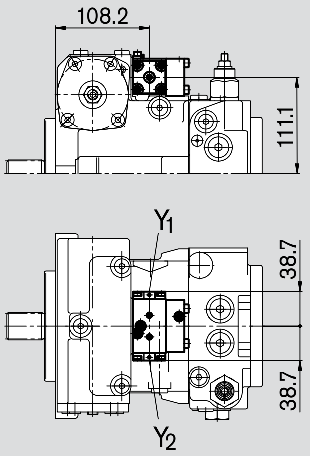
A, B	service line ports (high-pressure series)	SAE J518	3/4 in	
	fixing thread A/B	DIN 13	M10x1.5; 17 deep 2)	
T_1	case drain or fill	DIN 3852	M22x1.5; 14 deep	210 Nm 2)
T_2	case drain 3)	DIN 3852	M22x1.5; 14 deep	210 Nm 2)
M_A, M_B	pressure gauge - operating pressure A, B 3)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
R	air bleed 3)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
S	boost suction port	DIN 3852	M33x2; 18 deep	540 Nm 2)
X_1, X_2	ports for control pressure (before orifice) 3)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
G	pressure port for auxiliary circuits 3)	DIN 3852	M18x1.5; 12 deep	140 Nm 2)
P_S	control pressure supply, boost pressure 3)	DIN 3852	M14x1.5; 12 deep	80 Nm 2)
F_a	filter output 3)	DIN 3852	M18x1.5; 12 deep	140 Nm 2)
F_e	filter input 3)	DIN 3852	M18x1.5; 12 deep	140 Nm 2)
Y_1, Y_2	remote control ports (only HD)	DIN 3852	M14x1.5; 12 deep	80 Nm 2)
M_H	port for balanced high pressure3) (only with pressure cut-off)	DIN 3852	M12x1.5; 12 deep	50 Nm 2)
Z	pilot pressure port (only DA4/8) 3)	DIN 3852	M10x1; 8 deep	30 Nm 2)
Y	pilot pressure port (only DA7)	DIN 3852	M14x1.5; 12 deep	80 Nm 2)

1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Please observe the general notes for the max. tightening torques on 44
3) Plugged

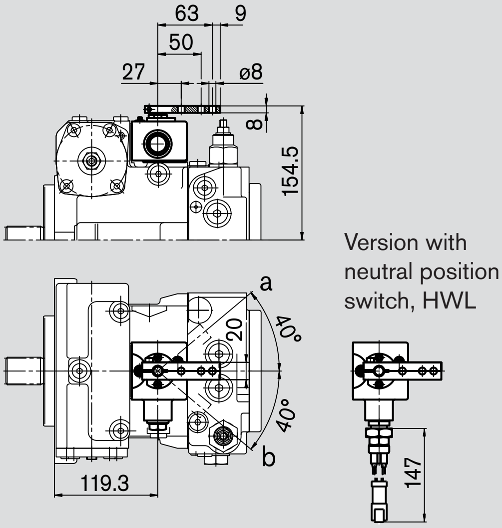
Unit Dimensions, Size 63

Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

Hydraulic control, pilot-pressure related, HD

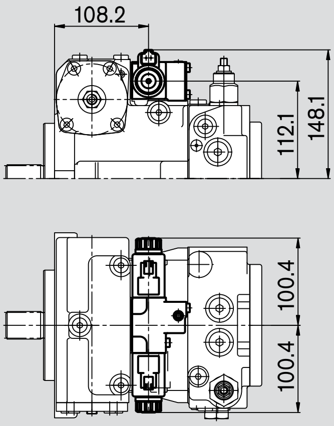


Hydraulic control, mechanical servo, HW

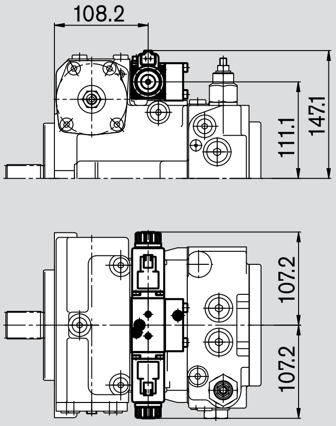


Version with neutral position switch, HWL

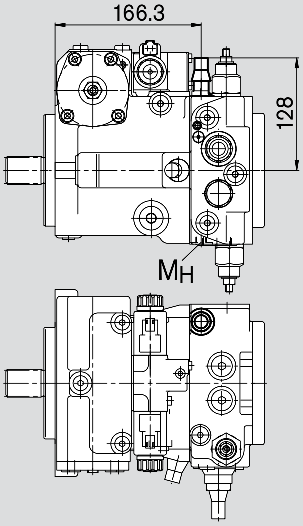
Electric two-position control with switching solenoid, EZ



Electric control with proportional solenoid, EP



Pressure cut-off, D

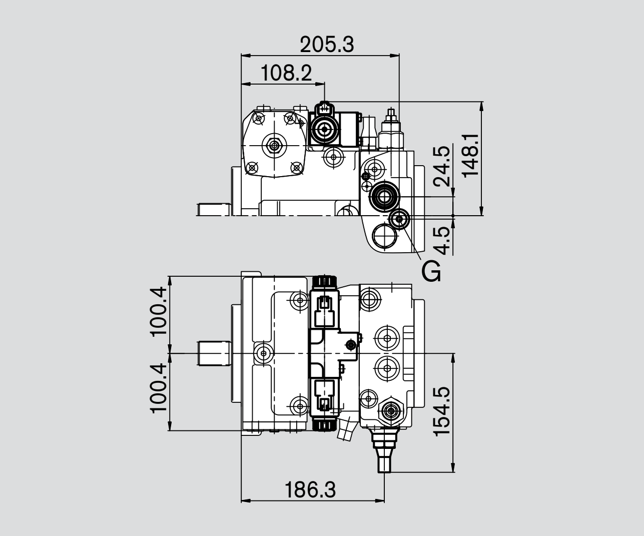


Unit Dimensions, Size 63

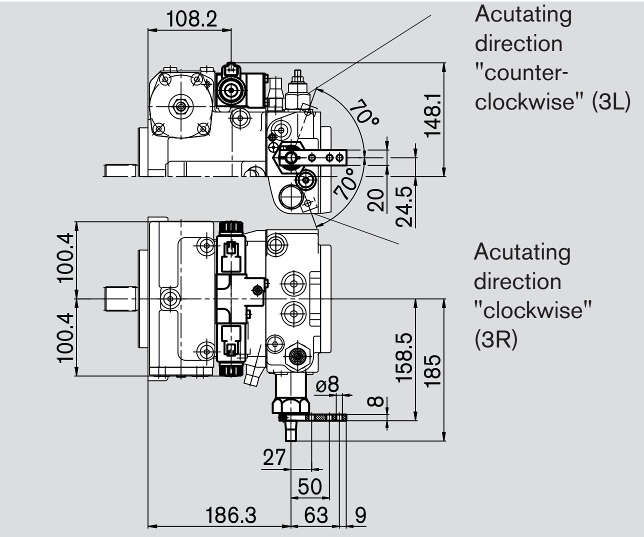
Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

Hydraulic control, speed related, DA

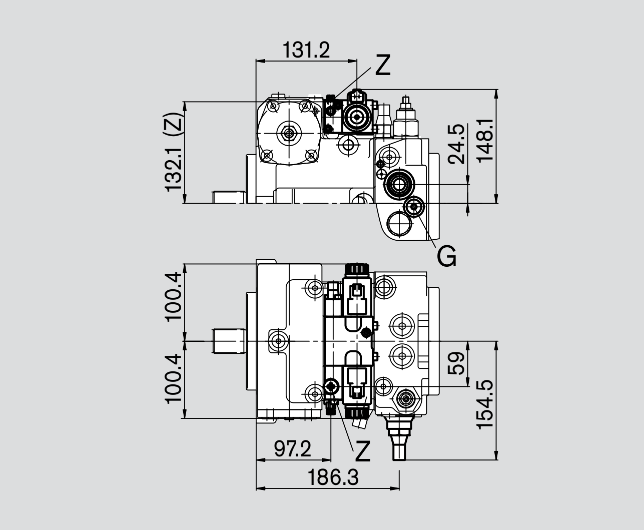
Control valve, fixed setting, DA2



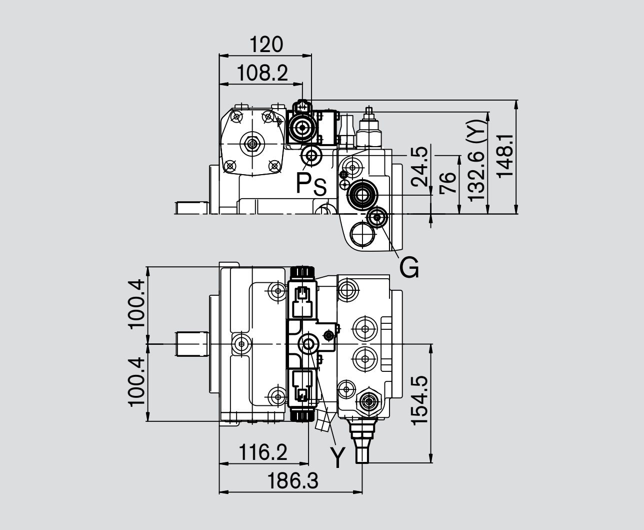
Control valve, mech. adjustable with position lever, DA3



Control valve, fixed setting and hydraulic inch valve mounted, DA4/DA8



Control valve, fixed setting and ports for pilot control device, DA7



Important:

Position and size of port G on version with DA control valve

G	DIN 3852	M14x1.5; 12 deep	80 Nm 1)

---

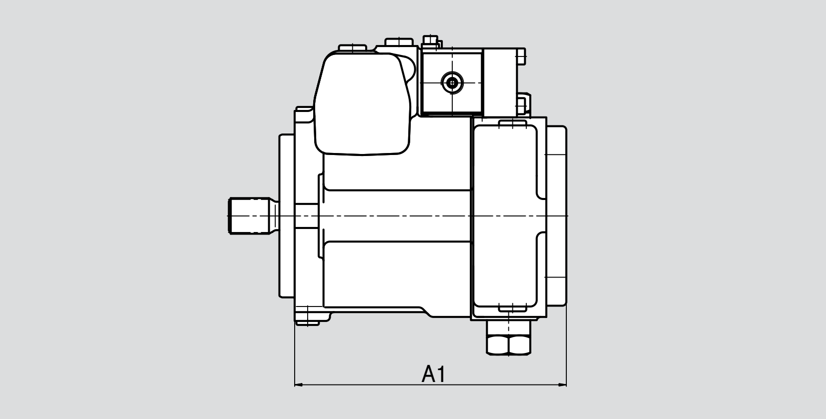
1) Please observe the general notes for the max. tightening torques on 44

Through Drive Dimensions

Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

N00 Without boost pump, without through drive

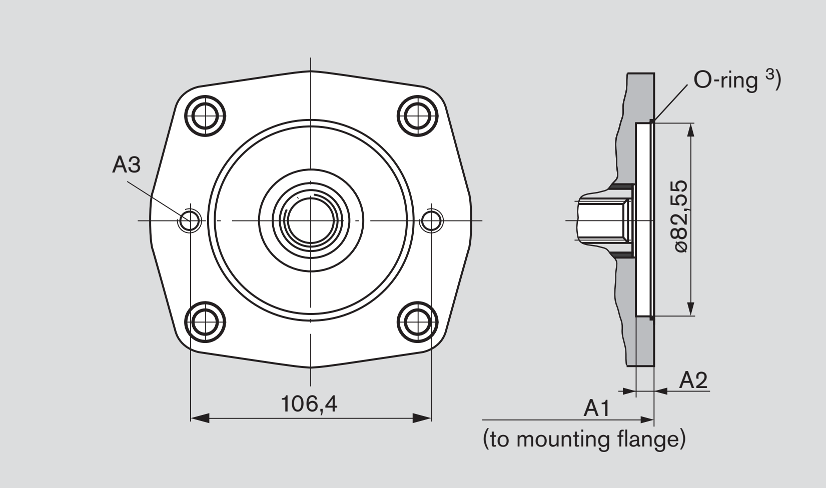
F00 With boost pump, without through drive



Size	A1 (N00)	A1 (F00)
18	169.4	169.4
28	201.7	215.3
45	216.8	230.5
63	224.5	238.2

F01/K01 **Flange** SAE J744 – 82-2 (A)

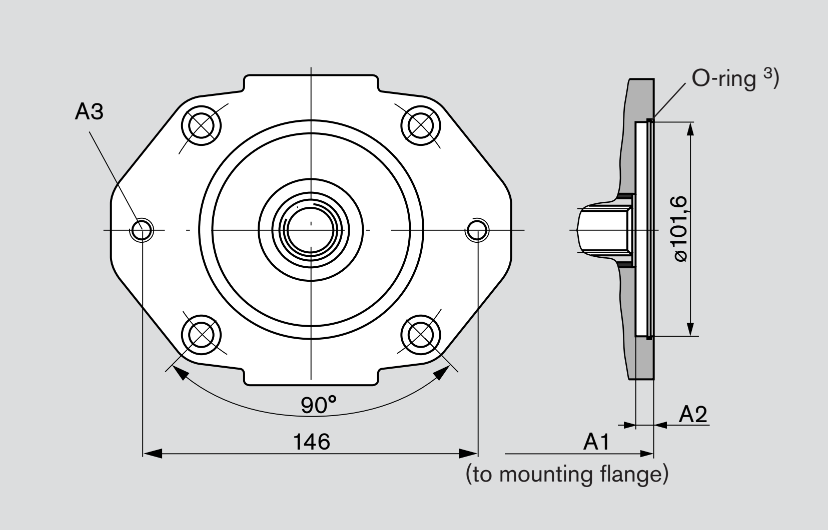
Hub for splined shaft according to ANSI B92.1a-1976 5/8in 9T 16/32DP 1) (SAE J744 – 16-4 (A))



Size	A1	A2	A3 2)
18	178.4	9	M10x1.5; 15 deep
28	219.2	9	M10x1.5; 17.5 deep
45	234.5	9	M10x1.5; 17.5 deep
63	242.2	9	M10x1.5; 17.5 deep

F02/K02 **Flange** SAE J744 – 101-2 (B)

Hub for splined shaft according to ANSI B92.1a-1976 7/8in 13T 16/32DP 1) (SAE J744 – 22-4 (B))



Size	A1	A2	A3 2)
18	187.4	10	M12x1.75; 18 deep
28	220.2	10	M12x1.75; 18.5 deep
45	235.5	10	M12x1.75; 18.5 deep
63	243.2	10	M12x1.75; 18.5 deep

1) 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread acc. to DIN 13, please observe the general notes for the max. tightening torques on 44

3) O-ring included in supply

Note: the mounting flange can be turned through 90°. Standard position is shown. Please state in plain text if required.

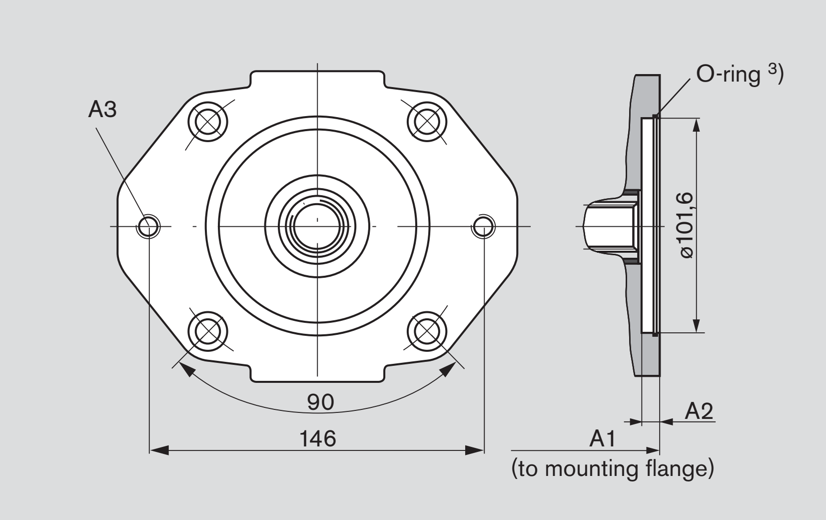
Through Drive Dimensions

Before finalizing your design, please request a binding installation drawing. Dimensions in mm.

F04/K04

Flange SAE J744 – 101-2 (B)

Hub for splined shaft according to ANSI B92.1a-1976 1in 15T 16/32DP [1] (SAE J744 – 25-4 (B-B))

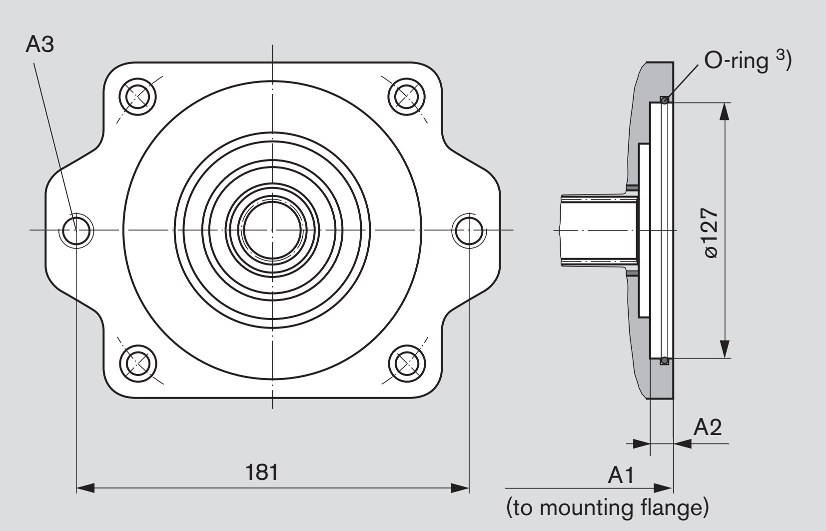


Size	A1	A2	A3 [2]
28	220.2	10	M12x1.75; 18.5 deep
45	235.5	10	M12x1.75; 18.5 deep
63	243.2	10	M12x1.75; 18.5 deep

F07/K07

Flange SAE J744 – 127-2 (C)

Hub for splined shaft according to ANSI B92.1a-1976 1 1/4in 14T 12/24DP [1] (SAE J744 – 32-4 (C))



Size	A1	A2	A3 [2]
63	249.5	14	M16x2; 24.8 deep

[1] 30° pressure angle, flat root, side fit, tolerance class 5
[2] Thread acc. to DIN 13, please observe the general notes for the max. tightening torques on 44
[3] O-ring included in supply

Note: the mounting flange can be turned through 90°. Standard position is shown. Please state in plain text if required.

Overview of Attachments on A10VG

Through drive – A10VG										**Through drive**
Flange	Hub for splined shaft	Code	A10VG Size (shaft)	A4VG Size (shaft)	A10V(S)O/31 Size (shaft)	A10V(S)O/53 Size (shaft)	A4FO Size (shaft)	A11VO Size (shaft)	External gear pump	Available for size
82-2 (A)	5/8 in	**F/K01**	–	–	18 (U)	10 (U)	–	–	size F size 4-22 1)	18...63
101-2 (B)	7/8 in	**F/K02**	18 (S)	–	28 (S,R)	28 (S,R)	16 (S) 22 (S)	–	Size N size 20-32 1)	18...63
					45 (U)	45 (U,W)	28 (S)		Size G size 38-45 1)	
	1 in	**F/K04**	28 (S) 45 (S)	28 (S)	45 (S,R)	45 (S,R) 60 (U,W)	–	40 (S)	–	28...63
127-2 (C)	1 1/4 in	**F/K07**	63 (S)	40 (S), 56 (S) 71 (S)	71 (S,R) 100 (U)	85 (U)	–	60 (S)	–	63

1) Rexroth recommends special gear pump versions. Please contact us.

Combination Pumps A10VG + A10VG

Overall length A

A10VG (1st pump)	**A10VG (2nd pump) 1)** **Size 18**	**Size 28**	**Size 45**	**Size 63**
Size 18	356.8	–	–	–
Size 28	389.6	435.5	–	–
Size 45	404.9	450.8	466.0	–
Size 63	412.6	458.5	473.7	487.7

1) 2nd pump without through drive and with boost pump, F00

Combination pumps make it possible to have independent circuits without the need to fit splitter gearboxes.

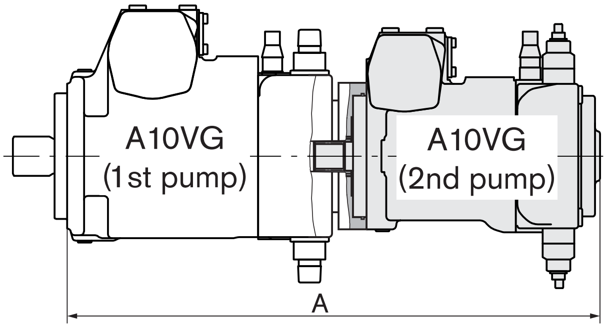
When ordering combination pumps, the type designations of the 1st and 2nd pumps must be linked by a "+".

Example of order:

A10VG45HW1/10R-NTC10F04 + A10VG45HW1/10R-NSC10F00

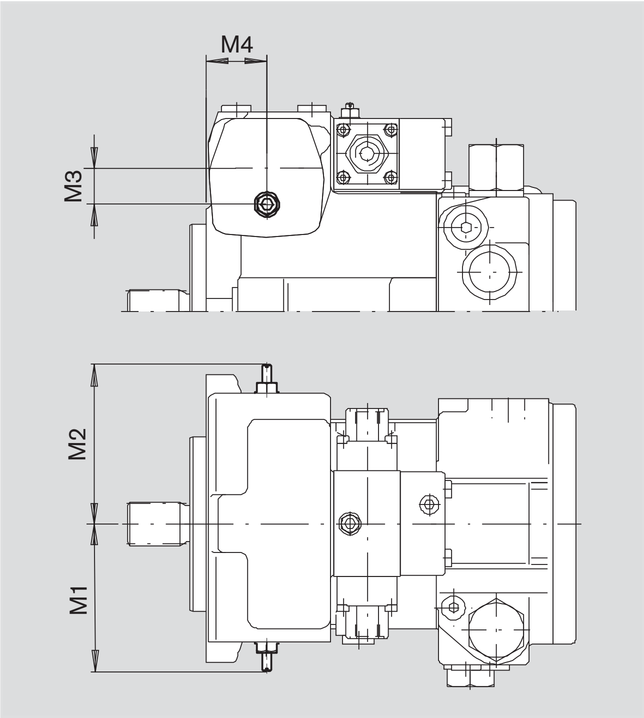
A tandem pump combined of two equal sizes is permissible without additional supports where the dynamic acceleration does not exceed max. 10*g* (= 98.1 m/s^2).

For combination pumps consisting of more than two pumps, the mounting flange must be rated for the permissible mass torque.



Mechanical Stroke Limiter, M

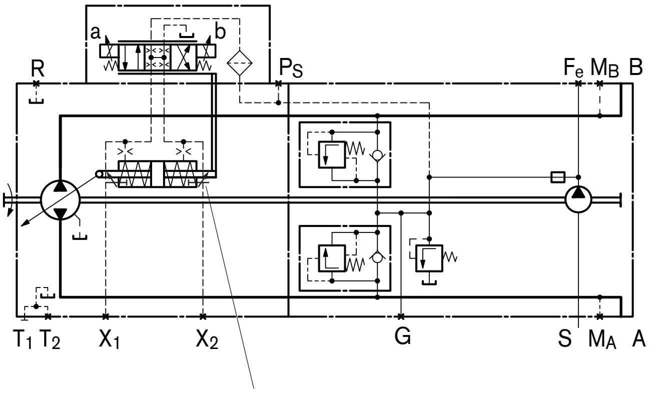
The mechanical stroke limiter is an additional function allowing continuous reduction of the maximum displacement of the pump, regardless of the control unit used.
The stroke of the stroke cylinder and hence the maximum swivel angle of the pump are limited by means of two adjusting screws.



Dimensions

Size	M1	M2	M3	M4
18	94.9	96.9	18	42.1
28	99	99	21.5	35
45	101.6	101.6	22.5	35.5
63	124	124	26.5	43

Circuit diagram



Mechanical stroke limiter, M

Filtration Types

Standard: Filtration in the suction line of the boost pump, S

Standard version (preferred)

Filter type: filter **without** bypass

Recommendation: **with** contamination indicator

Flow resistance at the filter element:

at $\nu = 30\ \text{mm}^2/\text{s}$, $n = n_{max}$ $\Delta p \le 0.1$ bar

at $\nu = 1000\ \text{mm}^2/\text{s}$, $n = n_{max}$ $\Delta p \le 0.3$ bar

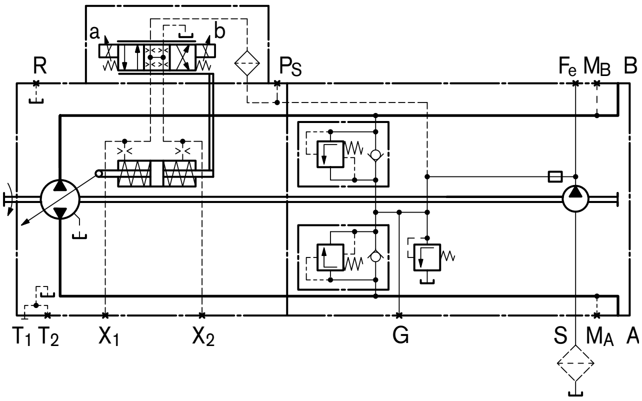
Pressure at port S of the boost pump:

at $\nu = 30\ \text{mm}^2/\text{s}$ $p \ge 0.8$ bar

at cold start ($\nu = 1600\ \text{mm}^2/\text{s}$, $n \le 1000$ rpm) $p \ge 0.5$ bar

Filter is not included in supply.

Circuit diagram - standard version S



Variation: External supply, E

This variation should be used in versions **without** integral boost pump (N00 or K..).

The supply is provided as follows:

Size 18 port S

Size 28, 45 (without DA control valve) port G

Sizes 28, 45 (with DA control valve) port Fe

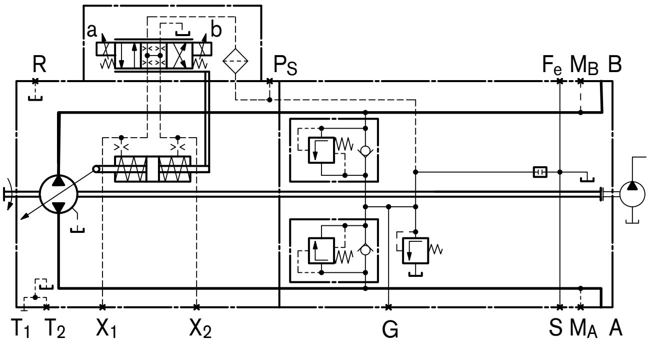
Size 63 port F_a

With size 28, 45 and 63, port S is closed.

Filter arrangement: separate

For functional reliability ensure required cleanliness level for the boost pressure fluid (see page 6).

Circuit diagram variation E (external supply)



Variation:
Filtration in the pressure line of the boost pump, ports for external boost circuit filter, D

Filter input:		Port F_e
Filter output:	Size 63	Port F_a
	Size 28, 45	Port G (F_a)
Filter type:	Filter with bypass are **not recommended**. When applying with bypass please consult us.	

Recommendation: **with** contamination indicator

Note:

- In conjunction with a DA control valve, no pressure filtration is possible with size 28, 45 (refer to ordering code, page 4).
- With sizes 28, 45, port G serves as “filter output F_a”.

Note:
For versions with **DG** control (with pilot pressure not from boost circuit), the following filter type should be employed:

Filter **with** bypass and **with** contamination indicator

Filter arrangement: separately in the pressure line (line filter)

Flow resistance at the filter element:

at $\nu = 30\ \text{mm}^2/\text{s}$ $\Delta p \le 1$ bar

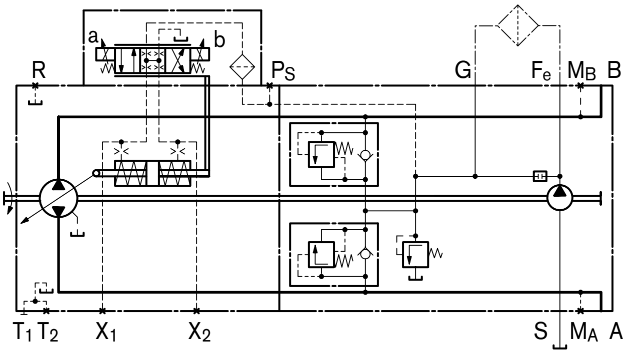
for cold start $\Delta p \le 3$ bar

(valid for entire speed range $n_{min} - n_{max}$)

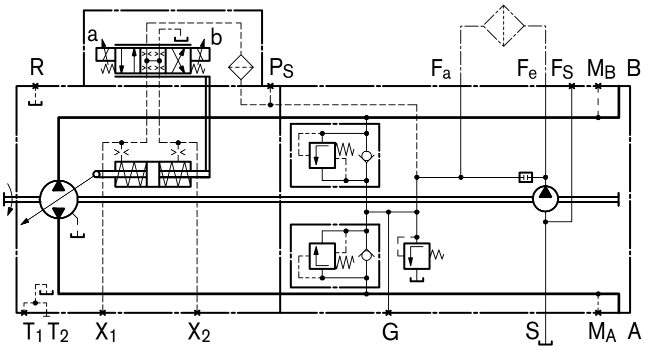
Filter is not included in supply.

Circuit diagram variation D

Size 28, 45



Size 63



Connector for Solenoids (Only for EP, EZ, DA)

DEUTSCH DT04-2P-EP04, 2-pin

Molded, without bi-directional suppressor diode (standard) _P

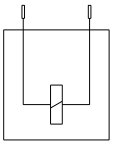
Molded, with bi-directional suppressor diode
(only for switching solenoids on control unit EZ1/2, DA) ____Q

Type of protection according to DIN/EN 60529: IP67 and IP69K

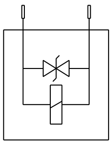
The protection circuit with a bi-directional suppressor diode is necessary for limiting overvoltages. Overvoltages are generated by disconnecting the current using switches, relay contacts or by unplugging an energized mating connector.

Circuit symbol

without bi-directional
suppressor diode



with bi-directional
suppressor diode

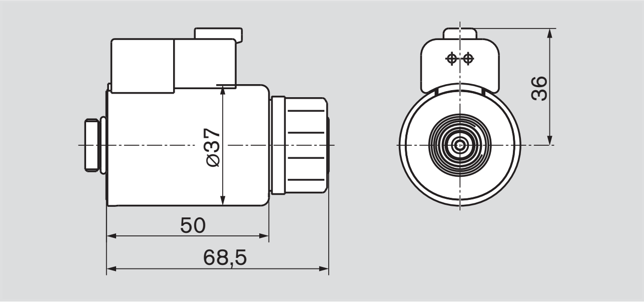


Mating connector

DEUTSCH DT06-2S-EP04
Rexroth Mat. No. R902601804

consisting of:	DT designation
– 1 case	DT06-2S-EP04
– 1 wedge	W2S
– 2 sockets	0462-201-16141

The mating connector is not included in supply.
This can be supplied by Rexroth on request.



Note for round solenoids:

The position of the connector can be changed by turning the solenoid body.

Proceed as follows:

1. Loosen the fixing nut (1)
2. Turn the solenoid body (2) to the desired position
3. Tighten the fixing nut
   Tightening torque of the fixing nut: 5^{+1} Nm
   (width across flats WAF26, 12-sided DIN 3124)

Rotary Inch Valve

The rotary inch valve permits the control pressure to be reduced, independent from the drive speed through the mechanical operation of the actuating lever. Maximum rotation angle 90°. The lever may be fixed in any position.

The valve is mounted separately from the pump and connected with a pump by the hydraulic control line at port P_S (max. line length approximately 2 meters).

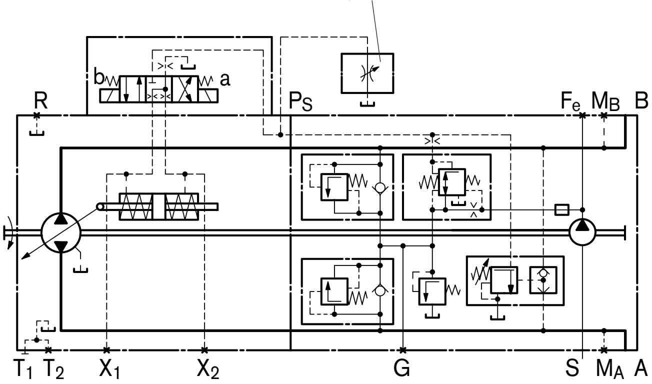
The rotary inch valve must be ordered separately.

Size	Material no.	Direction of actuation of position lever
18, 28, 45, 63	R902048734 R902048735	clockwise counter-clockwise

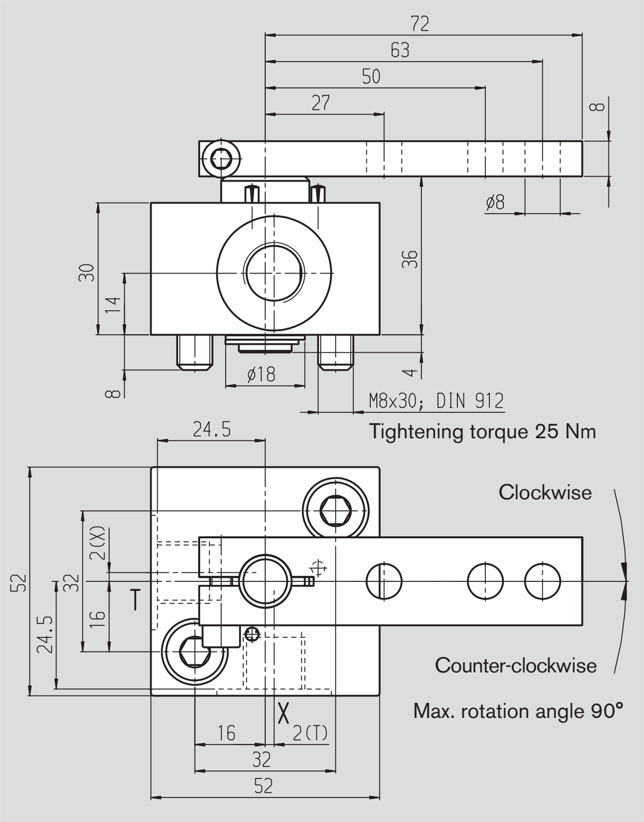
Attention:
The rotary inch valve can be used independently from the control unit.

Circuit diagram:
hydraulic control, speed related, DA
with separate rotary inching valve

Rotary inch valve (see material no.)



Unit dimensions



Ports

X	pressure port DIN 3852	M14x1.5; 12 deep	80 Nm 1)
T	drain tank DIN 3852	M14x1.5; 12 deep	80 Nm 1)

1) Please observe the general notes for the max. tightening torques on page 44

Installation Situation for Coupling Assembly

To ensure that rotating components (coupling hub) and fixed components (case, retaining ring) do not come into contact with each other, the installation conditions described here must be observed. This depends on the size and the splined shaft.

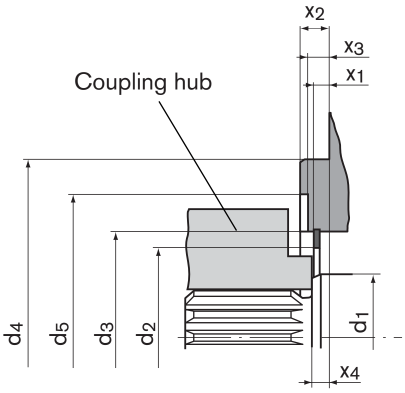
Size 18...45 (with free turning):

– Please observe diameter of the free turning.

Size 63 (without free turning):

– The outer diameter of the coupling hub must be smaller than the inner diameter of the retaining ring $\mathbf{d}_2$ in the zone of the drive shaft collar (dimension $x_2 - x_4$).

SAE splined shaft (spline acc. to ANSI B92.1a-1976)



Size	ød$_1$	ød$_{2\ min}$	ød$_3$	ød$_4$	ød$_5$	x$_1$	x$_2$	x$_3$	x$_4$
18	30	36.1	49 ±0.1	101.6	65	$5.9^{+0.2}$	$9.5_{-0.5}$	7	$8^{+0.9}_{-0.6}$
28	(35)	43.4	55 ±0.1	101.6	72	$3.9^{+0.2}$	$9.5_{-0.5}$	7	$8^{+0.9}_{-0.6}$
45	40	51.4	63 ±0.1	101.6	80	$4.3^{+0.2}$	$9.5_{-0.5}$	7	$8^{+0.9}_{-0.6}$
63	40	54.4	68 ±0.1	127	–	$7.0^{+0.2}$	$12.7_{-0.5}$	–	$8^{+0.9}_{-0.6}$

Installation Notes

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This is also to be observed following a relatively long standstill as the system may empty via the hydraulic lines.

The pump case drain connection (i.e. T_1/T_2) must be directed to the tank via the highest case drain port. The minimum suction pressure at port S must not fall below 0.8 bar abs. (cold start 0.5 bar absolute).

In all operating states, the suction line and case drain line must flow into the tank below the minimum fluid level.

Installation position

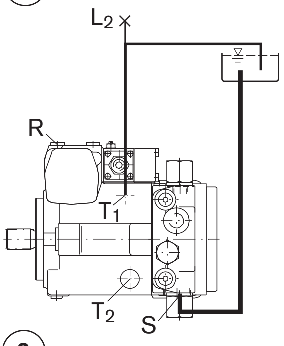
See examples below. Additional installation positions are available upon request.

Below-tank installation (standard)

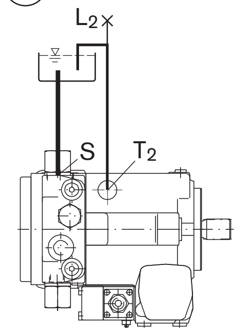
Pump below the minimum fluid level of the tank.

Recommended installation positions: 1 and 2.

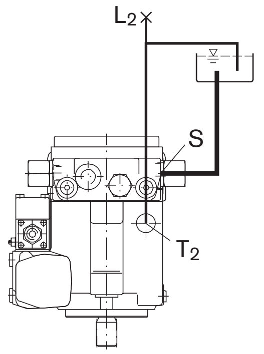
①



②



③



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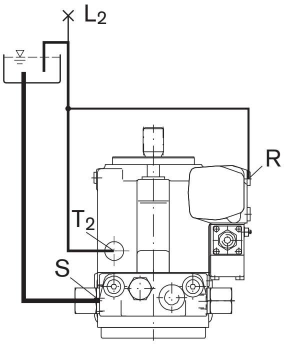


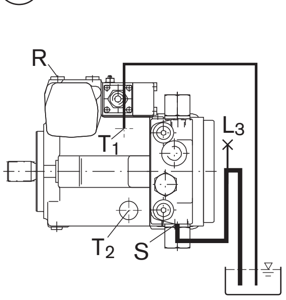
Installation position	Air bleeding	Filling
1	R	$S + T_1\ (L_2)$
2	L_2	$S + T_2\ (L_2)$
3	L_2	$S + T_2\ (L_2)$
4	$R + L_2$	$S + T_2\ (L_2)$

Above-tank installation

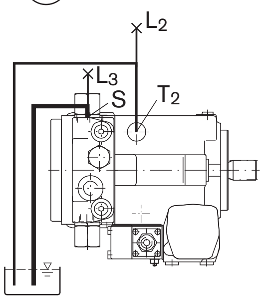
Pump above the min. fluid level of the tank

Observe the maximum permissible suction height $h_{max} = 800$ mm.
Recommendation for installation position 8 (shaft upwards):
A check valve in the case drain line (opening pressure 0.5 bar) can prevent draining of the case interior.

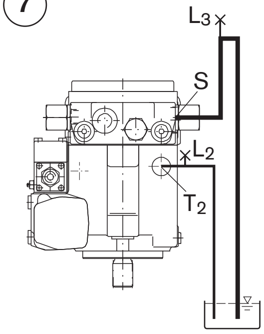
⑤



⑥



⑦



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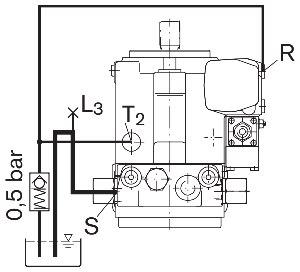


Installation position	Air bleeding	Filling
5	R	$T_1 + (L_3)$
6	L_2	$S\ (L_3) + T_2\ (L_2)$
7	$L_2 + L_3$	$S\ (L_3) + T_2\ (L_2)$
8	$R + L_3$	$S\ (L_3) + T_2$

Notice

General Notes

– The A10VG pump is designed to be used in closed circuits.

– Project planning, assembly and commissioning of the pump require the involvement of qualified personnel.

– The service line ports and function ports are only designed to accommodate hydraulic lines.

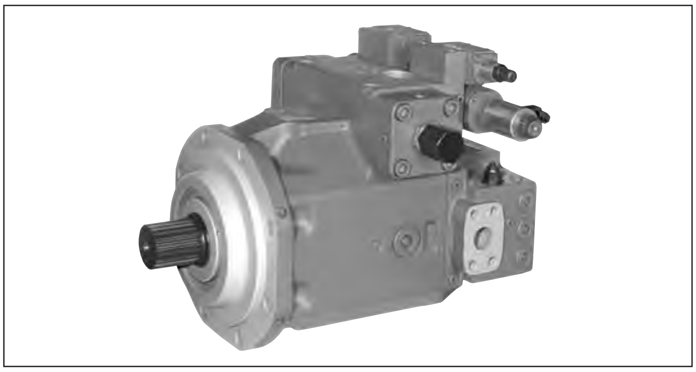
– During and shortly after operation, there is a risk of burns on the pump and especially on the solenoids. Take suitable safety precautions, e.g. wear protective clothing

– There may be shifts in the characteristic depending on the operating state of the pump (operating pressure, fluid temperature).

– Tightening torques:
  - The tightening torques specified in this data sheet are maximum values and must not be exceeded
    (maximum values for screw thread).
    Manufacturer´s instruction for the max. permissible tightening torques of the used fittings must be observed!
  - For DIN 13 fixing screws, we recommend checking the tightening torque individually according to VDI 2230 Edition 2003.

– The data and information contained herein must be adhered to.

Axial piston variable pump A4CSG Series 3x



- Sizes 250 to 750
- Nominal pressure 350 bar
- Maximum pressure 400 bar
- Closed circuit

Features

- Variable pump in axial piston swashplate design for hydrostatic drives in closed circuit.
- The flow is proportional to the drive speed and displacement.
- By controlling the swashplate angle, infinitely variable flow is possible.
- The boost pump required for closed-circuit operation and the corresponding valve technology are integrated in the pump.
- The integrated boost pump acts as a feed pump and pilot pressure supply.
- Compact design with extremely short installation length
- Favorable power/weight ratio
- Low noise level
- Long service life
- High efficiency
- Electrohydraulic proportional control with neutral position in the event of a power failure
- Through drive and pump combination also possible with integrated boost pump
- For descriptions of the control devices, please refer to separate data sheets 92076, 92080, 92084.

Contents

Type code for standard program

01	02	03	04		05	06		07	08	09	10	11	12	13	14
A4CS	G			/			–	V			35				

Axial piston unit

01	Swashplate design, variable, nominal pressure 350 bar, maximum pressure 400 bar	**A4CS**

Operating mode

02	Pump, closed circuit	**G**

Size

03	Geometric displacement, see technical data on page 7	**250**	**355**	**500**	**750**

Control device

04	Control system hydraulic	with control valve	see 92076	●	●	●	○	**HS4**
		with proportional valve		○	●	●	○	**EO2**
	Proportional control	hydraulic control, pilot-pressure related	see 92080	●	●	●	●	**HD..**
		electrohydraulic	see 92084	●	●	●	●	**EP..**

Series

05	Standard version	●	●	●	●	**30**
	Efficiency-optimized version	○	○	●	○	**33**

Directions of rotation

06	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Sealing material

		250	355	500	750	
07	FKM (fluoroelastomer)	●	●	●	●	**V**
	NBR (nitrile rubber), shaft seal made of FKM (fluoroelastomer)	○	○	○	○	**P**

Drive shaft

		250	355	500	750	
08	Parallel keyed shaft DIN 6885	●	●	●	●	**P**
	Splined shaft DIN 5480	●	●	●	●	**Z**

Mounting flange

			250	355	500	750	
09	Based on ISO 3019-2 (metric)	4-hole	●	●	–	–	**B**
		8-hole	–	–	●	●	**H**

Working port

10	SAE flange ports A and B, positioned laterally opposite each other, metric fastening thread SAE flange port S, positioned laterally offset from A and B by 90°, metric fastening thread	**35**

Boost pump

11	With integrated boost pump	●	●	●	●	**F**
	Without integrated boost pump	●	●	●	●	**K**

● = Available ○ = On request – = Not available

Notice

- ▶ Note the project planning notes on page 36!

01	02	03	04		05	06		07	08	09	10	11	12	13	14
A4CS	**G**			**/**			**–**	**V**			**35**				

Through drive (for mounting options, see page 23)

			250	355	500	750	
12	With through-drive shaft, without hub, without intermediate flange, closed with cover		●	●	●	●	**99**
	With through drive for mounting a second unit						
	Flange ISO 3019-2 (metric)	Hub for splined shaft DIN 5480					
	125, 4-hole	W32×2×14x9 g	○	●	●	○	**31**
	140, 4-hole	W40×2×18x9 g	○	○	●	○	**33**
	160, 4-hole	W50×2×24x9 g	●	●	●	●	**34**
	224, 4-hole	W60×2×28x9 g	●	○	●	○	**35**
	224, 4-hole	W70×3×22x9 g	–	●	●	○	**77**
	315, 8-hole	W80×3×25x9 g	–	–	●	○	**43**
	400, 8-hole	W90×3×28x9 g	–	–	–	○	**76**
	Flange ISO 3019-2 (metric)	Hub for splined shaft SAE J744					
	80, 2-hole	3/4 in (19-4)	○	○	○	○	**B2**
	100, 2-hole	7/8 in (22-4)	●	●	○	○	**B3**
	100, 2-hole	1 in (25-4)	○	○	○	○	**B4**
	125, 4-hole	1 in (25-4)	○	○	○	○	**E1**
	125, 2-hole	1 1/4 in (32-4)	●	●	○	○	**B5**
	160, 4-hole	1 1/4 in (32-4)	○	○	○	○	**B8**
	125, 2-hole	1 1/2 in (38-4)	○	●	○	○	**B6**
	180, 4-hole	1 1/2 in (38-4)	○	○	○	○	**B9**
	180, 4-hole	1 3/4 in (44-4)	○	○	○	○	**B7**
	Flange SAE J744	Hub for splined shaft SAE J744					
	82-2 (A)	5/8 in (16-4)	●	●	●	●	**01**
	82-2 (A)	3/4 in (19-4)	○	●	●	○	**52**
	101-2 (B)	7/8 in (22-4)	●	●	●	○	**68**
	101-2 (B)	1 in (25-4)	○	●	●	○	**04**
	127-2 (C)	1 1/4 in (32-4)	●	●	●	○	**07**
	127-4 (C)	1 1/4 in (32-4)	○	○	○	○	**15**
	127-2 (C)	1 1/2 in (38-4)	●	●	●	○	**24**
	152-4 (D)	1 3/4 in (44-4)	●	●	●	●	**17**

Valves

		250	355	500	750	
13	Boost, control pressure relief and flushing valve integrated; direct operated high-pressure relief valve integrated	○	○	○	○	**3**
	Boost, control pressure relief and flushing valve integrated; pilot-operated high-pressure relief valve integrated	●	●	●	●	**4**

Filtration (see page 31)

		250	355	500	750	
14	Without filter	●	●	●	●	**N**
	With threaded port for filter in the boost circuit	●	●	●	●	**D**
	With mounted filter (optical/electrical contamination indicator) in the boost circuit	●	●	●	●	**M**
	With threaded port for filter in the boost circuit (D) and intermediate plate filter for HS control (see data sheet 92076)	○	●	–	–	**Z**
	With mounted filter in the boost circuit (M) and intermediate plate filter for HS control (see data sheet 92076)	○	○	–	–	**U**

● = Available ○ = On request – = Not available

Hydraulic fluids

The A4CSG variable pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets prior to project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids

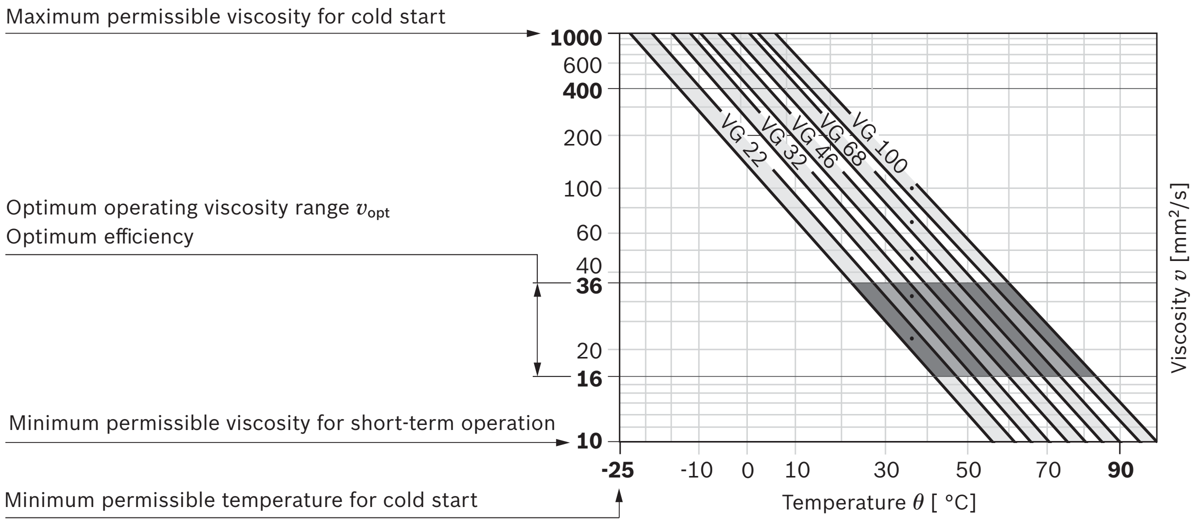
Notes on selection of hydraulic fluid
The hydraulic fluid should be selected so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}, see selection diagram).

Note
At no point on the component may the temperature be higher than 90 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \leq 1000\ mm^2/s$	$\theta_{St} \geq -25$ °C	$t \leq 3$ min, without load $p \leq 50$ bar
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid in the system
Warm-up phase	$\nu = 1000$ to $100\ mm^2/s$	$\theta \geq -25$ °C	at p_{nom}, $0.5 \times n_{max}$ and $t \leq 15$ min
Continuous operation	$\nu = 100$ to $16\ mm^2/s$	$\theta = -25$ °C to $+90$ °C	Note the permissible temperature range of the shaft seal measured at the drain port
	$\nu_{opt} = 36$ to $16\ mm^2/s$		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \leq 10\ mm^2/s$	$\theta_{max} = +90$ °C	$t < 3$ min, $p < 0.3 \times p_{nom}$

▼ **Selection diagram**



Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.
A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.
Depending on the system and application, we recommend for the A4CSG filter cartridges $\beta_{20} \geq 100$.

A "threaded port for filter in the boost circuit" is optionally available with order designation **D** or "a filter mounted in the boost circuit" with order designation **M**. For a description, see pages 31 to 32.

Bearing flushing

For the following operating conditions bearing flushing is required for a safe, continuous operation:

- Applications with special fluids (not mineral fluids) due to limited lubricity and narrow operating temperature range
- Operation with borderline conditions for temperature and viscosity during operation with mineral oil

With vertical installation (drive shaft upwards), bearing flushing is recommended for lubricating the front bearing and the shaft seal, otherwise a reduced service life of the shaft seal is to be expected.
Bearing flushing is realized at port "**U**" in the area of the front flange of the variable pump. The flushing fluid flows through the front bearing and discharges with the pump drain at the drain port.
Depending on the individual sizes, the following flushing flows are recommended:

Size			250	355	500	750
recommended flushing flow	q_{sp}	L/min	10	15	20	30

For the flushing flows stated, there is a pressure differential of approximately 3 bar between the port "**U**" (including fitting) and the housing area.

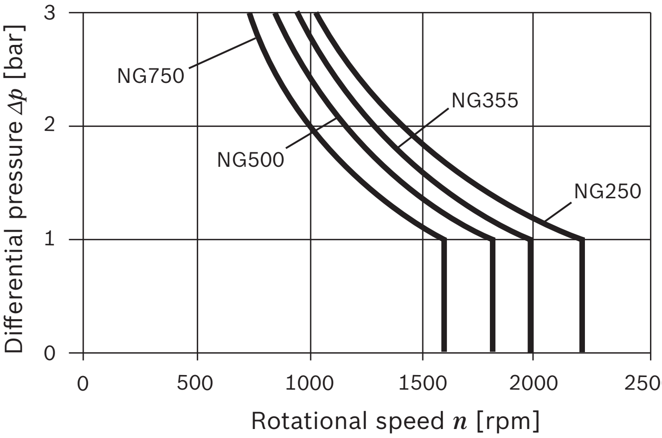
Note on bearing flushing

When using bearing flushing on port **U**, the throttle screw in port **U** must be turned in to the end stop.

Shaft seal

Permissible pressure load

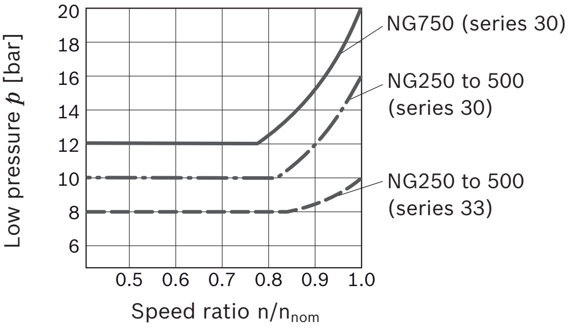
The service life of the shaft seal ring is affected by the rotational speed of the axial piston unit and the leakage pressure (case pressure). Momentary (t < 0.1 s) pressure peaks of up to 10 bar are permitted. The service life of the shaft seal decreases with an increase in the frequency of pressure peaks and an increase in the mean differential pressure.
The pressure in the case must be equal to or greater than the ambient pressure.



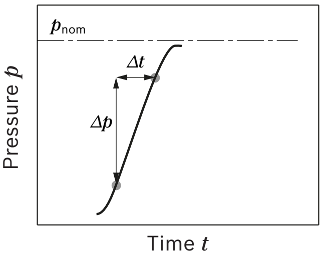
Working pressure range

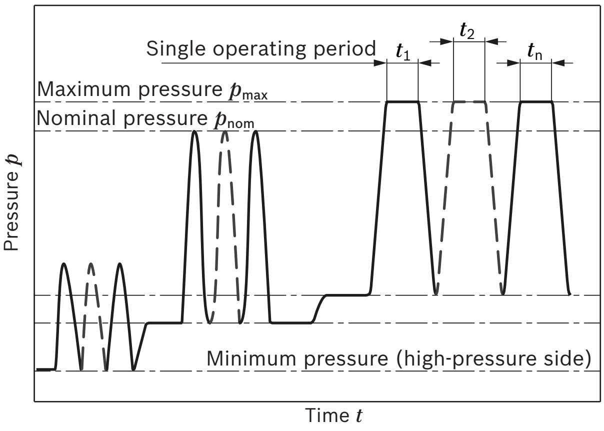
Pressure at working ports A or B			Definition	
Nominal pressure p_{nom}		350 bar	The nominal pressure corresponds to the maximum design pressure.	
Maximum pressure p_{max}		400 bar	The maximum pressure corresponds to the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.	
Single operating period		1 s		
Total operating period		300 h		
Minimum pressure (high-pressure side)		15 bar	Minimum pressure at the high-pressure side (A or B) which is required to prevent damage to the axial piston unit.	
Minimum pressure (low-pressure side)		Speed related (see diagram)	Minimum pressure at the low-pressure side (A or B) which is required in order to prevent damage to the axial piston unit. Boost pressure setting must be higher depending on system. The low pressure is present at port **MK4** with the flushing slide deflected.	
Rate of pressure change $R_{A\ max}$		16000 bar/s	Maximum permissible speed of pressure build-up and reduction during a pressure change across the entire pressure range.	
Boost pressure at port E – without integrated boost pump version K..				
Recommended boost pressure p_{Sp}		16 bar	NG250 to 500 series 30	Short-term for setting operations: Measuring port **MK4** (Please contact us for coupled multiple systems)
		20 bar	NG750 series 30	
		10 bar	NG250 to 500 series 33	
Minimum static boost pressure $p_{Sp\ min}$		8 bar		
Maximum static boost pressure $p_{Sp\ max}$		30 bar		
Permissible pressure peaks in boost pressure	minimum	4 bar		
	maximum	40 bar		
Suction pressure at suction port S with integrated boost pump version F..				
Minimum pressure $p_{S\ min}$		≥ 0.8 bar absolute	Minimum pressure at suction port S (inlet) that is required in order to avoid damage to the axial piston unit.	
Maximum pressure $p_{S\ max}$		30 bar absolute		
Control pressure for EP and HD control.				
Minimum required control pressure $p_{Sr\ min}$		double boost pressure at NG 355 +5 bar	Measuring port **M1** (small stroking chamber)	

▼ **Required low pressure depending on the speed ratio**



▼ **Rate of pressure change**





Total operating period = $t_1 + t_2 + \ldots + t_n$

Notice

Working pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical data

Size		NG		250	355	500	750
Displacement, geometric, per revolution	Variable pump	$V_{g\,max}$	cm³	250	355	500	750
	Integrated boost pump	$V_{g\,Sp}$	cm³	63	80	98	143
Rotational speed[1]	maximum at $V_{g\,max}$	n_{nom}	rpm	2200	2000	1800	1600
	minimal[2]	n_{min}	rpm	800	800	800	800
Flow (variable pump) at $V_{g\,max}$ and	n_{max}	q_v	L/min	550	710	900	1200
	n_E = 1500 rpm	q_{VE}	L/min	375	533	750	1125
Power[3] at $V_{g\,max}$, Δp = 350 bar and	n_{max}	P	kW	321	414	525	700
	n_E = 1500 rpm	P_E	kW	219	311	438	656
Torque[3] at $V_{g\,max}$ and	Δp = 350 bar	T	Nm	1391	1976	2783	4174
	Δp = 100 bar	T	Nm	398	564	795	1193
Rotary stiffness of drive shaft	P	c	kNm/rad	527	800	1145	1860
	Z	c	kNm/rad	543	770	1209	1812
Moment of inertia for rotary group		J_{TW}	kgm²	0.0959	0.19	0.3325	0.66
Maximum angular acceleration[4]		α	rad/s²	775	600	540	400
Case volume		V	L	10	8	14	19
Weight (pump with EP control and integrated boost pump without filter) approx.		m	kg	260	275	390	520

Determining the characteristics		
Flow	$q_v = \dfrac{V_g \cdot n \cdot \eta_v}{1000}$	[l/min]
Torque	$T = \dfrac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}}$	[Nm]
Power	$P = \dfrac{2\,\pi \cdot T \cdot n}{60000} = \dfrac{q_v \cdot \Delta p}{600 \cdot \eta_t}$	[kW]

Key

V_g = Displacement per revolution [cm³]

Δp = Differential pressure [bar]

n = Rotational speed [rpm]

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

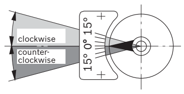
Notice

- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommends testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.

Flow direction

Direction of rotation		Swiveling range*
clockwise	counter-clockwise	
B to A	A to B	clockwise
A to B	B to A	counter-clockwise

* cf. swivel angle indicator



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1) The values are applicable:
   - – for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s
   - – for hydraulic fluid based on mineral oils

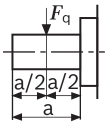
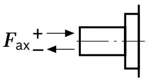
2) Lower values on request

3) Without boost pump

4) The data are valid for values between the minimum required and maximum permissible rotational speed.
   Valid for external excitation (e.g. diesel engine 2 to 8 times rotary frequency, cardan shaft twice the rotary frequency).
   The limit value is only valid for a single pump.
   The load capacity of the connecting parts must be considered.

Working pressure range

Permissible radial and axial forces of the drive shafts

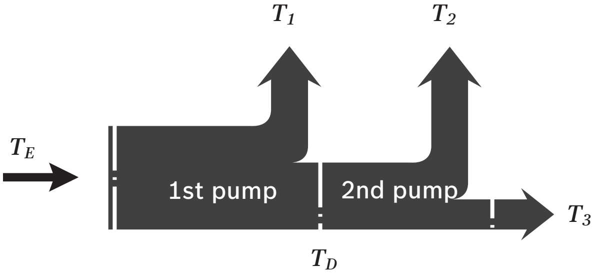
Size		NG		250	355	500	750
Drive shaft							
Maximum radial force at X/2		$F_{q\ max}$	N	2000	2200	2500	3000
Maximum axial force		$+ F_{ax\ max}$	N	1800	2000	2000	2000
		$– F_{ax\ max}$	N				

Note
Special requirements apply in the case of belt drives.
Please contact us.

Permissible input and through-drive torques

Size		NG		250	355	500	750
Torque at $V_{g\ max}$ and Δp = 350 bar[1]		T_{max}	Nm	1391	1976	2783	4174
Maximum input torque at drive shaft[2]							
	Splined shaft Z	$T_{E\ max}$	Nm	2782	3952	5566	8348
	Shaft key P	$T_{E\ max}$	Nm	2300	3557	5200	7513
Maximum through-drive torque				$T_{D\ max} = T_{E\ max}$			

Distribution of torques



Torque at 1st pump	T_1		
Torque at 2nd pump	T_2		
Torque at 3rd pump	T_3		
Input torque	T_E	=	$T_1 + T_2 + T_3$
	T_E	<	$T_{E\ max}$
Through-drive torque	T_D	=	$T_2 + T_3$
	T_D	<	$T_{D\ max}$

---

1) Efficiency not considered

2) For drive shafts free of radial force

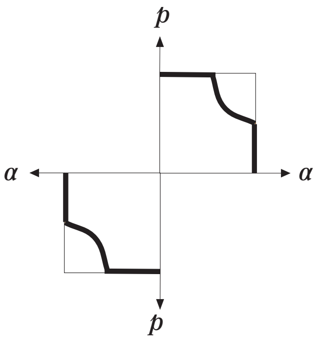
Overview of control devices

HS4 – control system, hydraulic with proportional valve
(see data sheet 92076)
The stepless displacement control is accomplished by means of a proportional valve and electrical feedback of the swivel angle.
The HS4**P** control system is equipped with mounted pressure transducers, which means that it can be used for electric pressure and power control.

Optional:

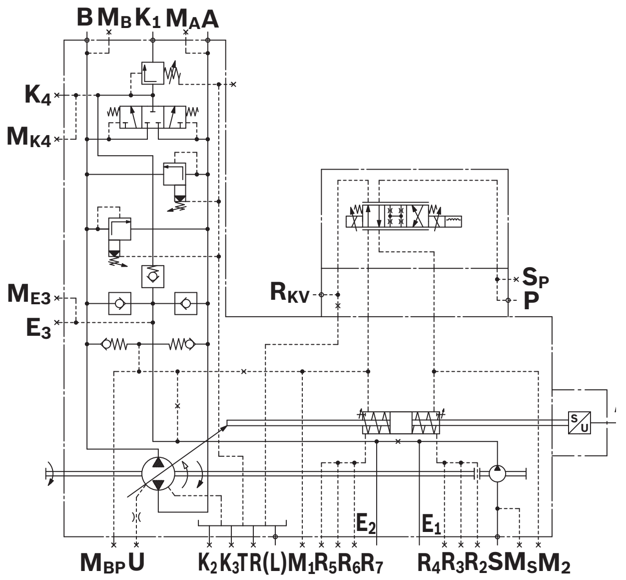
- With pressure transducer (HS4P)
- Short circuit valve (HS4K, HS4KP)
- For oil-immersed use (HS4M)

▼ **Characteristic curve**



▼ **Circuit diagram**

Example: A4CSG 250/355 HS4...F..4D

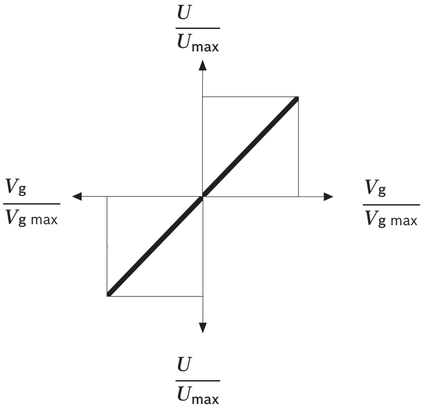


EO2 – control system, hydraulic with proportional valve
(see data sheet 92076)
The stepless control of the displacement flow is accomplished by means of a proportional valve and electrical feedback of the swivel angle.
Thus, the control can be used as an electric displacement control.

Optional:

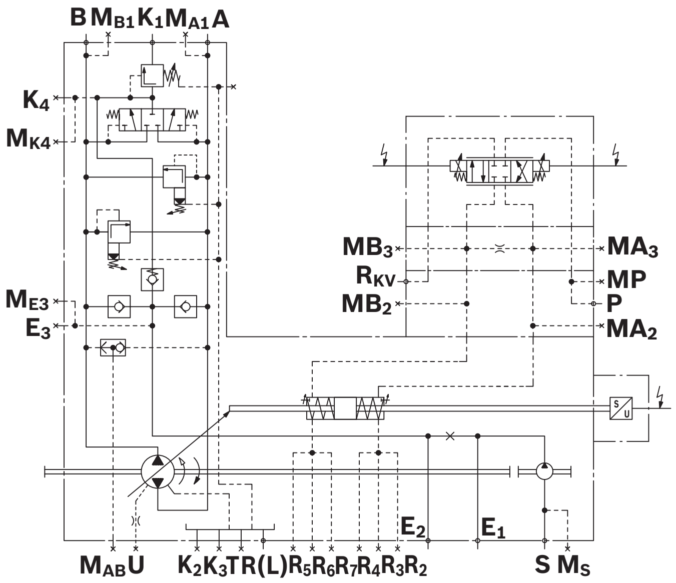
- Short circuit valve (EO2K)

▼ **Characteristic curve**



▼ **Circuit diagram**

Example: A4CSG 500/750 EO2...F..4D



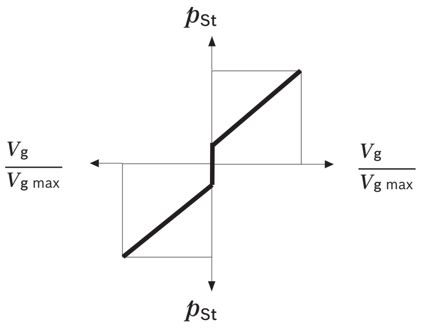
HD – Proportional control, hydraulic, pilot-pressure related (see data sheet 92080)

Stepless adjustment of the pump displacement according to the pilot pressure. The control is proportional to the specified pilot pressure setpoint value (difference between **X_1, X_2**).
For version **F** with integrated boost pump, the control is supplied internally with the control pressure from the boost circuit. This saves using a separate control pressure pump.

Optional:

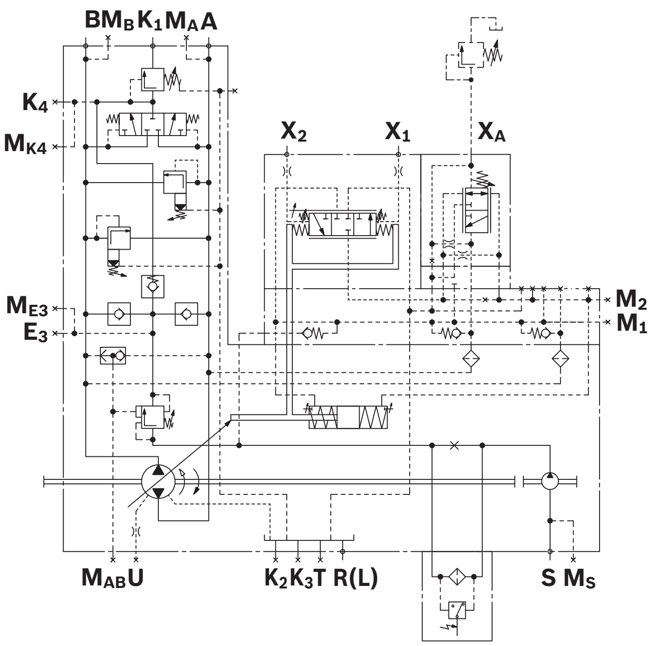
- Control characteristics (HD1, HD2, HD3)
- Pressure control (HD.A, HD.B, HD.D)
- Remote pressure control (HD.GA, HD.GB, HD.G)
- Power control (HD1P)
- Electrical control of pilot pressure (HD1T)

▼ Characteristic curve



▼ Circuit diagram

Example: A4CSG 500/750 HD1...F..4M



EP – proportional control, electrohydraulic

(see data sheet 92084)

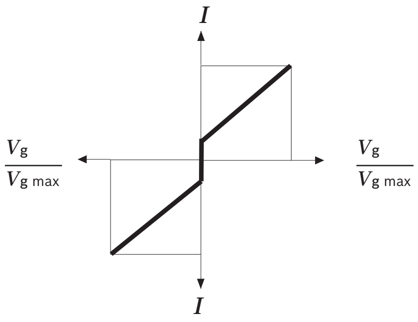
The EP control adjusts the pump displacement proportionally to the current at the solenoid. Current-regulated control units with pulse-width modulation are recommended for controlling the solenoids.

For version **F** with integrated boost pump, the control is supplied internally with the control pressure from the boost circuit. This saves using a separate control pressure pump.

Optional:

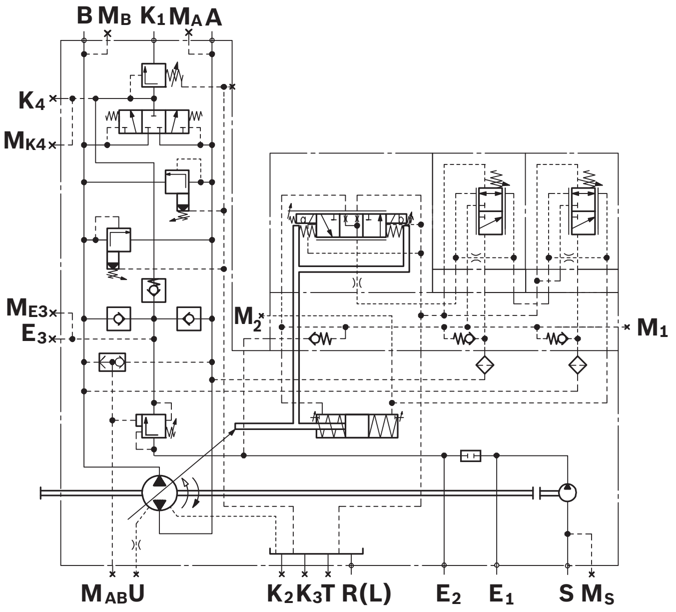
- Pressure control (EPA, EPB, EPD)
- Remote pressure control (EPGA, EPGB, EPG)

▼ Characteristic curve



▼ Circuit diagram

Example: A4CSG 500/750 EPD...F..4D[1]



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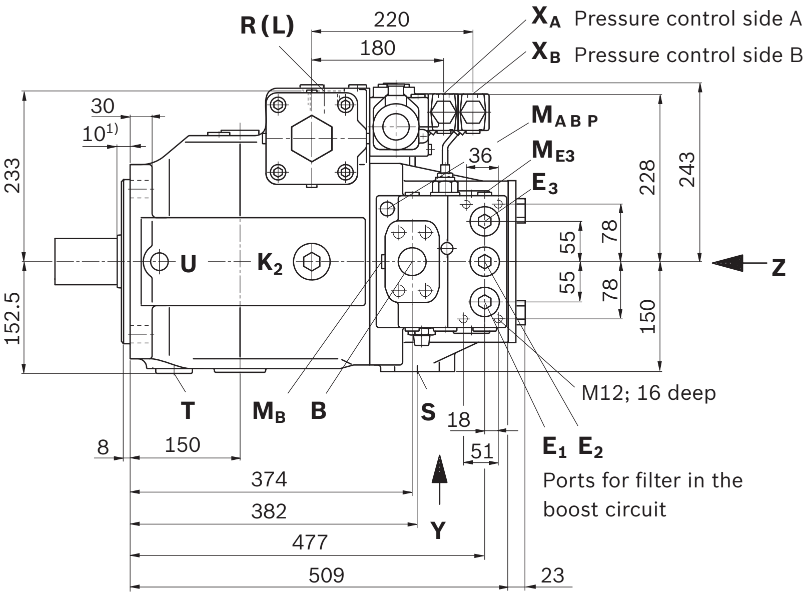
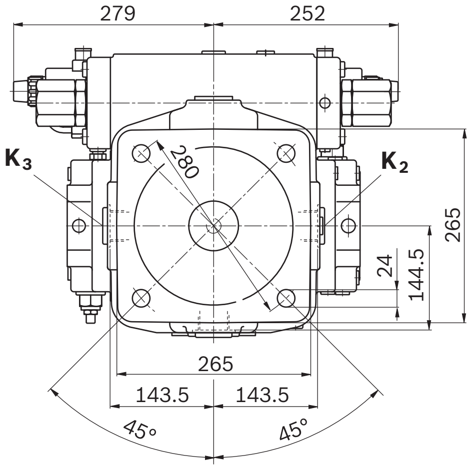
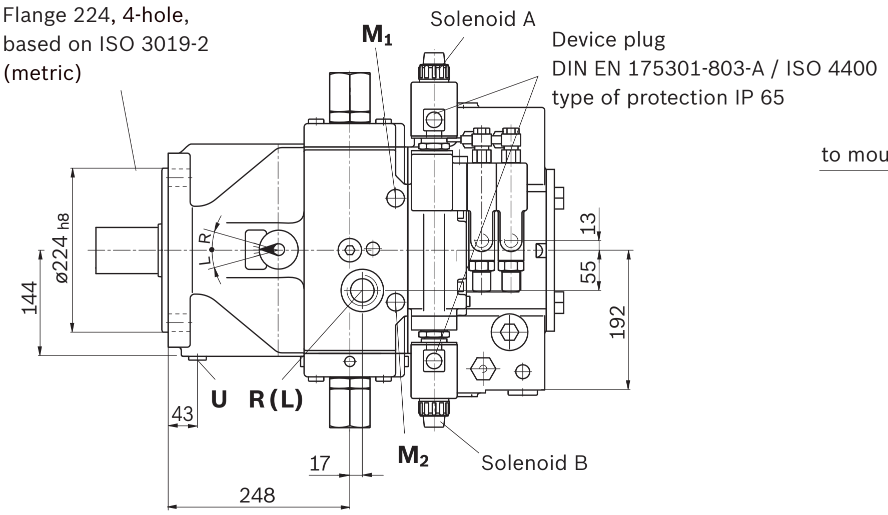
[1] Version M with filter, see page 30

Dimensions, size 250

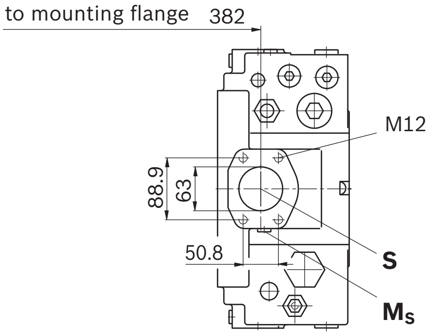
A4CSG250EPG/30R-XXB35F994N



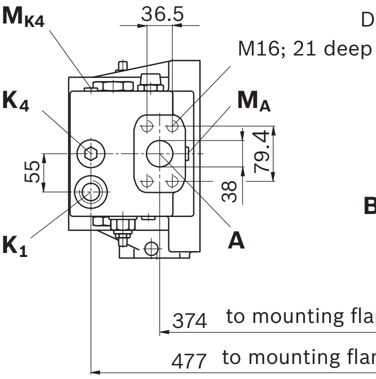




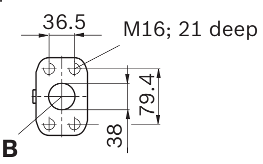
Detail Y



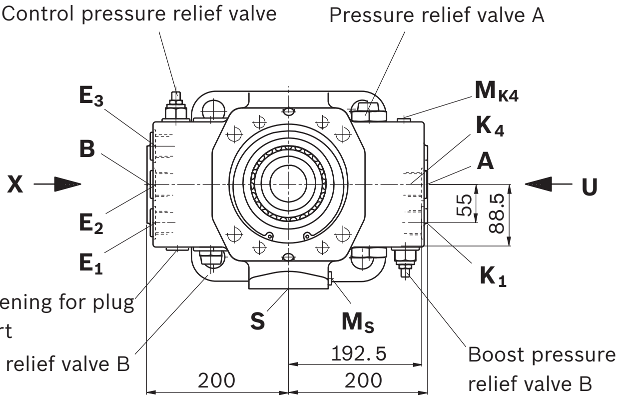
Detail U



Detail X



Detail Z[2]



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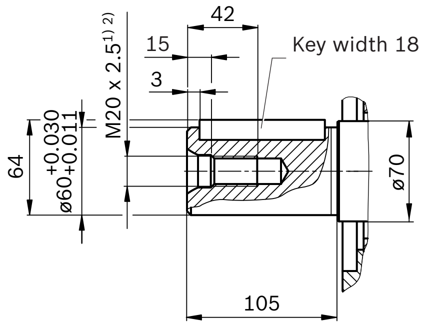
1) Up to shaft collar

2) Through drive F99 shown without cover, for dimensions see page 22

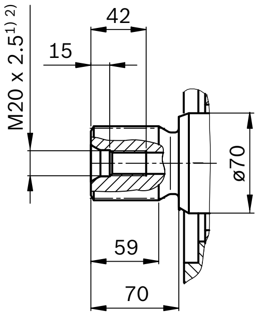
▼ Parallel keyed shaft DIN 6885

P – AS18x11x100



▼ Splined shaft DIN 5480

Z – W60x2x28x9 g



Ports		Standard	Size[2]	p_{max} [bar][3]	State[7]
A, B	Working line (high-pressure series)	SAE J518[4]	1 1/2 in	400	O
	Fastening thread A/B	DIN 13	M16 × 2; 21 deep		
S	Suction port (standard pressure series)	SAE J518[4]	2 1/2 in	30	O
	Fastening thread S	DIN 13	M12 x 1.75; 17 deep		
M_A, M_B, M_{ABP}	Measuring working pressure A/B	DIN 3852	M14 × 1.5; 12 deep	400	X
M_S	Measuring suction	DIN 3852	M14 × 1.5; 12 deep	30	X
T	Fluid drain	DIN 3852[5]	M42 × 2; 20 deep	4	X[6]
E_1	Filter, supply	DIN 3852	M33 × 2; 18 deep	40	X
E_2	Filter, return	DIN 3852	M33× 2; 18 deep	40	X
K_1	Flushing port	DIN 3852	M33 × 2; 18 deep	5	O
K_2, K_3	Fluid filling + air bleeding	DIN 3852[5]	M42 × 2; 20 deep	4	X[6]
R(L)	Return flow (drain port)			4	O[6]
U	Bearing flushing	DIN 3852[5]	M14 × 1.5; 12 deep	7	X
E_3	Boost pressure supply	DIN 3852	M33 × 2; 18 deep	40	X
M_{E3}	Measuring boost pressure	DIN 3852	M14 × 1.5; 12 deep	40	X
K_4	Accumulator port	DIN 3852	M33 × 2; 18 deep	40	X
M_{K4}	Measuring boost pressure	DIN 3852	M14 × 1.5; 12 deep	40	X
M_1, M_2	Measuring control pressure	DIN 3852	M18 × 1.5; 12 deep	400	X
X_A, X_B	Pilot pressure, remote control pressure controller	DIN 3852	M14 × 1.5; 12 deep	350	O

---

1) Center bore according to DIN 332 (thread according to DIN 13)

2) For notes on tightening torques, see the instruction manual

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

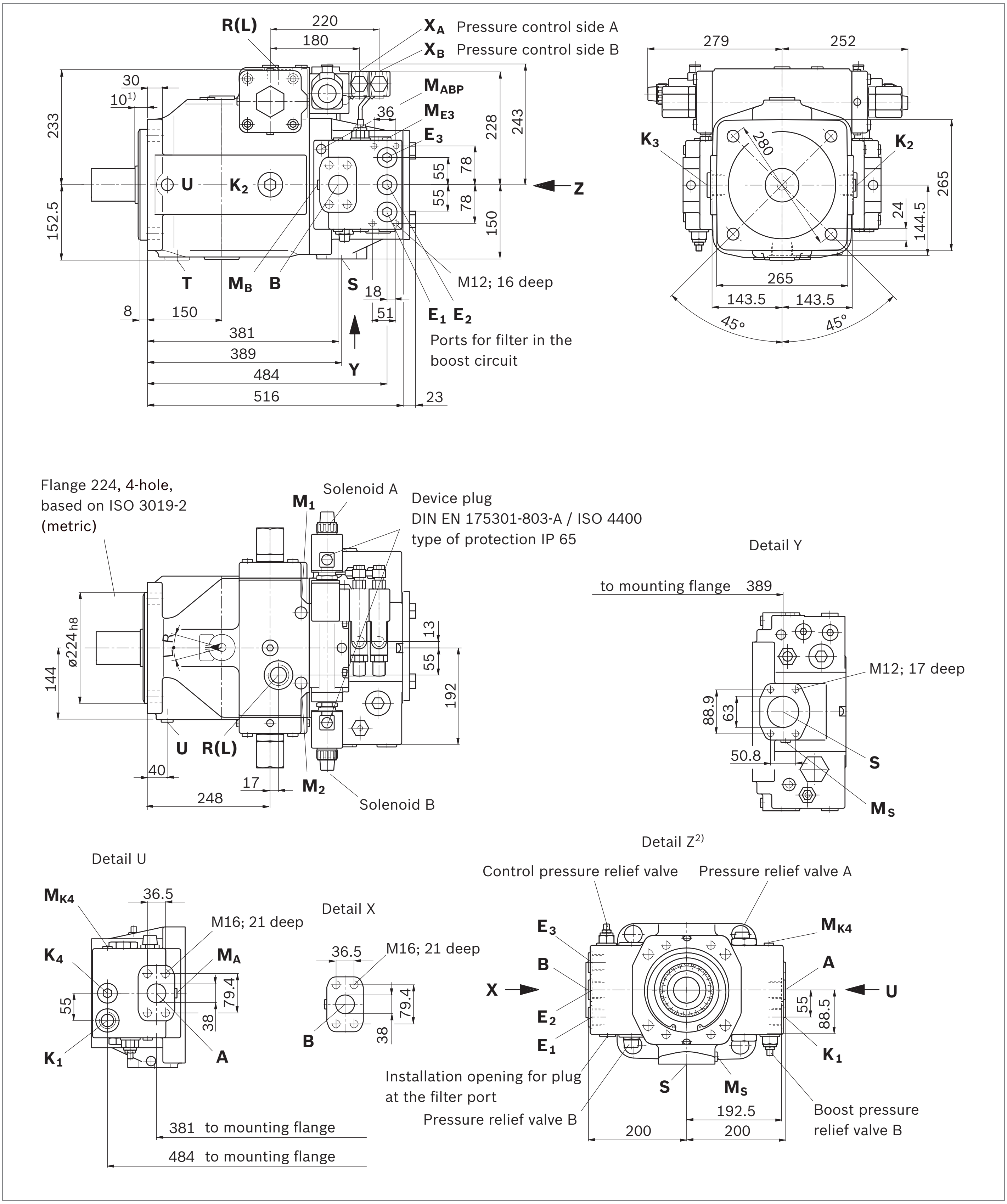
5) The countersink can be deeper than that specified in the standard.

6) Depending on the installation position, T, K_2, K_3 or R(L) must be connected (see also pages 33 to 35)

7) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

Dimensions, size 355

A4CSG355EPG/30R-XXB35F994N



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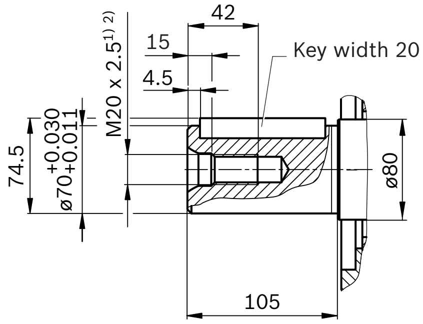
1) Up to shaft collar

2) Through drive F99 shown without cover, for dimensions see page 22

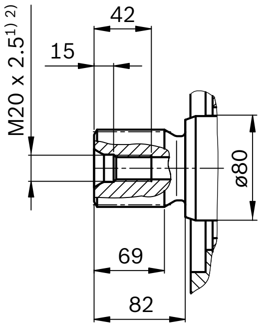
▼ Parallel keyed shaft DIN 6885

P – AS20x12x100



▼ Splined shaft DIN 5480

Z – W70x3x22x9 g



Ports		Standard	Size[2]	p_{max} [bar][3]	State[7]
A, B	Working line (high-pressure series)	SAE J518[4]	1 1/2 in	400	O
	Fastening thread A/B	DIN 13	M16 × 2; 21 deep		
S	Suction port (standard pressure series)	SAE J518[4]	2 1/2 in	30	O
	Fastening thread S	DIN 13	M12 x 1.75; 17 deep		
M_A, M_B, M_{ABP}	Measuring working pressure A/B	DIN 3852	M14 × 1.5; 12 deep	400	X
M_S	Measuring suction	DIN 3852	M14 × 1.5; 12 deep	30	X
T	Fluid drain	DIN 3852[5]	M42 × 2; 20 deep	4	X[6]
E_1	Filter, supply	DIN 3852	M33 × 2; 18 deep	40	X
E_2	Filter, return	DIN 3852	M33 × 2; 18 deep	40	X
K_1	Flushing port	DIN 3852	M33 × 2; 18 deep	5	O
K_2, K_3	Fluid filling + air bleeding	DIN 3852[5]	M42 × 2; 20 deep	4	X[6]
R(L)	Return flow (drain port)			4	O[6]
U	Bearing flushing	DIN 3852[5]	M18 × 1.5; 12 deep	7	X
E_3	Boost pressure supply	DIN 3852	M33 × 2; 18 deep	40	X
M_{E3}	Measuring boost pressure	DIN 3852	M14 × 1.5; 12 deep	40	X
K_4	Accumulator port	DIN 3852	M33 × 2; 18 deep	40	X
M_{K4}	Measuring boost pressure	DIN 3852	M14 × 1.5; 12 deep	40	X
M_1, M_2	Measuring control pressure	DIN 3852	M18 × 1.5; 12 deep	400	X
X_A, X_B	Pilot pressure, remote control pressure controller	DIN 3852	M14 × 1.5; 12 deep	350	O

---

1) Center bore according to DIN 332 (thread according to DIN 13)

2) For notes on tightening torques, see the instruction manual

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

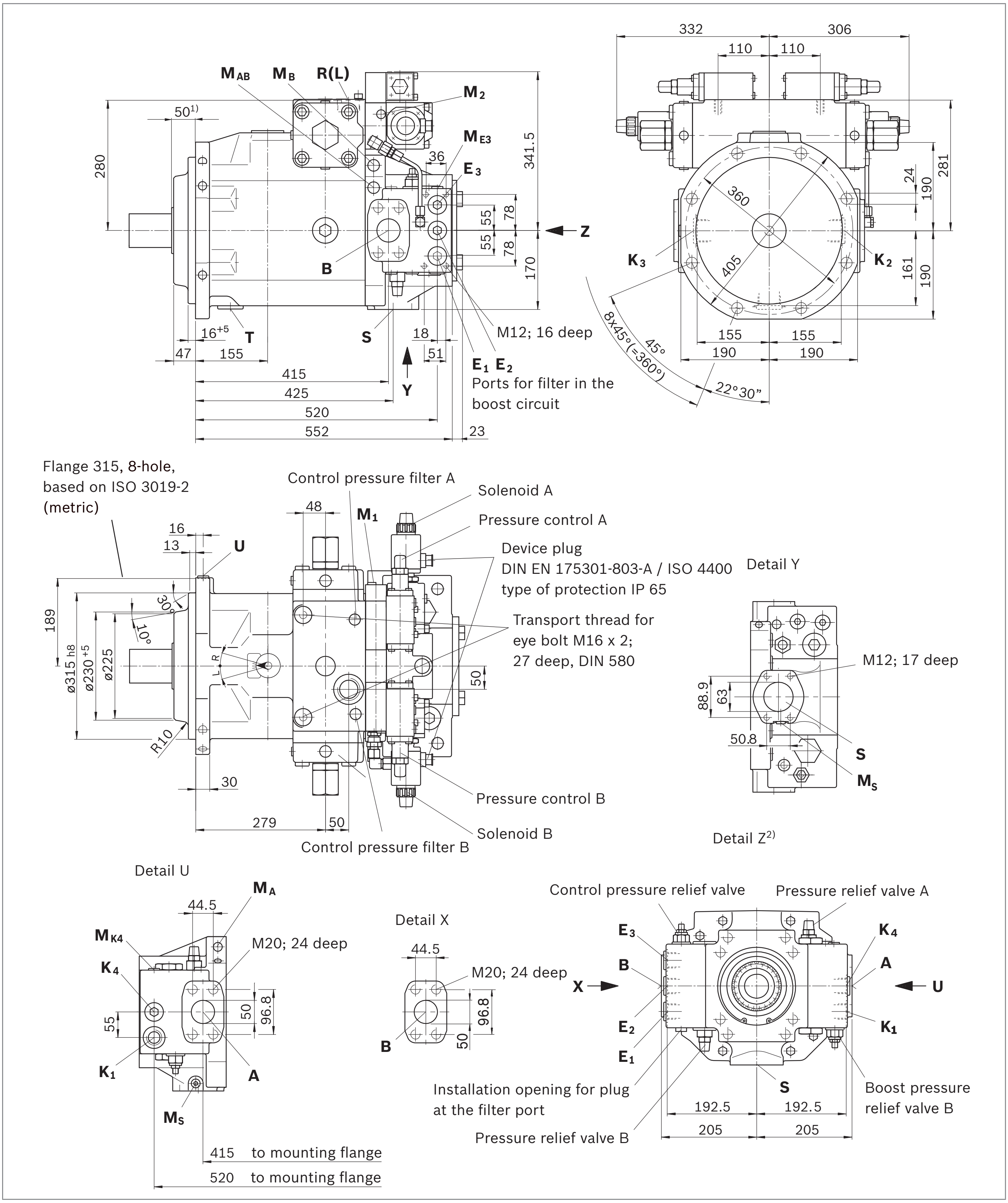
5) The countersink can be deeper than that specified in the standard.

6) Depending on the installation position, T, K_2, K_3 or R(L) must be connected (see also pages 33 to 35)

7) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

Dimensions, size 500

A4CSG500EPD/30R-XXH35F994N



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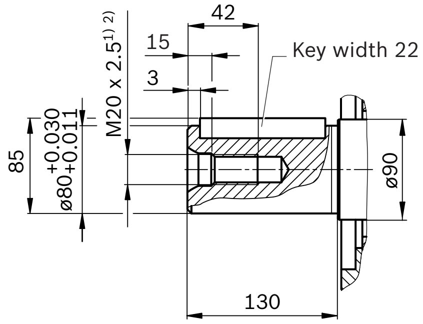
1) Up to shaft collar

2) Through drive F99 shown without cover, for dimensions see page 22

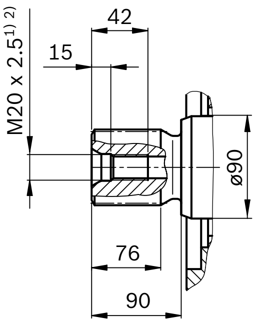
▼ Parallel keyed shaft DIN 6885

P – AS22x14x125



▼ Splined shaft DIN 5480

Z – W80x3x25x9 g



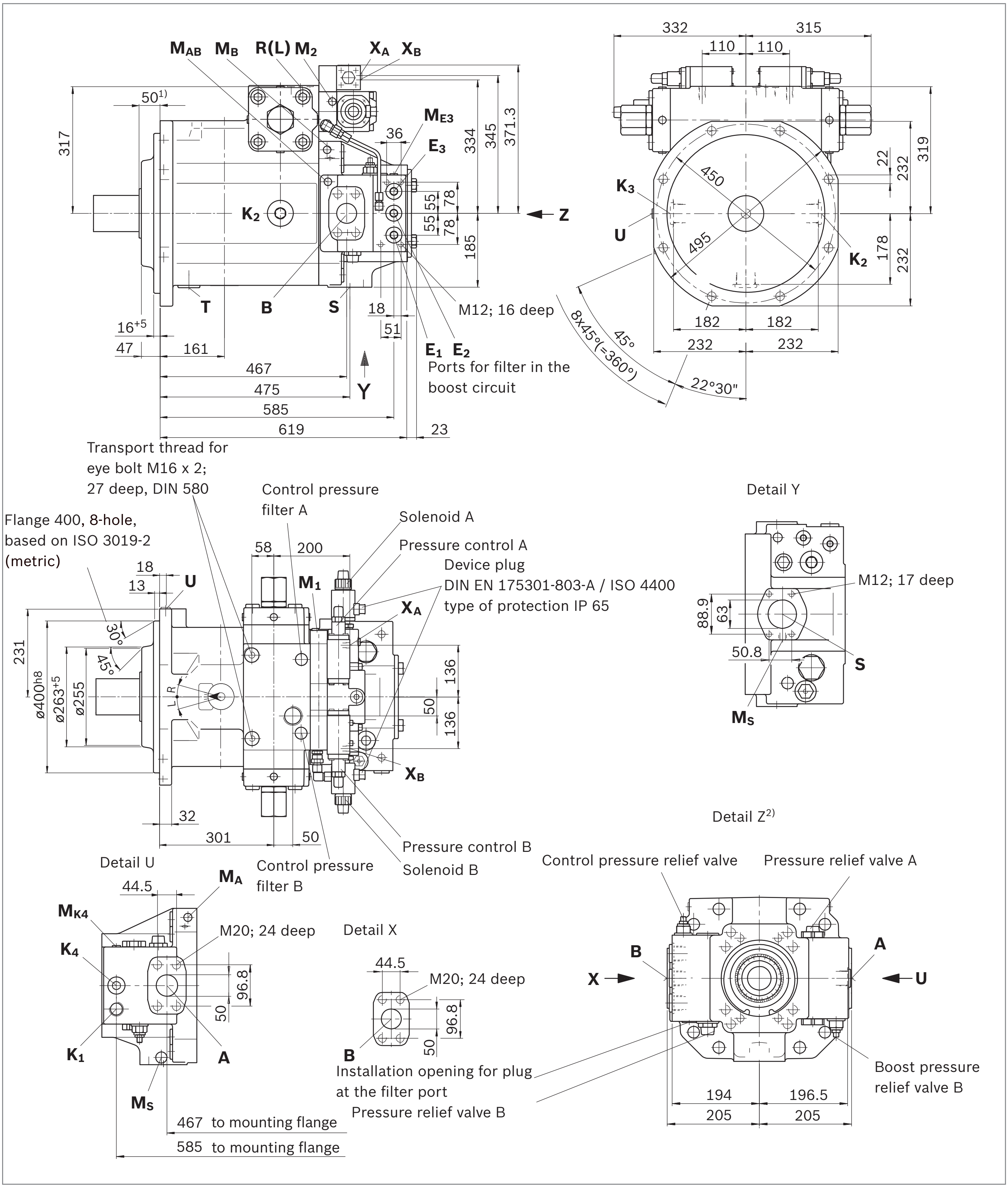
Ports		**Standard**	**Size** 2)	**p_{max} [bar]** 3)	**State** 7)
A, B	Working line (high-pressure series)	SAE J518 4)	2 in	400	O
	Fastening thread A/B	DIN 13	M20 × 2.5; 24 deep		
S	Suction port (standard pressure series)	SAE J518 4)	2 1/2 in	30	O
	Fastening thread S	DIN 13	M12 x 1.75; 17 deep		
M_A, M_B, M_{ABP}	Measuring working pressure A/B	DIN 3852	M14 × 1.5; 12 deep	400	X
M_S	Measuring suction	DIN 3852	M14 × 1.5; 12 deep	30	X
T	Fluid drain	DIN 3852 5)	M48 × 2; 22 deep	4	X 6)
E_1	Filter, supply	DIN 3852	M33 × 2; 18 deep	40	X
E_2	Filter, return	DIN 3852	M33 × 2; 18 deep	40	X
K_1	Flushing port	DIN 3852	M33 × 2; 18 deep	5	O
K_2, K_3	Fluid filling + air bleeding	DIN 3852 5)	M48 × 2; 22 deep	4	X 6)
R(L)	Return flow (drain port)			4	O 6)
U	Bearing flushing	DIN 3852 5)	M18 × 1.5; 12 deep	7	X
E_3	Boost pressure supply	DIN 3852	M33 × 2; 18 deep	40	X
M_{E3}	Measuring boost pressure	DIN 3852	M14 × 1.5; 12 deep	40	X
K_4	Accumulator port	DIN 3852	M33 × 2; 18 deep	40	X
M_{K4}	Measuring boost pressure	DIN 3852	M14 × 1.5; 12 deep	40	X
M_1	Measuring stroking chamber pressure	DIN 3852	M22 × 1.5; 14 deep	400	X
M_2	Measuring stroking chamber pressure	DIN 3852	M14 × 1.5; 12 deep	400	X
X_A, X_B	Pilot pressure, remote control pressure controller	DIN 3852	M14 × 1.5; 12 deep	350	O

---

1) Center bore according to DIN 332 (thread according to DIN 13)
2) For notes on tightening torques, see the instruction manual
3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.
4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
5) The countersink can be deeper than that specified in the standard.
6) Depending on the installation position, T, K_2, K_3 or R(L) must be connected (see also pages 33 to 35)
7) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

Dimensions, size 750

A4CSG750EPG/30R-XXH35F994N



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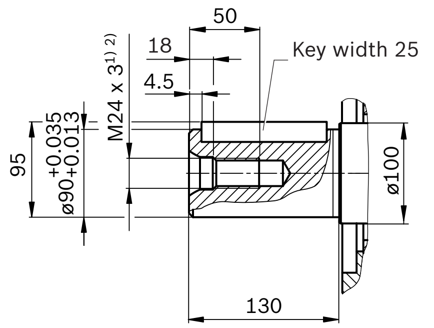
1) Up to shaft collar

2) Through drive F99 shown without cover, for dimensions see page 22

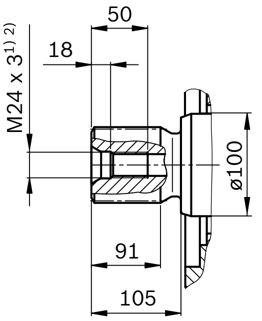
▼ Parallel keyed shaft DIN 6885

P – AS25x14x125



▼ Splined shaft DIN 5480

Z – W90x3x28x9 g



Ports		Standard	Size[2]	$p_{\max}$ [bar][3]	State[7]
A, B	Working line (high-pressure series)	SAE J518[4]	2 in	400	O
	Fastening thread A/B	DIN 13	M20 × 2.5; 24 deep		
S	Suction port (standard pressure series)	SAE J518[4]	2 1/2 in	30	O
	Fastening thread S	DIN 13	M12 x 1.75; 17 deep		
M_A, M_B, M_{ABP}	Measuring working pressure A/B	DIN 3852	M14 × 1.5; 12 deep	400	X
M_S	Measuring suction	DIN 3852	M14 × 1.5; 12 deep	30	X
T	Fluid drain	DIN 3852[5]	M48 × 2; 22 deep	4	X[6]
E_1	Filter, supply	DIN 3852	M33 × 2; 18 deep	40	X
E_2	Filter, return	DIN 3852	M33 × 2; 18 deep	40	X
K_1	Flushing port	DIN 3852	M33 × 2; 18 deep	5	O
K_2, K_3	Fluid filling + air bleeding	DIN 3852[5]	M48 × 2; 22 deep	4	X[6]
R(L)	Return flow (drain port)			4	O[6]
U	Bearing flushing	DIN 3852[5]	M18 × 1.5; 12 deep	7	X
E_3	Boost pressure supply	DIN 3852	M33 × 2; 18 deep	40	X
M_{E3}	Measuring boost pressure	DIN 3852	M14 × 1.5; 12 deep	40	X
K_4	Accumulator port	DIN 3852	M33 × 2; 18 deep	40	X
M_{K4}	Measuring boost pressure	DIN 3852	M14 × 1.5; 12 deep	40	X
M_1	Measuring stroking chamber pressure	DIN 3852	M22 × 1.5; 14 deep	400	X
M_2	Measuring stroking chamber pressure	DIN 3852	M14 × 1.5; 12 deep	400	X
X_A, X_B	Pilot pressure, remote control pressure controller	DIN 3852	M14 × 1.5; 12 deep	350	O

---

1) Center bore according to DIN 332 (thread according to DIN 13)

2) For notes on tightening torques, see the instruction manual

3) Depending on the application, momentary pressure peaks can occur. Keep this in mind when selecting measuring devices and fittings.

4) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.

5) The countersink can be deeper than that specified in the standard.

6) Depending on the installation position, T, K_2, K_3 or R(L) must be connected (see also pages 33 to 35)

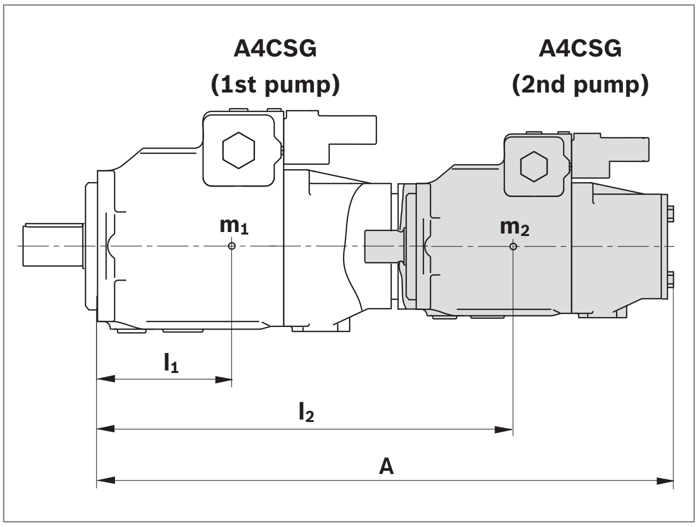
7) O = Must be connected (plugged when delivered)
X = Plugged (in normal operation)

Through drive

The variable pump A4CSG can be supplied with through drive despite the integrated boost pump, in accordance with the type code on page 3.

If no further pumps are to be mounted at the factory, then the simple type designation is sufficient.

The scope of delivery then includes
- for all through drives except F/K99:
  hub, mounting bolts, seal and, if applicable, an intermediate flange
- for F/K99:
  with through-drive shaft, without hub, without intermediate flange; unit with closed fluid-tight, pressure-tight cover



Total length A

A4CSG	A4CSG (2nd pump with through drive F/k99, without filter)			
(1st pump)	NG250	NG355	NG500	NG750
NG250	1079	–	–	–
NG355	1086	1114	–	–
NG500	1143	1150	1235	–
NG750	1210	1217	1302	1396

Combination pumps

By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes.

When ordering combination pumps, the type designations of the 1st and 2nd pump must be connected by a "**+**".

- **Order example:**
  A4CSG 500 EPG / 30 R – VPH35F434M +
  A4CSG 500 EPG / 30 R – VZH35F994M

For through drives **F/K01**, **04**, **07**, **24**, **52**, **68** and **B6**, various possible attachment angle positions are available. As standard, the second pump is attached at the same angle as the supplied screws, as shown in the drawing on pages 26 and 27. If this angle differs, please contact us.

If a gear pump is to be mounted at the factory as an attachment pump, please contact us.

For maximum permissible drive and through-drive torques, see page 8.

m_1, m_2 [kg]

l_1, l_2 [mm]

$$T_\mathrm{m} = (m_1 \cdot l_1 + m_2 \cdot l_2 + m_3 \cdot l_3) \frac{1}{102} \text{ [Nm]}$$

Permissible mass torque

Size			250	355	500	750
Permissible mass torque	T_m	Nm	9300	9300	15600	19500
Permissible mass torque for dynamic mass acceleration 10g ≙ 98.1 m/s²	T_m	Nm	930	930	1560	1950
Weight	m_1	kg	260	275	390	520
Distance from center of gravity	l_1	mm	270	280	300	330

Overview of mounting options on A4CSG

Through drive - A4CSG			Mounting option 2nd pump				
Flange	**Hub for splined shaft[1]**	**Code**	**A4CSG NG (shaft)**	**A4VSO/G NG (shaft)**	**A10V(S)O/31/32[4] NG (shaft)**	**A10V(S)O/52/53 NG (shaft)**	**External/internal gear pump**
Flange ISO 3019-2 (metric)							
80, 2-hole	3/4 in (19-4)	**F/KB2**	–	–	18 (S)/31	10 (S)	–
100, 2-hole	7/8 in (22-4)	**F/KB3**	–	–	28 (S)/31	–	–
	1 in (25-4)	**F/KB4**	–	–	45 (S)/31	–	–
125, 2-hole	1 1/4 in (32-4)	**F/KB5**	–	–	71 (S)/31	–	–
	1 1/2 in (38-4)	**F/KB6**	–	–	100 (S)/31	–	–
125, 4-hole	W32	**F/K31**	–	40 (Z)	–	–	–
125, 4-hole	1 in (25-4)	**F/KE1**	–	–	45 (S)/32	–	–
140, 4-hole	W40	**F/K33**	–	71 (Z)	–	–	–
160, 4-hole	W50	**F/K34**	–	125, 180 (Z)	–	–	–
	1 1/4 in (32-4)	**F/KB8**	–	–	71 (S)/32	–	–
180, 4-hole	1 1/2 in (38-4)	**F/KB9**	–	–	100 (S)/32	–	–
	1 3/4 in (44-4)	**F/KB7**	–	–	140 (S)/31/32	–	–
224, 4-hole	W60	**F/K35**	250 (Z)	250 (Z)	–	–	–
	W70	**F/K77**	355 (Z)	355 (Z)	–	–	–
315, 8-hole	W80	**F/K43**	500 (Z)	500 (Z)	–	–	–
400, 8-hole	W90	**F/K76**	750 (Z)	750 (Z)	–	–	–
Flange SAE J744 (ISO 3019-1)[2]							
82-2 (A)	5/8 in (16-4)	**F/K01**	–	–	–	–	AZPF-1X-004 to 022[3]
	3/4 in (19-4)	**F/K52**	–	–	18 (S)/31	10 (S)	–
101-2 (B)	7/8 in (22-4)	**F/K68**	–	–	28 (S)/31	28 (S)	AZPN-1X-020 to 032[3]
	1 in (25-4)	**F/K04**	–	–	45 (S)/31	45 (S)	PGH4
127-2 (C)	1 1/4 in (32-4)	**F/K07**	–	–	71 (S)/31	–	–
	1 1/2 in (38-4)	**F/K24**	–	–	100 (S)/31	85 (S)	PGH5
127-4 (C)	1 1/4 in (32-4)	**F/KE15**	–	–	71 (S)/32	–	–
152-4 (D)	1 3/4 in (44-4)	**F/K17**	–	–	140 (S)/31	–	–

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[1] According to DIN 5480 (e.g. W32) or according to SAE J744 (e.g. 3/4 in)

[2] 2 = 2-hole, 4 = 4-hole

[3] Bosch Rexroth recommends special versions of the gear pumps. Please contact us.

[4] If a through drive for an A10V(S)O with R-shaft is desired, please contact us.

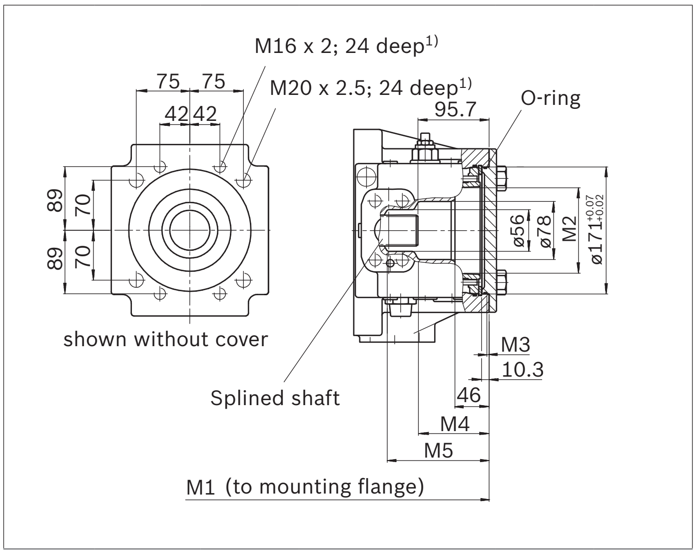
4

Dimensions through drive

with through-drive shaft	**Splined shaft DIN 5480**	**Availability over sizes**				**Code**
without hub or intermediate flange,	**Diameter**	**250**	**355**	**500**	**750**	**F/K**
plugged with fluid-tight, pressure-tight cover and O-ring for later mounting	W42x1.25x32x9 g	●	●	–	–	**99**
	W55x1.25x42x9 g	–	–	●	●	**99**

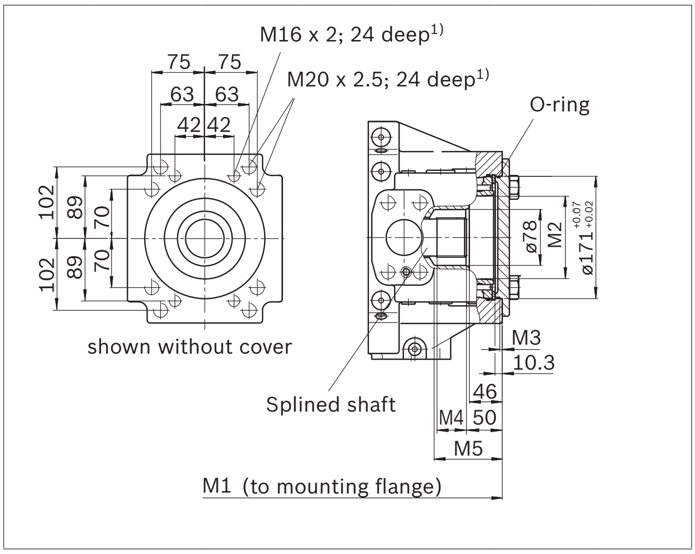
● = Available – = Not available

▼ **F/K99**



99	NG	M1	M2	M3	M4	M5
	250	509	ø115	3	95	137
	355	516	ø115	3	95	137

▼ **F/K99**



99	NG	M1	M2	M3	M4	M5
	500	552	ø115	3.4	41	95
	750	619	ø115	3.4	45	116.6

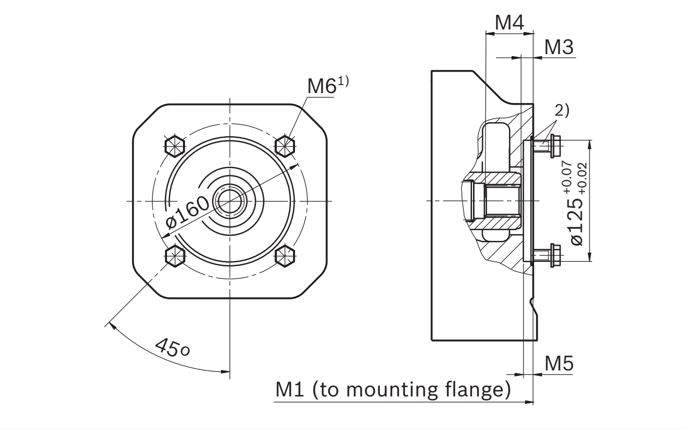
---

[1] Thread according to DIN 13, see instruction manual for details on tightening torques

Flange ISO 3019-2 Diameter	Hub for splined shaft DIN 5480	Availability over sizes 250	 355	 500	 750	Code F/K
125, 4-hole	W32x2x14x9 g	○	●	●	○	**31**
140, 4-hole	W40x2x18x9 g	○	○	●	○	**33**
160, 4-hole	W50x2x24x9 g	●	●	●	●	**34**
224, 4-hole	W60x2x28x9 g	●	○	○	○	**35**

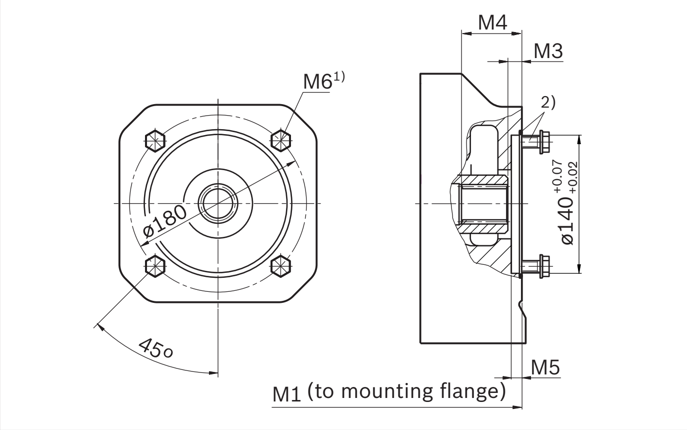
● = Available ○ = On request

▼ F/K31



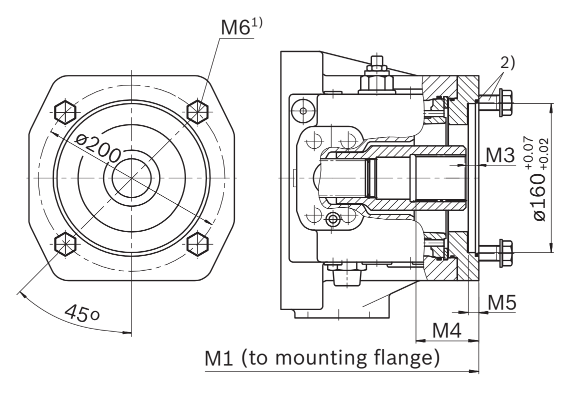
31	NG	M1	M3	M4	M5	M6
	355	539	11.5	46	10	M12; 18 deep
	500	575	12.5	51	10	

▼ F/K33



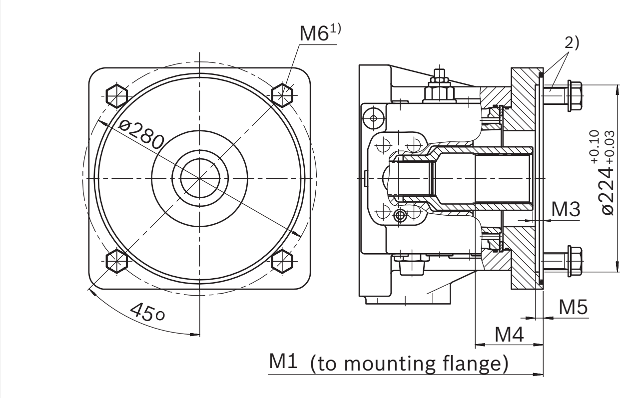
33	NG	M1	M3	M4	M5	M6
	355	541	12.5	60	10	M12; 14.5 deep
	500	577	14.5	50	10	

▼ F/K34



34	NG	M1	M3	M4	M5	M6
	250	531	12.5	66	10	M16; 22 deep
	355	538	12.5	66	10	
	500	574	12.5	67	10	
	750	641	12.5	67	10	

▼ F/K35



35	NG	M1	M3	M4	M5	M6
	250	547	12.5	81	8	M20; 30 deep
	355	554	12.5	81	8	
	500	611	12.5	81	8	
	750	678	12.5	81	8	

---

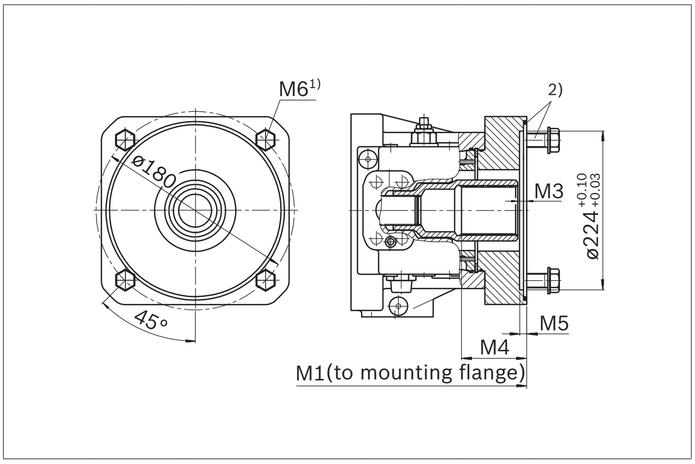
[1] Thread according to DIN 13, see instruction manual for details on tightening torques

[2] 4 mounting bolts and O-ring seal are included in the scope of delivery.

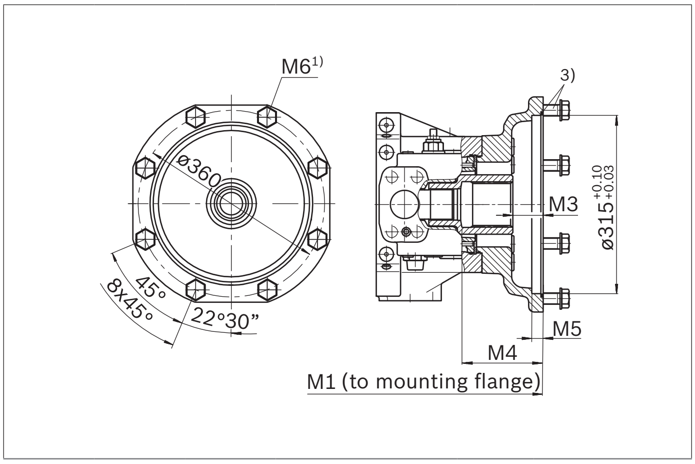
Flange ISO 3019-2		**Availability over sizes**				**Code**
Diameter	**Hub for splined shaft DIN 5480**	**250**	**355**	**500**	**750**	**F/K**
224, 4-hole	W70x3x22x9 g	○	●	●	○	**77**
315, 8-hole	W80x3x25x9 g	○	○	●	○	**43**

● = Available ○ = On request

▼ **F/K77**



▼ **F/K43**



77	NG	M1	M3	M4	M5	M6
	355	575	12.4	92	8	M20; 30 deep
	500	611	12.5	94.5	8	

43	NG	M1	M3	M4	M5	M6
	500	660	53.5	143	19	M20; 26 deep

---

1) Thread according to DIN 13, see instruction manual for details on tightening torques

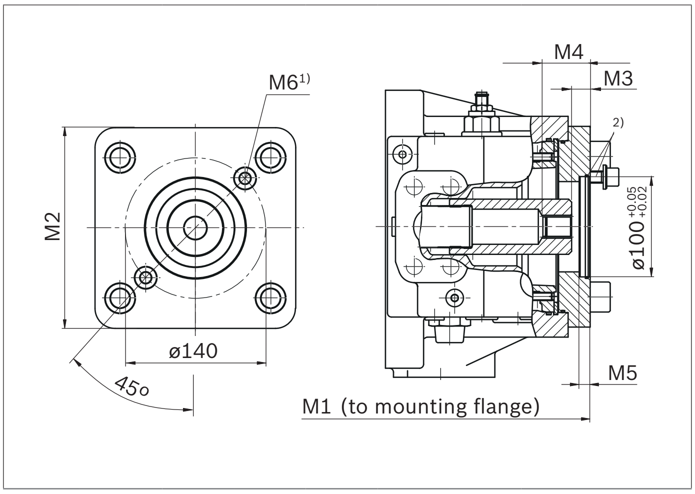
2) 4 mounting bolts and O-ring seal are included in the scope of delivery.

3) 8 mounting bolts and O-ring seal are included in the scope of delivery.

Flange ISO 3019-2		Availability over sizes				Code
Diameter	Hub for splined shaft SAE J744	250	355	500	750	F/K
100, 2-hole	7/8 in 13T 16/32DP	●	●	○	○	B3
125, 2-hole	1 1/4 in 14T 12/24DP	●	○	○	○	B5
125, 2-hole	1 1/2 in 17T 12/24DP	○	●	○	○	B6

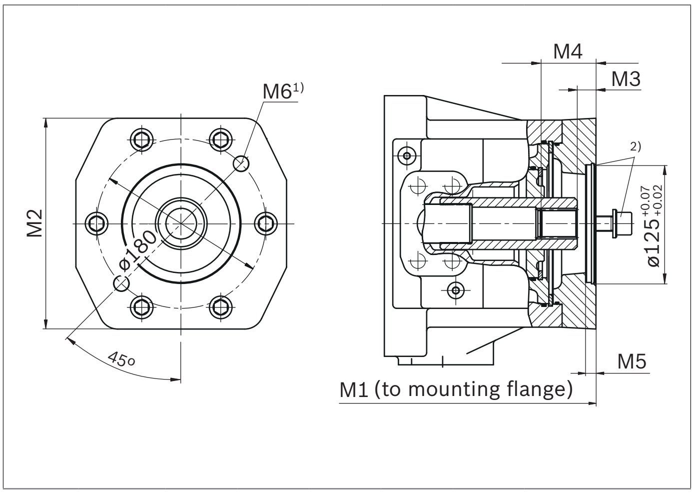
● = Available ○ = On request

▼ F/KB3



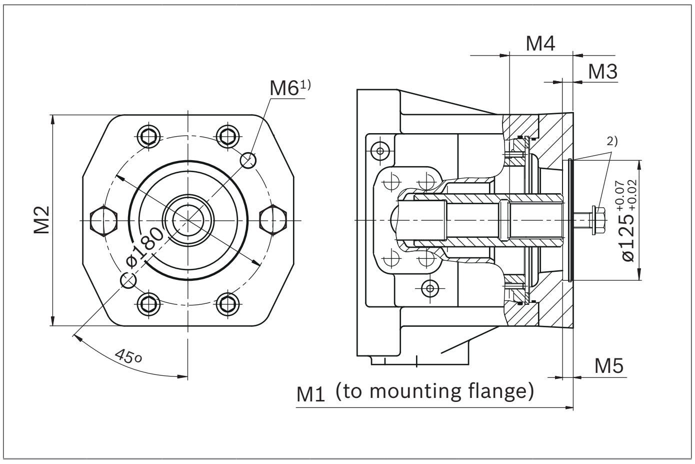
B3	NG	M1	M2	M3	M4	M5	M6
	250	531	200	18.5	43.5	10	M12; 18 deep
	355	538	200	18.5	43.5	10	

▼ F/KB5



B5	NG	M1	M2	M3	M4	M5	M6
	250	545	224	19.9	58	10	M16; 24 deep
	355	552	224	19.9	58	10	

▼ F/KB6



B6	NG	M1	M2	M3	M4	M5	M6
	355	552	224	10	66	10.4	M16; 24 deep

---

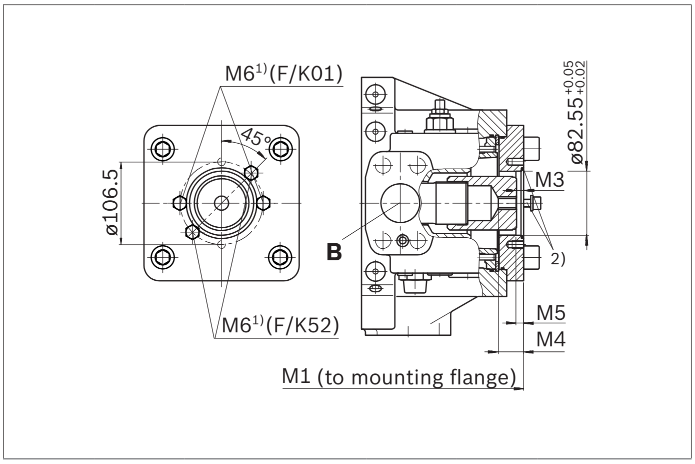
1) Thread according to DIN 13, see instruction manual for details on tightening torques

2) 2 mounting bolts and O-ring seal are included in the scope of delivery.

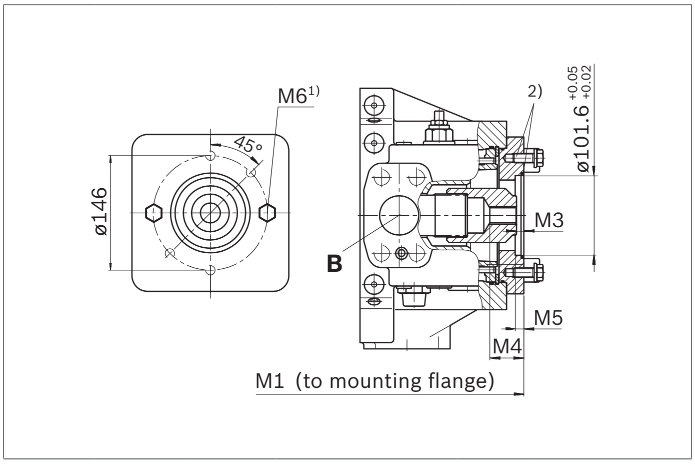
Flange SAE J744 (ISO 3019-1)		Availability over sizes				Code
Diameter	**Hub for splined shaft SAE J744**	**250**	**355**	**500**	**750**	**F/K**
82-2 (A)	5/8 in 9T 16/32DP	●	●	●	●	**01**
82-2 (A)	3/4 in 11T 16/32DP	○	●	●	○	**52**
101-2 (B)	7/8 in 13T 16/32DP	●	●	●	○	**68**
101-2 (B)	1 in 15T 16/32DP	○	●	●	○	**04**

● = Available ○ = On request

▼ F/K01; F/K52



▼ F/K68; F/K04



01	NG	M1	M3	M4	M5	M6
	250	531	10.5	33	10	M10; 15 deep
	355	538	10.5	33	10	
	500	574	9.3	33	10	
	750	641	9.3	33	10	

68	NG	M1	M3	M4	M5	M6
	250	531	18.5	43.5	10	M12; 15 deep
	355	538	18.5	43.5	10	
	500	574	18.5	43.5	10	

52	NG	M1	M3	M4	M5	M6
	355	531	19.5	40.5	10	M10; 15 deep
	500	574	19.5	40.5	10	

04	NG	M1	M3	M4	M5	M6
	355	538	18.9	48.4	10	M12; 15 deep
	500	574	19.4	48.4	10	

---

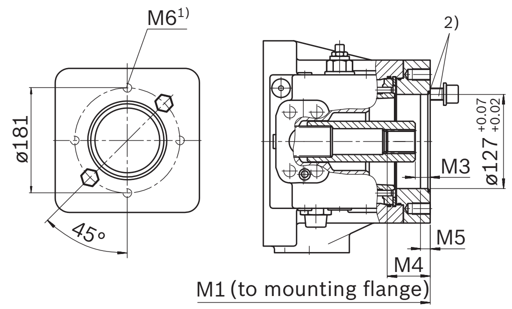
1) Thread according to DIN 13, see instruction manual for details on tightening torques

2) 2 mounting bolts and O-ring seal are included in the scope of delivery.

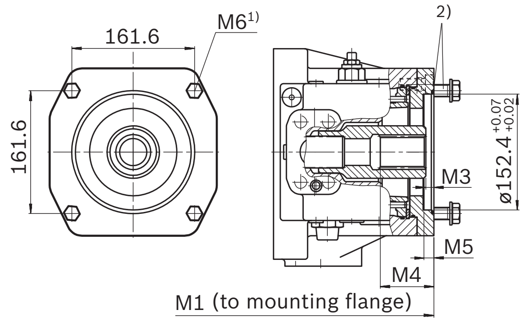
Flange SAE J744 (ISO 3019-1)		Availability over sizes				Code
Diameter	Hub for splined shaft SAE J744	250	355	500	750	F/K
127-2 (C)	1 1/4 in 14T 12/24DP	●	●	●	○	07
127-2 (C)	1 1/2 in 17T 12/24DP	○	●	●	○	24
152-4 (D)	1 3/4 in 13T 8/16DP	●	●	●	●	17

● = Available ○ = On request

▼ **F/K07; F/K24**



▼ **F/K17**



07	NG	M1	M3	M4	M5	M6
	250	545	19.9	58	13	M16; 24 deep
	355	552	19.9	58	13	
	500	588	18.3	58	13	

24	NG	M1	M3	M4	M5	M6
	250	545	10.4	75	13	M16; 24 deep
	355	552	10.4	75	13	
	500	588	10.3	67	13	

17	NG	M1	M3	M4	M5	M6
	250	531	10.4	73	13	M16; 22 deep
	355	538	10.4	73	13	
	500	600	10.4	73	13	M16; 32 deep
	750	667	10.4	73	13	

[1)] Thread according to DIN 13, see instruction manual for details on tightening torques

[2)] 2 mounting bolts and O-ring seal are included in the scope of delivery.

[3)] 4 mounting bolts and O-ring seal are included in the scope of delivery.

Integrated boost pump and valve technology (version F..)

High-pressure relief valve (Pos. 5)

Two pilot-operated pressure relief valves use pressure limitation to prevent damage to the hydraulic pump resulting from overpressure. A pressure relief valve is assigned to each pressure side.

Protection is provided by reducing the high pressure to the low pressure side.

Pressure limitation is set by default to 350 bar. If another setting is required, please state this in plain text.

Boost-pressure relief valve (Pos. 3)

direct operated

The boost pressure can be set on the boost-pressure relief valve.

Boost pressure

To prevent damage to the system, low pressure protection is recommended, which monitors the static pressure component. The ports $\mathbf{M}_{E3}$ or $\mathbf{M}_{K4.}$, for example, are suitable for low pressure monitoring. To prevent any impermissible drop in boost pressure a low pressure accumulator can be connected to the ports $\mathbf{E}_2$, $\mathbf{E}_3$ or $\mathbf{K}_4$. The design of the accumulator and the choice of the optimum connection location must be selected according to the hydraulic transmission behavior of the system and the operating conditions, taking the available boost volume into account. Depending on the quantity of system case drain fluid, it may be necessary to increase the boost volume with a larger or additional boost pump.

Integrated boost pump (Pos. 9)

Standard size

NG	250	355	500	750
cm^3	63[1)]	80[1)]	98	143

Control pressure relief valve (for EP and HD) (Pos. 8)

Direct operated, high-pressure-related relief

At low working pressure, the auxiliary pump pressure is regulated to the set value (e.g. 32 bar). This pressure is needed by the HD and EP controls to swivel out reliably. Using this valve saves the use of a separate control pressure pump.

If the working pressure exceeds the pressure of the boost pump, control is provided by the check valve via the high pressure. At the same time, the increase in working pressure relieves the control pressure relief valve.

The boost pump pressure is hereby reduced to the set boost pressure (e.g. 16 bar).

This function leads to energy savings, improved efficiency and a longer service life of the auxiliary pump.

For setting values, see page 6.

The control pressure relief valve is not required for the other control devices and is replaced with a threaded plug.

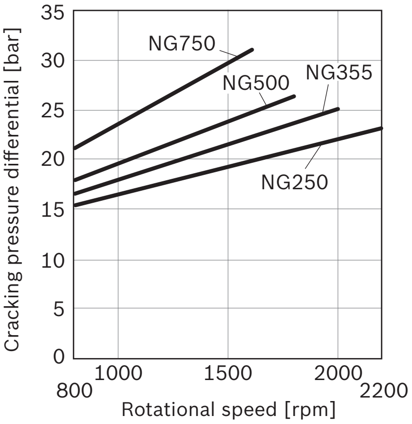
Control fluid filter (Pos. 10)

The HD and EP controls of the sizes 500 and 750 with internal control pressure supply from the high pressure are equipped with 0.2 mm coarse dirt filters as standard (regardless of the filtration order designation)

The dimensions are as show on pages 12 to 19. See circuit diagram on page 29.

Flushing valve (Pos. 4)

To open the flushing valve safely, the pressure differential between **A** and **B** is required, as shown in the diagram. The required pressure differential depends on the rotational speed and the size. The circuit temperature needs to be monitored to avoid any damage to the system.

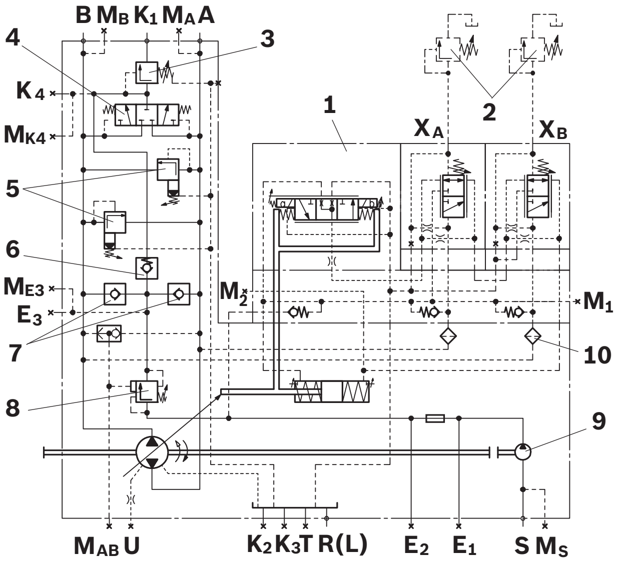


[1)] Larger boost pumps available on request

▼ Circuit diagram

Example: A4CSG...EPG...F..4N (without filter)

Sizes 500 and 750. Additional sizes available on request.



Circuit diagram NG 500/750 **with filter,** see page 32; **without** integrated boost pump, see page 30

Ports		P_{max} [bar]	State
A, B	Working line (pressure port)	400	O
S	Suction port	30	O
M_A, M_B, M_{AB}	Measuring working pressure A/B	400	X
M_S	Measuring suction	30	X
T	Fluid drain	4	X
E_1	Filter, supply	40	X
E_2	Filter, return	40	X
K_1	Flushing port	5	O
K_2, K_3	Fluid filling + air bleeding	4	X
R(L)	Return flow (drain port)	4	O
U	Bearing flushing	7	X
E_3	Boost pressure supply	40	X
M_{E3}	Measuring boost pressure	40	X
K_4	Accumulator port	40	X
M_{K4}	Measuring boost pressure	40	X
M_1	Measuring stroking chamber pressure	400	X
M_2	Measuring stroking chamber pressure	400	X
X_A, X_B	Pilot pressure, remote control pressure controller	350	O

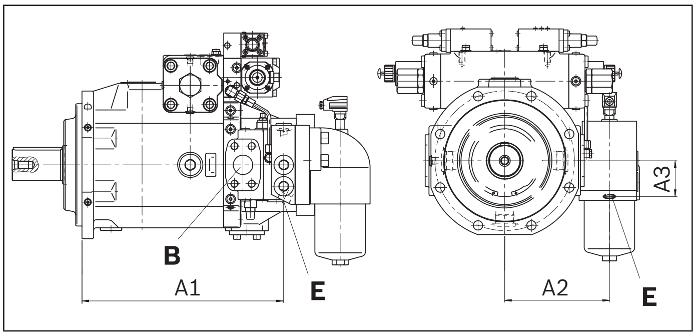
Components	
1	EPG control
2	**Pressure relief valves** (not included in the scope of delivery)
3	Boost-pressure relief valve
4	**Flushing valve**
5	High-pressure relief valves
6	Bypass valve
7	Boost check valves
8	Control pressure relief valve
9	Integrated boost pump
10	Control fluid filter for HD and EP (sizes 500 and 750)

External boost pressure supply

Without integrated boost pump (version K..)

Port **E** (or **E$_2$** for version K...N/D without filter) is intended as an external boost pressure supply and must be connected. To ensure functional reliability, maintain the required cleanliness level for the boost fluid fed in at port **E/E$_2$** (see page 5), and observe the boost pressure values (see page 6).

Dimensions, size 500



For the location and dimensions of the port E$_2$, see page 31

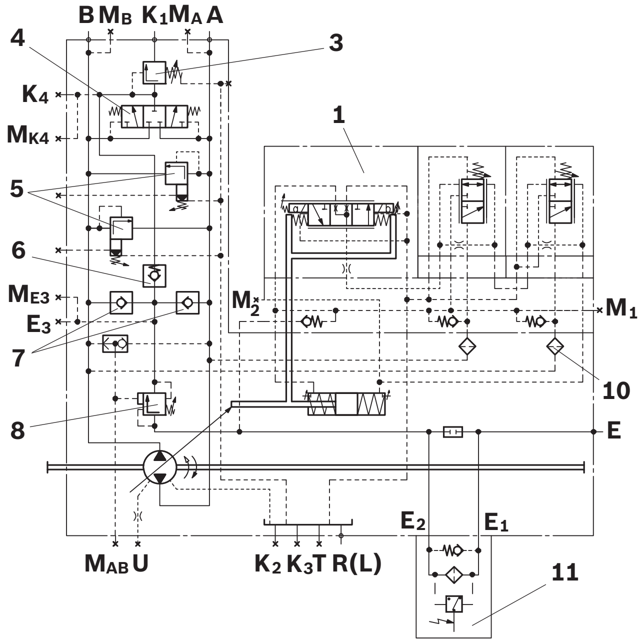
NG	A1	A2	A3	Port E	Standard
250	477	270	92	M33 × 2; 18 deep	DIN 3852
355	484	270	92	M33 × 2; 18 deep	DIN 3852
500	520	270	92	M33 × 2; 18 deep	DIN 3852
750	585	270	92	M33 × 2; 18 deep	DIN 3852

Ports		$P_{\max}$ [bar]	State
E	Boost pressure supply for version with filter	40	O
E$_2$	Boost pressure supply for version without filter	40	O
A, B	Working line (pressure port)	400	O
S	Suction port (only for version F)	30	O
M$_A$, M$_B$, M$_{AB}$	Measuring working pressure A/B	400	X
M$_S$	Measuring suction	30	X
T	Fluid drain	4	X
E$_1$	Filter, supply	40	X
E$_2$	Filter, return (for version with filter)	40	X
K$_1$	Flushing port	5	O
K$_2$, K$_3$	Fluid filling + air bleeding	4	X
R(L)	Return flow (drain port)	4	O
U	Bearing flushing	7	X
E$_3$	Boost pressure supply	40	X
M$_{E3}$	Measuring boost pressure	40	X
K$_4$	Accumulator port	40	X
M$_{K4}$	Measuring boost pressure	40	X
M$_1$	Measuring stroking chamber pressure	400	X
M$_2$	Measuring stroking chamber pressure	400	X

Circuit diagram

Example: A4CSG...EPD...K..4M

Sizes 500 and 750. Additional sizes available on request.



Components	
1	EP control
3	Boost-pressure relief valve
4	Flushing valve
5	High-pressure relief valves
6	Bypass valve
7	Boost check valves
8	Control pressure relief valve
10	Control fluid filter for HD and EP (sizes 500 and 750)
11	Filter with bypass

Filtration types[1)]

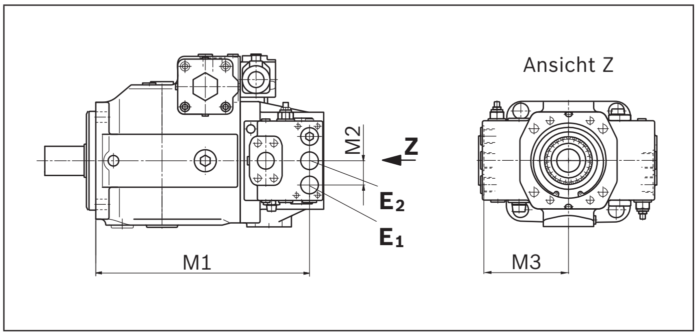
Regardless of the selected boost circuit filtration, the HD and EP controls in sizes 500 and 750 are equipped with 0.2 mm control fluid coarse dirt filters as standard (see circuit diagram).

Without filter in the boost circuit (version N)

Ports E_1 and E_2 are delivered plugged, pressure-proof and internally connected.
A boost circuit filter can be connected to these ports later on.
The internal passage between **E_1** and **E_2** must be plugged for this purpose (please contact us).
For unit dimensions, see pages 12 to 19.
See circuit diagram on page 29.

Ports for external boost circuit filtration (version D)

Ports E_1 and E_2 are intended for a filter port.
These ports are open and are only plugged with plastic screws for transportation.
The internal passage between **E_1** and **E_2** is plugged.



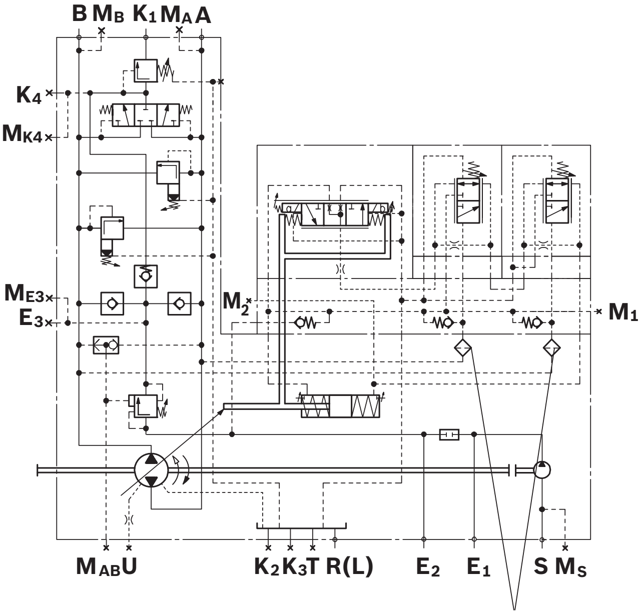
NG	M1	M2	M3	Port E1/E2	Standard
250	477	55	193	M33 × 2; 18 deep	DIN 3852
355	484	55	193	M33 × 2; 18 deep	DIN 3852
500	520	55	193	M33 × 2; 18 deep	DIN 3852
750	585	55	194	M33 × 2; 18 deep	DIN 3852

Ports		p_{max} [bar]	State
E1	Filter, supply	50	O
E2	Filter, return	50	O

Circuit diagram[1)]

Example: A4CSG...EPD...F..4D

Sizes 500 and 750. Additional sizes available on request.



Control fluid filter for HD and EP (sizes 500 and 750)

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1) For components and ports, see page 30

With mounted filter in the boost circuit (version M)

A filter is mounted directly on the pump in the pressure line of the boost pump, thus plugging the internal connection between E1 and E2.

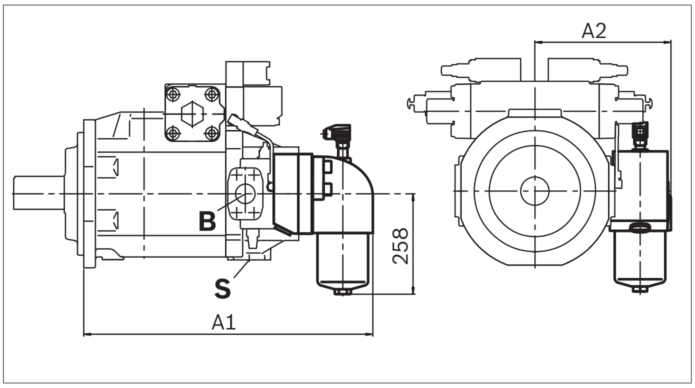
Filter version: Type DFBN/HC330QE10D1.X/V–L24

Filter with bypass and visual-electrical contamination indicator

Response pressure of the contamination indicator

Δp_a = 5 bar $_{-0.5\ \text{bar}}$

Cracking pressure of the bypass valve $\Delta p_ö$ = 6 bar $^{+0.6\ \text{bar}}$

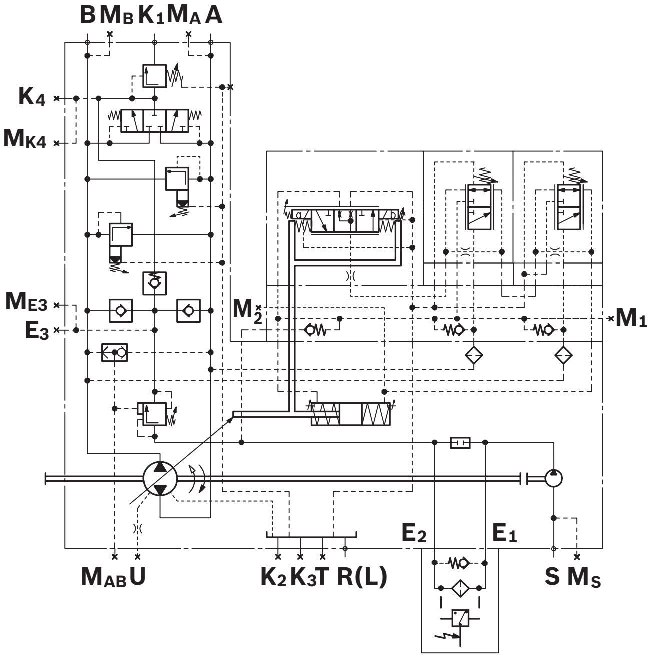


Size	A1	A2
250	699.5	200
355	706.5	347
500	742.5	
750		

Ports		$p_{\max}$ [bar]	State
A, B	Working line (pressure port)	400	O
S	Suction port	30	O
M_A, M_B, M_{AB}	Measuring working pressure A/B	400	X
M_S	Measuring suction	30	X
T	Fluid drain	4	X
E_1	Filter, supply	50	X
E_2	Filter, return	50	X
K_1	Flushing port	5	O
K_2, K_3	Fluid filling + air bleeding	4	X
R(L)	Return flow (drain port)	4	O
U	Bearing flushing	7	X
E_3	Boost pressure supply	40	X
M_{E3}	Measuring boost pressure	40	X
K_4	Accumulator port	40	X
M_{K4}	Measuring boost pressure	40	X
M_1	Measuring stroking chamber pressure	400	X
M_2	Measuring stroking chamber pressure	400	X

Example: A4CSG...EPD...F..4M

Sizes 250 and 355. Additional sizes available on request.



Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.

With particular regard to the “drive shaft upwards” installation position, we recommend bearing flushing to lubricate the front bearing and shaft seal at port **U** . See page 5.

The leakage in the housing area must be directed to the reservoir via the highest drain port (**T**, **R**(**L**), **K**$_2$, **K**$_3$).

If a shared drain line is used for several units, make sure that the respective case pressure is not exceeded. The shared drain line must be dimensioned to ensure that the maximum permissible case pressure of all connected units is not exceeded in any operational conditions, particularly at cold start. If this is not possible, separate reservoir lines must be installed if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction lines and the drain lines must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure, it must not, however, be higher than $h_{S\ max}$ = 800 mm. The minimum suction pressure at port **S** must also not fall below 0.8 bar absolute during operation. For external boost pressure supply (version **K..**) please refer to the attachment pump data sheet for details on the minimum suction pressure.

When designing the reservoir, ensure that there is adequate spacing between the suction line and the drain line. This minimizes oil turbulence and carries out degassing, which prevents the heated hydraulic fluid from being sucked directly back in again.

Installation position

See the following examples **1** to **8**.

Further installation positions are available upon request.

Recommended installation position: **1**st

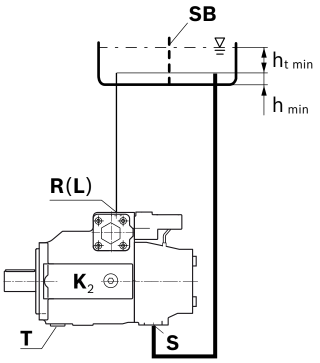
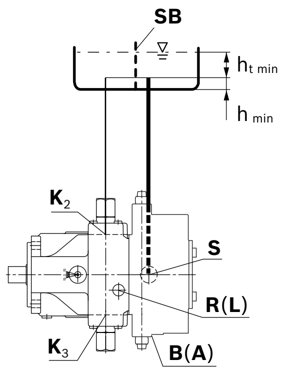
Notice

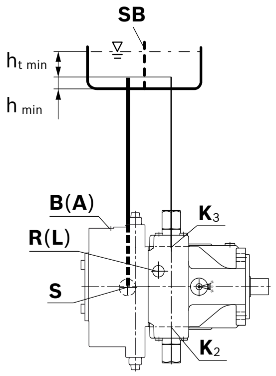
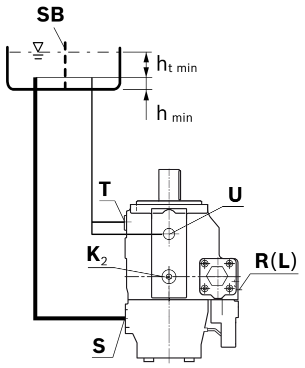
- To achieve an optimum control function, the stroking chambers must be air bled via the highest air bleed port**R2** to **R7** depending on the installation positions for HS4 and EO.
- You can expect installation positions **2**, **3**, **6** and **7** to affect the closed loop control. Due to gravity, dead weight and case pressure, minor characteristic shifts and actuating time changes may occur.

Key	
S	Suction port
T, **K**$_2$, **K**$_3$, **R**(**L**)	Fluid filling + air bleeding (drain port)
A, B	Pressure port
U	Bearing flushing port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to the reservoir bottom (100 mm)
$h_{s\ max}$	Maximum permissible suction height 800 mm for version F. For version K, observe the external boost pump specification.

Below-reservoir installation (recommended)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir and below the minimum fluid level of the reservoir.

Installation position	Air bleeding[1]	Filling
1	**R**(**L**)	**R**(**L**)
		
2	**K₂; R**(**L**) plug	**K₂**
		

Installation position	Air bleeding[1]	Filling
3	**K₃; R**(**L**) plug	**K₃**
		
4	**T; R**(**L**) plug	**T**
		

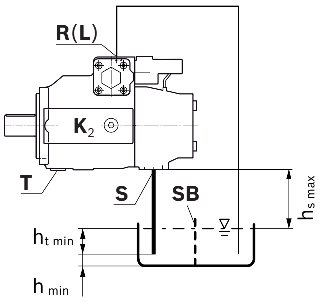
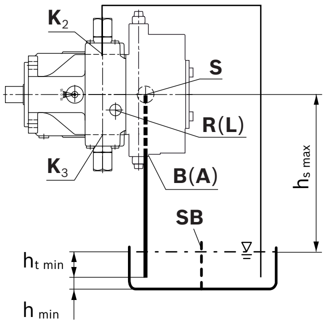
Key, see page 33.

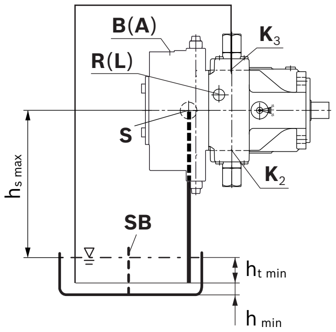
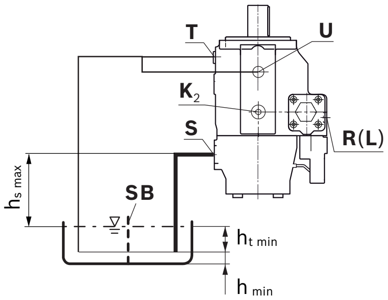
---

[1] To air bleed the stroking chamber, use the highest port on the control (see control data sheet)

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. A check valve in the drain line is to be avoided. Exceptions may be permissible, please consult us first.

Installation position	Air bleeding[1]	Filling
5 	**R**(**L**)	**R**(**L**)
6 	**K_2**; **R**(**L**) plug	**K_2**

Installation position	Air bleeding[1]	Filling
7 	**K_3**; **R**(**L**) plug	**K_3**
8 	**T**; **R**(**L**) plug	**T**

Key, see page 33.

---

[1] To air bleed the stroking chamber, use the highest port on the control (see control data sheet)

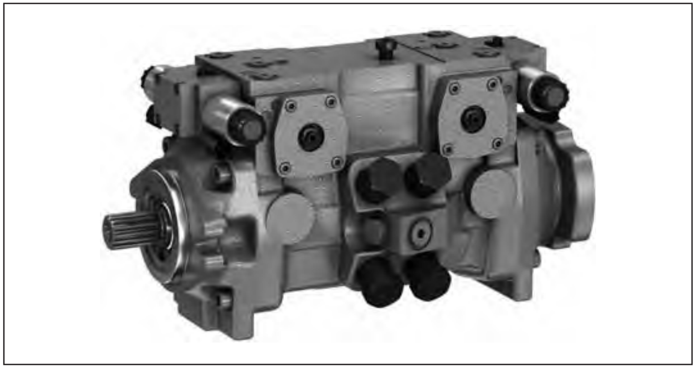
Project planning notes

- The pump A4CSG is designed to be used in closed circuit.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, this can be requested from Bosch Rexroth.
- Before finalizing your design, please request a binding installation drawing.
- The specified data and notes contained herein must be observed.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative protection is required (maximum 24 months), please specify this in plain text when placing your order. The preservation periods apply under optimal storage conditions, details of which can be found in the data sheet 90312 or in the instruction manual.
- Depending on the operating conditions of the axial piston unit (working pressure, fluid temperature), the characteristic curve may shift.
- Not all versions of the product are approved for use in a safety function according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. MTTF_d) for functional safety.
- Pressure controllers are not safeguards against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports are only intended to accommodate hydraulic lines.

Safety instructions

- During and shortly after operation, there is a risk of getting burnt on the axial piston unit and especially on the solenoids. Take the appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control equipment (e.g. valve spools) can, under certain circumstances, get stuck in position as a result of contamination (e.g. impure hydraulic fluid, abrasion, or residual dirt from components). As a result, the hydraulic fluid flow and the build-up of torque in the axial piston unit can no longer respond correctly to the operator's specifications. Even the use of various filter elements (external or internal flow filtration) will not rule out a fault but merely reduce the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to bring the driven consumer into a safe position (e.g. safe stop) and ensure any measures are properly implemented.

Axial piston variable double pump
A22VG series 40



- Size 45
- Nominal pressure 380 bar
- Maximum pressure 420 bar
- Closed circuit

Features

- Variable double pump with two axial piston rotary groups of swashplate design for hydrostatic drives in a closed circuit
- The flow is proportional to the drive speed and displacement.
- The flow can be infinitely varied by adjusting the swashplate angle.
- Flow direction changes smoothly when the swashplate is moved through the neutral position.
- Only one shared port for case drain fluid for both circuits
- Compact design for tight installation conditions

Note

Only for series no smaller than 200 units per year.
Please contact us regarding smaller series.

Contents

Ordering code

01	02	03	04	05	06	07	08	09		10	11	12	13	14	15	16	17	18	19		20
A22V	**G**	**045**							**/**	**40**	**A**		**N**	**B2**	**S7**	**3**			**A**	**–**	

Axial piston unit

01	Swashplate design, variable, nominal pressure 380 bar, maximum pressure 420 bar	**A22V**

Operating mode

02	Double pump, closed circuit	**G**

Size (NG)

03	Geometric displacement, see technical data on page 7	**045**

Control device

04	Proportional control hydraulic mechanical servo, hexagon shaft with lever, free position[1]	without neutral position switch	**HW2**
		with neutral position switch	**HW8**
	Proportional control electric	U = 12 V DC	**EP1**
		U = 24 V DC	**EP2**
	Hydraulic control, direct operated		**HT1**
	Electric control, direct operated; two pressure reducing valves per circuit	U = 12 V DC	**ET1**
		U = 24 V DC	**ET2**

Connector for solenoids[2] (see page 23)

05	Without connector (without solenoid, only for hydraulic control)	**0**
	DEUTSCH – molded connector, 2-pin – without suppressor diode	**P**

Swivel angle sensor (see page 22)

06	Without swivel angle sensor	**0**
	Electric swivel angle sensor mounted[3]	**R**

Pilot pressure ports		**HW**	**HT**	**EP**	**ET**	
07	Ports X_1 and X_2	●	–	●	●	**1**
	Ports X_3 and X_4	–	●	–	–	**3**
	Ports X_1, X_2 and X_3, X_4	●	–	●	●	**4**
	Ports X_5 and X_6	–	●	–	–	**5**

Mechanical stroke limiter (see page 22)

08	Without mechanical stroke limiter	**0**
	One-sided mechanical stroke limiter, externally adjustable, on opposite side to service line ports	**F**

DA control valve (see page 15)		**HW**	**HT**	**EP**	**ET**	
09	Without DA control valve	●	●	●	●	**0**
	DA control valve fixed setting	●	●	●	–	**1**

Series

10	Series 4, index 0	**40**

Configuration of ports and fastening threads

11	ANSI, port threads with O-ring seal according to ISO 11926	**A**

● = Available – = Not available

---

[1] On delivery, the position of the lever may differ from that shown in the brochure or drawing. If necessary, the position of the lever can be adjusted by the customer.

[2] Connectors for other electric components can deviate.

[3] Please contact us if the swivel angle sensor is used for control

01	02	03	04	05	06	07	08	09		10	11	12	13	14	15	16	17	18	19		20
A22V	**G**	**045**							**/**	**40**	**A**		**N**	**B2**	**S7**	**3**			**A**	**–**	

Direction of rotation

12	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Sealing material

13	NBR (nitrile-rubber), shaft seal in FKM (fluoroelastomer)	**N**

Mounting flange

14	SAE J744, 101-2	**B2**

Drive shaft (permissible input torque, see page 17)

15	Splined shaft ANSI B92.1a, 1 1/4 in 14T 12/24DP	**S7**

Service line ports

16	Threaded ports A and B, left (viewed on drive shaft)	**3**

Boost pump[4]

17	Without boost pump (standard)	**U**
	Boost pump	**F**

Through drive (mounting options, see page 19)

18	Flange SAE J744			Hub for splined shaft[5]			
	Diameter	Mounting[6]	Designation	Diameter		Designation	
	101-2 (B)	⚯	B2	7/8 in	13T 16/32DP	S4	**B2S4**
				1 in	15T 16/32DP	S5	**B2S5**

Pressure-relief valve

19	High-pressure relief valve, direct operated, without bypass (for values, see page 20)	**A**

Standard / special version

20	Standard version	**0**
	Standard version with installation variants, e.g. T ports against standard open or closed	**Y**
	Special version	**S**

● = Available – = Not available

Notes

- Observe the project planning notes on page 26!
- A pressure cut-off is not available for this unit.
- Preservation:
  - up to 12 months as standard
  - up to 24 months long-term (state in plain text when ordering)

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[4] Pressure or suction filtration required. To be supplied by customer. Boost pressure inlet at port G, a DA control valve is used at port G1.

[5] Hub for splined shaft according to ANSI B92.1a

[6] Mounting drillings pattern viewed on through drive with control at top

Hydraulic fluids

The A22VG variable double pump is designed for operation with HLP mineral oil according to DIN 51524.
Application notes and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)

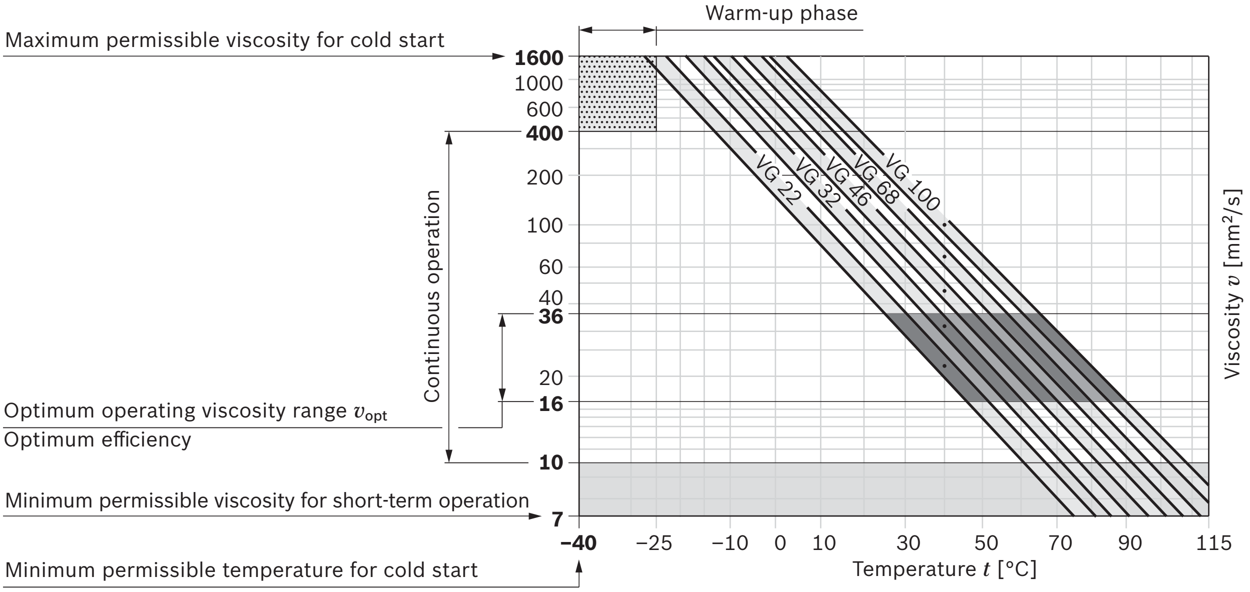
Details regarding the selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see selection diagram).

Note
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \leq 1600$ mm²/s	$\theta_{St} \geq -40$ °C	$t \leq 3$ min, $n \leq 1000$ rpm, without load $p \leq 50$ bar
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid in the system
Warm-up phase	$\nu < 1600$ to 400 mm²/s	$\theta = -40$ °C to -25 °C	At $p \leq 0.7 \times p_{nom}$, $n \leq 0.5 \times n_{nom}$ and $t \leq 15$ min
Continuous operation	$\nu = 400$ to 10 mm²/s		This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram)
		$\theta = -25$ °C to +110 °C	measured at port T Note the permissible temperature range of the shaft seal (ΔT = approx. 5 K between the bearing/shaft seal and port **T**)
	$\nu_{opt} = 36$ to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \geq 7$ mm²/s		$t < 3$ min, $p < 0.3 \times p_{nom}$

▼ **Selection diagram**



Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

A cleanliness level of at least 20/18/15 is to be maintained according to ISO 4406.

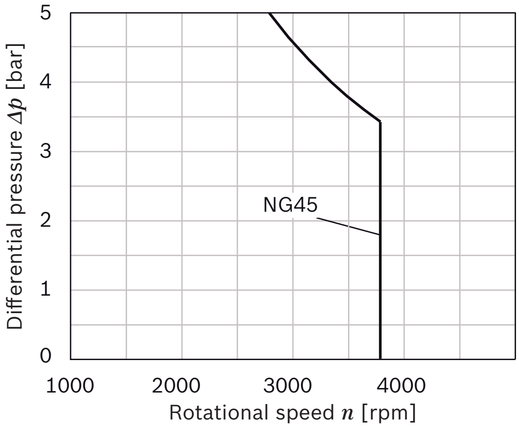
We recommend, depending on the system and application, for the A22VG: filter cartridges $\beta_{20} \geq 100$.

At very high hydraulic fluid temperatures (90 °C to maximum 110 °C, measured at port T), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

Shaft seal

Permissible pressure loading

The service life of the shaft seal is influenced by the speed of the axial piston unit and the leakage pressure in the housing (case pressure). Momentary pressure spikes ($t < 0.1$ s) of up to 10 bar are permitted. The service life of the shaft seal decreases with increasing frequency of pressure spikes and increasing mean differential pressure. The case pressure must be equal to or higher than the ambient pressure.

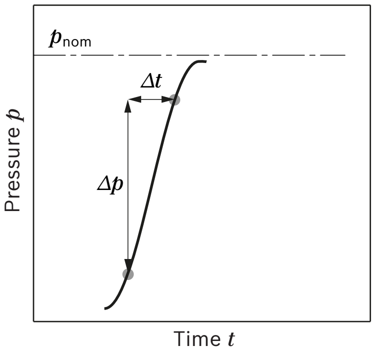


The FKM shaft seal may be used for leakage temperatures from –25 °C to +115 °C. For application cases below –25 °C, an NBR shaft seal is required (permissible temperature range: –40 °C to +90 °C).

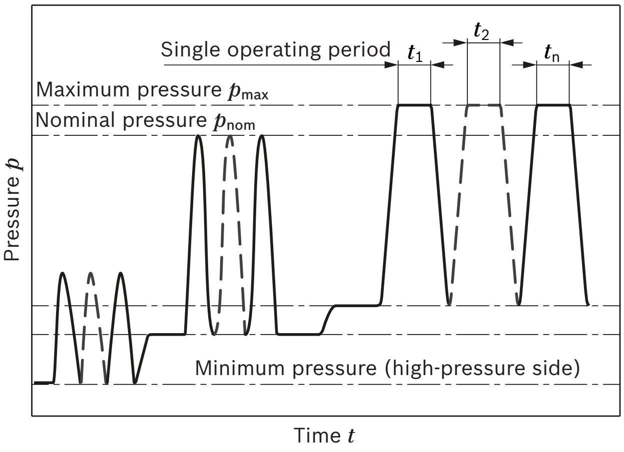
Operating pressure range

Pressure at service line port A or B		**Definition**
Nominal pressure p_{nom}	380 bar absolute	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	420 bar absolute	The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.
Single operating period	10 s	
Total operating period	300 h	
Minimum pressure (high-pressure side)	25 bar absolute	Minimum pressure at the high-pressure side (A or B) which is required in order to prevent damage to the axial piston unit.
Minimum pressure (low-pressure side)	10 bar above case pressure	Minimum pressure at the low-pressure side (A or B) which is required in order to prevent damage to the axial piston unit. Boost pressure setting must be higher depending on system.
Rate of pressure change $R_{A\ max}$	9000 bar/s	Maximum permissible rate of pressure build-up and reduction during a pressure change over the entire pressure range.
Boost pump		
Nominal pressure $p_{Sp\ nom}$	25 bar absolute	
Maximum pressure $p_{Sp\ max}$	30 bar absolute	
Pressure at suction port S (inlet)		
Continuous $p_{S\ min}$ ($\nu \leq 30\ mm^2/s$)	≥0.8 bar absolute	
Short-term, on cold start (t < 3 min)	≥0.5 bar absolute	
Maximum pressure $p_{S\ max}$	≤5 bar absolute	
Control pressure		
Minimum control pressure $p_{St\ min}$		To ensure the function of the control, a minimum control pressure $p_{St\ min}$ at n = 2000 rpm is required depending on the rotational speed and operating pressure.
Controls EP and HW	18 bar above case pressure	
Controls ET and HT	25 bar above case pressure	

▼ **Rate of pressure change $R_{A\ max}$**



▼ **Pressure definition**



Total operating period = $t_1 + t_2 + ... + t_n$

Note

Operating pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

Technical data

Size			NG		45
Displacement geometric, per revolution	variable pump (for each rotary group)		$V_{g\,max}$	cm^3	2 x 46
	boost pump (at p = 25 bar)		$V_{g\,Sp}$	cm^3	14.9
Rotational speed[1]	maximum at $V_{g\,max}$		n_{nom}	rpm	3300[6]
	limited maximum[2]		n_{max1}	rpm	3550
	intermittent maximum[3]		n_{max2}	rpm	3800
	minimum		n_{min}	rpm	500
Flow	at $V_{g\,max}$ and n_{nom}		q_v	l/min	2 x 152
Power[4]	at $V_{g\,max}$, n_{nom} and Δp = 380 bar		P	kW	192
Torque[4]	at $V_{g\,max}$ and	Δp = 300 bar	T	Nm	556
		Δp = 100 bar	T	Nm	146
Rotary stiffness drive shaft	1 1/4 in S7	Pump 1	c_1	Nm/rad	73804
		Pump 2	c_2	Nm/rad	23066
Moment of inertia (see graphic below)	rotary group 1		J_{TW1}	kgm^2	0.003327
	rotary group 2		J_{TW2}	kgm^2	0.003293
Maximum angular acceleration for each rotary group[5]			α	rad/s^2	4000
Case volume			V	L	1.7
Weight with HT control (approx.)			m	kg	53

Determination the operating characteristics		
Flow	$q_v = \dfrac{V_g \times n \times \eta_v}{1000}$	[l/min]
Torque	$T = \dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{mh}}$	[Nm]
Power	$P = \dfrac{2\,\pi \times T \times n}{60000} = \dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g = Displacement per revolution [cm^3]

Δp = Differential pressure [bar]

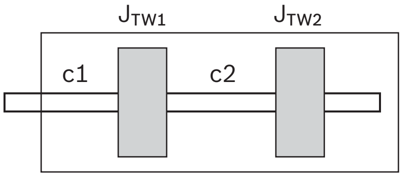
n = Rotational speed [rpm]

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Total efficiency ($\eta_t = \eta_v \times \eta_{mh}$)

▼ **Spring-mass system with moment of inertia**



Notes

- Theoretical values, without efficiency levels and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Bosch Rexroth recommends checking the loading by means of testing or calculation / simulation and comparison with the permissible values.
- Transport and storage
  - $\theta_{min} \geq -50$ °C
  - θ_{opt} = +5 °C to +20 °C

---

[1] The values are valid:
- for the optimum viscosity range of ν_{opt} = 36 to 16 mm^2/s
- with hydraulic fluid based on mineral oil

[2] limited maximum speed:
At half corner power (e.g., at $V_{g\,max}$ and $p_{nom}/2$)

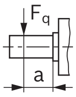
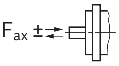
[3] Intermittent maximum speed at:
- high idle
- overspeed: Δp = 70 to 150 bar and $V_{g\,max}$
- reversing peaks: Δp < 300 bar and t < 0.1 s.

[4] Without boost pump

[5] The data are valid for values between the minimum required and maximum permissible rotational speed. Valid for external excitation (e. g. diesel engine 2 to 8 times rotary frequency; cardan shaft twice the rotary frequency). The limit value applies for a single pump only. The load capacity of the connection parts must be considered.

[6] When using a boost pump, please consult with the responsible plant.

Permissible radial and axial forces of the drive shaft

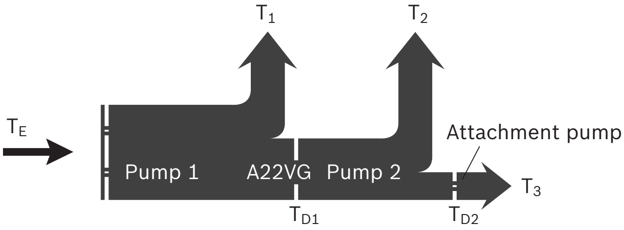
Size		NG		45
Drive shaft			in	1 1/4
Maximum radial force at distance a (from shaft collar)		$F_{q\ max}$	N	3190
		a	mm	24
Maximum axial force		$\pm F_{ax\ max}$	N	1500

Note
Special requirements apply in the case of belt drive and cardan shaft. Please contact us.

Permissible input and through-drive torques

Size			NG		45
Torque at $V_{g\ max}$ and Δp = 380 bar[1]			T	Nm	556
Maximum input torque at drive shaft[2]					
	S7	1 1/4 in	$T_{E\ max}$	Nm	602
Maximum through-drive torque			$T_{D1\ max}$	Nm	300
			$T_{D2\ max}$	Nm	$T_{D2\ perm} = 300 - T_2$

▼ **Torque distribution**



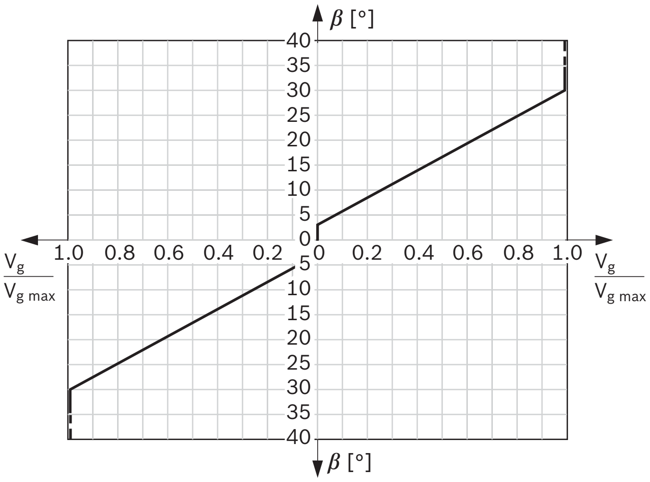
Torque – A22VG	1st pump	T_1		
	2nd pump	T_2		
Torque – attachment pump		T_3		
Input torque		T_E	=	$T_1 + T_2 + T_3$
		T_E	<	$T_{E\ max}$
Through-drive torque		T_{D1}		
		T_{D2}		

---

1) Efficiency not considered
2) For drive shafts without radial force

HW – proportional control hydraulic, mechanical servo

The output flow of the pump is infinitely variable between 0 to 100%, proportional to the swivel angle of the control lever.
A feedback lever, connected to the stroking piston maintains the pump flow for a given position of the control lever.
If the pump is also equipped with a DA control valve (see page 15), automotive operation is possible for travel drives.



Swivel angle β at the control lever for pump displacement change:

- Start of control at $\beta = \pm 3°$
- End of control at β (max. displacement $V_{g\,max}$) at ±30°
- Rotation limiting β of the control lever (internal) ±38°

The maximum required torque at the lever is 170 Ncm. To prevent damage to the HW control module, a mechanical stop must be provided by the customer for the HW control lever.

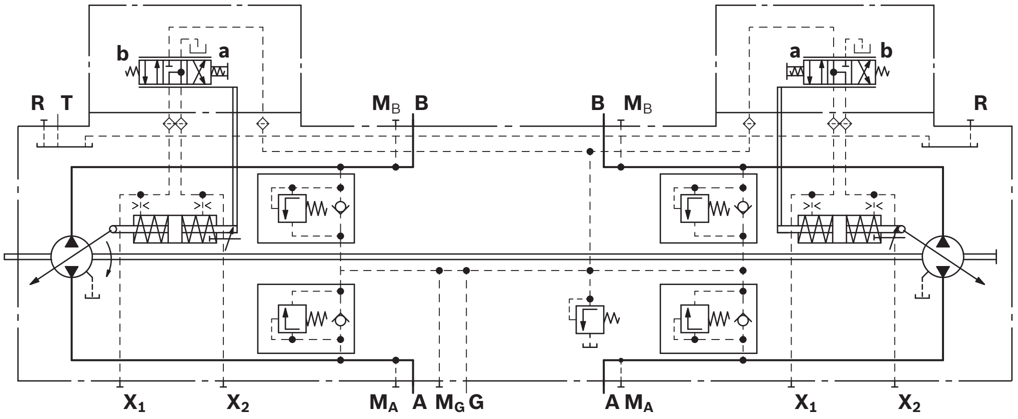
Note
Spring centering enables the pump, depending on pressure and rotational speed, to move automatically to the neutral position ($V_g = 0$) as soon as there is no longer any torque on the control lever of the HW control module (regardless of deflection angle).

Variation: Neutral position switch

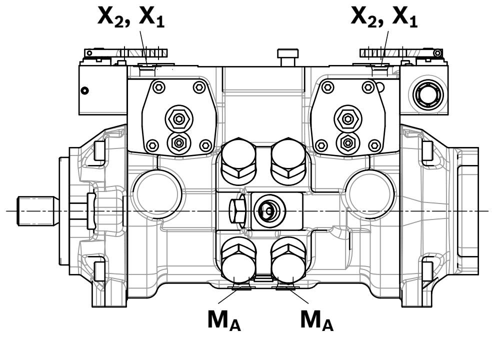
The switch contact in the neutral position switch is closed when the control lever on the HW control module is in its neutral position. The switch opens when the control lever is moved out of neutral in either direction.
Thus, the neutral position switch provides a monitoring function for drive units that require the pump to be in the neutral position during certain operating conditions (e.g. starting diesel engines).

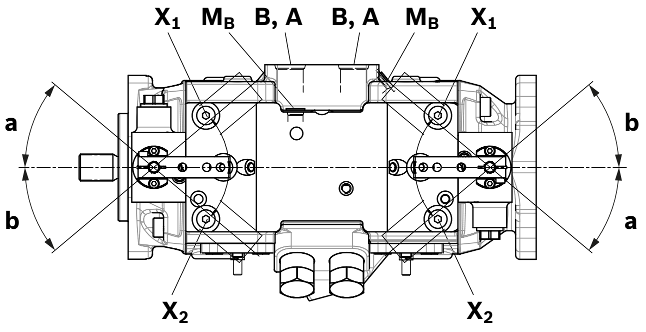
Technical data	
Load capacity	20 A (continuous), without switching operations
Switching capacity	15 A / 32 V (resistive load)
	4 A / 32 V (inductive load)
Connector version	DEUTSCH DT04-2P-EP04 (Mating connector, see page 23)

▼ **Schematic**



Assignment of direction of rotation, control and flow direction								
Direction of rotation	clockwise				counter-clockwise			
Pump	Pump 1		Pump 2		Pump 1		Pump 2	
Lever direction	a	b	a	b	a	b	a	b
Control pressure (X_3, X_4 optional, see page 21)	X_2	X_1	X_1	X_2	X_2	X_1	X_1	X_2
	X_4	X_3	X_3	X_4	X_4	X_3	X_3	X_4
Flow direction	A to B	B to A	B to A	A to B	B to A	A to B	A to B	B to A
Operating pressure	M_B	M_A	M_A	M_B	M_A	M_B	M_B	M_A





EP – Proportional control electric

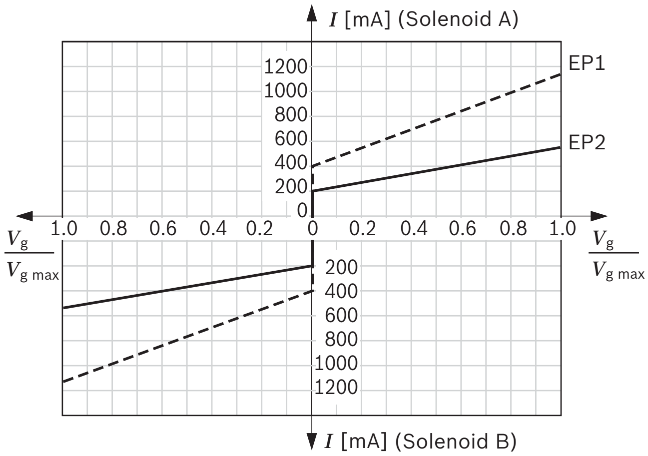
The output flow of the pump is infinitely variable between 0 to 100%, proportional to the electrical current supplied to solenoid **a** or **b**.

The electrical energy is converted into a force acting on the control spool.

This valve spool then directs control oil into and out of the stroking cylinder to adjust pump displacement as required.

A feedback lever, connected to the stroking piston maintains the pump flow for a given current within the control range.

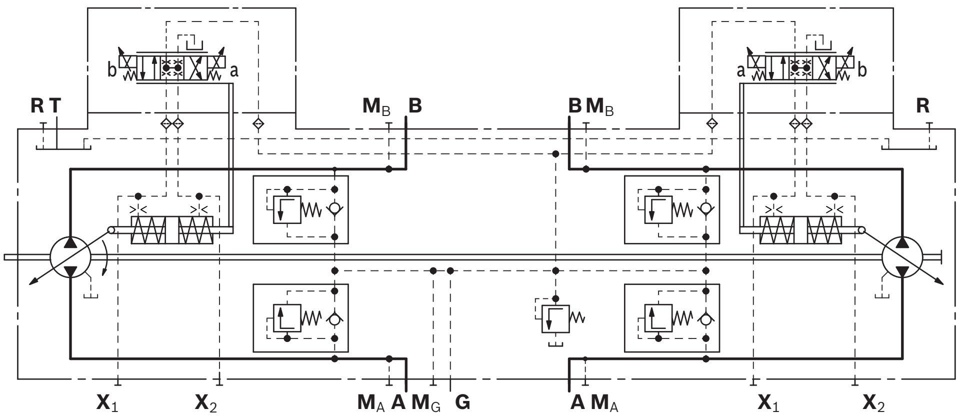
If the pump is also equipped with a DA control valve (see page 15), automotive operation is possible for travel drives.



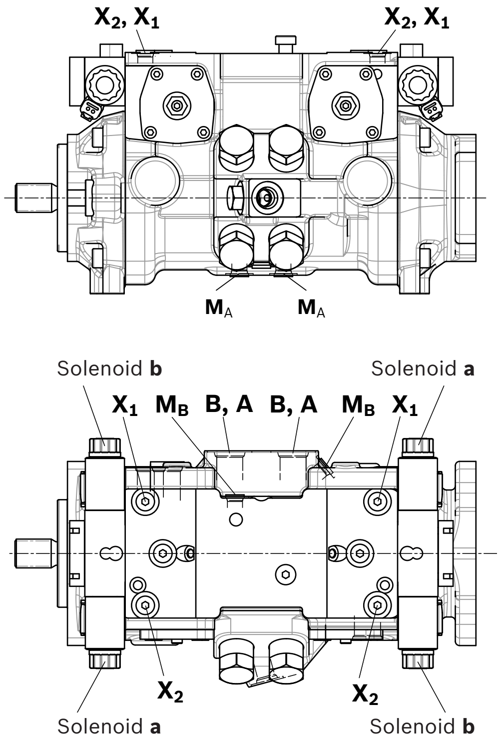
Technical data, solenoid	**EP1**	**EP2**
Voltage	12 V (±20%)	24 V (±20%)
Control current		
Beginning of control at $V_g = 0$	400 mA	200 mA
End of control at $V_{g\,max}$	1115 mA	560 mA
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100 %	100 %
Type of protection, see connector version on page 23		

Various BODAS controllers with application software and amplifiers are available for controlling the proportional solenoids.

▼ **Schematic**

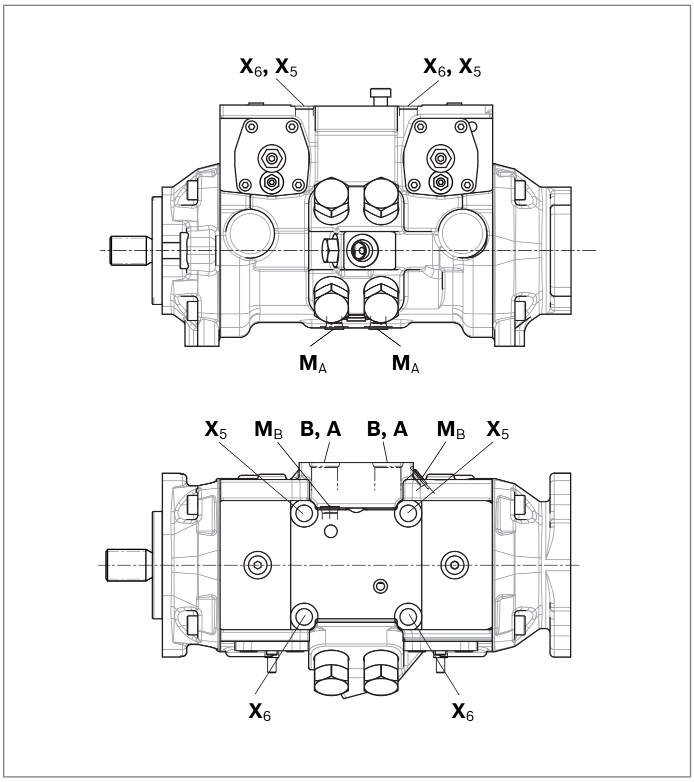


Assignment of direction of rotation, control and flow direction								
Direction of rotation	clockwise				counter-clockwise			
Pump	Pump 1		Pump 2		Pump 1		Pump 2	
Actuation of solenoid	a	b	a	b	a	b	a	b
Control pressure (X_3, X_4 optional, see page 21)	X_2	X_1	X_1	X_2	X_2	X_1	X_1	X_2
	X_4	X_3	X_3	X_4	X_4	X_3	X_3	X_4
Flow direction	A to B	B to A	B to A	A to B	B to A	A to B	A to B	B to A
Operating pressure	M_B	M_A	M_A	M_B	M_A	M_B	M_B	M_A

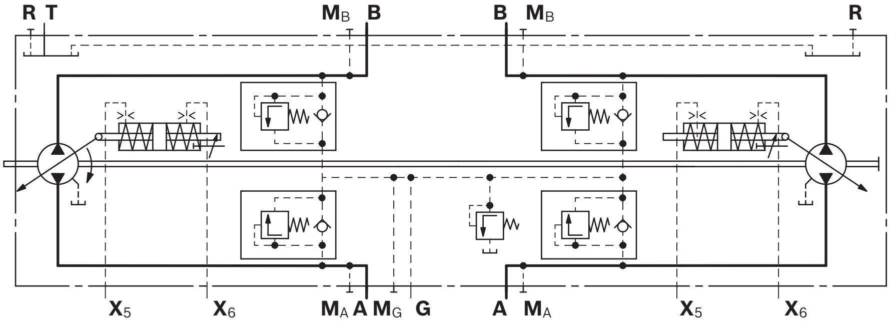


HT – Hydraulic control, direct operated

With the direct hydraulic control, the flow of the pump is influenced by a hydraulic control pressure that is applied directly to the stroking piston through **X_5** or **X_6**.
Flow direction is determined by which control pressure port is pressurized (refer to table below).
Pump displacement is infinitely variable and proportional to the applied control pressure, but is also influenced by system pressure and pump drive speed.
Maximum permissible control pressure: 30 bar
Use of the HT control requires a review of the engine and vehicle parameters to ensure that the pump is set up correctly. We recommend that all HT applications be reviewed by a Bosch Rexroth application engineer.
The DA control valve only becomes effective if the pilot control device used for controlling the HT control is supplied from port **Y**.



▼ **Schematic**

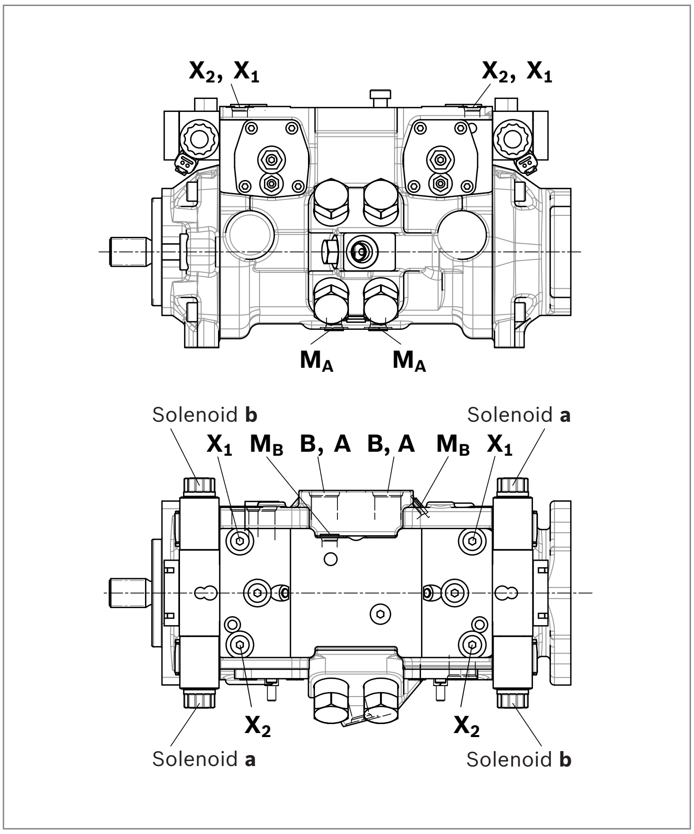


Assignment of direction of rotation, control and flow direction								
Direction of rotation	clockwise				counter-clockwise			
Pump	Pump 1		Pump 2		Pump 1		Pump 2	
Control pressure (X_3, X_4 optional, see page 21)	X_6	X_5	X_5	X_6	X_6	X_5	X_5	X_6
	X_4	X_3	X_3	X_4	X_4	X_3	X_3	X_4
Flow direction	A to B	B to A	B to A	A to B	B to A	A to B	A to B	B to A
Operating pressure	M_B	M_A	M_A	M_B	M_A	M_B	M_B	M_A

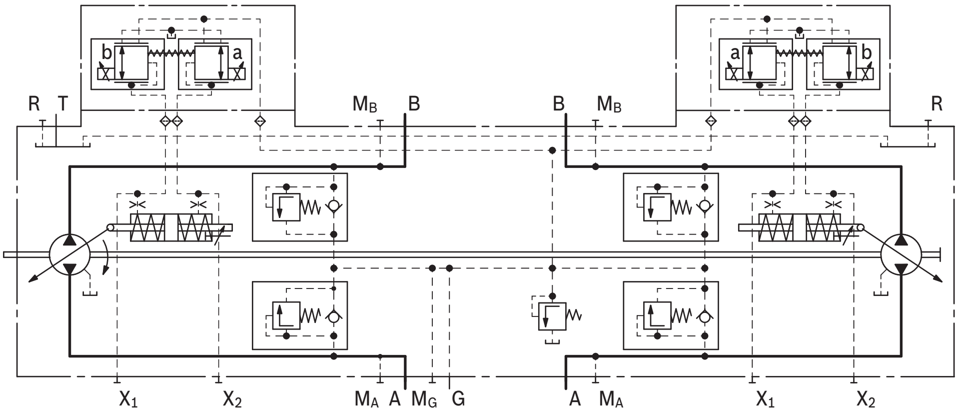
ET – Electric control, direct operated

The output flow of the pump is infinitely variable in the range 0 to 100%. Depending on the preselected current I (mA) at solenoids **a** and **b** of the pressure reducing valves, the stroking cylinder of the pump is proportionally supplied with control pressure. The pump displacement that arises at a certain control current is dependent on the rotational speed and operating pressure of the pump. A different flow direction is associated with each pressure reducing valve. Maximum permissible control pressure: 30 bar

Technical data, solenoid	ET1	ET2
Voltage	12 V (±20%)	24 V (±20%)
Current limit	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100 %	100 %
Type of protection, see connector version on page 23		



▼ Schematic



Assignment of direction of rotation, control and flow direction								
Direction of rotation	clockwise				counter-clockwise			
Pump	Pump 1		Pump 2		Pump 1		Pump 2	
Actuation of solenoid	a	b	a	b	a	b	a	b
Control pressure (X_3, X_4 optional, see page 21)	X_2	X_1	X_1	X_2	X_2	X_1	X_1	X_2
	X_4	X_3	X_3	X_4	X_4	X_3	X_3	X_4
Flow direction	A to B	B to A	B to A	A to B	B to A	A to B	A to B	B to A
Operating pressure	M_B	M_A	M_A	M_B	M_A	M_B	M_B	M_A

DA – Control valve, fixed setting

Speed related pilot pressure supply

The DA closed loop control is an engine speed-dependent system for travel drives. The built-in DA control valve generates a pilot pressure which is proportional to pump (engine) drive speed. The pump displacement is infinitely variable in each flow direction and is influenced by both pump drive speed and system pressure.

Increasing the pump drive speed causes the DA control valve to generate a higher pilot pressure with a resulting increase in the flow from the pump.

Depending on the selected pump operating characteristics, increasing system pressure (e.g. machine load) causes the pump to swivel back towards a smaller displacement.

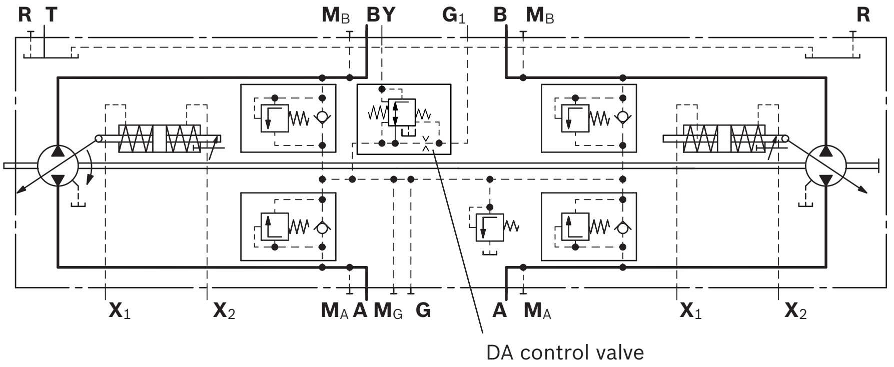
Diesel engine overload protection (anti-stall) is achieved by the combination of this pressure-related pump de-stroking, and the reduction of pilot pressure as the engine speed drops.

Any additional power requirement, e.g. for hydraulic functions from attachments, could cause the engine speed to drop further. This would cause a further reduction in pilot pressure and thus of pump displacement. Automatic power distribution and full exploitation of the available power are achieved in this way, both for the travel drive and for the implement hydraulics, with priority given to the implement hydraulics.

The DA control valve can also be used in pumps with EP, HT and HW control modules to protect the combustion engine against overload.

DA closed loop control is only suitable for certain types of drive systems and requires review of the engine and vehicle parameters to ensure that the pump is used correctly and that machine operation is safe and efficient. We recommend that all DA applications be reviewed by a Bosch Rexroth application engineer.

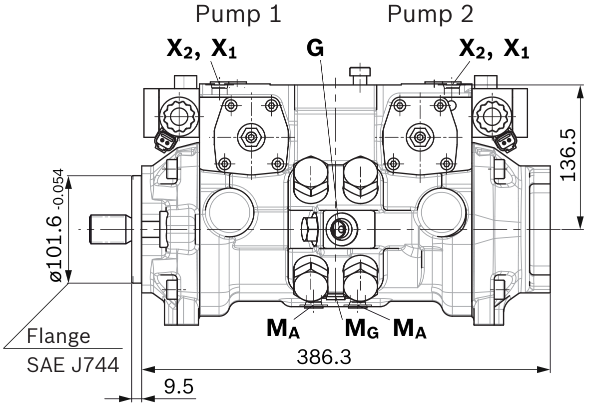
▼ **Schematic**

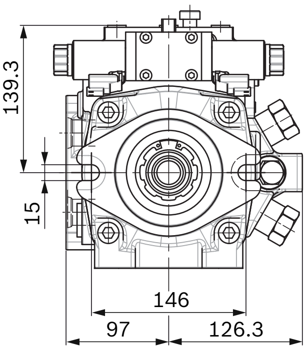


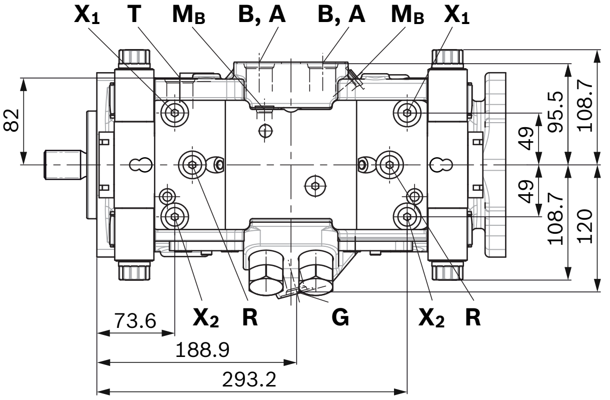
Dimensions size 45

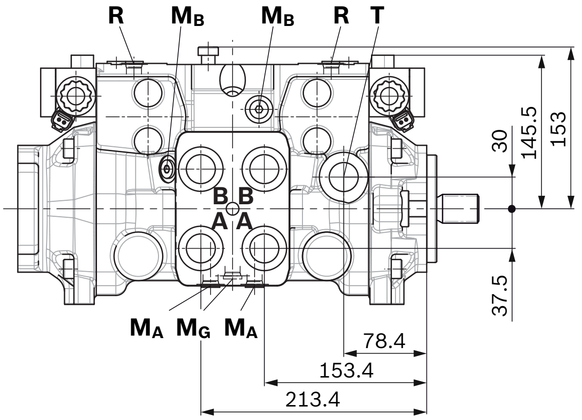
EP – Proportional control electric

ET – Electric control, direct operated

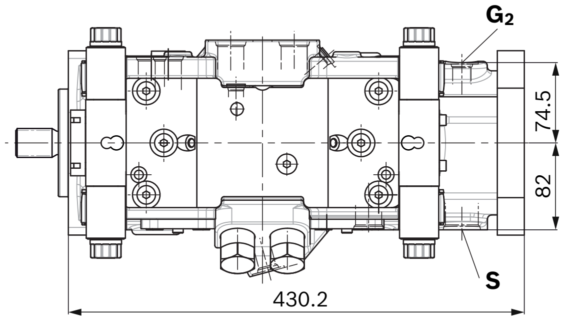


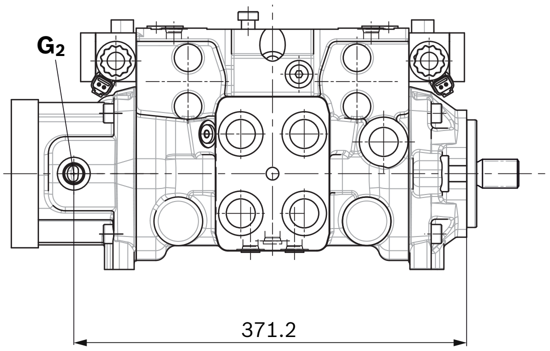






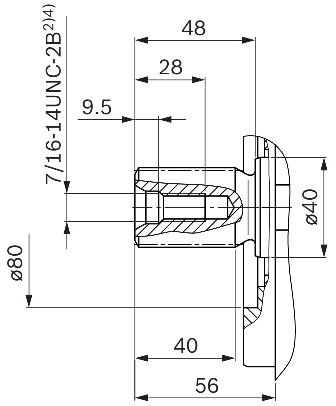
Version with boost pump





▼ Splined shaft SAE J744

S7 – 1 1/4 in 14T 12/24DP[1]



Ports		**Standard**[3]	**Size [in]**[4]	**$p_{\text{max abs}}$ [bar]**[5]	**State**[7]
A, B	Working port	ISO 11926	1 1/16-12 UN-2B; 20 deep	420	O
S	Suction port (only for boost pump)	ISO 11926	1 5/16-12 UN-2B; 20 deep	5	O
T	Drain port	ISO 11926	1 1/16-12 UN-2B; 20 deep	3	O
R	Air bleed	ISO 11926	9/16-18 UNF-2B; 13 deep	3	X
X_1, X_2	Control pressure (upstream of orifice, only HP, HW, EP, ET)	ISO 11926	9/16-18 UNF-2B; 13 deep	30	X
X_5, X_6	Control pressure (upstream of orifice, HT only)	ISO 11926	9/16-18 UNF-2B; 13 deep	30	O
X_3, X_4[6]	Stroking chamber pressure	ISO 11926	7/16-20 UNF-2B; 12 deep	30	X
Y	Pilot pressure, outlet (only for DA control valve)	ISO 11926	9/16-18 UNF-2B; 13 deep	30	O
G	Boost pressure, inlet	ISO 11926	3/4-16 UNF-2B; 15 deep	30	O
G_1	Boost pressure, inlet (only for DA control valve)	ISO 11926	3/4-16 UNF-2B; 13 deep	30	O
G_2	Boost pressure, outlet (only for boost pump)	ISO 11926	3/4-16 UNF-2B; 15 deep	30	O
M_G	Measuring boost pressure G	ISO 11926	9/16-18 UNF-2B; 13 deep	30	X
M_A, M_B	Measuring pressure A, B	ISO 11926	9/16-18 UNF-2B; 13 deep	420	X

---

1) Involute spline according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

2) Thread according to ASME B1.1

3) The spot face can be deeper than specified in the appropriate standard.

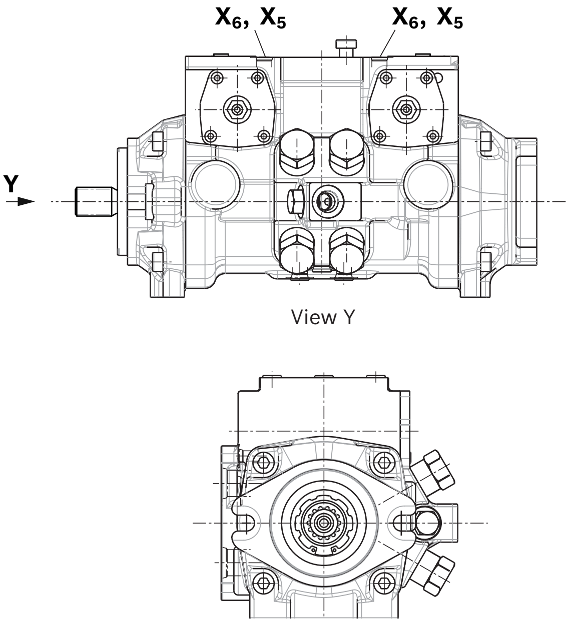
4) For notes on tightening torques, see instruction manual

5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

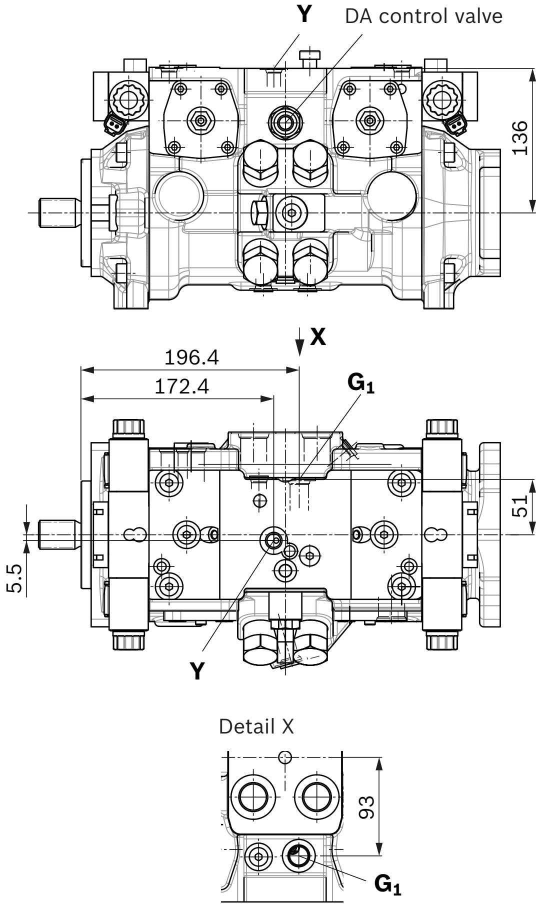
6) Optional, see page 21

7) O = Must be connected (plugged on delivery)
X = Plugged (normal operation)

▼ **HT – Hydraulic control, direct operated**



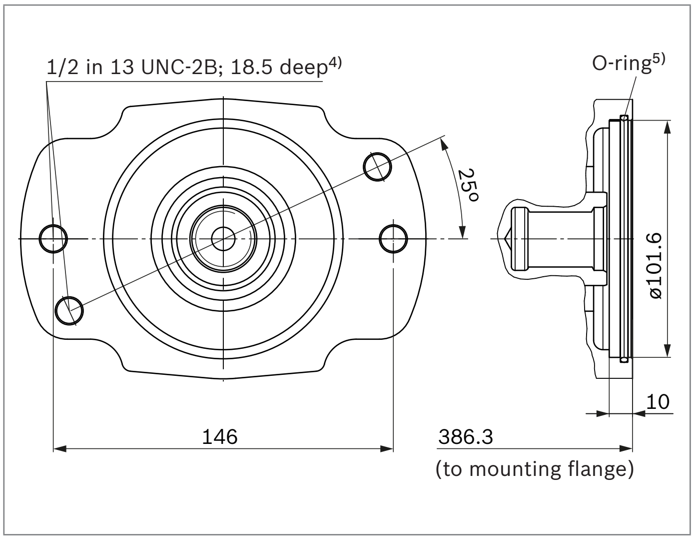
▼ **DA control valve**



Through drive dimensions

Flange SAE J744[1]			Hub for splined shaft[2]			Availability	Short code
Diameter	attachment[3]	Designation	Diameter		Designation	045	
101-2 (B)	⚬⚬	B2	7/8 in	13T 16/32DP	S4	●	B2S4
			1 in	15T 16/32DP	S5	●	B2S5

▼ **101-2**



Overview of attachment options

Through drive			Attachment option – additional pumps		
Flange	Hub for splined shaft	Short code	A10VG NG (shaft)	A10V(S)O/53 NG (shaft)	External gear pump[6]
101-2 (B)	7/8 in	B2S4	18 (S)	28 (S) 45 (U)	Series N, NG20 to 36 Series G, NG32 to 50
	1 in	B2S5	28, 45 (S)	45 (S) 60 (U)	–

Combination pumps

By using combination pumps, it is possible to have independent circuits without the need for splitter gearboxes. When ordering combination pumps, the type designations of the 1st and 2nd pump must be linked by a "**+**".

Ordering example

A22VG045HT100100/40AR + AZPN....

The A22VG variable double pump is permissible without additional supports where the dynamic mass acceleration does not exceed maximum 10 *g* (= 98.1 m/s^2). When mounting another pump on the A22VG, the mounting flange must be rated for the permissible mass torque.

---

[1] The through-drive flange is only supplied with the fastening thread corresponding to the ordering code designation.

[2] According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[3] Mounting drillings pattern viewed on through drive, with control at top

[4] Thread according to ASME B1.1, for notes on tightening torques, see instruction manual

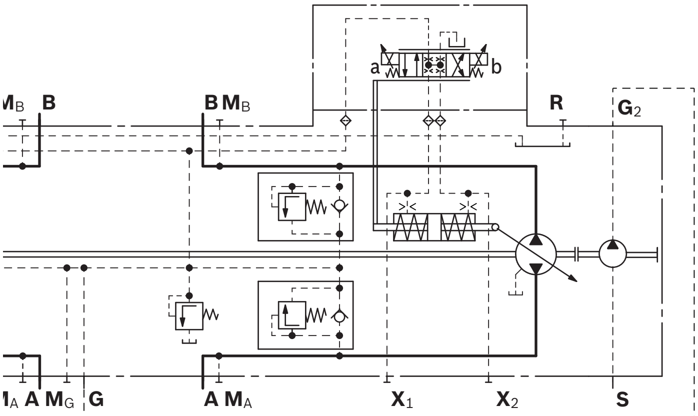
[5] O-ring included in the scope of delivery

[6] Bosch Rexroth recommends special versions of the external gear pumps. Please contact us.

Boost pump

The boost pump continuously supplies a volume of fluid (boost volume) from a reservoir to the low-pressure side of the closed circuit via a check valve to replenish the internal leakage of the variable double pump and consumer.
The boost pump is an internal gear pump that is driven directly via the drive shaft. The pressure port $\mathbf{G}_2$ of the boost pump must be externally piped up to port **G** (or $\mathbf{G}_1$ by the customer for version with DA control valve) (see example circuit diagram below). Suction or pressure filtration is to be provided by the customer.

▼ **Schematic**

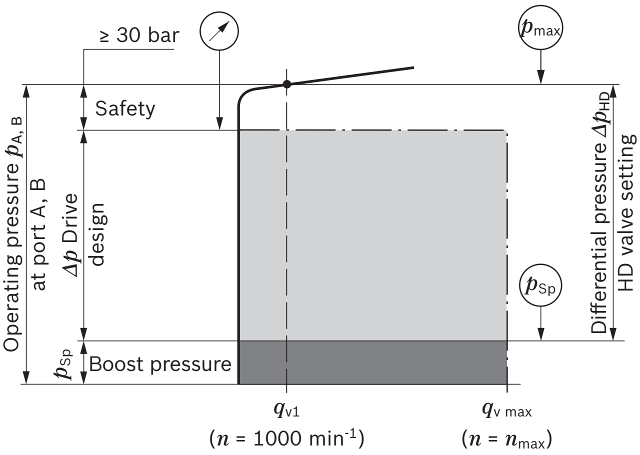


Piping by customer

High-pressure relief valves

The four high-pressure relief valves protect the hydrostatic transmission (pump and motor) from overload. They limit the maximum pressure in the respective high-pressure line and serve simultaneously as boost valves.
High-pressure relief valves are not working valves and are only suitable for pressure spikes or high rates of pressure change.

Setting the valves



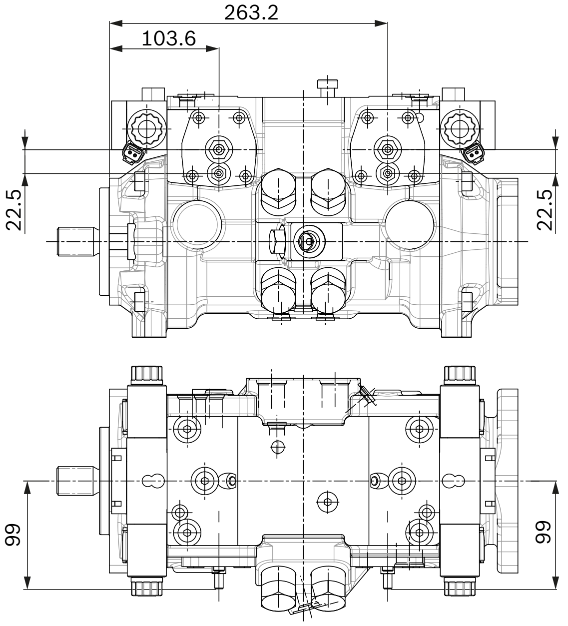
- ▶ The valve settings are made at n = 1000 rpm and at $V_{g\,max}$ ($q_{v\,1}$). There may be deviations in the cracking pressures with other operating parameters.
- ▶ The differential pressure setting is preset in the range Δp = 250 to 390 bar in increments of 10 bar.
- ▶ When ordering, state differential pressure setting in plain text.

Settings on high-pressure relief valve A and B (Pump 1 and 2)	
Differential pressure setting	Δp_{HD} = ... bar
Cracking pressure of the HD valve (at $q_{V\,1}$) ($p_{max} = \Delta p_{HD} + p_{Sp}$)	p_{max} = ... bar

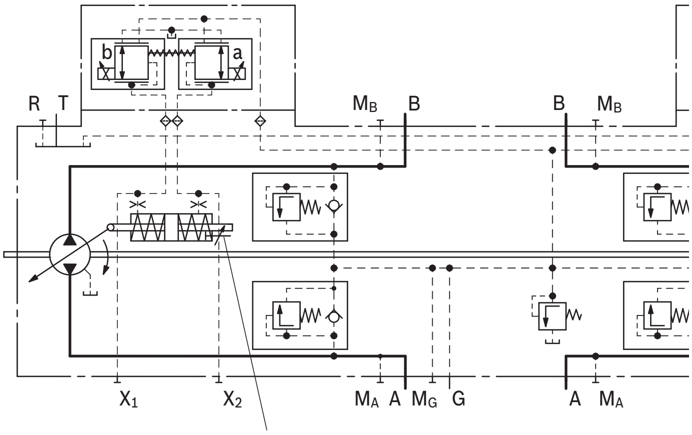
Mechanical stroke limiter

The mechanical stroke limiter is an additional function allowing the maximum displacement of the pump to be steplessly reduced, regardless of the control module used. With one threaded pin per pump, the stroke of the stroking piston and thus the maximum swivel angle per pump is limited on one side.

Dimensions



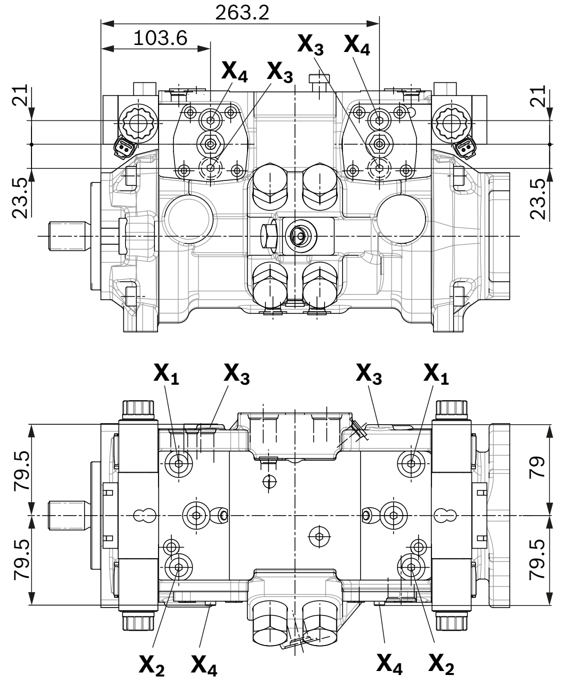
▼ Schematic



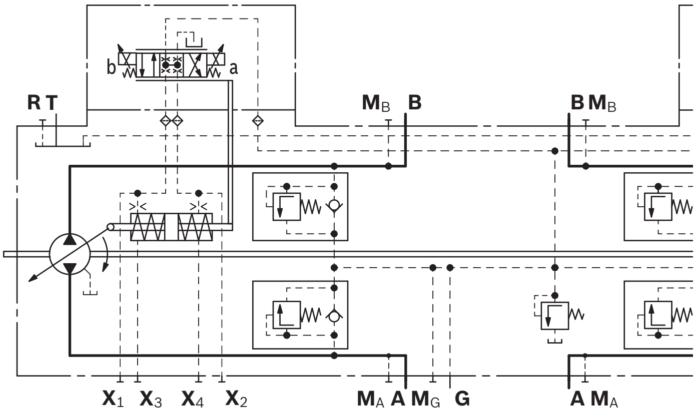
Mechanical stroke limiter, on one side

Ports X_3 and X_4 for stroking chamber pressure

Dimensions



▼ Schematic



Ports		Standard[1]	Size [in][2]	$p_{max\ abs}$ [bar][3]	State[4]
X_3, **X_4**	Stroking chamber pressure	ISO 11926	7/16-20 UNF-2B; 12 deep	30	X

---

[1] The spot face can be deeper than specified in the appropriate standard.

[2] For notes on tightening torques, see instruction manual

[3] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[4] X = Plugged (in normal operation)

Swivel angle sensor

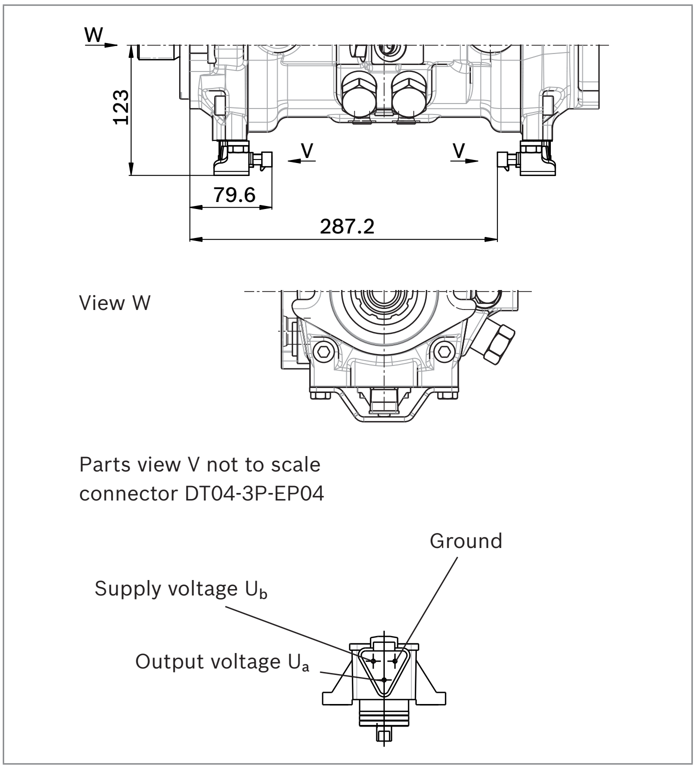
For the swivel angle indicator, the pump swivel angle is measured by an electric swivel angle sensor.
As an output parameter, the Hall-effect swivel angle sensor delivers a voltage proportional to the swivel angle (see table of output voltages).
Please contact us if the swivel angle sensor is used for control.

Characteristics			
Supply voltage U_b	10 to 30 V DC		
Output voltage U_a	1 V ($V_{g\ max}$)	2.5 V ($V_{g\ 0}$)	4 V ($V_{g\ max}$)
Reverse polarity protection	Short circuit-resistant		
EMC resistance	Details on request		
Operating temperature range	–40 °C to +115 °C		
Vibration resistance sinusoidal vibration EN 60068-2-6	10 g / 5 to 2000 Hz		
Shock resistance continuous shock IEC 68-2-29	25 g		
Salt spray resistance DIN 50 021-SS	96h		
Type of protection with mounted mating connector	IP67 (DIN/EN 60529) and IP69K (DIN 40050-9)		
Housing material	Plastic		

Output voltage

Direction of rotation	Flow direction[1]	Operating pressure	Output voltage
cw	**B** to **A**	M_A	> 2.5 V
	A to **B**	M_B	< 2.5 V
ccw	**A** to **B**	M_B	> 2.5 V
	B to **A**	M_A	< 2.5 V

Dimensions

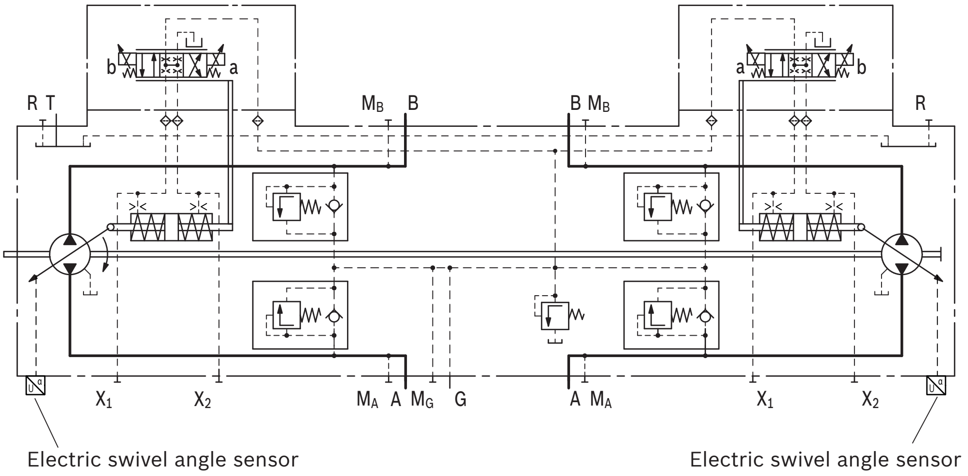


▼ Mating connector DEUTSCH DT06-3S-EP04

Consisting of	DT designation
1 housing	DT06-3S-EP04
1 wedge	W3S
3 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902603524).

▼ Schematic



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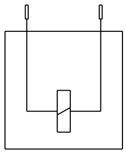
1) For flow direction, see controls

Connector for solenoids

DEUTSCH DT04-2P-EP04
Molded, 2-pin, without bidirectional suppressor diode. There is the following type of protection with mounted mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)

▼ **Circuit symbol**



▼ **Mating connector DEUTSCH DT06-2S-EP04**

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).

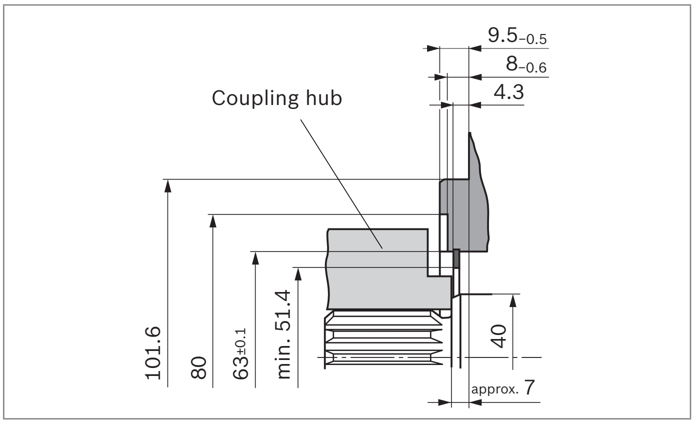
Note

- If necessary, you can change the connector orientation by turning the solenoid housing.
- Refer to the instruction manual for the procedure.

Installation dimensions for coupling assembly

To ensure that rotating components (coupling hub) and fixed components (housing, snap ring) do not come into contact with each other, the installation conditions described here must be observed. This depends on the size and the splined shaft.

SAE splined shaft (spline according to ANSI B92.1a)
The outer diameter of the coupling hub must be smaller than the inner diameter of the snap ring (dimension d_2) in the area near the drive shaft collar (dimension $x_2 - x_3$). Please observe diameter d_5 of the free turning.



Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also observed following a relatively long standstill as the axial piston unit may drain back to the reservoir via the hydraulic lines.

The leakage in the housing must be directed to the reservoir via the highest drain port **T**.

For combinations of multiple units, the leakage must be drained at each pump. If a shared drain line is used for this purpose, make certain that the respective case pressure is not exceeded. In the event of pressure differences at the drain ports of the units, the shared drain line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation. If this is not possible, separate drain lines must be laid if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

In all operating conditions, the suction and drain lines must flow into the reservoir below the minimum fluid level. The permissible suction height h_S results from the overall loss of pressure; it must not, however, be higher than $h_{S\ max}$ = 800 mm. The minimum suction pressure at port **S** must also not fall below 0.8 bar absolute during operation (cold start 0.5 bar absolute).

When designing the reservoir, ensure adequate space between the suction line and the drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Installation position

See the following examples 1 to 4.

Further installation positions are possible upon request.

Notes

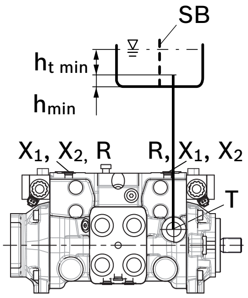
- If it is not possible to fill the stroking chambers via $\mathbf{X}_1$ to $\mathbf{X}_4$ in the final installation position, this must be done prior to installation.
- To prevent unexpected actuation and damage, the stroking chambers must be air bled via ports $\mathbf{X}_1$, $\mathbf{X}_2$ or $\mathbf{X}_3$, $\mathbf{X}_4$ depending on the installation position.
- For HT control, $\mathbf{X}_1$, $\mathbf{X}_2$ are not present and are replaced by $\mathbf{X}_5$, $\mathbf{X}_6$.
- In certain installation positions, an influence on the control characteristics can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristics and changes in response time.

Key	
L	Filling / air bleed
R	Air bleed port
S	Suction port
T	Drain port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir bottom (100 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)

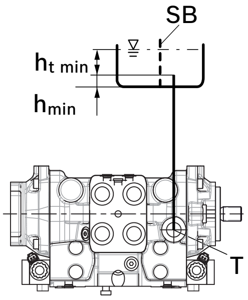
Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.

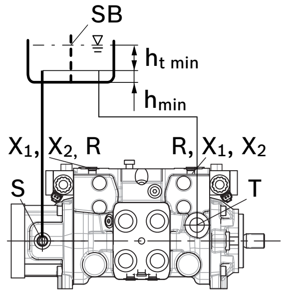
Installation position	Air bleed the housing	Air bleed the stroking chamber	Filling
1 Without boost pump	R	X_1, X_2	T + X_1 + X_2



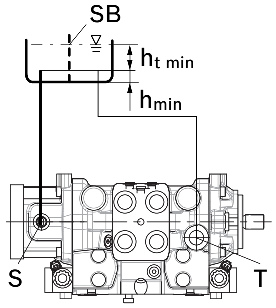
2 Without boost pump	–	–	T



3 With boost pump	R	X_1, X_2	S + T + X_1 + X_2



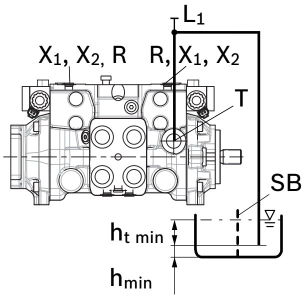
4 With boost pump	–	–	S + T



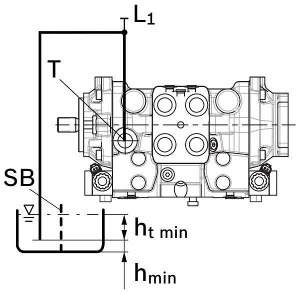
Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.

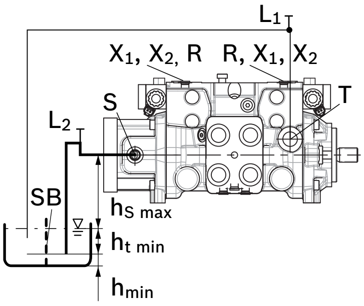
Installation position	Air bleed the housing	Air bleed the stroking chamber	Filling
5 Without boost pump	R	X_1, X_2	L_1 + X_1 + X_2



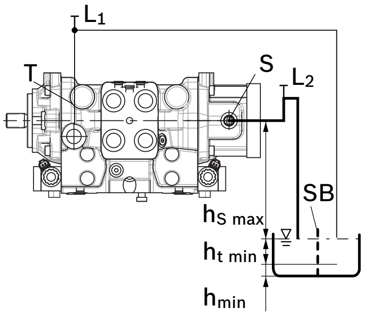
6 Without boost pump	L_1	–	L_1



7 With boost pump	R + L_2 (S)	X_1, X_2	L_1 + L_2(S) + X_1 + X_2



8 With boost pump	L_1 + L_2 (S)	–	L_1 + L_2(S)



For legend and notes, see page 24.

Project planning notes

- The pump A22VG is designed to be used in closed circuit.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified skilled person.
- Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The data and notes contained herein must be adhered to.
- Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic curve may shift.
- Not all variants of the product are approved for use in safety functions according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Working ports:
  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
  - The working ports and function ports can only be used to accommodate hydraulic lines.

Safety instructions

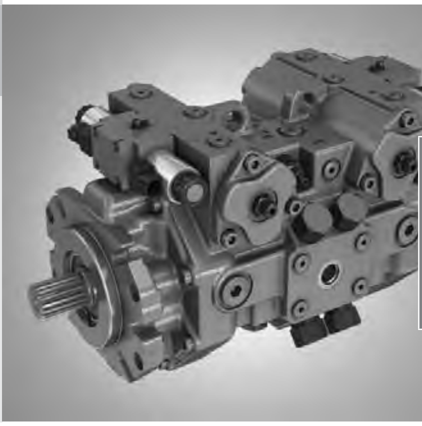
- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g. by wearing protective clothing).
- Moving parts in control and regulation systems (e.g. valve spools) may in certain circumstances become stuck in an undefined position due to contamination (e.g. contaminated hydraulic fluid, abrasion or residual dirt from components). As a result, the hydraulic fluid flow or build-up of torque of the axial piston unit will no longer respond correctly to the operator’s commands. Even the use of different filter cartridges (external or internal inlet filter) will not rule out a fault but merely minimize the risk. The machine/system manufacturer must test whether remedial measures are needed on the machine for the application concerned in order to set the consumer being driven to a safe position (e.g. safe stop) and if necessary to ensure it is properly implemented.

Rexroth
Bosch Group

Axial Piston Variable Double Pump A24VG

Data sheet

Series 10
Size 045-045 / 065-045 / 065-065
Nominal pressure 450 bar
Maximum pressure 500 bar
Closed circuit



Contents

Features

- Variable double pump with two axial piston rotary groups of swashplate design for hydrostatic drives in closed circuit
- The flow is proportional to the drive speed and displacement
- Two flows independent of each other
- The flow can be infinitely varied by adjusting the swashplate angle
- Flow direction changes smoothly when the swashplate is moved through the neutral position
- A wide range of highly adaptable control devices with different control and regulating functions, for all important applications
- Four pressure relief valves are provided on the high-pressure side to protect the hydrostatic transmission (pump and motor) from overload
- The high-pressure relief valves also function as boost valves
- The maximum boost pressure is limited by a built-in low-pressure relief valve
- High pressure level for high power density and good efficiency
- Compact design for tight installation conditions
- Optional through drive for mounting additional pumps

Ordering code for standard program

A24V	G								0	/	10	M						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17		18

Axial piston unit

01	Swashplate design, variable, nominal pressure 450 bar, maximum pressure 500 bar	**A24V**

Operating mode

02	Double pump, closed circuit	**G**

Sizes (NG)

	Geometric displacement, see table of values on page 9		
	1st pump	2nd pump	
03	NG045	NG045	**045-045**
	NG065	NG045	**065-045**
	NG065	NG065	**065-065**

Control devices, 1st pump

04	Proportional control hydraulic	pilot-pressure related	p = 6 to 18 bar	●	**HP1**
		mechanical servo, hexagon shaft with lever, free position[1]		●	**HW2**
			with neutral position switch	●	**HW8**
	Proportional control electric		U = 12 V DC	●	**EP1**
			U = 24 V DC	●	**EP2**
	Two-point control electric		U = 12 V DC	●	**EZ1**
			U = 24 V DC	●	**EZ2**
	Hydraulic control, direct controlled			●	**HT1**
	Electric control, direct controlled, with one pressure reducing valve (DRE) and 4/3-directional valve		U = 12 V DC	❍	**EV1**
			U = 24 V DC	❍	**EV2**

Control devices, 2nd pump

05	Proportional control hydraulic	pilot-pressure related	p = 6 to 18 bar	●	**HP1**
		mechanical servo, hexagon shaft with lever, free position[1]		●	**HW2**
			with neutral position switch	●	**HW8**
	Proportional control electric		U = 12 V DC	●	**EP1**
			U = 24 V DC	●	**EP2**
	Two-point control electric		U = 12 V DC	●	**EZ1**
			U = 24 V DC	●	**EZ2**
	Hydraulic control, direct controlled			●	**HT1**
	Electric control, direct controlled, with one pressure reducing valve (DRE) and 4/3-directional valve		U = 12 V DC	❍	**EV1**
			U = 24 V DC	❍	**EV2**

● = Available ❍ = On request – = Not available

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[1] On delivery, the position of the lever may differ from that shown in the brochure or drawing. If necessary, the position of the lever can be adjusted by the customer.

Ordering code for standard program

A24V	G								0	/	10	M						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17		18

Pressure cut-off (see page 31)

	Pump 1	Pump 2	045…065	
06	Without pressure cut-off	Without pressure cut-off	●	**0**
	1x pressure cut-off, jointly for pump 1 and pump 2		●	**W**
	With pressure cut-off	Without pressure cut-off	●	**P**
	Without pressure cut-off	With pressure cut-off	●	**L**

Swivel angle sensor (see page 34)

07	Without swivel angle sensor	**0**
	Electric swivel angle sensor mounted to pumps 1 and 2[2]	**T**

Additional function for pump 1 (see page 31)

08	Without additional function	**0**
	Mechanical stroke limiter, externally adjustable	**M**
	Ports X_3, X_4 for stroking chamber pressure	**T**
	Mechanical stroke limiter and ports X_3, X_4	**B**

Additional function for pump 2 (see page 31)

09	Without additional function	**0**
	Mechanical stroke limiter, externally adjustable	**M**
	Ports X_3, X_4 for stroking chamber pressure	**T**
	Mechanical stroke limiter and ports X_3, X_4	**B**

DA control valve

10	Without DA control valve	**0**

Series

11	Series 1, index 0	**10**

Configuration of ports and fastening threads

12	Metric, port threads with O-ring seal according to ISO 6149	**M**

Directions of rotation

13	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Mounting flanges (pump 1)

			045	065	
14	SAE J744	127-2	●	–	**C2**
		127-2/4	–	●	**C6**

Drive shafts (pump 1) (permissible input torques see page 10)

			045	065	
15	Splined shaft ANSI B92.1a	1 3/8 in 21T 16/32DP	●	–	**V8**
		1 1/2 in 17T 12/24DP	●	●	**S9**

● = Available ❍ = On request – = Not available ▨ = Preferred program

[2] Please contact us if the swivel angle sensor is used for control.

Ordering code for standard program

A24V	G								0	/	10	M						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17		18

Through drives (mounting options see page 28)

	Flange SAE J744			Coupling for splined shaft[3]					
		Mounting variant							
	Diameter	Symbol[4]	Designation	Diameter		Designation	045	065	
16	Without through drive						●	●	**0000**
	82-2 (A)	⦂	A1	5/8 in	9T 16/32DP	S2	❍	❍	**A1S2**
				3/4 in	11T 16/32DP	S3	❍	❍	**A1S3**
		⚭	A2	5/8 in	9T 16/32DP	S2	❍	❍	**A2S2**
				3/4 in	11T 16/32DP	S3	❍	❍	**A2S3**
	101-2 (B)	⦂	B1	7/8 in	13T 16/32DP	S4	❍	❍	**B1S4**
				1 in	15T 16/32DP	S5	❍	❍	**B1S5**
		⚭	B2	7/8 in	13T 16/32DP	S4	●	❍	**B2S4**
				1 in	15T 16/32DP	S5	●	❍	**B2S5**
		⋰	B5	7/8 in	13T 16/32DP	S4	❍	❍	**B5S4**
				1 in	15T 16/32DP	S5	❍	❍	**B5S5**
	101-4 (B)	⸬	B4	7/8 in	13T 16/32DP	S4	❍	❍	**B4S4**
				1 in	15T 16/32DP	S5	❍	❍	**B4S5**
	127-2 (C)	⦂	C1	1 in	15T 16/32DP	S5	❍	❍	**C1S5**
				1 1/4 in	14T 12/24DP	S7	–	❍	**C1S7**
		⚭	C2	1 in	15T 16/32DP	S5	❍	❍	**C2S5**
				1 1/4 in	14T 12/24DP	S7	–	❍	**C2S7**
		⋰	C5	1 in	15T 16/32DP	S5	❍	❍	**C5S5**
				1 1/4 in	14T 12/24DP	S7	–	❍	**C5S7**
	127-4 (C)	⸬	C4	1 in	15T 16/32DP	S5	❍	❍	**C4S5**
				1 1/4 in	14T 12/24DP	S7	–	❍	**C4S7**

Selection of other features

17	See table on page 5	

Standard / special version

18	Standard version	**0**
	Standard version with installation variants, e. g. T ports against standard open or closed	**Y**
	Special version	**S**

● = Available ❍ = On request – = Not available

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3) Coupling for splined shaft according to ANSI B92.1a

4) Mounting drillings pattern viewed on through drive with control at top

Ordering code for standard program

01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17		18
A24V	**G**								**0**	**/**	**10**	**M**						**–**	

Selection of other features

				A1	A2	A3	A4	B1	B2
17	Connector control module[5] pump 1		Without connector (only for hydraulic control)				X	X	
			DEUTSCH - molded connector, 2-pin – without suppressor diode	X	X	X			X
	Connector control module[5] pump 2		Without connector (only for hydraulic control)				X	X	
			DEUTSCH - molded connector, 2-pin – without suppressor diode	X	X	X			X
	Seals		NBR (nitrile-caoutchouc), shaft seal in FKM (fluor-caoutchouc)	X	X	X	X	X	X
	Service line ports		Threaded ports A and B, on left side	X	X			X	
			Threaded ports A and B, on right side			X			
	Boost pump		Without boost pump	X	X	X	X	X	X
	High-pressure relief valve HD	Pump 1	Direct controlled, fixed setting, without bypass	X	X	X		X	X
		Pump 2	Direct controlled, fixed setting, without bypass	X	X	X		X	X
	Low-pressure relief valve ND		Fixed setting	X	X	X		X	X
	Pressure sensor	Pump 1	Without pressure sensor	X	X	X	X	X	X
			At measuring port M_A						
			At measuring port M_B						
		Pump 2	Without pressure sensor	X	X	X	X	X	X
			At measuring port M_A						
			At measuring port M_B						
	Speed sensor		Without speed sensor		X	X	X	X	X
			DSA speed sensor mounted[6]	X					
	Other sensors	Pump 1	Without sensors	X	X	X	X	X	X
		Pump 2	Without sensors	X	X	X	X	X	X

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[5] Connectors for other electric components can deviate.

[6] Specify ordering code of sensor according to data sheet (DSA – RE 95133) separately and observe the requirements on the electronics.

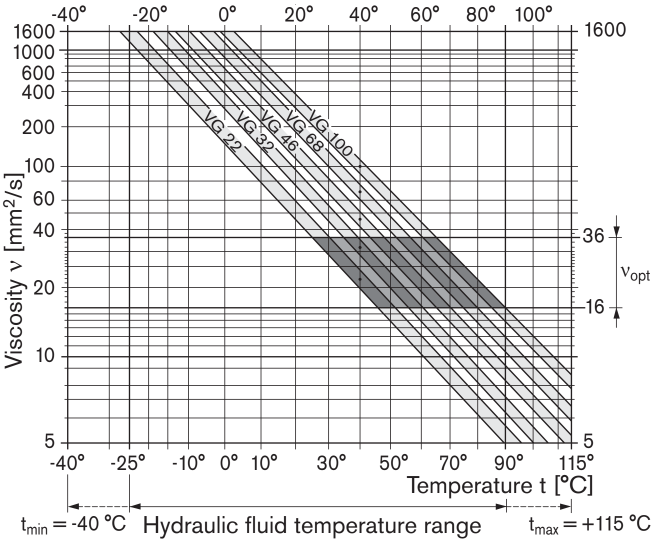
Technical data

Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids) and RE 90222 (HFD hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.

The variable double pump A24VG is not suitable for operation with HFA, HFB and HFC hydraulic fluids. If HFD or environmentally acceptable hydraulic fluids are used, the limitations regarding technical data or other seals must be observed. Please contact us.

Selection diagram



Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature: in a closed circuit, the circuit temperature.

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see shaded area of the selection diagram). We recommended that the higher viscosity class be selected in each case.

Example: At an ambient temperature of X °C, an operating temperature of 60 °C is set in the circuit. In the optimum operating viscosity range (ν_{opt}, shaded area), this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Note

The case drain temperature, which is affected by pressure and speed, can be higher than the circuit temperature. At no point of the component may the temperature be higher than 115 °C. The temperature difference specified below is to be taken into account when determining the viscosity in the bearing.

If the above conditions cannot be maintained due to extreme operating parameters, please contact us.

Viscosity and temperature of hydraulic fluid

	Viscosity [mm²/s]	Temperature	Comment
Transport and storage at ambient temperature		$T_{min} \geq -50$ °C $T_{opt} = +5$ °C to +20 °C	factory preservation: up to 12 months with standard, up to 24 months with long-term
(Cold) start-up[1]	$\nu_{max} = 1600$	$T_{St} \geq -40$ °C	$t \leq 3$ min, without load ($p \leq 50$ bar), $n \leq 1000$ rpm
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu < 1600$ to 400	$T = -40$ °C to -25 °C	at $p \leq 0.7 \cdot p_{nom}$, $n \leq 0.5 \cdot n_{nom}$ and $t \leq 15$ min
Operating phase			
Temperature difference		$\Delta T =$ approx. 5 K	between hydraulic fluid in the bearing and at port T.
Maximum temperature		115 °C	in the bearing
		110 °C	measured at port T
Continuous operation	$\nu = 400$ to 10 $\nu_{opt} = 36$ to 16	$T = -25$ °C to +90 °C	measured at port T, no restriction within the permissible data
Short-term operation	$\nu_{min} \geq 7$	$T_{max} = +110$ °C	measured at port T, $t < 3$ min, $p < 0.3 \cdot p_{nom}$
FKM shaft seal[1]		$T \leq +115$ °C	see page 7

[1] At temperatures below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C).

Technical data

Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

To ensure the functional reliability of the axial piston unit, a gravimetric analysis of the hydraulic fluid is necessary to determine the amount of solid contaminant and to determine the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 is to be maintained.

Depending on the system and the application, for the A24VG, we recommend

Filter cartridges $\beta_{20} \geq 100$.

With an increasing differential pressure at the filter cartridges, the β value must not deteriorate.

At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

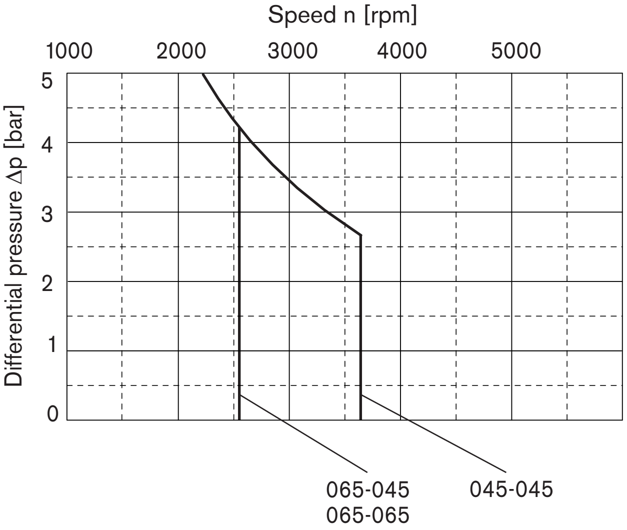
If the above classes cannot be achieved, please contact us.

Shaft seal

Permissible pressure loading

The service life of the shaft seal is influenced by the speed of the axial piston unit and the case drain pressure (case pressure p_G). The mean differential pressure of 2 bar between the case and the ambient pressure may not be enduringly exceeded at normal operating temperature. For a higher differential pressure at reduced speed, see diagram. Momentary pressure spikes ($t < 0.1$ s) of up to 10 bar are permitted. The service life of the shaft seal decreases with an increase in the frequency of pressure spikes.

The case pressure must be equal to or higher than the ambient pressure.



These values are valid for an ambient pressure $p_{abs} = 1$ bar.

Temperature range

The FKM shaft seal may be used for case drain temperatures from -25 °C to +115 °C.

Note
For application cases below -25 °C, an NBR shaft seal is required (permissible temperature range: -40 °C to +90 °C). State NBR shaft seal in plain text when ordering. Please contact us.

Technical data

Operating pressure range

(operating with mineral oil)

Pressure at service line port A_1, A_2 or B_1, B_2

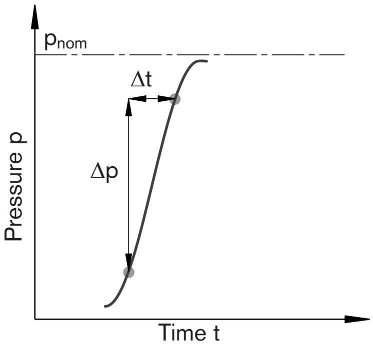
Nominal pressure p_{nom} ________________ 450 bar absolute

Maximum pressure p_{max} ______________ 500 bar absolute
Single operating period ___________________________ 10 s
Total operating period ___________________________ 300 h

Minimum pressure (high-pressure side) ___25 bar absolute

Minimum pressure (low-pressure side) ___ 10 bar above p_G
(boost pressure setting must be higher depending on system)

Rate of pressure change $R_{A\ max}$ _____________ 9000 bar/s



Control pressure
To ensure the function of the control, the following control pressure is required depending on the speed and operating pressure (measuring point, port P_S):

For controls EP, HW and HP
Minimum control pressure
$p_{St\ min}$ (at n = 2000 rpm) _________________ 20 bar above p_G

For controls HT, EV, EZ
Minimum control pressure
$p_{St\ min}$ (at n = 2000 rpm) _________________ 25 bar above p_G

Note
Values for other hydraulic fluids, please contact us

p_G = case pressure

Definition

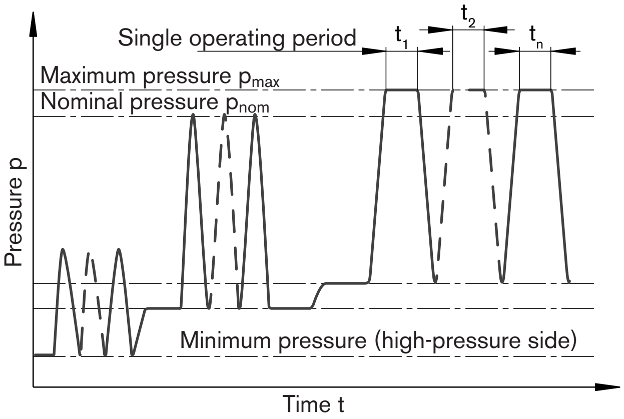
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

Maximum pressure p_{max}
The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.

Minimum pressure (high-pressure side)
Minimum pressure at the high-pressure side (A or B) which is required in order to prevent damage to the axial piston unit.

Minimum pressure (low-pressure side)
Minimum pressure at the low-pressure side (A or B) which is required in order to prevent damage to the axial piston unit.

Rate of pressure change R_A
Maximum permissible rate of pressure rise and reduction during a pressure change over the entire pressure range.



Total operating period = $t_1 + t_2 + ... + t_n$

Technical data

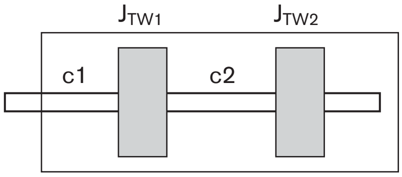
Table of values (theoretical values, without efficiency and tolerances; values rounded)

Size				NG		045-045	065-045	065-065
Displacement geometric, per revolution								
variable double pump				$V_{g\,max}$	cm^3	2 x 45.3	1 x 65.2 + 1 x 45.3	2 x 65.2
Speed1)								
maximum at $V_{g\,max}$				n_{nom}	rpm	3700	2600	2600
at $\Delta p \geq 40$ bar ($t < 15$ s)				$n_{max\,40}$	rpm	3900	2800	2800
minimum				n_{min}	rpm	500	500	500
Flow								
at n_{nom} and $V_{g\,max}$				q_v	L/min	2 x 168	1 x 170 + 1 x 118	2 x 170
Power2)								
at n_{nom}, $V_{g\,max}$ and $\Delta p = 430$ bar				P	kW	240	206	243
Torque2)								
at $V_{g\,max}$ and	$\Delta p = 430$ bar			T	Nm	620	756	892
	$\Delta p = 100$ bar			T	Nm	144	176	208
Rotary stiffness3) drive shaft	1 3/8	V8	pump 1	c1	kNm/rad	97	–	–
			pump 2	c2	kNm/rad	20	–	–
	1 1/2	S9	pump 1	c1	kNm/rad	–	133	133
			pump 2	c2	kNm/rad	–	21	22
Moment of inertia3)			rotary group 1	J_{TW1}	kgm^2	0.0048	0.0089	0.0089
			rotary group 2	J_{TW2}	kgm^2	0.0048	0.0048	0.0089
Maximum angular acceleration4)				α	rad/s^2	28000	22000	22000
Case Volume				V	L	2.8	2.9	3.0
Mass approx. (without through drive)				m	kg	90	93	97

1) The values are valid:
- for the optimum viscosity range from $\nu_{opt} = 36$ to 16 mm^2/s
- with hydraulic fluid based on mineral oils.

2) Without boost pump

3) Illustration of spring mass system:

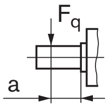
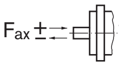


4) The data are valid for values between the minimum required and maximum permissible speed.
Valid for external excitation (e. g. engine 2 to 8 times rotary frequency; cardan shaft twice the rotary frequency).
The limit value applies for a single pump only.
The load capacity of the connection parts must be considered.

Note
Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. We recommend testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.

Technical data

Permissible radial and axial forces of the drive shafts

Size	NG			045-045	045-045	065-045	065-065
Drive shaft			in	1 3/8	1 1/2	1 1/2	1 1/2
Maximum radial force at distance a (from shaft collar)		$F_{q\,max}$	N	3474	2970	4670	4670
		a	mm	24	27	27	27
Maximum axial force		$+ F_{ax\,max}$	N	3490	3490	4300	4300
		$- F_{ax\,max}$	N	2310	2310	2700	2700

Note

Special requirements apply in the case of belt drive and cardan shaft. Please contact us.

Determining the operating characteristics

Flow $$q_v = \frac{V_g \cdot n \cdot \eta_v}{1000} \quad [\text{L/min}]$$

Torque $$T = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}} \quad [\text{Nm}]$$

Power $$P = \frac{2\,\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p}{600 \cdot \eta_t} \quad [\text{kW}]$$

V_g = Displacement per revolution in cm^3

Δp = Differential pressure in bar

n = Speed in rpm

η_v = Volumetric efficiency

η_{mh} = Mechanical-hydraulic efficiency

η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

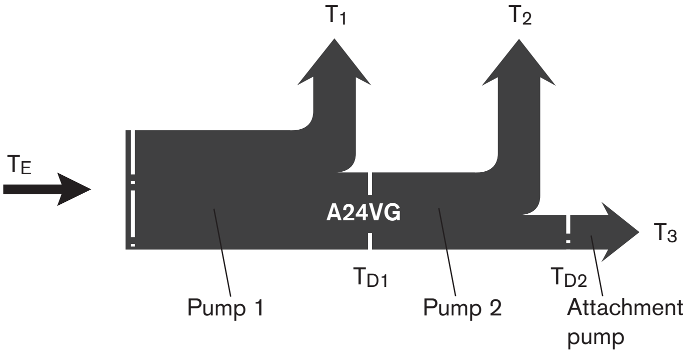
Permissible input and through-drive torques

Size			NG		045-045	065-045	065-065
Torque at $V_{g\,max}$ and $\Delta p = 430$ bar[1]			T	Nm	620	756	892
Input torque at drive shaft, maximum[2]							
	V8	1 3/8 in	$T_{E\,max}$	Nm	970	970	–
	S9	1 1/2 in	$T_{E\,max}$	Nm	1125	1125	1125
Maximum through-drive torque			$T_{D1\,max}$	Nm	495	495	495
			$T_{D2\,max}$	Nm	$T_{D2\,perm} = T_{D1\,max} - T_2$	$T_{D2\,perm} = T_{D1\,max} - T_2$	$T_{D2\,perm} = T_{D1\,max} - T_2$

[1] Efficiency not considered

[2] For drive shafts without radial force

Torque distribution



T_E consists as follows:
$T_E = T_1 + T_2 + T_3$
$T_E < T_{E\,max}$

HT – Hydraulic control, direct controlled

With the direct hydraulic control (HT), the output flow of the pump is controlled by a hydraulic control pressure, applied directly to the stroking piston through either port X_1 or X_2.

Flow direction is determined by which control pressure port is pressurized (refer to table below).

Pump displacement is infinitely variable and proportional to the applied control pressure, but is also influenced by system pressure and pump drive speed.

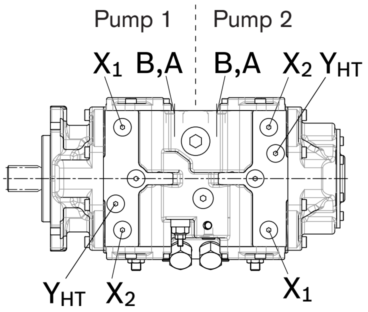
In order to use the optional built-in pressure cut-off valve, port Y_{HT} must be used as the control pressure source for the selected control module. See page 29 for a description of the pressure cut-off function.

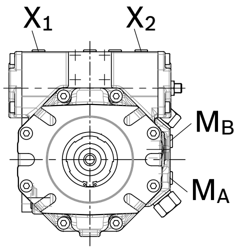
Maximum permissible control pressure: 40 bar

Use of the HT control requires a review of the engine and vehicle parameters to ensure that the pump is set up correctly. We recommend that all HT applications be reviewed by a Bosch Rexroth application engineer.

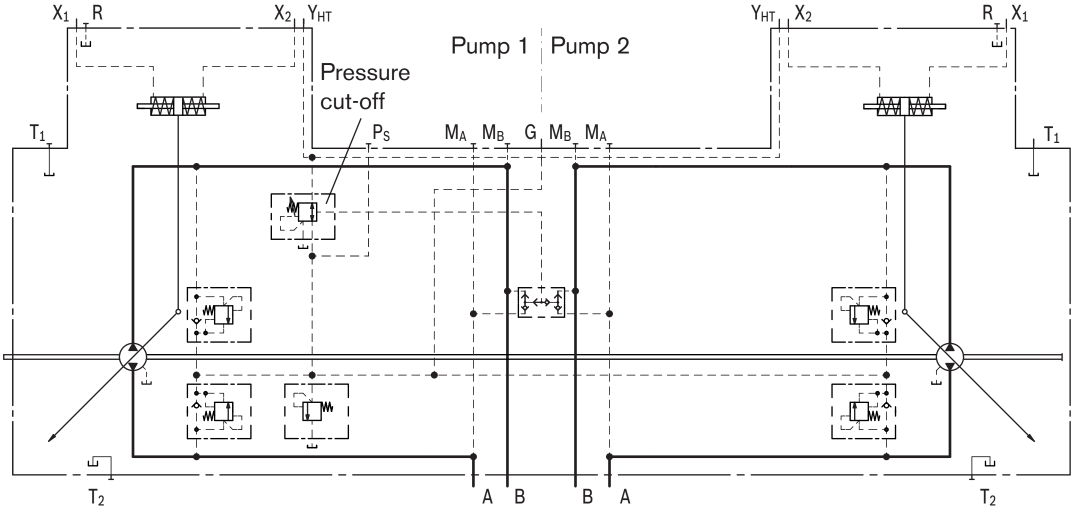
Correlation
Direction of rotation - Control - Flow direction

Direction of rotation	clockwise				counter-clockwise			
Pump	Pump 1		Pump 2		Pump 1		Pump 2	
Control pressure	X_1	X_2	X_1	X_2	X_1	X_2	X_1	X_2
Flow direction	B to A	A to B	A to B	B to A	A to B	B to A	B to A	A to B
Operating pressure	M_A	M_B	M_B	M_A	M_B	M_A	M_A	M_B





Schematic
Illustration with service line ports on left side



Note

The combination and operation of all controls must be considered in the complete system!

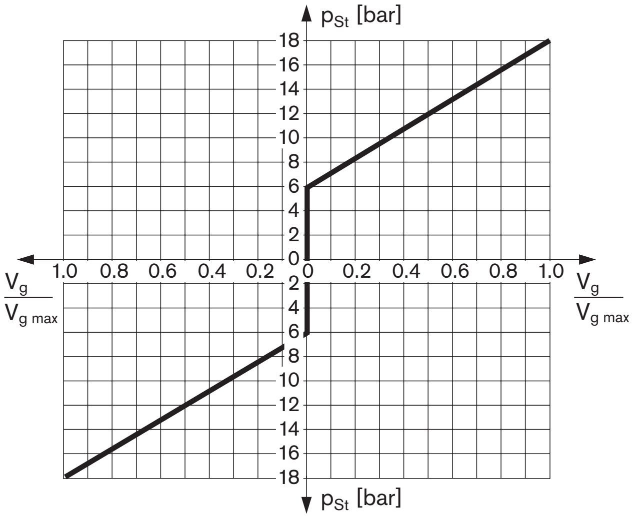
HP – Proportional control hydraulic, pilot-pressure related

The output flow of the pump is infinitely variable between 0 to 100 %, proportional to the difference in pilot pressure applied to the two control ports (Y_1 and Y_2).

The pilot signal, coming from an external source, is a pressure signal. Flow is negligible, as the pilot signal acts only on the spool of the control valve.

This valve spool then directs control oil into and out of the stroking cylinder to adjust pump displacement as required.

A feedback lever, connected to the stroking piston maintains the pump flow for any given pilot signal within the control range.



V_g = Displacement at p_{St}
$V_{g\,max}$ = Displacement at p_{St} = 18 bar

Pilot signal p_{St} = 6 to 18 bar (at port Y_1, Y_2)

Beginning of control at 6 bar

End of control at 18 bar (maximum displacement $V_{g\,max}$)

Note
In the neutral position, the HP control module must be vented to reservoir via the external pilot control device.

Note

The spring return feature in the control module is not a safety device

The control module can stick in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the control will no longer respond correctly to the operator's commands.

Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

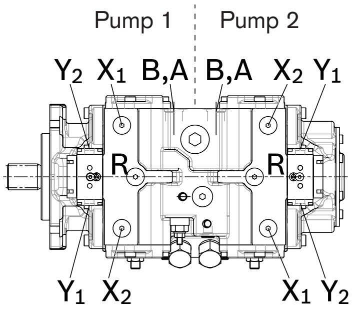
Note

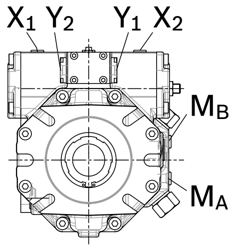
The combination and operation of all controls must be considered in the complete system!

HP – Proportional control hydraulic, pilot-pressure related

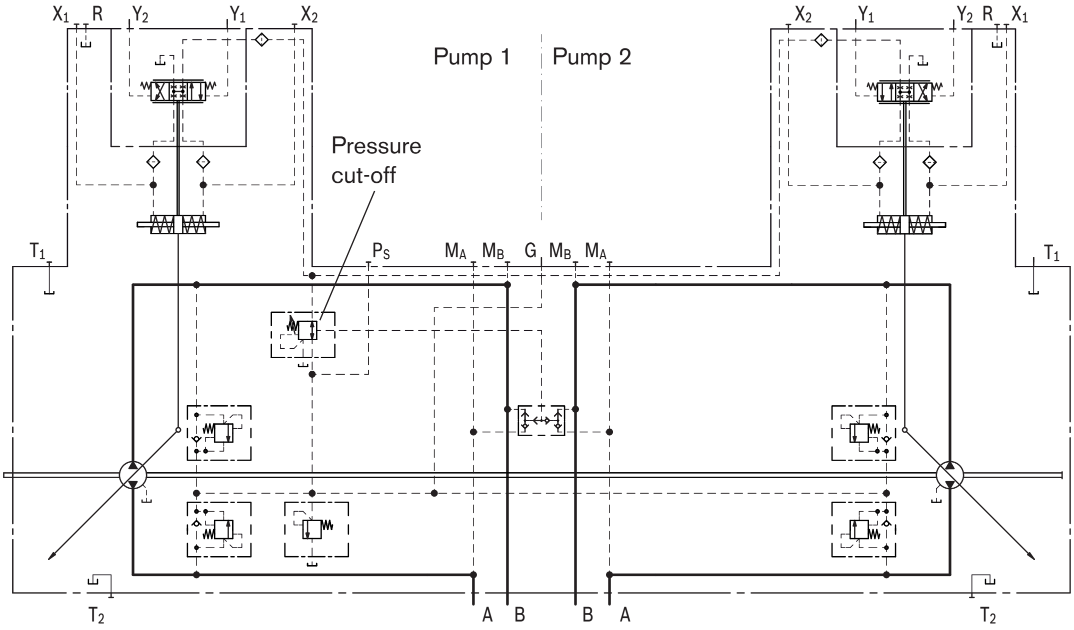
Correlation
Direction of rotation - Control - Flow direction

Direction of rotation	clockwise				counter-clockwise			
Pump	Pump 1		Pump 2		Pump 1		Pump 2	
Pilot signal	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
Control pressure	X_2	X_1	X_2	X_1	X_2	X_1	X_2	X_1
Flow direction	A to B	B to A	B to A	A to B	B to A	A to B	A to B	B to A
Operating pressure	M_B	M_A	M_A	M_B	M_A	M_B	M_B	M_A





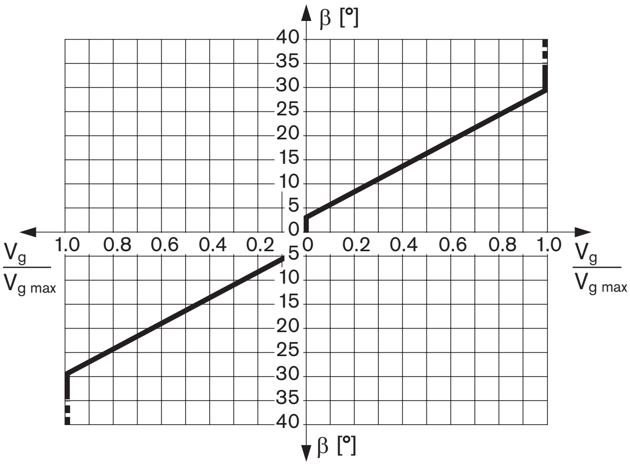
Schematic
Illustration with service line ports on left side



HW – Proportional control hydraulic, mechanical servo

The output flow of the pump is infinitely variable between 0 to 100 %, proportional to the swivel angle of the control lever between 0° and ±29° from the spring centered zero flow position.

A feedback lever, connected to the stroking piston maintains the pump flow for any given position of the control lever between 0° and 29°.



Swivel angle β at the control lever for pump displacement change:

Start of control at β = 3°

End of control β = 29° (maximum displacement $V_{g\,max}$)

Mechanical stop for β: ±40°

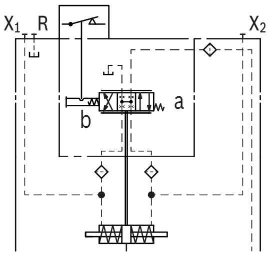
The maximum required torque at the lever is 170 Ncm. To prevent damage to the HW control module, a positive mechanical stop must be provided for the HW control lever.

Note
Spring centering enables the pump, depending on pressure and speed, to move automatically to the neutral position ($V_g = 0$) as soon as there is no longer any torque on the control lever of the HW control module (regardless of deflection angle).

