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Rexroth
Bosch Group

Product Catalog
Mobile Hydraulics

Part 2: Hydraulic Motors
Gears












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Bosch Group

Product Catalog Mobile Hydraulics

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Gears

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Part 1	Hydraulic Pumps	Axial Piston Pumps, External Gear Pumps, Electrohydraulic Pumps, Gerotor Pumps	RE 90010-01
Part 2	Hydraulic 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, Steering Units	RE 90010-03
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Hydraulic fluids based on mineral oils and related hydrocarbons

RE 90220/05.12 **1**/16
Replaces: 05.10

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.

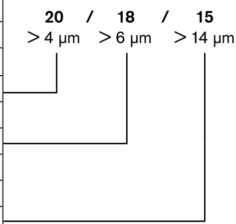
Hydraulic fluids frequently fail to meet these cleanliness requirements on delivery. Careful filtering is therefore required during operation and in particular, during filling in order to ensure the required cleanliness levels. Your lubricant manufacturer can tell you the cleanliness level of hydraulic 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.

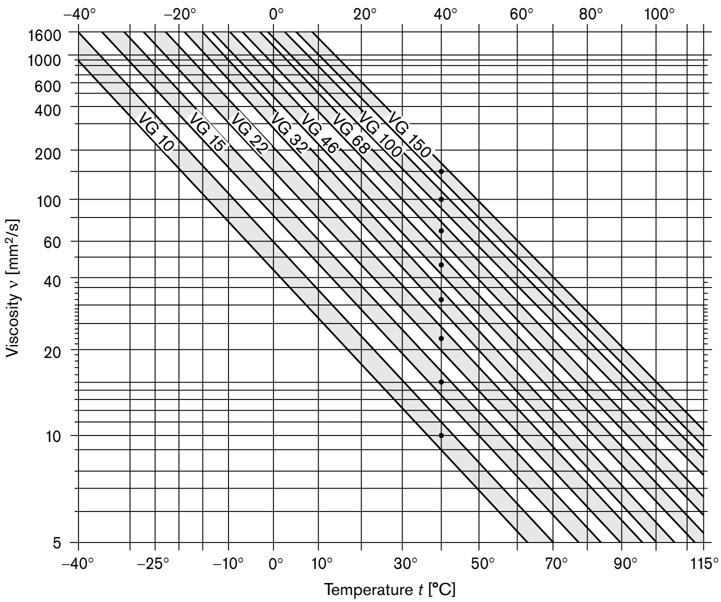
If the viscosity of a hydraulic fluid is below the permitted operating viscosity, increased leakage, wear, susceptibility to contamination and a shorter component life cycle will result.

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 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 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	Hydraulic fluids for military applications to MIL 13919 or H 540, MIL 46170 or H 544, MIL 5606 or H 515, MIL 83282 or H 537, MIL 87257	– 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, water separation capability and filterability. **Caution!** Hydraulic fluids for military applications do not meet the current requirements for high-quality hydraulic fluids and are suitable for use only to a limited degree.
15	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!

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	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!
17	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.
18	Fluids for power steering, hydro-pneumatic sus-pension, 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.

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No statements concerning the suitability of a hydraulic fluid for a specific purpose can be derived from our information. The information given does not release the user from the obligation of own judgment and verification.

It must be remembered that our products are subject to a natural process of wear and aging.

Subject to change.

Rexroth
Bosch Group

Environmentally acceptable hydraulic fluids

RE 90221/05.12 **1**/14
Replaces: 05.10

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.

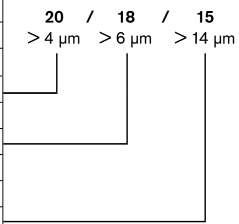
Hydraulic fluids frequently fail to meet these cleanliness requirements on delivery. Careful filtering is therefore required during operation and in particular, during filling in order to ensure the required cleanliness levels. Your lubricant manufacturer can tell you the cleanliness level of hydraulic 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

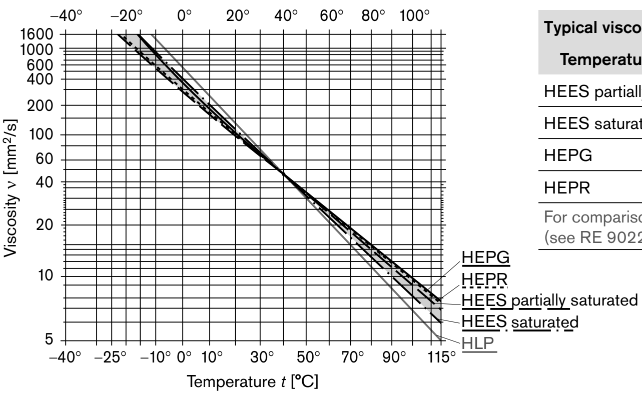
For hydraulic fluids, the viscosity temperature behavior (V-T behavior) is of particular importance. Viscosity is characterized in that it drops when the temperature increases and rises when the temperature drops. The interrelation between viscosity and temperature is described by the viscosity index (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/dm³ 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/dm³ 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/dm³ 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 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 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 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.

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No statements concerning the suitability of a hydraulic fluid for a specific purpose can be derived from our information. The information given does not release the user from the obligation of own judgment and verification.

It must be remembered that our products are subject to a natural process of wear and aging.

Subject to change.

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

20 / **18** / **15**
> 4 µm > 6 µm > 14 µm

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.

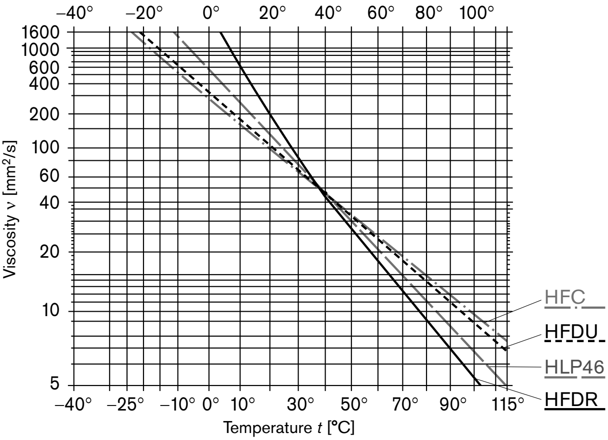
We recommend that the optimum operating viscosity range of each component be kept within the permissible temperature range. This usually requires either cooling or heating, or both. The permissible viscosity range and the necessary cleanliness level can be found in the product data sheet for the component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

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Axial Piston Motors
Fixed motors

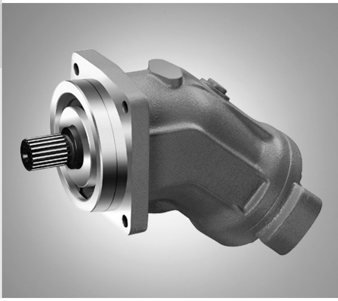
Designation	Type	Size	Series	Nominal pressure	Data sheet	page
Fixed motor	A2FM	5…1000	60/61/63	315…400 bar	RE 91001	55
Fixed plug-in motor	A2FE	28…355	60/61	350…400 bar	RE 91008	101
Fixed motor	A4FM	22…500	10/30/32	350…400 bar	RE 91120	125
Fixed motor	A10FM/E	10…63	52	280 bar	RE 91172	137

For the latest information on axial piston motors, please visit our website:
www.boschrexroth.com/axial-piston-motors

Axial Piston Fixed Motor A2FM

RE 91001/06.2012
Replaces: 09.07

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 and closed circuits

Contents

Features

– Fixed motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuits

– For use in mobile and stationary applications

– The output speed is dependent on the flow of the pump and the displacement of the motor.

– The output torque increases with the pressure differential between the high-pressure and the low-pressure side.

– Finely graduated sizes permit far-reaching adaptation to the drive case

– High power density

– Small dimensions

– High total efficiency

– Good starting characteristics

– Economical design

– One-piece tapered piston with piston rings for sealing

Ordering code for standard program

	A2F		M		/	6		W	–	V					
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15

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	Motor (plug-in motor A2FE, see RE 91008)	**M**

Size (NG)

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
05	**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**

Direction of rotation

08	Viewed on drive shaft, bidirectional	**W**

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		M		/	6		W	–	V						
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15

Port plates for service lines[2)]

				5	10-16	23	28, 32	45	56,63	80,90	107-125	160-180	200	250	355-500	1000	
12	SAE flange ports A and B at rear	01	0	–	–	●	●	●	●	●	●	●	●	●	●	●	010
			7	–	–	–	–	–	–	–	–	–	–	–	●	–	017
	SAE flange ports A and B at side, opposite	02	0	–	–	●	●	●	●	●	●	●	–	●	–	–	020
			7	–	–	–	–	●	▲	▲	●	●	–	●	–	–	027
			9	–	–	–	–	–	●	●	–	–	–	–	–	–	029
	Threaded ports A and B at side, opposite	03	0	●	●	●	●	–	–	–	–	–	–	–	–	–	030
	Threaded ports A and B at side and rear[3)]	04	0	–	●	●	●	●	●	–	–	–	–	❍	–	–	040
	SAE flange ports A and B at bottom (same side)	10	0	–	–	–	●	●	●	●	●	●	–	–	❍	–	100
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve[5)] BVD	17	1	–	–	–	–	–	–	–	●	–					171 178
		18	8	–	–	–	●	●	●	●	●	●	–	–	–	–	181
	BVE	18		–	–	–	–	–	–	–	●	●	–	–[4)]	–	–	188
	Port plate with pressure-relief valves	19	1	–	–	–	●	●	●	●	●	●	–	–	–	–	191
			2	–	–	–	●	●	●	●	●	●	–	–	–	–	192

Valves (see pages 34 to 41)

Without valve	0
Pressure-relief valve (without pressure boost facility)	1
Pressure-relief valve (with pressure boost facility)	2
Flushing and boost pressure valve, mounted	7
Counterbalance valve BVD/BVE mounted[5)6)]	8
Flushing and boost pressure valve, integrated	9

Speed sensors (see pages 42 and 43)

		5 to 16	23 to 180	200	250 to 500	710 to 1000[4)]	
13	Without speed sensor (without code)	●	●	●	●	●	
	Prepared for HDD speed sensor	–	▲	▲	●	–	F
	HDD speed sensor mounted[7)]	–	▲	▲	●	–	H
	Prepared for DSA speed sensor	–	❍	❍	❍	–	U
	DSA speed sensor mounted[7)]	–	❍	❍	❍	–	V

Special version

14	Standard version (without code)	
	Special version for slew drives (standard with port plate 19)	J

Standard / special version

15	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 ▲ = Not for new projects ▒ = Preferred program

2) Fastening thread or threaded ports, metric
3) Threaded ports at the sides (sizes 10 to 63) plugged with threaded plugs
4) Please contact us.
5) Note the restrictions on page 39.
6) Specify ordering code of counterbalance valve according to data sheet (BVD – RE 95522, BVE – RE 95525) separately.
7) Specify ordering code of sensor according to data sheet (DSA – RE 95133, HDD – RE 95135) separately and observe the requirements on the electronics

2

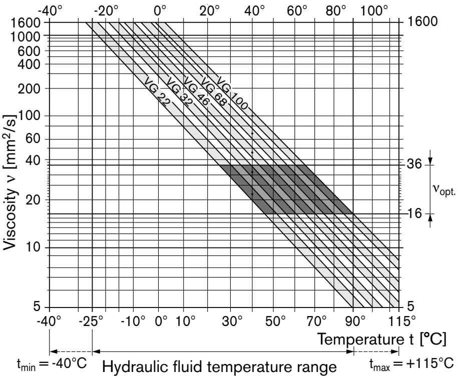
Technical data

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 motor A2FM 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 a closed circuit, the circuit 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 circuit temperature or 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) or using a flushing and boost pressure valve (see pages 34).

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]	ν_{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	ν < 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	ν = 400 to 10 ν_{opt} = 36 to 16	T = -25 °C to +90 °C	measured at port T, no restriction within the permissible data
Short-term operation[2]	$\nu_{min} \geq$ 7	T_{max} = +103 °C	measured at port T, t < 3 min, $p < 0.3 \cdot p_{nom}$
FKM shaft seal[1]		$T \leq$ +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.

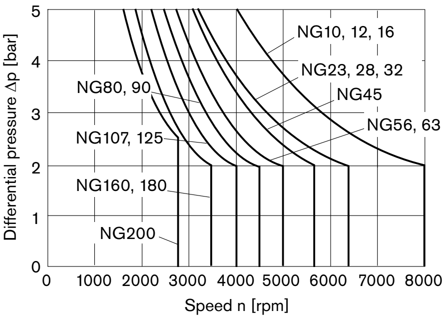
Shaft seal

Permissible pressure loading

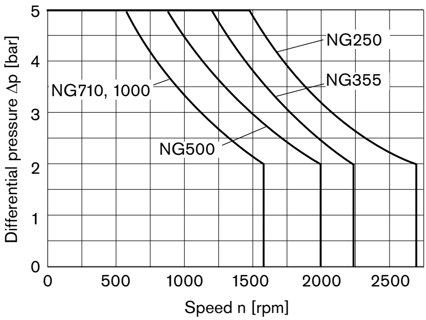
The service life of the shaft seal is influenced by the speed of the axial piston unit and the case drain pressure (case pressure). The mean differential pressure of 2 bar between the case and the ambient pressure may not be enduringly exceeded at normal operating temperature. For a higher differential 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**
A to **B**	**B** to **A**

Speed range

No limit to minimum speed n_{min}. If uniformity of motion is required, speed n_{min} must not be less than 50 rpm. See table of values on page 7 for maximum speed.

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

2

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

Summation pressure (pressure A + pressure B) p_{Su} 630 bar

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

Summation pressure (pressure A + pressure B) p_{Su} _ 700 bar

Sizes 250 to 1000

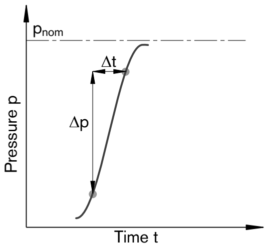
Nominal pressure p_{nom} ______ 350 bar absolute

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

Summation pressure (pressure A + pressure B) p_{Su} _ 700 bar

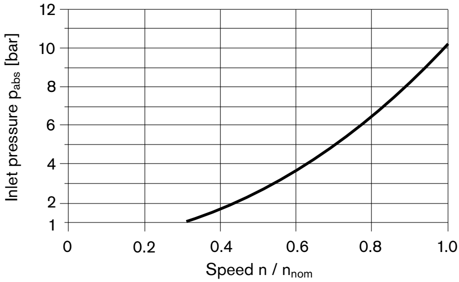
Minimum pressure (high-pressure side) ___25 bar absolute

Rate of pressure change $R_{A\,max}$
with integrated pressure-relief valve ______ 9000 bar/s
without pressure-relief valve ______ 16000 bar/s



Note
Values for other hydraulic fluids, please contact us.

Minimum pressure – pump mode (inlet)
To prevent damage to the axial piston motor in pump operating mode (change of high-pressure side with unchanged direction of rotation, e. g. when braking), a minimum pressure must be guaranteed at the service line port (inlet). The minimum pressure depends on the speed of the axial piston unit (see characteristic curve below).



This diagram is valid only for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s.
Please contact us if these conditions cannot be satisfied.

Definition

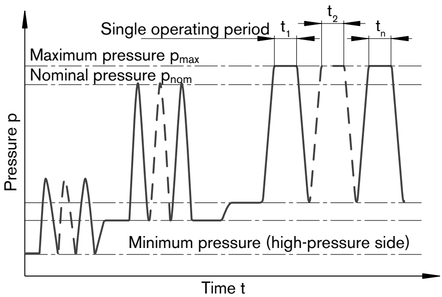
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

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.

Summation pressure p_{Su}
The summation pressure is the sum of the pressures at both service line ports (A and B).

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		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	10000	8000	8000	8000	6300	6300	6300	5600	5000	5000	4500
	n_{max}[2)]	rpm	11000	8800	8800	8800	6900	6900	6900	6200	5500	5500	5000
Input flow[3)] at n_{nom} and V_g	q_V	L/min	49	82	96	128	144	177	202	255	281	315	362
Torque[4)] at V_g and $\Delta p = 350$ bar	T	Nm	24.7[5)]	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	5.4	5.4	5.4	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	4500	4000	4000	3600	3600	2750	2700	2240	2000	1600	1600
	n_{max}[2)]	rpm	5000	4400	4400	4000	4000	3000	–	–	–	–	–
Input flow[3)] at n_{nom} and V_g	q_V	L/min	405	427	500	577	648	550	675	795	1000	1136	1600
Torque[4)] 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:
- for the optimum viscosity range from $\nu_{opt} = 36$ to $16\ mm^2/s$
- with hydraulic fluid based on mineral oils

2) Intermittent maximum speed: overspeed for unload and overhauling processes, $t < 5$ s and $\Delta p < 150$ bar

3) Restriction of input flow with counterbalance valve, see page 39

4) Torque without radial force, with radial force see page 8

5) 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 force[1] 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 force[2]	$+F_{ax\,max}$	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 force[1] 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 force[2]	$+F_{ax\,max}$	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 force[1] 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 force[2]	$+F_{ax\,max}$	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 force[1] at distance a (from shaft collar)	$F_{q\,max}$	kN	20.3	1.2[6]	1.5[6]	1.9[6]	3.0[6]	2.6[6]
	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 force[2]	$+F_{ax\,max}$	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

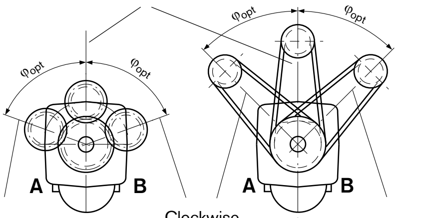
$-F_{ax\,max}$ = Reduction in service life of bearings (avoid)

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	φ_{opt}	φ_{opt}
5 to 180	± 70°	± 45°
200 to 1000	± 45°	± 70°



Determining the operating characteristics

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

Speed $$n = \frac{q_V \cdot 1000 \cdot \eta_v}{V_g} \quad [\text{min}^{-1}]$$

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

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

V_g = Displacement per revolution in cm^3

Δp = Differential pressure in bar

n = Speed in rpm

η_v = Volumetric efficiency

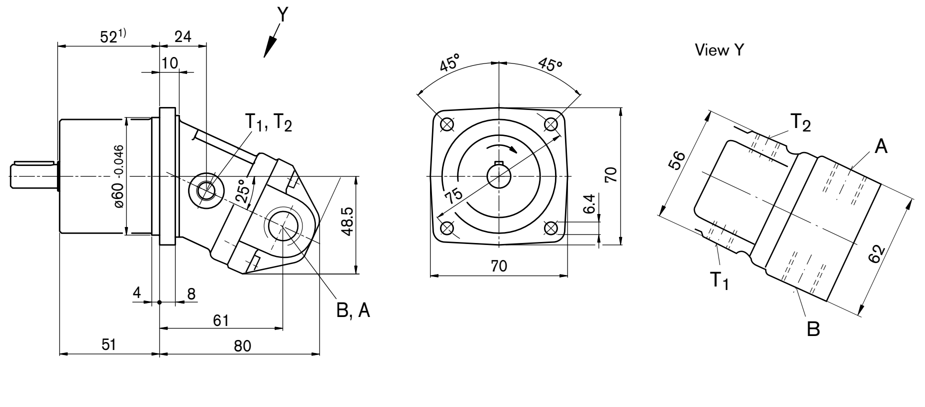
η_{mh} = Mechanical-hydraulic efficiency

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

2

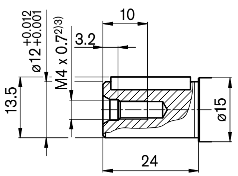
Dimensions size 5

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

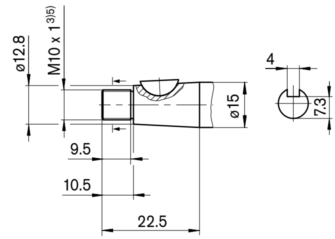


Drive shafts

B Parallel keyed shaft
DIN 6885, A4x4x20



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



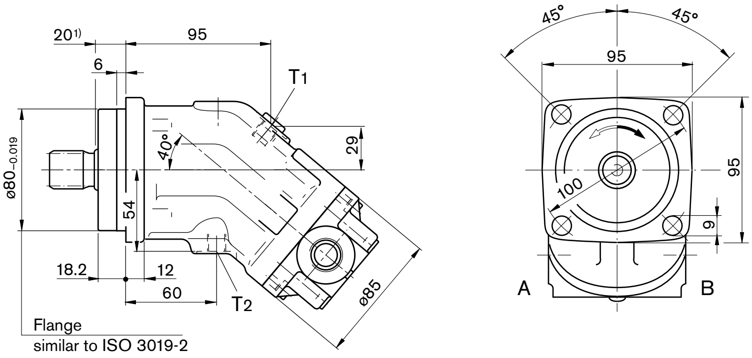
Ports

Designation	Port for	Standard[6)]	Size[3)]	Maximum pressure [bar][4)]	State[7)]
A, B	Service line	DIN 3852	M18 x 1.5; 12 deep	350	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 46 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) Thread according to DIN 3852, maximum tightening torque: 30 Nm
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

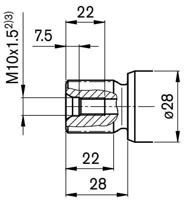
Before finalizing your design, request a binding installation drawing. Dimensions in mm.



Drive shafts

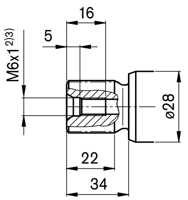
Sizes 10, 12, 16

A Splined shaft DIN 5480 W25x1.25x18x9g



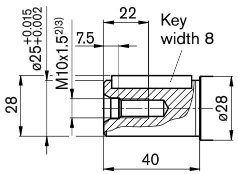
Sizes 10, 12

Z Splined shaft DIN 5480 W20x1.25x14x9g



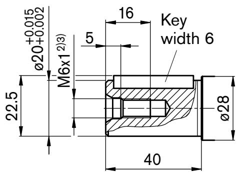
Sizes 10, 12, 16

B Parallel keyed shaft DIN 6885, AS8x7x32



Sizes 10, 12

P Parallel keyed shaft DIN 6885, AS6x6x32



Ports

Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[7)]
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852[6)]	M12 x 1.5; 12 deep	3	X[5)]
T_2	Drain line	DIN 3852[6)]	M12 x 1.5; 12 deep	3	O[5)]

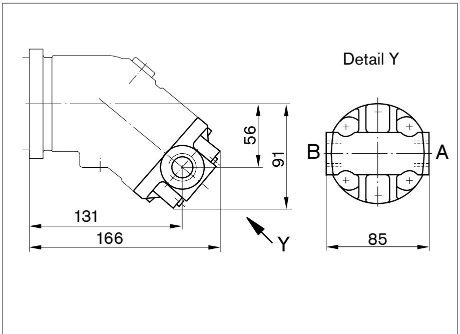
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
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 10, 12, 16

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

Location of the service line ports on the port plates

03 – Threaded ports at side, opposite



04 – Threaded ports at side and rear

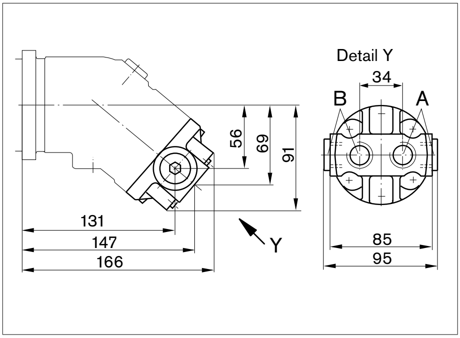
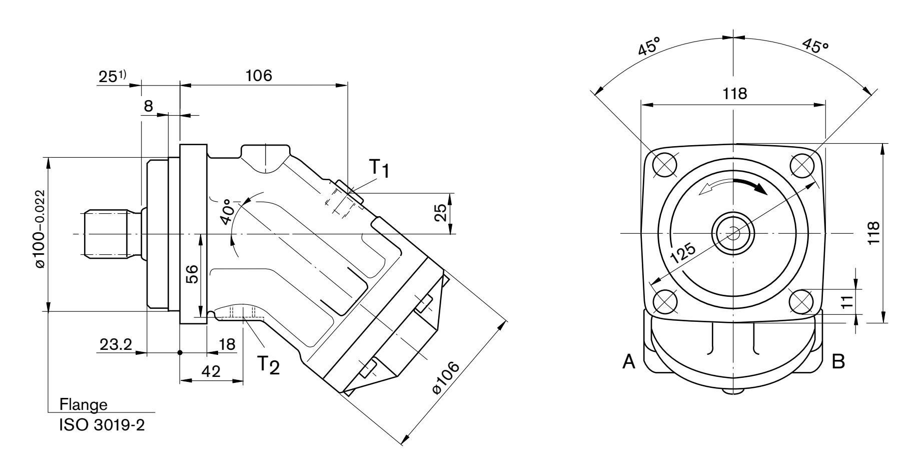


Plate	Designation	Port for	Standard[3]	Size[1]	Maximum pressure [bar][2]	State[4]
03	A, B	Service line	DIN 3852	M22 x 1.5; 14 deep	450	O
04		Service line	DIN 3852	M22 x 1.5; 14 deep	450	1x O each

1) Observe the general instructions on page 46 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) The spot face can be deeper than specified in the appropriate standard.
4) O = Must be connected (plugged on delivery)

Dimensions sizes 23, 28, 32

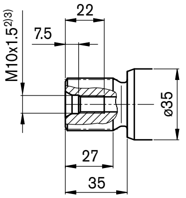
Before finalizing your design, request a binding installation drawing. Dimensions in mm.



Drive shafts

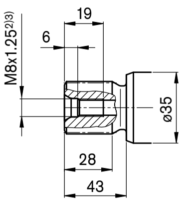
Sizes 23, 28, 32

A Splined shaft DIN 5480 W30x2x14x9g



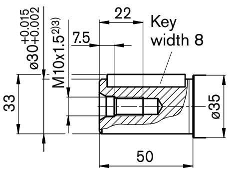
Sizes 23, 28

Z Splined shaft DIN 5480 W25x1.25x18x9g



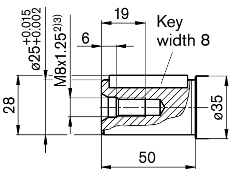
Sizes 23, 28, 32

B Parallel keyed shaft DIN 6885, AS8x7x40



Sizes 23, 28

P Parallel keyed shaft DIN 6885, AS8x7x40



Ports

Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[7)]
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852[6)]	M16 x 1.5; 12 deep	3	X[5)]
T_2	Drain line	DIN 3852[6)]	M16 x 1.5; 12 deep	3	O[5)]

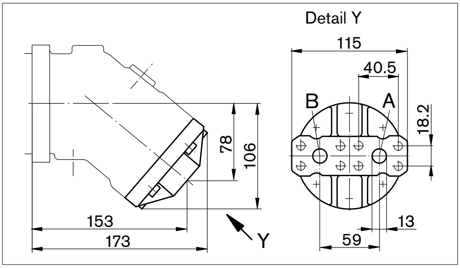
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
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 23, 28, 32

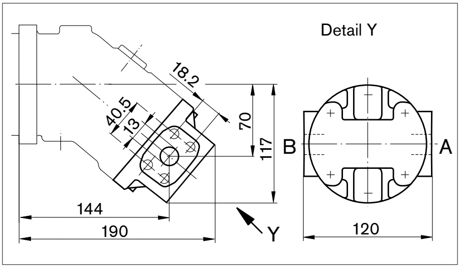
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

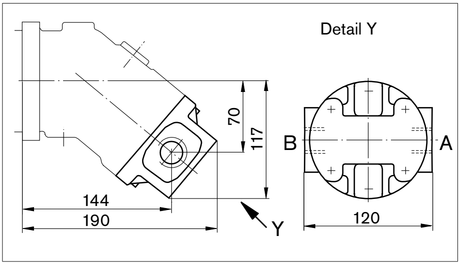
01 – SAE flange ports at rear



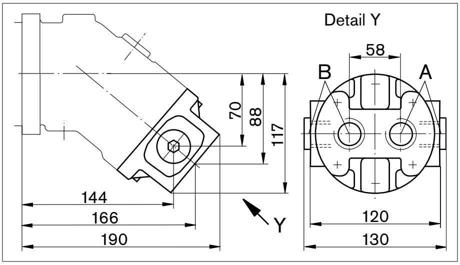
02 – SAE flange ports at side, opposite



03 – Threaded ports at side, opposite



04 – Threaded ports at side and rear



10 – SAE flange ports at bottom (same side)4)

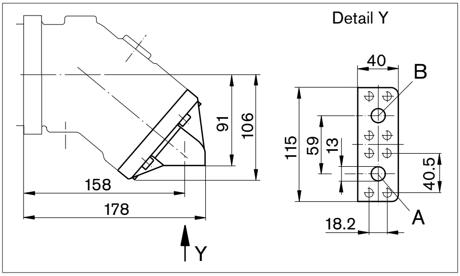


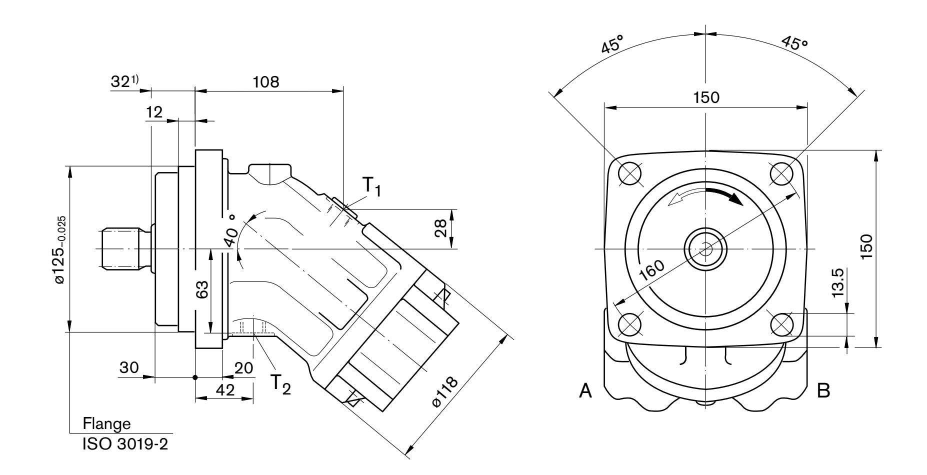
Plate	Designation	Port for	Standard	Size1)	Maximum pressure [bar]2)	State6)
01, 02, 10	A, B	Service line Fastening thread A/B	SAE J5183) DIN 13	1/2 in M8 x 1.25; 15 deep	450	O
03		Service line	DIN 38525)	M27 x 2; 16 deep	450	O
04		Service line	DIN 38525)	M27 x 2; 16 deep	450	1x O each

1) Observe the general instructions on page 46 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard
4) Only sizes 28 and 32
5) The spot face can be deeper than specified in the appropriate standard.
6) O = Must be connected (plugged on delivery)

Note
Port plates 18 and 19: see pages 37 and 40

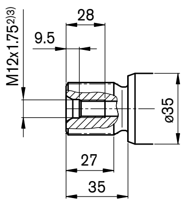
Dimensions size 45

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

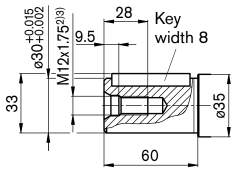


Drive shafts

Z Splined shaft DIN 5480
W30x2x14x9g



P Parallel keyed shaft
DIN 6885, AS8x7x50



Ports

Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[7]
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852[6]	M18 x 1.5; 12 deep	3	X[5]
T_2	Drain line	DIN 3852[6]	M18 x 1.5; 12 deep	3	O[5]

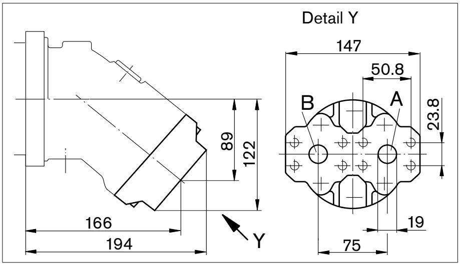
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
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

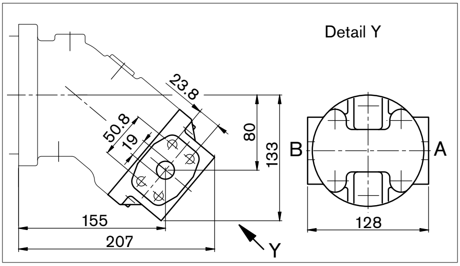
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

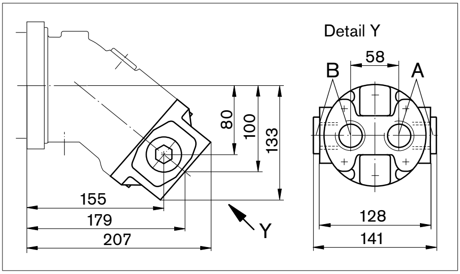
01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite



04 – Threaded ports at side and rear



10 – SAE flange ports at bottom (same side)

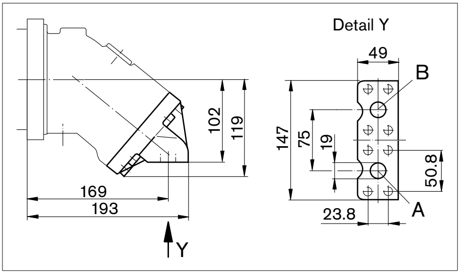


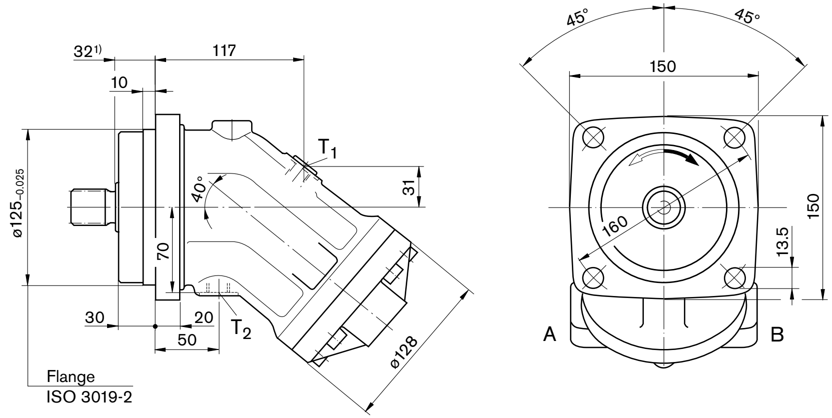
Plate	Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[5]
01, 02, 10	A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 x 1.5; 17 deep	450	O
04		Service line	DIN 3852[4]	M33 x 2; 18 deep	450	1x O each

1) Observe the general instructions on page 46 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) The spot face can be deeper than specified in the appropriate standard.
5) O = Must be connected (plugged on delivery)

Note
Port plates 18 and 19: see pages 37 and 40

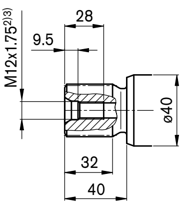
Dimensions sizes 56, 63

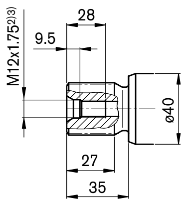
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

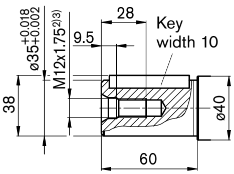


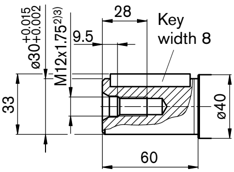
Drive shafts

NG56, 63	NG56	NG56, 63	NG56
A Splined shaft DIN 5480 W35x2x16x9g	**Z** Splined shaft DIN 5480 W30x2x14x9g	**B** Parallel keyed shaft DIN 6885, AS10x8x50	**P** Parallel keyed shaft DIN 6885, AS8x7x50









Ports

Designation	Port for	Standard	Size 3)	Maximum pressure [bar] 4)	State 7)
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852 6)	M18 x 1.5; 12 deep	3	X 5)
T_2	Drain line	DIN 3852 6)	M18 x 1.5; 12 deep	3	O 5)

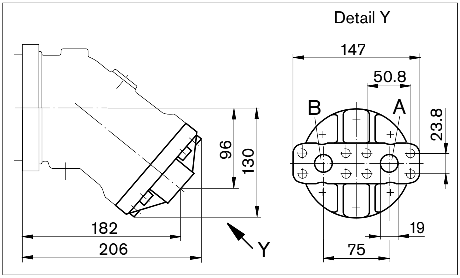
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
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

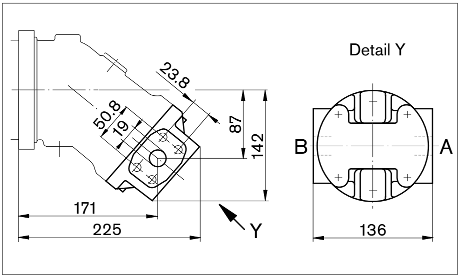
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

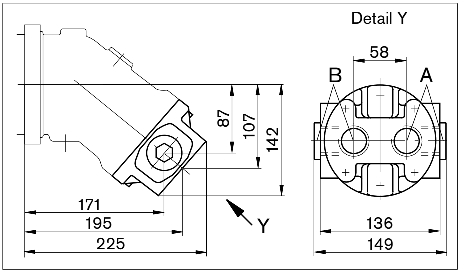
01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite



04 – Threaded ports at side and rear



10 – SAE flange ports at bottom (same side)

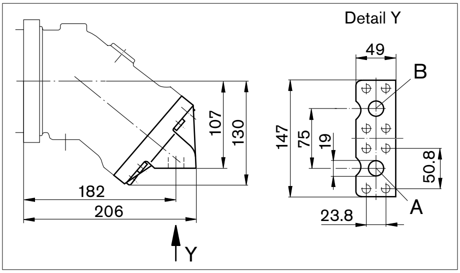


Plate	Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[5]
01, 02, 10	A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 x 1.5; 17 deep	450	O
04		Service line	DIN 3852[4]	M33 x 2; 18 deep	450	1x O each

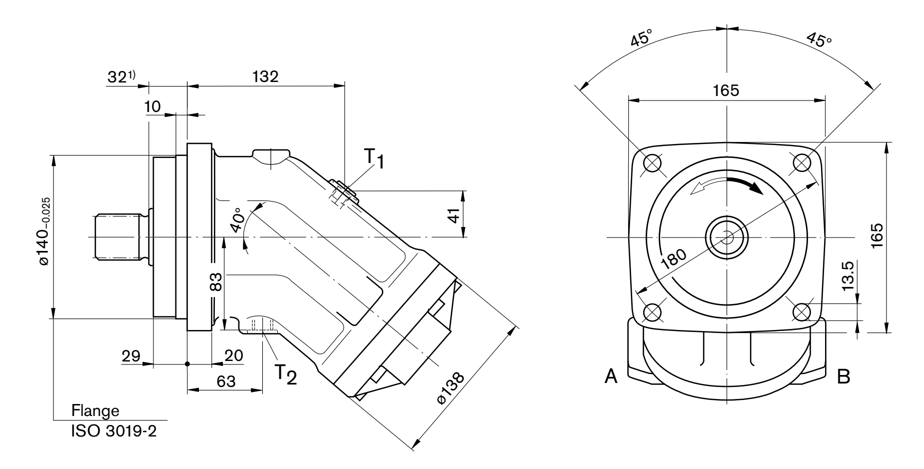
1) Observe the general instructions on page 46 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) The spot face can be deeper than specified in the appropriate standard.
5) O = Must be connected (plugged on delivery)

Note

Port plates 18 and 19: see pages 37 and 40

Dimensions sizes 80, 90

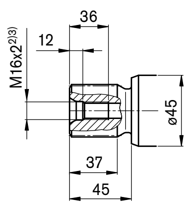
Before finalizing your design, request a binding installation drawing. Dimensions in mm.



Drive shafts

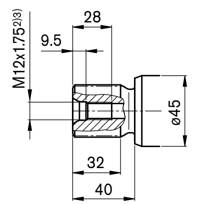
NG80, 90

A Splined shaft DIN 5480 W40x2x18x9g



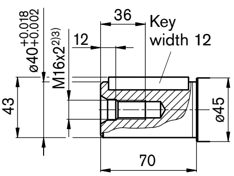
NG80

Z Splined shaft DIN 5480 W35x2x16x9g



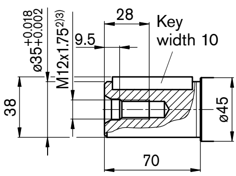
NG80, 90

B Parallel keyed shaft DIN 6885, AS12x8x56



NG80

P Parallel keyed shaft DIN 6885, AS10x8x56



Ports

Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[7]
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852[6]	M18 x 1.5; 12 deep	3	X[5]
T_2	Drain line	DIN 3852[6]	M18 x 1.5; 12 deep	3	O[5]

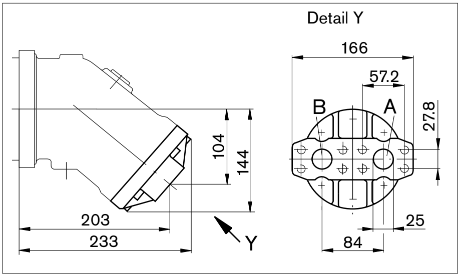
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
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

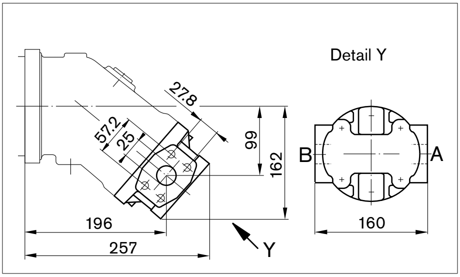
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite



10 – SAE flange ports at bottom (same side)

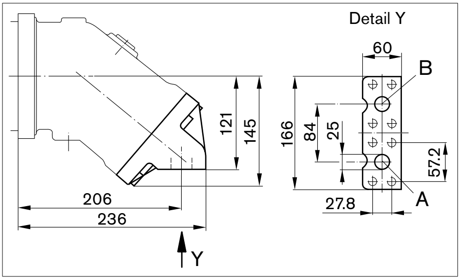


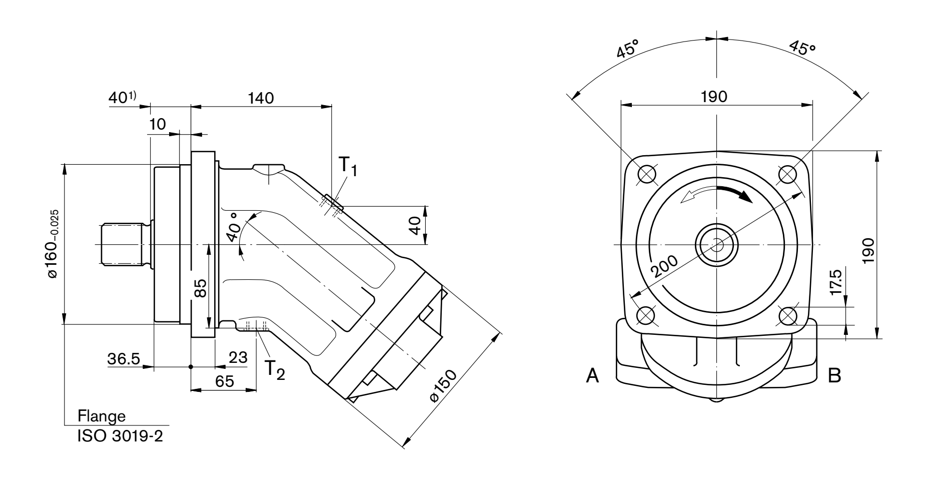
Plate	Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[4]
01, 02, 10	A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	450	O

1) Observe the general instructions on page 46 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) O = Must be connected (plugged on delivery)

Note
Port plates 18 and 19: see pages 37 and 40

Dimensions sizes 107, 125

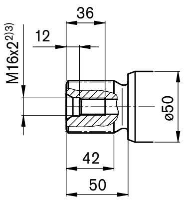
Before finalizing your design, request a binding installation drawing. Dimensions in mm.



Drive shafts

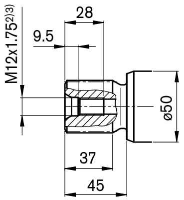
NG107, 125

A Splined shaft DIN 5480 W45x2x21x9g



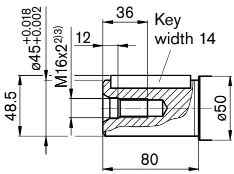
NG107

Z Splined shaft DIN 5480 W40x2x18x9g



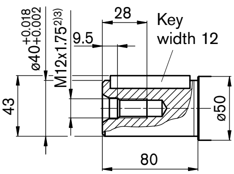
NG107, 125

B Parallel keyed shaft DIN 6885, AS14x9x63



NG107

P Parallel keyed shaft DIN 6885, AS12x8x63



Ports

Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[7)]
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852[6)]	M18 x 1.5; 12 deep	3	X[5)]
T_2	Drain line	DIN 3852[6)]	M18 x 1.5; 12 deep	3	O[5)]

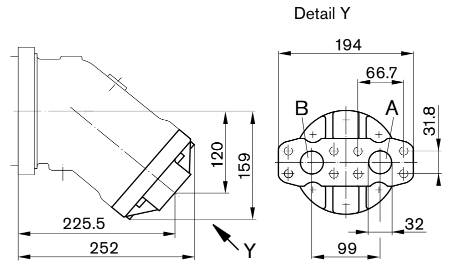
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
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

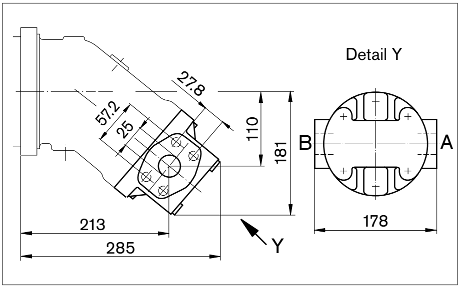
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

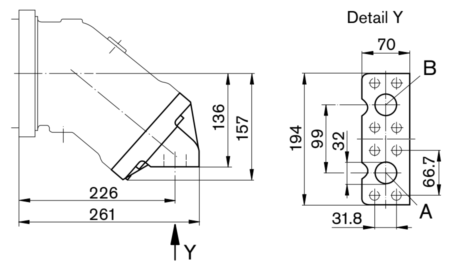
01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite (size 107)



10 – SAE flange ports at bottom (same side)



02 – SAE flange ports at side, opposite (size 125)

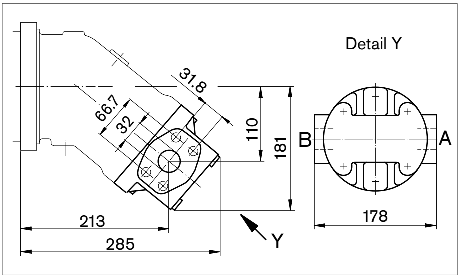


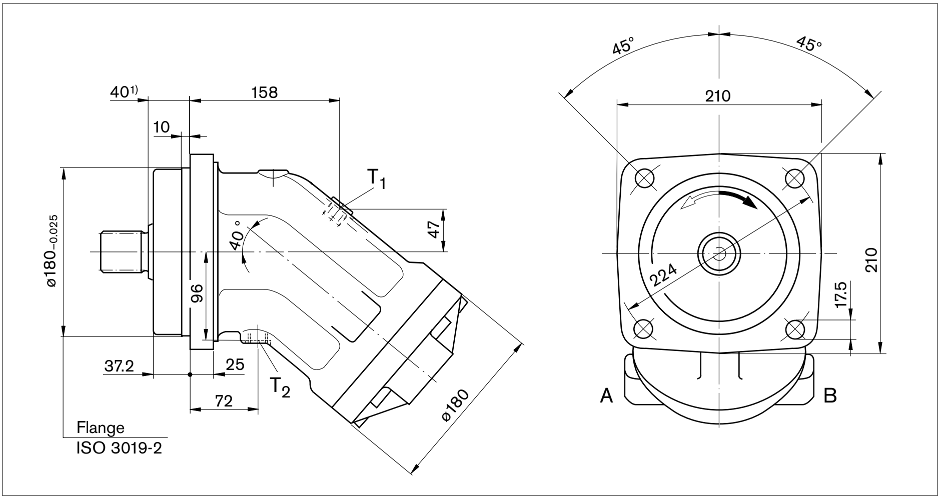
Plate	Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[4]
01, 10	A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	450	O
02 (size 107)		Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	450	O
02 (size 125)		Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	450	O

1) Observe the general instructions on page 46 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) O = Must be connected (plugged on delivery)

Note
Port plates 17, 18 and 19: see pages 37 and 40

Dimensions sizes 160, 180

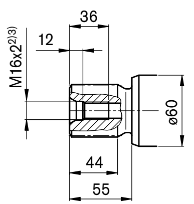
Before finalizing your design, request a binding installation drawing. Dimensions in mm.



Drive shafts

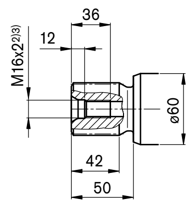
NG160, 180

A Splined shaft DIN 5480 W50x2x24x9g



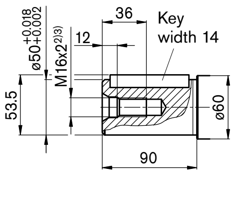
NG160

Z Splined shaft DIN 5480 W45x2x21x9g



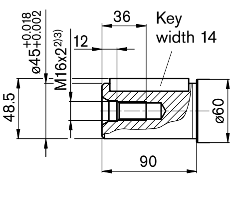
NG160, 180

B Parallel keyed shaft DIN 6885, AS14x9x70



NG160

P Parallel keyed shaft DIN 6885, AS14x9x70



Ports

Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[7)]
A, B	Service line (see port plates)			450	
T_1	Drain line	DIN 3852[6)]	M22 x 1.5; 14 deep	3	X[5)]
T_2	Drain line	DIN 3852[6)]	M22 x 1.5; 14 deep	3	O[5)]

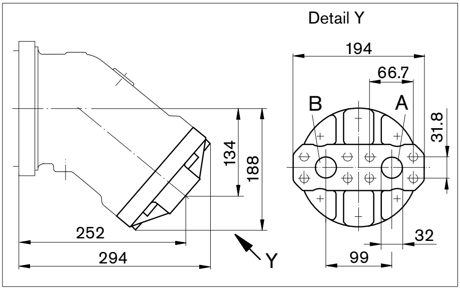
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
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

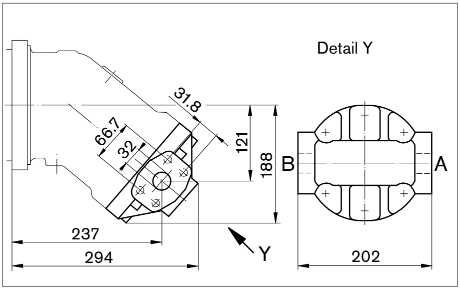
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates

01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite



10 – SAE flange ports at bottom (same side)

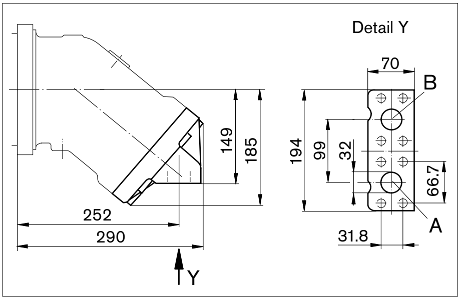


Plate	Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[4]
01, 02, 10	A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	450	O

1) Observe the general instructions on page 46 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) O = Must be connected (plugged on delivery)

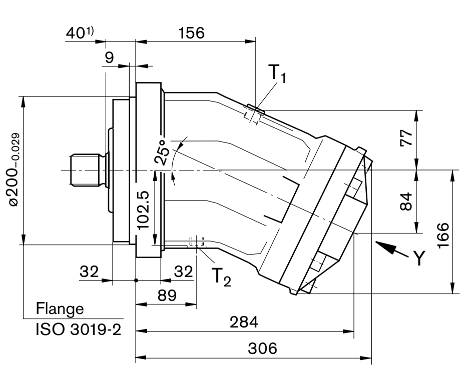
Note

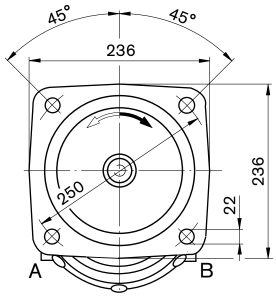
Port plates 18 and 19: see pages 37 and 40

Dimensions size 200

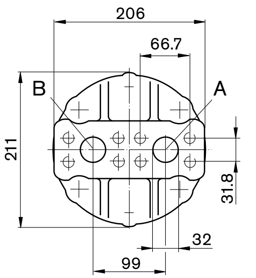
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 01 – SAE flange ports at rear



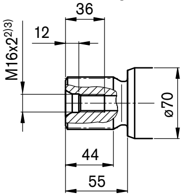


Detail Y

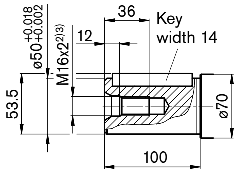


Drive shafts

A Splined shaft DIN 5480 W50x2x24x9g



B Parallel keyed shaft DIN 6885, AS14x9x80



Ports

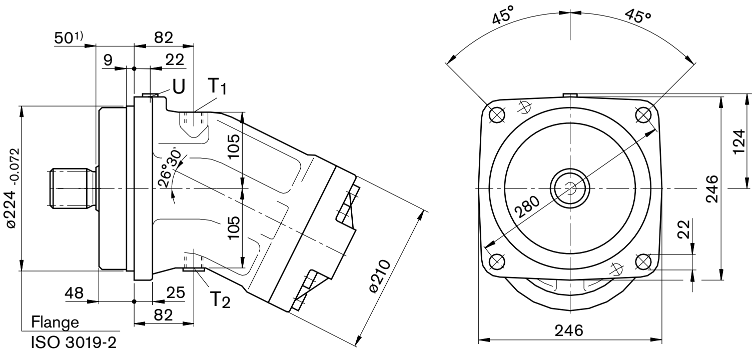
Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[8)]
A, B	Service line Fastening thread A/B	SAE J518[5)] DIN 13	1 1/4 in M14 x 2; 19 deep	450	O
T_1	Drain line	DIN 3852[7)]	M22 x 1.5; 14 deep	3	X[6)]
T_2	Drain line	DIN 3852[7)]	M22 x 1.5; 14 deep	3	O[6)]

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
6) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
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)

Notes

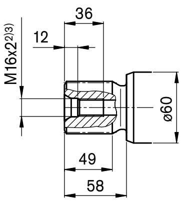
Dimensions size 250

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

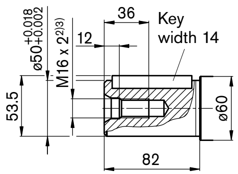


Drive shafts

Z Splined shaft DIN 5480 W50x2x24x9g



P Parallel keyed shaft DIN 6885, AS14x9x80



Ports

Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[7)]
A, B	Service line (see port plates)			400	
T_1	Drain line	DIN 3852[6)]	M22 x 1.5; 14 deep	3	O[5)]
T_2	Drain line	DIN 3852[6)]	M22 x 1.5; 14 deep	3	X[5)]
U	Bearing flushing	DIN 3852[6)]	M14 x 1.5; 12 deep	3	X

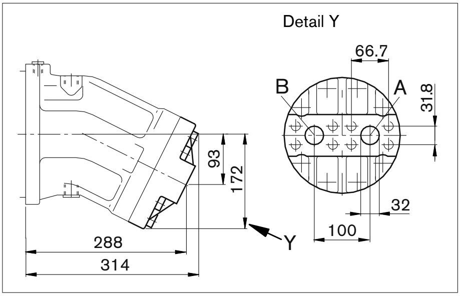
1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
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 250

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

Location of the service line ports on the port plates

01 – SAE flange ports at rear



02 – SAE flange ports at side, opposite

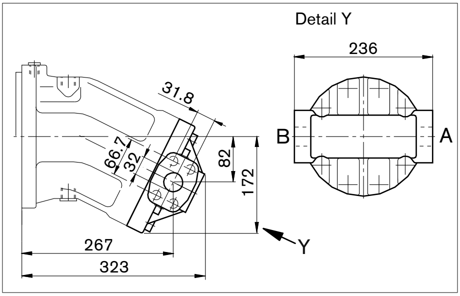


Plate	Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[4]
01, 02	A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	400	O

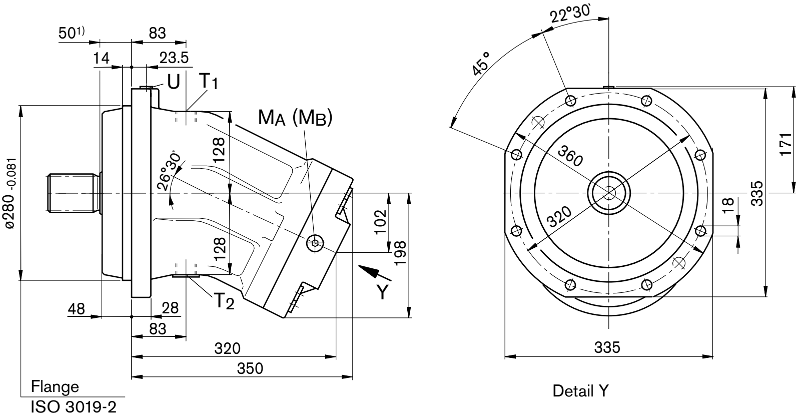
1) Observe the general instructions on page 46 for the maximum tightening torques
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) O = Must be connected (plugged on delivery)

2

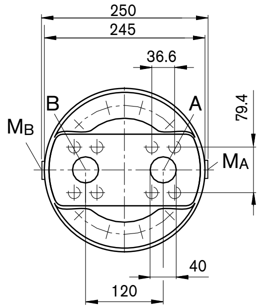
Dimensions size 355

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

Port plate 01 – SAE flange ports at rear

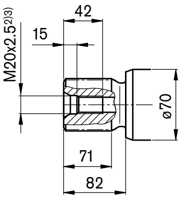


Detail Y

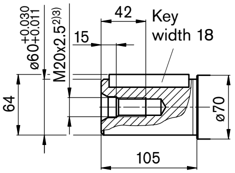


Drive shafts

Z Splined shaft DIN 5480 W60x2x28x9g



P Parallel keyed shaft DIN 6885, AS18x11x100



Ports

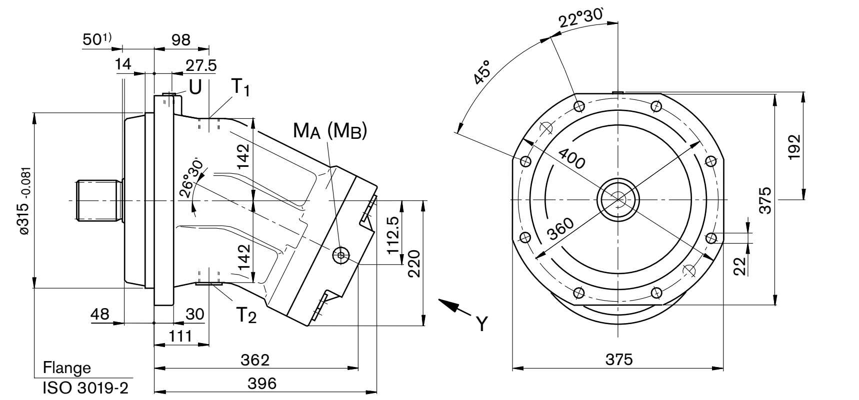
Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[8)]
A, B	Service line Fastening thread A/B	SAE J518[5)] DIN 13	1 1/2 in M16 x 2; 21 deep	400	O
T_1	Drain line	DIN 3852[7)]	M33 x 2; 18 deep	3	O[6)]
T_2	Drain line	DIN 3852[7)]	M33 x 2; 18 deep	3	X[6)]
U	Bearing flushing	DIN 3852[7)]	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

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
6) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
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)

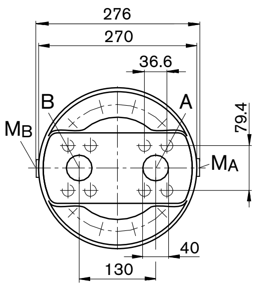
Dimensions size 500

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

Port plate 01 – SAE flange ports at rear

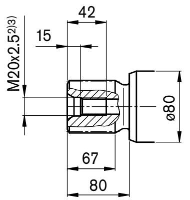


Detail Y

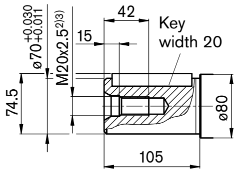


Drive shafts

Z Splined shaft DIN 5480 W70x3x22x9g



P Parallel keyed shaft DIN 6885, AS20x12x100



Ports

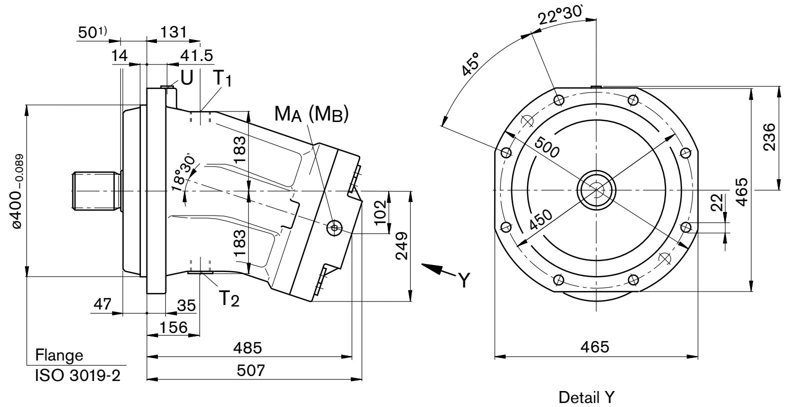
Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[8)]
A, B	Service line Fastening thread A/B	SAE J518[5)] DIN 13	1 1/2 in M16 x 2; 21 deep	400	O
T_1	Drain line	DIN 3852[7)]	M33 x 2; 18 deep	3	O[6)]
T_2	Drain line	DIN 3852[7)]	M33 x 2; 18 deep	3	X[6)]
U	Bearing flushing	DIN 3852[7)]	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

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
6) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
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)

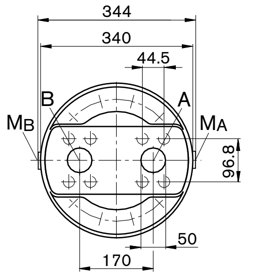
Dimensions size 710

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

Port plate 01 – SAE flange ports at rear

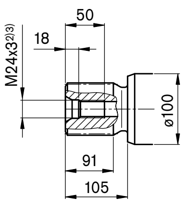


Detail Y

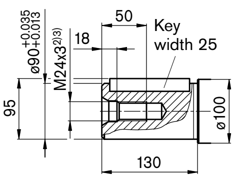


Drive shafts

Z Splined shaft DIN 5480 W90x3x28x9g



P Parallel keyed shaft DIN 6885, AS25x14x125



Ports

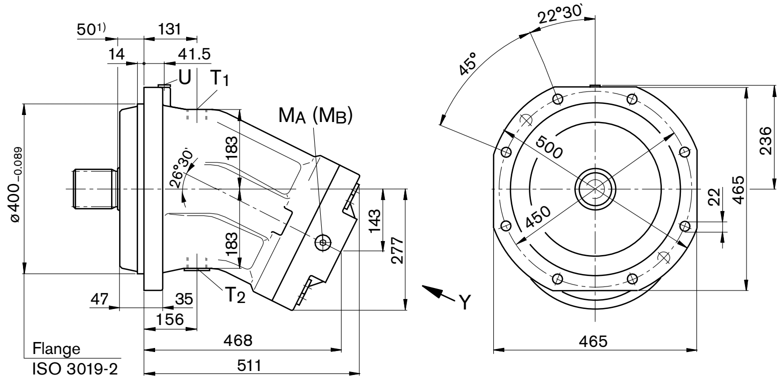
Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[5] DIN 13	2 in M20 x 2.5; 30 deep	400	O
T_1	Drain line	DIN 3852[7]	M42 x 2; 20 deep	3	O[6]
T_2	Drain line	DIN 3852[7]	M42 x 2; 20 deep	3	X[6]
U	Bearing flushing	DIN 3852[7]	M18 x 1.5; 12 deep	3	X
M_A, M_B	Measuring operating pressure	DIN 3852[7]	M14 x 1.5; 12 deep	400	X

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
6) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
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

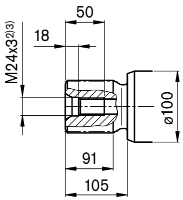
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 01 – SAE flange ports at rear

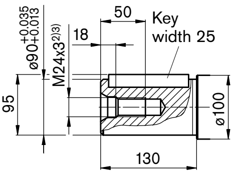


Drive shafts

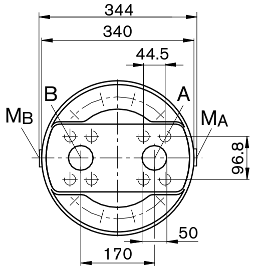
Z Splined shaft DIN 5480 W90x3x28x9g



P Parallel keyed shaft DIN 6885, AS25x14x125



Detail Y



Ports

Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[5] DIN 13	2 in M20 x 2.5; 30 deep	400	O
T_1	Drain line	DIN 3852[7]	M42 x 2; 20 deep	3	O[6]
T_2	Drain line	DIN 3852[7]	M42 x 2; 20 deep	3	X[6]
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

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 46 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
6) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 44).
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)

Flushing and boost pressure valve

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

The flushing and boost pressure valve is used to remove heat from the hydraulic circuit.

In an open circuit, it is used only for flushing the housing.

In a closed circuit, it ensures a minimum boost pressure level in addition to the case flushing.

Hydraulic fluid is directed from the respective low pressure side into the motor housing. This is then fed into the reservoir, together with the case drain fluid. The hydraulic fluid, removed out of the closed circuit must be replaced by cooled hydraulic fluid from the boost pump.

With port plate 027, the valve is mounted directly on the fixed motor (sizes 45 to 180, 250); with port plate 017 (sizes 355 and 500) on a plate.

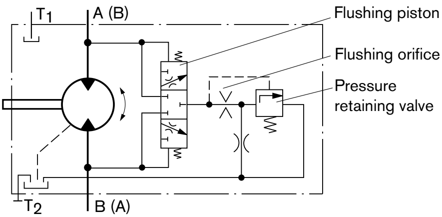
Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
Sizes 45 to 500, fixed setting ____ 16 bar

Switching pressure of flushing piston Δp
Sizes 45 to 500 ____ 8±1 bar

Flushing flow q_v

Orifice (throttles with integrated valve) can be used to set the flushing flows as required.
Following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G = 25$ bar and $\nu = 10$ mm²/s
(p_{ND} = low pressure, p_G = case pressure)

Schematic



Standard flushing flows

Flushing and boost pressure valve, mounted (code 7)

Size	Flushing flow q_v [L/min]	ø [mm]	Mat. No. of orifice
45	3.5	1.2	R909651766
107, 125	8	1.8	R909419696
160, 180	10	2.0	R909419697
250	10	2.0	R909419697
355, 500	16	2.5	R910803019

With sizes 45 to 180, orifices can be supplied for flushing flows from 3.5 to 10 L/min. For other flushing flows, please state the required flushing flow when ordering. The flushing flow without orifice is approx. 12 to 14 L at low pressure Δp_{ND} = 25 bar.

Flushing and boost pressure valve, integrated (code 9)

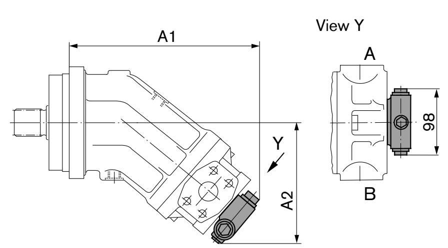
Size	Throttle ø [mm]	q_v [L/min]
56, 63, 80, 90	1.5	6
	1.8	7.3

Flushing and boost pressure valve

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

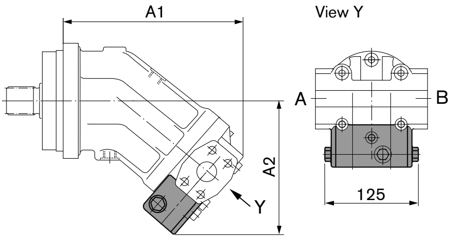
Dimensions

Port plate 027 – SAE flange ports at side



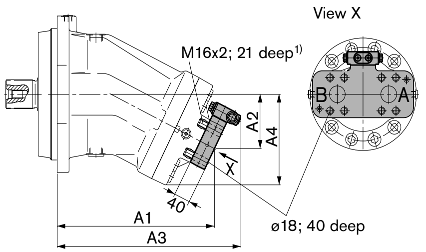
Size	A1	A2
45	223	151
107, 125	294	192
160, 180	315	201
250	344	172

Port plate 029 – SAE flange ports at side



Size	A1	A2
56, 63	225	176
80, 90	257	186.7

Port plate 017 – SAE flange ports at rear



Size	A1	A2	A3	A4
355	356	120	421	198
500	397	130	464	220

1) DIN 13, observe the general instructions on page 46 for the maximum tightening torques

2

Pressure-relief valve

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

The MHDB pressure-relief valves (see RE 64642) protect the hydraulic motor from overload. As soon as the set cracking pressure is reached, the hydraulic fluid flows from the high-pressure side to the low-pressure side.

The pressure-relief valves are only available in combination with port plates 181, 191 or 192 (counterbalance valve for mounting to port plate 181: see next page).

Cracking pressure setting range ____________ 50 to 420 bar

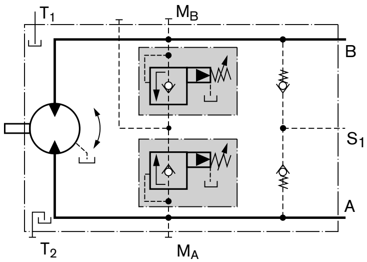
With the version "with pressure boost facility" (192), a higher pressure setting can be realized by applying an external pilot pressure of 25 to 30 bar to port P_{St}.

When ordering, please state in plain text:

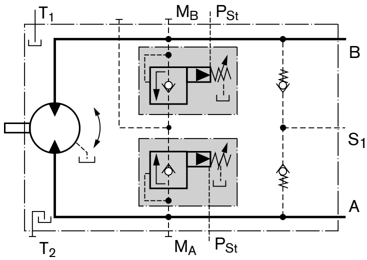
– Cracking pressure of pressure-relief valve

– Cracking pressure with pilot pressure applied to P_{St} (only with version 192)

Version without pressure boost facility "191"



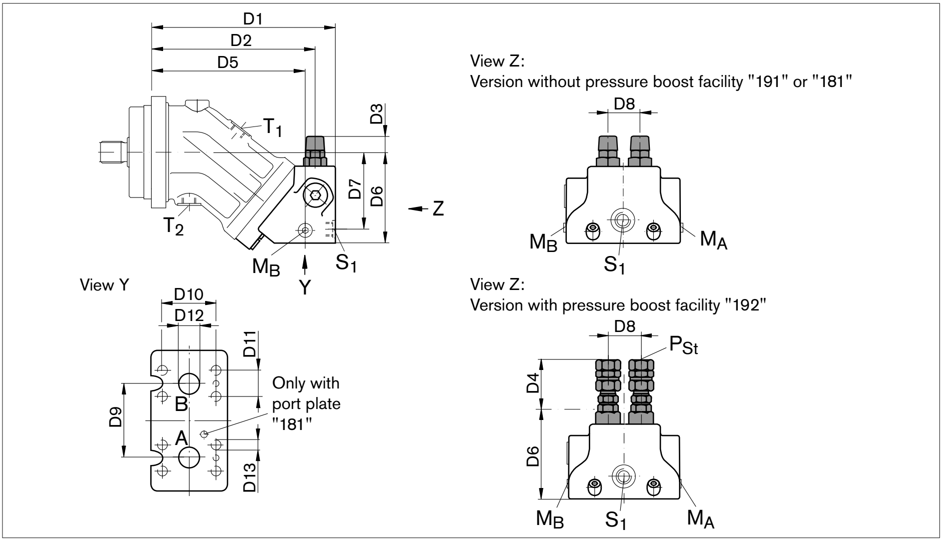
Version with pressure boost facility "192"



Pressure-relief valve

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

Dimensions



2

Size		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13[2]
28, 32	MHDB.**16**	209	186	25	68	174	102	87	36	66	50.8	23.8	ø19	M10; 17 deep
45	MHDB.**16**	222	198	22	65	187	113	98	36	66	50.8	23.8	ø19	M10; 17 deep
56, 63	MHDB.**22**	250	222	19	61	208	124	105	42	75	50.8	23.8	ø19	M10; 13 deep
80, 90	MHDB.**22**	271	243	17.5	59	229	134	114	42	75	57.2	27.8	ø25	M12; 18 deep
107, 125	MHDB.**32**	298	266	10	52	250	149.5	130	53	84	66.7	31.8	ø32	M14; 19 deep
160, 180	MHDB.**32**	332	301	5	47	285	170	149	53	84	66.7	31.8	ø32	M14; 19 deep

Size	A, B	S_1[1]	M_A, M_B[1]	P_{St}[1]
28, 32	3/4 in	M22 x 1.5; 14 deep	M20 x 1.5; 14 deep	G 1/4
45	3/4 in	M22 x 1.5; 14 deep	M20 x 1.5; 14 deep	G 1/4
56, 63	3/4 in	M26 x 1.5; 16 deep	M26 x 1.5; 16 deep	G 1/4
80, 90	1 in	M26 x 1.5; 16 deep	M26 x 1.5; 16 deep	G 1/4
107, 125	1 1/4 in	M26 x 1.5; 16 deep	M26 x 1.5; 16 deep	G 1/4
160, 180	1 1/4 in	M26 x 1.5; 16 deep	M30 x 1.5; 16 deep	G 1/4

Assembly instructions for port plate with pressure boost facility "192":
The lock nut must be counterheld when installing the hydraulic line at the p_{st} port!

Ports

Designation	Port for	Standard	Size	Maximum pressure [bar][2]	State[3]
A, B	Service line	SAE J518	See above	450	O
S_1	Supply (only with port plate 191/192)	DIN 3852	See above	5	O
M_A, M_B	Measuring operating pressure	DIN 3852	See above	450	X
P_{St}	Pilot pressure (only with port plate 192)	DIN ISO 228	See above	30	O

1) Observe the general instructions on page 46 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) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Counterbalance valve BVD and BVE

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

Function

Travel drive/winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if the motor speed is greater than it should be for the given input flow while braking, travelling downhill, or lowering a load.

If the inlet pressure drops, the counterbalance spool throttles the return flow and brakes the motor until the inlet pressure returns to approx. 20 bar.

Note

– BVD available for sizes 28 to 180 and BVE available for sizes 107 to 180.

– The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: A2FM90/61W–VAB**188** + BVD20F27S/41B–V03K16D0400S12

– The counterbalance valve does not replace the mechanical service brake and park brake.

– Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525!

– For the design of the brake release valve, we must know for the mechanical park brake:

  - the pressure at the start of opening

  - the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)

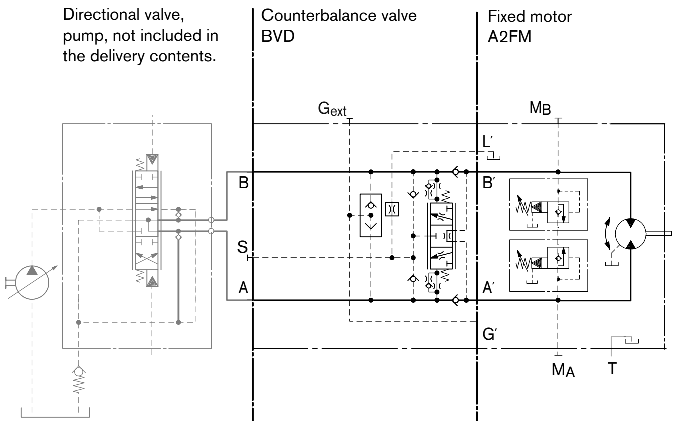
  - the required closing time for a warm device (oil viscosity approx. 15 mm²/s)

Travel drive counterbalance valve BVD...F

Application option

– Travel drive on wheeled excavators

Example schematic for travel drive on wheeled excavators
A2FM090/61W-VAB188 + BVD20F27S/41B–V03K16D0400S12



Counterbalance valve BVD and BVE

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

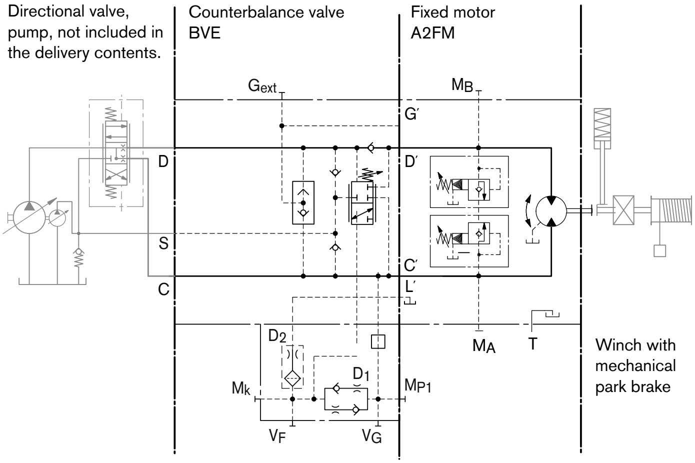
Winch counterbalance valve BVD...W and BVE

Application options

– Winch drive in cranes (BVD and BVE)

– Track drive in excavator crawlers (BVD)

Example schematic for winch drive in cranes
A2FM090/61W-VAB188 + BVE25W385/51ND-V100K00D4599T30S00-0



Permissible input flow or pressure in operation with DBV and BVD/BVE

Motor NG	Without valve p_{nom}/p_{max} [bar]	$q_{V\ max}$ [L/min]	Restricted values in operation with DBV and BVD/BVE: DBV NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code	BVD/BVE NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code
28	400/450	176	16	350/420	100	181 191, 192	20 (BVD)	350/420	100	188
32		201								
45		255								
56		280	22		240				220	
63		315								
80		360								
90		405								
107		427				171 191, 192				178
125		500								
107		427	32		400	181 191, 192	25 (BVD/BVE)		320	188
125		500								
160		577								
180		648								

DBV ______________________________ pressure-relief valve

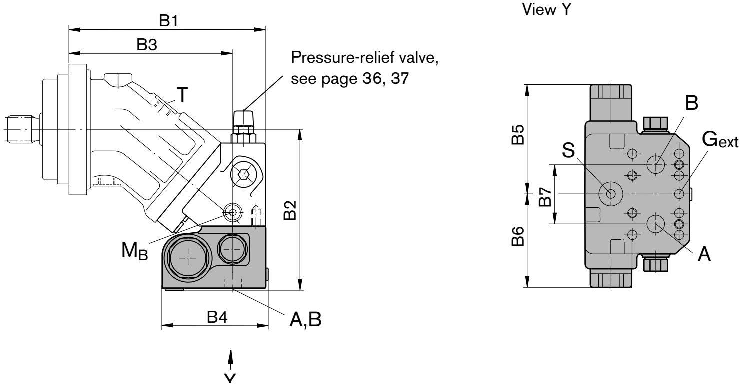
BVD _________________counterbalance valve, double-acting

BVE ____________________counterbalance valve, one-sided

Counterbalance valve BVD and BVE

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

Dimensions



A2FM Size	Counterbalance valve Type	Ports A, B	Dimensions B1	B2	B3	B4 (S)	B4 (L)	B5	B6	B7
28, 32	BVD**20**..16	3/4 in	209	175	174	142	147	139	98	66
45	BVD**20**..16	3/4 in	222	196	187	142	147	139	98	66
56, 63	BVD**20**..17	3/4 in	250	197	208	142	147	139	98	75
80, 90	BVD**20**..27	1 in	271	207	229	142	147	139	98	75
107, 125	BVD**20**..28	1 in	298	238	251	142	147	139	98	84
107, 125	BVD**25**..38	1 1/4 in	298	239	251	158	163	175	120.5	84
160, 180	BVD**25**..38	1 1/4 in	332	260	285	158	163	175	120.5	84
107, 125	BVE**25**..38	1 1/4 in	298	240	251	167	172	214	137	84
160, 180	BVE**25**..38	1 1/4 in	332	260	285	167	172	214	137	84
250	On request									

Ports

Designation	Port for	Version	Standard	Size[1]	Maximum pressure [bar][2]	State[4]
A, B	Service line		SAE J518	see table above	420	O
S	Infeed	BVD20	DIN 3852[3]	M22 x 1.5; 14 deep	30	X
		BVD25, BVE25	DIN 3852[3]	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high pressure	L	DIN 3852[3]	M12 x 1.5; 12.5 deep	30	O
G_{ext}	Brake release, high pressure	S	DIN 3852[3]	M12 x 1.5; 12.5 deep	420	X
M_A, M_B	Measuring pressure A and B		ISO 6149[3]	M12 x 1.5; 12 deep	420	X

1) Observe the general instructions on page 46 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) The spot face can be deeper than specified in the appropriate standard.
4) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Counterbalance valve BVD and BVE

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

Mounting the counterbalance valve

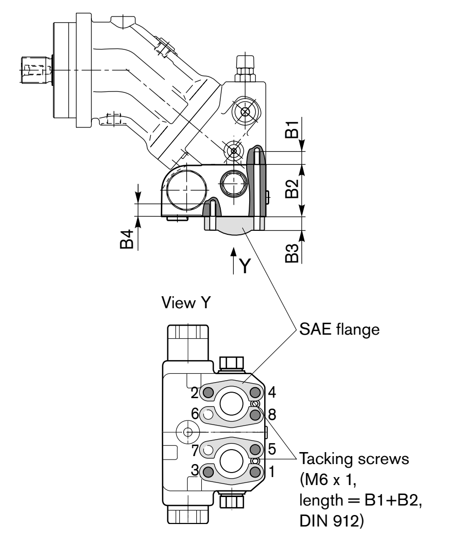
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the motor port plate using the provided tacking screws. The counterbalance valve is finally mounted to the motor by screwing on the SAE flange with the following screws:

6 screws (**1, 2, 3, 4, 5, 8**) ______________ length B1+B2+B3
2 screws (**6, 7**) ___________________________ length B3+B4

Tighten the screws in two steps in the specified sequence from 1 to 8 (see following scheme).

In the first step, the screws must be tightened with half the tightening torque, and in the second step with the maximum tightening torque (see following table).

Thread	Strength class	Tightening torque [Nm]
M6 x 1 (tacking screw)	10.9	15.5
M10	10.9	75
M12	10.9	130
M14	10.9	205



Size	28, 32, 45	56, 63	80, 90	107, 125, 160, 180	107, 125
Port plate	18				17
B1[1]	M10 x 1.5; 17 deep	M10 x 1.5; 17 deep	M12 x 1.75; 18 deep	M14 x 2; 19 deep	M12 x 1.75; 17 deep
B2	78[2]	68	68	85	68
B3	customer-specific				
B4	M10 x 1.5; 15 deep	M10 x 1.5; 15 deep	M12 x 1.75; 16 deep	M14 x 2; 19 deep	M12 x 1.75; 17 deep

1) Minimum required thread reach 1 x ø-thread
2) Including sandwich plate

2

Speed sensors

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

The versions A2FM...U and A2FM...F ("prepared for speed sensor", i.e. without sensor) is equipped with a toothed ring on the rotary group.

On deliveries "prepared for speed sensor", the port is plugged with a pressure-resistant cover.

With the DSA or HDD speed sensor mounted a signal proportional to motor speed can be generated.
The sensors measures the speed and direction of rotation.

Ordering code, technical data, dimensions and details on the connector, plus safety information about the sensor can be found in the relevant data sheet.

DSA ______________________________ RE 95133

HDD ______________________________ RE 35135

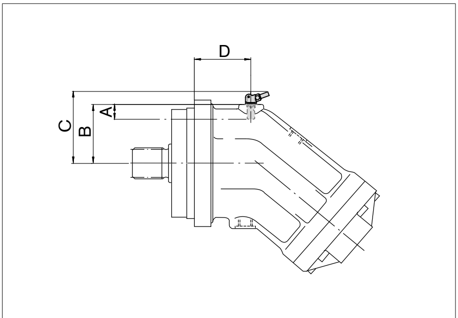
The sensor is mounted at the specially provided port D as follows:

DSA ____________________ with one mounting bolt

HDD ____________________ with two mounting bolts

We recommend ordering the A2FM fixed motor complete with sensor mounted.

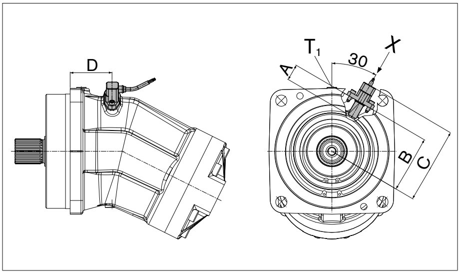
Version "V"
Sizes 23 to 200 with DSA sensor



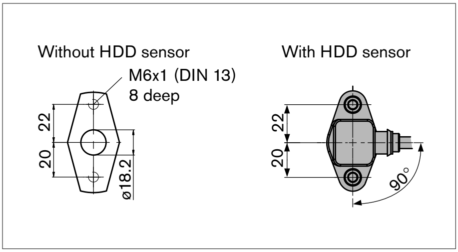
Version "V"
Sizes 250 to 500 with DSA sensor

On request

Version "H"
Sizes 250 to 500 with HDD sensor



View X



Speed sensors

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

Size			23, 28, 32	45	56, 63	80, 90	107, 125
Number of teeth			38	45	47	53	59
DSA	A	Insertion depth (tolerance ± 0.1)	18.4	18.4	18.4	18.4	18.4
	B	Contact surface	57.9	64.9	69.9	74.9	79.9
	C		74.5	81.5	86.5	91.5	96.5
	D		54.7	54.3	61.5	72.5	76.8

Size			160, 180	200	250	355	500
Number of teeth			67	80	78	90	99
HDD	A	Insertion depth (tolerance ± 0.1)	–	–	32	32	32
	B	Contact surface	–	–	110.5	122.5	132.5
	C		–	–	149	161	171
	D		–	–	82	93	113
DSA	A	Insertion depth (tolerance ± 0.1)	18.4	18.4	32	32	32
	B	Contact surface	87.4	100.9	–	–	–
	C		104	117.5	–	–	–
	D		86.8	97.5			

2

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 drain line must flow into the reservoir below the minimum fluid level.

Installation position

See the following examples 1 to 8.
Further installation positions are possible upon request.

Recommended installation positions: 1 and 2.

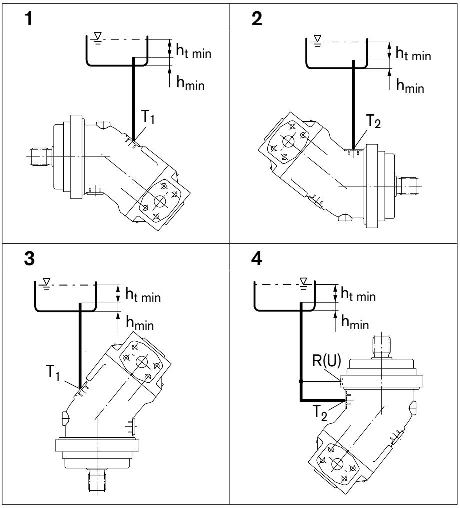
Note
With sizes 10 to 200 with installation position "shaft upward", an air-bleed port R is required (state in plain text when ordering - special version). With sizes 250 to 1000, port U is provided as standard in the area near the bearings for air bleeding.

Installation position	Air bleed	Filling
1	–	T_1
2	–	T_2
3	–	T_1
4	R (U)	T_2
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 (special version)
- **U** Bearing flushing / 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)

Below-reservoir installation (standard)

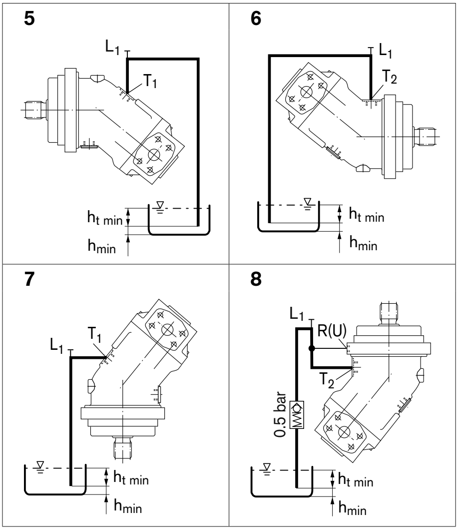
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



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 motor housing.



2

General instructions

– The motor A2FM is designed to be used in open and closed 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.

– 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 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
	M16 x 1.5	100 Nm	50 Nm	8 mm
	M18 x 1.5	140 Nm	60 Nm	8 mm
	M20 x 1.5	170 Nm	80 Nm	10 mm
	M22 x 1.5	210 Nm	80 Nm	10 mm
	M26 x 1.5	230 Nm	120 Nm	12 mm
	M27 x 2	330 Nm	135 Nm	12 mm
	M30 x 2	420 Nm	215 Nm	17 mm
	M33 x 2	540 Nm	225 Nm	17 mm
	M42 x 2	720 Nm	360 Nm	22 mm
DIN ISO 228	G 1/4	40 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" state, the M_V is reduced to 10 Nm for M10 x 1 and 17 Nm for M12 x 1.5.

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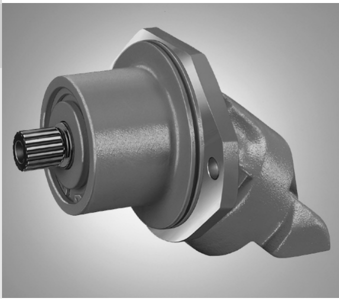
Fixed Plug-In Motor A2FE

RE 91008/06.2012
Replaces: 09.07

Data sheet



Series 6

Size	Nominal pressure/Maximum pressure
28 to 180	400/450 bar
250 to 355	350/400 bar

Open and closed circuits

Contents

Features

– Fixed plug-in motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuits

– Far-reaching integration in mechanical gearbox due to recessed mounting flange located in the center of the case (extremely space-saving construction)

– The output speed is dependent on the flow of the pump and the displacement of the motor

– The output torque increases with the pressure differential between the high-pressure and the low-pressure side.

– Small dimensions

– High total efficiency

– Complete unit, ready-assembled and tested

– Easy to install, simply plug into the mechanical gearbox

– No configuration specifications to be observed when installing

Ordering code for standard program

01	02	03	04	05		06	07	08		09	10	11	12	13	14	15
	A2F		E		/	6		W	–	V						

Hydraulic fluid

01	Mineral oil and HFD. HFD for sizes 250 and 355 only in combination with long-life bearings "L" (without code)		
	HFB, HFC hydraulic fluid	Sizes 28 to 180 (without code)	
		Sizes 250 to 355 (only in combination with long-life bearings "L")	**E-**

Axial piston unit

02	Bent-axis design, fixed	**A2F**

Drive shaft bearing

		28 to 180	250 to 355	
03	Standard bearing (without code)	●	●	
	Long-life bearing	–	●	**L**

Operating mode

04	Motor, plug-in version	**E**

Sizes (NG)

05	Geometric displacement, see table of values on page 7												
	28	**32**	**45**	**56**	**63**	**80**	**90**	**107**	**125**	**160**	**180**	**250**	**355**

Series

06		**6**

Index

07	NG28 to 180	**1**
	NG250 and 355	**0**

Direction of rotation

08	Viewed on drive shaft, bidirectional	**W**

Seals

09	FKM (fluor-caoutchouc)	**V**

Drive shafts

		28	32	45	56	63	80	90	107	125	160	180	250	355	
10	Splined shaft DIN 5480	●	●	–	●	●	●	●	●	●	●	●	–	–	**A**
		●	–	●	●	–	●	–	●	–	●	–	●	●	**Z**

Mounting flanges

			28 to 180	250 and 355	
11	ISO 3019-2	2-hole	●	–	**L**
		4-hole	–	●	**M**

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

Ordering code for standard program

	A2F		E		/	6		W	–	V						
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15

Port plates[1)]

				28	32	45	56	63	80	90	107	125	160	180	250	355	
12	SAE flange ports A and B at rear	01	0	–	–	–	–	–	–	–	–	–	–	–	●	❍	010
			7	–	–	–	–	–	–	–	–	–	–	–	–	❍	017
	SAE flange ports A and B at side, opposite	02	0	–	–	–	–	–	–	–	–	–	–	–	●	❍	020
			7	–	–	●	▲	▲	▲	▲	●	●	●	●	●	–	027
			9	–	–	–	●	●	●	●	–	–	–	–	–	–	029
	SAE flange ports A and B at bottom (same side)	10	0	●	●	●	●	●	●	●	●	●	●	●	–	●	100
			7	–	–	–	–	–	–	–	–	–	–	–	–	●	107
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve[2)] BVD	17	1 8	–	–	–	–	–	–	–	●	●	–	–	–	–	171 178
		18	8	●	●	●	●	●	●	●	●	●	●	●	–	–	181
	BVE	18	8	–	–	–	–	–	–	–	●	●	●	●	–[4)]	–	188
	Port plate with pressure-relief valves	19	1	●	●	●	●	●	●	●	●	●	●	●	–	–	191
			2	●	●	●	●	●	●	●	●	●	●	●	–	–	192

Valves (see pages 14 to 21)

Without valve	0
Pressure-relief valve (without pressure boost facility)	1
Pressure-relief valve (with pressure boost facility)	2
Flushing and boost pressure valve, mounted	7
Counterbalance valve BVD/BVE mounted[2)3)]	8
Flushing and boost pressure valve, integrated	9

Speed sensor (see page 22)

		28 to 45	56 to 180	250	355[4)]	
13	Without speed sensor (without code)	●	●	●	●	
	Prepared for HDD speed sensor	–	▲	●	–	F
	HDD speed sensor mounted[5)]	–	▲	●	–	H
	Prepared for DSA speed sensor	❍	❍	❍	–	U
	DSA speed sensor mounted[5)]	❍	❍	❍	–	V

Special version (only sizes 28 to 180)

14	Standard version (without code)	
	Special version for slew drives (standard with port plate 19)	J

Standard / special version

15	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 ▲ = Not for new projects ▒ = Preferred program

1) Fastening thread or threaded ports, metric
2) Note the restrictions on page 19.
3) Specify ordering code of counterbalance valve according to data sheet (BVD – RE 95522, BVE – RE 95525) separately.
4) Please contact us.
5) Specify ordering code of sensor according to data sheet (DSA – RE 95133, HDD – RE 95135) separately and observe the requirements on the electronics

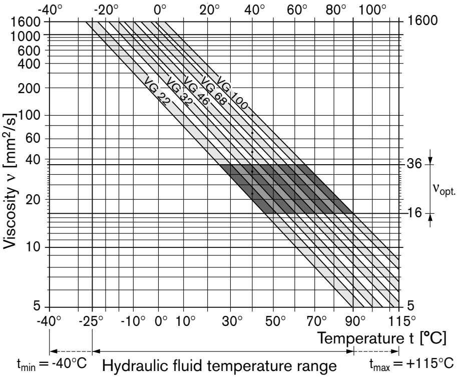
Technical data

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) and RE 90223 (HFA, HFB, HFC hydraulic fluids) for detailed information regarding the choice of hydraulic fluid and application conditions.

The plug-in motor A2FE 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 a closed circuit, the circuit 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 circuit temperature or 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 the use of a flushing and boost pressure valve (see page 14).

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]	ν_{max} = 1600	$T_{St} \geq$ -40 °C	$t \leq$ 3 min, without load ($p \leq$ 50 bar), $n \leq$ 1000 rpm (for sizes 28 to 180) $n \leq 0.25 \cdot n_{nom}$ (for sizes 250 and 355)
Permissible temperature difference		$\Delta T \leq$ 25 K	between axial piston unit and hydraulic fluid
Warm-up phase	ν < 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	ν = 400 to 10 ν_{opt} = 36 to 16	T = -25 °C to +90 °C	measured at port T, no restriction within the permissible data
Short-term operation[2]	$\nu_{min} \geq$ 7	T_{max} = +103 °C	measured at port T, $t <$ 3 min, $p < 0.3 \cdot p_{nom}$
FKM shaft seal[1]		$T \leq$ +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 and 355, 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.

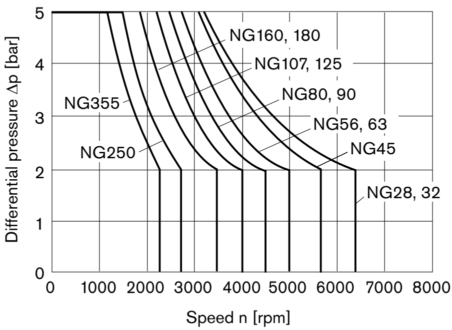
If the above classes cannot be achieved, please contact us.

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.



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**
A to **B**	**B** to **A**

Speed range

No limit to minimum speed n_{min}. If uniformity of motion is required, speed n_{min} must not be less than 50 rpm. See table of values on page 7 for maximum speed.

Long-life bearing

Sizes 250 and 355
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.

2

Technical data

Operating pressure range
(operating with mineral oil)

Pressure at service line port A or B

Sizes 28 to 180

Nominal pressure p_{nom} ________________ 400 bar absolute

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

Summation pressure (pressure A + pressure B) p_{Su} 700 bar

Sizes 250 and 355

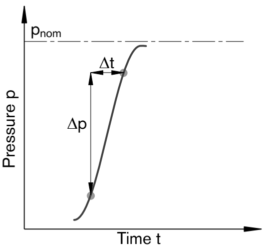
Nominal pressure p_{nom} ________________ 350 bar absolute

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

Summation pressure (pressure A + pressure B) p_{Su} _ 700 bar

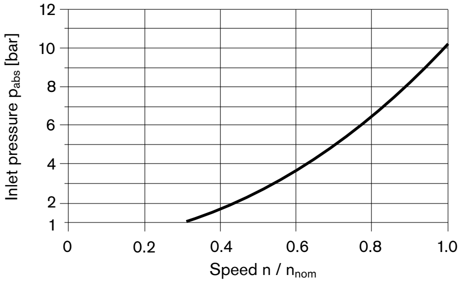
Minimum pressure (high-pressure side) ___25 bar absolute

Rate of pressure change $R_{A\,max}$
with integrated pressure-relief valve____________ 9000 bar/s
without pressure-relief valve _________________ 16000 bar/s



Note
Values for other hydraulic fluids, please contact us.

Minimum pressure – pump mode (inlet)
To prevent damage to the axial piston motor in pump operating mode (change of high-pressure side with unchanged direction of rotation, e. g. when braking), a minimum pressure must be guaranteed at the service line port (inlet). The minimum pressure depends on the speed of the axial piston unit (see characteristic curve below).



This diagram is valid only for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s.
Please contact us if these conditions cannot be satisfied.

Definition

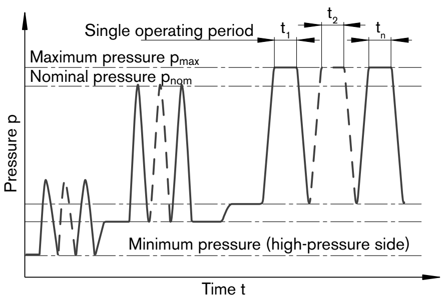
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

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.

Summation pressure p_{Su}
The summation pressure is the sum of the pressures at both service line ports (A and B).

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 = $t_1 + t_2 + ... + t$

Technical data

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

Size		NG		28	32	45	56	63	80
Displacement geometric, per revolution		V_g	cm³	28.1	32	45.6	56.1	63	80.4
Speed maximum[1]		n_{nom}	rpm	6300	6300	5600	5000	5000	4500
		n_{max}[2]	rpm	6900	6900	6200	5500	5500	5000
Input flow[3] at n_{nom} and V_g		q_V	L/min	177	202	255	281	315	362
Torque[4] at V_g and	$\Delta p = 350$ bar	T	Nm	157	178	254	313	351	448
	$\Delta p = 400$ bar	T	Nm	179	204	290	357	401	512
Rotary stiffness		c	kNm/rad	2.93	3.12	4.18	5.94	6.25	8.73
Moment of inertia for rotary group		J_{GR}	kgm²	0.0012	0.0012	0.0024	0.0042	0.0042	0.0072
Maximum angular acceleration		α	rad/s²	6500	6500	14600	7500	7500	6000
Case volume		V	L	0.20	0.20	0.33	0.45	0.45	0.55
Mass (approx.)		m	kg	10.5	10.5	15	18	19	23

Size		NG		90	107	125	160	180	250	355
Displacement geometric, per revolution		V_g	cm³	90	106.7	125	160.4	180	250	355
Speed maximum[1]		n_{nom}	rpm	4500	4000	4000	3600	3600	2700	2240
		n_{max}[2]	rpm	5000	4400	4400	4000	4000	–	–
Input flow3[)] at n_{nom} and V_g		q_V	L/min	405	427	500	577	648	675	795
Torque[4] at V_g and	$\Delta p = 350$ bar	T	Nm	501	594	696	893	1003	1393	1978
	$\Delta p = 400$ bar	T	Nm	573	679	796	1021	1146	–	–
Rotary stiffness		c	kNm/rad	9.14	11.2	11.9	17.4	18.2	73.1	96.1
Moment of inertia for rotary group		J_{GR}	kgm²	0.0072	0.0116	0.0116	0.0220	0.0220	0.061	0.102
Maximum angular acceleration		α	rad/s²	6000	4500	4500	3500	3500	10000	8300
Case volume		V	L	0.55	0.8	0.8	1.1	1.1	2.5	3.5
Mass (approx.)		m	kg	25	34	36	47	48	82	110

1) The values are valid:
- for the optimum viscosity range from $\nu_{opt} = 36$ to 16 mm²/s
- with hydraulic fluid based on mineral oils

2) Intermittent maximum speed: overspeed for unload and overhauling processes, $t < 5$ s and $\Delta p < 150$ bar

3) Restriction of input flow with counterbalance valve, see page 19

4) Torque without radial force, with radial force see page 8

Note

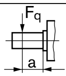
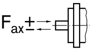
Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. Other permissible limit values, with respect to speed variation, reduced angular acceleration as a function of the frequency and the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

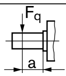
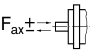
2

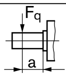
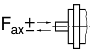
Technical data

Permissible radial and axial forces of the drive shafts

(splined shaft and parallel keyed shaft)

Size	NG		28	28	32	45	56	56[4]	56
Drive shaft	ø	mm	25	30	30	30	30	30	35
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\ max}$	kN	5.7	5.4	5.4	7.6	9.5	7.8	9.1
	a	mm	16	16	16	18	18	18	18
with permissible torque	T_{max}	Nm	179	179	204	290	357	294	357
≙ permissible pressure Δp	Δp_{perm}	bar	400	400	400	400	400	330	400
Maximum axial force[2] 	$+F_{ax\ max}$	N	500	500	500	630	800	800	800
	$-F_{ax\ max}$	N	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

Size	NG		63	80	80[4]	80	90	107	107
Drive shaft	ø	mm	35	35	35	40	40	40	45
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\ max}$	kN	9.1	11.6	11.1	11.4	11.4	13.6	14.1
	a	mm	18	20	20	20	20	20	20
with permissible torque	T_{max}	Nm	401	512	488	512	573	679	679
≙ permissible pressure Δp	Δp_{perm}	bar	400	400	380	400	400	400	400
Maximum axial force[2] 	$+F_{ax\ max}$	N	800	1000	1000	1000	1000	1250	1250
	$-F_{ax\ max}$	N	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\ perm/bar}$	N/bar	8.7	10.6	10.6	10.6	10.6	12.9	12.9

Size	NG		125	160	160	180	250	355
Drive shaft	ø	mm	45	45	50	50	50	60
Maximum radial force[1] at distance a (from shaft collar) 	$F_{q\ max}$	kN	14.1	18.1	18.3	18.3	1.2[5]	1.5[5]
	a	mm	20	25	25	25	41	52.5
with permissible torque	T_{max}	Nm	796	1021	1021	1146	[3]	[3]
≙ permissible pressure Δp	Δp_{perm}	bar	400	400	400	400	[3]	[3]
Maximum axial force[2] 	$+F_{ax\ max}$	N	1250	1600	1600	1600	2000	2500
	$-F_{ax\ max}$	N	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$\pm F_{ax\ perm/bar}$	N/bar	12.9	16.7	16.7	16.7	[3]	[3]

1) With intermittent operation
2) Maximum permissible axial force during standstill or when the axial piston unit is operating in non-pressurized condition.
3) Please contact us.
4) Restricted technical data only for splined shaft
5) 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

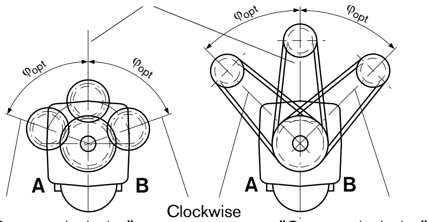
$-F_{ax\ max}$ = Reduction in service life of bearings (avoid)

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	φ_{opt}	φ_{opt}
28 to 180	± 70°	± 45°
250 and 355	± 45°	± 70°



Determining the operating characteristics

Input flow $q_v = \dfrac{V_g \cdot n}{1000 \cdot \eta_v}$ [L/min]

Speed $n = \dfrac{q_V \cdot 1000 \cdot \eta_v}{V_g}$ [min^{-1}]

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

Power $P = \dfrac{2\,\pi \cdot T \cdot n}{60000} = \dfrac{q_v \cdot \Delta p \cdot \eta_t}{600}$ [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

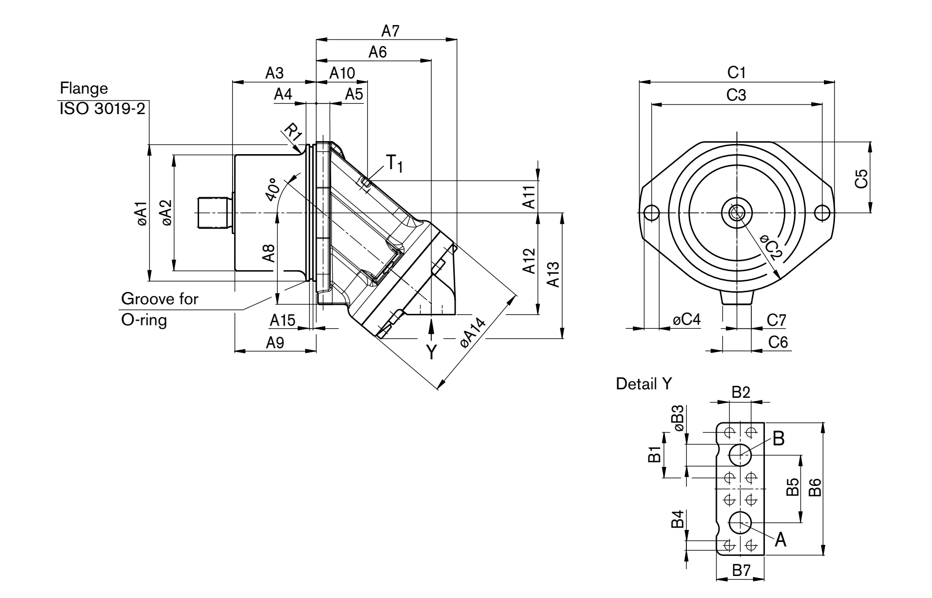
η_t = Total efficiency ($\eta_t = \eta_v \cdot \eta_{mh}$)

2

Dimensions sizes 28 to 180

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

Port plate 10 – SAE flange ports at bottom



Size	øA1	øA2	A3[1]	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	øA14	A15
28, 32	$135_{-0.025}$	$94_{-0.5}$	88.8	15	16	94	114	95	87.1	45	27	91	106	106	5.2
45	$160_{-0.025}$	$117^{+1.5}_{-2}$	92.3	15	18	109	133	106	90	50	31.3	102	119	118	5.2
56, 63	$160_{-0.025}$	$121_{-0.5}$	92.3	15	18	122	146	109	90	59	34	107	130	128	5.2
80, 90	$190_{-0.029}$	$140.3_{-0.5}$	110	15	20	127	157	123	106	54	41	121	145	138	5.2
107, 125	$200_{-0.029}$	$152.3_{-0.5}$	122.8	15	20	143	178	135	119	58	41	136	157	150	5.2
160, 180	$200_{-0.029}$	$171.6_{-0.5}$	122.8	15	20	169	206	134	119.3	75	47	149	185	180	5.2

Size	B1	B2	øB3	B4, DIN 13[2]	B5	B6	B7	C1	øC2	C3	øC4	C5	C6	C7
28, 32	40.5	18.2	13	M8 x 1.25; 15 deep	59	115	40	188	154	160	14	71	42	13
45	50.8	23.8	19	M10 x 1.5; 17 deep	75	147	49	235	190	200	18	82	47.5	15
56, 63	50.8	23.8	19	M10 x 1.5; 17 deep	75	147	48	235	190	200	18	82	36	0
80, 90	57.2	27.8	25	M12 x 1.75; 17 deep	84	166	60	260	220	224	22	98	40	0
107, 125	66.7	31.8	32	M14 x 2; 19 deep	99	194	70	286	232	250	22	103	40	0
160, 180	66.7	31.8	32	M14 x 2; 19 deep	99	194	70	286	232	250	22	104	42	0

Size	R1	O-ring[3]	Service line port A, B SAE J518	Drain port T_1 DIN 3852[2]
28, 32	10	126 x 4	1/2 in	M16 x 1.5; 12 deep
45	10	150 x 4	3/4 in	M18 x 1.5; 12 deep
56, 63	10	150 x 4	3/4 in	M18 x 1.5; 12 deep
80, 90	10	180 x 4	1 in	M18 x 1.5; 12 deep
107, 125	16	192 x 4	1 1/4 in	M18 x 1.5; 12 deep
160, 180	12	192 x 4	1 1/4 in	M22 x 1.5; 14 deep

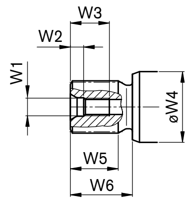
1) To shaft collar
2) Observe the general instructions on page 24 for the maximum tightening torques.
3) Not included in the delivery contents

Note
Port plates 17, 18 and 19; see pages 17 and 20.

Dimensions sizes 28 to 180

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

Drive shaft



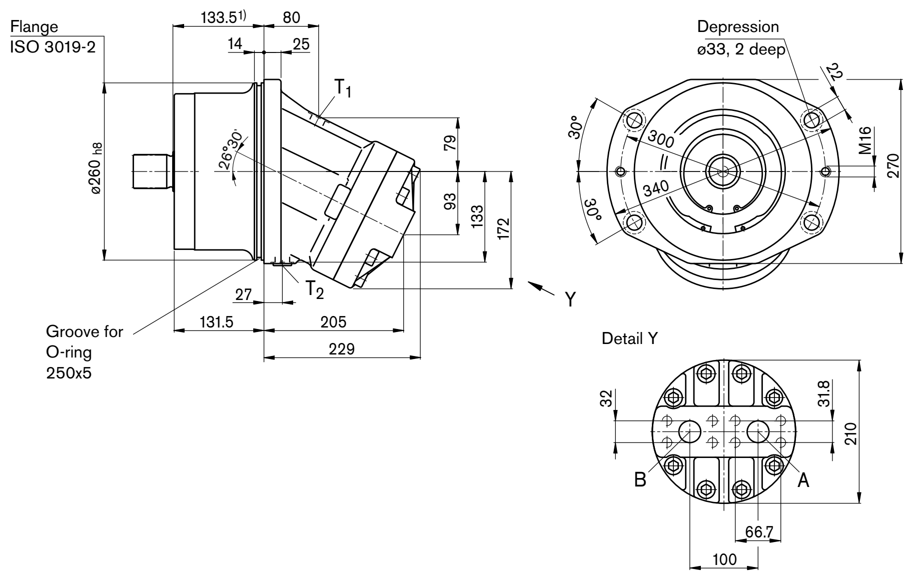
Size	Splined shaft (DIN 5480)	W1 [1)]	W2	W3	øW4	W5	W6
28, 32	**A** W30 x 2 x 14 x 9g	M10 x 1.5	7.5	22	35	27	35
28	**Z** W25 x 1.25 x 18 x 9g	M8 x 1.25	6	19	35	28	43
45	**Z** W30 x 2 x 14 x 9g	M12 x 1.75	9.5	28	35	27	35
56, 63	**A** W35 x 2 x 16 x 9g	M12 x 1.75	9.5	28	40	32	40
56	**Z** W30 x 2 x 14 x 9g	M12 x 1.75	9.5	28	40	27	35
80, 90	**A** W40 x 2 x 18 x 9g	M16 x 2	12	36	45	37	45
80	**Z** W35 x 2 x 16 x 9g	M12 x 1.75	9.5	28	45	32	40
107, 125	**A** W45 x 2 x 21 x 9g	M16 x 2	12	36	50	42	50
107	**Z** W40 x 2 x 18 x 9g	M12 x 1.75	9.5	28	50	37	45
160, 180	**A** W50 x 2 x 24 x 9g	M16 x 2	12	36	60	44	55
160	**Z** W45 x 2 x 21 x 9g	M16 x 2	12	36	60	42	50

1) Center bore according to DIN 332 (thread according to DIN 13), observe the general instructions on page 24 for the maximum tightening torques.

Dimensions size 250

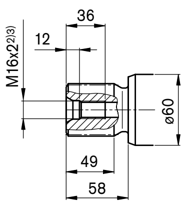
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 01 – SAE flange ports at rear

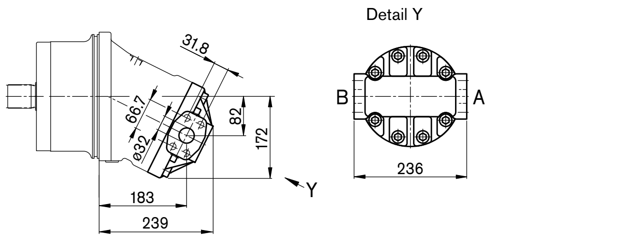


Drive shaft

Z Splined shaft DIN 5480
W50x2x24x9g



Port plate 02 – SAE flange ports at side



Ports

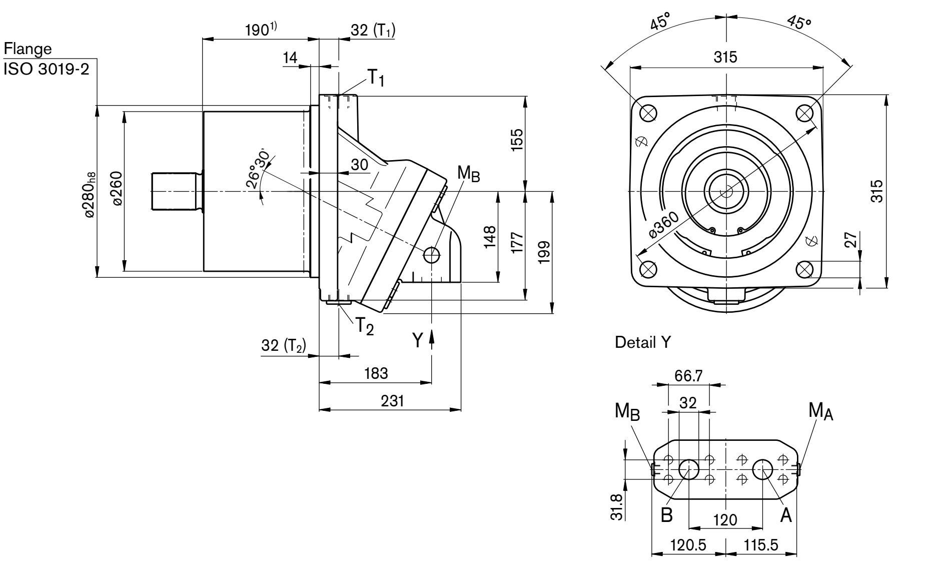
Designation	Port for	Standard	Size[3)]	Maximum pressure [bar][4)]	State[8)]
A, B	Service line fastening thread A/B	SAE J518[6)] DIN 13	1 1/4 in M14 x 2; 19 deep	400	O
T_1	Drain line	DIN 3852[7)]	M22 x 1.5; 14 deep	3	O[5)]
T_2	Drain line	DIN 3852[7)]	M22 x 1.5; 14 deep	3	X[5)]

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 24 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 page 23).
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

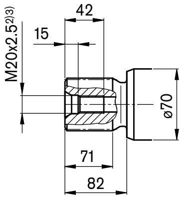
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Port plate 10 – SAE flange ports at bottom



Drive shaft

Z Splined shaft DIN 5480
W60x2x28x9g



Ports

Designation	Port for	Standard	Size[3]	Maximum pressure [bar][4]	State[8]
A, B	Service line fastening thread A/B	SAE J518[6] DIN 13	1 1/4 in M14 x 2; 22 deep	400	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]

1) To shaft collar
2) Center bore according to DIN 332 (thread according to DIN 13)
3) Observe the general instructions on page 24 for the maximum tightening torques.
4) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devcies and fittings.
5) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 23).
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)

Flushing and boost pressure valve

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

The flushing and boost pressure valve is used to remove heat from the hydraulic circuit.

In an open circuit, it is used only for flushing the housing.

In a closed circuit, it ensures a minimum boost pressure level in addition to the case flushing.

Hydraulic fluid is directed from the respective low pressure side into the motor housing. This is then fed into the reservoir, together with the case drain fluid. The hydraulic fluid, removed out of the closed circuit must be replaced by cooled hydraulic fluid from the boost pump.

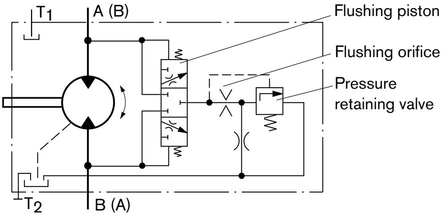
With port plate 027 (sizes 45 to 180 and 250) and with port plate 107 (size 355), the valve is mounted directly on the fixed motor.

Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
Sizes 45 to 355, fixed setting ______ 16 bar

Switching pressure of flushing piston Δp
Sizes 45 to 355 ______ 8±1 bar

Flushing flow q_v
Orifice (throttles with integrated valve) can be used to set the flushing flows as required.
Following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G = 25$ bar and $\nu = 10$ mm^2/s
(p_{ND} = low pressure, p_G = case pressure)

Schematic



Standard flushing flows

Flushing and boost pressure valve, mounted (code 7)

Size	Flushing flow q_v [L/min]	ø [mm]	Mat. No. of orifice
45	3.5	1.2	R909651766
107, 125	8	1.8	R909419696
160, 180	10	2.0	R909419697
250	10	2.0	R909419697
355	16	2.5	R910803019

With sizes 45 to 180, orifices can be supplied for flushing flows from 3.5 to 10 L/min. For other flushing flows, please state the required flushing flow when ordering. The flushing flow without orifice is approx. 12 to 14 L at low pressure $\Delta p_{ND} = 25$ bar.

Flushing and boost pressure valve, integrated (code 9)

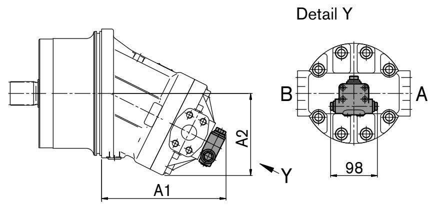
Size	Throttle ø [mm]	q_v [L/min]
56, 63, 80, 90	1.5	6
	1.8	7.3

Flushing and boost pressure valve

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

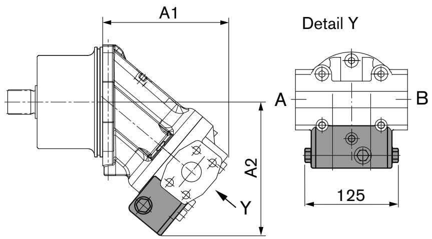
Dimensions

Sizes 107 to 250
Port plate 027 – SAE flange ports at side



Size	A1	A2
107, 125	211	192
160, 180	232	201
250	260.5	172

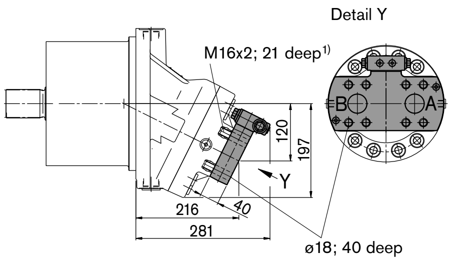
Sizes 56 to 90
Port plate 029 – SAE flange ports at side



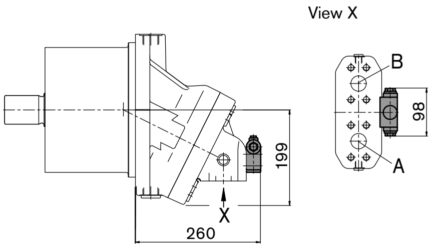
Size	A1	A2
56, 63	165	176
80, 90	178	186.7

1) DIN 13, observe the general instructions on page 24 for the maximum tightening torques.

Size 355
Port plate 017 – SAE flange ports at rear



Port plate 107 – SAE flange ports at bottom



Pressure-relief valve

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

The MHDB pressure-relief valves (see RE 64642) protect the hydraulic motor from overload. As soon as the set cracking pressure is reached, the hydraulic fluid flows from the high-pressure side to the low-pressure side.

The pressure-relief valves are only available in combination with port plates 181, 191 or 192 (counterbalance valve for mounting to port plate 181: see next page).

Cracking pressure setting range ____________ 50 to 420 bar

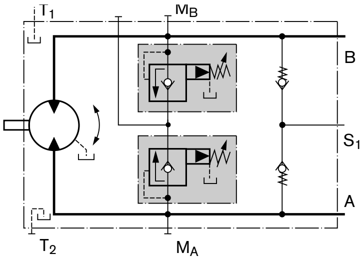
With the version "with pressure boost facility" (192), a higher pressure setting can be realized by applying an external pilot pressure of 25 to 30 bar to port P_{St}.

When ordering, please state in plain text:

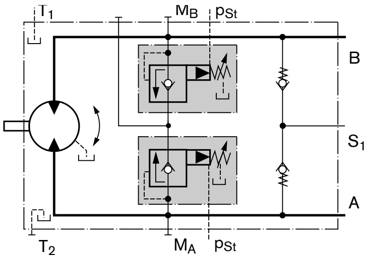
– Cracking pressure of pressure-relief valve

– Cracking pressure with pilot pressure applied to P_{St} (only with version 192)

Version without pressure boost facility "191"



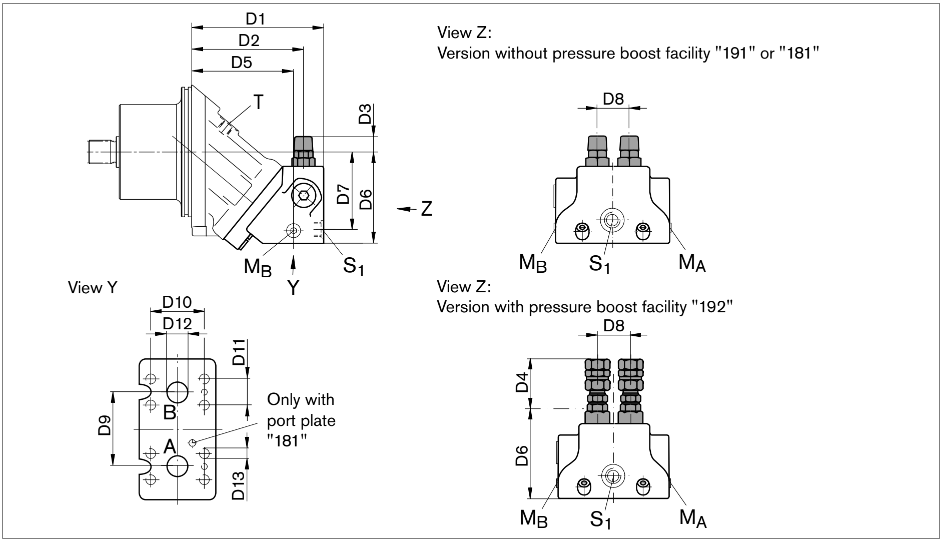
Version with pressure boost facility "192"



Pressure-relief valve

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

Dimensions



Size		D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11	D12	D13[2)]
28, 32	MHDB.**16**	145	122	25	68	110	102	87	36	66	50.8	23.8	ø19	M10; 17 deep
45	MHDB.**16**	161	137	22	65	126	113	98	36	66	50.8	23.8	ø19	M10; 17 deep
56, 63	MHDB.**22**	189	162	19	61	147	124	105	42	75	50.8	23.8	ø19	M10; 13 deep
80, 90	MHDB.**22**	193	165	17.5	59	151	134	114	42	75	57.2	27.8	ø25	M12; 18 deep
107, 125	MHDB.**32**	216	184	10	52	168	149.5	130	53	84	66.7	31.8	ø32	M14; 19 deep
160, 180	MHDB.**32**	249	218	5	47	202	170	149	53	84	66.7	31.8	ø32	M14; 19 deep

Size	A, B	S_1[1)]	M_A, M_B[1)]	P_{St}[1)]
28, 32	3/4 in	M22 x 1.5; 14 deep	M20 x 1.5; 14 deep	G 1/4
45	3/4 in	M22 x 1.5; 14 deep	M20 x 1.5; 14 deep	G 1/4
56, 63	3/4 in	M26 x 1.5; 16 deep	M26 x 1.5; 16 deep	G 1/4
80, 90	1 in	M26 x 1.5; 16 deep	M26 x 1.5; 16 deep	G 1/4
107, 125	1 1/4 in	M26 x 1.5; 16 deep	M26 x 1.5; 16 deep	G 1/4
160, 180	1 1/4 in	M26 x 1.5; 16 deep	M30 x 1.5; 16 deep	G 1/4

Assembly instruction for port plate with pressure boost facility "192":
The lock nut must be counterheld when installing the hydraulic line at the p_{st} port!

Ports

Designation	Port for	Standard	Size	Maximum pressure [bar][2)]	State [3)]
A, B	Service line	SAE J518	See above	450	O
S_1	Supply (only with port plate 191/192)	DIN 3852	See above	5	O
M_A, M_B	Measuring operating pressure	DIN 3852	See above	450	X
P_{St}	Pilot pressure (only with port plate 192)	DIN ISO 228	See above	30	O

1) Observe the general instructions on page 24 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) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Counterbalance valve BVD and BVE

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

Function

Travel drive/winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if the motor speed is greater than it should be for the given input flow while braking, travelling downhill, or lowering a load.

If the inlet pressure drops, the counterbalance spool throttles the return flow and brakes the motor until the inlet pressure returns to approx. 20 bar.

Note

– BVD available for sizes 28 to 180 and BVE available for sizes 107 to 180.

– The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: A2FE90/61W–VAB**188** + BVD20F27S/41B–V03K16D0400S12

– The counterbalance valve does not replace the mechanical service brake and park brake.

– Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525!

– For the design of the brake release valve, we must know for the mechanical park brake:

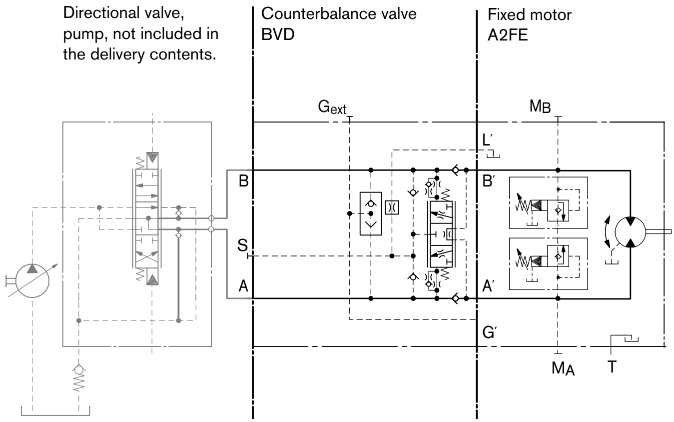
- the pressure at the start of opening
- the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)
- the required closing time for a warm device (oil viscosity approx. 15 mm²/s)

Travel drive counterbalance valve BVD...F

Application option

– Travel drive on wheeled excavators

Example schematic for travel drive on wheeled excavators
A2FE090/61W-VAB188 + BVD20F27S/41B–V03K16D0400S12



Counterbalance valve BVD and BVE

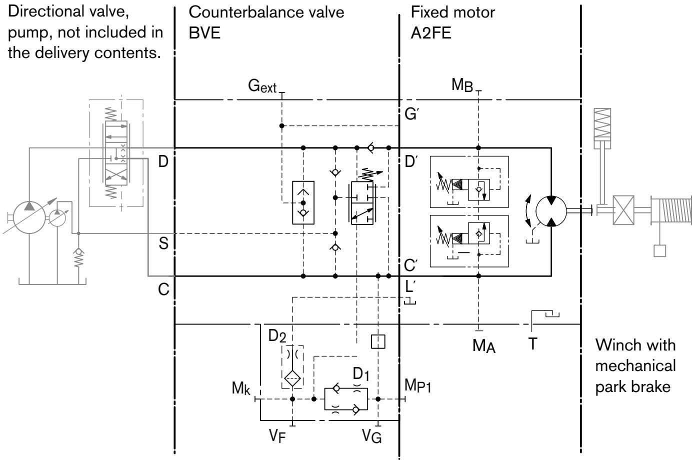
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Winch counterbalance valve BVD...W and BVE

Application options

- Winch drive in cranes (BVD and BVE)
- Track drive in excavator crawlers (BVD)

Example schematic for winch drive in cranes
A2FE090/61W-VAB188 + BVE25W385/51ND-V100K00D4599T30S00-0



Permissible input flow or pressure in operation with DBV and BVD/BVE

Motor NG	Without valve p_{nom}/p_{max} [bar]	Without valve $q_{V\,max}$ [L/min]	DBV NG	DBV p_{nom}/p_{max} [bar]	DBV q_V [L/min]	DBV Code	BVD/BVE NG	BVD/BVE p_{nom}/p_{max} [bar]	BVD/BVE q_V [L/min]	BVD/BVE Code
28	400/450	176	16	350/420	100	181 191, 192	20 (BVD)	350/420	100	188
32		201								
45		255								
56		280	22		240				220	
63		315								
80		360								
90		405								
107		427				171 191, 192				178
125		500								
107		427	32		400	181 191, 192	25 (BVD/BVE)		320	188
125		500								
160		577								
180		648								

DBV ________________ pressure-relief valve

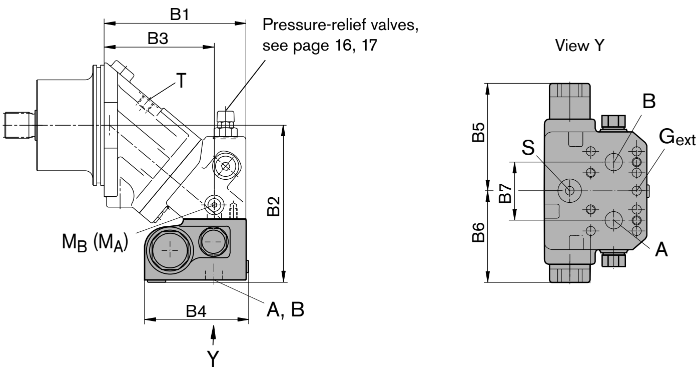
BVD ________________ counterbalance valve, double-acting

BVE ________________ counterbalance valve, one-sided

Counterbalance valve BVD and BVE

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

Dimensions



A2FE	Counterbalance valve									
Size	Type	Ports	Dimensions							
		A, B	B1	B2	B3	B4 (S)	B4 (L)	B5	B6	B7
28, 32	BVD**20**..16	3/4 in	145	175	110	142	147	139	98	66
45	BVD**20**..16	3/4 in	161	196	126	142	147	139	98	66
56, 63	BVD**20**..17	3/4 in	189	197	147	142	147	139	98	75
80, 90	BVD**20**..27	1 in	193	207	151	142	147	139	98	75
107, 125	BVD**20**..28	1 in	216	238	168	142	147	139	98	84
107, 125	BVD**25**..38	1 1/4 in	216	239	168	158	163	175	120.5	84
160, 180	BVD**25**..38	1 1/4 in	249	260	202	158	163	175	120.5	84
107, 125	BVE**25**..38	1 1/4 in	216	240	168	167	172	214	137	84
160, 180	BVE**25**..38	1 1/4 in	249	260	202	167	172	214	137	84
250	On request									

Ports

Designation	Port for	Version	Standard	Size1)	Maximum pressure [bar]2)	State4)
A, B	Service line		SAE J518	see table above	420	O
S	Infeed	BVD20	DIN 3852 3)	M22 x 1.5; 14 deep	30	X
		BVD25, BVE25	DIN 3852 3)	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high pressure	L	DIN 3852 3)	M12 x 1.5; 12.5 deep	30	O
G_{ext}	Brake release, high pressure	S	DIN 3852 3)	M12 x 1.5; 12.5 deep	420	X
M_A, M_B	Measuring pressure A and B		ISO 6149 3)	M12 x 1.5; 12 deep	420	X

1) Observe the general instructions on page 24 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) The spot face can be deeper than specified in the appropriate standard.
4) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Counterbalance valve BVD and BVE

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

Mounting the counterbalance valve

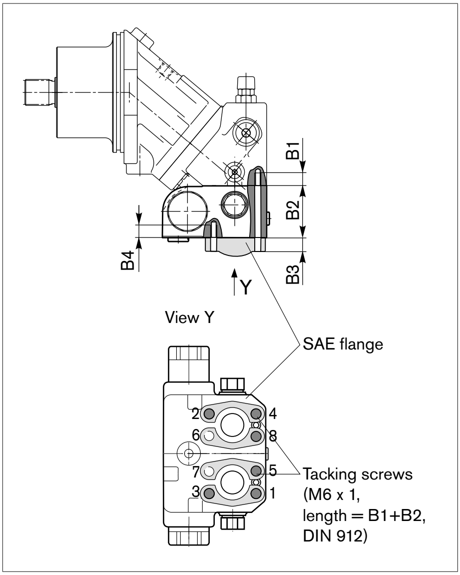
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the motor port plate using the provided tacking screws. The counterbalance valve is finally mounted to the motor by screwing on the SAE flange with the following screws:

6 screws (**1, 2, 3, 4, 5, 8**) ____________ length B1+B2+B3
2 screws (**6, 7**) ______________________ length B3+B4

Tighten the screws in two steps in the specified sequence from 1 to 8 (see following scheme).

In the first step, the screws must be tightened with half the tightening torque, and in the second step with the maximum tightening torque (see following table).

Thread	Strength class	Tightening torque [Nm]
M6 x 1 (tacking screw)	10.9	15.5
M10	10.9	75
M12	10.9	130
M14	10.9	205



Size	28, 32, 45	56, 63	80, 90	107, 125, 160, 180	107, 125
Port plate	18				17
B1[1]	M10 x 1.5; 17 deep	M10 x 1.5; 17 deep	M12 x 1.75; 18 deep	M14 x 2; 19 deep	M12 x 1.75; 17 deep
B2	78[2]	68	68	85	68
B3	customer-specific				
B4	M10 x 1.5; 15 deep	M10 x 1.5; 15 deep	M12 x 1.75; 16 deep	M14 x 2; 19 deep	M12 x 1.75; 16 deep

1) Minimum required thread reach 1 x ø-thread
2) Including sandwich plate

Speed sensors

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

The versions A2FE...U and A2FE...F ("prepared for speed sensor", i.e. without sensor) is equipped with a toothed ring.

On deliveries "prepared for speed sensor", the port is plugged with a pressure-resistant cover.

With the DSA or HDD speed sensor mounted a signal proportional to motor speed can be generated. The sensors measures the speed and direction of rotation.

Ordering code, technical data, dimensions and details on the connector, plus safety information about the sensor can be found in the relevant data sheet.

DSA ______________________________ RE 95133

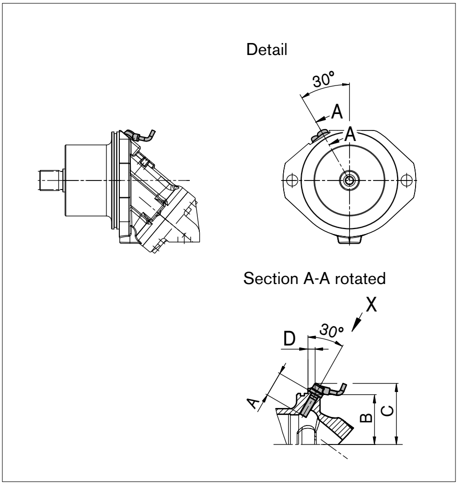
HDD ______________________________ RE 95135

The sensor is mounted on the port provided for this purpose with a mounting bolt.

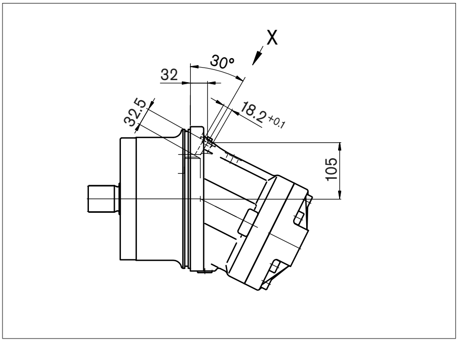
We recommend ordering the A2FE plug-in motor complete with sensor mounted.

Version "V"
Sizes 28 to 180 with DSA sensor

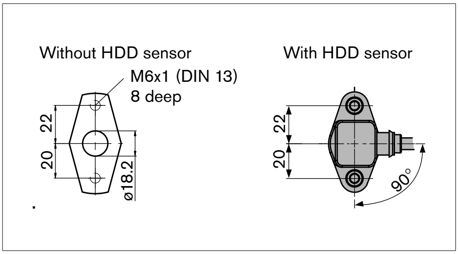
Size 250 with DSA sensor on request.



Version "H"
Size 250 with HDD sensor



View X



Size			**28, 32**	**45**	**56, 63**	**80, 90**	**107, 125**	**160, 180**	**250**
Number of teeth			38	45	47	53	59	67	78
DSA	A	Insertion depth (tolerance ± 0.1)	32	32	32	32	32	32	32
	B	Contact surface	66	On request					
	C		On request						
	D		12.3	On request					

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 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 drain line must flow into the reservoir below the minimum fluid level.

Installation position

See the following examples 1 to 5.
Further installation positions are possible upon request.

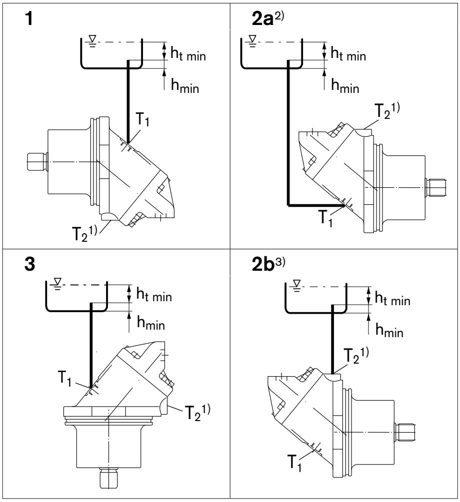
Recommended installation positions: 1 and 2.

Installation position	Air bleed	Filling
1	–	T_1
2	–	T_1 (sizes 28 to 180) T_2 (sizes 250 and 355)
3	–	T_1
4	(L_1)	T_1, (L_1)
5	(L_1)	T_2, (L_1)
6	(L_1)	T_1, (L_1)

L_1	Filling / air bleed
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)

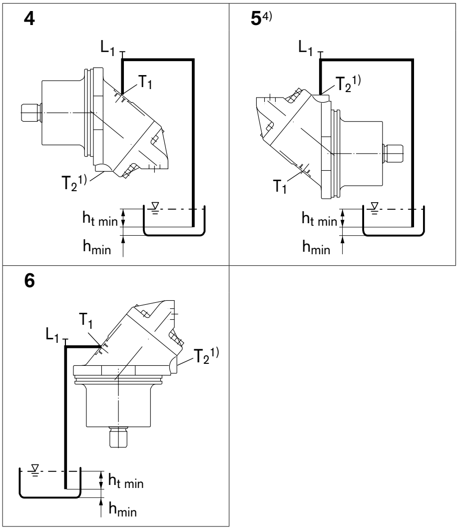
Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.



1) Standard for sizes 250 and 355, special version for sizes 28 to 180
2) Piping suggestion without port T_2 (standard for sizes 28 to 180).
3) Piping suggestion with port T_2 (standard for sizes 250 to 355, special version for sizes 28 to 180).
4) Installation position only permissible if port T_2 is fitted (standard for sizes 250 and 355, special version for sizes 28 to 180).

General instructions

- The motor A2FE is designed to be used in open and closed 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.
- 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 of the threaded plugs
DIN 3852	M12 x 1.5	50 Nm	25 Nm 2)	6 mm
	M16 x 1.5	100 Nm	50 Nm	8 mm
	M18 x 1.5	140 Nm	60 Nm	8 mm
	M20 x 1.5	170 Nm	80 Nm	10 mm
	M22 x 1.5	210 Nm	80 Nm	10 mm
	M26 x 1.5	230 Nm	120 Nm	12 mm
	M27 x 2	330 Nm	135 Nm	12 mm
	M30 x 2	420 Nm	215 Nm	17 mm
	M33 x 2	540 Nm	225 Nm	17 mm
DIN ISO 228	G 1/4	40 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" state, the M_V is reduced to 17 Nm for M12 x 1.5.

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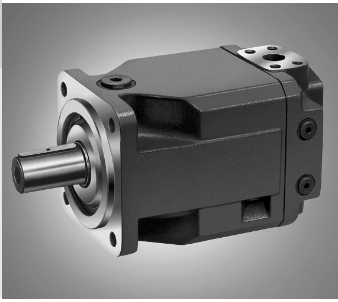
Rexroth
Bosch Group

Fixed Displacement Motor A4FM

RE 91 120/04.00
replaces: 03.95
and RE 91 100

2

for open and closed circuits



Sizes 22...500
Series 1, Series 3
Nominal pressure up to 400 bar
Peak pressure up to 450 bar

Index

Features

- Axial Piston Fixed Displacement Motor A4FM of swashplate design is used in open and closed loop circuits for hydrostatic drives.
- Output speed is proportional to input flow and inversely proportional to motor displacement.
- Output torque increases with the pressure drop across the motor between the high and low pressure sides.
- Long service life, optimum efficiencies
- Compact design for special applications where A2FM cannot be applied
- Proven rotary group in swashplate-technology

Ordering Code

	A4F	M		/			W	–				

Hydraulic fluid

Mineral oil, HFD (no code)	
HFA, HFB, HFC-Hydraulic fluid (only sizes 71...500)	E-

Axial piston unit

Swashplate design, fixed displacement	A4F

Mode of operation

Motor	M

Size

≙ Displacement V_g (cm³)	22	28	40	56	71	125	250	500
	●	●	●	●	●	●	●	○

Series

Sizes 22...56, 125...500	3
Size 71	1

Index

Sizes 22...56	2
Sizes 71...500	0

Direction of rotation

Viewed on shaft end	alternating	W

Seals

NBR (Nitril-caoutchouc), shaft sealing in FKM (Fluor-caoutchouc)	Sizes 22...56	N
	Sizes 71...500	P
FKM (Fluor-caoutchouc)	Sizes 71...500	V

Shaft end	22	28	40	56	71	125	250	500	
Splined shaft SAE	○	○	–	–	–	–	–	–	S
Splined shaft SAE	●	●	–	–	–	–	–	–	T
Splined shaft DIN 5480	–	–	●	●	●	●	●	○	Z
Parallel with key DIN 6885	–	–	–	–	●	●	●	○	P

Mounting flange	22	28	40	56	71	125	250	500	
SAE 2-hole	●	●	●	●	–	–	–	–	C
ISO 4-hole	–	–	–	–	●	●	●	–	B
ISO 8-hole	–	–	–	–	–	–	–	○	H

Service line connections	22...40	56	71...500	
Ports A, B: SAE at rear (with metric fixing screws)	–	●	●	01
Ports A, B: SAE at side (on opposite sides) (with metric fixing screws)	●	–	●	02

● = available
○ = available on enquiry
– = not available

Technical Data

Fluid

We request that before starting a project detailed information about the choice of pressure fluids and application conditions are taken from our catalogue sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids) and RE 90223 (fire resistance fluids, HF).

When using HF- or environmentally acceptable hydraulic fluids possible limitations for the technical data have to be taken into consideration. If necessary please consult our technical department (please indicate type of the hydraulic fluid used for your application on the order sheet).

The sizes 22..56 are not suitable for operation with HFA, HFB and HFC.

Operation viscosity range

In order to obtain optimum efficiency and service life, we recommend that the operating viscosity (at operating temperature) be selected from within the range:

ν_{opt} = operating viscosity 16...36 mm²/s

referred to the loop temperature (closed circuit) or tank temperature (open circuit).

Viscosity limits

The limiting values for viscosity are as follows:

Size 22...56

ν_{min} = 5 mm²/s, short term at a max. permissible temp. of t_{max}= 115°C
ν_{max} = 1600 mm²/s, short term on cold start (t_{min} = -40°C)

Size 71...500

ν_{min} = 10 mm²/s, short term at a max. permissible drain temp. t_{max} = 90°C
ν_{max} = 1000 mm²/s, short term on cold start (t_{min} = -25°C)

Please note that the max. fluid temperature is also not exceeded in certain areas (for instance bearing area).

At temperature of -25°C up to -40°C special measures may be required for certain installation positions, please contact us.

Notes on the selection of the hydraulic fluid

In order to select the correct fluid, it is necessary to know the operating temperature in the loop (closed circuit) or the tank temperature (open circuit) in relation to the ambient temperature.

The hydraulic fluid should be selected so that within the operating temperature range, the operating viscosity lies within the optimum range (ν_{opt}) (see shaded section of the selection diagram). We recommend that the highest possible viscosity range should be chosen in each case.

Example: At an ambient temperature of X°C the operating temperature is 60°C. Within the operating viscosity range (ν_{opt}; shaded area), this corresponds to viscosity ranges VG 46 or VG 68. VG 68 should be selected.

Important: The leakage oil (case drain oil) temperature is influenced by pressure and motor speed and is always higher than the circuit temperature. However, at no point in the circuit may the temperature exceed 115°C for sizes 22...56 or 90°C for sizes 71...500.

If it is not possible to comply with the above condition because of extreme operating parameters or high ambient temperatures we recommend housing flushing. Please consult us.

Filtration

The finer the filtration the better the achieved purity grade of the pressure fluid and the longer the life of the axial piston unit. To ensure the functioning of the axial piston unit a minimum purity grade of:

9 to NAS 1638

18/15 to ISO/DIS 4406 is necessary.

At very high temperatures of the hydraulic fluid (90°C to max. 115°C, not permissible for sizes 71...500) at least cleanless class

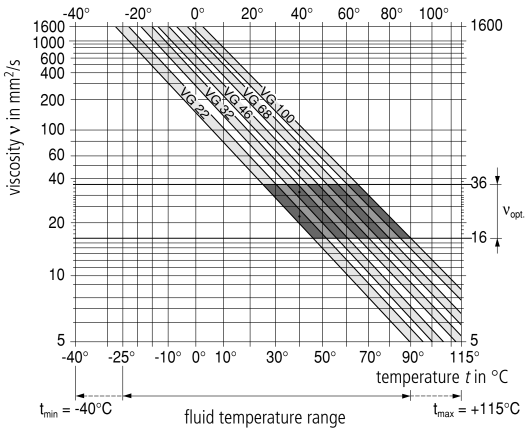
8 to NAS 1638

17/14 to ISO/DIS 4406 is necessary.

If above mentioned grades cannot be maintained please consult supplier.

2

Selection diagram



Technical Data

valid for operation with mineral oils

Flushing of the bearings (Sizes 125...500)

operating conditions, flushing quantities and notes on bearing flushing see RE 92 050 (A4VSO).

Operating pressure range

Maximum pressure at port A or B (Pressure data to DIN 24312)

Size		22...56	71...500
Nominal pressure p_N	*bar*	400 [1])	350
Peak pressure p_{max}	*bar*	450 [1])	400

[1]) Size 28 with S-shaft: 315/350 bar

The summ of the pressures at ports A and B may not exceed 700 bar.

Direction of flow

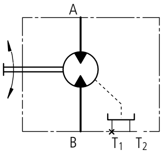
clockwise rotation	anti-clockwise rotation
A to **B**	**B** to **A**

Symbol

Size 22...56

A, B Service line ports

T_1, T_2 Case drain (1 port plugged)



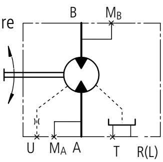
Size 71...500

A, B Service line ports

M_A,M_B Pressure gauge, working pressure

T, R(L) Case drain, Air bleed (1port plugged)

U Flushing port (Sizes71...500)



Case drain pressure

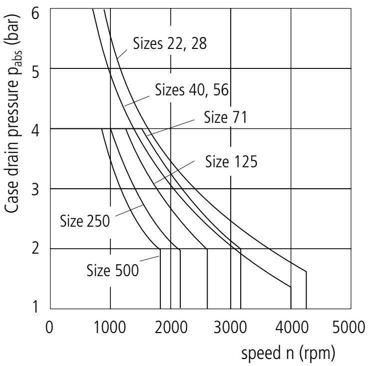
The max. permissible leakage pressure (housing pressure) is dependent on speed (see diagram). The pressure in the housing must be equal to or greater than the external pressure on the shaft sealing ring.

Max. leakage pressure (housing pressure)

$p_{abs.\ max.}$ ______________________________ 6 bar (sizes 22...56)

______________________________ 4 bar(sizes71...500)

A leakage line to the tank is necessary.



Installation and Commissioning Guidelines

General

At start-up and during operation the motor housing has imperatively to be filled up with hydraulic fluid (filling of the case chamber). Start-up has to be carried out at low speed and without load till the system is completely bleeded.

At a longer standstill the case may discharge via operating line. At new start-up a sufficient filling of the housing has to be granted.

The leakage oil in the housing has to be discharged to the tank via highest positioned case drain port.

Installation position

- Sizes 22...56:	Shaft horizontal or shaft down
- Sizes 71 (series1):	Shaft horizontal, vertical installation position as to agreement
- Sizes 125...500:	Optional, at vertical installation position bearing flushing is recommended at port U (as to RD 9205)

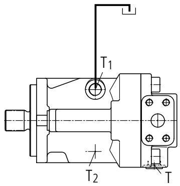
Installation below tank level

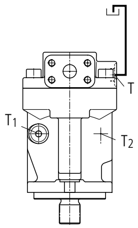
Motor below min. oil level in the tank (standard)

➔ Fill up axial piston motor before start-up via highest positioned case drain port

➔ Operate motor at low speed till motor system is completely filled up

➔ Minimum immerson depth of the drain line in the tank: 200mm (relative to the min. oil level in the tank).



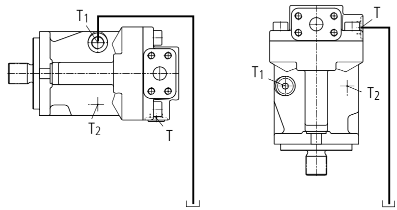


Installation on top of tank level

Motor on top of min. oil level in the tank

➔ Actions as installation below tank level

➔ Note: installation position "drive shaft up" for sizes 22...56 not permissible



Technical Data

valid for operation with mineral oil

Table of values (theoretical values, without considering η_{mh} and η_v; values rounded)

Size			22	28	40	56	71	125	250	500
Displacement	V_g	cm^3	22	28	40	56	71	125	250	500
Max. speed	$n_{max\ continuous}$	rpm	4250	4250	4000	3600	3200	2600	2200	1800
	$n_{max\ interm.}$ 1)	rpm	5000	5000	5000	4500	–	–	–	–
Max. flow (at n_{max})	$q_{V\,max}$	L/min	93	119	160	202	227	325	550	900
Torque constants	T_K	Nm/bar	0,35	0,445	0,64	0,89	1,13	1,99	3,97	7,95
Torque (at Δp = 400 bar)	T_{max}	Nm	140	178	255	356	395 2)	696 2)	1391 2)	2783 2)
Filling volume		L	0,3	0,3	0,4	0,5	2,0	3,0	7,0	11,0
Moment of inertia about drive axis	J	kgm^2	0,0015	0,0015	0,0043	0,0085	0,0121	0,0300	0,0959	0,3325
Actual starting torque at n = 0 rpm (Δp = 350 bar)		Nm (approx.)					320	564	1127	
Weight (approx.)	m	kg	11	11	15	21	34	61	120	

1) Intermittent max. speed at overspeed: Δp = 70…150 bar   2) Δp = 350 bar

Calculation of size

Flow $q_v = \dfrac{V_g \bullet n}{1000 \bullet \eta_v}$ in L/min

Output speed $n = \dfrac{q_V \bullet 1000 \bullet \eta_V}{V_g}$

Output torque $T = \dfrac{V_g \bullet \Delta p \bullet \eta_{mh}}{20 \bullet \pi}$ in Nm

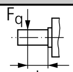
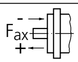
$= T_K \bullet \Delta p \bullet \eta_{mh}$

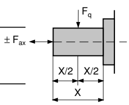
Output power $P = \dfrac{T \bullet n}{9549} = \dfrac{2\,\pi \bullet T \bullet n}{60\,000}$ in kW

$= \dfrac{q_v \bullet \Delta p \bullet \eta_t}{600}$

V_g = geometric displacement per rev. in cm^3
Δp = pressure differential in bar
n = speed in rpm
η_v = volumetric efficiency
η_{mh} = mech.-hyd. efficiency
η_t = overall efficiency

Output drive
permissible axial and radial loading on drive shaft

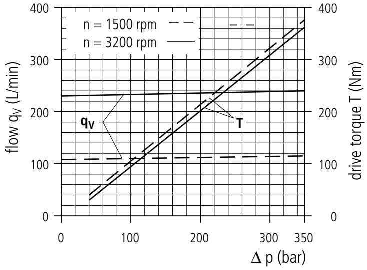
Size				22	28	40	56
Distance of F_q (from shaft shoulder)		a	mm	17,5	17,5	17,5	17,5
		b	mm	30	30	30	30
		c	mm	42,5	42,5	42,5	42,5
Max. permissible radial force at distance	a	$F_{q\,max}$	N	2500	2050	3600	5000
	b	$F_{q\,max}$	N	1400	1150	2890	4046
	c	$F_{q\,max}$	N	1000	830	2416	3398
Max. permissible axial load		$-F_{ax\,max}$	N	1557	1557	2120	2910
		$+F_{ax\,max}$	N	417	417	880	1490

Size				71	125	250	500
Max. axial force at housing pressure p_{max} 1 bar abs.		$\pm F_{ax\,max}$	N	1400	1900	3000	4000
Max. axial force at housing pressure p_{max} 4 bar abs.		$+F_{ax\,max}$	N	810	1050	1850	2500
		$-F_{ax\,max}$	N	1990	2750	4150	5500
Max. radial force		$F_{q\,max}$	N	1700	2500	4000	5000

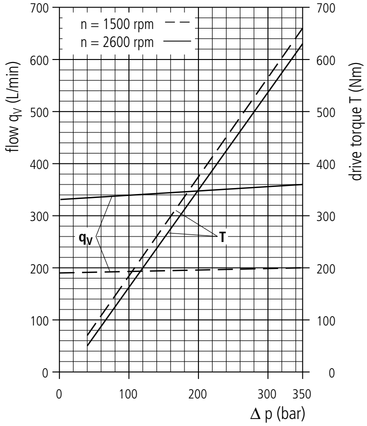
2

Flow and Drive Torque

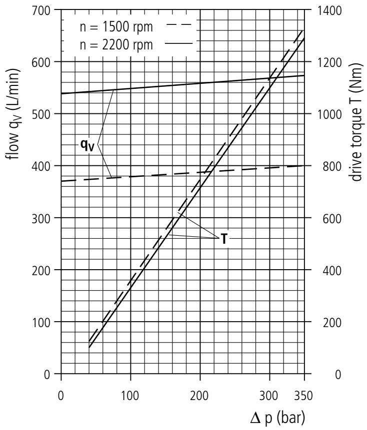
Size 71



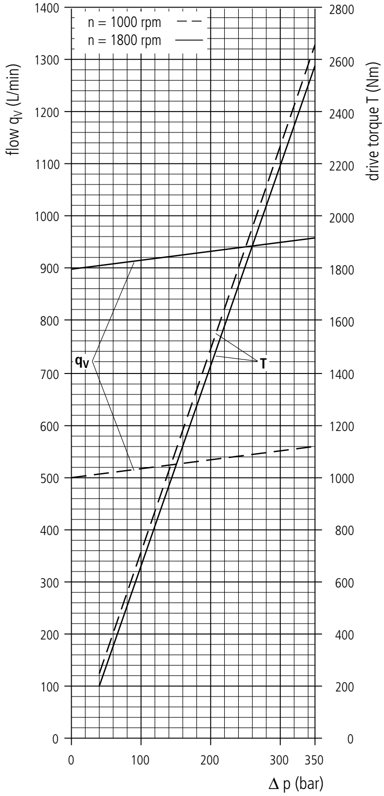
Size 125



Size 250



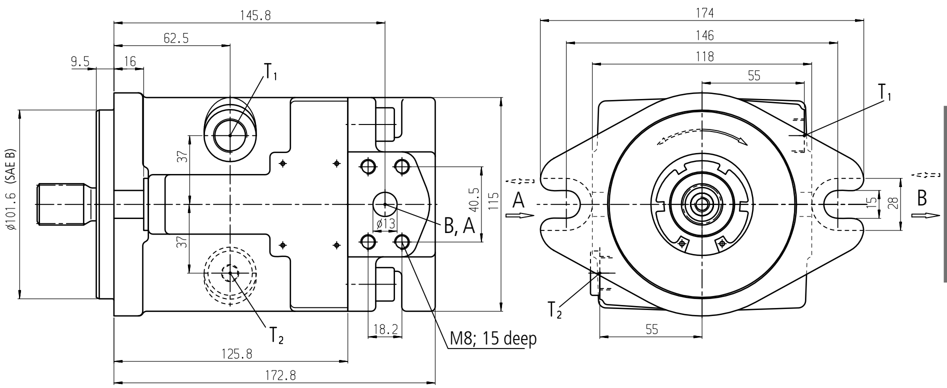
Size 500



(Fluid: Hydraulic oil ISO VG 46 DIN 51519, t = 50°C)

Unit Dimensions, Size 22, 28

Before finalising your design, please request a certified drawing.



2

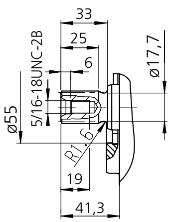
Connections

A, B	Service line ports	SAE $^1/_2$" 420 bar (6000 psi) high pressure series
T_1, T_2	Leakage port / oil filling port	M18x1,5; 12 deep

Shaft ends

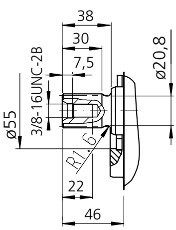
S

Splined shaft SAE $^7/_8$",
30° pressure angle,
13 teeth, 16/32 pitch,
flat root, side fit,
tolerance class 5
ANSI B92.1a-1976



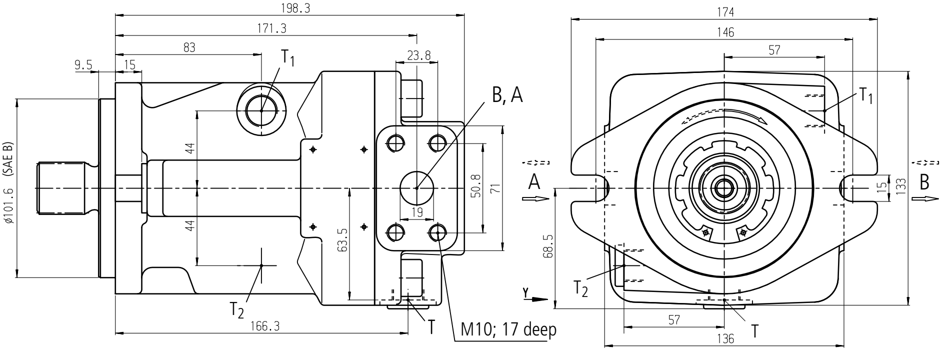
T

Splined shaft SAE 1"
30° pressure angle,
15 teeth, 16/32 pitch,
flat root, side fit,
tolerance class 5
ANSI B92.1a-1976



Unit Dimensions, Size 40

Before finalising your design, please request a certified drawing.



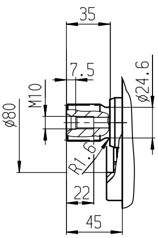
Connections

A, B	Service line ports	SAE $^3/_4$" 420 bar (6000 psi) high pressure serie
T, T_1, T_2	Leakage port / oil filling port	M18x1,5; 15 deep

Shaft ends

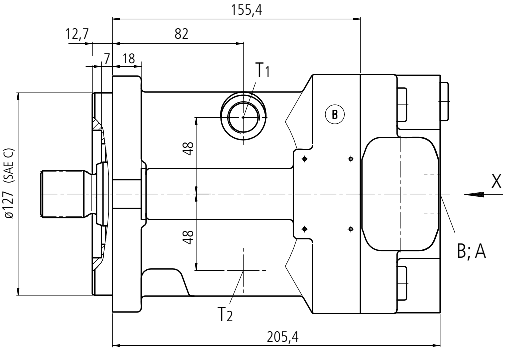
Z

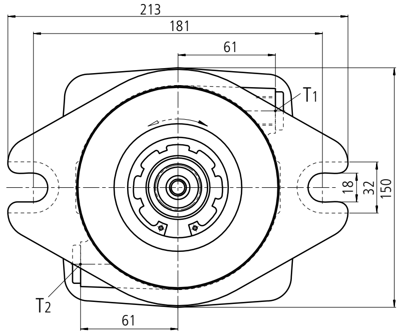
Splined shaft
W 30x2x30x14x9g
DIN 5480



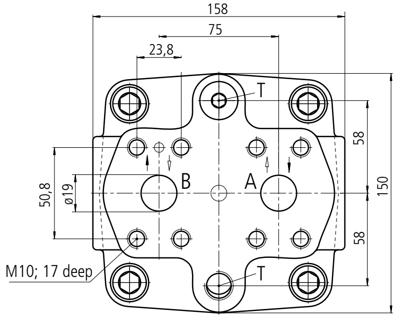
Unit Dimensions, Size 56

Before finalising your design, please request a certified drawing.





View X



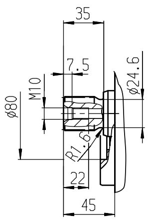
Connections

A, B	Service line ports	SAE $^{3}/_{4}$" 420 bar (6000 psi) high pressure serie
T, T_1, T_2	Leakage port / oil filling port	M 18x1,5 ; 12 deep

Shaft ends

Z

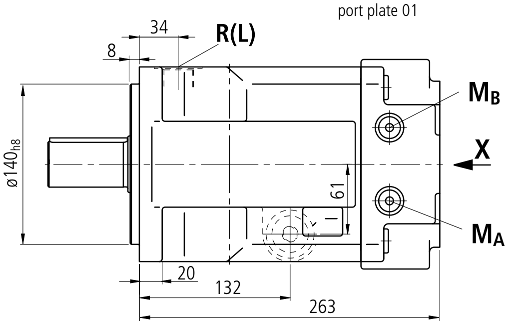
Splined shaft
W 30x2x30x14x9g
DIN 5480

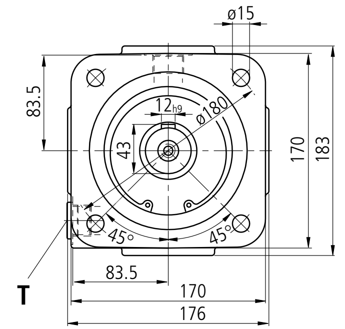


Unit Dimensions, Size 71

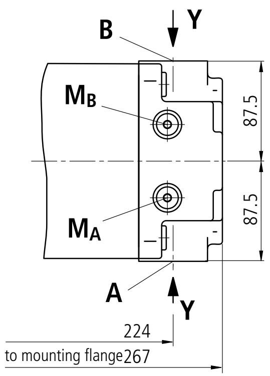
Before finalising your design, please request a certified drawing.

port plate 01

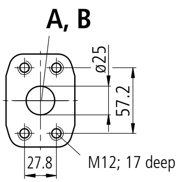




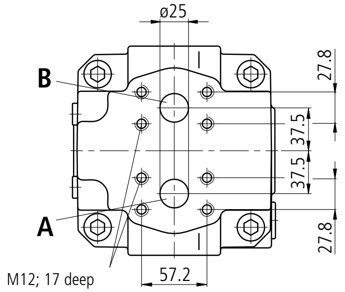
port plate 02



View Y



port plate 01
View X



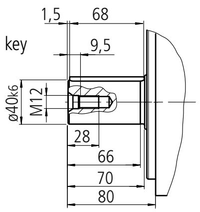
Connections

A, B	service line ports	SAE 1" (high pressure series)
R (L)	oil filling and bleed	M27x2
T	oil drain (plugged)	M27x2
M_A, M_B	measuring port for pressure (plugged)	M14x1,5

Shaft end

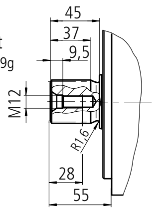
P

Parallel shaft with key
AS 12x8x68
DIN 6885



Z

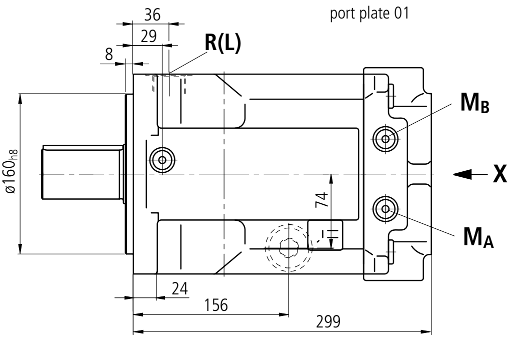
Splined shaft
W40x2x30x18x9g
DIN 5480

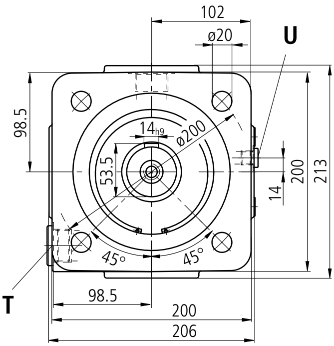


Unit Dimensions, Size 125

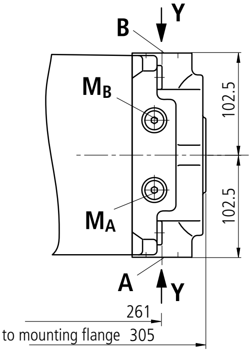
Before finalising your design, please request a certified drawing.

port plate 01

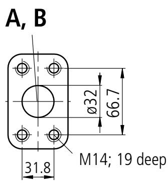




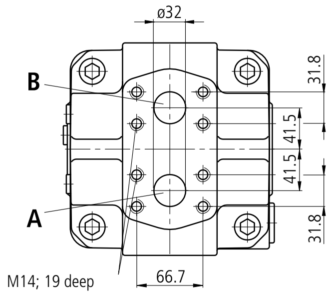
port plate 02



View Y



port plate 01
View X



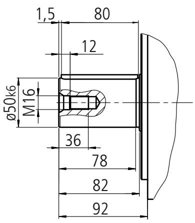
Connections

A, B	service line ports	SAE 1 1/4" (high pressure series)
R (L)	oil filling and bleed	M33x2
T	oil drain (plugged)	M33x2
M_A, M_B	measuring port for pressure (plugged)	M14x1,5
U	Flushing port, flushing of the bearings (plugged)	M14x1,5

Shaft end

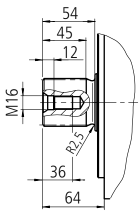
P

Parallel shaft with key
14x9x80
DIN 6885



Z

Splined shaft
W50x2x30x24x9g
DIN 5480

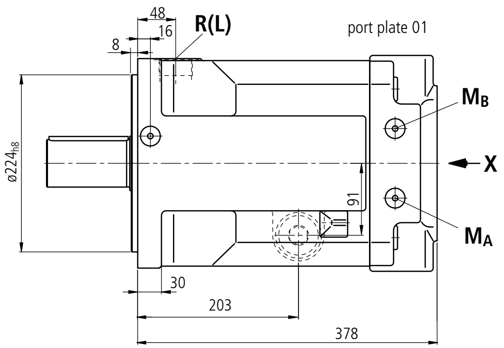


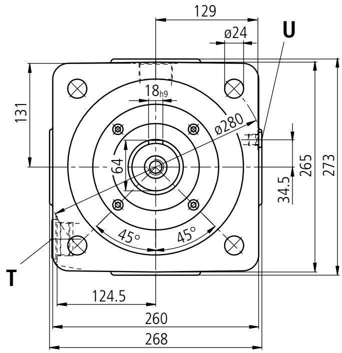
2

Unit Dimensions, Size 250

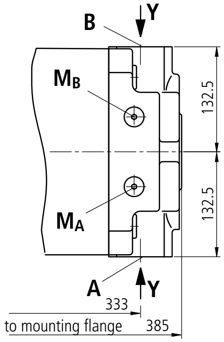
Before finalising your design, please request a certified drawing.

port plate 01

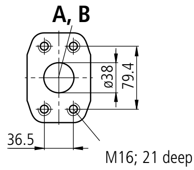




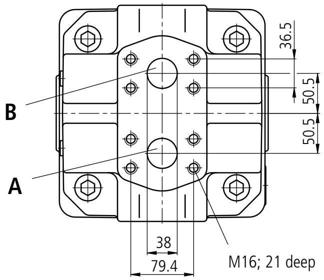
port plate 02



View Y



port plate 01
View X



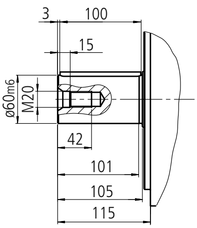
Connections

A, B	service line ports	SAE 1 1/2" (high pressure series)
R (L)	oil filling and bleed	M42x2
T	oil drain (plugged)	M42x2
M_A, M_B	measuring port for pressure (plugged)	M14x1,5
U	Flushing port, flushing of the bearings (plugged)	M14x1,5

Shaft end

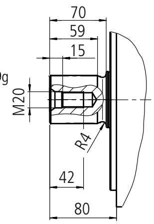
P

Parallel shaft with key
AS 18x11x100
DIN 6885



Z

Splined shaft
W60x2x30x28x9g
DIN 5480



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Mobile Hydraulics
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Rexroth
Bosch Group

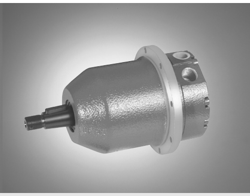
Fixed displacement motor
Axial piston design
A10FM / A10FE

RE 91172/02.12
Replaces: 11.10

Data sheet

A10FM 23...63

A10FE 10...45
(2-hole-flange)



A10FE 11...18
(8-hole-flange)

Series 52
Sizes 10 to 63
Nominal pressure 280 bar
Maximum pressure 350 bar
Open and closed circuit

Contents

Features

- Fixed displacement motor in axial piston swashplate design for hydrostatic drives in open and closed circuit operation
- The output speed is proportional to the inlet flow
- The output torque increases with the pressure differential between the high and low pressure sides
- For use in mobile and industrial applications
- Long service life
- High permissible output speeds
- Well proven A10-rotary group technology
- High power to weight ratio – compact design
- Plug-in version for space saving installation
- Low noise level
- Mechanical and hydraulic connections also acc. to SAE standards
- Speed sensor optional
- Integrated anti cavitation valve optional, i.e. for fan drives

Ordering code for standard program

A10F	M		/	52		–	V		C			
01	02	03		04	05		06	07	08	09	10	11

Axial piston unit

01	Swashplate design, fixed displacement, nominal pressure 280 bar, maximum pressure 350 bar	**A10F**

Operating mode

02	Motor, open and closed circuit	**M**

Size (NG)

03	Theoretical displacement see page 6	**018**	**023**	**028**	**037**	**045**	**058**	**063**

Series

04	Series 5, Index 2	**52**

Direction of rotation

05	Viewed on drive shaft	clockwise	**R**[1]
		counter clockwise	**L**[1]
		bidirectional	**W**

Seals

06	FKM (Fluoro-rubber)	**V**

Drive shaft

		018	023	028	037	045	058	063	
07	Splined shaft to ISO 3019-1 (SAE J744)	❍	●	●	●	●	●	●	**R**
	Splined shaft to ISO 3019-1 (SAE J744)	–	❍	❍	●	●	●	●	**W**
	Tapered with woodruff key and threaded end	❍	●	●	●	●	●	●	**C**

Mounting flange

		018	023	028	037	045	058	063	
08	SAE 2-hole	❍	●	●	●	●	●	●	**C**

Ports for service lines

		018	023	028	037	045	058	063	
09	SAE-flange ports A and B on side, same side Mounting bolts metric	–	●	●	●	●	●	●	**10N00**
	Threaded ports A and B,metric, on side, same side	❍	●	●	●	●	●	●	**16N00**

Ventile

		018	023	028	037	045	058	063	
10	Without valves	❍	●	●	●	●	●	●	**0**
	With integrated flushing valve	–	●	●	●	●	●	●	**7**
	With integrated anti cavitation valve	❍	●	●	●	●	●	●	**2**

Speed sensor

		018	023	028	037	045	058	063	
11	Without speed sensor	❍	●	●	●	●	●	●	
	Prepared for speed sensor (for inductive speed sensor ID)	❍	●	●	●	●	❍	❍	**D**

● = available ❍ = on request – = not available

1) Only necessary in conjunction with valve configuration „2“ (integrated anti cavitation valve)

Ordering code for standard program

A10F	E		/	52		–	V					
01	02	03		04	05		06	07	08	09	10	11

Axial piston unit

01	Swashplate design, fixed displacement, nominal pressure 280 bar, maximum pressure 350 bar	**A10F**

Operating mode

02	Motor, open and closed circuit	**E**

Size (NG)

03	Theoretical displacement see page 6	**010**	**011**	**014**	**016**	**018**	**023**	**028**	**037**	**045**	**058**	**063**

Series

04	Series 5, Index 2	**52**

Direction of rotation

05	Viewed on drive shaft	clockwise	**R**[1)]
		counter clockwise	**L**[1)]
		bidirectional	**W**

Seals

06	FKM (Fluoro-rubber)	**V**

	Drive shaft	**010**	**011**	**014**	**016**	**018**	**023**	**028**	**037**	**045**	**058**	**063**	
07	Splined shaft to ISO 3019-1 (SAE J744)	❍	●	●	●	●	●	●	●	●	●	●	**R**
	Splined shaft to ISO 3019-1 (SAE J744)	–	–	–	–	–	❍	❍	●	●	●	●	**W**
	Tapered with woodruff key and threaded end	●	●	●	●	●	●	●	●	●	●	●	**C**

	Mounting flange	**010**	**011**	**014**	**016**	**018**	**023**	**028**	**037**	**045**	**058**	**063**	
08	SAE 2-hole	●	●	●	●	●	–	–	–	–	–	–	**C**[2)]
	Special 2-hole	–	–	–	–	–	●	●	●	●	●	●	**F**
	Special 8-hole	–	●	●	●	●	–	–	–	–	–	–	**H**

	Ports for service lines	**010**	**011**	**014**	**016**	**018**	**023**	**028**	**037**	**045**	**058**	**063**	
09	SAE-flange ports A and B, on side, same side mounting bolts metric	–	–	–	–	–	●	●	●	●	●	●	**10N00**
	Threaded ports A and B, metric, on side, same side	●	●	●	●	●	●	●	●	●	●	●	**16N00**

	Valves	**010**	**011**	**014**	**016**	**018**	**023**	**028**	**037**	**045**	**058**	**063**	
10	Without valves	❍	●	❍	●	●	●	●	●	●	●	●	**0**
	With integrated flushing valve	–	–	–	–	–	●	●	●	●	●	●	**7**
	With integrated anti cavitation valve	●	●	●	●	●	●	●	●	●	●	●	**2**

	Speed sensor	**010**	**011**	**014**	**016**	**018**	**023**	**028**	**037**	**045**	**058**	**063**	
11	Without speed sensor	●	●	●	●	●	●	●	●	●	●	●	
	Prepared for speed sensor (for inductive speed sensor ID)	–	–	–	–	❍	●	●	●	●	❍	❍	**D**

● = available ❍ = on request – = not available

1) Only necessary in conjunction with valve configuration „2“ (integrated anti cavitation valve)

2) R-shaft with C-flange on sizes 10 to 18 in preparation

Technical data

Fluids

Prior to project design, please see our technical data sheets RE 90220 (mineral oil) and RE 90221 (environmentally acceptable fluis) for detailed information on fluids and operating conditions.

For operation on environmentally acceptable fluids please consult us (when ordering, please state in clear text the fluid to be used).

Operating viscosity range

To achieve optimum values for efficiency and service life we recommend an operation viscosity (at operating temperature) within the range,

ν_{opt} = opt. operating viscosity 16 ... 36 mm²/s

referred to the tank temperature (open circuit).

Limit of viscosity range

For critical operation conditions the following values apply:

ν_{min} = 5 mm²/s (closed circuit)
10 mm²/s (open circuit)
for short periods ($t \leq 1$ min)
at a max. perm. temperature of 115 °C.

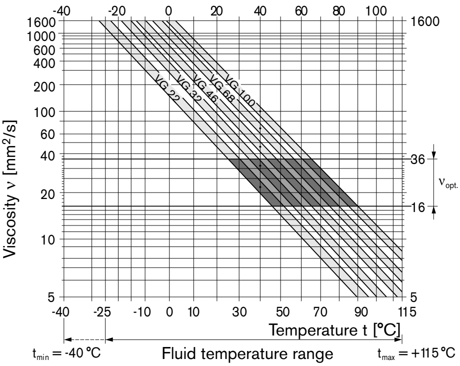
Please note that the max. leakage fluid temperature of 115 °C is also not exceeded in certain areas (for instance bearing area).The fluid temperature in the bearing area is approx. 5 K higher than the average leakage fluid temperature

ν_{max} = 1600 mm²/s
for short periods ($t \leq 1$ min)
on cold start
($t_{min} = p \leq 30$ bar, $n \leq 1000$ min^{-1}, –25 °C).

At temperatures between -40 °C and -25 °C special measures are required, please consult us for further information.

For detailed information on operation with low temperatures see data sheet RE 90300-03-B.

Selection diagram



Notes on the selection of the 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 fluid should be selected so that witin the operating temperature range, the viscosity lies within the optimum range (ν_{opt}), see shaded section of the selection diagram. We recommend to select the higher viscosity grade 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 viscosity grades VG 46 resp. VG 68; VG 68 should be selected.

Important: The leakage oil (case drain oil) temperature is influenced by pressure and input speed and is always higher than the tank temperature. However, at no point of the component may the temperature exceed 115 °C.

If it is not possible to comply with the above conditions because of extreme operating parameters please consult us.

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 to ISO 4406 is to be maintained.

If above requirements cannot be maintained please consult us.

Technical data

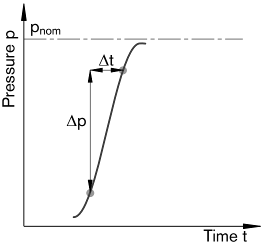
Operating pressure range

Pressure at service line port (pressure port) A or B

Nominal pressure p_{nom} ________________ 280 bar absolute

Maximum pressure p_{max} ________________ 350 bar absolute
Single operating period ________________ 2,5 ms
Total operating period ________________ 300 h
Minimum pressure (high pressure side) ________ 10 bar[2)]

Rate of pressure change $R_{A\ max}$ ____________ 16000 bar/s



Outlet pressure

at n_{max}
Minimum pressure at low pressure side $p_{abs\ max}$ ________ 18 bar

Case drain pressure

Maximum permissible case drain pressure
(at port L, L_1):

$p_{max\ abs}$ motor operation in open circuit ____________ 4 bar_{abs}
$p_{max\ abs}$ motor operation in closed circuit ____________ 4 bar_{abs}
$p_{max\ abs}$ pump/motor operation in open circuit ________ 2 bar_{abs}

Direction of flow

viewed on drive shaft	
clockwise rotation	**counter clockwise rotation**
A to **B**	**B** to **A**

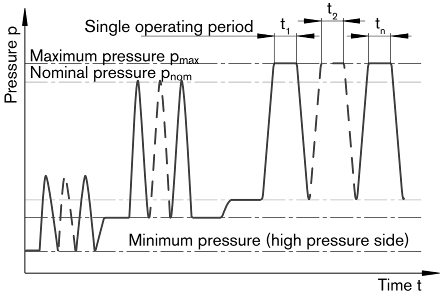
Definitions

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.

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



Total operating period = $t_1 + t_2 + ... + t_n$

[1)] Other values on request

[2)] Lower pressures time dependent, please consult us.

2

Technical data

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

Size		NG		010	011	014	016	018	023
Displacement		$V_{g\ max}$	cm^3	10.6	11.5	14.1	16.1	18	23.5
Speed 1) at $V_{g\ max}$		n_{nom}	rpm	5000	4200	4200	4200	4200	4900
Input flow at n_{nom}		$q_{v\ max}$	L/min	53	48	59	68	76	115
Power at n_{nom}, $\Delta p = 280$ bar		P_{max}	kW	24.7	22.5	27.6	31.6	35.3	53.6
Actual starting torque at n= 0 rpm, $\Delta p = 280$ bar			Nm	37.5	30	45	53	67.5	75
Torque at $V_{g\ max}$	$\Delta p = 280$ bar	T_{max}	Nm	47	51	63	72	80	105
Torsional stiffness	R	c	Nm/rad	–	–	–	–	14835	28478
Drive shaft	W	c	Nm/rad	–	–	–	–	–	–
	C	c	Nm/rad	15084	18662	18662	18662	18662	30017
Moment of inertia rotary group		J_{TW}	kgm^2	0.0006	0.00093	0.00093	0.00093	0.00093	0.0017
Maximum angular acceleration		α	rad/s^2	8000	6800	6800	6800	6800	5500
Case volume		V	L	0.1	0.15	0.15	0.15	0.15	0.6
Weight approx.		m	kg	5	6.5	6.5	6.5	6.5	12

Size		NG		028	037	045	058	063
Displacement		$V_{g\ max}$	cm^3	28.5	36.7	44.5	58	63.1
Speed 1) at $V_{g\ max}$		n_{nom}	rpm	4700	4200	4000	3600	3400
Input flow at n_{nom}		$q_{v\ max}$	L/min	134	154	178	209	215
Power at n_{nom}, $\Delta p = 280$ bar		P_{max}	kW	62.5	71.8	83.1	97.4	100.1
Actual starting torque at n= 0 min^{-1}, $\Delta p = 280$ bar			Nm	105	125	170	205	230
Torque at $V_{g\ max}$	$\Delta p = 280$ bar	T_{max}	Nm	127	163	198	258	281
Torsional stiffness	R	c	Nm/rad	28478	46859	46859	80590	80590
Drive shaft	W	c	Nm/rad	–	38489	38489	60907	60907
	C	c	Nm/rad	30017	46546	46546	87667	87667
Moment of inertia rotary group		J_{TW}	kgm^2	0.0017	0.0033	0.0033	0.0056	0.0056
Maximum angular acceleration		α	rad/s^2	5500	4000	4000	3300	3300
Case volume		V	L	0.6	0.7	0.7	0.8	0.8
Weight approx.		m	kg	12	17	17	22	22

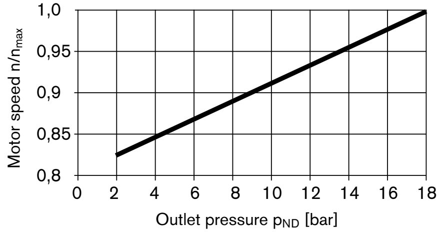
1) for maximum speed an outlet pressure (in low pressure side) of 18 bar is required (see diagram on page 7)

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 motor speed in relation to outlet pressure



Determination of motor size (NG)

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

Torque $$T = \frac{1{,}59 \cdot V_g \cdot \Delta p \cdot \eta_{mh}}{100} \quad \text{[Nm]}$$

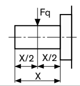
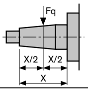
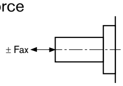
or $$T = T_k \cdot \Delta p \cdot \eta_{mh}$$

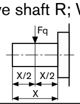
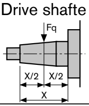
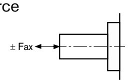
Power $$P = \frac{2\,\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p \cdot \eta_t}{600} \quad \text{[kW]}$$

Output speed $$n = \frac{q_v \cdot 1000 \cdot \eta_v}{V_g} \quad \text{[rpm]}$$

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 ($\eta_t = \eta_v \cdot \eta_{mh}$)
T_k = Torque constant

Permissible radial and axial forces on the drive shaft

Size			NG		10	11	14	16	18	23
Max. radial force at X/2	Drive shaft R; W 	Drive shaft C 	$F_{q\,max}$	N	250	350	350	350	350	1200
Maximum axial force			$\pm F_{ax\,max}$	N	400	700	700	700	700	1000

Size			NG		28	37	45	58	63
Max. radial force at X/2	Drive shaft R; W 	Drive shafte C 	$F_{q\,max}$	N	1200	1500	1500	1700	1700
Maximum axial force			$\pm F_{ax\,max}$	N	1000	1500	1500	2000	2000

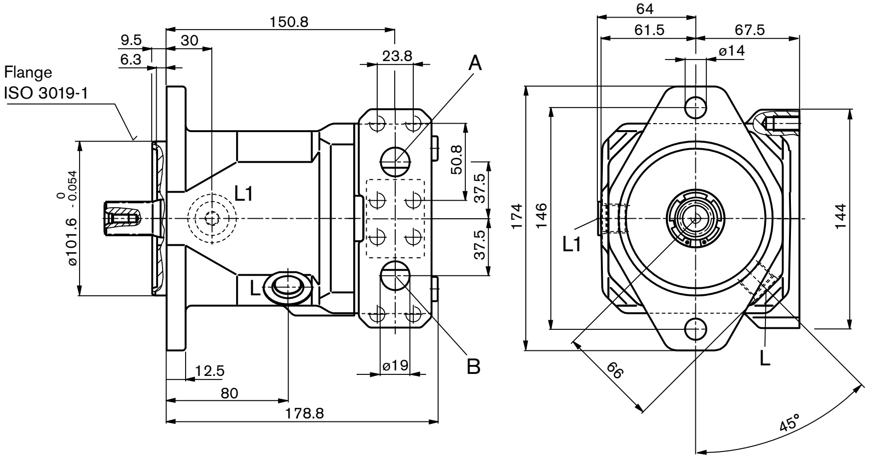
2

Dimensions A10FM size 23 - 28

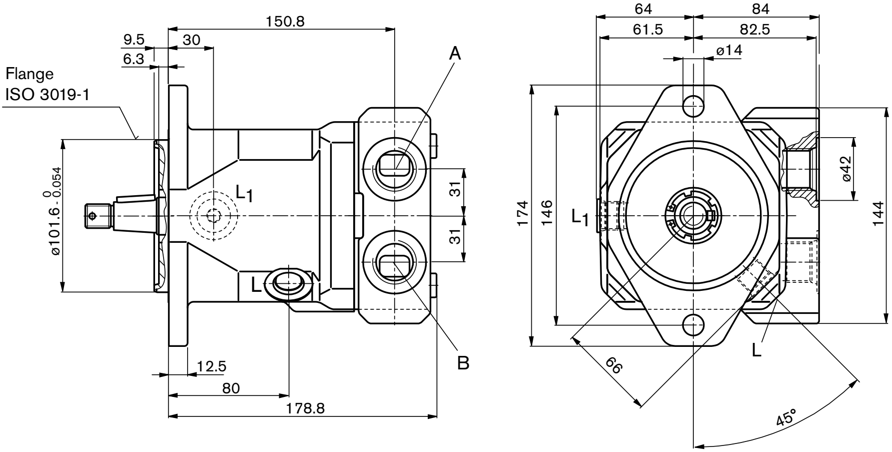
Before finalising your design request a certified installation drawing. Dimensions in mm.

A10FM 23-28/52W-VxCxxN000

Port plate 10



Port plate 16

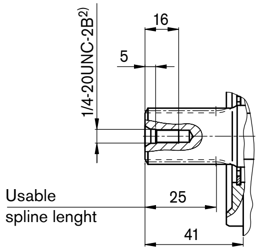


Dimensions A10FM size 23 - 28

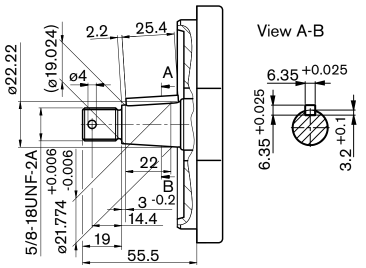
Before finalising your design request a certified installation drawing. Maße in mm.

Drive shafts

R Splined shaft 7/8 in 13T 16/32DP[1] (SAE J744; 22-4(B))



C Tapered with woodruff key and threaded end (SAE J744; 22-3(B))



Ports

Designation	Port for	Standard	Size[2]	Max. pressure [bar][3]	State
A, B	Service line (high pressure series)	SAE J518	3/4 in	350	O
Port plate 10	Mounting bolts	DIN 13	M10 x 1.5; 17 deep		
A, B Port plate 16	Service line	DIN 3852	M27 x 2; 16 deep	350	O
L	Case drain	ISO 11926[5]	3/4-16 UNF-2B; 11 deep	4	O[4]
L_1	Case drain	ISO 11926[5]	3/4-16 UNF-2B; 11 deep	4	X[4]

[1] ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, tolerance class 5
[2] Observe the general instructions on page 28 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. Pressure data in bar absolut
[4] Depending on the installation position, L or L_1 must be connected (see also page 26 - 27).
[5] The counterbore can be deeper than stipulated in the standard.
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

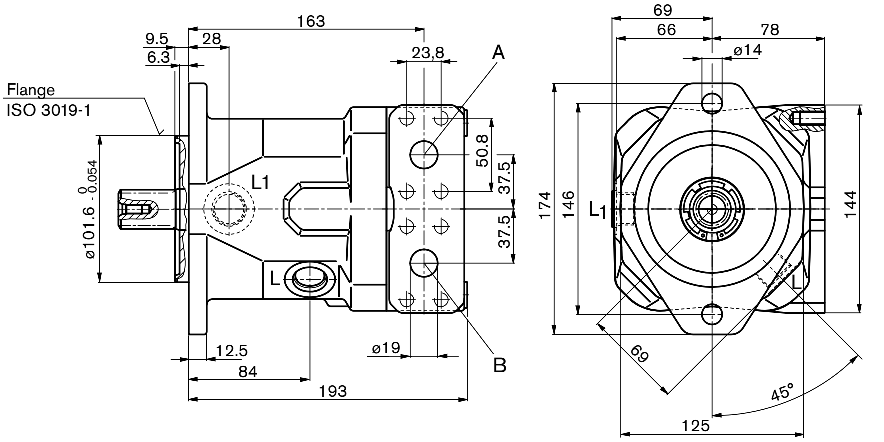
2

Dimensions A10FM size 37 - 45

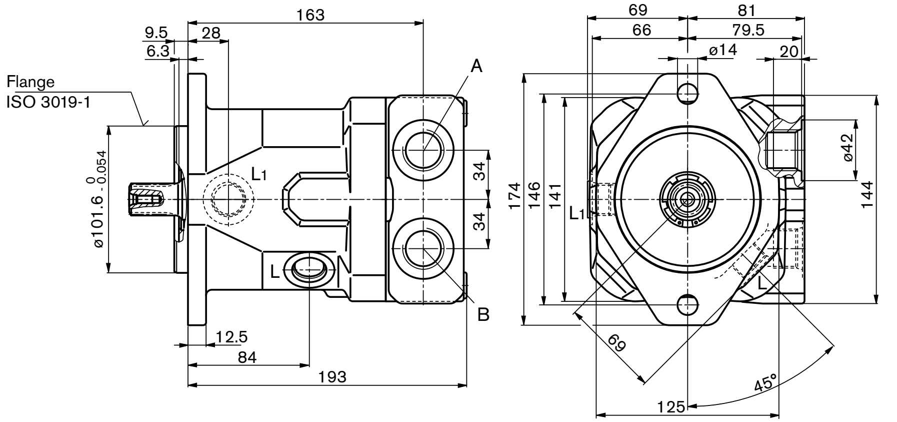
Before finalising your design request a certified installation drawing. Dimensions in mm.

A10FM 37-45/52W-VxCxxN000

Port plate 10



Port plate16

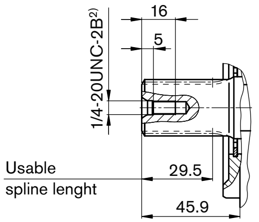


Dimensions A10FM size 37 - 45

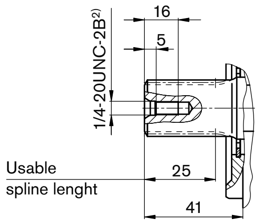
Before finalising your design request a certified installation drawing. Dimensions in mm.

Drive shafts

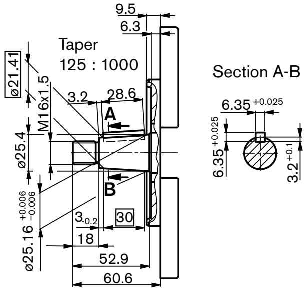
R Splined shaft 1 in 15T 16/32DP[1)] (SAE J744; 25-4(B-B))



W Splined shaft 7/8 in 13T 16/32DP[1)] (SAE J744; 22-4(B))



C Tapered with woodruff key and threaded end (SAE J744; 22-3(B))



Ports

Designation	Port for	Standard	Size[2)]	Max. pressure [bar][3)]	State
A, B	Service line (high pressure series)	SAE J518	3/4 in	350	O
Port plate 10	Mounting bolts	DIN 13	M10 x 1.5; 17 deep		
A, B Port plate 16	Service line	DIN 3852-1	M27 x 2; 16 deep	350	O
L	Case drain	ISO 11926[5)]	7/8-14 UNF-2B; 13 deep	4	O[4)]
L_1	Case drain	ISO 11926[5)]	7/8-14 UNF-2B; 13 deep	4	X[4)]

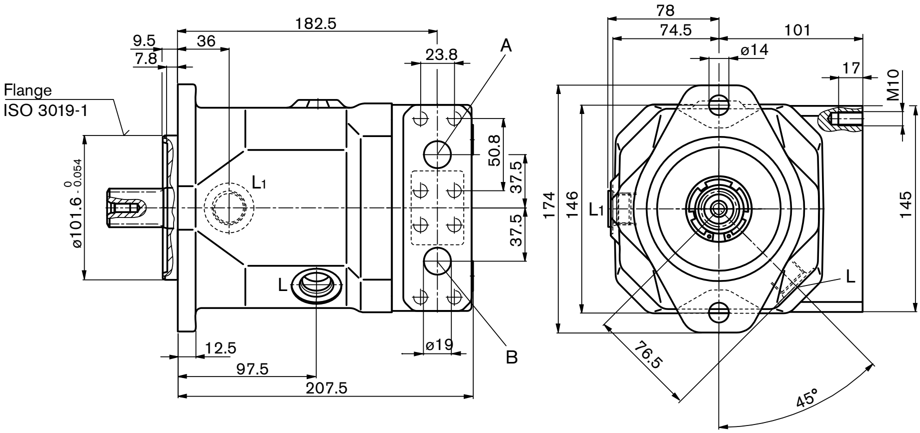
1) ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, tolerance class 5
2) Observe the general instructions on page 28 for the maximum tightening torques.
3) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings. Pressure data in bar absolut.
4) Depending on the installation position, L or L_1 must be connected (see also page 26 - 27).
5) The counterbore can be deeper than stipulated in the standard.
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions A10FM size 58 - 63

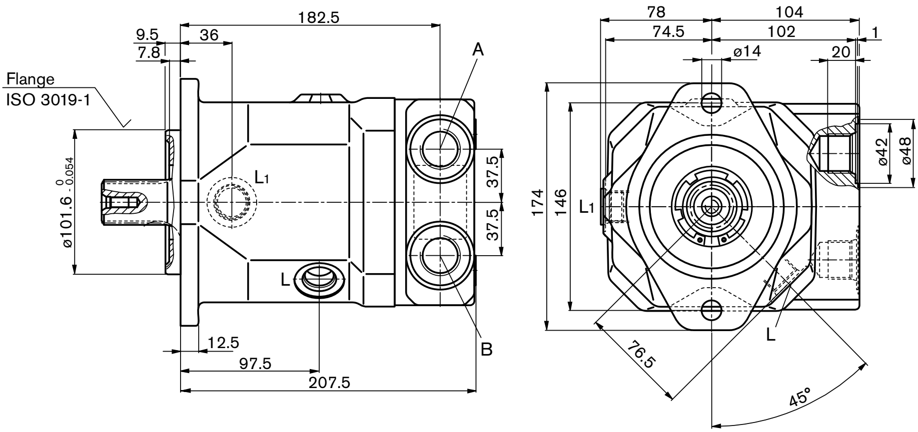
Before finalising your design request a certified installation drawing. Dimensions in mm.

A10FM 58-63/52W-VxCxxN000

Port plate 10



Port plate 16

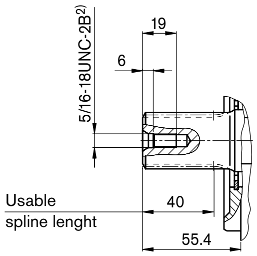


Dimensions A10FM size 58 - 63

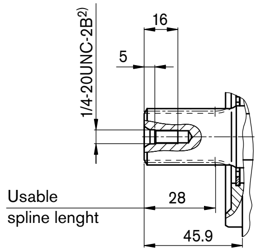
Before finalising your design request a certified installation drawing. Dimensions in mm

Drive shafts

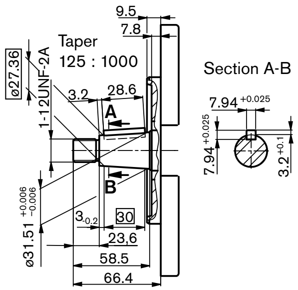
R Drive shaft 1 1/4 in 14T 12/24DP[1)](SAE J744; 32-4(C))



W Drive shaft 1 in 15T 16/32DP[1)](SAE J744; 25-4(B-B))



C Tapered with woodruff key and threaded end (SAE J744; 32-3(C))



2

Ports

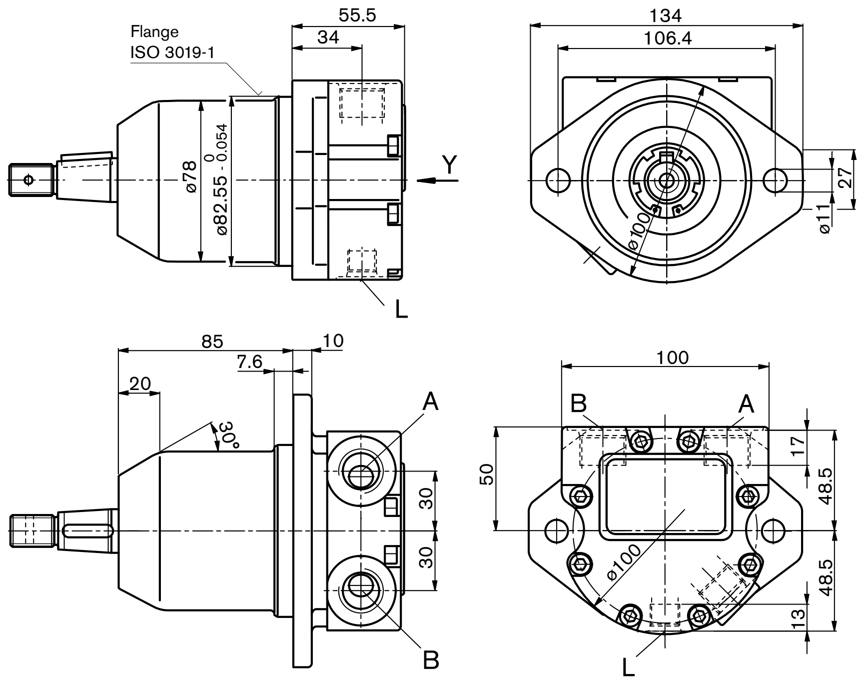
Designation	Port for	Standard	Size[2)]	Max. press. [bar][3)]	State
A, B	Service line (high pressure series)	SAE J518	3/4 in	350	O
Port plate 10	Mounting bolts	DIN 13	M10 x 1.5; 17deep		
A, B Port plate 16	Service line	DIN 3852-1	M27 x 2; 16 deep	350	O
L	Case drain	ISO 11926[5)]	7/8-14 UNF-2B; 13 deep	4	O[4)]
L_1	Case drain	ISO 11926[5)]	7/8-14 UNF-2B; 13 deep	4	X[4)]

[1)] ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, tolerance class 5
[2)] Observe the general instructions on page 28 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. Pressure data in bar absolut.
[4)] Depending on the installation position, L or L_1 must be connected (see also page 26 - 27).
[5)] The counterbore can be deeper than stipulated in the standard.
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions A10FE size 10

Before finalising your design request a certified installation drawing. Dimensions in mm

A10FE 10/52W-VxC16N000

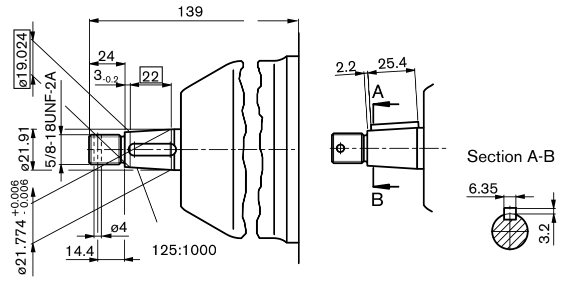


Dimensions A10FE size 10

Before finalising your design request a certified installation drawing. Dimensions in mm.

Drive shaft

C Tapered shaft with woodruff key and threaded end (SAE J744; 22-3(B))



2

Ports

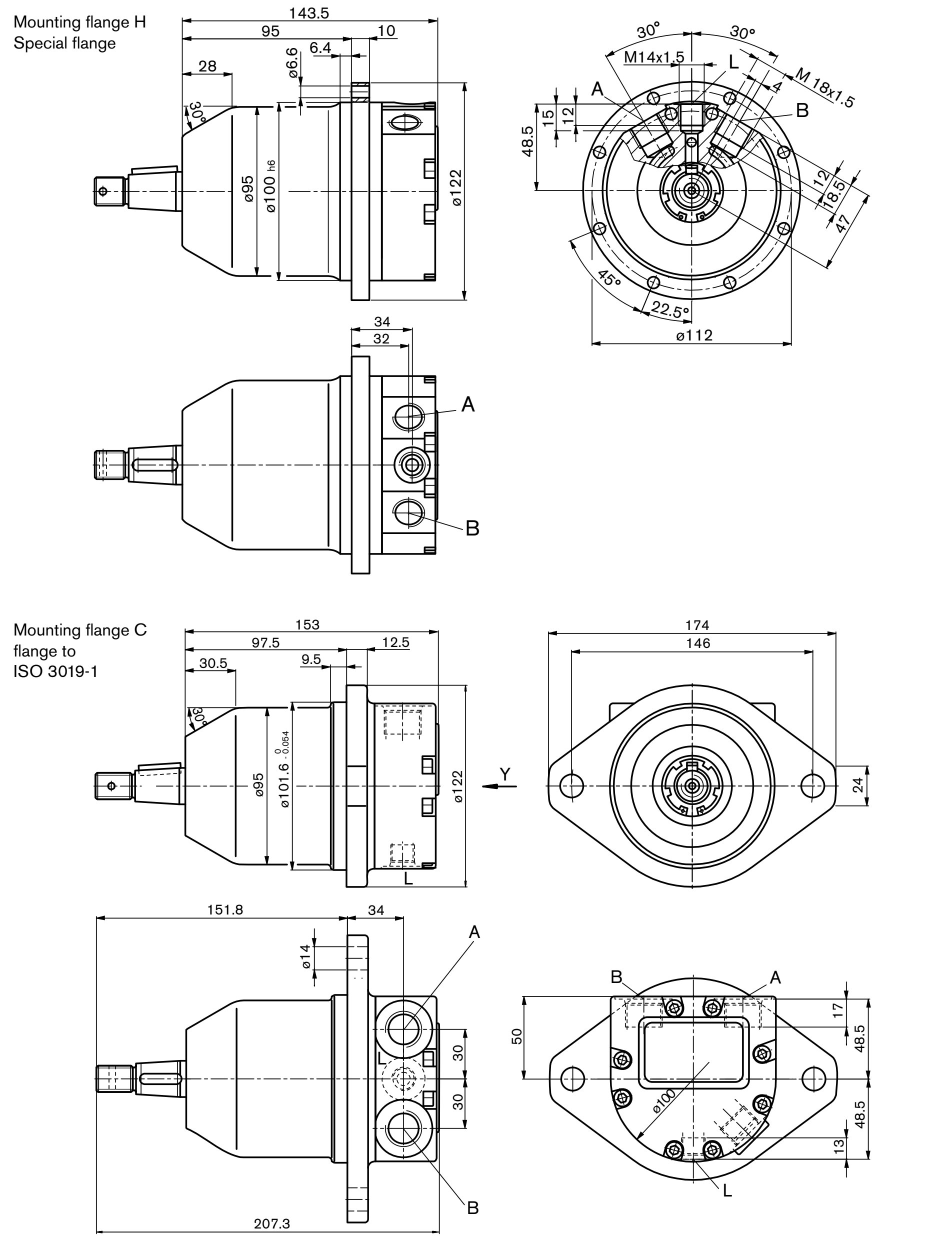
Designation	Port for	Standard	Size[2]	Max. pressure [bar][3]	State
A, B	Service line	DIN 3852-1	M18 x 1.5; 17 deep	350	O
L	Case drain	DIN 3852-1	M14 x 1.5; 13 deep	4	O[4]

[1] ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, tolerance class 5
[2] Observe the general instructions on page 28 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. Pressure data in bar absolut.
[4] Depending on the installation position, L or L_1 must be connected (see also page 26 - 27).
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions A10FE size 11 - 18

Before finalising your design request a certified installation drawing. Dimensions in mm.

A10FE 11-18/52W-Vxx16N000

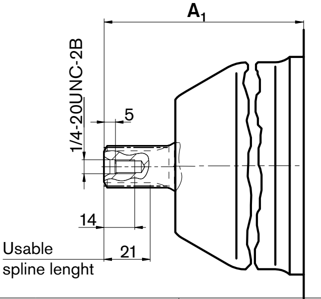


Dimensions A10FE size 11 - 18

Before finalising your design request a certified installation drawing. Dimensions in mm

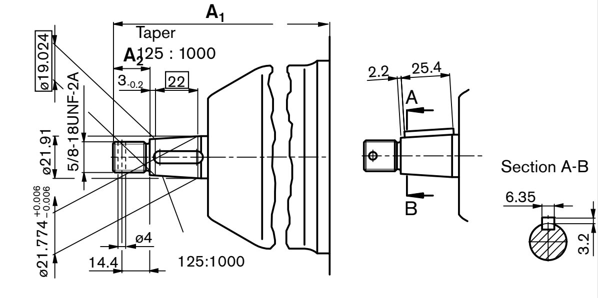
Drive shafts

R[5)] Splined shaft 3/4 in 11T 16/32DP[1)] (SAE J744; 19-4(A-B))



Mounting flange	A_1
H	126,6
C	–

C Tapered with woodruff key and threaded end (SAE J744; 22-3(B))



Mounting flange	A_1	A_2
H	**144.2**	**19**
C	**151.8**	**24**

Ports

Designation	Port for	Standard	Size[2)]	Max. pressure [bar][3)]	State
A, B	Service line	DIN 3852-1	M18 x 1.5; 12 deep	350	O
L	Case drain	DIN 3852-1	M14 x 1.5; 12 deep	4	O[4)]
L_1	Case drain	DIN 3852-1	M14 x 1.5; 12 deep	4	X[4)]

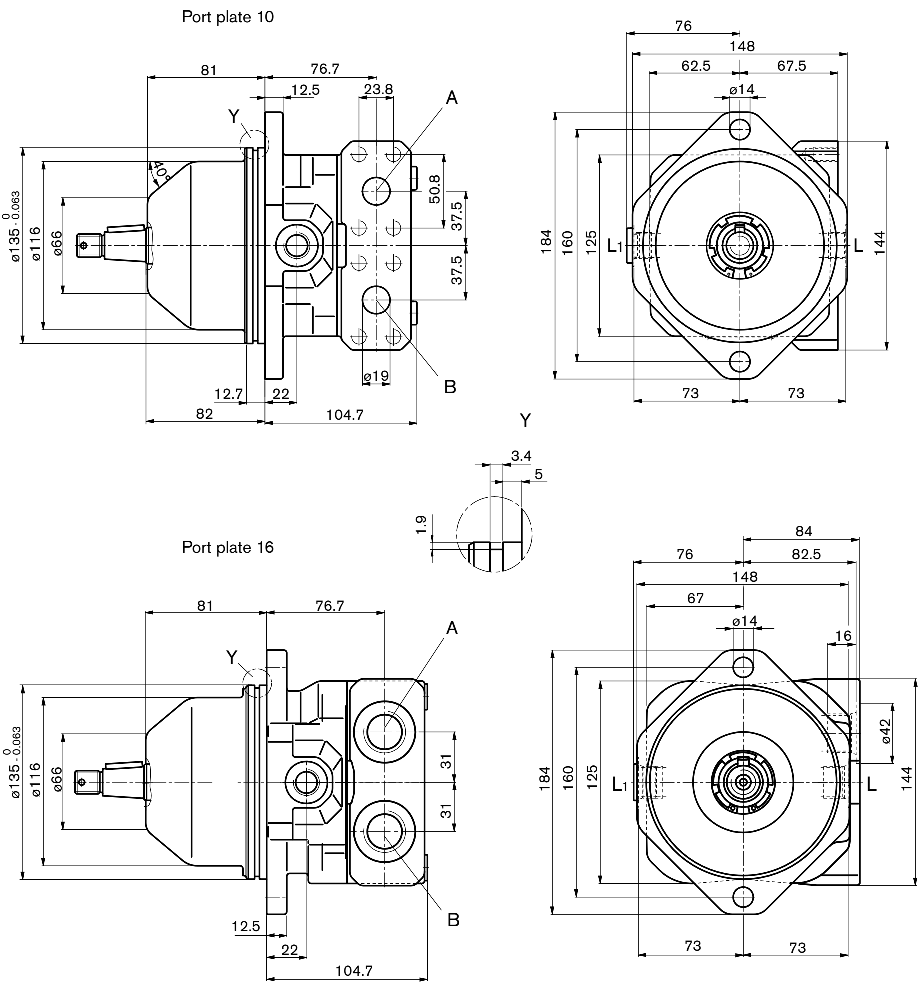
1) ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, tolerance class 5
2) Observe the general instructions on page 28 for the maximum tightening torques.
3) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings. Pressure data in bar absolut.
4) Depending on the installation position, L or L_1 must be connected (see also page 26 - 27).
5) R-shaft with C-flange for size 10 resp. 11 to 18 in preparation.

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

Dimensions A10FE size 23 - 28

Before finalising your design request a certified installation drawing. Dimensions in mm

A10FE 23-28/52W-VxFxxN000

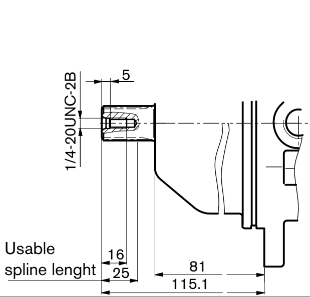


Dimensions A10FE size 23 - 28

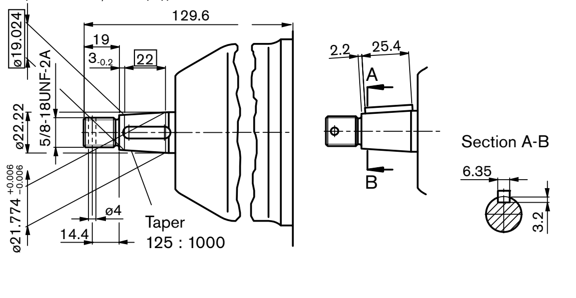
Before finalising your design request a certified installation drawing. Dimensions in mm

Drive shafts

R Drive shaft 7/8 in 13T 16/32DP[1)]
(SAE J744; 22-4(B))



C Tapered with woodruff key and threaded end
(SAE J744; 22-3(B))



Ports

Designation	Port for	Standard	Size[2)]	Max. pressure [bar][3)]	State
A, B	Service line (high pressure series)	SAE J518	3/4 in	350	O
Port plate 10	Mounting bolts	DIN 13	M10 x 1.5; 17 deep		
A, B Port plate 16	Service line	DIN 3852-1	M27 x 2; 16 deep	350	O
L	Case drain	ISO 11926[5)]	3/4-16 UNF-2B; 11 deep	4	O[4)]
L_1	Case drain	ISO 11926[5)]	3/4-16 UNF-2B; 11 deep	4	X[4)]

1) ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, tolerance class 5
2) Observe the general instructions on page 28 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. Pressure data in bar absolut.
4) Depending on the installation position, L or L_1 must be connected (see also page 26 - 27).
5) The counterbore can be deeper than stipulated in the standard.

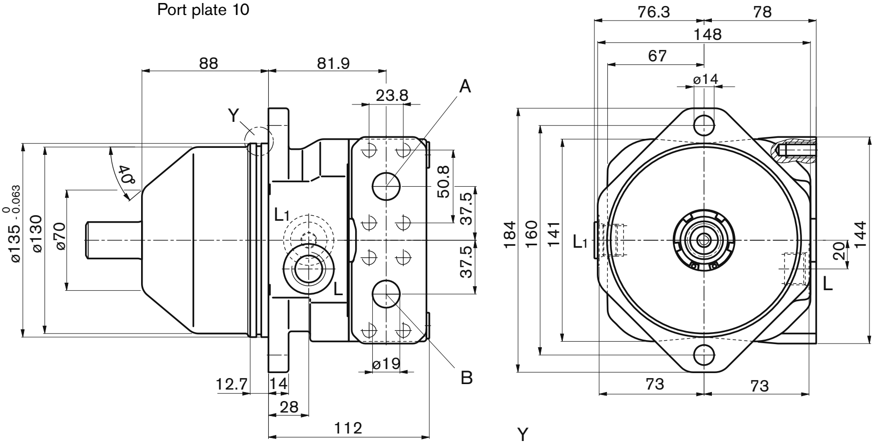
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

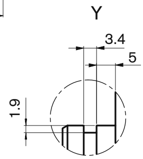
Dimensions A10FE size 37 - 45

Before finalising your design request a certified installation drawing. Dimensions in mm

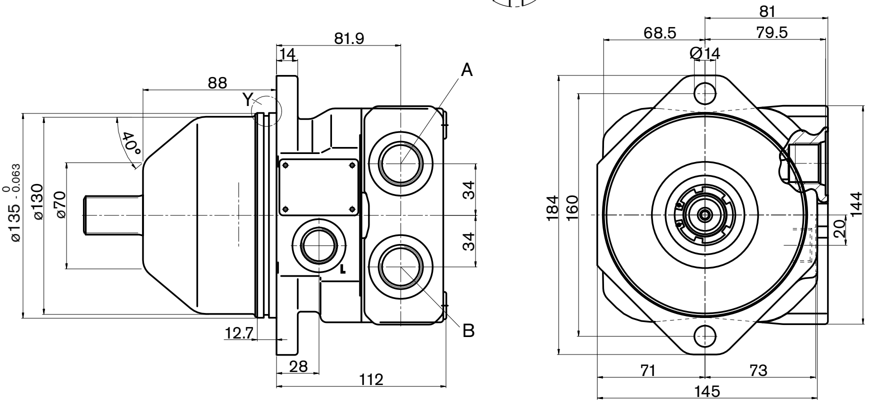
A10FE 37-45/52W-VxFxxN000

Port plate 10





Port plate 16

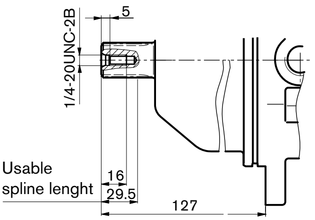


Dimensions A10FE size 37 - 45

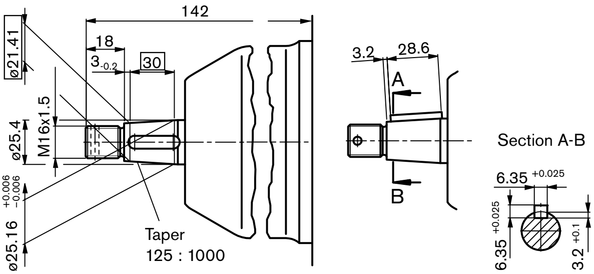
Before finalising your design request a certified installation drawing. Dimensions in mm.

Drive shafts

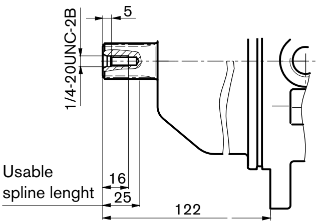
R Splined shaft 1 in 15T 16/32DP[1]
(SAE J744; 25-4(B-B))



C Tapered with woodruff key and threaded end
(SAE J744; 25-3(B-B))



W Splined shaft 7/8 in 13T 16/32DP[1]
(SAE J744; 22-4(B))



2

Ports

Designation	Port for	Standard	Size[2]	Max. pressure [bar][3]	State
A, B	Service line (high pressure range)	SAE J518	3/4 in	350	O
Port plate 10	Mounting bolts	DIN 13	M10 x 1.5; 17 deep		
A, B Port plate 16	Service line	DIN 3852-1	M27 x 2; 16 deep	350	O
L	Case drain	ISO 11926[5]	7/8-14 UNF-2B; 13 deep	4	O[4]
L_1	Case drain	ISO 11926[5]	7/8-14 UNF-2B; 13 deep	4	X[4]

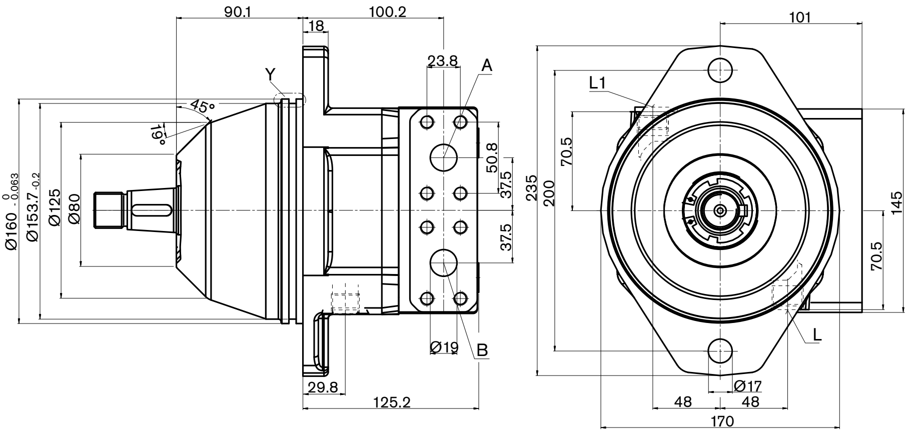
1) ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, tolerance class 5
2) Observe the general instructions on page 28 for the maximum tightening torques.
3) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings. Pressure data in bar absolut.
4) Depending on the installation position, L or L_1 must be connected (see also page 26 - 27).
5) The counterbore can be deeper than stipulated in the standard.
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions A10FE size 58 - 63

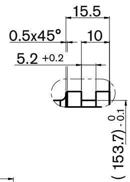
Before finalising your design request a certified installation drawing. Dimensions in mm.

A10FE 58-63/52W-VxFxxN000

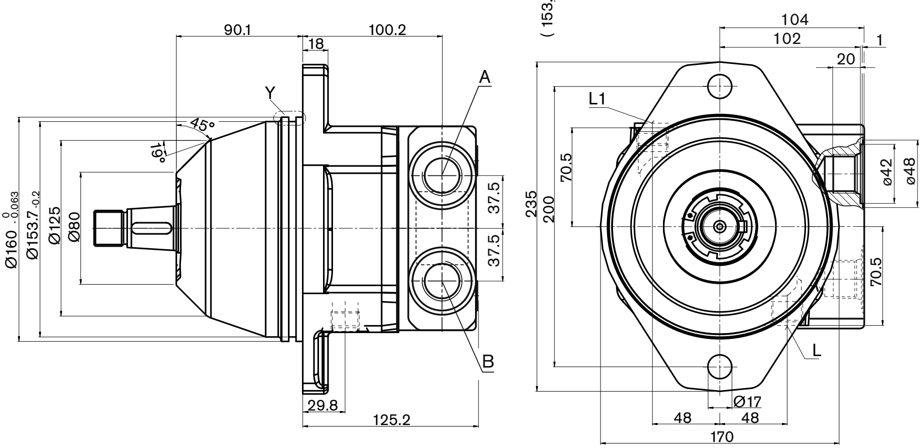
Port plate 10



View Y 2:1



Port plate 16

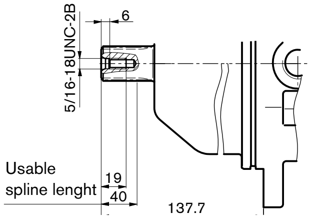


Dimensions A10FE size 58 - 63

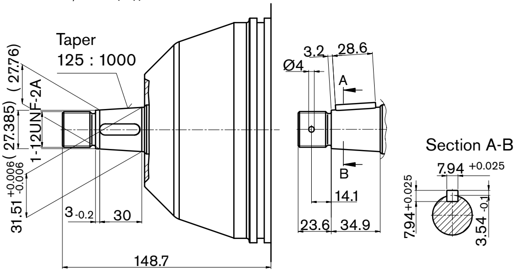
Before finalising your design request a certified installation drawing. Dimensions in mm.

Drive shafts

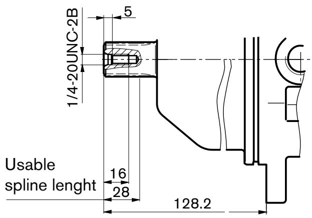
R Splined shaft 1 1/4 in 14T 12/24DP[1]
(SAE J744; 32-4(C))



C Tapered with woodruff key and threaded end
(SAE J744; 32-3(C))



W Splined shaft 1 in 15T 16/32DP[1]
(SAE J744; 25-4(B-B))



Ports

Designation	Port for	Standard	Size[2]	Max. pressure [bar][3]	State
A, B	Service line (high pressure range)	SAE J518	3/4 in	350	O
Port plate 10	Mounting bolts	DIN 13	M10 x 1.5; 17 deep		
A, B Port plate 16	Service line	DIN 3852-1	M27 x 2; 16 deep	350	O
L	Case drain	ISO 11926[5]	7/8-14 UNF-2B; 13 deep	4	O[4]
L_1	Case drain	ISO 11926[5]	7/8-14 UNF-2B; 13 deep	4	X[4]

1) ANSI B92.1a-1996, 30° pressure angle, flat base, flank centering, tolerance class 5
2) Observe the general instructions on page 28 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. Pressure data in bar absolut.
4) Depending on the installation position, L or L_1 must be connected (see also page 26 - 27).
5) The counterbore can be deeper than stipulated in the standard.
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Flushing and boost pressure valve

Before finalising your design request a certified installation drawing. Dimensions in mm.

Ordering Option N007

This valve assembly is used to flush an unacceptable heat load out of the closed loop circuit, and to maintain the necessary minimum boost pressure (16 bar, fixed setting). The valve is integrated into the port plate.

A built-in fixed orifice determines the flushing flow, which is taken out of the low pressure side of the loop and directed into the motor housing. It leaves the housing together with the case drain flow. This combined flow is replenished with fresh oil by means of the boost pump.

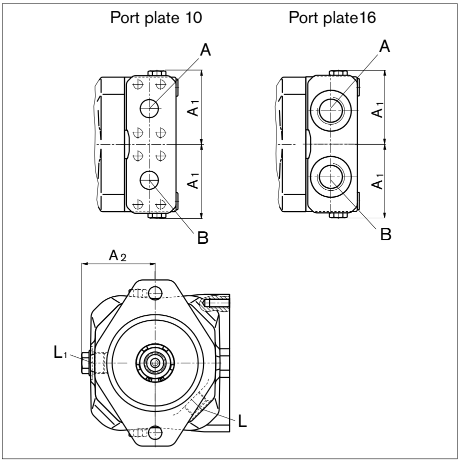
Standard flushing flow

With low press. side p_{ND} = 20 bar and an orifice dia. 1,6 mm: 5,5 L/min (sizes 23 - 63). Other orifice diameters are available, please state in clear text.

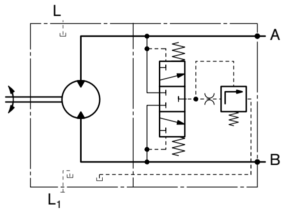
Further flushing flows for sizes 23 - 63 see table:

Flushing flow [L/min]	Orifice ø [mm]
3.5	1.2
5.5	1.6
9	2

Dimensions A10FM / A10FE



Schematic



	Port for
A; B	Service line
L, L_1	Case drain (L_1 plugged)

Size (NG)	A_1	A_2
23/28	72	72
37/45	77	77
58/63	77	82

Anti cavitation valve

Ordering option N002

When stopping a system with a relatively large mass (i.e. fan drive) the anti-cavitation valve provides fluid to the motor inlet during the coasting time.

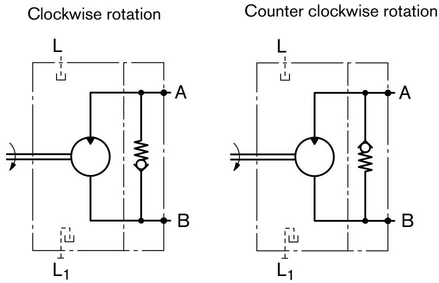
The valve assembly is integrated inside the port plate.

Important

It is necessary **to specify a direction of rotation (clockwise or counter clockwise)** looking at the shaft end of the motor.

The outside dimensions are identical to the standard units except the A10FE 11 - 18 with the 8-hole mounting flange, for the difference in lenght see unit dimensions.

Schematic



	Port for
A; B	Service line
L, L_1	Case drain (L_1 plugged)

Speed sensor

Ordering option D

The version A10FM...D comprises gearing around the rotary unit (prepared for speed pickup).

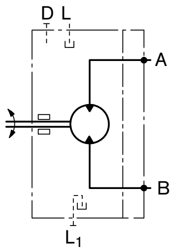
In this case, the rotating cylinder barrel can provide a speed dependent signal, which can be picked up by a suitable sensor and processed for further evaluation. Sensor port (D) will be closed for delivery.

A motor, prepared for speed sensing will be delivered without the necessary accessory parts which must be ordered separately.

Inductive speed sensor ID R 18/20-L250 (see RE 95130) and mounting parts (spacer and 2 seals per kit) can be ordered separately with the following part numbers:

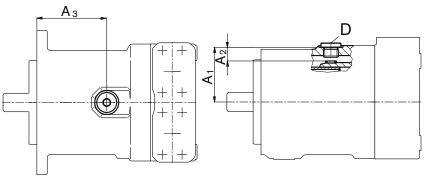
Size (NG)	Ordering Nr.	Nr. of teeth
23/28	R902428802	48
37/45	R902433368	48
58/63	in preparation	9

Schematic



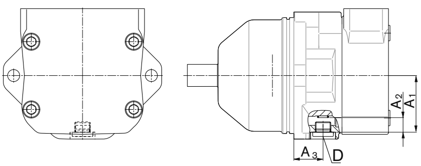
	Port for
A; B	Service line
L, L_1	Case drain (L_1 plugged)

Dimensions



A10FM....D

Size (NG)	A1	A2	A3	Port „D“ (plugged)
23/28	61	15.5	101.8	M18 x 1.5
37/45	66	17	84.2	M18 x 1.5
58/63	69	14.8	128.5	M18 x 1.5



A10FE.....D

Size (NG)	A1	A2	A3	Port „D“ (plugged)
23/28	61	15.5	27.7	M18 x 1.5
37/45	66	17	33.9	M18 x 1.5
58/63	69	14.8	46.1	M18 x 1.5

2

Installation instructions

General

At all times, the axial piston unit must be filled with fluid and air bled during commissioning and operation. This must also be observed after a prolonged period of standstill as the system may drain back to the reservoir via the hydraulic lines.

The case drain fluid in the motor housing must be directed to tank via the highest available tank port and must drain the fluid below the minimum fluid level in the reservoir.

Installation position

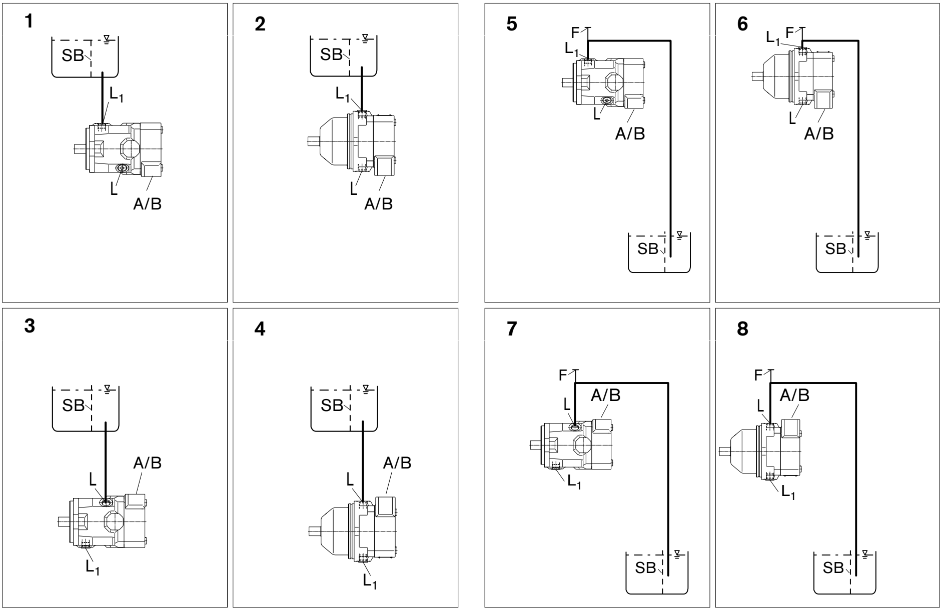
See following examples 1 to 8.
Recommended installation positions: 1 and 3 resp. 2 and 4.
Additional installation positions are available on request.

Below reservoir installation (standard)

Below reservoir installation means, that the motor is mounted below the minimum fluid level.

Above reservoir installation

Above reservoir installation means, that the motor is mounted above the minimum fluid level. A check valve in the case drain line is only permissible under certain conditions; please consult us.



Install. position	Air bleed	Filling
1, 2	–	L_1
3, 4	–	L

Install. position	Air bleed	Filling
5, 6	F	L_1 (F)
7, 8	F	L (F)

L/L_1 = Case drain port, F = Air bleed resp. filling port, , SB = Baffle.

Notes

General instructions

– The motor A10FM and A10FE has been designed to be used in open and closed circuits.

– Project planning, assembly and commissioning of the axial piston unit require the involvement of qualified personnel.

– Before operating the axial piston unit read the relevant operating manual thoroughly and completely. If needed request this information from 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).

- Pressure 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 service line ports and function ports are only designed 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 DIN 13849.

– The following tightening torques apply:

- Fittings:
  Observe the manufacturer‘s instructions regarding the tightening torques of the fittings used.

- Mounting bolts:
  For fixing screws with metric ISO thread according to DIN 13 or thread according to ASME B1.1, we recommend checking the tightening torque individually according to VDI 2230.

- Mounting bolts threads and threaded ports 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 threaded plugs, supplied with the axial piston unit, the required tightening torques M_V apply. For values, see the following table.

Ports **Standard**	**Thread sizes**	**Maximum permissible tightening torque for the female threads $M_{G\,max}$**	**Required tightening torque for the threaded plugs M_V**	**WAF hexagon socket of the threaded plugs**
DIN 3852	M14 x 1.5	80 Nm	35 Nm[1)]	6 mm
	M18 x 1.5	140 Nm	60 Nm[1)]	8 mm
	M27 x 2	330 Nm	135 Nm[1)]	12 mm
ISO 11926	3/4-16 UNF-2B	160 Nm	62 Nm	5/16 in
	7/8-14 UNF-2B	240 Nm	110 Nm	3/8 in

1) The tightening torques apply for screws in the “dry” state as received on delivery and in the “lightly oiled” state for installation.

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Axial Piston Motors
Variable motors

Designation	Type	Size	Series	Nominal pressure	Data sheet	page
Variable motor	A6VM	28…1000	63	350…400 bar	RE 91604	167
Variable motor	A6VM	60…280	71	450 bar	RE 91610	247
Variable plug-in motor	A6VE	28…250	63	350…400 bar	RE 91606	323
Variable plug-in motor	A6VE	60…170	71	450 bar	RE 91616	363
Variable motor	A10VM/E	28…85	52	280 bar	RE 91703	411

For the latest information on axial piston motors, please visit our website:
www.boschrexroth.com/axial-piston-motors

Rexroth
Bosch Group

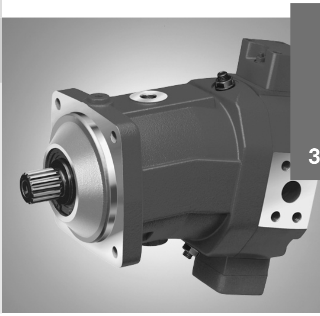
Axial Piston Variable Motor A6VM

Data sheet

Series 63

Size	Nominal pressure
28 to 200	400 bar/450 bar
250 to 1000	350 bar/400 bar

Open and closed circuits



3

Contents

Features

- Variable motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuits
- For use in mobile and stationary applications
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The displacement can be infinitely changed from $V_{g\,max}$ to $V_{g\,min} = 0$.
- The output speed is dependent on the flow of the pump and the displacement of the motor.
- The output torque increases with the pressure differential between the high-pressure and low-pressure side and with increasing displacement.
- Wide control range with hydrostatic transmissions
- Wide selection of control devices
- Cost savings through elimination of gear shifts and possibility of using smaller pumps
- Compact, robust motor with long service life
- High power density
- Good starting characteristics
- Small swing torque

Ordering code for standard program

	A6V		M					/	63	W		–	V								–	
01	02	03	04	05	06	07	08		09	10	11		12	13	14	15	16	17	18	19		20

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 28 to 200 (without code)	
		Sizes 250 to 1000 (only in combination with long-life bearings "L")	E

Axial piston unit

02	Bent-axis design, variable	A6V

Drive shaft bearing

		28...200	250	355	500	1000	
03	Standard bearing (without code)	●	●	●	●	–	
	Long-life bearing	–	●	●	●	●	L

Operating mode

04	Motor (plug-in motor A6VE, see RE 91606)	M

Sizes (NG)

05	Geometric displacement, see table of values on page 8	28	55	80	107	140	160	200	250	355	500	1000

Control devices

				28	55	80	107	140	160	200	250	355	500	1000	
06	Proportional control hydraulic		Δp = 10 bar	●	●	●	●	●	●	●	●	●	●	●	HD1
			Δp = 25 bar	●	●	●	●	●	●	●	●	●	●	●	HD2
			Δp = 35 bar	–	–	–	–	–	–	–	●	●	●	●	HD3
	Two-point control hydraulic			–	–	–	–	–	–	–	●	●	●	●	HZ
				●	–	–	–	●	●	●	–	–	–	–	HZ1
				–	●	●	●	–	–	–	–	–	–	–	HZ3
	Proportional control electric		12 V	●	●	●	●	●	●	●	●	●	●	●	EP1
			24 V	●	●	●	●	●	●	●	●	●	●	●	EP2
	Two-point control electric		12 V	●	–	–	–	●	●	●	●	●	●	●	EZ1
			24 V	●	–	–	–	●	●	●	●	●	●	●	EZ2
			12 V	–	●	●	●	–	–	–	–	–	–	–	EZ3
			24 V	–	●	●	●	–	–	–	–	–	–	–	EZ4
	Automatic control high-pressure related	with minimum pressure increase $\Delta p \leq$ approx. 10 bar		●	●	●	●	●	●	●	●	●	●	●	HA1
		with pressure increase Δp = 100 bar		●	●	●	●	●	●	●	●	●	●	●	HA2
	Automatic control speed-related p_{St}/p_{HD} = 3/100	hydraulic travel direction valve		–	–	–	–	–	–	–	●	●	●	❍	DA
	p_{St}/p_{HD} = 5/100	hydraulic travel direction valve		●	●	●	●	●	●	●	–	–	–	–	DA1
		electric travel direction valve	12 V	●	●	●	●	●	●	●	–	–	–	–	DA2
		+ electric $V_{g\,max}$-circuit	24 V	●	●	●	●	●	●	●	–	–	–	–	DA3
	p_{St}/p_{HD} = 8/100	hydraulic travel direction valve		●	●	●	●	●	●	●	–	–	–	–	DA4
		electric travel direction valve	12 V	●	●	●	●	●	●	●	–	–	–	–	DA5
		+ electric $V_{g\,max}$-circuit	24 V	●	●	●	●	●	●	●	–	–	–	–	DA6

Pressure control (only for HD, EP)

			28	55	80	107	140	160	200	250	355	500	1000	
07	Without pressure control (without code)		●	●	●	●	●	●	●	●	●	●	●	
	Pressure control	fixed setting	●	●	●	●	●	●	●	●	●	●	●	D
		hydraulic override, two-point	●	●	●	●	●	●	●	1)	1)	1)	1)	E
		hydraulic remote control, proportional	–	–	–	–	–	–	–	●	●	●	●	G

● = Available ❍ = On request ▲ = Not for new projects – = Not available ▭ = Preferred program

1) Fitted as standard with version D (sizes 250 to 1000)

Ordering code for standard program

	A6V		M					/	63	W		–	V								–	
01	02	03	04	05	06	07	08		09	10	11		12	13	14	15	16	17	18	19		20

Overrides for controls HA1 and HA2

			28	55	80	107	140	160	200	250	355	500	1000	
08	Without override (without code)		●	●	●	●	●	●	●	●	●	●	●	
	Hydraulic override, remote control, proportional		●	●	●	●	●	●	●	●	●	●	●	**T**
	Electric override, two-point	12 V	●	●	●	●	●	●	●	–	–	–	–	**U1**
		24 V	●	●	●	●	●	●	●	–	–	–	–	**U2**
	Electric override + electric travel direction valve	12 V	●	●	●	●	●	●	●	–	–	–	–	**R1**
		24 V	●	●	●	●	●	●	●	–	–	–	–	**R2**

Series

09	Series 6, index 3	**63**

Direction of rotation

10	Viewed on drive shaft, bidirectional	**W**

Setting ranges for displacement2)

			28	55	80	107	140	160	200	250	355	500	1000	
11	$V_{g\,min} = 0$ to $0.7\ V_{g\,max}$ (without code)		●	●	●	●	●	●	●	–	–	–	–	
	$V_{g\,min} = 0$ to $0.4\ V_{g\,max}$	$V_{g\,max} = V_{g\,max}$ to $0.8\ V_{g\,max}$	–	–	–	–	–	–	–	●	●	●	●	**1**
	$V_{g\,min} > 0.4\ V_{g\,max}$ to $0.8\ V_{g\,max}$	$V_{g\,max} = V_{g\,max}$ to $0.8\ V_{g\,max}$	–	–	–	–	–	–	–	●	●	●	●	**2**

Seals

12	FKM (fluor-caoutchouc)	**V**

Drive shafts

		28	55	80	107	140	160	200	250	355	500	1000	
13	Splined shaft DIN 5480	●	●	●	●	–	●	●	–	–	–	–	**A**
		●	●	●	●	●	●	–	●	●	●	●	**Z**
	Parallel keyed shaft DIN 6885	–	–	–	–	–	–	–	●	●	●	●	**P**

Mounting flanges

			28	55	80	107	140	160	200	250	355	500	1000	
14	ISO 3019-2	4-hole	●	●	●	●	●	●	●	●	–	–	–	**B**
		8-hole	–	–	–	–	–	–	–	–	●	●	●	**H**

Port plates for service lines3)

					28	55	80	107	140	160	200	250	355	500	1000	
15	SAE flange ports A and B at rear		01	0	●	●	●	●	●	●	●	●	●	●	●	**010**
				7	●	●	●	●	●	●	●	●	●	●	●	**017**
	SAE flange ports A and B at side, opposite		02	0	●	●	●	●	●	●	●	●	●	●	●	**020**
				7	●	●	●	●	●	●	●	●	●	●	●	**027**
	SAE flange ports A and B at side, opposite + rear		15	0	–	–	–	–	–	–	–	●	●	●	●	**150**
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve4)	BVD	37	0 / 8	–	–	–	●	–	–	–	–	–	–	–	**370** **378**
			38	0 / 8	–	●	●	●	●	●	●	●6)	–	–	–	**380**
		BVE	38	0 / 8	–	–	–	●	●	●	●	–6)	–	–	–	**388**

Valves (see pages 71 to 76)

Without valve	**0**
Flushing and boost pressure valve mounted	**7**
Counterbalance valve mounted5)	**8**

● = Available ❍ = On request ▲ = Not for new projects – = Not available ▢ = Preferred program

2) Specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering: $V_{g\,min}$ = ... cm^3, $V_{g\,max}$ = ... cm^3
3) Metric fastening thread
4) Only possible in combination with HD, EP and HA control. Note the restrictions on page 74.
5) Specify ordering code of counterbalance valve according to data sheet (BVD – RE 95522, BVE – RE 95525) separately. Note the restrictions on page 74.
6) Counterbalance valve MHB32, please contact us.

Ordering code for standard program

	A6V		M					/	63	W		–	V								–	
01	02	03	04	05	06	07	08		09	10	11		12	13	14	15	16	17	18	19		20

	Speed sensors (see page 78)	28	55	80	107	140	160	200	250	355	500	1000[7]	
16	Without speed sensor	●	●	●	●	●	●	●	●	●	●	●	0
	Prepared for HDD speed sensor	–	▲	▲	▲	▲	▲	▲	▲	●	●	–	F
	HDD speed sensor mounted[8]	–	▲	▲	▲	▲	▲	▲	▲	●	●	–	H
	Prepared for DSA speed sensor	●	●	●	●	●	●	●	❍	❍	❍	–	U
	DSA speed sensor mounted[8]	●	●	●	●	●	●	●	❍	❍	❍	–	V

	Swivel angle sensor (see page 77)	28	55	80	107	140	160	200	250	355	500	1000	
17	Without swivel angle sensor (without code)	●	●	●	●	●	●	●	●	●	●	–	
	Optical swivel angle sensor	–	–	–	–	–	–	–	●	●	●	●	V
	Electric swivel angle sensor	–	–	–	–	–	–	–	●	●	●	●	E

	Connector for solenoids (see page 70)	28 to 200	250 to 1000	
18	Without connector (without solenoid, only with hydraulic controls)	●	–	0
	(size 250 to 1000 without code)	–	●	
	DEUTSCH – molded connector, 2-pin – without suppressor diode	●	–	P
	HIRSCHMANN connector – without suppressor diode (without code)	–	●	

	Beginning of control	28	55	80	107	140	160	200	250	355	500	1000	
19	At $V_{g\ min}$ (standard for HA)	●	●	●	●	●	●	●	●	●	●	●	A
	At $V_{g\ max}$ (standard for HD, HZ, EP, EZ, DA)	●	●	●	●	●	●	●	●	●	●	●	B

	Standard / special version	
20	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 for new projects – = Not available (shaded) = Preferred program

7) Please contact us.
8) Specify ordering code of sensor according to data sheet (DSA – RE 95133, HDD – RE 95135) separately and observe the requirements on the electronics.

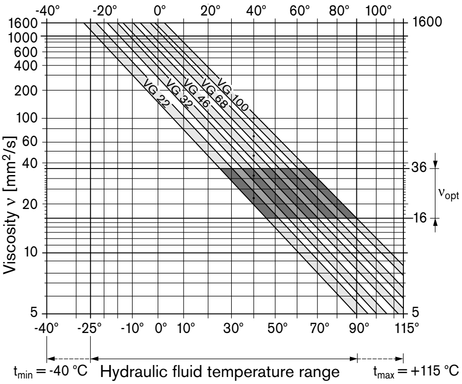
Technical data

Hydraulic fluid

Before starting project planning, please refer to our data sheets RE 90220 (mineral oil), RE 90221 (environmentally acceptable hydraulic fluids), 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 variable motor A6VM 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 a closed circuit, the circuit 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 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 circuit temperature or 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 or using a flushing and boost pressure valve (see pages 71 and 72).

3

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]	ν_{max} = 1600	$T_{St} \geq$ -40 °C	$t \leq 3$ min, without load ($p \leq 50$ bar), $n \leq 1000$ rpm (sizes 28 to 200), $n \leq 0.25 \cdot n_{nom}$ (sizes 250 to 1000)
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	ν < 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. The bearing temperature can be reduced by flushing via port U.
Maximum temperature		115 °C	in the bearing
		103 °C	measured at port T
Continuous operation	ν = 400 to 10 ν_{opt} = 36 to 16	T = -25 °C to +90 °C	measured at port T, no restriction within the permissible data
Short-term operation[2]	$\nu_{min} \geq 7$	T_{max} = +103 °C	measured at port T, t < 3 min, $p < 0.3 \cdot p_{nom}$
FKM shaft seal[1]		$T \leq +115$ °C	see page 6

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.

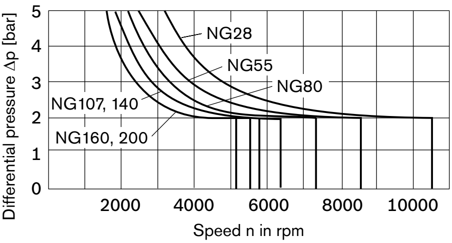
Shaft seal

Permissible pressure loading

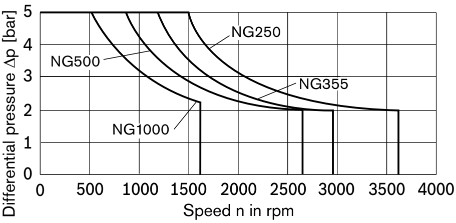
The service life of the shaft seal is influenced by the speed of the axial piston unit and the case drain pressure (case pressure). The mean differential pressure of 2 bar between the case and the ambient pressure may not be enduringly exceeded at normal operating temperature. For a higher differential 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 28 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.

Influence of case pressure on beginning of control

An increase in case pressure affects the beginning of control of the variable motor when using the following control options:

HD, HA.T (sizes 28 to 200) ____________ increase
HD, EP, HA, HA.T (sizes 250 to 1000) ____________ increase
DA ____________ decrease

With the following controls, an increase in the case pressure has no influence on the beginning of control:
EP, HA, HA.R, HA.U (sizes 28 to 200)

The factory settings for the beginning of control are made at $p_{abs} = 2$ bar (sizes 28 to 200) and $p_{abs} = 1$ bar (sizes 250 to 1000) case pressure.

Direction of flow

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

Long-life bearings

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. Bearings and case flushing via port U is recommended.

Flushing flow (recommended)

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

Technical data

Operating pressure range

(operating with mineral oil)

Pressure at service line port A or B

Sizes 28 to 200

Nominal pressure p_{nom} ________________ 400 bar absolute

Maximum pressure p_{max} ________________ 450 bar absolute
Single operating period____________________________ 10 s
Total operating period at __________________________ 300 h

Sizes 250 to 1000

Nominal pressure p_{nom} ________________ 350 bar absolute

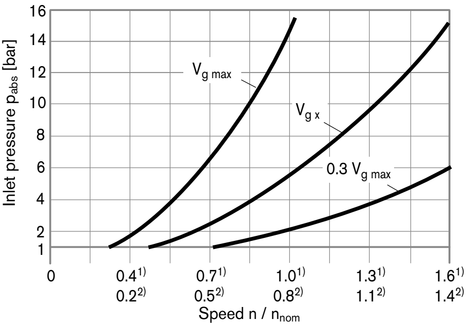
Maximum pressure p_{max} ________________ 400 bar absolute
Single operating period____________________________ 10 s
Total operating period ____________________________ 300 h

Minimum pressure (high-pressure side) ___25 bar absolute

Summation pressure (pressure A + pressure B) p_{Su} _ 700 bar

Rate of pressure change $R_{A\,max}$
with integrated pressure-relief valve____________ 9000 bar/s
without pressure-relief valve _________________ 16000 bar/s

Minimum pressure – pump mode (inlet)
To prevent damage to the axial piston motor in pump operating mode (change of high-pressure side with unchanged direction of rotation, e. g. when braking), a minimum pressure must be guaranteed at the service line port (inlet). This minimum pressure is dependent on the speed and displacement of the axial piston unit (see characteristic curve below).



1) For sizes 28 to 200
2) For sizes 250 to 1000

This diagram is valid only for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s.
Please contact us if the above conditions cannot be satisfied.

Note
Values for other hydraulic fluids, please contact us.

Definition

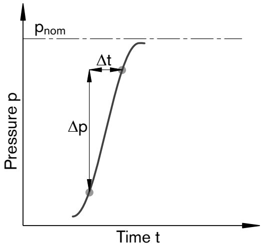
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

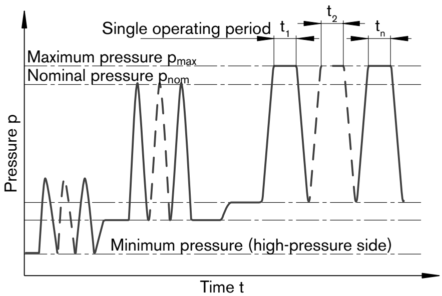
Maximum pressure p_{max}
The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.

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.

Summation pressure p_{Su}
The summation pressure is the sum of the pressures at both service line ports (A and B).

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

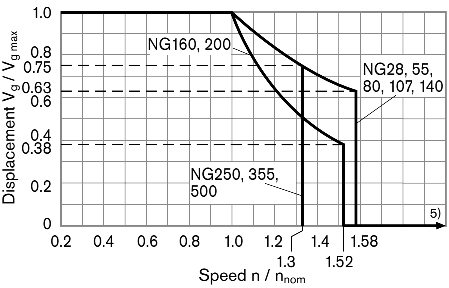
Table of values (theoretical values, without efficiency and tolerances; values rounded)

Size		NG	28	55	80	107	140	160	200	250	355	500	1000
Displacement geometric[1], per revolution	$V_{g\,max}$	cm^3	28.1	54.8	80	107	140	160	200	250	355	500	1000
	$V_{g\,min}$	cm^3	0	0	0	0	0	0	0	0	0	0	0
	$V_{g\,x}$	cm^3	18	35	51	68	88	61	76	188	270	377	762
Speed maximum[2] (while adhering to the maximum permissible input flow)													
at $V_{g\,max}$	n_{nom}	rpm	5550	4450	3900	3550	3250	3100	2900	2700	2240	2000	1600
at $V_g < V_{g\,x}$ (see diagram below)	n_{max}	rpm	8750	7000	6150	5600	5150	4900	4600	3600	2950	2650	1600
at $V_{g\,0}$	n_{max}	rpm	10450	8350	7350	6300	5750	5500	5100	3600	2950	2650	1600
Input flow[3]													
at n_{nom} and $V_{g\,max}$	$q_{V\,max}$	L/min	156	244	312	380	455	496	580	675	795	1000	1600
Torque[4]													
at $V_{g\,max}$ and $\Delta p = 400$ bar	T	Nm	179	349	509	681	891	1019	1273	–	–	–	–
at $V_{g\,max}$ and $\Delta p = 350$ bar	T	Nm	157	305	446	596	778	891	1114	1391	1978	2785	5571
Rotary stiffness													
$V_{g\,max}$ to $V_g/2$	c_{min}	KNm/rad	6	10	16	21	34	35	44	60	75	115	281
$V_g/2$ to 0 (interpolated)	c_{max}	KNm/rad	18	32	48	65	93	105	130	181	262	391	820
Moment of inertia for rotary group	J_{GR}	kgm^2	0.0014	0.0042	0.008	0.0127	0.0207	0.0253	0.0353	0.061	0.102	0.178	0.55
Maximum angular acceleration	α	rad/s^2	47000	31500	24000	19000	11000	11000	11000	10000	8300	5500	4000
Case volume	V	L	0.5	0.75	1.2	1.5	1.8	2.4	2.7	3.0	5.0	7.0	16.0
Mass (approx.)	m	kg	16	26	34	47	60	64	80	100	170	210	430

1) The minimum and maximum displacement are infinitely adjustable, see ordering code, page 3.
(standard setting for sizes 250 to 1000 if not specified in the order: $V_{g\,min} = 0.2 \cdot V_{g\,max}$, $V_{g\,max} = V_{g\,max}$).
2) 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
3) Restriction of input flow with counterbalance valve, see page 74
4) Torque without radial force, with radial force see page 9

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 startup angular acceleration (lower than the maximum angular acceleration) can be found in data sheet 90261.

Permissible displacement in relation to speed



5) Values in this range on request

Determining the operating characteristics

Input flow $$q_v = \frac{V_g \cdot n}{1000 \cdot \eta_v}$$ [L/min]

Speed $$n = \frac{q_V \cdot 1000 \cdot \eta_v}{V_g}$$ [min^{-1}]

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

Power $$P = \frac{2\,\pi \cdot T \cdot n}{60000} = \frac{q_v \cdot \Delta p \cdot \eta_t}{600}$$ [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 forces of the drive shafts

Size	NG		28	28	55	55	80	80	107	107	140
Drive shaft	ø	mm	30	25	35	30	40	35	45	40	45
Maximum radial force[1] at distance a (from shaft collar)	$F_{q\,max}$	N	4838	6436	8069	7581	10283	10266	12215	13758	15982
	a	mm	17.5	14	20	17.5	22.5	20	25	22.5	25
with permissible torque	T_{max}	Nm	179	179	349	281	509	444	681	681	891
≙ Permissible pressure Δp at $V_{g\,max}$	$p_{nom\,perm.}$	bar	400	400	400	322	400	349	400	400	400
Maximum axial force[2] F_{ax} ±	$+F_{ax\,max}$	N	315	315	500	500	710	710	900	900	1030
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$F_{ax\,perm./bar}$	N/bar	4.6	4.6	7.5	7.5	9.6	9.6	11.3	11.3	13.3

Size	NG		160	160	200	250	355	500	1000
Drive shaft	ø	mm	50	45	50	50	60	70	90
Maximum radial force[1] at distance a (from shaft collar)	$F_{q\,max}$	N	16435	18278	20532	1200[3]	1500[3]	1900[3]	2600[3]
	a	mm	27.5	25	27.5	41	52.5	52.5	67.5
with permissible torque	T_{max}	Nm	1019	1019	1273	[4]	[4]	[4]	[4]
≙ Permissible pressure Δp at $V_{g\,max}$	$p_{nom\,perm.}$	bar	400	400	400	[4]	[4]	[4]	[4]
Maximum axial force[2] F_{ax} ±	$+F_{ax\,max}$	N	1120	1120	1250	1200	1500	1900	2600
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$F_{ax\,perm./bar}$	N/bar	15.1	15.1	17.0	[4]	[4]	[4]	[4]

1) With intermittent operation.
2) Maximum permissible axial force during standstill or when the axial piston unit is operating in non-pressurized condition.
3) When at a standstill or when axial piston unit operating in non-pressurized conditions. Higher forces are permissible when under pressure, please contact us.
4) Please contact us.

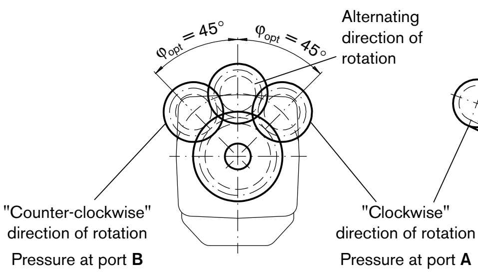
Note
Influence of the direction of the permissible axial force:

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

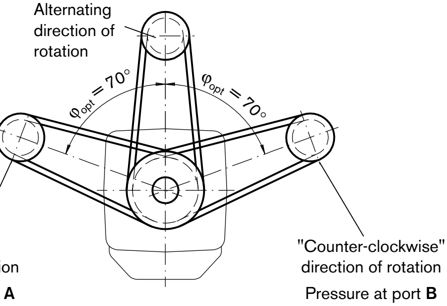
Effect of radial force F_q on the service life of bearings

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 drive



HD – Proportional control hydraulic

The proportional hydraulic control provides infinite setting of the displacement, proportional to the pilot pressure applied to port X.

- Beginning of control at $V_{g\ max}$ (maximum torque, minimum speed at minimum pilot pressure)
- End of control at $V_{g\ min}$ (minimum torque, maximum permissible speed at maximum pilot pressure)

Note

- Maximum permissible pilot pressure: p_{St} = 100 bar
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 450 bar can occur at port G.
- Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 10 bar.
- The beginning of control and the HD characteristic are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 6) and thus a parallel shift of the characteristic.
- A leakage flow of maximum 0.3 L/min can escape at port X due to internal leakage (operating pressure > pilot pressure). The control is to be suitably configured to avoid an independent build-up of pilot pressure.

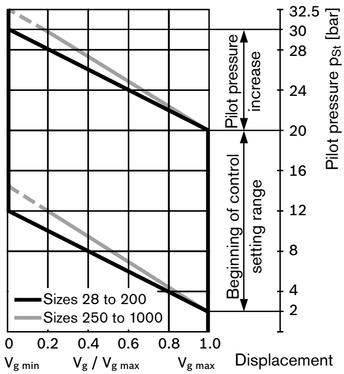
HD1
Pilot pressure increase Δp_{St} = 10 bar

A pilot pressure increase of 10 bar at port X results in a decrease in displacement from $V_{g\ max}$ to 0 cm³ (sizes 28 to 200) or from $V_{g\ max}$ to 0.2 $V_{g\ max}$ (sizes 250 to 1000).

Beginning of control, setting range ______________2 to 20 bar

Standard setting:
Beginning of control at 3 bar (end of control at 13 bar)

HD1 characteristic



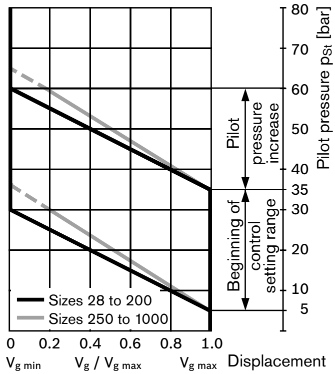
HD2
Pilot pressure increase Δp_{St} = 25 bar

A pilot pressure increase of 25 bar at port X results in a decrease in displacement from $V_{g\ max}$ to 0 cm³ (sizes 28 to 200) or from $V_{g\ max}$ to 0.2 $V_{g\ max}$ (sizes 250 to 1000).

Beginning of control, setting range ______________5 to 35 bar

Standard setting:
Beginning of control at 10 bar (end of control at 35 bar)

HD2 characteristic



HD3
Pilot pressure increase Δp_{St} = 35 bar

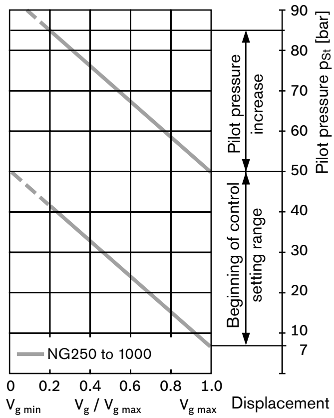
(sizes 250 to 1000)

A pilot pressure increase of 35 bar at port X results in a decrease in displacement from $V_{g\ max}$ to 0.2 $V_{g\ max}$.

Beginning of control, setting range ______________7 to 50 bar

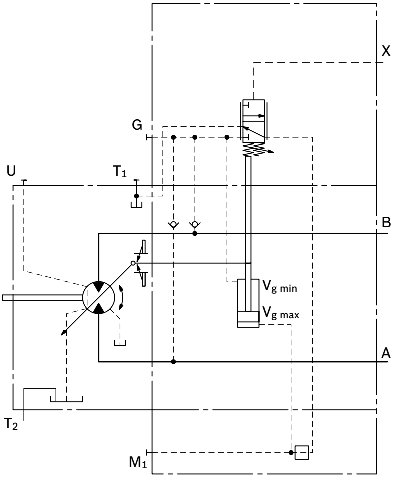
Standard setting:
Beginning of control at 10 bar (end of control at 45 bar)

HDR3 characteristic

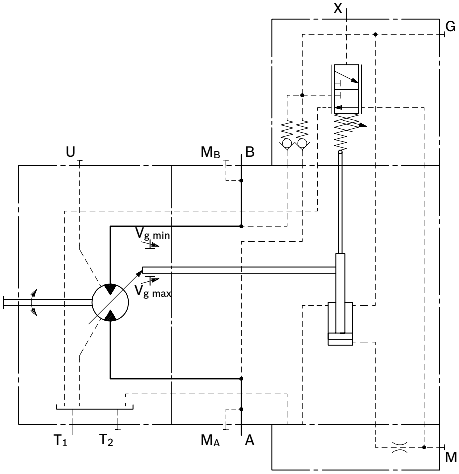


HD – Proportional control hydraulic

Schematic HD1, HD2, HD3
Sizes 28 to 200



Schematic HD1, HD2, HD3
Sizes 250 to 1000



3

Note

The spring return feature in the control part is not a safety device

The control part 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.

HD – Proportional control hydraulic

HD.D
Pressure control, fixed setting

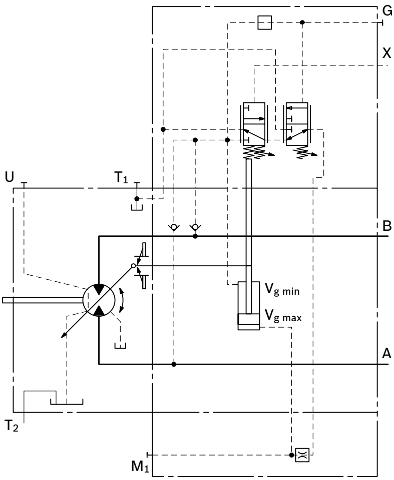
The pressure control overrides the HD control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

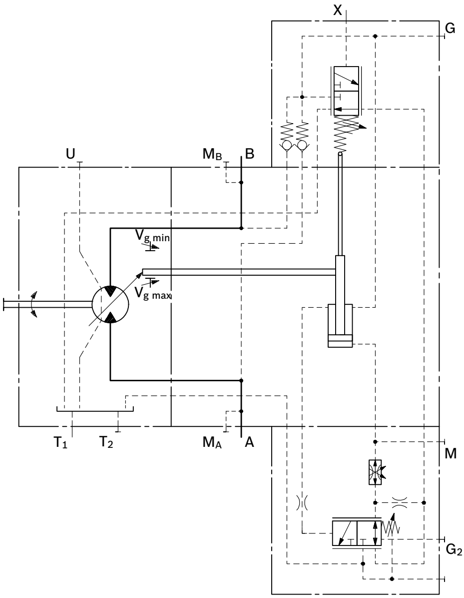
Setting range of the pressure control valve

Sizes 28 to 200	80 to 400 bar
Sizes 250 to 1000	80 to 350 bar

Schematic HD.D
Sizes 28 to 200



Schematic HD.D
Sizes 250 to 1000



HD – Proportional control hydraulic

HD.E
Pressure control, hydraulic override, two-point

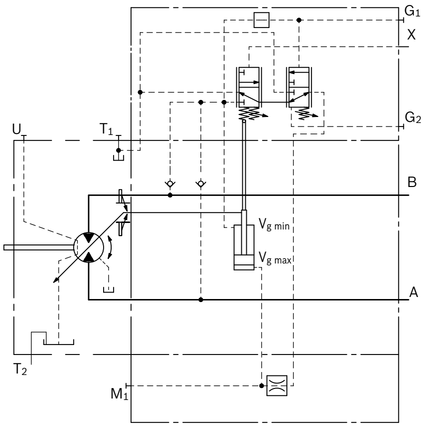
Sizes 28 to 200

The pressure control setting can be overridden by applying an external pilot pressure at port G_2, realizing a 2nd pressure setting.

Required pilot pressure at port G_2:
p_{St} = 20 to 50 bar

Please state the 2nd pressure setting in plain text when ordering.

Schematic HD.E



Sizes 250 to 1000 (HD.D)

Pressure control with 2nd pressure setting for HD.D provided as standard (see page 12).

The pressure control setting can be overridden by applying an external pilot pressure at port G_2, realizing a 2nd pressure setting.

Required pilot pressure at port G_2:
$p_{St} \geq 100$ bar

Please state the 2nd pressure setting in plain text when ordering.

HD.G
Pressure control, remote control

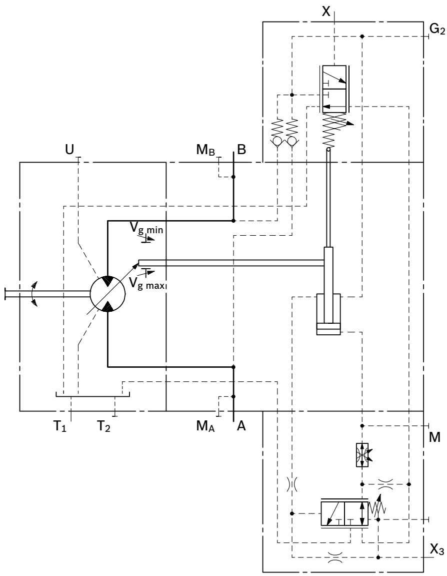
Sizes 250 to 1000

When the set pressure value is reached, the remote control pressure control continually regulates the motor to maximum displacement $V_{g\,max}$. A pressure-relief valve (not included in the delivery contents), which is located separately from the motor and which is connected to port X_3, assumes the task of controlling the internal pressure cut-off valve.
So long as the target pressure value has not been reached, pressure is evenly applied to the valve from both sides in addition to the force of the spring, and the valve remains closed.
The target pressure value is between 80 bar and 350 bar.
When the target pressure value is reached at the separate pressure-relief valve, this will open, reliving the pressure on the spring side to the reservoir. The internal control valve switches and the motor swivels to maximum displacement $V_{g\,max}$.
The differential pressure at the control valve is set as standard to 25 bar. As a separate pressure-relief valve, we recommend:

DBD 6 (hydraulic) as per RE 25402

The maximum line length should not exceed 2 m.

Schematic HD.G



3

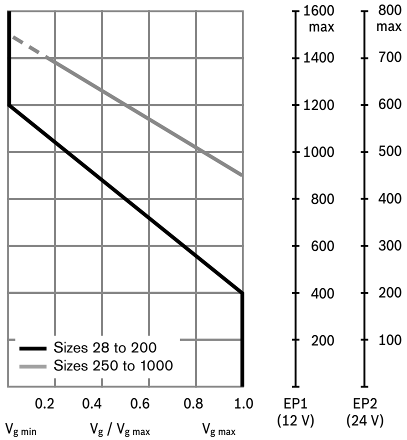
EP – Proportional control electric

The proportional electric control provides infinite setting of the displacement, proportional to the control current applied to the solenoid (sizes 28 to 200) or proportional valve (sizes 250 to 1000).

For sizes 250 to 1000, the pilot oil supply at port P requires an external pressure of $p_{min} = 30$ bar ($p_{max} = 100$ bar).

- Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum control current)
- End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum control current)

Characteristic



Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 450 bar can occur at port G.

The following only needs to be noted for sizes 250 to 1000:

- The beginning of control and the EP characteristic are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 6) and thus a parallel shift of the characteristic.

Technical data, solenoid
Sizes 28 to 200

	EP1	EP2
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 design page 70		

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
- Electric amplifier VT 2000, series 5X (see RE 29904) (for stationary application)

Further information can also be found on the Internet at www.boschrexroth.com/mobile-electronics

Technical data, proportional valve
Sizes 250 to 1000

	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Beginning of control at $V_{g\,max}$	900 mA	450 mA
End of control at $V_{g\,min}$	1400 mA	700 mA
Limiting current	2.2 A	1.0 A
Nominal resistance (at 20 °C)	2.4 Ω	12 Ω
Duty cycle	100 %	100 %
Type of protection see connector design page 70		

See also proportional pressure-reducing valve DRE 4K (RE 29181).

Note

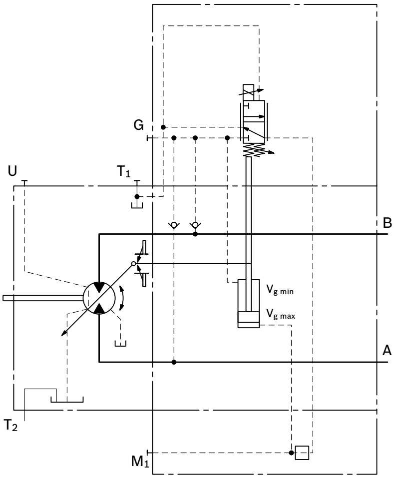
The spring return feature in the control part is not a safety device

The control part 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.

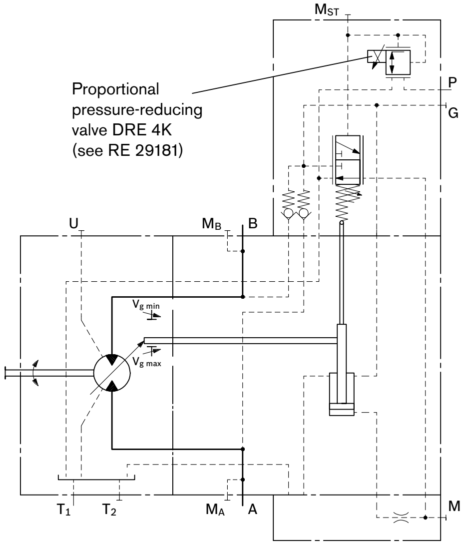
Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

EP – Proportional control electric

Schematic EP1, EP2
Sizes 28 to 200



Schematic EP1, EP2
Sizes 250 to 1000



3

EP – Proportional control electric

EP.D
Pressure control, fixed setting

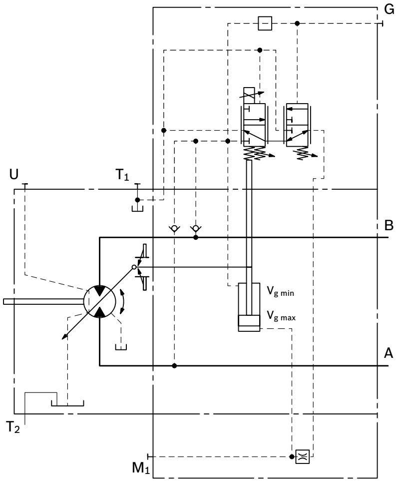
The pressure control overrides the EP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

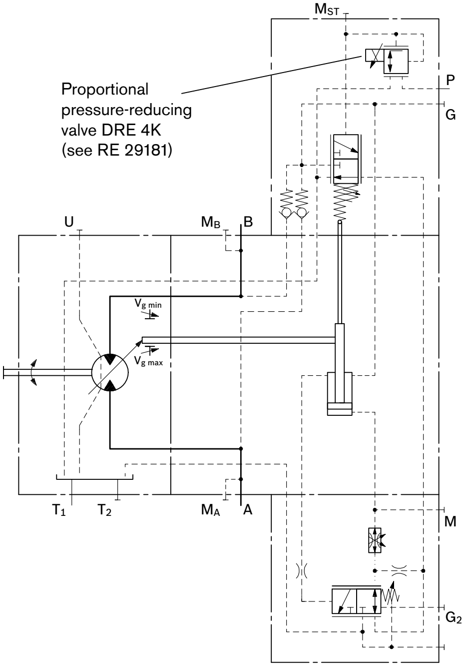
Setting range of the pressure control valve:

Sizes 28 to 200	80 to 400 bar
Sizes 250 to 1000	80 to 350 bar

Schematic EP.D
Sizes 28 to 200



Schematic EP.D
Sizes 250 to 1000



EP – Proportional control electric

EP.E
Pressure control, hydraulic override, two-point

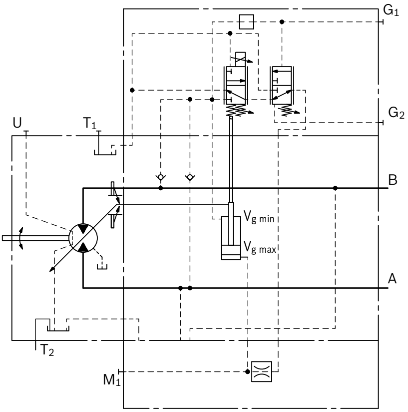
Sizes 28 to 200

The pressure control setting can be overridden by applying an external pilot pressure at port G_2, realizing a 2nd pressure setting.

Required pilot pressure at port G_2:
$p_{St} = 20$ to 50 bar

Please state the 2nd pressure setting in plain text when ordering.

Schematic EP.E



Sizes 250 to 1000 (EP.D)

Pressure control with 2nd pressure setting for EP.D provided as standard (see on page 16).

The pressure control setting can be overridden by applying an external pilot pressure at port G_2, realizing a 2nd pressure setting.

Required pilot pressure at port G_2:
$p_{St} \geq 100$ bar

Please state the 2nd pressure setting in plain text when ordering.

EP.G
Pressure control, remote control

Sizes 250 to 1000

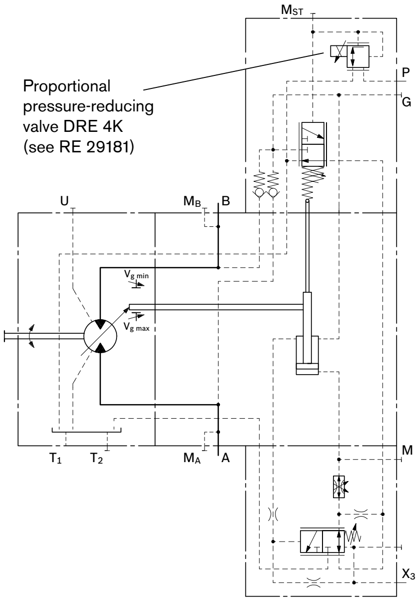
When the set pressure value is reached, the remote control pressure control continually regulates the motor to maximum displacement $V_{g\,max}$. A pressure-relief valve (not included in the delivery contents), which is located separately from the motor and which is connected to port X_3, assumes the task of controlling the internal pressure cut-off valve.

So long as the target pressure value has not been reached, pressure is evenly applied to the valve from both sides in addition to the force of the spring, and the valve remains closed. The target pressure value is between 80 bar and 350 bar. When the target pressure value is reached at the separate pressure-relief valve, this will open, reliving the pressure on the spring side to the reservoir. The internal control valve switches and the motor swivels to maximum displacement $V_{g\,max}$.
The differential pressure at the control valve is set as standard to 25 bar. As a separate pressure-relief valve, we recommend:

DBD 6 (hydraulic) as per RE 25402

The maximum line length should not exceed 2 m.

Schematic EP.G



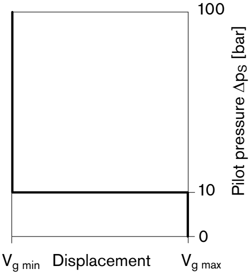
HZ – Two-point control hydraulic

The two-point hydraulic control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the pilot pressure at port X on or off.

– Position at $V_{g\,max}$ (without pilot pressure, maximum torque, minimum speed)

– Position at $V_{g\,min}$ (with pilot pressure > 10 bar activated, minimum torque, maximum permissible speed)

Characteristic HZ



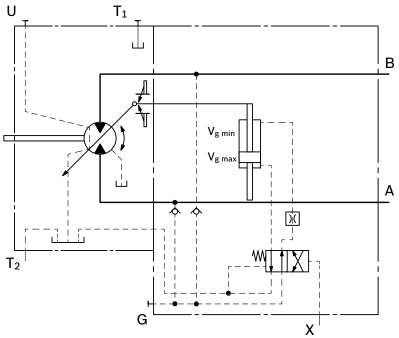
Note

– Maximum permissible pilot pressure: 100 bar

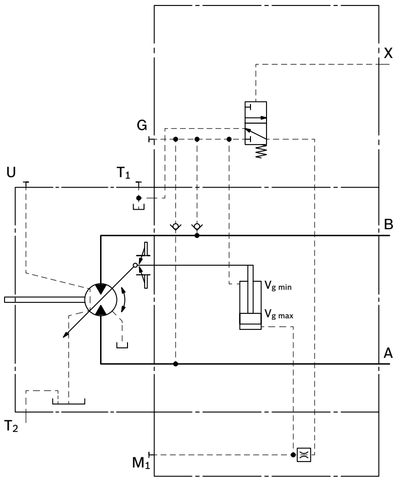
– The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 450 bar can occur at port G.

– A leakage flow of maximum 0.3 L/min is present at port X (operating pressure > pilot pressure). To avoid a build-up of pilot pressure, pressure is to be relieved from port X to the reservoir.

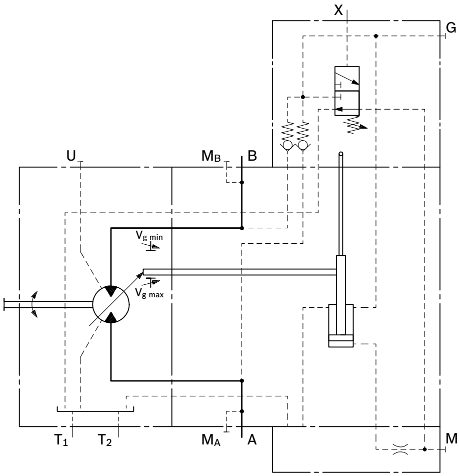
Schematic HZ3
Sizes 55 to 107



Schematic HZ1
Sizes 28, 140, 160, 200



Schematic HZ
Sizes 250 to 1000



EZ – Two-point control electric

The two-point electric control with switching solenoid (sizes 28 to 200) or control valve (sizes 250 to 1000) allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the electric current at the switching solenoid or control valve on or off.

Note
The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 450 bar can occur at port G.

Technical data, solenoid with Ø37
Sizes 28, 140, 160, 200

	EZ1	EZ2
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	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 page 70		

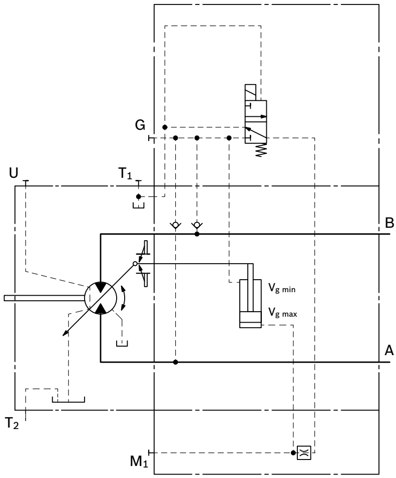
Technical data, solenoid with Ø45
Sizes 55 to 107

	EZ3	EZ4
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30W
Minimum required current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection see connector design page 70		

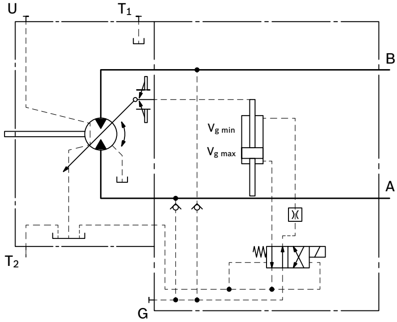
Technical data, control valve
Sizes 250 to 1000

	EZ1	EZ2
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	6 Ω	23 Ω
Nominal power	26 W	26W
Minimum required current	2 A	1.04 A
Duty cycle	100 %	100 %
Type of protection see connector design page 70		

Schematic EZ1, EZ2
Sizes 28, 140, 160, 200

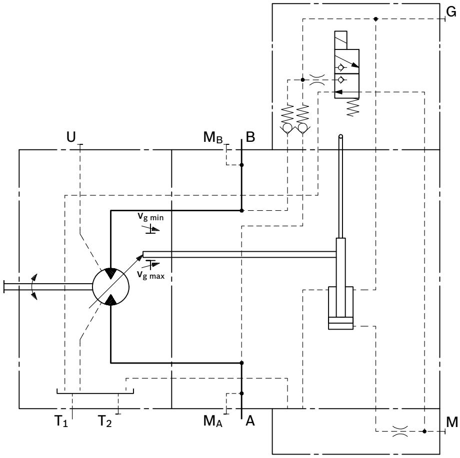


Schematic EZ3, EZ4
Sizes 55 to 107



EZ – Two-point control electric

Schematic EZ1, EZ2
Sizes 250 to 1000



HA – Automatic control high-pressure related

The automatic high-pressure related control adjusts the displacement automatically depending on the operating pressure.

The displacement of the A6VM motor with HA control is $V_{g\ min}$ (maximum speed and minimum torque). The control unit measures internally the operating pressure at A or B (no control line required) and upon reaching the beginning of control, the controller swivels the motor from $V_{g\ min}$ to $V_{g\ max}$ with increase of pressure. The displacement is modulated between $V_{g\ min}$ and $V_{g\ max}$, thereby depending on load conditions.

– Beginning of control at $V_{g\ min}$ (minimum torque, maximum speed)

– End of control at $V_{g\ max}$ (maximum torque, minimum speed)

Note

– For safety reasons, winch drives are not permissible with beginning of control at $V_{g\ min}$ (standard for HA).

– The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure $<$ 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 450 bar can occur at port G.

– The beginning of control and the HA characteristic are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 7) and thus a parallel shift of the characteristic. Only for HA1T (sizes 28 to 200) and HA1, HA2, HA.T, (sizes 250 to 1000).

– A leakage flow of maximum 0.3 L/min is present at port X (operating pressure $>$ pilot pressure). To avoid a build-up of pilot pressure, pressure is to be relieved from port X to the reservoir. **Only for control HA.T**.

3

HA – Automatic control high-pressure related

HA1
With minimum pressure increase

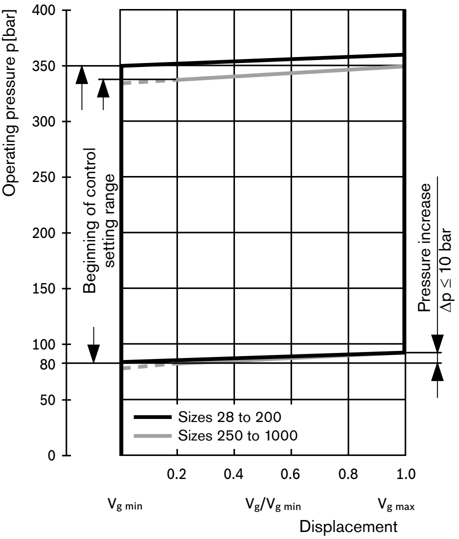
An operating pressure increase of $\Delta p \leq$ approx. 10 bar results in an increase in displacement from 0 cm^3 to $V_{g\,max}$ (sizes 28 to 200) or from 0.2 $V_{g\,max}$ to $V_{g\,max}$ (sizes 250 to 1000).

Beginning of control, setting range

Sizes 28 to 200	80 to 350 bar
Sizes 250 to 1000	80 to 340 bar

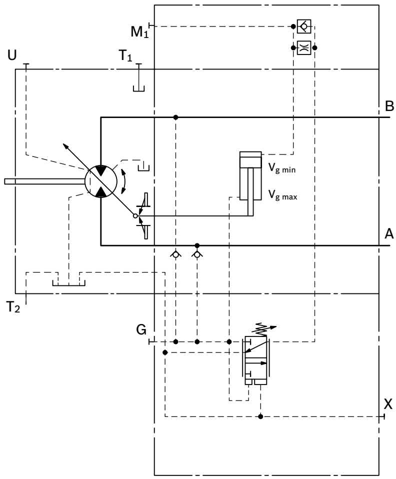
Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 300 bar.

Characteristic HA1

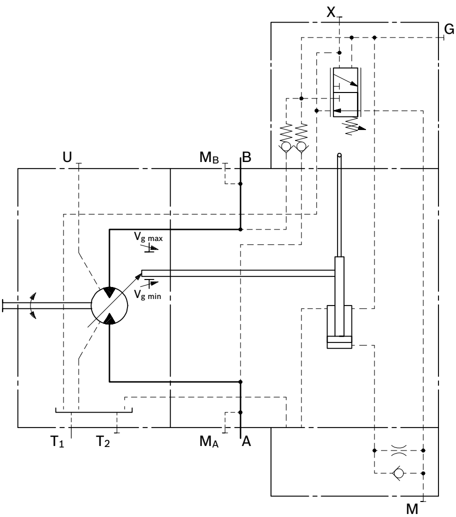


Schematic HA1

Sizes 28 to 200



Sizes 250 to 1000



HA – Automatic high-pressure related control

HA2
With pressure increase

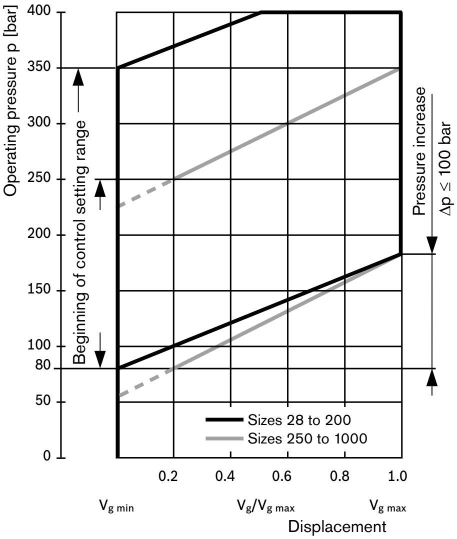
An operating pressure increase of Δp = approx. 100 bar results in an increase in displacement from 0 cm³ to $V_{g\,max}$ (sizes 28 to 200) or from 0.2 $V_{g\,max}$ to $V_{g\,max}$ (sizes 250 to 1000).

Beginning of control, setting range

Sizes 28 to 200	80 to 350 bar
Sizes 250 to 1000	80 to 250 bar

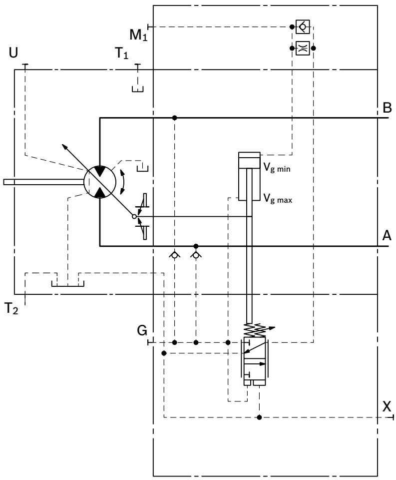
Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 200 bar.

Characteristic HA2

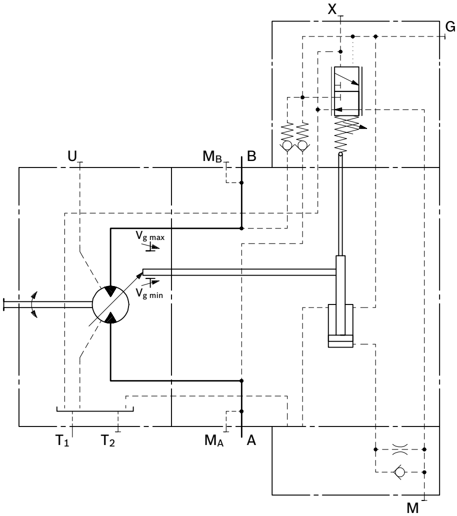


Schematic HA2

Sizes 28 to 200



Sizes 250 to 1000



HA – Automatic control high-pressure related

HA.T
Override hydraulic remote control, proportional

With the HA.T3 control, the beginning of control can be influenced by applying a pilot pressure to port X.

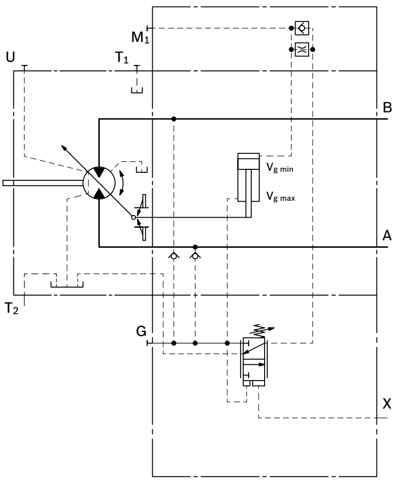
For each 1 bar of pilot pressure increase, the beginning of control is reduced by 17 bar (sizes 28 to 200) or 8 bar (sizes 250 to 1000).

Example (sizes 28 to 200):

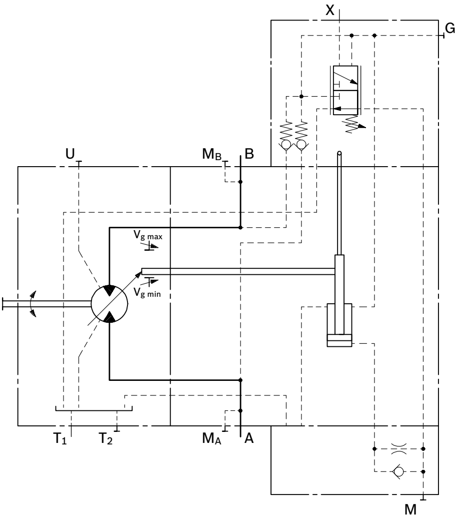
Beginning of control setting	300 bar	300 bar
Pilot pressure at port X	0 bar	10 bar
Beginning of control at	300 bar	130 bar

Note
Maximum permissible pilot pressure 100 bar.

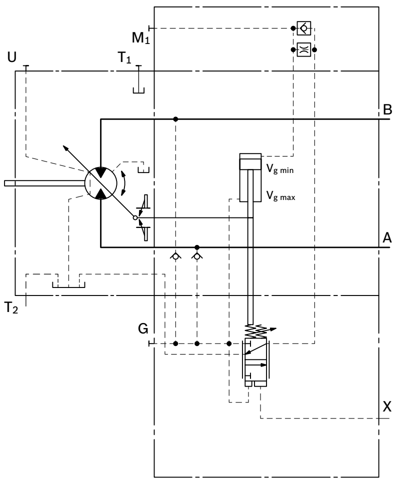
Schematic HA1.T
Sizes 28 to 200



Schematic HA1.T
Sizes 250 to 1000



Schematic HA2.T
Sizes 28 to 200



HA – Automatic control high-pressure related

HA.**U1**, HA.**U2**
Override electric two-point

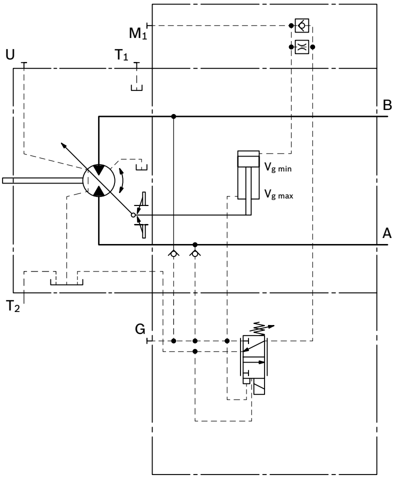
Sizes 28 to 200

With the HA.U1 or HA.U2 control, the beginning of control can be overridden by an electric signal to a switching solenoid. When the override solenoid is energized, the variable motor swivels to maximum swivel angle, without intermediate position. The beginning of control is adjustable between 80 and 300 bar (specify required setting in plain text when ordering).

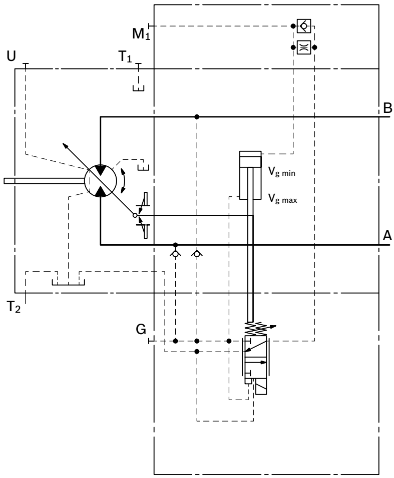
Technical data, solenoid with Ø45

	U1	U2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Displacement $V_{g\,max}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection see connector design page 70		

Schematic HA1U1, HA1U2



Schematic HA2U1, HA2U2



3

HA – Automatic control high-pressure related

HA.**R1**, HA.**R2**
Override electric,
travel direction valve electric (see page 29)

Sizes 28 to 200

With the HA.R1 or HA.R2 control, the beginning of control can be overridden by an electric signal to switching solenoid b. When the override solenoid b is energized, the variable motor swivels to maximum swivel angle, without intermediate position.

The travel direction valve ensures that the preselected pressure side of the hydraulic motor (A or B) is always connected to the HA control, and thus determines the swivel angle, even if the high-pressure side changes (e. g. -travel drive during a downhill operation). This thereby prevents undesired jerky deceleration and/or braking characteristics.

Depending on the direction of rotation (direction of travel), the travel direction valve is actuated through the pressure spring or the switching solenoid a (see page 29 for further details).

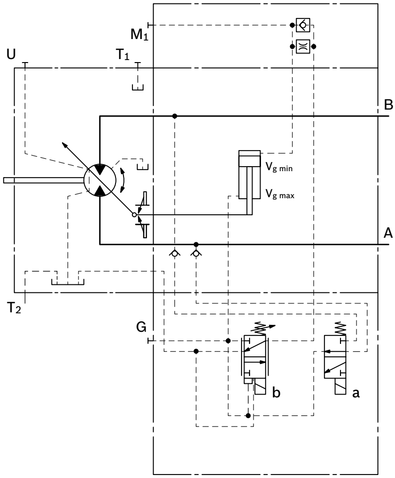
Technical data, solenoid a with Ø37
(travel direction valve)

		R1	R2
Voltage		12 V (±20 %)	24 V (±20 %)
No override		de-energized	de-energized
Direction of rotation	Operating pressure in		
ccw	B	energized	energized
cw	A	de-energized	de-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 page 70			

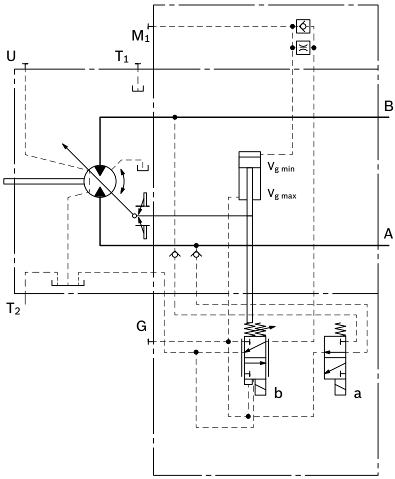
Technical data, solenoid b with Ø45
(electric override)

	R1	R2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Displacement $V_{g\ max}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection see connector design page 70		

Schematic HA1R1, HA1R2



Schematic HA2R1, HA2R2



DA – Automatic control speed-related

The variable motor A6VM with automatic speed-related control is intended for use in hydrostatic travel drives in combination with the variable pump A4VG with DA control.

A drive-speed-related pilot pressure signal is generated by the A4VG variable pump, and that signal, together with the operating pressure, regulates the swivel angle of the hydraulic motor.

Increasing pump speed, i.e. increasing pilot pressure, causes the motor to swivel to a smaller displacement (lower torque, higher speed), depending on the operating pressure.

If the operating pressure exceeds the pressure setpoint set on the controller, the variable motor swivels to a larger displacement (higher torque, lower speed).

Pressure ratio p_{St}/p_{HD}: 3/100, 5/100, 8/100

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 motor 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.

Detailed information is available from our sales department and on the Internet at www.boschrexroth.com/da-control.

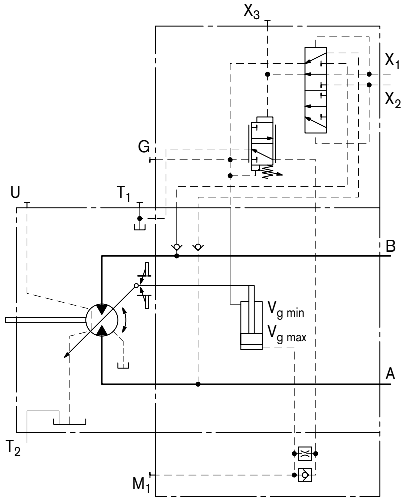
Note
The beginning of control and the DA characteristic are influenced by case pressure. An increase in case pressure causes a decrease in the beginning of control (see page 6) and thus a parallel shift of the characteristic.

DA, DA1, DA4
Hydraulic travel direction valve

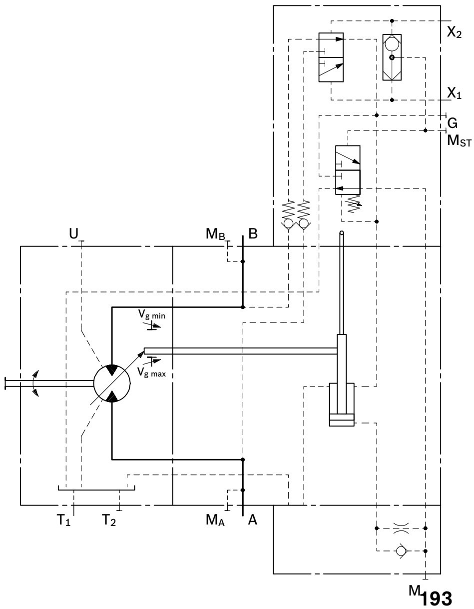
Dependent on the direction of rotation (travel direction), the travel direction valve is switched by using pilot pressures connections X_1 or X_2.

Direction of rotation	Operating pressure in	Pilot pressure in
cw	A	X_1
ccw	B	X_2

Schematic DA1, DA4
Sizes 28 to 200



Schematic DA
Sizes 250 to 1000



3

DA – Automatic control speed-related

DA2, DA3, DA5, DA6
Electric travel direction valve + electric $V_{g\,max}$-circuit

The travel direction valve is either spring offset or switched by energizing switching solenoid a, depending on the direction of rotation (travel direction).

When the switching solenoid b is energized, the DA control is overridden and the motor swivels to maximum displacement (high torque, lower speed) (electric $V_{g\,max}$-circuit).

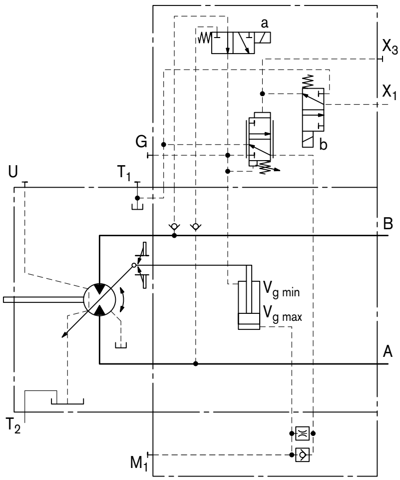
Technical data, solenoid a with Ø37
(travel direction valve)

		DA2, DA5	DA3, DA6
Voltage		12 V (±20 %)	24 V (±20 %)
Direction of rotation	Operating pressure in		
ccw	B	de-energized	de-energized
cw	A	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 page 70			

Technical data, solenoid b with Ø37
(electric override)

	DA2, DA5	DA3, DA6
Voltage	12 V (±20 %)	24 V (±20 %)
No override	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 page 70		

Schematic DA2, DA3, DA5, DA6
Sizes 28 to 200



Electric travel direction valve (for DA, HA.R)

Application in travel drives in closed circuits. The travel direction valve of the motor is actuated by an electric signal that also switches the swivel direction of the travel drive pump (e. g. A4VG with DA control valve).

If the pump in the closed circuit is switched to the neutral position or into reverse, the vehicle may experience jerky deceleration or braking, depending on the vehicle's mass and current travel speed.

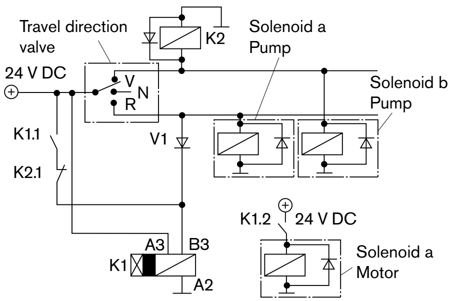
When the travel direction valve of the pump (e. g. 4/3-directional valve of the DA-control) is switched to

– the neutral position,
  the electric circuitry causes the previous signal on the travel direction valve on the motor to be retained.

– reversing,
  the electric circuitry causes the travel direction valve on the motor to switch to the other travel direction following a time delay (approx. 0.8 s) with respect to the pump.

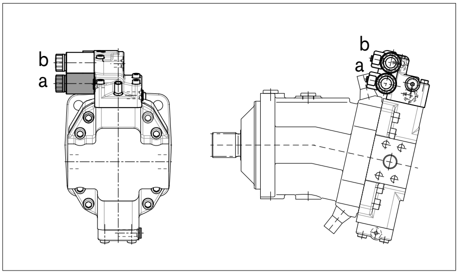
As a result, jerky deceleration or braking is prevented in both cases.

Schematic – electric travel direction valve

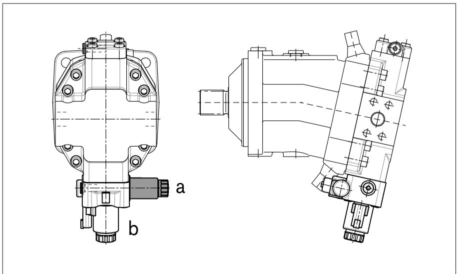


Note
The shown diodes and relays are not included in the delivery of the motor.

DA2, DA3, DA5, DA6 control (see page 28)



HA1R., HA2R. control (see page 26)



Switching solenoid a on the travel direction valve

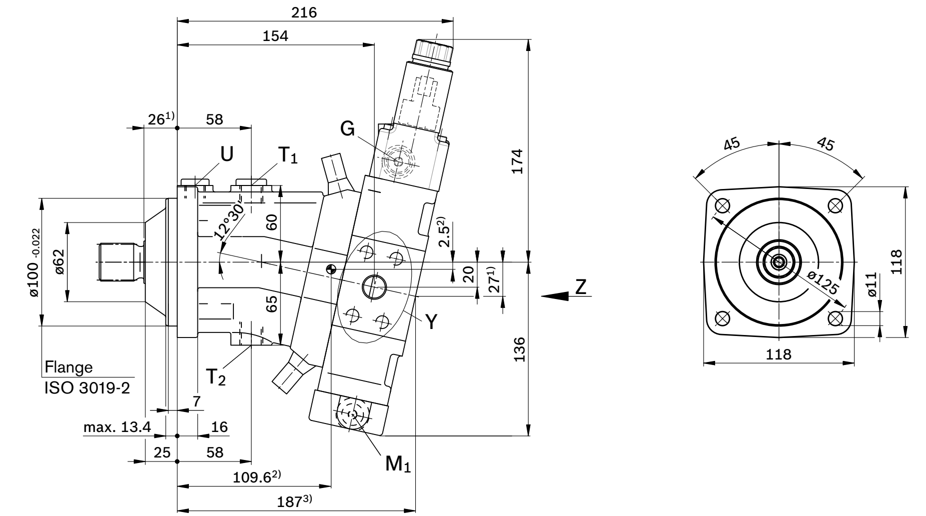
3

Dimensions size 28

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

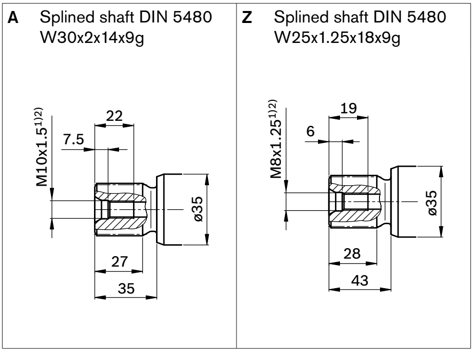
EP1, EP2 – Proportional control electric

Port plate 02 – SAE flange ports A and B at side, opposite

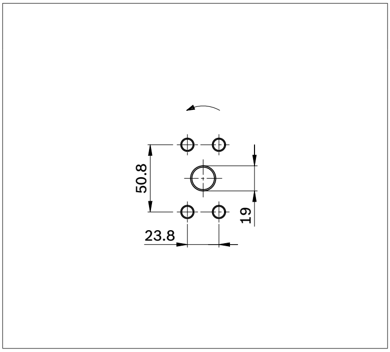


1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

Drive shafts



Service line port (detail Y)

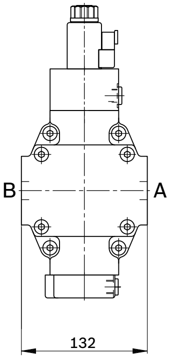
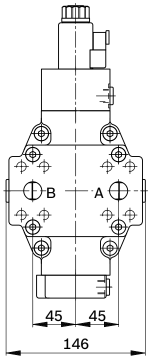


1) Observe the general instructions on page 80 for the maximum tightening torques.
2) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 28

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

Location of the service line ports on the port plates (view Z)

02 SAE flange ports A and B at side, opposite	**01** SAE flange ports A and B at rear
	

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 x 1.5; 17 deep	450	O
T_1	Drain line	DIN 3852[5]	M18 x 1.5; 12 deep	3	X[4]
T_2	Drain line	DIN 3852[5]	M18 x 1.5; 12 deep	3	O[4]
G	Synchronous control	DIN 3852[5]	M14 x 1.5; 12 deep	450	X
G_2	2nd pressure setting (HD.E, EP.E)	DIN 3852[5]	M14 x 1.5; 12 deep	100	X
U	Bearing flushing	DIN 3852[5]	M16 x 1.5; 12 deep	3	X
X	Pilot signal (HD, HZ, HA1T/HA2T)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
X	Pilot signal (HA1 and HA2)	DIN 3852[5]	M14 x 1.5; 12 deep	3	X
X_1, X_2	Pilot signal (DA1, DA4)	DIN 2353-CL	8B-ST	40	O
X_1	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852[5]	M14 x 1.5; 12 deep	40	O
X_3	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852[5]	M14 x 1.5; 12 deep	40	X
M_1	Measuring stroking chamber	DIN 3852[5]	M14 x 1.5; 12 deep	450	X

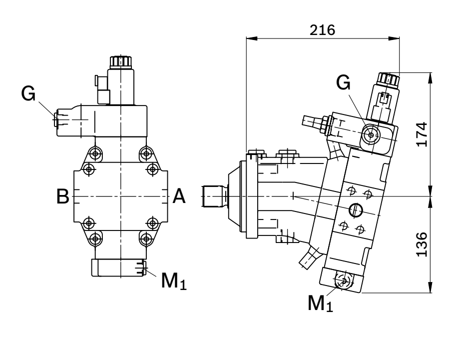
1) Observe the general instructions on page 80 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 79).
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 size 28

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

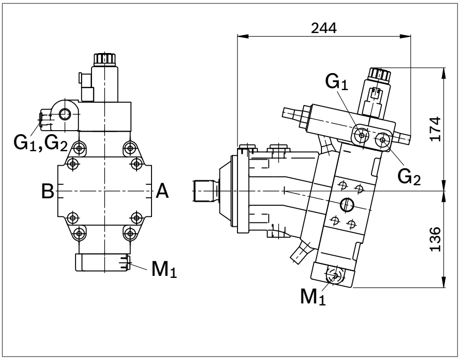
EP.D

Proportional control electric,
with pressure control fixed setting



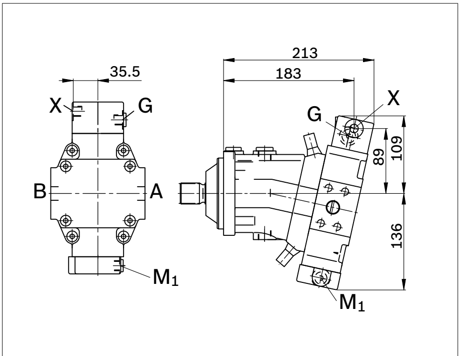
EP.E

Proportional control electric,
with pressure control hydraulic override, two-point



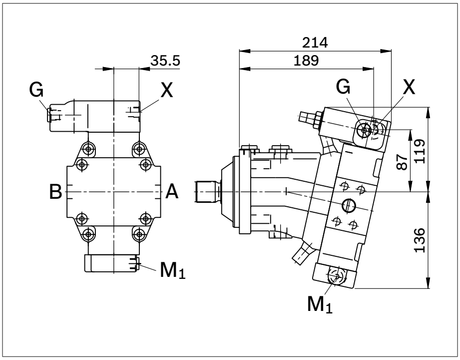
HD1, HD2

Proportional control hydraulic



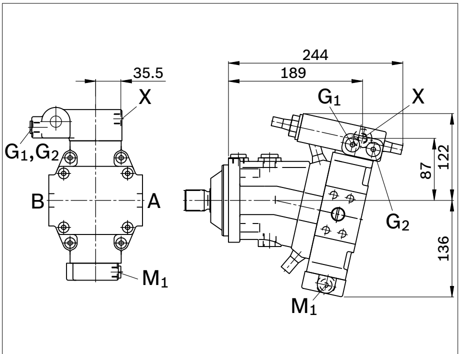
HD.D

Proportional control hydraulic,
with pressure control fixed setting



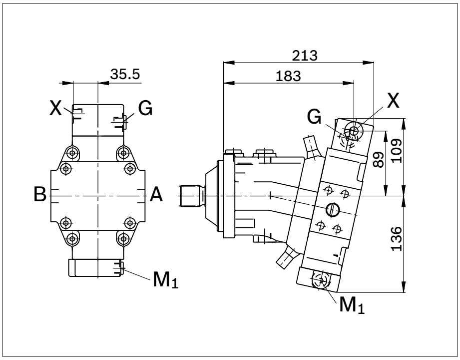
HD.E

Proportional control hydraulic,
with pressure control hydraulic override, two-point



HZ1

Two-point control hydraulic

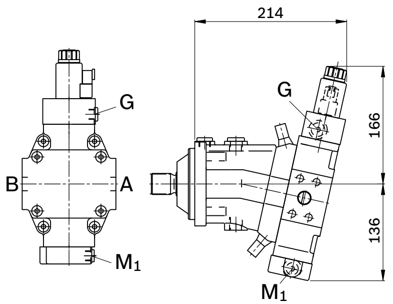


Dimensions size 28

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

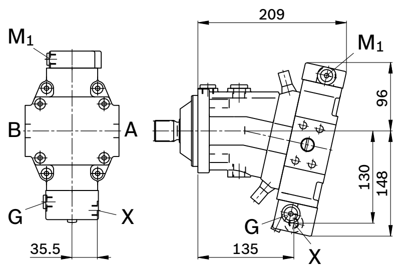
EZ1, EZ2

Two-point control electric



HA1, HA2 / HA1T, HA2T

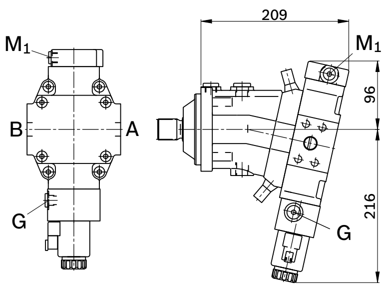
Automatic control high-pressure related,
with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

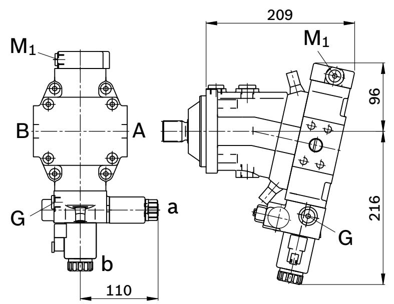
HA1U1, HA2U2

Automatic control high-pressure related,
with override electric, two-point



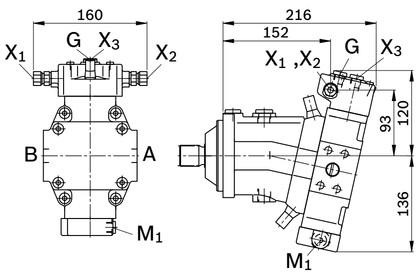
HA1R1, HA2R2

Automatic control high-pressure related,
with override electric and travel direction valve electric



DA1, DA4

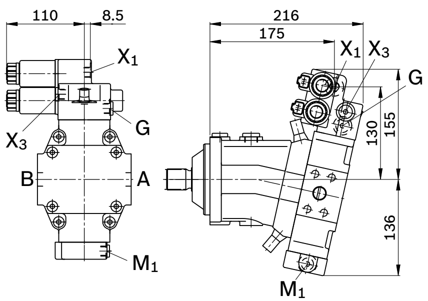
Automatic control speed related,
with hydraulic travel direction valve



X_1, X_2 pipe fitting 8B-ST according to DIN 2353-CL
Use installed fittings!

DA2, DA3, DA5, DA6

Automatic control speed related,
with electric travel direction valve and electric $V_{g\,max}$-circuit



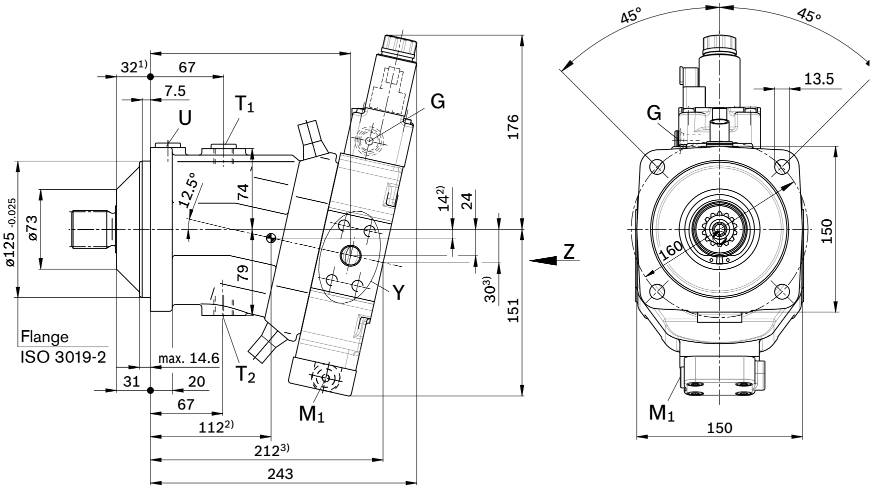
3

Dimensions size 55

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

EP1, EP2 – Proportional control electric

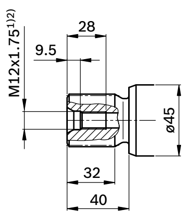
Port plate 02 – SAE flange ports A and B at side, opposite



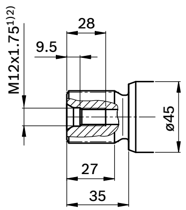
1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

Drive shafts

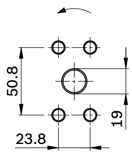
A Splined shaft DIN 5480 W35x2x16x9g



Z Splined shaft DIN 5480 W30x2x14x9g



Service line port (detail Y)



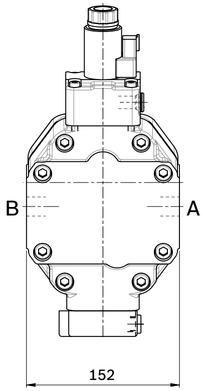
1) Observe the general instructions on page 80 for the maximum tightening torques.
2) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 55

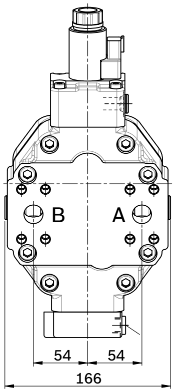
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

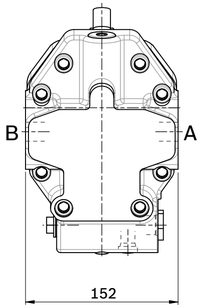
02 SAE flange ports
A and B at side,
opposite



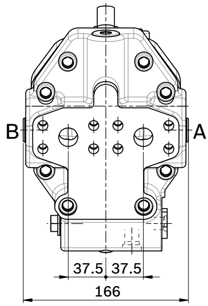
01 SAE flange ports
A and B at rear



02 SAE flange port
A and B at side,
opposite
only HZ3, EZ3, EZ4



01 SAE flange port
A and B at rear
only HZ3, EZ4, EZ4



3

Ports

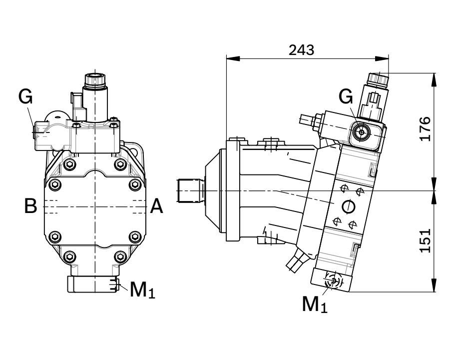
Designation	Port for	Standard	Size1)	Maximum pressure [bar]2)	State6)
A, B	Service line Fastening thread A/B	SAE J518 3) DIN 13	3/4 in M10 x 1.5; 17 deep	450	O
T_1	Drain line	DIN 3852 5)	M18 x 1.5; 12 deep	3	X 4)
T_2	Drain line	DIN 3852 5)	M18 x 1.5; 12 deep	3	O 4)
G	Synchronous control	DIN 3852 5)	M14 x 1.5; 12 deep	450	X
G_2	2nd pressure setting (HD.E, EP.E)	DIN 3852 5)	M14 x 1.5; 12 deep	100	X
U	Bearing flushing	DIN 3852 5)	M18 x 1.5; 12 deep	3	X
X	Pilot signal (HD, HZ, HA1T/HA2T)	DIN 3852 5)	M14 x 1.5; 12 deep	100	O
X	Pilot signal (HA1 and HA2)	DIN 3852 5)	M14 x 1.5; 12 deep	3	X
X_1, X_2	Pilot signal (DA1, DA4)	DIN 2353-CL	8B-ST	40	O
X_1	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852 5)	M14 x 1.5; 12 deep	40	O
X_3	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852 5)	M14 x 1.5; 12 deep	40	X
M_1	Measuring stroking chamber	DIN 3852 5)	M14 x 1.5; 12 deep	450	X

1) Observe the general instructions on page 80 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 79).
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)

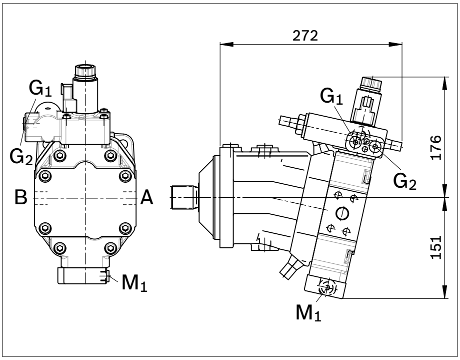
Dimensions size 55

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

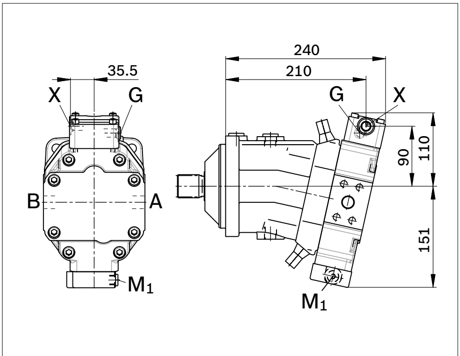
EP.D
Proportional control electric,
with pressure control fixed setting



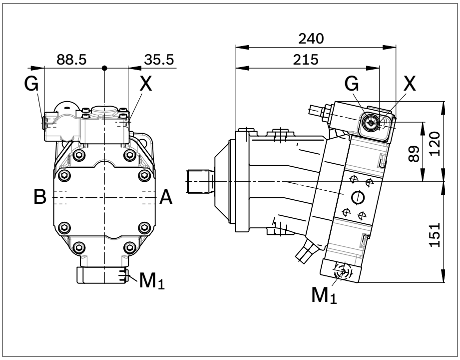
EP.E
Proportional control electric,
with pressure control hydraulic override, two-point



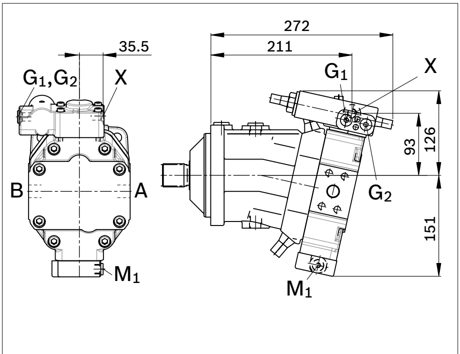
HD1, HD2
Proportional control hydraulic



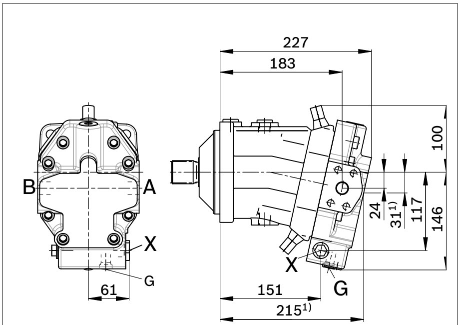
HD.D
Proportional control hydraulic,
with pressure control fixed setting



HD.E
Proportional control hydraulic,
with pressure control hydraulic override, two-point



HZ3
Two-point control hydraulic



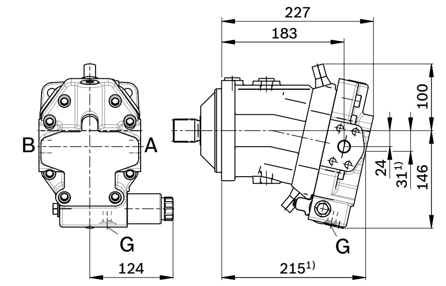
1) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 55

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

EZ3, EZ4

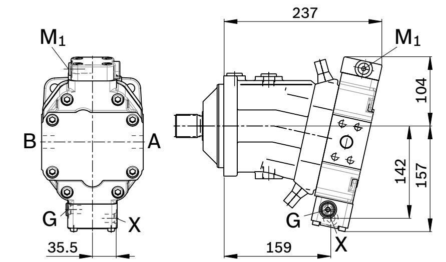
Two-point control electric



1) Port plate 1 – SAE flange ports A and B at rear

HA1, HA2 / HA1T, HA2T

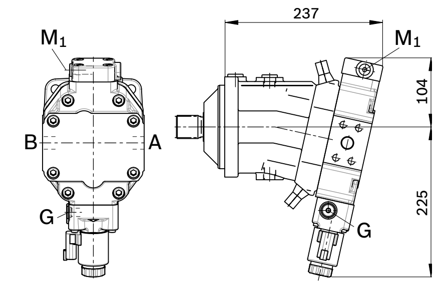
Automatic control high-pressure related,
with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

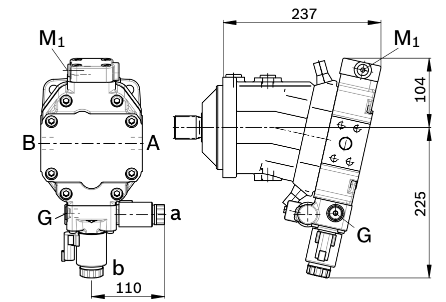
HA1U1, HA2U2

Automatic control high-pressure related,
with override electric, two-point



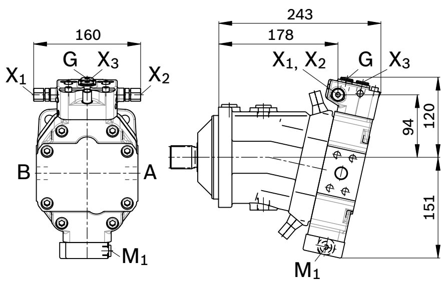
HA1R1, HA2R2

Automatic control high-pressure related,
with override electric and travel direction valve electric



DA1, DA4

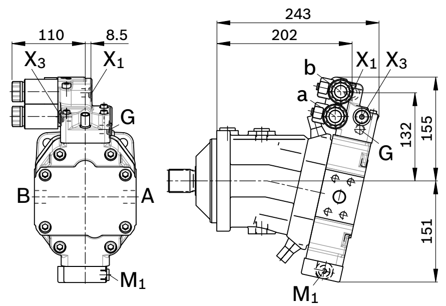
Automatic control speed related,
with hydraulic travel direction valve



X_1, X_2 pipe fitting 8B-ST according to DIN 2353-CL
Use installed fittings!