Variation: neutral position switch
The switch contact in the neutral position switch is closed when the control lever on the HW control module is in its neutral position. The switch opens when the control lever is moved out of neutral in either direction.
Thus, the neutral position switch provides a monitoring function for drive units that require the pump to be in the neutral position during certain operating conditions (e. g. starting diesel engines).

Technical data, neutral position switch	
Load capacity	20 A (continuous), without switching operating
Switching capacity	15 A / 32 V (resistive load)
	4 A / 32 V (inductive load)
Connector design	DEUTSCH DT04-2P-EP04 (mating connector, see page 33)

Schematic with neutral position switch



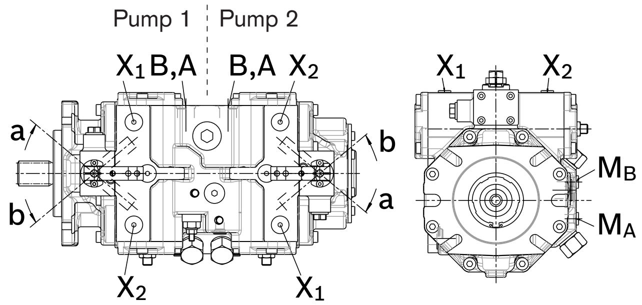
Note

The combination and operation of all controls must be considered in the complete system!

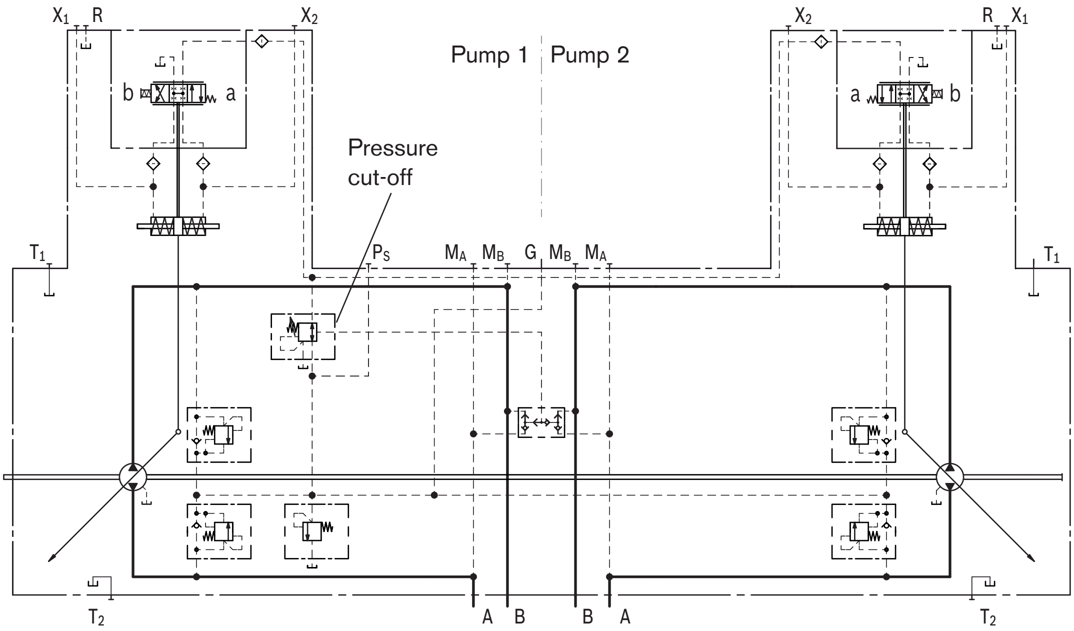
HW – Proportional control hydraulic, mechanical servo

Correlation
Direction of rotation - Control - Flow direction

Direction of rotation	clockwise				counter-clockwise			
Pump	Pump 1		Pump 2		Pump 1		Pump 2	
Lever direction	a	b	a	b	a	b	a	b
Control pressure	X_2	X_1	X_2	X_1	X_2	X_1	X_2	X_1
Flow direction	A to B	B to A	A to B	B to A	B to A	A to B	B to A	A to B
Operating pressure	M_B	M_A	M_B	M_A	M_A	M_B	M_A	M_B



Schematic
Illustration with service line ports on left side



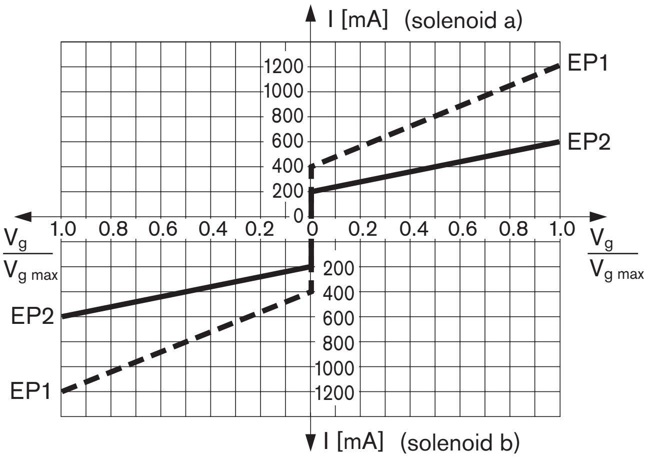
EP – Proportional control electric

The output flow of the pump is infinitely variable between 0 to 100 %, proportional to the electrical current supplied to solenoid a or b.

The electrical energy is converted into a force acting on the spool of the control valve.

This valve spool then directs control oil into and out of the stroking cylinder to adjust pump displacement as required.

A feedback lever, connected to the stroking piston maintains the pump flow for any given current within the control range.



Standard
Proportional solenoid without manual override.

On request
Proportional solenoid with manual override and spring return.

Technical data, solenoid

	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Control current		
Beginning of control at $V_g = 0$	400 mA	200 mA
End of control at $V_{g\,max}$	1200 mA	600 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100 %	100 %
Type of protection, see connector design on page 33		

The following electronic controllers and amplifiers are available for controlling the proportional solenoids:

- BODAS controller RC

Series 20	RE 95200
Series 21	RE 95201
Series 22	RE 95202
Series 30	RE 95203, RE 95204

and application software

– Analog amplifier RA	RE 95230

Note

The spring return feature in the control module is not a safety device

The control module can stick in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the control will no longer respond correctly to the operator's commands.

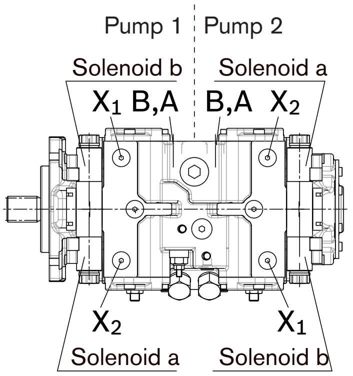
Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

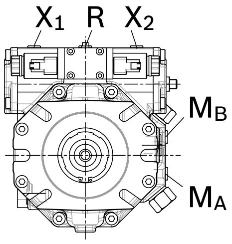
Note

The combination and operation of all controls must be considered in the complete system!

EP – Proportional control electric

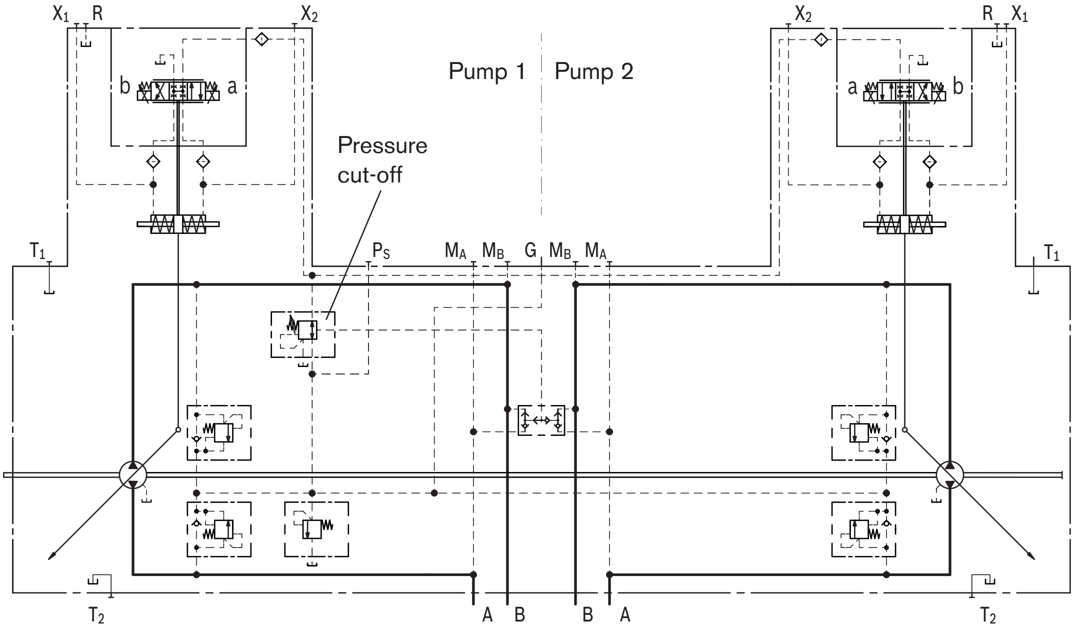
Correlation **Direction of rotation - Control - Flow direction**								
Direction of rotation	clockwise				counter-clockwise			
Pump	Pump 1		Pump 2		Pump 1		Pump 2	
Actuation of solenoid	a	b	a	b	a	b	a	b
Control pressure	X_2	X_1	X_2	X_1	X_2	X_1	X_2	X_1
Flow direction	A to B	B to A	B to A	A to B	B to A	A to B	A to B	B to A
Operating pressure	M_B	M_A	M_A	M_B	M_A	M_B	M_B	M_A





Schematic

Illustration with service line ports on left side



EZ – Two-point control electric

By energizing either switching solenoid a or b, internal control pressure is connected directly to the stroking piston and the pump swivels to maximum displacement. With the EZ control, pump flow is switchable between $V_g = 0$ and $V_{g\ max}$.
Flow direction is determined by which solenoid is energized.

Standard
Switching solenoid without manual override.

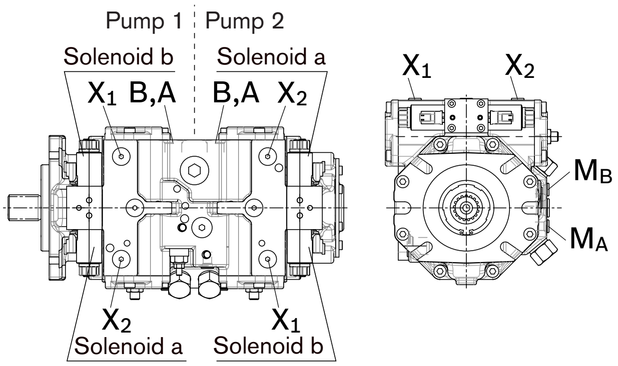
On request
Switching solenoid with manual override and spring return.

Technical data, solenoid

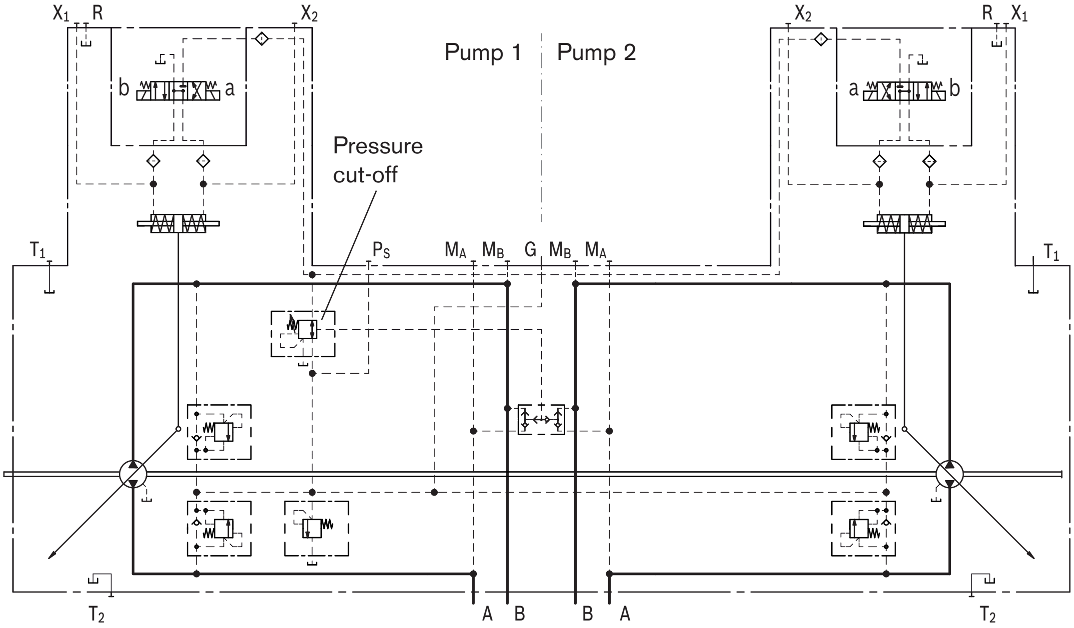
	EZ1	EZ2
Voltage	12 V (±20 %)	24 V (±20 %)
Neutral position $V_g = 0$	de-energized	de-energized
Displacement $V_{g\ max}$	energized	energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required current	1.32 A	0.67 A
Duty cycle	100 %	100 %
Type of protection see connector design on page 33		

Correlation
Direction of rotation - Control - Flow direction

Direction of rotation	clockwise				counter-clockwise			
Pump	Pump 1		Pump 2		Pump 1		Pump 2	
Actuation of solenoid	a	b	a	b	a	b	a	b
Control pressure	X_1	X_2	X_1	X_2	X_1	X_2	X_1	X_2
Flow direction	B to A	A to B	A to B	B to A	A to B	B to A	B to A	A to B
Operating pressure	M_A	M_B	M_B	M_A	M_B	M_A	M_A	M_B



Schematic
Illustration with service line ports on left side



Note

The combination and operation of all controls must be considered in the complete system!

EV – Electric control, direct controlled

With the direct electric control (EV), the output flow of the pump is infinitely variable between 0 to 100 %, controlled by the control pressure of the pressure reducing valve. This control pressure level is proportional to the electric current, applied to the solenoid of the pressure reducing valve. This control pressure is then connected directly to the stroking cylinder of the pump by energizing either switching solenoid a or b on the EV control module, which determines the direction of the pump flow.
The resulting pump displacement at a certain control pressure is also influenced by pump drive speed and operating pressure.

Technical data, pressure reducing valve

	EV1	EV2
Voltage	12 V	24 V
Control current		
Beginning of control at $V_g = 0$	515 mA	255 mA
End of control at $V_{g\ max}$	990 mA	495 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Duty cycle	100%	100%
Type of protection see connector design on page 33		

Depending on the operating point, the specified values may vary slightly.

The following electronic controllers and amplifiers are available for controlling the proportional solenoids:

- BODAS controller RC
  Series 20 ____ RE 95200
  Series 21 ____ RE 95201
  Series 22 ____ RE 95202
  Series 30 ____ RE 95203, RE 95204
  and application software
- Analog amplifier RA ____ RE 95230

Technical data, solenoid

	EV1	EV2
Voltage	12 V (±20 %)	24 V (±20 %)
Neutral position $V_g = 0$	de-energized	de-energized
Displacement V_g	energized	energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Minimum required current	1.32 A	0.67 A
Duty cycle	100%	100%
Type of protection see connector design on page 33		

Standard
Switching solenoid without manual override.

On request
Switching solenoid with manual override and spring return.

Correlation
Direction of rotation - Control - Flow direction

Direction of rotation	clockwise				counter-clockwise			
Pump	Pump 1		Pump 2		Pump 1		Pump 2	
Actuation of solenoid	a	b	a	b	a	b	a	b
Control pressure	X_1	X_2	X_1	X_2	X_1	X_2	X_1	X_2
Flow direction	B to A	A to B	A to B	B to A	A to B	B to A	B to A	A to B
Operating pressure	M_A	M_B	M_B	M_A	M_B	M_A	M_A	M_B

Note

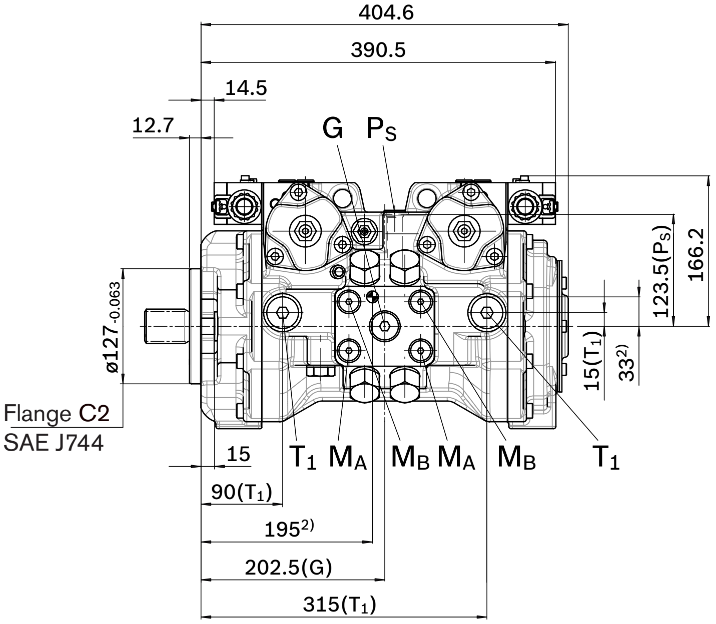
The combination and operation of all controls must be considered in the complete system!

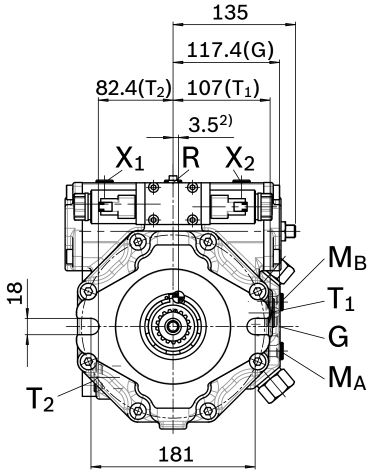
Dimensions size 045-045

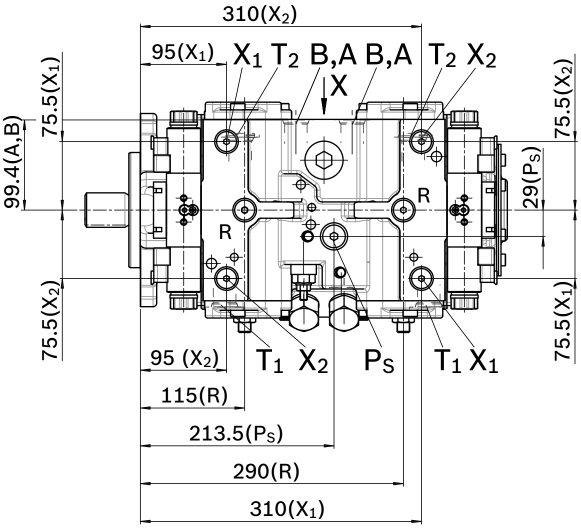
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

EP – Proportional control electric

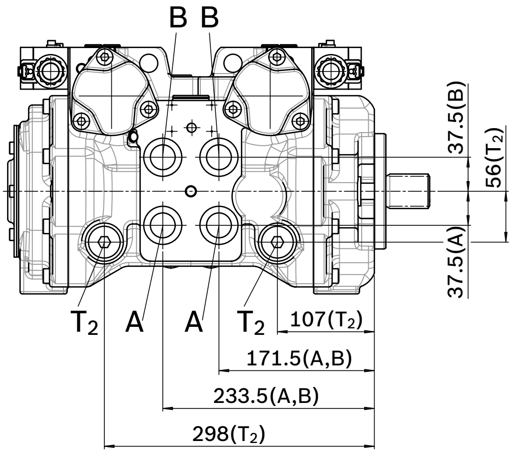
Threaded ports A and B, on left side (viewed on drive shaft)[1]

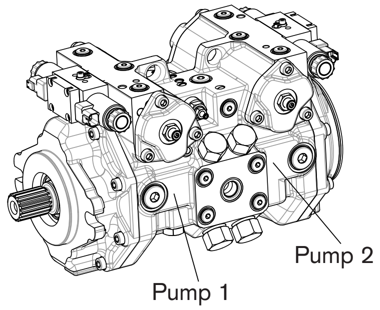






View X





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1) For threaded ports A and B, on right side (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

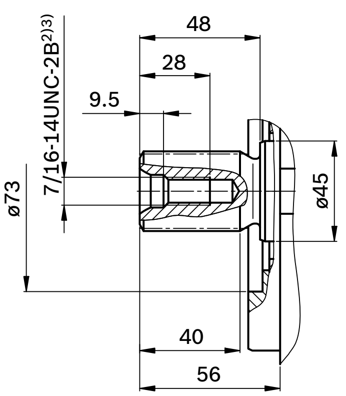
2) Center of gravity

Dimensions size 045-045

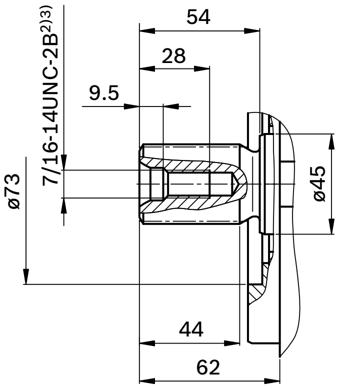
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shafts

V8 Splined shaft 1 3/8 in
21T 16/32DP[1]



S9 Splined shaft 1 1/2 in
17T 12/24DP[1]



Ports

Designation	Port for	Standard[4]	Size[3]	Maximum pressure [bar][5]	State[8]	
					Pump 1	Pump 2
A, B	Service line	ISO 6149	M27 x 2; 19 deep	500	O	O
T_1	Drain line	ISO 6149	M27 x 2; 19 deep	3	X[6]	X[6]
T_2	Drain line	ISO 6149	M27 x 2; 19 deep	3	X[6]	O[6]
R	Air bleed	ISO 6149	M14 x 1.5; 11.5 deep	3	X	X
X_1, X_2	Control pressure (upstream of orifice)	ISO 6149	M14 x 1.5; 11.5 deep	40	X	X
X_1, X_2	Control pressure (upstream of orifice, HT only)	ISO 6149	M14 x 1.5; 11.5 deep	40	O	O
X_3, X_4[7]	Stroking chamber pressure	ISO 6149	M14 x 1.5; 11.5 deep	40	X	X
G	Boost pressure	ISO 6149	M22 x 1.5; 17 deep	40	O	
P_S	Pilot pressure, inlet	ISO 6149	M18 x 1.5; 14.5 deep	40	X	
Y_{HT}	Pilot pressure, outlet (HT only)	ISO 6149	M14 x 1.5; 11.5 deep	40	O	O
M_A, M_B	Measuring pressure A, B	ISO 6149	M14 x 1.5; 11.5 deep	500	X	X
Y_1, Y_2	Pilot signal (HP only)	ISO 6149	M14 x 1.5; 11.5 deep	40	O	O

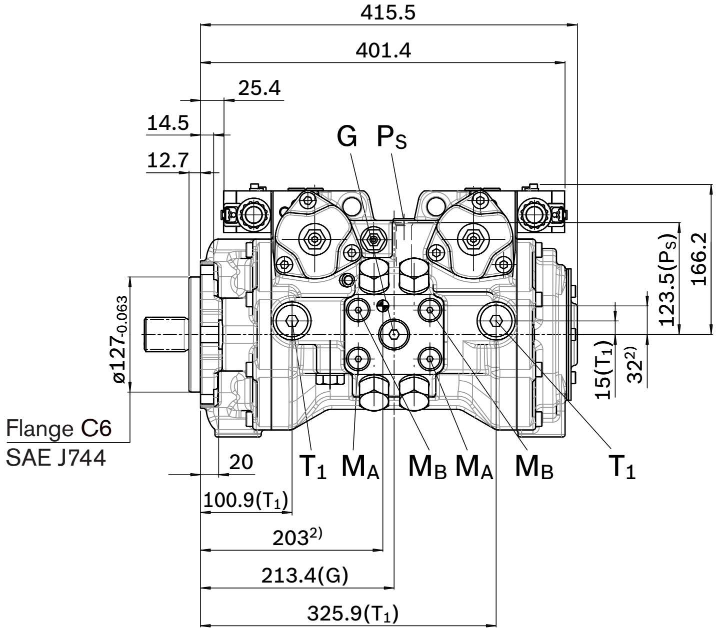
[1] ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
[2] Thread according to ASME B1.1
[3] Observe the general instructions on page 38 for the maximum tightening torques.
[4] The spot face can be deeper than specified in the appropriate standard.
[5] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
[6] Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 36 and 37).
[7] Optional, see page 31
[8] O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

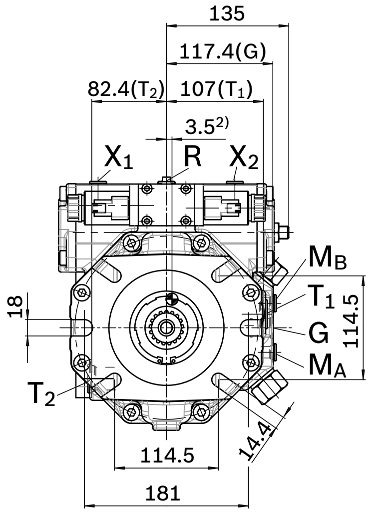
Dimensions size 065-045

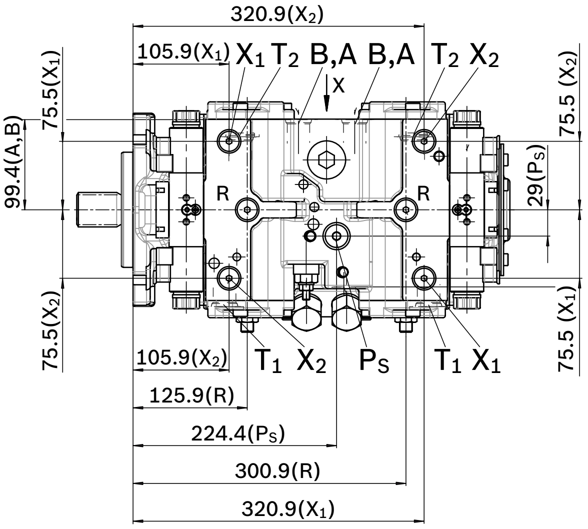
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

EP – Proportional control electric

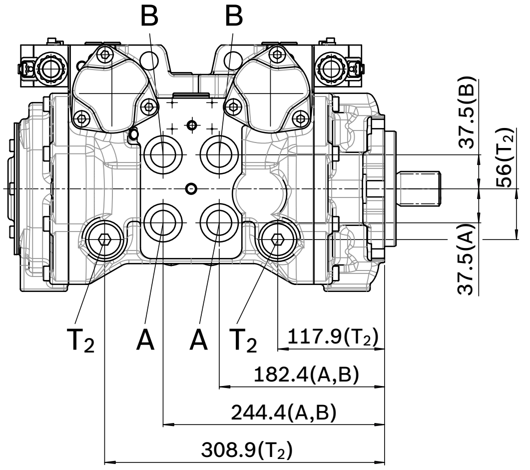
Threaded ports A and B, on left side (viewed on drive shaft)[1]

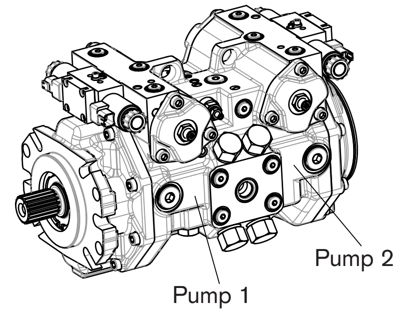






View X





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[1] For threaded ports A and B, on right side (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

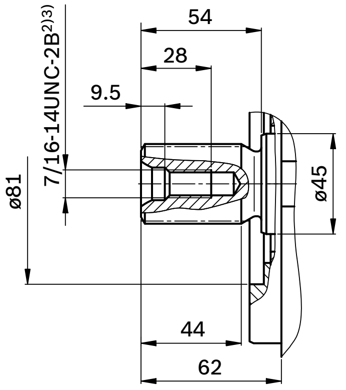
[2] Center of gravity

Dimensions size 065-045

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shaft

S9 Splined shaft 1 1/2 in
17T 12/24DP[1]



Ports

Designation	Port for	Standard[4]	Size[3]	Maximum pressure [bar][5]	State[8]	
					Pump 1	Pump 2
A, B	Service line	ISO 6149	M27 x 2; 19 deep	500	O	O
T_1	Drain line	ISO 6149	M27 x 2; 19 deep	3	X[6]	X[6]
T_2	Drain line	ISO 6149	M27 x 2; 19 deep	3	X[6]	O[6]
R	Air bleed	ISO 6149	M14 x 1.5; 11.5 deep	3	X	X
X_1, X_2	Control pressure (upstream of orifice)	ISO 6149	M14 x 1.5; 11.5 deep	40	X	X
X_1, X_2	Control pressure (upstream of orifice, HT only)	ISO 6149	M14 x 1.5; 11.5 deep	40	O	O
X_3, X_4[7]	Stroking chamber pressure	ISO 6149	M14 x 1.5; 11.5 deep	40	X	X
G	Boost pressure	ISO 6149	M22 x 1.5; 17 deep	40	O	
P_S	Pilot pressure, inlet	ISO 6149	M18 x 1.5; 14.5 deep	40	X	
Y_{HT}	Pilot pressure, outlet (HT only)	ISO 6149	M14 x 1.5; 11.5 deep	40	O	O
M_A, M_B	Measuring pressure A, B	ISO 6149	M14 x 1.5; 11.5 deep	500	X	X
Y_1, Y_2	Pilot signal (HP only)	ISO 6149	M14 x 1.5; 11.5 deep	40	O	O

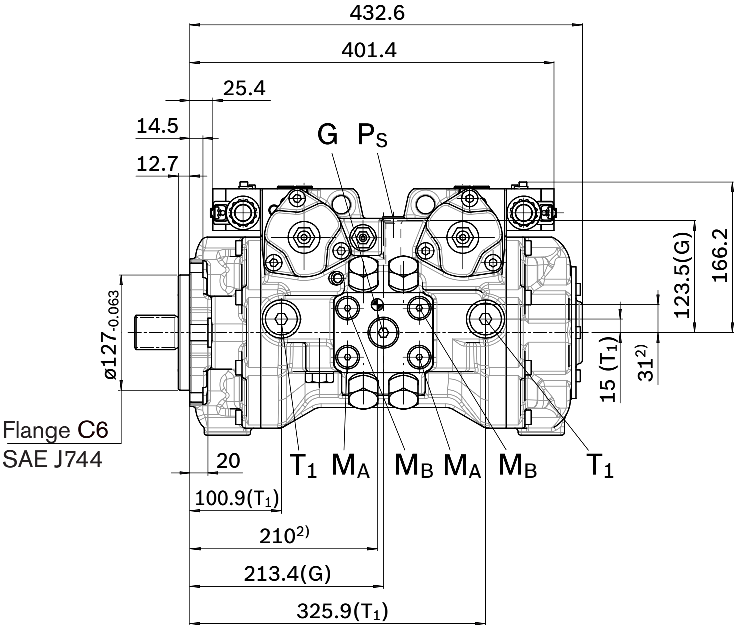
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Observe the general instructions on page 38 for the maximum tightening torques.
4) The spot face can be deeper than specified in the appropriate standard.
5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
6) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 36 and 37).
7) Optional, see page 31
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

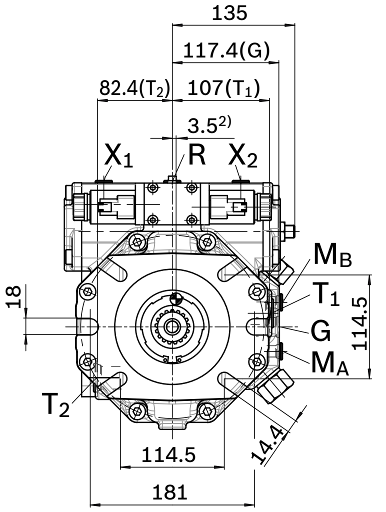
Dimensions size 065-065

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

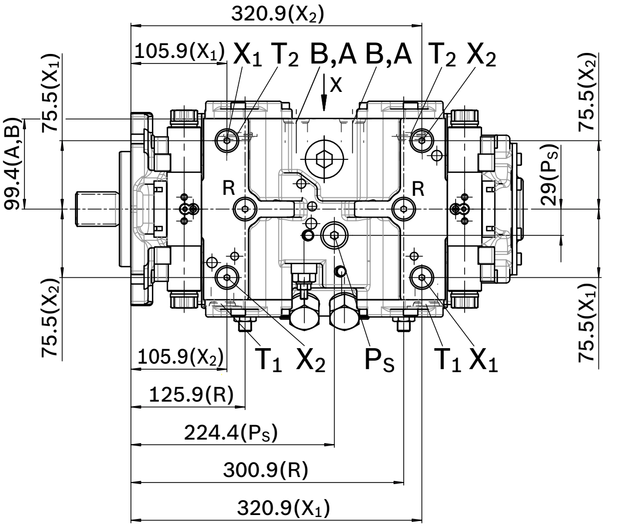
EP – Proportional control electric

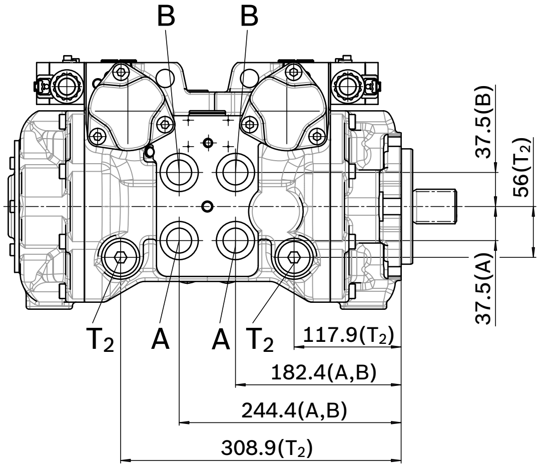
Threaded ports A and B, on left side (viewed on drive shaft)[1]

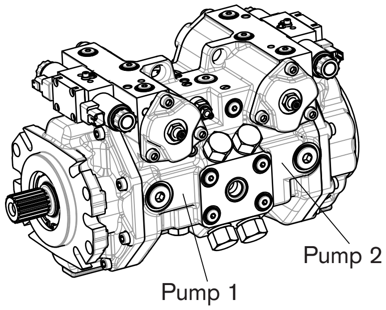




View X







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1) For threaded ports A and B, on right side (viewed on drive shaft), the complete case and thus the dimensions are mirrored.

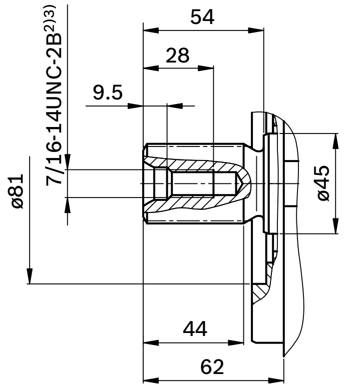
2) Center of gravity

Dimensions size 065-065

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shaft

S9 Splined shaft 1 1/2 in
17T 12/24DP[1]



Ports

Designation	Port for	Standard[4]	Size[3]	Maximum pressure [bar][5]	State[8]	
					Pump 1	Pump 2
A, B	Service line	ISO 6149[7]	M27 x 2; 19 deep	500	O	O
T_1	Drain line	ISO 6149[7]	M27 x 2; 19 deep	3	X[6]	X[6]
T_2	Drain line	ISO 6149[7]	M27 x 2; 19 deep	3	X[6]	O[6]
R	Air bleed	ISO 6149[7]	M14 x 1.5; 11.5 deep	3	X	X
X_1, X_2	Control pressure (upstream of orifice)	ISO 6149[7]	M14 x 1.5; 11.5 deep	40	X	X
X_1, X_2	Control pressure (upstream of orifice, HT only)	ISO 6149[7]	M14 x 1.5; 11.5 deep	40	O	O
X_3, X_4[7]	Stroking chamber pressure	ISO 6149[7]	M14 x 1.5; 11.5 deep	40	X	X
G	Boost pressure	ISO 6149[7]	M22 x 1.5; 17 deep	40	O	
P_S	Pilot pressure, inlet	ISO 6149[7]	M18 x 1.5; 14.5 deep	40	X	
Y_{HT}	Pilot pressure, outlet (HT only)	ISO 6149[7]	M14 x 1.5; 11.5 deep	40	O	O
M_A, M_B	Measuring pressure A, B	ISO 6149[7]	M14 x 1.5; 11.5 deep	500	X	X
Y_1, Y_2	Pilot signal (HP only)	ISO 6149[7]	M14 x 1.5; 11.5 deep	40	O	O

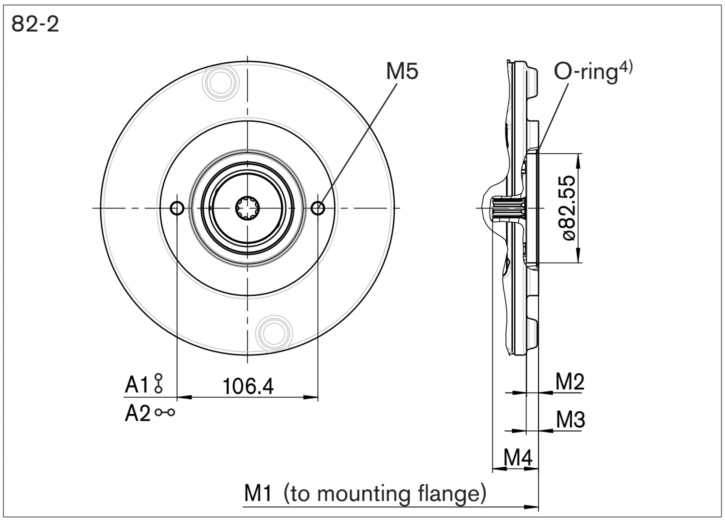
1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Thread according to ASME B1.1
3) Observe the general instructions on page 38 for the maximum tightening torques.
4) The spot face can be deeper than specified in the appropriate standard.
5) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
6) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on pages 36 and 37).
7) Optional, see page 31
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Through drive dimensions

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

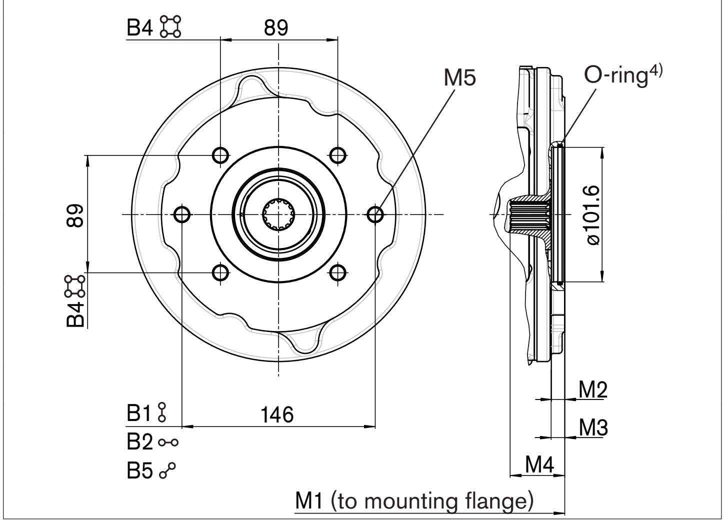
Flange SAE J744[1]			Coupling for splined shaft[2]					
	Mounting variant							
Diameter	Symbol[3]	Designation	Diameter		Designation	045	065	
Without through drive						●	●	**0000**
82-2 (A)	8	A1	5/8 in	9T 16/32DP	S2	○	○	**A1S2**
			3/4 in	11T 16/32DP	S3	○	○	**A1S3**
	⚯	A2	5/8 in	9T 16/32DP	S2	○	○	**A2S2**
			3/4 in	11T 16/32DP	S3	○	○	**A2S3**
101-2 (B)	8	B1	7/8 in	13T 16/32DP	S4	○	○	**B1S4**
			1 in	15T 16/32DP	S5	○	○	**B1S5**
	⚯	B2	7/8 in	13T 16/32DP	S4	●	○	**B2S4**
			1 in	15T 16/32DP	S5	●	○	**B2S5**
	o°	B5	7/8 in	13T 16/32DP	S4	○	○	**B5S4**
			1 in	15T 16/32DP	S5	○	○	**B5S5**
101-4 (B)	⌘	B4	7/8 in	13T 16/32DP	S4	○	○	**B4S4**
			1 in	15T 16/32DP	S5	○	○	**B4S5**

82-2



NG	M1[5]	M2	M3	M4	M5[6]
045-045	412.6	9	9.4	35	M10 x 1.5; 13 deep
065-065	447.4	9	9.4	35	
065-045	423.5	9	9.4	35	

101-2
101-4



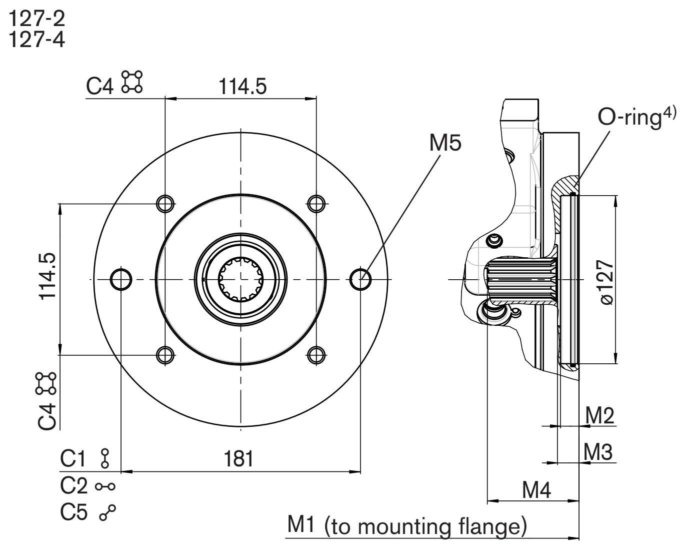
NG	M1[5]	M2	M3	M4	M5[6]
045-045	412.6	10	15	38	M12 x 1.75; 16 deep
065-065	447.4	10	15	38	
065-045	423.5	10	15	38	

[1] The through-drive flange is only supplied with the fastening thread corresponding to the ordering code designation.
[2] Coupling for splined shaft according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
[3] Mounting drillings pattern viewed on through drive with control at top
[4] O-ring included in the delivery contents
[5] Installation length M1 is valid for standard mounting flange (without integrated boost pump).
[6] Thread according to DIN 13, observe the general instructions on page 38 for the maximum tightening torques.

Through drive dimensions

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Flange SAE J744[1]			Coupling for splined shaft[2]					
	Mounting variant							
Diameter	Symbol[3]	Designation	Diameter		Designation	045	065	
127-2 (C)	⦂	C1	1 in	15T 16/32DP	S5	○	○	**C1S5**
			1 1/4 in	14T 12/24DP	S7	–	○	**C1S7**
	∘∘	C2	1 in	15T 16/32DP	S5	○	○	**C2S5**
			1 1/4 in	14T 12/24DP	S7	–	○	**C2S7**
	⸝	C5	1 in	15T 16/32DP	S5	○	○	**C5S5**
			1 1/4 in	14T 12/24DP	S7	–	○	**C5S7**
127-4 (C)	⁘	C4	1 in	15T 16/32DP	S5	○	○	**C4S5**
			1 1/4 in	14T 12/24DP	S7	–	○	**C4S7**



NG	M1[5]	M2	M3	M4
045-045	427.6	14	13	53
065-065	462.4	14	13	53
065-045	438.5	14	13	53

M5[6]	2-hole	4-hole
045-045 **065-065** **065-045**	M16 x 2; 19 deep	M12 x 1.75; 19 deep

[1] The through-drive flange is only supplied with the fastening thread corresponding to the ordering code designation.

[2] Coupling for splined shaft according to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5

[3] Mounting drillings pattern viewed on through drive with control at top

[4] O-ring included in the delivery contents

[5] Installation length M1 is valid for standard mounting flange (without integrated boost pump).

[6] Thread according to DIN 13, observe the general instructions on page 38 for the maximum tightening torques.

Overview of mounting options

Through drive[1]			**Mounting option – additional pump**						
Flange	Coupling for splined shaft	Short code	A4VG/40 NG (shaft)	A4VG/32 NG (shaft)	A10VG NG (shaft)	A10VO/31 NG (shaft)	A10VO/53 NG (shaft)	A11VO NG (shaft)	External gear pump[2]
82-2 (A)	5/8 in	**A_S2**	–	–	–	18 (U)	10 (U)	–	Series F Size 4 to 22
	3/4 in	**A_S3**	–	–	–	18 (S, R)	10 (S) 18 (S, R)	–	–
101-2 (B)	7/8 in	**B_S4**	–	–	18 (S)	28 (S, R) 45 (U, W)	28 (S, R) 45 (U, W)	–	Series N Size 20 to 36 Series G Size 32 to 50
	1 in	**B_S5**	–	28 (S)	28,45 (S)	45 (S, R)	45 (S,R) 60 (U,W)	40 (S)	–
101-4 (B)	7/8 in	**B4S4**	–	–	–	–	–	–	–
	1 in	**B4S5**	–	–	–	–	–	–	–
127-2 (C)	1 in	**C_S5**	–	40 (U)	–	71 (U, W)	–	–	–
	1 1/4 in	**C_S7**	45 (S7) 65 (S7)	40, 56, 71 (S)	63 (S)	71 (S,R) 100 (U,W)	85 (U, W)	60 (S)	–
127-4 (C)	1 1/4 in	**C4S7**	65 (S7)	71 (S)	–	–	60 (S, R)	–	–

[1] Availability of the individual sizes, see ordering code on page 4.

[2] Bosch Rexroth recommends special versions of the gear pumps. Please contact us.

Pressure cut-off

The pressure cut-off is a pressure control which, after reaching the set pressure, adjusts the displacement of the pump back to $V_{g\ min}$.

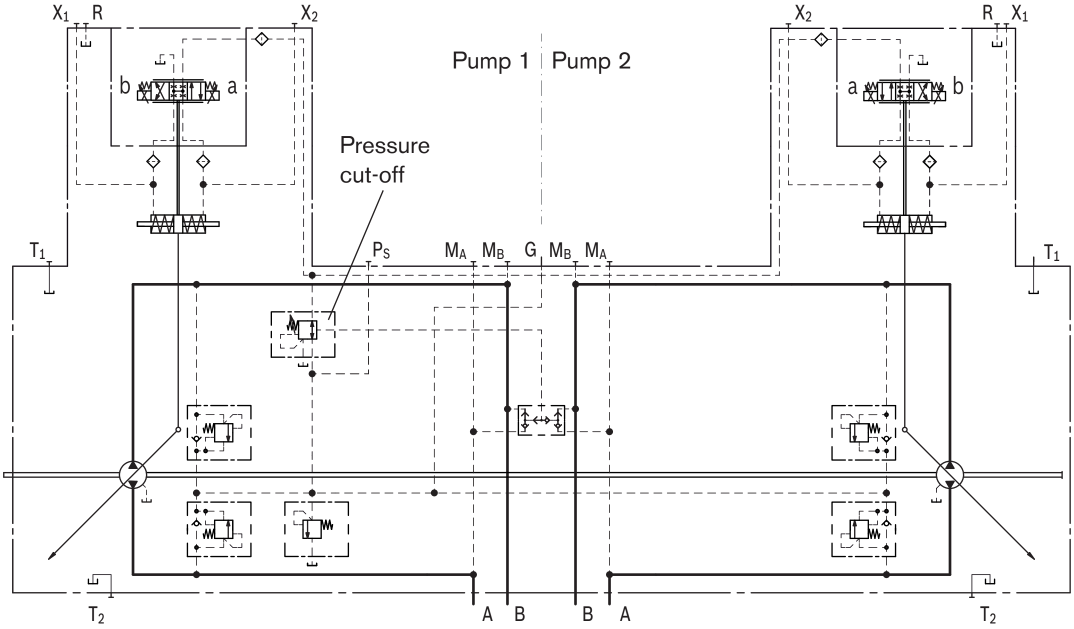
This valve prevents the operation of the high-pressure relief valves when accelerating or decelerating.

The high-pressure relief valves protect against the pressure spikes which occur during fast swiveling of the swashplate and limit the maximum pressure in the system.

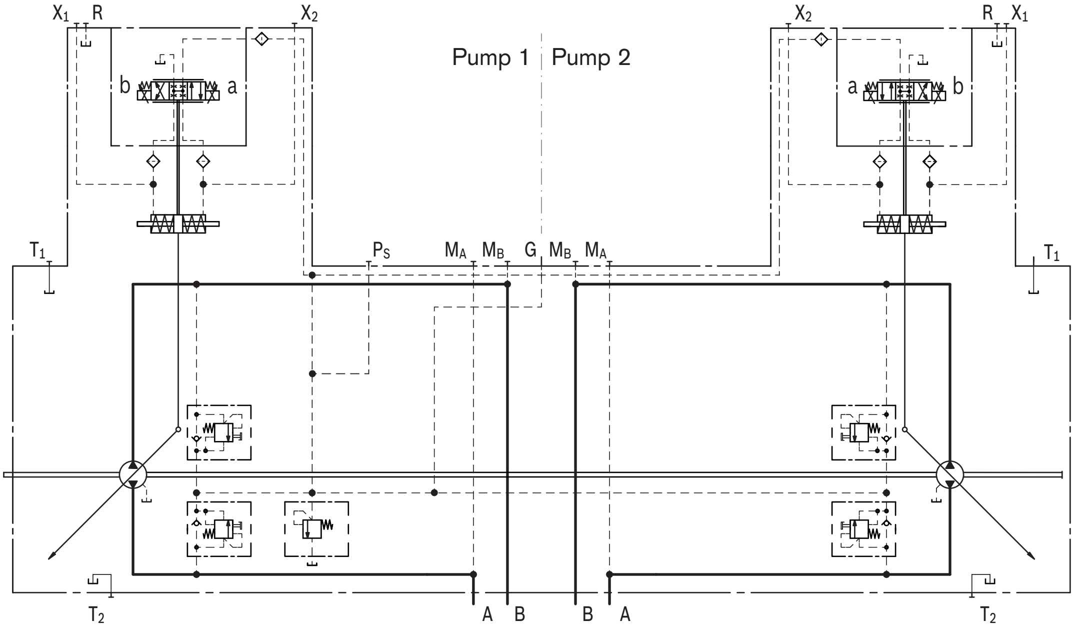
The setting range of the pressure cut-off may be anywhere within the entire operating pressure range. However, it must be set 30 bar lower than the setting of the high-pressure relief valves (see setting diagram, page 30).

Please state the setting value of the pressure cut-off in plain text when ordering.

Schematic with pressure cut-off
Example: electric control, EP_D



Schematic without pressure cut-off



Illustrations with service line ports on left side

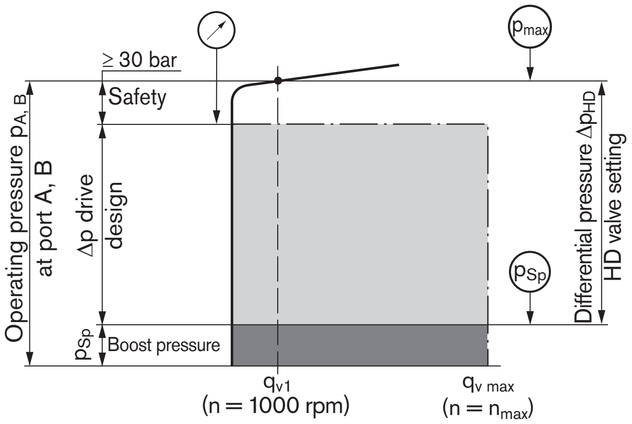
High-pressure relief valves

The four high-pressure relief valves protect the hydrostatic transmission (pump and motor) from overload. They limit the maximum pressure in the respective high-pressure line and serve simultaneously as boost valves.

High-pressure relief valves are not working valves and are only suitable for pressure spikes or high rates of pressure change.

Setting diagram

Version without pressure cut-off

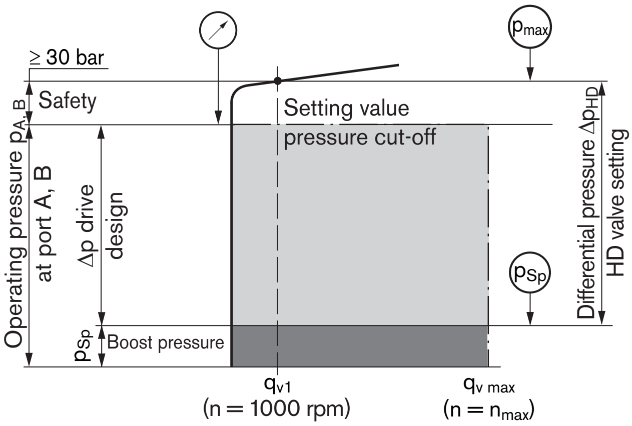


Example:

Operating pressure $p_{A,B}$ ______________________ 450 bar
Boost pressure p_{Sp} ______________________ 20 bar
Differential pressure Δp_{HD} ______________________ 430 bar

$p_{A,B}$ 450 bar − p_{Sp} 20 bar = Δp_{HD} **430 bar**

Version with pressure cut-off



Example:

Operating pressure $p_{A,B}$ ______________________ 450 bar
Boost pressure p_{Sp} ______________________ 20 bar
Differential pressure Δp_{HD} ______________________ 460 bar

$p_{A,B}$ 450 bar − p_{Sp} 20 bar + Safety 30 bar = Δp_{HD} **460 bar**

When ordering, state differential pressure setting in plain text:
The following values are available for selection of the differential pressure setting (fixed setting):
Preferred values [bar]: 400, 410, 420, 430, 440, 450, 460, 470
Optional values [bar]: 300, 320, 340, 360, 380
If not specified in the order, valves will be set to the differential pressure Δp = 420 bar.

High-pressure relief valve A
Differential pressure setting ______________ Δp_{HD} = ... bar

Cracking pressure of the HD valve (at $q_{V\,1}$) ______ p_{max} = ... bar
($p_{max} = \Delta p_{HD} + p_{Sp}$)

High-pressure relief valve B
Differential pressure setting ______________ Δp_{HD} = ... bar

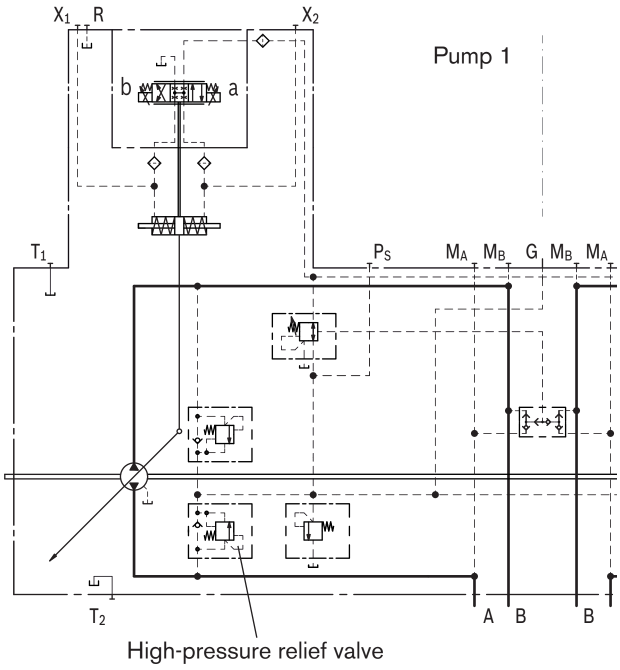
Cracking pressure of the HD valve (at $q_{V\,1}$) ______ p_{max} = ... bar
($p_{max} = \Delta p_{HD} + p_{Sp}$)

Note

The valve settings are made at **n = 1000 rpm** and at **$V_{g\,max}$ ($q_{v\,1}$)**. There may be deviations in the cracking pressures with other operating parameters.

Schematic

Illustration with service line ports on left side



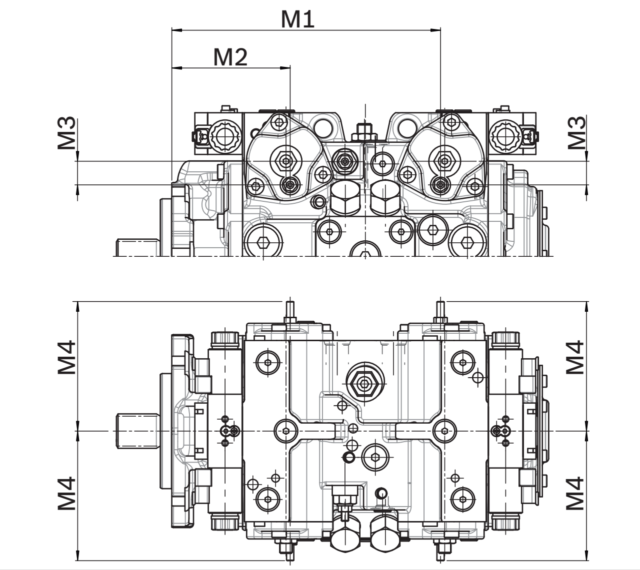
Mechanical stroke limiter

The mechanical stroke limiter is an auxiliary function allowing the maximum displacement of the pump to be steplessly reduced, regardless of the control module used.

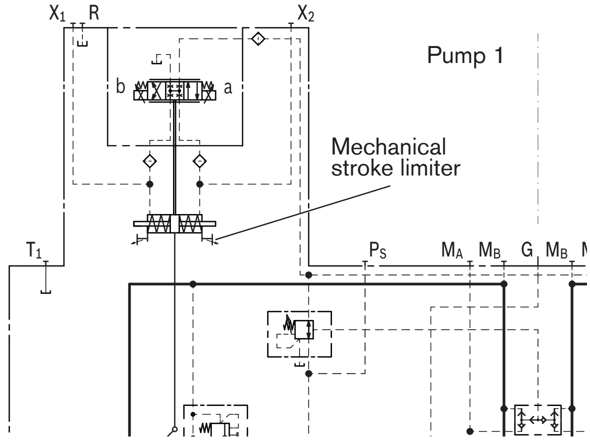
With two threaded pins per pump, the stroke of the stroke piston and thus the maximum swivel angle of each pump is limited.

Dimensions

NG	M1	M2	M3	M4
045-045	285.4	119.6	26.1	143
065-065	296.3	130.6	26.1	143
065-045	296.3	130.6	26.1	143



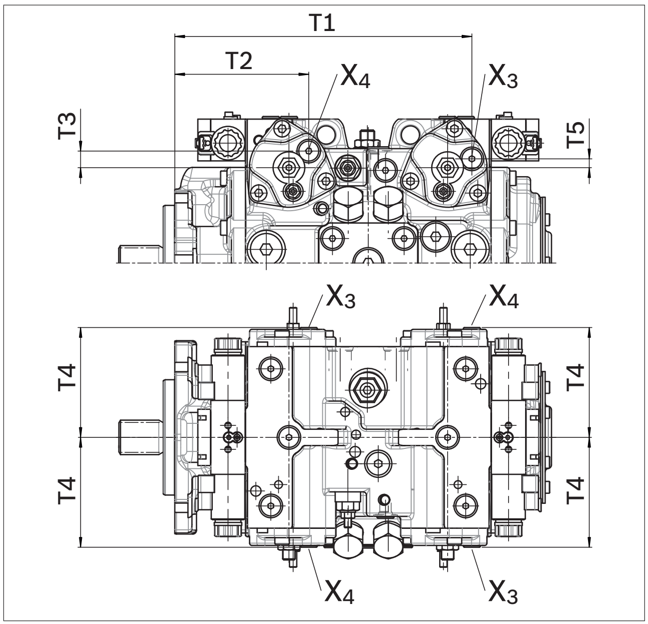
Schematic
Illustration with service line ports on left side



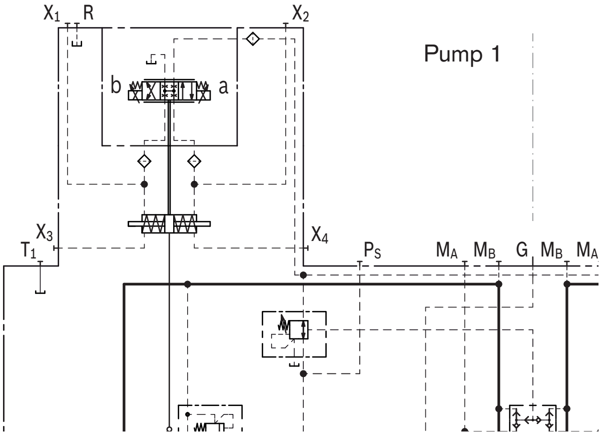
Ports X_3 and X_4 for stroking chamber pressure

Dimensions

NG	T1	T2	T3	T4	T5
045-045	316.8	136.8	18.3	117	9.7
065-065	327.7	147.7	18.3	117	9.7
065-045	327.7	147.7	18.3	117	9.7



Schematic
Illustration with service line ports on left side



Designation	Port for	Standard[1]	Size[2]	Maximum pressure [bar][3]	State[4]	
					Pump 1	Pump 2
X_3, X_4	Stroking chamber pressure	ISO 6149	M14 x 1.5; 11.5 deep	40	X	X

[1] The spot face can be deeper than specified in the appropriate standard.
[2] Observe the general instructions on page 38 for the maximum tightening torques.
[3] Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
[4] X = Plugged (in normal operation)

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Filtration boost circuit / external supply

Version E
External supply

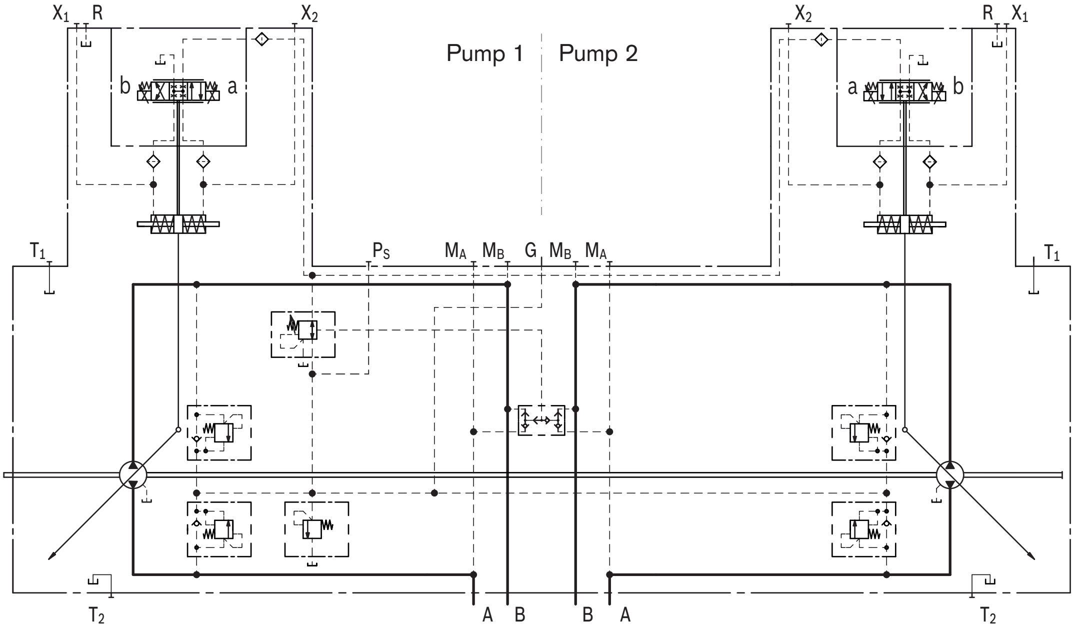
This variation should be used in versions **without** integrated boost pump.

Supply comes from port G.

Filter arrangement ____________________________ separate

To ensure the functional reliability, maintain the required cleanliness level for the boost fluid fed in at port G (see page 7).

Schematic version E
Illustration shows service line ports on left side



Connector for solenoids

DEUTSCH DT04-2P-EP04

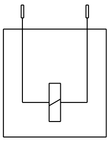
Molded , 2-pin, without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:

IP67 DIN/EN 60529

and IP69K DIN 40050-9

Circuit symbol

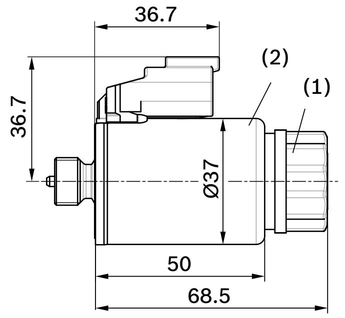


Mating connector

DEUTSCH DT06-2S-EP04
Bosch Rexroth Mat. No. R902601804

Consisting of:	DT designation
– 1 housing	DT06-2S-EP04
– 1 wedge	W2S
– 2 sockets	0462-201-16141

The mating connector is not included in the delivery contents. This can be supplied by Bosch Rexroth on request.



Changing connector orientation

If necessary, you can change the connector orientation by turning the solenoid housing.

To do this, proceed as follows:

1. Loosen the mounting nut (1) of the solenoid. To do this, turn the mounting nut (1) one turn counter-clockwise.
2. Turn the solenoid body (2) to the desired orientation.
3. Retighten the mounting nut. Tightening torque: 5+1 Nm. (size WAF 26, 12kt DIN 3124)

On delivery, the connector orientation may differ from that shown in the brochure or drawing.

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

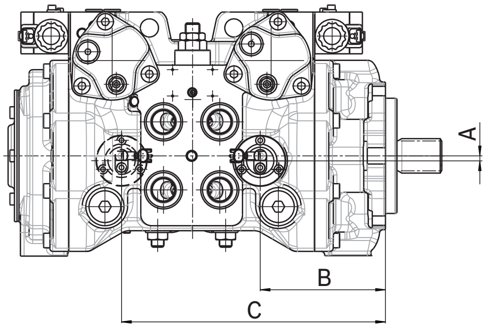
Speed sensor

With the speed sensor DSA mounted, a signal proportional to pump speed can be generated. The DSA sensor measures the speed and direction of rotation.

Ordering code, technical data, dimensions and details on the connector, plus safety instructions about the sensor can be found in the relevant data sheet (DSA – RE 95133).

The sensor is mounted on the port provided for this purpose with a mounting bolt.

Dimensions



Service line ports on left side

NG	A	B	Number of teeth
045-045	5.5	127	32
065-065	5.5	137.9	45
065-045	5.5	137.9	45

Service line ports on right side

NG	A	C	Number of teeth
045-045	5.5	278	32
065-065	5.5	288.9	45
065-045	5.5	288.9	32

Swivel angle sensor

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

For the swivel angle indicator, the pump swivel angle is measured by an electric swivel angle sensor.

As an output parameter, the Hall-effect swivel angle sensor delivers a voltage proportional to the swivel angle (see table of output voltages).

Please contact us if the swivel angle sensor is used for control.

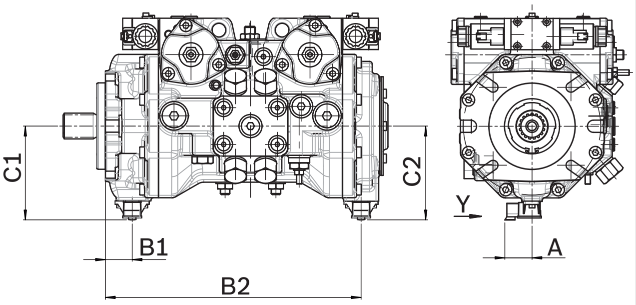
Characteristics			
Supply voltage U_b	10 to 30 V DC		
Output voltage U_a	1 V ($V_{g\,max}$)	2.5 V ($V_{g\,0}$)	4 V ($V_{g\,max}$)
Reverse voltage protection	Short circuit-resistant		
EMC resistance	Details on request		
Operating temperature range	-40 °C to +115 °C		
Vibration resistance sinusoidal vibration EN 60068-2-6	10 *g* / 5 to 2000 Hz		
Shock resistance continuous shock IEC 68-2-29	25 *g*		
Resistance to salt spray DIN 50 021-SS	96 h		
Type of protection with mounted mating connector	IP67 – DIN/EN 60529 IP69K – DIN 40050-9		
Housing material	Plastic		

Output voltage

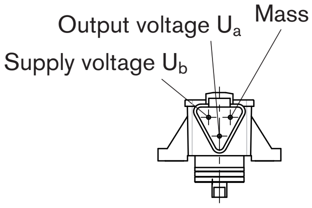
		Flow direction[1]	Operating pressure	Output voltage
Direction of rotation	cw	B to A	M_A	> 2.5 V
		A to B	M_B	< 2.5 V
	ccw	A to B	M_B	> 2.5 V
		B to A	M_A	< 2.5 V

[1] For flow direction, see controls

Dimensions



Detail Y not to scale
Connector DT04-3P-EP04



NG	A	B1	B2	C1	C2
045-045	37	35.9	325.2	134.8	134.8
065-065	37	39.4	348	134.8	134.8
065-045	37	39.4	336.6	134.8	134.8

Mating connector

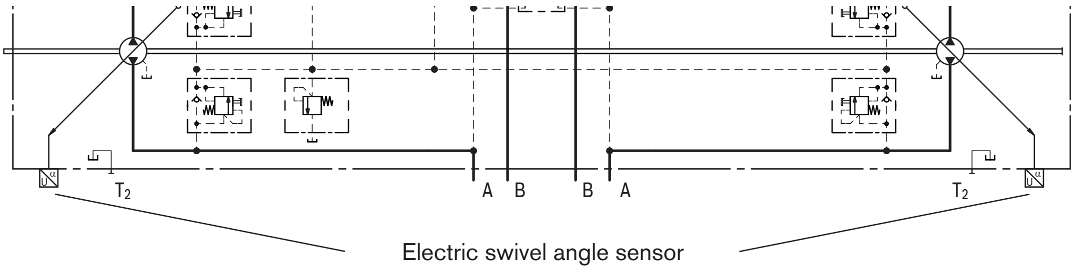
DEUTSCH DT06-3S-EP04
Bosch Rexroth Mat. No. R902603524

Consisting of:	DT designation
– 1 housing	DT06-3S-EP04
– 1 wedge	W3S
– 3 sockets	0462-201-16141

The mating connector is not included in the delivery contents. This can be supplied by Bosch Rexroth on request.

Schematic

Illustration with service line ports on left side



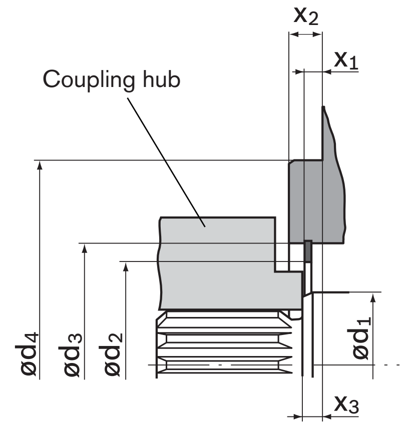
Installation dimensions for coupling assembly

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

To ensure that rotating components (coupling hub) and fixed components (housing, circlip) do not come into contact with each other, the installation conditions described here must be observed. This depends on the pump size and the splined shaft.

SAE splined shaft (spline according to ANSI B92.1a)

The outer diameter of the shoulder on coupling hub must be smaller than the inner diameter of the circlip **d**$_2$ in the area near the drive shaft collar (dimension $x_2 - x_3$).



NG	Mounting flange	ød$_1$	ød$_{2\ min}$	ød$_3$	ød$_4$	x$_1$	x$_2$	x$_3$ (approx.)
45	127-2 (C)	45	50.5	73 ±0.1	127	0.1	$12.7_{-0.5}$	8
65	127-2/4 (C)	45	58.5	81 ±0.1	127	6.4	$12.7_{-0.5}$	8

Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This must also be observed following a relatively long standstill as the axial piston unit may drain back to the reservoir via the hydraulic lines.

The case drain fluid in the pump housing must be directed to the reservoir via the highest available drain port (T_1, T_2).

For combinations of multiple units, make sure that the respective case pressure in each unit is not exceeded. In the event of pressure differences at the drain ports of the units, the shared drain line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation. If this is not possible, separate drain lines must be laid if necessary.

To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.

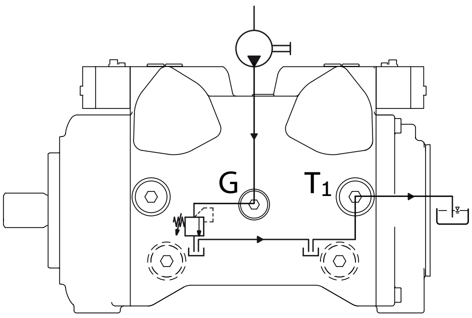
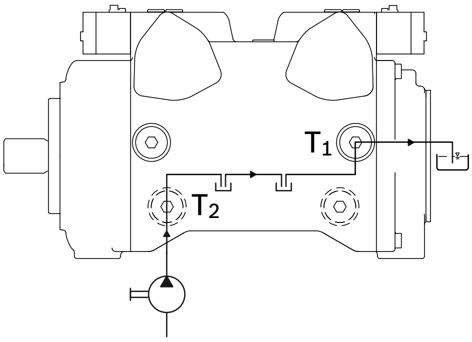
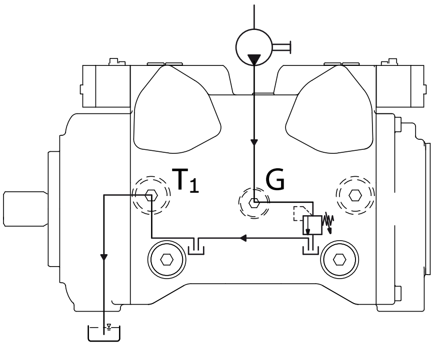
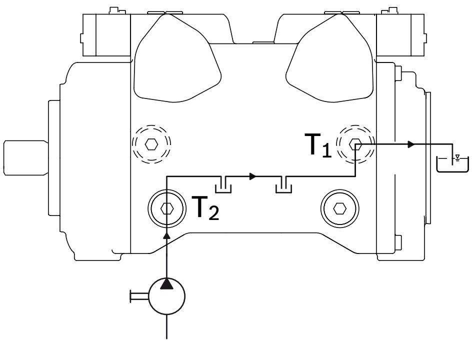
In all operating conditions, the drain line must flow into the reservoir below the minimum fluid level.

Connection of the drain line

Besides the actual case drain fluid, an additional cooling fluid flow is needed in the housing for lubricating and cooling the rotary group in the housing. To guarantee the flushing of both rotary groups, the connection specifications for the T-ports must be observed.

Internal flushing: If the integrated boost pressure valve is used, internal flushing is guaranteed.

External flushing: If the boost pressure is backed up with an external pressure-relief valve, external flushing of the pump housing via the T-ports will be necessary.

	Internal flushing	External flushing
Threaded ports A and B, on left side (viewed on drive shaft)	 	
Threaded ports A and B, on right side (viewed on drive shaft)	 	

Installation instructions

Installation position

See the following examples 1 to 8
Further installation positions are possible upon request.

Recommended installation position: 1

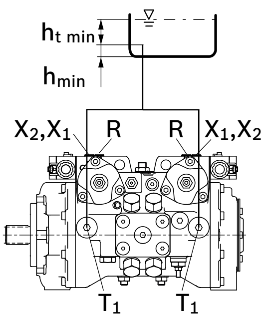
Notes

- If it is not possible to fill the stroking chambers via X_1 to X_4 in the final installation position, this must be done prior to installation.
- To prevent unexpected actuation and damage, the stroking chambers must be bled via the ports X_1, X_2 or X_3, X_4 depending on the installation position.
- In certain installation positions, an influence on the control characteristics can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristics and changes in response time.

Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.

1



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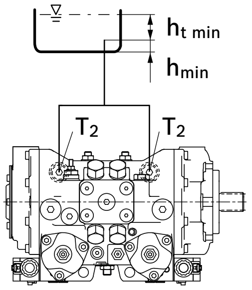

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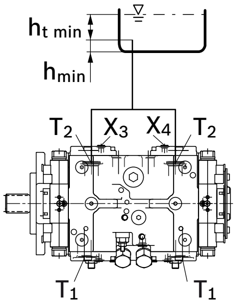

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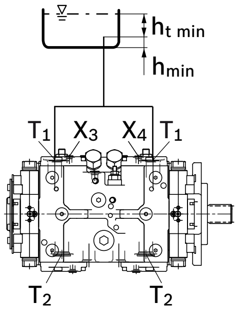


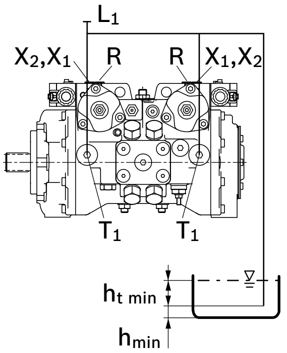
Installation position	Bleeding the case	Bleeding the stroking chamber	Filling
1	R	X_1, X_2	$T_1 + X_1 + X_2$
2	–	–	T_2
3	–	X_3, X_4	$T_2 + X_3 + X_4$
4	–	X_3, X_4	$T_1 + X_3 + X_4$

Note instructions!

Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.

5



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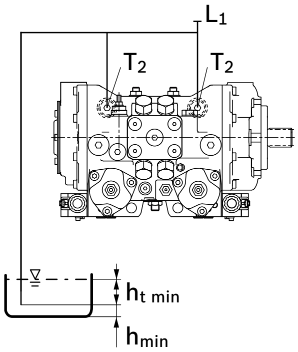

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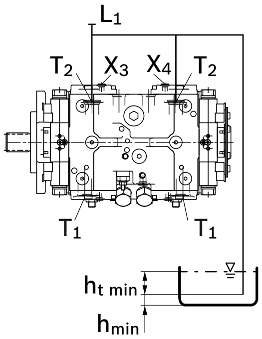

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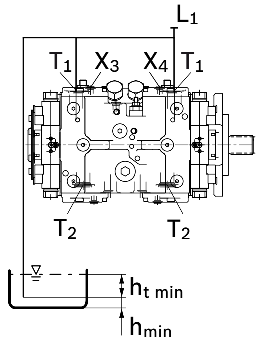


Installation position	Bleeding the case	Bleeding the stroking chamber	Filling
5	R	X_1, X_2	$L_1 + X_1 + X_2$
6	L_1 (T_2)	–	L_1 (T_2)
7	L_1 (T_2)	X_3, X_4	L_1 (T_2) $+ X_3 + X_4$
8	L1 (T1)	X_3, X_4	L_1 (T_1) $+ X_3 + X_4$

Note instructions!

L_1, L_2	Filling / air bleed
R	Air bleed port
T_1, T_2	Drain port
$h_{t\,min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required spacing to reservoir bottom (100 mm)

General instructions

– The pump A24VG is designed to be used in closed circuit.

– The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.

– Before using the axial piston unit, please read the corresponding instruction manual completely and thoroughly. If necessary, these can be requested from Bosch Rexroth.

– During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e. g. by wearing protective clothing).

– Depending on the operating conditions of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.

– Service line ports:

  - The ports and fastening threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified application conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.

  - The service line ports and function ports can only be used to accommodate hydraulic lines.

– The data and notes contained herein must be adhered to.

– The product is not approved as a component for the safety concept of a general machine according to ISO 13849.

– The following tightening torques apply:

  - Fittings:
    Observe the manufacturer's instruction regarding tightening torques for the used fittings.

  - Mounting bolts:
    For mounting bolts with metric ISO thread according to DIN 13 or with thread according to ASME B1.1, we recommend checking the tightening torque in individual cases in accordance with VDI 2230.

  - Female threads in the axial piston unit:
    The maximum permissible tightening torques $M_{G\ max}$ are maximum values of the female threads and must not be exceeded. For values, see the following table.

  - Threaded plugs:
    For the metallic threaded plugs supplied with the axial piston unit, the required tightening torques of threaded plugs M_V apply. For values, see the following table.

Ports **Standard**	 **Size of thread**	**Maximum permissible tightening torque of the female threads $M_{G\ max}$**	**Required tightening torque of the threaded plugs M_V**	**WAF hexagon socket of the threaded plugs**
ISO 6149	M14 x 1.5	80 Nm	45 Nm	6 mm
	M18 x 1.5	140 Nm	70 Nm	8 mm
	M22 x 1.5	210 Nm	100 Nm	10 mm
	M27 x 2	330 Nm	170 Nm	12 mm

Rexroth
Bosch Group

2-Circuit Axial Piston Variable Pump A30VG

Data sheet

Series 10
Size NG28
Nominal pressure 300 bar
Maximum pressure 350 bar
Closed circuit

Contents

Features

- Compact 2-circuit variable pump of swashplate design for hydrostatic drives in closed circuit
- Two equal flows from one pump to supply two separate circuits
- All functions needed to achieve a differential lock effect are integrated in the pump.
- The flow increases as the angle of the swashplate is adjusted from zero to its maximum value.
- A wide range of highly adaptable control devices with different control and regulating functions, for all important applications.
- Single control for both circuits
- Two pressure-relief valves are provided on the high pressure ports to protect the hydrostatic transmission (pump and motor) from overload.
- The high-pressure relief valves also function as boost valves.
- The integrated boost pump acts as a feed pump and control pressure supply.
- The maximum boost pressure is limited by a built-in boost pressure-relief valve.
- All types of hydraulic motor can be used as drive units
- Short, compact design makes installation and wiring easier in tight spaces

Ordering code for standard program

A30V	G	028			0			/	10	M		–	N	C2		1					
01	02	03	04	05	06	07	08		09	10	11		12	13	14	15	16	17	18	19	20

Axial piston unit

01	Swashplate design, variable, nominal pressure 300 bar, maximum pressure 350 bar	**A30V**

Operation mode

02	Pump, closed circuit	**G**

Size

03	Displacement $V_{g\ max}$ in cm^3	**028**

Control device

			028	
04	Proportional control hydraulic	mechanical servo, hexagon shaft with lever	●	**HW1**
	Proportional control electric, with supply filtration	U = 12 V DC	●	**EP3**
		U = 24 V DC	●	**EP4**

Connector for solenoids[1]

05	Without	**0**
	DEUTSCH - molded connector, 2-pin – without suppressor diode	**P**

Auxiliary function 1

06	Without	**0**

Auxiliary function 2

07	Without	**0**
	With mechanical stroke limiter, externally adjustable	**M**
	With ports X_3, X_4 for stroking chamber pressure	**T**
	With mechanical stroke limiter and ports X_3, X_4	**B**

DA control valve

		HW	EP	
08	Without	●	●	**0**
	With DA control valve, fixed setting	○	○	**1**

Series

09	Series 1, Index 0	**10**

Version of port and fixing threads

10	Metric	**M**

Direction of rotation

11	Viewed from drive shaft	clockwise	**R**
		counter-clockwise	**L**

Seals

12	NBR (nitrile-caoutchouc), shaft seal ring in FKM (fluor-caoutchouc)	**N**

Mounting flange

13	SAE J744	127-2 (C)	**C2**

● = Available ○ = On request

[1] Connectors for other electric components can deviate.

Ordering code for standard program

A30V	G	028						/	10	M		–	N	C2		1					
01	02	03	04	05	06	07	08		09	10	11		12	13	14	15	16	17	18	19	20

Drive shaft

14	Splined shaft ANSI B92.1a-1976	1 1/4 in 14T 12/24DP	**S7**
		1 3/8 in 21T 16/32DP	**V8**

Service line ports

15	Circuit 1: double SAE flange port, left; Circuit 2: single SAE flange port at top and bottom; suction port at bottom (viewed from drive shaft)	**1**

Boost pump

16	With integrated boost pump (standard)	**F**
	Without integrated boost pump (no pressure filtration possible)	**U**

Through drive

	Flange SAE J744			Coupling for splined shaft[2]			
		Mounting variant					
	Diameter	Symbol	Designation	Diameter		Designation	
17	Without						**0000**
	82-2 (A)	⦂	A1	5/8 in 9T	16/32DP	S2	**A1S2**
		⚯	A2	5/8 in 9T	16/32DP	S2	**A2S2**
	101-2 (B)	⦂	B1	7/8 in 13T	16/32DP	S4	**B1S4**
				1 in 15T	16/32DP	S5	**B1S5**
		⚯	B2	7/8 in 13T	16/32DP	S4	**B2S4**
				1 in 15T	16/32DP	S5	**B2S5**
	127-2 (C)	⚯	C2	1 1/4 in 14T	12/24DP	S7	**C2S7**

High-pressure valves

18	With high-pressure relief valve, direct controlled	without bypass	**3**
		with bypass	**5**

Filtration boost circuit / external supply

19	Filtration in the boost pump suction line	**S**
	Filtration in the boost pump pressure line: Ports for external boost circuit filtration (F_e and F_a)	**D**
	External supply (on version without integrated boost pump)	**E**

Standard / special version

20	Standard version		**-O**
		combined with attachment part or attachment pump	**-K**
	Special version		**-S**
		combined with attachment part or attachment pump	**-T**

Note

Short designation X refers to a special version not covered by the ordering code.

● = Available ❍ = On request

[2] Coupling for splined shaft acc. to ANSI B92.1a-1976

Technical data

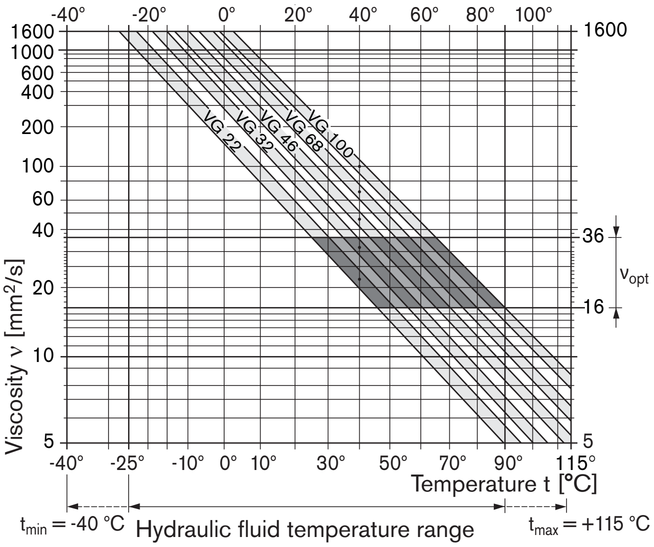
Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil) and RE 90221 (environmentally acceptable hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.

The variable pump A30VG is not suitable for operation with HFA, HFB and HFC. If HFD or environmentally acceptable hydraulic fluids are being used, the limitations regarding technical data and seals must be observed.
Please contact us.

When ordering, indicate the hydraulic fluid that is to be used.

Selection diagram



Details regarding the choice of hydraulic fluid

The correct choice of hydraulic fluid requires knowledge of the operating temperature in relation to the ambient temperature: in a closed circuit the circuit temperature.

The hydraulic fluid should be chosen so that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt}), see shaded area of the selection diagram. We recommended that the higher viscosity class be selected in each case.

Example: At an ambient temperature of X °C, an operating temperature of 60 °C is set in the circuit. In the optimum operating viscosity range ($\nu_{opt.}$, shaded area), this corresponds to the viscosity classes VG 46 or VG 68; to be selected: VG 68.

Note

The case drain temperature, which is affected by pressure and speed, is always higher than the circuit temperature. At no point of the component may the temperature be higher than 115 °C, however. The temperature difference specified below is to be taken into account when determining the viscosity in the bearing.

If the above conditions cannot be maintained due to extreme operating parameters, please contact us.

Viscosity and temperature

	Viscosity [mm²/s]	Temperature	Comment
Storage		$T_{min} \geq -50$ °C $T_{opt} = +5$ °C to +20 °C	up to 12 months with standard factory conservation up to 24 months with long-term factory conservation
(Cold) start-up[1]	$\nu_{max} = 1600$	$T_{St} \geq -40$ °C	$t \leq 3$ min, without load ($p \leq 50$ bar), $n \leq 1000$ rpm
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu < 1600$ to 400	T = -40 °C to -25 °C	at p_{nom}, $0.5 \cdot n_{nom}$ and $t \leq 15$ min
Operating phase			
Temperature difference		ΔT = approx. 5 K	The temperature of the hydraulic fluid in the bearing is (depending on pressure and speed) approx. 5 K higher than that of the case drain fluid at port T.
Continuous operation	$\nu = 400$ to 10 $\nu_{opt} = 16$ to 36	T = -25 °C to +90 °C	no restriction within the permissible data
Short-term operation	$\nu_{min} =< 10$ to 5	$T_{max} = +115$ °C	$t < 3$ min, $p < 0.3 \cdot p_{nom}$
Shaft seal ring FKM[1]		$T \leq +115$ °C	See page 5

[1] At temperatures below -25°C, an NBR shaft seal ring is required (permissible temperature range: -40 °C to +90 °C).

Filtration of the hydraulic fluid

Filtration improves the cleanliness level of the hydraulic fluid, which, in turn, increases the service life of the axial piston unit.

To ensure the functional reliability of the axial piston unit, a gravimetric evaluation is necessary for the hydraulic fluid to determine the amount of contamination by solid matter and to determine the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 is to be maintained.

Depending on the system and the application, for the A30VG, we recommend

Filter cartridges $\beta_{20} \geq 100$.

With an increasing differential pressure at the filter cartridges, the β-value must not deteriorate.

At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), a cleanliness level of at least 19/17/14 according to ISO 4406 is necessary.

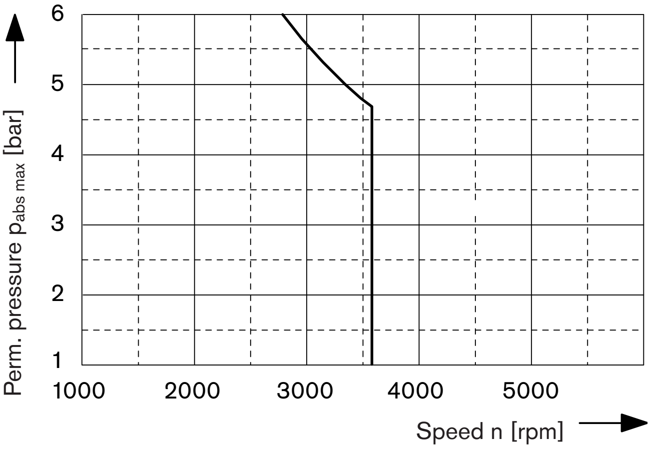
If the above classes cannot be achieved, please contact us. For notes on filtration types, see page 18.

Shaft seal ring

Permissible pressure loading

The service life of the shaft seal ring is affected by the speed of the pump and the case drain pressure. It is recommended that the average, continuous case drain pressure 3 bar absolute at operating temperature not be exceeded (maximum permissible case drain pressure 6 bar absolute at reduced speed, see diagram). Short-term ($t < 0.1$ s) pressure spikes of up to 10 bar absolute are permitted. The service life of the shaft seal ring decreases with an increase in the frequency of pressure spikes.

The case pressure must be equal to or greater than the external pressure on the shaft seal ring.



Temperature range

The FKM shaft seal ring may be used for case drain temperatures from -25 °C to +115 °C.

Note
For application cases below -25 °C, an NBR shaft seal ring is necessary (permissible temperature range: -40 °C to +90 °C). State NBR shaft seal ring in plain text when ordering.
Please contact us.

Technical data

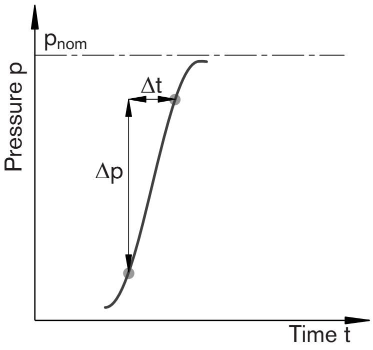
Operating pressure range

Pressure at service line port A or B

Nominal pressure p_{nom}	300 bar absolute
Maximum pressure p_{max}	350 bar absolute
Single operating period	10 s
Total operating period	300 h
Minimum pressure (high-pressure side)	25 bar
Minimum pressure (inlet)	10 bar

(boost pressure setting must be higher depending on system)

Rate of pressure change $R_{A\ max}$	9000 bar/s



Boost pump

Pressure at suction port S

Duration $p_{S\ min}$ ($\nu \leq 30\ mm^2/s$)	≥ 0.8 bar absolute
at cold starts, short-term ($t < 3$ min)	≥ 0.5 bar absolute
Maximum $p_{S\ max}$	≤ 5 bar absolute
Nominal pressure $p_{Sp\ nom}$	25 bar
Maximum pressure $p_{Sp\ max}$	40 bar

Control pressure

To ensure the function of the control, the following control pressure is required depending on the speed and operating pressure (measurement point, port P_S):

For controls EP and HW

Minimum control pressure $p_{St\ min}$ (at $n = 2000$ rpm)	20 bar

Definition

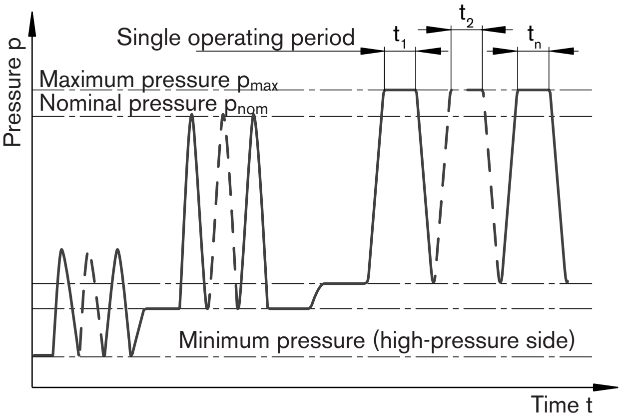
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

Maximum pressure p_{max}
The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.

Minimum pressure (high-pressure side)
Minimum pressure on the high-pressure side (A or B) that is required in order to prevent damage to the axial piston unit.

Minimum pressure (inlet)
Minimum pressure in inlet (A or B) that is required in order to prevent damage to the axial piston unit.

Rate of pressure change R_A
Maximum permissible rate of pressure build-up and pressure reduction during a pressure change over the entire pressure range.



Total operating period = $t_1 + t_2 + ... + t_n$

Technical data

Table of values (theoretical values, without efficiency and tolerances; values rounded)

Size			NG		28
Displacement					
	variable pump for each circuit		$V_{g\ max}$	cm^3	28
	boost pump (at $p = 20$ bar)		$V_{g\ max}$	cm^3	15.1
Speed					
	at $V_{g\ max}$		n_{nom}	rpm	3600
	minimum		n_{min}	rpm	500
Flow for each circuit					
	at n_{nom} and $V_{g\ max}$		$q_{v\ max}$	l/min	101
Power[1]					
	at n_{nom}, $V_{g\ max}$ and	$\Delta p = 300$ bar	P_{max}	kW	101
Torque[1]					
	at $V_{g\ max}$ and	$\Delta p = 300$ bar	T_{max}	Nm	267
		$\Delta p = 100$ bar	T	Nm	89
Rotary stiffness		drive shaft S7	c	Nm/rad	89793
		drive shaft V8	c	Nm/rad	91445
Moment of inertia for rotary group			J_{GR}	kgm^2	0.0083
Maximum angular acceleration[2]			α	rad/s^2	16660
Filling capacity			V	L	1.1
Mass approx. (without through drive)			m	kg	51.5

1) Without boost pump

2) The area of validity lies between the minimum required and maximum permissible speed.
It applies for external stimuli (e. g. engine 2 to 8 times rotary frequency, cardan shaft twice the rotary frequency).
The limit value applies for a single pump only.
The load capacity of the connection parts must be considered.

Note
Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. We recommend testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.

Determining the size

Flow $$q_v = \frac{V_g \cdot n \cdot \eta_v}{1000} \quad [\text{L/min}]$$

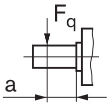
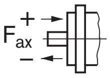
Torque $$T = \frac{V_g \cdot \Delta p}{20 \cdot \pi \cdot \eta_{mh}} \quad [\text{Nm}]$$

Power $$P = \frac{2\,\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p}{600 \cdot \eta_t} \quad [\text{kW}]$$

V_g = Displacement per revolution in cm^3
Δp = Differential pressure in bar
n = Speed in rpm
η_v = Volumetric efficiency
η_{mh} = Mechanical-hydraulic efficiency
η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

Technical data

Permissible radial and axial loading on drive shaft

Size		NG		28	28
Drive shaft			in	1 1/4	1 3/8
Radial force maximum at distance a (from shaft collar)		$F_{q\ max}$ a	N mm	4505 24	7000 24
Axial force maximum		$+ F_{ax\ max}$	N	2910	2910
		$– F_{ax\ max}$	N	1490	1490

Note
Special requirements apply in the case of belt drives. Please contact us.

Force-transfer direction of the permissible axial force:

$+ F_{ax\ max}$ = Increase in service life of bearings

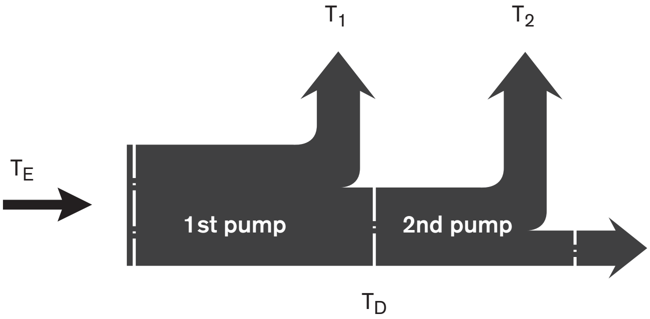
$– F_{ax\ max}$ = Reduction in service life of bearings (avoid)

Permissible input and through-drive torques

Size			NG		28
Torque at $V_{g\ max}$ and $\Delta p = 300$ bar[1]			T_{max}	Nm	267
Input torque at drive shaft, maximum[2]					
	S7	1 1/4 in	$T_{E\ max}$	Nm	602
	V8	1 3/8 in	$T_{E\ max}$	Nm	970
Maximum through-drive torque			$T_{D\ max}$	Nm	521

[1] Efficiency not considered
[2] For drive shafts with no radial force

Torque distribution

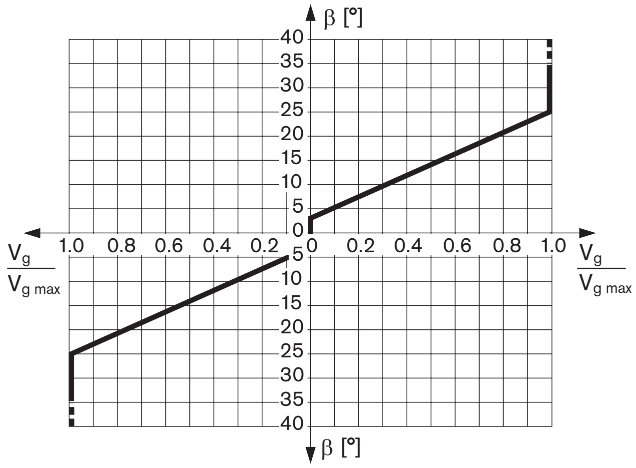


HW – Proportional control hydraulic, mechanical servo

The output flow of the pump can be steplessly varied in the range between 0 to 100 %, proportional to the rotation of the control lever between 0° and ±29°.

A feedback lever connected to the stroke piston maintains the pump flow for any given position of the control lever between 0° and 29°.

If the pump is also equipped with a DA control valve (see page 11), automotive operation is possible for travel drives.



Swivel angle β at the control lever for deflection:

Start of control at $\beta = 3°$

End of control at $\beta = 25°$ (max. displacement $V_{g\ max}$)

Mechanical stop for β: ±40°

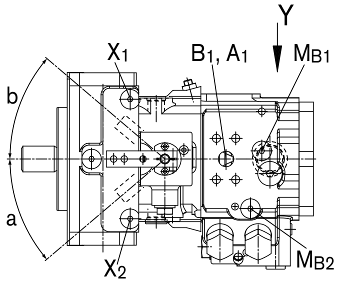
The maximum required torque at the lever is 170 Ncm. To prevent damage to the HW control unit, a positive mechanical stop must be provided for the HW control lever.

Note
Spring centering enables the pump, depending on pressure and speed, to move automatically to the neutral position ($V_g = 0$) as soon as there is no longer any torque on the control lever of the HW control unit (regardless of deflection angle).

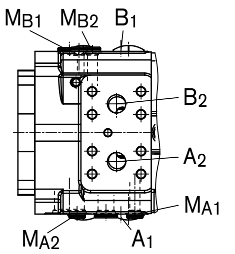
Assignment

Direction of rotation - Control - Flow direction

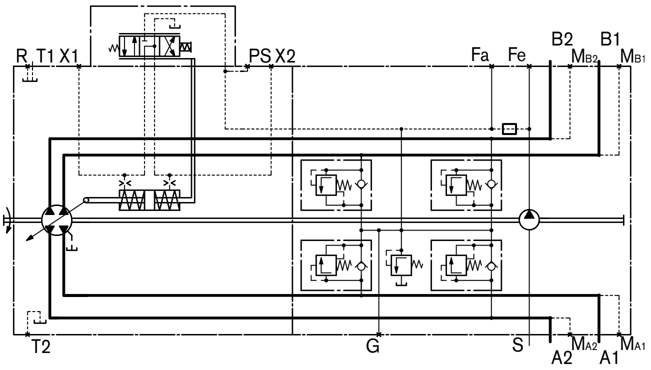
		Lever direction	Control pressure	Flow direction	Operating pressure
Direction of rotation	**cw**	a	X_2	B_1 to A_1	M_{A1}
				B_2 to A_2	M_{A2}
		b	X_1	A_1 to B_1	M_{B1}
				A_2 to B_2	M_{B2}
	ccw	a	X_2	A_1 to B_1	M_{B1}
				A_2 to B_2	M_{B2}
		b	X_1	B_1 to A_1	M_{A1}
				B_2 to A_2	M_{A2}



View Y



Circuit diagram



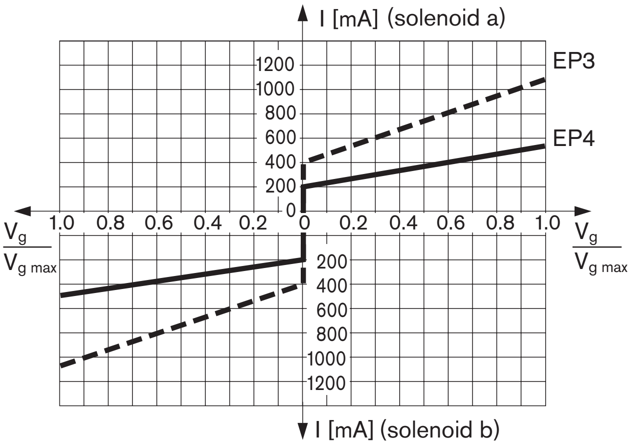
EP – Proportional control electric

The output flow of the pump can be steplessly varied in the range between 0 to 100 %, proportional to the electrical current supplied to solenoid a or b.

The electrical energy is converted into a force acting on the control piston. This control piston then directs control hydraulic fluid into and out of the stroke cylinder to adjust pump displacement as required.

A feedback lever connected to the stroke piston maintains the pump flow for any given current within the control range.

If the pump is also equipped with a DA control valve (see page 11), automotive operation is possible for travel drives.



Standard
Proportional solenoid without emergency actuation.

On request
Proportional solenoid with emergency actuation and spring return.

Technical data, solenoid	EP3	EP4
Voltage	12 V (±20 %)	24 V (±20 %)
Start of control at $V_{g\,0}$	400 mA	200 mA
End of control at $V_{g\,max}$	1090 mA	540 mA
Limiting current	1.54 A	0.77 A
Nominal resistance (at 20 °C)	5.5 Ω	22.7 Ω
Dither frequency	100 Hz	100 Hz
Actuated time	100 %	100 %
Type of protection see connector design page 11		

The following electronic controllers and amplifiers are available for controlling the proportional solenoids:

- BODAS controller RC
  Series 20 RE 95200
  Series 21 RE 95201
  Series 22 RE 95202
  Series 30 RE 95203
  and application software
- Analog amplifier RA RE 95230

Note

The spring return feature in the control unit is not a safety device

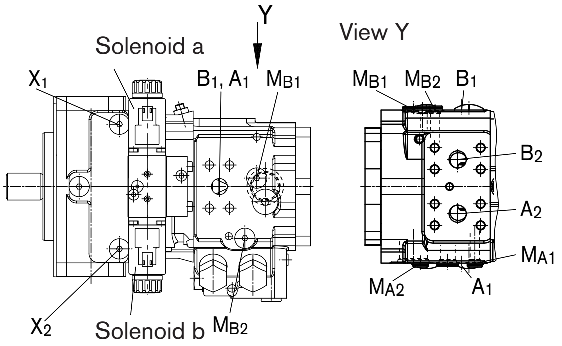
The spool valve inside the control unit can get stuck in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the axial piston unit can no longer supply the flow specified by the operator.

Check whether your application requires that remedial measures be taken on your machine in order to bring the driven consumer into a safe position (e. g. immediate stop).

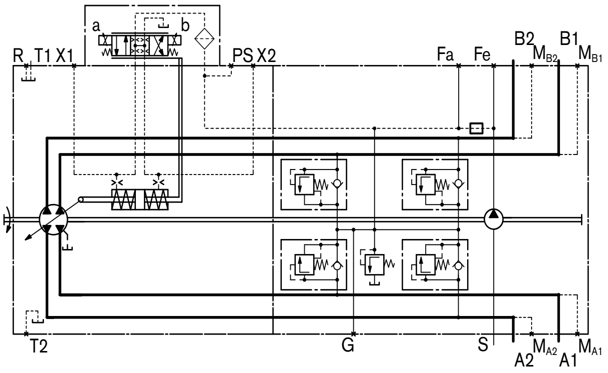
Assignment

Direction of rotation - Control - Flow direction

		Actuation of solenoid	Control pressure	Flow direction	Operating pressure
Direction of rotation	**cw**	a	X_1	A_1 to B_1	M_{B1}
				A_2 to B_2	M_{B2}
		b	X_2	B_1 to A_1	M_{A1}
				B_2 to A_2	M_{A2}
	ccw	a	X_1	B_1 to A_1	M_{A1}
				B_2 to A_2	M_{A2}
		b	X_2	A_1 to B_1	M_{B1}
				A_2 to B_2	M_{B2}



Circuit diagram



Connector for solenoids

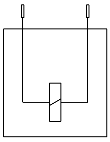
DEUTSCH DT04-2P-EP04, 2-pin

Molded, without bidirectional suppressor diode ______ **P**

Type of protection according to DIN/EN 60529:
IP67 and IP69K

Circuit symbol

Without bidirectional suppressor diode

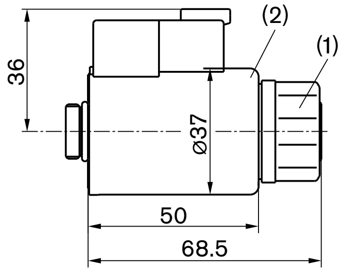


Mating connector

DEUTSCH DT06-2S-EP04
Rexroth Mat. No. R902601804

Consisting of:	DT designation
– 1 case	DT06-2S-EP04
– 1 wedge	W2S
– 2 female connectors	0462-201-16141

The mating connector is not included in the delivery contents. This can be supplied by Rexroth on request.



Changing connector position

If necessary, you can change the position of the connector by turning the solenoid.

To do this, proceed as follows:

1. Loosen the fixing nut (1) of the solenoid. To do this, turn the fixing nut (1) one turn counter-clockwise.
2. Turn the solenoid body (2) to the desired position.
3. Retighten the fixing nut.
   Tightening torque of the fixing nut: 5 ±1 Nm
   (size SW 26, 12 kt DIN 3124).

On delivery, the position of the connector may differ from that shown in the brochure or drawing.

DA control valve

Fixed setting, speed related control pressure supply

The DA closed loop control is an engine speed-dependent system for travel drives. The built-in DA control valve generates a pilot pressure that is proportional to pump (engine) drive speed. This pilot pressure is directed to the stroke cylinder of the pump by an electromagnetically actuated 4/3-directional valve. The pump displacement can be steplessly varied in each flow direction and is influenced by both the speed of the pump drive and the system pressure. The flow direction (i. e. machine moving forward or backward) is determined by either solenoid a or b being activated.

Increasing the speed of the pump drive generates a higher pilot pressure by the DA control valve with the resulting flow and/or delivery pressure from the pump.

Depending on the selected operating characteristics of the pump, increasing the system pressure (i. e. machine load) will have the effect of swiveling the pump back to a smaller displacement. An overload protection circuit for the engine (against stalling) is achieved by combining this pressure-dependent reduction in pump stroke with a reduction in pilot pressure as the engine speed drops.

Any additional power requirement, e. g. hydraulic functions from attachments, could cause the speed of the engine to drop further. This will cause a further reduction in pilot pressure and thus of the pump displacement. Automatic power distribution and full exploitation of the available power are achieved in this way, both for the travel drive and for the implement hydraulics, with priority given to the implement hydraulics.

Various override options are available for DA control function to allow controlled operation of the implement hydraulics with high rpm at reduced vehicle speed.

The DA control valve can be used in pumps with EP and HW control units to protect the combustion engine against overload.

DA closed loop control is only suitable for certain types of drive system and requires review of the engine and vehicle parameters to ensure that the pump is used correctly and that machine operation is safe and efficient. We recommend that all DA applications be reviewed by a Rexroth application engineer.

Standard
Switching solenoid without emergency actuation.

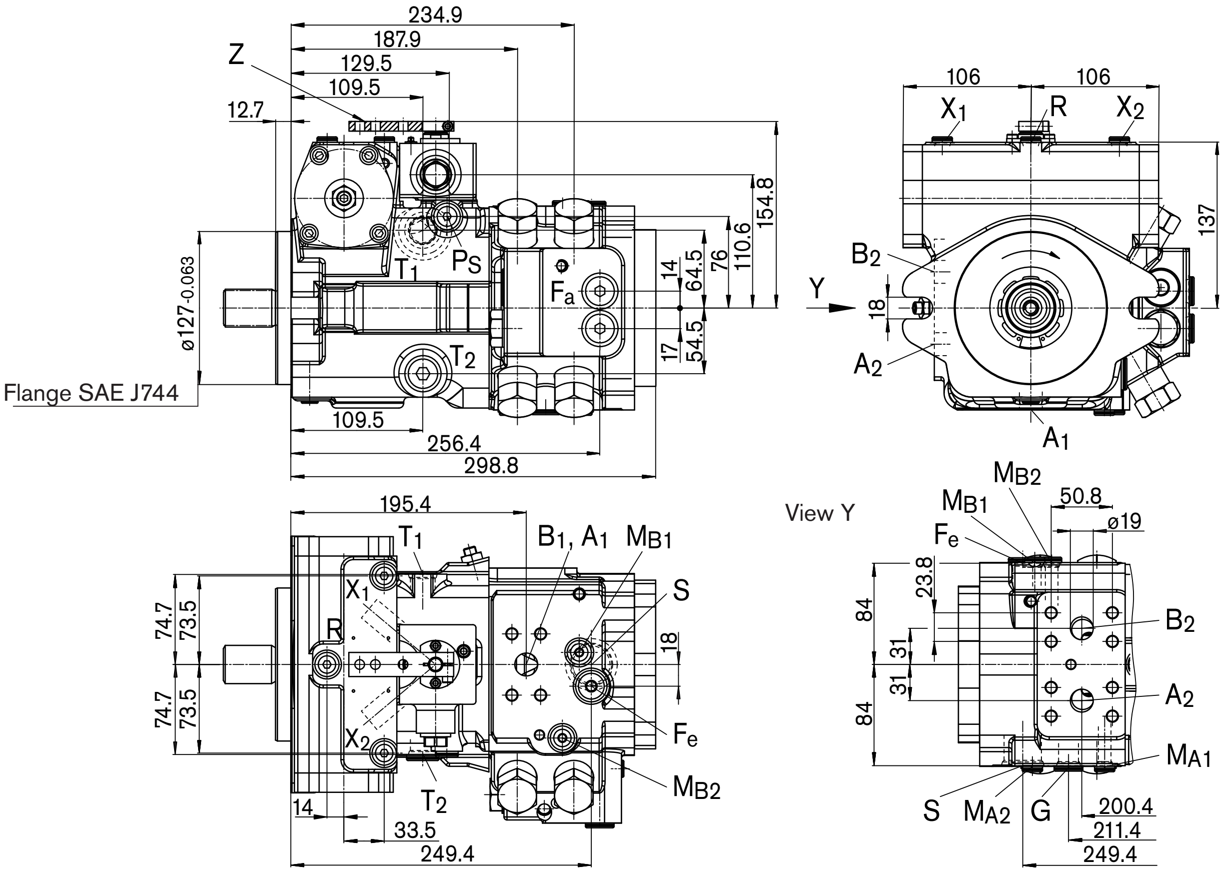
On request
Switching solenoid with emergency actuation and spring return.

Technical data, solenoid	DA1	DA2
Voltage	12 V DC (±20 %)	24 V DC (±20 %)
Neutral position $V_{g\,0}$	de-energized	de-energized
Position $V_{g\,max}$	current energized	current energized
Nominal resistance (at 20 °C)	5.5 Ω	21.7 Ω
Nominal power	26.2 W	26.5 W
Active current, minimum required	1.32 A	0.67 A
Actuated time	100 %	100 %
Type of protection see connector design page 11		

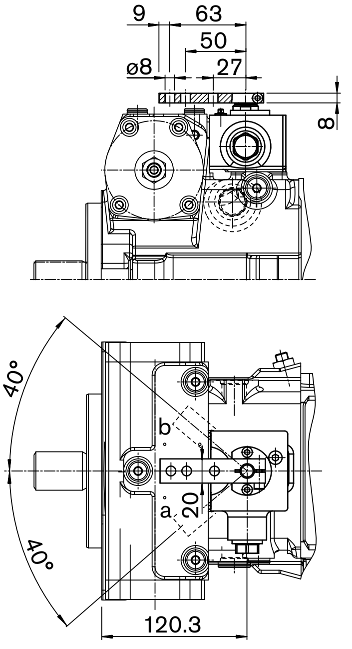
Dimensions size 28

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

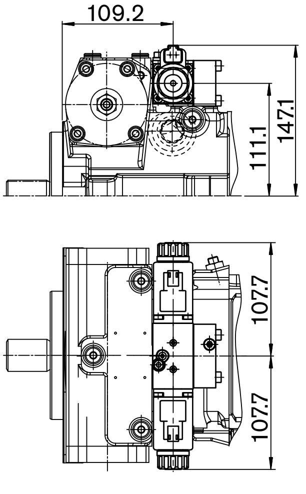
HW – Proportional control hydraulic, mechanical servo



Detail Z



EP – Proportional control electric

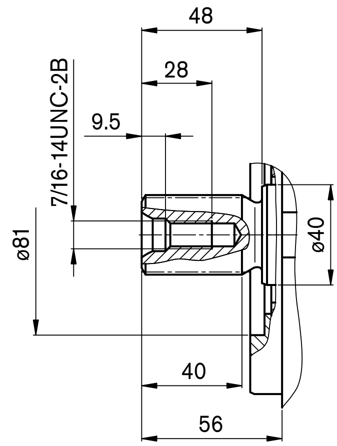


Dimensions size 28

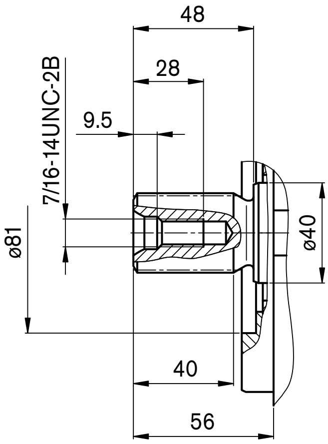
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Drive shafts

S7 Splined shaft 1 1/4 in
14T 12/24DP[1] (SAE J744)



V8 Splined shaft 1 3/8 in
21T 16/32DP[1] (SAE J744)



Ports

Designation	Port for	Standard	Size[2]	Maximum pressure [bar][3]	State
A, B	Service line	SAE J518[4]	3/4 in	350	O
	Fixing thread A/B	DIN 13	M10 x 1.5; 17 deep		O
S	Suction	ISO 6149	M33 x 2; 18 deep	5	O[5]
T_1	Tank	ISO 6149	M22 x 1.5; 14 deep	3	O[6]
T_2	Tank	ISO 6149	M22 x 1.5; 14 deep	3	X[6]
R	Air bleed	ISO 6149	M12 x 1.5; 12 deep	3	X
X_1, X_2	Control pressure (upstream of orifice)	ISO 6149	M12 x 1.5; 12 deep	40	X
X_3, X_4[7]	Stroking chamber pressure	ISO 6149	M12 x 1.5; 12 deep	40	X
G	Auxiliary pressure	ISO 6149	M18 x 1.5; 14.5 deep	40	X
P_S	Control pressure supply	ISO 6149	M14 x 1.5; 13 deep	40	X
M_A, M_B	Measuring pressure A, B	ISO 6149	M12 x 1.5; 11.,5 deep	350	X
F_a	Filter outlet	ISO 6149	M18 x 1.5; 14.5 deep	40	X
F_e	Filter inlet	ISO 6149	M18 x 1.5; 14.5 deep	40	X

[1] ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Observe the general instructions on page 20 for the maximum tightening torques.

[3] Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[4] Only dimensions according to SAE J518

[5] Plugged for external supply

[6] Depending on installation position, T1 or T2 must be connected (see also page 19).

[7] Optional, see page 17

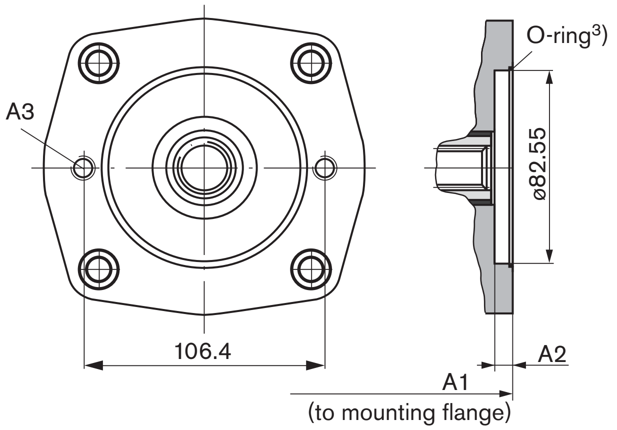
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Through drive dimensions

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

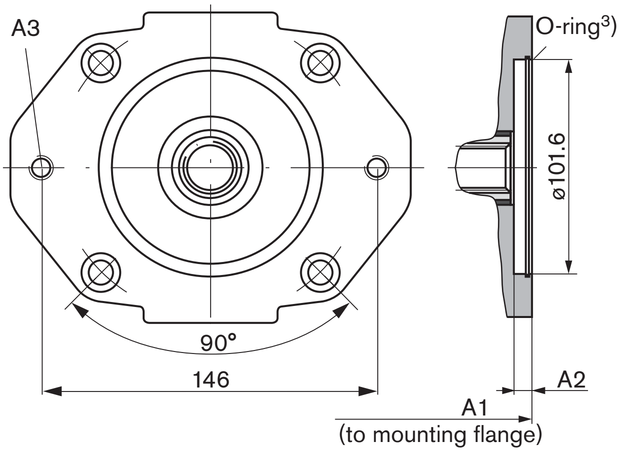
Flange SAE J744	Mounting variant		Coupling for splined shaft[1]			
Diameter	Symbol	Designation	Diameter		Designation	
Without						**0000**
82-2 (A)	⦂	A1	5/8 in	9T 16/32DP	S2	**A1S2**
	⚯	A2	5/8 in	9T 16/32DP	S2	**A2S2**
101-2 (B)	⦂	B1	7/8 in	13T 16/32DP	S4	**B1S4**
			1 in	15T 16/32DP	S5	**B1S5**
	⚯	B2	7/8 in	13T 16/32DP	S4	**B2S4**
			1 in	15T 16/32DP	S5	**B2S5**

82-2



NG	A1	A2	A3[2]
28	302.8	9	M10 x 1.5; 17.5 deep

101-2



NG	A1	A2	A3[2]
28	303.8	10	M12 x 1.75; 18.5 deep

---

1) Coupling for splined shaft according to ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

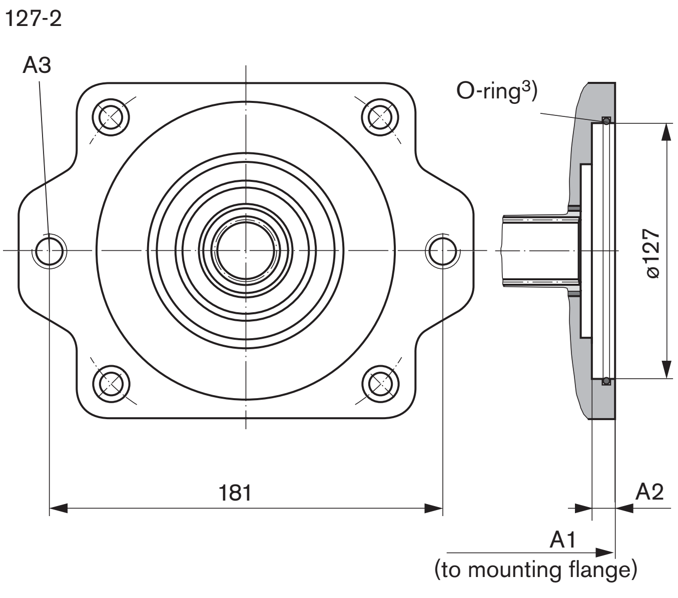
2) Thread according to DIN 13, observe the general instructions on page 20 for the maximum tightening torques.

3) O-ring included in the delivery contents

Through drive dimensions

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Flange SAE J744			Coupling for splined shaft[1]		
	Mounting variant				
Diameter	Symbol	Designation	Diameter	Designation	
127-2 (C)	⚯	C2	1 1/4 in 14T 12/24DP	S7	**C2S7**



NG	A1	A2	A3[2]
28	310.1	14	M16 x 2; 24.8 deep

Note

For the mounting of a pump at the through drive, a pump support is recommended.
Please contact us.

---

[1] Coupling for splined shaft according to ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5

[2] Thread according to DIN 13, observe the general instructions on page 20 for the maximum tightening torques.

[3] O-ring included in the delivery contents

Overview of attachments

Through drive			**Attachment for 2nd pump**						
Flange	Coupling for splined shaft	Short code	A4VG/32 NG (shaft)	A10VG NG (shaft)	A10V(S)O/31 NG (shaft)	A10V(S)O/53 NG (shaft)	A4FO NG (shaft)	A11VO NG (shaft)	External gear pump
82-2 (A)	5/8 in	A_S2	–	–	18 (U)	10 (U)	–	–	Size F NG4 to 22[1]
101-2 (B)	7/8 in	B_S4	–	18 (S)	28 (S, R)	28 (S,R)	16 (S), 22 (S)	–	Size N NG20 to 32[1]
					45 (U)	45 (U,W)	28 (S)		Size G NG38 to 45[1]
	1 in	B_S5	28 (S)	28 (S), 45 (S)	45 (S,R)	45 (S,R) 60 (U,W)	–	40 (S)	–
127-2 (C)	1 1/4 in	C_S7	40 (S), 56 (S), 71 (S)	63 (S)	71 (S, R) 100 (U)	85 (U)	–	60 (S)	–

[1] Rexroth recommends special versions of the gear pumps. Please contact us.

High-pressure relief valves

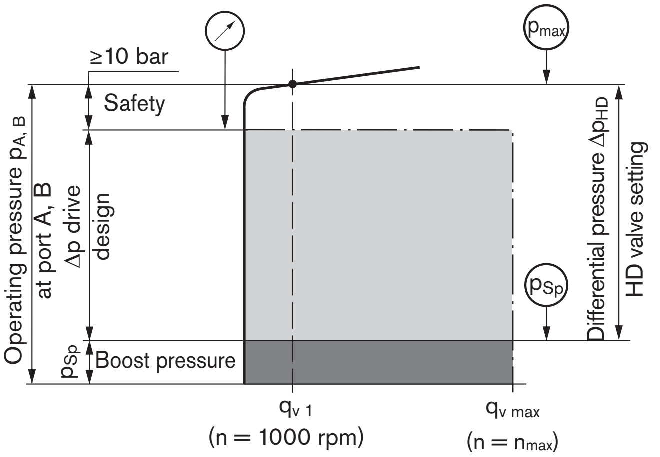
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

The two high-pressure relief valves protect the hydrostatic transmission (pump and motor) from overload. They limit the maximum pressure in the respective high-pressure line and serve simultaneously as boost valves.

Standard setting Δp_{HD} ________________________ 280 bar

For other pressure settings in the p_{abs} = 250 to 330 bar range, please contact us.

Setting diagram



Note

The valve settings are made at **n = 1000 rpm** and at **$V_{g\ max}$ ($q_{v\ 1}$)**. There may be deviations in the opening pressures with other operating parameters.

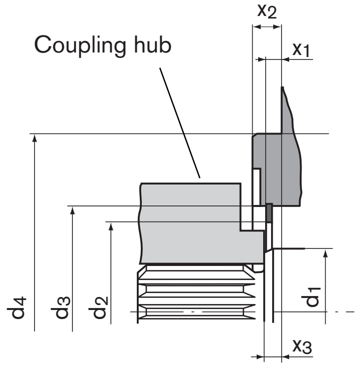
For reasons of simplification, the bypass function is not shown in these circuit diagrams.

Installation situation for coupling assembly

To ensure that rotating components (coupling hub) and fixed components (case, retaining ring) do not come into contact with each other, the installation conditions described here must be observed. This depends on the size and the splined shaft.

SAE splined shaft (spline according to ANSI B92.1a-1976)

The outer diameter of the coupling hub must be smaller than the inner diameter of the retaining ring **d_2** in the area near the drive shaft collar (dimension $x_2 - x_3$).



NG	Mounting flange	ød_1	ø$d_{2\ min}$	ød_3	ød_4	x_1	x_2	x_3
28	127-2 (C)	40	54.4	68 ±0.1	127	$7.0^{+0.2}$	$12.7_{-0.5}$	$8^{+0.9}_{-0.6}$

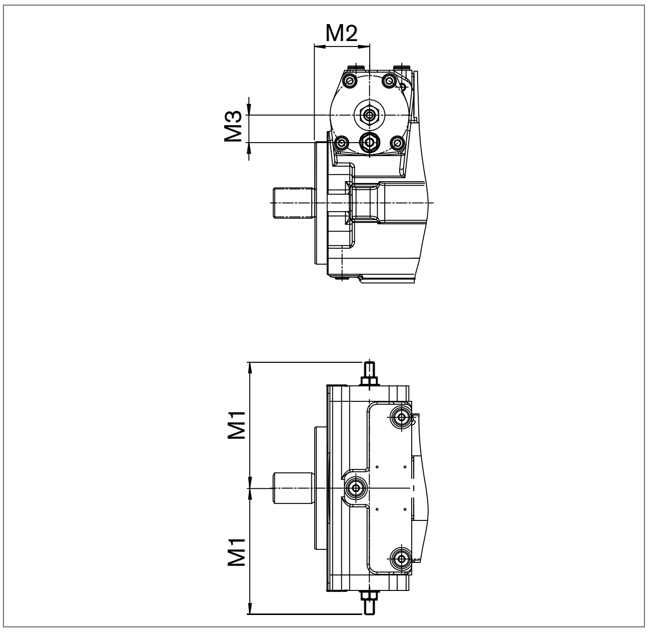
Mechanical stroke limiter

The mechanical stroke limiter is an auxiliary function allowing the maximum displacement of the pump to be steplessly reduced, regardless of the control unit used.

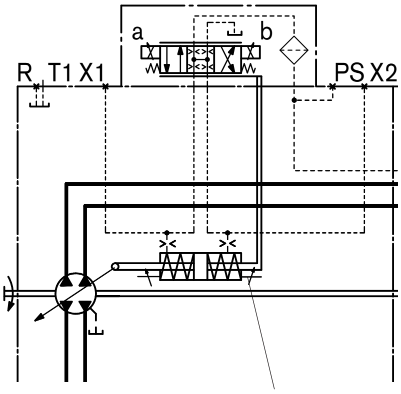
The stroke of the stroke cylinder and hence the maximum swivel angle of the pump are limited by means of two adjusting screws.

Dimensions

NG	M1	M2	M3
28	130.5 maximum	44	25.5



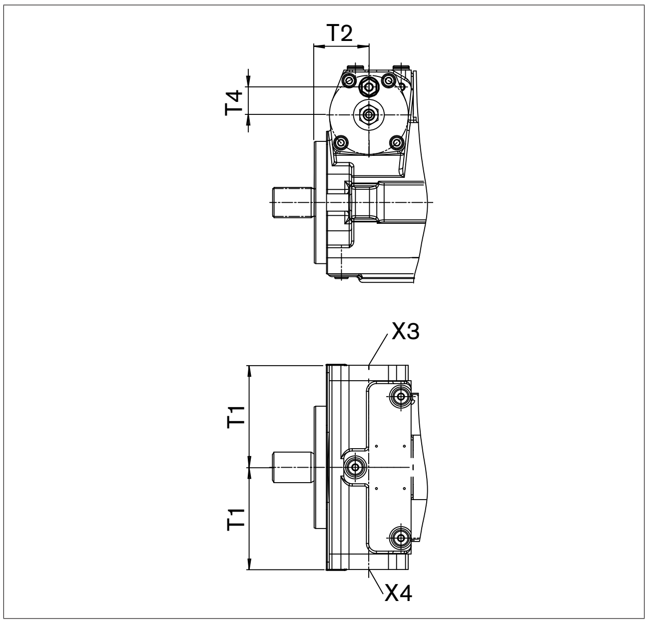
Circuit diagram



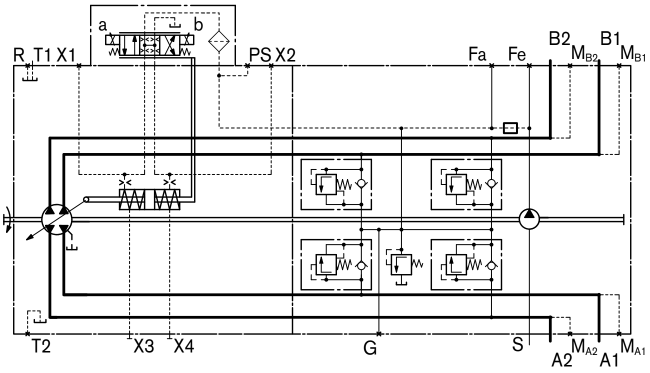
Ports X_3 and X_4 for stroking chamber pressure

Dimensions

NG	T1	T2	T4
28	104.5	44	25



Circuit diagram



Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State
X_3, X_4	Stroking chamber pressure	ISO 6149	M12 x 1.5; 12 deep	40	X

[1] Observe the general instructions on page 20 for the maximum tightening torques.

[2] Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Filtration boost circuit / external supply

Version S (standard)
Filtration in the suction line of the boost pump

Standard version (preferred)

Filter type ____________ filter **without** bypass

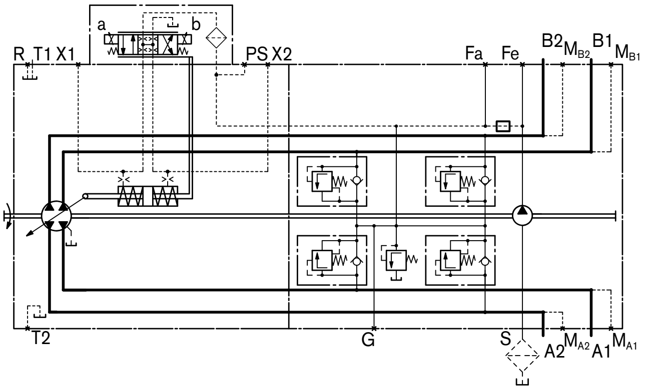
Recommendation ______ **with** contamination indicator

Flow resistance at filter cartridge
With $\nu = 30\ \text{mm}^2/\text{s}$, $n = n_{max}$ ________ $\Delta p \le 0.1$ bar
With $\nu = 1000\ \text{mm}^2/\text{s}$, $n = n_{max}$ ______ $\Delta p \le 0.3$ bar

Pressure at port S of the boost pump
Suction pressure $p_{S\ min}$ $(\nu \le 30\ \text{mm}^2/\text{s})$ ___ ≥ 0.8 bar absolute
At cold start, short-term $(t < 3\ \text{min})$ ___ ≥ 0.5 bar absolute
Suction pressure $p_{S\ max}$ ________ ≤ 5 bar absolute

The filter is not included in the delivery contents.

Circuit diagram - standard version S



Version E
External supply

This variation should be used in versions **without** integrated boost pump (U).

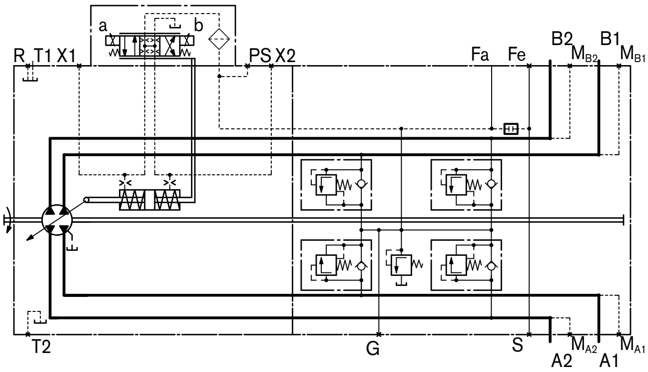
Port S is plugged.

Supply comes from port F_a.

Filter arrangement ______________ separate

To ensure the functional reliability, maintain the required cleanliness level for the boost pressure fluid fed in at port F_a (see page 5).

Circuit diagram - version E



Version D
Filtration in the pressure line of the boost pump, ports for external boost circuit filter

Filter inlet __________________ port F_e

Filter outlet: _________________ port F_a

Filter type
Filters with bypass are **not recommended**. For applications with bypass please contact us.

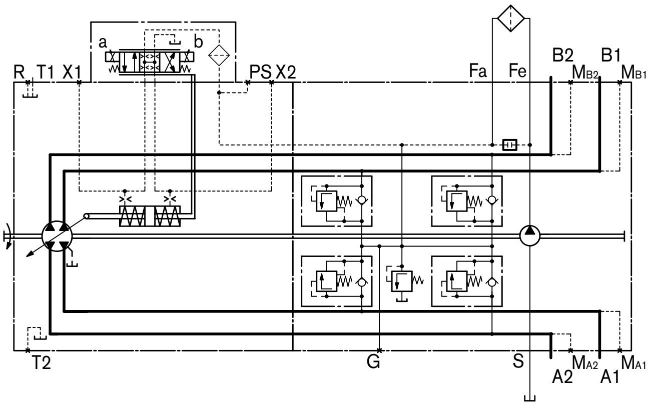
Recommendation ______ **with** contamination indicator

Flow resistance at filter cartridge
With $\nu = 30\ \text{mm}^2/\text{s}$ ____________ $\Delta p \le 1$ bar
On cold start ______________ $\Delta p \le 3$ bar

(valid for entire speed range $n_{min} - n_{max}$)

The filter is not included in the delivery contents.

Circuit diagram - version D



Installation instructions

General

During commissioning and operation, the axial piston unit must be filled with hydraulic fluid and air bled. This is also to be observed following a relatively long standstill as the system may empty via the hydraulic lines.

The case drain fluid in the case interior must be directed to the tank via the highest tank port (T_1, T_2). The minimum suction pressure at port S must not fall below 0.8 bar absolute (cold start 0.5 bar absolute).

In all operational states, the suction line and tank line must flow into the tank below the minimum fluid level.

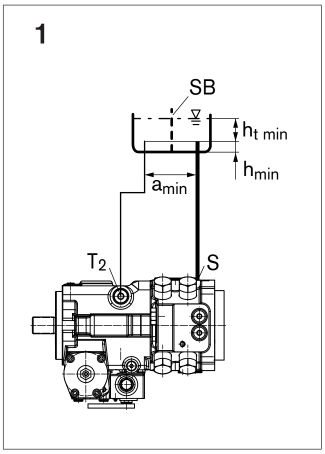
Installation position

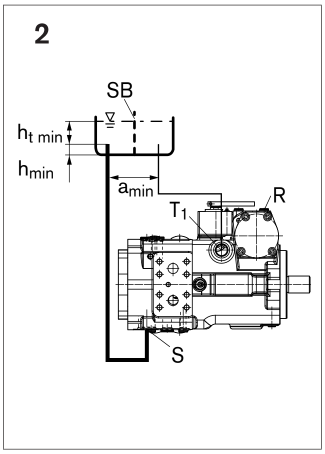
See examples below. Additional installation positions are available upon request.

Recommended installation positions: 1 and 2.

Below-tank installation (standard)

Pump below minimum fluid level of the tank.

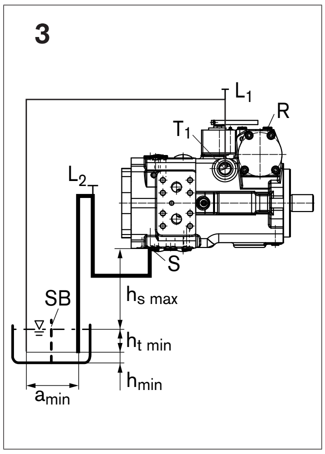


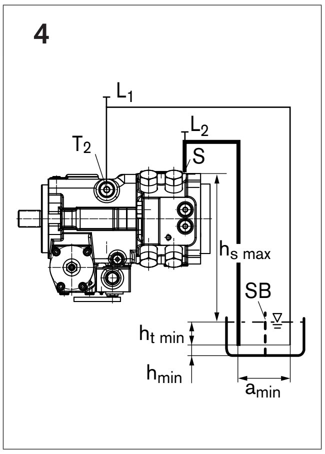


Above-tank installation

Pump above minimum fluid level of the tank

Observe the maximum permissible suction height $h_{S\ max} = 800$ mm.





$h_{S\ max} = 800$ mm, $h_{t\ min} = 200$ mm, $h_{min} = 100$ mm, SB = baffle (baffle plate)

When designing the tank, ensure adequate distance a_{min} between the suction line and the case drain line to prevent the heated, return flow from being drawn directly back into the suction line.

Installation position	Air bleed	Filling
1	–	S + T_2
2	R	S + T_1

Installation position	Air bleed	Filling
3	L_2 + R	L_1 + L_2
4	L_2 (S) + L_1 (T_2)	L_2 (S) + L_1 (T_2)

General instructions

- The A30VG pump is designed to be used in closed circuit.
- Project planning, assembly and commissioning of the axial piston unit require the involvement of qualified personnel.
- The service line ports and function ports are only designed to accommodate hydraulic lines.
- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e. g. by wearing protective clothing).
- Depending on the operational state of the axial piston unit (operating pressure, fluid temperature), the characteristic may shift.
- Pressure ports:
  The ports and fixing threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
- The data and notes contained herein must be adhered to.
- The following tightening torques apply:
  - Threaded hole for axial piston unit:
    The maximum permissible tightening torques $M_{G\ max}$ are maximum values for the threaded holes and must not be exceeded. For values, see the following table.
  - Fittings:
    Observe the manufacturer's instruction regarding the tightening torques of the used fittings.
  - Fixing screws:
    For fixing screws according to DIN 13, we recommend checking the tightening torque individually according to VDI 2230.
  - Locking screws:
    For the metal locking screws supplied with the axial piston unit, the required tightening torques of locking screws M_V apply. For values, see to the following table.
- The product is not approved as a component for the safety concept of a general machine according to DIN EN ISO 13849.

Threaded port sizes		**Maximum permissible tightening torque of the threaded holes $M_{G\ max}$**	**Required tightening torque of the locking screws M_V**	**WAF hexagon socket of the locking screws**
M10 x 1.5	ISO 6149	30 Nm	20 Nm	5 mm
M12 x 1.5	ISO 6149	50 Nm	35 Nm	6 mm
M14 x 1.5	ISO 6149	80 Nm	45 Nm	6 mm
M18 x 1.5	ISO 6149	140 Nm	70 Nm	8 mm
M22 x 1.5	ISO 6149	210 Nm	100 Nm	10 mm
M33 x 2	ISO 6149	540 Nm	310 Nm	17 mm1)

1) Different from ISO 6149

Axial piston pumps
Accessories

Designation	Type	Size	Series	Data sheet	Page
Flushing valve with pressure holding valve	SV	40...90	10	95512	1221
Power valve	LA	6	10	95514	1229
Universal through drive for axial piston variable pump A10VSO, A4VSO, A15VSO/ A15VLO and A11V(L)O	A10VSO/32, A4VSO/30, A15VSO/10, A11VO/40			95581	1233
Hydraulic tank made of polymer or steel	TMP, TMS	8	10	95721	1249

Flushing valve with pressure holding valve SV

Data sheet

Series 10
Nominal pressure 400 bar
Maximum pressure 450 bar
Closed circuit

Contents

Features

- The flushing valve is used to flush heated hydraulic fluid from the closed circuit, and, thus, dirt particles as well.
- The integrated pressure holding valve is used to prevent drops in the boost pressure.
- The flushing valve with pressure holding valve is available in two basic versions:
  - Line valve for universal use
  - Flange valve for reduced piping and installation costs and effort

Ordering code for standard program

SV				/	10	M	V						–	
01	02	03	04		05	06	07	08	09	10	11	12		13

Valve type

01	Flushing valve with pressure holding valve	**SV**

Mounting variant

02	Flange valve for flange-mounting to the pump, e.g. A10VG	Standard	**F**
		Heightened (NG75G only)	**H**
	Line valve		**L**

Size

			Flange valve		Line valve	
		Mounting variant	**F** (standard)	**H** (heightened)		
03	Spacing, port A to B	40 mm	–	–	●	**40**
		75 mm (e.g. for A4VG/32 NG28; A10VG NG28, 45, 63)	●	●	–	**75**
		90 mm	●	–	–	**90**

Port versions

			Flange valve		Line valve	
04		Mounting variant	**F** (standard)	**H** (heightened)		
	Threaded port		●	●	●	**G**
	SAE flange port		●	–	–	**S**

Series

05	Series 1, index 0	**10**

Version of port thread

06	Metric	**M**

Seals

07	FKM (fluor-caoutchouc)	**V**

	Orifices		**Orifice dia.**	**Flange valve**	**Line valve**	
08	Without					**00**
	Flushing flow q_v (L/min) with $\Delta p = p_{ND} - p_G = 25$ bar and $\nu = 10\ \text{mm}^2/\text{s}$ p_{ND} = low pressure p_G = case pressure ν = viscosity	2.2 L/min	1.0 mm	–	●	**10**
		3.2 L/min	1.2 mm	●	●	**12**
		4.3 L/min	1.4 mm	●	●	**14**
		5.5 L/min	1.6 mm	●	●	**16**
		7 L/min	1.8 mm	●	●	**18**
		8.8 L/min	2.0 mm	●	●	**20**
		11.5 L/min	2.3 mm	●	–	**23**
		12.5 L/min	2.4 mm	●	–	**24**
		13.7 L/min	2.5 mm	–	●	**25**
		17.2 L/min	2.8 mm	–	●	**28**
		20 L/min	3.0 mm	●	–	**30**
		27 L/min	3.5 mm	–	●	**35**
		35 L/min	4.0 mm	–	●	**40**
		55 L/min	5.0 mm	–	●	**50**

● = Available ❍ = On request – = Not available

Ordering code for standard program

SV				/	10	M	V						–	
01	02	03	04		05	06	07	08	09	10	11	12		13

	Flushing side (low-pressure side)	**Flange valve**	**Line valve**	
09	A (one sided)	●	●	**A**
	B (one sided)	●	●	**B**
	A and B (alternating, standard)	●	●	**C**

	Switching pressure	**Flange valve**	**Line valve**	
10	Differential pressure Δp = 3 to 5 bar (standard)	●	●	**3**
	Differential pressure Δp = 8 to 12 bar	–	●	**8**

	Flushing-piston damping	
11	Low	**D2**
	Medium	**D4**
	Medium-strong	**D6**
	Strong	**D8**

	Minimum holding pressure	
12	16 bar (standard)	**H16**
	20 bar	**H20**
	25 bar	**H25**

	Standard / special version	
13	Standard version	**0**
	Special version	**S**

Note

Short designation X on a feature refers to a special version not covered by the ordering code.

● = Available ❍ = On request – = Not available

Technical data

Table of values

Distance between axes	**NG**	**Line valve 40 (SVL40G…)**	**Flange valve 75, standard (SVF75G/S…)**	**Flange valve 75, heightened (SVH75G…)**	**Flange valve 90, standard (SVF90G/S…)**
Holding pressure	bar	16, 20, 25	16, 20, 25	16, 20, 25	16, 20, 25
Switching pressure Δp of the flushing piston	bar	3 to 5 or 8 to 12	3 to 5	3 to 5	3 to 5
Temperature range	°C	-40 °C to +115 °C	-40 °C to +115 °C	-40 °C to +115 °C	-40 °C to +115 °C
Installation position		arbitrary	arbitrary	arbitrary	arbitrary
Mass	kg	1.5	1.9	3.0	2.1

Hydraulic fluid

For the choice of hydraulic fluid, the used axial piston unit is decisive. For further information, please refer to our data sheets during project planning.

Functional description

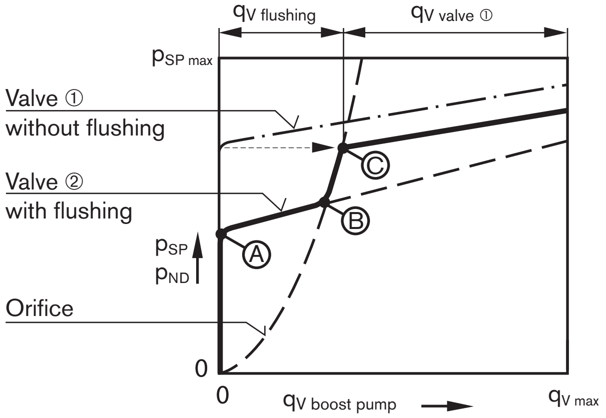
The flushing valve is used to flush heated hydraulic fluid from the closed circuit, and, thus, dirt particles as well.
Via the flushing piston, the respective low-pressure side of the closed circuit is detected and, at a pressure difference exceeding approx. 5 bar, flushed out of this line.
During this process, it is necessary that the flushed quantity and the case drain fluid of the axial piston unit be replaced via an infeed. The infeed with filtered and cooled hydraulic fluid decreases the circuit temperature. The flushed quantity is determined by an orifice in the tank canal. This is dependent on the orifice size, the pressure difference between low pressure and tank line as well as the current viscosity.
A pressure holding valve is also installed in the tank canal. As soon as the pressure level drops below the set holding pressure, e.g due to an excessive flush quantity, the pressure holding valve reduces the flush quantity, thereby preventing an impermissible pressure drop.

The flushing valve with pressure holding valve is available in two basic versions:

- As a line valve which is connected to the two lines of the closed circuit via the piping. Fixing to the device frame is by means of three through-holes.
  The separate arrangement enables universal use.
- As a flange valve which is flanged onto the adjacent high-pressure ports of the variable pumps A10VG and A4VG series 32. Fixing is by means of the screws for the SAE flange port.
  This arrangement eliminates the piping and reduces installation costs and effort.

The tank ports of the flushing valves are directed to the tank via the cooler.

Characteristic



—·— Flushing valve in middle position, without flushing

━━ Flushing valve switched

Point A: Pressure holding valve ② opens (16 bar).
Start of flushing.

Point B: Limiting of flushing quantity by orifice.

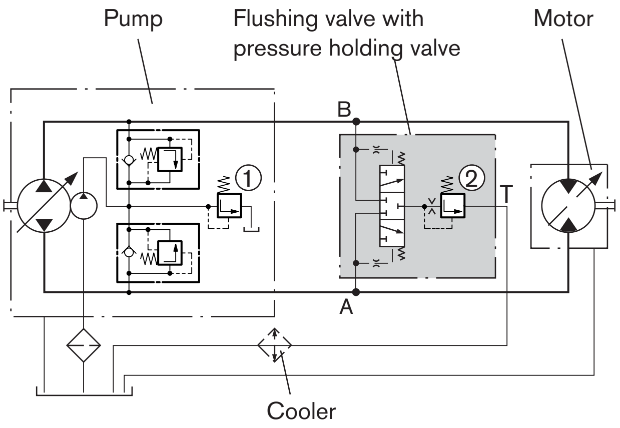
Point C: $q_{V\ max\ flushing}$ (boost pressure valve with adjustment $>$ 16 bar of variable pump ① opens). Flushing flow increases only according to the pressure-relief valve characteristic.

$q_{V\ flushing}$: Flushing flow; flows to the tank via the pressure holding valve ②.

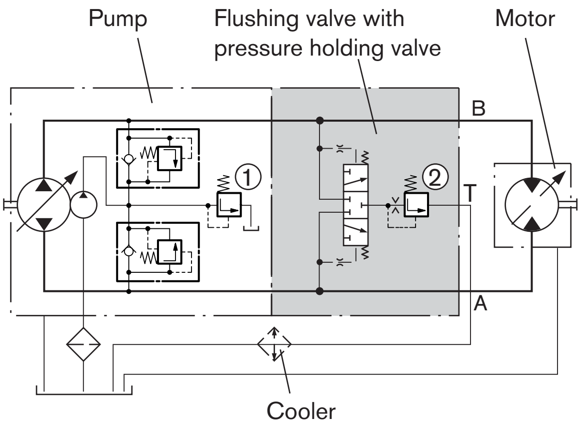
$q_{V\ valve\ ①}$: Residual quantity of the boost pump is flushed out via valve ① into the case of the variable pump.

Circuit diagram examples

Line valve

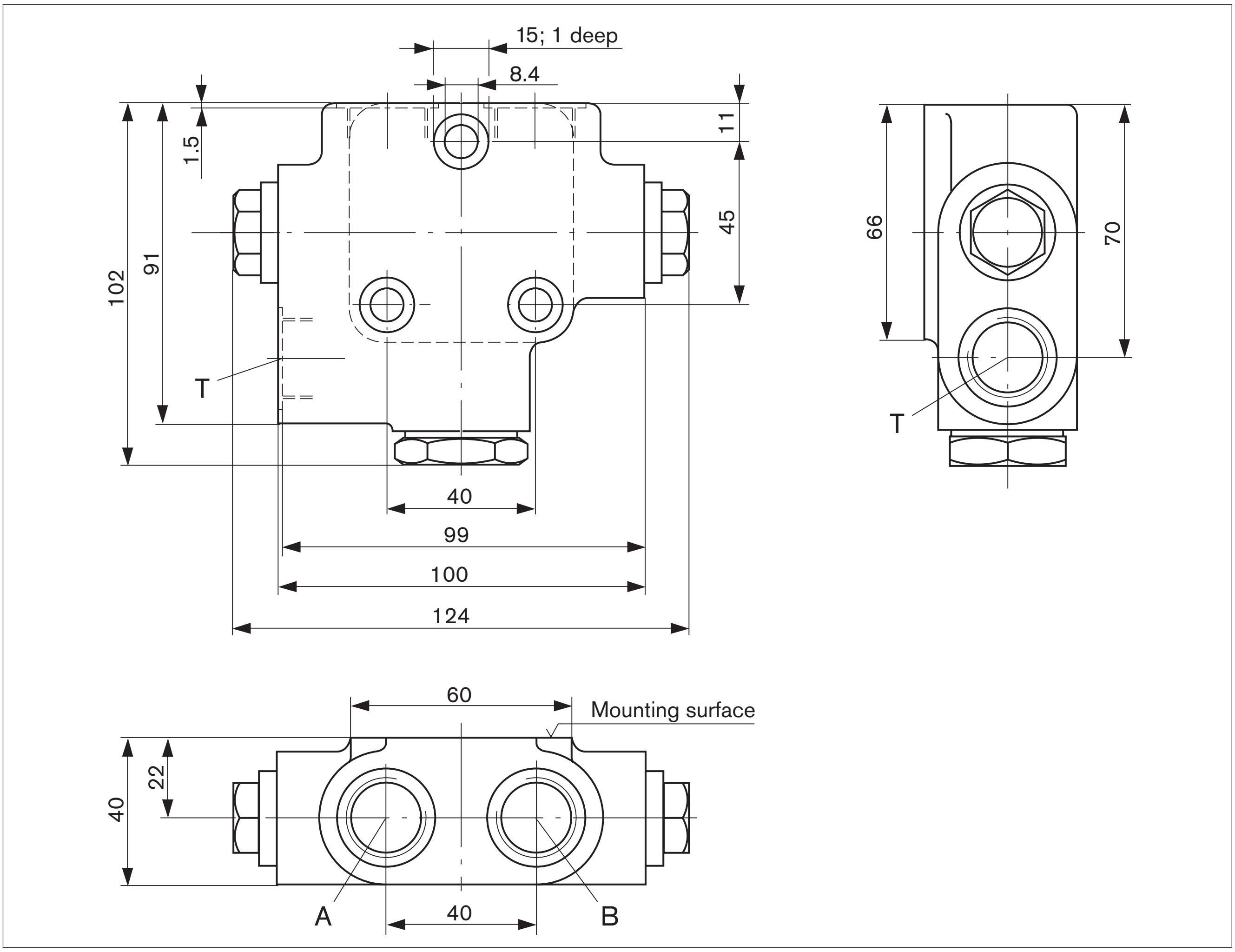


Flange valve



① Boost pressure-relief valve in the pump
② Pressure holding valve in the flushing valve

Line valve dimensions



Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State
A, B	Service line	DIN 3852	M22 x 1.5; 14 deep	450	O
T	Tank	DIN 3852	M22 x 1.5; 14 deep	30	O

[1] Observe the general instructions on page 8 for the maximum tightening torques.

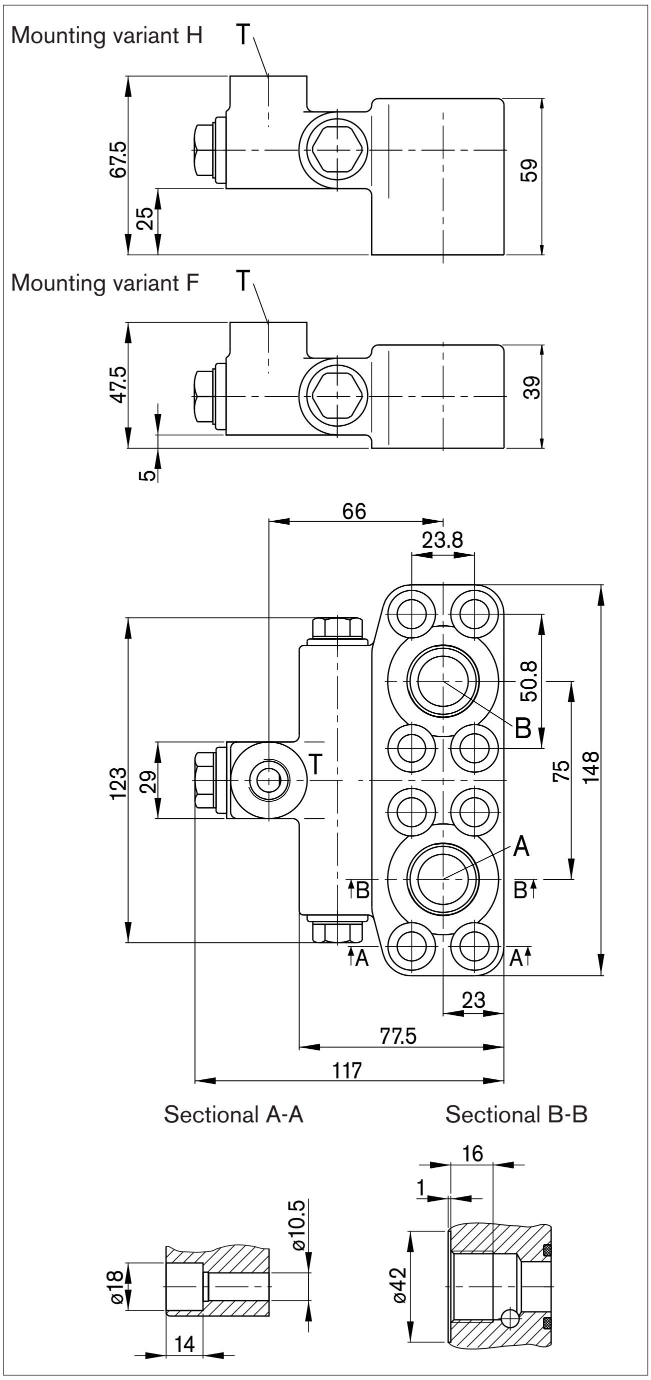
[2] Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

O = Must be connected (plugged on delivery)

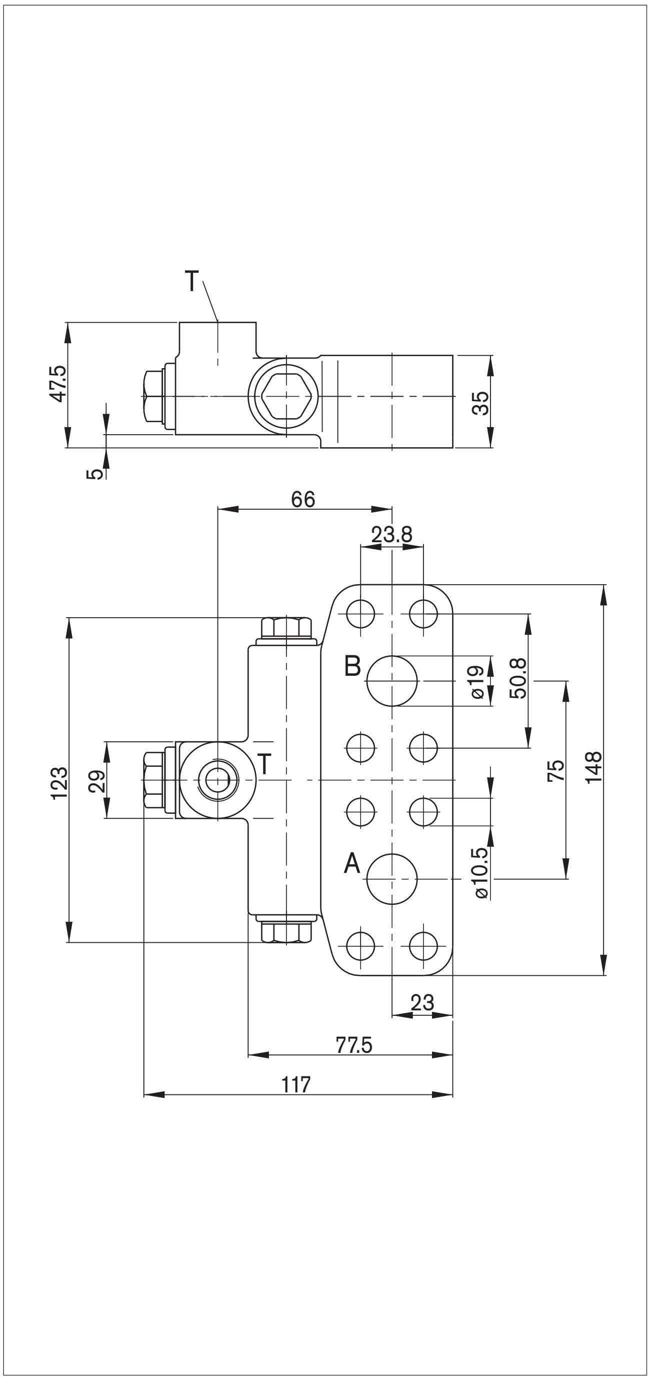
Flange valve dimensions, size 75

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port version G



Port version S



Ports

Designation	Port for	Port version	Standard	Size[1]	Maximum pressure [bar][2]	State
A, B	Service line (high-pressure series)	G	DIN 3852	M27 x 2; 16 deep	450	O
A, B	Service line (high-pressure series)	S	SAE J518	3/4 in	450	O
T	Tank		DIN 3852[3]	M16 x 1.5; 12 deep	30	O

[1] Observe the general instructions on page 8 for the maximum tightening torques.

[2] Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

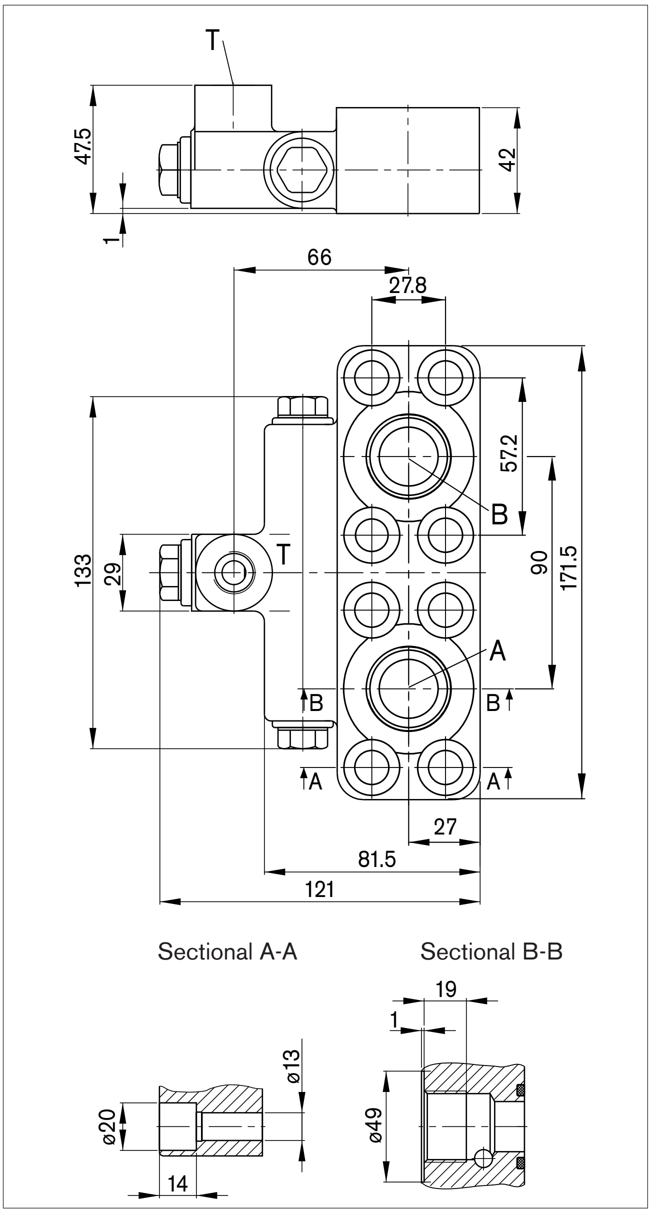
[3] The spot face can be deeper than specified in the appropriate standard.

O = Must be connected (plugged on delivery)

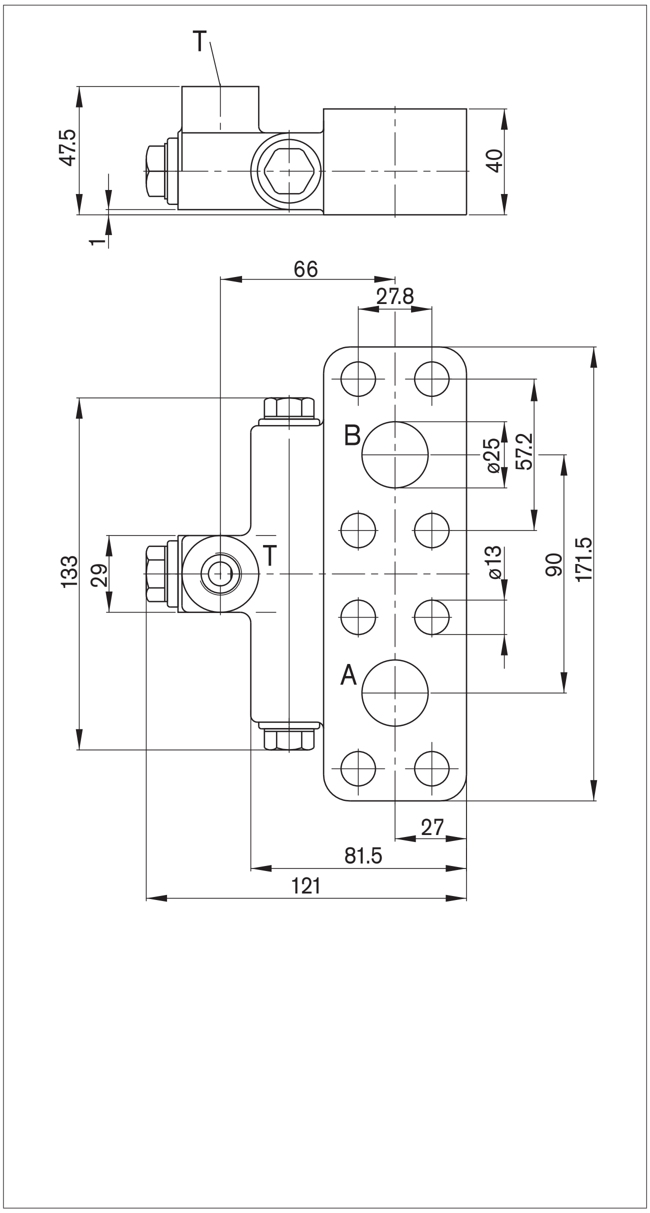
Flange valve dimensions, size 90

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port version G



Port version S



Ports

Designation	Port for	Port version	Standard	Size[1]	Maximum pressure [bar][2]	State
A, B	Service line (high-pressure series)	G	DIN 3852	M33 x 2; 19 deep	450	O
A, B	Service line (high-pressure series)	S	SAE J518	1 in	450	O
T	Tank		DIN 3852[3]	M16 x 1.5; 12 deep	30	O

[1] Observe the general instructions on page 8 for the maximum tightening torques.

[2] Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[3] The spot face can be deeper than specified in the appropriate standard.

O = Must be connected (plugged on delivery)

General instructions

- The SV flushing valve with pressure holding valve is designed to be used in closed circuits.
- Project planning, assembly and commissioning of components for the axial piston unit require the involvement of qualified personnel.
- The service line ports and function ports are only designed to accommodate hydraulic lines.
- During and shortly after operation, there is a risk of burns on the flushing valve. Take appropriate safety measures (e. g. by wearing protective clothing).
- Depending on the operational state of the axial piston unit or flushing valve (operating pressure, fluid temperature), the characteristic may shift.
- Pressure ports:
  The ports and fixing threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
- The data and notes contained herein must be adhered to.
- The product is not approved as a component for the safety concept of a general machine according to DIN EN ISO 13849.
- The following tightening torques apply:
  - Fittings:
    Observe the manufacturer's instruction regarding the tightening torques of the used fittings.
  - Threaded hole of the flushing valve:
    The maximum permissible tightening torques $M_{G\ max}$ are maximum values of the threaded holes and must not be exceeded. For values, see the following table.

Ports		**Maximum permissible tightening torque of the threaded holes $M_{G\ max}$**	**Required tightening torque of the locking screws M_V**	**WAF hexagon socket of the locking screws**
Standard	**Threaded size**			
DIN 3852	M16 x 1.5	100 Nm	50 Nm	8 mm
	M22 x 1.5	210 Nm	80 Nm	10 mm
	M27 x 2	330 Nm	135 Nm	12 mm
	M33 x 2	540 Nm	225 Nm	17 mm

Power Valve LA

Data sheet

Series 10
Size 6
Nominal pressure 350 bar
Maximum pressure 400 bar
External power limiting of variable pumps

Contents

Description

The LA power valve is used for the external power limiting of variable pumps with hydraulic proportional control (pilot-pressure related, HD or HP).

It controls variable pump displacement depending on the operating pressure so that a specified drive power is not exceeded at a constant speed. The power characteristic is tangentially approximated to the hyberbolic characteristic by adjusting the pre-tension of 2 springs in the power valve.

Via a piston, the springs act on the valve spring of a pressure reduction valve. Operating pressure is applied at the opposite end of the piston. Below the start of control the variable pump's pilot pressure-actuated control unit is supplied with max. 18 bar pilot pressure via port A of the power valve. If the operating pressure exceeds the start of control specified by the power characteristic, the pilot pressure is reduced on port A and the pump swiveled back. At constant drive speed, this is the equivalent of power controlling.

Optionally, the pilot pressure can be reduced again via a separate pressure reduction valve and the pump swiveled to a lower displacement volume (stroke limiter).

Ordering code for standard program

LA	6	/	10	M	P		–	
01	02		03	04	05	06		07

Valve type

01	Power valve	**LA**

Control range

02	Pilot pressure $6 < p_{St} < 18$ bar	**6**

Series

03	Series 1, index 0	**10**

Version of port and fixing threads

04	Metric	**M**

Seals

05	NBR (nitrile-caoutchouc)	**P**

Port plate

06	Without	**0**
	with port plate	**A**

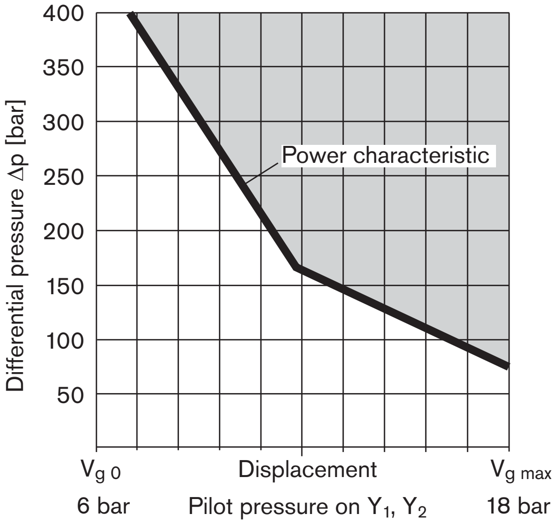
Standard / special version

07	Standard version	**0**
	Special version	**S**

When ordering, state in clear text:

- Type name and size of the implemented axial piston variable pump from Rexroth with pilot-pressure related adjustment HD or HP
- Pump operating speed
- Specified drive power

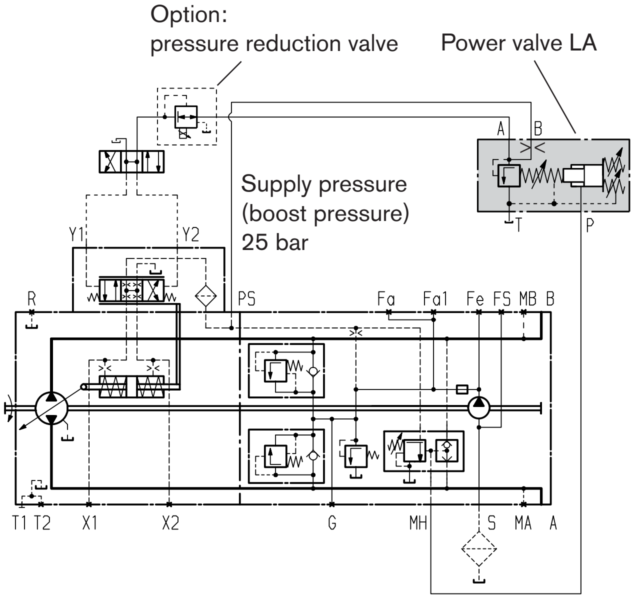
Characteristic



Circuit diagram

Example:

LA power valve with axial piston variable pump A4VG...HD (version with pressure reduction valve)



Technical data

Table of values

		NG	6
Nominal pressure p_{nom}		bar	350
Maximum pressure p_{max}		bar	400
Pilot pressure range on port A		bar	$6 < p_{St} < 18$ bar
Supply pressure on port B		bar	25
Minimum start of control high-pressure variable pump		bar	70
Maximum flow on LA with orifice Ø1.2 and 18 bar		l/min	4
Hydraulic fluid temperature range		°C	-20 to +80
Viscosity range		mm^2/s	5 to 1600
Installation position			any
Mass	without plate	kg	2.0
	with plate	kg	2.6

Note

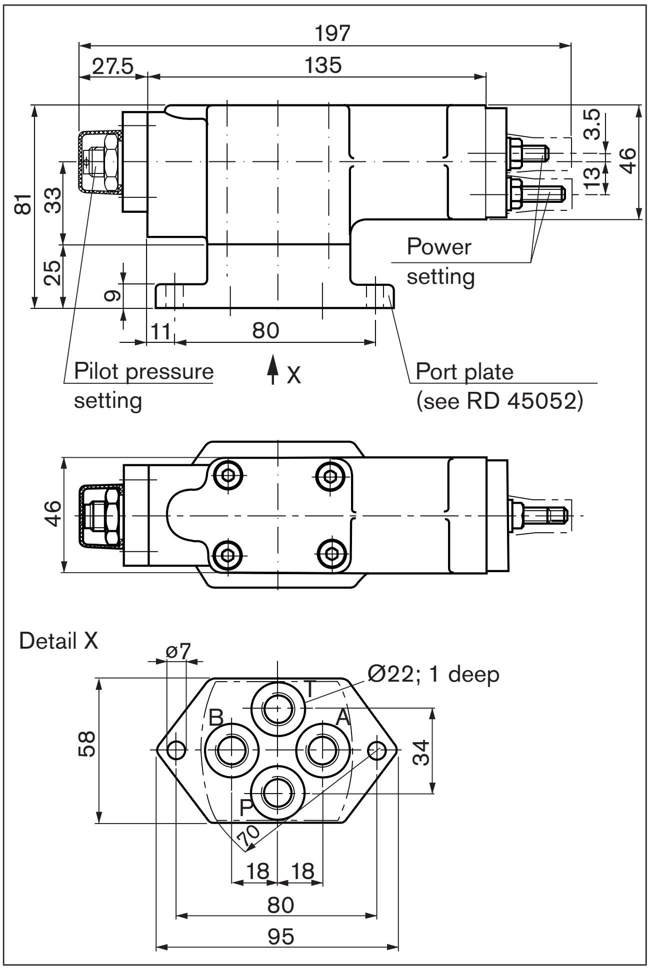
The power valve is always supplied with an orifice (Ø1.2) in port B. If the orifice is outside the power valve, port B is plugged.

Full functional capability of the power valve is achieved in the viscosity range from 10 to 30 mm^2/s.

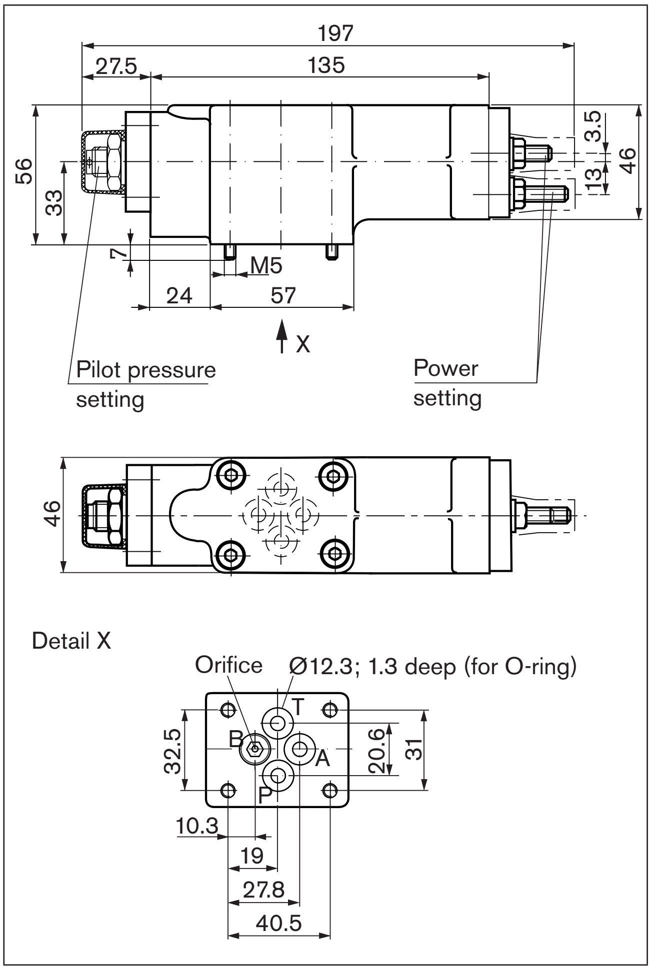
Dimensions

Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Version with port plate



Version without port plate



Ports

Version with port plate

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State
A	Pilot pressure output	DIN ISO 228	G1/4 in; 13 deep	30	O
B	Pilot pressure input (in front of orifice)	DIN ISO 228	G1/4 in; 13 deep	30	O[3]
P	Pump operating pressure	DIN ISO 228	G1/4 in; 13 deep	400	O
T	Tank	DIN ISO 228	G1/4 in; 13 deep	5	O

[1] Observe the general instructions on page 8 for the maximum tightening torques.

[2] Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.

[3] If the orifice is outside the power valve, port B is plugged.

O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Version without port plate

Designation	Port for	Size	Maximum pressure [bar]	State
A	Pilot pressure output	Ø6	30	O
B	Pilot pressure input (in front of orifice) (fitted with orifice, thread M6)	Ø6	30	O
P	Pump operating pressure	Ø6	400	O
T	Tank	Ø6	5	O

General instructions

- The LA power valve is designed to be used in open and closed circuits.
- Project planning, assembly and commissioning of the components for the axial piston unit require the involvement of qualified personnel.
- The service line ports and function ports are only designed to accommodate hydraulic lines.
- During and shortly after operation, there is a risk of burns on the power valve. Take appropriate safety measures (e.g. by wearing protective clothing).
- Depending on the operational state of the axial piston unit or power valve (operating pressure, fluid temperature) the characteristic may shift.
- Pressure ports:
  The ports and fixing threads are designed for the specified maximum pressure. The machine or system manufacturer must ensure that the connecting elements and lines correspond to the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.
- The data and notes contained herein must be adhered to.
- The following tightening torques apply:
  - Threaded hole of the power valve:
    The maximum permissible tightening torques $M_{G\ max}$ are maximum values of the threaded holes and must not be exceeded. For values, see the following table.
  - Fittings:
    Observe the manufacturer's instruction regarding the tightening torques of the used fittings.
- The product is not approved as a component for the safety concept of a general machine according to DIN EN ISO 13849.

Ports		**Maximum permissible tightening torque of the threaded holes $M_{G\ max}$**	**Required tightening torque of the locking screws M_V**	**WAF hexagon socket of the locking screws**
Standard	**Threaded size**			
DIN ISO 228	G1/4	70 Nm	–	–

Universal through drive
for axial piston variable pump
A10VSO, A4VSO, A15VSO/A15VLO and A11V(L)O

- For A10VSO series 32
  size 45 to 180
- For A4VSO Series 30
  Size 125 to 355
- For A15VSO/A15VLO series 10
  size 110 to 280
- For A11VO/A11VLO series 40
  size 110 to 280

Features

- Flexibel unioversal through drive
- The through drive are exchangeable without machining the port plate

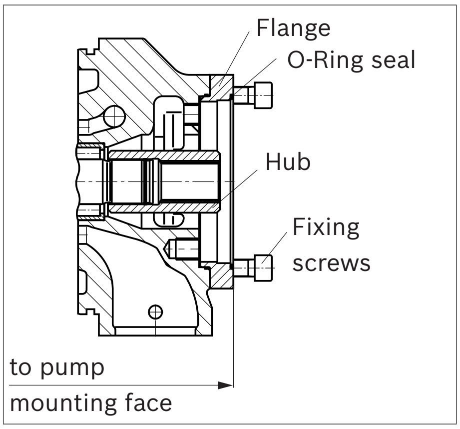
Informations and possible through drives you will find in the data sheets:

▶ 92714	variable pump A10VSO series 32
▶ 92050	variable pump A4VSO
▶ 92800	variable pump A15VSO/A15VLO
▶ 92510	variable pumpe A11VO/A11VLO

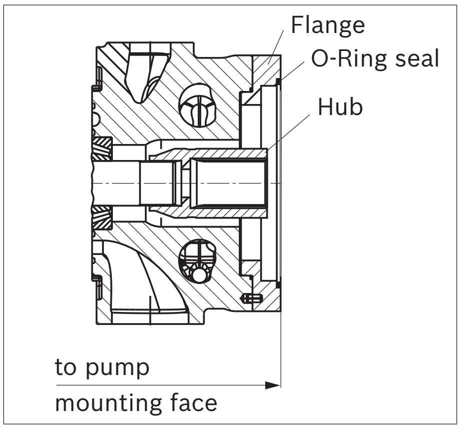
Contents

Adapter kits

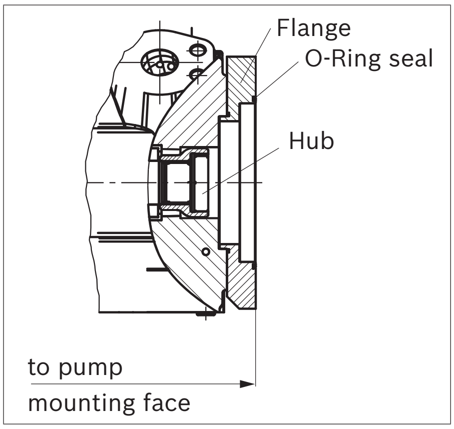
A4VSO/30



A10VSO/32



A15VSO; A15VLO/10; A11V(L)O/40



Assembly group

The through drive come as assembly group. The assembly group „flange and hub“ includes flange, hub, cylinder head screws and O-ring seal.
Fixing screws for the 2. pump will be delivered only for universal through drives of the A4VSO.

Material number for U00 at A10VSO series 32

Code	**Available for pump**	**Length to pump mounting flange** [mm]	**Assembly group „Cover“** with cover, cylinder screw
U00	A10VSO45	254	R902496168
	A10VSO71	289	R902496186
	A10VSO100	350	R902496173
	A10VSO140	367	
	A10VSO180	377	
ISO 3019-2			**Assembly group „Flange and hub“** with Flange, hub, cylinder screw
UB2	A10VSO45	264	R902496439
	A10VSO71	299	R902496440
	A10VSO100	360	R902496441
	A10VSO140	377	R902496442
	A10VSO180	387	R902496443
UB3	A10VSO45	264	R902492531
	A10VSO71	299	R902512434
	A10VSO100	360	R902496445
	A10VSO140	377	R902496446
	A10VSO180	387	R902496447
UE1	A10VSO 45	264	R902510125
	A10VSO 71	299	R902510126
	A10VSO 100	360	R902510127
	A10VSO 140	377	R902510128
	A10VSO 180	387	R902510129
UB8	A10VSO71	299	R902496458
	A10VSO100	360	R902496459
	A10VSO140	377	R902496460
	A10VSO180	387	R902496461

ISO 3019-2	**Available for pump**	**Length to pump mounting flange** [mm]	**Assembly group „Flange and Hub“** with flange, hub, cylinder screw
UB9	A10VSO100	360	R902496462
	A10VSO140	377	R902496463
	A10VSO180	387	R902496464
UB7	A10VSO140	377	R902496465
	A10VSO180	387	R902496466

ISO 3019-1 (SAE J744)			**Assembly group „Flange and Hub“** with flange, hub, cylinder screw
U01	A10VSO45	264	R902496467
	A10VSO71	299	R902496468
	A10VSO100	360	R902496469
	A10VSO140	377	R902496470
	A10VSO180	387	R902496471
U52	A10VSO45	264	R902496472
	A10VSO71	299	R902496473
	A10VSO100	360	R902496474
	A10VSO140	377	R902496475
	A10VSO180	387	R902496476
U68	A10VSO45	264	R902496477
	A10VSO71	299	R902496478
	A10VSO100	360	R902496479
	A10VSO140	377	R902496480
	A10VSO180	387	R902496481
U04	A10VSO45	264	R902496482
	A10VSO71	299	R902496663
	A10VSO100	360	R902496664
	A10VSO140	377	R902496665
	A10VSO180	387	R902496666
UE2	A10VSO 45	264	R902510131
	A10VSO 71	299	R902510132
	A10VSO 100	360	R902510133
	A10VSO 140	377	R902510134
	A10VSO 180	387	R902510135
U24	A10VSO 100	360	R902510136
	A10VSO 140	377	R902510137
	A10VSO 180	387	R902510138
U15	A10VSO 71	299	R902510139
	A10VSO 100	360	R902510140
	A10VSO 140	377	R902510141
	A10VSO 180	387	R902510142
U96	A10VSO100	360	R902496667
	A10VSO140	377	R902496668
	A10VSO180	387	R902496669
U17	A10VSO140	377	R902496670
	A10VSO180	387	R902496671

Material number at A4VSO series 30

Code	Available for pump	Length to pump mounting flage [mm]	Assenbly group „Cover“ with cover, cylinder screw
U99	A4VSO125	359	R902438778
	AA4VSO125	361	
	A4VSO180	383	
	AA4VSO180	385	
	A4VSO250	443	R902444736
	AA4VSO 250	445	
	A4VSO355	472	
	AA4VSO 355	474	
ISO 3019-2			**Assembly group „Flange and Hub“** with cover, hub, cylinder screw
UB2	A4VSO125	369	R902446991
	A4VSO180	393	
	A4VSO250	453	R902446993
	A4VSO355	482	
UB3	A4VSO125	369	R902446996
	A4VSO180	393	
	A4VSO250	453	R902446998
	A4VSO355	482	
UB4	A4VSO125	369	R902447001
	A4VSO180	393	
	A4VSO250	453	R902447003
	A4VSO355	482	
UB5	A4VSO125	369	R902447006
	A4VSO180	393	
	A4VSO250	453	R902447007
	A4VSO355	482	
UB6	A4VSO125	369	R902447008
	A4VSO180	393	
	A4VSO250	453	R902447009
	A4VSO355	482	
U31	A4VSO125	369	R902447010
	A4VSO180	393	
	A4VSO250	453	R902447011
	A4VSO355	482	
U33	A4VSO125	369	R902447012
	A4VSO180	393	
	A4VSO250	453	R902447013
	A4VSO355	482	
UB8	A4VSO125	369	R902447014
	A4VSO180	393	
	A4VSO250	453	R902447016
	A4VSO355	482	

ISO 3019-2			**Assembly group „Flange and Hub“** with cover, hub, cylinder screw
U34	A4VSO125	369	R902447019
	A4VSO180	393	
	A4VSO250	453	R902447020
	A4VSO355	482	
UB9	A4VSO125	382	R902447021
	A4VSO180	406	
	A4VSO250	453	R902447022
	A4VSO355	482	
UB7	A4VSO180	406	R902447025
	A4VSO250	453	R902447026
	A4VSO355	482	
U35	A4VSO250	469	R902447028
	A4VSO355	498	
U77	A4VSO355	498	R902447029

ISO 3019-1 (SAE J744)

(The lengths to the pump mounting face are valid for the SAE version. The metric pumps are 2 mm shorter)

Code	**Available for pump**	**Length to pump mounting flange** [mm]	**Assembly group „Flange and Hub“** with flange, hub, cylinder screw
U01	A4VSO125	369	R902447030
	AA4VSO125	371	
	A4VSO180	393	
	AA4VSO180	395	
	A4VSO250	453	R902447032
	AA4VSO250	455	
	A4VSO355	482	
	AA4VSO355	484	
U52	A4VSO125	369	R902447035
	AA4VSO125	371	
	A4VSO180	393	
	AA4VSO180	395	
	A4VSO250	453	R902447037
	AA4VSO250	455	
	A4VSO355	482	
	AA4VSO355	484	
U68	A4VSO125	369	R902447040
	AA4VSO125	371	
	A4VSO180	393	
	AA4VSO180	395	
	A4VSO250	453	R902447042
	AA4VSO250	455	
	A4VSO355	482	
	AA4VSO355	484	

ISO 3019-1 (SAE J744)

(The lengths to the pump mounting face are valid for the SAE version. The metric pumps are 2 mm shorter)

Code	Available for pump	Length to pump mounting flange [mm]	Assembly group „Flange and Hub“ with flange, hub, cylinder screw
U04	A4VSO125	369	R902447045
	AA4VSO125	371	
	A4VSO180	393	
	AA4VSO180	395	
	A4VSO250	453	R902447047
	AA4VSO250	455	
	A4VSO355	482	
	AA4VSO355	484	
U07	A4VSO125	369	R902447050
	AA4VSO125	371	
	A4VSO180	393	
	AA4VSO180	395	
	A4VSO250	453	R902447051
	AA4VSO250	455	
	A4VSO355	482	
	AA4VSO355	484	
U24	A4VSO125	369	R902447052
	AA4VSO125	371	
	A4VSO180	393	
	AA4VSO180	395	
	A4VSO250	453	R902447053
	AA4VSO250	455	
	A4VSO355	482	
	AA4VSO355	484	
U15	A4VSO125	369	R902447054
	AA4VSO125	371	
	A4VSO180	393	
	AA4VSO180	395	
	A4VSO250	453	R902447055
	AA4VSO250	455	
	A4VSO355	482	
	AA4VSO355	484	
U16	A4VSO125	369	R902447056
	AA4VSO125	371	
	A4VSO180	393	
	AA4VSO180	395	
	A4VSO250	453	R902447057
	AA4VSO250	455	
	A4VSO355	482	
	AA4VSO355	484	

ISO 3019-1 (SAE J744)

(The lengths to the pump mounting face are valid for the SAE version. The metric pumps are 2 mm shorter)

Code	**Available for pump**	**Length to pump mounting flange** [mm]	**Assembly group „Flange and Hub“** with flange, hub, cylinder screw
U96	A4VSO125	369	R902447058
	AA4VSO125	371	
	A4VSO180	393	
	AA4VSO180	395	
	A4VSO250	453	R902447059
	AA4VSO250	455	
	A4VSO355	482	
	AA4VSO355	484	
U17	A4VSO125	382	R902447062
	AA4VSO125	384	
	A4VSO180	406	
	AA4VSO180	408	
	A4VSO250	453	R902447063
	AA4VSO250	455	
	A4VSO355	482	
	AA4VSO355	484	
U18	A4VSO250	479	R902447067
	AA4VSO250	481	
	A4VSO355	508	
	AA4VSO355	510	
U72	A4VSO250	479	R902453019
	AA4VSO250	481	
	A4VSO355	508	
	AA4VSO355	510	

Material number at A15VSO; A15VLO series 10

Code	Available for pump	Length to pump **mounting flange** [mm]	Assembly group „Cover“ with cover, O-Ring, cylinder screw	
U000	A15VSO 110	285	R902473330	
	A15VSO 145	310	R902473330	
	A15VLO 145	375	R902496066	
	A15VSO 175	328	R902473330	
	A15VLO 175	395	R902514110	
	A15VSO 210	345	R902473330	
	A15VLO 210	412	R902514110	
	A15VSO 280	387	R902473330	
	A15VLO 280	443	R902514110	
ISO 3019-2			**Assembly group „Flange and Hub“** with flange, hub, cylinder screw	
			metric	**ANSI**
K3S3	A15VSO 110	301	R902534268	On request
	A15VSO 145	326	R902534268	On request
	A15VLO 145	375	R902534268	On request
	A15VSO 175	On request	On request	On request
	A15VLO 175	On request	On request	On request
	A15VSO 210	On request	On request	On request
	A15VLO 210	On request	On request	On request
	A15VSO 280	On request	On request	On request
	A15VLO 280	On request	On request	On request
K5S3	A15VSO 110	301	R902535194	On request
	A15VSO 145	326	R902535194	On request
	A15VLO 145	375	R902535194	On request
	A15VSO 175	341	R902497161	On request
	A15VLO 175	390	R902497161	On request
	A15VSO 210	358	R902497161	On request
	A15VLO 210	407	R902497161	On request
	A15VSO 280	On request	On request	On request
	A15VLO 280	On request	On request	On request
L5S4	A15VSO 110	312	R902545964	On request
	A15VSO 145	337	R902545964	On request
	A15VLO 145	386	R902545964	On request
	A15VSO 175	On request	On request	On request
	A15VLO 175	On request	On request	On request
	A15VSO 210	On request	On request	On request
	A15VLO 210	On request	On request	On request
	A15VSO 280	On request	On request	On request
	A15VLO 280	On request	On request	On request

ISO 3019-2			**Assembly group „Flange and Hub“** with flange, hub, cylinder screw	
			metric	**ANSI**
P4S7	A15VSO 110	On request	On request	On request
	A15VSO 145	On request	On request	On request
	A15VLO 145	On request	On request	On request
	A15VSO 175	On request	On request	On request
	A15VLO 175	On request	On request	On request
	A15VSO 210	On request	On request	On request
	A15VLO 210	On request	On request	On request
	A15VSO 280	414	R902512007	On request
	A15VLO 280	452	R902512007	On request
N4Z9	A15VSO 110	On request	On request	On request
	A15VSO 145	On request	On request	On request
	A15VLO 145	On request	On request	On request
	A15VSO 175	On request	On request	On request
	A15VLO 175	On request	On request	On request
	A15VSO 210	On request	On request	On request
	A15VLO 210	On request	On request	On request
	A15VSO 280	414	R902544243	On request
	A15VLO 280	452	R902544243	On request
R4S9	A15VSO 110	On request	On request	On request
	A15VSO 145	On request	On request	On request
	A15VLO 145	On request	On request	On request
	A15VSO 175	360	R902488851	On request
	A15VLO 175	409	R902488851	On request
	A15VSO 210	377	R902488851	On request
	A15VLO 210	426	R902488851	On request
	A15VSO 280	419	R902514299	On request
	A15VLO 280	457	R902514299	On request

Material number at A15VSO; A15VLO series 10

ISO 3019-1 (SAE J744)			**Assembly group „Flange and Hub“** with flange, hub, cylinder screw	
			metric	**ANSI**
A3S2	A15VSO 110	301	R902542364	R902543056
	A15VSO 145	326	R902542364	R902543056
	A15VLO 145	375	R902542364	R902543056
	A15VSO 175	341	R902535272	R902542470
	A15VLO 175	390	R902535272	R902542470
	A15VSO 210	358	R902535272	R902542470
	A15VLO 210	407	R902535272	R902542470
	A15VSO 280	400	R902541607	On request
	A15VLO 280	438	R902541607	On request
B3S4	A15VSO 110	312	R902516812	R902541079
	A15VSO 145	337	R902516812	R902541079
	A15VLO 145	386	R902516812	R902541079
	A15VSO 175	355	R902510920	On request
	A15VLO 175	404	R902510920	On request
	A15VSO 210	372	R902510920	On request
	A15VLO 210	421	R902510920	On request
	A15VSO 280	414	R902512054	R902542488
	A15VLO 280	452	R902512054	R902542488
B3S5	A15VSO 110	312	R902512157	On request
	A15VSO 145	337	R902512157	On request
	A15VLO 145	386	R902512157	On request
	A15VSO 175	355	R902517320	R902545124
	A15VLO 175	404	R902517320	R902545124
	A15VSO 210	372	R902517320	R902545124
	A15VLO 210	421	R902517320	R902545124
	A15VSO 280	414	R902517267	On request
	A15VLO 280	452	R902517267	On request
B5S4	A15VSO 110	312	On request	R902543104
	A15VSO 145	337	On request	R902543104
	A15VLO 145	386	On request	R902543104
	A15VSO 175	On request	On request	On request
	A15VLO 175	On request	On request	On request
	A15VSO 210	On request	On request	On request
	A15VLO 210	On request	On request	On request
	A15VSO 280	414	R902541685	On request
	A15VLO 280	452	R902541685	On request
B5S5	A15VSO 110	On request	On request	On request
	A15VSO 145	On request	On request	On request
	A15VLO 145	On request	On request	On request
	A15VSO 175	355	R902536089	On request
	A15VLO 175	404	R902536089	On request
	A15VSO 210	372	R902536089	On request
	A15VLO 210	421	R902536089	On request
	A15VSO 280	On request	On request	On request
	A15VLO 280	On request	On request	On request

ISO 3019-1 (SAE J744)			**Assembly group „Flange and Hub“** with flange, hub, cylinder screw	
			metric	**ANSI**
C3S7	A15VSO 110	323	R902511033	R902543544
	A15VSO 145	348	R902511033	R902543544
	A15VLO 145	397	R902511033	R902543544
	A15VSO 175	355	R902514325	On request
	A15VLO 175	404	R902514325	On request
	A15VSO 210	372	R902514325	On request
	A15VLO 210	421	R902514325	On request
	A15VSO 280	414	R902515215	On request
	A15VLO 280	452	R902515215	On request
C3S9	A15VSO 110	323	R902545065	On request
	A15VSO 145	348	R902545065	On request
	A15VLO 145	397	R902545065	On request
	A15VSO 175	360	R902531105	On request
	A15VLO 175	409	R902531105	On request
	A15VSO 210	377	R902531105	On request
	A15VLO 210	426	R902531105	On request
	A15VSO 280	414	R902514098	R902539947
	A15VLO 280	452	R902514098	R902539947
D4A1	A15VSO 110	325	R902512707	On request
	A15VSO 145	350	R902512707	On request
	A15VLO 145	399	R902512707	On request
	A15VSO 175	364	R902533134	On request
	A15VLO 175	413	R902533134	On request
	A15VSO 210	381	R902533134	On request
	A15VLO 210	430	R902533134	On request
	A15VSO 280	414	R902515220	On request
	A15VLO 280	452	R902515220	On request
D4A2	A15VSO 145	350	R902542404	On request
	A15VLO 145	399	R902542404	On request
	A15VSO 175	364	R902542402	On request
	A15VLO 175	413	R902542402	On request
	A15VSO 210	381	R902542402	On request
	A15VLO 210	430	R902542402	On request
	A15VSO 280	423	R902519158	On request
	A15VLO 280	461	R902519158	On request
E4A2	A15VSO 175	364	R902495006	On request
	A15VLO 175	413	R902495006	On request
	A15VSO 210	381	R902495006	On request
	A15VLO 210	430	R902495006	On request
	A15VSO 280	423	R902495955	On request
	A15VLO 280	461	R902495955	On request
E4A4	A15VSO 280	423	R902495953	On request
	A15VLO 280	461	R902495953	On request

Material number at A11V(L)O series 40

Code	Available for pump	Length to pump mounting flange [mm]	Assembly group „Cover“ with cover, O-Ring, cylinder screw	
U000	A11VO 110	285	R902473330	
	A11VO 145	310	R902473330	
	A11VLO 145	375	R902496066	
	A11VO 175	328	R902473330	
	A11VLO 175	395	R902514110	
	A11VO 210	345	R902473330	
	A11VLO 210	412	R902514110	
	A11VO 280	387	R902473330	
	A11VLO 280	443	R902514110	
ISO 3019-1 (SAE J744)			**Assembly group „Flange and Hub“** with flange, hub, cylinder screw	
			metric	**ANSI**
A3S2	A11VO 110	301	R902542364	R902543056
	A11VO 145	326	R902542364	R902543056
	A11VLO 145	375	R902542364	R902543056
	A11VO 175	341	R902535272	R902542470
	A11VLO 175	390	R902535272	R902542470
	A11VO 210	358	R902535272	R902542470
	A11VLO 210	407	R902535272	R902542470
	A11VO 280	400	R902541607	On request
	A11VLO 280	438	R902541607	On request
A3S3	A11VO 110	301	On request	R902546963
	A11VO 145	326	On request	R902546963
	A11VLO 145	375	On request	R902546963
	A11VO 175	341	On request	R902542454
	A11VLO 175	390	On request	R902542454
	A11VO 210	358	On request	R902542454
	A11VLO 210	407	On request	R902542454
	A11VO 280	400	On request	R902543060
	A11VLO 280	438	On request	R902543060
B3S4	A11VO 110	312	R902516812	R902541079
	A11VO 145	337	R902516812	R902541079
	A11VLO 145	386	R902516812	R902541079
	A11VO 175	355	R902510920	On request
	A11VLO 175	404	R902510920	On request
	A11VO 210	372	R902510920	On request
	A11VLO 210	421	R902510920	On request
	A11VO 280	414	R902512054	R902542488
	A11VLO 280	452	R902512054	R902542488

ISO 3019-1 (SAE J744)			**Assembly group „Flange and Hub“** with flange, hub, cylinder screw	
			metric	**ANSI**
B3S5	A11VO 110	312	R902512157	On request
	A11VO 145	337	R902512157	On request
	A11VLO 145	386	R902512157	On request
	A11VO 175	355	R902517320	R902545124
	A11VLO 175	404	R902517320	R902545124
	A11VO 210	372	R902517320	R902545124
	A11VLO 210	421	R902517320	R902545124
	A11VO 280	414	R902517267	On request
	A11VLO 280	452	R902517267	On request
B5S4	A11VO 110	312	On request	R902543104
	A11VO 145	337	On request	R902543104
	A11VLO 145	386	On request	R902543104
	A11VO 175	On request	On request	On request
	A11VLO 175	On request	On request	On request
	A11VO 210	On request	On request	On request
	A11VLO 210	On request	On request	On request
	A11VO 280	414	R902541685	On request
	A11VLO 280	452	R902541685	On request
B5S5	A11VO 110	On request	On request	On request
	A11VO 145	On request	On request	On request
	A11VLO 145	On request	On request	On request
	A11VO 175	355	R902536089	On request
	A11VLO 175	404	R902536089	On request
	A11VO 210	372	R902536089	On request
	A11VLO 210	421	R902536089	On request
	A11VO 280	On request	On request	On request
	A11VLO 280	On request	On request	On request
C3S7	A11VO 110	323	R902511033	R902543544
	A11VO 145	348	R902511033	R902543544
	A11VLO 145	397	R902511033	R902543544
	A11VO 175	355	R902514325	On request
	A11VLO 175	404	R902514325	On request
	A11VO 210	372	R902514325	On request
	A11VLO 210	421	R902514325	On request
	A11VO 280	414	R902515215	On request
	A11VLO 280	452	R902515215	On request
C3S9	A11VO 110	323	R902545065	On request
	A11VO 145	348	R902545065	On request
	A11VLO 145	397	R902545065	On request
	A11VO 175	360	R902531105	On request
	A11VLO 175	409	R902531105	On request
	A11VO 210	377	R902531105	On request
	A11VLO 210	426	R902531105	On request
	A11VO 280	414	R902514098	R902539947
	A11VLO 280	452	R902514098	R902539947

Material number at A11V(L)O series 40

ISO 3019-1 (SAE J744)			**Assembly group „Flange and Hub“** with flange, hub, cylinder screw	
			metric	**ANSI**
C5S7	A11VO 110	On request	On request	On request
	A11VO 145	On request	On request	On request
	A11VLO 145	On request	On request	On request
	A11VO 175	355	R902497179	On request
	A11VLO 175	404	R902497179	On request
	A11VO 210	372	R902497179	On request
	A11VLO 210	421	R902497179	On request
	A11VO 280	414	On request	R902542469
	A11VLO 280	452	On request	R902542469
C4S7	A11VO 110	323	R902542207	R902543105
	A11VO 145	348	R902542207	R902543105
	A11VLO 145	397	R902542207	R902543105
	A11VO 175	355	R902497177	On request
	A11VLO 175	404	R902497177	On request
	A11VO 210	372	R902497177	On request
	A11VLO 210	421	R902497177	On request
	A11VO 280	414	R902543496	On request
	A11VLO 280	452	R902543496	On request
C4V8	A11VO 110	323	R902545504	On request
	A11VO 145	348	R902545504	On request
	A11VLO 145	397	R902545504	On request
	A11VO 175	On request	On request	On request
	A11VLO 175	On request	On request	On request
	A11VO 210	On request	On request	On request
	A11VLO 210	On request	On request	On request
	A11VO 280	On request	On request	On request
	A11VLO 280	On request	On request	On request
D4T1	A11VO 110	336	R902516670	R902543106
	A11VO 145	361	R902516670	R902543106
	A11VLO 145	410	R902516670	R902543106
	A11VO 175	373	R902495015	R902546266
	A11VLO 175	422	R902495015	R902546266
	A11VO 210	390	R902495015	R902546266
	A11VLO 210	439	R902495015	R902546266
	A11VO 280	432	R902497428	R902539862
	A11VLO 280	470	R902497428	R902539862
D4S7	A11VO 110	On request	On request	On request
	A11VO 145	On request	On request	On request
	A11VLO 145	On request	On request	On request
	A11VO 175	On request	On request	On request
	A11VLO 175	On request	On request	On request
	A11VO 210	On request	On request	On request
	A11VLO 210	On request	On request	On request
	A11VO 280	On request	On request	On request
	A11VLO 280	On request	On request	On request

ISO 3019-1 (SAE J744)			**Assembly group „Flange and Hub“** with flange, hub, cylinder screw	
			metric	**ANSI**
D4V8	A11VO 110	On request	On request	On request
	A11VO 145	On request	On request	On request
	A11VLO 145	On request	On request	On request
	A11VO 175	On request	On request	On request
	A11VLO 175	On request	On request	On request
	A11VO 210	On request	On request	On request
	A11VLO 210	On request	On request	On request
	A11VO 280	On request	On request	On request
	A11VLO 280	On request	On request	On request
E4T1	A11VO 175	373	R902536130	On request
	A11VLO 175	422	R902536130	On request
	A11VO 210	390	R902536130	On request
	A11VLO 210	439	R902536130	On request
	A11VO 280	432	On request	R902542451
	A11VLO 280	470	On request	R902542451
E4T2	A11VO 175	386	R902543051	R902542482
	A11VLO 175	435	R902543051	R902542482
	A11VO 210	403	R902543051	R902542482
	A11VLO 210	452	R902543051	R902542482
	A11VO 280	445	R902545123	R902542449
	A11VLO 280	483	R902545123	R902542449
E4T3	A11VO 280	445	R902545886	R902535350
	A11VLO 280	483	R902545886	R902535350
E4A4	A11VO 280	423	R902495953	On request
	A11VLO 280	461	R902495953	On request

Project planning notes

- The A10VSO, A4VSO, A15VSO und A11V(L)O pumps are designed to be used in open circuits.
- Project planning, installation and commissioning of the axial piston units requires the involvement of skilled personnel.
- Before using the axial piston unit, please read the corresponding instruction manual thoroughly and completely. If necessary, request these from Bosch Rexroth.
- Before finalizing your design, request a binding installation drawing.
- The data and notes contained herein must be adhered to.
  For further informations see the data sheets of the products on page 1.

Safety instructions

- During and shortly after operation, there is a risk of burns on the axial piston unit and especially on the solenoids. Take appropriate safety measures (e.g., by wearing protective clothing).

Hydraulic reservoir
TMP (polymer reservoir)
TMS (steel reservoir)

- Hydraulic reservoir for rotary drives
- Steel or polymer versions
- Total volume 8 liters
- Flow rate up to 90 l/min

Features

- Power supply for one pump and optional second pump
- 6.5 l filling volume for up to 75 l/min throughput (steel reservoir)
- 6 l filling volume for up to 90 l/min throughput (polymer reservoir)
- Robust design for mobile applications with rotary drives
- Light weight (polymer reservoir)
- Compact dimensions
- Reservoir cap with air bleed
- Oil level gauge
- Integrated return line filter

Contents

Type code

01	02	03		04		05	06	07	08
TM			**/**	**10**	**–**				

Design				
01	Hydraulic reservoir for mobile applications			**TM**
Version				
02	Polymer reservoir			**P**
	Steel reservoir			**S**
Total volume		**TMP**	**TMS**	
03	8 liters	●	●	**08**
Series				
04				**10**
Filtration				
05	Glass fiber filter, filter grade 10 µm / dirt absorption capacity 12 g	●	–	**G1012**
	Glass fiber filter, filter grade 10 µm / dirt absorption capacity 60 g	–	●	**G1060**
Oil level gauge				
06	Visual	●	●	**V**
	Visual and electrical (optional)	●	○	**E**
Suction port for second pump				
07	Not available	●	–	**S0**
	Fitted	●	●	**S1**
Ports				
08	Plugged (with plastic plug to protect against dirt)	●	●	**L1**

● = Available ○ = On request – = Not available

Preferred series

Type code	Material number
TMP08/10–G1012VS0L1	R902651116
TMP08/10-G1012ES0L1	R902476412
TMP08/10-G1012ES1L1	R902484689
TMP08/10-G1012VS1L1	R902492164
TMS08/10-G1060VS1L1	R902519518

Description

The robust hydraulic reservoirs are designed for rotary drives in open circuits with no or very low differential volumes. Polymer and steel versions are available. Light weight and compact dimensions mean that Rexroth hydraulic reservoirs are optimally adapted to requirements of hydraulics for rotary drives.
The hydraulic reservoir allows the optional supply of a second pump.
An automatic air bleed is integrated into the reservoir cap.
The hydraulic reservoirs are fitted as standard with a visual oil level indicator. The polymer reservoir can also be equipped as necessary with electrical level monitoring.
A return line filter is installed in the reservoir.

Hydraulic fluid

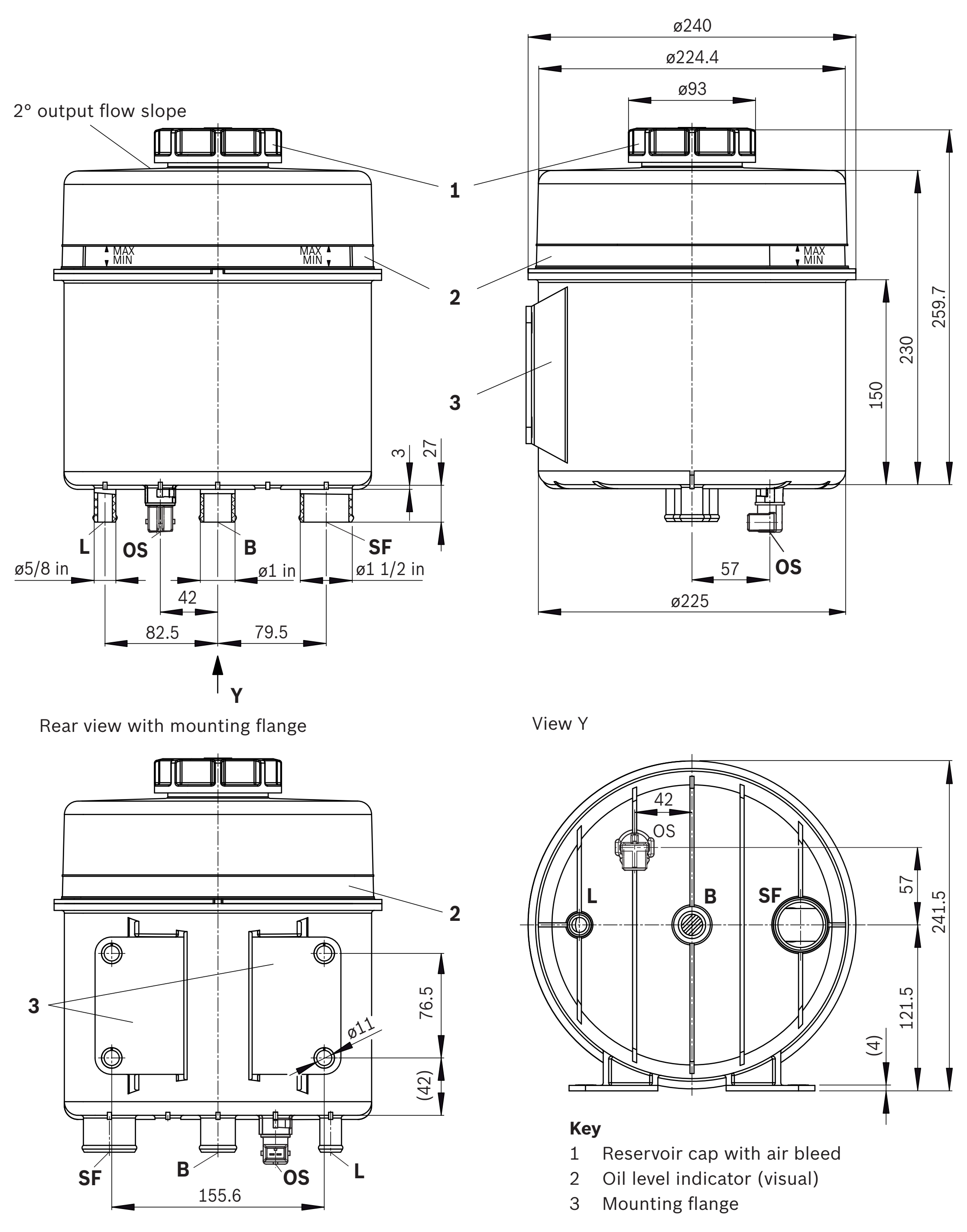
Prior to project planning, please see our data sheets RE 90220 (mineral oil) and RE 90221 (environmentally acceptable hydraulic fluids) for detailed information regarding the selection of hydraulic fluid and application conditions. For operation with environmentally acceptable hydraulic fluids, restrictions of the technical data are required. Please contact us. When ordering, indicate the hydraulic fluid that is to be used.

Technical Data

Hydraulic reservoir		Polymer reservoir TMP	Steel reservoir TMS
Material		Polymer, PA66GF25 (UV-stabilized)	Steel, S235JR
Wall thickness		2.5 mm	2 mm
Color		white	Black (painted), RAL 9005
Weight (empty)		1.6 kg	5.6 kg
Maximum flow rate		90 l/min	75 l/min
Total volume		8 l	8 l
Filling volume		6 l	6.5 l
Reservoir air bleed		Fitted	**Fitted**
Pressure, maximum permissible			
	Port B (return line)	2.0 bar absolute	2.5 bar absolute
	Port L (drain line)	2.0 bar absolute	2.0 bar absolute
Temperature range		−30 °C to 90 °C	−30 °C to 90 °C
	Maximum operating temperature, short-term < 3 min	120 °C	120 °C
Filter			
	Filter material	**Glass fiber filter**	Glass fiber filter
	Retention rate (ISO 16889)	**β_{10} > 100 Separation rate > 99% for 10 µm particles**	**β_{10} > 100 Separation rate > 99% for 10 µm particles**
	Contamination retention capacity (ISO 16889)	**12 g**	**60 g**

Dimensions of polymer reservoir

With oil level sensor, without suction port for second pump

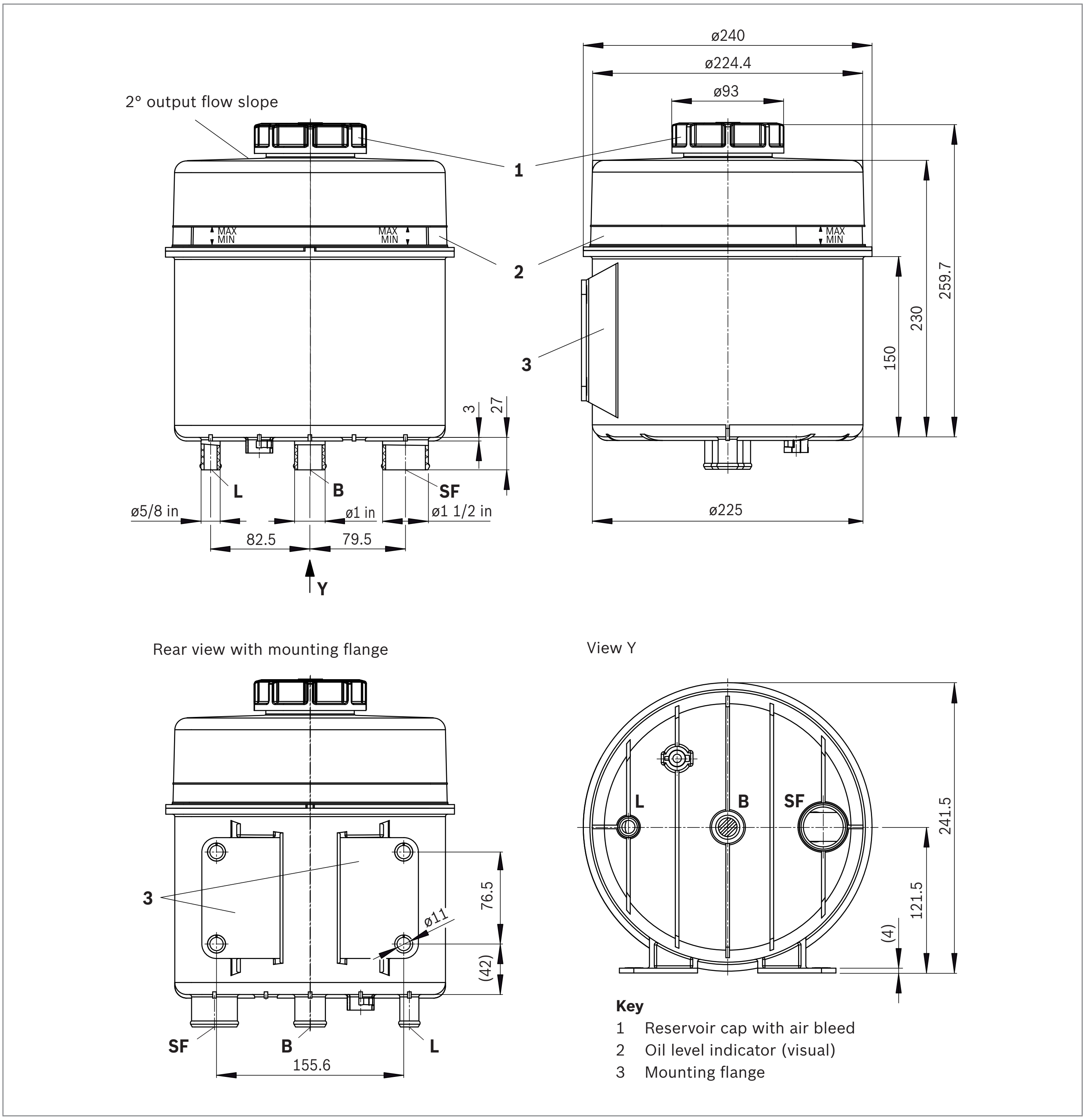


Key
1 Reservoir cap with air bleed
2 Oil level indicator (visual)
3 Mounting flange

Ports		Socket piece, outer diameter[1]	Recommended hose clamp		
			Standard	Width	Tightening torque
L	Drain port	5/8 in	DIN 3017-1	9 mm	3 Nm +0.5
B	Return port	1 in	DIN 3017-1	13 mm	5 Nm +0.5
SF	Suction port for fan pump	1 1/2 in	DIN 3017-3	20 mm	7 Nm
OS	Oil level sensor, electric	–	–	–	–

[1] For these socket pieces, hose corresponding to the SAE J 517 standard are recommended

Without oil level sensor, without suction port for second pump



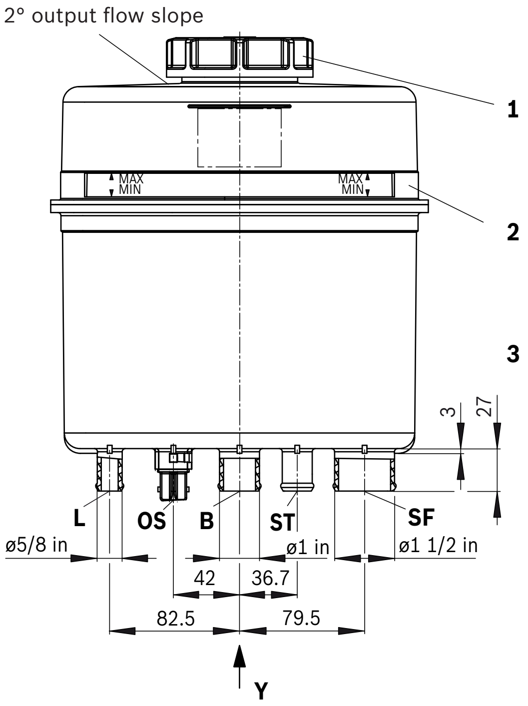
Key

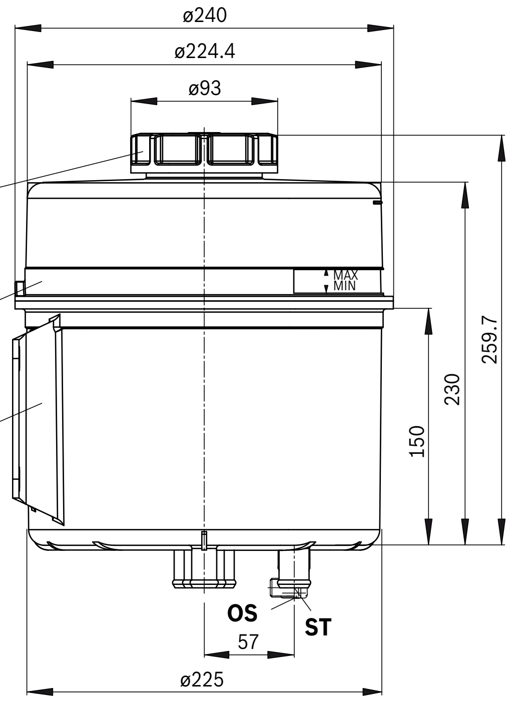
1 Reservoir cap with air bleed
2 Oil level indicator (visual)
3 Mounting flange

Ports		Socket piece, outer diameter[1)]	Recommended hose clamp		
			Standard	Width	Tightening torque
L	Drain port	5/8 in	DIN 3017-1	9 mm	3 Nm +0.5
B	Return port	1 in	DIN 3017-1	13 mm	5 Nm +0.5
SF	Suction port for fan pump	1 1/2 in	DIN 3017-3	20 mm	7 Nm

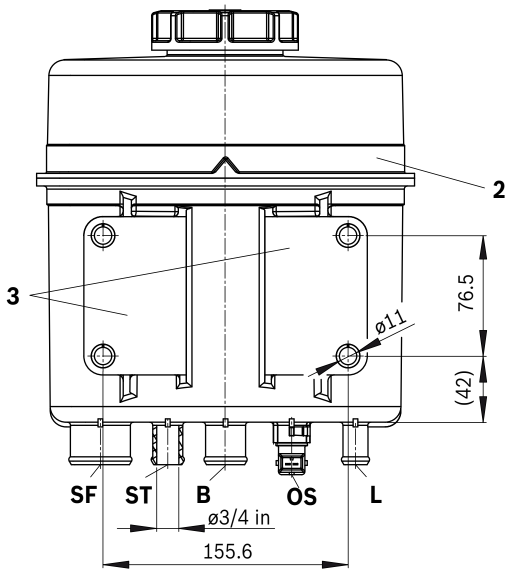
1) For these socket pieces, hose corresponding to the SAE J 517 standard are recommended

With oil level sensor, with suction port for second pump

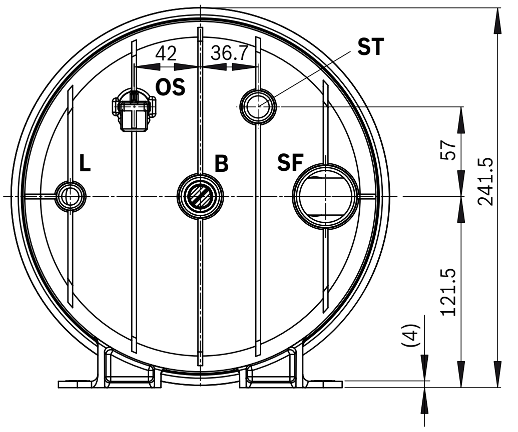




Rear view with mounting flange



View Y



Key
1 Reservoir cap with air bleed
2 Oil level indicator (visual)
3 Mounting flange

Ports		Socket piece, outer diameter[1]	Recommended hose clamp		
			Standard	**Width**	**Tightening torque**
L	Drain port	5/8 in	DIN 3017-1	9 mm	3 Nm +0.5
B	Return port	1 in	DIN 3017-1	13 mm	5 Nm +0.5
SF	Suction port for fan pump	1 1/2 in	DIN 3017-3	20 mm	7 Nm
ST	Suction port, second pump	3/4 in	DIN 3017-3	18 mm	4 Nm
OS	Oil level sensor, electric	–	–	–	–

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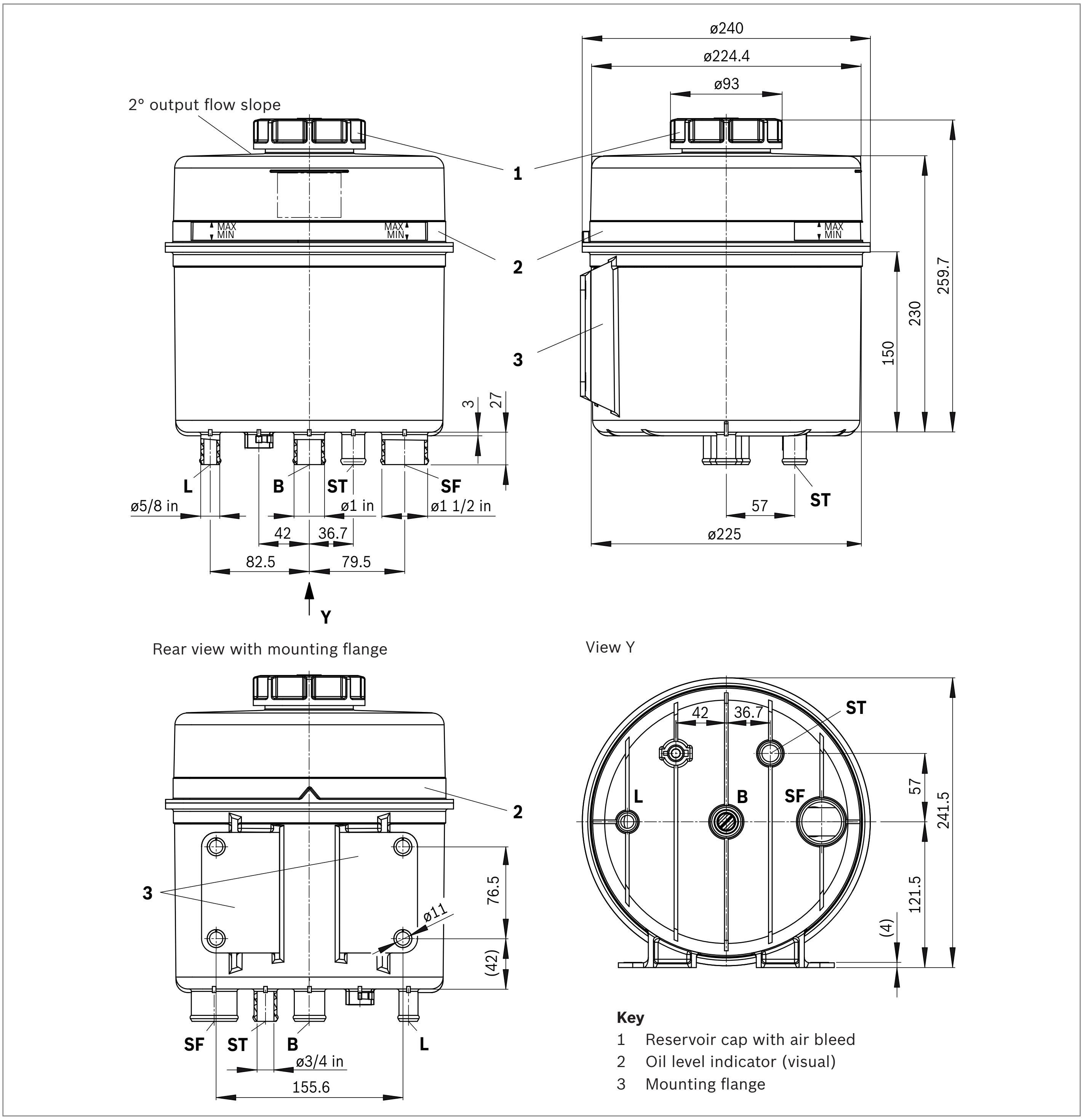
[1] For these socket pieces, hose corresponding to the SAE J 517 standard are recommended

Without oil level sensor, without suction port for second pump



Key
1 Reservoir cap with air bleed
2 Oil level indicator (visual)
3 Mounting flange

Ports		Socket piece, outer diameter[1]	Recommended hose clamp Standard	Width	Tightening torque
L	Drain port	5/8 in	DIN 3017-1	9 mm	3 Nm +0.5
B	Return port	1 in	DIN 3017-1	13 mm	5 Nm +0.5
SF	Suction port for fan pump	1 1/2 in	DIN 3017-3	20 mm	7 Nm
ST	Suction port, second pump	3/4 in	DIN 3017-3	18 mm	4 Nm

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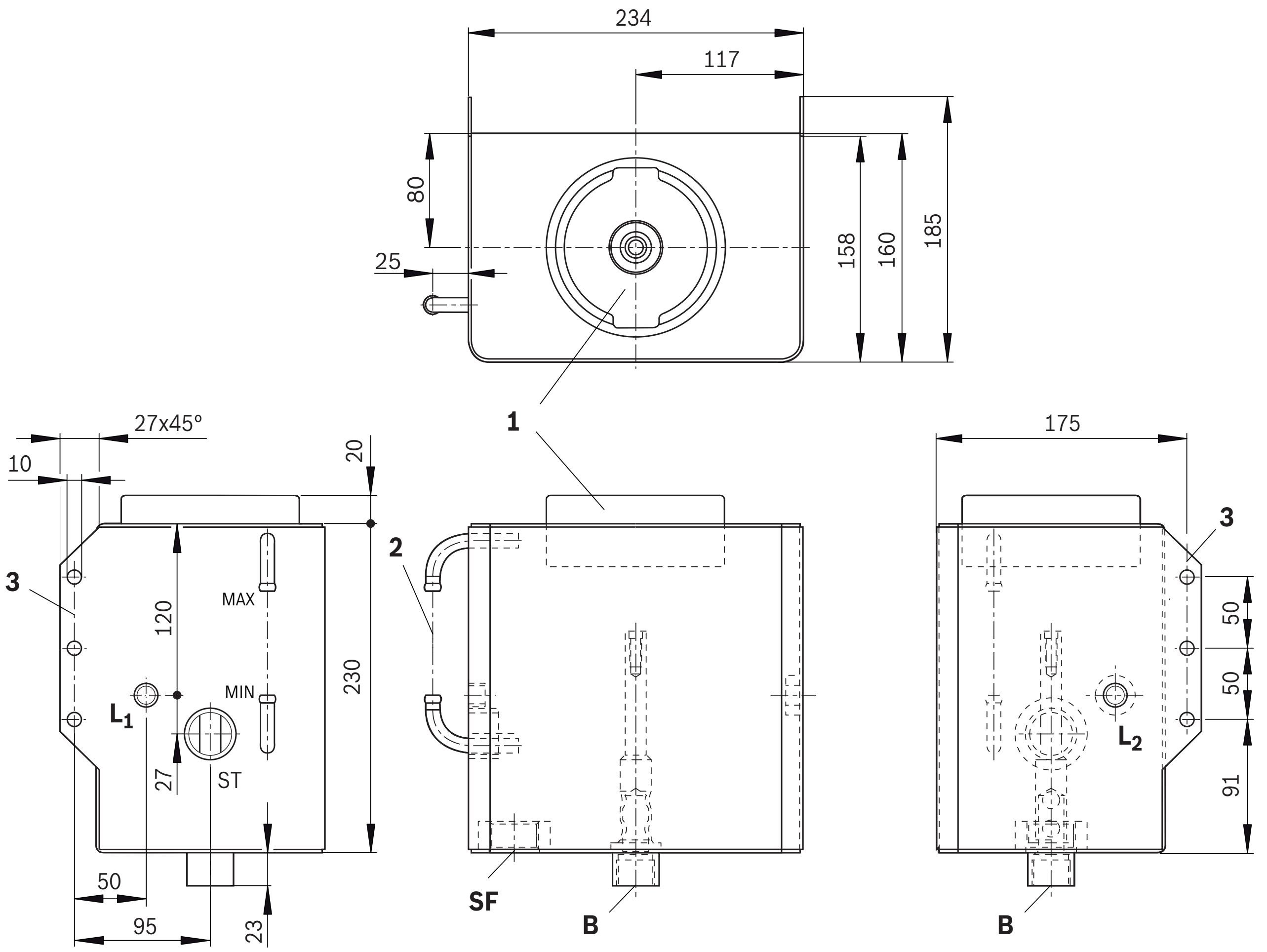
[1] For these socket pieces, hose corresponding to the SAE J 517 standard are recommended

Dimensions of steel reservoir



Key

1 Reservoir cap with air bleed
2 Oil level gage (visual)
3 Mounting flange

Ports		**Standard**	**Thread**
L_1	Drain port	ISO 6149	M14 × 1.5
L_2	Drain port	ISO 6149	M14 × 1.5
B	Return port	ISO 6149	M26 × 1.5
SF	Suction port for fan pump	ISO 6149	M33 × 2
ST	Suction port, second pump	ISO 6149	M33 × 2

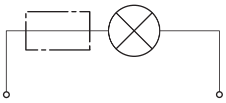
Oil level sensor

Function

The oil level sensor opens as the level drops.

Nominal voltage	Breakdown voltage
12 V / 24 V	≥ 200 V (DC)

▼ Circuit diagram



Indicator light not included in the scope of delivery.

Note

Contact protection measures recommended for non-resistive loads.

Mating Connector

On the version with electrical oil level sensor, the mating connector is not included in the scope of delivery.

▼ Order designation:

Material number	R900313533	R901022127
Litz wire cross-section	0.5 to 1 mm²	0.5 to 1 mm²
Insulation diameter of individual seals	1.2 to 2.1 mm	2.2 to 3 mm

Oil level check

Regular visual inspection of the oil level by means of a light source is recommended.

Maintenance

The service life of the hydraulic pump is heavily dependent on the quality of the hydraulic fluid in the reservoir. Our advice is to have the hydraulic fluid and the filter changed after every 2000 operating hours or at least once per year.

Spare part filter:

Hydraulic reservoir	Material number
TMP08/10–G1012. . .	R928019283
TMS08/10–G1060. . .	R928018948

Installation instructions

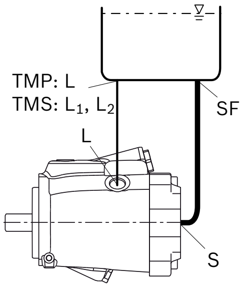
Piping of hydraulic reservoir to pump:

Connection Hydraulic reservoir	Connection Pump/oil cooler
L, L_1/L_2	Highest positioned case drain port for pump
SF	Suction line for pump
B	Return line for oil cooler

If using the reservoir with a second pump, its suction line can be connected to the **ST** port.

Installation position (recommended)

The minimum oil level in the reservoir should always be above the pump. In order to guarantee optimum suction properties for the pump, the suction line must always be routed so that it is descending from the reservoir to the pump.



Notes

- ▶ The polymer reservoir TMP must be protected against external strains (e.g. rock fall or climbing aid) and chemical contamination.
- ▶ The installation position must be selected so that the reservoir will not be damaged in an accident (crash-proof installation).
- ▶ The reservoir mounting must withstand all foreseeable loads.
- ▶ Except at the mounting points, no mechanical loads are to be exerted on the reservoir.
- ▶ The permissible temperatures must not be exceeded.
- ▶ It must be ensured that escaping hydraulic fluid is unable to come into contact with ignition sources (hot vehicle components, sparks).
- ▶ For example, the reservoir could be dropped and damaged during transportation. Reservoirs that have been dropped are not approved for operation.

General instructions for project planning

- The project planning, installation and commissioning of a hydraulic reservoir require the involvement of qualified skilled persons.
- The working ports and function ports can only be used to accommodate hydraulic lines.
- Manufacturer's instructions for the tightening torques of the used fittings must be observed!
- No faulty components are to be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.
- During and for a short time after operation, the case temperature of the reservoir may increase. Take suitable safety measures (e.g. wear protective clothing).
- The product is not approved as a component for the safety concept of a general machine according to DIN EN ISO 13849.
- The sensor for electrical level monitoring cannot be retrofitted.
- Surge movements of the oil can cause oil to leak via the reservoir air bleed, which can cause an oil film on the reservoir surface.

Intended use

- Rexroth hydraulic reservoirs are designed for rotary drives in an open circuit.
- When designing the system, make sure the maximum oil level is not exceeded even at high temperatures (e.g. by temperature expansion of the oil).
- When cleaning the reservoir (e.g. by water jet), make sure no water enters the reservoir through the reservoir air bleed.
- In case of continuous irradiation with UV light (e.g. sunlight), UV protection for the reservoir is necessary.
- The warranty by Rexroth only applies to the delivered configuration. In case of extensions or conversions, the warranty will become void.

External gear pumps
Standard Performance / High Performance

Designation	Type	Size	Series	Data sheet	Page
Standard Performance					
External gear pump Standard-Performance	AZPW	4...22	1x/2x	10090	1261
High Performance					
External gear pump High Performance	AZPB	1...7.1	3x	10088	1297
External gear pump High Performance	AZPF	4...28	1x/2x	10089	1329
External gear pump High Performance	AZPN	20...36	1x/2x	10091	1397
External gear pump High Performance	AZPG	22...100	2x/3x	10093	1421

External gear pump Standard performance AZPW

- Platform F
- Fixed displacement
- Sizes 4 to 22
- Continuous pressure up to 190 bar
- Intermittent pressure up to 210 bar

Features

- Consistently high quality due to high-volume series production
- Long service life
- Slide bearings for high loads
- Drive shafts conform to ISO or SAE and customer-specific solutions
- Line connections: Connection flange or screw-in thread

Contents

Functional description

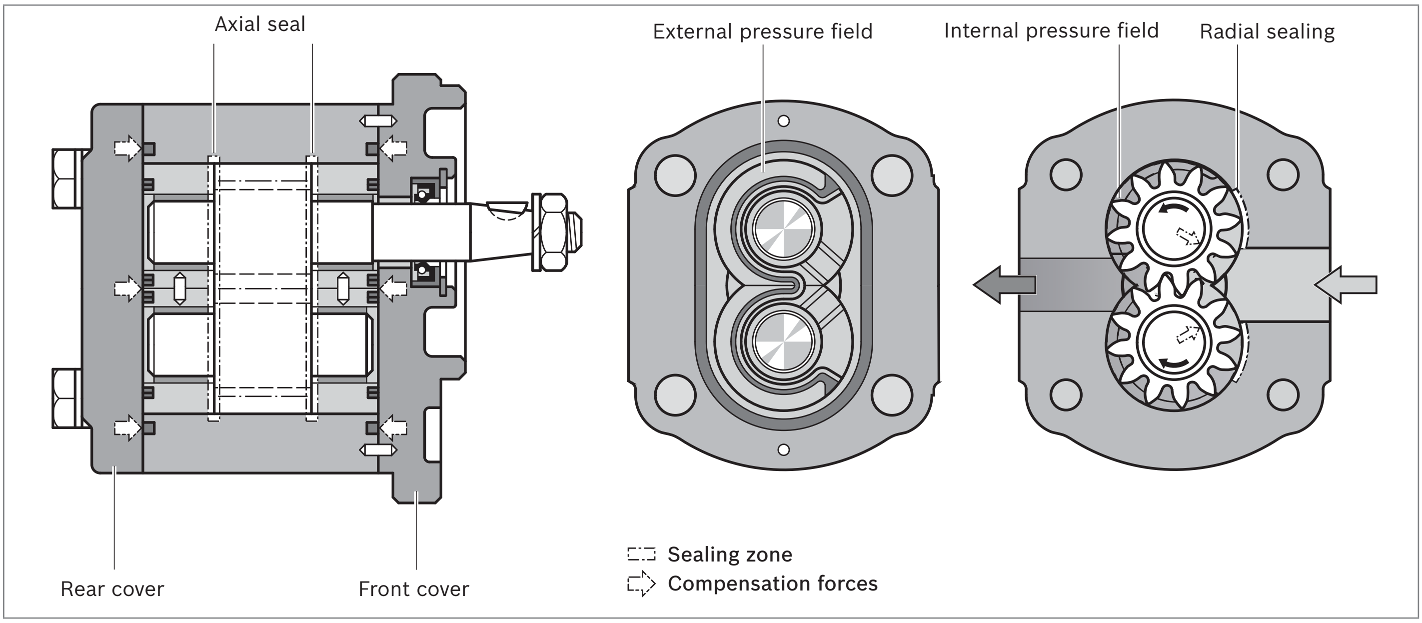
General

Rexroth external gear pumps are available as standard performance gear pumps in the series W. The displacements are graded by different gear widths. Further configuration variants are given by different flanges, shafts, valve arrangements and multiple pump combinations.

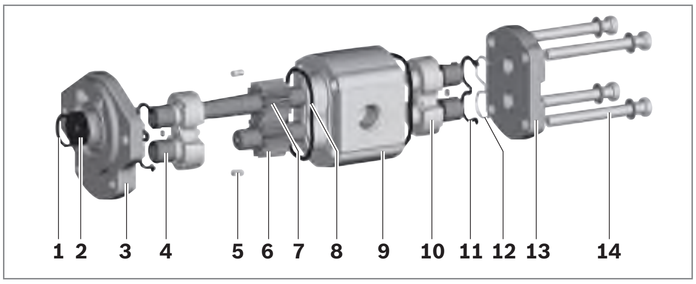
Construction

The external gear pump consists essentially of a pair of gear wheels supported in bearing bushes and the housing with a front and a rear cover. The drive shaft protrudes from the front cover where it is usually sealed by the shaft seal. The bearing forces are absorbed by slide bearings. These were designed for high pressures and have excellent emergency running properties, especially at low rotational speeds. The gear wheels have 12 teeth. This keeps both flow pulsation and noise emission to a minimum. The internal sealing of the pressure chambers is achieved by delivery pressure-dependent forces. This ensures optimum efficiency. On the rear side, the movable bearing bushes are pressurized with working pressure and pressed as seals against the gear wheels. The pressurized compression springs are limited by special seals. The seal on the area between the gear teeth and the housing is ensured by the smallest of gaps that adjust depending on the pressure between the gear teeth and housing.

▼ **Axial compensation standard performance**

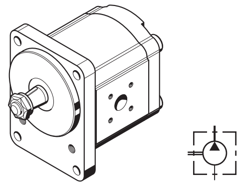
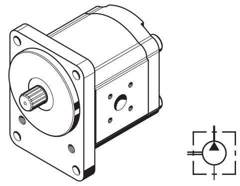
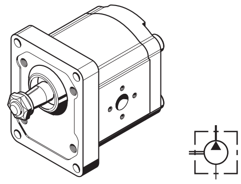
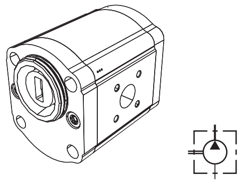
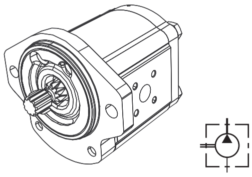


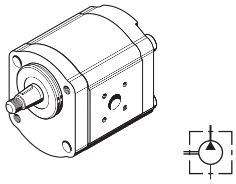
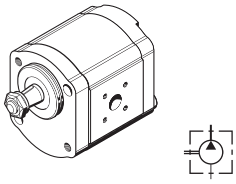
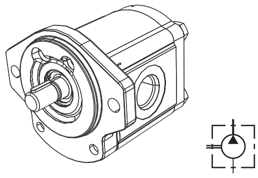
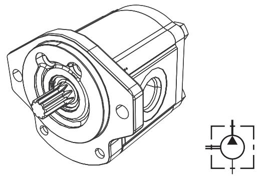
▼ **Layout AZPW** (schematic diagram)

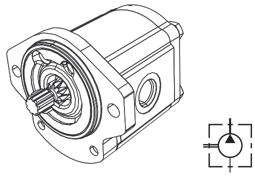
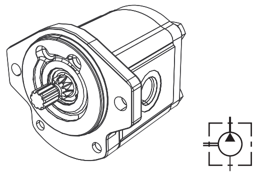
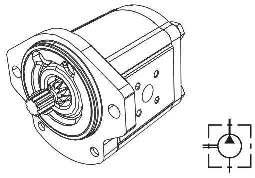
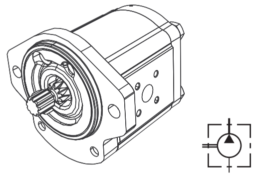


1	Snap ring
2	Shaft seal
3	Front cover
4	Slide bearings
5	Centering pin
6	Gear wheel
7	Drive shaft
8	Housing seal ring
9	Pump housing
10	Bearing bushing
11	Axial field seal
12	Support element
13	Rear cover
14	Hexagon screw

Product overview AZPW preferred types

Version	Page
	16
	17
	18
	19
 Line connections in Non-standard version	28

Version	Page
	20
	21
	22
	23

Version	Page
 Suction port in the front cover	24
	25
 Suction port in the front cover	26
	27

Type code single pump

01	02		03	04		05	06	07	08	09	10	11		12
AZP	W	–		1	–							B	–	

External gear unit

01	External gear pump	**AZP**

Series

02	Standard performance, platform F	**W**

Series

03	Standard housing	**1**
	Stronger housing	**2**

Version

04	Phosphated	**1**

Size (NG)

05	Geometric displacement V_g [cm^3], see "Technical data" on page 6	**004**	**005**	**008**	**011**	**014**	**016**	**019**	**022**

Direction of rotation

06	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Drive shaft			**Suitable front cover**	
07	Tapered shaft	1 : 5	**B, P**	**C**
		1 : 8	**O**	**H**
	Dihedral, claw		**T**	**N**
	Splined shaft	SAE J744 16-4 9T	**R**	**R**
		DIN 5482 B17 × 14	**B, P**	**F**
	Parallel keyed shaft	SAE J744 16-1 A	**R**	**Q**

Front cover

08	Rectangular flange	Ø80 mm		**B**
		Ø36.47 mm		**O**
	2-bolt flange	Ø82.55 mm	SAE J744 82-2 A	**R**
		Ø50 mm	connection variant 1	**N**
		Ø50 mm	connection variant 2	**P**
	4-bolt mounting	Ø52 mm	with O-ring	**T**

Line connection

09	Thread UNF-2B, SAE O-ring		**12**
	Square flange		**20**
	Square flange		**30**
	Non-standard size		**XX**

Sealing material

10	NBR (nitrile rubber)	**M**
	FKM (fluoroelastomer)	**P**

01	02		03	04		05	06	07	08	09	10	11		12
AZP	**W**	**–**		**1**	**–**							**B**	**–**	

Rear cover

11	Without valve (standard)	**B**

Special version

12	Serial number, e.g., S0001	**SXXXX**
	Without nut and washer	**S0007**
	For mounting on an axial piston unit and suction port in the front cover	**S0036**
	For mounting on an axial piston unit	**S0081**
	For mounting on an axial piston unit and line connections in Non-standard version	**S0593**

Note

- ▶ Not all of the variants according to the type code are possible.
- ▶ Please select the desired pump with the help of the selection table (preferred types) or after consultation with Bosch Rexroth.
- ▶ Further options are available on request.

Technical data

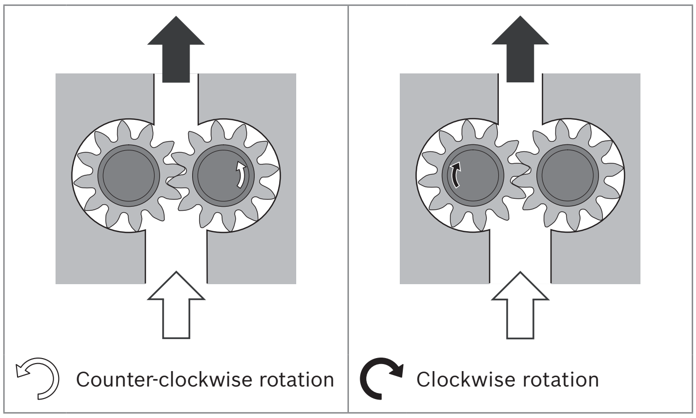
General				
Installation position				Any
Mounting type				See proposal drawing
Line connections				See proposal drawing The screw threads for the suction and pressure port, that are manufactured true to gauge, are deformed slightly due to the pump assembly. The mounting of conventional screw fittings in accordance with DIN EN ISO 1179, 6149, 9974 etc. is easily possible.
Direction of rotation (viewed on drive shaft)				Clockwise or counter-clockwise, the pump may only be driven in the direction indicated
Drive shaft loading				Radial and axial forces only after consultation
Ambient temperature range θ			°C	-30 to +80 with NBR seals -20 to +110 with FKM seals

Hydraulic				
Hydraulic fluid				Mineral oil according to DIN 51524, 1-3, however under higher load at least HLP compliant with DIN 51524 Part 2 is recommended. Please observe data sheet 90220. Other hydraulic fluids on request
Hydraulic fluid temperature range		θ	°C	-30 to +80 with NBR seals (NBR = nitrile rubber) -20 to +110 with FKM seals (FKM = fluoroelastomer)
Viscosity range	Permissible in continuous operation	ν	mm²/s	12 to 800
	Recommended in continuous operation	ν_{opt}	mm²/s	20 to 100
	Permissible for cold start	ν_{max}	mm²/s	≤ 2000
Maximum admissible degree of contamination of the hydraulic fluid Cleanliness level according to ISO 4406 (c)				20/18/15[1]

Note

- ▶ Safety requirements pertaining to the whole system are to be observed.
- ▶ Please contact us for applications with frequent load changes.
- ▶ The dimensions represent pumps for clockwise rotation. The position of the drive shaft or suction and pressure port changes for counter-clockwise rotation.

▼ **Direction of rotation, viewed on drive shaft**



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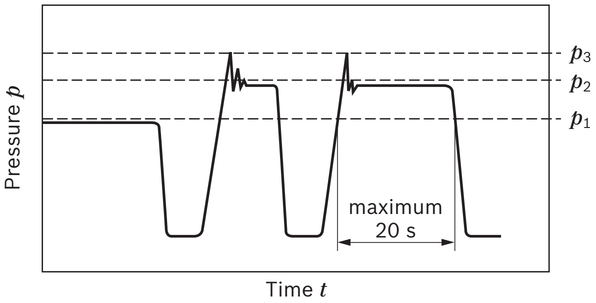
[1] For hydraulic systems or devices with function-related, critical failure effects, such as steering and brake valves, the type of filtration selected must be adapted to the sensitivity of these devices.

AZPW-1x				**NG**	**004**	**005**	**008**	**011**	**014**	**016**	**019**	**022**
Displacement, geometric, per revolution			V_g	cm³	4.0	5.5	8.0	11.0	14.0	16.0	19.0	22.5
Pressure in suction port		absolute	p_e	bar	0.7 to 3							
Maximum continuous pressure			p_1	bar	190	190	190	190	190	190	180	170
Maximum intermittent pressure			p_2	bar	210	210	210	210	210	210	200	190
Maximum pressure peak			p_3	bar	230	230	230	230	230	230	220	210
Minimum speed	at 12 mm²/s and	< 100 bar	n_{min}	rpm	700	700	700	700	700	700	700	700
		100 to 180 bar		rpm	1200	1200	1000	1000	800	800	800	800
		180 bar to p_2		rpm	1400	1400	1400	1200	1000	1000	1000	1000
	at 25 mm²/s and	p_2		rpm	700	700	700	700	700	700	700	700
Maximum speed	at p_2		n_{max}	rpm	3500	3500	3500	3500	3000	3000	3000	2500

▼ Pressure definition

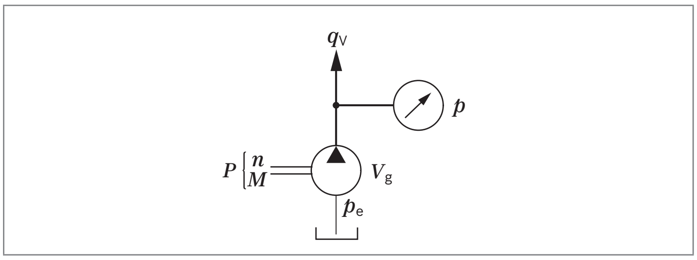


p_1 Maximum continuous pressure
p_2 Maximum intermittent pressure
p_3 Maximum pressure peak

Design calculations for pumps			
Flow	q_v	$= \frac{V_g \times n \times \eta_v}{1000}$	[l/min]
Torque	M	$= \frac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$	[Nm]
Power	P	$= \frac{2 \pi \times M \times n}{60000} = \frac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]
Pressure	Δp	$= \frac{M \times 20 \times \pi \times \eta_{hm}}{V_g}$	[bar]
	Δp	$= \frac{P \times 600 \times \eta_t}{q_V}$	[bar]
Displacement	V_g	$= \frac{q_V \times 1000}{n \times \eta_V}$	[cm³]
	V_g	$= \frac{M \times 20 \times \pi \times \eta_{hm}}{\Delta p}$	[cm³]
Rotational speed	n	$= \frac{q_V \times 1000}{V_g \times \eta_V}$	[rpm]

Key

V_g	Displacement per revolution [cm³]
Δp	Differential pressure [bar] ($\Delta p = p - p_e$)
n	Rotational speed [rpm]
q_v	Flow [l/min]
M	Torque [Nm]
P	Power [kW]
η_v	Volumetric efficiency[1]
η_{hm}	Hydraulic-mechanical efficiency[1]
η_t	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)[1]



Note
On the following pages you can find diagrams for a rough calculation.

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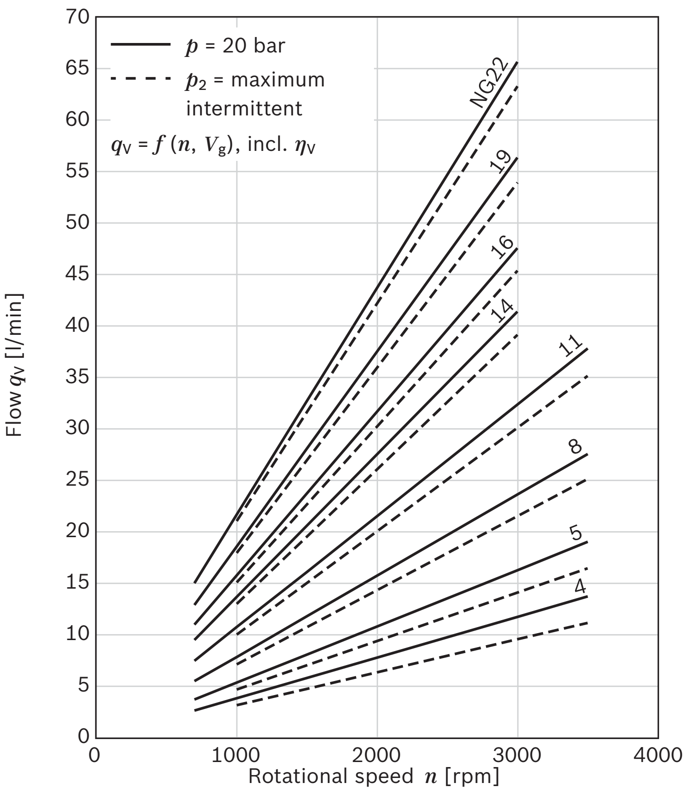
[1] Parameter as a decimal, e.g. 0.9

Flow and power characteristic curves

▼ Flow



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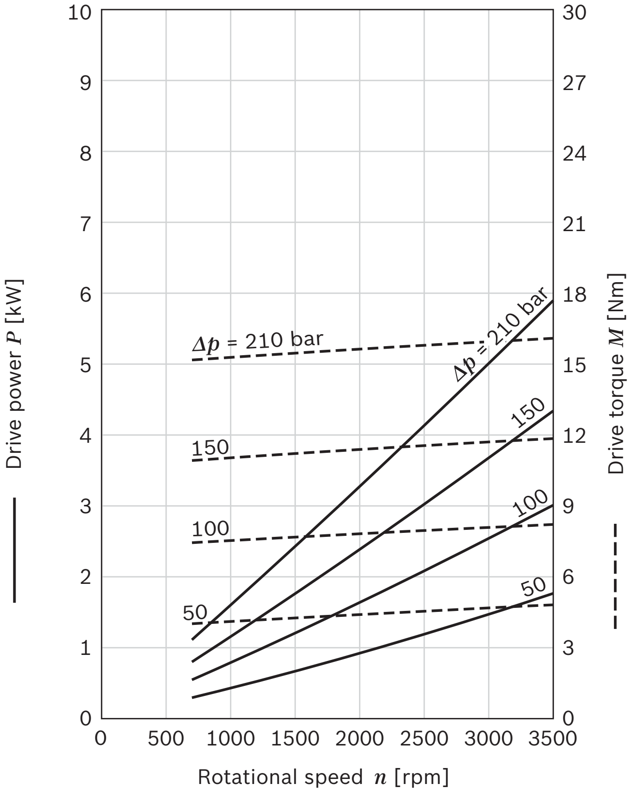

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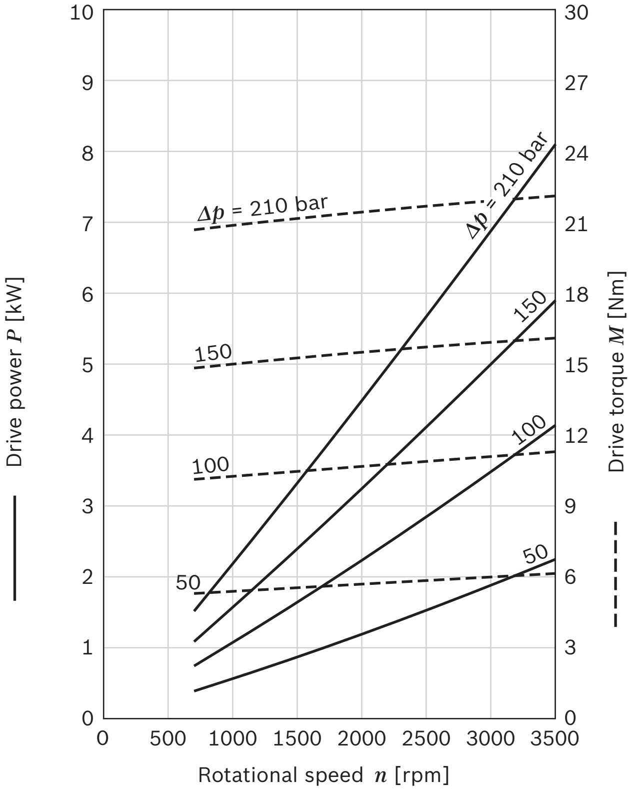

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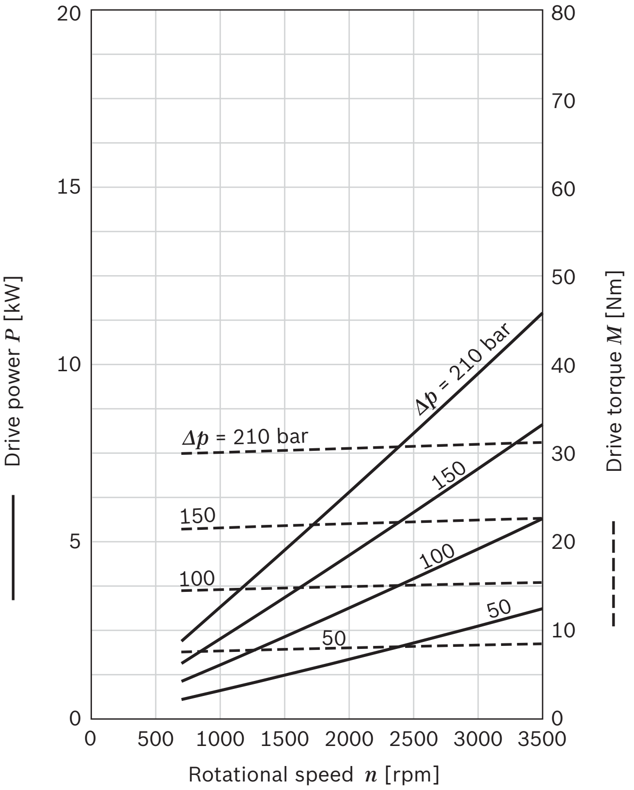
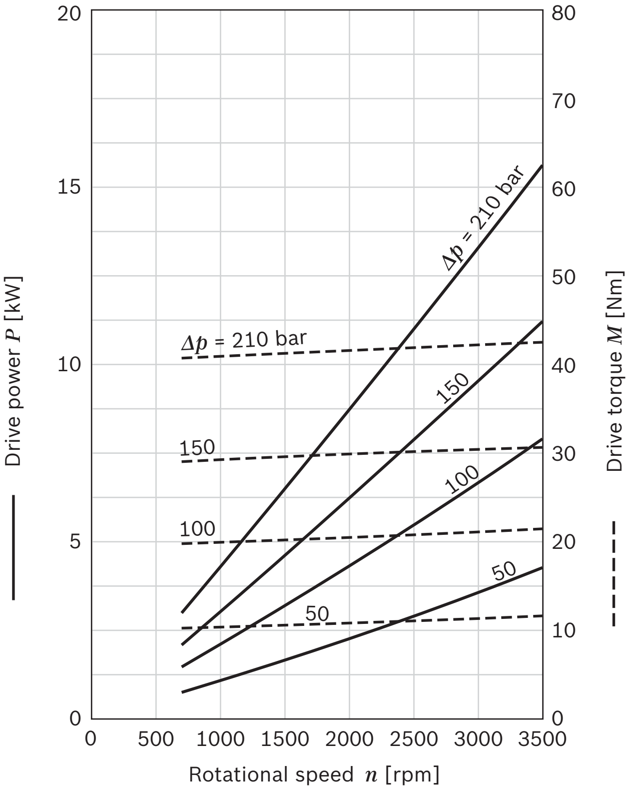


▼ Size 11



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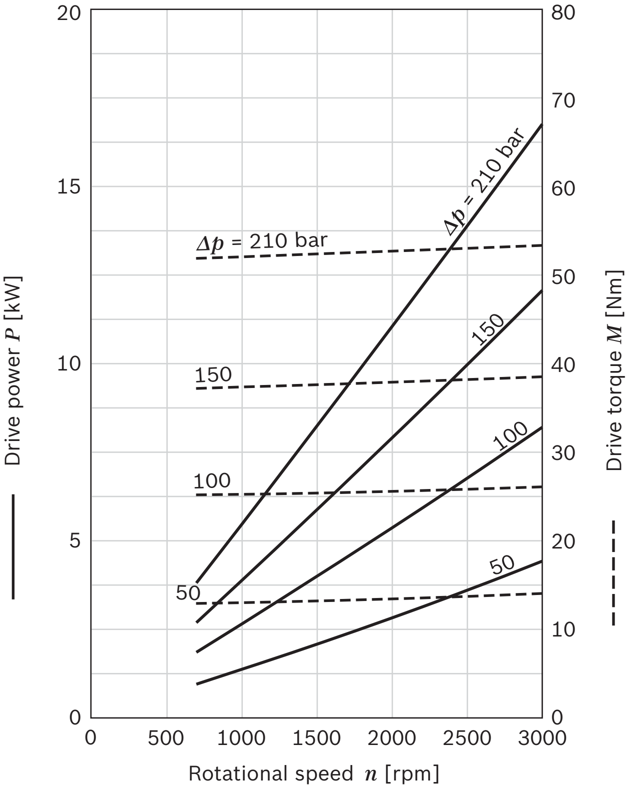

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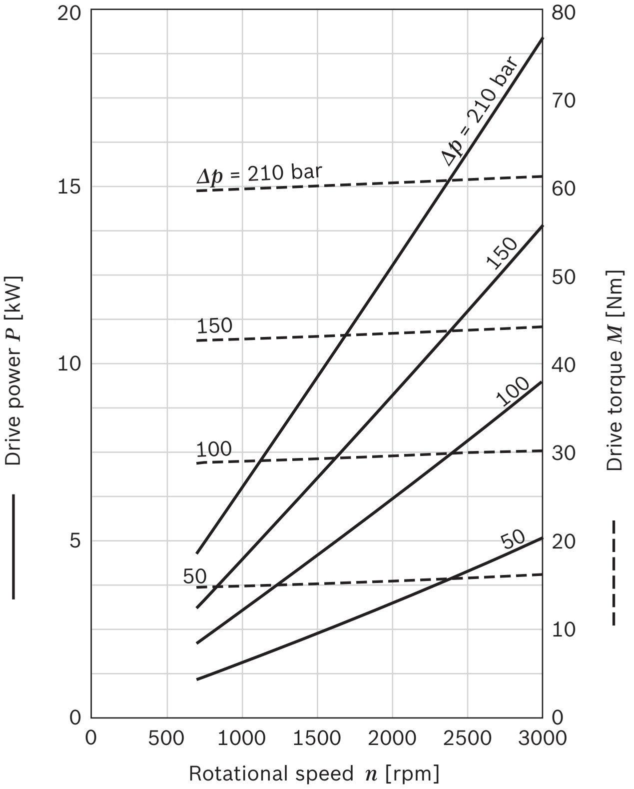
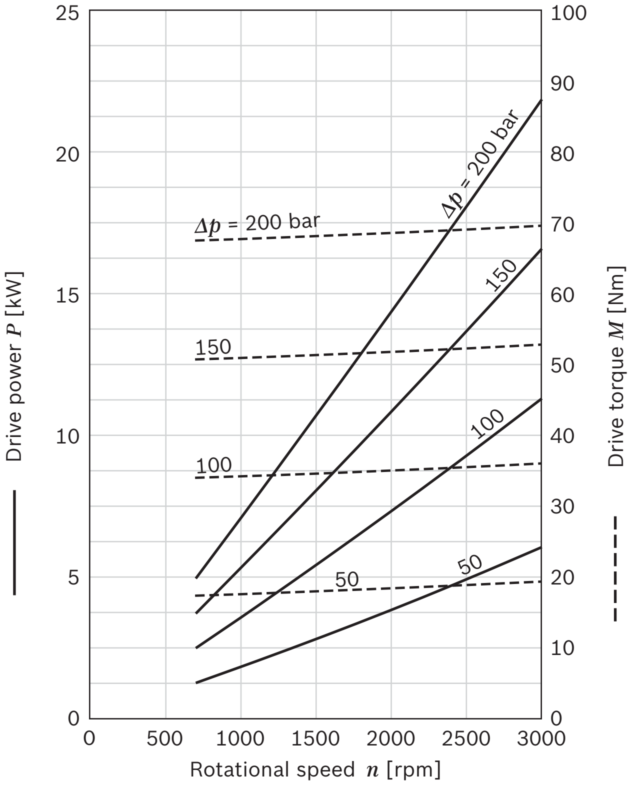
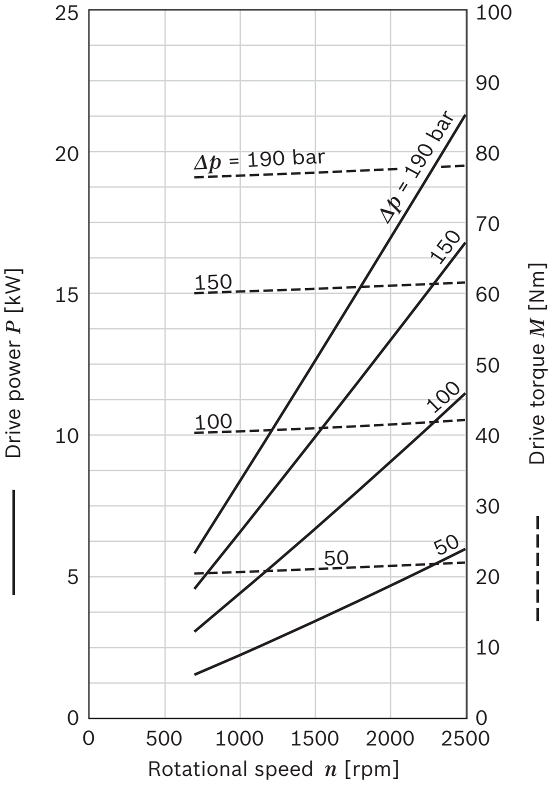


▼ **Size 19**



▼ **Size 22**



Note

Characteristic curves measured at ν = 32 mm²/s and θ = 50 °C.