DA2, DA3, DA5, DA6

Automatic control speed related,
with electric travel direction valve and electric $V_{g\,max}$-circuit



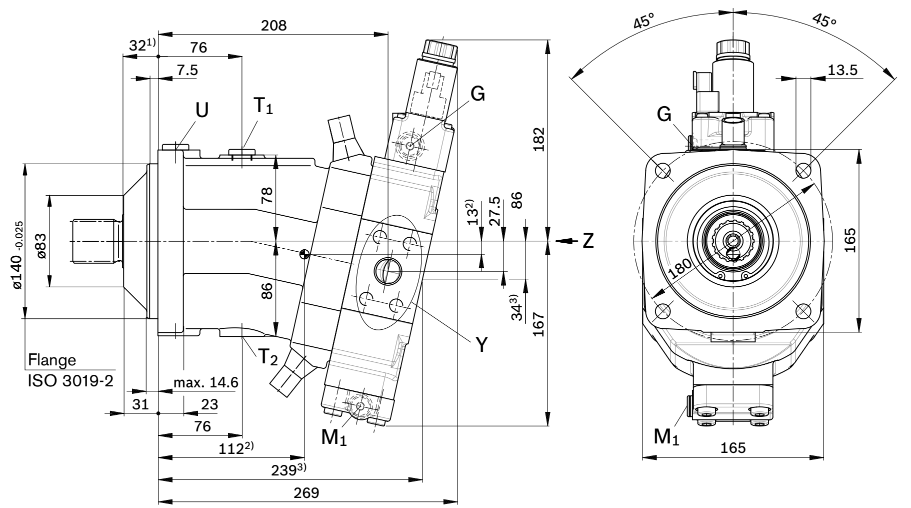
3

Dimensions size 80

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

EP1, EP2 – Proportional control electric

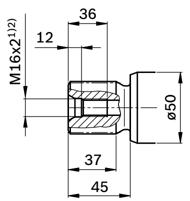
Port plate 02 – SAE flange ports A and B at side, opposite



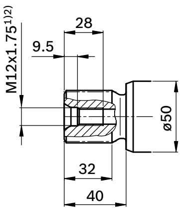
1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

Drive shafts

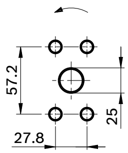
A Splined shaft DIN 5480 W40x2x18x9g



Z Splined shaft DIN 5480 W35x2x16x9g



Service line port (detail Y)



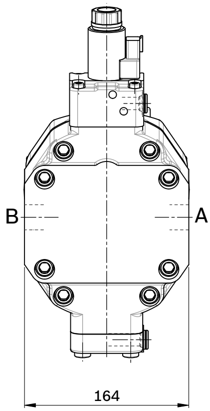
1) Observe the general instructions on page 80 for the maximum tightening torques.
2) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 80

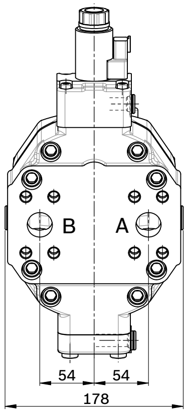
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

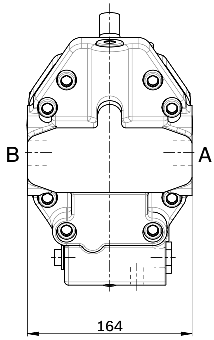
02 SAE flange ports A and B at side, opposite



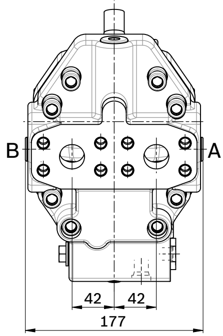
01 SAE flange ports A and B at rear



02 SAE flange port A and B at side, opposite only HZ3, EZ3, EZ4



01 SAE flange port A and B at rear only HZ3, EZ3, EZ4



Ports

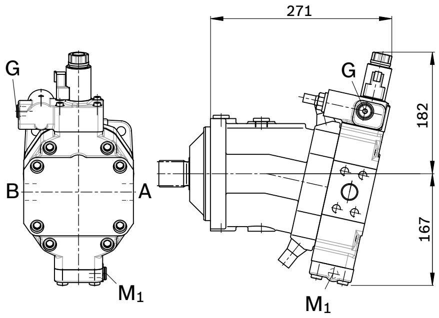
Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	450	O
T_1	Drain line	DIN 3852[5]	M18 x 1.5; 12 deep	3	X[4]
T_2	Drain line	DIN 3852[5]	M18 x 1.5; 12 deep	3	O[4]
G	Synchronous control	DIN 3852[5]	M14 x 1.5; 12 deep	450	X
G_2	2nd pressure setting (HD.E, EP.E)	DIN 3852[5]	M14 x 1.5; 12 deep	100	X
U	Bearing flushing	DIN 3852[5]	M18 x 1.5; 12 deep	3	X
X	Pilot signal (HD, HZ, HA1T/HA2T)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
X	Pilot signal (HA1 and HA2)	DIN 3852[5]	M14 x 1.5; 12 deep	3	X
X_1, X_2	Pilot signal (DA1, DA4)	DIN 2353-CL	8B-ST	40	O
X_1	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852[5]	M14 x 1.5; 12 deep	40	O
X_3	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852[5]	M14 x 1.5; 12 deep	40	X
M_1	Measuring stroking chamber	DIN 3852[5]	M14 x 1.5; 12 deep	450	X

1) Observe the general instructions on page 80 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 79).
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)

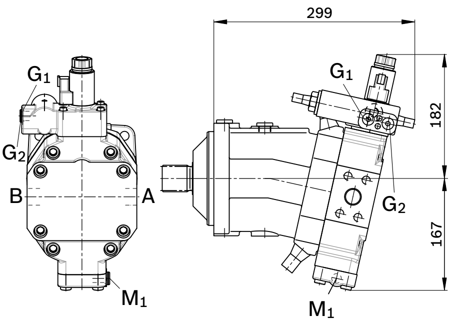
Dimensions size 80

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

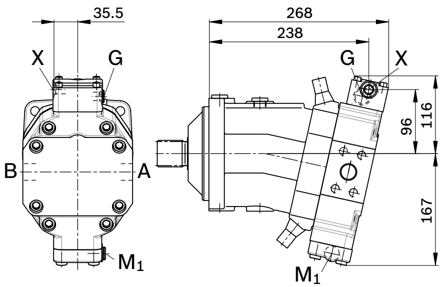
EP.D
Proportional control electric,
with pressure control fixed setting



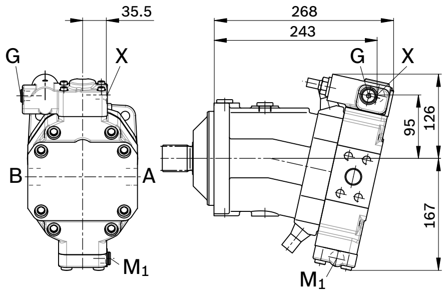
EP.E
Proportional control electric,
with pressure control hydraulic override, two-point



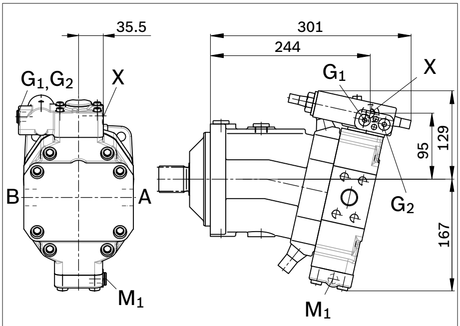
HD1, HD2
Proportional control hydraulic



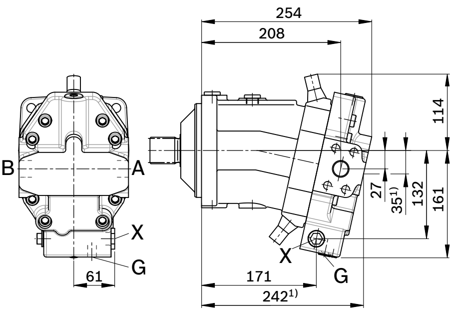
HD.D
Proportional control hydraulic,
with pressure control fixed setting



HD.E
Proportional control hydraulic,
with pressure control hydraulic override, two-point



HZ3
Two-point control hydraulic



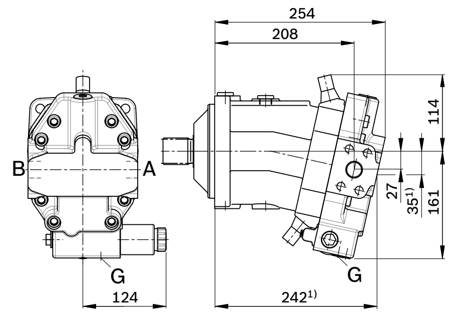
1) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 80

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

EZ3, EZ4

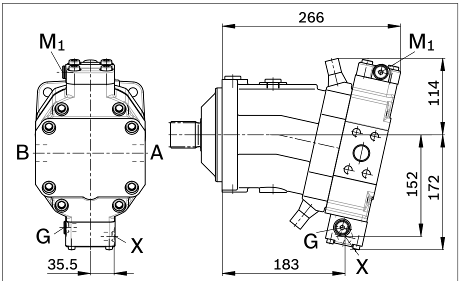
Two-point control electric



1) Port plate 1 – SAE flange ports A and B at rear

HA1, HA2 / HA1T, HA2T

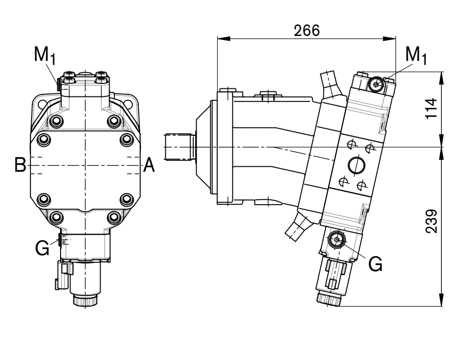
Automatic control high-pressure related, with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

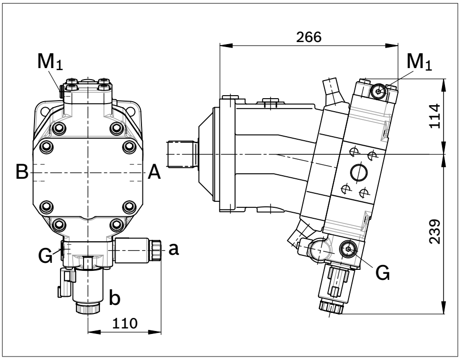
HA1U1, HA2U2

Automatic control high-pressure related, with override electric, two-point



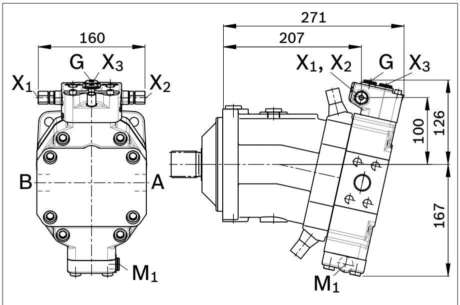
HA1R1, HA2R2

Automatic control high-pressure related, with override electric and travel direction valve electric



DA1, DA4

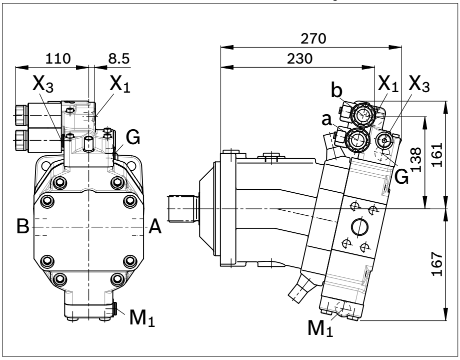
Automatic control speed related, with hydraulic travel direction valve



X_1, X_2 pipe fitting 8B-ST according to DIN 2353-CL
Use installed fittings!

DA2, DA3, DA5, DA6

Automatic control speed related, with electric travel direction valve and electric $V_{g\ max}$-circuit



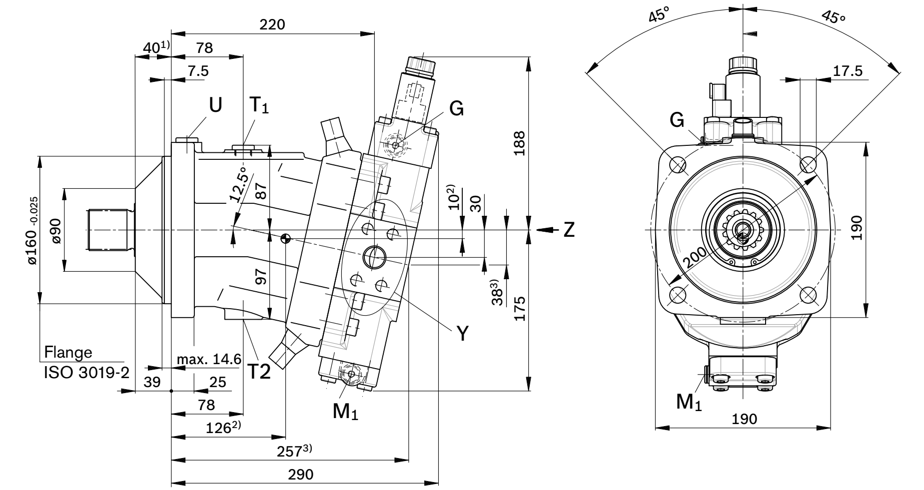
3

Dimensions size 107

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

EP1, EP2 – Proportional control electric

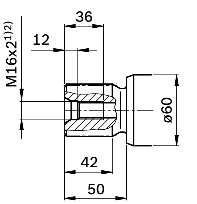
Port plate 02 – SAE-SAE flange ports A and B at side, opposite



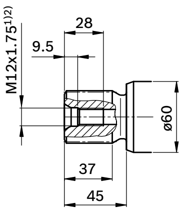
1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

Drive shafts

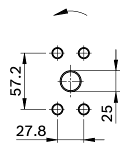
A Splined shaft DIN 5480 W45x2x21x9g



Z Splined shaft DIN 5480 W40x2x18x9g



Service line port (detail Y)



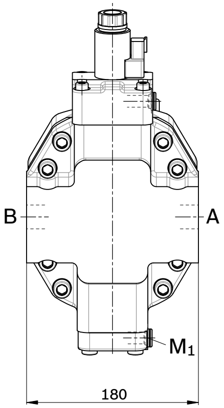
1) Observe the general instructions on page 80 for the maximum tightening torques.
2) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 107

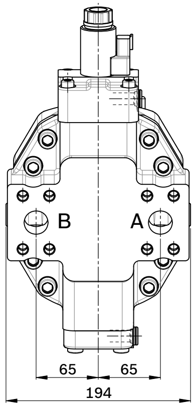
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

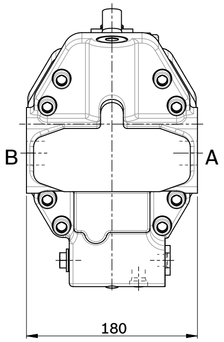
02 SAE flange ports A and B at side, opposite



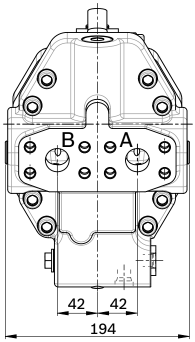
01 SAE flange ports A and B at rear



02 SAE flange port A and B at side, opposite only HZ3, EZ3, EZ4



01 SAE flange port A and B at rear only HZ3, EZ3, EZ4



Ports

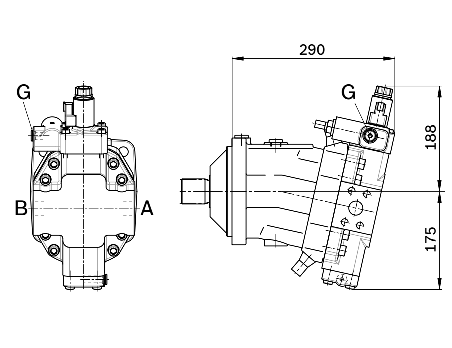
Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	450	O
T_1	Drain line	DIN 3852[5]	M18 x 1.5; 12 deep	3	X[4]
T_2	Drain line	DIN 3852[5]	M18 x 1.5; 12 deep	3	O[4]
G	Synchronous control	DIN 3852[5]	M14 x 1.5; 12 deep	450	X
G_2	2nd pressure setting (HD.E, EP.E)	DIN 3852[5]	M14 x 1.5; 12 deep	100	X
U	Bearing flushing	DIN 3852[5]	M18 x 1.5; 12 deep	3	X
X	Pilot signal (HD, HZ, HA1T/HA2T)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
X	Pilot signal (HA1 and HA2)	DIN 3852[5]	M14 x 1.5; 12 deep	3	X
X_1, X_2	Pilot signal (DA1, DA4)	DIN 2353-CL	8B-ST	40	O
X_1	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852[5]	M14 x 1.5; 12 deep	40	O
X_3	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852[5]	M14 x 1.5; 12 deep	40	X
M_1	Measuring stroking chamber	DIN 3852[5]	M14 x 1.5; 12 deep	450	X

1) Observe the general instructions on page 80 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 79).
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)

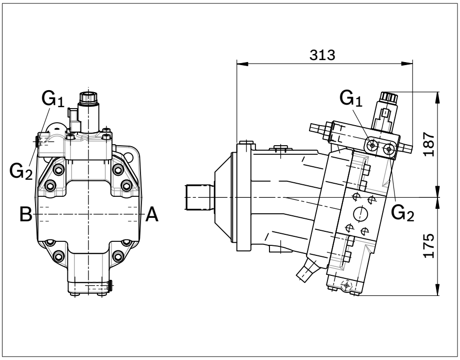
Dimensions size 107

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

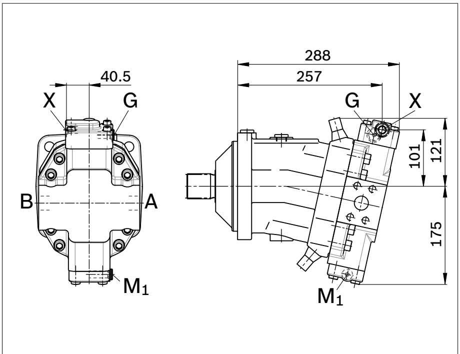
EP.D
Proportional control electric,
with pressure control fixed setting



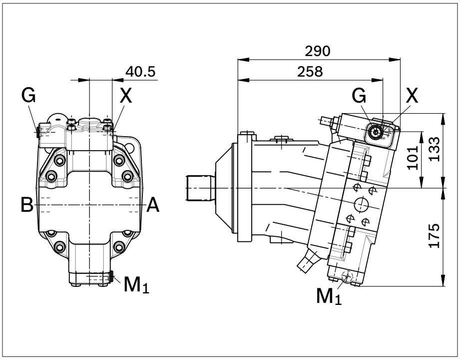
EP.E
Proportional control electric,
with pressure control hydraulic override, two-point



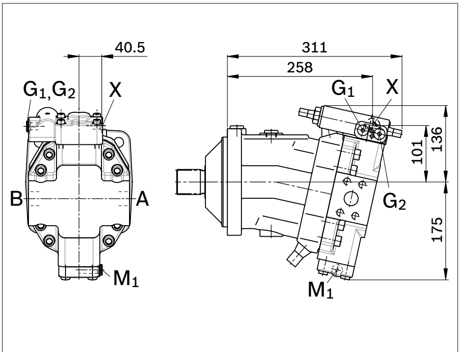
HD1, HD2
Proportional control hydraulic



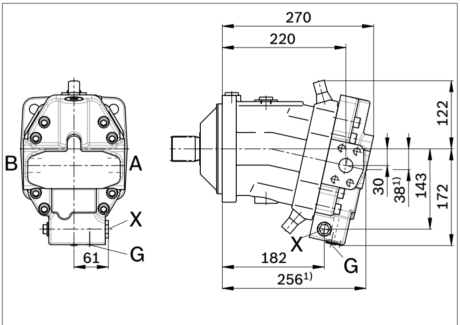
HD.D
Proportional control hydraulic,
with pressure control fixed setting



HD.E
Proportional control hydraulic,
with pressure control hydraulic override, two-point



HZ3
Two-point control hydraulic



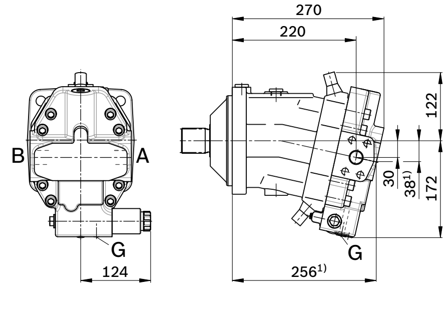
1) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 107

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

EZ3, EZ4

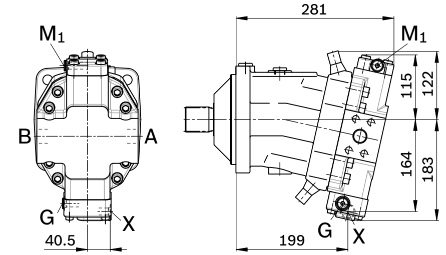
Two-point control electric



1) Port plate 1 – SAE flange ports A and B at rear

HA1, HA2 / HA1T, HA2T

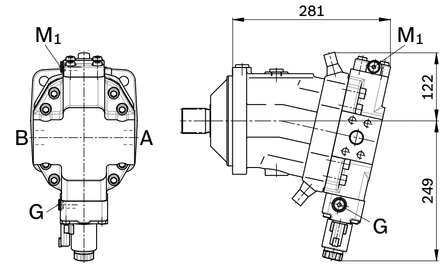
Automatic control high-pressure related, with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

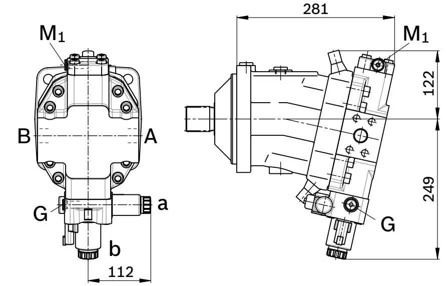
HA1U1, HA2U2

Automatic control high-pressure related, with override electric, two-point



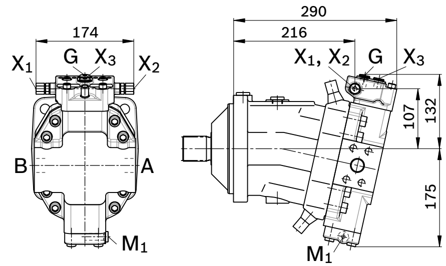
HA1R1, HA2R2

Automatic control high-pressure related, with override electric and travel direction valve electric



DA1, DA4

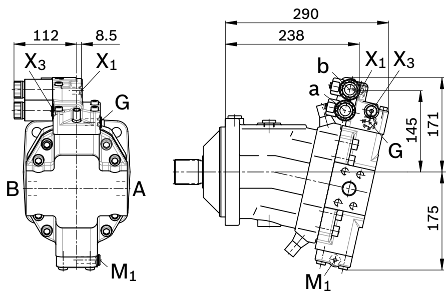
Automatic control speed related, with hydraulic travel direction valve



X_1, X_2 pipe fitting 8B-ST according to DIN 2353-CL
Use installed fittings!

DA2, DA3, DA5, DA6

Automatic control speed related, with electric travel direction valve and electric $V_{g\,max}$-circuit



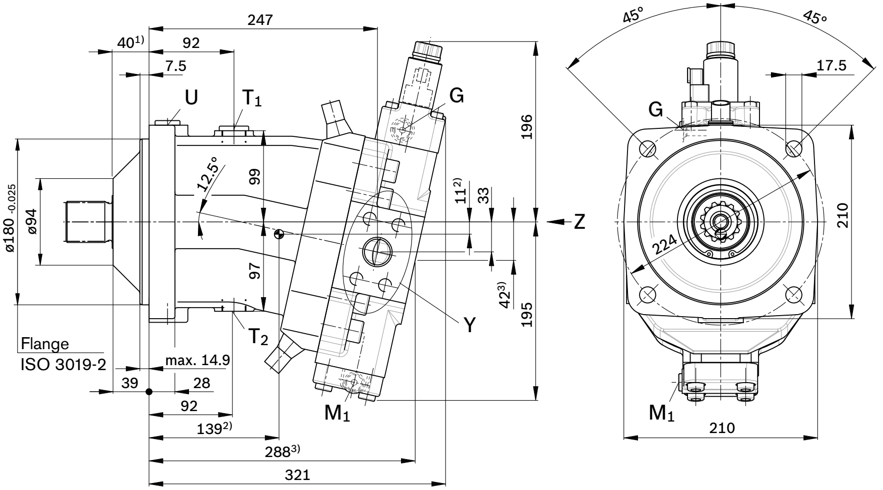
3

Dimensions size 140

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

EP1, EP2 – Proportional control electric

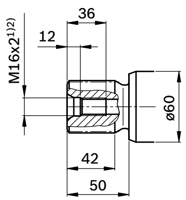
Port plate 02 – SAE flange ports A and B at side, opposite



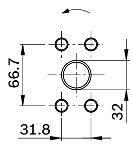
1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

Drive shaft

Z Splined shaft DIN 5480 W45x2x21x9g



Service line port (detail Y)



1) Observe the general instructions on page 80 for the maximum tightening torques.
2) Center bore according to DIN 332 (thread according to DIN 13)

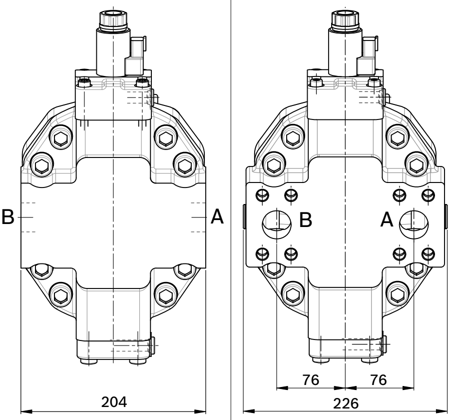
Dimensions size 140

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

Location of the service line ports on the port plates (view Z)

02 SAE flange ports A and B at side, opposite

01 SAE flange ports A and B at rear



Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	450	O
T_1	Drain line	DIN 3852[5]	M26 x 1.5; 16 deep	3	X[4]
T_2	Drain line	DIN 3852[5]	M26 x 1.5; 16 deep	3	O[4]
G	Synchronous control	DIN 3852[5]	M14 x 1.5; 12 deep	450	X
G_2	2nd pressure setting (HD.E, EP.E)	DIN 3852[5]	M14 x 1.5; 12 deep	100	X
U	Bearing flushing	DIN 3852[5]	M22 x 1.5; 14 deep	3	X
X	Pilot signal (HD, HZ, HA1T/HA2T)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
X	Pilot signal (HA1 and HA2)	DIN 3852[5]	M14 x 1.5; 12 deep	3	X
X_1, X_2	Pilot signal (DA1, DA4)	DIN 2353-CL	8B-ST	40	O
X_1	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852[5]	M14 x 1.5; 12 deep	40	O
X_3	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852[5]	M14 x 1.5; 12 deep	40	X
M_1	Measuring stroking chamber	DIN 3852[5]	M14 x 1.5; 12 deep	450	X

1) Observe the general instructions on page 80 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 79).
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)

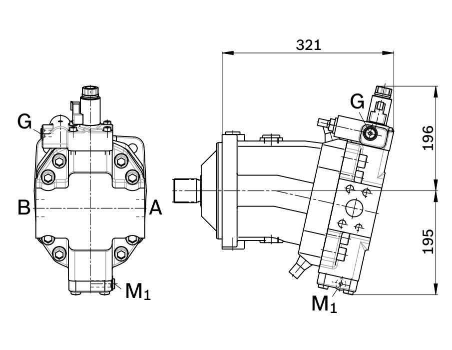
3

Dimensions size 140

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

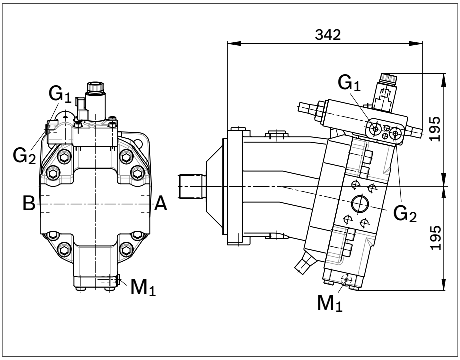
EP.D

Proportional control electric, with pressure control fixed setting



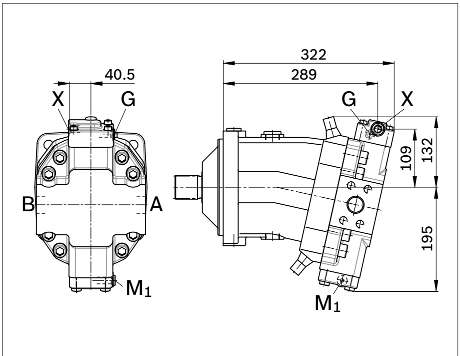
EP.E

Proportional control electric, with pressure control hydraulic override, two-point



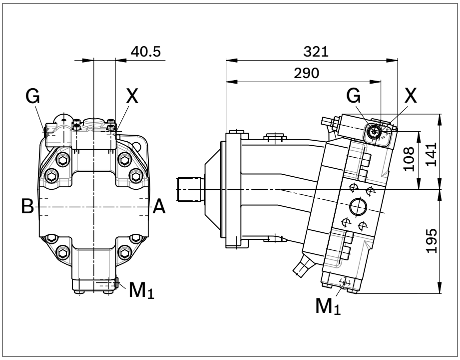
HD1, HD2

Proportional control hydraulic



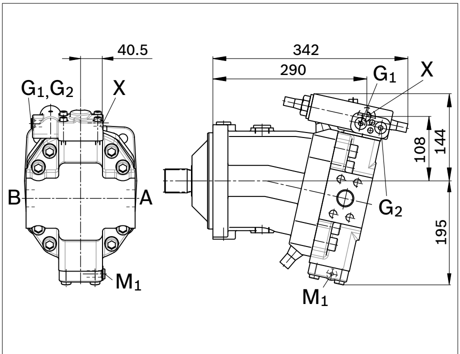
HD.D

Proportional control hydraulic, with pressure control fixed setting



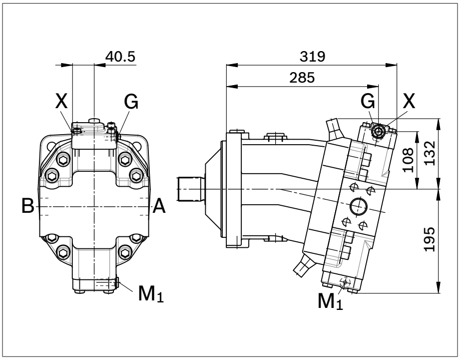
HD.E

Proportional control hydraulic, with pressure control hydraulic override, two-point



HZ1

Two-point control hydraulic

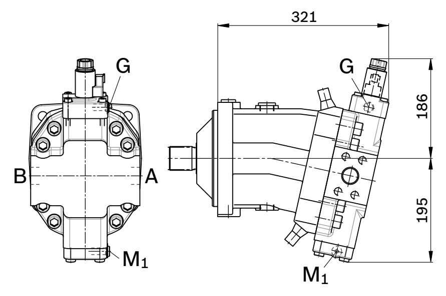


Dimensions size 140

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

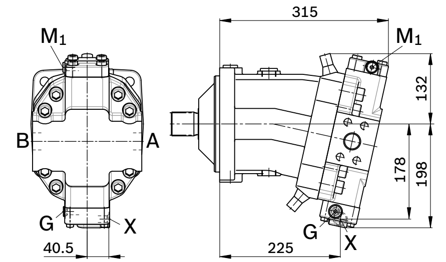
EZ1, EZ2

Two-point control electric



HA1, HA2 / HA1T, HA2T

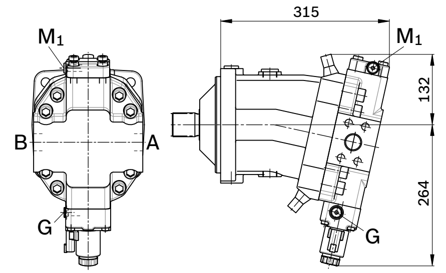
Automatic control high-pressure related, with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

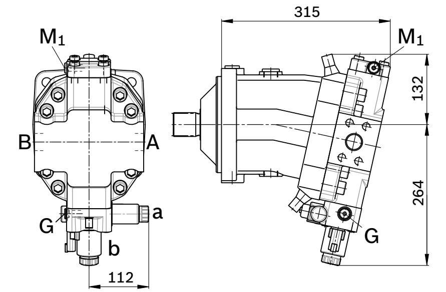
HA1U1, HA2U2

Automatic control high-pressure related, with override electric, two-point



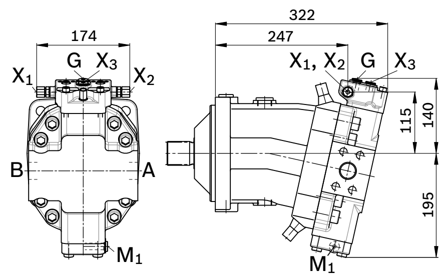
HA1R1, HA2R2

Automatic control high-pressure related, with override electric and travel direction valve electric



DA1, DA4

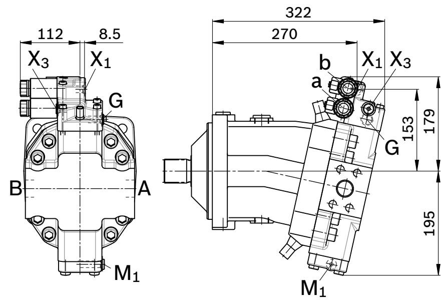
Automatic control speed related, with hydraulic travel direction valve



X_1, X_2 pipe fitting 8B-ST according to DIN 2353-CL
Use installed fittings!

DA2, DA3, DA5, DA6

Automatic control speed related, with electric travel direction valve and electric $V_{g\,max}$-circuit



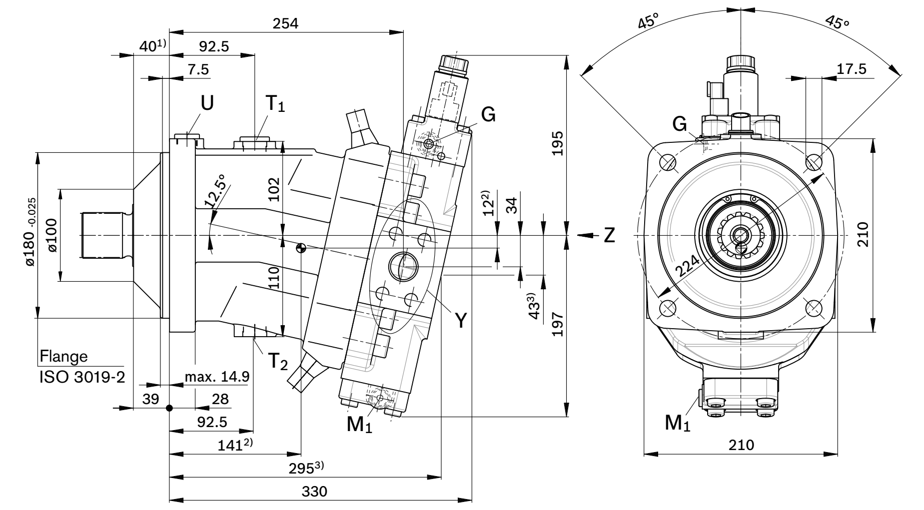
3

Dimensions size 160

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

EP1, EP2 – Proportional control electric

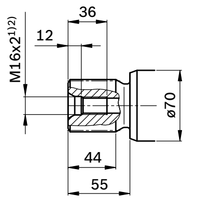
Port plate 02 – SAE-SAE flange ports A and B at side, opposite



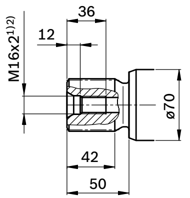
1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

Drive shafts

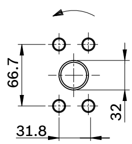
A Splined shaft DIN 5480 W50x2x24x9g



Z Splined shaft DIN 5480 W45x2x21x9g



Service line port (detail Y)

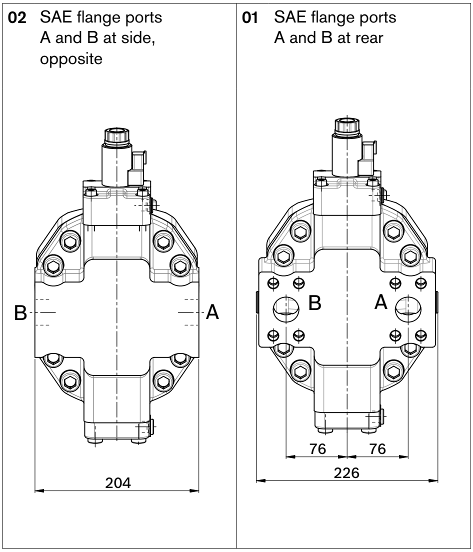


1) Observe the general instructions on page 80 for the maximum tightening torques.
2) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 160

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

Location of the service line ports on the port plates (view Z)



Ports

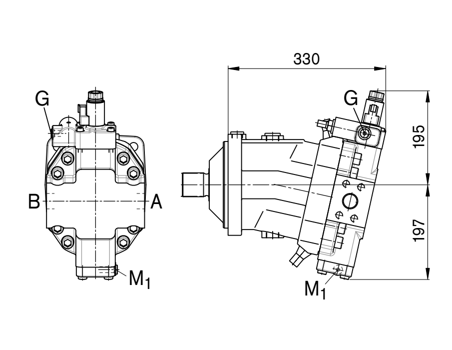
Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	450	O
T_1	Drain line	DIN 3852[5]	M26 x 1.5; 16 deep	3	X[4]
T_2	Drain line	DIN 3852[5]	M26 x 1.5; 16 deep	3	O[4]
G	Synchronous control	DIN 3852[5]	M14 x 1.5; 12 deep	450	X
G_2	2nd pressure setting (HD.E, EP.E)	DIN 3852[5]	M14 x 1.5; 12 deep	100	X
U	Bearing flushing	DIN 3852[5]	M22 x 1.5; 14 deep	3	X
X	Pilot signal (HD, HZ, HA1T/HA2T)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
X	Pilot signal (HA1 and HA2)	DIN 3852[5]	M14 x 1.5; 12 deep	3	X
X_1, X_2	Pilot signal (DA1, DA4)	DIN 2353-CL	8B-ST	40	O
X_1	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852[5]	M14 x 1.5; 12 deep	40	O
X_3	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852[5]	M14 x 1.5; 12 deep	40	X
M_1	Measuring stroking chamber	DIN 3852[5]	M14 x 1.5; 12 deep	450	X

1) Observe the general instructions on page 80 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 79).
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)

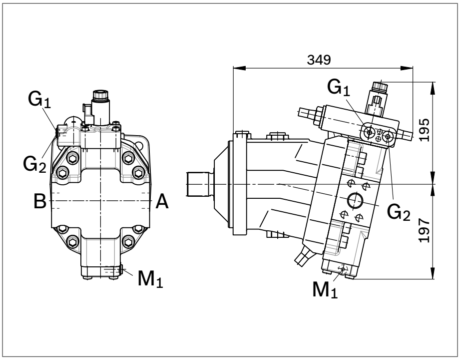
Dimensions size 160

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

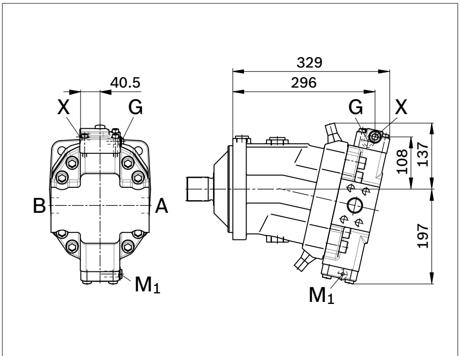
EP.D
Proportional control electric,
with pressure control fixed setting



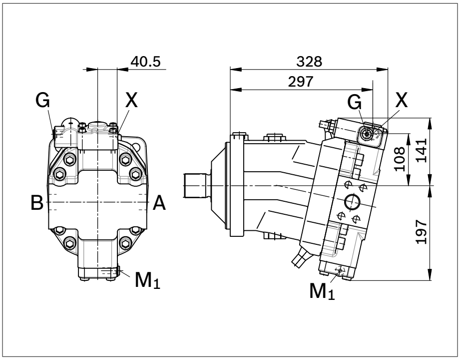
EP.E
Proportional control electric,
with pressure control hydraulic override, two-point



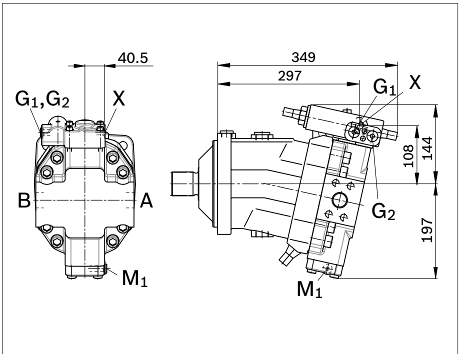
HD1, HD2
Proportional control hydraulic



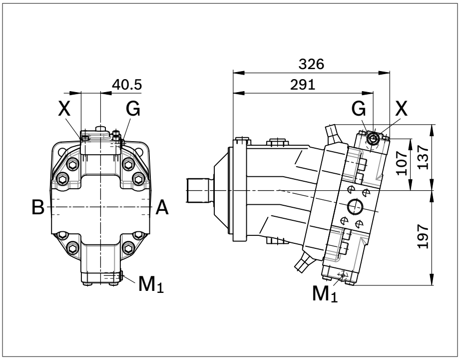
HD.D
Proportional control hydraulic,
with pressure control fixed setting



HD.E
Proportional control hydraulic,
with pressure control hydraulic override, two-point



HZ1
Two-point control hydraulic

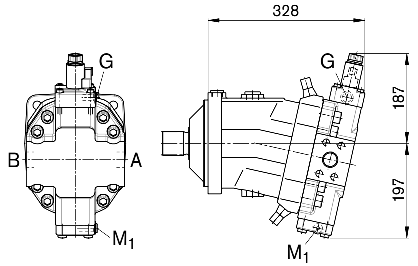


Dimensions size 160

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

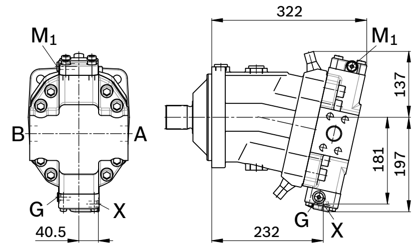
EZ1, EZ2

Two-point control electric



HA1, HA2 / HA1T, HA2T

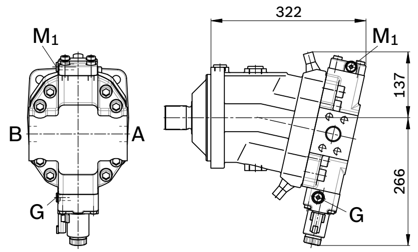
Automatic control high-pressure related, with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

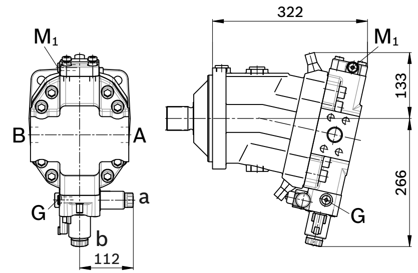
HA1U1, HA2U2

Automatic control high-pressure related, with override electric, two-point



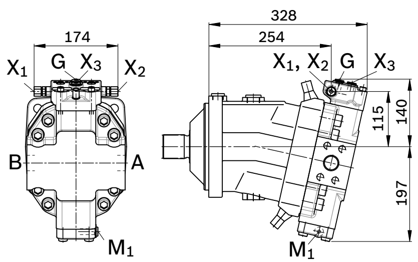
HA1R1, HA2R2

Automatic control high-pressure related, with override electric and travel direction valve electric



DA1, DA4

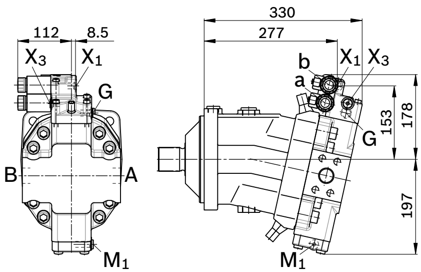
Automatic control speed related, with hydraulic travel direction valve



X_1, X_2 pipe fitting 8B-ST according to DIN 2353-CL
Use installed fittings!

DA2, DA3, DA5, DA6

Automatic control speed related, with electric travel direction valve and electric $V_{g\,max}$-circuit



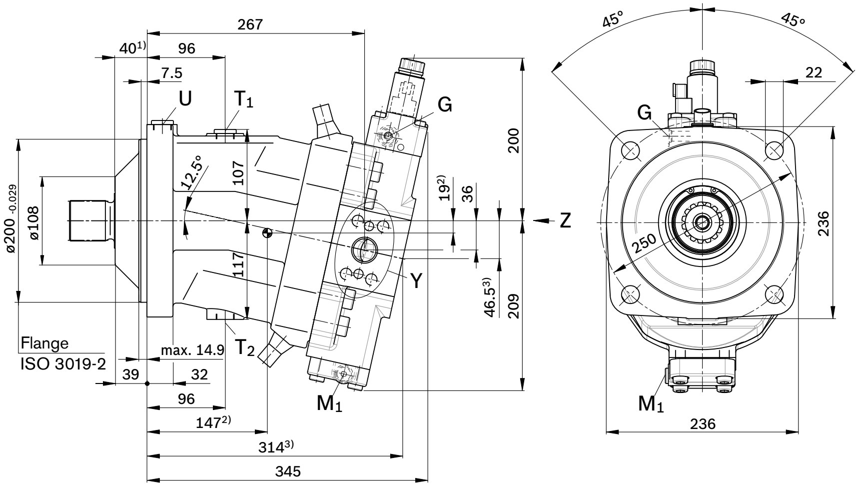
3

Dimensions size 200

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

EP1, EP2 – Proportional control electric

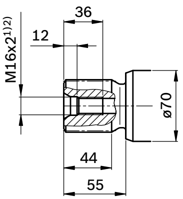
Port plate 02 – SAE-SAE flange ports A and B at side, opposite



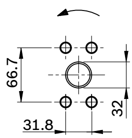
1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

Drive shaft

A Splined shaft DIN 5480 W50x2x24x9g



Service line port (detail Y)

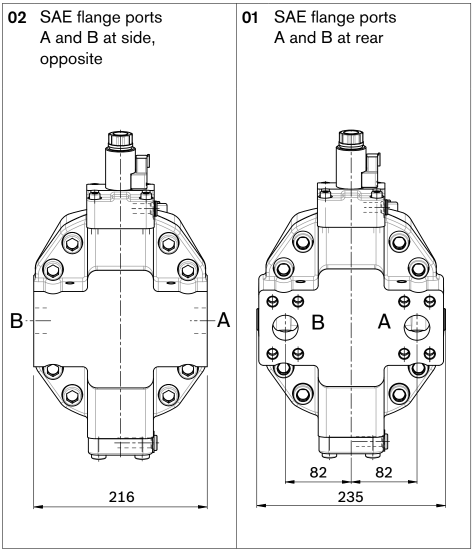


1) Observe the general instructions on page 80 for the maximum tightening torques.
2) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 200

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

Location of the service line ports on the port plates (view Z)



Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	450	O
T_1	Drain line	DIN 3852[5]	M26 x 1.5; 16 deep	3	X[4]
T_2	Drain line	DIN 3852[5]	M26 x 1.5; 16 deep	3	O[4]
G	Synchronous control	DIN 3852[5]	M14 x 1.5; 12 deep	450	X
G_2	2nd pressure setting (HD.E, EP.E)	DIN 3852[5]	M14 x 1.5; 12 deep	100	X
U	Bearing flushing	DIN 3852[5]	M22 x 1.5; 14 deep	3	X
X	Pilot signal (HD, HZ, HA1T/HA2T)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
X	Pilot signal (HA1 and HA2)	DIN 3852[5]	M14 x 1.5; 12 deep	3	X
X_1, X_2	Pilot signal (DA1, DA4)	DIN 2353-CL	8B-ST	40	O
X_1	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852[5]	M14 x 1.5; 12 deep	40	O
X_3	Pilot signal (DA2, DA3, DA5, DA6)	DIN 3852[5]	M14 x 1.5; 12 deep	40	X
M_1	Measuring stroking chamber	DIN 3852[5]	M14 x 1.5; 12 deep	450	X

1) Observe the general instructions on page 80 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 79).
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)

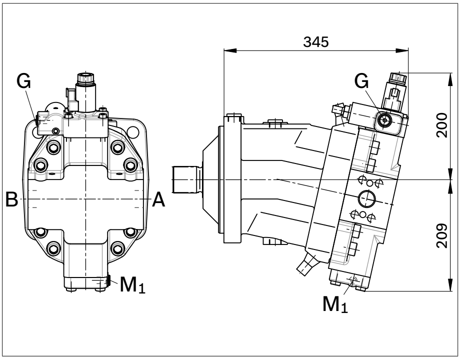
3

Dimensions size 200

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

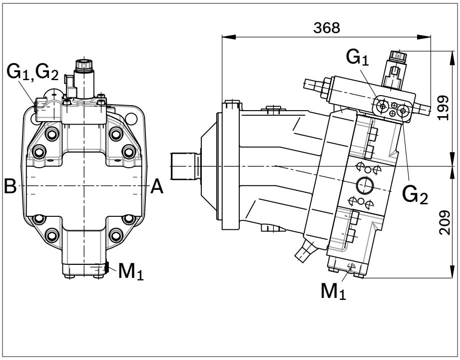
EP.D

Proportional control electric,
with pressure control fixed setting



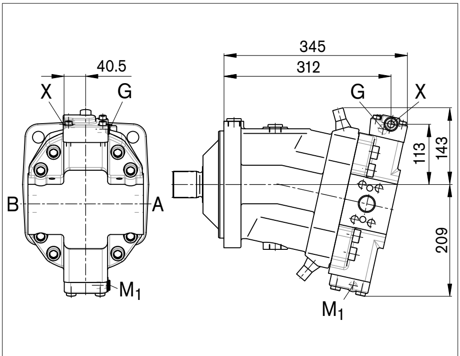
EP.E

Proportional control electric,
with pressure control hydraulic override, two-point



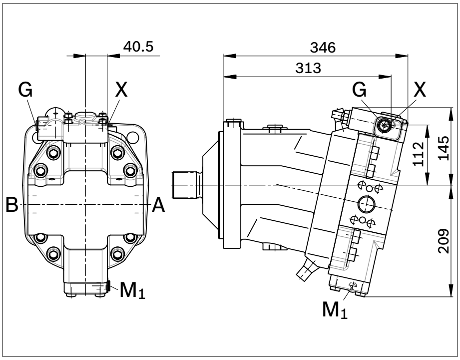
HD1, HD2

Proportional control hydraulic



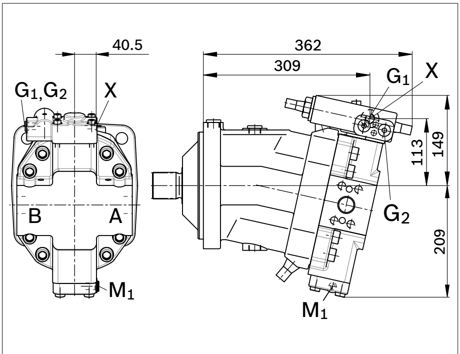
HD.D

Proportional control hydraulic,
with pressure control fixed setting



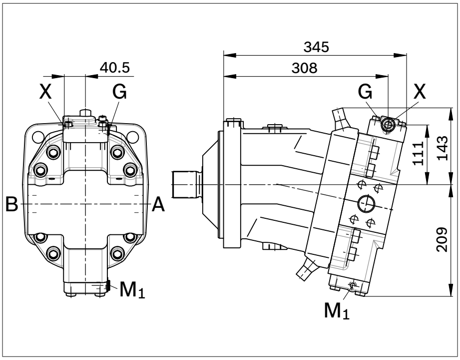
HD.E

Proportional control hydraulic,
with pressure control hydraulic override, two-point



HZ1

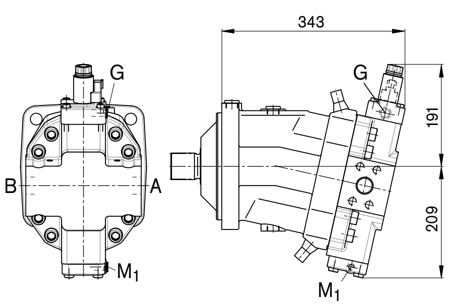
Two-point control hydraulic



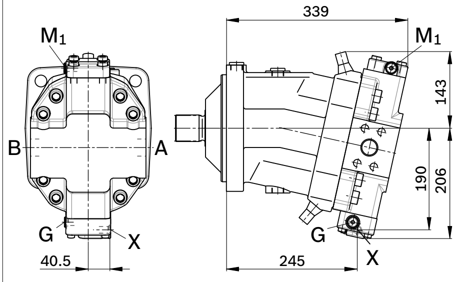
Dimensions size 200

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

EZ1, EZ2
Two-point control electric

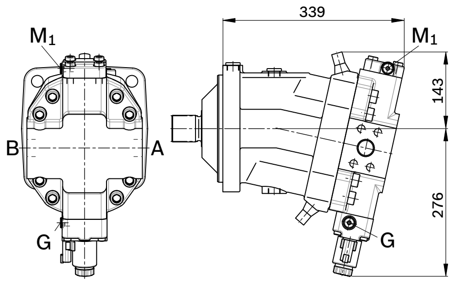


HA1, HA2 / HA1T, HA2T
Automatic control high-pressure related,
with override hydraulic remote control, proportional

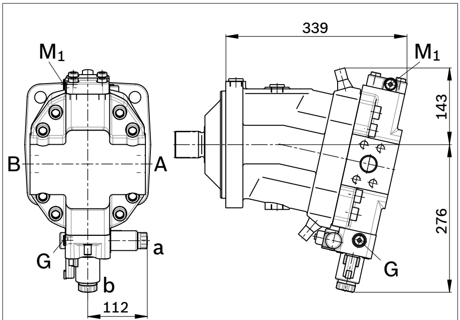


HA1 and HA2, X plugged
HA1T and HA2T, X open

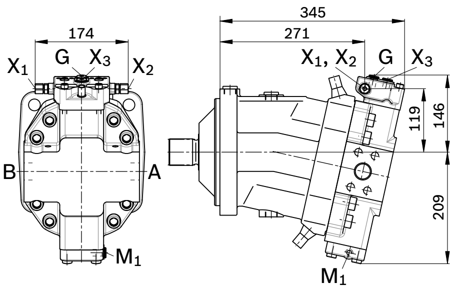
HA1U1, HA2U2
Automatic control high-pressure related,
with override electric, two-point



HA1R1, HA2R2
Automatic control high-pressure related,
with override electric and travel direction valve electric

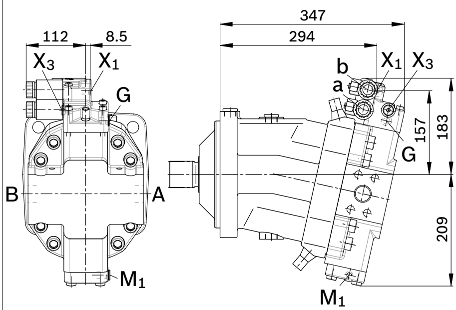


DA1, DA4
Automatic control speed related,
with hydraulic travel direction valve



X_1, X_2 pipe fitting 8B-ST according to DIN 2353-CL
Use installed fittings!

DA2, DA3, DA5, DA6
Automatic control speed related,
with electric travel direction valve and electric $V_{g\ max}$-circuit

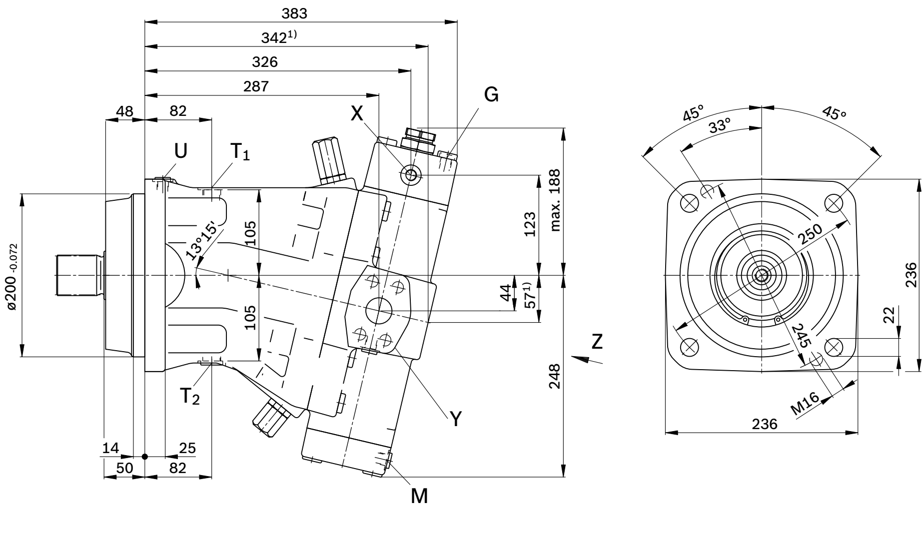


Dimensions size 250

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

HD1, HD2 – Proportional control hydraulic
HZ – Two-point control hydraulic

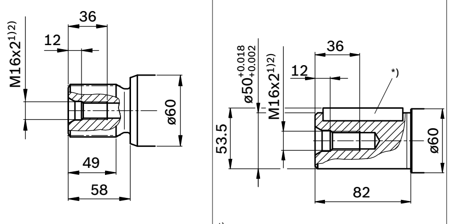
Port plate 02 – SAE flange ports A and B at side, opposite



1) Port plate 01/15 – SAE flange ports A and B at rear

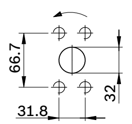
Drive shafts

Z	Splined shaft DIN 5480 W50x2x24x9g	P	Cyl. shaft with key AS14x9x80 (DIN 6885)



*) Key width 14

Service line port (detail Y)



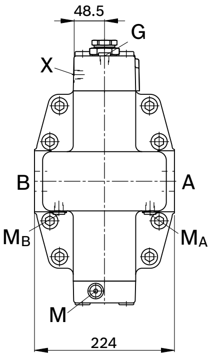
1) Observe the general instructions on page 80 for the maximum tightening torques.
2) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 250

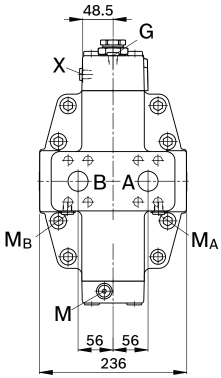
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

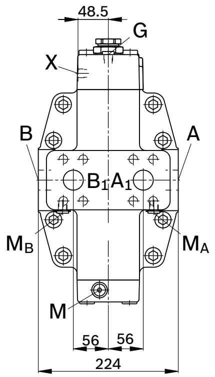
02 SAE flange ports A and B at side, opposite



01 SAE flange ports A and B at rear



15 SAE flange port A and B at side, opposite, A_1 and B_1 at rear



Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	400	O
A_1, B_1	Additional service line for plate 15 Fastening thread A_1/B_1	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	400	O
T_1	Drain line	DIN 3852[5]	M22 x 1.5; 14 deep	3	X[4]
T_2	Drain line	DIN 3852[5]	M22 x 1.5; 14 deep	3	O[4]
G	Synchronous control	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
G_2	2nd pressure setting (HD.D, EP.D)	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
P	Pilot oil supply (EP)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
U	Bearing flushing	DIN 3852[5]	M14 x 1.5; 12 deep	3	X
X	Pilot signal (HD, HZ, HA1T/HA2T)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
X	Pilot signal (HA1 and HA2)	DIN 3852[5]	M14 x 1.5; 12 deep	3	X
X_1, X_2	Pilot signal (DA)	DIN 2353-CL	8B-ST	40	O
X_3	Remote control valve (HD.G, EP.G)	DIN 3852[5]	M14 x 1.5; 12 deep	400	O
M	Measuring stroking chamber	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
M_A, M_B	Measuring pressure A/B	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
M_{St}	Measuring pilot pressure	DIN 3852[5]	M14 x 1.5; 12 deep	400	X

1) Observe the general instructions on page 80 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 79).
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)

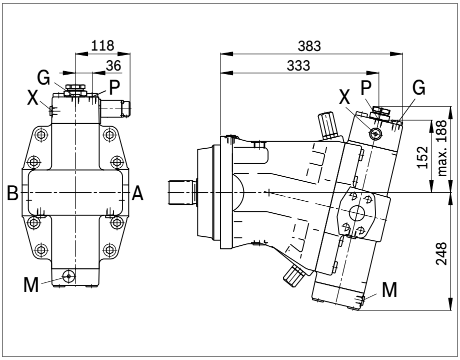
3

Dimensions size 250

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

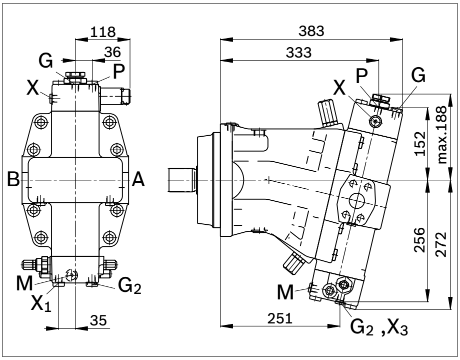
EP1, EP2

Proportional control electric



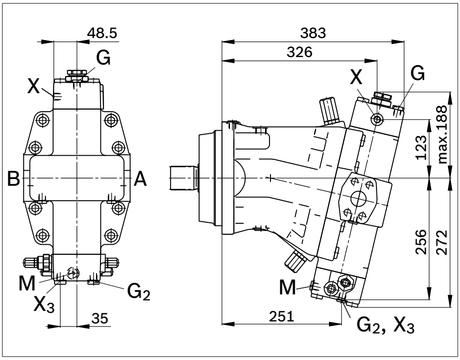
EP.D, EP.G

Proportional control electric,
with pressure control fixed setting; remote control (EP.G)



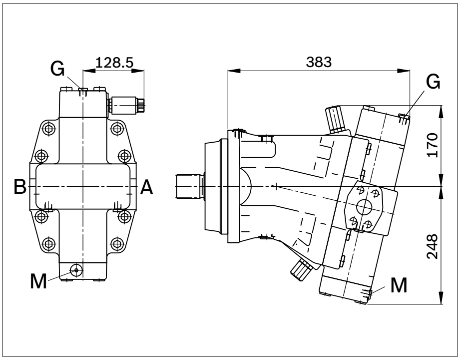
HD.D, HD.G

Proportional control hydraulic,
with pressure control fixed setting; remote control (EP.G)



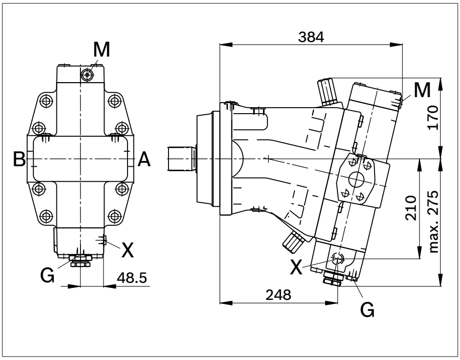
EZ1, EZ2

Two-point control electric



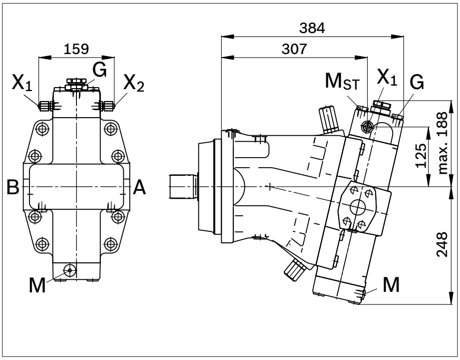
HA1, HA2 / HA1T, HA2T

Automatic control high-pressure related,
with override hydraulic remote control, proportional



DA

Automatic control speed related,
with hydraulic travel direction valve

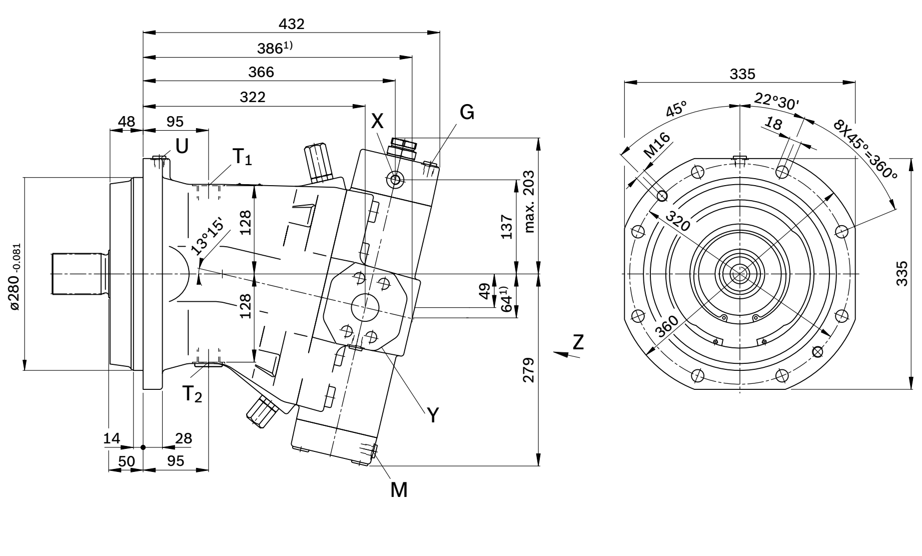


Dimensions size 355

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

HD1, HD2 – Proportional control hydraulic
HZ – Two-point control hydraulic

Port plate 02 – SAE flange ports A and B at side, opposite

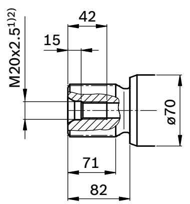


1) Port plate 01/15 – SAE flange ports A and B at rear

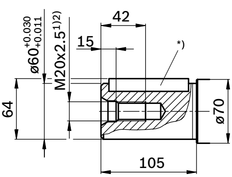
3

Drive shafts

Z Splined shaft DIN 5480 W60x2x28x9g

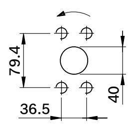


P Cyl. shaft with key AS18x11x100 (DIN 6885)



*) Key width 18

Service line port (detail Y)

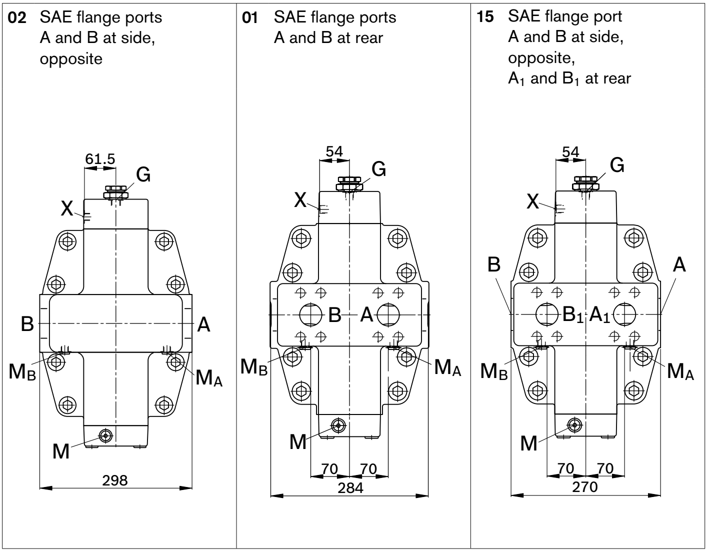


1) Observe the general instructions on page 80 for the maximum tightening torques.
2) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 355

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

Location of the service line ports on the port plates (view Z)



Ports

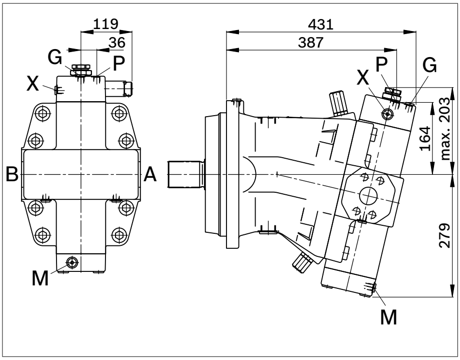
Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/2 in M16 x 2; 24 deep	400	O
A_1, B_1	Additional service line for plate 15 Fastening thread A_1/B_1	SAE J518[3] DIN 13	1 1/2 in M16 x 2; 24 deep	400	O
T_1	Drain line	DIN 3852[5]	M33 x 2; 18 deep	3	X[4]
T_2	Drain line	DIN 3852[5]	M33 x 2; 18 deep	3	O[4]
G	Synchronous control	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
G_2	2nd pressure setting (HD.D, EP.D)	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
P	Pilot oil supply (EP)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
U	Bearing flushing	DIN 3852[5]	M14 x 1.5; 12 deep	3	X
X	Pilot signal (HD, HZ, HA1T/HA2T)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
X	Pilot signal (HA1 and HA2)	DIN 3852[5]	M14 x 1.5; 12 deep	3	X
X_1, X_2	Pilot signal (DA)	DIN 2353-CL	8B-ST	40	O
X_3	Remote control valve (HD.G, EP.G)	DIN 3852[5]	M14 x 1.5; 12 deep	400	O
M	Measuring stroking chamber	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
M_A, M_B	Measuring pressure A/B	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
M_{St}	Measuring pilot pressure	DIN 3852[5]	M14 x 1.5; 12 deep	400	X

1) Observe the general instructions on page 80 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 79).
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)

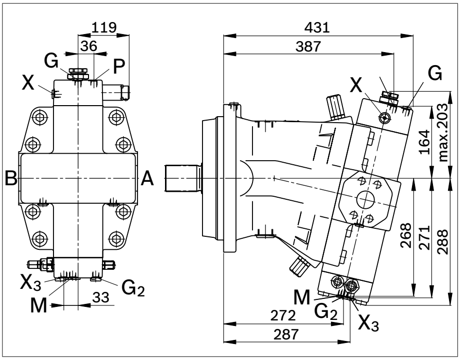
Dimensions size 355

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

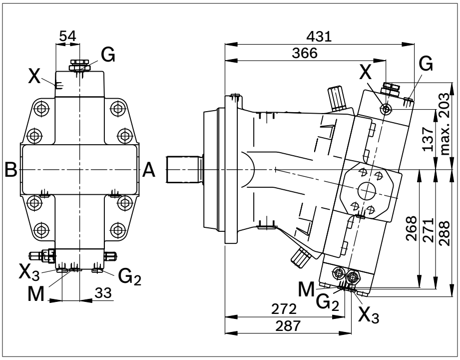
EP1, EP2
Proportional control electric



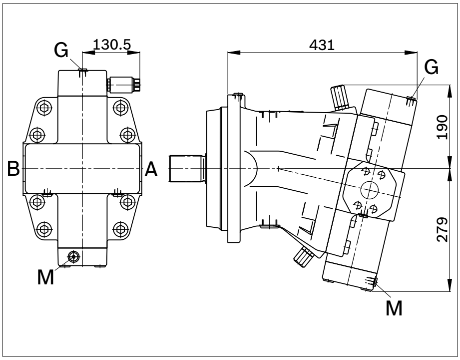
EP.D, EP.G
Proportional control electric,
with pressure control fixed setting; remote control (EP.G)



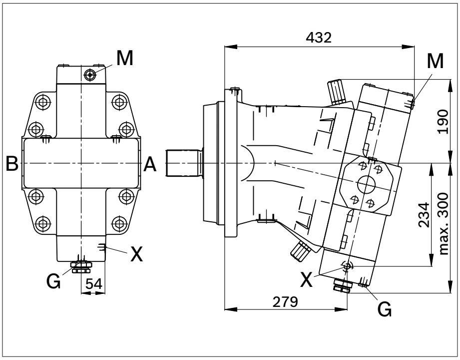
HD.D, HD.G
Proportional control hydraulic,
with pressure control fixed setting; remote control (EP.G)



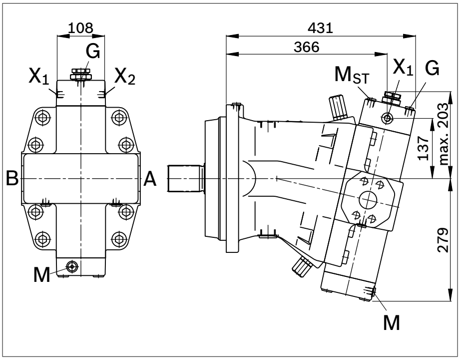
EZ1, EZ2
Two-point control electric



HA1, HA2 / HA1T, HA2T
Automatic control high-pressure related,
with override hydraulic remote control, proportional



DA
Automatic control speed related,
with hydraulic travel direction valve



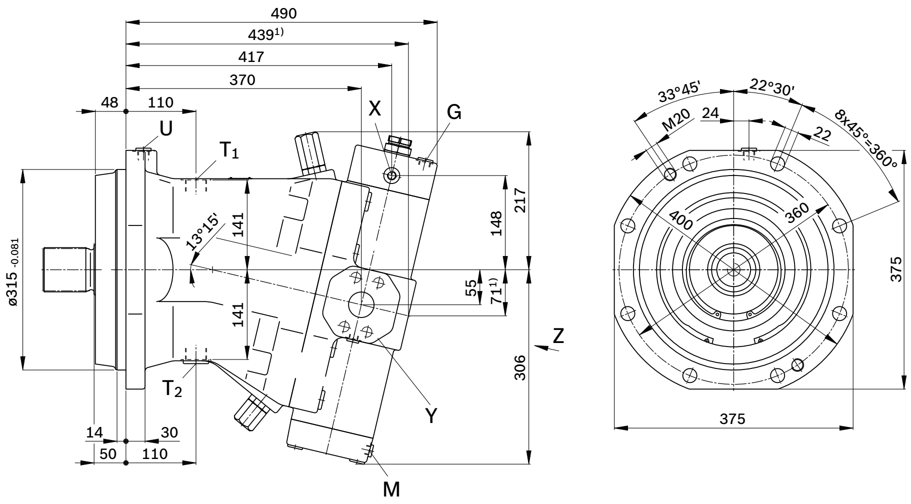
3

Dimensions size 500

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

HD1, HD2 – Proportional control hydraulic
HZ – Two-point control hydraulic

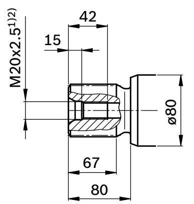
Port plate 02 – SAE flange ports A and B at side, opposite



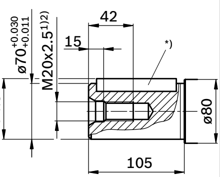
1) Port plate 01/15 – SAE flange ports A and B at rear

Drive shafts

Z Splined shaft DIN 5480 W70x3x22x9g

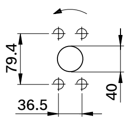


P Cyl. shaft with key AS20x12x100 (DIN 6885)



*) Key width 20

Service line port (detail Y)



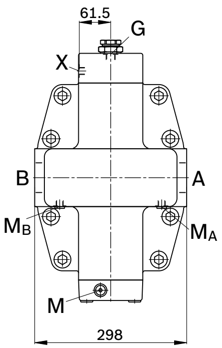
1) Observe the general instructions on page 80 for the maximum tightening torques.
2) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 500

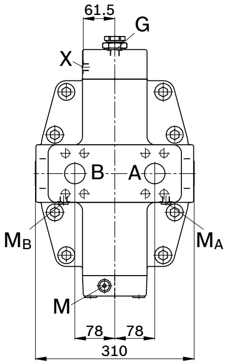
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

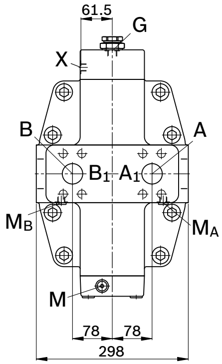
02 SAE flange ports A and B at side, opposite



01 SAE flange ports A and B at rear



15 SAE flange port A and B at side, opposite, A_1 and B_1 at rear



Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/2 in M16 x 2; 24 deep	400	O
A_1, B_1	Additional service line for plate 15 Fastening thread A_1/B_1	SAE J518[3] DIN 13	1 1/2 in M16 x 2; 24 deep	400	O
T_1	Drain line	DIN 3852[5]	M33 x 2; 18 deep	3	X[4]
T_2	Drain line	DIN 3852[5]	M33 x 2; 18 deep	3	O[4]
G	Synchronous control	DIN 3852[5]	M18 x 1.5; 12 deep	400	X
G_2	2nd pressure setting (HD.D, EP.D)	DIN 3852[5]	M18 x 1.5; 12 deep	400	X
P	Pilot oil supply (EP)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
U	Bearing flushing	DIN 3852[5]	M18 x 1.5; 12 deep	3	X
X	Pilot signal (HD, HZ, HA1T/HA2T)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
X	Pilot signal (HA1 and HA2)	DIN 3852[5]	M14 x 1.5; 12 deep	3	X
X_1, X_2	Pilot signal (DA)	DIN 2353-CL	8B-ST	40	O
X_3	Remote control valve (HD.G, EP.G)	DIN 3852[5]	M14 x 1.5; 12 deep	400	O
M	Measuring stroking chamber	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
M_A, M_B	Measuring pressure A/B	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
M_{St}	Measuring pilot pressure	DIN 3852[5]	M14 x 1.5; 12 deep	400	X

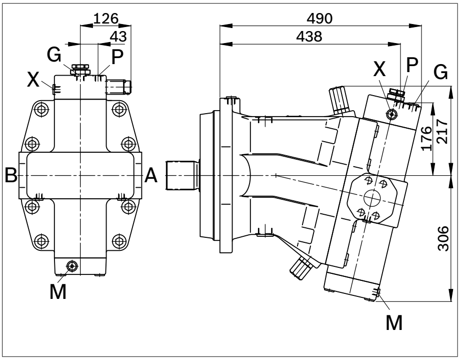
1) Observe the general instructions on page 80 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 79).
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 size 500

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

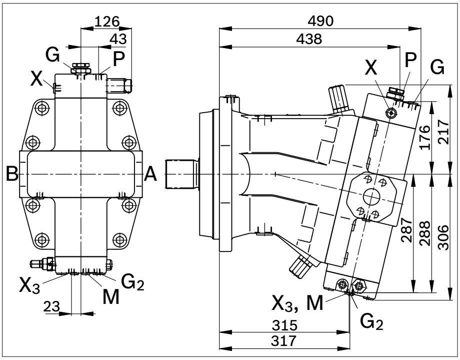
EP1, EP2

Proportional control electric



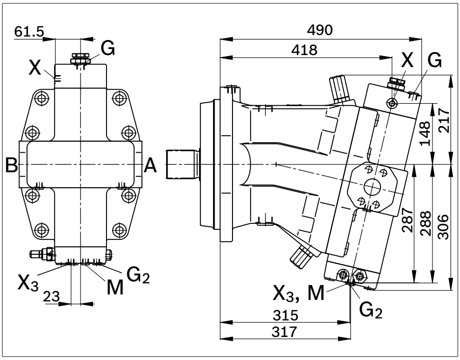
EP.D, EP.G

Proportional control electric,
with pressure control fixed setting; remote control (EP.G)



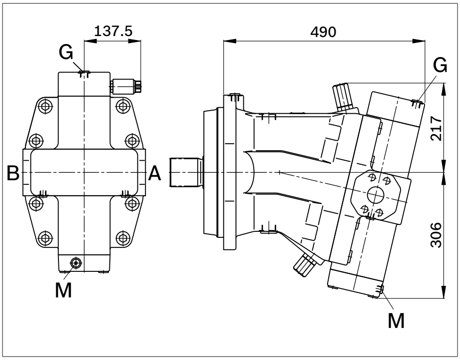
HD.D, HD.G

Proportional control hydraulic,
with pressure control fixed setting; remote control (EP.G)



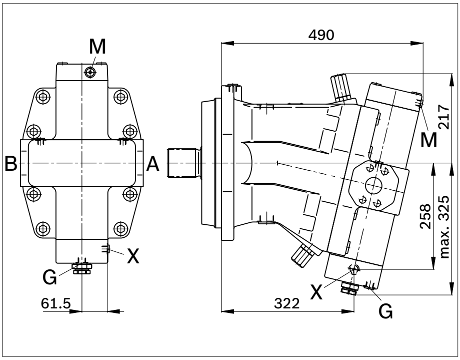
EZ1, EZ2

Two-point control electric



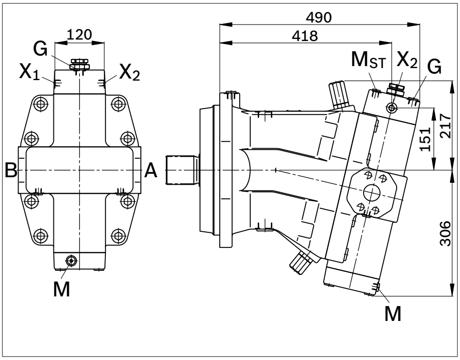
HA1, HA2 / HA1T, HA2T

Automatic control high-pressure related,
with override hydraulic remote control, proportional



DA

Automatic control speed related,
with hydraulic travel direction valve

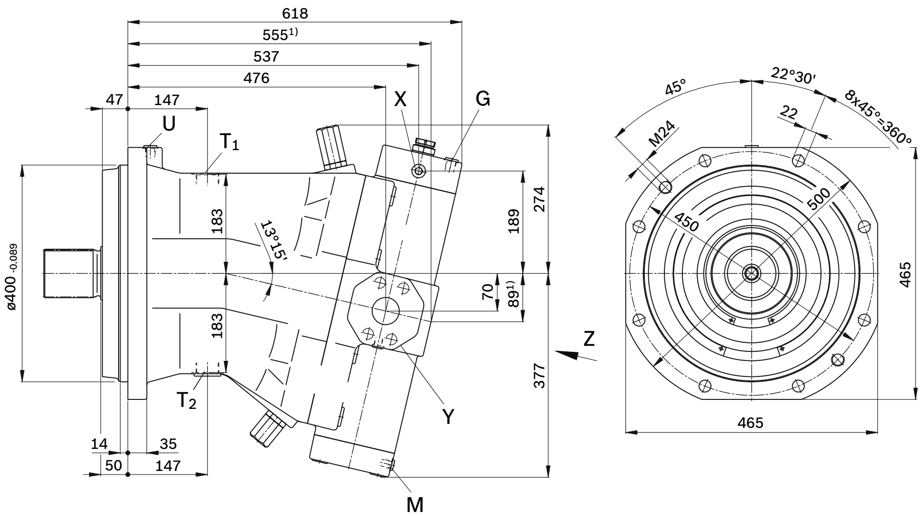


Dimensions size 1000

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

HD1, HD2 – Proportional control hydraulic
HZ – Two-point control hydraulic

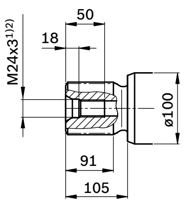
Port plate 02 – SAE-SAE flange ports A and B at side, opposite



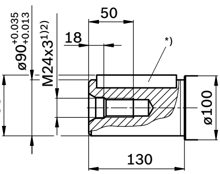
1) Port plate 01/15 – SAE flange ports A and B at rear

Drive shafts

A Splined shaft DIN 5480 W90x3x28x9g

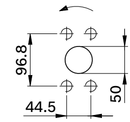


P Cyl. shaft with key AS25x14x125 (DIN 6885)



*) Key width 25

Service line port (detail Y)



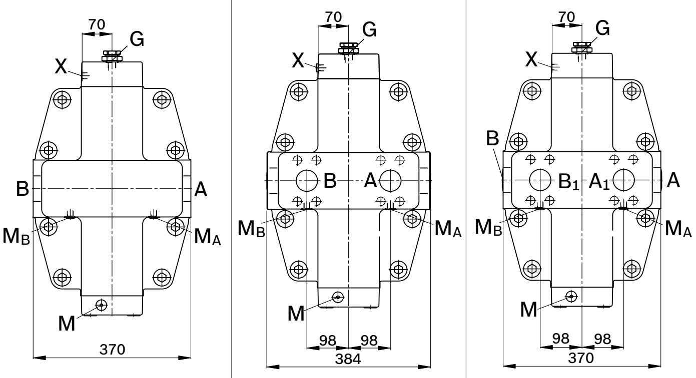
1) Observe the general instructions on page 80 for the maximum tightening torques.
2) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 1000

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

Location of the service line ports on the port plates (view Z)

02 SAE flange ports A and B at side, opposite	**01** SAE flange ports A and B at rear	**15** SAE flange port A and B at side, opposite, A_1 and B_1 at rear



Ports

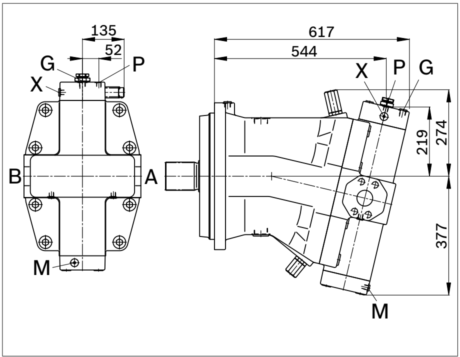
Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	2 in M20 x 2.5; 24 deep	400	O
A_1, B_1	Additional service line for plate 15 Fastening thread A_1/B_1	SAE J518[3] DIN 13	2 in M20 x 2.5; 24 deep	400	O
T_1	Drain line	DIN 3852[5]	M42 x 2; 20 deep	3	X[4]
T_2	Drain line	DIN 3852[5]	M42 x 2; 20 deep	3	O[4]
G	Synchronous control	DIN 3852[5]	M18 x 1.5; 12 deep	400	X
G_2	2nd pressure setting (HD.D, EP.D)	DIN 3852[5]	M18 x 1.5; 12 deep	400	X
P	Pilot oil supply (EP)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
U	Bearing flushing	DIN 3852[5]	M18 x 1.5; 12 deep	3	X
X	Pilot signal (HD, HZ, HA1T/HA2T)	DIN 3852[5]	M14 x 1.5; 12 deep	100	O
X	Pilot signal (HA1 and HA2)	DIN 3852[5]	M14 x 1.5; 12 deep	3	X
X_3	Remote control valve (HD.G, EP.G)	DIN 3852[5]	M14 x 1.5; 12 deep	400	O
M	Measuring stroking chamber	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
M_A, M_B	Measuring pressure A/B	DIN 3852[5]	M14 x 1.5; 12 deep	400	X
M_{St}	Measuring pilot pressure	DIN 3852[5]	M14 x 1.5; 12 deep	400	X

1) Observe the general instructions on page 80 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 79).
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)

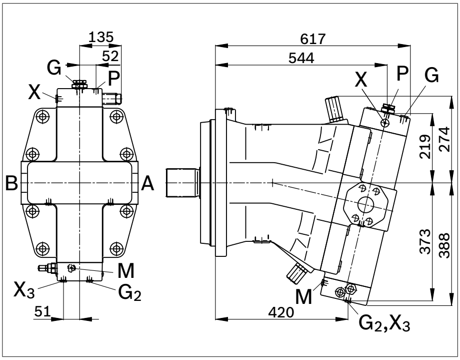
Dimensions size 1000

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

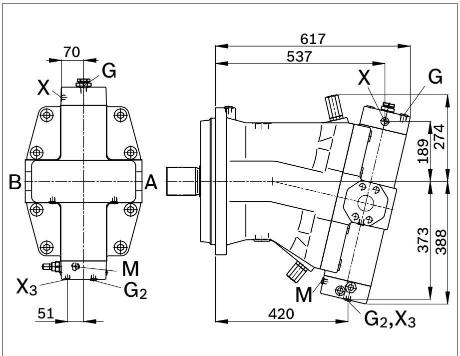
EP1, EP2
Proportional control electric



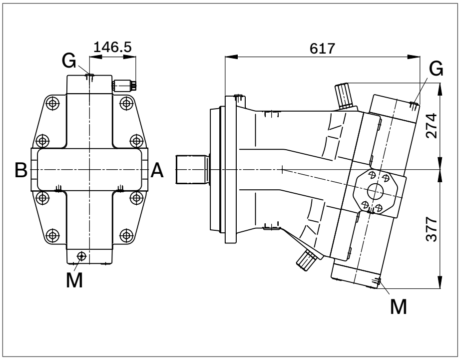
EP.D, EP.G
Proportional control electric,
with pressure control fixed setting; remote control (EP.G)



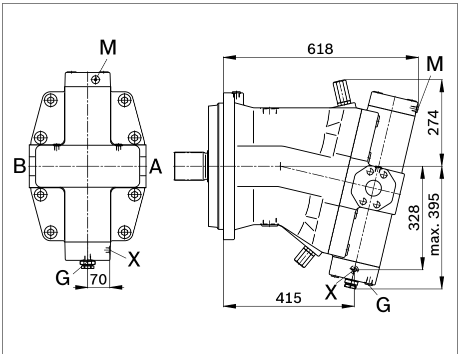
HD.D, HD.G
Proportional control hydraulic,
with pressure control fixed setting; remote control (EP.G)



EZ1, EZ2
Two-point control electric



HA1, HA2 / HA1T, HA2T
Automatic control high-pressure related,
with override hydraulic remote control, proportional



Connector for solenoids

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

DEUTSCH DT04-2P-EP04

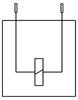
Sizes 28 to 200

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

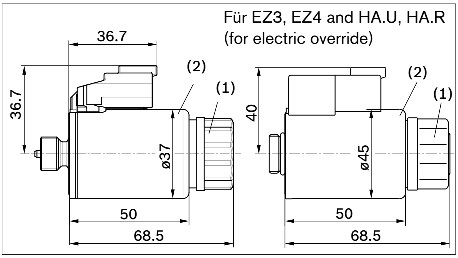


Mating connector

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.



HIRSCHMANN DIN EN 175 301-803-A/ISO 4400

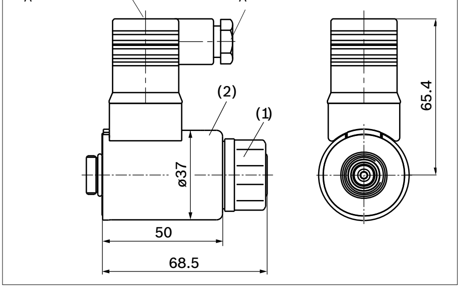
Sizes 250 to 1000

Without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:
IP65 ____________________________DIN/EN 60529

The seal ring in the cable fitting is suitable for line diameters of 4.5 mm to 10 mm.

The HIRSCHMANN connector is included in the delivery contents of the motor.



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. (WAF26, 12-sided DIN 3124)

On delivery, the connector orientation may differ from that shown in the brochure or drawing.

Flushing and boost pressure valve

The flushing and boost pressure valve is used to remove heat from the hydraulic circuit.

In an open circuit, it is used only for flushing the housing.

In a closed circuit, it ensures a minimum boost pressure level in addition to the case flushing.

Hydraulic fluid is directed from the respective low pressure side into the motor housing. This is then fed into the reservoir, together with the case drain fluid. The hydraulic fluid, removed out of the closed circuit must be replaced by cooled hydraulic fluid from the boost pump.

The valve is mounted onto the port plate or integrated (depending on the control type and size).

Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
fixed setting ________________ 16 bar

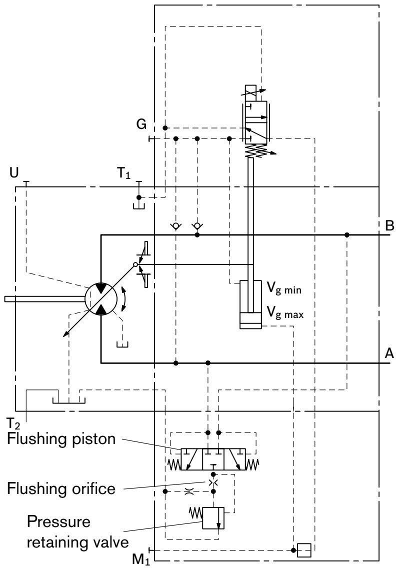
Switching pressure of flushing piston Δp ________ 8±1 bar

Flushing flow q_v
Orifices can be used to set the flushing flows as required.
Following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G = 25$ bar and $\nu = 10$ mm²/s
(p_{ND} = low pressure, p_G = case pressure)

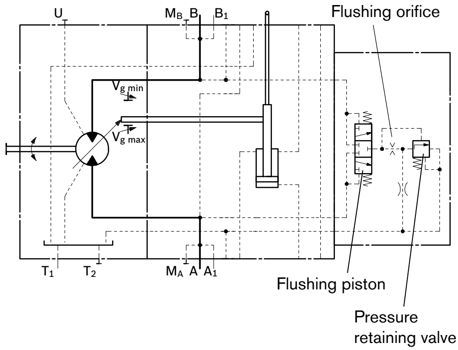
Size	Flushing flow q_V [L/min]	Mat. No. of orifice
28, 55	3.5	R909651766
80	5	R909419695
107	8	R909419696
140, 160, 200	10	R909419697
250	10	R909419697
355, 500, 1000	16	R910803019

With sizes 28 to 200, orifices can be supplied for flushing flows from 3.5 to - 10 L/min. For other flushing flows, please state the required flushing flow when ordering. The flushing flow without orifice is approx. 12 to 14 L at low pressure $\Delta p_{ND} = 25$ bar.

Schematic EP
Sizes 28 to 200



Schematic
Sizes 250 to 1000

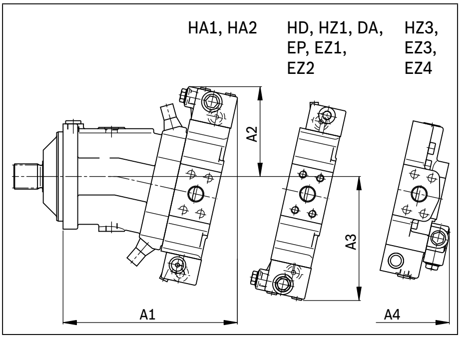


Flushing and boost pressure valve

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

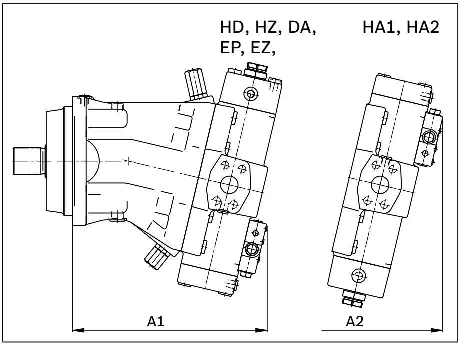
Dimensions

Sizes 28 to 200



NG	A1	A2	A3	A4
28	214	125	161	–
55	243	133	176	236
80	273	142	193	254
107	288	144	200	269
140	321	154	218	–
160	328	154	220	–
200	345	160	231	–

Sizes 250 to 1000



NG	A1	A2
250	357	402
355	397	446
500	440	504
1000	552	629

Counterbalance valve BVD and BVE

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

Function

Travel drive/winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if the motor speed is greater than it should be for the given input flow while braking, travelling downhill, or lowering a load.

If the inlet pressure drops, the counterbalance spool throttles the return flow and brakes the motor until the inlet pressure returns to approx. 20 bar.

Note

- BVD available for sizes 55 to 200 and BVE available for sizes 107 to 200.
- The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: A6VM80HA1T/63W–VAB38800A + BVD20F27S/41B–V03K16D0400S12
- For safety reasons, controls with beginning of control at $V_{g\ min}$ (e. g. HA) are not permissible for winch drives!
- The counterbalance valve does not replace the mechanical service brake and park brake.
- Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525.
- For the design of the brake release valve, we must know for the mechanical park brake:
  - the pressure at the start of opening
  - the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)
  - the required closing time for a warm device (oil viscosity approx. 15 mm^2/s)

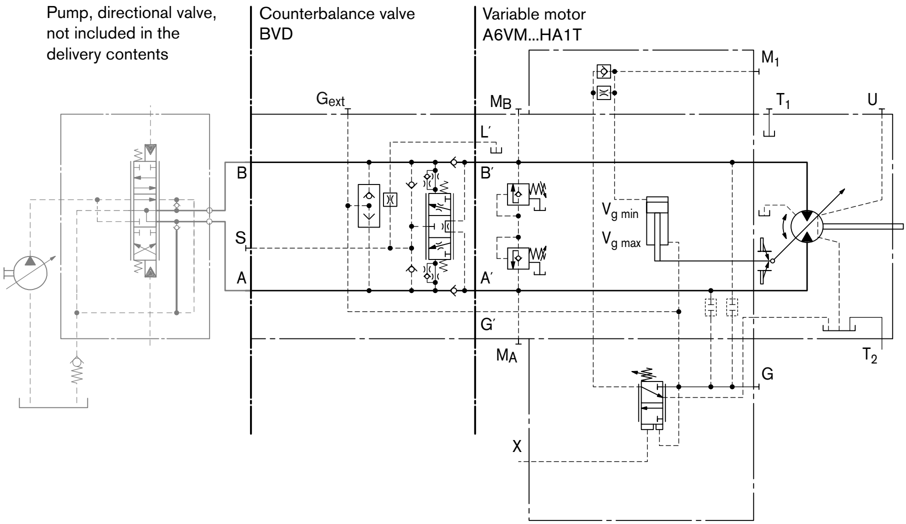
3

Travel drive counterbalance valve BVD...F

Application option

- Travel drive on wheeled excavators

Example schematic for travel drive for wheeled excavators
A6VM80HA1T/63W–VAB38800A + BVD20F27S/41B–V03K16D0400S12



Counterbalance valve BVD and BVE

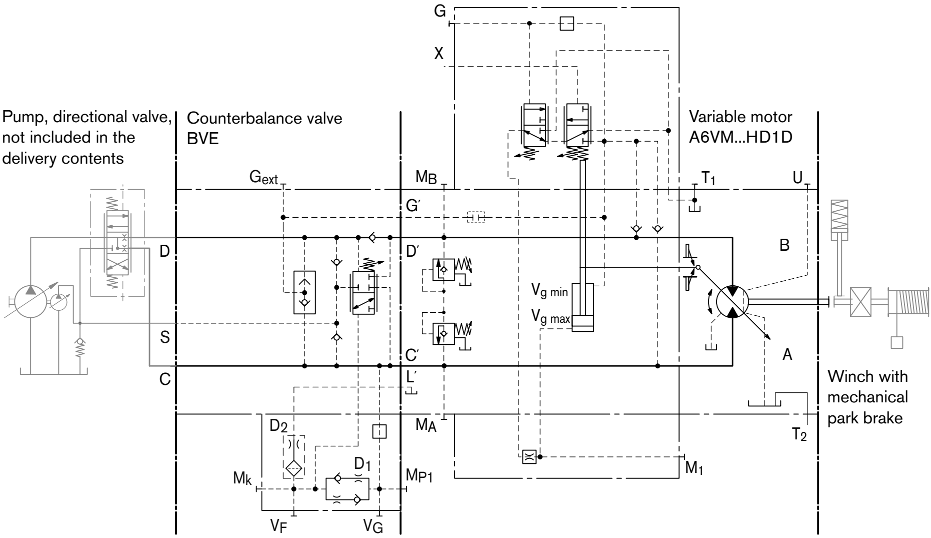
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Winch counterbalance valve BVD...W and BVE

Application options

- Winch drive in cranes (BVD and BVE)
- Track drive in excavator crawlers (BVD)

Example schematic for winch drive in cranes
A6VM80HD1D/63W–VAB38800B + BVE25W38S/51ND-V100K00D4599T30S00-0



Permissible input flow or pressure in operation with DBV and BVD/BVE

Motor	Without valve		Restricted values in operation with DBV and BVD/BVE							
			DBV				BVD/BVE			
NG	p_{nom}/p_{max} [bar]	$q_{V\ max}$ [L/min]	NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code	NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code
55	400/450	244	22	350/420	240	380	20 (BVD)	350/420	220	388
80		312								
107		380	32		400	370				378
107		380				380	25 (BVD/BVE)		320	388
140		455								
160		496								
200		580	On request							
250	350/400	675	On request							

DBV ______________________ pressure-relief valve

BVD ______________counterbalance valve, double-acting

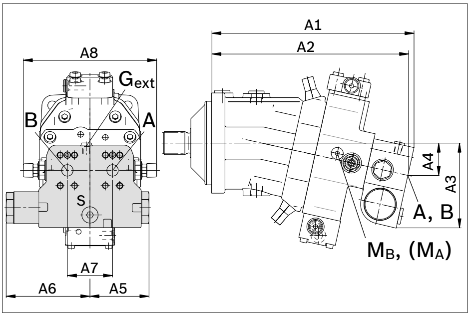
BVE ________________counterbalance valve, one-sided

Counterbalance valve BVD and BVE

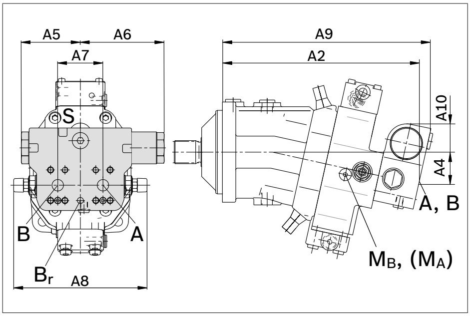
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Dimensions

A6VM...HA



A6VM...HD or EP1)



A6VM	Counterbalance valve												
NG...plate	Type	Ports	Dimensions										
		A, B	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
55...38	BVD20...17	3/4 in	311	302	143	50	98	139	75	222	326	50
80...38	BVD20...27	1 in	340	331	148	55	98	139	75	222	355	46
107...37	BVD20...28	1 in	362	353	152	59	98	139	84	234	377	41
107...38	BVD25...38	1 1/4 in	380	370	165	63	120.5	175	84	238	395	56
140...38	BVD25...38	1 1/4 in	411	401	168	67	120.5	175	84	238	426	53
160...38	BVD25...38	1 1/4 in	417	407	170	68	120.5	175	84	238	432	51
200...38	BVD25...38	1 1/4 in	448	438	176	74	120.5	175	84	299	463	46
107...38	BVE25...38	1 1/4 in	380	370	171	63	137	214	84	238	397	63
140...38	BVE25...38	1 1/4 in	411	401	175	67	137	214	84	238	423	59
160...38	BVE25...38	1 1/4 in	417	407	176	68	137	214	84	238	432	59
200...38	BVE25...38	1 1/4 in	448	438	182	74	137	214	84	299	463	52

Ports

Designation	Port for	Version	A6VM Plate	Standard	Size[2]	Maximum pressure [bar][3]	State[5]
A, B	Service line			SAE J518	see table above	420	O
S	Infeed	BVD20		DIN 3852[4]	M22 x 1.5; 14 deep	30	X
		BVD25, BVE25		DIN 3852[4]	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high-pressure	L	7	DIN 3852[4]	M12 x 1.5; 12.5 deep	30	O
			8	DIN 3852[4]	M12 x 1.5; 12 deep	30	O
G_{ext}	Brake release, high-pressure	S		DIN 3852[4]	M12 x 1.5; 12.5 deep	420	X
M_A, M_B	Measuring pressure A and B			ISO 6149[4]	M18 x 1.5; 14.5 deep	420	X

1) At the mounting version for the controls HD and EP, the cast-in port designations A and B on the counterbalance valve BVD do not correspond with the connection drawing of the A6VM motor.
The designation of the ports on the installation drawing of the motor is binding!
2) Observe the general instructions on page 80 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) The spot face can be deeper than specified in the appropriate standard.
5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

3

Counterbalance valve BVD and BVE

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

Mounting the counterbalance valve

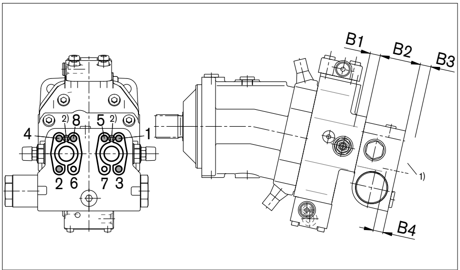
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the motor port plate using the provided tacking screws. The counterbalance valve is finally mounted to the motor by screwing on the SAE flange with the following screws:

6 screws (**1, 2, 3, 4, 5, 8**) ____________ length B1+B2+B3
2 screws (**6, 7**) ______________________ length B3+B4

Tighten the screws in two steps in the specified sequence from 1 to 8 (see following scheme).

In the first step, the screws must be tightened with half the tightening torque, and in the second step with the maximum tightening torque (see following table).

Thread	Strength class	Tightening torque [Nm]
M6 x 1 (tacking screw)	10.9	15.5
M10	10.9	75
M12	10.9	130
M14	10.9	205



1) SAE flange
2) Tacking screw (M6 x 1, length = B1 + B2, DIN 912)

NG...plate	55...38	80...38, 107...37	107, 140, 160, 200...38
B1[3]	M10 x 1.5 17 deep	M12 x 1.75 15 deep	M14 x 2 19 deep
B2	68	68	85
B3	customer-specific		
B4	M10 x 1.5 15 deep	M12 x 1.75 16 deep	M14 x 2 19 deep

3) Minimum required thread reach 1 x Ø-thread

Swivel angle indicator (sizes 250 to 1000)

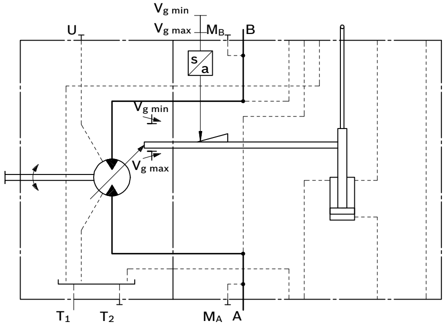
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

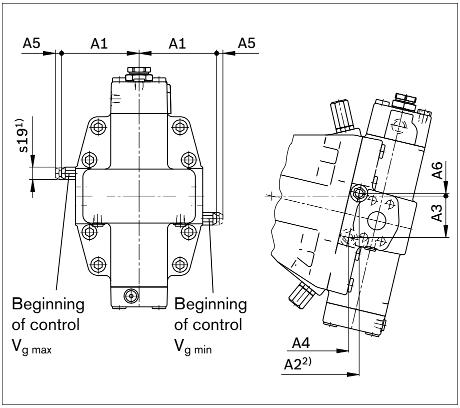
Optical swivel angle indicator (V)

The swivel position is indicated by a pin on the side of the port plate. The length of pin protruding depends on the position of the lens plate.

If the pin is flush with the port plate, the motor is at the beginning of control. At max. swivel, the pin length is 8 mm (visible after removing the cap nut).

Example: beginning of control at $V_{g\,max}$





NG	A1	A2[2]	A3	A4	A5[3]	A6
250	136.5	256	73	238	11	5
355	159.5	288	84	266	11	8
500	172.5	331	89	309	11	3
1000	208.5	430	114	402	11	3

1) Size
2) Dimension to mounting flange
3) Required clearance for removal of cap nut

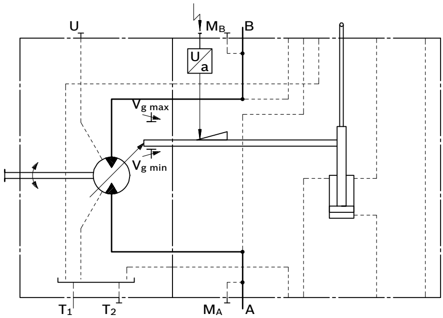
Electric swivel angle indicator (E)

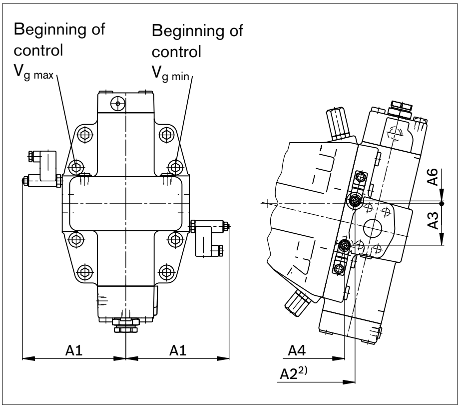
The motor position is measured by an inductive position transducer. This converts the stroke of the control device into an electric signal.

This signal is used to forward the swivel position to an electric controller.

Inductive position transducer, type IW9–03–01
type of protection according to DIN/EN 60529: IP65

Example: beginning of control at $V_{g\,min}$





NG	A1	A2[2]	A3	A4	A6
250	182	256	73	238	5
355	205	288	84	266	8
500	218	331	89	309	3
1000	254	430	114	402	3

Speed sensors

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

Version A6VM...U and A6VM...F ("prepared for speed sensor", i.e. without sensor) is quipped with a toothed ring on the rotary group.

On deliveries "prepared for speed sensor", the port is plugged with a pressure-resistant cover.

With the speed sensor DSA or HDD mounted, a signal proportional to the motor speed can be generated. The sensors measure the speed and direction of rotation.

Ordering code, technical data, dimensions and details on the connector, plus safety information about the sensor can be found in the relevant data sheet.

DSA ______________________________ RE 95133

HDD ______________________________ RE 95135

Version "V" (sizes 28 to 200)

Suitable for mounting the DSA speed sensor. The sensor is fastened at the upper reservoir port T_1.

Note

With speed measuring, only port T_2 can be used to drain the case drain.

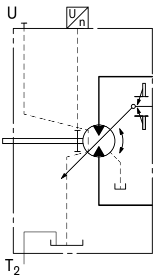
Version "H" (sizes 355 and 500)

Suitable for mounting the HDD speed sensor. The sensor is flanged onto the port provided for this purpose with two mounting bolts.

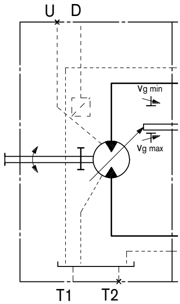
We recommend ordering the A6VM variable motor complete with installed sensor.

Schematic

Sizes 28 to 200

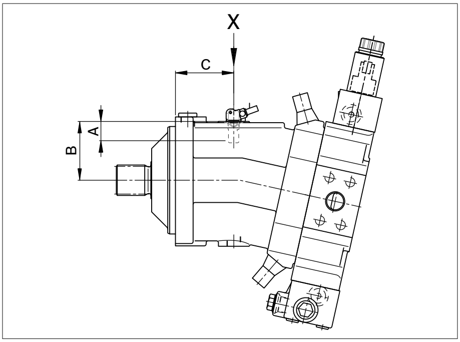


Sizes 250 to 1000



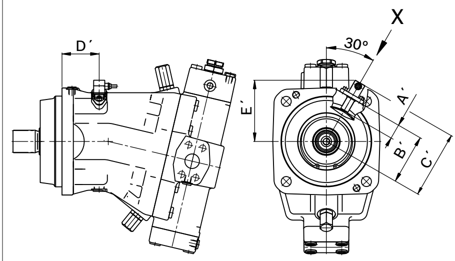
Dimensions

Version "V" with DSA sensor (sizes 28 to 200)



Dimensions

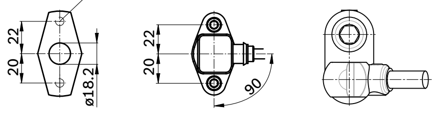
Version "H" with HDD sensor (sizes 355 and 500)



View X

Without HDD sensor | With HDD sensor | With DSA sensor

M6 x 1 (DIN 13)
8 deep



Size			55	80	107	140	160	200	250	355	500
Number of teeth			54	58	67	72	75	80	78	90	99
DSA	A	Insertion depth (tolerance -0.25)	18.4	18.4	18.4	18.4	18.4	18.4	On request	-	-
	B	Contact surface	75	79	88	93	96	101		-	-
	C		66.2	75.2	77.2	91.2	91.7	95.2		-	-
HDD	A'	Insertion depth (tolerance ± 0.1)	-	-	-	-	-	-	-	32.5	32.5
	B'	Contact surface	-	-	-	-	-	-	-	122.5	132.5
	C'		-	-	-	-	-	-	-	161	171
	D'		-	-	-	-	-	-	-	93	113
	E'		-	-	-	-	-	-	-	145	154

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 drain line must flow into the reservoir below the minimum fluid level.

Installation position

See the following examples 1 to 8.
Further installation positions are possible upon request.

Recommended installation positions: 1 and 2.

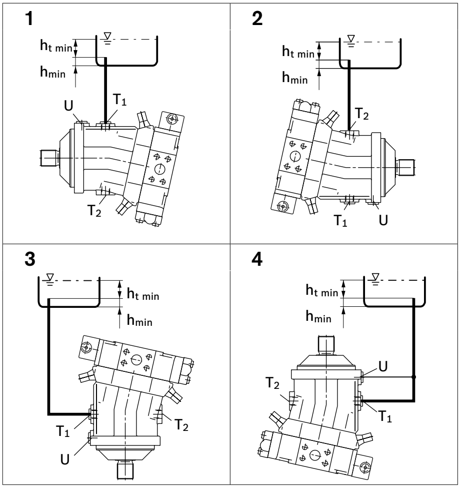
Note
In certain installation conditions, an influence on the control characteristics can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristics and changes in response time.

Installation position	Air bleed	Filling
1	–	T_1
2	–	T_2
3	–	T_1
4	U	T_1
5	U (L_1)	T_1 (L_1)
6	L_1	T_2 (L_1)
7	L_1	T_1 (L_1)
8	U	T_1 (L_1)

L_1	Filling / air bleed
U	Bearing flushing / 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)

Below-reservoir installation (standard)

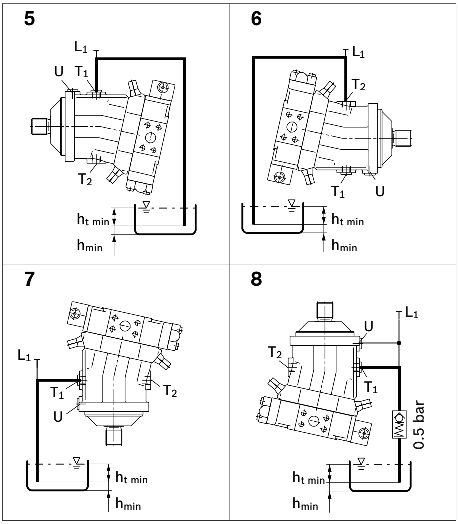
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



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 motor housing.



3

General instructions

– The motor A6VM is designed to be used in open and closed 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.

– 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 fittings used.

- Mounting bolts:
  For mounting bolts with metric ISO thread according to DIN 13 or 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 of the threaded plugs
DIN 3852	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
	M26 x 1.5	230 Nm	120 Nm	12 mm
	M27 x 2	330 Nm	135 Nm	12 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 17 Nm for M12 x 1.5.

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info.brm@boschrexroth.de
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An den Kelterwiesen 14
72160 Horb, Germany
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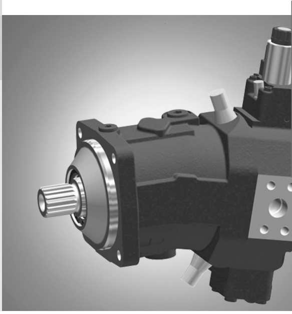
Fax: +49-7451-82-21

Rexroth
Bosch Group

Axial Piston Variable Motor A6VM

RE 91610/06.12
Replaces: 01.12

Data sheet



3

Series 71
Sizes 60 to 280
Nominal pressure 450 bar
Maximum pressure 500 bar
Open and closed circuits

Contents

Features

- Variable motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuits
- For use in mobile and stationary applications
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The displacement can be infinitely changed from $V_{g\,max}$ to $V_{g\,min} = 0$.
- The output speed is dependent on the flow of the pump and the displacement of the motor.
- The output torque increases with the pressure differential between the high-pressure and low-pressure side and with increasing displacement.
- Wide control range with hydrostatic transmissions
- Wide selection of control devices
- Cost savings through elimination of gear shifts and possibility of using smaller pumps
- Compact, robust motor with long service life
- High power density
- Good starting characteristics
- Version with 9-piston rotary group
- Good low speed characteristics
- High uniformity

Ordering code for standard program

A6V	M					0	0			/	71	M	W	V	0						–	
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	Bent-axis design, variable, nominal pressure 450 bar, maximum pressure 500 bar	A6V

Operating mode

02	Motor	M

Sizes (NG)

03	Geometric displacement, see table of values on page 8	060	085	115	150	170	215	280

Control devices

				060	085	115	150	170	215	280	
04	Proportional control hydraulic	positive control	Δp_{St} = 10 bar	●	●	●	●	●	●	●	HP1
			Δp_{St} = 25 bar	●	●	●	●	●	●	❍	HP2
		negative control	Δp_{St} = 10 bar	●	●	●	●	●	●	●	HP5
			Δp_{St} = 25 bar	●	●	●	●	●	●	❍	HP6
	Proportional control electric	positive control	U = 12 V DC	●	●	●	●	●	●	●	EP1
			U = 24 V DC	●	●	●	●	●	●	●	EP2
		negative control	U = 12 V DC	●	●	●	●	●	●	●	EP5
			U = 24 V DC	●	●	●	●	●	●	●	EP6
	Two-point control hydraulic	negative control		–	–	–	●	●	●	●	HZ5
				●	●	●	–	–	–	–	HZ7
	Two-point control electric	negative control	U = 12 V DC	–	–	–	●	●	●	❍	EZ5
			U = 24 V DC	–	–	–	●	●	●	❍	EZ6
			U = 12 V DC	●	●	●	–	–	–	–	EZ7
			U = 24 V DC	●	●	●	–	–	–	–	EZ8
	Automatic control high-pressure related, positive control	with minimum pressure increase	$\Delta p \leq$ approx. 10 bar	●	●	●	●	●	●	●	HA1
		with pressure increase	Δp = 100 bar	●	●	●	●	●	●	●	HA2
	Automatic control speed-related, negative control p_{St}/p_{HD} = 5/100	hydr. travel direction valve		●	●	●	●	●	●	❍	DA0
		elect. travel direction valve + electric $V_{g\,max}$ circuit	U = 12 V DC	●	●	●	●	●	●	–	DA1
			U = 24 V DC	●	●	●	●	●	●	–	DA2

Pressure control/overrides

				060	085	115	150	170	215	280	
05	Without pressure control/override			●	●	●	●	●	●	●	00
	Pressure control fixed setting, only for HP5, HP6, EP5 and EP6			●	●	●	●	●	●	●	D1
	Override of the HA1 and HA2 controls	hydraulic remote control, proportional		●	●	●	●	●	●	❍	T3
		electric, two-point	U = 12 V DC	●	●	●	●	●	●	–	U1
			U = 24 V DC	●	●	●	●	●	●	–	U2
		electric and travel direction valve, electric	U = 12 V DC	●	●	●	●	●	●	–	R1
			U = 24 V DC	●	●	●	●	●	●	–	R2

Connector for solenoids[1] (see page 65)

06	Without connector (without solenoid, only with hydraulic controls)	0
	DEUTSCH - molded connector, 2-pin – without suppressor diode	P

● = Available ❍ = On request – = Not available

1) Connectors for other electric components can deviate.

Ordering code for standard program

A6V	M					0	0			/	71	M	W	V	0						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21

Additional function 1

07	Without additional function	**0**

Additional function 2

08	Without additional function	**0**

Response time damping (for selection, see control)

09	Without damping (standard with HP and EP)		**0**
	Damping	HP, EP, HP5,6D. and EP5,6D., HZ, EZ, HA with counterbalance valve BVD/BVE	**1**
		One-sided in inlet to large stroking chamber (HA)	**4**
		One-sided in outlet from large stroking chamber (DA)	**7**

Setting ranges for displacement[2)]

	$V_{g\,max}$-adjusting screw	$V_{g\,min}$-adjusting screw	060	085	115	150	170	215	280	
10	Without adjusting screw (not for NG280)	short (0-adjustable)	●	●	●	●	●	●	–	**A**
		medium	●	●	●	●	●	●	–	**B**
		long	●	●	●	●	●	●	–	**C**
		extra long	–	–	●	●	●	●	–	**D**
	Short	short (0-adjustable)	●	●	●	●	●	●	●	**E**
		medium	●	●	●	●	●	●	●	**F**
		long	●	●	●	●	●	●	●	**G**
		extra long	–	–	●	●	●	●	●	**H**
	Medium	short (0-adjustable)	●	●	●	●	●	●	●	**J**
		medium	●	●	●	●	●	●	●	**K**
		long	●	●	●	●	●	●	●	**L**
		extra long	–	–	●	●	●	●	●	**M**

Series

11	Series 7, index 1	**71**

Configuration of ports and fastening threads

12	Metric, port threads with O-ring seal according to ISO 6149	**M**

Direction of rotation

13	Viewed on drive shaft, bidirectional	**W**

Seals

14	FKM (fluor-caoutchouc)	**V**

Drive shaft bearing

15	Standard bearing	**0**

Mounting flanges

			060	085	115	150	170	215	280	
16	ISO 3019-2	125-4	●	–	–	–	–	–	–	**M4**
		140-4	–	●	–	–	–	–	–	**N4**
		160-4	–	–	●	–	–	–	–	**P4**
		180-4	–	–	–	●	●	–	–	**R4**
		200-4	–	–	–	–	–	●	●	**S4**

● = Available ❍ = On request – = Not available

2) The settings for the adjusting screws can be found in the table (pages 73 and 74).

3

Ordering code for standard program

A6V	M					0	0			/	71	M	W	V	0						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21

Drive shafts

			060	085	115	150	170	215	280	
17	Splined shaft ANSI B92.1a	1 1/4 in 14T 12/24DP	●	–	–	–	–	–	–	**S7**
		1 1/2 in 17T 12/24DP	–	●	–	–	–	–	–	**S9**
		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	W35x2x16x9g	●	–	–	–	–	–	–	**Z8**
		W40x2x18x9g	–	●	●	–	–	–	–	**Z9**
		W45x2x21x9g	–	–	–	●	●	–	–	**A1**
		W50x2x24x9g	–	–	–	–	–	●	–	**A2**
		W60x2x28x9g	–	–	–	–	–	–	●	**A4**

Port plates for service lines

			060	085	115	150	170	215	280	
18	SAE flange ports A and B at rear		●	●	●	●	●	●	●	**1**
	SAE flange ports A and B at side, opposite		●	●	●	●	●	●	●	**2**
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve[3]	BVD20	●	●	●	–	–	–	–	**7**
		BVD25, BVE25	–	–	●	●	●	●	–	**8**

Valves (see pages 66 to 71)

			060	085	115	150	170	215	280	
19	Without valve		●	●	●	●	●	●	●	**0**
	Counterbalance valve BVD/BVE mounted[4]		●	●	●	●	●	●	–	**W**
	Flushing and boost pressure valve mounted, flushing on both sides Flushing flow with: $\Delta p = p_{ND} - p_G = 25$ bar and $\nu = 10\ mm^2/s$ (p_{ND} = low pressure, p_G = case pressure) Only possible with port plates 1 and 2	**Flushing flow q_v [L/min]**								
		3.5	●	●	●	–	–	–	–	**A**
		5	●	●	●	–	–	–	–	**B**
		8	●	●	●	●	●	●	–	**C**
		10	●	●	●	●	●	●	–	**D**
		14	●	●	●	–	–	–	–	**F**
		17	–	–	–	●	●	●	–	**G**
		20	–	–	●[5]	●	●	●	–	**H**
		25	–	–	●[5]	●	●	●	–	**J**
		30	–	–	●[5]	●	●	●	–	**K**
		35	–	–	–	●	●	●	–	**L**
		40	–	–	–	●	●	●	–	**M**
		adjustable 0 to 60[6]	–	–	–	–	–	–	●	**V**

Speed sensors (see page 72)

		060	085	115	150	170	215	280	
20	Without speed sensor	●	●	●	●	●	●	●	**0**
	Prepared for DSA speed sensor	●	●	●	●	●	●	❍	**U**
	DSA speed sensor mounted[7]	●	●	●	●	●	●	❍	**V**

● = Available ❍ = On request – = Not available

3) Only possible in combination with HP, EP and HA control. Note the restrictions on page 69.
4) Specify ordering code of counterbalance valve acc. to data sheet (BVD – RE 95522, BVE – RE 95525) separately. Note the restrictions on page 69.
5) Not for EZ7, EZ8 and HZ7
6) Indicate in your order the required flushing flow in plain text.
7) Specify ordering code of sensor acc. to data sheet (DSA – RE 95133) separately and observe the requirements on the electronics.

Ordering code for standard program

A6V	M					0	0			/	71	M	W	V	0						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21

Standard / special version

21	Standard version	**0**
	Standard version with installation variants, e. g. T ports against standard open or closed	**Y**
	Special version	**S**

3

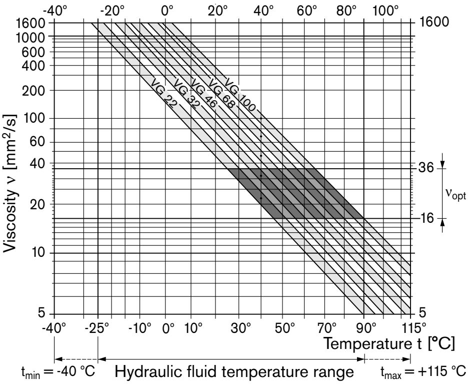
Technical data

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 motor A6VM 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.
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; 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 circuit temperature or 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 or using a flushing and boost pressure valve (see pages 66 and 67).

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]	ν_{max} = 1600	$T_{St} \geq$ -40 °C	t ≤ 3 min, without load (p ≤ 50 bar), n ≤ 1000 rpm
Permissible temperature difference		ΔT ≤ 25 K	between axial piston unit and hydraulic fluid
Warm-up phase	ν < 1600 to 400	T = -40 °C to -25 °C	at p ≤ 0.7 • p_{nom}, n ≤ 0.5 • n_{nom} and t ≤ 15 min
Operating phase			
Temperature difference		ΔT = approx. 12 K	between hydraulic fluid in the bearing and at port T. The bearing temperature can be reduced by flushing via port U.
Maximum temperature		115 °C	in the bearing
		103 °C	measured at port T
Continuous operation	ν = 400 to 10 ν_{opt} = 36 to 16	T = -25 °C to +90 °C	measured at port T, no restriction within the permissible data
Short-term operation[2]	$\nu_{min} \geq 7$	T_{max} = +103 °C	measured at port T, t < 3 min, p < 0.3 • p_{nom}
FKM shaft seal[1]		T ≤ +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).
2) Size 280, 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.

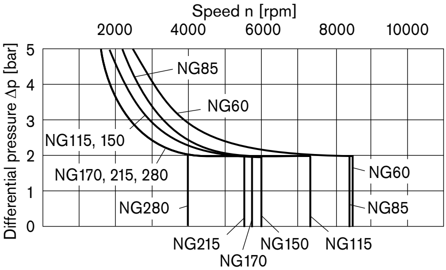
If the above classes cannot be achieved, please contact us.

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.



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.

Influence of case pressure on beginning of control

An increase in case pressure affects the beginning of control of the variable motor when using the following control options:

HP, HA.T3 ______ increase
DA ______ decrease

With the following controls, an increase in the case pressure has no influence on the beginning of control:
HA.R and HA.U (sizes 60 to 215), EP, HA

The factory setting of the beginning of control is made at $p_{abs} = 2$ bar case pressure.

Direction of flow

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

3

Technical data

Operating pressure range

(operating with mineral oil)

Pressure at service line port A or B

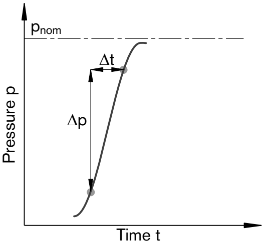
Nominal pressure p_{nom} ______ 450 bar absolute

Maximum pressure p_{max} ______ 500 bar absolute
Single operating period ______ 10 s
Total operating period ______ 300 h

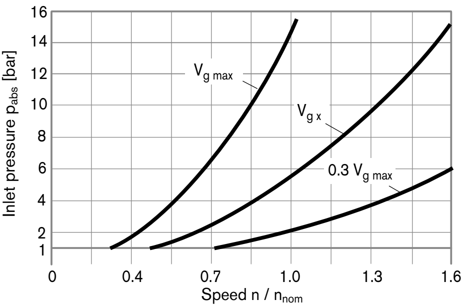
Minimum pressure (high-pressure side) ___25 bar absolute

Summation pressure (pressure A + pressure B) p_{Su} __ 700 bar

Rate of pressure change $R_{A\ max}$
with integrated pressure-relief valve______ 9000 bar/s
without pressure-relief valve ______ 16000 bar/s



Minimum pressure – pump mode (inlet)
To prevent damage to the axial piston motor in pump operating mode (change of high-pressure side with unchanged direction of rotation, e. g. when braking), a minimum pressure must be guaranteed at the service line port (inlet). This minimum pressure is dependent on the speed and displacement of the axial piston unit (see characteristic curve below).



This diagram is valid only for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s.
Please contact us if the above conditions cannot be satisfied.

Note
Values for other hydraulic fluids, please contact us.

Definition

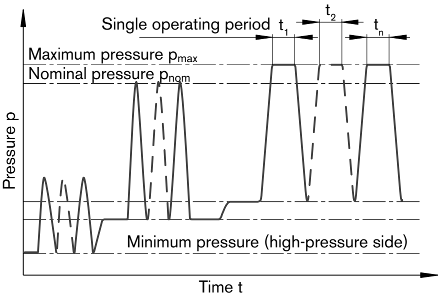
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

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.

Summation pressure p_{Su}
The summation pressure is the sum of the pressures at both service line ports (A and B).

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

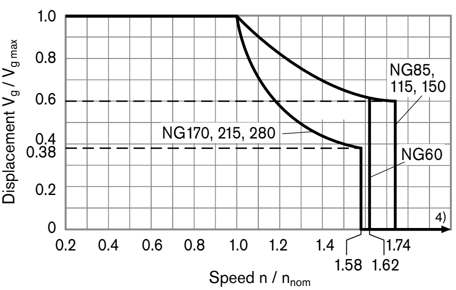
Table of values (theoretical values, without efficiency and tolerances; values rounded)

Nenngröße	NG		60	85	115	150	170	215	280
Displacement geometric, per revolution	$V_{g\,max}$	cm^3	62.0	85.2	115.6	152.1	171.8	216.5	280.1
	$V_{g\,min}$	cm^3	0	0	0	0	0	0	0
	$V_{g\,x}$	cm^3	37	51	69	91	65	82	175
Speed maximum[1)] (while adhering to the maximum permissible input flow)									
at $V_{g\,max}$	n_{nom}	rpm	4450	3900	3550	3250	3100	2900	2500
at $V_g < V_{g\,x}$ (see diagram below)	n_{max}	rpm	7200	6800	6150	5600	4900	4600	3950
at $V_{g\,0}$	n_{max}	rpm	8400	8350	7350	6000	5750	5500	3950
Input flow[2)]									
at n_{nom} and $V_{g\,max}$	$q_{V\,max}$	L/min	276	332	410	494	533	628	700
Torque[3)]									
at $V_{g\,max}$ and $\Delta p = 450$ bar	T	Nm	444	610	828	1089	1230	1550	2006
Rotary stiffness									
$V_{g\,max}$ to $V_g/2$	c_{min}	kNm/rad	15	22	37	44	52	70	72
$V_g/2$ to 0 (interpolated)	c_{max}	kNm/rad	45	68	104	124	156	196	209
Moment of inertia for rotary group	J_{GR}	kgm^2	0.0043	0.0072	0.0110	0.0181	0.0213	0.0303	0.0479
Maximum angular acceleration	α	rad/s^2	21000	17500	15500	11000	11000	10000	7000
Case volume	V	L	0.8	1.0	1.5	1.7	2.3	2.8	3.4
Mass (approx.)	m	kg	28	36	46	61	62	78	101

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.

Permissible displacement in relation to speed



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) Restriction of input flow with counterbalance valve, see page 69

3) Torque without radial force, with radial force see page 10

4) Values in this range on request

Determining the operating characteristics

Input flow $q_v = \dfrac{V_g \cdot n}{1000 \cdot \eta_v}$ [L/min]

Speed $n = \dfrac{q_V \cdot 1000 \cdot \eta_v}{V_g}$ [min^{-1}]

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

Power $P = \dfrac{2\,\pi \cdot T \cdot n}{60000} = \dfrac{q_v \cdot \Delta p \cdot \eta_t}{600}$ [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 ($\eta_t = \eta_v \cdot \eta_{mh}$)

3

Technical data

Permissible radial and axial forces of the drive shafts

Size	NG		60	85	115	150	150	170	215	280
Drive shaft		in	1 1/4	1 1/2	1 3/4	1 3/4	2	2	2	2 1/4
Maximum radial force[1]	$F_{q\,max}$	N	7620	12463	14902	15948	17424	19370	22602	26821
at distance a (from shaft collar)	a	mm	24.0	27.0	33.5	33.5	33.5	33.5	33.5	40
with permissible torque	T_{max}	Nm	310	595	828	890	1089	1230	1445	1916
≙ permissible pressure Δp at $V_{g\,max}$	$p_{nom\,perm.}$	bar	315	440	450	370	450	450	420	430
Maximum axial force[2]	$+F_{ax\,max}$	N	500	710	900	1030	1030	1120	1250	1575
	$-F_{ax\,max}$	N	0	0	0	0	0	0	0	0[3]
Permissible axial force per bar operating pressure	$F_{ax\,perm./bar}$	N/bar	7.5	9.6	11.3	13.3	13.3	15.1	17.0	19.4

Size	NG		60	85	115	150		170	215	280
Drive shaft		mm	W35	W40	W40	W45		W45	W50	W60
Maximum radial force[1]	$F_{q\,max}$	N	10266	12323	16727	19534		21220	25016	26913
at distance a (from shaft collar)	a	mm	20.0	22.5	22.5	25.0		25.0	27.5	35
Permissible nominal pressure at $V_{g\,max}$	$p_{nom\,perm.}$	bar	450	450	450	450		440	450	450
Permissible torque	T_{max}	Nm	444	610	828	1089		1200	1550	2005
Maximum axial force[2]	$+F_{ax\,max}$	N	500	710	900	1030		1120	1250	1575
	$-F_{ax\,max}$	N	0	0	0	0		0	0	0[3]
Permissible axial force per bar operating pressure	$F_{ax\,perm./bar}$	N/bar	7.5	9.6	11.3	13.3		15.1	17.0	19.4

1) With intermittent operation.
2) Maximum permissible axial force during standstill or when the axial piston unit is operating in non-pressurized condition.
3) Please contact us.

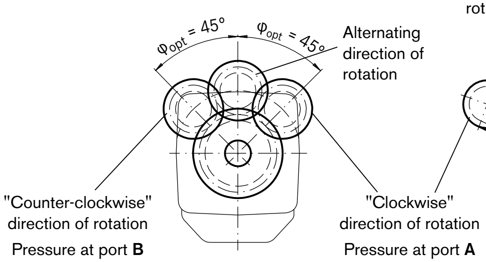
Note
Influence of the direction of the permissible axial force:

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

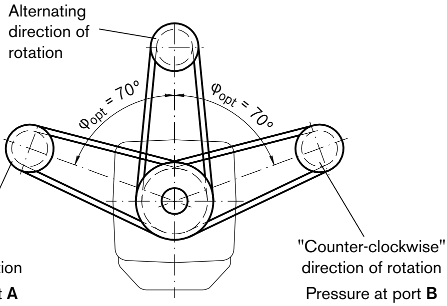
Effect of radial force F_q on the service life of bearings

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 drive



HP – Proportional control hydraulic

The proportional hydraulic control provides infinite setting of the displacement, proportional to the pilot pressure applied to port X.

HP1, HP2 positive control

- Beginning of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at minimum pilot pressure)
- End of control at $V_{g\,max}$ (maximum torque, minimum speed at maximum pilot pressure)

HP5, HP6 negative control

- Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum pilot pressure)
- End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum pilot pressure)

Note

- Maximum permissible pilot pressure: p_{St} = 100 bar
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 500 bar can occur at port G.
- Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 10 bar.
- The beginning of control and the HP characteristic are influenced by the case pressure. An increase in the case pressure causes an increase in the beginning of control (see page 6) and thus a parallel shift of the characteristic.

HP1, HP5 pilot pressure increase Δp_{St} = 10 bar

HP1 positive control

A pilot pressure increase of 10 bar at port X results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

HP5 negative control

A pilot pressure increase of 10 bar at port X results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

Beginning of control, setting range ____________ 2 to 20 bar

Standard setting:
Beginning of control at 3 bar (end of control at 13 bar)

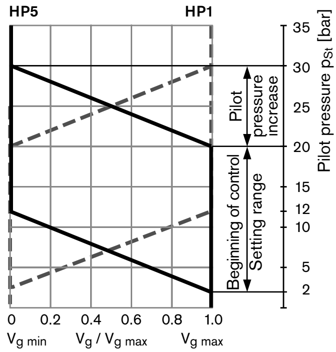
Note

The spring return feature in the control part is not a safety device

The control part 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.

Characteristic



HP2, HP6 pilot pressure increase Δp_{St} = 25 bar

HP2 positive control

A pilot pressure increase of 25 bar at port X results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

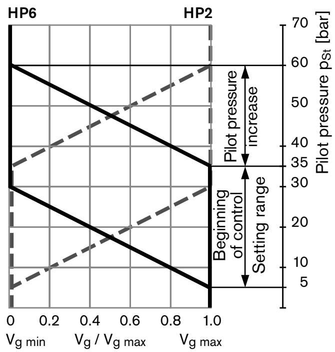
HP6 negative control

A pilot pressure increase of 25 bar at port X results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

Beginning of control, setting range ____________ 5 to 35 bar

Standard setting:
Beginning of control at 10 bar (end of control at 35 bar)

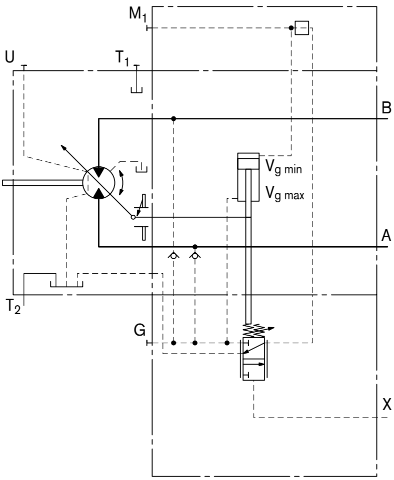
Characteristic



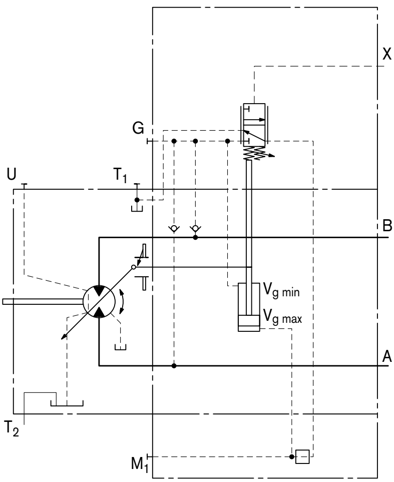
3

HP – Proportional control hydraulic

Schematic HP1, HP2: positive control
Sizes 60 to 215 (size 280 on request)



Schematic HP5, HP6: negative control
Sizes 60 to 215 (size 280 on request)



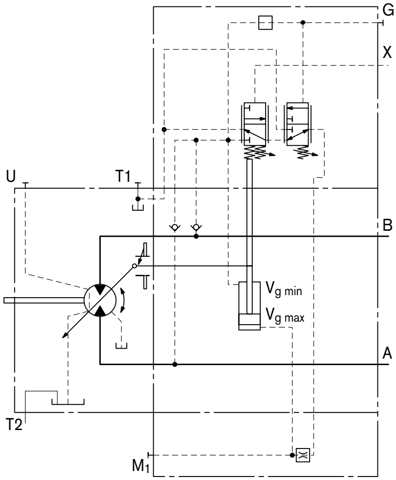
HP5D1, HP6D1
Pressure control, fixed setting

The pressure control overrides the HP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve_____ 80 to 450 bar

Schematic HP5D1, HP6D1: negative control
Sizes 60 to 215 (size 280 on request)



EP – Proportional control electric

The proportional electric control provides infinite setting of the displacement, proportional to the control current applied to the solenoid.

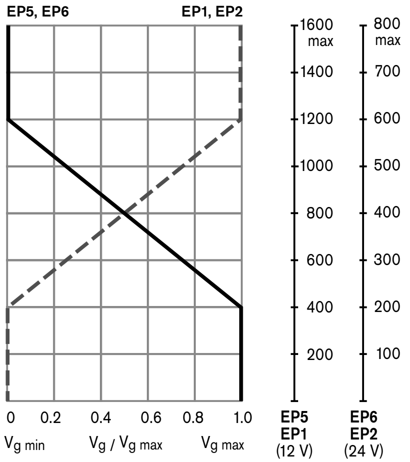
EP1, EP2 positive control

- Beginning of control at $V_{g\ min}$ (minimum torque, maximum permissible speed at minimum control current)
- End of control at $V_{g\ max}$ (maximum torque, minimum speed at maximum control current)

EP5, EP6 negative control

- Beginning of control at $V_{g\ max}$ (maximum torque, minimum speed at minimum control current)
- End of control at $V_{g\ min}$ (minimum torque, maximum permissible speed at maximum control current)

Characteristic



Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 500 bar can occur at port G.

Technical data, solenoid

	EP1, EP5	EP2, EP6
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 design page 65		

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
- Electric amplifier VT 2000, series 5X (see RE 29904) (for stationary application)

Further information can also be found on the Internet at www.boschrexroth.com/mobile-electronics

Note

The spring return feature in the control part is not a safety device

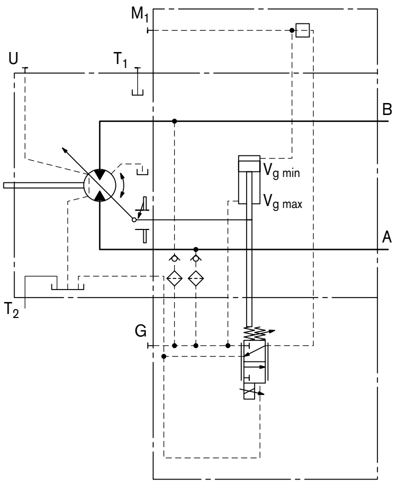
The control part can stick in an undefined position by internal contamination (contaminated hydraulic fluid, abrasion or residual contamination from system components). As a result, the control will no longer respond correctly to the operator's commands.

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.

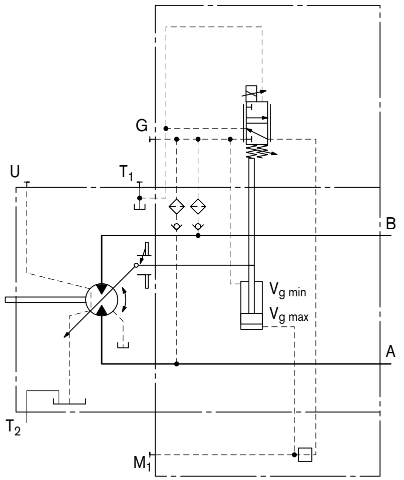
3

EP – Proportional control electric

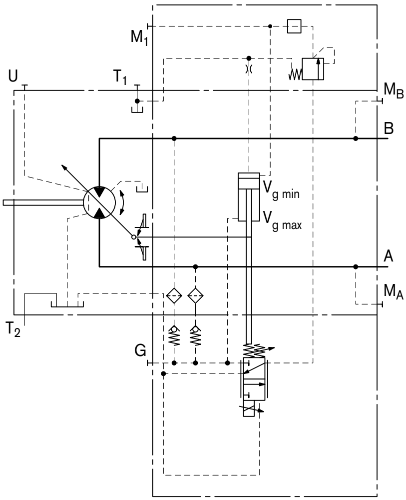
Schematic EP1, EP2: positive control
Sizes 60 to 215



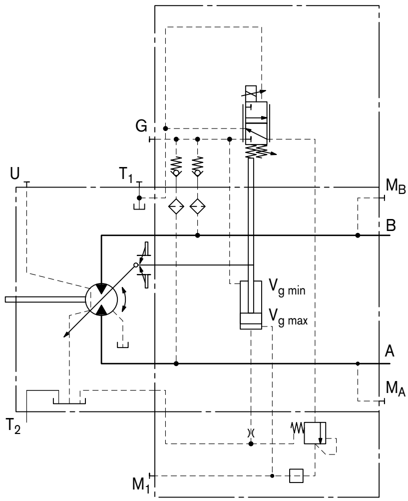
Schematic EP5, EP6: negative control
Sizes 60 to 215



Schematic EP1, EP2: positive control
Size 280



Schematic EP1, EP2: negative control
Size 280



EP – Proportional control electric

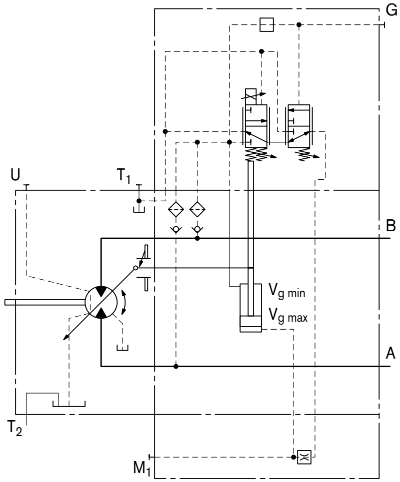
EP5**D1,** EP6**D1**
Pressure control, fixed setting

The pressure control overrides the EP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

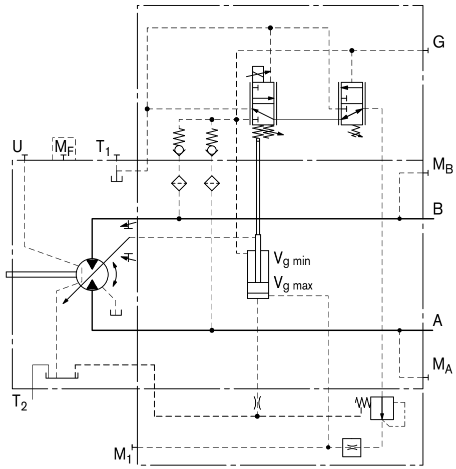
The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve ____ 80 to 450 bar

Schematic EP5D1, EP6D1: negative control
Sizes 60 to 215



Schematic EP5D1, EP6D1: negative control
Size 280



3

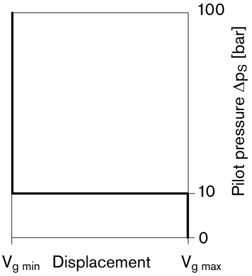
HZ – Two-point control hydraulic

The two-point hydraulic control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the pilot pressure at port X on or off.

HZ5, HZ7 negative control

- Position at $V_{g\,max}$ (without pilot pressure, maximum torque, minimum speed)
- Position at $V_{g\,min}$ (with pilot pressure > 10 bar activated, minimum torque, maximum permissible speed)

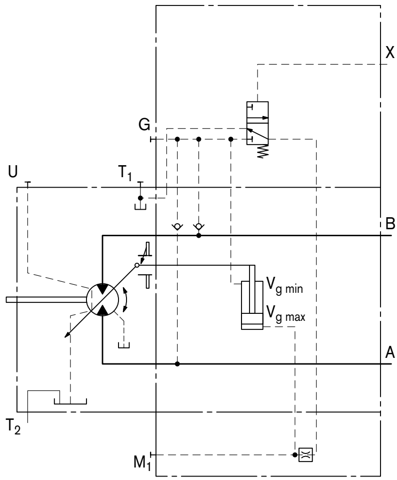
Characteristic HZ5, HZ7



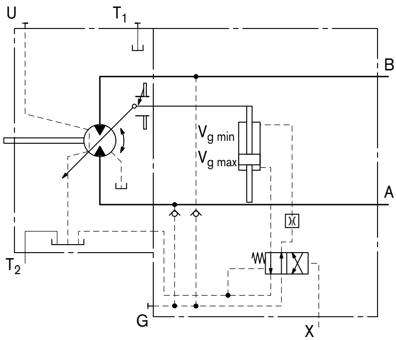
Note

- Maximum permissible pilot pressure: 100 bar
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 500 bar can occur at port G.

Schematic HZ5: negative control
Sizes 150 to 215 (size 280 on request)



Schematic HZ7: negative control
Sizes 60 to 115



EZ – Two-point control electric

The two-point electric control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the electric current to a switching solenoid on or off.

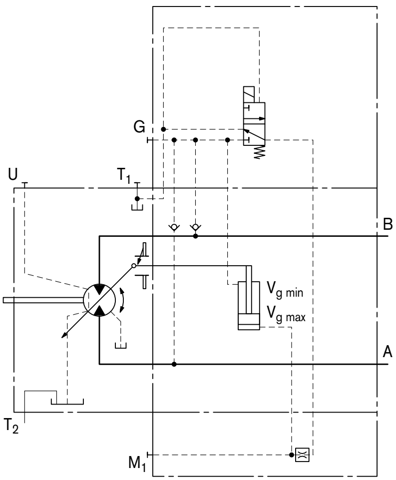
Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 500 bar can occur at port G.

Technical data, solenoid with Ø37
Sizes 150 to 280

	EZ5	EZ6
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	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 page 65		

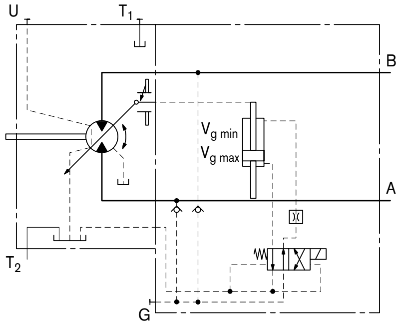
Schematic EZ5, EZ6: negative control
Sizes 150 to 215 (size 280 on request)



Technical data, solenoid with Ø45
Sizes 60 to 115

	EZ7	EZ8
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30W
Minimum required current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection see connector design page 65		

Schematic EZ7, EZ8: negative control
Sizes 60 to 115



3

HA – Automatic control high-pressure related

The automatic high-pressure related control adjusts the displacement automatically depending on the operating pressure.

The displacement of the A6VM motor with HA control is $V_{g\,min}$ (maximum speed and minimum torque). The control unit measures internally the operating pressure at A or B (no control line required) and upon reaching the beginning of control , the controller swivels the motor from $V_{g\,min}$ to $V_{g\,max}$ with increase of pressure. The displacement is modulated between $V_{g\,min}$ and $V_{g\,max}$, thereby depending on load conditions.

HA1, HA2 positive control

- Beginning of control at $V_{g\,min}$ (minimum torque, maximum speed)
- End of control at $V_{g\,max}$ (maximum torque, minimum speed)

Note

- For safety reasons, winch drives are not permissible with beginning of control at $V_{g\,min}$ (standard for HA).
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 500 bar can occur at port G.
- The beginning of control and the HA.T3 characteristic are influenced by case pressure. An increase in case pressure causes an increase in the beginning of control (see page 7) and thus a parallel shift of the characteristic.

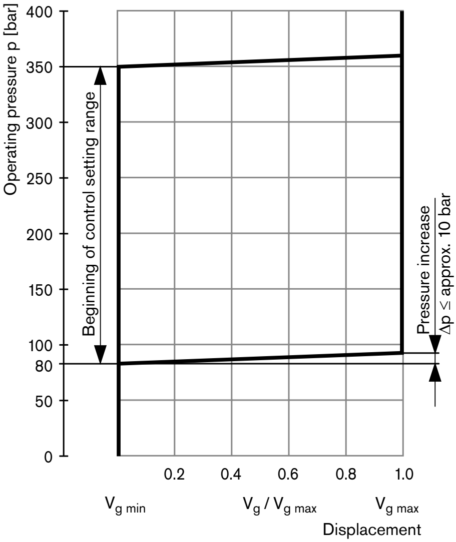
HA1
With minimum pressure increase, positive control

An operating pressure increase of $\Delta p \le$ approx. 10 bar results in an increase in displacement from $V_{g\,min}$ towards $V_{g\,max}$.

Beginning of control, setting range __________ 80 to 350 bar

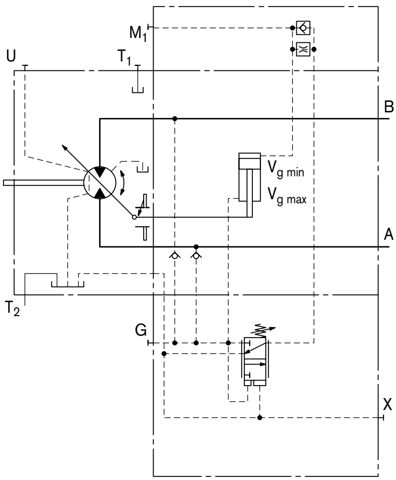
Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 300 bar.

Characteristic HA1



Schematic HA1

Sizes 60 to 215 (size 280 on request)



HA – Automatic control high-pressure related

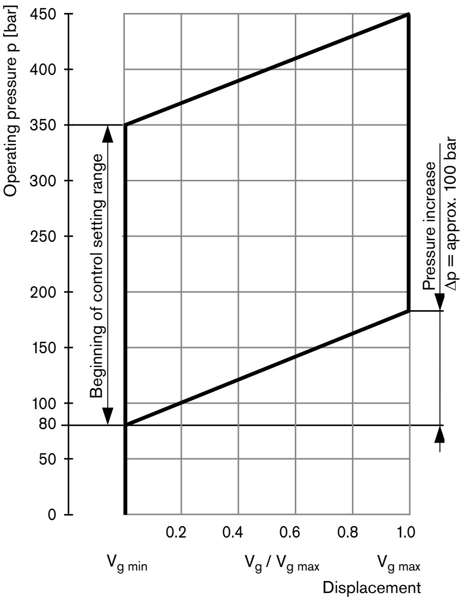
HA2
With pressure increase, positive control

An operating pressure increase of Δp = approx. 100 bar results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

Beginning of control, setting range ___________ 80 to 350 bar

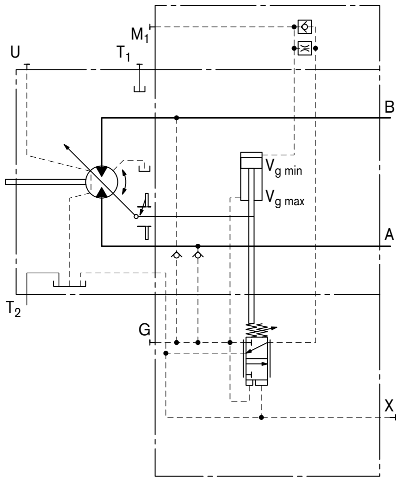
Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 200 bar

Characteristic HA2



Schematic HA2

Sizes 60 to 215 (size 280 on request)



HA – Automatic control high-pressure related

HA.**T3**
Override hydraulic remote control, proportional

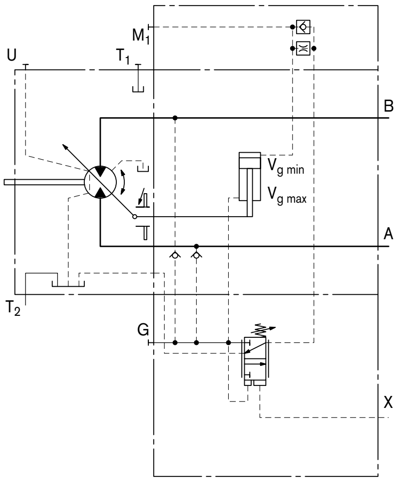
With the HA.T3 control, the beginning of control can be influenced by applying a pilot pressure to port X.

For each 1 bar of pilot pressure increase, the beginning of control is reduced by 17 bar.

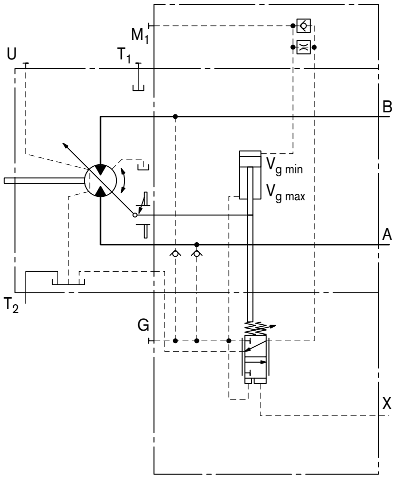
Beginning of control setting	300 bar	300 bar
Pilot pressure at port X	0 bar	10 bar
Beginning of control at	300 bar	130 bar

Note
Maximum permissible pilot pressure 100 bar.

Schematic HA1.T3
Sizes 60 to 215 (size 280 on request)



Schematic HA2.T3
Sizes 60 to 215 (size 280 on request)



HA – Automatic control high-pressure related

HA.**U1**, HA.**U2**
Override electric, two-point

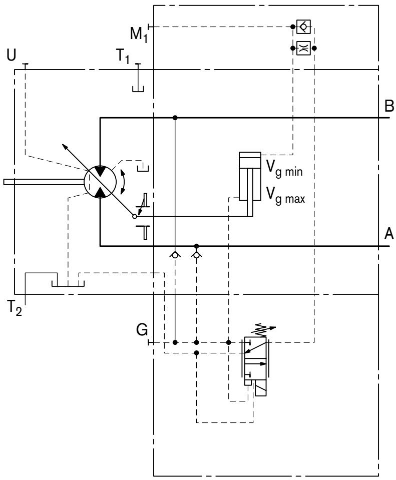
Sizes 60 to 215

With the HA.U1 or HA.U2 control, the beginning of control can be overridden by an electric signal to a switching solenoid. When the override solenoid is energized, the variable motor swivels to maximum swivel angle, without intermediate position. The beginning of control is adjustable between 80 and 300 bar (specify required setting in plain text when ordering).

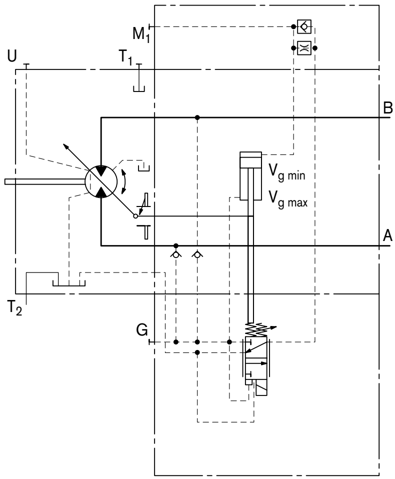
Technical data, solenoid with Ø45

	U1	U2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Displacement $V_{g\ max}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection see connector design page 65		

Schematic HA1U1, HA1U2



Schematic HA2U1, HA2U2



3

HA – Automatic control high-pressure related

HA.**R1**, HA.**R2**
Override electric,
travel direction valve electric (see page 25)

Sizes 60 to 215

With the HA.R1 or HA.R2 control, the beginning of control can be overridden by an electric signal to switching solenoid b. When the override solenoid b is energized, the variable motor swivels to maximum swivel angle, without intermediate position.