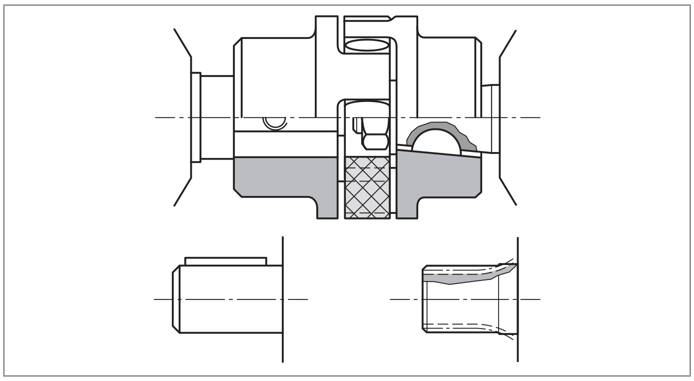
$P = f(n, p)$, incl. η_t ———

$M = f(n, p)$, incl. η_{hm} - - - -

Drives

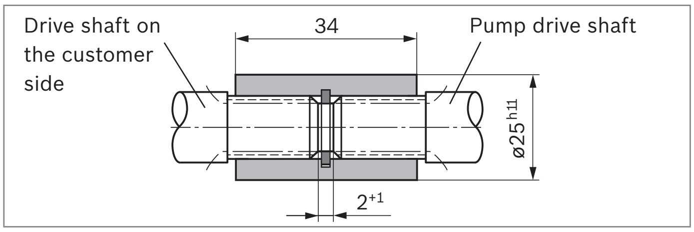
1. Elastic coupling

- The coupling must not transfer any radial or axial forces to the pump.
- The maximum radial runout from the shaft to the spigot may not exceed 0.3 mm.
- See the coupling manufacturer's assembly instructions for acceptable shaft misalignments.



2. Coupling sleeve

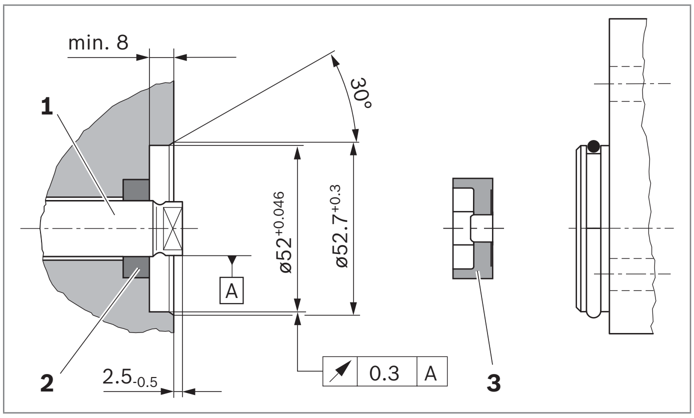
- To be used on splined shaft profile according to DIN and SAE
- Attention: No radial or axial forces are permitted on the pump shaft or coupling sleeve. The coupling sleeve must be free to move axially.
- The distance between the pump drive shaft and drive shaft on the customer side must be 2^{+1} mm
- Oil-bath or oil-mist lubrication is required



Drive shaft	M_{max} [Nm]	Size	p_{max} [bar]
F	100	4 to 16	210
		19	200
		22	190
R	110	4 to 16	210
		19	200
		22	190

3. Coupling dog

- For attaching the pump directly to an electric motor or combustion engine, gear, etc.
- The pump shaft has a special coupling dog and driver (**3**)
- No shaft seal
- Drive-side installation and sealing according to the following recommendations and dimensions



Drive shaft	M_{max} [Nm]	Size	p_{max} [bar]
N	52	4 to 14	210
		16	180
		19	150
		22	130

- **Drive shaft on the customer side (1)**
  - Case-hardening steel DIN 17210 e.g., 20 MnCrS 5 case-hardened 0.6 deep; HRC $60^{\pm 3}$
  - Seal ring running surface ground without rifling $R_{max} \leq 4\ \mu m$

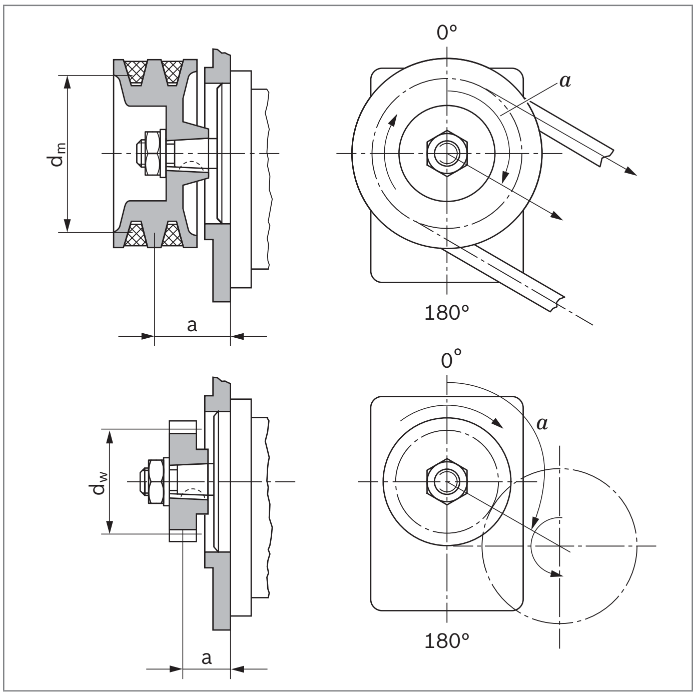
- **Radial shaft seal on the customer side (2)**
  - Provide with rubber cover (see DIN 3760, type AS, or double-lipped ring)
  - Provide installation edge with 15° slant or install shaft seal with protection sleeve

4. Tapered and keyed shafts

Drive shaft	M_{max} [Nm][1]	Size	p_{max} [bar]
C	130	4 to 16	210
		19	200
		22	190
H	130	4 to 16	210
		19	200
		22	190
Q	55	4 to 14	210
		16	190
		19	165
		22	140

5. V-belts and straight gear wheels or helical toothed gear drives without outboard bearing

For V-belt or gear wheel drives, please contact us specifying the application and mounting conditions (dimensions a, d_m, d_w and angle α). For helical toothed gear drives, details of the helix angle β are also required.



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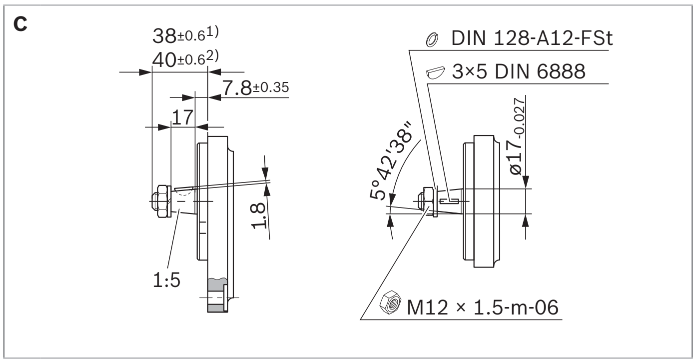
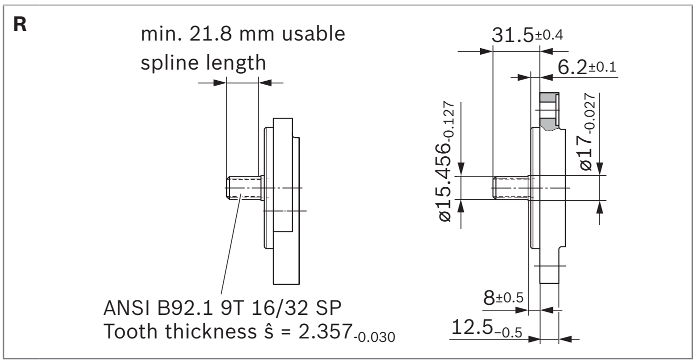
[1] These values only apply while adhering to the defined conditions on page 6. Please consult Bosch Rexroth if the specified values are to be exceeded.

Dimensions – drive shaft

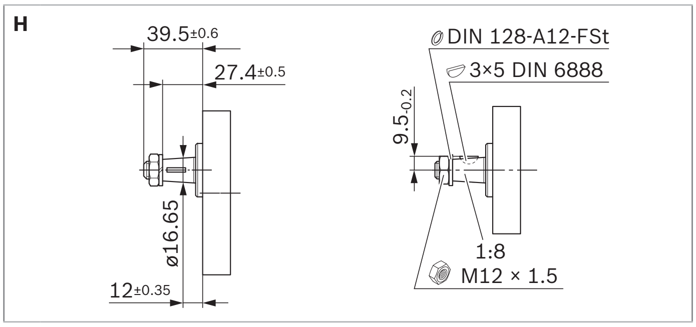
▼ Tapered shaft 1:5



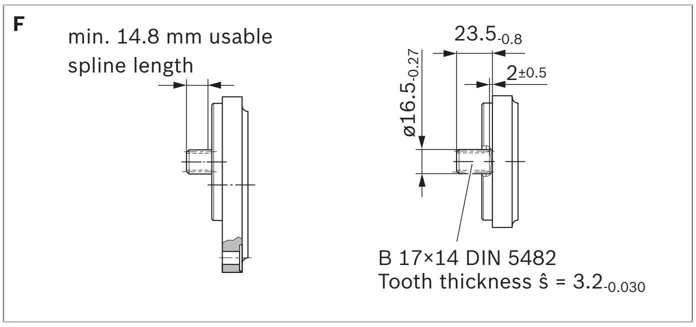
▼ Splined shaft (SAE J744 16-4 9T)[3]



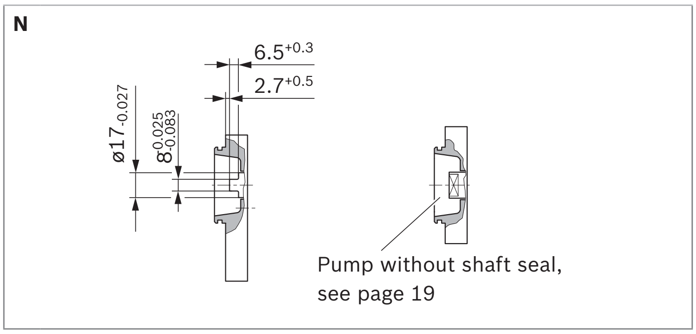
▼ Tapered shaft 1:8



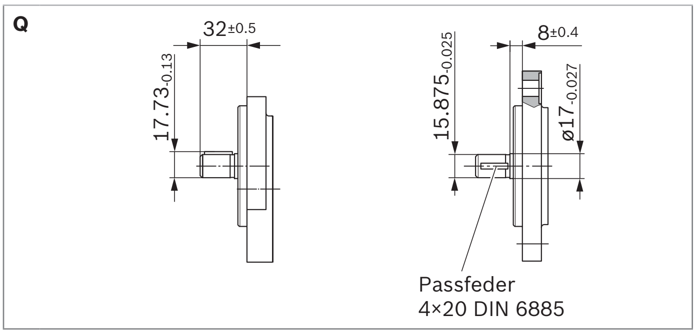
▼ Splined shaft (DIN 5482 B17 × 14)



▼ Dihedral claw



▼ Parallel keyed shaft (SAE J744 16-1 A)



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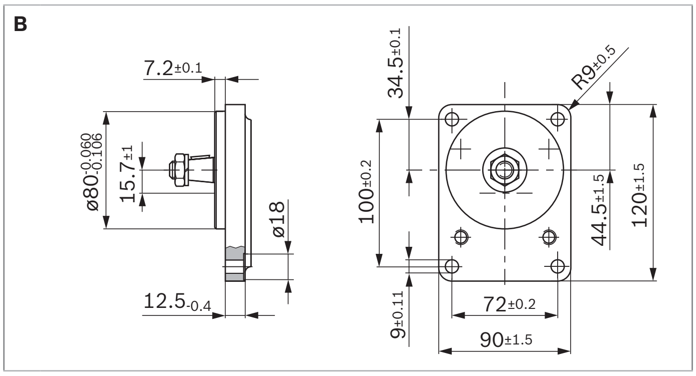
1) In combination with front cover B

2) In combination with front cover P and front cover N

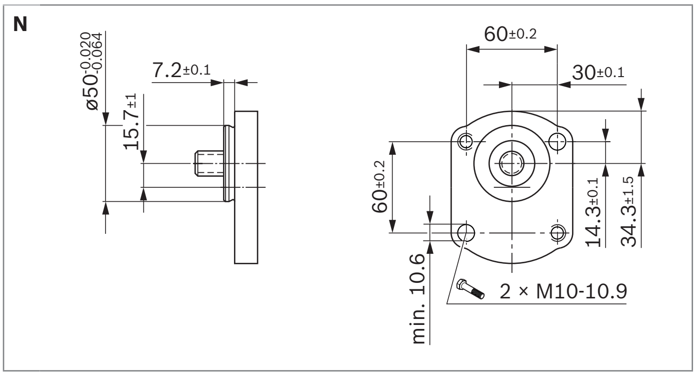
3) For combination with an axial piston unit, see page 24 to 28

Dimensions – front cover

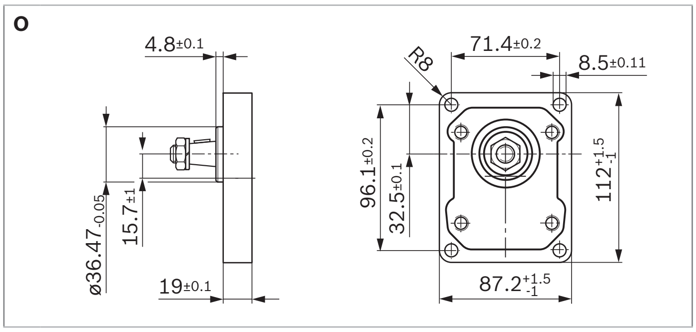
▼ Rectangular flange Ø80 mm



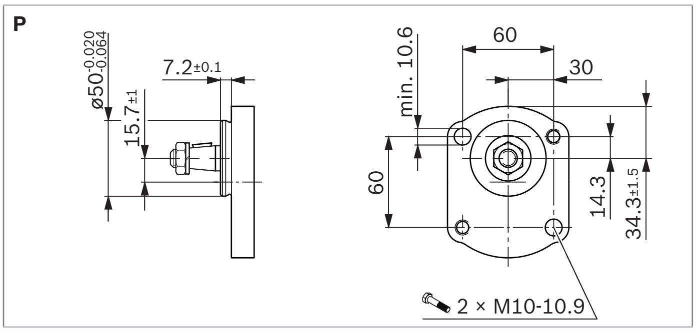
▼ 2-bolt mounting Ø50 mm, connection variant 1



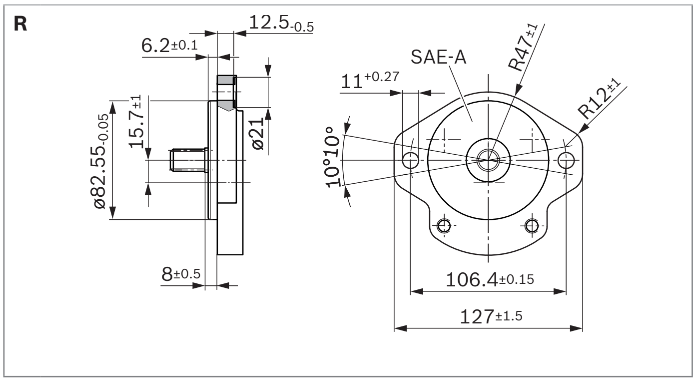
▼ Rectangular flange Ø36.47 mm



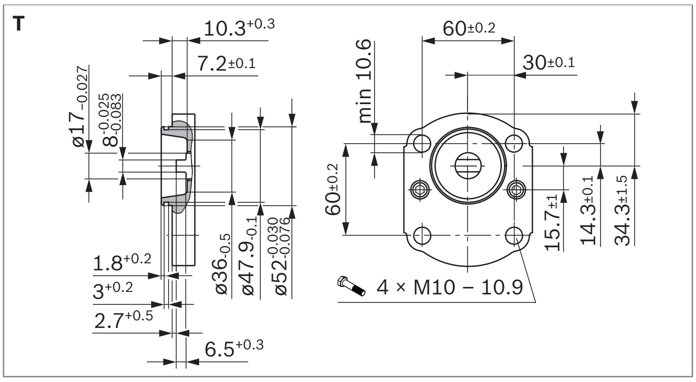
▼ 2-bolt mounting Ø50 mm, connection variant 2



▼ 2-bolt flange Ø82.55 mm, SAE J744 82-2 A[1]



▼ 4-bolt mounting Ø = 52 mm with O-ring



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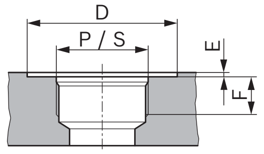
[1] For combination with an axial piston unit, see page 24 to 28

Dimensions – line connection

▼ Thread UNF-2B, SAE with O-ring

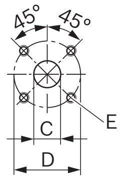
12



Size	Pressure side				Suction side			
	P	D	E	F	S	D	E	F
4 to 5	3/4-16 UNF-2B	30.2	0.5	14	7/8-14 UNF-2B	35	0.5	17
8 to 22	7/8-14 UNF-2B	35	0.5	17	1 1/16-12 UN-2B	45	0.5	19

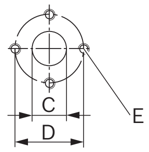
▼ Square flange

20



Size	Pressure side			Suction side		
	C	D	E	C	D	E
4 to 5	15	35	M6; 13 deep	15	40	M6; 13^{+1} deep
8 to 22	15	35	M6; 13 deep	20	40	M6; 13^{+1} deep

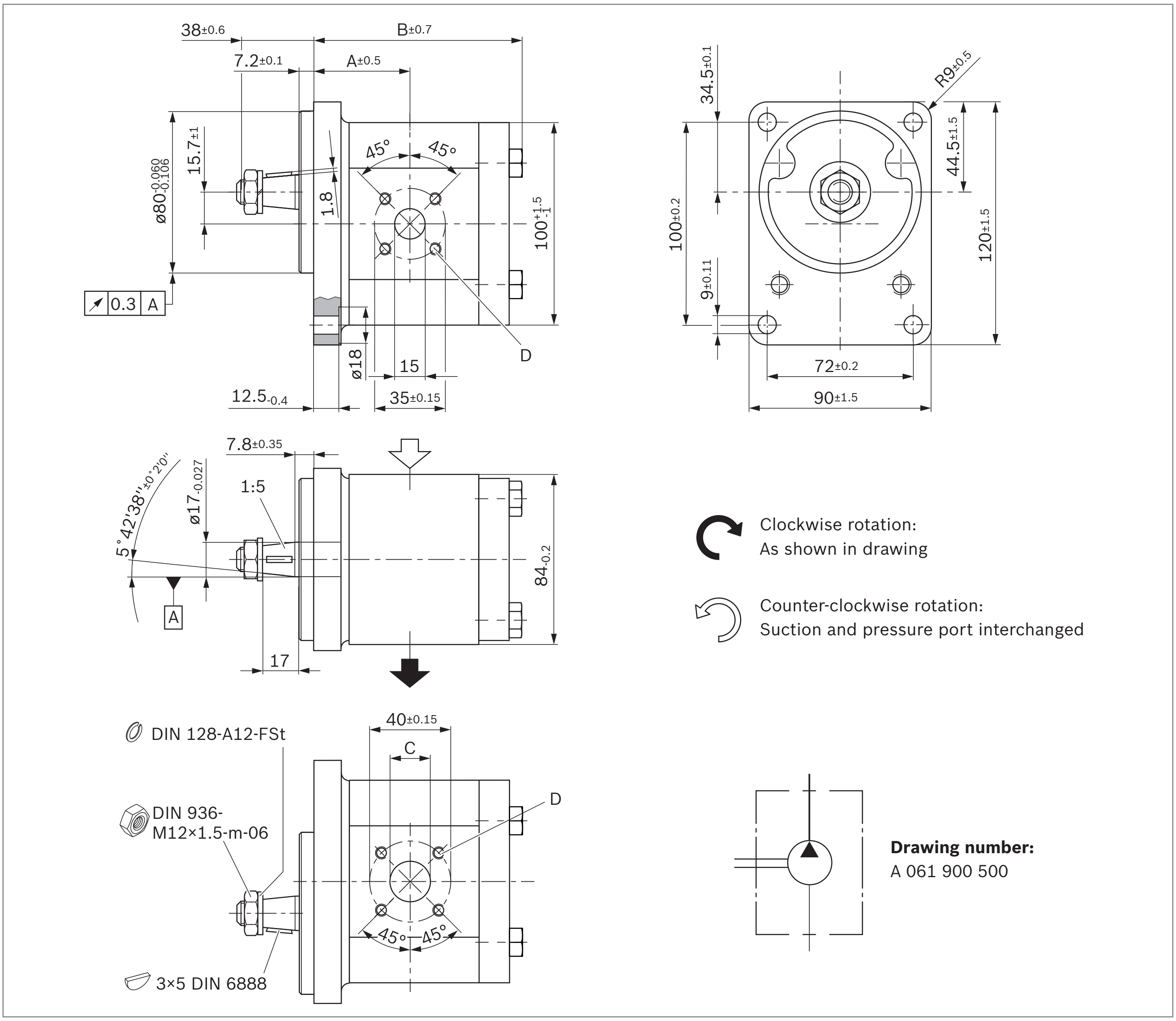
30



Size	Pressure side			Suction side		
	C	D	E	C	D	E
4 to 8	13.5	30.2	M6; 13 deep	13.5	30.2	M6; 13^{+1} deep
11 to 22	13.5	30.2	M6; 13 deep	20	39.7	M8; 13^{+1} deep

Dimensions – preferred series

▼ **Tapered shaft 1:5 with rectangular flange Ø80 mm**
AZPW–11– ... **CB20**MB



Clockwise rotation:
As shown in drawing

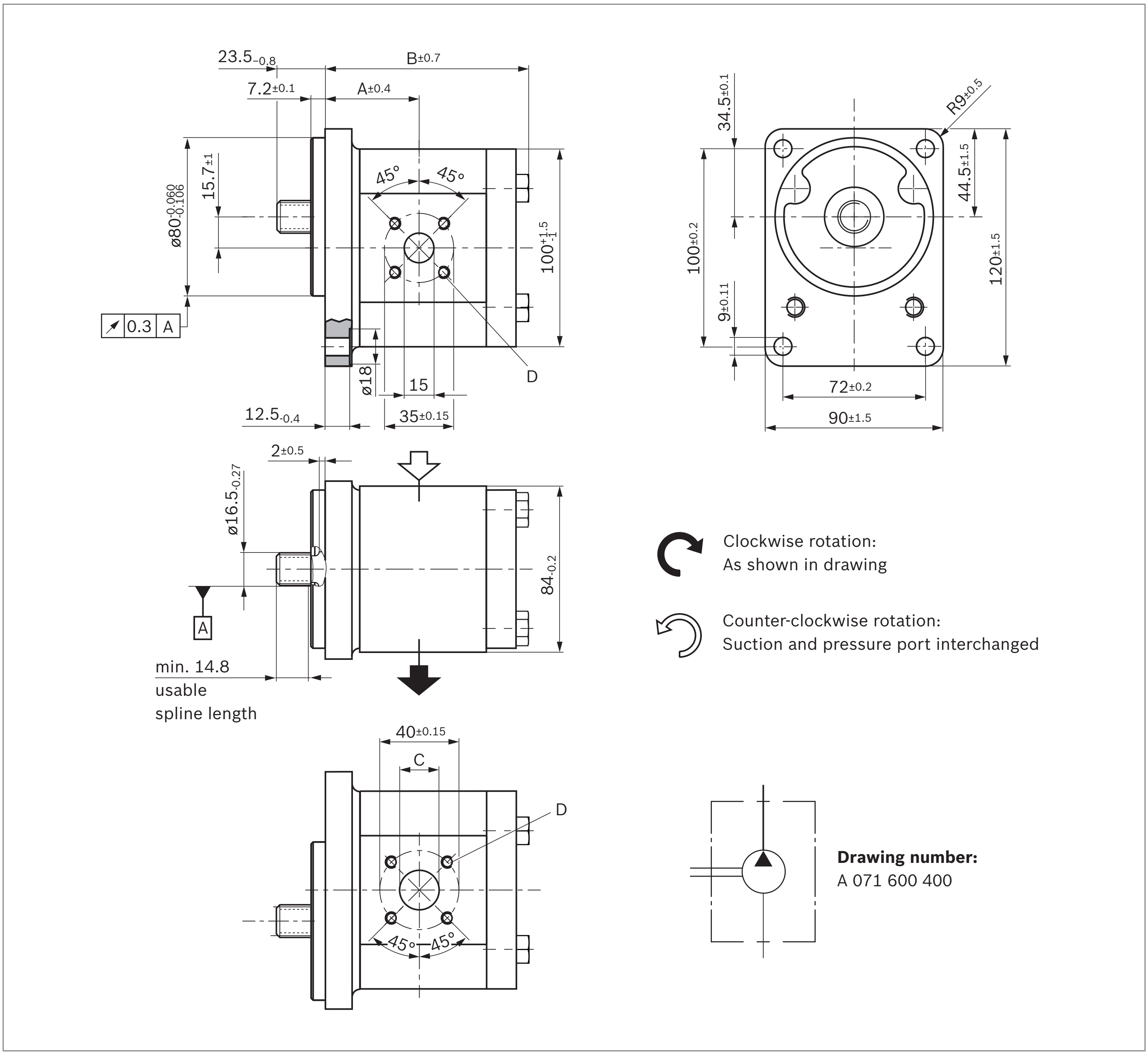
Counter-clockwise rotation:
Suction and pressure port interchanged

Drawing number:
A 061 900 500

NG	Order number Direction of rotation Counter-clockwise	 Counter-clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Dimensions A	 B	 C	 D
4	R983074473	R983074465	210	3500	39.9	83.8	15	M6; 13^{+1} deep
5	R983074474	R983074466	210	3500	41.1	86.3	15	
8	R983074475	R983074467	210	3500	43.2	90.4	20	
11	R983074476	R983074468	210	3500	47	95.4	20	
14	R983074477	R983074469	210	3000	47.5	100.4	20	
16	R983074478	R983074470	210	3000	47.5	103.8	20	
19	R983074479	R983074471	200	3000	47.5	108.8	20	
22	R983074480	R983074472	190	2500	55.1	114.2	20	

▼ Splined shaft (DIN 5482 B17 × 14) with rectangular flange Ø80 mm

AZPW–11 – ... **FB20**MB



Clockwise rotation:
As shown in drawing

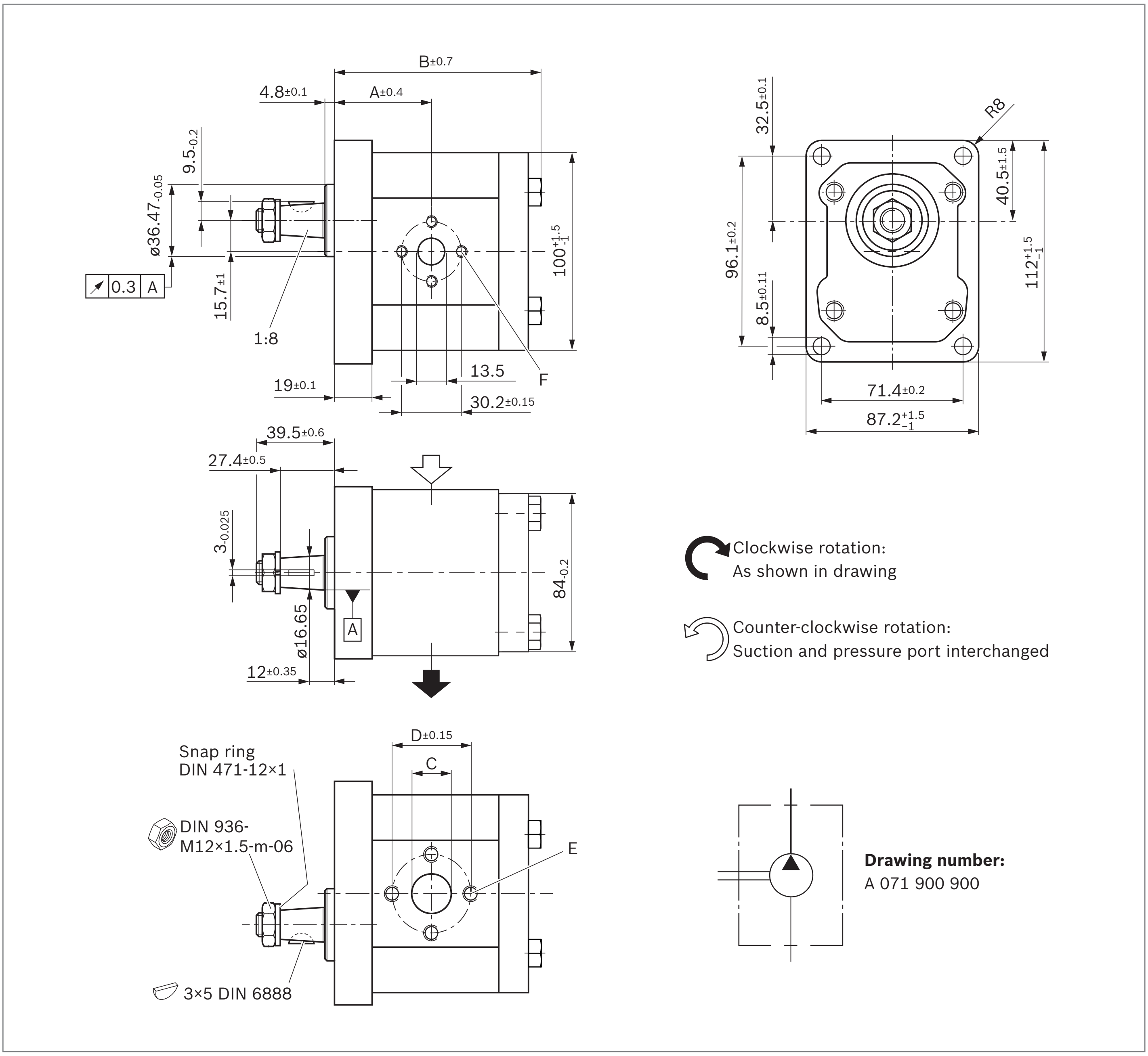
Counter-clockwise rotation:
Suction and pressure port interchanged

Drawing number:
A 071 600 400

NG	Order number Direction of rotation		Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Dimensions			
	Counter-clockwise	Clockwise			A	B	C	D
4	R983072848	R983072840	210	3500	39.9	83.8	15	M6; 13^{+1} deep
5	R983072849	R983072841	210	3500	41.1	86.3	15	
8	R983072850	R983072842	210	3500	43.2	90.4	20	
11	R983072851	R983072843	210	3500	47	95.4	20	
14	R983072852	R983072844	210	3000	47.5	100.4	20	
16	R983072853	R983072845	210	3000	47.5	103.8	20	
19	R983072854	R983072846	200	3000	47.5	108.8	20	
22	R983072855	R983072847	190	2500	55.1	114.2	20	

▼ Tapered shaft 1:8 with rectangular flange Ø36.47 mm

AZPW–11 – ... **HO30**MB



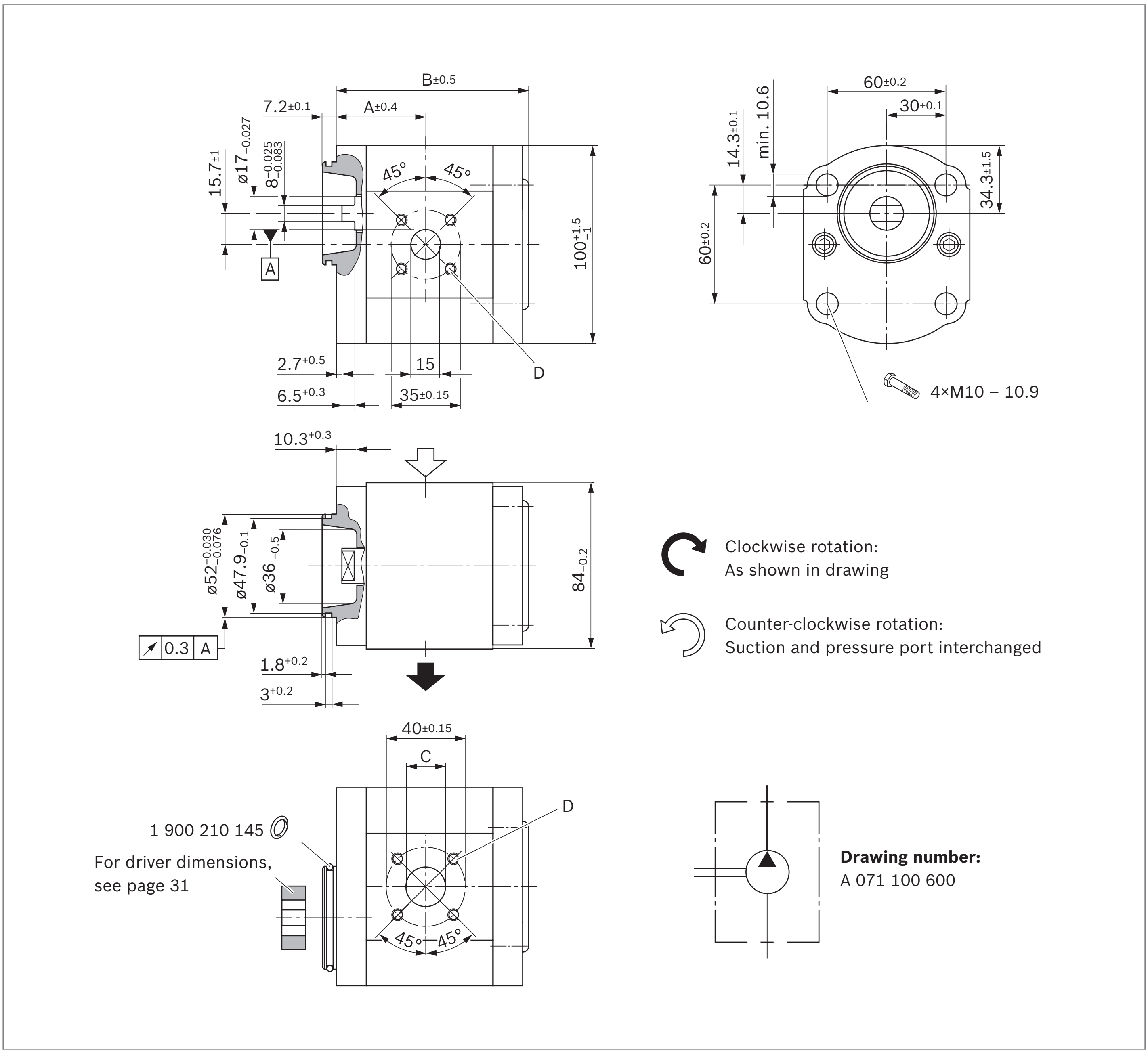
Clockwise rotation:
As shown in drawing

Counter-clockwise rotation:
Suction and pressure port interchanged

Drawing number:
A 071 900 900

NG	Order number Direction of rotation Counter-clockwise	 Counter-clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Dimensions A	 B	 C	 D	 E	 F
4	R983072831	R983072823	3500	210	41.4	85.4	13.5	30.2	M6; 13^{+1} deep	M6; 13^{+1} deep
5	R983072832	R983072824	3500	210	42.6	87.9	13.5	30.2		
8	R983072833	R983072825	3500	210	44.7	92	13.5	30.2		
11	R983072834	R983072826	3500	210	48.5	97	20	39.7	M8; 13^{+1} deep	
14	R983072835	R983072827	3000	210	49	102	20	39.7		
16	R983072836	R983072828	3000	210	49	105.4	20	39.7		
19	R983072837	R983072829	3000	200	49	110.4	20	39.7		
22	R983072838	R983072830	2500	190	56.6	115.8	20	39.7		

▼ Dihedral claw with 4-bolt mounting Ø52 mm
AZPW–11 – ... NT20MB



For driver dimensions, see page 31

Clockwise rotation:
As shown in drawing

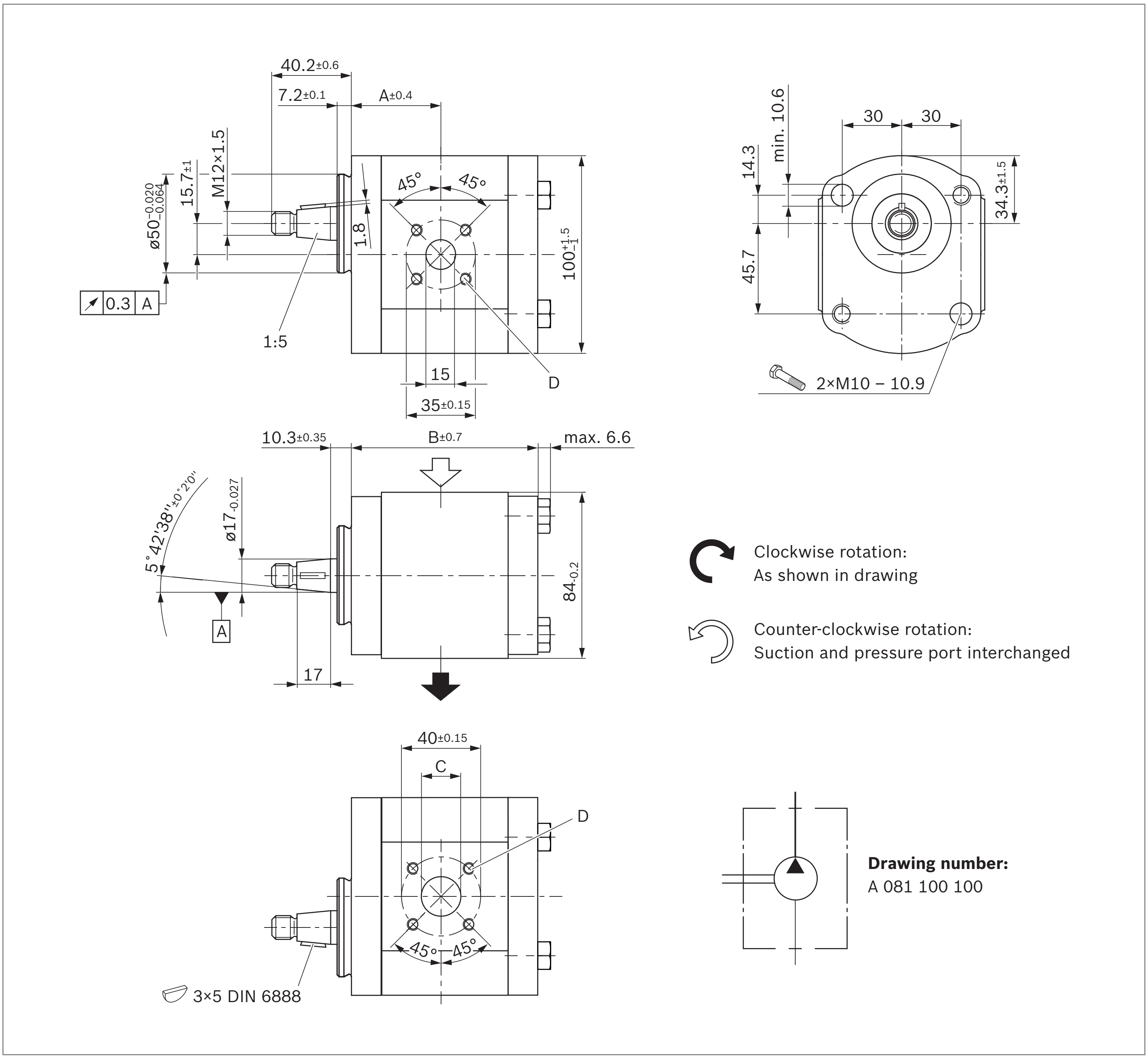
Counter-clockwise rotation:
Suction and pressure port interchanged

Drawing number:
A 071 100 600

NG	Order number Direction of rotation Counter-clockwise	 Counter-clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Dimensions A	 B	 C	 D
4	R983072863	R983072856	210	3500	37.4	75	15	M6; 13^{+1} deep
5	R983072864	R983076112	210	3500	38.6	77.5	15	
8	R983072865	R983072857	210	3500	40.7	81.6	20	
11	R983072866	R983072858	210	3500	44.5	86.6	20	
14	R983072867	R983072859	210	3000	45	91.6	20	
16	R983072868	R983072860	180	3000	45	95	20	
19	R983072869	R983072861	150	3000	45	100	20	
22	R983072870	R983072862	130	2500	52.6	105.4	20	

▼ Tapered shaft 1:5 with 2-bolt flange Ø50 mm without nut and washer

AZPW–11 – ... **CP20**MB-**S0007**



Clockwise rotation:
As shown in drawing

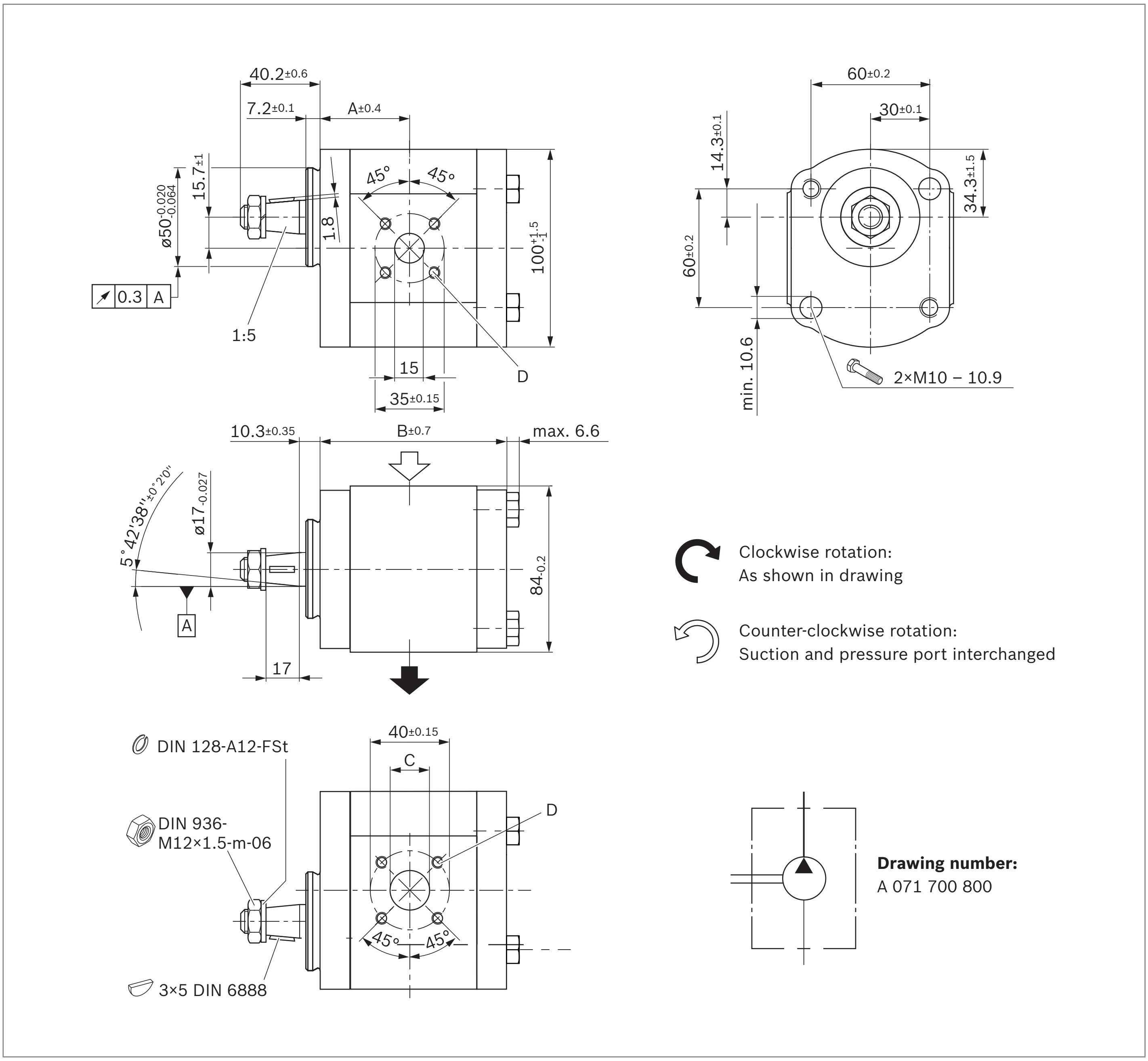
Counter-clockwise rotation:
Suction and pressure port interchanged

Drawing number:
A 081 100 100

NG	Order number Direction of rotation Counter-clockwise	Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Dimensions A	B	C	D
4	R983072788	R983072780	210	3500	37.3	75	15	M6; 13^{+1} deep
5	R983072789	R983072781	210	3500	38.6	77.5	15	
8	R983072790	R983072782	210	3500	40.6	81.6	20	
11	R983072791	R983072783	210	3500	44.5	86.6	20	
14	R983072792	R983072784	210	3000	45	91.6	20	
16	R983072793	R983072785	210	3000	45	95	20	
19	R983072794	R983072786	200	3000	45	100	20	
22	R983072795	R983072787	190	2500	52.6	105.4	20	

▼ Tapered shaft 1:5 with 2-bolt flange Ø50 mm

AZPW–11 – ... **CN20**MB



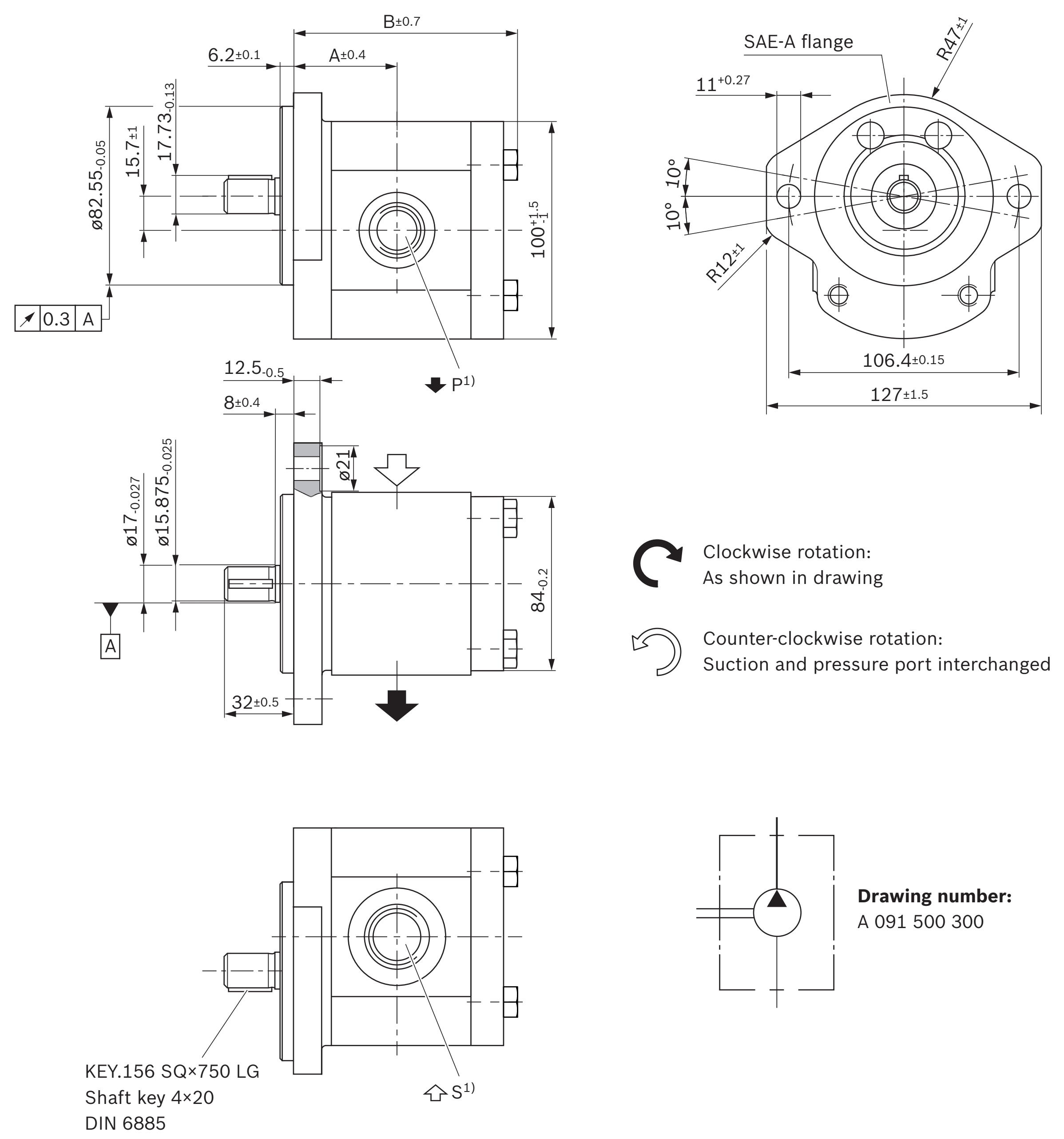
Clockwise rotation:
As shown in drawing

Counter-clockwise rotation:
Suction and pressure port interchanged

Drawing number:
A 071 700 800

NG	Order number Direction of rotation Counter-clockwise	 Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Dimensions A	 B	 C	 D
4	R983072886	R983072878	210	3500	37.3	75	15	M6; 13^{+1} deep
5	R983072887	R983072879	210	3500	38.6	77.5	15	
8	R983072888	R983072880	210	3500	40.6	81.6	20	
11	R983072889	R983072881	210	3500	44.5	86.6	20	
14	R983072890	R983072882	210	3000	45	91.6	20	
16	R983072891	R983072883	210	3000	45	95	20	
19	R983072892	R983072884	200	3000	45	100	20	
22	R983072893	R983072885	190	2500	52.6	105.4	20	

▼ **Parallel keyed shaft (SAE J744 16-1 A) with 2-bolt flange Ø82.55 mm (SAE J744 82-2 A)**
AZPW–11 – ... **QR12**MB



Clockwise rotation:
As shown in drawing

Counter-clockwise rotation:
Suction and pressure port interchanged

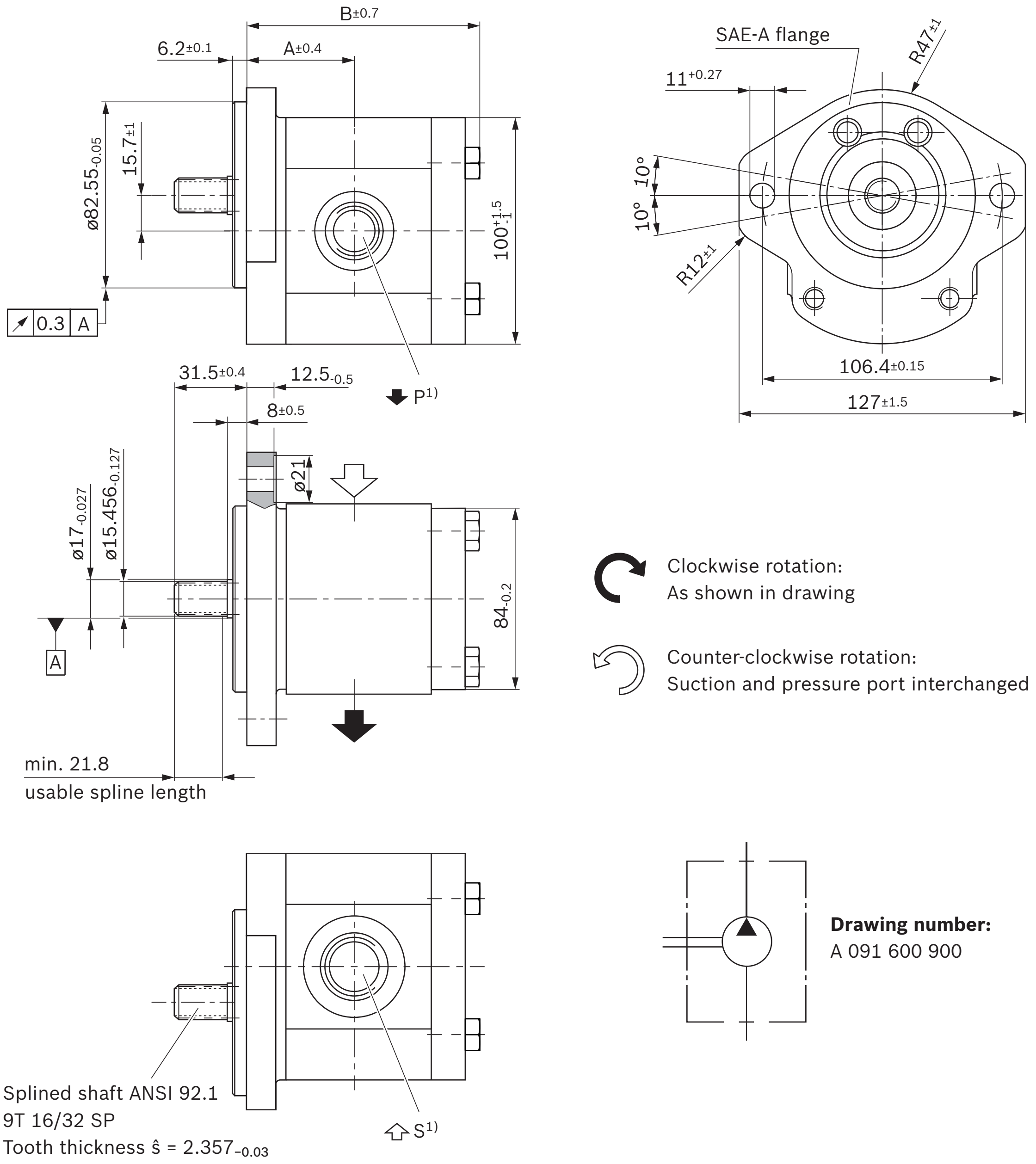
Drawing number:
A 091 500 300

1) For dimension please see page 15

NG	Order number Direction of rotation Counter-clockwise	Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Dimensions A	B	P	S
4	R983072763	R983072755	210	3500	39.9	83.8	3/4-16 UNF-2B	7/8-14 UNF-2B
5	R983072765	R983072756	210	3500	41.1	86.3	3/4-16 UNF-2B	7/8-14 UNF-2B
8	R983072766	R983072757	210	3500	43.2	90.4	7/8-14 UNF-2B	1 1/16-12 UN-2B
11	R983072767	R983072758	210	3500	47	95.4	7/8-14 UNF-2B	1 1/16-12 UN-2B
14	R983072768	R983072759	210	3000	47.5	100.4	7/8-14 UNF-2B	1 1/16-12 UN-2B
16	R983072769	R983072760	190	3000	47.5	103.8	7/8-14 UNF-2B	1 1/16-12 UN-2B
19	R983072770	R983072761	165	3000	47.5	108.8	7/8-14 UNF-2B	1 1/16-12 UN-2B
22	R983072772	R983072762	140	2500	55.1	114.2	7/8-14 UNF-2B	1 1/16-12 UN-2B

▼ Splined shaft (SAE J744 16-4 9T) with 2-bolt flange Ø82.55 mm (SAE J744 82-2 A)

AZPW–11 – ... **RR12**MB



Clockwise rotation:
As shown in drawing

Counter-clockwise rotation:
Suction and pressure port interchanged

Drawing number:
A 091 600 900

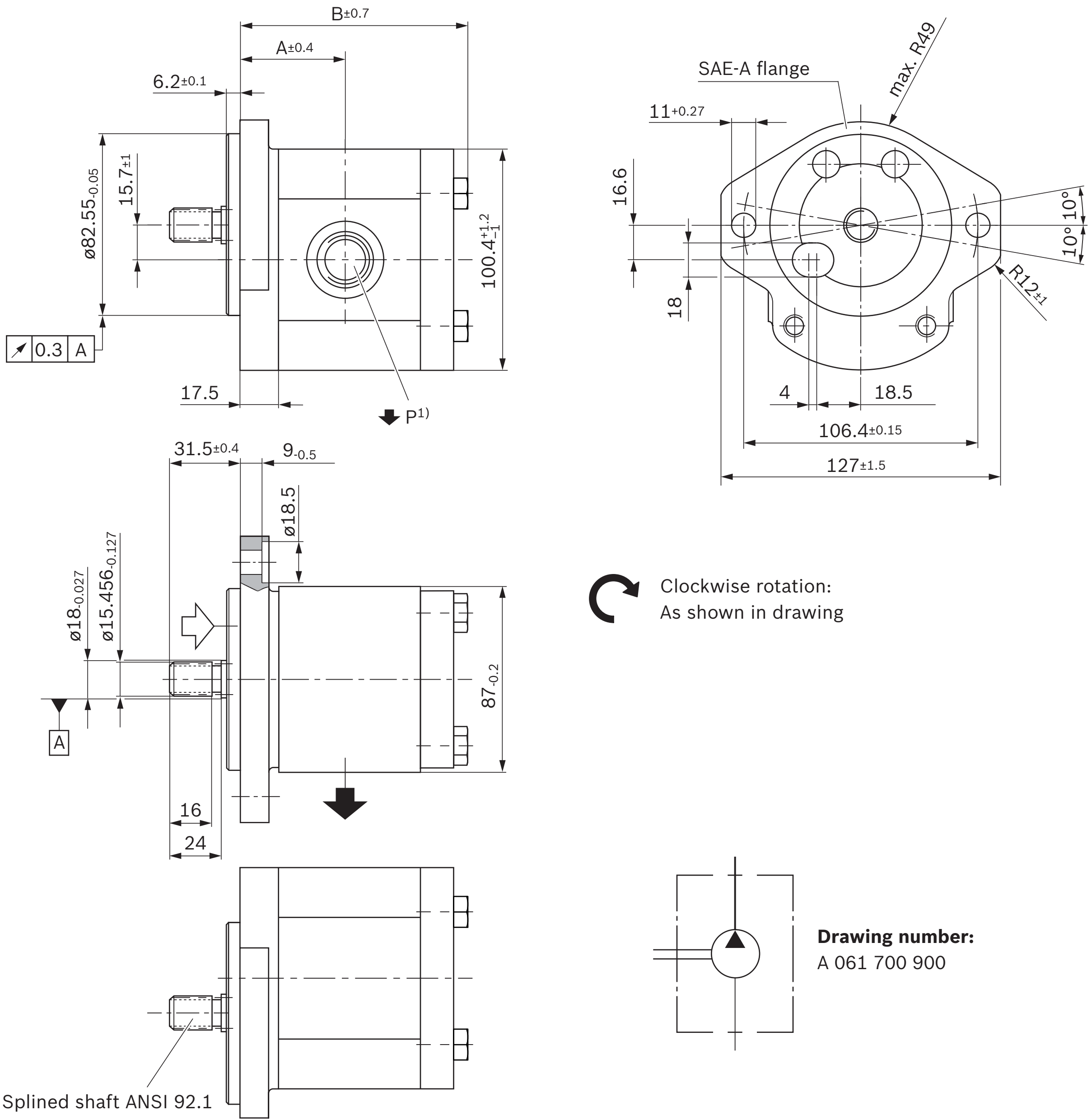
Splined shaft ANSI 92.1
9T 16/32 SP
Tooth thickness ŝ = 2.357-0.03

1) For dimension please see page 15

NG	Order number Direction of rotation Counter-clockwise	 Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Dimensions A	 B	 P	 S
4	R983075416	R983075404	210	3500	39.9	83.8	3/4-16 UNF-2B	7/8-14 UNF-2B
5	R983075417	R983075405	210	3500	41.1	86.3	3/4-16 UNF-2B	7/8-14 UNF-2B
8	R983075418	R983075406	210	3500	43.2	90.4	7/8-14 UNF-2B	1 1/16-12 UN-2B
11	R983075419	R983075409	210	3500	47	95.4	7/8-14 UNF-2B	1 1/16-12 UN-2B
14	R983075420	R983075412	210	3000	47.5	100.4	7/8-14 UNF-2B	1 1/16-12 UN-2B
16	R983075421	R983075413	210	3000	47.5	103.8	7/8-14 UNF-2B	1 1/16-12 UN-2B
19	R983075422	R983075414	200	3000	47.5	108.8	7/8-14 UNF-2B	1 1/16-12 UN-2B
22	R983075423	R983075415	190	2500	55.1	114.2	7/8-14 UNF-2B	1 1/16-12 UN-2B

▼ Splined shaft (SAE J744 16-4 9T) with 2-bolt flange Ø82.55 mm (SAE J744 82-2 A) for mounting on an axial piston unit and suction port in the front cover

AZPW–11 – ... **RR12**PB-**S0036**



Clockwise rotation:
As shown in drawing

Drawing number:
A 061 700 900

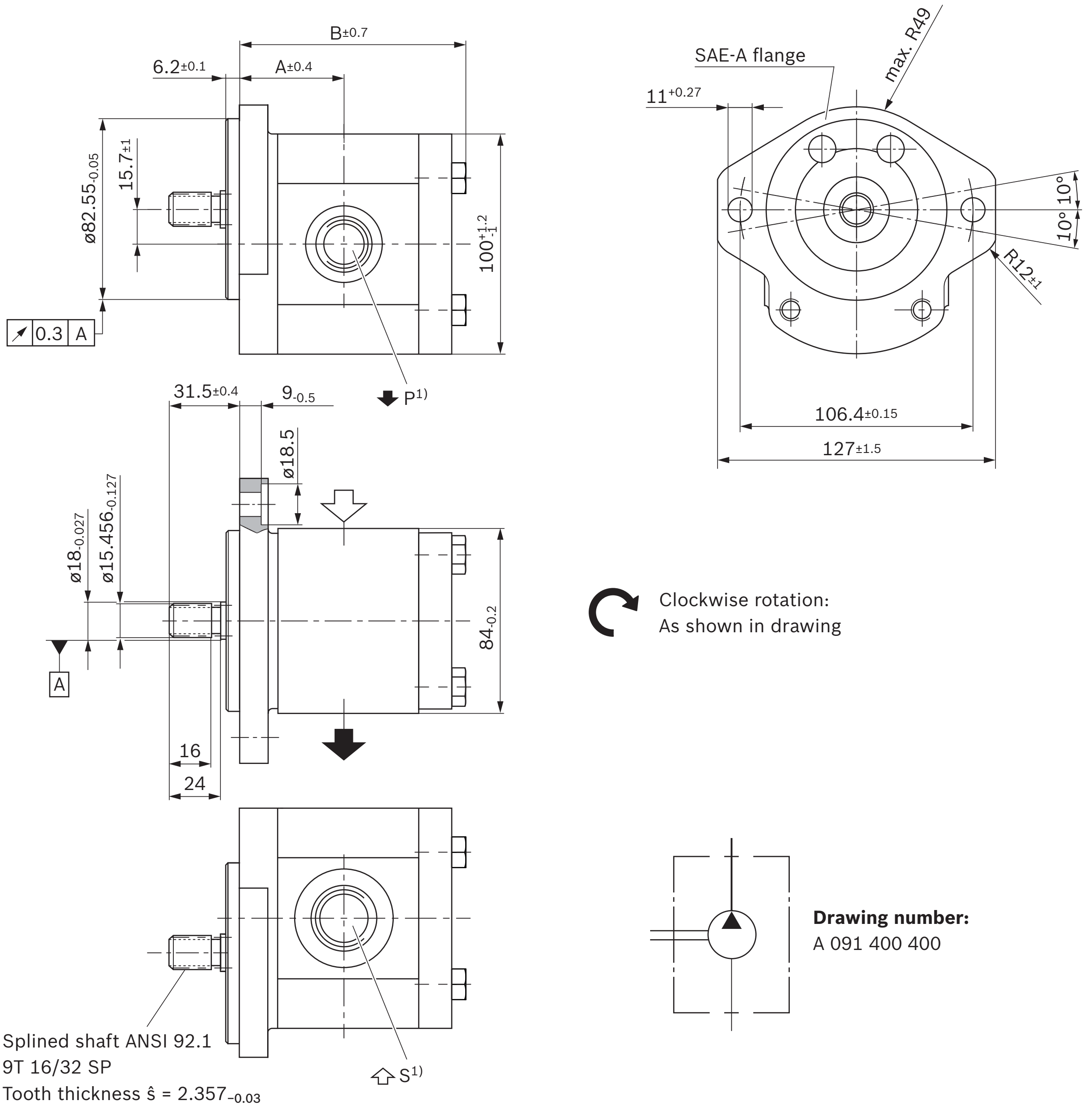
Splined shaft ANSI 92.1
9T 16/32 SP
Tooth thickness ŝ = $2.357_{-0.03}$

1) For dimension please see page 15

NG	Order number Direction of rotation Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Dimensions A	 B	 P
5	R983074188	210	3500	41.2	86.3	3/4-16 UNF-2B
8	R983067892	210	3500	43.2	90.4	7/8-14 UNF-2B
11	R983074189	210	3500	45.6	95.4	7/8-14 UNF-2B
14	R983070537	210	3000	48.4	100.4	7/8-14 UNF-2B
16	R983074190	210	3000	49.9	103.8	7/8-14 UNF-2B
19	R983064536	200	2900	53.9	108.8	7/8-14 UNF-2B
22	R983074191	190	2400	55	114.2	7/8-14 UNF-2B

▼ Splined shaft (SAE J744 16-4 9T) with 2-bolt flange Ø82.55 mm (SAE J744 82-2 A) for mounting on an axial piston unit

AZPW–11 – ... **RR12**PB-**S0081**



Splined shaft ANSI 92.1
9T 16/32 SP
Tooth thickness ŝ = 2.357₋0.03

1) For dimension please see page 15

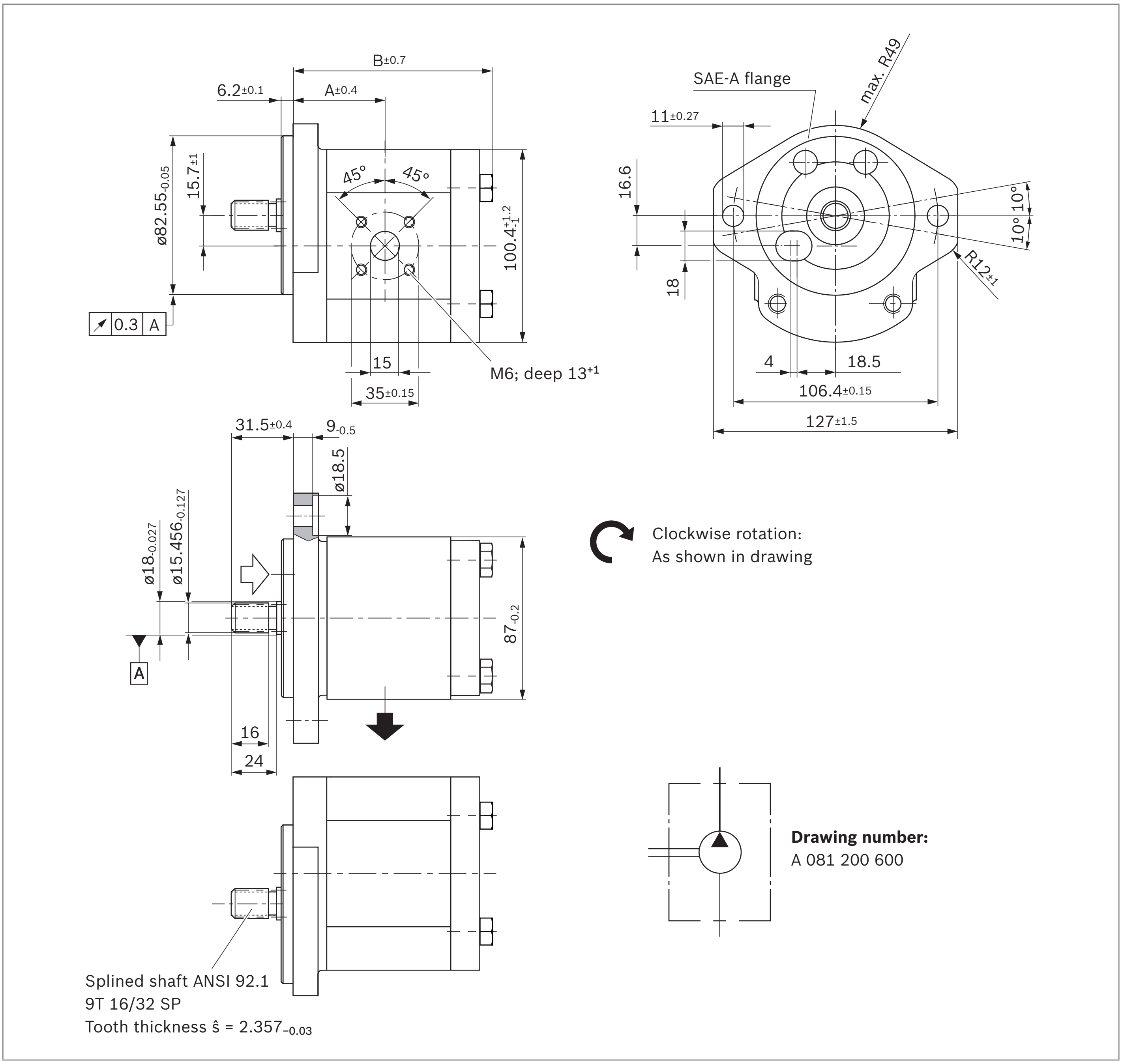
Clockwise rotation:
As shown in drawing

Drawing number:
A 091 400 400

NG	Order number Direction of rotation Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Dimensions			
				A	B	P	S
5	R983072871	210	3500	41.1	86.4	3/4-16 UNF-2B	7/8-14 UNF-2B
8	R983072872	210	3500	43.2	90.5	7/8-14 UNF-2B	1 1/16-12 UN-2B
11	R983072873	210	3500	45.7	95.5	7/8-14 UNF-2B	1 1/16-12 UN-2B
14	R983072874	210	3000	48.2	100.5	7/8-14 UNF-2B	1 1/16-12 UN-2B
16	R983072875	210	3000	49.9	103.9	7/8-14 UNF-2B	1 1/16-12 UN-2B
19	R983072876	200	3000	52.4	108.9	7/8-14 UNF-2B	1 1/16-12 UN-2B
22	R983072877	190	2500	55.1	114.3	7/8-14 UNF-2B	1 1/16-12 UN-2B

▼ Splined shaft (SAE J744 16-4 9T) with 2-bolt flange Ø82.55 mm (SAE J744 82-2 A) for mounting on an axial piston unit and suction port in the front cover

AZPW–11 – ... **RR20**PB-**S0036**



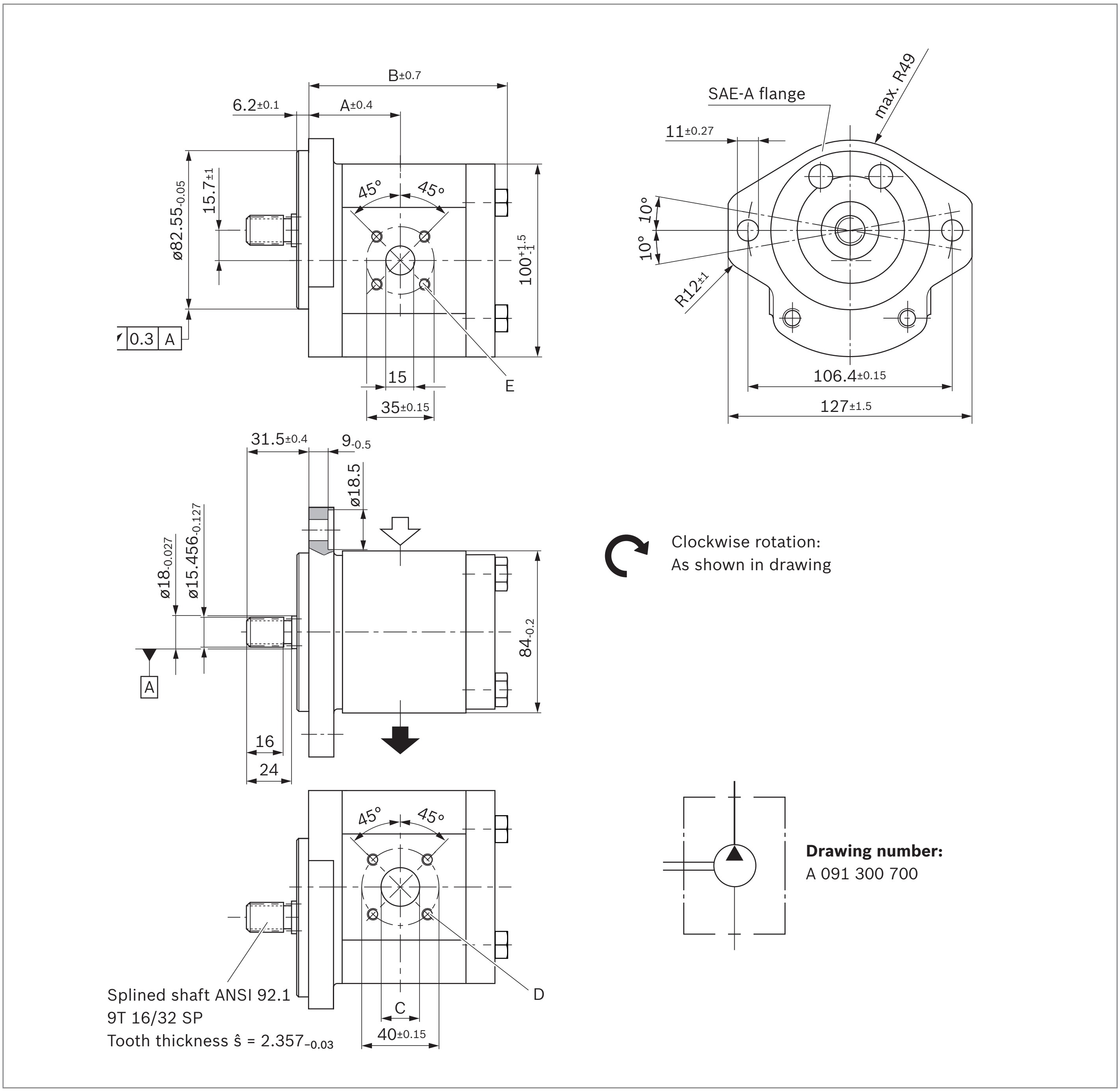
Clockwise rotation:
As shown in drawing

Drawing number:
A 081 200 600

Splined shaft ANSI 92.1
9T 16/32 SP
Tooth thickness ŝ = 2.357$_{-0.03}$

NG	Order number Direction of rotation Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Dimensions A	 B
5	R983072894	210	3500	41.1	86.3
8	R983072895	210	3500	43.2	90.4
11	R983072896	210	3500	47	95.4
14	R983072897	210	3500	47.5	100.4
16	R983072898	210	3500	47.5	103.8
19	R983072899	200	2900	47.5	108.8
22	R983072900	190	2400	55.1	114.2

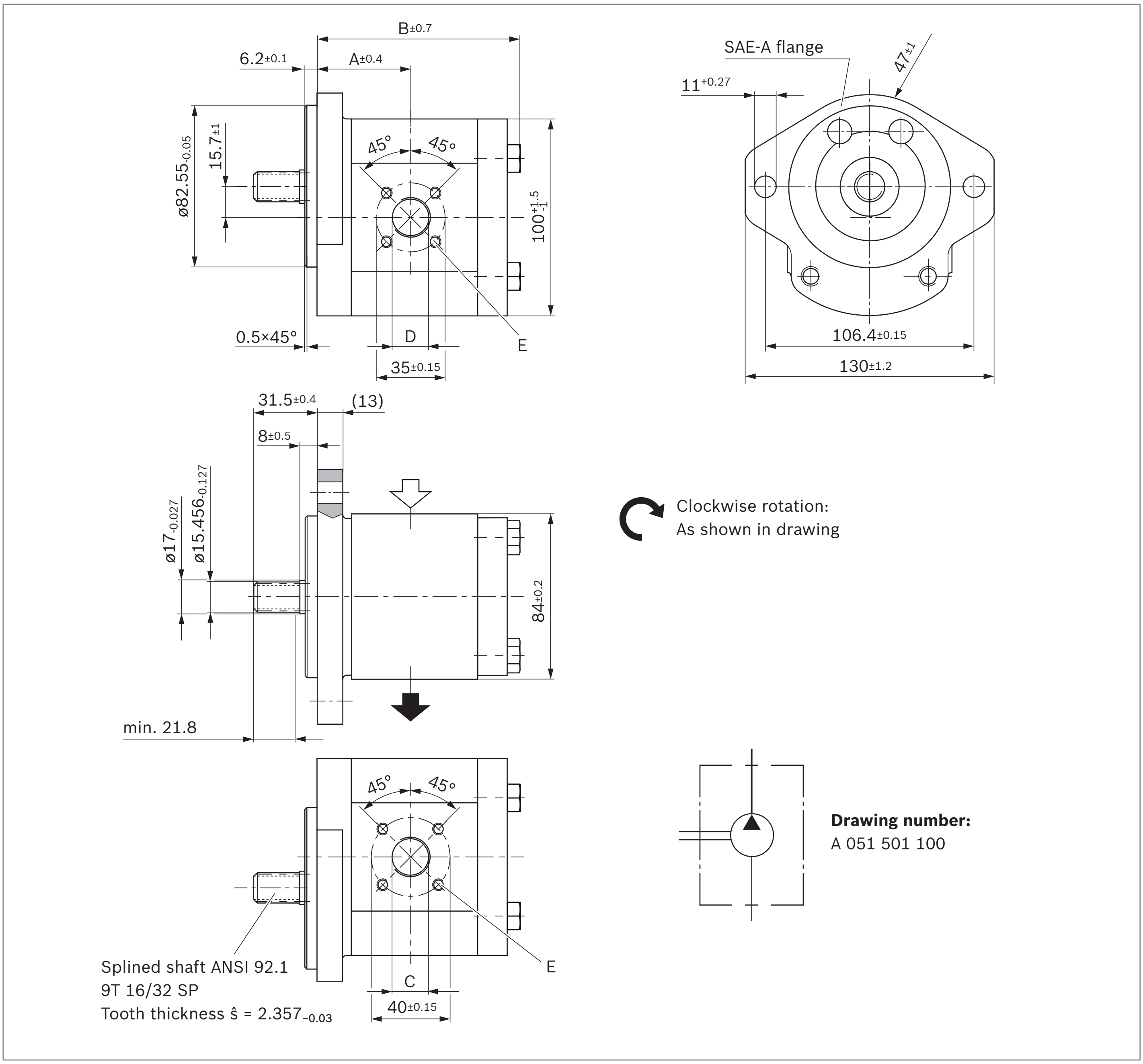
▼ **Splined shaft (SAE J744 16-4 9T) with 2-bolt flange Ø82.55 mm (SAE J744 82-2 A) for mounting on an axial piston unit**
AZPW–11 – ... **RR20**PB-**S0081**



NG	Order number Direction of rotation Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Dimensions A	B	C	D	E
5	R983077585	210	3500	41.1	86.3	15	M6; 13^{+1} deep	M6; 13^{+1} deep
8	R983077586	210	3500	43.2	90.4	20		
11	R983077587	210	3500	47	95.4	20		
14	R983077588	210	3500	47.5	100.4	20		
16	R983077589	210	3500	47.5	103.8	20		
19	R983077590	200	3300	47.5	108.8	20	M8; 13^{+1} deep	
22	R983077591	190	3200	55.1	114.2	20		

▼ Splined shaft (SAE J744 16-4 9T) with 2-bolt flange Ø82.55 mm (SAE J744 82-2 A) for mounting on an axial piston unit and line connections in Non-standard version

AZPW–21 – ... **RRXX**MB-**S0593**



Splined shaft ANSI 92.1
9T 16/32 SP
Tooth thickness ŝ = $2.357_{-0.03}$

Clockwise rotation:
As shown in drawing

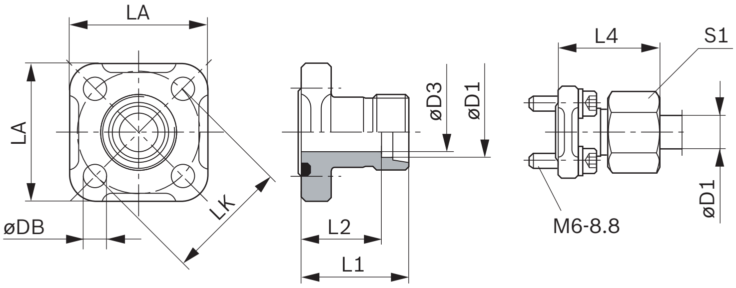
Drawing number:
A 051 501 100

NG	Order number Direction of rotation Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Dimensions				
				A	B	C	D	E
4	R983035496	210	3500	39.9	84.7	3/8; 15 deep	3/8; 15 deep	M6; min. 13 deep
5	R983035497	210	3500	41.1	87.3	3/8; 15 deep	3/8; 15 deep	
8	R983035498	210	3500	43.2	91.4	1/2; 15 deep	1/2; 15 deep	
11	R983035499	210	3500	47	95.7	1/2; 19 deep	1/2; 15 deep	
14	R983035500	210	3500	47.5	101.4	3/4; 19 deep	1/2; 15 deep	
16	R983035501	210	3500	47.5	104.8	3/4; 19 deep	1/2; 15 deep	
19	R983035502	200	3300	47.5	109.8	3/4; 19 deep	1/2; 15 deep	
22	R983035503	190	3200	55.1	115.2	3/4; 19 deep	1/2; 15 deep	

Accessories

Gear pump flanges, straight, for square flange 20 (see page 14)

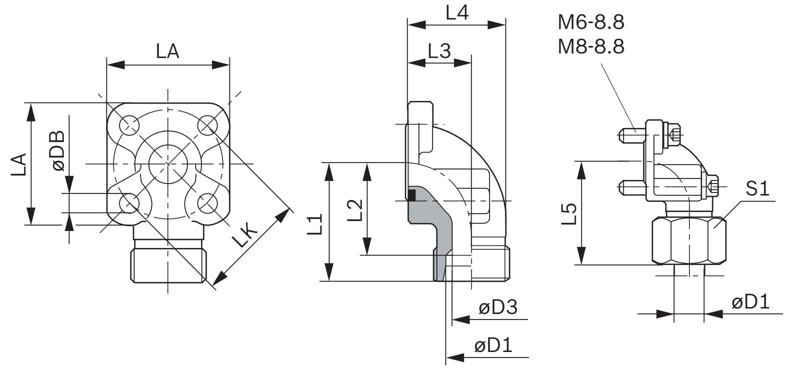
Complete fitting with
O-ring, metric screw set,
nuts and olive.



LK	D1	D3	L1	L2	L4	LA	1	DB	Screws 4 pcs.	O-ring NBR	Weight [kg]	Order number	*p* [bar]
35	10L	8	30	23.0	39.0	40	19	6.4	M6 × 22	20 × 2.5	0.09	1 515 702 064	315
35	12L	10	30	23.0	39.0	40	22	6.4	M6 × 22	20 × 2.5	0.10	1 515 702 065	315
35	15L	12	30	23.0	38.0	40	27	6.4	M6 × 22	20 × 2.5	0.10	1 515 702 066	250
40	15L	12	35	28.0	43.0	42	27	6.4	M6 × 22	24 × 2.5	0.12	1 515 702 067	100
40	18L	15	35	27.5	44.0	42	32	6.4	M6 × 22	24 × 2.5	0.13	1 515 702 068	100
40	22L	19	35	27.5	44.5	42	36	6.4	M6 × 22	24 × 2.5	0.12	1 515 702 069	100
40	28L	24	42	27.5	34.5	42	41	6.4	M6 × 22	24 × 2.5	0.15	1 515 702 008	100

Gear pump flanges, 90° angle, for square flange 20 (see page 14)

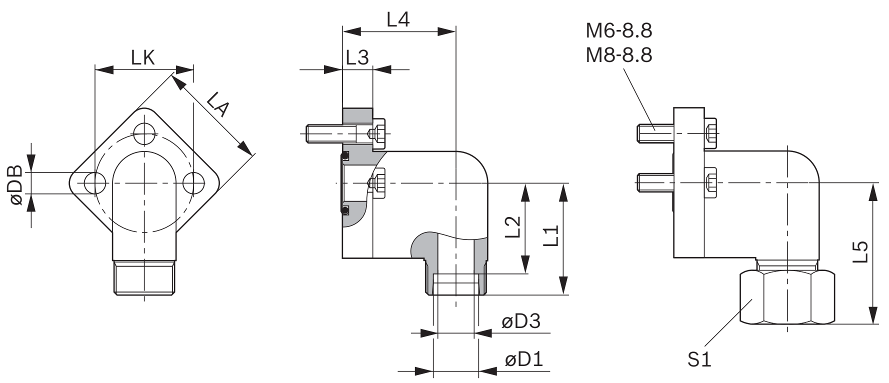
Complete fitting with
O-ring, metric screw set,
nuts and olive.



LK	D1	D3	L1	L2	L3	L4	L5	LA	1	DB	Screws 2 pcs.	2 pcs.	O-ring NBR	Weight [kg]	Order number	*p* [bar]
35	10L	8	38	31.0	16.5	26.5	47.0	40	19	6.4	M6 × 22	M6 × 35	20 × 2.5	0.16	1 515 702 070	315
35	12L	10	38	31.0	16.5	26.5	47.0	40	22	6.4	M6 × 22	M6 × 35	20 × 2.5	0.16	1 515 702 071	315
35	15L	12	38	31.0	16.5	26.5	46.0	40	27	6.4	M6 × 22	M6 × 35	20 × 2.5	0.15	1 515 702 072	250
35	16S	12	38	29.5	20.0	31.0	48.0	40	30	6.4	M6 × 22	M6 × 40	20 × 2.5	0.18	1 515 702 002	315
35	18L	15	38	29.5	20.0	31.0	47.0	40	32	6.4	M6 × 22	M6 × 40	20 × 2.5	0.18	1 545 702 006	250
35	20S	16	45	34.5	25.0	38.0	56.0	40	36	6.4	M6 × 22	M6 × 45	20 × 2.5	0.24	1 515 702 017	315
40	15L	12	38	31.0	22.5	36.5	46.0	42	27	6.4	M6 × 22	M6 × 22	24 × 2.5	0.15	1 515 702 073	100
40	18L	15	38	30.5	22.5	36.5	47.0	42	32	6.4	M6 × 22	M6 × 22	24 × 2.5	0.17	1 515 702 074	100
40	20S	16	40	29.5	22.5	35.5	50.0	42	36	6.4	M6 × 22	M6 × 45	24 × 2.5	0.20	1 515 702 011	250
40	22L	19	38	30.5	22.5	36.5	47.5	42	36	6.4	M6 × 22	M6 × 22	24 × 2.5	0.17	1 515 702 075	100
40	28L	22	40	32.5	28.0	43.0	49.0	42	41	6.4	M6 × 20	M6 × 50	24 × 2.5	0.24	1 515 702 010	100
40	35L	31	41	30.5	34.0	55.0	52.0	42	50	6.4	M6 × 22	M6 × 60	24 × 2.5	0.33	1 515 702 018	100

Gear pump flange, 3-hole, 90° angle, for square flange 30 (see page 14)

Complete fitting with
O-ring, metric screw set,
nuts and olive.



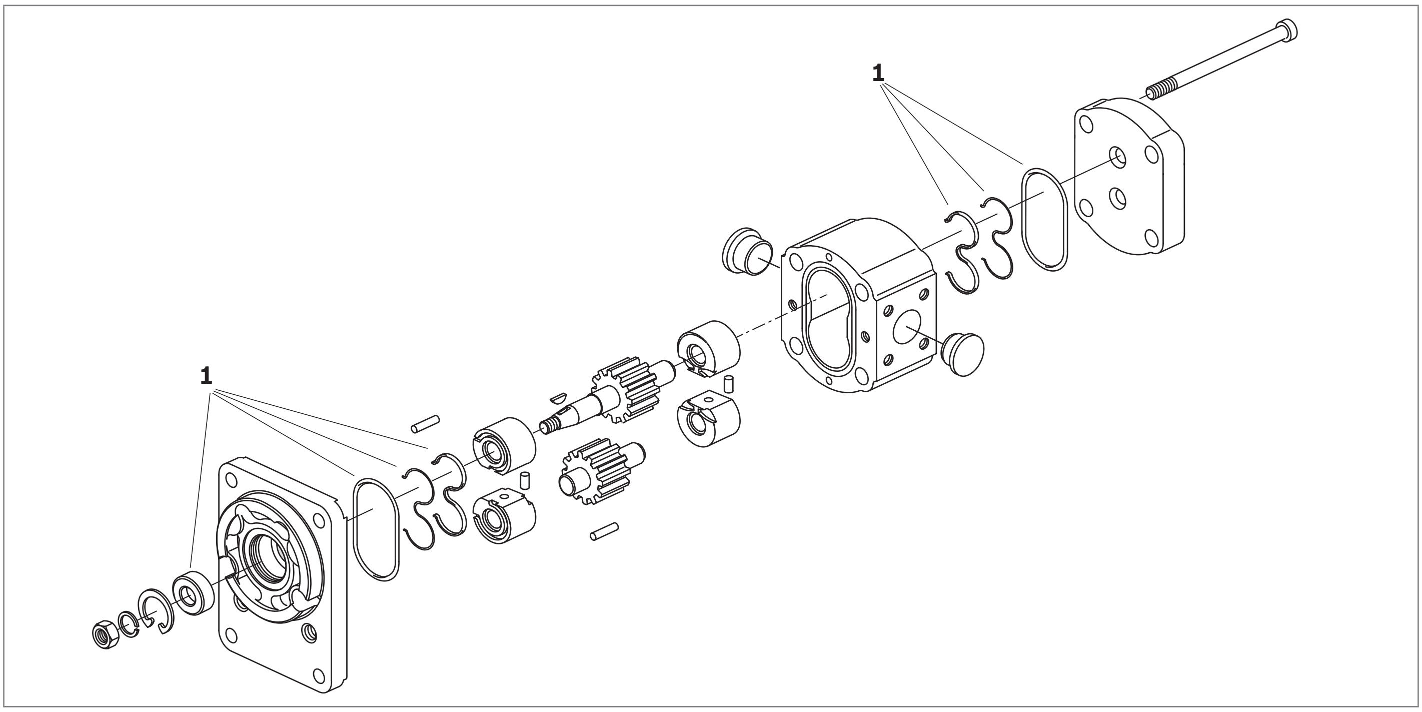
LK	D1	D3	L1	L2	L3	L4	L5	LA	1	DB	Screws 3 pcs.	O-ring NBR	Weight [kg]	Order number	*p* [bar]
30	12L	10	37	30.0	10	37.5	46	38	22	6.4	M6 × 22	16 × 2.5	0.13	1 515 702 146	250
30	15L	12	37	30.0	10	37.5	47	38	27	6.4	M6 × 22	16 × 2.5	0.14	1 515 702 147	250
30	18L	15	37	30.0	10	37.5	47	38	32	6.4	M6 × 22	16 × 2.5	0.17	1 515 702 148	160
40	22L	19	43	35.5	14	41.0	53	48	36	8.4	M8 × 30	24 × 2.5	0.29	1 515 702 149	160
40	28L	24	43	35.5	14	41.0	53	48	41	8.4	M8 × 30	24 × 2.5	0.40	1 515 702 150	160

Note

You can find the permissible tightening torques in our publication 07012-B1 “General Instruction Manual for External Gear Units”.

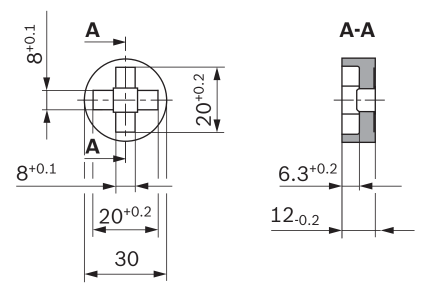
Spare parts

▼ Schematic diagram

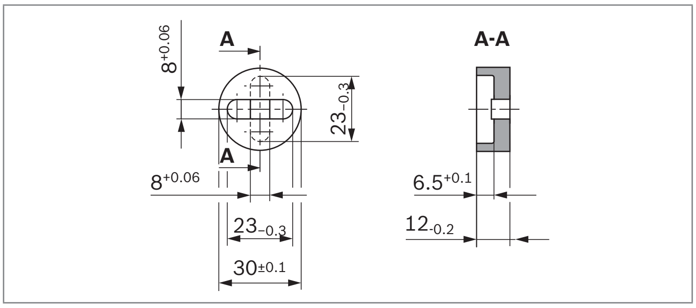


Item	Designation	Order number	Material	AZPW–22 – …								
				CB…	**FB…**	**HO…**	**NT…**	**CP…**	**CN…**	**QR…**	**RR12**	**RR20**
1	Seal kit	R 983 032 388	NBR	x	x	x	x	x	x	x	x	
		R 983 069 216	FKM								x	x

▼ Driver for sizes 4 to 11



▼ Driver for sizes 14 to 22



Designation	Order number EU	Order number APA / US
Driver for sizes 4 to 11	1 510 240 009	R 002 G11 025
Driver for sizes 14 to 22	1 510 240 011	F 000 511 445

Notes on commissioning

General
Pumps delivered by Bosch Rexroth are tested for function and performance. No changes of any nature may be made, otherwise the warranty is rendered void.
The pump may only be operated with the permissible data (see page 6).

Technical data
All mentioned technical data are dependent on manufacturing tolerances and are applicable for certain boundary conditions. Note that certain deviations are therefore possible and that technical data may vary when certain boundary conditions (e.g., viscosity) change.

Characteristic curves
When dimensioning the gear pump, observe the maximum possible application data on the basis of the characteristic curves shown starting on page 8.

Scope of delivery
The scope of delivery includes the components with the characteristics described under type codes and dimensions starting on page 16.

Further information

- Further information on installation, commissioning, and operation can be found in the publication 07012-B1: “General Operating Instructions for External Gear Units”.
- Extensive notes and suggestions can be found in the Hydraulic Trainer, volume 3: “Planning and Design of Hydraulic Power Systems”, order number R900018547.

Filter recommendation
Since the majority of premature failures in gear pumps occur due to contaminated hydraulic fluid, filtration should maintain a cleanliness level of 20/18/15 as defined by ISO 4406.
Cleanliness level 20/18/15 can reduce contamination to an acceptable degree in terms of particle size and concentration.

Bosch Rexroth generally recommends full-flow filtration. Basic contamination of the hydraulic fluid used may not exceed class 20/18/15 according to ISO 4406. New fluids are often above this value. In such instances, a filling device with a special filter should be used.
Bosch Rexroth is not liable for wear due to contamination.

Order number overview

Order number	Type	Page
R983074473	AZPW–11– 004LCB20MB	16
R983074474	AZPW–11– 005LCB20MB	16
R983074475	AZPW–11– 008LCB20MB	16
R983074476	AZPW–11– 011LCB20MB	16
R983074477	AZPW–11– 014LCB20MB	16
R983074478	AZPW–11– 016LCB20MB	16
R983074479	AZPW–11– 019LCB20MB	16
R983074480	AZPW–11– 022LCB20MB	16
R983074465	AZPW–11– 004RCB20MB	16
R983074466	AZPW–11– 005RCB20MB	16
R983074467	AZPW–11– 008RCB20MB	16
R983074468	AZPW–11– 011RCB20MB	16
R983074469	AZPW–11– 014RCB20MB	16
R983074470	AZPW–11– 016RCB20MB	16
R983074471	AZPW–11– 019RCB20MB	16
R983074472	AZPW–11– 022RCB20MB	16
R983072848	AZPW–11 – 004LFB20MB	17
R983072849	AZPW–11 – 005LFB20MB	17
R983072850	AZPW–11 – 008LFB20MB	17
R983072851	AZPW–11 – 011LFB20MB	17
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R983072855	AZPW–11 – 022LFB20MB	17
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R983072846	AZPW–11 – 019RFB20MB	17
R983072847	AZPW–11 – 022RFB20MB	17
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R983072832	AZPW–11 – 005LHO30MB	18
R983072833	AZPW–11 – 008LHO30MB	18
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R983072824	AZPW–11 – 005RHO30MB	18
R983072825	AZPW–11 – 008RHO30MB	18
R983072826	AZPW–11 – 011RHO30MB	18
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R983072828	AZPW–11 – 016RHO30MB	18
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R983072863	AZPW–11 – 004LNT20MB	19
R983072864	AZPW–11 – 005LNT20MB	19
R983072865	AZPW–11 – 008LNT20MB	19
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R983072883	AZPW–11 – 016RCN20MB	21

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R983035500	AZPW–21 – 014-RRRXXMB-S0593	28
R983035501	AZPW–21 – 016-RRRXXMB-S0593	28
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AZ configurator

With our practical product selector, it will take you next to no time to find the right solution for your applications, no matter whether it is Standard Performance or another external gear unit.

The selector guides you through a selection of features to all of the products available for order. By clicking on the order number, you can view and download the following product information: Data sheet, dimension sheet, instruction manual, operating conditions, and tightening torques.

You can order your selection directly via our online shop and at the same time benefit from an additional discount of 2%. And if you need something really quickly, simply use our fast delivery and preferred programs (GoTo). Then the goods will be sent within 10 business days.

You also have the possibility to easily and conveniently configure your individual external gear unit with our AZ configurator. All the necessary data that you need for the project planning of external gear units is requested by means of the menu navigation.

For an already existing configuration you receive as a result the order number, the type code, as well as further information. If your configuration does not lead to a product that is available for order, our online tools provide you with the possibility of sending a project request directly to Bosch Rexroth. We will then get in contact with you.

Fit4SILENCE app

You want to quickly determine the noise level of an application but don't have a measuring device at hand? No problem with Fit4SILENCE! Our new noise measurement app for all Android devices can be immediately downloaded free of charge. After calibration, you can start using it straight away and conduct fast, accurate noise measurements with different weightings in no time at all. An additional measuring device is no longer necessary, because calibrated smartphones using the app can achieve an accuracy that approximates professional measuring devices.

Last but not least, the app contains interesting information about the SILENCE PLUS technology, including an audio sample.

Your notes

External gear pump
Series B

AZPB-3x

Fixed pumps
$V = 1.0...7.1$ cm^3/rev

Overview of contents

Features

- Nominal pressure 250 bar (up to 6.3 cm^3/rev)
- Slide bearings for heavy duty applications
- Standardized drive shafts
- Line ports:
  Connection flange or internal thread
- Long service life through reinforced design of shafts and cast iron cover
- Consistent high quality through mass production
- Numerous configuration variants available
- Same mounting dimensions as the AZPB-1x

General

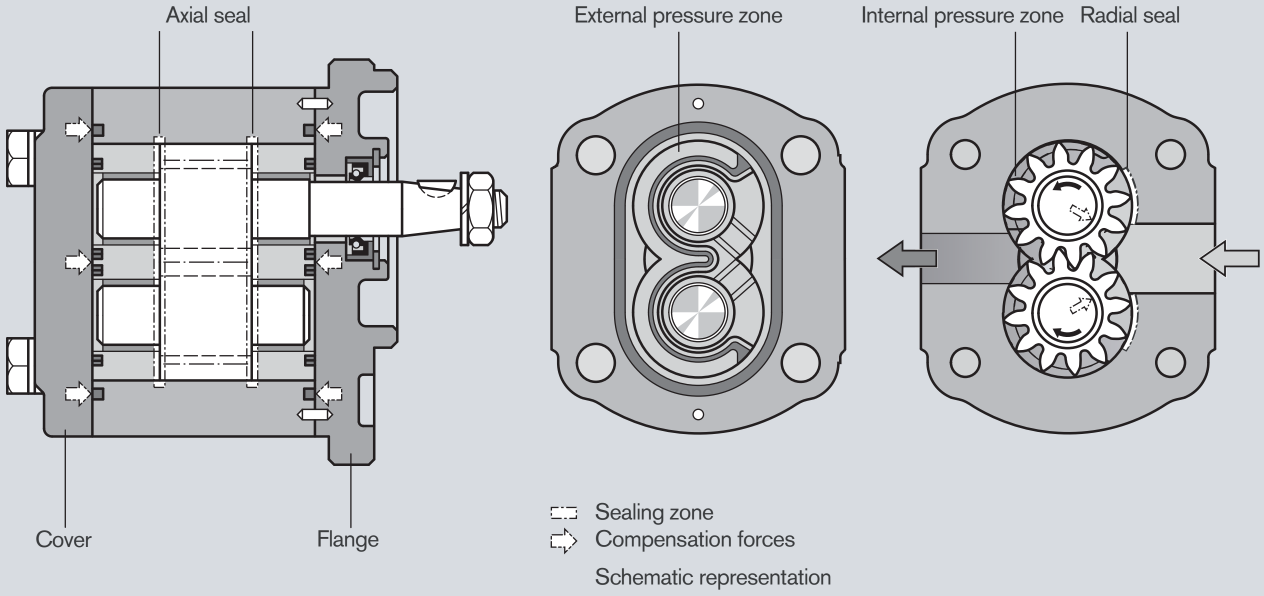
Rexroth external gear pumps are available as standard gear pumps in the 4 series of B, F, N and G and as SILENCE gear pumps in the S, T and U series, and as the SILENCE PLUS version in the J series, in which the displacements are graded by different gear widths. Further configuration variants are given by different flanges, shafts, valve arrangements and multiple pump combinations.

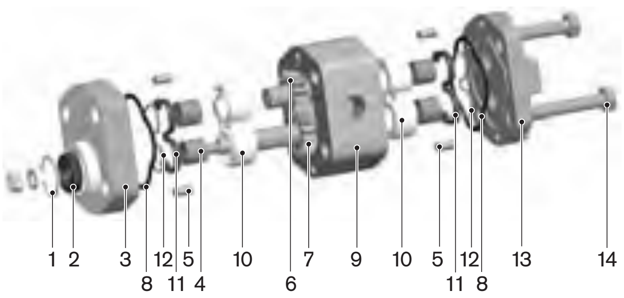
Construction

The external gear pump consists essentially of a pair of gears supported in bearing bushings and the housing with a front and a rear cover. The drive shaft protrudes from the front cover where it is sealed by the shaft seal ring. The bearing forces are absorbed by special slide bearings with sufficient elasticity to produce surface contact instead of line contact. They also ensure excellent resistance to galling – especially at low speed. The gear wheels of the standard and SILENCE pumps have 12 teeth and the gear wheels of the SILENCE PLUS have 7 non-evolute teeth. This keeps both flow pulsation and noise emission to a minimum.

The internal sealing is achieved by forces which are proportional to delivery pressure. This ensures optimum efficiency. The bearings provide the seal at the ends of the gaps between the teeth which carry the pressurized oil. The sealing zone between the gear teeth and the bearings is controlled by the admission of operating pressure to the rear of the bearings. Special seals form the boundary of the zone. The radial clearance at the tips of the gear teeth is sealed by internal forces pushing them against the case.

Axial and radial compensation for gear pump





1	Retaining ring	8	Housing seal
2	Shaft seal ring	9	Pump housing
3	Front cover	10	Bearing
4	Slide bearing	11	Axial zone seal
5	Centering pin	12	Supporting element
6	Gear	13	End cover
7	Gear (driving)	14	Fixing screws

Overview of “Series B” standard program

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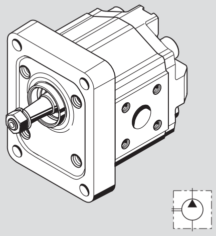
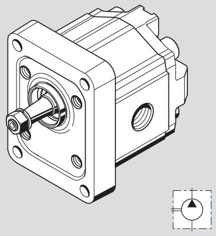
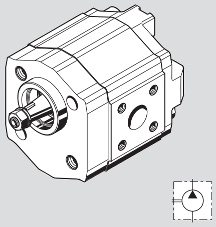
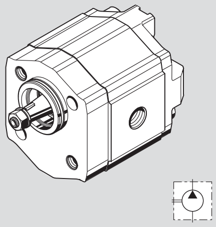
	16
	17
	18
	19

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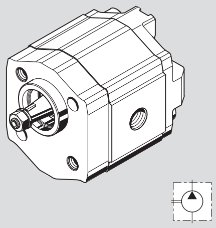
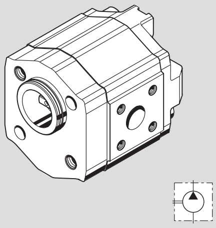
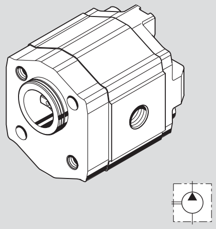
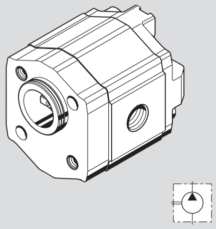
	20
	21
	22
	23

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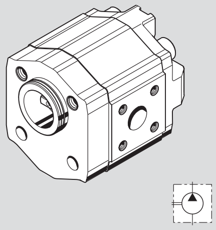
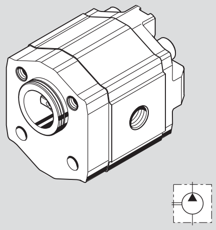
	24
	25

Ordering code

External gear units Single pumps Standard

AZ	P	B	–	x	x	–	4.0	R	C	P	02	M	D	200 xx	S xxxx

Function

P = Pump

Series

3 = 3rd generation

Version

2 = corrosion-resistant, pinned

Size (B)

1.0 = 1.00 cm³/rev
2.0 = 2.00 cm³/rev
2.5 = 2.50 cm³/rev
3.1 = 3.15 cm³/rev
4.0 = 4.00 cm³/rev
4.5 = 4.50 cm³/rev
5.0 = 5.00 cm³/rev
6.3 = 6.30 cm³/rev
7.1 = 7.10 cm³/rev

Direction of rotation

R = Clockwise
L = Counterclockwise

*) Some of the special designs shown on pages 16–25 are not covered in the illustration of the ordering code.

Special design *)

Valve adjustment

200 xx = PRV 200 bar

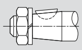
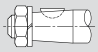
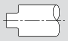
Rear cover

B = Standard
A = Axial inlet and outlet port

Seals

M = NBR
K = NBR, shaft seal ring in FKM
P = FKM

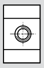
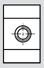
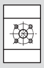
Drive shafts

			Suitable front cover
C	Tapered key shaft 1:5		P
H	Tapered key shaft 1:8		O
N	Dihedral Claw		M Y

Front cover

P	2-bolt mounting Centering Ø 32 mm	
O	Square flange Centering Ø 25.28 mm	
M	2-bolt mounting Centering Ø 32 mm, with seal ring	
Y	2-bolt mounting Centering Ø 32 mm, with seal ring, mounting on series F	

Line ports

01	Pipe thread ISO 228/1	
02	Thread, metric ISO 9974-1	
20	Rectangular flange	

Not all variants can be selected by using the ordering code!
Please select the required pump by using the selection tables (standard types from standard range, see pages 16…25) or after consultation with Bosch Rexroth!
Special options are possible upon request.

Ordering code

External gear units, Multiple pumps, Standard

AZ	P	BB	–	x	x	–		4.0/4.0	R	H	O	20 20	K	B

Function

P = Pump

Series

B = 1.0...7.1 cm^3/rev
S = 4.0...28 cm^3/rev
F = 4.0...28 cm^3/rev
J = 12.0...16 cm^3/rev
T = 20.0...36 cm^3/rev
N = 20.0...36 cm^3/rev
U = 22.5...63 cm^3/rev
G = 22.5...63 cm^3/rev

Series, relates to pump section 1

2 = Housing width 110 mm

Version, relates to pump section 1

2 = corrosion-resistant, pinned

Size

as per individual Series

Direction of rotation

R = Clockwise
L = Counterclockwise

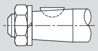
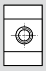
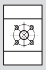
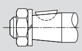
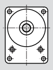
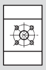
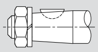
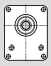
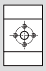
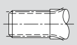
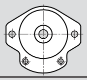
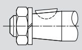
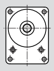
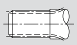
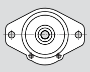
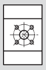
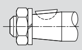
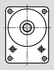
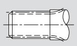
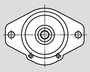
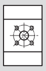
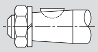
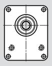
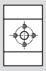
Rear cover

relates to last pump stage

B = Standard

Seals

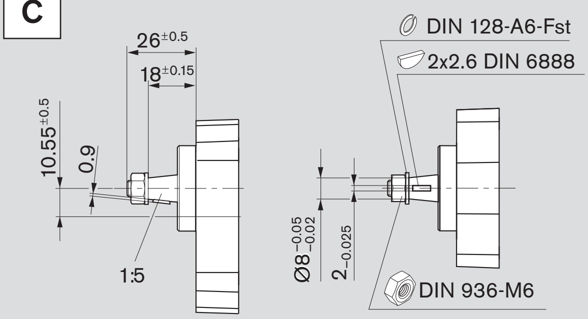
M = NBR
K = NBR, shaft seal ring pump stage 1 in FKM
P = FKM

Drive shafts relates to pump stage 1			Suitable front cover	**Front cover** relates to pump stage 1			**Line ports** every pump stage		
Series B:									
H	Tapered key shaft 1 : 8		O	O	Square flange Centering Ø 25.38 mm		01	Pipe thread ISO 228/1	
							20	Rectangular flange	
Series F, S, J:									
C	Tapered key shaft 1 : 5		B	B	Square flange Centering Ø 80 mm		20	Rectangular flange	
H	Tapered key shaft 1 : 8		O	O	Square flange Centering Ø 36.47 mm		30	Rectangular flange	
R	Splined shaft SAE J 744 16-4 9T		R	R	SAE J 744 82-2 A Centering Ø 82.55 mm 2-hole mounting				
Series N, T:									
C	Tapered key shaft 1 : 5		B	B	Square flange Centering Ø 100 mm		07	Square flange SAE thread, metric	
D	Splined shaft SAE J 744 22-4 13T		C	C	SAE J 744 101-2 B Centering Ø 101.6 mm 2-hole mounting		20	Rectangular flange	
Series G, U:									
C	Tapered key shaft 1 : 5		B	B	Square flange Centering Ø 105 mm		07	Square flange SAE thread, metric	
D	Splined shaft SAE J 744 22-4 13T		C	C	SAE J 744 101-2 B Centering Ø 101.6 mm 2-hole mounting		20	Rectangular flange	
H	Tapered key shaft 1 : 8		O	O	Square flange Centering Ø 50.78 mm		30	Rectangular flange	

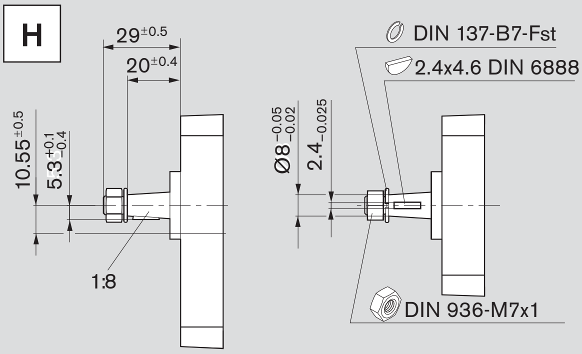
Not all variants can be selected by using the ordering code!
Please select the required pump by using the selection tables (standard types from standard range, see pages 16…25) or after consultation with Bosch Rexroth!
Special options are possible upon request.

Drive shafts

C



H



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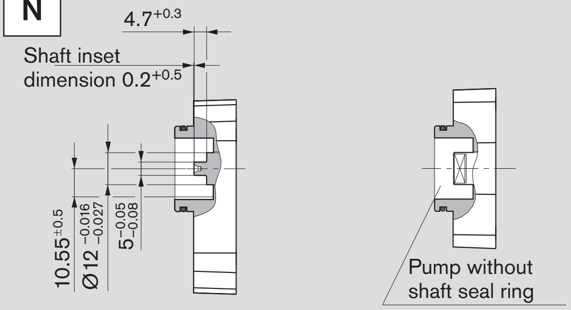
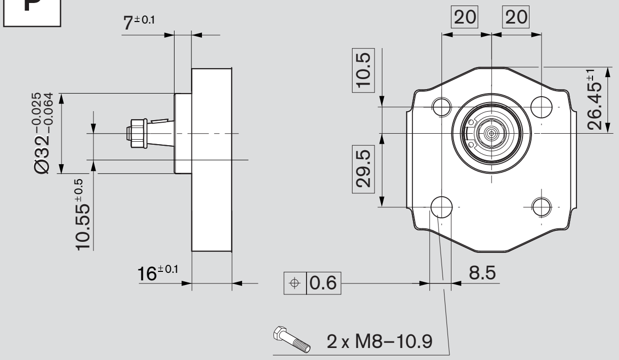
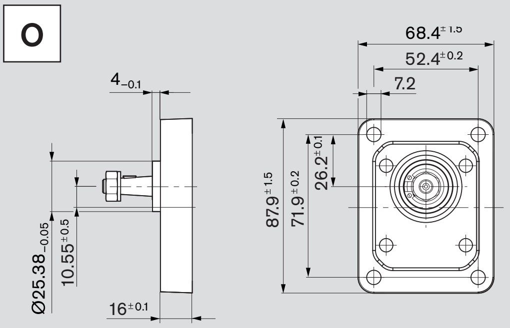


Front cover

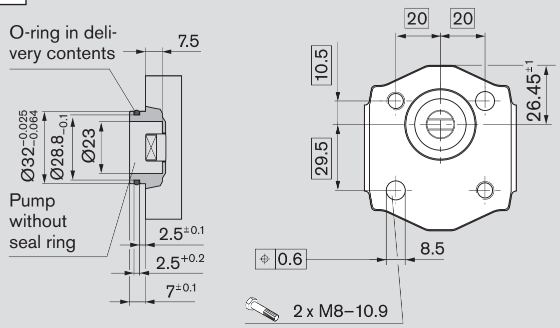
P



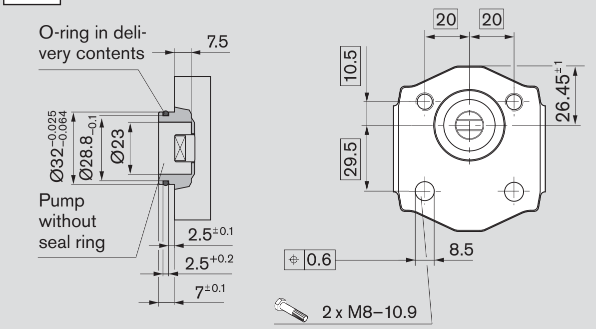
O



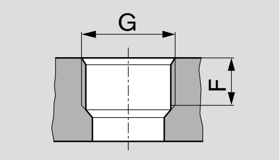
M



Y



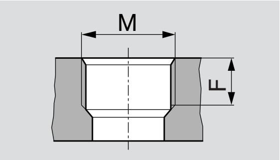
Line ports



01 **Pipe thread ISO 228/1**

Limited service life
compared to line port 20

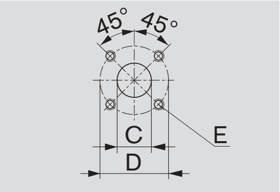
Ordering code	Size	Pressure side		Suction side	
		G	**F**	**G**	**F**
01	1...3.15 cm^3	G $^3/_8$	13	G $^3/_8$	13
	4.0...7.1 cm^3	G $^3/_8$		G $^1/_2$	13



02 **Pipe thread ISO 9974-1**

Limited service life
compared to line port 20

Ordering code	Size	Pressure side		Suction side	
		M	**F**	**M**	**F**
02	1...3.15 cm^3	14 x 1.5	13	M18 x 1.5	13
	4...7.1 cm^3			M22 x 1,5	

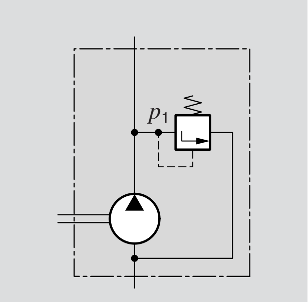


20 **Rectangular flange**

Ordering code	Size	Pressure side			Suction side		
		C	**D**	**E**	**C**	**D**	**E**
20	2...2.5 cm^3	12	30	M6 depth 13	12	30	M6 depth 11.5
	3.15...7.1 cm^3	15	35		15	35	

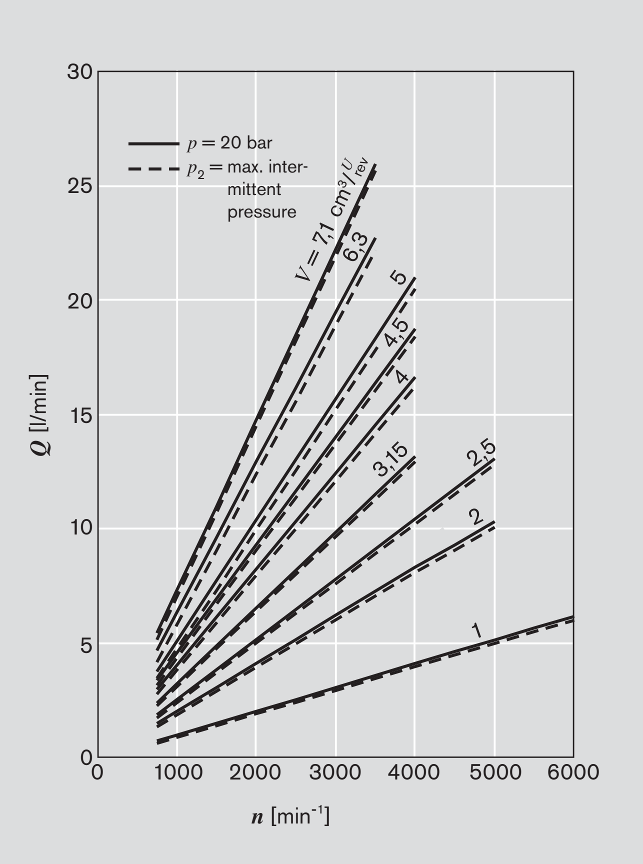
Gear pumps with integrated pressure-relief valve

In order to reduce external pipework it is possible to incorporate a pressure-relief valve in the cover of the gear pump.



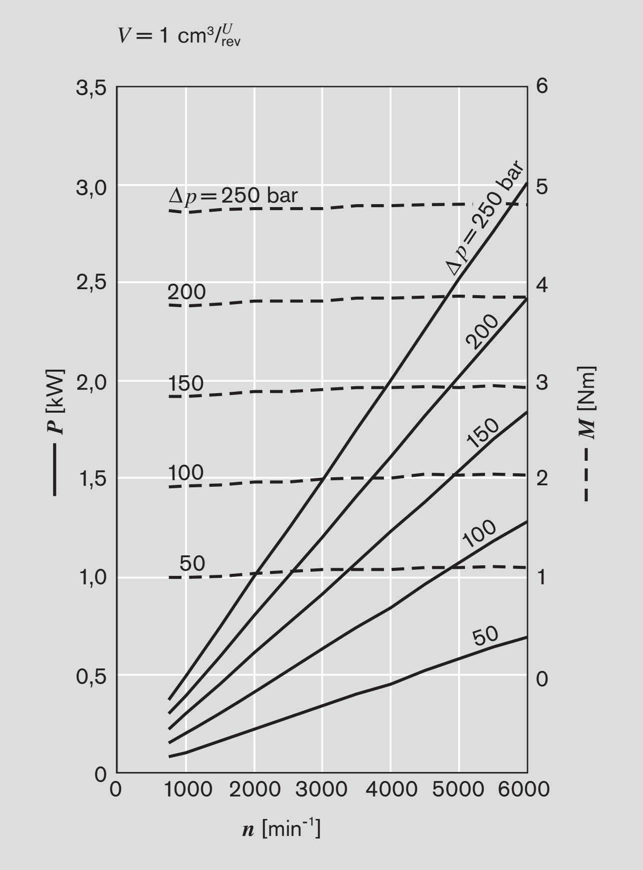
Pressure-relief valve.
Discharge returned to suction line
$p_1 = 5...250$ bar

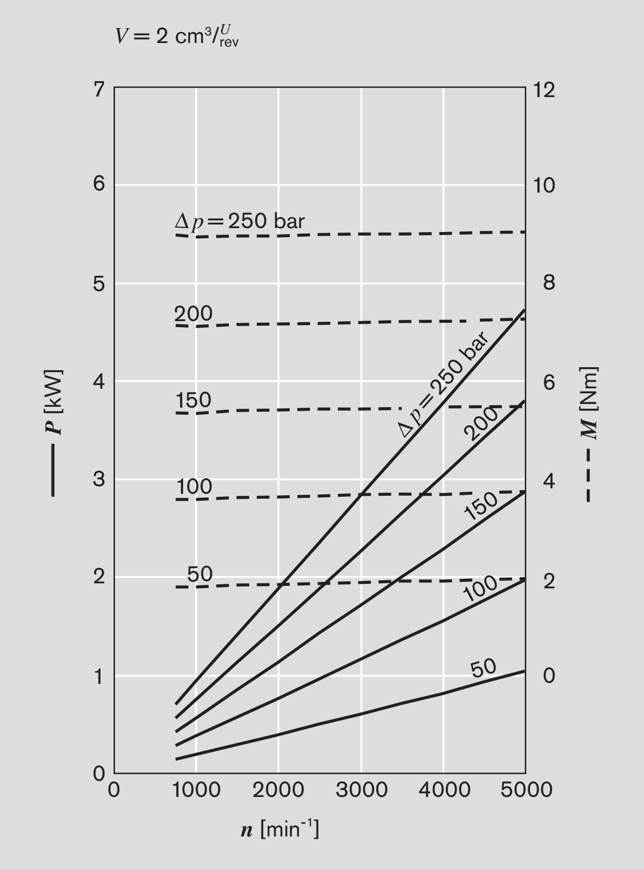
Performance charts



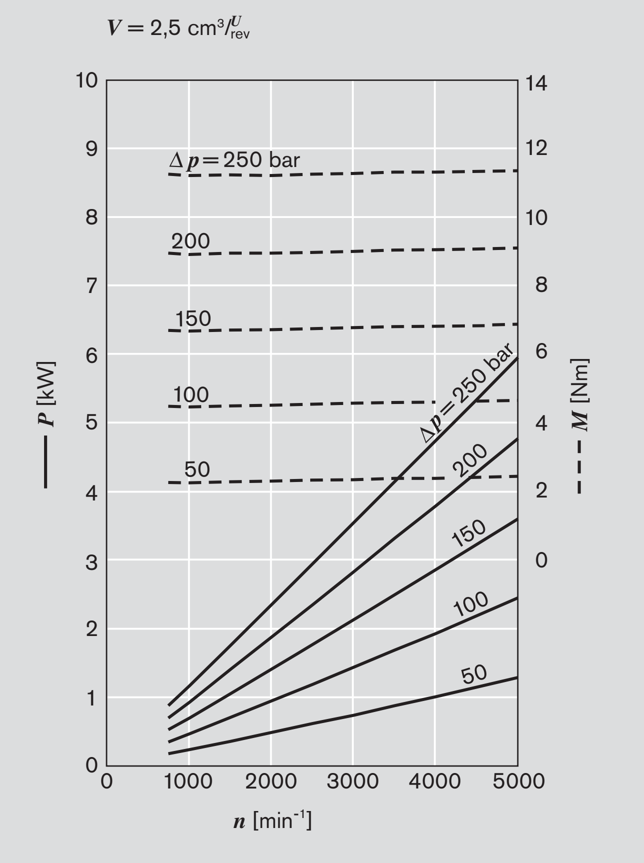
$\nu = 35$ mm²/s, $\vartheta = 50$ °C

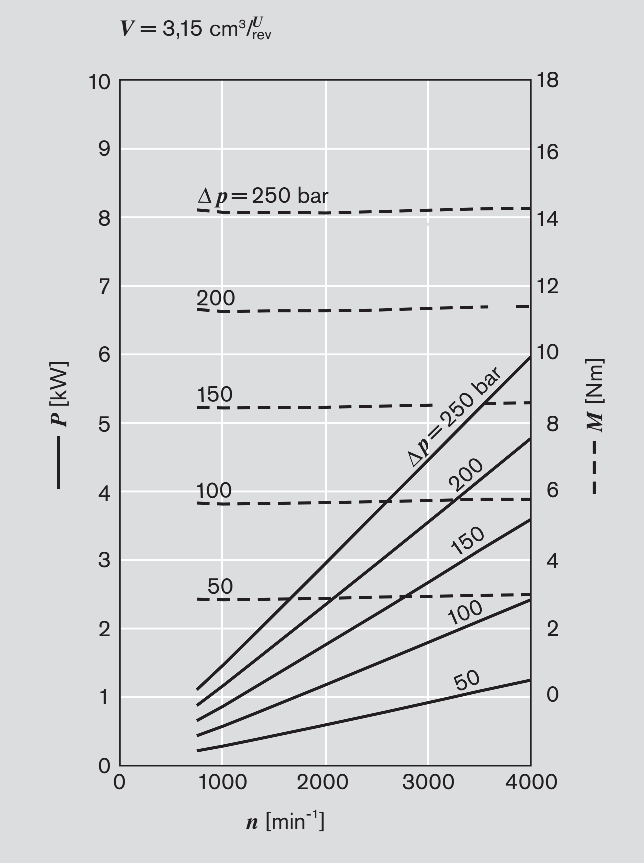
$Q = f\ (n, V)$ incl. η_v
$P = f\ (n, p)$ ——— incl. η_t
$M = f\ (n, p)$ – – – incl. η_{hm}

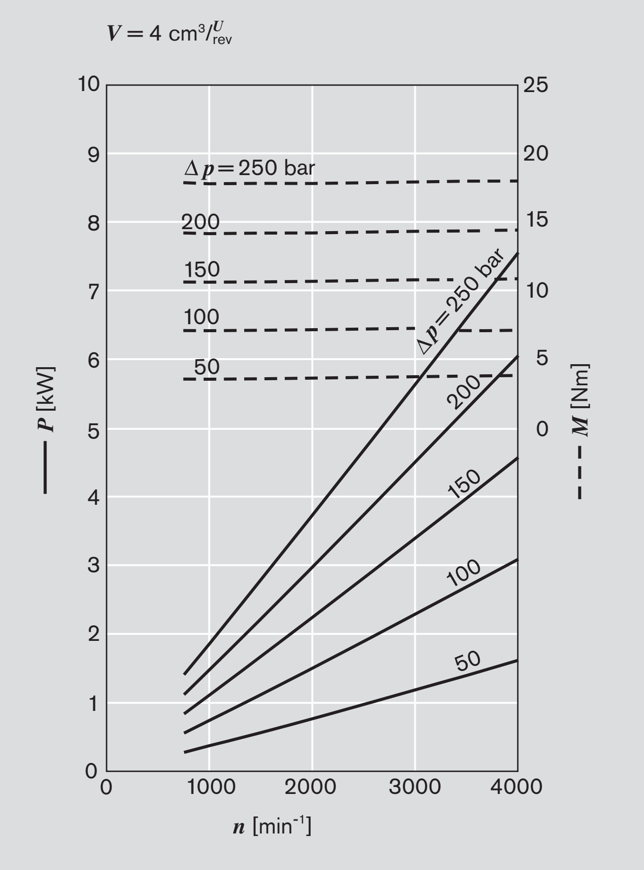


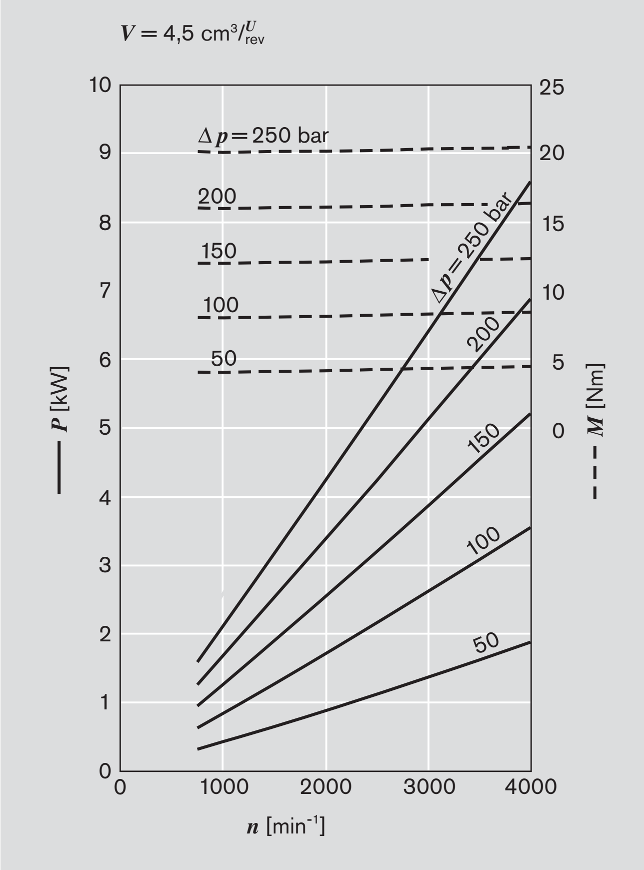


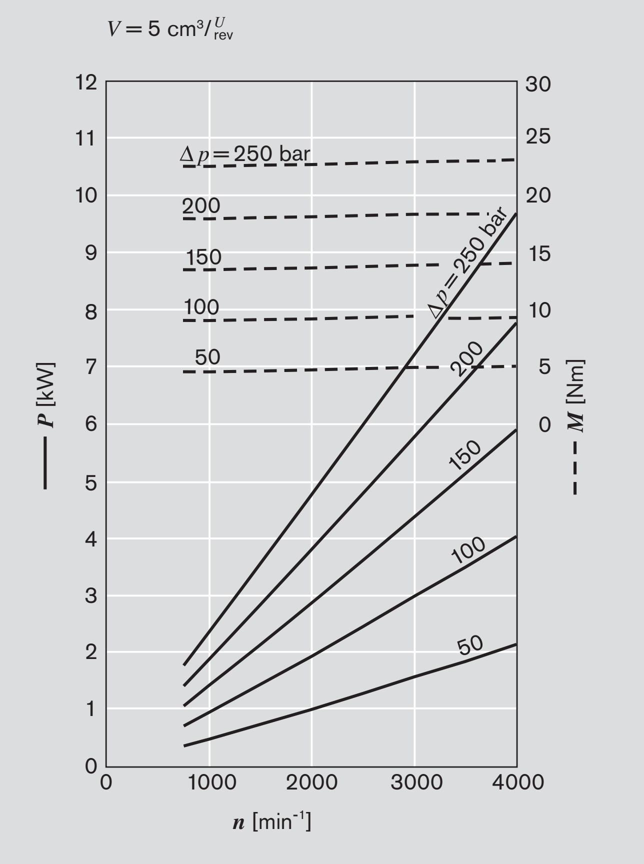
Performance charts (continued)

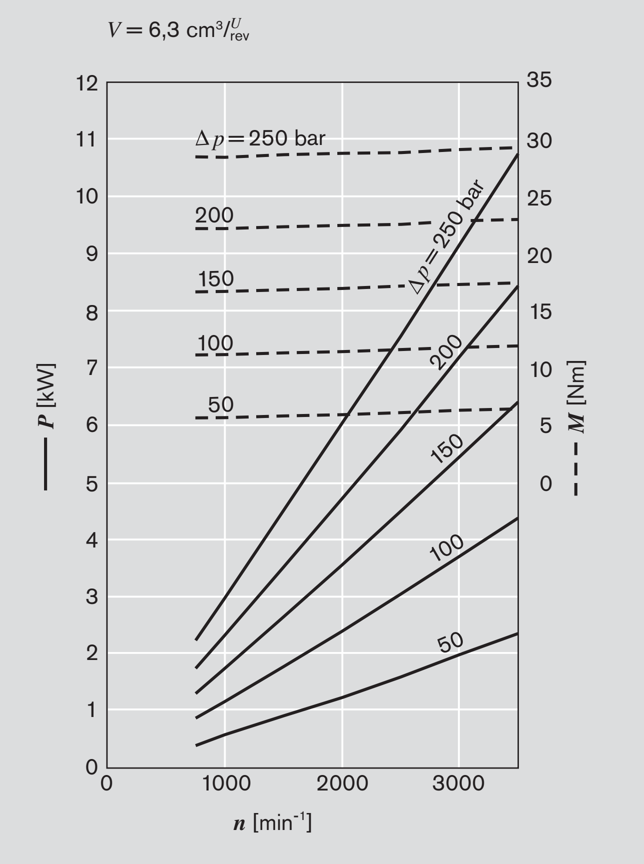


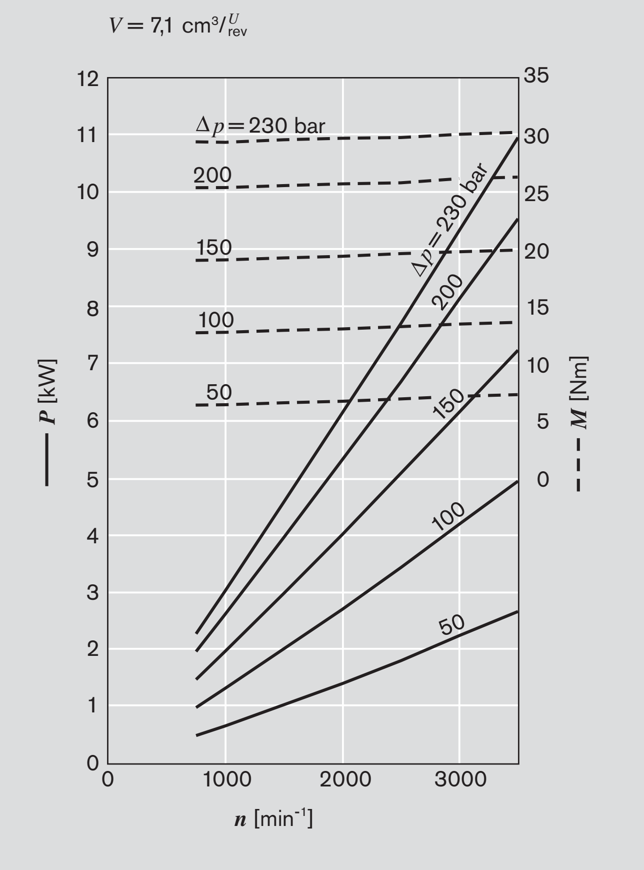







$V = 5$ cm³/$^{U}_{\text{rev}}$
P [kW]
M [Nm]
n [min⁻¹]
Δp = 250 bar
200
150
100
50
Δp = 250 bar
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12
0
5
10
15
20
25
30
0
1000
2000
3000
4000

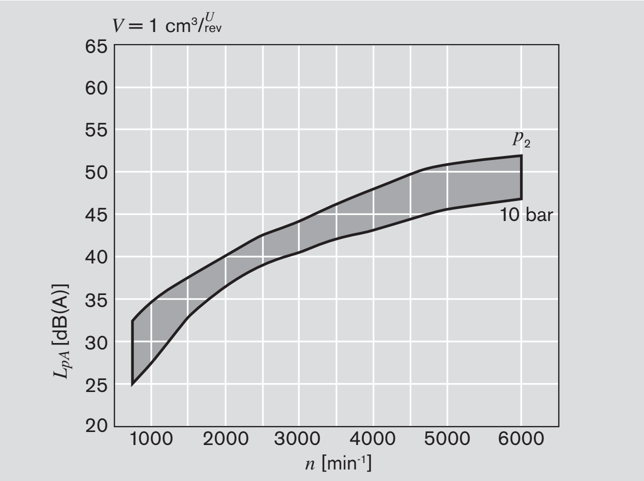

$V = 6{,}3$ cm³/$^{U}_{\text{rev}}$
P [kW]
M [Nm]
n [min⁻¹]
Δp = 250 bar
200
150
100
50
Δp = 250 bar
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12
0
5
10
15
20
25
30
35
0
1000
2000
3000

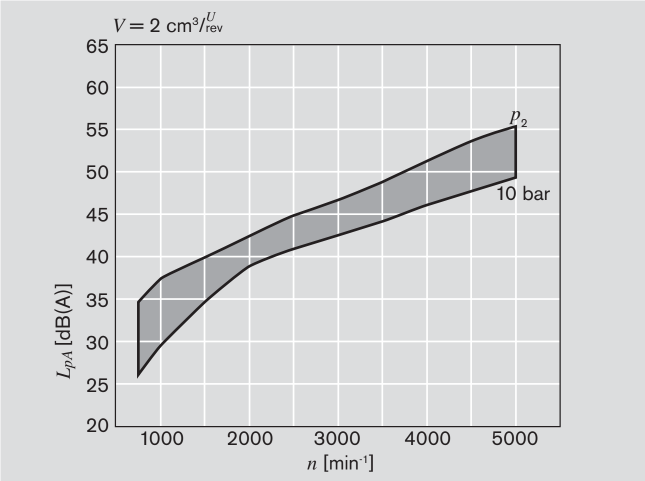

$V = 7{,}1$ cm³/$^{U}_{\text{rev}}$
P [kW]
M [Nm]
n [min⁻¹]
Δp = 230 bar
200
150
100
50
Δp = 230 bar
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12
0
5
10
15
20
25
30
35
0
1000
2000
3000

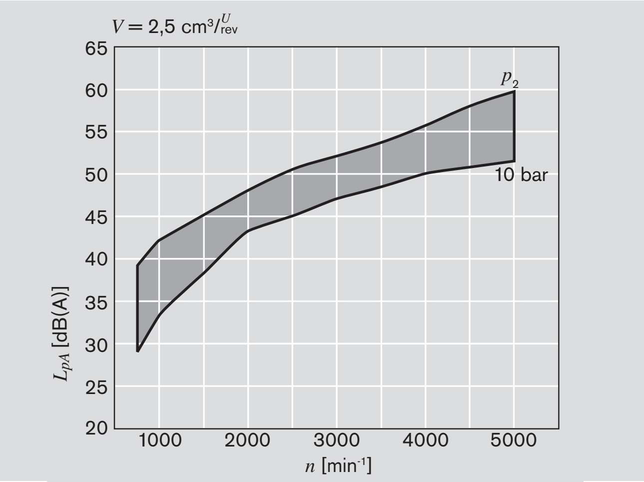
Noise charts

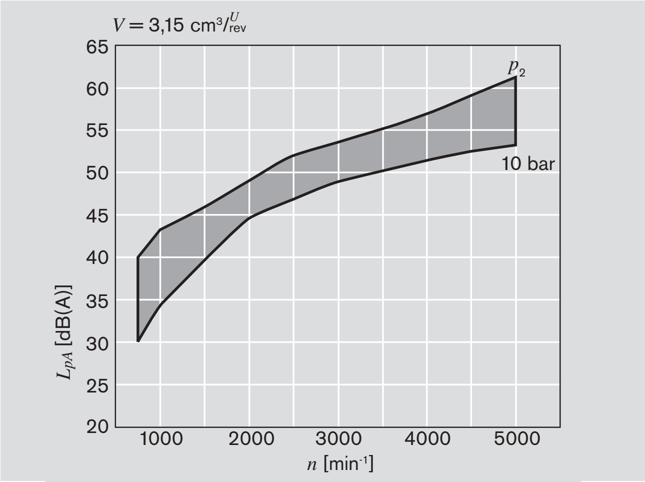
Noise level depending on the rotational speed, pressure range between 10 bar and pressure value p_2 (see page 13 Specifications table).
Oil data: $\nu = 32$ mm²/s, $\vartheta = 50$ °C.
Sound pressure level calculated from noise measurements made in the sound absorbent measuring room compliant with DIN 45635, Part 26.
Distance between measuring instrument – pump: 1 m.

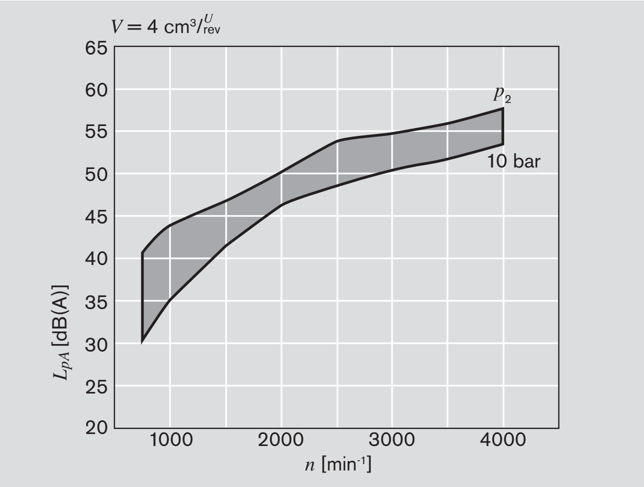
These are typical characteristic values for the respective pump size.
They describe the airborne sound emitted solely by the pump. Environmental influences (installation site, piping, further system components) are not taken into consideration.
Each value applies for a single pump.

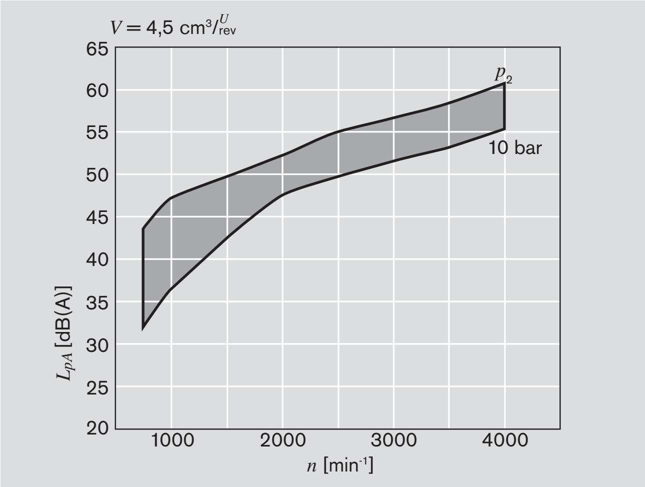


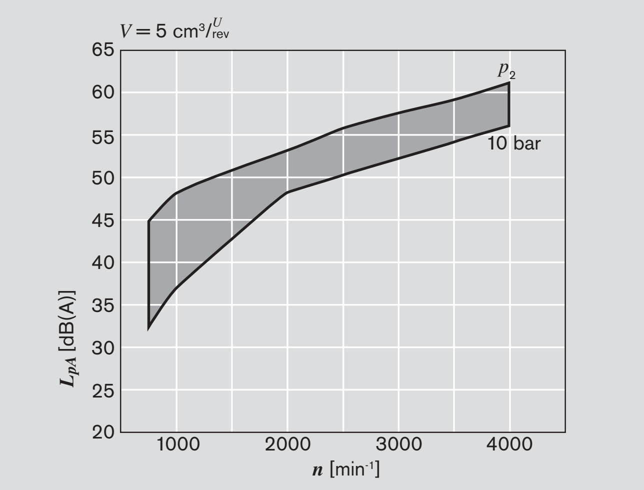


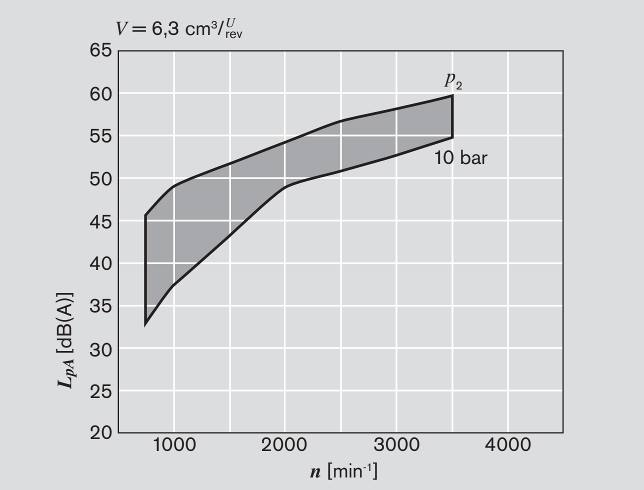


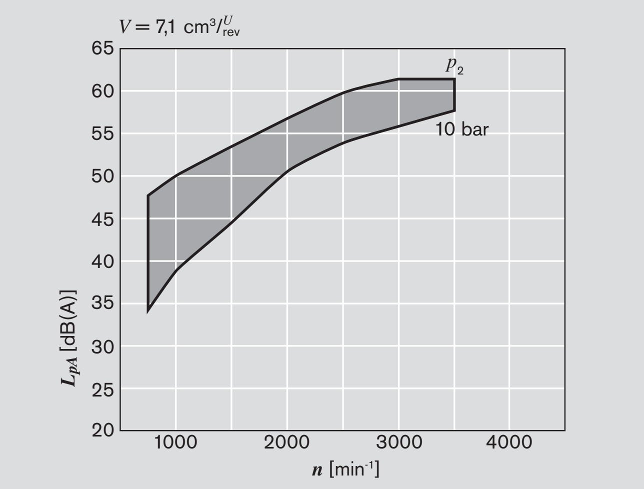












Design calculations for pumps

The design calculations for pumps are based on the following parameters:

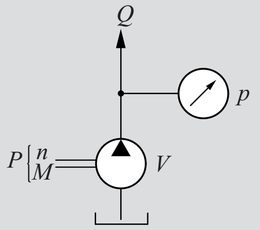
V [cm³/rev]	Displacement
Q [l/min]	Delivery
p [bar]	Pressure
M [Nm]	Drive torque
n [rev/min]	Drive speed
P [kW]	Drive power

It is also necessary to allow for different efficiencies such as:

η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Overall efficiency

The following formulas describe the various relationships.
They include correction factors for adapting the parameters to the usual units encountered in practice.

Caution: Diagram for approximate selection data can be found on pages 8...10.



$$Q = V \cdot n \cdot \eta_v \cdot 10^{-5}$$

$$p = \frac{M \cdot \eta_{hm}}{1.59 \cdot V}$$

$$P = \frac{p \cdot Q}{6 \cdot \eta_t}$$

$$V = \frac{Q}{n \cdot \eta_v} \cdot 10^5$$

$$V = \frac{M \cdot \eta_{hm}}{159 \cdot p}$$

$$Q = \frac{6 \cdot P \cdot \eta_t}{p}$$

$$n = \frac{Q}{V \cdot \eta_v} \cdot 10^5$$

$$M = \frac{1.59 \cdot V \cdot p}{\eta_{hm}}$$

$$p = \frac{6 \cdot P \cdot \eta_t}{Q}$$

[%]
n —— $\eta_v \longrightarrow Q$
M —— $\eta_{hm} \longrightarrow p$
P —— $\eta_t \longrightarrow p \cdot Q$

V [cm³/rev] Q [l/min] p [bar]
n [rev/min] P [kW] M [Nm]

Caution: η [%] e.g. 95 [%]

Specification

General	
Construction	External gear pump
Mounting	Flange or through-bolting with spigot
Line ports	Flange or thread
Direction of rotation (looking on shaft)	Clockwise or counter-clockwise; the pump may only be driven in the direction indicated
Installation position	Any
Load on shaft	Radial and axial forces only after consulting
Ambient temperature range	−30 °C...+80 °C with NBR seals or −20 °C...+110 °C with FKM seals
Hydraulic fluid	– Mineral oil compliant with DIN 51 524, 1–3, however under higher load at least HLP compliant with DIN 51 524 Part 2 recommended. – Comply with RE 90220 – Further operating fluids possible after consultation
Viscosity	12...800 mm^2/s permitted range 20...100 mm^2/s recommended range ...2000 mm^2/s range permitted for starting
Hydraulic fluid temperature range	max. +80 °C with NBR seals *) max. +110 °C with FKM seals **)
Filtration ***)	At least cleanliness level 20/18/15 compliant with ISO 4406 (1999)
Efficiency	on request, depending on load cycle
Service life	on request, depending on load cycle

*) NBR = Perbunan®

**) FKM = Viton®

***) On hydraulic systems or devices with critical counter-reaction, such as steering and counterbalance valves, the type of filtration selected must be adapted to the sensitivity of these devices/systems.

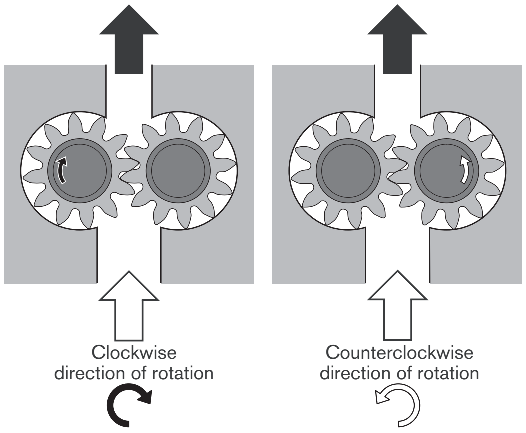
Safety requirements pertaining to the whole systems are to be observed.

In the case of applications with high numbers of load cycles please consult Bosch Rexroth.

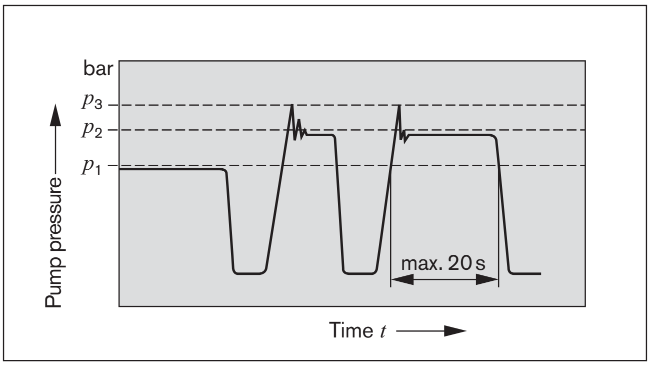
Definition of direction of rotation

Always look on the drive shaft.

Caution: Dimensional drawings always show clockwise-rotating pumps. For counterclockwise-rotating pumps the positions of the drive shaft and the suction and pressure ports are different.



Definitions of pressures



p_1 max. continuous pressure
p_2 max. intermittent pressure
p_3 max. peak pressure

AZPB-3x

Displacement	V	cm^3/rev	1	2	2.5	3.15	4	4.5	5	6.3	7.1
Suction pressure	p_e	bar	0.7...3 (absolute)								
max. continuous pressure	p_1		220	220	220	220	220	220	220	220	200
max. intermittent pressure	p_2		250	250	250	250	250	250	250	250	230
max. peak pressure	p_3		270	270	270	270	270	270	270	270	250
min. rotational speed		rpm	750	750	750	750	750	750	750	750	750
max. rotational speed at	p_2		6,000	5,000	5,000	4,000	4,000	4,000	4,000	3,500	3,500

Project planning up to 280 bar (p_2) possible in agreement with Product Management, External Gear Units.

Drive arrangement

The coupling must not transfer any radial or axial forces to the pump.

1. Flexible couplings
Refer to the fitting instructions provided by the coupling manufacturer for details of the maximum permitted shaft misalignment.

The maximum radial runout from the pump shaft to the spigot is 0.2 mm.

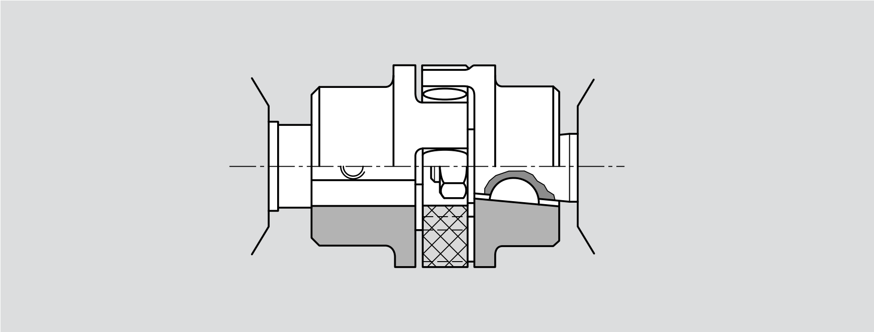
2. Drive shaft with tang
For directly mounting the pump to an electric motor or an internal-combustion engine, gear, etc. the pump shaft has a special tang and driver ③ (not included in delivery).
There is no shaft sealing.

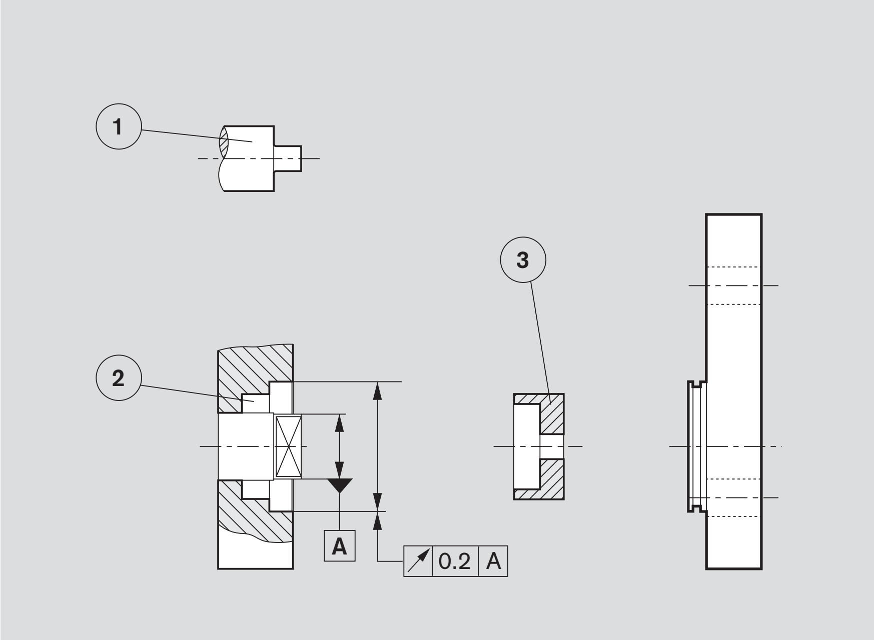
The recommended arrangements and dimensions for the drive end and sealing are as follows.

Transferrable torque:
AZPB-3x = 25 Nm.
Suitable couplings for AZPB-3x:
1 510 001 002 for AZPFB,
1 510 240 001 for AZPBB.

① **Drive shaft**
Case-hardening steel DIN 17 210
e.g. 20 MnCrS 5
case-hardened 1.0 deep; HRA $83^{\pm 2}$
Surface for sealing ring
ground without rifling $R_t \leq 4 \mu m$

② **Radial shaft seal**
with rubber covered seal
(see DIN 3760, Type AS, or double-lipped ring).
Please take note of the seal ring manufacturer's guidelines for arrangement of the installation space.





Multiple gear pumps

Gear pumps are suitable for multiple setups, whereby the drive shaft for the 1st pump is extended to a second and even a 3rd pump. A coupling is fitted between each pair of pumps.
In most cases each pump is isolated from its neighbor, i.e. the suction ports are separate from one another. A common suction port is also possible as an option.
Caution: Basically, the specifications for the single pumps apply, but with certain restrictions:
Max. speed: This is determined by the highest rated pump speed in use.
Pressures: These are restricted by the strength of the drive shaft, the through drives and the drivers. Appropriate data is given in the dimensional drawings.

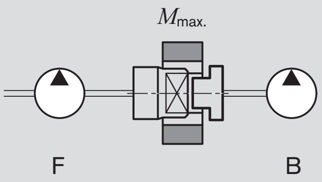
Pressure restrictions
In the case of series B (AZPB-3x), the driver for the second pumping stage can carry a load of up to $M_{\text{max.}} = 25$ Nm, i.e. there is a pressure restriction for the second stage and any further stages.

Drive shaft		max. transferrable drive torque * [Nm]
C	1:5	26
H	1:8	30
N	Claw	25

* These values only apply when the conditions described above are complied with. Bosch Rexroth is to be consulted if the stated values are exceeded.

If the first stage is driven through a tang (driver) or outboard bearing type 1, pressure restrictions apply as indicated in the formula below.

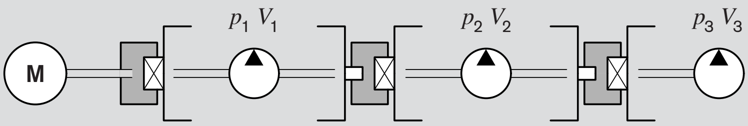
Reinforced through drives are available for applications with higher transfer torques and/or rotational vibrations. Customized designs available on request.



Combinations

Series Pump 1	$M_{\text{max.}}$ [Nm]	Series Pump 2
F	25	B
B	25	B

When configuring multiple pumps, the pumps are to be ordered according to the largest displacement on the drive side, e.g. BB, FB, SB, JB as double, FBB, SBB, JBB, NFB, GFB, TSB, USB as triple.

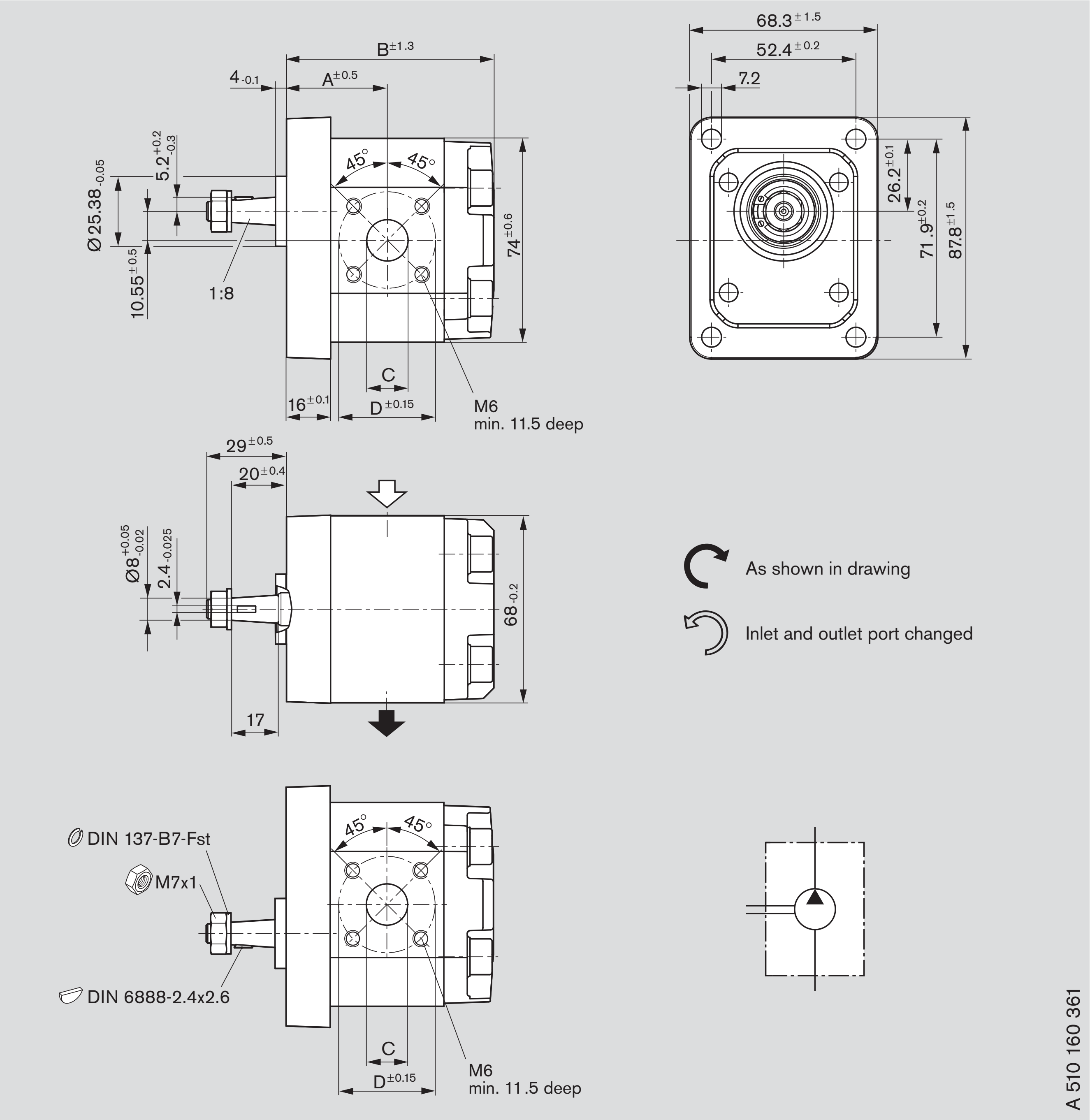


$$M_{\text{max.}} \geqq \Delta p_1 \cdot V_1 \cdot 0{,}0177 + \Delta p_2 \cdot V_2 \cdot 0{,}0177 + \Delta p_3 \cdot V_3 \cdot 0{,}0177$$

Δp [bar] V [cm^3/rev]

Dimensions

Standard range



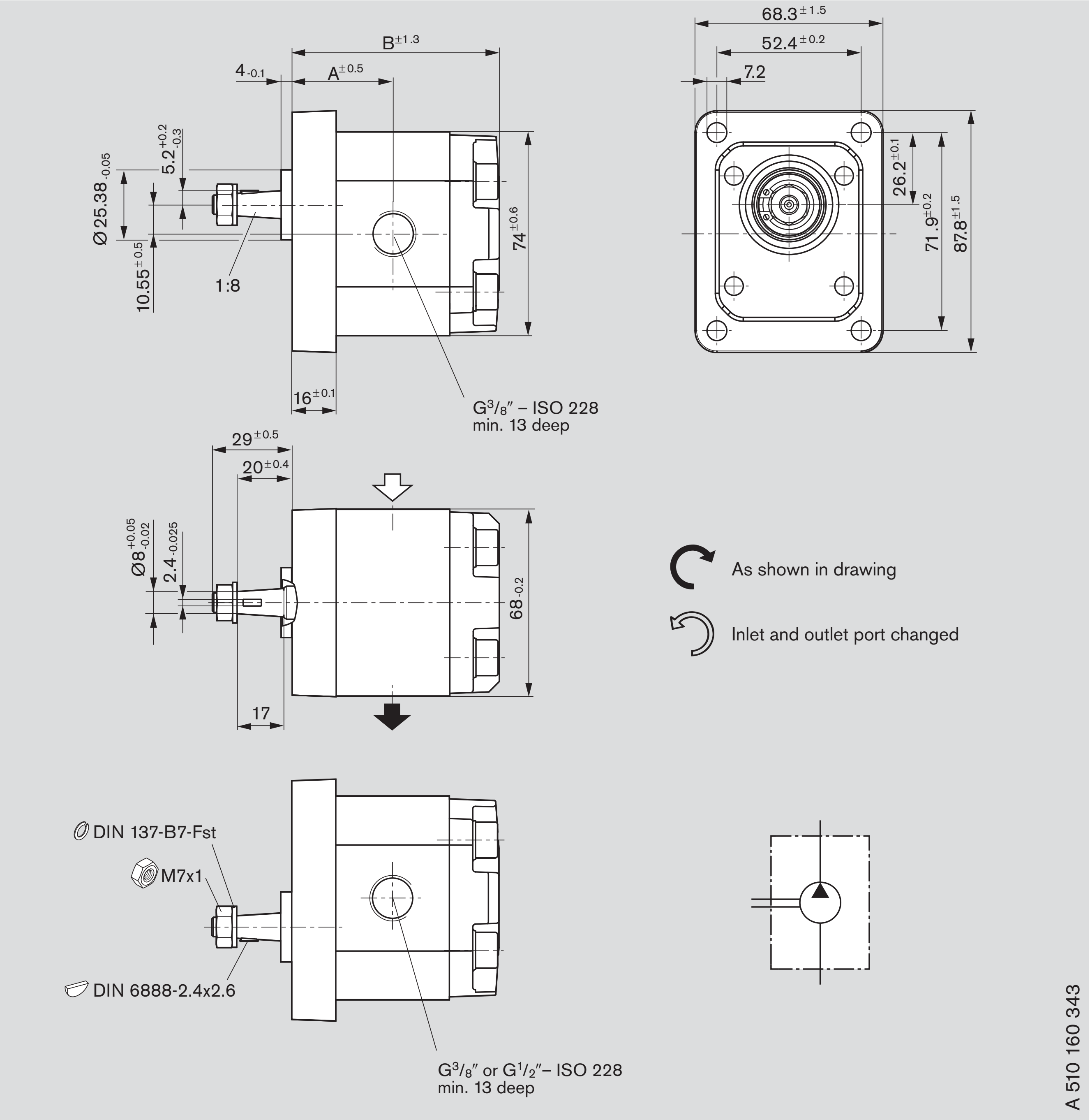
Ordering code:

AZPB – 32 – ☐☐☐ ☐ H O 20 M B

Displacement [cm³/rev]	Ordering-No. L	 R	max. operating pressure [bar]	max. rotation speed [rpm]	Mass [kg]	Dimension [mm] A	 B	 C	 D
2	**0 510 120 326**	**0 510 120 028**	250	5,000		32.8	67.9	12	30
2.5	**0 510 120 327**	**0 510 120 029**	250	5,000		33.8	69.8	12	30
3.15	**0 510 120 328**	**0 510 120 030**	250	4,000		35.0	72.3	15	35
4	**0 510 120 329**	**0 510 120 031**	250	4,000		36.6	75.5	15	35
4.5	**0 510 120 330**	**0 510 120 032**	250	4,000		37.6	77.4	15	35
5	**0 510 120 331**	**0 510 120 033**	250	4,000		38.6	79.5	15	35
6.3	**0 510 120 332**	**0 510 120 034**	250	3,500		41.0	84.2	15	35
7.1	**0 510 120 333**	**0 510 120 035**	230	3,500		42.5	87.3	15	35

Dimensions

Standard range

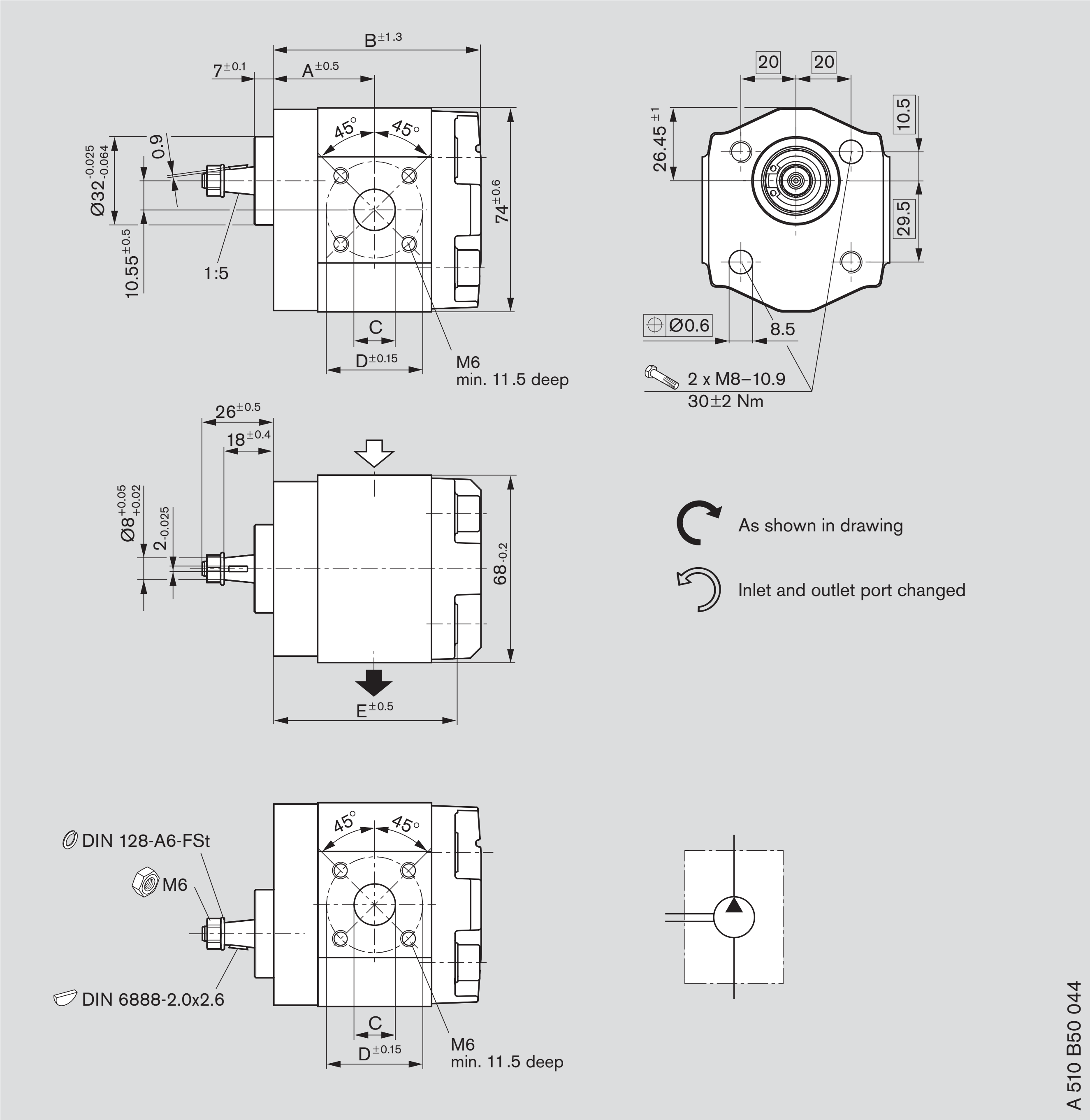


Ordering code:
AZPB – 32 – ☐☐☐ ☐H O 01 M B

Displacement [cm^3/rev]	Ordering-No. L	Ordering-No. R	max. operating pressure [bar]	max. rotation speed [rpm]	Mass [kg]	Dimension [mm] A	Dimension [mm] B	Version
1	**0 510 020 303**	**0 510 020 003**	250	6,000		30.9	64.1	$^{3}/_{8}$
2	**0 510 120 318**	**0 510 120 020**	250	5,000		32.8	67.9	$^{3}/_{8}$
2.5	**0 510 120 319**	**0 510 120 021**	250	5,000		33.8	69.8	$^{3}/_{8}$
3.15	**0 510 120 320**	**0 510 120 022**	250	4,000		35.0	72.3	$^{3}/_{8}$
4	**0 510 120 321**	**0 510 120 023**	250	4,000		36.6	75.5	$^{1}/_{2}$
4.5	**0 510 120 322**	**0 510 120 024**	250	4,000		37.6	77.4	$^{1}/_{2}$
5	**0 510 120 323**	**0 510 120 025**	250	4,000		38.6	79.5	$^{1}/_{2}$
6.3	**0 510 120 324**	**0 510 120 026**	250	3,500		41.0	84.2	$^{1}/_{2}$
7.1	**0 510 120 325**	**0 510 120 027**	230	3,500		42.5	87.3	$^{1}/_{2}$

Dimensions

Standard range

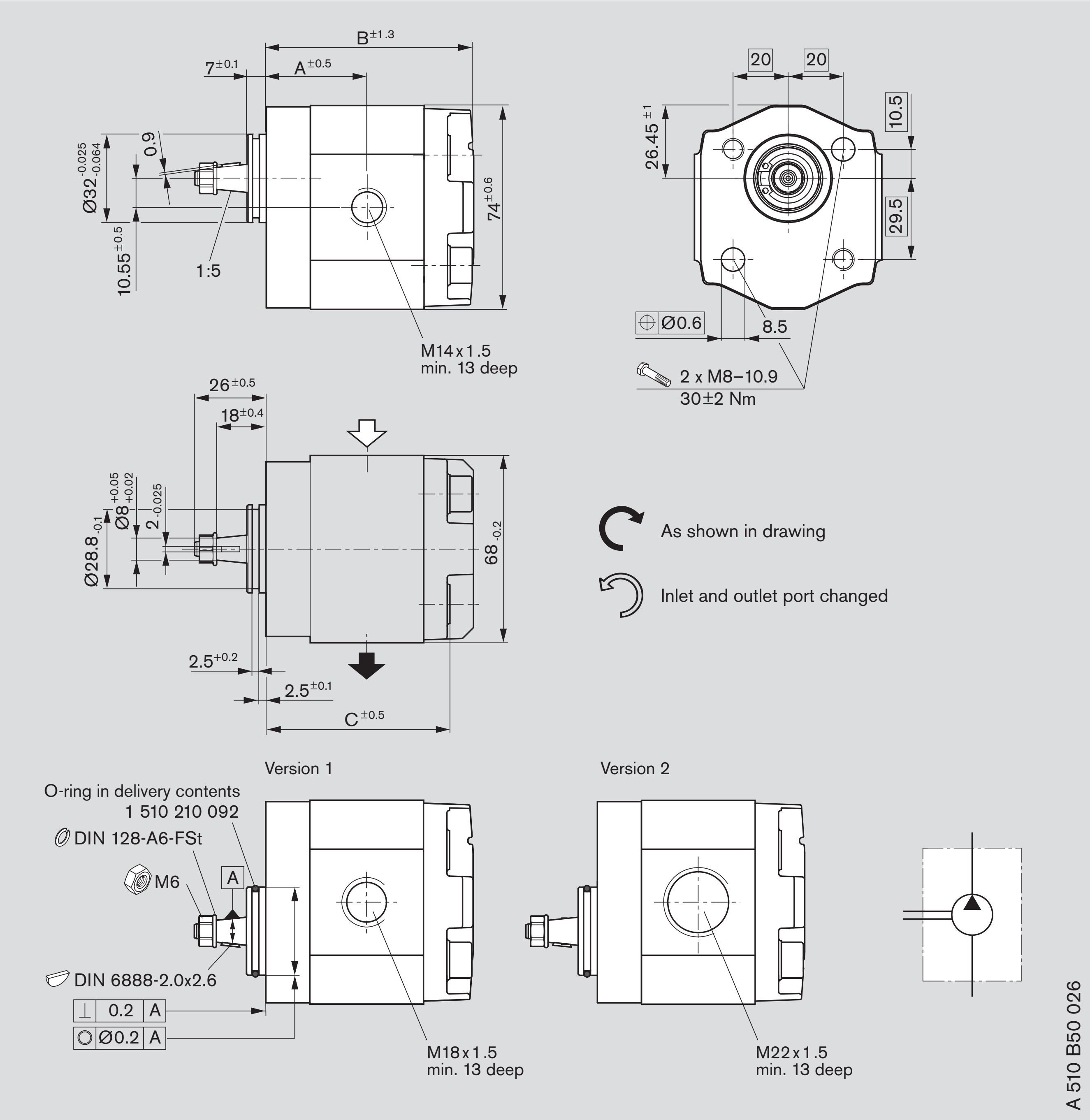


Ordering code:
AZPB – 32 – ☐☐☐ ☐ C P 20 M B

Displacement [cm³/rev]	Ordering-No. L	 R	max. operating pressure [bar]	max. rotation speed [rpm]	Mass [kg]	Dimension [mm] A	 B	 C	 D	 E
2	**0 510 110 332**	**0 510 110 025**	250	5,000		32.8	67.9	12	30	59.0
2.5	**0 510 110 333**	**0 510 110 026**	250	5,000		33.8	69.8	12	30	60.9
3.15	**0 510 112 325**	**0 510 112 019**	250	4,000		35.0	72.3	15	35	63.4
4	**0 510 114 336**	**0 510 114 030**	250	4,000		36.6	75.5	15	35	66.6
4.5	**0 510 114 337**	**0 510 114 031**	250	4,000		37.6	77.4	15	35	68.5
5	**0 510 114 338**	**0 510 114 032**	250	4,000		38.6	79.5	15	35	70.6
6.3	**0 510 122 324**	**0 510 122 020**	250	3,500		41.0	84.2	15	35	75.3
7.1	**0 510 122 325**	**0 510 122 021**	230	3,500		42.5	87.3	15	35	78.4

Dimensions

Standard range

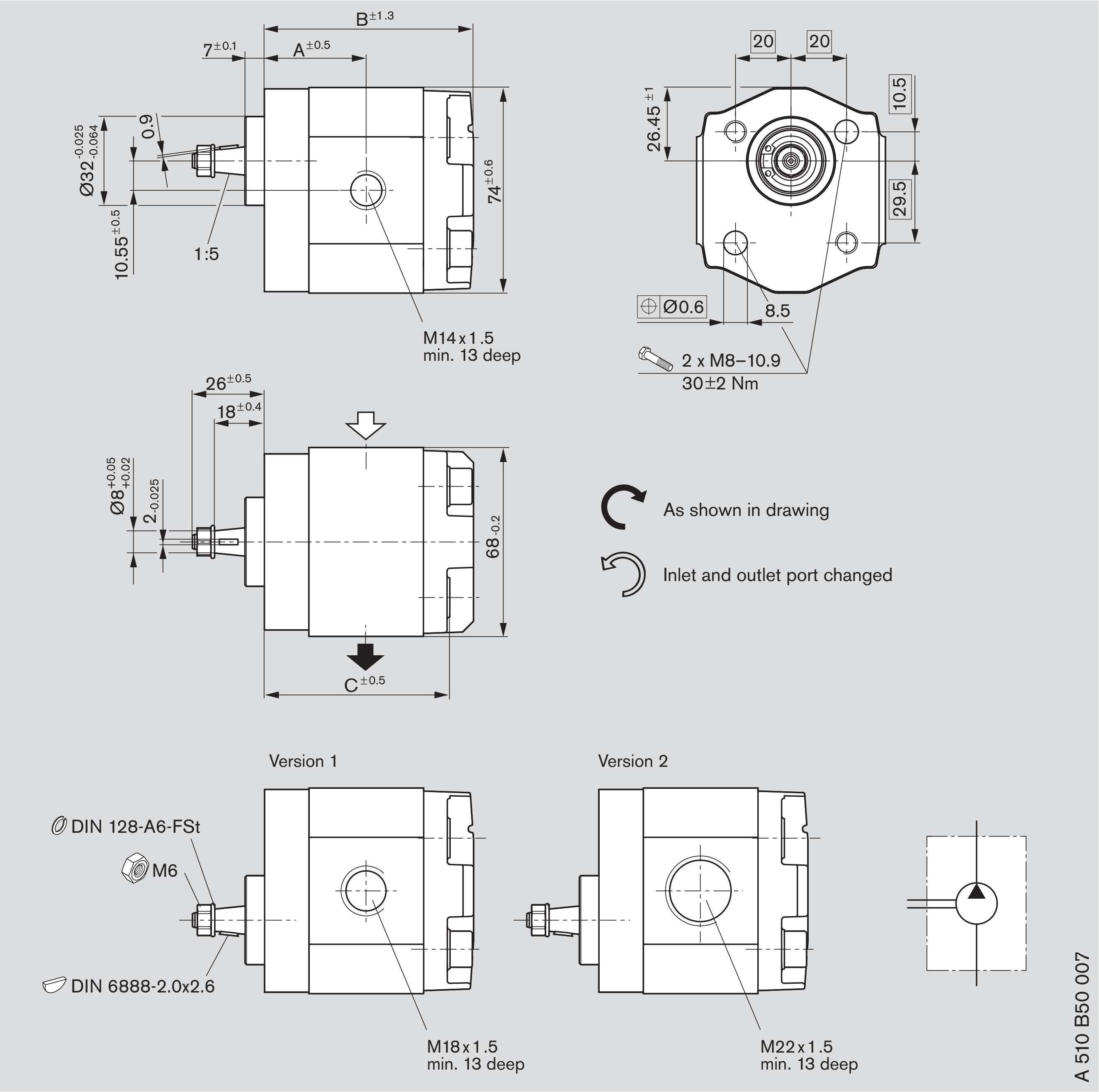


Ordering code:
AZPB – 32 – ☐☐☐ ☐ C P 02 M B

Displacement [cm^3/rev]	Ordering-No. L	Ordering-No. R	max. operating pressure [bar]	max. rotation speed [rpm]	Mass [kg]	Dimension [mm] A	B	C	Version
1	**0 510 010 315**	**0 510 010 010**	250	6,000		30.9	64.1	55.2	1
2	**0 510 110 328**	**0 510 110 022**	250	5,000		32.8	67.9	59.0	1
2.5	**0 510 110 329**	**0 510 110 023**	250	5,000		33.8	69.8	60.9	1
3.15	**0 510 112 323**	**0 510 112 018**	250	4,000		35.0	72.3	63.4	1
4	**0 510 114 330**	**0 510 114 025**	250	4,000		36.6	75.5	66.6	2
4.5	**0 510 114 331**	**0 510 114 026**	250	4,000		37.6	77.4	68.5	2
5	**0 510 114 332**	**0 510 114 027**	250	4,000		38.6	79.5	70.6	2
6.3	**0 510 122 320**	**0 510 122 016**	250	3,500		41.0	84.2	75.3	2
7.1	**0 510 122 321**	**0 510 122 017**	230	3,500		42.5	87.3	78.4	2

Dimensions

Standard range



Ordering code:

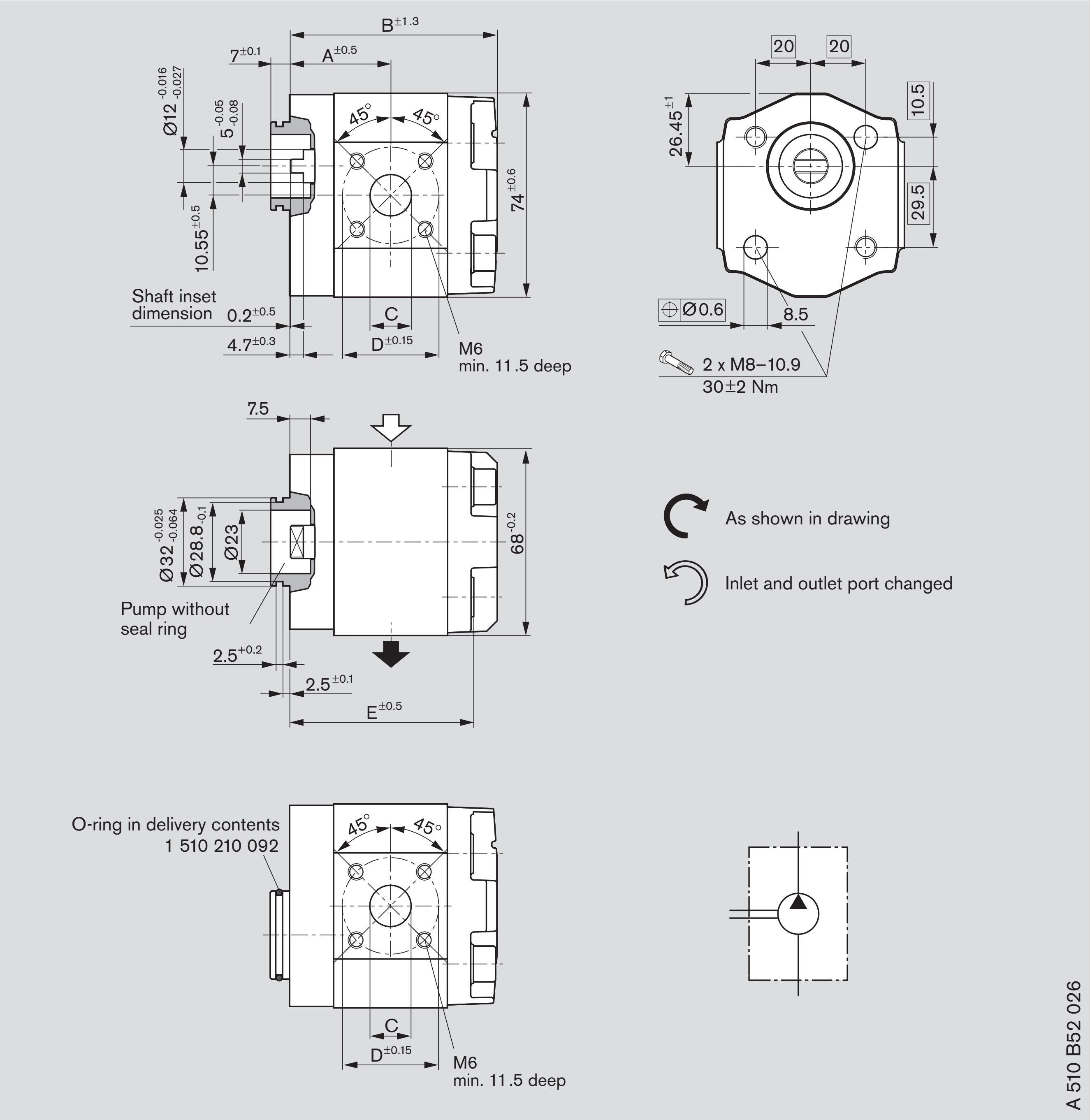
AZPB – 32 – ☐☐☐ ☐ C P 02 M B

AZPB – 32 – ☐☐☐ ☐ C P 02 K B*

Displacement [cm³/rev]	Ordering-No. L	 R	max. operating pressure [bar]	max. rotation speed [rpm]	Mass [kg]	Dimension [mm] A	 B	 C	 Version
1	**0 510 010 313**	**0 510 010 008**	250	6,000		30.9	64.1	55.2	1
2	**0 510 110 324**	**0 510 110 017**	250	5,000		32.8	67.9	59.0	1
2.5	**0 510 110 325**	**0 510 110 018**	250	5,000		33.8	69.8	60.9	1
3.15		**0 510 112 015***	250	4,000		35.0	72.3	63.4	1
3.15	**0 510 112 321**	**0 510 112 014**	250	4,000		35.0	72.3	63.4	1
4	**0 510 114 324**	**0 510 114 018**	250	4,000		36.6	75.5	66.5	2
4.5	**0 510 114 325**	**0 510 114 019**	250	4,000		37.6	77.4	68.5	2
5	**0 510 114 326**	**0 510 114 020**	250	4,000		38.6	79.5	70.6	2
6.3	**0 510 122 316**	**0 510 122 012**	250	3,500		41.0	84.2	75.3	2
7.1	**0 510 122 317**	**0 510 122 013**	230	3,500		42.5	87.3	78.4	2

Dimensions

Standard range

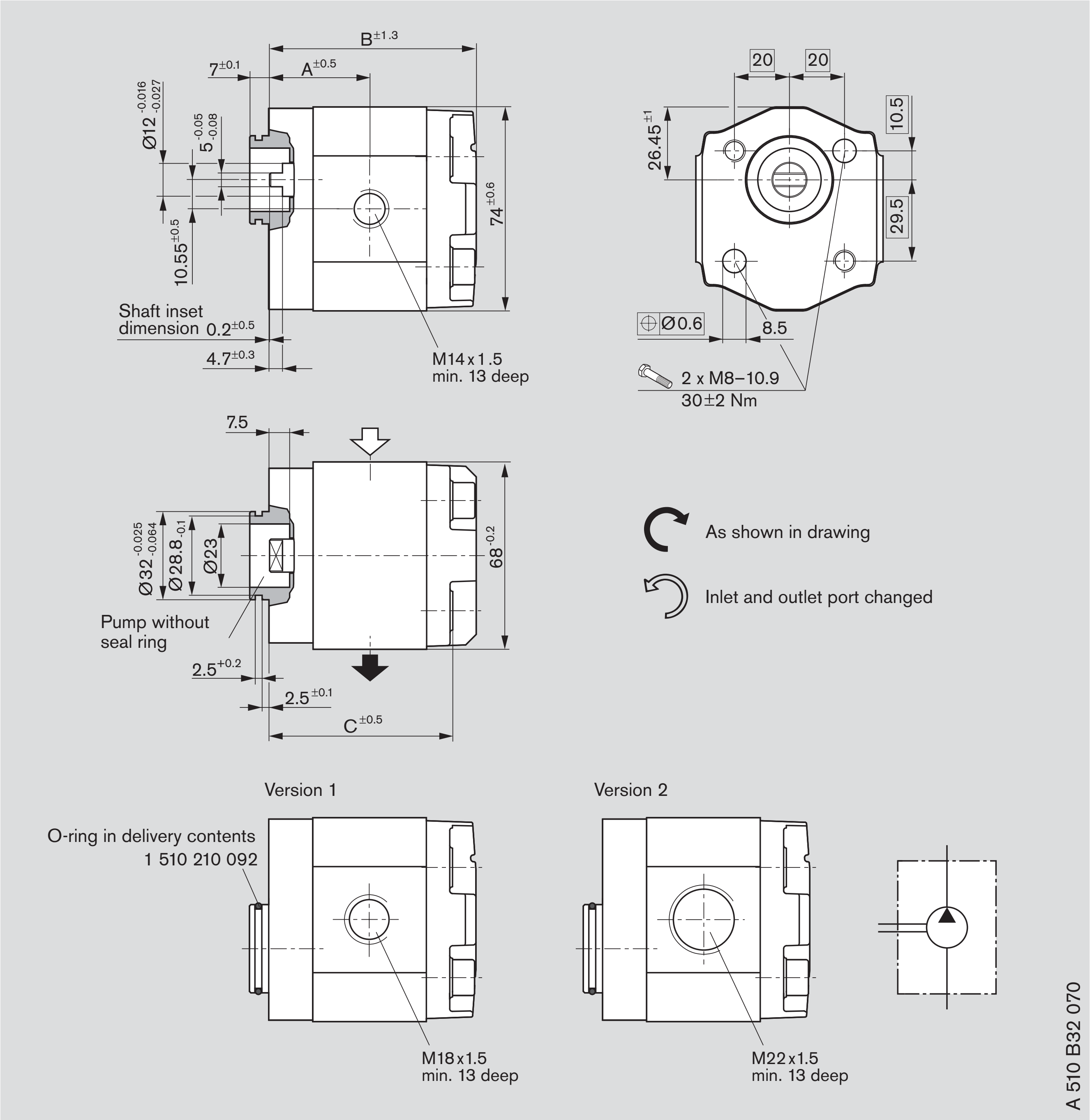


Ordering code:
AZPB – 32 – ☐☐☐ ☐N M 20 M B

Displacement [cm³/rev]	Ordering-No. L	 R	max. operating pressure [bar]	max. rotation speed [rpm]	Mass [kg]	Dimension [mm] A	 B	 C	 D	 E
2	**0 510 110 334**	**0 510 110 027**	250	5,000		32.8	67.9	12	30	59.0
2.5	**0 510 110 335**	**0 510 110 028**	250	5,000		33.8	69.8	12	30	60.9
3.15	**0 510 112 326**	**0 510 112 020**	250	4,000		35.0	72.3	15	35	63.4
4	**0 510 114 339**	**0 510 114 033**	250	4,000		36.6	75.5	15	35	66.6
4.5	**0 510 114 340**	**0 510 114 034**	250	4,000		37.6	77.4	15	35	68.5
5	**0 510 114 341**	**0 510 114 035**	250	4,000		38.6	79.5	15	35	70.6
6.3	**0 510 122 326**	**0 510 122 022**	250	3,500		41.0	84.2	15	35	75.3
7.1	**0 510 122 327**	**0 510 122 023**	230	3,500		42.5	87.3	15	35	78.4

Dimensions

Standard range



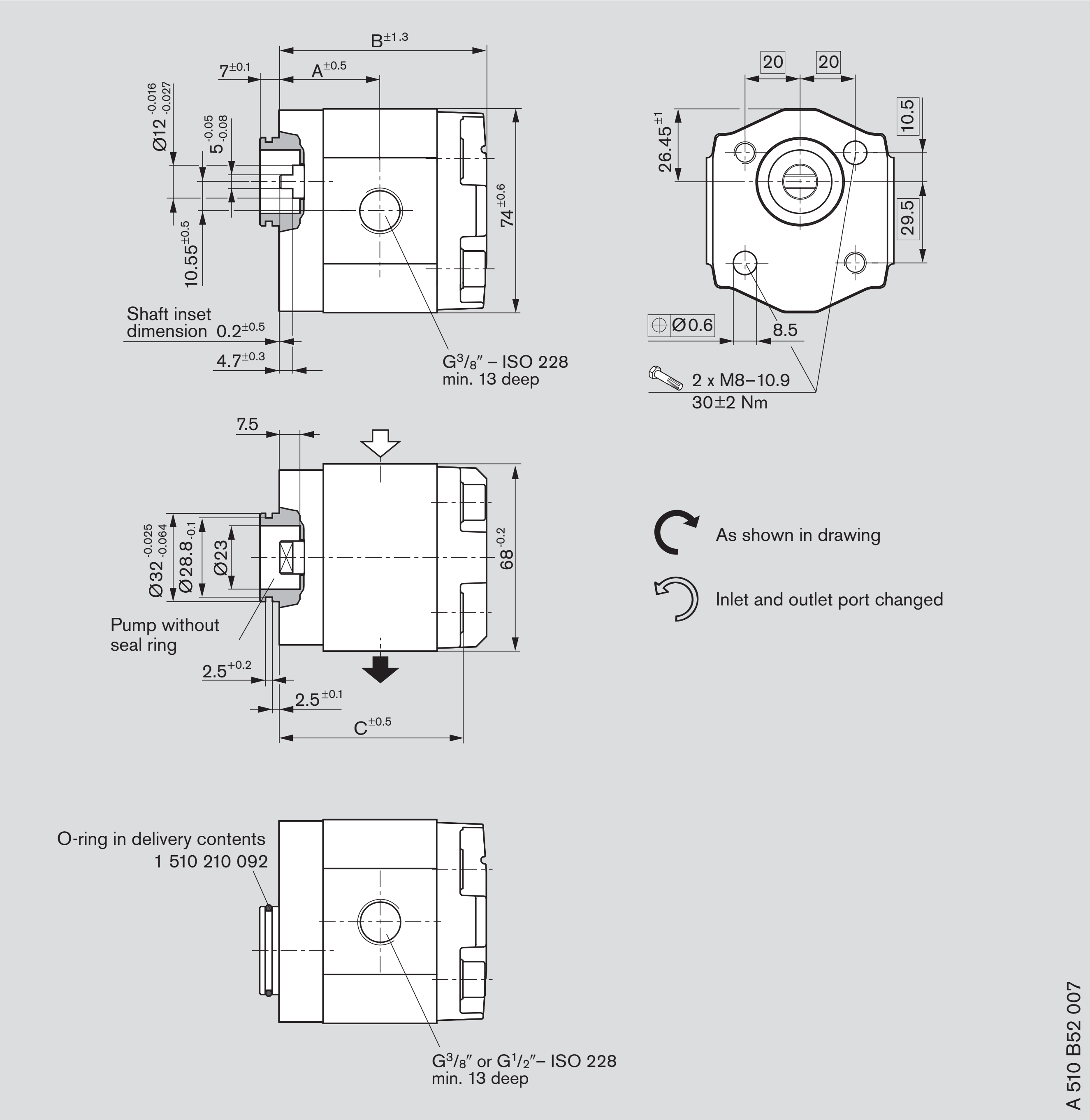
Ordering code:

AZPB – 32 – ☐☐☐ ☐ N M 02 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	max. operating pressure [bar]	max. rotation speed [rpm]	Mass [kg]	Dimension [mm] A	B	C	Version
1	**0 510 010 314**	**0 510 010 009**	250	6,000		30.9	64.1	55.2	1
2	**0 510 110 326**	**0 510 110 019**	250	5,000		32.8	67.9	59.0	1
2.5	**0 510 110 327**	**0 510 110 020**	250	5,000		33.8	69.8	60.9	1
3.15	**0 510 112 322**	**0 510 112 016**	250	4,000		35.0	72.3	63.4	1
4	**0 510 114 327**	**0 510 114 021**	250	4,000		36.6	75.5	66.6	2
4.5	**0 510 114 328**	**0 510 114 022**	250	4,000		37.6	77.4	68.5	2
5	**0 510 114 329**	**0 510 114 023**	250	4,000		38.6	79.5	70.6	2
6.3	**0 510 122 318**	**0 510 122 014**	250	3,500		41.0	84.2	75.3	2
7.1	**0 510 122 319**	**0 510 122 015**	230	3,500		42.5	87.3	78.4	2

Dimensions

Standard range



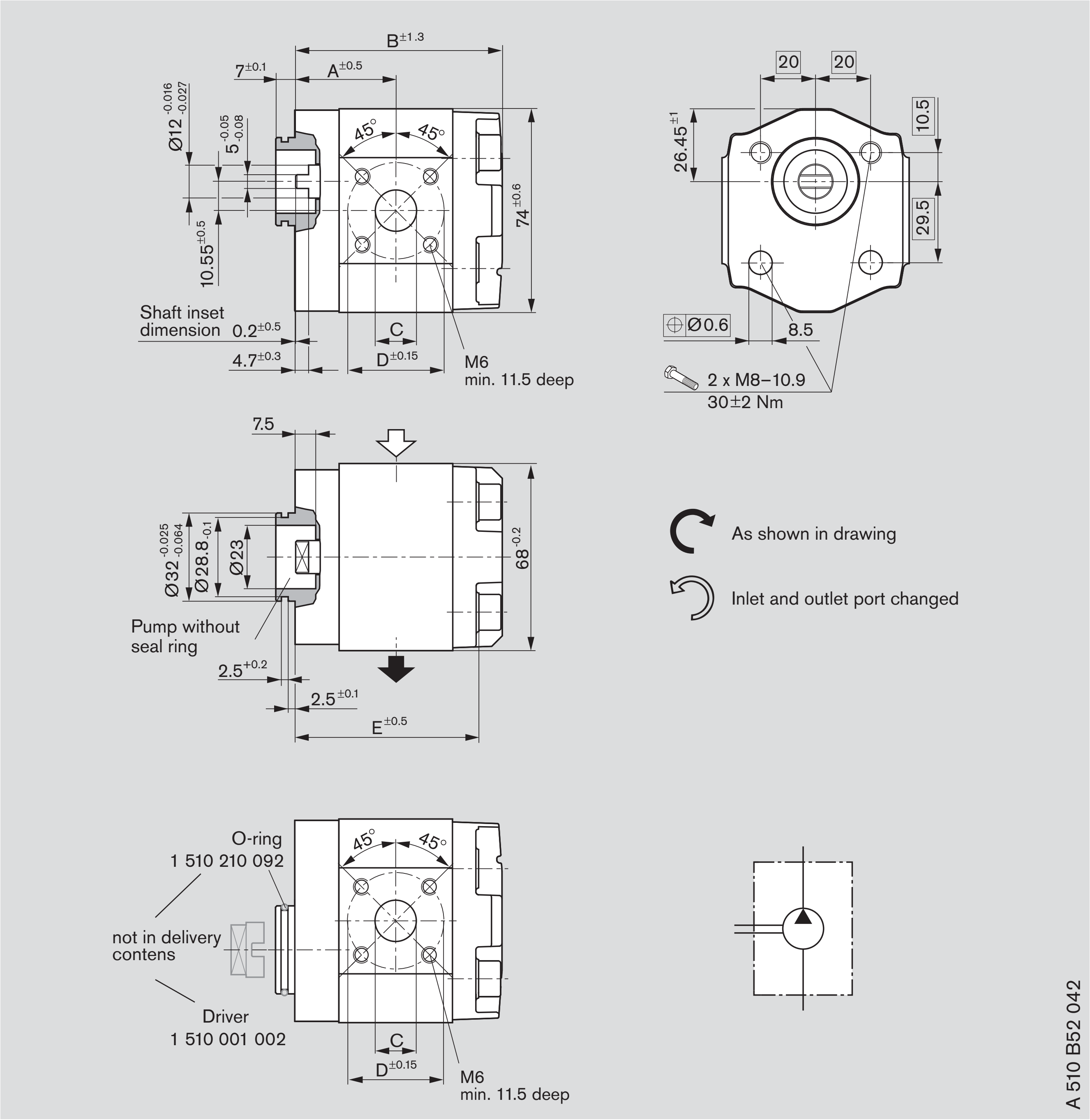
Ordering code:

AZPB – 32 – ☐☐☐ ☐N M 01 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	max. operating pressure [bar]	max. rotation speed [rpm]	Mass [kg]	Dimension [mm] A	B	C	Version
1	**0 510 010 316**	**0 510 010 011**	250	6,000		30.9	64.1	55.2	$^{3}/_{8}$
2	**0 510 110 330**	**0 510 110 021**	250	5,000		32.8	67.9	59.0	$^{3}/_{8}$
2.5	**0 510 110 331**	**0 510 110 024**	250	5,000		33.8	69.8	60.9	$^{3}/_{8}$
3.15	**0 510 112 324**	**0 510 112 017**	250	4,000		35.0	72.3	63.4	$^{3}/_{8}$
4	**0 510 114 333**	**0 510 114 028**	250	4,000		36.6	75.5	66.6	$^{1}/_{2}$
4.5	**0 510 114 334**	**0 510 114 024**	250	4,000		37.6	77.4	68.5	$^{1}/_{2}$
5	**0 510 114 335**	**0 510 114 029**	250	4,000		38.6	79.5	70.6	$^{1}/_{2}$
6.3	**0 510 122 322**	**0 510 122 018**	250	3,500		41.0	84.2	75.3	$^{1}/_{2}$
7.1	**0 510 122 323**	**0 510 122 019**	230	3,500		42.5	87.3	78.4	$^{1}/_{2}$

Dimensions

Standard range



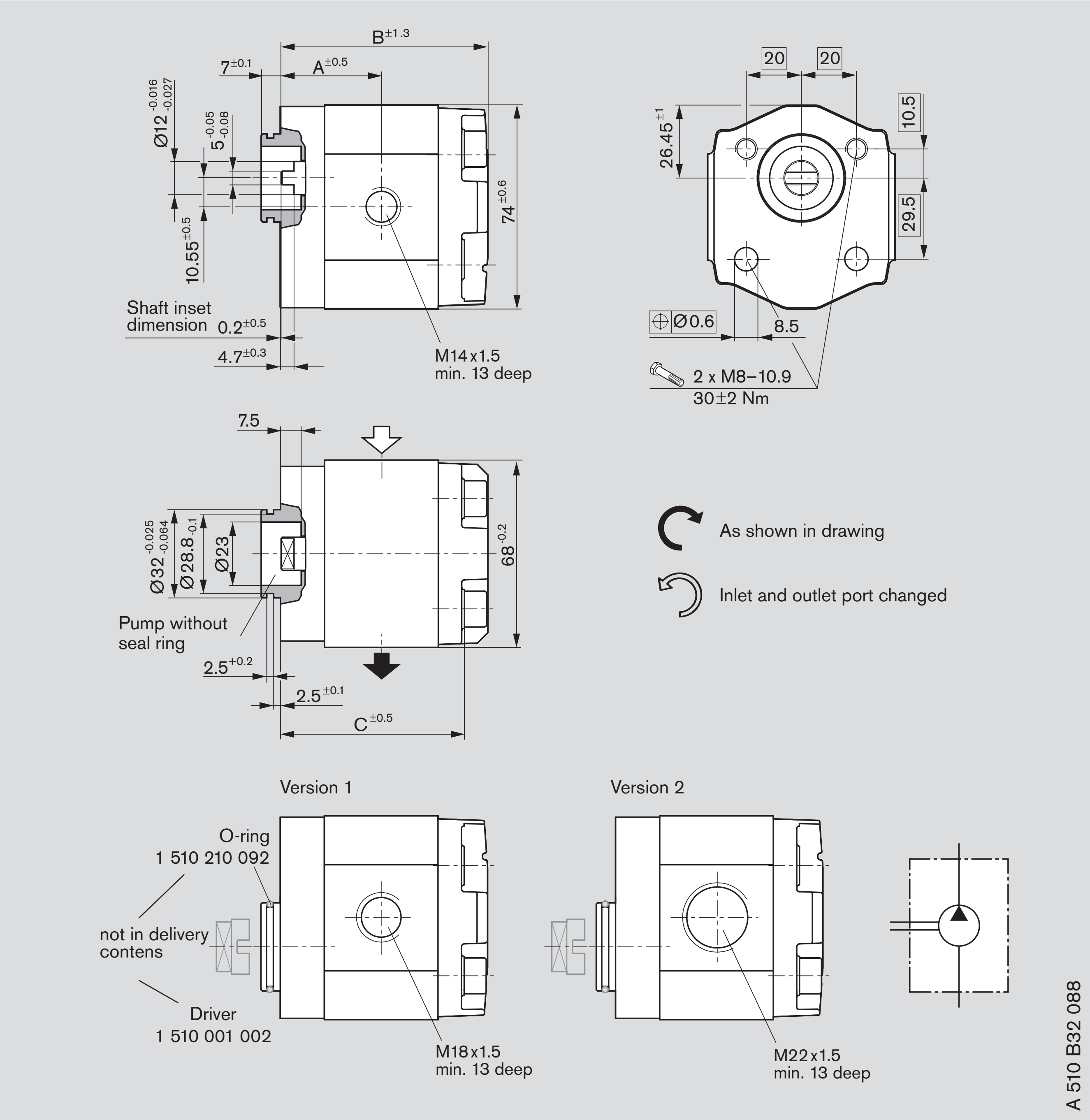
Ordering code:

AZPB – 32 – ☐☐☐ ☐ N Y 20 M B

Displacement	Ordering-No.		max. operating	max. rotation	Mass	Dimension [mm]				
[cm³/rev]	L	R	pressure [bar]	speed [rpm]	[kg]	A	B	C	D	E
2	**1 519 222 469**	**1 519 222 468**	250	5,000		32.8	67.9	12	30	59.0
2.5	**1 519 222 471**	**1 519 222 470**	250	5,000		33.8	69.8	12	30	60.9
3.15	**1 519 222 473**	**1 519 222 472**	250	4,000		35.0	72.3	15	35	63.4
4	**1 519 222 475**	**1 519 222 474**	250	4,000		36.6	75.5	15	35	66.6
4.5	**1 519 222 477**	**1 519 222 476**	250	4,000		37.6	77.4	15	35	68.5
5	**1 519 222 479**	**1 519 222 478**	250	4,000		38.6	79.5	15	35	70.6
6.3	**1 519 222 481**	**1 519 222 480**	250	3,500		41.0	84.2	15	35	75.3
7.1	**1 519 222 483**	**1 519 222 482**	230	3,500		42.5	87.3	15	35	78.4

Dimensions

Standard range

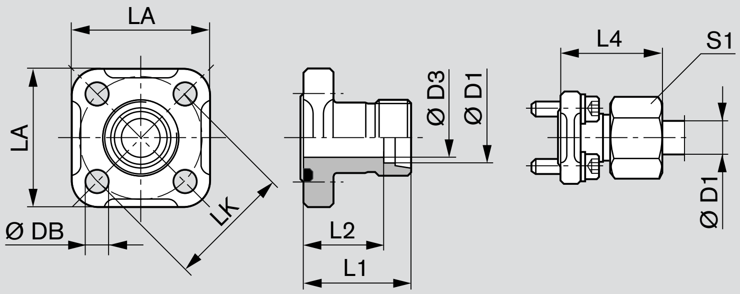


Ordering code:
AZPB – 32 – ☐☐☐ ☐N Y 02 M B

Displacement [cm³/rev]	Ordering-No. L	 R	max. operating pressure [bar]	max. rotation speed [rpm]	Mass [kg]	Dimension [mm] A	 B	 C	 Version
1	**1 519 222 444**	**1 519 222 443**	250	6,000		30.9	64.1	55.2	1
2	**1 519 222 446**	**1 519 222 445**	250	5,000		32.8	67.9	59.0	1
2.5	**1 519 222 448**	**1 519 222 447**	250	5,000		33.8	69.8	60.9	1
3.15	**1 519 222 450**	**1 519 222 449**	250	4,000		35.0	72.3	63.4	1
4	**1 519 222 452**	**1 519 222 451**	250	4,000		36.6	75.5	66.6	2
4.5	**1 519 222 454**	**1 519 222 453**	250	4,000		37.6	77.4	68.5	2
5	**1 519 222 456**	**1 519 222 455**	250	4,000		38.6	79.5	70.6	2
6.3	**1 519 222 458**	**1 519 222 457**	250	3,500		41.0	84.2	75.3	2
7.1	**1 519 222 460**	**1 519 222 459**	230	3,500		42.5	87.3	78.4	2

Fittings

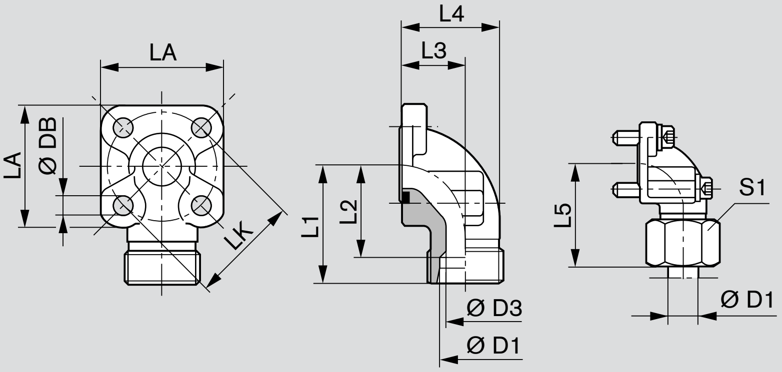
Gear pump flange, straight, for rectangular flange 20 see page 7



LK	D1	D3	L1	L2	L4	LA	S1	DB	Screws (metr.) 4 pieces	Seal ring	Mass kg	Part number	*p* (bar)
35	10L	8	30	23.0	39.0	40	19	6.4	M6x22	20x2.5	0.09	**1 515 702 064**	315
35	12L	10	30	23.0	39.0	40	22	6.4	M6x22	20x2.5	0.10	**1 515 702 065**	315
35	15L	12	30	23.0	38.0	40	27	6.4	M6x22	20x2.5	0.10	**1 515 702 066**	250

Complete fittings with seal ring, metric screw set, nuts and olive.

Gear pump flange, 90° angle, for rectangular flange 20 see page 7



LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws		Seal ring	Mass kg	Part number	*p* (bar)
											2 pieces	2 pieces				
35	10L	8	38	31.0	16.5	26.5	47.0	40	19	6.4	M6x22	M6x35	20x2.5	0.16	**1 515 702 070**	315
35	12L	10	38	31.0	16.5	26.5	47.0	40	22	6.4	M6x22	M6x35	20x2.5	0.16	**1 515 702 071**	315
35	15L	12	38	31.0	16.5	26.5	46.0	40	27	6.4	M6x22	M6x35	20x2.5	0.15	**1 515 702 072**	250
35	16S	12	38	29.5	20.0	31.0	48.0	40	30	6.4	M6x22	M6x40	20x2.5	0.18	**1 515 702 002**	315
35	18L	15	38	29.5	20.0	31.0	47.0	40	32	6.4	M6x22	M6x40	20x2.5	0.18	**1 545 702 006**	250
35	20S	16	45	34.5	25.0	38.0	56.0	40	36	6.4	M6x22	M6x45	20x2.5	0.24	**1 515 702 017**	315

Complete fittings with seal ring, metric screw set, nuts and olive.

Notes on commissioning and maintenance

Filter recommendation

The major share of premature failures in external gear pumps is caused by contaminated hydraulic fluid.
Since a warranty cannot be issued for wear caused by dirt, we recommended filtration compliant with cleanliness level 20/18/15 ISO 4406, which reduces the degree of contamination to a permissible limit in terms of the size and concentration of dirt particles:

Operating pressure [bar]	>160	<160
Contamination class ISO 4406	18/15	19/16
To be reached with $\beta_X = 75$	20	25

We recommend that a full-flow filter always be used.
Basic contamination of the hydraulic fluid used may not exceed class 20/18/15 according to ISO 4406. Experience has shown that new fluid quite often lies above this value. In such instances a filling device with special filter should be used.

General

- The pumps supplied by us have been checked for function and performance. No modifications of any kind may be made to the pumps; any such changes will render the warranty null and void!
- Pump may only be operated in compliance with permitted data (see page 12).

Project planning notes

Where external gear pumps are used we recommend that the following note be adhered to.

Technical data

All stated technical data is dependent on production tolerances and is valid for specific marginal conditions.
Note that, as a consequence, variance is possible, and at certain marginal conditions (e.g. viscosity) **the technical data may change**.

Characteristics

When designing the external gear pump, note the maximum possible service data based on the characteristics shown on pages 8 – 10.

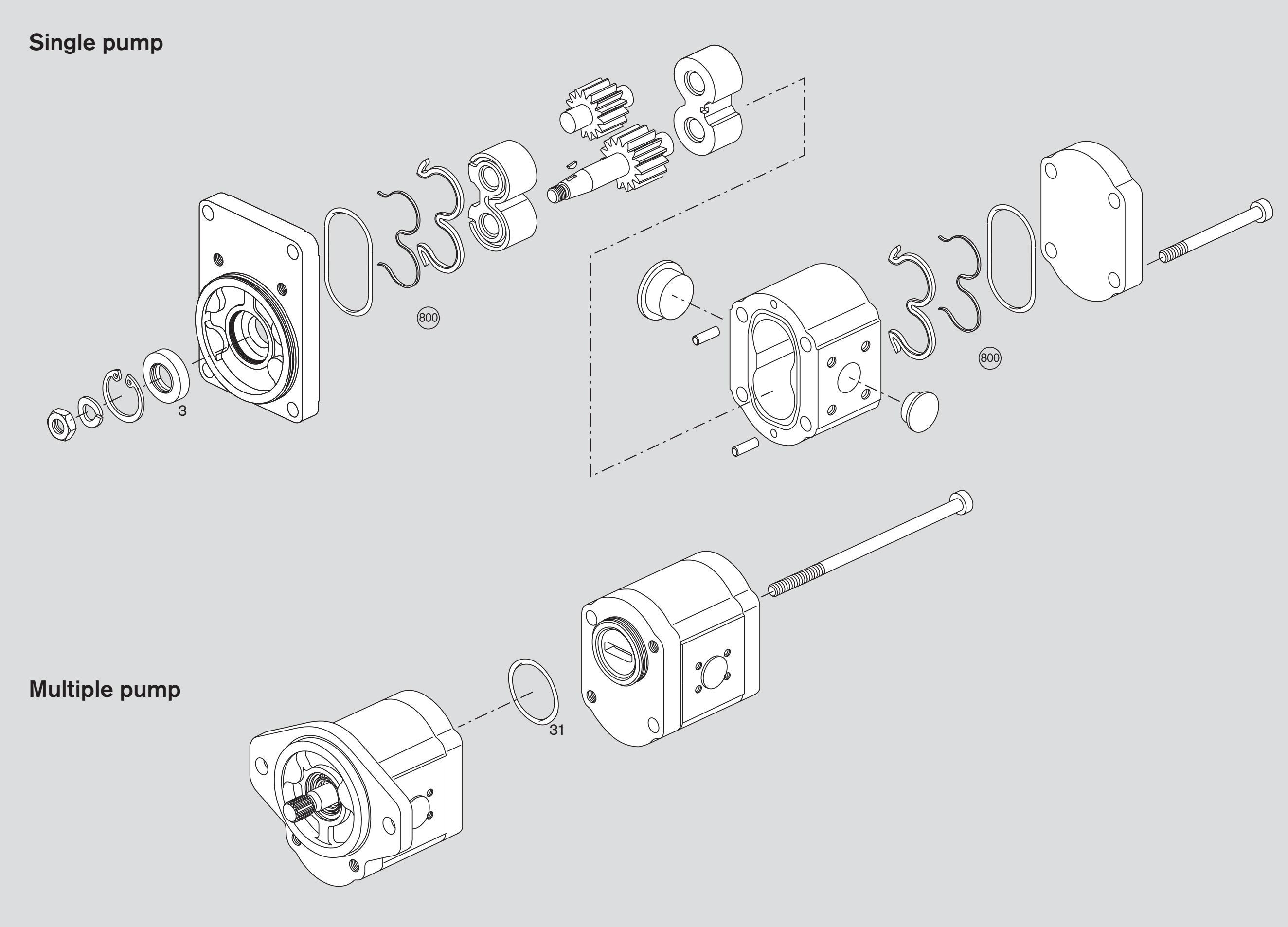
Additional information on the proper handling of hydraulic products from Bosch Rexroth is available in our document: “General product information for hydraulic products” RE 07 008.

Contained in delivery

The components with characteristics as described under ordering code and device measurements, pages 16 – 25, are contained in delivery.

You can find further information in our publication: “General Operating Instructions for External Gear Units” RE 07 012-B1.

Spare parts


Single pump

Multiple pump

Page	Ordering code	Figure	Seal kit “B” Item 800 NBR	Shaft seal ring Item 3	Dimension	Material
16	**AZPB – 32 – □□□ □ H O 20 M B**	A510160361	1517010248	1510283074	22 x 12 x 6	NBR
17	**AZPB – 32 – □□□ □ H O 01 M B**	A510160343	1517010248	1510283074	22 x 12 x 6	NBR
18	**AZPB – 32 – □□□ □ C P 20 M B**	A510B50044	1517010248	1510283074	22 x 12 x 6	NBR
19	**AZPB – 32 – □□□ □ C P 02 M B**	A510B50026	1517010248	1510283074	22 x 12 x 6	NBR
20	**AZPB – 32 – □□□ □ C P 02 K B**	A510B50007	1517010248	1510283071	22 x 12 x 6	FKM
21	**AZPB – 32 – □□□ □ N M 20 M B**	A510B52026	1517010248	–	–	–
22	**AZPB – 32 – □□□ □ N M 02 M B**	A510B32070	1517010248	–	–	–
23	**AZPB – 32 – □□□ □ N M 01 M B**	A510B52007	1517010248	–	–	–
24	**AZPB – 32 – □□□ □ N Y 20 M B**	A510B52042	1517010248	–	–	–
25	**AZPB – 32 – □□□ □ N Y 02 M B**	A510B32088	1517010248	–	–	–

NBR = Perbunan®

FKM = Viton®

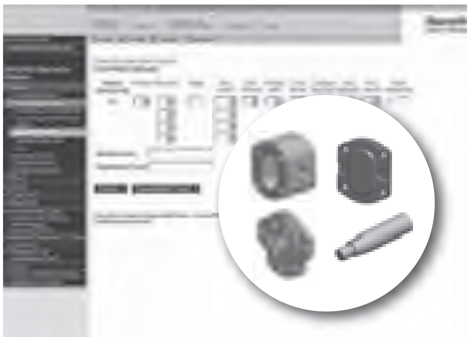
For multiple pumps

Seal ring Item 31 NBR	1 900 210 127

The AZ configurator

The AZ configurator assists you to easily-configure your individual external gear unit. You only need to specify your requirements: from the displacement, direction of rotation, drive shaft, connection flange right up to the required rear cover. You immediately receive a project drawing (PDF format) if a configuration already exists. You receive the price of the configured external gear unit upon request.

The AZ configurator assists you to easily configure your individual external gear unit – all data needed for project planning are acquired through menu guidance.



Selection is made either by an ordering code or your technical requirements. This means that you can search for external gear units that have already been configured, or you can specify the configuration variant of the external gear unit based upon the operating parameters you require.

If the external gear unit you selected has been released you will receive the part number, ordering code and a detailed installation drawing. If your special configuration is not available please send your specification to Rexroth. One of our employees will then contact you.

Ordering-No.

Ordering-No.

Notes

Rexroth
Bosch Group

External Gear Pumps
Series F

AZPF-...

Fixed pumps
$V = 4.0...28\ \text{cm}^3/\text{rev}$

Overview of contents

Features

- Nominal pressure 280 bar
- Slide bearings for heavy duty applications
- Drive shafts to ISO or SAE
- Combination of several pumps possible
- Line ports:
  connection flange or screw thread
- Consistent high quality thru mass production
- Numerous configuration variants available

General

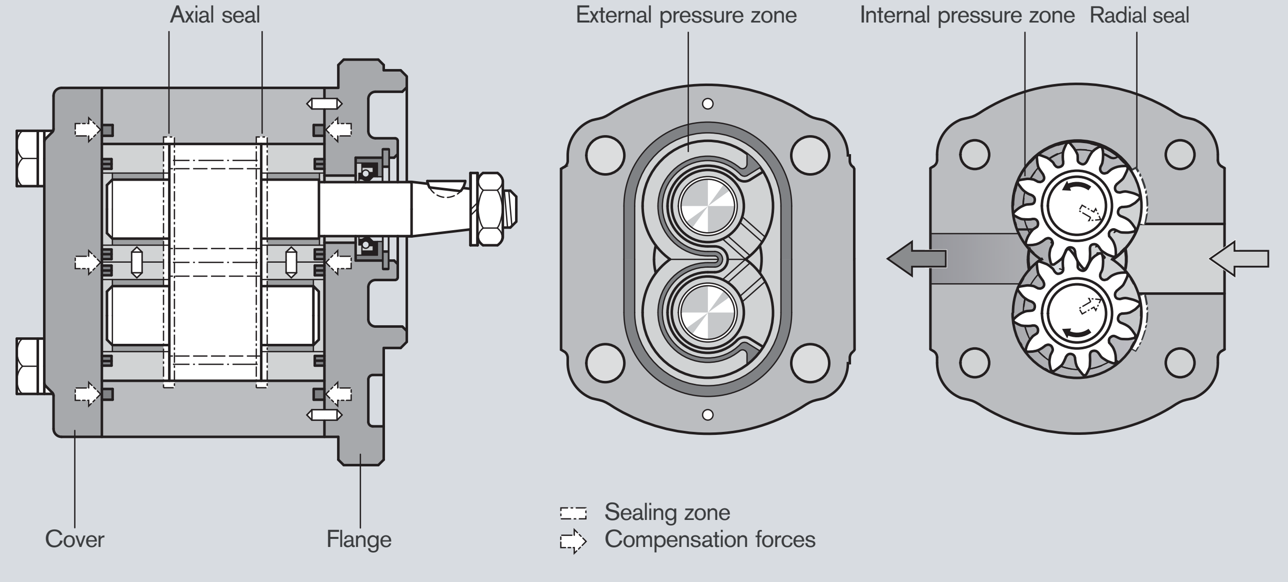
Rexroth external gear pumps are available as standard gear pumps in the 4 series of B, F, N and G and as SILENCE gear pumps in the series of S, T and U, in which the displacements are graded by different gear widths. Further configuration variants are given by different flanges, shafts, valve arrangements and multiple pump combinations.

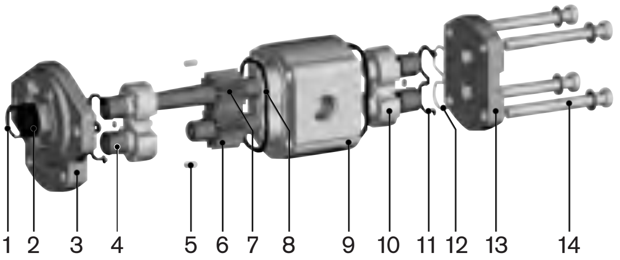
Construction

The external gear pump consists essentially of a pair of gears supported in bearing bushings and the case with a front and a rear cover. The drive shaft protrudes from the front cover where it is sealed by the shaft seal ring. The bearing forces are absorbed by special bearing bushings with sufficient elasticity to produce surface contact instead of line contact. They also ensure excellent resistance to galling – especially at low speed. The gears have 12 teeth. This keeps both flow pulsation and noise emission to a minimum.

The internal sealing is achieved by forces which are proportional to delivery pressure. This ensures optimum efficiency. The bearings provide the seal at the ends of the gaps between the teeth which carry the pressurized oil. The sealing zone between the gear teeth and the bearing is controlled by the admission of operating pressure to the rear of the bearing bushings. Special seals form the boundary of the zone. The radial clearance at the tips of the gear teeth is sealed by internal forces pushing them against the case.

Gear pump axial compensation





1	Retaining ring
2	Shaft seal ring
3	Front cover
4	Slide bearing
5	Centering pin
6	Gear
7	Gear (frictional)
8	Case seal
9	Pump case
10	Bearing
11	Axial zone seal
12	Support
13	End cover
14	Fixing screws

Product overview of “Series F” standard types

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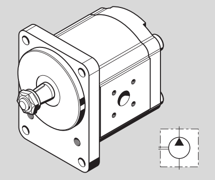
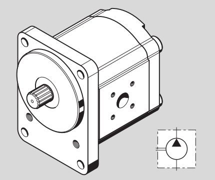
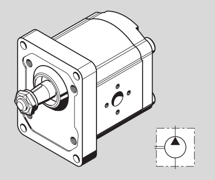
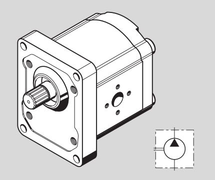
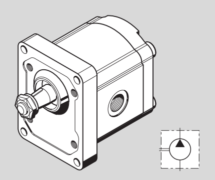
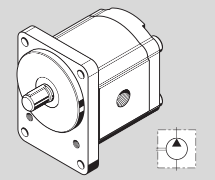
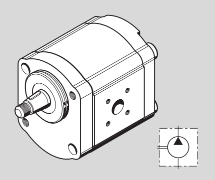
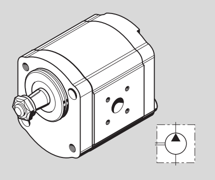
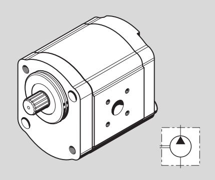
	20
	21
	22
	23
	24
	25
	26
	27
	28

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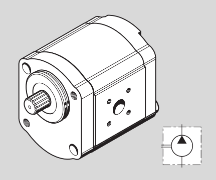
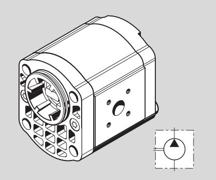
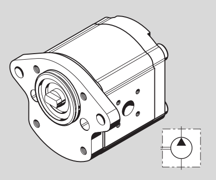
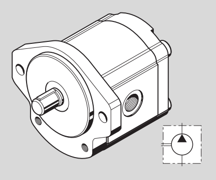
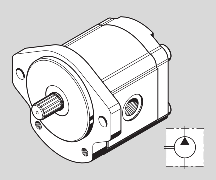
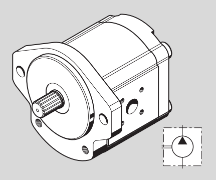
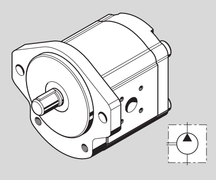
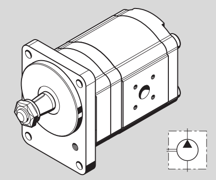
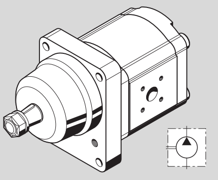
	29
	30
	31
	32
	33
	34
	35
	36
	37

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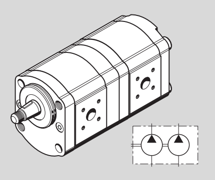
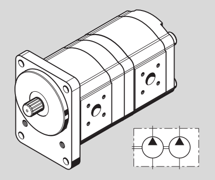
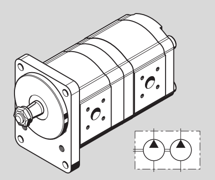
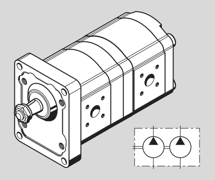
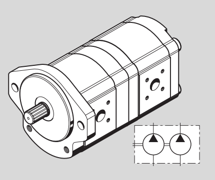
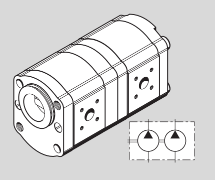
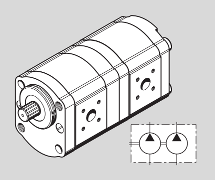
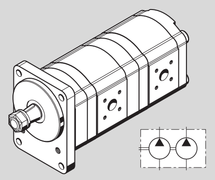
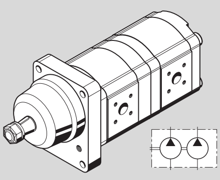
	38
	40
	42
	44
	46
	48
	49
	50
	51

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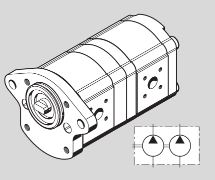
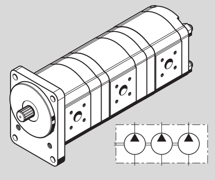
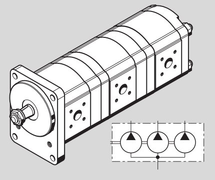
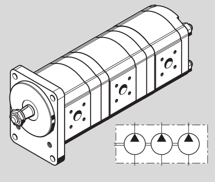
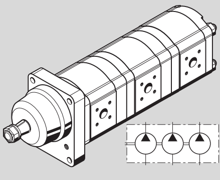
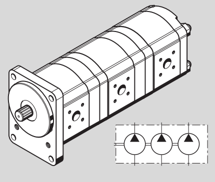
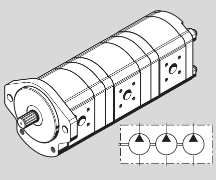
	52
	53
	54
	55
	56
	57
	58

Ordering code

External gear units, single pumps, standard

AZ	P	F	–	x	x	–		016	R	C	B	20	M	B	18009	S xxxx

Function
P = Pump

Series
1 = Standard bearing
2 = Reinforced bearing

Version
0 = Phosphatized
1 = Phosphatized, pinned
2 = Chromatized, pinned

Size (F)
004 = 4.0 cm^3/rev
005 = 5.5 cm^3/rev
008 = 8.0 cm^3/rev
011 = 11.0 cm^3/rev
014 = 14.0 cm^3/rev
016 = 16.0 cm^3/rev
019 = 19.0 cm^3/rev
022 = 22.5 cm^3/rev
025 = 25.0 cm^3/rev
028 = 28.0 cm^3/rev

Direction of rotation
R = Clockwise
L = Counterclockwise

*) Some of the special designs shown on pages 18–55 are not covered in the illustration of the ordering code.

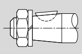
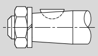
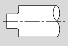
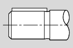
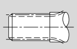
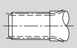
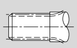
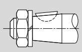
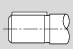
Special design *)

Valve adjustment
200 xx = PRV 200 bar
xxx 11 = FCV 11 l/min
18009 = PRV + FCV 180 bar, 9 l/min

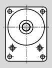
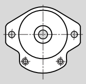
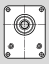
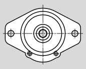
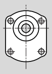
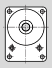
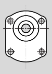
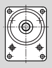
Rear cover
B = Standard
D = PRV residual flow internal
E = FCV residual flow external
S = FCV residual flow internal
V = PRV + FCV

Seals
M = NBR
P = FKM
K = NBR, SSR in FKM

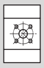
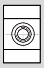
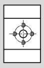
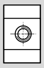
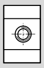
Drive shafts

			Suitable front cover		
C	Tapered key shaft 1:5		B		P
H	Tapered key shaft 1:8			O	
N	Dihedral claw			M	
Q	Straight keyed shaft SAE J 744 16-1 A			R	
R	Splined shaft SAE J 744 16-4 9T		R		C
P	Splined shaft SAE J 744 19-4 11T		R		C
F	Splined shaft DIN 5482 B 17 x 14		B		P
S	Tapered key shaft 1:5 for flange A			A	
A	Straight keyed shaft ISO Ø 18 mm			B	

Front cover

B	Square flange Centering Ø 80 mm	
R	SAE J 744 82-2 A 2-bolt flange Ø 82.55 mm	
P	2-bolt mounting Centering Ø 50 mm	
O	Square flange Centering Ø 36.47 mm	
C	SAE J 744 101-2 B 2-bolt flange Ø 101.6 mm	
M	2-bolt mounting Centering Ø 52 mm with seal ring	
A	Outboard bearing Ø 80 mm, Type 1	
N	2-bolt mounting Centering Ø 50 mm	
T	4-bolt mounting Ø 52 mm with seal ring	
G	Outboard bearing Ø 80 mm, Type 2	

Line ports

20	Rectangular flange	
12	Thread (UNF-2B) SAE Seal ring BOSS	
30	Rectangular flange	
01	Pipe thread ISO 228/1	
03	Thread, metric ISO 6149 with seal ring	

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Special options are possible upon request.

Ordering code

External gear units, multiple pumps, standard

AZ	P	GGFF	–	x	x	–	032/022/016/005	R	C	B	20 20 20 20	K	B

Function

P = Pump

Series

B = 1.0...7.1 cm³/rev
S = 4.0...28 cm³/rev
F = 4.0...28 cm³/rev
T = 20.0...36 cm³/rev
N = 20.0...36 cm³/rev
U = 22.5...63 cm³/rev
G = 22.5...63 cm³/rev

Series, relates to pump section 1

1x = Standard bearing
2x = Reinforced bearing

Version, relates to pump section 1

1 = Phosphatized, pinned
2 = Chromatized, pinned

Size

corresponding to each series

Direction of rotation

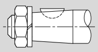
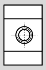
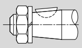
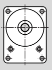
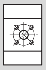
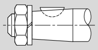
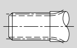
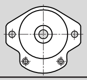
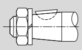
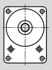
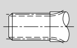
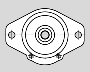
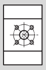
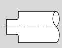
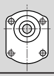
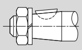
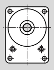
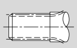
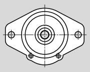
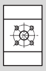
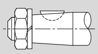
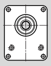
R = Clockwise,
L = Counter-clockwise

Rear cover
relates to last pump section

B = Standard

Seals

M = NBR
P = FKM
K = NBR, SSR in FKM
Shaft seal relate to pump section 1

Drive shafts relates to pump part 1				**Front cover** relates to pump part 1			**Line ports** every pump parts		
Series B:			Suitable front cover						
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 25.38 mm		**02**	Thread, metric DIN 3852 T1	
Series F, S:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 80 mm		**20**	Rectangular flange	
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 36.47 mm				
R	Splined shaft SAE J 744 16-4 9T		**R**	**R**	SAE J 744 82-2 A Centering Ø 82.55 mm 2-bolt mounting				
Series N, T:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 100 mm		**07**	Square flange SAE Thread, metric	
D	Splined shaft SAE J 744 22-4 13T		**C**	**C**	SAE J 744 101-2 B Centering Ø 101.6 mm 2-bolt mounting		**20**	Rectangular flange	
N	Dihedral claw		**M**	**M**	Centering Ø 52 mm with seal ring				
Series G, U:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 105 mm		**07**	Square flange SAE Thread, metric	
D	Splined shaft SAE J 744 22-4 13T		**C**	**C**	SAE J 744 101-2 B Centering Ø 101.6 mm 2-bolt mounting		**20**	Rectangular flange	
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 50.78 mm				

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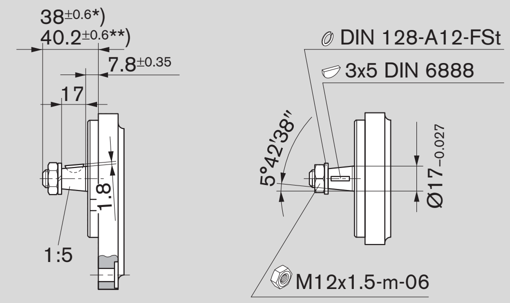
Drive shafts

C



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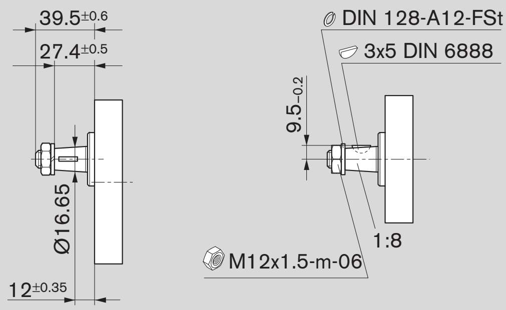

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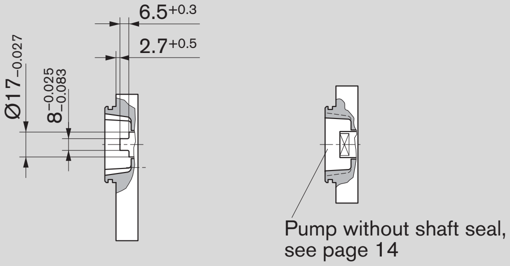

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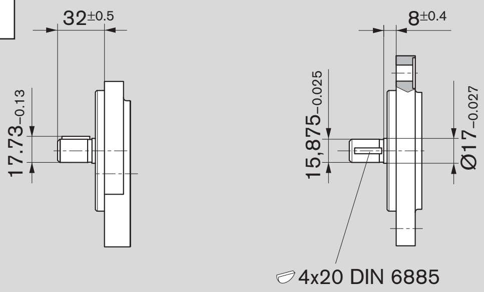

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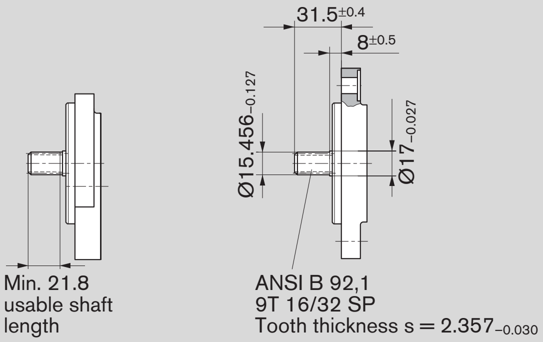

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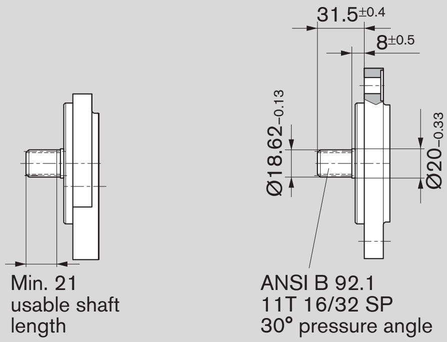

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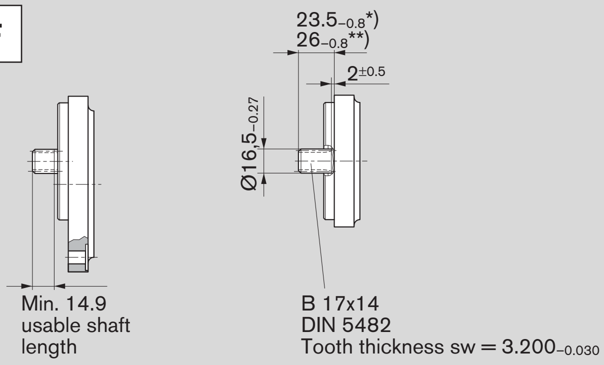

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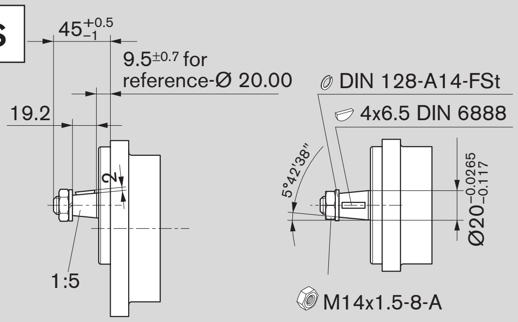
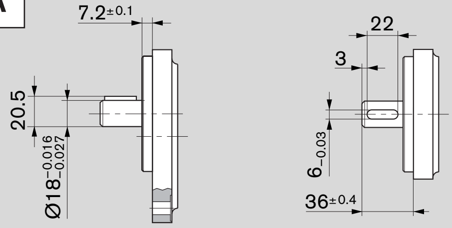


A

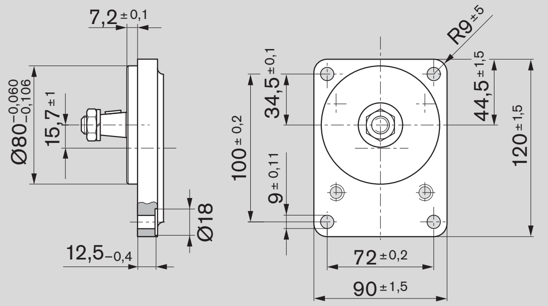


*) in combination with front cover B

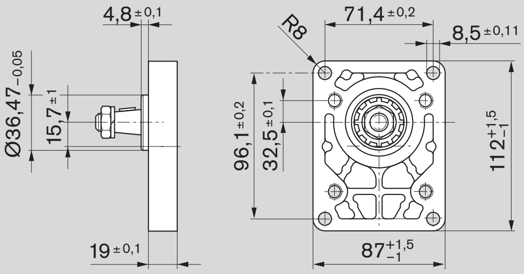
**) in combination with front cover P

Front cover

B



O



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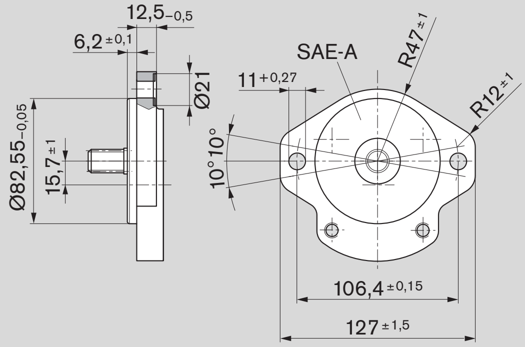

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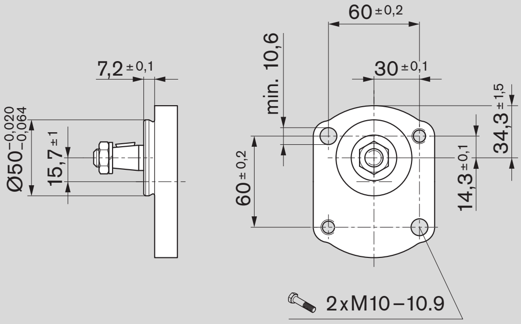

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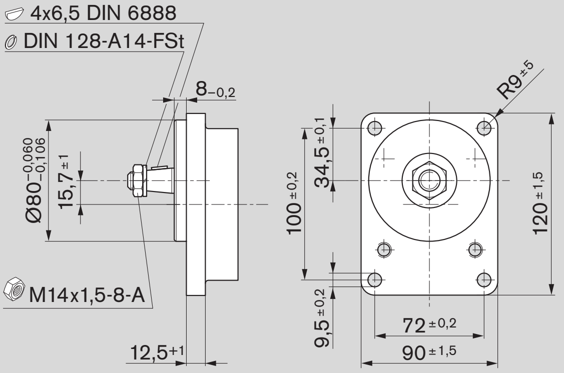

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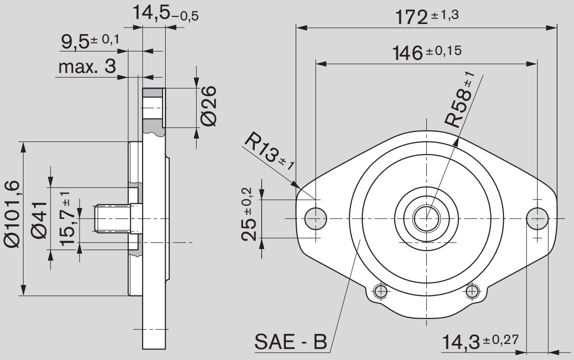

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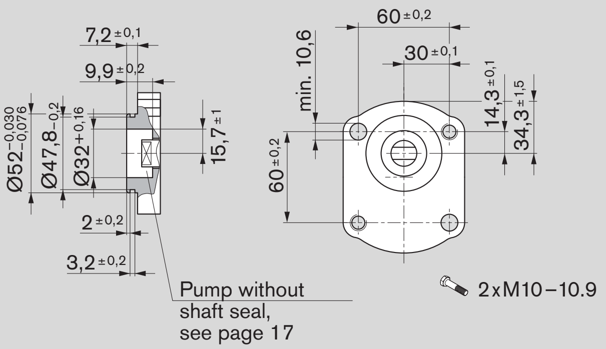

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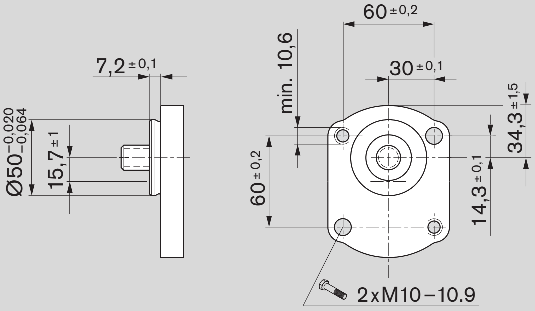
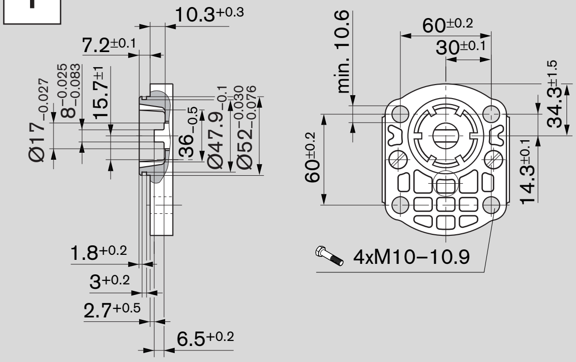


Front cover (continued)

T



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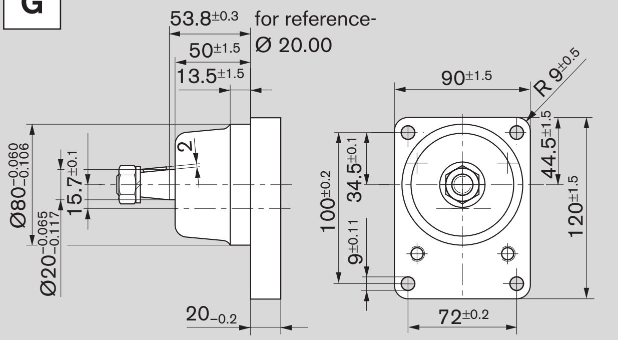
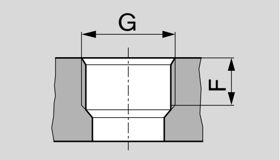


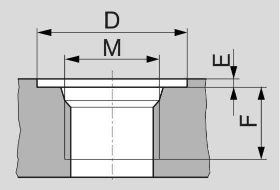
Line ports



01 **Pipe thread ISO 228/1**

At pressures $p_2 > 210$ bar limited fatigue strength

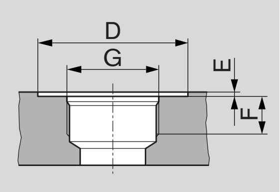
Ordering code	Size	Pressure side		Suction side	
		G	F	G	F
01	4...16 cm^3	G 1/2	16	G 3/4	16
	19...28 cm^3	G 3/4		G 1	19



03 **Thread, metric ISO 6149 with seal ring**

At pressures $p_2 > 210$ bar limited service life

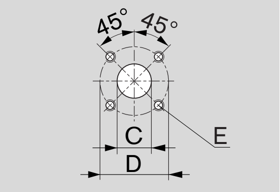
Ordering code	Size	Pressure side				Suction side			
		M	D	E	F	M	D	E	F
03	4...5.5 cm^3	M18 x 1.5	29	0.5	16	M18 x 1.5	29	0.5	16
	8...16 cm^3	M22 x 1.5	34		18	M27 x 2	40		19
	19...28 cm^3					M33 x 2	46		22



12 **Thread (UN-2B, UNF-2B) SAE seal ring BOSS**

At pressures $p_2 > 210$ bar limited service life

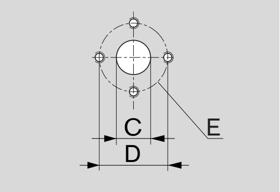
Ordering code	Size	Pressure side				Suction side			
		G	D	E	F	G	D	E	F
12	4...5.5 cm^3	9/16–18 UNF-2B	25	0.5	13	9/16–18 UNF-2B	25	0.5	13
	8 cm^3	7/8–14 UNF-2B	35		16	7/8–14 UNF-2B	35		16
	11...28 cm^3					1 1/16–12 UN-2B	45		19



20 **Rectangular flange**

*) Dimension of Series 2

Ordering code	Size	Pressure side			Suction side		
		C	D	E	C	D	E
20	4...5.5 cm^3	15	35	M6, depth 13	15	40	M6, depth 13
	8...22.5 cm^3				20		
	19...28 cm^3 *)				26	55	M8, depth 13



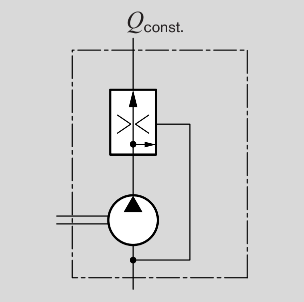
30 **Rectangular flange**

Ordering code	Size	Pressure side			Suction side		
		C	D	E	C	D	E
30	4...8 cm^3	13.5	30.2	M6, depth 13	13.5	30.2	M6, depth 13
	11...28 cm^3				20.0	39.7	M8, depth 13

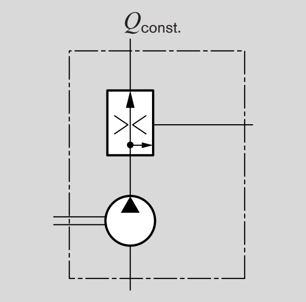
Gear pumps with integral valves

In order to reduce external pipework it is possible to incorporate a flow-control valve or pressure-relief valve in the rear cover of the gear pump. A typical application of this is in the supply of hydraulic oil in power steering systems. The pump delivers a constant flow irrespective of the speed at which it is driven. The excess flow is either returned internally to the suction port or distributed externally to other items of equipment.

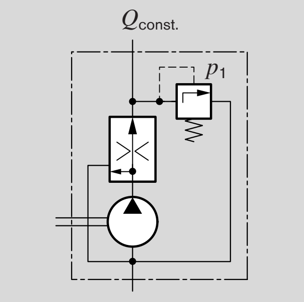
upon request



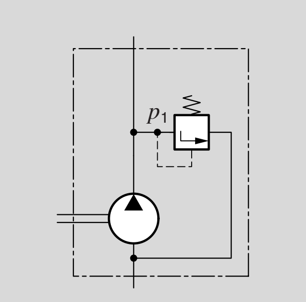
3-way flow-control valve.
Excess flow returned to suction line
$Q_{const.} = 2...30$ l/min



3-way flow-control valve.
Excess flow distributed externally; loadable
$Q_{const.} = 2...30$ l/min



3-way flow-control valve with pressure-relief valve.
Excess flow returned to suction line
$Q_{const.} = 2...30$ l/min
$p_1 = 100...180$ bar



Pressure-relief valve.
Discharge returned to suction line
$p_1 = 5...250$ bar

Ordering code

S	**xxx17**	**E**	**xxx12**	**V**	**15011**	**D**	**180xx**

Design calculations for pumps

The design calculations for pumps are based on the following parameters:

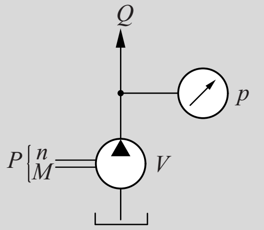
V	[cm^3/rev]	Displacement
Q	[l/min]	Delivery
p	[bar]	Pressure
M	[Nm]	Drive torque
n	[rev/min]	Drive speed
P	[kW]	Drive power

It is also necessary to allow for different efficiencies such as:

η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Overall efficiency

The following formulas describe the various relationships.
They include correction factors for adapting the parameters to the usual units encountered in practice.