The travel direction valve ensures that the preselected pressure side of the hydraulic motor (A or B) is always connected to the HA control, and thus determines the swivel angle, even if the high-pressure side changes (e. g. -travel drive during a downhill operation). This thereby prevents undesired jerky deceleration and/or braking characteristics.

Depending on the direction of rotation (direction of travel), the travel direction valve is actuated through the pressure spring or the switching solenoid a (see page 25 for further details).

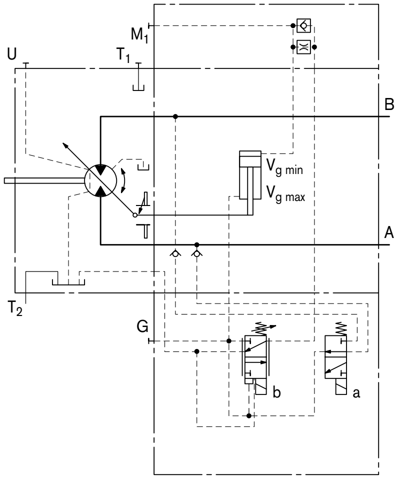
Technical data, solenoid a with Ø37
(travel direction valve)

		R1	**R2**
Voltage		12 V (±20 %)	24 V (±20 %)
No override		de-energized	de-energized
Direction of rotation	Operating pressure in		
ccw	B	energized	energized
cw	A	de-energized	de-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 page 65			

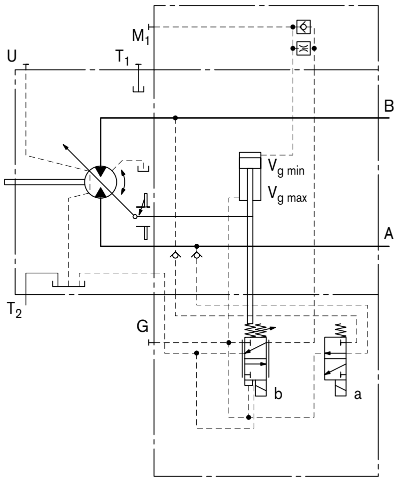
Technical data, solenoid b with Ø45
(electric override)

	R1	**R2**
Voltage	12 V (±20 %)	24 V (±20 %)
No override	de-energized	de-energized
Displacement $V_{g\ max}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection see connector design page 65		

Schematic HA1R1, HA1R2



Schematic HA2R1, HA2R2



DA – Automatic control speed-related

The variable motor A6VM with automatic speed-related control is intended for use in hydrostatic travel drives in combination with the variable pump A4VG with DA control.

A drive-speed-related pilot pressure signal is generated by the A4VG variable pump, and that signal, together with the operating pressure, regulates the swivel angle of the hydraulic motor.

Increasing pump speed, i.e. increasing pilot pressure, causes the motor to swivel to a smaller displacement (lower torque, higher speed), depending on the operating pressure.

If the operating pressure exceeds the pressure setpoint set on the controller, the variable motor swivels to a larger displacement (higher torque, lower speed).

Pressure ratio p_{St}/p_{HD} ______ 5/100

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 motor 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.

Detailed information is available from our sales department and on the Internet at www.boschrexroth.com/da-control.

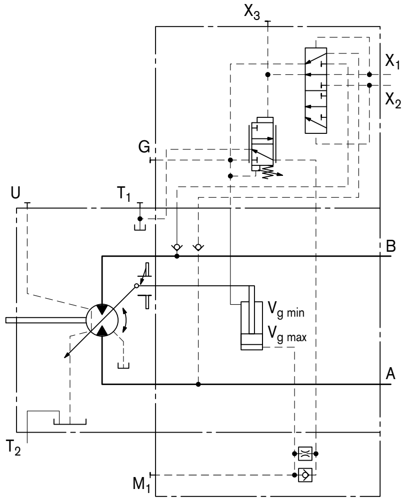
Note
The beginning of control and the DA characteristic are influenced by case pressure. An increase in case pressure causes a decrease in the beginning of control (see page 7) and thus a parallel shift of the characteristic.

DA0
Hydraulic travel direction valve, negative control

Dependent on the direction of rotation (travel direction), the travel direction valve is switched by using pilot pressures connections X_1 or X_2.

Direction of rotation	Operating pressure in	Pilot pressure in
cw	A	X_1
ccw	B	X_2

Schematic DA0
Sizes 60 to 215 (size 280 on request)



3

DA – Automatic control speed-related

DA1, DA2
Electric travel direction valve + electric $V_{g\ max}$-circuit, negative control

The travel direction valve is either spring offset or switched by energizing switching solenoid a, depending on the direction of rotation (travel direction).

When the switching solenoid b is energized, the DA control is overridden and the motor swivels to maximum displacement (high torque, lower speed) (electric $V_{g\ max}$-circuit).

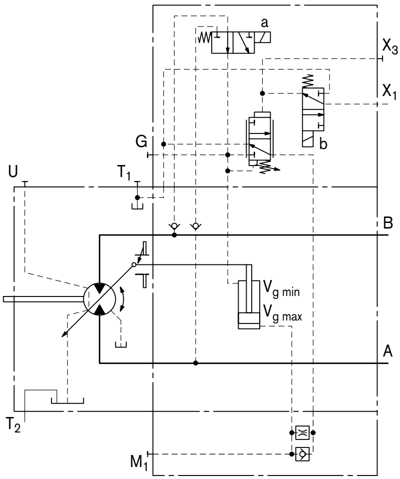
Technical data, solenoid a with Ø37
(travel direction valve)

		DA1	DA2
Voltage		12 V (±20 %)	24 V (±20 %)
Direction of rotation	Operating pressure in		
ccw	B	de-energized	de-energized
cw	A	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 page 65			

Technical data, solenoid b with Ø37
(electric override)

	DA1	DA2
Voltage	12 V (±20 %)	24 V (±20 %)
No override	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 page 65		

Schematic DA1, DA2
Sizes 60 to 215



Electric travel direction valve (for DA, HA.R)

Application in travel drives in closed circuits. The travel direction valve of the motor is actuated by an electric signal that also switches the swivel direction of the travel drive pump (e. g. A4VG with DA control valve).

If the pump in the closed circuit is switched to the neutral position or into reverse, the vehicle may experience jerky deceleration or braking, depending on the vehicle's mass and current travel speed.

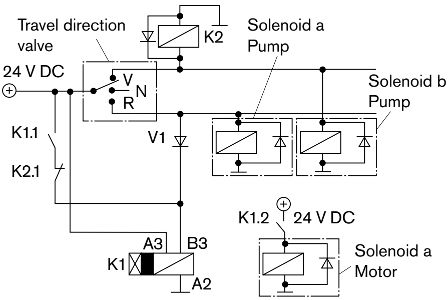
When the travel direction valve of the pump (e. g. 4/3-directional valve of the DA-control) is switched to

– the neutral position,
  the electric circuitry causes the previous signal on the travel direction valve on the motor to be retained.

– reversing,
  the electric circuitry causes the travel direction valve on the motor to switch to the other travel direction following a time delay (approx. 0.8 s) with respect to the pump.

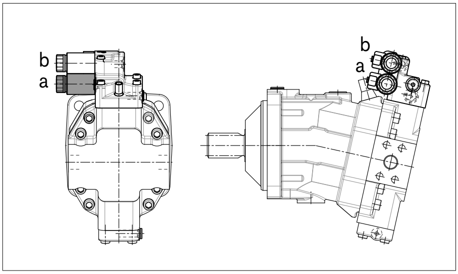
As a result, jerky deceleration or braking is prevented in both cases.

Schematic - electric travel direction valve

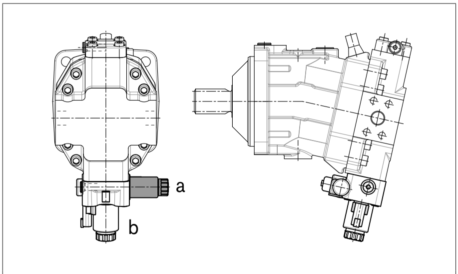


Note
The shown diodes and relays are not included in the delivery of the motor.

DA1, DA2 control (see page 24)



HA1R., HA2R. control (see page 22)



Switching solenoid a on the travel direction valve

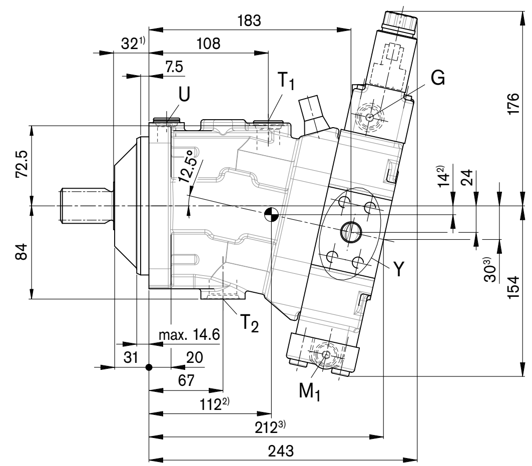
3

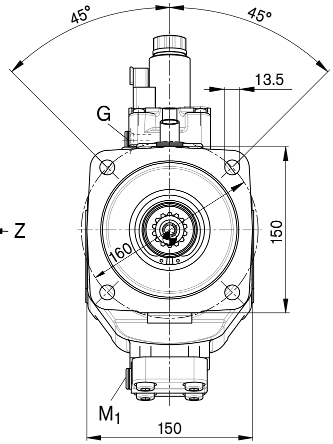
Dimensions size 60

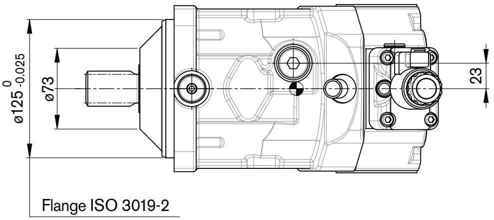
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

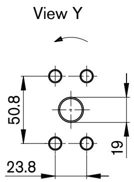
EP5, EP6 – Proportional control electric, negative control

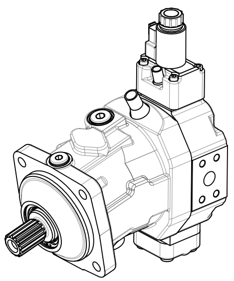
Port plate 2 – SAE flange ports A and B at side, opposite











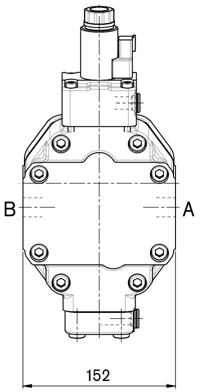
1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 60

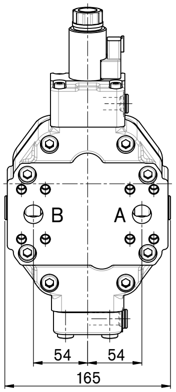
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

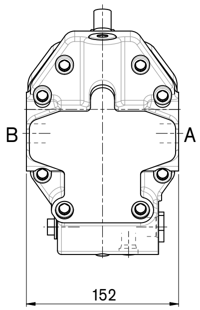
2 SAE flange ports A and B at side, opposite



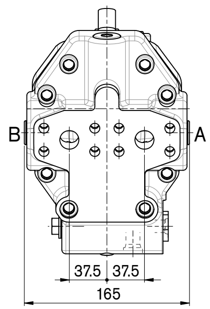
1 SAE flange ports A and B at rear



2 SAE flange ports A and B at side, opposite only HZ7, EZ7/8

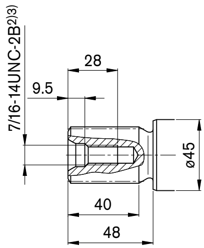


1 SAE flange ports A and B at rear only HZ7, EZ7/8

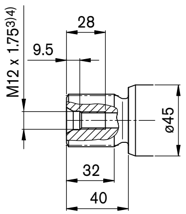


Drive shafts

S7 Splined shaft 1 1/4 in 14 T 12/24DP[1)]



Z8 Splined shaft DIN 5480 W35x2x16x9g



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 76 for the maximum tightening torques.
4) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 60

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

Ports

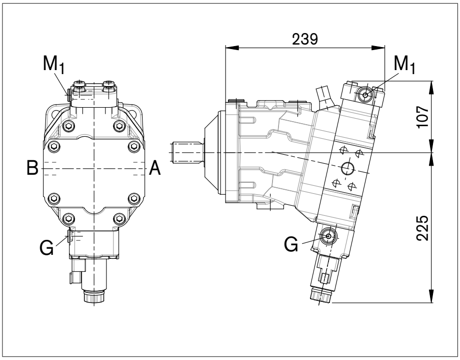
Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 x 1.5; 17 deep	500	O
T_1	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M27 x 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M18 x 1.5; 14.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC–L8xM12–F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	40	X
M_1	Measuring stroking chamber	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X

1) Observe the general instructions on page 76 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 75).
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)

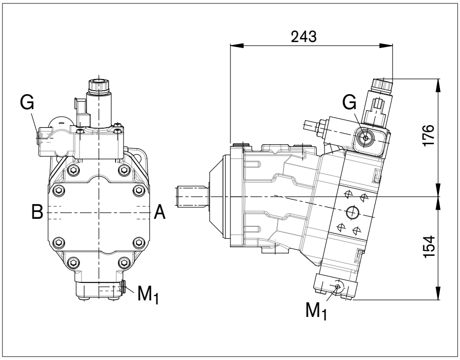
Dimensions size 60

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

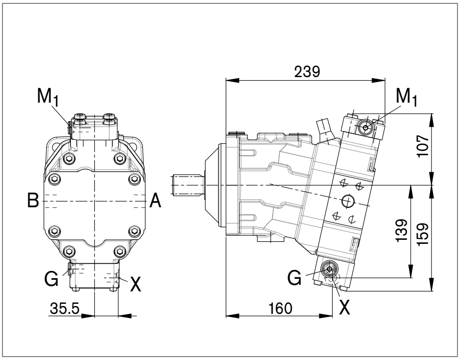
EP1, EP2
Proportional control electric, positive control



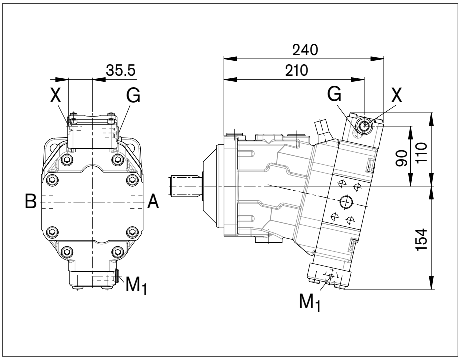
EP5D1, EP6D1
Proportional control electric, negative control, with pressure control fixed setting



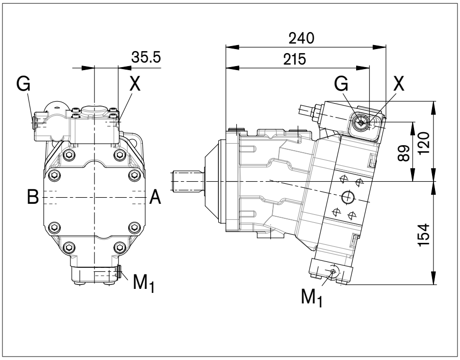
HP1, HP2
Proportional control hydraulic, positive control



HP5, HP6
Proportional control hydraulic, negative control



HP5D1, HP6D1
Proportional control hydraulic, negative control, with pressure control fixed setting



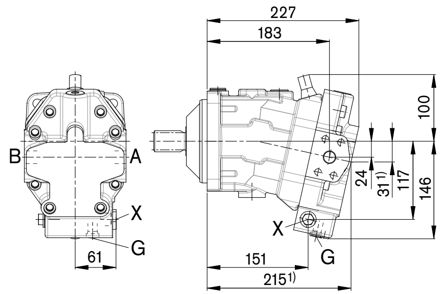
3

Dimensions size 60

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

HZ7

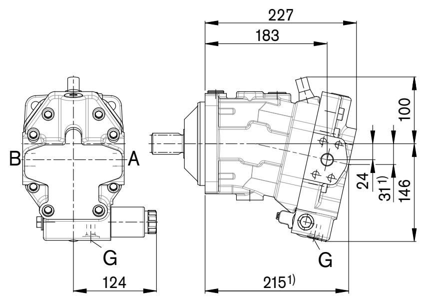
Two-point control hydraulic, negative control



1) Port plate 1 – SAE flange ports A and B at rear

EZ7, EZ8

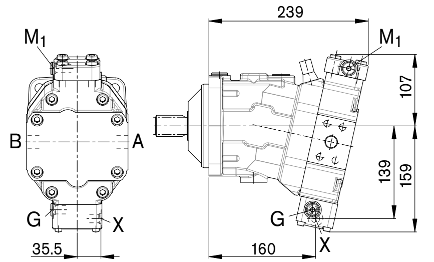
Two-point control electric, negative control



1) Port plate 1 – SAE flange ports A and B at rear

HA1, HA2 / HA1T3, HA2T3

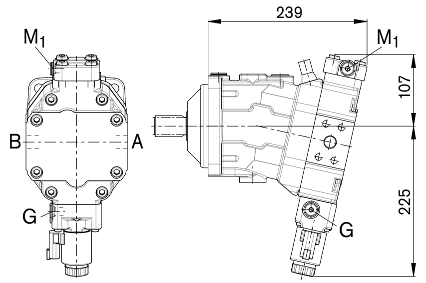
Automatic control high-pressure related, positive control, with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

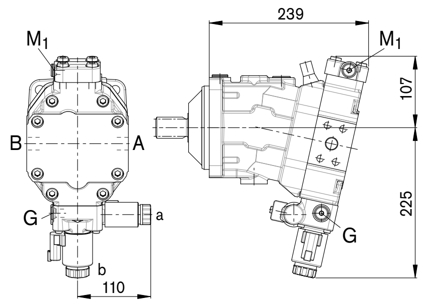
HA1U1, HA2U2

Automatic control high-pressure related, positive control, with override electric, two-point



HA1R1, HA2R2

Automatic control high-pressure related, positive control, with override electric and travel direction valve electric

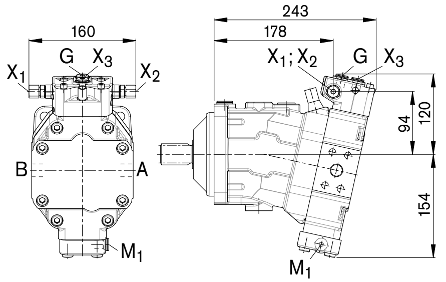


Dimensions size 60

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

DA0

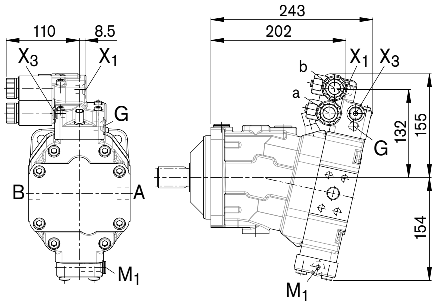
Automatic control speed related, negative control, with hydraulic travel direction valve



X_1, X_2 Pipe fitting SDSC – L8xM12 – F acc. to ISO 8434-1
Use assembled fitting!

DA1, DA2

Automatic control speed related, negative control, with electric travel direction valve and electric $V_{g\ max}$- circuit

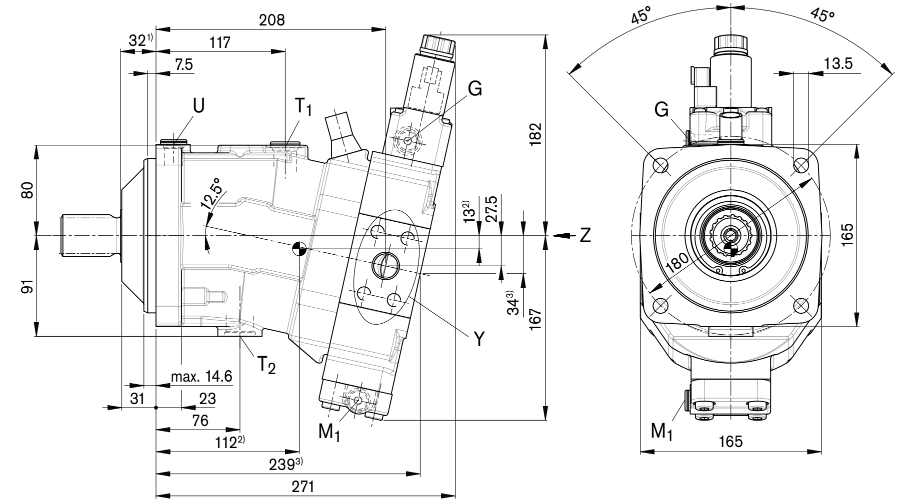


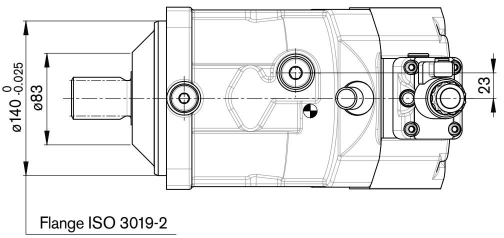
Dimensions size 85

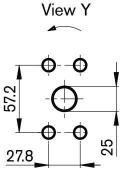
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

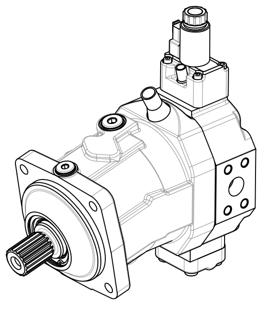
EP5, EP6 – Proportional control electric, negative control

Port plate 2 – SAE flange ports A and B at side, opposite









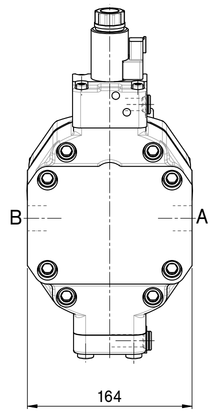
1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 85

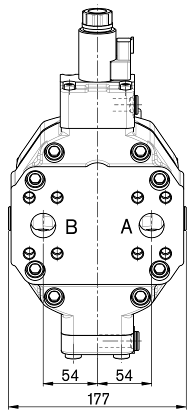
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

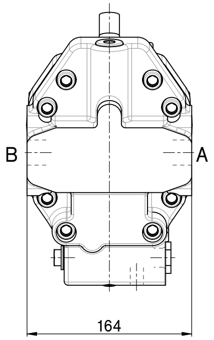
2 SAE flange ports A and B at side, opposite



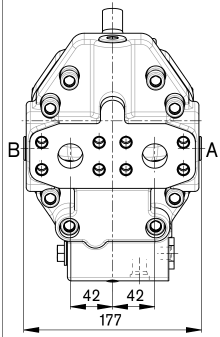
1 SAE flange ports A and B at rear



2 SAE flange ports A and B at side, opposite only HZ7, EZ7/8

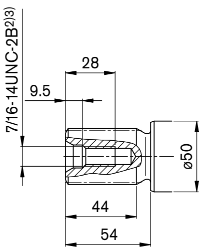


1 SAE flange ports A and B at rear only HZ7, EZ7/8

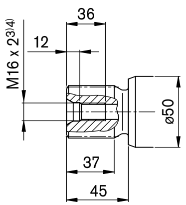


Drive shafts

S9 Splined shaft 1 1/2 in 17 T 12/24DP[1]



Z9 Splined shaft DIN 5480 W40x2x18x9g



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 76 for the maximum tightening torques.
4) Center bore according to DIN 332 (thread according to DIN 13)

3

Dimensions size 85

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

Ports

Designation	Port for	Standard	Size[1)]	Maximum pressure [bar][2)]	State[6)]
A, B	Service line Fastening thread A/B	SAE J518[3)] DIN 13	1 in M12 x 1.75; 17 deep	500	O
T_1	Drain line	ISO 6149[5)]	M22 x 1.5; 15.5 deep	3	X[4)]
T_2	Drain line	ISO 6149[5)]	M27 x 2; 19 deep	3	O[4)]
G	Synchronous control	ISO 6149[5)]	M14 x 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5)]	M18 x 1.5; 14.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5)]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5)]	M14 x 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC–L8xM12–F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5)]	M14 x 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5)]	M14 x 1.5; 11.5 deep	40	X
M_1	Measuring stroking chamber	ISO 6149[5)]	M14 x 1.5; 11.5 deep	500	X

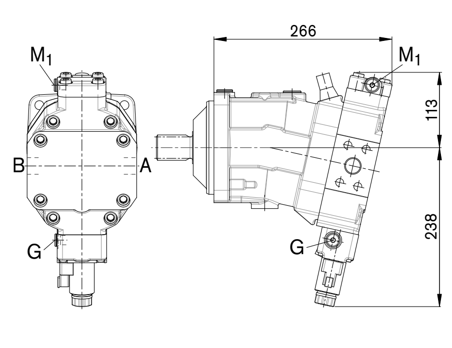
1) Observe the general instructions on page 76 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 75).
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 size 85

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

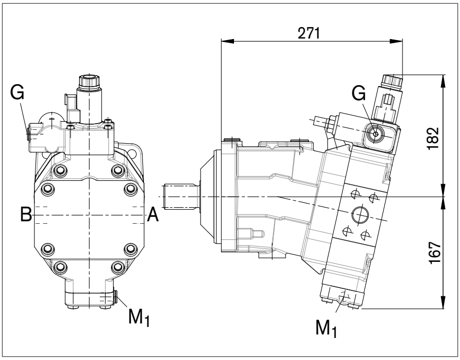
EP1, EP2

Proportional control electric, positive control



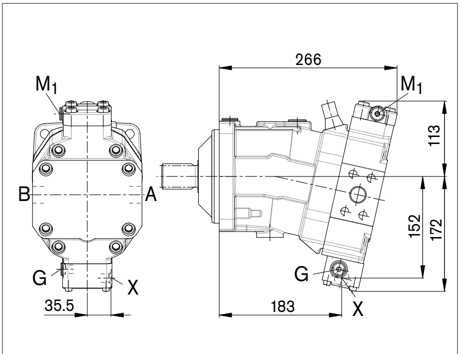
EP5D1, EP6D1

Proportional control electric, negative control, with pressure control fixed setting



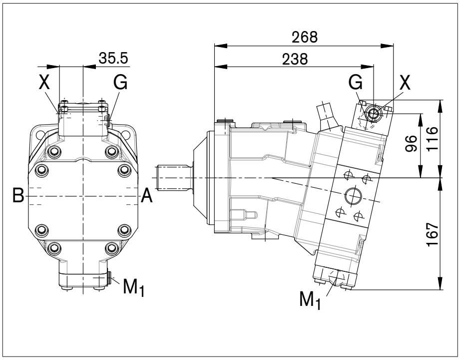
HP1, HP2

Proportional control hydraulic, positive control



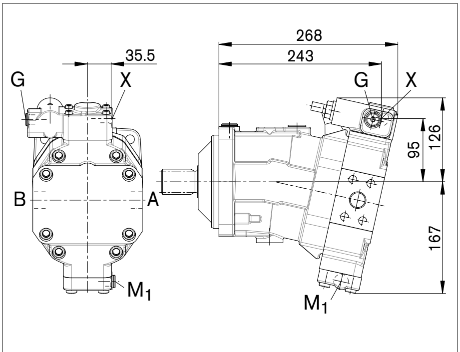
HP5, HP6

Proportional control hydraulic, negative control



HP5D1, HP6D1

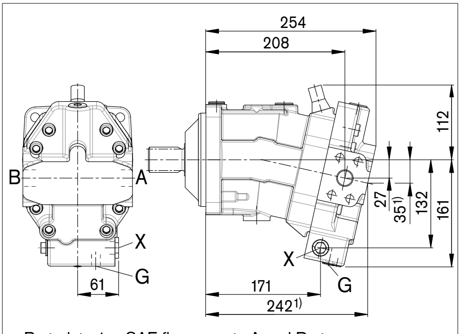
Proportional control hydraulic, negative control, with pressure control fixed setting



Dimensions size 85

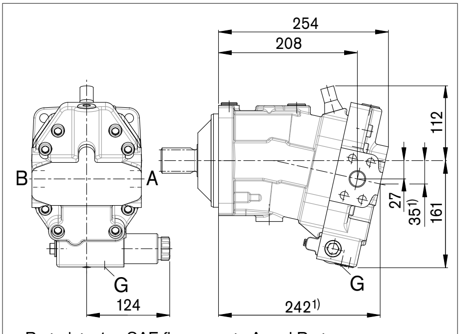
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HZ7
Two-point control hydraulic, negative control



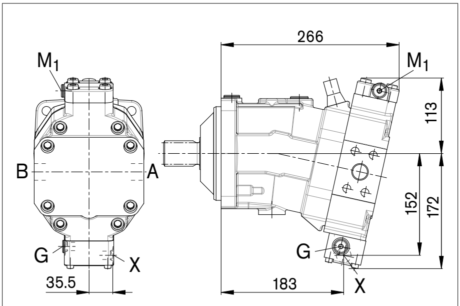
1) Port plate 1 – SAE flange ports A and B at rear

EZ7, EZ8
Two-point control electric, negative control



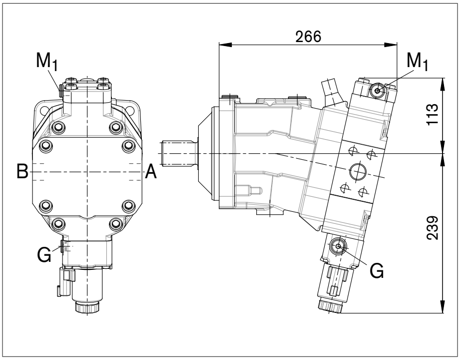
1) Port plate 1 – SAE flange ports A and B at rear

HA1, HA2 / HA1T3, HA2T3
Automatic control high-pressure related, positive control, with override hydraulic remote control, proportional

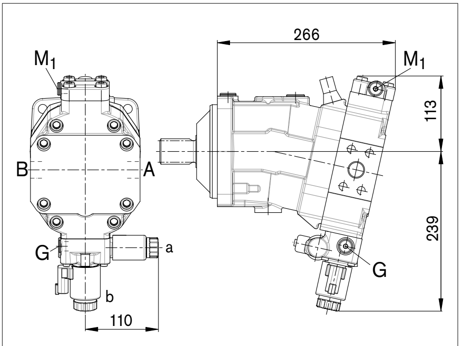


HA1 and HA2, X plugged
HA1T and HA2T, X open

HA1U1, HA2U2
Automatic control high-pressure related, positive control, with override electric, two-point



HA1R1, HA2R2
Automatic control high-pressure related, positive control, with override electric and travel direction valve electric

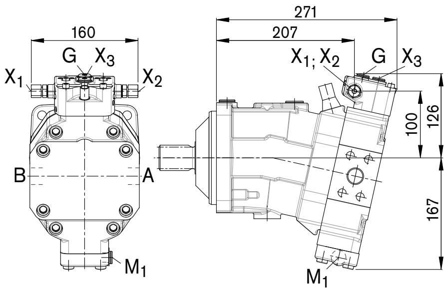


Dimensions size 85

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

DA0

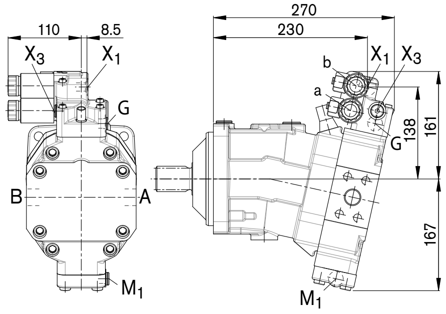
Automatic control speed related, negative control, with hydraulic travel direction valve



X_1, X_2 Pipe fitting SDSC – L8xM12 – F acc. to ISO 8434-1
Use assembled fitting!

DA1, DA2

Automatic control speed related, negative control, with electric travel direction valve and electric $V_{g\ max}$- circuit



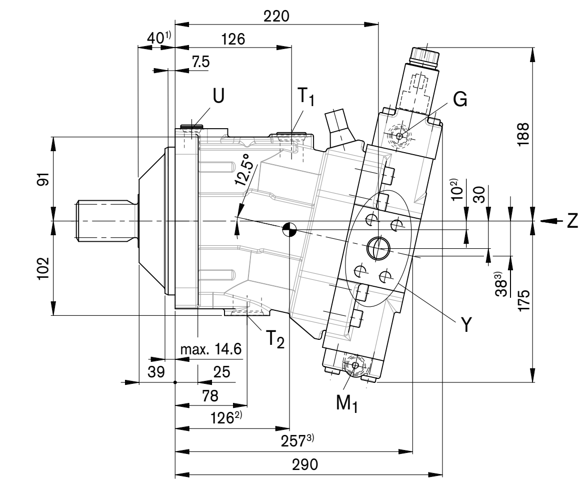
3

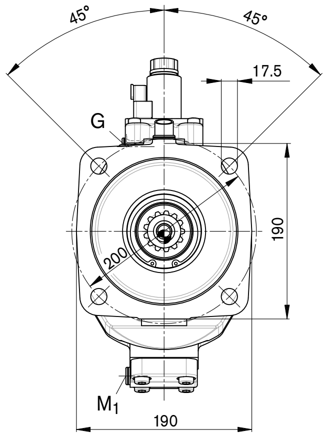
Dimensions size 115

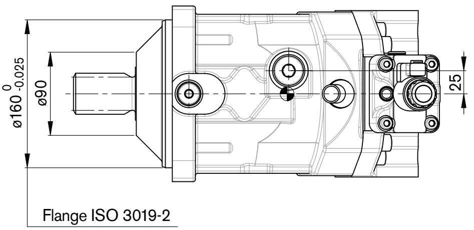
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

EP5, EP6 – Proportional control electric, negative control

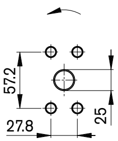
Port plate 2 – SAE flange ports A and B at side, opposite

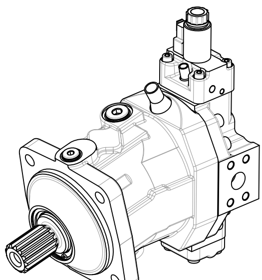






View Y



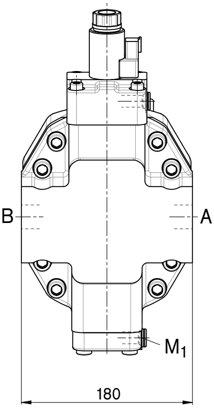
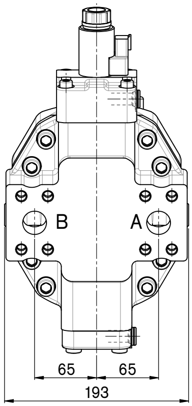
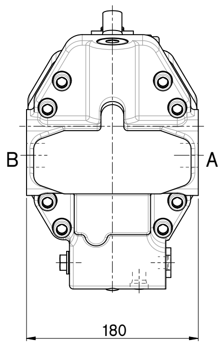
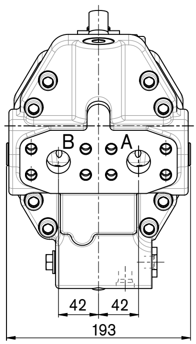


1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

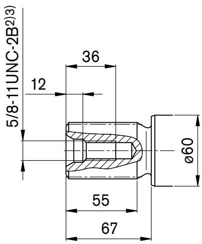
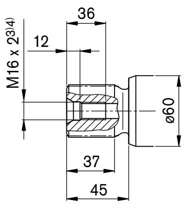
Dimensions size 115

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

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite	**1** SAE flange ports A and B at rear	**2** SAE flange ports A and B at side, opposite only HZ7, EZ7/8	**1** SAE flange ports A and B at rear only HZ7, EZ7/8
			

Drive shafts

T1 Splined shaft 1 3/4 in 13 T 8/16DP[1]	**Z9** Splined shaft DIN 5480 W40x2x18x9g
	

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 76 for the maximum tightening torques.
4) Center bore according to DIN 332 (thread according to DIN 13)

3

Dimensions size 115

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

Ports

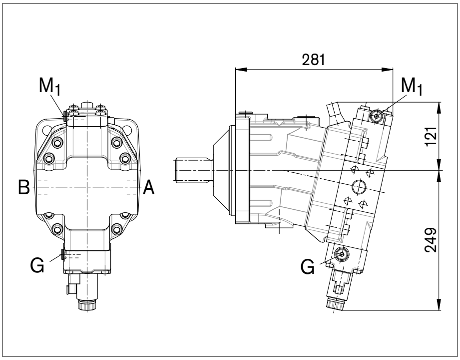
Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	500	O
T_1	Drain line	ISO 6149[5]	M27 x 2; 19 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M33 x 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M18 x 1.5; 14.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC–L8xM12–F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	40	X
M_1	Measuring stroking chamber	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X

1) Observe the general instructions on page 76 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 75).
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)

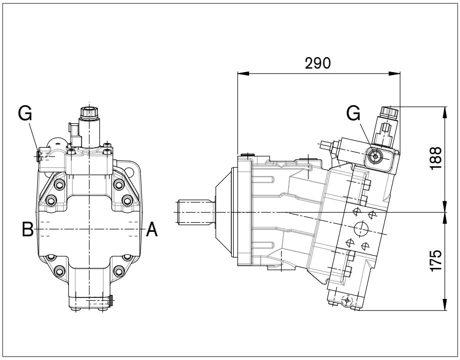
Dimensions size 115

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

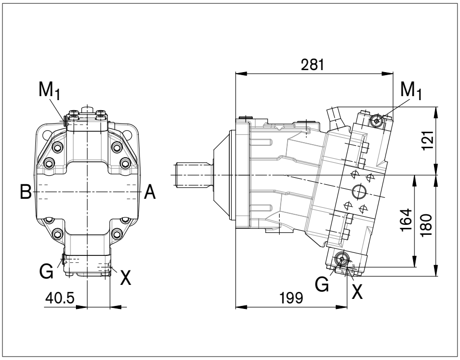
EP1, EP2
Proportional control electric, positive control



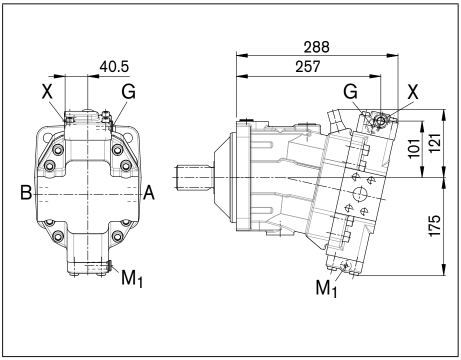
EP5D1, EP6D1
Proportional control electric, negative control, with pressure control fixed setting



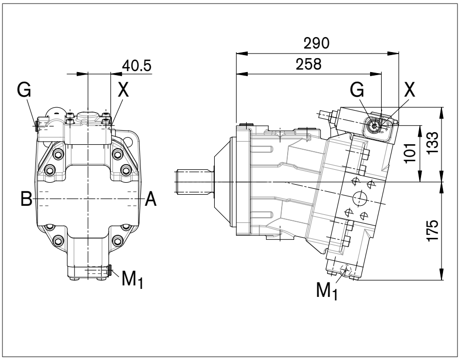
HP1, HP2
Proportional control hydraulic, positive control



HP5, HP6
Proportional control hydraulic, negative control



HP5D1, HP6D1
Proportional control hydraulic, negative control, with pressure control fixed setting

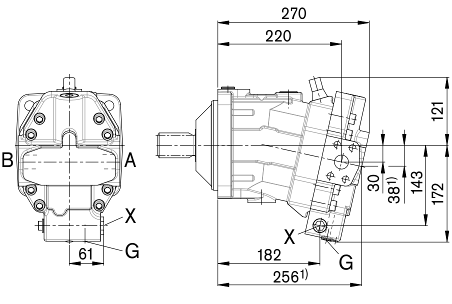


3

Dimensions size 115

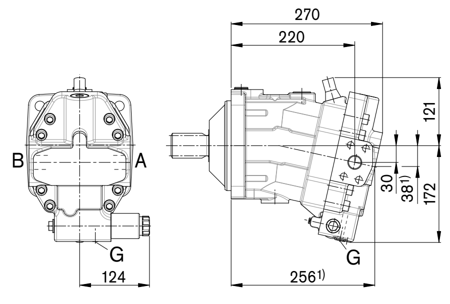
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HZ7
Two-point control hydraulic, negative control



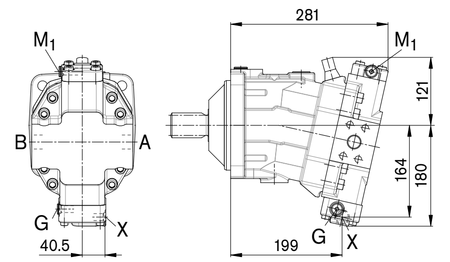
1) Port plate 1 – SAE flange ports A and B at rear

EZ7, EZ8
Two-point control electric, negative control



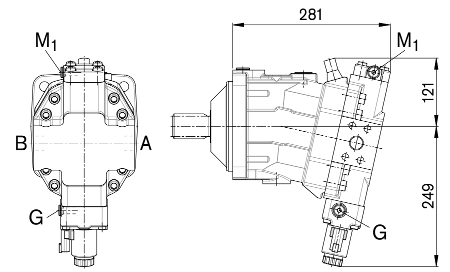
1) Port plate 1 – SAE flange ports A and B at rear

HA1, HA2 / HA1T3, HA2T3
Automatic control high-pressure related, positive control, with override hydraulic remote control, proportional

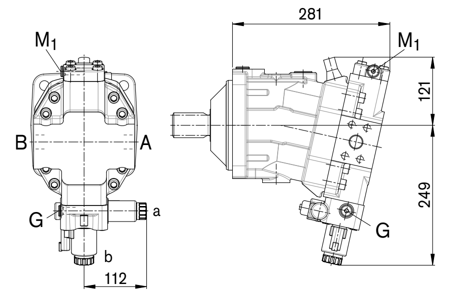


HA1 and HA2, X plugged
HA1T and HA2T, X open

HA1U1, HA2U2
Automatic control high-pressure related, positive control, with override electric, two-point



HA1R1, HA2R2
Automatic control high-pressure related, positive control, with override electric and travel direction valve electric

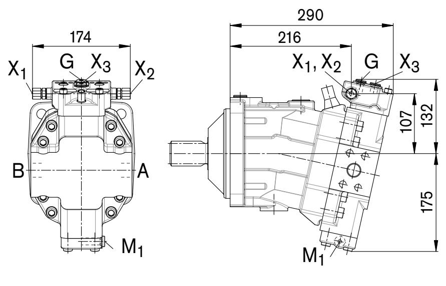


Dimensions size 115

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

DA0

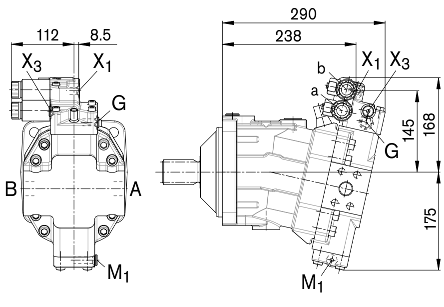
Automatic control speed related, negative control, with hydraulic travel direction valve



X_1, X_2 Pipe fitting SDSC – L8xM12 – F acc. to ISO 8434-1
Use assembled fitting!

DA1, DA2

Automatic control speed related, negative control, with electric travel direction valve and electric $V_{g\ max}$- circuit



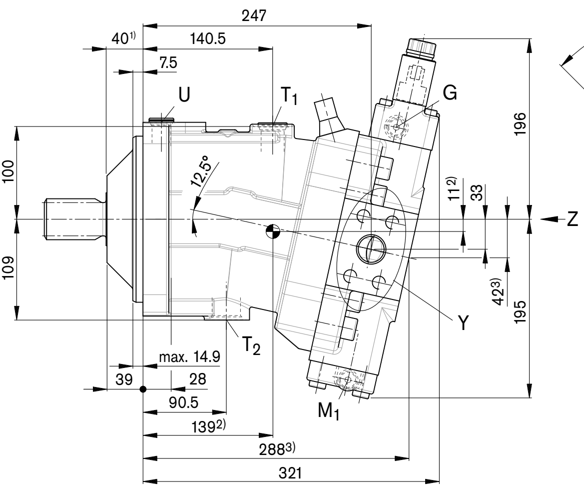
3

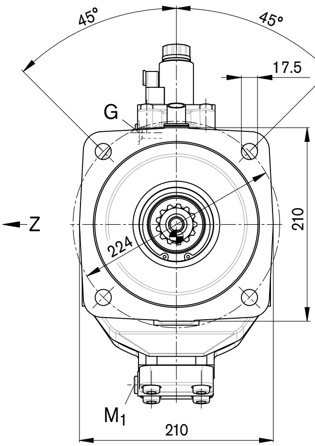
Dimensions size 150

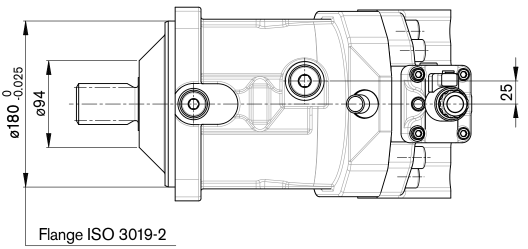
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

EP5, EP6 – Proportional control electric, negative control

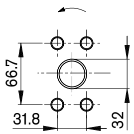
Port plate 2 – SAE flange ports A and B at side, opposite

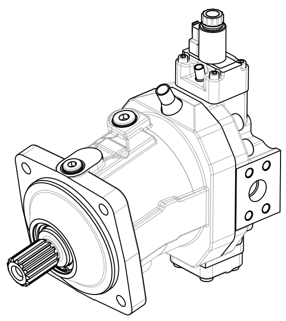






View Y





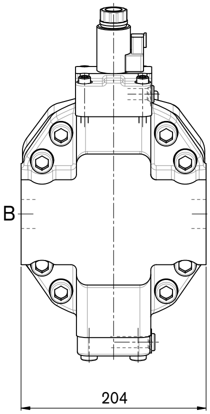
1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 150

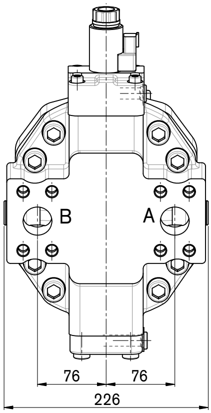
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite

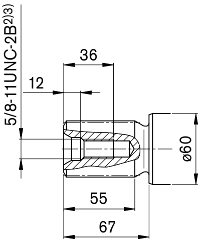


1 SAE flange ports A and B at rear

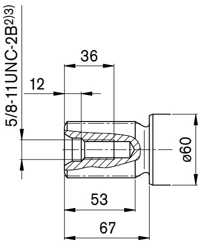


Drive shafts

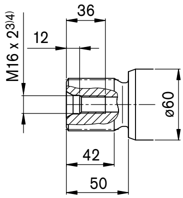
T1 Splined shaft 1 3/4 in 13 T 8/16DP[1]



T2 Splined shaft 2 in 15 T 8/16DP[1]



A1 Splined shaft DIN 5480 W45x2x21x9g



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 76 for the maximum tightening torques.
4) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 150

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

Ports

Designation	Port for	Standard	Size[1)]	Maximum pressure [bar][2)]	State[6)]
A, B	Service line Fastening thread A/B	SAE J518[3)] DIN 13	1 1/4 in M14 x 2; 19 deep	500	O
T_1	Drain line	ISO 6149[5)]	M27 x 2; 19 deep	3	X[4)]
T_2	Drain line	ISO 6149[5)]	M33 x 2; 19 deep	3	O[4)]
G	Synchronous control	ISO 6149[5)]	M14 x 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5)]	M22 x 1.5; 15.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5)]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5)]	M14 x 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC–L8xM12–F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5)]	M14 x 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5)]	M14 x 1.5; 11.5 deep	40	X
M_1	Measuring stroking chamber	ISO 6149[5)]	M14 x1.5; 11.5 deep	500	X

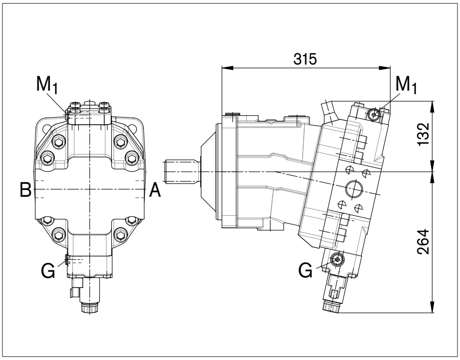
1) Observe the general instructions on page 76 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 75).
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 size 150

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

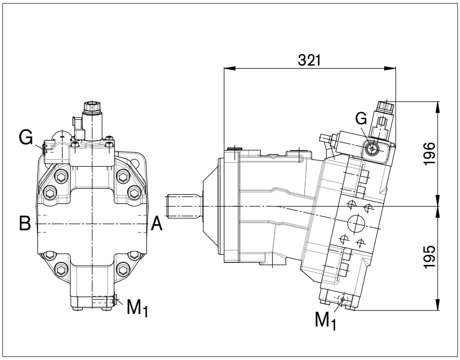
EP1, EP2

Proportional control electric, positive control



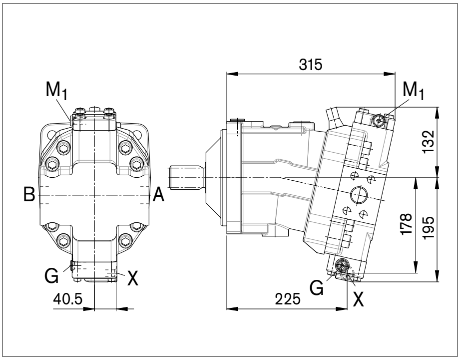
EP5D1, EP6D1

Proportional control electric, negative control, with pressure control fixed setting



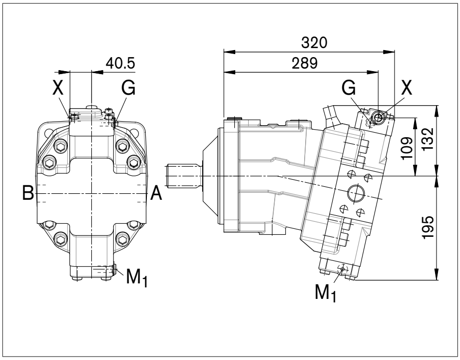
HP1, HP2

Proportional control hydraulic, positive control



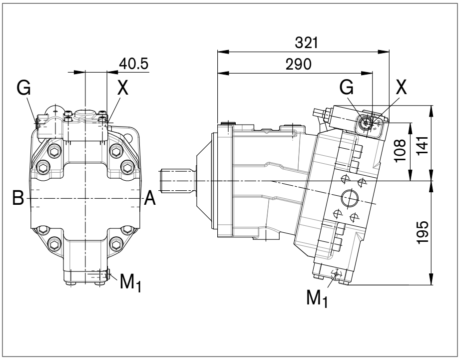
HP5, HP6

Proportional control hydraulic, negative control



HP5D1, HP6D1

Proportional control hydraulic, negative control, with pressure control fixed setting

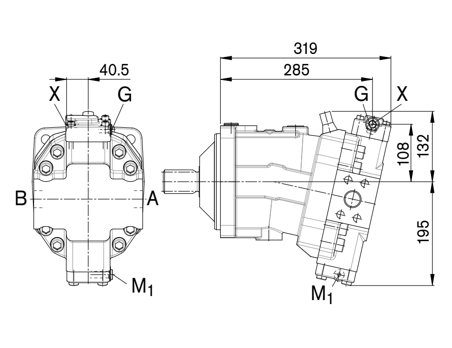


Dimensions size 150

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

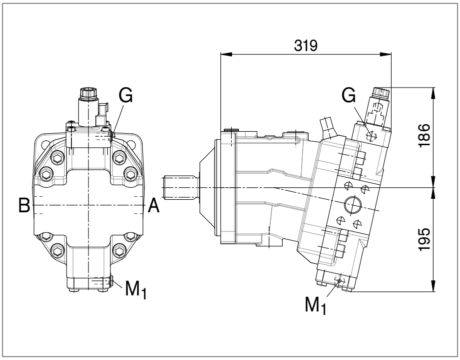
HZ5

Two-point control hydraulic, negative control



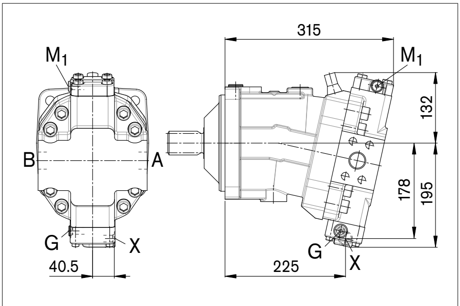
EZ5, EZ6

Two-point control electric, negative control



HA1, HA2 / HA1T3, HA2T3

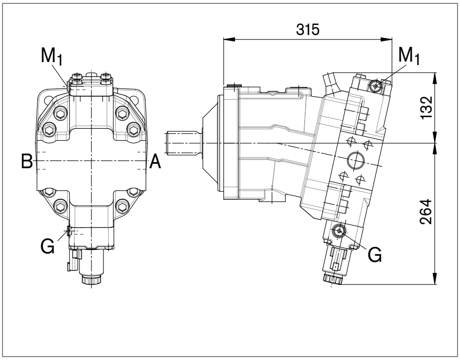
Automatic control high-pressure related, positive control, with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

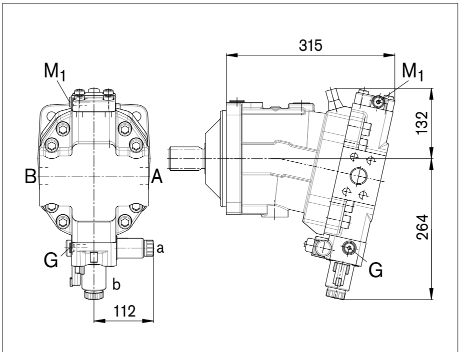
HA1U1, HA2U2

Automatic control high-pressure related, positive control, with override electric, two-point



HA1R1, HA2R2

Automatic control high-pressure related, positive control, with override electric and travel direction valve electric

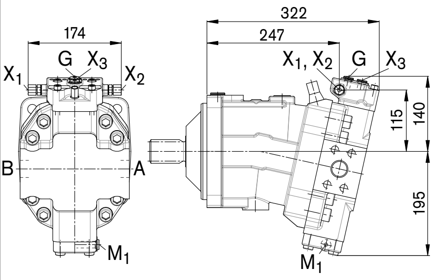


Dimensions size 150

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

DA0

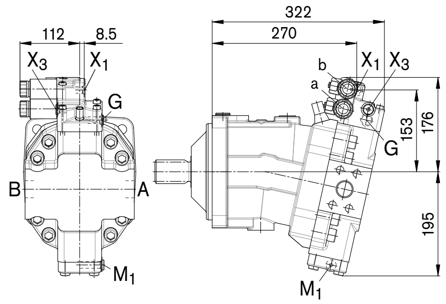
Automatic control speed related, negative control, with hydraulic travel direction valve



X_1, X_2 Pipe fitting SDSC – L8xM12 – F acc. to ISO 8434-1
Use assembled fitting!

DA1, DA2

Automatic control speed related, negative control, with electric travel direction valve and electric $V_{g\ max}$- circuit



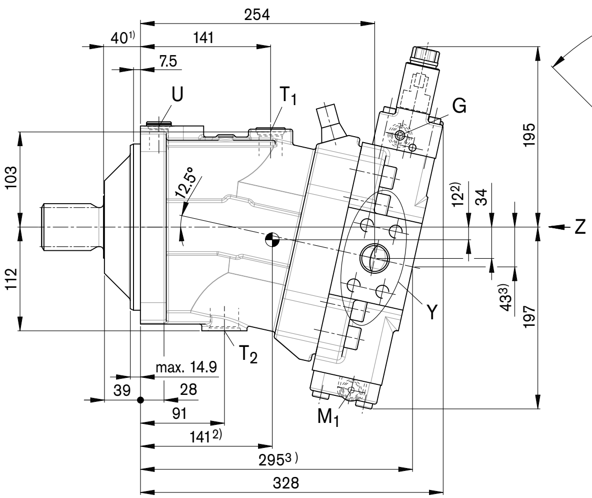
3

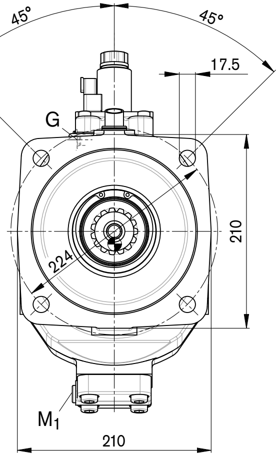
Dimensions size 170

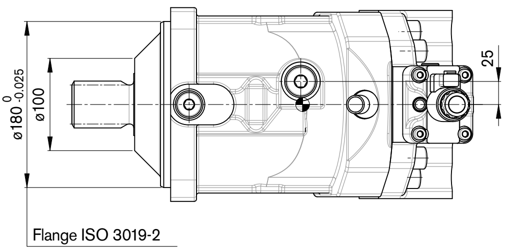
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

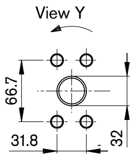
EP5, EP6 – Proportional control electric, negative control

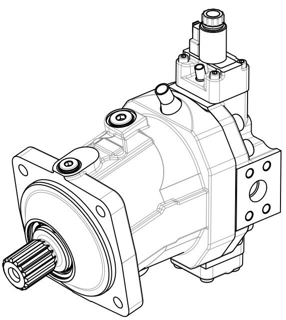
Port plate 2 – SAE flange ports A and B at side, opposite











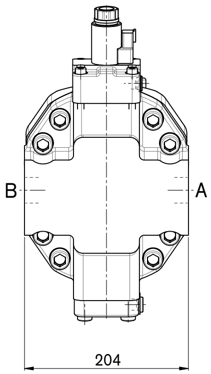
1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 170

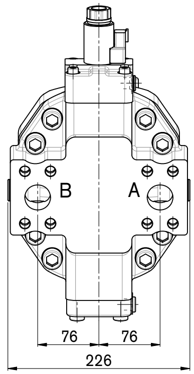
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite

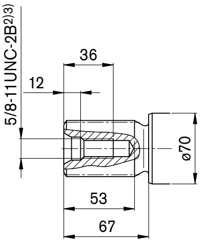


1 SAE flange ports A and B at rear

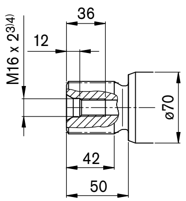


Drive shafts

T2 Splined shaft 2 in 15 T 8/16DP1)



A1 Splined shaft DIN 5480 W45x2x21x9g



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 76 for the maximum tightening torques.
4) Center bore according to DIN 332 (thread according to DIN 13)

3

Dimensions size 170

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

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	500	O
T_1	Drain line	ISO 6149[5]	M27 x 2; 19 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M33 x 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 x1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC–L8xM12–F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	40	X
M_1	Measuring stroking chamber	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X

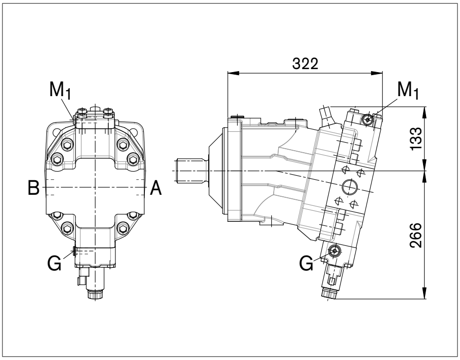
1) Observe the general instructions on page 76 for the maximum tightening torques.
2) Momentary pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
3) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 75).
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 size 170

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

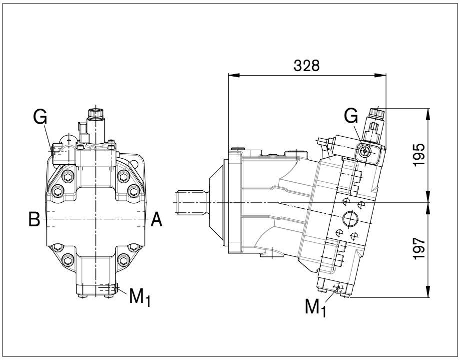
EP1, EP2

Proportional control electric, positive control



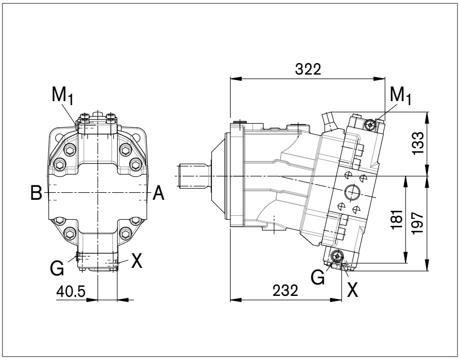
EP5D1, EP6D1

Proportional control electric, negative control, with pressure control fixed setting



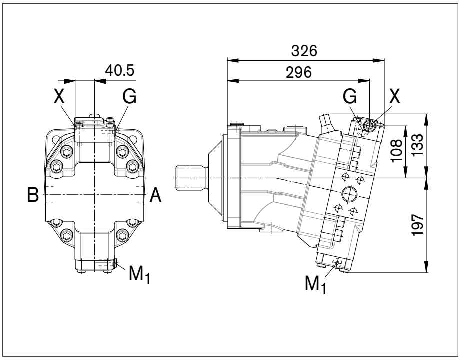
HP1, HP2

Proportional control hydraulic, positive control



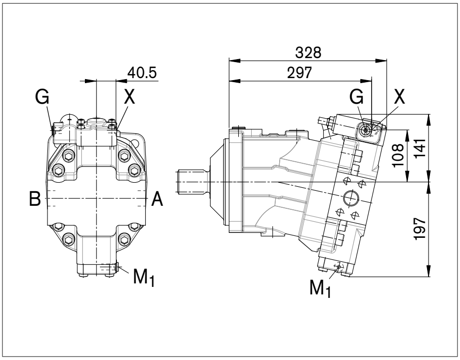
HP5, HP6

Proportional control hydraulic, negative control



HP5D1, HP6D1

Proportional control hydraulic, negative control, with pressure control fixed setting

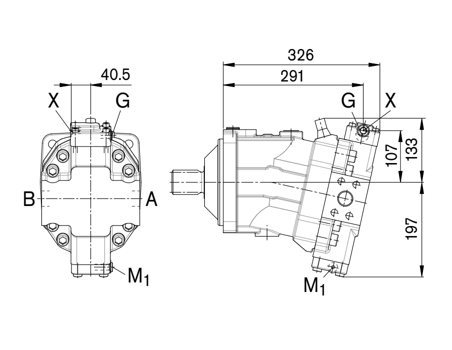


3

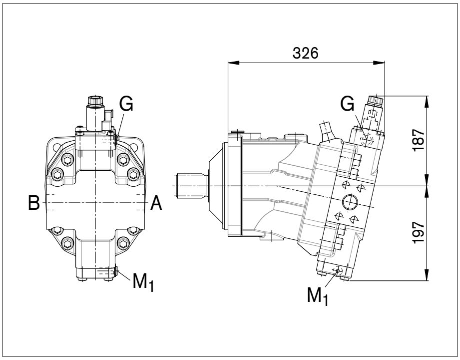
Dimensions size 170

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

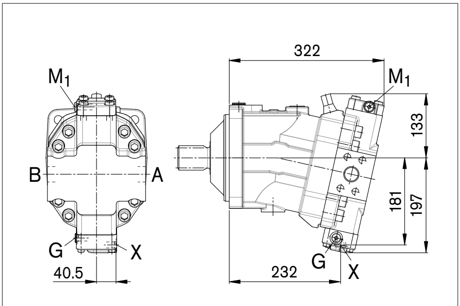
HZ5
Two-point control hydraulic, negative control



EZ5, EZ6
Two-point control electric, negative control

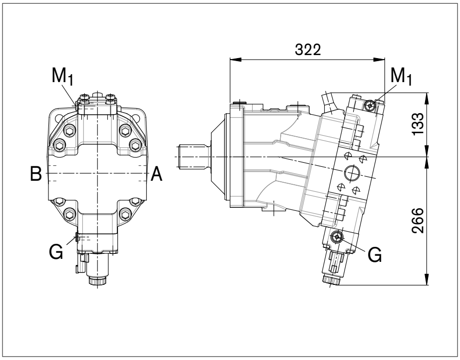


HA1, HA2 / HA1T3, HA2T3
Automatic control high-pressure related, positive control, with override hydraulic remote control, proportional

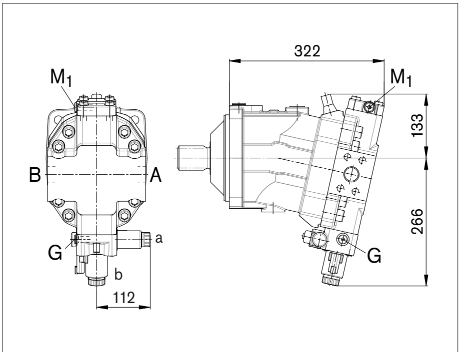


HA1 and HA2, X plugged
HA1T and HA2T, X open

HA1U1, HA2U2
Automatic control high-pressure related, positive control, with override electric, two-point



HA1R1, HA2R2
Automatic control high-pressure related, positive control, with override electric and travel direction valve electric

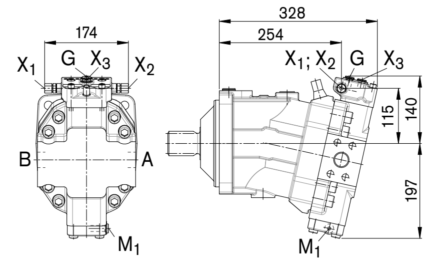


Dimensions size 170

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

DA0

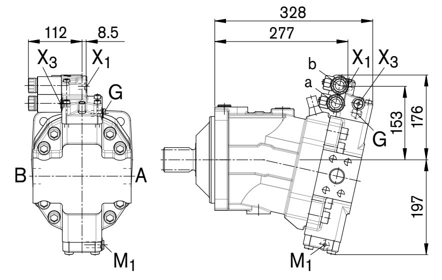
Automatic control speed related, negative control, with hydraulic travel direction valve



X_1, X_2 Pipe fitting SDSC – L8xM12 – F acc. to ISO 8434-1
Use assembled fitting!

DA1, DA2

Automatic control speed related, negative control, with electric travel direction valve and electric $V_{g\ max}$- circuit



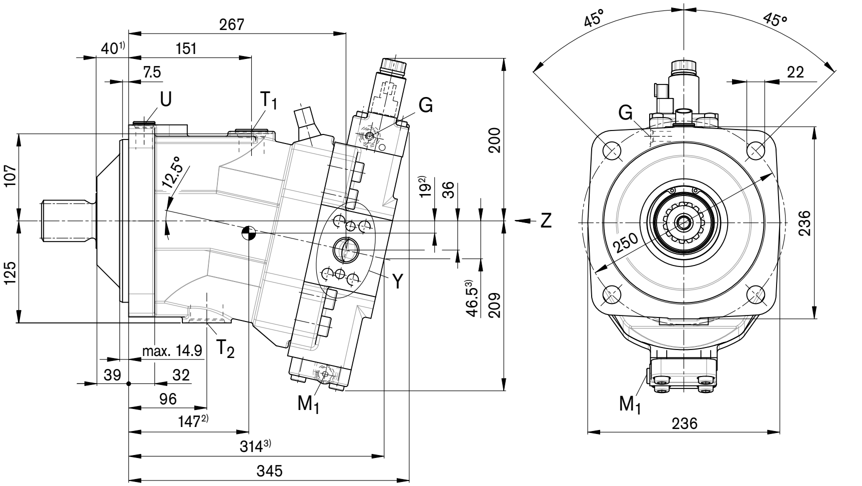
3

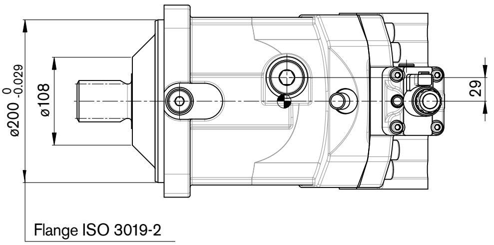
Dimensions size 215

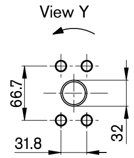
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

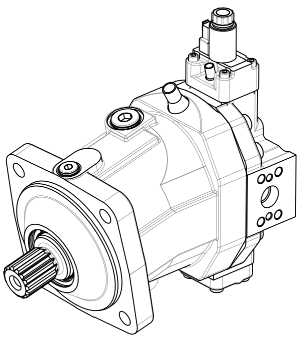
EP5, EP6 – Proportional control electric, negative control

Port plate 2 – SAE flange ports A and B at side, opposite









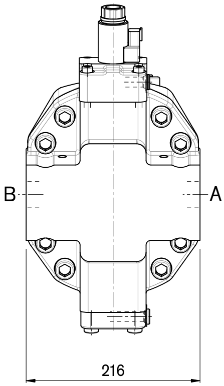
1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 215

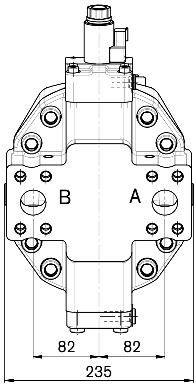
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite

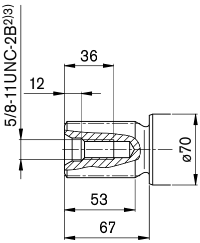


1 SAE flange ports A and B at rear

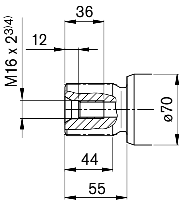


Drive shafts

T2 Splined shaft 2 in 15 T 8/16DP[1]



A2 Splined shaft DIN 5480 W50x2x24x9g



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 76 for the maximum tightening torques.
4) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 215

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

Ports

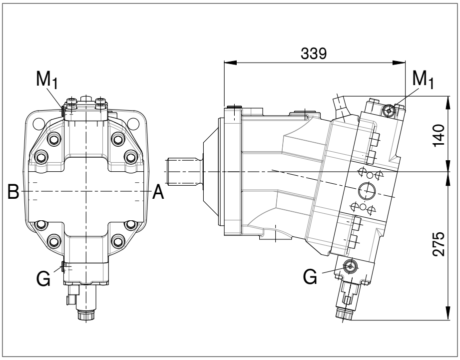
Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	500	O
T_1	Drain line	ISO 6149[5]	M33 x 2; 19 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M42 x 2; 19.5 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	3	X
X_1, X_2	Pilot signal (DA0)	ISO 8434-1	SDSC–L8xM12–F	40	O
X_1	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	40	O
X_3	Pilot signal (DA1, DA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	40	X
M_1	Measuring stroking chamber	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X

1) Observe the general instructions on page 76 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 75).
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)

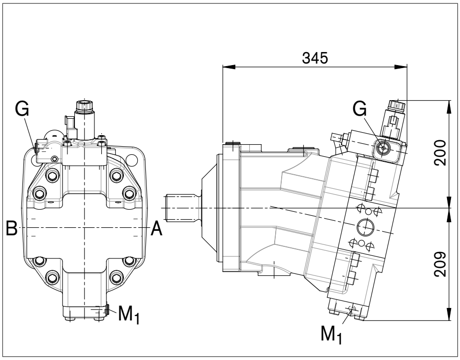
Dimensions size 215

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

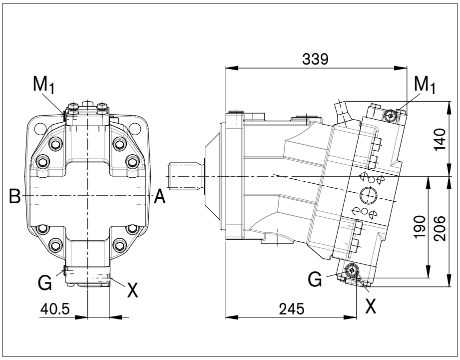
EP1, EP2
Proportional control electric, positive control



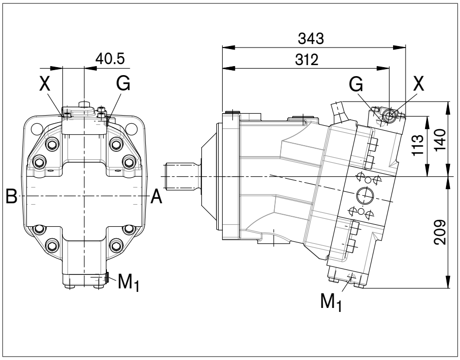
EP5D1, EP6D1
Proportional control electric, negative control, with pressure control fixed setting



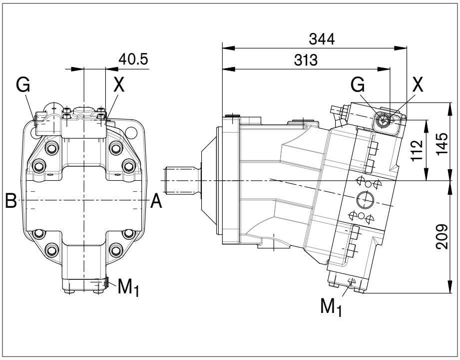
HP1, HP2
Proportional control hydraulic, positive control



HP5, HP6
Proportional control hydraulic, negative control



HP5D1, HP6D1
Proportional control hydraulic, negative control, with pressure control fixed setting



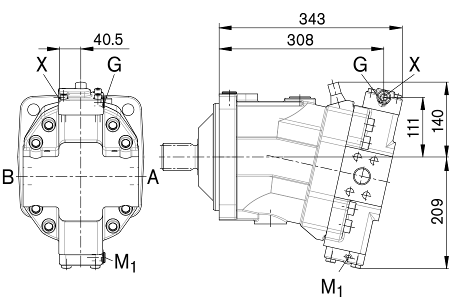
3

Dimensions size 215

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

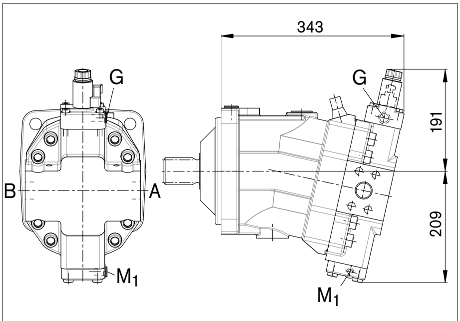
HZ5

Two-point control hydraulic, negative control



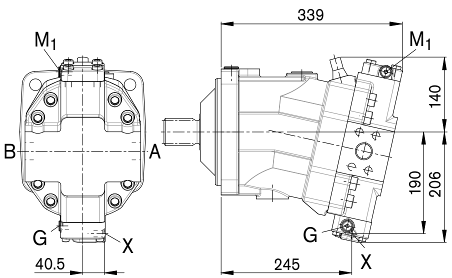
EZ5, EZ6

Two-point control electric, negative control



HA1, HA2 / HA1T3, HA2T3

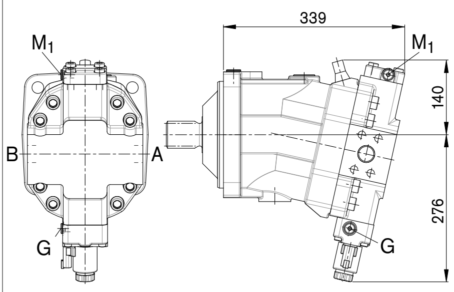
Automatic control high-pressure related, positive control, with override hydraulic remote control, proportional



HA1 and HA2, X plugged
HA1T and HA2T, X open

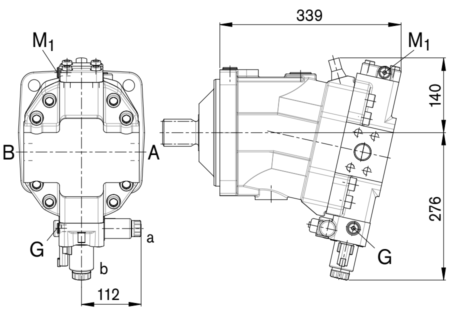
HA1U1, HA2U2

Automatic control high-pressure related, positive control, with override electric, two-point



HA1R1, HA2R2

Automatic control high-pressure related, positive control, with override electric and travel direction valve electric

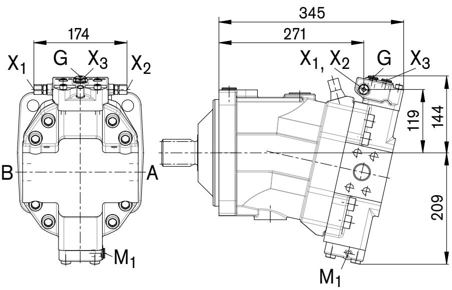


Dimensions size 215

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

DA0

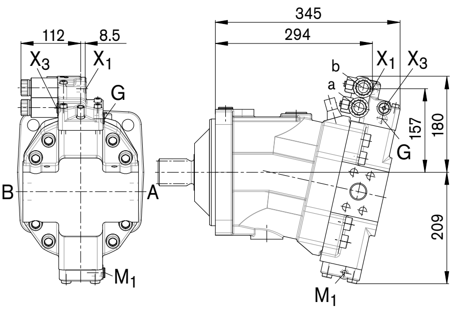
Automatic control speed related, negative control, with hydraulic travel direction valve



X_1, X_2 Pipe fitting SDSC – L8xM12 – F acc. to ISO 8434-1
Use assembled fitting!

DA1, DA2

Automatic control speed related, negative control, with electric travel direction valve and electric $V_{g\ max}$- circuit

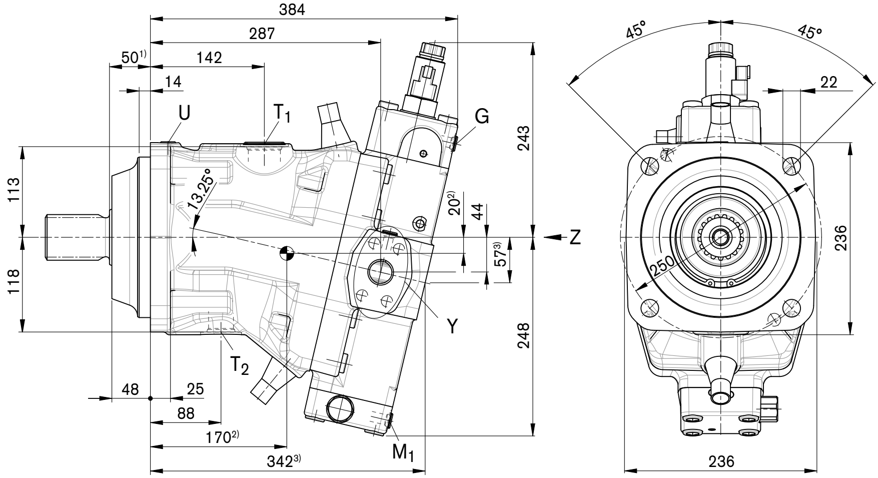


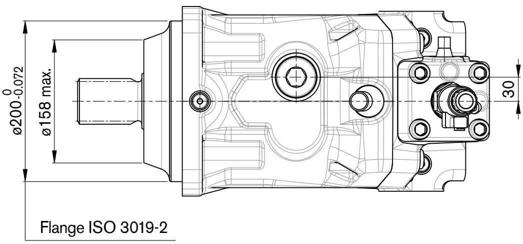
Dimensions size 280

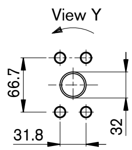
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

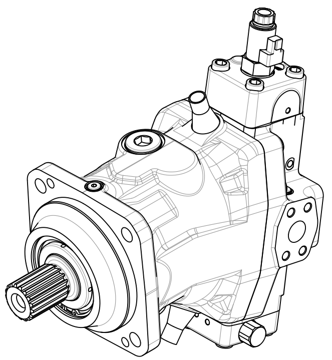
EP5, EP6 – Proportional control electric, negative control

Port plate 2 – SAE flange ports A and B at side, opposite









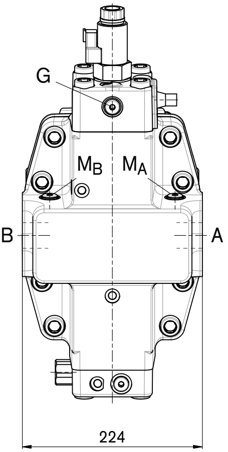
1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear

Dimensions size 280

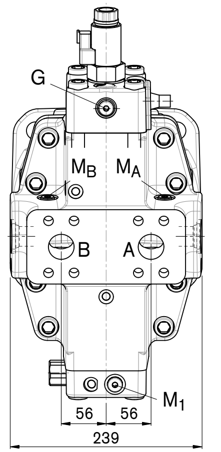
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite

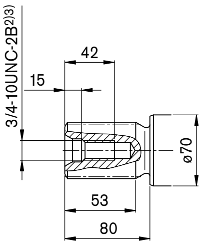


1 SAE flange ports A and B at rear

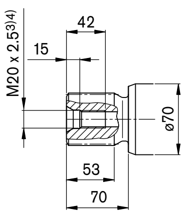


Drive shafts

T3 Splined shaft 2 1/4 in 17 T 8/16DP[1)]



A4 Splined shaft DIN 5480 W60x2x28x9g



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 76 for the maximum tightening torques.
4) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions size 280

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

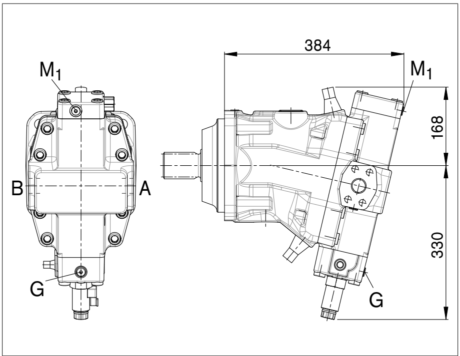
Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[6]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 1/4 in M14 x 2; 19 deep	500	O
T_1	Drain line	ISO 6149[5]	M42 x 2; 19.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M33 x 2; 19 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X
U	Bearing flushing	ISO 6149[5]	M14 x 1.5; 11.5 deep	3	X
M_1	Measuring stroking chamber	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X
M_A	Measuring pressure A	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X
M_B	Measuring pressure B	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X

1) Observe the general instructions on page 76 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 75).
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)

EP1, EP2

Proportional control electric, positive control



Connector for solenoids

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

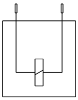
DEUTSCH DT04-2P-EP04

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

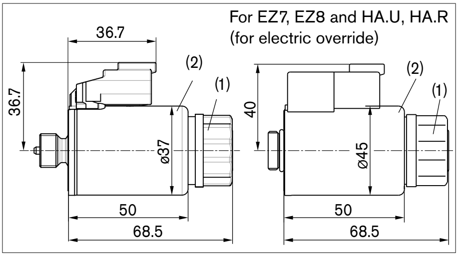


Mating connector

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. (WAF26, 12-sided DIN 3124)

On delivery, the connector orientation may differ from that shown in the brochure or drawing.

3

Flushing and boost pressure valve

The flushing and boost pressure valve is used to remove heat from the hydraulic circuit.

In an open circuit, it is used only for flushing the housing.

In a closed circuit, it ensures a minimum boost pressure level in addition to the case flushing.

Hydraulic fluid is directed from the respective low pressure side into the motor housing. This is then fed into the reservoir, together with the case drain fluid. The hydraulic fluid, removed out of the closed circuit must be replaced by cooled hydraulic fluid from the boost pump.

The valve is mounted onto the port plate or integrated (depending on the control type and size).

Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
Sizes 60 to 215, fixed setting ______ 16 bar
Size 280, adjustable ______ 15 to 35 bar

Switching pressure of flushing piston Δp
Sizes 60 to 115 (small flushing valve) ______ 8±1 bar
Sizes 115 to 215 (medium and large flushing valve) 17.5±1.5 bar
Size 280 ______ on request

Flushing flow q_v
Sizes 60 bis 215
Orifices can be used to set the flushing flows as required.
Following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G = 25$ bar und $\nu = 10\ mm^2/s$
(p_{ND} = low pressure, p_G = case pressure)
Size 280
(Flushing volume up to 60 L/min adjustable, please contact us)

Small flushing valve for sizes 60 to 115

Material number of orifice	ø [mm]	q_v [L/min]	Code
R909651766	1.2	3.5	A
R909419695	1.4	5	B
R909419696	1.8	8	C
R909419697	2.0	10	D
R909444361	2.4	14	F

Medium flushing valve for size 115

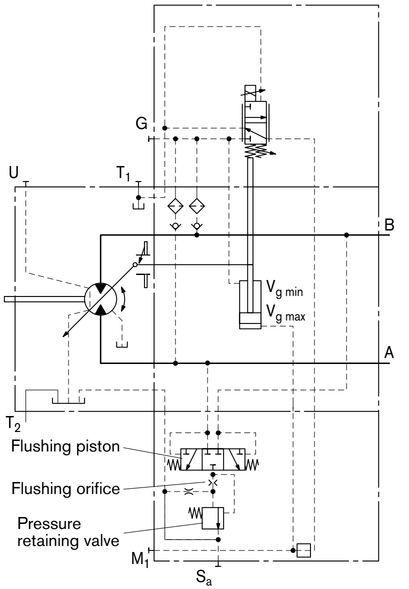
Material number of orifice	ø [mm]	q_v [L/min]	Code
R909431310	2.8	20	H
R909435172	3.5	25	J
R909449967	5.0	30	K

Large flushing valve for sizes 150 to 215

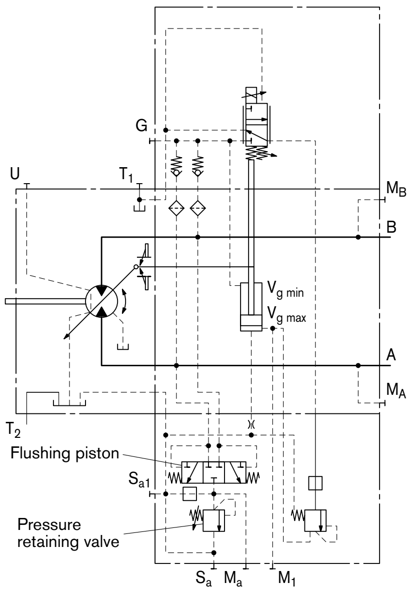
Material number of orifice	ø [mm]	q_v [L/min]	Code
R909449998	1.8	8	C
R909431308	2.0	10	D
R909431309	2.5	17	G
R909431310	2.8	20	H
R902138235	3.1	25	J
R909435172	3.5	30	K
R909436622	4.0	35	L
R909449967	5.0	40	M

For a flushing flow greater than 35 L/min, it is recommended that port S_a be connected in order to prevent an increase in case pressure. An increased case pressure reduces the flushing flow.

Schematic EP
Sizes 60 to 215
Port S_a only for sizes 150 to 215



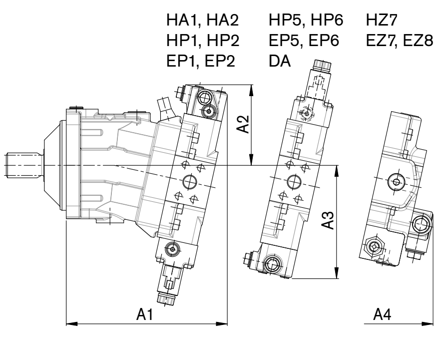
Schematic EP
Size 280



Flushing and boost pressure valve

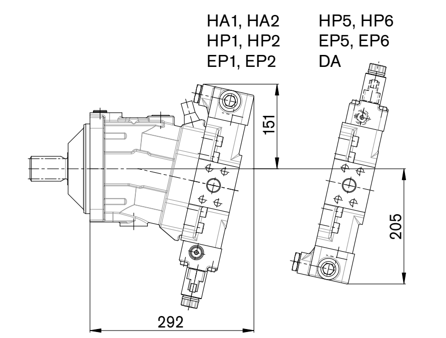
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Dimensions of sizes 60 to 115 (small flushing valve)



NG	A1	A2	A3	A4
060	243	133	176	236
085	273	142	194	254
115	287	143	202	269

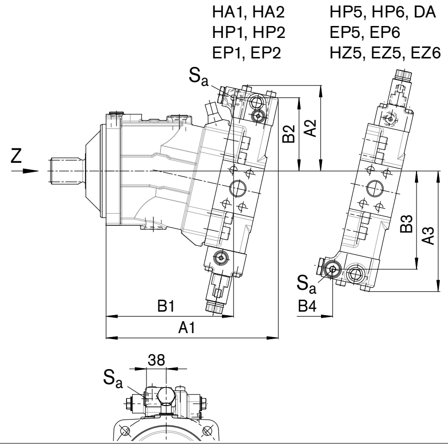
Dimensions of size 115 (medium flushing valve)



NG	S_a[1]	S_{a1}[1]	M_a[1]
150	M22 x 1.5; 15.5 deep	–	–
170	M22 x 1.5; 15.5 deep	–	–
215	M22 x 1.5; 15.5 deep	–	–
280	M22 x 1.5; 15.5 deep	M14 x 1.5; 11.5 deep	M14 x 1.5; 11.5 deep

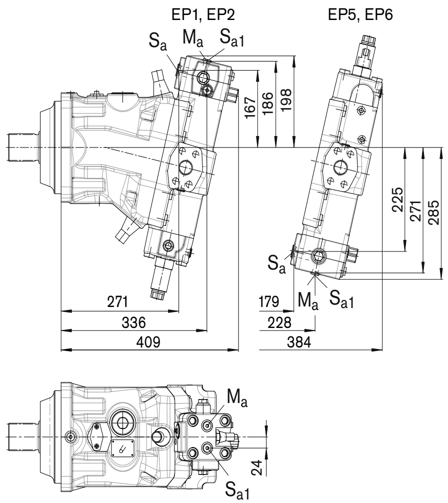
1) ISO 6149, ports plugged (in normal operation)
Observe the general instructions on page 76 for the maximum tightening torques.
The spot face can be deeper than specified in the appropriate standard.

Dimensions for sizes 150 to 215 (large flushing valve)



NG	A1	B1	A2	B2	A3	B3	B4
150	325	239	165	142	230	187	166
170	332	246	165	142	233	190	172
215	349	263	172	148	244	201	185

Dimensions size 280



3

Counterbalance valve BVD and BVE

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

Function

Travel drive/winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if the motor speed is greater than it should be for the given input flow while braking, travelling downhill, or lowering a load.

If the inlet pressure drops, the counterbalance spool throttles the return flow and brakes the motor until the inlet pressure returns to approx. 20 bar.

Note

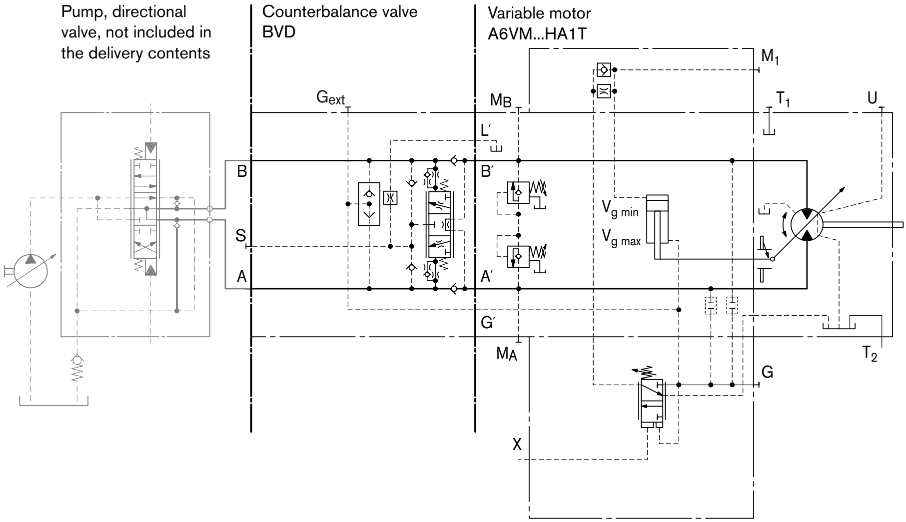
- BVD available for sizes 60 to 215 and BVE available for sizes 115 to 215.
- The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: A6VM085HA1T30004A/71MWV0N4S97W0-0 + BVD20F27S/41B–V03K16D0400S12
- For safety reasons, controls with beginning of control at $V_{g\ min}$ (e. g. HA) are not permissible for winch drives!
- The counterbalance valve does not replace the mechanical service brake and park brake.
- Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525!
- For the design of the brake release valve, we must know for the mechanical park brake:
  - the pressure at the start of opening
  - the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)
  - the required closing time for a warm device (oil viscosity approx. 15 mm²/s)

Travel drive counterbalance valve BVD...F

Application option

- Travel drive on wheeled excavators

Example schematic for travel drive on wheeled excavators
A6VM085HA1T30004A/71MWV0N4S97W0-0 + BVD20F27S/41B–V03K16D0400S12



Counterbalance valve BVD and BVE

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

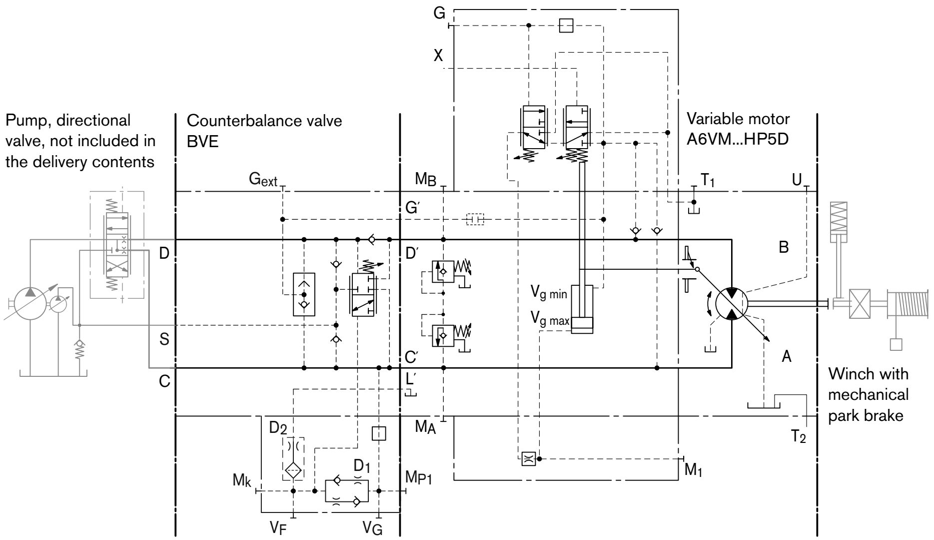
Winch counterbalance valve BVD...W and BVE

Application options

– Winch drive in cranes (BVD and BVE)

– Track drive in excavator crawlers (BVD)

Example schematic for winch drive in cranes
A6VM085HP5D10001A/71MWV0N4S97W0-0 + BVE25W38S/51ND-V100K00D4599T30S00-0



Permissible input flow or pressure in operation with DBV and BVD/BVE

Motor NG	Without valve p_{nom}/p_{max} [bar]	$q_{V\ max}$ [L/min]	Restricted values in operation with DBV and BVD/BVE: DBV NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code	BVD/BVE NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code
60	450/500	276	22	350/420	240	7	20 (BVD)	350/420	220	7W
85		332								
115		410	32		400					
115		410				8	25 (BVD/BVE)		320	8W
150		494								
170		533								
215		628	On request							
280		700	–	–	–	–	–	–	–	–

DBV ________________________ pressure-relief valve

BVD ______________counterbalance valve, double-acting

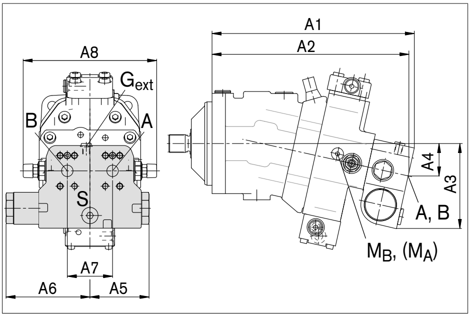
BVE ________________counterbalance valve, one-sided

Counterbalance valve BVD and BVE

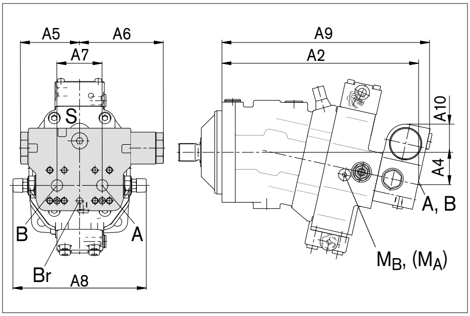
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Dimensions

A6VM...HA, HP1, HP2 and EP1, EP2



A6VM...HP5, HP6 and EP5, EP6[1)]



A6VM NG...plate	Counterbalance valve Type	Ports A, B	Dimensions A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
60...7	BVD20...17	3/4 in	311	302	143	50	98	139	75	222	326	50
85...7	BVD20...27	1 in	340	331	148	55	98	139	75	222	355	46
115...7	BVD20...28	1 in	362	353	152	59	98	139	84	234	377	41
115...8	BVD25...38	1 1/4 in	380	370	165	63	120.5	175	84	238	395	56
150...8	BVD25...38	1 1/4 in	411	401	168	67	120.5	175	84	238	426	53
170...8	BVD25...38	1 1/4 in	417	407	170	68	120.5	175	84	238	432	51
215...8	BVD25...38	1 1/4 in	448	438	176	74	120.5	175	84	299	463	46
115...8	BVE25...38	1 1/4 in	380	370	171	63	137	214	84	238	397	63
150...8	BVE25...38	1 1/4 in	411	401	175	67	137	214	84	238	423	59
170...8	BVE25...38	1 1/4 in	417	407	176	68	137	214	84	238	432	59
215...8	BVE25...38	1 1/4 in	448	438	182	74	137	214	84	299	463	52

Ports

Designation	Port for	Version	A6VM plate	Standard	Size[2)]	Maximum pressure [bar][3)]	State[5)]
A, B	Service line			SAE J518	see table above	420	O
S	Infeed	BVD20		DIN 3852[4)]	M22 x 1.5; 14 deep	30	X
		BVD25, BVE25		DIN 3852[4)]	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high pressure	L	7	DIN 3852[4)]	M12 x 1.5; 12.5 deep	30	O
			8	DIN 3852[4)]	M12 x 1.5; 12 deep	30	O
G_{ext}	Brake release, high pressure	S		DIN 3852[4)]	M12 x 1.5; 12.5 deep	420	X
M_A, M_B	Measuring pressure A and B			ISO 6149[4)]	M18 x 1.5; 14.5 deep	420	X

1) At the mounting version for the controls HP5, HP6 and EP5, EP6, the cast-in port designations A and B on the counterbalance valve BVD do not correspond with the connection drawing of the A6VM motor.
The designation of the ports on the installation drawing of the motor is binding!
2) Observe the general instructions on page 76 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) The spot face can be deeper than specified in the appropriate standard.
5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Counterbalance valve BVD and BVE

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

Mounting the counterbalance valve

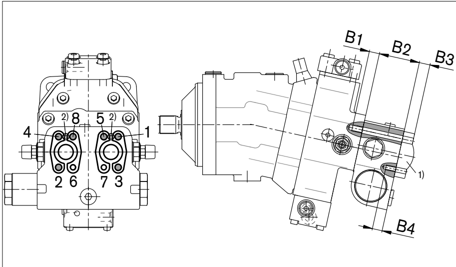
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the motor port plate using the provided tacking screws. The counterbalance valve is finally mounted to the motor by screwing on the SAE flange with the following screws:

6 screws (**1, 2, 3, 4, 5, 8**) _____________ length B1+B2+B3
2 screws (**6, 7**) ________________________ length B3+B4

Tighten the screws in two steps in the specified sequence from 1 to 8 (see following scheme).

In the first step, the screws must be tightened with half the tightening torque, and in the second step with the maximum tightening torque (see following table).

Thread	Strength class	Tightening torque [Nm]
M6 x 1 (tacking screw)	10.9	15.5
M10	10.9	75
M12	10.9	130
M14	10.9	205



1) SAE flange
2) Tacking screw (M6 x 1, length = B1 + B2, DIN 912)

NG...plate	60...7	85...7 115...7	115...8, 150...8, 170...8
B1[3]	M10 x 1.5 17 deep	M12 x 1.75 15 deep	M14 x 2 19 deep
B2	68	68	85
B3	customer-specific		
B4	M10 x 1.5 15 deep	M12 x 1.75 16 deep	M14 x 2 19 deep

3) Minimum required thread reach 1 x Ø-thread

3

Speed sensor

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

Version A6VM...U ("prepared for speed sensor", i.e. without sensor) is equipped with a toothed ring on the rotary group.

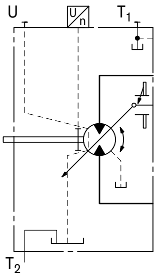
With the speed sensor DSA mounted, a signal proportional to motor speed can be generated. The DSA sensor measures the speed and direction of rotation.

Ordering code, technical data, dimensions and details on the connector, plus safety information 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. On deliveries without sensor, the port is plugged with a pressure-resistant cover.

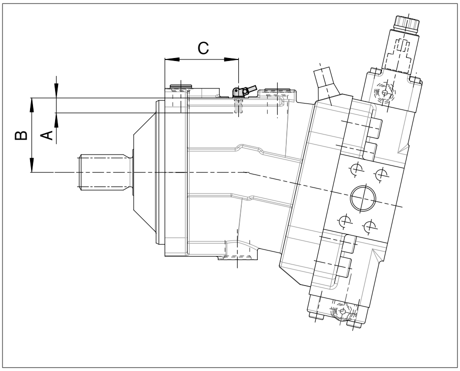
We recommend ordering the A6VM variable motor complete with sensor mounted.

Schematic



Dimensions

Version "V" with mounted speed sensor



Size		60	85	115	150	170	215	280
Number of teeth		54	58	67	72	75	80	78
A	Insertion depth (tolerance -0.25)	18.4	18.4	18.4	18.4	18.4	18.4	32
B	Contact surface	75	79	88	93	96	101	111.5
C		66.2	75.2	77.2	91.2	91.7	95.2	82

Setting range for displacement

	60				85				115				150			
	$V_{g\ max}$ (cm^3/rev)		$V_{g\ min}$ (cm^3/rev)		$V_{g\ max}$ (cm^3/rev)		$V_{g\ min}$ (cm^3/rev)		$V_{g\ max}$ (cm^3/rev)		$V_{g\ min}$ (cm^3/rev)		$V_{g\ max}$ (cm^3/rev)		$V_{g\ min}$ (cm^3/rev)	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
A	62.0	62.0	0.0	15.0	85.2	85.2	0.0	31.5	115.6	115.6	0.0	24.0	152.1	152.1	0.0	44.0
	without screw		M10 x 60 R909154690		without screw		M12 x 70 R909085976		without screw		M12 x 70 R909085976		without screw		M12 x 80 R909153075	
B	62.0	62.0	> 15.0	30.5	85.2	85.2	> 31.5	52.0	115.6	115.6	> 24.0	47.5	152.1	152.1	> 44.0	69.0
	without screw		M10 x 70 R909153779		without screw		M12 x 80 R909153075		without screw		M12 x 80 R909153075		without screw		M12 x 90 R909154041	
C	62.0	62.0	> 30.5	43.0	85.2	85.2	> 52.0	59.0	115.6	115.6	> 47.5	71.0	152.1	152.1	> 69.0	99.0
	without screw		M10 x 80 R909154058		without screw		M12 x 90 R909154041		without screw		M12 x 90 R909154041		without screw		M12 x 100 R909153975	
D	x		x		x		x		115.6	115.6	> 71.0	80.0	152.1	152.1	> 99.0	106.0
									without screw		M12 x 100 R909153975		without screw		M12 x 110 R909154212	
E	< 62.0	47.5	0.0	15.0	< 85.2	55.5	0.0	31.5	< 115.6	93.5	0.0	24.0	< 152.1	111.0	0.0	44.0
	M10 x 60 R909154690		M10 x 60 R909154690		M12 x 70 R909085976		M12 x 70 R909085976		M12 x 70 R909085976		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 80 R909153075	
F	< 62.0	47.5	> 15.0	30.5	< 85.2	55.5	> 31.5	52.0	< 115.6	93.5	> 24.0	47.5	< 152.1	111.0	> 44.0	69.0
	M10 x 60 R909154690		M10 x 70 R909153779		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 90 R909154041	
G	< 62.0	47.5	> 30.5	43.0	< 85.2	55.5	> 52.0	59.0	< 115.6	93.5	> 47.5	71	< 152.1	111.0	> 69.0	99.0
	M10 x 60 R909154690		M10 x 80 R909154058		M12 x 70 R909085976		M12 x 90 R909154041		M12 x 70 R909085976		M12 x 90 R909154041		M12 x 80 R909153075		M12 x 100 R909153975	
H	x		x		x		x		< 115.6	93.5	> 71.0	80.0	< 152.1	111.0	> 99.0	106.0
									M12 x 70 R909085976		M12 x 100 R909153975		M12 x 80 R909153075		M12 x 110 R909154212	
J	< 47.5	33.0	0.0	15.0	< 55.5	35.0	0.0	31.5	< 93.5	71.0	0.0	24.0	< 111.0	87.0	0.0	44.0
	M10 x 70 R909153779		M10 x 60 R909154690		M12 x 80 R909153075		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 70 R909085976		M12 x 90 R909154041		M12 x 80 R909153075	
K	< 47.5	33.0	> 15.0	30.5	< 55.5	35.0	> 31.5	52.0	< 93.5	71.0	> 24.0	47.5	< 111.0	87.0	> 44.0	69.0
	M10 x 70 R909153779		M10 x 70 R909153779		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 90 R909154041	
L	< 47.5	33.0	> 30.5	43.0	< 55.5	35.0	> 52.0	59.0	< 93.5	71.0	> 47.5	71.0	< 111.0	87.0	> 69.0	99.0
	M10 x 70 R909153779		M10 x 80 R909154058		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 90 R909154041		M12 x 100 R909153975	
M	x		x		x		x		< 93.5	71.0	> 71.0	80.0	< 111.0	87.0	> 99.0	106.0
									M12 x 80 R909153075		M12 x 100 R909153975		M12 x 90 R909154041		M12 x 110 R909154212	

Specify exact settings for $V_{g\ min}$ and $V_{g\ max}$ in plain text when ordering:
$V_{g\ min}$ = ... cm^3, $V_{g\ max}$ = ... cm^3

Theoretical, maximum setting:
for $V_{g\ min} = 0.7 \cdot V_{g\ max}$
for $V_{g\ max} = 0.3 \cdot V_{g\ max}$

Settings that are not listed in the table may lead to damage. Please contact us.

Setting range for displacement

	170				215				280			
	$V_{g\ max}$ (cm³/rev)		$V_{g\ min}$ (cm³/rev)		$V_{g\ max}$ (cm³/rev)		$V_{g\ min}$ (cm³/rev)		$V_{g\ max}$ (cm³/rev)		$V_{g\ min}$ (cm³/rev)	
	from	to	from	to	from	to	from	to	from	to	from	to
A	171.8	171.8	0.0	35.0	216.5	216.5	0.0	44.5	x		x	
	without screw		M12 x 80 R909153075		without screw		M12 x 80 R909153075					
B	171.8	171.8	> 35.0	63.5	216.5	216.5	> 44.5	80.0	x		x	
	without screw		M12 x 90 R909154041		without screw		M12 x 90 R909154041					
C	171.8	171.8	> 63.5	98.0	216.5	216.5	> 80.0	115.0	x		x	
	without screw		M12 x 100 R909153975		without screw		M12 x 100 R909153975					
D	171.8	171.8	> 98.0	120.0	216.5	216.5	> 115.0	150.0	x		x	
	without screw		M12 x 110 R909154212		without screw		M12 x 110 R909154212					
E	< 171.8	139.0	0.0	35.0	< 216.5	175.0	0.0	44.5	280.1	230.0	0.0	55.0
	M12 x 80 R909153075		M10 x 80 R909153075		M12 x 80 R909153075		M12 x 80 R909153075		M16 x 100 R910909811		M16 x 100 R910909811	
F	< 171.8	139.0	> 35.0	63.5	< 216.5	175.0	> 44.5	80.0	280.1	230.0	> 55.0	98.0
	M12 x 80 R909153075		M12 x 90 R909154041		M12 x 80 R909153075		M12 x 90 R909154041		M16 x 100 R910909811		M16 x 110 R910909719	
G	< 171.8	139.0	> 63.5	98.0	< 216.5	175.0	> 80.0	115.0	280.1	230.0	> 98.0	141.0
	M12 x 80 R909153075		M12 x 100 R909153975		M12 x 80 R909153075		M12 x 100 R909153975		M16 x 100 R910909811		M16 x 120 R910909477	
H	< 171.8	139.0	> 98.0	120.0	< 216.5	175.0	> 115.0	150.0	280.1	230.0	> 141.0	184.0
	M12 x 80 R909153075		M12 x 110 R909154212		M12 x 80 R909153075		M12 x 110 R909154212		M16 x 100 R910909811		M16 x 130 R910900271	
J	< 139.0	112.0	0.0	35.0	< 175.0	141.0	0.0	44.5	< 230.0	188.0	0.0	55.0
	M12 x 90 R909154041		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 80 R909153075		M16 x 110 R910909719		M16 x 100 R910909811	
K	< 139.0	112.0	> 35.0	63.5	< 175.0	141.0	> 44.5	80.0	< 230.0	188.0	> 55.0	98.0
	M12 x 90 R909154041		M12 x 90 R909154041		M12 x 90 R909154041		M12 x 90 R909154041		M16 x 110 R910909719		M16 x 110 R910909719	
L	< 139.0	112.0	> 63.5	98.0	< 175.0	141.0	> 80.0	115.0	< 230.0	188.0	> 98.0	141.0
	M12 x 90 R909154041		M12 x 100 R909153975		M12 x 90 R909154041		M12 x 100 R909153975		M16 x 110 R910909719		M16 x 120 R910909477	
M	< 139.0	112.0	> 98.0	120.0	< 175.0	141.0	> 115.0	150.0	< 230.0	188.0	> 141.0	184.0
	M12 x 90 R909154041		M12 x 110 R909154212		M12 x 90 R909154041		M12 x 110 R909154212		M16 x 110 R910909719		M16 x 130 R910900271	

Specify exact settings for $V_{g\ min}$ and $V_{g\ max}$ in plain text when ordering:
$V_{g\ min}$ = ... cm³, $V_{g\ max}$ = ... cm³

Theoretical, maximum setting:
for $V_{g\ min} = 0.7 \cdot V_{g\ max}$
for $V_{g\ max} = 0.3 \cdot V_{g\ max}$

Settings that are not listed in the table may lead to damage. Please contact us.

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 via flushing port U 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 drain line must flow into the reservoir below the minimum fluid level.

Installation position

See the following examples 1 to 8.
Further installation positions are possible upon request.

Recommended installation position: 1 and 2.

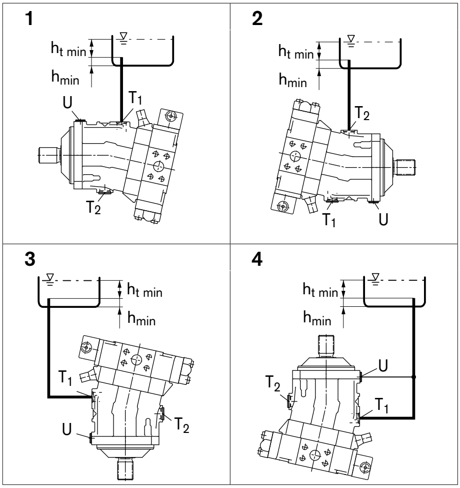
Note
In certain installation positions, an influence on the control characteristics can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristics and changes in response time.

Installation position	Air bleed	Filling
1	–	T_1
2	–	T_2
3	–	T_1
4	U	T_1
5	U (L_1)	T_1 (L_1)
6	L_1	T_2 (L_1)
7	L_1	T_1 (L_1)
8	U	T_1 (L_1)

L_1 Filling / air bleed
U Bearing flushing / 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)

Below-reservoir installation (standard)

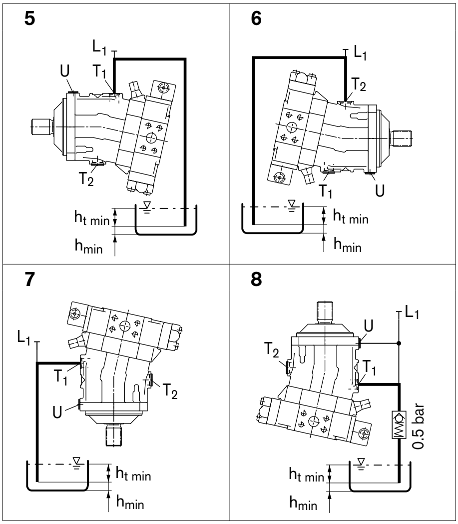
Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



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 motor housing.



3

General instructions

– The motor A6VM is designed to be used in open and closed 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.

– 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 instructions regarding the tightening torques of the fittings used.

- Mounting bolts:
For mounting bolts with metric ISO thread according to DIN 13 or 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	M10 x 1	30 Nm	15 Nm	5 mm
	M12 x 1.5	50 Nm	25 Nm	6 mm
	M14 x 1.5	80 Nm	45 Nm	6 mm
	M16 x 1.5	100 Nm	55 Nm	8 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
	M33 x 2	540 Nm	310 Nm	17 mm
	M42 x 2	720 Nm	330 Nm	22 mm
DIN 3852	M12 x 1.5	50 Nm	25 Nm[1)2)]	6 mm
	M22 x 1.5	210 Nm	80 Nm[1)]	10 mm
	M27 x 2	330 Nm	135 Nm[1)]	12 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 17 Nm for M12 x 1.5.

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Variable Plug-in Motor A6VE

RE 91606/06.12 **1**/40
Replaces: 10.07

Data sheet

3

Series 63

Size	Nominal pressure/Maximum pressure
28 to 160	400 bar/450 bar
250	350 bar/400 bar

Open and closed circuits

Contents

Features

- Variable plug-in motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuits
- Far-reaching integration in mechanical gearbox due to a recessed mounting flange located on the center of the case (extremely space-saving construction)
- Easy to install, simply plug into the mechanical gearbox (no configuration specifications to be observed)
- Tested unit ready to install
- For use especially in mobile applications
- The displacement can be infinitely changed from $V_{g\,max}$ to $V_{g\,min} = 0$.
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The output speed is dependent on the flow of the pump and the displacement of the motor.
- The output torque increases with the pressure differential between the high-pressure and low-pressure side and with increasing displacement.

Ordering code for standard program

A6V	E					/	63	W		–	V							
01	02	03	04	05	06		07	08	09		10	11	12	13	14	15	16	17	18

Axial piston unit

01	Bent-axis design, variable	**A6V**

Operating mode

02	Motor, plug-in version	**E**

Sizes (NG)

03	Geometric displacement, see table of values on page 7	**28**	**55**	**80**	**107**	**160**	**250**	

Control devices

			28	55	80	107	160	250	
04	Proportional control hydraulic	$\Delta p = 10$ bar	●	●	●	●	●	●	**HD1**
		$\Delta p = 25$ bar	●	●	●	●	●	●	**HD2**
	Two-point control hydraulic		–	–	–	–	–	●	**HZ**
			●	–	–	–	●	–	**HZ1**
			–	●	●	●	●[1]	–	**HZ3**
	Proportional control electric	12 V	●	●	●	●	●	●	**EP1**
		24 V	●	●	●	●	●	●	**EP2**
	Two-point control electric	12 V	●	–	–	–	●	●	**EZ1**
		24 V	●	–	–	–	●	●	**EZ2**
		12 V	–	●	●	●	–	–	**EZ3**
		24 V	–	●	●	●	–	–	**EZ4**
	Automatic control high-pressure related	with minimum pressure increase $\Delta p \leq 10$ bar	●	●	●	●	●	●	**HA1**
		with pressure increase $\Delta p = 100$ bar	●	●	●	●	●	●	**HA2**
		with minimum pressure increase $\Delta p \leq 10$ bar	–	●	●	●	●	–	**HA3**[1]
	Automatic control speed related $p_{St}/p_{HD} = 3/100$, hydraulic travel direction valve		–	–	–	–	–	●	**DA**
	$p_{St}/p_{HD} = 5/100$, electric travel direction valve + electric $V_{g\,max}$-circuit	24 V	●	●	●	●	●	–	**DA3**

Pressure control (only for HD, EP)

05	Without pressure control (without code)	
	Pressure control, fixed setting	**D**

Override of controls HA

06	Without override (without code)	
	Hydraulic override, remote control, proportional	**T**

Series

07	Series 6, index 3	**63**

Direction of rotation

08	Viewed on drive shaft, bidirectional	**W**

Setting ranges for displacement[2]

			28	55	80	107	160	250	
09	$V_{g\,min} = 0$ to $0.7\ V_{g\,max}$ (without code)		●	●	●	●	●	–	
	$V_{g\,min} = 0$ to $0.4\ V_{g\,max}$	$V_{g\,max} = V_{g\,max}$ to $0.8\ V_{g\,max}$	–	–	–	–	–	●	**1**
	$V_{g\,min} > 0.4\ V_{g\,max}$ to $0.8\ V_{g\,max}$	$V_{g\,max} = V_{g\,max}$ to $0.8\ V_{g\,max}$	–	–	–	–	–	●	**2**

Seals

		28	55	80	107	160	250	
10	FKM (fluor-caoutchouc)	●	●	●	●	●	●	**V**

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

1) Only possible in combination with port plate 22 (integrated counterbalance valve).

2) Specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering: $V_{g\,min} = ...\ cm^3$, $V_{g\,max} = ...\ cm^3$

Ordering code for standard program

A6V	E					/	63	W		–	V							
01	02	03	04	05	06		07	08	09		10	11	12	13	14	15	16	17	18

Drive shafts

		28	55	80	107	160	250	
11	Splined shaft DIN 5480	●	–	●	–	●	–	**A**
		–	●	–	●	–	●	**Z**

Mounting flanges

			28	55	80	107	160	250	
12	Similar to ISO 3019-2	2-hole	●	●	●	●	●	–	**L**
		4-hole	–	–	–	–	–	●	**M**
	Modified adapter flange	2-hole	–	–	–	●	–	–	**U**

Port plates for service lines[3]

					28	55	80	107	160	250	
13	SAE flange ports A and B at side, opposite		**02**	**0**	●	●	●	●	●	●	**020**
				7	●	●	●	●	●	●	**027**
	SAE flange ports A and B at bottom only with integrated counterbalance valve BVI[4]		**22**	**1**	–	●	●	●	●	–	**221**
				2	–	●	●	●	●	–	**222**
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve[5)7)]	BVD	**37**	**0** **8**	–	–	–	●	–	–	**370** **378**
			38		–	●	●	●	●	●[9)]	**380**
		BVE	**38**		–	–	–	●	●	–[9)]	**388**

Valves (see pages 29 to 37)

14	Without valve		**0**
	Brake release valve integrated (pilot pressure for brake release)	internal ducting	**1**
		external piping	**2**
	Flushing and boost pressure valve mounted		**7**
	Counterbalance valve mounted[6)7)]		**8**

Speed sensor (see page 38)

		28	55	80	107	160	250	
15	Without speed sensor	●	●	●	●	●	●	**0**
	Prepared for DSA speed sensor	❍	❍	❍	❍	❍	❍	**U**
	DSA speed sensor mounted[8)]	❍	❍	❍	❍	❍	❍	**V**

Connector for solenoids (see page 28)

		28 to 160	250	
16	Without connector (without solenoid, only with hydraulic controls)	●	–	**0**
	(size 250 without code)	–	●	
	DEUTSCH – molded connector, 2-pin – without suppressor diode	●	–	**P**
	HIRSCHMANN connector – without suppressor diode (without code)	–	●	

Beginning of control

			28	55	80	107	160	250	
17	Port plate 02, 37, 38	at $V_{g\,min}$ (standard for HA)	●	●	●	●	●	●	**A**
		at $V_{g\,max}$ (standard for HD, HZ, EP, EZ, DA)	●	●	●	●	●	●	**B**
	Port plate 22	at $V_{g\,min}$ (standard for HA3)	–	●	●	●	●	–	**B**
		at $V_{g\,max}$ (standard for HZ3)	–	●	●	●	●	–	**B**

Standard / special version

18	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

3) Metric fastening thread
4) Only for HZ3 and HA3. Add specification of integrated counterbalance valve BVI, see separate ordering code on page 35. Note the restrictions on page 36.
5) Only possible in conjunction with HD, EP and HA1 and HA2 control
6) Specify ordering code of counterbalance valve according to data sheet (BVD – RE 95522, BVE - RE 95525) separately.
7) Note the restrictions on page 32.
8) Specify ordering code of sensor according to data sheet (DSA – RE 95133) separately and observe the requirements on the electronics.
9) Counterbalance valve MHB32, please contact us.

3

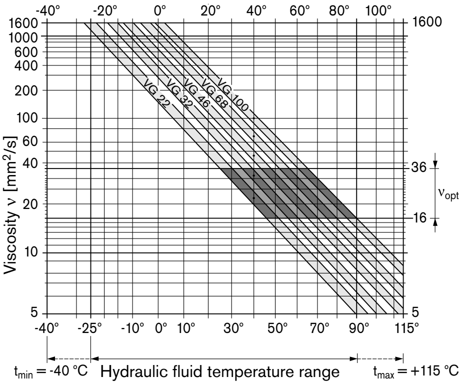
Technical data

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 variable motor A6VE 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 a closed circuit, the circuit 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 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 circuit temperature or 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 with a flushing and boost pressure valve (see page 29).

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]	ν_{max} = 1600	$T_{St} \geq$ -40 °C	t ≤ 3 min, without load (p ≤ 50 bar), n ≤ 1000 rpm (sizes 28 to 160), n ≤ 0.25 • n_{nom} (size 250)
Permissible temperature difference		ΔT ≤ 25 K	between axial piston unit and hydraulic fluid
Warm-up phase	ν < 1600 to 400	T = -40 °C to -25 °C	At p ≤ 0.7 • p_{nom}, n ≤ 0.5 • n_{nom} and t ≤ 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	ν = 400 to 10 ν_{opt} = 36 to 16	T = -25 °C to +90 °C	measured at port T, no restriction within the permissible data
Short-term operation[2]	$\nu_{min} \geq 7$	T_{max} = +103 °C	measured at port T, t < 3 min, p < 0.3 • p_{nom}
FKM shaft seal[1]		T ≤ +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) Size 250, 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.

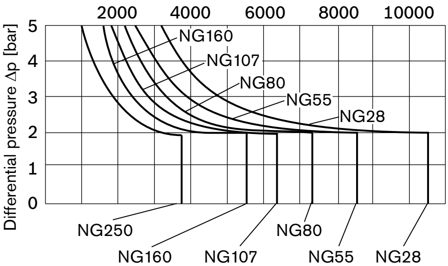
If the above classes cannot be achieved, please contact us.

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.



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.

Influence of case pressure on beginning of control

An increase in case pressure affects the beginning of control of the variable motor when using the following control options:

HD, HA.T (sizes 28 to 160) ____________ increase
HD, EP, HA, HA.T (size 250) ____________ increase
DA ____________ decrease

With the following controls, an increase in the case pressure has no influence on the beginning of control:
EP, HA (sizes 28 to 160)

The factory settings for the beginning of control are made at $p_{abs} = 2$ bar (sizes 28 to 160) or $p_{abs} = 1$ bar (size 250) case pressure.

Direction of flow

Direction of rotation, viewed on drive shaft	
cw	**ccw**
A to **B**	**B** to **A**

3

Technical data

Operating pressure range

(operating with mineral oil)

Pressure at service line port A or B

Sizes 28 to 160

Nominal pressure p_{nom} ________________ 400 bar absolute

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

Size 250

Nominal pressure p_{nom} ________________ 350 bar absolute

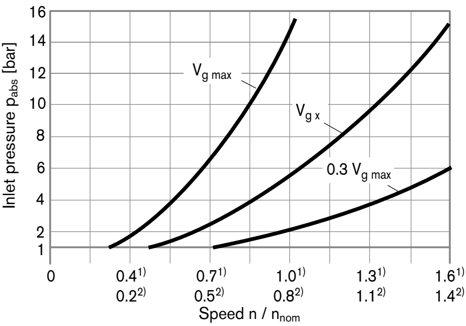
Maximum pressure p_{max} ________________ 400 bar absolute
Single operating period__________________________ 10 s
Total operating period __________________________ 300 h

Minimum pressure (high-pressure side) ___25 bar absolute

Summation pressure (pressure A + pressure B) p_{Su} _ 700 bar

Rate of pressure change $R_{A\,max}$
with integrated pressure-relief valve____________ 9000 bar/s
without pressure-relief valve _________________ 16000 bar/s

Minimum pressure – pump mode (inlet)
To prevent damage to the axial piston motor in pump operation mode (change of high-pressure side with unchanged direction of rotation, e. g. when braking), a minimum pressure must be guaranteed at the service line port (inlet). This minimum pressure is dependent on the speed and displacement of the axial piston unit (see characteristic curve below).



[1] For sizes 28 to 160
[2] For size 250

This diagram is valid only for the optimum viscosity range from ν_{opt} = 36 to 16 mm²/s.
Please contact us if the above conditions cannot be satisfied.

Note
Values for other hydraulic fluids, please contact us.

Definition

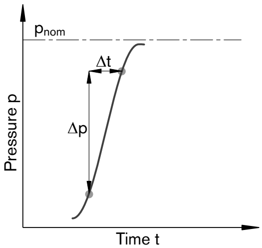
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

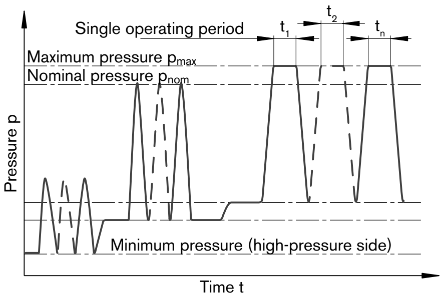
Maximum pressure p_{max}
The maximum pressure corresponds to the maximum operating pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period.

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.

Summation pressure p_{Su}
The summation pressure is the sum of the pressures at both service line ports (A and B).

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)

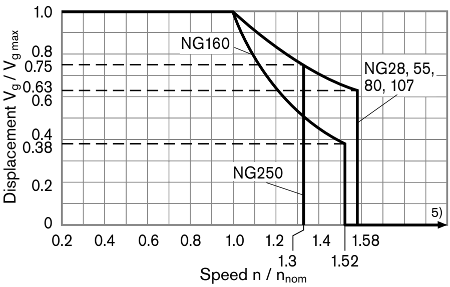
Size		NG	28	55	80	107	160	250
Displacement geometric[1], per revolution	$V_{g\,max}$	cm³	28.1	54.8	80	107	160	250
	$V_{g\,min}$	cm³	0	0	0	0	0	0
	$V_{g\,x}$	cm³	18	35	51	68	61	188
Speed maximum[2] (while adhering to the maximum permissible input flow)								
at $V_{g\,max}$	n_{nom}	rpm	5550	4450	3900	3550	3100	2700
At $V_g < V_{g\,x}$ (see diagram below)	n_{max}	rpm	8750	7000	6150	5600	4900	3600
at $V_{g\,0}$	n_{max}	rpm	10450	8350	7350	6300	5500	3600
Input flow[3]								
at n_{nom} and $V_{g\,max}$	$q_{V\,max}$	L/min	156	244	312	380	496	675
Torque[4]								
At $V_{g\,max}$ and $\Delta p = 400$ bar	T	Nm	179	349	509	681	1019	–
At $V_{g\,max}$ and $\Delta p = 350$ bar	T	Nm	157	305	446	596	891	1391
Rotary stiffness								
$V_{g\,max}$ to $V_{g/2}$	c_{min}	KNm/rad	6	10	16	21	35	60
$V_{g/2}$ to 0 (interpolated)	c_{max}	KNm/rad	18	32	48	65	105	181
Moment of inertia for rotary group	J_{GR}	kgm²	0.0014	0.0042	0.008	0.0127	0.0253	0.061
Maximum angular acceleration	α	rad/s²	47000	31500	24000	19000	11000	10000
Case volume	V	L	0.5	0.75	1.2	1.5	2.4	3.0
Mass (approx.)								
Port plate 02, 37, 38	m	kg	16	26	34	47	64	90
Port plate 22	m	kg	–	35	43	53	72	–

1) The minimum and maximum displacement are infinitely adjustable, see ordering code, page 2. (standard setting for size 250 if not specified in the order: $V_{g\,min} = 0.2 \cdot V_{g\,max}$, $V_{g\,max} = V_{g\,max}$).
2) The values are valid:
- for the optimum viscosity range from $\nu_{opt} = 36$ to 16 mm²/s
- with hydraulic fluid based on mineral oils
3) Restriction of input flow with counterbalance valve, see page 32
4) Torque without radial force, with radial force see page 8

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 startup angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.

Permissible displacement in relation to speed



5) Values in this range on request

Technical data

Permissible radial and axial forces of the drive shafts

Size	NG		28	55	80	107	160	250
Drive shaft	ø	mm	30	30	40	40	50	50
Maximum radial force[1] at distance a (from shaft collar)	$F_{q\,max}$	N	4838	7581	10283	13758	16435	1200[3]
	a	mm	17.5	17.5	22.5	22.5	27.5	41
with permissible torque	T_{max}	Nm	179	281	509	681	1019	[4]
≙ Permissible pressure Δp at $V_{g\,max}$	$p_{nom\,perm.}$	bar	400	322	400	400	400	[4]
Maximum axial force[2]	$+F_{ax\,max}$	N	315	500	710	900	1120	1200
	$-F_{ax\,max}$	N	0	0	0	0	0	0
Permissible axial force per bar operating pressure	$F_{ax\,perm./bar}$	N/bar	4.6	7.5	9.6	11.3	15.1	[4]

1) With intermittent operation.
2) Maximum permissible axial force during standstill or when the axial piston unit is operating in non-pressurized condition.
3) When at a standstill or when axial piston unit operating in non-pressurized conditions. Higher forces are permissible when under pressure, please contact us.
4) Please contact us.

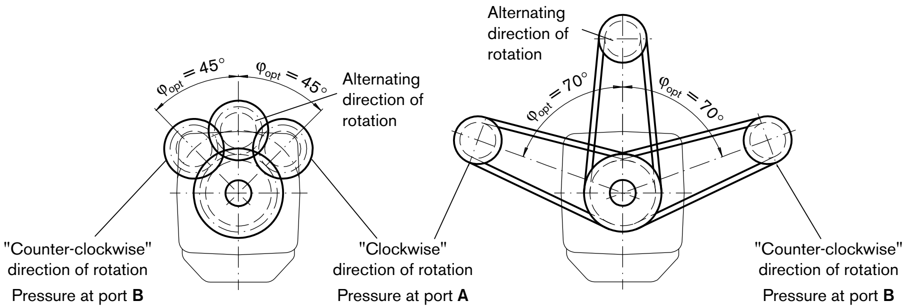
Note
Influence of the direction of the permissible axial force:

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

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 drive**



Determining the operating characteristics

Input flow $q_v = \dfrac{V_g \cdot n}{1000 \cdot \eta_v}$ [L/min]

Speed $n = \dfrac{q_V \cdot 1000 \cdot \eta_v}{V_g}$ [min^{-1}]

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

Power $P = \dfrac{2\,\pi \cdot T \cdot n}{60000} = \dfrac{q_v \cdot \Delta p \cdot \eta_t}{600}$ [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 ($\eta_t = \eta_v \cdot \eta_{mh}$)

HD – Proportional control hydraulic

The proportional hydraulic control provides infinite setting of the displacement, proportional to the pilot pressure applied to port X.

- Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum pilot pressure)
- End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum pilot pressure)

Note

- Maximum permissible pilot pressure: $p_{St} = 100$ bar
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 450 bar can occur at port G.
- Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 10 bar.
- The beginning of control and the HD characteristic are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 5) and thus a parallel shift of the characteristic.
- A leakage flow of maximum 0.3 L/min can escape at port X due to internal leakage (operating pressure > pilot pressure). The control is to be suitably configured to avoid an independent build-up of pilot pressure.

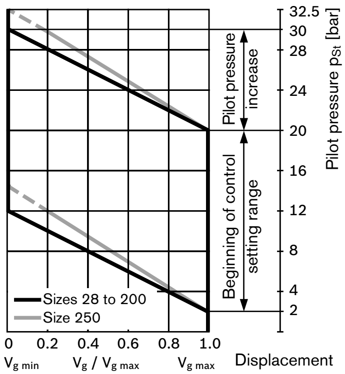
HD1
Pilot pressure increase $\Delta p_{St} = 10$ bar

A pilot pressure increase of 10 bar at port X results in a decrease in displacement from $V_{g\,max}$ to 0 cm³ (sizes 28 to 160) or from $V_{g\,max}$ to 0.2 $V_{g\,max}$ (size 250).

Beginning of control, setting range ____________2 to 20 bar

Standard setting:
Beginning of control at 3 bar (end of control at 13 bar)

HD1 characteristic



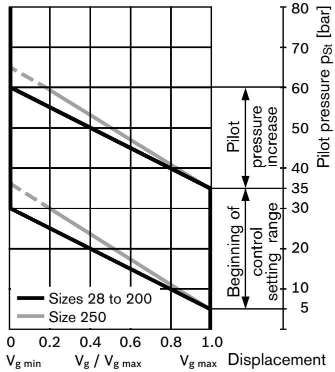
HD2
Pilot pressure increase $\Delta p_{St} = 25$ bar

A pilot pressure increase of 25 bar at port X results in a decrease in displacement from $V_{g\,max}$ to 0 cm³ (sizes 28 to 160) or from $V_{g\,max}$ to 0.2 $V_{g\,max}$ (size 250).

Beginning of control, setting range ____________5 to 35 bar

Standard setting:
Beginning of control at 10 bar (end of control at 35 bar)

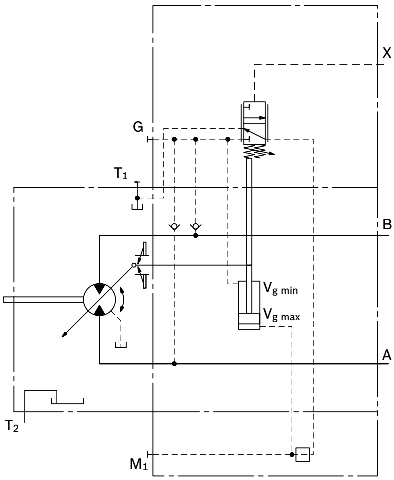
HD2 characteristic



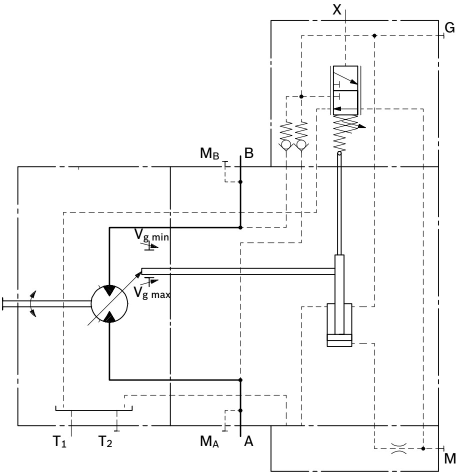
3

HD – Proportional control hydraulic

Schematic HD1, HD2
Sizes 28 to 160



Schematic HD1, HD2
Size 250



Note

The spring return feature in the control part is not a safety device

The control part 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.

HD – Proportional control hydraulic

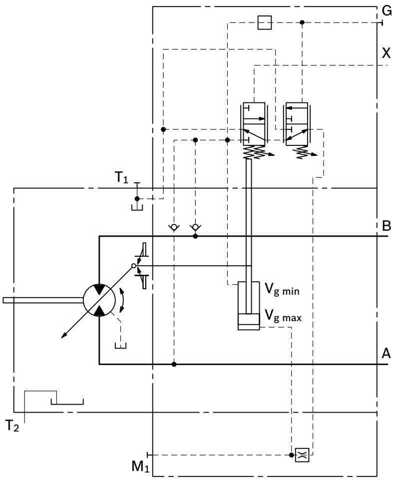
HD.D
Pressure control, fixed setting

The pressure control overrides the HD control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

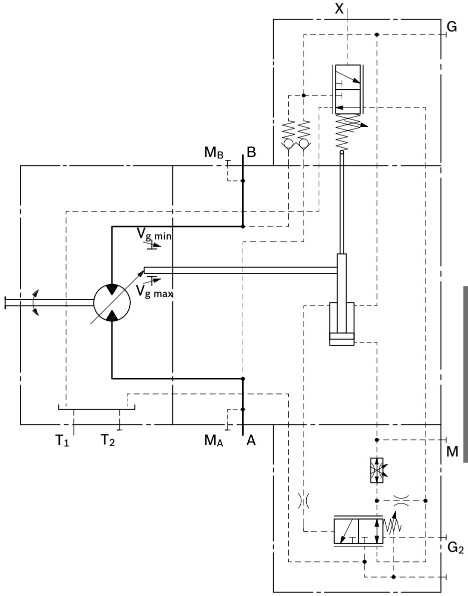
The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve
Sizes 28 to 160 ________________________ 80 to 400 bar
Size 250 ___________________________ 80 to 350 to bar

Schematic HD.D
Sizes 28 to 160



Schematic HD.D
Size 250



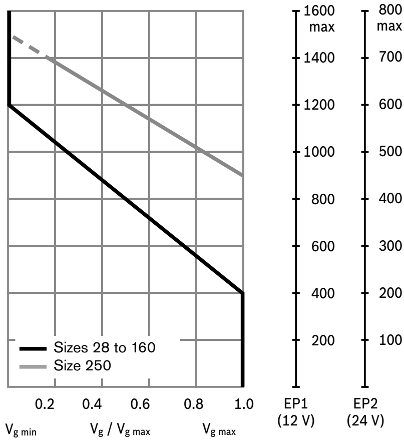
EP – Proportional control electric

The proportional electric control provides infinite setting of the displacement, proportional to the control current applied to the solenoid (sizes 28 to 200) or proportional valve (sizes 250).

For size 250, the pilot oil supply at port P requires an external pressure of $p_{min} = 30$ bar ($p_{max} = 100$ bar).

- Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum control current)
- End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum control current)

Characteristic



Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 450 bar can occur at port G.

The following only needs to be noted for size 250:

- The beginning of control and the EP characteristic are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 5) and thus a parallel shift of the characteristic.

Technical data, solenoid
Sizes 28 to 160

	EP1	EP2
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 design page 28		

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
- Electric amplifier VT 2000, series 5X (see RE 29904) (for stationary application)

Further information can also be found on the Internet at www.boschrexroth.com/mobile-electronics

Technical data, proportional valve
Size 250

	EP1	EP2
Voltage	12 V (±20 %)	24 V (±20 %)
Beginning of control at $V_{g\,max}$	900 mA	450 mA
End of control at $V_{g\,min}$	1400 mA	700 mA
Limiting current	2.2 A	1.0 A
Nominal resistance (at 20 °C)	2.4 Ω	12 Ω
Duty cycle	100 %	100 %
Type of protection see connector design page 28		

See also proportional pressure-reducing valve DRE 4K (RE 29181).

Note

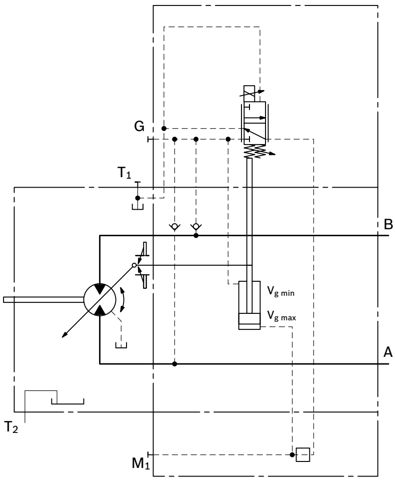
The spring return feature in the control part is not a safety device

The control part 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.

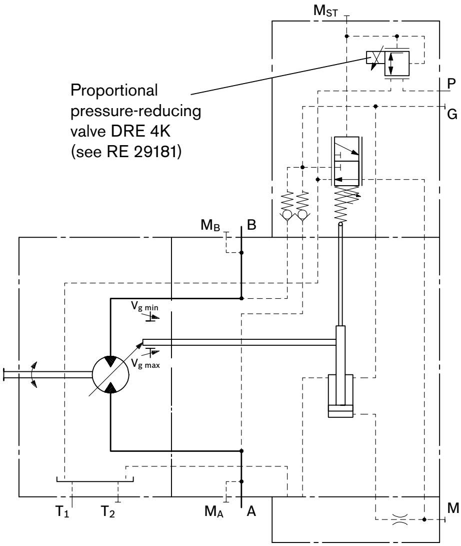
Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

EP – Proportional control electric

Schematic EP1, EP2
Sizes 28 to 160



Schematic EP1, EP2
Size 250



3

EP – Proportional control electric

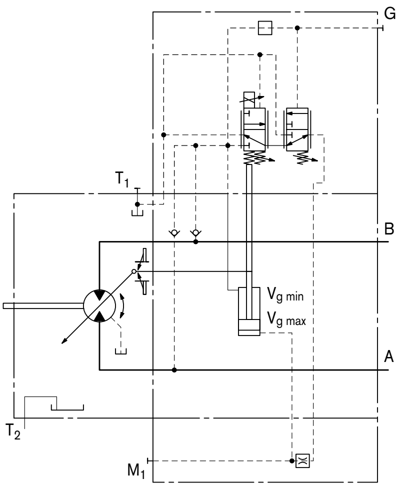
EP.D
Pressure control, fixed setting

The pressure control overrides the EP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

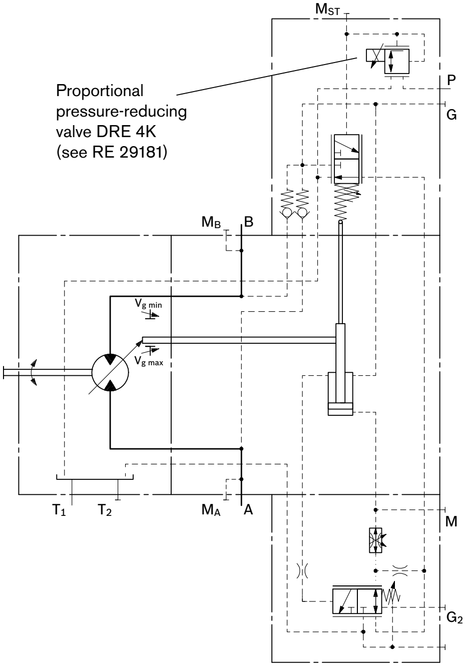
The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve
Sizes 28 to 160 ________________________ 80 to 400 bar
Size 250 __________________________ 80 to 350 to bar

Schematic EP.D
Sizes 28 to 160



Schematic EP.D
Size 250

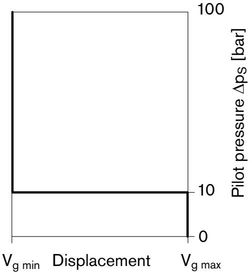


HZ – Two-point control hydraulic

The two-point hydraulic control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the pilot pressure at port X on or off.

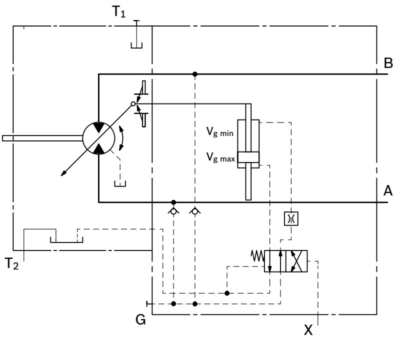
- Position at $V_{g\,max}$ (without pilot pressure, maximum torque, minimum speed)
- Position at $V_{g\,min}$ (with pilot pressure > 10 bar activated, minimum torque, maximum permissible speed)

Characteristic HZ



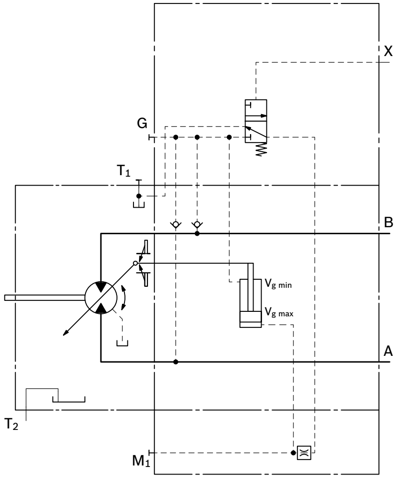
Note
- Maximum permissible pilot pressure: 100 bar
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 450 bar can occur at port G.
- A leakage flow of maximum 0.3 L/min is present at port X (operating pressure > pilot pressure). To avoid a build-up of pilot pressure, pressure is to be relieved from port X to the reservoir.

Schematic HZ3
Sizes 55 to 107

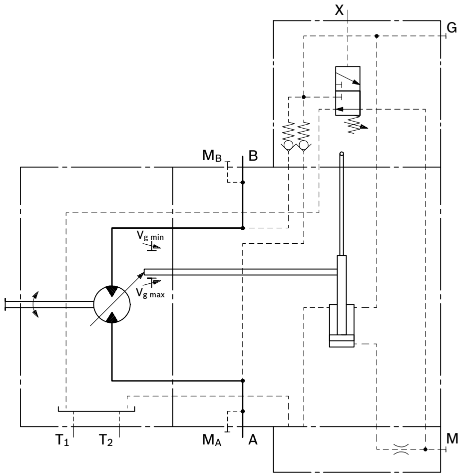


Size 160
With integrated counterbalance valve BVI, see page 37

Schematic HZ1
Sizes 28, 160



Schematic HZ
Size 250



EZ – Two-point control electric

The two-point electric control with switching solenoid (sizes 28 to 160) or control valve (size 250) allows the displacement to be set to either $V_{g\ min}$ or $V_{g\ max}$ by switching the electric current at the switching solenoid or control valve on or off.

Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 450 bar can occur at port G.

Technical data, solenoid with Ø37
Sizes 28, 160

	EZ1	EZ2
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\ max}$	de-energized	de-energized
Displacement $V_{g\ min}$	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 page 28		

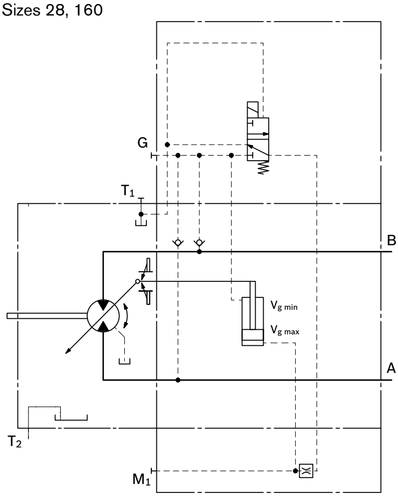
Technical data, solenoid with Ø45
Sizes 55 to 107

	EZ3	EZ4
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\ max}$	de-energized	de-energized
Displacement $V_{g\ min}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30W
Minimum required current	1.5 A	0.75 A
Duty cycle	100 %	100 %
Type of protection see connector design page 28		

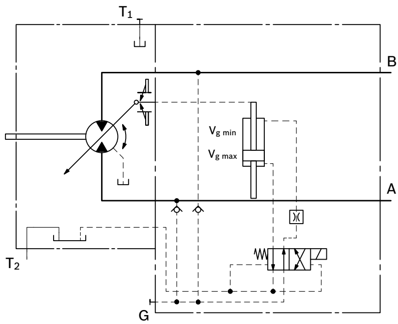
Technical data, control valve
Size 250

	EZ1	EZ2
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\ max}$	de-energized	de-energized
Displacement $V_{g\ min}$	energized	energized
Nominal resistance (at 20 °C)	6 Ω	23 Ω
Nominal power	26 W	26W
Minimum required current	2 A	1.04 A
Duty cycle	100 %	100 %
Type of protection see connector design page 28		

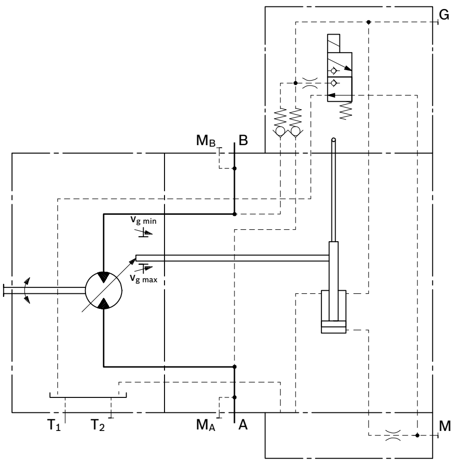
Schematic EZ1, EZ2
Sizes 28, 160



Schematic EZ3, EZ4
Sizes 55 to 107



Schematic EZ1, EZ2
Size 250



HA – Automatic control high-pressure related

The automatic high-pressure related control adjusts the displacement automatically depending on the operating pressure.

The displacement of the A6VE motor with HA control is $V_{g\ min}$ (maximum speed and minimum torque). The control unit measures internally the operating pressure at A or B (no control line required) and upon reaching the beginning of control, the controller swivels the motor from $V_{g\ min}$ to $V_{g\ max}$ with increase of pressure. The displacement is modulated between $V_{g\ min}$ and $V_{g\ max}$, thereby depending on load conditions.

– Beginning of control at $V_{g\ min}$ (minimum torque, maximum speed)

– End of control at $V_{g\ max}$ (maximum torque, minimum speed)

Note

– For safety reasons, winch drives are not permissible with beginning of control at $V_{g\ min}$ (standard for HA).

– The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 450 bar can occur at port G.

– The beginning of control and the HA characteristic are influenced by the case pressure. An increase in case pressure causes an increase in the beginning of control (see page 5) and thus a parallel shift of the characteristic. Only for HA1T (sizes 28 to 160) and HA1, HA2, HA3, HA.T, (size 250).

– A leakage flow of maximum 0.3 L/min is present at port X (operating pressure > pilot pressure). To avoid a build-up of pilot pressure, pressure is to be relieved from port X to the reservoir. **Only for control HA.T**.

3

HA – Automatic control high-pressure related

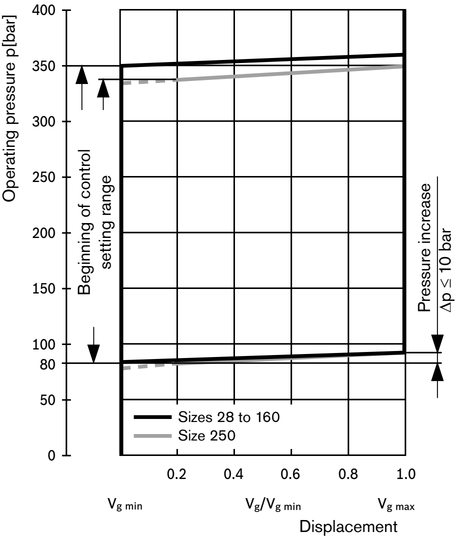
HA1, HA3
With minimum pressure increase

An operating pressure increase of Δp ≤ approx. 10 bar results in an increase in displacement from 0 cm^3 to $V_{g\,max}$ (sizes 28 to 160) or from 0.2 $V_{g\,max}$ to $V_{g\,max}$ (size 250).

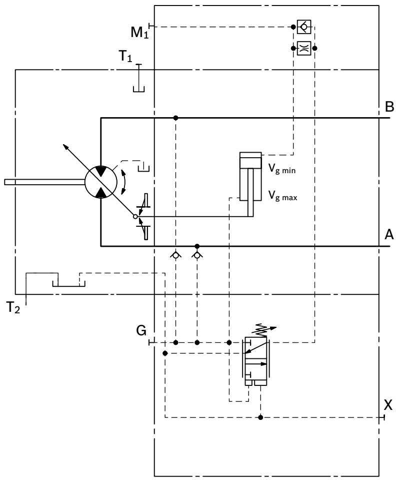
Beginning of control, setting range
Sizes 28 to 160 ________________________ 80 to 350 bar
Size 250 _____________________________ 80 to 340 bar

Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 300 bar.

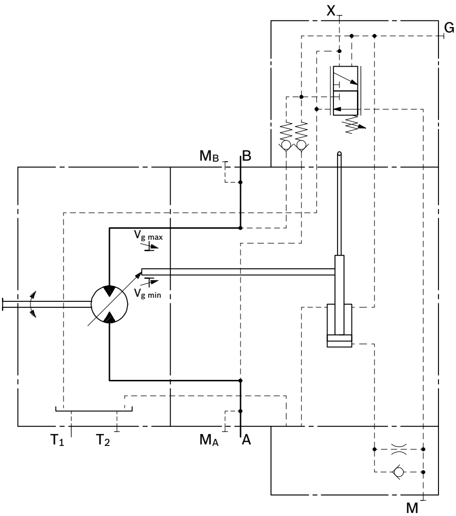
Characteristic HA1, HA3



Schematic HA1
Sizes 28 to 160



Size 250



Schematic HA3
Sizes 55 to 160
With integrated counterbalance valve BVI, see page 37

HA – Automatic control high-pressure related

HA2
With pressure increase

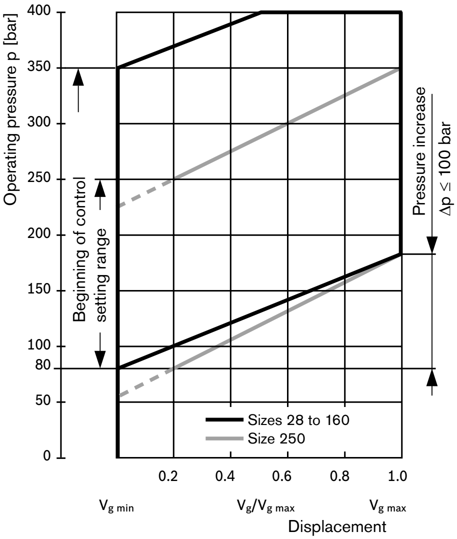
An operating pressure increase of Δp = approx. 100 bar results in an increase in displacement from 0 cm^3 to $V_{g\,max}$ (sizes 28 to 160) or from 0.2 $V_{g\,max}$ to $V_{g\,max}$ (size 250).

Beginning of control, setting range

Sizes 28 to 160	80 to 350 bar
Size 250	80 to 250 bar

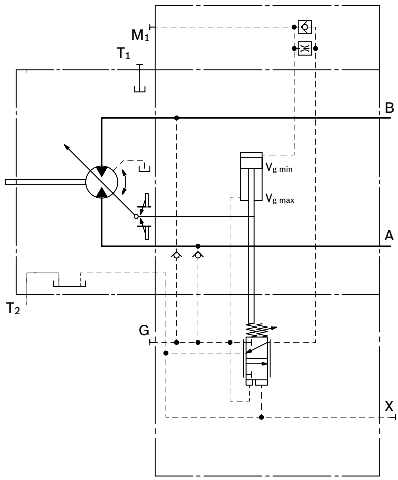
Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 200 bar.

Characteristic HA2

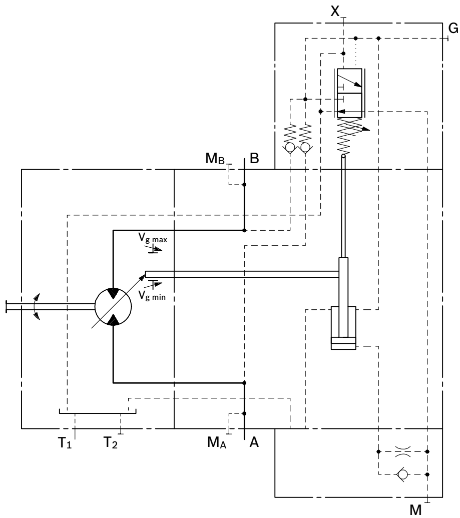


Schematic HA2

Sizes 28 to 160



Size 250



3

HA – Automatic control high-pressure related

HA.T
Override hydraulic remove control, proportional

With the HA.T control, the beginning of control can be influenced by applying a pilot pressure to port X.

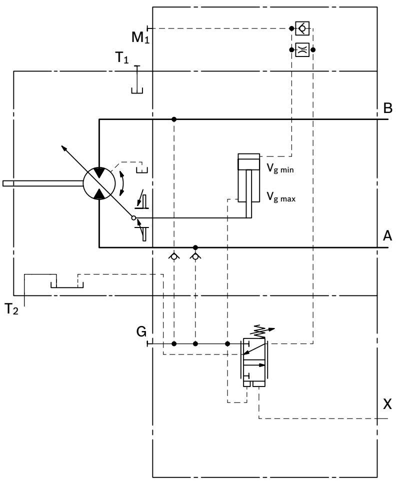
For each 1 bar of pilot pressure increase, the beginning of control is reduced by 17 bar (sizes 28 to 160) or 8 bar (size 250).

Example (sizes 28 to 160):

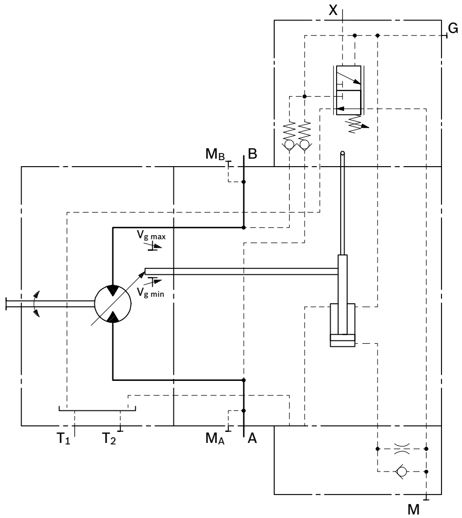
Beginning of control setting	300 bar	300 bar
Pilot pressure at port X	0 bar	10 bar
Beginning of control at	300 bar	130 bar

Note
Maximum permissible pilot pressure 100 bar.

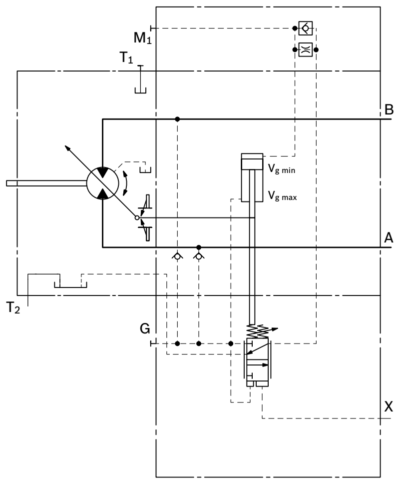
Schematic HA1.T
Sizes 28 to 160



Schematic HA1.T
Size 250



Schematic HA2.T
Sizes 28 to 160



DA – Automatic control speed-related

The variable motor A6VE with automatic speed-related control, is intended for use in hydrostatic travel drives in combination with the variable pump A4VG with DA control.

A drive-speed-related pilot pressure signal is generated by the A4VG variable pump, and that signal, together with the operating pressure, regulates the swivel angle of the hydraulic motor.

Increasing pump speed, i.e. increasing pilot pressure, causes the motor to swivel to a smaller displacement (lower torque, higher speed), depending on the operating pressure.

If the operating pressure exceeds the pressure setpoint set on the controller, the variable motor swivels to a larger displacement (higher torque, lower speed).

Pressure ratio p_{St}/p_{HD}: 3/100, 5/100

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 motor 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.

Detailed information is available from our sales department and on the Internet at www.boschrexroth.com/da-control.

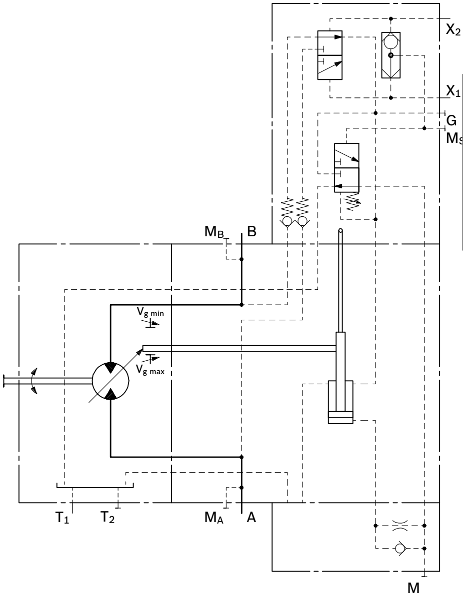
Note
The beginning of control and the DA characteristic are influenced by case pressure. An increase in case pressure causes a decrease in the beginning of control (see page 5) and thus a parallel shift of the characteristic.

DA
Hydraulic travel direction valve

Dependent on the direction of rotation (travel direction), the travel direction valve is switched by using pilot pressures connections X_1 or X_2.

Direction of rotation	Operating pressure in	Pilot pressure in
cw	A	X_1
ccw	B	X_2

Schematic DA
Size 250



DA – Automatic control speed-related

DA3
Electric travel direction valve + electric $V_{g\ max}$-circuit

The travel direction valve is either spring offset or switched by energizing switching solenoid a, depending on the direction of rotation (travel direction).

When the switching solenoid b is energized, the DA control is overridden and the motor swivels to maximum displacement (high torque, lower speed) (electric $V_{g\ max}$-circuit).

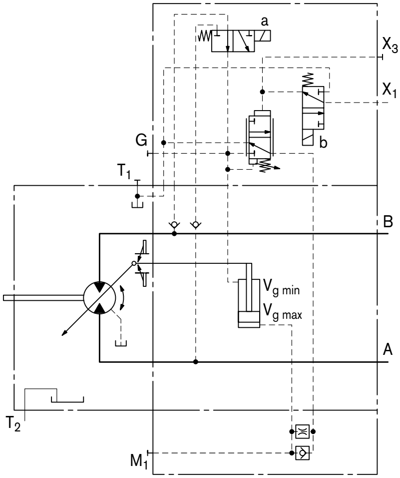
Technical data, solenoid a with Ø37
(travel direction valve)

		DA3
Voltage		24 V (±20 %)
Direction of rotation	Operating pressure in	
ccw	B	de-energized
cw	A	energized
Nominal resistance (at 20 °C)		21.7 Ω
Nominal power		26.5 W
Minimum required current		0.67 A
Duty cycle		100 %
Type of protection see connector design page 28		

Technical data, solenoid b with Ø37
(electric override)

	DA3,
Voltage	24 V (±20 %)
No override	de-energized
Displacement $V_{g\ max}$	energized
Nominal resistance (at 20 °C)	21.7 Ω
Nominal power	26.5 W
Minimum required current	0.67 A
Duty cycle	100 %
Type of protection see connector design page 28	

Schematic DA3
Sizes 28 to 160



Electric travel direction valve (for DA)

Application in travel drives in closed circuits. The travel direction valve of the motor is actuated by an electric signal that also switches the swivel direction of the travel drive pump (e. g. A4VG with DA control valve).

If the pump in the closed circuit is switched to the neutral position or into reverse, the vehicle may experience jerky deceleration or braking, depending on the vehicle's mass and current travel speed.

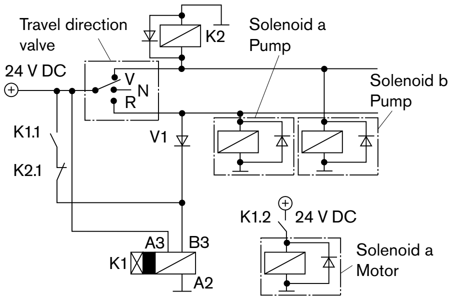
When the travel direction valve of the pump (e. g. 4/3-directional valve of the DA-control) is switched to

– the neutral position,
  the electric circuitry causes the previous signal on the travel direction valve on the motor to be retained.

– reversing,
  the electric circuitry causes the travel direction valve on the motor to switch to the other travel direction following a time delay (approx. 0.8 s) with respect to the pump.

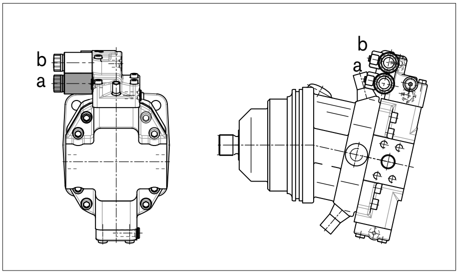
As a result, jerky deceleration or braking is prevented in both cases.

Schematic - electric travel direction valve



Note
The shown diodes and relays are not included in the delivery of the motor.

DA3 control (see page 22)

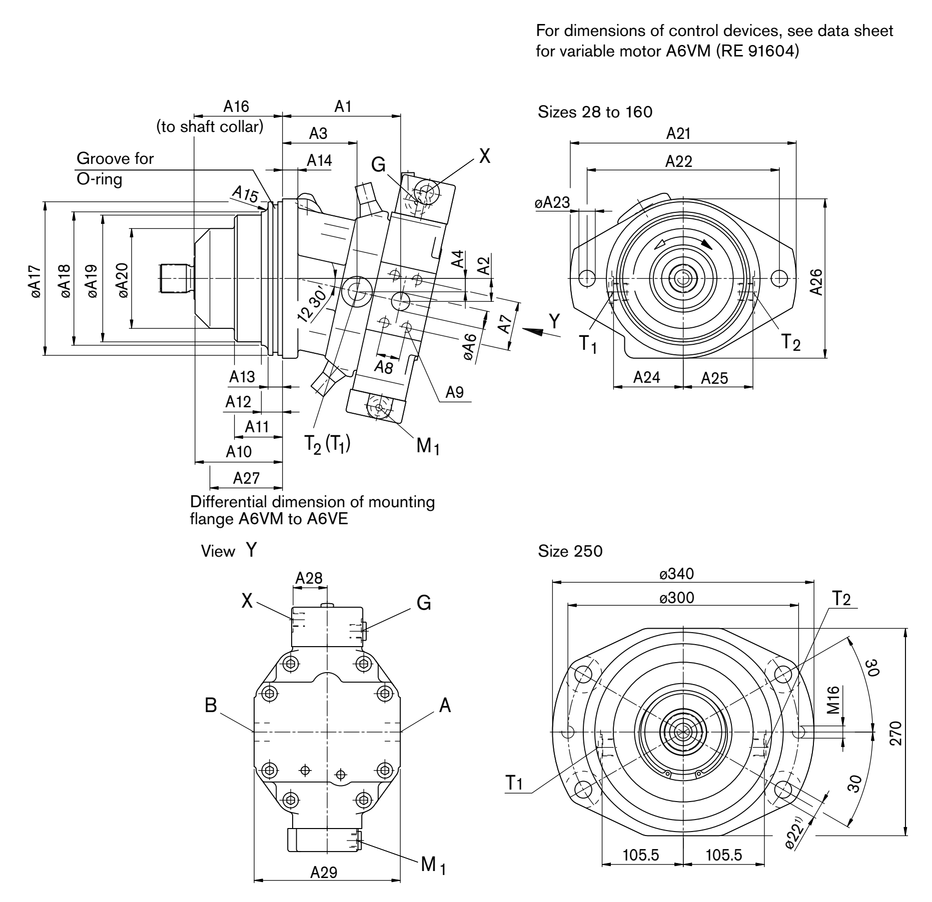


Dimensions

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

HD1, HD2 – Proportional control hydraulic

Port plate 02 – SAE flange port A and B at side, opposite



Ports

Size	Service line port A, B SAE J518	Drain port T_1; T_2 2) DIN 3852 3)
28	3/4 in	M18 x 1.5; 12 deep
55	3/4 in	M18 x 1.5; 12 deep
80	1 in	M18 x 1.5; 12 deep
107	1 in	M18 x 1.5; 12 deep
160	1 1/4 in	M26 x 1.5; 16 deep
250	1 1/4 in	M22 x 1.5; 14 deep

1) Hole ø22 with spot face ø48; 2 deep
2) 1x plugged
3) Observe the general instructions on page 40 for the maximum tightening torques.
For further ports, see variable motor A6VM (RE 91604)!

Dimensions

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

Standard flange L (sizes 28 to 160), **M** (size 250)

NG	A1	A2	A3	A4	øA6	A7	A8	A9 (DIN 13)[2)]	A10	A11	A12	A13	A14	A15
28	91	20	47	10	ø19	50.8	23.8	M10 x 1.5; 17 deep	88	54	–	15	14	R10
55	123	24	77	14	ø19	50.8	23.8	M10 x 1.5; 17 deep	91	50	22	15	16	R6
80	129	28	78	16	ø25	57.2	27.8	M12 x 1.75; 17 deep	109.5	65	30	15	18	R10
107	137	30	84	18	ø25	57.2	27.8	M12 x 1.75; 17 deep	121.8	72	35	15	18	R12
160	171	34	109	20	ø32	66.7	31.8	M14 x 2; 19 deep	122	67	29	15	20	R5
250	204	44	103	20	ø32	66.7	31.8	M14 x 2; 19 deep	131.5	–	–	14	25[1)]	–

NG	A16[3)]	A17	A18	A19	A20	A21	A22	øA23	A24	A25	A26	A27	A28	A29	O-ring[4)]
28	89	$135_{-0.025}$	110	–	86	188	160	ø13.5	62.5	62.5	142	64	35.5	132	126x4
55	92	$160_{-0.025}$	139	132	104	235	200	ø17	72.5	72.5	166	59	35.5	152	150x4
80	110.5	$190_{-0.029}$	151	143	116	260	224	ø21	78.5	78.5	198	79	35.5	164	182x4
107	122.8	$200_{-0.029}$	168	160	132	286	250	ø21	86.5	86.5	210	82	40.5	180	192x4
160	123	$200_{-0.029}$	188	180	146	286	250	ø21	98.5	98.5	210	83	40.5	204	192x4
250	133.5	$260_{-0.081}$	230	–	–	–	–	–	–	–	–	83.5	48.5	224	250x5

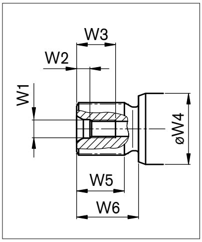
Adapter flange U (size 107)

NG	A1	A2	A3	A4	A5	A6	A7	A8	A9 (DIN 13)[2)]	A10	A11	A12	A13	A14
107	150	30	96	18	15.5	25	57.2	27.8	M12 x 1.75; 17 deep	109.5	59.7	22.7	18	15

NG	A15	A16	A17	A18	A19	A20	A21	A22	A23	A24	A25	A26	A27	A28	A29	O-ring[4)]
107	R8	110.5	$190_{-0.025}$	168	160	132	260	224	22	86.5	86.5	198	91.5	13.8	70	182x4

3

Drive shafts



NG	Splined shaft DIN 5480	W1[2)5)]	W2	W3	øW4	W5	W6
28	**A** (W30x2x14x9g)	M10 x 1.5	7.5	22	ø35	27	35
55	**Z** (W30x2x14x9g)	M12 x 1.75	9.5	28	ø45	27	35
80	**A** (W40x2x18x9g)	M16 x 2	12	36	ø50	37	45
107	**Z** (W40x2x18x9g)	M12 x 1.75	9.5	28	ø60	37	45
160	**A** (W50x2x24x9g)	M16 x 2	12	36	ø70	44	55
250	**Z** (W50x2x24x9g)	M16 x 2	12	36	ø60	49	58

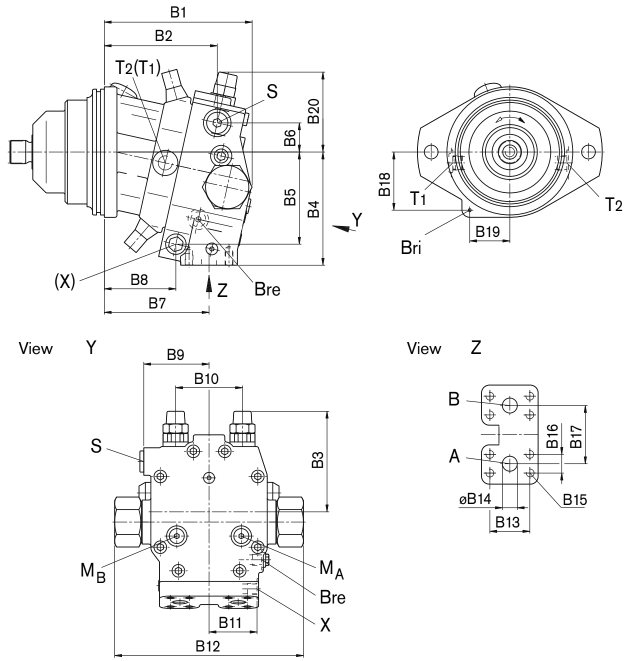
1) Hole ø22 with spot face ø48; 2 deep
2) Observe the general instructions on page 40 for the maximum tightening torques.
3) To shaft collar
4) The O-ring is not included in the delivery contents
5) Center bore according to DIN 332 (thread according to DIN 13)

Dimensions

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

HA3 – Automatic control high-pressure related

Port plate 22 – SAE flange port A and B at bottom, with integrated counterbalance valve



Ports

NG	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	B13	B14	B15 (DIN 13)[2)]	B16	B17
55	192	144	127	144	117	37	133	91	83	85	64	259	50.8	19	M10 x 1.5; 17 deep	23.8	80
80	198	150	136	162	132	40	138	93	83	90	69	259	57.2	25	M12 x 1.75; 17 deep	27.8	86
107	202	161	139	171.5	143	40	144	99	85	96	72	259	57.2	25	M12 x 1.75; 17 deep	27.8	86
160	240	195	152	197	162	47	177	128	102	108	78	259	66.7	32	M14 x 2; 19 deep	31.8	94

NG	B18	B19	B20	Service line port A, B SAE J518	Drain port T_1; T_2[1)] DIN 3852[2)]	Infeed S DIN 3852[2)]
55	74	51	102	3/4 in	M18 x 1.5; 12 deep	M22 x 1.5; 14 deep
80	90	53	114	1 in	M18 x 1.5; 12 deep	M22 x 1.5; 14 deep
107	96	58	122	1 in	M18 x 1.5; 12 deep	M22 x 1.5; 14 deep
160	94	65	136	1 1/4 in	M26 x 1.5; 16 deep	M27 x 2; 16 deep

1) 1x plugged

2) Observe the general instructions on page 40 for the maximum tightening torques.

Note:
Port plate HZ3 and HA3 are not identical!

Dimensions

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

Ports

Designa-tion	Port for	Standard[5]	Size[1]	Maximum pressure [bar][2]	State[8]
X	Pilot signal (open with HZ and HA3T, plugged with HA3)	ISO 6149	M14 x 1.5; 11.5 deep	100	O
M_A, M_B	Measuring stroking chamber	DIN 3852	M14 x 1.5; 11.5 deep	420	X
Bre	Brake release, external	DIN 3852	M14 x 1.5; 11.5 deep	30	O/X[6]
Bri	Brake release, internal (not provided on versions with flange U)	–	ø4	30	X/O[7]

1) Observe the general instructions on page 40 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 39).
5) The spot face can be deeper than specified in the appropriate standard.
6) Must be connected for external piping. Is plugged with internal ducting.
7) Is plugged with external ducting. Must be connected with internal piping.
8) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Connector for solenoids

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

DEUTSCH DT04-2P-EP04

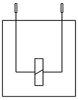
Sizes 28 to 160

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

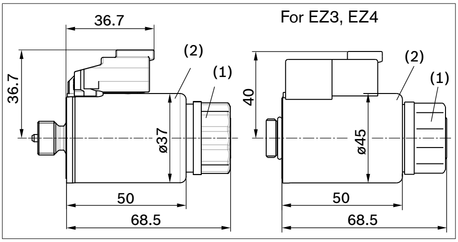
Consisting of: DT designation

– 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.



HIRSCHMANN DIN EN 175 301-803-A/ISO 4400

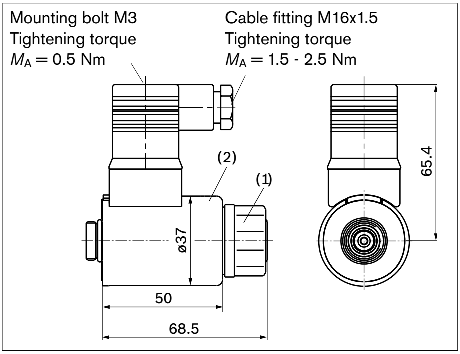
Size 250

Without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:
IP65 ______________________ DIN/EN 60529

The seal ring in the cable fitting is suitable for line diameters of 4.5 mm to 10 mm.

The HIRSCHMANN connector is included in the delivery contents of the motor.



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. (WAF26, 12-sided DIN 3124)

On delivery, the connector orientation may differ from that shown in the brochure or drawing.

Flushing and boost pressure valve

The flushing and boost pressure valve is used to remove heat from the hydraulic circuit.

In an open circuit, it is used only for flushing the housing.

In a closed circuit, it ensures a minimum boost pressure level in addition to the case flushing.

Hydraulic fluid is directed from the respective low pressure side into the motor housing. This is then fed into the reservoir, together with the case drain fluid. The hydraulic fluid, removed out of the closed circuit must be replaced by cooled hydraulic fluid from the boost pump.

The valve is mounted onto the port plate or integrated (depending on the control type and size).

Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
fixed setting ________________ 16 bar

Switching pressure of flushing piston Δp ________ 8±1 bar

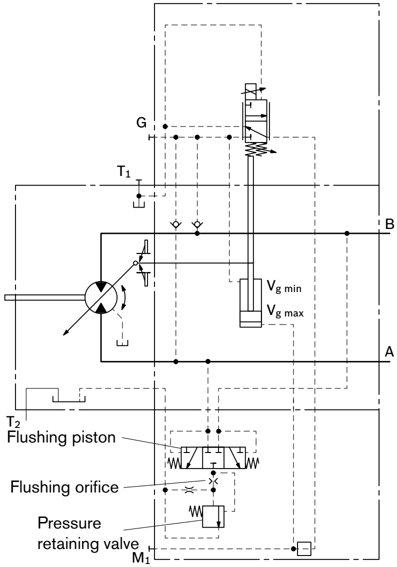
Flushing flow q_v

Orifices can be used to set the flushing flows as required. Following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G = 25$ bar and $\nu = 10$ mm²/s
(p_{ND} = low pressure, p_G = case pressure)

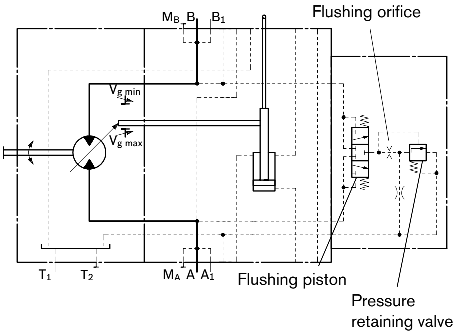
Size	Flushing flow q_V [L/min]	Mat. No. of orifice
28, 55	3.5	R909651766
80	5	R909419695
107	8	R909419696
160	10	R909419697
250	10	R909419697

With sizes 28 to 160, orifices can be supplied for flushing flows from 3.5 to - 10 L/min. For other flushing flows, please state the required flushing flow when ordering. The flushing flow without orifice is approx. 12 to 14 L at low pressure $\Delta p_{ND} = 25$ bar.

Schematic EP
Sizes 28 to 160



Schematic
Size 250

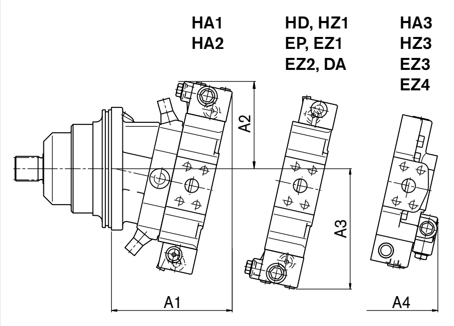


Flushing and boost pressure valve

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

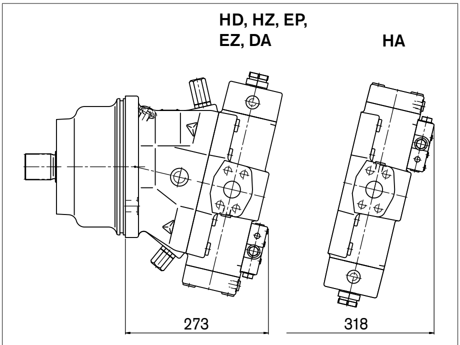
Dimensions

Sizes 28 to 160



NG	A1	A2	A3	A4
28	152	125	161	–
55	182	133	176	176
80	194	141	192	176
107 (L flange)	204	143	202	186
107 (U flange)	217	143	202	199
160	245	154	220	–

Size 250



Counterbalance valve BVD and BVE

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

Function

Travel drive/winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if the motor speed is greater than it should be for the given input flow while braking, travelling downhill, or lowering a load.

If the inlet pressure drops, the counterbalance spool throttles the return flow and brakes the motor until the inlet pressure returns to approx. 20 bar.

Note

– BVD available for sizes 55 to 160 and BVE available for sizes 107 and 160.

– The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: A6VE80HA1T/63W–VAL38800A + BVD20F27S/41B–V03K16D0400S12

– For safety reasons, controls with beginning of control at $V_{g\ min}$ (e. g. HA) are not permissible for winch drives!

– The counterbalance valve does not replace the mechanical service brake and park brake.

– Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525

– For the design of the brake release valve, we must know for the mechanical park brake:

  - the pressure at the start of opening
  - the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)
  - the required closing time for a warm device (oil viscosity approx. 15 mm²/s)

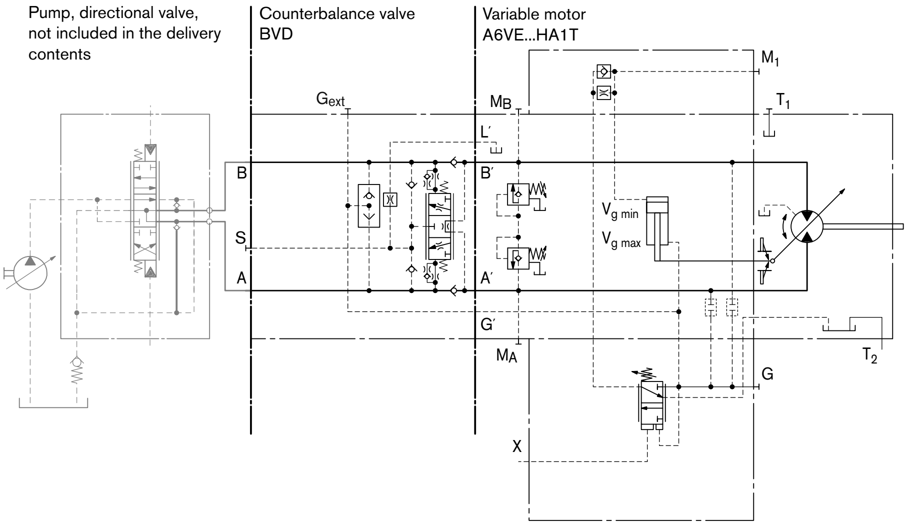
3

Travel drive counterbalance valve BVD...F

Application option

– Travel drive on wheeled excavators

Example schematic for travel drive for wheeled excavators
A6VE80HA1T/63W–VAL38800A + BVD20F27S/41B–V03K16D0400S12



Counterbalance valve BVD and BVE

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

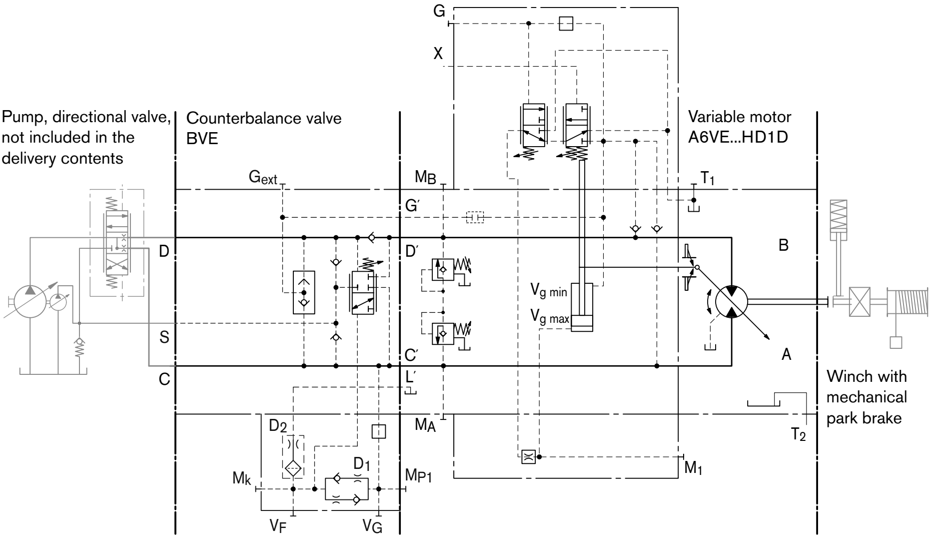
Winch counterbalance valve BVD...W and BVE

Application options

– Winch drive in cranes (BVD and BVE)

– Track drive in excavator crawlers (BVD)

Example schematic for winch drive in cranes
A6VE80HD1D/63W–VAL38800B + BVE25W38S/51ND-V100K00D4599T30S00-0



Permissible input flow or pressure in operation with DBV and BVD/BVE

Motor NG	Without valve p_{nom}/p_{max} [bar]	$q_{V\ max}$ [L/min]	Restricted values in operation with DBV and BVD/BVE: DBV NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code	BVD/BVE NG	p_{nom}/p_{max} [bar]	q_V [L/min]	Code
55	400/450	244	22	350/420	240	380	20 (BVD)	350/420	220	388
80		312								
107		380	32		400	370				378
107		380				380	25 (BVD/BVE)		320	388
160		496								
250	350/400	675	On request							

DBV ______________________________ pressure-relief valve

BVD _________________counterbalance valve, double-acting

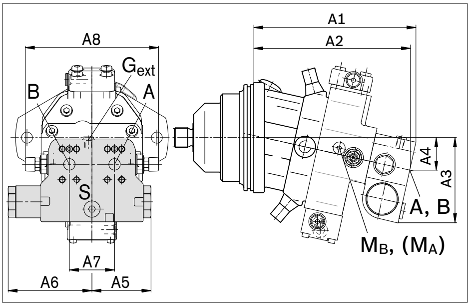
BVE ____________________counterbalance valve, one-sided

Counterbalance valve BVD and BVE

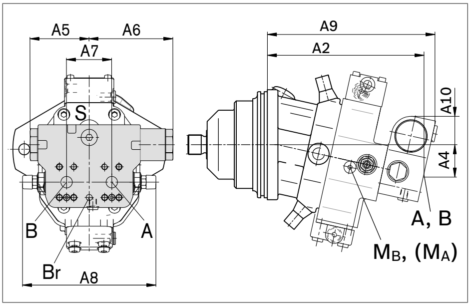
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Dimensions

A6VE...HA1/2



A6VE...HD or EP[1)]



A6VE	Counterbalance valve												
NG...plate	Type	Ports	Dimensions										
		A, B	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
55...38	BVD20...17	3/4 in	252	243	143	50	98	139	75	222	267	50
80...38	BVD20...27	1 in	261	252	148	55	98	139	75	222	276	46
107...37	BVD20...28	1 in	280	271	152	59	98	139	84	234	295	41
107...38	BVD25...38	1 1/4 in	298	288	165	63	120.5	175	84	238	311	56
160...38	BVD25...38	1 1/4 in	334	324	170	68	120.5	175	84	238	349	51
107...38	BVE25...38	1 1/4 in	298	288	171	63	137	214	84	238	315	63
160...38	BVE25...38	1 1/4 in	334	324	176	68	137	214	84	238	349	59

Ports

Designation	Port for	Version	A6VE Plate	Standard	Size[2)]	Maximum pressure [bar][3)]	State[5)]
A, B	Service line			SAE J518	see table above	420	O
S	Infeed	BVD20		DIN 3852[4)]	M22 x 1.5; 14 deep	30	X
		BVD25, BVE25		DIN 3852[4)]	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high-pressure	L	7	DIN 3852[4)]	M12 x 1.5; 12.5 deep	30	O
			8	DIN 3852[4)]	M12 x 1.5; 12 deep	30	O
G_{ext}	Brake release, high-pressure	S		DIN 3852[4)]	M12 x 1.5; 12.5 deep	420	X
M_A, M_B	Measuring pressure A and B			ISO 6149[4)]	M18 x 1.5; 14.5 deep	420	X

1) At the mounting version for the controls HD and EP, the cast-in port designations A and B on the counterbalance valve BVD do not correspond with the connection drawing of the A6VE motor.
The designation of the ports on the installation drawing of the motor is binding!
2) Observe the general instructions on page 40 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) The spot face can be deeper than specified in the appropriate standard.
5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Counterbalance valve BVD and BVE

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

Mounting the counterbalance valve

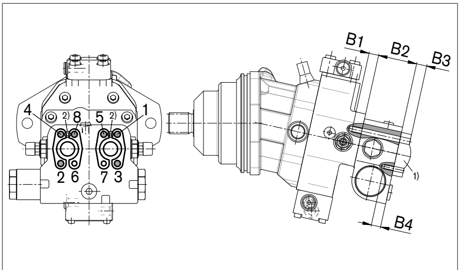
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the motor port plate using the provided tacking screws. The counterbalance valve is finally mounted to the motor by screwing on the SAE flange with the following screws:

6 screws (**1, 2, 3, 4, 5, 8**) ____________ length B1+B2+B3
2 screws (**6, 7**) ______________________ length B3+B4

Tighten the screws in two steps in the specified sequence from 1 to 8 (see following scheme).

In the first step, the screws must be tightened with half the tightening torque, and in the second step with the maximum tightening torque (see following table).

Thread	Strength class	Tightening torque [Nm]
M6 x 1 (tacking screw)	10.9	15.5
M10 x 1.5	10.9	75
M12 x 1.75	10.9	130
M14 x 2	10.9	205



1) SAE flange
2) Tacking screw (M6 x 1, length = B1 + B2, DIN 912)

NG...plate	55...38	80...38, 107...37	107...38, 160...38
B1[3]	M10 x 1.5 17 deep	M12 x 1.75 15 deep	M14 x 2 19 deep
B2	68	68	85
B3	customer-specific		
B4	M10 x 1.5 15 deep	M12 x 1.75 16 deep	M14 x 2 19 deep

3) Minimum required thread reach 1 x Ø-thread

Counterbalance valve integrated BVI

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

Function

The integrated counterbalance valve is designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if the motor speed is greater than it should be for the given input flow while braking or traveling downhill.

Note

– The integrated counterbalance valve must be ordered additionally, see ordering code below.

– The counterbalance valve does not replace the mechanical service brake and park brake.

– For the design of the brake release valve, we must know for the mechanical park brake:

  - the pressure at the start of opening
  - the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)
  - the required closing time for a warm device (oil viscosity approx. 15 mm^2/s)

Application options

– Track drive in excavator crawlers

Ordering code

BVI			00		–	
01	02	03	04	05		06

	Counterbalance valve			
01	Counterbalance valve integrated			BVI

	Brake piston version	qv [L/min]	Material number	
02	Volume preselected	≤ 150	R902038832	51
		= 150 – 210	R902038936	52
		= 210 – 270	R902038833	53
		= 270 – 330	R902038834	54
		= 330 – 400	R902038835	55
		≥ 400	R902038836	56

	Throttle mounting	Material number	
03	Constant throttle	R909432302	0008
	Throttle pin	R909651165	0603

	Check valve	
04	Without residual opening	00

	Brake release valve		
05	With brake release valve (standard with HZ)	Without disable function	1
	With brake release valve (standard with HA)	With disable function	2

	Standard / special version	
06	Standard version	0
	Special version	S

3

Counterbalance valve integrated BVI

Table of values

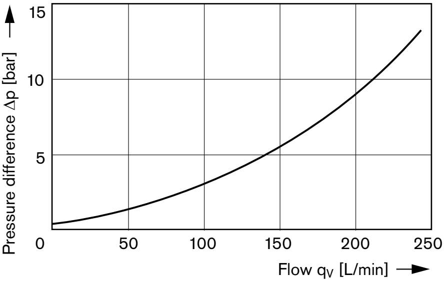
Operating pressure	nominal pressure	p	bar	350
	peak pressure	p	bar	420
Flow, maximum		$q_{v\ max}$	L/min	400
Counterbalance spool	start of opening	p	bar	12
	fully open	p	bar	26
Pressure-reducing valve for brake release (fixed setting)	control pressure	p	bar	21^{+4}
	beginning of control	p	bar	10^{+4}

Comparison between port plates 02 and 22

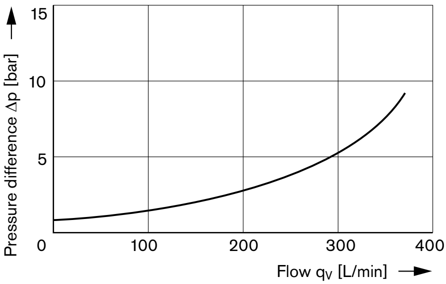
Maximum permissible input flow with restricted nominal pressure 350 bar, maximum pressure 420 bar

Motor	**Without restrictions standard plate (02)**		**Restricted values plate with integrated counterbalance valve (22)**		
					with BVI + DBV
NG	**p_{nom}/p_{max} [bar]**	**$q_{V\ max}$ [L/min]**	**Code**	**p_{nom}/p_{max} [bar]**	**q_V [L/min]**
55	400/450	276	22	350/420	240
80		332			
107		410			
160		533			400

Infeed characteristic M22 x 1.5

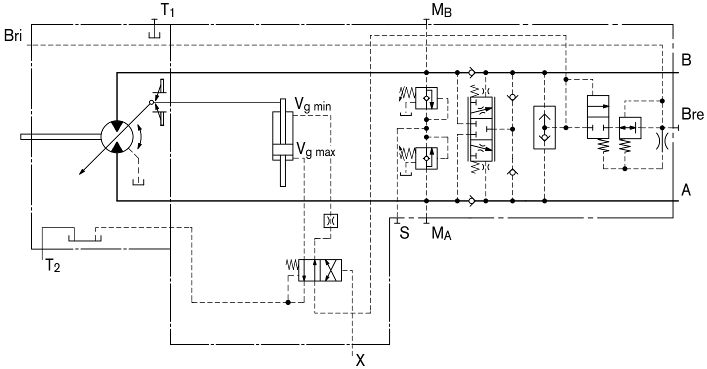


Infeed characteristic M27 x 2

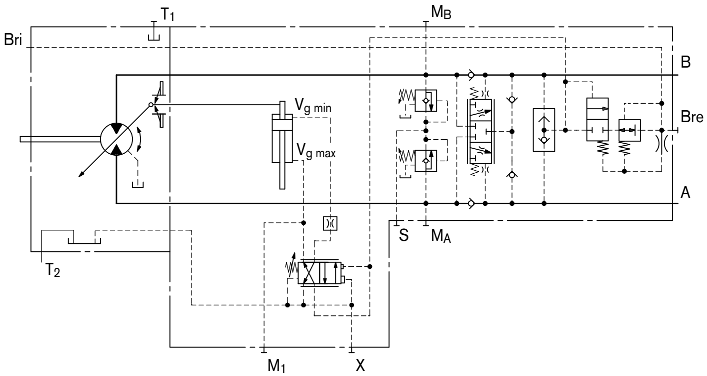


Counterbalance valve integrated BVI

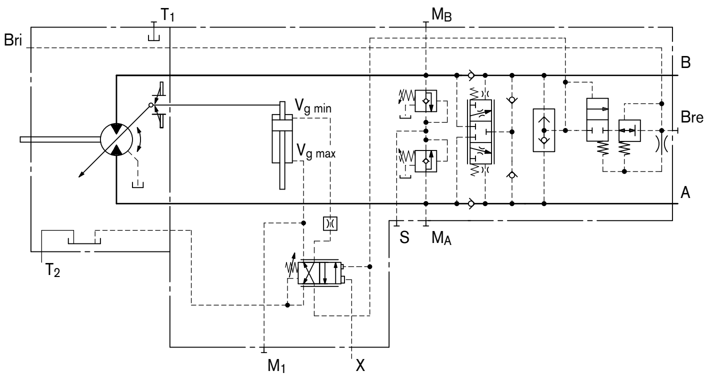
Schematic HZ3



Schematic HA3



Schematic HA3.T



3

Speed sensor

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

Version A6VE...U ("prepared for speed spensor", i.e. without sensor) is equipped with a toothed ring on the rotary group.

On deliveries "prepared for speed sensor", the port is plugged with a pressure-resistant cover.

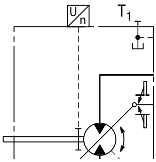
With the speed sensor DSA mounted, a signal proportional to motor speed can be generated. The sensor measures the speed and direction of rotation.

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.

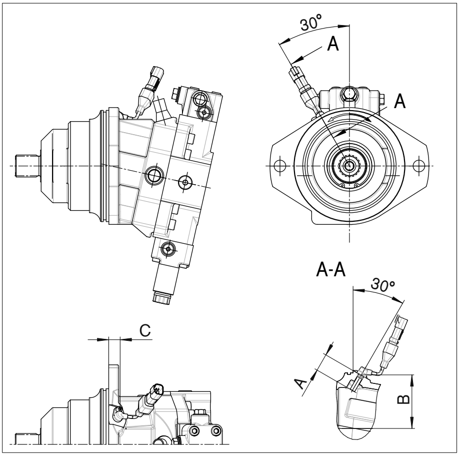
We recommend ordering the A6VE variable motor complete with installed sensor.

Schematic



Dimensions

Version "V" with mounted speed sensor



NG	55	80	107	160	250
Number of teeth	54	58	67	75	86
A	32	32	32	32	on request
B	83.3	87.3	96.3	104.3	on request
C	26	16.5	14.2	28.5	on request

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 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 drain line must flow into the reservoir below the minimum fluid level.

Installation position

See the following examples 1 to 6.
Further installation positions are possible upon request.

Recommended installation positions: 1 and 2.

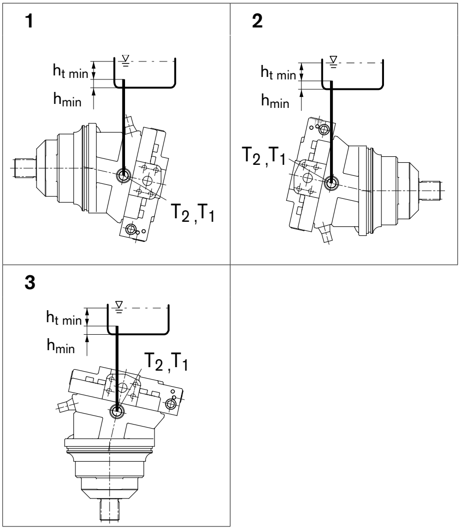
Note
In certain installation conditions, an influence on the control characteristics can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristics and changes in response time.

Installation position	Air bleed	Filling
1	–	T_2, T_1
2	–	T_2, T_1
3	–	T_2, T_1
4	L_1	T_2, T_1 (L_1)
5	L_1	T_2, T_1 (L_1)
6	L_1	T_2, T_1 (L_1)

L_1 Filling / air bleed
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)

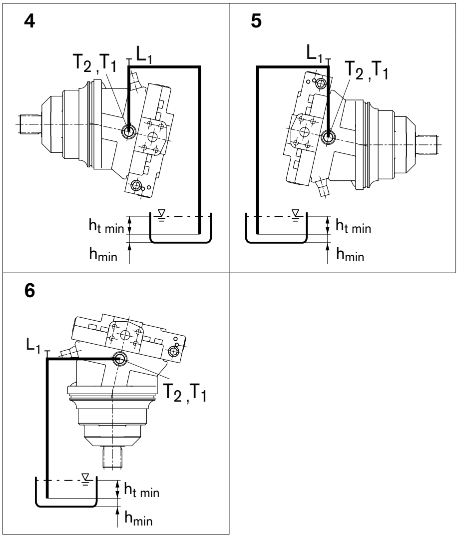
Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.



3

General instructions

– The motor A6VE is designed to be used in open and closed 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.

– 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 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 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 of the threaded plugs
DIN 3852	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
	M26 x 1.5	230 Nm	120 Nm	12 mm
	M27 x 2	330 Nm	135 Nm	12 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 17 Nm for M12 x 1.5.

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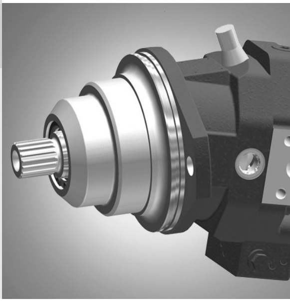
Variable Plug-in Motor A6VE



Data sheet

Series 71
Sizes 60 to 170
Nominal pressure 450 bar
Maximum pressure 500 bar
Open and closed circuits

Contents

Features

- Variable plug-in motor with axial tapered piston rotary group of bent-axis design, for hydrostatic drives in open and closed circuits
- Far-reaching integration in mechanical gearbox due to a recessed mounting flange located in the center of the case (extremely space-saving construction)
- Easy to install, simply plug into the mechanical gearbox (no configuration specifications to be observed)
- Tested unit ready to install
- For use especially in mobile applications
- The displacement can be infinitely changed from $V_{g\,max}$ to $V_{g\,min} = 0$.
- The wide control range enables the variable motor to satisfy the requirement for high speed and high torque.
- The output speed is dependent on the flow of the pump and the displacement of the motor.
- The output torque increases with the pressure differential between the high-pressure and low-pressure side and with increasing displacement.

Ordering code for standard program

A6V	E					0	0			/	71	M	W	V	0						–	
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	Bent-axis design, variable, nominal pressure 450 bar, maximum pressure 500 bar	**A6V**

Operating mode

02	Plug-in motor	**E**

Sizes (NG)

03	Geometric displacement, see table of values on page 8	**060**	**085**	**115**	**170**

Control devices

				060	**085**	**115**	**170**	
04	Proportional control hydraulic	positive control	$\Delta p_{St} = 10$ bar	●	●	●	●	**HP1**
			$\Delta p_{St} = 25$ bar	●	●	●	●	**HP2**
		negative control	$\Delta p_{St} = 10$ bar	●	●	●	●	**HP5**
			$\Delta p_{St} = 25$ bar	●	●	●	●	**HP6**
	Proportional control electric	positive control	U = 12 V DC	●	●	●	●	**EP1**
			U = 24 V DC	●	●	●	●	**EP2**
		negative control	U = 12 V DC	●	●	●	●	**EP5**
			U = 24 V DC	●	●	●	●	**EP6**
	Two-point control hydraulic	negative control		–	–	–	●	**HZ5**
				●	●	●	❍[1]	**HZ7**
	Two-point control electric	negative control	U = 12 V DC	–	–	–	●	**EZ5**
			U = 24 V DC	–	–	–	●	**EZ6**
			U = 12 V DC	●	●	●	–	**EZ7**
			U = 24 V DC	●	●	●	–	**EZ8**
	Automatic control, high-pressure related, positive control	with minimum pressure increase	Δp ≤ approx. 10 bar	●	●	●	●	**HA1**
		with pressure increase	Δp = 100 bar	●	●	●	●	**HA2**
		with minimum pressure increase	Δp ≤ approx. 10 bar	❍	❍	❍	❍	**HA3**[1]

Pressure control/override

05	Without pressure control/override	**00**
	Pressure control fixed setting, only for HP5, HP6, EP5 and EP6	**D1**
	Override of the HA1 and HA2 controls, hydraulic remote control, proportional	**T3**

Connector for solenoids[2] (see page 36)

06	Without connector (without solenoid, only with hydraulic controls)	**0**
	DEUTSCH - molded connector, 2-pin – without suppressor diode	**P**

Additional function 1

07	Without additional function	**0**

Additional function 2

08	Without additional function	**0**

● = Available ❍ = On request – = Not available

1) Only possible in combination with port plate 6 (integrated counterbalance valve)
2) Connectors for other electric components can deviate.

Ordering code for standard program

A6V	E					0	0			/	71	M	W	V	0						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21

Response time damping (for selection, see control)

09	Without damping (standard with HP and EP)		0
	Damping	HP, EP, HP5, 6D. and EP5,6D.; HZ, EZ, HA3, HA1 and HA2 with counterbalance valve BVD/BVE	1
		One-sided in inlet to large stroking chamber (HA)	4

Setting range for displacement[3)]

			060	085	115	170	
	$V_{g\ max}$-adjusting screw	$V_{g\ min}$-adjusting screw					
10	Without adjusting screw	short (0-adjustable)	●	●	●	●	A
		medium	●	●	●	●	B
		long	●	●	●	●	C
		extra long	–	–	●	●	D
	Short	short (0-adjustable)	●	●	●	●	E
		medium	●	●	●	●	F
		long	●	●	●	●	G
		extra long	–	–	●	●	H
	Medium	short (0-adjustable)	●	●	●	●	J
		medium	●	●	●	●	K
		long	●	●	●	●	L
		extra long	–	–	●	●	M

Series

11	Series 7, index 1	71

Configuration of ports and fastening threads

12	Metric, port threads with O-ring seal according to ISO 6149	M

Direction of rotation

13	Viewed on drive shaft, bidirectional	W

Seals

14	FKM (fluor-caoutchouc)	V

Drive shaft bearing

15	Standard bearing	0

Mounting flanges

			060	085	115	170	
16	ISO 3019-2	160-2	●	–	–	–	P2
		190-2	–	●	–	–	Y2
		200-2	–	–	●	●	S2

Drive shafts

			060	085	115	170	
17	Splined shaft DIN 5480	W35x2x16x9g	●	–	–	–	Z8
		W40x2x18x9g	–	●	●	–	Z9
		W45x2x21x9g	–	–	–	●	A1

● = Available ❍ = On request – = Not available

3) The settings for the adjusting screws can be found in the table (page 46).

3

Ordering code for standard program

A6V	E					0	0			/	71	M	W	V	0						–	
01	02	03	04	05	06	07	08	09	10		11	12	13	14	15	16	17	18	19	20		21

Port plates for service lines

			060	085	115	170	
18	SAE flange ports A and B at rear		●	●	●	●	**1**
	SAE flange ports A and B at side, opposite		●	●	●	●	**2**
	SAE flange port A and B at bottom only with integrated counterbalance valve BVI[4)]		●	●	●	❍	**6**
	Port plate with 1-level pressure-relief valves for mounting a counterbalance valve[5)]	BVD20	●	●	●	–	**7**
		BVD25, BVE25	–	–	●	●	**8**

Valves (see pages 37 to 46)

			060	085	115	170	
19	Without valve		●	●	●	●	**0**
	Counterbalance valve BVD/BVE mounted[6)]		●	●	●	●	**W**
	Brake release valve integrated (only with port plate 6)	for external piping	●	●	●	❍	**Y**
		with internal ducting	●	●	●	❍	**Z**
	Flushing and boost pressure valve mounted, flushing on both sides Flushing flow with: $\Delta p = p_{ND} - p_G = 25$ bar and $\nu = 10$ mm²/s (p_{ND} = low pressure, p_G = case pressure) Only possible with port plates 1 and 2	**Flushing flow q_v [L/min]**					
		3.5	●	●	●	–	**A**
		5	●	●	●	–	**B**
		8	●	●	●	●	**C**
		10	●	●	●	●	**D**
		14	●	●	●	–	**F**
		17	–	–	–	●[7)]	**G**
		20	–	–	●[7)]	●[7)]	**H**
		25	–	–	●[7)]	●[7)]	**J**
		30	–	–	●[7)]	●[7)]	**K**
		35	–	–	–	●[7)]	**L**
		40	–	–	–	●[7)]	**M**

Speed sensor (see page 36)

20	Without speed sensor	**0**
	Prepared for DSA speed sensor	**U**
	DSA speed sensor mounted[8)]	**V**

Standard / special version

21	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

4) Only for HZ7 and HA3. Supplement specification for integrated counterbalance valve BVI, see separate ordering code on page 43. Note the restrictions on page 44.
5) Only possible in combination with HP, EP and HA control. Note the restrictions on page 40.
6) Specify ordering code of counterbalance valve acc. to data sheet (BVD – RE 95522, BVE – RE 95525) separately. Note the restrictions on page 40.
7) Not for EZ7, EZ8, HZ7 and HA3
8) Specify ordering code of sensor acc. to data sheet (DSA – RE 95133) separately and observe the requirements on the electronics.

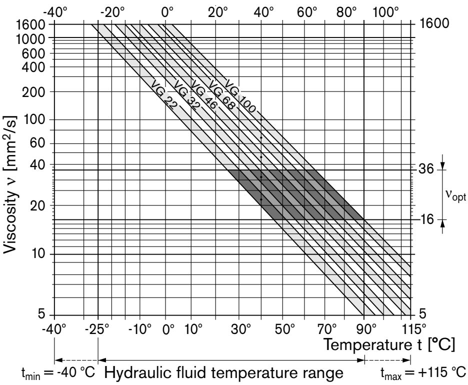
Technical data

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 motor A6VE 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.
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; 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 circuit temperature or 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 using a flushing and boost pressure valve (see pages 37 and 38).

3

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]	ν_{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 T.
Maximum temperature		115 °C	in the bearing
		103 °C	measured at port T
Continuous operation	ν = 400 to 10 ν_{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} = +103 °C	measured at port T, $t <$ 3 min, $p < 0.3 \cdot p_{nom}$
FKM shaft seal[1]		$T \leq$ +115 °C	see page 6

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.

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.

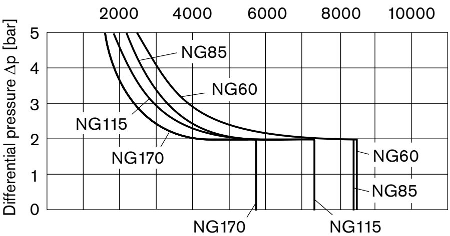
If the above classes cannot be achieved, please contact us.

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.



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.

Influence of case pressure on beginning of control

An increase in case pressure affects the beginning of control of the variable motor when using the following control options:

HP, HA.T3 ________________________________ increase

With the following controls, an increase in the case pressure has no influence on the beginning of control: EP, HA

The factory setting of the beginning of control is made at $p_{abs} = 2$ bar case pressure.

Direction of flow

Direction of rotation, viewed on drive shaft	
cw	**ccw**
A to **B**	**B** to **A**

Technical data

Operating pressure range

(operating with mineral oil)

Pressure at service line port A or B

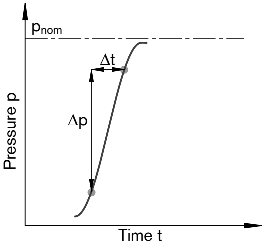
Nominal pressure p_{nom} ________________ 450 bar absolute

Maximum pressure p_{max} ________________ 500 bar absolute
Single operating period ________________ 10 s
Total operating period ________________ 300 h

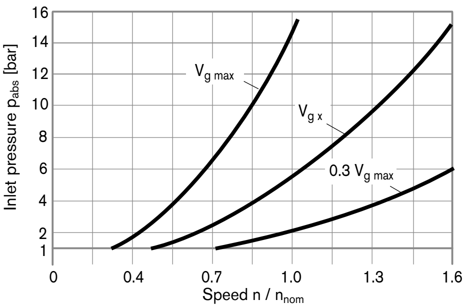
Minimum pressure (high-pressure side) ___25 bar absolute

Summation pressure (pressure A + pressure B) p_{Su} _ 700 bar

Rate of pressure change $R_{A\,max}$
with integrated pressure-relief valve____________ 9000 bar/s
without pressure-relief valve ________________ 16000 bar/s



Minimum pressure – pump mode (inlet)
To prevent damage to the axial piston motor in pump operating mode (change of high-pressure side with unchanged direction of rotation, e. g. when braking), a minimum pressure must be guaranteed at the service line port (inlet). This minimum pressure is dependent on the speed and displacement of the axial piston unit (see characteristic curve below).



This diagram is valid only for the optimum viscosity range from $\nu_{opt} = 36$ to 16 mm²/s.
Please contact us if the above conditions cannot be satisfied.

Note
Values for other hydraulic fluids, please contact us.

Definition

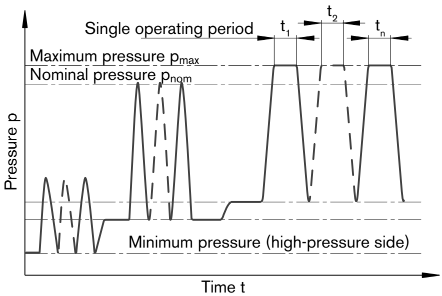
Nominal pressure p_{nom}
The nominal pressure corresponds to the maximum design pressure.

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.

Summation pressure p_{Su}
The summation pressure is the sum of the pressures at both service line ports (A and B).

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

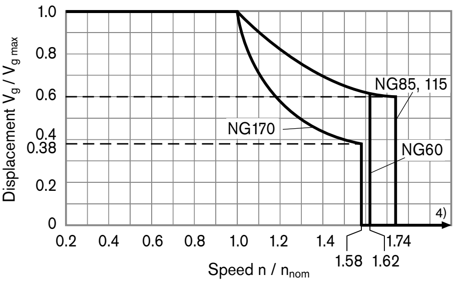
Table of values (theoretical values, without efficiency and tolerances; values rounded)

Size		NG		60	85	115	170
Displacement geometric, per revolution		$V_{g\,max}$	cm^3	62.0	85.2	115.6	171.8
		$V_{g\,min}$	cm^3	0	0	0	0
		$V_{g\,x}$	cm^3	37	51	69	65
Speed maximum[1] (while adhering to the maximum permissible input flow)							
at $V_{g\,max}$		n_{nom}	rpm	4450	3900	3550	3100
at $V_g < V_{g\,x}$ (see diagram below)		n_{max}	rpm	7200	6800	6150	4900
at $V_{g\,0}$		n_{max}	rpm	8400	8350	7350	5750
Input flow[2]							
at n_{nom} and $V_{g\,max}$		$q_{V\,max}$	L/min	276	332	410	533
Torque[3]							
at $V_{g\,max}$ and $\Delta p = 450$ bar		T	Nm	444	610	828	1230
Rotary stiffness							
$V_{g\,max}$ to $V_g/2$		c_{min}	kNm/rad	15	22	37	52
$V_g/2$ to 0 (interpolated)		c_{max}	kNm/rad	45	68	104	156
Moment of inertia for rotary group		J_{GR}	kgm^2	0.0043	0.0072	0.0110	0.0213
Maximum angular acceleration		α	rad/s^2	21000	17500	15500	11000
Case volume		V	L	0.8	1.0	1.5	2.3
Mass (approx.)	without BVI	m	kg	28	36	46	62
	with BVI	m	kg	37	45	52	70

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 startup angular acceleration (lower than the maximum angular acceleration) can be found in data sheet RE 90261.

Permissible displacement in relation to speed



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) Restriction of input flow with counterbalance valve, see pages 40 and 44

3) Torque without radial force, with radial force see page 9

4) Values in this range on request

Technical data

Permissible radial and axial forces of the drive shaft

Size	NG		60	85	115	170
Drive shaft		in	W35	W40	W40	W45
Maximum radial force[1] at distance a (from shaft collar)	$F_{q\,max}$	N	10266	12323	16727	21220
	a	mm	20	22.5	22.5	25
with permissible torque	T_{max}	Nm	444	610	828	1189
≙ Permissible pressure Δp at $V_{g\,max}$	$p_{nom\,perm.}$	bar	450	450	450	435
Maximum axial force[2]	$+F_{ax\,max}$	N	500	710	900	1120
	$-F_{ax\,max}$	N	0	0	0	0
Permissible axial force per bar operating pressure	$F_{ax\,perm./bar}$	N/bar	7.5	9.6	11.3	15.1

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

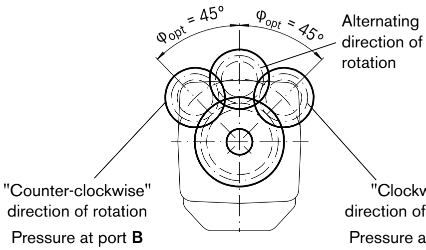
Note
Influence of the direction of the permissible axial force:

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

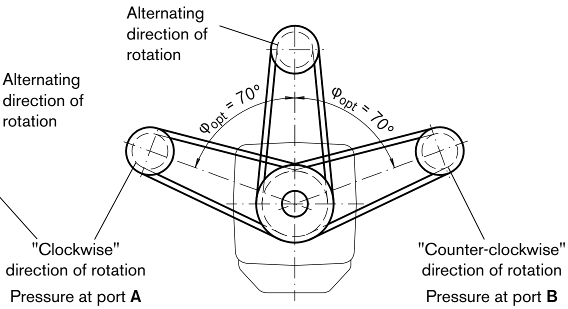
Effect of radial force F_q on the service life of bearings

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 drive



Determining the operating characteristics

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

Speed $$n = \frac{q_V \cdot 1000 \cdot \eta_v}{V_g} \quad \text{[rpm]}$$

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

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

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

HP – Proportional control hydraulic

The proportional hydraulic control provides infinite setting of the displacement, proportional to the pilot pressure applied to port X.

HP1, HP2 positive control
- Beginning of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at minimum pilot pressure)
- End of control at $V_{g\,max}$ (maximum torque, minimum speed at maximum pilot pressure)

HP5, HP6 negative control
- Beginning of control at $V_{g\,max}$ (maximum torque, minimum speed at minimum pilot pressure)
- End of control at $V_{g\,min}$ (minimum torque, maximum permissible speed at maximum pilot pressure)

Note
- Maximum permissible pilot pressure: $p_{St} = 100$ bar
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 500 bar can occur at port G.
- Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 10 bar.
- The beginning of control and the HP characteristic are influenced by the case pressure. An increase in the case pressure causes an increase in the beginning of control (see page 6) and thus a parallel shift of the characteristic.

HP1, HP5 pilot pressure increase $\Delta p_{St} = 10$ bar

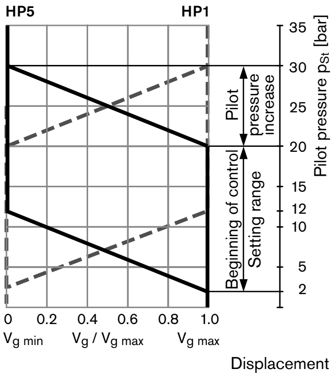
HP1 positive control
A pilot pressure increase of 10 bar at port X results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

HP5 negative control
A pilot pressure increase of 10 bar at port X results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

Beginning of control, setting range ____________ 2 to 20 bar

Standard setting:
Beginning of control at 3 bar (end of control at 13 bar)

Characteristic



HP2, HP6 pilot pressure increase $\Delta p_{St} = 25$ bar

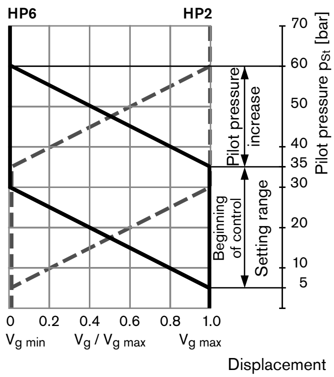
HP2 positive control
A pilot pressure increase of 25 bar at port X results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

HP6 negative control
A pilot pressure increase of 25 bar at port X results in a decrease in displacement from $V_{g\,max}$ to $V_{g\,min}$.

Beginning of control, setting range ____________5 to 35 bar

Standard setting:
Beginning of control at 10 bar (end of control at 35 bar)

Characteristic



Note

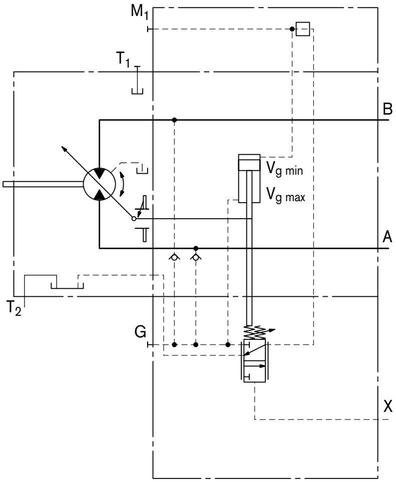
The spring return feature in the control part is not a safety device

The control part 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.

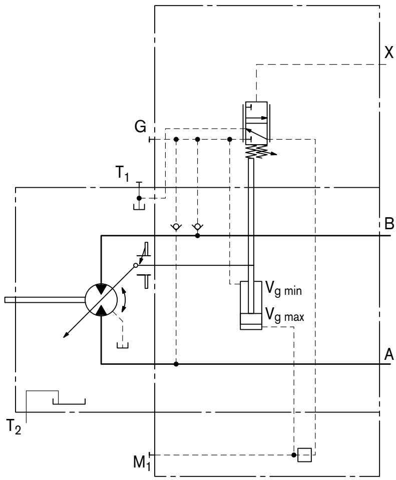
Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

HP – Proportional control hydraulic

Schematic HP1, HP2: positive control



Schematic HP5, HP6: negative control



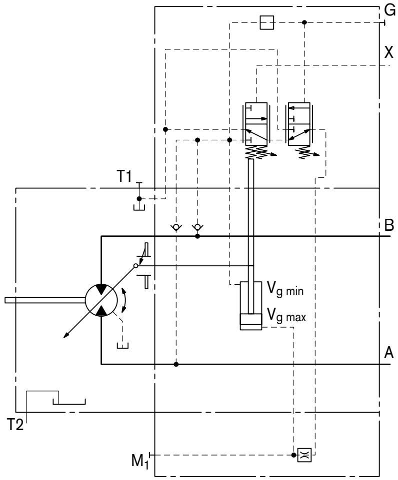
HP5D1, HP6D1
Pressure control, fixed setting

The pressure control overrides the HP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve_____ 80 to 450 bar

Schematic HP5D1, HP6D1: negative control



3

EP – Proportional control electric

The proportional electric control provides infinite setting of the displacement, proportional to the control current applied to the solenoid.

EP1, EP2 positive control

– Beginning of control at $V_{g\ min}$ (minimum torque, maximum permissible speed at minimum control current)

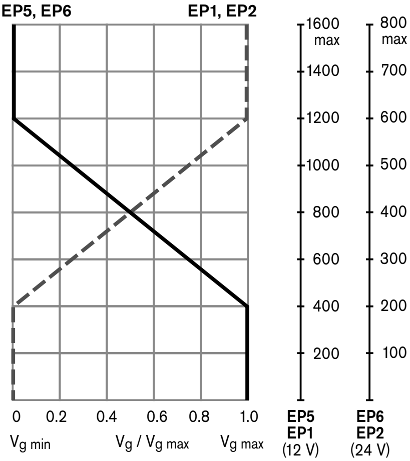
– End of control at $V_{g\ max}$ (maximum torque, minimum speed at maximum control current)

EP5, EP6 negative control

– Beginning of control at $V_{g\ max}$ (maximum torque, minimum speed at minimum control current)

– End of control at $V_{g\ min}$ (minimum torque, maximum permissible speed at maximum control current)

Characteristic



Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 500 bar can occur at port G.

Technical data, solenoid

	EP1, EP5	EP2, EP6
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 design page 36		

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

– Electric amplifier VT 2000, series 5X (see RE 29904) (for stationary application)

Further information can also be found on the internet at: www.boschrexroth.com/mobile-electronics

Note

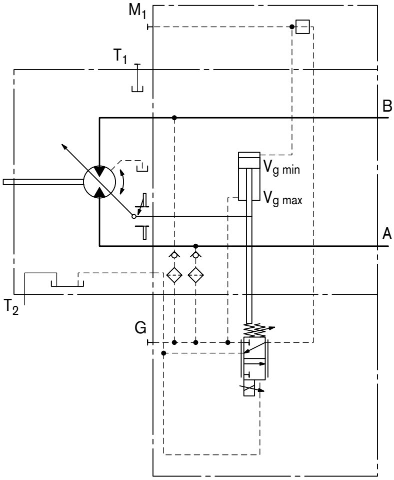
The spring return feature in the control part is not a safety device

The control part 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.

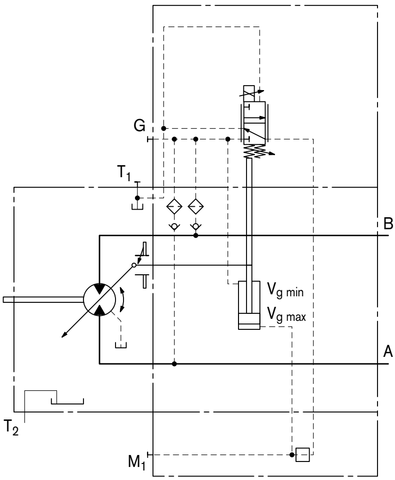
Check whether the application on your machine requires additional safety measures, in order to bring the driven actuator into a controlled and safe position (immediate stop). If necessary, make sure these are properly implemented.

EP – Proportional control electric

Schematic EP1, EP2: positive control



Schematic EP5, EP6: negative control



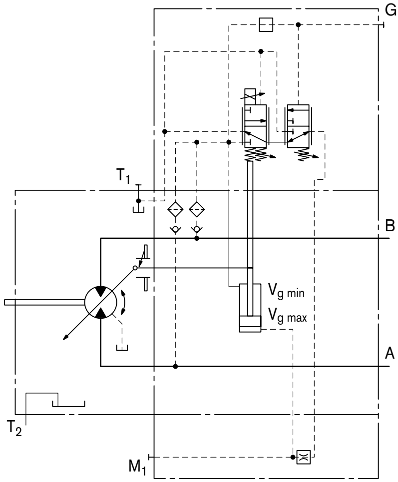
EP5**D1**, EP6**D1**
Pressure control, fixed setting

The pressure control overrides the EP control function. If the load torque or a reduction in motor swivel angle causes the system pressure to reach the setpoint of the pressure control, the motor will swivel towards a larger displacement.

The increase in the displacement and the resulting reduction in pressure cause the control deviation to decrease. With the increase in displacement the motor develops more torque, while the pressure remains constant.

Setting range of the pressure control valve_____ 80 to 450 bar

Schematic EP5D1, EP6D1: negative control



3

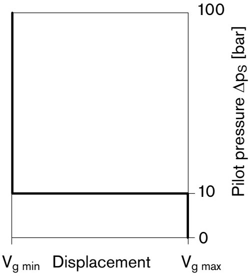
HZ – Two-point control hydraulic

The two-point hydraulic control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the pilot pressure at port X on or off.

HZ5, HZ7 negative control

- Position at $V_{g\,max}$ (without pilot pressure, maximum torque, minimum speed)
- Position at $V_{g\,min}$ (with pilot pressure > 10 bar activated, minimum torque, maximum permissible speed)

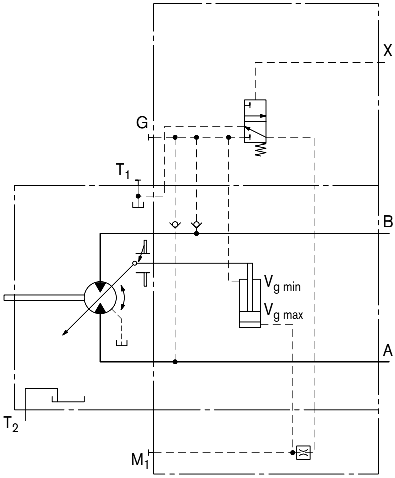
Characteristic HZ5, HZ7



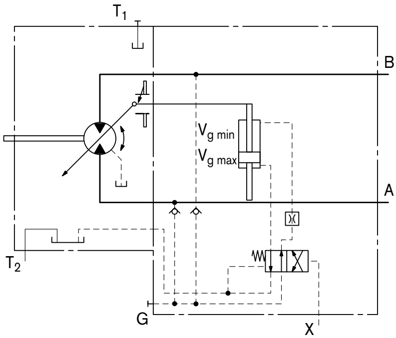
Note

- Maximum permissible pilot pressure: 100 bar
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 500 bar can occur at port G.

Schematic HZ5: negative control
Size 170



Schematic HZ7: negative control
Sizes 60 to 115



Schematic HZ7: negative control
Size 170 with integrated counterbalance valve BVI, see page 45

EZ – Two-point control electric

The two-point electric control allows the displacement to be set to either $V_{g\,min}$ or $V_{g\,max}$ by switching the electric current to a switching solenoid on or off.

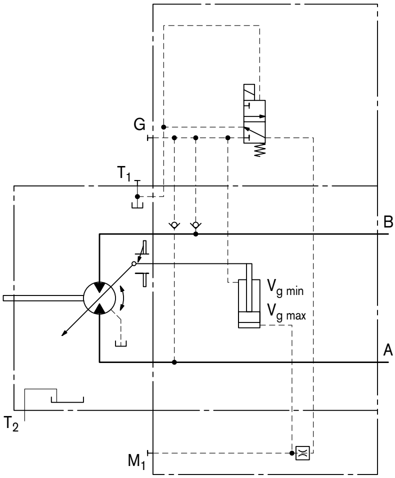
Note

The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
Please note that pressures up to 500 bar can occur at port G.

Technical data, solenoid with Ø37
Size 170

	EZ5	EZ6
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	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 page 36		

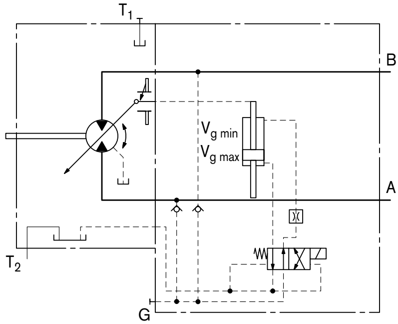
Schematic EZ5, EZ6: negative control
Size 170



Technical data, solenoid with Ø45
Sizes 60 to 115

	EZ7	EZ8
Voltage	12 V (±20 %)	24 V (±20 %)
Displacement $V_{g\,max}$	de-energized	de-energized
Displacement $V_{g\,min}$	energized	energized
Nominal resistance (at 20 °C)	4.8 Ω	19.2 Ω
Nominal power	30 W	30 W
Minimum required current	1.5 A	0.75 A
Duty Cycle	100%	100%
Type of protection see connector design page 36		

Schematic EZ7, EZ8: negative control
Sizes 60 to 115



3

HA – Automatic control high-pressure related

The automatic high-pressure related control adjusts the displacement automatically depending on the operating pressure.

The displacement of the A6VE motor with HA control is $V_{g\,min}$ (maximum speed and minimum torque). The control unit measures internally the operating pressure at A or B (no control line required) and upon reaching the beginning of control, the controller swivels the motor from $V_{g\,min}$ to $V_{g\,max}$ with increase of pressure. The displacement is modulated between $V_{g\,min}$ and $V_{g\,max}$, thereby depending on load conditions.

HA1, HA2, HA3 positive control

- Beginning of control at $V_{g\,min}$ (minimum torque, maximum speed)
- End of control at $V_{g\,max}$ (maximum torque, minimum speed)

Note

- For safety reasons, winch drives are not permissible with beginning of control at $V_{g\,min}$ (standard for HA).
- The control oil is internally taken out of the high-pressure side of the motor (A or B). For reliable control, an operating pressure of at least 30 bar is required in A (B). If a control operation is performed at an operating pressure < 30 bar, an auxiliary pressure of at least 30 bar must be applied at port G via an external check valve. For lower pressures, please contact us.
  Please note that pressures up to 500 bar can occur at port G.
- The beginning of control and the HA.T3 characteristic are influenced by case pressure. An increase in the case pressure causes an increase in the beginning of control (see page 6) and thus a parallel shift of the characteristic.

HA – Automatic control high-pressure related

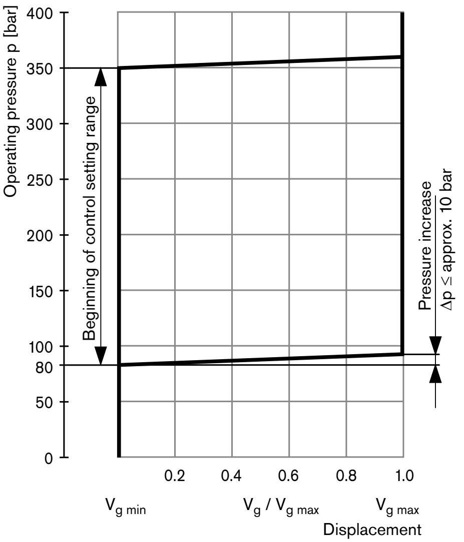
HA1, HA3
With minimum pressure increase, positive control

An operating pressure increase of $\Delta p \leq$ approx. 10 bar results in an increase in displacement from $V_{g\,min}$ towards $V_{g\,max}$.

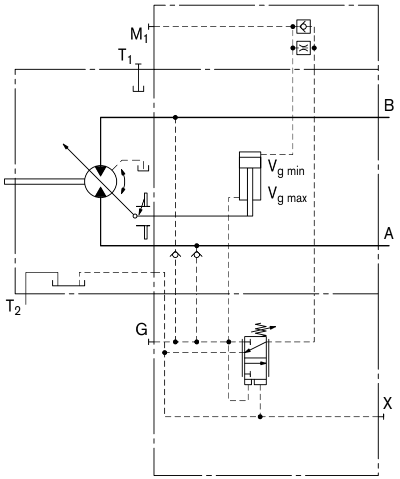
Beginning of control, setting range ___________ 80 to 350 bar

Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 300 bar.

Characteristic HA1, HA3



Schematic HA1



Schematic HA3

With integrated counterbalance valve BVI, see page 45

HA – Automatic control high-pressure related

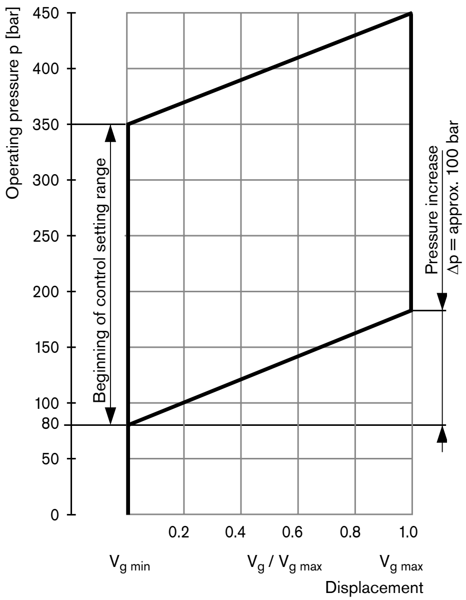
HA2
With pressure increase, positive control

An operating pressure increase of Δp = approx. 100 bar results in an increase in displacement from $V_{g\,min}$ to $V_{g\,max}$.

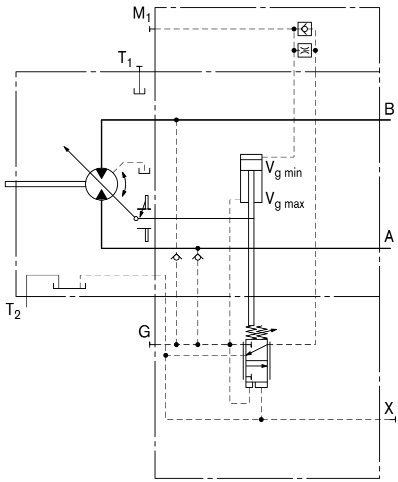
Beginning of control, setting range ___________ 80 to 350 bar

Please state the desired beginning of control in plain text when ordering, e. g.: beginning of control at 200 bar.

Characteristic HA2



Schematic HA2



HA – Automatic control high-pressure related

HA.T3
Override hydraulic remote control, proportional

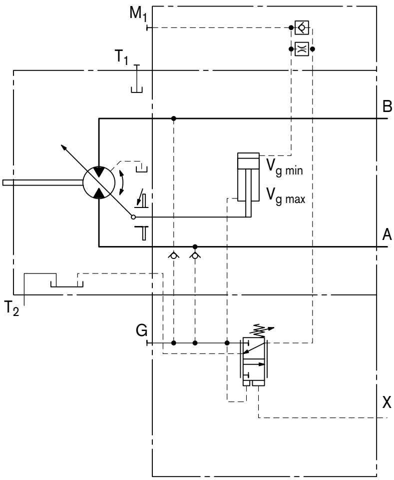
With the HA.T3 control, the beginning of control can be influenced by applying a pilot pressure to port X.

For each 1 bar of pilot pressure increase, the beginning of control is reduced by 17 bar.

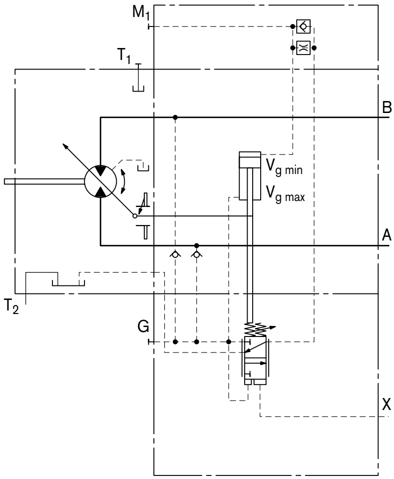
Beginning of control setting	300 bar	300 bar
Pilot pressure at port X	0 bar	10 bar
Beginning of control at	300 bar	130 bar

Note
Maximum permissible pilot pressure 100 bar.

Schematic HA1.T3



Schematic HA2.T3



Schematic HA3.T3
With integrated counterbalance valve BVI, see page 45

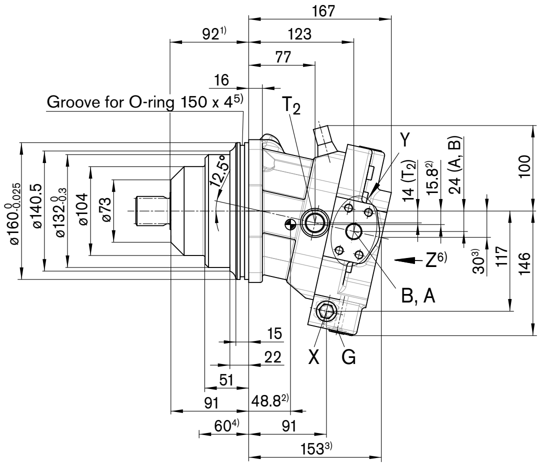
3

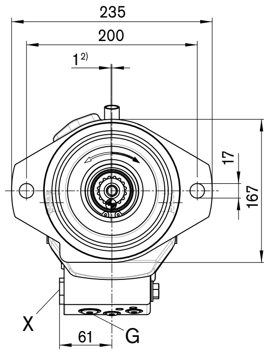
Dimensions size 60

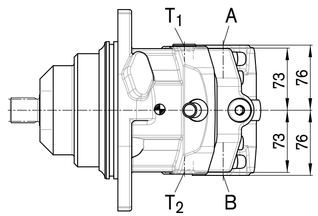
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HZ7 – Two-point control hydraulic

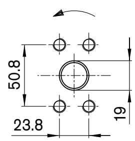
Port plate 2 – SAE flange ports A and B at side, opposite

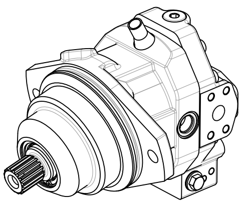






View Y





1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear
4) Differential dimension of mounting flange A6VM to A6VE
5) The O-ring is not included in the delivery contents
6) See page 22

Note

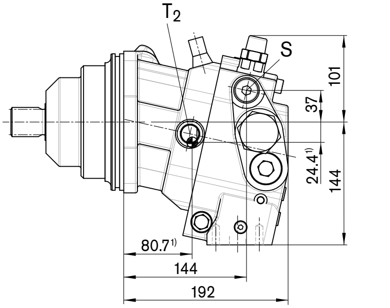
Dimensions of control devices, see RE 91610.

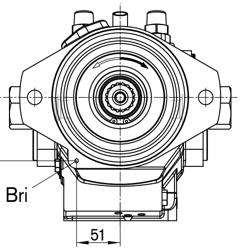
Dimensions size 60

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

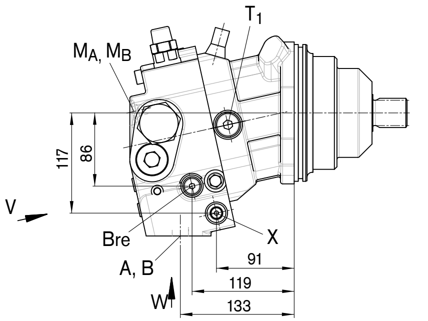
HZ7 – Two-point control hydraulic

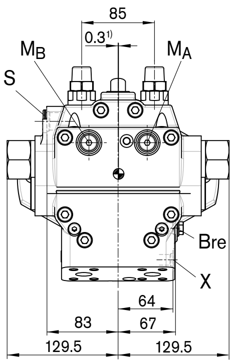
Port plate 6, with integrated counterbalance valve BVI – SAE flange port A and B at bottom



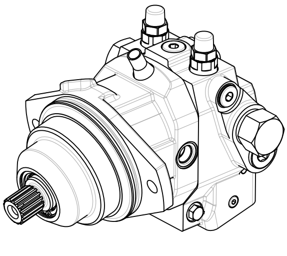


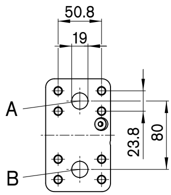
View V





View W





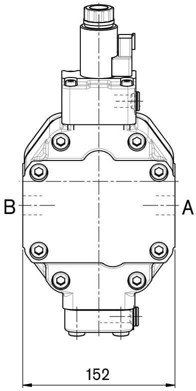
1) Center of gravity

Dimensions size 60

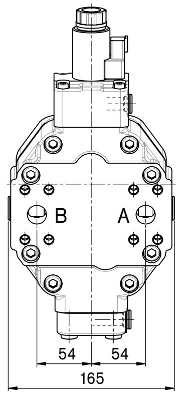
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

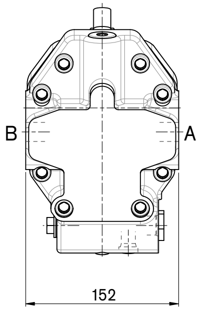
2 SAE flange ports A and B at side, opposite



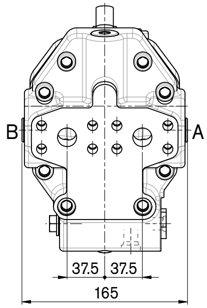
1 SAE flange ports A and B at rear



2 SAE flange ports A and B at side, opposite only HZ7, EZ7/8

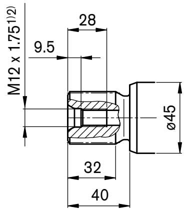


1 SAE flange ports A and B at rear only HZ7, EZ7/8



Drive shaft

Z8 Splined shaft DIN 5480 W35x2x16x9g



1) Center bore according to DIN 332 (thread according to DIN 13)
2) Observe the general instructions on page 48 for the maximum tightening torques.

Dimensions size 60

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

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 x 1.5; 17 deep	500	O
T_1	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	3	X

Ports with integrated counterbalance valve

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	3/4 in M10 x 1.5; 17 deep	420	O
T_1	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	O[4]
X	Pilot signal	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
S	Infeed	ISO 6149[5]	M22 x 1.5; 15.5 deep	30	X
M_A, M_B	Measuring stroking chamber	ISO 6149[5]	M14 x 1.5; 11.5 deep	420	X
M_1 only for HA3	Measuring stroking chamber	ISO 6149[5]	M10 x 1; 10 deep	420	X
Bre	Brake release, external	ISO 6149[5]	M14 x 1.5; 11.5 deep	30	O/X[6]
Bri	Brake release, internal	–	ø4	30	X/O[7]

1) Observe the general instructions on page 48 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 47).
5) The spot face can be deeper than specified in the appropriate standard.
6) Must be connected for external piping. Is plugged with internal ducting.
7) Is plugged with external ducting. Must be connected with internal piping.
8) O = Must be connected (plugged on delivery)
X = Plugged (in standard operation)

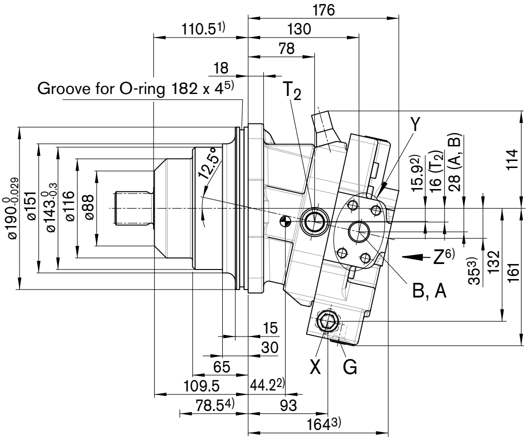
3

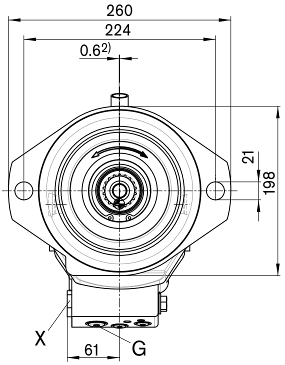
Dimensions size 85

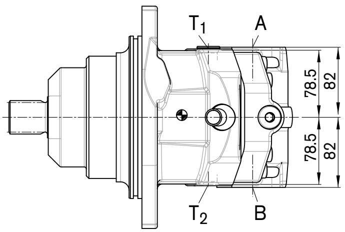
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HZ7 – Two-point control hydraulic

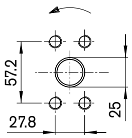
Port plate 2 – SAE flange ports A and B at side, opposite

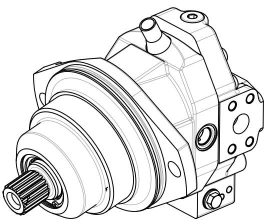






View Y





1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear
4) Difference in dimension of mounting flange A6VM to A6VE
5) The O-ring is not included in the delivery contents
6) See page 26

Note

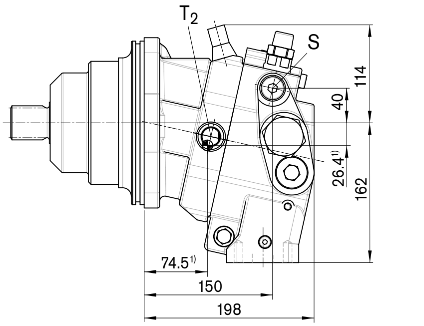
Dimensions of control device, see RE 91610.

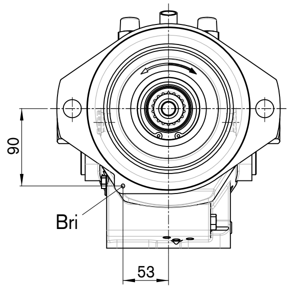
Dimensions size 85

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

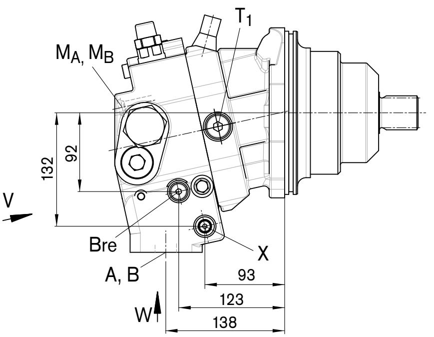
HZ7 – Two-point control hydraulic

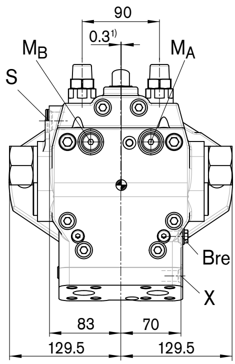
Port plate 6, with integrated counterbalance valve BVI – SAE flange port A and B at bottom



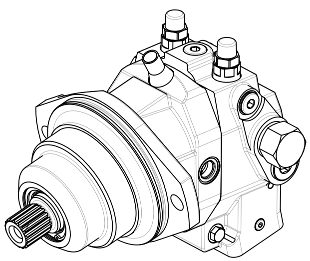


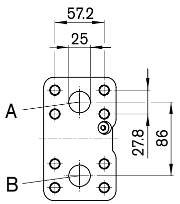
View V





View W



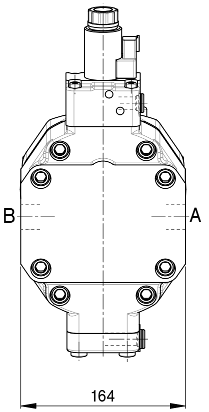
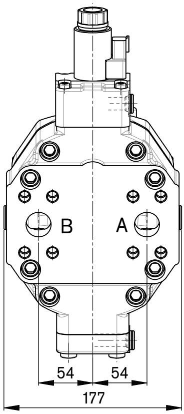
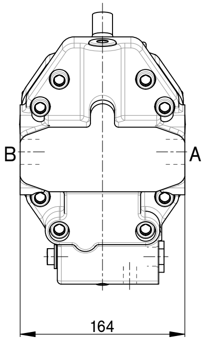
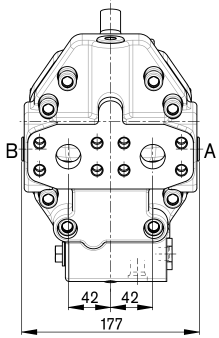


1) Center of gravity

Dimensions size 85

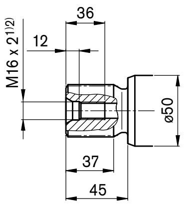
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite	**1** SAE flange ports A and B at rear	**2** SAE flange ports A and B at side, opposite only HZ7, EZ7/8	**1** SAE flange ports A and B at rear only HZ7, EZ7/8
			

Drive shaft

Z9 Splined shaft DIN 5480 W40x2x18x9g



1) Center bore according to DIN 332 (thread according to DIN 13)
2) Observe the general instructions on page 48 for the maximum tightening torques.

Dimensions size 85

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

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	500	O
T_1	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	3	X

Ports with integrated counterbalance valve

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	420	O
T_1	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	O[4]
X	Pilot signal	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
S	Infeed	ISO 6149[5]	M22 x 1.5; 15.5 deep	30	X
M_A, M_B	Measuring stroking chamber	ISO 6149[5]	M14 x 1.5; 11.5 deep	420	X
M_1 only for HA3	Measuring stroking chamber	ISO 6149[5]	M10 x 1; 10 deep	420	X
Bre	Brake release, external	ISO 6149[5]	M14 x 1.5; 11.5 deep	30	O/X[6]
Bri	Brake release, internal	–	ø4	30	X/O[7]

1) Observe the general instructions on page 48 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 47).
5) The spot face can be deeper than specified in the appropriate standard.
6) Must be connected for external piping. Is plugged with internal ducting.
7) Is plugged with external ducting. Must be connected with internal piping.
8) O = Must be connected (plugged on delivery)
X = Plugged (in standard operation)

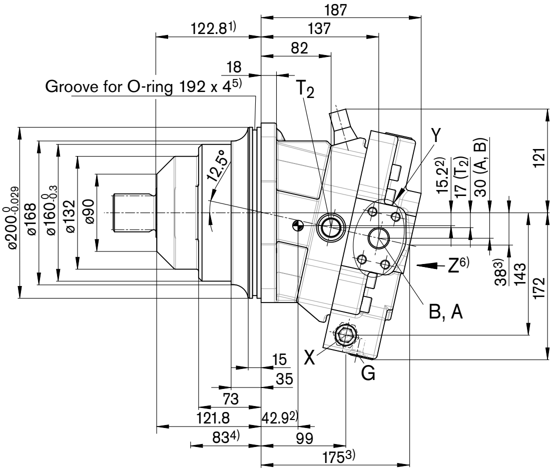
3

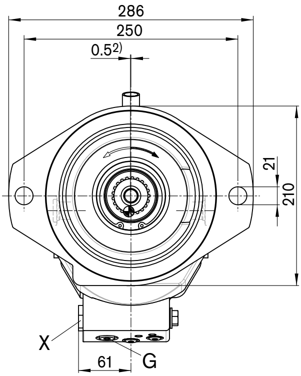
Dimensions size 115

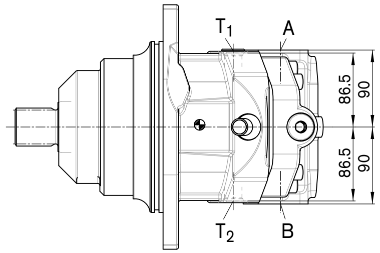
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HZ7 – Two-point control hydraulic

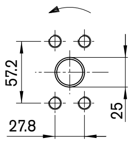
Port plate 2 – SAE flange ports A and B at side, opposite

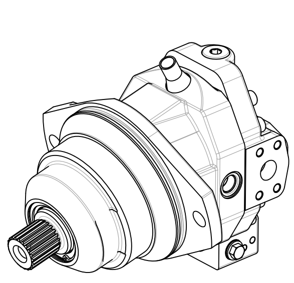






View Y





1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear
4) Difference in dimension of mounting flange A6VM to A6VE
5) The O-ring is not included in the delivery contents
6) See page 30

Note

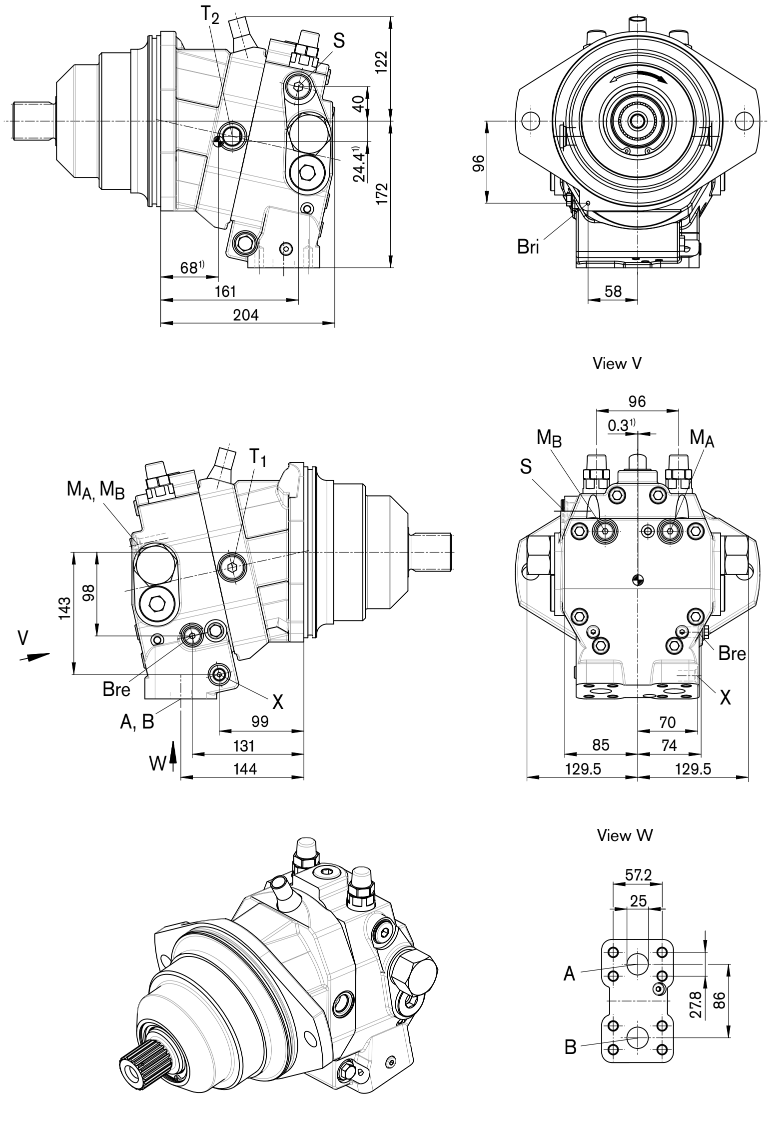
Dimensions of control device, see RE 91610.

Dimensions size 115

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

HZ7 – Two-point control hydraulic

Port plate 6, with integrated counterbalance valve BVI – SAE flange port A and B at bottom



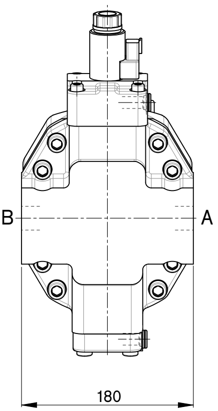
1) Center of gravity

Dimensions size 115

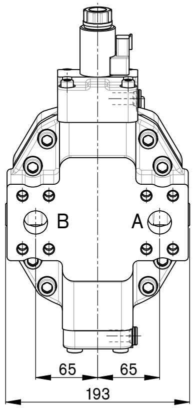
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

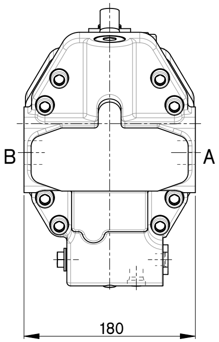
2 SAE flange ports A and B at side, opposite



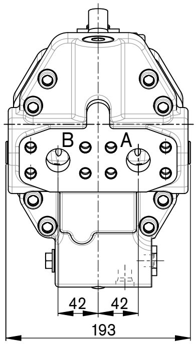
1 SAE flange ports A and B at rear



2 SAE flange ports A and B at side, opposite only HZ7, EZ7/8

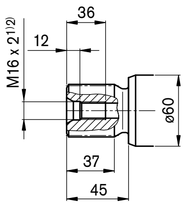


1 SAE flange ports A and B at rear only HZ7, EZ7/8



Drive shaft

Z9 Splined shaft DIN 5480 W40x2x18x9g



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

2) Observe the general instructions on page 48 for the maximum tightening torques.

Dimensions size 115

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

Ports

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	500	O
T_1	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	O[4]
G	Synchronous control	ISO 6149[5]	M14 x 1.5; 11.5 deep	500	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5]	M14 x 1.5; 11.5 deep	3	X

Ports with integrated counterbalance valve

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[8]
A, B	Service line Fastening thread A/B	SAE J518[3] DIN 13	1 in M12 x 1.75; 17 deep	420	O
T_1	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	X[4]
T_2	Drain line	ISO 6149[5]	M22 x 1.5; 15.5 deep	3	O[4]
X	Pilot signal	ISO 6149[5]	M14 x 1.5; 11.5 deep	100	O
S	Infeed	ISO 6149[5]	M22 x 1.5; 15.5 deep	30	X
M_A, M_B	Measuring stroking chamber	ISO 6149[5]	M14 x 1.5; 11.5 deep	420	X
M_1 only for HA3	Measuring stroking chamber	ISO 6149[5]	M10 x 1; 10 deep	420	X
Bre	Brake release, external	ISO 6149[5]	M14 x 1.5; 11.5 deep	30	O/X[6]
Bri	Brake release, internal	–	ø4	30	X/O[7]

1) Observe the general instructions on page 48 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 47).
5) The spot face can be deeper than specified in the appropriate standard.
6) Must be connected for external piping. Is plugged with internal ducting.
7) Is plugged with external ducting. Must be connected with internal piping.
8) O = Must be connected (plugged on delivery)
X = Plugged (in standard operation)

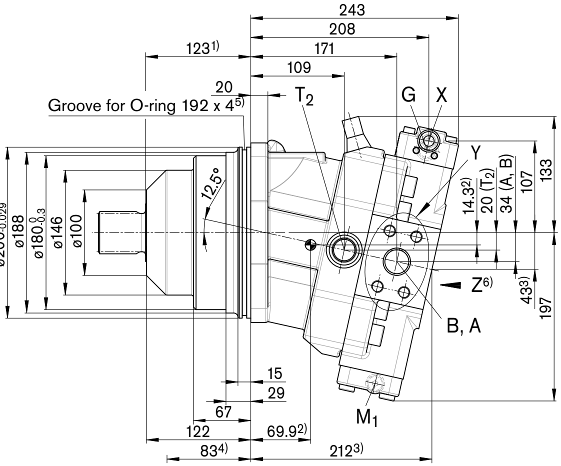
3

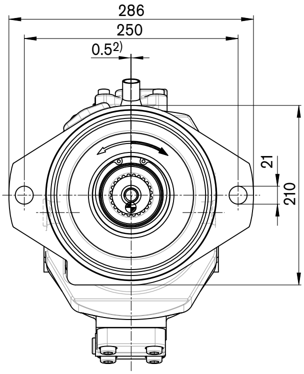
Dimensions size 170

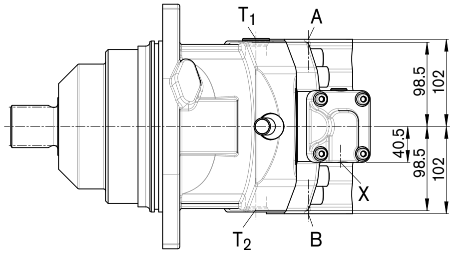
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

HZ5 – Two-point control hydraulic

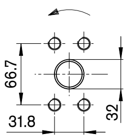
Port plate 2 – SAE flange ports A and B at side, opposite

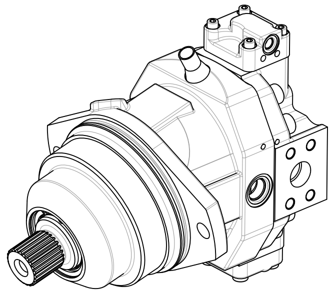






View Y





1) To shaft collar
2) Center of gravity
3) Port plate 1 – SAE flange ports A and B at rear
4) Difference in dimension of mounting flange A6VM to A6VE
5) The O-ring is not included in the delivery contents
6) See page 34

Note

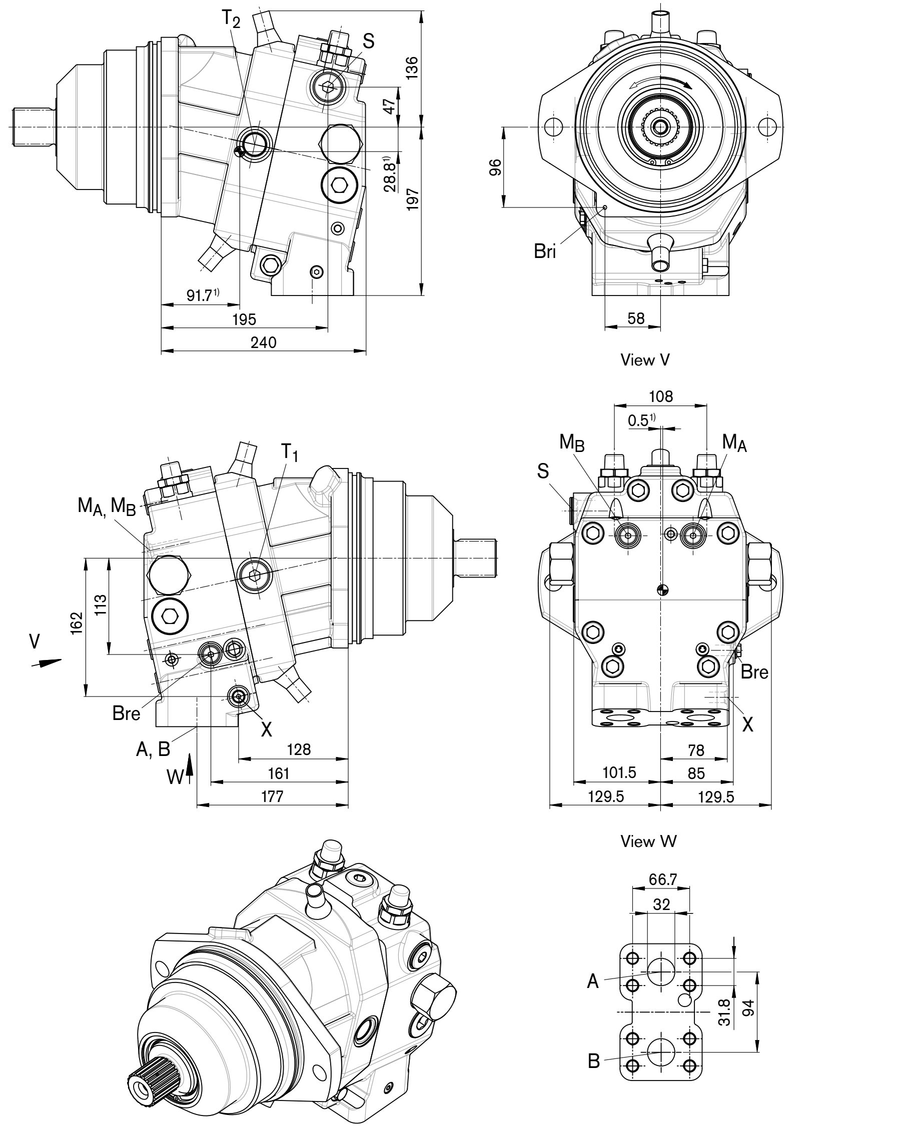
Dimensions of control device, see RE 91610.

Dimensions size 170

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

HZ7 – Two-point control hydraulic

Port plate 6, with integrated counterbalance valve BVI – SAE flange port A and B at bottom



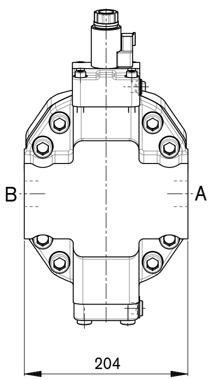
1) Center of gravity

Dimensions size 170

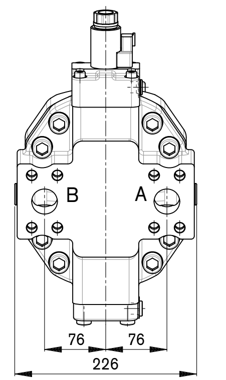
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Location of the service line ports on the port plates (view Z)

2 SAE flange ports A and B at side, opposite

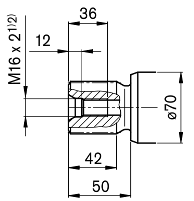


1 SAE flange ports A and B at rear



Drive shaft

A1 Splined shaft DIN 5480 W45x2x21x9g



1) Center bore according to DIN 332 (thread according to DIN 13)
2) Observe the general instructions on page 48 for the maximum tightening torques.

Dimensions size 170

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

Ports

Designation	Port for	Standard	Size[1)]	Maximum pressure [bar][2)]	State[8)]
A, B	Service line Fastening thread A/B	SAE J518[3)] DIN 13	1 1/4 in M14 x 2; 19 deep	500	O
T_1	Drain line	ISO 6149[5)]	M27 x 2; 19 deep	3	X[4)]
T_2	Drain line	ISO 6149[5)]	M27 x 2; 19 deep	3	O[4)]
G	Synchronous control	ISO 6149[5)]	M14 x 1.5; 11.5 deep	500	X
X	Pilot signal (HP, HZ, HA1T/HA2T)	ISO 6149[5)]	M14 x 1.5; 11.5 deep	100	O
X	Pilot signal (HA1 and HA2)	ISO 6149[5)]	M14 x 1.5; 11.5 deep	3	X
M_1	Measuring stroking chamber	ISO 6149[5)]	M14 x 1.5; 16 deep	500	X

Ports with integrated counterbalance valve

Designation	Port for	Standard	Size[1)]	Maximum pressure [bar][2)]	State[8)]
A, B	Service line Fastening thread A/B	SAE J518[3)] DIN 13	1 1/4 in M14 x 2; 19 deep	420	O
T_1	Drain line	ISO 6149[5)]	M27 x 2; 19 deep	3	X[4)]
T_2	Drain line	ISO 6149[5)]	M27 x 2; 19 deep	3	O[4)]
X	Pilot signal	ISO 6149[5)]	M14 x 1.5; 11.5 deep	100	O
S	Infeed	ISO 6149[5)]	M27 x 2; 19 deep	30	X
M_A, M_B	Measuring stroking chamber	ISO 6149[5)]	M14 x 1.5; 11.5 deep	420	X
M_1 only for HA3	Measuring stroking chamber	ISO 6149[5)]	M10 x 1; 10 deep	420	X
Bre	Brake release, external	ISO 6149[5)]	M14 x 1.5; 11.5 deep	30	O/X[6)]
Bri	Brake release, internal	–	ø4	30	X/O[7)]

1) Observe the general instructions on page 48 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) Depending on installation position, T_1 or T_2 must be connected (see also installation instructions on page 47).
5) The spot face can be deeper than specified in the appropriate standard.
6) Must be connected for external piping. Is plugged with internal ducting.
7) Is plugged with external ducting. Must be connected with internal piping.
8) O = Must be connected (plugged on delivery)
X = Plugged (in standard operation)

3

Connector for solenoids

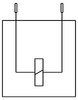
DEUTSCH DT04-2P-EP04

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

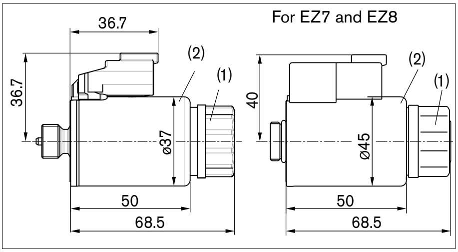
Consisting of: DT designation

– 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. (WAF26, 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

Version A6VE...U ("prepared for speed sensing", i.e. without sensor) is equipped with a toothed ring on the rotary group.

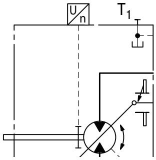
With the speed sensor DSA mounted, a signal proportional to motor speed can be generated.The DSA sensor measures the speed and direction of rotation.

Ordering code, technical data, dimensions and details on the connector, plus safety information 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. On deliveries without sensor, the port is plugged with a pressure-resistant cover.

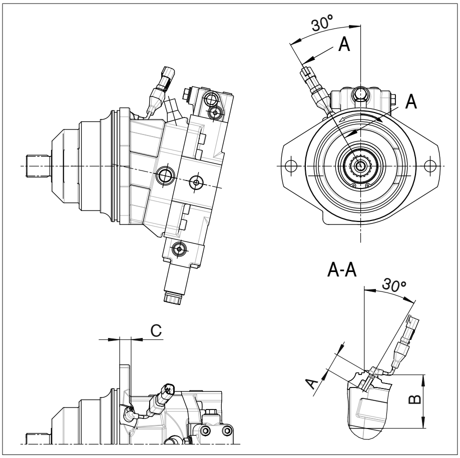
We recommend ordering the A6VE variable motor complete with sensor mounted.

Schematic



Dimensions

Version "V" with mounted speed sensor



NG	60	85	115	170
Number of teeth	54	58	67	75
A	32	32	32	32
B	83.3	87.3	96.3	104.3
C	26	16.5	14.2	28.5

Flushing and boost pressure valve

The flushing and boost pressure valve is used to remove heat from the hydraulic circuit.

In an open circuit, it is used only for flushing the housing.

In a closed circuit, it ensures a minimum boost pressure level in addition to the case flushing.

Hydraulic fluid is directed from the respective low pressure side into the motor housing. This is then fed into the reservoir, together with the case drain fluid. The hydraulic fluid, removed out of the closed circuit must be replaced by cooled hydraulic fluid from the boost pump.

The valve is mounted onto the port plate or integrated (depending on the control type and size).

Cracking pressure of pressure retaining valve
(observe when setting the primary valve)
fixed setting ______ 16 bar

Switching pressure of flushing piston Δp
Size 60 to 115 (small flushing valve) ______ 8 ±1 bar
Size 115 to 170 (medium and large flushing valve 17.5 ±1.5 bar

Flushing flow q_v
Orifices can be used to set the flushing flows as required.
Following parameters are based on:
$\Delta p_{ND} = p_{ND} - p_G = 25$ bar and $\nu = 10$ mm²/s
(p_{ND} = low pressure, p_G = case pressure)

Small flushing valve for sizes 60 to 115

Mat. No. of orifice	ø [mm]	q_v [L/min]	Code
R909651766	1.2	3.5	A
R909419695	1.4	5	B
R909419696	1.8	8	C
R909419697	2.0	10	D
R909444361	2.4	14	F

Medium flushing valve for size 115

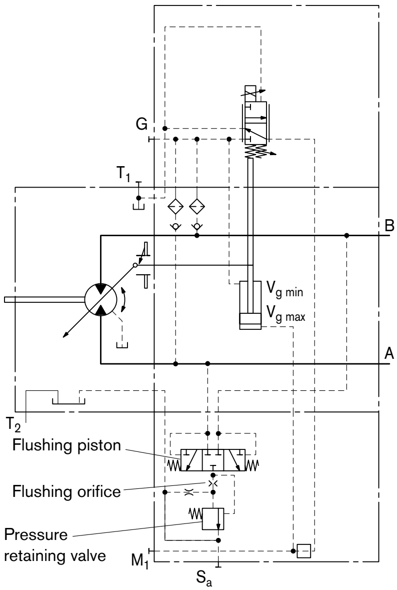
Mat. No. of orifice	ø [mm]	q_v [L/min]	Code
R909431310	2.8	20	H
R909435172	3.5	25	J
R909449967	5.0	30	K

Large flushing valve for size 170

Mat. No. of orifice	ø [mm]	q_v [L/min]	Code
R909449998	1.8	8	C
R909431308	2.0	10	D
R909431309	2.5	17	G
R909431310	2.8	20	H
R902138235	3.1	25	J
R909435172	3.5	30	K
R909436622	4.0	35	L
R909449967	5.0	40	M

For a flushing flow greater than 35 L/min, it is recommended that port S_a be connected in order to prevent an increase in case pressure. An increased case pressure reduces the flushing flow.

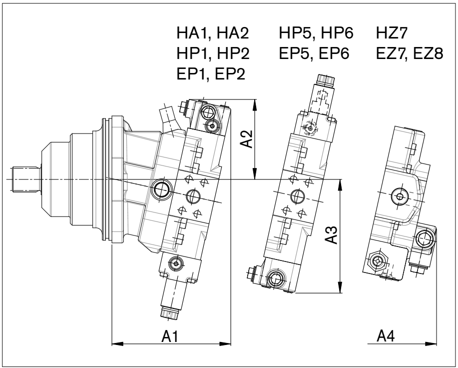
Schematic EP
Port S_a only for size 170



Flushing and boost pressure valve

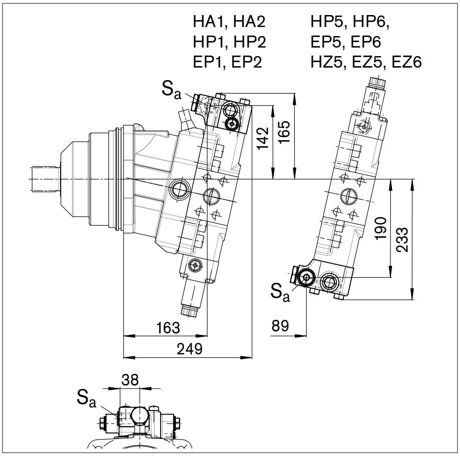
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Dimensions of sizes 60 to 115 (small flushing valve)

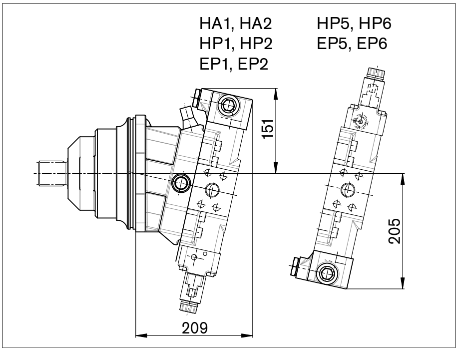


NG	A1	A2	A3	A4
060	183	133	176	176
085	195	142	194	176
115	204	143	202	186

Dimensions, size 170 (large flushing valve)



Dimensions of size 115 (medium flushing valve)



Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State[4]
S_a	Flushing (only size 170)	ISO 6149[3]	M22 x 1.5; 15.5 deep	3	X

1) Observe the general instructions on page 48 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) The spot face can be deeper than specified in the appropriate standard.
4) X = Plugged (in normal operation)

Counterbalance valve BVD and BVE

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

Function

Travel drive/winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if the motor speed is greater than it should be for the given input flow while braking, travelling downhill, or lowering a load.

If the inlet pressure drops, the counterbalance spool throttles the return flow and brakes the motor until the inlet pressure returns to approx. 20 bar.

Note

- BVD available for sizes 60 to 170 and BVE available for sizes 115 to 170.
- The counterbalance valve must be ordered additionally. We recommend ordering the counterbalance valve and the motor as a set. Ordering example: A6VE085HA1T30004A/71MWV0Y2Z97W0-0 + BVD20F27S/41B–V03K16D0400S12
- For safety reasons, controls with beginning of control at $V_{g\ min}$ (e. g. HA) are not permissible for winch drives!
- The counterbalance valve does not replace the mechanical service brake and park brake.
- Observe the detailed notes on the BVD counterbalance valve in RE 95522 and BVE counterbalance valve in RE 95525!
- For the design of the brake release valve, we must know for the mechanical park brake:
  - the pressure at the start of opening
  - the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)
  - the required closing time for a warm device (oil viscosity approx. 15 mm²/s)

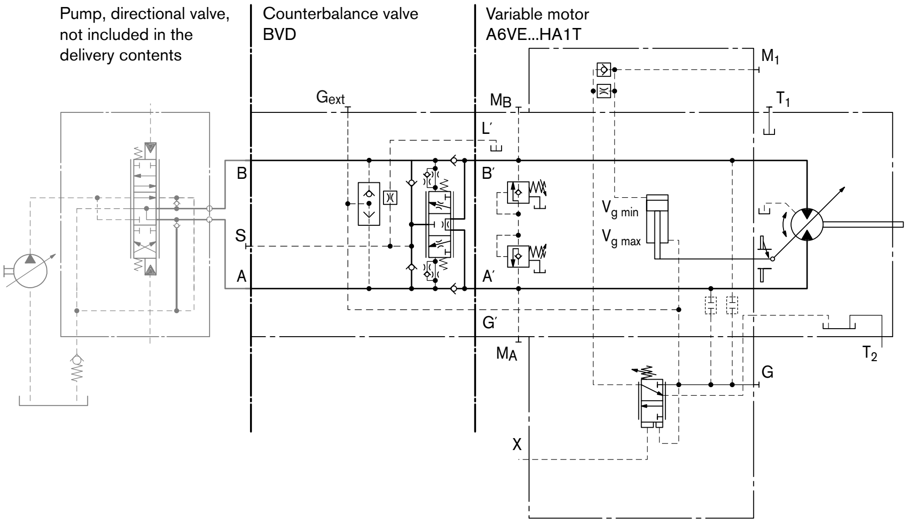
3

Travel drive counterbalance valve BVD...F

Application option

- Travel drive on wheeled excavators

Example schematic for travel drive on wheeled excavators
A6VE085HA1T30004A/71MWV0Y2Z97W0-0 + BVD20F27S/41B–V03K16D0400S12



Counterbalance valve BVD and BVE

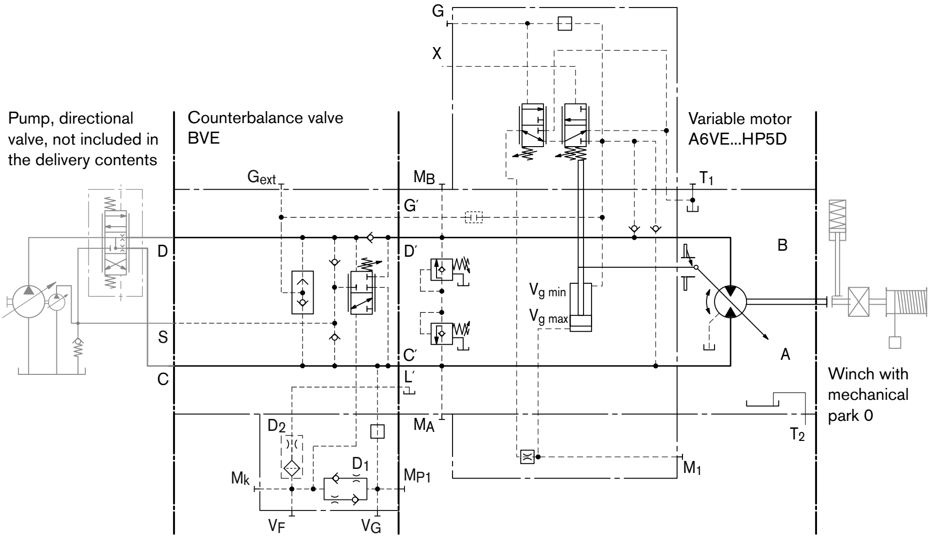
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Winch counterbalance valve BVD...W and BVE

Application options

- Winch drive in cranes (BVD and BVE)
- Track drive in excavator crawlers (BVD)

Example schematic for winch drive in cranes
A6VE085HP5D10001A/71MWV0Y2Z97W0-0 + BVE25W38S/51ND-V100K00D4599T30S00-0



Permissible input flow or pressure in operation with DBV and BVD/BVE

Motor NG	Without valve p_{nom}/p_{max} [bar]	Without valve $q_{V\ max}$ [L/min]	Restricted values in operation with DBV and BVD/BVE: DBV NG	DBV p_{nom}/p_{max} [bar]	DBV q_V [L/min]	DBV Code	BVD/BVE NG	BVD/BVE p_{nom}/p_{max} [bar]	BVD/BVE q_V [L/min]	BVD/BVE Code
60	450/500	276	22	350/420	240	7	20 (BVD)	350/420	220	7W
85		332								
115		410	32		400					
115		410				8	25 (BVD/BVE)		320	8W
170		533								

DBV ______________________________ pressure relief valve

BVD _________________counterbalance valve, double-acting

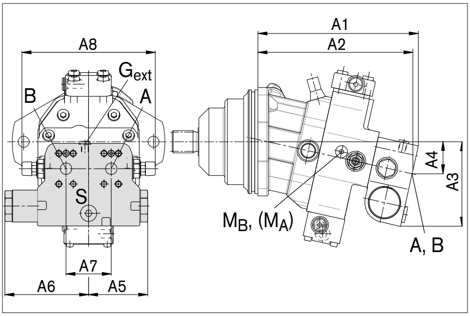
BVE ____________________counterbalance valve, one-sided

Counterbalance valve BVD and BVE

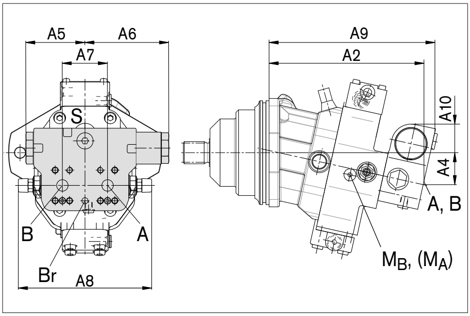
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Dimensions

A6VE...HA, HP1, HP2 and EP1, EP2



A6VE...HP5, HP6 and EP5, EP6[1]



A6VE	Counterbalance valve												
NG...plate	Type	Ports	Dimensions										
		A, B	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
60...7	BVD20...17	3/4 in	252	243	143	50	98	139	75	222	267	50
85...7	BVD20...27	1 in	261	252	148	55	98	139	75	222	276	46
115...7	BVD20...28	1 in	280	271	152	59	98	139	84	234	295	41
115...8	BVD25...38	1 1/4 in	298	288	165	63	120.5	175	84	238	311	56
170...8	BVD25...38	1 1/4 in	334	324	170	68	120.5	175	84	238	349	51
115...8	BVE25...38	1 1/4 in	298	288	171	63	137	214	84	238	315	63
170...8	BVE25...38	1 1/4 in	334	325	176	68	137	214	84	238	349	59

Ports

Designation	Port for	Version	A6VE plate	Standard	Size[2]	Maximum pressure [bar][3]	State[5]
A, B	Service line			SAE J518	see table above	420	O
S	Infeed	BVD20		DIN 3852[4]	M22 x 1.5; 14 deep	30	X
		BVD25, BVE25		DIN 3852[4]	M27 x 2; 16 deep	30	X
Br	Brake release, reduced high-pressure	L	7	DIN 3852[4]	M12 x 1.5; 12.5 deep	30	O
			8	DIN 3852[4]	M12 x 1.5; 12 deep	30	O
G_{ext}	Brake release, high-pressure	S		DIN 3852[4]	M12 x 1.5; 12.5 deep	420	X
M_A, M_B	Measuring pressure A and B			ISO 6149[4]	M18 x 1.5; 14.5 deep	420	X

1) At the mounting version for the controls HP5, HP6 and EP5, EP6, the cast-in port designations A and B on the counterbalance valve BVD do not correspond with the connection drawing of the A6VE motor.
The designation of the ports on the installation drawing of the motor is binding!
2) Observe the general instructions on page 48 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) The spot face can be deeper than specified in the appropriate standard.
5) O = Must be connected (plugged on delivery)
X = Plugged (in standard operation)

Counterbalance valve BVD and BVE

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

Mounting the counterbalance valve

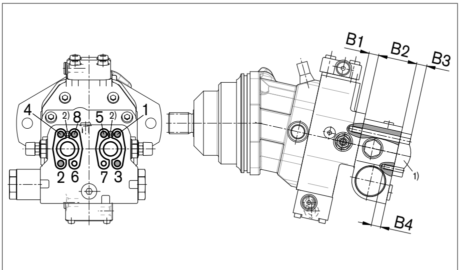
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the motor port plate using the provided tacking screws. The counterbalance valve is finally mounted to the motor by screwing on the SAE flange with the following screws:

6 screws (**1, 2, 3, 4, 5, 8**) ____________ length B1+B2+B3
2 screws (**6, 7**) ______________________ length B3+B4

Tighten the screws in two steps in the specified sequence from 1 to 8 (see following scheme).

In the first step, the screws must be tightened with half the tightening torque, and in the second step with the maximum tightening torque (see following table).

Thread	Strength class	Tightening torque [Nm]
M6 x 1 (tacking screw)	10.9	15.5
M10 x 1.5	10.9	75
M12 x 1.75	10.9	130
M14 x 2	10.9	205



1) SAE flange
2) Tacking screw (M6 x 1, length = B1 + B2, DIN 912)

NG... plate	60...7	85...7, 115...7	115...8, 170...8
B1[3]	M10 x 1.5 17 deep	M12 x 1.75 15 deep	M14 x 2 19 deep
B2	68	68	85
B3	customer-specific		
B4	M10 x 1.5 15 deep	M12 x 1.75 16 deep	M14 x 2 19 deep

3) Minimum required thread reach 1 x Ø-thread

Counterbalance valve integrated BVI

Function

The integrated counterbalance valve is designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if the motor speed is greater than it should be for the given input flow while braking or travelling downhill.

Note

- The integrated counterbalance valve must be ordered additionally, see ordering code below.
- The counterbalance valve does not replace the mechanical service brake and park brake.
- For the design of the brake release valve, we must know for the mechanical park brake:
  - the pressure at the start of beginning
  - the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)
  - the required closing time for a warm device (oil viscosity approx. 15 mm²/s)

Application options

- Track drive in excavator crawlers

Ordering code

BVI			00		–	
01	02	03	04	05		06

Counterbalance valve

01	Counterbalance valve integrated	**BVI**

	Counterbalance spool version	qv [L/min]	Material number	
02	Volume preselection	≤ 150	R902038832	**51**
		= 150 – 210	R902038936	**52**
		= 210 – 270	R902038833	**53**
		= 270 – 330	R902038834	**54**
		= 330 – 400	R902038835	**55**
		≥ 400	R902038836	**56**

	Throttle mounting	Material number	
03	Constant throttle	R909432302	**0008**
	Throttle pin	R909651165	**0603**

Check valve

04	Without residual opening	**00**

Brake release valve

05	With brake release valve (standard HZ) without disable function	**1**
	With brake release valve (standard HA) with disable function	**2**

Standard / special version

06	Standard version	**0**
	Special version	**S**

Counterbalance valve integrated BVI

Table of values

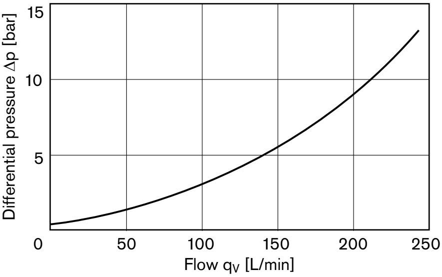
Operating pressure	nominal pressure	p	bar	350
	maximum pressure	p	bar	420
Flow, maximum		$q_{v\ max}$	L/min	400
Counterbalance spool	start of opening	p	bar	12
	fully open	p	bar	26
Pressure-reducing valve for brake release (fixed setting)	control pressure	p	bar	21^{+4}
	beginning of control	p	bar	10^{+4}

Comparison of port plates 1 + 2 and 6

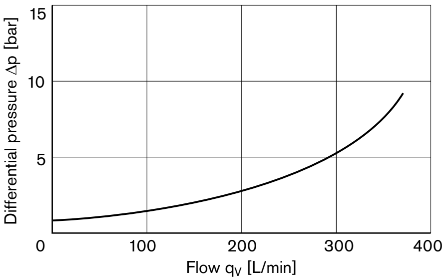
Maximum permissible input flow with restricted nominal pressure 350 bar, maximum pressure 420 bar

Motor NG	Without restrictions standard plate (1 + 2) p_{nom}/p_{max} [bar]	$q_{V\ max}$ [L/min]	Restricted values plate with integrated counterbalance valve (6) Code	p_{nom}/p_{max} [bar]	with BVE + DBV q_V [L/min]
60	450/500	276	6	350/420	240
85		332			
115		410			
170		533			400

Infeed characteristic M22 x 1.5

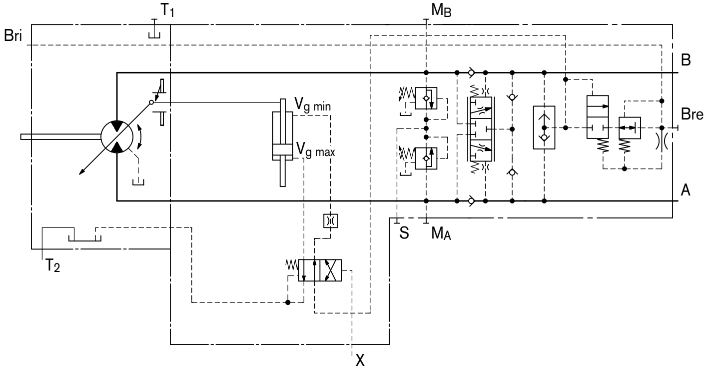


Infeed characteristic M27 x 2

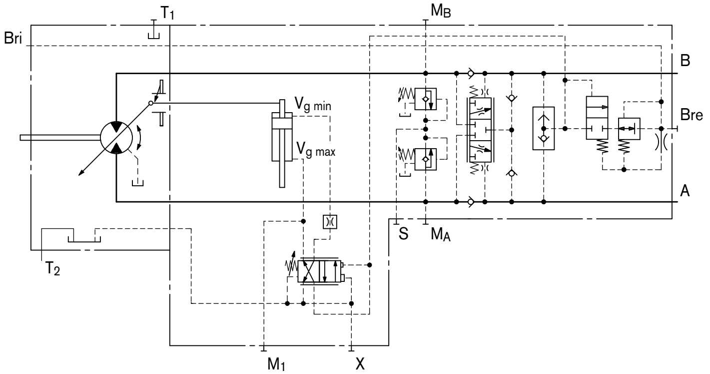


Counterbalance valve integrated BVI

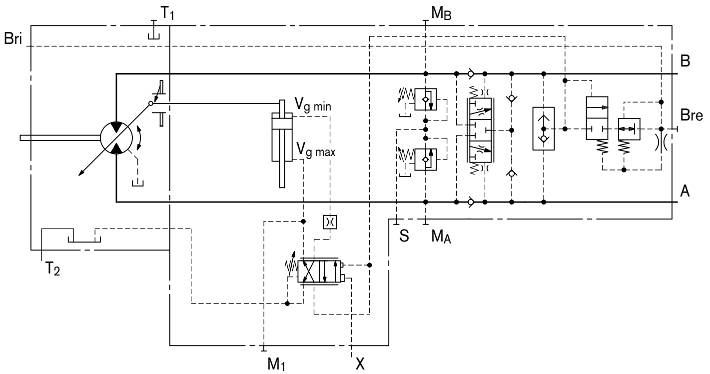
Schematic HZ7



Schematic HA3



Schematic HA3.T3



Setting range for displacement

	60				85				115				170			
	$V_{g\,max}$ (cm^3/rev)		$V_{g\,min}$ (cm^3/rev)		$V_{g\,max}$ (cm^3/rev)		$V_{g\,min}$ (cm^3/rev)		$V_{g\,max}$ (cm^3/rev)		$V_{g\,min}$ (cm^3/rev)		$V_{g\,max}$ (cm^3/rev)		$V_{g\,min}$ (cm^3/rev)	
	from	to	from	to	from	to	from	to	from	to	from	to	from	to	from	to
A	62.0	62.0	0.0	15.0	85.2	85.2	0.0	28.0	115.6	115.6	0.0	24.0	171.8	171.8	0.0	28.0
	without screw		M10 x 60 R909154690		without screw		M12 x 70 R909085976		without screw		M12 x 70 R909085976		without screw		M12 x 80 R909153075	
B	62.0	62.0	> 15.0	30.5	85.2	85.2	> 28.0	48.0	115.6	115.6	> 24.0	47.5	171.8	171.8	> 28.0	56.0
	without screw		M10 x 70 R909153779		without screw		M12 x 80 R909153075		without screw		M12 x 80 R909153075		without screw		M12 x 90 R909154041	
C	62.0	62.0	> 30.5	43.0	85.2	85.2	> 48.0	59.0	115.6	115.6	> 47.5	71.0	171.8	171.8	> 56.0	91.0
	without screw		M10 x 80 R909154058		without screw		M12 x 90 R909154041		without screw		M12 x 90 R909154041		without screw		M12 x 100 R909153975	
D	x		x		x		x		115.6	115.6	> 71.0	80.0	171.8	171.8	> 91.0	118.0
									without screw		M12x100 R909153975		without screw		M12x110 R909154212	
E	< 62.0	47.5	0.0	15.0	< 85.2	59.0	0.0	28.0	< 115.6	93.5	0.0	24.0	< 171.8	145.0	0.0	28.0
	M10 x 60 R909154690		M10 x 60 R909154690		M12 x 70 R909085976		M12 x 70 R909085976		M12 x 70 R909085976		M12 x 70 R909085976		M12 x 80 R909153075		M10 x 80 R909153075	
F	< 62.0	47.5	> 15.0	30.5	< 85.2	59.0	> 28.0	48.0	< 115.6	93.5	> 24.0	47.5	< 171.8	145.0	> 28.0	56.0
	M10 x 60 R909154690		M10 x 70 R909153779		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 90 R909154041	
G	< 62.0	47.5	> 30.5	43.0	< 85.2	59.0	> 48.0	59.0	< 115.6	93.5	> 47.5	71	< 171.8	145.0	> 56.0	91.0
	M10 x 60 R909154690		M10 x 80 R909154058		M12 x 70 R909085976		M12 x 90 R909154041		M12 x 70 R909085976		M12 x 90 R909154041		M12 x 80 R909153075		M12 x 100 R909153975	
H	x		x		x		x		< 115.6	93.5	> 71.0	80.0	< 171.8	145.0	> 91.0	118.0
									M12 x 70 R909085976		M12 x 100 R909153975		M12 x 80 R909153075		M12 x 110 R909154212	
J	< 47.5	33.0	0.0	15.0	< 59.0	38.5	0.0	28.0	< 93.5	71.0	0.0	24.0	< 145.0	118.0	0.0	28.0
	M10 x 70 R909153779		M10 x 60 R909154690		M12 x 80 R909153075		M12 x 70 R909085976		M12 x 80 R909153075		M12 x 70 R909085976		M12 x 90 R909154041		M12 x 80 R909153075	
K	< 47.5	33.0	> 15.0	30.5	< 59.0	38.5	> 28.0	48.0	< 93.5	71.0	> 24.0	47.5	< 145.0	118.0	> 28.0	56.0
	M10 x 70 R909153779		M10 x 70 R909153779		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 90 R909151041	
L	< 47.5	33.0	> 30.5	43.0	< 59.0	38.5	> 48.0	59.0	< 93.5	71.0	> 47.5	71.0	< 145.0	118.0	> 56.0	91.0
	M10 x 70 R909153779		M10 x 80 R909154058		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 80 R909153075		M12 x 90 R909154041		M12 x 90 R909154041		M12 x 100 R909153975	
M	x		x		x		x		< 93.5	71.0	> 71.0	80.0	< 145.0	118.0	> 91.0	118.0
									M12 x 80 R909153075		M12 x 100 R909153975		M12 x 90 R909154041		M12 x 110 R909154212	

Specify exact settings for $V_{g\,min}$ and $V_{g\,max}$ in plain text when ordering:
$V_{g\,min}$ = ... cm^3, $V_{g\,max}$ = ... cm^3

Theoretical, maximum setting:
for $V_{g\,min} = 0.7 \cdot V_{g\,max}$
for $V_{g\,max} = 0.3 \cdot V_{g\,max}$

Settings that are not listed in the table may lead to damage. Please contact us.

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 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 drain line must flow into the reservoir below the minimum fluid level.

Installation position

See the following examples 1 to 6.
Further installation positions are possible upon request.

Recommended installation position: 1 and 2.

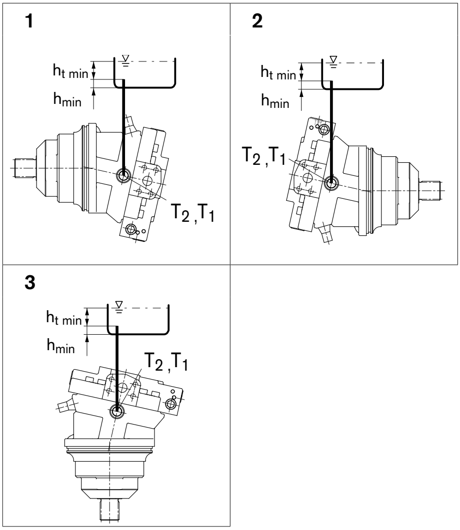
Note
In certain installation positions, an influence on the control characteristics can be expected. Gravity, dead weight and case pressure can cause minor shifts in control characteristics and changes in response time.

Installation position	Air bleed	Filling
1	–	T_2, T_1
2	–	T_2, T_1
3	–	T_2, T_1
4	L_1	T_2, T_1 (L_1)
5	L_1	T_2, T_1 (L_1)
6	L_1	T_2, T_1 (L_1)

L_1	Filling / air bleed
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)

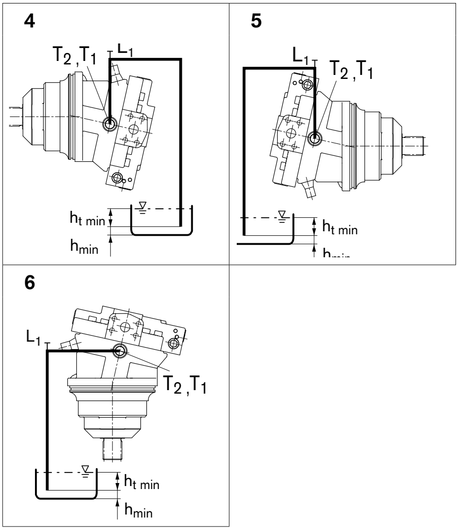
Below-reservoir installation (standard)

Below-reservoir installation means that the axial piston unit is installed outside of the reservoir below the minimum fluid level.



Above-reservoir installation

Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir.



General instructions

– The motor A6VE is designed to be used in open and closed 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.

– 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 instructions regarding the tightening torques of the fittings used.

  - Mounting bolts:
    For mounting bolts with metric ISO thread according to DIN 13, we recommend checking the tightening torque in individual cases in accordance with VDI 2230.

  - Female threads 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 the 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	M10 x 1	30 Nm	15 Nm	5 mm
	M12 x 1.5	50 Nm	25 Nm	6 mm
	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
DIN 3852	M12 x 1.5	50 Nm	25 Nm[1)2)]	6 mm
	M22 x 1.5	210 Nm	80 Nm[1)]	10 mm
	M27 x 2	330 Nm	135 Nm[1)]	12 mm

1) The tightening torques apply for screws in the "dry" state as received on delivery and 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.

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Rexroth
Bosch Group

Axial piston variable motor A10VM Plug-in version A10VE

Data sheet


A10VM


A10VE

3

Series 52
Size 28 to 85
Nominal pressure 280 bar
Maximum pressure 350 bar
Open and closed circuit

Contents

Features

- Dual displacement motor, axial piston swashplate design, for hydrostatic transmissions in open and closed circuits
- Output speed is directly proportional to inlet flow and inversely proportional to motor displacement
- Output torque increases proportional to the pressure difference between high and low pressure sides and increasing displacement
- Heavy duty bearings for long service life
- High permissible output speed
- Well proven A10-rotary unit technology
- High power/weight ratio – compact dimensions
- Cost effective
- Low noise
- External control pressure supply possible
- Minimum displacement can be set externally
- SAE-2-bolt mounting flange on A10VM
- Special 2-bolt mounting flange on A10VE

Ordering code for standard program

A10V	M			/	52	W		–	V		C				
01	02	03	04		05	06	07		08	09	10	11	12	13	14

Axial piston unit

01	Swash plate design, variable, nominal pressure 280 bar, maximum pressure 350 bar	**A10V**

Operating Mode

02	Motor, open and closed circuit	**M**

Size (NG)

03	Displacement $V_{g\,max}$ in cm^3	**028**	**045**	**063**	**085**

Control devices

					028	045	063	085	
04	Two point control	Directly operated, external control supply, without pilot valve			●	●	●	●	**DG**
		Hydraulically operated	Stroking time orifice	without	●	●	●	❍	**HZ**
				with	●	●	●	❍	**HZ6**
		Electricaly with solenoid valve control voltage **12V**	Stroking time orifice	without	●	●	●	●	**EZ1**
				with	●	●	●	●	**EZ6**
		Electricaly with solenoid valve control voltage **24V**	Stroking time orifice	without	●	●	●	❍	**EZ2**
				with	●	●	●	❍	**EZ7**

Series

05	Series 5, Index 2	**52**

Direction of rotation

06	Viewed on shaft end	Bi-directional	**W**

Minimum displacement

			028	045	063	085	
07	$V_{g\,min}$ (in cm^3) steplessly adjustable	from/to	8/28	12/25	16/38	22/50	**1**
	Adjustment state in clear text	from/to	–	26/45	40/62	48/85	**2**

Seals

08	FKM (flour-rubber)	**V**

Drive shaft

		028	045	063	085	
09	Splined shaft, ANSI B92.1a-1976, for higher drive torque	●	●	●	●	**R**
	Splined shaft, ANSI B92.1a-1976, for reduced drive torque	–	●	●	●	**W**

Mounting flange

10	SAE J744 2-bolt	**C**

Ports for service lines

11	SAE flanges , at side-same side, metric fixing screws	●	●	●	●	**10N00**
	SAE flanges at rear, metric fixing screws	❍	●	❍	❍	**11N00**
	Threaded ports on side, same side, metric thread	●	●	●	❍	**16N00**

Valves

12	Without valves	●	●	●	●	**0**
	Integrated flushing valve, only with side ports (10N00 and 16N00)	●	●	●	●	**7**

Speed pickup

13	Without speed pickup	●	●	●	●	**–**
	Prepared for inductive type of speed pickup ID R	●	●	●	❍	**D**

Connector for solenoids

14	HIRSCHMANN - connector – without suppressor diod	▲	▲	▲	▲	**H**
	DEUTSCH - connector, molded, 2-pin – without suppressor diod	●	●	●	●	**P**

● = available ❍ = in preparation – = not available ▲ = not for new projects

Ordering code for standard program

A10V	E			/	52	W		–	V		F				
01	02	03	04		05	06	07		08	09	10	11	12	13	14

Axial piston unit

01	Swash plate design, variable, nominal pressure 280 bar, maximum pressure 350 bar	**A10V**

Operating mode

02	Motor, plug in type, open and closed circuit	**E**

Size (NG)

03	Displacement $V_{g\,max}$ in cm³	**028**	**045**	**063**

Control devices

					028	045	063	
04	Two point control	Directly operated, external control supply, without pilot valve			●	●	❍	**DG**
		Hydraulically	Stroking time orifice	without	●	●	●	**HZ**
				with	●	●	●	**HZ6**
		Electricaly with solenoid valve control voltage **12V**	Stroking time orifice	without	●	●	●	**EZ1**
				with	●	●	●	**EZ6**
		Electricaly with solenoid valve control voltage **24V**	Stroking time orifice	without	●	●	●	**EZ2**
				with	●	●	●	**EZ7**

Series

05	Series 5, Index 2	**52**

Direction of rotation

06	Viewed on shaft end	Bi-directional	**W**

Minimum displacement

			028	045	063	
07	$V_{g\,min}$ (in cm³) stepples adjustable	from/to	10/28	12/25	16/38	**1**
	Adjustment please state in clear text	from/to	–	26/45	40/62	**2**

Seals

08	FKM (flour-rubber)	**V**

Drive shaft

		028	045	063	
09	Splined shaft, ANSI B92.1a-1976, for higher drive torque	●	●	●	**R**
	Splined shaft, ANSI B92.1a-1976, for reduced drive torque	–	●	●	**W**

Mounting flange

10	Special 2-bolt	**F**

Ports for service line

11	SAE flanges at side-same side, metric fixing screws	●	●	●	**10N00**
	SAE flanges at rear, metric fixing screws	❍	●	❍	**11N00**
	Threaded ports on side , same side, metric thread	●	●	●	**16N00**

Valves

12	Without valves	●	●	●	**0**
	Integrated flushing valve, only with side ports (10N00 and 16N00)	●	●	●	**7**

Speed pickup

13	Without speed pickup	●	●	●	**–**
	Prepared for inductive type of speed pickup ID R	❍	●	❍	**D**

Connector for solenoids

14	HIRSCHMANN - connector – without suppressor diod	▲	▲	▲	**H**
	DEUTSCH - connector, molded, 2-pin – without suppressor diod	●	●	●	**P**

● = available ❍ = in preparation – = not available ▲ = not for new projects

3

Technical data

Fluid

Prior to project design please see our data sheets RE 90220 (mineral oil), RE 90221 (ecologically acceptable fluids) and RE90223 (HF-fluids) for detailed information on fluids and application conditions.

When operating on ecologically acceptable fluids, limitations to the techical data may be necessary.

Please contact us and state the fluid used in clear text when ordering.

Operating viscosity range

For optimum efficiency and service life we recommend an operating viscosity (at operating temperature) in the range

ν_{opt} = opt. operating viscosity 16...36 mm²/s

referred to circuit temperature in closed circuits or tank temperature in open circuits.

The following limits are valid for extreme operating conditions:

ν_{min} = 5 mm²/s (closed circuit)
ν_{min} = 10 mm²/s (open circuit)

briefly (t ≤ 1 min) at max. permissible temperature of 115 °C.

Please note, that the max. fluid temperature of 115 °C may also not be exceeded in certain areas (for instance bearing area) The temperature in the bearing area is approx. 5 K higher than the average fluid temperature.

ν_{max} = 1600 mm²/s
briefly (t ≤ 1 min)
on cold start (t_{min} = -25°C, p ≤ 30 bar, n ≤ 1000 rpm).

At temperatures between –25 °C and –40 °C special measures may be required for certain installation positions. Please consult us for further information

For detailed information on operation at very low temperatures see RE 90300-03-B.

Notes on the selection of the hydraulic fluid

In order to select the correct fluid, it is necessary to know the operating temperature in the tank (open circuit), circuit temperature (closed circuits), in relation to the ambient temperature.

The fluid should be selected, so that within the operating temperatue range, the viscosity lies within the optimum range (ν_{opt}), see shaded section of the selection diagram. We recommend to select the higher viscosity grade 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 viscosity grades VG 46 resp. VG 68; select VG 68.

Important: The leakage fluid (case drain fluid) temperature is influenced by pressure and motor speed and is always higher than the tank temperature. However, at no point in the circuit may the temperature exceed 115 °C.

If it is not possible to comply with the above conditions because of extreme operating parameters or high ambient temperatures please consult us

Filtration of fluid

The finer the filtration the better the achieved cleanliness of the fluid and the longer the life of the axial piston unit.

To ensure a reliable functioning of the axial piston unit, a minimum cleanliness of

20/18/15 to ISO 4406 is necessary.

At very high fluid temperatures (90 °C to max. 115 °C) the minimum cleanliness has to be at least

19/17/14 to ISO 4406.

If above cleanliness classes cannot be met please consult us.

Operating pressure range

Pressure at port A or B

(Pressure data to DIN 24312)

Nominal pressure pN 280 bar [1)]
Maximum pressure p_{max} 350 bar
With motors connected in series please consult us.

Case drain pressure

Max. permissible pressure at leakage port L

p_{abs} max operation as a motor in open circuit 4 bar abs
p_{abs} max operation as a motor in closed circuit 4 bar abs
p_{abs} max motor/pump operation in open circuit 2 bar abs

Direction of rotation

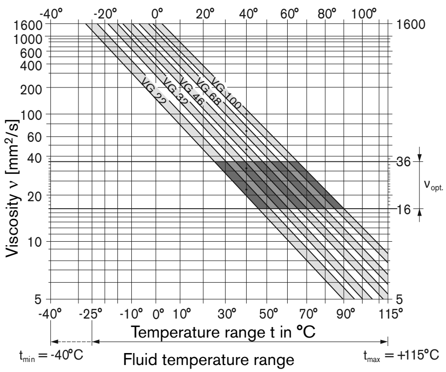
Direction of rotation, viewed on shaft end	
clockwise	counter-clockwise
B to **A**	**A** to **B**

Adjustment of displacement

The minimum displacement is steplessly adjustable within the range of the screw lenghts 1 or 2 (see ordering code).

Please state minimum displacement in clear text when ordering.

Selection diagram



Technical data

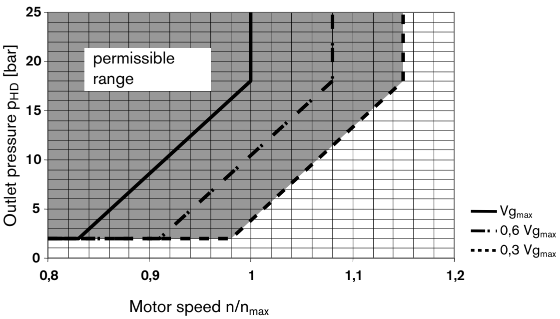
Table of values (theoretical values, without efficiency levels and tolerances; values rounded)

Size				28	45	63	85
Displacement		$V_{g\,max}$	cm^3	28	45	62	87
		$V_{g\,min}$	cm^3	8 (VM)/10(VE)	12	16	22
Speed[1]							
max. at $V_{g\,max}$		$n_{0\,max}$	min^{-1}	4700	4000	3300	3100
max. at $V_{g\,min}$		$n_{0\,max\,zul}$	min^{-1}	5400	4600	3900	3560
Min. speed in cont. operation		$n_{0\,min}$	min^{-1}	250	250	250	250
Inlet flow							
bei $n_{0\,max}$ and $V_{g\,max}$		$q_{V0\,max}$	L/min	131,6	180	205	270
Torque constant[2] at $V_{g\,max}$		T_K	Nm/bar	0,445	0,716	1,002	1,35
Torque							
at $V_{g\,max}$	p_N= 280 bar	T_{max}	Nm	125	200	276	387
Actual starting torque							
at n = 0 min^{-1}	p_N = 280 bar	T	Nm ca.	92	149	205	253
Rotary stiffness	Shaft R	c	Nm/rad	26000	41000	69400	152900
	Shaft W	c	Nm/rad	19800	34400	54000	117900
Mass moment of inertia (about output shaft)		J	kgm^2	0,0017	0,0033	0,0056	0,012
Filling volume		V	L	0,6	0,7	0,8	1,0
Weight approx.		m	kg	14	18	26	34

1) At maximal speed in closed circuit operation make sure that motor outlet pressure is at least ≥ 18 bar.
2) In open circuit Δp 280bar at $p_{boostpress.}$ 2bar
In closed circuit Δp 260bar at $p_{boostpress.}$ 20bar

3

Minimum required outlet pressure (low pressure) at port A (B) depending on motor speed



Technical data

Calculating size

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

Torque $$T = \frac{1{,}59 \cdot V_g \cdot \Delta p \cdot \eta_{mh}}{100} \quad \text{[Nm]}$$

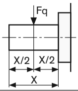
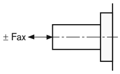
or $$T = T_K \cdot \Delta p \cdot \eta_{mh}$$

Output power $$P = \frac{2\pi \cdot T \cdot n}{60000} = \frac{q_V \cdot \Delta p \cdot \eta_t}{600} \quad \text{[kW]}$$

Output speed $$n = \frac{q_v \cdot 1000 \cdot \eta_v}{V_g} \quad \text{[min}^{-1}\text{]}$$

V_g = Displacement per rev. 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 ($\eta_t = \eta_V \cdot \eta_{mh}$)
T_K = Torque constant

Permissible radial and axial forces on drive shaft

Size					28	45	63	85
Max. radial force		at X/2	$F_{q\,max}$	N	1200	1500	1700	2000
Max. axial force			F_{ax}	N	1000	1500	2000	3000

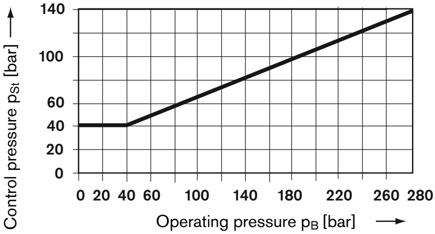
Two-point direct control DG

Normally the motor is at max. displacement. By applying an external pressure to port G, the control piston is directly pressurized and the motor swivels back to min. displacement

The minimum required control pressure is $p_{St} \geq 40$ bar

Please note, that this minimum required control pressure at port G depends directly on the operating pressure p_B in port A or B. (Pressure in A or B),see control pressure diagram below. With a control pressure above this minimum required pressure level the motor will destroke properly.

Control pressure diagram



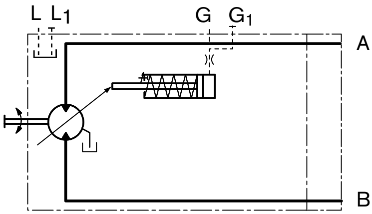
Control pressure = 0 bar ≙ $V_{g\ max}$

Control pressure ≥ 40 bar ≙ $V_{g\ min}$ (see circuit diagram)

The max. permissible control pressure is $p_{St} = 280$ bar.

V_{gmin} adjustment please state in clear text with order

Circuit diagram



Ports for	
A, B	Pressure
L, L_1	Caise drain (L_1 plugged)
G, G_1	For external control pressure (G_1 plugged)

3

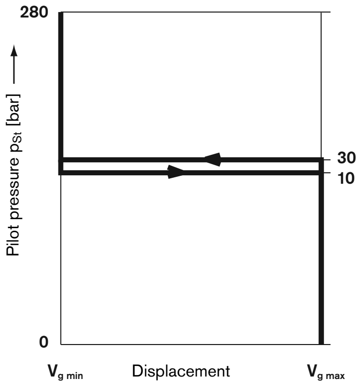
Two-point control, hydraulically operated HZ/HZ6

Normally the motor is at max. displacement. By applying a pilot pressure p_X to port X the pilot valve shifts and the control piston is pressurized causing the motor to swivel to min. displacement ($p_X \geq$ 30bar).

The necessary control pressure is via a shuttle valve taken out of the motor pressure side A or B. A minimum pressure difference of $\Delta p_{A,B} \geq$ 20 bar between the motor pressure sides is required.

Only $V_{g\,max}$ or $V_{g\,min}$ are possible.

$V_{g\,min}$ - adjustment please state in clear text when ordering.



Pilot pressure p_X = 0 bar ≙ $V_{g\,max}$

Pilot pressure p_X ≥ 30 bar ≙ $V_{g\,min}$

Techn. data HZ/HZ6	
Minimum pilot pressure	30 bar
Maximum permissible pilot pressure	280 bar

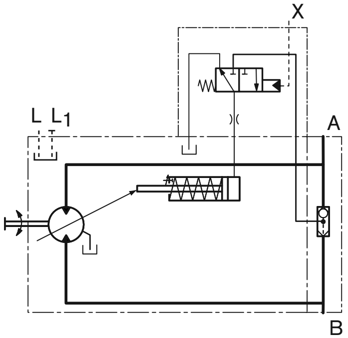
Version HZ6 with stroking time shuttle orifice

Slow down of swivel action by means of shuttle orifice.

This enables a smooth swivel action.

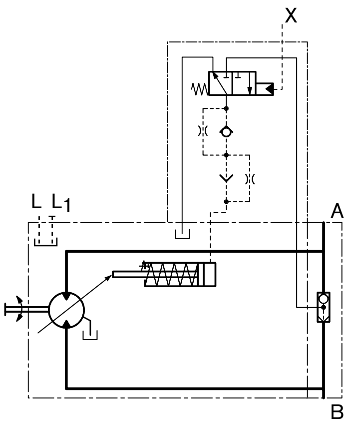
Standard orifice size = 0.21 mm; other sizes on request.

Circuit diagram HZ



Ports for	
A, B	Pressure
L, L_1	Caise drain (L_1 plugged)
X	Pilot pressure (plugged)

Circuit diagram HZ6



Ports for	
A, B	Pressure
L, L_1	Caise drain (L_1 plugged)
X	Pilot pressure (plugged)

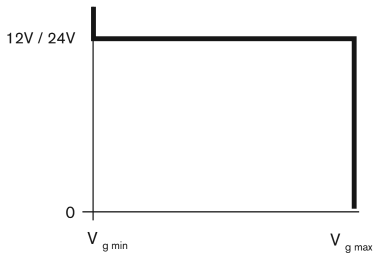
Two-point control, electrically operated EZ[1)]

Normally the motor is at maximum displacement. By energizing the solenoid of the control valve, the control piston is pressurized and the motor swivels to minimum displacement.

The control pressure is via a shuttle valve taken out of the motor pressure side A or B. A minimum pressure difference of $\Delta p_{A,B} \geq$ 20 bar between the pressure sides is required.

The motor can only swivel between $V_{g\ max}$ or $V_{g\ min}$.

$V_{g\ min}$ - adjustment please state in clear text when ordering.



De-energized ≙ $V_{g\ max}$

Energized ≙ $V_{g\ min}$

Techn. data EZ		
Version	EZ 1/6	EZ 2/7
Supply voltage	12V DC	24V DC
Nom. current at 20°C	1.5 A	0.8 A
Duty cycler	100% ED	100% ED
Plug protection class to DIN 43650	IP 65	IP 65

Ambient temperature range -20°C to +60°C.
If the above temperature range cannot be met please consult us

Features

– with spring return at solenoid

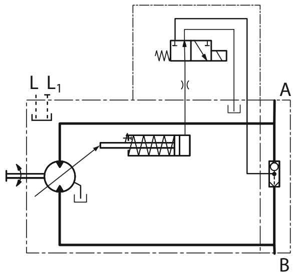
– Solenoid plug can be turned 4 x 90°

Version EZ6/7 with stroking time shuttle orifice.

Slow down of swivel action by means of shuttle orifice.
This enables a smooth swivel action.
Standard orifice size = 0.21 mm; other sizes on request.