Caution: Diagrams providing approximate selection data will be found on subsequent pages.



$$Q = V \cdot n \cdot \eta_v \cdot 10^{-5}$$

$$V = \frac{Q}{n \cdot \eta_v} \cdot 10^5$$

$$n = \frac{Q}{V \cdot \eta_v} \cdot 10^5$$

$$p = \frac{M \cdot \eta_{hm}}{1.59 \cdot V}$$

$$V = \frac{M \cdot \eta_{hm}}{159 \cdot p}$$

$$M = \frac{1.59 \cdot V \cdot p}{\eta_{hm}}$$

$$P = \frac{p \cdot Q}{6 \cdot \eta_t}$$

$$Q = \frac{6 \cdot P \cdot \eta_t}{p}$$

$$p = \frac{6 \cdot P \cdot \eta_t}{Q}$$

[%]

n —— $\eta_v \longrightarrow Q$
M —— $\eta_{hm} \longrightarrow p$
P —— $\eta_t \longrightarrow p \cdot Q$

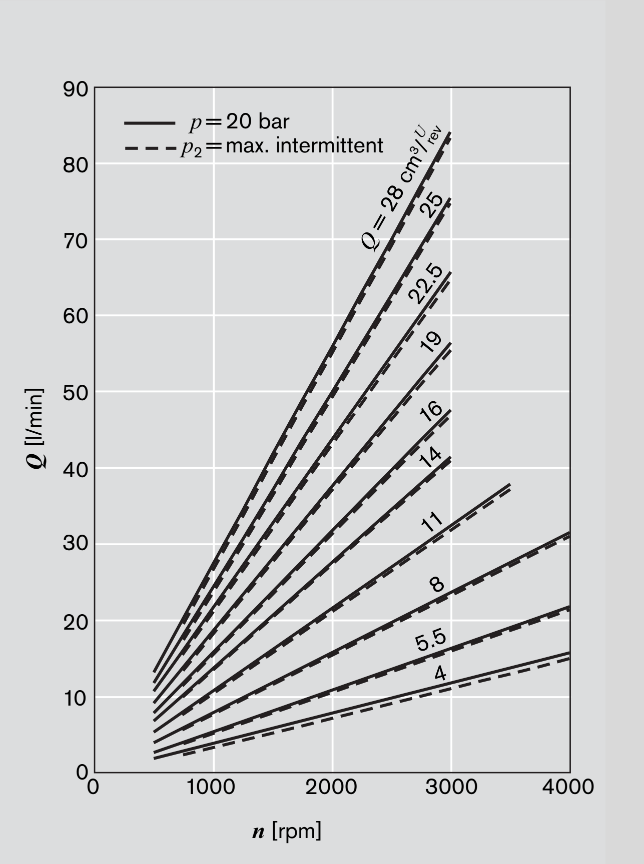
V [cm^3/rev] Q [l/min] p [bar]

n [rev/min] P [kW] M [Nm]

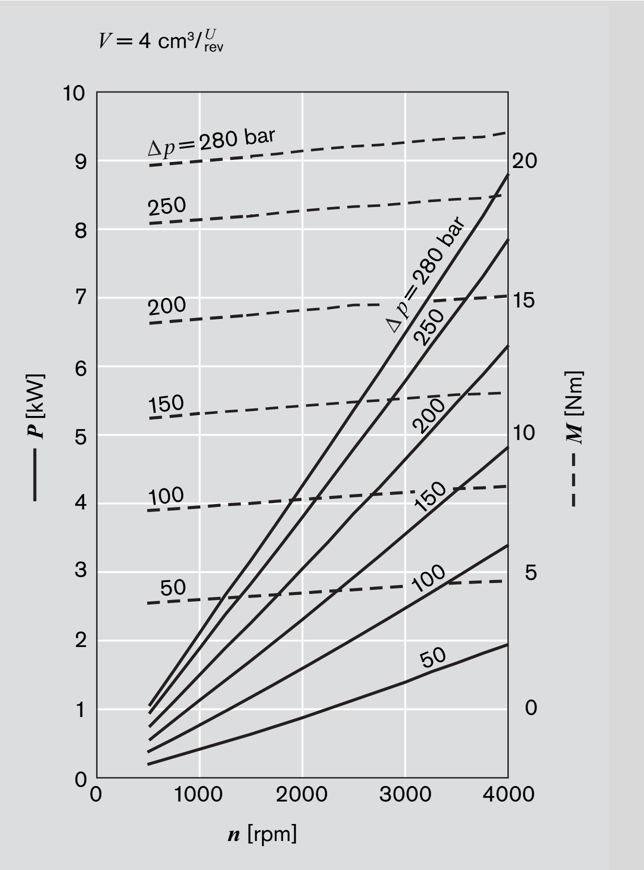
Caution: η [%] e.g. 95 [%]

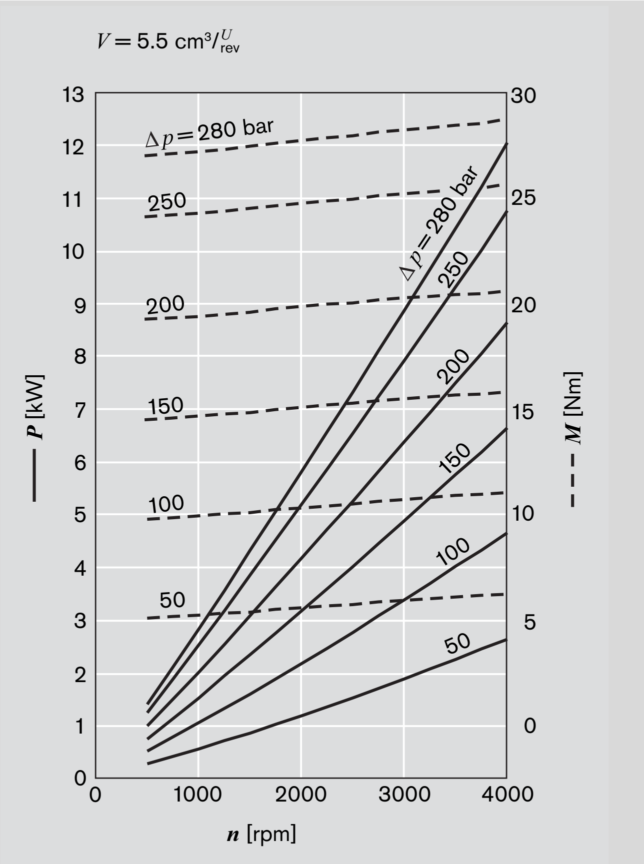
Performance charts

$\nu = 32\ \text{mm}^2/\text{s}$, $\vartheta = 50\ °\text{C}$

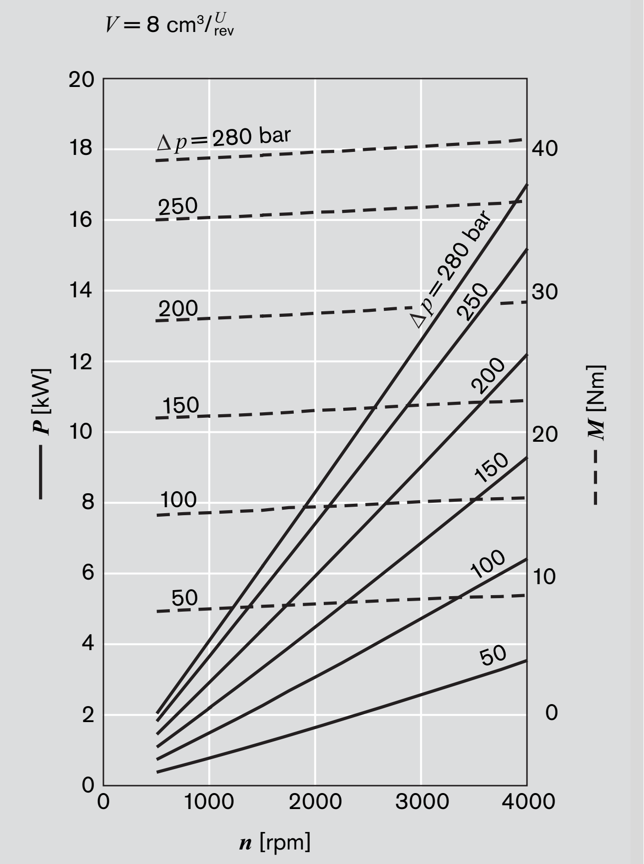


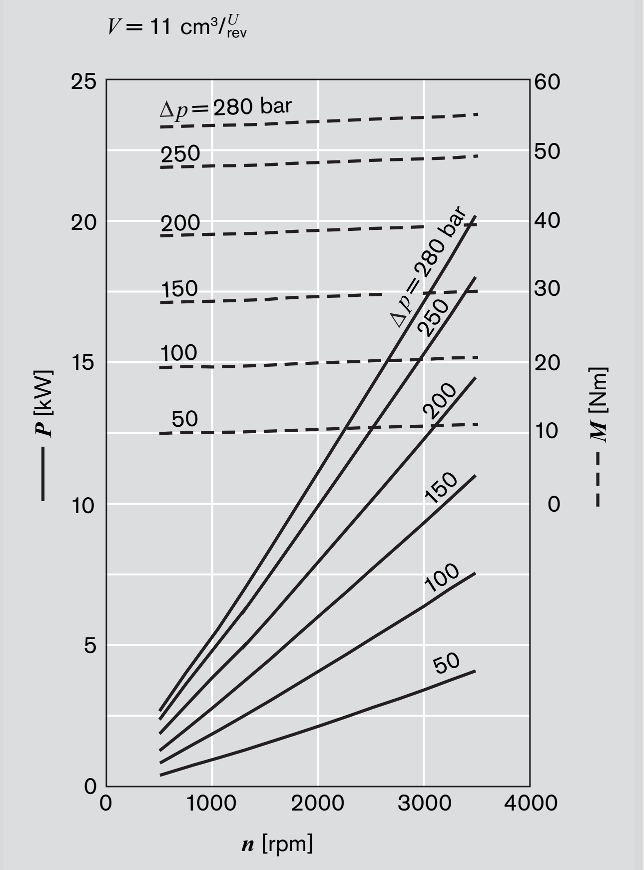
$Q = f\ (n, V)$ incl. η_v
$P = f\ (n, p)$ ——— incl. η_t
$M = f\ (n, p)$ – – – incl. η_{hm}

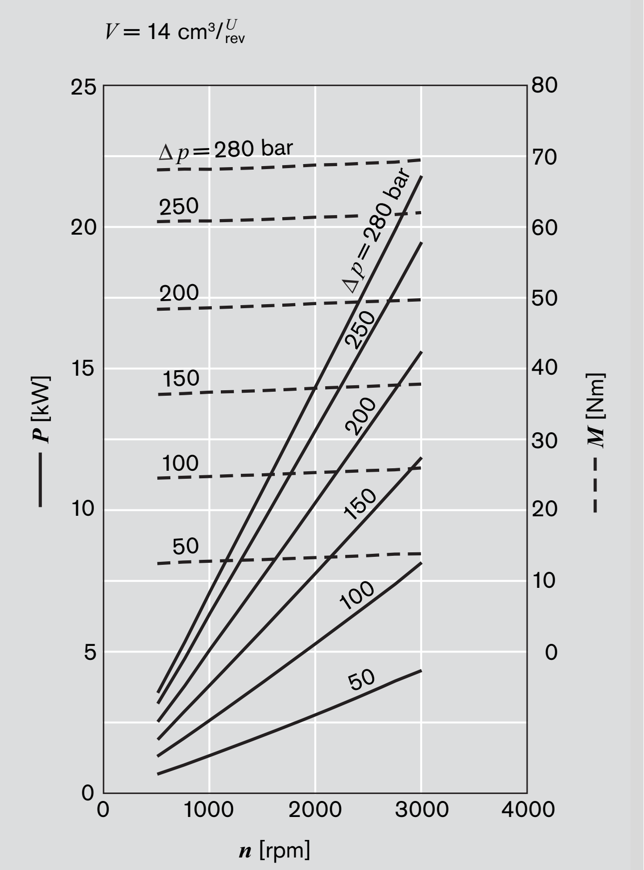


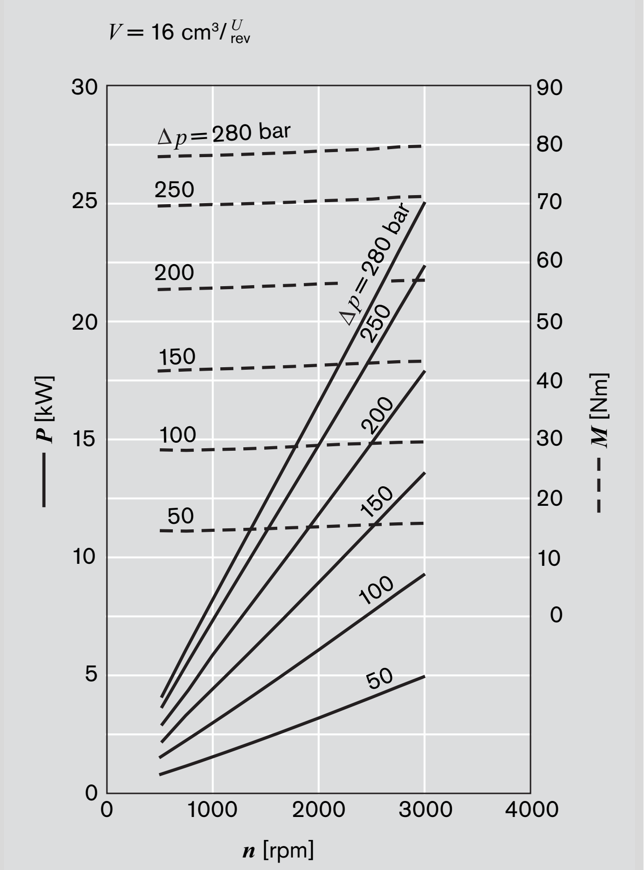


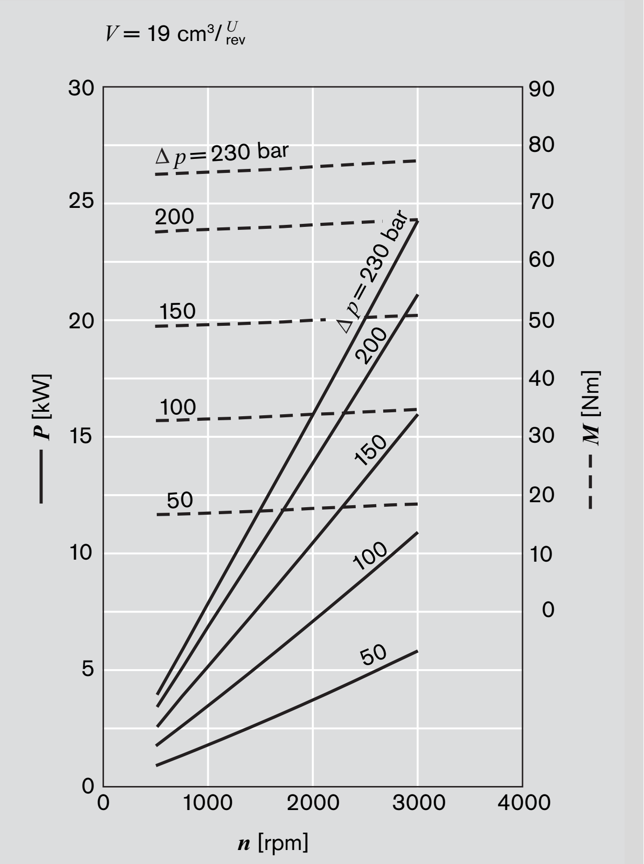
Performance charts (continued)

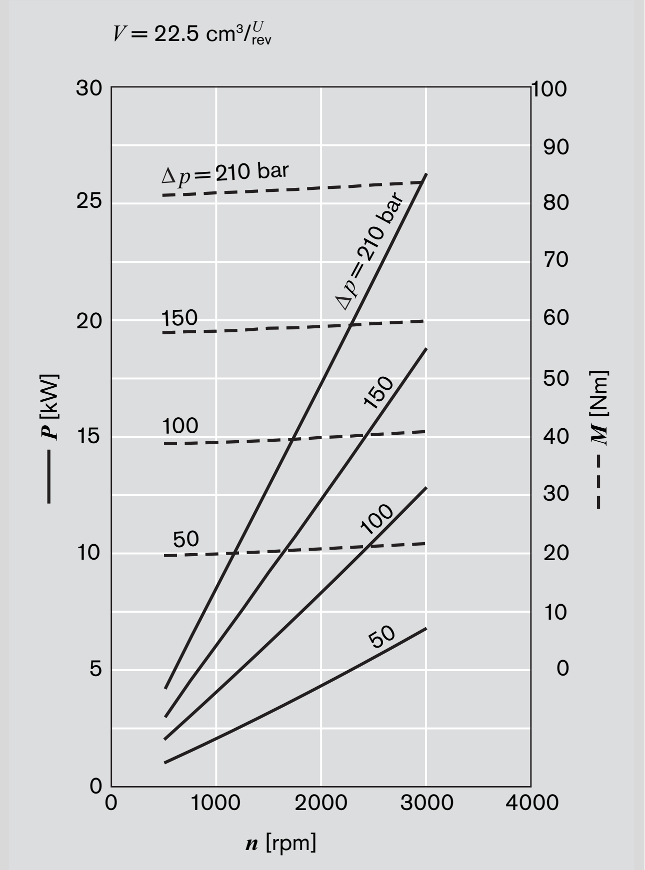


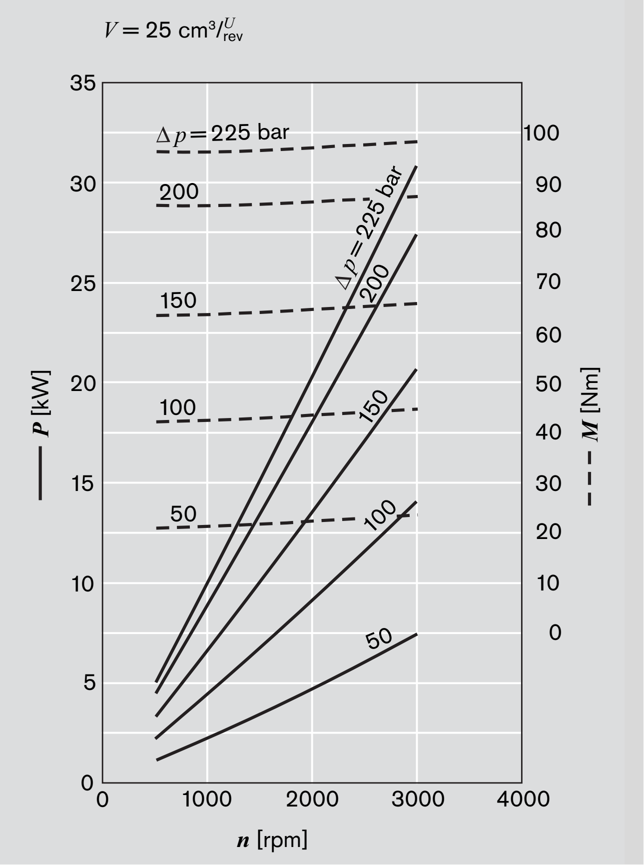


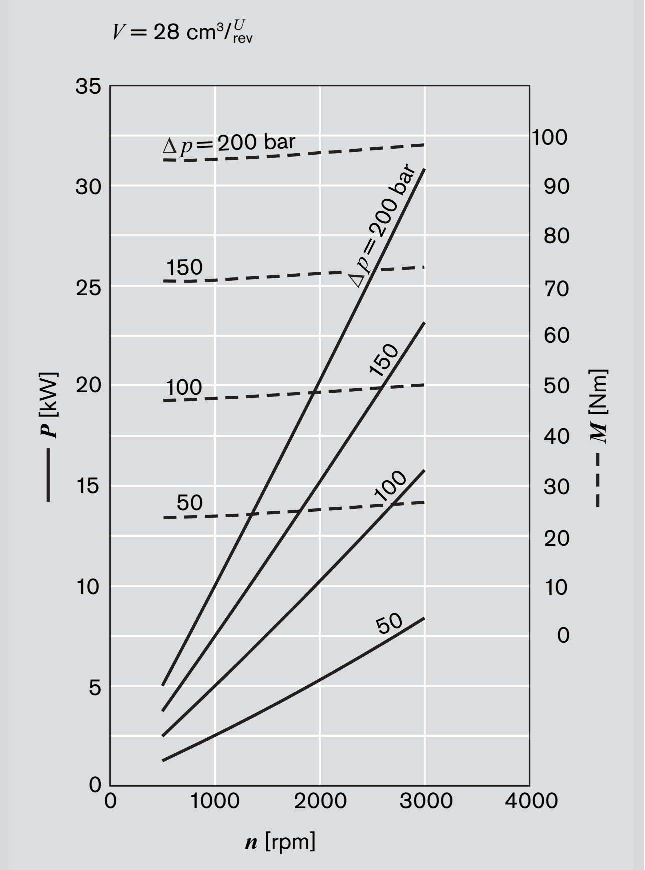





$V = 19\ \text{cm}^3/{}^{U}_{\text{rev}}$


$V = 22.5\ \text{cm}^3/{}^{U}_{\text{rev}}$

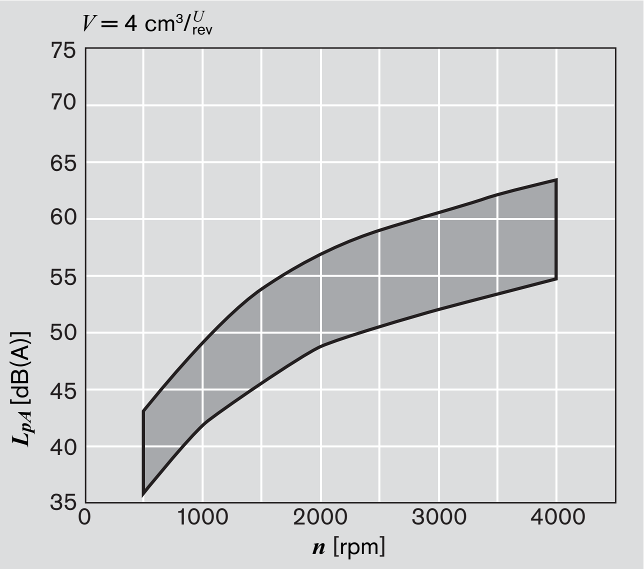

$V = 25\ \text{cm}^3/{}^{U}_{\text{rev}}$

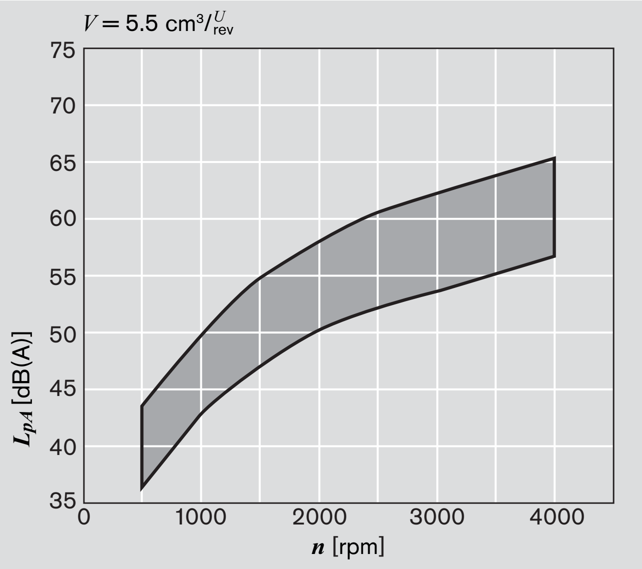

$V = 28\ \text{cm}^3/{}^{U}_{\text{rev}}$

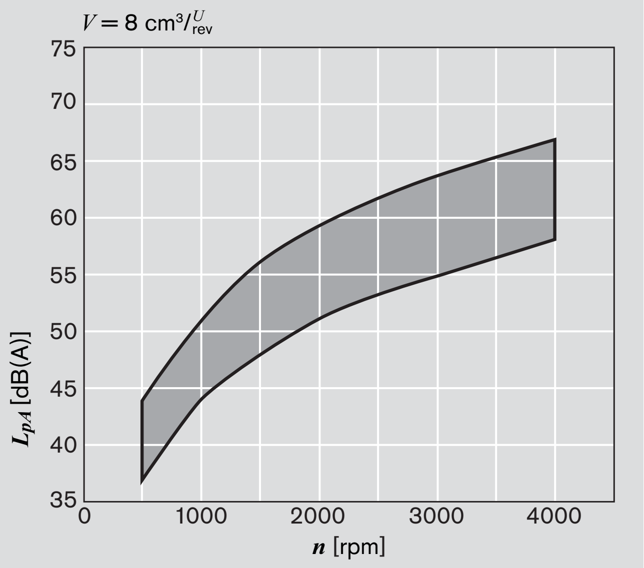
Noise charts

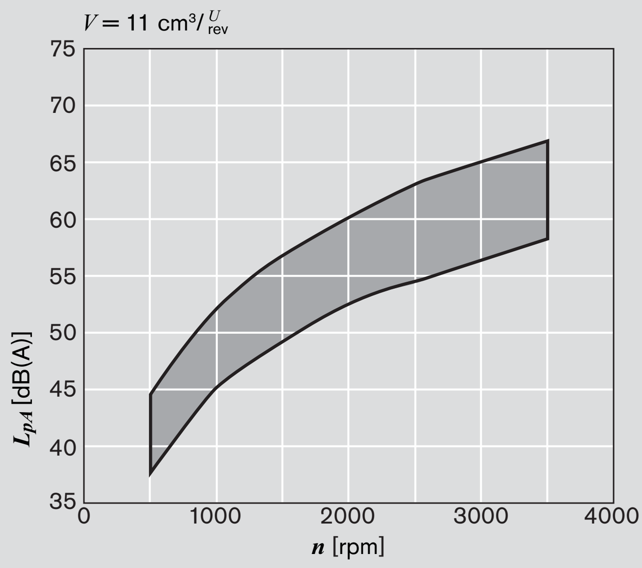
Noise level dependent on rotational speed, pressure range between 10 bar and pressure value p_2 (see page 16 Specifications table).
Oil data: $\nu = 32$ mm²/s, $\vartheta = 50$ °C.
Sound pressure level calculated from noise measurements made in the sound absorbent measuring room compliant with DIN 45 635, Part 26.
Spacing between measuring sensor – pump: 1 m.

These are typical characteristic values for the respective model. They describe the airborne sound emitted solely by the pump. Environmental influences (installation site, piping, further system components) are not taken into consideration.
Each value applies for a single pump.

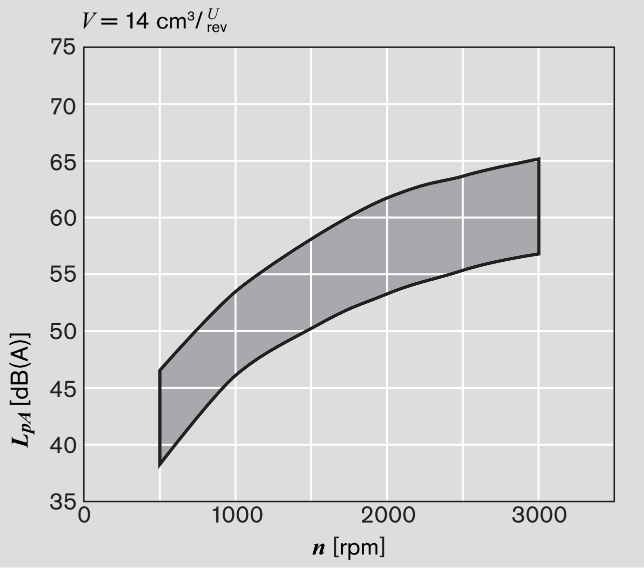


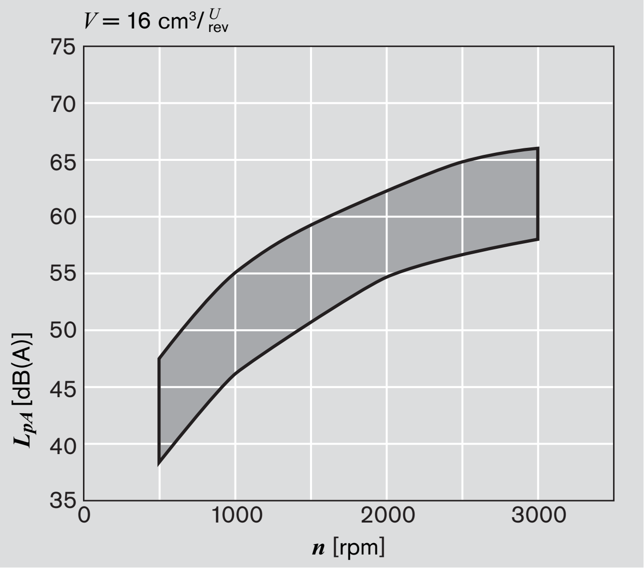


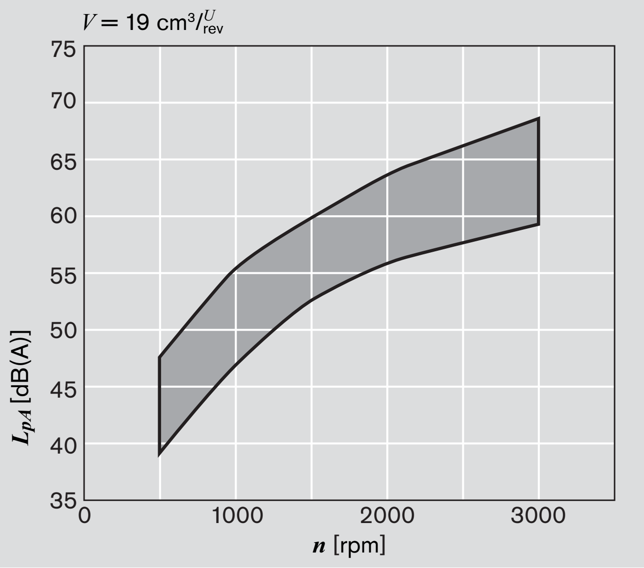


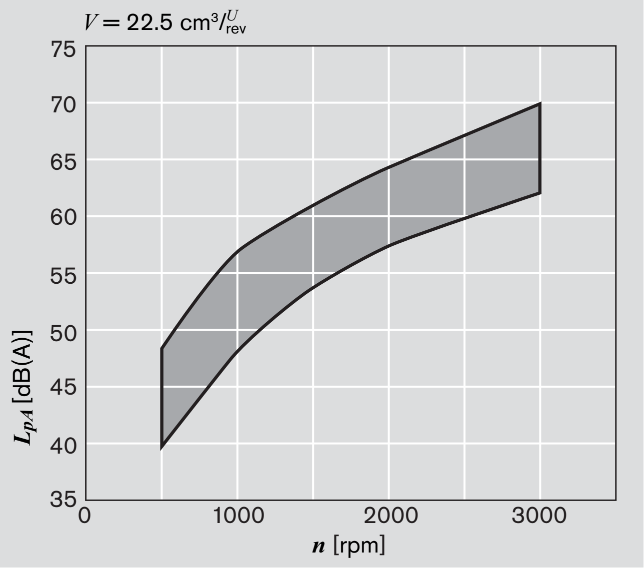


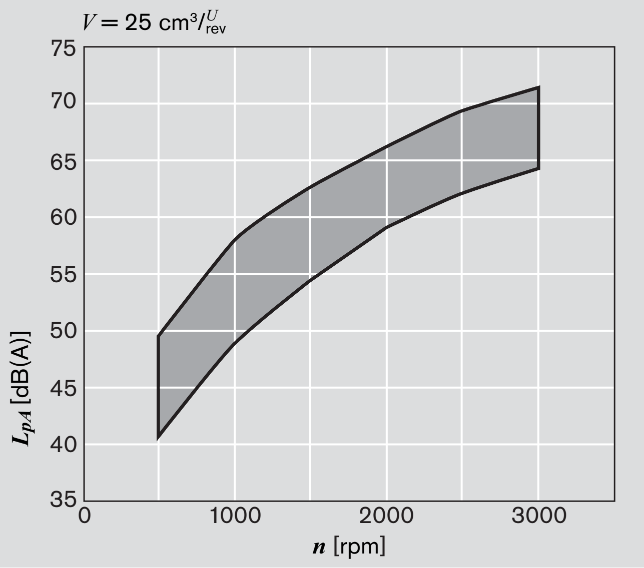
Noise charts (continued)

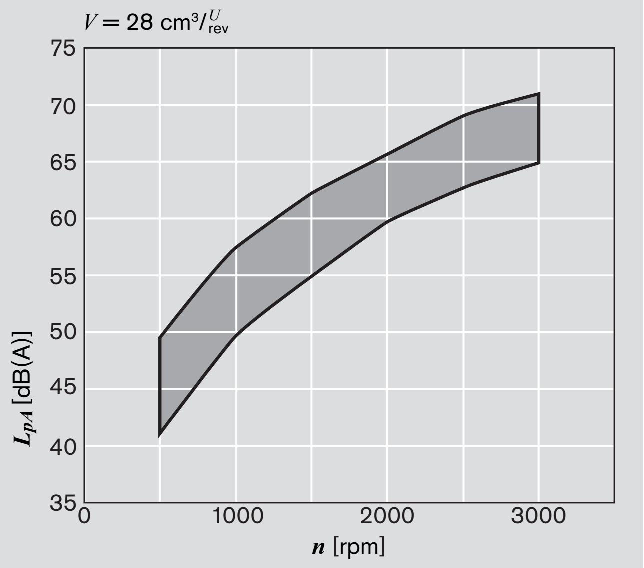












Specification

General	
Construction	External gear pump
Mounting	Flange or through-bolting with spigot
Line ports	Screw, flange
Direction of rotation (looking on shaft)	Clockwise or counter-clockwise, the pump may only be driven in the direction indicated
Installation position	Any
Load on shaft	Radial and axial forces after consulting
Ambient temperature range	–30 °C...+80 °C or max. 110 °C with FKM seal
Hydraulic fluid	– Mineral oil compliant with DIN 51 524, 1–3, however under higher load at least HLP compliant with DIN 51 524 Part 2 recommended. – Comply with RE 90220 – Further operating fluids possible after consultation
Viscosity	12...800 mm^2/s permitted range 20...100 mm^2/s recommended range ...2000 mm^2/s range permitted for starting
Hydraulic fluid temperature range	max. +80 °C with NBR seals*) max. +110 °C with FKM seals**)
Filtration ***)	At least cleanliness level 20/18/15 compliant with ISO 4406 (1999)

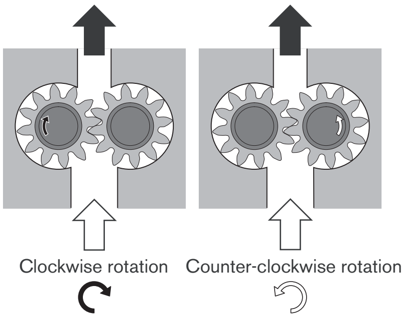
*) NBR = Perbunan®
**) FKM = Viton®
***) During the application of control systems or devices with critical counter-reaction, such as steering and brake valves, the type of filtration selected must be adapted to the sensitivity of these devices/systems.

Safety requirements pertaining to the whole systems are to be observed.

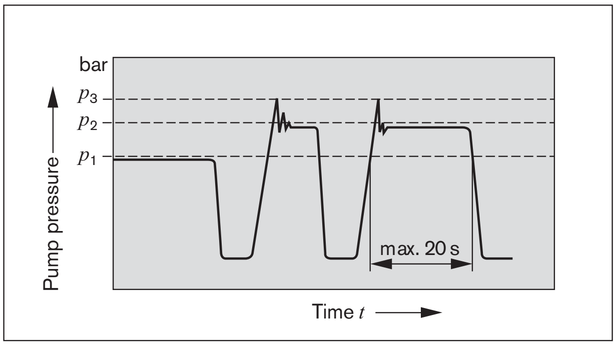
In the case of applications with high numbers of load cycles please consulting.

Definition of direction of rotation

Always look on the drive shaft.
Caution: Dimensions drawings always show clockwise-rotation pumps. On counter-clockwise-rotation pumps the positions of the drive shaft and the suction and pressure ports are different.



Definitions of pressures



p_1 max. continuous pressure
p_2 max. intermittent pressure
p_3 max. peak pressure

AZPF-1x

Displacement	V	cm^3/rev	4	5.5	8	11	14	16	19	22.5	22.5 *)
Suction pressure	p_e	bar	0.7...3 (absolute), with tandem pumps: p_e (p_2) = max. 0.5 > p_e (p_1)								
Max. continuous pressure	p_1		250						210	180	210
Max. intermittent pressure	p_2		280						230	210	230
Max. peak pressure	p_3		300						250	230	250
Min. rotational speed	<100	rpm	600	500	500	500	500	500	500	500	500
at bar 12 mm^2/s	100...180		1200	1200	1000	1000	800	800	800	800	800
	180... p_2		1400	1400	1400	1200	1000	1000	1000	1000	1000
25 mm^2/s	p_2		700	700	700	600	500	500	500	500	500
Max. rotational speed at	p_2		4000			3500	3000	3000	3000	2500	3000

*) Version with extended bearings

AZPF-2x

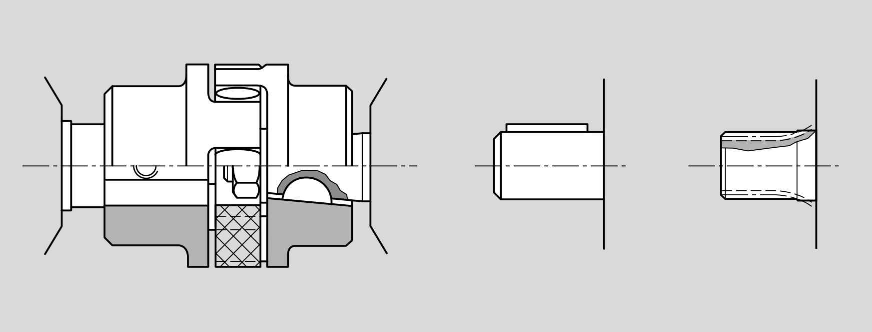
Displacement	V	cm^3/rev	4	5.5	8	11	14	16	19	22.5	25	28
Suction pressure	p_e	bar	0.7...3 (absolute), with tandem pumps: p_e (p_2) = max. 0.5 > p_e (p_1)									
Max. continuous pressure	p_1		250							220	195	170
Max. intermittent pressure	p_2		280							250	225	200
Max. peak pressure	p_3		300							290	265	240
Min. rotational speed	<100	rpm	600	500	500	500	500	500	500	500	500	500
at bar 12 mm^2/s	100...180		1200	1200	1000	1000	800	800	800	800	800	800
	180... p_2		1400	1400	1400	1200	1000	1000	1000	1000	1000	1000
25 mm^2/s	p_2		700	700	700	600	500	500	500	500	500	500
Max. rotational speed at	p_2		4000			3500	3000	3000	3500	3500	3000	3000

Drive arrangements

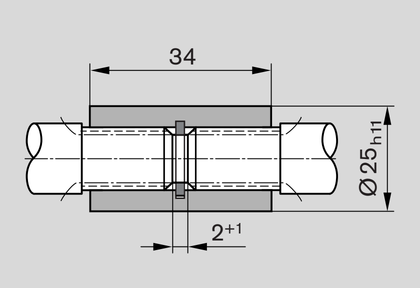
1. Flexible couplings
The coupling must not transfer any radial or axial forces to the pump.

The maximum radial runout of shaft spigot is 0.2 mm.

Refer to the fitting instructions provided by the coupling manufacturer for details of the maximum permitted shaft misalignment.



2. Coupling sleeve
Used on shafts with DIN or SAE splining. Caution: There must be no radial or axial forces exerted on the pump shaft or coupling sleeve. The coupling sleeve must be free to move axially. The distance between the pump shaft and drive shaft must be 2^{+1}. Oil-bath or oil-mist lubrications is necessary.



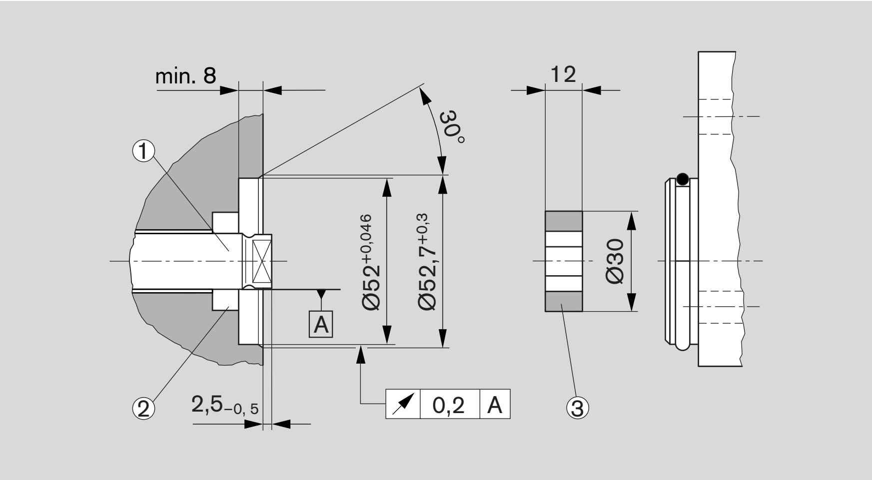
Splined shaft	M_{max} [Nm]	V [cm³/rev]	p_{max} [bar]
DIN	100	4...28	p_{max}
SAE 9t	110		
SAE 11t	180		

3. Drive shaft with tang
For the close-coupling of the pumps to electric motor or internal-combustion engine, gear, etc.
The pump shaft has a special tang and driver ③ (not included in supply).
There is no shaft sealing.

The recommended arrangements and dimensions for the drive end and sealing are as follows.

① Drive shaft
Case-hardening steel DIN 17 210
e.g. 20 MnCrS 5
case-hardened 0.6 deep; HRC 60 ±3.
Surface for sealing ring
ground without rifling $R_{max.} \leq 4 \mu m$

② Radial shaft seal ring
Rubber-covered seal (see DIN 3760, Type AS or double-lipped ring).
Cut 15° chamfer or fit shaft seal ring with protection sleeve.



Drive with tang

AZPF-1x

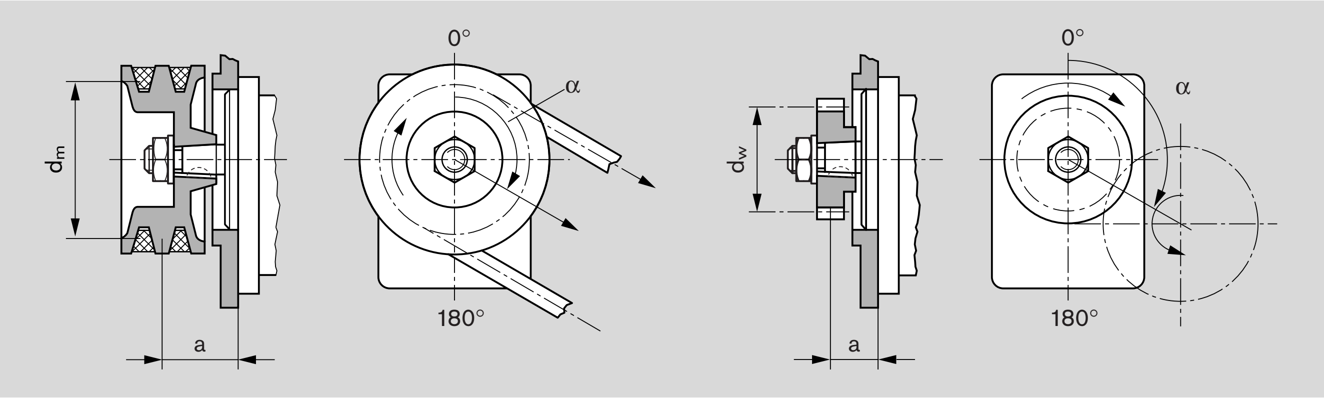
$M_{max.}$ [Nm]	V [cm³/rev]	$p_{max.}$ [bar]
65	4...14	280
	16	230
65	19	190
	22.5	160

AZPF-2x

$M_{max.}$ [Nm]	V [cm³/rev]	$p_{max.}$ [bar]
85	4...14	280
	16	280
	19	250
	22.5	210
	25	190
	28	170

4. V-belts and straight gearwheels or helical toothed gear drives without outboard bearing

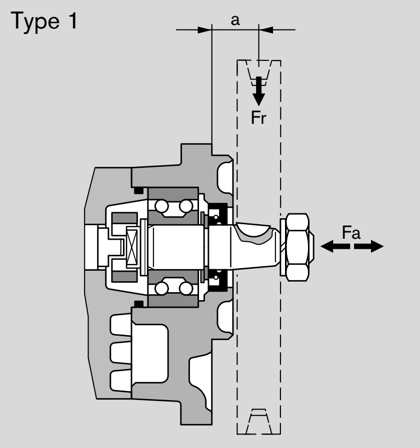
When proposing to use V-belt or gear drive, please submit details of the application for our comments (especially dimensions a, d_m, d_w and angle α).
For helical toothed gear drives, details of the helix angle β are also required.

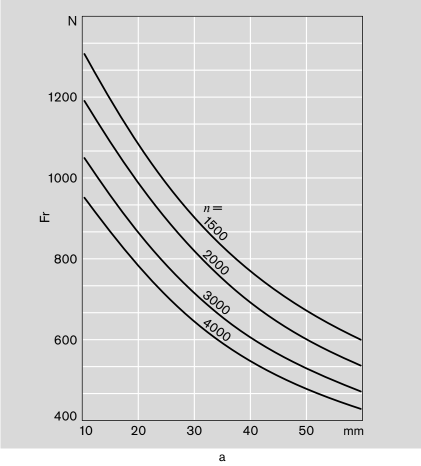


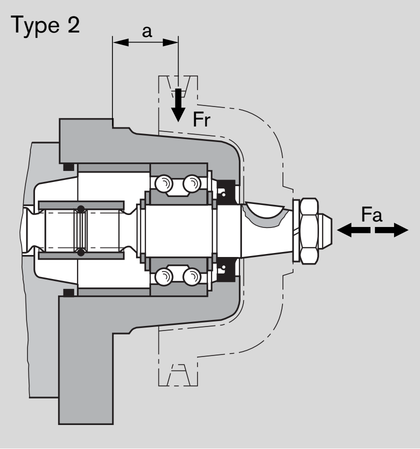
5. Outboard bearing

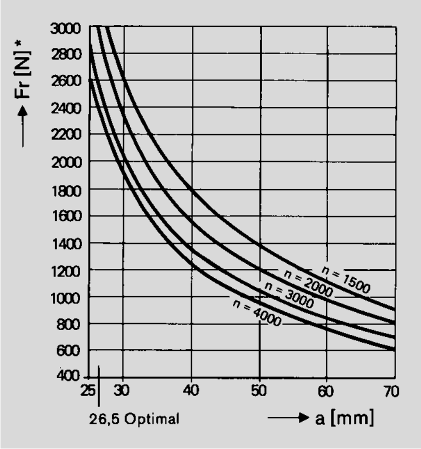
Outboard bearing eliminate possible problems when the pumps are driven by V-belts or gearwheels. The diagrams below show the maximum radial and axial loads that can be tolerated based on a bearing life of $L_H = 1000$ hours.

$M_{max.}$ [Nm]	V [cm^3/rev]	$p_{max.}$ [bar]
65	16	230
	19	190
	22.5	160









Multiple gear pumps

Gear pumps are well-suited to tandem combinations of pumps in which the drive shaft of the first pump is extended to drive a second pump and sometimes a third pump in the same manner. A coupling is fitted between each pair of pumps.
In most cases each pump is isolated from its neighbor, i.e. the suction ports are separate from one another. A common suction port is also possible as an option.
Caution: Basically, the specifications for the single pumps apply, but with certain restrictions:
Max. speed: This is determined by the highest rated pump speed in use.
Pressures: These are restricted by the strength of the drive shaft, the through drives and the drivers. Appropriate data is given in the dimensional drawings.

Pressure restrictions during standard through drive

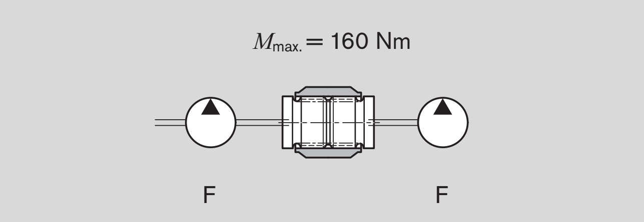
In the case of series S, the driver for the second pumping stage can carry a load of up to $M_{max.} = 65$ Nm, i.e. there is a pressure restriction for the second stage and any further stages.

$M_{max.}$ [Nm]	V [cm^3/rev]	$p_{max.}$ [bar]
65	16	230
	19	190
	22.5	160
	25	140
	28	130

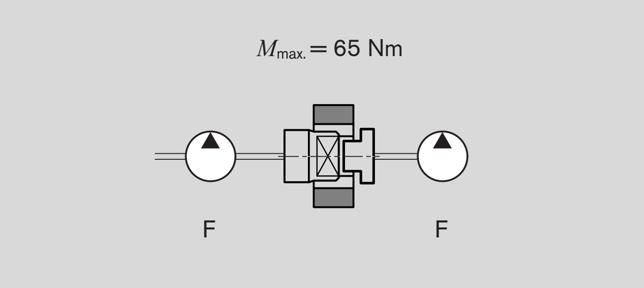
If the first stage is driven through a tang (driver) or outboard bearing type 1, pressure restrictions apply as indicated in the formula below.

Reinforced through drives are available for applications with higher transfer torques and/or rotational vibrations. Customized designs available on request.

Reinforced through drive



Standard through drive



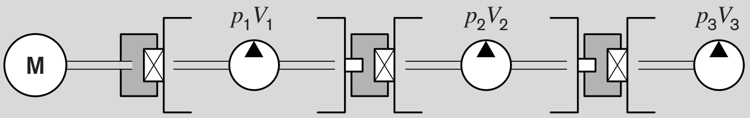
Combinations

Series pump 1	$M_{max.}$ [Nm]	Series pump 2
F	65	F
F	65	S
F	12	B

Max. transferrable drive torque *

Function	Code letter	Designation	Max. transferrable drive torque * [Nm]
Splined shafts	R	SAE J744 16-4 9T	110
	P	SAE J744 19-4-11T	180
Tapered key shaft	C	1:5	155
	H	1:8	160
Cylinder shafts	G	Shafts Ø 15.875	55
	A	Shafts Ø 18	75
Claw	N	Dihedral claw	65

* These values only apply when the conditions described on page 16 are complied with. Bosch Rexroth is to be consulted if the stated values are exceeded.

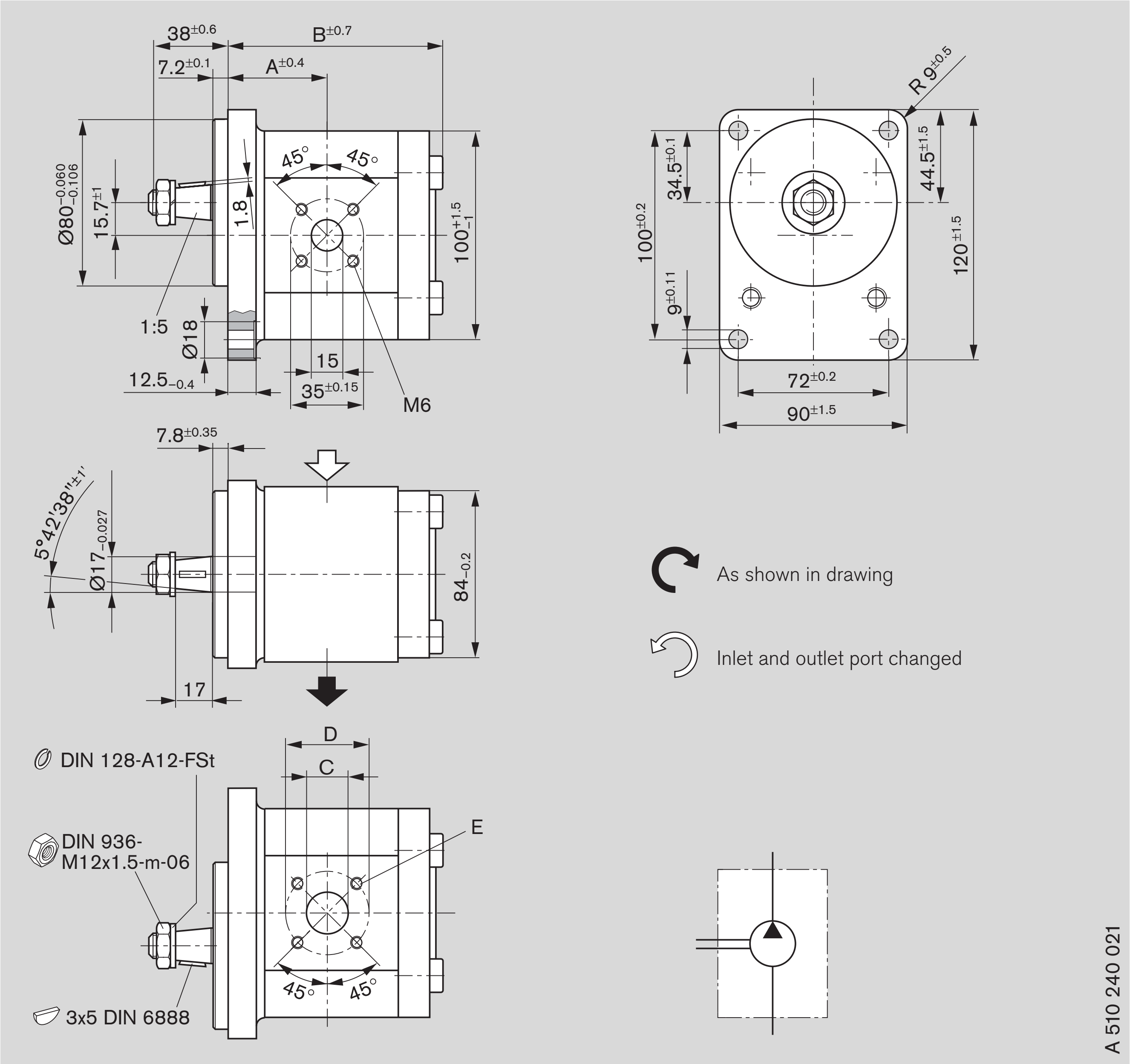


$$M_{max.} \geqq \varDelta p_1 \cdot V_1 \cdot 0.0177 + \varDelta p_2 \cdot V_2 \cdot 0.0177 + \varDelta p_3 \cdot V_3 \cdot 0.0177$$

$\varDelta p$ [bar] V [cm^3/rev]

Dimensions

Standard range



Ordering code

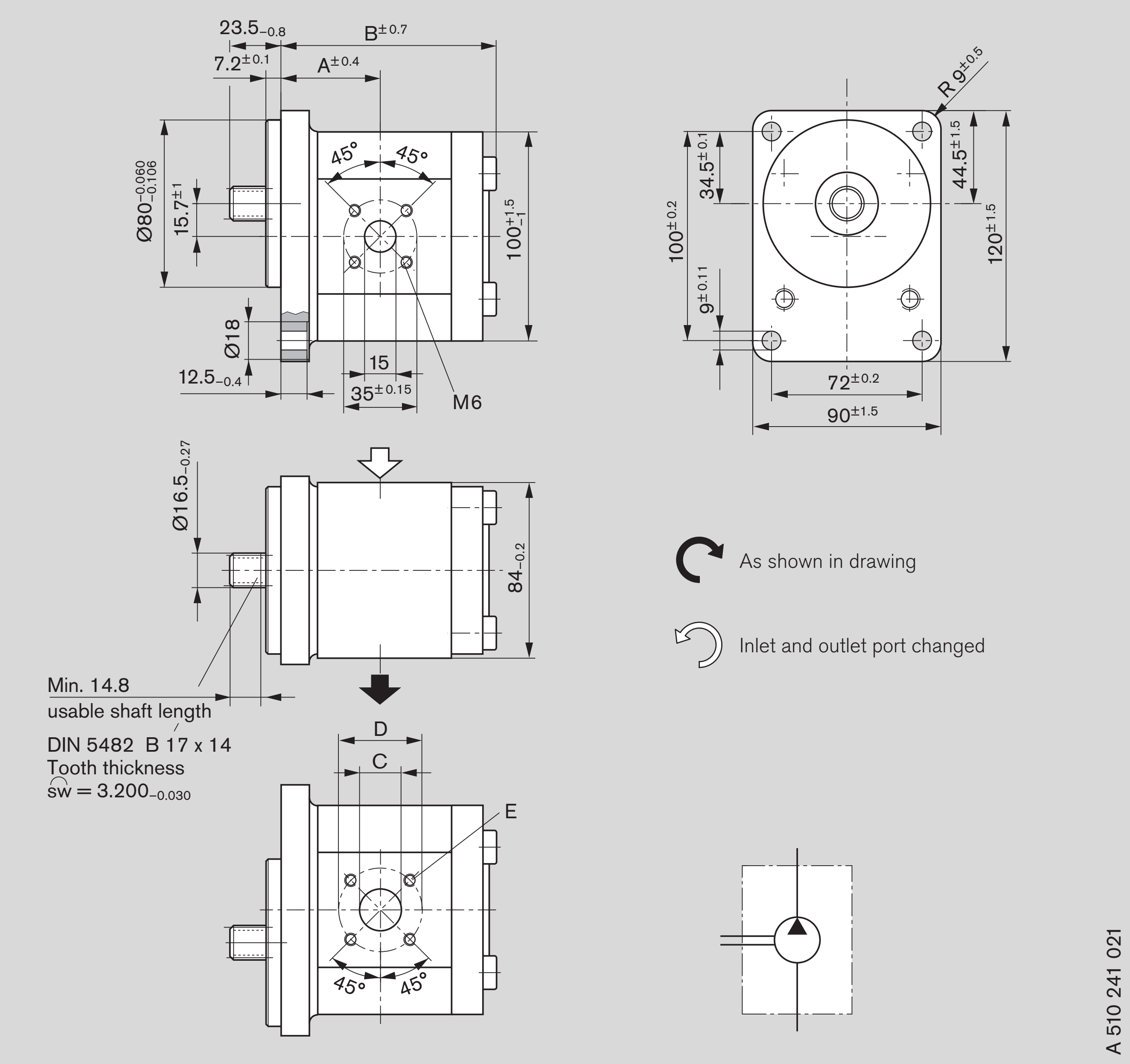
AZPF – 10 – ☐☐☐ ☐C B 20 M B

AZPF – 11 – ☐☐☐ ☐C B 20 M B*

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C	D	E
4	**0 510 225 306**	**0 510 225 006**	280	4000	3.2	39.9	85.0	15	40	M6 depth 13
5.5	**0 510 325 306**	**0 510 325 006**	280	4000	3.2	41.1	87.5	15	40	
8	**0 510 425 307**	**0 510 425 009**	280	4000	3.3	43.2	91.6	20	40	
11	**0 510 525 311**	**0 510 525 009**	280	3500	3.5	47.0	96.6	20	40	
14	**0 510 525 319**	**0 510 525 018**	280	3000	3.7	47.5	101.6	20	40	
16	**0 510 625 315**	**0 510 625 022**	280	3000	3.7	47.5	105.0	20	40	
19	**0 510 625 314**	**0 510 625 013**	230	3500	3.8	47.5	110.0	20	40	
22.5	**0 510 725 330***	**0 510 725 030**	210	2500	3.8	55.1	115.4	20	40	

Dimensions

Standard range



Ordering code

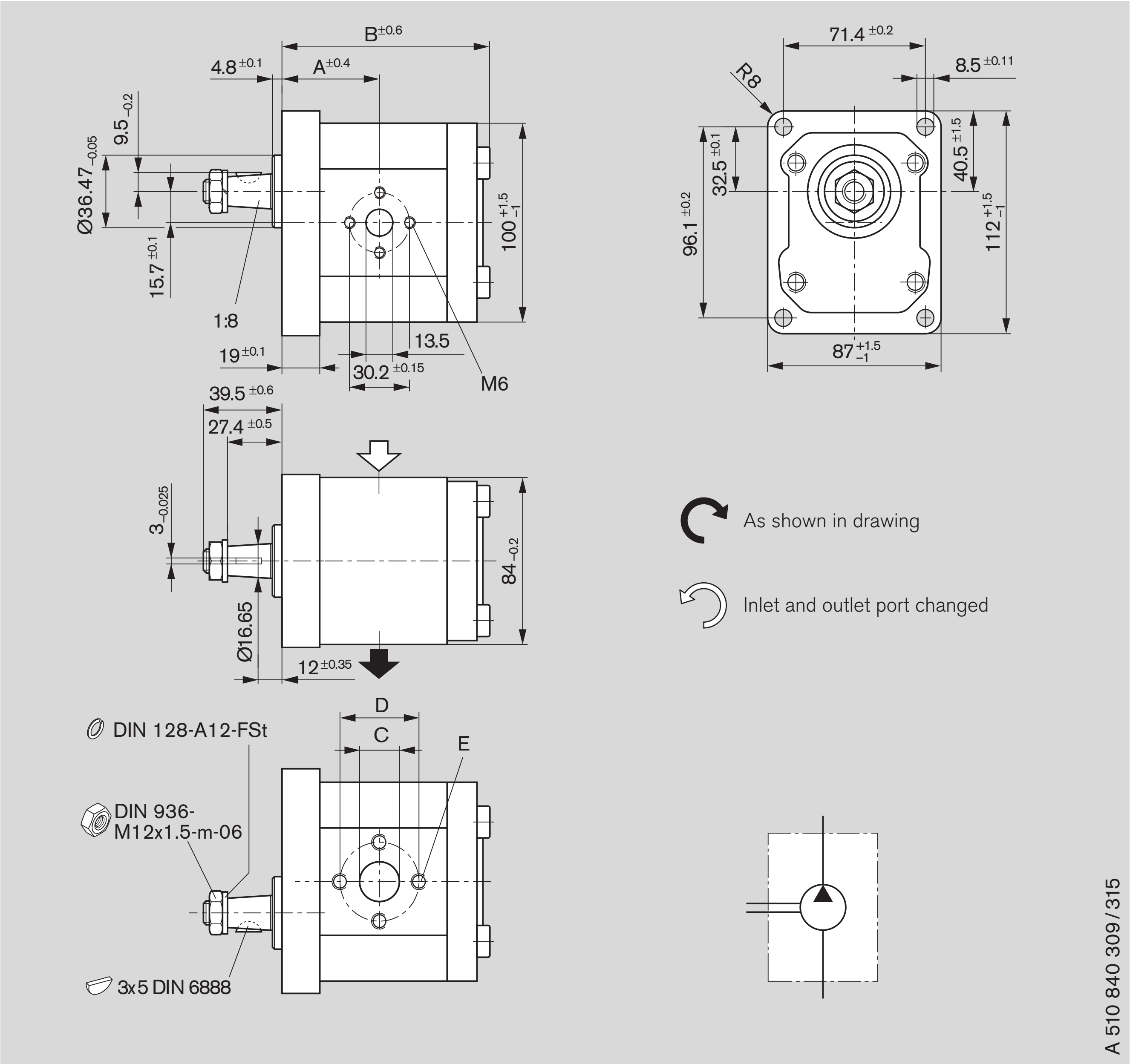
AZPF – 10 – ☐☐☐ ☐ F B 20 M B

AZPF – 11 – ☐☐☐ ☐ F B 20 M B*

Displacement [cm³/rev]	Ordering-No. ↺ L	↻ R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C	D	E
4	**0 510 225 307**	**0 510 225 007**	280	4000	3.1	39.9	85.0	15	40	M6 depth 13
5.5	**0 510 325 307**	**0 510 325 007**	280	4000	3.2	41.1	87.5	15	40	
8	**0 510 425 308**	**0 510 425 010**	280	4000	3.3	43.2	91.6	20	40	
9	**0 510 425 336***	**–**	280	4000	3.4	43.7	92.4	20	40	
11	**0 510 525 312**	**0 510 525 010**	280	3500	3.5	47.0	96.6	20	40	
14	**0 510 525 328**	**0 510 525 030**	280	3000	3.6	47.5	101.6	20	40	
16	**0 510 625 317**	**0 510 625 015**	280	3000	3.65	47.5	105.0	20	40	
19	**0 510 625 316**	**0 510 625 014**	230	3000	3.8	47.5	110.0	20	40	
22.5	**0 510 725 349**	**–**	230	3000	4.4	61.1	127.4	20	40	
22.5	**–**	**0 510 725 062**	210	2500	4.0	55.1	115.4	20	40	

Dimensions

Standard range



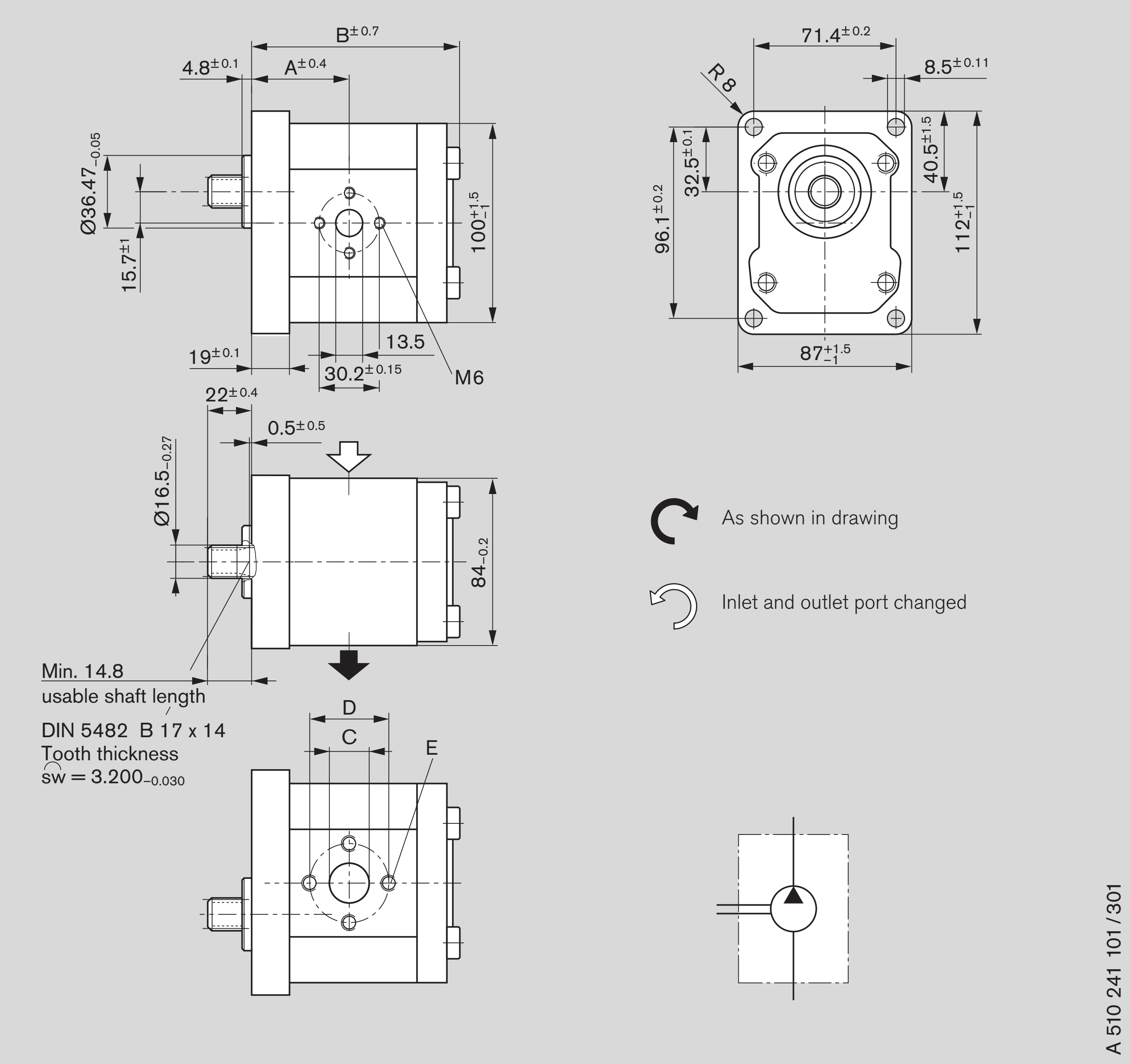
Ordering code

AZPF – 12 – ☐☐☐ ☐ H O 30 K B
AZPF – 22 – ☐☐☐ ☐ H O 30 K B*

Displacement [cm^3/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	 B	 C	 D	 E
4	**0 510 225 317**	**0 510 225 022**	280	4000	3.1	41.4	84.1	13.5	30.2	M6 depth 13
5.5	**0 510 325 320**	**0 510 325 025**	280	4000	3.2	42.6	86.6	13.5	30.2	
8	**0 510 425 334**	**0 510 425 043**	280	4000	3.3	44.7	92.5	13.5	30.2	
11	**0 510 525 374**	**0 510 525 074**	280	3500	3.4	48.5	97.5	13.5	30.2	M8 depth 13
14	**0 510 525 375**	**0 510 525 075**	280	3000	3.6	49.0	102.5	13.5	30.2	
16	**0 510 625 381**	**0 510 625 075**	280	3000	3.6	49.0	105.9	13.5	30.2	
19	**0 510 625 386***	**0 510 625 076***	280	3500	4.1	59.9	121.1	20.0	39.7	
22.5	**0 510 725 410***	**0 510 725 112***	250	3500	4.2	62.6	126.5	20.0	39.7	
25	**0 510 725 411***	**0 510 725 113***	225	3000	4.4	64.7	132.5	20.0	39.7	
28	**0 510 725 412***	**0 510 725 114***	200	3000	4.5	67.1	137.3	20.0	39.7	

Dimensions

Standard range



Ordering code

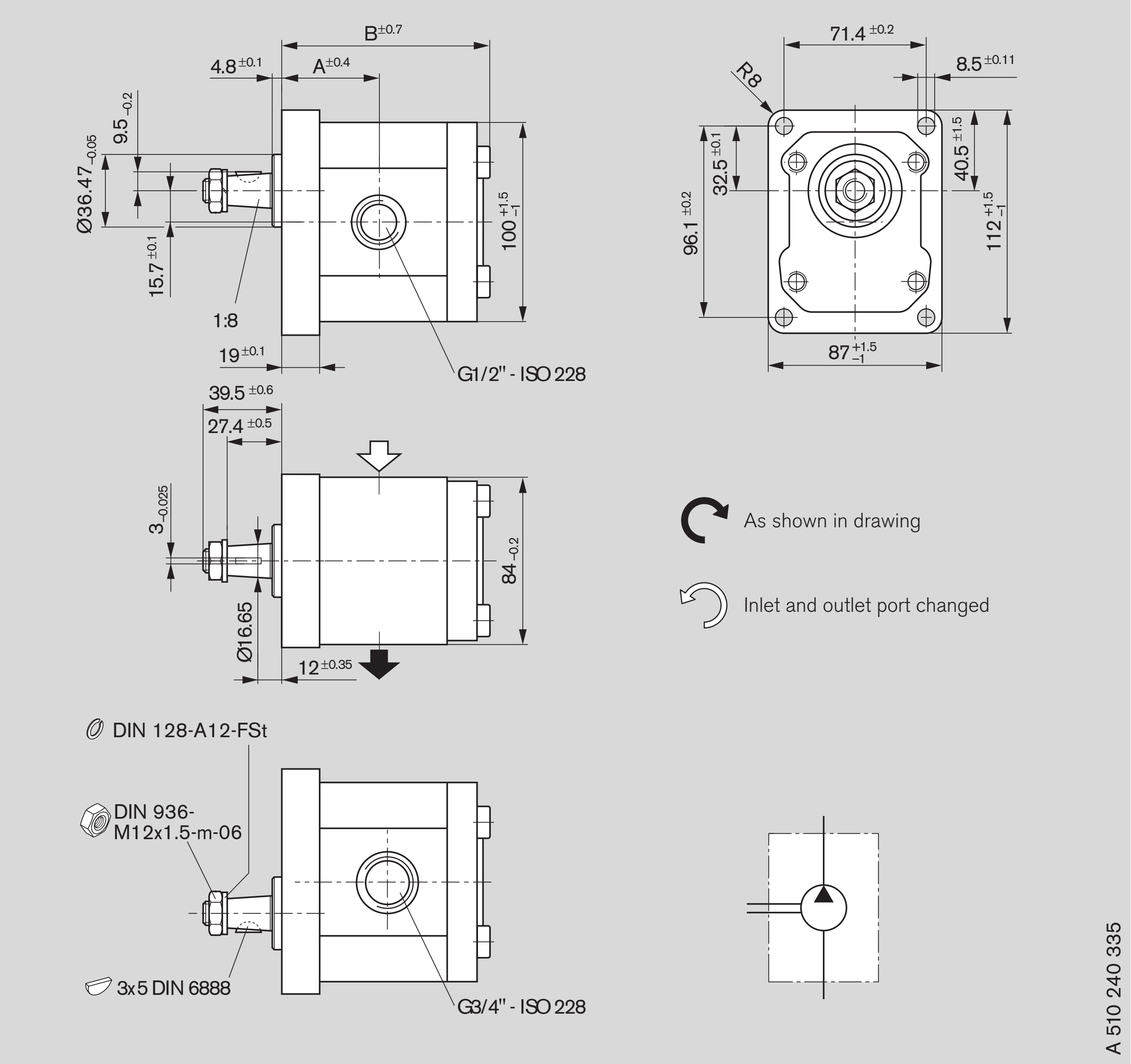
AZPF – 10 – ☐☐☐ ☐ F O 30 M B

AZPF – 10 – ☐☐☐ ☐ F O 30 P B*

Displacement [cm³/rev]	Ordering-No. ↺ L	Ordering-No. ↻ R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C	D	E
8	**0 510 425 315**	**0 510 425 021**	280	4000	3.3	44.7	93.1	13.5	30.2	M6, depth 13
11	**0 510 525 323**	**0 510 525 024**	280	3500	3.4	48.5	98.1	20.0	39.7	M8, depth 13
11	**0 510 525 331***	–	210	3500	3.3	48.5	98.1	20.0	39.7	
14	–	**0 510 525 034***	210	3000	3.4	49.0	103.1	20.0	39.7	
16	**0 510 625 327***	**0 510 625 039***	210	3000	3.5	49.0	106.5	20.0	39.7	
19	–	**0 510 625 049***	210	3000	3.7	49.0	111.5	20.0	39.7	
19	**0 510 625 332***	–	210	3000	4.0	59.9	123.5	20.0	39.7	
22.5	**0 510 725 348***	**0 510 725 076***	210	3000	4.2	62.6	127.8	20.0	39.7	

Dimensions

Standard range



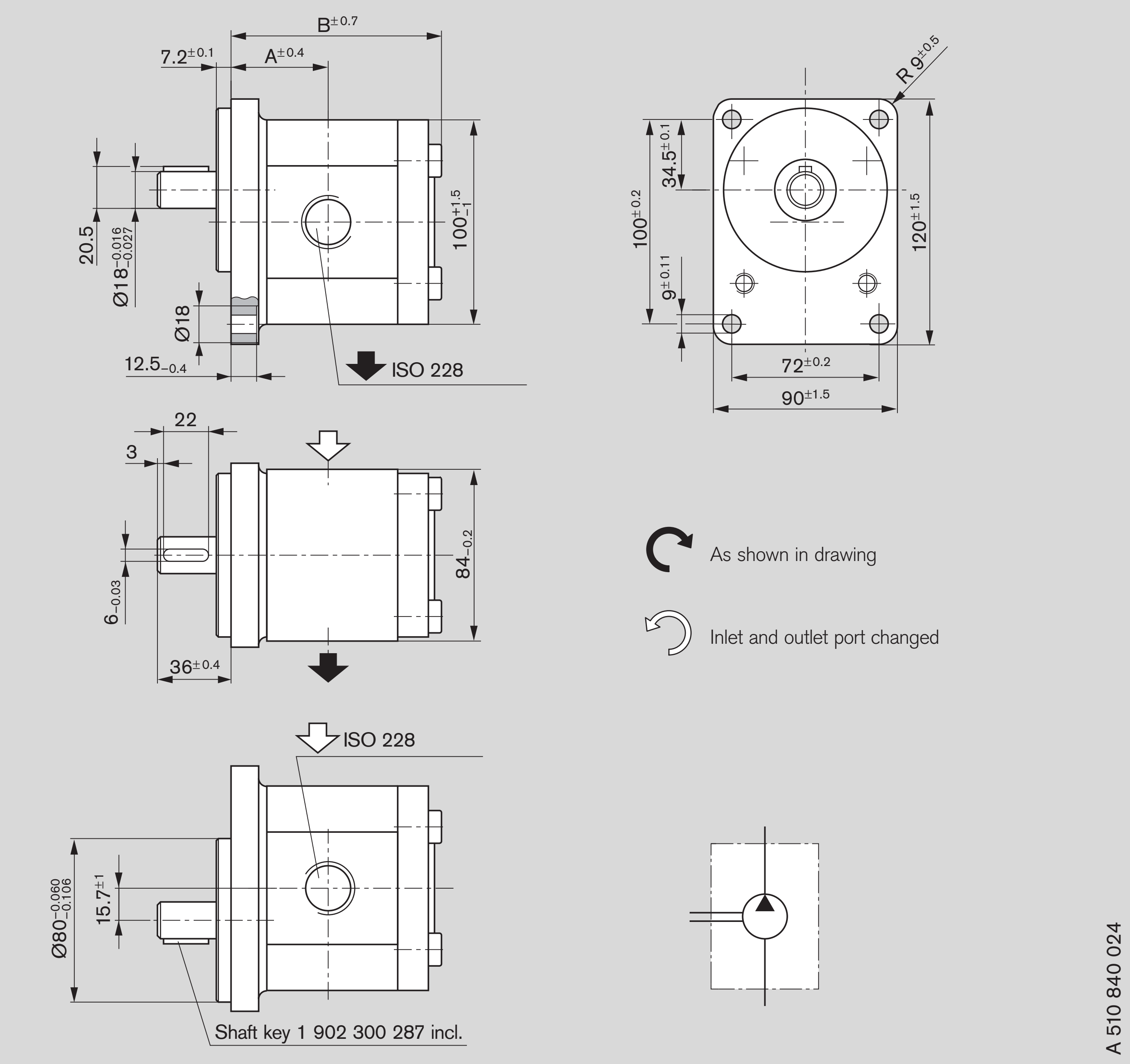
Ordering code

AZPF – 10 – ☐☐☐ ☐H O 01 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	G
4	–	–	–	–	–	–	–	ISO 228 depth 16
5.5	–	**0 510 325 018**	280	4000	3.1	42.6	89.0	
8	–	**0 510 425 027**	280	4000	3.15	44.7	93.1	
11	–	**0 510 525 039**	280	3500	3.3	48.5	98.1	
14	–	**0 510 525 040**	280	3000	3.4	49.0	103.1	
16	–	**0 510 625 047**	280	3000	3.58	49.0	106.5	
19	–	**0 510 625 052**	230	3000	3.6	49.0	111.5	
22.5	–	**0 510 725 084**	210	2500	3.8	56.6	116.4	

Dimensions

Standard range



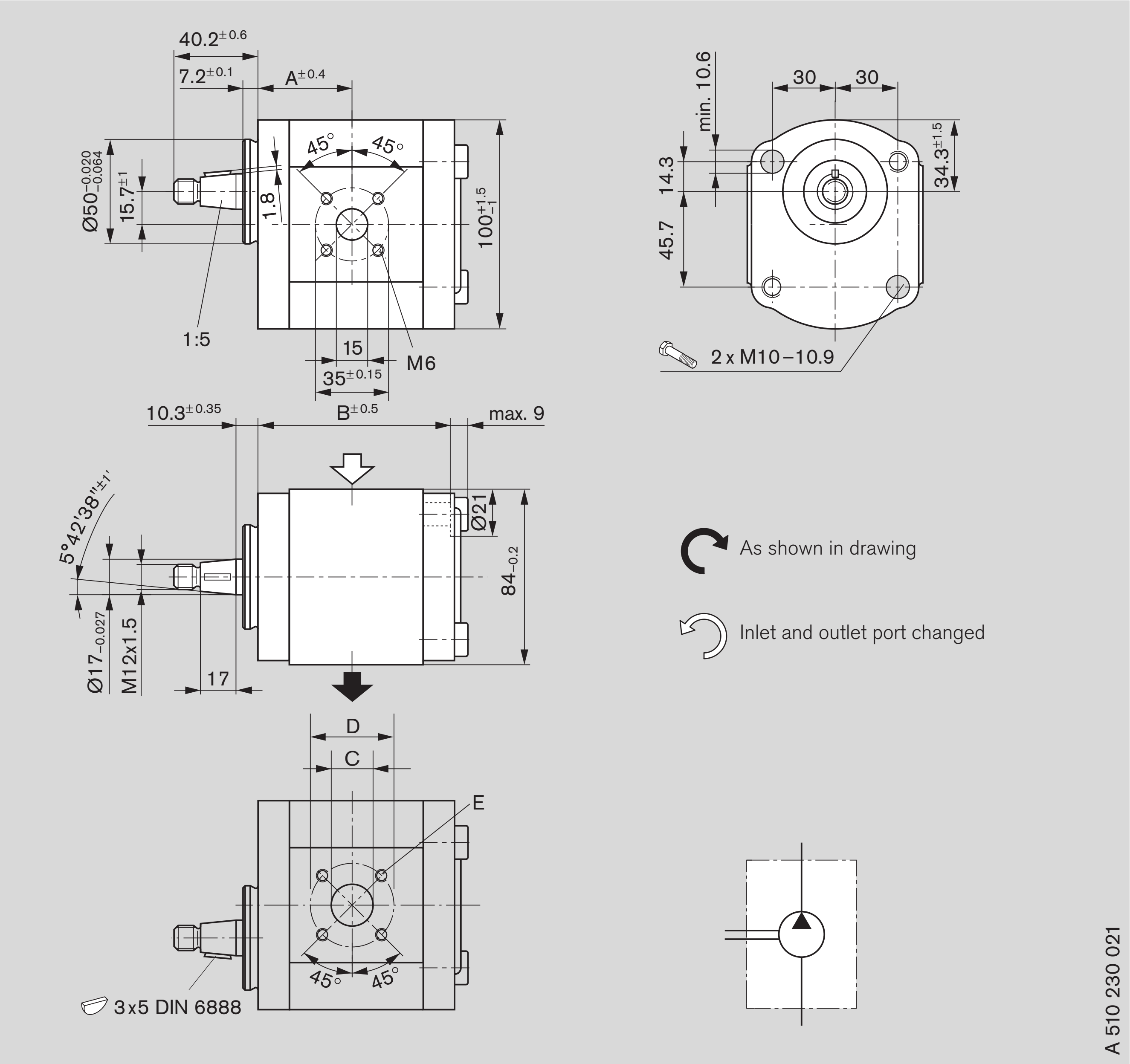
Ordering code

AZPF – 11 – ☐☐☐ ☐ A B 01 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	G
4	**0 510 225 318**	**0 510 225 023**	280	4000	3.3	39.9	84.3	G $^1/_2$ – ISO 228 depth 16
5.5	**0 510 325 321**	**0 510 325 026**	280	4000	3.3	41.1	85.2	
8	**0 510 425 335**	**0 510 425 044**	280	4000	3.4	43.2	89.3	
11	**0 510 525 376**	**0 510 525 076**	280	3500	3.6	45.6	94.3	G $^3/_4$ – ISO 228 depth 16
14	–	–	–	–	–	–	–	
16	**0 510 625 382**	**0 510 625 077**	250	3000	3.8	49.9	102.7	
19	–	–	–	–	–	–	–	
22.5	**0 510 725 418**	**0 510 725 120**	180	2500	4.1	55.1	114.7	

Dimensions

Standard range



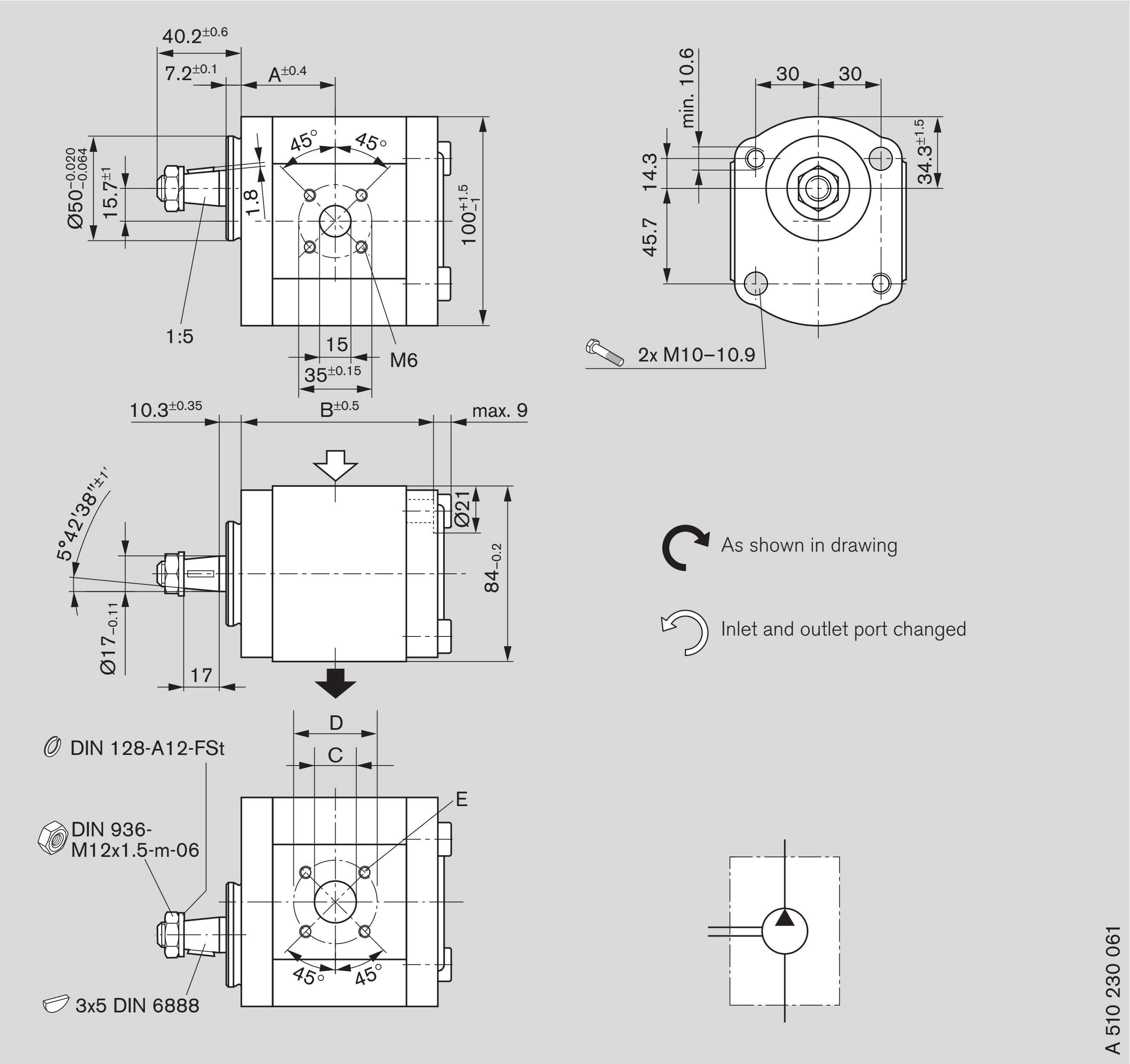
Ordering code

AZPF – 10 – ☐☐☐ ☐ C P 20 M B
AZPF – 10 – ☐☐☐ ☐ C P 20 K B*
AZPF – 11 – ☐☐☐ ☐ C P 20 M B**

Displacement [cm³/rev]	Ordering-No. ↺ L	↻ R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C	D	E
4	**0 510 215 009**	**0 510 215 309**	280	4000	2.5	37.7	73.7	15	40	M6 depth 13
5.5	**0 510 315 307**	**0 510 315 006**	280	4000	2.65	38.6	76.2	15	40	
8	**0 510 415 316****	**–**	280	4000	2.7	40.6	80.3	20	40	
11	**0 510 515 309**	**0 510 515 007**	280	3500	2.75	44.5	85.5	20	40	
14	**0 510 515 316**	**0 510 515 018**	280	3000	3.1	45.0	90.3	20	40	
16	**0 510 615 317**	**0 510 615 010**	280	3000	2.9	45.0	93.7	20	40	
19	**0 510 615 318**	**0 510 615 005**	230	3000	3.2	45.0	98.7	20	40	
22.5	**0 510 715 306***	**–**	210	2500	3.3	52.5	104.1	20	40	

Dimensions

Standard range



Ordering code

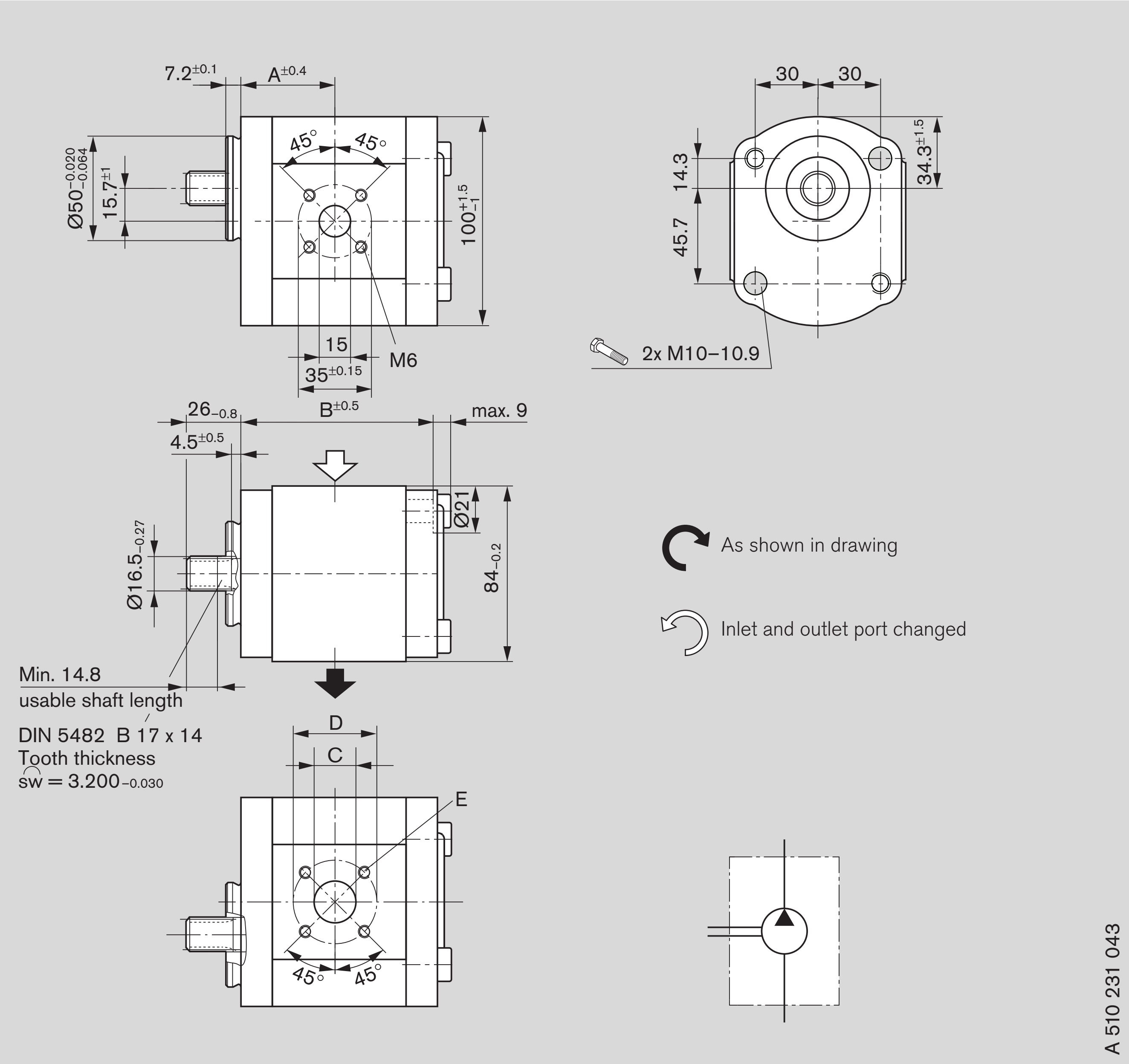
AZPF – 10 – ☐☐☐ ☐C N 20 M B

AZPF – 11 – ☐☐☐ ☐C N 20 M B*

Displacement [cm³/rev]	Ordering-No. L	R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C	D	E
4	**0 510 215 306**	**0 510 215 006**	280	4000	2.6	37.4	73.7	15	40	M6 depth 13
5.5	**0 510 315 304**	**0 510 315 004**	280	4000	2.6	38.6	76.2	15	40	
8	**0 510 415 313**	**0 510 415 005**	280	4000	2.8	40.7	80.3	20	40	
11	**0 510 515 310**	**0 510 515 004**	280	3500	2.9	44.5	85.3	20	40	
14	–	**0 510 515 015***	280	3000	3.0	45.0	90.3	20	40	
16	**0 510 615 314**	**0 510 615 006**	280	3000	3.1	45.0	93.7	20	40	
19	**0 510 615 341**	–	230	3000	3.2	45.0	98.7	20	40	

Dimensions

Standard range



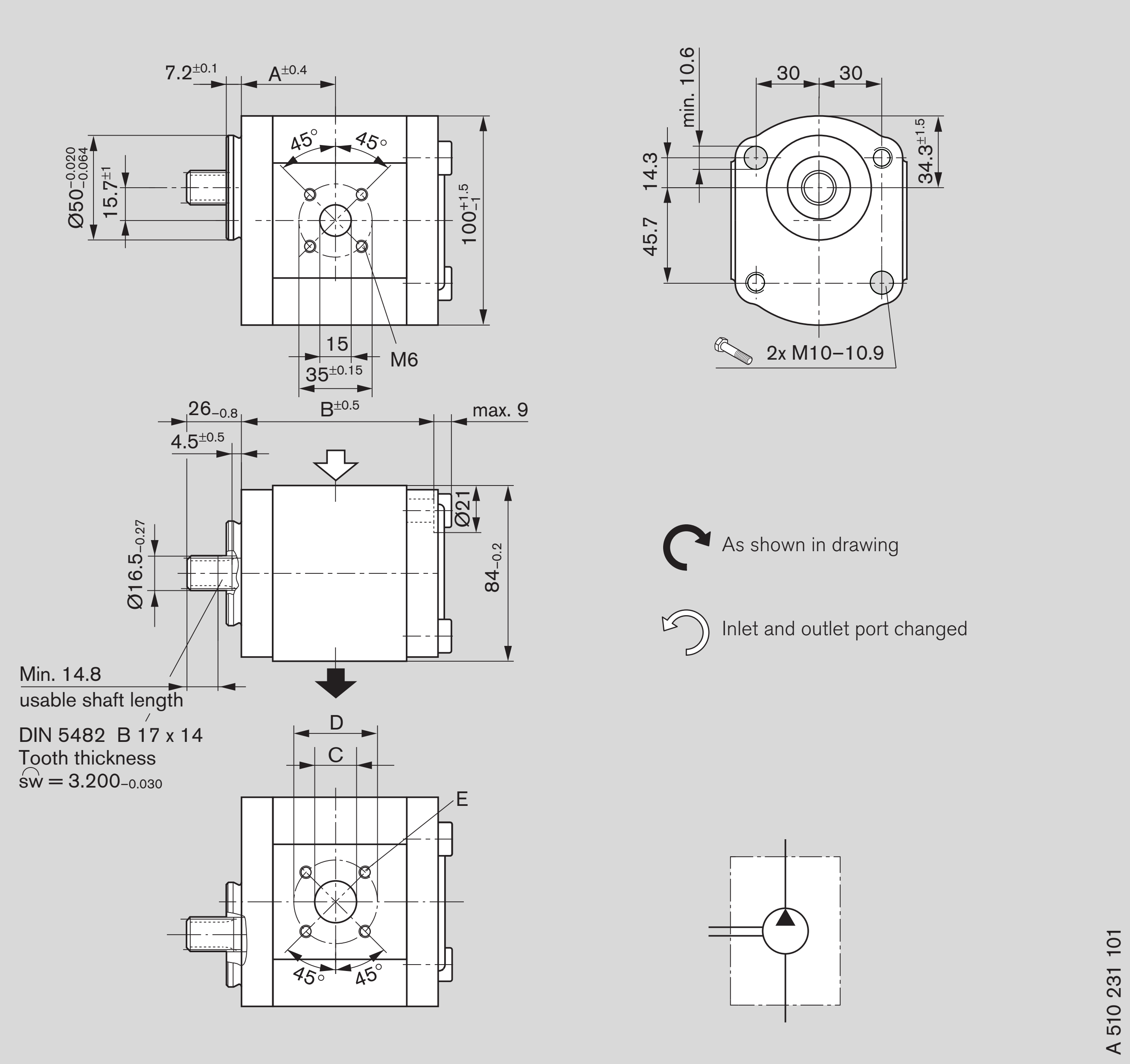
Ordering code

AZPF – 10 – ☐☐☐ ☐F N 20 M B

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	kg	Dimension				
[cm^3/rev]	**L**	**R**	[bar]	[rpm]		[mm] A	B	C	D	E
5.5	**–**	**0 510 315 007**	280	4000	2.55	38.6	76.2	15	40	M6 depth 13
8	**–**	**–**	–	–	–	–	–	–		
11	**–**	**0 510 515 011**	280	3500	2.85	44.5	85.3	20	40	
14	**–**	**–**	–	–	–	–	–	–		
16	**–**	**–**	–	–	–	–	–	–		
19	**–**	**0 510 615 009**	230	3000	3.2	45.0	98.7	20	40	
19	**–**	**–**	–	–	–	–	–	–		
22.5	**–**	**–**	–	–	–	–	–	–		

Dimensions

Standard range



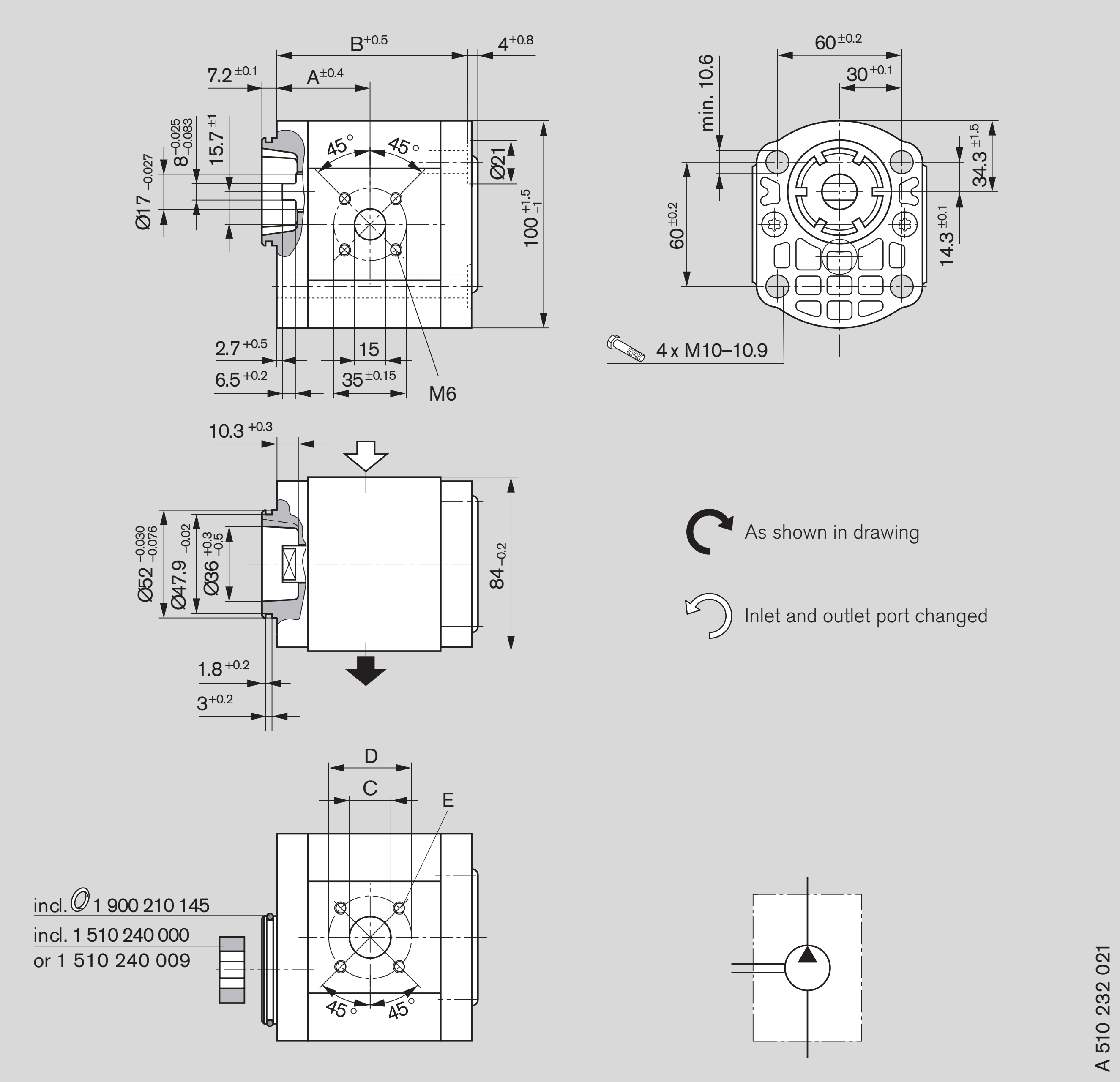
Ordering code

AZPF – 10 – ☐ ☐ ☐ ☐ F P 20 P B
AZPF – 12 – ☐ ☐ ☐ ☐ F P 20 P B*
AZPF – 12 – ☐ ☐ ☐ ☐ F P 20 P B S xxxx**

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C	D	E
5.5	**–**	**–**	–	–	–	–	–	–	–	M6 depth 13
8	**0 510 415 328**	**–**	210	4000	2.7	40.7	80.3	20	15	
11	**0 510 515 337***	**0 510 515 012**	280	3500	2.8	44.5	85.3	20	15	
14	**0 510 515 338**	**0 510 515 013**	210	3000	3.0	45.0	90.3	20	15	
16	**–**	**–**	–	–	–	–	–	–	–	
19	**–**	**–**	–	–	–	–	–	–	–	
22.5	**0 510 715 320****	**0 510 715 008****	210	3000	3.6	58.6	116.1	20	15	

Dimensions

Standard range



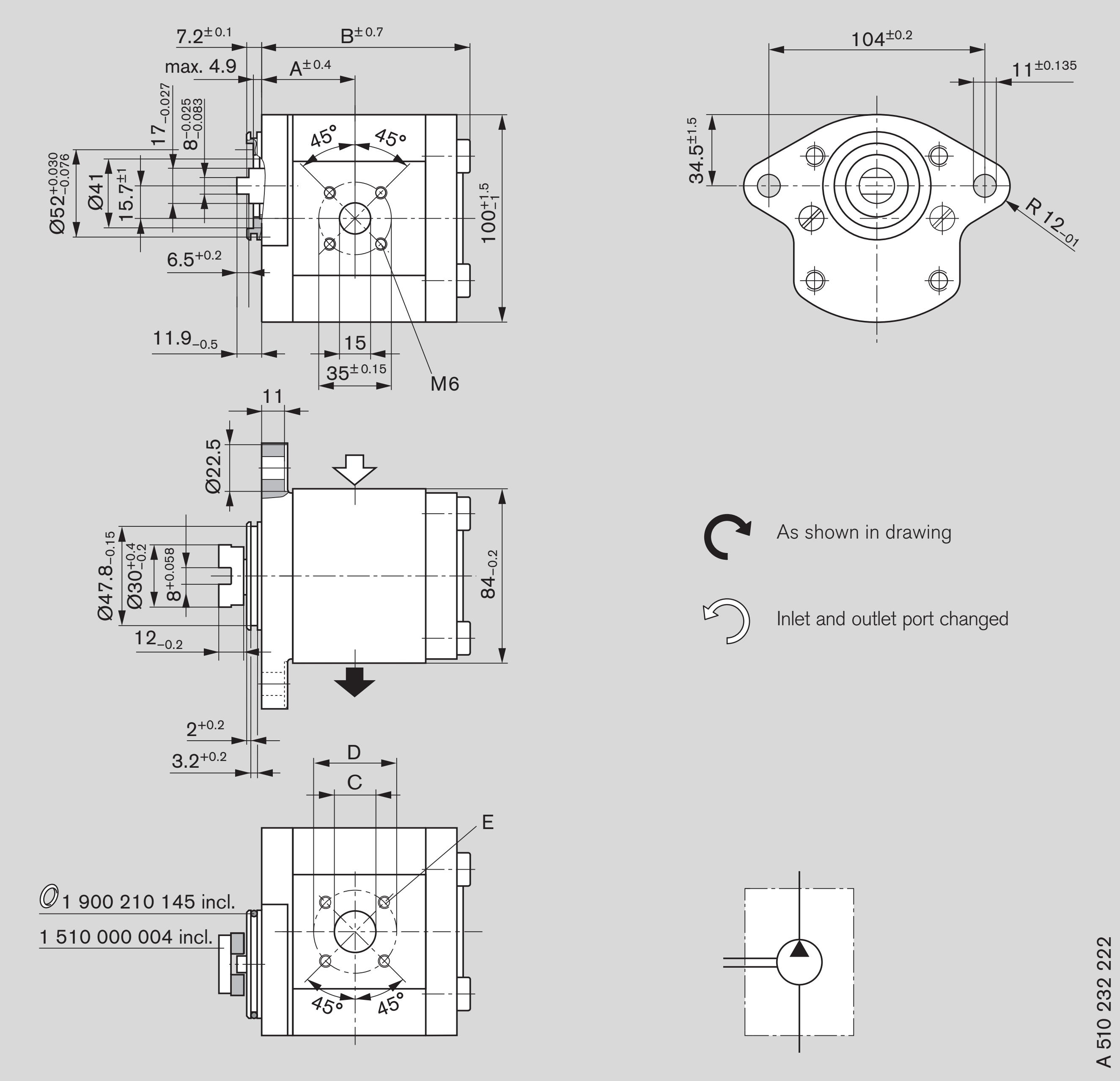
Ordering code

AZPF – XX – ☐☐☐ ☐N T 20 M B

Displacement [cm³/rev]	Ordering-No.		Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm]				
	↺ **L**	↻ **R**				A	B	C	D	E
4	**0 510 215 307**	**0 510 215 007**	280	4000	2.5	37.4	73.7	15	40	M6 depth 13
5.5	**0 510 315 305**	**0 510 315 005**	280	4000	2.5	38.6	76.2	15	40	
8	**0 510 415 314**	**0 510 415 006**	280	4000	2.5	40.7	80.3	20	40	
11	**0 510 515 311**	**0 510 515 005**	280	3500	2.6	44.5	85.3	20	40	
14	**0 510 515 340**	**0 510 515 019**	280	3000	2.38	45.0	90.3	20	40	
16	**0 510 615 315**	**0 510 615 007**	230	3000	3.0	45.0	93.7	20	40	
19	**0 510 615 321**	**0 510 615 008**	190	3000	3.0	45.0	98.7	20	40	
22.5	**0 510 715 307**	**0 510 715 004**	160	2500	3.2	52.6	104.1	20	40	

Dimensions

Standard range



Ordering code

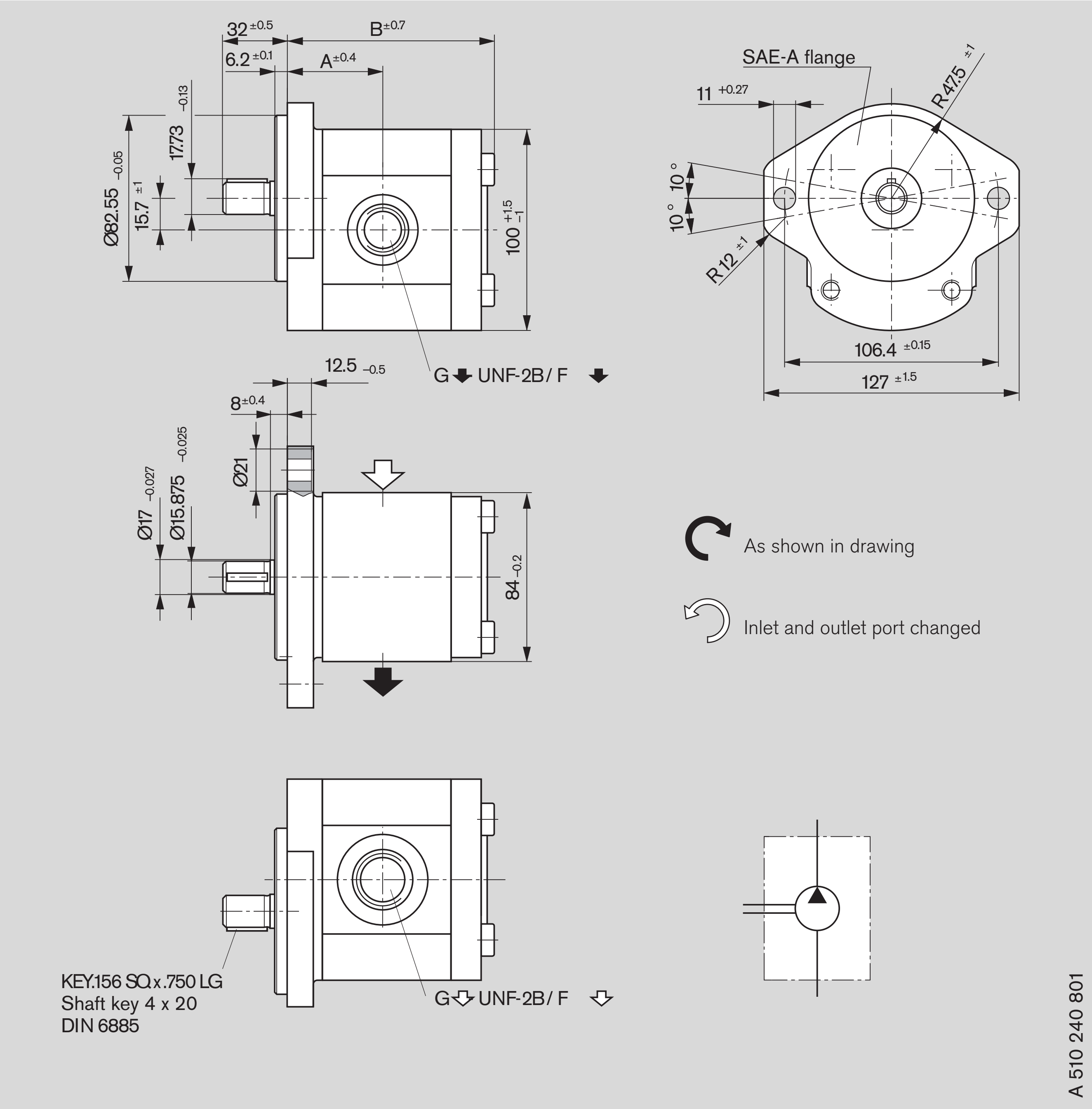
AZPF – 10 – ☐ ☐ ☐ ☐ N L 20 K B

AZPF – 11 – ☐ ☐ ☐ ☐ N L 20 K B*

Displacement [cm^3/rev]	Ordering-No.		Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm]				
	L	R				A	B	C	D	E
4	–	**0 510 225 012**	280	4000	2.8	37.4	81.7	15	40	M6 depth 13
5.5	**0 510 325 312**	**0 510 325 012**	280	4000	2.82	38.6	84.4	15	40	
8	**0 510 425 331***	**0 510 425 019**	280	4000	3.0	40.7	88.5	20	40	
11	–	**0 510 525 025**	280	3500	3.1	44.5	93.3	20	40	
16	**0 510 625 358***	**0 510 625 027***	230	3000	3.3	45.0	101.9	20	40	
19	**0 510 625 368**	**0 510 625 032**	190	3000	3.5	45.0	106.9	20	40	
22.5	–	**0 510 725 044***	160	3000	4.0	58.6	122.5	20	40	

Dimensions

Standard range



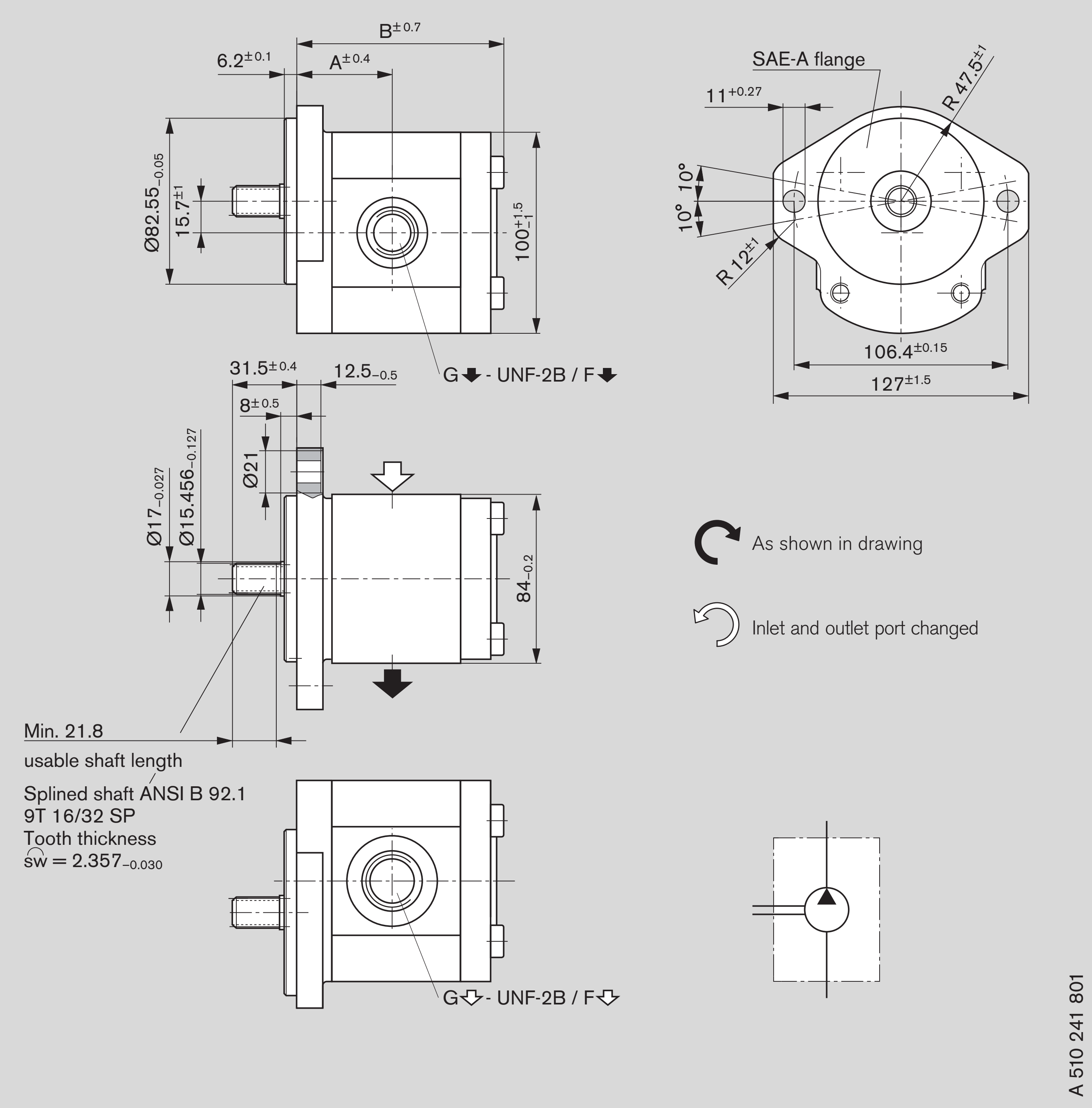
Ordering code

AZPF – 10 – ☐☐☐ ☐Q R 12 M B

Displace-ment [cm³/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	 B	 G ⇩	 G ⬇	 F ⇩	 F ⬇
4	–	**0 510 225 011**	260	4000	3.3	39.9	85.0	9/16-18	9/16-18	13	13
5.5	–	**0 510 325 011**	260	4000	3.3	41.1	87.5	9/16-18	9/16-18	13	13
8	–	**0 510 425 016**	260	4000	3.4	43.2	91.6	7/8-14	7/8-14	16	16
11	–	**0 510 525 015**	260	3500	3.6	47.0	96.6	7/8-14	7/8-14	16	16
14	–	**0 510 525 031**	230	3000	3.65	47.5	101.6	11/16-12	7/8-14	19	16
16	–	**0 510 625 021**	200	3000	3.7	47.5	105.0	11/16-12	7/8-14	19	16
19	–	**0 510 625 041**	170	3500	3.9	47.5	110.0	11/16-12	7/8-14	19	16
22.5	–	**0 510 725 059**	140	2500	4.0	55.1	115.4	11/16-12	7/8-14	19	16

Dimensions

Standard range



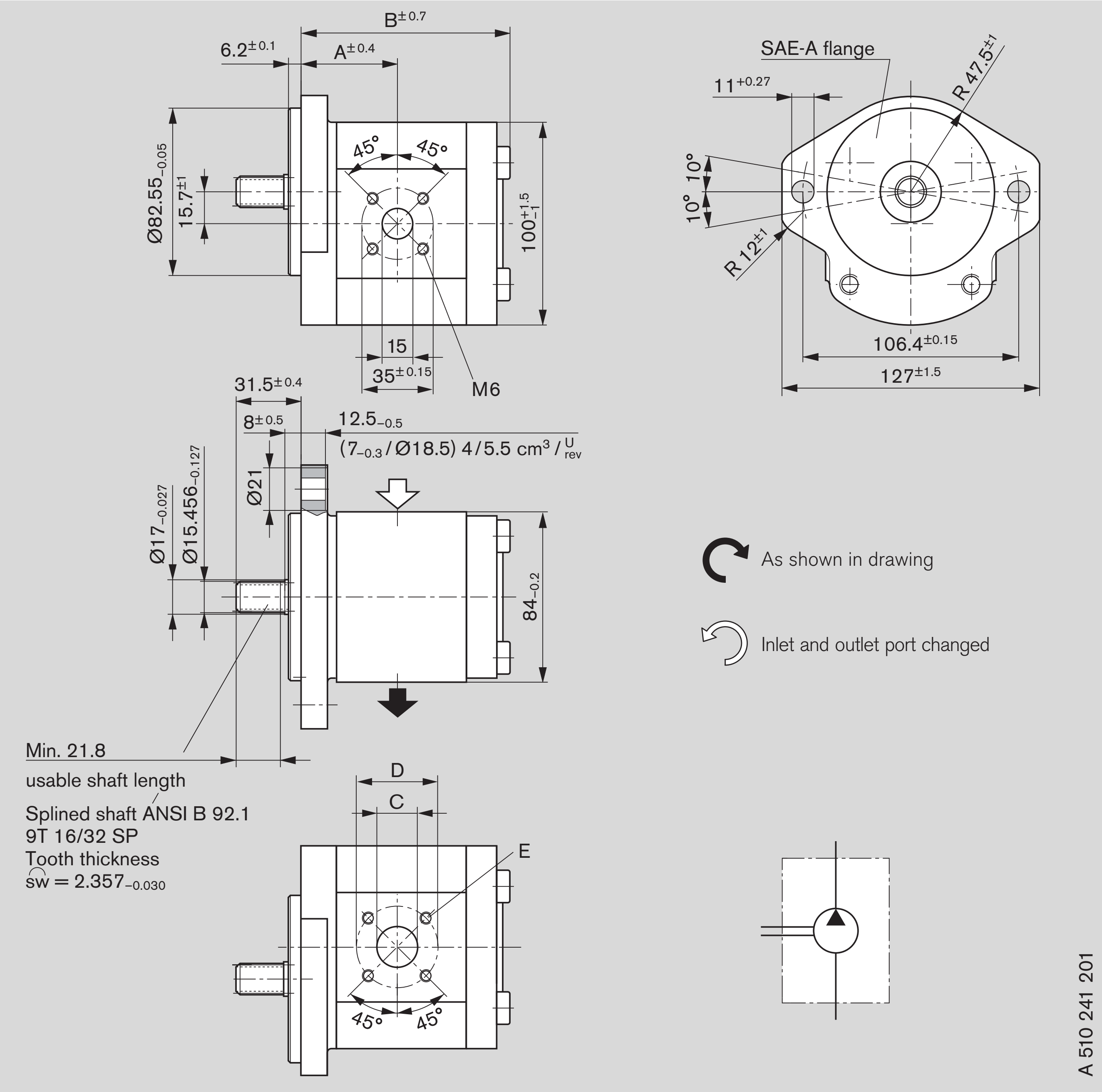
Ordering code

AZPF – 10 – ☐☐☐ ☐RR12MB

Dis-place-ment [cm³/rev]	Ordering-No.		Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm]					
	L	R				A	B	G ⇩	G ⬇	F ⇩	F ⬇
4	–	**0 510 225 010**	280	4000	3.15	39.9	82.7	9/16-18	9/16-18	13	13
5.5	–	**0 510 325 010**	280	4000	3.2	41.4	85.2	9/16-18	9/16-18	13	13
8	–	**0 510 425 015**	280	4000	3.3	43.2	91.1	7/8-14	7/8-14	16	16
11	**0 510 525 315**	**0 510 525 014**	280	3500	3.4	47.0	96.1	11/16-12	7/8-14	19	16
14	–	**0 510 525 041**	280	3000	3.5	47.5	101.1	11/16-12	7/8-14	19	16
16	–	**0 510 625 020**	280	3000	3.75	47.5	104.5	11/16-12	7/8-14	19	16
19	**0 510 625 346**	**0 510 625 048**	230	3000	3.9	47.5	109.5	11/16-12	7/8-14	19	16
22.5	–	**0 510 725 063**	210	2500	4.0	55.1	114.9	11/16-12	7/8-14	19	16

Dimensions

Standard range



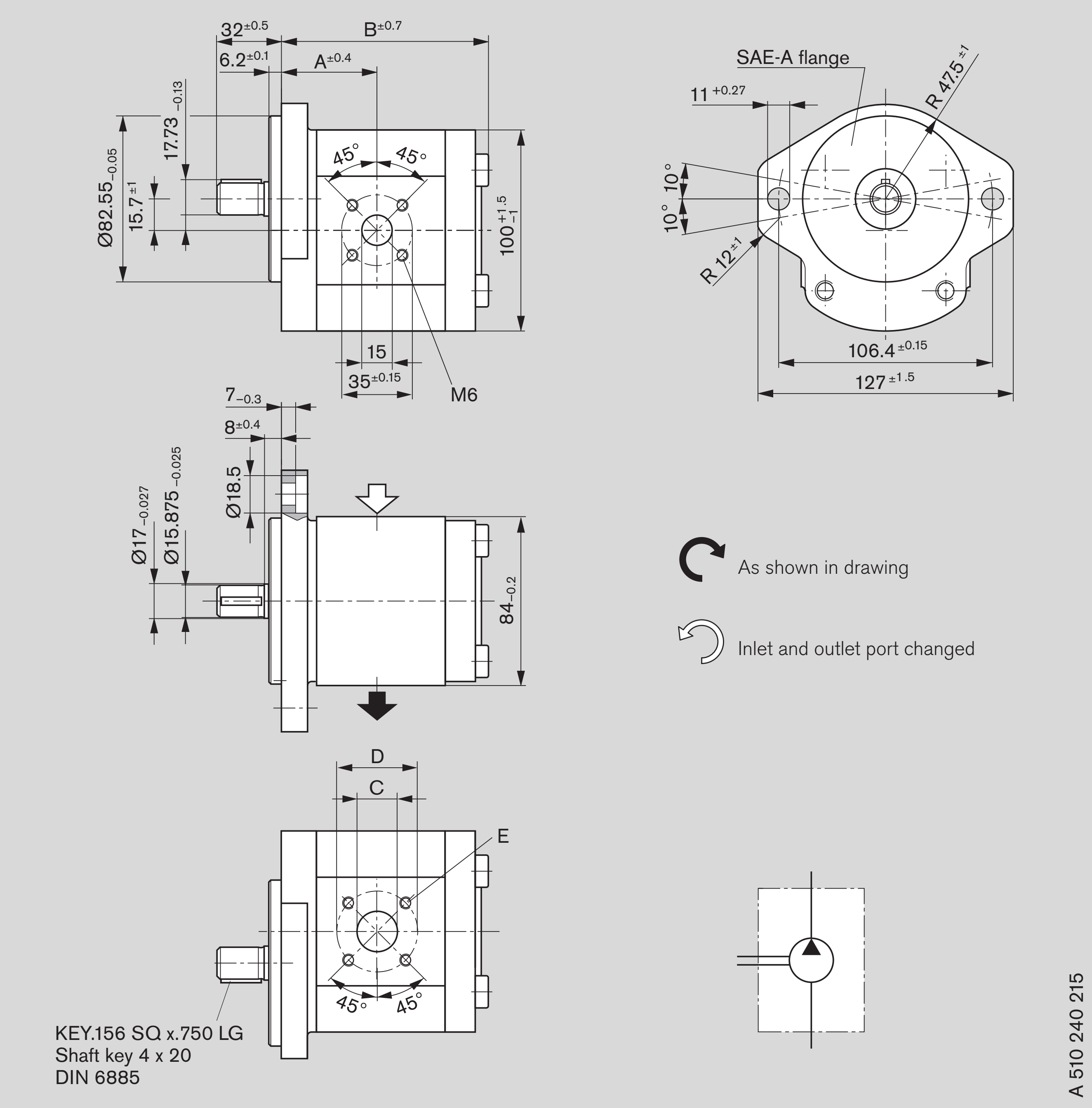
Ordering code

AZPF – 10 – ☐☐☐ ☐ R R 20 M B
AZPF – 11 – ☐☐☐ ☐ R R 20 K B*

Displace-ment [cm³/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	 B	 C	 D	 E
4	**0 510 225 314**	**0 510 225 013**	280	4000	3.15	39.9	85.0	15	40	M6 depth 13
5.5	**0 510 325 313**	**0 510 325 013**	280	4000	3.2	41.1	87.5	15	40	
8	**0 510 425 314**	**0 510 425 020**	280	4000	3.3	43.2	91.6	20	40	
11	**0 510 525 324***	**0 510 525 019**	280	3500	3.5	47.0	96.6	20	40	
14	**0 510 525 325**	**0 510 525 020**	280	3000	3.6	47.5	101.6	20	40	
16	**0 510 625 329**	**0 510 625 028**	280	3000	3.8	47.5	105.0	20	40	
19	**0 510 625 330***	**0 510 625 029***	230	3000	3.9	47.5	110.0	20	40	
22.5	**0 510 725 361**	**0 510 725 077***	210	2500	4.1	55.1	115.4	20	40	

Dimensions

Standard range



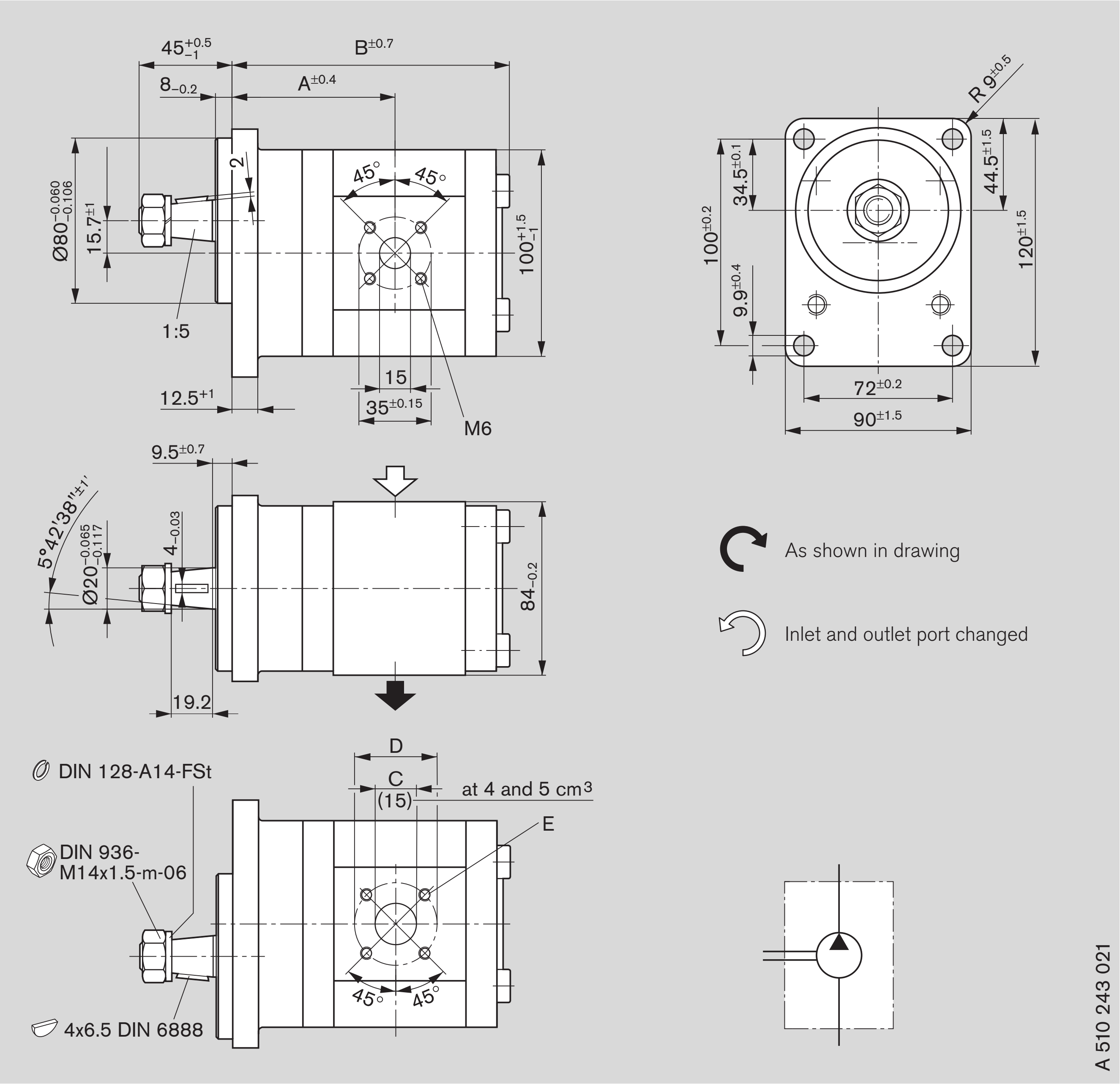
Ordering code

AZPF – 10 – ☐☐☐ ☐ Q R 20 M B

Displace-ment [cm³/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	 B	 C	 D	 E
4	–	**0 510 225 014**	280	4000	3.2	39.9	84.5	15	40	M6 depth 13
5.5	–	**0 510 325 016**	280	4000	3.3	41.1	87.0	15	40	
8	–	**0 510 425 025**	280	4000	3.3	43.2	91.1	20	40	
11	–	**0 510 525 033**	280	3500	3.5	47.0	96.1	20	40	
16	–	**0 510 625 042**	200	3000	3.8	47.5	104.5	20	40	
19	–	**0 510 625 043**	170	3000	3.9	47.5	109.5	20	40	
22.5	**0 510 725 396**	**0 510 725 060**	140	2500	3.9	55.1	114.9	20	40	

Dimensions

Standard range



Ordering code

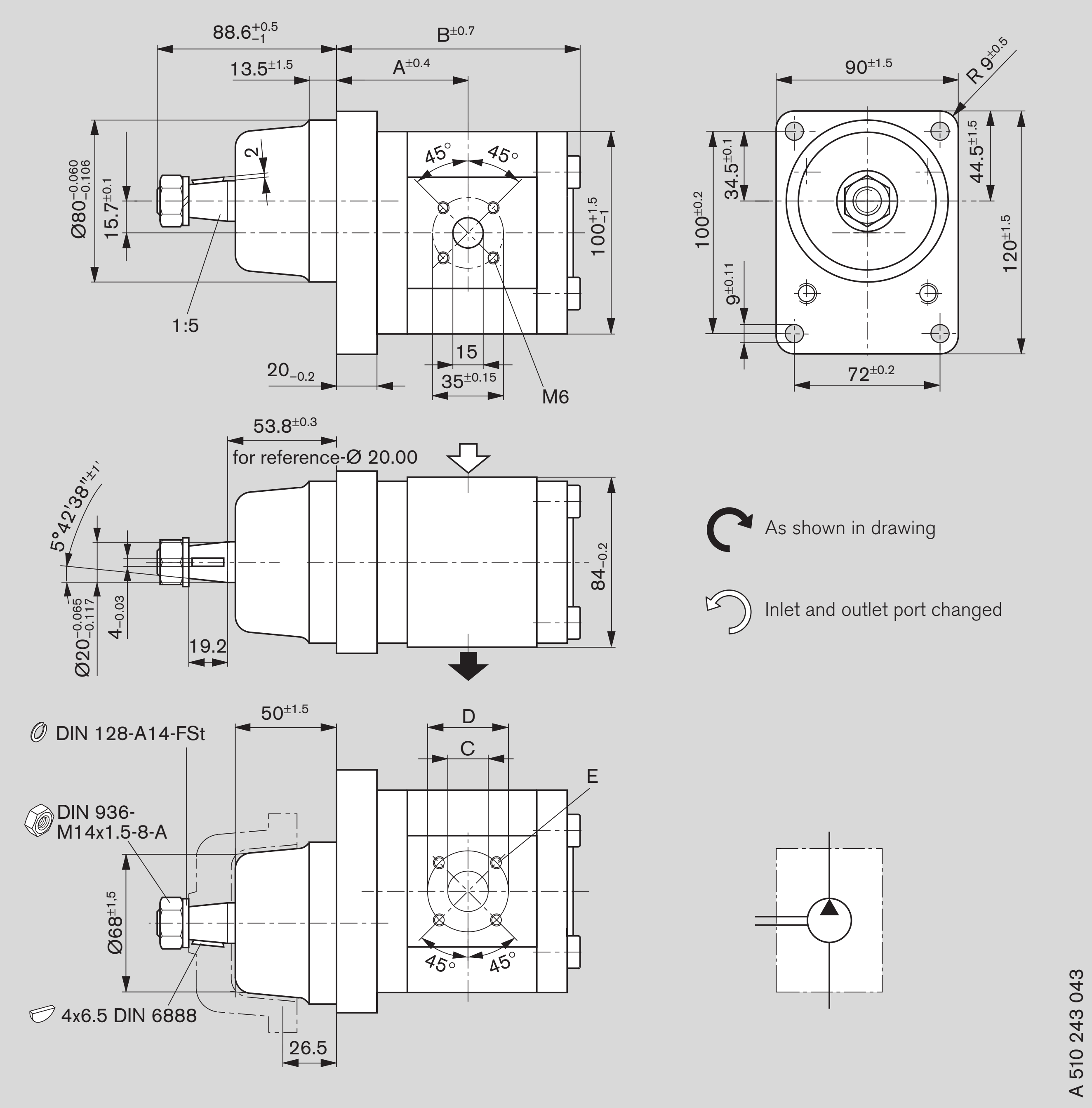
AZPF – 11 – ☐ ☐ ☐ ☐ S A 20 M B

AZPF – 11 – ☐ ☐ ☐ ☐ S A 20 K B*

Displace-ment [cm^3/rev]	Ordering-No. ↺ L	 ↻ R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	 B	 C	 D	 E
4	**0 510 245 300**	**0 510 245 001**	280	4000	3.1	71.1	114.2	15	40	M6 depth 13
5.5	**0 510 345 300**	**0 510 345 001**	280	4000	3.1	72.3	116.7	15	40	
8	**0 510 445 300**	**0 510 445 001***	280	4000	3.3	74.4	120.8	20	40	
11	**0 510 545 300**	**0 510 545 001**	280	3500	3.5	78.2	125.8	20	40	
14			280	3000		78.7	130.8	20	40	
16	**0 510 645 300**	**0 510 645 004**	230	3000	3.6	78.7	134.2	20	40	
19		**0 510 645 002**	190	3000	3.9	78.7	139.2	20	40	
22.5			160	2500		92.3	156.6	20	40	

Dimensions

Standard range



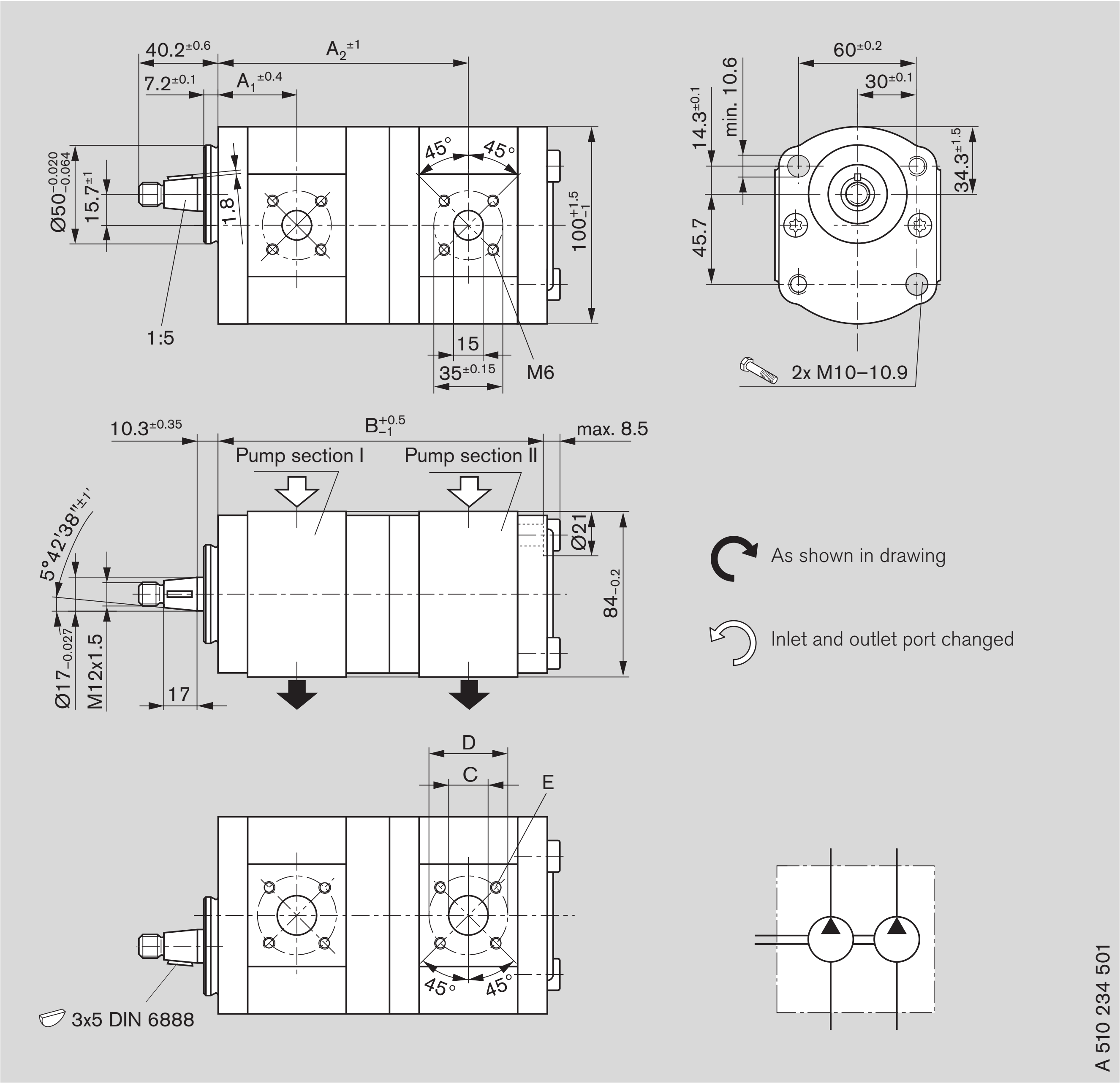
Ordering code

AZPF – 10 – ☐☐☐ ☐ S G 20 M B

Displacement [cm³/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	 B	 C	 D	 E
11	–	**0 510 545 003**	280	3500	3.8	64.5	113.8	20	40	M6 depth 13
14	**0 510 545 302**	**0 510 545 002**	280	3000	4.0	65.0	118.8	20	40	
16	–	**0 510 645 005**	230	3000	4.1	65.0	122.0	20	40	
19	–	**0 510 645 003**	230	3000	4.3	65.0	127.0	20	40	

Dimensions

Standard range



Ordering code

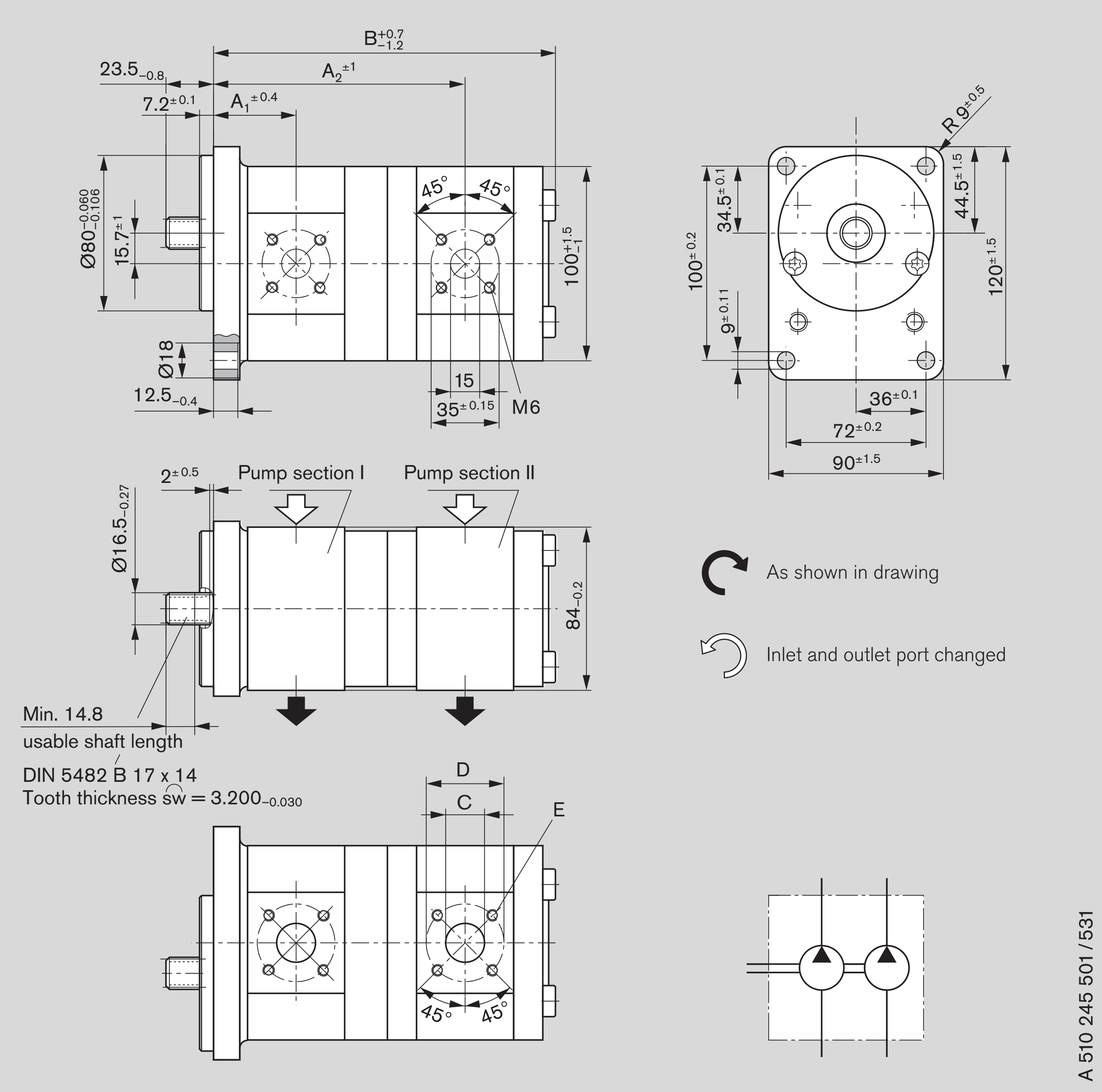
AZPFF – 12 – ☐☐☐/☐☐☐ ☐C P 20 20 K B

Displace-ment [cm^3/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed [rpm]	kg	Dimension [mm]					
P_I	P_{II}	↺ **L**	↻ **R**	P_I	P_{II}			A_1	A_2	B	C 1)	D	E
5.5	4	**0 510 365 305**	–	280	280	4000	4.8	38.6	121.6	157.9	15	40	M6 depth 13
8	4	**0 510 465 324**	**0 510 465 011**	280	280	4000	4.4	40.7	125.7	162.0	20	40	
8	5.5	**0 510 465 344**	**0 510 465 032**	280	280	4000	4.4	40.7	126.9	164.5	20	40	
8	8	**0 510 465 320**	**0 510 465 023**	280	280	4000	5.4	40.7	129.0	168.6	20	40	
11	4	**0 510 565 387**	–	280	280	3500	4.5	44.5	130.7	167.0	20	40	
11	5.5	**0 510 565 319**	**0 510 565 095**	280	280	3500	4.5	44.5	131.9	169.5	20	40	
11	8	**0 510 565 389**	**0 510 565 014**	280	280	3500	4.6	44.5	134.0	173.6	20	40	
11	11	**0 510 565 376**	**0 510 565 061**	280	280	3500	4.8	44.5	137.8	178.6	20	40	
14	4	**0 510 565 406**	–	280	280	3000	4.6	45.0	135.7	172.0	20	40	
14	8	**0 510 565 335**	**0 510 565 072**	280	280	3000	4.8	45.0	139.0	178.6	20	40	
14	11	**0 510 565 393**	–	280	280	3000	5.0	45.0	142.8	183.6	20	40	
14	14	–	**0 510 565 417**	280	280	3000	5.0	45.0	143.3	188.6	20	40	
16	4	**0 510 665 348**	–	280	280	3000	4.75	45.0	139.1	175.4	20	40	
16	5.5	**0 510 665 337**	–	280	280	3000	4.8	45.0	140.3	177.9	20	40	
16	8	**0 510 665 328**	**0 510 665 135**	280	280	3000	6.0	45.0	142.4	182.0	20	40	
16	11	**0 510 665 382**	**0 510 665 152**	280	280	3000	5.0	45.0	146.2	187.0	20	40	
16	14	**0 510 665 381**	**0 510 665 144**	280	280	3000	5.1	45.0	146.7	192.0	20	40	
16	16	**0 510 665 330**	**0 510 665 052**	280	230	3000	6.4	45.0	146.7	195.4	20	40	
19	4	**0 510 665 369**	–	230	280	3000	4.9	45.0	144.1	180.4	20	40	
19	5	**0 510 665 442**	–	230	280	3000	4.8	45.0	145.3	183.2	20	40	
19	11	**0 510 665 368**	–	230	280	3000	5.2	45.0	146.2	192.0	20	40	
19	14	**0 510 665 418**	–	230	280	3000	5.0	45.0	151.7	197.0	20	40	
19	19	**0 510 665 336**	–	230	190	3000	6.6	45.0	151.7	205.4	20	40	
22	8	**0 510 765 345**	**0 510 765 045**	210	280	2500	5.1	52.6	152.8	192.4	20	40	
22	11	**0 510 765 309**	**0 510 765 049**	210	280	2500	5.2	52.6	156.7	197.7	20	40	
22	16	**0 510 765 343**	**0 510 765 028**	210	230	2500	5.5	52.6	157.1	205.8	20	40	

1) 4 and 5.5 cm^3 Ø 15

Dimensions

Standard range



Ordering code

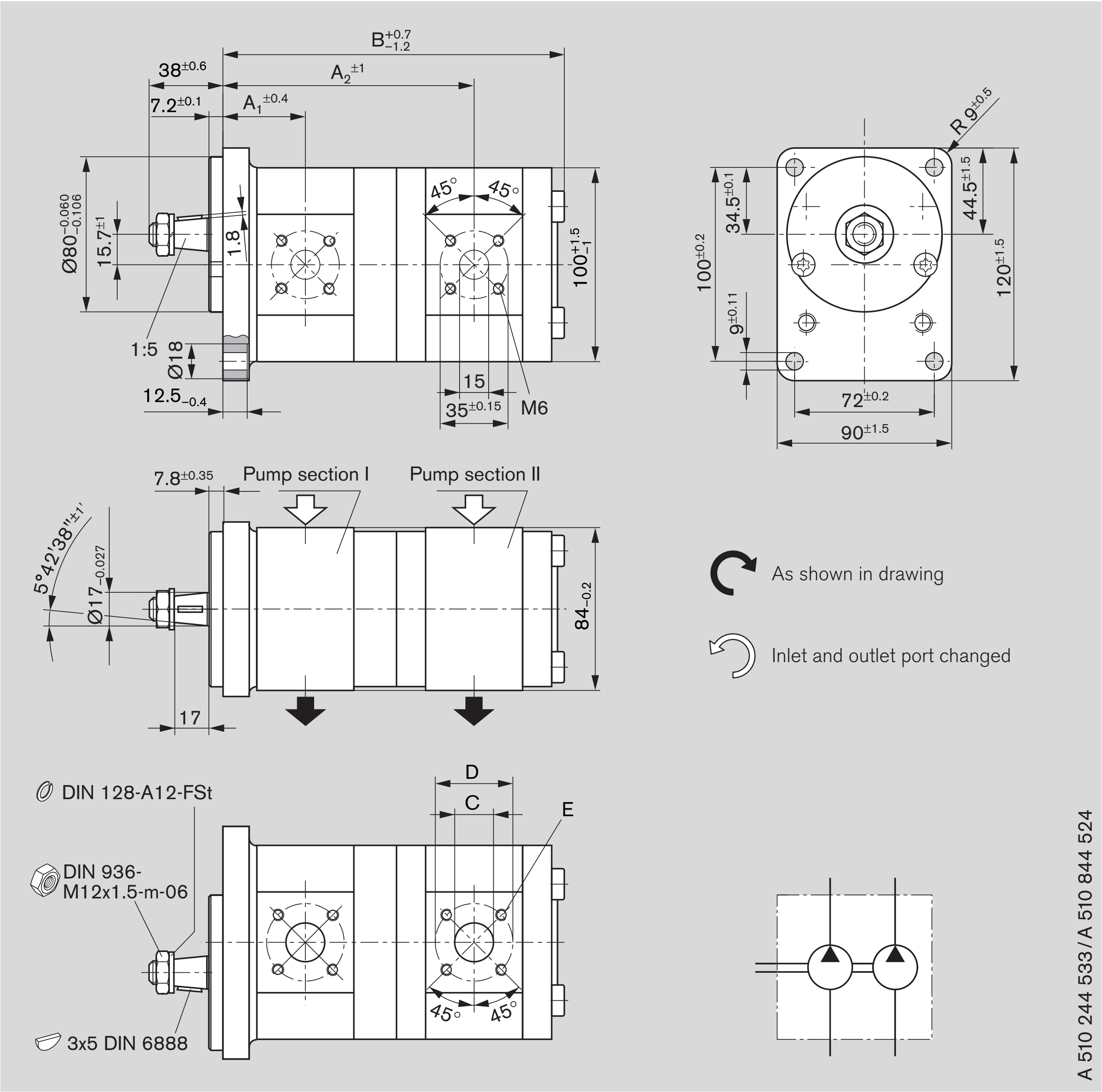
AZPFF – 10 – ☐☐☐ / ☐☐☐ ☐ F B 20 20 M B
AZPFF – 11 – ☐☐☐ / ☐☐☐ ☐ F B 20 20 M B*

Displacement [cm^3/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed [rpm]	kg	Dimension [mm]					
P_I	P_{II}	↺ **L**	↻ **R**	P_I	P_{II}			A_1	A_2	B	C 1)	D	E
8	5.5	**0 510 465 345**	–	280	280	4000	5.1	43.2	129.4	174.0	20	40	M6 depth 13
8	8	**0 510 465 326***	–	280	280	4000	5.1	43.2	131.5	178.1	20	40	
11	4	–	**0 510 565 032**	280	280	3500	6.3	47.0	133.2	176.5	20	40	
11	5.5	**0 510 565 332**	**0 510 565 034**	280	280	3500	6.35	47.0	134.4	179.0	20	40	
11	8	**0 510 565 334***	**0 510 565 018**	280	280	3500	6.4	47.0	136.5	183.1	20	40	
11	11	**0 510 565 328**	**0 510 565 035**	280	280	3500	6.5	47.0	140.3	188.1	20	40	
14	4	**0 510 565 367**	–	280	280	3000	6.4	47.5	138.2	181.5	20	40	
14	5.5	**0 510 565 069**	–	280	280	3500	6.5	47.5	139.4	183.7	20	40	
14	8	**0 510 565 356**	**0 510 565 019**	280	280	3000	6.5	47.5	141.5	188.1	20	40	
16	4	–	**0 510 665 058**	280	280	3000	6.7	47.5	141.6	184.9	20	40	
16	8	**0 510 665 333**	**0 510 665 064**	280	280	3000	6.8	47.5	144.9	191.5	20	40	
16	11	**0 510 665 347**	**0 510 665 036**	280	280	3000	6.9	47.5	148.7	196.5	20	40	
16	16	**0 510 665 334**	**0 510 665 029**	280	230	3000	7.3	47.5	149.2	204.9	20	40	
19	4	–	**0 510 665 115**	230	280	3000	5.5	47.5	146.6	189.0	20	40	
19	11	**0 510 665 375***	–	230	280	3000	5.9	47.5	153.7	201.5	20	40	
19	19	**0 510 665 420**	**0 510 665 097**	230	190	3000	6.3	47.5	154.2	214.9	20	40	
22.5	5.5	**0 510 765 317**	**0 510 765 022**	210	280	2500	5.8	61.1	165.2	209.8	20	40	
22.5	8	**0 510 765 331**	–	210	280	2500	6.18	61.1	167.3	213.9	20	40	
22.5	16	**0 510 765 341**	–	210	230	2500	6.4	61.1	171.6	227.3	20	40	
22.5	22.5	**0 510 765 338**	–	210	160	2500	7.05	61.1	185.2	249.7	20	40	

1) 4 and 5.5 cm^3 Ø 15

Dimensions

Standard range



Ordering code

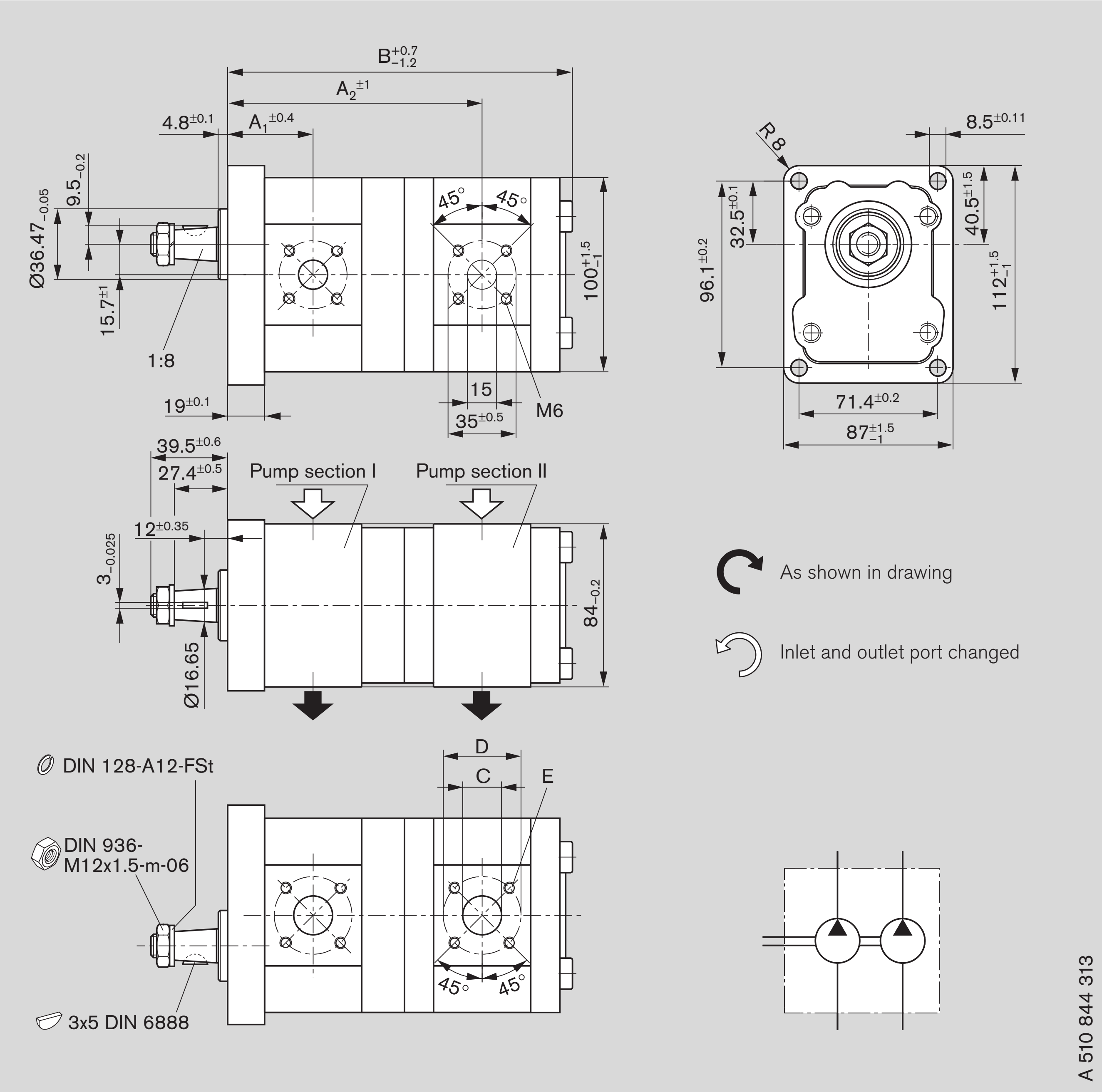
AZPFF – 10 – ☐☐☐/☐☐☐ ☐C B 20 20 M B
AZPFF – 11 – ☐☐☐/☐☐☐ ☐C B 20 20 M B*

Displacement [cm^3/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed [rpm]	kg	Dimension [mm]					
P_I	P_{II}	↺ **L**	↻ **R**	P_I	P_{II}			A_1	A_2	B	C [1])	D	E
4	4	**0 510 900 002***	**0 510 900 001***	280	280	4000	4.5	39.9	121.6	164.4	15	40	M 6 depth 13
5.5	4	**0 510 900 005***	–	280	280	4000	4.9	41.1	124.1	166.9	15	40	
5.5	5.5	**0 510 900 004***	**0 510 900 003***	280	280	4000	5.0	41.1	125.3	169.4	15	40	
8	16	–	**0 510 900 042***	280	230	3000	5.6	43.2	135.8	191.0	20	40	
8	4	**0 510 900 008***	**0 510 900 051***	280	280	4000	5.1	43.2	128.2	171.0	20	40	
8	5.5	**0 510 900 009***	**0 510 900 007***	280	280	4000	5.1	43.2	129.4	173.5	20	40	
8	8	**0 510 900 010***	**0 510 900 006***	280	280	4000	5.2	43.2	131.5	177.6	20	40	
11	4	**0 510 900 015***	**0 510 900 012***	280	280	3500	5.2	47.0	133.2	176.0	20	40	
11	5.5	**0 510 900 017***	**0 510 900 046***	280	280	3500	5.2	47.0	134.4	178.5	20	40	
11	8	**0 510 900 016***	**0 510 900 044***	280	280	3500	5.4	47.0	136.5	182.6	20	40	
11	11	**0 510 900 018***	**0 510 900 039***	280	280	3500	5.5	47.0	140.3	187.6	20	40	
14	4	**0 510 900 036***	–	280	280	3000	5.3	47.5	138.2	181	20	40	
14	5.5	–	**0 510 900 060***	280	280	3000	5.4	47.5	139.4	183.5	20	40	
14	8	**0 510 900 020***	**0 510 900 011***	280	280	3000	5.5	47.5	141.5	187.6	20	40	
14	8	**0 510 565 364**	**0 510 565 012**	280	280	3000	5.6	47.5	141.5	188.1	20	40	
14	11	**0 510 900 019***	**0 510 900 013***	280	280	3000	5.6	47.5	145.3	192.6	20	40	
14	11	**0 510 565 353**	**0 510 565 033**	280	280	3000	5.7	47.5	145.3	193.1	20	40	
14	14	–	**0 510 900 014***	280	280	3000	5.8	47.5	145.8	197.6	20	40	
14	14	–	**0 510 565 037**	280	280	3000	5.9	47.5	145.8	198.1	20	40	
16	4	**0 510 900 059***	**0 510 900 021***	280	280	3000	5.5	47.5	141.6	184.4	20	40	
16	5.5	**0 510 900 028***	–	280	280	3000	5.5	47.5	142.8	186.9	20	40	
16	8	**0 510 900 035***	**0 510 900 022***	280	280	3000	5.6	47.5	144.9	191.0	20	40	
16	11	**0 510 900 029***	**0 510 900 023***	280	280	3000	5.7	47.5	148.7	196.0	20	40	
16	14	–	**0 510 900 061***	280	280	3000	5.9	47.5	149.2	201.0	20	40	
16	16	**0 510 900 030***	**0 510 900 024***	280	230	3000	6.0	47.5	149.2	204.4	20	40	
19	4	**0 510 900 043***	**0 510 900 049***	230	280	3000	5.6	47.5	146.6	189.4	20	40	
19	5.5	–	**0 510 665 067**	230	280	3000	5.6	47.5	147.8	192.4	20	40	
19	5.5	–	**0 510 900 027***	230	280	3000	5.6	47.5	147.8	191.9	20	40	
19	8	**0 510 900 031***	**0 510 900 047***	230	280	3000	5.8	47.5	149.9	196.0	20	40	
19	8	**0 510 665 325***	**0 510 665 024**	230	280	3000	6.7	47.5	149.9	196.5	20	40	
19	11	**0 510 900 032***	**0 510 900 052***	230	280	3000	5.9	47.5	153.7	201.0	20	40	
19	11	**0 510 665 326**	–	230	280	3000	6.9	47.5	153.9	201.5	20	40	
19	14	**0 510 900 053***	–	230	280	3000	6.0	47.5	154.2	206.0	20	40	
19	16	**0 510 665 327**	**0 510 665 053**	230	230	3000	7.1	47.5	154.2	209.9	20	40	
19	16	**0 510 900 033***	**0 510 900 026***	230	230	3000	6.1	47.5	154.2	209.4	20	40	
19	19	**0 510 900 034***	**0 510 900 025***	230	210	3000	6.2	47.5	154.2	214.4	20	40	
19	19	**0 510 665 400**	**0 510 665 025**	230	190	3000	6.2	47.5	154.2	214.9	20	40	
22.5	4	–	**0 510 900 050***	210	280	2500	5.8	55.1	152.0	194.8	20	40	
22.5	5.5	**0 510 900 055***	**0 510 900 045***	210	280	2500	5.8	55.1	153.2	197.3	20	40	
22.5	8	**0 510 900 057***	**0 510 900 040***	210	280	2500	5.9	55.1	155.3	201.4	20	40	
22.5	8	–	**0 510 765 023**	230	280	3000	5.9	61.0	167.3	213.9	20	40	
22.5	11	–	**0 510 900 054***	210	280	2500	6.0	55.1	159.1	206.4	20	40	
22.5	11	**0 510 765 320**	–	210	250	3000	6.3	61.0	171.1	218.9	20	40	
22.5	14	**0 510 900 048***	**0 510 900 058***	210	280	2500	6.2	55.1	159.6	211.4	20	40	
22.5	16	**0 510 900 041***	**0 510 900 037***	210	230	2500	6.2	55.1	159.6	214.8	20	40	
22.5	16	**0 510 765 340**	–	210	230	3000	6.55	61.0	171.6	227.3	20	40	
22.5	22.5	**0 510 900 056***	**0 510 900 038***	210	180	2500	6.5	55.1	167.2	225.2	20	40	
22.5	22.5	–	**0 510 765 012**	210	160	3000	6.5	61.0	185.2	249.7	20	40	

[1]) 4 and 5.5 cm^3 Ø 15

Dimensions

Standard range



Ordering code

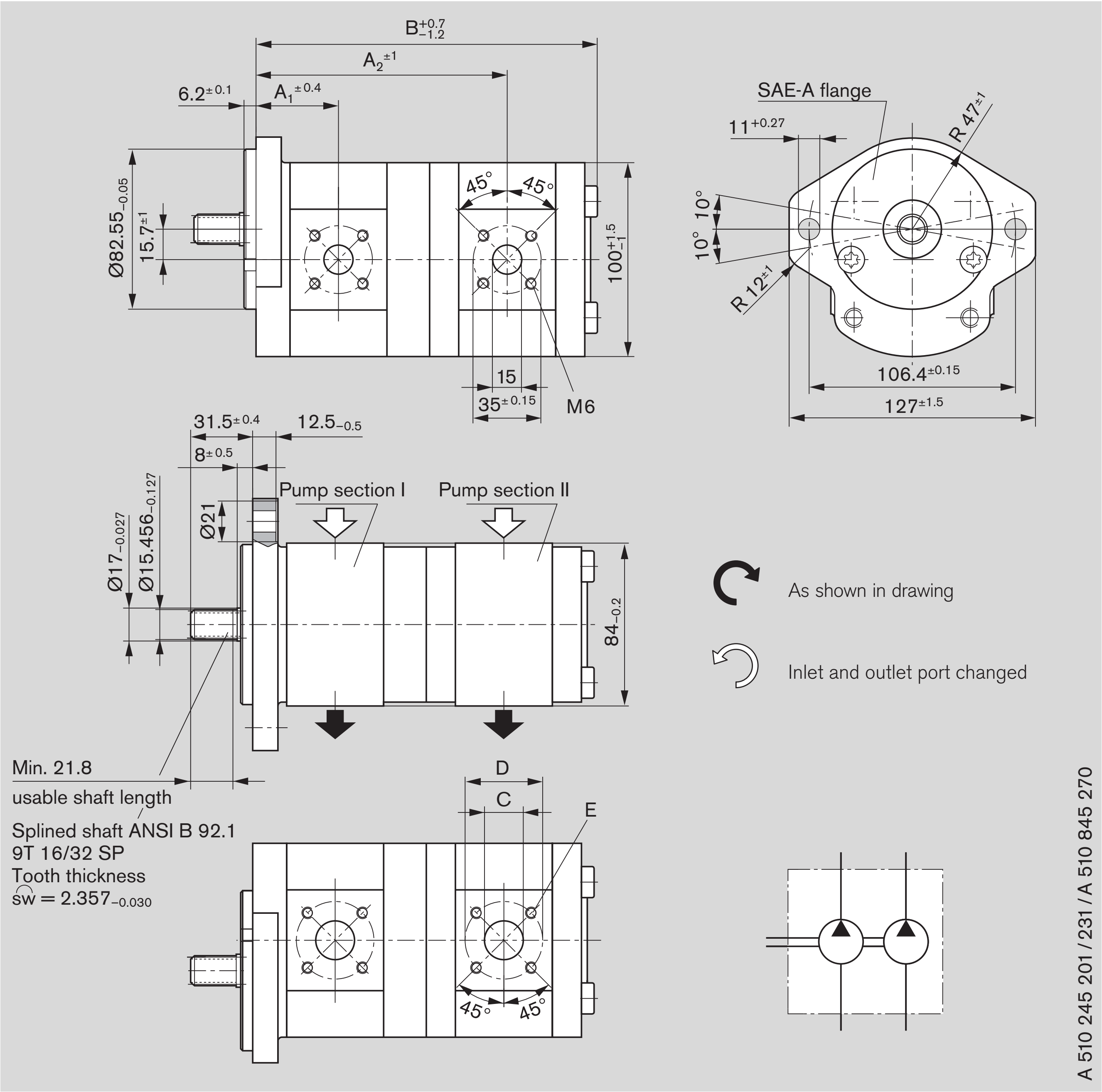
AZPFF – 10 – ☐ ☐ ☐ / ☐ ☐ ☐ ☐ H O 20 20 M B
AZPFF – 10 – ☐ ☐ ☐ / ☐ ☐ ☐ ☐ H O 20 20 K B*

Displacement [cm^3/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed [rpm]	kg	Dimension [mm]					
P_I	P_{II}	↺ **L**	↻ **R**	P_I	P_{II}			A_1	A_2	B	C [1]	D	E
4	4	–	**0 510 901 500**	280	280	4000	4.7	41.4	123.1	165.9	15	40	M 6 depth 13
8	5.5	**0 510 901 512**		280	280	4000	4.9	44.7	130.9	175.0	20	40	
8	8	–	**0 510 901 504**	280	280	4000	5.0	44.7	133.0	179.1	20	40	
11	4	–	**0 510 901 509**	280	280	3500	5.0	48.5	134.7	177.5	20	40	
11	5.5	**0 510 565 436***	**0 510 901 503**	280	280	3500	5.1	48.5	135.9	180.0	20	40	
14	5.5	**0 510 565 435***	–	280	280	3000	5.2	49.0	140.9	185.0	20	40	
14	11	–	**0 510 901 513**	280	280	3000	5.5	49.0	146.8	194.1	20	40	
16	5.5	–	**0 510 901 510**	280	280	3000	5.3	49.0	144.3	188.4	20	40	
16	8	**0 510 901 514**	–	280	280	3000	5.4	49.0	146.4	192.5	20	40	
16	14	–	**0 510 901 515**	280	280	3000	5.7	49.0	150.7	202.5	20	40	
16	16	–	**0 510 901 501**	280	230	3000	5.8	49.0	150.7	205.9	20	40	
19	8	–	**0 510 901 507**	230	280	3000	5.5	49.0	151.4	197.5	20	40	
19	11	–	**0 510 901 508**	230	280	3000	5.6	49.0	155.2	202.5	20	40	
19	16	–	**0 510 901 502**	230	230	3000	5.9	49.0	155.7	210.9	20	40	
19	19	**0 510 901 506**	–	230	190	3000	6.0	49.0	155.7	215.9	20	40	
22.5	16	**0 510 901 511**	–	210	230	2500	6.1	56.6	161.1	216.3	20	40	
22.5	19	–	**0 510 901 505**	210	190	2500	6.2	56.6	161.7	220.3	20	40	

[1] 4 and 5.5 cm^3 Ø 15

Dimensions

Standard range



Ordering code

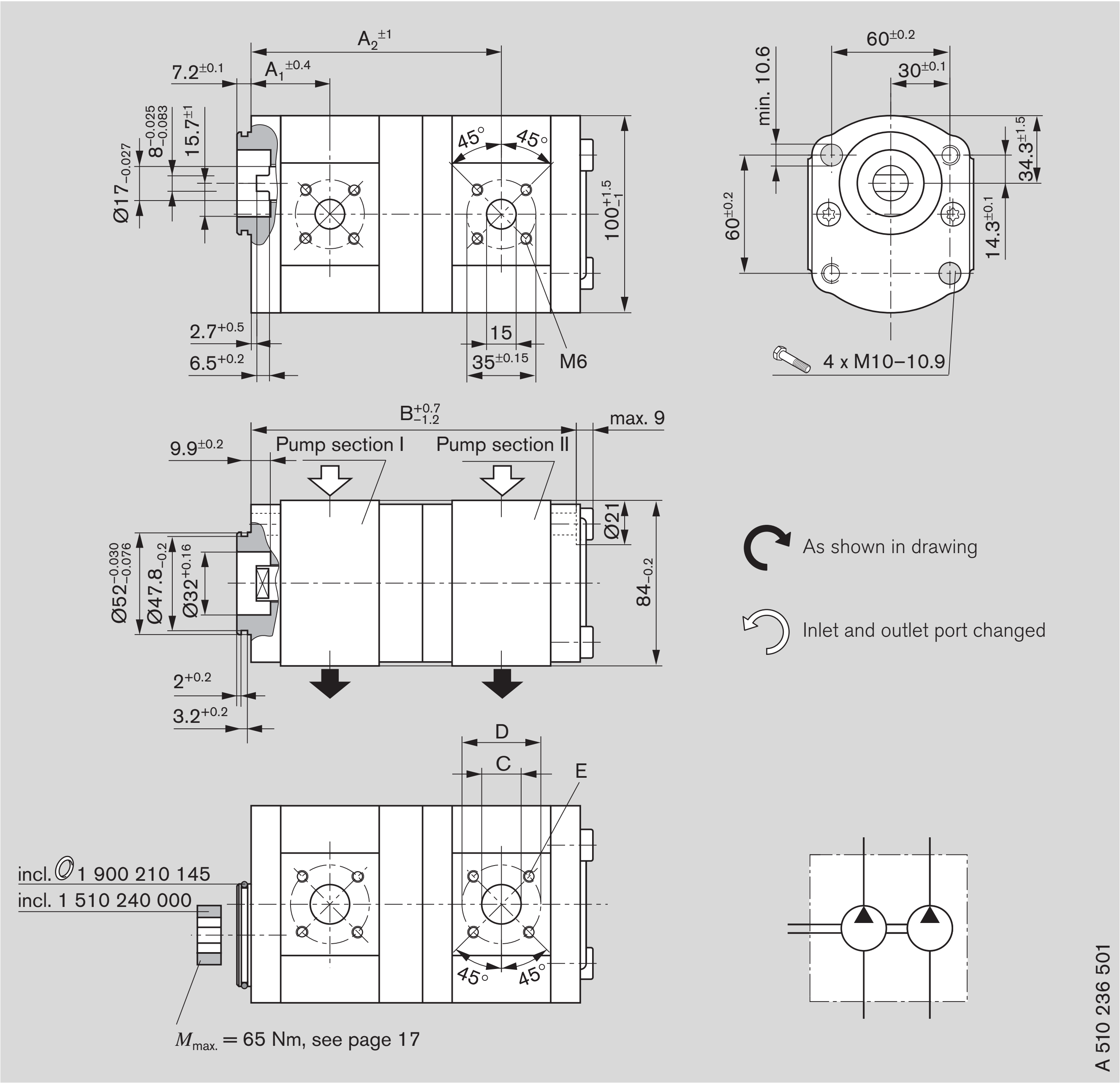
AZPFF – 10 – ☐ ☐ ☐ / ☐ ☐ ☐ ☐ R R 20 20 M B
AZPFF – 11 – ☐ ☐ ☐ / ☐ ☐ ☐ ☐ R R 20 20 M B*
AZPFF – 11 – ☐ ☐ ☐ / ☐ ☐ ☐ ☐ R R 20 20 K B**

Displacement [cm^3/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed [rpm]	kg	Dimension [mm]					
		↺	↻										
P_I	P_{II}	**L**	**R**	P_I	P_{II}			A_1	A_2	B	C [1])	D	E
5.5	4	**0 510 901 029***	–	280	280	4000	4.9	41.1	124.1	166.9	15	40	M6 depth 13
5.5	5.5	–	**0 510 901 042***	280	280	4000	5.0	41.1	125.3	169.4	15	40	
8	4	**0 510 901 032***	**0 510 901 034***	280	280	4000	5.0	43.2	128.2	171.0	20	40	
8	5.5	**0 510 901 018***	**0 510 901 030***	280	280	4000	5.1	43.2	129.4	173.5	20	40	
8	8	–	**0 510 901 021***	280	280	4000	5.1	43.2	131.5	177.6	20	40	
11	4	–	**0 510 901 024***	280	280	3500	5.1	47.0	133.2	176.0	20	40	
11	4	–	**0 510 565 022**	280	280	3500	5.2	47.0	133.2	176.5	20	40	
11	5.5	**0 510 901 015***	**0 510 901 000***	280	280	3500	5.2	47.0	134.4	178.5	20	40	
11	5.5	–	**0 510 565 023**	280	280	3500	5.2	47.0	134.4	179.0	20	40	
11	8	**0 510 901 031***	**0 510 901 037***	280	280	3500	5.3	47.0	136.5	182.6	20	40	
11	11	**0 510 901 009***	**0 510 901 035****	280	280	3500	5.5	47.0	140.3	187.6	20	40	
14	5.5	**0 510 901 033***	–	280	280	3000	5.4	47.5	139.4	183.5	20	40	
14	8	–	**0 510 901 016***	280	280	3000	5.5	47.5	141.5	187.6	20	40	
14	11	**0 510 565 346**	–	280	280	3000	5.7	47.5	145.3	193.1	20	40	
14	11	**0 510 901 001***	**0 510 901 011***	280	280	3000	5.6	47.5	145.3	192.6	20	40	
14	14	–	**0 510 901 036***	280	280	3000	5.7	47.5	145.8	197.6	20	40	
16	4	–	**0 510 901 028***	280	280	3000	5.4	47.5	141.6	184.4	20	40	
16	5.5	**0 510 901 014***	**0 510 901 008***	280	280	3000	5.4	47.5	142.8	186.9	20	40	
16	8	**0 510 901 006***	**0 510 901 005***	280	280	3000	5.5	47.5	144.9	191.0	20	40	
16	11	**0 510 901 012***	**0 510 901 002***	280	280	3000	5.7	47.5	148.7	196.0	20	40	
16	11	**0 510 665 354**	**0 510 665 042**	280	280	3000	5.8	47.5	148.7	196.0	20	40	
16	16	**0 510 901 027***	**0 510 901 022***	280	280	3000	5.9	47.5	149.2	204.4	20	40	
19	4	–	**0 510 901 044***	230	280	3000	5.5	47.5	146.6	189.4	20	40	
19	5.5	**0 510 901 041***	**0 510 901 043***	230	280	3000	5.6	47.5	147.8	191.9	20	40	
19	8	**0 510 901 017***	**0 510 901 003***	230	280	3000	5.7	47.5	149.9	196.0	20	40	
19	8	–	**0 510 665 126****	230	280	3000	5.6	47.5	149.9	196.0	20	40	
19	8	–	**0 510 665 047**	230	280	3000	5.8	47.5	149.9	196.0	20	40	
19	11	**0 510 665 435**	**0 510 901 004***	230	280	3000	5.8	47.5	153.7	201.0	20	40	
19	14	**0 510 901 040***	**0 510 901 025***	230	280	3000	5.9	47.5	154.2	206.0	20	40	
19	16	**0 510 901 039***	**0 510 901 045***	230	230	3000	6.0	47.5	154.2	209.4	20	40	
19	19	**0 510 901 010***	–	230	190	3000	6.2	47.5	154.2	214.4	20	40	
19	19	–	**0 510 665 132**	230	190	3000	6.1	47.5	154.2	214.4	20	40	
22.5	4	–	**0 510 901 023***	210	280	2500	5.7	55.1	152.0	194.8	20	40	
22.5	5.5	–	**0 510 901 020***	210	280	2500	5.7	55.1	153.2	197.3	20	40	
22.5	8	–	**0 510 765 016**	180	280	2500	7.6	55.1	155.3	201.4	20	40	
22.5	11	**0 510 901 019***	**0 510 901 026***	210	280	2500	5.9	55.1	159.1	206.4	20	40	
22.5	14	**0 510 901 013***	**0 510 901 007***	210	280	2500	6.1	55.1	159.6	211.4	20	40	
22.5	22.5	**0 510 901 038***	–	210	180	2500	6.4	55.1	167.2	225.2	20	40	

[1]) 4 and 5.5 cm^3 Ø 15

Dimensions

Standard range



Ordering code

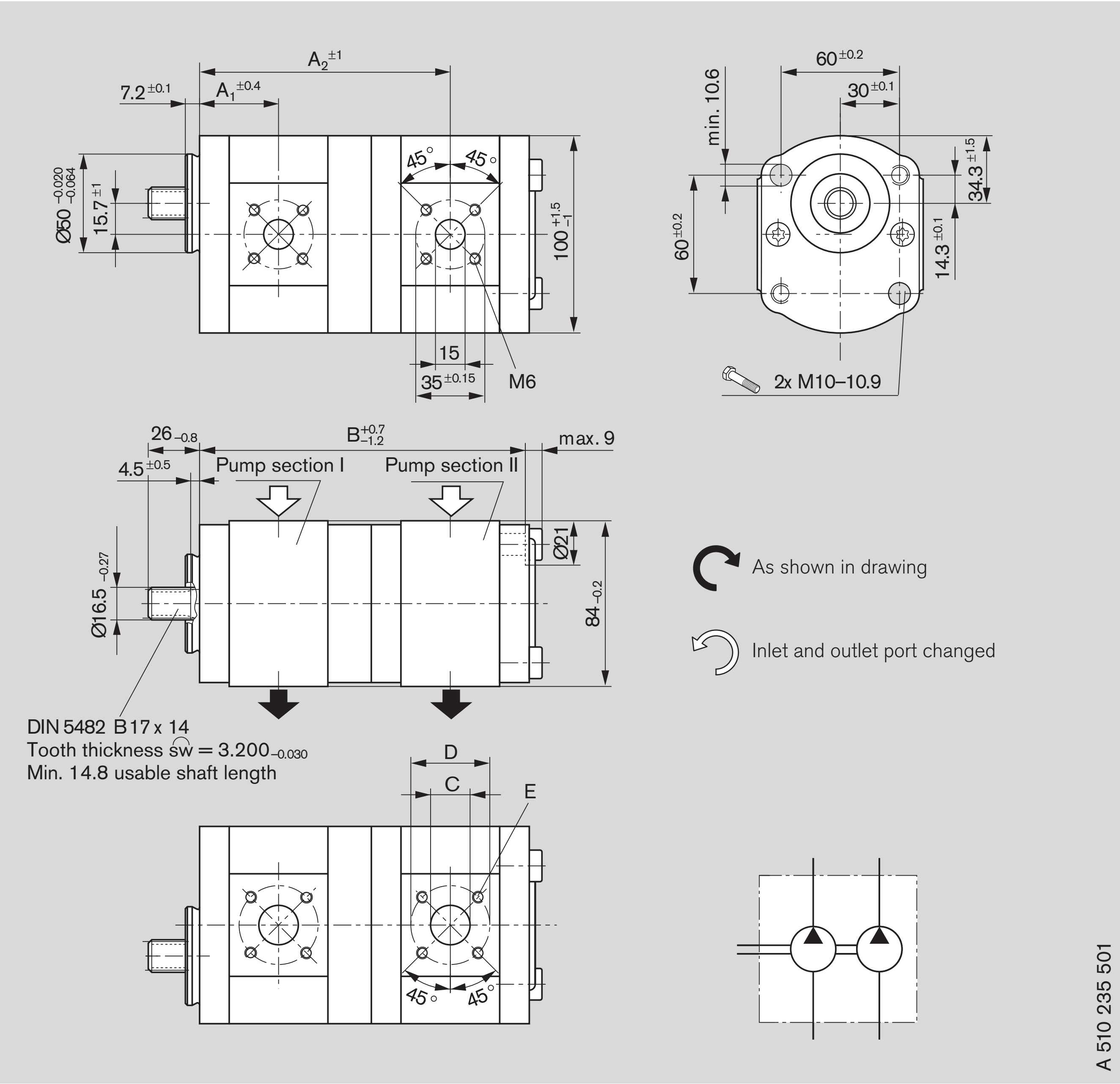
AZPFF – 10 – ☐☐☐/☐☐☐ ☐N M 20 20 M B

Displacement [cm^3/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed [rpm]	kg	Dimension [mm]					
P_I	P_{II}	**L**	**R**	P_I	P_{II}			A_1	A_2	B	C [1]	D	E
5.5	4	**0 510 365 314**	**0 510 365 010**	280	280	4000	4.2	38.6	121.6	157.9	15	40	M6 depth 13
8	4	–	**0 510 465 012**	280	280	4000	4.4	40.7	125.7	162.0	20	40	
8	5.5	**0 510 465 346**	–	280	280	4000	4.4	40.7	126.9	164.5	20	40	
8	8	–	**0 510 465 008**	280	380	4000	5.6	40.7	129.0	168.6	20	40	
11	4	**0 510 565 329**	**0 510 565 015**	280	280	3500	4.5	44.5	130.7	167.0	20	40	
11	5.5	–	**0 510 565 016**	280	280	3500	4.6	44.5	131.9	169.5	20	40	
11	8	**0 510 565 379**	**0 510 565 078**	280	280	3500	4.65	44.5	134.0	173.6	20	40	
16	16	**0 510 665 339**	**0 510 665 030**	280	230	3000	5.2	45.0	146.7	195.4	20	40	
22.5	8	**0 510 765 312**	–	210	280	2500	5.2	52.5	152.8	192.4	20	40	

[1] 4 and 5.5 cm^3 Ø 15

Dimensions

Standard range



DIN 5482 B17 x 14
Tooth thickness $\overset{\frown}{sw} = 3.200_{-0.030}$
Min. 14.8 usable shaft length

↻ As shown in drawing

↺ Inlet and outlet port changed

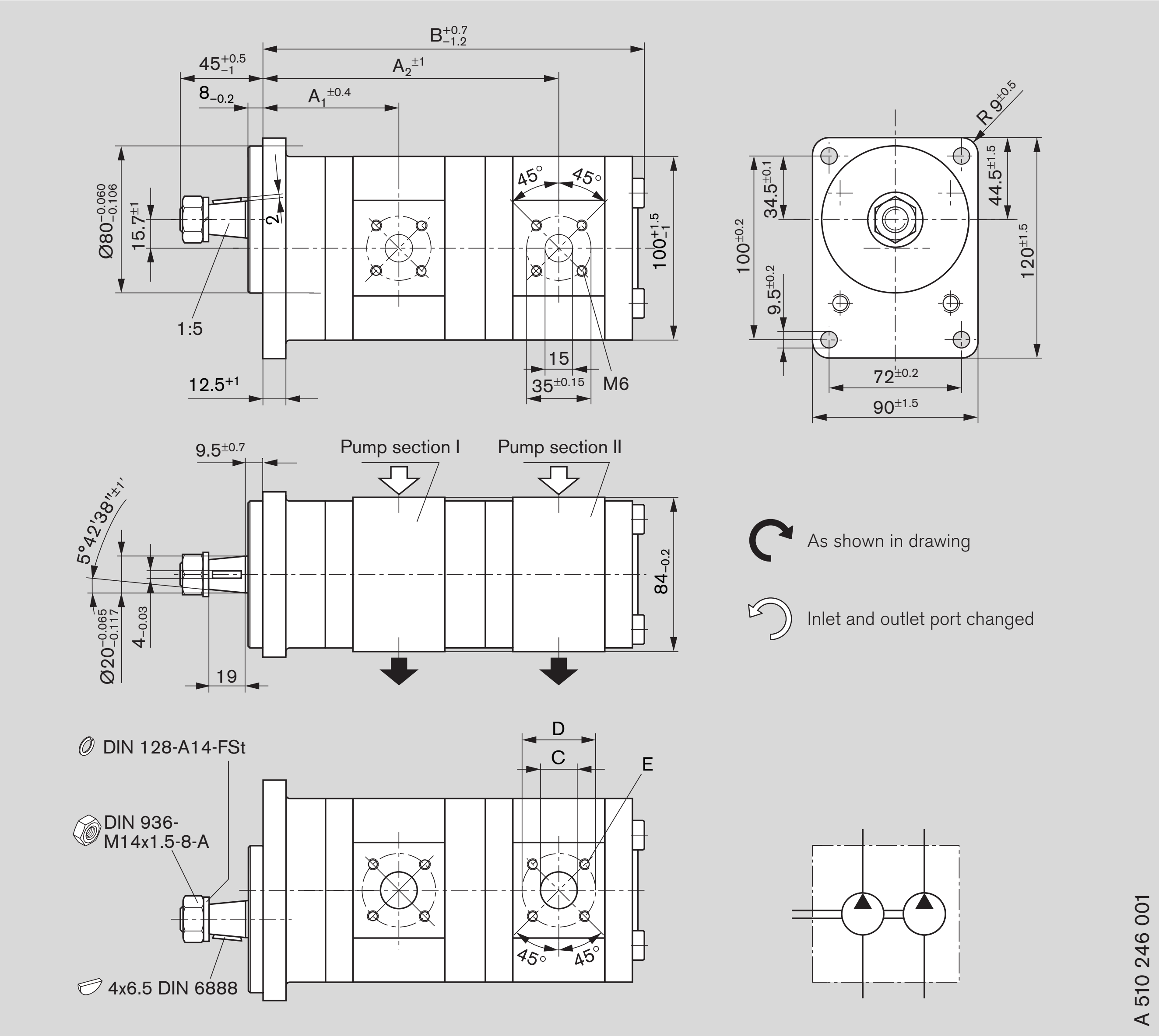
Ordering code
AZPFF – 10 – ☐☐☐/☐☐☐ ☐F P 20 20 M B
AZPFF – 10 – ☐☐☐/☐☐☐ ☐F P 20 20 K B*

Displacement [cm^3/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed [rpm]	kg	Dimension [mm]					
P_I	P_{II}	↺ L	↻ R	P_I	P_{II}			A_1	A_2	B	C 1)	D	E
8	4	**0 510 465 355**	–	280	280	4000	4.4	40.7	125.7	162.0	20	40	M6 depth 13
11	8	**0 510 565 385**	–	280	280	3500	4.6	44.5	134.0	173.6	20	40	
16	8	–	**0 510 665 071**	280	280	3000	4.85	45.0	142.4	182.0	20	40	
16	11	–	**0 510 665 076**	280	280	3000	4.98	45.0	146.2	187.0	20	40	
16	14	**0 510 665 404***	–	280	280	3000	5.12	45.0	146.7	192.0	20	40	
16	16	**0 510 665 376**	**0 510 665 062**	280	230	3000	5.2	45.0	146.7	195.4	20	40	

1) 4 and 5.5 cm^3 Ø 15

Dimensions

Standard range



Ordering code

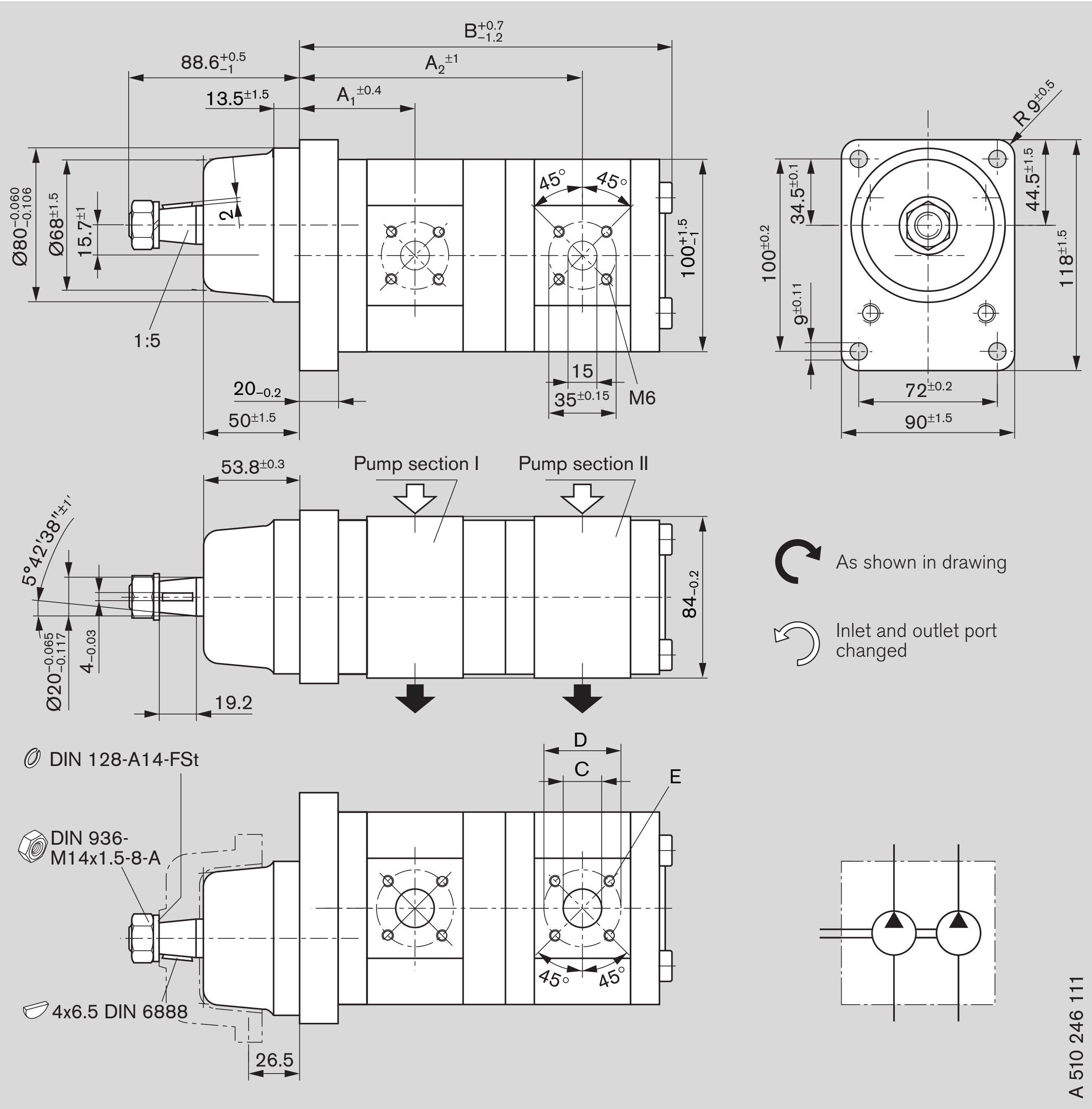
AZPFF – 10 – ☐☐☐/☐☐☐ ☐SA 20 20 M B

Displacement [cm³/rev]		Ordering-No. ↺	↻	Max. operating pressure [bar]		Max. rotation speed [rpm]	kg	Dimension [mm]					
P_I	P_{II}	L	R	P_I	P_{II}			A_1	A_2	B	C [1]	D	E
4	4	**0 510 255 300**	–	280	280	4000	4.8	71.3	153.0	197.0	15	40	M6 depth 13
5.5	4	**0 510 355 301**	–	280	280	4000	5.0	72.6	155.5	199.5	15	40	
8	5.5	**0 510 455 300**	**0 510 455 001**	280	280	4000	5.2	74.6	160.8	206.1	20	40	
8	8	**0 510 455 301**	**0 510 455 002**	280	280	4000	5.3	74.6	163.0	210.2	20	40	
11	5.5	**0 510 555 300**	**0 510 555 001**	280	280	3500	5.3	79.0	165.8	211.1	20	40	
11	8	**0 510 555 301**	**0 510 555 002**	280	280	3500	5.4	79.0	168.0	215.2	20	40	
11	11	**0 510 555 302**	**0 510 555 003**	280	280	3500	5.5	79.0	172.3	220.2	20	40	
16	4	**0 510 655 300**	**0 510 655 001**	280	280	3000	6.4	79.0	173.0	217.0	20	40	
16	5.5	**0 510 655 301**	**0 510 655 002**	280	280	3000	5.5	79.0	174.2	219.5	20	40	
16	8	**0 510 655 302**	**0 510 655 003**	280	280	3000	5.6	79.0	176.3	223.6	20	40	
16	11	**0 510 655 303**	**0 510 655 004**	280	280	3000	5.7	79.0	180.7	228.6	20	40	
16	16	**0 510 655 304**	**0 510 655 005**	280	230	3000	6.0	79.0	180.7	237.0	20	40	

[1] 4 and 5.5 cm³ Ø 15

Dimensions

Standard range



Ordering code:

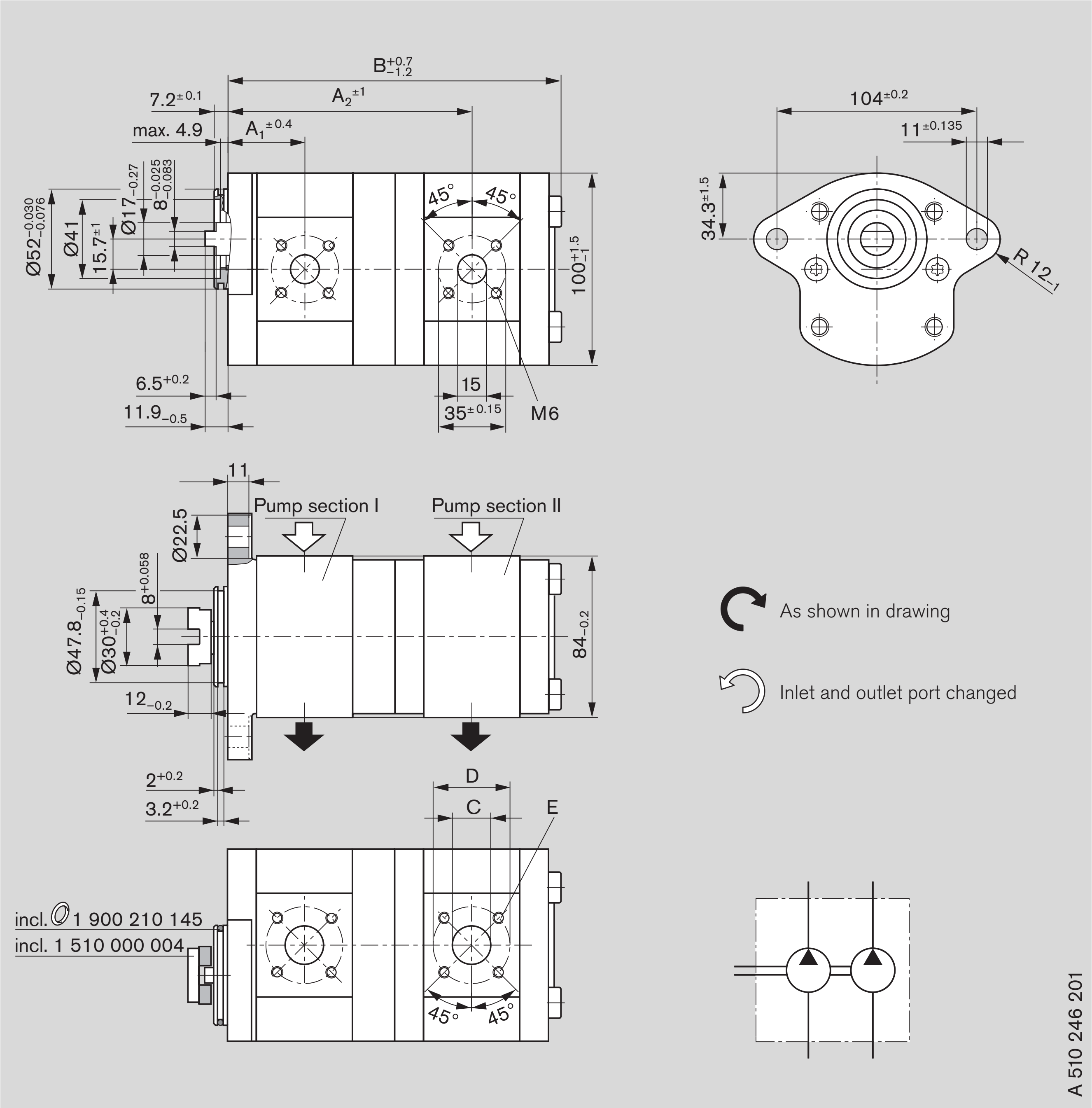
AZPFF – 10 – ☐☐☐/☐☐☐ ☐S G 20 20 P B

Displacement [cm³/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed [rpm]	kg	Dimension [mm]					
		↺	↻										
P_I	P_{II}	**L**	**R**	P_I	P_{II}			A_1	A_2	B	C 1)	D	E
16	16	–	**0 510 655 007**	280	280	3000	6.2	65.0	166.7	221.9	20	40	M6 depth 13
19	19	–	**0 510 655 011**	230	190	3000	6.6	65.0	171.7	231.9	20	40	

1) 4 and 5.5 cm³ Ø 15

Dimensions

Standard range



Ordering code

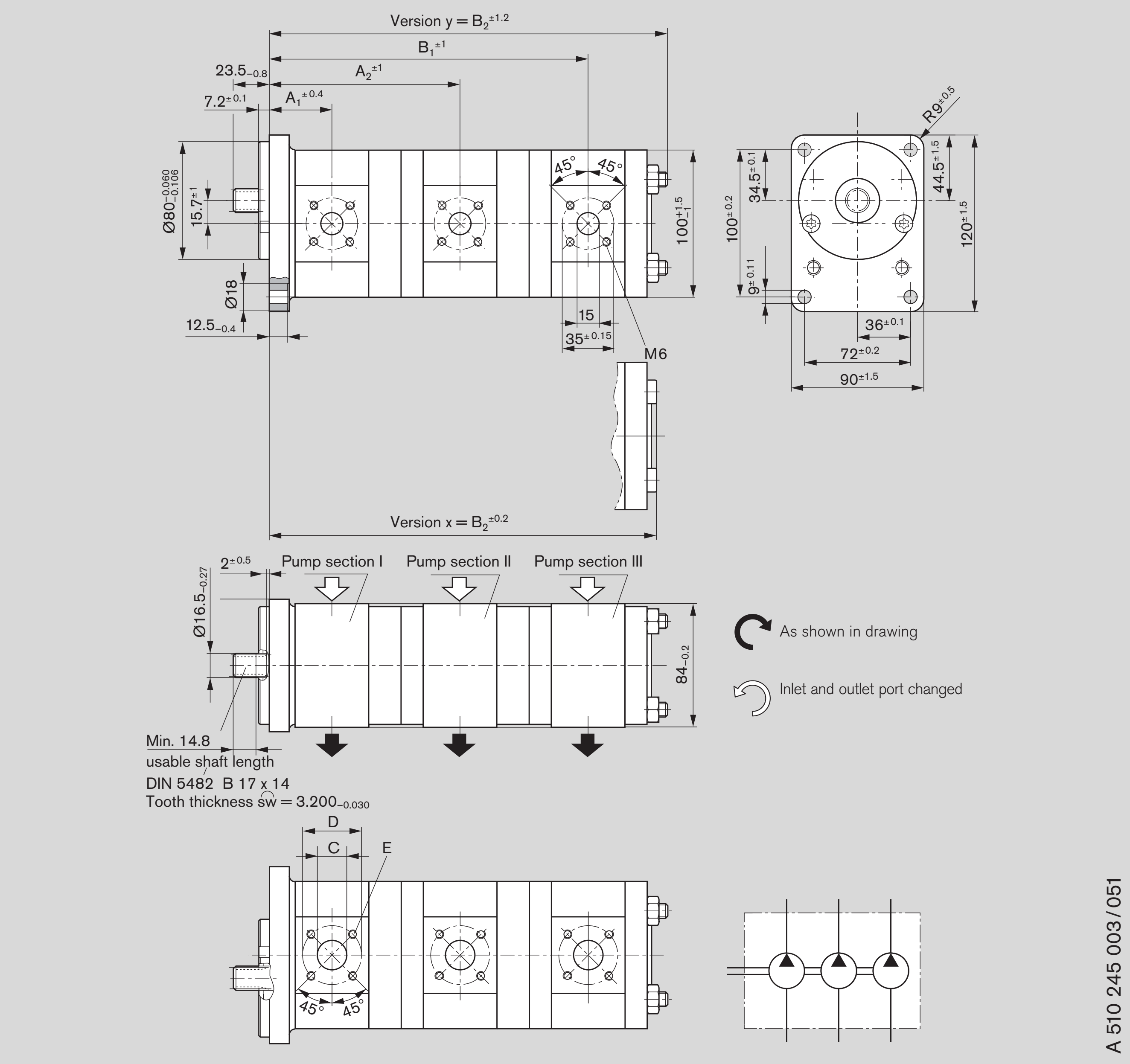
AZPFF – 10 – ☐☐☐/☐☐☐ ☐N L 20 20 K B

Displacement [cm³/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed [rpm]	kg	Dimension [mm]					
P_I	P_{II}	**L**	**R**	P_I	P_{II}			A_1	A_2	B	C ¹)	D	E
5.5	5.5	–	**0 510 365 009**	280	280	4000	4.65	38.6	122.8	169.2	15	40	M6 depth 13
11	11	–	**0 510 565 043**	280	280	3500	5.2	44.5	137.5	187.4	20	40	
16	8	**0 510 665 449**	–	280	280	3000	5.2	45.0	142.4	188.4	20	40	
16	22.5	**0 510 665 068**	–	280	160	2500	6.17	45.0	160.3	226.6	20	40	

¹) 4 and 5.5 cm³ Ø 15

Dimensions

Standard range



Ordering code

AZPFFF – 10 – ☐ ☐ ☐ / ☐ ☐ ☐ / ☐ ☐ ☐ ☐ F B 20 20 20 M B

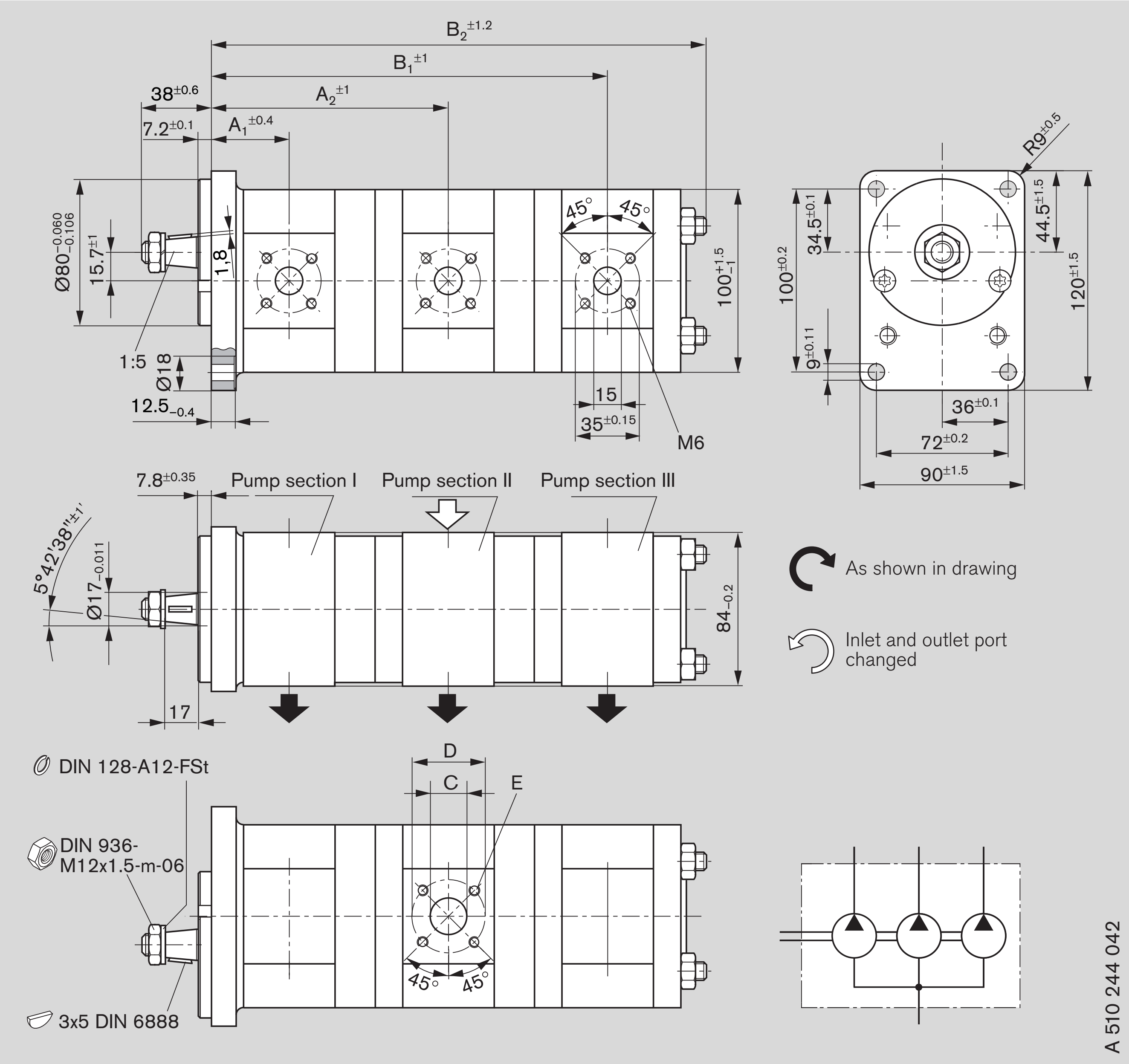
AZPFFF – 11 – ☐ ☐ ☐ / ☐ ☐ ☐ / ☐ ☐ ☐ ☐ F B 20 20 20 M B*

Displacement [cm³/rev]			Ordering-No.		Max. operating pressure [bar]			Max. rotation speed [rpm]	kg	Dimension [mm]							Version
P_I	P_{II}	P_{III}	↺ L	↻ R	P_I	P_{II}	P_{III}			A_1	A_2	B_1	B_2	C ¹)	D	E	
11	4	4	**0 510 565 371**	–	280	280	280	3500	6.9	47.0	133.2	214.9	259.0	20	40	M6 depth 13	y
14	4	8	**0 510 565 408**	–	280	280	280	3000	7.2	47.5	138.2	223.2	270.6	20	40		x
14	8	8	**0 510 565 422**	–	280	280	280	3000	7.3	47.5	141.5	229.8	275.9	20	40		x
16	4	4	**0 510 665 379**	–	280	280	280	3000	7.2	47.5	141.6	223.3	267.4	20	40		x
16	5.5	5.5	**0 510 665 416**	**0 510 665 061**	280	280	280	3000	7.4	47.5	142.8	227.0	272.4	20	40		x
16	11	4	**0 510 665 372**	–	280	210	210	3000	7.5	47.5	148.7	234.9	276.5	20	40		x
16	11	5.5	–	**0 510 665 092***	280	210	120	3000	7.6	47.5	148.7	236.1	280.2	20	40		x
16	16	11	**0 510 665 371**	–	280	120	120	3000	8.1	47.5	149.2	250.4	302.5	20	40		x
19	8	5.5	–	**0 510 665 111***	230	250	160	3000	7.5	47.5	149.2	236.1	280.2	20	40		x
19	11	5.5	–	**0 510 665 112***	230	230	230	3000	7.6	47.5	153.7	241.1	285.2	20	40		x

¹) 4 and 5.5 cm³ Ø 15

Dimensions

Standard range



Ordering code

AZPFFF – 11 – ☐ ☐ ☐ / ☐ ☐ ☐ / ☐ ☐ ☐ ☐ C B 20 20 20 M B

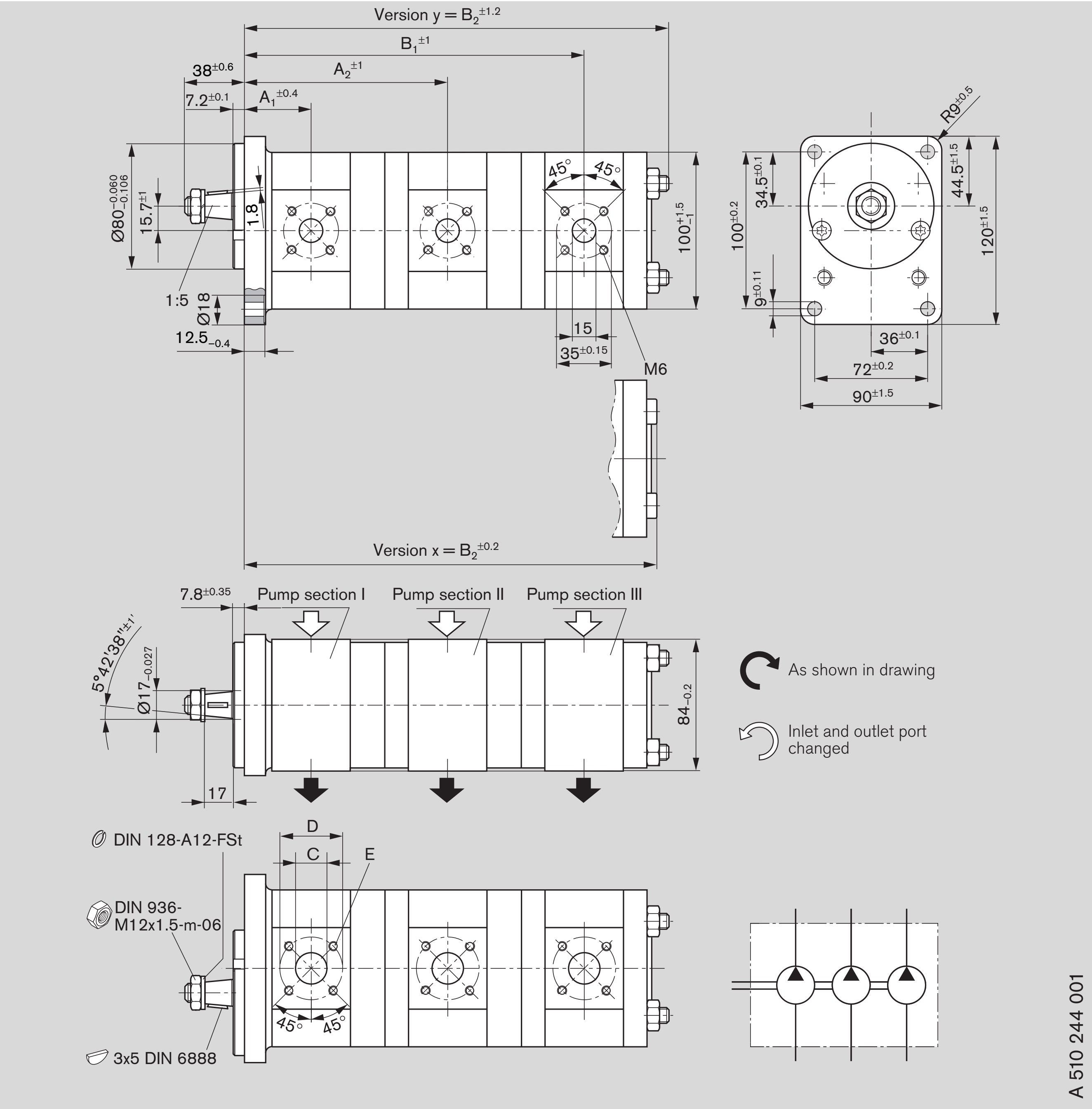
Displacement [cm^3/rev]			Ordering-No.		Max. operating pressure [bar]			Max. rotation speed [rpm]	kg	Dimension [mm]						
P_I	P_{II}	P_{III}	L	R	P_I	P_{II}	P_{III}			A_1	A_2	B_1	B_2	C[1]	D	E
8	8	5.5	–	**0 510 465 031**	230	230	230	4000	6.5	43.2	119.5	193.7	238.1	20	40	M6 depth 13
11	11	8	–	**0 510 565 065**	230	230	230	3500	6.8	47.0	128.3	205.8	251.9	20	40	
11	11	8	–	**0 510 565 080**[2]	280	280	280	3500	6.8	47.0	128.3	205.8	251.9	20	40	

[1] 4 and 5.5 cm^3 Ø 15

[2] heavy through drive

Dimensions

Standard range



Ordering code

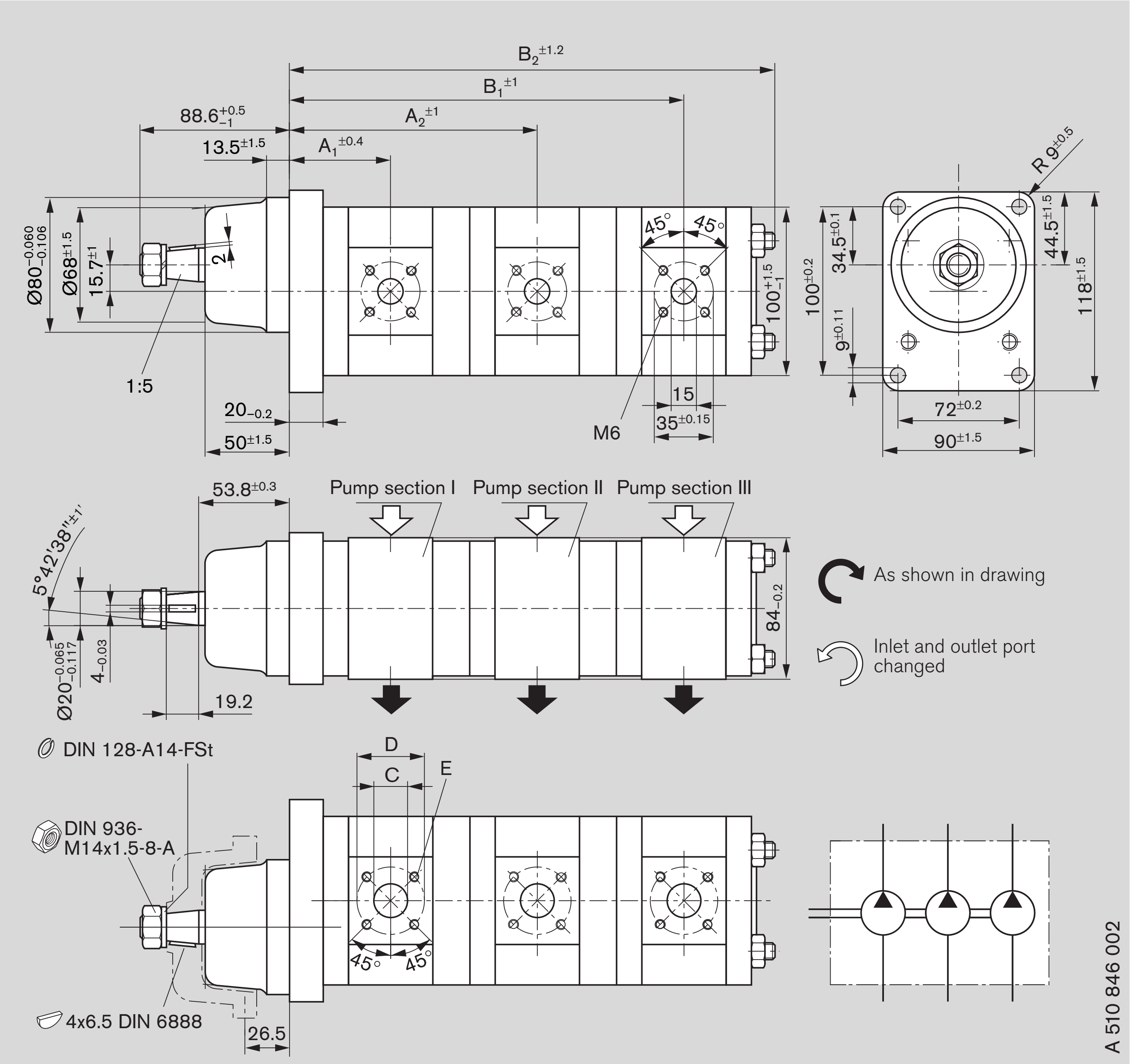
AZPFFF – 10 – ☐☐☐ / ☐☐☐ / ☐☐☐ ☐ C B 20 20 20 M B
AZPFFF – 11 – ☐☐☐ / ☐☐☐ / ☐☐☐ ☐ C B 20 20 20 K B*

Displacement [cm^3/rev]			Ordering-No.		Max. operating pressure [bar]			Max. rotation speed	kg	Dimension [mm]							Version
P_I	P_{II}	P_{III}	L	R	P_I	P_{II}	P_{III}	[rpm]		A_1	A_2	B_1	B_2	C 1)	D	E	
8	8	4	–	**0 510 465 027**	280	280	280	4000	7.0	43.2	131.5	216.5	260.6	20	40	M6 depth 13	x
11	8	8	–	**0 510 565 081**	280	230	230	3500	7.2	47.0	136.5	224.8	272.2	20	40		x
16	4	4	**0 510 665 419***	–	280	280	280	3000	7.1	47.5	141.6	223.3	267.4	20	40		x
16	8	4	–	**0 510 665 134**	280	280	280	3000	7.3	47.5	144.9	229.9	272.7	20	40		x
22.5	8	9	**0 510 765 334***	–	230	210	210	3000	8.15	61.6	167.3	255.6	307.5	20	40		y

1) 4 and 5.5 cm^3 Ø 15

Dimensions

Standard range



Ordering code

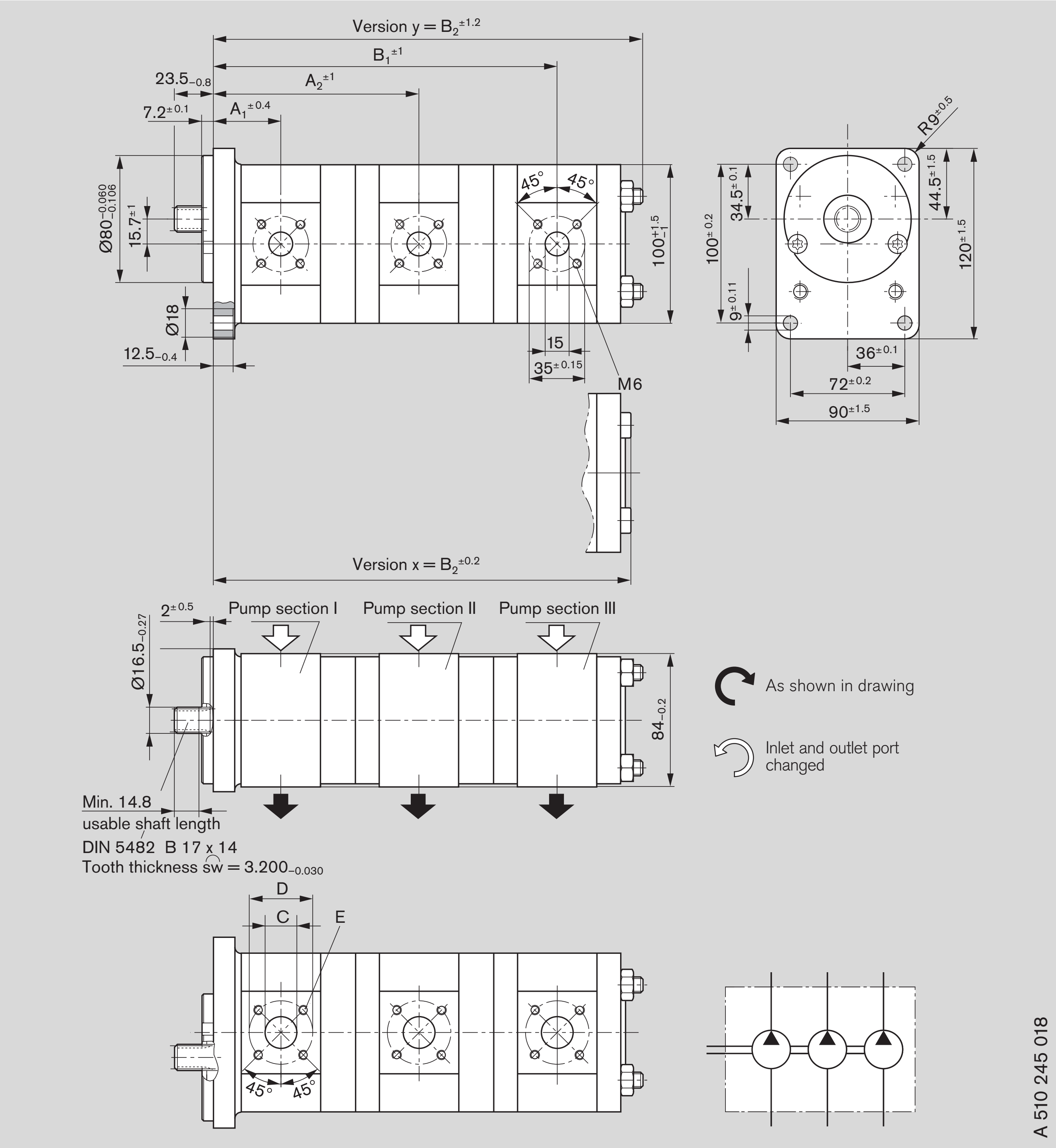
AZPFFF – 10 – ☐☐☐/☐☐☐/☐☐☐ ☐S G 20 20 20 M B

Displacement [cm^3/rev]			Ordering-No.		Max. operating pressure [bar]			Max. rotation speed [rpm]	kg	Dimension [mm]						
P_I	P_{II}	P_{III}	L	R	P_I	P_{II}	P_{III}			A_1	A_2	B_1	B_2	C1)	D	E
8	8	5.5	–	**0 510 455 004**	280	250	250	4000	7.4	60.7	149.0	235.2	284.0	20	40	M6 depth 13
14	14	5.5	–	**0 510 555 007**	280	210	210	3000	7.9	65.0	163.3	255.3	304.0	20	40	

1) 4 and 5.5 cm^3 Ø 15

Dimensions

Standard range



Ordering code

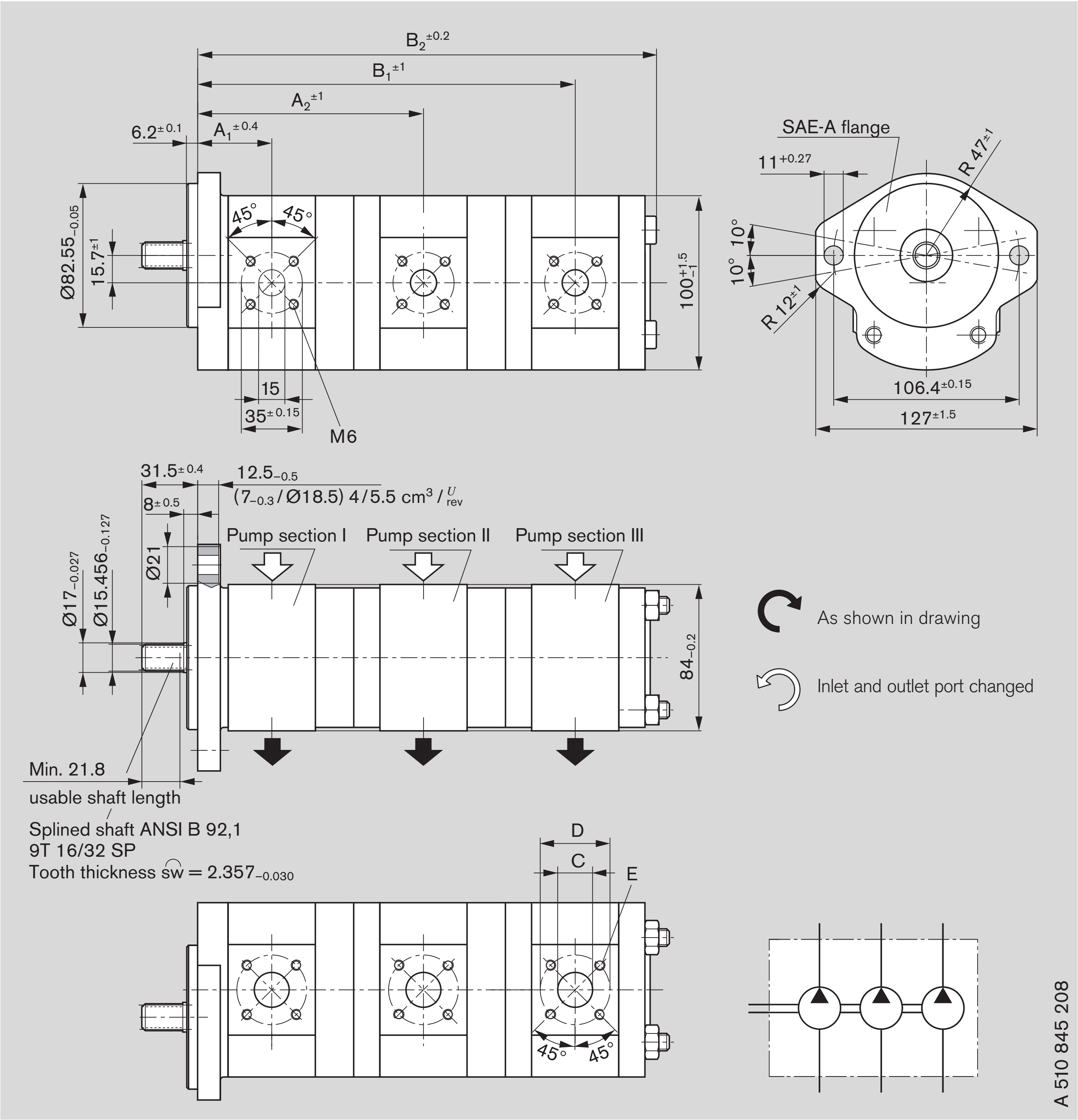
AZPFFF – 10 – ☐☐☐/☐☐☐/☐☐☐ ☐F B 20 20 20 M B

Displacement [cm^3/rev]			Ordering-No.		Max. operating pressure [bar]			Max. rotation speed [rpm]	kg	Dimension [mm]							Version
P_I	P_{II}	P_{III}	L	R	P_I	P_{II}	P_{III}			A_1	A_2	B_1	B_2	C 1)	D	E	
8	8	4	–	**0 510 465 019**	280	280	280	4000	7.0	43.2	131.5	216.5	260.8	20	40	M6 depth 13	x
19	16	4	**0 510 665 380**	–	230	190	190	3000	7.8	47.5	154.2	248.3	297.5	20	40		y

1) 4 and 5.5 cm^3 Ø 15

Dimensions

Standard range



Ordering code:

AZPFFF – 10 – ☐☐☐/☐☐☐/☐☐☐ ☐RR 20 20 20 M B

Displacement [cm³/rev]			Ordering-No.		Max. operating pressure [bar]			Max. rotation speed [rpm]	kg	Dimension [mm]						
P_I	P_{II}	P_{III}	L	R	P_I	P_{II}	P_{III}			A_1	A_2	B_1	B_2	C 1)	D	E
8	5.5	5.5	–	**0 510 465 025**	280	280	280	4000	7.0	43.2	129.4	213.6	257.7	20	40	M6 depth 13

1) 4 and 5.5 cm³ Ø 15

Notes for commissioning

Filter recommendation

The major share of premature failures in external gear pumps is caused by contaminated hydraulic fluid.
As a warranty cannot be issued for dirt-specific wear, we recommended filtration compliant with cleanliness level 20/18/15 ISO 4406, which reduces the degree of contamination to a permissible dimension in terms of the size and concentration of dirt particles:

Operating pressure [bar]	>160	<160
Contamination class ISO 4406	18/15	19/16
To be reached with $\beta_X = 75$	20	25

We recommend that a full-flow filter always be used.
Basic contamination of the hydraulic fluid used may not exceed class 20/18/15 according to ISO 4406. Experience has shown that new fluid quite often lies above this value. In such instances a filling device with special filter should be used.

General

– The pumps supplied by us have been checked for function and performance. No modifications of any kind may be made to the pumps; any such changes will render the warranty null and void!
– Pump may only be operated in compliance with permitted data (see pages 15 – 18).

Project planning notes

Comprehensive notes and suggestions are available in Hydraulics Trainer, Volume 3 RE 00 281, “Project planning notes and design of hydraulic systems”. Where external gear pumps are used we recommend that the following note be adhered to.

Technical data

All stated technical data is dependent on production tolerances and is valid for specific marginal conditions.
Note that, as a consequence, scattering is possible, and at certain marginal conditions (e.g. viscosity) **the technical data may change**.

Characteristics

When designing the external gear pump, note the maximum possible service data based on the characteristics displayed on pages 10 to 12.

Additional information on the proper handling of hydraulic products from Bosch Rexroth is available in our document: “General product information for hydraulic products” RE 07 008.

Contained in delivery

The components with characteristics as described under ordering code and device measurements, pages 20 – 58, are contained in delivery.

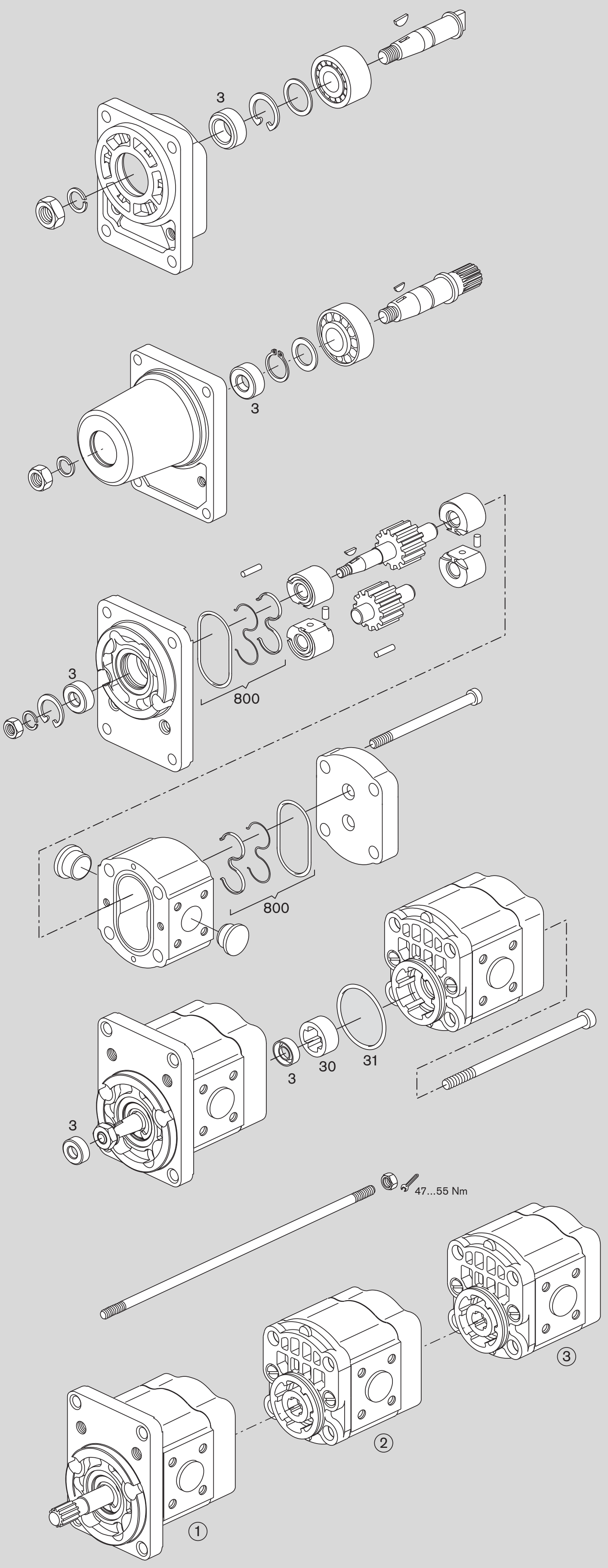
You can find further information in our publication: “General Operating Instructions for External Gear Units” RE 07 012-B1.

Service parts

Page	Ordering code	Seal kit Pos. 800 1 517 010 ...	Shaft seal ring Pos. 3 1 510 283 ...	Mate-rial	Dimension	Seal ring Pos. 31 1 900 210 ...	Mate-rial	Dimen-sion
20	AZPF – 1x – □□□ □ CB 20 **MB**	152 NBR	008	NBR	17 x 30 x 7			
21	AZPF – 1x – □□□ □ FB 20 **MB**	152 NBR	008	NBR	17 x 30 x 7			
22	AZPF – 1x – □□□ □ HO 30 **KB**	152 NBR	044	FKM	18 x 30 x 7			
23	AZPF – 1x – □□□ □ FO 30 **MB**	152 NBR	008	NBR	17 x 30 x 7			
23	AZPF – 1x – □□□ □ FO 30 **PB**	193 FKM	027	FKM	17 x 30 x 7			
24	AZPF – 1x – □□□ □ HO 01 **MB**	152 NBR	008	NBR	17 x 30 x 7			
25	AZPF – 1x – □□□ □ AB 01 **MB**	208 FKM	037	NBR	18 x 30 x 6			
26	AZPF – 1x – □□□ □ CP 20 **MB**	152 NBR	008	NBR	17 x 30 x 7			
26	AZPF – 1x – □□□ □ CP 20 **KB**	152 NBR	027	FKM	17 x 30 x 7			
27	AZPF – 1x – □□□ □ CN 20 **MB**	152 NBR	008	NBR	17 x 30 x 7	145	NBR	45 x 2.5
28	AZPF – 1x – □□□ □ FN 20 **MB**	152 NBR	008	NBR	17 x 30 x 7			
29	AZPF – 1x – □□□ □ FP 20 **PB**	193 FKM	027	FKM	17 x 30 x 7			
30	AZPF – 1x – □□□ □ NT 20 **MB**	152 NBR	008	NBR	17 x 30 x 7	145	NBR	45 x 2.5
31	AZPF – 1x – □□□ □ NL 20 **KB**	152 NBR	027	FKM	17 x 30 x 7	145	NBR	45 x 2.5
32	AZPF – 1x – □□□ □ QR 12 **MB**	152 NBR	008	NBR	17 x 30 x 7			
33	AZPF – 1x – □□□ □ RR 12 **MB**	152 NBR	008	NBR	17 x 30 x 7			
34	AZPF – 1x – □□□ □ RR 20 **MB**	152 NBR	008	NBR	17 x 30 x 7			
34	AZPF – 1x – □□□ □ RR 20 **KB**	152 NBR	027	FKM	17 x 30 x 7			
35	AZPF – 1x – □□□ □ QR 20 **MB**	152 NBR	008	NBR	17 x 30 x 7			
36	AZPF – 1x – □□□ □ SA 20 **MB**	152 NBR	008	NBR	17 x 30 x 7	145	NBR	45 x 2.5
36	AZPF – 1x – □□□ □ SA 20 **KB**	152 NBR	015	FKM	17 x 30 x 7	145	NBR	45 x 2.5
37	AZPF – 1x – □□□ □ SG 20 **MB**	152 NBR	009	NBR	20 x 40 x 7	145	NBR	45 x 2.5
39	AZPF – 1x – □□□ □ CP 20 20 **KB**	152 NBR	027/008	NBR	17 x 30 x 7	145	NBR	45 x 2.5
41	AZPFF – 1x – □□□ / □□□ □ FB 20 20 **MB**	152 (2x) NBR	008 (2x)	NBR	17 x 30 x 7	145	NBR	45 x 2.5
43	AZPFF – 1x – □□□ / □□□ □ CB 20 20 **MB**	152 (2x) NBR	008 (2x)	NBR	17 x 30 x 7	145	NBR	45 x 2.5
45	AZPFF – 1x – □□□ / □□□ □ HO 20 20 **MB**	152 (2x) NBR	008 (2x)	NBR	17 x 30 x 7	145	NBR	45 x 2.5
45	AZPFF – 1x – □□□ / □□□ □ HO 20 20 **KB**	152 (2x) NBR	027/008	FKM/ NBR	17 x 30 x 7	145	NBR	45 x 2.5
47	AZPFF – 1x – □□□ / □□□ □ RR 20 20 **MB**	152 (2x) NBR	008 (2x)	NBR	17 x 30 x 7	145	NBR	45 x 2.5
47	AZPFF – 1x – □□□ / □□□ □ RR 20 20 **KB**	152 (2x) NBR	027 (2x)	FKM	17 x 30 x 7	145	NBR	45 x 2.5
48	AZPFF – 1x – □□□ / □□□ □ NM 20 20 **MB**	152 (2x) NBR	008	NBR	17 x 30 x 7	145	NBR	45 x 2.5
49	AZPFF – 1x – □□□ / □□□ □ FP 20 20 **MB**	152 NBR	008 (2x)	NBR	17 x 30 x 7	145	NBR	45 x 2.5
49	AZPFF – 1x – □□□ / □□□ □ FP 20 20 **KB**	152 (2x) NBR	027	FKM	17 x 30 x 7	145	NBR	45 x 2.5
50	AZPFF – 1x – □□□ / □□□ □ SA 20 20 **MB**	152 (2x) NBR	008/009	NBR	17 x 30 x 7	145	NBR	45 x 2.5
51	AZPFF – 1x – □□□ / □□□ □ SG 20 20 **PB**	193 (2x) FKM	015/027	FKM	17 x 30 x 7	1 520 210 101	FKM	45 x 2.5
52	AZPFF – 1x – □□□ / □□□ □ NL 20 20 **KB**	152 (2x) NBR	027 (2x)	FKM	17 x 30 x 7	145	NBR	45 x 2.5
53	AZPFFF – 1x – □□□ / □□□ / □□□ □ FB 20 20 20 **MB**	152 (3x) NBR	008 (3x)	NBR	17 x 30 x 7	145 (2x)	NBR	45 x 2.5
54	AZPFFF – 1x – □□□ / □□□ / □□□ □ CB 20 20 20 **MB**	152 (3x) NBR	008 (3x)	NBR	17 x 30 x 7	145 (2x)	NBR	45 x 2.5
55	AZPFFF – 1x – □□□ / □□□ / □□□ □ CB 20 20 20 **MB**	152 (3x) NBR	008 (3x)	NBR	17 x 30 x 7	145 (2x)	NBR	45 x 2.5
55	AZPFFF – 1x – □□□ / □□□ / □□□ □ CB 20 20 20 **KB**	152 (3x) NBR	027/008 (2x)	FKM/ NBR	17 x 30 x 7	145	NBR	45 x 2.5
56	AZPFFF – 1x – □□□ / □□□ / □□□ □ SG 20 20 20 **MB**	152 (3x) NBR	008 (3x)	NBR	17 x 30 x 7	145 (2x)	NBR	45 x 2.5
57	AZPFFF – 1x – □□□ / □□□ / □□□ □ FB 20 20 20 **MB**	152 (3x) NBR	008 (3x)	NBR	17 x 30 x 7	145 (2x)	NBR	45 x 2.5
58	AZPFFF – 1x – □□□ / □□□ / □□□ □ RR 20 20 20 **MB**	152 (3x) NBR	008 (3x)	NBR	17 x 30 x 7	145 (2x)	NBR	45 x 2.5

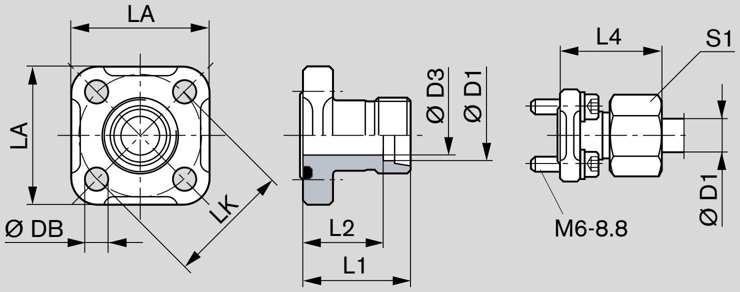
NBR = Perbunan® FKM = Viton®

For further service parts refer to CD-ROM HYparts 1 987 760 010


3
3
3
800
800
3
30
31
3
47...55 Nm
③
②
①

Fittings

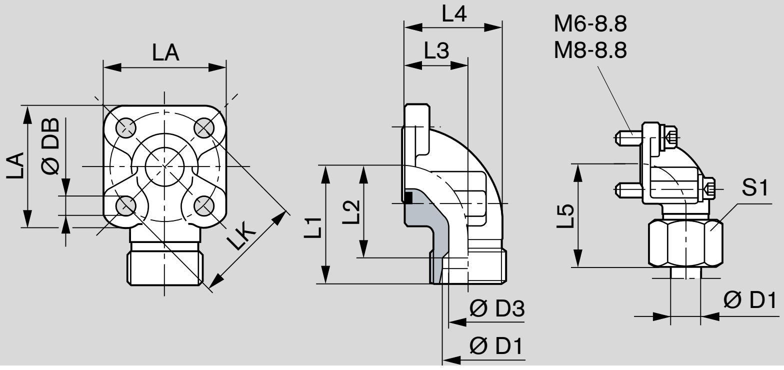
Gear pump flange, straight, for rectangular flange 20 see page 9



LK	D1	D3	L1	L2	L4	LA	S1	DB	Screws 4x	Seal ring NBR *)	Mass [kg]	Part number	*p* [bar]
35	10L	8	30	23.0	39.0	40	19	6.4	M 6x22	20x2.5	0.09	**1 515 702 064**	315
35	12L	10	30	23.0	39.0	40	22	6.4	M 6x22	20x2.5	0.10	**1 515 702 065**	315
35	15L	12	30	23.0	38.0	40	27	6.4	M 6x22	20x2.5	0.10	**1 515 702 066**	250
40	15L	12	35	28.0	43.0	42	27	6.4	M 6x22	24x2.5	0.12	**1 515 702 067**	100
40	18L	15	35	27.5	44.0	42	32	6.4	M 6x22	24x2.5	0.13	**1 515 702 068**	100
40	22L	19	35	27.5	44.5	42	36	6.4	M 6x22	24x2.5	0.12	**1 515 702 069**	100
40	28L	24	42	27.5	34.5	42	41	6.4	M 6x22	24x2.5	0.15	**1 515 702 008**	100

Complete fittings with seal ring, metric screw set, nuts and olive. *) NBR = Perbunan®

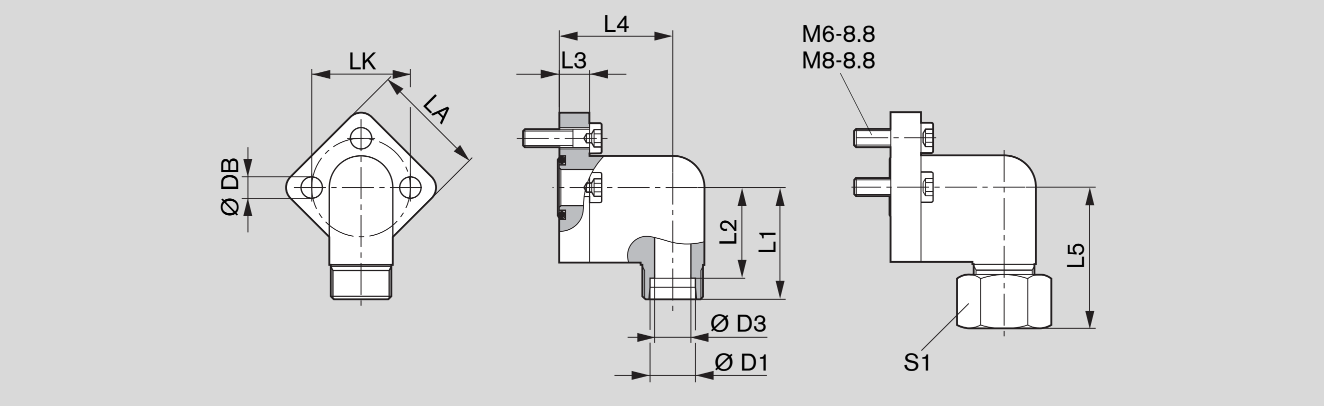
Gear pump flange, 90° angle, for rectangular flange 20 see page 9



LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws		Seal ring NBR *)	Mass [kg]	Part number	*p* (bar)
											2x	2x				
35	10L	8	38	31.0	16.5	26.5	47.0	40	19	6.4	M 6x22	M 6x35	20x2.5	0.16	**1 515 702 070**	315
35	12L	10	38	31.0	16.5	26.5	47.0	40	22	6.4	M 6x22	M 6x35	20x2.5	0.16	**1 515 702 071**	315
35	15L	12	38	31.0	16.5	26.5	46.0	40	27	6.4	M 6x22	M 6x35	20x2.5	0.15	**1 515 702 072**	250
35	16S	12	38	29.5	20.0	31.0	48.0	40	30	6.4	M 6x22	M 6x40	20x2.5	0.18	**1 515 702 002**	315
35	18L	15	38	29.5	20.0	31.0	47.0	40	32	6.4	M 6x22	M 6x40	20x2.5	0.18	**1 545 702 006**	250
35	20S	16	45	34.5	25.0	38.0	56.0	40	36	6.4	M 6x22	M 6x45	20x2.5	0.24	**1 515 702 017**	315
40	15L	12	38	31.0	22.5	36.5	46.0	42	27	6.4	M 6x22	M 6x22	24x2.5	0.15	**1 515 702 073**	100
40	18L	15	38	30.5	22.5	36.5	47.0	42	32	6.4	M 6x22	M 6x22	24x2.5	0.17	**1 515 702 074**	100
40	20S	16	40	29.5	22.5	35.5	50.0	42	36	6.4	M 6x22	M 6x45	24x2.5	0.20	**1 515 702 011**	250
40	22L	19	38	30.5	22.5	36.5	47.5	42	36	6.4	M 6x22	M 6x22	24x2.5	0.17	**1 515 702 075**	100
40	28L	22	40	32.5	28.0	43.0	49.0	42	41	6.4	M 6x20	M 6x50	24x2.5	0.24	**1 515 702 010**	100
40	35L	31	41	30.5	34.0	55.0	52.0	42	50	6.4	M 6x22	M 6x60	24x2.5	0.33	**1 515 702 018**	100

Complete fittings with seal ring, metric screw set, nuts and olive. *) NBR = Perbunan®

Gear pump flange, 3-hole, 90° angle, for rectangular flange 30 see page 9



LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws 3x	Seal ring NBR *)	Mass [kg]	Part number	*p* [bar]
30	12L	10	37	30.0	10	37.5	46	38	22	6.4	M6x22	16x2.5	0.13	**1 515 702 146**	250
30	15L	12	37	30.0	10	37.5	47	38	27	6.4	M6x22	16x2.5	0.14	**1 515 702 147**	250
30	18L	15	37	30.0	10	37.5	47	38	32	6.4	M6x22	16x2.5	0.17	**1 515 702 148**	160
40	22L	19	43	35.5	14	41.0	53	48	36	8.4	M8x30	24x2.5	0.29	**1 515 702 149**	160
40	28L	24	43	35.5	14	41.0	53	48	41	8.4	M8x30	24x2.5	0.40	**1 515 702 150**	160

Complete fittings with seal ring, metric screw set, nuts and olive. *) NBR = Perbunan®

Note
You can find the permissible tightening torques in our publication:
“General Operating Instructions for External Gear Units”
RE 07 012-B1.

Ordering-No.

The AZ configurator

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly. You only need to specify your requirements: From the displacement, direction of rotation, drive shaft, connection flange right up to the required rear cover. You immediately receive a project drawing (PDF format) if a configuration already exists. You receive the price of the configured external gear unit upon request.

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly – all data needed for project planning are acquired thru menu guidance.

Selection is made either on an ordering code or your technical requirements. This means that you can search for external gear units that have already been configured, or you specify the configuration variant of the external gear unit based upon the operating parameters you require.

If the external gear unit you selected has been released you will receive the part number, ordering code and a detailed installation drawing. If your special configuration is not available please send your specification to Rexroth. One of our employees will then contact you.

Rexroth
Bosch Group

External Gear Pumps
Series N

AZPN-...

Fixed pumps
$V = 20...36\ \text{cm}^3/\text{rev}$

Overview of contents

Features

- Nominal pressure 250 bar
- Slide bearings for heavy duty applications
- Drive shafts to ISO or SAE
- Combination of several pumps possible
- Line ports: connection flanges
- Consistent high quality thru mass production
- Numerous configuration variants available

General

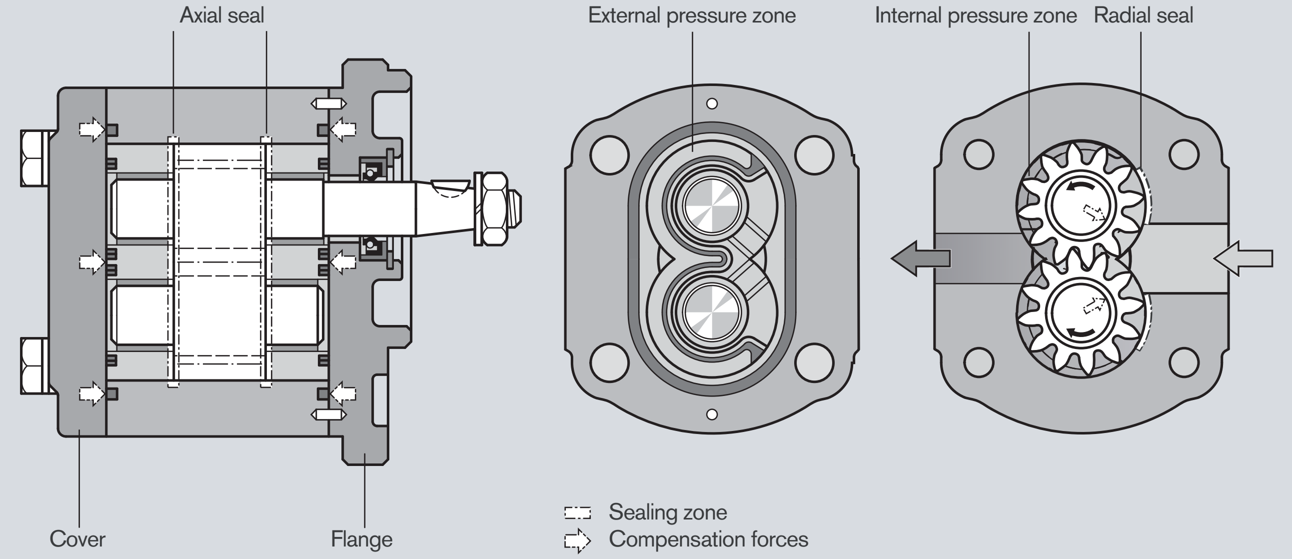
Rexroth external gear pumps are available as standard gear pumps in the 4 series of B, F, N and G and as SILENCE gear pumps in the series of S, T and U, in which the displacements are graded by different gear widths. Further configuration variants are given by different flanges, shafts, valve arrangements and multiple pump combinations.

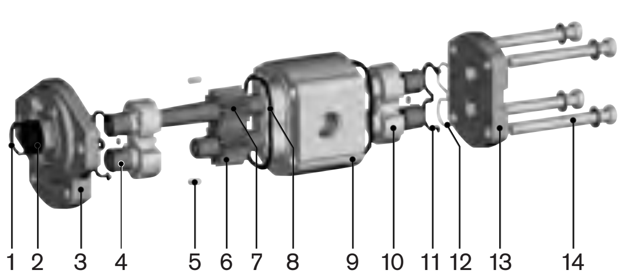
Construction

The external gear pump consists essentially of a pair of gears supported in bearing bushings or bearing, dependent on the series, and the case with a front and rear cover. The drive shaft protrudes from the front cover where it is sealed by the shaft seal ring. The bearing forces are absorbed by special bearing bushings with sufficient elasticity to produce surface contact instead of line contact. They also ensure excellent resistance to galling – especially at low speed. The gears have 12 teeth. This keeps both flow pulsation and noise emission to a minimum.

The internal sealing is achieved by forces which are proportional to delivery pressure. This ensures optimum efficiency. The bearings provide the seal at the ends of the gaps between the teeth which carry the pressurized oil. The sealing zone between the gear teeth and the bearings is controlled by the admission of operating pressure to the rear of the bearing bushings. Special seals form the boundary of the zone. The radial clearance at the tips of the gear teeth is sealed by internal forces pushing them against the case.

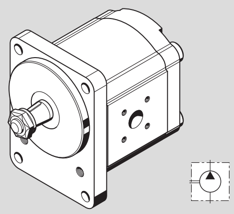
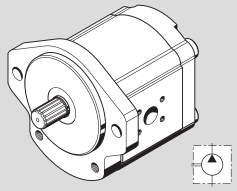
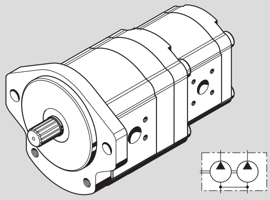
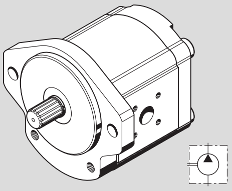
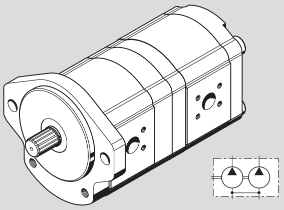
Gear pump axial compensation





1 Retaining ring
2 Shaft seal ring
3 Front cover
4 Slide bearing
5 Centering pin
6 Gear
7 Gear (frictional)
8 Case seal
9 Pump case
10 Bearing
11 Axial zone seal
12 Support
13 End cover
14 Fixing screws

Overview of “Series N” standard types

Version	Page	Version	Page	Version	Page
	16		18		20
	17		19		

The AZ configurator

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly. You only need to specify your requirements: From the displacement, direction of rotation, drive shaft, connection flange right up to the required rear cover. You immediately receive a project drawing (PDF format) if a configuration already exists. You receive the price of the configured external gear unit upon request.

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly – all data needed for project planning are acquired thru menu guidance.

Selection is made either on an ordering code or your technical requirements. This means that you can search for external gear units that have already been configured, or you specify the configuration variant of the external gear unit based upon the operating parameters you require.

If the external gear unit you selected has been released you will receive the part number, ordering code and a detailed installation drawing. If your special configuration is not available please send your specification to Rexroth. One of our employees will then contact you.

Ordering code

External gear units, single pumps, standard

AZ	P	N	–	x	x	–	020	R	C	B	20	M	B	18009	S xxxx

Function
P = Pump

Series
1 = Case width 92 mm
2 = Case width 110 mm

Version
1 = Phosphatized, pinned
2 = Chromatized, pinned

Size N
020 = 20.0 cm^3/rev
022 = 22.5 cm^3/rev
025 = 25.0 cm^3/rev
028 = 28.0 cm^3/rev
032 = 32.0 cm^3/rev
036 = 36.0 cm^3/rev

Direction of rotation
R = Clockwise
L = Counterclockwise

*) Some of the special designs shown on pages 16–21 are not covered in the illustration of the ordering code.

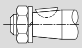
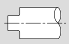
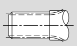
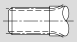
Special design *)

Valve adjustment
200 xx = PRV 200 bar
xxx 11 = FCV 11 l/min
18009 = PRV + FCV 180 bar, 9 l/min

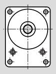
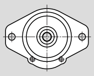
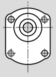
Rear cover
B = Standard
D = PRV residual flow internal
E = FCV residual flow external
S = FCV residual flow internal
V = PRV + FCV

Seals
M = NBR
K = NBR, SSR in FKM

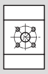
Drive shafts

Code	Drive shaft		Suitable front cover
C	Tapered key shaft 1 : 5		B
N	Dihedral claw		M
D	Splined shaft SAE J 744 22-4 13T		C
P	Splined shaft SAE J 744 19-4 11T		C

Front cover

Code	Front cover	
B	Square flange Centering Ø 100 mm	
C	SAE J 744 101-2 B 2-bolt flange Ø 101.6 mm	
M	2-bolt mounting Centering Ø 52 mm with seal ring	

Line ports

Code	Line ports	
07	Square flange SAE Thread, metric	
20	Rectangular flange	

Not all variants can be selected by using ordering code!
Please select the required pump by using the selection tables (standard types) or after consultation with Bosch Rexroth!
Special options are possible upon request.

Ordering code

External gear units, multiple pumps, standard

AZ	P	NNFF	–	x	x	–		032/022/016/005	R	C	B	20 20 20 20	K	B

Function

P = Pump

Series

B = 1.0... 7.1 cm³/rev
S = 4.0...28.0 cm³/rev
F = 4.0...28.0 cm³/rev
N = 20.0...36.0 cm³/rev
G = 22.5...56.0 cm³/rev

Series,
relates to pump section 1

1 = Case width 92 mm
2 = Case width 110 mm

Version,
relates to pump section 1

1 = Phosphatized, pinned
2 = Chromatized, pinned

Size

corresponding to each series

Direction of rotation

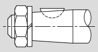
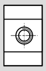
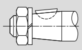
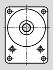
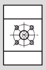
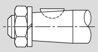
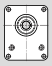
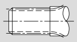
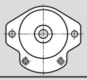
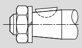
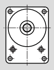
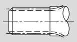
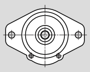
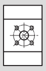
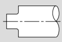
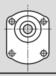
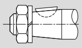
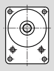
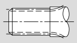
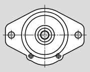
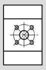
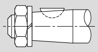
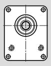
R = Clockwise
L = Counterclockwise

Rear cover
relates to last pump section

B = Standard

Seals

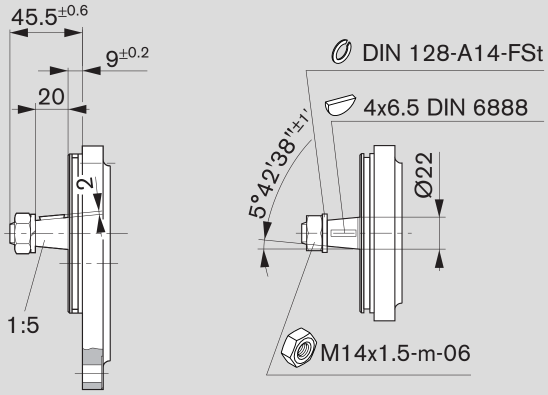
M = NBR
P = FKM
K = NBR, SSR in FKM
Shaft seal relate to pump section 1

Drive shafts relates to pump part 1				**Front cover** relates to pump part 1			**Line ports** every pump parts		
Series B:			Suitable front cover						
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 25.38 mm		**02**	Thread, metric DIN 3852 T1	
Series F, S:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 80 mm		**20**	Rectangular flange	
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 36.47 mm				
R	Splined shaft SAE J 744 16-4 9T		**R**	**R**	SAE J 744 82-2 A Centering Ø 82.55 mm 2-bolt mounting				
Series N, T:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 100 mm		**07**	Square flange SAE Thread, metric	
D	Splined shaft SAE J 744 22-4 13T		**C**	**C**	SAE J 744 101-2 B Centering Ø 101.6 mm 2-bolt mounting		**20**	Rectangular flange	
N	Dihedral claw		**M**	**M**	Centering Ø 52 mm with seal ring				
Series G, U:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 105 mm		**07**	Square flange SAE Thread, metric	
D	Splined shaft SAE J 744 22-4 13T		**C**	**C**	SAE J 744 101-2 B Centering Ø 101.6 mm 2-bolt mounting		**20**	Rectangular flange	
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 50.78 mm				

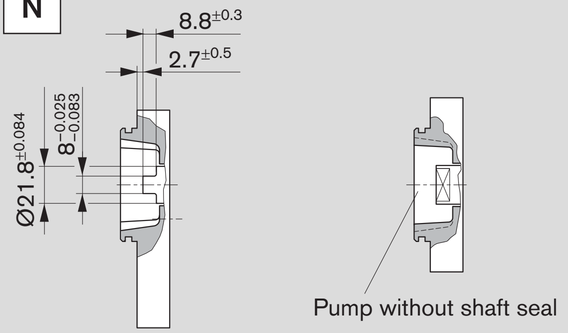
Not all variants can be selected by using ordering code!
Please select the required pump by using the selection tables (standard types) or after consultation with Bosch Rexroth!
Special options are possible upon request.

Drive shafts

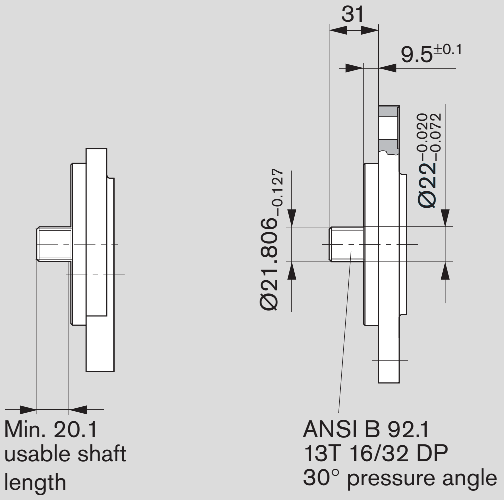
C



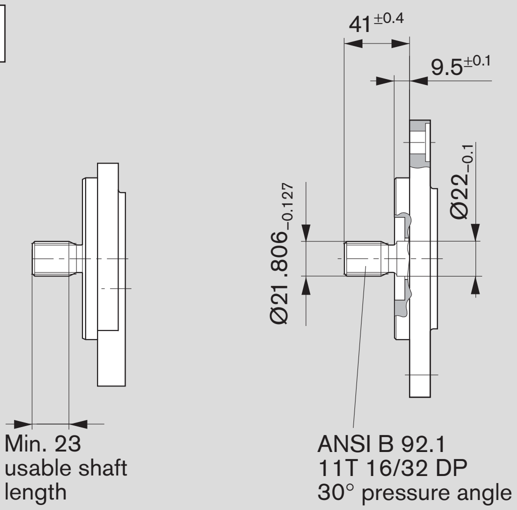
N



D

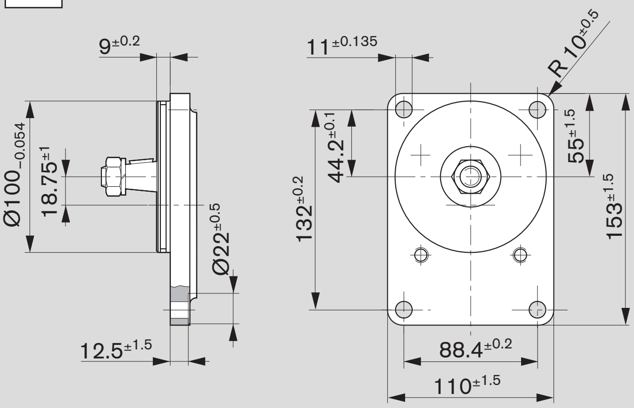


P

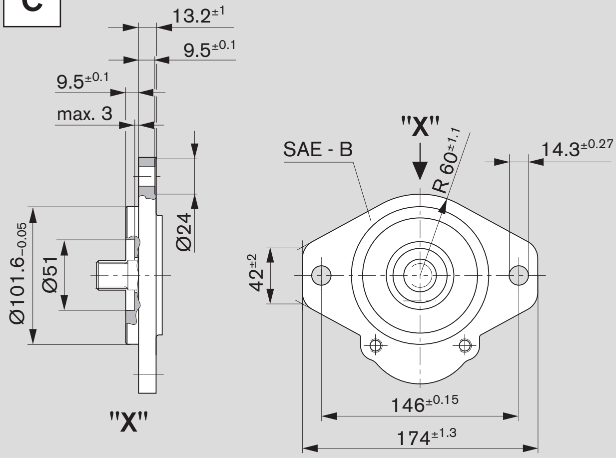


Front cover

B

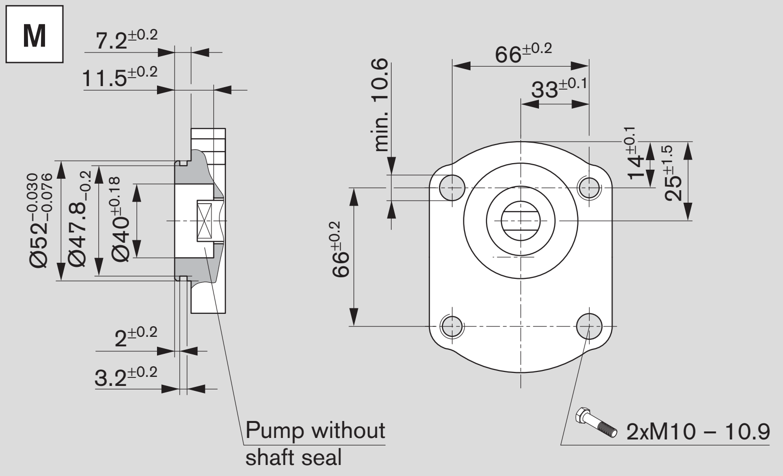


C

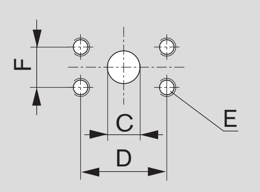


Front cover (continued)

M

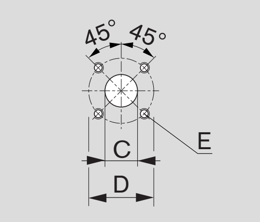


Line ports



07 **Square flange SAE, thread, metric**

Ordering code	Size	Pressure side				Suction side			
		C	D	E	F	C	D	E	F
07	20 cm^3	18	47.6	M10 depth 14	22.2	18	47.6	M10 depth 14	22.2
	22.5...36 cm^3				26.2	26	52.4		26.2



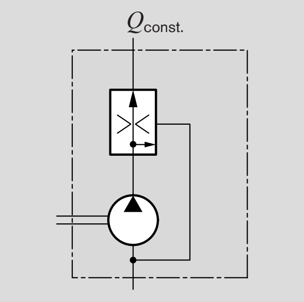
20 **Rectangular flange**

Ordering code	Size	Pressure side			Suction side		
		C	D	E	C	D	E
20	20...36 cm^3	18	55	M8 depth 13	26	55	M8 depth 13

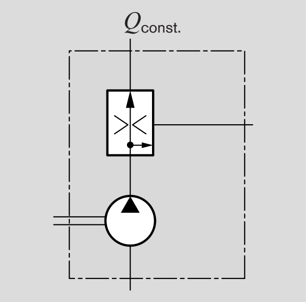
Gear pumps with integral valves

In order to reduce external pipework it is possible to incorporate a flow-control valve or pressure-relief valve in the cover of the gear pump. A typical application of this is in the supply of hydraulic oil in power steering systems. The pump delivers a constant flow irrespective of the speed at which it is driven. The excess flow is either returned internally to the suction port or distributed externally to other items of equipment.

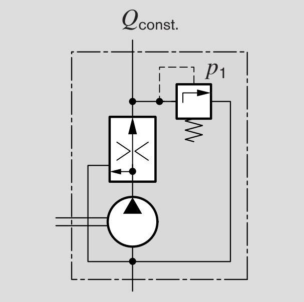
upon request



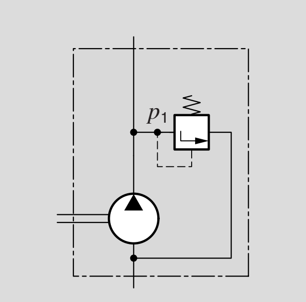
3-way flow-control valve.
Excess flow returned to suction line
$Q_{const.} = 2...30$ l/min



3-way flow-control valve.
Excess flow distributed externally; loadable
$Q_{const.} = 2...30$ l/min



3-way flow-control valve with pressure-relief valve.
Excess flow returned to suction line
$Q_{const.} = 2...30$ l/min
$p_1 = 100...180$ bar



Pressure-relief valve.
Discharge returned to suction line
$p_1 = 5...250$ bar

Ordering code

S	**xxx17**

E	**xxx12**

V	**15011**

D	**180xx**

Design calculations for pumps

The design calculations for pumps are based on the following parameters:

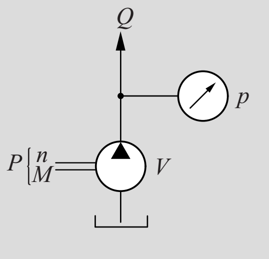
V	[cm³/rev]	Displacement
Q	[l/min]	Delivery
p	[bar]	Pressure
M	[Nm]	Drive torque
n	[rev/min]	Drive speed
P	[kW]	Drive power

It is also necessary to allow for different efficiencies such as:

η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Overall efficiency

The following formulas describe the various relationships.
They include correction factors for adapting the parameters to the usual units encountered in practice.

Caution: Diagrams providing approximate selection data will be found on subsequent pages.



$$Q = V \cdot n \cdot \eta_v \cdot 10^{-5}$$

$$p = \frac{M \cdot \eta_{hm}}{1.59 \cdot V}$$

$$P = \frac{p \cdot Q}{6 \cdot \eta_t}$$

$$V = \frac{Q}{n \cdot \eta_v} \cdot 10^5$$

$$V = \frac{M \cdot \eta_{hm}}{159 \cdot p}$$

$$Q = \frac{6 \cdot P \cdot \eta_t}{p}$$

$$n = \frac{Q}{V \cdot \eta_v} \cdot 10^5$$

$$M = \frac{1.59 \cdot V \cdot p}{\eta_{hm}}$$

$$p = \frac{6 \cdot P \cdot \eta_t}{Q}$$

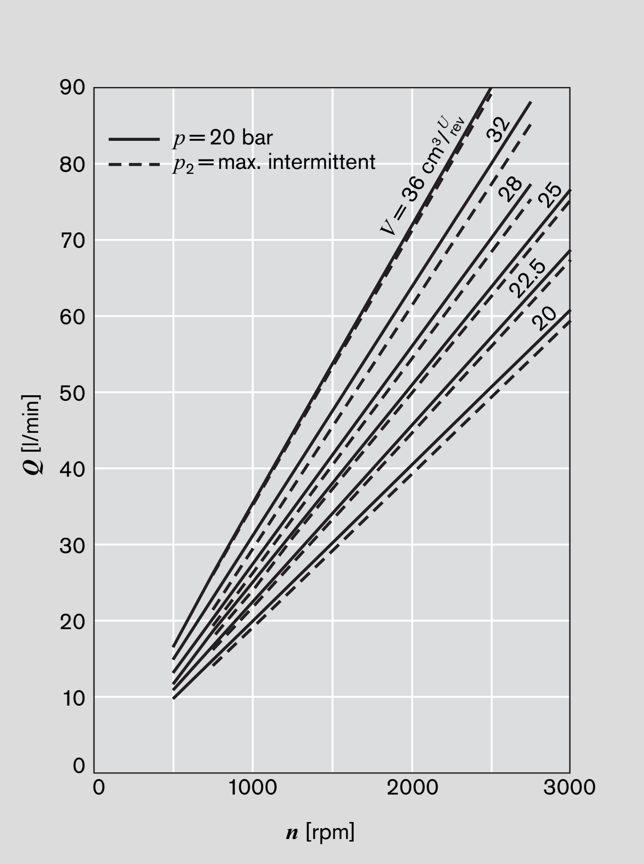
[%]

n —— $\eta_v \longrightarrow Q$
M —— $\eta_{hm} \longrightarrow p$
P —— $\eta_t \longrightarrow p \cdot Q$

V [cm³/rev] Q [l/min] p [bar]
n [rev/min] P [kW] M [Nm]

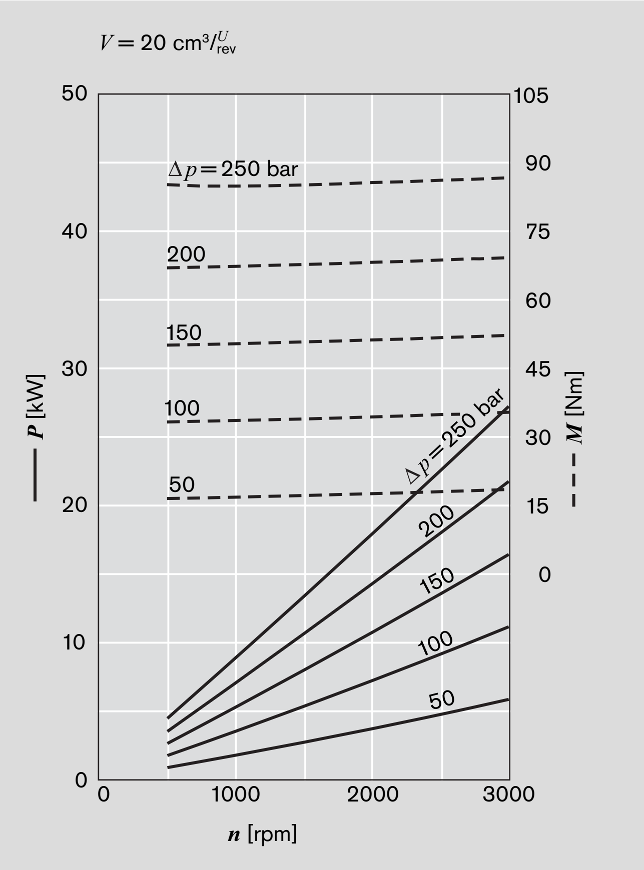
Caution: η [%] e.g. 95 [%]

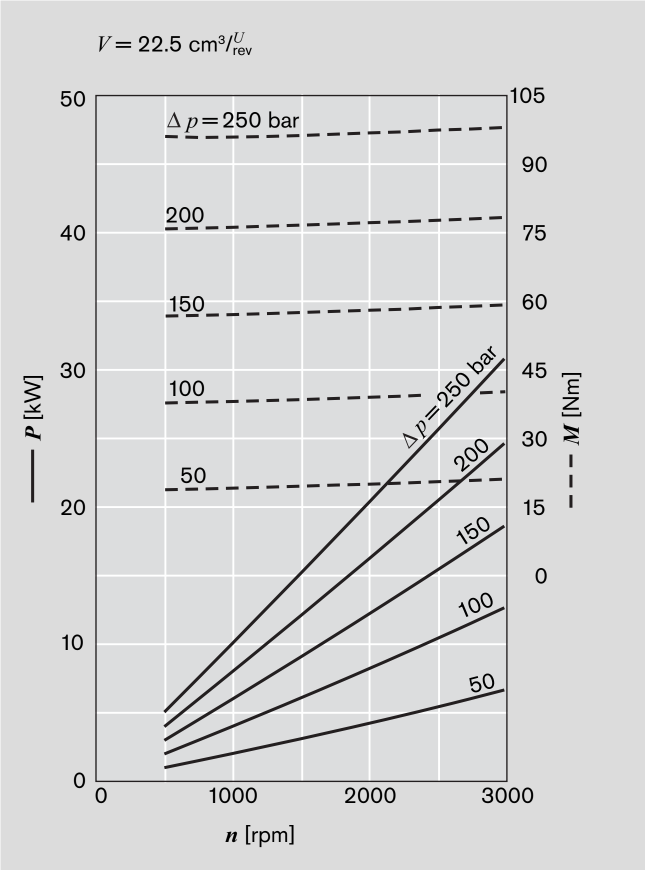
Performance charts



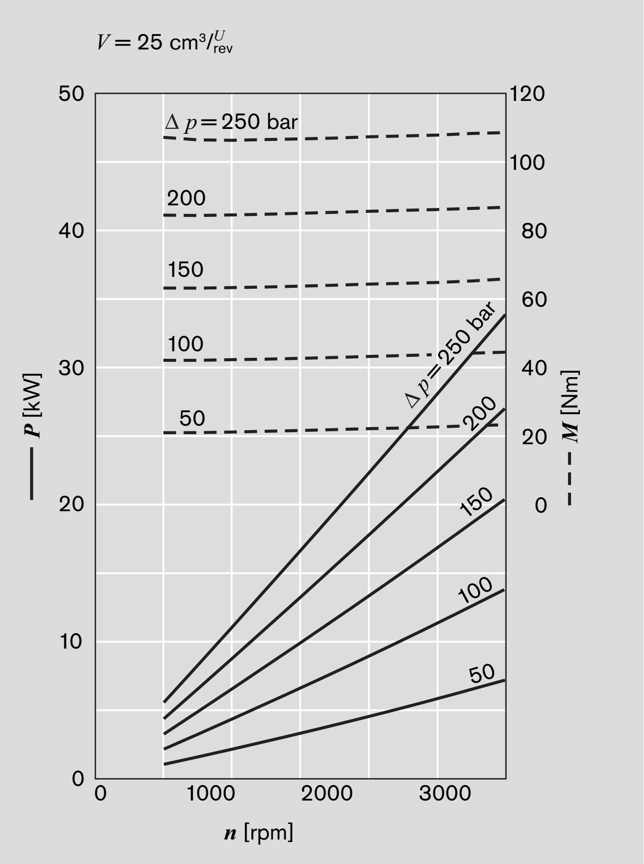
$\nu = 35\ mm^2/s,\ \vartheta = 50\,°C$

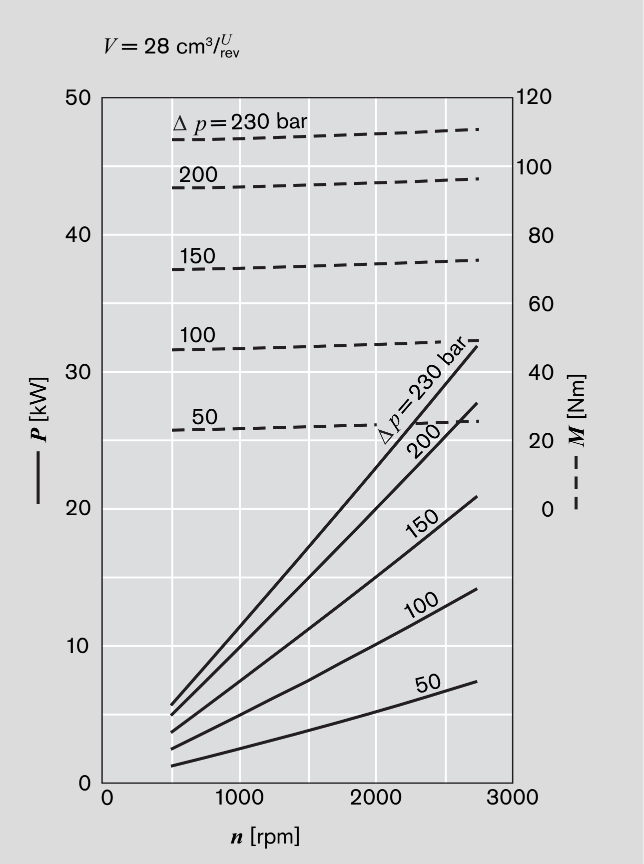
$Q = f\ (n, V)$ incl. η_v
$P = f\ (n, p)$ —— incl. η_t
$M = f\ (n, p)$ - - - incl. η_{hm}

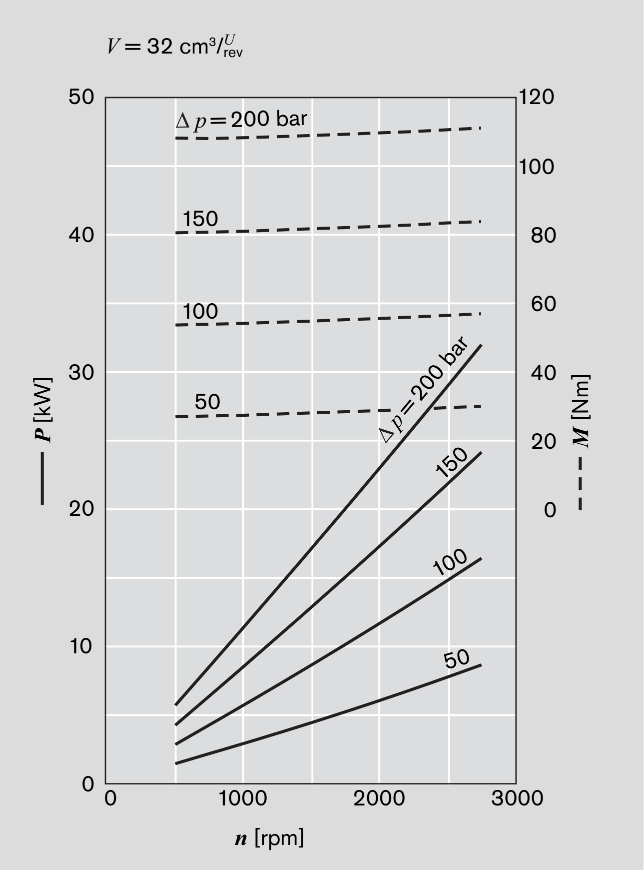


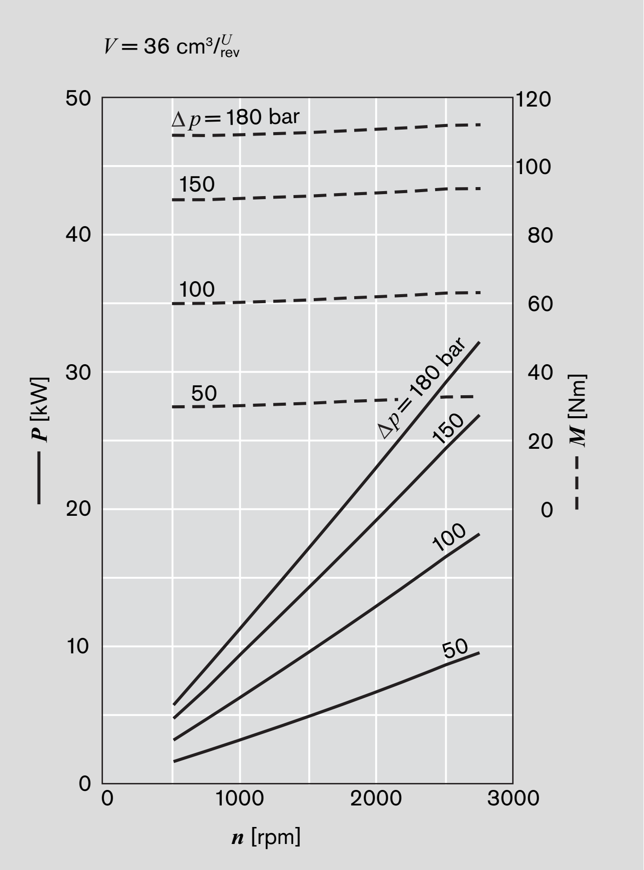


Performance charts (continued)





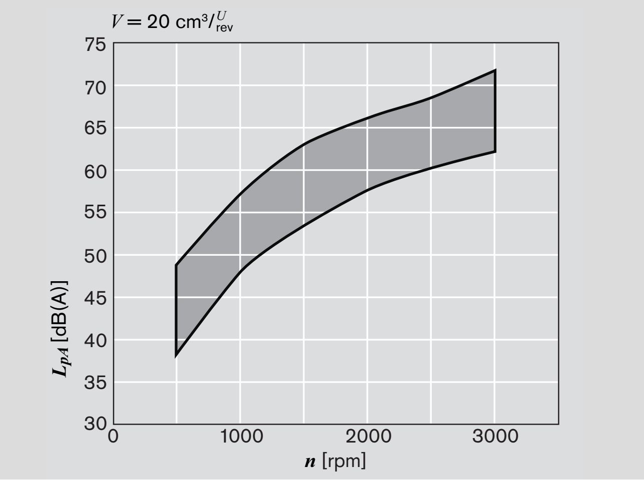


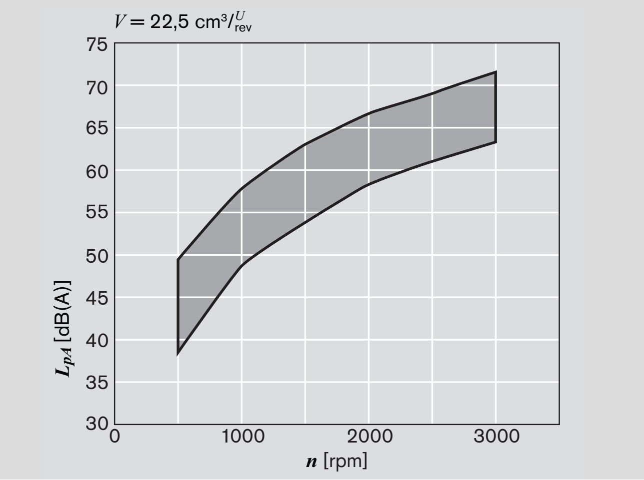


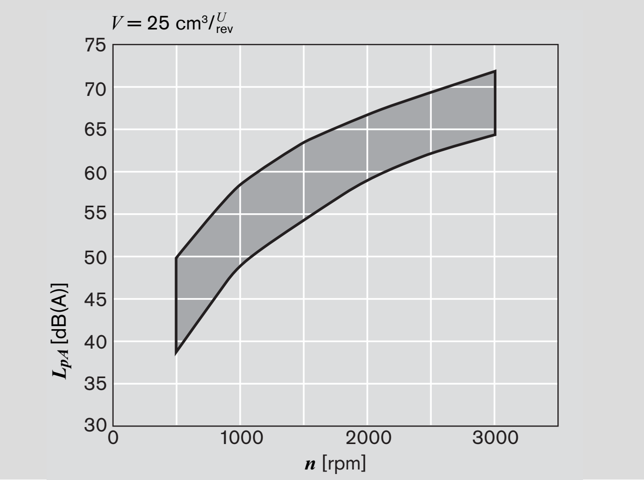
Noise charts

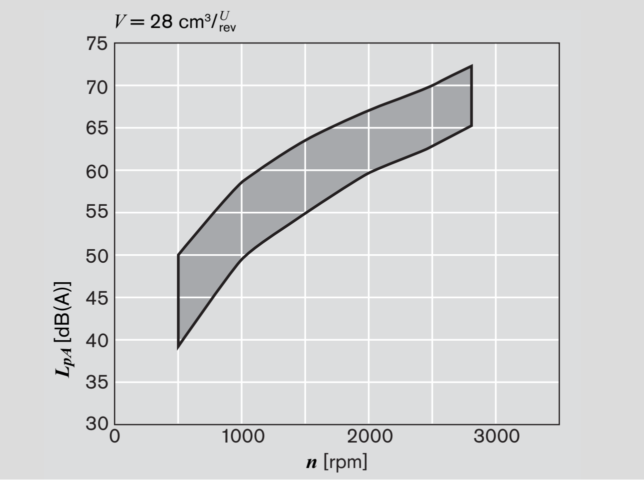
Noise level dependent on rotational speed, pressure range between 10 bar and pressure value p_2 (see page 12/13 Specifications table).
Oil data: $\nu = 32$ mm²/s, $\vartheta = 50$ °C.
Sound pressure level calculated from noise measurements made in the sound absorbent measuring room compliant with DIN 45635, Part 26.
Spacing between measuring sensor – pump: 1 m.

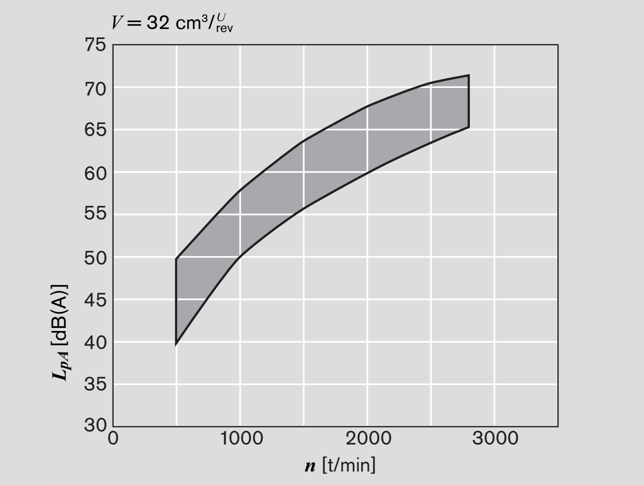
These are typical characteristic values for the respective model. They describe the airborne sound emitted solely by the pump. Environmental influences (installation site, piping, further system components) are not taken into consideration.
Each value applies for a single pump.

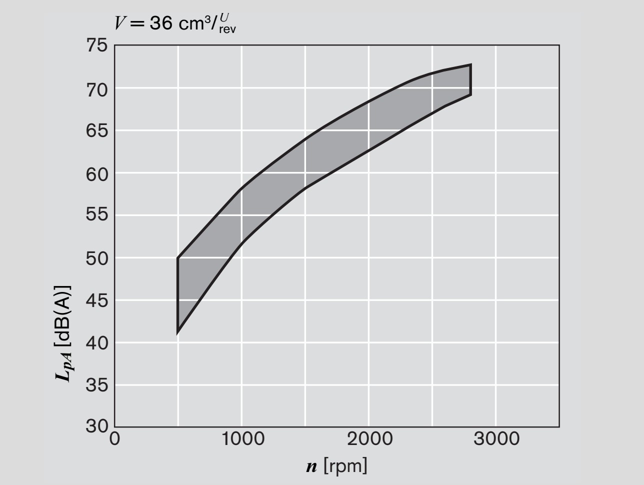












Specifications

General	
Construction	External gear pump
Mounting	Flange or through-bolting with spigot
Line ports	Flange
Direction of rotation (looking on shaft)	Clockwise or counterclockwise, the pump may only be driven in the direction indicated
Installation position	Any
Load on shaft	Radial and axial forces after consulting
Ambient temperature range	–30 °C...+80 °C or max. 110 °C with FKM seals
Hydraulic fluid	– Mineral oil compliant with DIN 51 524, 1–3, however under higher load at least HLP compliant with DIN 51 524 Part 2 recommended. – Comply with RE 90220 – Further operating fluids possible after consultation
Viscosity	12...800 mm²/s permitted range 20...100 mm²/s recommended range ...2000 mm²/s range permitted for starting
Hydraulic fluid temperature range	max. +80 °C with NBR seals *) max. +110 °C with FKM seals **)
Filtration ***)	At least cleanliness level 20/18/15 compliant with ISO 4406 (1999)

*) NBR = Perbunan®

**) FKM = Viton®

***) During the application of hydraulic systems or devices with critical counter-reaction, such as steering and counterbalance valves, the type of filtration selected must be adapted to the sensitivity of these devices.

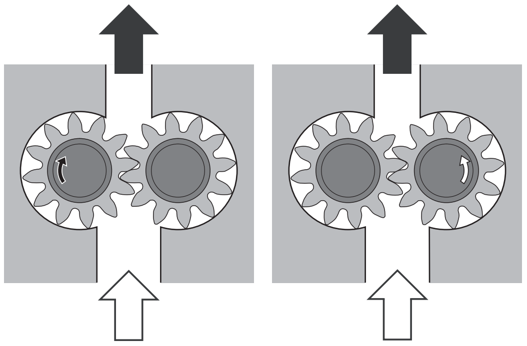
Safety requirements pertaining to the whole systems are to be observed.

In the case of applications with high numbers of load cycles please consulting.

Definition of direction of rotation

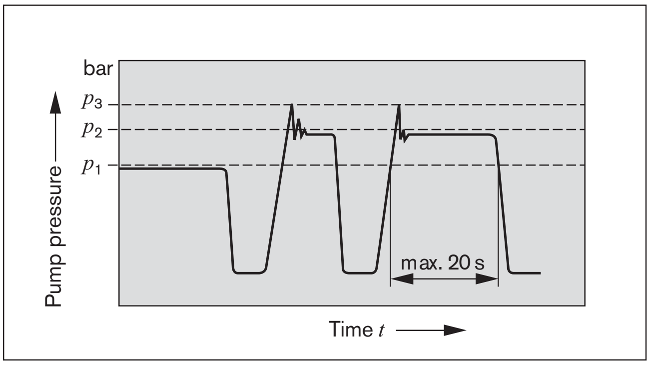
Always look on the drive shaft.

Caution: Dimensions drawings always show clockwise-rotation pumps. On counter-clockwise-rotation pumps the positions of the drive shaft and the suction and pressure ports are different.



Clockwise rotation ↻ Counter-clockwise rotation ↺

Definitions of pressures



p_1 max. continuous pressure
p_2 max. intermittent pressure
p_3 max. peak pressure

AZPN-1x

Displacement		V	cm³/rev	20	22.5	25	28	32	36
Suction pressure		p_e	0.7...3 (absolute), with tandem pumps p_e (p_2) = max. 0.5 p_e (p_1)						
Max. continuous pressure		p_1	bar	230	230	230	210	180	160
Max. intermittent pressure		p_2		250	250	250	230	200	180
Max. peak pressure		p_3		270	270	270	250	220	200
Min. rotational speed		<100	rpm	500	500	500	500	500	500
at bar	12 mm²/s	100...180		600	600	600	600	600	600
		180... p_2		800	800	800	800	800	800
	25 mm²/s	p_2		500	500	500	400	400	400
Max. rotational speed at		p_2		3000	3000	3000	2800	2800	2800

AZPN-2x (only upon request)

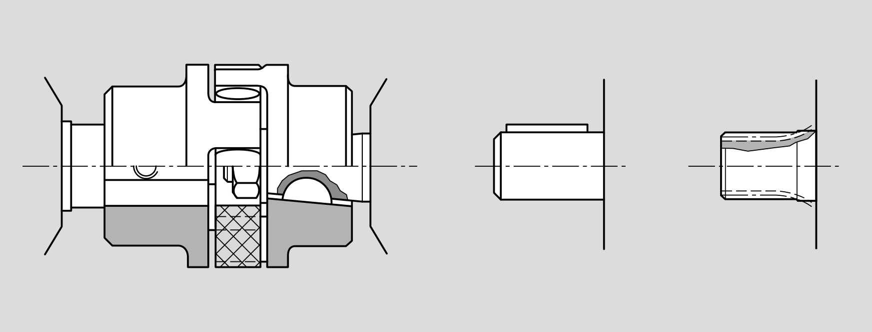
Displacement	V	cm³/rev	20	22.5	25	28	32	36
Suction pressure	p_e	bar	0.7...3 (absolute), with tandem pumps p_e (p_2) = max. 0.5 p_e (p_1)					
Max. continuous pressure	p_1		250	250	250	230	210	180
Max. intermittent pressure	p_2		280	280	280	260	240	210
Max. peak pressure	p_3		300	300	300	280	260	230
Min. rotational speed	<100	rpm	500	500	500	500	500	500
at bar 12 mm²/s	100...180		600	600	600	600	600	600
	180... p_2		800	800	800	800	800	800
25 mm²/s	p_2		500	500	500	500	500	500
Max. rotational speed at	p_2		3000	3000	3000	2800	2800	2800

Drive arrangements

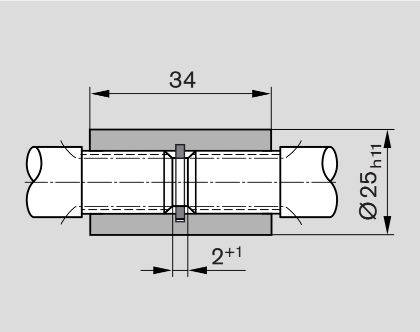
1. Flexible couplings
The coupling must not transfer any radial or axial forces to the pump.

The maximum radial runout of shaft spigot is 0.2 mm.

Refer to the fitting instructions provided by the coupling manufacturer for details of the maximum permitted shaft misalignment.



2. Coupling sleeve
Used on shafts with DIN or SAE splining. Caution: There must be no radial or axial forces exerted on the pump shaft or coupling sleeve. The coupling sleeve must be free to move axially. The distance between the pump shaft and drive shaft must be 2^{+1}. Oil-bath or oil-mist lubrications is necessary.



Splined shaft profile	Ordering code	M_{max} [Nm]
SAE-B 13 teeth	D	300
SAE-C 11 teeth	P	n. n.

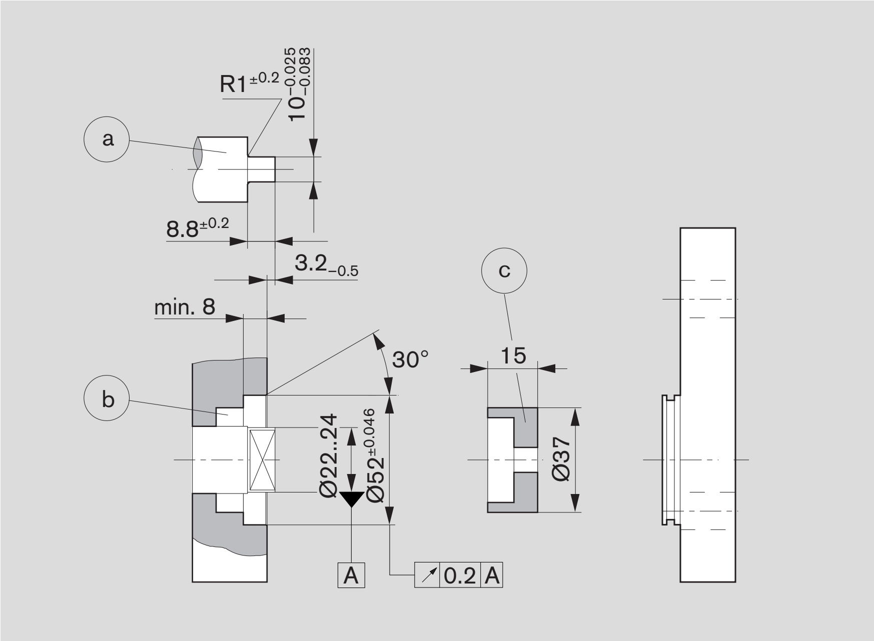
3. Drive shaft with tang

For the close-coupling of the pumps to electric motor or internal-combustion engine, gear, etc. The pump shaft has a special tang and driver ⓒ (not included in supply).
There is no shaft sealing.

The recommended arrangements and dimensions for the drive end and sealing are as follows.

ⓐ Drive shaft
Case-hardening steel DIN 17 210
e.g. 20 MnCrS 5
case-hardened 1.0 deep; HRA $83^{\pm 2}$
Surface for sealing ring
ground without rifling $R_t \leq 4 \mu m$

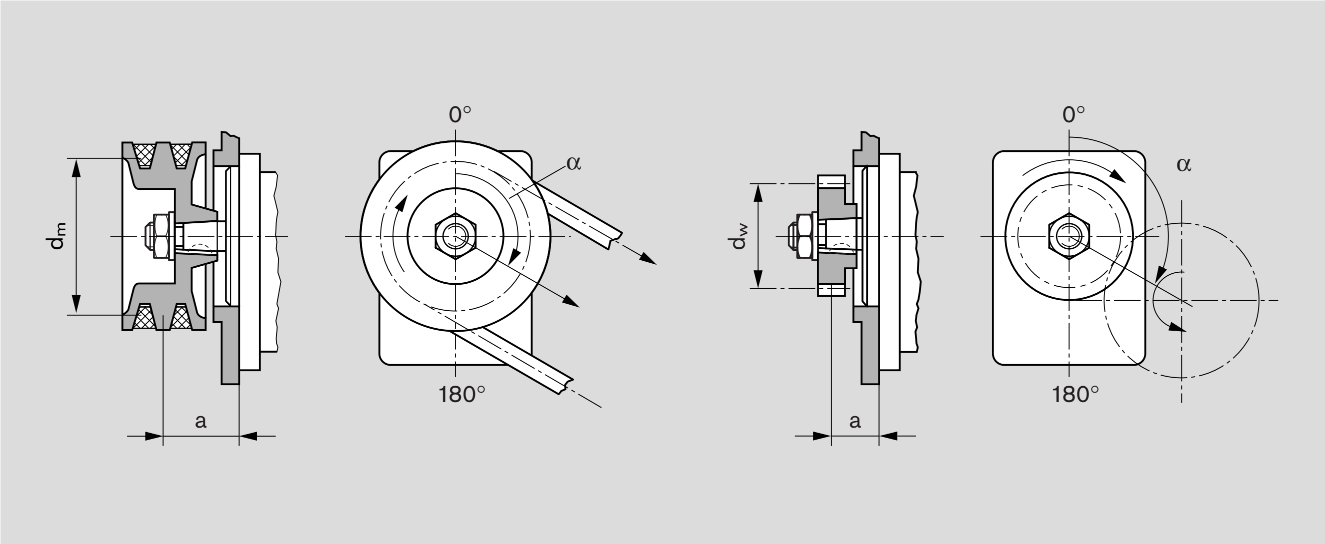
ⓑ Radial shaft seal ring
Rubber-covered seal (see DIN 3760, Type AS, or double-lipped ring).
Cut 15° chamfer or fit shaft seal ring with protection sleeve.



M_{max} [Nm]	V [cm³/rev]	p_{max} [bar]
95	20	270
	22.5	240
	25	220
	28	190
	32	170
	36	150

4. V-belts and straight gearwheels or helical toothed gear drives without outboard bearing

When proposing to use V-belt or gear drive, please submit details of the application for our comments (especially dimensions a, d_m, d_w and angle α).
For helical toothed gear drives, details of the helix angle β are also required.



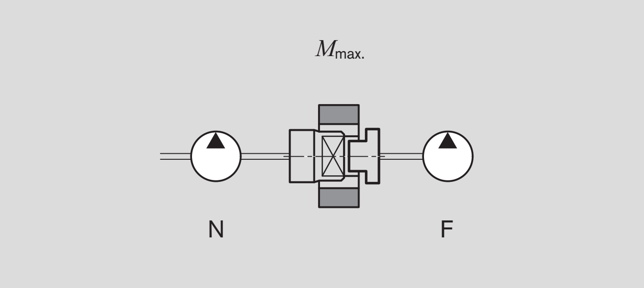
Multiple gear pumps

Gear pumps are well-suited to tandem combinations of pumps in which the drive shaft of the first pump is extended to drive a second pump and sometimes a third pump in the same manner. A coupling is fitted between each pair of pumps.
In most cases each pump is isolated from its neighbor, i.e. the suction ports are separate from one another. A common suction port is also possible as an option.
Caution: Basically, the specifications for the single pumps apply, but with certain restrictions:
Max. speed: This is determined by the highest rated pump speed in use.
Pressures: These are restricted by the strength of the drive shaft, the through drives and the drivers. Appropriate data is given in the dimensional drawings.

Pressure restrictions during standard through drive
In the case of series N, the driver for the second pumping stage can carry a load of up to $M_{max.} = 95$ Nm, i.e. there is a pressure restriction for the second stage and any further stages.

Drive shaft		Max. transferrable drive torque * [Nm]
C	1:5	200
N	Claw	95
D	SAE 13t	320
P	SAE 11t	180

* These values only apply when the conditions described above are complied with. Bosch Rexroth is to be consulted if the stated values are exceeded.



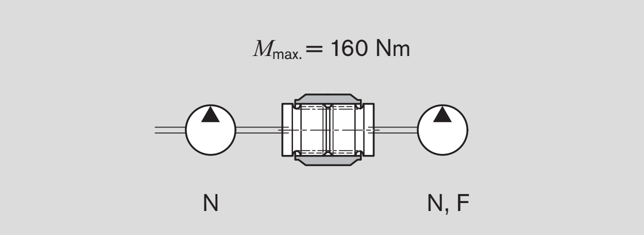
Combinations

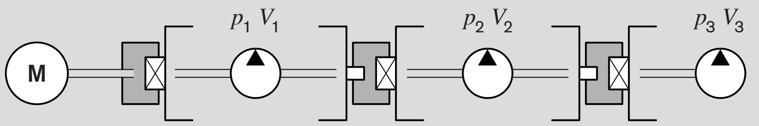
Series pump 1	$M_{max.}$ [Nm]	Series pump 2
N	95	N
N	65	F

For configuration of multiple pumps we recommend the pump is positioned with the largest displacement on the drive side.

If the first stage is driven through a tang (driver) or outboard bearing type 1, pressure restrictions apply as indicated in the formula below.

Reinforced through drives are available for applications with higher transfer torques and/or rotational vibrations. Customized designs available on request.



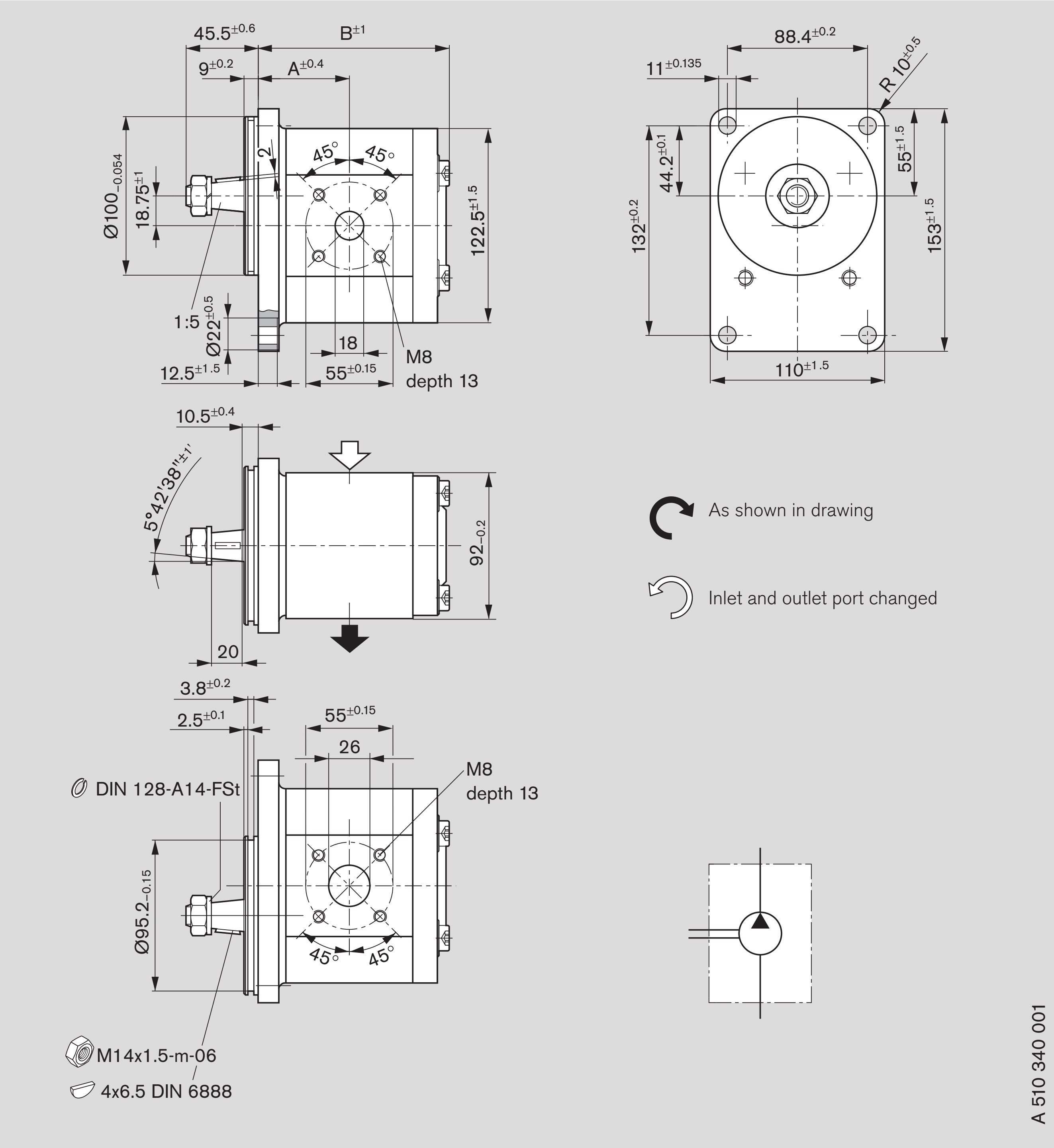


$$M_{max.} \geqq \Delta p_1 \cdot V_1 \cdot 0.0177 + \Delta p_2 \cdot V_2 \cdot 0.0177 + \Delta p_3 \cdot V_3 \cdot 0.0177$$

Δp [bar] V [cm^3/rev]

Dimensions

Standard range

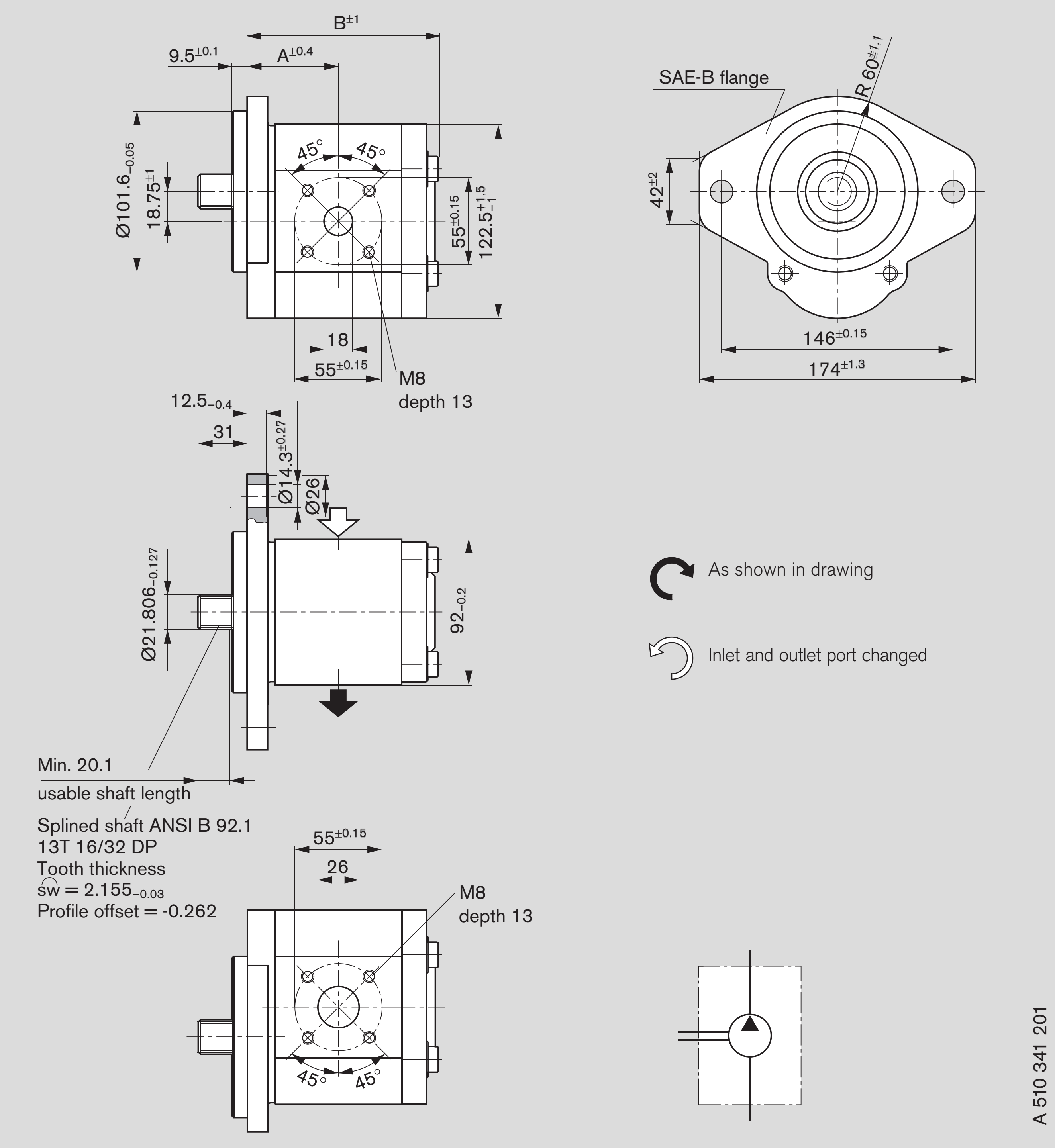


Ordering code:
AZPN – 11 – ☐☐☐ ☐C B 20 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	Dimension [mm] B
20	**0 510 625 335**	**0 510 625 035**	250	3000	5.4	52	109.8
22.5			250	3000		53.5	112.8
25	**0 510 725 352**	**0 510 725 047**	250	3000	5.6	55	115.8
28	**0 510 725 364**	**0 510 725 055**	230	2800	5.7	56.5	118.8
32	**0 510 725 353**	**0 510 725 048**	200	2800	5.9	59	123.3

Dimensions

Standard range



Ordering code:

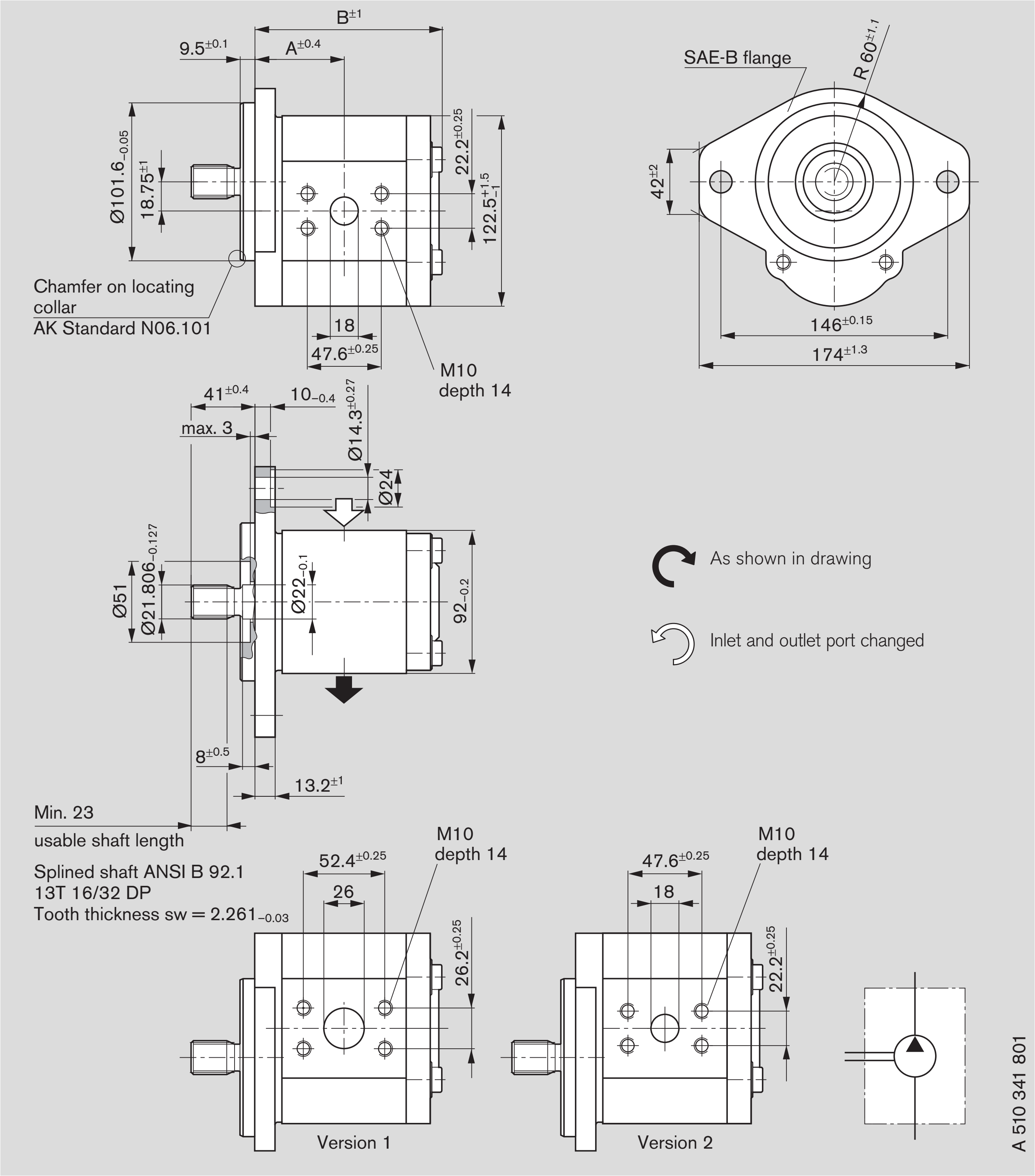
AZPN – 1X – ☐ ☐ ☐ ☐ D C 20 M B

AZPN – 1X – ☐ ☐ ☐ ☐ D C 20 K B*

Displacement [cm³/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	 B
20			3000	250		52	110.1
22.5			3000	250		53.5	112.6
25	**0 510 725 377**	**0 510 725 057**	3000	250	5.5	55	115.3
25		**0 510 725 094***	3000	250	5.5	55	115.3
28	**0 510 725 431**	**0 510 725 058***	2800	230	5.7	56.5	118.3
36	**0 510 725 363**	**0 510 725 155**	2600	180	6.0	61	127.3

Dimensions

Standard range

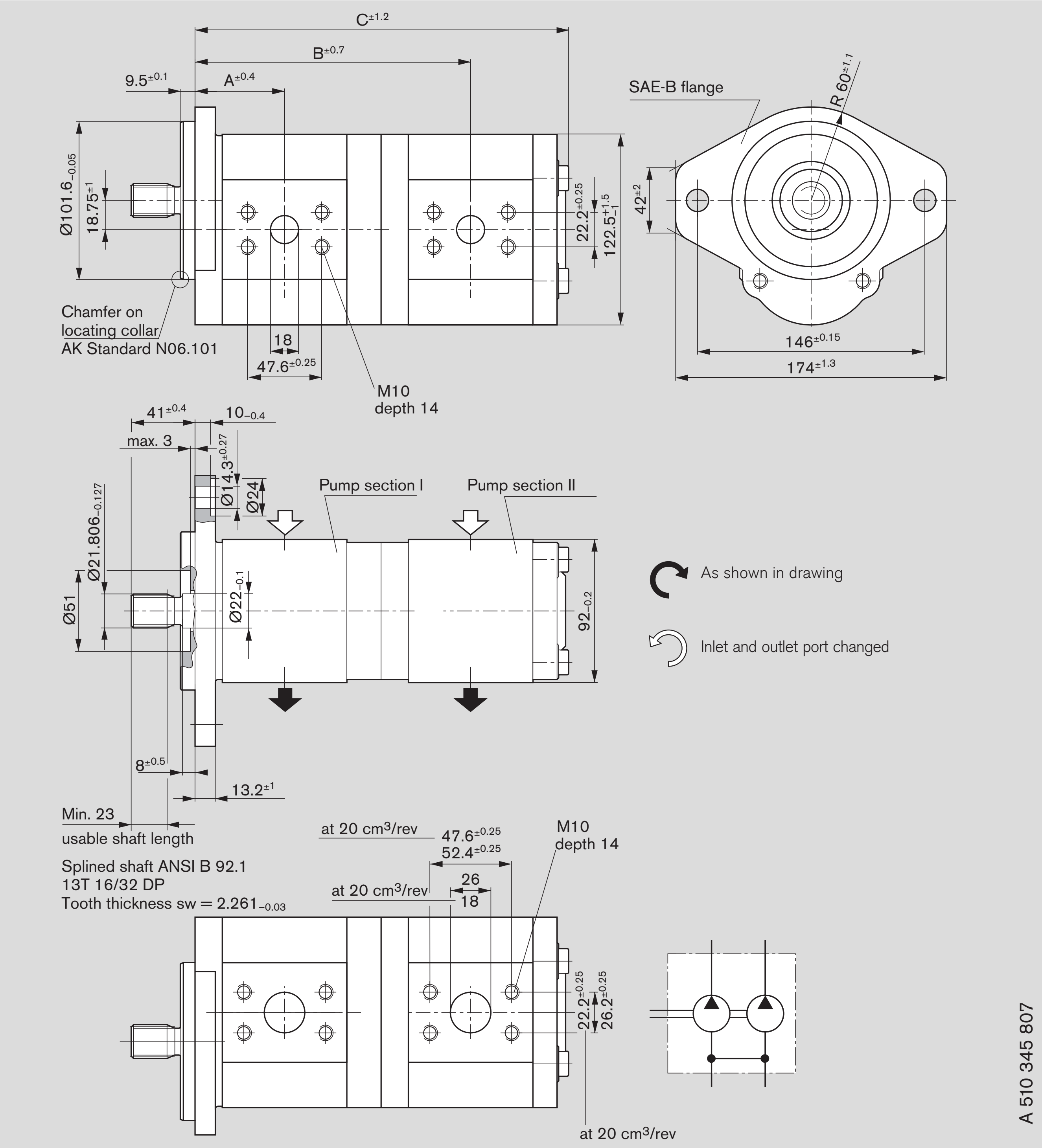


Ordering code:
AZPN – 11 – ☐☐☐ ☐ D C 07 K B S0023

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	kg	Dimension [mm]		Version
[cm³/rev]	↺ L	↻ R	[bar]	[rpm]		A	B	
20	**0 510 625 380**	**0 510 625 073**	250	3000	5.3	52	109.8	2
22.5	**0 510 725 404**	**0 510 725 103**	250	3000	5.4	52	112.8	1
25	**0 510 725 405**	**0 510 725 104**	250	3000	5.5	55	115.8	1
28	**0 510 725 406**	**0 510 725 105**	230	2800	5.7	56.5	118.8	1
32	**0 510 725 407**	**0 510 725 106**	200	2800	5.8	59	123.3	1
36			180	2600		61	127.8	1

Dimensions

Standard range



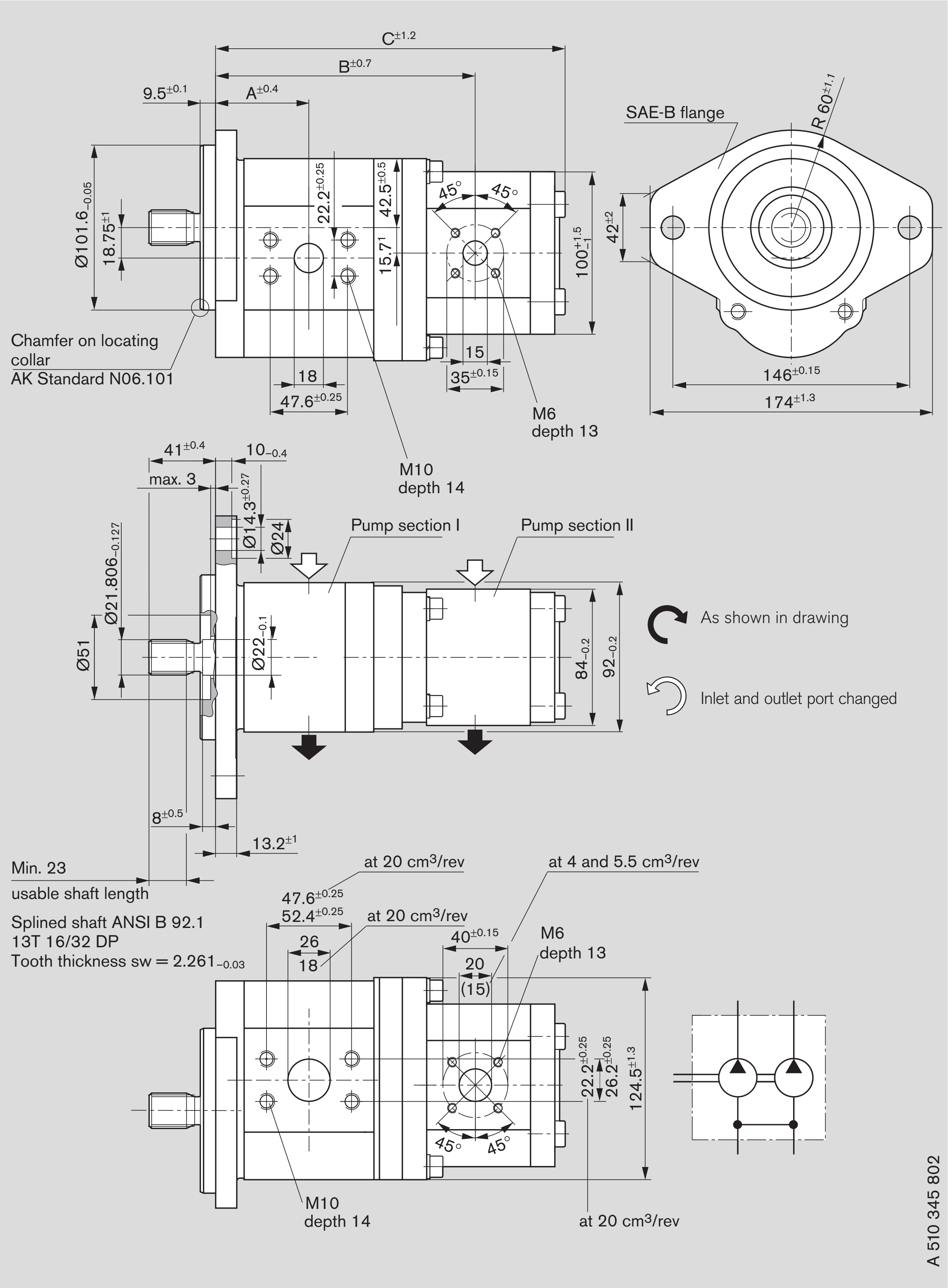
Ordering code:

AZPNN – 11 – ☐☐☐ ☐ D C 07 07 K B S0023

Displacement [cm³/rev] P I	Displacement [cm³/rev] P II	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar] P I	Max. operating pressure [bar] P II	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C
20	20	**0 510 665 461**	**0 510 665 149**	250	250	2000	9.9	52.0	160.7	217.9
22.5	20	**0 510 765 369**		250	250	2000	10.0	53.5	163.6	222.7
22.5	22.5	**0 510 765 380**	**0 510 765 086**	250	230	3000	10.1	53.5	165.2	225.7
25	20		**0 510 765 067**	250	250	2000	10.1	55.0	166.6	225.7
25	22.5		**0 510 765 068**	250	230	3000	10.2	55.0	168.2	228.7
25	25	**0 510 766 315**	**0 510 765 069**	250	200	3000	10.3	55.0	169.7	229.9
32	32	**0 510 765 370**	**0 510 768 034**	200	160	2500	10.9	29.0	181.2	244.9

Dimensions

Standard range



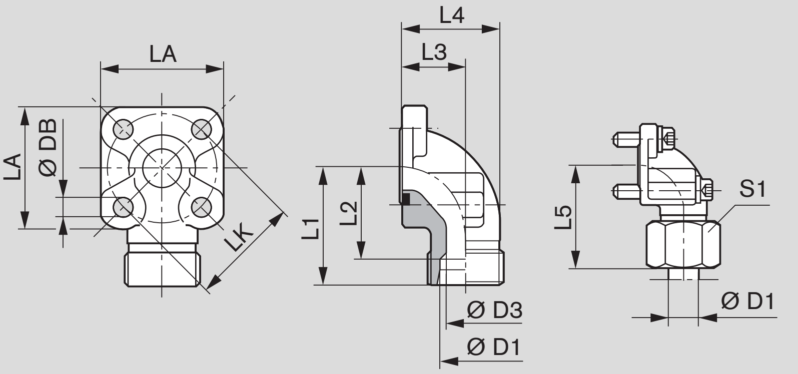
Ordering code:
AZPNF – 1X – ☐☐☐ ☐ D C 07 20 K B S0023
AZPNF – 1X – ☐☐☐ ☐ D C 07 20 K B S0081*
AZPNF – 1X – ☐☐☐ ☐ D C 07 20 M B S0081**

Displacement [cm^3/rev] P I	Displacement [cm^3/rev] P II	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar] P I	Max. operating pressure [bar] P II	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C
20	4		**0 510 665 181**	250	280	3000	–	52.0	141.5	184.2
22.5	8	**0 510 765 387***	**0 510 765 078**	250	280	3000	8.4	53.5	147.9	193.8
22.5	11	**0 510 765 381**	**0 510 765 062**	250	280	3000	8.5	53.5	151.7	200.6
25	4	**0 510 766 316**		250	280	3000	–	55.0	147.6	190.2
25	11	**0 510 765 377**	**0 510 765 079**	250	280	3000	8.6	55.0	154.7	203.6
25	14		**0 510 766 014****	250	250	3000	8.7	55.0	155.2	206.8
25	16		**0 510 765 080**	250	230	3000	8.8	55.0	155.2	210.2
28	11		**0 510 765 092**	230	280	2800	8.7	56.5	157.7	206.6
28	16	**0 510 765 384**	**0 510 765 063**	230	230	2800	8.9	56.5	158.2	213.2
28	19	**0 510 766 314**	**0 510 767 058**	200	200	2800	9.0	56.5	158.2	219.8
28	22.5		**0 510 767 045**	230	200	2100	9.2	56.5	165.8	223.6
28	22.5	**0 510 767 322***		230	150	2100	9.3	56.5	165.8	223.6
32	8		**0 510 765 064**	200	280	2500	8.8	59.0	158.4	204.3
32	11	**0 510 768 320**	**0 510 765 065**	200	280	2500	8.9	59.0	162.2	211.1
32	14	**0 510 765 378**		200	250	2500	9.0	59.0	162.7	216.1
32	16		**0 510 765 066**	200	230	2500	9.1	59.0	162.7	217.7
32	22.5	**0 510 768 318***		200	150	2100	–	59.0	170.3	229.9

Fittings

Fittings can be used for rectangular flange 20 see page 7

Gear pump flange, 90° angle

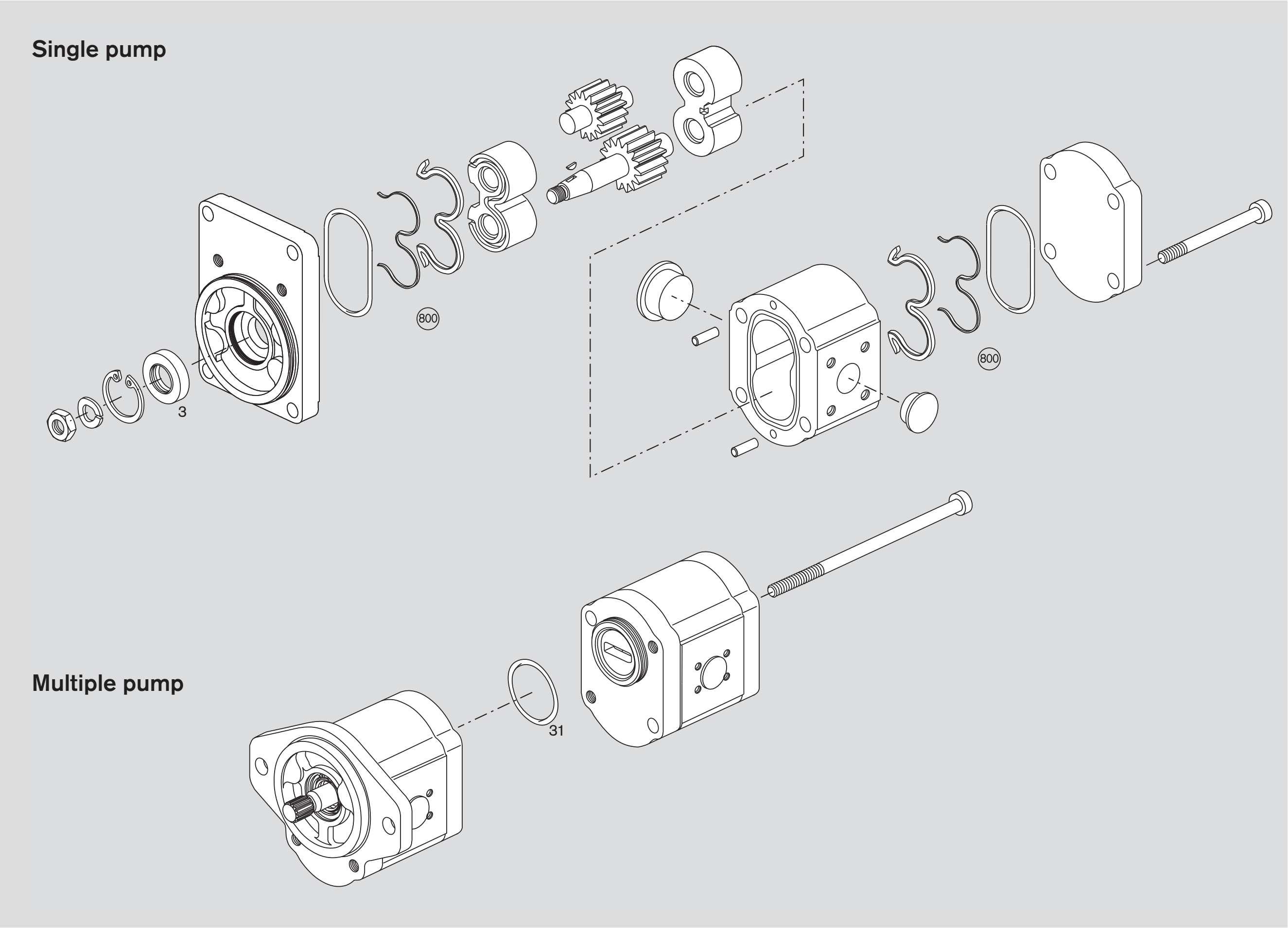


LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws 2x	2x	Seal ring	Mass kg	Part number	p (bar)
55	20S	17	45	34.5	24.0	40.0	56.0	58	36	8.4	M8x25	M8x50	33x2.5	0.44	**1 515 702 004**	250
55	30S	26	49	35.5	32.0	50.0	62.0	58	50	8.4	M8x25	M8x50	33x2.5	0.50	**1 515 702 006**	250
55	35L	31	49	38.5	32.0	51.5	62.0	58	50	8.4	M8x25	M8x60	32x2.5	0.47	**1 515 702 005**	100
55	42 L	38	49	38.0	40.0	64.5	61.0	58	60	8.4	M8x25	M8x70	32x2.5	0.60	**1 515 702 019**	100

Complete fittings with seal ring, metric screw set, nuts and olive.

Note
You can find the permissible tightening torques in our publication:
“General Operating Instructions for External Gear Units”
RE 07 012-B1.

Service parts



Page	Ordering code	Seal kit “N” Pos. 800 NBR	Seal kit “F” Pos. 800 NBR	Shaft seal ring Pos. 3	Dimension	Seal ring Pos. 3.1	Material	Dimension
16	AZPN – 1X – □□□ □ C B 20 M B	1517010226		1510283023	40x22x7		NBR	
17	AZPN – 1X – □□□ □ D C 20 M B	1517010226		1510283023	40x22x7		NBR	
17	AZPN – 1X – □□□ □ D C 20 K B	1517010226		1510283028	40x22x7		FKM (SSR)	
18	AZPN – 1X – □□□ □ D C 07 K B S0023	1517010226		1510283028	40x22x7		FKM (SSR)	
19	AZPNF – 1X – □□□ □ D C 07 07 K B S0023	1517010226	1517010208	1510283028	40x22x7	1510210043	FKM (SSR)	60x2.5 FPM
20	AZPNF – 1X – □□□ □ D C 07 20 K B S0081	1517010226	1517010208	1510283028	40x22x7	1510210043	FKM (SSR)	60x2.5 FPM
20	AZPNF – 1X – □□□ □ D C 07 20 M B S0081	1517010226	1517010208	1510283028	40x22x7	1510210043	FKM (SSR)	60x2.5 FPM
20	AZPNN – 1X – □□□ □ D C 07 20 K B S0023	1517010226	1517010226	1510283028	40x22x7	1900210145	FKM (SSR)	45x2.5 NBR

NBR = Perbunan® FKM = Viton®

Notes for commissioning

Filter recommendation

The major share of premature failures in external gear pumps is caused by contaminated hydraulic fluid.

As a warranty cannot be issued for dirt-specific wear, we recommended filtration compliant with cleanliness level 20/18/15 ISO 4406, which reduces the degree of contamination to a permissible dimension in terms of the size and concentration of dirt particles:

Operating pressure [bar]	>160	<160
Contamination class ISO 4406	18/15	19/16
To be reached with $\beta_X = 75$	20	25

We recommend that a full-flow filter always be used.

Basic contamination of the hydraulic fluid used may not exceed class 20/18/15 according to ISO 4406. Experience has shown that new fluid quite often lies above this value. In such instances a filling device with special filter should be used.

General

- The pumps supplied by us have been checked for function and performance. No modifications of any kind may be made to the pumps; any such changes will render the warranty null and void!
- Pump may only be operated in compliance with permitted data (see pages 15 – 18).

Project planning notes

Comprehensive notes and suggestions are available in Hydraulics Trainer, Volume 3 RE 00 281, “Project planning notes and design of hydraulic systems”. Where external gear pumps are used we recommend that the following note be adhered to.

Technical data

All stated technical data is dependent on production tolerances and is valid for specific marginal conditions.

Note that, as a consequence, scattering is possible, and at certain marginal conditions (e.g. viscosity) **the technical data may change**.

Characteristics

When designing the external gear pump, note the maximum possible service data based on the characteristics displayed on pages 10 to 12.

Additional information on the proper handling of hydraulic products from Bosch Rexroth is available in our document: “General product information for hydraulic products” RE 07 008.

Contained in delivery

The components with characteristics as described under ordering code and device measurements, pages 16 – 20, are contained in delivery.

You can find further information in our publication: “General Operating Instructions for External Gear Units” RE 07 012-B1.

Ordering-No.

Ordering-No.	Page	Ordering-No.	Page	Ordering-No.	Page	Ordering-No.	Page
0 510 625 035	16	0 510 725 105	18	0 510 765 064	21	0 510 765 380	19
0 510 625 073	18	0 510 725 106	18	0 510 765 065	21	0 510 765 381	21
0 510 625 335	16	0 510 725 155	17	0 510 765 066	21	0 510 765 384	21
0 510 625 380	18	0 510 725 352	16	0 510 765 067	19	0 510 765 387	21
0 510 665 149	19	0 510 725 353	16	0 510 765 068	19	0 510 766 014	21
0 510 665 181	21	0 510 725 363	17	0 510 765 069	19	0 510 766 314	21
0 510 665 461	19	0 510 725 364	16	0 510 765 078	21	0 510 766 315	19
0 510 725 047	16	0 510 725 377	17	0 510 765 079	21	0 510 766 316	21
0 510 725 048	16	0 510 725 404	18	0 510 765 080	21	0 510 767 045	21
0 510 725 055	16	0 510 725 405	18	0 510 765 086	19	0 510 767 058	21
0 510 725 057	17	0 510 725 406	18	0 510 765 092	21	0 510 767 322	21
0 510 725 058	17	0 510 725 407	18	0 510 765 369	19	0 510 768 034	19
0 510 725 094	17	0 510 725 431	17	0 510 765 370	19	0 510 768 318	21
0 510 725 103	18	0 510 765 062	21	0 510 765 377	21	0 510 768 320	21
0 510 725 104	18	0 510 765 063	21	0 510 765 378	21		

The AZ configurator

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly. You only need to specify your requirements: From the displacement, direction of rotation, drive shaft, connection flange right up to the required rear cover. You immediately receive a project drawing (PDF format) if a configuration already exists. You receive the price of the configured external gear unit upon request.

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly – all data needed for project planning are acquired thru menu guidance.

Selection is made either on an ordering code or your technical requirements. This means that you can search for external gear units that have already been configured, or you specify the configuration variant of the external gear unit based upon the operating parameters you require.

If the external gear unit you selected has been released you will receive the part number, ordering code and a detailed installation drawing. If your special configuration is not available please send your specification to Rexroth. One of our employees will then contact you.

External gear pump
Series G

AZPG-22

Fixed pumps
$V = 22.5...100\ \text{cm}^3/\ \text{rev}$

Overview of contents

Features

- Nominal pressure 280 bar
- Slide bearings for heavy duty applications
- Drive shafts to ISO or SAE
- Combination of several pumps possible
- Line ports: connection flanges
- Consistent high quality thru mass production
- Numerous configuration variants available
- Cast case available on request

General

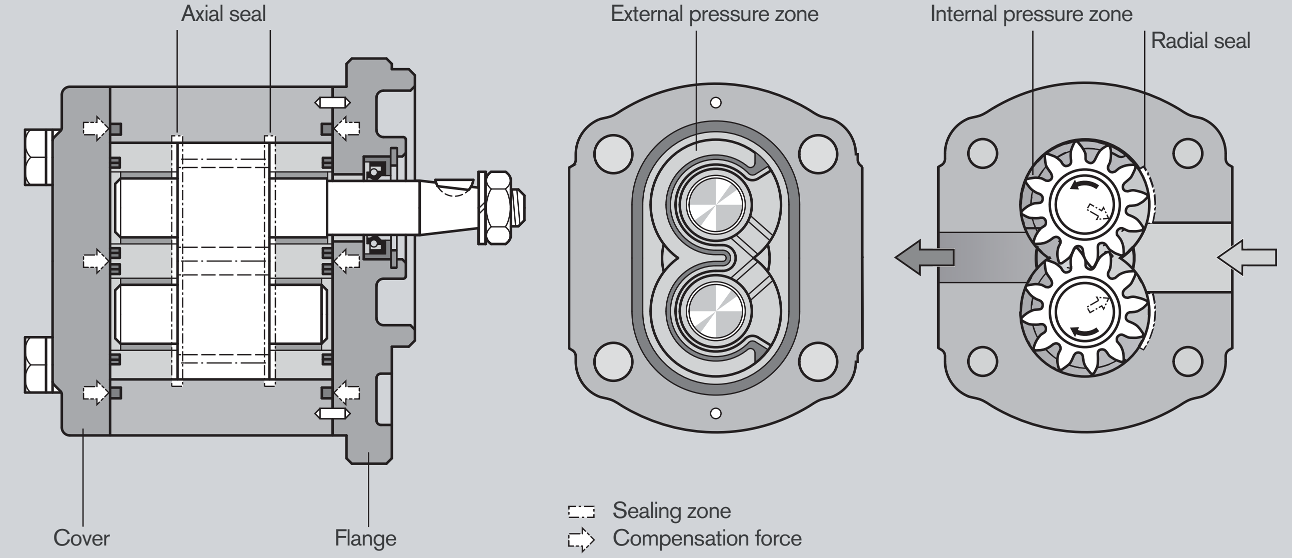
Rexroth external gear pumps are available as standard gear pumps in the 4 series of B, F, N and G, as SILENCE gear pumps in the S, T and U series, and as the SILENCE PLUS version in the J series in which the displacements are graded by different gear widths. Further configuration variants are given by different flanges, shafts, valve arrangements and multiple pump combinations.

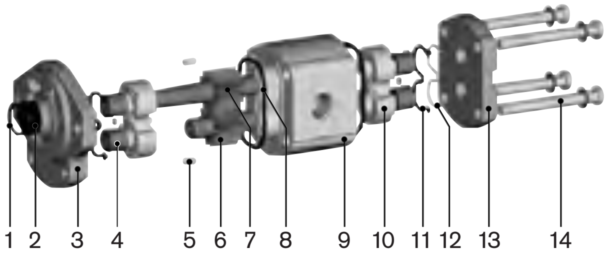
Construction

The external gear pump consists essentially of a pair of gears supported in bearing bushings or bearing, dependent on the series, and the case with a front and rear cover. The drive shaft protrudes from the front cover where it is sealed by the shaft seal ring. The bearing forces are absorbed by special slide bearings with sufficient elasticity to produce surface contact instead of line contact. They also ensure excellent resistance to galling – especially at low speed. The gears have 12 teeth. This keeps both flow pulsation and noise emission to a minimum.

The internal sealing is achieved by forces which are proportional to delivery pressure. This ensures optimum efficiency. This ensures optimum efficiency. The sealing zone between the gear teeth and the bearings is controlled by the admission of operating pressure to the rear of the bearing bushings. Special seals form the boundary of the zone. The radial clearance at the tips of the gear teeth is sealed by internal forces pushing them against the case.

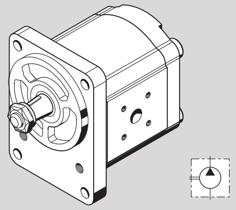
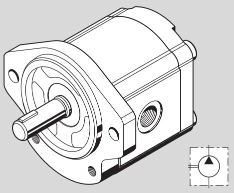
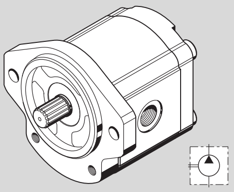
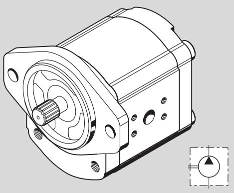
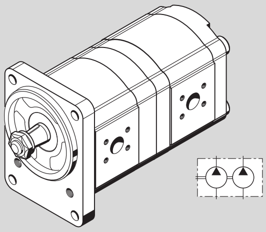
Axial and radial compensation for gear pump

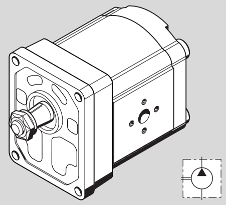
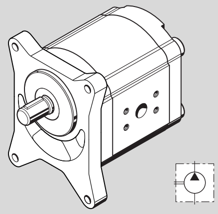
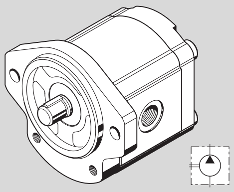
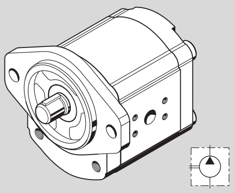
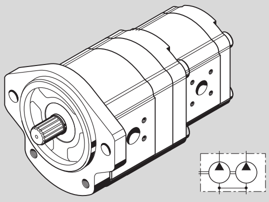


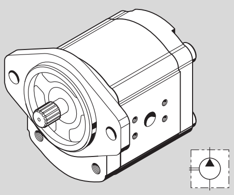
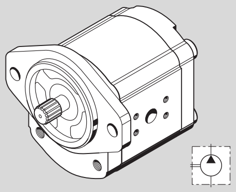
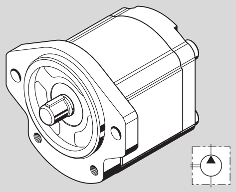
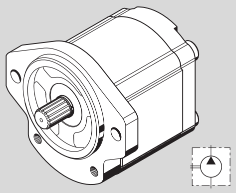
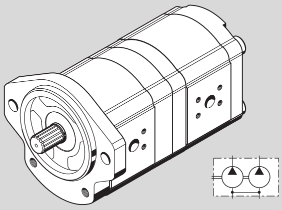


1 Retaining ring
2 Shaft seal ring
3 Front cover
4 Slide bearing
5 Centering pin
6 Gear
7 Gear (frictional)
8 Case seal
9 Pump case
10 Bearing
11 Axial zone seal
12 Support
13 End cover
14 Fixing screws

Overview of “Series G” standard program

Version	Page
	18
	23 24 25
	32 33 34
	40 41 42 43 44 45
	54

Version	Page
	19
	26 27 28
	35 36 37
	46 47 48 49 50 51
	55 57

Version	Page
	20 21 22
	29 30 31
	38 39
	52 53
	56

Ordering code

External gear units Single pumps Standard

AZ	P	G	–	2	2	–	063	R	C	B	20	M	B	18009	S xxxx

Function

P = Pump

Series

1 = Reinforced baring
2 = Standard bearing
3 = in GJS-400 execution

Version

2 = corrosion-resistant, pinned

Size G

022 = 22.5 cm^3/rev
025 = 25.0 cm^3/rev
028 = 28.0 cm^3/rev
032 = 32.0 cm^3/rev
036 = 36.0 cm^3/rev
040 = 40.0 cm^3/rev
045 = 45.0 cm^3/rev
050 = 50.0 cm^3/rev
056 = 56.0 cm^3/rev
063 = 63.0 cm^3/rev
070 = 70.0 cm^3/rev
080 = 80.0 cm^3/rev
100 = 100.0 cm^3/rev

Direction of rotation

R = Clockwise
L = Counterclockwise

*) Some of the special designs shown on pages 18–57 are not covered in the illustration of the ordering code.

Special design *)

Valve adjustment

200 xx = PRV 200 bar
xxx 11 = FCV 11 l/min
18009 = PRV + FCV 180 bar, 9 l/min

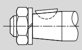
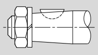
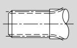
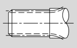
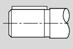
Rear cover

A = with inlet and outlet port
B = Standard
D = PRV residual flow internal
E = FCV residual flow external
S = FCV residual flow internal
V = PRV + FCV

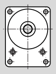
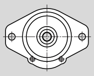
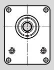
Seals

M = NBR
P = FKM
K = NBR, SSR in FKM

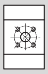
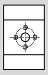
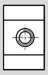
Drive shafts

			Suitable front cover
C	Tapered key shaft 1 : 5		**B**
H	Tapered key shaft 1 : 8		**O**
D	Splined shaft SAE J 744 22-4 13T		**C**
E	Splined shaft SAE J 744 15T		**C**
Q	Straight keyed shaft SAE J 744 22-1		**C**

Front cover

B	Rectangular flange Centering Ø 105 mm	
C	SAE J 744 101-2 B 2-bolt flange Ø 101.6 mm	
O	Rectangular flange Centering Ø 50.78 mm	

Line ports

07	Square flange SAE thread, metric	
20	Rectangular Flange	
30	Rectangular Flange	
40	Square flange SAE thread, UNC	
12	Thread (UN-2B) SAE seal ring BOSS	

Not all variants can be selected by using ordering code!
Please select the required pump by using the selection tables (standard types) or after consultation with Bosch Rexroth!
Special options are possible upon request.

Ordering code

External gear units Multiple pumps

AZ	P	GGSS	–	x	x	–	032/022/016/005	R	C	B	20 20 20 20	K	B

Function

P = Pump

Series

B = 1.0...7.1 cm³/rev *)
F = 4.0...28 cm³/rev
N = 20.0...36 cm³/rev
G = 22.5...100 cm³/rev

S = 4.0...28 cm³/rev **)
T = 20.0...36 cm³/rev
U = 22.5...63 cm³/rev

J = 12.0...16 cm³/rev ***)

*) Standard

**) SILENCE

***) SILENCE PLUS

Series, relates to pump section 1

1x = Standard bearing
2x = Reinforced bearing

Version, relates to pump section 1

1 = Phosphatized, pinned
2 = Chromatized, pinned

Size

corresponding to each series

Direction of rotation

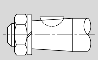
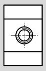
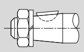
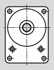
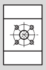
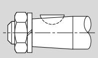
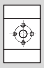
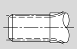
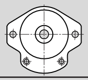
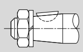
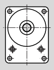
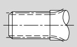
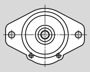
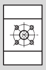
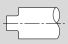
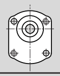
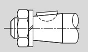
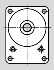
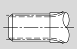
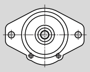
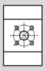
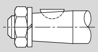
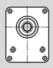
R = cw, **L** = ccw

Rear cover
relates to last pump section

B = Standard

Seals

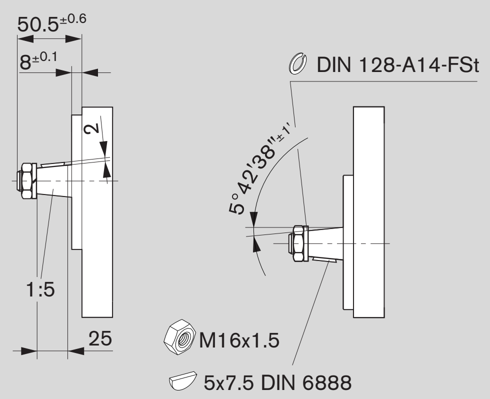
M = NBR
P = FKM
K = NBR, SSR in FKM
Shaft seal relate to pump section 1

Drive shafts relates to pump part 1			Suitable front cover	**Front cover** relates to pump part 1			**Line ports** every pump parts		
Series B:									
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 25.38 mm		**02**	Thread, metric DIN 3852 T1	
Series F, S, J:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 80 mm		**20**	Rectangular flange	
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 36.47 mm		**30**	Rectangular flange	
R	Splined shaft SAE J 744 16-4 9T		**R**	**R**	SAE J 744 82-2 A Centering Ø 82.55 mm 2-bolt mounting				
Series N, T:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 100 mm		**07**	Square flange SAE Thread, metric	
D	Splined shaft SAE J 744 22-4 13T		**C**	**C**	SAE J 744 101-2 B Centering Ø 101.6 mm 2-bolt mounting		**20**	Rectangular flange	
N	Dihedral claw		**M**	**M**	Centering Ø 52 mm with seal ring				
Series G, U:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 105 mm		**07**	Square flange SAE Thread, metric	
D	Splined shaft SAE J 744 22-4 13T		**C**	**C**	SAE J 744 101-2 B Centering Ø 101.6 mm 2-bolt mounting		**20**	Rectangular flange	
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 50.78 mm				

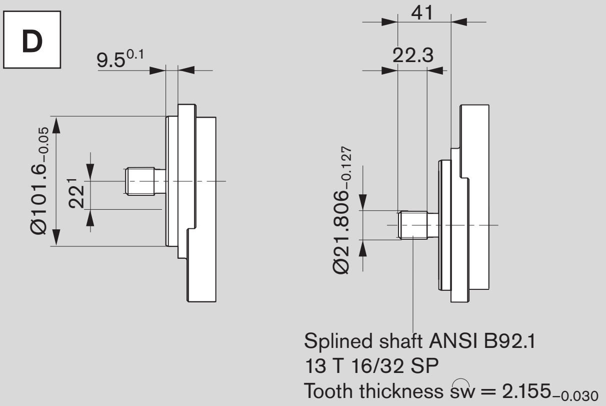
Not all variants can be selected by using ordering code! Please select the required pump by using the selection tables (standard types) or after consultation with Bosch Rexroth! Special options are possible upon request.

Drive shafts

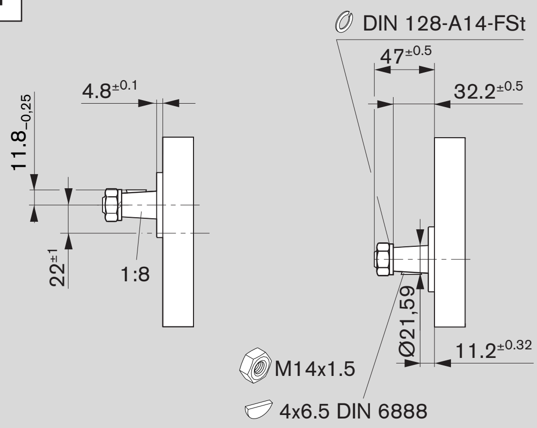
C



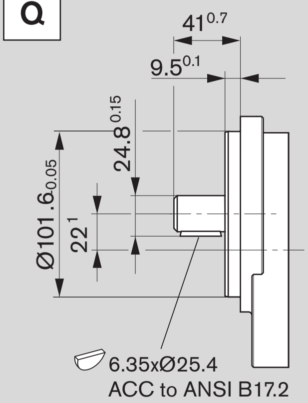
D



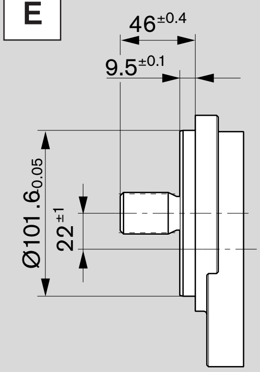
H



Q

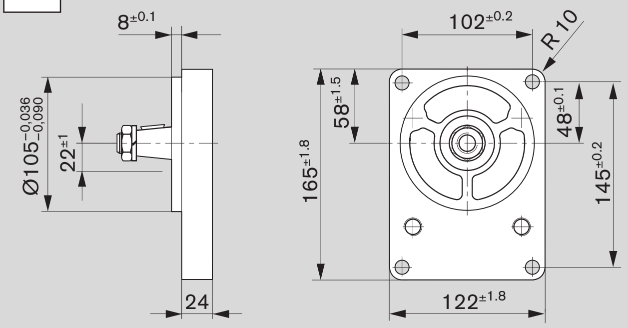


E

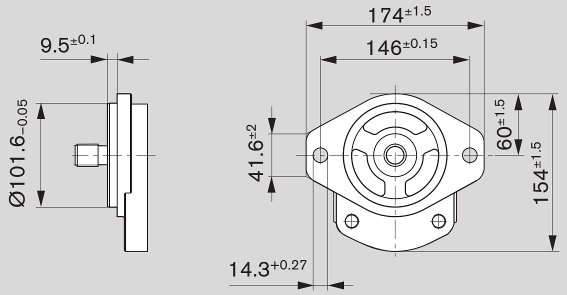


Front cover

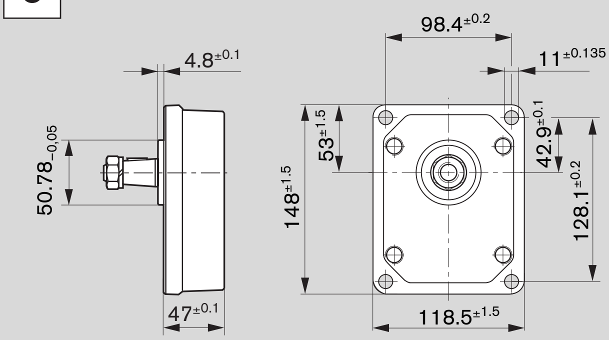
B



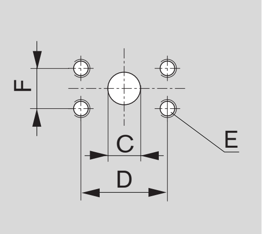
C



O

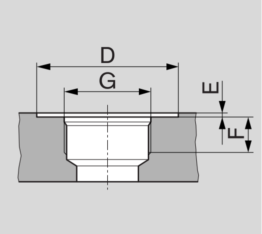


Line port



07 Square flange SAE, thread metric

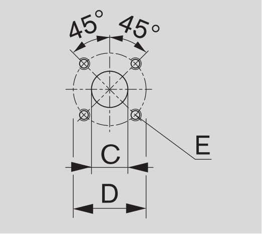
Ordering code	Size	Delivery side				Suction side			
		C	D	E	F	C	D	E	F
07	22.5...28 cm^3	18	47.6	M10 depth 18	22.2	25	52.4	M10 depth 18	26.2
	32.0...50 cm^3	25	52.4		26.2	32	58.7		30.2
	56.0...63 cm^3	32	58.7		30.2	38	69.8	M12 depth 23	35.8



12 Thread (UN-2B, UNF-2B) SAE O Ring BOSS

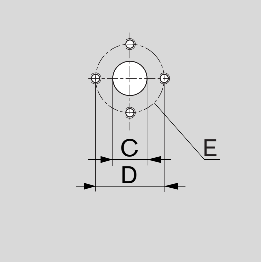
At pressures $p_2 > 210$ bar limited service life

Ordering code	Size	Delivery side				Suction side			
		G	D	E	F	G	D	E	F
07	022...028	11/16"-12 UN-2B	45	0.5	19	15/16"-12 UN-2B	50	0.5	19
	032...045	15/16"-12 UN-2B	50			15/18"-12 UN-2B	58		
	050...063	15/18"-12 UN-2B	58			17/18"-12 UN-2B	68		



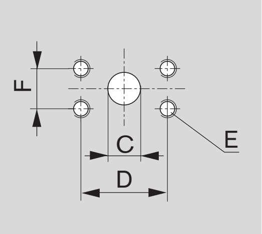
20 Rectangular flange

Ordering code	Size	Delivery side			Suction side		
		C	D	E	C	D	E
20	22.5...63 cm^3	18	55	M8 depth 13	26	55	M8 depth 13



30 Rectangular flange

Ordering code	Size	Delivery side			Suction side		
		C	D	E	C	D	E
30	22.5...56 cm^3	18	39.7	M8 depth 13	26	50.8	M10 depth 13
30	63 cm^3	26	50.8	M10 depth 13	36	62	M10 depth 13

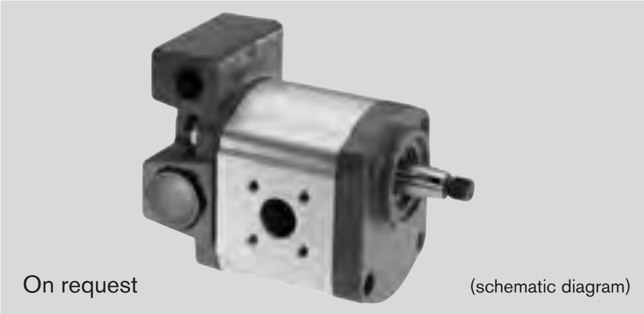


40 Rectangular flange SAE, thread UNC

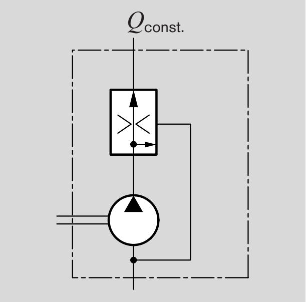
Ordering code	Size	Delivery side				Suction side			
		C	D	E	F	C	D	E	F
40	22.5...36 cm^3	19	47.6	3/8"-16 UNC-2B depth	22.2	25	52.4	3/8"-16 UNC-2B depth	26.2
	32.0...50 cm^3	25	52.4		26.2	32	58.7		30.2
	56.0...63 cm^3	32	58.7		30.2	38	69.8		35.8

Gear pumps with integral valves

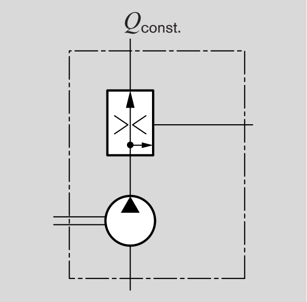
In order to reduce external pipework it is possible to incorporate a flow-control valve or pressure-relief valve in the cover of the gear pump. A typical application of this is in the supply of hydraulic oil in power steering systems. The pump delivers a constant flow irrespective of the speed at which it is driven. The excess flow is either returned internally to the suction port or distributed externally to other items of equipment.


On request

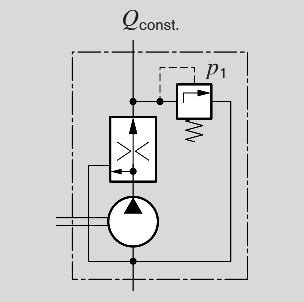
(schematic diagram)



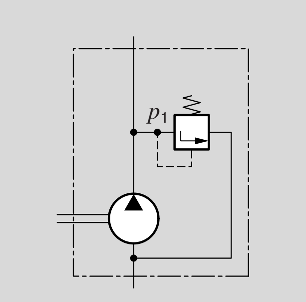
3-way flow-control valve.
Excess flow returned to suction line
$Q_{const.} = 2...30$ l/min



3-way flow-control valve.
Excess flow distributed externally; loadable
$Q_{const.} = 2...30$ l/min



3-way flow-control valve with pressure-relief valve.
Excess flow returned to suction line
$Q_{const.} = 2...30$ l/min
$p_1 = 100...180$ bar



Pressure-relief valve.
Discharge returned to suction line
$p_1 = 5...250$ bar

Ordering code

S	**xxx17**	**E**	**xxx12**	**V**	**15011**	**D**	**180xx**

Design calculations for pumps

The design calculations for pumps are based on the following parameters:

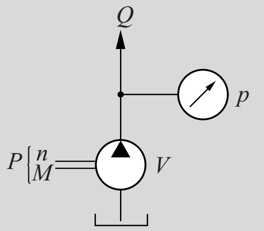
V	[cm^3/rev]	Displacement
Q	[l/min]	Delivery
p	[bar]	Pressure
M	[Nm]	Drive torque
n	[rev/min]	Drive speed
P	[kW]	Drive power

It is also necessary to allow for different efficiencies such as:

η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Overall efficiency

The following formulas describe the various relationships.
They include correction factors for adapting the parameters to the usual units encountered in practice.

Caution: Diagrams providing approximate selection data will be found on subsequent pages.



$$Q = V \cdot n \cdot \eta_v \cdot 10^{-5}$$

$$V = \frac{Q}{n \cdot \eta_v} \cdot 10^5$$

$$n = \frac{Q}{V \cdot \eta_v} \cdot 10^5$$

$$p = \frac{M \cdot \eta_{hm}}{1.59 \cdot V}$$

$$V = \frac{M \cdot \eta_{hm}}{159 \cdot p}$$

$$M = \frac{1.59 \cdot V \cdot p}{\eta_{hm}}$$

$$P = \frac{p \cdot Q}{6 \cdot \eta_t}$$

$$Q = \frac{6 \cdot P \cdot \eta_t}{p}$$

$$p = \frac{6 \cdot P \cdot \eta_t}{Q}$$

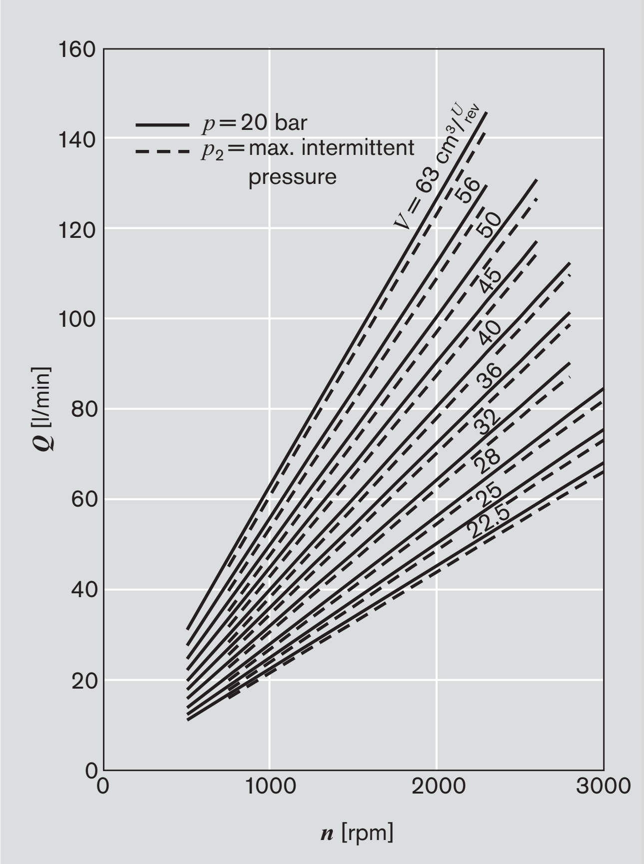
[%]

n —— $\eta_v \longrightarrow Q$
M —— $\eta_{hm} \longrightarrow p$
P —— $\eta_t \longrightarrow p \cdot Q$

V [cm^3/rev] Q [l/min] p [bar]
n [rev/min] P [kW] M [Nm]

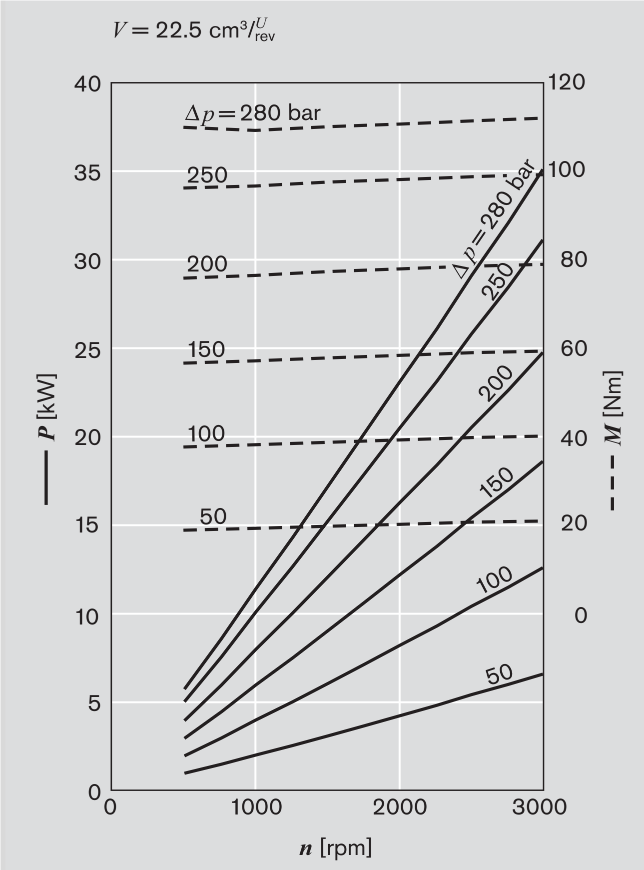
Caution: η [%] e.g. 95 [%]

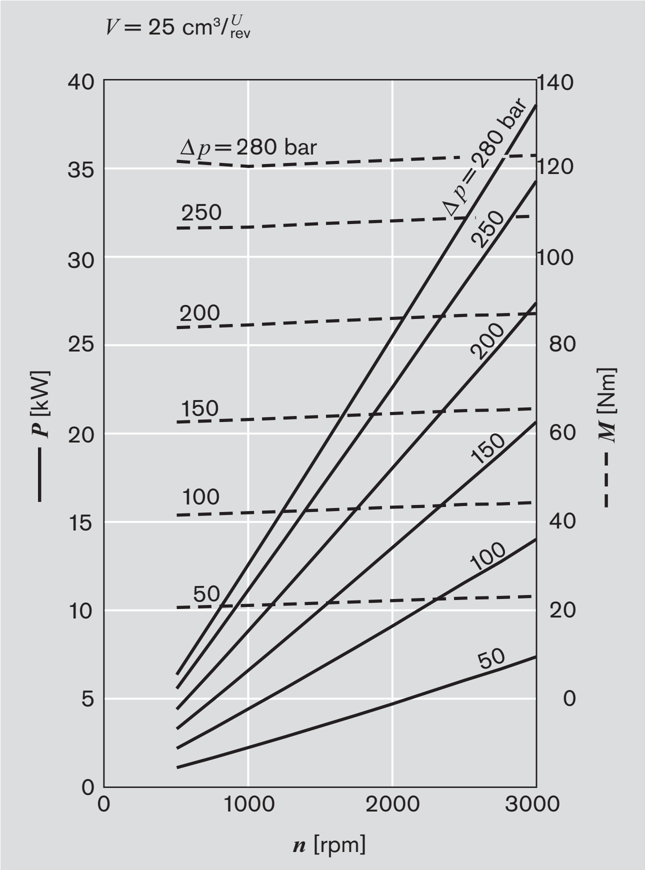
Performance charts



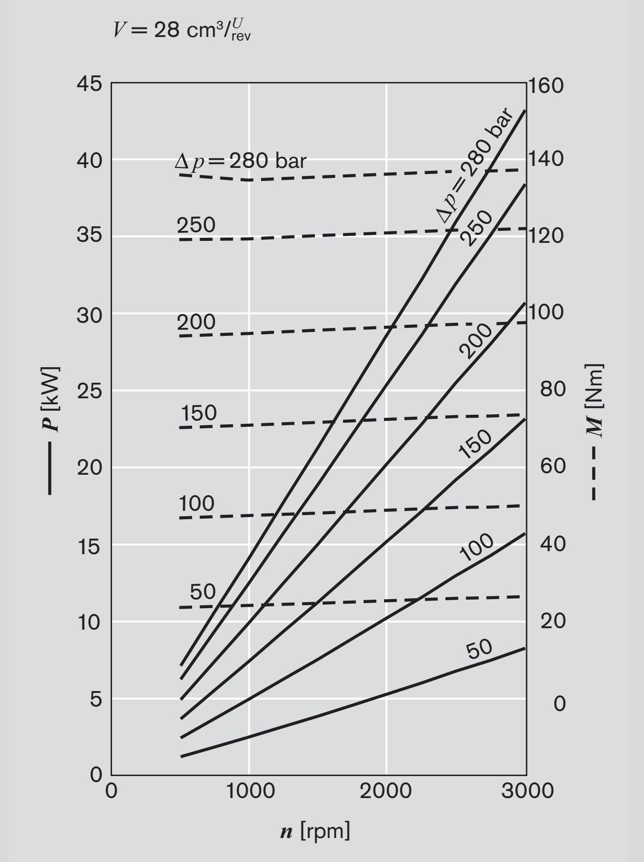
$\nu = 35$ mm^2/s, $\vartheta = 50$ °C

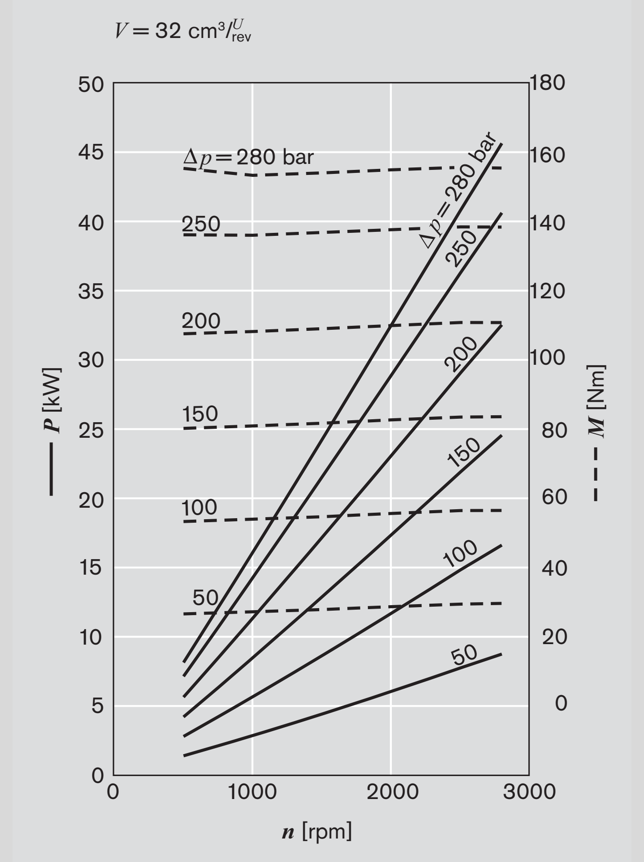
$Q = f\ (n, V)$ incl. η_v
$P = f\ (n, p)$ ——— incl. η_t
$M = f\ (n, p)$ – – – incl. η_{hm}

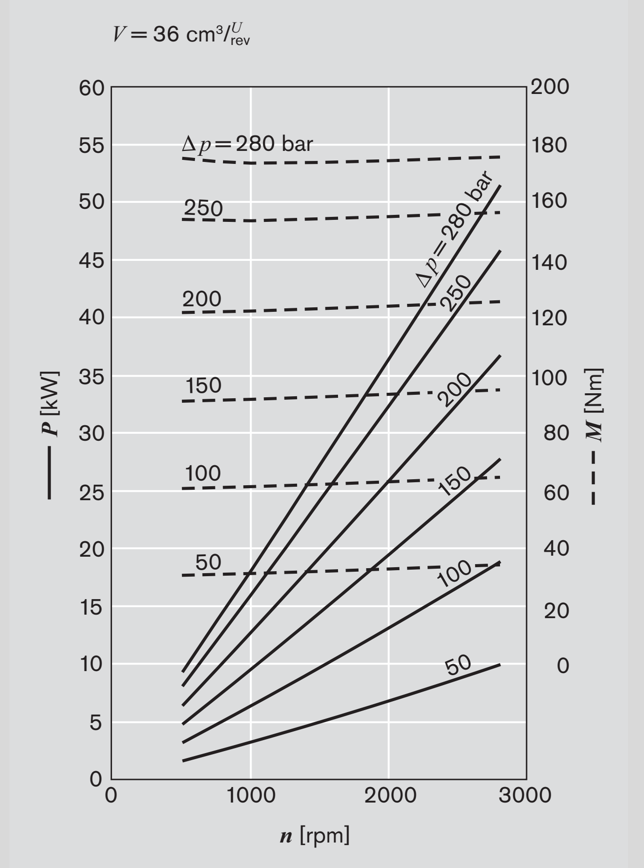


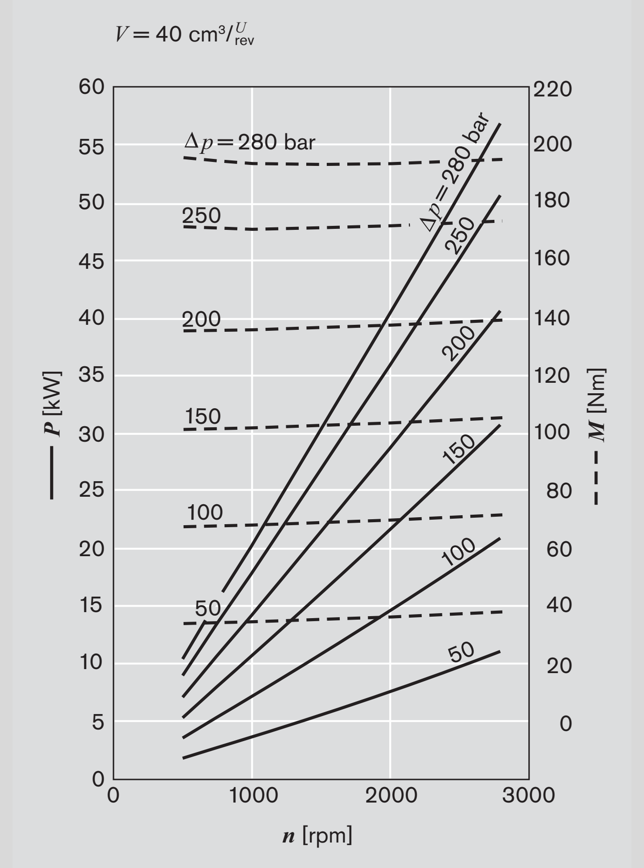


Performance charts (continued)

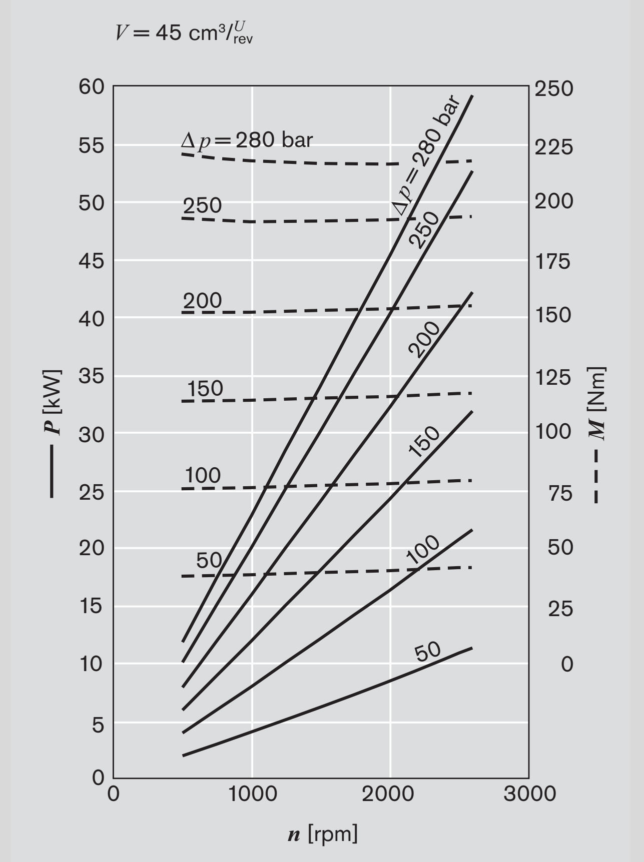

$V = 28\ \mathrm{cm^3}/^{U}_{\mathrm{rev}}$

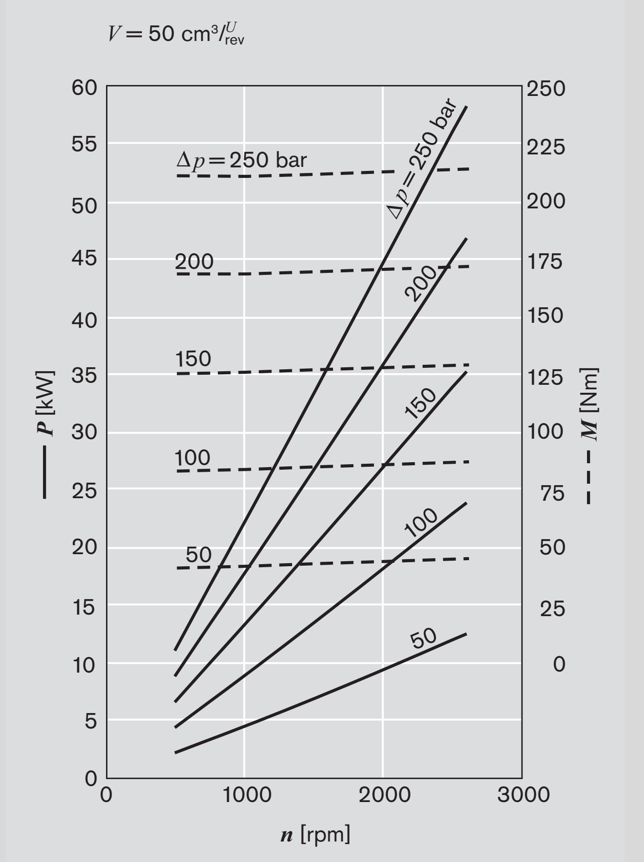

$V = 32\ \mathrm{cm^3}/^{U}_{\mathrm{rev}}$

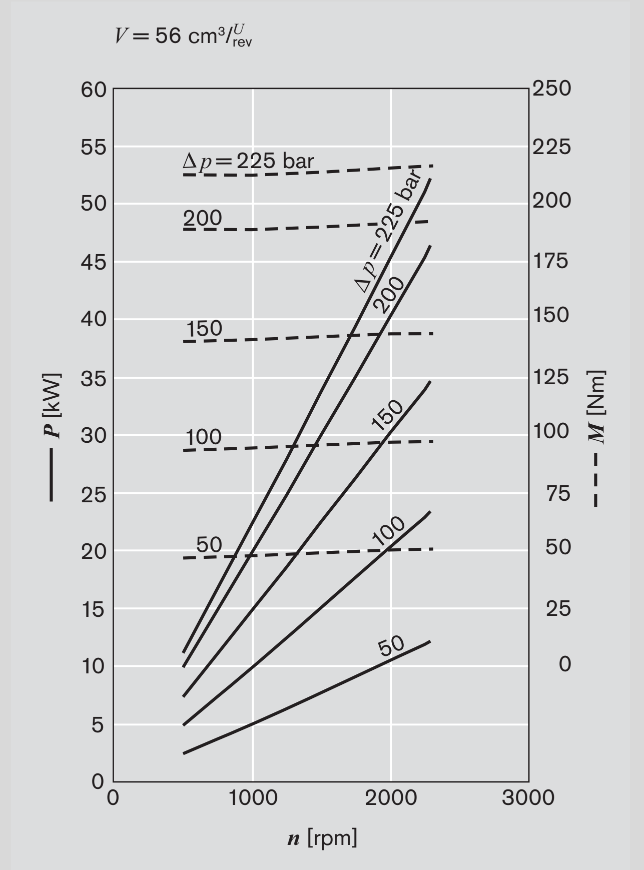

$V = 36\ \mathrm{cm^3}/^{U}_{\mathrm{rev}}$

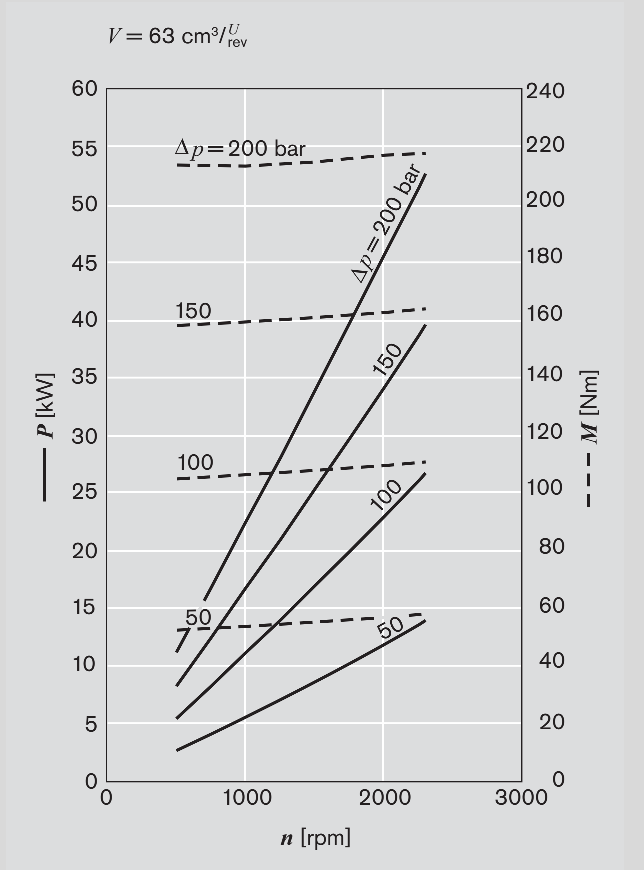

$V = 40\ \mathrm{cm^3}/^{U}_{\mathrm{rev}}$

Performance charts (continued), $V = 70, 80, 100\ \mathrm{cm^3}/^{U}_{rev}$ on request


$V = 45\ \mathrm{cm^3}/^{U}_{\mathrm{rev}}$


$V = 50\ \mathrm{cm^3}/^{U}_{\mathrm{rev}}$

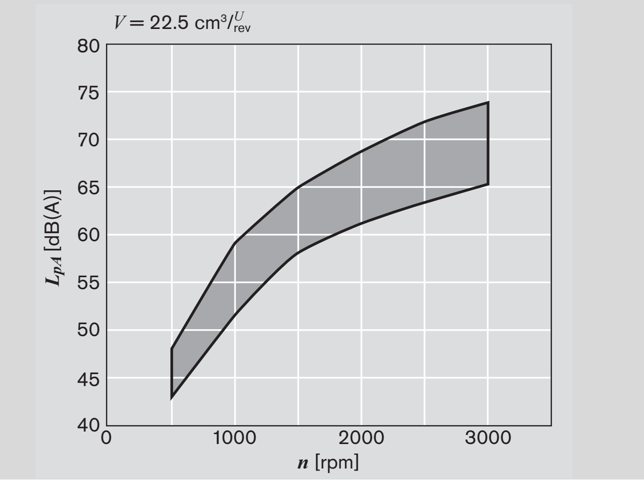

$V = 56\ \mathrm{cm^3}/^{U}_{\mathrm{rev}}$

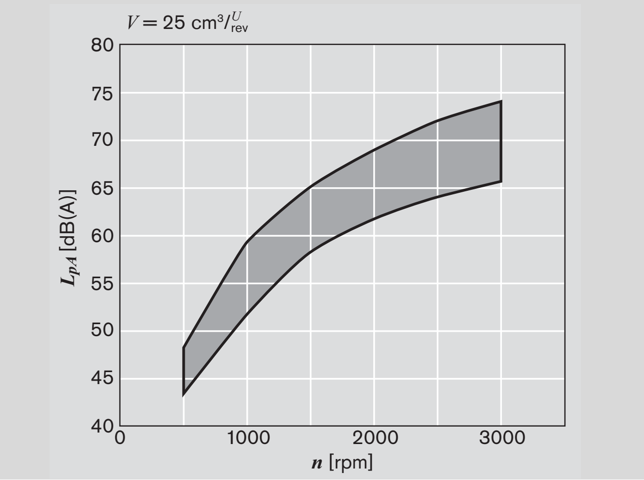

$V = 63\ \mathrm{cm^3}/^{U}_{\mathrm{rev}}$

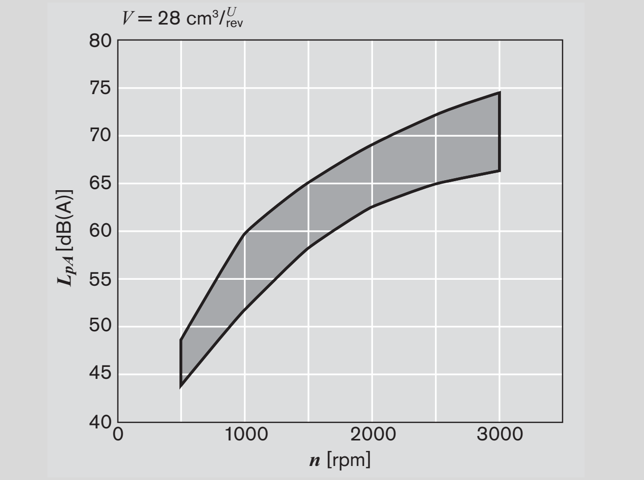
Noise charts

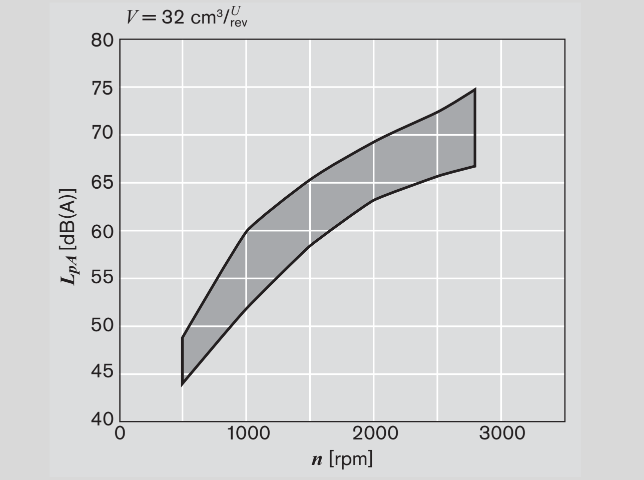
Noise level dependent on rotational speed, pressure range between 10 bar and pressure value p_2 (see page 14 Specifications table).
Oil data: $\nu = 32$ mm²/s, $\vartheta = 50$ °C.
Sound pressure level calculated from noise measurements made in the sound absorbent measuring room compliant with DIN 45 635, Part 26.
Spacing between measuring sensor – pump: 1 m.

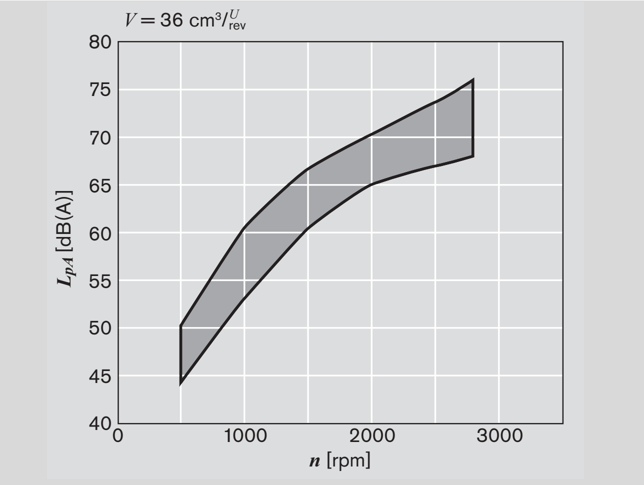
These are typical characteristic values for the respective model. They describe the airborne sound emitted solely by the pump. Environmental influences (installation site, piping, further system components) are not taken into consideration.
Each value applies for a single pump.

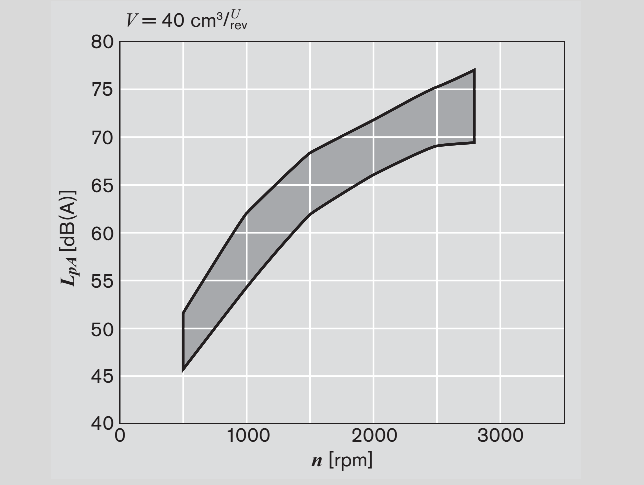




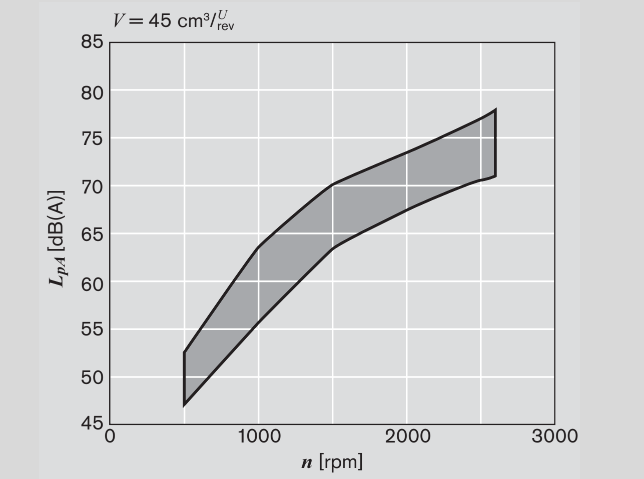


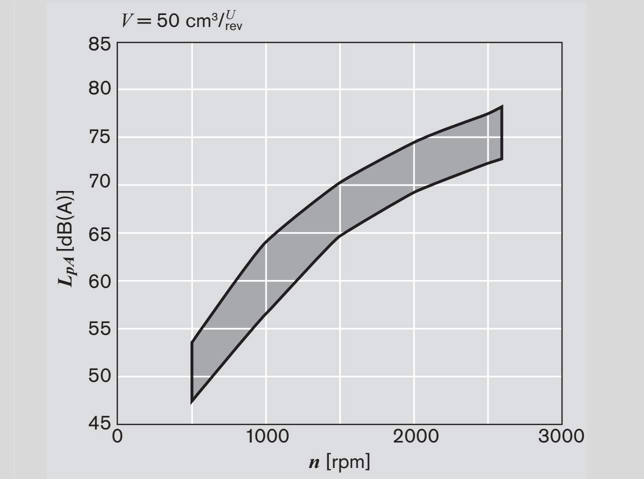


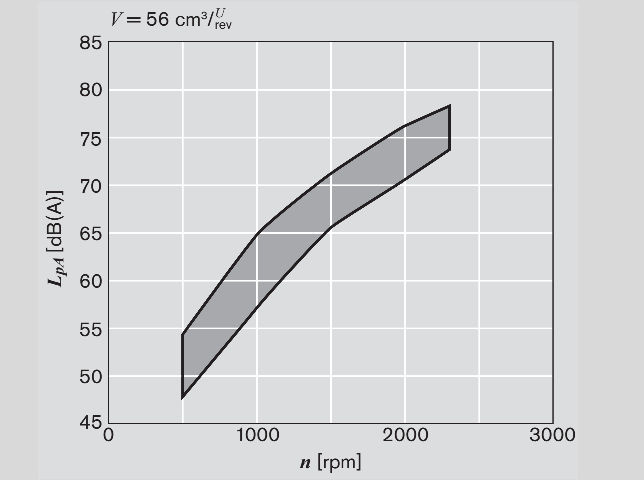


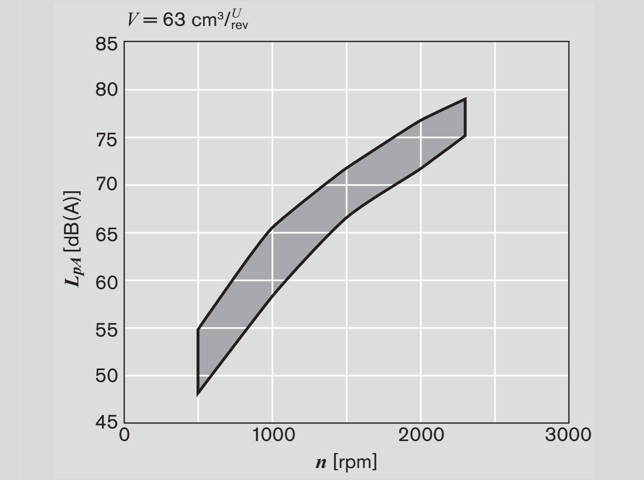


Noise charts (continued), $V = 70, 80, 100\ \text{cm}^3/{}^{U}_{rev}$ on request









Specification

General	
Construction	External gear pump
Mounting	Flange or through-bolting with spigot
Line ports	Flange
Direction of rotation (looking on shaft)	Clockwise or counter-clockwise, the pump may only be driven in the direction indicated
Installation position	Any
Load on shaft	Radial and axial forces after consulting
Ambient temperature range	−30 °C...+80 °C with NBR seals or −20 °C...+110 °C with FKM seals
Hydraulic fluid	– Mineral oil compliant with DIN 51 524, 1–3, however under higher load at least HLP compliant with DIN 51 524 Part 2 recommended. – Comply with RE 90220 – Further operating fluids possible after consultation
Viscosity	12...800 mm²/s permitted range 20...100 mm²/s recommended range ...2000 mm²/s range permitted for starting
Hydraulic fluid temperature range	max. +80 °C with NBR seals *) max. +110 °C with FKM seals **)
Filtration ***)	At least cleanliness level 20/18/15 compliant with ISO 4406 (1999)

*) NBR = Perbunan®
**) FKM = Viton®
***) On hydraulic systems or devices with critical counter-reaction, such as steering and counterbalance valves, the type of filtration selected must be adapted to the sensitivity of these devices/systems.

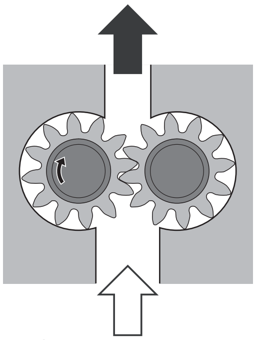
Safety requirements pertaining to the whole systems are to be observed.

In the case of applications with high numbers of load cycles please consulting.

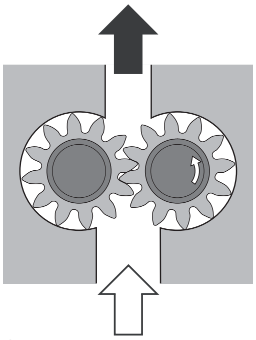
Definition of direction of rotation

Always look on the drive shaft.

Caution: Dimensions drawings always show clockwise-rotation pumps. On counterclockwise-rotation pumps the positions of the drive shaft and the suction and pressure ports are different.

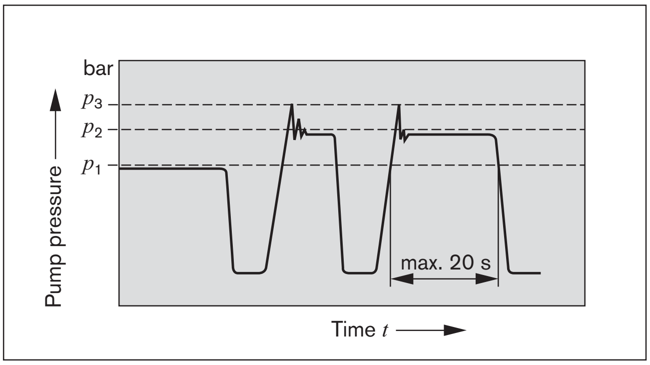


Clockwise direction of rotation



Counterclockwise direction of rotation

Definitions of pressures



p_1 max. continuous pressure
p_2 max. intermittent pressure
p_3 max. peak pressure

Model AZPG

Displacement		V	cm³/rev	22.5	25	28	32	36	40	45	50	56	63	70	80	100
Suction pressure		p_e		0.7...3 (absolute), with tandem pumps: p_e (p_2) = max. 0.5 > p_e (p_1)												
max. continuous pressure		p_1	bar	250							220	195	170	120	90	80
max. intermittent pressure		p_2		280							250	225	200	150	120	100
max. peak pressure		p_3		300							280	250	230	180	150	120
min. rpm at bar	12 mm²/s	< 100	rpm	500	500	500	500	500	500	500	500	500	500	500	500	500
		100...180		1200	1200	1000	1000	1000	800	800	800	800	800	800	800	800
		180... p_2		1400	1400	1400	1400	1200	1200	1000	1000	1000	1000	1000	1000	1000
	25 mm²/s	p_2		600	600	500	500	500	500	500	500	500	500	500	600	800
max. rpm at		p_2		3000	3000	3000	2800	2800	2800	2600	2600	2300	2300	2200	2000	1700

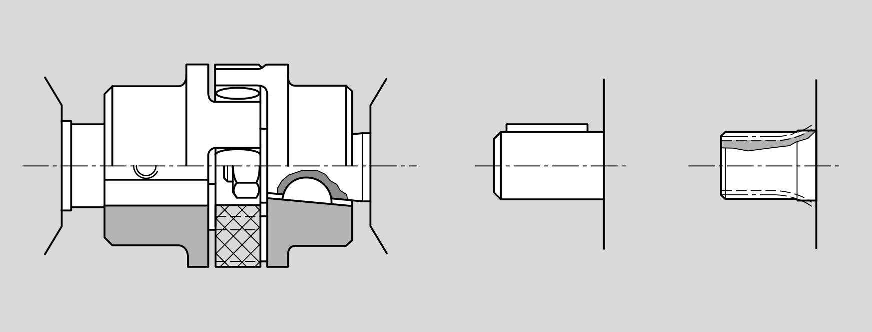
Drive arrangement

1. Flexible couplings

The coupling must not transfer any radial or axial forces to the pump.

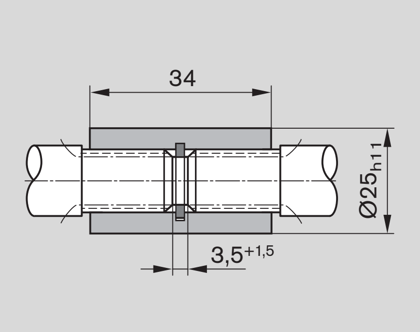
The maximum radial runout of shaft spigot is 0.2 mm.

Refer to the fitting instructions provided by the coupling manufacturer for details of the maximum permitted shaft misalignment.



2. Coupling sleeve

Used on shafts with DIN or SAE splining. Caution: There must be no radial or axial forces exerted on the pump shaft or coupling sleeve. The coupling sleeve must be free to move axially. The distance between the pump shaft and drive shaft must be $3.5^{+1.5}$. Oil-bath or oil-mist lubrications is necessary.



Splined shaft	M_{max} [Nm]	V [cm³/rev]
SAE-B 13 teeth	300	12.5...100
SAE-C 15 teeth	450	

3. Drive shaft with tang

For the close-coupling of the pumps to electric motor or internal-combustion engine, gear, etc. The pump shaft has a special tang and driver ③ (not included in supply). There is no shaft sealing.

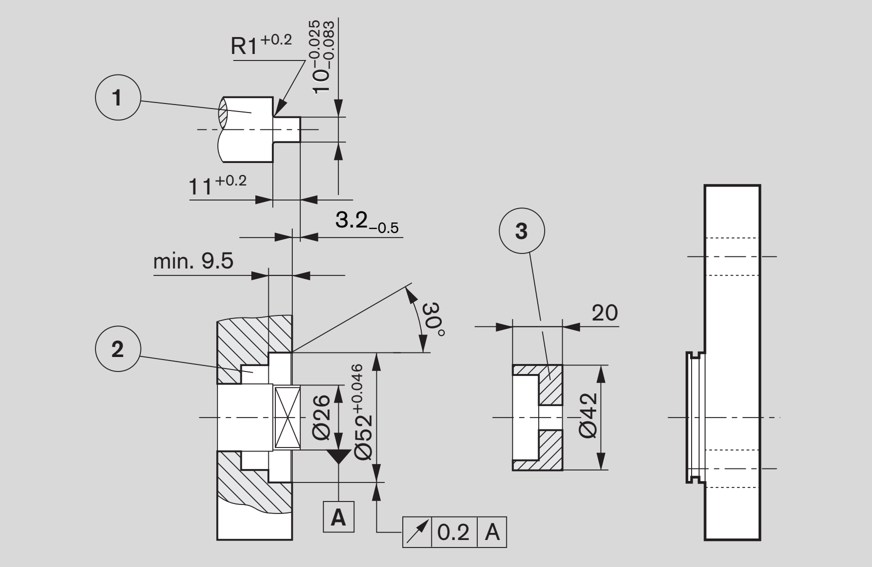
The recommended arrangements and dimensions for the drive end and sealing are as follows.

① Drive shaft

Case-hardening steel DIN 17 210
e.g. 20 MnCrS 5
case-hardened 1.0 deep; HRA $83^{\pm 2}$
Surface for sealing ring
ground without rifling $R_t \leq 4\mu m$

② Radial shaft seal

with rubber covered seal
(see DIN 3760, Type AS, or double-lipped ring).
Cut 15° chamfer or fit shaft seal ring with protection sleeve.



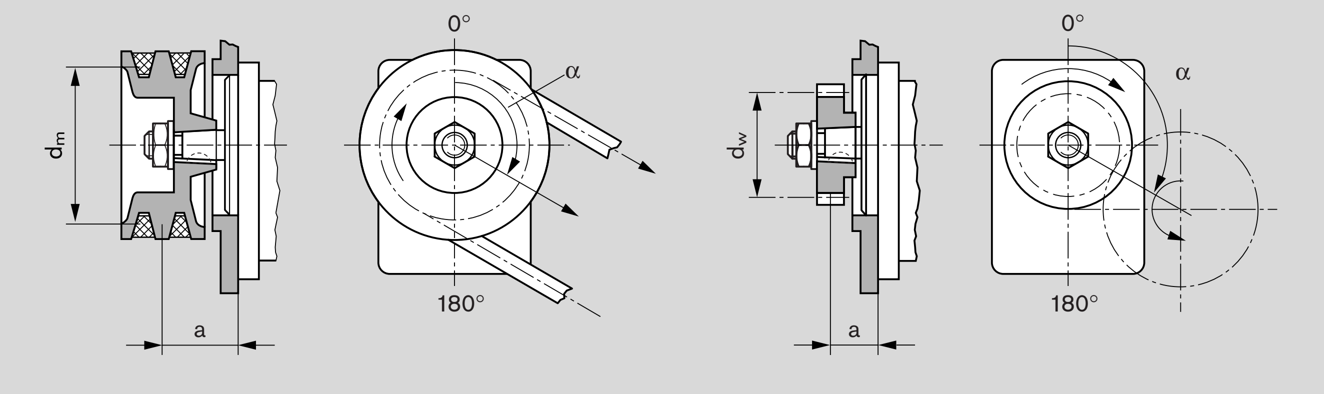
Drive with special tang

M_{max} [Nm]	V [cm³/rev]	p_{max} [bar]
130	28	270
	36	210
	40	190
	45	160
	50	150
	56	135
	63	120
	70	110
	80	95
	100	75

For drive shaft with tang

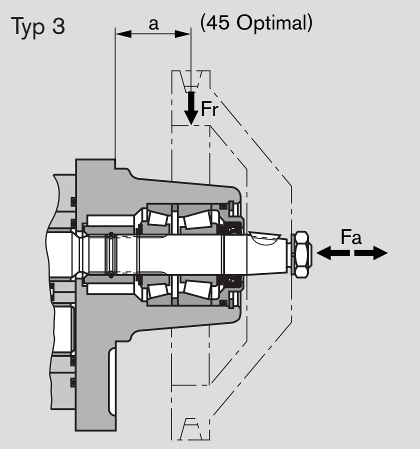
4. V-belts and straight gearwheels or helical toothed gear drives without outboard bearing

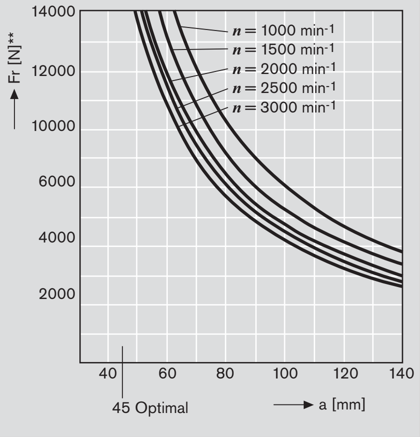
When proposing to use V-belt or gear drive, please submit details of the application for our comments (especially dimensions a, d_m, d_w and angle α).
For helical toothed gear drives, details of the helix angle β are also required.



5. Outboard bearing

Outboard bearing eliminate possible problems when the pumps are driven by V-belts or gearwheels. The diagrams below show the maximum radial and axial loads that can be tolerated based on a bearing life of $L_H = 1000$ h.





Multiple gear pumps

Gear pumps are well-suited to tandem combinations of pumps in which the drive shaft of the first pump is extended to drive a second pump and sometimes a third pump in the same manner. A coupling is fitted between each pair of pumps. In most cases each pump is isolated from its neighbor, i.e. the suction ports are separate from one another. A common suction port is also possible as an option.

Caution: Basically, the specifications for the single pumps apply, but with certain restrictions:

Max. speed: This is determined by the highest rated pump speed in use.

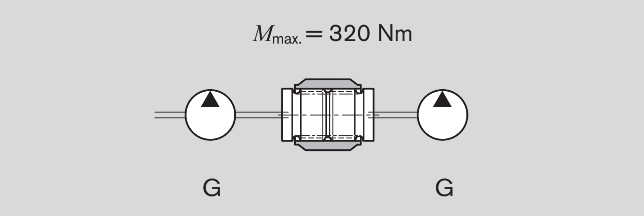
Pressures: These are restricted by the strength of the drive shaft, the through drives and the drivers. Appropriate data is given in the dimensional drawings.

Pressure restrictions during standard through drive

In the case of series G, the driver for the second pumping stage can carry a load of up to $M_{max.} = 130$ Nm, i.e. there is a pressure restriction for the second stage and any further stages.

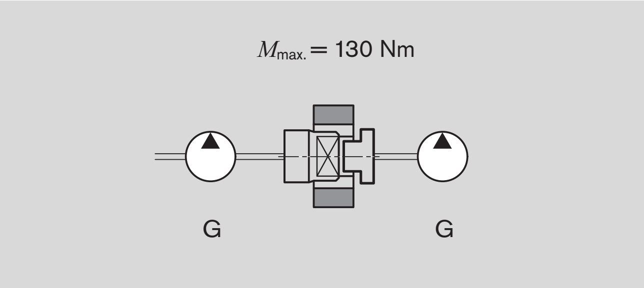
$M_{max.}$ [Nm]	V [cm³/rev]	p_{max} [bar]
65 Series F, S	16	230
	19	190
	22.5	160
	25	140
130 Series G, U	22.5	280
	25	280
	28	260
	32	230
	36	200
	40	180
	45	160
	50	150
	56	130
	63	110
	70	100
	80	90
	100	70

Reinforced through drive



If the first stage is driven through a tang (driver) or outboard bearing type 1, pressure restrictions apply as indicated in the formula below.

Reinforced through drives are available for applications with higher transfer torques and/or rotational vibrations. Customized designs available on request.



Combinations

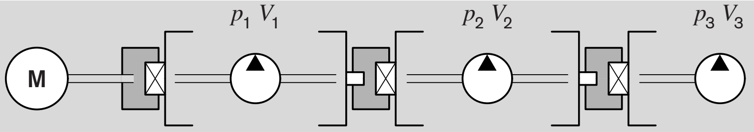
Series pump 1	$M_{max.}$ [Nm]	Series pump 2
G	130	G, U
G	65	F
G	65	S

For configuration of multiple pumps we recommend the pump is positioned with the largest displacement on the drive side.

Max. transferrable drive torque

Function	Code letter	Designation	Max. transferrable drive torque* [Nm]
Splined shafts	D	SAE J744 22-4 (13T 16/32 DL)	300
	E	SAE J744 22-4 (15T 16/32 DL)	450
Tapered key shaft	C	1:5	290
	H	1:8	240

* These figures are valid providing the conditions defined on pages 15 and 16 are observed. Bosch Rexroth is to be consulted if the stated values are exceeded.

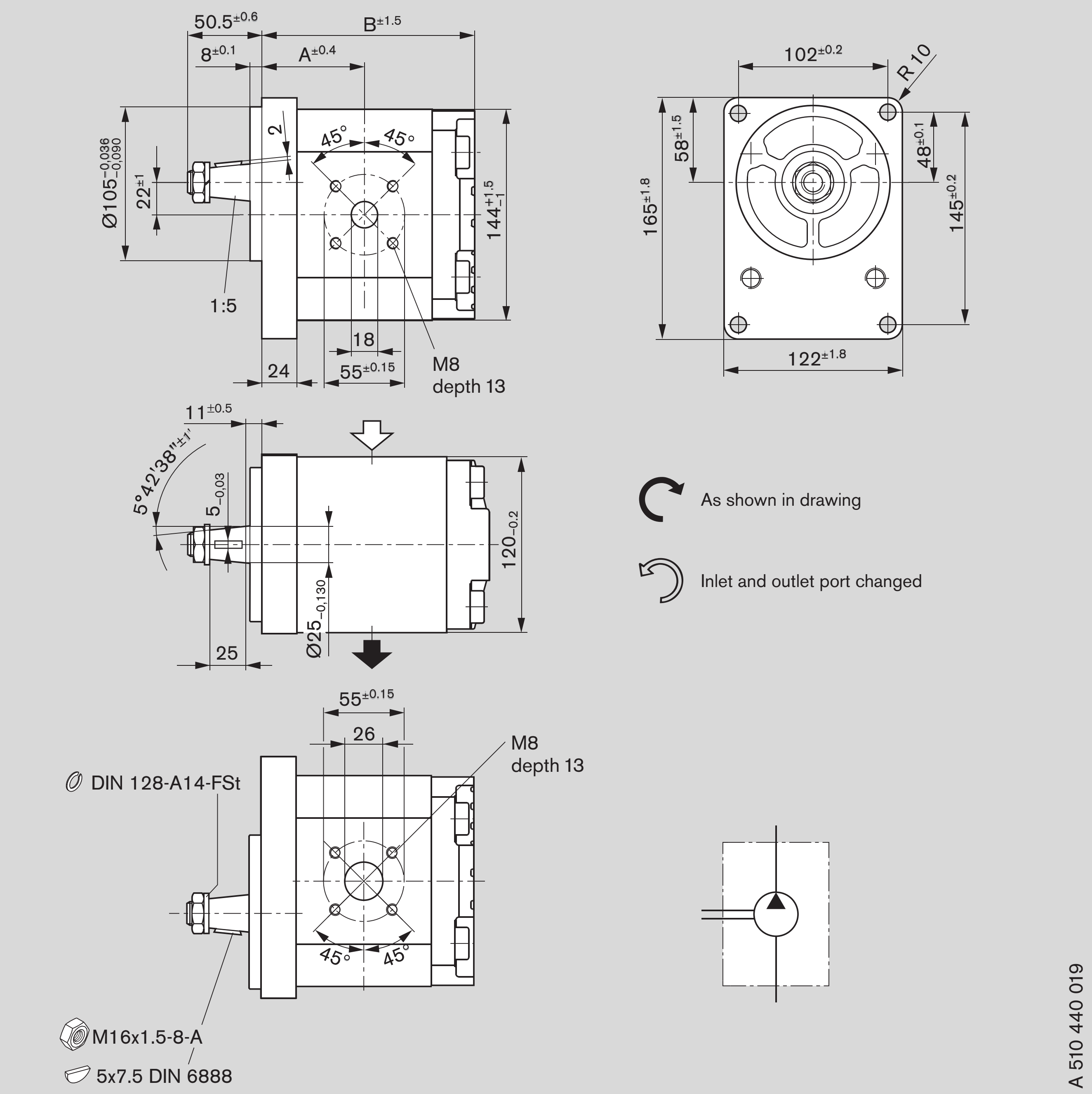


$$M_{max.} \geqq \Delta p_1 \cdot V_1 \cdot 0.0177 + \Delta p_2 \cdot V_2 \cdot 0.0177 + \Delta p_3 \cdot V_3 \cdot 0.0177$$

Δp [bar] V [cm³/rev]

Dimensions

Standard range



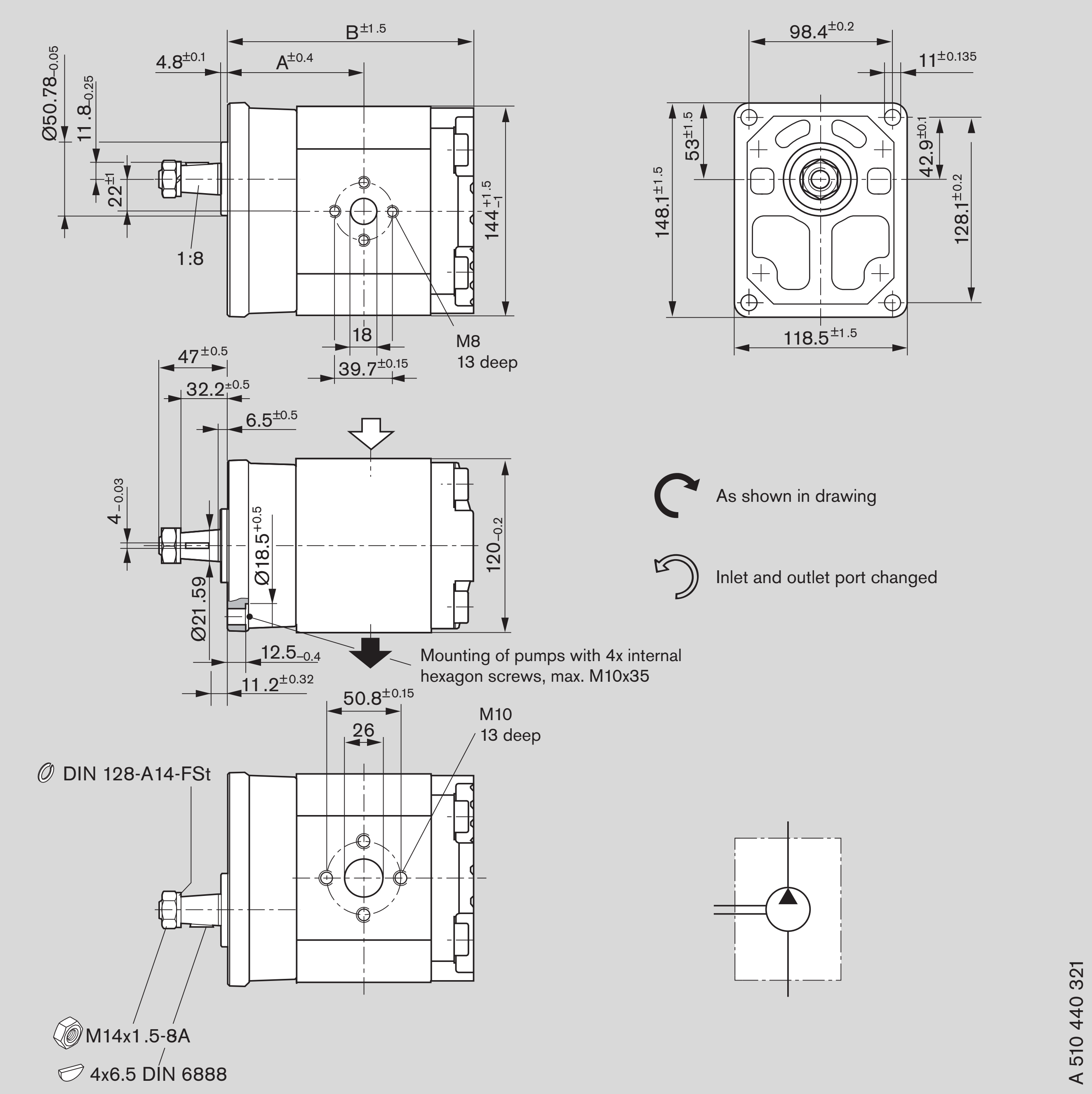
Ordering code:

AZPG – 22 – ☐ ☐ ☐ ☐ C B 20 M B

Displacement [cm³/rev]	Ordering-No. ↺ L	 ↻ R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	 B
22.5	**0 510 725 441**	**0 510 725 164**	280	3000	10.3	60.9	124.6
25	**0 510 725 442**	**0 510 725 165**	280	3000	10.4	61.9	126.6
28	**0 510 725 443**	**0 510 725 166**	280	3000	10.5	63.2	129.1
32	**0 510 725 444**	**0 510 725 167**	280	2800	10.7	64.8	132.4
36	**0 510 725 445**	**0 510 725 168**	280	2800	10.9	66.4	135.7
40	**0 510 725 446**	**0 510 725 169**	280	2800	11.0	68.1	139.0
45	**0 510 725 447**	**0 510 725 170**	280	2600	11.2	70.1	143.1
50	**0 510 825 324**	**0 510 825 024**	250	2600	11.4	72.2	147.2
56	**0 510 825 325**	**0 510 825 025**	225	2300	11.7	74.7	152.2
63	**0 510 825 326**	**0 510 825 026**	200	2300	12.0	77.6	158.0

Dimensions

Standard range

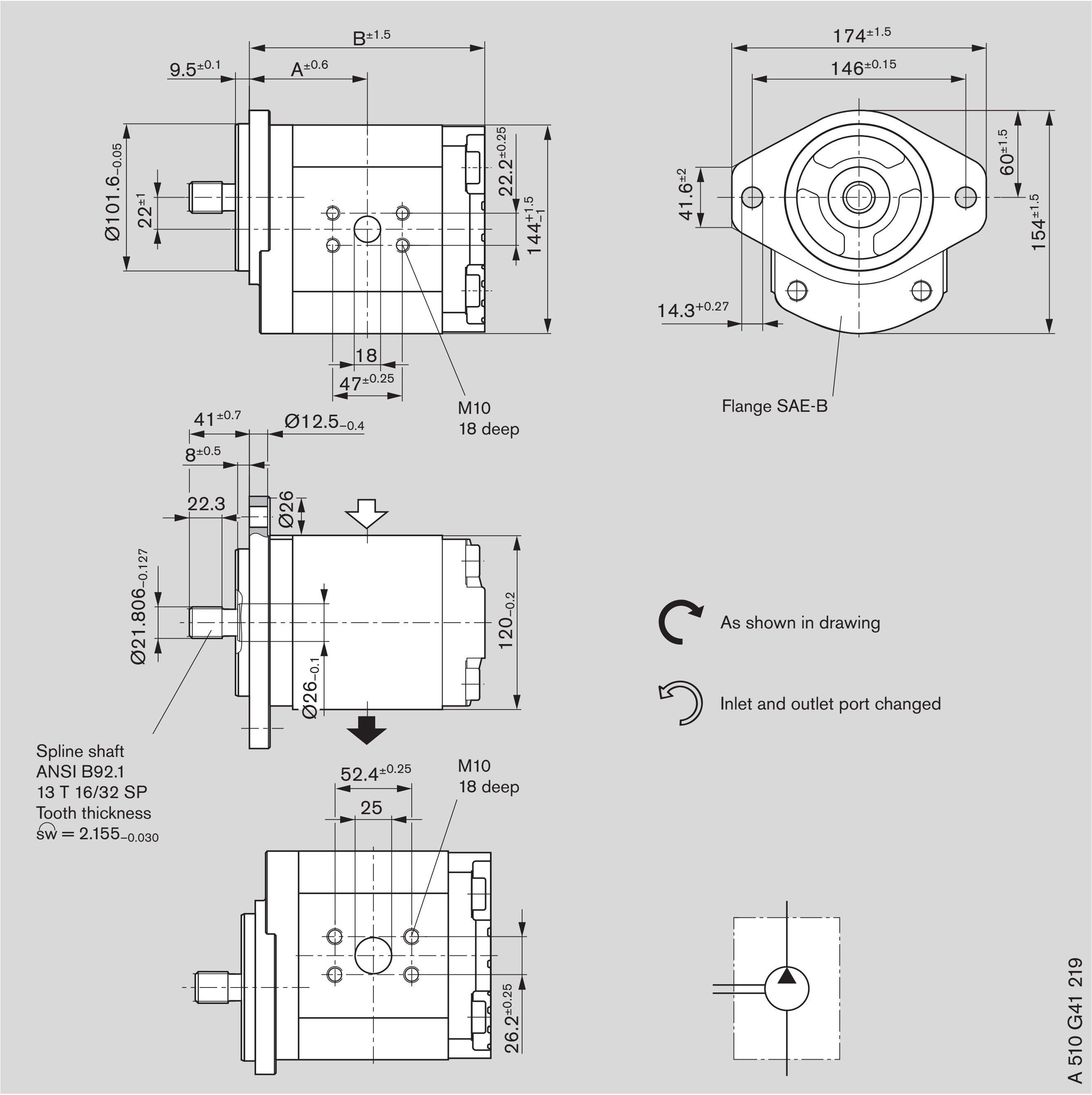


Ordering code:
AZPG – 22 – ☐ ☐ ☐ ☐ H O 30 M B

Displacement [cm³/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	 B
22.5	**0 510 725 448**	**0 510 725 171**	280	3000	9.6	63.9	147.8
25	**0 510 725 449**	**0 510 725 172**	280	3000	9.7	84.9	149.8
28	**0 510 725 450**	**0 510 725 173**	280	3000	9.8	86.2	152.3
32	**0 510 725 451**	**0 510 725 174**	280	2800	10.0	87.8	155.6
36	**0 510 725 452**	**0 510 725 175**	280	2800	10.1	89.4	158.9
40	**0 510 725 453**	**0 510 725 176**	280	2800	10.3	91.1	162.3
45	**0 510 725 454**	**0 510 725 177**	280	2600	10.5	93.1	166.3
50	**0 510 825 327**	**0 510 825 027**	250	2600	10.7	95.2	170.5
56	**0 510 825 328**	**0 510 825 028**	225	2300	11.0	97.7	175.4
63	**0 510 825 329**	**0 510 825 029**	200	1800	11.2	100.6	181.3

Dimensions

Standard range



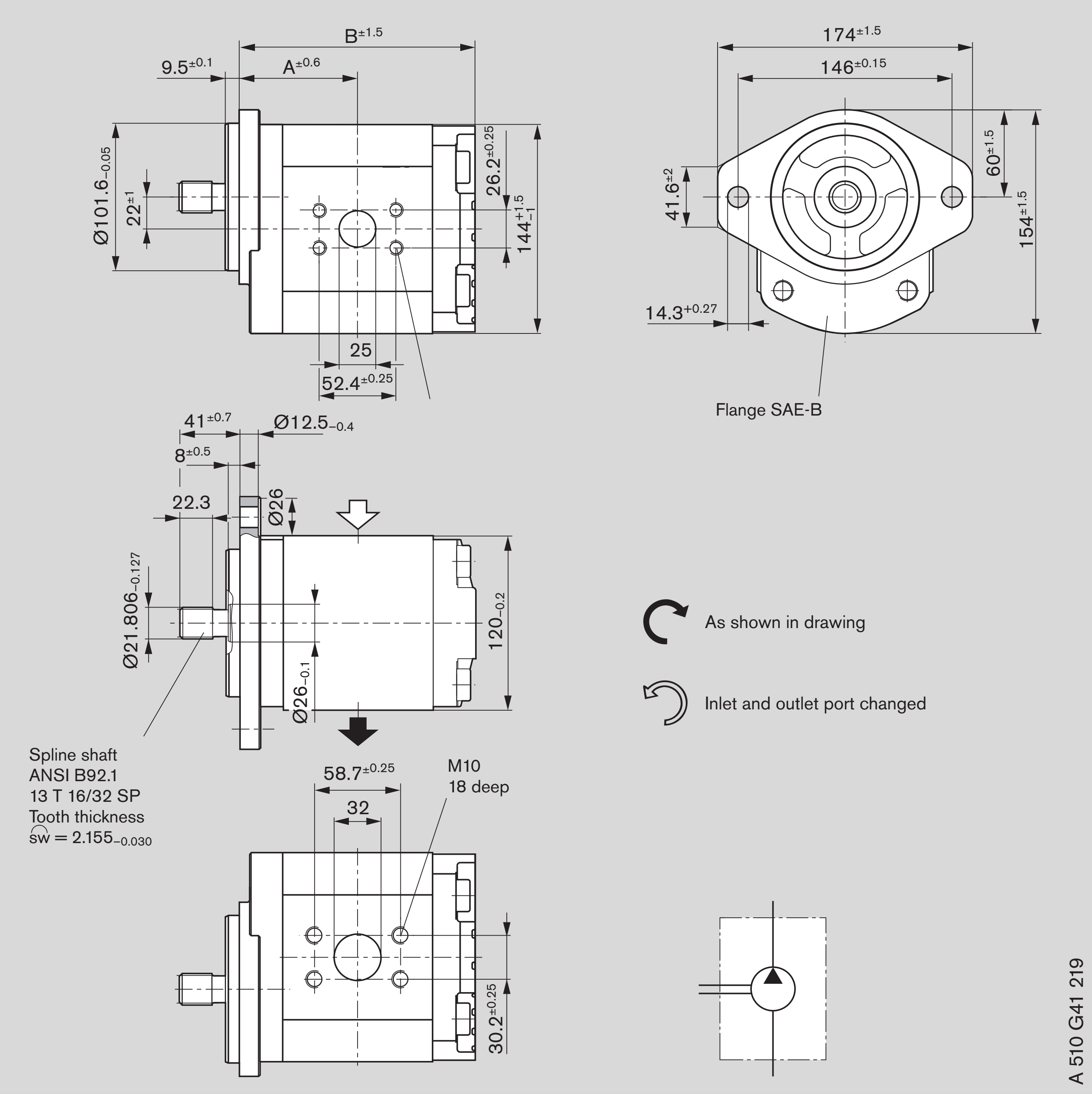
Ordering code:

AZPG – 22 – ☐ ☐ ☐ ☐ D C 07 K B

Displacement [cm³/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	 B
22.5	**0 510 725 434**	**0 510 725 157**	280	3000	9.6	66.4	130.1
25	**0 510 725 435**	**0 510 725 158**	280	3000	9.7	67.4	132.1
28	**0 510 725 436**	**0 510 725 159**	280	3000	9.8	68.7	134.6

Dimensions

Standard range



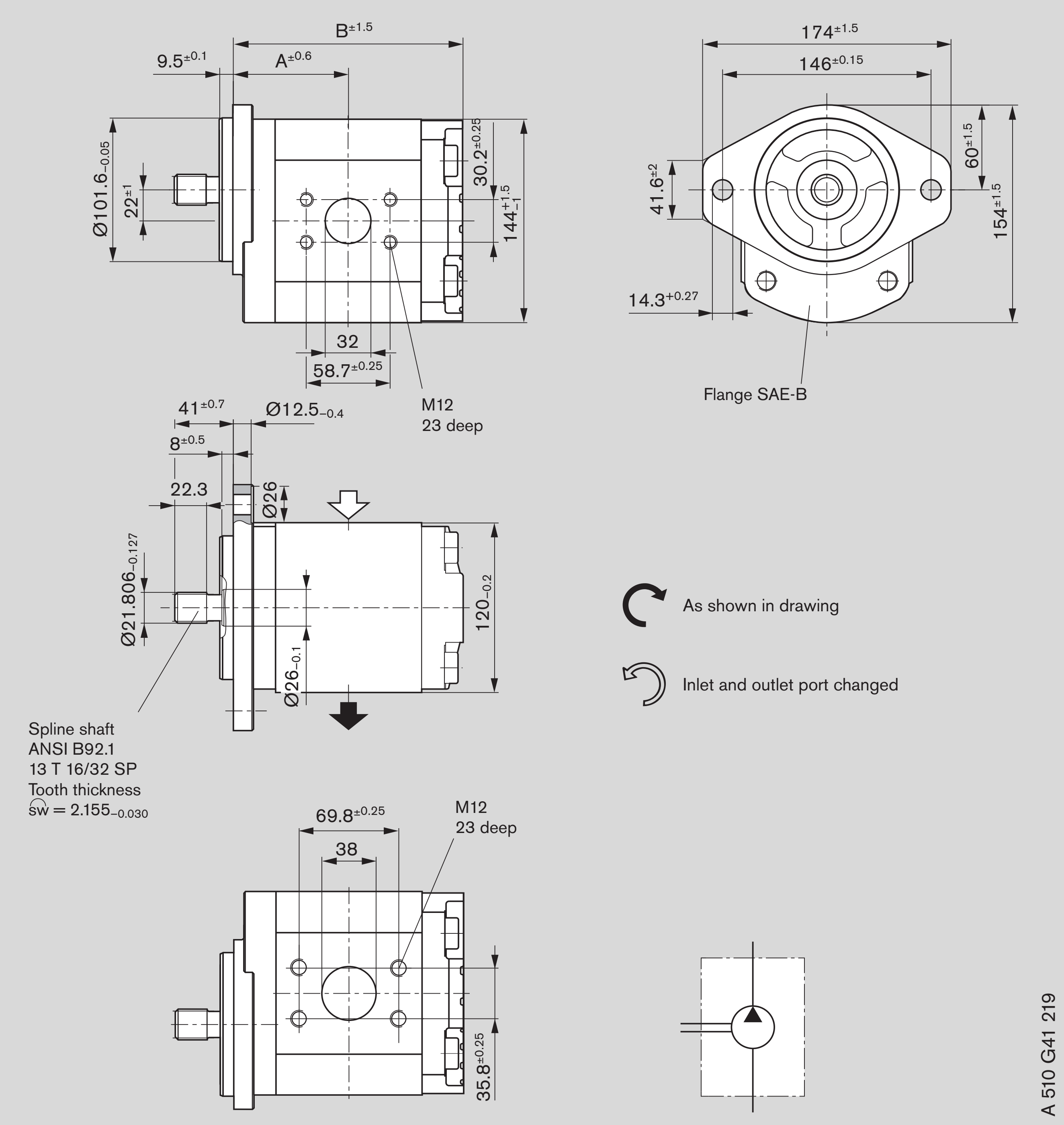
Ordering code:

AZPG – 22 – ☐ ☐ ☐   ☐ D C 07 K B

Displacement [cm³/rev]	Ordering-No. ↺ L	↻ R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B
32	**0 510 725 437**	**0 510 725 160**	280	2800	10.0	70.3	137.9
36	**0 510 725 438**	**0 510 725 161**	280	2800	10.1	71.9	141.2
40	**0 510 725 439**	**0 510 725 162**	280	2800	10.3	73.6	144.5
45	**0 510 725 440**	**0 510 725 163**	280	2600	10.5	75.6	148.6
50	**0 510 825 321**	**0 510 825 021**	250	2600	10.7	77.7	152.7

Dimensions

Standard range

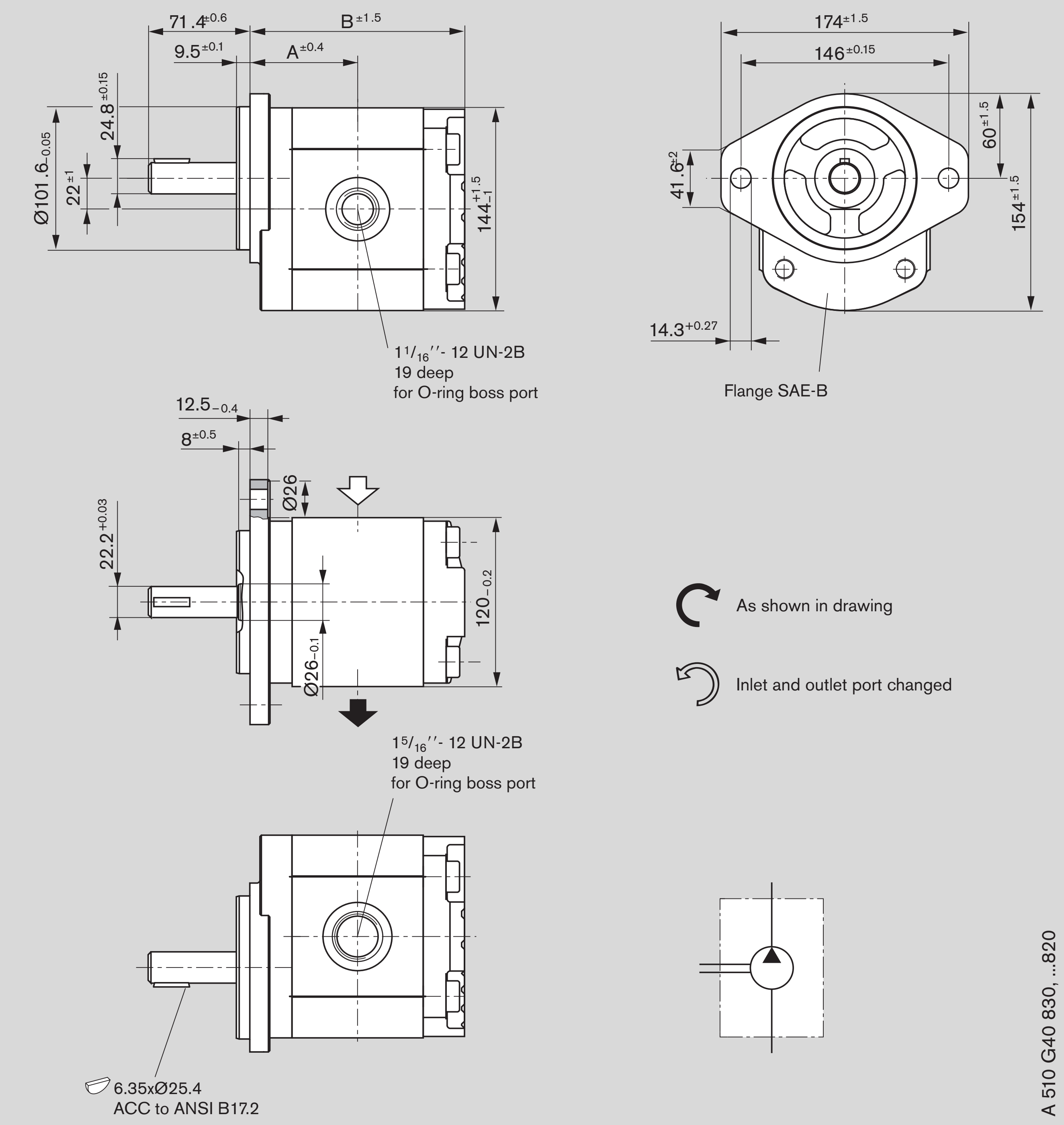


Ordering code:
AZPG – 22 – ☐ ☐ ☐ ☐ D C 07 K B

Displacement [cm^3/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	 B
56	**0 510 825 322**	**0 510 825 022**	225	2300	11.0	80.2	157.7
63	**0 510 825 323**	**0 510 825 023**	200	2300	11.3	83.1	163.5

Dimensions

Standard range

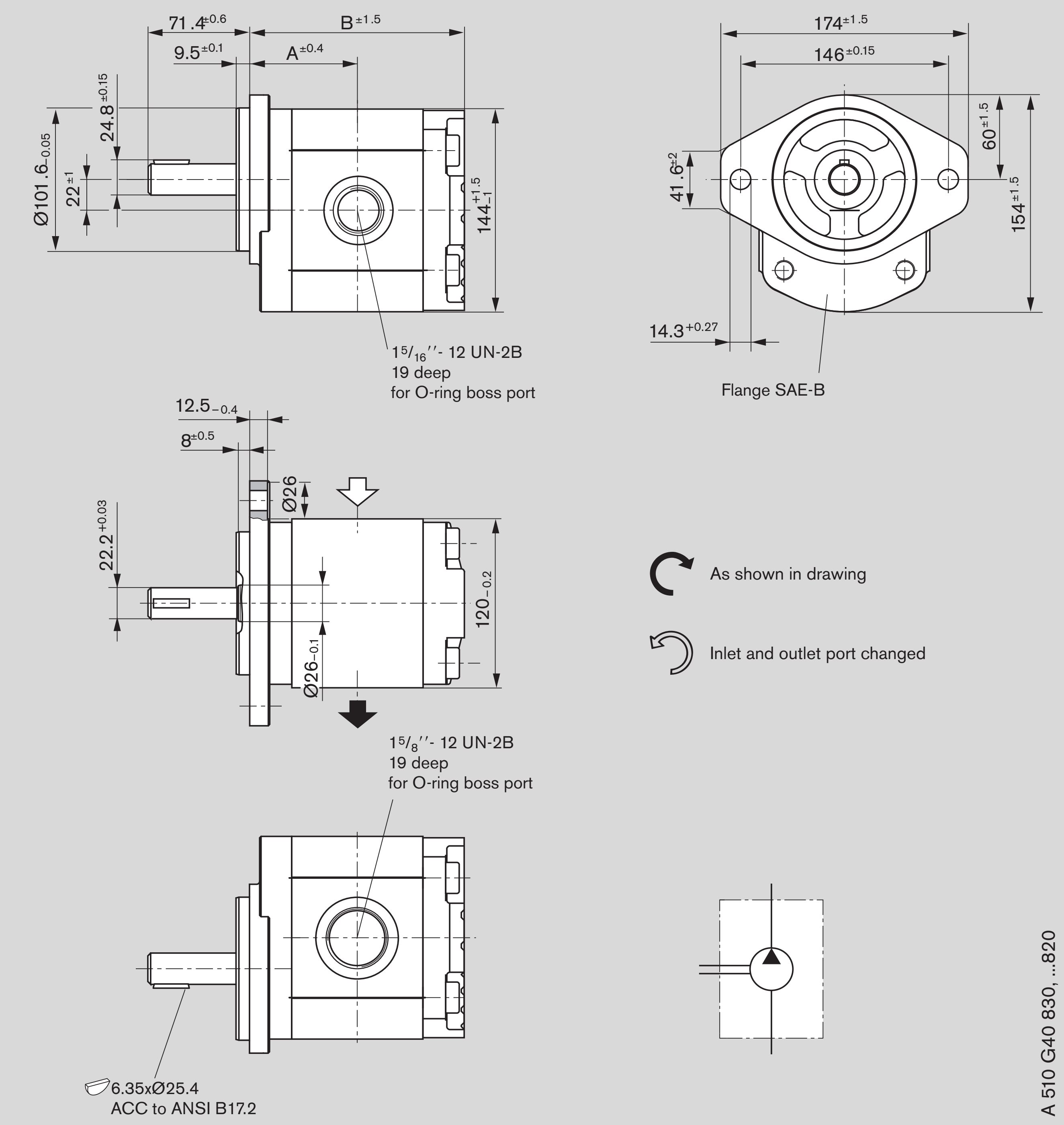


Ordering code:
AZPG – 22 – ☐ ☐ ☐ ☐ Q C 12 M B – S 0662

Displacement [cm^3/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	 B	Execution Suction port	 Pressure port
22.5	**9 510 490 132**	**9 510 490 122**	250	3000	66.4	130.3	S1	P1
25	**9 510 490 133**	**9 510 490 123**	250	3000	67.4	132.3	S1	P1
28	**9 510 490 134**	**9 510 490 124**	250	3000	68.7	134.8	S1	P1

Dimensions

Standard range

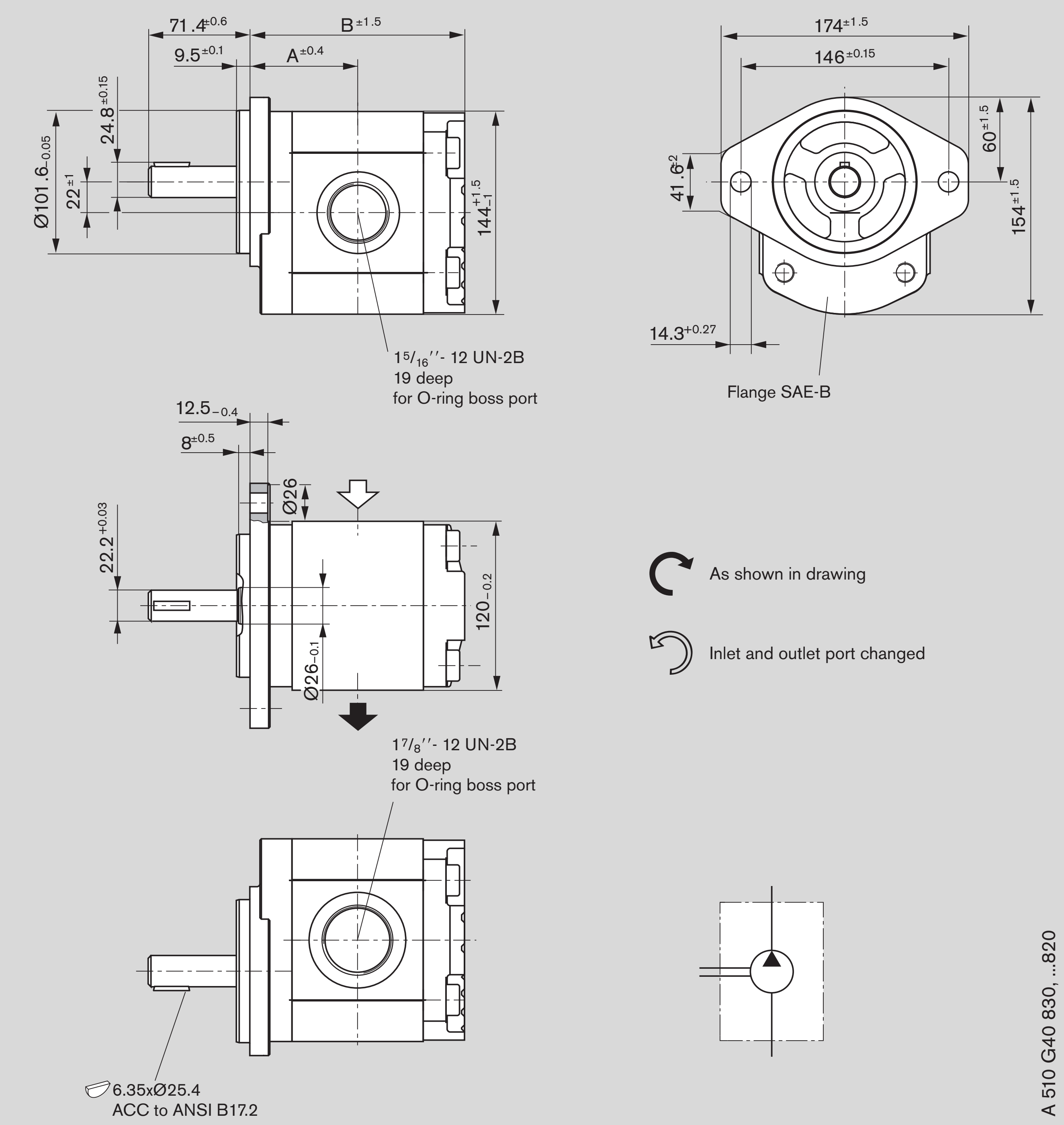


Ordering code:
AZPG – 22 – ☐ ☐ ☐ ☐ Q C 12 M B – S 0662

Displacement [cm^3/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	Dimension [mm] B	Execution Suction port	Execution Pressure port
32	**9 510 490 135**	**9 510 490 125**	250	2800	70.3	138.1	S2	P2
36	**9 510 490 136**	**9 510 490 126**	250	2800	71.9	141.5	S2	P2
40	**9 510 490 137**	**9 510 490 127**	250	2800	73.6	144.8	S2	P2
45	**9 510 490 138**	**9 510 490 128**	250	2600	75.6	148.8	S2	P2

Dimensions

Standard range

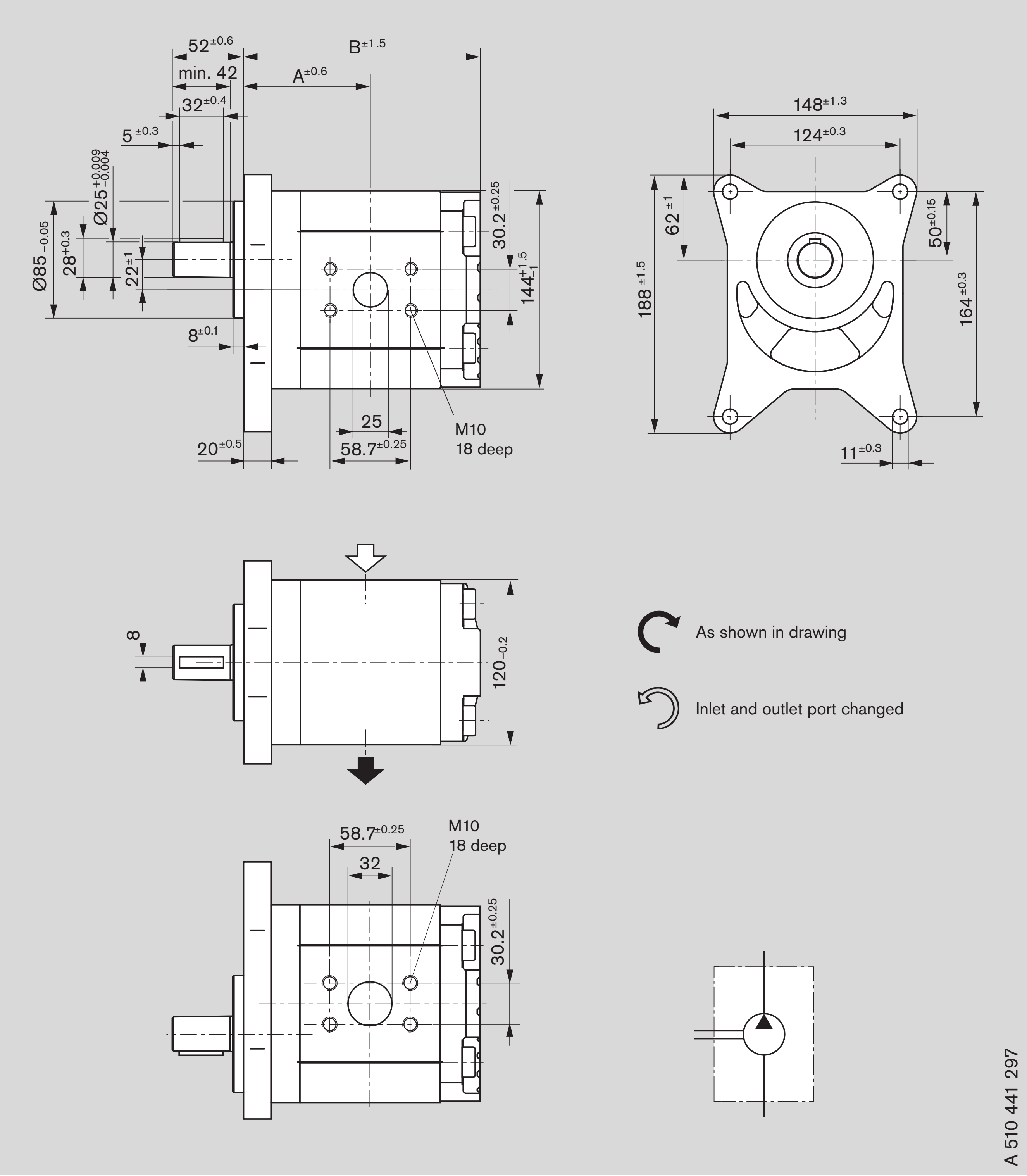


Ordering code:
AZPG – 22 – ☐ ☐ ☐ ☐ Q C 12 M B – S 0662

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	Dimension [mm]		Execution	
[cm³/rev]	↺ L	↻ R	[bar]	[rpm]	A	B	Suction port	Pressure port
50	**9 510 490 139**	**9 510 490 129**	220	2600	77.7	153.0	S3	P3
56	**9 510 490 140**	**9 510 490 130**	195	2300	80.2	157.9	S3	P3
63	**9 510 490 141**	**9 510 490 131**	170	2300	83.1	163.8	S3	P3

Dimensions

Standard range



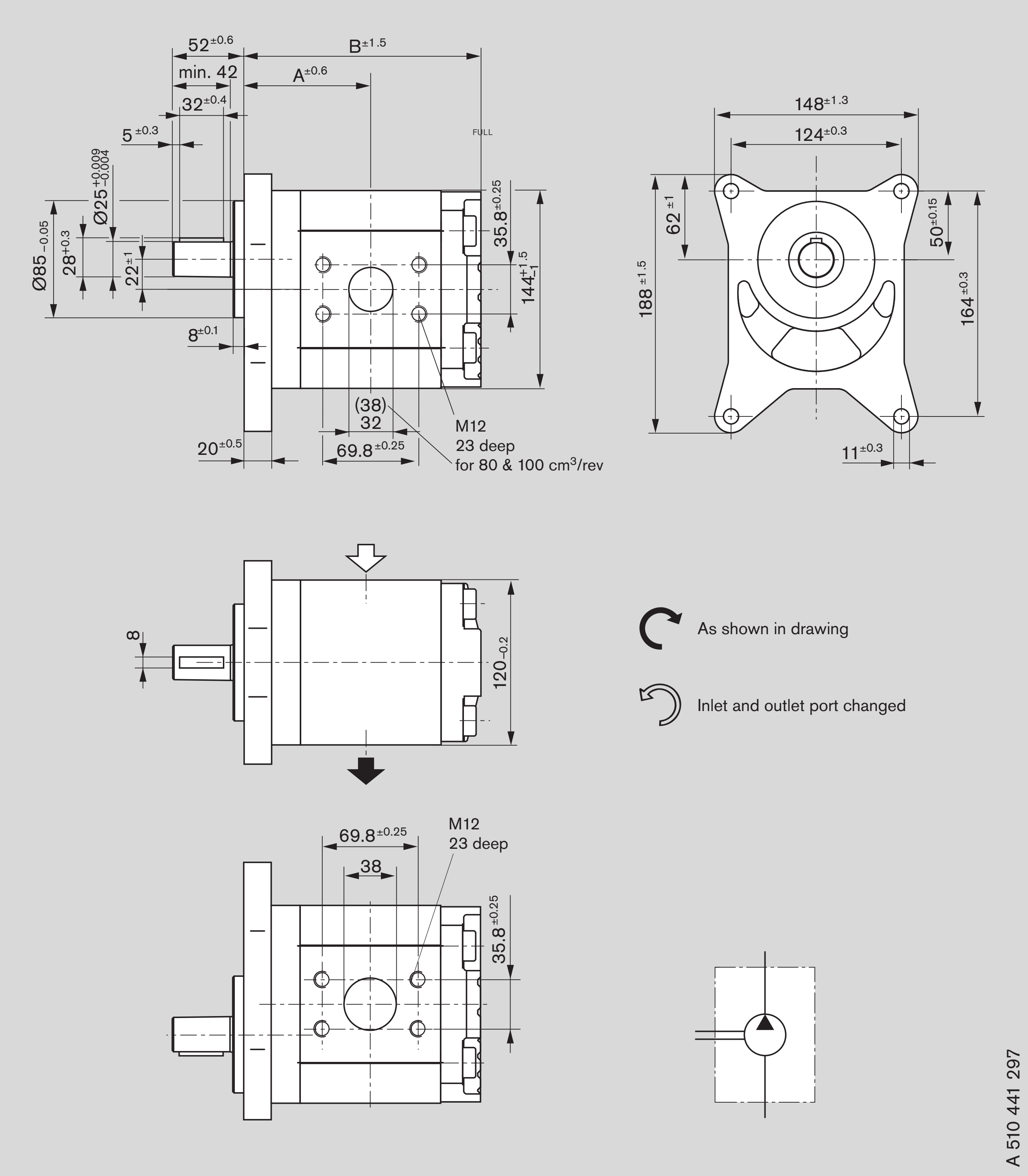
Ordering code:

AZPG – 22 – ☐ ☐ ☐ ☐ A X 07 K B – S 0303

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	Dimension [mm]		Execution	
[cm^3/rev]	↺ L	↻ R	[bar]	[rpm]	A	B	Suction port	Pressure port
40	**0 510 725 432**	**0 510 725 147**	280	2800	85.1	157.7	S1	P1
50	**0 510 825 314**	**0 510 825 015**	250	2600	89.2	165.9	S1	P1

Dimensions

Standard range



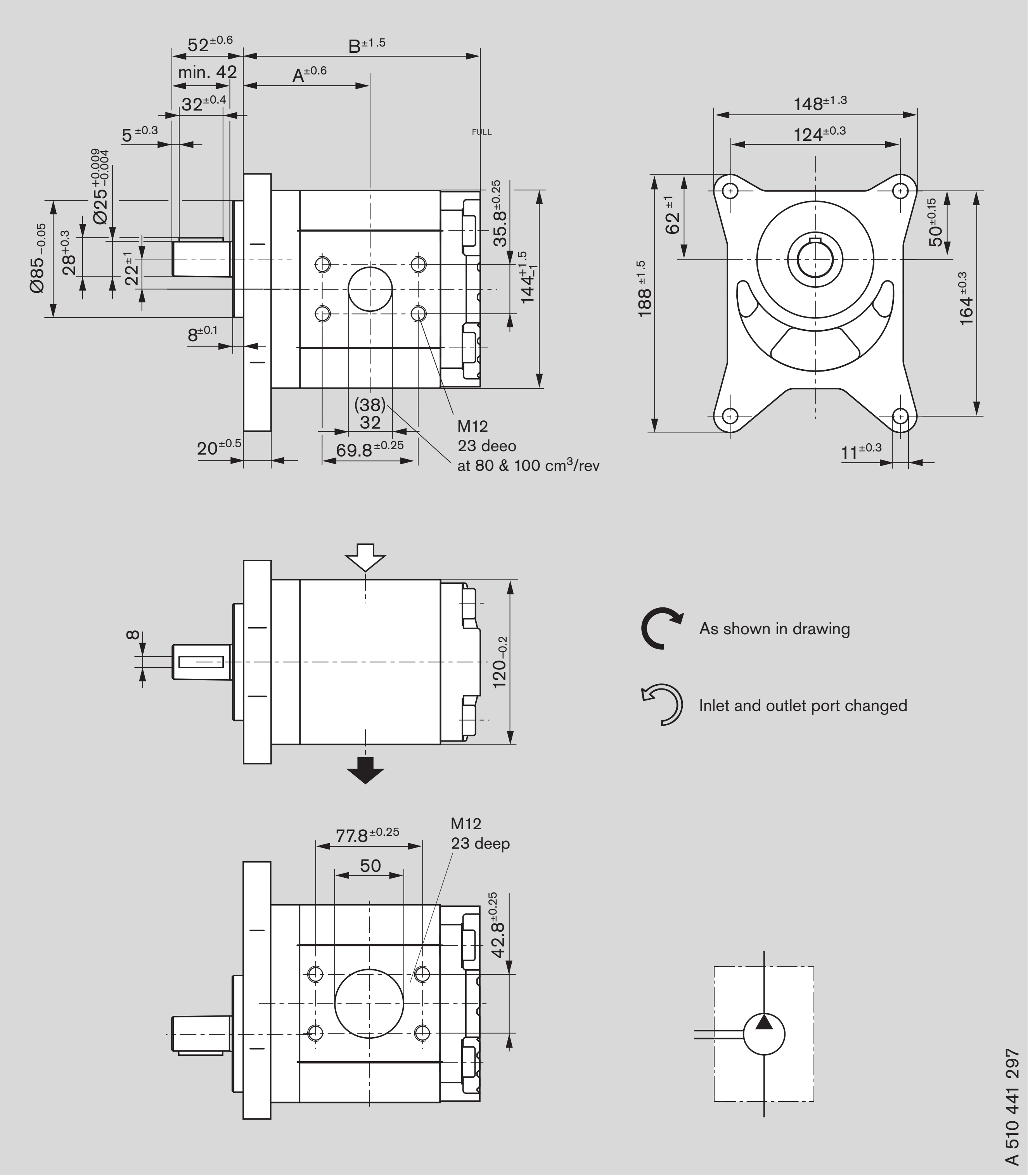
Ordering code:

AZPG – 22 – ☐ ☐ ☐ ☐ A X 07 K B – S 0303

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	Dimension [mm]		Execution	
[cm^3/rev]	L	R	[bar]	[rpm]	A	B	Suction port	Pressure port
63	**0 510 825 315**	**0 510 825 016**	200	2300	94.6	176.7	S2	P2
70	**0 510 825 316**	**0 510 825 017**	150	2200	97.5	182.5	S2	P2

Dimensions

Standard range

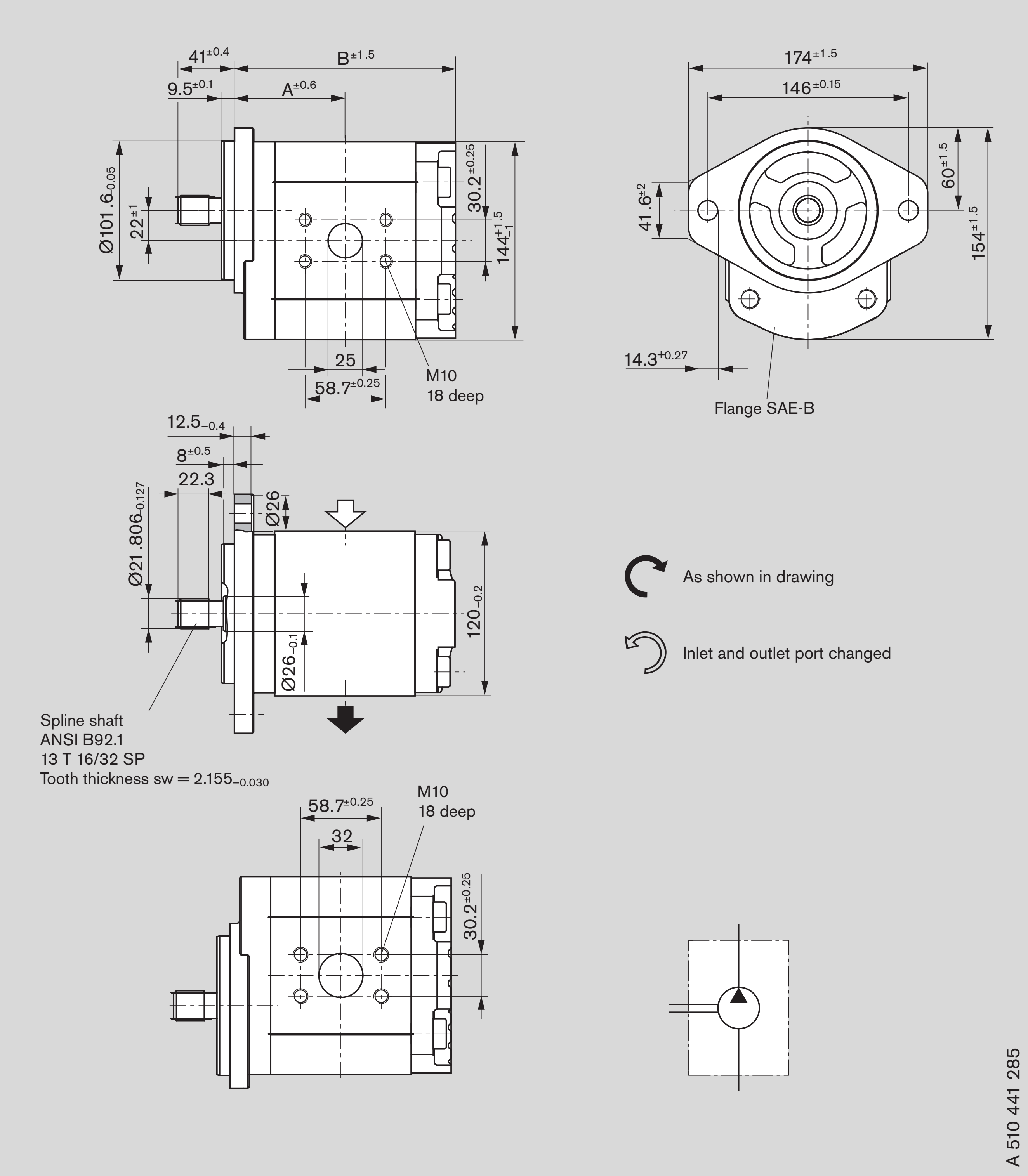


Ordering code:
AZPG – 22 – ☐ ☐ ☐ ☐ A X 07 K B – S 0303

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	Dimension [mm]		Execution	
[cm³/rev]	L	R	[bar]	[rpm]	A	B	Suction port	Pressure port
80	**0 510 825 317**	**0 510 825 018**	120	2200	100.6	190.7	S3	P2
100	**0 510 825 318**	**0 510 825 019**	100	1700	109.8	207.2	S3	P2

Dimensions

Standard range

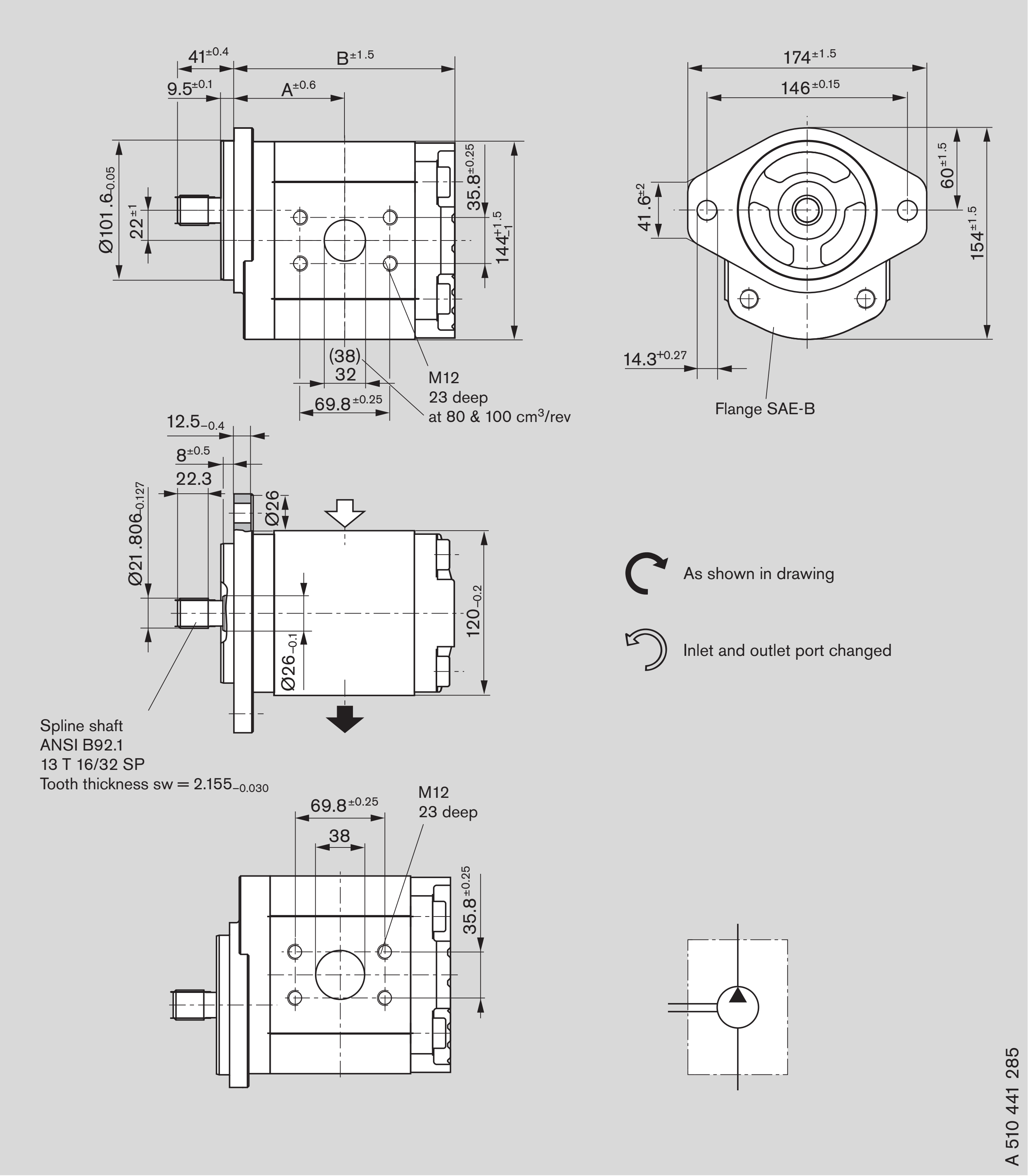


Ordering code:
AZPG – 22 – ☐ ☐ ☐ ☐ D C 07 K B – S 0039

Displacement [cm³/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	 B	Execution Suction port	 Pressure port
40	**0 510 725 421**	**0 510 725 136**	280	2800	73.6	144.8	S1	P1
50	**0 510 725 420**	**0 510 725 135**	250	2600	77.7	153.0	S1	P1

Dimensions

Standard range



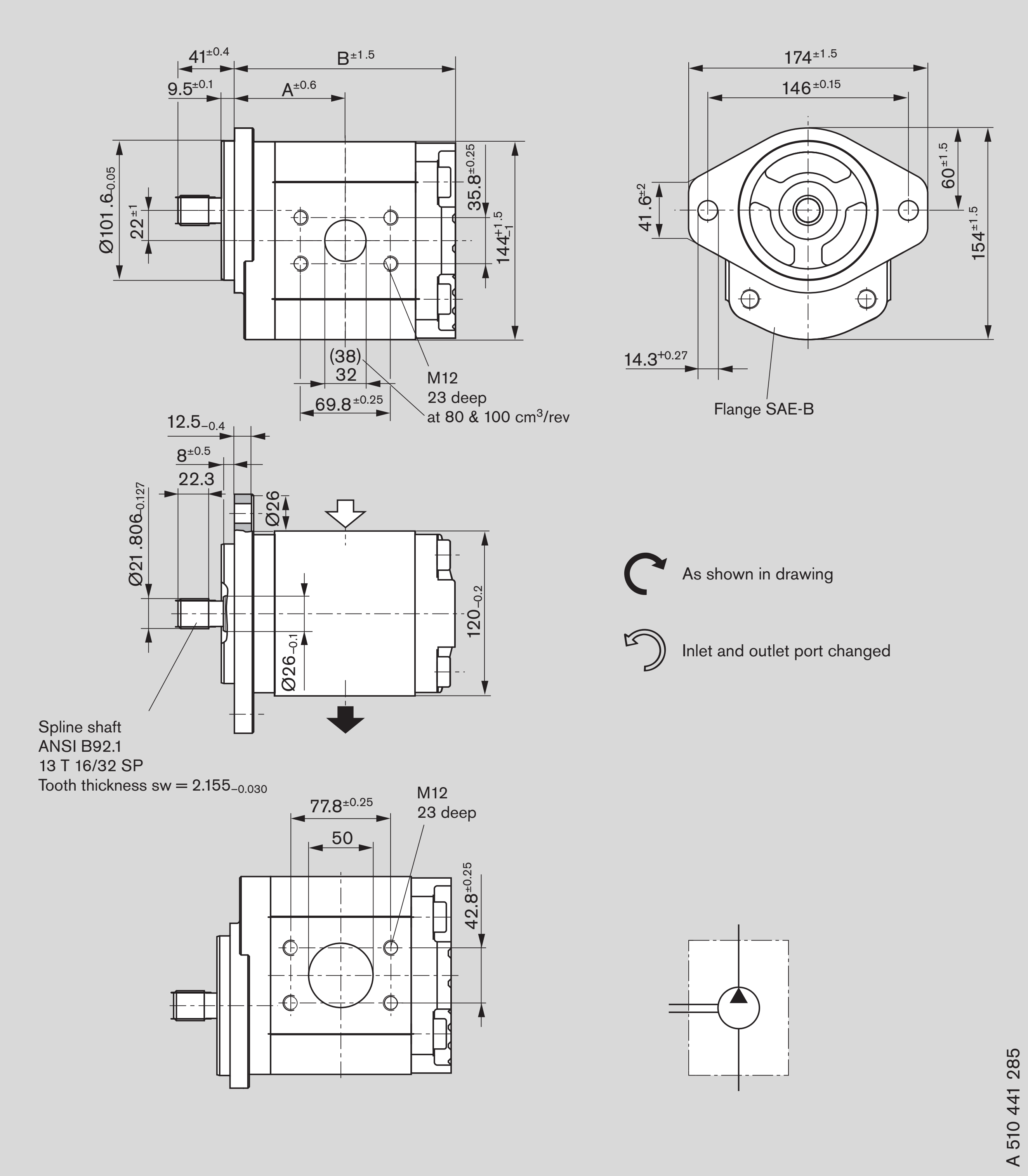
Ordering code:

AZPG – 22 – □ □ □ □ D C 07 K B – S 0039

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	Dimension [mm]		Execution	
[cm^3/rev]	L	R	[bar]	[rpm]	A	B	Suction port	Pressure port
63	**0 510 825 313**	**0 510 825 011**	200	2300	83.1	163.8	S2	P2
70	**0 510 825 312**	**0 510 825 014**	150	2200	86.0	169.5	S2	P2

Dimensions

Standard range



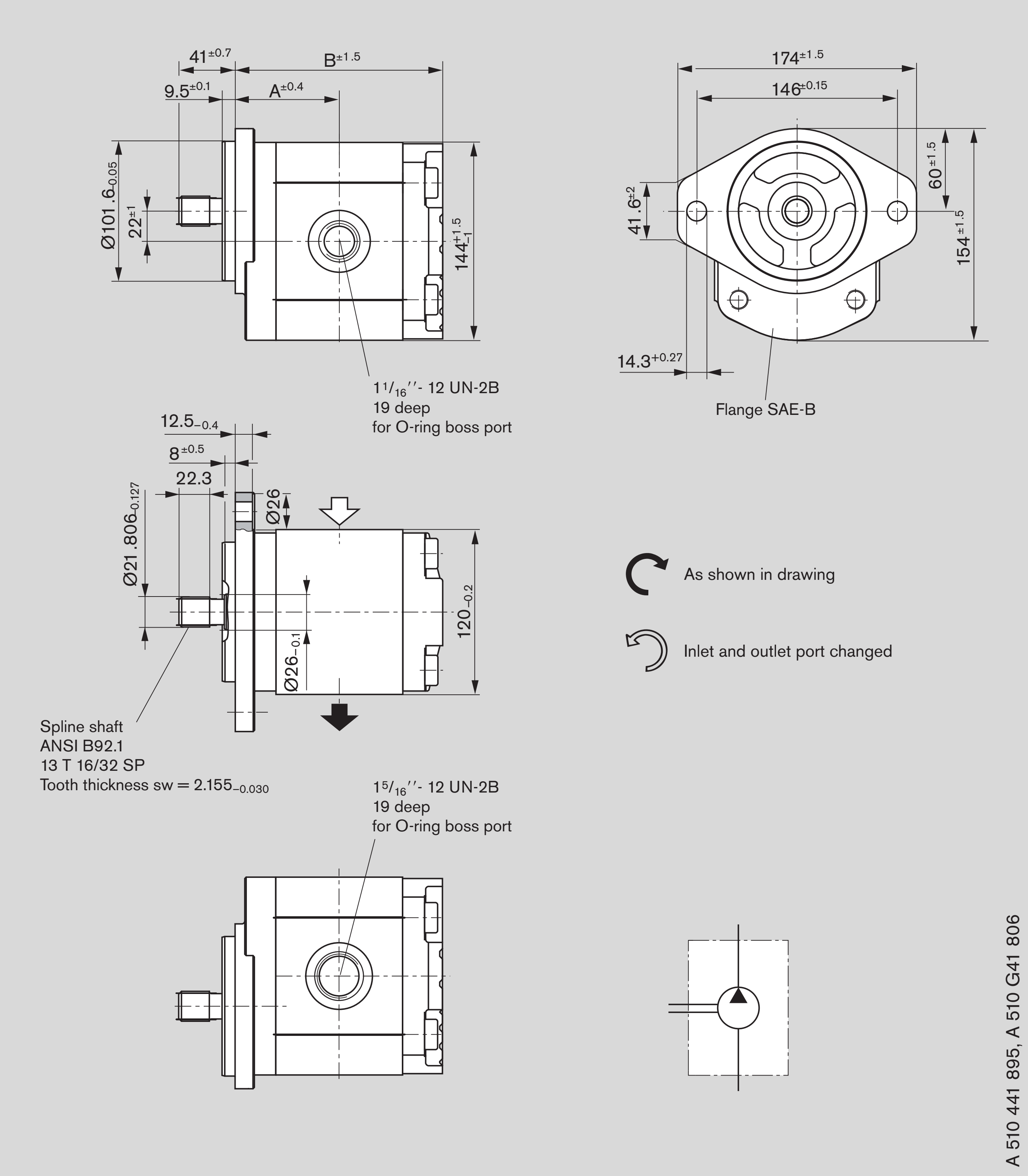
Ordering code:

AZPG – 22 – ☐ ☐ ☐ ☐ D C 07 K B – S 0039

Displacement [cm³/rev]	Ordering-No. ↺ L	↻ R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B	Execution Suction port	Pressure port
80	**0 510 825 311**	**0 510 825 012**	120	2200	90.1	177.8	S3	P2
100	**0 510 825 310**	**0 510 825 013**	100	1700	98.3	194.3	S3	P2

Dimensions

Standard range

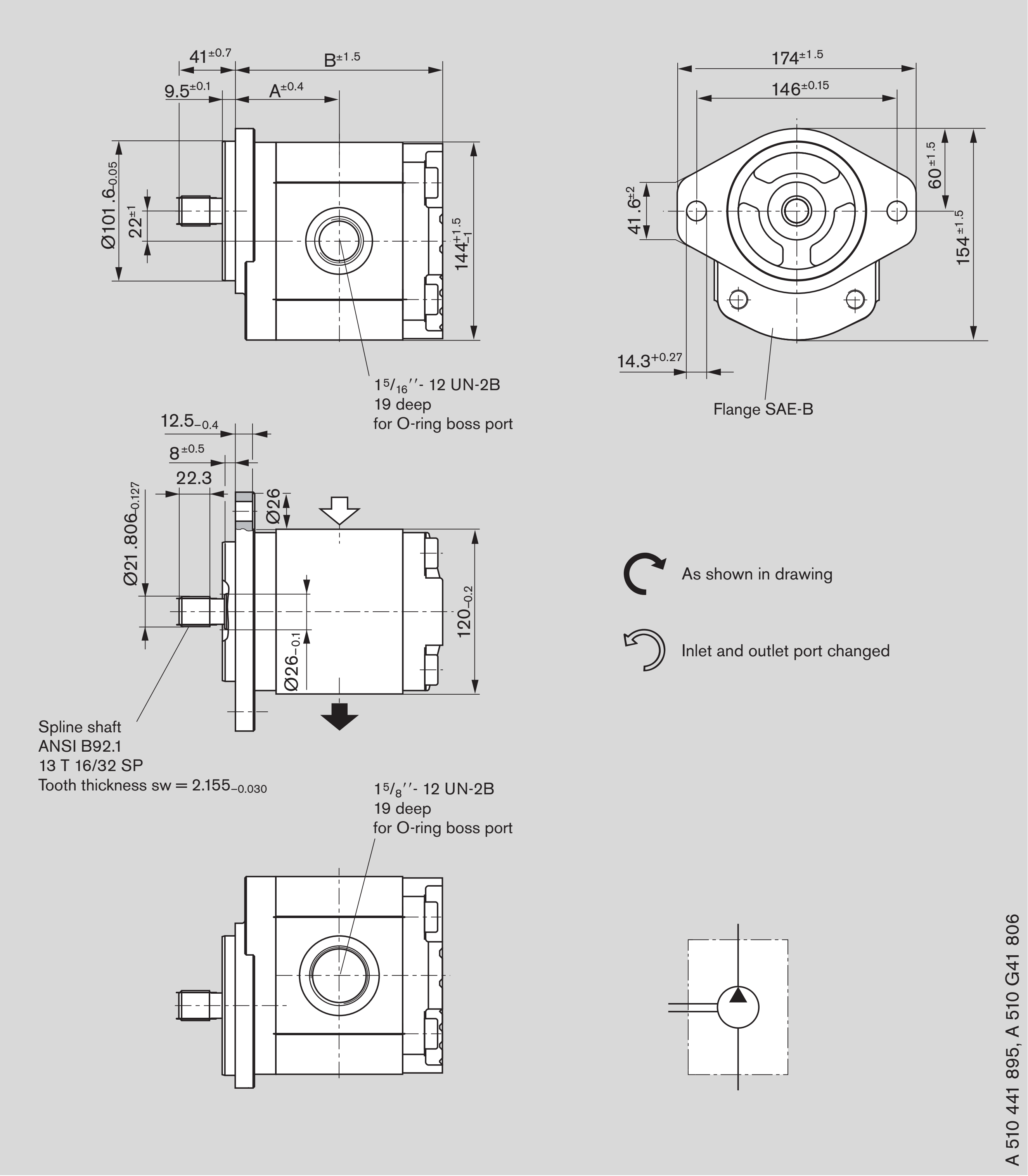


Ordering code:
AZPG – 22 – ☐ ☐ ☐ ☐ D C 12 M B

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	Dimension [mm]		Execution	
[cm^3/rev]	L	R	[bar]	[rpm]	A	B	Suction port	Pressure port
22.5	**9 510 490 011**	**9 510 490 001**	250	3000	66.4	130.3	S1	P1
25	**9 510 490 012**	**9 510 490 002**	250	3000	67.4	132.3	S1	P1
28	**9 510 490 013**	**9 510 490 003**	250	3000	68.7	134.8	S1	P1

Dimensions

Standard range



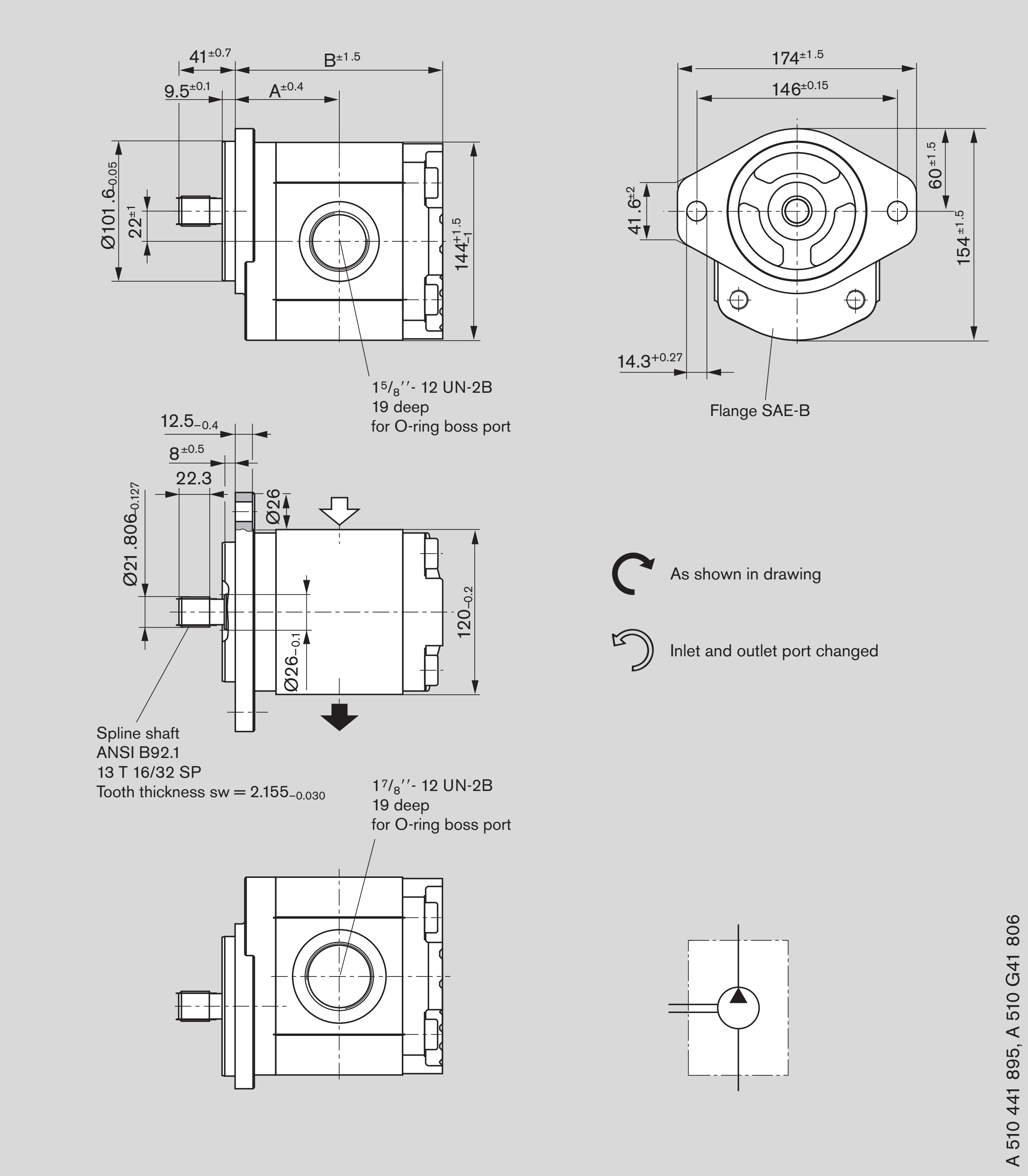
Ordering code:

AZPG – 22 – ☐ ☐ ☐ ☐ D C 12 M B

Displacement [cm³/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	 B	Execution Suction port	 Pressure port
32	**9 510 490 014**	**9 510 490 004**	250	2800	70.3	138.1	S2	P2
36	**9 510 490 015**	**9 510 490 005**	250	2800	71.9	141.5	S2	P2
40	**9 510 490 016**	**9 510 490 006**	250	2800	73.6	144.8	S2	P2
45	**9 510 490 017**	**9 510 490 007**	250	2600	75.6	148.8	S2	P2

Dimensions

Standard range

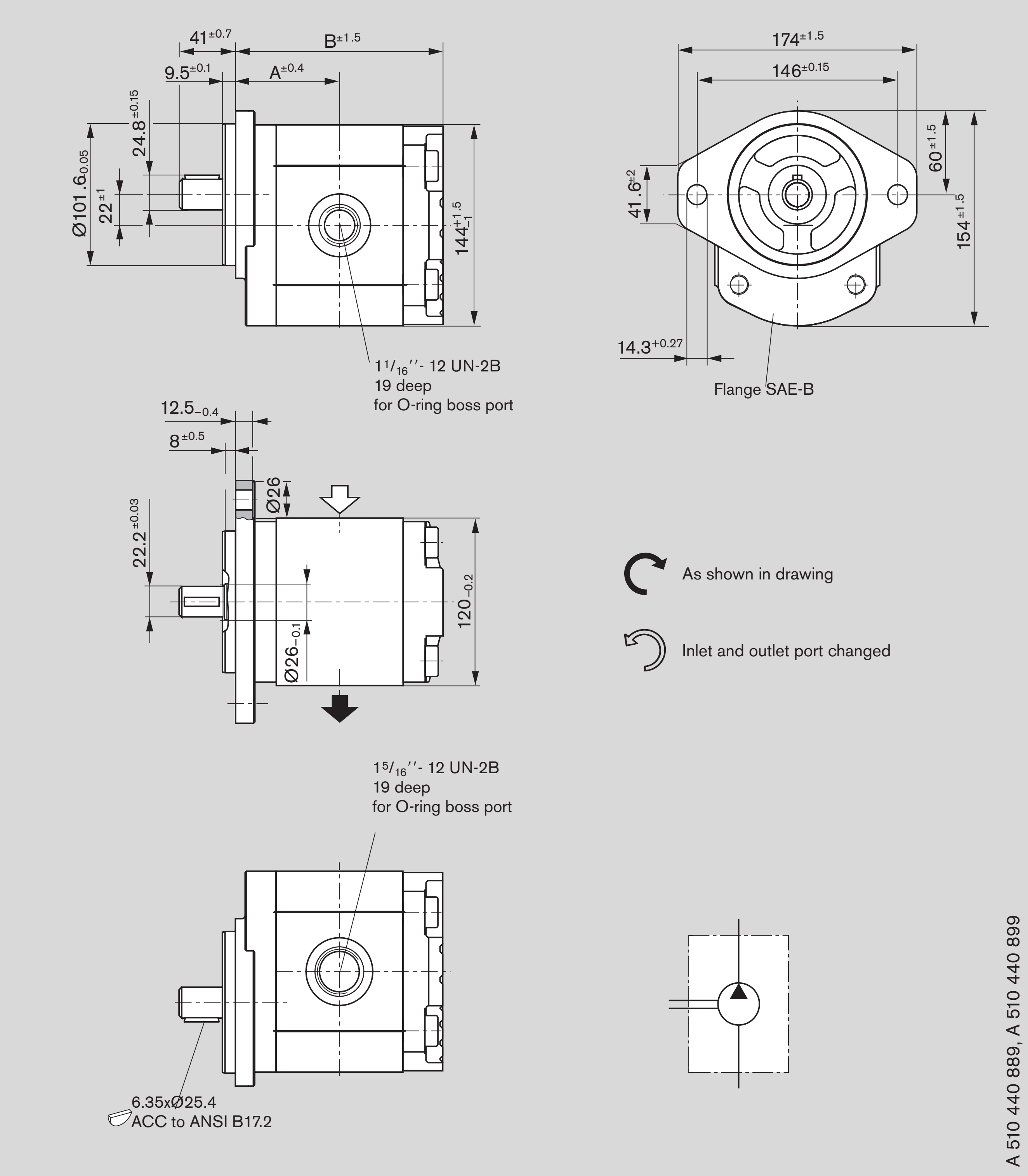


Ordering code:
AZPG – 22 – ☐ ☐ ☐ ☐ D C 12 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	Dimension [mm] B	Execution Suction port	Execution Pressure port
50	**9 510 490 018**	**9 510 490 008**	220	2600	77.7	153.0	S3	P3
56	**9 510 490 019**	**9 510 490 009**	195	2300	80.2	157.9	S3	P3
63	**9 510 490 020**	**9 510 490 010**	170	2300	63.1	163.8	S3	P3

Dimensions

Standard range

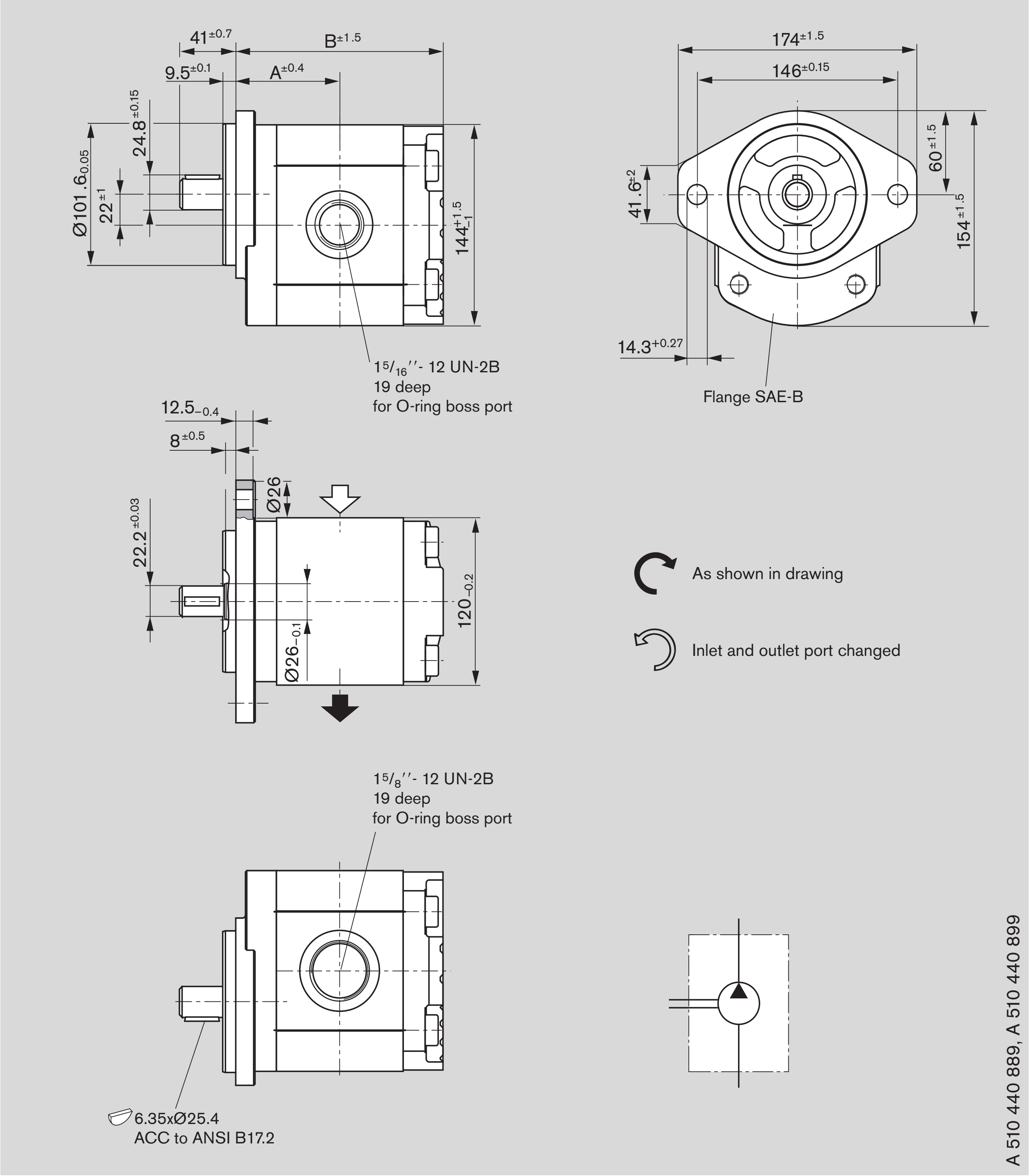


Ordering code:
AZPG – 22 – ☐ ☐ ☐ ☐ Q C 12 M B

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	Dimension [mm]		Execution	
[cm³/rev]	L	R	[bar]	[rpm]	A	B	Suction port	Pressure port
22.5		**9 510 490 021**	250	3000	66.4	130.3	S1	P1
25		**9 510 490 022**	250	3000	67.4	132.3	S1	P1
28		**9 510 490 023**	250	3000	68.7	134.8	S1	P1

Dimensions

Standard range



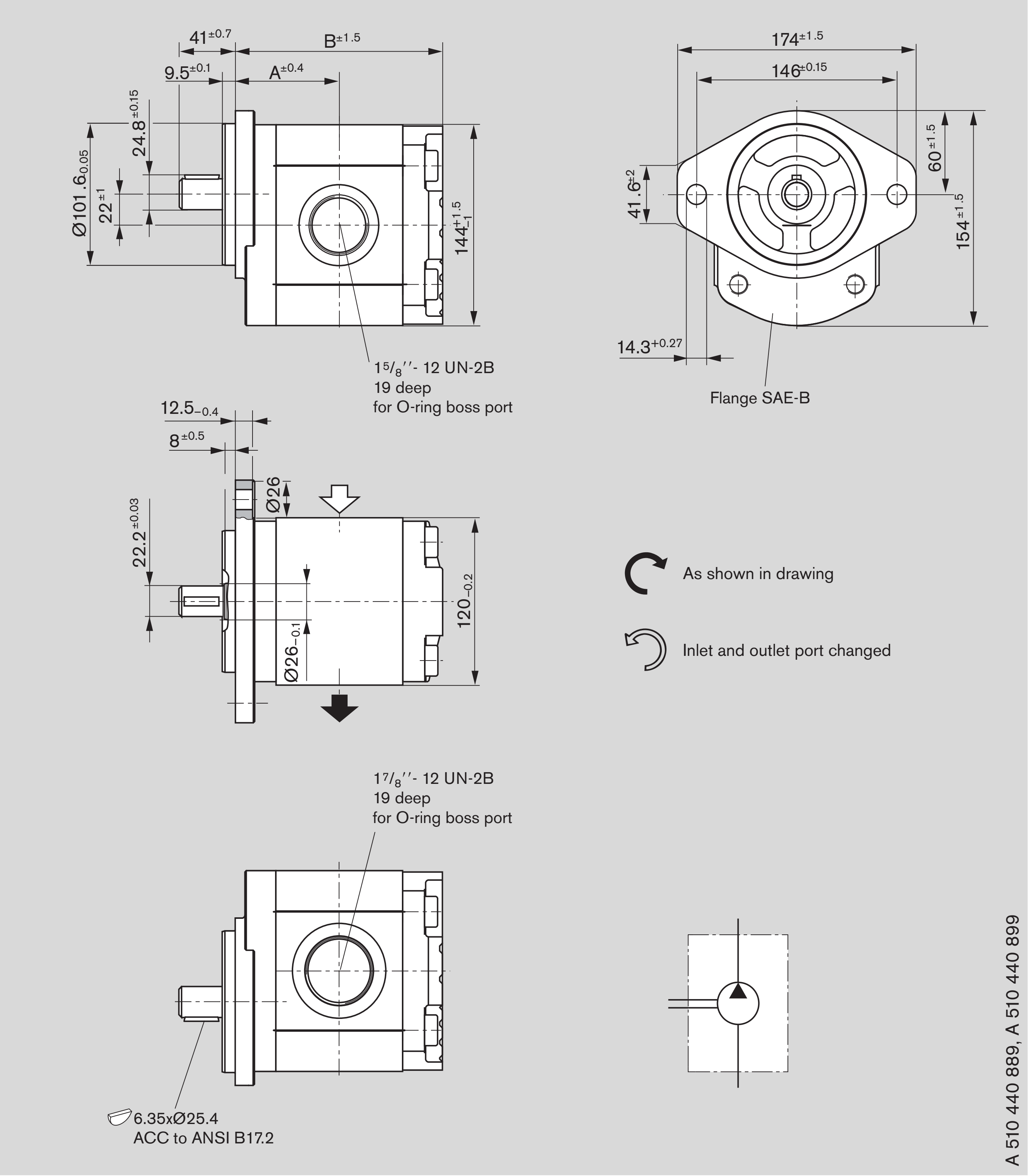
Ordering code:

AZPG – 22 – ☐ ☐ ☐ ☐ Q C 12 M B

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	Dimension [mm]		Execution	
[cm^3/rev]	**L**	**R**	[bar]	[rpm]	A	B	Suction port	Pressure port
32	**9 510 490 034**	**9 510 490 024**	250	2800	70.3	138.1	S2	P2
36	**9 510 490 035**	**9 510 490 025**	250	2800	71.9	141.5	S2	P2
40		**9 510 490 026**	250	2800	73.6	144.8	S2	P2
45	**9 510 490 037**	**9 510 490 027**	250	2600	75.6	148.8	S2	P2

Dimensions

Standard range

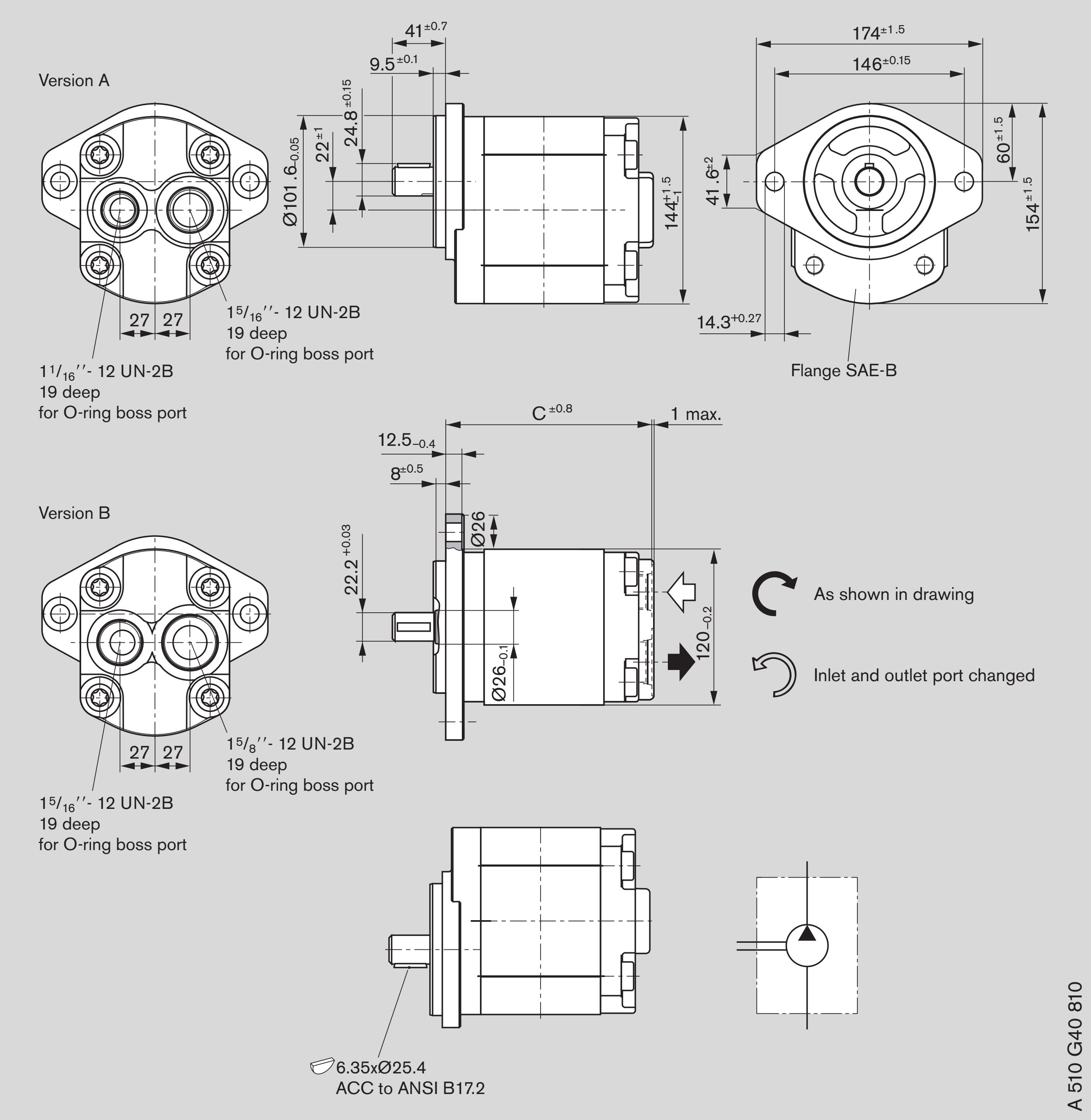


Ordering code:
AZPG – 22 – ☐ ☐ ☐ ☐ Q C 12 M B

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	Dimension [mm]		Execution	
[cm^3/rev]	L	R	[bar]	[rpm]	A	B	Suction port	Pressure port
50	**9 510 490 038**	**9 510 490 028**	220	2600	77.7	153.0	S3	P3
56	**9 510 490 039**	**9 510 490 029**	195	2300	80.2	157.9	S3	P3
63	**9 510 490 040**	**9 510 490 030**	170	2300	63.1	163.8	S3	P3

Dimensions

Standard range

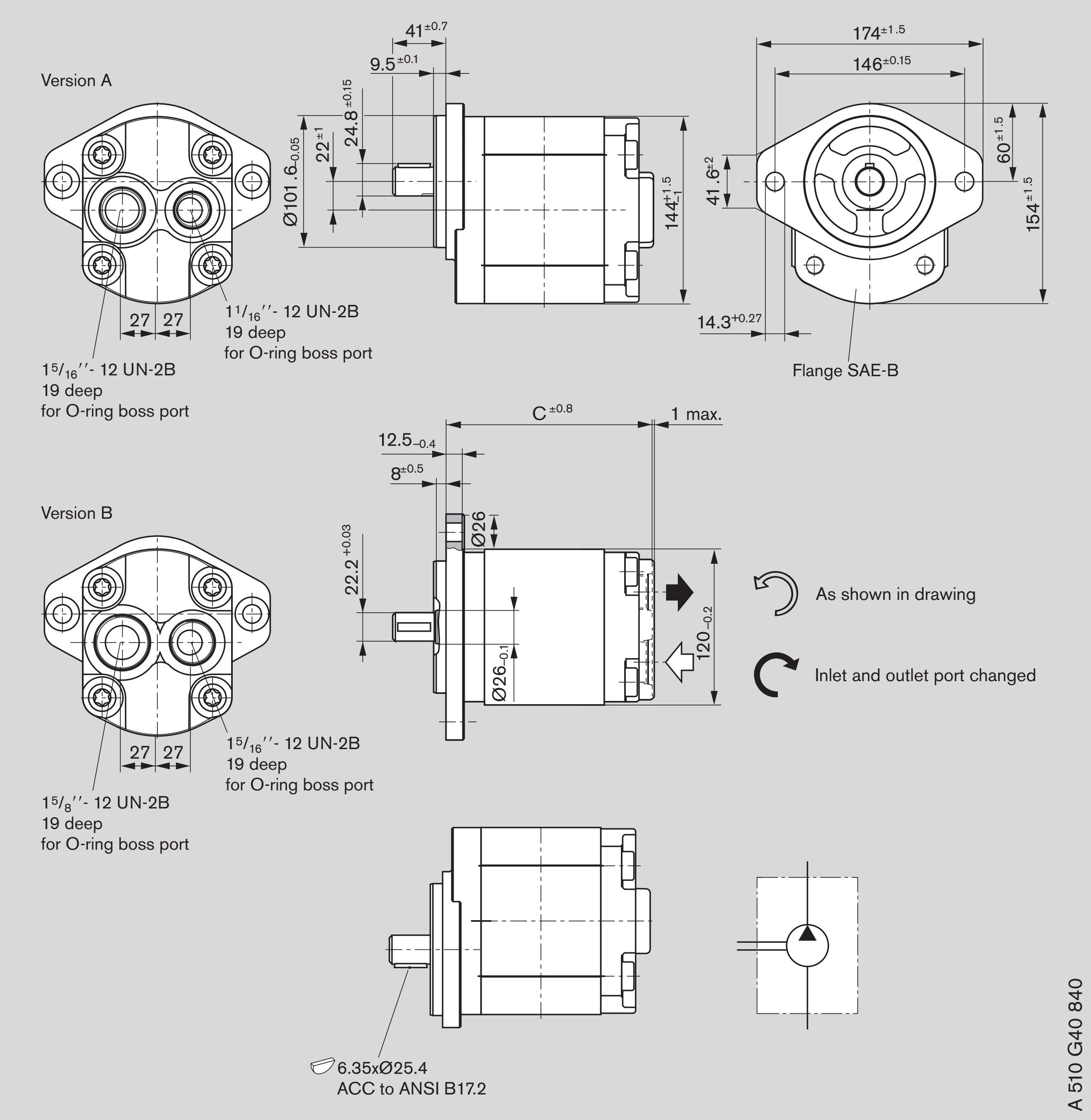


Ordering code:
AZPG – 22 – ☐ ☐ ☐ R Q C 12 M A

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	Dimension [mm]	Version
[cm^3/rev]	L	R	[bar]	[rpm]	C	
22.5		**9 510 490 101**	250	3000	141.2	A
25		**9 510 490 102**	250	3000	143.2	A
28		**9 510 490 103**	250	3000	145.7	A
32		**9 510 490 104**	250	2800	149.0	B
36		**9 510 490 105**	250	2800	152.4	B
40		**9 510 490 106**	250	2800	155.7	B
45		**9 510 490 107**	250	2600	159.7	B
50		**9 510 490 108**	220	2600	163.9	B
56		**9 510 490 109**	195	2300	169.8	B
63		**9 510 490 110**	170	2300	174.7	B

Dimensions

Standard range

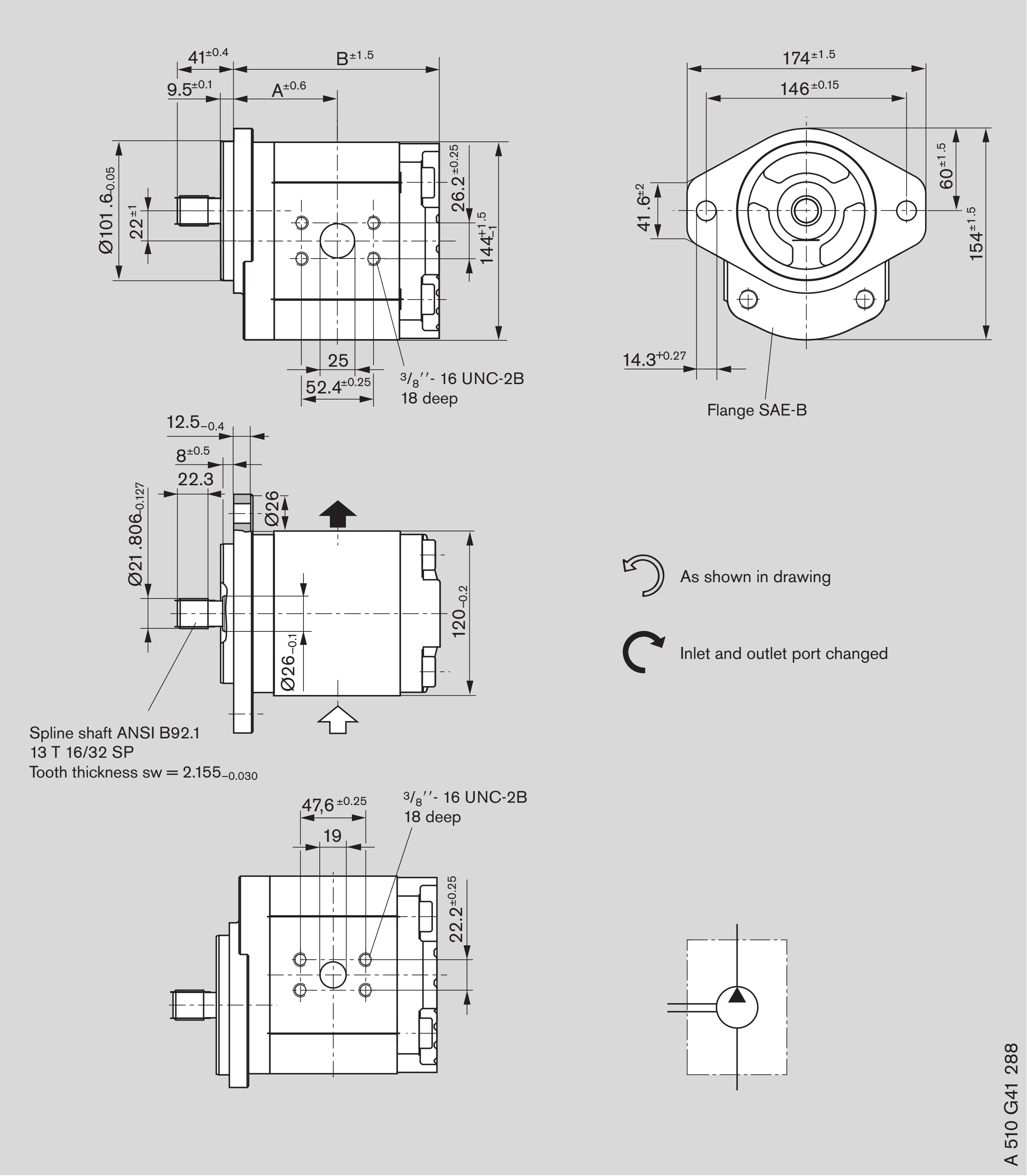


Ordering code:
AZPG – 22 – ☐ ☐ ☐ L Q C 12 M A

Displacement [cm³/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] C	Version
22.5	**9 510 490 111**		250	3000	141.2	A
25	**9 510 490 112**		250	3000	143.2	A
28	**9 510 490 113**		250	3000	145.7	A
32	**9 510 490 114**		250	2800	149.0	B
36	**9 510 490 115**		250	2800	152.4	B
40	**9 510 490 116**		250	2800	155.7	B
45	**9 510 490 117**		250	2600	159.7	B
50	**9 510 490 118**		220	2600	163.9	B
56	**9 510 490 119**		195	2300	169.8	B
63	**9 510 490 120**		170	2300	174.7	B

Dimensions

Standard range

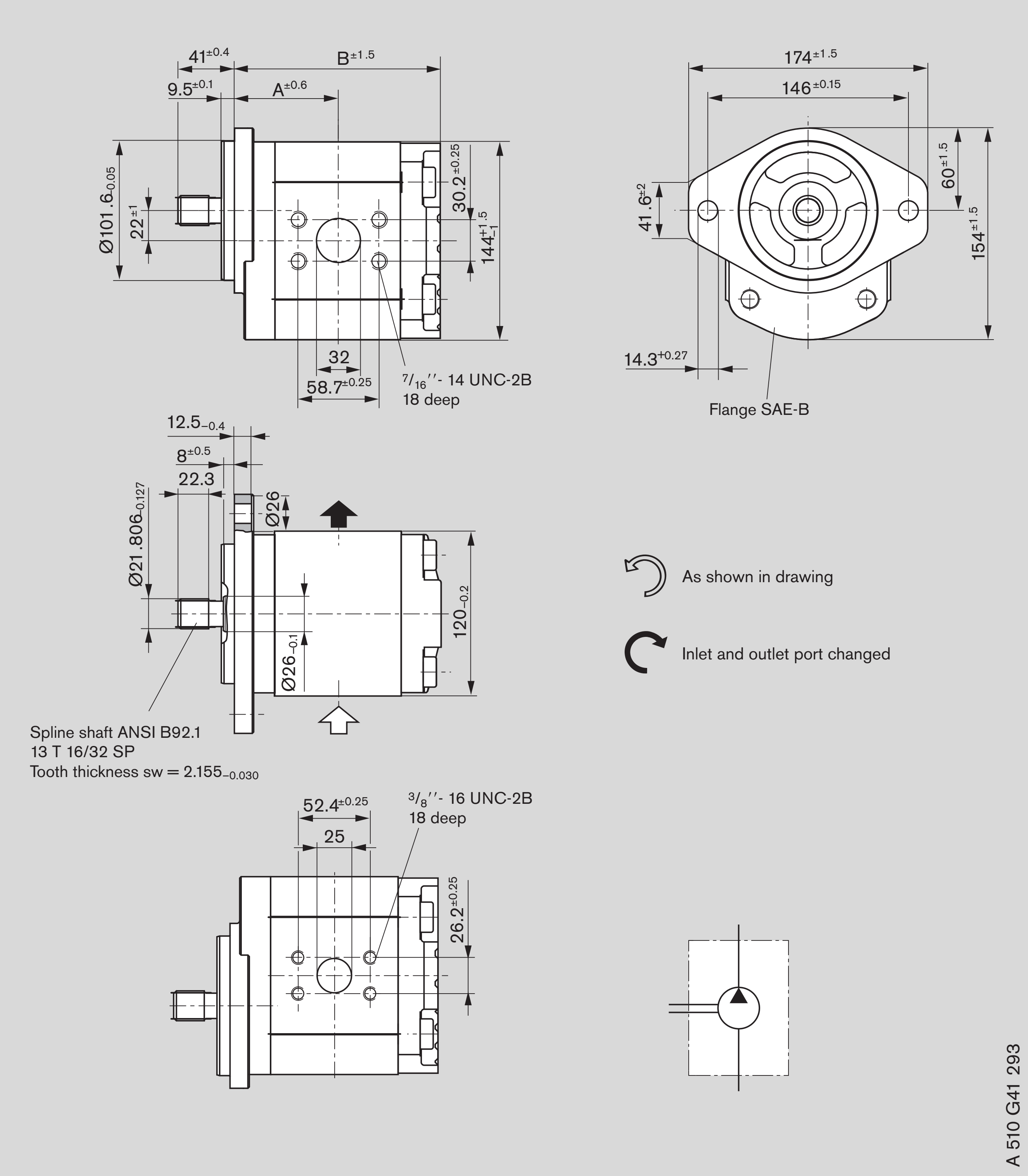


Ordering code:
AZPG – 22 – ☐ ☐ ☐ L D C 40 M B

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	Dimension [mm]	
[cm³/rev]	↺ L	↻ R	[bar]	[rpm]	A	B
22.5	**9 510 490 051**		250	3000	66.4	130.3
25	**9 510 490 052**		250	3000	67.4	132.3
28	**9 510 490 053**		250	3000	68.7	134.8
32	**9 510 490 054**		250	2800	70.3	138.1
36	**9 510 490 055**		250	2800	71.9	141.5

Dimensions

Standard range

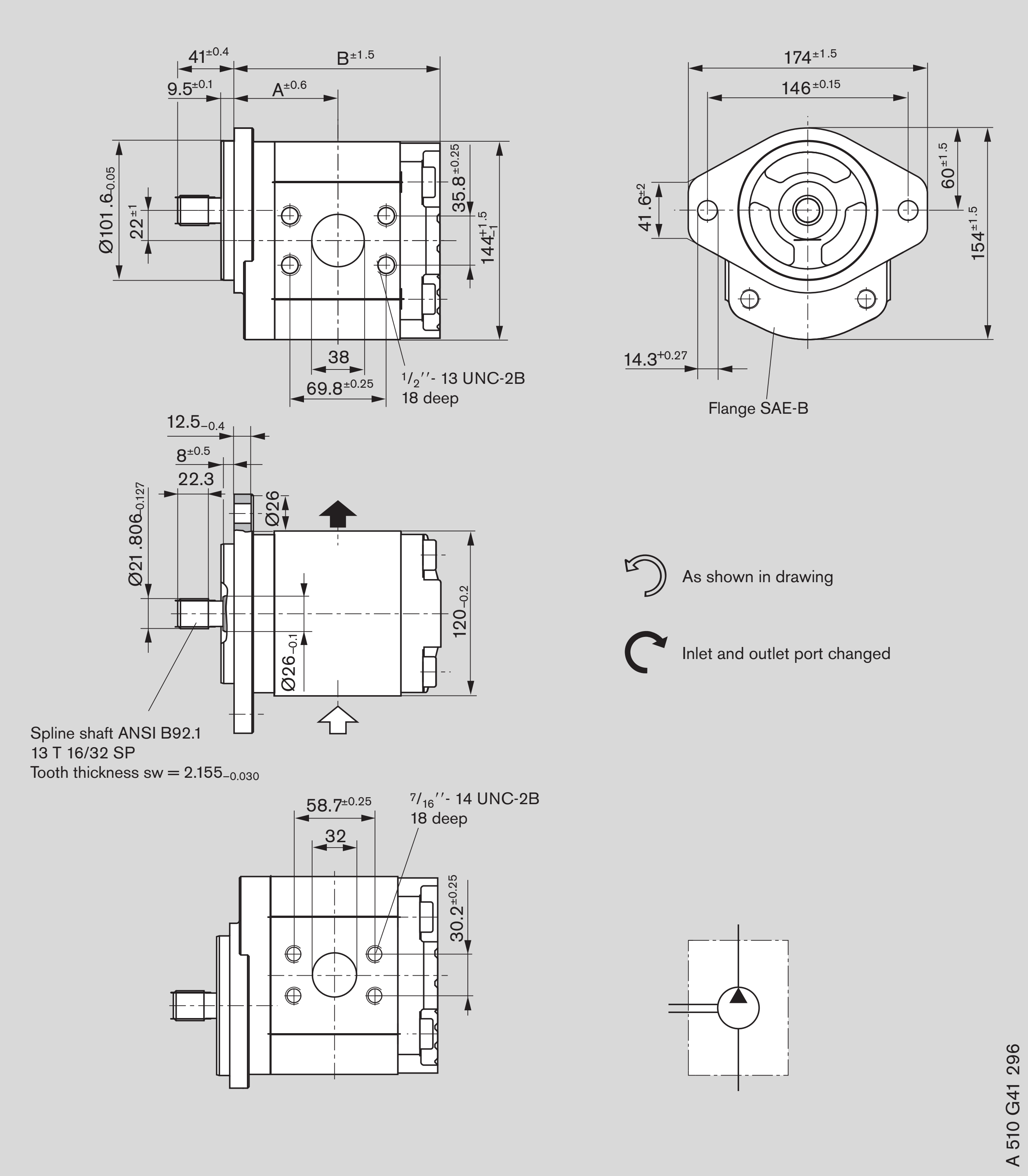


Ordering code:
AZPG – 22 – ☐ ☐ ☐ L D C 40 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	Dimension [mm] B
40	**9 510 490 056**		250	2800	73.6	144.8
45	**9 510 490 057**		250	2600	75.6	148.8
50	**9 510 490 058**		220	2600	77.7	153.0