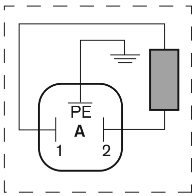
More information see page 25

Circuit diagram EZ1/2

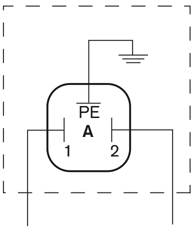


Ports for	
A, B	Pressure
L, L$_1$	Caise drain (L$_1$ plugged)

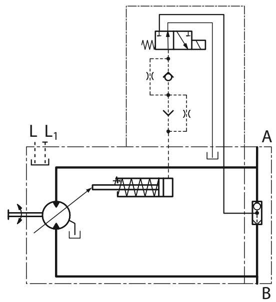
Connection to solenoid according to DIN 43650



Plug connection to DIN EN 175301-803-A Cable screw joint M 16x1.5



Circuit diagram EZ6/7



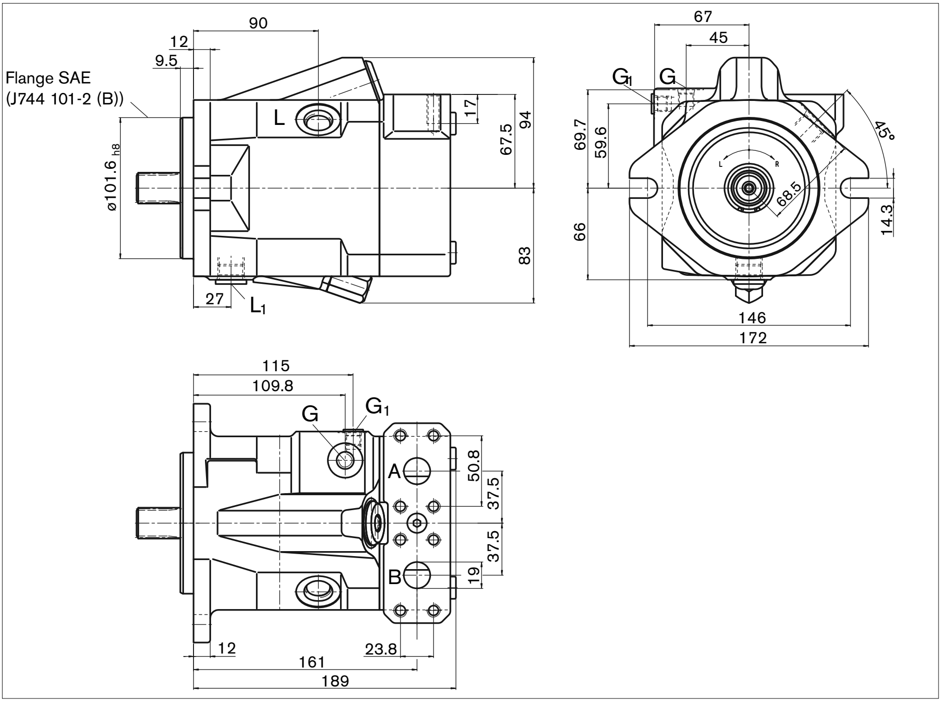
Ports for	
A, B	Pressure
L, L$_1$	Caise drain (L$_1$ plugged)

1) Shown in the unit dimensions: DIN connector from HIRSCHMANN;
Preferred for mobile applications (other dimensions): DEUTSCH connector molded, 2-pin – without suppressor diode

Dimensions A10VM size28

Before finalising your design please request a certified installation drawing.
Dimensions in mm

A10VM 28**DG**/52WX-VXC**10**N000



Ports

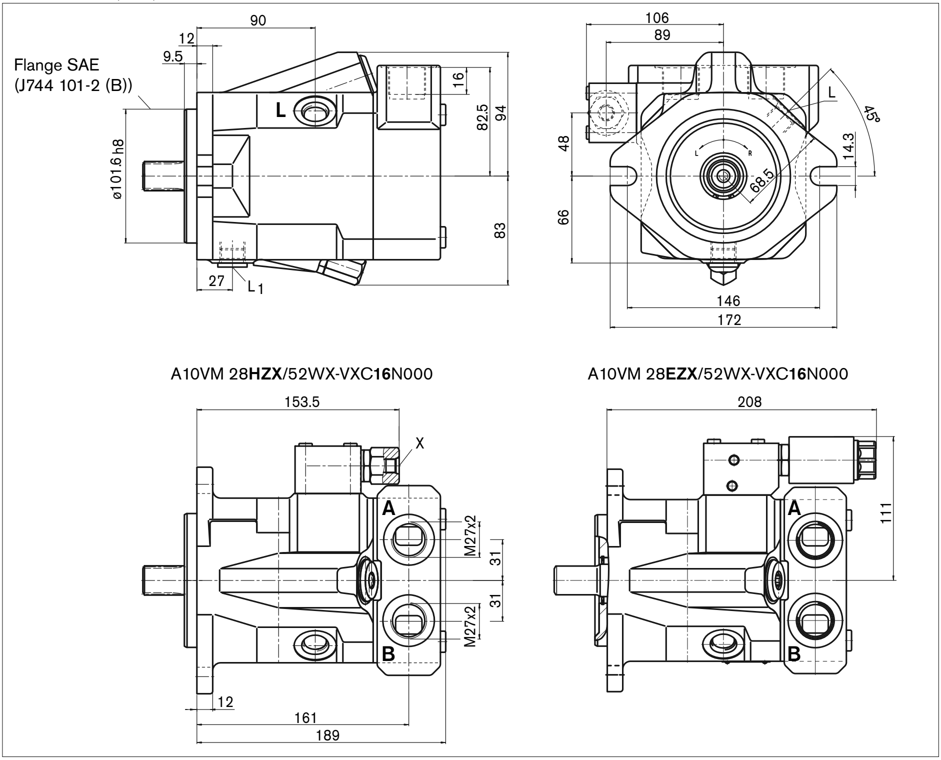
Designation	Port for	Standard	Size[2]	Max. press. [bar][3]	State
A, B	Pressure (High presure series, code 62)	SAE J518	3/4 in	350	O
	Fixing thread (port plate 10)	DIN 13	M10; 17 deep		O
A, B	Pressure (port plate 16)	DIN 3852-1[5]	M27x2; 16 deep	350	O
L	Case drain	ISO 11926[5]	3/4-16UNF-2B	4	O[4]
L_1	Case drain	ISO 11926[5]	3/4-16UNF-2B	4	X[4]
G	External control pressure	ISO 11926[5]	7/16-20 UNF-2B; 12 deep	350	O
G_1	External control pressure	ISO 11926[5]	7/16-20 UNF-2B; 12 deep	350	X
X	Pilot pressure	ISO 11926[5]	7/16-20UNF-2B; 10 deep	350	O

1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Observe the general instruction on page 28 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) Depending on installation position L oder L_1 must be connected (see also page 27).
5) The spot face can be deeper than specified in the appropriate standard.
O = must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions A10VM size 28

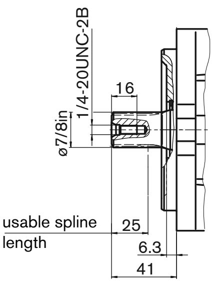
Before finalising your design please request a certified installation drawing.
Dimensions in mm

A10VM 28**HZX(EZX)**/52WX-VXC**16**N000



Drive shaft

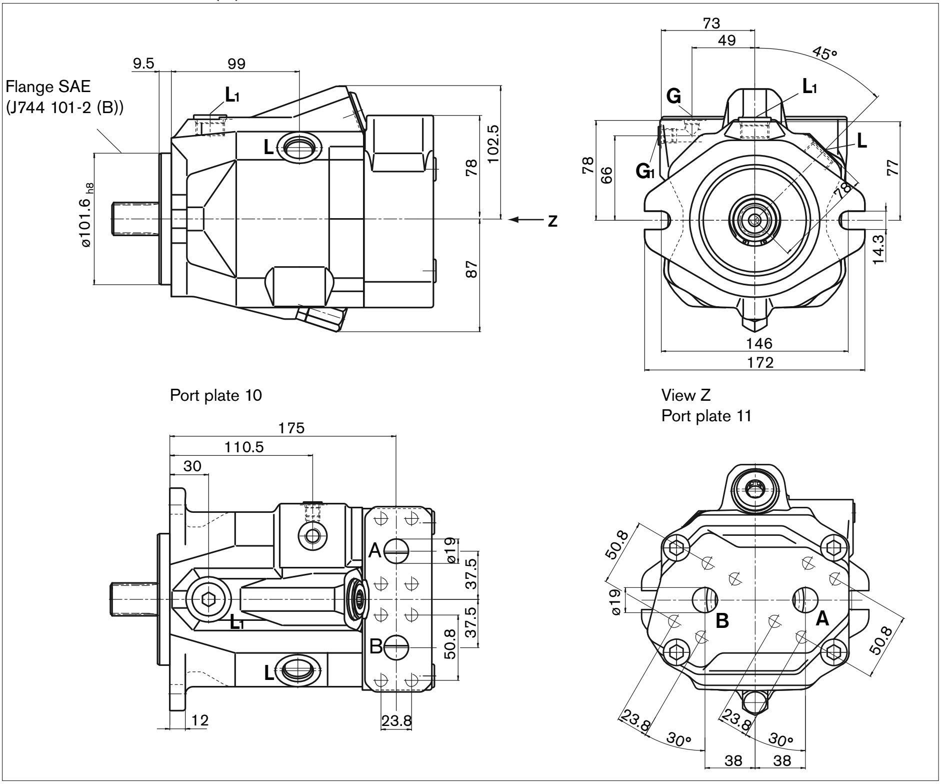
R Splined 7/8 in 13T 16/32DP[1)]
(SAE J744 - 22-4 (B))



Dimensions A10VM size 45

Before finalising your design please request a certified installation drawing.
Dimensions in mm

A10VM 45**DG**/52WX-VXC**10(11)**N000



Ports

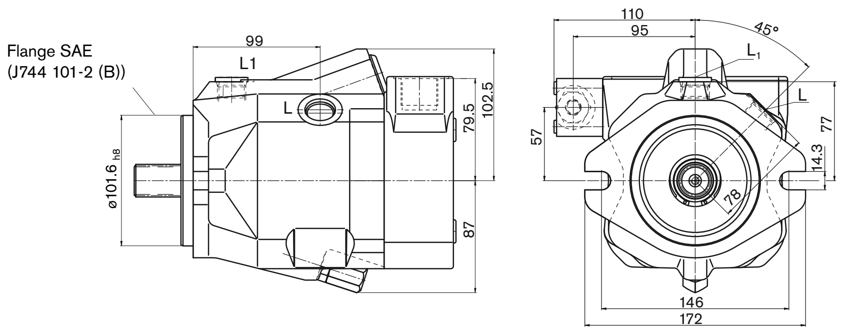
Designation	Port for	Standard	Size2)	Max. press. [bar]3)	State
A, B	Pressure (high pressure series, code 62)	SAE J518	3/4 in	350	O
	Fixing thread (port plate 10)	DIN 13	M10; 17 deep		O
A, B	Pressure (port plate 16)	DIN 3852-1 5)	M27x2; 16 deep	350	O
L	Case drain	ISO 11926 5)	7/8-14UNF-2B	4	O 4)
L_1	Case drain	ISO 11926 5)	7/8-14UNF-2B	4	X 4)
G	External control pressure	ISO 11926 5)	7/16-20 UNF-2B; 12 deep	350	O
G_1	External control pressure	ISO 11926 5)	7/16-20 UNF-2B; 12 deep	350	X
X	Pilot pressure	ISO 11926 5)	7/16-20UNF-2B; 10 deep	350	O

1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Observe the general instruction on page 28 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) Depending on installation position L oder L_1 must be connected (see also page 27).
5) The spot face can be deeper than specified in the appropriate standard.
O = must be connected (plugged on delivery)
X = Plugged (in normal operation)

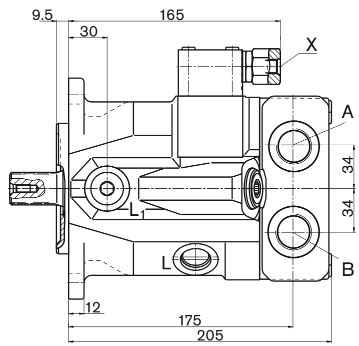
Dimensions A10VM size 45

Before finalising your design please request a certified installation drawing.
Dimensions in mm

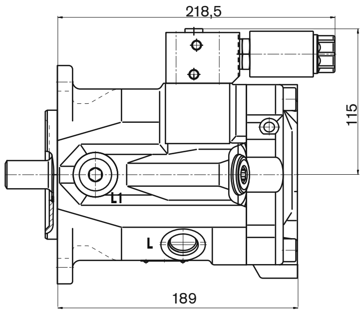
A10VM 45**HZX(EZX)**/52WX-VXC**11(16)**N000



A10VM 45**HZX**/52WX-VXC**16**N000



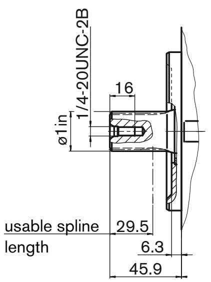
A10VM 45**EZX**/52WX-VXC**11**N000



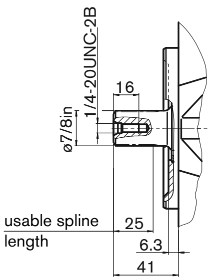
3

Drive shaft

R Splined 1 in 15T 16/32DP[1] (SAE J744 - 25-4 (B-B))



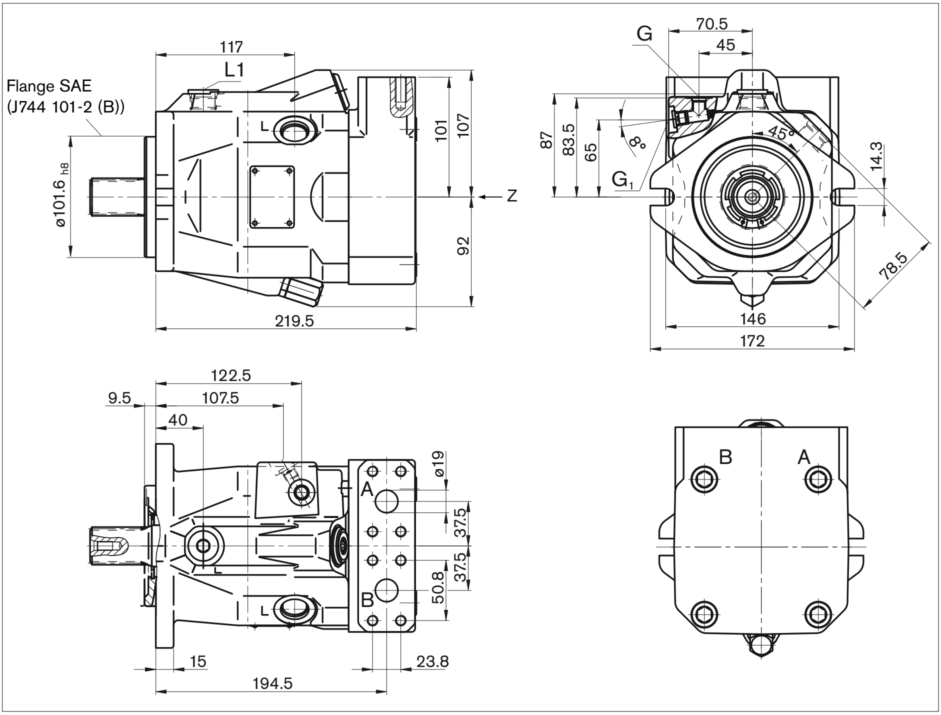
W Splined 7/8 in 13T 16/32DP[1] (SAE J744 - 22-4 (B))



Dimensions A10VM size 63

Before finalising your design please request a certifified installation drawing.
Dimensions in mm

A10VM 63**DG**/52WX-VXC**10**N000



Ports

Designation	Port for	Standard	Size[2]	Max. press. [bar][3]	State
A, B	Pressure (high pressure series, code 62)	SAE J518	3/4 in	350	O
	Fixing thread (port plate 10)	DIN 13	M10; 17 deep		O
A, B	Pressure (port plate 16)	DIN 3852-1[5]	M27x2; 16 deep	350	O
L	Case drain	ISO 11926[5]	7/8-14UNF-2B	4	O[4]
L_1	Case drain	ISO 11926[5]	7/8-14UNF-2B	4	X[4]
G	External control pressure	ISO 11926[5]	7/16-20 UNF-2B; 12 deep	350	O
G_1	External control pressure	ISO 11926[5]	7/16-20 UNF-2B; 12 deep	350	X
X	Pilot pressure	ISO 11926[5]	7/16-20UNF-2B; 10 deep	350	O

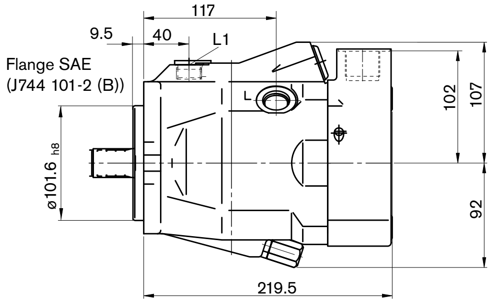
1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Observe the general instruction on page 28 for the maximum tightening torques.
3) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
4) Depending on installation position L oder L_1 must bee connected (see also page 27).
5) The spot face can be deeper than specified in the appropriate standard.

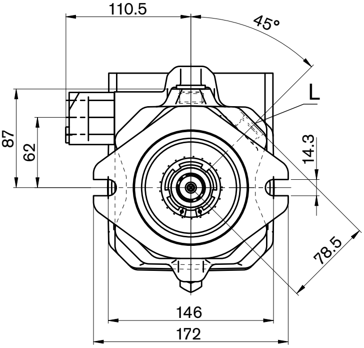
O = must bee connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions A10VM size 63

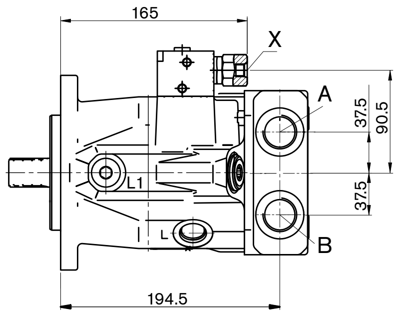
Before finalising your design please request a certified installation drawing.
Dimensions in mm

A10VM 63**HZX(EZX)**/52WX-VXC**10(16)**N000

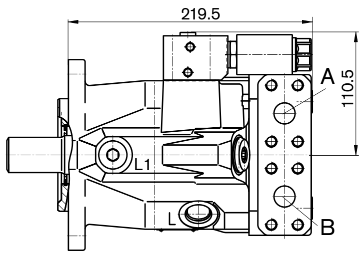




A10VM 63**HZX**/52WX-VXC**16**N000

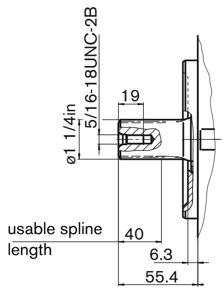


A10VM 63**EZX**/52WX-VXC**10**N000

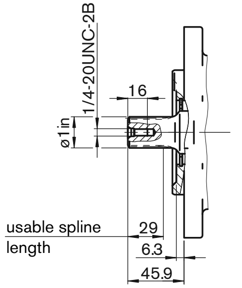


Drive shaft

R Splined 1 1/4 in 14T 12/24DP[1)]
(SAE J744 - 32-4 (C))



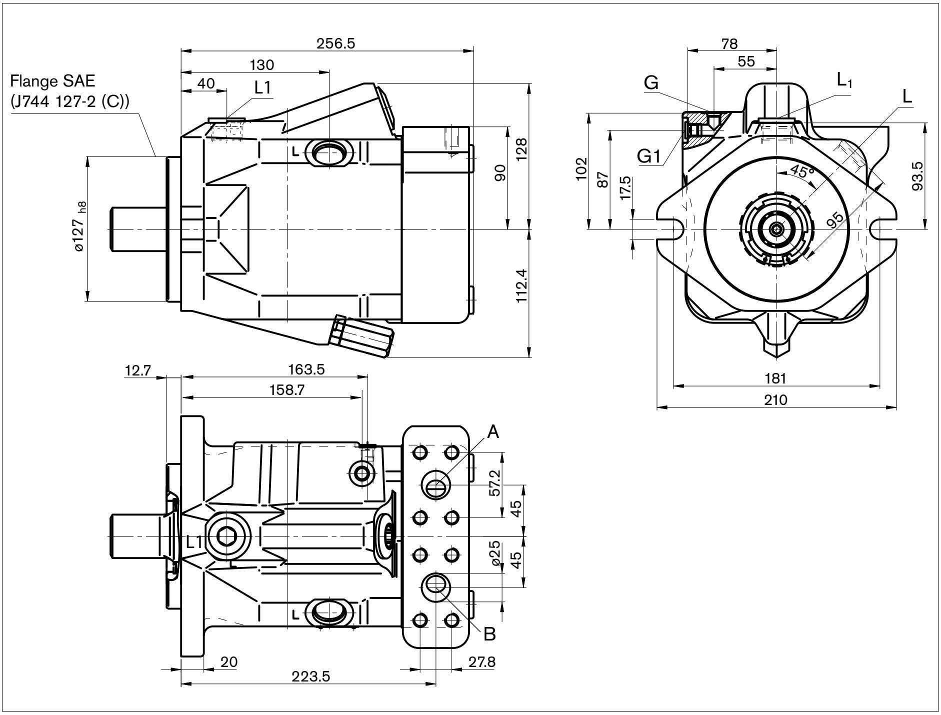
W Splined 1 in 15T 16/32DP[1)]
(SAE J744 - 25-4 (B-B))



Dimensions A10VM size 85

Before finalising your design please request a certifified installation drawing.
Dimensions in mm

A10VM 85**DG**/52WX-VXC**10**N000



Ports

Designation	Port for	Standard	Size[2)]	Max. press. [bar][3)]	State
A, B	Pressure (high pressure sereis, code 62)	SAE J518C	1 in	350	O
	Fixing thread (port plate 10)	DIN 13	M12; 17 deep		O
L	Case drain	ISO 11926[5)]	1 1/16-12UN-2B	4	O[4)]
L_1	Case drain	ISO 11926[5)]	1 1/16-12UN-2B	4	X[4)]
G	external control pressure	ISO 11926[5)]	7/16-20 UNF-2B; 12 deep	350	O
G_1	external control pressure	ISO 11926[5)]	7/16-20 UNF-2B; 12 deep	350	X

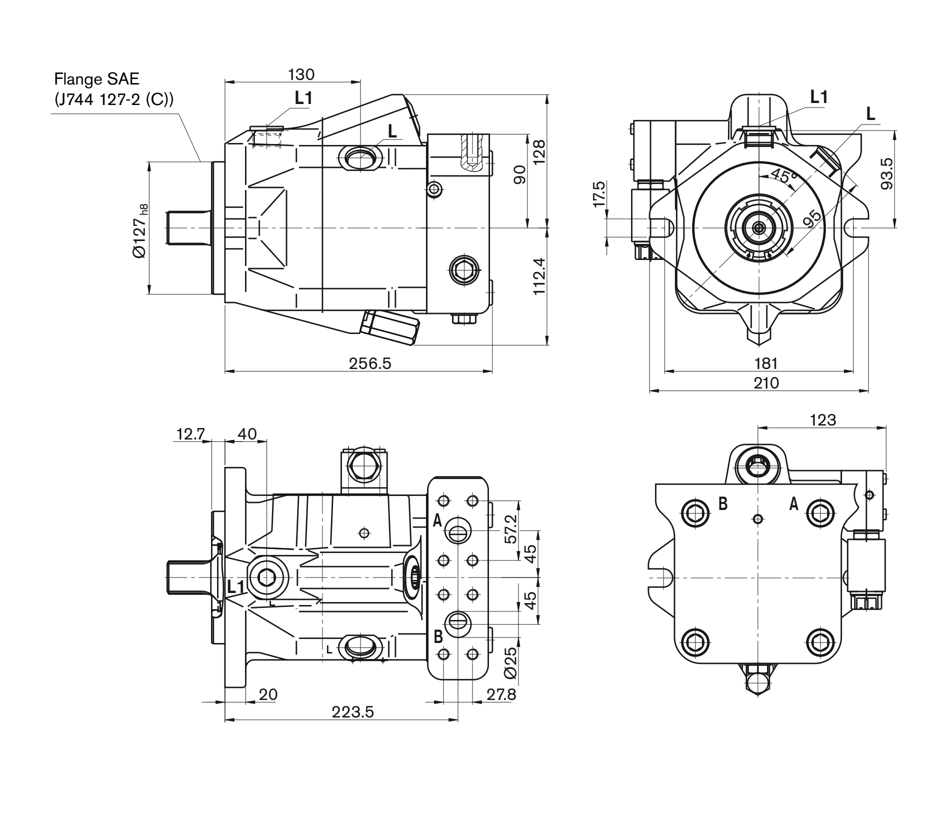
1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Observe the general instruction on page 28 for the maximum tightening torques.
3) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
4) Depending on installation position L oder L_1 must be connected (see also page 27).
5) The spot face can be deeper than specified in the appropriate standard.

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

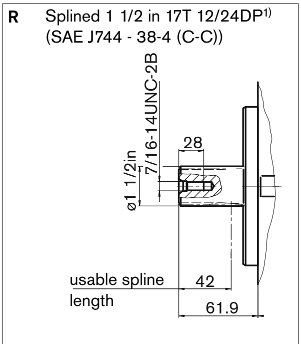
Dimensions A10VM size 85

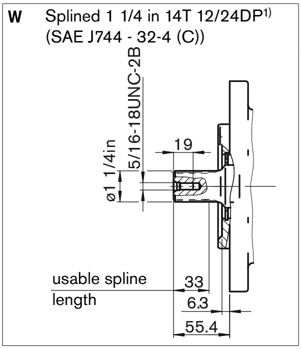
Before finalising your design please request a certified installation drawing.
Dimensions in mm

A10VM 85**EZX**/52WX-VXC**10**N000



Drive shaft



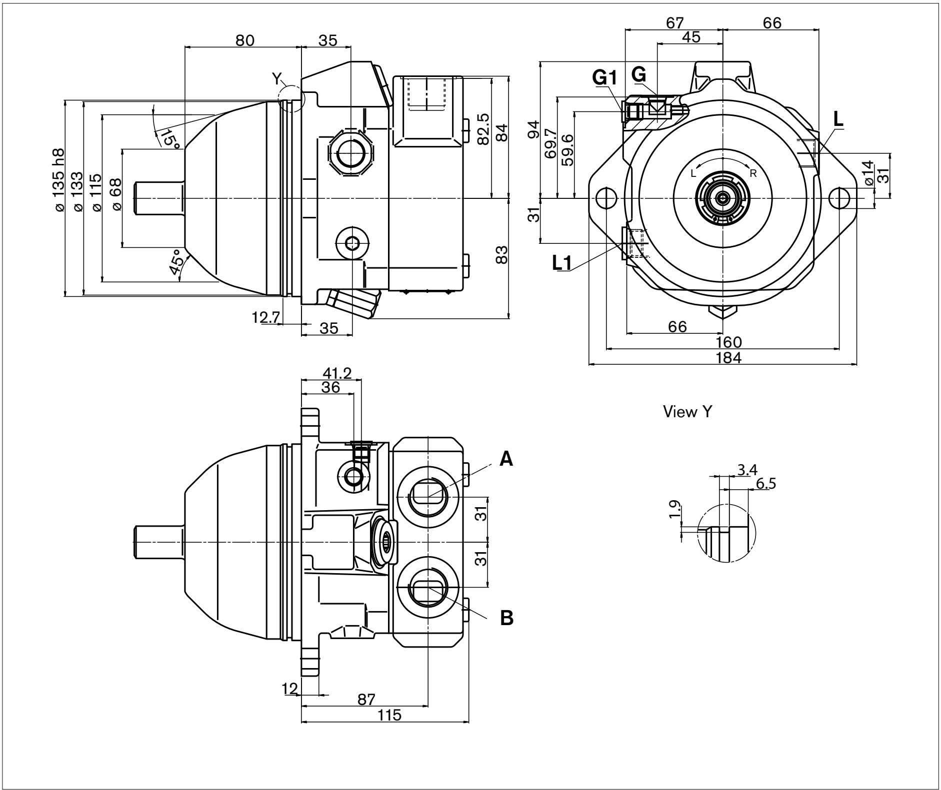


3

Dimensions A10VE size 28

Before finalising your design please request a certified installation drawing.
Dimensions in mm

A10VE 28**DG**/52WX-VXF**16**N000



Ports

Designation	Port for	Standard	Size[2]	Max. press. [bar][3]	State
A, B	Pressure (high pressure series, code 62)	SAE J518	3/4 in	350	O
	Fixing thread (port plate 10)	DIN 13	M10; 17 deep		O
A, B	Pressure (port plate 16)	DIN 3852-1[5]	M27x2; 16 deep	350	O
L	Case drain	ISO 11926[5]	3/4-16UNF-2B	4	O[4]
L_1	Case drain	ISO 11926[5]	3/4-16UNF-2B	4	X[4]
G	External control pressure	ISO 11926[5]	7/16-20 UNF-2B; 12 deep	350	O
G_1	External control pressure	ISO 11926[5]	7/16-20 UNF-2B; 12 deep	350	X
X	Pilot pressure	ISO 11926[5]	7/16-20UNF-2B; 10 deep	350	O

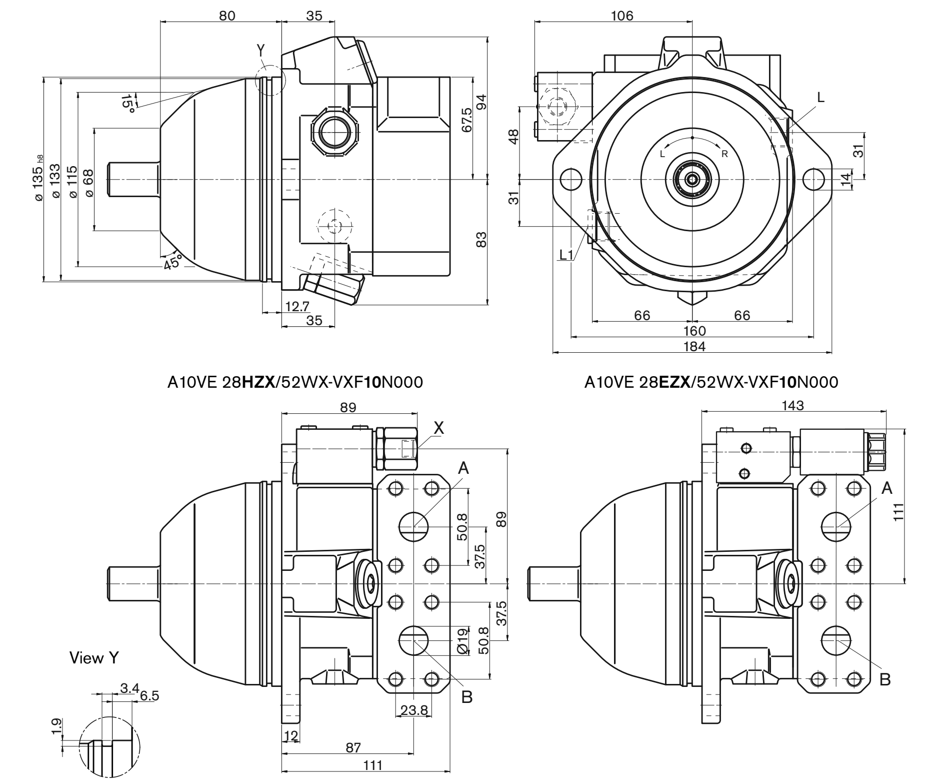
1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Observe the general instruction on page 28 for the maximum tightening torques.
3) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
4) Depending on installation position L oder L_1 must be connected (see also page 27).
5) The spot face can be deeper than specified in the appropriate standard.

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

Dimensions A10VE size 28

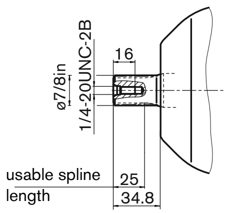
Before finalising your design please request a certified installation drawing.
Dimensions in mm

A10VE 28**HZX(EZX)**/52WX-VXF**10**N000



Drive shaft

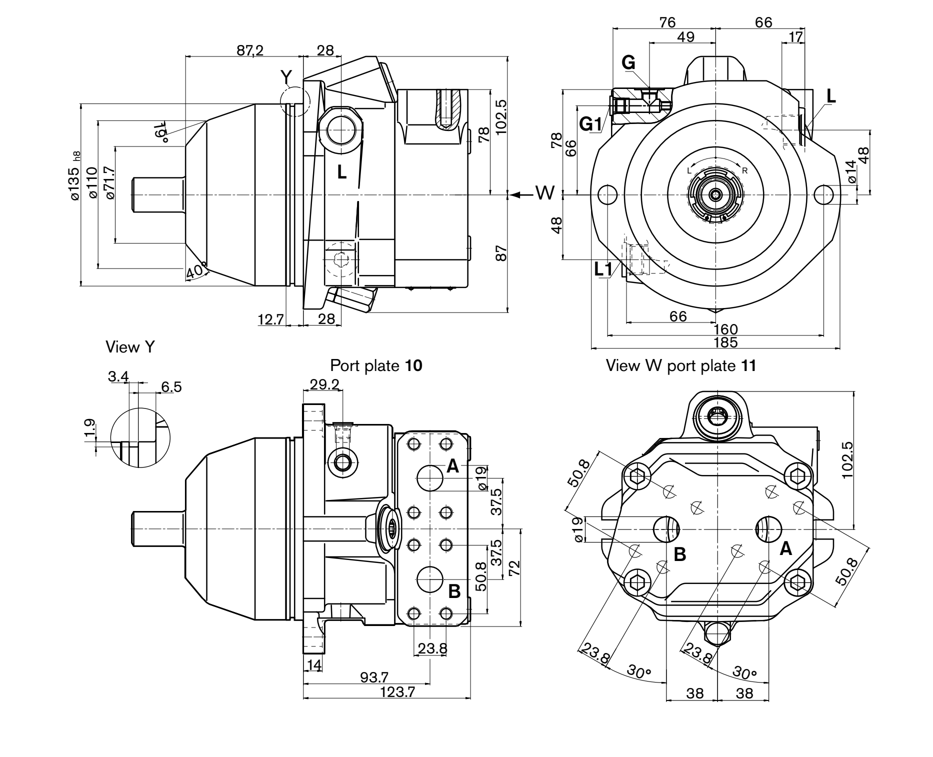
R Splined 7/8 in 13T 16/32DP[1)]
(SAE J744 - 22-4 (B))



Dimensions A10VE size 45

Before finalising your design please request a certifified installation drawing.
Dimensions in mm

A10VE 45**DG**/52WX-VXF**10(11)**N000



Ports

Designation	Port for	Standard	Size[2]	Max. press. [bar][3]	State
A, B	Pressure (high pressure series, code 62)	SAE J518	3/4 in	350	O
	Fixing thread (port plate 10, 11)	DIN 13	M10; 17 deep		O
A, B	Pressure (port plate 16)	DIN 3852-1[5]	M27x2; 16 deep	350	O
L	Case drain	ISO 11926[5]	7/8-14UNF-2B	4	O[4]
L_1	Case drain	ISO 11926[5]	7/8-14UNF-2B	4	X[4]
G	External control pressure	ISO 11926[5]	7/16-20 UNF-2B; 12 deep	350	O
G_1	External control pressure	ISO 11926[5]	7/16-20 UNF-2B; 12 deep	350	X
X	Pilot pressure	ISO 11926[5]	7/16-20UNF-2B; 10 deep	350	O

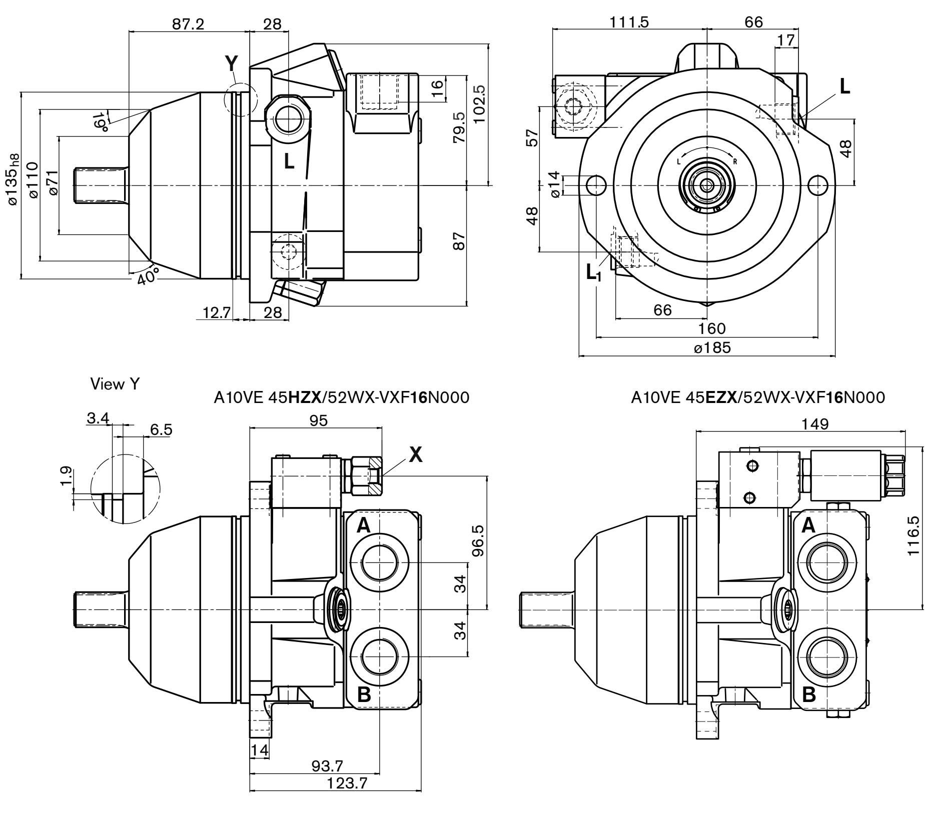
1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Observe the general instruction on page 28 for the maximum tightening torques.
3) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
4) Depending on installation position L oder L_1 must be connected (see also page 27).
5) The spot face can be deeper than specified in the appropriate standard.

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

Dimensions A10VE size 45

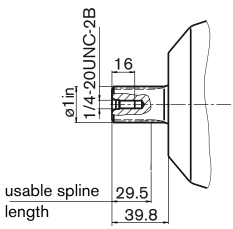
Before finalising your design please request a certified installation drawing.
Dimensions in mm

A10VE 45**HZX(EZX)**/52WX-VXF**16**N000

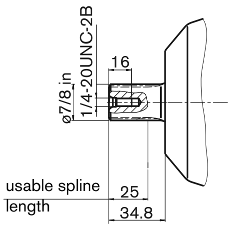


Drive shaft

R Splined 1 in 15T 16/32DP[1] (SAE J744 - 25-4 (B-B))



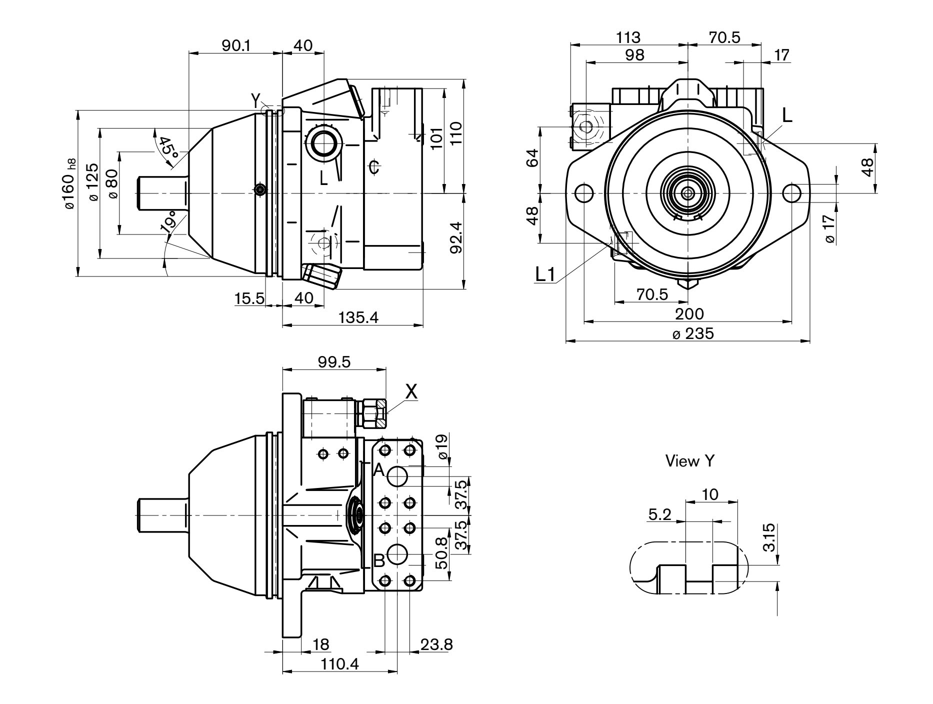
W Splined 7/8 in 13T 16/32DP[1] (SAE J744 - 22-4 (B))



Dimensions A10VE size 63

Before finalising your design please request a certifified installation drawing.
Dimensions in mm

A10VE 63**HZ**/52WX-VXF**10**N000



Ports

Designation	Port for	Standard	Size[2]	Max. press. [bar][3]	State
A, B	Pressure (high pressure series, code 62)	SAE J518	3/4 in	350	O
	Fixing thread (port plate 10)	DIN 13	M10; 17 deep		O
A, B	Pressure (port plate 16)	DIN 3852-1[5]	M27x2; 16 deep	350	O
L	Case drain	ISO 11926[5]	7/8-14UNF-2B	4	O[4]
L_1	Case drain	ISO 11926[5]	7/8-14UNF-2B	4	X[4]
X	External control pressure	ISO 11926[5]	7/16-20UNF-2B; 10 deep	350	O

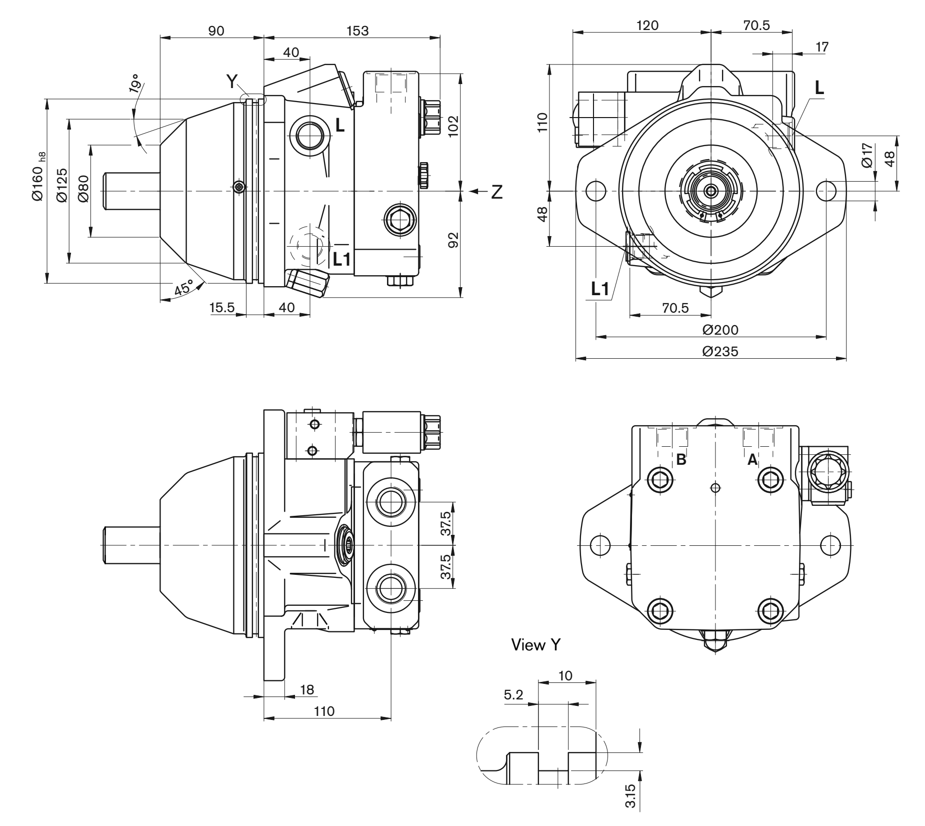
1) ANSI B92.1a-1976, 30° pressure angle, flat root, side fit, tolerance class 5
2) Observe the general instruction on page 28 for the maximum tightening torques.
3) Short-term pressure spikes may occur depending on the application. Keep this in mind when selecting measuring devices and fittings.
4) Depending on installation position L oder L_1 must be connected (see also page 27).
5) The spot face can be deeper than specified in the appropriate standard.

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

Dimensions A10VE size 63

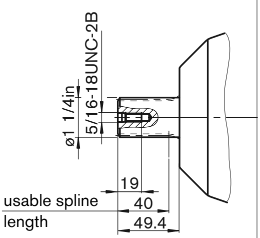
Before finalising your design please request a certified installation drawing.
Dimensions in mm

A10VE 63**EZX**/52WX-VXF**16**N000

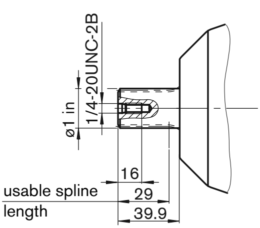


Drive shaft

R Splined 1 1/4 in 14T 12/24DP1) (SAE J744 - 32-4 (C))



W Splined 1 in 15T 16/32DP1) (SAE J744 - 25-4 (B-B))



Integrated flushing and boost press. relief valve, N007

The flushing and boost pressure relief valve is used in closed circuits to flush an unacceptable heat load out of the circuit and to maintain a minimum boost pressure level (fixed setting). The valve is integrated into the port plate.

A built-in fixed orifice determines the flushing flow, which is taken out of the low pressure side of the loop and directed into the motor housing. It leaves the housing together with the case drain flow. This combined flow must be replenished with fresh, cool fluid by means of the boost pump.

Standard flushing flow

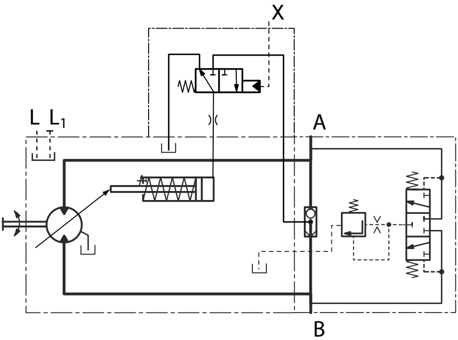
With a pressure of p_{ND} = 20 bar in the low pressure side of the circuit and an orifice dia. of ø1.6 mm the flushing flow amounts to 5.5 L/min (Size 28 - 85).
Other orifice diameters can be ordered in clear text.

Further flushing flows for sizes 28 - 85 see table:

Flushing flow (L/min)	Orifice dia. in mm
3.5	1.2
5.5	1.6
7.2	1.8

Circuit diagram

e.g. A10VO..HZ/...N007



Ports for	
A, B	pressure
L, L_1	case drain (L_1 plugged)
X	pilot pressure

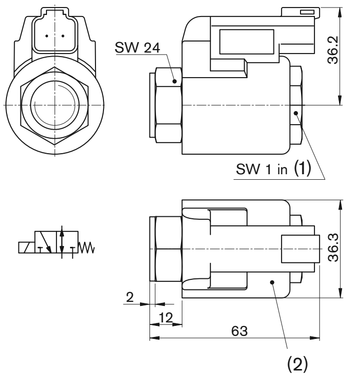
Connector for solenoids

DEUTSCH WKM08130D-01-C-V-XXDN, 2-pin

Molded, without bidirectionale suppressor diode
(Standard) ________________________________ P

Rexroth part-No. R902650409________________ 12V
R902650408________________ 24V

Technical data of electric	
Voltage	Cocurrent flow
Supply voltage	12 or 24 V
Nominal current	1.5 A
Voltage tolerance	-15 % bis +15 %
Operating period	100 %
Protection class	IP 65
Technical data of hydraulic	
Nominal pressure	maximum 350 bar
Flow	maximum 25 L/min
Sealing	FKM (flour-rubber)
Operating temperature of fluid	-20 °C to +120 °C
Viskosity range	10 mm^2/s to 420 mm^2/s
Function	D



The female connector is not part of the scope of supply.
This can be supplied by Rexroth on request.

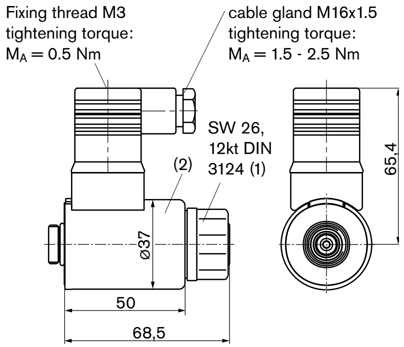
HIRSCHMANN DIN EN 175 301-803-A /ISO 4400
(not for new projects)

without bidirectional suppressor diode ______________ H

Degree of protection to DIN/EN 60529: IP65

The sealing ring in the cable gland (M16x1,5) is suitable for cables 4.5 mm to 10 mm in diameter.

The HIRSCHMANN-connector is part of the scope of supply of the motor.



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

Electronic controls

Control	Electronic function	Electronics		Further information
Electric pressure control	Regulated current outout	RA	analogue	RD 95 230
		VT2000	analogue	RD 29 904
		RC2-2/21 1)	digital	RD 95 201

1) Current outputs for 2 valves, sparately controllable

Speed pickup

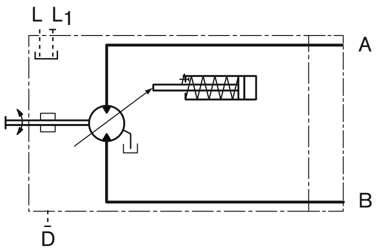
Before finalising your design please request a certified installation drawing.
Dimensions in mm

The version A10VM/E...D („prepared for speed pickup“) comprises gearing around the rotary unit.

In this case, the rotating cylinder barrel can provide a speed dependent signal, which can be picked up by a suitable sensor and processed for further evaluation. The sensor port will be plugged for delivery.
This preparation for speed pickup does not include the necessary working parts. They must be ordered separately as a kit with a corresponding part number.
Inductive speed sensor ID R 18/20-L250 (see RE 95130) and mounting parts (spacer and 2 seals per kit) can be ordered separately under the following part numbers:

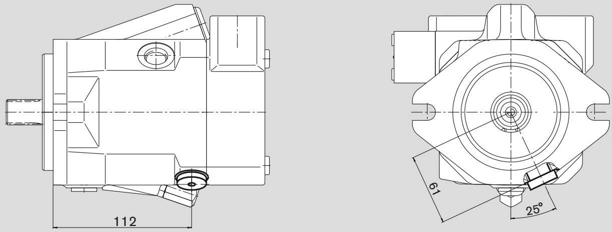
Size	Part Nr.	Number of teeth
28	R902428802	48
45	R902437557	48
63	R902428802	56
85	in preparation	

Circuit diagram



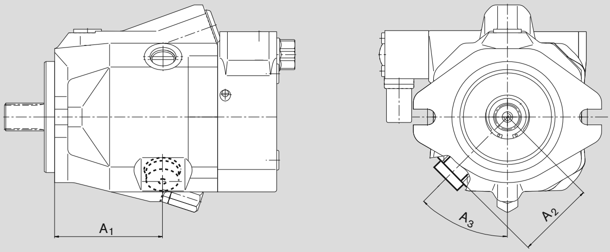
Dimension port D

A10VM 28

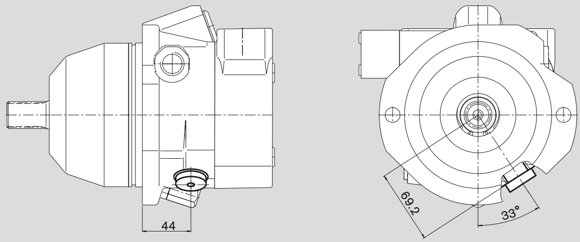


A10VM 45, 63 and 85

Size	A1	A2	A3
45	96	69.2	45°
63	140.5	71	57.5°
85	130	91.3	45°



A10VE 45



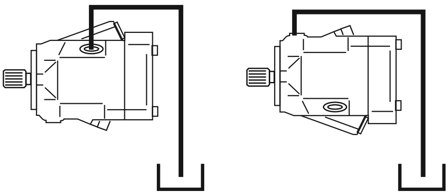
Mounting position

The motor housing must be filled during start up and operation. The drain line must be arranged, so that the housing cannot empty itself when the motor is at standstill. The end of the drain line must enter the tank below the minimum fluid level.

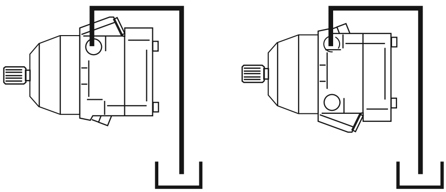
In all installation positions the highest case drain port must be used to fill the housing and to connect the drain line.

In case of a vertical installation please consult us.

A10VM



A10VE



3

General instructions

– The A10VM/VE is designed for operation in open and closed circuits

– Systems design, installation and commissioning requires trained technicians or tradesmen.

– Be sure to read the entire operating instructions throughly and completely befor using the axial piston unit. If necessary, request them at Rexroth.

– All hydraulic ports can only be used for the fastening of hydraulic service lines.

– During and shortly after operation of a axial piston unit 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 unit (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 maximum pressure.
The machine and system manufacturer must ensure, that all connecting elements and hydraulic lines are suitable for the actual operating pressures.

– Pressure cut off and pressure control are not suitable for providing system protection against excessive pressures. A suitable overall main line relief valve must be incorporated.

– All given data and information must be adhered to.

– 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. Value 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 ISO 68 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).

Threaded port sizes		Maximum permissible tightening torque of the threaded holes $M_{G\ max}$	Requiered tightening torque of the locking screws M_V	WAF hexagon socket of the locking screws
7/8-14 UNF-2B	ISO 11926	240 Nm	127 Nm	3/8 in
7/16-20UNF-2B	ISO 11926	40 Nm	15 Nm	3/16 in
3/4-16 UNF-2B	ISO 11936	160 Nm	62 Nm	5/16 in
1 1/16-12 UNF-2B	ISO 11926	360 Nm	147 Nm	9/16 in
M14x1,5	DIN 3852	80 Nm	35 Nm	6 mm
M16x1,5	DIN 3852	100 Nm	50 Nm	8 mm
M18x1,5	DIN 3852	140 Nm	60 Nm	8 mm
M22x1,5	DIN 3852	210 Nm	80 Nm	10 mm
M27x2	DIN 3852	330 Nm	135 Nm	12 mm

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Fax +49 (0) 74 51 82 21
info.brm-ak@boschrexroth.de
www.boschrexroth.com/axial-piston-motors

Axial Piston Motors
Accessories

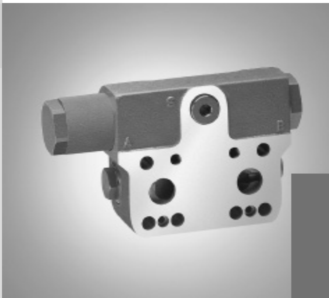
Designation	Type	Size	Series	Nominal pressure	Data sheet	page
Counterbalance valve for travel drives, winch drives and turas drives	BVD	20, 25	41	350 bar	RE 95522	441
Counterbalance valve for winch drives	BVE	25	51	350 bar	RE 95525	453

For the latest information on axial piston motors, please visit our website:
www.boschrexroth.com/axial-piston-motors

Rexroth
Bosch Group

Counterbalance Valve BVD

Data sheet



Series 41
Size NG20, 25
Nominal pressure 350 bar
Peak pressure 420 bar
for travel drives, winch drives and track drives

4

Contents

Features

- Space-saving installation due to compact design and direct mounting on A2FM(E) and A6VM axial piston motors (series 63)
- Available as a complete set with A2FM(E) and A6VM axial piston motors (series 63) and GFT gear units; test stand run as standard.
- Standard service line ports according to SAE J518
- Integrated brake release valve, with and without pressure reduction
- High efficiency due to low flow resistance
- Easy optimization options during commissioning due to modular design.

Ordering Code / Standard Program

BVD					/	41		–	V				
01	02	03	04	05		06	07		08	09	10	11	12

Valve type

01	Counterbalance valve, double-acting	**BVD**

Size

02	Flow, max. $q_{v\ max}$ 220 l/min	**20**
	Flow, max. $q_{v\ max}$ 320 l/min	**25**

Control range (pressure when brake piston starts/stops opening)

03	7...30 bar (travel drive)	**F**
	20...40 bar (winch and track drive)	**W**

Ports (size classification)

	NG	A2FM/E./.181	A2FE./.171	A6VM./.370	A6VM./.380	
04	20	28, 32, 45[1])				**16**
		56, 63			55	**17**
		80, 90			80	**27**
			107, 125	107		**28**
	25	107, 125, 160, 180			107, 140, 160	**38**

Ports for brake release

05	with high pressure	**S**
	with reduced high pressure 21^{+4} bar (brake release valve)	**L**

Series

06	Series 4, Index 1	**41**

Long cover

07	B-side (standard)	**B**
	A-side	**O**

Seals

08	FKM (fluor-caoutchouc)	**V**

Piston version

09	100% of max. flow $q_{v\ max}$ (see size)	**01**
	75% of max. flow $q_{v\ max}$ (see size)	**02**
	50% of max. flow $q_{v\ max}$ (see size)	**03**

Residual opening in piston

10	Without residual opening (obligatory for winches)		**K00**
	With residual opening	Ø 1.2	**K12**
		Ø 1.6	**K16**
		Ø 1.8	**K18**
		Ø 2.0	**K20**

1) Intermediate plate necessary for all three sizes

Ordering Code / Standard Program

BVD					/	41		–	V				
01	02	03	04	05		06	07		08	09	10	11	12

Damping during closing

11	Throttle pin	Comparative surface area	0.0361 mm²	Designation on pin	25	**D2500**
			0.0520 mm²		3	**D0300**
			0.0836 mm²		38 2)	**D0400**
			0.1762 mm²		55	**D0600**
			0.2798 mm²		69 3)	**D0800**

Flushing cavity

12	Plugged		**S00**
	With orifice (only for A6VM)	Ø 1.2	**S12**
		Ø 1.6	**S16**
		Ø 1.8	**S18**

2) Standard for travel drives
3) Standard for winch and track drive

Ordering information

When placing the order, the following information is necessary to ensure correct settings at our test stands:

- **Motor ordering code**
- **Counterbalance valve ordering code**
- **Flow**
- **Application (e.g. excavator, winch etc.)**
- **Pressure setting of the secondary pressure relief valves in the motor**

Gear unit and/or counterbalance valve and axial piston motor can be ordered as ready-assembled and tested units.

Type selection (Ordering Code)

Size
depends on the necessary flow rate and the available motor port plates.

Control range
defines the pressure range at which the brake piston starts to open.

For travel drives in wheeled vehicles, use code "F":

The control piston opens at a differential pressure between A and B of 7 bar. In this case, the brake is not operated via the port for brake release on the counterbalance valve.

For winch and track drives, use code "W"

The control piston opens at a differential pressure between A and B of 20 bar. This ensures that the mechanical park brake actuated via the brake release port is fully opened (generally at 18 bar) before the brake piston opens.

Ports
depend on the motor size used.

The line ports A and B on the motor port plates are of different distance and diameter. To choose the appropriate connection, please refer to the table in the ordering code and on page 10.

For A2FM/E, sizes 28, 32 and 45, a intermediate plate is required between motor port plate 181 and the counterbalance valve. This intermediate plate is automatically included when motor and counterbalance valve are ordered as a set.

Brake release
The integrated pressure reduction valve is necessary when the mechanical brake on the gear unit cannot handle the full system pressure.

The maximum permitted brake release pressure must be agreed with the winch manufacturer. The brake release valve limits the high pressure to 21...25 bar (4 bar tolerance). It opens at about 10-14 bar.

Piston version ...
depends on the maximum flow across the counterbalance valve.

If for instance the maximum operational flow is only some 110 l/min while using a size 20 counterbalance valve which features a nominal flow of 220 l/min, then select the 50% control piston (code „03“). This ensures smooth operation.

If the desired flow is not within the range of the pistons supplied, please contact us.

Residual opening in piston ...
ensures soft stopping of wheeled vehicles. In winch applications, any residual opening is prohibited, since otherwise the load would not stay suspended. Therefore select code "K00".

Damping
defines the closing speed of the counterbalance valve.
The higher the value, the faster the valve closes.

For the initial layout (prototype), we recommend the following damping:

- for wheel drives: D0400
- for winches and track drives: D0800

Flushing cavity
supplies motor flushing oil via an internal port. Only available for A6VM.

4

Design and Safety Instructions

Failure to observe any of the following points can lead to uncontrolled working conditions with serious personal injury and material damage:

- The counterbalance valve does **not** replace the mechanical park brake. Provide appropriate mechanical brake systems.
- Counterbalance valves are only used in open circuit.
- System optimization for the first prototype is recommended with regard to the valve block, axial piston motor, counterbalance valve and park brake.
- The counterbalance valve and main control valve must be matched to one another.
- If a park brake is installed, it must not close until after the counterbalance valve has closed. Otherwise excessive wear will be caused to the brake linings.
- Comply with the maximum control pressure of the park brake. If necessary, use the integrated pressure reduction valve as a brake release valve with reduced high pressure (code "L")
- The counterbalance valve converts the entire kinetic energy/potential energy into heat during the braking/lowering process. Consequently, ensure sufficient cooler and/or tank capacity.
- Counterbalance valves should be operated in combination with close-by secondary pressure relief valves, in order to protect the motor against pressure spikes. The motor port plates for direct installation of the counterbalance valve (A2FM: plate 181; A2FE: plate 171/181; A6VM: plate 370/380) already contain these secondary pressure relief valves.
- Auxiliary boost pressure at port S of the counterbalance valve reliably reduces the risk of cavitation due to lack of fluid in the low-pressure line. Ensure sufficient boost pressure and flow.
- The axial piston motor and counterbalance valve should always be ordered as a complete set. This ensures optimal matching and combined testing.
- If motor and counterbalance valve are ordered separately, consult our application engineers for the appropriate motor version.

The above safety measures and instructions must be adapted to the application and extended if necessary.

Technical Data

Hydraulic fluid

Please refer to the detailed information in our catalog sheets concerning the choice of hydraulic fluids and application conditions (see cross-references on page 11).

Table of values

Size				20	25
Operating pressure	p	bar	Nominal pressure	350	350
			Peak pressure	420	420
Flow, max.	$q_{v\,max}$	l/min		220	320
Opening pressure of brake piston	p	bar	BVD.F	7	7
			BVD.W	20	20
Pressure at which brake piston finishes opening	p	bar	BVD.F	30	30
			BVD.W	40	40
Pressure reduction valve for brake release (fixed values) Opening pressure	p	bar	BVD...L/	21^{+4}	21^{+4}
			BVD...L/	10^{+4}	10^{+4}
Weight, approx.	m	kg		9	15

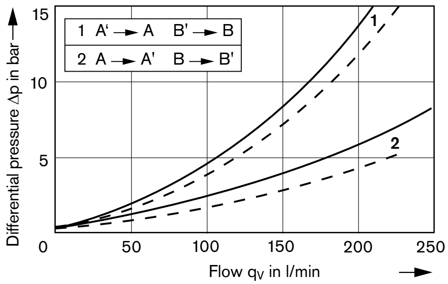
Technical Data

Characteristics

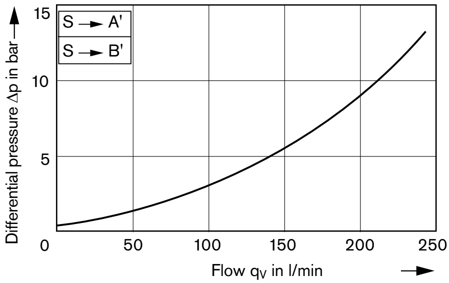
Size 20

BVD 20...16 and 20...17
(Service line ports A, B .... 3/4 in) ————

BVD 20...27 and 20...28
(Service line ports A, B .... 1 in) — — —

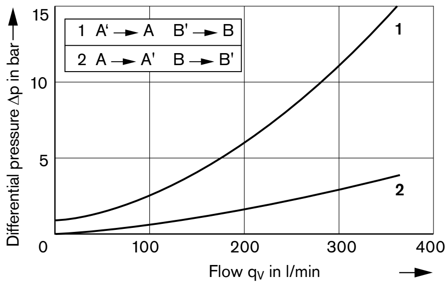


BVD 20 - boost characteristic
(Boost port S .... M22x1.5)

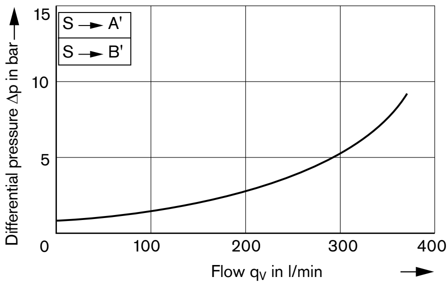


Size 25

BVD 25...38
(Service line ports A, B .... 1 1/4 in)



BVD 25 - boost characteristic
(Boost port S .... M27x2)



The above specifications are based on:

- Oil viscosity $\nu = 41$ mm²/s
- Oil temperature $\vartheta = 50$ °C
- Brake piston fully open
- Piston code 01 (100% $q_{v\ max}$)

4

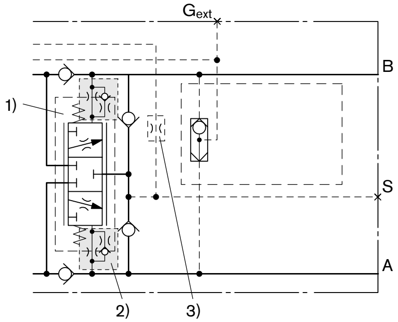
Operation

Travel/winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open controls. Cavitation occurs if the motor speed is greater than it should be for the given flow during braking, downhill travel or decrease in motor load.

BVD circuit diagram

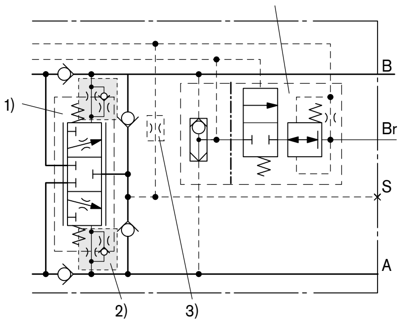
Counterbalance valve with shuttle valve and G_{ext} (plugged).

Ordering code designation "S" for brake release via port G_{ext}.



Counterbalance valve with shuttle valve, brake release valve and port Br.

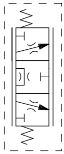
Ordering code designation "L" for brake release port Br.



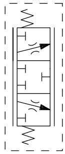
1) Residual opening

Brake piston

with residual opening (K..)



without residual opening (K00)



2) Damping

3) Flushing cavity...

...plugged (S00)

...with orifice (S..)

Operation

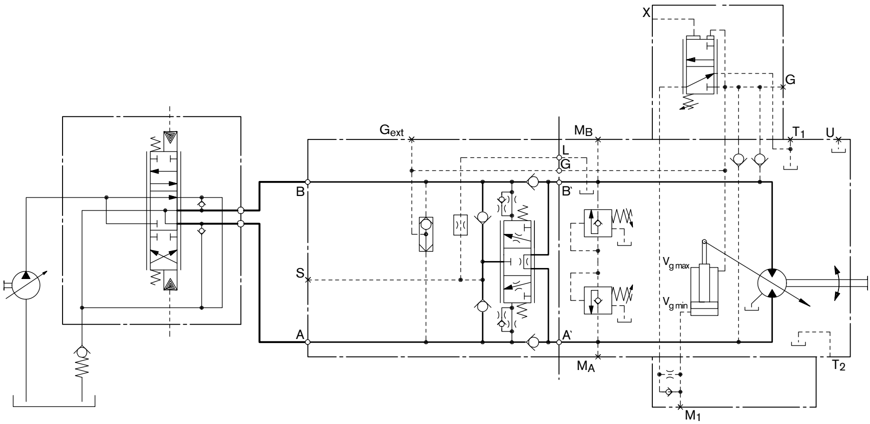
Circuit diagram – Travel counterbalance valve BVD..F

Application example

Travel drive for wheeled excavators
e.g. A6VM80HA1T/63W-VAB380 + BVD20F27S/41B-V03K16D0400S12

Variable motor with high pressure related control and hydraulic override (HA1T), port plate with integrated pressure-relief valves, prepared for mounting a counterbalance valve (380).

Travel counterbalance valve, size 20 with 50% piston (03) for approx. 110 l/min, internal residual opening in piston for smooth braking (K16),
high damping rate (D0400), internal flushing cavity to motor with 1.2 mm orifice (S12).



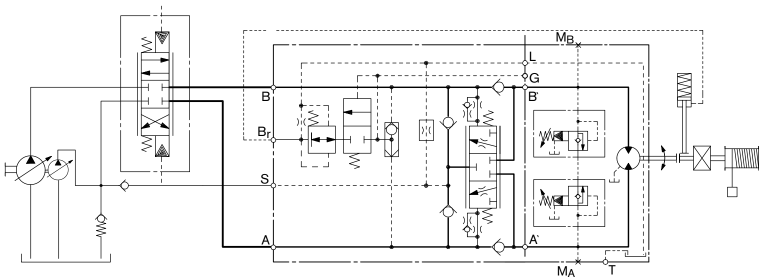
Circuit diagram – Winch counterbalance valve BVD..W

Application example

Winch drive in cranes; track drive in crawler excavators
e.g. A2FE160/61W-VAL181 + BVD25W38L/41B-V02K00D0600S00 mounted on a GFT-W Rexroth winch gear unit

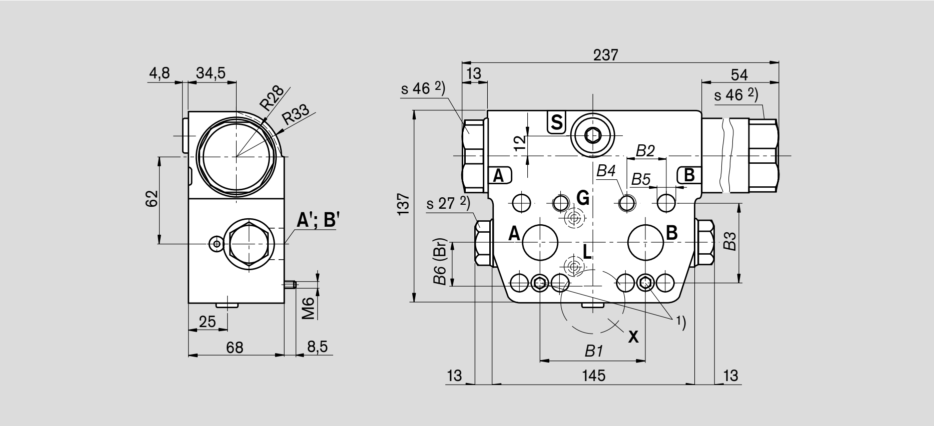
Fixed motor with port plate with integrated pressure-relief valves for mounting a counterbalance valve (181).

Winch counterbalance valve, size 25 with pressure reduction valves for brake release pressure (L), with 75% piston (02) for approx. 240 l/min, without internal residual opening (K00, obligatory for winches), low damping rate (D0800).



Other A6VM and A2FM/E axial piston motors can alternatively also be used.

Dimensions, Size 20



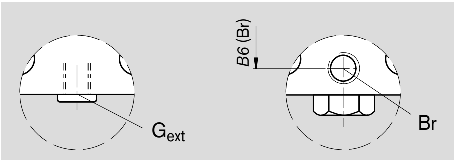
1) Countersink ø 11x6.5 and through-hole ø 6.6 for 2x M6 mounting screws for fixing the counterbalance valve to the motor. In order to prevent incorrect assembly, the mounting screws must be used (included in the delivery contents)

2) Width across flats

Detail X

With shuttle valve and G_{ext} port (code S)

With shuttle valve, brake release valve and Br port (code L)



	B1	B2	B3	B4	ØB5	B6
BVD 20...16	66	23.8	50.8	M10x1.5	10.5	25.5
BVD 20...17	75	23.8	50.8	M10x1.5	10.5	27.0
BVD 20...27	75	27.8	57.2	M12x1.75	13	27.0
BVD 20...28	84	27.8	57.2	M12x1.75	13	27.0

Ports

Designation	Operation		Standard	Size 1)	Peak pressure (bar) 2)	Status
A, B	Service line port, fixing thread A/B	Version 16, 17	SAE J518 3) DIN 13	3/4 in M10x1.5; 15 deep	420	O
		Version 27, 28	SAE J518 3) DIN 13	1 in M10x1.75; 16 deep	420	O
S	Boost port		DIN 3852	M22x1.5; 14 deep	30	X
Br	Brake release, reduced high pressure	Version L	DIN 3852	M12x1.5; 12.5 deep	30	O
G_{ext}	Brake release, high pressure	Version S	DIN 3852	M12x1.5; 12.5 deep	420	X
O-rings for connection to mounted axial piston motor						
A′, B′	Service line port	Version 16, 17	AS 568 A	24.99x3.53 (S-FKM90)		
		Version 27, 28	AS 568 A	32.92x3.53 (S-FKM90)		
G	High pressure for A6VM motor HA control (with O-ring)		DIN 3771	9x2 (N-V80G1)		
L	Flushing (with O-ring)		DIN 3771	9x2 (N-V80G1)		

1) Please observe the general instructions for the max. tightening torques on page 12

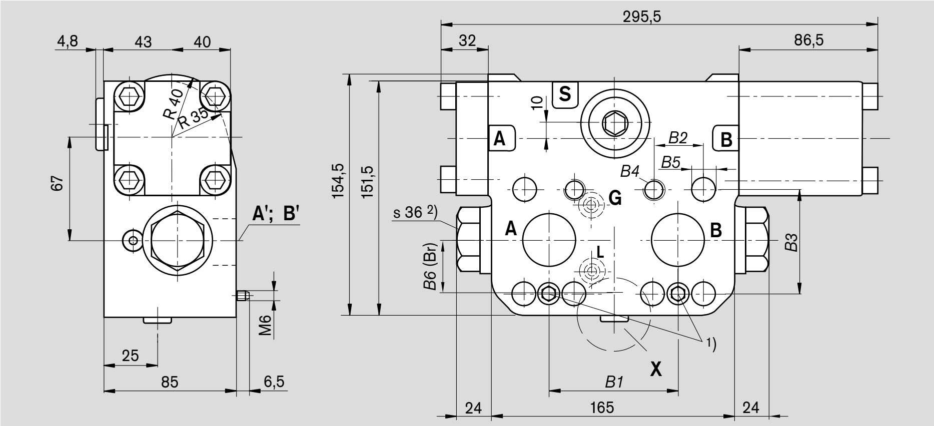
2) Short-term pressure spikes may occur depending on the application. Please keep this in mind when selecting testers and armatures.

3) Only dimensions according to SAE J518

O = open, must be connected (plugged on delivery)

X = plugged (in normal operation)

Dimensions, Size 25



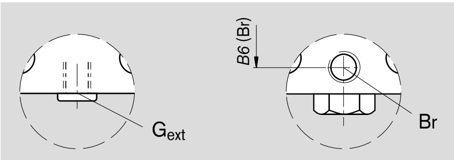
1) Countersink ø 11x6.5 and through-hole ø 6.6 for 2x M6 mounting screws for fixing the counterbalance valve to the motor. In order to prevent incorrect assembly, the mounting screws must be used (included in the delivery contents)

2) Width across flats

Detail X

With shuttle valve and G_{ext} port (code S)

With shuttle valve, brake release valve and Br port (code L)



	B1	B2	B3	B4	ØB5	B6
BVD 25...38	84	31.8	66.7	M14x2	15	31.6

Ports

Designation	Operation		Standard	Size 1)	Peak pressure (bar) 2)	Status
A, B	Service line port, fixing thread A/B	Version 38	SAE J518 3) DIN 13	1 1/4 in M14x2; 19 deep	420	O
S	Boost port		DIN 3852	M27x2; 16 deep	30	X
Br	Brake release, reduced high pressure	Version L	DIN 3852	M12x1.5; 12 deep	30	O
G_{ext}	Brake release, high pressure	Version S	DIN 3852	M12x1.5; 12.5 deep	420	X

O-rings for connection to mounted axial piston motor

A′, B′	Service line port	Version 38	AS 568 A	37.69x3.53 (S-FKM90)
G	High pressure for A6VM motor HA control (with O-rings)		DIN 3771	9x2 (N-V80G1)
L	Flushing (with O-ring)		DIN 3771	9x2 (N-V80G1)

1) Please observe the general instructions for the max. tightening torques on page 12

2) Short-term pressure spikes may occur depending on the application. Please keep this in mind when selecting testers and armatures.

3) Only dimensions according to SAE J518

O = open, must be connected (plugged on delivery)

X = plugged (in normal operation)

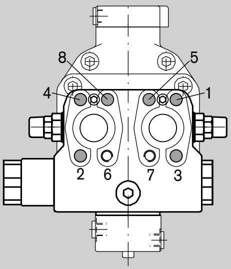
Fixing the Counterbalance Valve

When delivered, the counterbalance valve is attached to the motor using 2 tacking screws. Do not remove the tacking screws when connecting the service lines. If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be attached to the motor port plate using the provided tacking screws. In both cases, the final attachment of the counterbalance valve to the motor is by the connectio of the service lines, e.g. using SAE 4-bolt flanges. A total of 6 screws with thread lengths B1+B2+B3 and 2 screws with thread lengths B3+B4 are required.

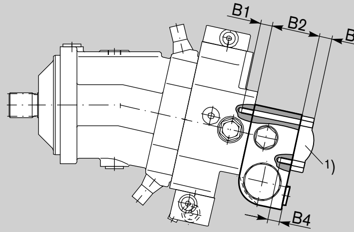
When tightening the screws, it is imperative that the sequence 1 to 8 (as shown in the adjacent diagram) be adhered to and carried out in two phases.

In the first phase the screws should be tightened to 50% of their tightening torque before being tightened to maximum tightening torque in the second phase (see table below).

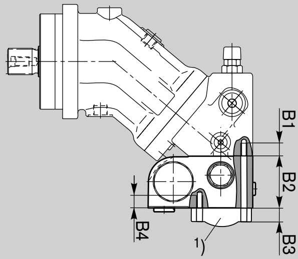
Thread	Strength class	Tightening torque in Nm
M10	10.9	75
M12	10.9	130
M14	10.9	205



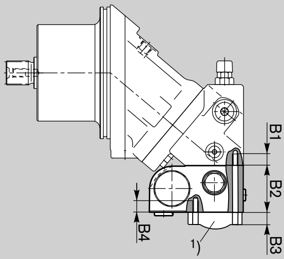
A6VM



A2FM



A2FE



1) Flange, e.g. SAE flange

Axial piston motor	A2FM/E	A2FM/E	A6VM	A2FM/E	A6VM	A2FE	A6VM	A2FM/E	A6VM
NG	28, 32, 45	56, 63	55	80, 90	80	107, 125	107	107, 125, 160, 180	107, 140 160
Dimension B1 1)	M10x1.5 17 deep	M10x1.5 17 deep	M10x1.5 17 deep	M12x1.75 18 deep	M12x1.75 15 deep	M12x1.75 17 deep	M12x1.75 15 deep	M14x2 19 deep	M14x2 19 deep
Dimension B2	78 2)	68	68	68	68	68	68	85	85
Dimension B3	Customer-specific								
Dimension B4	M10x1.5 15 deep	M10x1.5 15 deep	M10x1.5 15 deep	M12x1.75 16 deep	M12x1.75 16 deep	M12x1.75 16 deep	M12x1.75 16 deep	M14x2 19 deep	M14x2 19 deep

1) Minimum necessary screw insertion depth 1xØ
2) Including intermediate plate

Port Types

	NG20							NG25	
Ordering code	16	17		27		28		38	
Service line port A and B	3/4 in			1 in				1 1/4 in	
Boost port S (plugged)	M22x1.5; 14 deep							M27x2; 16 deep	
Spacing between service line ports (A'-B')	66	75				84		84	
For mounting on axial piston motor	A2FM/E	A2FM/E	A6VM	A2FM/E	A6VM	A2FE	A6VM	A2FM/E	A6VM
Size	28, 32, 45	56,63	55	80, 90	80	107, 125	107	107, 125, 160, 180	107, 140, 160
Motor port plate required (with secondary pressure-relief valves, mutual bleed-off)	181	181	380	181	380	171	370	181	380

Cross-References

Mineral oil ________ RE 90220

Environmentally acceptable hydraulic fluids ________ RE 90221

HF hydraulic fluids ________ RE 90223

A2FM ________ RE 91001

A2FE ________ RE 91008

A6VM ________ RE 91604

Hydrotrac GFT ________ RE 77110

Mobilex GFT-W ________ RE 77502

General Instructions

– The BVD counterbalance valve is designed to be used in open circuits.

– Project planning, assembly and commissioning of the axial piston unit with counterbalance valve require the involvement of qualified personnel.

– The service line ports and function ports are only designed to mounting hydraulic lines.

– During and shortly after operation, there is a risk of burns on the axial piston unit. Take suitable safety measures (e.g. wear protective clothing).

– There may be shifts in the characteristic depending on the operating state of the axial piston unit (operating pressure, fluid temperature).

– The data and note contained herein must be adhered to.

– The following tightening torques apply:

- Threaded hole in axial piston unit:
  The maximum permissible tightening torques M_{Gmax} are the maximum values for the threaded holes that must not be exceeded. For values, refer to the following table.
- Armatures:
  Observe the manufacturer's instruction regarding tightening torques for the used armatures.
- Fixing screws:
  For fixing screws according to DIN 13, we recommend checking the tightening torque in individual cases as per VDI 2230.
- Locking screws:
  For the metallic locking screws supplied with the axial piston unit, the required tightening torques of locking screws M_V apply. For values, refer to the following table.

Thread size at ports		Max. permissible tightening torque of the threaded holes M_{Gmax}	Required tightening torque of the locking screws M_V	WAF hexagon socket
M12x1.5	DIN 3852	50 Nm	25 Nm	6 mm
M22x1.5	DIN 3852	210 Nm	80 Nm	10 mm
M27x2	DIN 3852	330 Nm	135 Nm	12 mm

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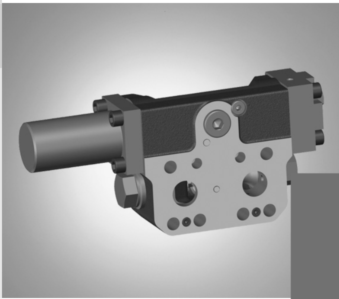
www.boschrexroth.com/axial-piston-pumps

Rexroth
Bosch Group

Counterbalance Valve BVE

Data sheet



Series 51
Size 25
Nominal pressure 350 bar
Maximum pressure 420 bar
For winch drives, open circuit

Contents

Features

- Single-action counterbalance valve especially for winch drives in open circuits
- Sensitive damping for stable lowering
- Simple adaptation to application
- Compact design and direct fitting to axial piston motors A2FM, A2FE and A6VM, A6VE
- Available in a set with axial piston motors A2FM, A2FE and A6VM, A6VE.
- Standard service line ports according to SAE J518
- Integrated brake release valve optional, with or without pressure reduction
- Good efficiency through reduced flow losses

Ordering code for standard program

BVE	25		38		/	51	N		–	V		0	K00		T30	S00	–	
01	02	03	04	05		06	07	08		09	10	11	12	13	14	15		16

Valve type

01	Counterbalance valve, single-side	**BVE**

Size (NG)

02	Flow, nominal $q_{v\ nom}$ 320 l/min, at $\Delta p = 20$ bar	**25**

Control range (pressure when counterbalance spool starts/stops opening)

03	Spring value (without return pressure)	18 to 38 bar	**W**
		9 to 39 bar	**V**

Ports

04	Size allocation: see page 11	**38**

Ports for brake release

05	With high pressure	**S**
	With reduced high pressure 21^{+4} bar (brake release valve)	**L**

Series

06	Series 5, index 1	**51**

Configuration of ports and fastening threads

07	Metric, port threads with profiled sealing ring according to DIN 3852	**N**

Long spring cover (design: see page 8)

08	On port side C, lift via port C	**C**
	On port side D, lift via port D	**D**

Seals

09	FKM (fluor-caoutchouc)	**V**

Counterbalance spool version (selection: see page 5)

10	10	**10**
	20	**20**

Opening characteristics of counterbalance spool

11	Standard	**0**

Residual opening in counterbalance spool

12	Without	**K00**

Damping D1 (channel to counterbalance spool)

13	Throttle pin, comparative diameter	Inlet	Outlet	
		0.4 mm	2.0 mm	**D4599**
		0.4 mm	0.4 mm	**D4545**
		0.4 mm	0.7 mm	**D4580**

Damping D2 (reservoir outlet)

14	With orifice ø0.3 mm	**T30**

Flushing cavity

15	Plugged	**S00**

Standard / special version

16	Standard version	**0**
	Standard version with installation variant, e.g. ports open or closed, contrary to standard	**Y**
	Special version	**S**

Note

Short designation X on a feature refers to a special version not covered by the ordering code.

Project planning and safety instructions

Order details

When placing the order, the following information is necessary to ensure correct acceptance at our test stands:

– Motor ordering code

– Counterbalance valve ordering code

– Flow

– Application (e.g winch)

– Pressure setting of the secondary pressure relief valves in the motor

– For the design of the brake release valve, we must know the following data for the mechanical park brake:

- the cracking pressure
- the volume of the counterbalance spool between minimum stroke (brake closed) and maximum stroke (brake released with 21 bar)
- the required closing time for a warm device (oil viscosity approx. 15 mm^2/s)

Counterbalance valve and axial piston motor can be ordered as a ready-assembled and tested unit.

Type selection (ordering code)

Control range
The control range defines the pressure range at which the counterbalance spool starts to open.

The control range of the counterbalance spool is to be chosen so that the mechanical park brake is fully open before the counterbalance spool starts to open.

Brake release
The integrated pressure reduction valve is necessary when the mechanical brake on the gear unit cannot handle the full system pressure.

The maximum permissible brake release pressure must be agreed with the winch manufacturer. The brake release valve reduces the high pressure to the value stated.

Counterbalance spool version
The counterbalance spool version depends on the maximum flow required through the counterbalance valve.

Counterbalance spool selection for required flow as per diagram on page 5.

If the desired flow is not within the range of the counterbalance spool supplied, please contact us.

Residual opening in counterbalance spool
In winch applications, any residual opening is prohibited, since otherwise the load would not stay suspended. For that reason, version "K00" is prescribed.

Damping
The throttle pin from D1 (inlet) and the orifice D2, plus the return pressure to the reservoir, define the actual cracking pressure of the counterbalance spool in M_{P1}.

The damping D1 (outlet) and D2 define the closing speed of the counterbalance spool. The larger the comparative diameter D1 (outlet), the faster the counterbalance spool will close (see table on page 4).

For the initial equipment (prototype), we recommend damping D1 = D4599 and D2 = T30.

Safety instructions

Failure to observe any of the following points can lead to uncontrolled operating conditions with serious personal injury and material damage.

– The counterbalance valve does **not** replace the mechanical park brake. If necessary, provide mechanical brake systems.

– Counterbalance valves are usually only used in open circuits.

– System optimization (reduction) for the first prototype is recommended with regard to the valve block, axial piston motor, counterbalance valve and park brake.

– The opening and closing characteristics of the counterbalance valve and control piston in the directional valve must be mutually compatible.

– The mechanical park brake in winch drives must only be effective after the counterbalance valve spool has closed. Otherwise, the brake will be subject to wear.

– Note the maximum permissible cracking pressure of the park brake. If necessary, use the integrated pressure reduction valve as a brake release valve with reduced high pressure (version "L").

– The counterbalance valve converts the entire kinetic energy/potential energy into heat during the braking/lowering process. Consequently, ensure sufficient cooler and/or tank capacity.

– Counterbalance valves should only be operated in combination with close-by secondary pressure relief valves in order to protect the motor against pressure spikes. The table on page 11 lists the motor and port plate types for the counterbalance valve BVE25. The port plates already contain the secondary pressure-relief valves.

– Feeding at port S of the counterbalance valve reduces the risk of cavitation. Ensure sufficient pressure and flow for feeding.

– We recommend ordering an axial piston motor and counterbalance valve as a single unit. This ensures optimal matching and combined testing.

– If motor and counterbalance valve are ordered separately, we recommend that you consult our application engineers for the appropriate motor version.

Further safety-relevant measures for the application must be added as necessary by the customer.

Technical data

Hydraulic fluid

The axial piston motor used is decisive for the choice of hydraulic fluid.
Further information should be taken from our data sheets during project planning.

Operating pressure range

Pressure at service line port C or D

Nominal pressure p_{nom} ________________ 350 bar absolute

Maximum pressure p_{max} ______________ 420 bar absolute
Single operating period ___________________________ 10 s
Total operating period ___________________________ 300 h

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.

Identification of cracking pressure p_1

(value without return pressure)

The throttle chain from D_1 and D_2 is used to damp the opening and closing speeds of the counterbalance spool. The actual working pressure, measured at M_{P1}, is reduced by the throttle chain from D_1 and D_2 and actuates the counterbalance spool. The dependence of the actual pressure value at M_{P1} for the opening of the counterbalance spool on the cross-sectional area of the orifice at D_1 and D_2 is stated in the table below.

Schematic

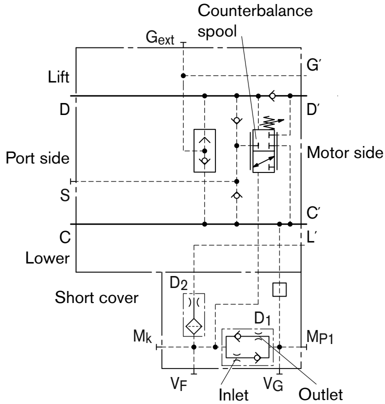


Table of values (theoretical values, without efficiency and tolerances; values rounded)

Size		NG			BVE.W	BVE.V
Operating pressure		p	bar	Nominal pressure	350	350
				Maximum pressure	420	420
Flow, nominal, at $\Delta p = 20$ bar		$q_{v\,max}$	L/min		320	320
Start of opening of counterbalance spool at port M_k		$\Delta p_{K\,B}$	bar		18	9
End of opening of counterbalance spool at port M_k		$\Delta p_{K\,E}$	bar		38	39
Pressure reduction valve for brake release (fixed values)	Maximum control pressure	p	bar	BVE...L/	21^{+4}	21^{+4}
	Start of control	p	bar	BVE...L/	10^{+4}	10^{+4}
Mass approx.		m	kg		18	18

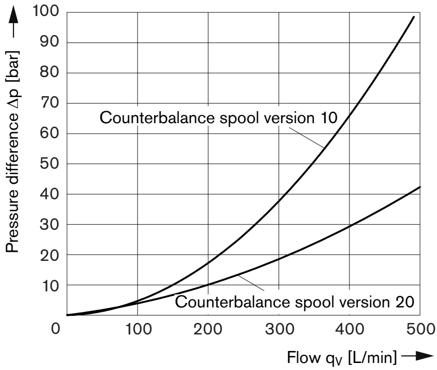
Cracking pressure p_1

			Pressure value at counterbalance spool		Pressure value at port M_{P1}	
Pressure spring	Throttle pin in inlet channel D1	Orifice in reservoir outlet D2	Start of opening $\Delta p_{K\,B}$ [bar] (approx.)	End of opening $\Delta p_{K\,E}$ [bar] (approx.)	Start of opening Δp_1 [bar] (approx.)	End of opening Δp_1 [bar] (approx.)
W	0.45	0.3	18	38	24	51
V	0.45	0.3	9	39	12	52

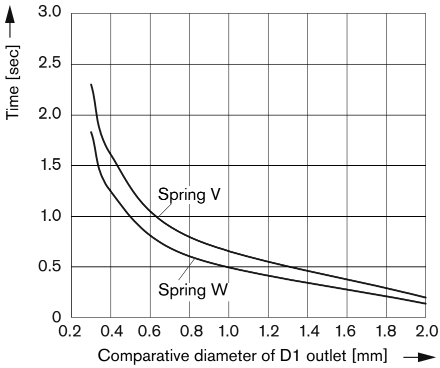
Choosing the counterbalance spool version

Characteristic valid for BVE.../51.D). Schematic: see page 4

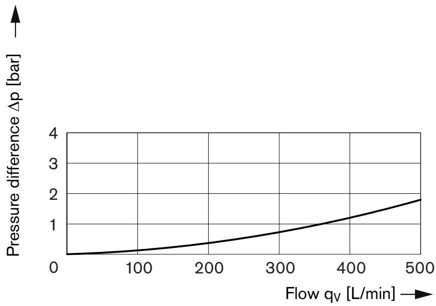
Pressure difference D → D′
(counterbalance spool at maximum opening)



Counterbalance spool closing time
(for choosing D1 outlet damping)



Pressure difference C′ → C

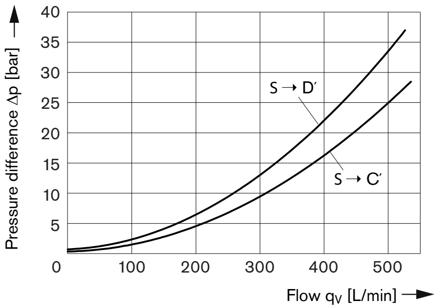


The above specifications are based on:

- Oil viscosity $\nu = 10\ mm^2/s$
- Oil temperature $\vartheta = 50\ °C$
- Counterbalance spool fully open

Note
Pressure Δp of approx. 20 to 50 bar is normal for regulating the maximum flow in winch systems.
If the desired flow is not within the range of the two counterbalance spool supplied, please contact us.

Feed pressure at port S



4

Functional description

Winch counterbalance valves are designed to reduce the danger of overspeeding and cavitation of axial piston motors in open circuits. Cavitation occurs if during braking or the load-lowering process the motor speed is greater than it should be for the given inlet flow and therefore the inlet pressure collapses. If the inlet pressure drops below the given value $\Delta p_{K\,E}$ (see table on page 4), the counterbalance spool will move towards the close position. The cross-sectional area of the counterbalance valve return channel is then reduced, creating a bottleneck in the return flow of the hydraulic fluid. The pressure increases and brakes the motor until the rotational speed of the motor is again as it should be for the given inlet flow.

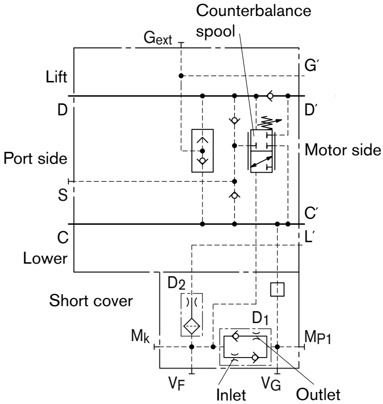
Brake release

Version S

Counterbalance valve with shuttle valve and port G_{ext} (plugged), without brake release valve (pressure reduction).

The respective high pressure is balanced via the shuttle valve and is available at port G_{ext} for release of the mechanical park brake. The brake release function without pressure reduction via the brake release valve is only employed if the mechanical park brake is approved for the maximum operating pressure.

Schematic



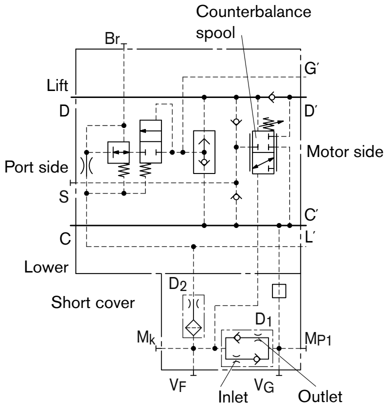
Version L

Counterbalance valve with shuttle valve, brake release valve for pressure reduction and port Br (plugged).

The respective high pressure is balanced and fed to the brake release valve (pressure reducing valve) via the shuttle valve. This opens from about 10 bar and reduces the respective operating pressure to approx. 21^{+4} bar. This brake release function is employed when the mechanical brake on the gear unit cannot handle the full system pressure.

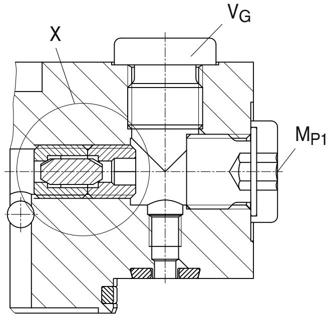
The maximum permissible brake release pressure must be agreed with the winch manufacturer.

Schematic

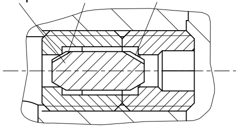


Damping D1

Installation position of throttle pin in short cover



View X



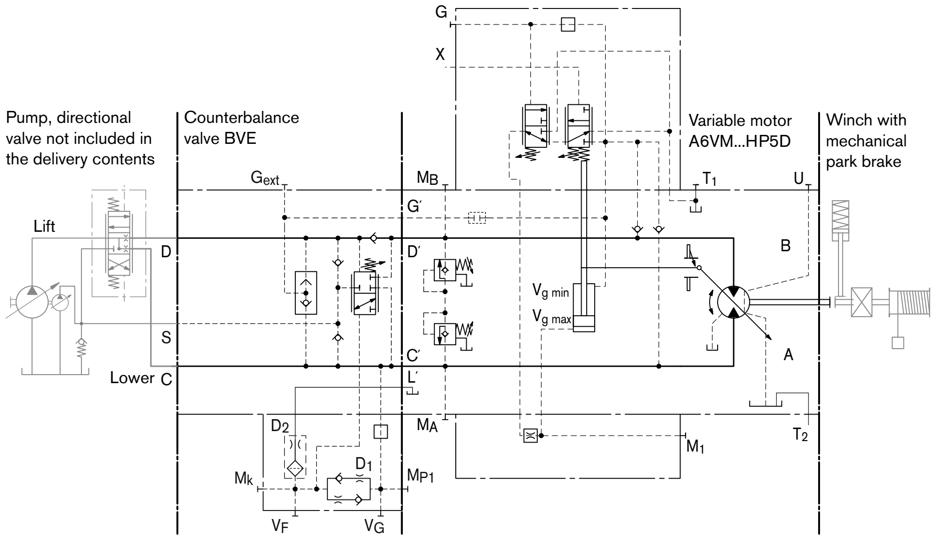
Application example of winch

Variable motor with integrated pressure-relief valves in the port plate and mounted counterbalance valve.

Winch counterbalance valve, size 25, without brake release valve (S), with counterbalance spool (10), without internal residual opening (K00, mandatory for winches), with weak damping (D4599).

e.g.: A6VM170HP5D10001F/71MWV0R4T28W0-0
+ BVE25W38S/51ND-V100K00D4599T30S00-0 fitted to a Rexroth winch drive

Schematic

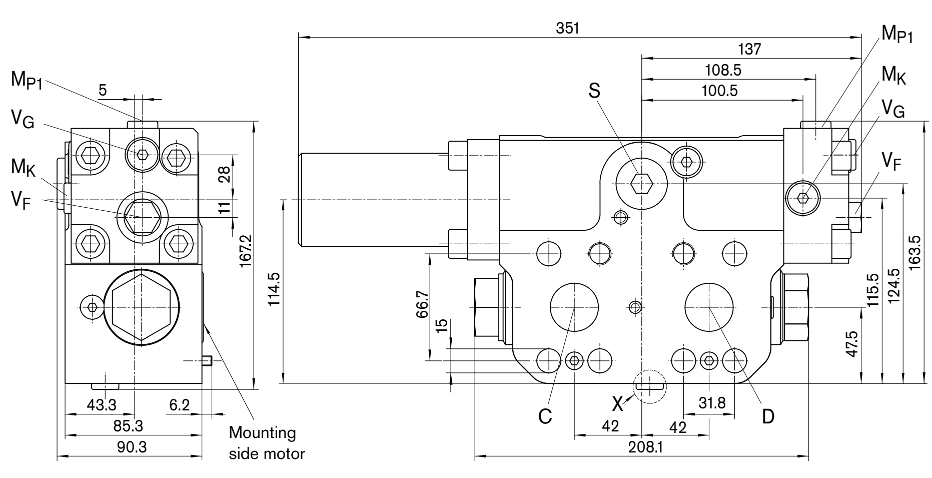


As an alternative to the above example, other axial piston motors from Bosch Rexroth (A2FM, A2FE and A6VM, A6VE) can also be used.

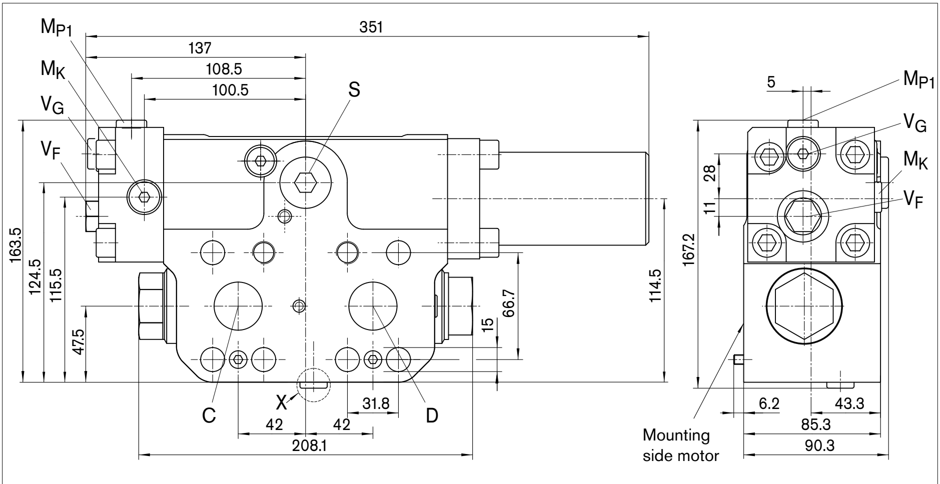
Dimensions size 25

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

Long spring cover on port side C, lift via port C

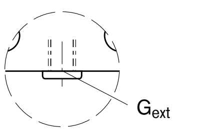


Long spring cover on port side D, lift via port D

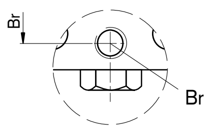


Detail X

With shuttle valve and port G_{ext} (version S)



With shuttle valve, brake release valve and Br port (version L)



Dimensions size 25

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

Ports with profiled sealing ring (ordering code designation N)

Designation	Port for	Standard	Size[1]	Maximum pressure [bar][2]	State
C, D	Service line	SAE J518[3]	1 1/4 in	420	O
	Fastening thread C/D	DIN 13	M14 x 2; 19 deep		
S	Infeed	DIN 3852	M27 x 2; 16 deep	[5]	X
Br	Brake release, reduced high pressure	DIN 3852	M12 x 1.5; 12.5 deep	8	X
G_{ext}	Brake release, high pressure	DIN 3852	M12 x 1.5; 12 deep	420	X
C′, D′	Service channel to motor[4]		ø30	420	O
G′	Selected high pressure, channel to motor[4]		ø4.2	420	O
L′	Leakage channel to motor[4]		ø4.2	10	O
M_{P1}	Measuring pressure A, before filter	DIN 3852	M14 x 1.5; 12 deep	420	X
V_G	Plug for threaded channel[4]	DIN 3852	M14 x 1.5; 12 deep	420	X
V_F	Threaded plug for filter channel[4]	DIN 6149	M16 x 1.5; 13 deep	420	X
M_K	Measuring pressure at counterbalance spool	DIN 3852	M14 x 1.5; 12 deep	420	X

O-ring for sealing to axial piston motor			
C′, D′	Service line port	AS 568 A	37.69 x 3.53 (-S-FKM90)
G′	Selected high-pressure channel for HA control of A6VM motor	DIN 3771	9 x 2 (-N-V80G1)
L′	Leakage channel	DIN 3771	9 x 2 (-N-V80G1)

1) Observe the general instructions on page 12 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) Only dimensions according to SAE J518, metric fastening thread is a deviation from standard.
4) No customer ports. Subject to technical change
5) Application-specific. Please contact us

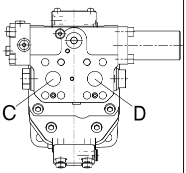
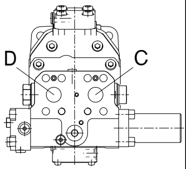
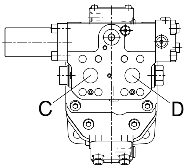
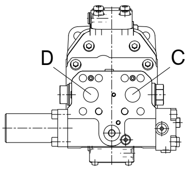
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

4

Installation versions

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

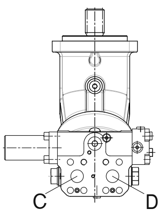
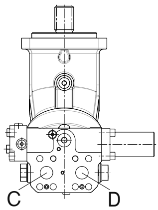
Design: A6VM

Direction of rotation: lift	Clockwise		Counter-clockwise	
Flow direction at motor	A to B		B to A	
Counterbalance valve effect at motor port	A		B	
Installation version of port plate	Start of control $V_{g\ max}$ Lifting winch	Start of control $V_{g\ min}$ Pulling winch – **not** permissible for lifting winch	Start of control $V_{g\ max}$ Lifting winch	Start of control $V_{g\ min}$ Pulling winch – **not** permissible for lifting winch
Long spring cover at BVE	On port side D	On port side C	On port side C	On port side D
Counterbalance valve ordering code	BVE25.../51.D	BVE25.../51.C	BVE25.../51.C	BVE25.../51.D
				

Start of control $V_{g\ max}$, negative control
HP5, HP6, EP5, EP6, HZ5, HZ7, EZ5, EZ6, EZ7, EZ8, DA0, DA1, DA2

Start of control $V_{g\ min}$, positive control – **not** permissible for lifting winch
HP1, HP2, EP1, EP2, HA1, HA2

Design: A2F

Direction of rotation: lift	Clockwise	Counter-clockwise
Flow direction at motor	A to B	B to A
Counterbalance valve effect at motor port	A	B
Long spring cover at BVE	On port side C	On port side D
Counterbalance valve ordering code	BVE25.../51.C	BVE25.../51.D
		

Mounting the counterbalance valve

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

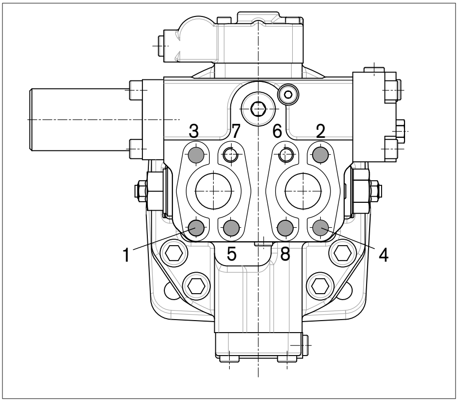
When delivered, the counterbalance valve is mounted to the motor with two tacking screws (transport protection). The tacking screws may not be removed while mounting the service lines! If the counterbalance valve and motor are delivered separately, the counterbalance valve must first be mounted to the motor port plate using the provided tacking screws. The counterbalance valve is finally mounted to the motor by screwing on the SAE flange with the following screws:

6 screws (**1, 2, 3, 4, 5, 8**) ____________ length B1+B2+B3
2 screws (**6, 7**) ______________________ length B3+B4

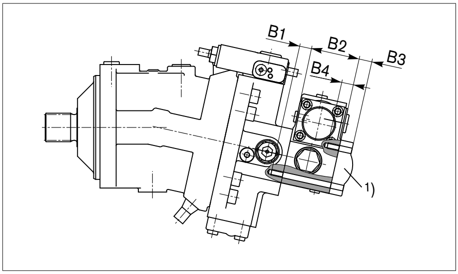
Tighten the screws in two steps in the specified sequence from 1 to 8 (see following scheme).

In the first step, the screws must be tightened with half the tightening torque, and in the second step with the maximum tightening torque (see following table).

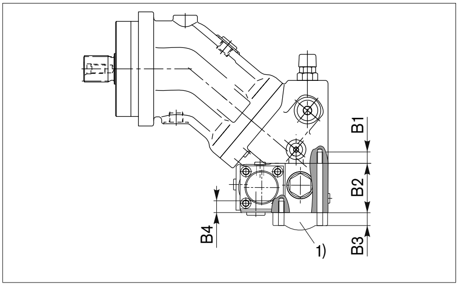
Thread	Strength class	Tightening torque [Nm]
M10	10.9	75
M12	10.9	130
M14	10.9	205



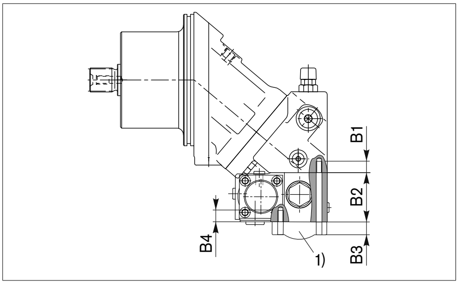
A6VM



A2FM



A2FE



Axial piston motor	A2FM, A2FE	A6VM/63,	A6VE/63	A6VM/71	A6VE/71
Size	107, 125, 160, 180	107, 140, 160	107, 160	115, 150, 170	115, 170
Motor port plate required (with secondary pressure-relief valves, mutual bleed-off)	181	380	380	8	8
Dimension B1[1)]	M14 x 2; 19 deep				
Dimension B2	85				
Dimension B3	Customer-specific				
Dimension B4	M14 x 2; 19 deep				

1) Minimum necessary thread length 1 x ⌀

4

General instructions

– The BVE counterbalance valve is designed to be used in an open circuit.

– The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified personnel.

– Before using the counterbalance valve, 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 counterbalance valve and the axial piston unit. Take appropriate safety measures (e.g. by wearing protective clothing).

– Depending on the operating conditions of the counterbalance valve (operating pressure, fluid temperature), the characteristic may shift.

– Service line ports:

  - The ports and fastening threads are designed for the specified maximum pressure of the counterbalance valve. 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.

– 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 instructions regarding the tightening torques of the fittings used.

  - Mounting bolts:
    For mounting bolts with metric ISO thread according to DIN 13, we recommend checking the tightening torque in individual cases in accordance with VDI 2230.

  - Female threads of the counterbalance valve or 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 counterbalance valve or 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 of the threaded plugs
ISO 3852	M12 x 1.5	50 Nm	25 Nm[2)]	6 mm
	M14 x 1.5	80 Nm	35 Nm	6 mm
	M27 x 2	330 Nm	135 Nm	12 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 17 Nm for M12 x 1.5.

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Fax: +49-7308-72-74
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External Gear Motors

For the latest information on external gear motors, please visit our website:
www.boschrexroth.com/gear-motors

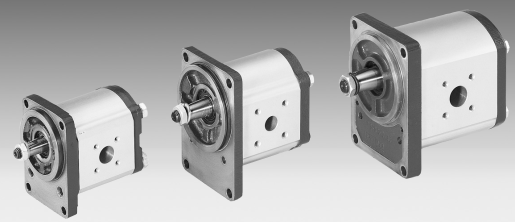
Rexroth
Bosch Group

External Gear Motors

RE 14 026/05.09
Replaces:
RE 14 026/01.05

AZMF ..., AZMN ..., AZMG ...

Model F = 8 ... 22.5 cm³/rev
N = 25 und 28 cm³/rev
G = 22.5 ... 45 cm³/rev



Contents

General

Rexroth external gear motors are produced in 3 different models, with different displacements being produced by means of gears of differing widths.
Different versions of motors are achieved by the use of different flanges, shafts, valves and integrated speed sensors.

Features

- High pressures combined with small size and low weight
- Large speed ranges
- Broad viscosity and temperature ranges
- Reversible motors for 2- and 4-quadrant operation

Fields of application

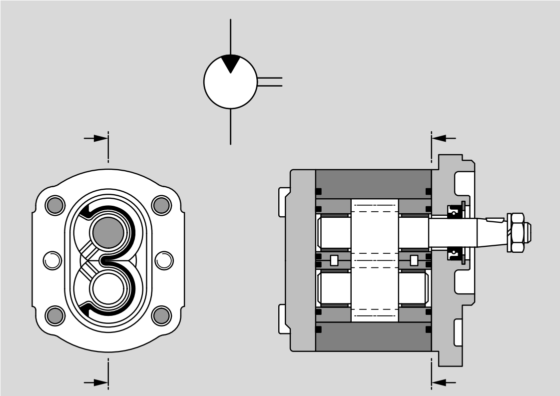
- Road construction machines as road rollers and pavers
- Agricultural machines and forestry technology as harvesters and forestry machines
- Street vehicles such as busses, trucks and special vehicles and above all in hydrostatic fan drives.

Function

If pressurized oil is fed into the motor, a torque can be obtained from the shaft leading out of the housing. Here, a distinction is made between motors that rotate on one direction and reversible motors.

External gear motors that rotate in one direction

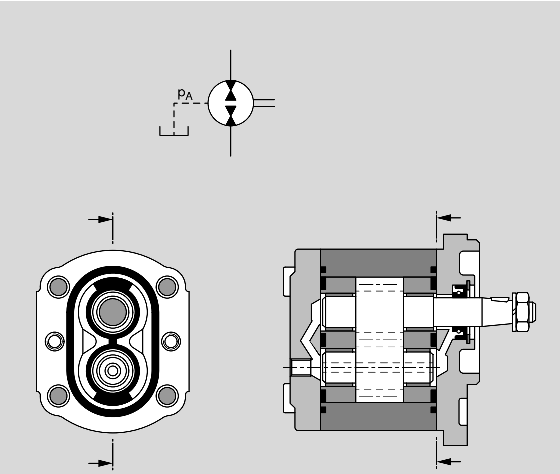
These are of asymmetrical design, i.e. the high and low pressure sides are defined and not interchangeable at will. In this case, reversible operation is not possible. In order to ensure a high efficiency level, a special running-in method is used for motors. Leakage oil is discharged internally to the outlet side. Pressure loading of the outlet is limited by the shaft seal.



Reversible external gear motors

The displacement method in external gear motors is the reverse of the pump process. Reversible motors have a special feature, however. Their symmetrical construction means that the high or low pressure chambers are separate from the bearing and shaft seal chamber. The resulting leakage oil is routed through a separate oil drain gland in the housing cover. This oil drainage enables the motor to be subjected to load via the return line, which in turn allows the use of series connections. Due to the connection between the shaft seal and the low-pressure end, however, standard motors and pumps can only withstand a pressure of up to approx. 3 bar.

The figure shows a reversible gear motor for 4-quadrant operation, i.e. both output and input torque in both directions. (Hydraulic motor becomes a pump if load reversal occurs.)



Product overview “Model F” preferential range

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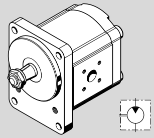
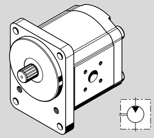
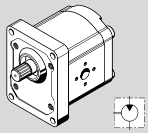
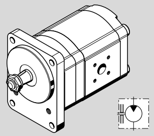
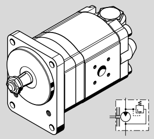
	19
	20
	21
	22
	23

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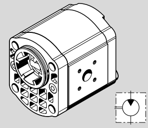
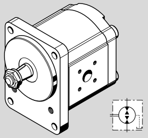
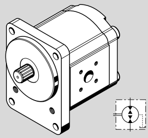
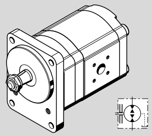
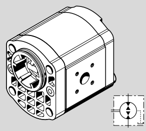
	24
	25
	26
	27
	28

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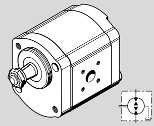
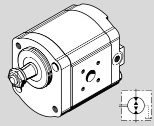
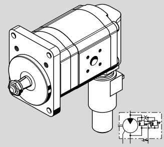
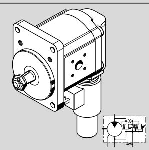
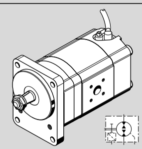
	29
	30
	31
	32
	34

Product overview “Model N” preferential range

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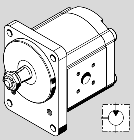	35

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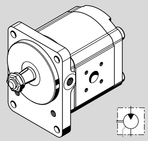	36

Product overview “Model G” preferential range

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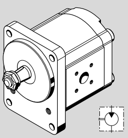	37

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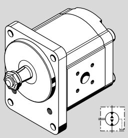	38

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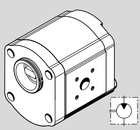
	39

5

Ordering code

External Gear Motors Model “F”

AZ	M	F	–	1x	–	022	R	C	B	20	M	B	200xx	–	S0001

Function

M = Motor

Series

1x = Standard bearing

Size (F)

8.0 cm^3/rev	= **008**
11.0 cm^3/rev	= **011**
14.0 cm^3/rev	= **014**
16.0 cm^3/rev	= **016**
19.0 cm^3/rev	= **019**
22.5 cm^3/rev	= **022**

Direction of rotation

Right	= **R**
Left	= **L**
Universal	= **U**

*) The special equipments partly contained on the pages 20–35, are not considered in the representation of the ordering code.

Special design*)

Valve adjustment

PRV 200 bar	= **200 xx**
PRV	= **180 xx**

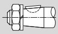
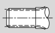
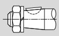
Rear cover

Standard	= **B**
PRV	= **G**
drain oil line connection (axial)	= **L**
PRV excess flow internal	= **D**

Seals

NBR	= **M**
FPM	= **P**
NBR, WDR in FPM	= **K**

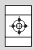
Drive shafts

			suitable front cover
C	Tapered keyed shaft 1 : 5		**B** **P**
N	Tang drive		**T**
F	Spline shaft DIN 5482 B 17 x 14		**B** **P**
S	Tapered keyed shaft 1 : 5 for flange A		**A**

Front cover

B	Square flange Centring Ø 80 mm	
P	2-bolt mounting Centring Ø 50 mm	
O	Square flange Centring Ø 36.47 mm	
A	Outboard bearing Ø 80 mm, Type 1	
N	2-bolt mounting Centring Ø 50 mm	
T	4-bolt mounting Ø 52 mm, with O-ring	

Port connections

20	Rectangular flange	
30	Rectangular flange	

Ordering code

External Gear Motors Model "N"

AZ	M	N	–	1x	–	020	R	C	B	20	M	B		–	S0001

Function
M = Motor

Series
1x = Standard bearing

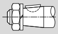
Size (N)
25.0 cm³/rev = **025**
28.0 cm³/rev = **028**

Direction of rotation
Right = **R**
Left = **L**

Special design

Rear cover
Standard = **B**
Special design = **X**

Seals
NBR = **M**
FPM = **P**

Drive shafts		suitable front cover	Front cover		Port connections	
C	Tapered keyed shaft 1 : 5 	**B**	**B**	Square flange Centring Ø 100 mm 	**20**	Rectangular flange 

External Gear Motors Model "G"

AZ	M	G	–	1x	–	022	R	C	B	20	M	B		–	S0001

Function
M = Motor

Model
G = 22.5...56 cm³/rev

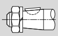
Size (G)
22.5 cm³/rev = **022**
28.0 cm³/rev = **028**
32.0 cm³/rev = **032**
45.0 cm³/rev = **045**

Direction of rotation
Right = **R**
Left = **L**
Universal = **U**

Special design

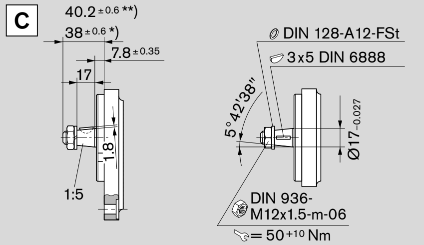
Rear cover
Standard = **B**
Special design = **X**

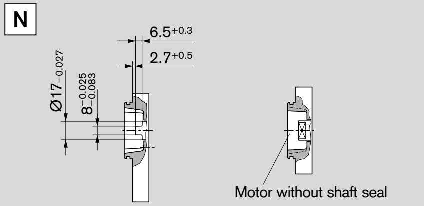
Seals
NBR = **M**
NBR, WDR in FPM = **K**

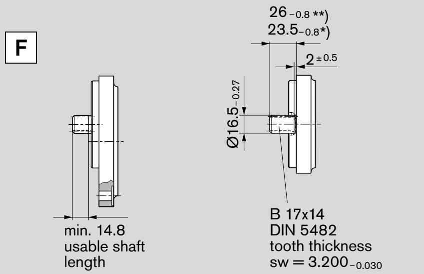
Drive shafts		suitable front cover	Front cover		Port connections	
C	Tapered keyed shaft 1 : 5 	**B**	**B**	Square flange Centring Ø 105 mm 	**20**	Rectangular flange 
N	Tang drive 	**M**	**M**	2-bolt mounting Ø 52 mm, with O-ring 		

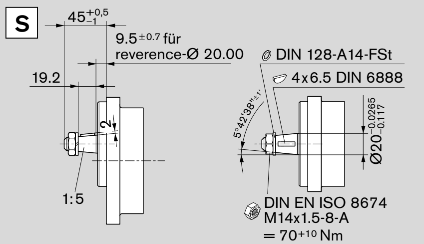
5

Drive shaft model "F"

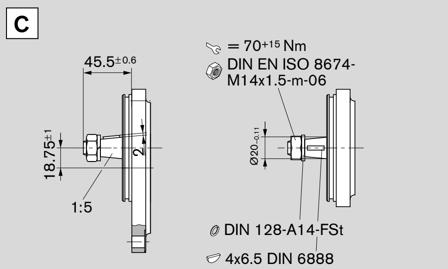








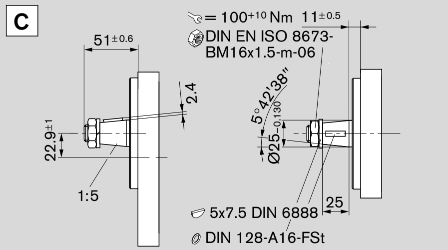
Drive shaft model "N"

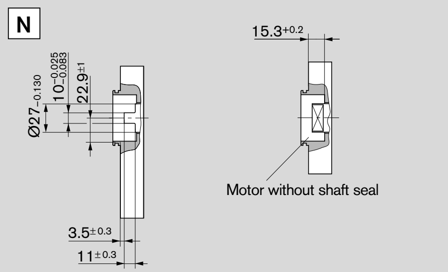


*) in combination with front cover B

**) in combination with front cover P

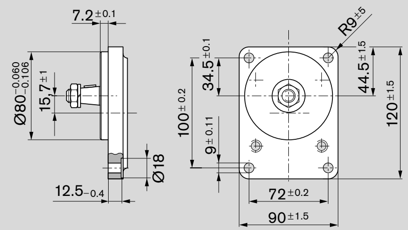
Drive shaft model "G"





Front cover model “F”

B



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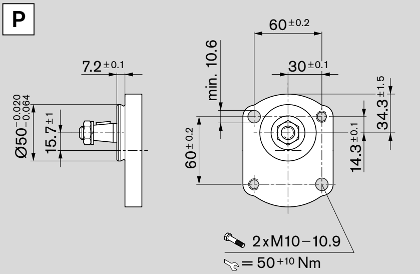
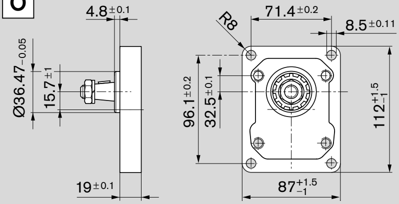
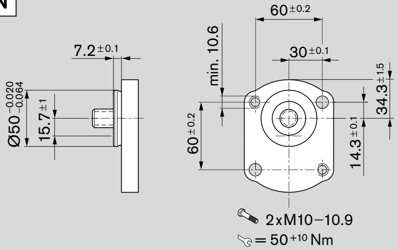


O



N



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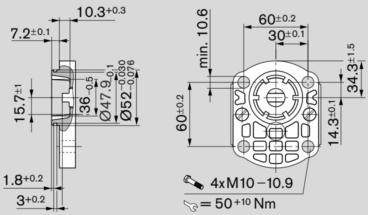
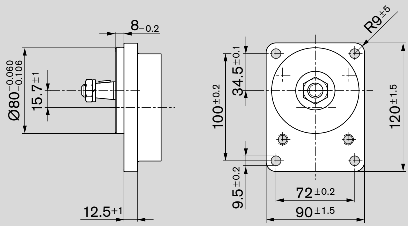
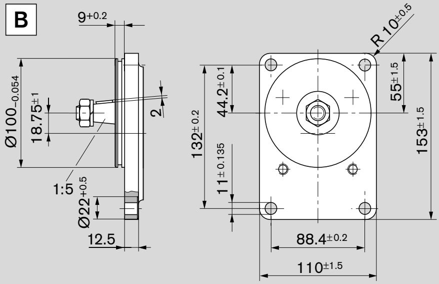


A



Front cover model “N”

B



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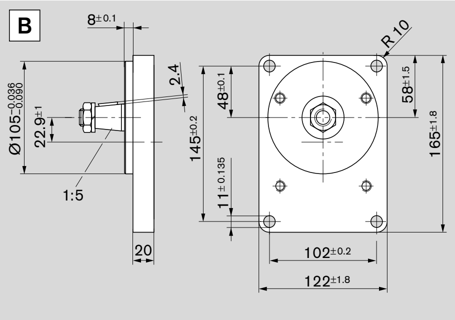
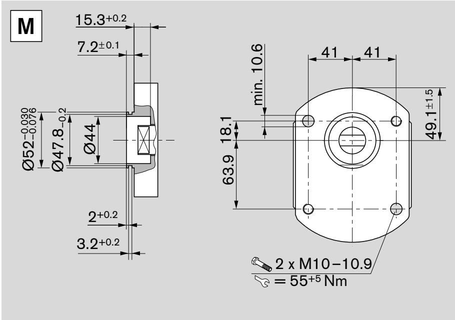
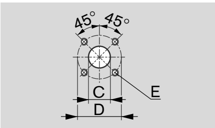
Front cover model "G"

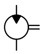


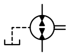


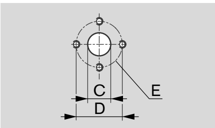
Port connections



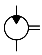
20 Rectangular flange

Synopsis of Type	Size	Inlet side			Outlet side		
		C	D	E	C	D	E
20 	8.0 ... 22.5 cm³	15	35	M6 utilizable depth 13	20	40	M6 utilizable depth 13
	22.5 ... 45.0 cm³	18	55	M8 utilizable depth 13	26	55	M8 utilizable depth 13

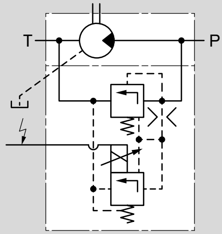
Synopsis of Type	Size	**Port connections** (direction of rotation universal)		
		C	D	E
20 	8.0 ... 22.5 cm³	15	35	M6 utilizable depth 13
	22.5 ... 45.0 cm³	18	55	M8 utilizable depth 13



30 Rectangular flange

Synopsis of Type	Size	Inlet side			Outlet side		
		C	D	E C	D	E	
30 	4 ... 8 cm³	13.5	30.2	M6 utilizable depth 13	13.5	30.2	M6 utilizable depth 13
	11 ... 28 cm³				20.0	39.7	M8 utilizable depth 13

External gear motors with integrated valves, sensors



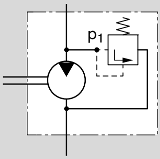
Pages 31, 32

Gear motor with integrated, pilot-operated proportional pressure relief valve and rotary shaft seal relieved of load thanks to the three-chamber design.
The use of gear motors without this relief of the rotary shaft seal is not recommended due to the loads from the oil return line, particularly when the oil is cold. The basis of this drive unit is a motor model “F”. The pilot proportional pressure relief valve is integrated in the rear end cover. This unit has the following advantages:

– No pipework necessary for the functioning of the prop. pressure relief valve
– Integrated pressure relief
– Fail-safe function in the event of power loss
– Drag speed virtually zero
– Motor speed prop. controllable
– Unaffected by pressure loads from the outlet

Additional information see:
Hydrostatic fan drives 1 987 761 700
http://www.boschrexroth.com/brm

External gear motors with pressure relief valve



return port pressure < 3 bar (10 bar at starting)

Page 23

External gear motors with integrated speed sensor

Page 34

The DSM1-10 Hall-effect speed sensor was specially developed for tough use in mobile work machines. The sensor detects the speed signal of ferromagnetic gear wheels. In this process, as an active sensor, it supplies a signal with constant amplitude independent of the rotational speed.
Due to its compact, sturdy design, the gear motor with integrated sensor is suitable for the applications such as

– In fan drives for buses, trucks and construction machinery from 7 to 20 kW
– As a vibration drive for road rollers and road construction machinery

For additional information see: **Speed Sensor DSM RE 95 132**
http://www.boschrexroth.com/brm

5

Design calculations for motors

The design calculations for motors are based on the following parameters:

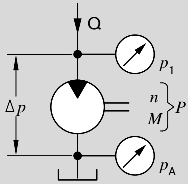
V	[cm³/rev]	Displacement
Q	[l/min]	Inlet flow rate
p	[bar]	Pressure (p_1, p_A)
M	[Nm]	Output torque
n	[rev/min]	Output speed
P	[kW]	Output power

It is also necessary to allow for different efficiencies such as:

- η_v Volumetric efficiency
- η_{hm} Mechanical-hydraulic efficiency
- η_t Total efficiency

The following formulas describe the various relationships. They include correction factors for adapting the parameters to the usual units encountered in practice.

Note: Diagrams providing approximate selection data can be found on subsequent pages. These graphs contain the levels of efficiency in each case.



$$Q = \frac{V \cdot n}{\eta_v} \cdot 10^{-1} \qquad V = \frac{Q \cdot \eta_v}{n} \cdot 10 \qquad n = \frac{Q \cdot \eta_v}{V} \cdot 10$$

$$\Delta p = \frac{M}{1.59 \cdot V \cdot \eta_{hm}} \cdot 10^4 \qquad V = 1.59 \cdot \frac{M}{\Delta p \cdot \eta_{hm}} \cdot 10^4 \qquad M = 1.59 \cdot V \cdot \Delta p \cdot \eta_{hm} \cdot 10^{-4}$$

$$P = \frac{Q \cdot \Delta p \cdot \eta_t}{6} \cdot 10^{-4}$$

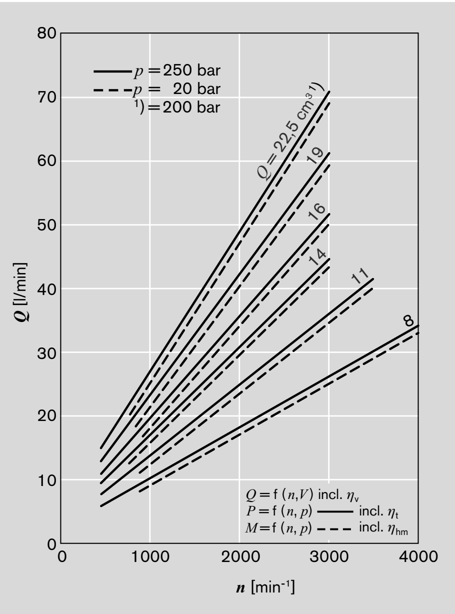
	[%]	
Q	— η_v	$\rightarrow n$
Δp	— η_{hm}	$\rightarrow M$
$\Delta p \cdot Q$	— η_t	$\rightarrow P$

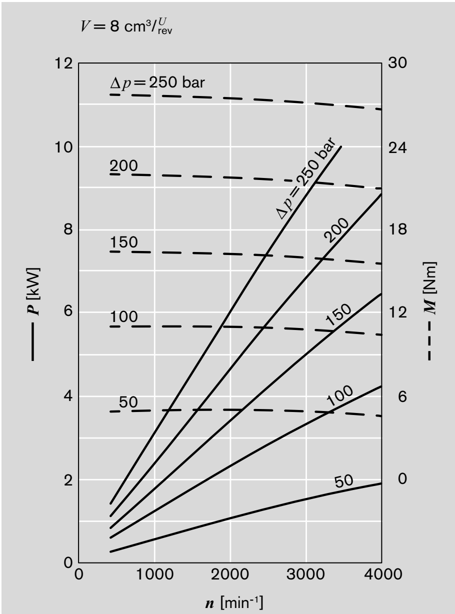
V [cm³/rev] Q [l/min] Δp [bar] **Note:** η [%]

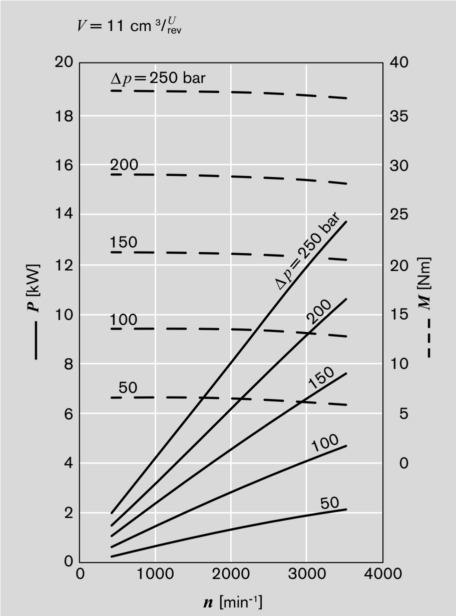
n [rev/min] P [kW] M [Nm]

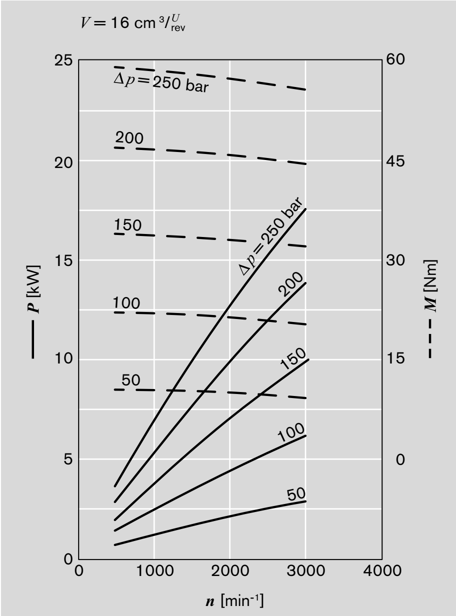
Diagrams Model "F"

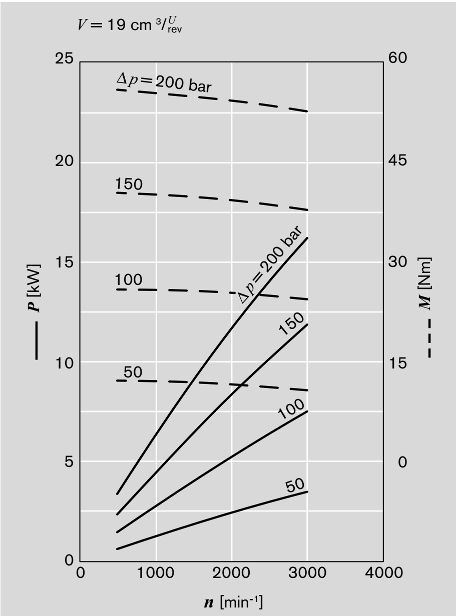
$\upsilon = 35$ mm²/s, $T = 50$ °C

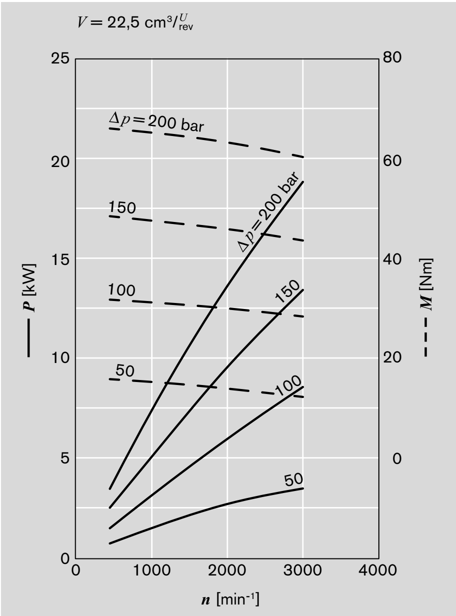





$V = 11$ cm ³/rev
Δp = 250 bar
200
150
100
50
Δp = 250 bar
P [kW]
M [Nm]
n [min⁻¹]
0
1000
2000
3000
4000


$V = 16$ cm ³/rev
Δp = 250 bar
200
150
100
50
Δp = 250 bar
P [kW]
M [Nm]
n [min⁻¹]
0
1000
2000
3000
4000

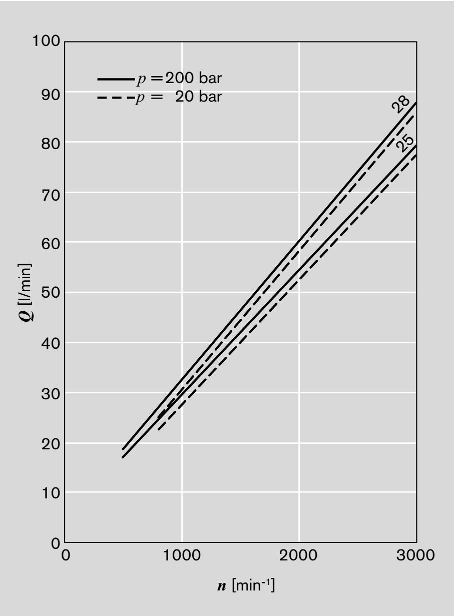

$V = 19$ cm ³/rev
Δp = 200 bar
150
100
50
Δp = 200 bar
P [kW]
M [Nm]
n [min⁻¹]
0
1000
2000
3000
4000


$V = 22,5$ cm³/rev
Δp = 200 bar
150
100
50
Δp = 200 bar
P [kW]
M [Nm]
n [min⁻¹]
0
1000
2000
3000
4000

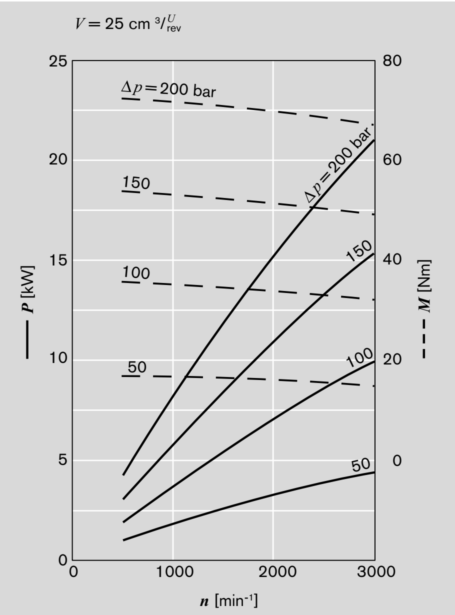
5

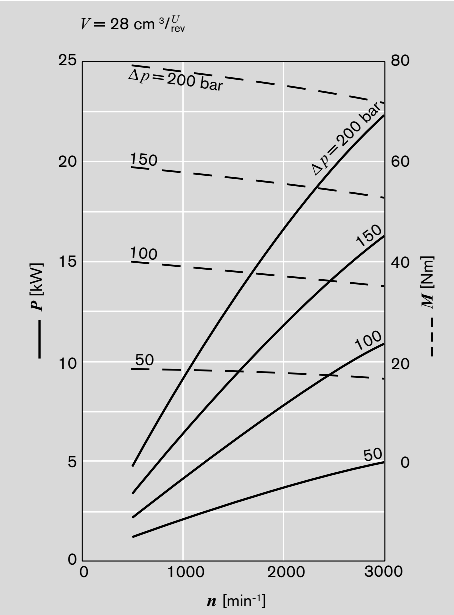
Diagrams Model "N"

$\upsilon = 35$ mm²/s, $T = 50$ °C



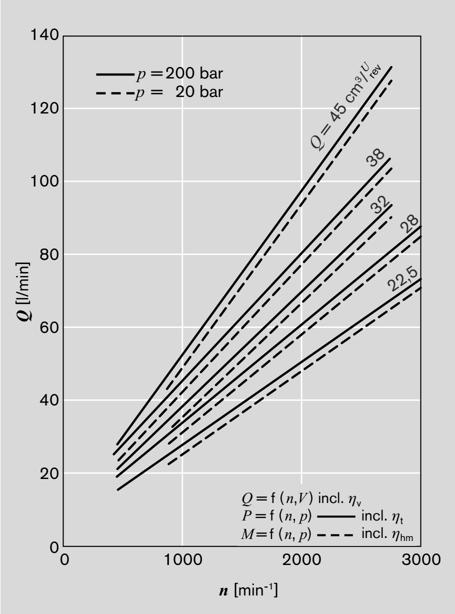
$Q = f(n, V)$ incl. η_v
$P = f(n, p)$ —— incl. η_t
$M = f(n, p)$ – – – incl. η_{hm}

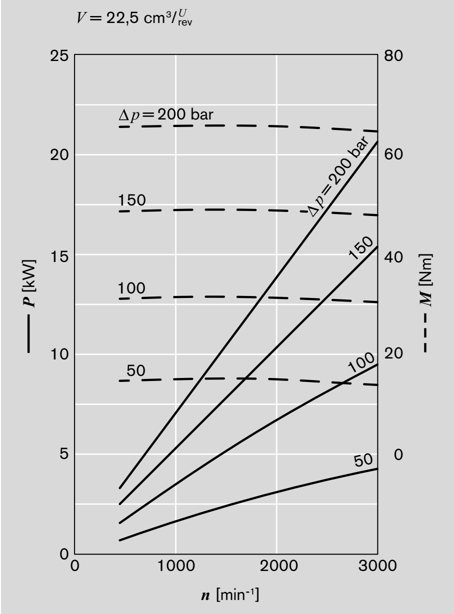


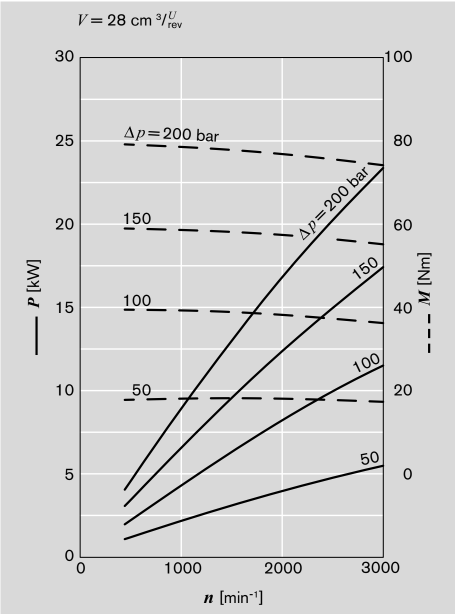


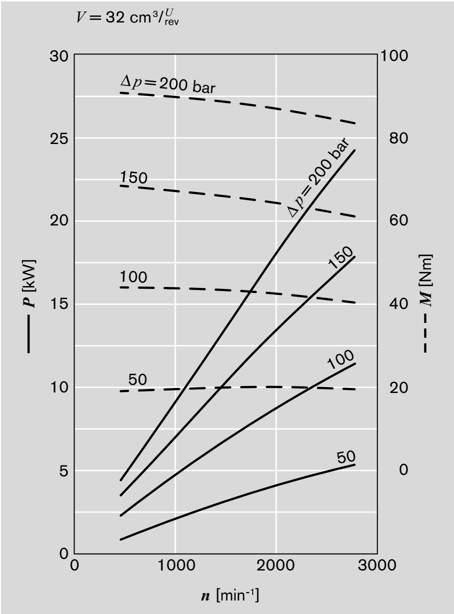
Diagrams Model “G”

$\upsilon = 35$ mm²/s, $T = 50$ °C









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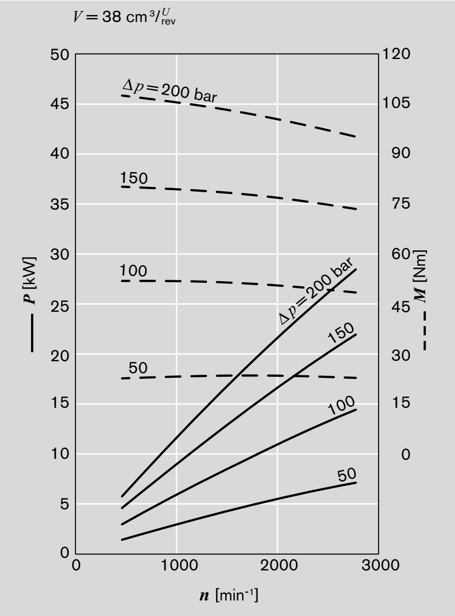
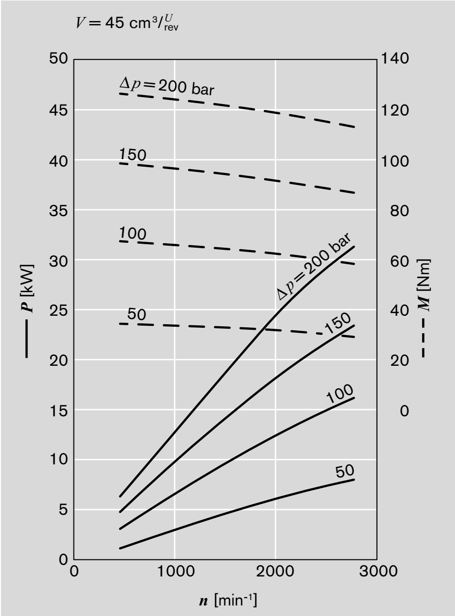




Specifications

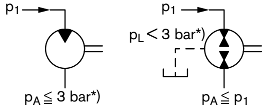
General	
Construction	external gear motor
Mounting	Flange or through-bolting with spigot
Port connections	screw, flange
Direction of rotation (looking on shaft)	One direction of rotation or reversible
Mounting position	any
Load on shaft	radial and axial forces after consulting
Ambient temperature range	–30 °C...+80 °C with NBR seals*) –20 °C...+110 °C with FPM seals**)
Fluids	mineral oil-based hydraulic fluids to DIN/ISO, other fluids upon request
Viscosity	12…800 mm²/s permitted range 20…100 mm²/s recommended range …2,000 mm²/s permitted for starting
Fluid temperature range	max. +80 °C with NBR seals*) max. 110 °C with FPM seals**)
Filter ***)	contamination at least class 19/16 according to ISO 4406 to be obtained with filter b20 = 75. For higher lifespan demands we recommend a corre spondingly higher filter class.

*) NBR = Perbunan®
**) FPM = 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.

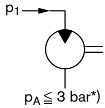
Safety requirements pertaining to the whole systems are to be observed.

In the case of applications with frequent load cycles please consult us.

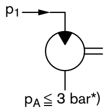
Model F

Displacement	cm³/rev	**5.5** 1)	**8**	**11**	**14**	**16**	**19**	**22.5**
max. continuous pressure p_1	bar	250					180	
max. starting pressure p_2		280					210	
min. rotational speed	min⁻¹	500						
max. rotational speed p_1		4,000		3,500	3,000			
Motor outlet pressure p_A Leakage-oil line pressure p_L	bar							

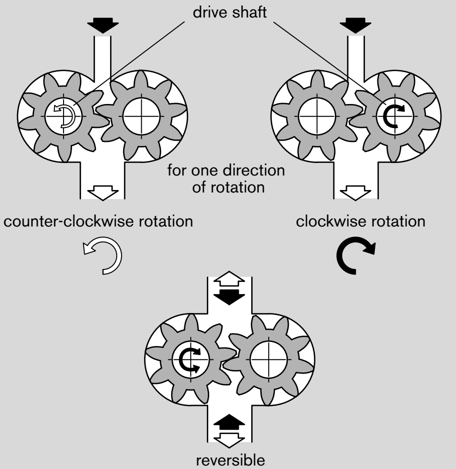
Model N

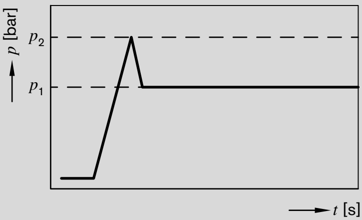
Displacement	cm³/rev	**25**	**28**
max. continuous pressure p_1	bar	210	200
max. starting pressure p_2		240	230
min. rotational speed	min⁻¹	500	
max. rotational speed p_1		3,000	
Motor outlet pressure p_A Leakage-oil line pressure p_L	bar		

Model G

Displacement	cm³/rev	**22.5**	**28**	**32**	**38**	**45**
max. continuous pressure p_1	bar	180				
max. starting pressure p_2		210				
min. rotational speed	min⁻¹	500				
max. rotational speed p_1		3,000		2,800	2,600	
Motor outlet pressure p_A Leakage-oil line pressure p_L	bar					

1) On request *) Short-term when starting 10 bar





p_1 max. continuous pressure
p_2 starting pressure (depending on the application, this must be taken into consideration when setting the pressure of the hydraulic system's pressure-relief valve).

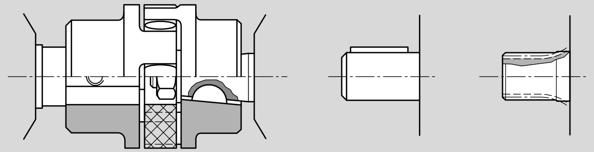
5

Power take-off

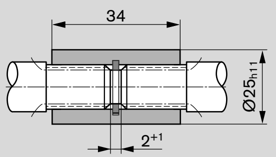
1. Flexible couplings
The coupling must not transfer any radial or axial forces to the motor.

The maximum radial run out 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. Sleeve couplings
Used on shafts with DIN or SAE splining.
Note: There must be no radial or axial forces exerted on the motor or sleeve coupling. The sleeve must be free to move axially. The distance between the motor shaft and drive shaft must be 2^{+1}.
Oil-bath or oil-mist lubrication is necessary.



Spline shaft	$M_{max.}$ [Nm]	V [cm³/rev]	$p_{max.}$ [bar]
DIN	190	8...22.5	$p_{max.}$
SAE	130		

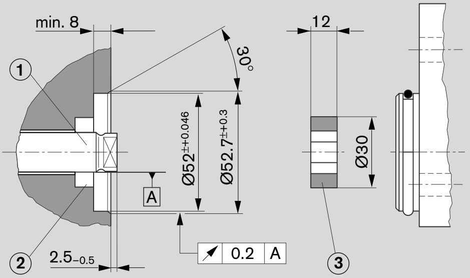
3. Drive shaft with tang
For the close-coupling of the motors to gearboxes, etc. the motors shaft has a special drive shaft with tang which combines with a center coupling ③.
There is no shaft seal.

The recommended arrangements and dimensions for the drive end and sealing are as follows.

① **Drive shaft**
Case-hardened 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**
Rubber-covered seal (see DIN 3760, Type AS or double-lipped ring).
Cut 15° chamfer or fit shaft seal with protective sleeve.

Model "F"

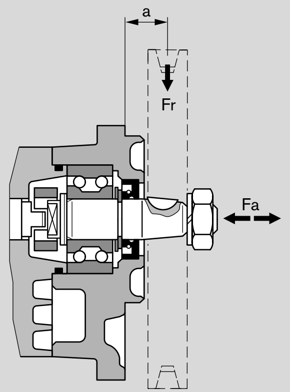


$M_{max.}$ [Nm]	V [cm³/rev]	$p_{max.}$ [bar]
65	8...14	280
	16	230
	19	190
	22.5	160

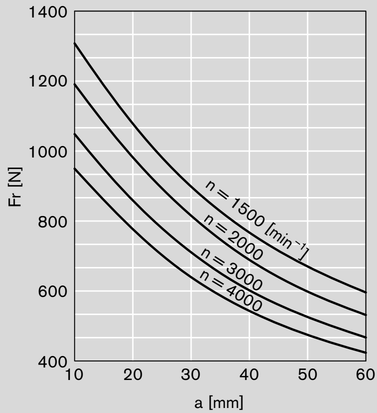
4. Outboard bearing Model "F"

Outboard bearings eliminate possible problems when the motors are driven by V-belts or gearwheels. The diagrams below show the maximum overhung and thrust loads that can be tolerated, referring to a bearing life of L_H = 1,000 hours.

$M_{max.}$ [Nm]	V [cm³/rev]	$p_{max.}$ [bar]
65	16	230
	19	190
	22.5	160

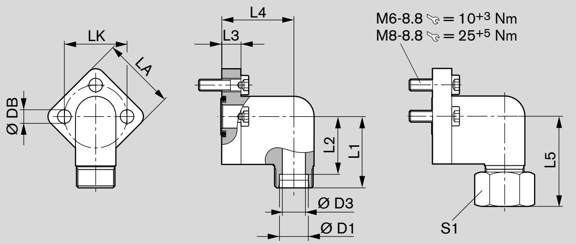


Fr is reduced by 0.7 Fa when axial loading Fa is applied.