Dimensions

Standard range

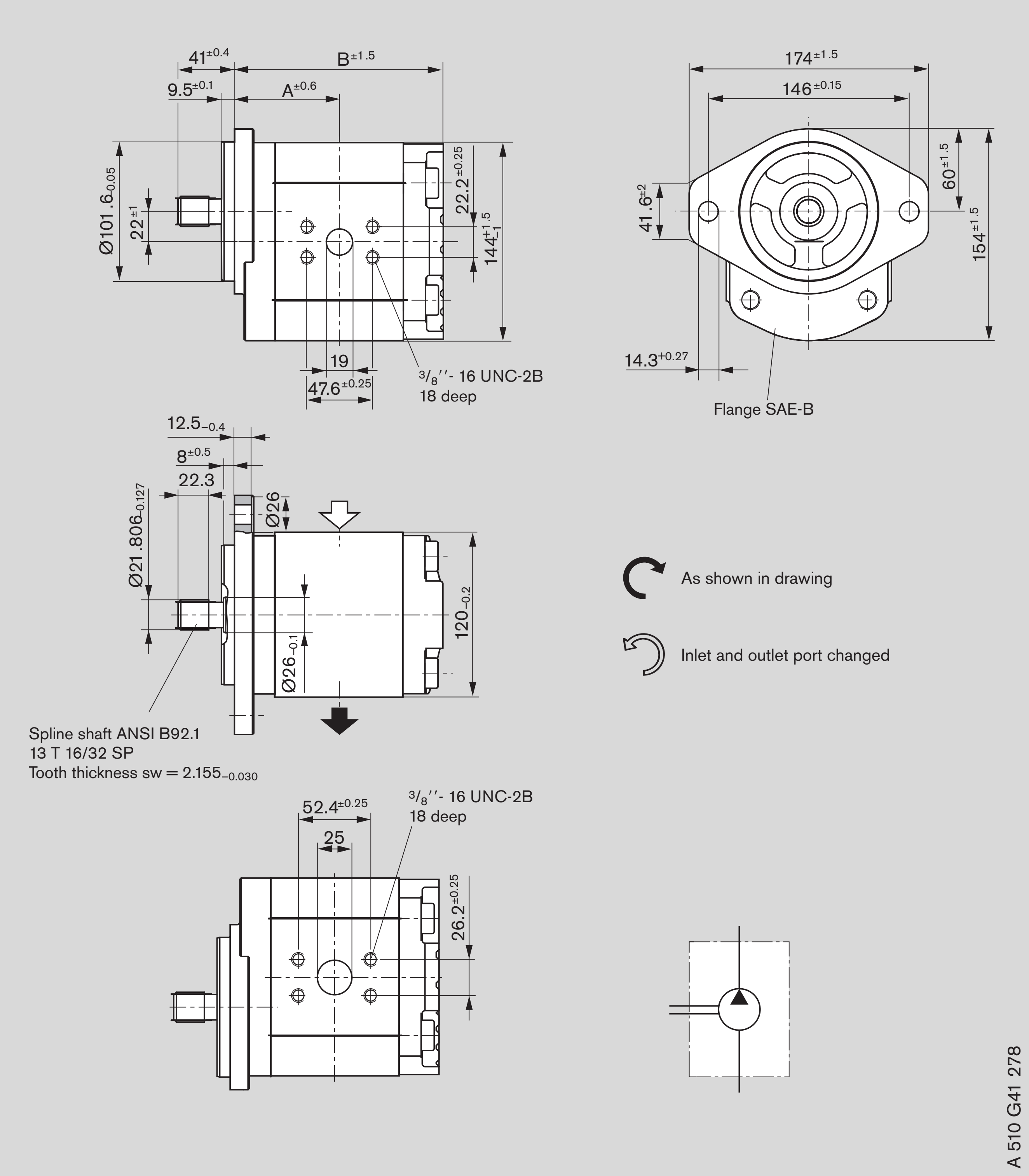


Ordering code:
AZPG – 22 – ☐ ☐ ☐ L D C 40 M B

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	Dimension [mm]	
[cm^3/rev]	↺ L	↻ R	[bar]	[rpm]	A	B
56	**9 510 490 059**		195	2300	80.2	157.9
63	**9 510 490 060**		170	2300	83.1	163.8

Dimensions

Standard range

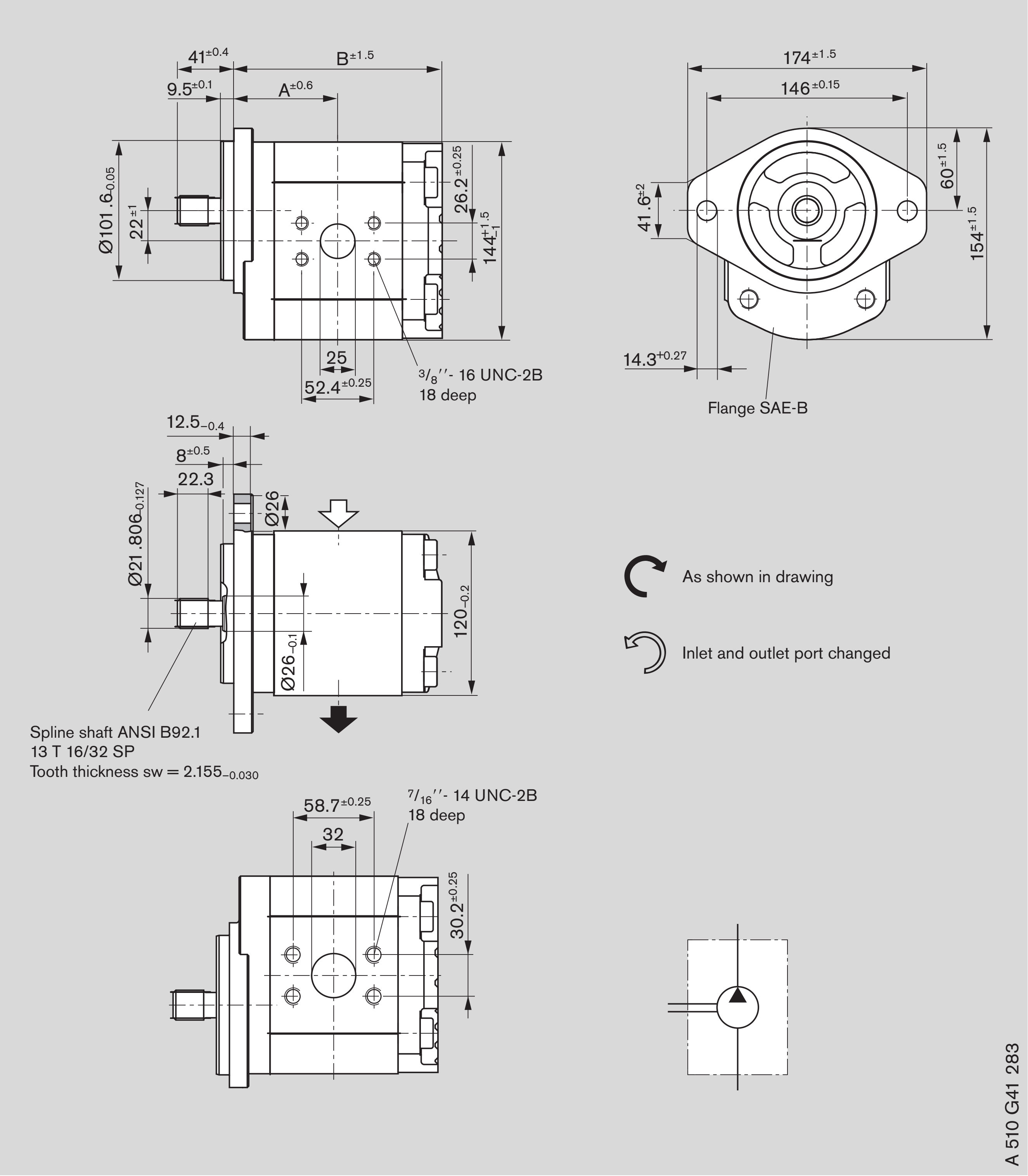


Ordering code:
AZPG – 22 – ☐ ☐ ☐ R D C 40 M B

Displacement [cm^3/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	Dimension [mm] B
22.5		**9 510 490 041**	250	3000	66.4	130.3
25		**9 510 490 042**	250	3000	67.4	132.3
28		**9 510 490 043**	250	3000	68.7	134.8
32		**9 510 490 044**	250	2800	70.3	138.1
36		**9 510 490 045**	250	2800	71.9	141.5

Dimensions

Standard range

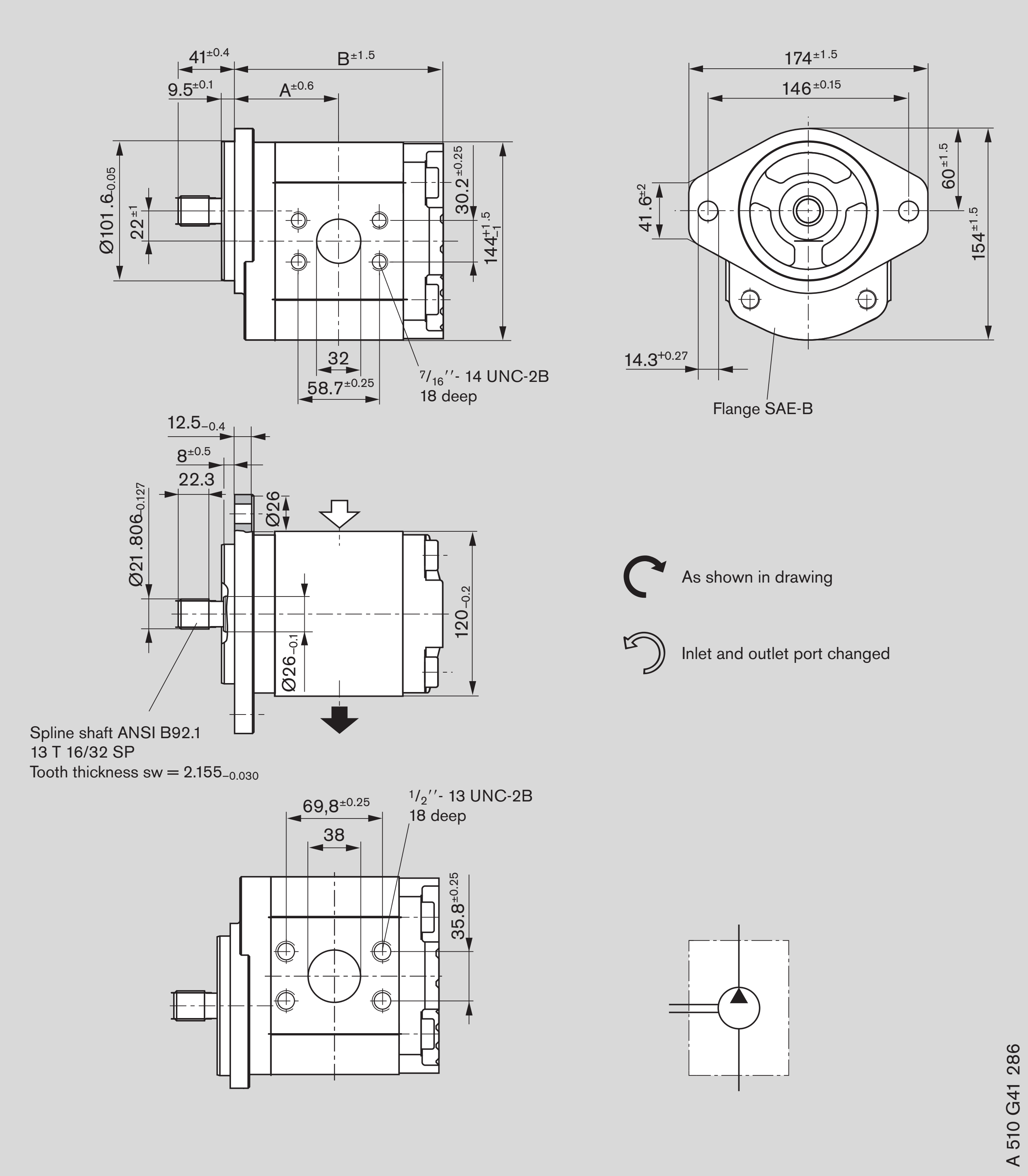


Ordering code:
AZPG – 22 – ☐ ☐ ☐ R D C 40 M B

Displacement [cm^3/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	 B
40		**9 510 490 046**	250	2800	73.6	144.8
45		**9 510 490 047**	250	2600	75.6	148.8
50		**9 510 490 048**	220	2600	77.7	153.0

Dimensions

Standard range

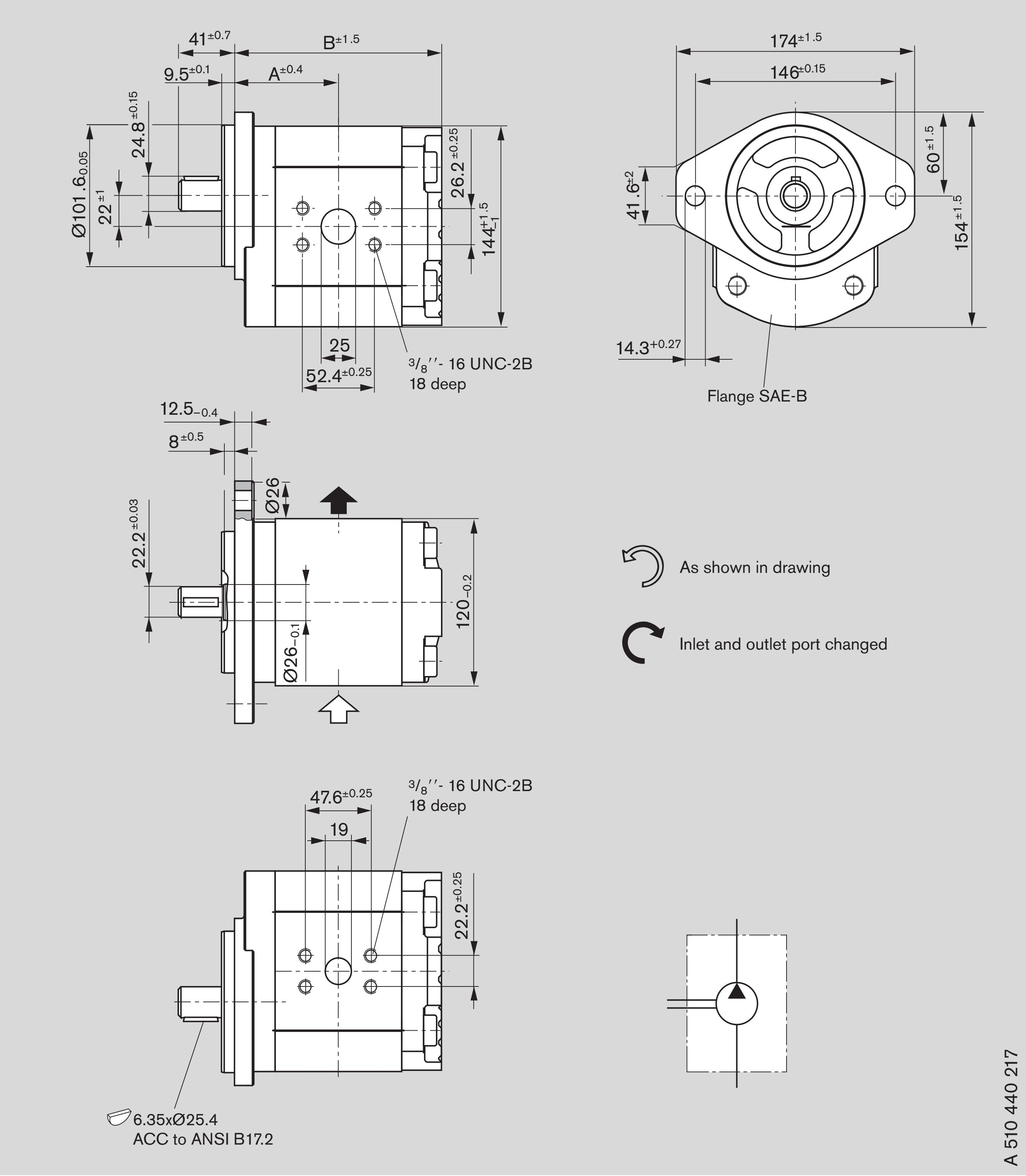


Ordering code:
AZPG – 22 – ☐ ☐ ☐ ☐ D C 40 M B

Displacement [cm³/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	 B
56		**9 510 490 049**	195	2300	80.2	157.9
63		**9 510 490 050**	170	2300	83.1	163.8

Dimensions

Standard range



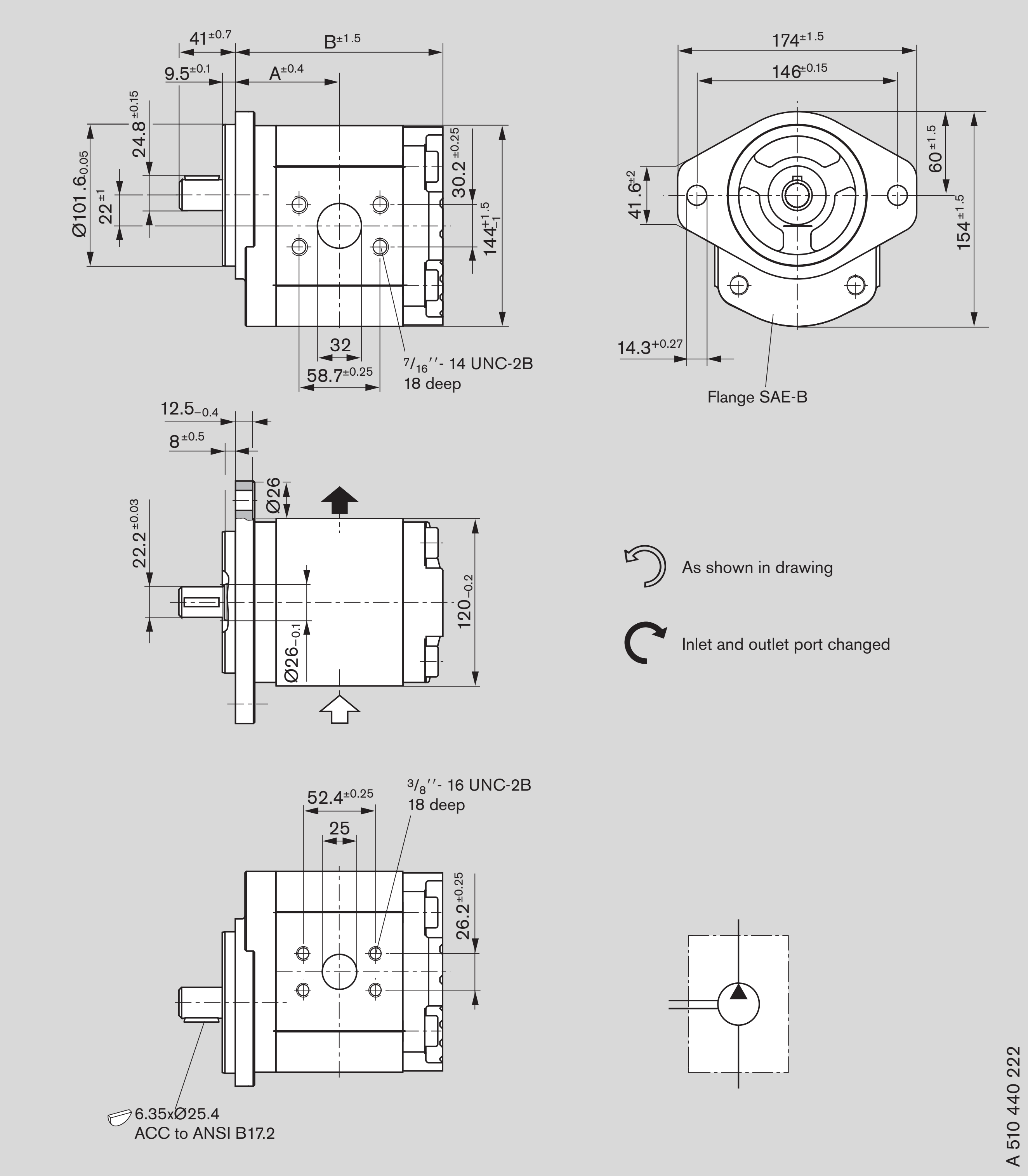
Ordering code:

AZPG – 22 – ☐ ☐ ☐ L Q C 40 M B

Displacement	Ordering-No.		Max. operating pressure	Max. rotation speed	Dimension	
[cm^3/rev]	L	R	[bar]	[rpm]	[mm] A	B
22.5	**9 510 490 091**		250	3000	66.4	130.3
25	**9 510 490 092**		250	3000	67.4	132.3
28	**9 510 490 093**		250	3000	68.7	134.8
32	**9 510 490 094**		250	2800	70.3	138.1
36	**9 510 490 095**		250	2800	71.9	141.5

Dimensions

Standard range

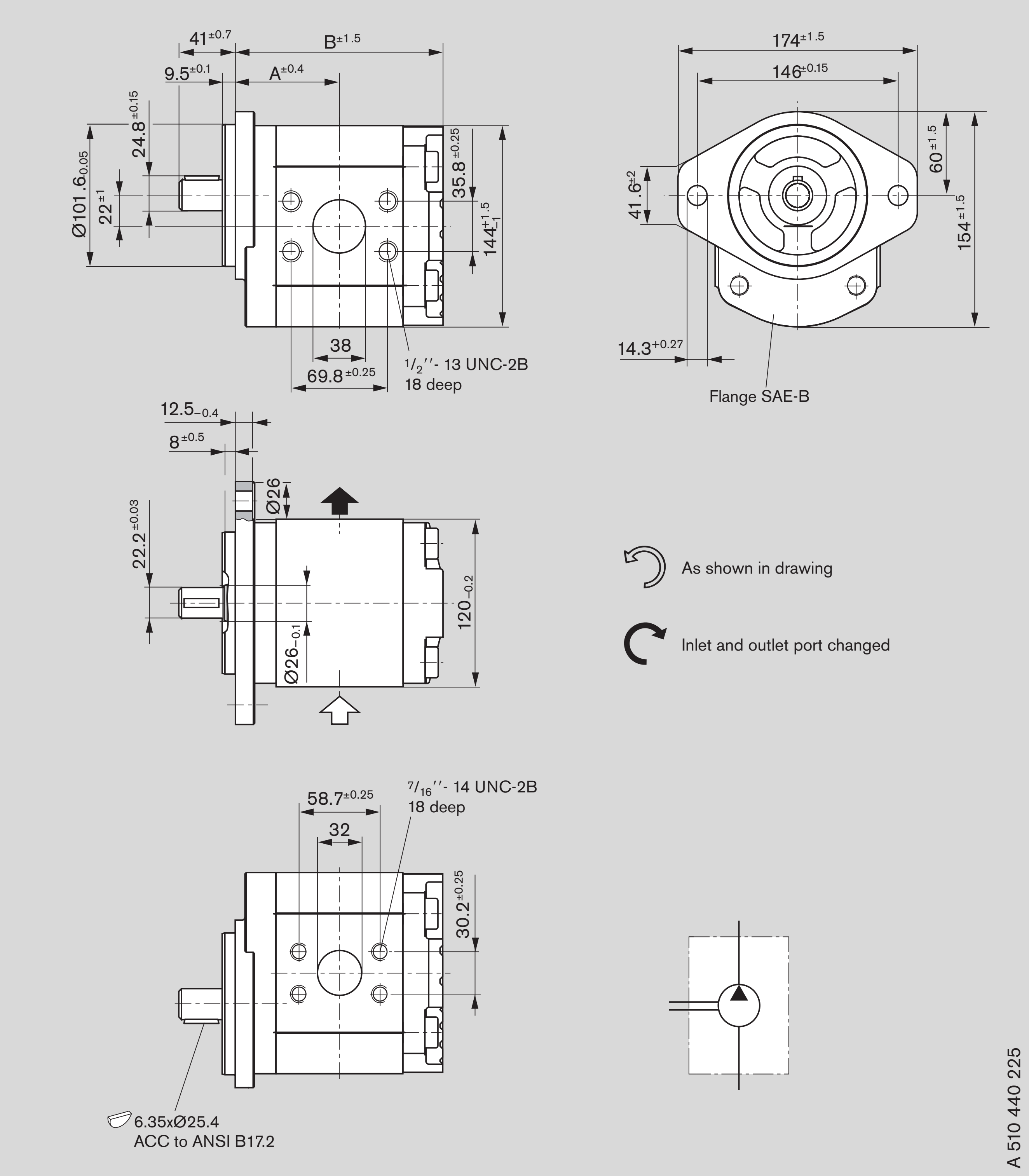


Ordering code:
AZPG – 22 – ☐ ☐ ☐ L Q C 40 M B

Displacement [cm^3/rev]	Ordering-No. ↺ L	↻ R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B
40	**9 510 490 096**		250	2800	73.6	144.8
45	**9 510 490 097**		250	2600	75.6	148.8
50	**9 510 490 098**		220	2600	77.7	153.0

Dimensions

Standard range



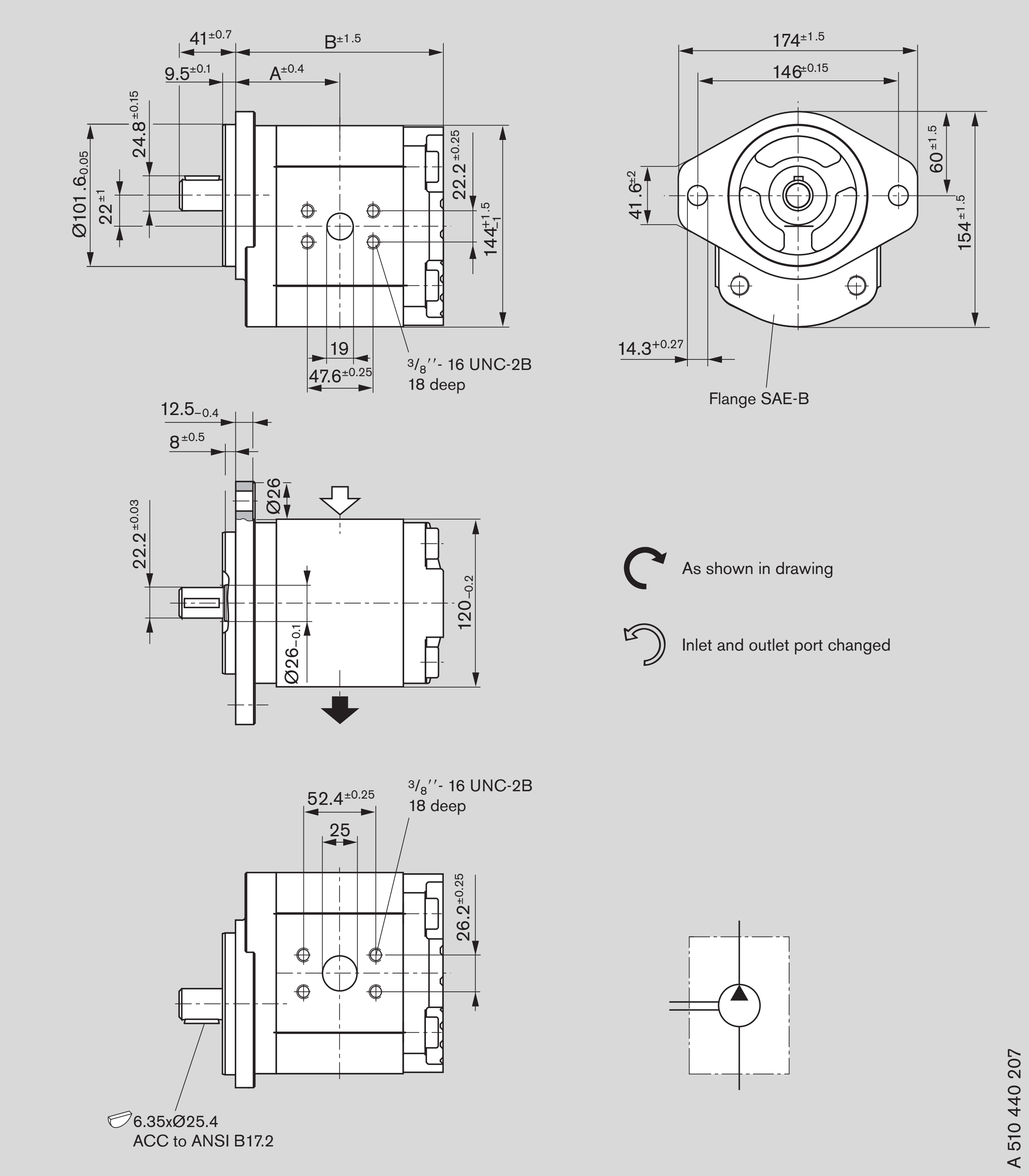
Ordering code:

AZPG – 22 – ☐ ☐ ☐ L Q C 40 M B

Displacement [cm³/rev]	Ordering-No. L	R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B
56	**9 510 490 099**		195	2300	80.2	157.9
63	**9 510 490 100**		170	2300	83.1	163.8

Dimensions

Standard range

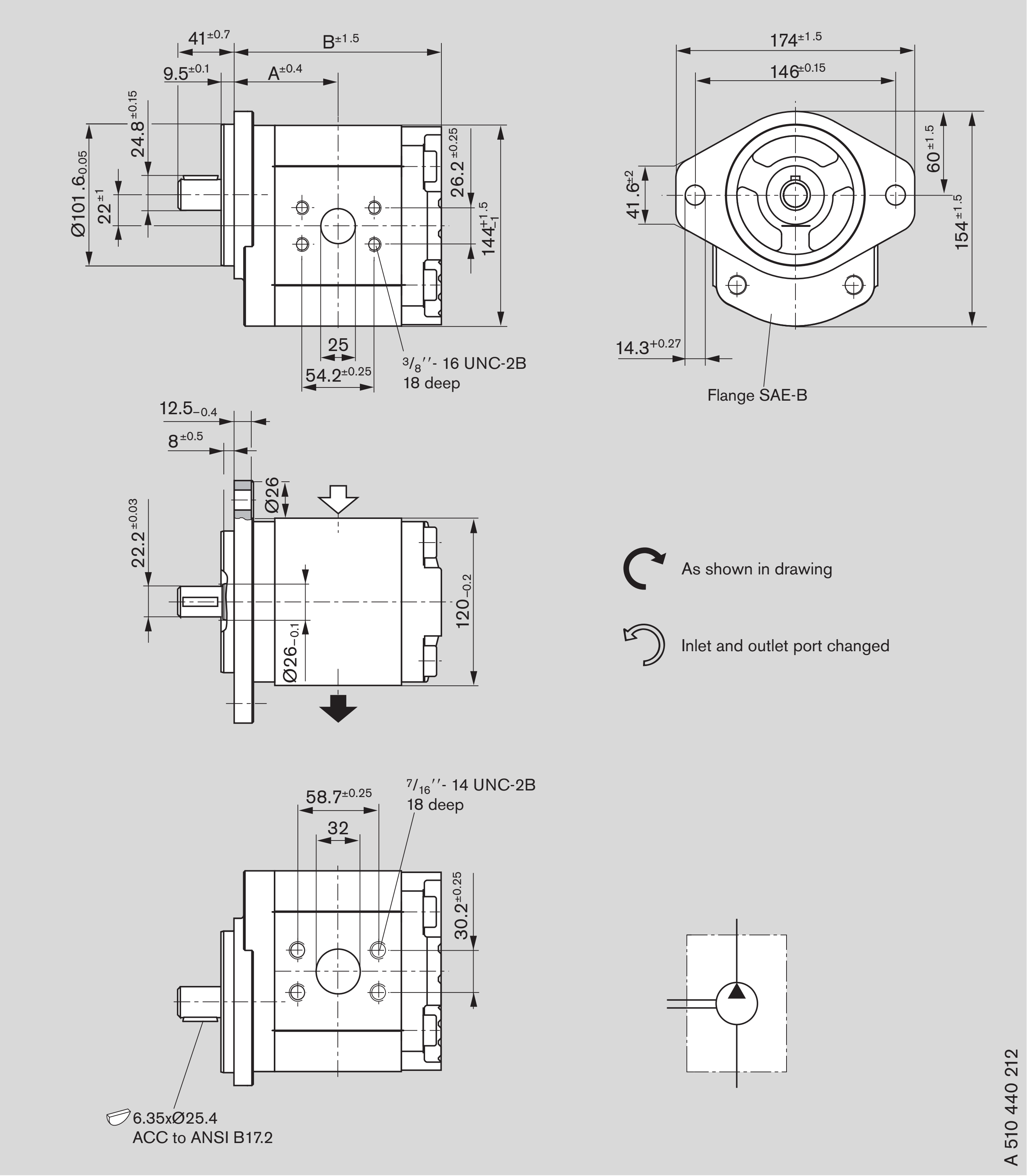


Ordering code:
AZPG – 22 – ☐ ☐ ☐ R Q C 40 M B

Displacement [cm³/rev]	Ordering-No. L	R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B
22.5		**9 510 490 081**	250	3000	66.4	130.3
25		**9 510 490 082**	250	3000	67.4	132.3
28		**9 510 490 083**	250	3000	68.7	134.8
32		**9 510 490 084**	250	2800	70.3	138.1
36		**9 510 490 085**	250	2800	71.9	141.5

Dimensions

Standard range

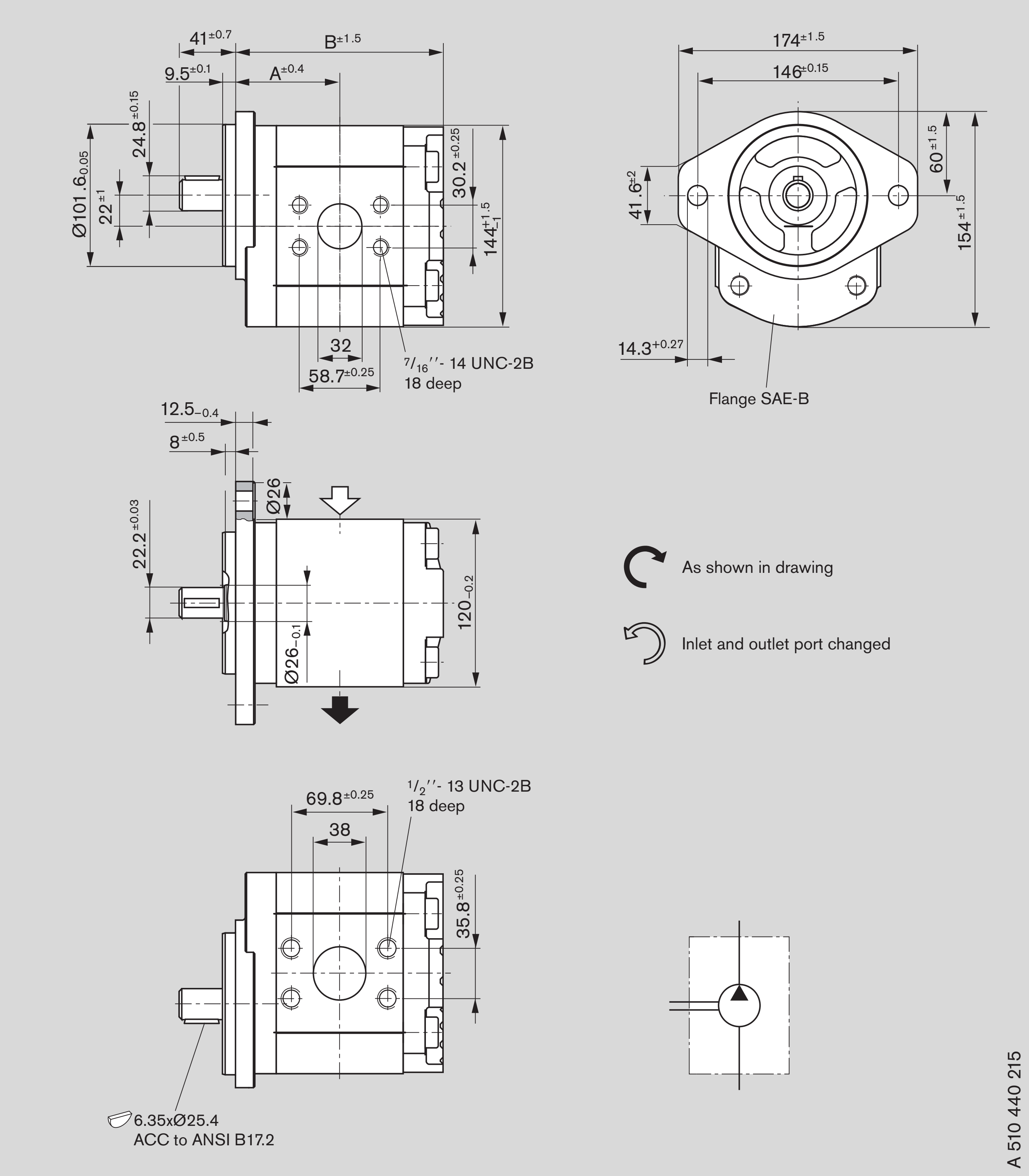


Ordering code:
AZPG – 22 – ☐ ☐ ☐ R Q C 40 M B

Displacement [cm³/rev]	Ordering-No. L	R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	B
40		**9 510 490 086**	250	2800	73.6	144.8
45		**9 510 490 087**	250	2600	75.6	148.8
50		**9 510 490 088**	220	2600	77.7	153.0

Dimensions

Standard range

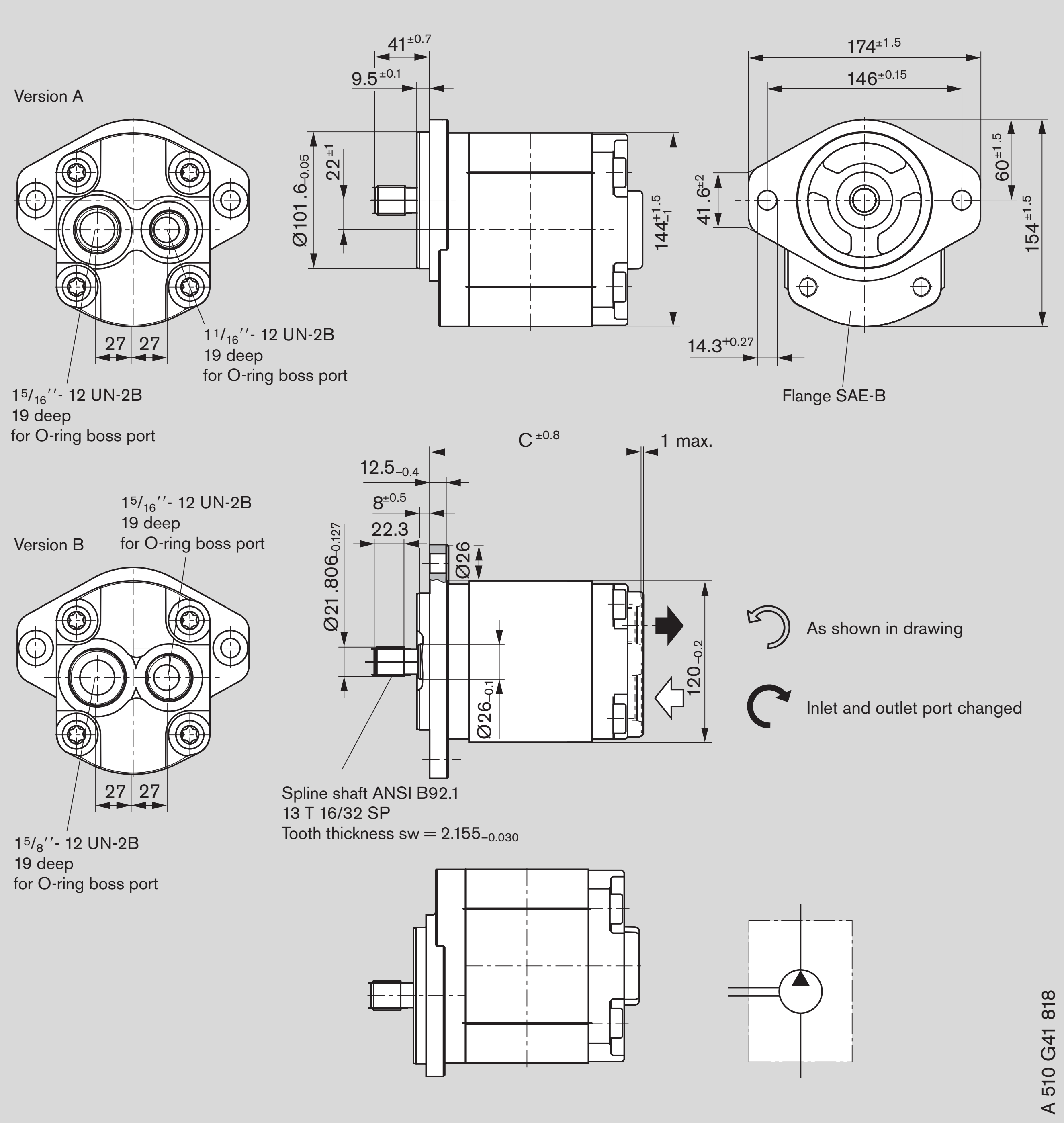


Ordering code:
AZPG – 22 – ☐ ☐ ☐ R Q C 40 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] A	Dimension [mm] B
56		**9 510 490 089**	195	2300	80.2	157.9
63		**9 510 490 090**	170	2300	83.1	163.8

Dimensions

Standard range

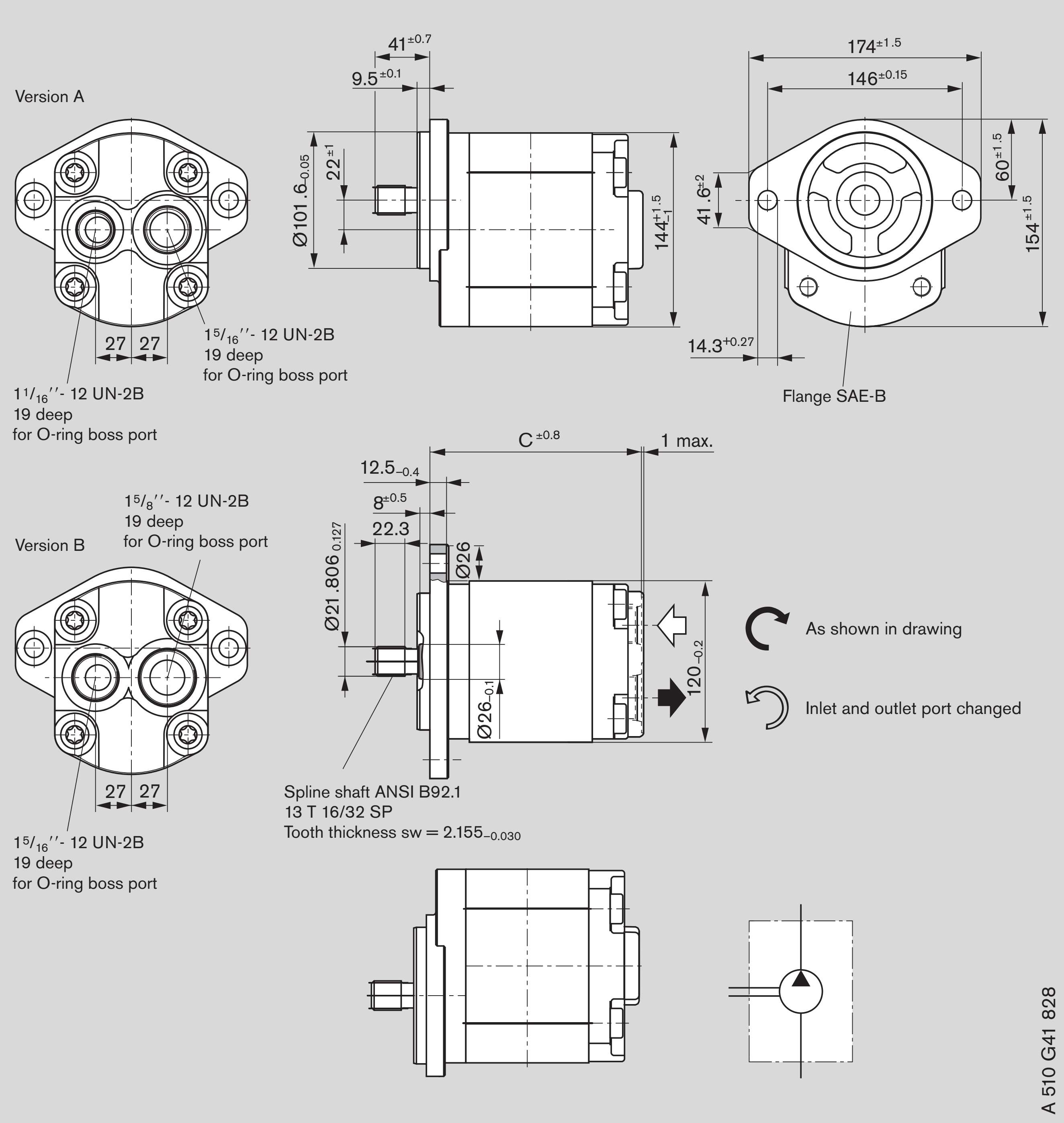


Ordering code:
AZPG – 22 – ☐ ☐ ☐ L D C 12 M A

Displacement [cm³/rev]	Ordering-No. L	R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] C	Version
22.5	**9 510 490 071**		250	3000	141.2	A
25	**9 510 490 072**		250	3000	143.2	A
28	**9 510 490 073**		250	3000	145.7	A
32	**9 510 490 074**		250	2800	149.0	B
36	**9 510 490 075**		250	2800	152.4	B
40	**9 510 490 076**		250	2800	155.6	B
45	**9 510 490 077**		250	2600	159.7	B
50	**9 510 490 078**		220	2600	163.9	B
56	**9 510 490 079**		195	2300	169.8	B
63	**9 510 490 080**		170	2300	174.6	B

Dimensions

Standard range

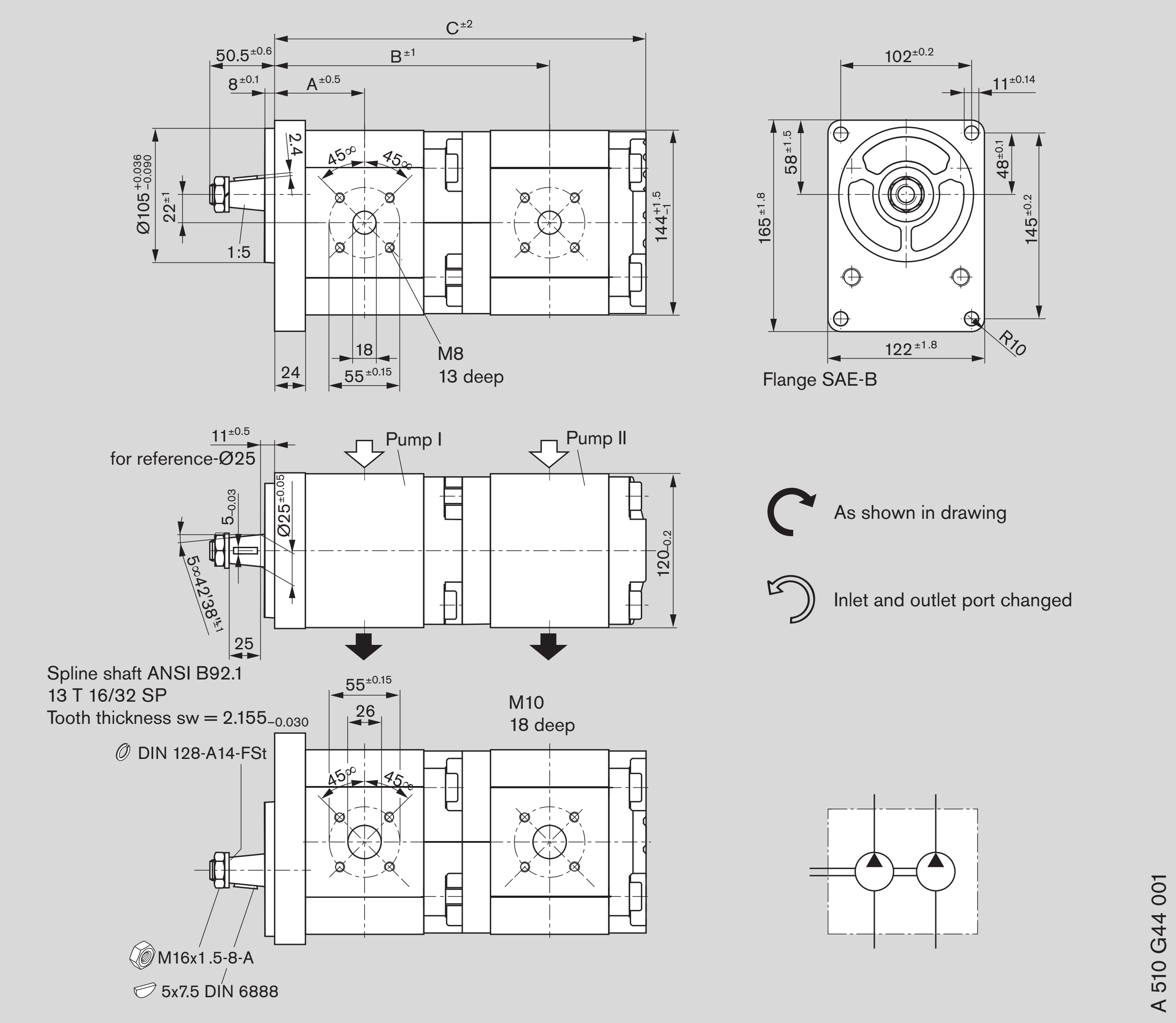


Ordering code:
AZPG – 22 – ☐ ☐ ☐ R D C 12 M A

Displacement [cm³/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	Dimension [mm] C	Version
22.5		**9 510 490 061**	250	3000	141.2	A
25		**9 510 490 062**	250	3000	143.2	A
28		**9 510 490 063**	250	3000	145.7	A
32		**9 510 490 064**	250	2800	149.0	B
36		**9 510 490 065**	250	2800	152.4	B
40		**9 510 490 066**	250	2800	155.6	B
45		**9 510 490 067**	250	2600	159.7	B
50		**9 510 490 068**	220	2600	163.9	B
56		**9 510 490 069**	195	2300	169.8	B
63		**9 510 490 070**	170	2300	174.6	B

Dimensions

Standard range



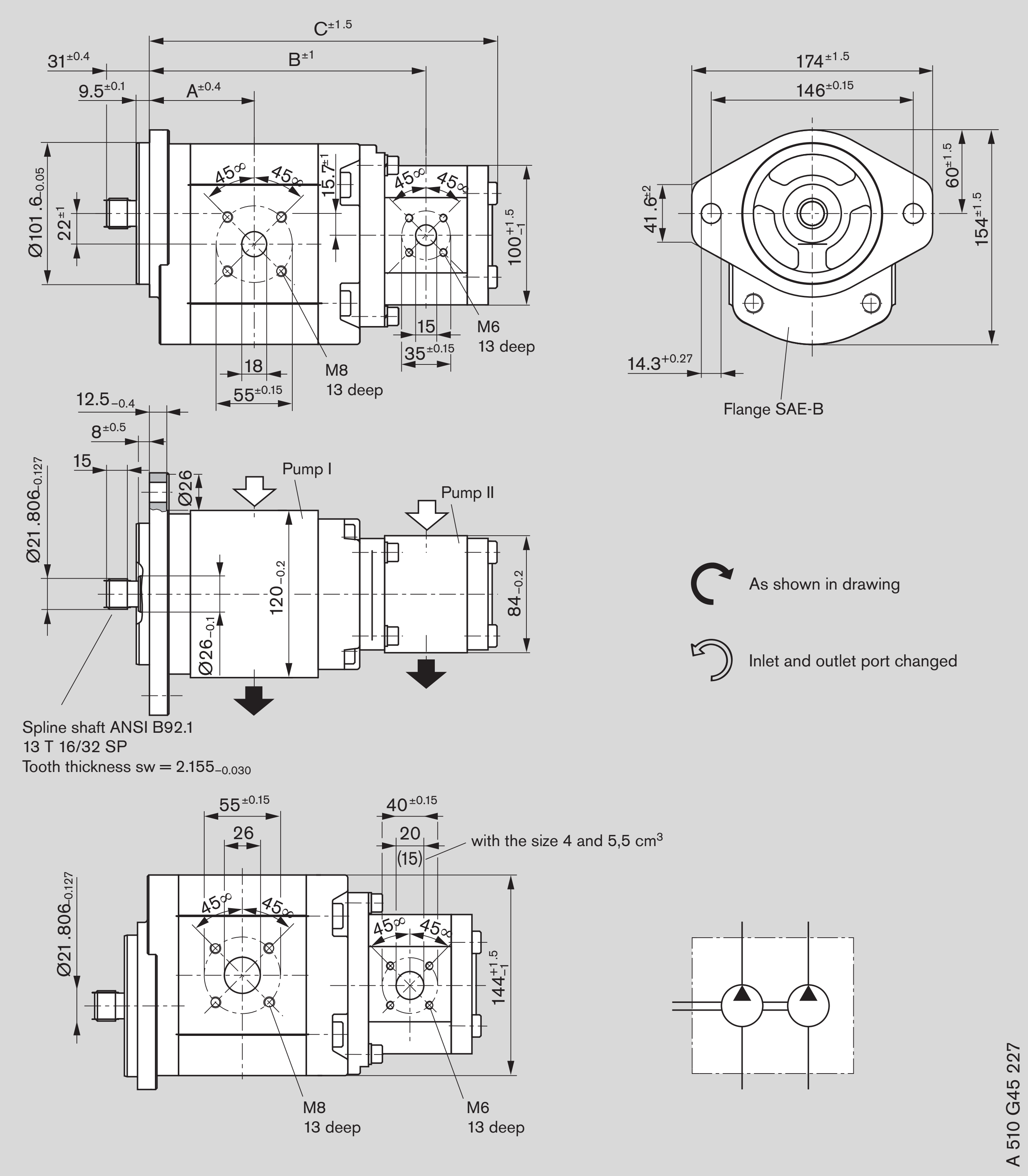
Ordering code:

AZPGG – 22 – ☐ ☐ ☐ / ☐ ☐ ☐ ☐ C B 20 20 M B

Displacement [cm³/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed	Dimension [mm]		
		↺	↻						
P_{I}	P_{II}	L	R	P_{I}	P_{II}	[rpm]	A	B	C
22.5	22.5		**0 510 765 115**	280	280	3000	60.9	186.4	250.4
22.5	22.5	**0 510 765 430**		280	280	3000	60.9	186.4	250.4
32	22.5		**0 510 767 079**	280	280	2800	64.8	194.2	258.2
32	22.5	**0 510 767 337**		280	280	2800	64.8	194.2	258.2
32	32		**0 510 767 078**	280	230	2800	64.8	198.1	266.0
32	32	**0 510 767 336**		280	230	2800	64.8	198.1	266.0
40	22.5		**0 510 768 051**	260	280	2800	68.1	200.9	264.8
40	22.5	**0 510 768 332**		260	280	2800	68.1	200.9	264.8
40	32		**0 510 768 050**	230	230	2800	68.1	204.8	272.6
40	32	**0 510 768 331**		230	230	2800	68.1	204.8	272.6
40	40		**0 510 768 049**	230	180	2800	68.1	208.1	279.3
40	40	**0 510 768 330**		230	180	2800	68.1	208.1	279.3
45	22.5		**0 510 769 033**	230	280	2600	70.1	204.9	268.9
45	32		**0 510 769 032**	200	230	2600	70.1	208.9	276.7
45	45	**0 510 769 325**		200	160	2600	70.1	214.2	287.4
45	45		**0 510 769 030**	200	160	2600	70.1	214.2	287.4
45	40		**0 510 769 031**	200	180	2600	70.1	212.2	283.3
56	40		**0 510 865 013**	170	180	2300	74.7	221.3	292.4

Dimensions

Standard range

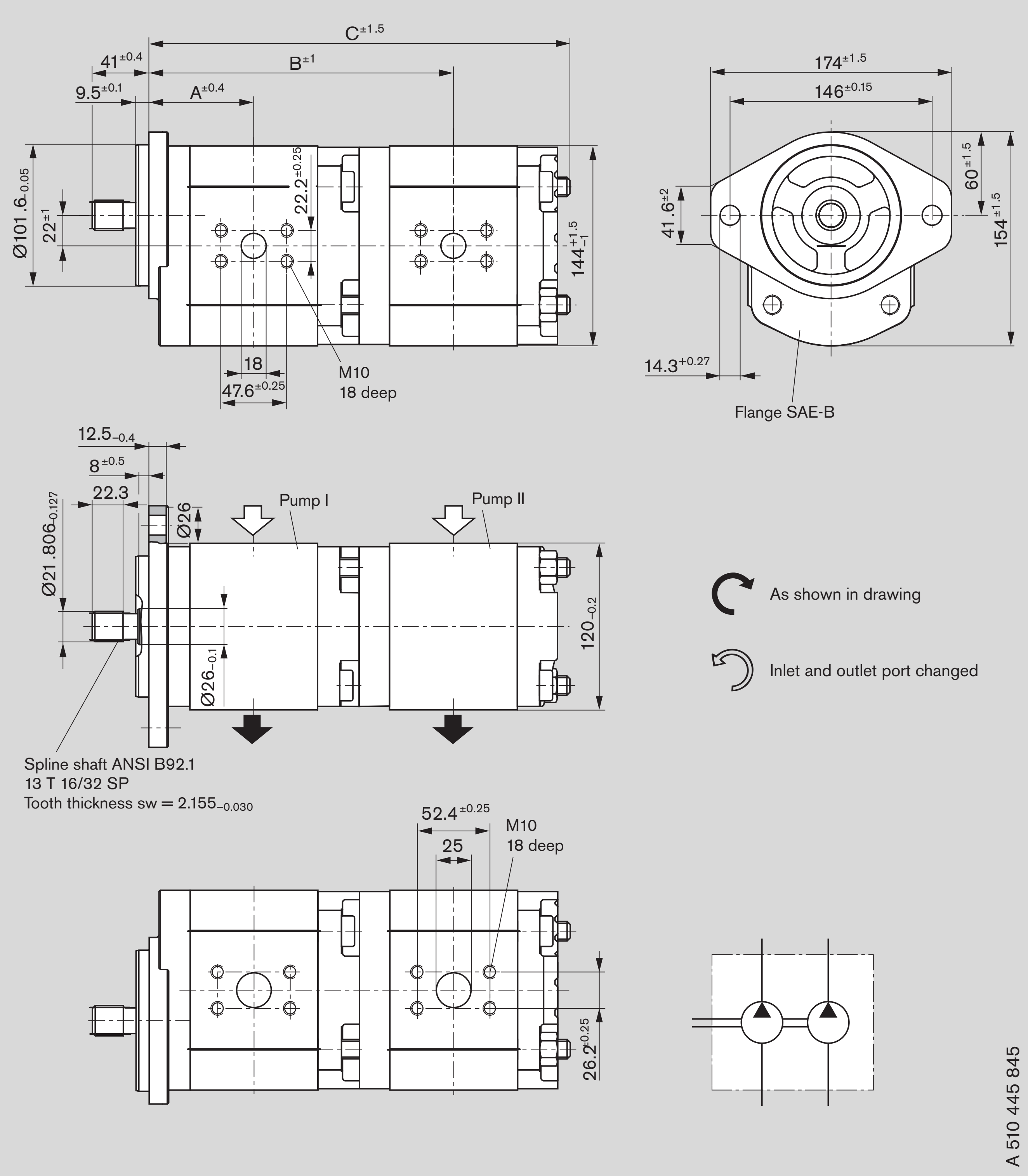


Ordering code:
AZPGF – 22 – ☐☐☐ / ☐☐☐ ☐ D C 20 20 M B

Displacement [cm³/rev]		Ordering-No. ↺	↻	Max. operating pressure [bar]		Max. rotation speed	Dimension [mm]		
PI	PII	**L**	**R**	PI	PII	[rpm]	A	B	C
22.5	16		**0 510 765 118**	250	230	3000	66.4	181.2	236.2
32	16		**0 510 767 067**	250	230	2800	70.3	189.0	244.0
56	16	**0 510 665 320**		200	230	2300	80.2	208.8	263.8
56	19	**0 510 865 319**		200	190	2300	80.2	208.8	268.8
56	22.5		**0 510 865 016**	200	160	2300	80.2	216.4	274.2

Dimensions

Standard range



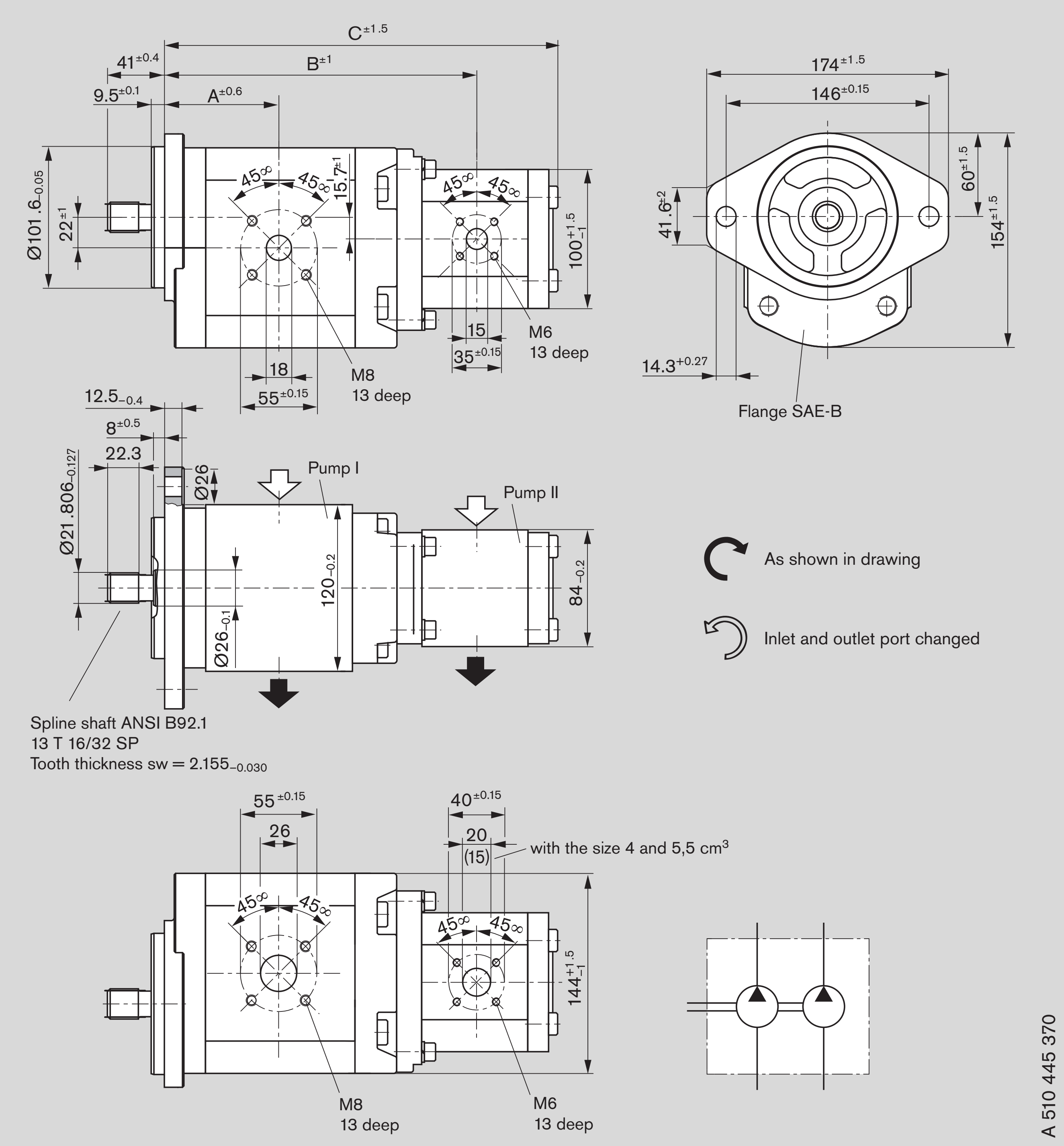
Ordering code:

AZPGG – 22 – ☐☐☐ ☐☐☐ ☐D C 07 07 M B

Displacement [cm^3/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed	Dimension [mm]		
PT 1	PT 2	L	R	PT 1	PT 2	[rpm]	A	B	C
28	28		**0 510 766 016**	260	260	2500	68.7	198.7	269.2

Dimensions

Standard range



Ordering code:

AZPGF – 22 – ☐☐☐ ☐☐☐ ☐DC 20 20 M B

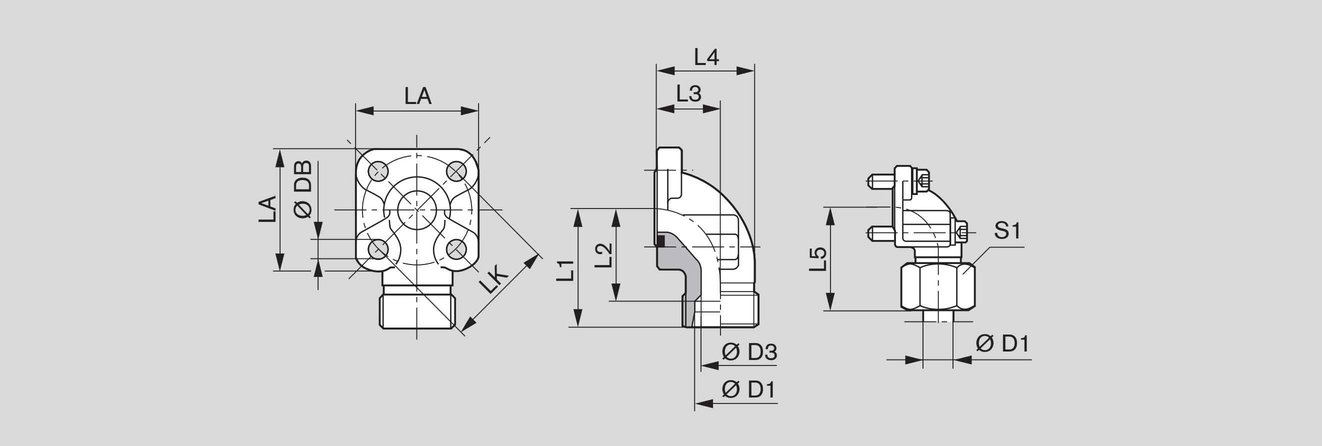
AZPGF – 22 – ☐☐☐ ☐☐☐ ☐DC 20 20 K B*

Displacement [cm^3/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed	Dimension [mm]		
PT 1	PT 2	↺ L	↻ R	PT 1	PT 2	[rpm]	A	B	C
32	11	**0 510 767 324***		280	280	1700	70.3	188.5	235.6
32	14		**0 510 767 066**	280	260	2800	70.3	189.0	240.6
32	16	**0 510 767 330**		280	230	2800	70.3	189.0	244.0
32	16	**0 510 767 328***	**0 510 767 064***	280	230	2800	70.3	189.0	244.0
40	14		**0 510 768 043**	280	260	2800	73.6	195.6	247.3
45	11	**0 510 769 318***		250	280	1700	75.6	199.2	246.4
45	16	**0 510 769 319***		250	230	1700	75.6	199.7	254.8
45	16		**0 510 769 022**	280	230	2600	75.6	199.7	254.8
45	19	**0 510 769 321**	**0 510 769 023**	280	190	2600	75.6	199.7	259.8

Fittings

Fittings can be used for rectangular flange 20 see page 7

Gear pump flange, 90° angle

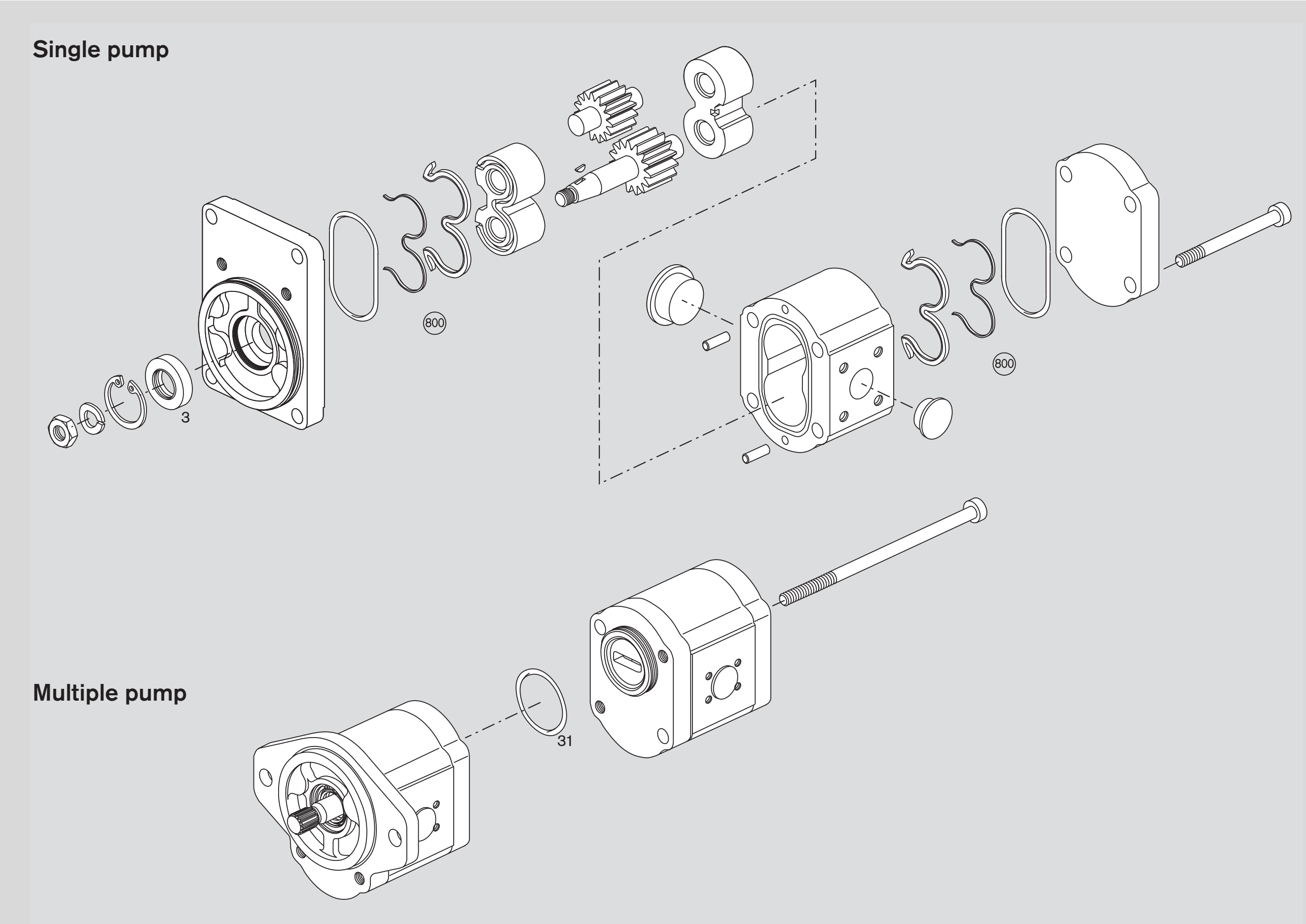


LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws 2x	 2x	Seal ring	Mass kg	Part number	*p* (bar)
55	20S	17	45	34.5	24.0	40.0	56.0	58	36	8.4	M8x25	M8x50	33x2.5	0.44	**1 515 702 004**	250
55	30S	26	49	35.5	32.0	50.0	62.0	58	50	8.4	M8x25	M8x50	33x2.5	0.50	**1 545 719 006**	250
55	35L	31	49	38.5	32.0	51.5	62.0	58	50	8.4	M8x25	M8x60	32x2.5	0.47	**1 515 702 005**	100
55	42L	38	49	38.0	40.0	64.5	61.0	58	60	8.4	M8x25	M8x70	32x2.5	0.60	**1 515 702 019**	100

Complete fittings with seal ring, metric screw set, nuts and olive.

Note
The permissible tightening torques can be found in our publication:
"General operating instructions for external gear units"
RE 07 012-B1.

Spare parts


Single pump

Multiple pump

Page	Ordering code	Seal kit „G“ NBR	Shaft seal ring Pos. 3	Qty.	Dimension	Material
18	AZPG – 22 – □□□ □C B 20 M B	1517010231	1510283072	1	42x26x7	NBR
19	AZPG – 22 – □□□ □H O 30 M B	1517010231	1510283072	1	42x26x7	NBR
20, 21, 22	AZPG – 22 – □□□ □D C 07 K B	1517010231	1510283069	1	42x26x7	FKM
23, 24, 25	AZPG – 22 – □□□ □Q C 12 M B – S 06 62	1517010231	1510283072	1	42x26x7	NBR
26, 27, 28	AZPG – 22 – □□□ □X 07 K B – S 03 03	1517010231	1510283069	1	42x26x7	FKM
29, 30, 31	AZPG – 22 – □□□ □D C 07 K B – S 00 39	1517010231	1510283069	1	42x26x7	FKM
32, 33, 34, 35, 36, 37	AZPG – 22 – □□□ □D C 12 M B	1517010231	1510283072	1	42x26x7	NBR
38, 39	AZPG – 22 – □□□ □Q C 12 M A	1517010234	1510283072	1	42x26x7	NBR
40, 41, 42, 43, 44, 45 46, 47, 48, 49, 50, 51	AZPG – 22 – □□□ □D C 40 M B	1517010231	1510283072	1	42x26x7	NBR
52, 53	AZPG – 22 – □□□ □D C 12 M A	1517010234	1510283072		42x26x7	NBR
54	AZPG – 22 – □□□/□□□ □C B 20 20 M B					
	Pump section 1	1517010231	1510283072	1	42x26x7	NBR
			1510283075	1	42x26x7	FKM
	Pump section 2	1517010208				
55	AZPG – 22 – □□□/□□□ □D C 20 20 K B					
	Pump section 1	1517010231	1510283069	2	42x26x7	FKM
	Pump section 2	1517010208				
56	AZPG – 22 – □□□/□□□ □D C 07 07 M B					
	Pump section 1	1517010231	1510283072	1	42x26x7	NBR
			1510283075	1	42x26x7	FKM
	Pump section 2	1517010231				
57	AZPG – 22 – □□□/□□□ □D C 20 20 M B					
	Pump section 1	1517010231	1510283069	2	42x26x7	FKM
	Pump section 2	1517010208				

NBR = Perbunan® FKM = Viton®

For multiple pumps	Seal ring Item 31 NBR	1 900 210 145

Notes for commissioning

Filter recommendation

The major share of premature failures in external gear pumps is caused by contaminated hydraulic fluid.

As a warranty cannot be issued for dirt-specific wear, we recommended filtration compliant with cleanliness level 20/18/15 ISO 4406, which reduces the degree of contamination to a permissible dimension in terms of the size and concentration of dirt particles:

Operating pressure [bar]	>160	<160
Contamination class ISO 4406	18/15	19/16
To be reached with $\beta_X = 75$	20	25

We recommend that a full-flow filter always be used.

Basic contamination of the hydraulic fluid used may not exceed class 20/18/15 according to ISO 4406. Experience has shown that new fluid quite often lies above this value. In such instances a filling device with special filter should be used.

General

- The pumps supplied by us have been checked for function and performance. No modifications of any kind may be made to the pumps; any such changes will render the warranty null and void!
- Pump may only be operated in compliance with permitted data (see pages 14 – 17).

Project planning notes

Comprehensive notes and suggestions are available in Hydraulics Trainer, Volume 3 RE 00 281, “Project planning notes and design of hydraulic systems”. Where external gear pumps are used we recommend that the following note be adhered to.

Technical data

All stated technical data is dependent on production tolerances and is valid for specific marginal conditions.

Note that, as a consequence, scattering is possible, and at certain marginal conditions (e.g. viscosity) **the technical data may change**.

Characteristics

When designing the external gear pump, note the maximum possible service data based on the characteristics displayed on pages 9 – 11 .

Additional information on the proper handling of hydraulic products from Bosch Rexroth is available in our document: “General product information for hydraulic products” RE 07 008.

Contained in delivery

The components with characteristics as described under ordering code and device measurements, pages 18 – 57, are contained in delivery.

You can find further information in our publication:
“General Operating Instructions for External Gear Units”
RE 07 012-B1.

Ordering-No.

Ordering-No.

The AZ configurator

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly. You only need to specify your requirements: From the displacement, direction of rotation, drive shaft, connection flange right up to the required rear cover. You immediately receive a project drawing (PDF format) if a configuration already exists. You receive the price of the configured external gear unit upon request.

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly – all data needed for project planning are acquired thru menu guidance.

Selection is made either on an ordering code or your technical requirements. This means that you can search for external gear units that have already been configured, or you specify the configuration variant of the external gear unit based upon the operating parameters you require.

If the external gear unit you selected has been released you will receive the part number, ordering code and a detailed installation drawing. If your special configuration is not available please send your specification to Rexroth. One of our employees will then contact you.

External gear pumps

SILENCE / SILENCE PLUS

Designation	Type	Size	Series	Data sheet	Page
SILENCE					
External gear pump SILENCE	AZPS	4…28	1x/2x	10095	1487
External gear pump SILENCE	AZPT	20…36	2x	10092	1519
External gear pump SILENCE	AZPU	22…63	2x	10098	1541
SILENCE PLUS					
External gear pump SILENCE PLUS	AZPJ	12…28	2x	10094	1567

External Gear Pumps
Series S

AZPS-...

Fixed pumps
$V = 4.0...28\ \text{cm}^3/\text{rev}$

SILENCE

Overview of contents

Features

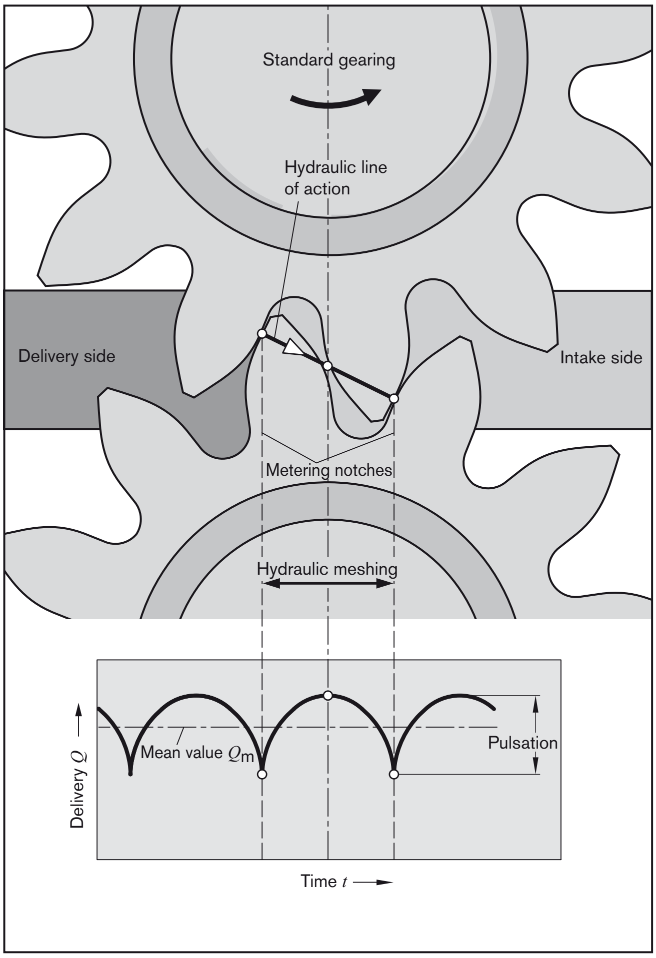
- Nominal pressure 280 bar
- Slide bearings for heavy duty applications
- Drive shafts to ISO or SAE
- Combination of several pumps possible
- Line ports:
  connection flange or screw thread
- Optimized pressure pulsation with reduced noise emissions and vibration excitation in the system
- Consistent high quality
- Considerably longer service life due to reinforced shaft and case

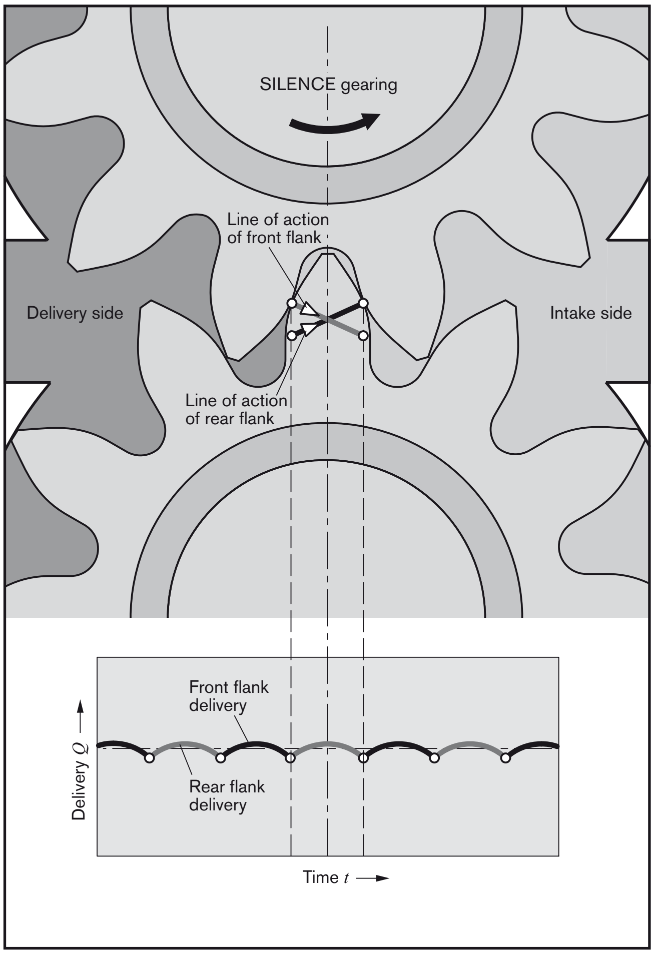
General

The key task of external gear units is to convert mechanical energy (torque and rotational speed) into hydraulic energy (flow and pressure). In external gear motors this is the other way round. These machines are required to be highly efficient in order to avoid unnecessary heat. This efficiency is achieved by means of precision production engineering and pressure-sensitive gap sealing.

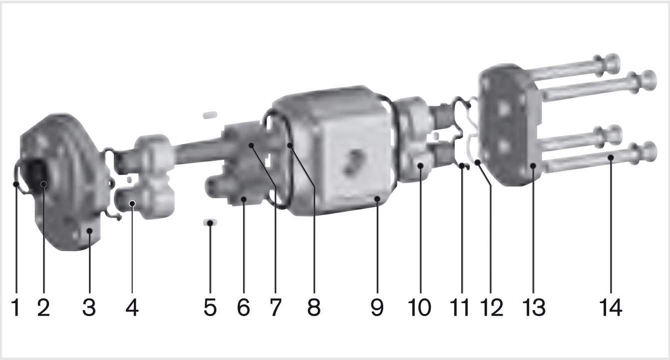
Moreover, in the low-noise SILENCE pumps, the dual-flank principle helps to reduce flow pulsation by up to 75 %.

The displacement method





The geometry of the displacement gearing, matched in form by the rotation of the drive shaft, results in the parabolic flow characteristic shown here on the left. In a standard pump, this characteristic is repeated each time a gear tooth meshes. With their dual-flank system, the flow pulsation of SILENCE pumps is reduced by 75 % – with correspondingly lower excitation of downstream system components – at double the fundamental frequency. During this process, the gear pair exhibits an extremely reduced rear flank backlash, so that hydraulic sealing is provided not just by the front flank of the driven gear, but also by the rear flanks. In this way, the front and rear flanks alternately contribute to flow displacement. And by adapting the shape of the metering notches, the expansion of the hydraulic line of action is half that of the standard pump.



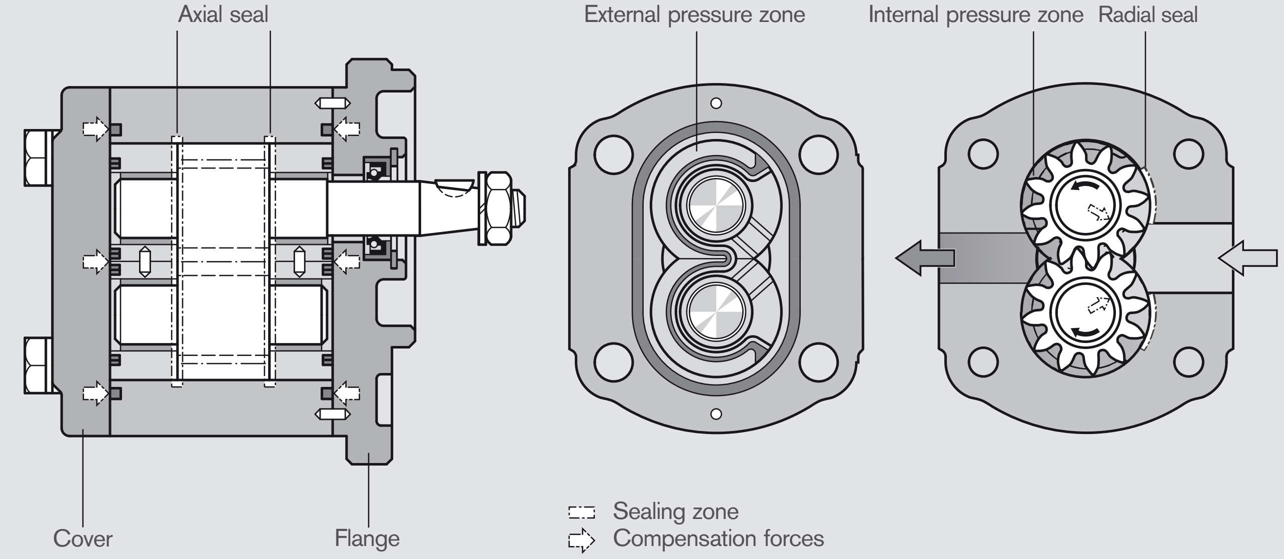
1 Retaining ring
2 Shaft seal ring
3 Front cover
4 Slide bearing
5 Centering pin
6 Gear
7 Gear (frictional)
8 Case seal
9 Pump case
10 Bearing
11 Axial zone seal
12 Support
13 End cover
14 Fixing screws

Construction

The external gear unit consists essentially of a pair of gears supported in bearing bushings and the case with a front and a rear cover. The drive shaft protrudes from the front cover where it is sealed by the shaft seal ring. The bearing forces are absorbed by special bearing bushings with sufficient elasticity to produce surface contact instead of line contact. They also ensure excellent resistance to galling – especially at low speed. The gears have 12 teeth. This keeps both flow pulsation and noise emission to a minimum.

The internal sealing is achieved by forces which are proportional to delivery pressure. This ensures optimum efficiency. The bearings provide the seal at the ends of the gaps between the teeth which carry the pressurized oil. The sealing zone between the gear teeth and the bearings is controlled by the admission of operating pressure to the rear of the bearing bushings. Special seals form the boundary of the zone. The radial clearance at the tips of the gear teeth is sealed by internal forces pushing them against the case.

Gear pump axial compensation



Product overview of “SILENCE standard range”

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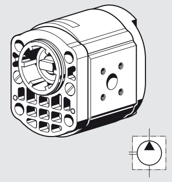
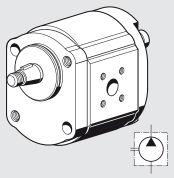
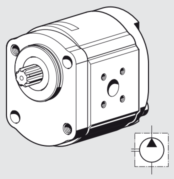
	19
	20
	21

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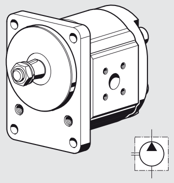
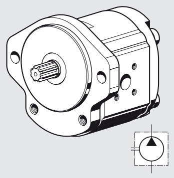
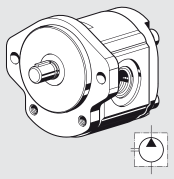
	22
	23
	24

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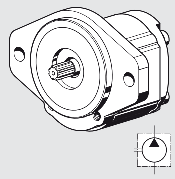
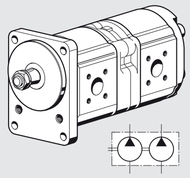
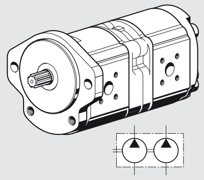
	25
	26
	27

Ordering code

External gear units Single pumps “SILENCE”

AZ	P	S	–	x	x	–	016	R	C	B	20	M	B	18009	S xxxx

Function

P = Pump

Series

1x = Standard bearing
2x = Reinforced bearing

Version

1 = Phosphatized, pinned
2 = Chromatized, pinned

Size (S)

004 = 4.0 cm³/rev
005 = 5.5 cm³/rev
008 = 8.0 cm³/rev
011 = 11.0 cm³/rev
014 = 14.0 cm³/rev
016 = 16.0 cm³/rev
019 = 19.0 cm³/rev
022 = 22.5 cm³/rev
025 = 25.0 cm³/rev
028 = 28.0 cm³/rev

Direction of rotation

R = Clockwise
L = Counter-clockwise

*) Some of the special designs shown on pages 19–27 are not covered in the illustration of the ordering code.

Special design *)

Valve adjustment

200 xx = PRV 200 bar
xxx 11 = FCV 11 l/min
18009 = PRV + FCV 180 bar, 9 l/min

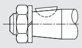
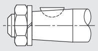
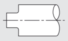
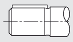
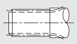
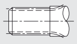
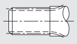
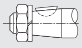
Rear cover

B = Standard
D = PRV residual flow internal
E = FCV residual flow external
S = FCV residual flow internal
V = PRV + FCV

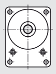
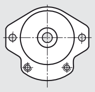
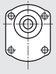
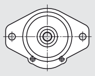
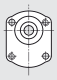
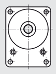
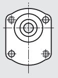
Seals

M = NBR
P = FKM
K = NBR, SSR in FKM

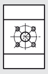
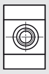
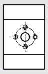
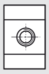
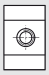
Drive shafts

			Suitable front cover	
C	Tapered key shaft 1 : 5		B	P
H	Tapered key shaft 1 : 8		O	
N	Dihedral claw		M	
Q	Straight keyed shaft SAE J 744 16-1		R	
R	Splined shaft SAE J 744 16-4 9T		R	C
P	Splined shaft SAE J 744 19-4 11T		R	C
F	Splined shaft DIN 5482 B 17 x 14		B	P
S	Tapered key shaft 1 : 5 for flange A		A	

Front cover

B	Square flange Centering Ø 80 mm	
R	SAE J 744 82-2 A 2-bolt flange Ø 82.55 mm	
P	2-bolt mounting Centering Ø 50 mm	
O	Square flange Centering Ø 36.47 mm	
C	SAE J 744 101-2 B 2-bolt flange Ø 101.6 mm	
M	2-bolt mounting Centering Ø 52 mm with seal ring	
A	Outboard bearing Ø 80 mm, Type 1	
N	2-bolt mounting Centering Ø 50 mm	

Line ports

20	Rectangular flange	
12	Thread (UN-2B) SAE seal ring BOSS	
30	Rectangular flange	
01	Pipe thread ISO 228/1	
03	Thread, metric ISO 6149 with seal ring	

Not all variants can be selected by using ordering code!
Please select the required pump by using the selection tables (standard types) or after consultation with Bosch Rexroth!
Special options are possible upon request.

Ordering code

External gear units Multiple pumps “SILENCE”

AZ	P	GGSS	–	x	x	–	032/022/016/005	R	C	B	20 20 20 20	K	B

Function
P = Pump

Series
B = 1.0...7.1 cm³/rev
S = 4.0...28 cm³/rev
F = 4.0...28 cm³/rev
N = 20.0...36 cm³/rev
G = 22.5...63 cm³/rev

Series, relates to pump section 1
1x = Standard bearing
2x = Reinforced bearing

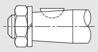
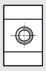
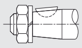
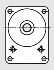
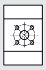
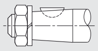
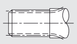
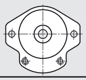
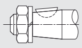
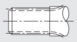
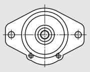
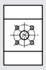
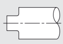
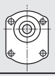
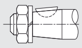
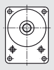
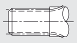
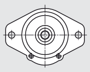
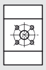
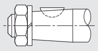
Version, relates to pump section 1
1 = Phosphatized, pinned
2 = Chromatized, pinned

Size
corresponding to each series

Direction of rotation
R = Clockwise,
L = Counter-clockwise

Rear cover
relates to last pump section
B = Standard

Seals
M = NBR
P = FKM
K = NBR, SSR in FKM
Shaft seal relate to pump section 1

Drive shafts relates to pump part 1			Suitable front cover	**Front cover** relates to pump part 1			**Line ports** every pump parts		
Series B:									
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 25.38 mm		**02**	Thread, metric DIN 3852 T1	
Series F, S:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 80 mm		**20**	Rectangular flange	
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 36.47 mm				
R	Splined shaft SAE J 744 16-4 9T		**R**	**R**	SAE J 744 82-2 A Centering Ø 82.55 mm 2-bolt mounting				
Series N, T:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 100 mm		**07**	Square flange SAE Thread, metric	
D	Splined shaft SAE J 744 22-4 13T		**C**	**C**	SAE J 744 101-2 B Centering Ø 101.6 mm 2-bolt mounting		**20**	Rectangular flange	
N	Dihedral claw		**M**	**M**	Centering Ø 52 mm with seal ring				
Series G, U:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 105 mm		**07**	Square flange SAE Thread, metric	
D	Splined shaft SAE J 744 22-4 13T		**C**	**C**	SAE J 744 101-2 B Centering Ø 101.6 mm 2-bolt mounting		**20**	Rectangular flange	
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 50.78 mm				

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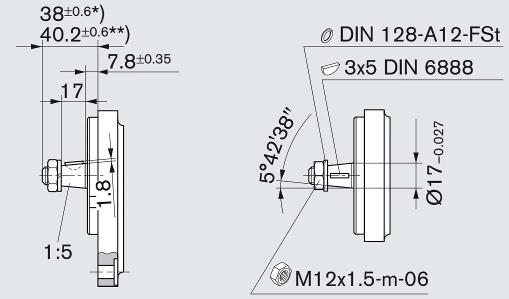
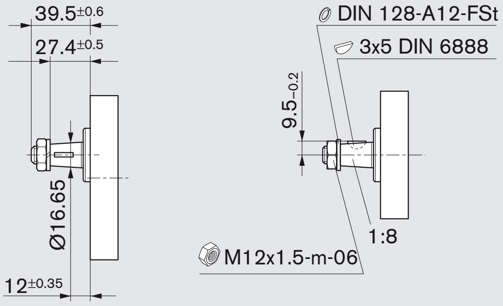
Special options are possible upon request.

Drive shafts

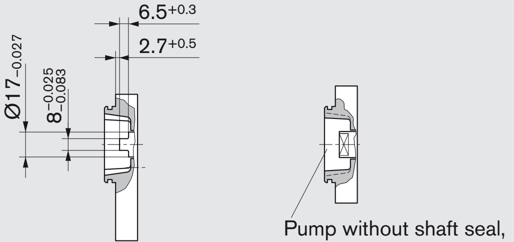
C



H

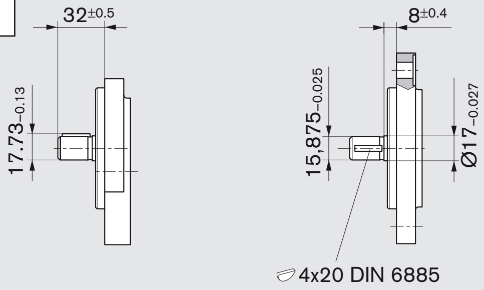


N



Pump without shaft seal, see page 14

Q



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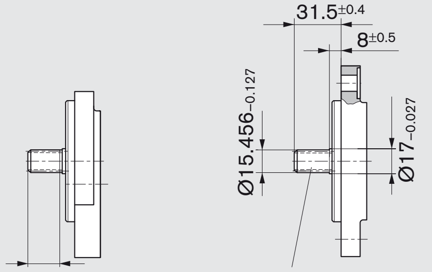
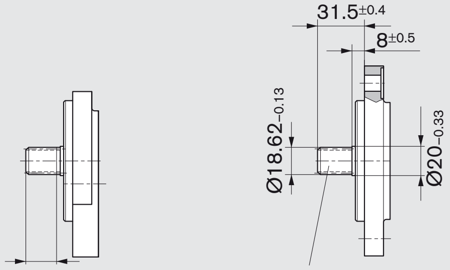


Min. 21.8
usable shaft
length

ANSI B 92,1
9T 16/32 SP
Tooth thickness s = 2.357–0.030

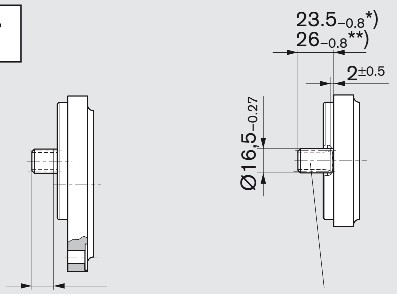
P



Min. 21
usable shaft
length

ANSI B 92.1
11T 16/32 SP
30° pressure angle

F



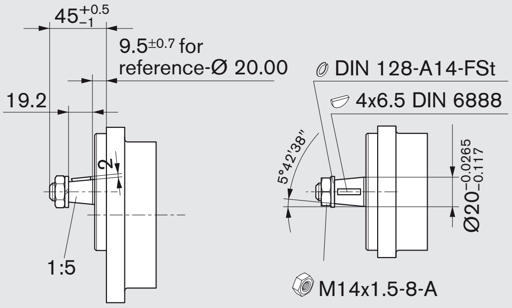
Min. 14.9
usable shaft
length

B 17x14
DIN 5482
Tooth thickness sw = 3.200–0.030

*) in combination with front cover B

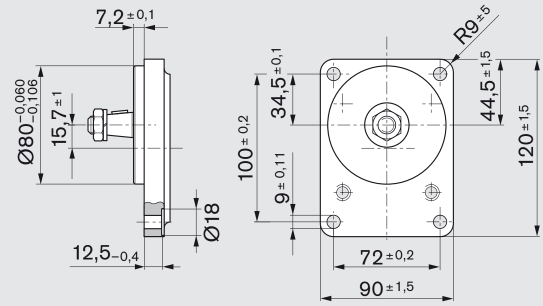
**) in combination with front cover P

S



Front cover

B



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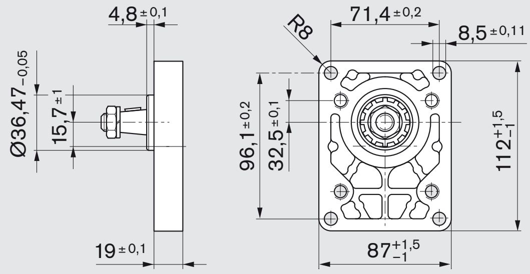

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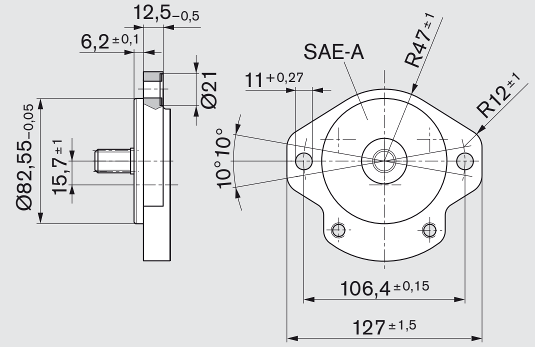
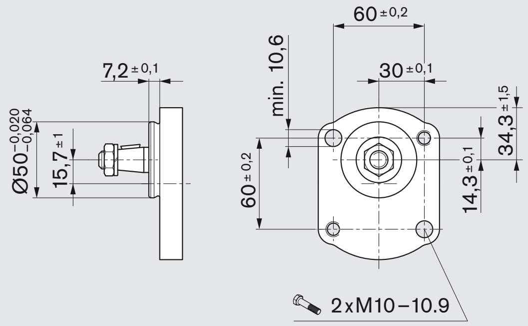


P



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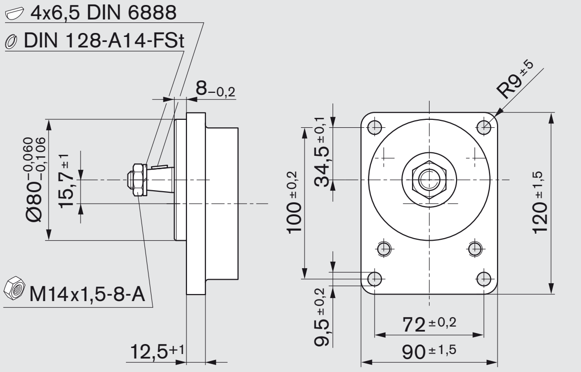
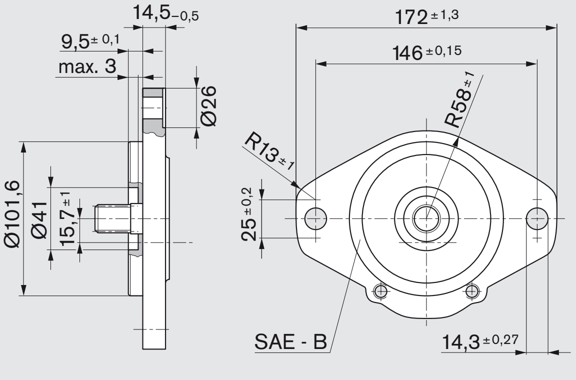
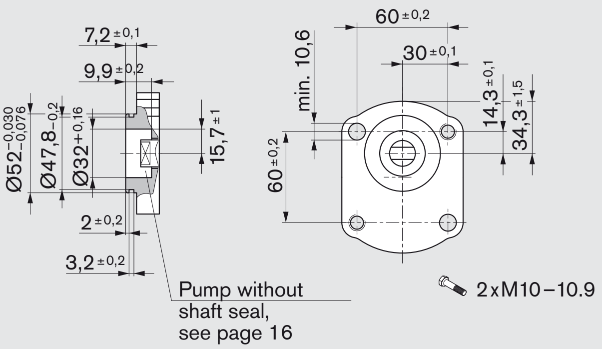


C

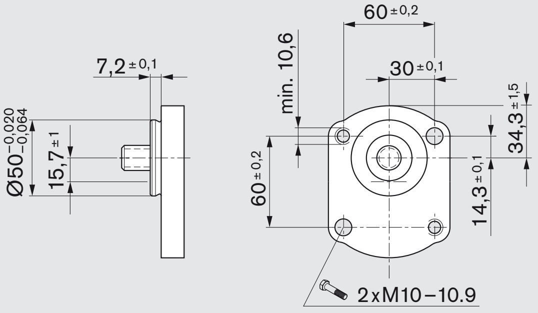


M

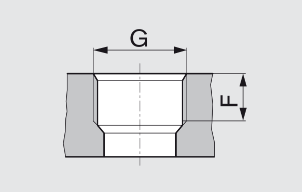


Pump without shaft seal, see page 16

N



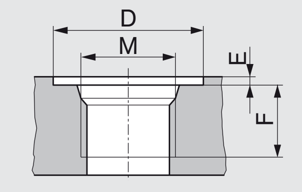
Line ports



01 **Pipe thread ISO 228/1**

At pressures $p_2 > 210$ bar
limited service life

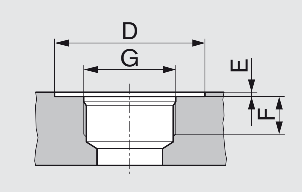
Ordering code	Size	Pressure side		Suction side	
		G	**F**	**G**	**F**
01	4...16 cm^3	G $^1/_2$	16	G $^3/_4$	16
	19...28 cm^3	G $^3/_4$		G 1	19



03 **Thread, metric ISO 6149 with seal ring**

At pressures $p_2 > 210$ bar
limited service life

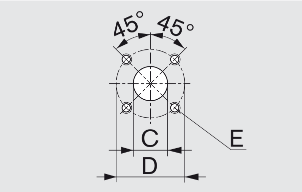
Ordering code	Size	Pressure side				Suction side			
		M	**D**	**E**	**F**	**M**	**D**	**E**	**F**
03	4...5.5 cm^3	M18 x 1.5	29	0.5	16	M18 x 1.5	29	0.5	16
	8...16 cm^3	M22 x 1.5	34		18	M27 x 1.5	40		19
	19...28 cm^3					M33 x 2	46		22



12 **Thread (UN-2B, UNF-2B) SAE Seal ring BOSS**

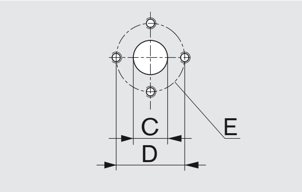
At pressures $p_2 > 210$ bar
limited service life

Ordering code	Size	Pressure side				Suction side			
		G	**D**	**E**	**F**	**G**	**D**	**E**	**F**
12	4...5.5 cm^3	9/16–18 UNF-2B	25	0.5	13	9/16–18 UNF-2B	25	0.5	13
	8 cm^3	7/8–14 UNF-2B	35		16	7/8–14 UNF-2B	35		16
	11...28 cm^3					1 1/16–12 UN-2B	45		19



20 **Rectangular flange**

Ordering code	Size	Pressure side			Suction side		
		C	**D**	**E**	**C**	**D**	**E**
20	4...5.5 cm^3	15	35	M6, depth 13	15	40	M6, depth 13
	8...16 cm^3				20		
	19...28 cm^3				26	55	M8, depth 13

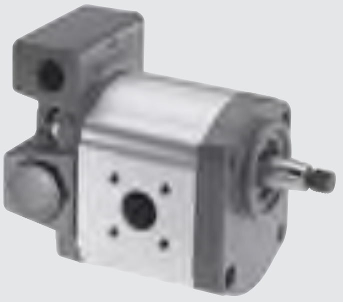


30 **Rectangular flange**

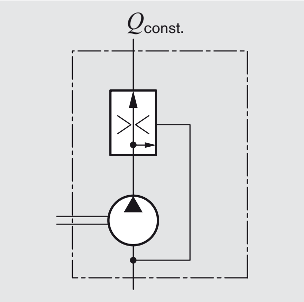
Ordering code	Size	Pressure side			Suction side		
		C	**D**	**E**	**C**	**D**	**E**
30	4...8 cm^3	13.5	30.2	M6, depth 13	13.5	30.2	M6, depth 13
	11...28 cm^3				20.0	39.7	M8, depth 13

Gear pumps with integral valves

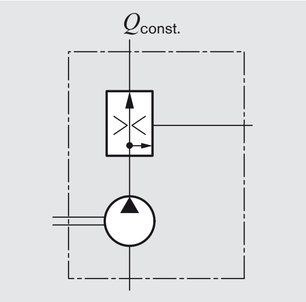
In order to reduce external pipework it is possible to incorporate a flow-control valve or pressure-relief valve in the rear cover of the gear pump. A typical application of this is in the supply of hydraulic oil in power steering systems. The pump delivers a constant flow irrespective of the speed at which it is driven. The excess flow is either returned internally to the suction port or distributed externally to other items of equipment.



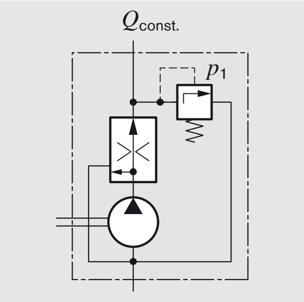
Upon request



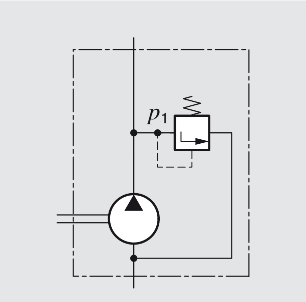
3-way flow-control valve.
Excess flow returned to suction line
$Q_{\text{const.}} = 2...30$ l/min



3-way flow-control valve.
Excess flow distributed externally; loadable
$Q_{\text{const.}} = 2...30$ l/min



3-way flow-control valve with pressure-relief valve.
Excess flow returned to suction line
$Q_{\text{const.}} = 2...30$ l/min
$p_1 = 100...180$ bar



Pressure-relief valve.
Discharge returned to suction line
$p_1 = 5...250$ bar

Ordering code

S	**xxx17**
E	**xxx12**
V	**15011**
D	**180xx**

Design calculations for pumps

The design calculations for pumps are based on the following parameters:

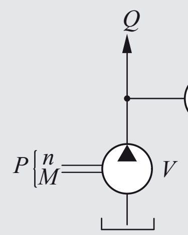
V	[cm^3/rev]	Displacement
Q	[l/min]	Delivery
p	[bar]	Pressure
M	[Nm]	Drive torque
n	[rev/min]	Drive speed
P	[kW]	Drive power

It is also necessary to allow for different efficiencies such as:

η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Overall efficiency

The following formulas describe the various relationships.
They include correction factors for adapting the parameters to the usual units encountered in practice.

Caution: Diagrams providing approximate selection data will be found on subsequent pages.



$$Q = V \cdot n \cdot \eta_v \cdot 10^{-5}$$

$$p = \frac{M \cdot \eta_{hm}}{1.59 \cdot V}$$

$$P = \frac{p \cdot Q}{6 \cdot \eta_t}$$

$$V = \frac{Q}{n \cdot \eta_v} \cdot 10^5$$

$$V = \frac{M \cdot \eta_{hm}}{159 \cdot p}$$

$$Q = \frac{6 \cdot P \cdot \eta_t}{p}$$

$$n = \frac{Q}{V \cdot \eta_v} \cdot 10^5$$

$$M = \frac{1.59 \cdot V \cdot p}{\eta_{hm}}$$

$$p = \frac{6 \cdot P \cdot \eta_t}{Q}$$

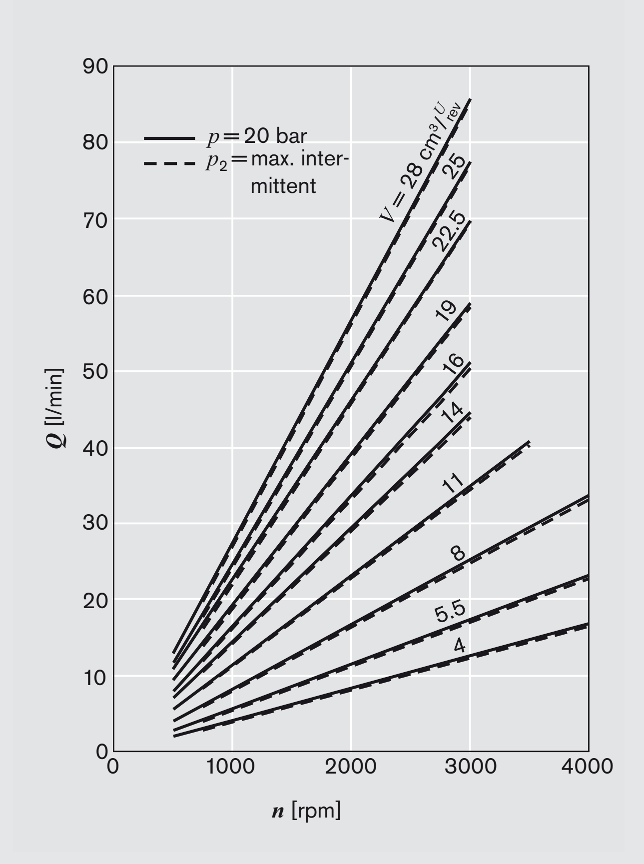
[%]

n —— $\eta_v \longrightarrow Q$
M —— $\eta_{hm} \longrightarrow p$
P —— $\eta_t \longrightarrow p \cdot Q$

V [cm^3/rev] Q [l/min] p [bar]
n [rev/min] P [kW] M [Nm]

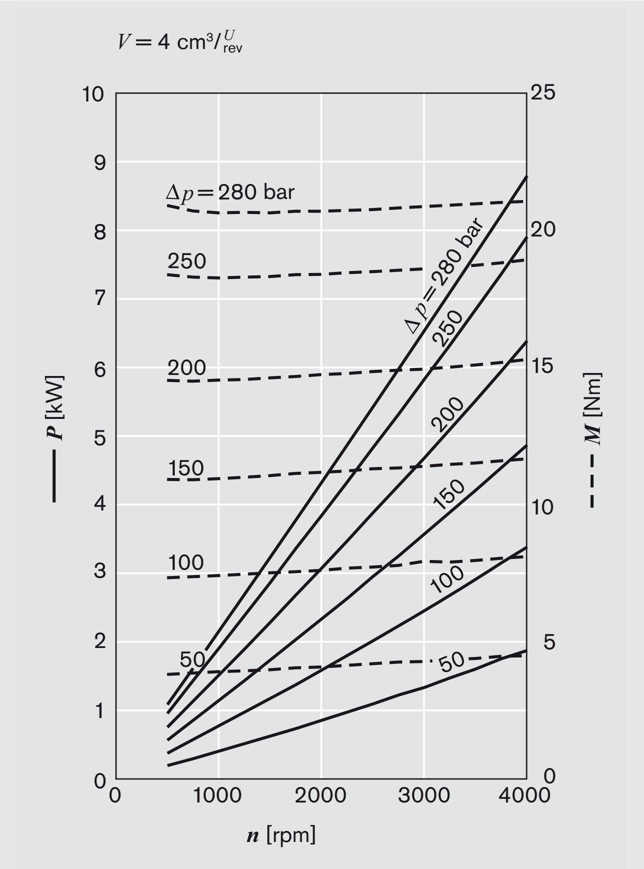
Caution: η [%] e.g. 95 [%]

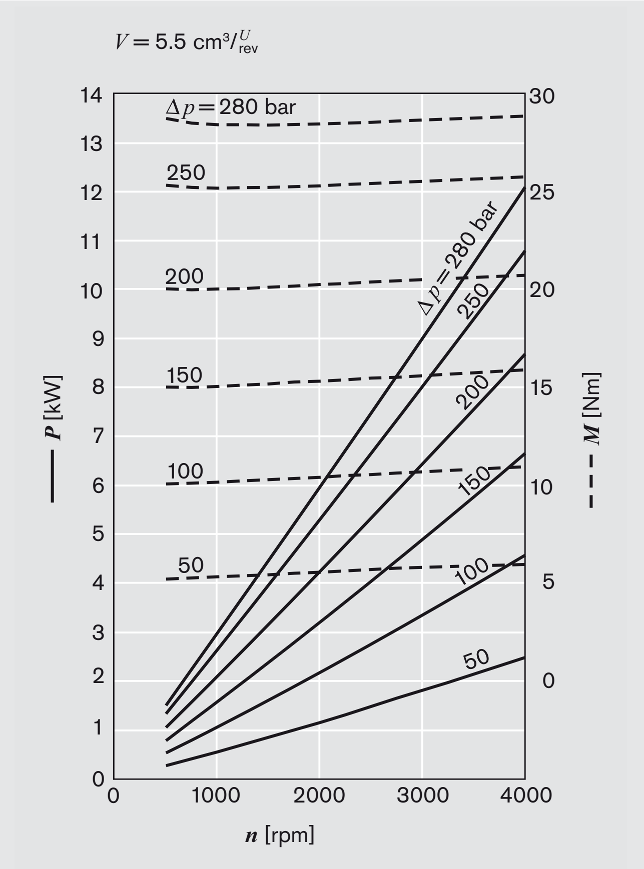
Performance charts



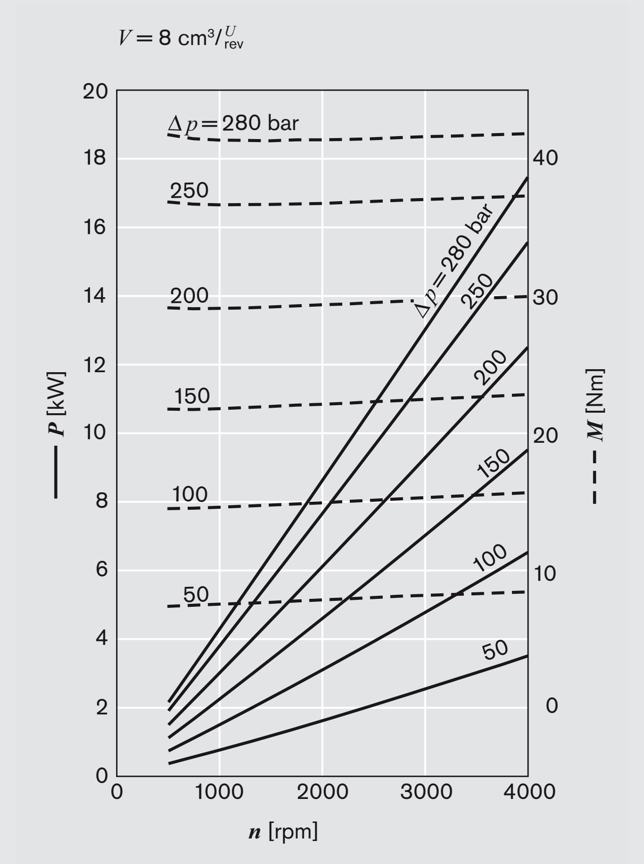
$\nu = 35$ mm^2/s, $\vartheta = 50$ °C

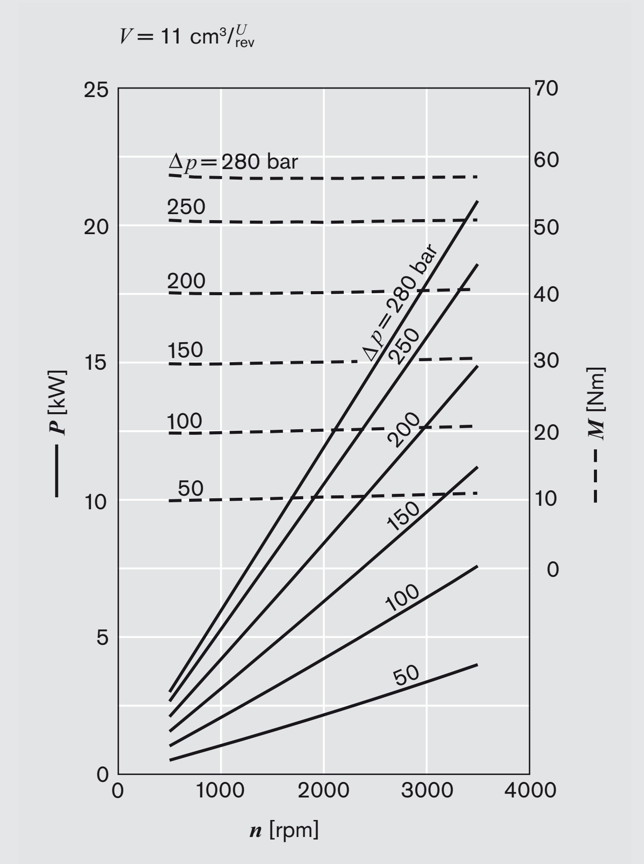
$Q = \text{f}(n, V)$ incl. η_v
$P = \text{f}(n, p)$ —— incl. η_t
$M = \text{f}(n, p)$ – – – incl. η_{hm}

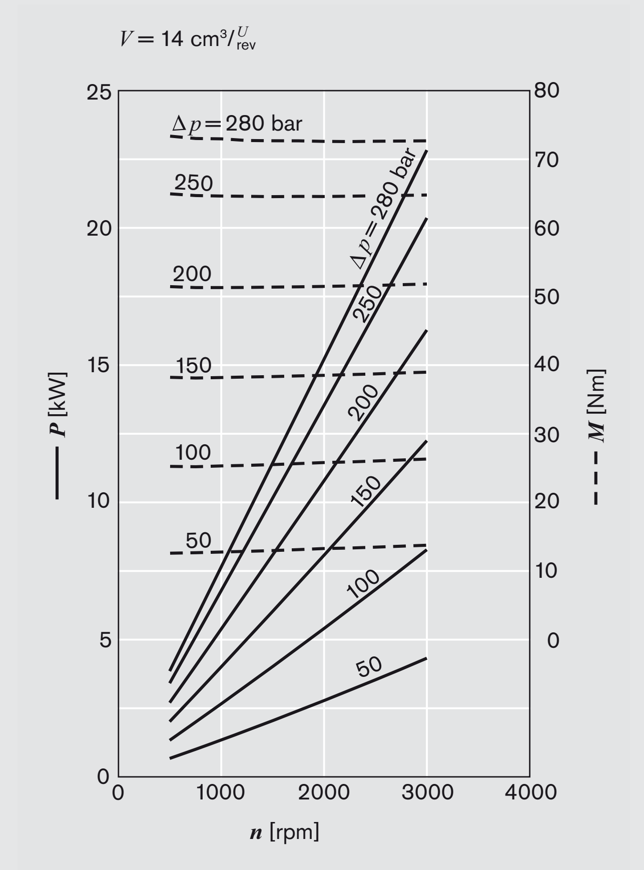


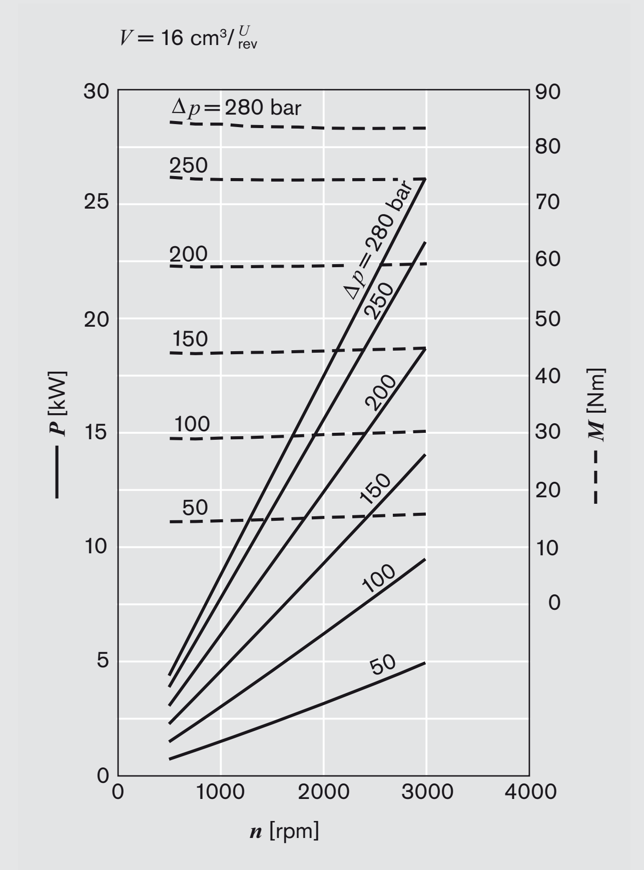


Performance charts (continued)

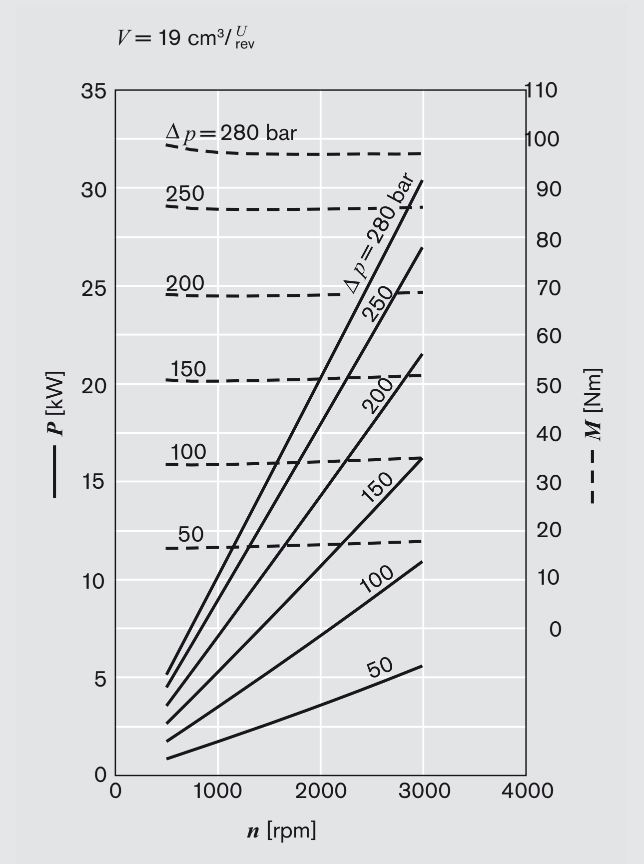

$V = 8~\text{cm}^3/^{U}_{\text{rev}}$

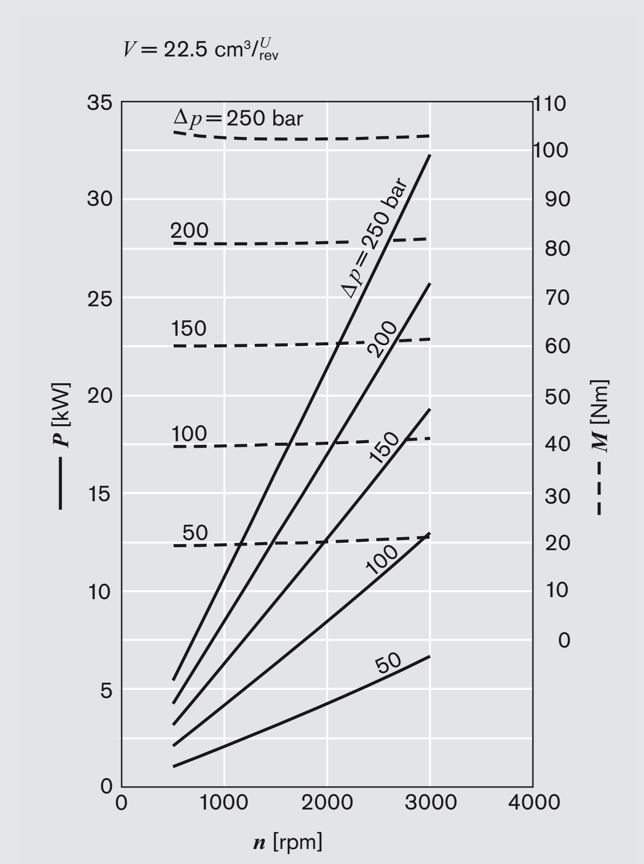

$V = 11~\text{cm}^3/^{U}_{\text{rev}}$

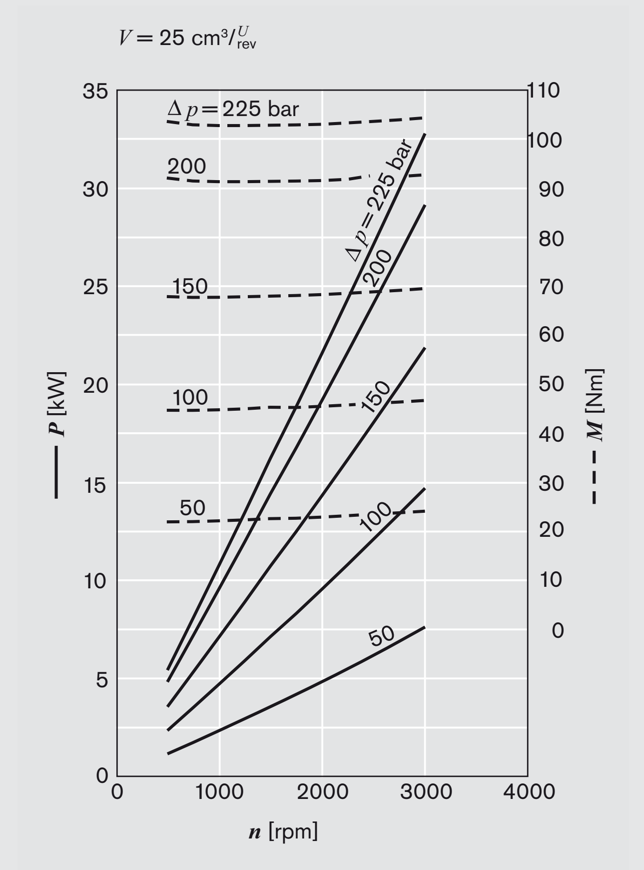

$V = 14~\text{cm}^3/^{U}_{\text{rev}}$

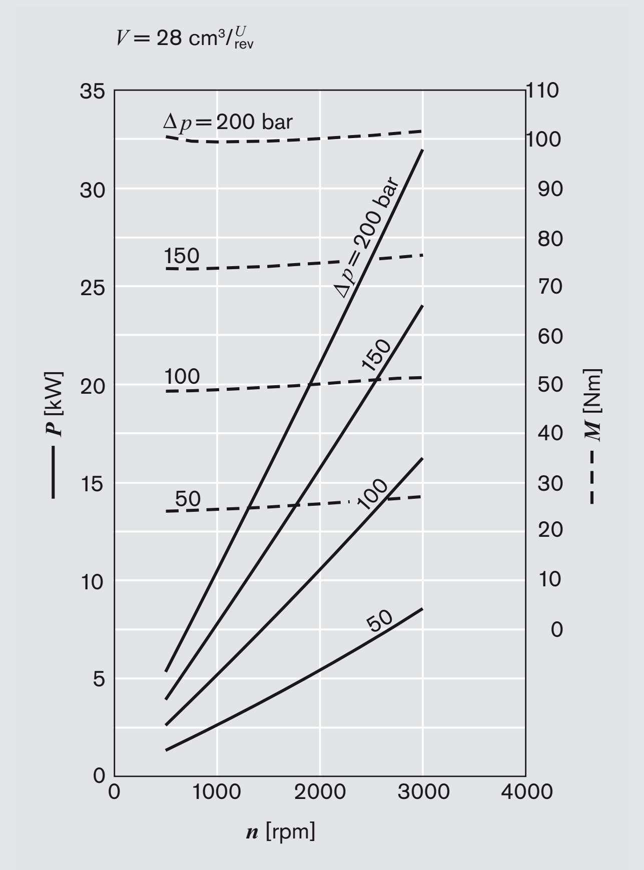

$V = 16~\text{cm}^3/^{U}_{\text{rev}}$

Performance charts (continued)





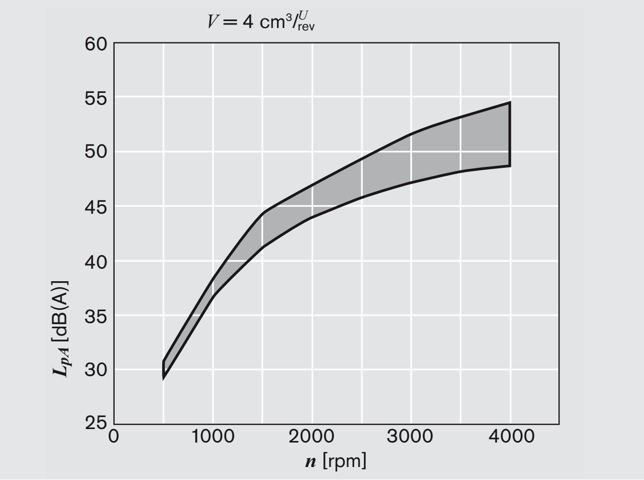


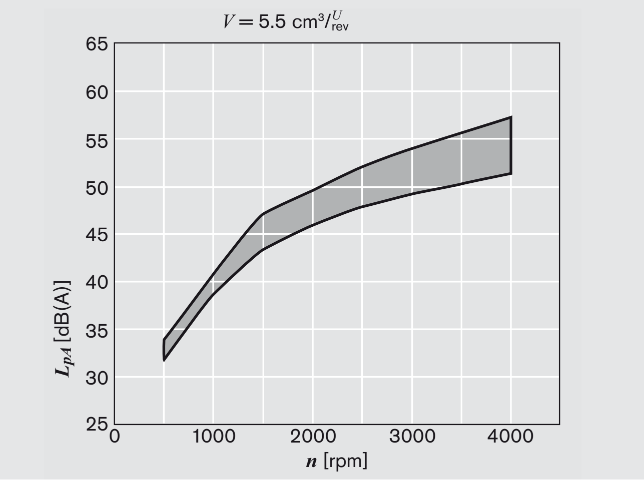


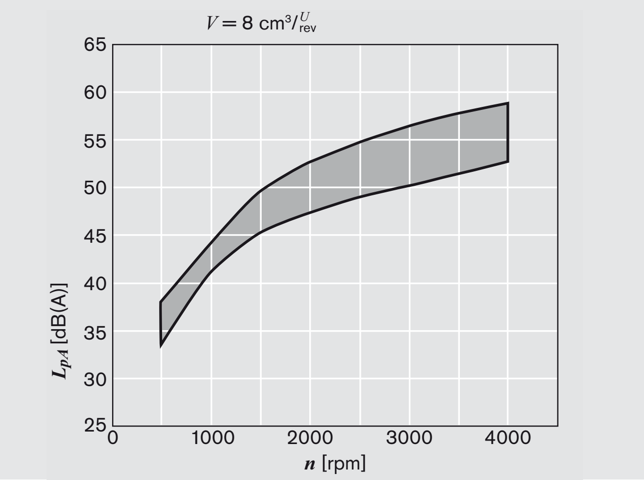
Noise charts

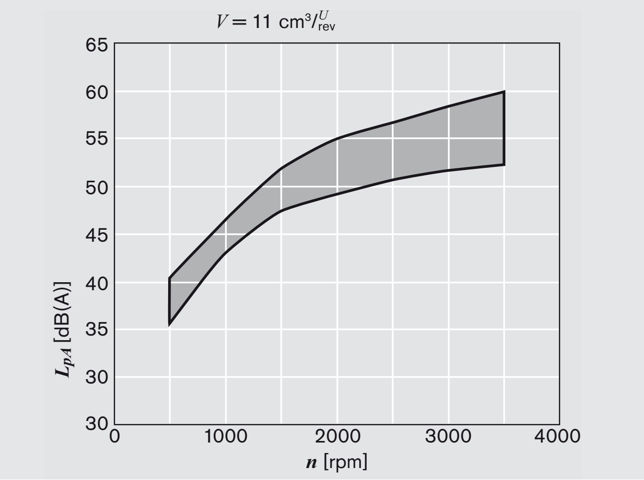
Noise level dependent on rotational speed, pressure range between 10 bar and pressure value p_2 (see page 15 Specifications table).
Oil data: $\nu = 32$ mm^2/s, $\vartheta = 50$ °C.
Sound pressure level calculated from noise measurements made in the sound absorbent measuring room compliant with DIN 45635, Part 26.
Spacing between measuring sensor – pump: 1 m.

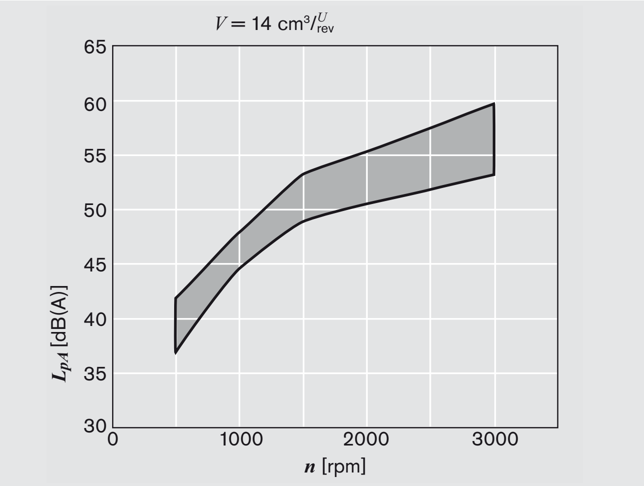
These are typical characteristic values for the respective model. They describe the airborne sound emitted solely by the pump. Environmental influences (installation site, piping, further system components) are not taken into consideration.
Each value applies for a single pump.

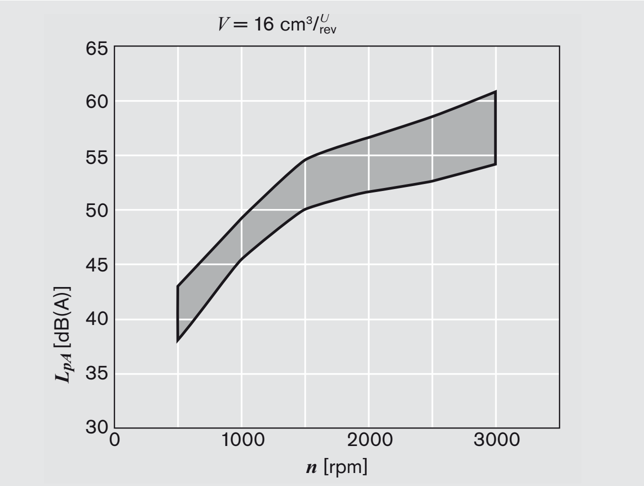




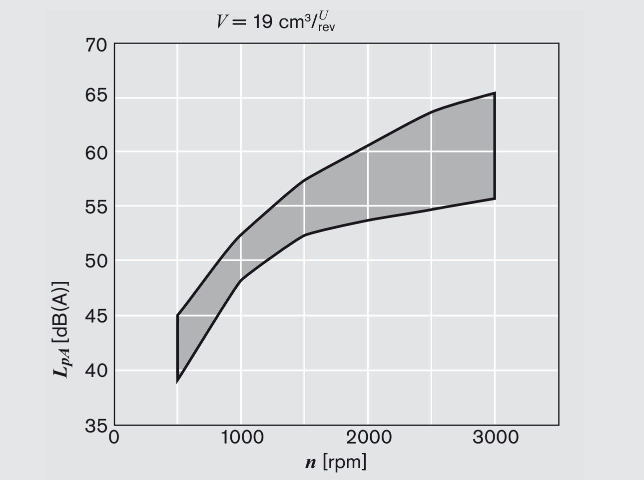


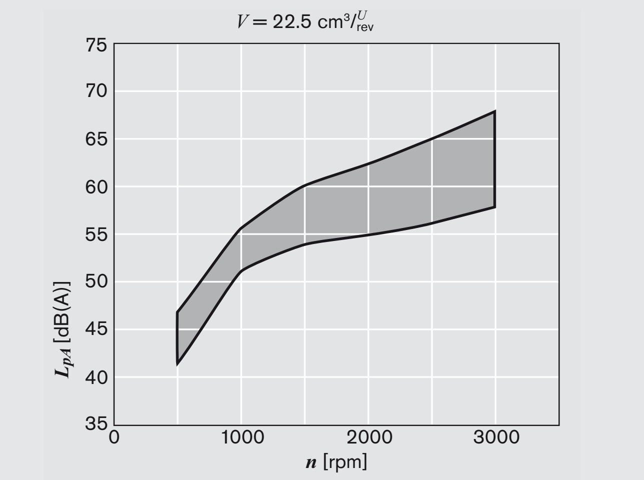


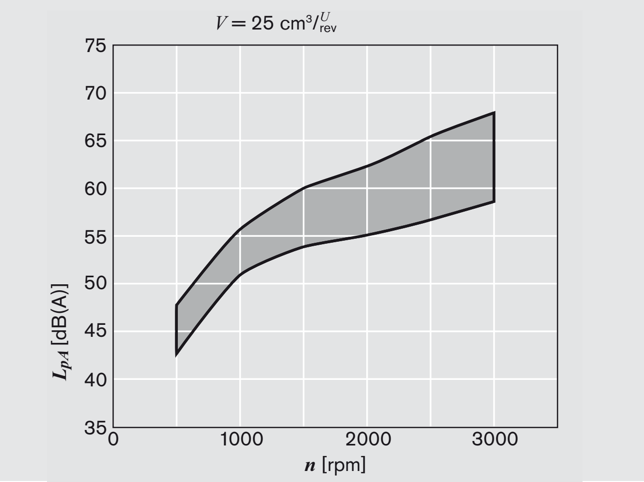


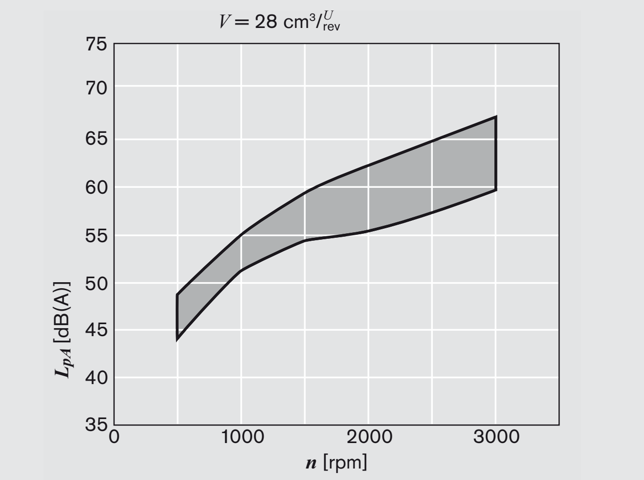


Noise charts (continued)









Specification

General	
Construction	External gear pump
Mounting	Flange or through-bolting with spigot
Line ports	Screw, flange
Direction of rotation (looking on shaft)	Clockwise or counter-clockwise, the pump may only be driven in the direction indicated
Installation position	Any
Load on shaft	Radial and axial forces after consulting
Ambient temperature range	−30 °C...+80 °C or max. 110 °C with FKM seal
Hydraulic fluid	– Mineral oil compliant with DIN 51 524, 1–3, however under higher load at least HLP compliant with DIN 51 524 Part 2 recommended. – Comply with RE 90220 – Further operating fluids possible after consultation
Viscosity	12...800 mm^2/s permitted range 20...100 mm^2/s recommended range ...2000 mm^2/s range permitted for starting
Hydraulic fluid temperature range	max. +80 °C with NBR seals*) max. +110 °C with FKM seals**)
Filtration ***)	At least cleanliness level 20/18/15 compliant with ISO 4406 (1999)

*) NBR = Perbunan®

**) FKM = Viton®

***) During the application of control systems or devices with critical counter-reaction, such as steering and brake valves, the type of filtration selected must be adapted to the sensitivity of these devices/systems.

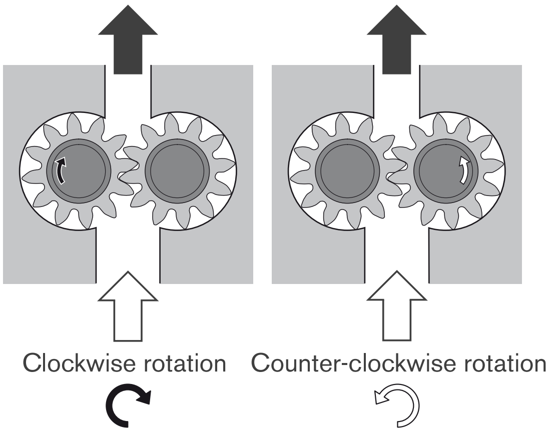
Safety requirements pertaining to the whole systems are to be observed.

In the case of applications with high numbers of load cycles please consulting.

Definition of direction of rotation

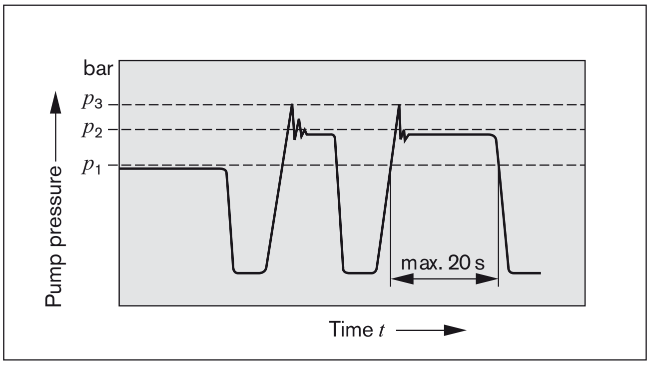
Always look on the drive shaft.

Caution: Dimensions drawings always show clockwise-rotation pumps.On counter-clockwise-rotation pumps the positions of the drive shaft and the suction and pressure ports are different.



Clockwise rotation Counter-clockwise rotation

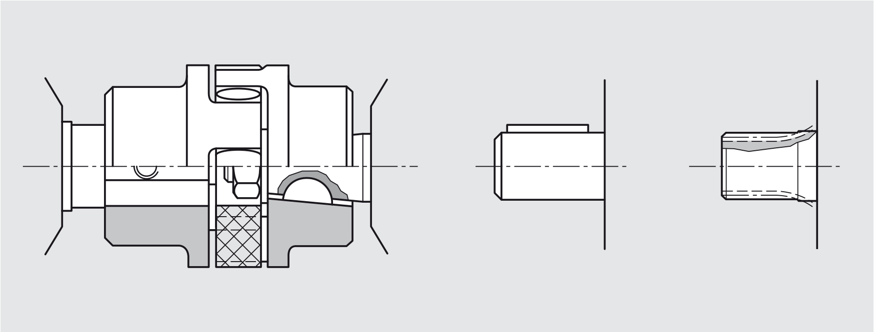
Definitions of pressures



p_1 max. continuous pressure
p_2 max. intermittent pressure
p_3 max. peak pressure

Series				AZPS-1x						AZPS-2x			
Displacement		V	cm^3/rev	4	5.5	8	11	14	16	19	22.5	25	28
Suction pressure		p_e	bar	0.7...3 (absolute), with tandem pumps: p_e (p_2) = max. 0.5 > p_e (p_1)									
Max. continuous pressure		p_1		250							220	195	170
Max. intermittent pressure		p_2		280							250	225	200
Max. peak pressure		p_3		300							290	265	240
Min. rotational speed		< 100	rpm	600	500	500	500	500	500	500	500	500	500
at bar	12 mm^2/s	100...180		1200	1200	1000	1000	800	800	800	800	800	800
		180... p_2		1400	1400	1400	1200	1000	1000	1000	1000	1000	1000
	25 mm^2/s	p_2		700	700	700	600	500	500	500	500	500	500
Max. rotational speed at		p_2		4000			3500	3000	3000	3500	3500	3000	3000

Drive arrangement



1. Flexible couplings

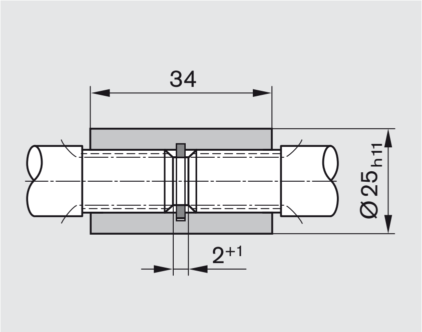
The coupling must not transfer any radial or axial forces to the pump.

The maximum radial runout of shaft spigot is 0.2 mm.

Refer to the fitting instructions provided by the coupling manufacturer for details of the maximum permitted shaft misalignment.

2. Coupling sleeve

Used on shafts with DIN or SAE splining. Caution: There must be no radial or axial forces exerted on the pump shaft or coupling sleeve. The coupling sleeve must be free to move axially. The distance between the pump shaft and drive shaft must be 2^{+1}. Oil-bath or oil-mist lubrications is necessary.

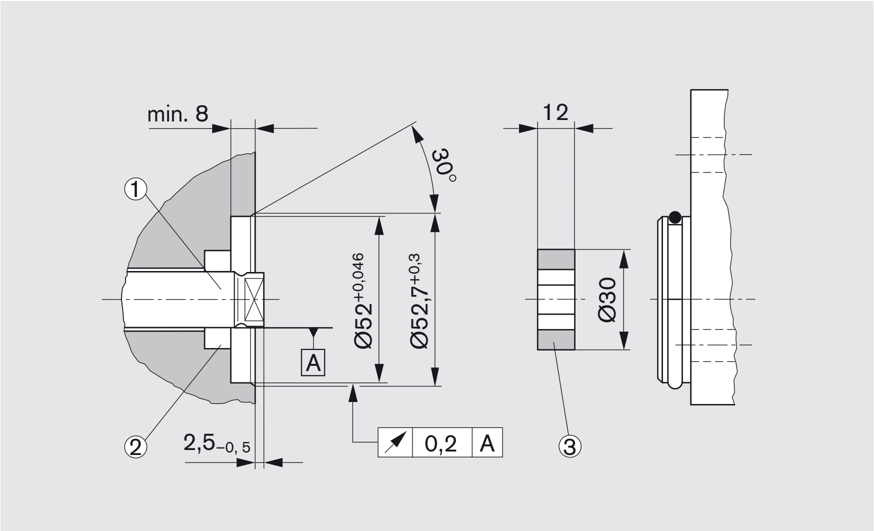


Splined shaft	M_{max} [Nm]	V [cm³/rev]	p_{max} [bar]
DIN	100	4...28	p_{max}
SAE 9t	110		
SAE 11t	180		

3. Drive shaft with tang

For the close-coupling of the pumps to electric motor or internal-combustion engine, gear, etc. The pump shaft has a special tang and driver ③ (not included in supply).
There is no shaft sealing.

The recommended arrangements and dimensions for the drive end and sealing are as follows.



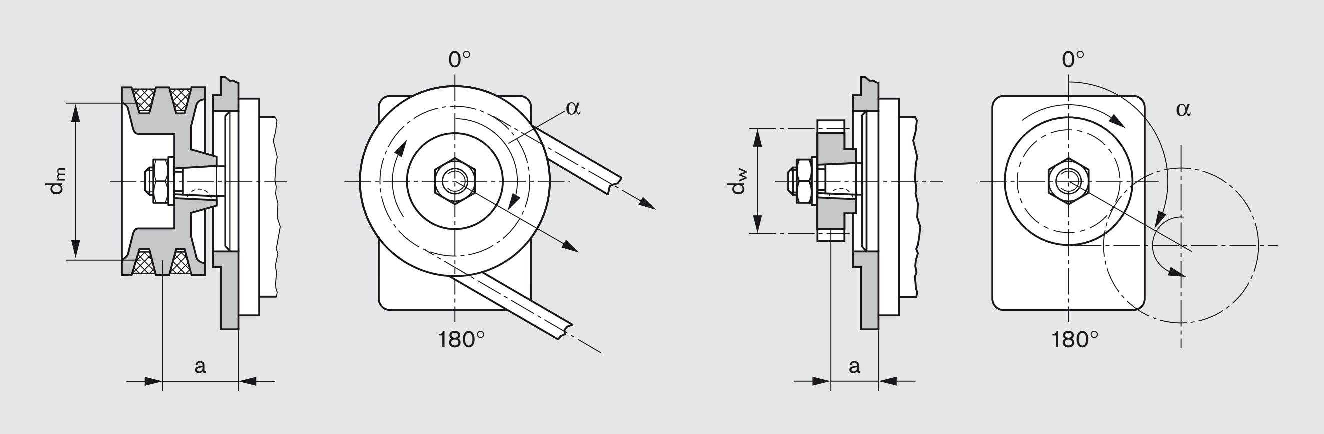
① Drive shaft
Case-hardening steel DIN 17 210
e.g. 20 MnCrS 5
case-hardened 0.6 deep; HRC $60^{\pm 3}$
Surface for sealing ring
ground without rifling $R_{max.} \leq 4\mu m$

② Radial shaft seal ring
Rubber-covered seal (see DIN 3760, Type AS, or double-lipped ring).
Cut 15° chamfer or fit shaft seal ring with protection sleeve.

M_{max} [Nm]	V [cm³/rev]	p_{max} [bar]
65	4...14	280
	16	230
85	19	250
	22.5	210
	25	190
	28	170

4. V-belts and straight gearwheels or helical toothed gear drives without outboard bearing

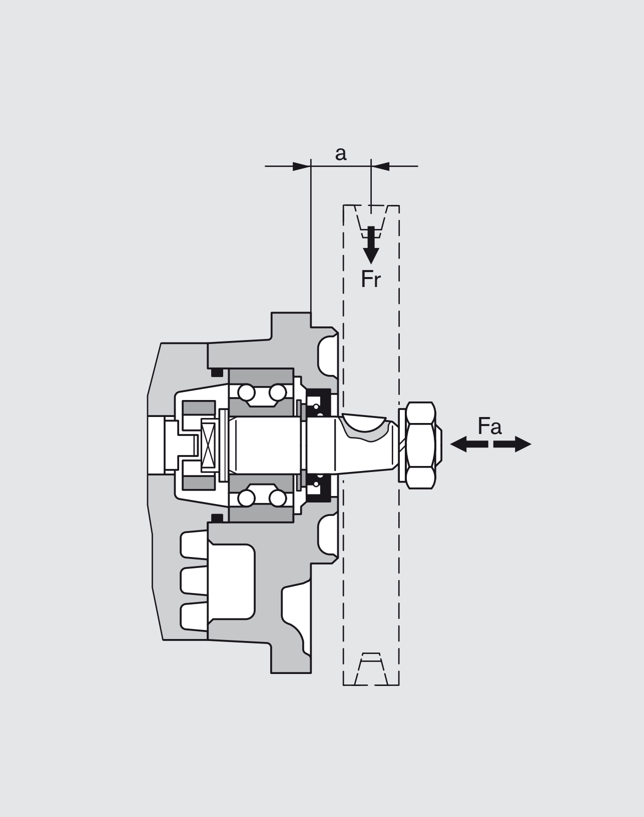
When proposing to use V-belt or gear drive, please submit details of the application for our comments (especially dimensions a, d_m, d_w and angle α).
For helical toothed gear drives, details of the helix angle β are also required.

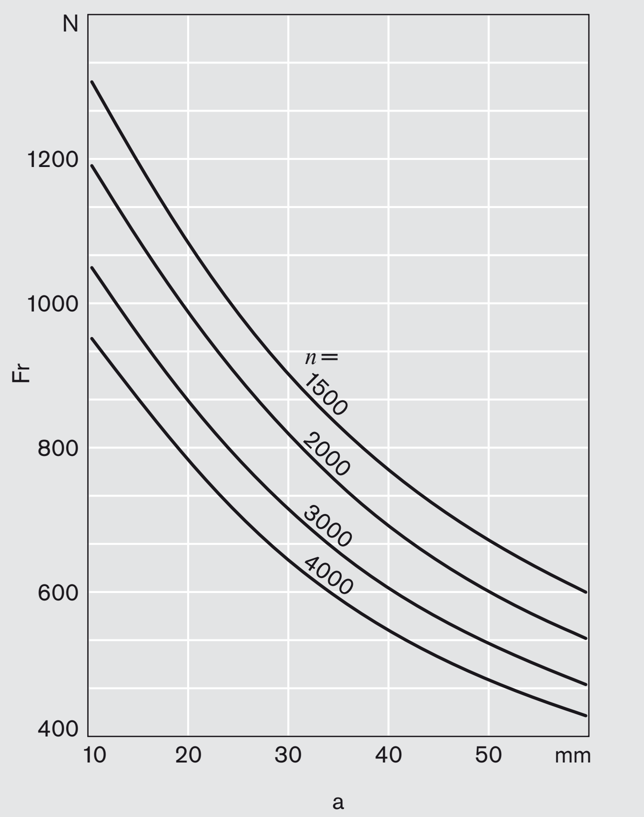


5. Outboard bearing

Outboard bearing eliminate possible problems when the pumps are driven by V-belts or gearwheels. The diagrams below show the maximum radial and axial loads that can be tolerated based on a bearing life of L_H = 1,000 hours.

M_{max} [Nm]	V [cm³/rev]	p_{max} [bar]
65	4...14	280
	16	230





Multiple gear pumps

Gear pumps are well-suited to tandem combinations of pumps in which the drive shaft of the first pump is extended to drive a second pump and sometimes a third pump in the same manner. A coupling is fitted between each pair of pumps.
In most cases each pump is isolated from its neighbor, i.e. the suction ports are separate from one another. A common suction port is also possible as an option.
Caution: Basically, the specifications for the single pumps apply, but with certain restrictions:
Max. speed: This is determined by the highest rated pump speed in use.
Pressures: These are restricted by the strength of the drive shaft, the through drives and the drivers.Appropriate data is given in the dimensional drawings.

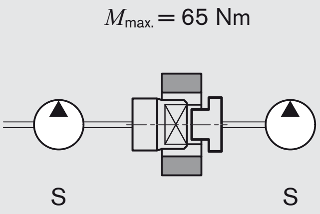
Pressure restrictions during standard through drive
In the case of series N, the driver for the second pumping stage can carry a load of up to $S_{\text{max.}} = 95$ Nm, i.e. there is a pressure restriction for the second stage and any further stages.

Drive shaft		Max. transferrable drive torque * [Nm]
C	1:5	155
N	Claw	65 or 85
D	SAE 13t	320
P	SAE 11t	180

* These values only apply when the conditions described above are complied with. Bosch Rexroth is to be consulted if the stated values are exceeded.

If the first stage is driven through a tang (driver) or outboard bearing type 1, pressure restrictions apply as indicated in the formula below.

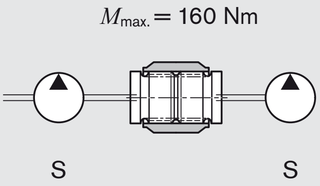
Reinforced through drives are available for applications with higher transfer torques and/or rotational vibrations. Customized designs available on request.

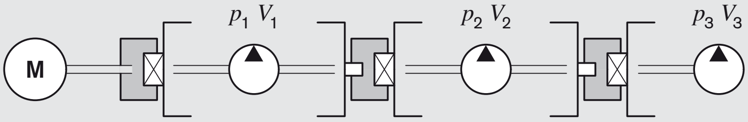


Combinations

Series pump 1	$M_{\text{max.}}$ [Nm]	Series pump 2
S	65	S
S	65	F
S	12	B – 1x
F	65	S
S	25	B – 2x

For configuration of multiple pumps we recommend the pump is positioned with the largest displacement on the drive side.



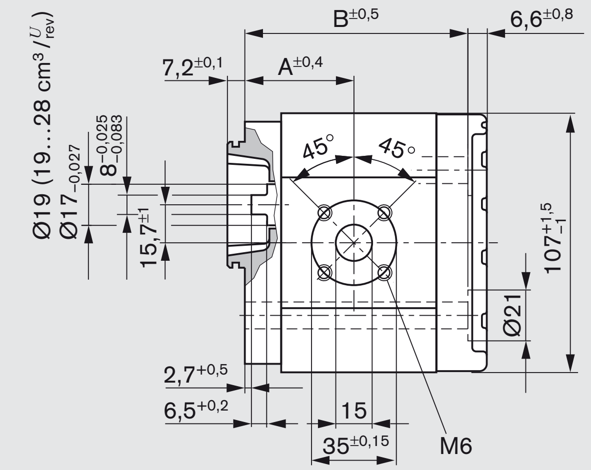


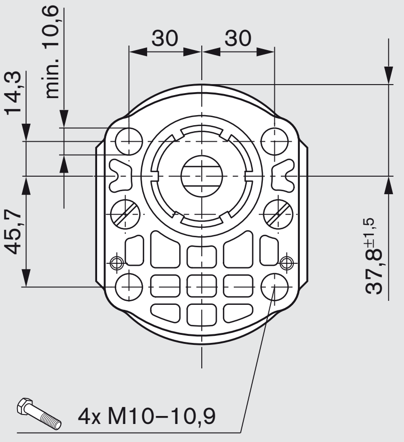
$$M_{\text{max.}} \geqq \Delta p_1 \cdot V_1 \cdot 0.0177 + \Delta p_2 \cdot V_2 \cdot 0.0177 + \Delta p_3 \cdot V_3 \cdot 0.0177$$

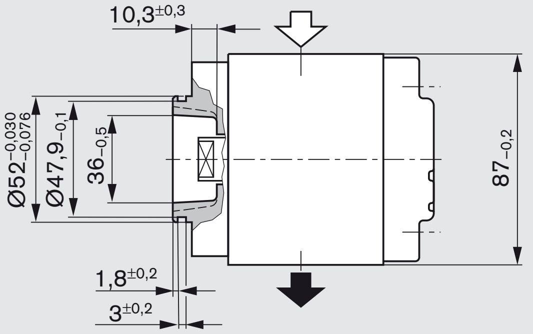
Δp [bar] V [cm^3/rev]

Dimensions

Standard range

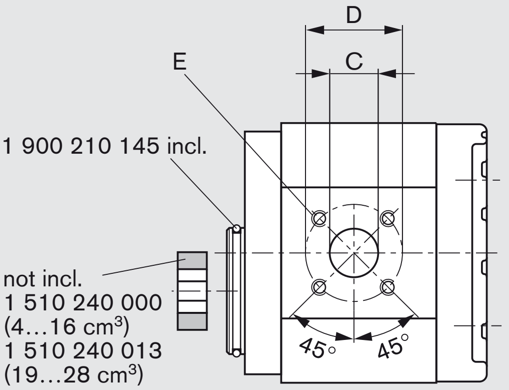


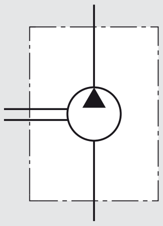




↻ As shown in drawing

↺ Inlet and outlet port changed





A 517 232 002/...014

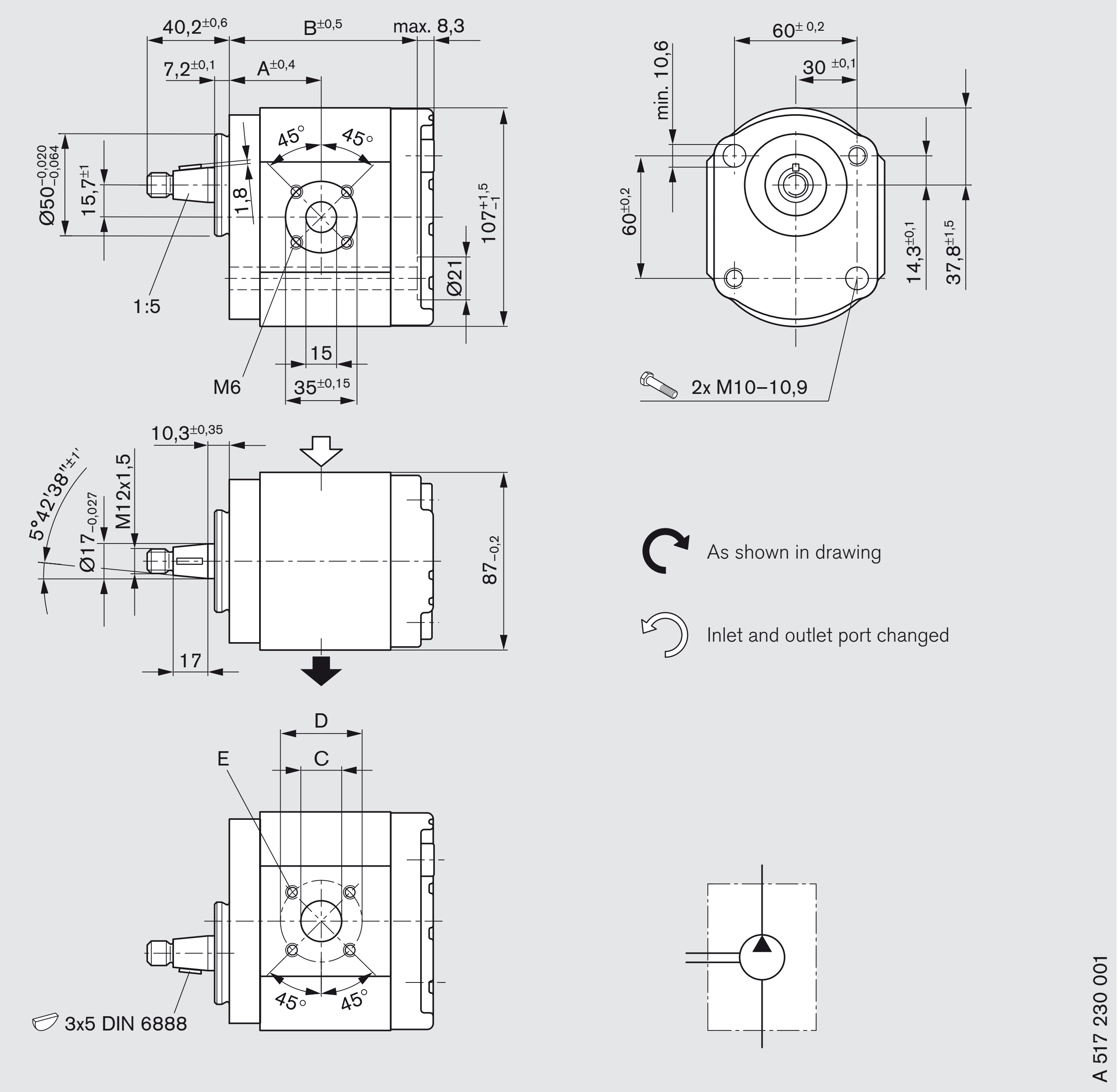
Ordering code:

AZPS – xx – ☐ ☐ ☐ ☐ N M 20 M B

Displacement [cm³/rev]	Ordering-No. ↺ L	↻ R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C	D	E
4	**0 517 215 301**	**0 517 215 001**	280	4000	2.15	37.4	73.7	15	40	M6 13 depth
5.5	**0 517 315 301**	**0 517 315 001**	280	4000	2.2	38.6	76.2	15	40	
8	**0 517 415 301**	**0 517 415 001**	280	4000	2.3	40.7	80.3	20	40	
11	**0 517 515 302**	**0 517 515 001**	280	3500	2.4	44.5	85.3	20	40	
14	**0 517 515 303**	**0 517 515 002**	280	3000	2.55	45	90.3	20	40	
16	**0 517 615 301**	**0 517 615 001**	230	3000	2.6	45	93.7	20	40	
19	**0 517 615 302**	**0 517 615 002**	250	3500	3.0	55.8	110.7	26	55	M8 13 depth
22.5	**0 517 715 301**	**0 517 715 001**	210	3500	3.2	58.5	116.1	26	55	
25	**0 517 715 302**	**0 517 715 002**	190	3000	3.3	60.6	120.3	26	55	
28	**0 517 715 303**	**0 517 715 003**	170	3000	3.4	63	125.1	26	55	

Dimensions

Standard range



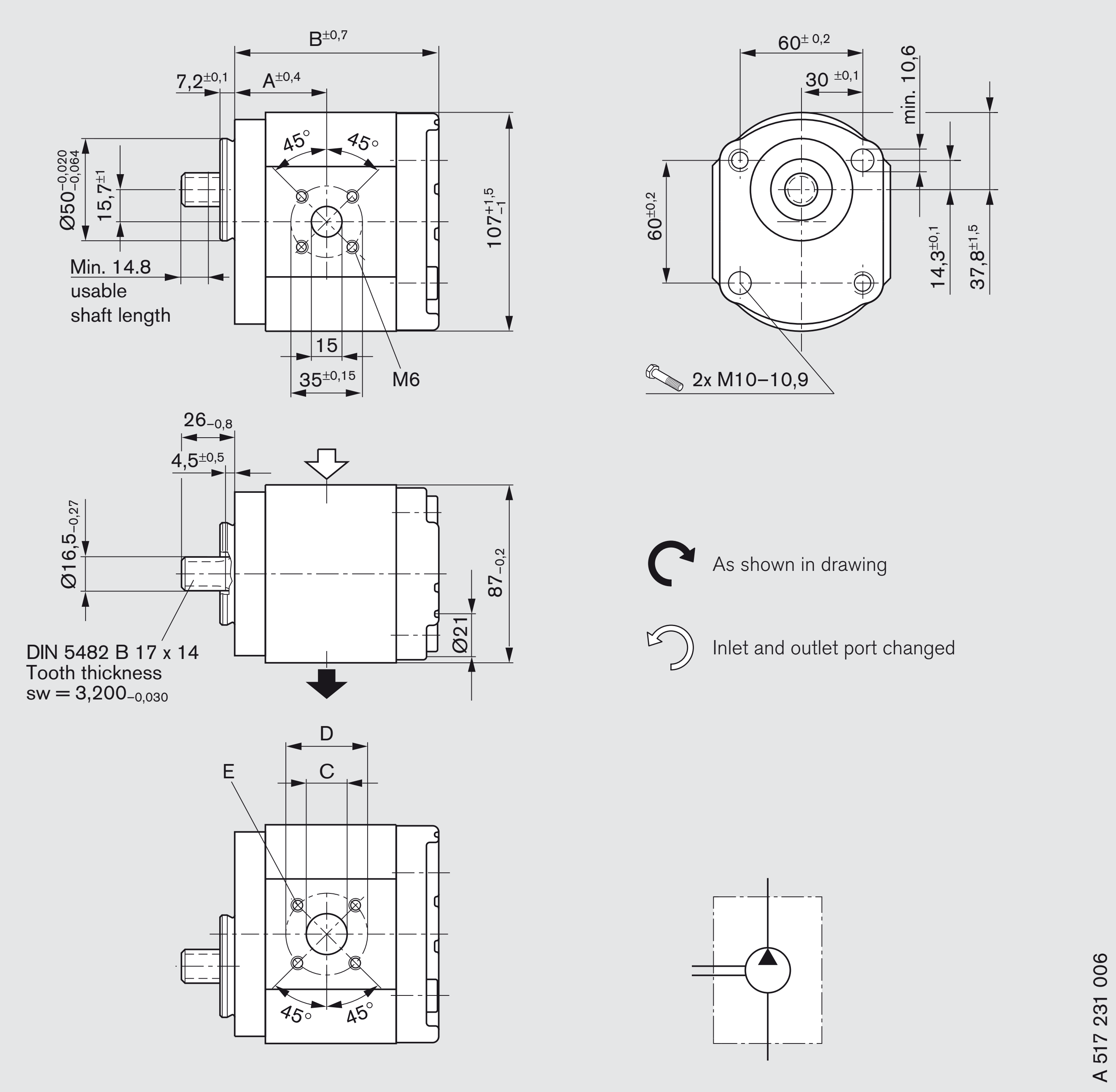
Ordering code:

AZPS – xx – ☐☐☐ ☐C P 20 K B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C	D	E
4			280	4000						M6 13 depth
5.5			280	4000						
8			280	4000						
11	**0 517 515 304**		280	3500	3.1	44.5	85.3	20	40	
14	**0 517 515 306**		280	3000	3.3	45	90.3	20	40	
16	**0 517 615 303**		280	3000	3.4	45	93.7	20	40	
19			280	3500						
22.5			250	3500						
25			225	3000						
28			200	3000						

Dimensions

Standard range

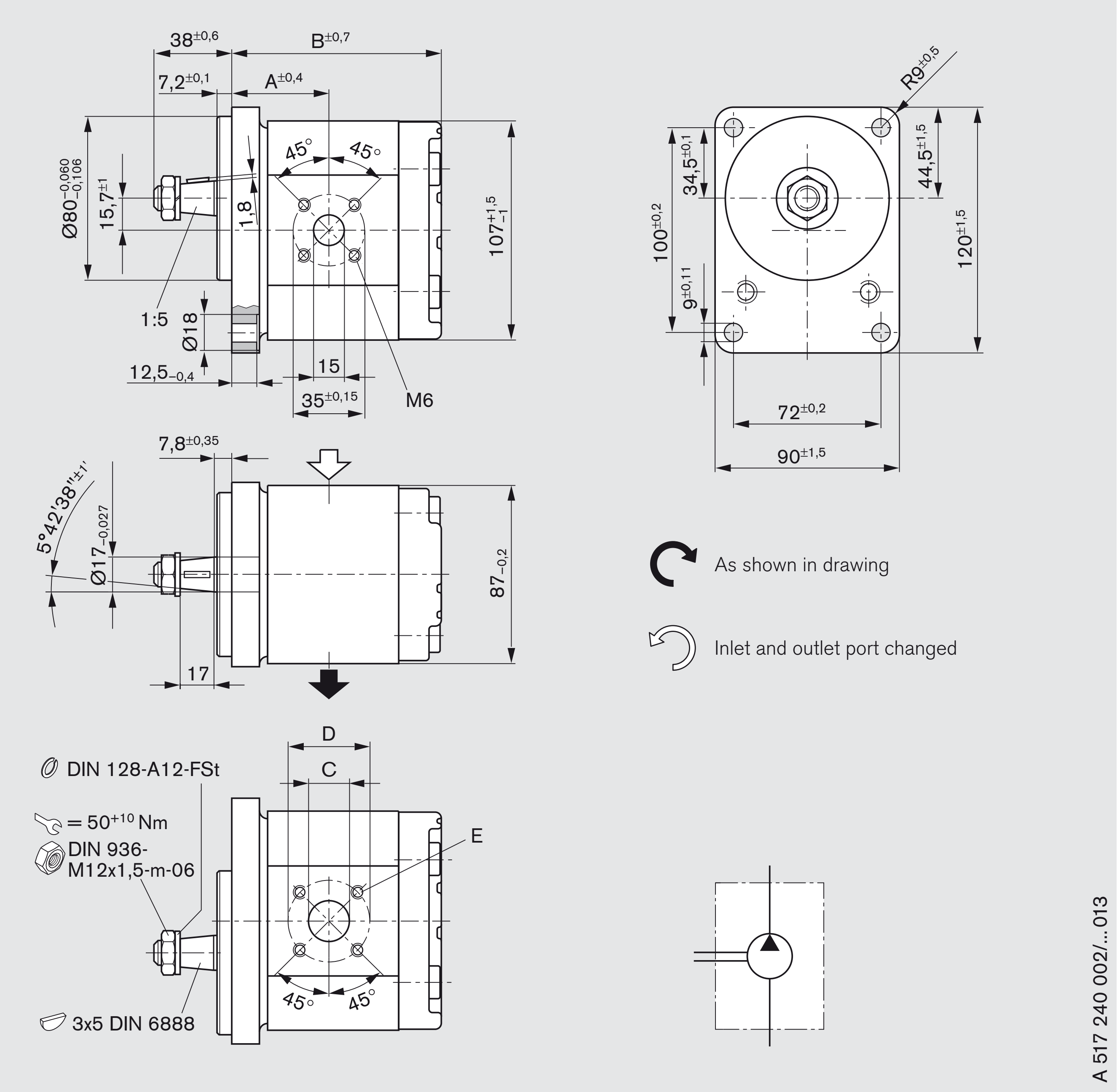


Ordering code:
AZPS – xx – ☐☐☐ ☐ F N 20 K B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C	D	E
4			280	4000						M6 13 depth
5.5			280	4000						
8			280	4000						
11			280	3500						
14			280	3000						
16		**0 517 615 003**	280	3000	3.3	45	100.5	20	40	
19			280	3500						
22.5			250	3500						
25			225	3000						
28			200	3000						

Dimensions

Standard range

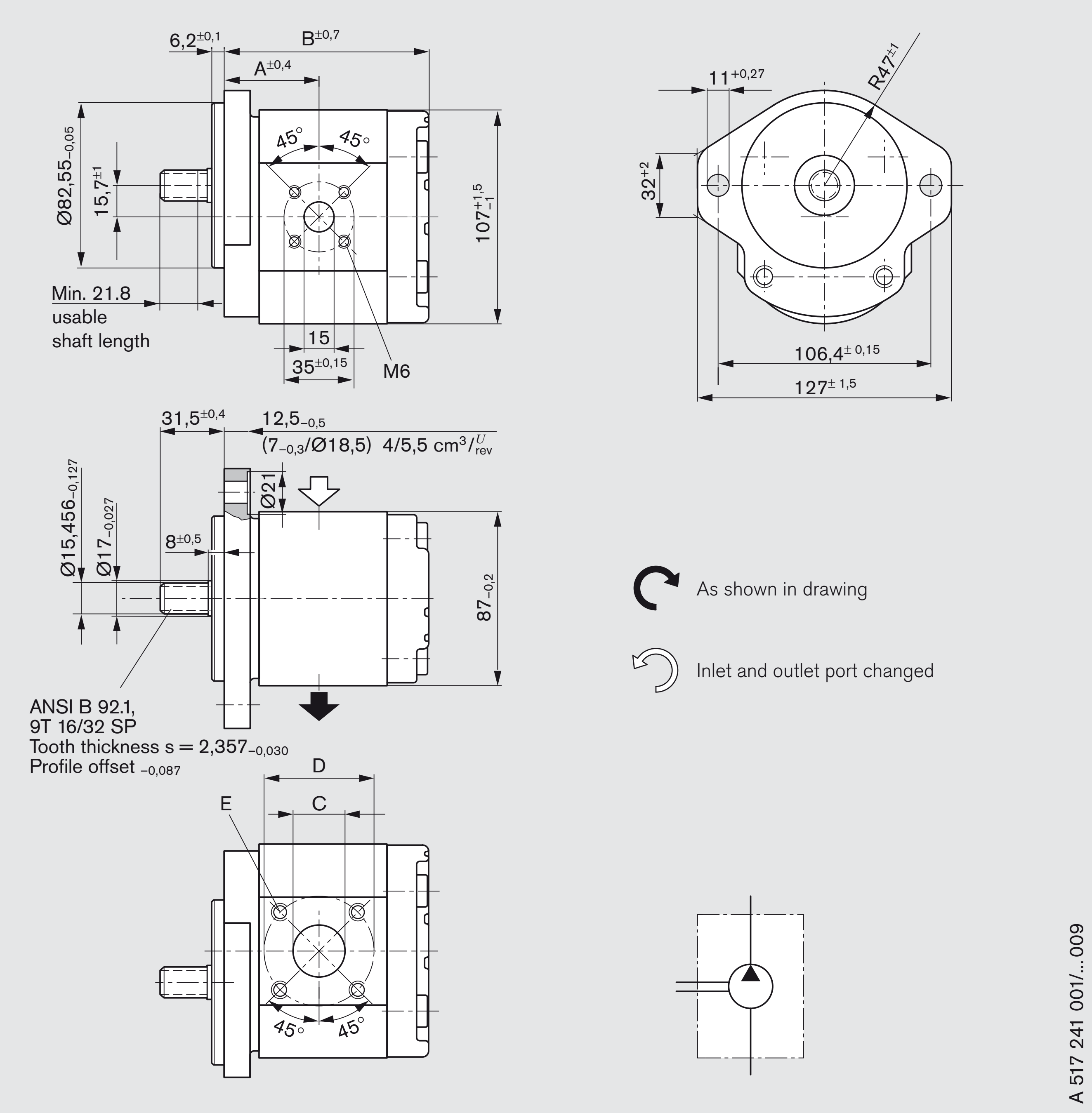


Ordering code:
AZPS – xx – ☐ ☐ ☐ ☐ C B 20 M B

Displacement [cm³/rev]	Ordering-No. ↺ L	Ordering-No. ↻ R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C	D	E
4	**0 517 225 301**	**0 517 225 001**	280	4000	3.4	39.9	83	15	40	M6 13 depth
5.5	**0 517 325 301**	**0 517 325 001**	280	4000	3.5	41.1	85.5	15	40	
8	**0 517 425 301**	**0 517 425 001**	280	4000	3.6	43.2	89.6	20	40	
11	**0 517 525 301**	**0 517 525 001**	280	3500	3.8	47	94.6	20	40	
14	**0 517 525 302**	**0 517 525 002**	280	3000	3.9	47.5	99.6	20	40	
16	**0 517 625 301**	**0 517 625 001**	280	3000	–	47.5	103	20	40	
19	**0 517 625 302**	**0 517 625 002**	280	3500	4.5	58.3	120	26	55	M8 13 depth
22.5	**0 517 725 301**	**0 517 725 001**	250	3500	4.6	61	125.4	26	55	
25	**0 517 725 302**	**0 517 725 002**	225	3000	4.8	63.1	129.6	26	55	
28	**0 517 725 303**	**0 517 725 003**	200	3000	4.9	65.5	134.4	26	55	

Dimensions

Standard range



Ordering code:

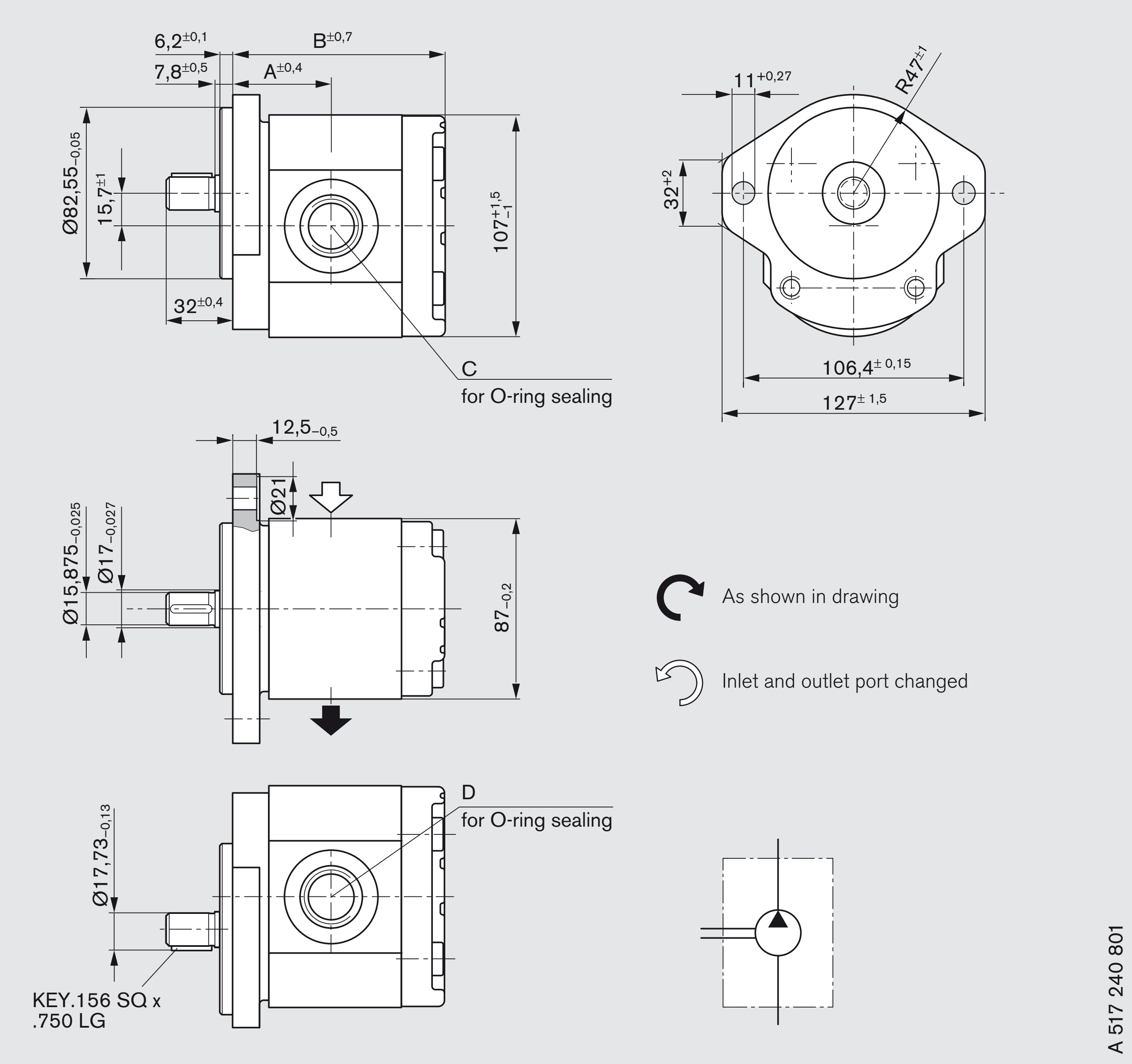
AZPS – xx – ☐ ☐ ☐ ☐ R R 20 M B

AZPS – 1x – 0 1 6 L R R 20 P B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C	D	E
4	**0 517 225 302**	**0 517 225 002**	280	4000	3.4	39.9	83	15	40	M6 13 depth
5.5	**0 517 325 302**	**0 517 325 002**	280	4000	3.5	41.1	85.5	15	40	
8	**0 517 425 302**	**0 517 425 002**	280	4000	3.6	43.2	89.6	20	40	
11	**0 517 525 303**	**0 517 525 003**	280	3500	3.7	47	94.6	20	40	
14	**0 517 525 304**	**0 517 525 004**	280	3000	3.9	47.5	99.6	20	40	
16	**0 517 625 303**	**0 517 625 003**	280	3000	3.9	47.5	103	20	40	
19	**0 517 625 304**	**0 517 625 004**	280	3500	4.4	58.3	120	26	55	M8 13 depth
22.5	**0 517 725 304**	**0 517 725 004**	250	3500	4.6	61	125.4	26	55	
25	**0 517 725 305**	**0 517 725 005**	225	3000	4.7	63.1	129.6	26	55	
28	**0 517 725 306**	**0 517 725 006**	200	3000	4.8	65.5	134.4	26	55	

Dimensions

Standard range

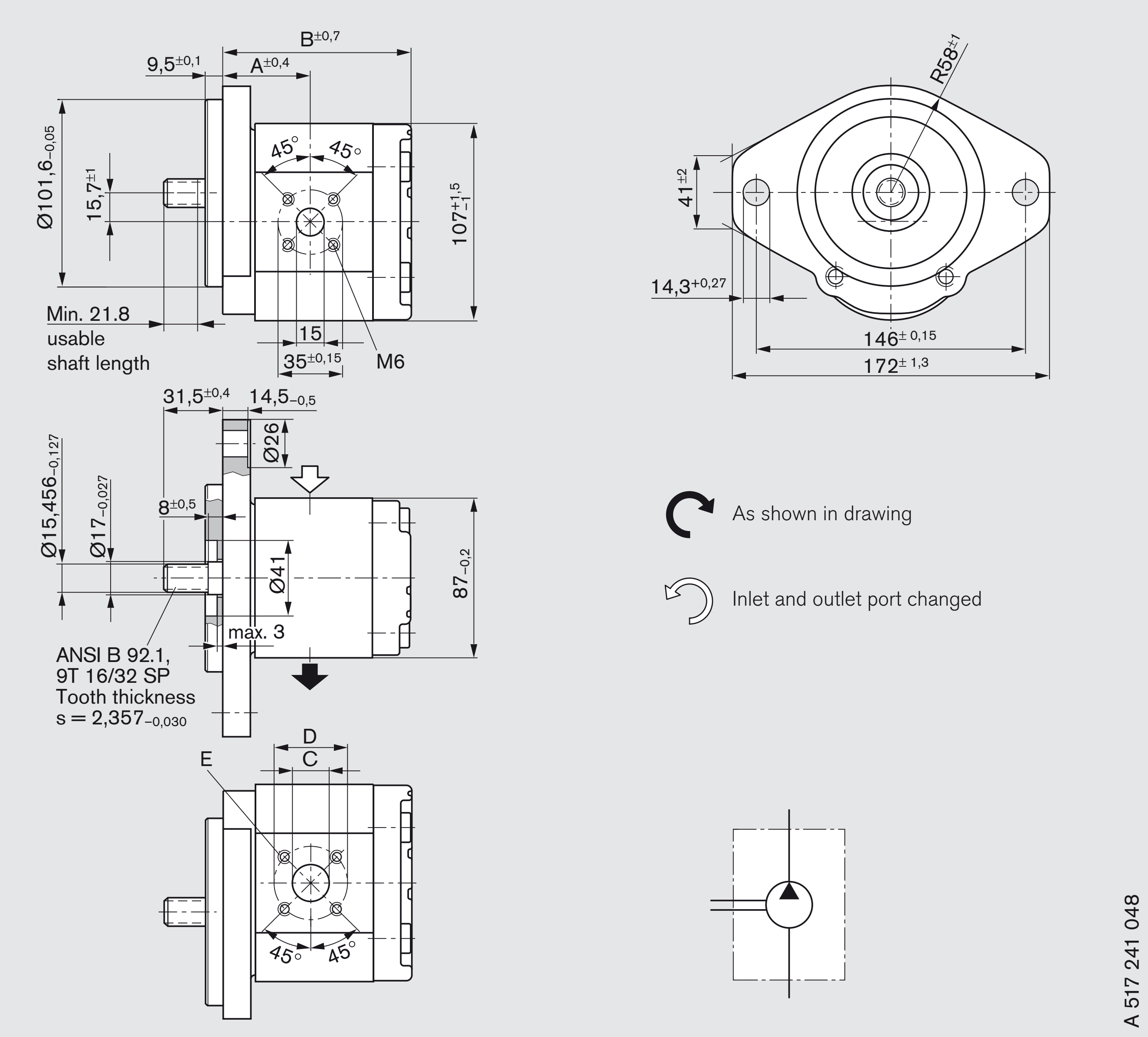


Ordering code:
AZPS – xx – ☐ ☐ ☐ ☐ Q R 12 M B

Displacement [cm³/rev]	Ordering-No. ↺ L	Ordering-No. ↻ R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C	D
4			260	4000					
5.5			260	4000					
8		**0 517 425 003**	260	4000	3.6	43.2	89.6	7/8″-14 UNF-2B 16 depth	
11			260	3500					
14			230	3000					
16			200	3000					
19			210	3500					
22.5			180	3500					
25			160	3000					
28			140	3000					

Dimensions

Standard range



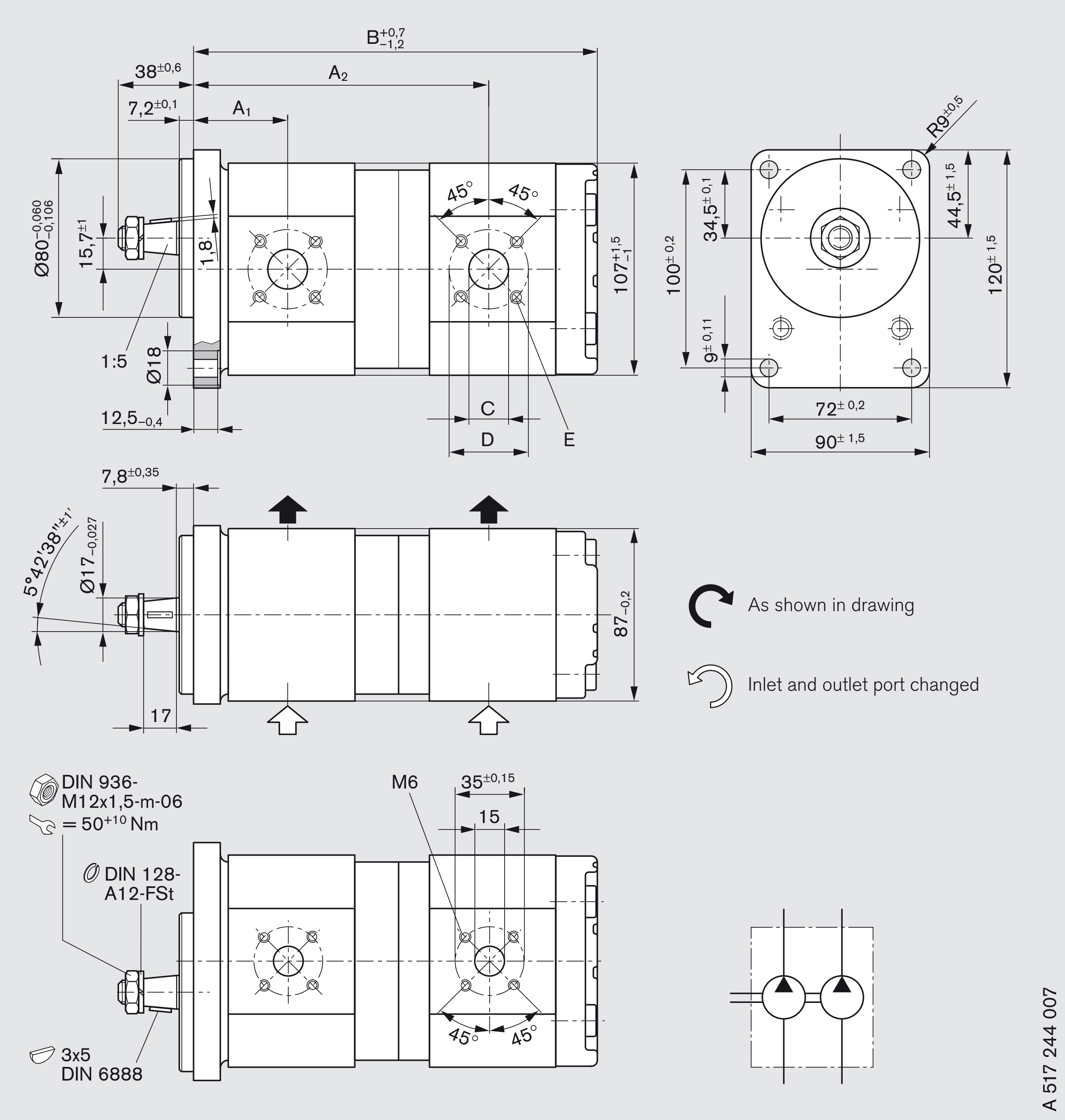
Ordering code:

AZPS – xx – ☐☐☐ ☐ R C 20 K B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	C	D	E
4			280	4000						M6 13 depth
5.5			280	4000						
8			280	4000						
11	**0 517 525 306**		280	3500	4.3	47	95.2	20	40	
14			280	3000						
16			280	3000						
19			280	3500						M8 13 depth
22.5			250	3500						
25		**0 517 725 008**	225	3000	5.2	63.1	130.2	26	55	
28			200	3000						

Dimensions

Standard range



Ordering code:

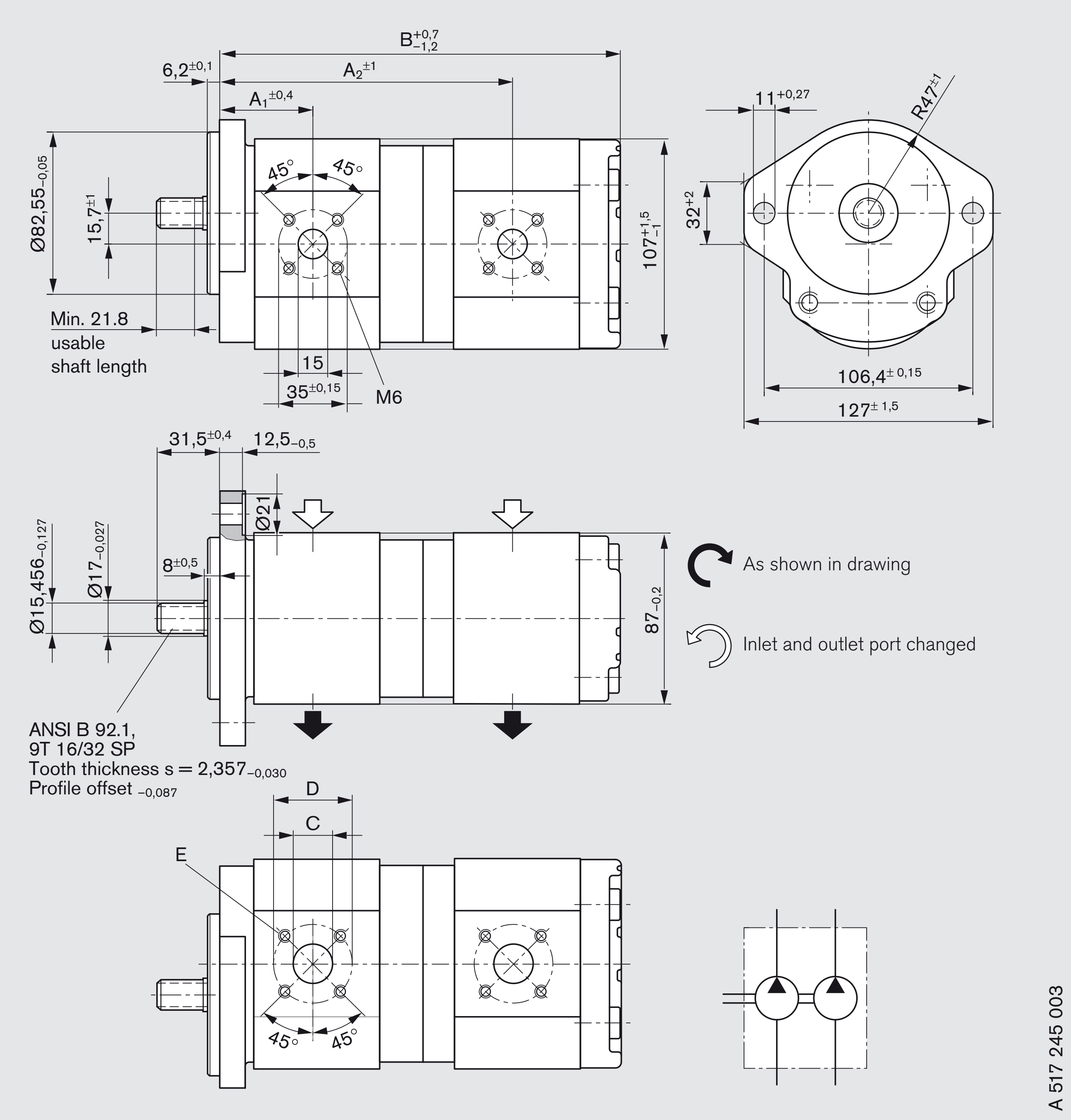
AZPSS – xx – ☐☐☐ / ☐☐☐ ☐ C B 20 20 M B

Displacement [cm³/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed [rpm]	kg	Dimension [mm]					
P1	P2	L	R	P1	P2			A_1	A_2	B	C*)	D	E
16	5.5	**0 517 665 304**		280	280	3000	5.8	47.5	142.8	187.0	20	40	M6 13 depth
16	8			280	280	3000							
16	11	**0 517 665 305**		280	280	3000	6.1	47.5	148.7	196.3	20	40	
14	11		**0 517 565 011**	280	260	3000	5.9	47.5	145.3	192.5	20	40	

*) at 4 and 5.5 cm³ Ø15

Dimensions

Standard range



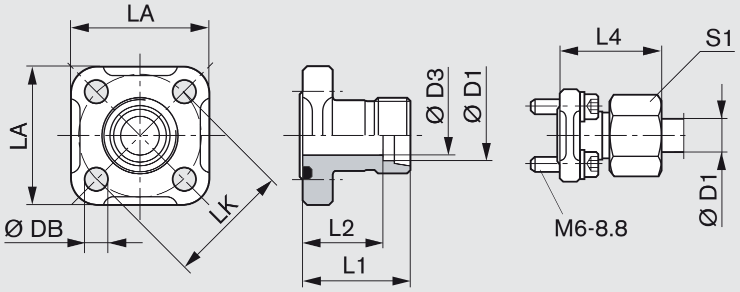
Ordering code:
AZPSS – xx – ☐☐☐/☐☐☐ ☐ R R 20 20 M B

Displacement [cm³/rev]		Ordering-No.		Max. operating pressure [bar]		Max. rotation speed [rpm]	kg	Dimension [mm]					
P1	P2	L	R	P1	P2			A_1	A_2	B	C*)	D	E
16	5.5		**0 517 665 007**	280	280	3000	5.8	47.5	142.8	186.9	20	40	M6 13 depth

*) at 4 and 5.5 cm³ Ø15

Fittings

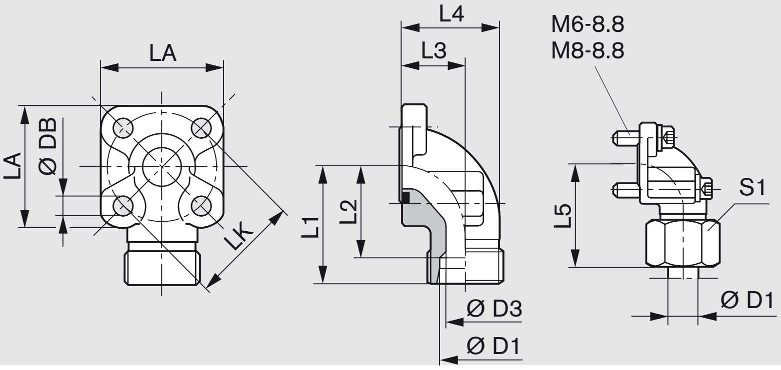
Gear pump flange, straight, for rectangular flange 20 see page 8



LK	D1	D3	L1	L2	L4	LA	S1	DB	Screws 4x	Seal ring NBR *)	Mass [kg]	Part number	*p* [bar]
35	10L	8	30	23.0	39.0	40	19	6.4	M 6x22	20x2.5	0.09	**1 515 702 064**	315
35	12L	10	30	23.0	39.0	40	22	6.4	M 6x22	20x2.5	0.10	**1 515 702 065**	315
35	15L	12	30	23.0	38.0	40	27	6.4	M 6x22	20x2.5	0.10	**1 515 702 066**	250
40	15L	12	35	28.0	43.0	42	27	6.4	M 6x22	24x2.5	0.12	**1 515 702 067**	100
40	18L	15	35	27.5	44.0	42	32	6.4	M 6x22	24x2.5	0.13	**1 515 702 068**	100
40	22L	19	35	27.5	44.5	42	36	6.4	M 6x22	24x2.5	0.12	**1 515 702 069**	100
40	28L	24	42	27.5	34.5	42	41	6.4	M 6x22	24x2.5	0.15	**1 515 702 008**	100

Complete fittings with seal ring, metric screw set, nuts and olive. *) NBR = Perbunan®

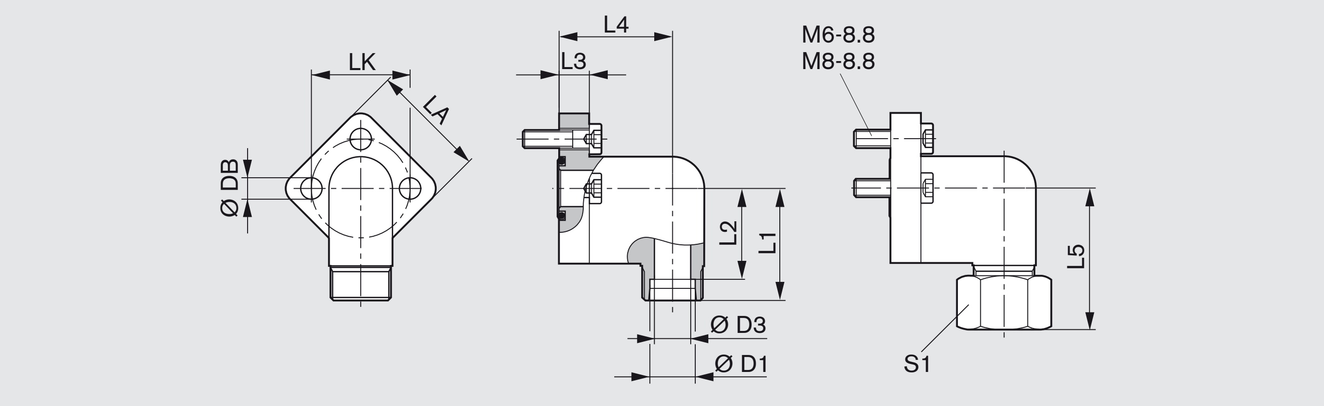
Gear pump flange, 90° angle, for rectangular flange 20 see page 8



LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws		Seal ring NBR *)	Mass [kg]	Part number	*p* (bar)
											2x	2x				
35	10L	8	38	31.0	16.5	26.5	47.0	40	19	6.4	M 6x22	M 6x35	20x2.5	0.16	**1 515 702 070**	315
35	12L	10	38	31.0	16.5	26.5	47.0	40	22	6.4	M 6x22	M 6x35	20x2.5	0.16	**1 515 702 071**	315
35	15L	12	38	31.0	16.5	26.5	46.0	40	27	6.4	M 6x22	M 6x35	20x2.5	0.15	**1 515 702 072**	250
35	16S	12	38	29.5	20.0	31.0	48.0	40	30	6.4	M 6x22	M 6x40	20x2.5	0.18	**1 515 702 002**	315
35	18L	15	38	29.5	20.0	31.0	47.0	40	32	6.4	M 6x22	M 6x40	20x2.5	0.18	**1 545 702 006**	250
35	20S	16	45	34.5	25.0	38.0	56.0	40	36	6.4	M 6x22	M 6x45	20x2.5	0.24	**1 515 702 017**	315
40	15L	12	38	31.0	22.5	36.5	46.0	42	27	6.4	M 6x22	M 6x22	24x2.5	0.15	**1 515 702 073**	100
40	18L	15	38	30.5	22.5	36.5	47.0	42	32	6.4	M 6x22	M 6x22	24x2.5	0.17	**1 515 702 074**	100
40	20S	16	40	29.5	22.5	35.5	50.0	42	36	6.4	M 6x22	M 6x45	24x2.5	0.20	**1 515 702 011**	250
40	22L	19	38	30.5	22.5	36.5	47.5	42	36	6.4	M 6x22	M 6x22	24x2.5	0.17	**1 515 702 075**	100
40	28L	22	40	32.5	28.0	43.0	49.0	42	41	6.4	M 6x20	M 6x50	24x2.5	0.24	**1 515 702 010**	100
40	35L	31	41	30.5	34.0	55.0	52.0	42	50	6.4	M 6x22	M 6x60	24x2.5	0.33	**1 515 702 018**	100

Complete fittings with seal ring, metric screw set, nuts and olive. *) NBR = Perbunan®

Gear pump flange, 3-hole, 90° angle, for rectangular flange 30 see page 8



LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws 3x	Seal ring NBR *)	Mass [kg]	Part number	*p* [bar]
30	12L	10	37	30.0	10	37.5	46	38	22	6.4	M6x22	16x2.5	0.13	**1 515 702 146**	250
30	15L	12	37	30.0	10	37.5	47	38	27	6.4	M6x22	16x2.5	0.14	**1 515 702 147**	250
30	18L	15	37	30.0	10	37.5	47	38	32	6.4	M6x22	16x2.5	0.17	**1 515 702 148**	160
40	22L	19	43	35.5	14	41.0	53	48	36	8.4	M8x30	24x2.5	0.29	**1 515 702 149**	160
40	28L	24	43	35.5	14	41.0	53	48	41	8.4	M8x30	24x2.5	0.40	**1 515 702 150**	160

Complete fittings with seal ring, metric screw set, nuts and olive. *) NBR = Perbunan®

Note
You can find the permissible tightening torques in our publication:
“General Operating Instructions for External Gear Units”
RE 07 012-B1.

Ordering-No.

Ordering-No.	Page
0 517 215 001	19
0 517 215 301	19
0 517 225 001	22
0 517 225 002	23
0 517 225 301	22
0 517 225 302	23
0 517 315 001	19
0 517 315 301	19
0 517 325 001	22
0 517 325 002	23
0 517 325 301	22
0 517 325 302	23
0 517 415 001	19
0 517 415 301	19
0 517 425 001	22
0 517 425 002	23
0 517 425 003	24
0 517 425 301	22
0 517 425 302	23
0 517 515 001	19
0 517 515 002	19
0 517 515 302	19
0 517 515 303	19
0 517 515 304	20
0 517 515 306	20
0 517 525 001	22
0 517 525 002	22
0 517 525 003	23
0 517 525 004	23
0 517 525 301	22
0 517 525 302	22
0 517 525 303	23
0 517 525 304	23
0 517 525 306	25
0 517 565 011	26
0 517 615 001	19
0 517 615 002	19
0 517 615 003	21
0 517 615 301	19
0 517 615 303	19
0 517 615 303	20
0 517 625 001	22
0 517 625 002	22
0 517 625 003	23
0 517 625 004	23
0 517 625 301	22
0 517 625 302	22
0 517 625 303	23
0 517 625 304	23
0 517 665 007	27
0 517 665 304	26
0 517 665 305	26
0 517 715 001	19
0 517 715 002	19
0 517 715 003	19
0 517 715 301	19
0 517 715 302	19
0 517 715 303	19
0 517 725 001	22
0 517 725 002	22
0 517 725 003	22
0 517 725 004	23
0 517 725 005	23
0 517 725 006	23
0 517 725 008	25
0 517 725 301	22
0 517 725 302	22
0 517 725 303	22
0 517 725 304	23
0 517 725 305	23
0 517 725 306	23

Notes for commissioning

Filter recommendation

The major share of premature failures in external gear pumps is caused by contaminated hydraulic fluid.
As a warranty cannot be issued for dirt-specific wear, we recommended filtration compliant with cleanliness level 20/18/15 ISO 4406, which reduces the degree of contamination to a permissible dimension in terms of the size and concentration of dirt particles:

Operating pressure [bar]	>160	<160
Contamination class ISO 4406	18/15	19/16
To be reached with $\beta_X = 75$	20	25

We recommend that a full-flow filter always be used.
Basic contamination of the hydraulic fluid used may not exceed class 20/18/15 according to ISO 4406. Experience has shown that new fluid quite often lies above this value. In such instances a filling device with special filter should be used.

General

- The pumps supplied by us have been checked for function and performance. No modifications of any kind may be made to the pumps; any such changes will render the warranty null and void!
- Pump may only be operated in compliance with permitted data (see pages 15 – 18).

Project planning notes

Comprehensive notes and suggestions are available in Hydraulics Trainer, Volume 3 RE 00 281, “Project planning notes and design of hydraulic systems”. Where external gear pumps are used we recommend that the following note be adhered to.

Technical data

All stated technical data is dependent on production tolerances and is valid for specific marginal conditions.
Note that, as a consequence, scattering is possible, and at certain marginal conditions (e.g. viscosity) **the technical data may change**.

Characteristics

When designing the external gear pump, note the maximum possible service data based on the characteristics displayed on pages 10 to 12.

Additional information on the proper handling of hydraulic products from Bosch Rexroth is available in our document:
“General product information for hydraulic products”
RE 07 008.

Contained in delivery

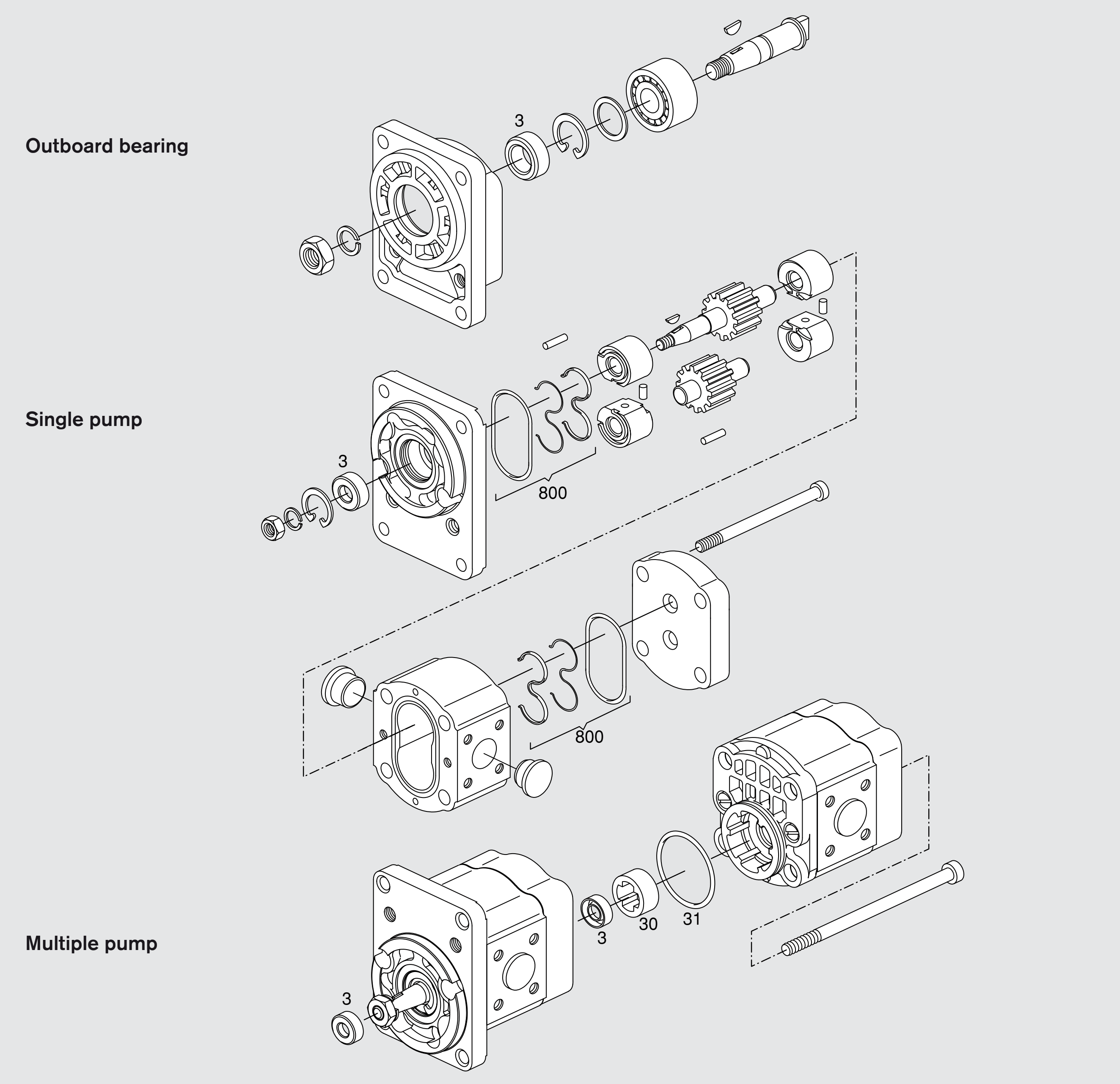
The components with characteristics as described under ordering code and device measurements, pages 19 – 27, are contained in delivery.

You can find further information in our publication:
“General Operating Instructions for External Gear Units”
RE 07 012-B1.

Service parts

Page	Ordering code	Seal kit Pos. 800 1 517 010 ...	Shaft seal ring Pos. 3 1 510 283 ...	Dimension	Seal ring Pos. 31 1 900 210 ...	Material	Dimen-sion	Driver Pos. 30 1 510 240 ...
19	AZPS – 1x – □□□ □N M 20 **M** B	208	–		145	NBR	45x2.5	000
19	AZPS – 2x – □□□ □N M 20 **K** B	212	–		145	NBR	45x2.5	013
20	AZPS – 1x – □□□ □C P 20 **K** B	208	027 FKM	17x30x7/8	–	–		–
21	AZPS – 1x – □□□ □F N 20 **K** B	208	027 FKM	17x30x7/8	–	–		–
22	AZPS – 1x – □□□ □C B 20 **M** B	208	008 NBR	17x30x7/8	–	–		–
22	AZPS – 2x – □□□ □C B 20 **M** B	212	008 NBR	17x30x7/8	–	–		–
23	AZPS – 1x – □□□ □R R 20 **M** B	208	008 NBR	17x30x7/8	–	–		–
23	AZPS – 1x – 0 1 6 L R R 20 **P** B	206	027 FKM	17x30x7/8	–	–		–
23	AZPS – 2x – □□□ □R R 20 **M** B	212	008 NBR	17x30x7/8	–	–		–
24	AZPS – 1x – □□□ □Q R 12 **M** B	208	008 NBR	17x30x7/8	–	–		–
25	AZPS – 1x – □□□ □R C 20 **K** B	208	027 FKM	17x30x7/8	–	–		–
25	AZPS – 2x – □□□ □R C 20 **K** B	212	027 FKM	17x30x7/8	–	–		–
26	AZPSS – 1x – □□□ □□□ □C B 20 20 **M** B	208	008 NBR	17x30x7/8	145	NBR	45x2.5	–
27	AZPSS – 1x – □□□ □□□ □R R 20 20 **M** B	208	008 NBR	17x30x7/8	145	NBR	45x2.5	–

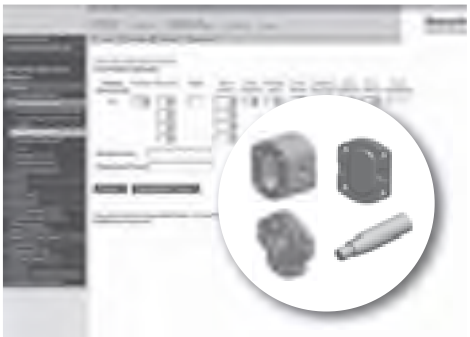
NBR = Perbunan® FKM = Viton®



The AZ configurator

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly. You only need to specify your requirements: From the displacement, direction of rotation, drive shaft, connection flange right up to the required rear cover. You immediately receive a project drawing (PDF format) if a configuration already exists. You receive the price of the configured external gear unit upon request.

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly – all data needed for project planning are acquired thru menu guidance.



Selection is made either on an ordering code or your technical requirements. This means that you can search for external gear units that have already been configured, or you specify the configuration variant of the external gear unit based upon the operating parameters you require.

If the external gear unit you selected has been released you will receive the part number, ordering code and a detailed installation drawing. If your special configuration is not available please send your specification to Rexroth. One of our employees will then contact you.

External Gear Pumps
Series T

AZPT-...

Fixed pumps
$V = 20...36\ \text{cm}^3/\text{rev}$

SILENCE

Overview of contents

Features

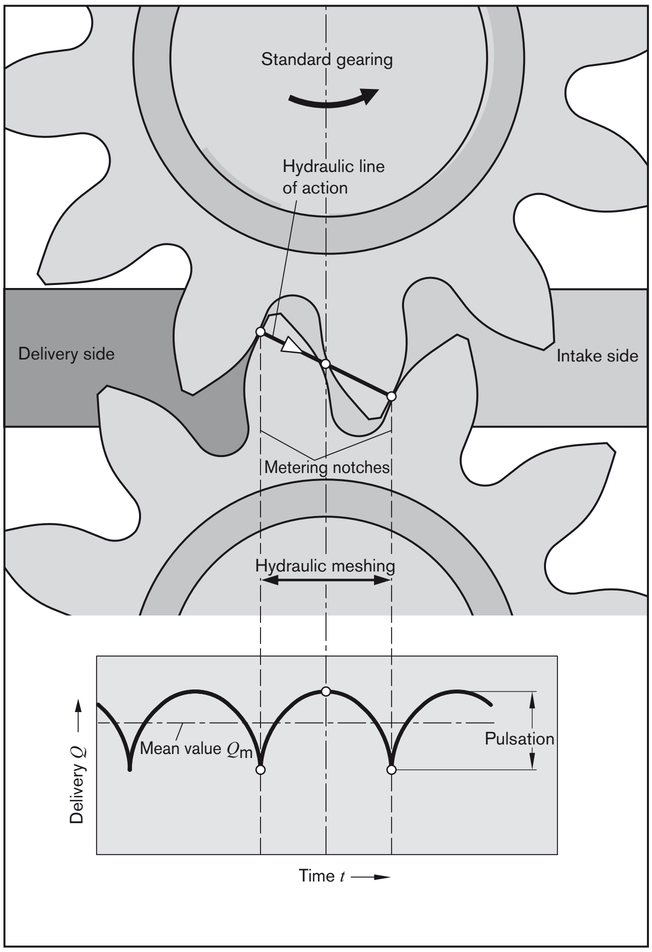
- Nominal pressure 280 bar
- Slide bearings for heavy duty applications
- Drive shafts to ISO or SAE
- Combination of several pumps possible
- Line ports:
  connection flange or screw thread
- Optimized pressure pulsation with reduced noise emissions and vibration excitation in the system
- Consistent high quality
- Considerably longer service life due to reinforced shaft and case

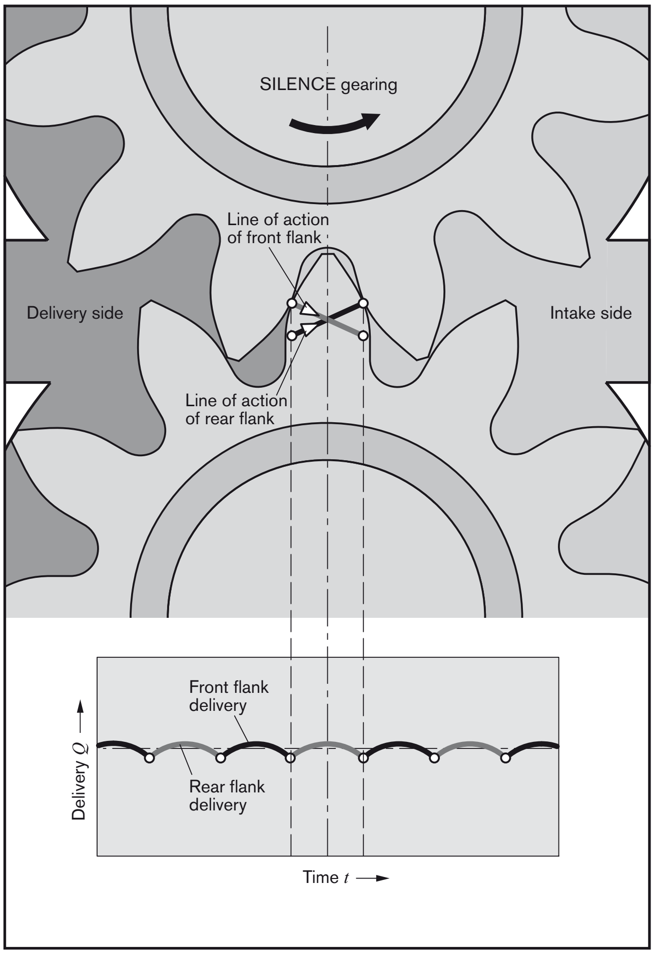
General

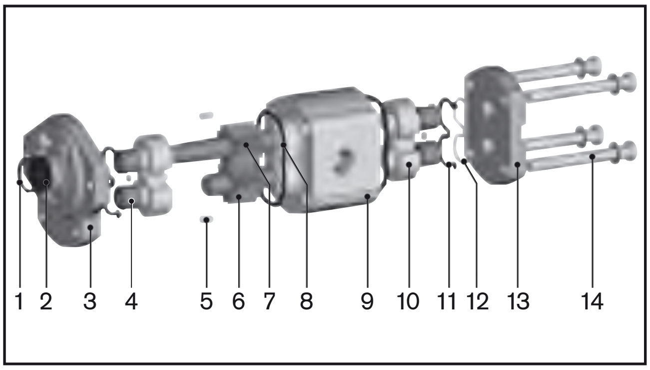
The key task of external gear units is to convert mechanical energy (torque and rotational speed) into hydraulic energy (flow and pressure). In external gear motors this is the other way round. These machines are required to be highly efficient in order to avoid unnecessary heat. This efficiency is achieved by means of precision production engineering and pressure-sensitive gap sealing.

Moreover, in the low-noise SILENCE pumps, the dual-flank principle helps to reduce flow pulsation by up to 75 %.

The displacement method







1 Retaining ring
2 Shaft seal ring
3 Front cover
4 Slide bearing
5 Centering pin
6 Gear
7 Gear (frictional)
8 Case seal
9 Pump case
10 Bearing
11 Axial zone seal
12 Support
13 End cover
14 Fixing screws

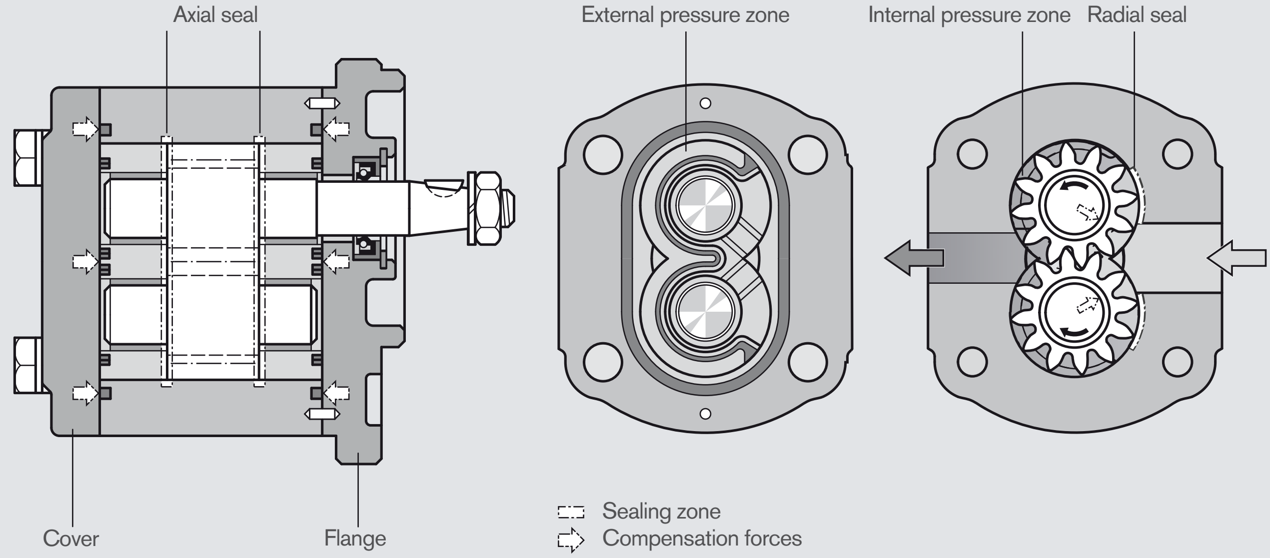
The geometry of the displacement gearing, matched in form by the rotation of the drive shaft, results in the parabolic flow characteristic shown here on the left. In a standard pump, this characteristic is repeated each time a gear tooth meshes. With their dual-flank system, the flow pulsation of SILENCE pumps is reduced by 75 % – with correspondingly lower excitation of downstream system components – at double the fundamental frequency. During this process, the gear pair exhibits an extremely reduced rear flank backlash, so that hydraulic sealing is provided not just by the front flank of the driven gear, but also by the rear flanks. In this way, the front and rear flanks alternately contribute to flow displacement. And by adapting the shape of the metering notches, the expansion of the hydraulic line of action is half that of the standard pump.

Construction

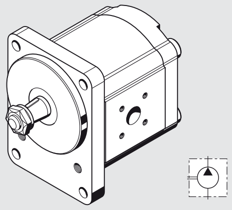
The external gear pump consists essentially of a pair of gears supported in bearing bushings or bearing, dependent on the series, and the case with a front and a rear cover. The drive shaft protrudes from the front cover where it is sealed by the shaft seal ring. The bearing forces are absorbed by special bearing bushings with sufficient elasticity to produce surface contact instead of line contact. They also ensure excellent resistance to galling – especially at low speed. The gears have 12 teeth. This keeps both flow pulsation and noise emission to a minimum.

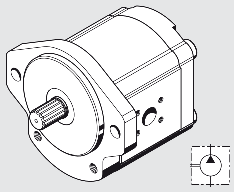
The internal sealing is achieved by forces which are proportional to delivery pressure. This ensures optimum efficiency. The bearings provide the seal at the ends of the gaps between the teeth which carry the pressurized oil. The sealing zone between the gear teeth and the bearings is controlled by the admission of operating pressure to the rear of the bearing bushings. Special seals form the boundary of the zone. The radial clearance at the tips of the gear teeth is sealed by internal forces pushing them against the case.

Gear pump axial compensation



Overview of “Series T” standard types

Version	Page
	16

Version	Page
	17

Ordering code

External gear units Single pumps “SILENCE”

AZ	P	T	–	x	x	–	020	R	C	B	20	M	B	18009	S xxxx

Function

P = Pump

Series

2 = Case width 110 mm

Version

2 = Chromatized, pinned

Size T

020 = 20.0 cm^3/rev
022 = 22.5 cm^3/rev
025 = 25.0 cm^3/rev
028 = 28.0 cm^3/rev
032 = 32.0 cm^3/rev
036 = 36.0 cm^3/rev

Direction of rotation

R = Clockwise
L = Counter-clockwise

Special design

Valve adjustment

200 xx = PRV 200 bar
xxx 11 = FCV 11 l/min
18009 = PRV + FCV 180 bar, 9 l/min

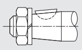
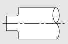
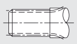
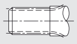
Rear cover

B = Standard
E = FCV residual flow external
S = FCV residual flow internal
V = PRV + FCV

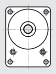
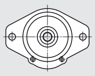
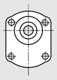
Seals

M= NBR
K = NBR, SSR in FKM

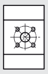
Drive shafts

			Suitable front cover
C	Tapered key shaft 1 : 5		**B**
N	Dihedral claw		**M**
D	Splined shaft SAE J 744 22-4 13T		**C**
P	Splined shaft SAE J 744 19-4 11T		**C**

Front cover

B	Square flange Centering Ø 100 mm	
C	SAE J 744 101-2 B 2-bolt flange Ø 101.6 mm	
M	2-bolt mounting Centering Ø 52 mm with seal ring	

Line ports

07	Square flange SAE Thread, metric	
20	Rectangular flange	

Not all variants can be selected by using ordering code!
Please select the required pump by using the selection tables (standard types) or after consultation with Bosch Rexroth!
Special options are possible upon request.

Ordering code

External gear units Multiple pumps “SILENCE”

AZ	P	TTSS	–	x	x	–	032/022/016/005	R	C	B	20 20 20 20	K	B

Function

P = Pump

Series

B = 1.0...7.1 cm³/rev
S = 4.0...28 cm³/rev
F = 4.0...28 cm³/rev
T = 20.0...36 cm³/rev
N = 20.0...36 cm³/rev
U = 22.5...63 cm³/rev
G = 22.5...63 cm³/rev

Series, relates to pump section 1

2 = Case width 110 mm

Version, relates to pump section 1

2 = Chromatized, pinned

Size

corresponding to each series

Direction of rotation

R = Clockwise
L = Counter-clockwise

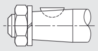
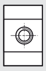
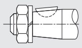
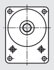
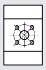
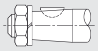
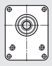
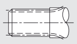
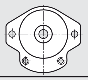
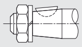
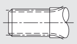
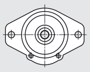
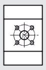
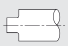
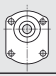
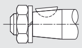
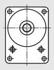
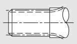
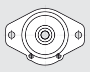
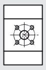
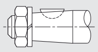
Rear cover

relates to last pump section

B = Standard

Seals

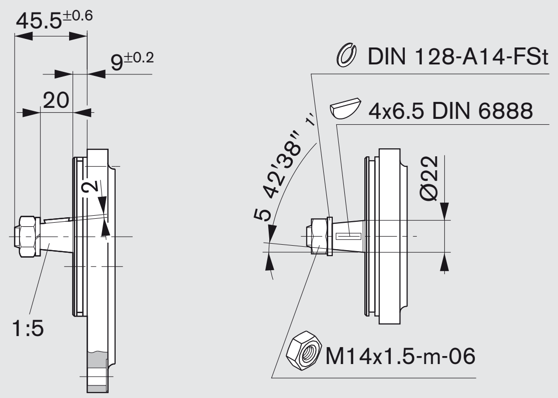
M = NBR
K = NBR, SSR in FKM
Shaft seal relate to pump section 1

Drive shafts relates to pump part 1			Suitable front cover	**Front cover** relates to pump part 1			**Line ports** every pump parts		
Series B:									
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 25.38 mm		**02**	Thread, metric DIN 3852 T1	
Series F, S:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 80 mm		**20**	Rectangular flange	
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 36.47 mm				
R	Splined shaft SAE J 744 16-4 9T		**R**	**R**	SAE J 744 82-2 A Centering Ø 82.55 mm 2-bolt mounting				
Series N, T:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 100 mm		**07**	Square flange SAE Thread, metric	
D	Splined shaft SAE J 744 22-4 13T		**C**	**C**	SAE J 744 101-2 B Centering Ø 101.6 mm 2-bolt mounting		**20**	Rectangular flange	
N	Dihedral claw		**M**	**M**	Centering Ø 52 mm with seal ring				
Series G, U:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 105 mm		**07**	Square flange SAE Thread, metric	
D	Splined shaft SAE J 744 22-4 13T		**C**	**C**	SAE J 744 101-2 B Centering Ø 101.6 mm 2-bolt mounting		**20**	Rectangular flange	
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 50.78 mm				

Not all variants can be selected by using ordering code!
Please select the required pump by using the selection tables (standard types) or after consultation with Bosch Rexroth!
Special options are possible upon request.

Drive shafts

C



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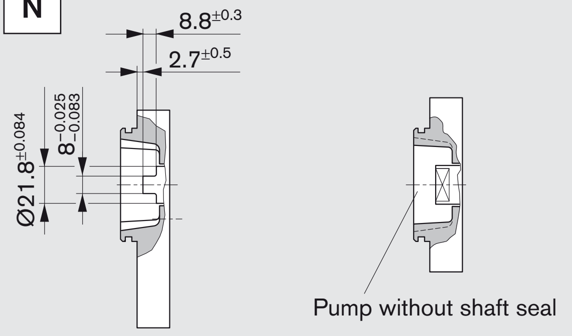
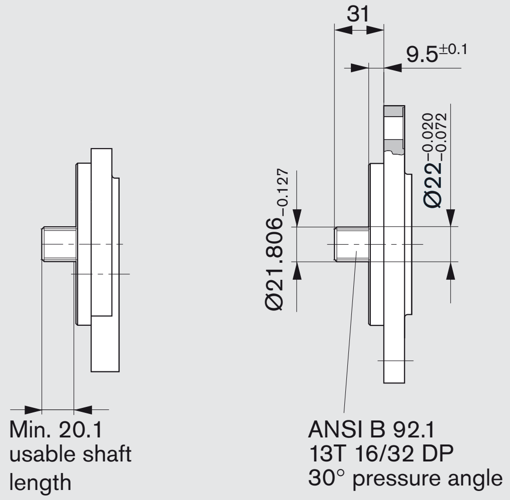
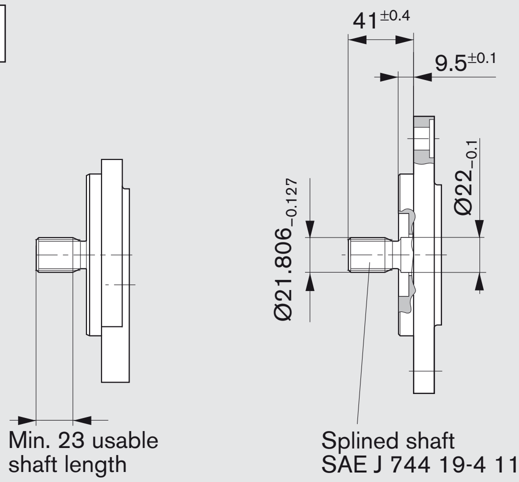


D

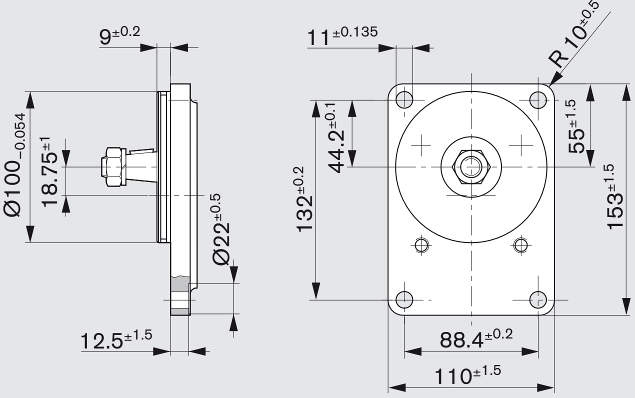


P

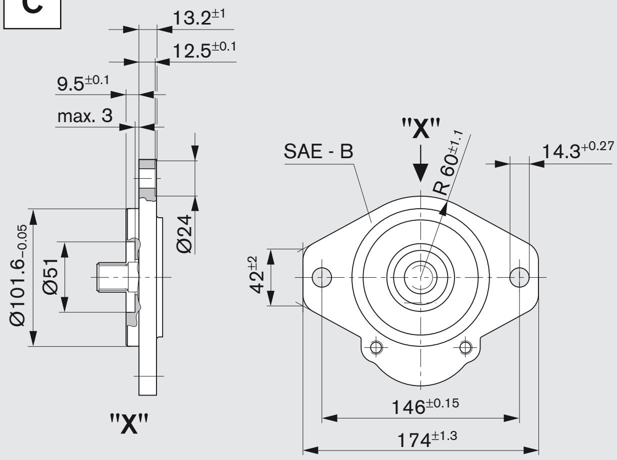


Front cover

B

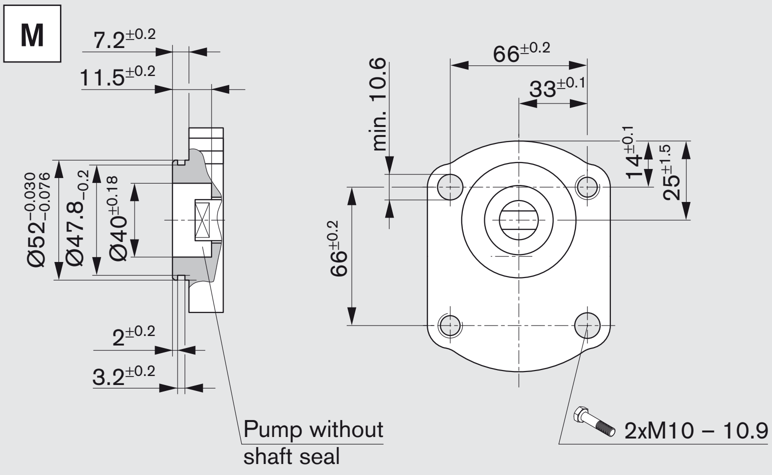


C

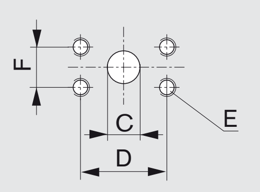


Front cover (continued)

M

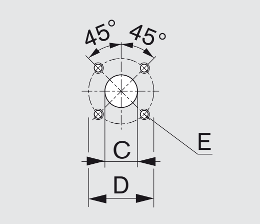


Line ports



07 **Square flange SAE, thread, metric**

Ordering code	Size	Pressure side				Suction side			
		C	**D**	**E**	**F**	**C**	**D**	**E**	**F**
07	20 cm^3	18	47.6	M10 depth 14	22.2	25	47.6	M10 depth 14	22.2
	22.5...36 cm^3						52.4		26.2



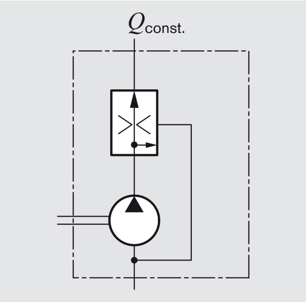
20 **Rectangular flange**

Ordering code	Size	Pressure side			Suction side		
		C	**D**	**E**	**C**	**D**	**E**
20	20...36 cm^3	18	55	M8 depth 13	26	55	M8 depth 13

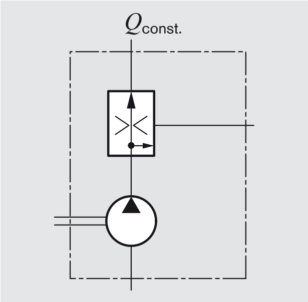
Gear pumps with integral valves

In order to reduce external pipework it is possible to incorporate a flow-control valve or pressure-relief valve in the rear cover of the gear pump. A typical application of this is in the supply of hydraulic oil in power steering systems. The pump delivers a constant flow irrespective of the speed at which it is driven. The excess flow is either returned internally to the suction port or distributed externally to other items of equipment.

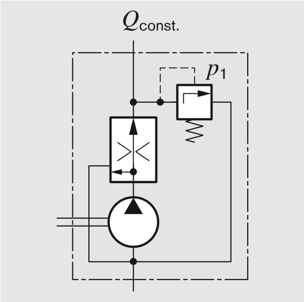
Upon request



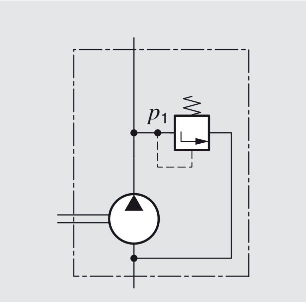
3-way flow-control valve.
Excess flow returned to suction line
$Q_{\text{const.}} = 2 \ldots 30$ l/min



3-way flow-control valve.
Excess flow distributed externally; loadable
$Q_{\text{const.}} = 2 \ldots 30$ l/min



3-way flow-control valve with pressure-relief valve.
Excess flow returned to suction line
$Q_{\text{const.}} = 2 \ldots 30$ l/min
$p_1 = 100 \ldots 180$ bar



Pressure-relief valve.
Discharge returned to suction line
$p_1 = 5 \ldots 250$ bar

Ordering code

S	**xxx17**

E	**xxx12**

V	**15011**

Design calculations for pumps

The design calculations for pumps are based on the following parameters:

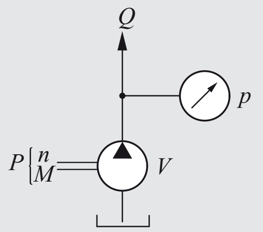
V	[cm^3/rev]	Displacement
Q	[l/min]	Delivery
p	[bar]	Pressure
M	[Nm]	Drive torque
n	[rev/min]	Drive speed
P	[kW]	Drive power

It is also necessary to allow for different efficiencies such as:

η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Overall efficiency

The following formulas describe the various relationships.
They include correction factors for adapting the parameters to the usual units encountered in practice.

Caution: Diagrams providing approximate selection data will be found on subsequent pages.



$$Q = V \cdot n \cdot \eta_v \cdot 10^{-5}$$

$$V = \frac{Q}{n \cdot \eta_v} \cdot 10^5$$

$$n = \frac{Q}{V \cdot \eta_v} \cdot 10^5$$

$$p = \frac{M \cdot \eta_{hm}}{1.59 \cdot V}$$

$$V = \frac{M \cdot \eta_{hm}}{159 \cdot p}$$

$$M = \frac{1.59 \cdot V \cdot p}{\eta_{hm}}$$

$$P = \frac{p \cdot Q}{6 \cdot \eta_t}$$

$$Q = \frac{6 \cdot P \cdot \eta_t}{p}$$

$$p = \frac{6 \cdot P \cdot \eta_t}{Q}$$

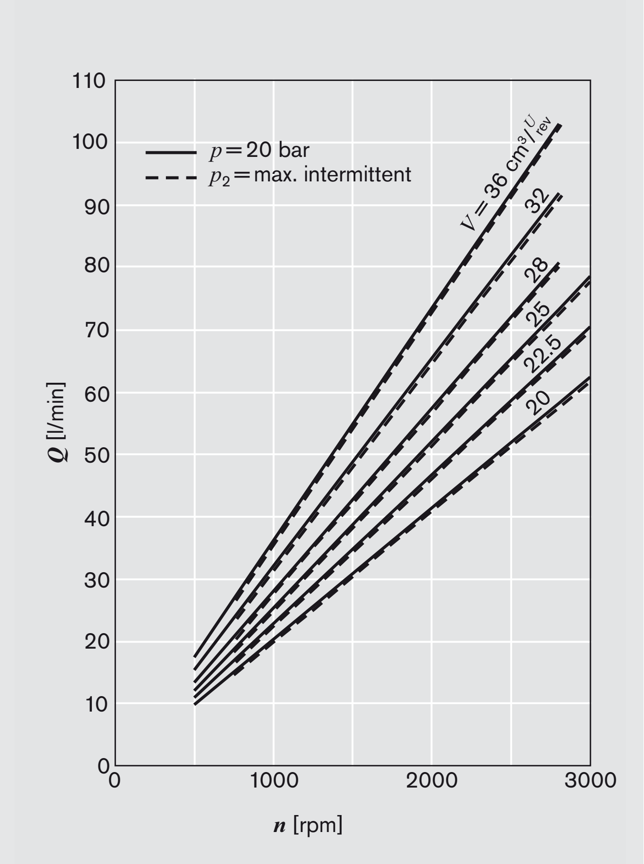
$$\begin{array}{llll} & [\%] & & \\ n & \text{———} & \eta_v \longrightarrow & Q \\ M & \text{———} & \eta_{hm} \longrightarrow & p \\ P & \text{———} & \eta_t \longrightarrow & p \cdot Q \end{array}$$

V [cm^3/rev] Q [l/min] p [bar]

n [rev/min] P [kW] M [Nm]

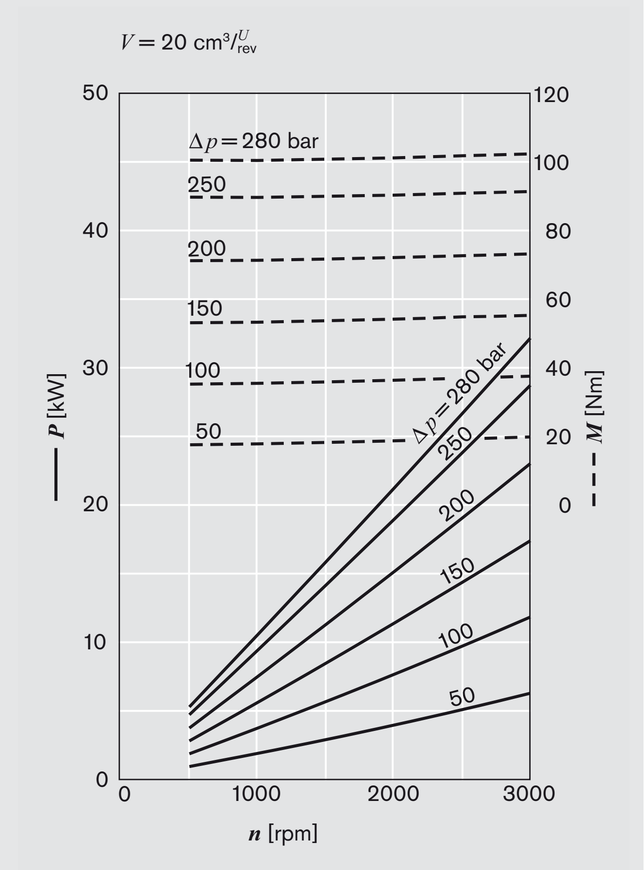
Caution: η [%] e.g. 95 [%]

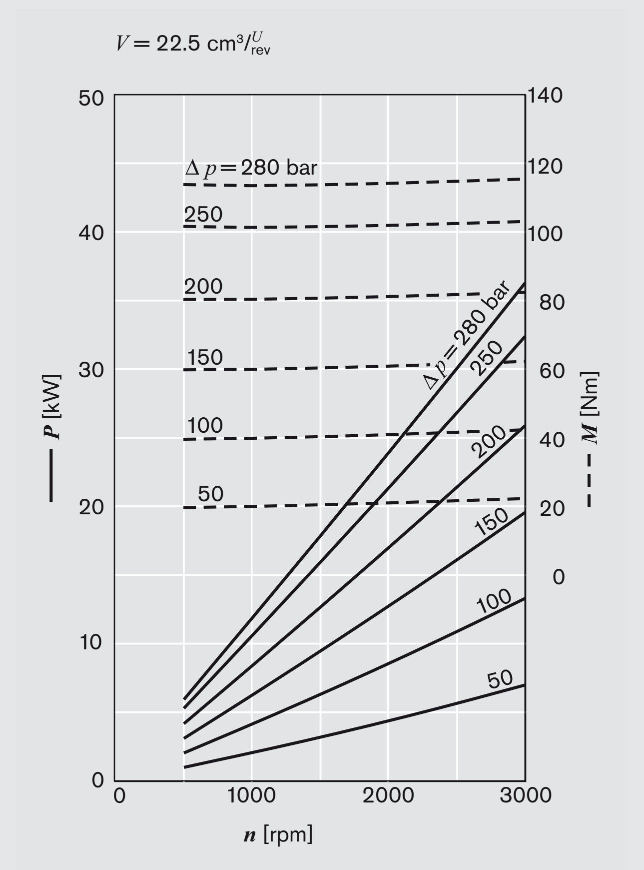
Performance charts



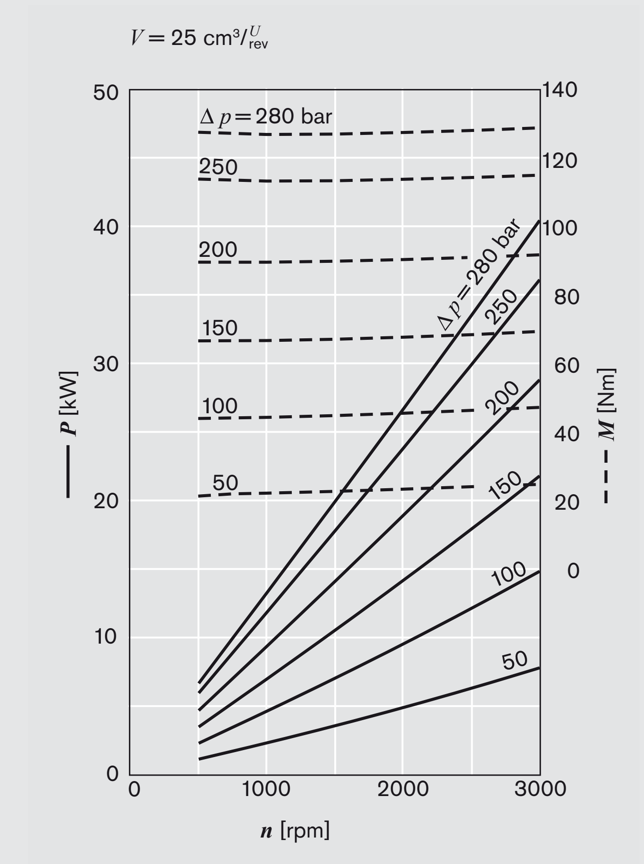
$\nu = 35$ mm²/s, $\vartheta = 50$ °C

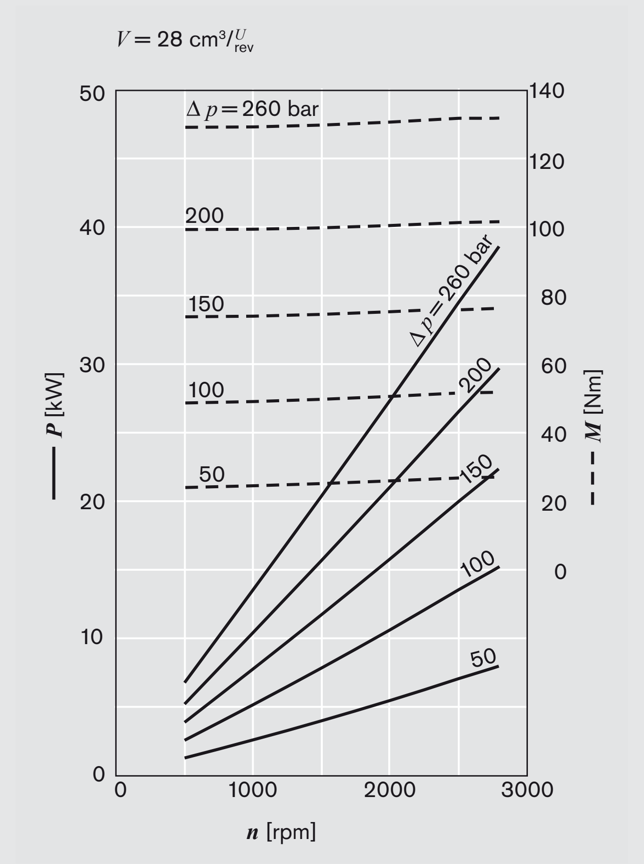
$Q = f(n, V)$ incl. η_v
$P = f(n, p)$ ——— incl. η_t
$M = f(n, p)$ – – – incl. η_{hm}

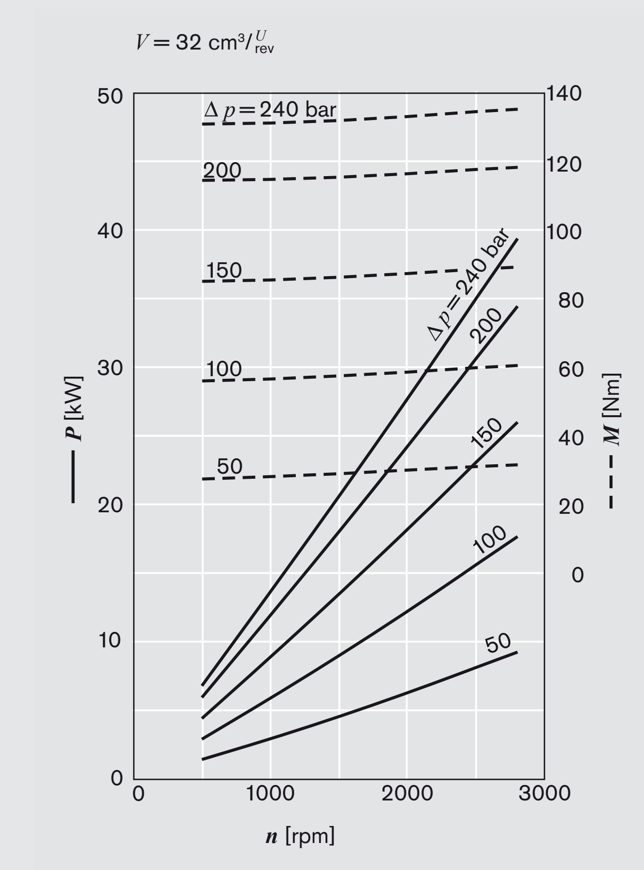


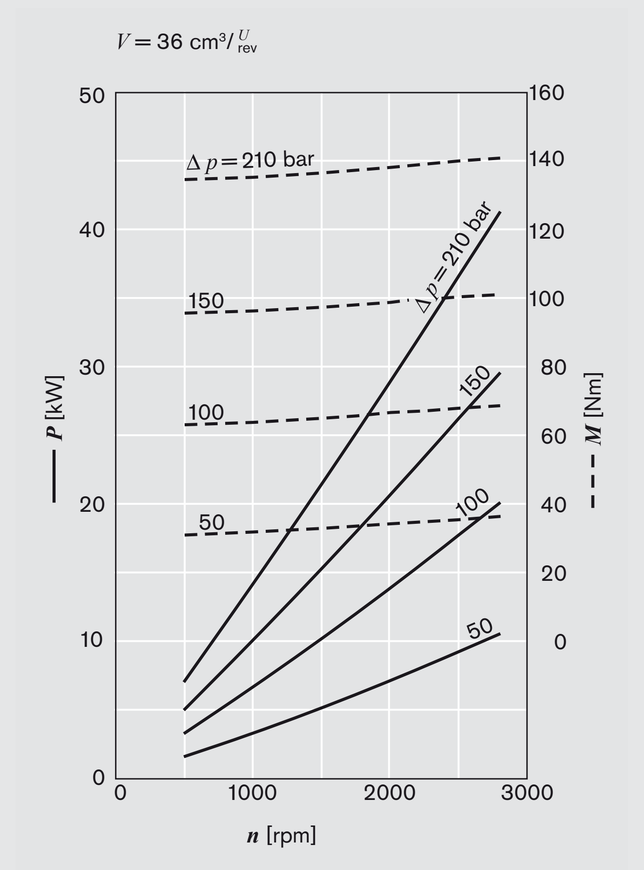


Performance charts (continued)





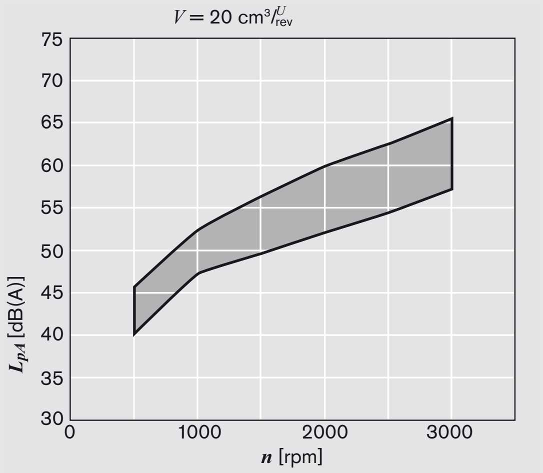


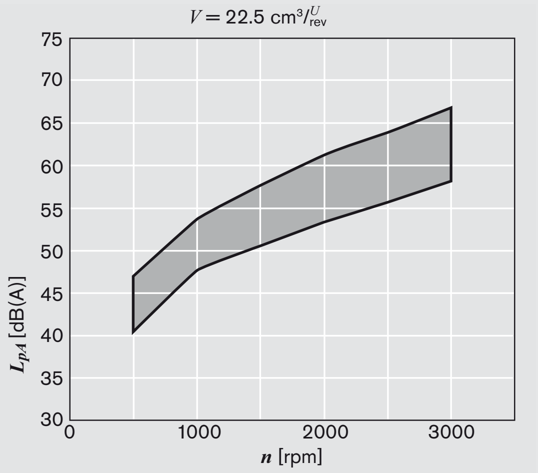


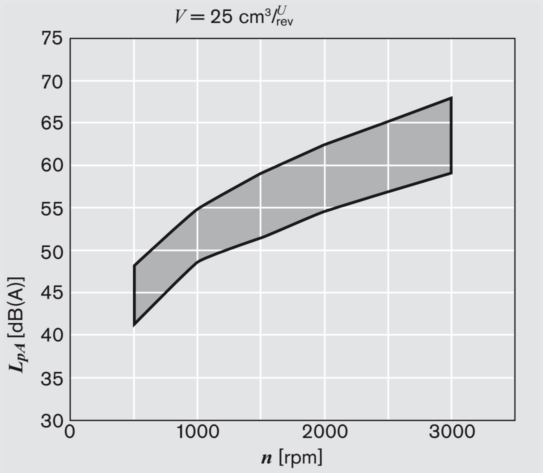
Noise charts

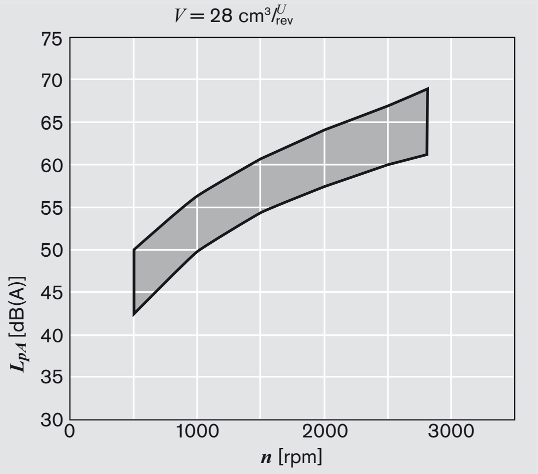
Noise level dependent on rotational speed, pressure range between 10 bar and pressure value p_2 (see page 12 Specifications table).
Oil data: $\nu = 32$ mm^2/s, $\vartheta = 50$ °C.
Sound pressure level calculated from noise measurements made in the sound absorbent measuring room compliant with DIN 45635, Part 26.
Spacing between measuring sensor – pump: 1 m.

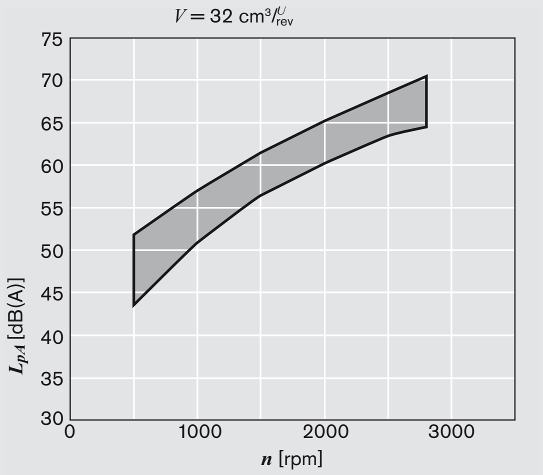
These are typical characteristic values for the respective model. They describe the airborne sound emitted solely by the pump. Environmental influences (installation site, piping, further system components) are not taken into consideration.
Each value applies for a single pump.

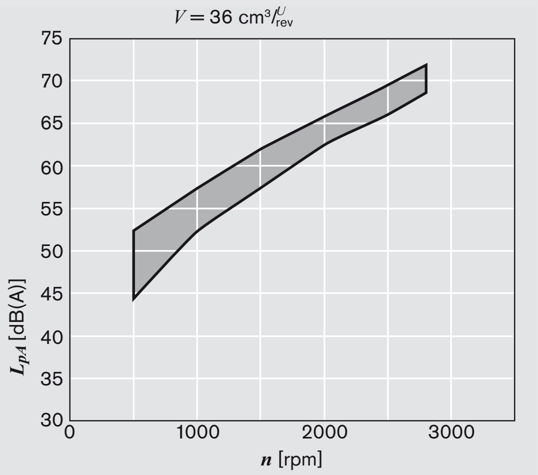

$V = 20$ cm^3/$^{U}_{\text{rev}}$


$V = 22.5$ cm^3/$^{U}_{\text{rev}}$


$V = 25$ cm^3/$^{U}_{\text{rev}}$


$V = 28$ cm^3/$^{U}_{\text{rev}}$


$V = 32$ cm^3/$^{U}_{\text{rev}}$


$V = 36$ cm^3/$^{U}_{\text{rev}}$

Specification

General	
Construction	External gear pump
Mounting	Flange or through-bolting with spigot
Line ports	Flange
Direction of rotation (looking on shaft)	Clockwise or counter-clockwise, the pump may only be driven in the direction indicated
Installation position	Any
Load on shaft	Radial and axial forces after consulting
Ambient temperature range	–30 °C...+80 °C or max. +110 °C with FKM seals
Hydraulic fluid	– Mineral oil compliant with DIN 51 524, 1–3, however under higher load at least HLP compliant with DIN 51 524 Part 2 recommended. – Comply with RE 90220 – Further operating fluids possible after consultation
Viscosity	12...800 mm²/s permitted range 20...100 mm²/s recommended range ...2000 mm²/s range permitted for starting
Hydraulic fluid temperature range	max. +80 °C with NBR seals *) max. +110 °C with FKM seals **)
Filtration ***)	At least cleanliness level 20/18/15 compliant with ISO 4406 (1999)

*) NBR = Perbunan®
**) FKM = Viton®
***) On hydraulic systems or devices with critical counter-reaction, such as steering and counterbalance valves, the type of filtration selected must be adapted to the sensitivity of these devices/ systems.

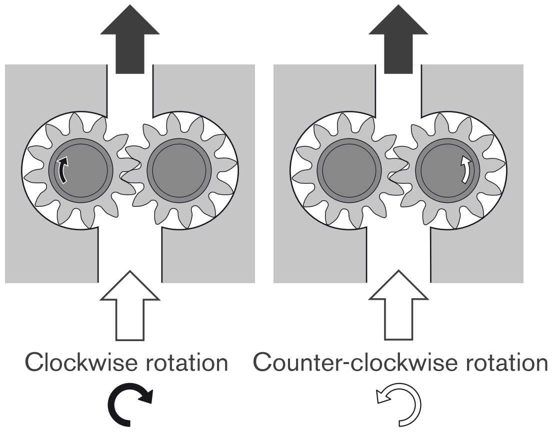
Safety requirements pertaining to the whole systems are to be observed.

In the case of applications with high numbers of load cycles please consulting.

Definition of direction of rotation

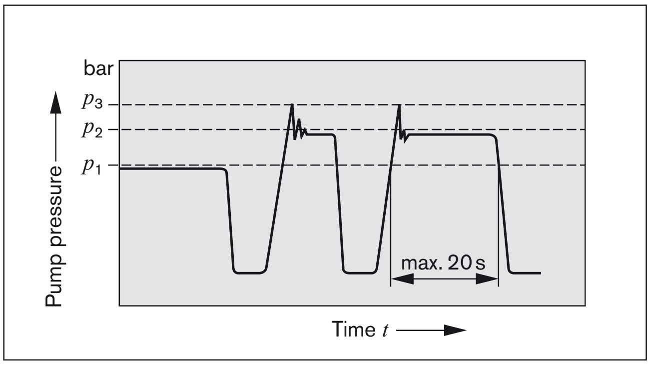
Always look on the drive shaft.

Caution: Dimensions drawings always show clockwise-rotation pumps.On counter-clockwise-rotation pumps the positions of the drive shaft and the suction and pressure ports are different.



Clockwise rotation Counter-clockwise rotation

Definitions of pressures

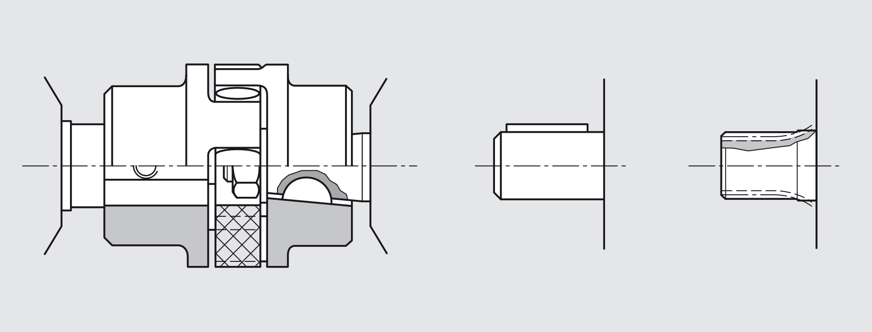


p_1 max. continuous pressure
p_2 max. intermittent pressure
p_3 max. peak pressure

AZPT-2x

Displacement	V	cm³/rev	20	22,5	25	28	32	36
Suction pressure	p_e	bar	0.7...3 (absolute), with tandem pumps $p_e\ (p_2)$ = max. 0.5 $p_e\ (p_1)$					
Max. continuous pressure	p_1		250	250	250	230	210	180
Max. intermittent pressure	p_2		280	280	280	260	240	210
Max. peak pressure	p_3		300	300	300	280	260	230
Min. rotational speed at bar 12 mm²/s	<100	rpm	500	500	500	500	500	500
	100...180		600	600	600	600	600	600
	180... p_2		800	800	800	800	800	800
25 mm²/s	p_2		500	500	500	500	500	500
Max. rotational speed at	p_2		3000	3000	3000	2800	2800	2800

Drive arrangement



1. Flexible couplings

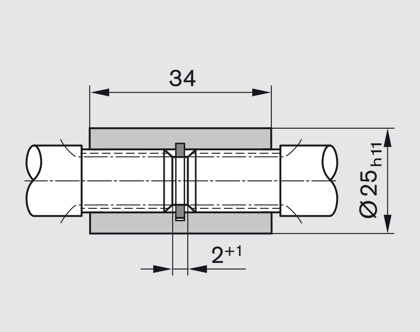
The coupling must not transfer any radial or axial forces to the pump.

The maximum radial runout of shaft spigot is 0.2 mm.

Refer to the fitting instructions provided by the coupling manufacturer for details of the maximum permitted shaft misalignment.

2. Coupling sleeve

Used on shafts with DIN or SAE splining. Caution: There must be no radial or axial forces exerted on the pump shaft or coupling sleeve. The coupling sleeve must be free to move axially. The distance between the pump shaft and drive shaft must be 2^{+1}. Oil-bath or oil-mist lubrications is necessary.



Splined shaft	Ordering code	M_{max} [Nm]
SAE-B 13 teeth	D	320
SAE-C 11 teeth	P	180

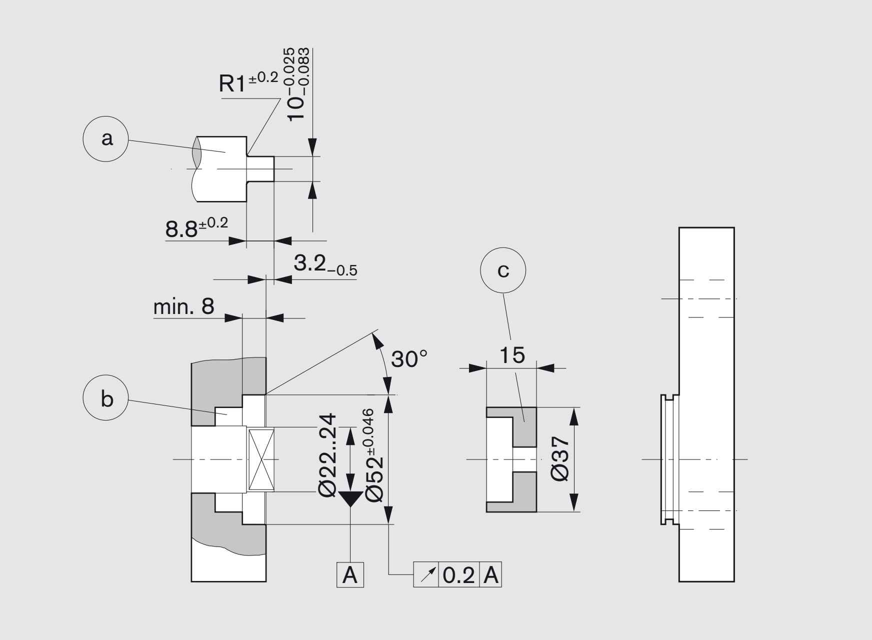
3. Drive shaft with tang

For the close-coupling of the pumps to electric motor or internal-combustion engine, gear, etc. The pump shaft has a special tang and driver ⓒ (not included in supply).
There is no shaft sealing.

The recommended arrangements and dimensions for the drive end and sealing are as follows.

ⓐ **Drive shaft**
Case-hardening steel DIN 17 210
e.g. 20 MnCrS 5
case-hardened 1.0 deep; HRA $83^{\pm 2}$
Surface for sealing ring
ground without rifling $R_t \leq 4\mu$m

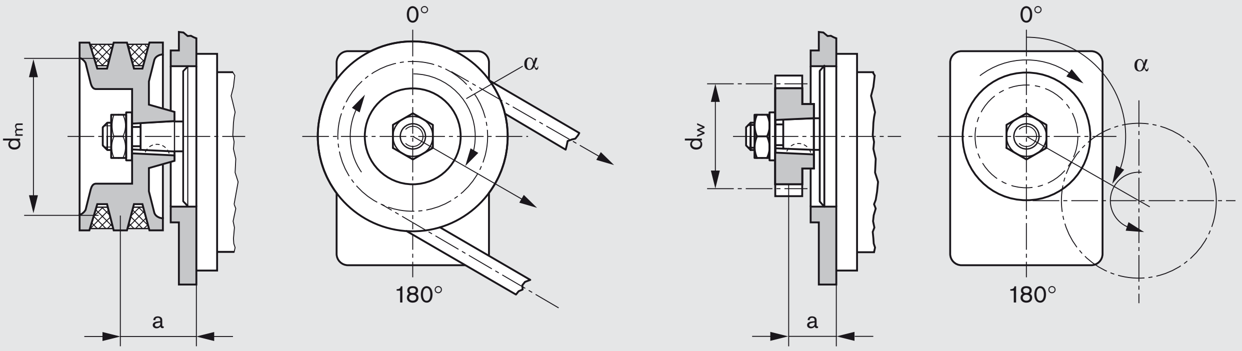
ⓑ **Radial shaft seal ring**
Rubber-covered seal (see DIN 3760, Type AS, or double-lipped ring).
Cut 15° chamfer or fit shaft seal ring with protection sleeve.



M_{max} [Nm]	V [cm³/rev]	p_{max} [bar]
95	20	270
	22.5	240
	25	220
	28	190
	32	170
	36	150

4. V-belts and straight gearwheels or helical toothed gear drives without outboard bearing

When proposing to use V-belt or gear drive, please submit details of the application for our comments (especially dimensions a, d_m, d_w and angle α).
For helical toothed gear drives, details of the helix angle β are also required.



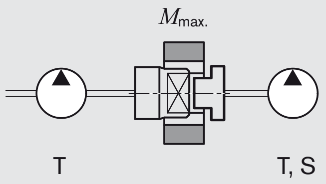
Multiple gear pumps

Gear pumps are well-suited to tandem combinations of pumps in which the drive shaft of the first pump is extended to drive a second pump and sometimes a third pump in the same manner. A coupling is fitted between each pair of pumps.
In most cases each pump is isolated from its neighbor, i.e. the suction ports are separate from one another. A common suction port is also possible as an option.
Caution: Basically, the specifications for the single pumps apply, but with certain restrictions:
Max. speed: This is determined by the highest rated pump speed in use.
Pressures: These are restricted by the strength of the drive shaft, the through drives and the drivers. Appropriate data is given in the dimensional drawings.

Pressure restrictions during standard through drive
In the case of series T, the driver for the second pumping stage can carry a load of up to $M_{max.} = 95$ Nm, i.e. there is a pressure restriction for the second stage and any further stages.

Drive shaft		**Max. transferrable drive torque * [Nm]**
C	1:5	200
N	Claw	95
D	SAE 13t	320
P	SAE 11t	180

* These values only apply when the conditions described above are complied with. Bosch Rexroth is to be consulted if the stated values are exceeded.



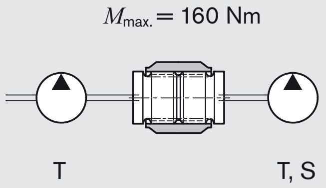
Combinations

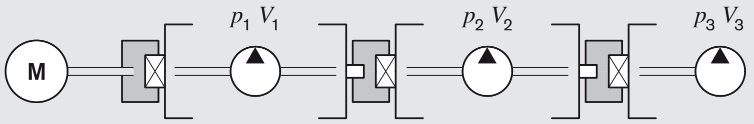
Series pump 1	$M_{max.}$ [Nm]	Series pump 2
T	95	T
T	65	S

For configuration of multiple pumps we recommend the pump is positioned with the largest displacement on the drive side.

If the first stage is driven through a tang (driver) or outboard bearing type 1, pressure restrictions apply as indicated in the formula below.

Reinforced through drives are available for applications with higher transfer torques and/or rotational vibrations. Customized designs available on request.



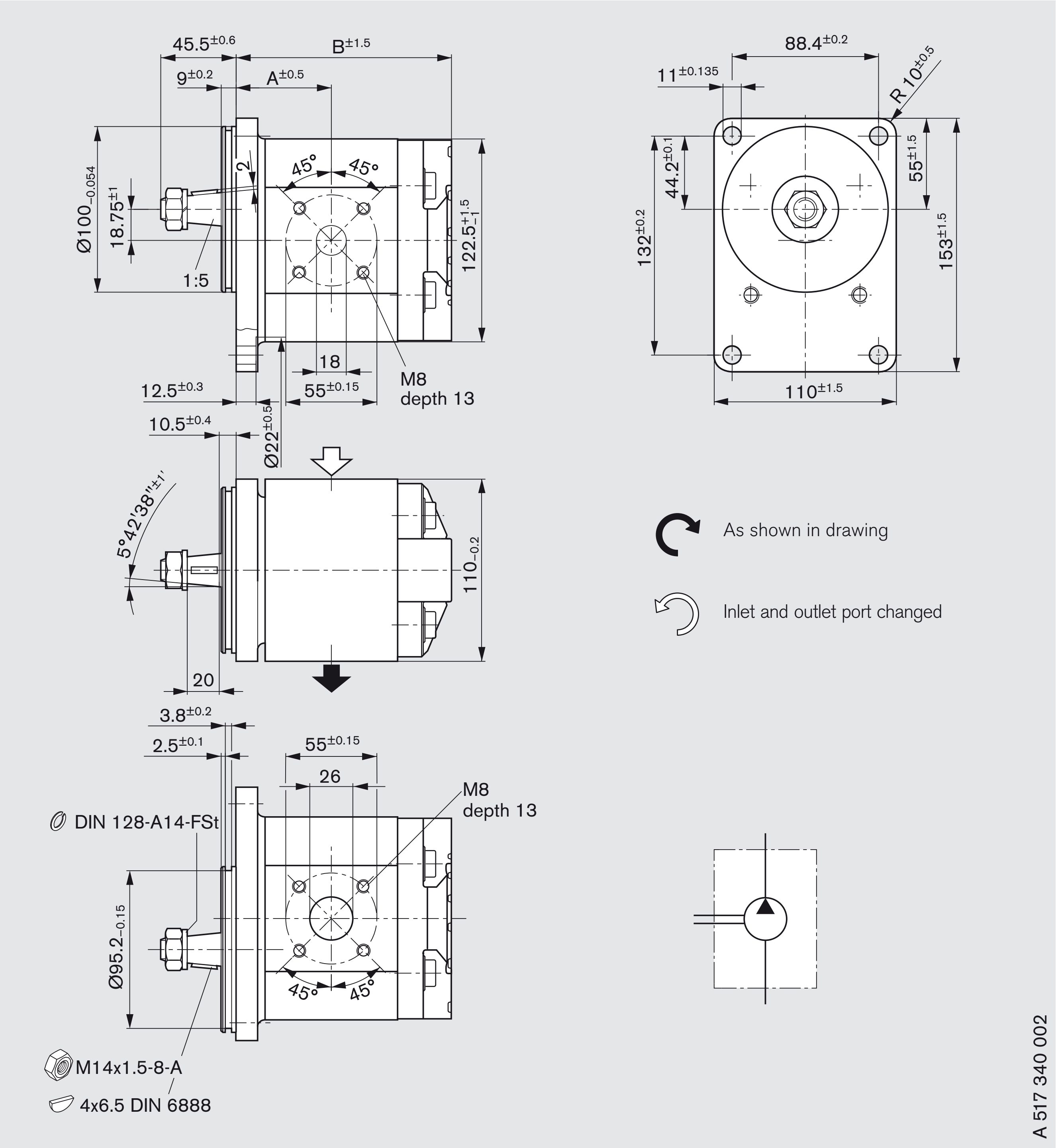


$$M_{max.} \geqq \Delta p_1 \cdot V_1 \cdot 0.0177 + \Delta p_2 \cdot V_2 \cdot 0.0177 + \Delta p_3 \cdot V_3 \cdot 0.0177$$

Δp [bar] V [cm^3/rev]

Dimensions

Standard range

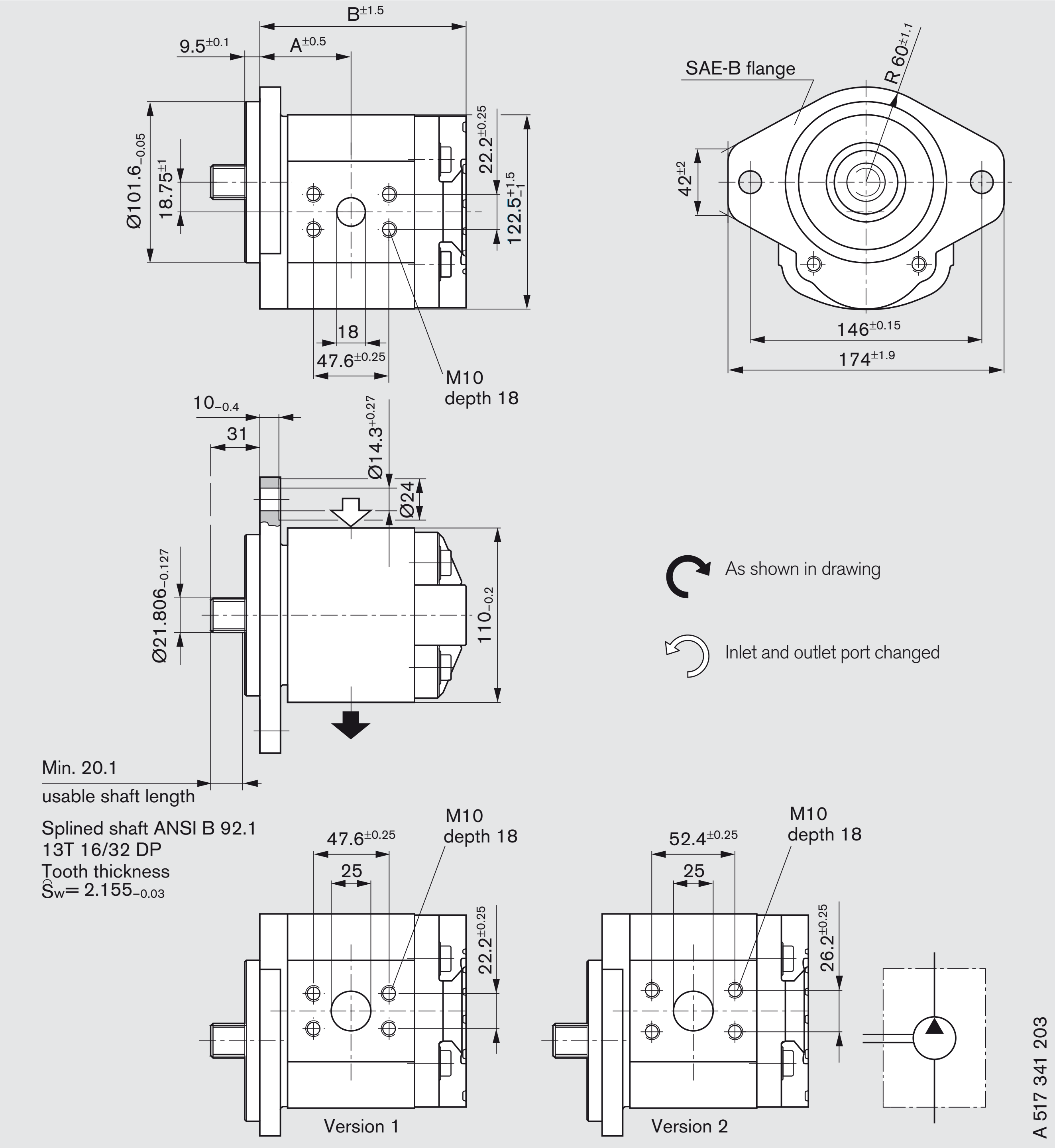


Ordering code:
AZPT – 22 – ☐☐☐ ☐ C B 20 M B

Displacement [cm³/rev]	Ordering-No. L	R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	B	
20	**0 517 625 309**	**0 517 625 008**	280	3000		52.0	119.1	M8 13 depth
22.5	**0 510 725 302**	**0 517 725 016**	280	3000		53.5	122.1	
25	**0 517 725 313**	**0 517 725 017**	280	3000		55.0	125.1	
28	**0 517 725 314**	**0 517 725 018**	260	3000		56.5	128.1	
32	**0 517 725 315**	**0 517 725 019**	240	2800		59.0	132.6	
36	**0 517 725 316**	**0 517 725 020**	210	2600		61.0	137.1	

Dimensions

Standard range



7

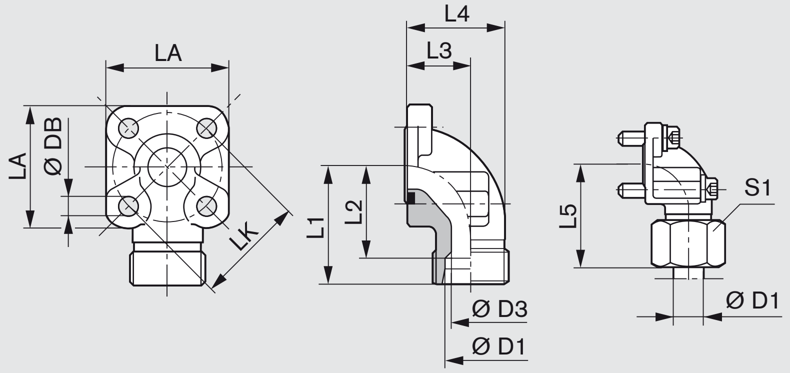
Ordering code:
AZPT – 22 – ☐☐☐ ☐D C 07 K B

Displacement [cm³/rev]	Ordering-No. L	 R	Max. operating pressure [bar]	Max. rotation speed [rpm]	kg	Dimension [mm] A	 B	 C	 D		Version
20	**0 517 625 310**	**0 517 625 009**	280	3000		52.0	119.1	25	47.6	M10 18 depth	1
22.5	**0 517 725 317**	**0 517 725 021**	280	3000		53.0	122.1	25	52.4		2
25	**0 517 725 318**	**0 517 725 022**	280	3000		55.0	125.1	25	52.4		
28	**0 517 725 319**	**0 517 725 023**	260	3000		56.5	128.1	25	52.4		
32	**0 517 725 320**	**0 517 725 024**	240	2800		59.0	132.6	25	52.4		
36	**0 517 725 321**	**0 517 725 025**	210	2600		61.0	137.1	25	52.4		

Fittings

Fittings can be used for rectangular flange 20 see page 7

Gear pump flange, 90° angle



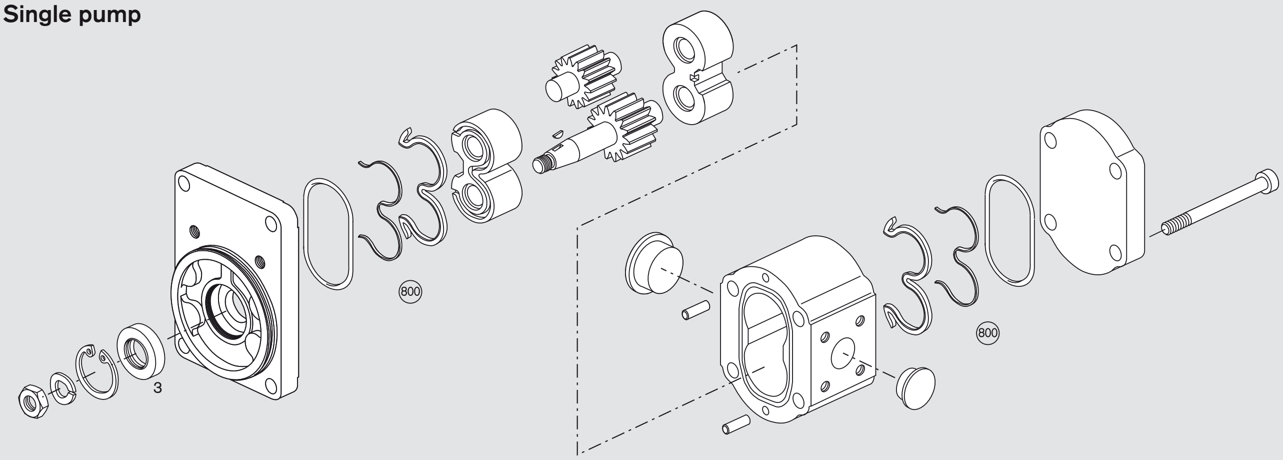
LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws		Seal ring	Mass kg	Part number	*p* (bar)
											2 pcs.	2 pcs.				
55	20S	17	45	34.5	24.0	40.0	56.0	58	36	8.4	M8x25	M8x50	33x2.5	0.44	**1 515 702 004**	250
55	30S	26	49	35.5	32.0	50.0	62.0	58	50	8.4	M8x25	M8x50	33x2.5	0.50	**1 515 702 006**	250
55	35L	31	49	38.5	32.0	51.5	62.0	58	50	8.4	M8x25	M8x60	32x2.5	0.47	**1 515 702 005**	100
55	42L	38	49	38.0	40.0	64.5	61.0	58	60	8.4	M8x25	M8x70	32x2.5	0.60	**1 515 702 019**	100

Complete fittings with seal ring, metric screw set, nuts and olive.

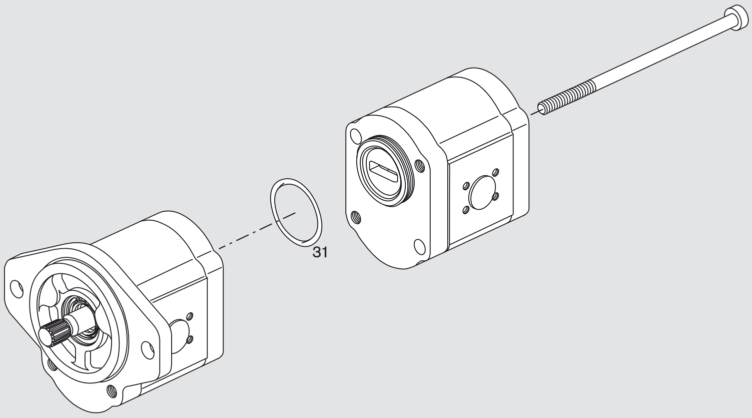
Note
You can find the permissible tightening torques in our publication:
“General Operating Instructions for External Gear Units”
RE 07 012-B1.

Service parts

Single pump



Multiple pump



Page	Ordering code	Seal kit “T” Pos. 800 NBR	Shaft seal ring Pos. 3	Dimension	Seal ring Pos. 31	Material	Dimension
16	AZPT – 22 – □□□ □ C B 20 M B	1517010226	1510283023	40x22x7	–	NBR	
17	AZPT – 22 – □□□ □ D C 20 K B	1517010226	1510283028	40x22x7	–	FKM (SSR)	

NBR = Perbunan® FKM = Viton®

Notes for commissioning

Filter recommendation

The major share of premature failures in external gear pumps is caused by contaminated hydraulic fluid.
As a warranty cannot be issued for dirt-specific wear, we recommended filtration compliant with cleanliness level 20/18/15 ISO 4406, which reduces the degree of contamination to a permissible dimension in terms of the size and concentration of dirt particles:

Operating pressure [bar]	>160	<160
Contamination class ISO 4406	18/15	19/16
To be reached with $\beta_X = 75$	20	25

We recommend that a full-flow filter always be used.
Basic contamination of the hydraulic fluid used may not exceed class 20/18/15 according to ISO 4406. Experience has shown that new fluid quite often lies above this value. In such instances a filling device with special filter should be used.

General

- The pumps supplied by us have been checked for function and performance. No modifications of any kind may be made to the pumps; any such changes will render the warranty null and void!
- Pump may only be operated in compliance with permitted data (see pages 15 – 18).

Project planning notes

Comprehensive notes and suggestions are available in Hydraulics Trainer, Volume 3 RE 00 281, “Project planning notes and design of hydraulic systems”. Where external gear pumps are used we recommend that the following note be adhered to.

Technical data

All stated technical data is dependent on production tolerances and is valid for specific marginal conditions.
Note that, as a consequence, scattering is possible, and at certain marginal conditions (e.g. viscosity) **the technical data may change**.

Characteristics

When designing the external gear pump, note the maximum possible service data based on the characteristics displayed on pages 10 to 12.

Additional information on the proper handling of hydraulic products from Bosch Rexroth is available in our document:
“General product information for hydraulic products”
RE 07 008.

Contained in delivery

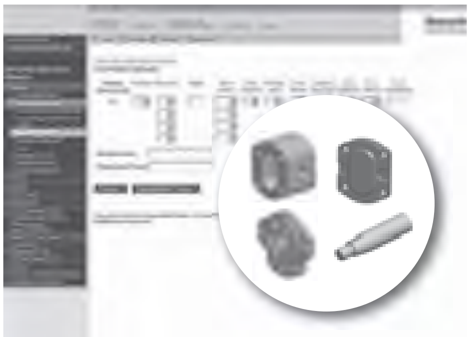
The components with characteristics as described under ordering code and device measurements, pages 16 – 17, are contained in delivery.

You can find further information in our publication:
“General Operating Instructions for External Gear Units”
RE 07 012-B1.

The AZ configurator

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly. You only need to specify your requirements: From the displacement, direction of rotation, drive shaft, connection flange right up to the required rear cover. You immediately receive a project drawing (PDF format) if a configuration already exists. You receive the price of the configured external gear unit upon request.

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly – all data needed for project planning are acquired thru menu guidance.



Selection is made either on an ordering code or your technical requirements. This means that you can search for external gear units that have already been configured, or you specify the configuration variant of the external gear unit based upon the operating parameters you require.

If the external gear unit you selected has been released you will receive the part number, ordering code and a detailed installation drawing. If your special configuration is not available please send your specification to Rexroth. One of our employees will then contact you.

Ordering-No.

Ordering-No.	Page
0 517 625 008	16
0 517 625 009	17
0 517 625 309	16
0 517 625 310	17
0 517 725 016	16
0 517 725 017	16
0 517 725 018	16
0 517 725 019	16
0 517 725 020	16
0 517 725 021	17
0 517 725 022	17
0 517 725 023	17
0 517 725 024	17
0 517 725 025	17
0 517 725 302	16
0 517 725 313	16
0 517 725 314	16
0 517 725 315	16
0 517 725 316	16
0 517 725 317	17
0 517 725 318	17
0 517 725 319	17
0 517 725 320	17
0 517 725 321	17

External gear pump
Series U

AZPU-...

Fixed pumps
$V = 22.5...63\ \text{cm}^3/\text{rev}$

SILENCE

Overview of contents

Features

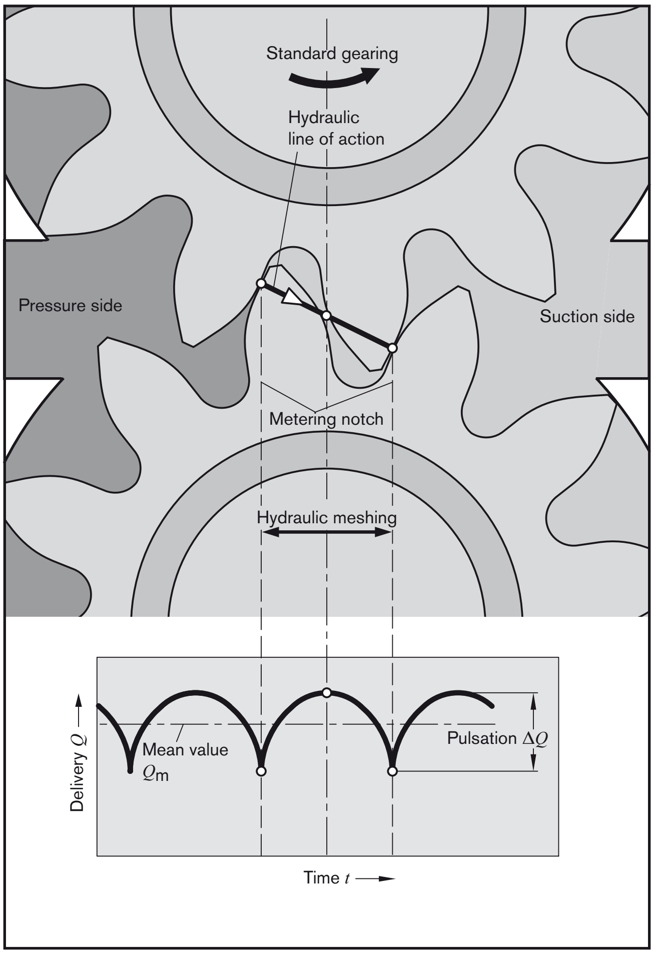
- Nominal pressure 280 bar
- Slide bearings for heavy duty applications
- Drive shafts to ISO or SAE
- Combination of several pumps possible
- Line ports: connection flanges
- Optimized pressure pulsation, which reduces noise emissions and vibration input in system
- Long service life thru reinforced design of shafts and case
- Consistent high quality thru mass production
- Numerous configuration variants available

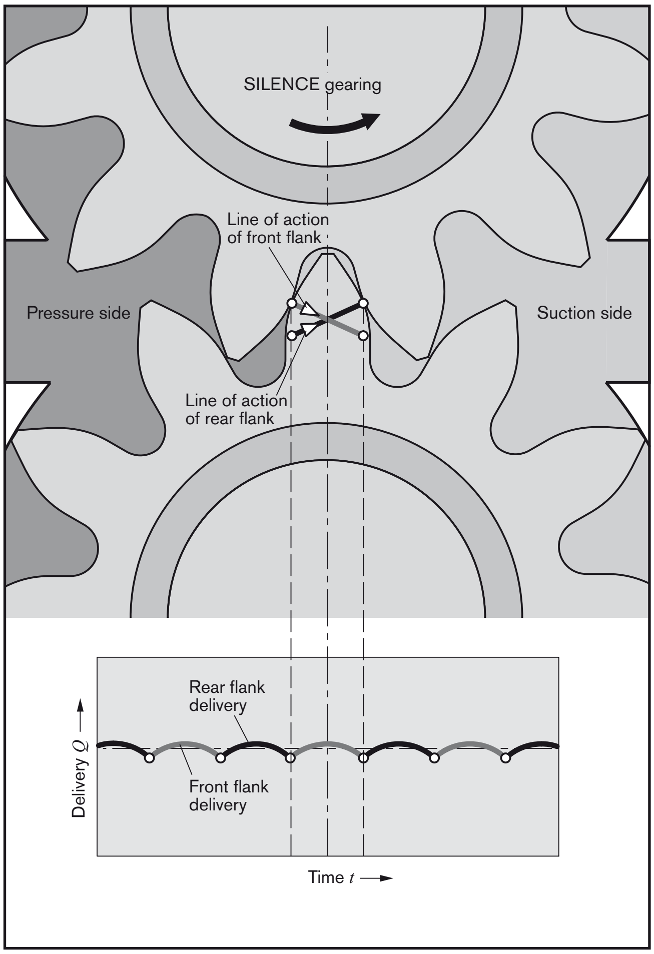
General

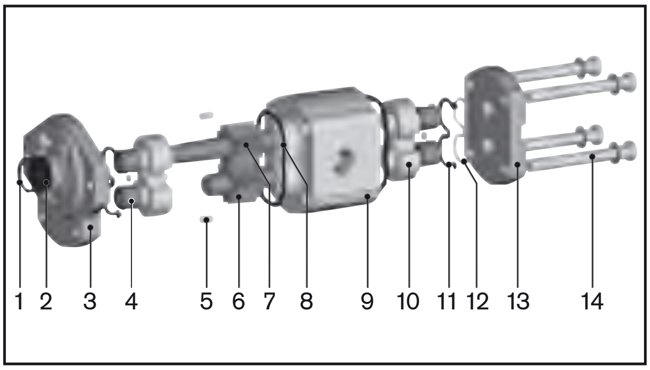
The key task of external gear units is to convert mechanical energy (torque and rotational speed) into hydraulic energy (flow and pressure). In external gear motors this is the other way round. These machines are required to be highly efficient in order to avoid unnecessary heat. This efficiency is achieved by means of precision production engineering and pressure-sensitive gap sealing.

Moreover, in the low-noise SILENCE pumps, the dual-flank principle helps to reduce flow pulsation by up to 75 %.

The displacement method







1	Retaining ring
2	Shaft seal ring
3	Front cover
4	Slide bearing
5	Centering pin
6	Gear
7	Gear (frictional)
8	Case seal
9	Pump case
10	Bearing
11	Axial zone seal
12	Support
13	End cover
14	Fixing screws

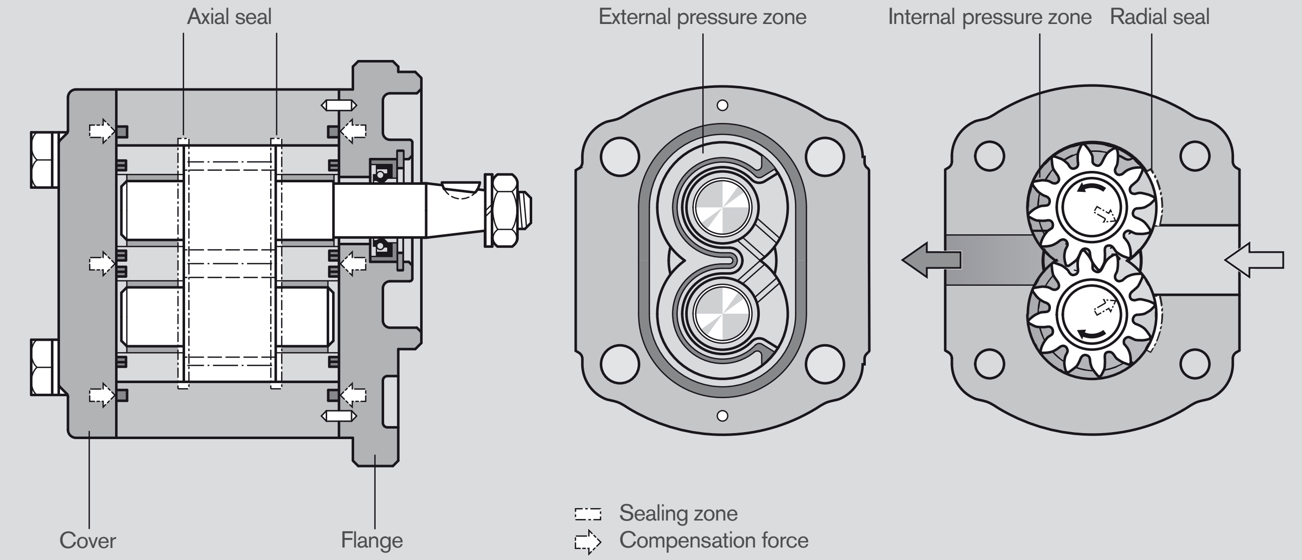
The geometry of the displacement gearing, matched in form by the rotation of the drive shaft, results in the parabolic flow characteristic shown here on the left. In a standard pump, this characteristic is repeated each time a gear tooth meshes. With their dual-flank system, the flow pulsation of SILENCE pumps is reduced by 75 % – with correspondingly lower excitation of downstream system components – at double the fundamental frequency. During this process, the gear pair exhibits an extremely reduced rear flank backlash, so that hydraulic sealing is provided not just by the front flank of the driven gear, but also by the rear flanks. In this way, the front and rear flanks alternately contribute to flow displacement. And by adapting the shape of the metering notches, the expansion of the hydraulic line of action is half that of the standard pump.

Construction

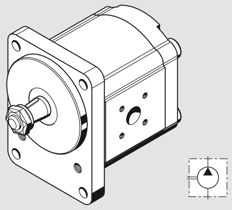
The external gear pump consists essentially of a pair of gears supported in bearing bushings or bearing, dependent on the series, and the case with a front and rear cover. The drive shaft protrudes from the front cover where it is sealed by the shaft seal ring. The bearing forces are absorbed by special slide bearings with sufficient elasticity to produce surface contact instead of line contact. They also ensure excellent resistance to galling – especially at low speed. The gears have 12 teeth. This keeps both flow pulsation and noise emission to a minimum.

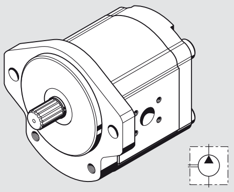
The internal sealing is achieved by forces which are proportional to delivery pressure. This ensures optimum efficiency. The sealing zone between the gear teeth and the bearings is controlled by the admission of operating pressure to the rear of the bearing bushings. Special seals form the boundary of the zone. The radial clearance at the tips of the gear teeth is sealed by internal forces pushing them against the case.

Axial and radial compensation for gear pump



Overview of “Series U” standard types

Version	Page
	18

Version	Page
	19 20 21

Ordering code

External gear units Single pumps “SILENCE”

AZ	P	U	–	2	2	–	063	R	C	B	20	M	D	18009	S xxxx

Function
P = Pump

Series
2 = 2nd generation

Version
2 = corrosion-resistant, pinned

Size G
022 = 22.5 cm^3/rev
025 = 25.0 cm^3/rev
028 = 28.0 cm^3/rev
032 = 32.0 cm^3/rev
036 = 36.0 cm^3/rev
040 = 40.0 cm^3/rev
045 = 45.0 cm^3/rev
050 = 50.0 cm^3/rev
056 = 56.0 cm^3/rev
063 = 63.0 cm^3/rev

Direction of rotation
R = Clockwise
L = Counterclockwise

Special design *)

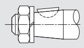
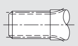
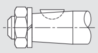
Valve adjustment
200 xx = PRV 200 bar
xxx 11 = FCV 11 l/min
18009 = PRV + FCV 180 bar, 9 l/min

Rear cover
B = Standard
D = PRV residual flow internal
E = FCV residual flow external
S = FCV residual flow internal
V = PRV + FCV

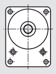
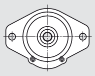
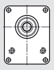
Seals
M = NBR
K = NBR, SSR in FKM

*) Some of the special designs shown on pages 18–21 are not covered in the illustration of the ordering code.

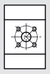
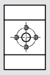
Drive shafts

			Suitable front cover
C	Tapered key shaft 1 : 5		B
D	Splined shaft SAE J 744 22-4 13T		C
H	Tapered key shaft 1 : 8		O

Front cover

B	Rectangular flange Centering Ø 105 mm	
C	SAE J 744 101-2 B 2-hole flange Ø 101.6 mm	
O	Rectangular flange Centering Ø 50.78 mm	

Line ports

20	Rectangular flange	
07	Square flange SAE thread, metric	
30	Rectangular flange	

Not all variants can be selected by using ordering code!
Please select the required pump by using the selection tables (standard types) or after consultation with Bosch Rexroth!
Special options are possible upon request.

Ordering code

External gear units Multiple pumps “SILENCE”

AZ	P	UUSS	–	x	x	–	032/022/016/005	R	C	B	20 20 20 20	K	B

Function

P = Pump

Series

B = 1.0...7.1 cm³/rev
S = 4.0...28 cm³/rev
F = 4.0...28 cm³/rev
T = 20.0...36 cm³/rev
N = 20.0...36 cm³/rev
U = 22.5...63 cm³/rev
G = 22.5...63 cm³/rev

Series, relates to pump section 1

2 = 2nd generation

Version, relates to pump section 1

2 = corrosion-resistant, pinned

Size

as per individual Series

Direction of rotation

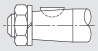
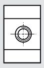
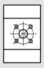
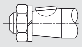
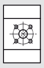
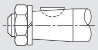
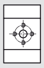
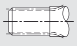
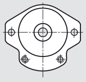
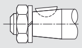
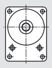
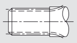
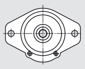
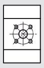
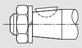
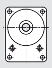
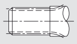
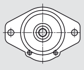
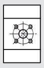
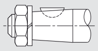
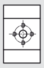
R = Clockwise
L = Counterclockwise

Rear cover
relates to last pump part

B = Standard

Seals

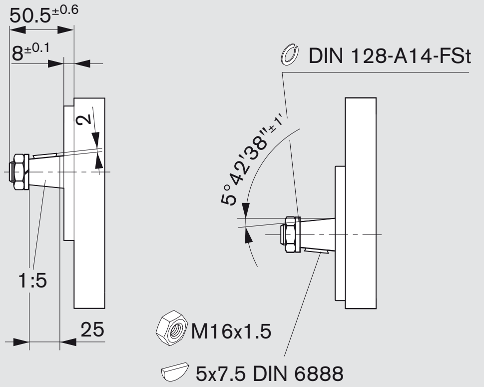
M = NBR
P = FKM
K = NBR, WDR in FKM
WDR relates to pump part 1

Drive shafts relates to pump part 1			Suitable front cover	**Front cover** relates to pump part 1			**Line ports** every pump parts		
Series B:									
H	Tapered key shaft 1 : 5		**O**	**O**	Square flange Centering Ø 25.38 mm		**01**	Pipe thread ISO 228/1	
							20	Rectangular flange	
Series F, S:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 80 mm		**20**	Rectangular flange	
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 36.47 mm		**30**	Rectangular flange	
R	Splined shaft SAE J 744 16-4 9T		**R**	**R**	SAE J 744 82-2 A 2-bolt flange Ø 82.55 mm				
Series N, T:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 100 mm		**07**	Square flange SAE Thread, metric	
D	Splined shaft SAE J 744 22-4 13T		**C**	**C**	SAE J 744 101-2 B 2-bolt flange Centering Ø 101.6 mm		**20**	Rectangular flange	
Series G, U:									
C	Tapered key shaft 1 : 5		**B**	**B**	Square flange Centering Ø 105 mm		**07**	Square flange SAE Thread, metric	
D	Splined shaft SAE J 744 22-4 13T		**C**	**C**	SAE J 744 101-2 B B 2-bolt flange Centering Ø 101.6 mm		**20**	Rectangular flange	
H	Tapered key shaft 1 : 8		**O**	**O**	Square flange Centering Ø 50.78 mm		**30**	Rectangular flange	

Not all variants can be selected by using ordering code!
Please select the required pump by using the selection tables (standard types) or after consultation with Bosch Rexroth!
Special options are possible upon request.

Drive shafts

C



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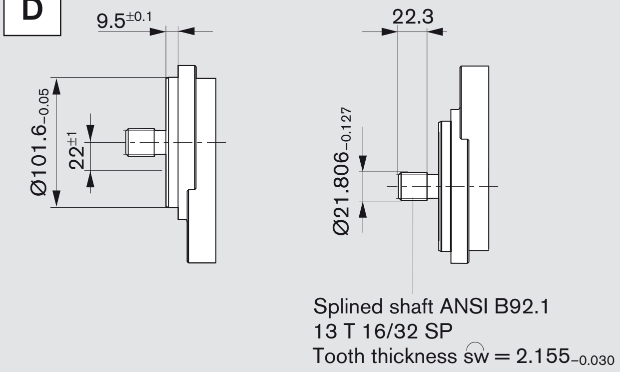

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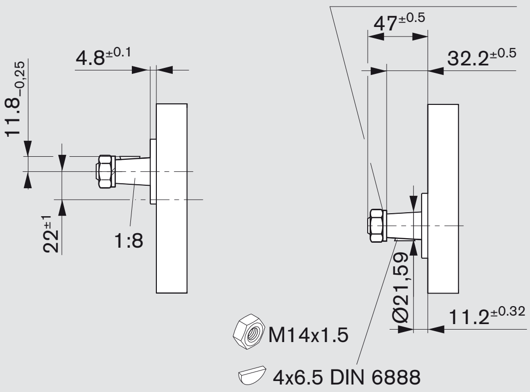
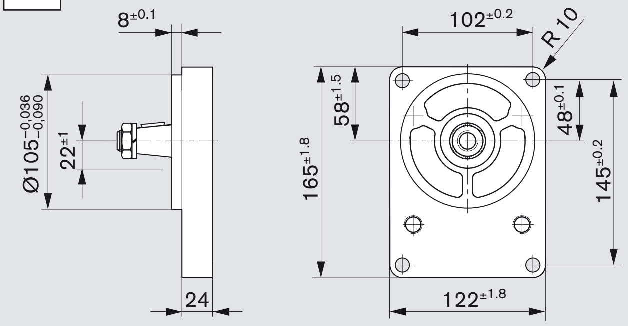


Front cover

B



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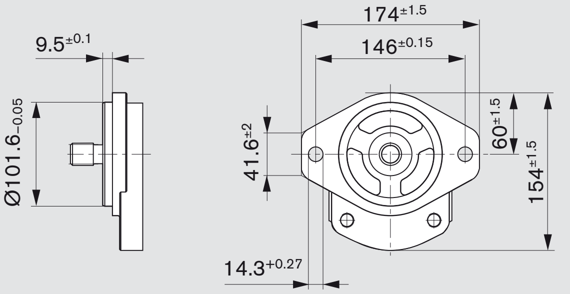
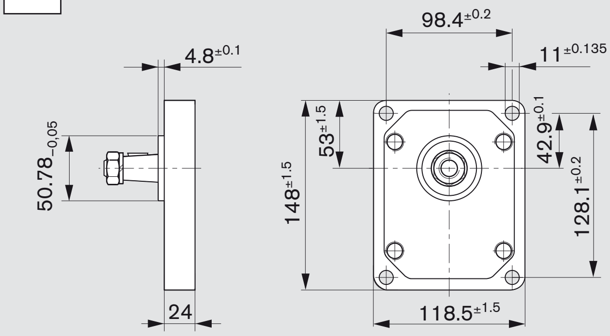
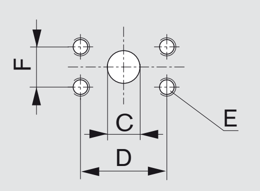


O

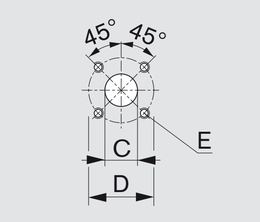


Line ports



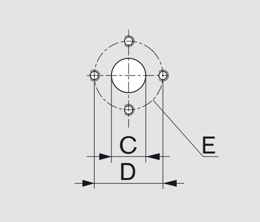
07 Square flange SAE, thread, metric

Ordering code	Size	Pressure side				Suction side			
		C	D	E	F	C	D	E	F
07	22.5...28 cm^3	18	47.6	M10 depth 18	22.2	25	52.4	M10 depth 14	26.2
	32.0...50 cm^3	25	52.4		26.2	32	58.7		30.2
	56.0...63 cm^3	32	58.7		30.2	38	69.8		35.8



20 Rectangular flange

Ordering code	Size	Pressure side			Suction side		
		C	D	E	C	D	E
20	22.5...63 cm^3	18	55	M8 depth 13	26	55	M8 depth 13



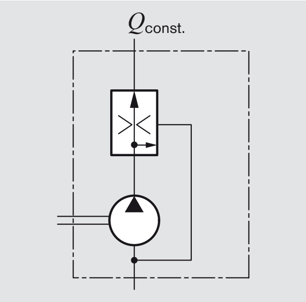
30 Rectangular flange

Ordering code	Size	Pressure side			Suction side		
		C	D	E	C	D	E
30		18	39.7	M8 depth 13	26	50.8	M10 depth 13

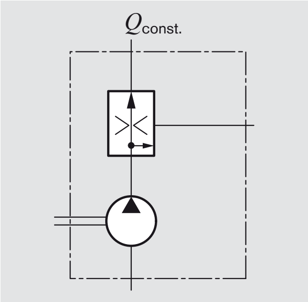
Gear pumps with integral valves

In order to reduce external pipework it is possible to incorporate a flow-control valve or pressure-relief valve in the cover of the gear pump. Such solutions are used, for example for supplying hydraulic oil to power steering systems. The pump delivers a constant flow irrespective of the speed at which it is driven. The excess flow is either returned internally to the suction port or distributed externally to other items of equipment.

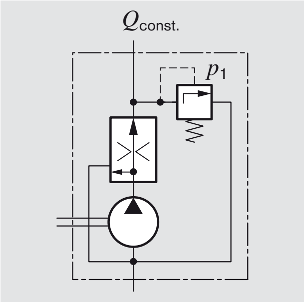

Upon request



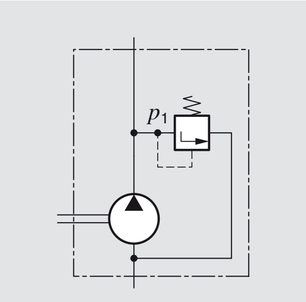
3-way flow-control valve.
Excess flow returned to suction line
$Q_{\text{const.}} = 2...30$ l/min



3-way flow-control valve.
Excess flow distributed externally; loadable
$Q_{\text{const.}} = 2...30$ l/min



3-way flow-control valve with pressure-relief valve.
Excess flow returned to suction line
$Q_{\text{const.}} = 2...30$ l/min
$p_1 = 100...180$ bar



Pressure-relief valve.
Discharge returned to suction line
$p_1 = 5...250$ bar

Ordering code

S	**xxx17**

E	**xxx12**

V	**15011**

D	**180xx**

Design calculations for pumps

The design calculations for pumps are based on the following parameters:

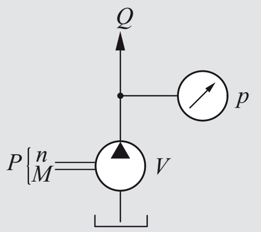
V	[cm^3/rev]	Displacement
Q	[l/min]	Delivery
p	[bar]	Pressure
M	[Nm]	Drive torque
n	[rev/min]	Drive speed
P	[kW]	Drive power

It is also necessary to allow for different efficiencies such as:

η_v	Volumetric efficiency
η_{hm}	Hydraulic-mechanical efficiency
η_t	Overall efficiency

The following formulas describe the various relationships.
They include correction factors for adapting the parameters to the usual units encountered in practice.

Caution: Diagrams providing approximate selection data will be found on subsequent pages.



$$Q = V \cdot n \cdot \eta_v \cdot 10^{-5}$$

$$V = \frac{Q}{n \cdot \eta_v} \cdot 10^5$$

$$n = \frac{Q}{V \cdot \eta_v} \cdot 10^5$$

$$p = \frac{M \cdot \eta_{hm}}{1.59 \cdot V}$$

$$V = \frac{M \cdot \eta_{hm}}{159 \cdot p}$$

$$M = \frac{1.59 \cdot V \cdot p}{\eta_{hm}}$$

$$P = \frac{p \cdot Q}{6 \cdot \eta_t}$$

$$Q = \frac{6 \cdot P \cdot \eta_t}{p}$$

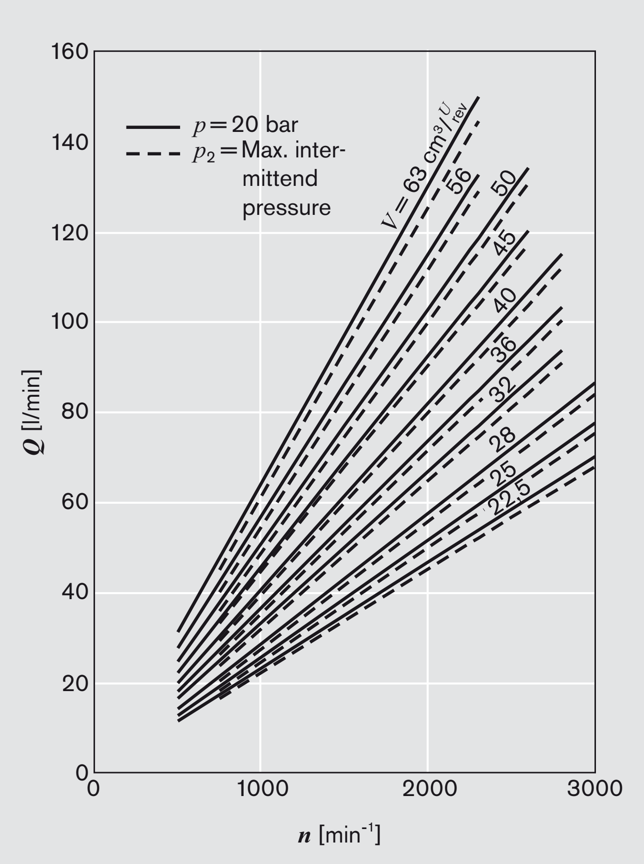
$$p = \frac{6 \cdot P \cdot \eta_t}{Q}$$

[%]
n —— $\eta_v \longrightarrow Q$
M —— $\eta_{hm} \longrightarrow p$
P —— $\eta_t \longrightarrow p \cdot Q$

V [cm^3/rev] Q [l/min] p [bar]
n [rev/min] P [kW] M [Nm]

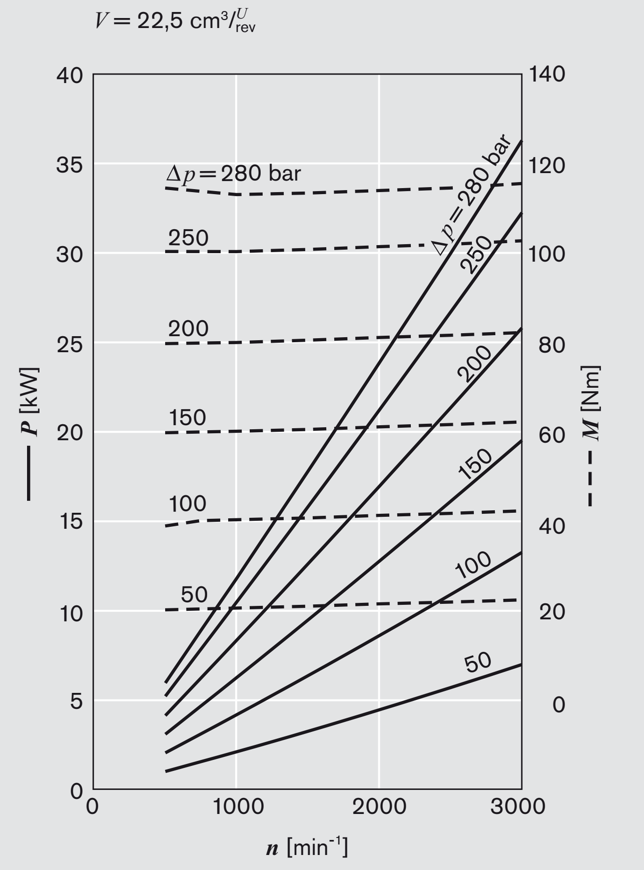
Caution: η [%] e.g. 95 [%]

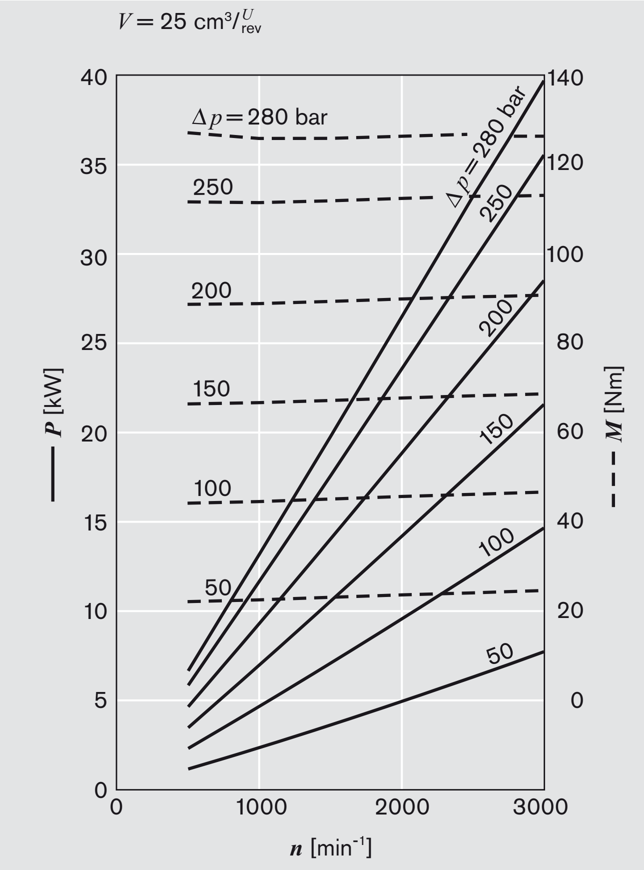
Performance charts



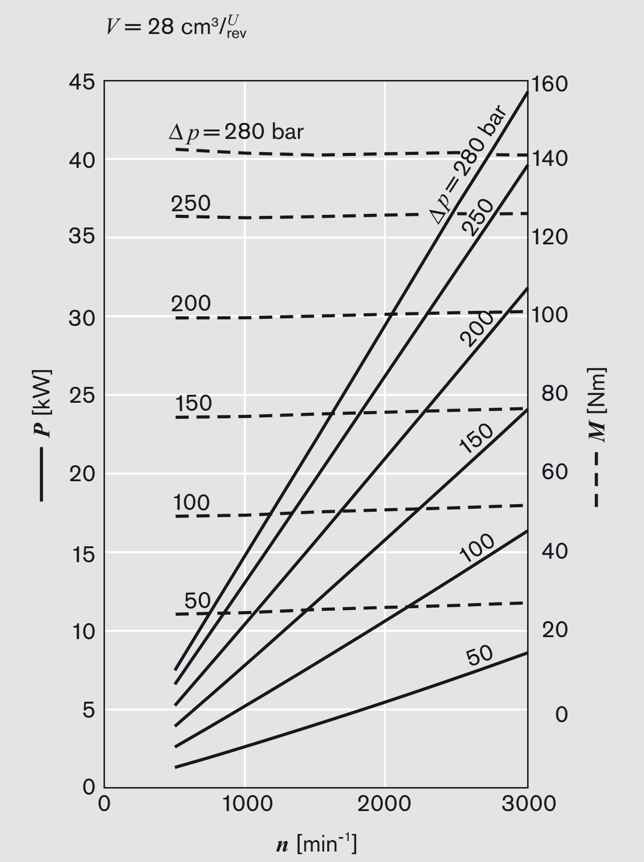
$\nu = 35$ mm^2/s, $\vartheta = 50$ °C

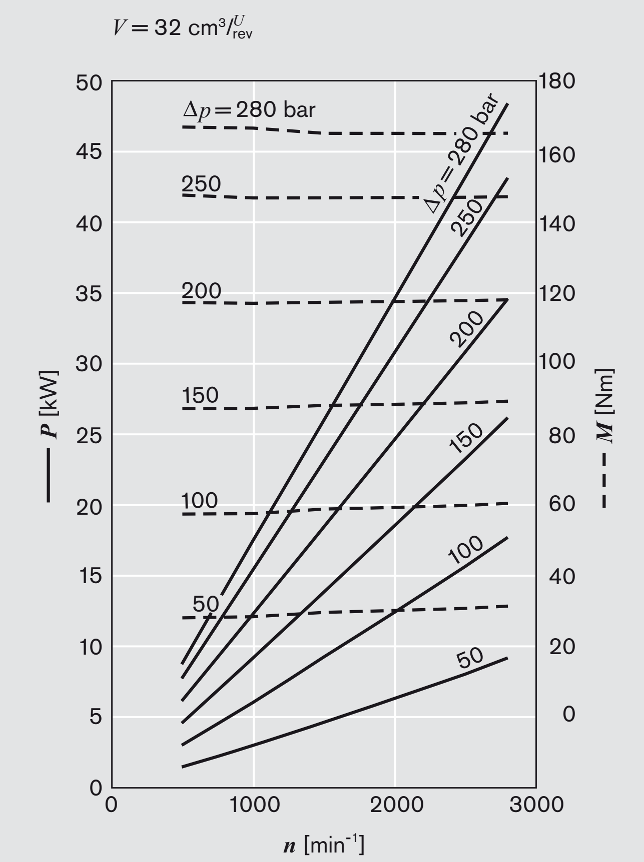
$Q = f\ (n, V)$ incl. η_v
$P = f\ (n, p)$ —— incl. η_t
$M = f\ (n, p)$ – – – incl. η_{hm}

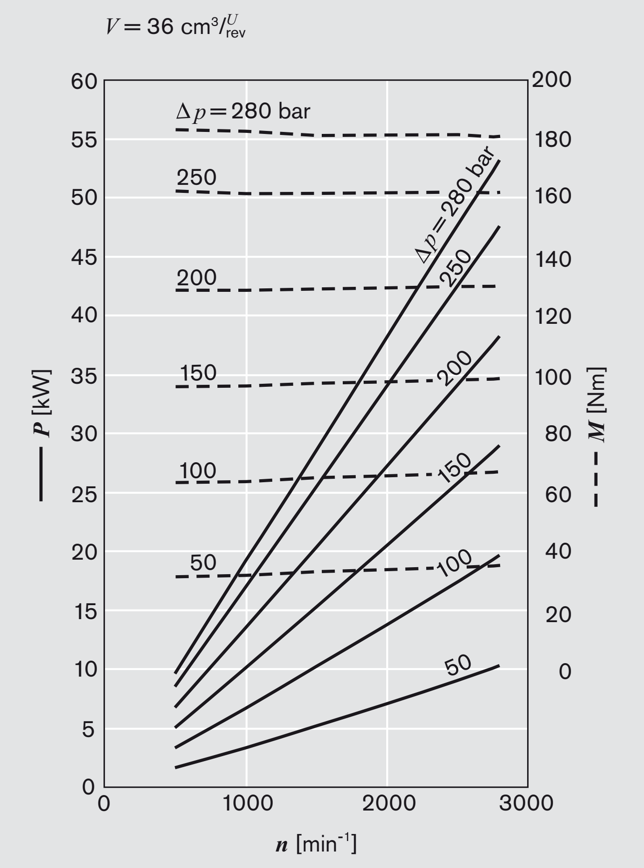


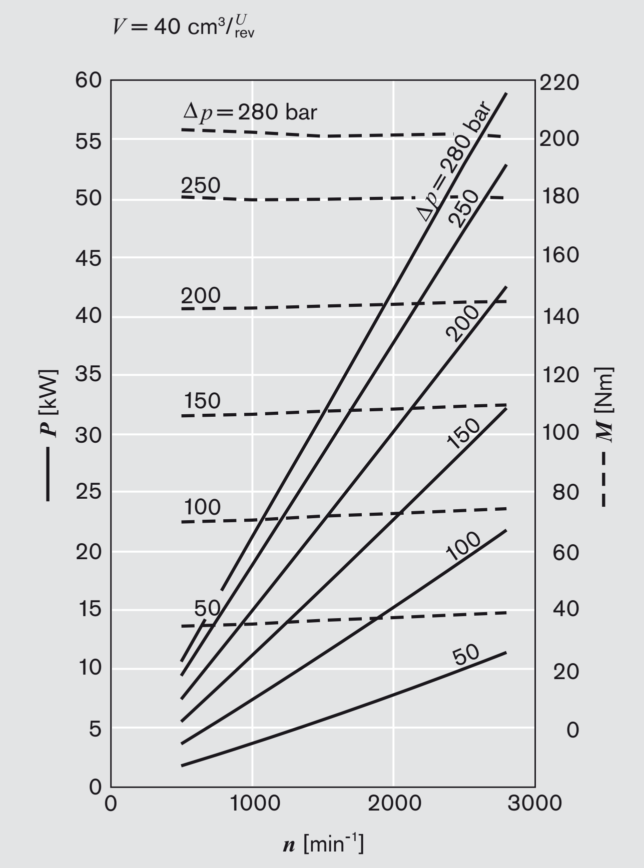


Performance charts (continued)

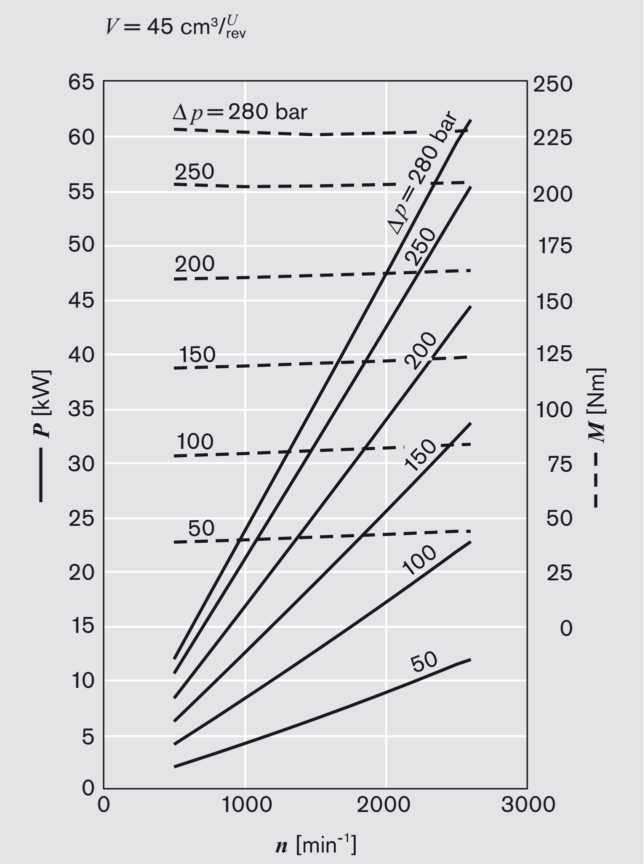


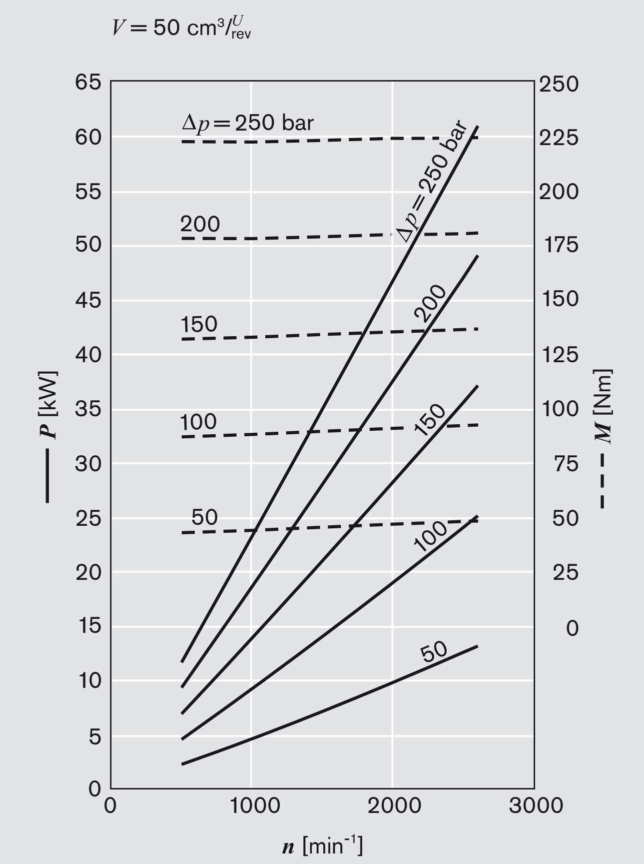


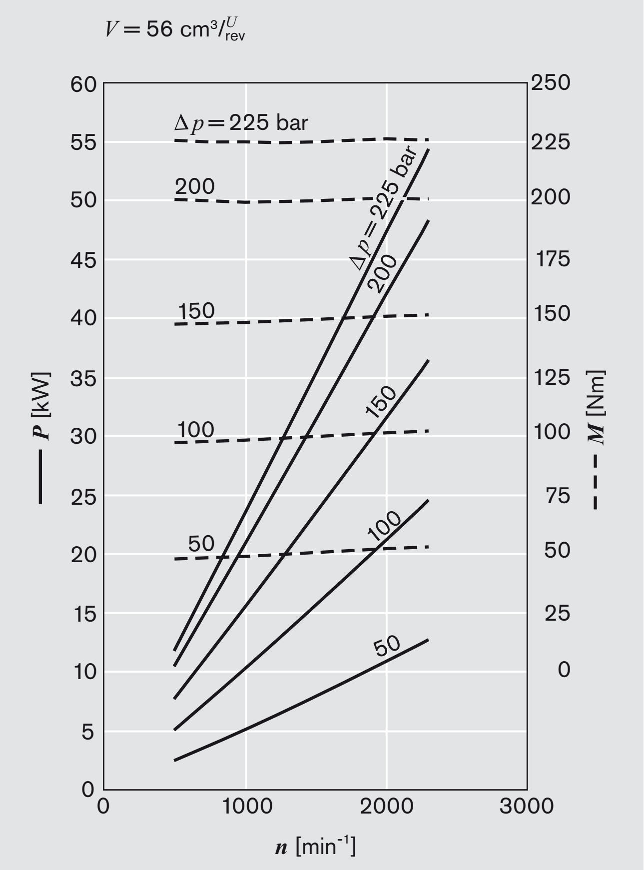


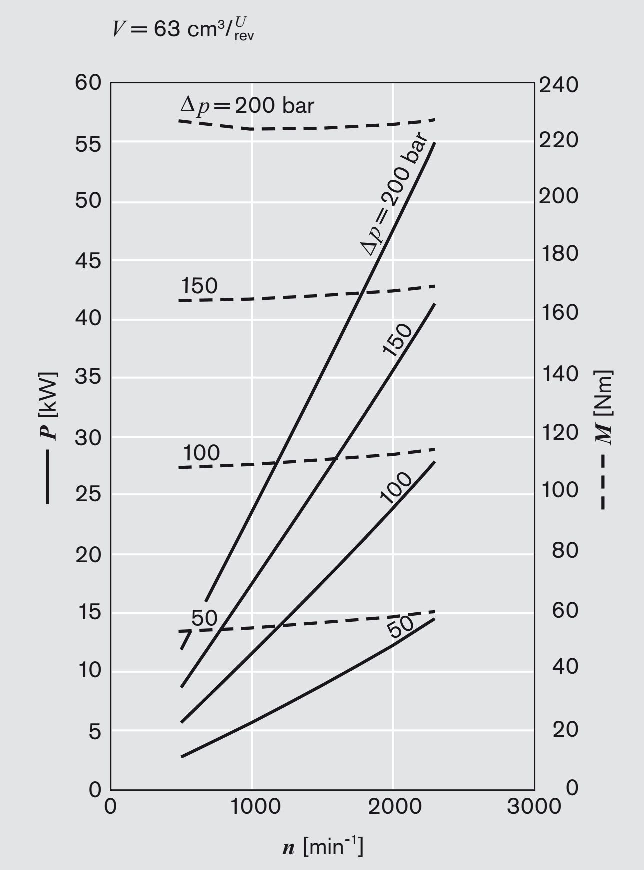


Performance charts (continued)





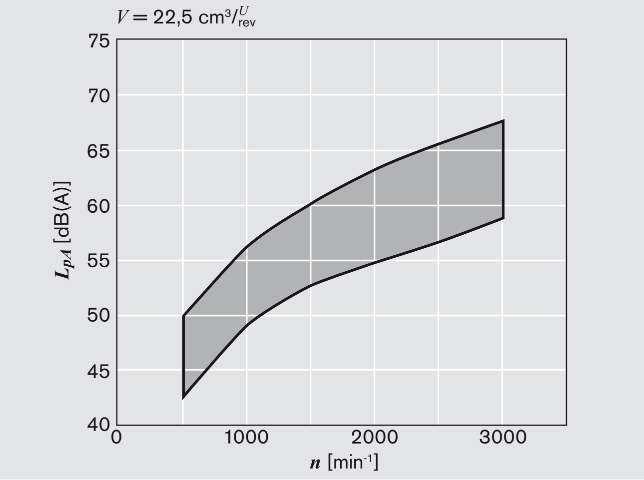


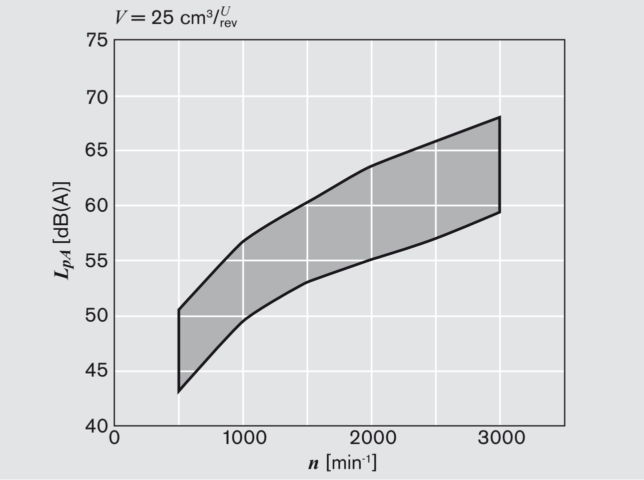


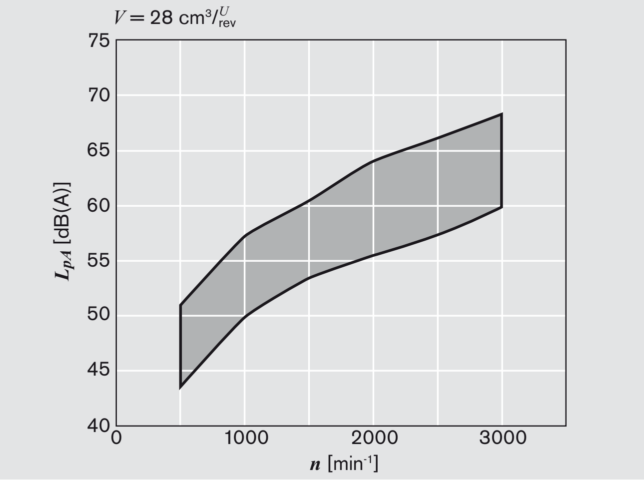
Noise charts

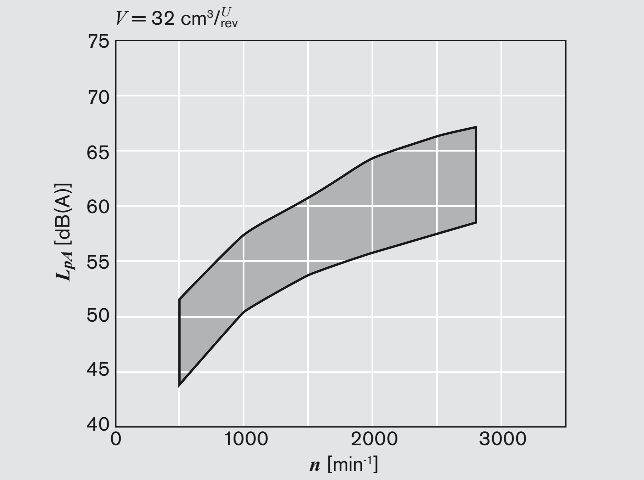
Noise level dependent on rotational speed, pressure range between 10 bar and pressure value p_2 (see page 14 Specifications table).
Oil data: $\nu = 32$ mm^2/s, $\vartheta = 50$ °C.
Sound pressure level calculated from noise measurements made in the sound absorbent measuring room compliant with DIN 45 635, Part 26.
Spacing between measuring sensor – pump: 1 m.

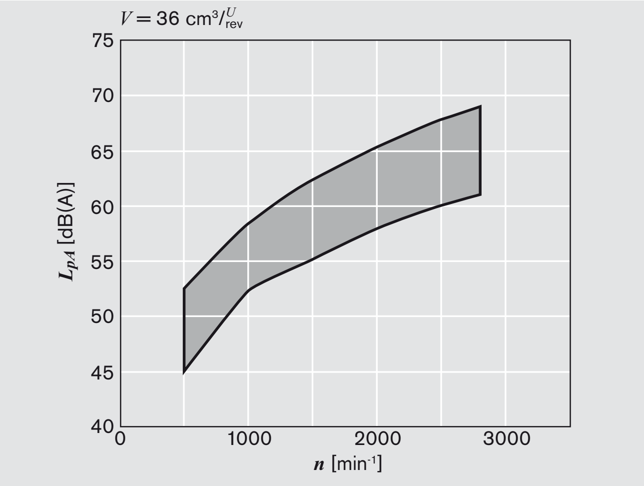
These are typical characteristic values for the respective model. They describe the airborne sound emitted solely by the pump. Environmental influences (installation site, piping, further system components) are not taken into consideration.
Each value applies for a single pump.

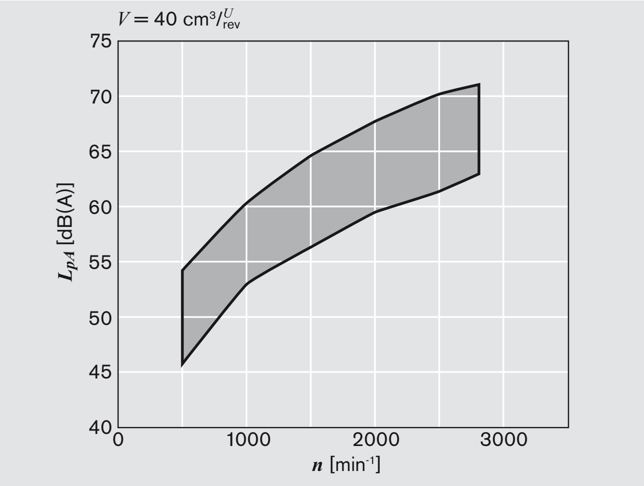




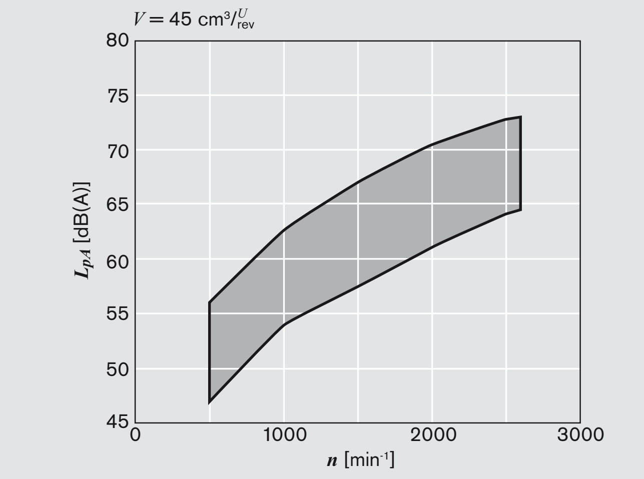


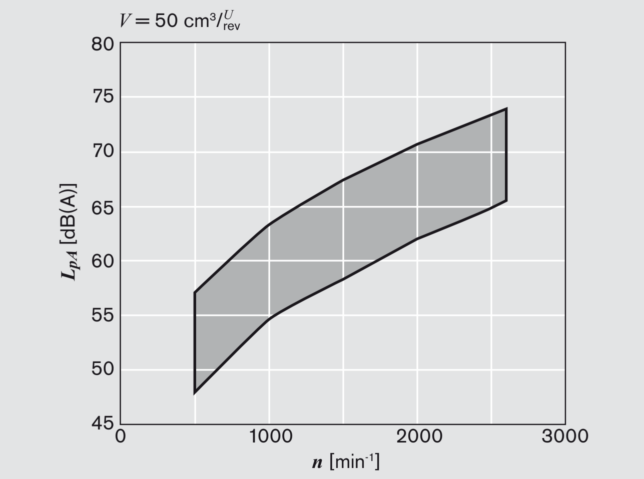


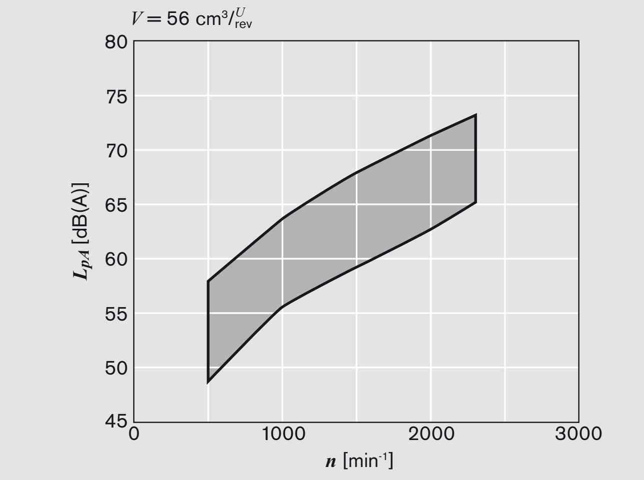


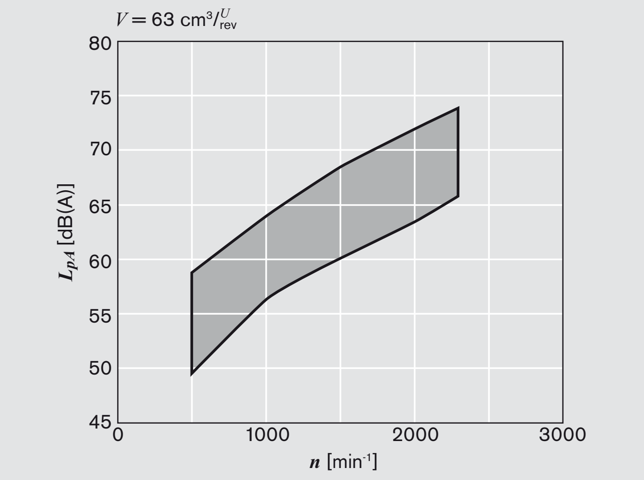


Noise charts (continued)









Specification

General	
Construction	External gear pump
Mounting	Flange or through-bolting with spigot
Line ports	Flange
Direction of rotation (looking on shaft)	Clockwise or counter-clockwise, the pump may only be driven in the direction indicated
Installation position	Any
Load on shaft	Radial and axial forces after consulting
Ambient temperature range	–30 °C...+80 °C or max. +110 °C with FKM seals
Hydraulic fluid	– Mineral oil compliant with DIN 51 524, 1–3, however under higher load at least HLP compliant with DIN 51 524 Part 2 recommended. – Comply with RE 90220 – Further operating fluids possible after consultation
Viscosity	12...800 mm²/s permitted range 20...100 mm²/s recommended range ...2000 mm²/s range permitted for starting
Hydraulic fluid temperature range	max. +80 °C with NBR seals *) max. +110 °C with FKM seals **)
Filtration ***)	At least cleanliness level 20/18/15 compliant with ISO 4406 (1999)

*) NBR = Perbunan®
**) FKM = Viton®
***) On hydraulic systems or devices with critical counter-reaction, such as steering and counterbalance valves, the type of filtration selected must be adapted to the sensitivity of these devices/systems.

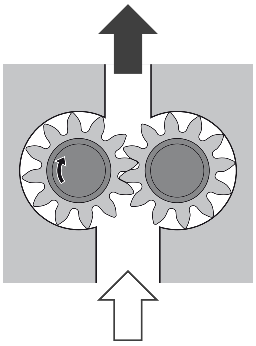
Safety requirements pertaining to the whole systems are to be observed.

In the case of applications with high numbers of load cycles please consulting.

Definition of direction of rotation

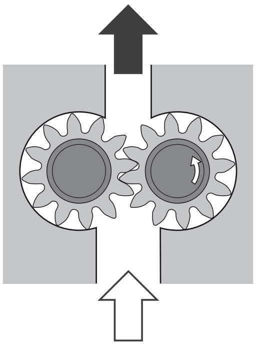
Always look on the drive shaft.

Caution: Dimensions drawings always show clockwise-rotation pumps. On counterclockwise-rotation pumps the positions of the drive shaft and the suction and pressure ports are different.



Clockwise direction of rotation

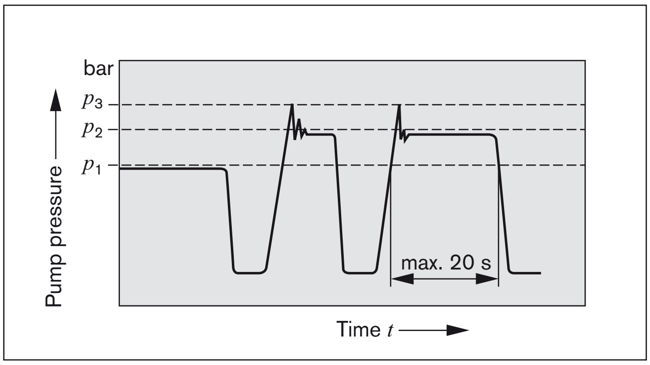
↻



Counterclockwise direction of rotation

↺

Definitions of pressures



p_1 max. continuous pressure
p_2 max. intermittend pressure
p_3 max. peak pressure

Size AZPU

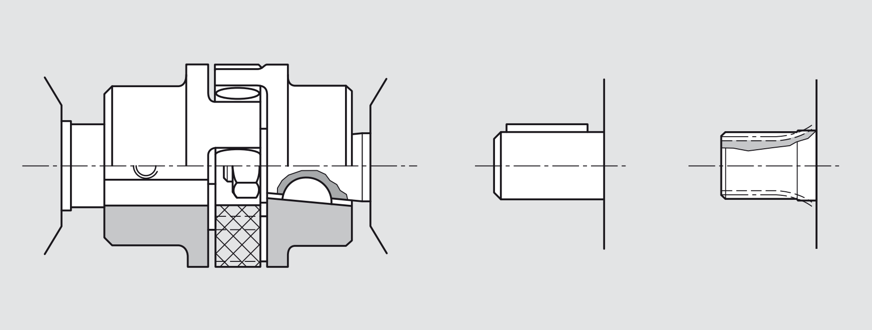
Displacement		V	cm³/rev	22.5	25	28	32	36	40	45	50	56	63
Suction pressure		p_e		0,7...3 (absolute), with tandem pumps: p_e (p_2) = max. 0.5 > p_e (p_1)									
max. continuous pressure		p_1	bar	250							220	195	170
max. intermittent pressure		p_2		280							250	225	200
max. peak pressure		p_3		300							280	250	230
min. rpm at bar	12 mm²/s	< 100	rpm	500	500	500	500	500	500	500	500	500	500
		100...180		1,200	1,200	1,000	1,000	1,000	800	800	800	800	800
		180... p_2		1,400	1,400	1,400	1,400	1,200	1,200	1,000	1,000	1,000	1,000
	25 mm²/s	p_2		600	600	500	500	500	500	500	500	500	500
max. rotational speed at		p_2		3,000	3,000	3,000	2,800	2,800	2,800	2,600	2,600	2,300	2,300

Drive arrangement

1. Flexible couplings

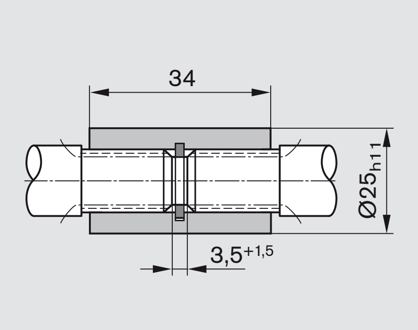
The coupling must not transfer any radial or axial forces to the pump.

Refer to the fitting instructions provided by the coupling manufacturer for details of the maximum permitted shaft misalignment.



2. Coupling sleeve

Used on shafts with DIN or SAE splining. Caution: There must be no radial or axial forces exerted on the pump shaft or coupling sleeve. The coupling sleeve must be free to move axially. The distance between the pump shaft and drive shaft must be $3.5^{+1.5}$. Oil-bath or oil-mist lubrications is necessary.



Splined shaft	Ordering code	M_{max} [Nm]
SAE-B 13 teeth	D	300

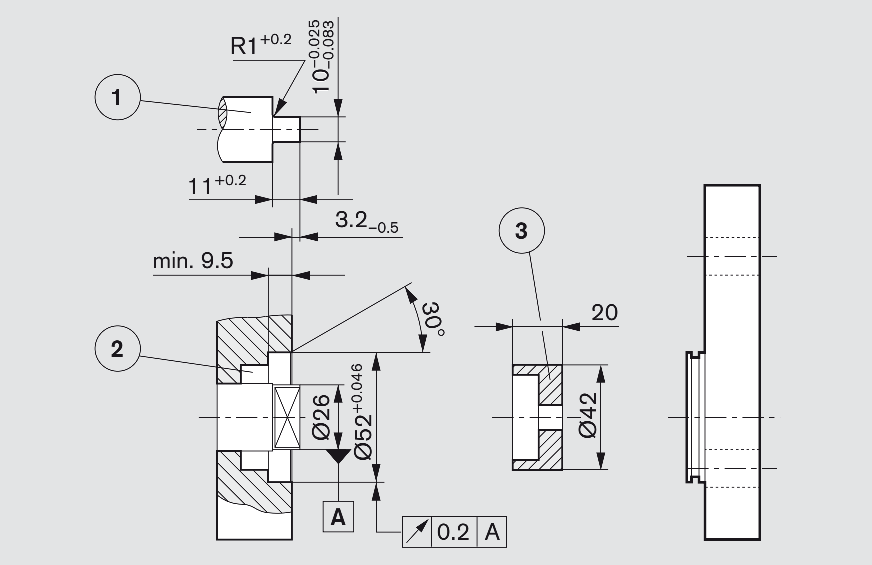
3. Drive shaft with tang

For the close-coupling of the pumps to electric motor or internal-combustion engine, gear, etc. The pump shaft has a special tang and driver ③ (not included in supply).
There is no shaft sealing.

The recommended arrangements and dimensions for the drive end and sealing are as follows.

① Drive shaft
Case-hardening steel DIN 17 210
e.g. 20 MnCrS 5
case-hardened 1.0 deep; HRA $83^{\pm 2}$
Surface for sealing ring
ground without rifling $R_t \leq 4 \mu m$

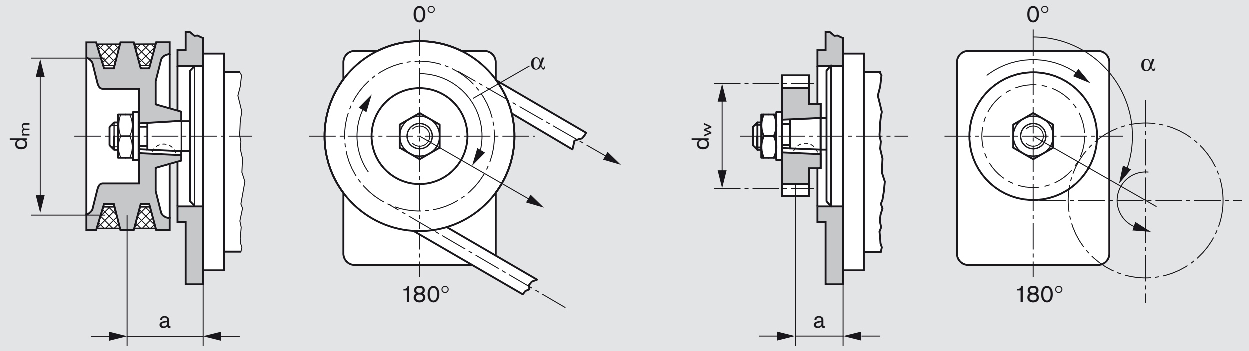
② Radial shaft seal
with rubber covered seal
(see DIN 3760, Type AS, or double-lipped ring).
Cut 15° chamfer or fit shaft seal ring with protection sleeve.



M_{max} [Nm]	V [cm³/rev]	p_{max} [bar]
130	28	260
	36	200
	40	180
	45	160
	50	150
	56	130
	63	110
	70	100
	80	90
	100	70

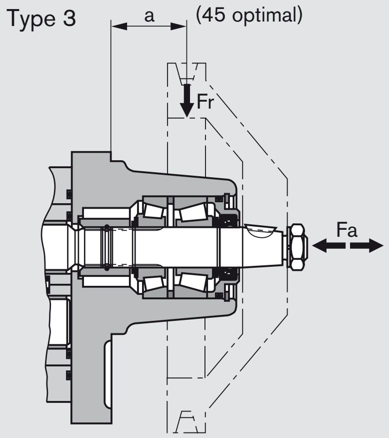
4. V-belts and straight gearwheels or helical toothed gear drives without outboard bearing

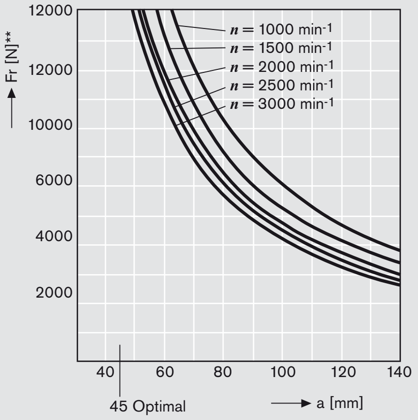
When proposing to use V-belt or gear drive, please submit details of the application for our comments (especially dimensions a, d_m, d_w and angle α).
For helical toothed gear drives, details of the helix angle β are also required.



5. Outboard bearing

Outboard bearing eliminate possible problems when the pumps are driven by V-belts or gearwheels. The diagrams below show the maximum radial and axial loads that can be tolerated based on a bearing life of $L_H = 1000$ h.





Multiple gear pumps

Gear pumps are suitable for multiple setups, whereby the drive shaft for the 1st pump is extended to a second and even a 3rd pump. A coupling is fitted between each pair of pumps.
In most cases each pump is isolated from its neighbor, i.e. the suction ports are separate from one another. A common suction port is also possible as an option.
Caution: Basically, the specifications for the single pumps apply, but with certain restrictions:
Max. speed: This is determined by the highest rated pump speed in use.
Pressures: These are restricted by the strength of the drive shaft, the through drives and the drivers. Appropriate data is given in the dimensional drawings.

Pressure restrictions during standard through drive
In the case of series U, the driver for the second pumping stage can carry a load of up to $M_{max.}$ = 130 Nm, i.e. there is a pressure restriction for the second stage and any further stages.

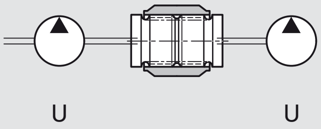
$M_{max.}$ [Nm]	V [cm^3/rev]	p_{max} [bar]
65 Series F, S	16	230
	19	190
	22.5	160
	25	140
	28	130
130 Series G, U	22.5	280
	25	280
	28	260
	32	230
	36	200
	40	180
	45	160
	50	150
	56	130
	63	110

If the 1st stage is driven through a tang (driver) or outboard bearing type 1, pressure restrictions apply as indicated in the formula below.

Reinforced through drives are available for applications with higher transfer torques and/or rotational vibrations. Customized designs available on request.

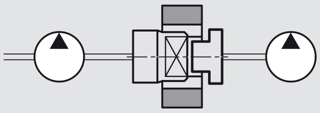
Reinforced through drive

$M_{max.}$ = 320 Nm



Standard through drive

$M_{max.}$



Combinations

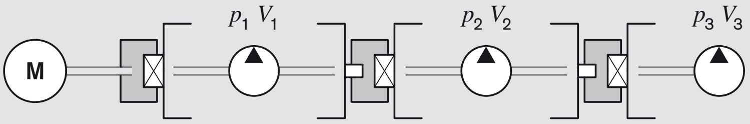
Series Pump 1	$M_{max.}$ [Nm]	Series Pump 2
U	130	G, U
U	65	F, S

For configuration of multiple pumps we recommend the pump is positioned with the largest displacement on the drive side.

Max. transferrable drive torque

Function	Code	Designation	Max. transferrable drive torque * [Nm]
Splined shafts	D	SAE J744 22-4 (13T 16/32 DL)	300
	E	SAE-C 15 teeth	450
Tapered key shaft	C	1:5	290
	H	1:8	240

* These figures are valid providing the conditions defined on pages 15 and 16 are observed. Bosch Rexroth is to be consulted if the stated values are exceeded.

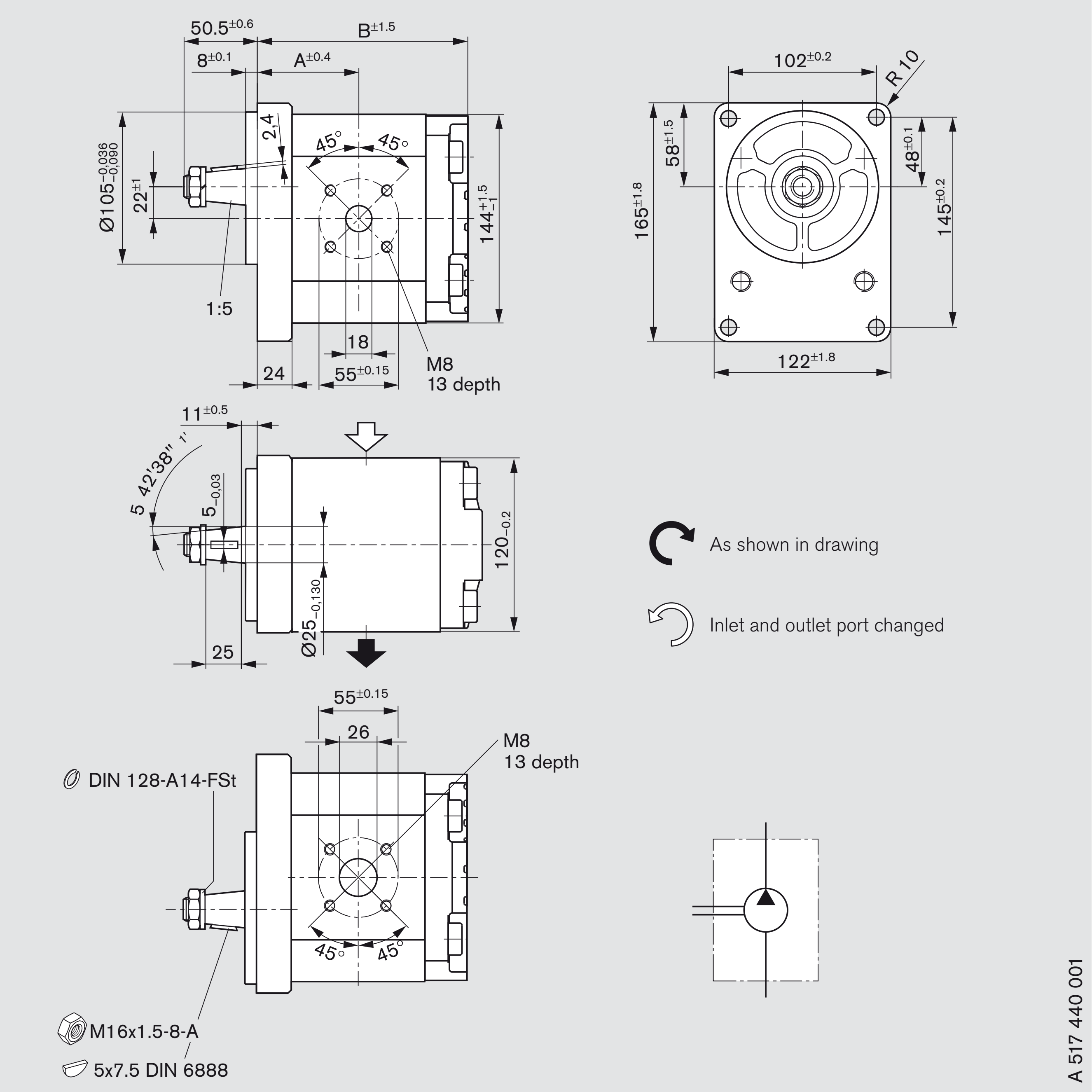


$$M_{max.} \geqq \Delta p_1 \cdot V_1 \cdot 0.0177 + \Delta p_2 \cdot V_2 \cdot 0.0177 + \Delta p_3 \cdot V_3 \cdot 0.0177$$

Δp [bar] V [cm^3/rev]

Dimensions

Standard range



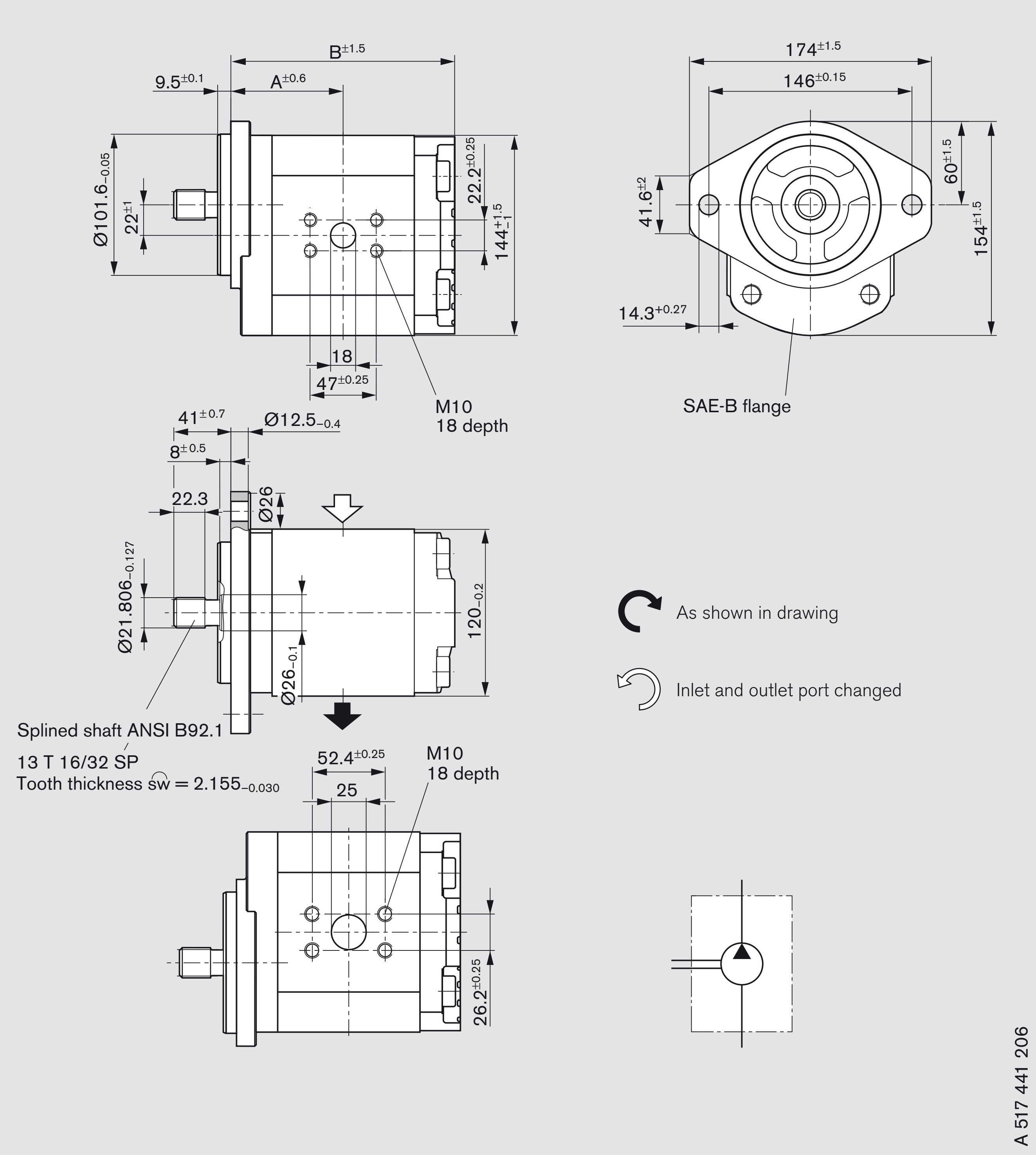
Ordering code:

AZPU – 22 – ☐☐☐ ☐ C B 20 M B

Displacement [cm^3/rev]	Ordering-No.		max. operating pressure [bar]	max. rotation speed [rpm]	Mass [kg]	Dimension [mm]	
	↺ L	↻ R				A	B
22.5	**0 517 725 322**	**0 517 725 026**	280	3,000	10.3	60.9	124.6
25	**0 517 725 323**	**0 517 725 027**	280	3,000	10.4	61.9	126.6
28	**0 517 725 324**	**0 517 725 028**	280	3,000	10.5	63.2	129.1
32	**0 517 725 325**	**0 517 725 029**	280	2,800	10.7	64.8	132.4
36	**0 517 725 326**	**0 517 725 030**	280	2,800	10.9	66.4	135.7
40	**0 517 725 327**	**0 517 725 031**	280	2,800	11.0	68.1	139.0
45	**0 517 725 328**	**0 517 725 032**	280	2,600	11.2	70.1	143.1
50	**0 517 825 301**	**0 517 825 001**	250	2,600	11.4	72.2	147.2
56	**0 517 825 302**	**0 517 825 002**	225	2,300	11.7	74.7	152.2
63	**0 517 825 303**	**0 517 825 003**	200	2,300	12.0	77.6	158.0

Dimensions

Standard range

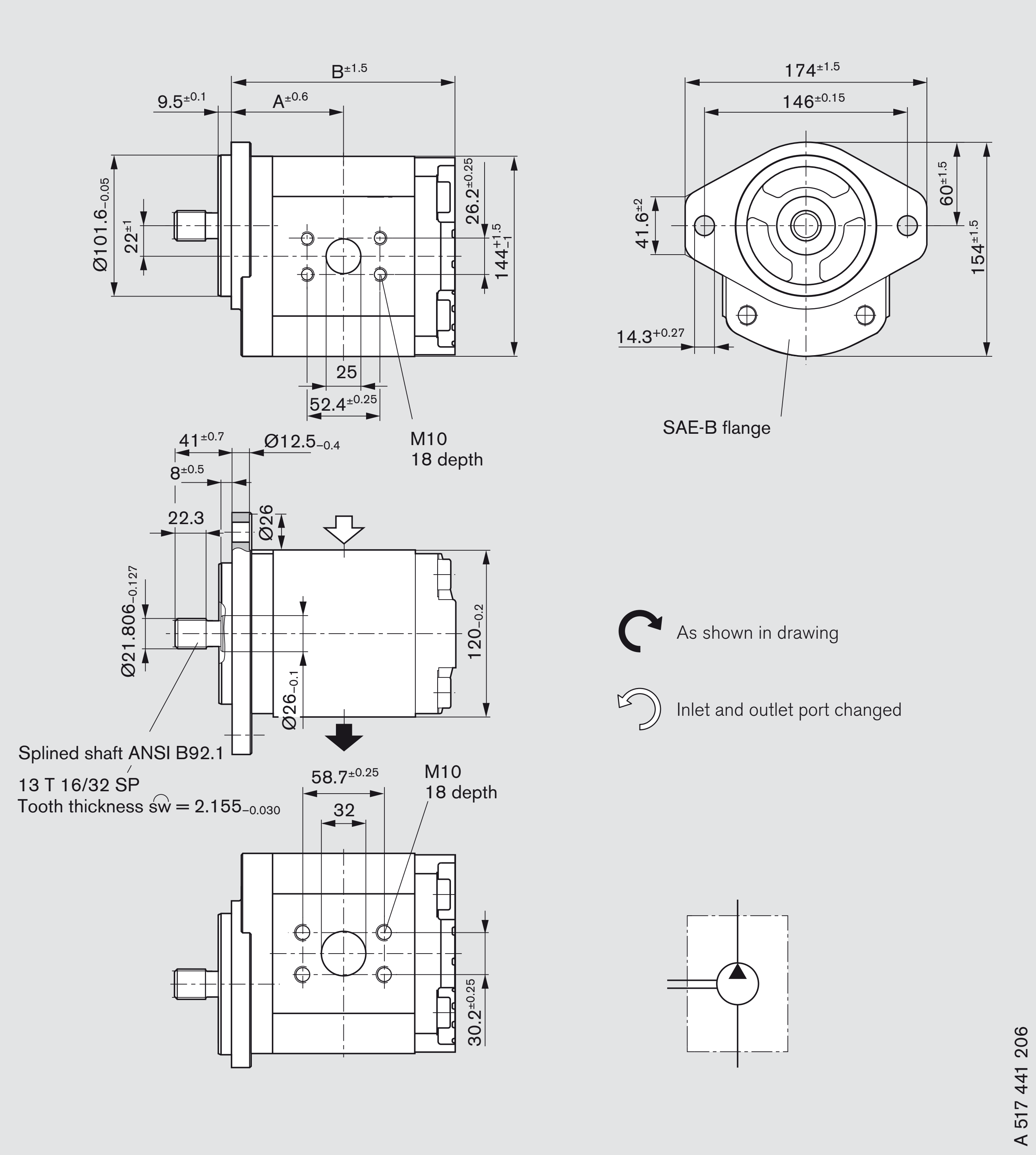


Ordering code:
AZPU – 22 – ☐☐☐ ☐ D C 07 K B

Displacement [cm³/rev]	Ordering-No. L	 R	max. operating pressure [bar]	max. rotation speed [rpm]	Mass [kg]	Dimension [mm] A	 B
22.5	**0 517 725 329**	**0 517 725 033**	280	3,000	9.6	66.4	130.1
25	**0 517 725 330**	**0 517 725 034**	280	3,000	9.7	67.4	132.1
28	**0 517 725 331**	**0 517 725 035**	280	3,000	9.8	68.7	134.6

Dimensions

Standard range



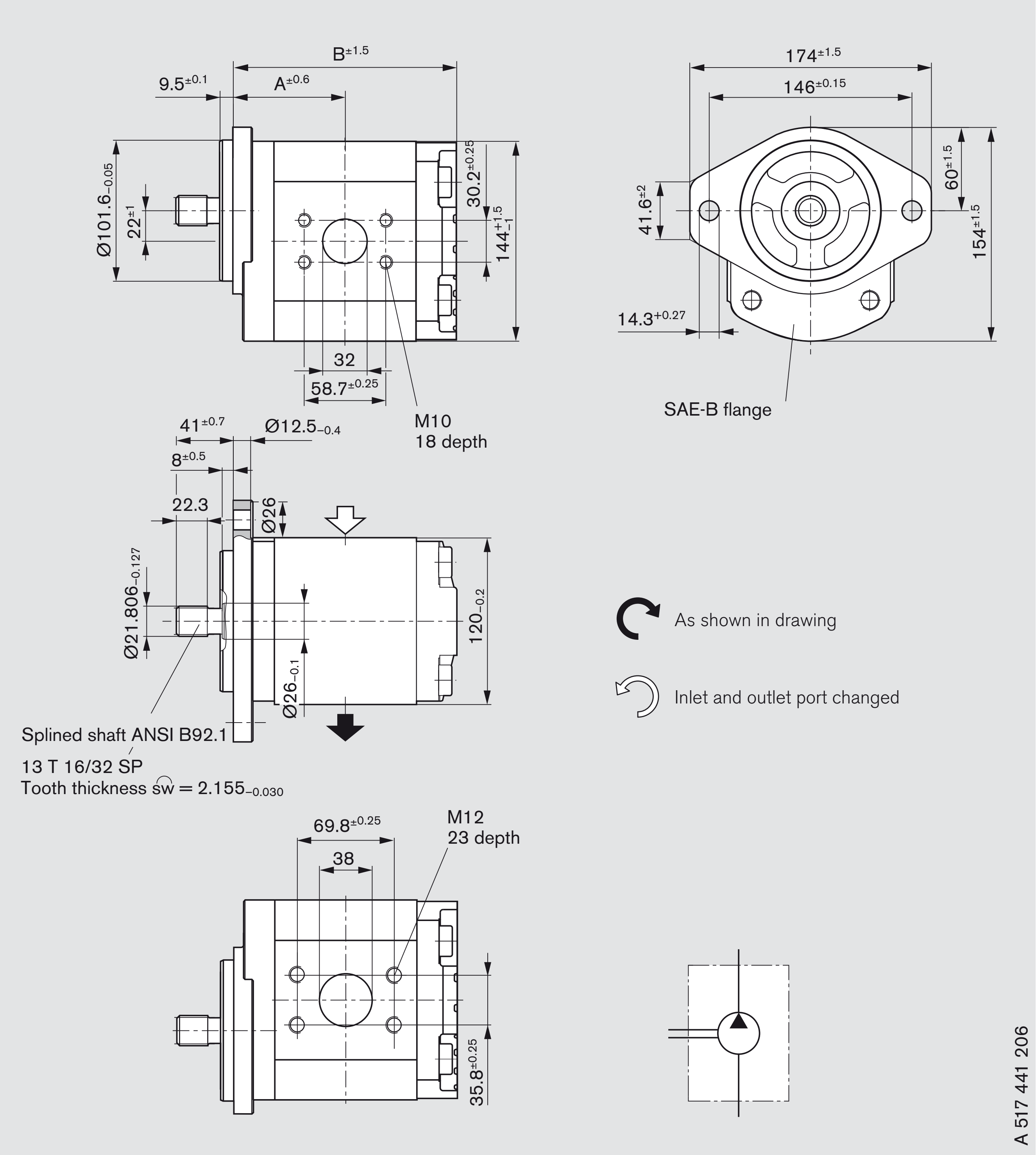
Ordering code:

AZPU – 22 – ☐☐☐ ☐ D C 07 K B

Displacement [cm³/rev]	Ordering-No. L	 R	max. operating pressure [bar]	max. rotation speed [rpm]	Mass [kg]	Dimension [mm] A	 B
32	**0 517 725 332**	**0 517 725 036**	280	2,800	10.0	70.3	137.9
36	**0 517 725 333**	**0 517 725 037**	280	2,800	10.1	71.9	141.2
40	**0 517 725 334**	**0 517 725 038**	280	2,800	10.3	73.6	144.5
45	**0 517 725 335**	**0 517 725 039**	280	2,600	10.5	75.6	148.6
50	**0 517 825 304**	**0 517 825 004**	250	2,600	10.7	77.7	152.7

Dimensions

Standard range



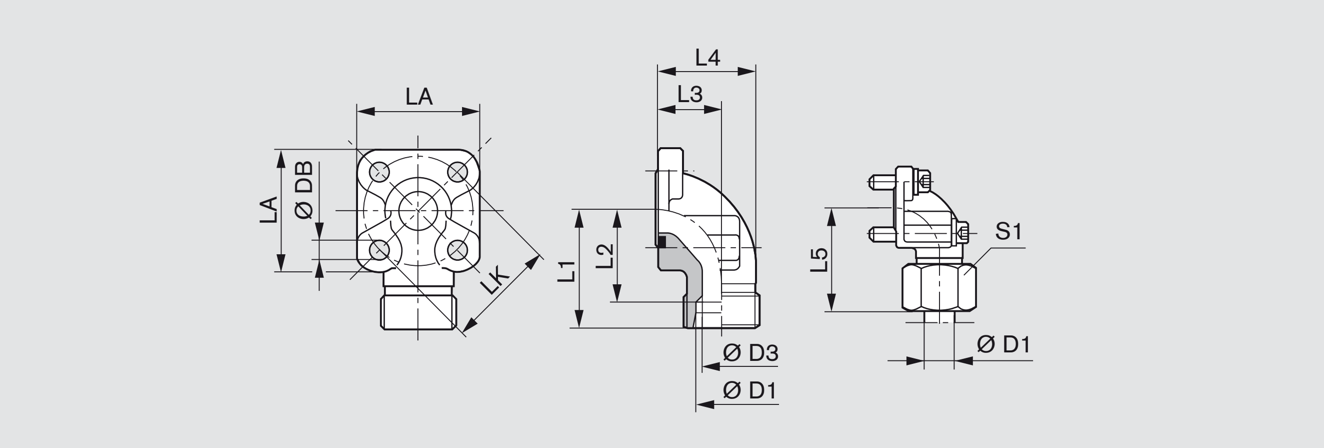
Ordering code:
AZPU – 22 – ☐ ☐ ☐ ☐ D C 07 K B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	max. operating pressure [bar]	max. rotation speed [rpm]	Mass [kg]	Dimension [mm] A	Dimension [mm] B
56	**0 517 825 305**	**0 517 825 005**	225	2,300	11.0	80.2	157.7
63	**0 517 825 306**	**0 517 825 006**	200	2,300	11.3	83.1	163.5

Fittings

Fittings can be used for rectangular flange 20 see page 7

Gear pump flange, 90° angle



LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws 2 pcs.	2 pcs.	Seal ring	Mass kg	Part number	p (bar)
55	20S	17	45	34.5	24.0	40.0	56.0	58	36	8.4	M8x25	M8x50	33x2.5	0.44	**1 515 702 004**	250
55	30S	26	49	35.5	32.0	50.0	62.0	58	50	8.4	M8x25	M8x50	33x2.5	0.50	**1 515 702 006**	250
55	35L	31	49	38.5	32.0	51.5	62.0	58	50	8.4	M8x25	M8x60	32x2.5	0.47	**1 515 702 005**	100
55	42L	38	49	38.0	40.0	64.5	61.0	58	60	8.4	M8x25	M8x70	32x2.5	0.60	**1 515 702 019**	100

Complete fittings with seal ring, metric screw set, nuts and olive.

Note
The permissible tightening torques can be found in our publication:
“General operating instructions for external gear units”
RE 07 012-B1.

Notes for commissioning

Filter recommendation

The major share of premature failures in external gear pumps is caused by contaminated hydraulic fluid.
As a warranty cannot be issued for dirt-specific wear, we recommended filtration compliant with cleanliness level 20/18/15 ISO 4406, which reduces the degree of contamination to a permissible dimension in terms of the size and concentration of dirt particles:

Operating pressure [bar]	>160	<160
Contamination class ISO 4406	18/15	19/16
To be reached with $\beta_X = 75$	20	25

We recommend that a full-flow filter always be used.
Basic contamination of the hydraulic fluid used may not exceed class 20/18/15 according to ISO 4406. Experience has shown that new fluid quite often lies above this value. In such instances a filling device with special filter should be used.

General

- The pumps supplied by us have been checked for function and performance. No modifications of any kind may be made to the pumps; any such changes will render the warranty null and void!
- Pump may only be operated in compliance with permitted data (see pages 15 – 18).

Project planning notes

Comprehensive notes and suggestions are available in Hydraulics Trainer, Volume 3 RE 00 281, “Project planning notes and design of hydraulic systems”. Where external gear pumps are used we recommend that the following note be adhered to.

Technical data

All stated technical data is dependent on production tolerances and is valid for specific marginal conditions.
Note that, as a consequence, scattering is possible, and at certain marginal conditions (e.g. viscosity) **the technical data may change**.

Characteristics

When designing the external gear pump, note the maximum possible service data based on the characteristics displayed on pages 10 to 12.

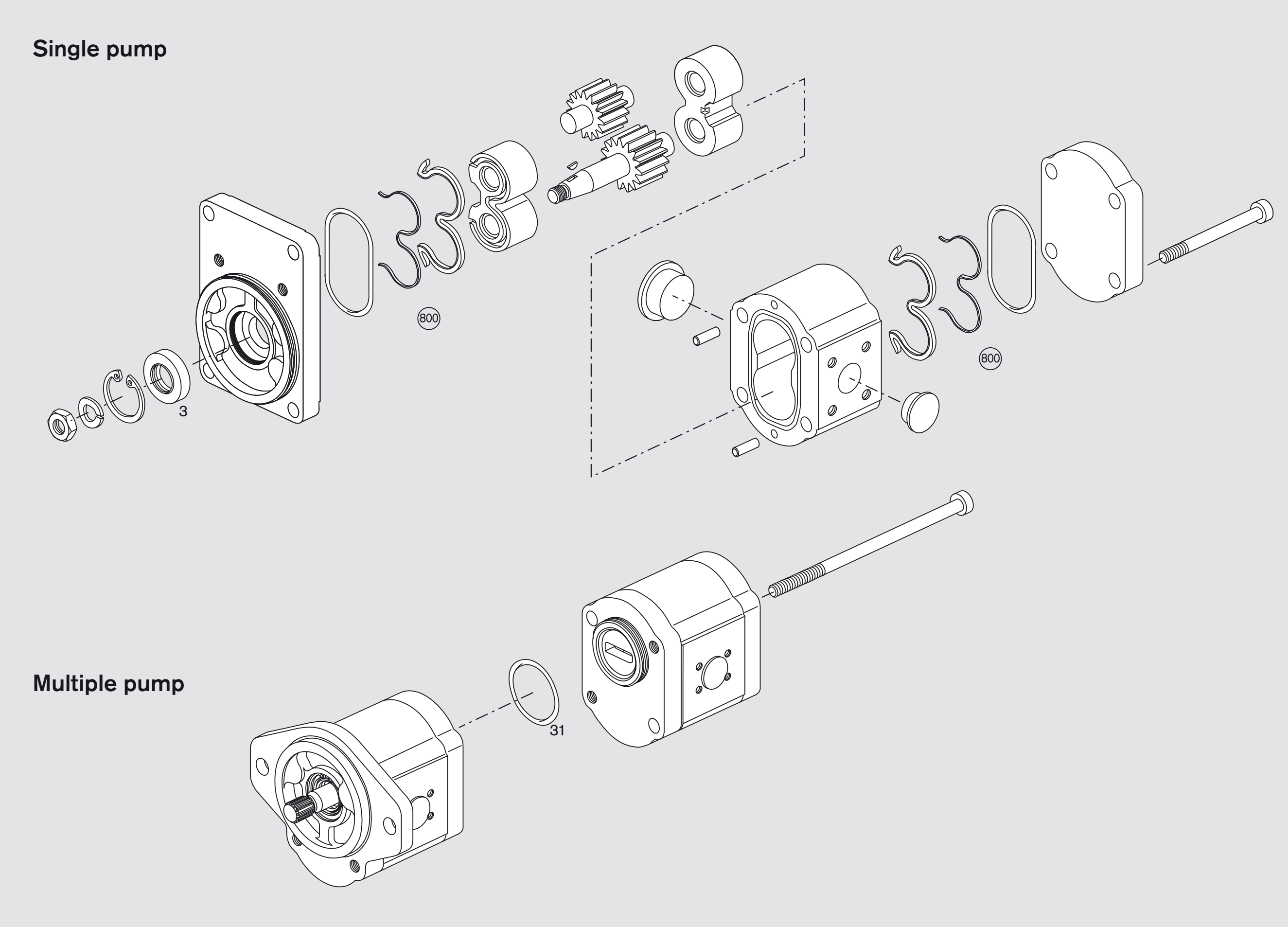
Additional information on the proper handling of hydraulic products from Bosch Rexroth is available in our document: “General product information for hydraulic products” RE 07 008.

Contained in delivery

The components with characteristics as described under ordering code and device measurements, pages 18 – 21, are contained in delivery.

You can find further information in our publication: “General Operating Instructions for External Gear Units” RE 07 012-B1.

Service parts



Page	Ordering code	Seal kit “U” Item 800 NBR	Shaft seal ring Item 3	Dimension	Material
18	AZPU – 22 – ☐☐☐ ☐ C B 20 M B	1 517 010 231	1 510 283 072	42 x 26 x 7	NBR
19, 20, 21	AZPU – 22 – ☐☐☐ ☐ D C 07 K B	1 517 010 231	1 510 283 069	42 x 26 x 7	FKM

NBR = Perbunan® FKM = Viton®

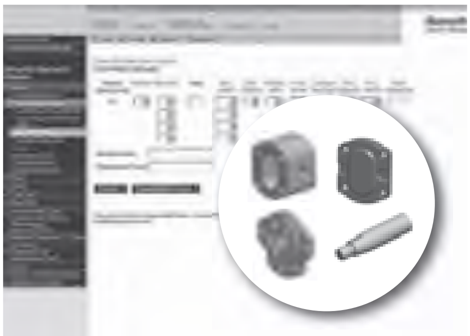
For multiple pumps

Seal ring Item 31 NBR	1 900 210 145

The AZ configurator

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly You only need to specify your requirements: From the displacement, direction of rotation, drive shaft, connection flange right up to the required rear cover. You immediately receive a project drawing (PDF format) if a configuration already exists. You receive the price of the configured external gear unit upon request.

The AZ configurator assists you to configure your individual external gear unit easily and user-friendly – all data needed for project planning are acquired thru menu guidance.



Selection is made either on an ordering code or your technical requirements. This means that you can search for external gear units that have already been configured, or you specify the configuration variant of the external gear unit based upon the operating parameters you require.

If the external gear unit you selected has been released you will receive the part number, ordering code and a detailed installation drawing. If your special configuration is not available please send your specification to Rexroth. One of our employees will then contact you.

Ordering-No.

Ordering-No.	Page
0 517 725 004	20
0 517 725 026	18
0 517 725 027	18
0 517 725 028	18
0 517 725 029	18
0 517 725 030	18
0 517 725 031	18
0 517 725 032	18
0 517 725 033	19
0 517 725 034	19
0 517 725 035	19
0 517 725 036	20
0 517 725 037	20
0 517 725 038	20
0 517 725 039	20
0 517 725 304	20
0 517 725 322	18
0 517 725 323	18
0 517 725 324	18
0 517 725 325	18
0 517 725 326	18
0 517 725 327	18
0 517 725 328	18
0 517 725 329	19
0 517 725 330	19
0 517 725 331	19
0 517 725 332	20
0 517 725 333	20
0 517 725 334	20
0 517 725 335	20
0 517 825 001	18
0 517 825 002	18
0 517 825 003	18
0 517 825 005	21
0 517 825 006	21
0 517 825 301	18
0 517 825 302	18
0 517 825 303	18
0 517 825 305	21
0 517 825 306	21

External gear pump SILENCE PLUS
AZPJ

- Platform F
- Low-noise fixed pump
- Sizes 12 to 28
- Continuous pressure up to 250 bar
- Intermittent pressure up to 280 bar

Features

- Very low inherent noise
- Optimized pressure pulsation reduces noise emissions and oscillations in the system
- Pleasant tone due to low frequency
- Consistently high quality due to high-volume series production
- Long service life
- Slide bearings for high loads
- Drive shafts according to ISO or SAE and customer-specific solutions
- Line connections: Connection flanges
- Combinations of several pumps possible

Contents

Functional description

General

The key task of external gear units is to convert mechanical energy (torque and rotational speed) into hydraulic energy (flow and pressure). To avoid unnecessarily high heat losses, units with high efficiencies are sought after. These are realized by means of pressure-dependent gap sealing and high-precision manufacturing technology.
With extremely low-noise SILENCE PLUS pumps, the intrinsic noise is reduced by 15 dB (A) on average as compared with standard external gear pumps and the flow pulsation is also decreased by 75%.

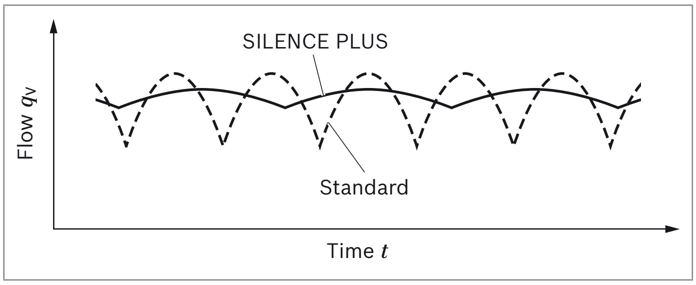
Pumping principle

Continuous tooth contact reduces operating noise:
A non-involute rounded tooth profile, combined with helical gearing, forms the heart of the SILENCE PLUS. Thanks to permanent tooth contact, the hydraulic fluid is transported almost continuously and noiselessly. The possibility of noise developing from trapped oil between the tooth flanks is prevented in the first place.
A hydrostatic bearing ensures long service life:
The high performance and long service life of the SILENCE PLUS is due to a Rexroth patented solution: Hydrostatic grooves provide wear-free compensation for the internal axial forces generated in the helical gearing – even at pressures up to 280 bar.

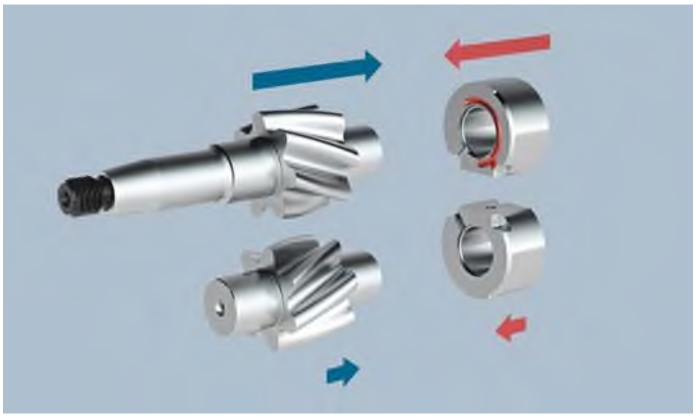
▼ **Standard**

▼ **SILENCE PLUS**

▼ **Flow pulsation**



▼ **Hydrostatic bearing SILENCE PLUS**

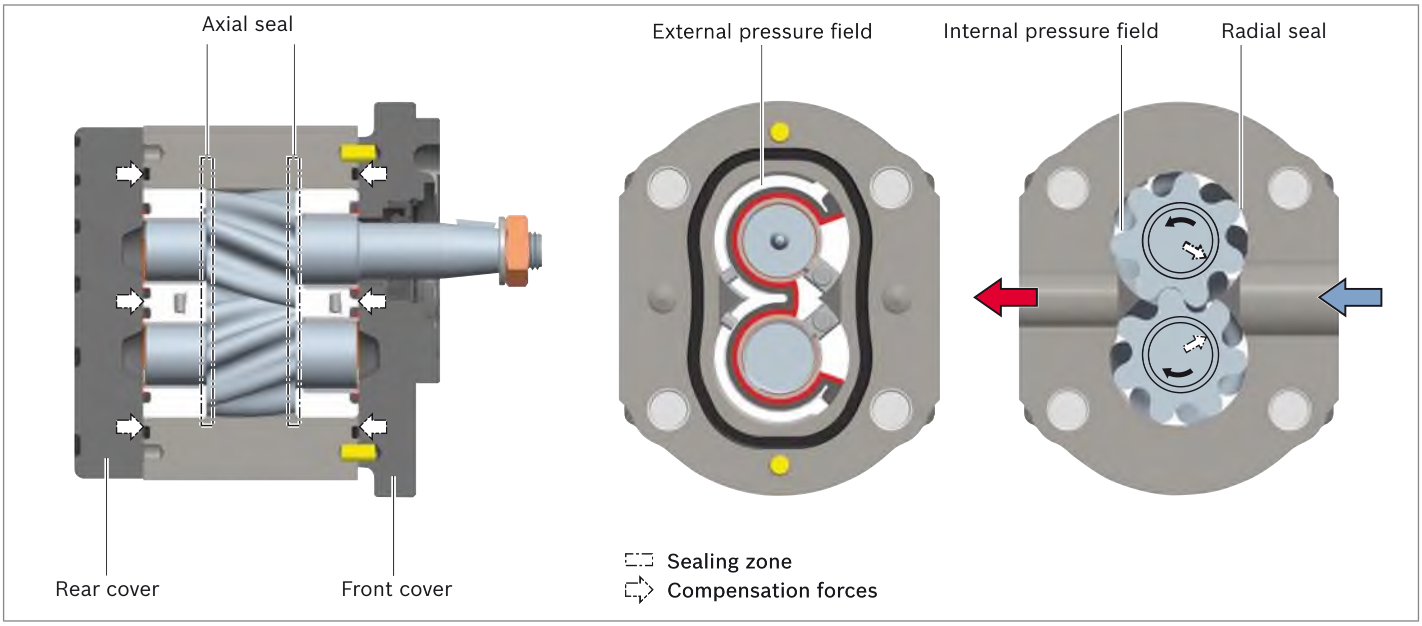


Construction

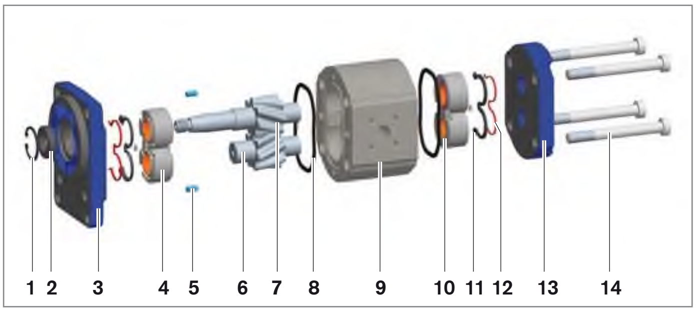
The external gear pump consists essentially of a pair of gear wheels supported in bearing bushes and the housing with a front and a rear cover. The drive shaft protrudes from the front cover where it is sealed by the shaft seal ring. The bearing forces are absorbed by slide bearings. These were designed for high pressures and have excellent emergency running properties, especially at low rotational speeds. The gear wheels have 7 teeth. This keeps both flow pulsation and noise emission to a minimum.

The internal sealing of the pressure chambers is achieved by pressure-dependent forces. This ensures optimum efficiency. On the outside, the movable bearing bushes are pressurized with operating pressure and pressed as seals against the gear wheels. The pressurized compression springs are limited by special seals. The seal on the area between the gear teeth and the housing is ensured by the smallest of gaps that adjust depending on the pressure between the gear teeth and housing.

▼ Axial compensation SILENCE PLUS

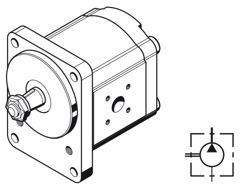
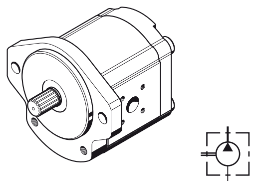
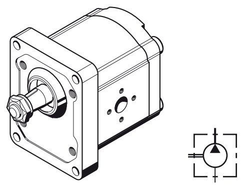
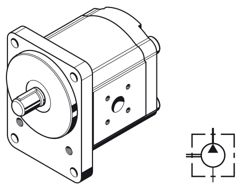
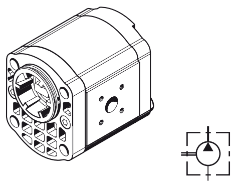


▼ Assembly AZPJ



1	Snap ring	**8**	Housing seal ring
2	Shaft seal	**9**	Pump housing
3	Front cover	**10**	Bearing bushing
4	Slide bearing	**11**	Axial field seal
5	Centering pin	**12**	Supporting element
6	Gear wheel	**13**	Rear cover
7	Drive shaft	**14**	Torx screws

▼ Product overview AZPJ preferred types

Version				
				
Page 21	Page 22	Page 23, 24	Page 25	Page 26

Type code single pump

01	02		03	04		05	06	07	08	09	10	11	12	13	14
AZP	J	–			–										

External gear unit

01	External gear pump	**AZP**

Series

02	SILENCE PLUS, platform F	**J**

Series

03	Shaft Ø20	**2**

Version

04	Phosphated, pinned	**1**
	Chromated, pinned	**2**

Size (NG)

05	Geometric displacement V_g [cm^3], see “Technical data” on page 9	**012**	**014**	**016**	**019**	**022**	**025**	**028**

Direction of rotation

06	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Drive shaft			**Suitable front cover**	
07	Tapered shaft	1 : 5	**B, P**	**C**
		1 : 5	**A, G**	**S**
		1 : 8	**O**	**H**
	Dihedral, claw		**M, T**	**N**
	Splined shaft	SAE J744 16-4 9T	**R, C**	**R**
		SAE J744 19-4 11T	**R, C**	**P**
		DIN 5482 B17 × 14	**B, P**	**F**
	Parallel keyed shaft	SAE J744 16-1 A	**R**	**Q**
		ISO Ø18 mm	**B**	**A**

Front cover

08	Rectangular flange	Ø80 mm		**B**
		Ø36.47 mm		**O**
	2-bolt flange	Ø82.55 mm	SAE J744 82-2 A	**R**
		Ø101.6 mm	SAE J744 101-2 B	**C**
	2-bolt mounting	Ø52 mm	With O-ring	**M**
		Ø50 mm	Connection variant 1	**N**
		Ø50 mm	Connection variant 2	**P**
	4-bolt mounting	Ø52 mm	With O-ring	**T**
	Outboard bearing	Ø80 mm	Type 1	**A**
			Type 2	**G**

01	02	03	04	05	06	07	08	09	10	11	12	13	14
AZP	**J**	**–**			**–**								

Line connection

			012	**014**	**016**	**019**	**022**	**025**	**028**	
09	Square flange		●	●	●	●	●	●	●	**20**
	Square flange		●	●	●	–	–	–	–	**30**

Sealing material

10	NBR (nitrile rubber)	**M**
	FKM (fluoroelastomer)	**P**
	NBR (nitrile rubber), shaft seal in FKM (fluoroelastomer)	**K**

Rear cover

11	Without valve (standard)			**B**
	With pressure relief valve	Residual flow	internal	**D**
			external	**T**
	With flow control valve	Residual flow	external	**E**
			internal	**S**
	With pressure relief valve and flow control valve			**V**

Valve setting pressure relief valve (parameter only required for rear cover with pressure relief and/or flow control valve)

12	Without pressure relief valve	**XXX**
	Cracking pressure in bar, 3-digit, e.g. 180 bar	**180**

Valve setting flow control valve (parameter only required for rear cover with pressure relief and/or flow control valve)

13	Without flow control valve	**XX**
	Flow in l/min, 2-digit, e.g. 9 l/min	**09**

Special version

14	Special version	**SXXXX**

● = Available **–** = Not available

Note

- Not all of the variants according to the type code are possible.
- Please select the desired pump with the help of the selection table (preferred types) or after consultation with Bosch Rexroth.
- Special options are available on request.

Type code multiple pump

01	02		03	04		05	06	07	08	09	10	11	12
AZP		**–**			**–**								

External gear unit

01	External gear pump	**AZP**

Series[1]

02	High-performance	1.0 to 7.1 cm^3/rev	Data sheet 10087	**B**
		4.0 to 28 cm^3/rev	Data sheet 10089	**F**
		20.0 to 36 cm^3/rev	Data sheet 10091	**N**
		22.5 to 100 cm^3/rev	Data sheet 10093	**G**
	SILENCE	4.0 to 28 cm^3/rev	Data sheet 10095	**S**
		20.0 to 36 cm^3/rev	Data sheet 10092	**T**
		22.5 to 63 cm^3/rev	Data sheet 10098	**U**
	SILENCE PLUS	12.0 to 28 cm^3/rev	Data sheet 10094	**J**

Series (relates to pump stage 1)

03	Standard bearing	**1**
	Reinforced bearing	**2**

Version (relates to pump stage 1)

04	Phosphated, pinned	**1**
	Chromated, pinned	**2**

Size (NG)[2]

05	In accordance with data sheet for the individual series	

Direction of rotation

06	Viewed on drive shaft	clockwise	**R**
		counter-clockwise	**L**

Drive shaft (relates to pump stage 1)

07	In accordance with data sheet of pump stage 1	

Front cover (relates to pump stage 1)

08	In accordance with data sheet of pump stage 1	

Line connection (per pump stage)[3]

09	In accordance with data sheet for the individual series	

Sealing material

10	NBR (nitrile rubber)	**M**
	FKM (fluoroelastomer)	**P**
	NBR (nitrile rubber), shaft seal in FKM (fluoroelastomer)	**K**

Rear cover (relates to last pump stage)

11	In accordance with data sheet for the last pump stage	

Special version

12	Special version	**SXXXX**

---

1) A letter is to be selected for each pump stage, e.g.
3-way pump AZPJ + AZPJ + AZPB: **JJB**

2) A numerical value is to be selected for each pump stage, e.g.
3-way pump **028/016/2.0**

3) A numerical value is to be selected for each pump stage, e.g.
3-way pump **202002**

Note

- Not all of the variants according to the type code are possible.
- Please select the desired pump with the help of the selection table (preferred types) or after consultation with Bosch Rexroth.
- Special options are available on request.

Example 4-way pump:

AZPG...032... + AZPG...022... + AZPJ...016... + AZPJ...012...

01	02		03	04		05	06	07	08	09	10	11
AZP	**GGJJ**	**–**	**2**	**2**	**–**	**032/022/016/012**	**R**	**C**	**B**	**20202020**	**K**	**B**

Technical data

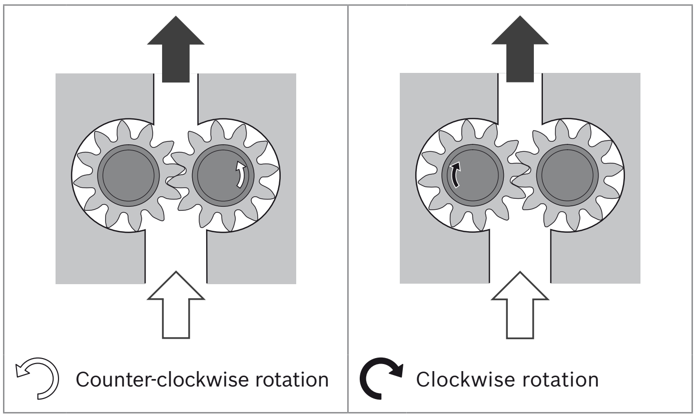
General		
Weight	kg	See dimensions starting on page 21
Installation position		Any
Mounting type		Flange or through-bolting with spigot
Line ports		Flange
Direction of rotation (viewed on drive shaft)		Clockwise or counter-clockwise, the pump may only be driven in the direction indicated
Drive shaft bearing		Radial and axial forces only after consultation
Ambient temperature range θ	°C	−30 to +80 with NBR seals −20 to +110 with FKM seals

Hydraulic				
Hydraulic fluid				Mineral oil according to DIN 51524, 1-3, however under higher load at least HLP compliant with DIN 51524 Part 2 is recommended. Please observe data sheet 90220. Other hydraulic fluids on request
Hydraulic fluid temperature range		θ	°C	−30 to +80 with NBR seals (NBR = nitrile rubber) −20 to +110 with NBR seals (FKM = fluoroelastomer)
Viscosity range	permissible in continuous operation	ν	mm^2/s	12 to 800
	recommended in continuous operation	ν_{opt}	mm^2/s	20 to 100
	permissible for cold start	ν_{max}	mm^2/s	≤ 2000
Maximum admissible degree of contamination of the hydraulic fluid, Cleanliness level according to ISO 4406 (c)				20/18/15 [1]

Note

- ▶ Safety requirements pertaining to the whole systems are to be observed.
- ▶ Please contact us for applications with frequent load changes.
- ▶ The dimensions represent pumps for clockwise rotation. The position of the drive shaft or suction and pressure port changes for counter-clockwise rotation.

▼ **Direction of rotation, viewed on drive shaft**



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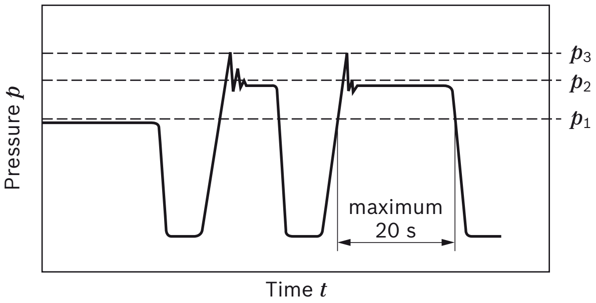
[1] For hydraulic systems or devices with function-related, critical failure effects, such as steering and brake valves, the type of filtration selected must be adapted to the sensitivity of these devices.

AZPJ-2x			**Size**	**12**	**14**	**16**	**19**	**22**	**25**	**28**
Displacement, geometric, per revolution		V_g	cm³	12	14	16	19	22.5	25	28
Pressure in suction port[1]	absolute	p_e	bar	0.7 to 3						
Maximum continuous pressure		p_1	bar	250	250	250	250	210	185	130
Maximum intermittent pressure		p_2	bar	280	280	280	280	240	215	160
Maximum pressure peak		p_3	bar	300	300	300	300	260	235	180
Minimum rotational speed at bar	12 mm²/s	< 100	rpm	500	500	500	500	500	500	500
		100 to 180	rpm	1000	800	800	800	800	800	800
		180 to p_2	rpm	1200	1000	1000	1000	1000	1000	–
	25 mm²/s	p_2	rpm	600	500	500	500	500	500	500
Maximum rotational speed at		p_2	rpm	3500	3000	3000	3000	3000	2800	2600

▼ **Pressure definition**

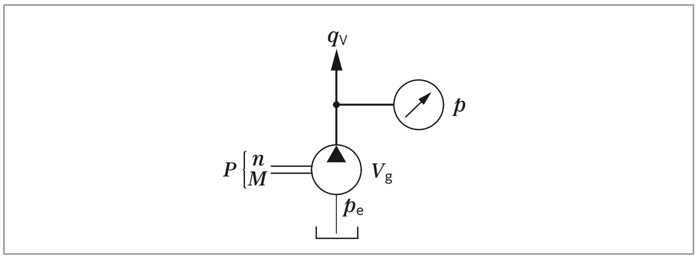


p_1 Maximum continuous pressure
p_2 Maximum intermittent pressure
p_3 Maximum pressure peak

Design calculations for pumps				
Flow	q_v	=	$\frac{V_g \times n \times \eta_v}{1000}$	[l/min]
Torque	M	=	$\frac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$	[Nm]
Power	P	=	$\frac{2\,\pi \times M \times n}{60000} = \frac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]
Pressure	Δp	=	$\frac{M \times 20 \times \pi \times \eta_{hm}}{V_g}$	[bar]
	Δp	=	$\frac{P \times 600 \times \eta_t}{q_V}$	[bar]
Displacement	V_g	=	$\frac{q_V \times 1000}{n \times \eta_V}$	[cm³]
	V_g	=	$\frac{M \times 20 \times \pi \times \eta_{hm}}{\Delta p}$	[cm³]
Rotational speed	n	=	$\frac{q_V \times 1000}{V_g \times \eta_V}$	[min⁻¹]

Key

V_g	Displacement per revolution [cm³]
Δp	Differential pressure [bar] ($\Delta p = p - p_e$)
n	Rotational speed [rpm]
q_v	Flow [l/min]
M	Torque [Nm]
P	Power [kW]
η_v	Volumetric efficiency[2]
η_{hm}	Hydraulic mechanical efficiency[2]
η_t	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)[2]



Note
On the following pages you can find diagrams for a rough calculation.

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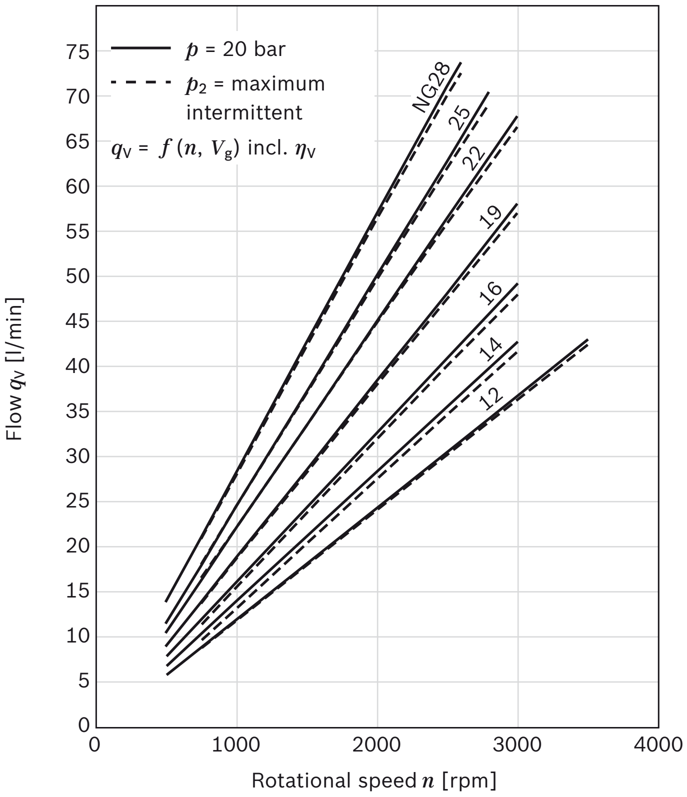
[1] In the case of tandem pumps, the suction-side pressure difference between the individual pump stages must not exceed 0.5 bar.

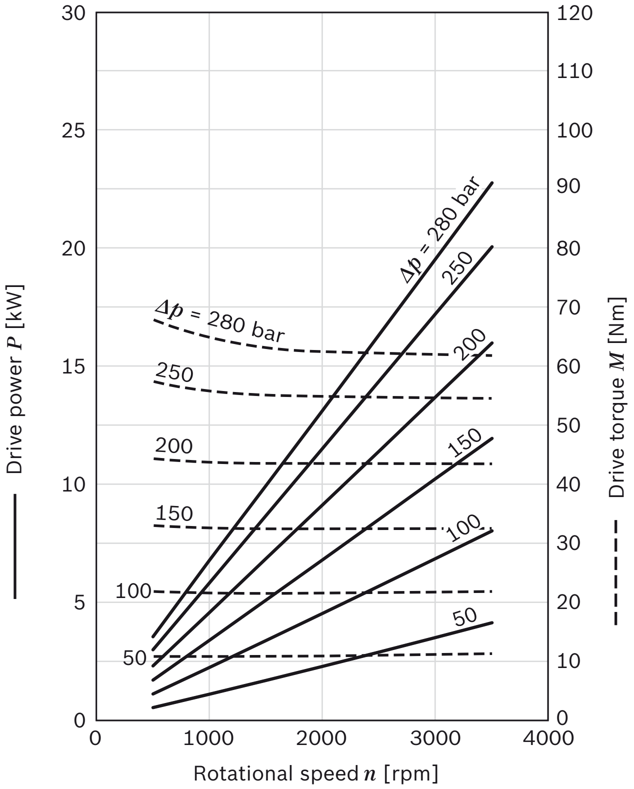
[2] Parameter as a decimal, e.g. 0.9

Flow and power characteristic curves

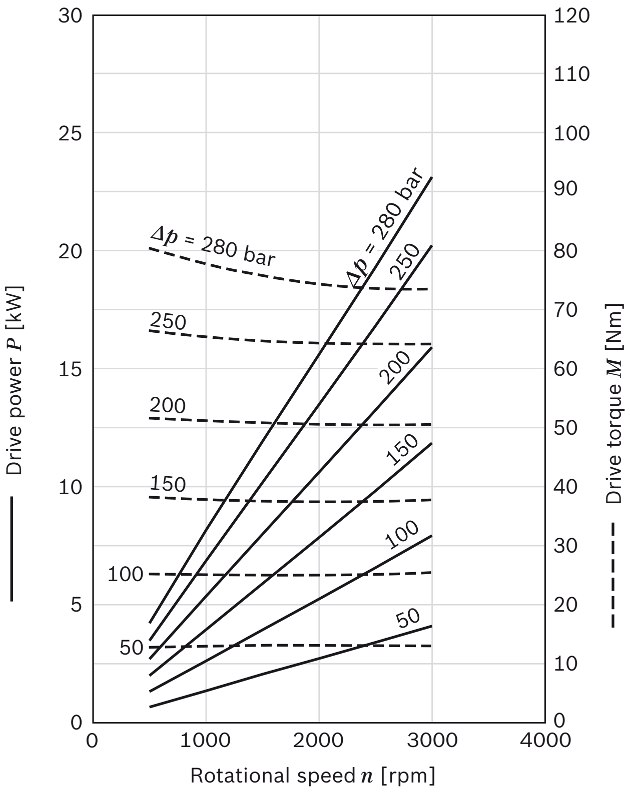
▼ **Flow**



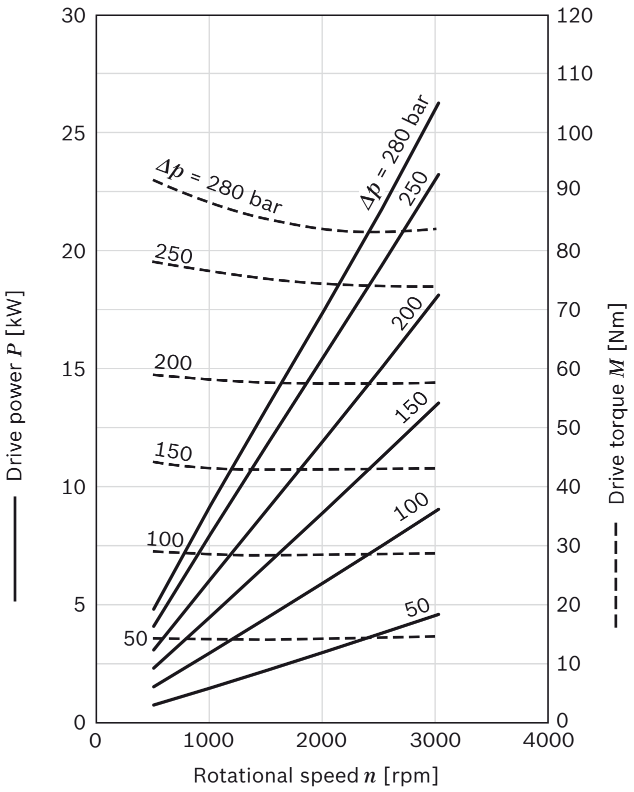
▼ **Size 12**



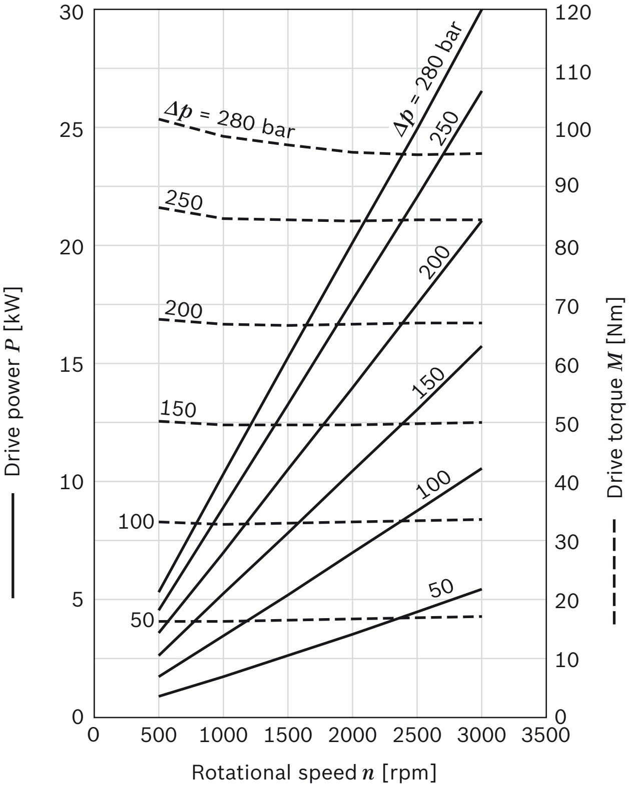
▼ **Size 14**



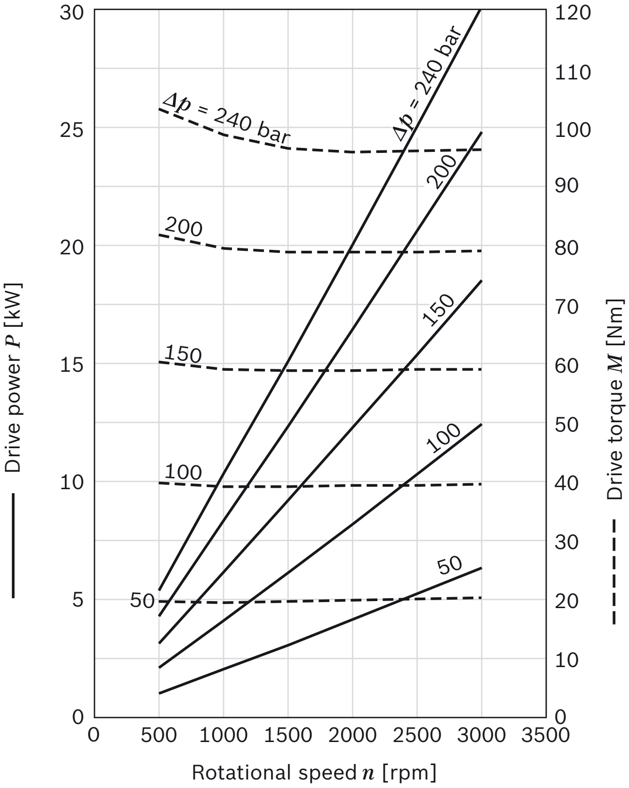
▼ **Size 16**



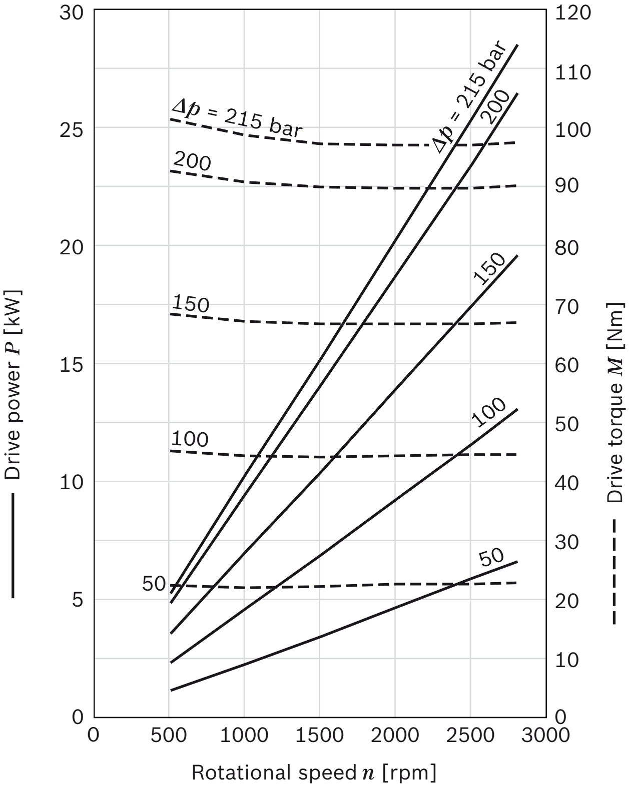
▼ Size 19



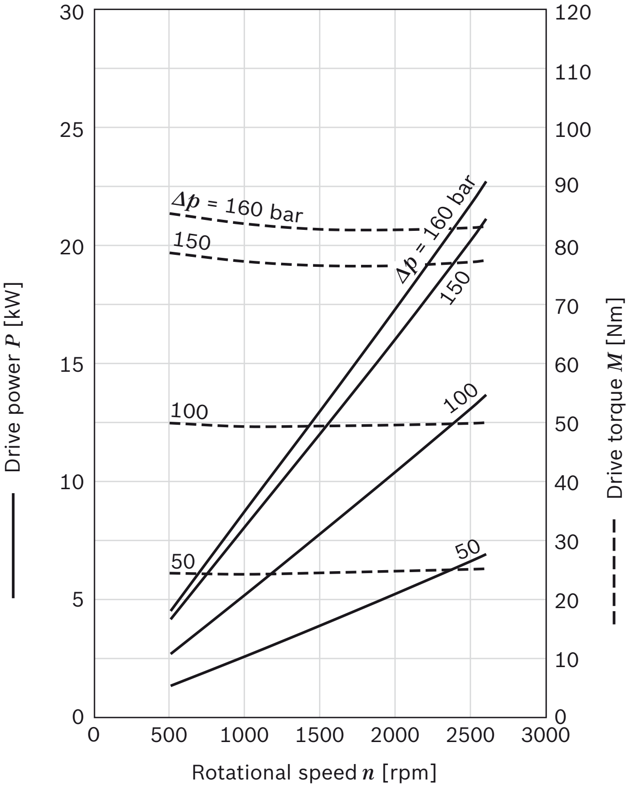
▼ Size 22



▼ Size 25



▼ Size 28



Note
Characteristic curves measured at ν = 32 mm²/s and θ = 50 °C.

$P = f(n, p)$ incl. η_t ———
$M = f(n, p)$ incl. η_{hm} – – – –

Noise charts

Apart from the low levels, the much lower frequency also contributes to the substantial noise benefits of the SILENCE PLUS compared with other pump designs.

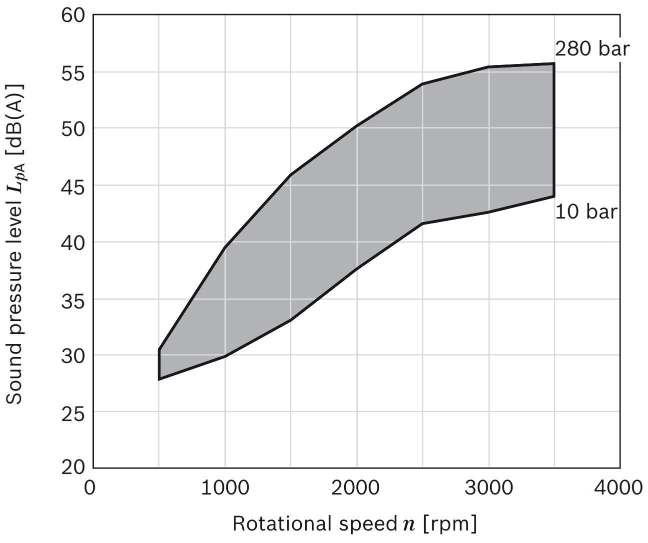
Noise levels dependent on the rotational speed, pressure range between 10 bar and pressure value p_2 (see technical data on page 9).
These are typical characteristic values for the respective size. They describe the airborne sound emitted solely by the pump.

Ambient influences (installation site, piping, other system components) were not taken into account.

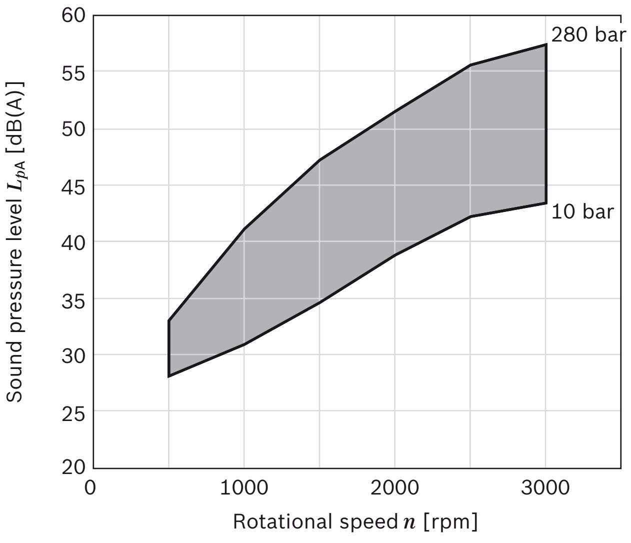
The values refer to one individual pump.

Note
Characteristic curves measured at ν = 32 mm²/s and θ = 50 °C.
Sound pressure level calculated from noise measurements made in the low reflection measuring room according to DIN 45635, Part 26.
Distance from measuring sensor to pump: 1 m.

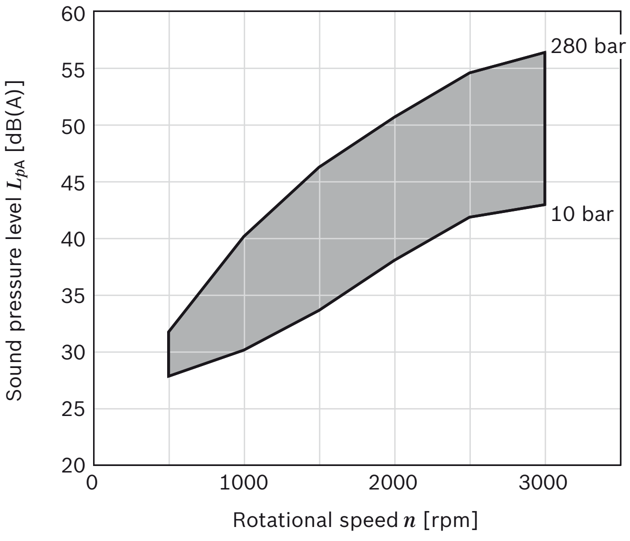
▼ **Size 12**



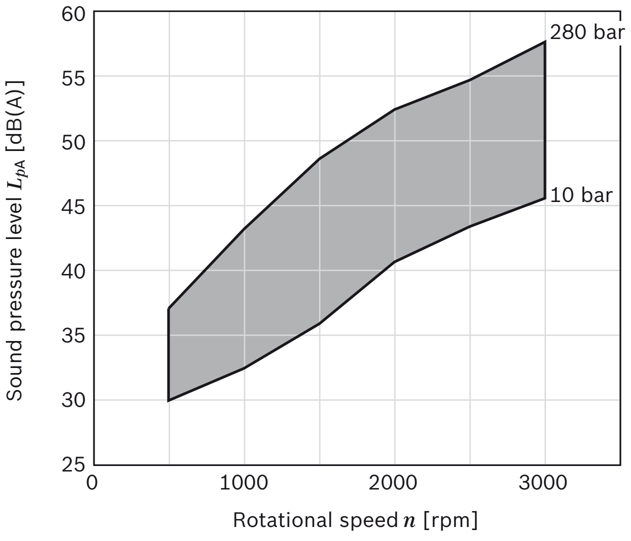
▼ **Size 16**



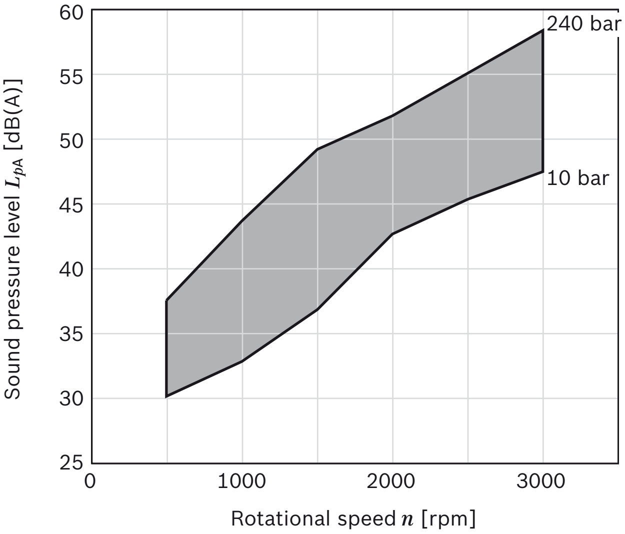
▼ **Size 14**



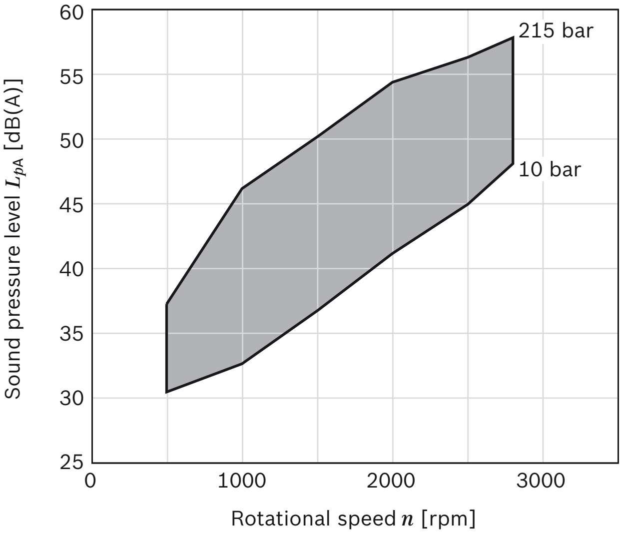
▼ **Size 19**



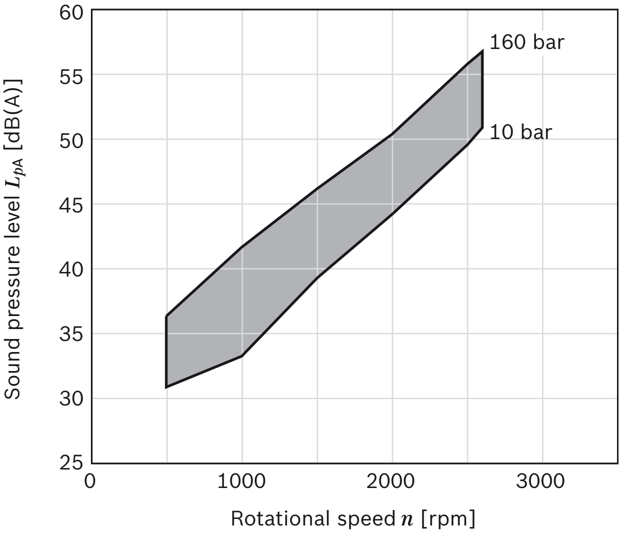
▼ Size 22



▼ Size 25



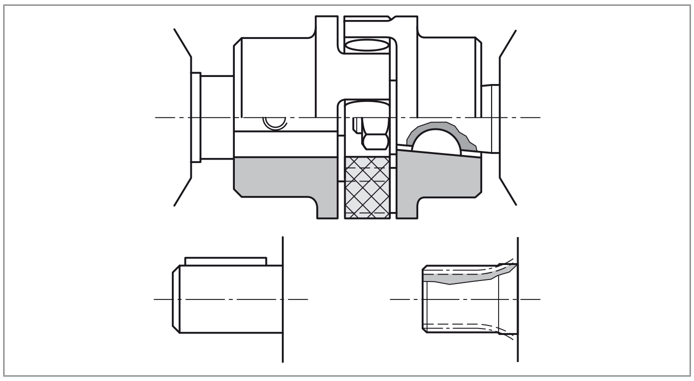
▼ Size 28



Drives

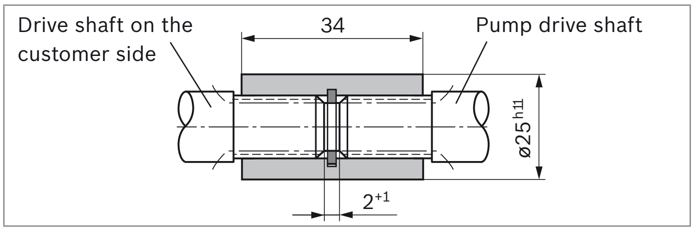
1. Elastic coupling

- ▶ The coupling must not transfer any radial or axial forces to the pump.
- ▶ The maximum radial runout from the shaft to the spigot may not exceed 0.2 mm.
- ▶ See the coupling manufacturer's assembly instructions for permissible shaft misalignments.



2. Coupling sleeve

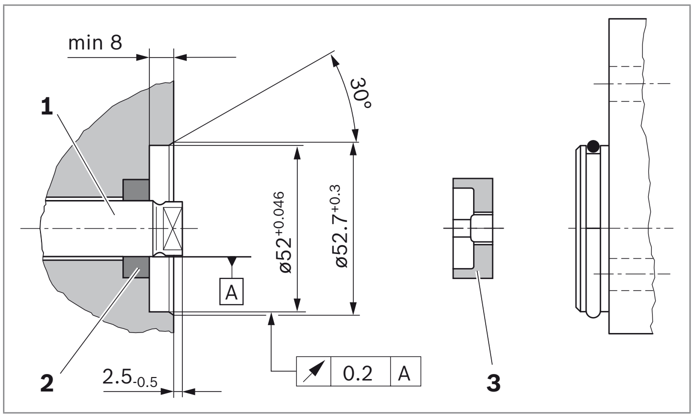
- ▶ To be used on splined shaft profile according to DIN and SAE
- ▶ Attention: No radial or axial forces are permitted on the pump shaft or coupling sleeve. The coupling sleeve must be free to move axially.
- ▶ The distance between the pump drive shaft and drive shaft on the customer side must be 2^{+1} mm
- ▶ Provide installation space for the snap ring.
- ▶ Oil-bath or oil-mist lubrication is required



Drive shaft	M_{max} [Nm]	Size	p_{max} [bar]
F	100	12 to 19	300
		22	250
		25	225
		28	180
R	110	12 to 19	300
		22	260
		25	235
		28	180
P	180	12 to 19	300
		22	260
		25	235
		28	180

3. Coupling dog

- ▶ For attaching the pump directly to an electric motor or combustion engine, gear, etc.
- ▶ The pump shaft has a special coupling dog and driver (**3**)
- ▶ There is no shaft sealing
- ▶ Drive-side installation and sealing according to the following recommendations and dimensions



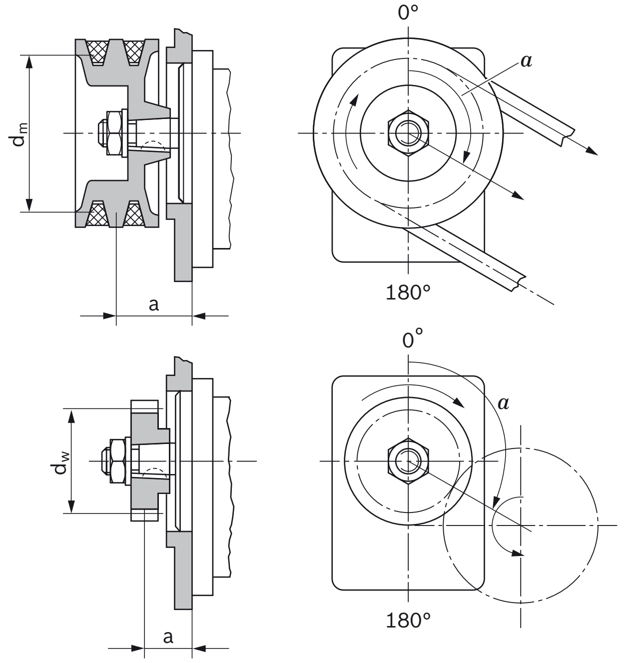
Drive shaft	M_{max} [Nm]	Size	p_{max} [bar]
N	65	12, 14	280
		16	230
	85	19	250
		22	210
		25	190
		28	170

- ▶ **Drive shaft on the customer side (1)**
  - – Case-hardening steel DIN 17210 e.g. 20 MnCrS 5 case-hardened 0.6 deep; HRC $60^{\pm3}$
  - – Seal ring running surface ground without rifling $R_{max} \leq 4\ \mu$m
  - – The maximal transmissible torque of 85 Nm applies to a claw height of 19 mm. With lower claw heights, e.g. 17 mm, the transmissible torque decreases to 65 Nm.

- ▶ **Radial shaft seals on the customer side (2)**
  - – Provide with rubber cover (see DIN 3760, type AS, or double-lipped ring)
  - – Provide installation edge with 15° slant or install shaft seal with protection sleeve

4. V-belts and straight gear wheels or helical toothed gear drives without outboard bearing

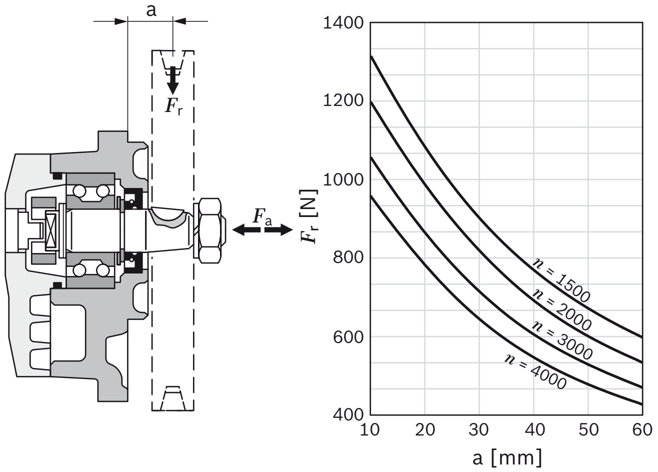
For V-belt or gear wheel drives, please contact us specifying the application and mounting conditions (dimensions a, d_m, d_w and angle α). For helical toothed gear drives, details of the helix angle β are also required.



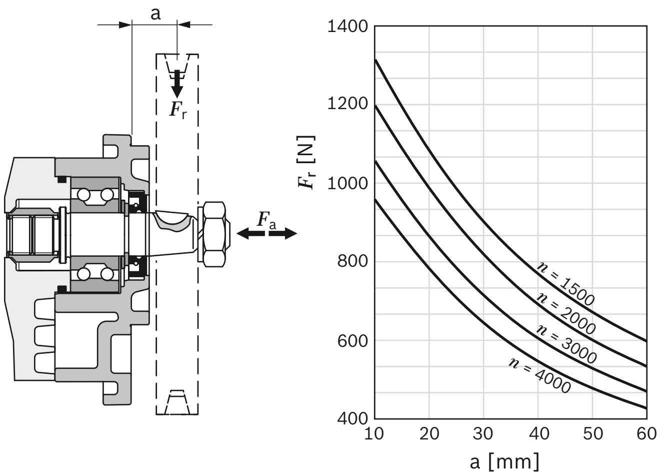
5. Outboard bearing

Outboard bearing are offered to eliminate possible problems when the pumps are driven by V-belts or gear wheels. The diagrams show the radial and axial load capacity in relation to a bearing service life of L_H = 1000 h.

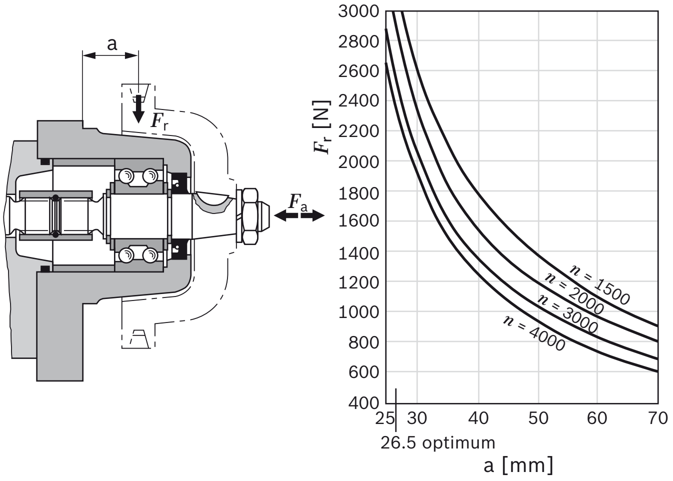
▼ Front cover A, standard (type 1 with claw)



▼ Front cover A, option (type 1 with sleeve)



▼ Front cover G (type 2)



Front cover	M_{max} [Nm]	Size	p_{max} [bar]
A with claw	65	12	300
		14	260
		16	230
		19	190
		22	160
		25	150
		28	130
A with sleeve	160	12 to 19	300
		22	260
		25	235
		28	180
G	160	12 to 19	300
		22	260
		25	235
		28	180

Multiple gear pumps

Gear pumps are well-suited to multiple arrangements, whereby the drive shaft of the first pump stage is extended to a second and possibly third pump stage. The shaft of the individual pump sections are connected via a driver.
In most cases, each pump stage is isolated from its neighbor, i.e. the suction ports are separate from one another.

Note

Basically, the parameters of the single pumps apply, however certain restrictions need to be observed:

- **Maximum rotational speed**
  This is determined by the largest pump stage used.
- **Pressures**
  These are restricted by the load capacity of the drive shaft, the through drive and the driver.
  See the dimensional drawings for the parameters.

Pressure restriction for standard through drive

In the case of series AZPJ, the driver for the second pump stage can carry a load of up to M_{max} = 65 Nm, i.e. there is a pressure restriction for the second stage and potentially additional stages.

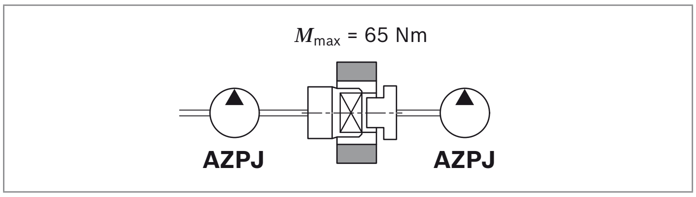
Maximum transferable drive torque

Drive shaft		Designation	M_{max} [Nm][1]
Splined shafts	**R**	SAE J744 16-4 9T	110
	P	SAE J744 19-4 11T	180
	F	DIN 5482 B17 × 14	100
Tapered shaft	**C**	1 : 5	155
	H	1 : 8	160
Parallel keyed shaft	**Q**	SAE J744 16-1 A	55
	A	Shaft Ø18	75
Claw	**N**	Dihedral claw	65 for sizes 12 and 14 85 for sizes 16 to 28

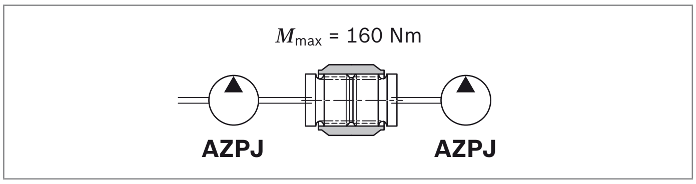
If the first stage is driven by a coupling dog (driver) or outboard bearing type 1, pressure restrictions apply as indicated in the formula.

Reinforced through drives are available for applications with higher transfer torques or torsional vibrations. Design available on request.

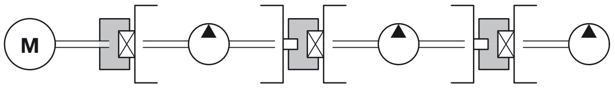
▼ **Standard through drive**



▼ **Reinforced through drive**



▼ **Formula**



$$M_{\text{max}} \geq \Delta p_1 \times V_{g1} \times 0.0177 + \Delta p_2 \times V_{g2} \times 0.0177 + \Delta p_3 \times V_{g3} \times 0.0177$$

Δp [bar], V_g [cm^3/rpm]

Combinations (coupling dog)

Pump stage 1	M_{max} [Nm]	Pump stage 2
AZPJ	65	AZPJ
AZPJ	65	AZPF
AZPF	65	AZPJ
AZPJ	25	AZPB-2x

For the configuration of multiple pumps, Bosch Rexroth recommends arranging the pump stage with the largest displacement on the drive side.

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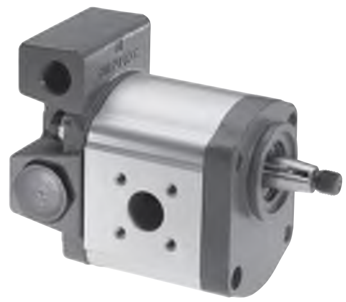
[1] These values only apply while adhering to the defined conditions on page 8. Please consult Bosch Rexroth if the specified values are to be exceeded.

Gear pumps with integrated valves

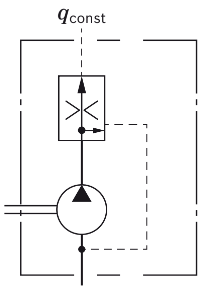
In order to reduce piping complexity, a flow control valve or pressure-relief valve can be integrated in the cover of the gear pump. Such solutions are used, for instance, for the hydraulic oil supply of power steering systems. The pump delivers a constant flow irrespective of the rotational speed. The residual flow is either returned internally to the suction port or distributed externally to other consumers.



Valves

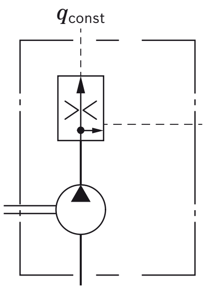
▼ **3-way flow control valve, residual flow returned in suction line**
q_{const} = 2 to 30 l/min

SXXX17 (example)



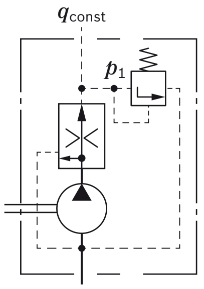
▼ **3-way flow control valve, residual flow distributed externally; loadable**
q_{const} = 2 to 30 l/min

EXXX12 (example)



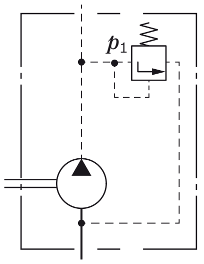
▼ **3-way flow control valve with pressure relief valve, residual flow returned in suction line**
q_{const} = 2 to 30 l/min
p_1 = 100 to 180 bar

V15011 (example)



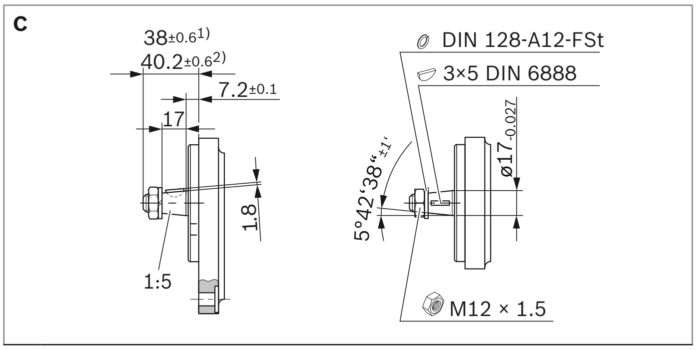
▼ **Pressure relief valve, pressure guide in suction line**
p_1 = 5 to 250 bar

D180XX (example)

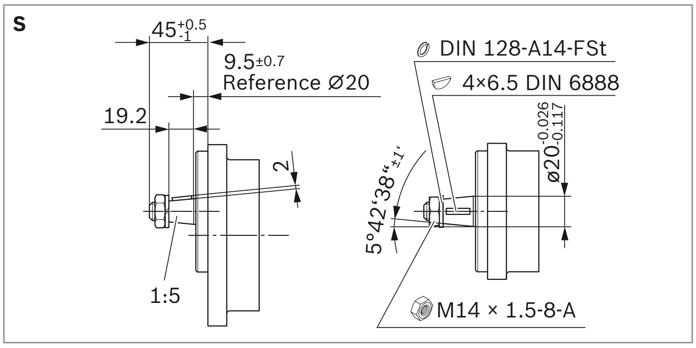


Dimensions – drive shafts

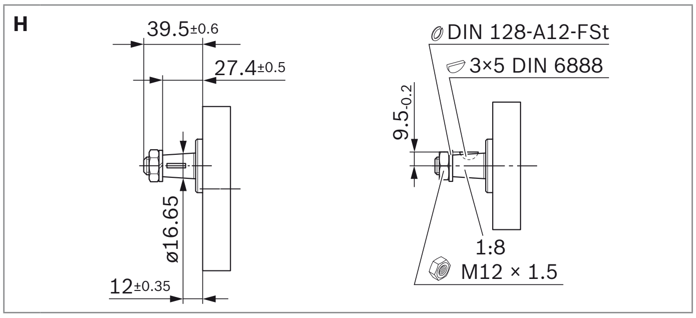
▼ Tapered shaft 1 : 5



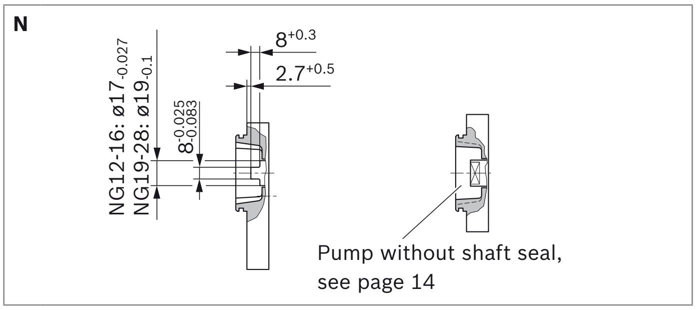
▼ Tapered shaft 1 : 5 (for front cover A, G)



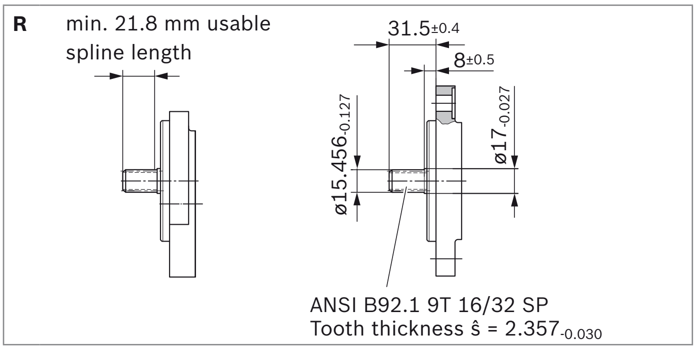
▼ Tapered shaft 1 : 8



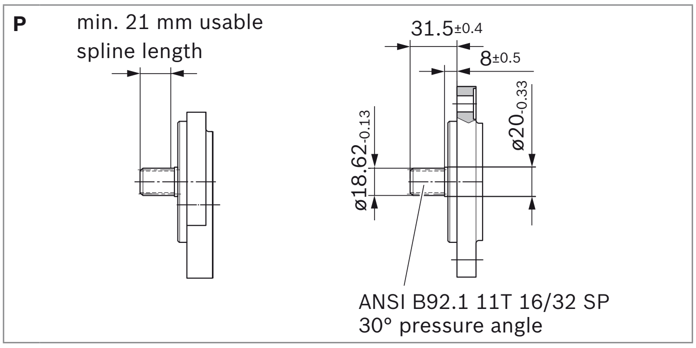
▼ Dihedral claw



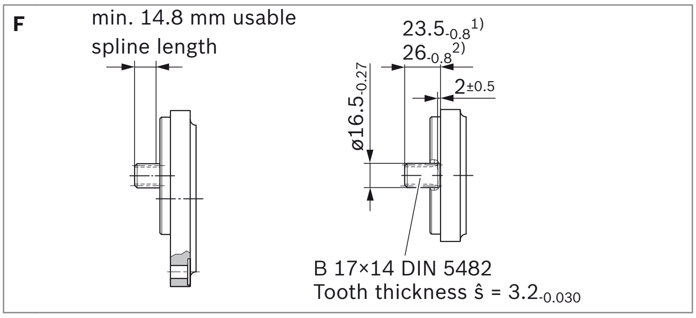
▼ Splined shaft (SAE J744 16-4 9T)



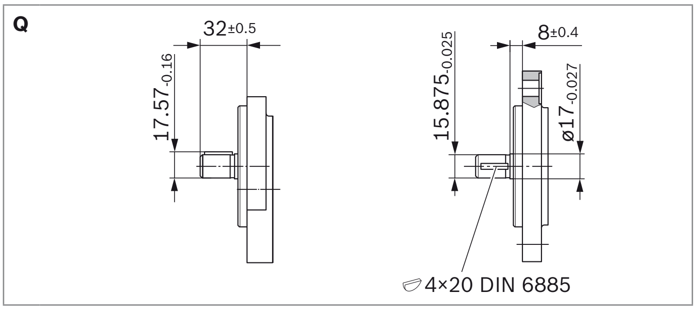
▼ Splined shaft (SAE J744 19-4 11T)



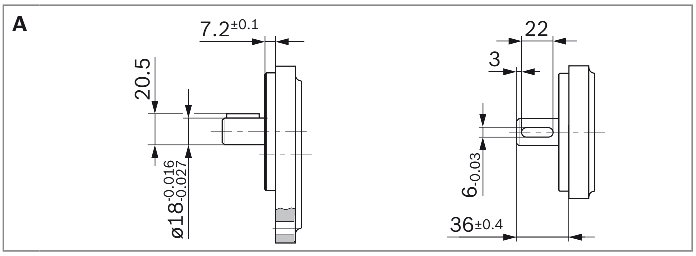
▼ Splined shaft / (DIN 5582 B17 × 14)



▼ Parallel keyed shaft (SAE J744 16-1 A)



▼ Parallel keyed shaft (ISO Ø18 mm)



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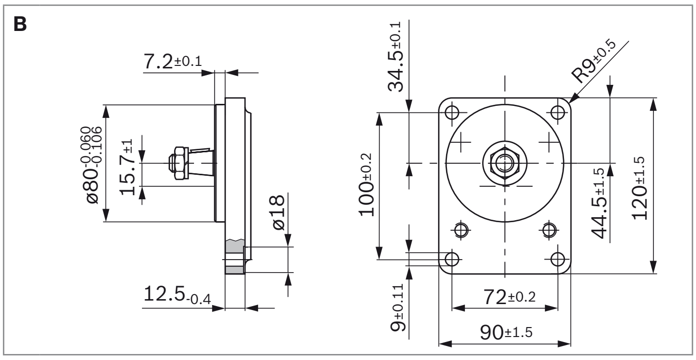
1) In combination with front cover B

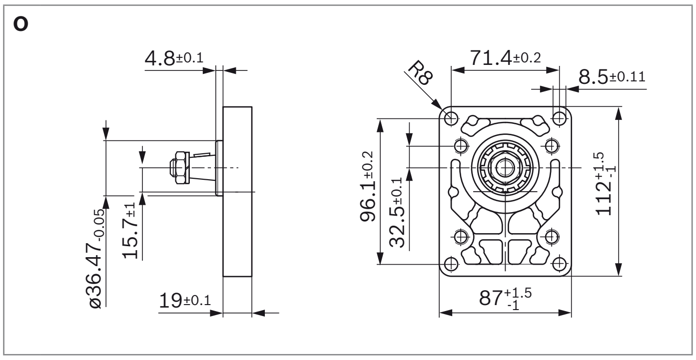
2) In combination with front cover P

Dimensions – front cover

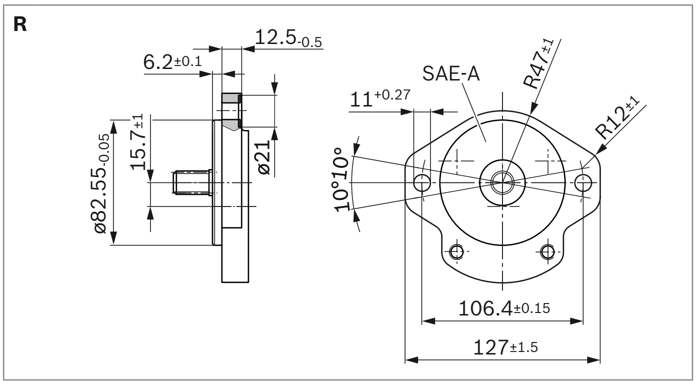
▼ Rectangular flange Ø80 mm



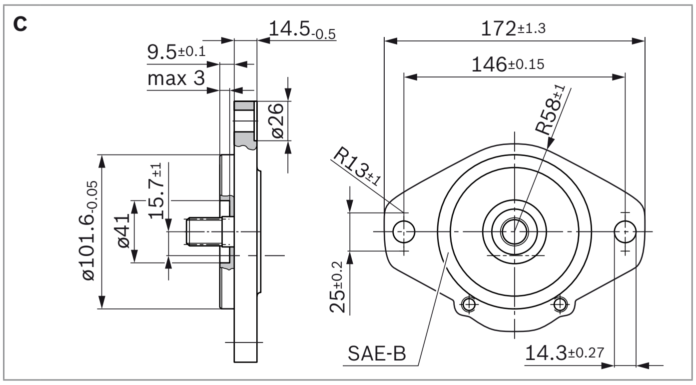
▼ Rectangular flange Ø36.47 mm



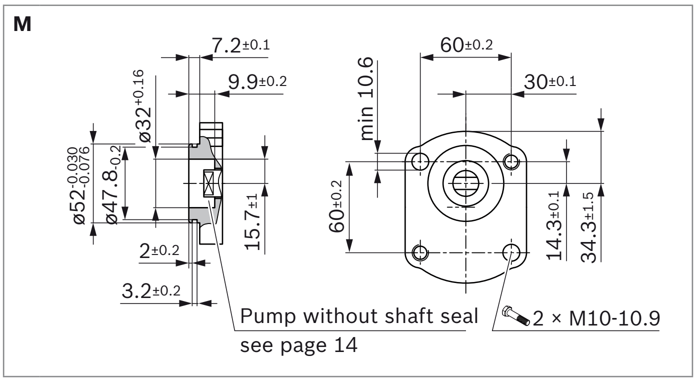
▼ 2-bolt flange Ø82.55 mm, SAE J744 82-2 A



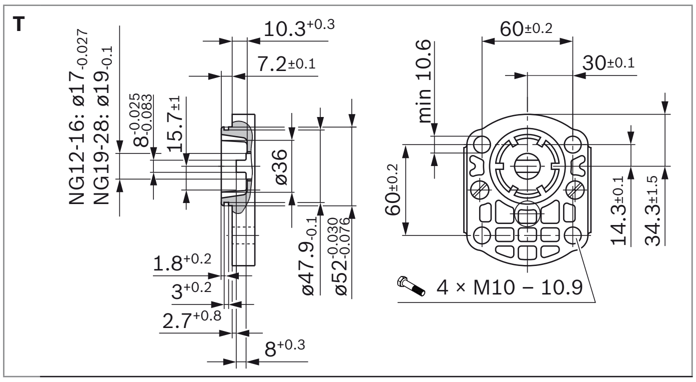
▼ 2-bolt flange Ø101.6 mm, SAE J744 101-2 B



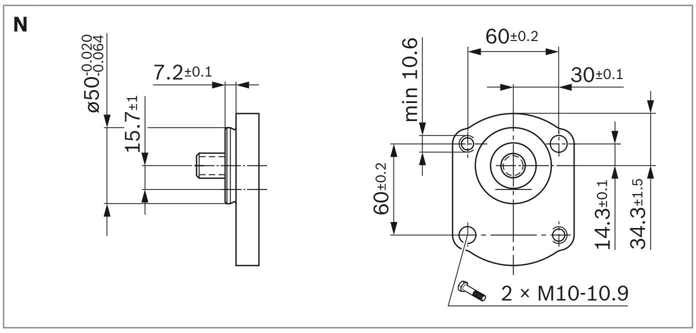
▼ 2-bolt mounting Ø52 mm with O-ring



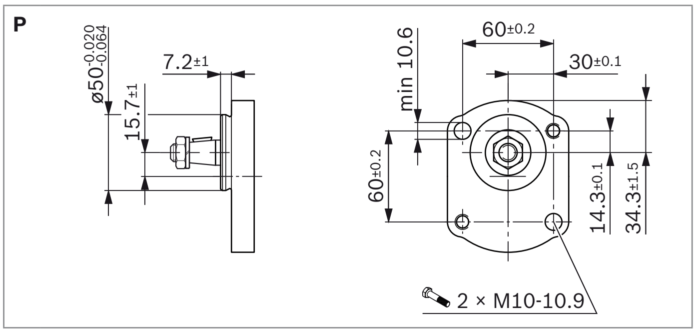
▼ 4-bolt mounting Ø52 mm with O-ring



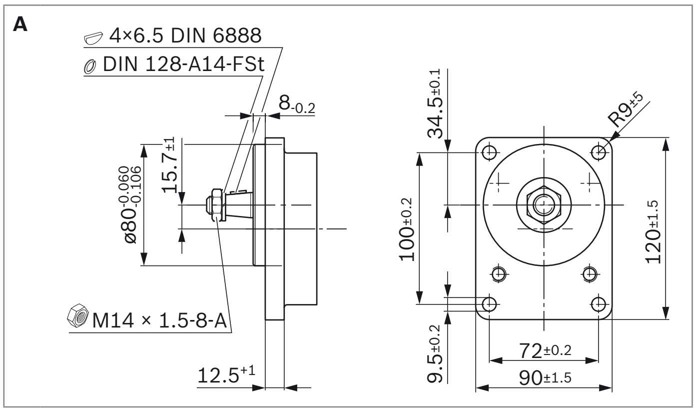
▼ 2-bolt mounting Ø50 mm, connection variant 1



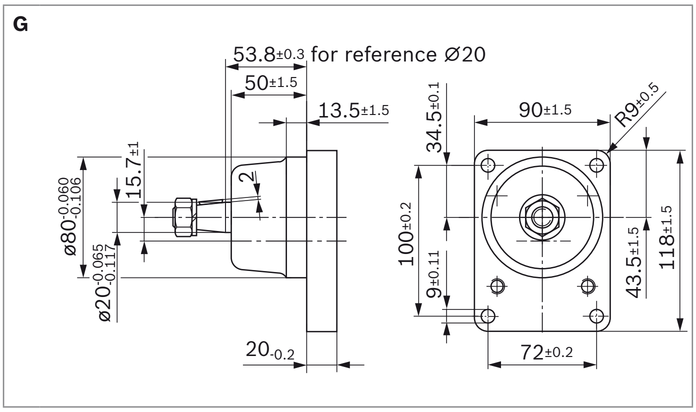
▼ 2-bolt mounting Ø50 mm, connection variant 2



▼ Outboard bearing Ø80 mm, type 1

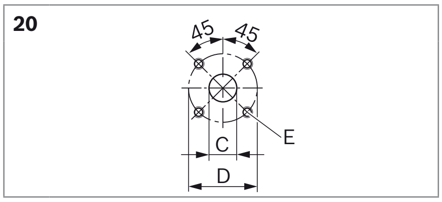


▼ Outboard bearing Ø80 mm, type 2

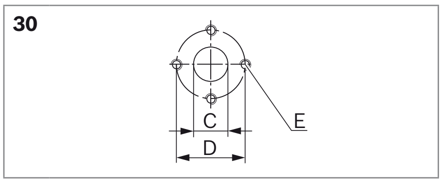


Dimensions – line ports

▼ Square flange



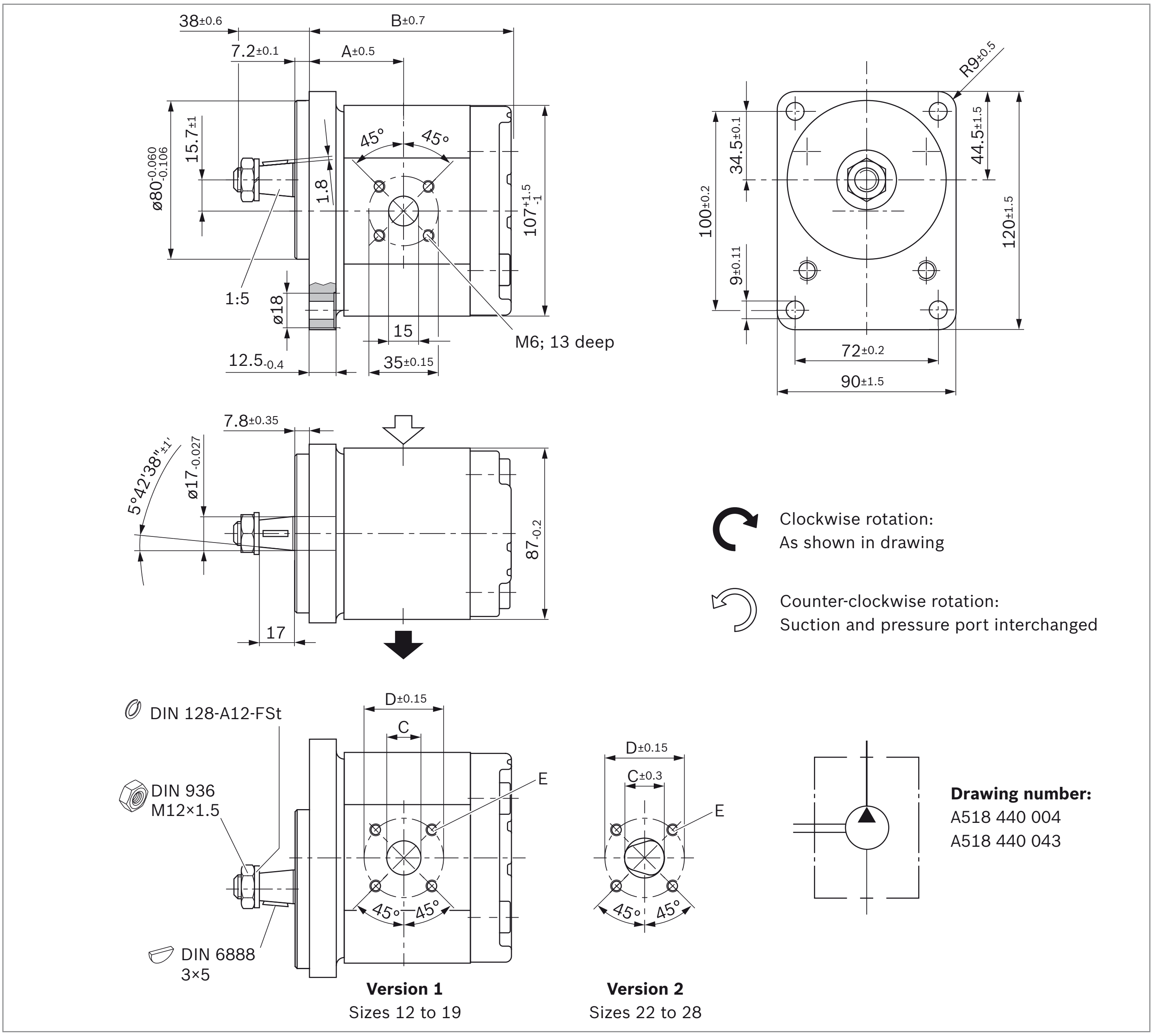
Size	Pressure side			Suction side		
	C	D	E	C	D	E
12 to 16	15	35	M6; 13 deep	20	40	M6; 13 deep
19	15	35	M6; 13 deep	22	55	M8; 13 deep
22 to 28	15	35	M6; 13 deep	26	55	M8; 13 deep



Size	Pressure side			Suction side		
	C	D	E	C	D	E
12 to 16	13.5	30.2	M6; 13 deep	20	39.7	M8; 13 deep

Dimensions – preferred series

▼ **Tapered shaft 1:5 with rectangular flange Ø80 mm**
AZPJ–22– ... **CB20**MB



Clockwise rotation:
As shown in drawing

Counter-clockwise rotation:
Suction and pressure port interchanged

Version 1
Sizes 12 to 19

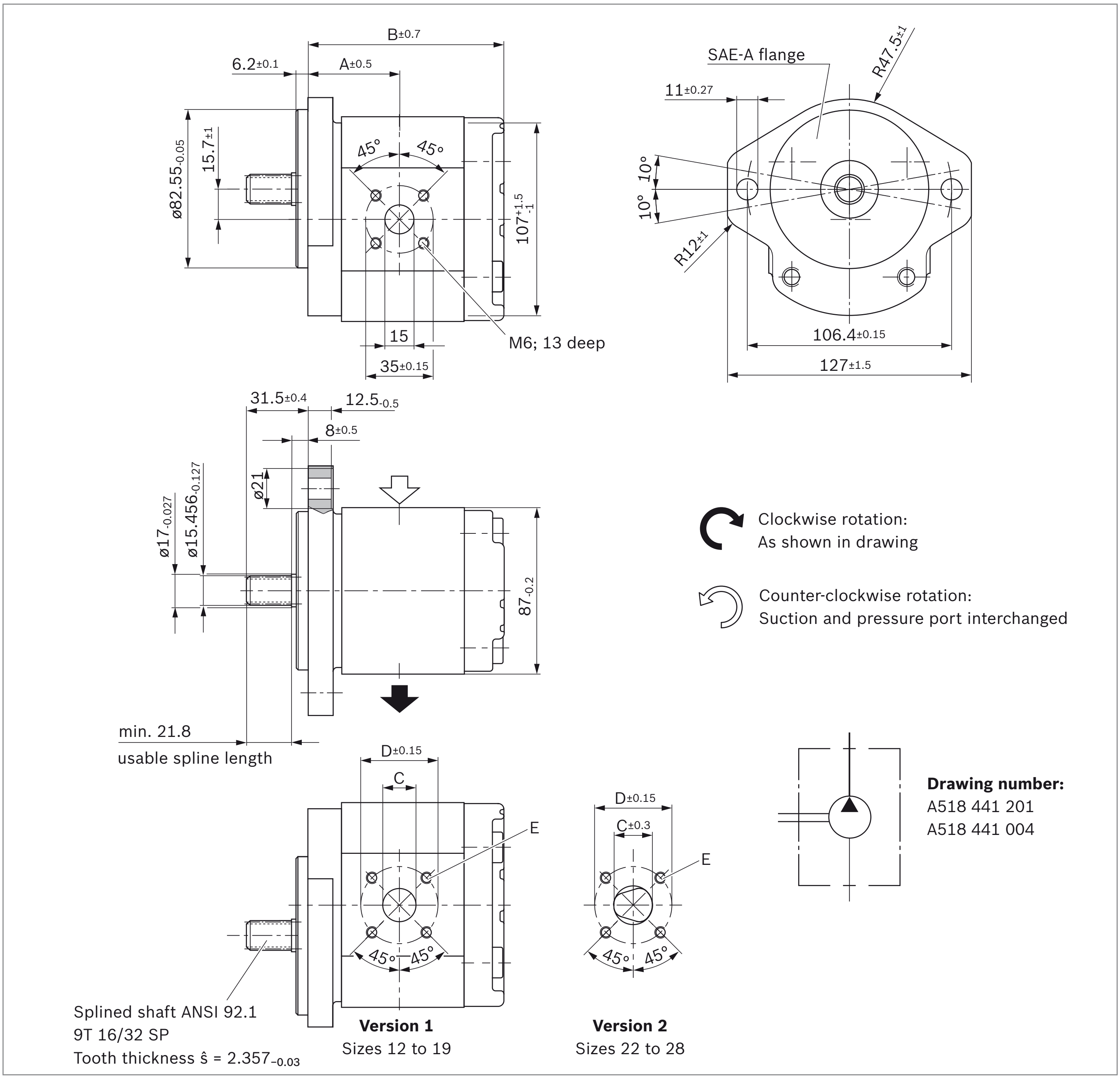
Version 2
Sizes 22 to 28

Drawing number:
A518 440 004
A518 440 043

Size	Order number Direction of rotation Counter-clockwise	Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Weight [kg]	Dimensions [mm]				
						A	B	C	D	E
12	0 518 525 302	0 518 525 001	280	3500	3.9	46.5	96.3	20	40	M6; 13 deep
14	0 518 525 303	0 518 525 002	280	3000	4.0	47.5	99.5	20	40	
16	0 518 625 301	0 518 625 001	280	3000	4.1	47.5	102.9	20	40	
19	0 518 625 309	0 518 625 010	280	3000	4.5	57.9	107.9	22	55	M8; 13 deep
22	0 518 725 310	0 518 725 011	240	3000	4.6	60.6	113.3	26	55	
25	0 518 725 311	0 518 725 012	215	2800	4.8	64.8	117.5	26	55	
28	0 518 725 312	0 518 725 013	160	2600	4.9	69.6	122.3	26	55	

▼ Splined shaft (SAE J744 16-4 9T) with 2-bolt flange Ø82.55 mm

AZPJ – 22 – ... **RR**20MB



Clockwise rotation:
As shown in drawing

Counter-clockwise rotation:
Suction and pressure port interchanged

Drawing number:
A518 441 201
A518 441 004

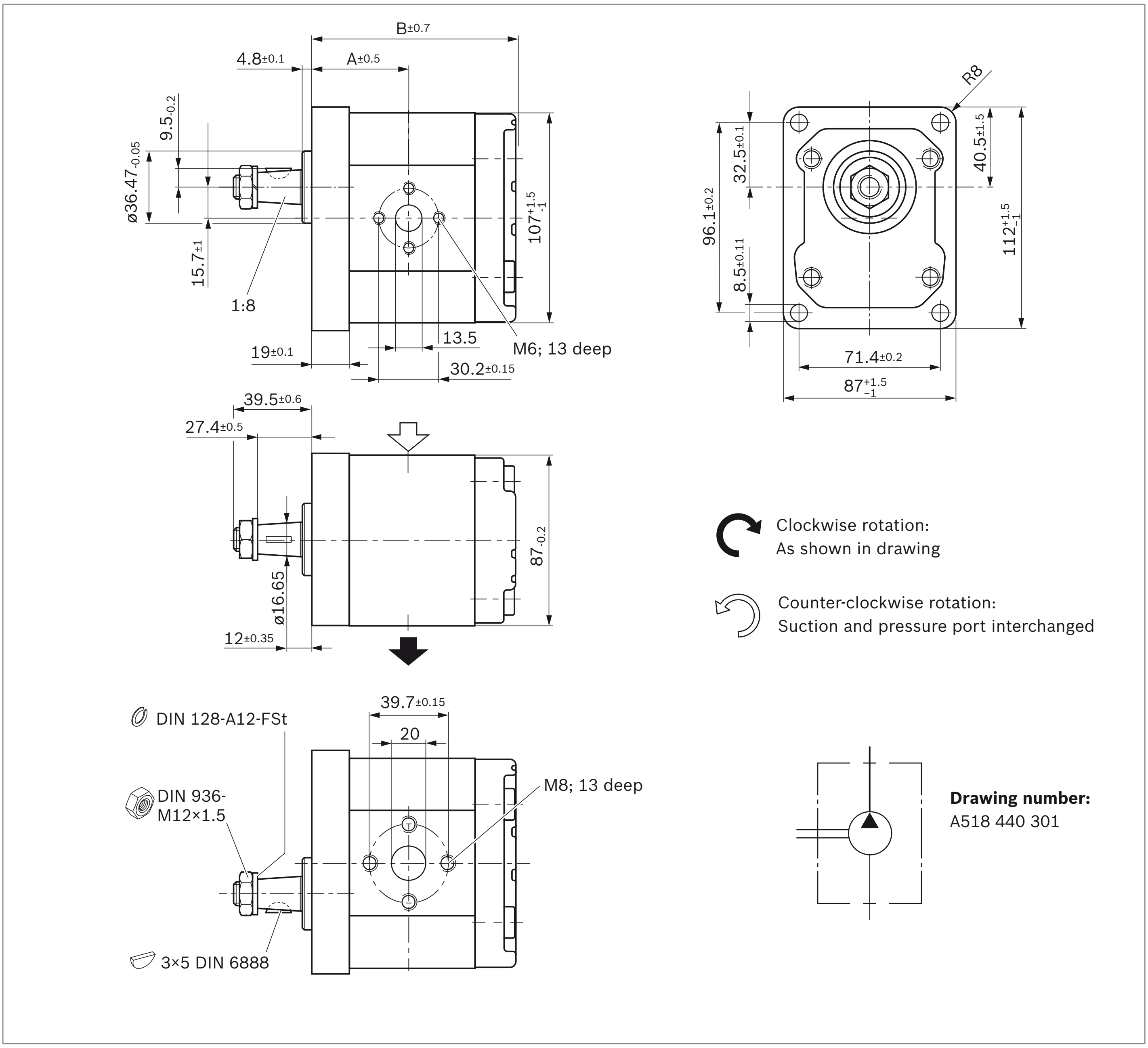
Version 1
Sizes 12 to 19

Version 2
Sizes 22 to 28

Size	Order number Direction of rotation Counter-clockwise	 Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Weight [kg]	Dimensions [mm] A	 B	 C	 D	 E
12	0 518 525 306	0 518 525 005	280	3500	3.8	46.5	96.3	20	40	M6; 13 deep
14	0 518 525 307	0 518 525 006	280	3000	3.9	47.5	99.5	20	40	
16	0 518 625 303	0 518 625 003	280	3000	4.0	47.5	102.9	20	40	
19	0 518 625 306	0 518 625 007	280	3000	4.4	57.9	107.9	22	55	M8; 13 deep
22	0 518 725 301	0 518 725 002	240	3000	4.6	60.6	113.3	26	55	
25	0 518 725 302	0 518 725 003	215	2800	4.7	64.8	117.5	26	55	
28	0 518 725 303	0 518 725 004	160	2600	4.8	69.6	122.3	26	55	

▼ Tapered shaft 1:8 with rectangular flange Ø36.47 mm

AZPJ – 22 – ... **HO**30MB



Clockwise rotation:
As shown in drawing

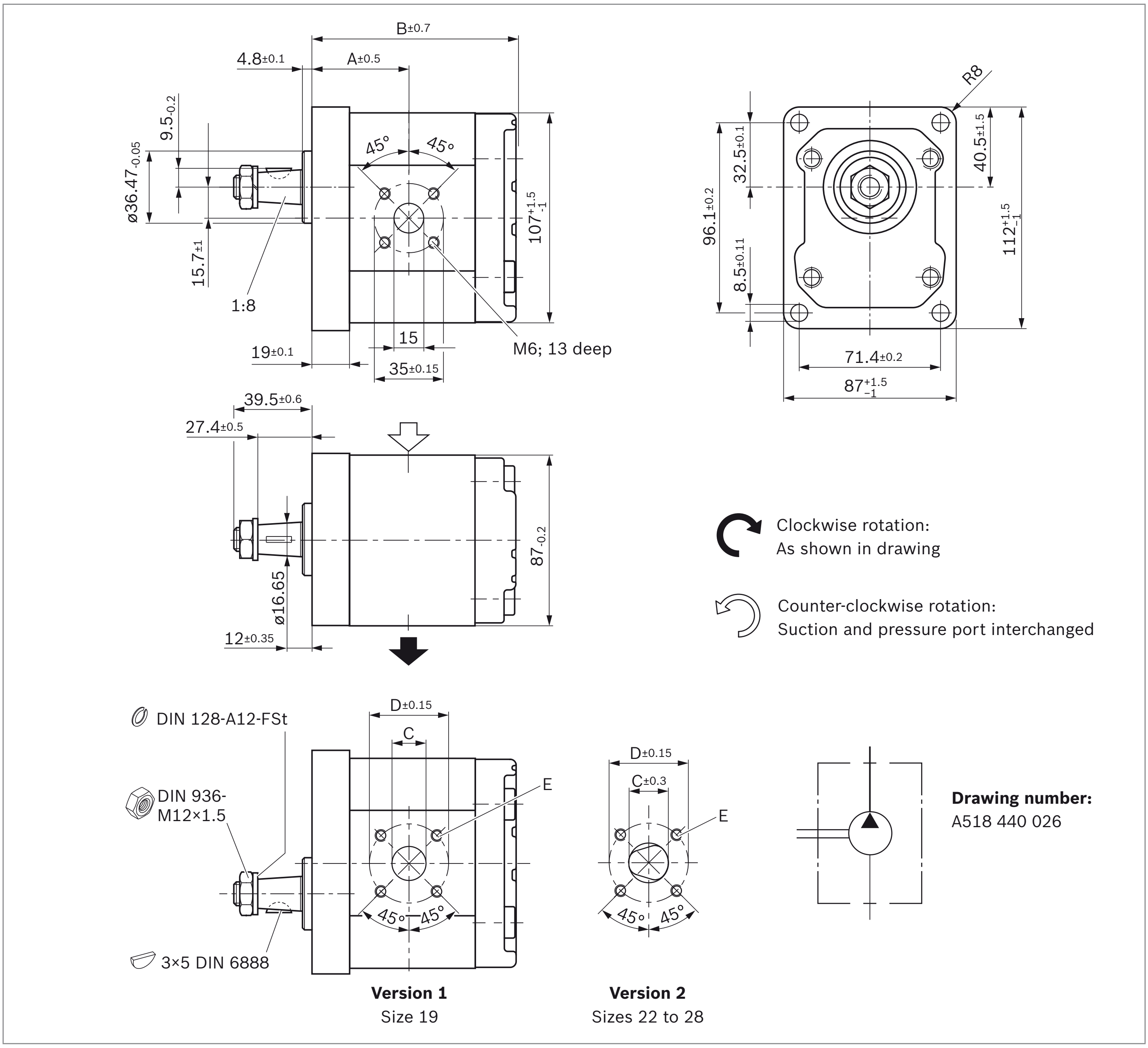
Counter-clockwise rotation:
Suction and pressure port interchanged

Drawing number:
A518 440 301

Size	Order number Direction of rotation Counter-clockwise	Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Weight [kg]	Dimensions [mm] A	B
12	0 518 525 308	0 518 525 007	280	3500	3.7	48.0	97.8
14	0 518 525 309	0 518 525 008	280	3000	2.8	49.0	101.0
16	0 518 625 304	0 518 625 004	280	3000	3.9	49.0	104.4

▼ Tapered shaft 1:8 with rectangular flange Ø36.47 mm

AZPJ – 22 – ... **HO**20MB



Clockwise rotation:
As shown in drawing

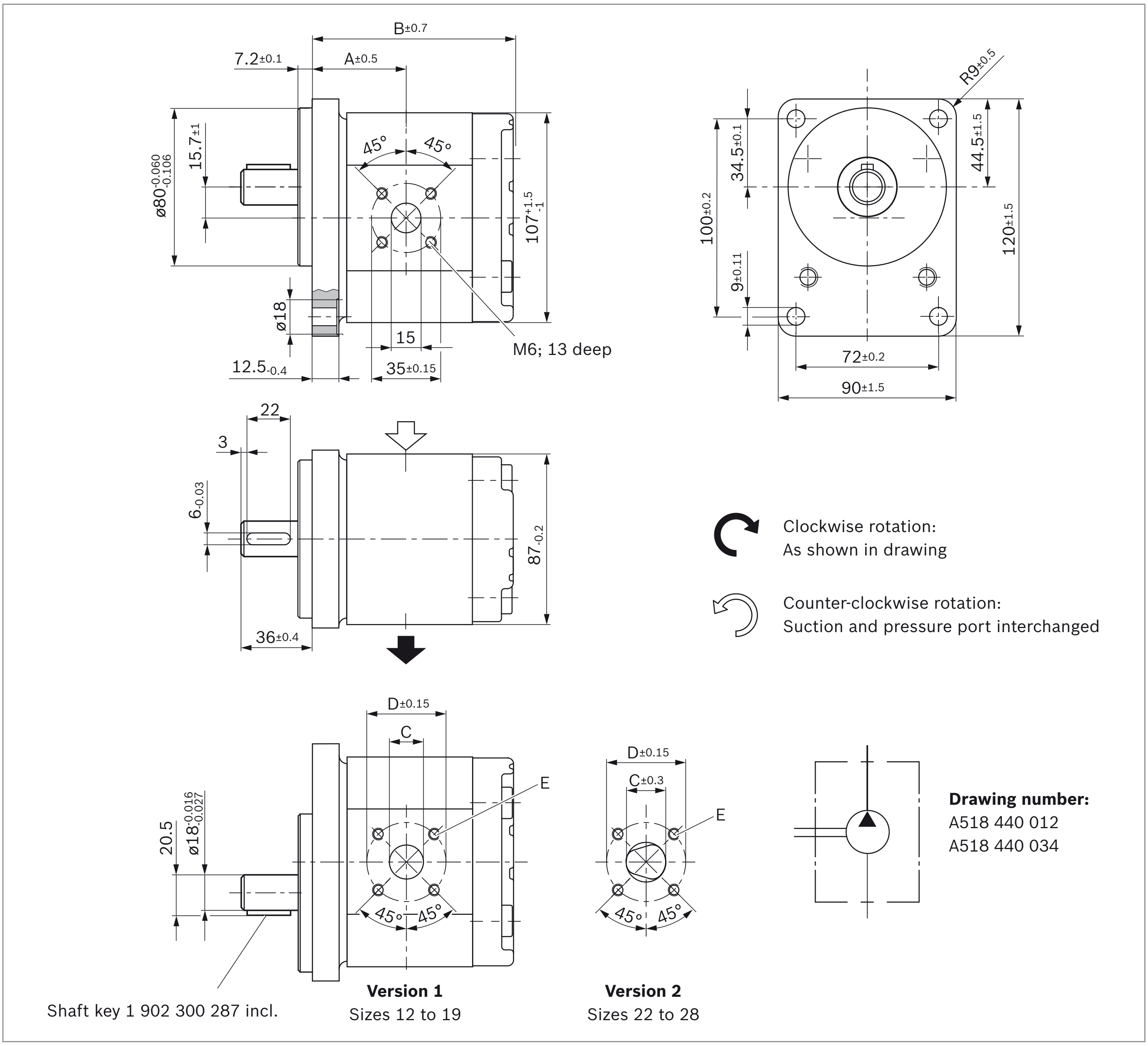
Counter-clockwise rotation:
Suction and pressure port interchanged

Drawing number:
A518 440 026

Size	Order number Direction of rotation Counter-clockwise	 Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Weight [kg]	Dimensions [mm] A	 B	 C	 D	 E
19	0 518 625 307	0 518 625 008	280	3000	4.5	59.4	109.4	22	55	M8; 13 deep
22	0 518 725 304	0 518 725 005	240	3000	4.6	62.1	114.8	26	55	
25	0 518 725 305	0 518 725 006	215	2800	4.8	66.3	119.0	26	55	
28	0 518 725 306	0 518 725 007	160	2600	4.9	71.1	123.8	26	55	

▼ Cylindrical shaft (ISO Ø18) with rectangular flange Ø80 mm

AZPJ – 22 – ... **AB**20MB



Clockwise rotation:
As shown in drawing

Counter-clockwise rotation:
Suction and pressure port interchanged

Drawing number:
A518 440 012
A518 440 034

Shaft key 1 902 300 287 incl.

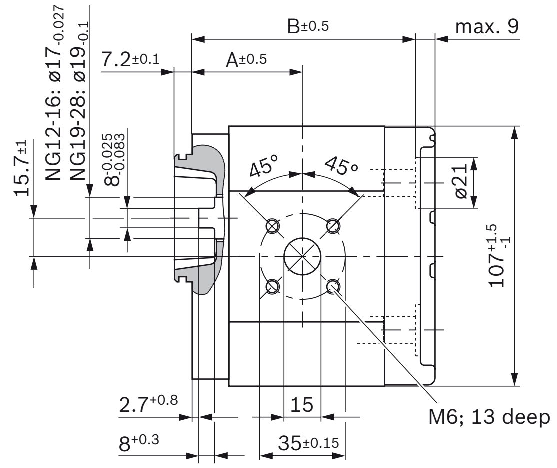
Version 1
Sizes 12 to 19

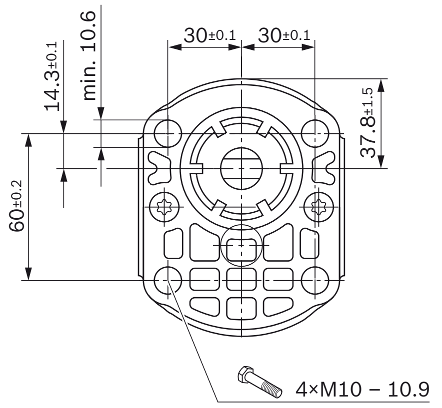
Version 2
Sizes 22 to 28

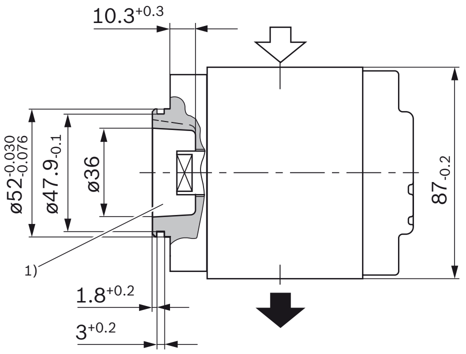
Size	Order number Direction of rotation Counter-clockwise	Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Weight [kg]	Dimensions [mm] A	B	C	D	E
12	0 518 525 304	0 518 525 003	280	3500	3.9	46.5	96.3	20	40	M6; 13 deep
14	0 518 525 305	0 518 525 004	280	3000	4.0	47.5	99.5	20	40	
16	0 518 625 302	0 518 625 002	270	3000	4.1	47.5	102.9	20	40	
19	0 518 625 308	0 518 625 009	230	3000	4.5	57.9	107.9	22	55	M8; 13 deep
22	0 518 725 307	0 518 725 008	190	3000	4.6	60.6	113.3	26	55	
25	0 518 725 308	0 518 725 009	170	2800	4.8	64.8	117.5	26	55	
28	0 518 725 309	0 518 725 010	150	2600	4.9	69.6	122.3	26	55	

▼ Dihedral claw with 4-bolt mounting Ø82.55 mm

AZPJ – 22 – ... **NT**20MB





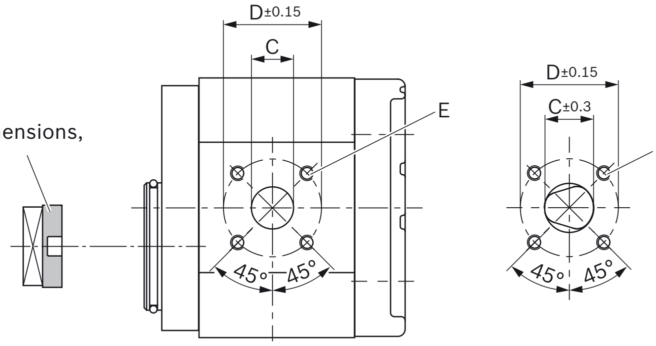


↻ Clockwise rotation:
As shown in drawing

↺ Counter-clockwise rotation:
Suction and pressure port interchanged

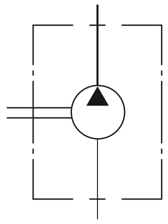
1) Pump without seal
provide with shaft seal according to Y 518 400 019

For driver dimensions, see page 29



Version 1
Sizes 12 to 19

Version 2
Sizes 22 to 28



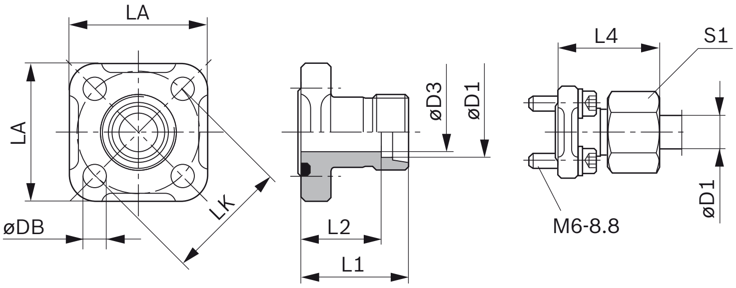
Drawing number:
A518 432 025
A518 432 001

Size	Order number Direction of rotation Counter-clockwise	 Clockwise	Maximum intermittent pressure p_2 [bar]	Maximum rotational speed [rpm]	Weight [kg]	Dimensions [mm] A	 B	 C	 D	 E
12	0 518 515 301	0 518 515 001	280	3500	2.5	44.0	87.1	20	40	M6; 13 deep
14	0 518 515 302	0 518 515 002	280	3000	2.6	45.0	90.3	20	40	
16	0 518 615 301	0 518 615 001	280	3000	2.7	45.0	93.7	20	40	
19	0 518 615 303	0 518 615 003	250	3000	3.0	55.4	98.7	22	55	M8; 13 deep
22	0 518 715 301	0 518 715 001	215	3000	3.2	58.1	104.1	26	55	
25	0 518 715 302	0 518 715 002	190	2800	3.3	62.3	108.3	26	55	
28	0 518 715 303	0 518 715 003	160	2600	3.4	67.1	113.1	26	55	

Accessories

Gear pump flanges, straight, for square flange 20 (see page 20)

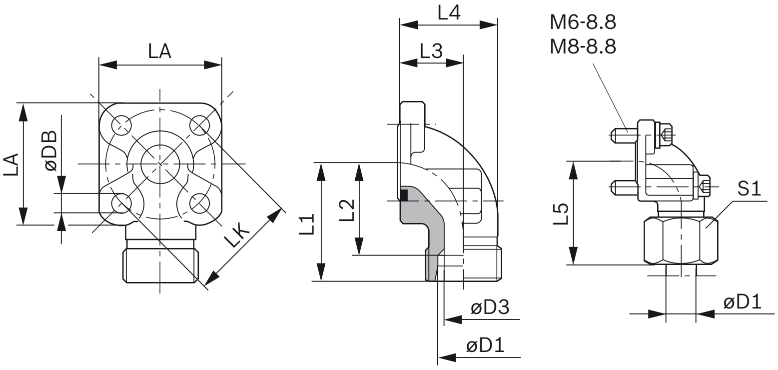
Complete screw connections with O-ring, metric screw set, nuts and olive.



LK	D1	D3	L1	L2	L4	LA	S1	DB	Screws 4x	O-ring NBR	Weight [kg]	Order number	*p* [bar]
35	10L	8	30	23.0	39.0	40	19	6.4	M6 × 22	20 × 2.5	0.09	1 515 702 064	315
35	12L	10	30	23.0	39.0	40	22	6.4	M6 × 22	20 × 2.5	0.10	1 515 702 065	315
35	15L	12	30	23.0	38.0	40	27	6.4	M6 × 22	20 × 2.5	0.10	1 515 702 066	250
40	15L	12	35	28.0	43.0	42	27	6.4	M6 × 22	24 × 2.5	0.12	1 515 702 067	100
40	18L	15	35	27.5	44.0	42	32	6.4	M6 × 22	24 × 2.5	0.13	1 515 702 068	100
40	22L	19	35	27.5	44.5	42	36	6.4	M6 × 22	24 × 2.5	0.12	1 515 702 069	100
40	28L	24	42	27.5	34.5	42	41	6.4	M6 × 22	24 × 2.5	0.15	1 515 702 008	100

Gear pump flanges, 90° angle, for square flange 20 (see page 20)

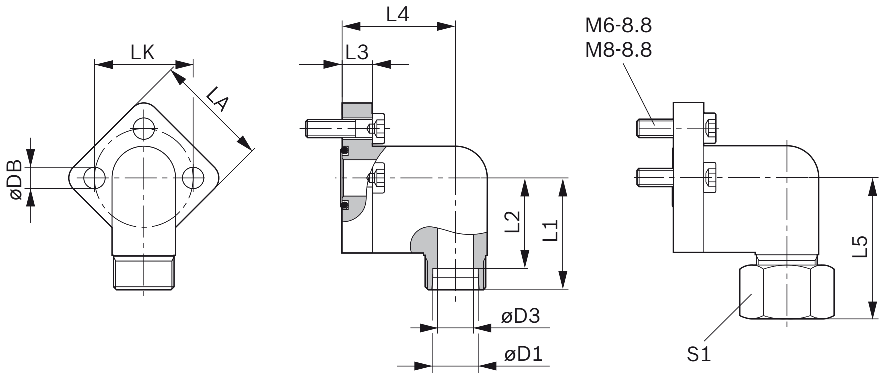
Complete screw connections with O-ring, metric screw set, nuts and olive.



LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws 2x	2x	O-ring NBR	Weight [kg]	Order number	*p* [bar]
35	10L	8	38	31.0	16.5	26.5	47.0	40	19	6.4	M6 × 22	M6 × 35	20 × 2.5	0.16	1 515 702 070	315
35	12L	10	38	31.0	16.5	26.5	47.0	40	22	6.4	M6 × 22	M6 × 35	20 × 2.5	0.16	1 515 702 071	315
35	15L	12	38	31.0	16.5	26.5	46.0	40	27	6.4	M6 × 22	M6 × 35	20 × 2.5	0.15	1 515 702 072	250
35	16S	12	38	29.5	20.0	31.0	48.0	40	30	6.4	M6 × 22	M6 × 40	20 × 2.5	0.18	1 515 702 002	315
35	18L	15	38	29.5	20.0	31.0	47.0	40	32	6.4	M6 × 22	M6 × 40	20 × 2.5	0.18	1 545 702 006	250
35	20S	16	45	34.5	25.0	38.0	56.0	40	36	6.4	M6 × 22	M6 × 45	20 × 2.5	0.24	1 515 702 017	315
40	15L	12	38	31.0	22.5	36.5	46.0	42	27	6.4	M6 × 22	M6 × 22	24 × 2.5	0.15	1 515 702 073	100
40	18L	15	38	30.5	22.5	36.5	47.0	42	32	6.4	M6 × 22	M6 × 22	24 × 2.5	0.17	1 515 702 074	100
40	20S	16	40	29.5	22.5	35.5	50.0	42	36	6.4	M6 × 22	M6 × 45	24 × 2.5	0.20	1 515 702 011	250
40	22L	19	38	30.5	22.5	36.5	47.5	42	36	6.4	M6 × 22	M6 × 22	24 × 2.5	0.17	1 515 702 075	100
40	28L	22	40	32.5	28.0	43.0	49.0	42	41	6.4	M6 × 20	M6 × 50	24 × 2.5	0.24	1 515 702 010	100
40	35L	31	41	30.5	34.0	55.0	52.0	42	50	6.4	M6 × 22	M6 × 60	24 × 2.5	0.33	1 515 702 018	100

Gear pump flange, 3-hole, 90° angle, for square flange 30 (see page 20)

Complete screw connections with O-ring, metric screw set, nuts and olive.



LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws 3x	O-ring NBR	Weight [kg]	Order number	*p* [bar]
30	12L	10	37	30.0	10	37.5	46	38	22	6.4	M 6 × 22	16 × 2.5	0.13	1 515 702 146	250
30	15L	12	37	30.0	10	37.5	47	38	27	6.4	M 6 × 22	16 × 2.5	0.14	1 515 702 147	250
30	18L	15	37	30.0	10	37.5	47	38	32	6.4	M 6 × 22	16 × 2.5	0.17	1 515 702 148	160
40	22L	19	43	35.5	14	41.0	53	48	36	8.4	M 8 × 30	24 × 2.5	0.29	1 515 702 149	160
40	28L	24	43	35.5	14	41.0	53	48	41	8.4	M 8 × 30	24 × 2.5	0.40	1 515 702 150	160

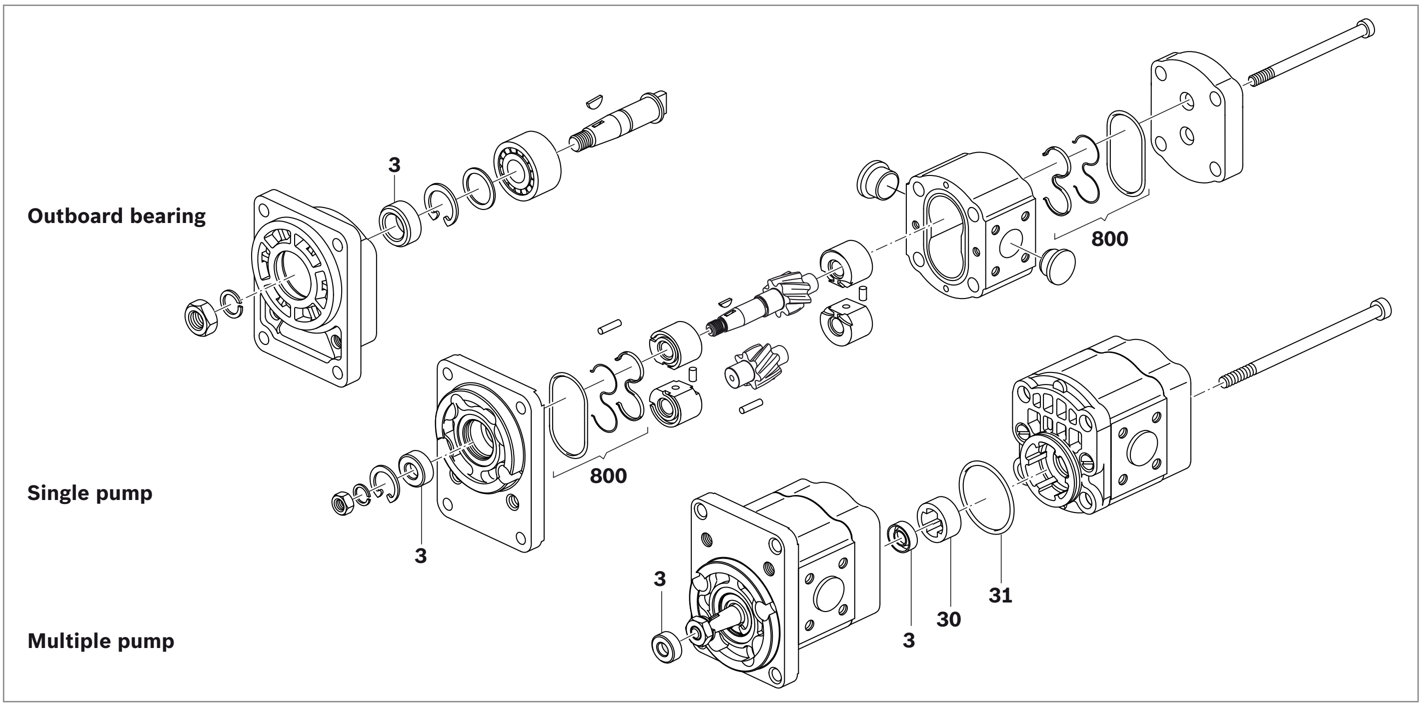
Note

You can find the permissible tightening torques in our publication 07012-B1 “General Operating Instructions for External Gear Units”.

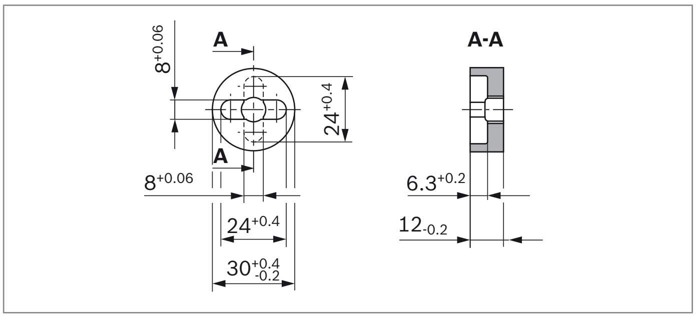
Spare parts

Pos.	Designation	Order number	Dimensions	Material	AZPJ–22 – ... CB...	AZPJ–22 – ... RR...	AZPJ–22 – ... HO...	AZPJ–22 – ... AB...	AZPJ–22 – ... NT...
3	Shaft seal	1 510 283 008	17 × 30 × 7	NBR	x	x	–	–	–
		1 510 283 027	17 × 30 × 7	FKM	x	x	–	–	–
		1 510 283 037	18 × 30 × 7	NBR	–	–	x	x	–
		1 510 283 077	18 × 30 × 7	FKM	–	–	x	x	–
30	Driver for sizes 12 to 16	1 510 240 011			–	–	–	–	x
	Driver for sizes 19 to 28	1 510 240 013			–	–	–	–	x
31	O-ring	1 900 210 145	45 × 2.5	NBR	–	–	–	–	x
		1 510 210 062	45 × 2.5	FKM	–	–	–	–	x
800	Seal kit	1 517 010 247		NBR	x	x	x	x	x
		1 517 010 269		FKM	x	x	x	x	x

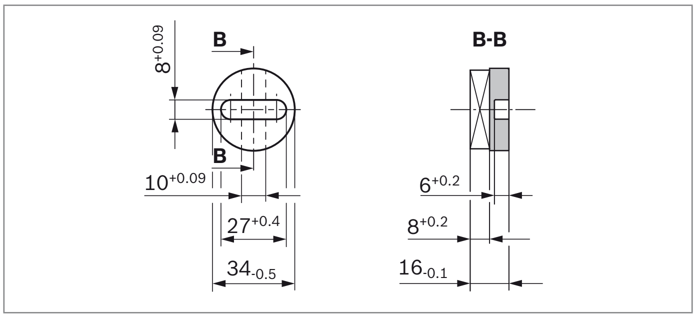
▼ **Schematic diagram**



▼ **Driver (Pos. 30) for sizes 12 to 16**



▼ **Driver (Pos. 30) for sizes 19 to 28**



Notes for commissioning

General

Pumps delivered by Bosch Rexroth are tested for function and performance. No changes of any nature may be made, otherwise the warranty is rendered void.
The pump may only be operated with the permissible data (see page 8).

Technical data

All mentioned technical data are dependent on manufacturing tolerances and are applicable for certain boundary conditions.
Note that certain deviations are therefore possible and that technical data may vary when certain boundary conditions (e.g., viscosity) change.

Characteristic curves

When dimensioning the gear pump, observe the maximum possible application data on the basis of the characteristic curves shown starting on page 10.

Scope of delivery

The scope of delivery contains the components with the properties as described under type codes and dimensions starting on page 21.

Further information

- Further information on installation, commissioning, and operation can be found in the publication 07012-B1: “General Operating Instructions for External Gear Units”.
- Extensive notes and suggestions can be found in the Hydraulic Trainer, volume 3: “Planning and Design of Hydraulic Power Systems”, order number R900018547.

Filter recommendation

Since the majority of premature failures in gear motors occur due to contaminated hydraulic fluid, filtration should maintain a cleanliness class of 20/18/15 as defined by ISO 4406.
Cleanliness class 20/18/15 can reduce contamination to an acceptable degree in terms of particle size and concentration.

Bosch Rexroth generally recommends full-flow filtration. Basic contamination of the hydraulic fluid should not exceed class 20/18/15 as defined by ISO 4406. New fluids are often above this value. In such instances, a filling device with a special filter should be used.
Bosch Rexroth is not liable for wear due to contamination.

Order number overview

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0 518 515 301	26
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0 518 525 005	22
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0 518 715 303	26
0 518 725 002	22
0 518 725 003	22
0 518 725 004	22
0 518 725 005	24
0 518 725 006	24
0 518 725 007	24
0 518 725 008	25
0 518 725 009	25
0 518 725 010	25
0 518 725 011	21
0 518 725 012	21
0 518 725 013	21
0 518 725 301	22
0 518 725 302	22
0 518 725 303	22
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AZ configurator

With our practical product selector, it will take you next to no time to find the right solution for your applications, no matter whether it is SILENCE PLUS or another external gear unit.

The selector guides you through a selection of features to all of the products available for order. By clicking on the order number, you can view and download the following product information: Data sheet, dimension sheet, operating conditions, and tightening torques.

You can order your selection directly via our online shop and at the same time benefit from an additional discount of 2%. And if you need something really quickly, simply use our fast delivery and preferred programs (GoTo). Then the goods will be sent within 10 working days.

You also have the possibility to easily and conveniently configure your individual external gear unit with our AZ configurator. All the necessary data that you need for the project planning of external gear units is requested by means of the menu navigation.

For an already existing configuration you receive as a result the order number, the type code, as well as further information. If your configuration does not lead to a product that is available for order, our online tools provide you with the possibility of sending a project request directly to Bosch Rexroth. We will then get in contact with you.

Fit4SILENCE app

You want to quickly determine the noise level of an application but don’t have a measuring device at hand? No problem with Fit4SILENCE! Our new noise measurement app for all Android devices can be immediately downloaded free of charge. After calibration, you can start using it straight away and conduct fast, accurate noise measurements with different weightings in no time at all. An additional measuring device is no longer necessary, because calibrated smartphones using the app can achieve an accuracy that approximates professional measuring devices.

Last but not least, the app contains interesting information about the SILENCE PLUS technology, including an audio sample.

Electrohydraulic pumps

Designation	Type	Size		Data sheet	Page
Electrohydraulic pumps	EHP	1...22		10104	1601

Electrohydraulic pumps

EHP

Nominal voltage (DC):12...110 V
Size of pump: 1.0...22.5 cm^3/rev

Table of contents

Content **Page**

Features

The staged modular principle means that electric motor and pump can be combined according to the required performance, guaranteeing:
- high efficiency
- low noise
- high operating pressure
- compact dimensions
- long service life
- consistent quality

Application areas
As drive groups in vehicles, they are employed primarily for the lifting and steering functions.

Ordering code

Electro-hydraulic single pump

Product designation
EHP = Electrohydraulic pump

Electric motor
Size:
I = Terminal case dia.: 110...<120 mm
K = Terminal case dia.: 120...<130 mm
L = Terminal case dia.: 130...<140 mm
P = Terminal case dia.: 150...<160 mm
S = Terminal case dia.: 160...<170 mm
T = Terminal case dia.: 170...<180 mm

Electric motor
Switch type for exciter windings to anchor:
A = BLDC (brushless direct current motor), asynchronous
D = Compound winding
N = Shunt winding
P = Permanently excited
R = Series winding
S = BLDC, synchronous

Electric motor
Cooling:
A = Motor closed (with external fan)
L = Motor open with fan
O = Motor open without fan
G = Motor closed (convection only)

EHP	012	I	D	G	66	F	011	–	20	C	0654	R	0	D120	–	S00

Electric motor
Nominal voltage DC/AC (Volt):
e.g.: 012 = 12 V, 024 = 24 V,
040 = 40 V, 048 = 48 V,
064 = 64 V, 072 = 72 V,
080 = 80 V, 110 = 110 V

Protection class Case:
e.g.: 10 = IP10, 12 = IP12, 14 = IP14,
20 = IP20, 23 = IP23, 24 = IP24,
43 = IP43, 44 = IP44, 54 = IP54,
66 = IP66

External gear pump
Series:
B = 1.0 – 7.1 cm^3/rev
F = 4.0 – 22.5 cm^3/rev
J = 12.0 – 22.5 cm^3/rev
S = 4.0 – 22.5 cm^3/rev

External gear pump
Size B:
e.g.: 1.0 = 1.0 cm^3/rev, 2.0 = 2.0 cm^3/rev,
2.5 = 2.5 cm^3/rev, 3.1 = 3.15 cm^3/rev,
4.0 = 4.0 cm^3/rev, 4.5 = 4.5 cm^3/rev,
5.0 = 5.0 cm^3/rev, 6.3 = 6.3 cm^3/rev,
7.1 = 7.1 cm^3/rev
Size F. S:
e. g.: 004 = 4.0 cm^3/rev, 005 = 5.0 cm^3/rev,
008 = 8.0 cm^3/rev, 011 = 11.0 cm^3/rev,
014 = 14.0 cm^3/rev, 016 = 16.0 cm^3/rev,
019 = 19.0 cm^3/rev, 022 = 22.5 cm^3/rev
Size J:
e. g.: 012 = 12.0 cm^3/rev, 014 = 14.0 cm^3/rev,
016 = 16.0 cm^3/rev, 019 = 19.0 cm^3/rev,
022 = 22.5 cm^3/rev

External gear pump
Case connection:
01 = Pipe thread according to DIN EN ISO 228-1
02 = Metric thread, DIN 3852-1
03 = Metric thread, DIN EN ISO 6149, O Ring
12 = Thread UNF-2B, SAE, O-ring ISO 11926-1
20 = Square flange for bolting (ISO 8434-1)
30 = Square flange (Italian version)

External gear pump
Mounting angle (with respect to electric ports):
e.g.: C = 90° (clockwise, looking at pump)
A = 0°, B = 45°, C = 90°, D = 135°, E = 180°,
F = 225°, G = 270°, H = 315°,
I = Electrical connections, axial

EHP characteristic
The last 4 digits of the characteristic number
e. g.: 0654 = Y 541 000 654

Switch relay:
N = No relay
A = Relay axially mounted
E = external engine management
I = internal engine management
L = Relay supplied loose
R = Relay radially mounted

Thermal protection switch for electric motor:
0 = No TPS
2 = TPS with 2 cable end sleeves
4 = TPS with cable end sleeve and cable terminal
6 = TPS with connector and cable terminal
8 = Connector contact, thermoswitch signal output

Valves:
= No valves
D120 = PRV with pressure setting (e.g.: 120 bar)
Residual current, internal

Special design [1]
SXX = Serial number

---

[1] In case of deviation from the standard version (for front/end cover and line connections), additional identification shall be provided in the form of a special number.

Ordering code

Electrohydraulic multiple pump

Product designation
EHP = Electrohydraulic pump

Electric motor
Size:
I = Terminal case dia.: 110...<120 mm
K = Terminal case dia.: 120...<130 mm
L = Terminal case dia.: 130...<140 mm
P = Terminal case dia.: 150...<160 mm
S = Terminal case dia.: 160...<170 mm
T = Terminal case dia.: 170...<180 mm

Electric motor
Switch type for exciter windings to anchor:
A = BLDC (brushless direct current motor), asynchronous
D = Compound winding
N = Shunt winding
P = Permanently excited
R = Series winding
S = BLDC, synchronous

Electric motor
Cooling:
A = Motor closed (with external fan)
L = Motor open with fan
O = Motor open without fan
G = Motor closed (convection only)

EHP	**024**	**K**	**D**	**L**	**54**	**FF**	**008**	**/**	**005**	**–**	**20**	**20**	**A**	**0654**	**R**	**0**	**D120**	**–**	**S00**

Electric motor
Nominal voltage DC/AC (Volt):
e.g.: 012 = 12 V, 024 = 24 V,
040 = 40 V, 048 = 48 V,
064 = 64 V, 072 = 72 V,
080 = 80 V, 110 = 110 V

Protection class Case:
e.g.: 10 = IP10, 12 = IP12, 14 = IP14,
20 = IP20, 23 = IP23, 24 = IP24,
43 = IP43, 44 = IP44, 54 = IP54,
66 = IP66

External gear pump
Pump sections 1 and 2
Series:
B = 1.0 – 7.1 cm³/rev
F = 4.0 – 22.5 cm³/rev
J = 12.0 – 22.5 cm³/rev
S = 4.0 – 22.5 cm³/rev

External gear pump
Pump sections 1 and 2
Size B:
e.g.: 1.0 = 1.0 cm³/rev, 2.0 = 2.0 cm³/rev,
2.5 = 2.5 cm³/rev, 3.1 = 3.15 cm³/rev,
4.0 = 4.0 cm³/rev, 4.5 = 4.5 cm³/rev,
5.0 = 5.0 cm³/rev, 6.3 = 6.3 cm³/rev,
7.1 = 7.1 cm³/rev
Size F. S:
e. g.: 004 = 4.0 cm³/rev, 005 = 5.0 cm³/rev,
008 = 8.0 cm³/rev, 011 = 11.0 cm³/rev,
014 = 14.0 cm³/rev, 016 = 16.0 cm³/rev,
019 = 19.0 cm³/rev, 022 = 22.5 cm³/rev
Size J:
e. g.: 012 = 12.0 cm³/rev, 014 = 14.0 cm³/rev,
016 = 16.0 cm³/rev, 019 = 19.0 cm³/rev,
022 = 22.5 cm³/rev

External gear pump
Case connection:
01 = Pipe thread according to DIN EN ISO 228-1
02 = Metric thread, DIN 3852-1
03 = Metric thread, DIN EN ISO 6149, O Ring
12 = Thread UNF-2B, SAE, O-ring ISO 11926-1
20 = Square flange for bolting (ISO 8434-1)
30 = Square flange (Italian version)

Special design [1]
SXX = Serial number

Valves:
= No valves
D120 = PRV with pressure setting (e.g.: 120 bar) Residual current, internal

Thermal protection switch for electric motor:
0 = No TPS
2 = TPS with 2 cable end sleeves
4 = TPS with cable end sleeve and cable terminal
6 = TPS with connector and cable terminal
8 = Connector contact, thermoswitch signal output

Switch relay:
N = No relay
A = Relay axially mounted
E = external engine management
I = internal engine management
L = Relay supplied loose
R = Relay radially mounted

EHP characteristic
The last 4 digits of the characteristic number
e. g.: 0654 = Y 541 000 654

External gear pump
Mounting angle (with respect to electric ports):
e.g.: C = 90° (clockwise, looking at pump)
A = 0°, B = 45°, C = 90°, D = 135°, E = 180°,
F = 225°, G = 270°, H = 315°,
I = Electrical connections, axial

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[1] In case of deviation from the standard version (for front/end cover and line connections), additional identification shall be provided in the form of a special number.

Program overview

Part number	Page	Characteristic	Quotation drawing	Ordering code
0 541 200 082	8	Y 541 001 049	A 541 020 330	EHP12IDG54F004-20E1049A0D040
0 541 000 026	10	Y 541 001 414	A 541 110 111	EHP12IDG66B1.0-02A0414N0
0 541 100 075	10	Y 541 000 416	A 541 110 111	EHP12IDG66B3.0-02A0416N0
0 541 000 024	14	Y 541 001 015	A 541 110 190	EHP24IDG54B1.0-02A1015L4
0 541 100 070	14	Y 541 001 016	A 541 110 190	EHP24IDG54B2.0-02A1016L4
0 541 100 067	12	Y 541 001 018	A 541 110 190	EHP24IDG54B3.0-02A1018N0
0 541 100 071	14	Y 541 001 018	A 541 110 190	EHP24IDG54B3.0-02A1018L4
0 541 100 072	13	Y 541 001 018	A 541 110 190	EHP24IDG54B3.0-02A1018R0
0 541 100 074	14	Y 541 001 018	A 541 110 190	EHP24IDG54B3.0-02A1018N2
0 541 200 063	16	Y 541 000 388	A 541 020 083	EHP24IDG43F004-20A0388N0
0 541 300 057	18	Y 541 000 402	A 541 020 085	EHP24IDG54F005-20A0402N6
0 541 300 081	20	Y 541 001 042	A 541 020 305	EHP24IDG54F005-20A1042A6
0 541 400 065	20	Y 541 001 043	A 541 020 305	EHP24IDG54F008-20A1043N0
0 541 100 046	22	Y 541 000 406	A 541 110 101	EHP24IDG43B2.0-02A0406N0
0 541 100 052	24	Y 541 000 902	A 541 110 130	EHP24IDL12B3.0-20C0902N0
0 541 100 053		Y 541 000 903	A 541 110 130	EHP24IDL12B3.8-20C0903N0
0 541 200 068	26	Y 541 000 904	A 541 110 154	EHP24IDL12B4.6-20A0904N0
0 541 100 058	28	Y 541 000 902	A 541 110 162	EHP24IDL12B3.0-02A0902N0
0 541 500 071	30	Y 541 000 656	A 541 023 062	EHP24KDG66F011-12A0656N0D060
0 541 500 078	32	Y 541 000 656	A 541 023 066	EHP24KDG66F011-20A0656L0D050
0 541 300 058	34	Y 541 001 096	A 541 026 001	EHP24KDL20FB005/1.0-2002A0096N0
0 541 100 055	36	Y 541 000 611	A 541 114 010	EHP24KDG43B3.0-02A0611N0
0 541 200 067	38	Y 541 000 613	A 541 114 014	EHP24KDG43B4.6-20C0613N0
0 541 100 054	40	Y 541 000 612	A 541 114 016	EHP24KDG43B3.8-20C0612N0
0 541 200 083	42	Y 541 001 325	A 541 021 351	EHP24PRL20F004-20E1325N0
0 541 300 068		Y 541 001 326	A 541 021 351	EHP24PRL20F005-20E1326N0
0 541 400 075		Y 541 001 327	A 541 021 351	EHP24PRL20F008-20E1327N0
0 541 500 082		Y 541 001 328	A 541 021 351	EHP24PRL24F011-20E1328N0
0 541 600 043		Y 541 001 338	A 541 021 351	EHP24PRL24F016-20E1338N0
0 541 400 079		Y 541 001 327	A 541 021 367	EHP24PRL20F008-20C1327N0
0 541 400 083	48	Y 541 001 327	A 541 021 383	EHP24PRL20F008-01E1327N0
0 541 400 077	48	Y 541 001 335	A 541 021 358	EHP24PRL20S008-20E1335N0
0 541 500 083	48	Y 541 001 337	A 541 021 358	EHP24PRL20S011-20E1337N0
0 541 400 082	50	Y 541 001 335	A 541 021 382	EHP24PRL24S008-20G1335N0
0 541 300 069	52	Y 541 001 324	A 541 021 357	EHP24PRL20FB005/3.0-2002E1324N0
0 541 300 074	54	Y 541 001 341	A 541 021 368	EHP48PRL20F005-20E1341N0
0 541 400 080	54	Y 541 001 344	A 541 021 368	EHP48PRL20F008-20E1344N0
0 541 300 079	56	Y 541 001 341	A 541 021 379	EHP48PRL20F005-20A1341N0
0 541 400 078	58	Y 541 001 339	A 541 021 366	EHP48PRL20S008-20C1339N0
0 541 500 074	60	Y 541 001 173	A 541 022 166	EHP48SDL14S011-20A1173N0
0 541 300 032	62	Y 541 001 003	A 541 023 013	EHP72KDO14F005-20A1003N0

Other versions on request.