Connectors

Gear motor flange, 3-bolt, 90° angle, for square flange 30 see page 8



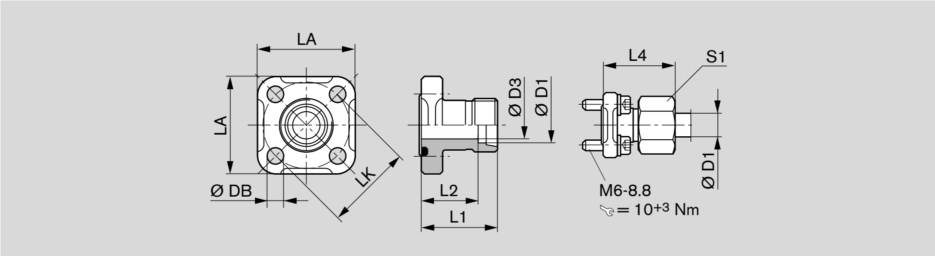
LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws 3 pieces	O-ring NBR *)	Weight [kg]	Ordering-No.	p [bar]
30	12L	10	37	30.0	10	37.5	46	38	22	6.4	M6x22	16x2.5	0.13	**1 515 702 146**	250
30	15L	12	37	30.0	10	37.5	47	38	27	6.4	M6x22	16x2.5	0.14	**1 515 702 147**	250
30	18L	15	37	30.0	10	37.5	47	38	32	6.4	M6x22	16x2.5	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 screw connection with O-ring, metric screw set, nut/mother and sleeve fitting *) NBR = Perbunan®

5

Connectors (continuation)

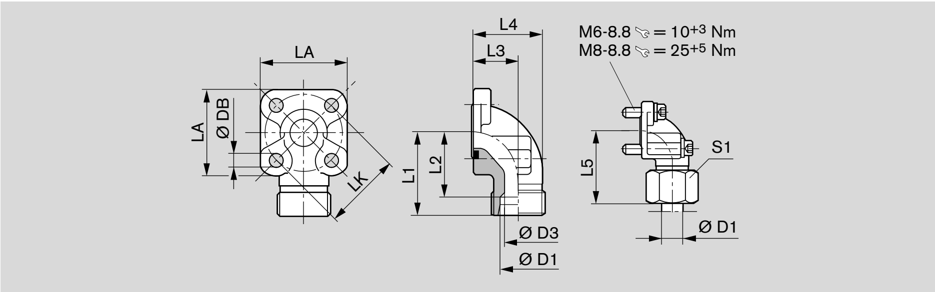
Gear motor flange, straight, for square flange 20 see page 8



LK	D1	D3	L1	L2	L4	LA	S1	DB	Screws 4 pieces	O-ring NBR *)	Weight [kg]	Ordering-No.	*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
40	15L	12	35	28.0	43.0	42	27	6.4	M6x22	24x2.5	0.12	**1 515 702 067**	100
40	18L	15	35	27.5	44.0	42	32	6.4	M6x22	24x2.5	0.13	**1 515 702 068**	100
40	22L	19	35	27.5	44.5	42	36	6.4	M6x22	24x2.5	0.12	**1 515 702 069**	100
40	28L	24	42	27.5	34.5	42	41	6.4	M6x22	24x2.5	0.15	**1 515 702 008**	100

Complete screw connection with O-ring, metric screw set, nut/mother and sleeve fitting *) NBR = Perbunan®

Gear motor flange, 90° angle, for square flange 20 see page 8

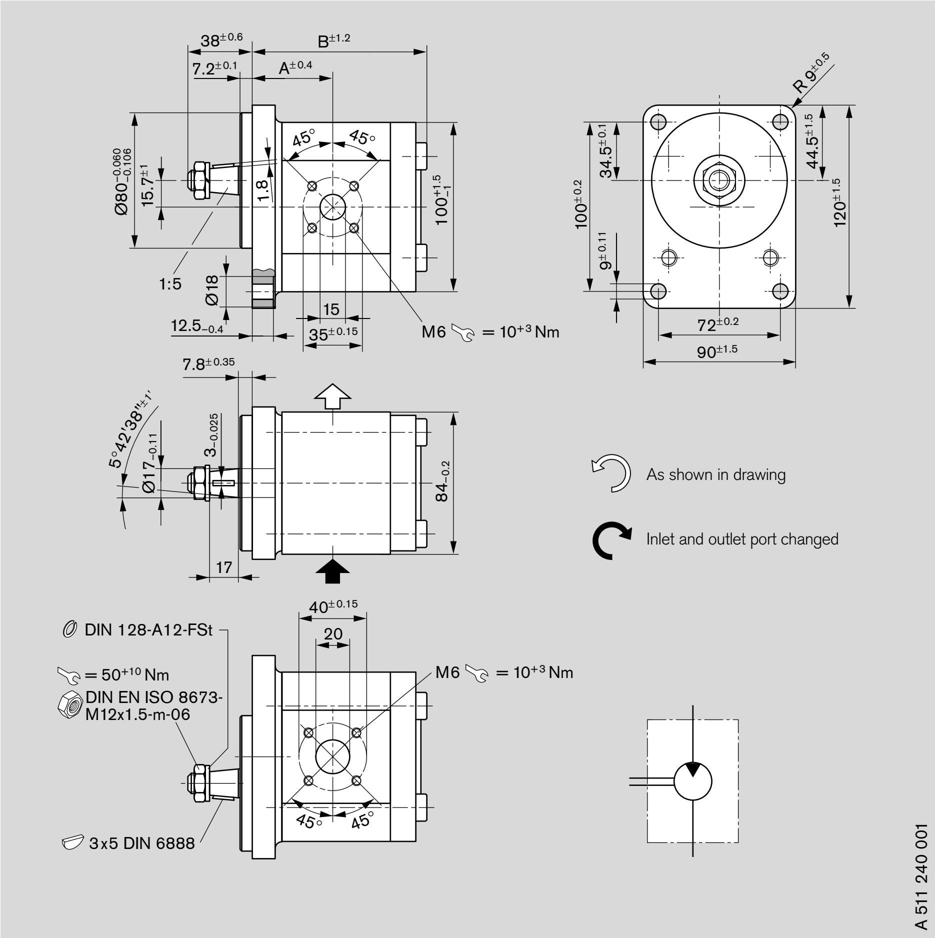


LK	D1	D3	L1	L2	L3	L4	L5	LA	S1	DB	Screws 2 pcs.	2 pcs.	O-ring NBR *)	Weight [kg]	Ordering-No.	*p* [bar]
35	10L	8	38	31.0	16.5	26.5	47.0	40	19	6.4	M6 x 22	M6 x 35	20 x 2.5	0.16	**1 515 702 070**	315
35	12L	10	38	31.0	16.5	26.5	47.0	40	22	6.4	M6 x 22	M6 x 35	20 x 2.5	0.16	**1 515 702 071**	315
35	15L	12	38	31.0	16.5	26.5	46.0	40	27	6.4	M6 x 22	M6 x 35	20 x 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 x 22	M6 x 40	20 x 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 x 22	M6 x 40	20 x 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 x 22	M6 x 45	20 x 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 x 22	M6 x 22	24 x 2.5	0.15	**1 515 702 076**	100
40	18L	15	38	30.5	22.5	36.5	47.0	42	32	6.4	M6 x 22	M6 x 22	24 x 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 x 22	M6 x 45	24 x 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 x 22	M6 x 22	24 x 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 x 20	M6 x 50	24 x 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 x 22	M6 x 60	24 x 2.5	0.33	**1 515 702 018**	100
55	20S	17	45	34.5	24.0	40.0	56.0	58	36	8.4	M8 x 25	M8 x 50	33 x 2.5	0.44	**1 515 702 004**	250
55	30S	26	49	35.5	32.0	50.0	62.0	58	50	8.4	M8 x 25	M8 x 50	33 x 2.5	0.50	**1 515 702 006**	250
55	35L	31	49	38.5	32.0	51.5	62.0	58	50	8.4	M8 x 25	M8 x 60	33 x 2.5	0.47	**1 515 702 005**	100
55	42L	38	49	38.0	40.0	64.5	61.0	58	60	8.4	M8 x 25	M8 x 70	33 x 2.5	0.60	**1 515 702 019**	100

Complete screw connection with O-ring. metric screw set. nut/mother and sleeve fitting *) NBR = Perbunan®

Dimensions in mm

F-Motor

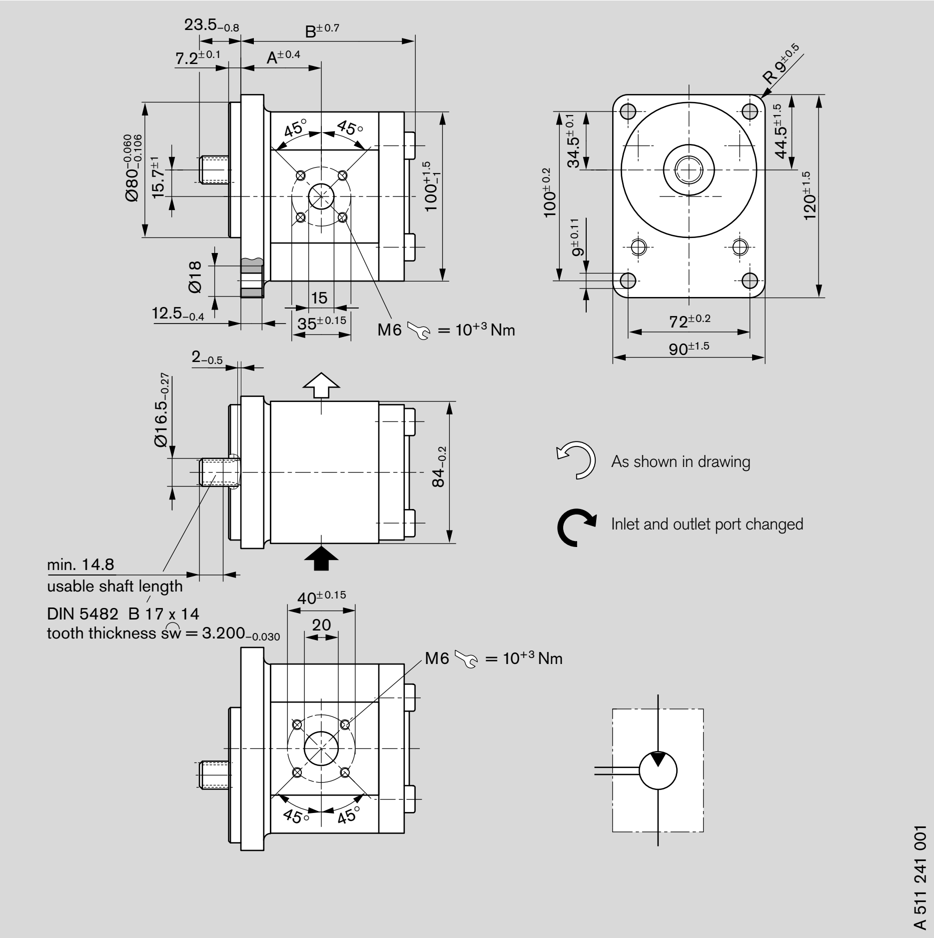


Ordering code
AZMF – 1x – □ □ □ □ C B 20 M B
AZMF – 10 – □ □ □ □ C B 20 K B*
AZMF – 10 – □ □ □ □ C B 20 M B – S0012 **

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
8	**0 511 425 300**	**0 511 425 001**	210	500	4,000	2.9	43.2	91.1
11	**0 511 525 300**	**0 511 525 001**	210	500	3,500	3.0	47.0	96.3
14	**0 511 525 304**	–	210	500	3,000	3.2	47.5	101.3
16	–	**0 511 625 005**	210	500	3,000	3.4	47.5	104.7
19	**0 511 625 308**	**0 511 625 003**	180	500	3,000	3.6	47.5	109.7
19	–	**0 511 625 009** *	180	500	3,000	3.6	47.5	109.7
22.5	**0 511 725 304** **	**0 511 725 005** **	210	500	3,000	3.9	61.1	125.3

Dimensions in mm

F-Motor



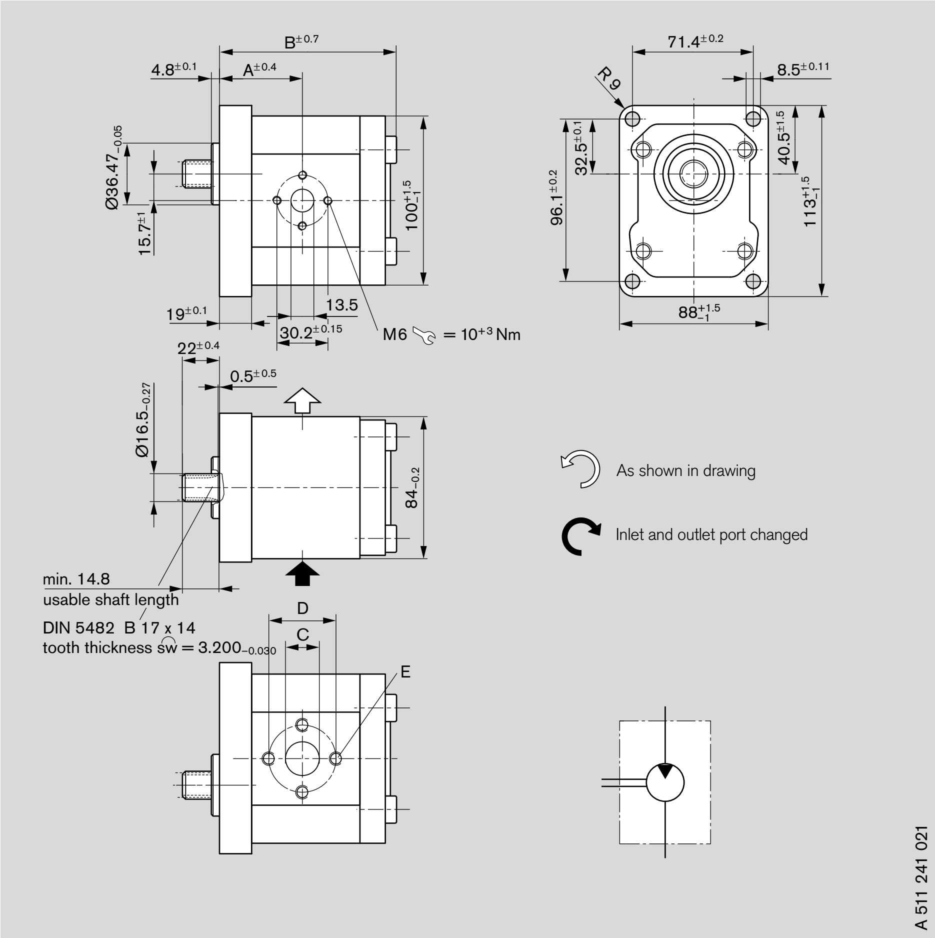
Ordering code

AZMF – 10 – □ □ □ □ F B 20 M B

Displace-ment [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
8	**0 511 425 301**	**0 511 425 002**	210	500	4,000	2.9	43.2	91.0
11	**0 511 525 301**	**0 511 525 002**	210	500	3,500	3.0	47.0	96.0
14	**0 511 525 303**	**–**	210	500	3,000	3.2	47.5	101.0
16	**0 511 625 301**	**0 511 625 001**	210	500	3,000	3.4	47.5	104.4
19	**0 511 625 300**	**0 511 625 002**	180	500	3,000	3.6	47.5	109.4
22.5	**0 511 725 303**	**0 511 725 004**	180	500	3,000	3.8	61.1	126.8

Dimensions in mm

F-Motor



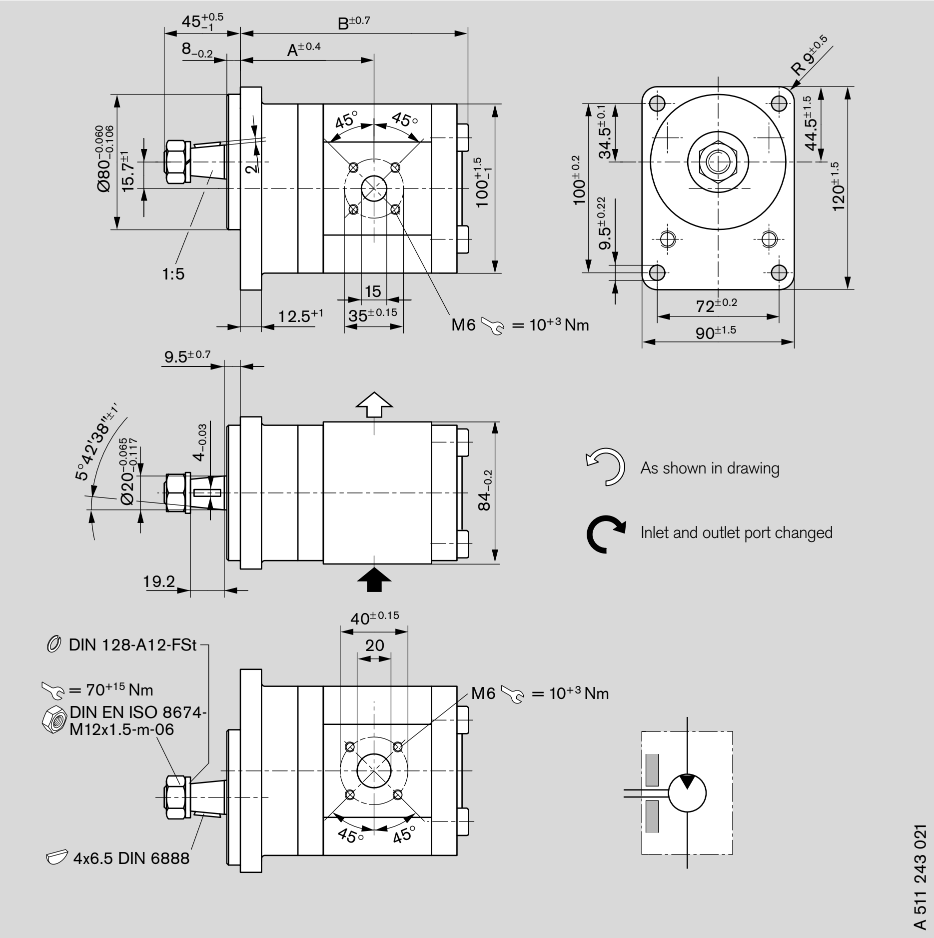
Ordering code

AZMF – 10 – □ □ □ □ F O 30 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	C	D	E
8	–	**0 511 425 003**	210	500	4,000	2.9	44.9	90.7	13.5	30.2	M6 = 10^{+3}
19	**0 511 625 303**	–	180	500	3,000	3.7	49.0	109.1	20.0	39.7	M8 = 25^{+5}
22.5	–	**0 511 725 305**	180	500	3,000	3.9	56.6	114.5	20.0	39.7	M8 = 25^{+5}

Dimensions in mm

F-Motor

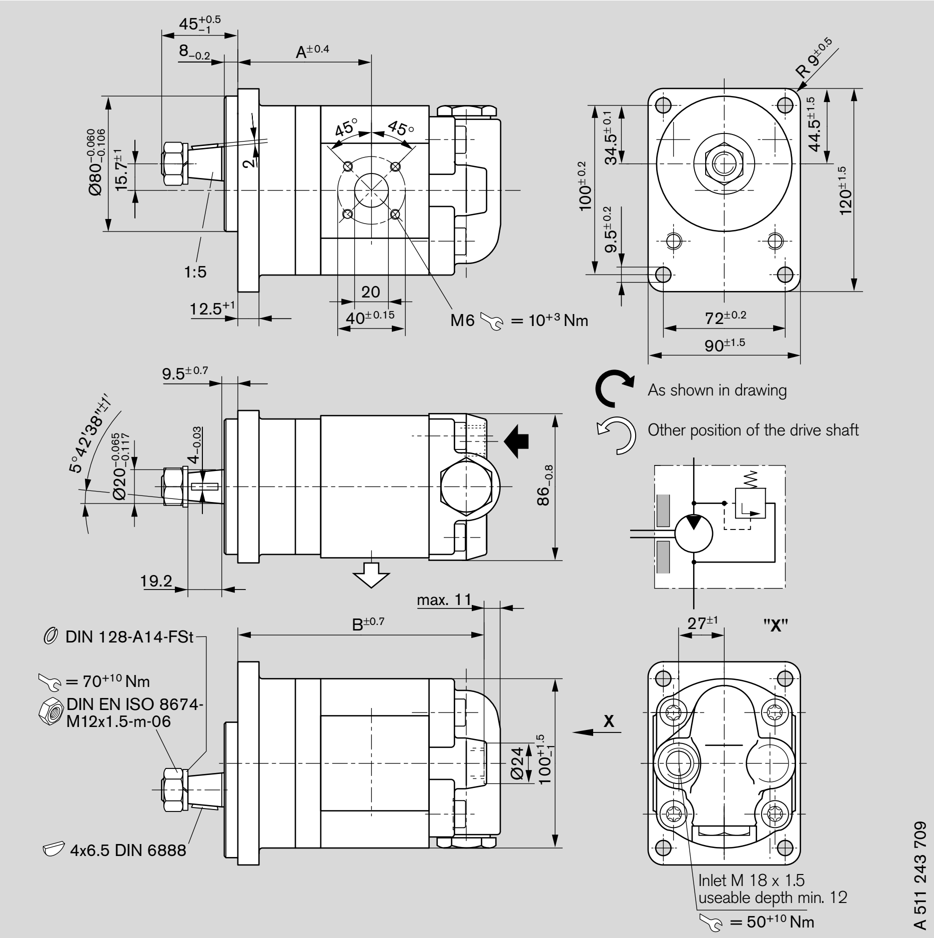


Ordering code
AZMF – 10 – □ □ □ □ S A 20 M B
AZMF – 10 – □ □ □ □ S A 20 M B – S0012

Displace-ment [cm³/rev]	Ordering-No. L	R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B
8	**0 511 445 300**	**0 511 445 001**	250	500	4,000	3.5	74.7	120.6
11	**0 511 545 300**	**0 511 545 001**	250	500	3,500	3.6	78.5	125.6
14	**0 511 545 301**	–	250	500	3,000	3.7	79.0	130.6
16	**0 511 645 300**	**0 511 645 001**	250	500	3,000	3.8	79.0	134.0
16	–	**0 511 645 003**	230	500	3,000	3.8	93.0	134.0
19	**0 511 645 302**	–	190	500	3,000	4.2	79.0	139.0
22.5	**0 511 745 300***	**0 511 745 001***	160	500	2,500	4.8	92.6	156.4

Dimensions in mm

F-Motor



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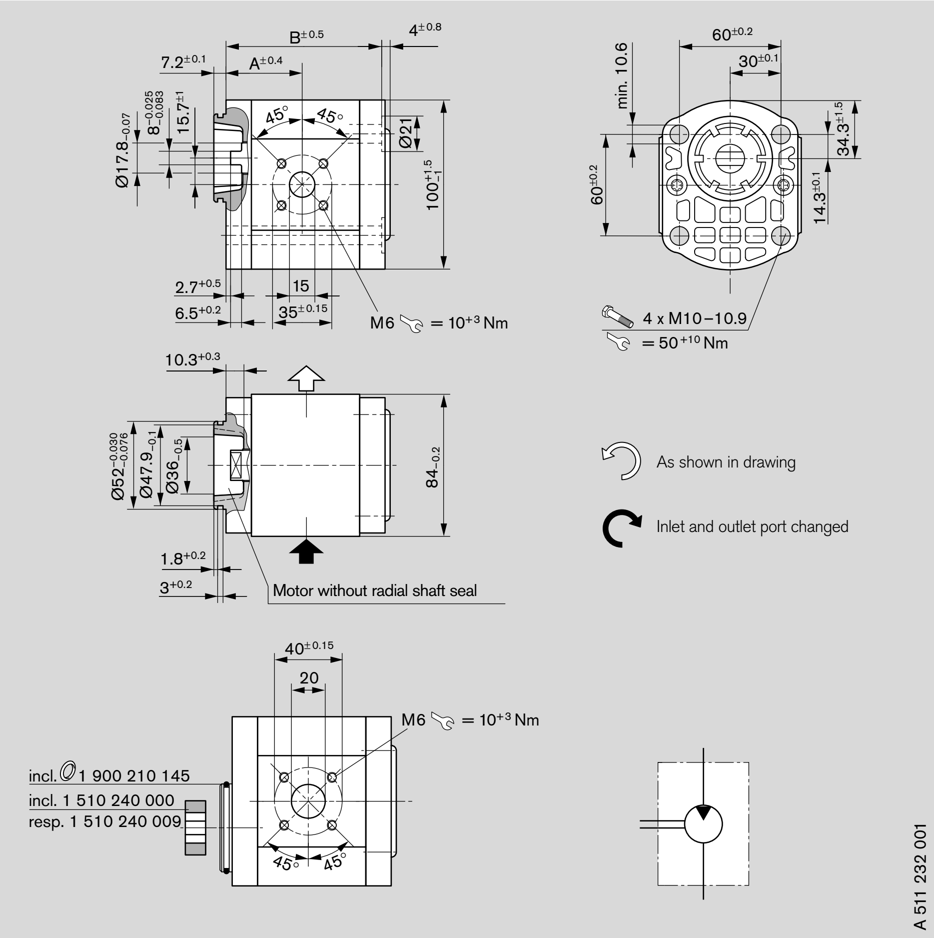
Ordering code
AZMF – 10 – ☐ ☐ ☐ ☐ S A 20 M D XXXXX – S0076

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
8	**0 511 445 301**	**0 511 445 003**	200	500	4,000	3.6	74.7	133.1
11	**0 511 545 302**	0 511 545 003	150	500	3,500	3.8	79.1	138.1

Dimensions in mm

F-Motor

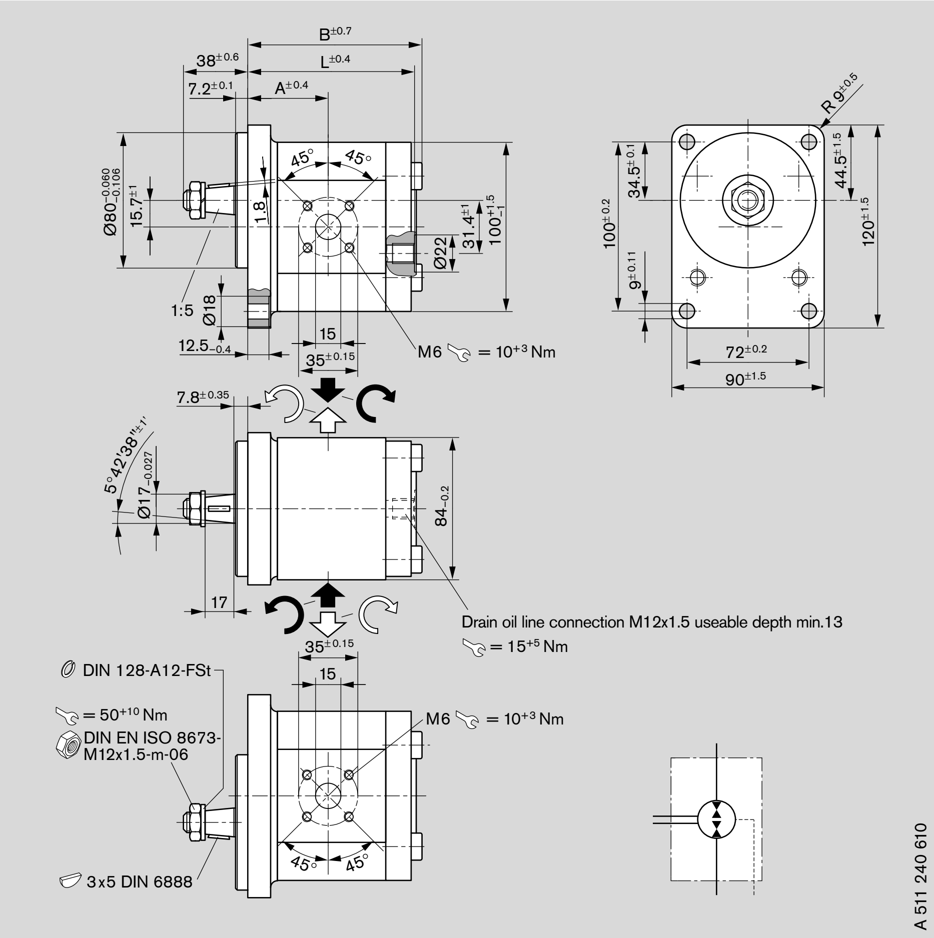


Ordering code
AZMF – 10 – ☐ ☐ ☐ ☐ N T 20 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
8	**0 511 415 300**	**0 511 415 001**	250	500	4,000	2.5	40.7	80.3
11	**0 511 515 300**	**0 511 515 001**	250	500	3,500	2.6	44.5	85.3
16	**0 511 615 301**	**0 511 615 002**	230	500	3,000	3.0	45.0	93.7
19	**0 511 615 300**	**0 511 615 001**	190	500	3,000	3.2	45.0	98.7
22.5	**0 511 715 300**	**0 511 715 001**	160	500	3,000	3.4	52.6	104.1

Dimensions in mm

F-Motor



5

Ordering code

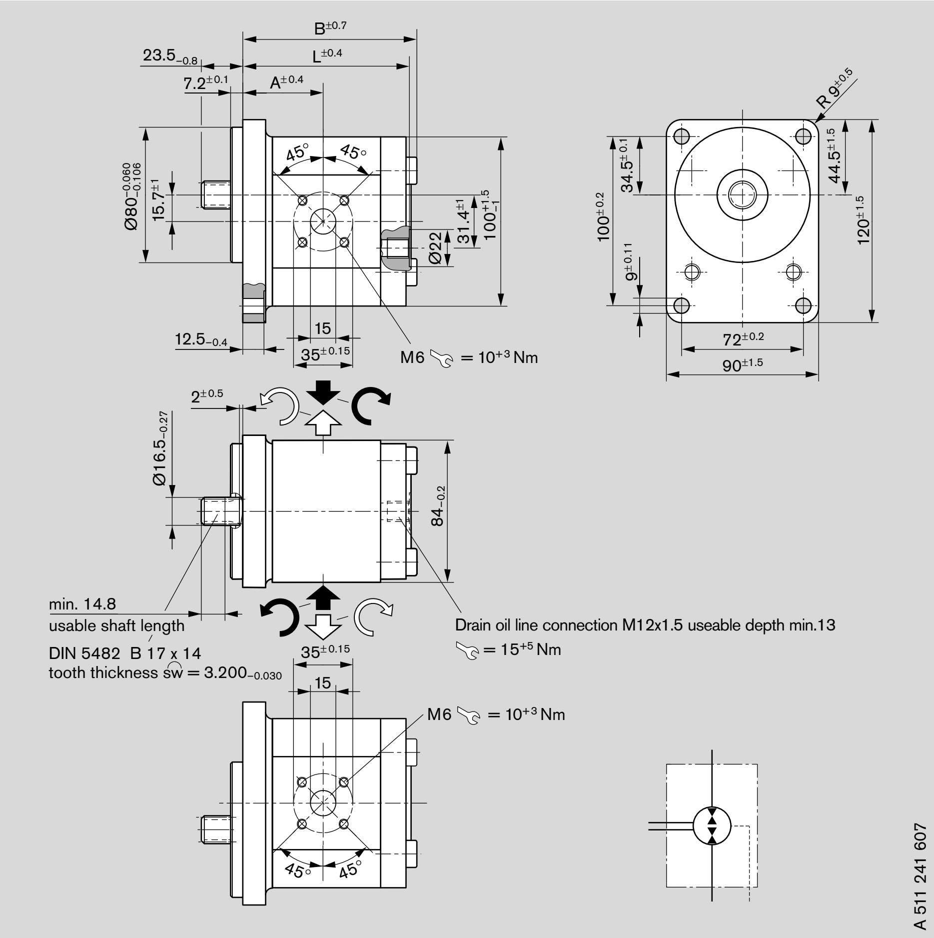
AZMF – 10 – □ □ □ U C B 20 M L

AZMF – 10 – □ □ □ U C B 20 K L*

Displacement [cm³/rev]	Ordering-No. Universal	Max. operating-pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	L
8	**0 511 425 601**	210	500	4,000	3.4	43.2	90.7	85.8
11	**0 511 525 604**	210	500	3,500	4.2	47.0	95.9	90.8
16	**0 511 625 602**	210	500	3,000	3.9	47.5	104.3	99.2
22.5	**0 511 725 601 ***	180	500	3,000	3.9	55.1	114.6	109.6

Dimensions in mm

F-Motor

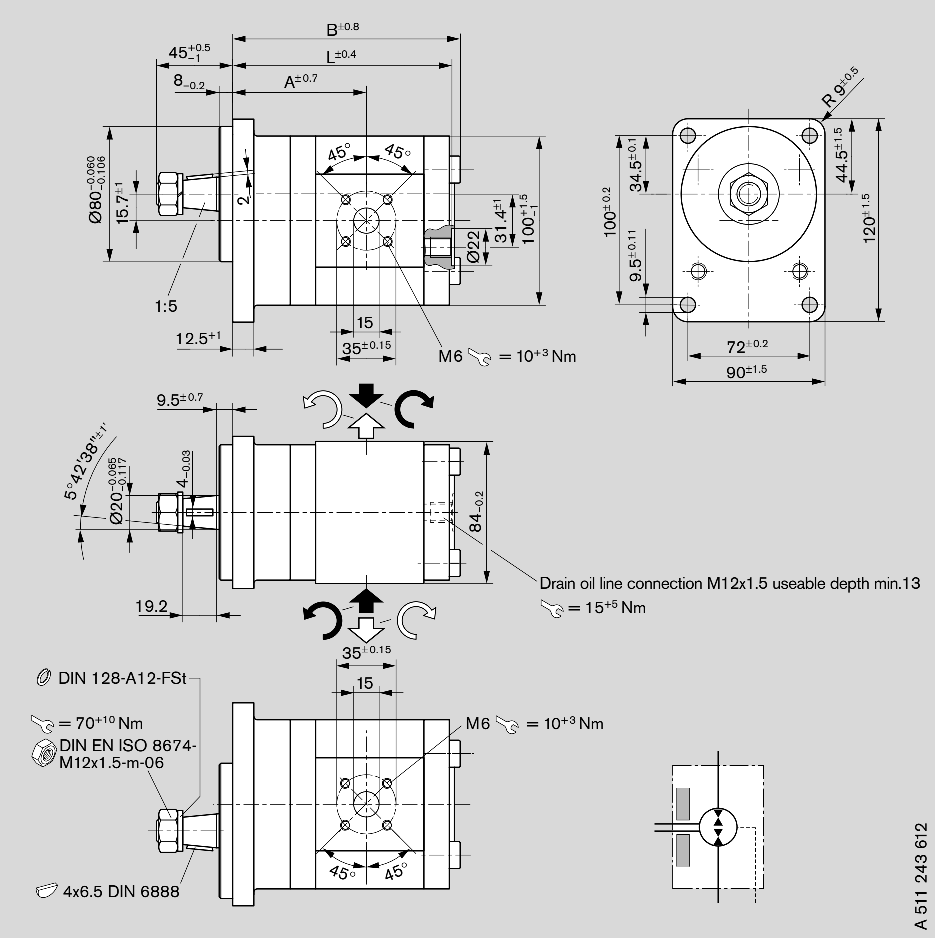


Ordering code
AZMF – 10 – ☐ ☐ ☐ U F B 20 M L

Displace-ment [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotating speed [min⁻¹]	Max. rotating speed [min⁻¹]	kg	Dimension [mm] A	B	L
8	**0 511 425 603**	210	500	4,000	2.9	43.2	91.0	85.8
11	**0 511 525 601**	210	500	3,500	3.0	47.0	96.0	90.8
16	**0 511 625 603**	210	500	3,000	3.4	47.5	104.4	99.2
19	**0 511 625 605**	180	500	3,000	3.6	47.5	109.4	104.2
22.5	**0 511 725 602**	180	500	3,000	3.8	55.1	114.8	109.6

Dimensions in mm

F-Motor

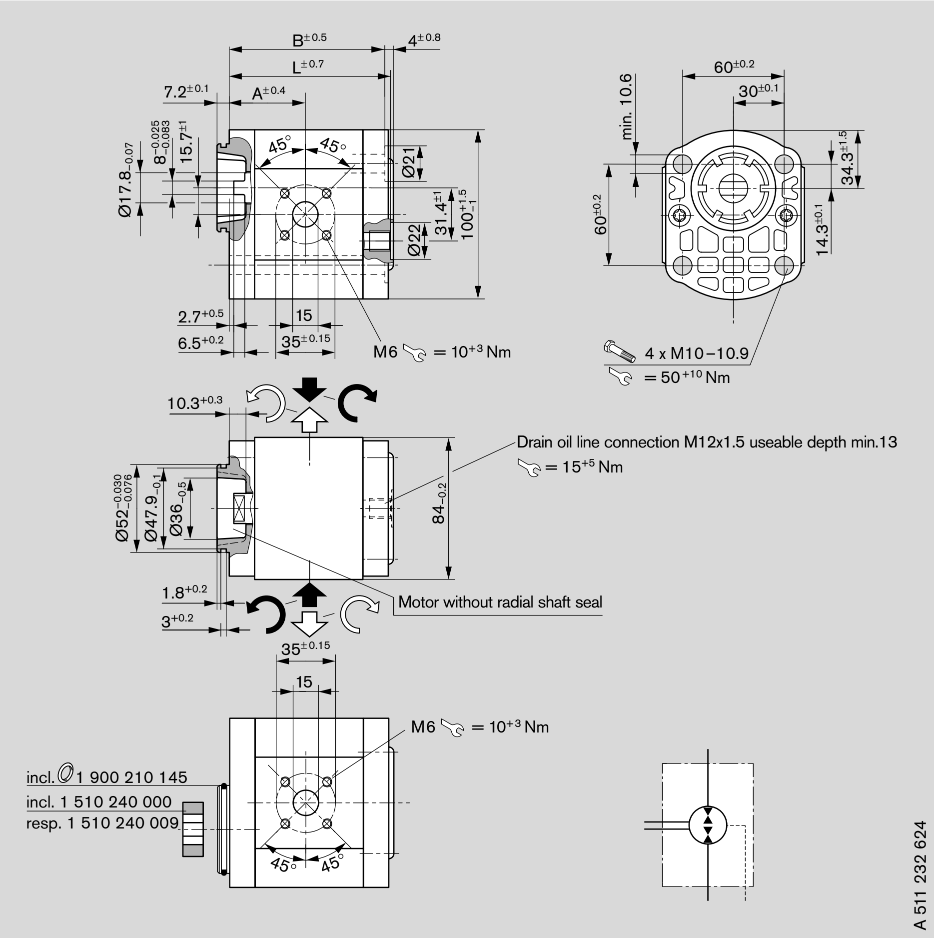


Ordering code
AZMF – 10 – ☐ ☐ ☐ U S A 20 M L

Displacement [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	L
8	**0 511 445 601**	250	500	4,000	3.5	74.8	120.8	116.9
11	**0 511 545 601**	250	500	3,500	3.6	78.6	125.8	121.9
16	**0 511 645 601**	230	500	3,000	4.0	79.1	134.2	130.3
19	**0 511 645 603**	190	500	3,000	4.2	79.1	139.2	135.3

Dimensions in mm

F-Motor

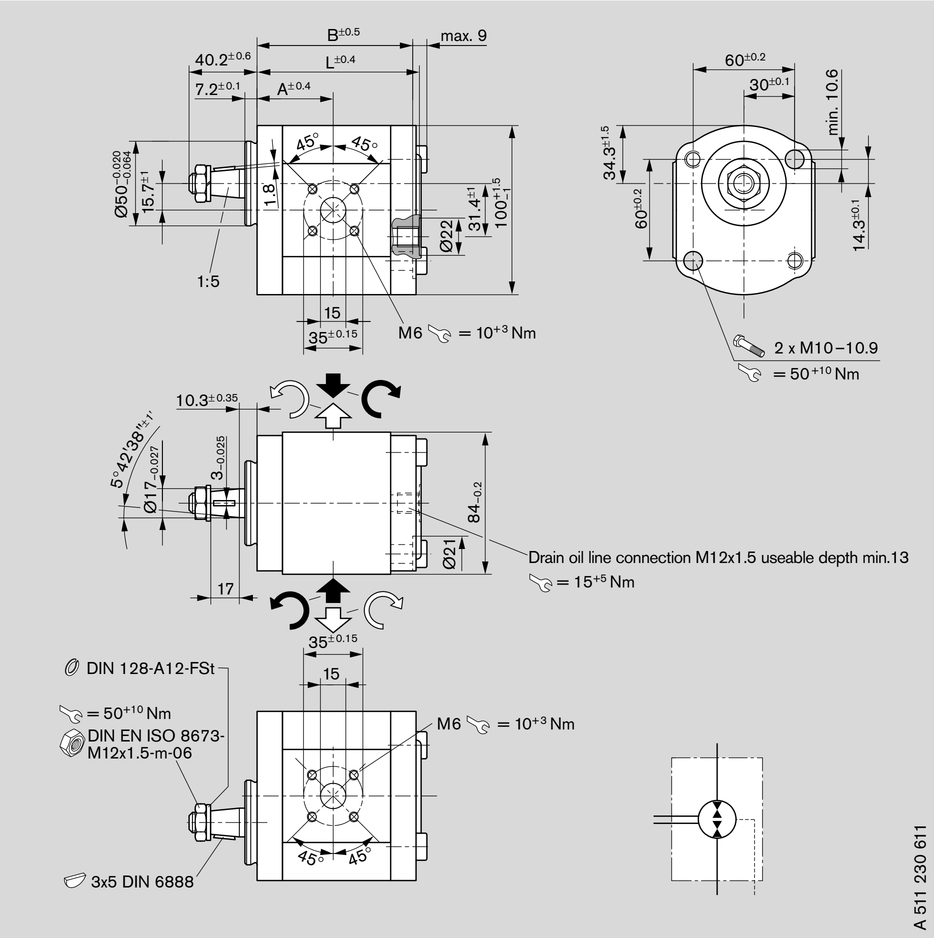


Ordering code
AZMF – 10 – ☐ ☐ ☐ U N T 20 M L – S0164

Displace-ment [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	L
8	**0 511 415 605**	250	500	4,000	2.5	40.7	80.3	82.8
11	**0 511 515 602**	250	500	3,500	2.6	44.5	85.3	87.8
16	**0 511 615 607**	230	500	3,000	3.0	45.0	93.7	96.2
19	**0 511 615 608**	190	500	3,000	3.2	45.0	98.7	101.2
22.5	**0 511 715 601**	160	500	3,000	3.4	52.6	104.1	106.6

Dimensions in mm

F-Motor



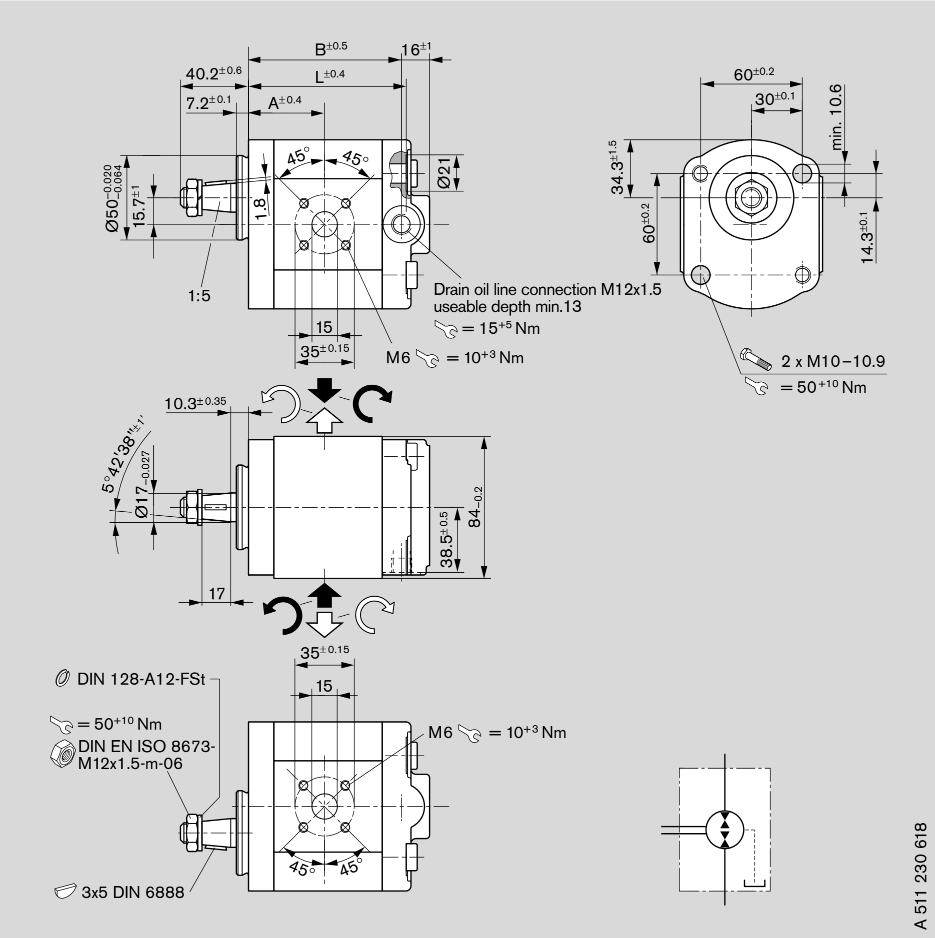
Ordering code

AZMF – 1X – □ □ □ U C P 20 M L

Displacement [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	L
8	**0 511 415 606**	210	500	4,000	2.8	40.7	80.3	83.3
11	**0 511 515 601**	210	500	3,500	2.8	44.5	85.3	88.3
14	**0 511 515 605**	210	500	3,000	3.1	45.0	90.3	93.3
16	**0 511 615 609**	210	500	3,000	3.1	45.0	93.7	96.7

Dimensions in mm

F-Motor



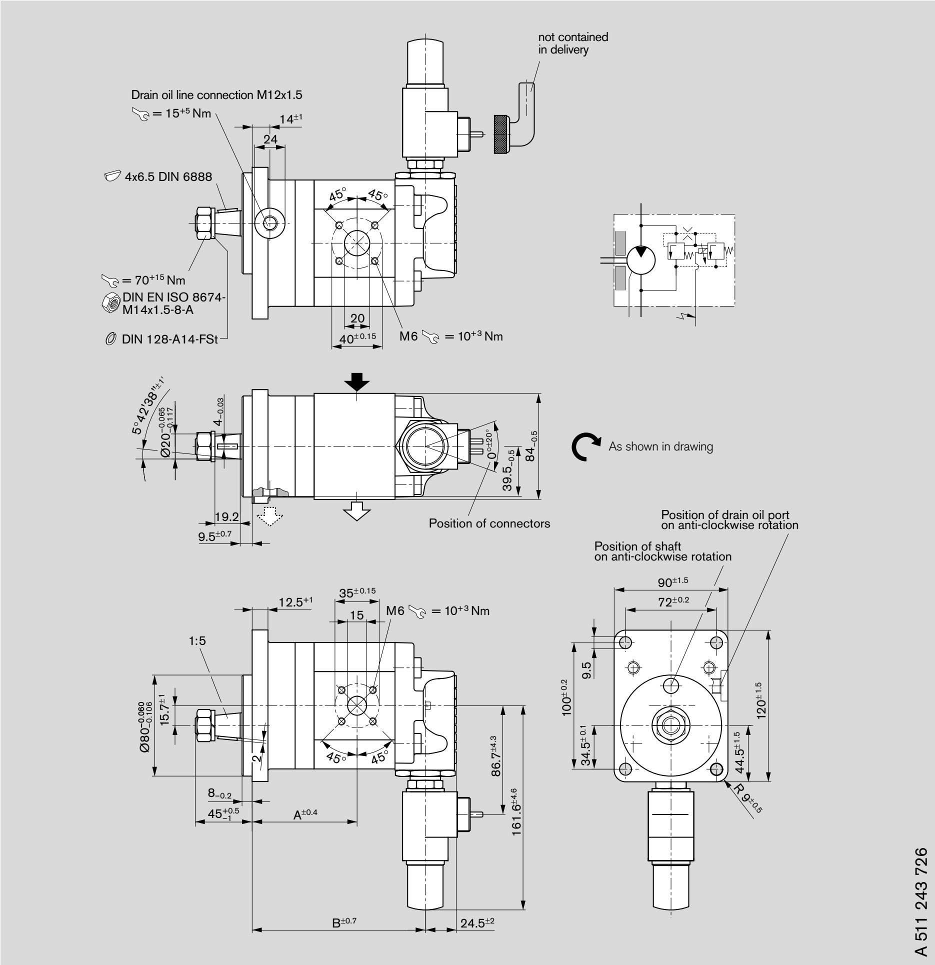
Ordering code

AZMF – 11 – □ □ □ U C N 20 M B – S0077

Displace-ment [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	L
8	**0 511 415 607**	210	500	4,000	2.9	40.7	80.3	80.3

Dimensions in mm

F-Motor



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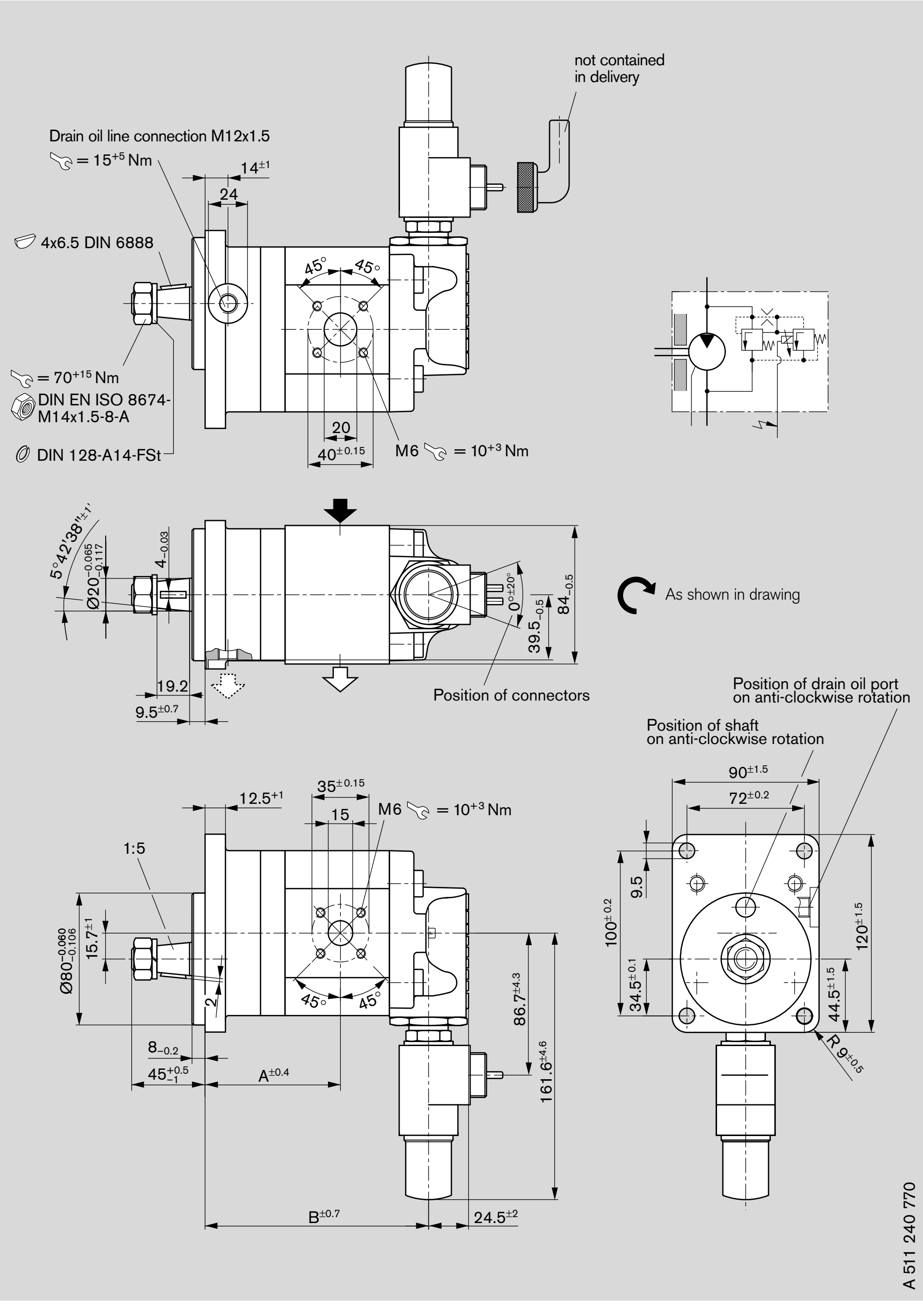
Ordering code
AZMF – 11 – ☐ ☐ ☐ ☐ S A 20 P GXXXX
AZMF – 12 – ☐ ☐ ☐ ☐ S A 20 P GXXXX*

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	PVR [bar]	Coil nominal current [*I*]	kg	Dimension [mm] A	Dimension [mm] B
16	–	**0 511 645 007**	500	3,000	130	1.5	5.0	79.0	137.7
16	–	**0 511 645 005** *	500	3,000	170	1.5	5.0	79.0	137.7
16	**0 511 645 306**	–	500	3,000	170	1.5	5.1	79.0	137.7
16	**0 511 645 307**	–	500	3,000	210	1.5	5.1	79.0	137.7
16	–	**0 511 645 011** *	500	3,000	210	1.5	5.1	79.0	137.7

Dimensions in mm

F-Motor



Dimensions in mm

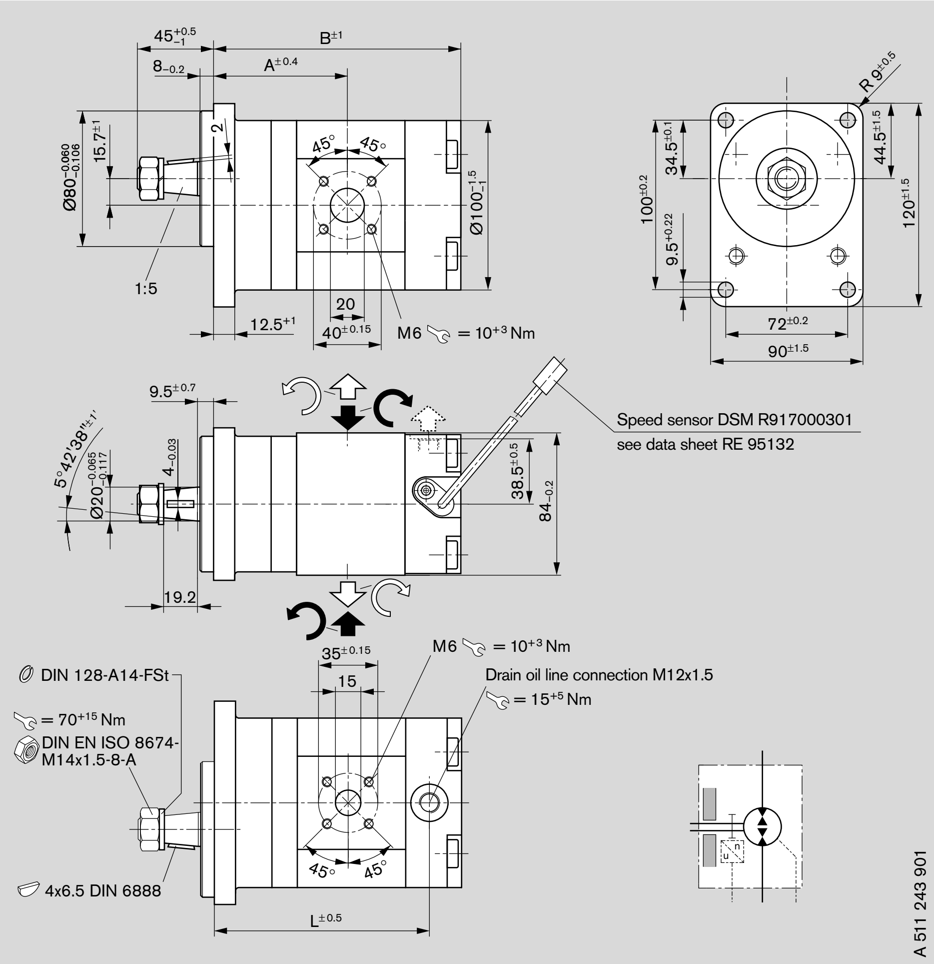
F-Motor

Ordering code
AZMF – 11 – ☐ ☐ ☐ ☐ C B 20 P GXXXX

Displacement [cm^3/rev]	Ordering-No. L	Ordering-No. R	Min. rotation speed [min^{-1}]	Max. rotation speed [min^{-1}]	PRV [bar]	Coil nominal current [*I*]	kg	Dimension [mm] A	Dimension [mm] B
8	**0 511 425 302**	–	500	4,000	210	0.75	4.7	48.7	98.3
8	–	**0 511 425 015**	500	4,000	90	1.5	4.6	48.7	98.3
8	–	**0 511 425 013**	500	4,000	130	1.5	4.7	48.7	98.3
8	–	**0 511 425 012**	500	4,000	170	1.5	4.7	48.7	98.3
8	–	**0 511 425 014**	500	4,000	150	1.5	4.7	48.7	98.3
11	–	**0 511 525 013**	500	3,500	170	1.5	4.7	47.5	103.5
11	–	**0 511 525 011**	500	3,500	180	0.75	4.8	47.5	103.5
11	**0 511 525 309**	–	500	3,500	90	1.5	4.8	47.5	103.5
11	**0 511 525 308**	–	500	3,500	180	0.75	4.8	47.5	103.5
14	–	**0 511 525 014**	500	3,000	210	1.5	4.9	43.2	108.5
16	–	**0 511 625 019**	500	3,000	210	1.5	5.0	47.5	111.7
16	**0 511 625 309**	–	500	3,000	210	1.5	5.0	47.5	111.7
16	–	**0 511 625 020**	500	3,000	210	0.75	5.0	47.5	111.7
19	–	**0 511 625 018**	500	3,000	210	1.5	5.1	47.5	116.7
19	–	**0 511 625 022**	500	3,000	210	0.75	4.0	47.5	116.7
19	–	**0 511 625 021**	500	3,000	180	0.75	5.1	47.5	116.7
22.5	**0 511 725 311**	–	500	3,000	210	1.5	5.3	55.1	122.1
22.5	–	**0 511 725 021**	500	3,000	210	1.5	5.3	55.1	122.1
22.5	–	**0 510 725 023**	500	3,000	210	0.75	5.3	55.1	122.1
22.5	–	**0 511 725 027**	500	3,000	170	1.5	5.2	55.1	122.1

Dimensions in mm

F-Motor

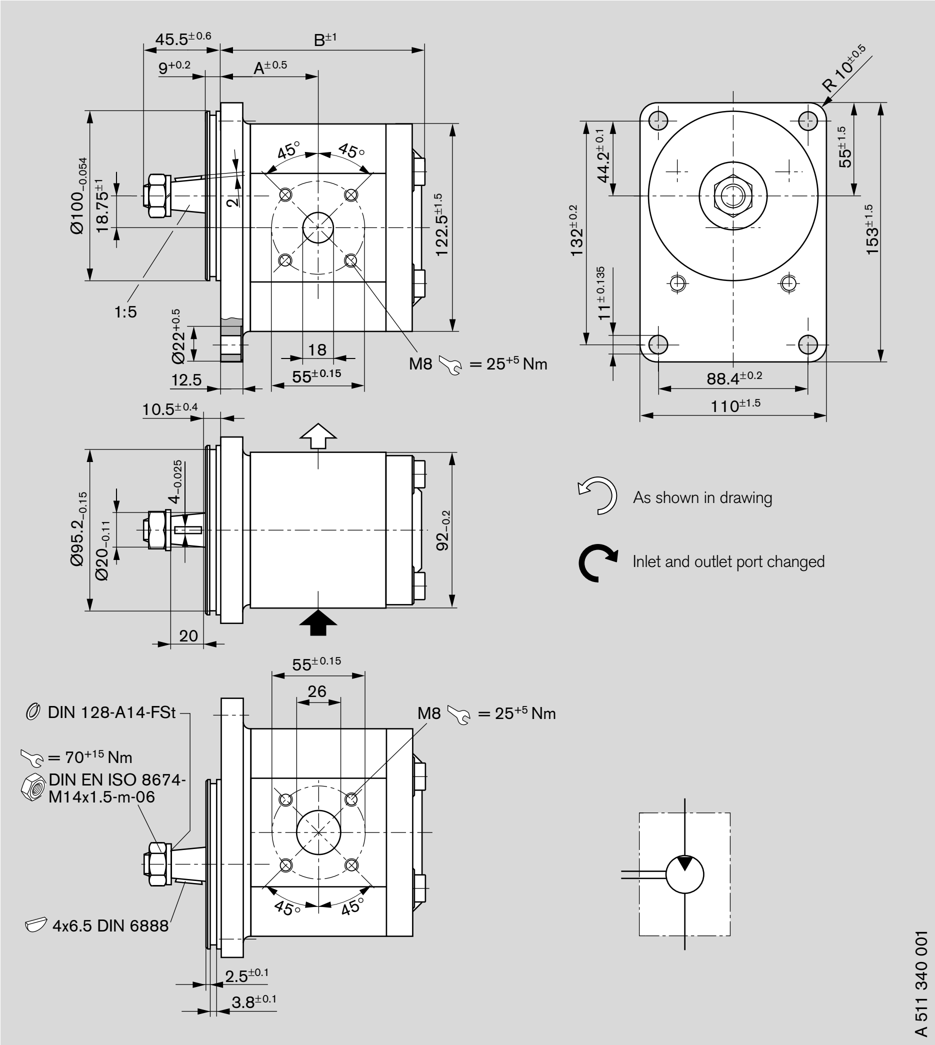


Ordering code
AZMF – 12 – □ □ □ U S A 20 P L – S0079

Displace-ment [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B	L
16	**0 511 645 607**	230	500	3,000	3.6	79	146.7	127.7

Dimensions in mm

N-Motor



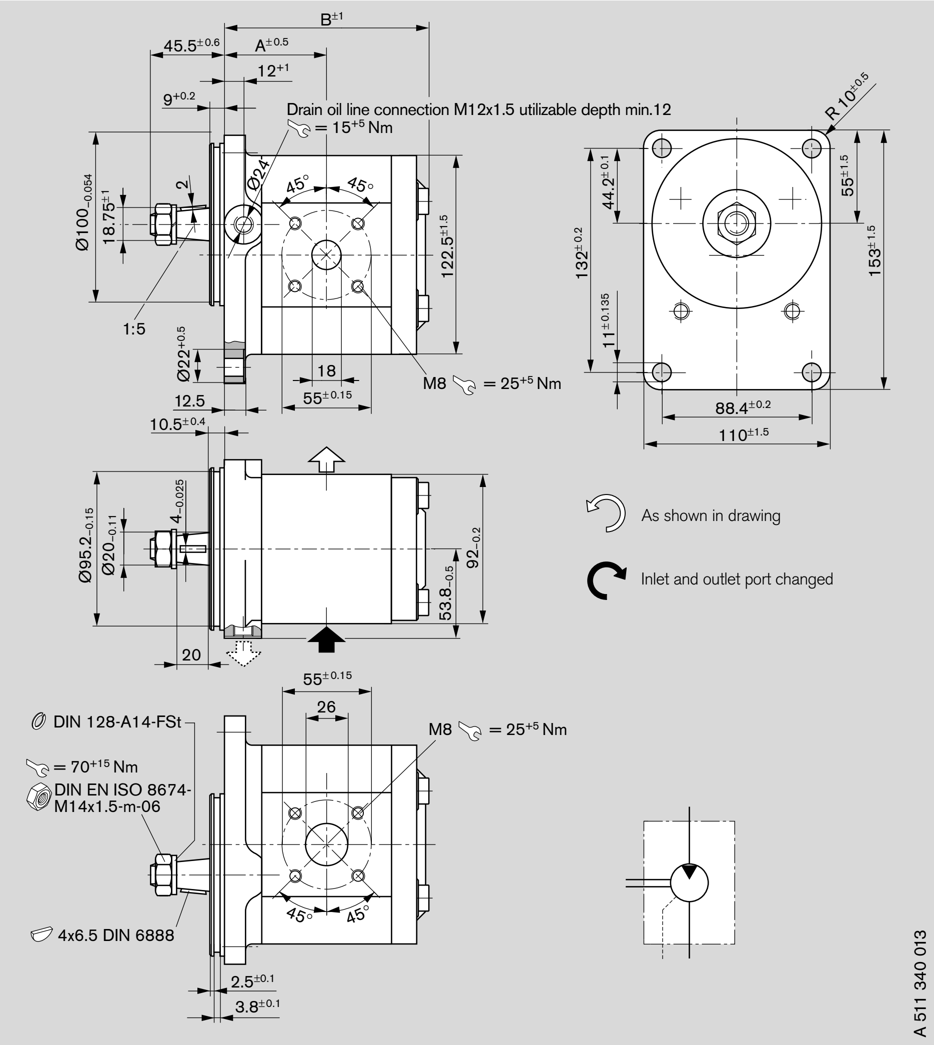
5

Ordering code
AZMN – 11 – □ □ □ □ C B 20 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
25	**0 511 725 307**	–	210	500	3,000	6.3	55.0	116.1
28	**0 511 725 309**	**0 511 725 019**	200	500	3,000	6.3	56.6	119.1

Dimensions in mm

N-Motor

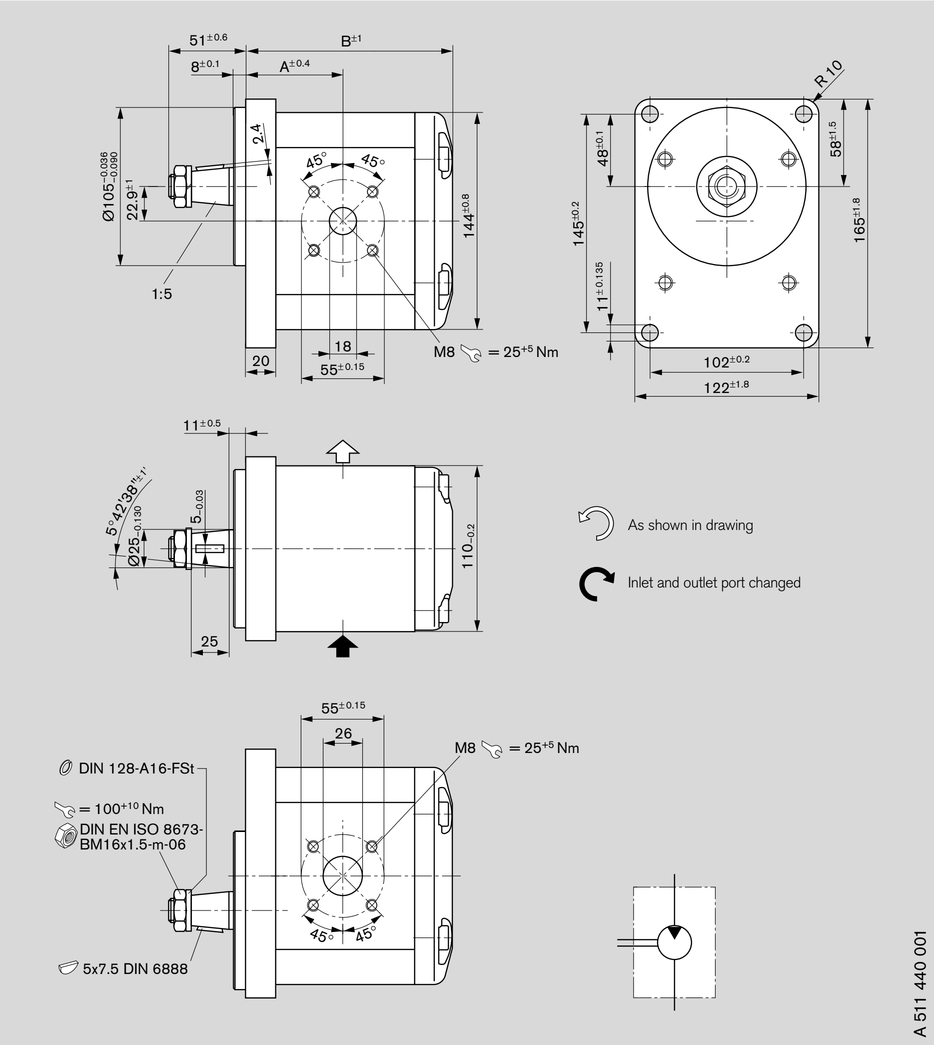


Ordering code
AZMN – 11 – □ □ □ □ C B 20 P B – S0097

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B
25	–	**0 511 725 024**	210		3,000	10.3	60.5	120.8
28	**0 511 725 312**	–	210		2,800	6.1	62.0	123.8

Dimensions in mm

G-Motor



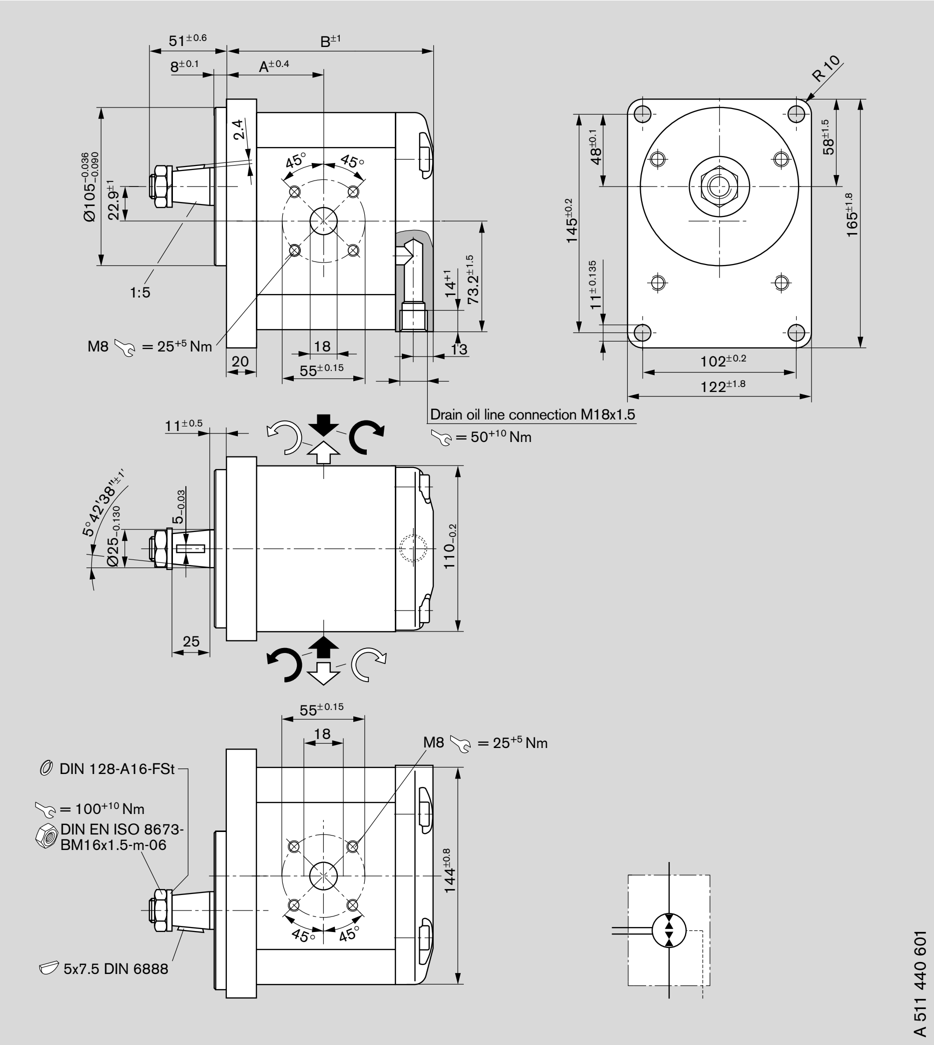
Ordering code

AZMG – 11 – ☐ ☐ ☐ ☐ C B 20 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
22.5	**0 511 725 300**	**0 511 725 001**	180	500	3,000	9.1	61.0	128.7
32	**0 511 725 301**	**0 511 725 002**	180	500	2,800	9.6	64.5	137.2
45	**0 511 725 302**	**0 511 725 003**	180	500	2,600	10.1	69.5	149.2

Dimensions in mm

G-Motor

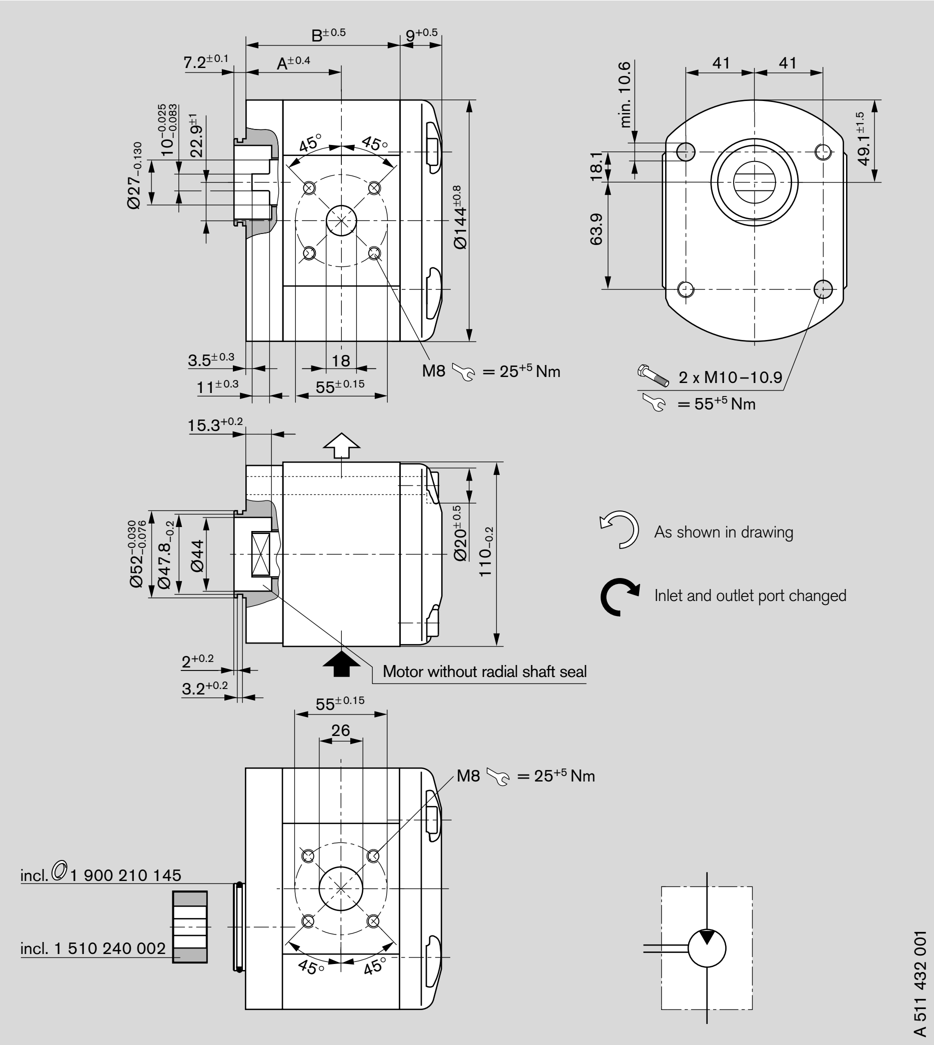


Ordering code
AZMG – 11 – □ □ □ U C B 20 K X* – S0077
AZMG – 11 – □ □ □ U C B 20 M X – S0077

Displace-ment [cm³/rev]	Ordering-No. Universal	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	B
22.5	**0 511 725 600**	210	500	3,000	9.0	61.0	128.7
28	**0 511 726 603**	210	500	3,000	9.2	63.0	133.7
32	**0 511 726 604***	210	500	2,800	9.4	64.5	137.2

Dimensions in mm

G-Motor



Ordering code
AZMG – 11 – □ □ □ □ N M 20 M B

Displacement [cm³/rev]	Ordering-No. L	Ordering-No. R	Max. operating pressure [bar]	Min. rotation speed [min⁻¹]	Max. rotation speed [min⁻¹]	kg	Dimension [mm] A	Dimension [mm] B
45		**0 511 715 002**	210	500	2,600	8.4	70.5	151.2

5

Notes

Filter recommendation
The major share of premature failures in external gear motors is caused by contaminated pressure 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 NAS 1638	9	10
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 pressure 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 motors 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!
- Motor may only be operated in compliance with permitted data (see pages 14 – 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 motors 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 motor, note the maximum possible service data based on the characteristics displayed on pages 10 to 14.

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.

Leakage oil line
A leakage oil line must be connected directly to the tank in reversible motors or motors stressed by run-back. Observe sufficient dimensions.

Contained in delivery
The components with characteristics as described under device measurements and ordering code, pages 19 – 39, are contained in delivery.

You can find further information in our publication: “General Operating Instructions for External Gear Units” RE 07 012-B1.

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Radial Piston Motors

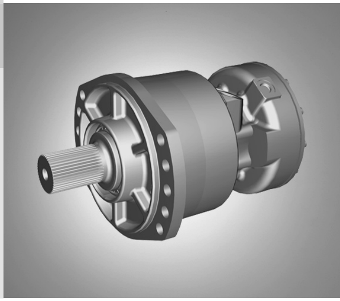
Designation	Type	Size	Series	Nominal pressure	Data sheet	Page
Radial piston motor (multi-stroke)	MCR3	160…400	3X	400…450 bar	RE 15205	509
Radial piston motor (multi-stroke)	MCR5	380…820	3X	400…450 bar	RE 15206	527
Radial piston motor (multi-stroke)	MCR10	780…1340	3X	400…450 bar	RE 15207	545
Radial piston motor (multi-stroke)	MCR15	1130…2150	3X	400…450 bar	RE 15208	561
Radial piston motor (multi-stroke)	MCR20	1750…3000	3X	400…450 bar	RE 15209	577
Radial piston motor for track drives	MCR-T	380…1340	3X	450 bar	RE 15221	589
Radial piston motor for slew drives	MCR-X	160…820	3X	300…350 bar	RE 15214	599

For the latest information on radial piston motors, please visit our website:
www.boschrexroth.com/radial-piston-motors

Rexroth
Bosch Group

Radial Piston Motor (Multi-Stroke) MCR3

Data sheet



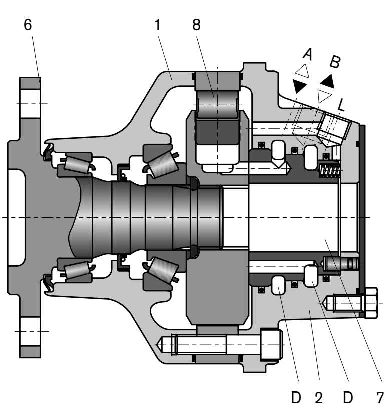
Series 3X
Size 160 to 400
Differential pressure up to 450 bar
Torque output up to 2300 Nm
Speed up to 875 rpm
Open and closed circuits

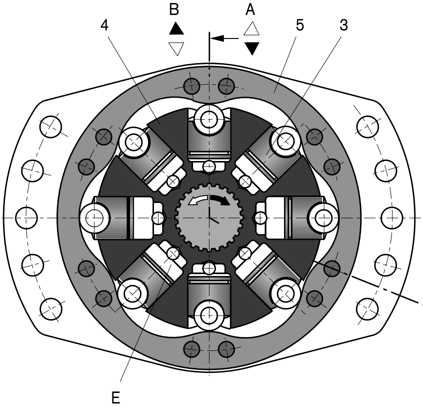
Contents

Features

– Compact robust construction
– High volumetric and mechanical efficiencies
– High pressure rating
– High reliability
– Low maintenance
– Smooth running at very low speeds
– Low noise
– Reversible
– Sealed tapered roller bearings
– High radial forces permitted on drive shaft
– Freewheeling possible
– Available with optional holding brake (multi-disc) or dynamic (drum) brake
– Available with:
  - Bi-directional two speed
  - Integrated flushing valve
  - Speed sensor

Functional description



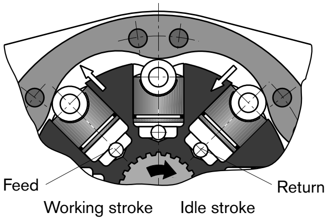


Hydraulic motors type MCR are radial piston motors with a rotating shaft.

Construction
Two part housing (1, 2), rotary group (3, 4), cam (5), drive shaft (6) and flow distributor (7)

Transmission
The cylinder block (4) is connected to the shaft (6) by means of splines. The pistons (3) are arranged radially in the cylinder block (4) and make contact with the cam (5) via rollers (8).

Torque Generation



The number of working and return strokes corresponds to the number of lobes on the cam x number of pistons (8).

Flow paths
The cylinder chambers (E) are connected to ports A and B via the axial bores and the annular passages (D).

Bearings
Tapered roller bearings capable of transmitting high axial and radial forces are fitted as standard, except on Hydrobase motors.

Freewheeling
In certain applications there may be a requirement to freewheel the motor. This may be achieved by connecting ports A and B to zero pressure and simultaneously applying a pressure of 2 bar to the housing through port L. In this condition, the pistons are forced into the cylinder block which forces the rollers to lose contact with the cam thus allowing free rotation of the shaft.

Two speed operation (2W)

In mobile applications where vehicles are required to operate at high speed with low motor loads, the motor can be switched to a low-torque and high-speed mode. This is achieved by operating an integrated valve which directs hydraulic fluid to only one half of the motor while continuously re-circulating the fluid in the other half. This “reduced displacement” mode reduces the flow required for a given speed and gives the potential for cost and efficiency improvements. The motor maximum speed remains unchanged.

Rexroth has developed a special spool valve to allow smooth switching to reduced displacement whilst on the move. This is known as “soft-shift” and is a standard feature of 2W motors. The spool valve requires either an additional sequence valve or electro-proportional control to operate in “soft-shift” mode.

Flushing valve

In a closed circuit, the same hydraulic fluid continuously flows between the pump and the motor. This could therefore lead to overheating of the hydraulic fluid.

The function of the flushing valve option is to replace hydraulic fluid in the closed circuit with that from the reservoir. When the hydraulic motor is operated under load, either in the clockwise or anti-clockwise direction, the flushing valve opens and takes a fixed flow of fluid through an orifice from the low pressure side of the circuit. This flow is then fed to the motor housing and back to the reservoir normally via a cooler. In order to charge the low pressure side of the circuit, cool fluid is drawn from the reservoir by the boost pump and is fed to the pump inlet through the check valve. Thus the flushing valve ensures a continuous renewal and cooling of the hydraulic fluid. The flushing feature incorporates a relief valve which is used to maintain a minimum boost pressure and operates at a standard setting of 14 bar (other options available on request).

Different orifice sizes may be used to select varying flows of flushing fluid. The following table gives flushing rate values based on a boost / charge pressure of 25 bar.

Functional Description

Flushing flow rates (for $p_{charge} - p_{case} = 25$ bar)

Ordering code	Flow	(±1 l/min)
F1	3	l/min
F2	5	l/min
F7	7	l/min
F4	10	l/min
F8	12.5	l/min
F6	13.5	l/min

Holding brake (multi-disc brake)

Mounting

By way of rear housing (2) and brake shaft (16).

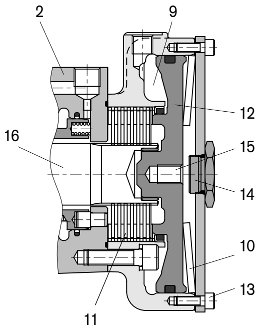
Brake application

As a safety requirement in mobile applications a parking brake may be provided to ensure that the motor cannot turn when the machine is not in use. The parking brake provides holding torque by means of discs (11) that are compressed by a disc spring (10). The brake is released when oil pressure is applied to brake port “Z” and the pressure in the annular area (9) compresses the disc spring allowing the brake discs to turn independently.

Note: This brake is provided solely for static use - not to be used dynamically.

Manual release of holding brake

The brake may also be released manually by loosening screws (13), or by removing plug (14) and inserting a puller into the tapped hole on the brake piston (15)



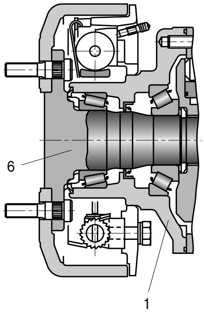
Dynamic brake

Where mechanical dynamic braking is required, a drum brake may be specified. The drum brake is mounted directly onto the drive shaft (6) and front housing (1). Braking torque is provided by brake shoes acting on the inside of the drum.

Operation of brake

– hydraulic brake fluid (special order required for mineral oil operation)

– mechanical brake cable (not supplied)

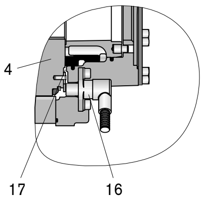


Speed sensor

A Hall-effect speed sensor (16) may be fitted as an option, giving a two-channel output of phase-displaced square waves, and enabling detection of speed and direction. A toothed target disc (17) is fitted to the motor cylinder block (4), and the sensor, fitted to a port in the rear case, produces a pulse on each channel as each tooth passes in front of it. The frequency of the pulses is proportional to the rotational speed.

Versions are available for use with regulated supplies (Code P1) and for direct connection to a 12 V or 24 V unregulated supply (Code P2).

The motor can also be supplied fitted with a target disc and with a speed sensor port machined, but covered and sealed with a blanking plate (Code P0). These “sensor-ready” motors may be fitted with a sensor at a later date.



6

Ordering code

MCR	3				Z	–	3X				12					
01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16

Radial piston motor

01		**MCR**

Frame size

02	Frame size 3	**3**

Housing Type

03	Front case flanged	**A**
	Front case flanged, SAE 4 metric holes	**D**
	Rear case flanged	**F**
	High radial load bearings fitted, rear case mounting flange	**W**
	Hydrobase (half motor)	**H**

	Nominal size, displacement V in cm³/rev		**160**	**225**	**255**	**280**	**325**	**365**	**400**
04	Low Displacement: motors use standard cylindrical pistons	**LD**	●	●	●	●	–	–	–
	High Displacement: motors use stepped pistons	**HD**	–	–	–	–	●	●	●

Drive shaft

05	Splined shaft ANSI B92.1 (only available with housing type "A")	**A45**
	Parallel keyed shaft Ø40 mm (only available with housing type "D" – maximum torque 1500 Nm)	**L40**
	With flange Ø180 mm (only available with housing type "F" and "W")	**F180**
	Without drive shaft (only available with housing type "H")	**Z**

Through shaft

06	Without through shaft	**Z**

Series

07	Series 30 to 39 (series 30 to 39 are dimensionally interchangeable)	**3X**

Brake

08	Without brake	**A0**
	Hydraulic release spring applied multi-disc holding brake 2200 Nm	**B2**
	Dynamic brake (drum brake) for right hand side of vehicle (see figure page 17)	**C2R**
	Dynamic brake (drum brake) for left hand side of vehicle (see figure page 17)	**C2L**

Seals

09	NBR (nitrile rubber) (except dynamic brake – see page 17)	**M**
	FKM (fluoroelastomer/Viton) (except dynamic brake – see page 17)	**V**

Single / Two-speed operation

10	Single speed, standard direction of rotation	**1L**
	Bi-directional two speed, standard direction of rotation	**2WL**

Ports

11	Tapped with UNF thread (SAE J514)	**12**

Studs

12	Without studs (no code)	
	With wheel studs and nuts (5 studs fitted only to motors with housing types "F" and "W")	**S**

Speed sensor

13	Without sensor (no code)	
	Sensor ready	**P0**
	Sensor without regulator	**P1**
	Sensor with regulator	**P2**

Flushing

14	Without flushing (no code)	
	With flushing (see table on page 3)	**F1 to F8**

● = available – = not available

Ordering code

MCR	3				Z	–	3X				12					
01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16

Special order

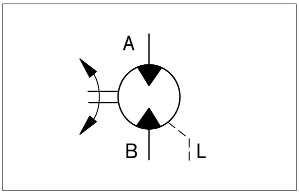
15	Special feature	SOXXX

Other

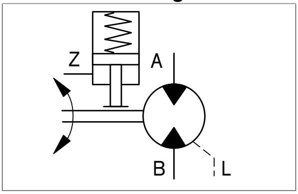
16	Mark in text here	*

Schematic diagrams

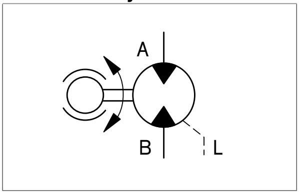
Motor without brake



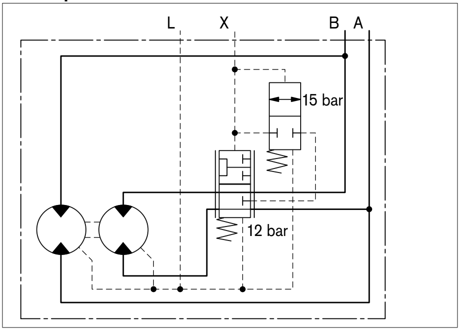
Motor with holding brake



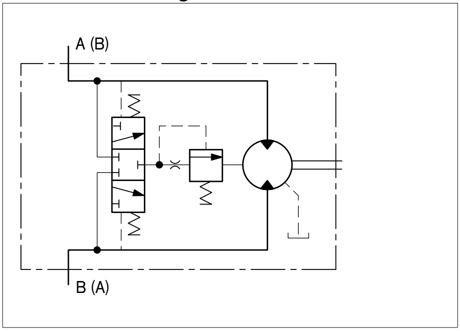
Motor with dynamic brake



Two-speed motor

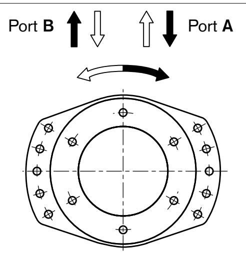


Motor with flushing valve



Direction of rotation

Direction of shaft rotation with flow (viewed from drive shaft)



Ordering code ... 1L ... or ... 2WL ...

6

Technical data

(For operation outside of these parameters, please consult Rexroth)

Description			Radial-piston type, low-speed, high-torque motor						
Frame size			MCR3						
Type of mounting			Flange mounting; face mounting						
Pipe connections[1)2)]			Threaded per SAE J514						
Shaft loading			see page 10						
Displacement	V_g	cm^3/rev	160	225	255	280	325	365	400
Output torque									
Specific torque (at $\Delta p = 250$ bar)		Nm	570	810	910	1000	1160	1310	1430
Maximum torque[3)4)]	T_{max}	Nm	1030	1450	1640	1800	1860	2090	2290
Output speed									
Minimum speed for smooth running[5)]	n_{min}	rpm	0.5						
Maximum speed (1L)[6) 7) 8)]	n_{max}	rpm	670	475	420	385	330	295	270
Maximum speed (2WL)[6) 7)]	n_{max}	rpm	875	620	550	500	430	385	350
Output power									
Nominal power[9)]	P	kW	18	18	18	18	22	22	22
Weight	m	kg	see unit dimensions on pages 11-17						
Moment of inertia	J_m	kgm^2	see unit dimensions on pages 11-17						
Hydraulic									
Pressure[10)]									
Nominal pressure[9)]	p_{nom}	bar	250	250	250	250	250	250	250
Maximum differential pressure[3)]	Δp_{max}	bar	450	450	450	450	400	400	400
Maximum pressure at port "A" or "B"[3)]	p_{max}	bar	470	470	470	470	420	420	420
Maximum case drain pressure	$p_{case\ max}$	bar	10	10	10	10	10	10	10
Hydraulic fluid[11) 12)]			Mineral oils (HLP) to DIN 51 524						
Hydraulic fluid temperature range[13)]	$t_{min/max}$	°C	-20 to +85						
Viscosity Range	$\nu_{min/max}$	mm^2/s	10 to 2000						
Fluid cleanliness			ISO 4406, Class 20/18/15						
Brake									
Holding brake (disc brake)			B2						
Minimum holding torque	T_{min}	Nm	2200						
Release pressure (min/max)	p_{rel}	bar	11/15						
Maximum pressure at brake port "Z"		bar	40						
Oil volume to operate brake	V_{rel}	cm^3	23						
Dynamic brake (drum brake)			see information on page 17						

1) Ensure motor case is filled with oil prior to start-up. See operating manual RE 15215-B.
2) For installation and maintenance details, please see operating manual RE 15215-B.
3) Maximum values should only be applied for a small portion of the duty cycle. Please consult Rexroth Engineering Department in Glenrothes for motor life calculations based on particular operating cases.
4) For motors with housing type D, maximum torque is 1500 Nm, which restricts maximum pressure accordingly.
5) For continuous operation at speeds < 5 rpm please consult Rexroth Engineering Department in Glenrothes.
6) Based on nominal no-load Δp of 20 bar in full-displacement mode.
7) Warning! During the running in period of the motor (min. 20 hrs) it should not be run unloaded at > 100 rpm.
8) Single-speed (1 L) motors are available by special order with a 30 % increase in the stated maximum speed.
9) Nominal values are guide values for continuous operation.
10) When operating motors in series, please consult Rexroth Engineering Department in Glenrothes.
11) For use with environmentally acceptable fluids HEES, HEPG, HETG, Viton seals must be specified. For further information, please refer to RE 90221.
12) For use with HF hydraulic fluids please refer to RE 90229.
13) Extension of the allowable temperature range may be possible depending on specification. Please consult Rexroth Engineering Department in Glenrothes for further details.

Technical data (Mean values, measured at ν = 46 mm²/s and t = 45 °C)

– All torques apply to run-in motors

– For reduced displacement operating mode multiply the torques by ratio of reduced displacement

Note

– Case pressure must be added to minimum charge pressures quoted. Quoted pressures are guide values but can be circuit-dependant. Please contact Bosch Rexroth Engineering Department in Glenrothes for further advice. Figures quoted in technical data tables below are average values.

– Where flushing is used, q_{VL} will increase by the flushing flow rate. Mean case leakage values are average values for single speed motors

T = Torque in Nm

q_V = Input flow in l/min

q_{VL} = Mean case leakage in l/min

p = Minimum charge pressure in pump mode in bar

			MCR3 . 160											
Pressure Diff. Δp (bar)	**Speed n**	rpm	0	25	50	100	150	200	250	300	350	400	500	600
100	T	Nm	132	227	232	232	229	227	224	219	206	196	220	208
	q_V	l/min	0.32	4.32	8.32	16.32	24.32	32.32	40.32	48.32	56.32	64.32	80.32	96.32
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
200	T	Nm	306	463	469	469	463	467						
	q_V	l/min	0.65	4.65	8.65	16.65	24.65	32.65						
	q_{VL}	l/min	0.18	0.18	0.18	0.18	0.18	0.18						
300	T	Nm	489	703	710	710	710							
	q_V	l/min	0.97	4.97	8.97	16.97	24.97							
	q_{VL}	l/min	0.27	0.27	0.27	0.27	0.27							
400	T	Nm	693	907	917	920								
	q_V	l/min	1.29	5.29	9.29	17.29								
	q_{VL}	l/min	0.35	0.35	0.35	0.35								
Min. charge pressure	p	bar	1	3	3	4	5	6	6	7	8	8	10	12

			MCR3 . 225										
Pressure Diff. Δp (bar)	**Speed n**	rpm	0	25	50	100	150	200	250	300	350	400	450
100	T	Nm	186	319	326	326	322	319	315	308	290	276	286
	q_V	l/min	0.32	5.95	11.57	22.82	34.07	45.32	56.57	67.82	79.07	90.32	101.57
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
200	T	Nm	430	652	659	659	652	650					
	q_V	l/min	0.65	6.27	11.90	23.15	34.40	45.65					
	q_{VL}	l/min	0.18	0.18	0.18	0.18	0.18	0.18					
300	T	Nm	688	988	999	999	1047						
	q_V	l/min	0.97	6.60	12.22	23.47	34.72						
	q_{VL}	l/min	0.27	0.27	0.27	0.27	0.27						
400	T	Nm	974	1275	1289	1261							
	q_V	l/min	1.29	6.92	12.54	23.79							
	q_{VL}	l/min	0.35	0.35	0.35	0.35							
Min. charge pressure	p	bar	1	3	3	4	5	6	8	9	10	11	13

Technical data (Mean values, measured at $\nu = 46\ mm^2/s$ and $t = 45\ °C$)

			MCR3 . 255									
Pressure Diff. Δp (bar)	Speed n	rpm	0	25	50	100	150	200	250	300	350	400
100	T	Nm	211	361	369	369	365	361	357	349	329	313
	q_V	l/min	0.32	6.70	13.07	25.82	38.57	51.32	64.07	76.82	89.57	102,32
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0,09
200	T	Nm	487	739	747	747	739					
	q_V	l/min	0.65	7.02	13.40	26.15	38.90					
	q_{VL}	l/min	0.08	0.18	0.08	0.18	0.08					
300	T	Nm	779	1120	1132	1132						
	q_V	l/min	0.97	7.35	13.72	26.47						
	q_{VL}	l/min	0.27	0.27	0.27	0.27						
400	T	Nm	1104	1445	1461							
	q_V	l/min	1.29	7.67	14.04							
	q_{VL}	l/min	0.35	0.35	0.35							
Min. charge pressure	p	bar	1	3	3	5	6	7	8	10	11	13

			MCR3 . 280								
Pressure Diff. Δp (bar)	**Speed n**	rpm	0	25	50	100	150	200	250	300	350
100	T	Nm	232	397	406	406	401	397	392	383	361
	q_V	l/min	0.32	7.32	14.32	28.32	42.32	56.32	70.32	84.32	98.32
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
200	T	Nm	267	406	410	410	406				
	q_V	l/min	0.65	7.65	14.65	28.65	42.65				
	q_{VL}	l/min	0.18	0.18	0.18	0.18	0.18				
300	T	Nm	856	1230	1243	1243					
	q_V	l/min	0.97	7.97	14.97	28.97					
	q_{VL}	l/min	0.27	0.27	0.27	0.27					
400	T	Nm	1212	1586	1604						
	q_V	l/min	1.29	8.29	15.29						
	q_{VL}	l/min	0.35	0.35	0.35						
Min. charge pressure	p	bar	1	3	3	5	6	8	9	10	12

			MCR3 . 325							
Pressure Diff. Δp (bar)	Speed n	rpm	0	25	50	100	150	200	250	300
100	T	Nm	269	460	471	471	463	455	434	409
	q_V	l/min	0.32	8.45	16.57	32.82	49.07	65.32	81.57	97.82
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
200	T	Nm	621	941	952	952	941			
	q_V	l/min	0.65	8.77	16.90	33.15	49.40			
	q_{VL}	l/min	0.18	0.18	0.18	0.18	0.18			
300	T	Nm	993	1428	1443	1443				
	q_V	l/min	0.97	9.10	17.22	33.47				
	q_{VL}	l/min	0.27	0.27	0.27	0.27				
400	T	Nm	1407	1841	1862					
	q_V	l/min	1.29	9.42	17.54					
	q_{VL}	l/min	0.35	0.35	0.35					
Min. charge pressure	p	bar	1	3	4	5	7	8	10	12

Technical data (Mean values, measured at $\nu = 46\ mm^2/s$ and $t = 45\ °C$)

			MCR3 . 365						
Pressure Diff. Δp (bar)	Speed n	rpm	0	25	50	100	150	200	250
100	T	Nm	302	517	529	529	520	511	488
	q_V	l/min	0.32	9.45	18.57	36.82	55.07	73.32	91.57
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09	0.09
200	T	Nm	697	1057	1069	1069	1057		
	q_V	l/min	0.65	9.77	18.90	37.15	55.40		
	q_{VL}	l/min	0.18	0.18	0.18	0.18	0.18		
300	T	Nm	1115	1603	1621	1621			
	q_V	l/min	0.97	10.10	19.22	37.47			
	q_{VL}	l/min	0.27	0.27	0.27	0.27			
400	T	Nm	1580	2068	2091				
	q_V	l/min	1.29	10.42	19.54				
	q_{VL}	l/min	0.35	0,35	0.35				
Min. charge pressure	p	bar	1	3	4	6	7	9	11

			MCR3 . 400						
Pressure Diff. Δp (bar)	**Speed n**	rpm	0	25	50	100	150	200	250
100	T	Nm	331	567	579	579	567	547	522
	q_V	l/min	0.32	10.32	20.32	40.32	60.32	80.32	100.32
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09	0.09
200	T	Nm	764	1159	1171	1171	1159		
	q_V	l/min	0.65	10.65	20.65	40.65	60.65		
	q_{VL}	l/min	0.18	0.18	0.18	0.18	0.18		
300	T	Nm	1222	1757	1776	1776			
	q_V	l/min	0.97	10.97	20.97	40.97			
	q_{VL}	l/min	0.27	0.27	0.27	0.27			
400	T	Nm	1732	2266	2292				
	q_V	l/min	1.29	11.29	21.29				
	q_{VL}	l/min	0.35	0.35	0.35				
Min. charge pressure	p	bar	1	3	4	6	8	10	13

Permitted loading on drive shaft

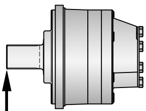
(Speed n = 50 rpm, pressure differential Δp = 250 bar, 2000 hrs L10 life at 50 °C)

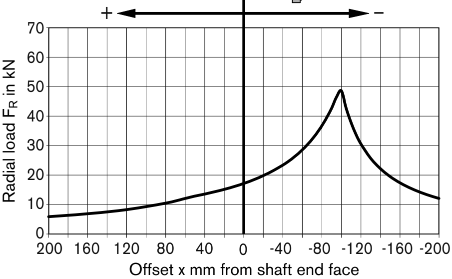
Drive shaft ...A45...

Housing type **...A...**

Maximum axial load $\mathbf{F}_{ax\ max}$ (with radial load $F_R = 0$):

Fax max = 30700 N ⇦ +
Fax max = 25200 N ⇨ –



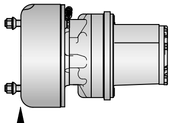


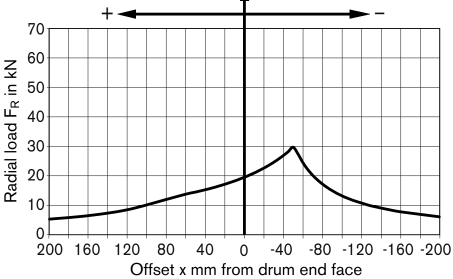
Drive shaft ...F180... (5 studs M14)

Housing type **...F...C2**

Maximum axial load $\mathbf{F}_{ax\ max}$ (with radial load $F_R = 0$):

Fax max = 30200 N ⇦ +
Fax max = 19800 N ⇨ –



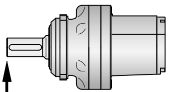


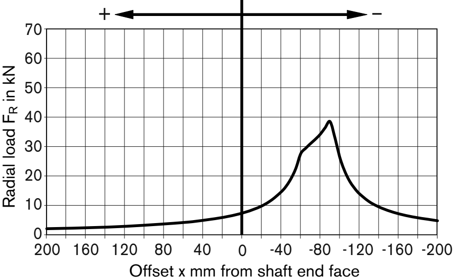
Drive shaft ...L40...

Housing type **...D...**

Maximum axial load $\mathbf{F}_{ax\ max}$ (with radial load $F_R = 0$):

Fax max = 30200 N ⇦ +
Fax max = 27000 N ⇨ –



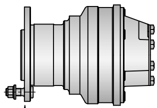


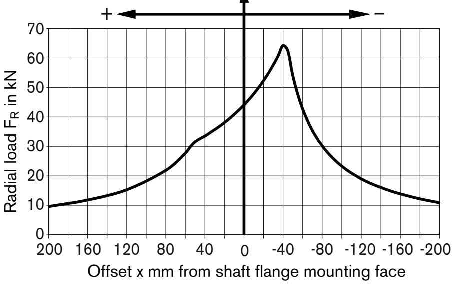
Drive shaft ...F180... (5 studs M14)

Housing type **...W...**

Maximum axial load $\mathbf{F}_{ax\ max}$ (with radial load $F_R = 0$):

Fax max = 38800 N ⇦ +
Fax max = 39700 N ⇨ –



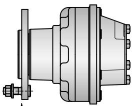


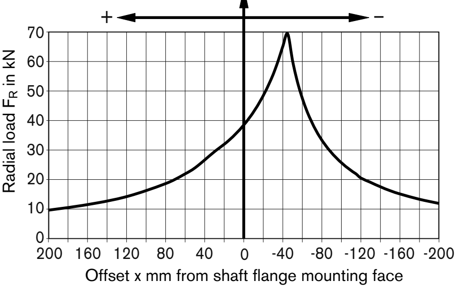
Drive shaft ...F180... (5 studs M14)

Housing type **...F...**

Maximum axial load $\mathbf{F}_{ax\ max}$ (with radial load $F_R = 0$):

Fax max = 30200 N ⇦ +
Fax max = 30600 N ⇨ –





Note:

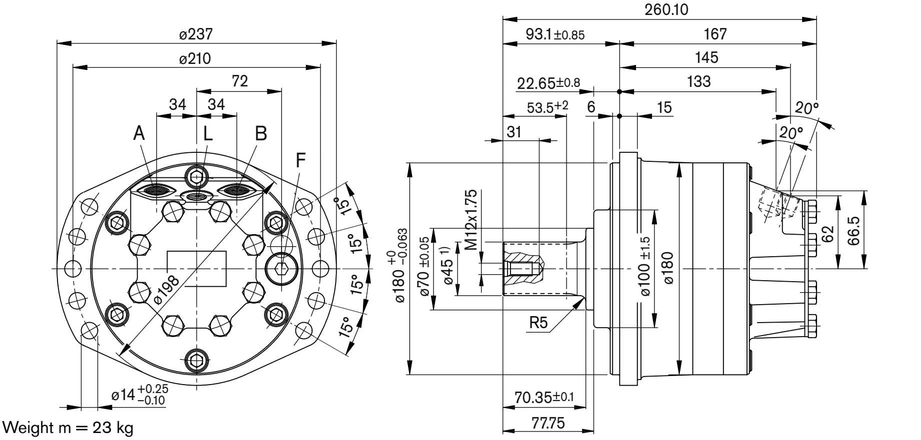
These values and graphs are for initial guidance only.
For actual motor life calculations under typical or specified duty cycles, contact Rexroth Engineering Department in Glenrothes.

Dimensions

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

Flanged front housing, splined drive shaft, single speed (1)

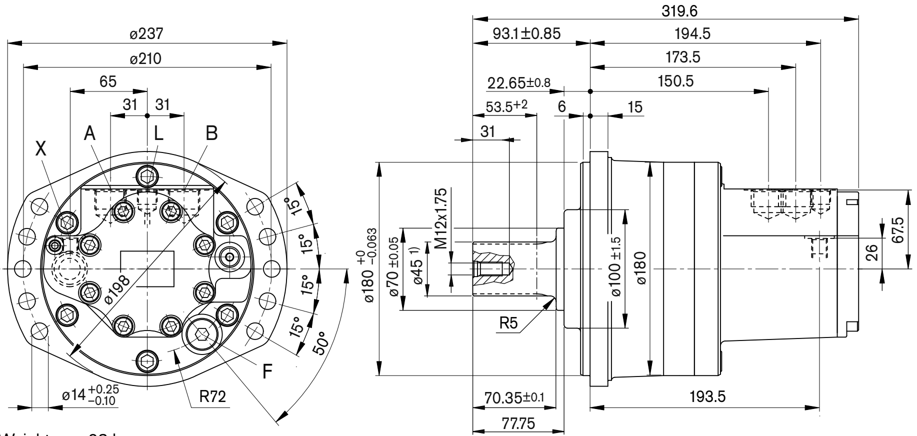
Ordering code: "MCR3A…A45Z-32/A0.1L/12./…"



Weight m = 23 kg
Polar moment of inertia J_m = 10175 kgmm²

Flanged front housing, splined drive shaft, two speed (2W)

Ordering code: "MCR3A…A45Z-32/A0.2WL/12./…"



Weight m = 28 kg
Polar moment of inertia J_m = 10175 kgmm²

Ports

Designation	Port function	Code 12	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J514	7/8 in - 14 UNF	470/420[2)]	O
L	Case drain	SAE J514	9/16 in - 18 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) Spline data: ANSI B92.1-1996 class 5, 30° Pressure angle, Fillet root side fit, Pitch 24/48, PCD 44.45 mm, No. of teeth 42
2) depends on nominal size

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

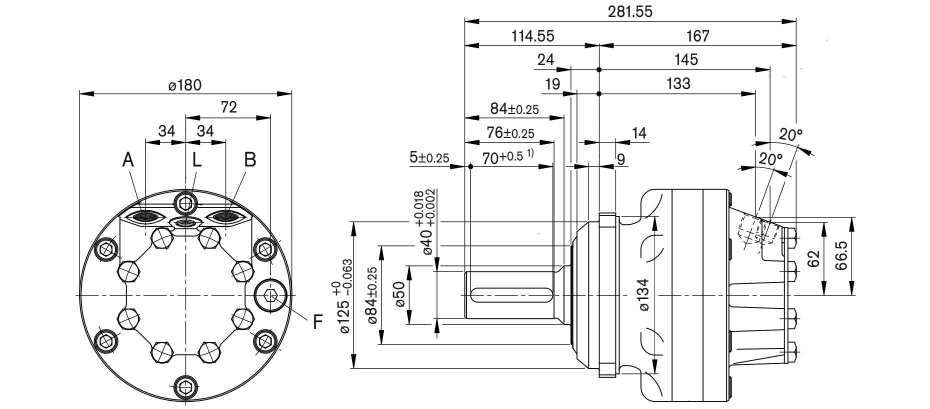
6

Dimensions

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

4 hole SAE flanged front housing, parallel drive shaft, single speed (1)

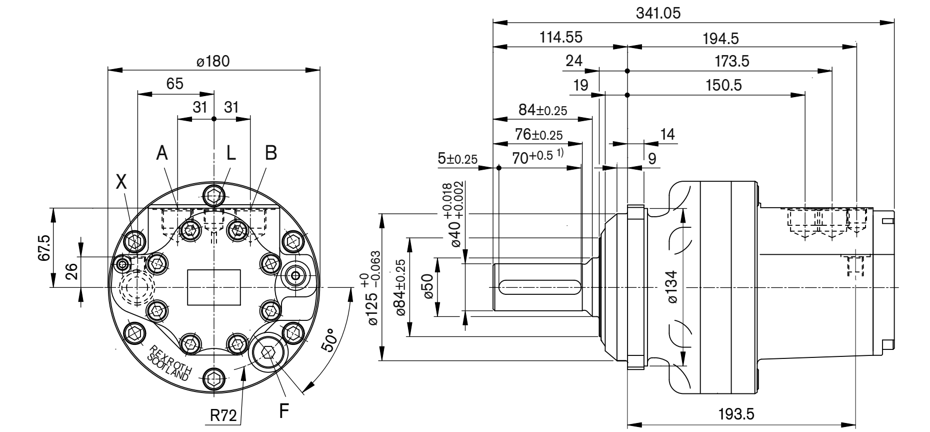
Ordering code: "MCR3D…L40Z-32/A0.1L/12./…"



Weight m = 21 kg
Polar moment of inertia J_m = 10600 kgmm²

4 hole SAE flanged front housing, parallel drive shaft, two speed (2W)

Ordering code: "MCR3D…L40Z-32/A0.2WL/12./…"



Weight m = 26 kg
Polar moment of inertia J_m = 10600 kgmm²

Note: To prevent excessive shaft loading with D-type motors, the mating bore should have F7 or G6 tolerance

Ports

Designation	Port function	Code 12	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J514	7/8 in - 14 UNF	470/420 2)	O
L	Case drain	SAE J514	9/16 in - 18 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) Parallel key A12x8x70 – DIN 6885
2) depends on nominal size

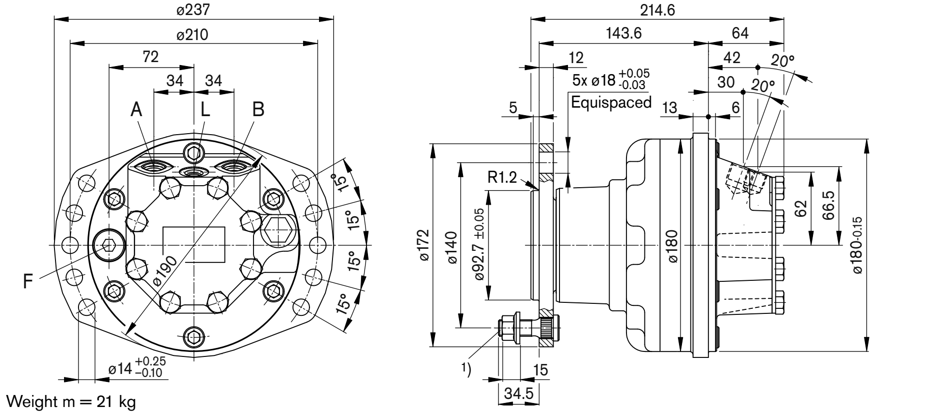
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions

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

Flanged rear housing, flanged drive shaft, single speed (1)

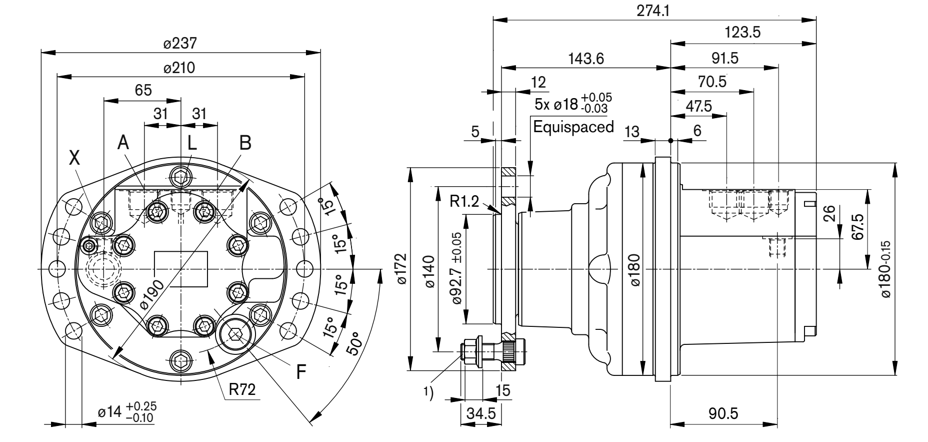
Ordering code: "MCR3F…F180Z-32/A0.1L/12./…"



Weight m = 21 kg
Polar moment of inertia J_m = 17840 kgmm²

Flanged rear housing, flanged drive shaft, two speed (2W)

Ordering code: "MCR3F…F180Z-32/A0.2WL/12./…"



Weight m = 26 kg
Polar moment of inertia J_m = 17840 kgmm²

Ports

Designation	Port function	Code 12	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J514	7/8 in - 14 UNF	470/420[2)]	O
L	Case drain	SAE J514	9/16 in - 18 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 5x wheel studs M14x1.5 with shouldered hex nut for wheel fixing, clamping length 5 to 20 mm, ordering code S (wheel studs and nuts equally spaced on P.C.D. of 140)

2) depends on nominal size

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

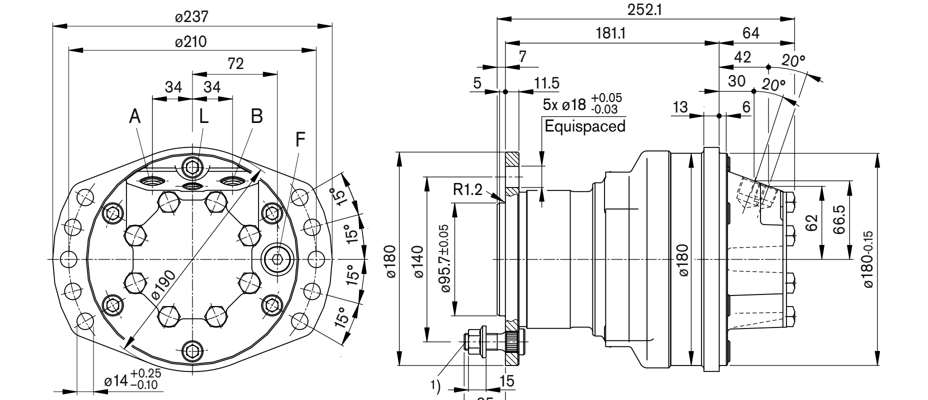
6

Dimensions

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

High radial load bearings fitted, rear case mounting flange, single speed (1)

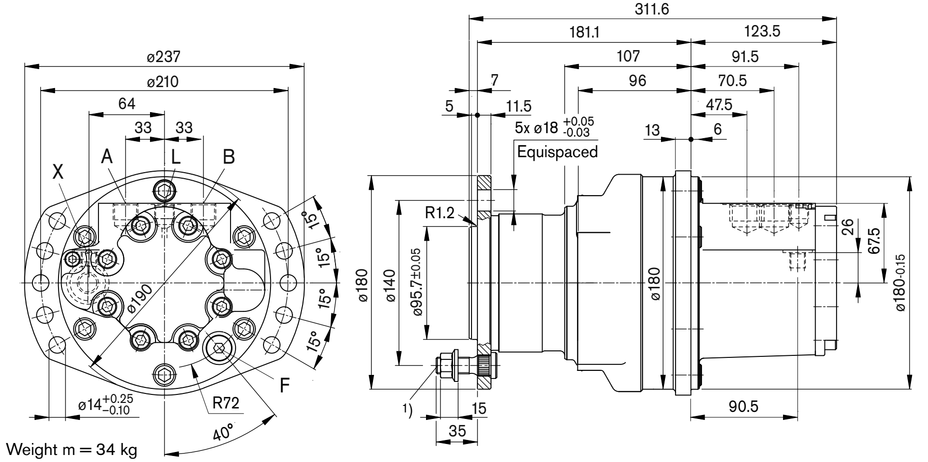
Ordering code: "MCR3W…F180Z-32/A0.1L/12./…"



Weight m = 27 kg
Polar moment of inertia J_m = 20560 kgmm²

High radial load bearings fitted, rear case mounting flange, two speed (2W)

Ordering code: "MCR3W…F180Z-32/A0.2WL/12./…"



Weight m = 34 kg
Polar moment of inertia J_m = 20560 kgmm²

Ports

Designation	Port function	Code 12	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J514	7/8 in - 14 UNF	470/420[2)]	O
L	Case drain	SAE J514	9/16 in - 18 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 5x wheel studs M14x1.5 with shouldered hex nut for wheel fixing, clamping length 5 to 20 mm, ordering code S (wheel studs and nuts equally spaced on P.C.D. of 140)

2) depends on nominal size

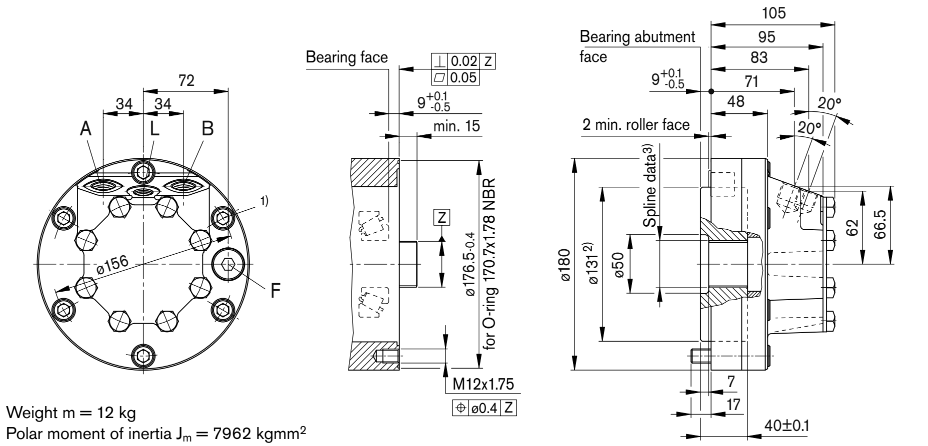
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions

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

Hydrobase for mounting on customer´s shaft, single speed (1)

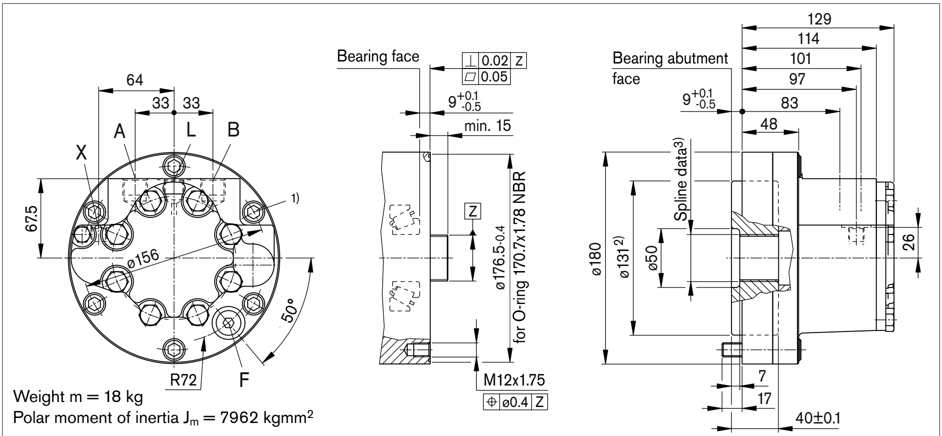
Ordering code: "MCR3H…ZZ-32/A0.1L/12./..."



Weight m = 12 kg
Polar moment of inertia J_m = 7962 kgmm²

Hydrobase for mounting on customer´s shaft, two speed (2W)

Ordering code: "MCR3H…ZZ-32/A0.2WL/12./..."



Weight m = 18 kg
Polar moment of inertia J_m = 7962 kgmm²

Ports

Designation	Port function	Code 12	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J514	7/8 in - 14 UNF	470/420[4)]	O
L	Case drain	SAE J514	9/16 in - 18 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 6x M12x1.75 bolts on a P.C.D of 156
2) Mating part must clear this diameter
3) Spline data: BS3550 class 1, Fillet root side fit, Pitch 24/48, PCD 38.1 mm, No. of spaces 36
4) depends on nominal size

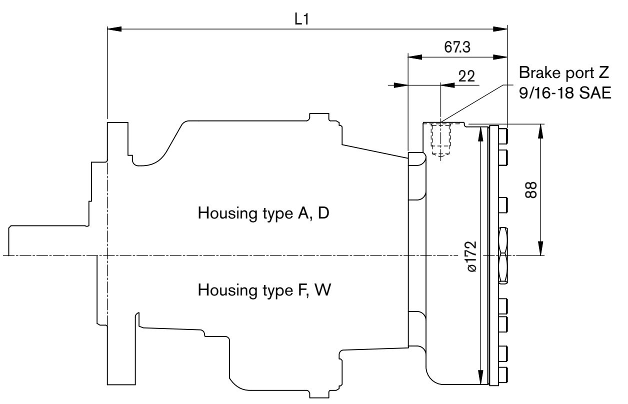
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

6

Dimensions

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

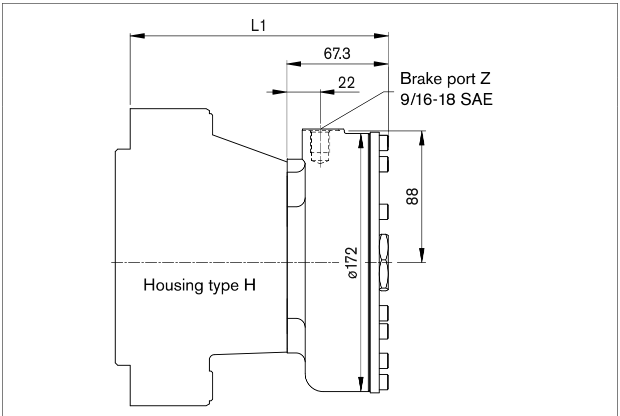
Holding Brake (multi-disc brake): ordering code "B2"



Housing type	Single speed (1) L1	Two speed (2W) L1
A	224.3	275.8
D	224.3	275.8
F	264.8	316.4
W	302.3	353.8

Weight m = 9 kg
Polar moment of inertia $J_m = 520$ kgmm^2

Holding Brake (multi-disc brake): ordering code "B2"



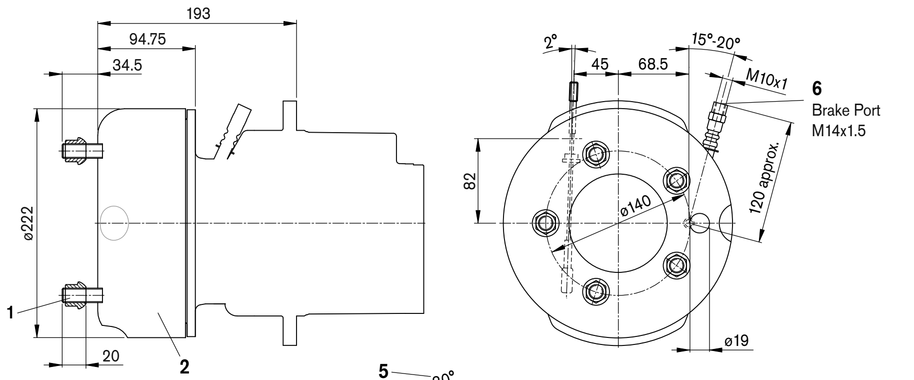
Housing type	Single speed (1) L1	Two speed (2W) L1
H	162.3	181.3

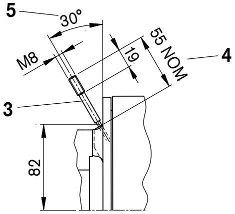
Weight m = 9 kg
Polar moment of inertia $J_m = 520$ kgmm^2

Dimensions

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

Dynamic brake (drum brake): ordering code "C2R" / "C2L"





Weight m = 9 kg
Polar moment of inertia $J_m = 54500$ kgmm^2

1 5 Studs M14x1.5 with spherical wheel nuts

2 Dynamic brake (drum brake) ordering code C2L/R for use with brake fluid DOT 3+5 or SAE JI 703.
If brake is to be used with mineral oil a special order is to be made.
Please state if seals for mineral oil are required when placing order.

3 Brake cable (Bowden cable).
The brake illustrated is for right side of vehicle. The left is a mirror image of this (see fig. below).

4 Brake cable length.

5 Angular position of brake cable.

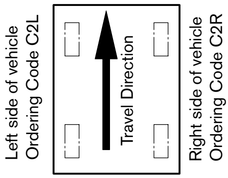
6 Brake port $p_{max} = 117$ bar.
Brake cylinder operating volume $V = 7$ cm^3.

Brake torque after run-in

Braking torque	Cable tension	Braking torque	Port pressure
2000 Nm	1000 N	2000 Nm	82 bar
2900 Nm	1440 N	2900 Nm	117 bar

MCR dynamic drum brake run-in procedure

- Brake the machine hard in forward and reverse directions until the brake drum temperature reaches 200 °C.
- Allow the brake to cool.
- To remove residue, brake gently 2 times each in the forward and reverse directions.

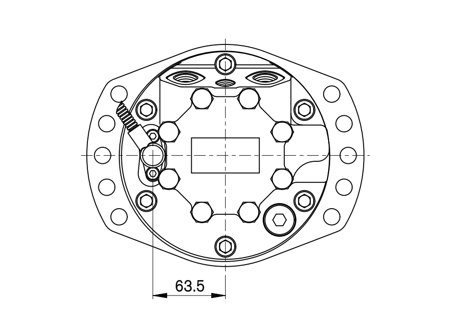


6

Dimensions

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

Speed sensor: ordering code “P1” / “P2”



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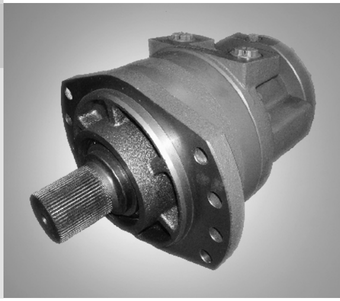
www.boschrexroth.co.uk

Rexroth
Bosch Group

Radial Piston Motor (Multi-Stroke) MCR5

Data sheet



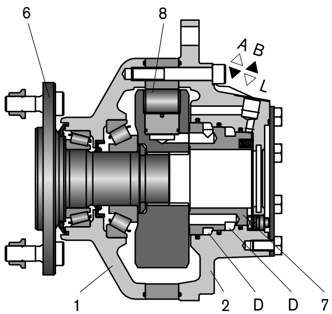
Series 3X
Size 380 to 820
Differential pressure up to 450 bar
Torque output up to 4900 Nm
Speed up to 570 rpm
Open and closed circuits

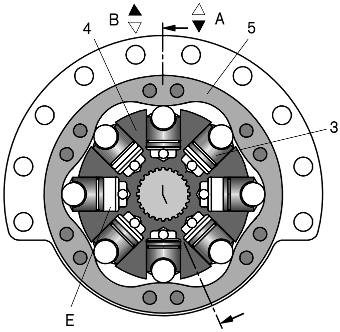
Contents

Features

– Compact robust construction
– High volumetric and mechanical efficiencies
– High pressure rating
– High reliability
– Low maintenance
– Smooth running at very low speeds
– Low noise
– Reversible
– Sealed tapered roller bearings
– High radial forces permitted on drive shaft
– Freewheeling possible
– Available with optional holding brake (multi-disc) or dynamic (drum) brake
– Available with:
  - Bi-directional two speed
  - Integrated flushing valve
  - Speed sensor

Functional description



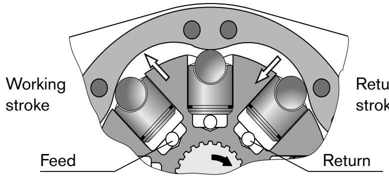


Hydraulic motors type MCR are radial piston motors with a rotating shaft.

Construction
Two part housing (1, 2), rotary group (3, 4), cam (5), drive shaft (6) and flow distributor (7)

Transmission
The cylinder block (4) is connected to the shaft (6) by means of splines. The pistons (3) are arranged radially in the cylinder block (4) and make contact with the cam (5) via rollers (8).

Torque Generation



The number of working and return strokes corresponds to the number of lobes on the cam x number of pistons (8).

Flow paths
The cylinder chambers (E) are connected to ports A and B via the axial bores and the annular passages (D).

Bearings
Tapered roller bearings capable of transmitting high axial and radial forces are fitted as standard, except on Hydrobase motors.

Freewheeling
In certain applications there may be a requirement to freewheel the motor. This may be achieved by connecting ports A and B to zero pressure and simultaneously applying a pressure of 2 bar to the housing through port L. In this condition, the pistons are forced into the cylinder block which forces the rollers to lose contact with the cam thus allowing free rotation of the shaft.

Two speed operation (2W)

In mobile applications where vehicles are required to operate at high speed with low motor loads, the motor can be switched to a low-torque and high-speed mode. This is achieved by operating an integrated valve which directs hydraulic fluid to only one half of the motor while continuously re-circulating the fluid in the other half. This “reduced displacement” mode reduces the flow required for a given speed and gives the potential for cost and efficiency improvements. The motor maximum speed remains unchanged.

Rexroth has developed a special spool valve to allow smooth switching to reduced displacement whilst on the move. This is known as “soft-shift” and is a standard feature of 2W motors. The spool valve requires either an additional sequence valve or electro-proportional control to operate in “soft-shift” mode.

Flushing valve

In a closed circuit, the same hydraulic fluid continuously flows between the pump and the motor. This could therefore lead to overheating of the hydraulic fluid.

The function of the flushing valve option is to replace hydraulic fluid in the closed circuit with that from the reservoir. When the hydraulic motor is operated under load, either in the clockwise or anti-clockwise direction, the flushing valve opens and takes a fixed flow of fluid through an orifice from the low pressure side of the circuit. This flow is then fed to the motor housing and back to the reservoir normally via a cooler. In order to charge the low pressure side of the circuit, cool fluid is drawn from the reservoir by the boost pump and is fed to the pump inlet through the check valve. Thus the flushing valve ensures a continuous renewal and cooling of the hydraulic fluid. The flushing feature incorporates a relief valve which is used to maintain a minimum boost pressure and operates at a standard setting of 14 bar (other options available on request).

Different orifice sizes may be used to select varying flows of flushing fluid. The following table gives flushing rate values based on a boost / charge pressure of 25 bar.

Functional Description

Flushing flow rates (for $p_{charge} - p_{case} = 25$ bar)

Ordering code	Flow	(±1 l/min)
F1	3	l/min
F2	5	l/min
F7	7	l/min
F4	10	l/min
F8	12.5	l/min
F6	13.5	l/min

Holding brake (multi-disc brake)

Mounting

By way of rear housing (2) and brake shaft (16).

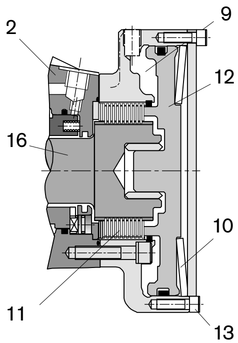
Brake application

As a safety requirement in mobile applications a parking brake may be provided to ensure that the motor cannot turn when the machine is not in use. The parking brake provides holding torque by means of discs (11) that are compressed by a disc spring (10). The brake is released when oil pressure is applied to brake port "Z" and the pressure in the annular area (9) compresses the disc spring allowing the brake discs to turn independently.

Note: This brake is provided solely for static use - not to be used dynamically.

Manual release of holding brake

The brake may also be released manually by loosening screws (13).



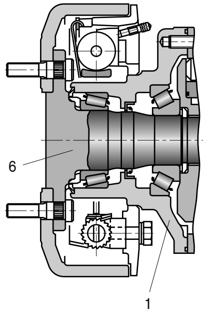
Dynamic brake

Where mechanical dynamic braking is required, a drum brake may be specified. The drum brake is mounted directly onto the drive shaft (6) and front housing (1). Braking torque is provided by brake shoes acting on the inside of the drum.

Operation of brake

– hydraulic brake fluid (special order required for mineral oil operation)

– mechanical brake cable (not supplied)

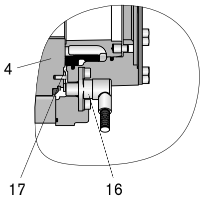


Speed sensor

A Hall-effect speed sensor (16) may be fitted as an option, giving a two-channel output of phase-displaced square waves, and enabling detection of speed and direction. A toothed target disc (17) is fitted to the motor cylinder block (4), and the sensor, fitted to a port in the rear case, produces a pulse on each channel as each tooth passes in front of it. The frequency of the pulses is proportional to the rotational speed.

Versions are available for use with regulated supplies (Code P1) and for direct connection to a 12 V or 24 V unregulated supply (Code P2).

The motor can also be supplied fitted with a target disc and with a speed sensor port machined, but covered and sealed with a blanking plate (Code P0). These "sensor-ready" motors may be fitted with a sensor at a later date.



6

Ordering code

MCR	5				Z	–	3X				12					
01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16

Radial piston motor

01		**MCR**

Frame size

02	Frame size 5	**5**

Housing Type

03	Front case flanged	**A**
	Front case flanged, SAE 4 metric holes	**D**
	Rear case flanged, compact	**C**
	Rear case flanged	**F**
	Hydrobase (half motor)	**H**

	Nominal size, displacement V in cm^3/rev		380	470	520	565	620	680	750	820
04	Low Displacement: motors use standard cylindrical pistons	**LD**	●	●	●	●	–	–	–	–
	High Displacement: motors use stepped pistons	**HD**	–	–	–	–	●	●	●	●

Drive shaft

05	Splined shaft ANSI B92.1 (only available with housing type "A")	**A60**
	Parallel keyed shaft Ø50 mm (only available with housing type "D" – maximum torque 3000 Nm)	**L50**
	With flange Ø180 mm (only available with housing type "C" and "F")	**F180**
	Without drive shaft (only available with housing type "H")	**Z**

Through shaft

06	Without through shaft	**Z**

Series

07	Series 30 to 39 (series 30 to 39 are dimensionally interchangeable)	**3X**

Brake

08	Without brake	**A0**
	Hydraulic release spring applied multi-disc holding brake 2200 Nm	**B2**
	Hydraulic release spring applied multi-disc holding brake 4400 Nm	**B4**
	Dynamic brake (drum brake) for right hand side of vehicle (see figure page 16)	**C4R**
	Dynamic brake (drum brake) for left hand side of vehicle (see figure page 16)	**C4L**

Seals

09	NBR (nitrile rubber) (except dynamic brake – see page 16)	**M**
	FKM (fluoroelastomer/Viton) (except dynamic brake – see page 16)	**V**

Single / Two-speed operation

10	Single speed, standard direction of rotation	**1L**
	Bi-directional two speed, standard direction of rotation	**2WL**

Ports

11	Tapped with UNF thread (SAE J514)	**12**

Studs

12	Without studs (no code)	
	With wheel studs and nuts (Studs only fitted to motors with housing type "C" and "F"; 5 studs on "C" type, 10 studs on "F" type)	**S**
	With twice normal number of wheel studs and nuts (only available with housing type "C")	**SS**

Speed sensor

13	Without sensor (no code)	
	Sensor ready	**P0**
	Sensor without regulator	**P1**
	Sensor with regulator	**P2**

Flushing

14	Without flushing (no code)	
	With flushing (see table on page 3)	**F1 to F8**

● = available – = not available

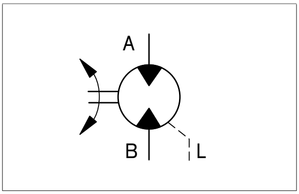
Ordering code

MCR	5				Z	–	3X				12					
01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16

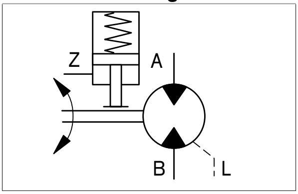
	Special order	
15	Special feature	SOXXX
	Other	
16	Mark in text here	*

Schematic diagrams

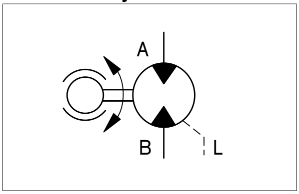
Motor without brake



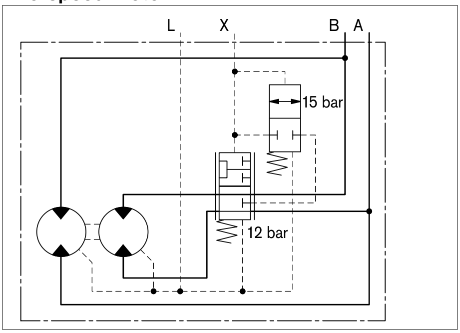
Motor with holding brake



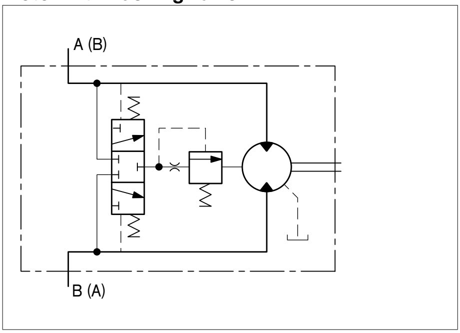
Motor with dynamic brake



Two-speed motor

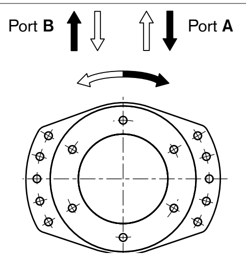


Motor with flushing valve



Direction of rotation

Direction of shaft rotation with flow (viewed from drive shaft)



Ordering code ... 1L ... or ... 2WL ...

Technical data

(For operation outside of these parameters, please consult Rexroth)

Description			Radial-piston type, low-speed, high-torque motor							
Frame size			MCR5							
Type of mounting			Flange mounting; face mounting							
Pipe connections[1)2)]			Threaded per SAE J514							
Shaft loading			see page 9							
Displacement	V_g	cm^3/rev	380	470	520	565	620	680	750	820
Output torque										
Specific torque (at Δp = 250 bar)		Nm	1360	1680	1860	2020	2220	2440	2690	2940
Maximum torque[3)4)]	T_{max}	Nm	2450	3030	3350	3640	3550	3900	4300	4700
Output speed										
Minimum speed for smooth running[5)]	n_{min}	rpm	5	5	5	5	0.5	0.5	0.5	0.5
Maximum speed (1L)[6) 7) 8)]	n_{max}	rpm	475	385	350	320	290	265	240	220
Maximum speed (2WL)[6) 7)]	n_{max}	rpm	570	465	420	385	350	320	290	265
Output power										
Nominal power[9)]	P	kW	29	29	29	29	35	35	35	35
Weight	m	kg	see unit dimensions on pages 10-17							
Moment of inertia	J_m	kgm^2	see unit dimensions on pages 10-17							
Hydraulic										
Pressure[10)]										
Nominal pressure[9)]	p_{nom}	bar	250	250	250	250	250	250	250	250
Maximum differential pressure[3)]	Δp_{max}	bar	450	450	450	450	400	400	400	400
Maximum pressure at port "A" or "B"[3)]	p_{max}	bar	470	470	470	470	420	420	420	420
Maximum case drain pressure	$p_{case\ max}$	bar	10	10	10	10	10	10	10	10
Hydraulic fluid [11) 12)]			Mineral oils (HLP) to DIN 51 524							
Hydraulic fluid temperature range[13)]	$t_{min/max}$	°C	-20 to +85							
Viscosity Range	$\nu_{min/max}$	mm^2/s	10 to 2000							
Fluid cleanliness			ISO 4406, Class 20/18/15							
Brake										
Holding brake (disc brake)			B2				B4			
Minimum holding torque	T_{min}	Nm	2200				4400			
Release pressure (min/max)	p_{rel}	bar	11/15				11/15			
Maximum pressure at brake port "Z"		bar	40				40			
Oil volume to operate brake	V_{rel}	cm^3	23				46			
Dynamic brake (drum brake)			see information on page 16							

1) Ensure motor case is filled with oil prior to start-up. See operating manual RE 15215-B.
2) For installation and maintenance details, please see operating manual RE 15215-B.
3) Maximum values should only be applied for a small portion of the duty cycle. Please consult Rexroth Engineering Department in Glenrothes for motor life calculations based on particular operating cases.
4) For motors with housing type D, maximum torque is 3000 Nm, which restricts maximum pressure accordingly.
5) For continuous operation at speeds < 5 rpm please consult Rexroth Engineering Department in Glenrothes.
6) Based on nominal no-load DP of 20 bar in full-displacement mode.
7) Warning! During the running in period of the motor (min. 20 hrs) it should not be run unloaded at >100 rpm.
8) Single-speed (1L) motors are available by special order with a 20 % increase in the stated maximum speed.
9) When operating motors in series, please consult Rexroth Engineering Department in Glenrothes.
10) Nominal values are guide values for continuous operation.
11) For use with environmentally acceptable fluids HEES, HEPG, HETG, Viton seals must be specified. For further information, please refer to RE 90221.
12) For use with HF hydraulic fluids please refer to RE 90229
Extension of the allowable temperature range may be possible depending on specification.
13) Please consult Rexroth Engineering Department in Glenrothes for further details.

Technical data (Mean values, measured at $\nu = 46\ mm^2/s$ and $t = 45\ °C$)

– All torques apply to run-in motors

– For reduced displacement operating mode multiply the torques by ratio of reduced displacement

Note

– Case pressure must be added to minimum charge pressures quoted. Quoted pressures are guide values but can be circuit-dependant. Please contact Bosch Rexroth Engineering Department in Glenrothes for further advice. Figures quoted in technical data tables below are average values.

– Where flushing is used, q_{VL} will increase by the flushing flow rate. Mean case leakage values are average values for single speed motors

T = Torque in Nm

q_V = Input flow in l/min

q_{VL} = Mean case leakage in l/min

p = Minimum charge pressure in pump mode in bar

			MCR5 . 380						MCR5 . 470					
Pressure Diff. Δp (bar)	**Speed n**	rpm	0	25	50	100	150	200	0	25	50	100	150	200
100	T	Nm	314	538	544	542	540	537	389	666	673	669	666	658
	q_V	l/min	0.55	10.05	19.55	38.55	57.55	76.55	0.55	12.30	24.05	47.55	71.05	94.55
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
200	T	Nm	726	1101	1113	1109	1104	1099	898	1361	1376	1369	1361	
	q_V	l/min	1.10	10.60	20.10	39.10	58.10	77.10	1.10	12.85	24.60	48.10	71.60	
	q_{VL}	l/min	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	
300	T	Nm	1161	1669	1687	1682	1674		1436	2065	2087	2076		
	q_V	l/min	1.65	11.15	20.65	39.65	58.65		1.65	13.40	25.15	48.65		
	q_{VL}	l/min	0.27	0.27	0.27	0.27	0.27		0.27	0.27	0.27	0.27		
400	T	Nm	1645	2153	2177	2177			2035	2663	2693			
	q_V	l/min	2.20	11.70	21.20	40.20			2.20	13.95	25.70			
	q_{VL}	l/min	0.35	0.35	0.35	0.35			0.35	0.35	0.35			
Min. charge pressure	p	bar	1	4	4	6	9	14	1	5	5	7	10	16

			MCR5 . 520						MCR5 . 565					
Pressure Diff. Δp (bar)	**Speed n**	rpm	0	25	50	100	150	200	0	25	50	100	150	200
100	T	Nm	430	737	745	740	734	725	468	791	809	800	782	773
	q_V	l/min	0.55	13.55	26.55	52.55	78.55	104.55	0.55	14.68	28.80	57.05	85.30	113.55
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
200	T	Nm	993	1506	1523	1513	1504		1079	800	809	818	827	
	q_V	l/min	1.10	14.10	27.10	53.10	79.10		1.10	15.23	29.35	57.60	85.85	
	q_{VL}	l/min	0.18	0.18	0.18	0.18	0.18		0.18	0.18	0.18	0.18	0.18	
300	T	Nm	1589	2284	2309	2294			1727	2374	2428	2482		
	q_V	l/min	1.65	14.65	27.65	53.65			1.65	15.78	29.90	58.15		
	q_{VL}	l/min	0.27	0.27	0.27	0.27			0.27	0.27	0.27	0.27		
400	T	Nm	2251	2946	2979				2446	3093	3165			
	q_V	l/min	2,20	15.20	28.20				2.20	16.33	30.45			
	q_{VL}	l/min	0.35	0.35	0.35				0.35	0.35	0.35			
Min. charge pressure	p	bar	1	6	6	7	11	17	1	6	6	8	12	18

Technical data (Mean values, measured at $\nu = 46\ mm^2/s$ and $t = 45\ °C$)

			MCR5 . 620					
Pressure Diff. Δp (bar)	**Speed n**	rpm	0	25	50	100	150	200
100	T	Nm	513	878	888	878	868	845
	q_V	l/min	0.55	16.05	31.55	62.55	9.55	124.55
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09
200	T	Nm	1184	1796	1816	1796	1776	
	q_V	l/min	1.10	16.60	32.10	63.10	94.10	
	q_{VL}	l/min	0.18	0.18	0.18	0.18	0.18	
300	T	Nm	1895	2723	2753	2738		
	q_V	l/min	1.65	17.15	32.65	63.65		
	q_{VL}	l/min	0.27	0.27	0.27	0.27		
400	T	Nm	2684	3513	3552			
	q_V	l/min	2.20	17.70	33.20			
	q_{VL}	l/min	0.35	0.35	0.35			
Min. charge pressure	p	bar	1	2	3	7	12	23

			MCR5 . 680					
Pressure Diff. Δp (bar)	**Speed n**	rpm	0	25	50	100	150	200
100	T	Nm	563	963	974	963	942	920
	q_V	l/min	0.55	17.55	34.55	68.55	102.55	136.55
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09
200	T	Nm	1299	1970	1991	1970	1948	
	q_V	l/min	1.10	18.10	35.10	69.10	103.10	
	q_{VL}	l/min	0.18	0.18	0.18	0.18	0.18	
300	T	Nm	2078	2987	3019	3003		
	q_V	l/min	1.65	18.65	35.65	69.65		
	q_{VL}	l/min	0.27	0.27	0.27	0.27		
400	T	Nm	2944	3853	3896			
	q_V	l/min	2.20	19.20	36.20			
	q_{VL}	l/min	0.35	0.35	0.35			
Min. charge pressure	p	bar	1	3	4	9	15	25

			MCR5 . 750				
Pressure Diff. Δp (bar)	**Speed n**	rpm	0	25	50	100	150
100	T	Nm	621	1062	1074	1056	1033
	q_V	l/min	0.55	19.30	38.05	75.55	113.05
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09
200	T	Nm	1432	2172	2196	2172	2149
	q_V	l/min	1.10	19.85	38.60	76.10	113.60
	q_{VL}	l/min	0.18	0.18	0.18	0,18	0.18
300	T	Nm	2292	3295	3330	3312	
	q_V	l/min	1.65	20.40	39.15	76.65	
	q_{VL}	l/min	0.27	0.27	0.27	0.27	
400	T	Nm	3247	4249	4297		
	q_V	l/min	2.20	20,95	39.70		
	q_{VL}	l/min	0.35	0.35	0.35		
Min. charge pressure	p	bar	1	3	4	9	15

			MCR5 . 820				
Pressure Diff. Δp (bar)	**Speed n**	rpm	0	25	50	100	150
100	T	Nm	679	1162	1175	1148	1135
	q_V	l/min	0.55	21.05	41.55	82.55	123.55
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09
200	T	Nm	1566	2375	2401	2375	2349
	q_V	l/min	1.10	19.85	38.60	76.10	113.60
	q_{VL}	l/min	0.18	0.18	0.18	0.18	0.18
300	T	Nm	2506	3602	3641	3622	
	q_V	l/min	1.65	20.40	39.15	76.65	
	q_{VL}	l/min	0.27	0.27	0.27	0.27	
400	T	Nm	3550	4646	4698		
	q_V	l/min	2.20	20.95	39.70		
	q_{VL}	l/min	0.35	0.35	0.35		
Min. charge pressure	p	bar	1	4	6	11	19

Permitted loading on drive shaft

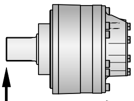
(Speed n = 50 rpm, pressure differential Δp = 250 bar, 2000 hrs L10 life at 50 °C)

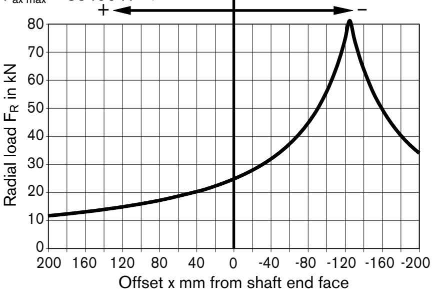
Drive shaft ...A60...

Housing type **...A...**

Maximum axial load $\mathbf{F}_{ax\ max}$ (with radial load F_R = 0):

$F_{ax\ max}$ = 49000 N ⇦ +
$F_{ax\ max}$ = 35400 N ⇨ –



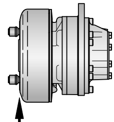


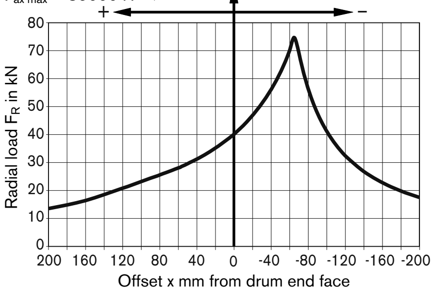
Drive shaft ...F180... (10 studs M18) C4 Brake

Housing type **...F...C4**

Maximum axial load $\mathbf{F}_{ax\ max}$ (with radial load F_R = 0):

$F_{ax\ max}$ = 50000 N ⇦ +
$F_{ax\ max}$ = 39000 N ⇨ –



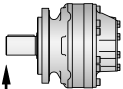


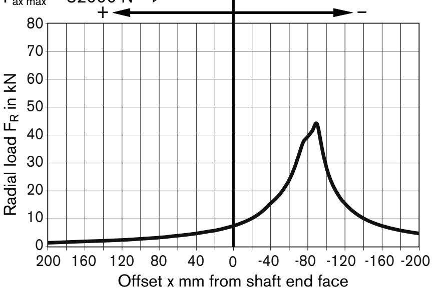
Drive shaft ...L50...

Housing type **...D...**

Maximum axial load $\mathbf{F}_{ax\ max}$ (with radial load F_R = 0):

$F_{ax\ max}$ = 50000 N ⇦ +
$F_{ax\ max}$ = 32000 N ⇨ –



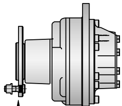


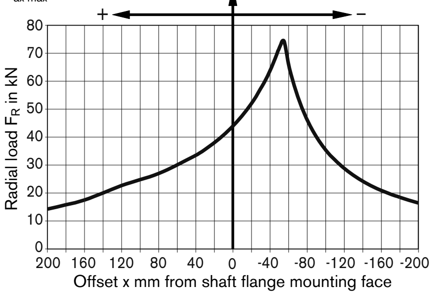
Drive shaft ...F180... (10 studs M14)

Housing type **...F...**

Maximum axial load $\mathbf{F}_{ax\ max}$ (with radial load F_R = 0):

$F_{ax\ max}$ = 50000 N ⇦ +
$F_{ax\ max}$ = 39000 N ⇨ –



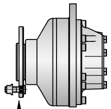


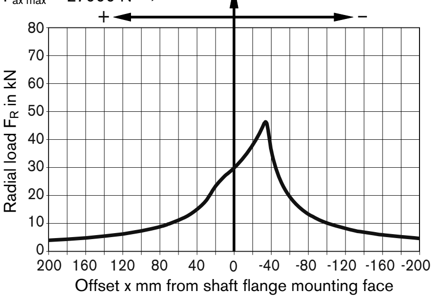
Drive shaft ...F180... (5 studs M14)

Housing type **...C...**

Maximum axial load $\mathbf{F}_{ax\ max}$ (with radial load F_R = 0):

$F_{ax\ max}$ = 50000 N ⇦ +
$F_{ax\ max}$ = 27000 N ⇨ –





Note:

These values and graphs are for initial guidance only.
For actual motor life calculations under typical or specified duty cycles, contact Rexroth Engineering Department in Glenrothes.

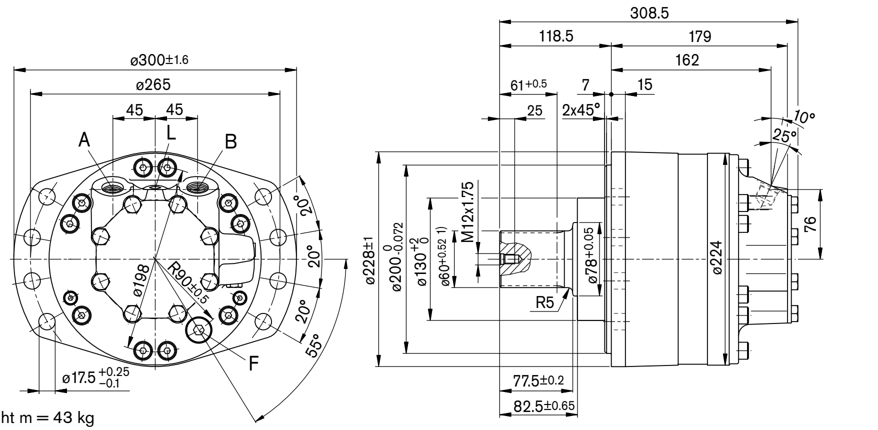
6

Dimensions

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

Flanged front housing, splined drive shaft, single speed (1)

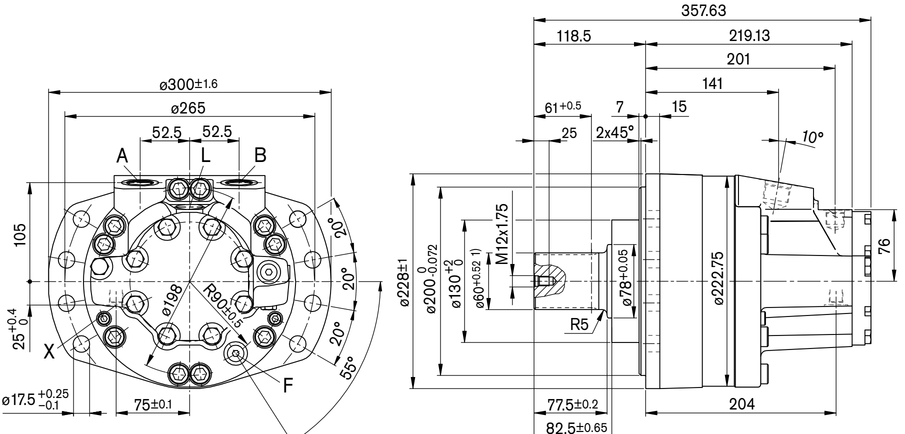
Ordering code: "MCR5A…A60Z-32/A0.1L/12./..."



Weight m = 43 kg
Polar moment of inertia J_m = 25050 kgmm²

Flanged front housing, splined drive shaft, two speed (2W)

Ordering code: "MCR5A…A60Z-32/A0.2WL/12./..."



Weight m = 50 kg
Polar moment of inertia J_m =25050 kgmm²

Ports

Designation	Port function	Code 12	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J514	1 1/16 in - 12 UNF	470/420[2)]	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) Spline data: ANSI B92.1-1996 class 5, 30° Pressure angle, Fillet root side fit, Pitch 24/48, PCD 59.26 mm, No. of teeth 56
2) depends on nominal size

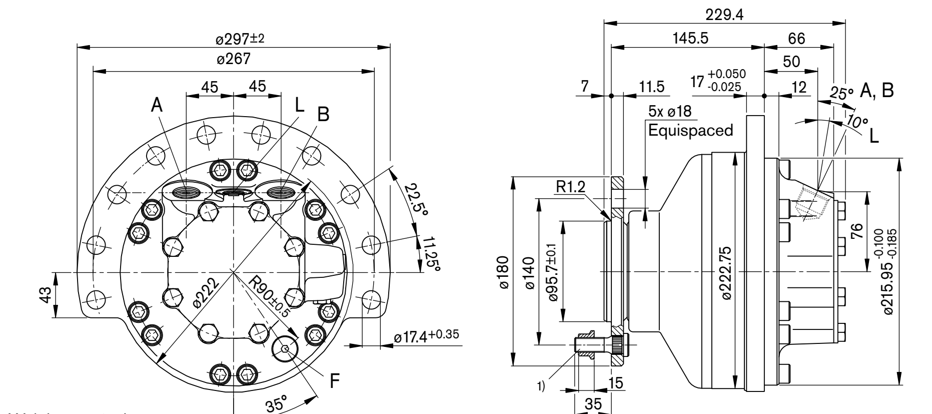
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions

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

Flanged rear housing, flanged drive shaft, compact front housing, single speed (1)

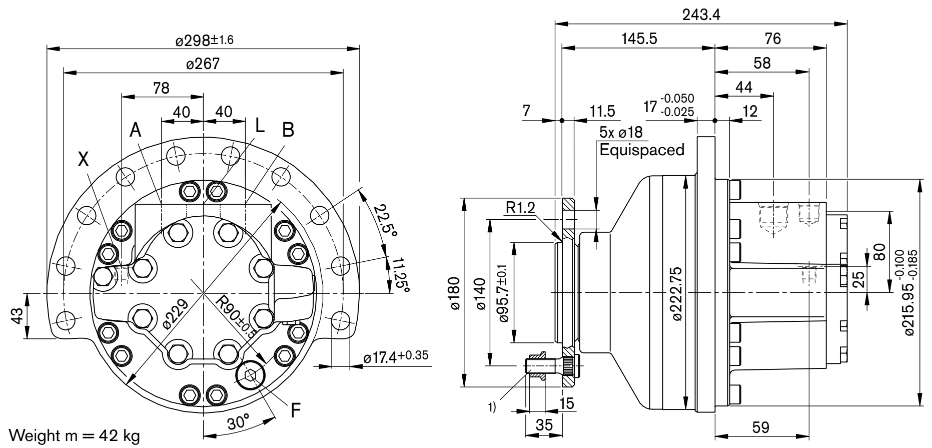
Ordering code: "MCR5C…F180Z-32/A0.1L/12./…"



Weight m = 35 kg
Polar moment of inertia J_m = 25050 kgmm²

Flanged rear housing, flanged drive shaft, compact front housing, two speed (2W)

Ordering code: "MCR5C…F180Z-32/A0.2WL/12./…"



Weight m = 42 kg
Polar moment of inertia J_m = 25050 kgmm²

Ports

Designation	Port function	Code 12	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J514	1 1/16 in - 12 UNF	470/420[2)]	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 5x wheel studs M14x1.5 with shouldered hex nut for wheel fixing, clamping length 5 to 20 mm, ordering code S (wheel studs and nuts equally spaced on P.C.D. of 140)

2) depends on nominal size

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

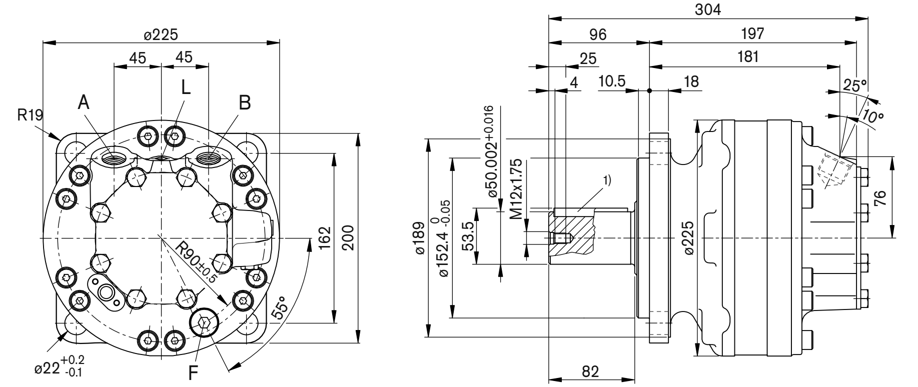
6

Dimensions

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

4 hole SAE flanged front housing, parallel drive shaft, single speed (1)

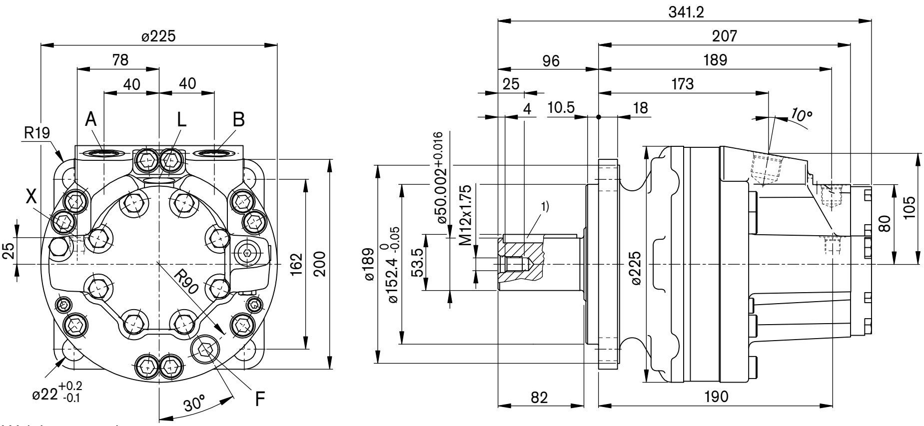
Ordering code: "MCR5D…L50Z-32/A0.1L/12./…"



Weight m = 39 kg
Polar moment of inertia J_m = 25050 kgmm²

4 hole SAE flanged front housing, parallel drive shaft, two speed (2W)

Ordering code: "MCR5D…L50Z-32/A0.2WL/12./…"



Weight m = 47 kg
Polar moment of inertia J_m = 25050 kgmm²

Note: To prevent excessive shaft loading with D-type motors, the mating bore should have F7 or G6 tolerance

Ports

Designation	Port function	Code 12	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J514	1 1/16 in - 12 UNF	470/420[2)]	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) Parallel key A14x9x70 – DIN 6885
2) depends on nominal size

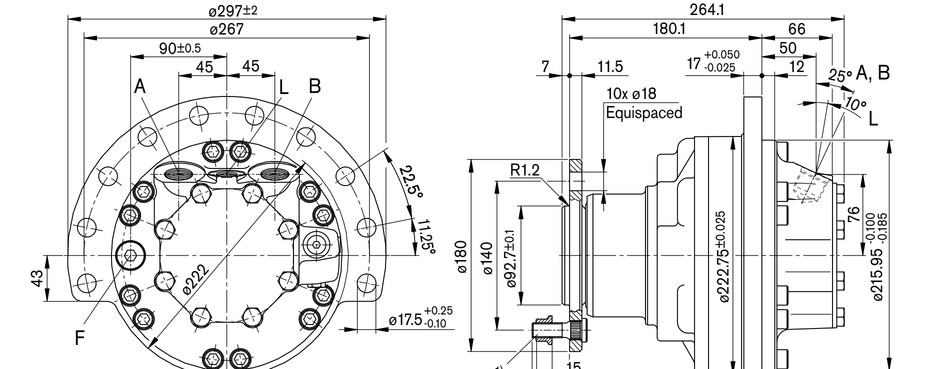
O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Dimensions

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

Flanged rear housing, flanged drive shaft, single speed (1)

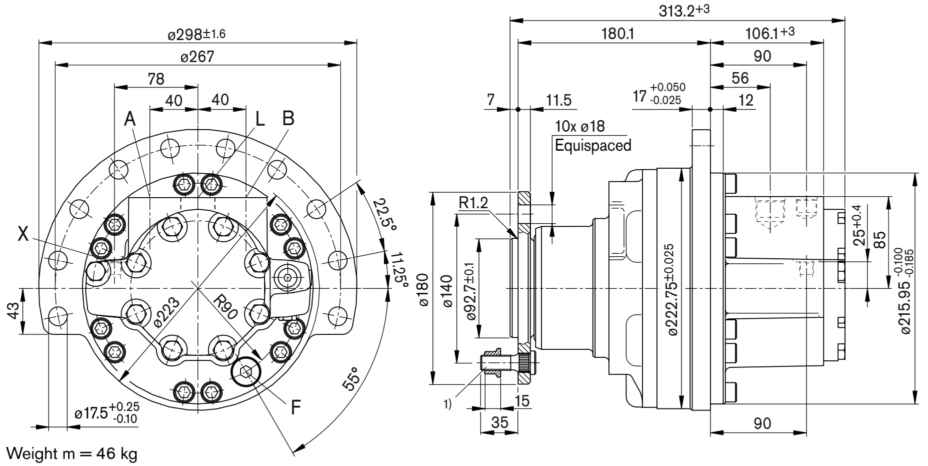
Ordering code: "MCR5F…F180Z-32/A0.1L/12./…"



Weight m = 38 kg
Polar moment of inertia J_m = 32116 kgmm²

Flanged rear housing, flanged drive shaft, two speed (2W)

Ordering code: "MCR5F…F180Z-32/A0.2WL/12./…"



Weight m = 46 kg
Polar moment of inertia J_m = 32116 kgmm²

Ports

Designation	Port function	Code 12	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J514	1 1/16 in - 12 UNF	470/420[2)]	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 10x wheel studs M14x1.5 with shouldered hex nut for wheel fixing, clamping length 5 to 20 mm, ordering code S (wheel studs and nuts equally spaced on P.C.D. of 140)

2) depends on nominal size

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

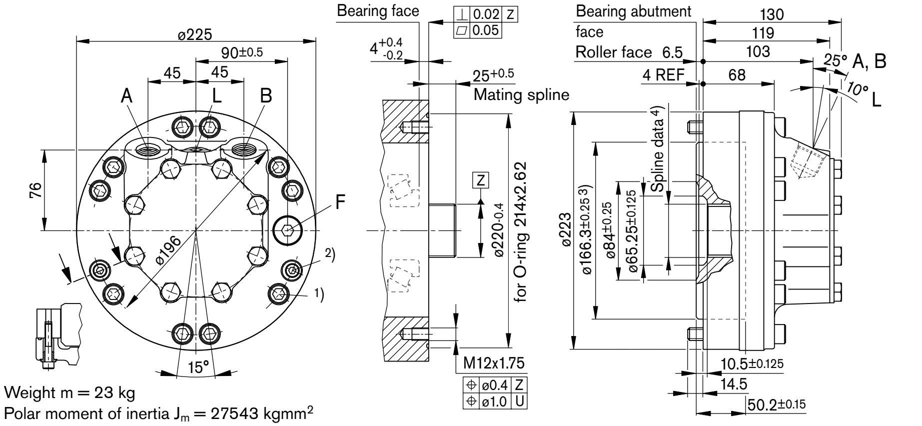
6

Dimensions

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

Hydrobase for mounting on customer´s shaft, single speed (1)

Ordering code: "MCR5H…ZZ-32/A0.1L/12./…"

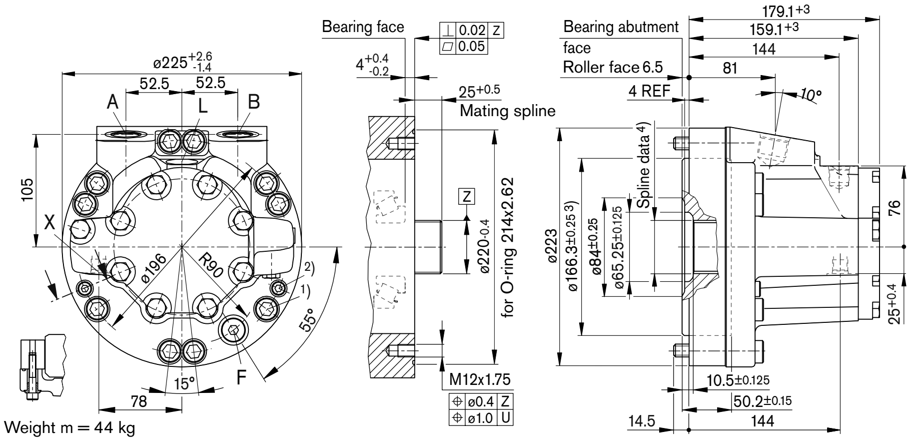


Weight m = 23 kg

Polar moment of inertia J_m = 27543 $kgmm^2$

Hydrobase for mounting on customer´s shaft, two speed (2W)

Ordering code: "MCR5H…ZZ-32/A0.2WL/12./…"



Weight m = 44 kg

Polar moment of inertia J_m = 27543 $kgmm^2$

Ports

Designation	Port function	Code 12	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J514	1 1/16 in - 12 UNF	470/420 5)	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 10x M12x1.75 bolts on a P.C.D of 196

2) 2x M8 bolts used to retain cam and cannot be used for mounting motor, see bolt sectional view

3) Mating part must clear this diameter

4) Spline data: N50x2x24x9H DIN 5480

5) depends on nominal size

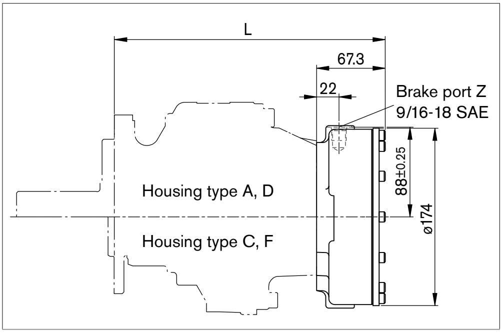
O = Must be connected (plugged on delivery)

X = Plugged (in normal operation)

Dimensions

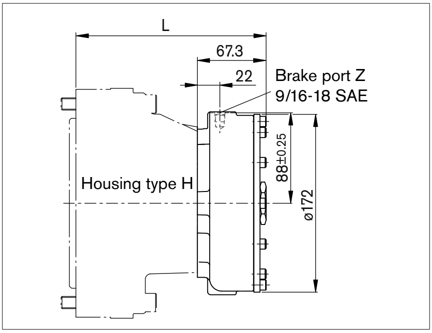
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

Holding Brake (multi-disc brake): ordering code “B2”



Housing type	Single speed (1) L	Two speed (2W) L
A	246.3	286.6
C	278.8	288.8
D	264.3	274.3
F	313.4	353.5

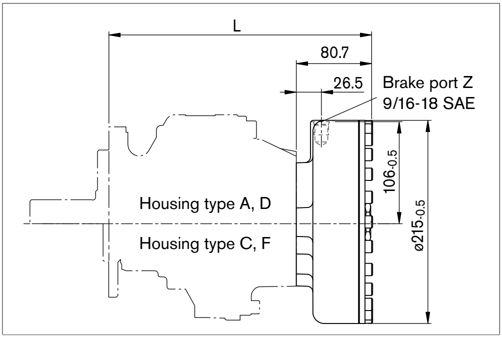
Weight m = 9.5 kg
Polar moment of inertia J_m = 1403 kgmm^2



Housing type	Single speed (1) L	Two speed (2W) L
H	186.3	226.4

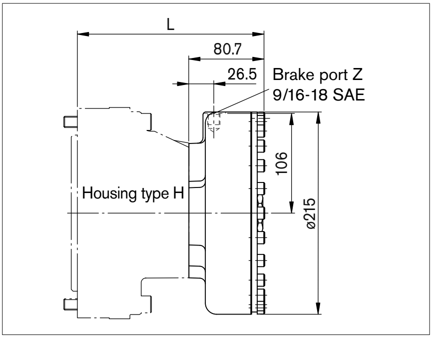
Weight m = 9.5 kg
Polar moment of inertia J_m = 1403 kgmm^2

Holding Brake (multi-disc brake): ordering code “B4”



Housing type	Single speed (1) L	Two speed (2W) L
A	259.7	300
C	292.2	302.2
D	277.7	287.7
F	326.8	366.9

Weight m = 16 kg
Polar moment of inertia J_m = 2980 kgmm^2



Housing type	Single speed (1) L	Two speed (2W) L
H	199.7	239.8

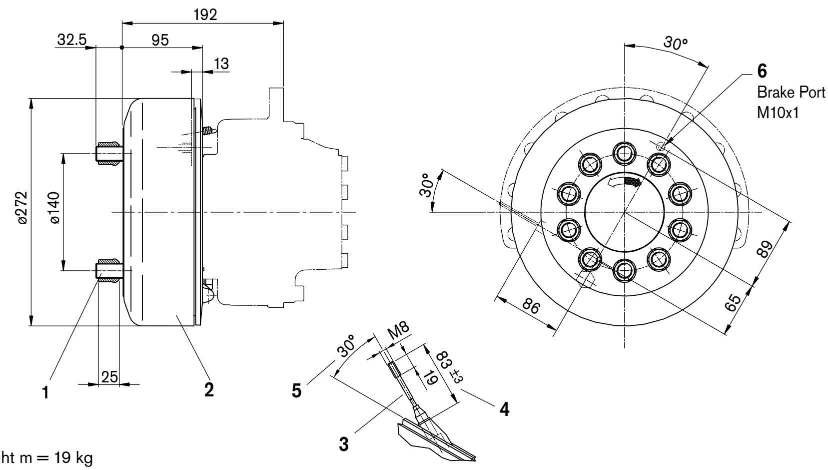
Weight m = 16 kg
Polar moment of inertia J_m = 2980 kgmm^2

6

Dimensions

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

Dynamic brake (drum brake): ordering code “C4R” / “C4L”



Weight m = 19 kg
Polar moment of inertia J_m = 53546 kgmm^2

1 **10** Studs M18x1.5 with spherical wheel nuts

2 Dynamic brake (drum brake) ordering code C4L/R for use with brake fluid DOT 3+5 or SAE Jl 703.
If brake is to be used with mineral oil a special order is to be made.
Please state if seals for mineral oil are required when placing order.