Technical data

General	
Installation position	Vertical, hydraulic pump at bottom; horizontal as shown in dimensions drawing. Condensation opening, if fitted, at bottom
Ambient temperature range	between –25 °C and +60 °C
Mounting	Saddle mounting with wire tie

Pump					
Design		External gear pump			
Type		AZPB…	AZPF…	AZPJ…	AZPS…
Displacement	cm^3/rev	1.0 – 7.1	4.0 – 22.5	12.0 – 22.5	4.0 – 22.5
Suction pressure	bar	min. 0.7 max. 3 (absolute)			
max. continuous pressure p_1**)		200 – 250	180 – 250	250	220 – 250
max. intermittent pressure p_2**)		230 – 280	210 – 280	280	250 – 280
max. peak pressure p_3**)		250 – 300	230 – 300	300	290 – 300
Line ports		AZPB/F/S: Thread, flange, others on request			
Fluids		– Mineral oil compliant with DIN 51524, 1–3, however under higher load at least HLP compliant with DIN 51524 Part 2 recommended. – Comply with RE 90220 – Further operating fluids possible after consultation			
Viscosity		12 … 800 mm^2/s permitted range 20 … 100 mm^2/s recommended range … 2000 mm^2/s permitted for start up			
Temperature of hydraulic fluid		–25 … +80 °C			
Filtration *)		At least cleanliness level 21/18/15 compliant with ISO 4406 (1999)			

Electric motor						
Design	DC motor with compound or series winding					
Size (code)	I	K	L	P	S	T
Terminal case Ø mm	110 … < 120	120 … < 130	130 … < 140	150 … < 160	160 … < 170	170 … < 180
Voltage (volts)	12, 24, 40, 48, 72, 80 see overview of range					
Power output (kW)	1.5 … 8.1, other outputs on request					
Protection class	see Program overview					
Diagrams	These are valid for operation under the following conditions: Ambient temperature +20 °C Electrolyte temperature +20 °C Motor temperature +20 °C Oil temperature +50 °C Viscosity $\nu = 32$ mm^2/s S2, S3 see VDE 0530					

Relay (not available in every version)		
Voltage	12 V	24 V
Exciter current	1.5 A	0.9 A
Contact current at S3 = 12 %	350 A	
Contact current, continuous	150 A	
Protection class	IP54 / IP6K9K / IP66 auf Anfrage	

**) On hydraulic systems or devices with critical counter-reaction, such as steering valves, brake valves, the type of filtration selected must be adapted to the sensitivity of these devices/systems.
Safety requirements pertaining to the whole systems are to be observed.
Please contact us with respect to applications with high numbers of load cycles.

**) Detailed information, see series B: RE10087
F: RE10089
J: RE10094
S: RE10095

Project planning notes

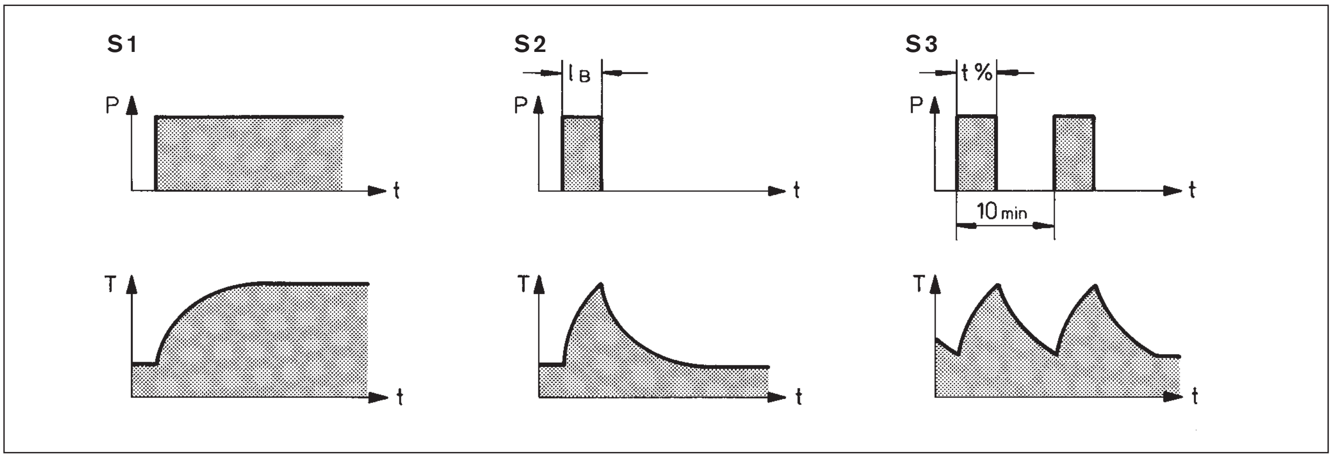
1. Operating modes

The starting points for dimensioning electrohydraulic pump are pressure p and flow rate Q.
However, the resulting power output P depends on the **operating mode**.
Here, a distinction is made between:

Continuous operation S 1
Operation with constant load, with a duration long enough for thermal equilibrium to be reached.

Short-term operation S 2
Operation with constant load.
Of short duration so that thermal equilibrium is not reached.
Example: S 2–60 min.

Intermittent operation S 3
Operation comprising a series of similar cycles (cycle duration 10 min), which include a time with constant load and a pause. Example: S 3–10 %



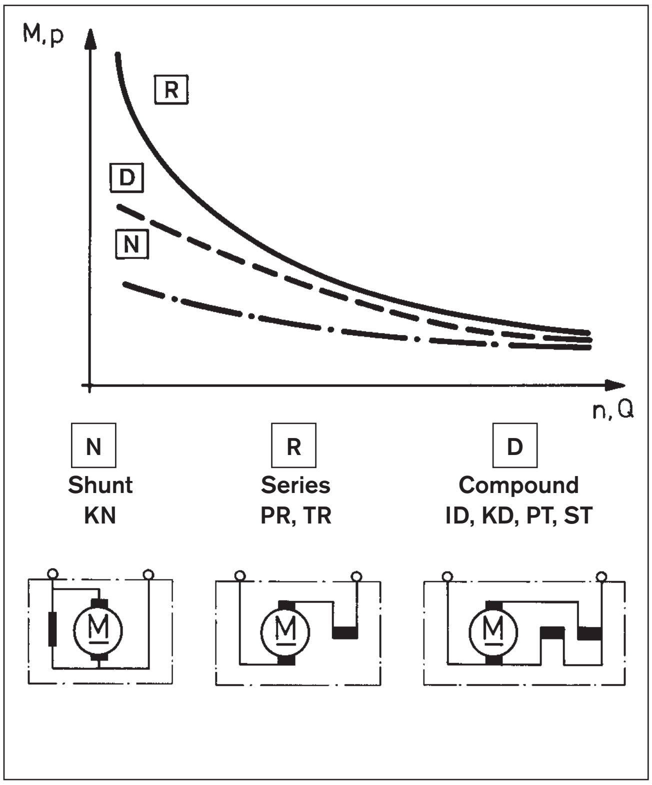
2. Motor characteristics

Speed and torque of a DC motor and thus the flow rate and pressure of the pump being driven are interdependent in accordance with the curves shown.
The curve is determined by both the power output and the type of winding. A distinction is made between:

Shunt winding
Benefit: Small change in speed with load fluctuation.
Drawback: Low start-up torque, current peaks.

Series winding
Benefit: High start-up torque
Drawback: “Motor overspeeding” without load

Compound winding
Compromise between shunt and series winding.



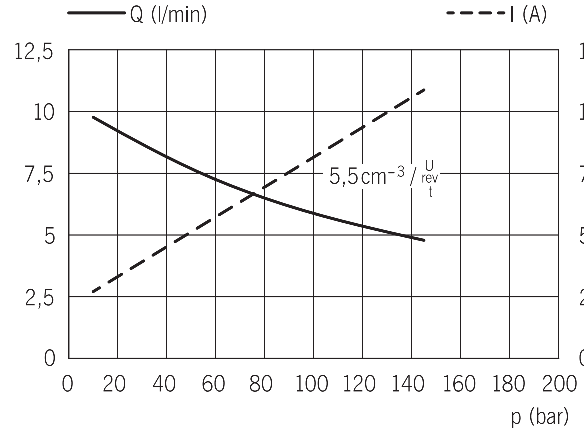
Project planning notes (continued)

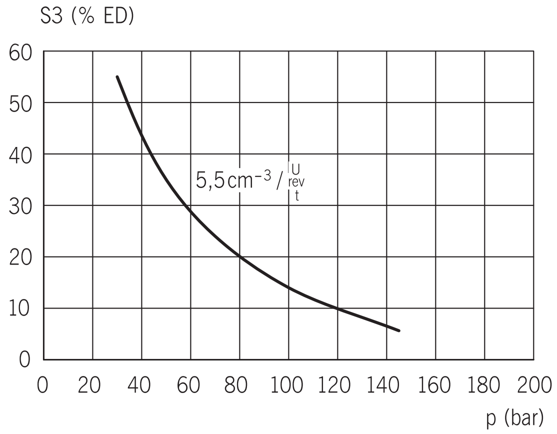
3. Selection

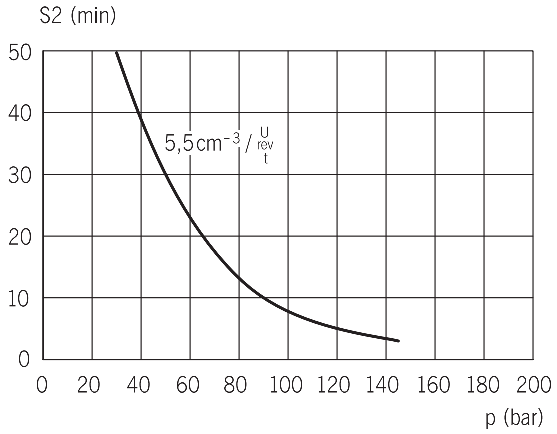
It is not the power output figure (in watts) that is decisive for the selection, but rather the actuated time under the required operating conditions, see Characteristics. This prevents the motor from being either overloaded or dimensioned too large. It is expedient to select a suitable electrohydraulic pump on the basis of the diagrams for the different combinations. These show:

a) the flow rate Q (l/min) and the electric current consumption I (A) depending on pressure p.

b) the permissible pressure p depending on the operating mode S 3 (%) or S 2 (min).







Commissioning

Installation and commissioning

- Fill pump with hydraulic fluid before installation.
- Pipelines to be cleaned of dirt, cinders, sand, chips etc. before installation.
  Pipes, in particular must be pickled or rinsed.
- Before the 1st commissioning, the overall hydraulic system is to be carefully vented.
- Cover up the radial lip-type shaft seal ring and the air vents when spraying and painting.
- Observe characteristics, in particular, speeds and pressures as well as negative pressure in the suction line.

You can find further information in our publication:
“General Operating Instructions for External Gear Units”
RE 07 012-B1.

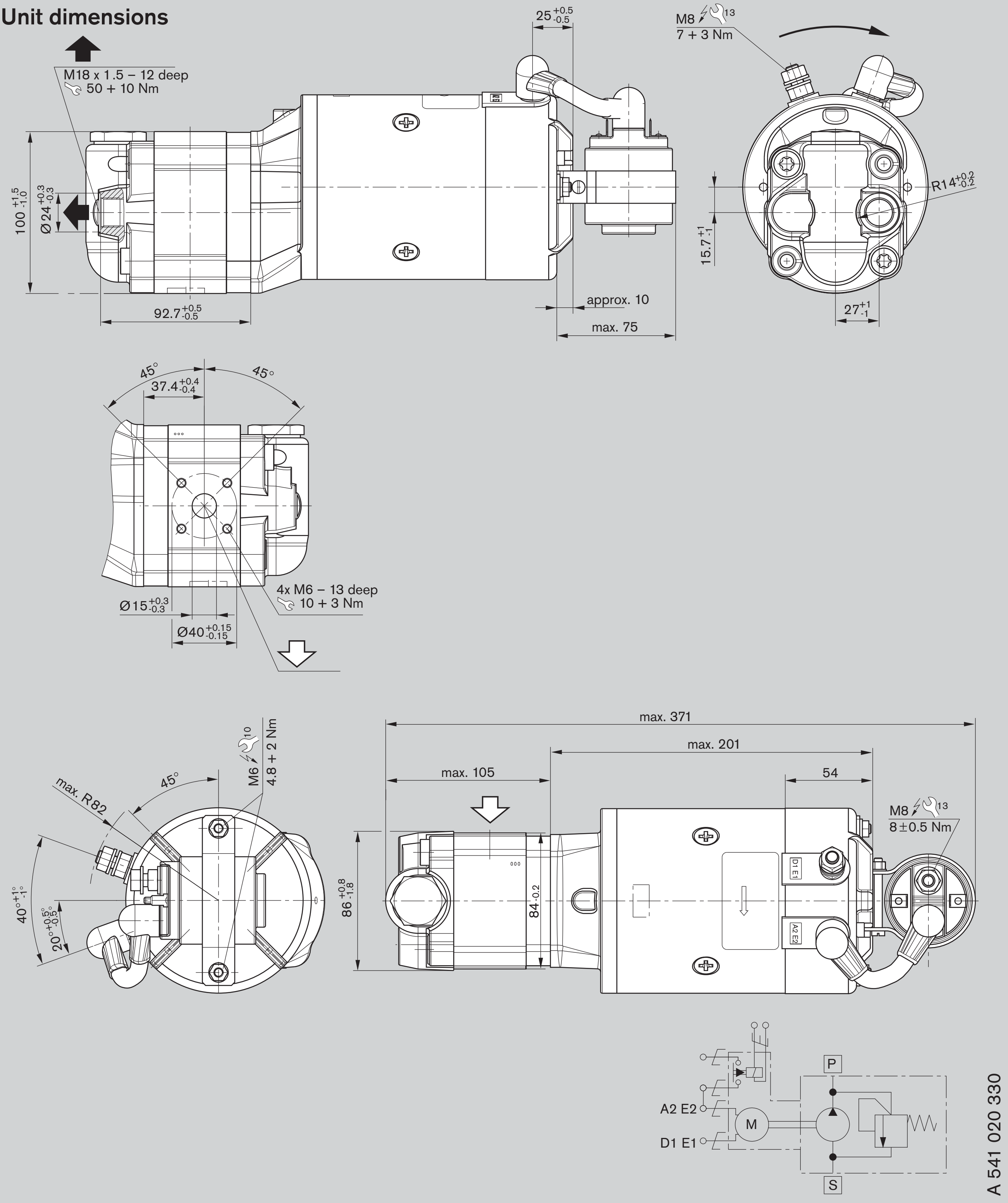
Filter recommendation

We recommend that a full-flow filter always be used.

Electrical installation

Dimension the line cross section in accordance with the maximum current.
Polarity without influence on the direction of rotation.
Note the protection class and environmental conditions.

Unit dimensions

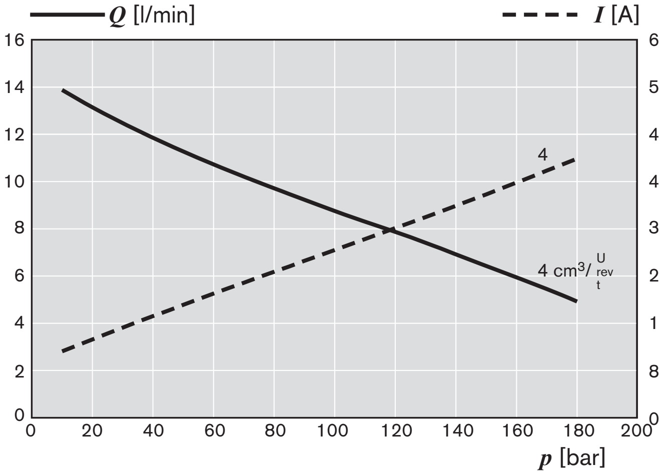


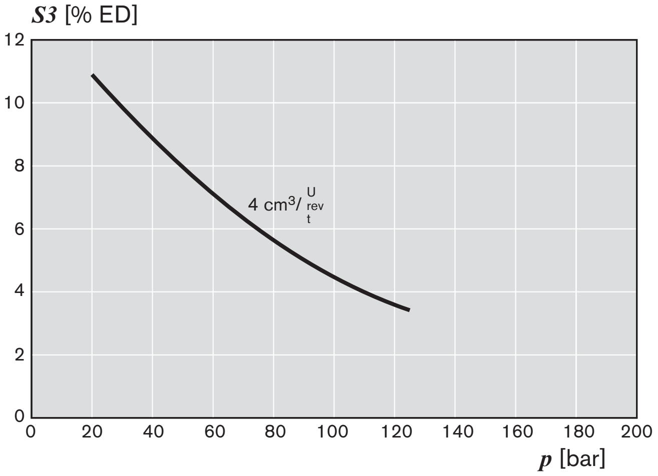
Type of protection:

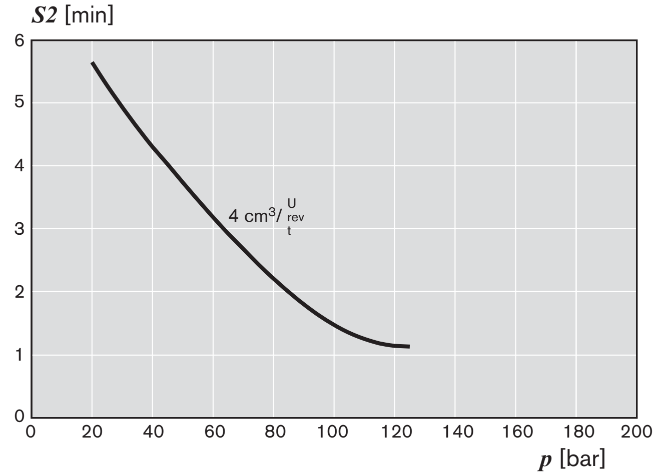
Motor case	IP 54
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			PRV	Weight	Part number
	V [cm^3/rev]	A	B	C	[bar]	[kg]	
EHP12IDG54F004-20E1049A0D040	4	–	–	–	40^{+5}	2.7	**0 541 200 082**

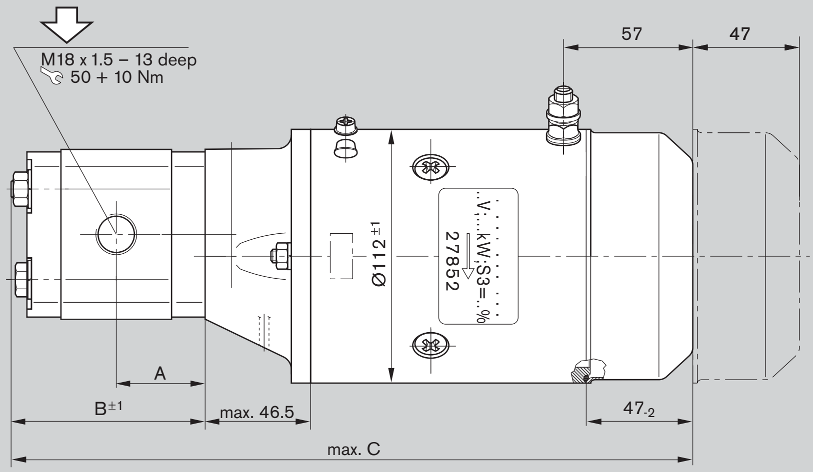
Characteristics
for A 541 020 330

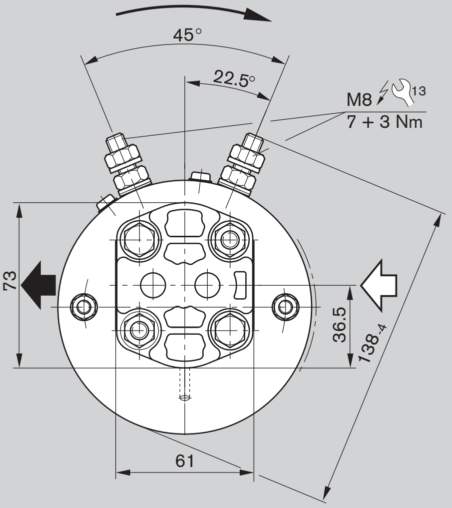


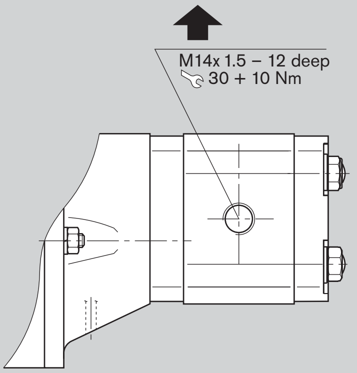


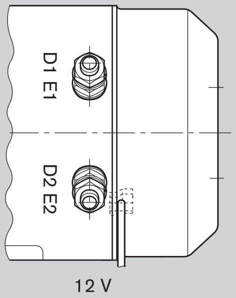


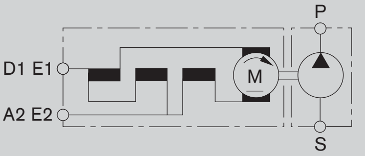
Unit dimensions











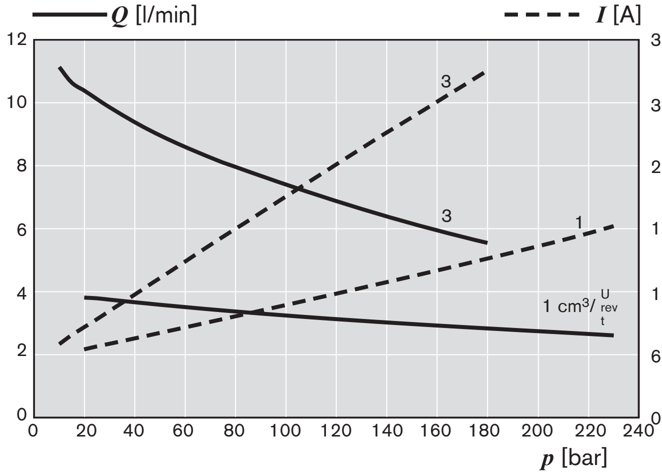
A 541 110 111

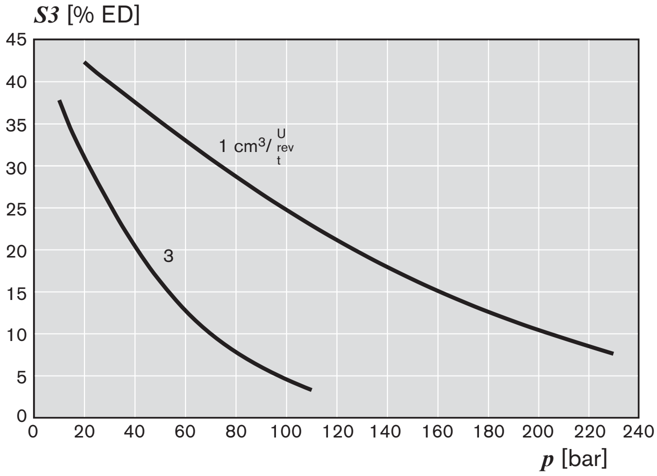
Type of protection:

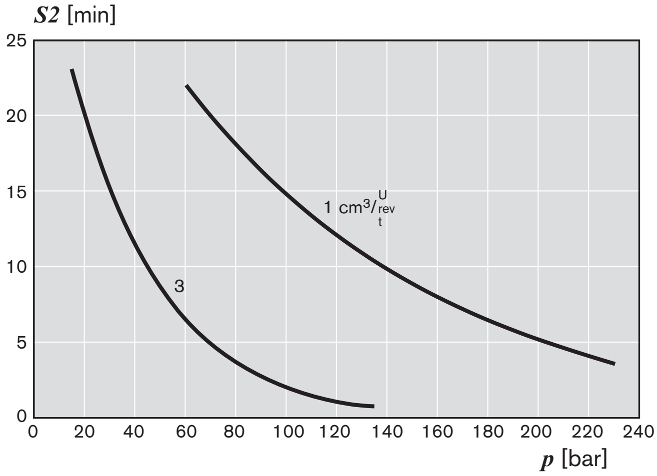
Motor case	IP 66
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Weight	Part number
	V [cm^3/rev]	A	B	C	[kg]	
EHP12IDG66B1.0-02A0414N0	1.0	35.0	76	292	8.5	**0 541 000 026**
EHP12IDG66B3.0-02A0416N0	3.0	39.2	86	302	8.5	**0 541 100 075**

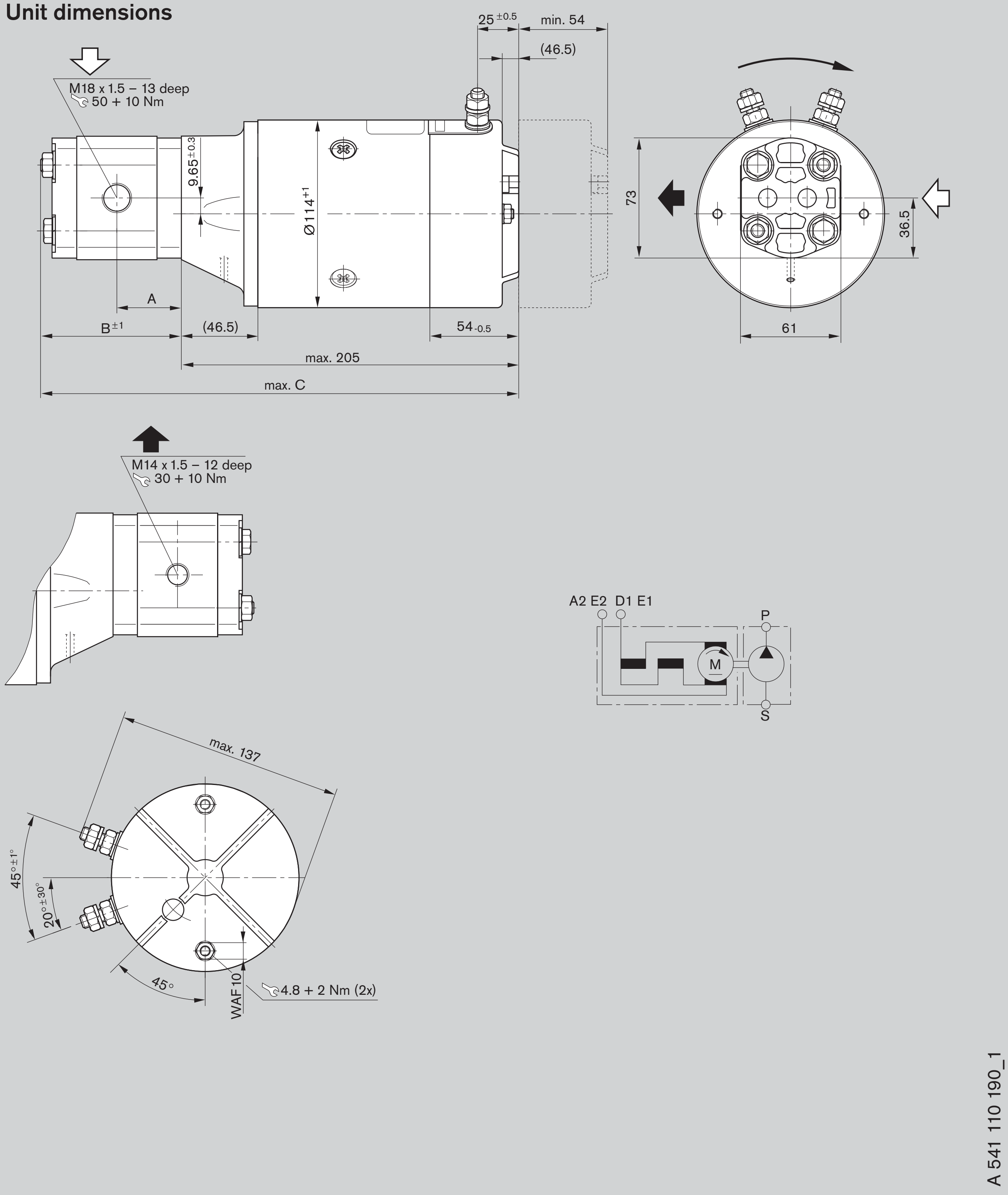
Characteristics for A 541 110 111







Unit dimensions



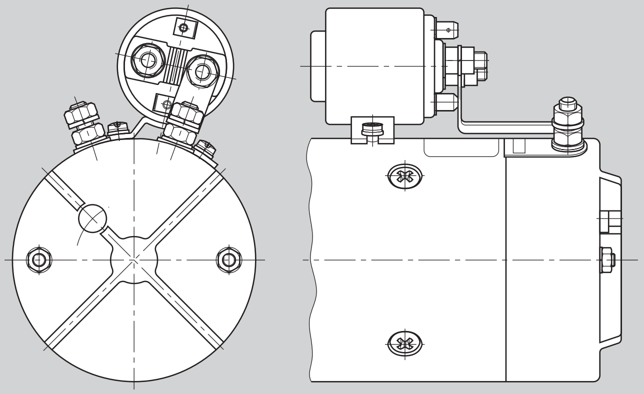
Type of protection:

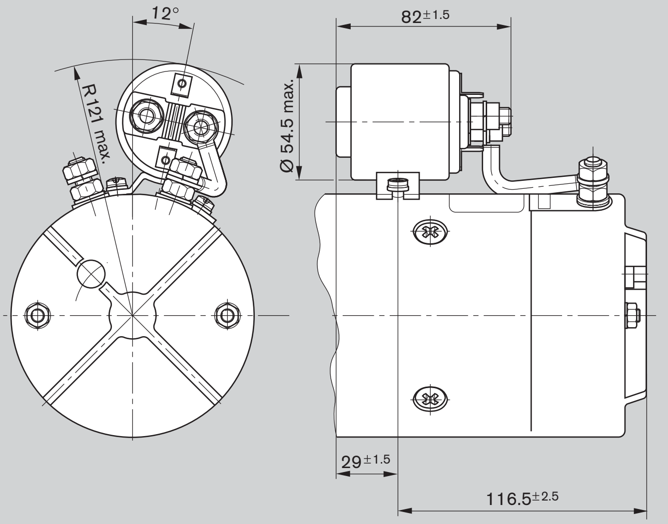
Motor case	IP 54
Ports	IP 00

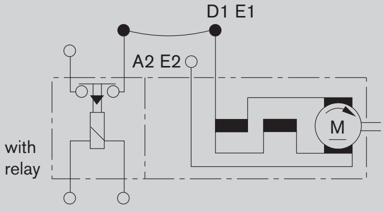
Ordering code	Displacement V [cm^3/rev]	Dimension [mm] A	 B	 C	TPS*)	Relay mounted	Relay loose	Weight [kg]	Part number
EHP24IDG54B3.0-02A1018N0	3.0	39.2	86	292	–	–		8.7	**0 541 100 067**

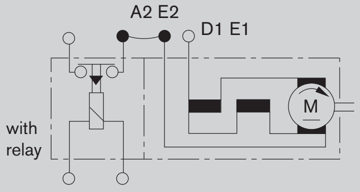
*) Thermal protection switch

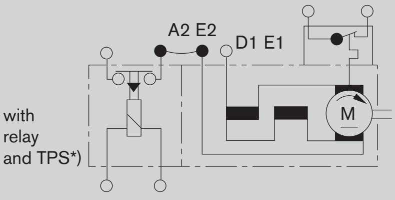
Unit dimensions











A 541 110 190_2

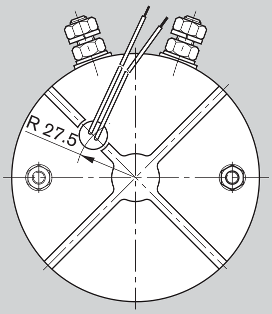
Type of protection:

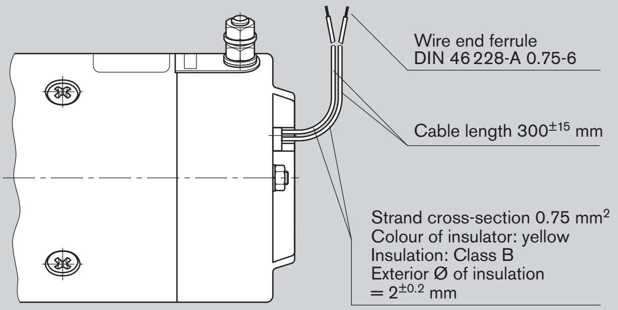
Motor case	IP 54
Ports	IP 00

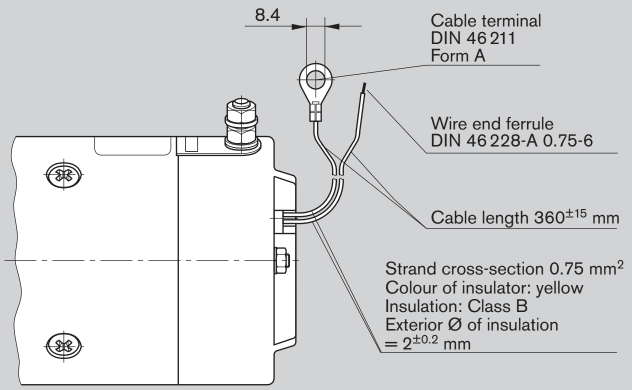
Ordering code	Displacement	Dimension [mm]			TPS *)	Relay mounted	Relay loose	Weight	Part number
	V [cm^3/rev]	A	B	C				[kg]	
EHP24IDG54B3.0-02A1018R0	3.0	39	86	292	–	×		9.4	**0 541 100 072**

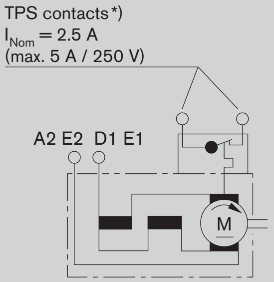
*) Thermal protection switch

Unit dimensions









A 541 110 190_3

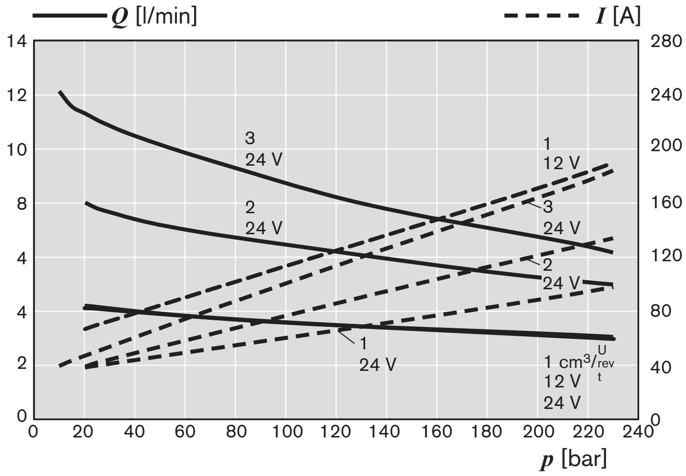
Type of protection:

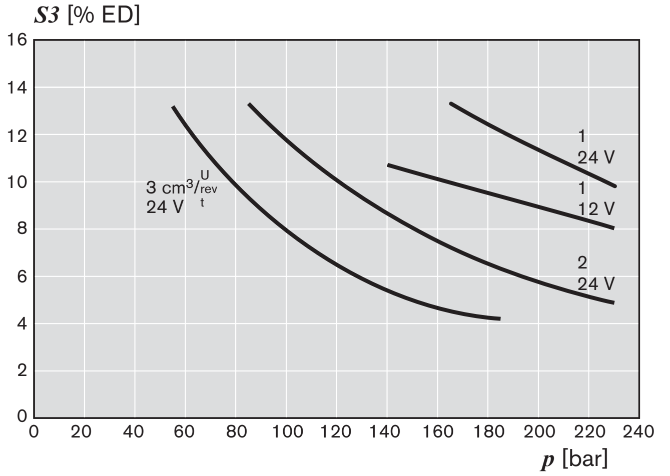
Motor case	IP 54
Ports	IP 00

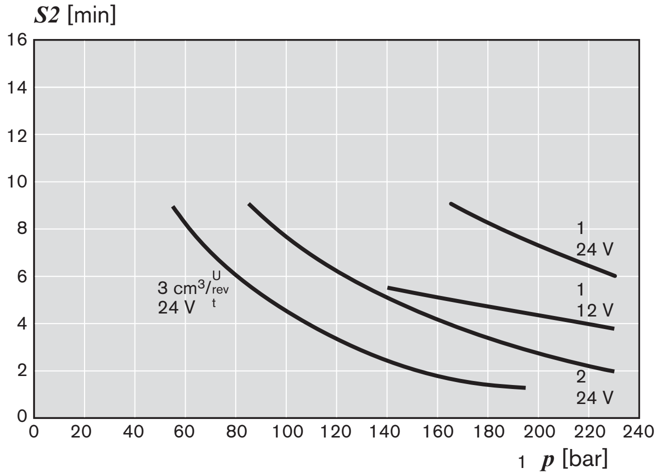
Ordering code	Displacement V [cm^3/rev]	Dimension [mm] A	B	C	TPS*)	Relay mounted	Relay loose	Weight [kg]	Part number
EHP24IDG54B1.0-02A1015L4	1.0	35.0	76.0	282	×	–	1 547 211 007	8.4	**0 541 000 024**
EHP24IDG54B2.0-02A1016L4	2.0	37.1	81.0	287	×	–	1 547 211 007	8.5	**0 541 100 070**
EHP24IDG54B3.0-02A1018L4	3.0	39.0	86.0	292	×	–	1 547 211 007	8.7	**0 541 100 071**
EHP24IDG54B3.0-02A1018N2	3.0	39.2	86.0	292	×	–		8.7	**0 541 100 074**

*) Thermal protection switch

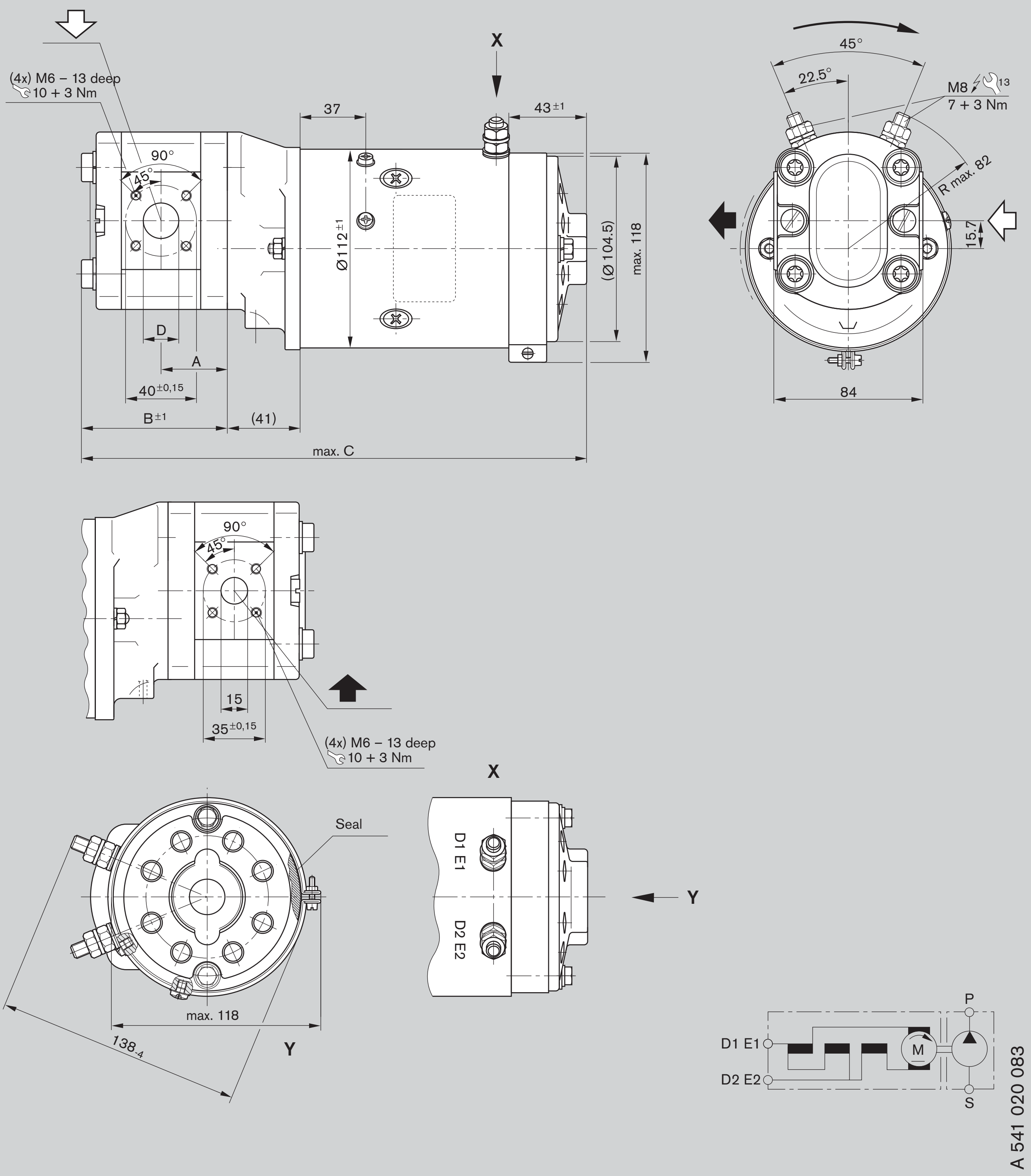
Characteristics
for A 541 110 190







Unit dimensions

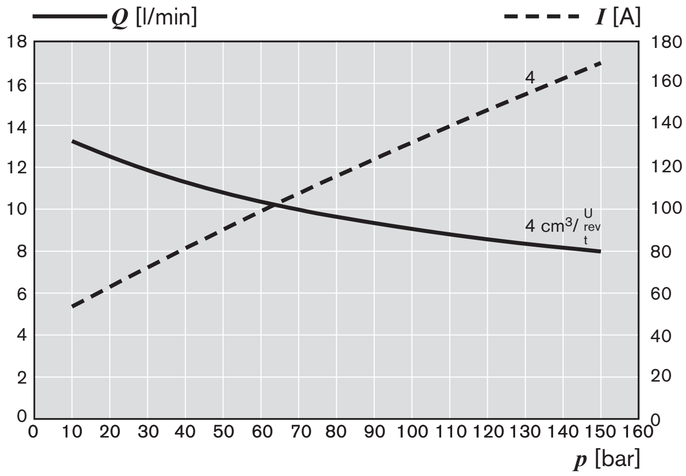


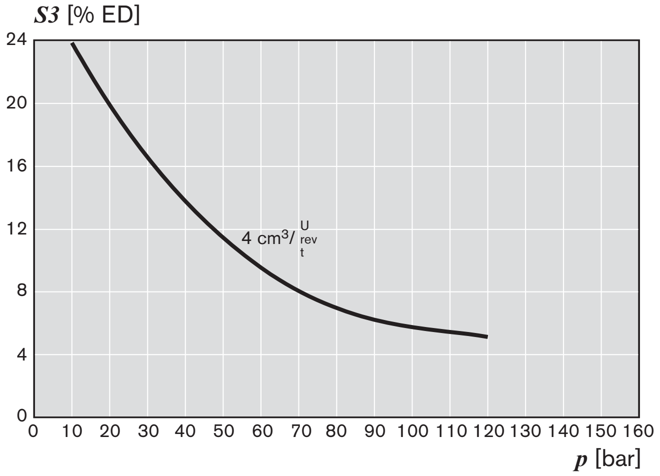
Type of protection:

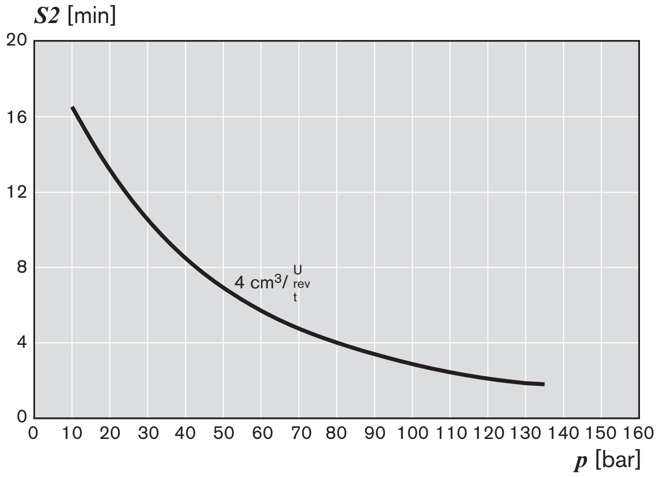
Motor case	IP 43
Ports	IP 00

Ordering code	Displacement	Dimension [mm]				Weight	Part number
	V [cm^3/rev]	A	B	C	D	[kg]	
EHP24IDG43F004-20A0388N0	4.0	37.3	82.5	293.5	15.0	10.0	**0 541 200 063**

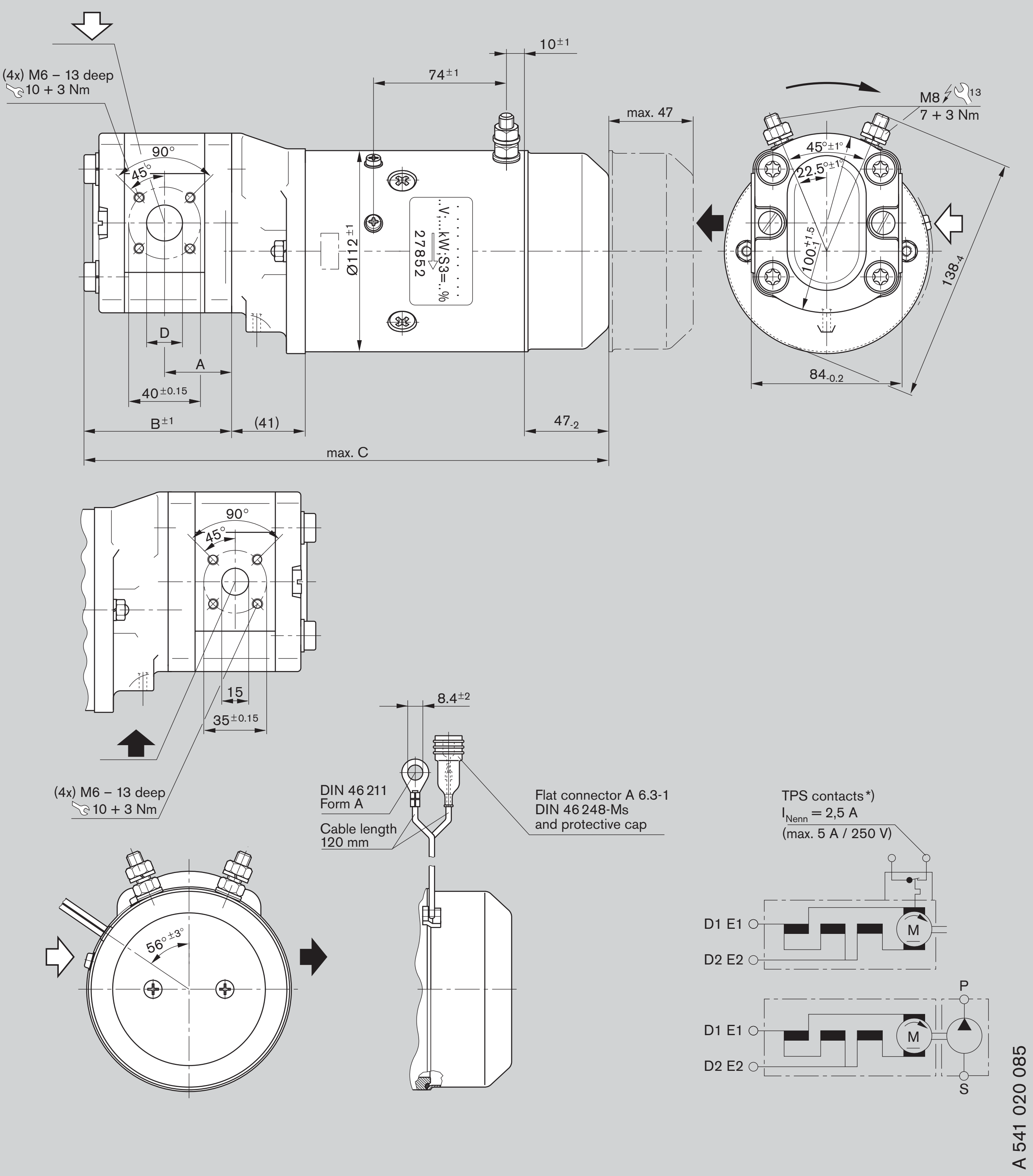
Characteristics for A 541 020 083







Unit dimensions



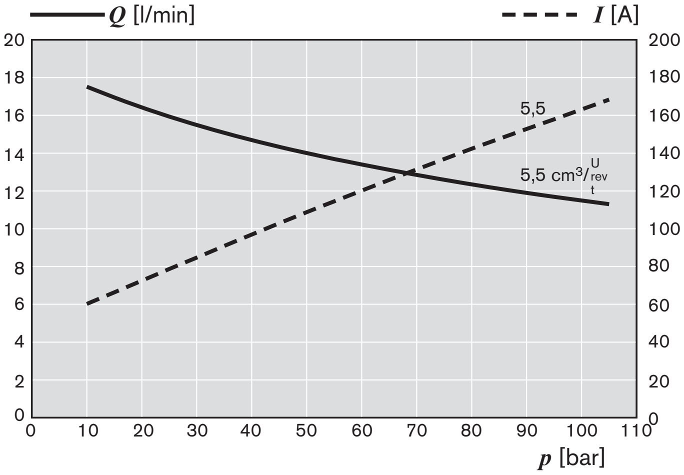
Type of protection:

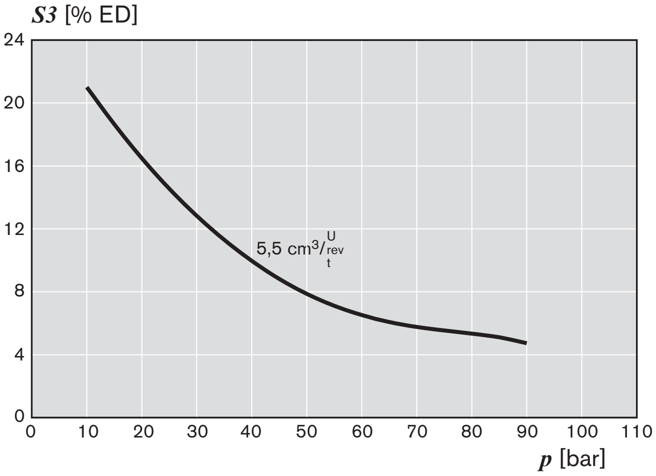
Motor case	IP 54
Ports	IP 00

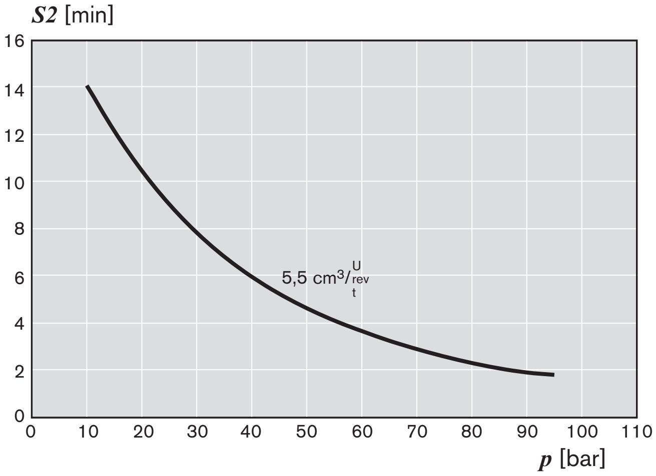
Ordering code	Displacement	Dimension [mm]				TPS *)	Weight	Part number
	V [cm³/rev]	A	B	C	D		[kg]	
EHP24IDG54F005-20A0402N6	5.5	38.6	85.0	296.0	15.0	×	10.1	**0 541 300 057**

*) Thermal protection switch

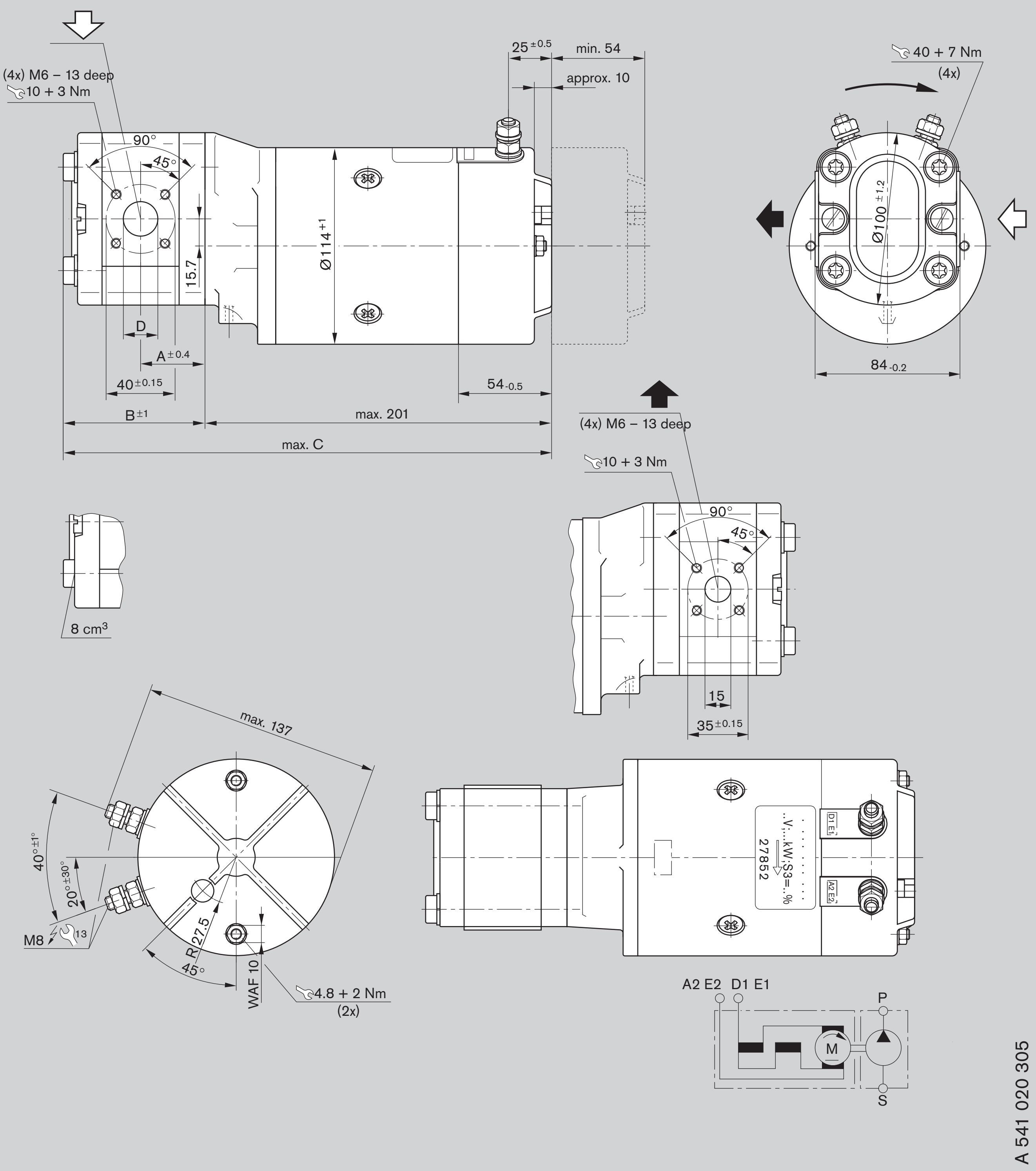
Characteristics
for A 541 020 085







Unit dimensions

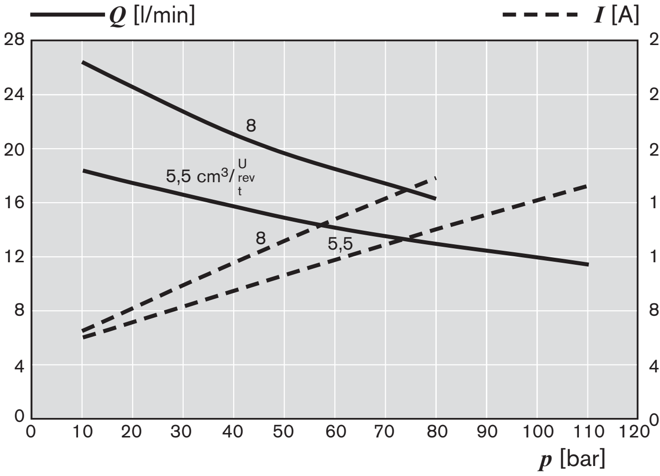


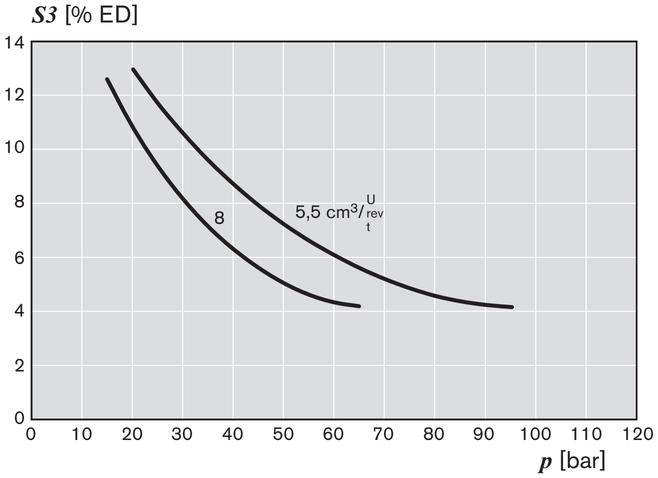
Type of protection:

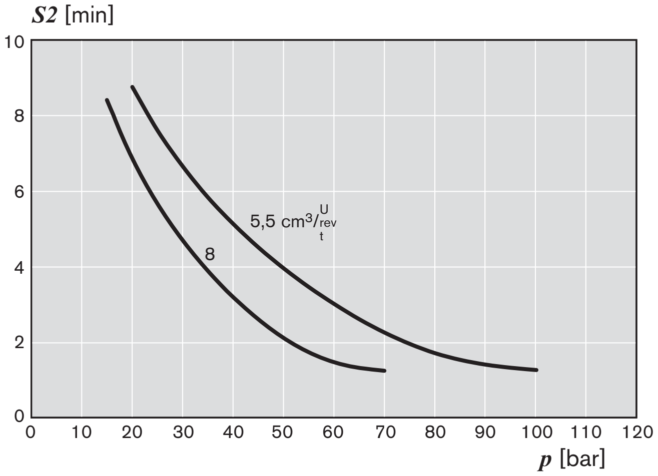
Motor case	IP 54
Ports	IP 00

Ordering code	Displacement	Dimension [mm]				Weight	Part number
	V [cm³/rev]	A	B	C	D	[kg]	
EHP24IDG54F005-20A1042A6	5.5	38.6	84.5	286.5	15.0	10.9	**0 541 300 081**
EHP24IDG54F008-20A1043N0	8.0	40.7	88.6	290.6	20.0	10.4	**0 541 400 065**

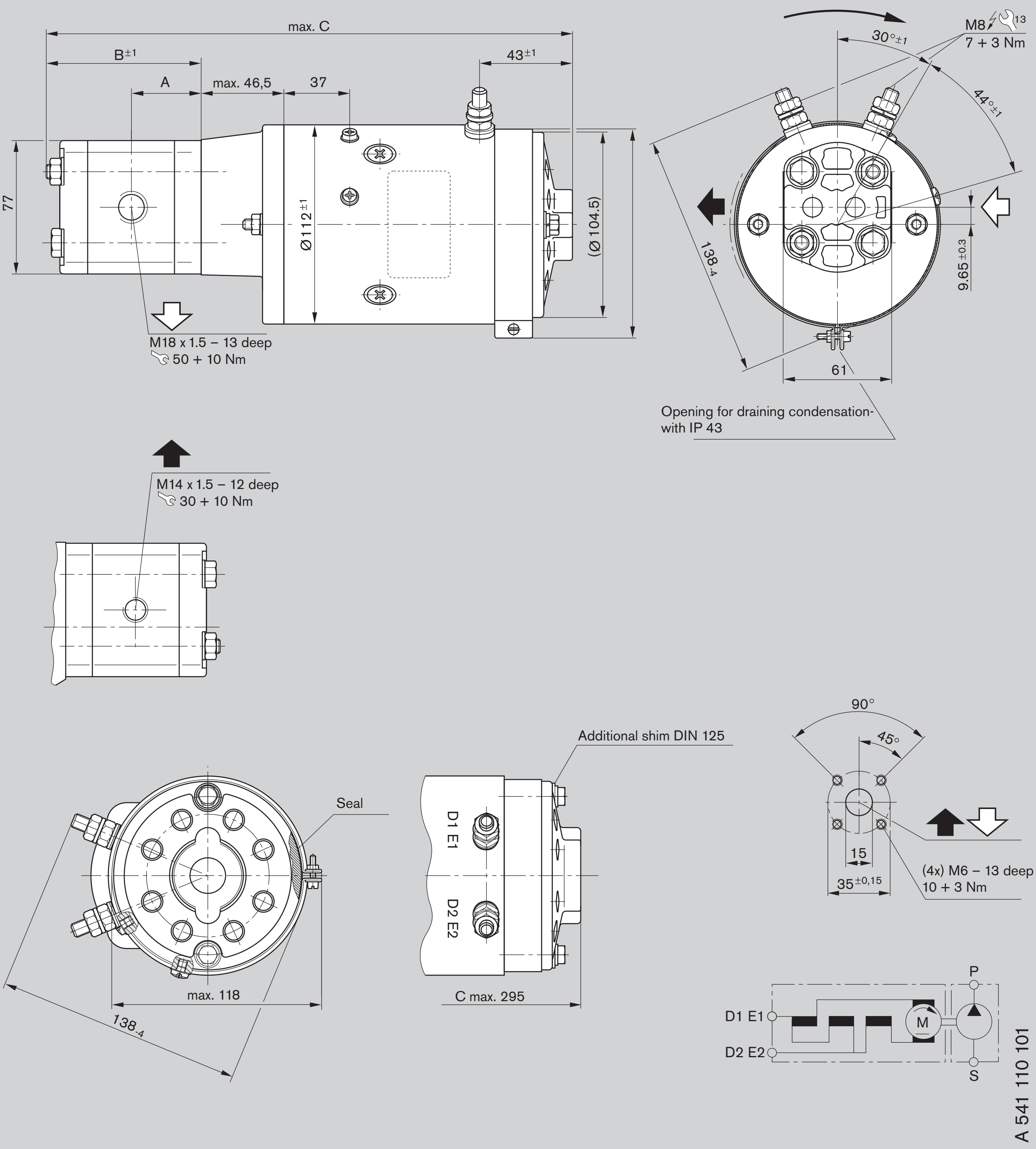
Characteristics for A 541 020 305







Unit dimensions

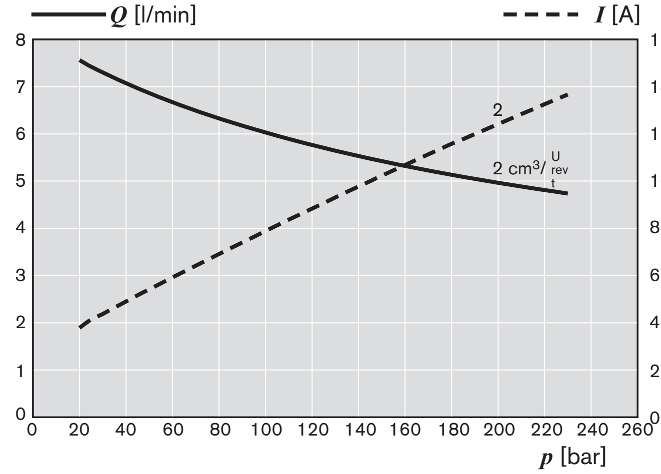


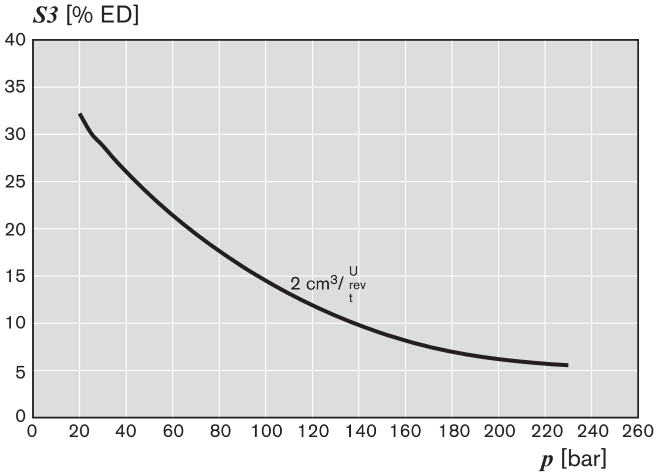
Type of protection:

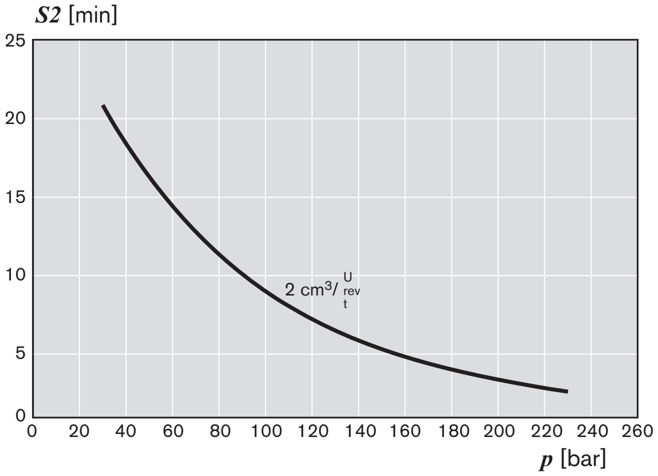
Motor case	IP 43
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Weight	Part number
	V [cm³/rev]	A	B	C	[kg]	
EHP24IDG43B2.0-02A0406N0	2.0	37.0	81.0	297.0	9.25	**0 541 100 046**

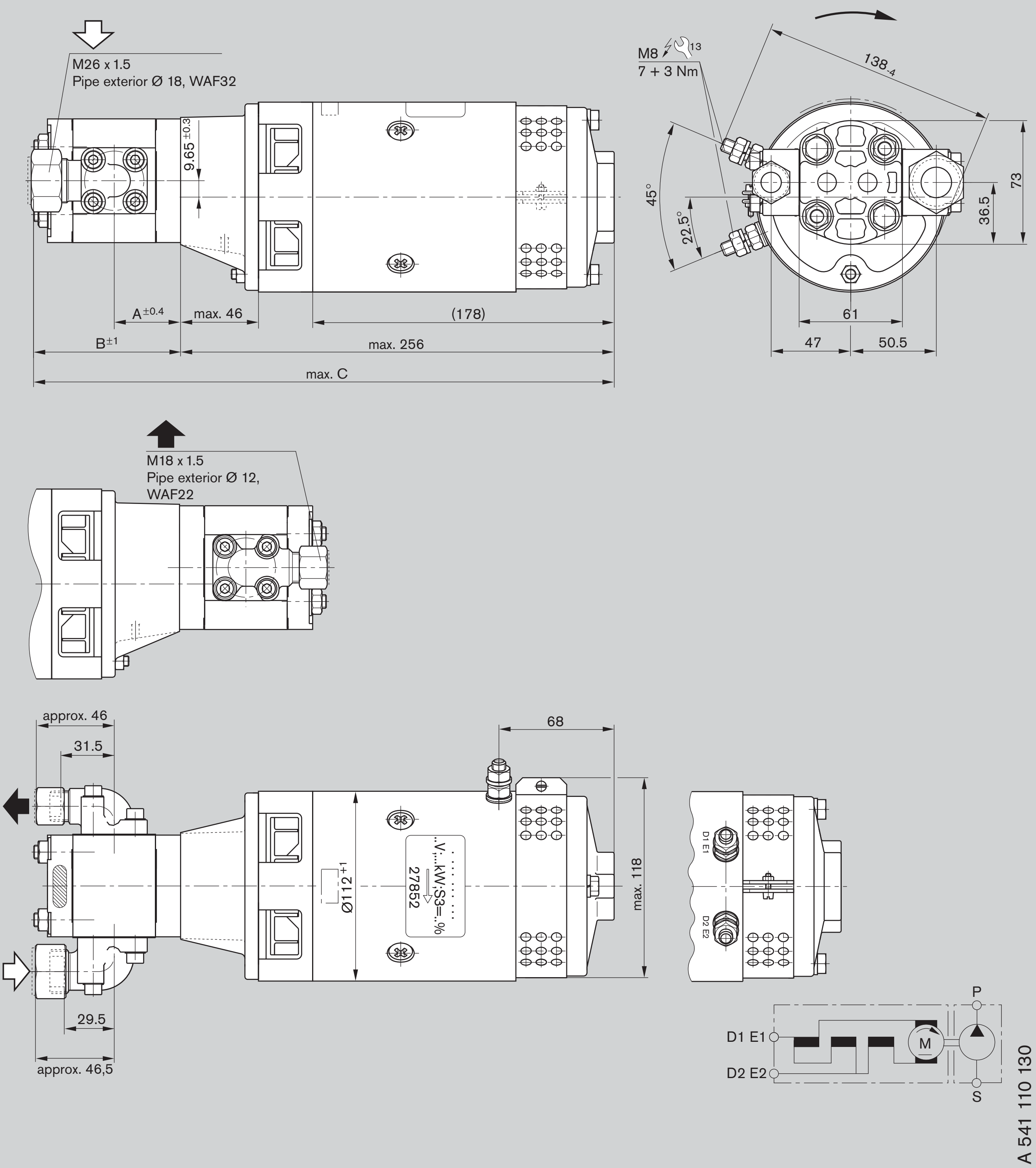
Characteristics for A 541 110 101







Unit dimensions

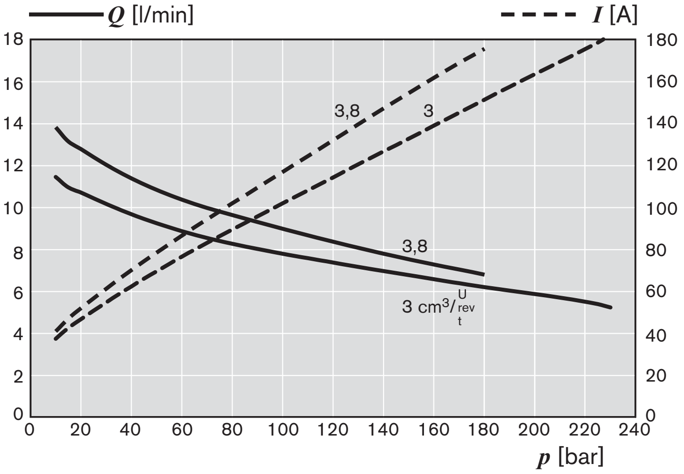


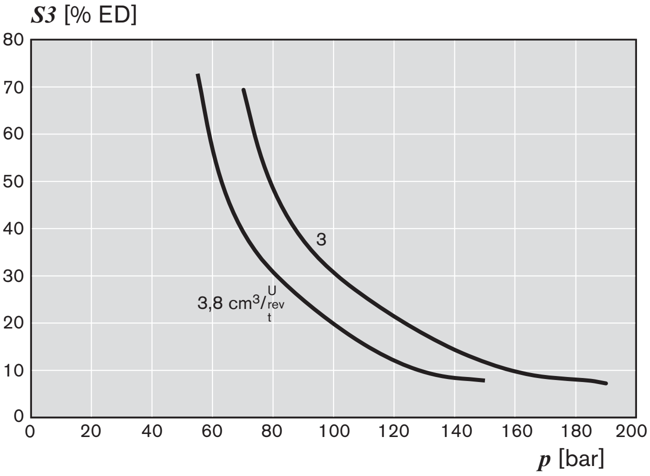
Type of protection:

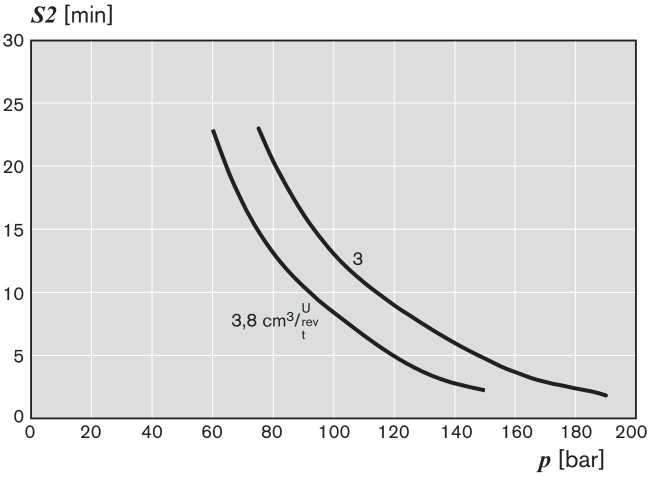
Motor case	IP 10
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Weight	Part number
	V [cm^3/rev]	A	B	C	[kg]	
EHP24IDL12B3.0-20C0902N0	3.0	39.2	86.0	343.0	10.5	**0 541 100 052**
EHP24IDL12B3.8-20C0903N0	3.8	40.7	91.0	348.0	10.6	**0 541 100 053**

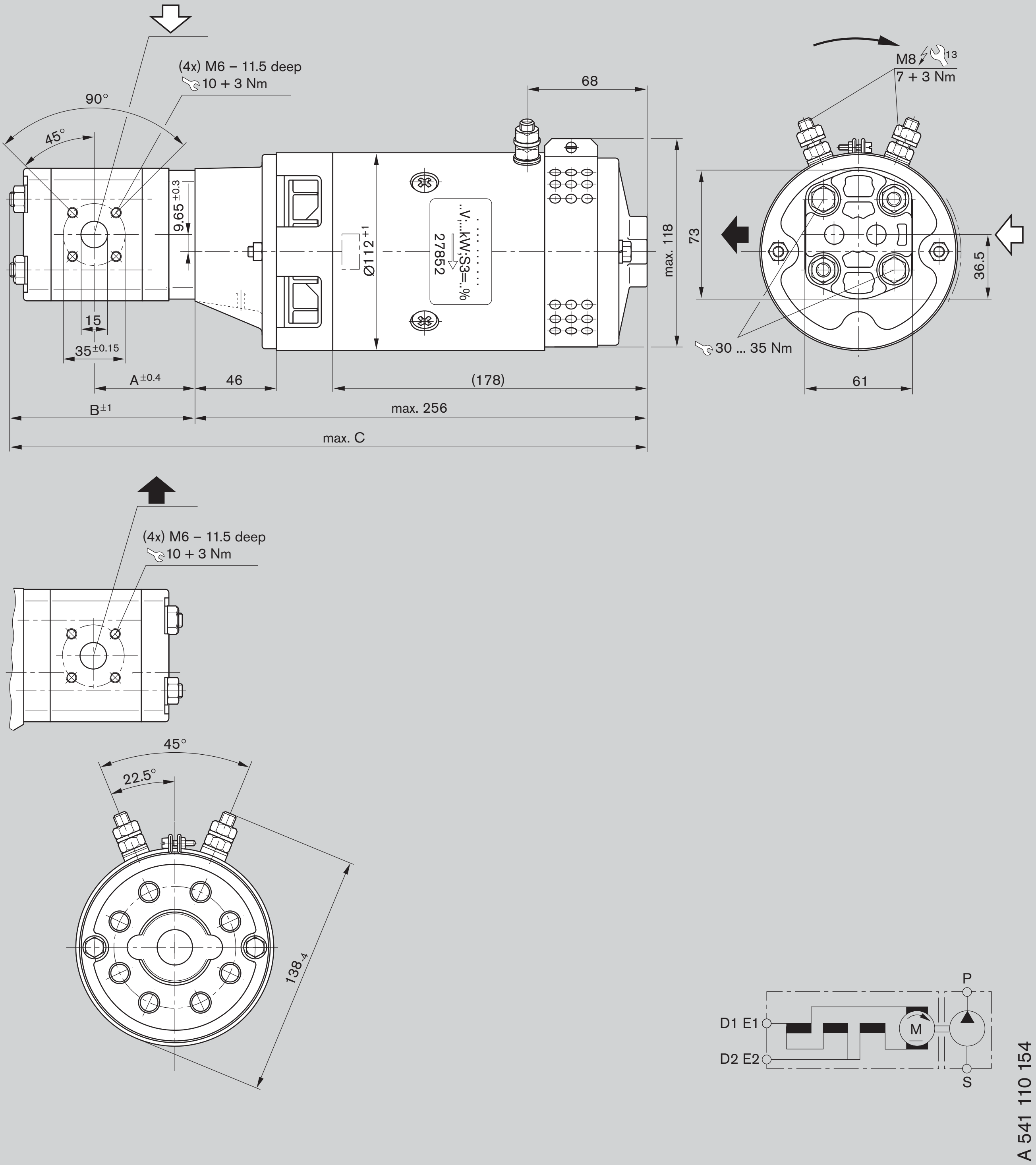
Characteristics for A 541 110 130







Unit dimensions

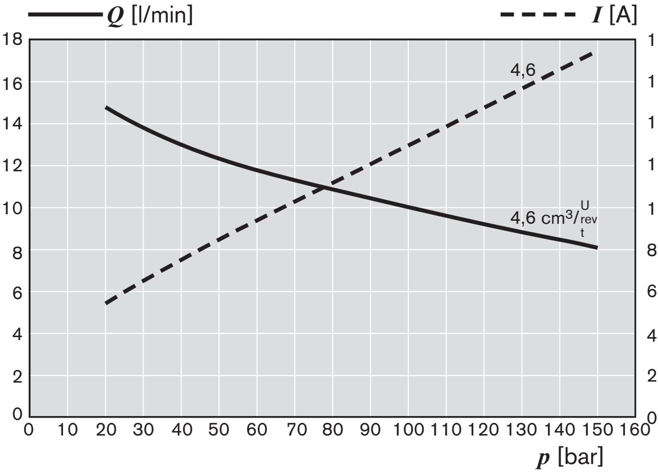


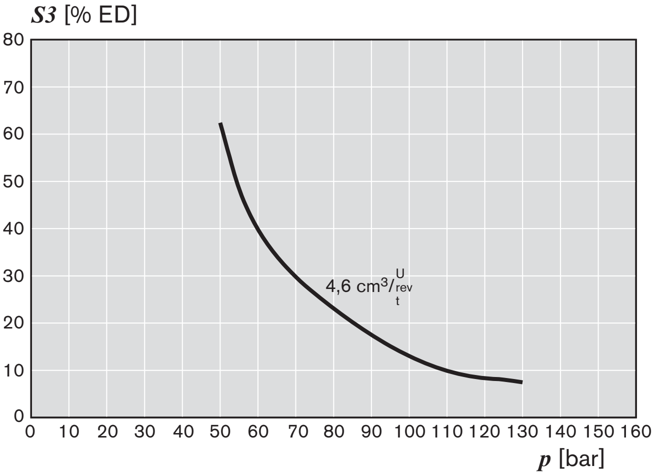
Type of protection:

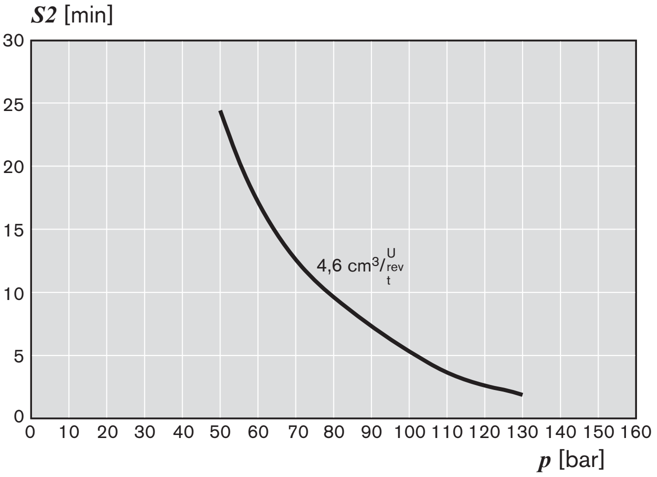
Motor case	IP 10
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Weight	Part number
	V [cm³/rev]	A	B	C	[kg]	
EHP24IDL12B4.6-20A0904N0	4.6	42.0	91.0	348.0	10.7	**0 541 200 068**

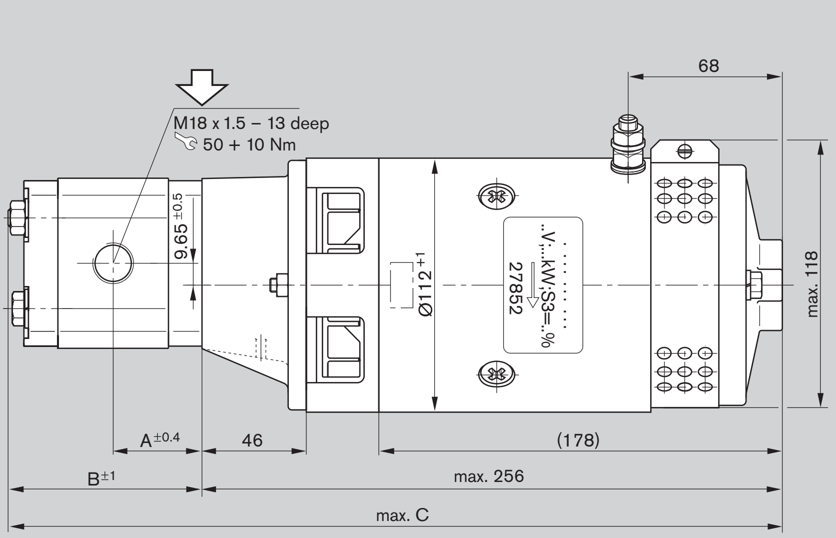
Characteristics for A 541 110 154

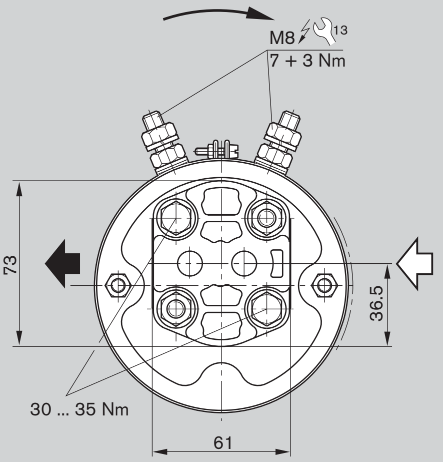


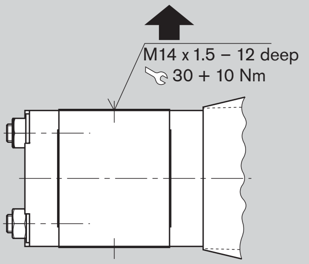


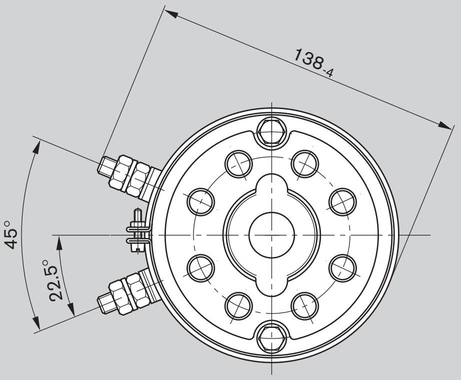


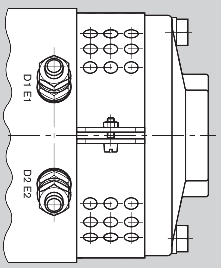
Unit dimensions

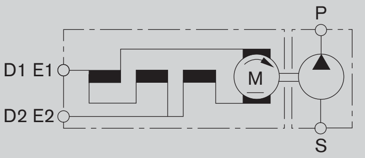












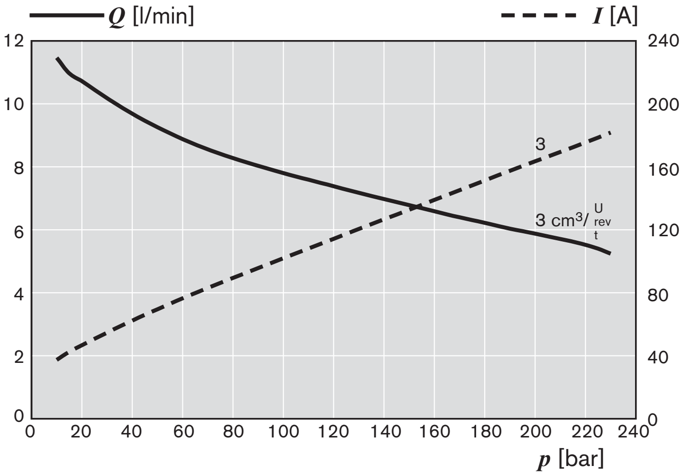
A 541 110 162

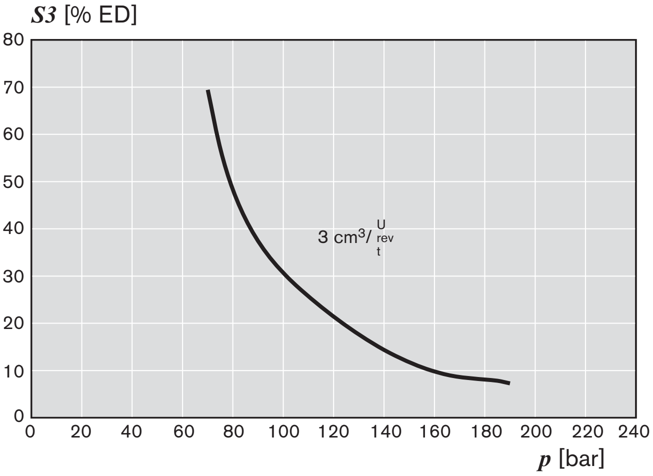
Type of protection:

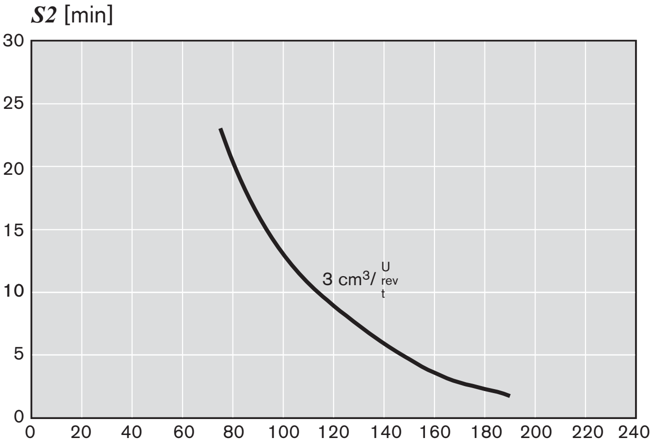
Motor case	IP 10
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Weight	Part number
	V [cm^3/rev]	A	B	C	[kg]	
EHP24IDL12B3.0-02A0902N0	3.0	39.0	86.0	343.0	9.9	**0 541 100 058**

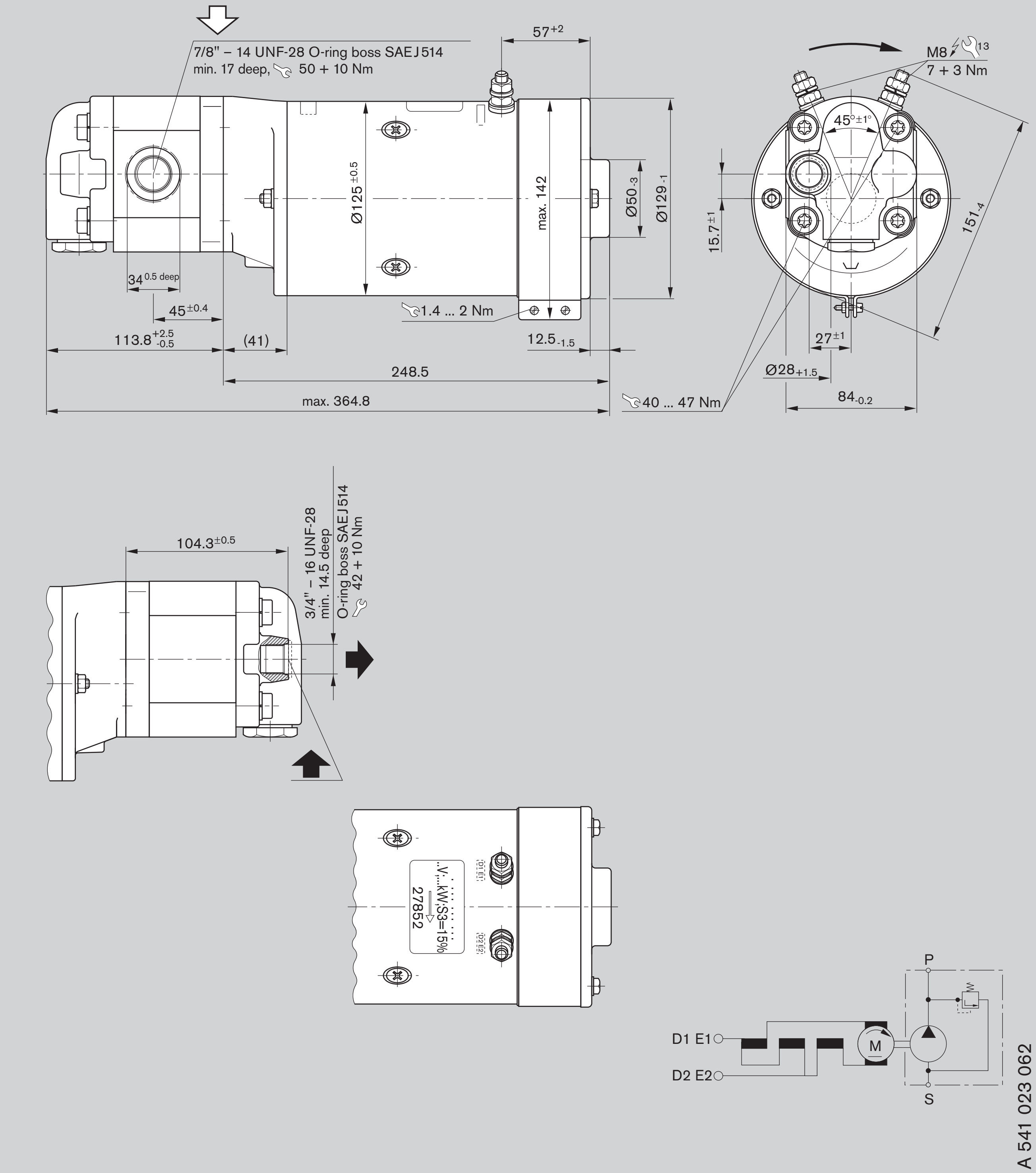
Characteristics for A 541 110 162







Unit dimensions

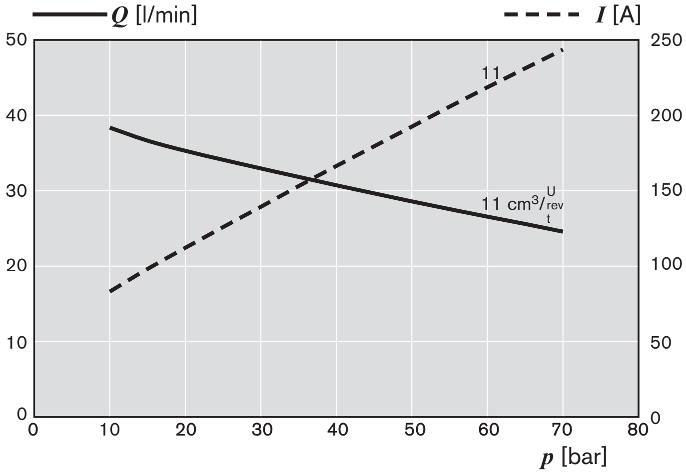


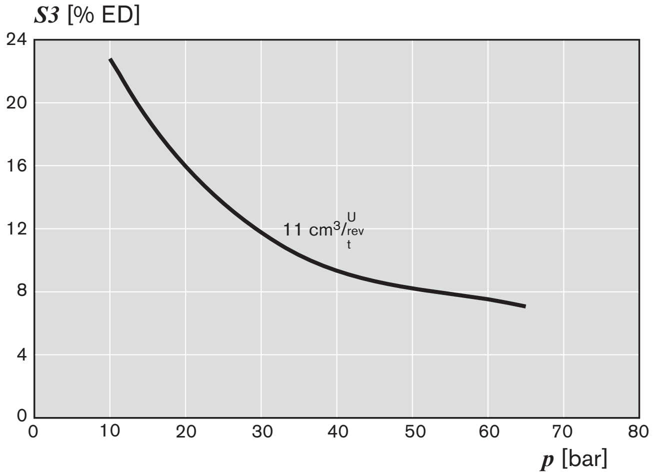
Type of protection:

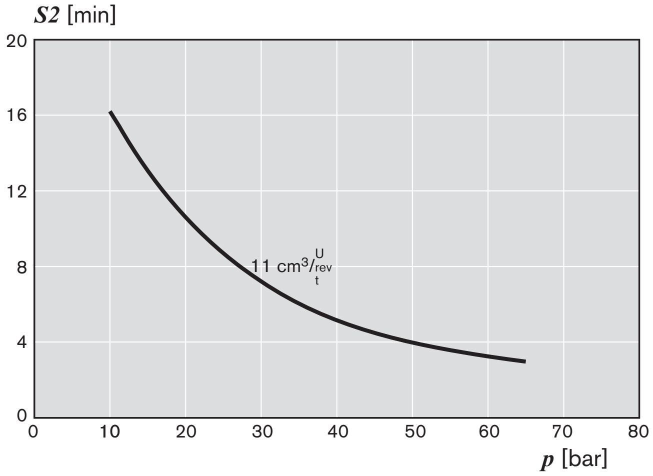
Motor case	IP 66
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			PRV	Weight	Part number
	V [cm^3/rev]	A	B	C	[bar]	[kg]	
EHP24KDG66F011-12A0656N0D060	11.0	–	–	–	60^{+5}	16.7	**0 541 500 071**

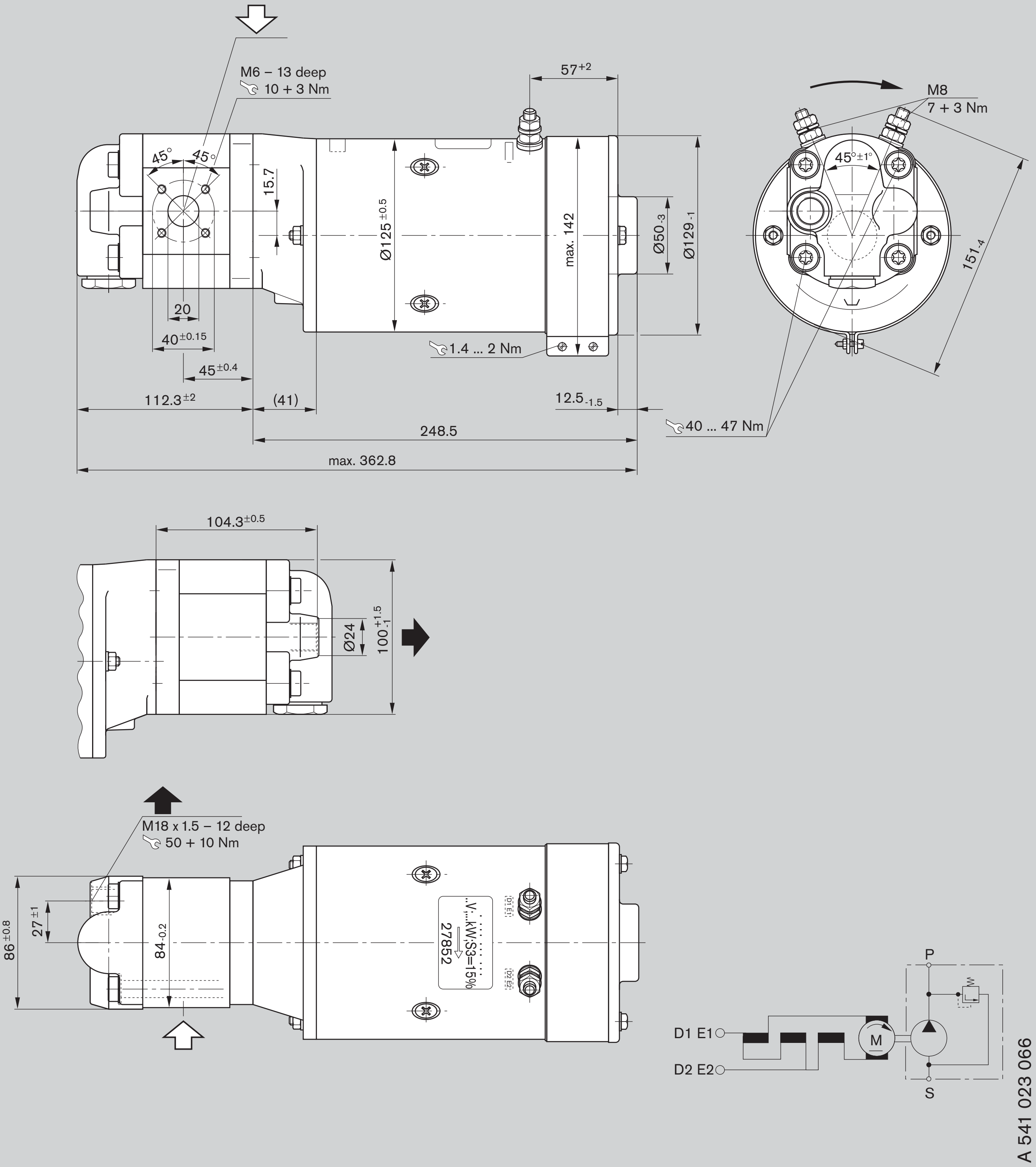
Characteristics
for A 541 023 062







Unit dimensions

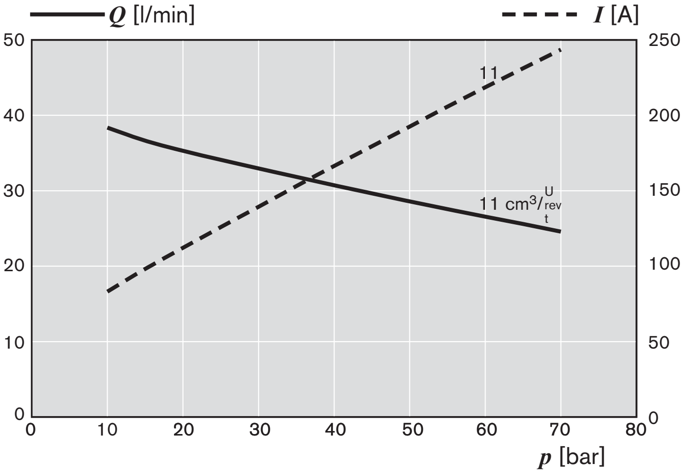


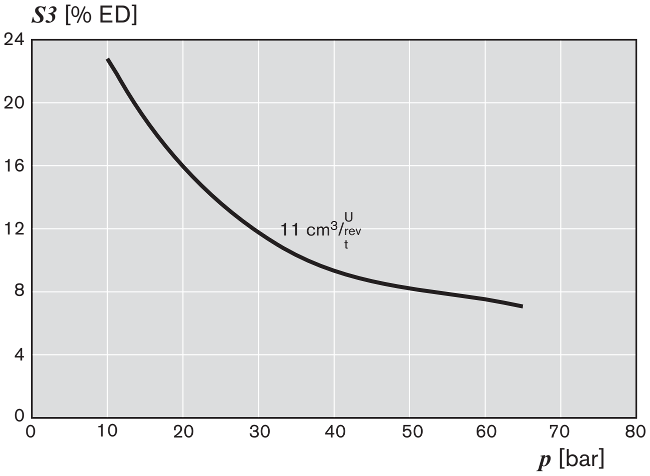
Type of protection:

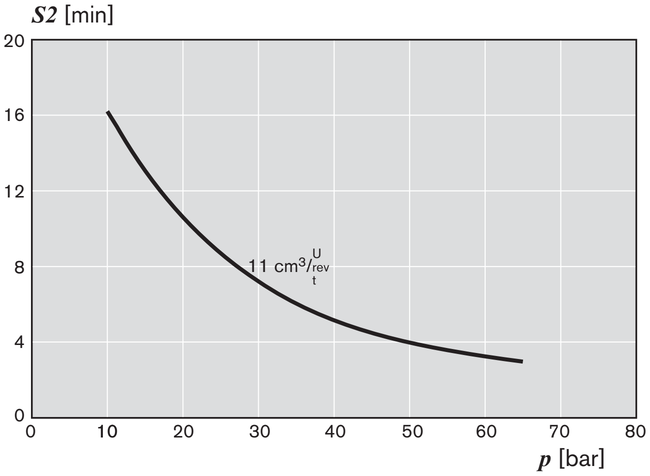
Motor case	IP 66
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Relay, supplied loose	PRV	Weight	Part number
	V [cm^3/rev]	A	B	C		[bar]	[kg]	
EHP24KDG66F011-20A0656L0D050	11.0	–	–	–	1 547 211 007	50^{+5}	16.7	**0 541 500 078**

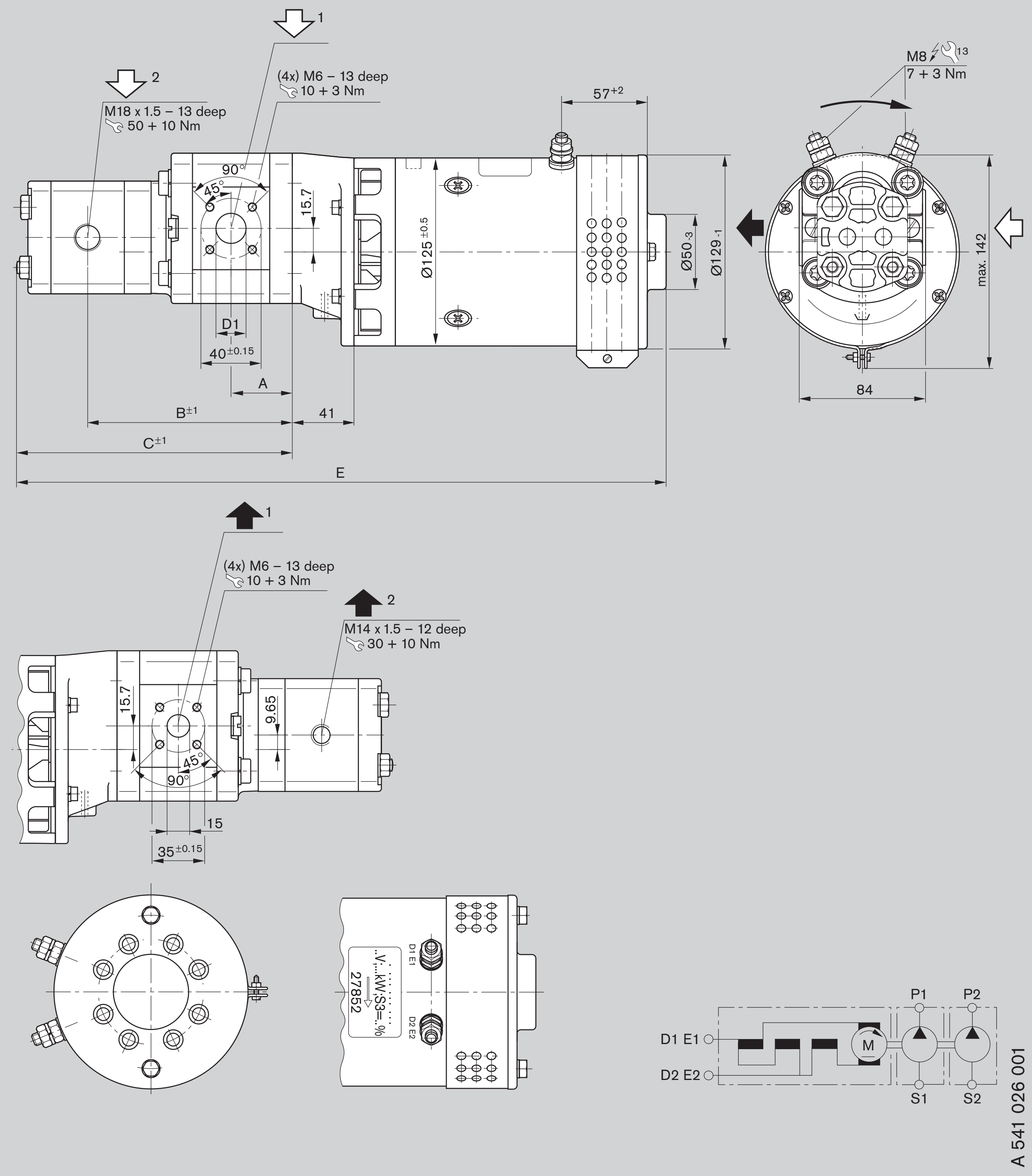
Characteristics for A 541 023 066







Unit dimensions

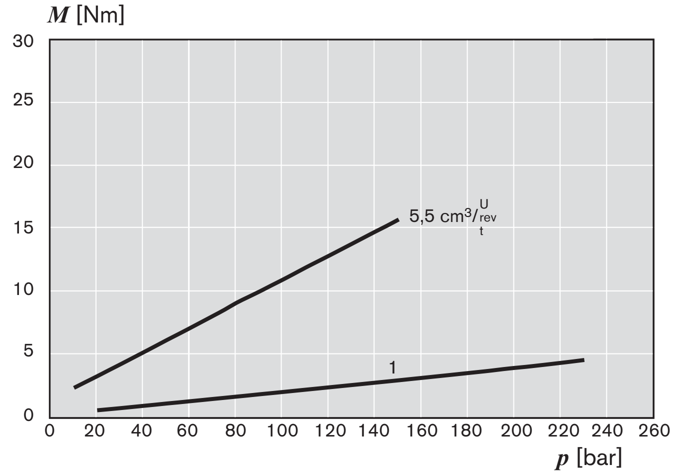


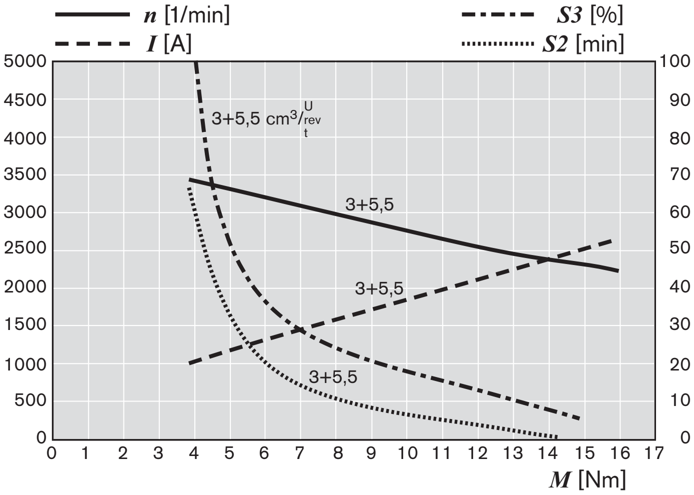
Type of protection:

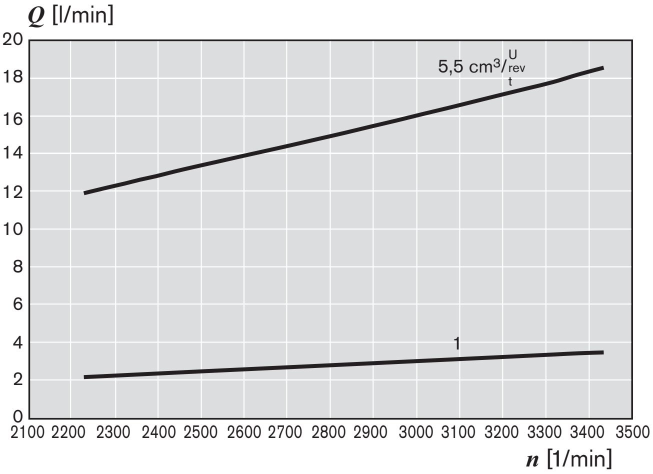
Motor case	IP 20
Ports	IP 00

Ordering code	Displacement	Dimension [mm]					Weight	Part number
	V [cm³/rev]	A	B	C	D	E	[kg]	
EHP24KDL20FB005/1.0-2002A1096N0	5.5 + 1.0	39.0	124.7	165.7	15.0	443.3	20	**0 541 300 058**

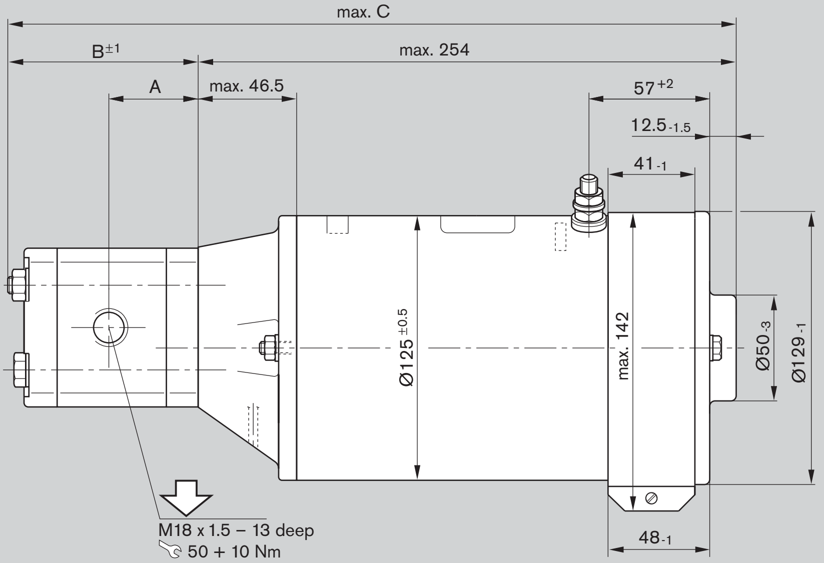
Characteristics
for A 541 001 096

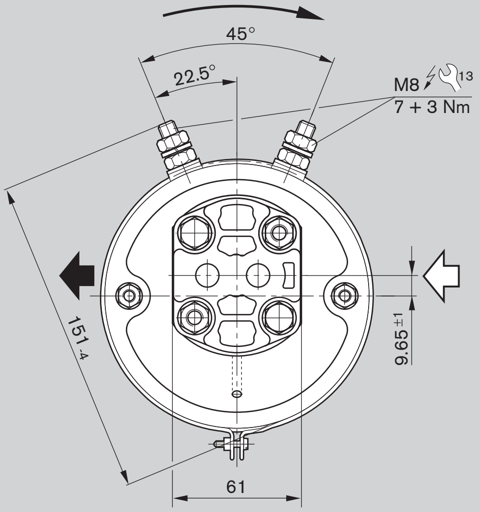


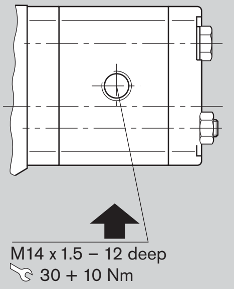


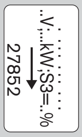


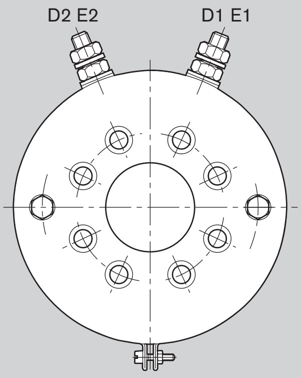
Unit dimensions

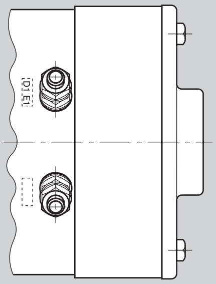


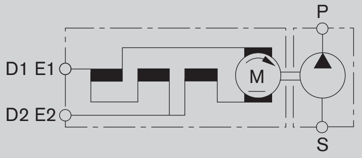












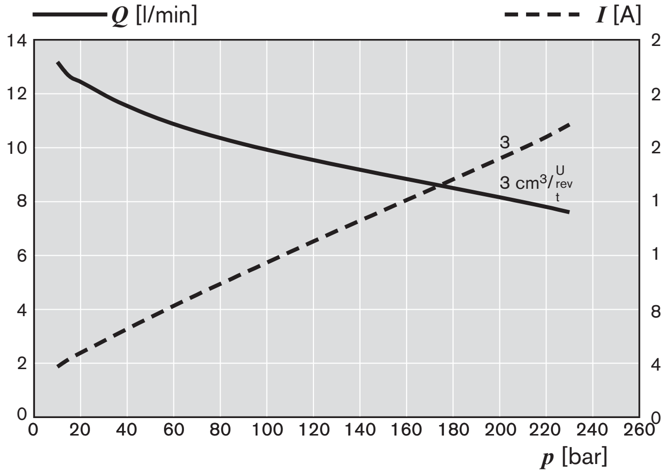
A 541 114 010

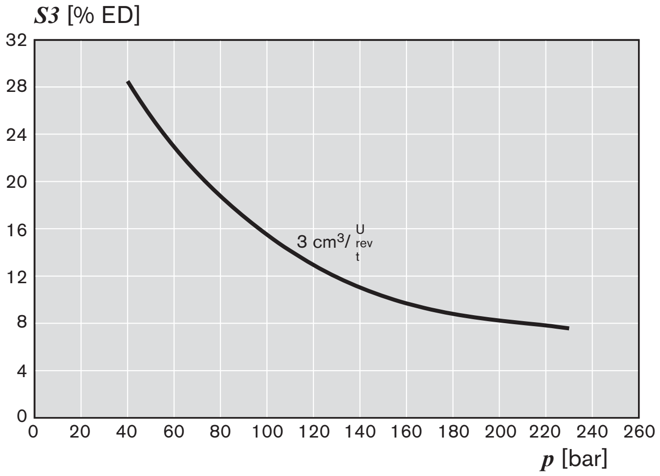
Type of protection:

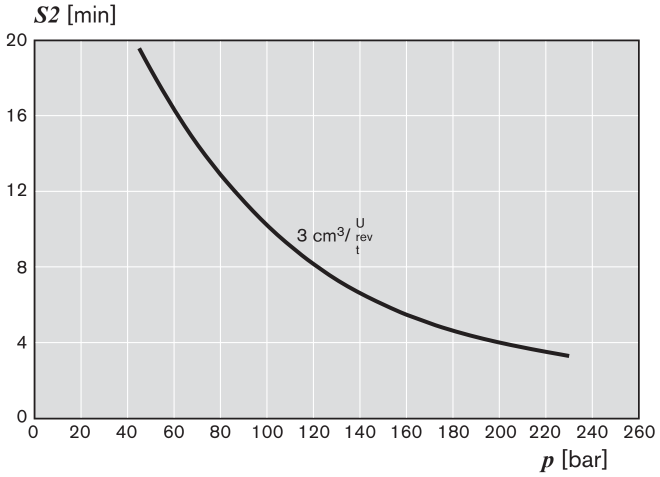
Motor case	IP 43
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Weight	Part number
	V [cm^3/rev]	A	B	C	[kg]	
EHP24KDG43B3.0-02A0611N0	3.0	39.2	86.0	341.0	13.5	**0 541 100 055**

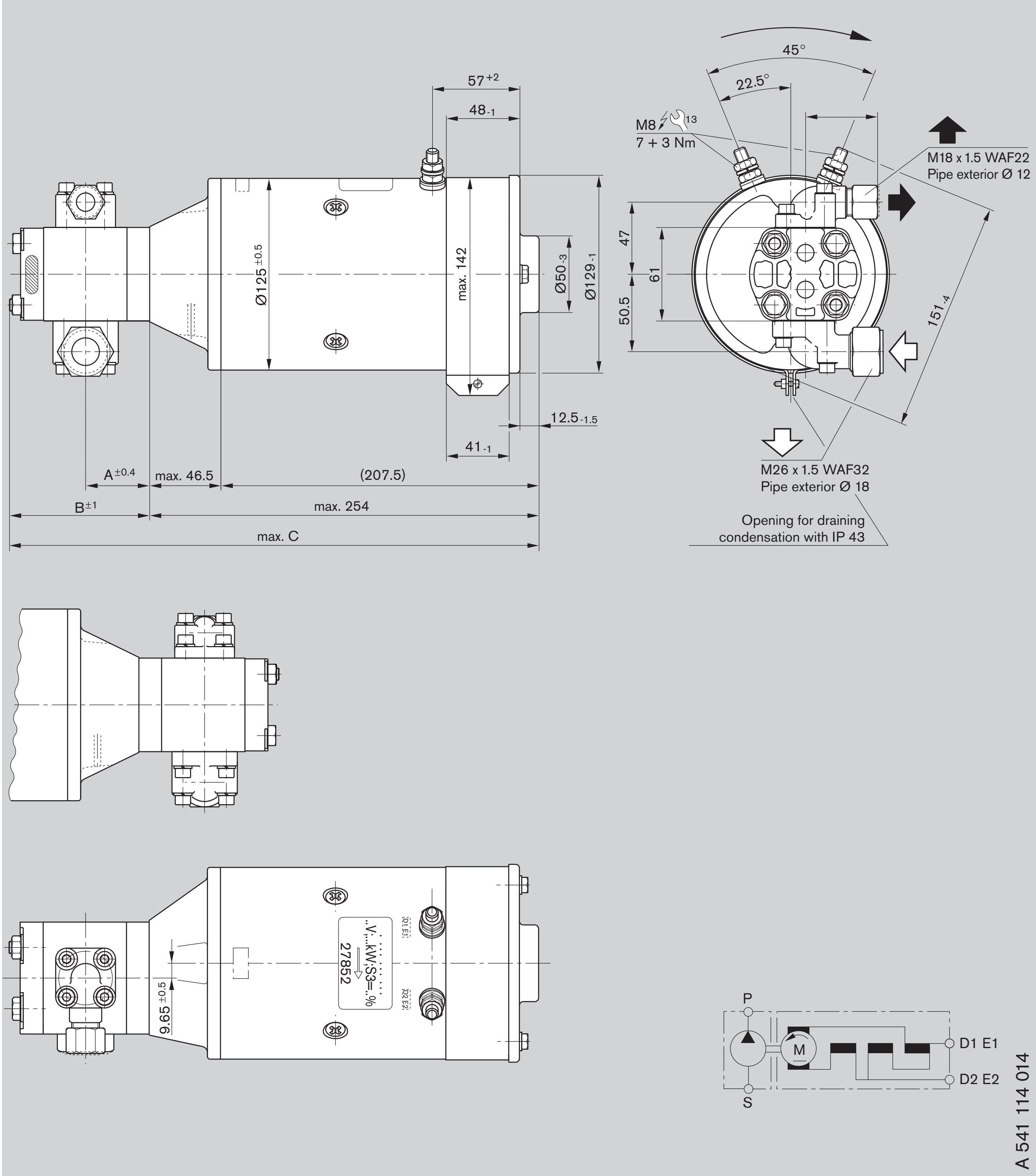
Characteristics for A 541 114 010







Unit dimensions

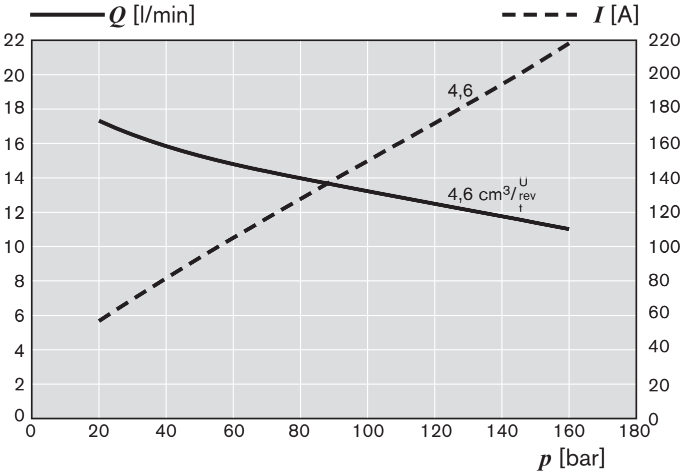


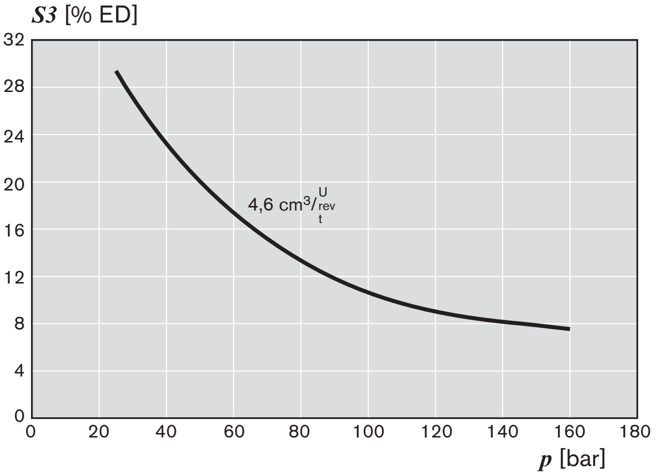
Type of protection:

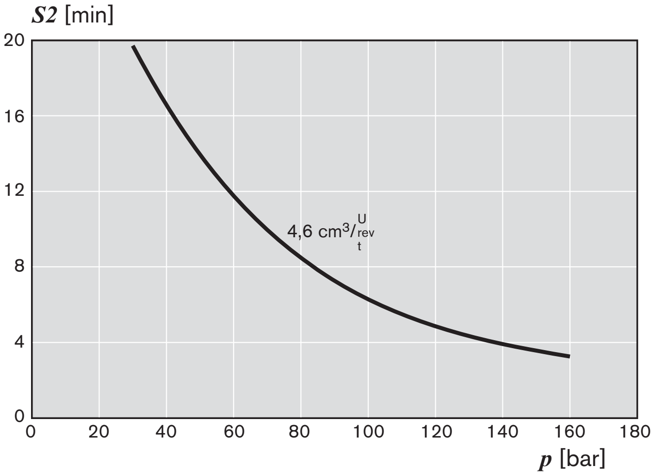
Motor case	IP 43
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Weight	Part number
	V [cm³/rev]	A	B	C	[kg]	
EHP24KDG43B4.6-20C0613N0	4.6	42.0	91.0	346.0	14.1	**0 541 200 067**

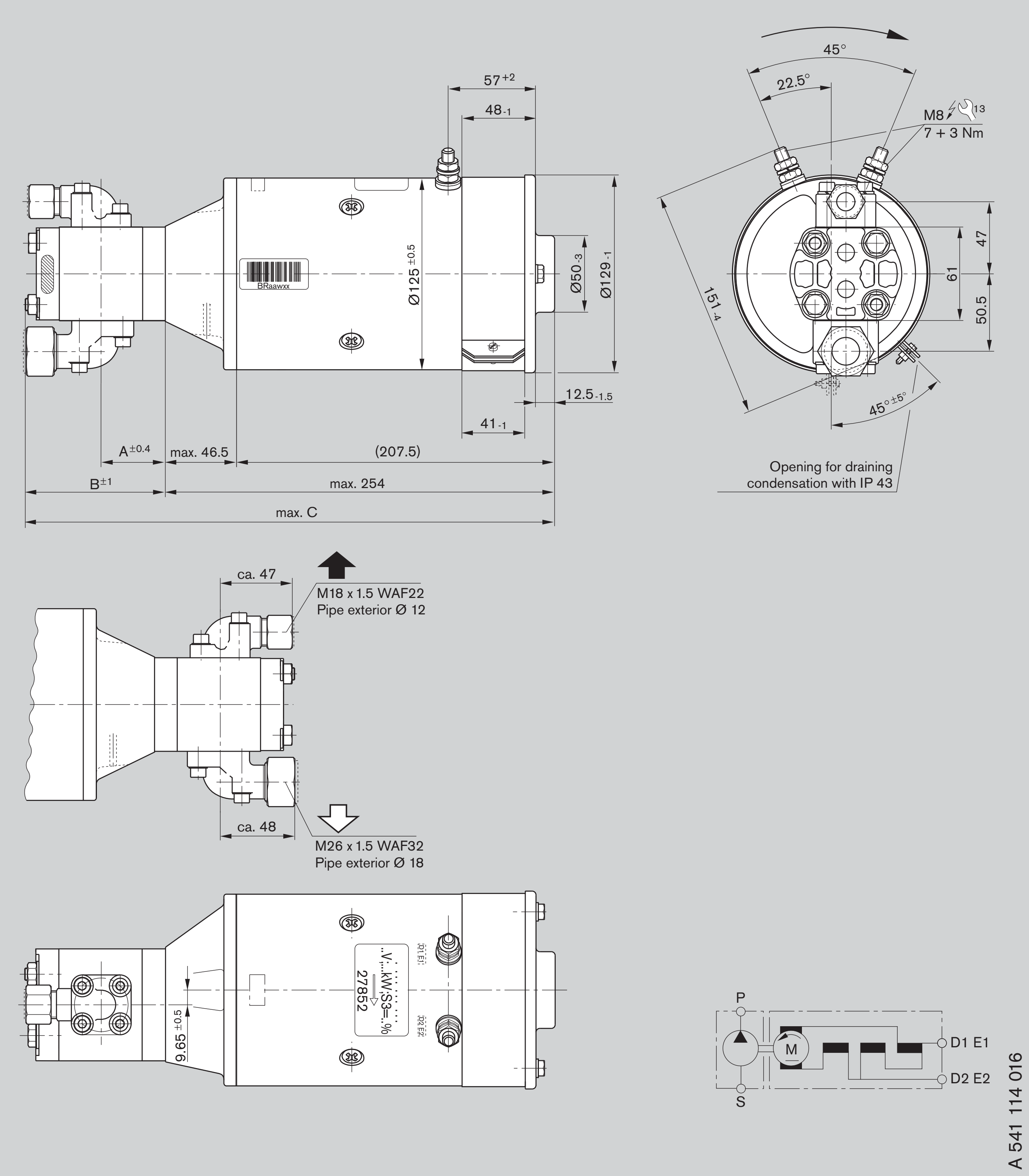
Characteristics
for A 541 114 014







Unit dimensions

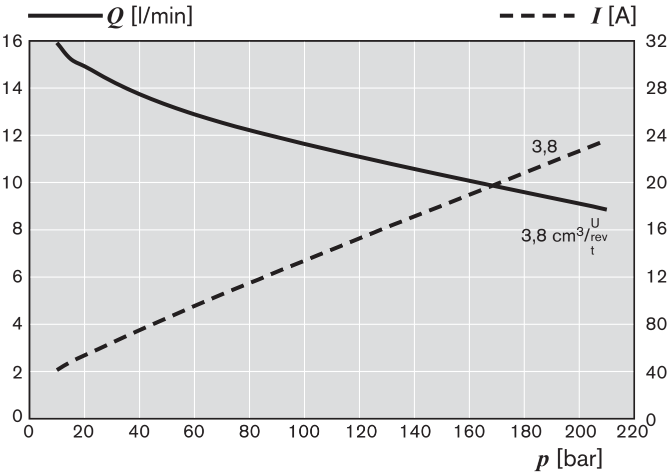


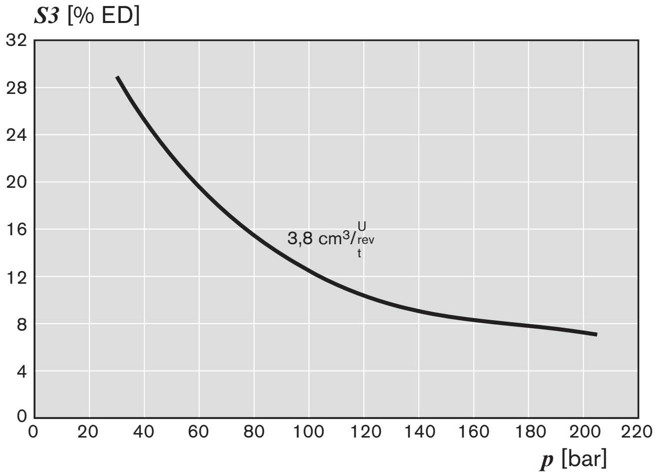
Type of protection:

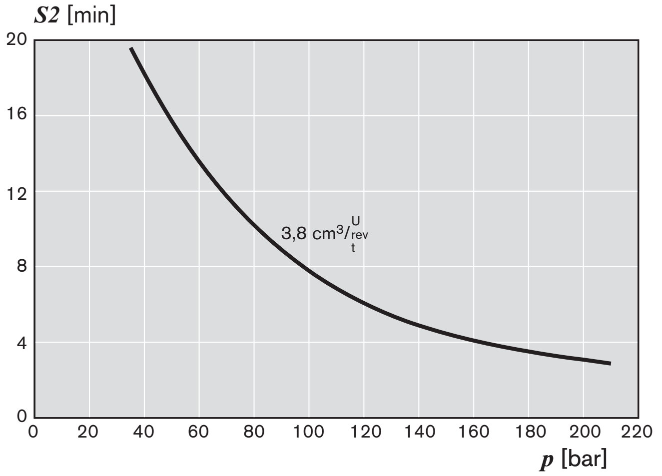
Motor case	IP 43
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Weight	Part number
	V [cm³/rev]	A	B	C	[kg]	
EHP24KDG43B3.8-20C0612N0	3.8	41.0	91.0	346.0	14.3	**0 541 100 054**

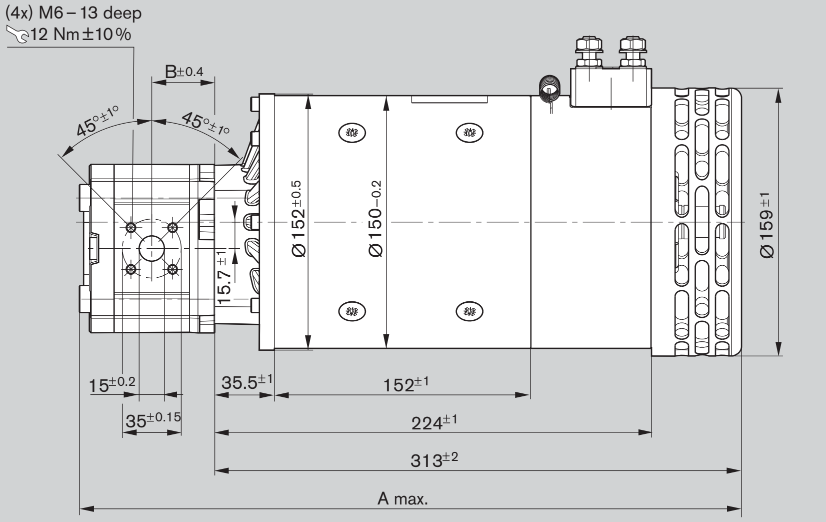
Characteristics for A 541 114 016

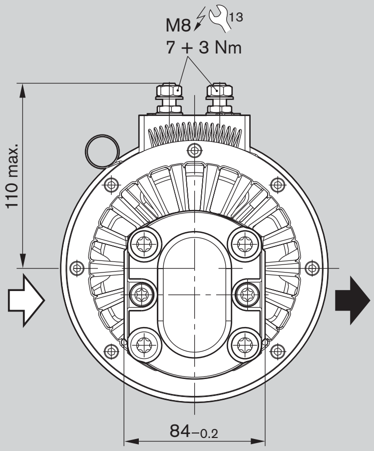


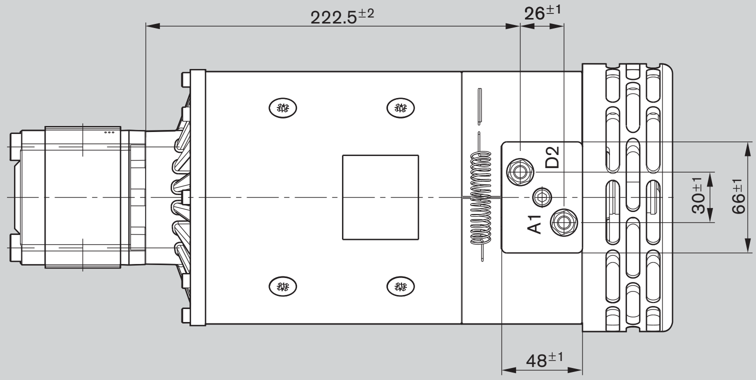


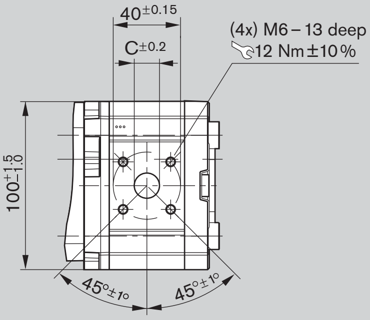


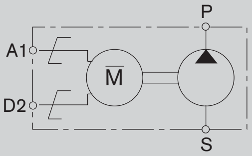
Unit dimensions











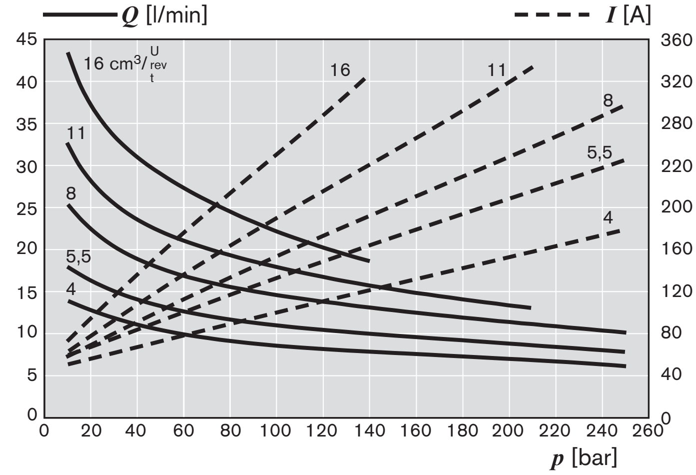
A 541 021 351

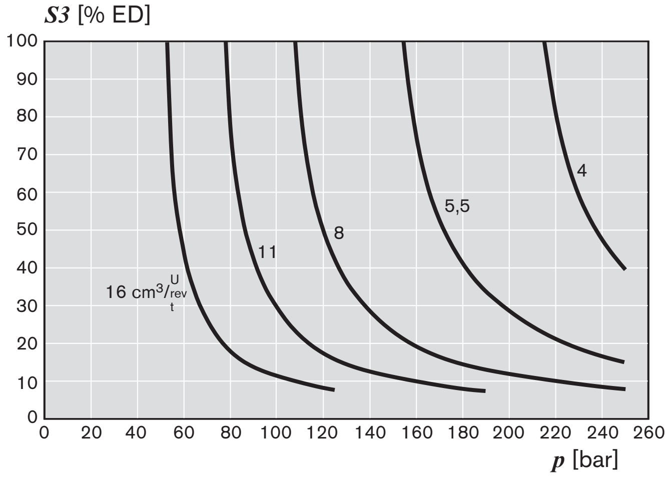
Type of protection:

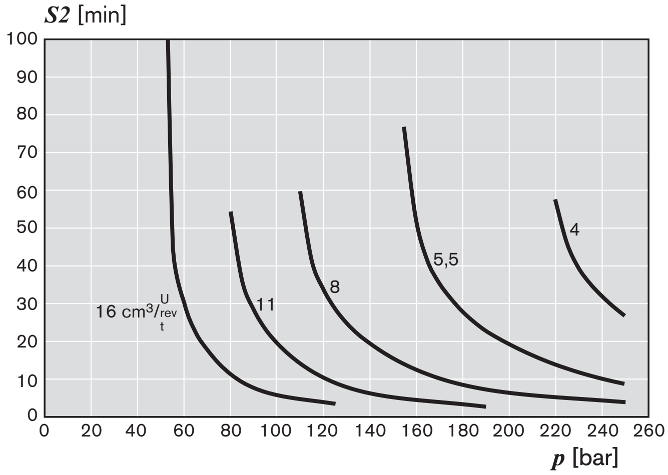
Motor case	IP 20
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Weight	Part number
	V [cm³/rev]	A	B	C	[kg]	
EHP24PRL20F004-20E1325N0	4.0	396.0	37.4	15.0	20.4	**0 541 200 083**
EHP24PRL20F005-20E1326N0	5.5	399.0	38.6	15.0	20.4	**0 541 300 068**
EHP24PRL20F008-20E1327N0	8.0	403.0	40.7	20.0	20.5	**0 541 400 075**
EHP24PRL20F011-20E1328N0	11.0	408.0	44.5	20.0	20.7	**0 541 500 082**
EHP24PRL20F016-20E1338N0	16.0	416.0	45.0	20.0	20.9	**0 541 600 043**

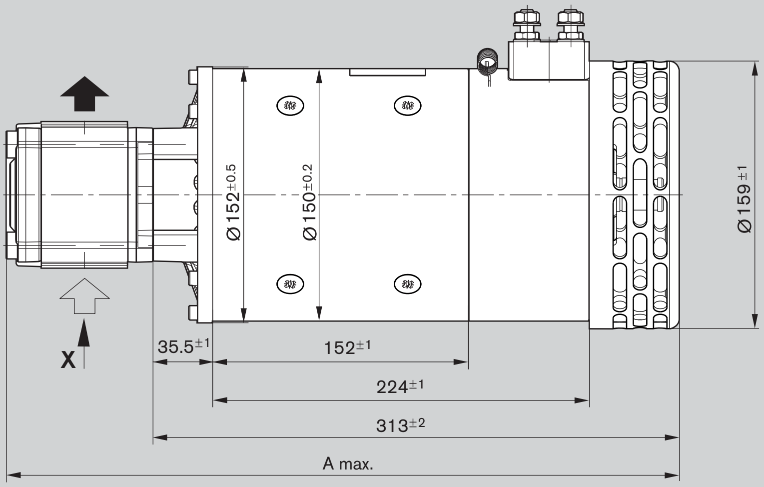
Characteristics
for A 541 021 351

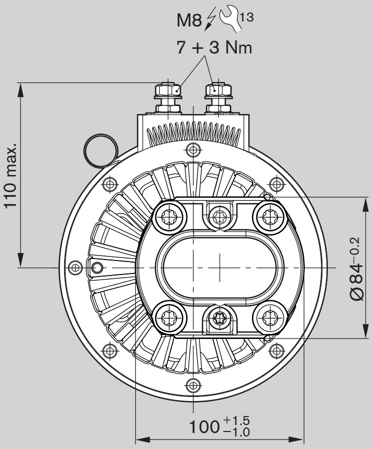


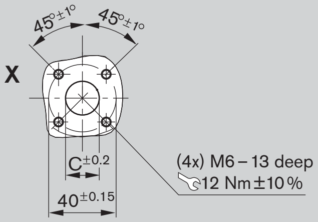


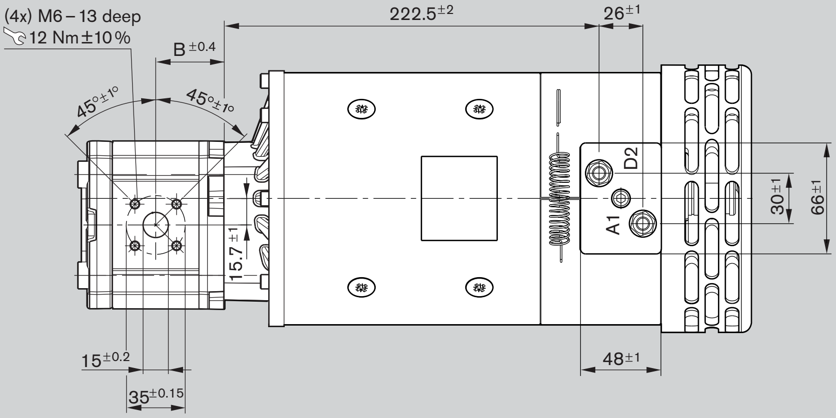


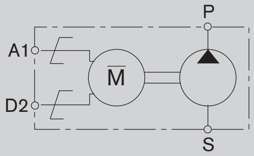
Unit dimensions











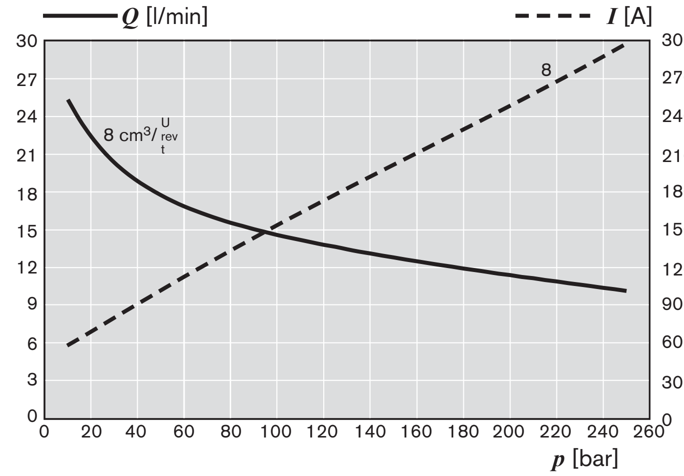
A 541 021 367

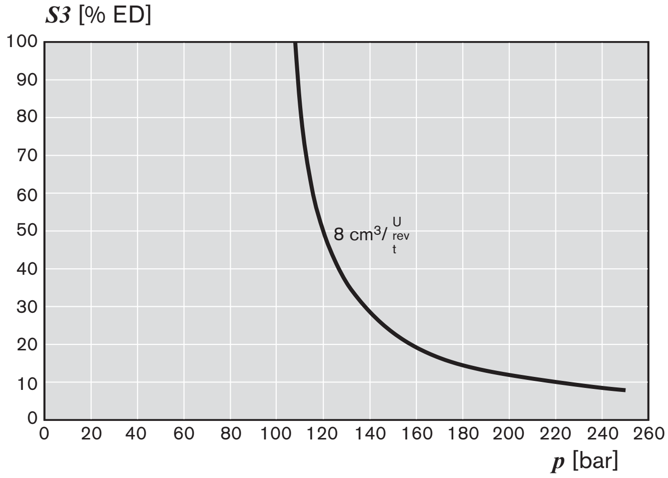
Type of protection:

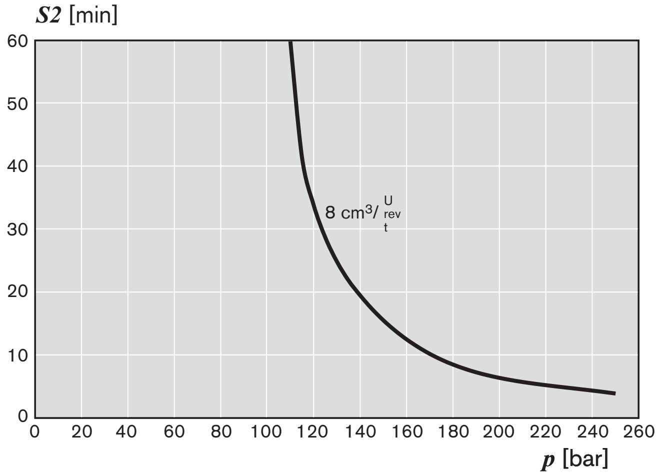
Motor case	IP 20
Ports	IP 00

Ordering code	Displacement	Dimension [mm]				Part number
	V [cm³/rev]	A	B	C	kg	
EHP24PRL20F008-20C1327N0	8.0	403	40.7	20	20.5	**0 541 400 079**

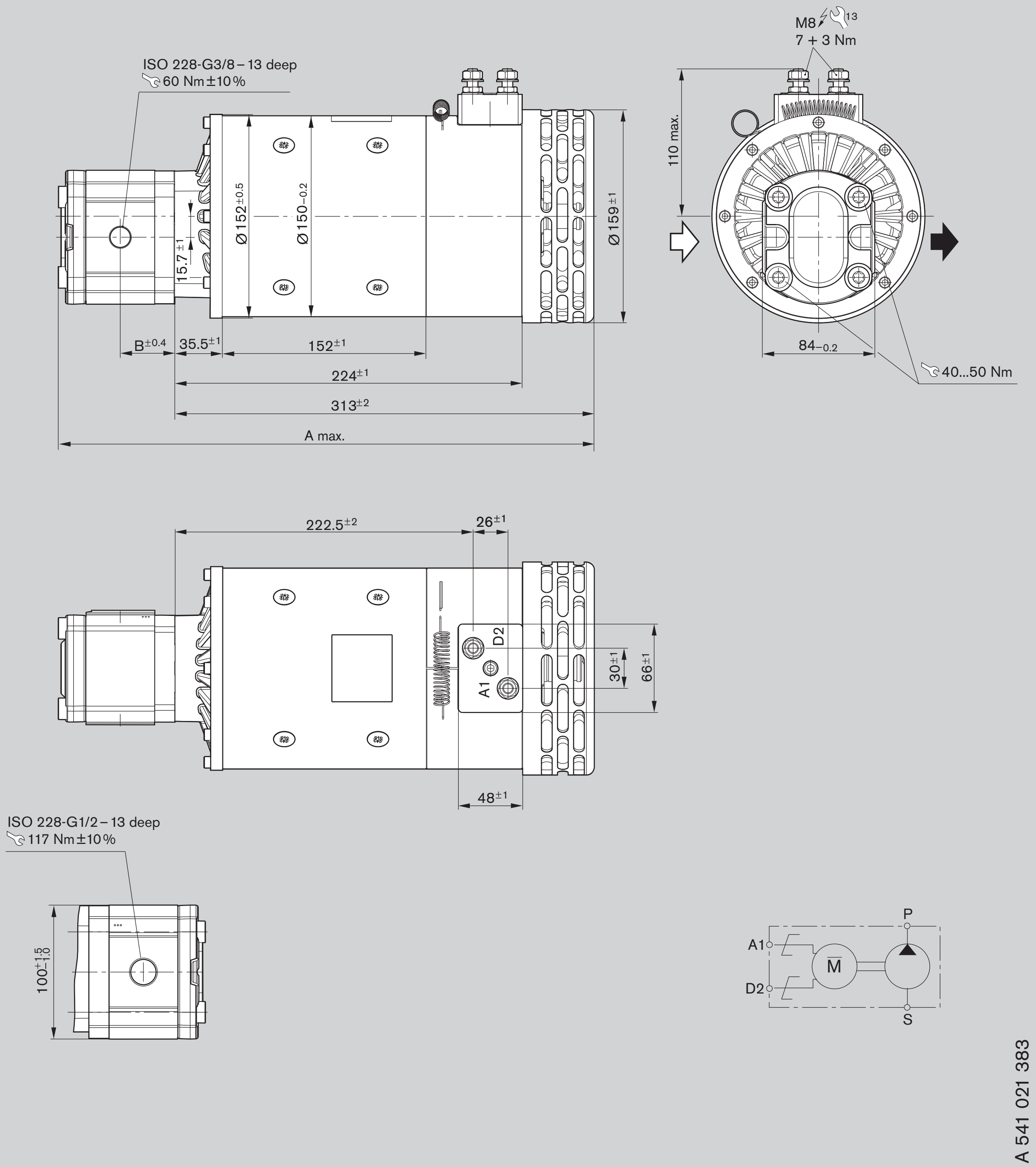
Characteristics
for A 541 021 367







Unit dimensions

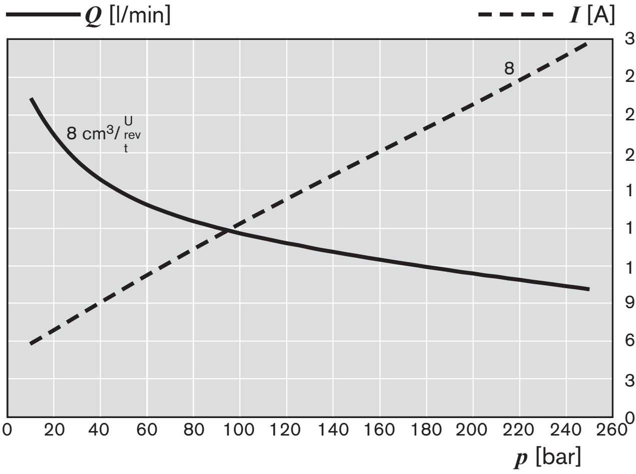


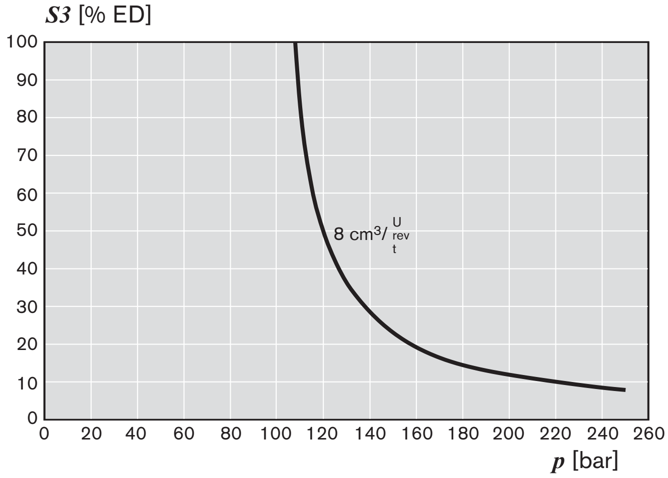
Type of protection:

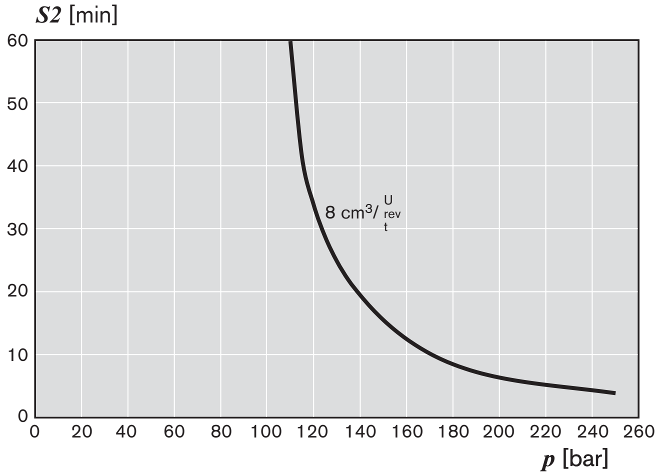
Motor case	IP 20
Ports	IP 00

Ordering code	Displacement	Dimension [mm]		Weight	Part number
	V [cm³/rev]	A	B	[kg]	
EHP24PRL20F008-01E1327N0	8.0	403	40.7	20.5	**0 541 400 083**

Characteristics
for A 541 021 383

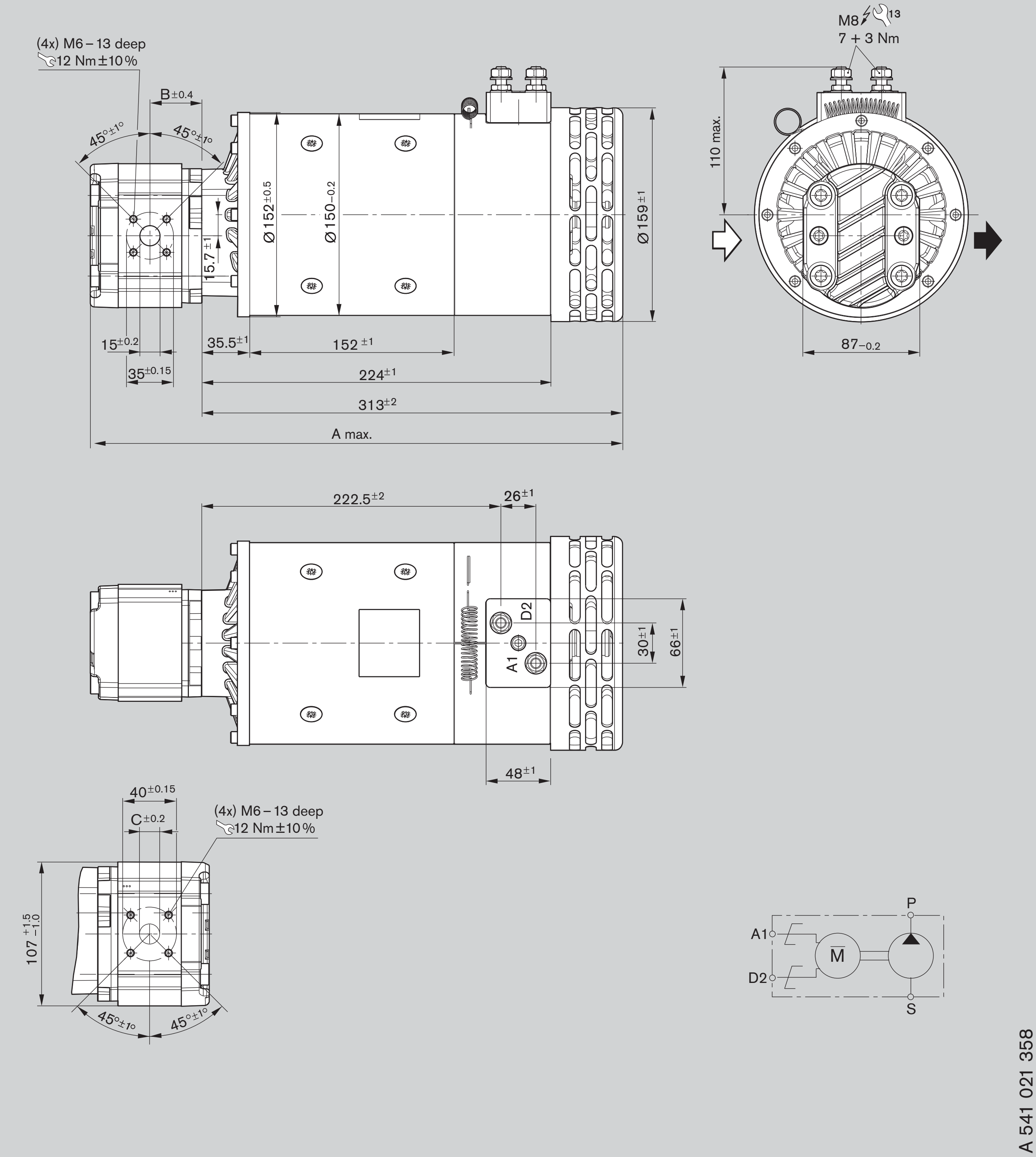






8

Unit dimensions

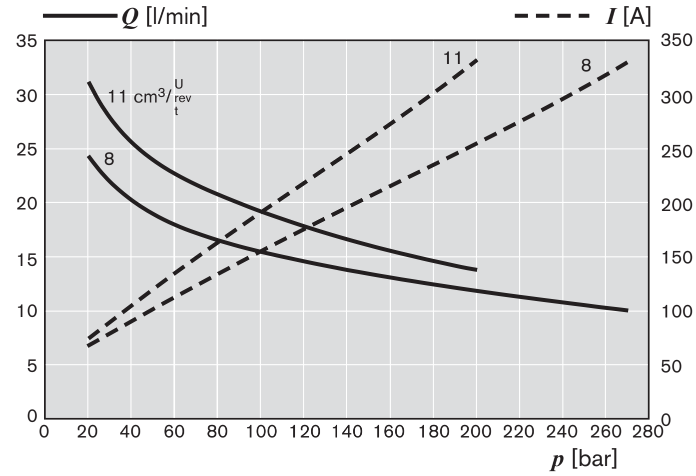


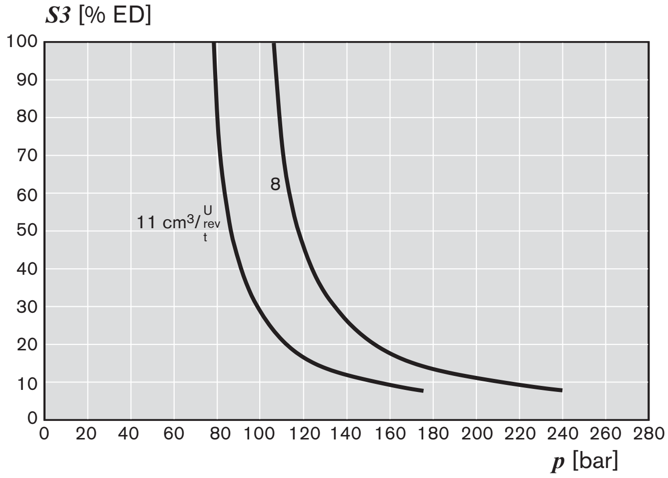
Type of protection:

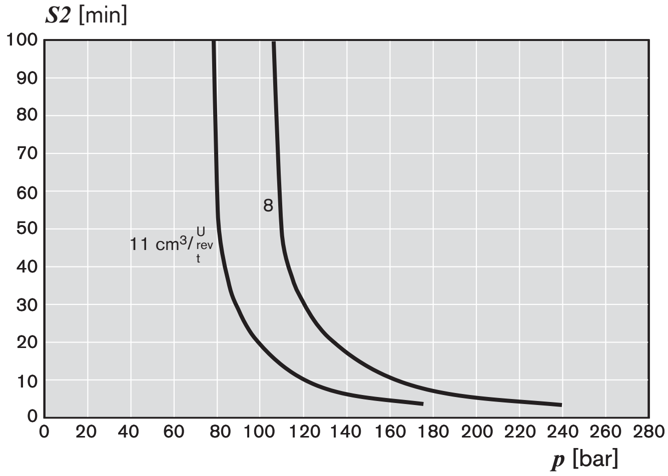
Motor case	IP 20
Ports	IP 00

Ordering code	Displacement V [cm^3/rev]	Dimension [mm] A	 B	 C	Weight [kg]	Part number
EHP24PRL24S008-20E1335N0	8.0	403	40.7	20	20.6	**0 541 400 077**
EHP24PRL24S011-20E1337N0	11.0	408	44.5	20	20.7	**0 541 500 083**

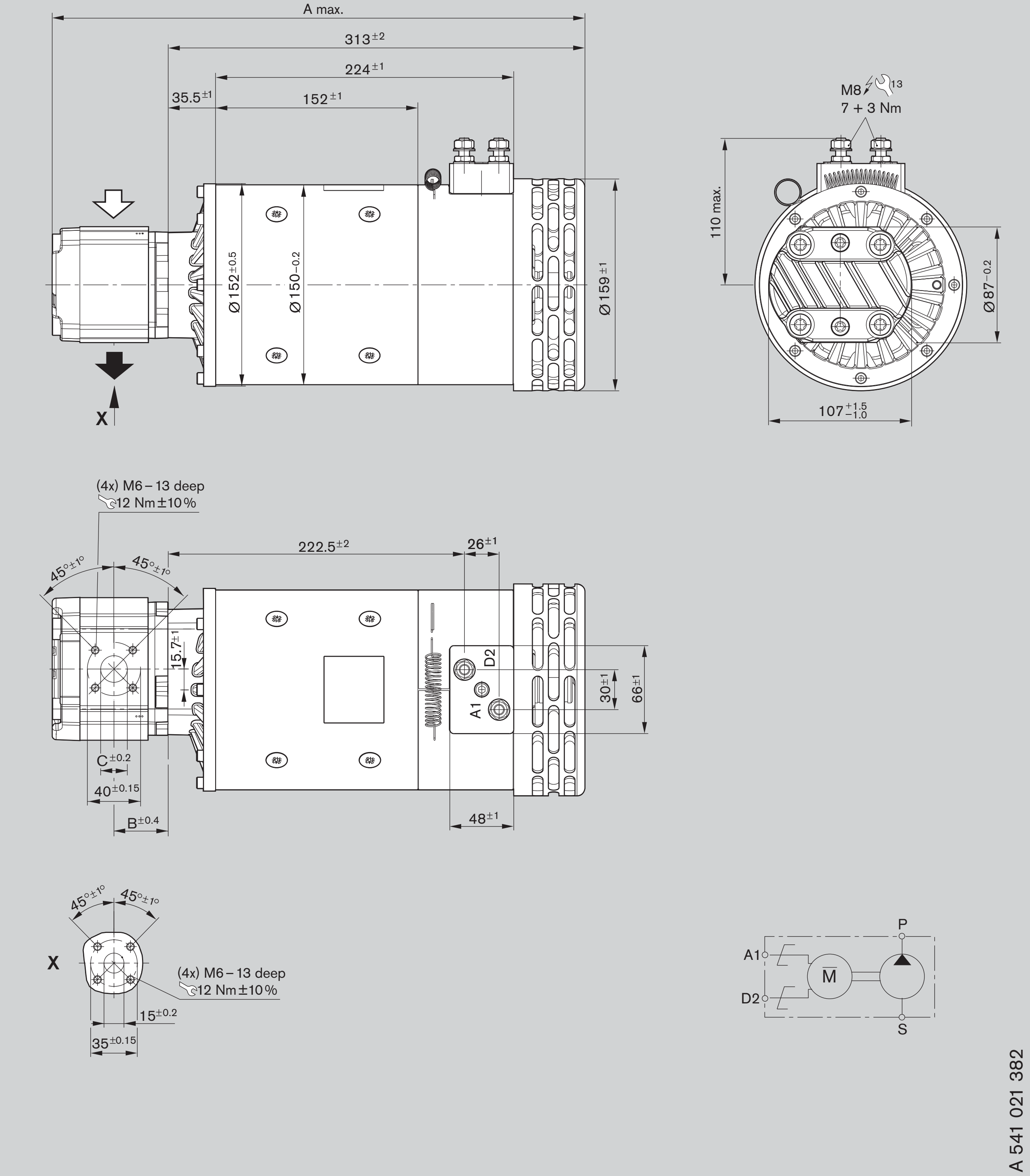
Characteristics for A 541 021 358







Unit dimensions

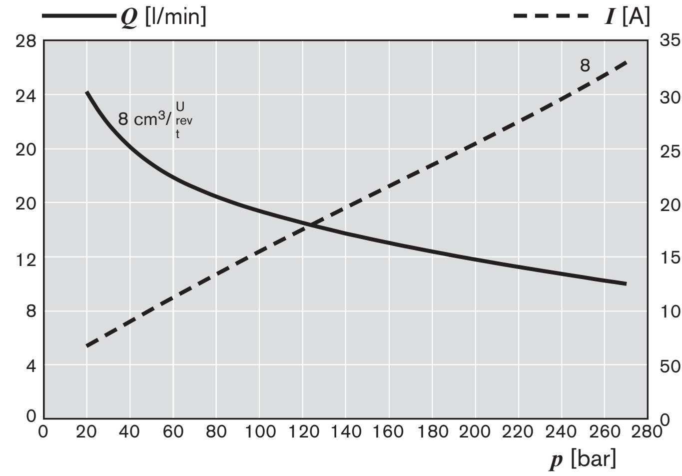


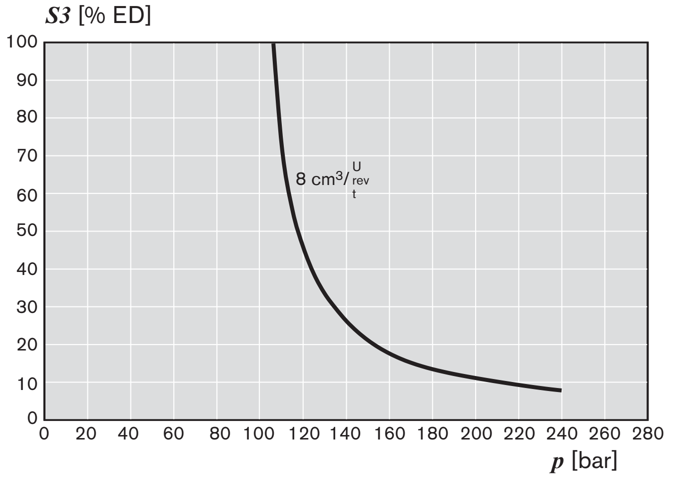
Type of protection:

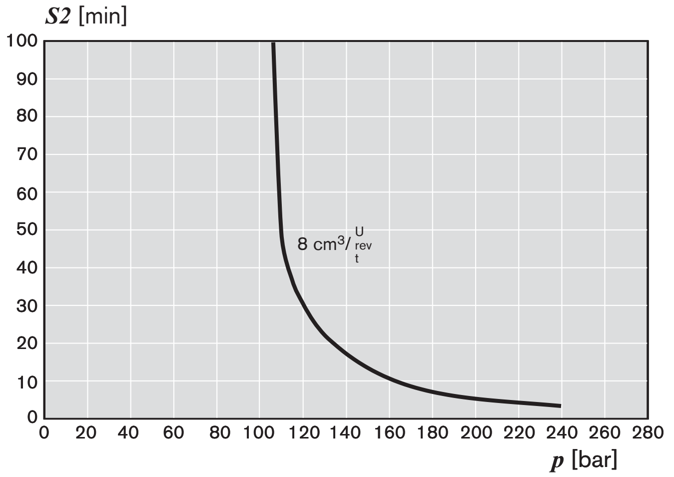
Motor case	IP 20
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Weight	Part number
	V [cm^3/rev]	A	B	C	[kg]	
EHP24PRL20S008-20G1335N0	8.0	403	40.7	20	20.6	**0 541 400 082**

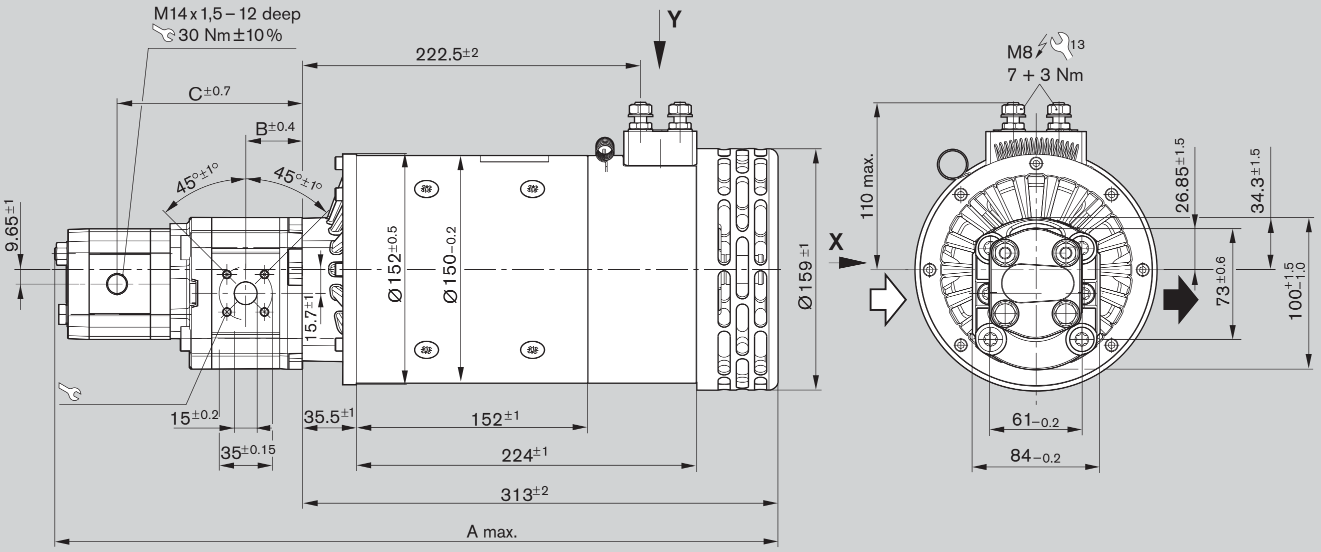
Characteristics for A 541 021 382

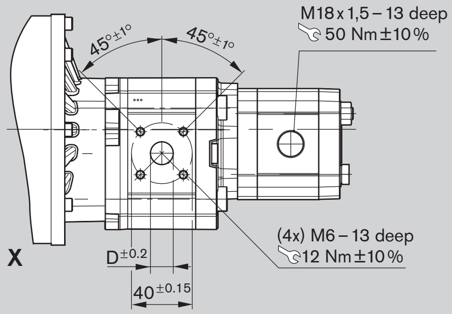


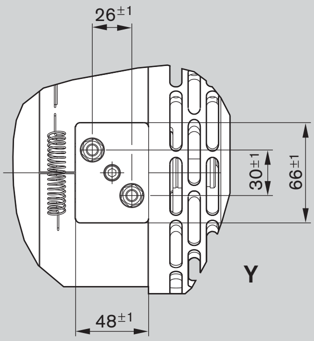


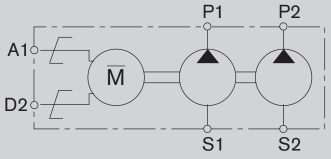


Unit dimensions









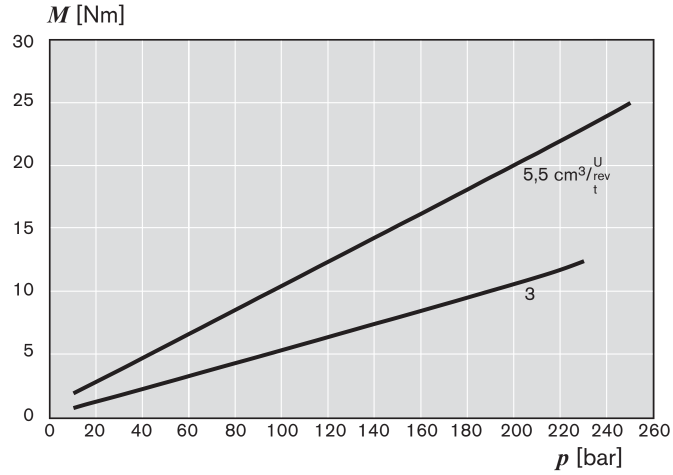
A 541 021 357

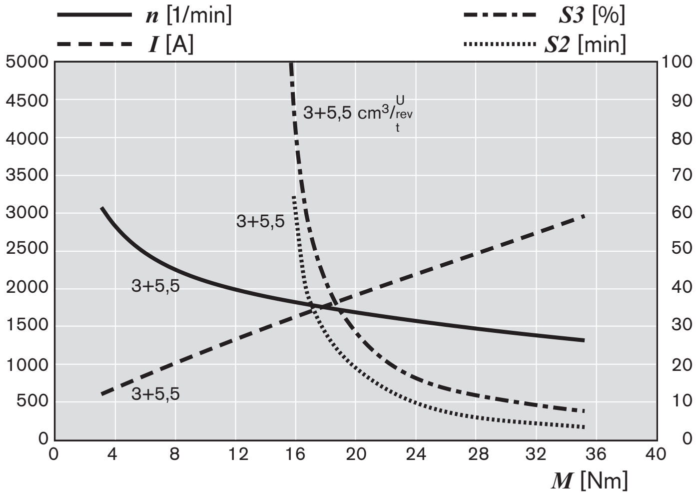
Type of protection:

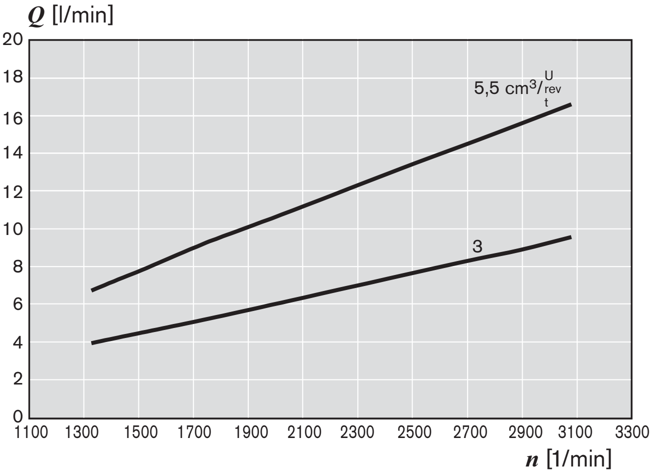
Motor case	IP 20
Ports	IP 00

Ordering code	Förder-volumen V [cm³/rev]	Dimension [mm]				Weight [kg]	Part number
		A	B	C	D		
EHP24PRL20FB005/3.0-2002E1324N0	5.5 + 3.0	492	38.6	128.9	15	21.6	**0 541 300 069**

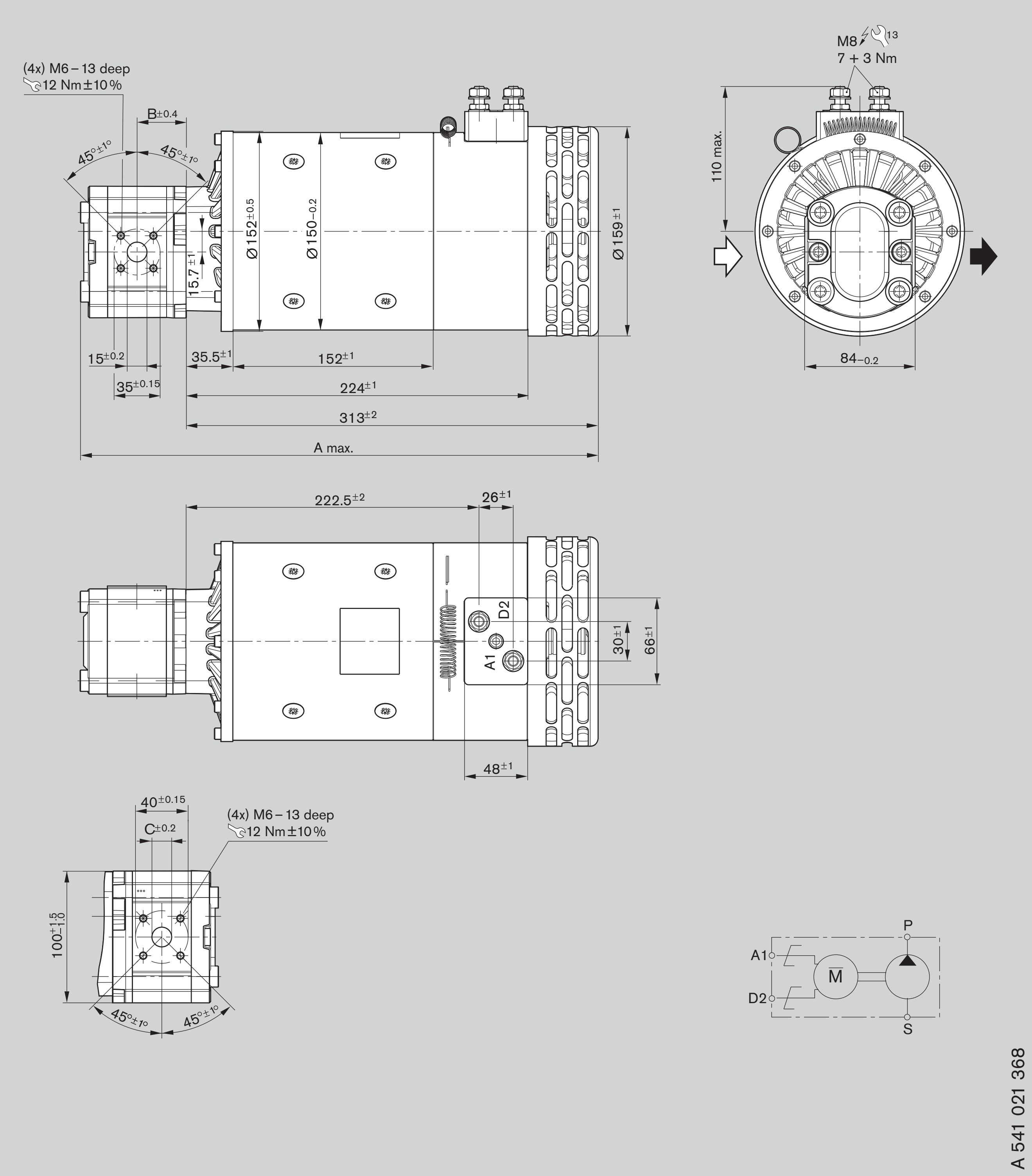
Characteristics for A 541 021 357







Unit dimensions

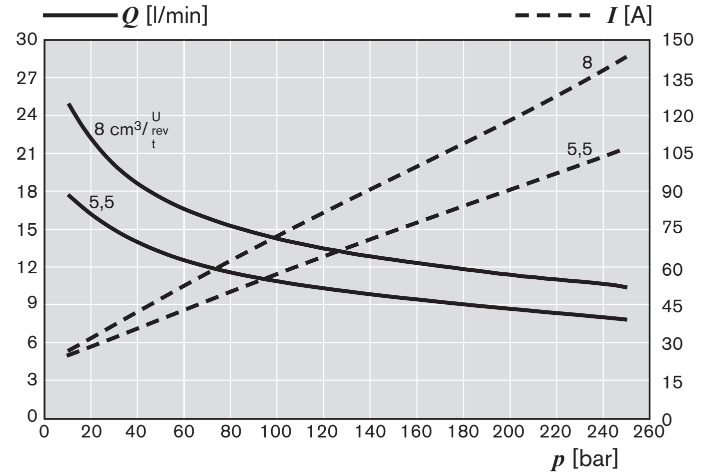


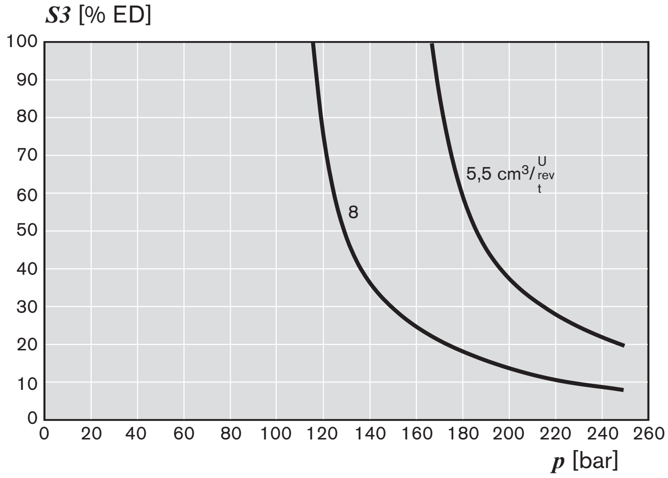
Type of protection:

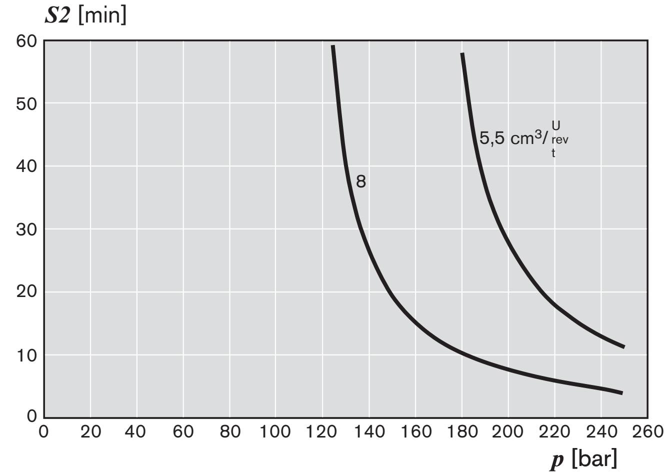
Motor case	IP 20
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Weight	Part number
	V [cm^3/rev]	A	B	C	[kg]	
EHP48PRL20F005-20E1341N0	5.5	399	38.6	15	20.4	**0 541 300 074**
EHP48PRL20F008-20E1344N0	8.0	403	40.7	20	20.5	**0 541 400 080**

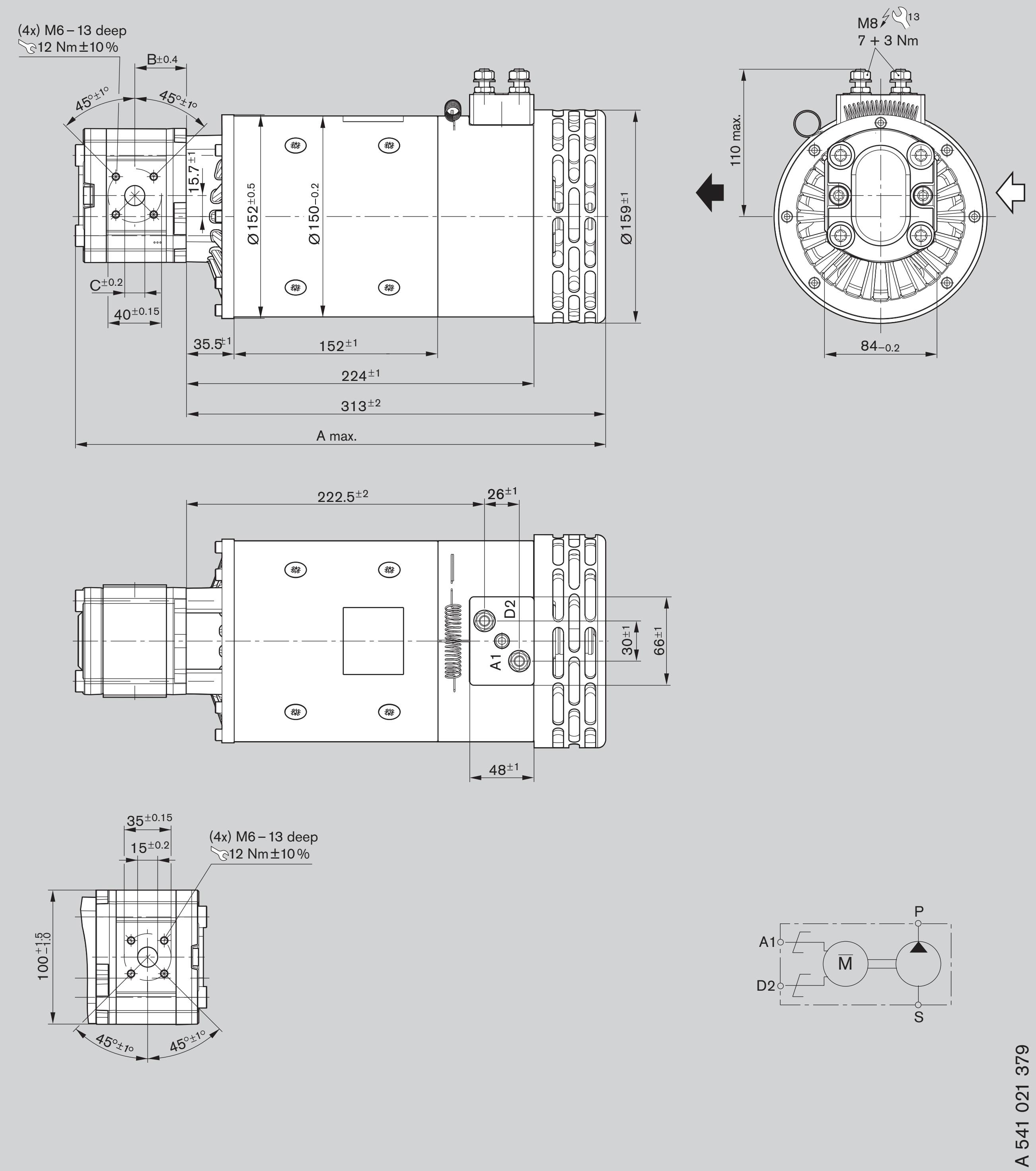
Characteristics
for A 541 021 368







Unit dimensions

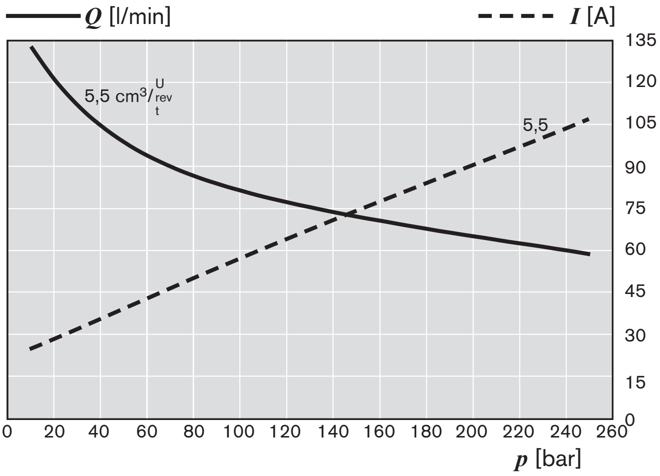


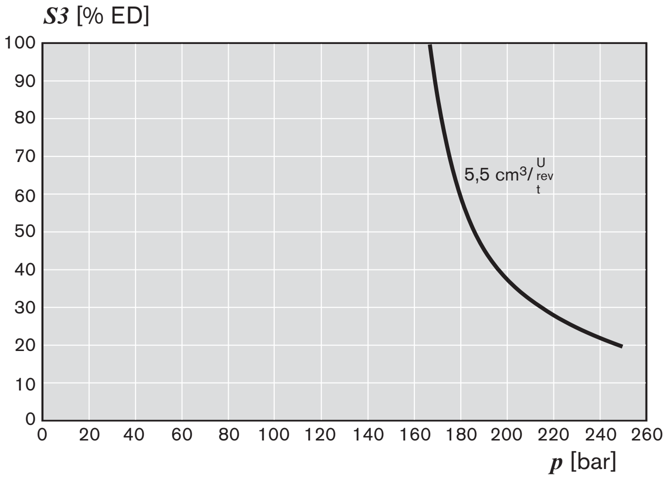
Type of protection:

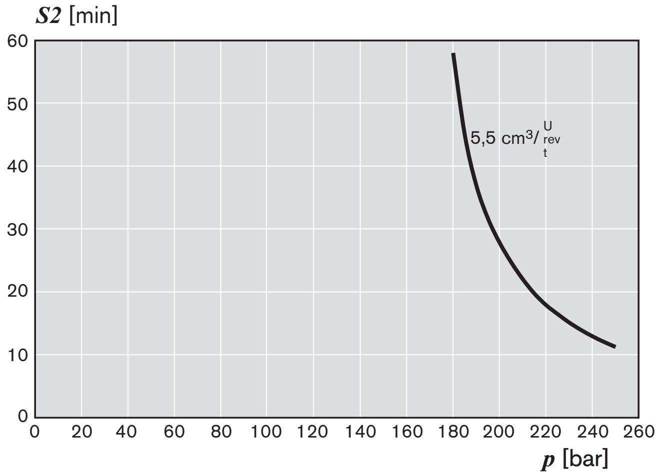
Motor case	IP 20
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Weight	Part number
	V [cm³/rev]	A	B	C	[kg]	
EHP48PRL20F005-20A1341N0	5.5	399	38.6	15	20.4	**0 541 300 079**

Characteristics
for A 541 021 379







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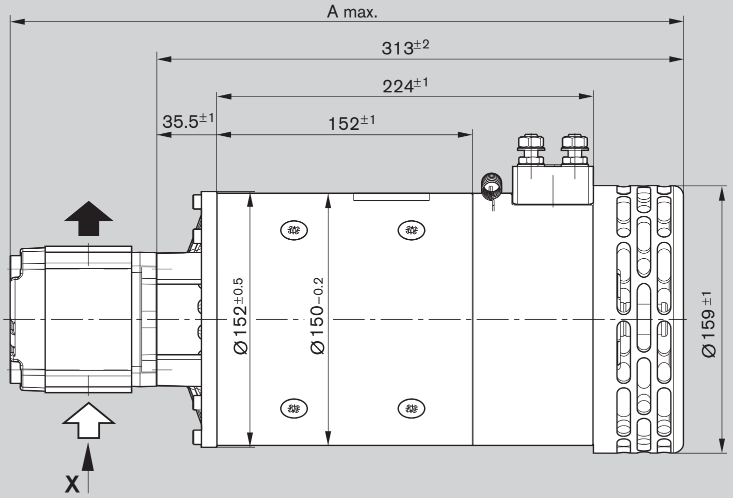
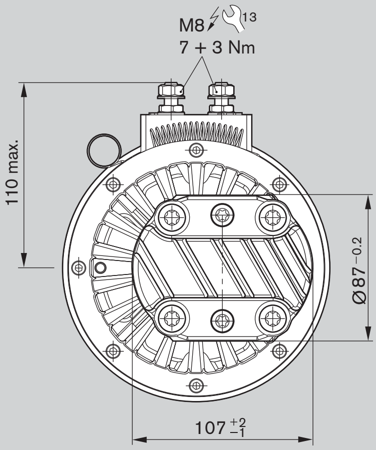
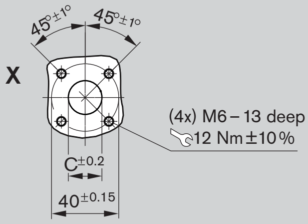
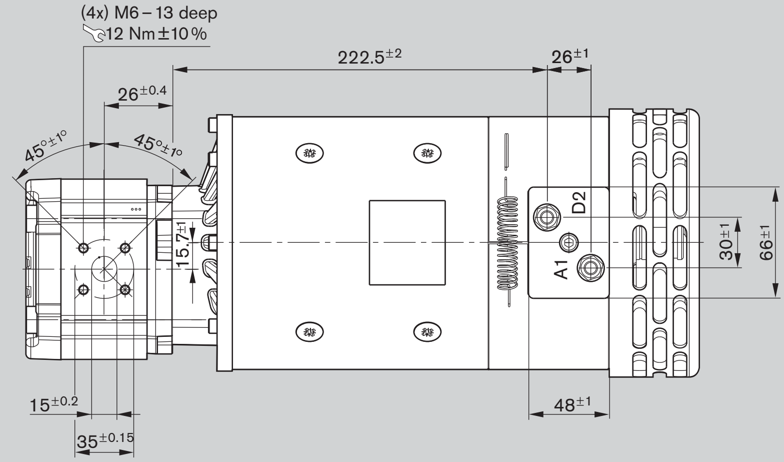
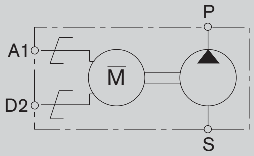










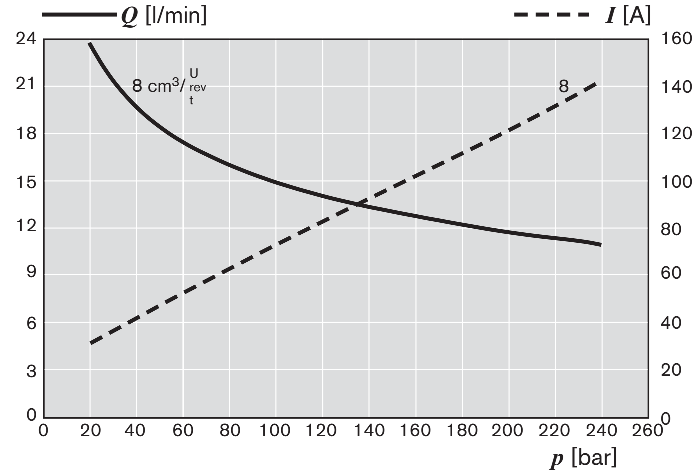
A 541 021 366

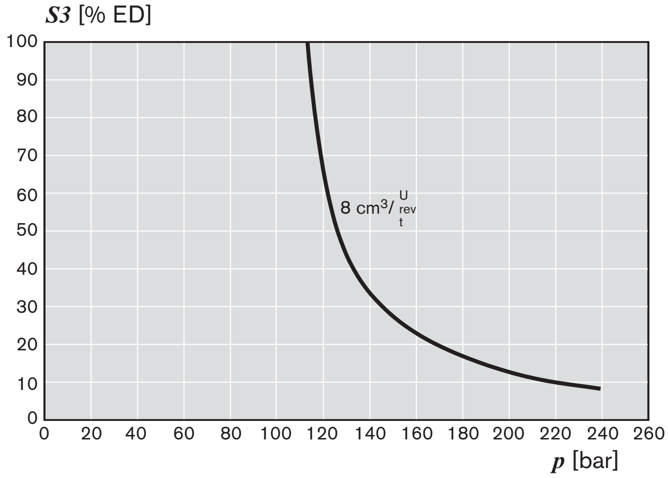
Type of protection:

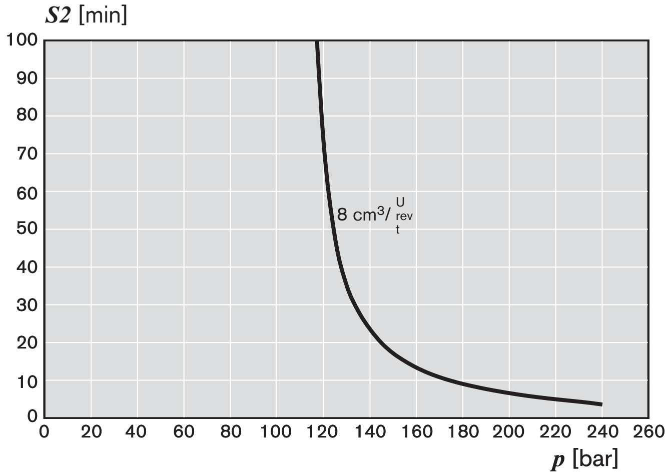
Motor case	IP 20
Ports	IP 00

Ordering code	Displacement	Dimension [mm]			Weight	Part number
	V [cm³/rev]	A	B	C	[kg]	
EHP48PRL20S008-20C1339N0	8.0	403	40.7	20	20.6	**0 541 400 078**

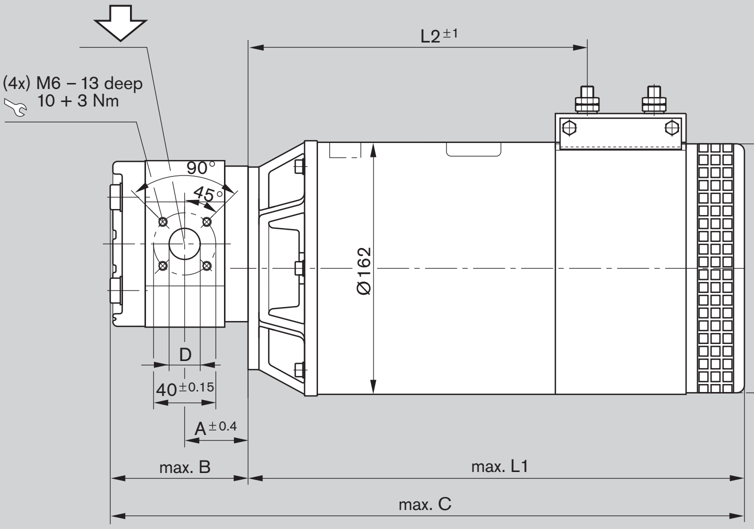
Characteristics
for A 541 021 366

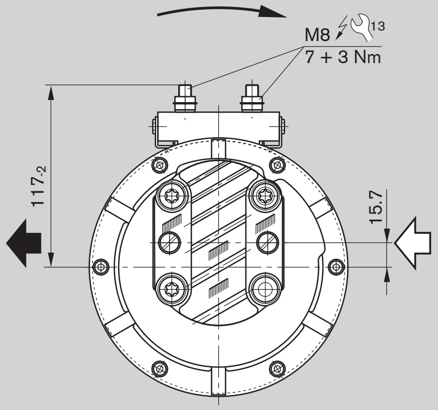


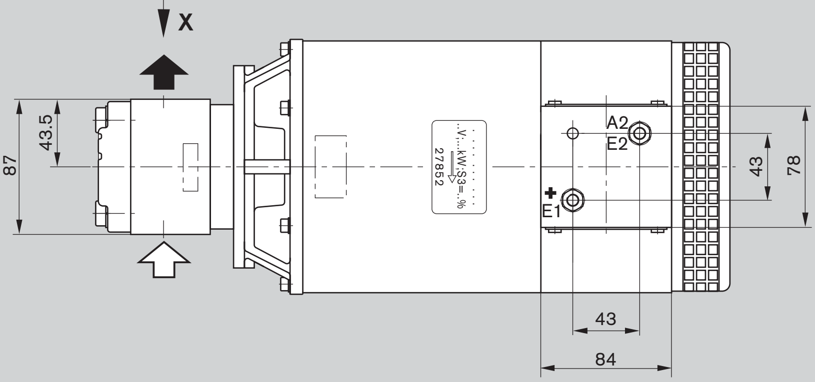


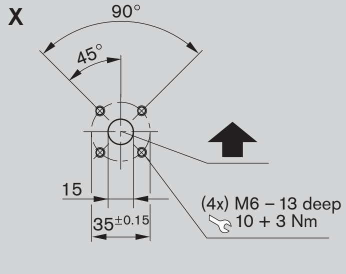


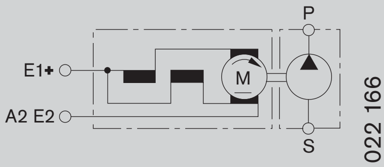
Unit dimensions











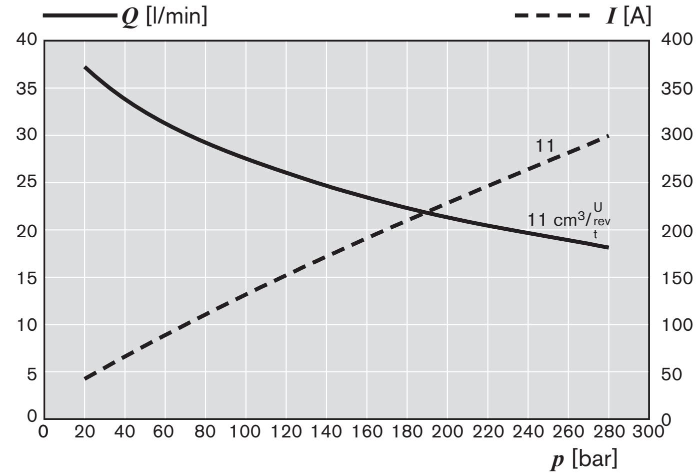
A 541 022 166

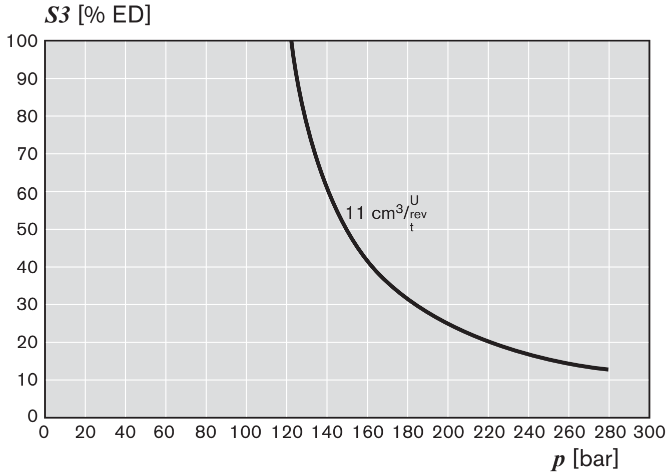
Type of protection:

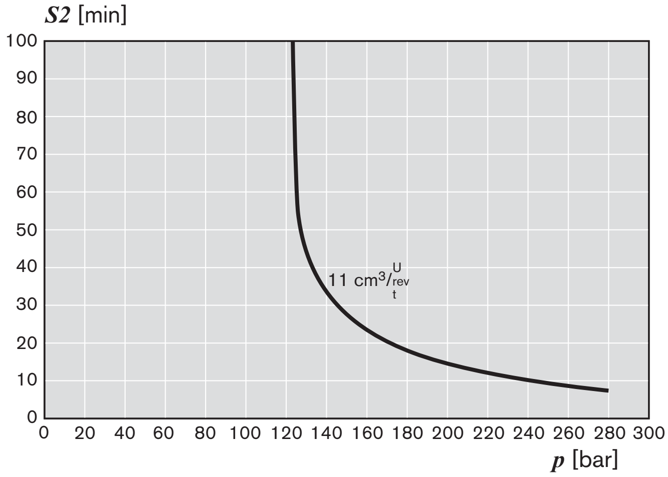
Motor case	IP 10
Ports	IP 00

Ordering code	Displacement	Dimension [mm]						Weight	Part number
	V [cm^3/rev]	A	B	C	D	L1	L2	[kg]	
EHP48SDL14S011-20A1173N0	11.0	45.5	94.2	461.0	20.0	366.0	262.5	26	**0 541 500 074**

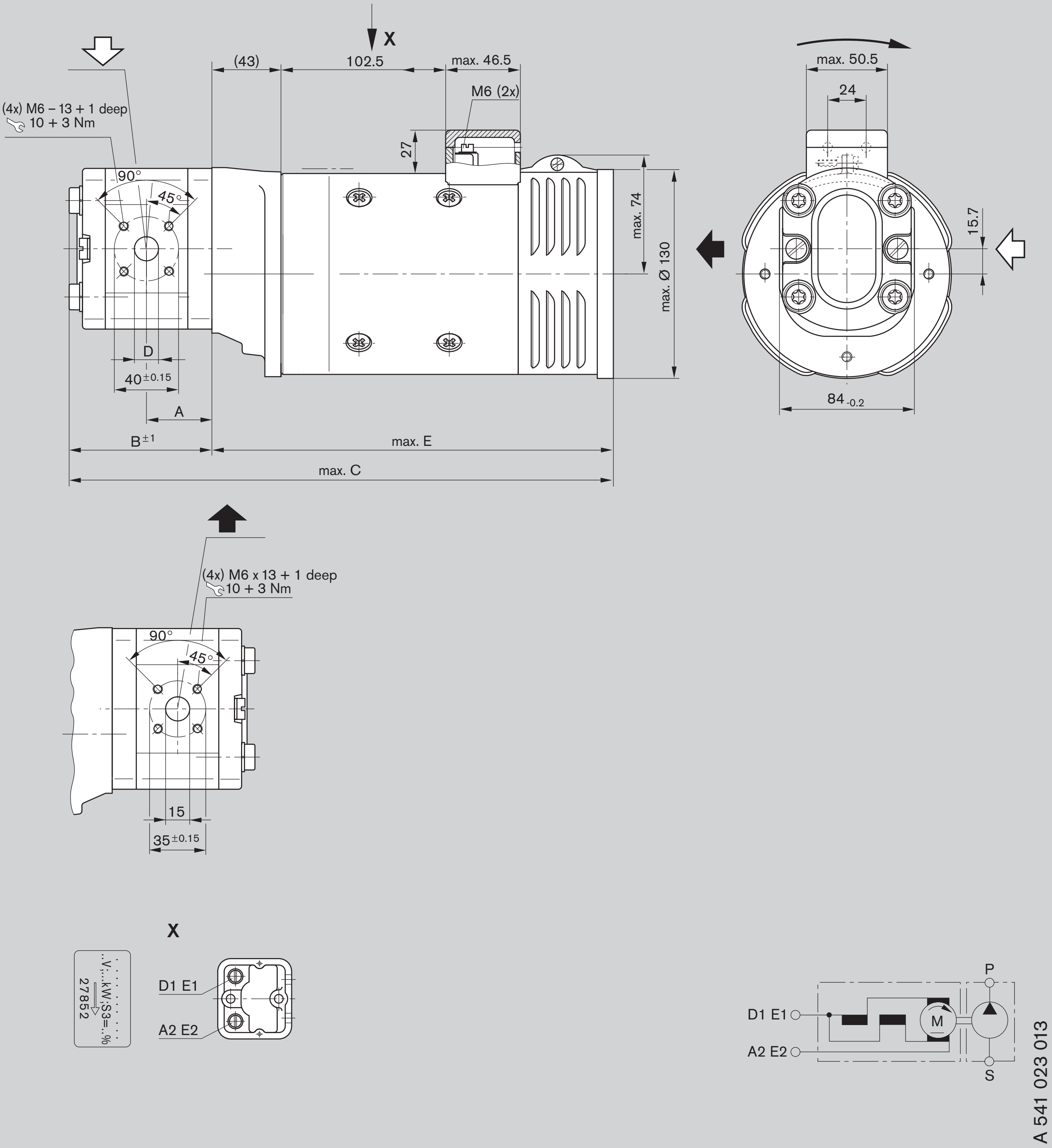
Characteristics for A 541 022 166







Unit dimensions

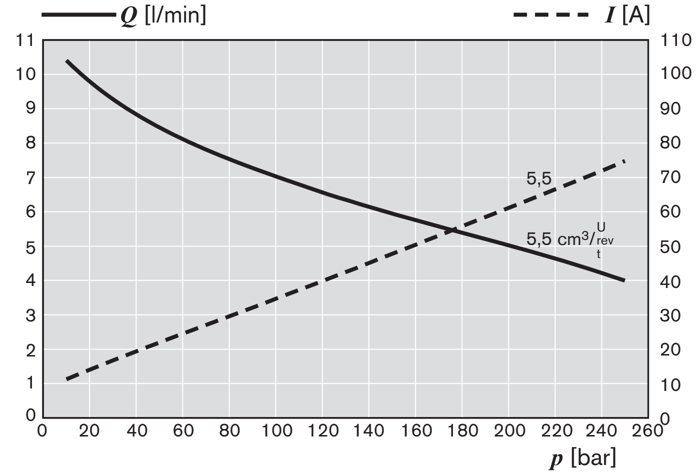


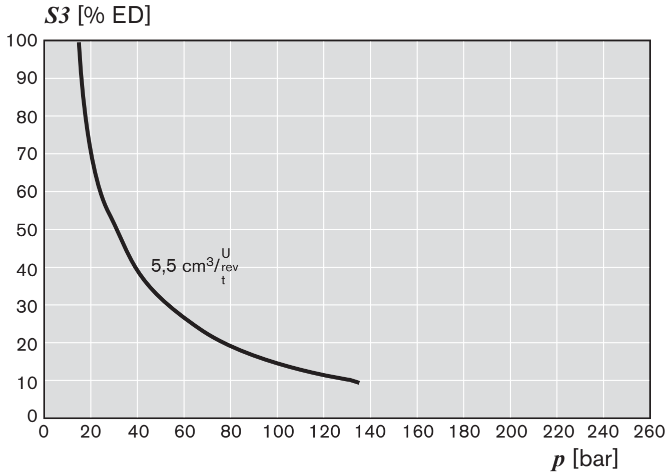
Type of protection:

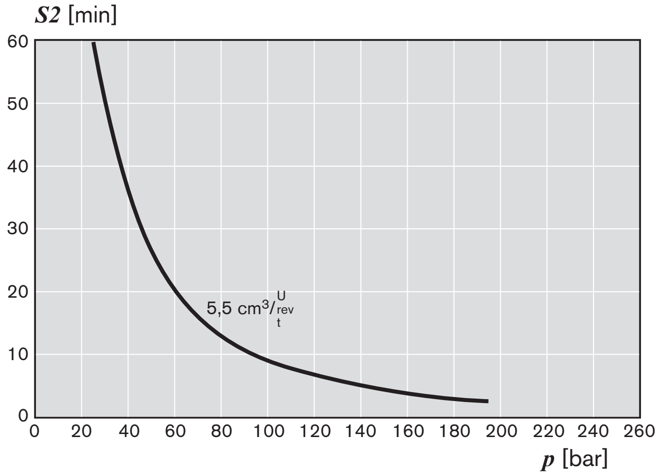
Motor case	IP 10
Ports	IP 44

Ordering code	Displacement	Dimension [mm]					Weight	Part number
	V [cm^3/rev]	A	B	C	D	E	[kg]	
EHP72KDO14F005-20A1003N0	5.5	38.6	85.0	336.0	15.0	250.0	15.0	**0 541 300 032**

Characteristics for A 541 023 013



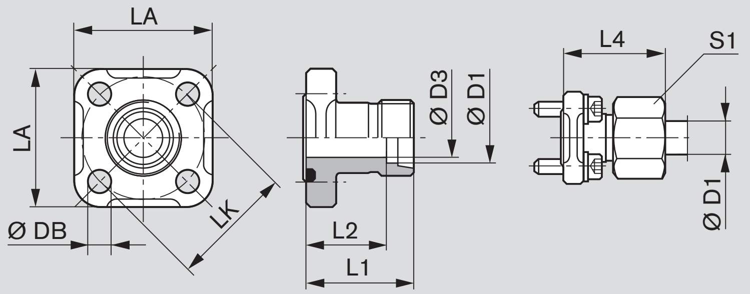




Accessories

Fittings that can be used for square flange 20

Gear pump flange, straight

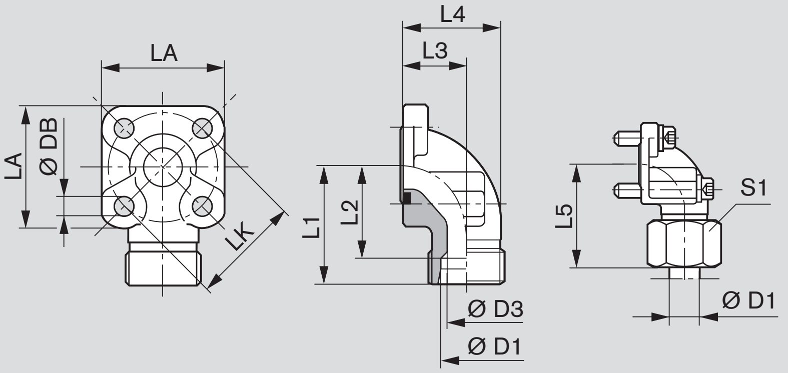


LK	D1	D3	L1	L2	L4	LA	S1	DB	Screws (metric) 4x	Seal ring	Part number	*p* [bar]
35	10L	8	30	23.0	39.0	40	19	6.4	M 6 x 22	20 x 2.5	**1 515 702 064**	315
35	12L	10	30	23.0	39.0	40	22	6.4	M 6 x 22	20 x 2.5	**1 515 702 065**	315
35	15L	12	30	23.0	38.0	40	27	6.4	M 6 x 22	20 x 2.5	**1 515 702 066**	250
40	15L	12	35	28.0	43.0	42	27	6.4	M 6 x 22	24 x 2.5	**1 515 702 067**	100
40	18L	15	35	27.5	44.0	42	32	6.4	M 6 x 22	24 x 2.5	**1 515 702 068**	100
40	22L	19	35	27.5	44.5	42	36	6.4	M 6 x 22	24 x 2.5	**1 515 702 069**	100
40	28L	24	42	27.5	44.5	42	41	6.4	M 6 x 22	24 x 2.5	**1 515 702 008**	100

Complete fittings with seal ring, metric screw set, nuts and olive.

Fittings that can be used for square flange 20

Gear pump flange, 90° angle

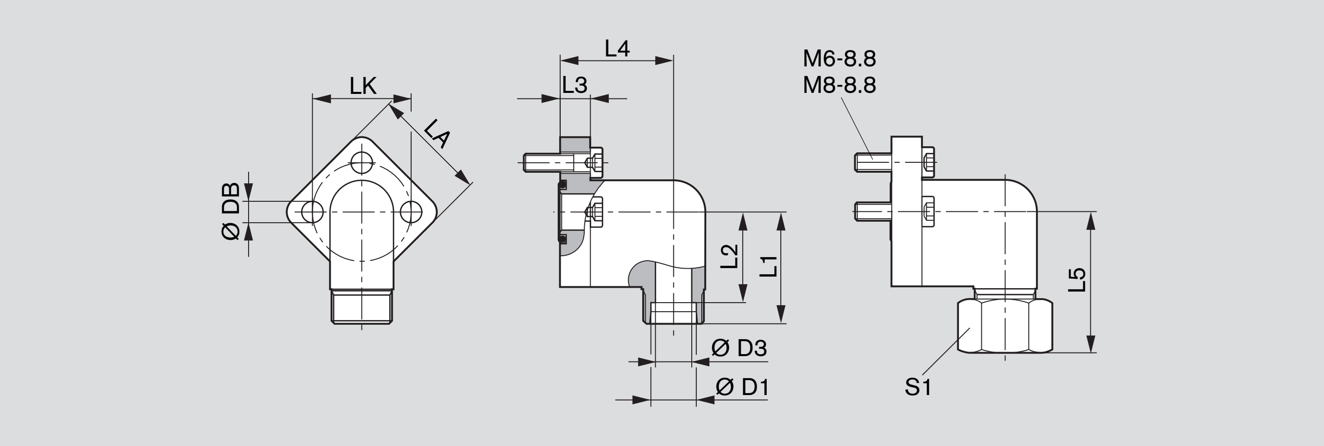


LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws		Seal ring	Part number	*p*
											2x	2x			[bar]
35	10L	8	38	31.0	16.5	26.5	47.0	40	19	6.4	M 6 x 22	M 6 x 35	20 x 2.5	**1 515 702 070**	315
35	12L	10	38	31.0	16.5	26.5	47.0	40	22	6.4	M 6 x 22	M 6 x 35	20 x 2.5	**1 515 702 071**	315
35	15L	12	38	31.0	16.5	26.5	46.0	40	27	6.4	M 6 x 22	M 6 x 35	20 x 2.5	**1 515 702 072**	250
35	16S	12	38	29.5	20.0	31.0	48.0	40	30	6.4	M 6 x 22	M 6 x 40	20 x 2.5	**1 515 702 002**	315
35	18L	15	38	29.5	20.0	31.0	47.0	40	32	6.4	M 6 x 22	M 6 x 40	20 x 2.5	**1 545 702 006**	250
35	20S	16	45	34.5	25.0	38.0	56.0	40	36	6.4	M 6 x 22	M 6 x 45	20 x 2.5	**1 515 702 017**	315
40	15L	12	38	31.0	22.5	36.5	46.0	42	27	6.4	M 6 x 22	M 6 x 22	24 x 2.5	**1 515 702 076**	100
40	18L	15	38	30.5	22.5	36.5	47.0	42	32	6.4	M 6 x 22	M 6 x 22	24 x 2.5	**1 515 702 074**	100
40	20S	16	40	29.5	22.5	35.5	50.0	42	36	6.4	M 6 x 22	M 6 x 45	24 x 2.5	**1 515 702 011**	250
40	22L	19	38	30.5	22.5	36.5	47.5	42	36	6.4	M 6 x 22	M 6 x 22	24 x 2.5	**1 515 702 075**	100
40	28L	22	40	32.5	28.0	43.0	49.0	42	41	6.4	M 6 x 20	M 6 x 50	24 x 2.5	**1 515 702 010**	100
40	35L	31	41	30.5	32.0	55.0	52.0	42	50	6.4	M 6 x 22	M 6 x 60	24 x 2.5	**1 515 702 018**	100

Complete fittings with seal ring, metric screw set, nuts and olive.

Fittings that can be used for square flange 30

Gear pump flange, 3-hole, 90° angle



LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws 3x	Seal ring NBR *)	Weight [kg]	Part number	*p* [bar]
30	12L	10	37	30.0	10	37.5	46	38	22	6.4	M 6 x 22	16 x 2.5	0.13	**1 515 702 146**	250
30	15L	12	37	30.0	10	37.5	47	38	27	6.4	M 6 x 22	16 x 2.5	0.14	**1 515 702 147**	250
30	18L	15	37	30.0	10	37.5	47	38	32	6.4	M 6 x 22	16 x 2.5	0.17	**1 515 702 148**	160
40	22L	19	43	35.5	14	41.0	53	48	36	8.4	M 8 x 30	24 x 2.5	0.29	**1 515 702 149**	160
40	28L	24	43	35.5	14	41.0	53	48	41	8.4	M 8 x 30	24 x 2.5	0.40	**1 515 702 150**	160

Complete fittings with seal ring, metric screw set, nuts and olive. *) NBR = Perbunan®

Note
The permissible tightening torques can be found in our publication:
“General operating instructions for external gear units”
RE 07 012-B1.

Rexroth
Bosch Group

Project specification
Electrohydraulic pump (EHP)

Hydraulics
DC-MA/SPP3
1/4

This project specification is intended as a guide for customer-specific projects, from the initial inquiry to the approval for a new product.
Full details under **1. Project details** are the basis for effective project management.
Detailed figures are the requirement for optimal design.
2. Project management is maintained internally by DC-MA/SPP3.
If any details are missing under **3. Technical data**, the Bosch Rexroth AG terms and conditions of supply and the figures stated in the catalogs and general operating conditions shall apply.
4. Customer requirements are to be submitted as completely as possible.

1. Project details

Sales person:
e-mail:
Telephone:

Department:
Date:
Customer number:

Customer/contact:
e-mail:

Customer number:
Telephone:

Customer vehicle/project

Application, project description (task of EHP in the system, e.g. implement hydraulics, emergency steering, etc.)

	Proposal	A sample	B sample	C sample	D sample	SOP	Year 1	Year 2	Year 3	Year 4
Deadline										
Quantity										
€/unit										

Additional business ☐

Replacement business ☐

Competition

Target price

Description of product (e.g. EHP24KDG66F004-20A0653N0)

Particular technical requirements and application conditions to be stated in section 3.
If any details are missing, compliance with the operating conditions Y 541... (see table on page 4)
and the figures in the catalog will be assumed.

Particular features (ZA 08916) and systems (remarks, sketches, notes, specifications, drawings, etc.)

2. Project management

Development location

Project category* S

* R = Fundamental R&D development
V = Variant development
M = Modification to series
N = Platform/new development
A = Application development
S = Series

Modification no.	Description	Date	Originator	Checked

Produceability declaration required?

Yes ☐ No ☐

Project Manager:

Project number:

3. Technical data

Operating voltage of motor (volts)

Motor voltage type Direct current (DC) ☐ Alternating current (AC) ☐

Protection class Motor (IP)

Thermal contact (yes/no)

Relay (yes/no)
If yes: axial or radial

Displacement [l/min] at working pressure [bar]	PT1	PT2	PT3	PT4
Displacement [l/min] at maximum pressure [bar]	PT1	PT2	PT3	PT4

Actuated time S2 in min

Actuated time S3 in %

Seals FPM ☐ NBR ☐ HNBR ☐ Radial shaft seal ring FPM/otherwise NBR ☐

Multiple pumps
- Tang (light through drive) ☐
- Splined shaft (heavy through drive) ☐
- Separation of medium ☐
- Common suction port ☐

Auxiliary function
- PRV adjustment ± bar at l/min
- SRV adjustment ± l/min
- Residual current, external ☐ Residual current, internal ☐
- Electrical connection Prop. PRV 12 V ☐ 24 V ☐
- Connector AMP Junior Timer (C4) ☐ DEUTSCH) (K40) ☐

Particular notes (e.g. surface protection …)

Other (load complex etc.)

Medium temperature min °C max °C

Ambient temperature min °C max °C

Operating medium

Viscosity range

Cleanliness level

Filter grade
- β ≧ – Suction filter
- β ≧ – Pressure filter

Ambient conditions (e.g. dust, spray water)

Additional stress

Noise requirements

Installation position

Interfaces

Rexroth
Bosch Group

Project specification
Electrohydraulic pump (EHP)

Hydraulics
DC-MA/SPP3
3/4

4. Customer demands

Legislation, standards

Patents, licenses

Additional customer demands (e.g. documentation, modification announcements, QM system, APQG, …)

Safety functions or limitations

Acceptance
Without testing ☐
Testing at customer ☐
BR acceptance ☐ (subject to charge)
Initial sample test report ☐
Volume
Additional examination
Additional documentation

Certificate

Terms of delivery

Labeling

Packaging
Differing from standard packaging
☐ Lattice box (reusable, EU only)
☐ SLC (= small load carrier, reusable, EU only)
☐ Wooden crate (disposable, sea freight only)
☐ Non-reusable packaging (rest of world)
☐ Customer wish

Customer specification

Prototype version

Recycling

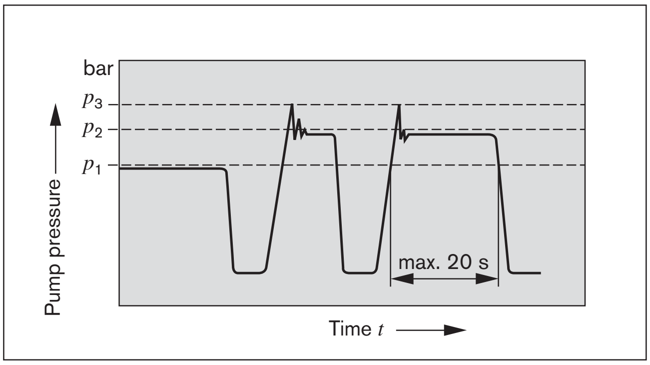
Service agreement

Repair

Warranty

Service life Hours Load cycles

Always state load complex with service life requirement (cf. example)



p_1 max. continuous pressure
p_2 max. intermittierent pressure
p_3 max. peakt pressure

Date, Signature of issuing party	Date, Signature of customer	Date, Signature of DC-MA/SPP3

Operating conditions

EHP	Y 541 … … or quotation drawing
Information Tightening torque	Y 510 202 040

Remarks:

Gerotor pumps

Designation	Type	Size	Series	Data sheet	Page
Gerotor pump, fixed displacement volume	PGZ	20...140	1x	10545	1673

Gerotor pump, fixed displacement volume

Type PGZ

Component series 1X
Maximum operating pressure 15 bar
Maximum displacement 140 cm³

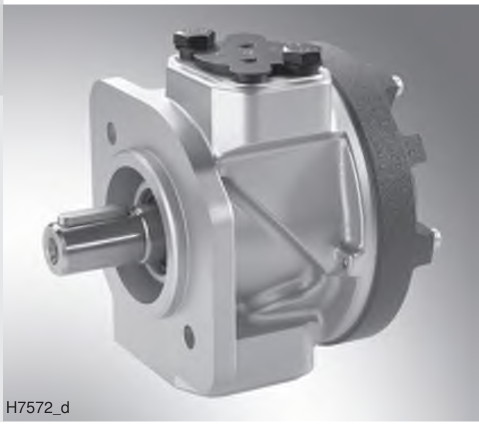

H7572_d

Table of contents

Features

- Low-pressure pump with fixed displacement
- Very low operating noise
- Suitable for wide viscosity and speed ranges
- Very good suction behavior
- Flexible combination possibilities with Rexroth axial piston, internal gear and vane pumps

- Use:
  For cooling, filtration or lubrication circuits at low pressures in industrial or mobile applications, e.g. plastics processing machines, machine tools, presses and wind turbines.

Ordering code

PG	Z		–1X/		R		07	V		*

Series

Gerotor pump, low-pressure **= Z**

Frame size

BG4 **= 4**
BG5 **= 5**

Component series: Component series 10 to 19 **= 1X**
(10 to 19: Unchanged installation and connection dimensions)

Size

	Size	Displacement volume/ rotation	
BG4	20	21.0 cm^3	**= 20**
	32	33.4 cm^3	**= 32**
	40	42.1 cm^3	**= 40**
	50	52.0 cm^3	**= 50**
	63	64.4 cm^3	**= 63**
	80	84.2 cm^3	**= 80**
BG5	63	64.4 cm^3	**= 63**
	80	84.2 cm^3	**= 80**
	100	105.3 cm^3	**= 100**
	140	136.3 cm^3	**= 140**

Direction of rotation

Clockwise (viewed on the shaft end) **= R**

Further details in the plain text
e.g. special designs

Type of connection

E4 = ISO 4-hole mounting flange according to ISO 3019-2 and VDMA 24560
U2 = SAE 2-hole mounting flange
B2 = ISO 2-hole mounting flange according to ISO 3019-2, secondary pump for through-drive KB2
B3 = ISO 2-hole mounting flange according to ISO 3019-2, secondary pump for through-drive KB3

Seal material

V = FKM seals

Line connection

07 = SAE flange standard pressure series

Shaft design

A = Cylindrical
T = SAE involute gear 11T
R = SAE involute gear 13T

Standard types PGZ-1X	
Type Size	**Material No.**
PGZ4-1X/**020**RA07VE4	**R901230020**
PGZ4-1X/**032**RA07VE4	**R901230024**
PGZ4-1X/**040**RA07VE4	**R901230028**
PGZ4-1X/**050**RA07VE4	**R901230032**
PGZ4-1X/**063**RA07VE4	**R901230036**
PGZ4-1X/**080**RA07VE4	**R901230040**
PGZ5-1X/**100**RA07VE4	**R901230052**
PGZ5-1X/**140**RA07VE4	**R901230056**

The possible flange shaft configurations can be found in the selection tables on the pages 6 to 9.

Function, section

Construction

Hydraulic pumps of the PGZ type are gerotor pumps with fixed displacement.

They mainly consist of: Flange housing (1), shaft (2), the displacer elements inner rotor (3) and outer rotor (4), as well as driving disk (5) and cover (6).

Suction and displacement procedure

Via the driving disk the shaft drives the inner rotor in the direction of rotation shown. The inner rotor meshes with the outer rotor and causes the same to rotate as well.

The tooth clearances opening in the suction area (S) prime the hydraulic fluid. The suction and pressure area are separated on the opposite side of the meshing area (Z) by a radial gap (R) created by the tooth profile of the outer and the inner rotor sliding against each other.

Within the pressure area (P) the hydraulic fluid is pumped into the pressure port as the chambers become.

Properties

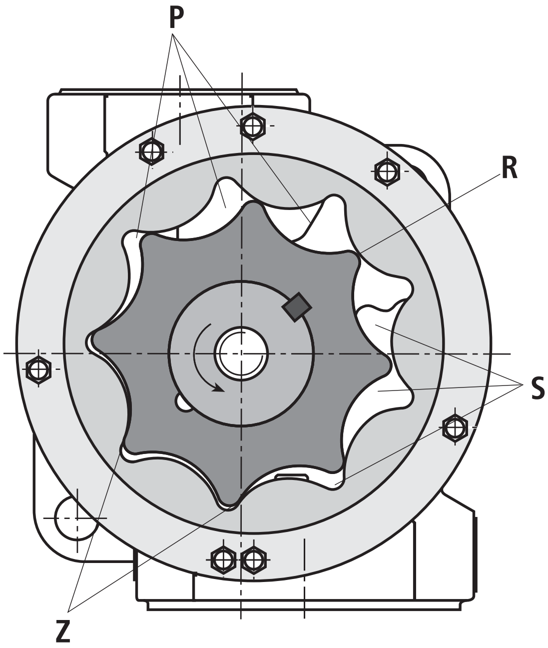
The gearing with cycloid contour is characterized by a large meshing length. Filling zone and displacement area cover a large rotation angle. This results in low flow pulsation and thus very low operating noise.
The shaft and the displacer are supported by a slide bearing and work in a wear-free manner when used as intended.

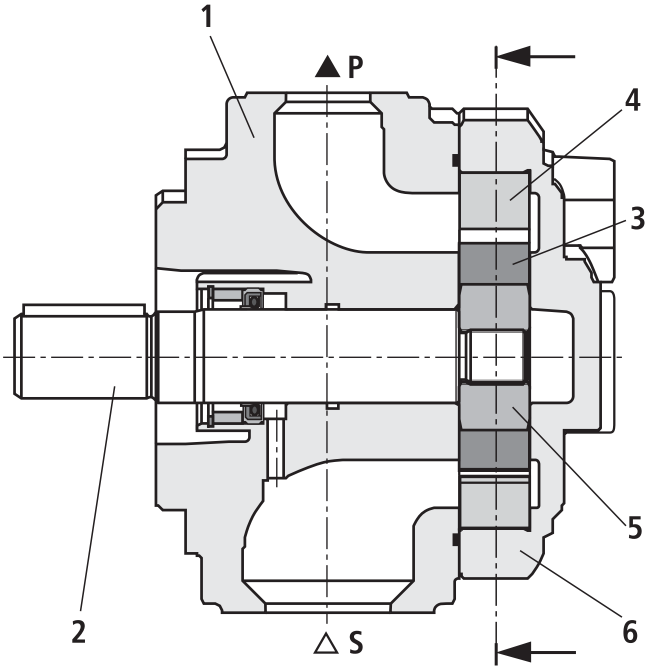
Gerotor pumps PGZ are self-priming.

Materials used

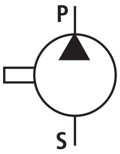
Flange housing (1): Aluminum

Shaft (2), inner rotor (3), outer rotor (4), and driving disk (5): Steel
Cover (6): Cast iron





Symbol



Technical data (For applications outside these parameters, please consult us!)

general

Type	Gerotor pump
Type of connection	ISO 4-hole mounting flange according to ISO 3019-2 and VDMA 24560 SAE 2-hole mounting flange ISO 2-hole mounting flange according to ISO 3019-2, matching through-drive KB2 ISO 2-hole mounting flange according to ISO 3019-2, matching through-drive KB3
Line connection	Flange connection
Shaft load	Radial and axial forces cannot be transmitted
Direction of rotation (viewed on shaft end)	Clockwise

hydraulic

Hydraulic fluid		HLP - mineral oil according to DIN 51524 part 2 **Please observe our specification according to data sheet RE 90220** **Other fluids upon request!**
Hydraulic fluid temperature range	°C	–20 to +80, observe the admissible viscosity range!
Ambient temperature range	°C	–20 to +80
Viscosity range	mm^2/s	10 to 2000
Max admissible degree of contamination of the hydraulic fluid - cleanliness class according to ISO 4406 (c)		Class 21/18/15 [1]

Frame size 4	**Frame size**		**PGZ4**					
Size	**Size**		**20**	**32**	**40**	**50**	**63**	**80**
Displacement	V	cm^3	21.0	33.4	42.1	52.0	64.4	84.2
Weight	m	kg	4.7	5.3	5.6	6.0	6.7	7.8
Flow [2]	q_V	l/min	28	46	58	71	88	116
Mass moment of inertia (around drive axis)	J	kgm^2	0.00086	0.00134	0.00167	0.00205	0.00253	0.00329
Speed range	n_{min}	rpm	200	200	200	200	200	200
	n_{max}	rpm	3000	3000	3000	3000	2300	1800
Operating pressure, absolute – Inlet	p	bar	0.7 to 2 (short-time during start 0.5 bar)					
Nominal pressure – Outlet, continuous	p_N	bar	15					
Min required driving power – at $\Delta p \approx 1$ bar, $n = 1{,}450$ min^{-1}		kW	0.75	1.1	1.1	1.1	1.1	1.1
– at $\Delta p \approx 10$ bar, $n = 1{,}450$ min^{-1}			1.5	2.2	2.2	2.2	3.0	3.0
Sound pressure level at 0 – 15 bar [3]		dB(A)	55	56	57	59	60	62

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[1] The cleanliness classes specified for the components must be adhered to in hydraulic systems.
An efficient filtration prevents failures and simultaneously increases the lifetime of the components.
For the selection of filters, see data sheets RE 50070, RE 50076, RE 50081, RE 50086 and RE 50088.

[2] Measured at $n = 1.450$ rpm, $p = 10$ bar, and $v = 30$ mm^2/s

[3] Measured in sound-absorbent acoustic room at $n = 1450$ rpm and $\nu = 30$ mm^2/s

Technical data (For applications outside these parameters, please consult us!)

Frame size 5	**Frame size**		**PGZ5**			
Size	**Size**		**63**	**80**	**100**	**140**
Displacement	V	cm^3	64.4	84.2	105.3	136.3
Weight	m	kg	6,6	7,7	8,9	10,7
Flow [1]	q_V	l/min	88	116	144	186
Mass moment of inertia (around drive axis)	J	kgm^2	0.00253	0.00329	0.00410	0.00529
Speed range	n_{min}	rpm	200	200	200	200
	n_{max}	rpm	3000	2300	1800	1500
Operating pressure, absolute – Inlet	p	bar	0.7 to 2 (short-time during start 0.5 bar)			
Nominal pressure – Outlet, continuous	p_N	bar	15			
Min required driving power – at $\Delta p \approx 1$ bar, $n = 1{,}450\ \text{min}^{-1}$		kW	1.1	1.1	1.5	1.5
– at $\Delta p \approx 10$ bar, $n = 1{,}450\ \text{min}^{-1}$			3.0	3.0	4.0	5.5
Sound pressure level at 0 – 15 bar [2]		dB(A)	60	62	63	66

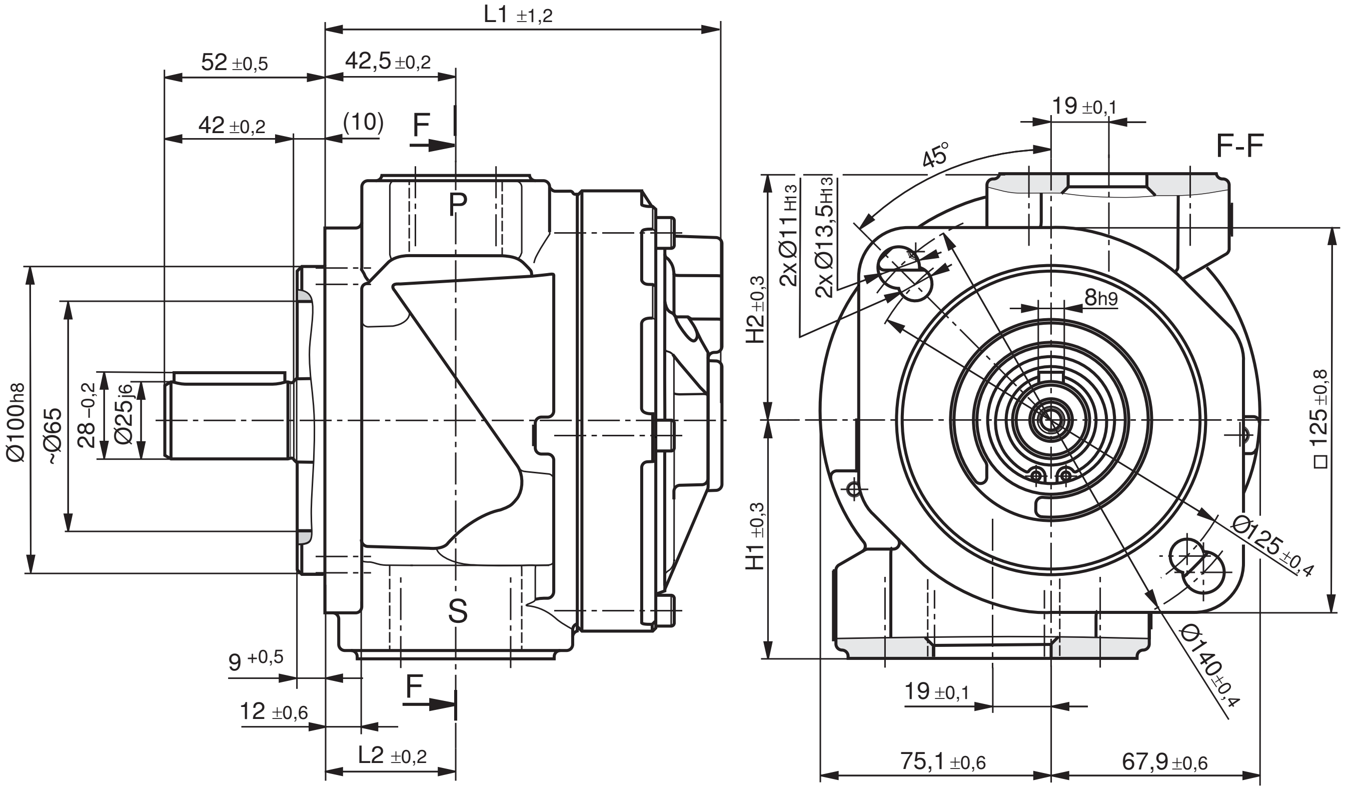
[1] Measured at $n = 1{,}450$ rpm, $p = 10$ bar, and $v = 30\ \text{mm}^2/\text{s}$

[2] Measured in sound-absorbent acoustic room at $n = 1450$ rpm and $\nu = 30\ \text{mm}^2/\text{s}$

Unit dimensions frame sizes 4 and 5, type...VE4 (dimensions in mm)

PGZ $\substack{4\\5}$ -1X/ … RA07VE4

Drive shaft cylindrical,
4-hole mounting flange according to ISO 3019-2
and VDMA 24560



Type Size	Material No.	L1	L2	H1	H2	S [1]	P [1]
PGZ4-1X/**020**RA07VE4	**R901230020**	116,5	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**032**RA07VE4	**R901230024**	121,5	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**040**RA07VE4	**R901230028**	125	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**050**RA07VE4	**R901230032**	129	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**063**RA07VE4	**R901230036**	134	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**080**RA07VE4	**R901230040**	142	42,5	77,4	79,6	1 1/2“	1“
PGZ5-1X/**063**RA07VE4	**R901230044**	134	48,5	72,9	76,1	2“	1 1/4“
PGZ5-1X/**080**RA07VE4	**R901230048**	142	48,5	72,9	76,1	2“	1 1/4“
PGZ5-1X/**100**RA07VE4	**R901230052**	150,5	48,5	72,9	76,1	2“	1 1/4“
PGZ5-1X/**140**RA07VE4	**R901230056**	163	48,5	72,9	76,1	2“	1 1/4“

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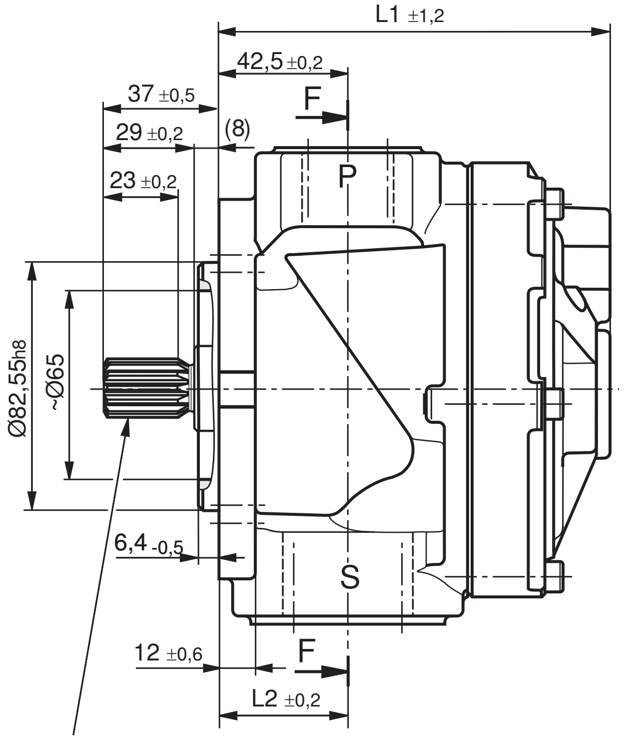
[1] Exact dimensions see table page 10

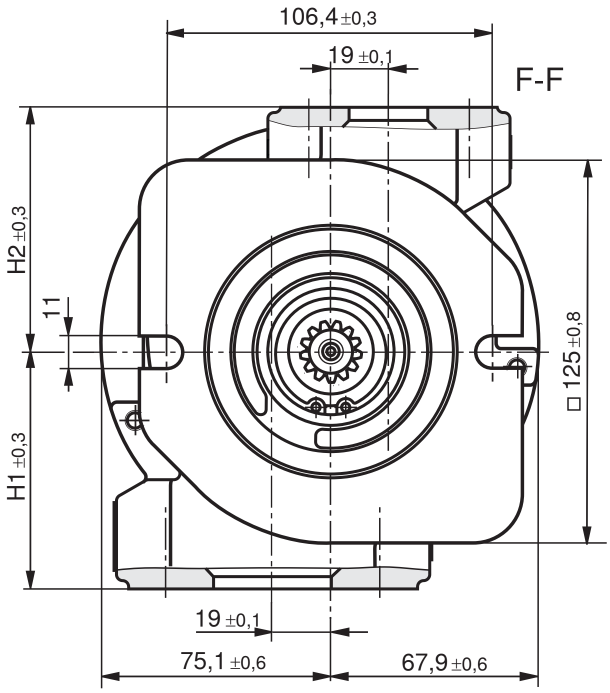
Unit dimensions frame sizes 4 and 5, type...VU2 (dimensions in mm)

PGZ $\substack{4\\5}$ -1X/ … RT07VU2

Drive shaft splined,
SAE 2-hole mounting flange



Involute gear ANSI B92.1-1996
11T 16/32 DP30°



Type Size	Material No.	L1	L2	H1	H2	S [1)]	P [1)]
PGZ4-1X/**020**RT07VU2	**R901230021**	116,5	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**032**RT07VU2	**R901230025**	121,5	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**040**RT07VU2	**R901230029**	125	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**050**RT07VU2	**R901230033**	129	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**063**RT07VU2	**R901230037**	134	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**080**RT07VU2	**R901230041**	142	42,5	77,4	79,6	1 1/2“	1“
PGZ5-1X/**063**RT07VU2	**R901230045**	134	48,5	72,9	76,1	2“	1 1/4“
PGZ5-1X/**080**RT07VU2	**R901230049**	142	48,5	72,9	76,1	2“	1 1/4“
PGZ5-1X/**100**RT07VU2	**R901230053**	150,5	48,5	72,9	76,1	2“	1 1/4“
PGZ5-1X/**140**RT07VU2	**R901230057**	163	48,5	72,9	76,1	2“	1 1/4“

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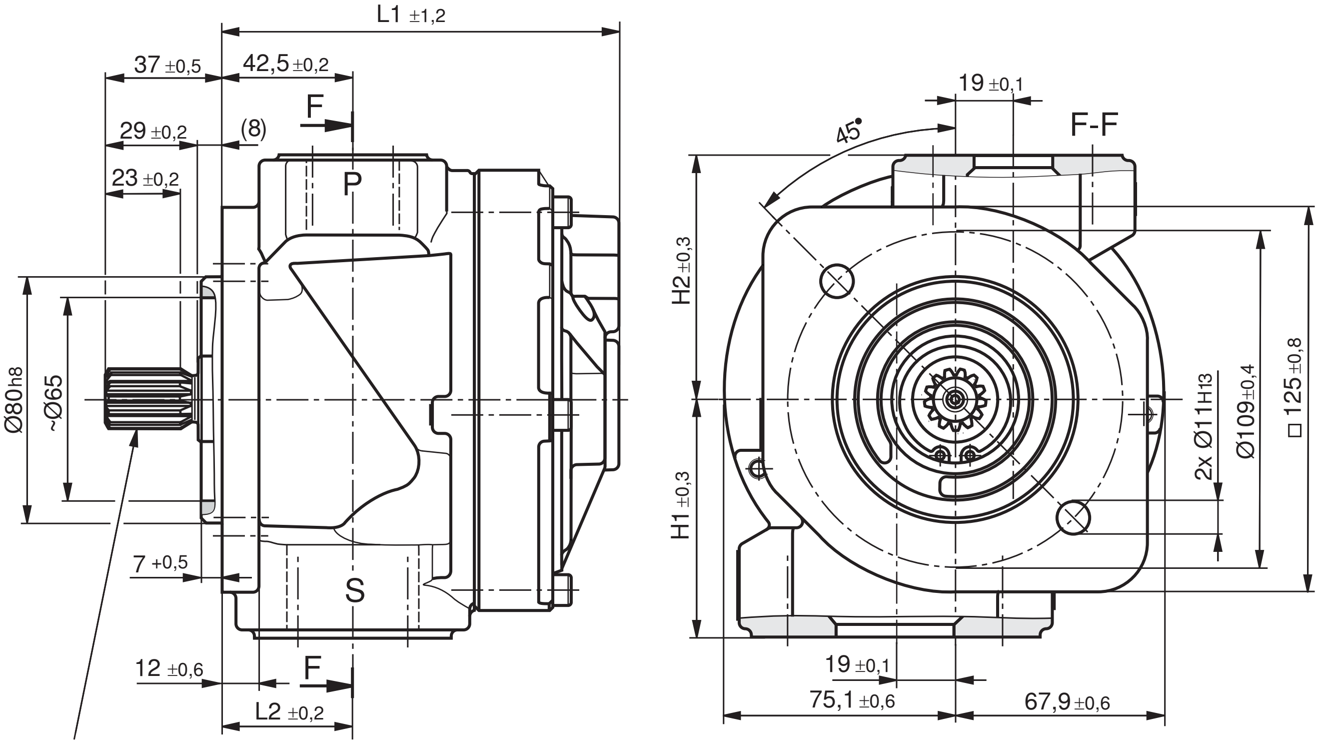
1) Exact dimensions see table page 10

Unit dimensions frame sizes 4 and 5, type...VB2 (dimensions in mm)

PGZ $\genfrac{}{}{0pt}{}{4}{5}$ -1X/ … RT07VB2

Drive shaft splined,
ISO 2-hole mounting flange according to ISO 3019-2

(Secondary pump for through-drive KB2)



Involute gear ANSI B92.1-1996
11T 16/32 DP30°

Type Size	Material No.	L1	L2	H1	H2	S [1]	P [1]
PGZ4-1X/**020**RT07VB2	**R901230022**	116,5	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**032**RT07VB2	**R901230026**	121,5	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**040**RT07VB2	**R901230030**	125	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**050**RT07VB2	**R901230034**	129	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**063**RT07VB2	**R901230038**	134	42,5	77,4	79,6	1 1/2“	1“
PGZ4-1X/**080**RT07VB2	**R901230042**	142	42,5	77,4	79,6	1 1/2“	1“
PGZ5-1X/**063**RT07VB2	**R901230046**	134	48,5	72,9	76,1	2“	1 1/4“
PGZ5-1X/**080**RT07VB2	**R901230050**	142	48,5	72,9	76,1	2“	1 1/4“
PGZ5-1X/**100**RT07VB2	**R901230054**	150,5	48,5	72,9	76,1	2“	1 1/4“
PGZ5-1X/**140**RT07VB2	**R901230058**	163	48,5	72,9	76,1	2“	1 1/4“

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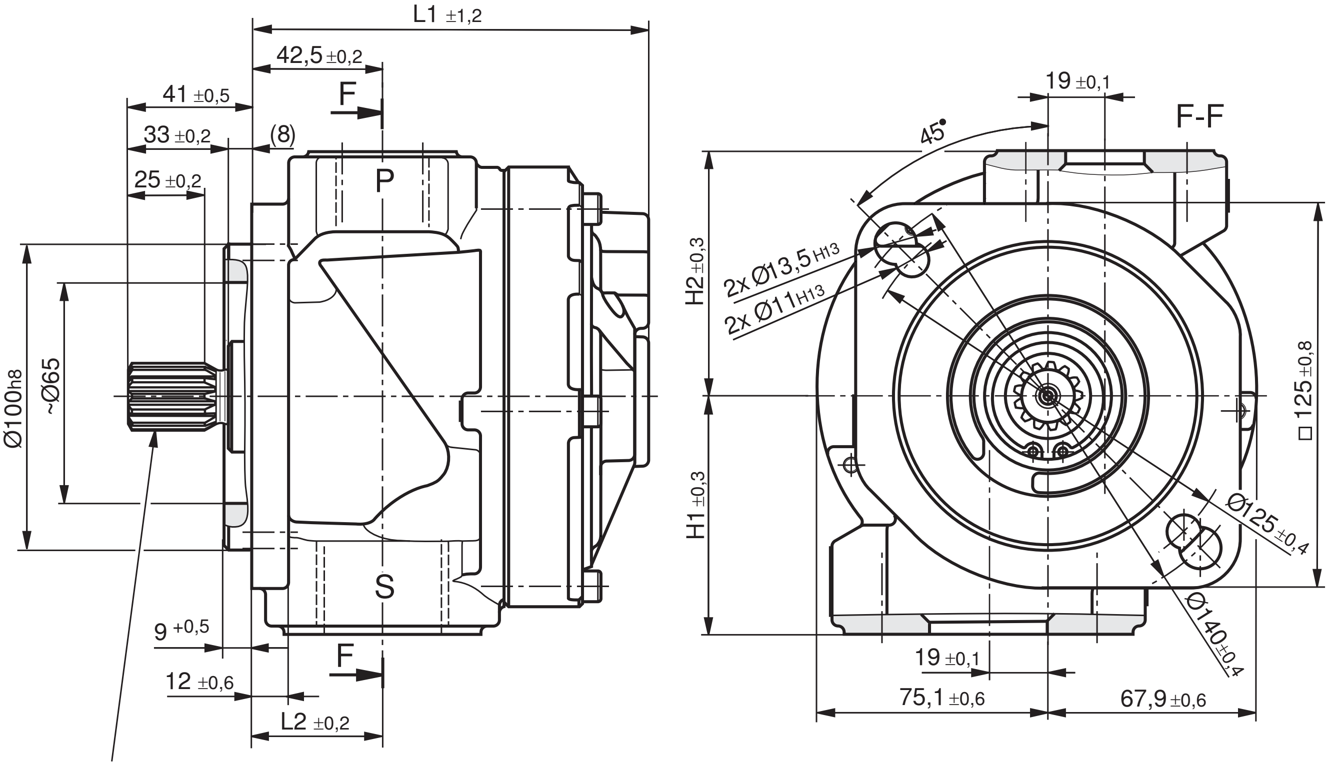
[1] Exact dimensions see table page 10

Unit dimensions frame sizes 4 and 5, type...VB3 (dimensions in mm)

PGZ $\genfrac{}{}{0pt}{}{4}{5}$ -1X/ … RR07VB3

Drive shaft splined,
ISO 2-hole mounting flange according to ISO 3019-2

(Secondary pump for through-drive KB3)



Involute gear ANSI B92.1-1996
13T 16/32 DP30°

Type Size	Material No.	L1	L2	H1	H2	S 1)	P 1)
PGZ4-1X/**020**RR07VB3	**R901230023**	116,5	42,5	77,4	79,6	1 1/2"	1"
PGZ4-1X/**032**RR07VB3	**R901230027**	121,5	42,5	77,4	79,6	1 1/2"	1"
PGZ4-1X/**040**RR07VB3	**R901230031**	125	42,5	77,4	79,6	1 1/2"	1"
PGZ4-1X/**050**RR07VB3	**R901230035**	129	42,5	77,4	79,6	1 1/2"	1"
PGZ4-1X/**063**RR07VB3	**R901230039**	134	42,5	77,4	79,6	1 1/2"	1"
PGZ4-1X/**080**RR07VB3	**R901230043**	142	42,5	77,4	79,6	1 1/2"	1"
PGZ5-1X/**063**RR07VB3	**R901230047**	134	48,5	72,9	76,1	2"	1 1/4"
PGZ5-1X/**080**RR07VB3	**R901230051**	142	48,5	72,9	76,1	2"	1 1/4"
PGZ5-1X/**100**RR07VB3	**R901230055**	150,5	48,5	72,9	76,1	2"	1 1/4"
PGZ5-1X/**140**RR07VB3	**R901230059**	163	48,5	72,9	76,1	2"	1 1/4"

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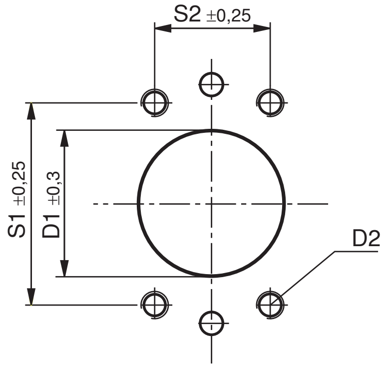
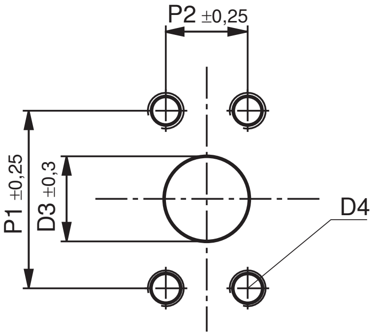
1) Exact dimensions see table page 10

Ports (dimensions in mm)

Hole pattern of suction port “S”



Hole pattern of discharge port “P”



Frame size	Hole pattern / suction port S	D1	D2	S1	S2	Hole pattern / discharge port P	D3	D4	P1	P2
4	1 1/2“	Ø38,1	M12; 21	69,9	35,7	1“	Ø25,4	M10; 16	52,4	26,2
5	2“	Ø50,8	M12; 21	77,8	42,9	1 1/4“	Ø31,8	M10; 18	58,7	30,2

Project planning information

1. General notes

This project planning information relates to the specific properties of the Rexroth PGZ.-1X gerotor pump. Please find comprehensive general information and suggestions in The Hydraulic Trainer, Volume 3 “Planning and Design of Hydraulic Power Systems”, RE 00281.

1.1 Intended use

Rexroth gerotor pumps are intended for the use in cooling, filtration, and lubrication circuits in the fields of machine and plant engineering. During project planning, the basic principles of the EU Machinery Directive or comparable national regulations outside of the EU have to be observed.

The pumps must not be used in potentially explosive atmospheres in accordance with Directive 94/9/EC (ATEX). The use as hydraulic motor is inadmissible!

1.2 Technical data

The plant or machine manufacturer has to ensure the compliance with the admissible technical data and operating conditions. The pump itself does not contain a device to prevent operation outside of the admissible data.

All mentioned technical features are average values and are applicable for the specified boundary conditions. In case of modifications to the boundary conditions (e.g. viscosity), the technical data may change as well. Tolerances are possible in accordance with state of the art.

Operating the pump outside of the admissible technical data (pages 4, 5) is possible to a certain extent, however, this requires an explicit written approval of Bosch Rexroth.

2. Hydraulic project planning

2.1 Installation location

When installing the pump more than 10 m below the tank, take additional measures to ensure that the inlet pressure is reduced to the maximum admissible value.

2.2 Suction line

The line cross-sections have to be dimensioned for the rated flows in a manner that an ideal suction speed of 0.6 to 1.2 m/s is achieved on average. The suction speed must not exceed a maximum value of 2 m/s.

The suction cross-sections at the very pump are dimensioned for the maximum flow and thus are a reference only. During continuous operation at speeds lower than the admissible maximum speed, the suction tube diameter is to be dimensioned smaller than the suction port of the pump in accordance with the actual suction speed.
All in all the suction line has to be designed in a way that the admissible inlet operating pressure is complied with (0.7 to 2 bar absolute)! Bends and a combination of the suction tubes of several pumps must be avoided.

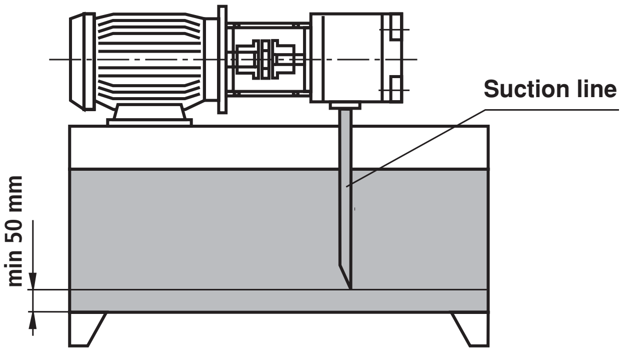
If suction filters have to be used, it has to be ensured on the system side that the lowest admissible inlet operating pressure is not exceeded even when the filter is clogged.

Please observe air tightness of the transitions and dimensional stability of the suction hose as regards to the external air pressure.

(continuation of 2.2 Suction line)

The value for the immersion depth of the suction tube should be selected as high as possible. Depending on the internal tank pressure, the viscosity of the hydraulic fluid, and the flow situation within the tank, no vortex must be formed even at maximum flow. Otherwise there is the risk of aspiring air.

We recommend selecting suction tubes according to AB 23-03.



2.3 Pressure limitation

The gerotor pump PGZ is not equipped with devices for not exceeding the maximum operating pressure. Setting and limiting the admissible operating pressure has to be ensured on the system side.

3. Mechanical project planning

3.1 Installation and disassembly option

For installing and disassembling the pump on or from the drive the accessibility has to be provided for on the system side.

Screws of the property class 8.8 or 10.9 have to be provided for mounting purposes.

3.2 Mounting

On the machine side, the screws have to be accessible in a way that the required tightening torque can be applied. The tightening torque is oriented on the operating conditions and elements involved in the screw connection and has to be specified by the manufacturer when engineering the power unit, the machine, or the plant.

3.3 Required power unit functions

Hydraulic power units should be equipped with the following features at least:

– Tanks, the internal pressure of which corresponds to the ambient pressure in accordance with the design, have to be equipped with breather filters for pressure compensation purposes.

– The hydraulic fluid should be filled in through filling connections with rule out filling with unfiltered hydraulic fluid.

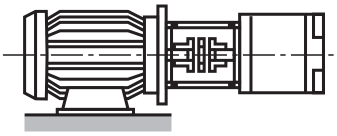
– The ingress of contaminants or moisture into the system must be avoided. When using the pump in a highly contaminated environment, the tank is to be pre-loaded by means of air pressure for this. If external cleansing of the tank is intended or to be expected during the period of use, tank fittings for tubes, lines, or hoses have to be selected ensuring a safe seal against external pressurization with water jet.

3.4 Ambient conditions

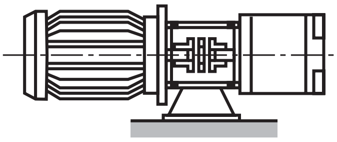
When operating the pump in salt-containing or corrosive environments or when when the pump can be exposed to strongly abrasive substances, it has to be ensured on the system side that the shaft seal and the sealing area of the shaft do not make direct contact with the environment and that the pump is equipped with a suitable corrosion protection.

3.5 Installation positions

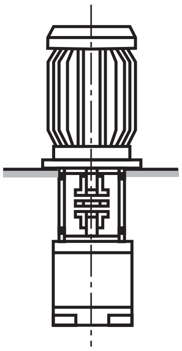
IM B3



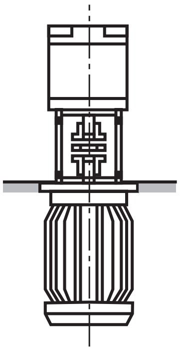
IM B5



IM V1



IM V2



4. Maintenance schedule and operational safety

For safe operation and a long lifetime of the pump a maintenance schedule has to be developed for the power unit, the machine, or the plant. The maintenance schedule has to ensure that the planned or admissible operating conditions of the pump are complied with during the period of use.

In particular, compliance with the following operating parameters has to be ensured:

- The required oil cleanliness
- The operating temperature range
- The level of the hydraulic fluid

Furthermore, the pump and the plant have to be checked for modifications of the following parameters on a regular basis:

- Vibrations
- Noise
- Temperature pump – hydraulic fluid in tank
- Foam formation in the tank
- Leak-proofness
- Operating pressure when using lubrication systems

Modifications of these parameters indicate wear of components (e.g. drive motor, coupling, pump, etc.). The reason has to be determined and remedied immediately.

In order to achieve high operational safety of the pump in the machine or plant we recommend checking the parameters mentioned above continuously and automatically and the automatic shut-down in case of changes exceeding the usual fluctuations in the designed operating range.

Plastic components of drive couplings should be replaced regularly, however, after 5 years at the latest. The corresponding information of the manufacturer is paramount.

For preventive maintenance of the pump we recommend having the seals replaced after an operating period of 5 years at the most by an authorized Bosch Rexroth service company.

5. Accessories

5.1 SAE connection flanges

We recommend selecting the SAE flanges for suction and pressure port according to AB 22-15 (with welded connection) or AB 22-13 (with threaded connection).

5.2 Other accessories

To install the Rexroth PGZ.-1X gerotor pump on electric motors we recommend selecting the pump mounting brackets according to AB 41-20 and torsionally flexible couplings according to AB 33-22.

☞ **Note!**

Please observe the following documentation in addition:

- **Data sheet RE 07008** General information on hydraulic products
- **Data sheet RE 07900** General information on installation, commissioning, and maintenance of hydraulic systems
- **Data sheet RE 90220** General information on hydraulic fluids on mineral oil basis

По вопросам продаж и поддержки обращайтесь:

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