3 Brake cable (Bowden cable).
The brake illustrated is for right side of vehicle. The left is a mirror image of this (see fig. below).

4 Brake cable length.

5 Angular position of brake cable.

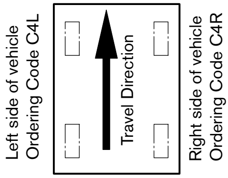
6 Brake port p_{max} = 97 bar.
Brake cylinder operating volume V = 9 cm^3.

MCR dynamic drum brake run-in procedure

– Brake the machine hard in forward and reverse directions until the brake drum temperature reaches 200 °C.

– Allow the brake to cool.

– To remove residue, brake gently 2 times each in the forward and reverse directions.



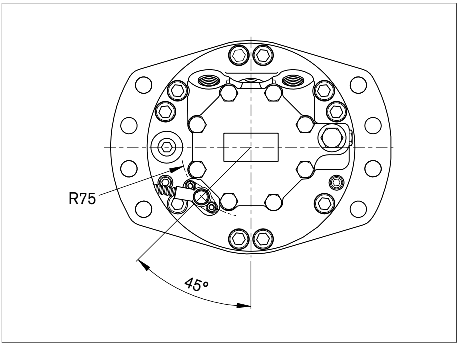
Brake torque after run-in

Braking torque	Cable tension	Braking torque	Port pressure
3000 Nm	1270 N	3000 Nm	73 bar
4000 Nm	1661 N	4000 Nm	97 bar

Dimensions

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

Speed sensor: ordering code “P1” / “P2”



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Telefax +44 (0) 15 92 631 936
www.boschrexroth.co.uk

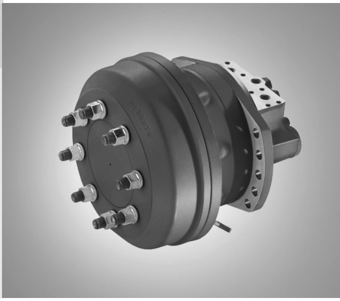
The data specified in this document serve only to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from this information. The given information does not release the user from the obligation of own judgement and verification. It must be remembered that our products are subject to a natural process of wear and ageing.

Subject to change.

Radial Piston Motor (Multi-Stroke) MCR10

Data sheet

Series 3X
Size 780 to 1340
Differential pressure up to 450 bar
Torque output up to 8000 Nm
Speed up to 215 rpm
Open and closed circuits

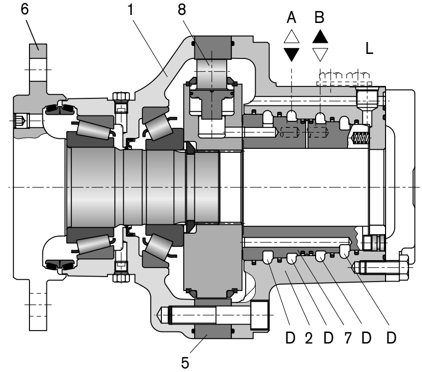


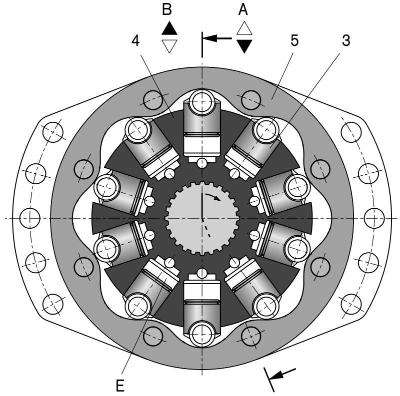
Contents

Features

– Compact robust construction
– High volumetric and mechanical efficiencies
– High pressure rating
– High reliability
– Low maintenance
– Smooth running at very low speeds
– Low noise
– Reversible
– Sealed tapered roller bearings
– High radial forces permitted on drive shaft
– Freewheeling possible
– Available with optional holding brake (multi-disc) or dynamic (drum) brake
– Available with:
  - Bi-directional two speed
  - Integrated flushing valve
  - Speed sensor

Functional description



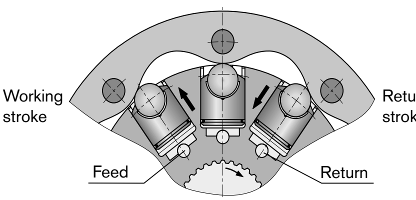


Hydraulic motors type MCR are radial piston motors with a rotating shaft.

Construction
Two part housing (1, 2), rotary group (3, 4), cam (5), drive shaft (6) and flow distributor (7)

Transmission
The cylinder block (4) is connected to the shaft (6) by means of splines. The pistons (3) are arranged radially in the cylinder block (4) and make contact with the cam (5) via rollers (8).

Torque Generation



The number of working and return strokes corresponds to the number of lobes on the cam x number of pistons (10).

Flow paths
The cylinder chambers (E) are connected to ports A and B via the axial bores and the annular passages (D).

Bearings
Tapered roller bearings capable of transmitting high axial and radial forces are fitted as standard, except on Hydrobase motors.

Freewheeling
In certain applications there may be a requirement to freewheel the motor. This may be achieved by connecting ports A and B to zero pressure and simultaneously applying a pressure of 2 bar to the housing through port L. In this condition, the pistons are forced into the cylinder block which forces the rollers to lose contact with the cam thus allowing free rotation of the shaft.

Two speed operation (2W)

In mobile applications where vehicles are required to operate at high speed with low motor loads, the motor can be switched to a low-torque and high-speed mode. This is achieved by operating an integrated valve which directs hydraulic fluid to only one half of the motor while continuously re-circulating the fluid in the other half. This “reduced displacement” mode reduces the flow required for a given speed and gives the potential for cost and efficiency improvements. The motor maximum speed remains unchanged.

Rexroth has developed a special spool valve to allow smooth switching to reduced displacement whilst on the move. This is known as “soft-shift” and is a standard feature of 2W motors. The spool valve requires either an additional sequence valve or electro-proportional control to operate in “soft-shift” mode.

Flushing valve

In a closed circuit, the same hydraulic fluid continuously flows between the pump and the motor. This could therefore lead to overheating of the hydraulic fluid.

The function of the flushing valve option is to replace hydraulic fluid in the closed circuit with that from the reservoir. When the hydraulic motor is operated under load, either in the clockwise or anti-clockwise direction, the flushing valve opens and takes a fixed flow of fluid through an orifice from the low pressure side of the circuit. This flow is then fed to the motor housing and back to the reservoir normally via a cooler. In order to charge the low pressure side of the circuit, cool fluid is drawn from the reservoir by the boost pump and is fed to the pump inlet through the check valve. Thus the flushing valve ensures a continuous renewal and cooling of the hydraulic fluid. The flushing feature incorporates a relief valve which is used to maintain a minimum boost pressure and operates at a standard setting of 14 bar (other options available on request).

Different orifice sizes may be used to select varying flows of flushing fluid. The following table gives flushing rate values based on a boost / charge pressure of 25 bar.

Functional Description

Flushing flow rates (for $p_{charge} - p_{case} = 25$ bar)

Ordering code	Flow	(±1 l/min)
F1	3	l/min
F2	5	l/min
F7	7	l/min
F4	10	l/min
F8	12.5	l/min
F6	13.5	l/min

Holding brake (multi-disc brake)

Mounting

By way of rear housing (2) and brake shaft (16).

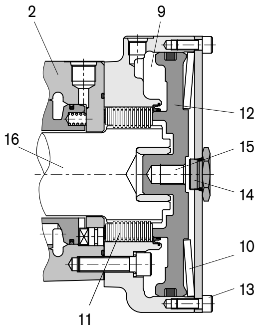
Brake application

As a safety requirement in mobile applications a parking brake may be provided to ensure that the motor cannot turn when the machine is not in use. The parking brake provides holding torque by means of discs (11) that are compressed by a disc spring (10). The brake is released when oil pressure is applied to brake port "Z" and the pressure in the annular area (9) compresses the disc spring allowing the brake discs to turn independently.

Note: This brake is provided solely for static use - not to be used dynamically.

Manual release of holding brake

The brake may also be released manually by loosening screws (13), or by removing plug (14) and inserting a puller into the tapped hole on the brake piston (15)



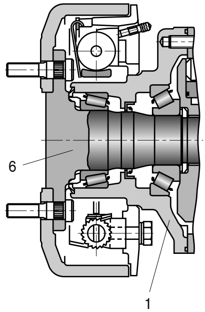
Dynamic brake

Where mechanical dynamic braking is required, a drum brake may be specified. The drum brake is mounted directly onto the drive shaft (6) and front housing (1). Braking torque is provided by brake shoes acting on the inside of the drum.

Operation of brake

– hydraulic brake fluid (special order required for mineral oil operation)

– mechanical brake cable (not supplied)

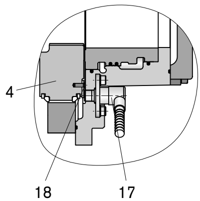


Speed sensor

A Hall-effect speed sensor (17) may be fitted as an option, giving a two-channel output of phase-displaced square waves, and enabling detection of speed and direction. A toothed target disc (18) is fitted to the motor cylinder block (4), and the sensor, fitted to a port in the rear case, produces a pulse on each channel as each tooth passes in front of it. The frequency of the pulses is proportional to the rotational speed.

Versions are available for use with regulated supplies (Code P1) and for direct connection to a 12 V or 24 V unregulated supply (Code P2).

The motor can also be supplied fitted with a target disc and with a speed sensor port machined, but covered and sealed with a blanking plate (Code P0). These "sensor-ready" motors may be fitted with a sensor at a later date.



6

Ordering code

MCR	10				Z	–	3X				42					
01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16

Radial piston motor

01		**MCR**

Frame size

02	Frame size 10	**10**

Housing Type

03	Front case flanged, SAE 4 metric holes	**D**
	Rear case flanged	**F**
	Hydrobase (half motor)	**H**

	Nominal size, displacement V in cm^3/rev		780	860	940	1120	1250	1340
04	Low Displacement: motors use standard cylindrical pistons	**LD**	●	●	●	–	–	–
	High Displacement: motors use stepped pistons	**HD**	–	–	–	●	●	●

Drive shaft

05	Parallel keyed shaft Ø60 mm (only available with housing type “D” – maximum torque 4800 Nm)	**L60**
	With flange Ø250 mm (only available with housing type “F”)	**F250**
	Without drive shaft (only available with housing type “H”)	**Z**

Through shaft

06	Without through shaft	**Z**

Series

07	Series 30 to 39 (series 30 to 39 are dimensionally interchangeable)	**3X**

Brake

08	Without brake	**A0**
	Hydraulic release spring applied multi-disc holding brake 4400 Nm	**B5**
	Hydraulic release spring applied multi-disc holding brake 7000 Nm	**B7**
	Dynamic brake (drum brake) for right hand side of vehicle (see figure page 15)	**C7R**
	Dynamic brake (drum brake) for left hand side of vehicle (see figure page 15)	**C7L**

Seals

09	NBR (nitrile rubber) (except dynamic brake – see page 15)	**M**
	FKM (fluoroelastomer/Viton) (except dynamic brake – see page 15)	**V**

Single / Two-speed operation

10	Single speed, standard direction of rotation	**1L**
	Bi-directional two speed, standard direction of rotation	**2WL**

Ports

11	Tapped with UNF thread (SAE J514) (A and B ports SAE split flange metric bolt holes)	**42**

Studs

12	Without studs (no code)	
	With wheel studs and nuts (6 studs fitted only to motors with housing type “F”)	**S**

Speed sensor

13	Without sensor (no code)	
	Sensor ready	**P0**
	Sensor without regulator	**P1**
	Sensor with regulator	**P2**

Flushing

14	Without flushing (no code)	
	With flushing (see table on page 3)	**F1 to F8**

● = available – = not available

Ordering code

MCR	10				Z	–	3X				42					
01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16

Special order

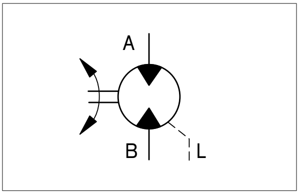
15	Special feature	SOXXX

Other

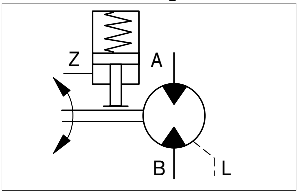
16	Mark in text here	*

Schematic diagrams

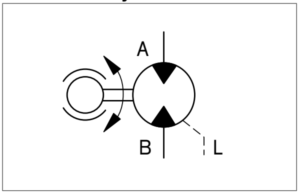
Motor without brake



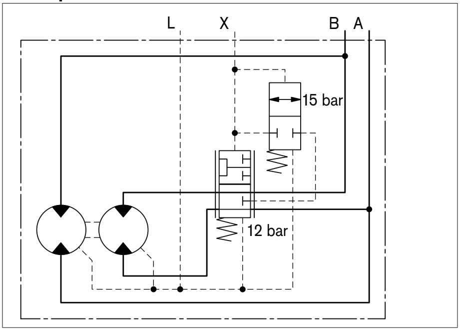
Motor with holding brake



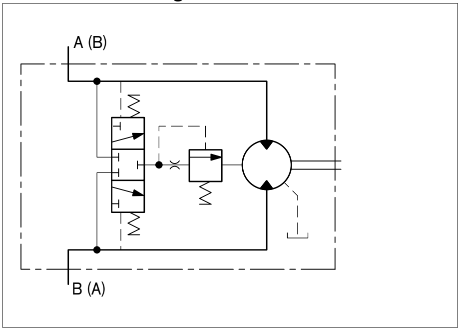
Motor with dynamic brake



Two-speed motor

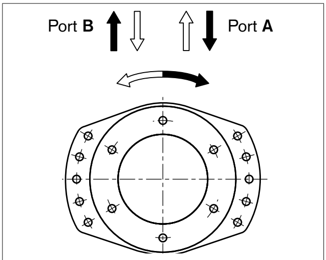


Motor with flushing valve



Direction of rotation

Direction of shaft rotation with flow (viewed from drive shaft)



Ordering code ... 1L ... or ... 2WL ...

6

Technical data

(For operation outside of these parameters, please consult Rexroth)

Description			Radial-piston type, low-speed, high-torque motor					
Frame size			MCR10					
Type of mounting			Flange mounting; face mounting					
Pipe connections[1)2)]			Flanged per SAE J518 (code 62), Threaded per SAE J514					
Shaft loading			See page 9					
Displacement	V_g	cm^3/rev	780	860	940	1120	1250	1340
Output torque								
Specific torque (at $\Delta p = 250$ bar)		Nm	2790	3080	3370	4010	4480	4800
Maximum torque[3)4)]	T_{max}	Nm	5030	5540	6060	6420	7160	7680
Output speed								
Minimum speed for smooth running[5)]	n_{min}	rpm	5	5	5	0,5	0,5	0,5
Maximum speed (1L and 2W)[6)7)]	n_{max}	rpm	215	195	180	150	135	125
Output power								
Nominal power[8)]	P	kW	44	44	44	50	50	50
Weight	m	kg	see dimensions on pages 10 - 15					
Moment of inertia	J_m	kgm^2	see dimensions on pages 10 - 15					
Hydraulic								
Pressure[9)]								
Nominal pressure[8)]	p_{nom}	bar	250	250	250	250	250	250
Maximum differential pressure[3)]	Δp_{max}	bar	450	450	450	400	400	400
Maximum pressure at port “A” or “B”[3)]	p_{max}	bar	470	470	470	420	420	420
Maximum case drain pressure	$p_{case\ max}$	bar	10	10	10	10	10	10
Hydraulic fluid [10)11)]			Mineral oils (HLP) to DIN 51 524					
Hydraulic fluid temperature range[12)]	$t_{min/max}$	°C	-20 to + 85					
Viscosity Range	$\nu_{min/max}$	mm^2/s	10 to 2000					
Fluid cleanliness			ISO 4406, Class 20/18/15					
Brake								
Holding brake (disc brake)			B5			B7		
Minimum holding torque[13)]	T_{min}	Nm	4400			7000		
Maximum pressure at brake port “Z“		bar	40			40		
Release pressure (min/max)	p_{rel}	bar	11/15			11/15		
Oil volume to operate brake	V_{rel}	cm^3	17			36		
Dynamic brake (drum brake)			see information on page 15					

1) Ensure motor case is filled with oil prior to start-up. See operating manual RE 15215-B.
2) For installation and maintenance details, please see operating manual RE 15215-B.
3) Maximum values should only be applied for a small portion of the duty cycle.
Please consult Rexroth Engineering Department in Glenrothes for motor life calculations based on particular operating cases.
4) For motors with housing type D, maximum torque is 4800 Nm, which restricts maximum pressure accordingly.
5) For continuous operation at speeds < 5 rpm please consult Rexroth Engineering Department in Glenrothes.
6) Based on nominal no-load Δp of 20 bar in full-displacement mode.
7) Warning! During the running in period of the motor (min. 20 hrs) it should not be run unloaded at > 100 rpm.
8) When operating motors in series, please consult Rexroth Engineering Department in Glenrothes.
9) Nominal values are guide values for continuous operation.
10) For use with environmentally acceptable fluids HEES, HEPG, HETG, Viton seals must be specified.
For further information, please refer to RE 90221.
11) For use with HF hydraulic fluids please refer to RE 90229.
12) Extension of the allowable temperature range may be possible depending on specification.
Please consult Rexroth Engineering Department in Glenrothes for further details.
13) Holding brake torque values apply when used with standard mineral oil (HLP) and may change where other fluids or friction modifying additives are used.

Technical data (Mean values, measured at $\nu = 46\ mm^2/s$ and $t = 45\ °C$)

- All torques apply to run-in motors
- For reduced displacement operating mode multiply the torques by ratio of reduced displacement

Note

- Case pressure must be added to minimum charge pressures quoted. Quoted pressures are guide values but can be circuit-dependant. Please contact Bosch Rexroth Engineering Department in Glenrothes for further advice. Figures quoted in technical data tables below are average values.
- Where flushing is used, q_{VL} will increase by the flushing flow rate. Mean case leakage values are average values for single speed motors

T = Torque in Nm

q_V = Input flow in l/min

q_{VL} = Mean case leakage in l/min

p = Minimum charge pressure in pump mode in bar

			MCR10 . 780					MCR10 . 860				
Pressure Diff. Δp (bar)	**Speed n**	rpm	0	25	50	100	150	0	25	50	100	150
100	T	Nm	646	1030	1092	1077	1034	712	1136	1204	1184	1117
	q_V	l/min	0.63	20.13	39.63	78.63	117.63	0.63	22.13	43.63	86.63	129.63
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
200	T	Nm	1490	2110	2235	2221	2217	1642	2327	2464	2446	2379
	q_V	l/min	1.25	20.75	40.25	79.25	118.25	1.25	22.75	44.25	87.25	130.25
	q_{VL}	l/min	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
300	T	Nm	2384	3240	3352	3331		2628	3572	3696	3693	
	q_V	l/min	1.88	21.38	40.88	79.88		1.88	23.38	44.88	87.88	
	q_{VL}	l/min	0.27	0.27	0.27	0.27		0.27	0.27	0.27	0.27	
400	T	Nm	3377	4370	4370			3723	4818	4818		
	q_V	l/min	2.51	22.01	41.51			2.51	24.01	45.51		
	q_{VL}	l/min	0.35	0.35	0.35			0.35	0.35	0.35		
Min. charge pressure	p	bar	1	3	3	5	6	1	3	3	5	7

			MCR10 . 940					MCR10 . 1120				
Pressure Diff. Δp (bar)	**Speed n**	rpm	0	25	50	100	150	0	25	50	100	150
100	T	Nm	778	1242	1317	1282	1307	927	1480	1569	1498	1346
	q_V	l/min	0.63	24.13	47.63	94.63	141.63	0.63	28.63	56.63	112.63	168.63
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
200	T	Nm	1795	2543	2693	2678		2139	3030	3209	3206	
	q_V	l/min	1.25	24.75	48.25	95.25		1.25	29.25	57.25	113.25	
	q_{VL}	l/min	0.18	0.18	0.18	0.18		0.18	0.18	0.18	0.18	
300	T	Nm	2872	3905	4039			3422	4652	4813		
	q_V	l/min	1.88	25.38	48.88			1.88	29.88	57.88		
	q_{VL}	l/min	0.27	0.27	0.27			0.27	0.27	0.27		
400	T	Nm	4069	5266	5266			4848	6275	6275		
	q_V	l/min	2.51	26.01	49.51			2.51	30.51	58.51		
	q_{VL}	l/min	0.35	0.35	0.35			0.35	0.35	0.35		
Min. charge pressure	p	bar	1	3	3	5	8	1	3	3	5	9

Technical data (Mean values, measured at $\nu = 46$ mm²/s and t = 45 °C)

			MCR10 . 1250					MCR10 . 1340				
Pressure Diff. Δp (bar)	**Speed n**	rpm	0	25	50	100	125	0	25	50	100	125
100	T	Nm	1035	1651	1751	1635	1530	1109	1770	1877	1726	1601
	q_V	l/min	0.63	31.88	63.13	125.63	156.88	0.63	34.13	67.63	134.63	168.13
	q_{VL}	l/min	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
200	T	Nm	2387	3382	3581	3486		2559	3626	3839	3670	
	q_V	l/min	1.25	32.50	63.75	126.25		1.25	34.75	68.25	135.25	
	q_{VL}	l/min	0.18	0.18	0.18	0.18		0.18	0.18	0.18	0.18	
300	T	Nm	3820	5192	5371			4095	5566	5758		
	q_V	l/min	1.88	33.13	64.38			1.88	35.38	68.88		
	q_{VL}	l/min	0.27	0.27	0.27			0.27	0.27	0.27		
400	T	Nm	5411	7003	7003			5801	7507	7507		
	q_V	l/min	2.51	33.76	65.01			2.51	36.01	69.51		
	q_{VL}	l/min	0.35	0.35	0.35			0.35	0.35	0.35		
Min. charge pressure	p	bar	1	3	3	7	9	1	3	3	7	9

Permitted loading on drive shaft

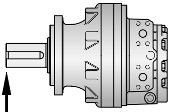
(Speed n = 50 rpm, pressure differential Δp = 250 bar, 2000 hrs L10 life at 50 °C)

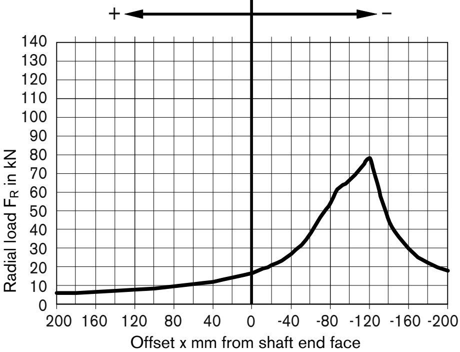
Drive shaft ...L60...

Housing type **...D...**

Maximum axial load $\mathbf{F}_{ax\ max}$ (with radial load $F_R = 0$):

Fax max = 78700 N ⇦ +
Fax max = 63400 N ⇨ –



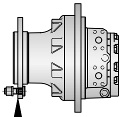


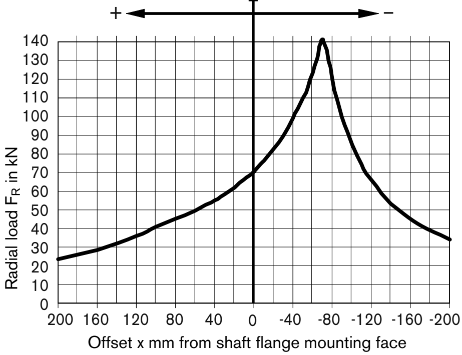
Drive shaft ...F250... (6 studs M18)

Housing type **...F...**

Maximum axial load $\mathbf{F}_{ax\ max}$ (with radial load $F_R = 0$):

Fax max = 76000 N ⇦ +
Fax max = 69800 N ⇨ –



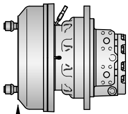


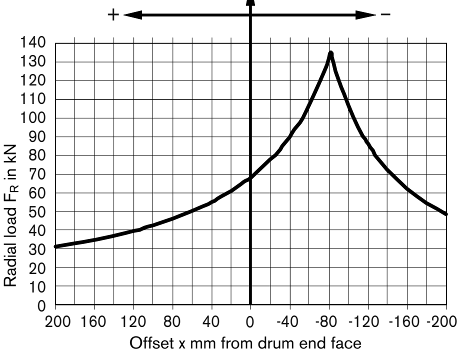
Drive shaft ...F250... (8 studs M20)

Housing type **...F...C7**

Maximum axial load $\mathbf{F}_{ax\ max}$ (with radial load $F_R = 0$):

Fax max = 75800 N ⇦ +
Fax max = 53900 N ⇨ –





Note:

These values and graphs are for initial guidance only.
For actual motor life calculations under typical or specified duty cycles, contact Rexroth Engineering Department in Glenrothes.

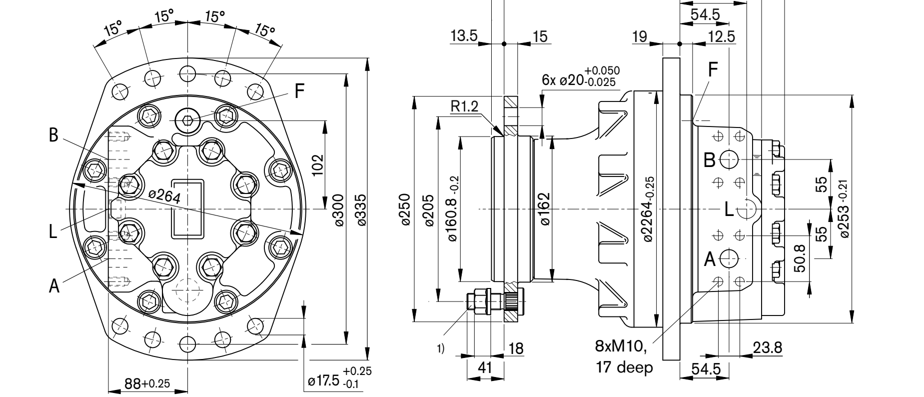
Dimensions

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

Flanged rear housing, flanged drive shaft, single speed (1)

Ordering code: "MCR10F…F250Z-32/A0.1L/42./…"

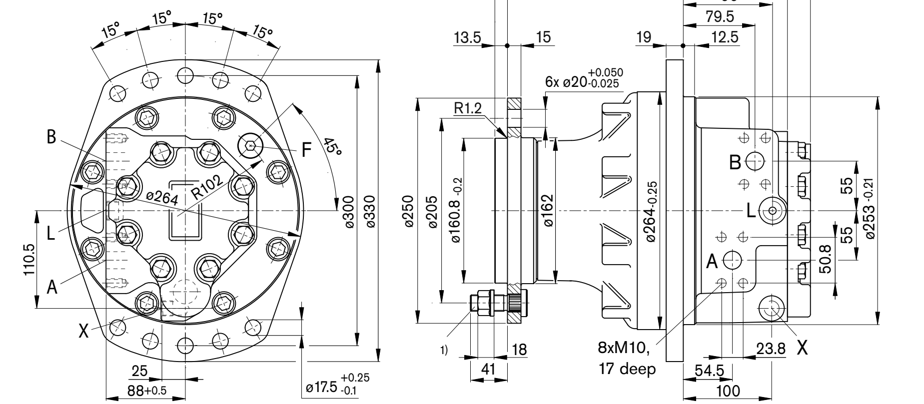
Weight m = 65 kg
Moment of inertia J_m = 110000 kgmm^2



Flanged rear housing, flanged drive shaft, two speed (2W)

Ordering code: "MCR10F…F250Z-32/A0.2WL/42./…"

Weight m = 70 kg
Moment of inertia J_m = 110000 kgmm^2



Ports

Designation	Port function	Code 42	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J518[2)]	3/4 in	470/420[3)]	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 6x wheel studs M18 x 1.5 with flat nuts (DIN74361-2) for wheel fixing, clamping length 5 to 23 mm, ordering code S (wheel studs and nuts equally spaced on P.C.D. of 205)
2) Only dimensions according to SAE J518 (code 62 – high pressure series)
3) Depends on nominal size

O = Must be connected (plugged /covered for transportation)
X = Plugged (in normal operation)

Dimensions

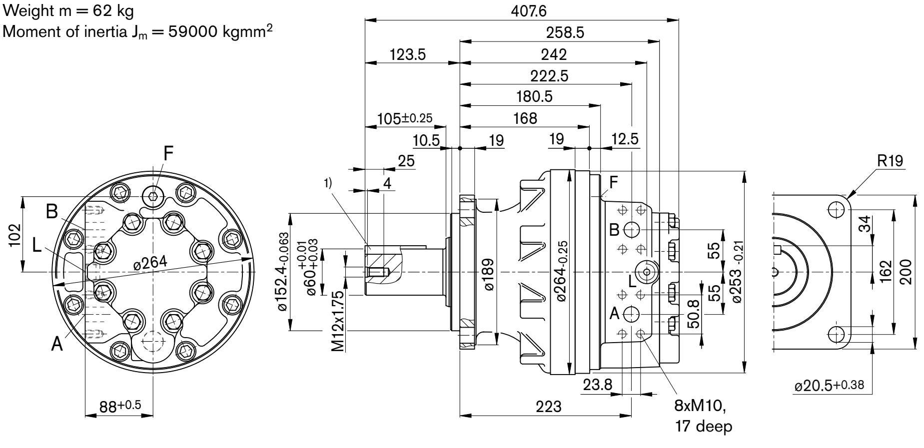
Before finalizing your design, request a binding installation drawing. Dimensions in mm.

4 Hole SAE flanged front housing, parallel drive shaft, single speed (1)

Ordering code: "MCR10D…L60Z-32/A0.1L/42./…"

Weight m = 62 kg

Moment of inertia J_m = 59000 kgmm^2

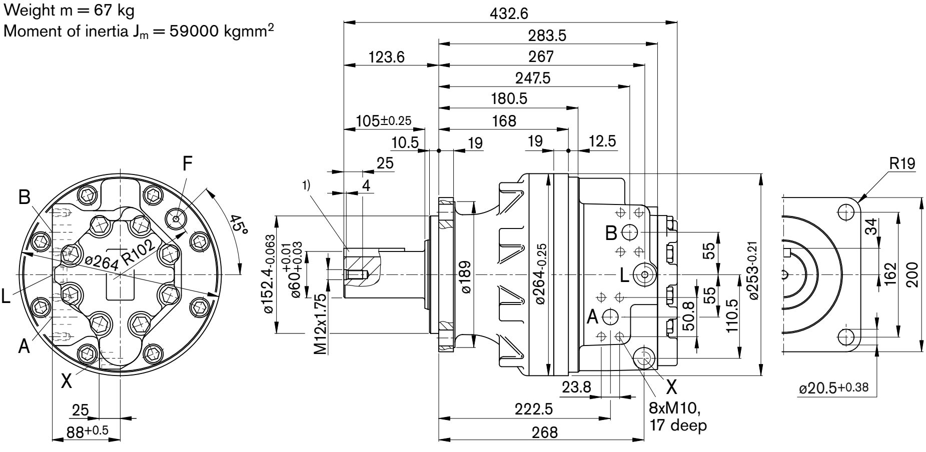


4 Hole SAE flanged front housing, parallel drive shaft, two speed (2W)

Ordering code: "MCR10D…L60Z-32/A0.2WL/42./…"

Weight m = 67 kg

Moment of inertia J_m = 59000 kgmm^2



Ports

Designation	Port function	Code 42	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J518[2)]	3/4 in	470/420[3)]	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) Parallel key A18 x 11 x 80 DIN 6885
2) Only dimensions according to SAE J518 (code 62 – high pressure series)
3) Depends on nominal size

O = Must be connected (plugged /covered for transportation)
X = Plugged (in normal operation)

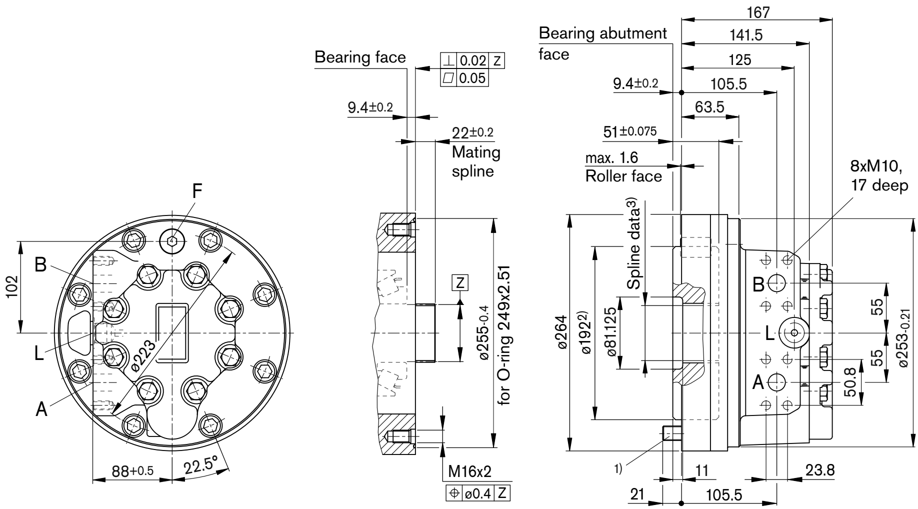
6

Dimensions

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

Hydrobase for mounting on customer´s shaft, single speed (1)

Ordering code: "MCR10H…ZZ-32/A0.1L/42./…"



Weight m = 36 kg

Moment of inertia J_m = 49000 kgmm^2

Ports

Designation	Port function	Code 42	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J518[4)]	3/4 in	470/420[5)]	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 8x hexagon socket head cap screw ISO 4762 M16x70 on a P.C.D of 223
2) Mating part must clear this diameter
3) Spline data: N65x2x31x9H DIN 5480
4) Only dimensions according to SAE J518 (code 62 – high pressure series)
5) Depends on nominal size

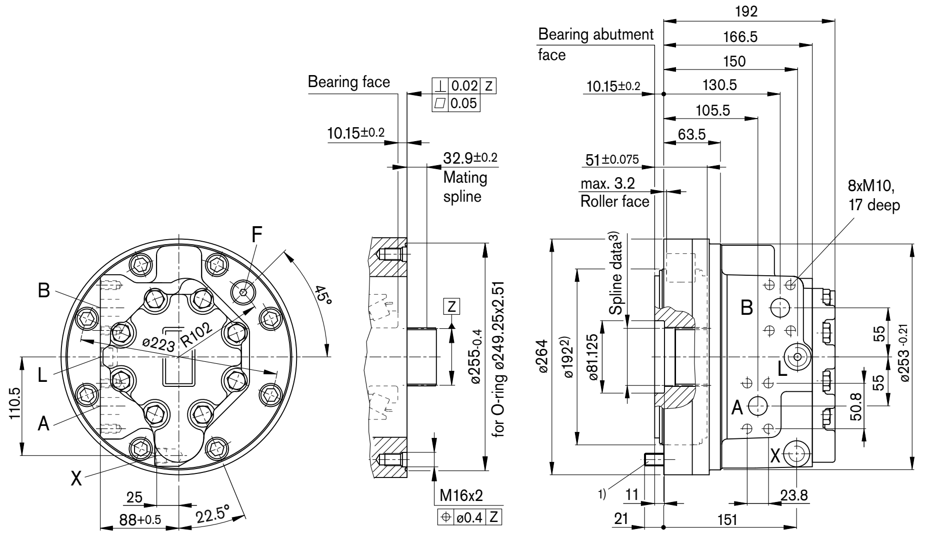
O = Must be connected (plugged /covered for transportation)
X = Plugged (in normal operation)

Dimensions

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

Hydrobase for mounting on customer´s shaft, two speed (2W)

Ordering code: "MCR10H…ZZ-32/A0.2WL/42./..."



Weight m = 40 kg
Moment of inertia J_m = 49000 kgmm²

Ports

Designation	Port function	Code 42	Size	Peak pressure [bar]	State
A, B	Inlet, outlet	SAE J518 4)	3/4 in	470/420 5)	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 8x hexagon socket head cap screw ISO 4762 M16x70 on a P.C.D of 223
2) Mating part must clear this diameter
3) Spline data: N65x2x31x9H DIN 5480
4) Only dimensions according to SAE J518 (code 62 – high pressure series)
5) Depends on nominal size

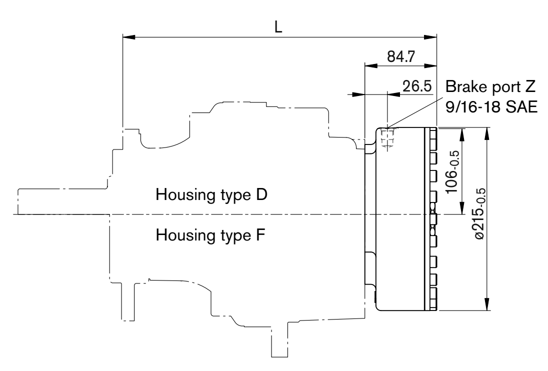
O = Must be connected (plugged /covered for transportation)
X = Plugged (in normal operation)

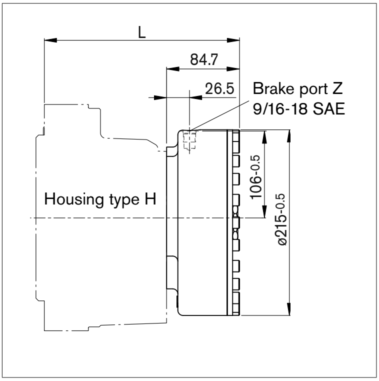
6

Dimensions

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

Holding Brake (multi-disc brake): ordering code "B5"





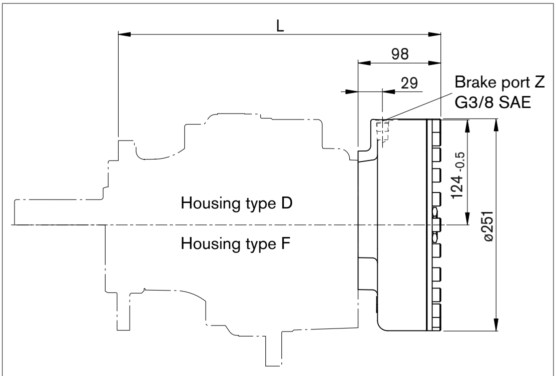
Housing type	Single speed (1) L	Two speed (2W) L
D	343.2	368.2
F	370.3	395.3

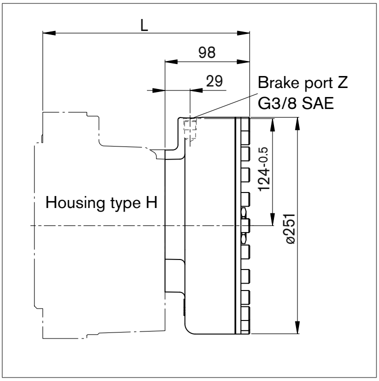
Weight m = 19 kg
Moment of inertia J_m = 3220 kgmm^2 (single speed)
Moment of inertia J_m = 3819 kgmm^2 (two speed)

Housing type	Single speed (1) L	Two speed (2W) L
H	226.2	251.2

Weight m = 19 kg

Holding Brake (multi-disc brake): ordering code "B7"





Housing type	Single speed (1) L	Two speed (2W) L
D	356.5	381.5
F	383.6	408.6

Weight m = 25 kg
Moment of inertia J_m = 3660 kgmm^2 (single speed)
Moment of inertia J_m = 4030 kgmm^2 (two speed)

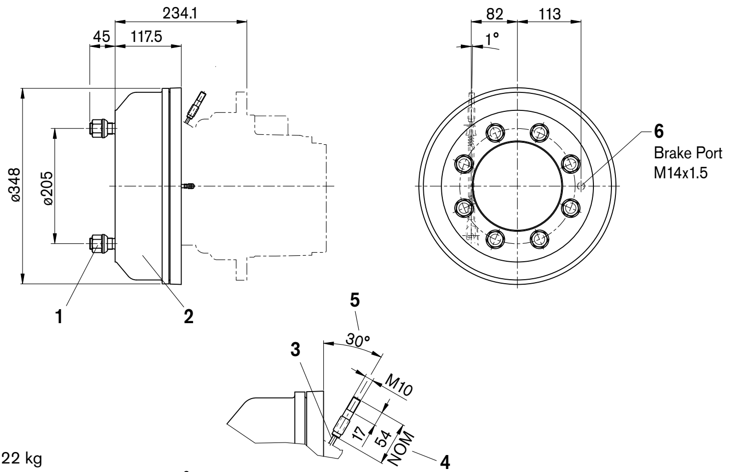
Housing type	Single speed (1) L	Two speed (2W) L
H	239.5	264.5

Weight m = 25 kg

Dimensions

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

Dynamic brake (drum brake): ordering code “C7R” / “C7L”



Weight m = 22 kg
Moment of inertia J_m = 196899 kgmm^2

1 **8** Studs M20x1.5 with spherical wheel nuts

2 Dynamic brake (drum brake) ordering code C7L/R for use with brake fluid DOT 3+5 or SAE J 1703.
If brake is to be used with mineral oil a special order is to be made.
Please state if seals for mineral oil are required when placing order.

3 Brake cable (Bowden cable).
The brake illustrated is for right side of vehicle. The left side is a mirror image of this (see fig. below).

4 Brake cable length.

5 Angular position of brake cable.

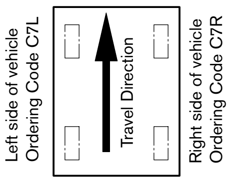
6 Brake port p_{max} = 120 bar.
Brake cylinder operating volume V = 13 cm^3.

MCR dynamic drum brake run-in procedure

– Brake the machine hard in forward and reverse directions until the brake drum temperature reaches 200 °C.

– Allow the brake to cool.

– To remove residue, brake gently 2 times each in the forward and reverse directions.



Brake torque after run-in

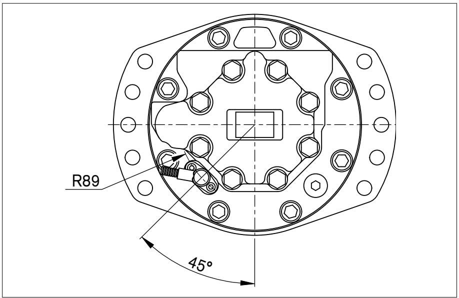
Braking torque	Cable tension	Braking torque	Port pressure
4700 Nm	1755 N	4700 Nm	89 bar
6400 Nm	2400 N	6400 Nm	120 bar

6

Dimensions

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

Speed sensor: ordering code “P1” / “P2”



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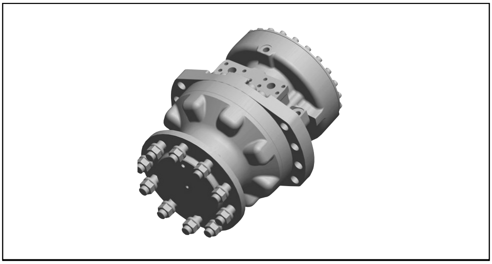
Radial Piston Motor (Multi-Stroke) MCR15

RE 15208
Edition: 05.2012
Replaces: 10.1994

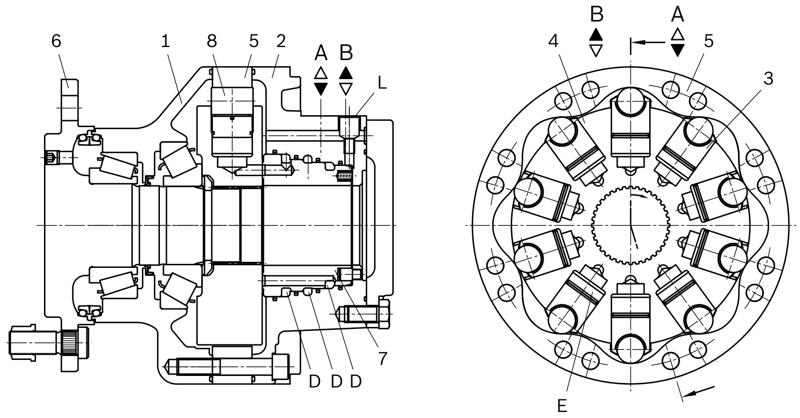


- Series 3X
- Size 1130 to 2150
- Differential pressure up to 450 bar
- Torque output up to 12730 Nm
- Speed up to 150 rpm
- Open and closed circuits

Features
- Compact robust construction
- High volumetric and mechanical efficiencies
- High pressure rating
- High reliability
- Low maintenance
- Smooth running at very low speeds
- Low noise
- Reversible
- Sealed tapered roller bearings
- High radial forces permitted on drive shaft
- Freewheeling possible
- Available with optional holding brake (multi-disc) or dynamic (drum) brake
- Available with:
  - Two speed option
  - Integrated flushing valve
  - Speed sensor

Contents

Functional description



Hydraulic motors type MCR are radial piston motors with a rotating shaft.

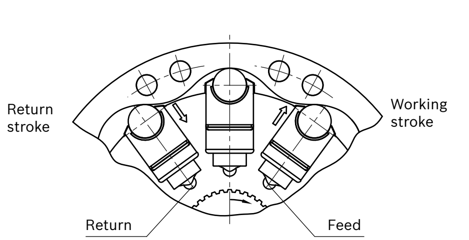
Construction

Two part housing (1, 2), rotary group (3, 4), cam (5), drive shaft (6) and flow distributor (7)

Transmission

The cylinder block (4) is connected to the shaft (6) by means of splines. The pistons (3) are arranged radially in the cylinder block (4) and make contact with the cam (5) via rollers (8).

Torque generation



The number of working and return strokes corresponds to the number of lobes on the cam x number of pistons.

Flow paths

The cylinder chambers (E) are connected to ports A and B via the axial bores and the annular passages (D).

Bearings

Tapered roller bearings capable of transmitting high axial and radial forces are fitted as standard, except on Hydrobase motors.

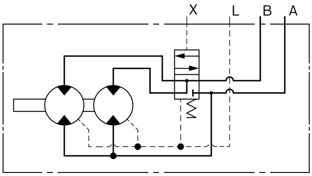
Freewheeling

In certain applications there may be a requirement to freewheel the motor. This may be achieved by connecting ports A and B to zero pressure and simultaneously applying a pressure of 2 bar to the housing through port L. In this condition, the pistons are forced into the cylinder block which forces the rollers to lose contact with the cam thus allowing free rotation of the shaft.

Two speed operation (2)

In mobile applications where vehicles are required to operate at high speed with low motor loads, the motor can be switched to a low-torque and high-speed mode. This is achieved by operating an integrated valve which directs hydraulic fluid to only one half of the motor while continuously re-circulating the fluid in the other half. This “reduced displacement” mode reduces the flow required for a given speed and gives the potential for cost and efficiency improvements. The motor maximum speed remains unchanged.

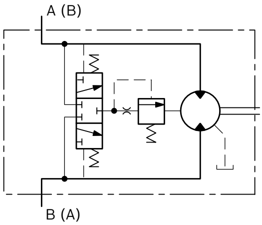
▼ **Two-speed motor**



Flushing valve

In a closed circuit, the same hydraulic fluid continuously flows between the pump and the motor. This could therefore lead to overheating of the hydraulic fluid.
The function of the flushing valve option is to replace hydraulic fluid in the closed circuit with that from the reservoir. When the hydraulic motor is operated under load, either in the clockwise or counter-clockwise direction, the flushing valve opens and takes a fixed flow of fluid through an orifice from the low pressure side of the circuit. This flow is then fed to the motor housing and back to the reservoir normally via a cooler. In order to charge the low pressure side of the circuit, cool fluid is drawn from the reservoir by the boost pump and is fed to the pump inlet through the check valve. Thus the flushing valve ensures a continuous renewal and cooling of the hydraulic fluid. The flushing feature incorporates a relief valve which is used to maintain a minimum boost pressure and operates at a standard setting of 14 bar (other options available on request). Different orifice sizes may be used to select varying flows of flushing fluid. The following table gives flushing rate values based on a boost / charge pressure of 25 bar.

▼ **Motor with flushing valve**



Flushing flow rates (for $p_{charge} - p_{case}$ = 25 bar)

Ordering code	Flow ±1 L/min
F1	3 L/min
F2	5 L/min
F7	7 L/min
F4	10 L/min
F8	12.5 L/min
F6	13.5 L/min

Holding brake (multi-disc brake)

Mounting

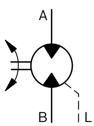
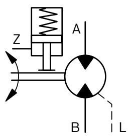
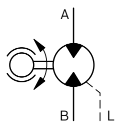
By way of rear housing (2) and brake shaft (16).

Brake application

As a safety requirement in mobile applications a parking brake may be provided to ensure that the motor cannot turn when the machine is not in use. The parking brake provides holding torque by means of discs (11) that are compressed by a disc spring (10). The brake is released when oil pressure is applied to brake port “Z” and the pressure in the annular area (9) compresses the disc spring allowing the brake discs to turn independently.

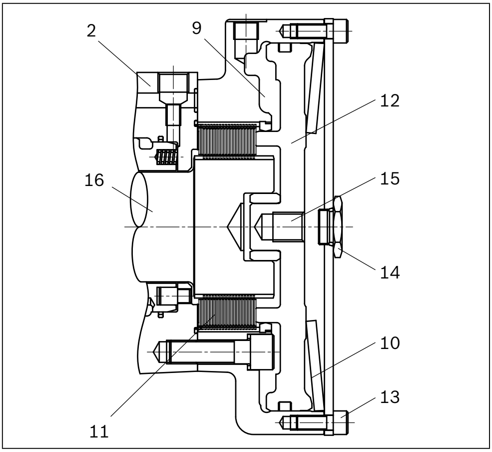
Note: This brake is provided solely for static use - not to be used dynamically

Schematic diagrams

Motor without brake	Motor with holding brake	Motor with dynamic brake
		

Manual release of holding brake

The brake may also be released manually by loosening screws (13), or by removing plug (14) and inserting a puller into the tapped hole on the brake piston (15).

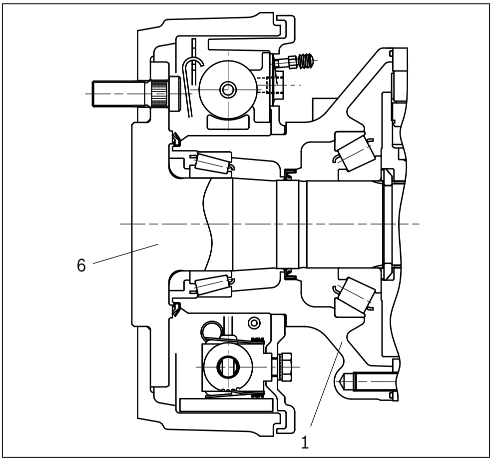


Dynamic brake

Where mechanical dynamic braking is required, a drum brake may be specified. The drum brake is mounted directly onto the drive shaft (6) and front housing (1). Braking torque is provided by brake shoes acting on the inside of the drum.

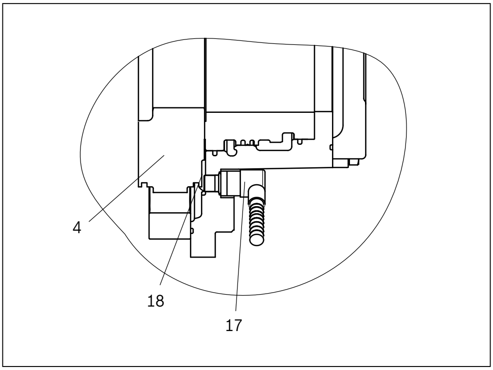
▼ **Operation of brake**

- Hydraulic brake fluid (special order required for mineral oil operation)
- Mechanical brake cable (not supplied)



Speed sensor

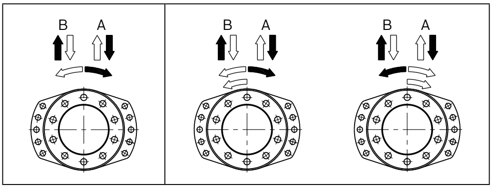
A Hall-effect speed sensor (17) may be fitted as an option, giving a two-channel output of phase-displaced square waves, and enabling detection of speed and direction. A toothed target disc (18) is fitted to the motor cylinder block (4), and the sensor, fitted to a port in the rear case, produces a pulse on each channel as each tooth passes in front of it. The frequency of the pulses is proportional to the rotational speed.
Versions are available for use with regulated supplies (code P1) and for direct connection to a 12 V or 24 V unregulated supply (code P2).
The motor can also be supplied fitted with a target disc and with a speed sensor port machined, but covered and sealed with a blanking plate (code P0). These “sensor-ready” motors may be fitted with a sensor at a later date.



Direction of shaft rotation with flow

(viewed from drive shaft)

Single speed Two speed



Order Code: 1L Order Code: 2L Order Code: 2R

Ordering code

01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16
MCR	**15**				**Z**	**/**	**3X**		**M**		**42**					

Radial piston motor

01	Radial piston type, low-speed, high-torque motor	**MCR**

Frame size

02	Frame size 15	**15**

Housing type

03	Short front case – rear mounting flange	**C**
	Rear case flanged	**F**
	Hydrobase (half motor)	**H**

	Nominal size, displacement V in cm^3/rev	**1130**	**1250**	**1500**	**1780**	**2150**
04	Low displacement: motors use standard cylindrical pistons LD	●	●	●	–	–
	High displacement: motors use stepped pistons HD	–	–	–	●	●

Drive shaft

05	With flange ø250 mm (only available with housing type “C”)	**F250**
	With flange ø280 mm (only available with housing type “F”)	**F280**
	Without shaft (only available with housing type “H”)	**Z**

Through shaft

06	Without through shaft	**Z**

Series

07	Series 30 to 39 (series 30 to 39 are dimensionally interchangeable)	**3X**

Brake

08	Without brake	**A0**
	Hydraulic release spring applied multi-disc holding brake 11000 Nm	**B11**
	Dynamic brake (drum brake) for right hand side of vehicle	**C12R**
	Dynamic brake (drum brake) for left hand side of vehicle	**C12L**

Seals

09	NBR (nitrile rubber)	**M**

Single- / Two-speed operation

10	Single speed, standard direction of rotation	**1L**
	Switchable two speed, anti-clockwise direction of rotation	**2L**
	Switchable two speed, clockwise direction of rotation	**2R**

Ports

11	Tapped with UNF thread (SAE J514) (A and B ports SAE split flange metric bolt holes)	**42**

Studs

12	Without studs (no code)	
	With wheel studs and nuts	**S**

Speed sensor

13	Without sensor (no code)	
	Sensor ready	**P0**
	Sensor without regulator	**P1**
	Sensor with regulator	**P2**

● = Available – = Not available

6

01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16
MCR	**15**				**Z**	**/**	**3X**		**M**		**42**					

Flushing

14	Without flushing (no code)	
	With flushing (see table on page 3)	**F1-F8**

Special order

15	Special feature	**SOXXX**

Other

16	Mark in text here	*

Technical data

Frame size			MCR15				
Type of mounting			Flange mounting; face mounting				
Pipe connections[1)2)]			Threaded per SAE J514 or flanged per J518 (code 62)				
Shaft loading			see page 9				
Displacement	V_g	cm^3/rev	1130	1250	1500	1780	2150
Output torque							
Specific torque (at Δp = 250 bar)		Nm	4180	4630	5550	6590	7960
Maximum torque[3)]	T_{max}	Nm	7530	8330	9990	10540	12730
Output speed							
Minimum speed for smooth running[4)]	n_{min}	rpm	5	5	5	5	5
Maximum speed (1L & 2L)[5) 6)]	n_{max}	rpm	150	150	150	125	125
Output power							
Nominal power[8)]	P	kW	55	55	55	60	60
Pressure							
Operating pressure[8)]	p_{nom}	bar	250	250	250	250	250
Maximum differential pressure[3)7)]	Δp_{max}	bar	450	450	450	400	400
Maximum pressure at port “A” or “B”[3)7)]	p_{max}	bar	470	470	470	420	420
Maximum case drain pressure	$p_{case\ max}$	bar	10	10	10	10	10
Weight	m	kg	see unit dimensions on pages 11 to 13				
Moment of Inertia	J	kgm^2	see unit dimensions on pages 11 to 13				
Hydraulic fluid[9)]							
Hydraulic fluid type			Mineral oils (HLP) to DIN 51 524				
Hydraulic fluid temperature range[10)]	$t_{min/max}$	°C	-20 to 85				
Viscosity range	$\nu_{min/max}$	mm^2/s	10 to 2000				
Fluid cleanliness			ISO 4406, Class 20/18/15				
Holding brake (disc brake)			B11				
Minimum holding torque	T	Nm	11000				
Release pressure (min)	$p_{rel\ min}$	bar	12				
Release pressure (max)	$p_{rel\ max}$	bar	15				
Maximum pressure at brake port “Z”	p	bar	40				
Oil volume required to operate brake	V	cm^3	77				
Dynamic brake (drum brake)			see information on page 15				

1) Ensure motor case is filled with oil prior to start-up. See operating manual RE 15215-B.
2) For installation and maintenance details, please see operating manual RE 15215-B.
3) Maximum values should only be applied for a small portion of the duty cycle. Please consult Bosch Rexroth Engineering Department in Glenrothes for motor life calculations based on particular operating cases.
4) For continuous operation at speeds < 5 rpm please consult Bosch Rexroth Engineering Department in Glenrothes.
5) Based on nominal no-load Δp of 20 bar in full-displacement mode.
6) Warning! During the running in period of the motor (min. 20 hrs) it should not be run unloaded at >100 rpm.
7) When operating motors in series, please consult Bosch Rexroth Engineering Department in Glenrothes.
8) Guide values for continuous operation.
9) For use with environmentally acceptable fluids HEES, HEPG, HETG, Viton seals must be specified.
For further information, please refer to RE 90221.
10) Extension of the allowable temperature range may be possible depending on specification. Please consult Bosch Rexroth Engineering Department in Glenrothes for further details.

Note
For operation outside of these parameters, please consult Bosch Rexroth.

6

Technical data – mean values

- Measured at ν = 46 mm^2/s and t = 45°C
- All torques apply to run-in motors
- For reduced displacement operating mode multiply the torques by ratio of reduced displacement

T = Torque in Nm
q_V = Input flow in L/min
q_{VL} = Mean case leakage in L/min
p = Minimum charge pressure in pump mode in bar

Note

- Case pressure must be added to minimum charge pressures quoted. Quoted pressures are guide values but can be circuit-dependant. Please contact Bosch Rexroth Engineering Department in Glenrothes for further advice. Figures quoted in technical data tables below are average values.
- Where flushing is used, q_{VL} will increase by the flushing flow rate. Mean case leakage values are average values for single speed motors.

	Size		**1130**					**1250**				
Pressure diff. Δp in bar	**Speed n**	**rpm**	**0**	**25**	**50**	**100**	**150**	**0**	**25**	**50**	**100**	**150**
100	T	Nm	1133	1529	1583	1493	1397	1253	1692	1751	1691	1512
	q_V	L/min	0.72	28.95	57.40	114.19	171.31	0.74	31.95	63.40	126.19	189.31
	q_{VL}	L/min	0.20	0.20	0.30	0.50	0.90	0.20	0.20	0.30	0.50	0.90
200	T	Nm	2447	3166	3238	3166	3133	2707	3503	3582	3503	–
	q_V	L/min	2.18	29.59	58.09	114.98	172.16	2.18	32.59	64.09	126.98	–
	q_{VL}	L/min	0.40	0.40	0.50	0.60	1.00	0.40	0.40	0.50	0.60	–
300	T	Nm	3670	4749	4858	4694	–	4060	5254	5373	–	–
	q_V	L/min	4.04	30.10	59.02	115.52	–	4.04	33.10	65.02	–	–
	q_{VL}	L/min	0.50	0.50	0.70	0.70	–	0.50	0.50	0.70	–	–
400	T	Nm	4892	6331	6474	–	–	5411	7003	7162	–	–
	q_V	L/min	5.84	31.00	59.81	–	–	5.82	34.00	65.81	–	–
	q_{VL}	L/min	1.00	1.00	1.00	–	–	1.00	1.00	1.00	–	–

	Size		**1500**					**1780**			
Pressure diff. Δp in bar	**Speed n**	**rpm**	**0**	**25**	**50**	**100**	**150**	**0**	**25**	**50**	**100**
100	T	Nm	1504	2030	2101	1983	1719	1558	2456	2420	2043
	q_V	L/min	0.40	37.90	75.60	151.00	226.80	0.74	45.41	90.05	179.22
	q_{VL}	L/min	0.20	0.20	0.30	0.50	0.90	0.37	0.41	0.45	0.53
200	T	Nm	3248	4203	4298	4203	–	3683	50.49	5116	5833
	q_V	L/min	0.80	38.30	76.00	151.20	–	2.18	46.55	91.22	180.55
	q_{VL}	L/min	0.40	0.40	0.50	0.60	–	1.09	1.11	1.13	1.17
300	T	Nm	4872	6304	6448	–	–	5949	7692	7794	–
	q_V	L/min	1.00	38.50	76.40	–	–	4.04	48.00	93.10	–
	q_{VL}	L/min	0.50	0.50	0.70	–	–	2.02	2.15	2.28	–
400	T	Nm	6494	8403	8594	–	–	8160	10335	10425	–
	q_V	L/min	2.00	39.50	77.40	–	–	5.82	49.46	94.81	–
	q_{VL}	L/min	1.00	1.00	1.00	–	–	2.92	3.21	3.50	–

	Size		2150			
Pressure diff. Δp in bar	**Speed n**	**rpm**	**0**	**25**	**50**	**100**
100	T	Nm	1882	2967	2922	2467
	q_V	L/min	0.72	54.66	108.55	216.22
	q_{VL}	L/min	0.37	0.41	0.45	0.53
200	T	Nm	4448	6098	6180	–
	q_V	L/min	2.18	55.80	109.72	–
	q_{VL}	L/min	1.09	1.11	1.13	–
300	T	Nm	7186	9290	9414	–
	q_V	L/min	4.04	57.25	111.60	–
	q_{VL}	L/min	2.02	2.15	2.28	–
400	T	Nm	9855	12483	–	–
	q_V	L/min	5.84	58.71	–	–
	q_{VL}	L/min	2.92	3.21	–	–

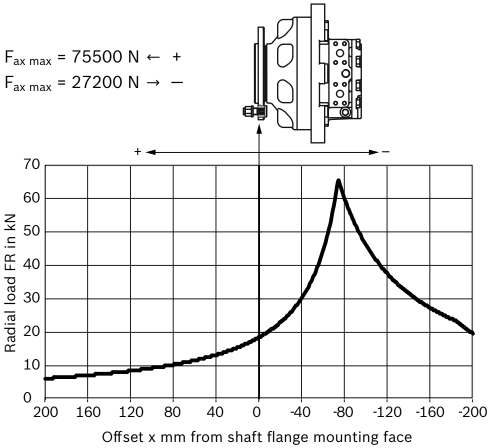
6

Permitted loading on drive shaft

Drive shaft ...F250...(6 studs M18)

Housing type ...C...

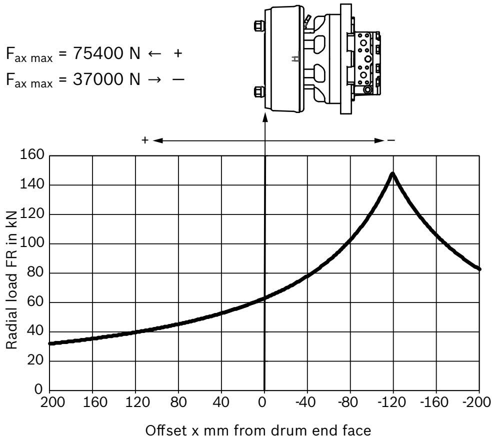
Maximum axial load $F_{ax\,max}$ (with radial load F_R = 0):



Drive shaft ...F280...(10 studs M22)

Housing type ...F...C12

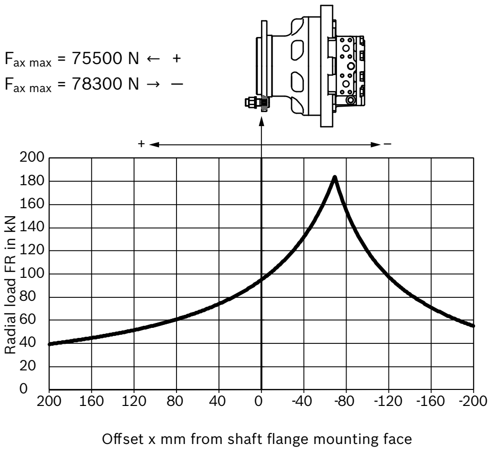
Maximum axial load $F_{ax\,max}$ (with radial load F_R = 0):



Drive shaft ...F280...(10 studs M22)

Housing type ...F...

Maximum axial load $F_{ax\,max}$ (with radial load F_R = 0):



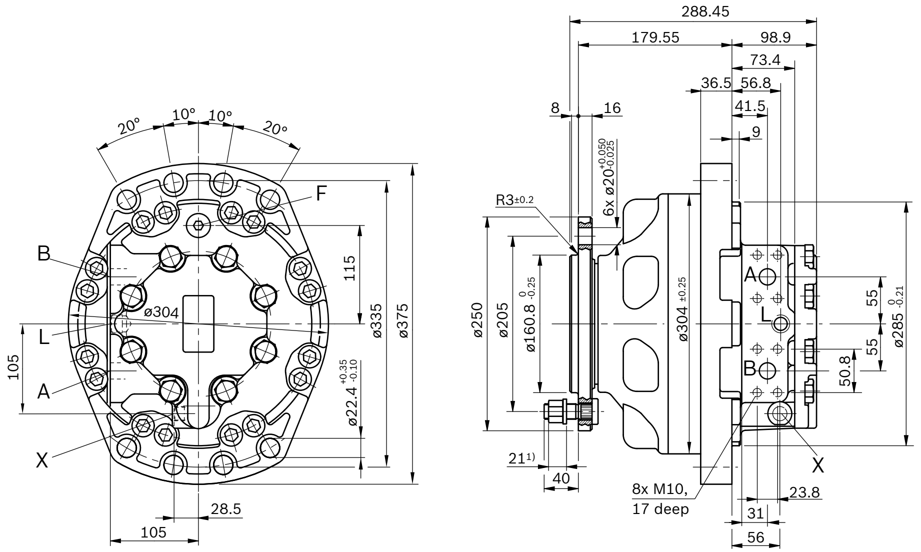
Note

- These values and graphs are for initial guidance only and are based on:
  Speed *n* = 50 rpm, pressure differential *Δp* = 250 bar, 2000 hrs L10 life at 50 °C
- For actual motor life calculations under typical or specified duty cycles, contact Rexroth Engineering Department in Glenrothes.

Dimensions

Flanged rear housing, flanged drive shaft, compact front housing, single speed (1)
Ordering code: “MCR15C...F250Z-32/A0.1L/11./...”

Flanged rear housing, flanged drive shaft, compact front housing, two speed (2)
Ordering code: “MCR15C...F250Z-32/A0.2L/11./...”



Weight m = 84 kg

Moment of inertia J_m = 0.1712 kgm²

Ports

Designation	Port function	Code 42	Size	Maximum pressure [bar]	State[3)]
A, B	Inlet, outlet	SAE J518	3/4 in	470/420[2)]	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 6x wheel studs M18 x 1.5 with flat nuts (DIN74361-2) for wheel fixing, clamping length 5 to 19 mm, ordering code S (wheel studs and nuts equally spaced on P.C.D. of 205)
2) Depends on nominal size
3) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

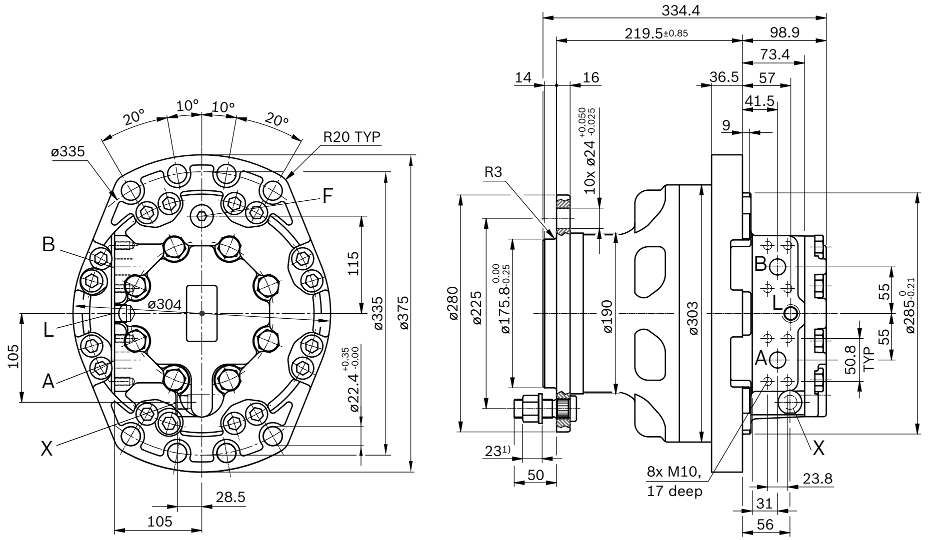
Before finalizing your design, request a binding installation drawing.
Dimensions in mm

Flanged rear housing, flanged drive shaft, single speed (1)

Ordering code: “MCR15F...F280Z-32/A0.1L/42./...”

Flanged rear housing, flanged drive shaft, two speed (2)

Ordering code: “MCR15F...F280Z-32/A0.2L/42./...”



Weight m = 95 kg

Moment of inertia J_m = 0.1690 kgm²

Ports

Designation	Port function	Code 42	Size	Maximum pressure [bar]	State[3]
A, B	Inlet, outlet	SAE J518	3/4 in	470/420[2]	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 10x wheel studs M22 x 1.5 with flat nuts (DIN74361-2) for wheel fixing, clamping length 5 to 27 mm, ordering code S (wheel studs and nuts equally spaced on P.C.D. of 225)

2) Depends on nominal size

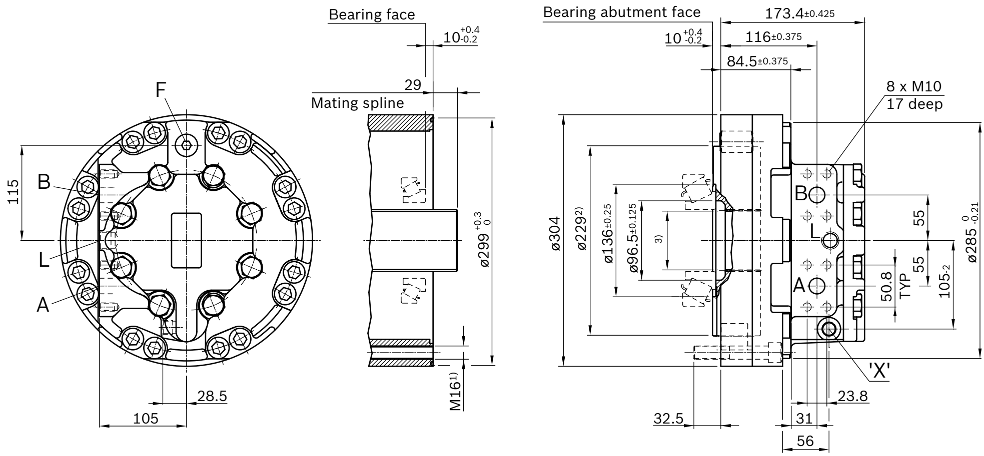
3) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Hydrobase for mounting on customer's shaft, single speed (1)

Ordering code: "MCR15H...ZZ-32/A0.1L/11./..."

Hydrobase for mounting on customer's shaft, two speed (2)

Ordering code: "MCR15H...ZZ-32/A0.2L/11./..."



Weight m = 54 kg

Moment of inertia J_m = 0.1118 kgm²

Ports

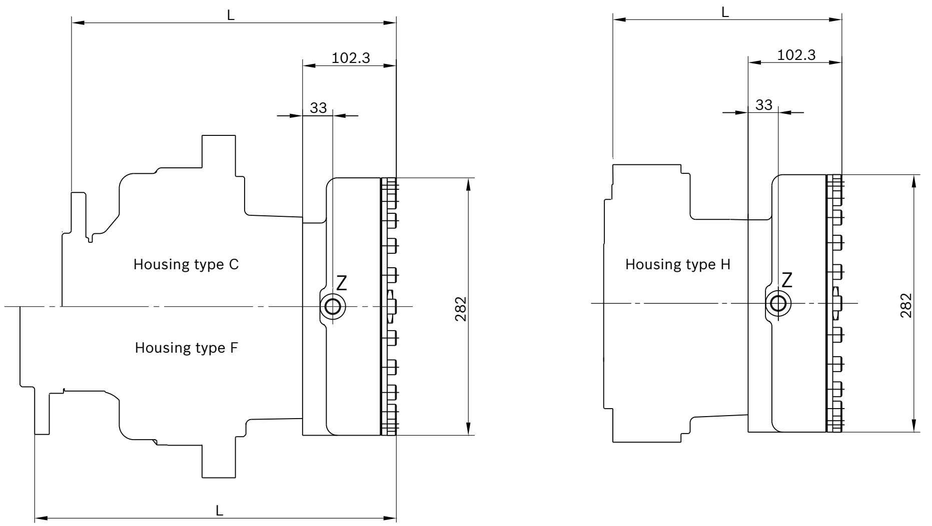
Designation	Port function	Code 42	Size	Maximum pressure [bar]	State[5)]
A, B	Inlet, outlet	SAE J518	3/4 in	470/420[2)]	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 14 x M16 x 2 bolts on a P.C.D of 270
2) Mating part must clear this diameter
3) Spline data: N75x2x36x9H DIN 5480
4) depends on nominal size
5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

6

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

Holding brake (multi-disc brake): ordering code “B11”

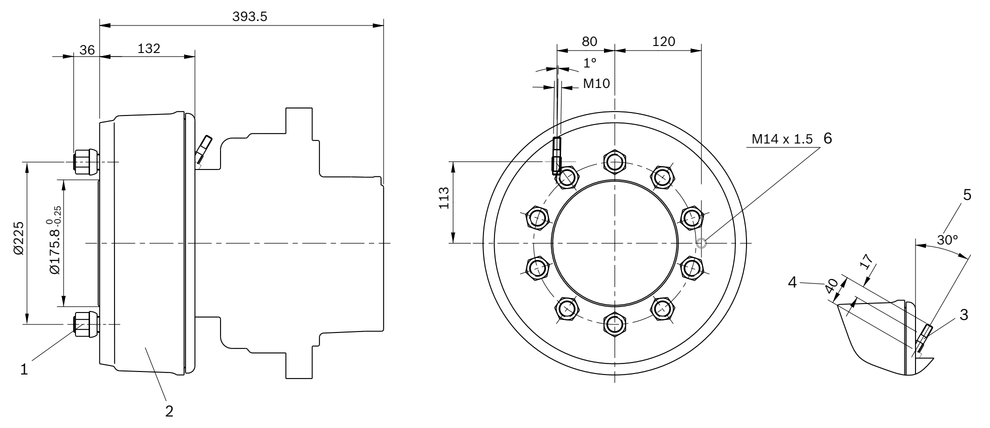


Weight m = 34.4 kg

Polar moment of inertia J_m = 0.0059 kgm²

Housing type	Single speed (1) L	Two speed (2) L
C	355.4	355.4
F	395.4	395.4
H	250.2	250.2

Dynamic brake (drum brake): ordering code “C12R” / “C12L”



Weight m = 24 kg

Polar moment of inertia J_m = 0.5357 kgm²

1 10 Studs M22 x 1.5 with hexagonal wheel nuts

2 Dynamic brake (drum brake) ordering code C12L/R for use with brake fluid DOT 3+5 or SAE Jl 703.
If brake is to be used with mineral oil a special order is to be made.
Please state if seals for mineral oil are required when placing order.

3 Brake cable (Bowden cable).
The brake illustrated is for right side of vehicle. The left is a mirror image of this (see fig. below).

4 Brake cable length (nominal).

5 Angular position of brake cable.

6 Brake port p_{max} = 112 bar.
Brake cylinder operating volume V = 24.91 cm³.

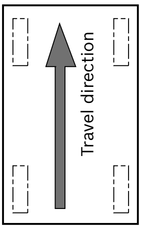
▼ **Brake torque after run-in**

Braking torque	Cable tension	Braking torque	Port pressure
9000 Nm	2580 N	9000 Nm	84 bar
12000 Nm	3460 N	12000 Nm	112 bar

MCR dynamic drum brake run-in procedure

- ▶ Brake the machine hard in forward and reverse directions until the brake drum temperature reaches 200°C.
- ▶ Allow the brake to cool.
- ▶ To remove residue, brake gently 2 times each in the forward and reverse directions.

Left side of vehicle
Ordering code C12L



Right side of vehicle
Ordering code C12R

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

Bosch Rexroth Limited
Viewfield Industrial Estate
Glenrothes, Fife
Scotland, KY6 2RD
UK
Phone +44 (0) 15 92 631 777
Telefax +44 (0) 15 92 631 936
www.boschrexroth.com/brm

Radial Piston Motor (Multi-Stroke) MCR20

RE 15209
Edition: 05.2012
Replaces: 03.1995

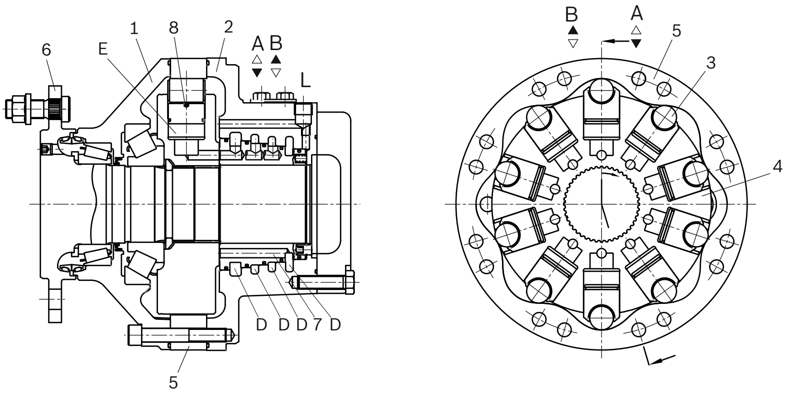
- Series 3X
- Size 1750 to 3000
- Differential pressure up to 450 bar
- Torque output up to 17760 Nm
- Speed up to 125 rpm
- Open and closed circuits

Features

- Compact robust construction
- High volumetric and mechanical efficiencies
- High pressure rating
- High reliability
- Low maintenance
- Smooth running at very low speeds
- Low noise
- Reversible
- Sealed tapered roller bearings
- High radial forces permitted on drive shaft
- Freewheeling possible
- Available with optional holding brake (multi-disc) or dynamic (drum) brake
- Available with:
  - Bi-directional two speed
  - Integrated flushing valve
  - Speed sensor

Contents

Functional description



Hydraulic motors type MCR are radial piston motors with a rotating shaft.

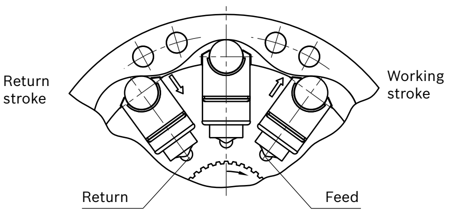
Construction

Two part housing (1, 2), rotary group (3, 4), cam (5), drive shaft (6) and flow distributor (7)

Transmission

The cylinder block (4) is connected to the shaft (6) by means of splines. The pistons (3) are arranged radially in the cylinder block (4) and make contact with the cam (5) via rollers (8).

Torque generation



The number of working and return strokes corresponds to the number of lobes on the cam x number of pistons.

Flow paths

The cylinder chambers (E) are connected to ports A and B via the axial bores and the annular passages (D).

Bearings

Tapered roller bearings capable of transmitting high axial and radial forces are fitted as standard, except on Hydrobase motors.

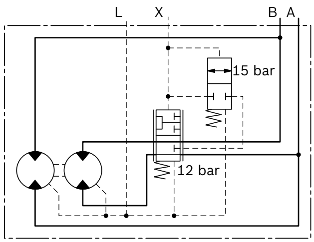
Freewheeling

In certain applications there may be a requirement to freewheel the motor. This may be achieved by connecting ports A and B to zero pressure and simultaneously applying a pressure of 2 bar to the housing through port L. In this condition, the pistons are forced into the cylinder block which forces the rollers to lose contact with the cam thus allowing free rotation of the shaft.

Two speed operation (2W)

In mobile applications where vehicles are required to operate at high speed with low motor loads, the motor can be switched to a low-torque and high-speed mode. This is achieved by operating an integrated valve which directs hydraulic fluid to only one half of the motor while continuously re-circulating the fluid in the other half. This “reduced displacement” mode reduces the flow required for a given speed and gives the potential for cost and efficiency improvements. The motor maximum speed remains unchanged.
Bosch Rexroth has developed a special spool valve to allow smooth switching to reduced displacement whilst on the move. This is known as “soft-shift” and is a standard feature of 2W motors. The spool valve requires either an additional sequence valve or electro-proportional control to operate in “soft-shift” mode.

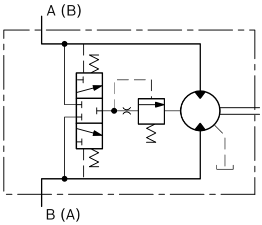
▼ **Two-speed motor**



Flushing valve

In a closed circuit, the same hydraulic fluid continuously flows between the pump and the motor. This could therefore lead to overheating of the hydraulic fluid.
The function of the flushing valve option is to replace hydraulic fluid in the closed circuit with that from the reservoir. When the hydraulic motor is operated under load, either in the clockwise or counter-clockwise direction, the flushing valve opens and takes a fixed flow of fluid through an orifice from the low pressure side of the circuit. This flow is then fed to the motor housing and back to the reservoir normally via a cooler. In order to charge the low pressure side of the circuit, cool fluid is drawn from the reservoir by the boost pump and is fed to the pump inlet through the check valve. Thus the flushing valve ensures a continuous renewal and cooling of the hydraulic fluid. The flushing feature incorporates a relief valve which is used to maintain a minimum boost pressure and operates at a standard setting of 14 bar (other options available on request).
Different orifice sizes may be used to select varying flows of flushing fluid. The following table gives flushing rate values based on a boost / charge pressure of 25 bar.

▼ **Motor with flushing valve**



Flushing flow rates (for $p_{charge} - p_{case} = 25$ bar)

Ordering code	Flow ±1 L/min
F1	3 L/min
F2	5 L/min
F7	7 L/min
F4	10 L/min
F8	12.5 L/min
F6	13.5 L/min

Holding brake (multi-disc brake)

Mounting

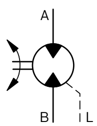
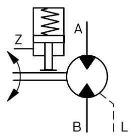
By way of rear housing (2) and brake shaft (16).

Brake application

As a safety requirement in mobile applications a parking brake may be provided to ensure that the motor cannot turn when the machine is not in use. The parking brake provides holding torque by means of discs (11) that are compressed by a disc spring (10). The brake is released when oil pressure is applied to brake port “Z” and the pressure in the annular area (9) compresses the disc spring allowing the brake discs to turn independently.

Note: This brake is provided solely for static use - not to be used dynamically

Schematic diagrams

Motor without brake	Motor with holding brake
	

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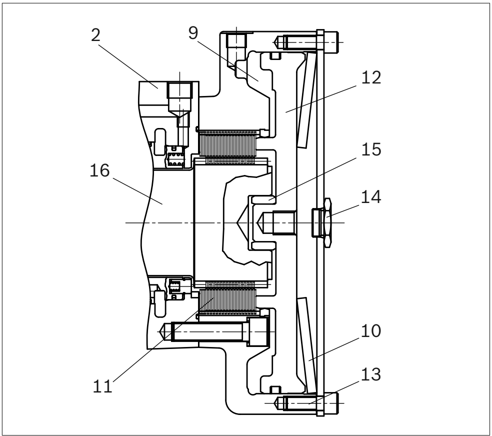
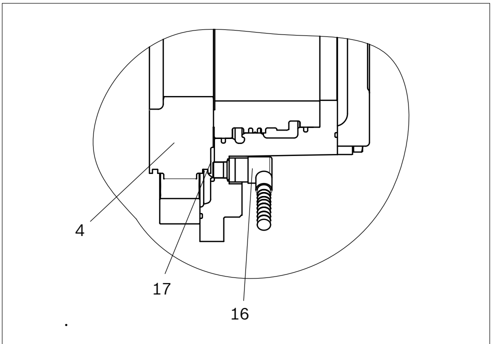
Manual release of holding brake

The brake may also be released manually by loosening screws (13), or by removing plug (14) and inserting a puller into the tapped hole on the brake piston (15).



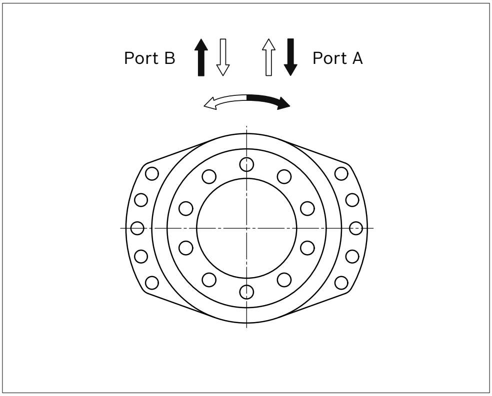
Speed sensor

A Hall-effect speed sensor (17) may be fitted as an option, giving a two-channel output of phase-displaced square waves, and enabling detection of speed and direction. A toothed target disc (18) is fitted to the motor cylinder block (4), and the sensor, fitted to a port in the rear case, produces a pulse on each channel as each tooth passes in front of it. The frequency of the pulses is proportional to the rotational speed.
Versions are available for use with regulated supplies (code P1) and for direct connection to a 12 V or 24 V unregulated supply (code P2).
The motor can also be supplied fitted with a target disc and with a speed sensor port machined, but covered and sealed with a blanking plate (code P0). These “sensor-ready” motors may be fitted with a sensor at a later date.



Direction of shaft rotation with flow

(viewed from drive shaft)



Ordering code

01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16
MCR	**20**				**Z**	**/**	**3X**		**M**							

Radial piston motor

01	Radial piston type, low-speed, high-torque motor	**MCR**

Frame size

02	Frame size 20	**20**

Housing type

03	Short front case – rear mounting flange	**C**
	Hydrobase (half motor)	**H**

	Nominal size, displacement V in cm^3/rev	**1750**	**2100**	**2500**	**3000**
04	Low displacement: motors use standard cylindrical pistons LD	●	●	–	–
	High displacement: motors use stepped pistons HD	–	–	●	●

Drive shaft

05	With flange ø280 mm (only available with housing type "C")	**F280**

Through shaft

06	Without through shaft	**Z**

Series

07	Series 30 to 39 (series 30 to 39 are dimensionally interchangeable)	**3X**

Brake

08	Without brake	**A0**
	Hydraulic release spring applied multi-disc holding brake 17000 Nm	**B19**

Seals

09	NBR (nitrile rubber)	**M**

Single- / Two-speed operation

10	Single speed, standard direction of rotation	**1L**
	Bi-directional two speed, standard direction of rotation	**2WL**

Ports

11	Tapped with UNF thread (SAE J514) (A and B ports SAE split flange metric bolt holes)	**42**

Studs

12	Without studs (no code)	
	With wheel studs and nuts	**S**

Speed sensor

13	Without sensor (no code)	
	Sensor ready	**P0**
	Sensor without regulator	**P1**
	Sensor with regulator	**P2**

Flushing

14	Without flushing (no code)	
	With flushing (see table on page 3)	**F1-F8**

Special order

15	Special feature	**SOXXX**

Other

16	Mark in text here	*

● = Available – = Not available

6

Technical data

Frame size			MCR20			
Type of mounting			Flange mounting; face mounting			
Pipe connections[1)2)]			Threaded per SAE J514 or flanged per J518 (code 62)			
Shaft loading			see page 8			
Displacement	V_g	cm^3/rev	1750	2100	2500	3000
Output torque						
Specific torque (at Δp = 250 bar)		Nm	6480	7770	9250	11100
Maximum torque[3)]	T_{max}	Nm	11660	13990	14800	17760
Output speed						
Minimum speed for smooth running[4)]	n_{min}	rpm	5	5	5	5
Maximum speed (1L & 2WL)[5) 6)]	n_{max}	rpm	125	125	115	115
Output power						
Nominal power[8)]	P	kW	70	70	85	85
Pressure						
Operating pressure[8)]	p_{nom}	bar	250	250	250	250
Maximum differential pressure[3)7)]	Δp_{max}	bar	450	450	400	400
Maximum pressure at port “A” or “B”[3)7)]	p_{max}	bar	470	470	420	420
Maximum case drain pressure	$p_{case\ max}$	bar	10	10	10	10
Weight	m	kg	see unit dimensions on pages 9 to 11			
Moment of Inertia	J	kgm^2	see unit dimensions on pages 9 to 11			
Hydraulic fluid[9)]						
Hydraulic fluid type			Mineral oils (HLP) to DIN 51 524			
Hydraulic fluid temperature range[10)]	$t_{min/max}$	°C	-20 to 85			
Viscosity range	$\nu_{min/max}$	mm^2/s	10 to 2000			
Fluid cleanliness			ISO 4406, Class 20/18/15			
Holding brake (disc brake)			B19			
Minimum holding torque	T	Nm	17000			
Release pressure (min)	$p_{rel\ min}$	bar	15			
Release pressure (max)	$p_{rel\ max}$	bar	30			
Maximum pressure at brake port “Z”	p	bar	40			
Oil volume required to operate brake	V	cm^3	99			

1) Ensure motor case is filled with oil prior to start-up. See operating manual RE 15215-B.
2) For installation and maintenance details, please see operating manual RE 15215-B.
3) Maximum values should only be applied for a small portion of the duty cycle. Please consult Bosch Rexroth Engineering Department in Glenrothes for motor life calculations based on particular operating cases.
4) For continuous operation at speeds < 5 rpm please consult Bosch Rexroth Engineering Department in Glenrothes.
5) Based on nominal no-load Δp of 20 bar in full-displacement mode.
6) Warning! During the running in period of the motor (min. 20 hrs) it should not be run unloaded at >100 rpm.
7) When operating motors in series, please consult Bosch Rexroth Engineering Department in Glenrothes.
8) Guide values for continuous operation.
9) For use with environmentally acceptable fluids HEES, HEPG, HETG, Viton seals must be specified.
For further information, please refer to RE 90221.
10) Extension of the allowable temperature range may be possible depending on specification. Please consult Bosch Rexroth Engineering Department in Glenrothes for further details.

Note
For operation outside of these parameters, please consult Bosch Rexroth.

Technical data – mean values

- Measured at ν = 46 mm^2/s and t = 45°C
- All torques apply to run-in motors
- For reduced displacement operating mode multiply the torques by ratio of reduced displacement

T = Torque in Nm
q_V = Input flow in L/min
q_{VL} = Mean case leakage in L/min
p = Minimum charge pressure in pump mode in bar

Note

- Case pressure must be added to minimum charge pressures quoted. Quoted pressures are guide values but can be circuit-dependant. Please contact Bosch Rexroth Engineering Department in Glenrothes for further advice. Figures quoted in technical data tables below are average values.
- Where flushing is used, q_{VL} will increase by the flushing flow rate. Mean case leakage values are average values for single speed motors.

	Size		**1750**					**2100**				
Pressure diff. Δp in bar	**Speed n**	**rpm**	**0**	**25**	**50**	**100**	**125**	**0**	**25**	**50**	**100**	**125**
100	T	Nm	1950	2423	2507	2206	2111	2335	2902	3002	2570	2390
	q_V	L/min	1.6	45.4	89.3	176.8	221.0	1.6	54.1	106.8	211.8	269.7
	q_{VL}	L/min	0.8	0.8	0.9	0.9	1.1	0.8	0.8	0.9	0.9	1.1
200	T	Nm	3899	5013	5124	5013	–	4670	6005	638.0	6005	–
	q_V	L/min	2.4	46.2	90.3	178.0	–	2.4	54.9	107.8	213.0	–
	q_{VL}	L/min	1.2	1.2	1.4	1.5	–	1.2	1.2	1.4	1.5	–
300	T	Nm	5850	7520	7688	–	–	7006	9007	9207	–	–
	q_V	L/min	3.4	47.2	91.3	–	–	3.4	55.9	108.8	–	–
	q_{VL}	L/min	1.7	1.7	1.9	–	–	1.7	1.7	1.9	–	–
400	T	Nm	7799	10028	10251	–	–	9341	12010	12276	–	–
	q_V	L/min	4.4	48.2	92.1	–	–	4.4	56.9	109.6	–	–
	q_{VL}	L/min	2.2	2.2	2.3	–	–	2.2	2.2	2.3	–	–

	Size		**2500**					**3000**				
Pressure diff. Δp in bar	**Speed n**	**rpm**	**0**	**25**	**50**	**100**	**115**	**0**	**25**	**50**	**100**	**115**
100	T	Nm	2188	3263	3342	2706	2594	2626	3915	4011	3247	2435
	q_V	L/min	1.6	64.1	126.8	251.8	289.5	1.6	76.6	151.8	301.8	347.0
	q_{VL}	L/min	0.8	0.8	0.9	0.9	1.0	0.8	0.8	0.9	0.9	1.0
200	T	Nm	5173	6844	7003	6605	–	6207	8212	8403	–	–
	q_V	L/min	2.4	64.9	127.8	253.0	–	2.4	77.4	152.8	–	–
	q_{VL}	L/min	1.2	1.2	1.4	1.5	–	1.2	1.2	1.4	–	–
300	T	Nm	8356	10504	10743	–	–	10027	12605	12891	–	–
	q_V	L/min	3.4	65.9	128.8	–	–	3.4	78.4	153.8	–	–
	q_{VL}	L/min	1.7	1.7	1.9	–	–	1.7	1.7	1.9	–	–
400	T	Nm	11459	14165	14244	–	–	13751	16998	–	–	–
	q_V	L/min	4.4	66.9	129.6	–	–	4.4	79.4	–	–	–
	q_{VL}	L/min	2.2	2.2	2.3	–	–	2.2	2.2	–	–	–

6

Permitted loading on drive shaft

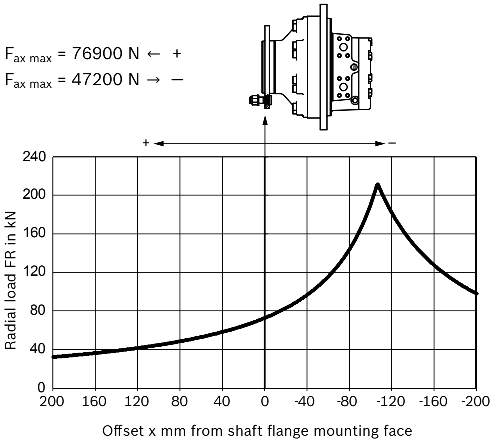
Drive shaft ...F280...(10 studs M22)

Housing type ...C...

Maximum axial load $F_{ax\ max}$ (with radial load F_R = 0):

$F_{ax\ max}$ = 76900 N ← +

$F_{ax\ max}$ = 47200 N → –



Note

- These values and graphs are for initial guidance only and are based on:
  Speed n = 50 rpm, pressure differential Δp = 250 bar, 2000 hrs L10 life at 50 °C
- For actual motor life calculations under typical or specified duty cycles, contact Rexroth Engineering Department in Glenrothes.

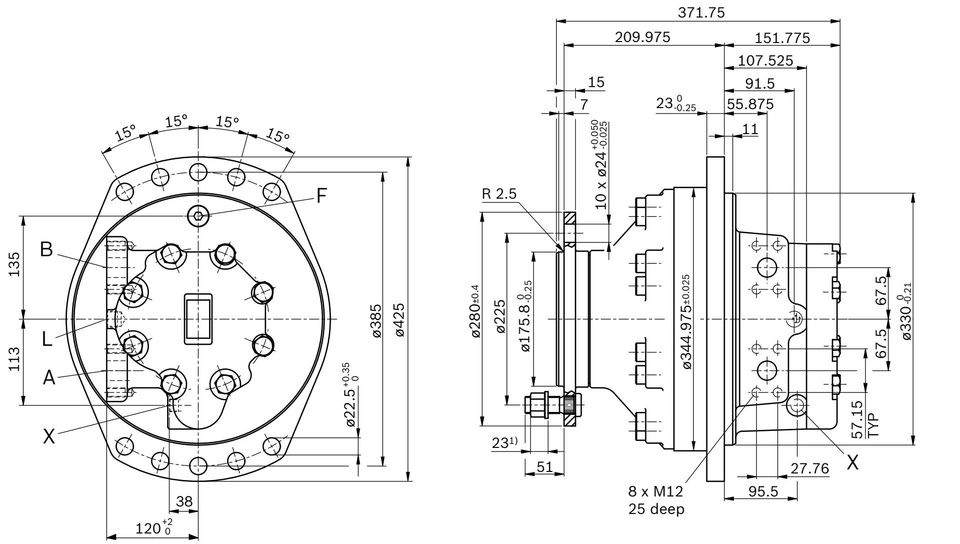
Dimensions

Flanged rear housing, flanged drive shaft, compact front housing, single speed (1)

Ordering code: “MCR20C...F280Z-32/A0.1L/11./...”

Flanged rear housing, flanged drive shaft, compact front housing, two speed (2W)

Ordering code: “MCR20C...F280Z-32/A0.2WL/11./...”



Weight: 123 kg

Moment of inertia: 0.3077kgm²

Ports

Designation	Port function	Code 42	Size	Maximum pressure [bar]	State[3)]
A, B	Inlet, outlet	SAE J518	1 in	470/420[2)]	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 10x wheel studs M22 x 1.5 with flat nuts (DIN74361-2) for wheel fixing, clamping length 5 to 28 mm, ordering code S (wheel studs and nuts equally spaced on P.C.D. of 225)

2) Depends on nominal size

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

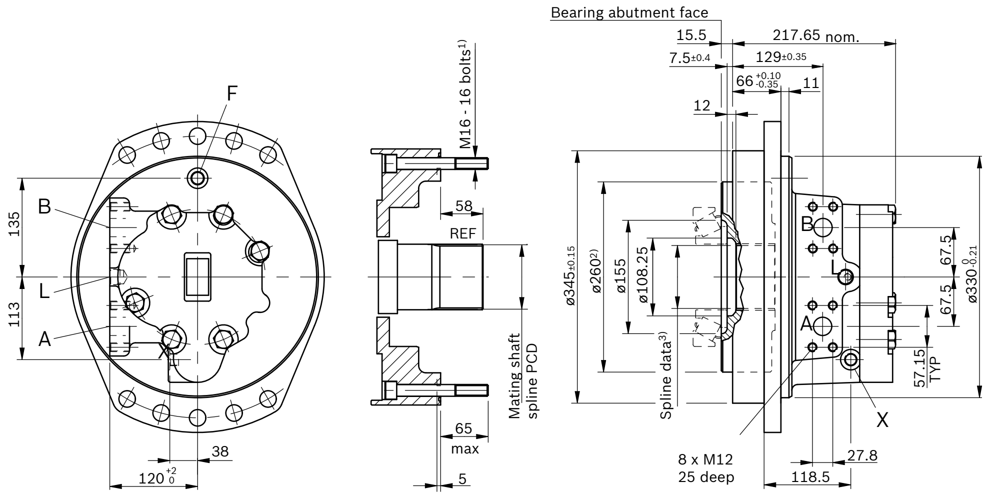
Before finalizing your design, request a binding installation drawing.
Dimensions in mm

Hydrobase for mounting on customer's shaft, single speed (1)

Ordering code: "MCR20H...ZZ-32/A0.1L/11./..."

Hydrobase for mounting on customer's shaft, two speed (2W)

Ordering code: "MCR20H...ZZ-32/A0.2WL/11./..."



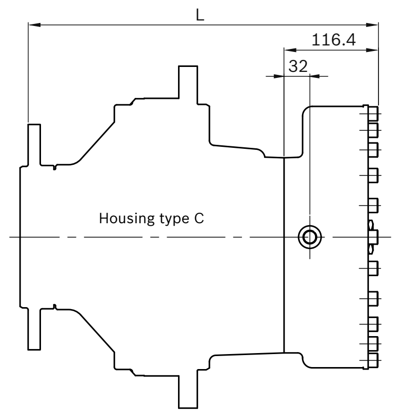
Weight: 76kg
Moment of Inertia: 0.2027kgm²

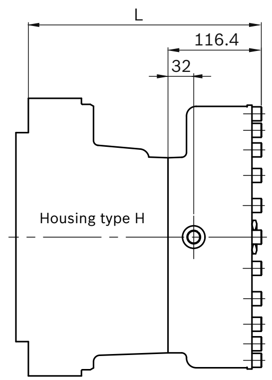
Ports

Designation	Port function	Code 42	Size	Maximum pressure [bar]	State[5]
A, B	Inlet, outlet	SAE J518	1 in	470/420[4]	O
L	Case drain	SAE J514	3/4 in - 16 UNF	10	O
X	2 speed port	SAE J514	9/16 in - 18 UNF	35	O
F	Filler port	SAE J514	3/4 in - 16 UNF	10	X

1) 16 x M16 x 2 bolts on a P.C.D of 310
2) Mating part must clear this diameter
3) Spline data: N90x2x44x9H DIN 5480
4) Depends on nominal size
5) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

Holding brake (multi-disc brake): ordering code “B19”





Housing type	Single speed (1) L	Two speed (2W) L
C	434.2	434.2
H	290.1	290.1

Weight m = 53.2 kg
Polar Moment of Inertia J_m = 0.0258kgm^2

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

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Radial Piston Motor for Track Drives MCR-T

RE 15221
Edition: 06.2012

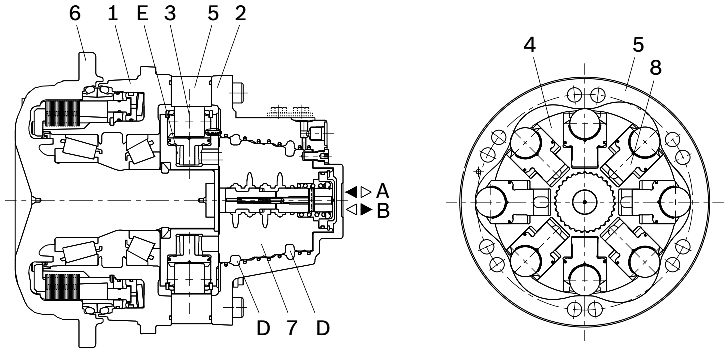
- Series 3X
- Size 380 to 1340
- Differential pressure up to 450 bar
- Torque output up to 8640 Nm (theoretical)
- Speed up to 475 rpm
- Open and closed circuits

Features

- Compact robust construction
- High brake capacity
- High volumetric and mechanical efficiencies
- High pressure rating
- High reliability
- High bearing life
- Low maintenance
- Smooth running at very low speeds
- Low noise
- Freewheeling possible
- Available with
  - Integrated flushing valve
  - Speed sensor
  - Bi-directional two speed
  - Integrated parking brake

Contents

Functional description



Hydraulic motors type MCR-T are specially designed radial piston motors for track drives.

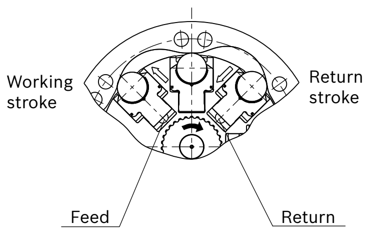
Construction

Two part housing (1, 2), rotary group (3, 4, 8), cam (5), drive shaft (6) and flow distributor (7)

Transmission

The cylinder block (4) is connected to the shaft (6) by means of splines. The pistons (8) are arranged radially in the cylinder block (4) and make contact with the cam (5) via rollers (3).

Torque generation



The number of working and return strokes corresponds to the number of lobes on the cam x number of pistons in the cylinder block.

Flow paths

The ports A and B which are located at the rear case carry oil through the distributor to the cylinder chambers (E).

Bearings

Tapered roller bearings capable of transmitting high axial and radial forces are fitted as standard.

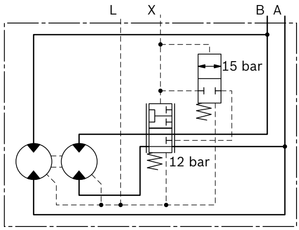
Freewheeling

In certain applications there may be a requirement to free-wheel the motor. This may be achieved by connecting ports A and B to zero pressure and simultaneously applying a pressure of 2 bar to the housing through port L. In this condition, the pistons are forced into the cylinder block which forces the rollers to loose contact with the cam thus allowing free rotation of the shaft.

Two speed operation (2W)

In mobile applications where vehicles are required to operate at high speed with low motor loads, the motor can be switched to a low-torque and high-speed mode. This is achieved by operating an integrated valve which directs hydraulic fluid to only one half of the motor while continuously re-circulating the fluid in the other half. This “reduced displacement” mode reduces the flow required for a given speed and gives the potential for cost and efficiency improvements. Maximum speed of the motor remains unchanged.
Bosch Rexroth has developed a special spool valve to allow smooth switching to reduced displacement whilst on the move. This is known as “soft-shift” and is a standard feature of 2W motors. The spool valve requires either an additional sequence valve or electro-proportional control to operate in “soft-shift” mode.

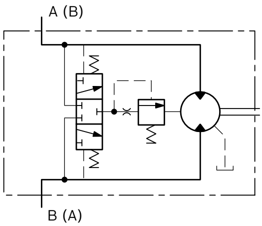
▼ **Two-speed motor**



Flushing valve

In a closed circuit, the same hydraulic fluid continuously flows between the pump and the motor. This could therefore lead to overheating of the hydraulic fluid.
The function of the flushing valve option is to replace hydraulic fluid in the closed circuit with that from the reservoir. When the hydraulic motor is operated under load, either in the clockwise or counter-clockwise direction, the flushing valve opens and allows a fixed flow of fluid through an orifice from the low pressure side of the circuit. This flow is then fed to the motor housing and back to the reservoir normally via a cooler. In order to charge the low pressure side of the circuit, cold fluid is drawn from the reservoir by the boost pump and is fed to the pump inlet through the check valve. Thus the flushing valve ensures a continuous renewal and cooling of the hydraulic fluid. The flushing feature incorporates a relief valve which is used to maintain a minimum boost pressure and operates at a standard setting of 14 bar (other options available on request).
Different orifice sizes may be used to select varying flows of flushing fluid. The following table gives flushing rate values based on a boost / charge pressure of 25 bar.

▼ **Motor with flushing valve**



Flushing flow (for $p_{charge} - p_{case}$ = 25 bar)

Ordering code	Flow ±1 L/min
F1	3 L/min
F2	5 L/min
F7	7 L/min
F4	10 L/min
F8	12.5 L/min
F6	13.5 L/min

Holding brake (multi-disc brake)

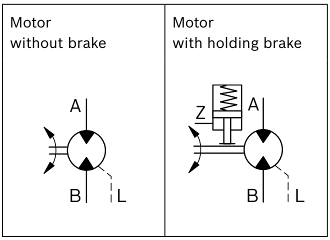
▼ **Mounting**

In MCRT, the brake is integrated into the motor itself. The brake parts that are attached to the shaft can rotate while the ones that are attached to the front case remain stationary.

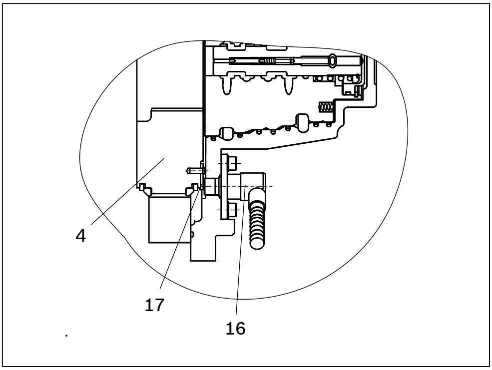
▼ **Brake application**

As a safety requirement in mobile applications a parking brake is provided to ensure that the motor cannot turn when the machine is not in use. The parking brake provides holding torque by means of discs that are compressed by a disc spring. The brake is released when oil pressure is applied to brake port “Z” and the pressure in the annular area compresses the disc spring allowing the brake discs to turn independently.
Note: This brake is provided solely for static use - not to be used dynamically.

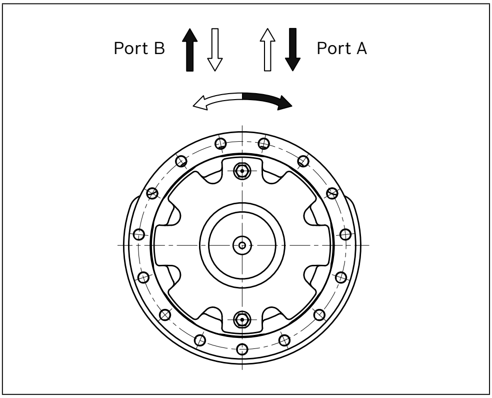
▼ **Schematic diagrams**



Speed sensor
A Hall-effect speed sensor (16) may be fitted as an option, giving a two-channel output of phase-displaced square waves, and enabling detection of speed and direction. A toothed target disc (17) is fitted to the motor cylinder block (4), and the sensor, fitted to a port in the rear case, produces a pulse on each channel as each tooth passes in front of it. The frequency of the pulses is proportional to the rotational speed.
Versions are available for use with regulated supplies (code P1) and for direct connection to a 12 V or 24 V unregulated supply (code P2).
The motor can also be supplied fitted with a target disc and with a speed sensor port machined, but covered and sealed with a blanking plate (code P0). These “sensor-ready” motors may be fitted with a sensor at a later date.



Direction of shaft rotation with flow
(view from drive shaft)



Ordering code

01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16
MCR		**T**			**Z**	**/**	**3X**		**V**							

Radial piston motor

01	Radial-piston type, low-speed, high-torque motor	**MCR**

Frame size

02	Frame size	5	**5**
		6	**6**
		10	**10**

Housing type

03	Front case flanged	**T**

Nominal size, displacement V_g in cm³/rev

04	Frame size 5		**380**	**470**	**520**	**565**	**620**	**680**	**750**	**820**
	Low displacement: motors use standard cylindrical pistons	LD	●	●	●	●	–	–	–	–
	High displacement motors use stepped pistons	HD	–	–	–	–	●	●	●	●
	Frame size 6									**920**
	High displacement motors use stepped pistons	HD								●
	Frame size 10			**780**	**860**	**940**	**1120**	**1180**	**1250**	**1340**
	Low displacement: motors use standard cylindrical pistons	LD		●	●	●	–	–	–	–
	High displacement motors use stepped pistons	HD		–	–	–	●	●	●	●

Drive shaft

05	With flange ø284 mm	**F284**
	With flange ø315 mm (only available with MCR10T)	**F315**

Through shaft

06	Without through shaft	**Z**

Series

07	Series 30 to 39 (series 30 to 39 are dimensionally interchangeable)	**3X**

Brake

08	Without brake	**A0**
	Hydraulic release spring applied multi-disc holding brake 4500 Nm	**B4.5**
	Hydraulic release spring applied multi-disc holding brake 5000 Nm	**B5**
	Hydraulic release spring applied multi-disc holding brake 7000 Nm (only available with MCR10T)	**B7**

Seals

09	NBR (nitrile rubber)	**M**
	FKM (fluoroelastomer/Viton)	**V**

Single/two-speed operation

10	Single speed, standard direction of rotation	**1L**
	Bi-directional two speed, standard direction of rotation	**2WL**

Ports

11	Tapped with UNF thread (SAE J514)	**12**
	Tapped with UNF thread (SAE J514) (A & B ports SAE split flange metric bolt holes) (only available with MCR10T)	**48**

6

● = Available – = Not available

01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16
MCR		**T**			**Z**	**/**	**3X**		**V**							

Studs

12	Without studs (no code)	
	With wheel studs and nuts	**S**

Speed sensor

13	Without sensor (no code)	
	Sensor ready	**P0**
	Sensor without regulator	**P1**
	Sensor with regulator	**P2**

Flushing

14	Without flushing (no code)	
	With flushing (see table on page 3)	**F1-F8**

Special order

15	Special feature	**SOXXX**

Other

16	Mark in text here	*

Technical data

Frame size			MCR5T								MCR6T
Type of mounting			Flange mounting								
Pipe connections[1)2)]			Threaded per SAE J514								
Displacement[11)]	V_g	cm³/rev	380	470	520	565	620	680	750	820	920
Output torque											
Specific torque (at Δp = 250 bar)		Nm	1360	1680	1860	2020	2220	2440	2690	2940	3290
Maximum torque[3)]	T_{max}	Nm	2450	3030	3350	3640	4000	4380	4830	5290	5930
Output speed											
Minimum speed for smooth running[4)]	n_{min}	rpm	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum speed (1L)[5)6)]	n_{max}	rpm	475	385	345	320	290	265	240	220	195
Maximum speed (2WL)[5)6)]	n_{max}	rpm	475	385	345	320	290	265	240	220	195
Output power											
Nominal power[8)]	P	kW	29	29	29	29	35	35	35	35	35
Pressure											
Operating pressure[8)]	p_{nom}	bar	250	250	250	250	250	250	250	250	250
Maximum differential pressure[3)7)]	Δp_{max}	bar	450	450	450	450	450	450	450	450	450
Maximum pressure at port „A“ or „B“[3)7)]	p_{max}	bar	470	470	470	470	470	470	470	470	470
Maximum case drain pressure	$p_{case\ max}$	bar	10	10	10	10	10	10	10	10	10
Weight	m	kg	62.8	62.8	62.8	62.8	62.8	62.8	62.8	62.8	65.9
Moment of Inertia	J	kgm²	0.000139	0.000139	0.000139	0.000139	0.000139	0.000139	0.000139	0.000139	0.000150
Hydraulic fluid[9)]											
Hydraulic fluid type			Mineral oils (HLP) to DIN 51524								
Hydraulic fluid temperature range[10)]	$t_{min/max}$	°C	-20 to 85								
Viscosity range	$\nu_{min/max}$	mm²/s	10 to 2000								
Fluid cleanliness			ISO 4406, Class 20/18/15								
Holding brake (disc brake)					B4.5					B5	
Minimum holding torque	T_{min}	Nm			4500					5000	
Release pressure (min)	$p_{rel\ min}$	bar			12.0					12.0	
Release pressure (max)	$p_{rel\ max}$	bar			15.0					15.0	
Maximum pressure at brake port „Z“	p	bar			40					40	
Oil volume to operate brake	V_{rel}	cm³			20.0					20.0	

1) Ensure motor case is filled with oil prior to start-up. See operating manual RE 15215-B
2) For installation and maintenance details, please see operating manual RE 15215-B.
3) Maximum values should only be applied for a small portion of the duty cycle. Please consult Rexroth Engineering Department in Glenrothes for motor life calculations based on particular operating cases.
4) For continuous operation at speeds <5 rpm please consult Rexroth Engineering Department in Glenrothes
5) Based on nominal no-load Δp of 20 bar in full-displacement mode.
6) Warning! During the running in period of the motor (min. 20 hrs) it should not be run unloaded at >100 rpm.
7) When operating motors in series, please consult Rexroth Engineering Department in Glenrothes.
8) Guide values for continuous operation.
9) For use with environmentally acceptable fluids HEES, HEPG, HETG, Viton seals must be specified.
For further information, please refer to RE 90221.
10) Extension of the allowable temperature range may be possible depending on specification.
Please consult Rexroth Engineering Department in Glenrothes for further details.
11) For available displacement options please consult Rexroth Engineering Department in Glenrothes
Note: For actual motor life calculations under typical or specified duty cycles, contact Rexroth Engineering Department in Glenrothes.

6

Frame size			**MCR10T**						
Type of mounting			Flange mounting						
Pipe connections[1)2)]			Flanged per SAE J518 (code 62), threaded per SAE J514						
Displacement[11)]	V_g	cm^3/rev	780	860	940	1120	1180	1250	1340
Output torque									
Specific torque (at Δp = 250 bar)		Nm	2790	3080	3370	4010	4230	4480	4800
Maximum torque[3)]	T_{max}	Nm	5030	5540	6060	7220	7610	8060	8640
Output speed									
Minimum speed for smooth running[4)]	n_{min}	rpm	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Maximum speed (1L)[5) 6)]	n_{max}	rpm	335	300	275	230	220	210	195
Maximum speed (2WL)[5) 6)]	n_{max}	rpm	335	300	275	230	220	210	195
Output power									
Nominal power[8)]	P	kW	44	44	44	50	50	50	50
Pressure									
Operating pressure[8)]	p_{nom}	bar	250	250	250	250	250	250	250
Maximum differential pressure[3)7)]	Δp_{max}	bar	450	450	450	450	450	450	450
Maximum pressure at port „A“ or „B“[3)7)]	p_{max}	bar	470	470	470	470	470	470	470
Maximum case drain pressure	$p_{case\ max}$	bar	10	10	10	10	10	10	10
Weight	m	kg	93.6	93.6	93.6	93.6	93.6	93.6	93.6
Moment of Inertia	J	kgm^2	0.000266	0.000266	0.000266	0.000266	0.000266	0.000266	0.000266
Hydraulic fluid[9)]									
Hydraulic fluid type			Mineral oils (HLP) to DIN 51524						
Hydraulic fluid temperature range[10)]	$t_{min/max}$	°C	-20 to 85						
Viscosity range	$\nu_{min/max}$	mm^2/s	10 to 2000						
Fluid cleanliness			ISO 4406, Class 20/18/15						
Holding brake (disc brake)			B7						
Minimum holding torque	T_{min}	Nm	7000						
Release pressure (min)	$p_{rel\ min}$	bar	10.0						
Release pressure (max)	$p_{rel\ max}$	bar	15.7						
Maximum pressure at brake port „Z“	p	bar	40						
Oil volume to operate brake	V_{rel}	cm^3	22.0						

1) Ensure motor case is filled with oil prior to start-up. See operating manual RE 15215-B
2) For installation and maintenance details, please see operating manual RE 15215-B.
3) Maximum values should only be applied for a small portion of the duty cycle. Please consult Rexroth Engineering Department in Glenrothes for motor life calculations based on particular operating cases.
4) For continuous operation at speeds <5 rpm please consult Rexroth Engineering Department in Glenrothes
5) Based on nominal no-load Δp of 20 bar in full-displacement mode.
6) Warning! During the running in period of the motor (min. 20 hrs) it should not be run unloaded at >100 rpm.
7) When operating motors in series, please consult Rexroth Engineering Department in Glenrothes.
8) Nominal values are guide values for continuous operation.
9) For use with environmentally acceptable fluids HEES, HEPG, HETG, Viton seals must be specified.
For further information, please refer to RE 90221.
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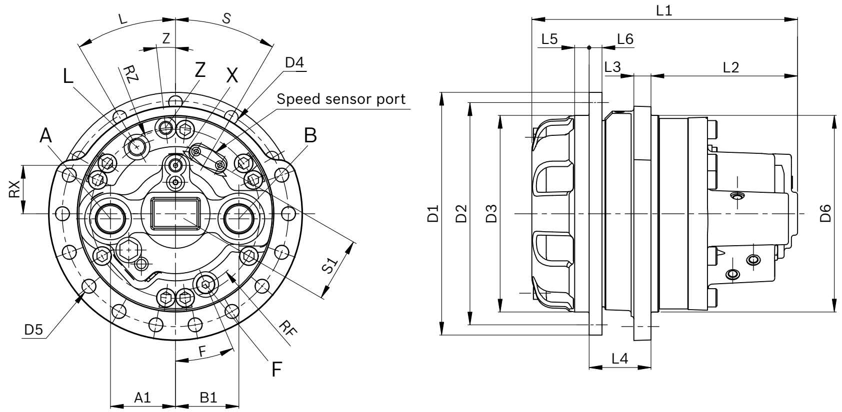
Please consult Rexroth Engineering Department in Glenrothes for further details.
11) For available displacement options please consult Rexroth Engineering Department in Glenrothes
Note: For actual motor life calculations under typical or specified duty cycles, contact Rexroth Engineering Department in Glenrothes.

Dimensions



Motor	D1	D2	D3	D4	D5	D6	L1	L2	L3	L4	L5	L6
MCR5T	ø284	ø260	ø230	15 x 1/2-13UNC	8 x 5/8-11UNC	ø230	310.4	171.2	20	72	17	15
MCR6T	ø284	ø260	ø230	15 x 1/2-13UNC	10 x ø17	ø240	310.4	171.2	20	72	17	15
MCR10T	ø321	ø285	ø255	8 x M16	10 x ø17	ø268	349.8	195.8	16	86	16	18

Motor	L	S	Z	F	RX	RZ	RF	A1	B1	S1
MCR5T	30°	30°	6.5°	23°	56.5	R101	R90	76	74	75
MCR6T	35°	30°	18.5°	23°	56.5	R101	R95	76	74	75
MCR10T	-87°	150°	-76.2°	-87°	71	R121	R108	45	45	89

Ports

Designation	Port function	Ordering code 12	Size	Ordering code 48[1]	Size[1]	Maximum pressure [bar]	State[2]
A, B	Inlet, outlet	SAE J514	1 5/16-12 UN	SAE J518	3/4 in	470	O
L	Case drain	SAE J514	3/4-16 UNF	SAE J514	3/4-16 UNF	10	O
X	2 speed port	SAE J514	9/16-18 UNF	SAE J514	9/16-18 UNF	30	O
Z	Brake port	SAE J514	9/16-18 UNF	SAE J514	9/16-18 UNF	40	O
F	Filler port	SAE J514	3/4-16 UNF	SAE J514	3/4-16 UNF	10	X

1) Applicable to MCR10T only
2) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

6

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

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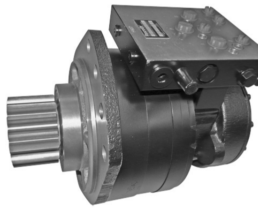
Radial Piston Motor for Slew Drives MCR-X

RE 15214
Edition: 06.2012
Replaces 04.2009



- Series 3X
- Size 160 to 820
- Maximum pressure 300 bar
- Torque output up to 3700 Nm
- Open circuits

Features

- Low-speed radial-piston design
- Short installation length
- Industry-standard mounting
- Integrated pinion
- High volumetric and mechanical efficiency
- Smooth operation at very low speed
- Low noise and backlash
- Anti-shock cross-port relief valves
- Anti-cavitation valves
- Holding brake
- Optional brake release valve with delay function

Contents

Application

The MCR-X motors are intended for open-circuit operation as drive motors for the slewing function primarily of excavators in the 2 to 8 ton weight range (MCR3X for 2 to 4 ton and MCR5X for 4 to 8 ton). Other possible areas of application include slewing for forestry machines and aerial work platforms.

Functional description

The MCR-X is a low-speed high-torque motor of radial-piston design. For a description of the operating principle see Bosch Rexroth data sheets RE 15205 and RE 15206.

Anti-shock relief valves

Pressure relief valves venting to return line are fitted to facilitate use in open circuits. These valves have an anti-shock function to limit the rate of rise of pressure and prevent overly rapid changes in acceleration, thus limiting the shock felt by the machine operator and extending gear life.

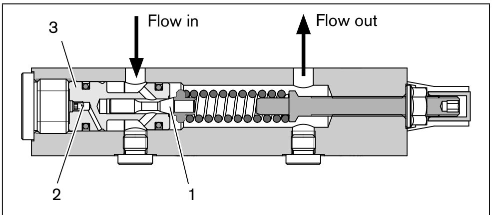
With reference to Figure 1, these valves function as follows:

- Flow enters as shown, causing the small piston (1) to push against the spring.
- When sufficient pressure builds up behind the small piston to overcome the spring force, it moves to the right, releasing fluid.
- The pressure causes oil to flow through the orifice (2) to the rear of the large piston (3).
- Pressure builds up at the rear of the large piston causing it to move to the right and further compress the spring. This movement gradually increases the relief pressure until the final setting is reached.

The result is a two-stage relief valve giving a rapid step up to the initial opening pressure of the small piston, followed by a gradual rise to the final pressure setting (see Technical Data on page 7 for typical pressure trace).

This architecture delivers a high degree of reliability and repeatability and is patented by Rexroth.

Section of an anti-shock relief valve (Figure 1)



Anti-cavitation valves

During deceleration it is necessary to maintain sufficient pressure at the motor inlet to hold the pistons against the cam ring and prevent cavitation. For this reason the motor is equipped with a make-up port M, which feeds anti-cavitation check valves connected to ports A and B (see schematic diagram on page 5). See Technical Data on page 6 for details of the pressure that is required at port M.

Holding brake

A holding brake is usually required to comply with relevant equipment standards such as EN474 and is, therefore, fitted as standard to the MCR-X motor.

The brake is mounted by way of the rear case (1) and brake shaft (2).

A disc pack (3), with alternate discs splined to the brake shaft and brake housing (4), is compressed by the force of a disc spring (5) acting through a piston (6). The friction between the discs generates a holding torque.

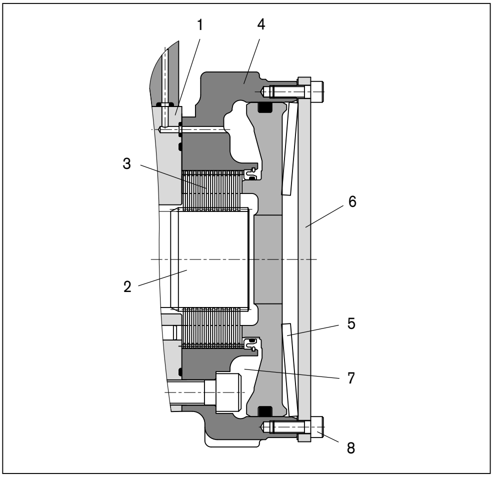
When fluid is fed into the annular area (7), the pressure on the underside of the piston rises, opposing the spring force.

If sufficient pressure is applied (see Technical Data on page 6), the piston moves to the right, removing the compression on the disc pack and allowing the motor to turn freely.

When the pressure is removed the spring forces the piston back to the left and once again compresses the disc pack. Thus, the brake is fail-safe.

In case of hydraulic system failure, it may be manually released by loosening the end cover screws (8).

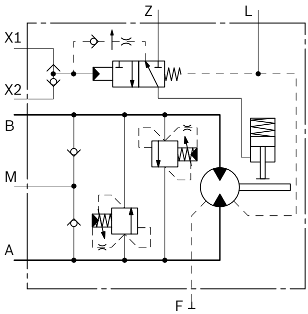
Section of holding brake (Figure 2)



Brake valve option

The holding brake is designed to be engaged only once the motor has stopped rotating. Premature engagement can lead to noise, overheating and wear or seizure of the brake discs. Thus, there is a need to delay brake engagement after the control joystick pilot pressure falls to zero, for sufficient time to allow the machine upperstructure to come to rest in the worst case of maximum speed and maximum moment of inertia. For this reason, a brake control valve with a delay function is offered as an option on the MCR-X.

▼ **MCR-X with brake valve**

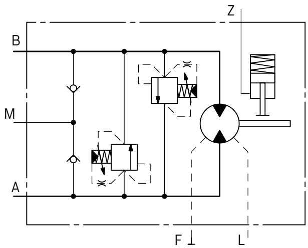


The valve functions as follows:

- The brake release pressure is fed to port Z.
- Pilot pressure from the joystick (one line for each direction) is fed to ports X1 and X2 and an internal shuttle valve feeds the higher of these to the brake control valve.
- If the pilot pressure is sufficient, the valve shifts and the brake is immediately released.
- When the joystick is returned to the centre position, pilot pressure falls, the valve shifts back and flow is drained from the brake at a metered rate determined by the diameter of an orifice within the valve. This metering of the flow out of the brake results in a delay in engagement.

Where the brake valve option is not supplied, the above functions must be implemented externally to the motor.

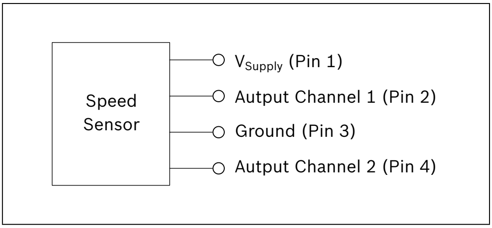
▼ **MCR-X without brake valve**



Speed sensor options

A hall-effect speed sensor may be fitted as an option, giving a two-channel output of phase-displaced square waves, and enabling detection of speed and direction. A toothed target disc is fitted to the motor cylinder block, and the sensor, fitted to a port in the rear case, produces a pulse on each channel as each tooth passes in front of it. The frequency of the pulses is proportional to the rotational speed.
Versions are available for use with regulated supplies (Code P1) and for direct connection to a 12 V or 24 V unregulated supply (Code P2).
The MCR-X may also be supplied fitted with a target disc and with a speed sensor port machined, but covered and sealed with a blanking plate (Code P0). These "sensor-ready" motors may be fitted with a sensor at a later date.

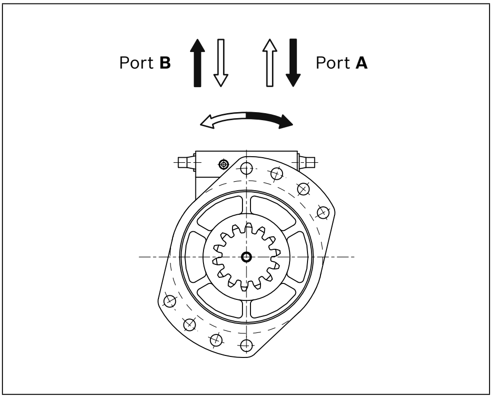
Terminal connections



Connector ______________________ Deutsch DT04-4P-E008
Cable length _________________________________ 600 mm
For technical data see standard DO/100/117 (please consult Rexroth Engineering Department in Glenrothes).

Direction of shaft rotation with flow

(view from drive shaft)



Ordering code

01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16
MCR		**X**			**Z**	**/**	**3X**		**V**							

Radial piston motor

01	Radial-piston type, low-speed, high-torque motor, equipped with cross-port relief and anti-cavitation valves	**MCR**

Frame size

02	Frame size 3	**3**
	5	**5**

Motor type

03	Slew motor	**X**

Nominal size, displacement V_g in cm^3/rev

04	Frame size 3			**160**	**225**	**255**	**280**	**325**	**365**	**400**
	Low displacement: motors use standard cylindrical pistons	LD		●	●	●	–	–	–	–
	High displacement motors use stepped pistons	HD		–	–	–	●	●	●	●
	Frame size 5		**380**	**470**	**520**	**565**	**620**	**680**	**750**	**820**
	Low displacement: motors use standard cylindrical pistons	LD	●	●	●	●	–	–	–	–
	High displacement motors use stepped pistons	HD	–	–	–	–	●	●	●	●

Drive shaft

05	Pinion specification: module 6, 14 teeth	**G101**
	Pinion specification: module 6.5, 17 teeth	**G126**
	Pinion specification: module 5, 13 teeth (only MCR3X)	**G79**
	Other[1)]	**GXXX**

Through shaft

06	Without through shaft	**Z**

Series

07	Series 30 to 39[2)]	**3X**

Brake

08	Hydraulic release multi-disc holding brake	**B2**
	Hydraulic release multi-disc holding brake (only MCR5X)	**B4**

Seals

09	NBR (nitrile rubber)	**M**
	FKM (fluoroelastomer/Viton)	**V**

Direction of rotation

10	Viewed from drive shaft: clockwise with flow into port A	**1L**

Ports

11	Tapped with UNF thread (SAE J514)	**12**
	Tapped to JIS B 2351	**64**

Speed sensor

13	Without sensor (no code)	
	Sensor ready	**P0**
	Sensor without regulator	**P1**
	Sensor with regulator	**P2**

01	02	03	04	05	06		07	08	09	10	11	12	13	14	15	16
MCR		**X**			**Z**	**/**	**3X**		**V**							

Valves

13	With brake valve orifice ø0.6 mm	**V01**
	Without brake valve	**V02**
	Other[3)]	**VXX**

Relief setting

14	220 bar	**A**
	Other	**B to Z**

Special order

15	Two-coat black paint	**SO400**
	Other	**SOXXX**

Other

16	Mark in text here	*

6

1) Other pinions may be provided to the customer's specification, depending on sales volume
2) Series 30 to 39 are dimensionally interchangeable

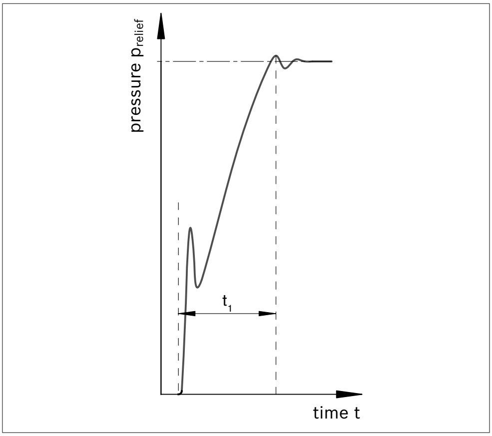
3) The brake delay orifice must be sized to suit the machine. ø0.6 mm is the standard size but other diameters may be supplied depending on the particular case.

● = Available – = Not available

Technical data

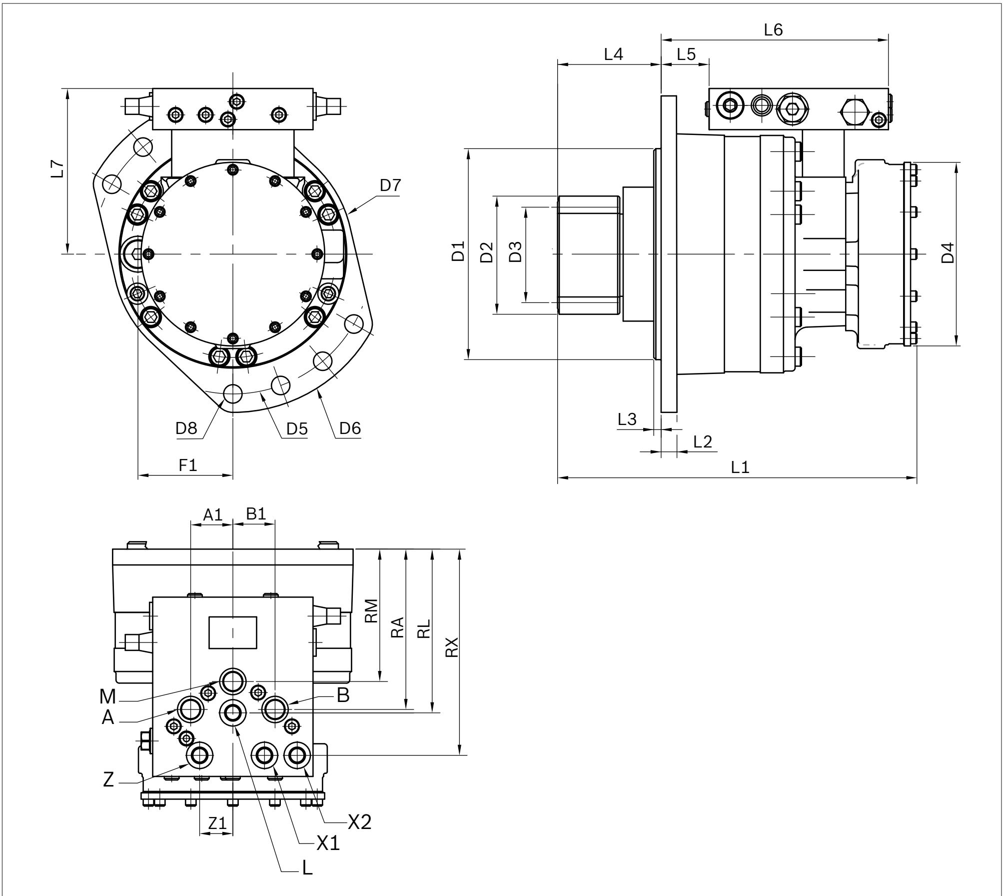
Frame size			**MCR3X and MCR5X**							
Type of mounting			Flange mounting via front case							
Mounting screws			6 x M16, Grade 12.9							
Minimum mounting screw torque		Nm	300							
Port type			Tapped to SAE J514 or JIS B 2351							
Shaft type			With integrated pinion (see page 9)							
Piston seat material			P23 (high efficiency)							
Weight										
MCR3X		kg	39							
MCR5X		kg	58							
Hydraulic fluid[1][2]			Mineral oils (HL, HLP) to DIN 51 524							
Fluid cleanliness			ISO 4406, Class 20/18/15							
Fluid viscosity range[3]	$n_{min/max}$	mm^2/s	10 to 2000							
Fluid temperature range	$t_{min/max}$	°C	-20 to +105							
Maximum flow into port A or B	$q_{V\,max}$	L/min	80							
Maximum pressure at ports A, B and M[4]	p_{max}	bar	300							
Maximum pressure at port L	$p_{case\,max}$	bar	10							
Maximum pressure at ports X1 and X2	$p_{X\,max}$	bar	70							
Maximum pressure at port Z	$p_{Z\,max}$	bar	40							
Minimum pressure at port M[5][6]	$p_{M\,min}$	bar	4							
Motor Performance MCR3X[7]										
Displacement	V_g	cm^3/rev	160	225	255	280	325	365	400	
Maximum speed, Single speed motor (1L)	n_{max}	rpm	375	265	235	215	185	165	150	
Maximum torque[4]	T_{max}	Nm	710	1000	1130	1240	1440	1620	1780	
Minimum speed for smooth running	n_{min}	rpm	0.5	0.5	0.5	0.5	0.5	0.5	0.5	
Motor Performance MCR5X[7]										
Displacement	V_g	cm^3/rev	380	470	520	565	620	680	750	820
Maximum speed, Single speed motor (1L)	n_{max}	rpm	155	125	115	105	95	85	80	75
Maximum torque[4]	T_{max}	Nm	1685	2090	2310	2510	2750	3020	3330	3640
Minimum speed for smooth running	n_{min}	rpm	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Relief valves										
Pressure setting range[8]		bar	100 to 250							
Nominal rise time (see diagram page 7)	t_1	s	0.15							
Anti-cavitation valves										
Cracking pressure		bar	0.25							
Brake delay valve										
Shift pressure	$p_{X\,shift}$	bar	3.7							
Orifice diameter[9]		mm	0.6							
Delay time[9]		s	2.9 to 5.8							
Holding brake[10]										
Minimum brake torque MCR3X	$T_{br\,min}$	Nm	1170							
MCR5X	$T_{br\,min}$	Nm	2100							
Minimum pressure at which brake release begins	$p_{rel\,min}$	bar	8							
Maximum pressure required to fully release brake	$p_{rel\,max}$	bar	11							
Speed sensor For technical data see standard DO/100/117 (please consult Rexroth Engineering Department in Glenrothes).										

Relief valve characteristic



1) The motor must be filled with oil prior to start-up. The filler port F is provided for this purpose.
2) For use with other fluids, please consult Rexroth Engineering Department in Glenrothes.
3) With high oil viscosity, there is an increased risk of cavitation, so p_M may need to be increased.
   The machine should be tested at the minimum operating temperature to ensure satisfactory operation.
4) An increase in the maximum pressure to 350 bar, and corresponding torque increase, may be possible by special order.
   Please consult Rexroth Engineering Department in Glenrothes for further details.
5) For operation below the quoted make-up pressure, please contact Rexroth Engineering Department in Glenrothes.
6) The quoted make-up pressure applies at the port M. Please take pressure drop in the make-up line into account.
   Rexroth recommends a minimum make-up line diameter of 5/8 in, but this must be confirmed by machine testing.
7) The quoted values are for initial reference only. Please contact Rexroth Engineering Department in Glenrothes for a full technical evaluation prior to ordering.
8) The setting range quoted applies with standard springs. Extension of the range may be possible by special order.
9) The standard orifice diameter is quoted, along with the delay time for ISO VG46 oil at 50°C. However, the orifice diameter must be selected to ensure that the brake does not apply before the motor has stopped rotating. Please contact Rexroth Engineering Department in Glenrothes for further information.
10) The holding brake must be applied only in the static condition. Application of the brake while the motor is turning may result in damage to the unit and reduction in holding torque. The machine designer must ensure that an adequate brake delay exists to prevent this. The brake is, however, applied with a noise-reduction coating, to prevent brake squeal during short-duration drive-through caused by swing ram operation.

Dimensions

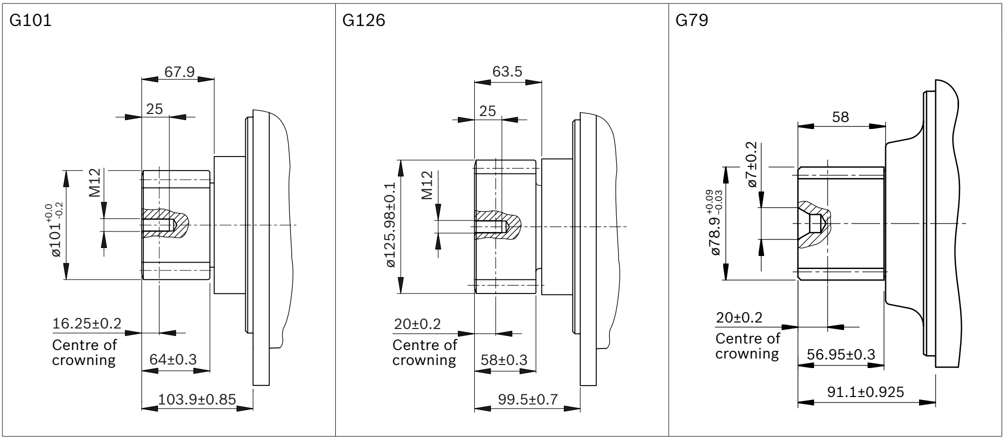


Motor	D1	D2	D3	D4	D5	D6	D7	D8	L1	L2	L3	L4	L5	L6	L7
MCR3X	ø175	ø79	ø69	ø174	ø220	ø248	ø190	ø17	315	15	8	17	15	191	132
MCR5X	ø200	ø112	ø91	ø174	ø265	ø300	ø228	ø17.5	334.7	15	7	16	18	215.5	157

Motor	A1	B1	Z1	F1	RM	RA	RL	RX
MCR3X	29.5	29.5	13	72	94	132	123.4	171
MCR5X	40	40	31.5	90	125.5	152	155.2	195.5

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

Drive shaft



Pinion data		**G101**	**G126**	**G79**
Module	mm	6	6.5	5
No. of teeth		14	17	13
Pressure angle	°	20	20	20
Addendum mod. coefficient		0.5	0.4	0.4
Dimension over pins	mm	102.88±0.05	128.64±0.04	81.7±0.09
Pin diameter	mm	10.5	11	9.60
Crowning	mm	0.0115/0.1035	0.0762/0.1016	0.0762/0.102
Accuracy grade (ISO1328)		8	8	8

Ports

Designation	**Port function**	**Ordering code 12**	**Size**	**Ordering code 64**	**Size**	**Maximum pressure [bar]**	**State**[1]
A, B	Inlet, outlet	SAE J514	3/4-16 UNF	JIS B 2351	G3/8 in	300	O
M	Anti-cavitation	SAE J514	3/4-16 UNF	JIS B 2351	G3/8 in	300	O
X1, X2	Brake pilot	SAE J514	9/16-18 UNF	JIS B 2351	G1/4 in	30	O
L	Case drain	SAE J514	9/16-18 UNF	JIS B 2351	G1/4 in	70	O
Z	Brake port	SAE J514	9/16-18 UNF	JIS B 2351	G1/4 in	40	O
F	Filler port	SAE J514	3/4-16 UNF	SAE J514	3/4 in - 16 UNF	10	X

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

6

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

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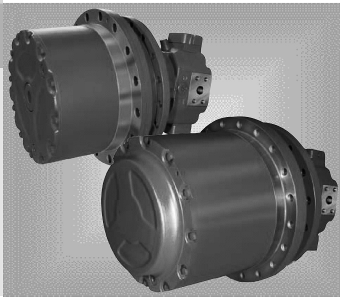
Rexroth
Bosch Group

Hydrostatic Drives
HYDROTRAC GFT
for Mobile Applications

Data Sheet



Output torques from 9000 to 450000 Nm

Contents

Features

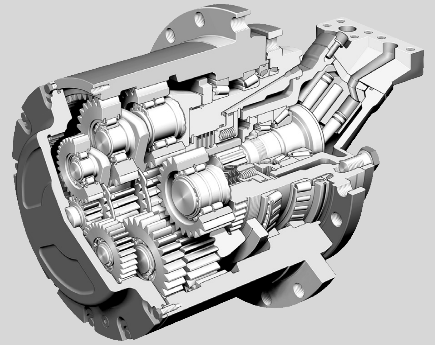
- compact, space-saving planetary design
- full-complement planet gear bearing system
- robust main bearing system
- easy mounting
- comfortable oil changing
- integrated multiplate parking device
- low-noise running characteristics

7

For further information visit: www.boschrexroth.com/gears

Description

Rexroth compact hydrostatic HYDROTRAC GFT drives are the ideal driving components for wheeled or track-laying vehicles and other mobile equipment. They are the perfect choice for every conceivable moving or turning application.
The drives are extremely compact and thus may also be installed in space-critical mounting configurations. The drives' load capacity and availability is extraordinary thanks to the use of case-hardened gearwheels as well as quenched and tempered, surface-hardened annulus gears.
The gearteeth design reflects both standard requirements and in-house operating strength calculations based on our comprehensive know-how and optimally adapted to our modern fabrication processes.



Three-stage compact hydrostatic drive
Rexroth HYDROTRAC GFT with multiplate parking device and Rexroth plug-type motor

The drives feature maximum total efficiency ratings which, inter alia, is due to the use of Rexroth plug-type motors.
The drives described in this bulletin are constantly reviewed and advanced. Other design variants with deviating transmission, dimensions and power characteristics are available if so requested for specific applications.

Gearbox Design

Gearbox design is based on long years of experience and reflects not only the customary standard design regulations but also satisfies operational strength requirements as per DIN 3990, ISO 6336, AGMA, GL or DNV. The output torque values indicated are short-term admissible peak torques meant for excavator travel drive applications. For other applications deviating output torques differing from those specified may apply to the respective gearbox. Even in the project stage we are prepared to offer application-specific consultation to customers aimed at finding the optimum drive configuration.

Hydraulic Motors

Rexroth hydraulic motors are preferably integrated in a space-saving manner as flanged-on fixed or variable displacement units plugged into the gearbox.

Multiplate Parking Device

As a standard supply feature a spring-loaded hydraulically released multiplate parking device is arranged on the input end of the gearbox. The parking torque of the device will suit the respective motor torque.

Disconnecting Device

If requested, some of the drive systems may also be provided with a mechanical disconnecting device so that, if time is of essence, the equipment can be towed without damaging the hydraulic system.

Sealing System

An axial mechanical seal is mounted between the stationary and rotating gearbox sections. This prevents moisture and dirt from entering the drive even under extreme operating conditions.

Oil Changes

Save for regular oil changes the drives do not require maintenance. Oil changes may conveniently be made from the outside. Recommendations as to lube oils are given in the operating manual.

Design Variants

Model designations 1000 - 9000 indicate basic size and design variants that are readily available to our customers.
To suit specific application requirements other models can also be furnished upon request. Depending on currently furnished units and transmission ratios many drives are available on preferential terms offering favorable prices and improved delivery times. If you are interested, please let us know.
To suit the required ratio the garboxes are of two- (T2) or three-stage (T3) design. If so requested, gear models 330 and 450 may be provided with an additional preliminary stage and in that case will be of four-stage design (T4).

Hydrostatic Drives HYDROTRAC GFT overview

Type/Design Variant GFT	Output Torque $T_{2\,max}$ Nm	Gear Ratio from/to i
GFT 0009 T2	9000	47.6 - 55.3
GFT 0013 T2	13000	32.1 - 37.6
GFT 0017 T2	17000	45.4 - 54.0
GFT 0017 T3	17000	77.9 - 88.2
GFT 0024 T3	24000	102.6 - 137.2
GFT 0026 T2	26000	50.5 - 62.0
GFT 0034 T2	34000	50.5
GFT 0036 T3	36000	115.0 - 138.8
GFT 0040 T2	40000	35.9 - 59.1
GFT 0050 T3	50000	73.9 - 125.7
GFT 0060 T3	60000	105.5 - 169.9
GFT 0065 T2	65000	55.4
GFT 0080 T3	80000	99.0 - 215.0
GFT 0110 T3	110000	95.8 - 173.9
GFT 0160 T3	160000	210.8 - 251.0
GFT 0220 T3 / R3	220000	97.7 - 365.0
GFT 0330 T3	330000	168.9 - 302.4
GFT 0330 T4	330000 / 380000	451.7 - 826.6
GFT 0450 T4	450000	347.1 - 421.7

For information on our currently available compact hydrostatic HYDROTRAC GFT drives please visit www.boschrexroth.com/gears

Should you need a special driving solution deviating from our standard product range please let us know. Differently sized units and additional design variants can be furnished if so requested.

Type Code

MOBILEX GFT 0080 T3 2000 SL

Travel gear GFT

Size
(Size = output torque T_2 (kNm)

T = Track-laying
R = Wheeled drive

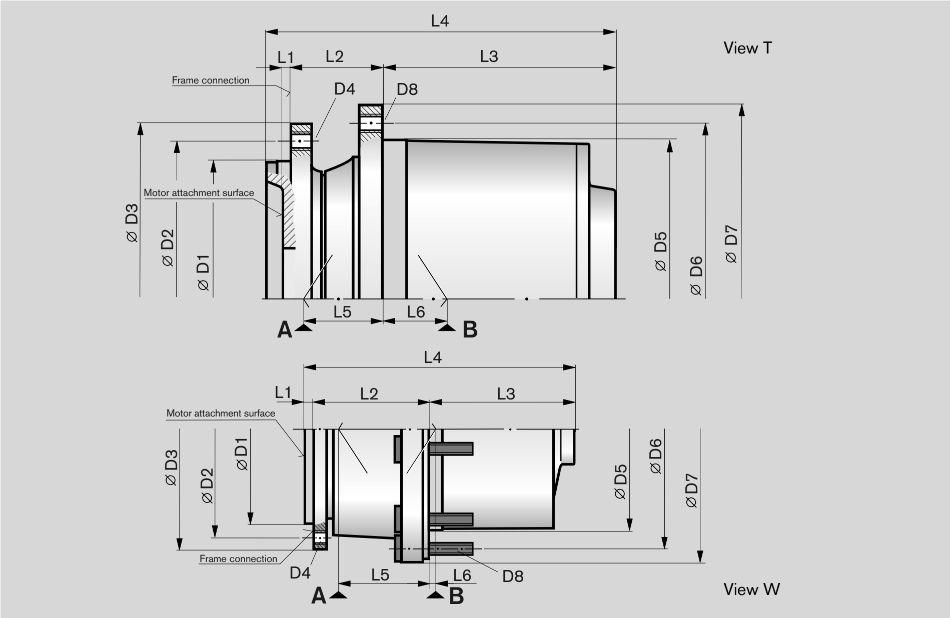
Number of stage design

Strength main bearings

Internal code

7

Dimensions



Technical Data

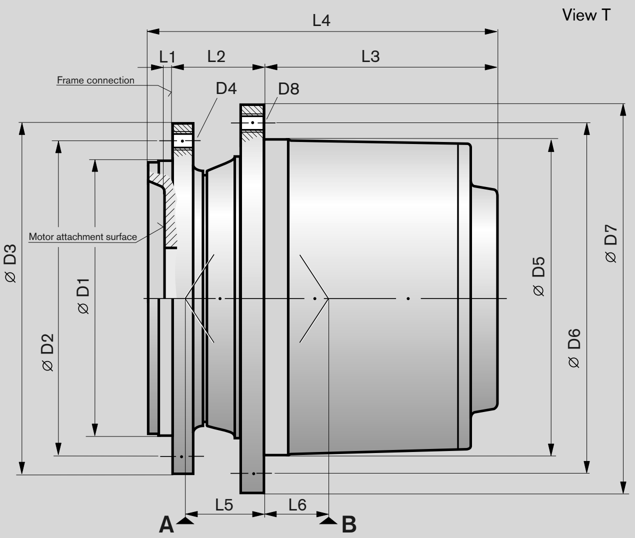
Type/Design Variant GFT	Output Torque $T_{max.}$ Nm	Ratio i	Holding Torque $T_{Br\ max.}$ Nm	Hydraulic Motor
GFT 0009 T2 3000	9000	47.6 • 55.3	215	A6VE 28
GFT 0013 T2 4000/1	13000	32.1 • 37.6	400	A6VE 55
GFT 0013 T2 4000/2	13000	32.1	400	A2FE 45
GFT 0017 T2 3000/1	17000	54.0	350	A6VE 55
GFT 0017 T2 3000/2	17000	54.0	350	A10VE 63/A2FE 45 • 63
GFT 0017 T2 9000/SL	17000	45.4	-	A6VE 55
GFT 0017 T3 1000	17000	77.9	250	A6VE 28/A2FE 28
GFT 0017 T3 9000/2 SL • 9000/3 SL	17000	77.9 • 88.2	-	A6VE 28
GFT 0024 T3 1000	24000	102.6 • 120.5 • 137.2	300	A6VE 55
GFT 0024 T3 5000	24000	137.2	250	A6VE 55/A10VEC 45
GFT 0024 T3 9000	24000	120.5	300	A10VEC 45
GFT 0026 T2 1000	26000	50.5 • 62.0	715	A6VE 80
GFT 0034 T2 4000	34000	50.5	-	A6VE 107
GFT 0036 T3 3000/1	36000	115.0 • 138.8	715	A6VE 55
GFT 0036 T3 3000/2	36000	115.0 • 138.8	715	A6VE 80/A2FE 80 • 90

Dimensions, Bearing Load Ratings and Mass

Type/Design Variant GFT	D1	D2	D3	D4	D5	D6	D7	D8
					mm			
GFT 0009 T2 3000	210	244	268	12x M14	230	260	284	16x M16
GFT 0013 T2 4000/1	240	275	300	18x M16	270	305	335	16x M16
GFT 0013 T2 4000/2	240	275	300	18x M16	270	305	335	16x M16
GFT 0017 T2 3000/1	250	290	320	16x M20	280	305	330	16x M16
GFT 0017 T2 3000/2	250	290	320	16x M20	280	305	330	16x M16
GFT 0017 T2 9000/SL	250	305	330	18x M16	260	300	335	10x M22x1.5
GFT 0017 T3 1000	240	275	300	18x M16	270	305	330	16x M16
GFT 0017 T3 9000/2 SL	240	275	310	12x M16	260	300	335	10x M22x1.5
GFT 0017 T3 9000/3 SL	250	305	330	18x M16 (S)	260	300	335	10x M22x1.5
GFT 0024 T3 1000	240	285	320	20x M20	280	305	330	20x M16
GFT 0024 T3 5000	240	275	304	18x M16	280	305	330	20x M16
GFT 0024 T3 9000	290	320	345	16x M16	280	305	330	20x M16
GFT 0026 T2 1000	270	310	350	16x M20	320	350	380	20x M16
GFT 0034 T2 4000	410	380	420	20x ø18	325	381	420	12x M22x1.5
GFT 0036 T3 3000/1	270	310	350	16x M20	320	350	380	20x M16x1.5
GFT 0036 T3 3000/2	270	310	350	16x M20	320	350	380	20x M16x1.5

Type/Design Variant GFT	L1	L2	L3	L4	L5	L6	A + B C	A + B Co	Mass	View
			mm				kN		kg	
GFT 0009 T2 3000	-	60	149	232	18	64	132	255	50	T
GFT 0013 T2 4000/1	8	75	149	232	49	54	140	290	85	T
GFT 0013 T2 4000/2	30	75	149	254	49	54	140	290	85	T
GFT 0017 T2 3000/1	8	82	152	242	78	69	108	142	90	T
GFT 0017 T2 3000/2	30	82	152	264	78	69	108	142	90	T
GFT 0017 T2 9000/SL	-	82	155	245	56	47	140	290	90	W
GFT 0017 T3 1000	27	75	181	283	71	76	108	142	100	T
GFT 0017 T3 9000/2 SL	5	75	184	267	49	54	140	290	95	W
GFT 0017 T3 9000/3 SL	8	75	184	267	49	54	140	290	95	T
GFT 0024 T3 1000	8	82	189.5	279.5	56	47	140	290	95	T
GFT 0024 T3 5000	16	82	209.5	307.5	56	47	140	290	110	T
GFT 0024 T3 9000	16	82	209.5	307.5	56	47	140	290	100	T
GFT 0026 T2 1000	20	90	220	330	58	50	186	400	145	T
GFT 0034 T2 4000	12	151	226	389	60	62	399	806	170	W
GFT 0036 T3 3000/1	15	90	200	333	56.5	56.5	170	405	125	T
GFT 0036 T3 3000/2	10	90	200	300	56.5	56.5	170	405	125	T

Dimensions



Technical Data

Type/Design Variant GFT	Output Torque $T_{max.}$ Nm	Ratio i	Holding Torque $T_{Br\ max.}$ Nm	Hydraulic Motor
GFT 0040 T2 9000	40000	35.9 • 41.0 • 48.3 • 59.1	800	A6VE 107 • 160
GFT 0050 T3 1000/1	50000	84.2 • 91.1	800	A6VE 80 • 107
GFT 0050 T3 1000/2	50000	125.7	800	A2FE 63
GFT 0050 T3 3000	50000	73.9 • 125.7	800	A6VE 80 • 107
GFT 0050 T3 9000 SL • 9000/1	50000	91.1	800	A6VE 80/A2FE 80
GFT 0050 T3 9000/2	50000	84.2	800	A6VE 80
GFT 0050 T3 9000/3	50000	125.7	800	A2FE 63
GFT 0060 T3 7000/1	60000	105.5 • 119.8 • 139.9 • 169.9	725	A6VE 80 • 107/A2FE 80 • 90
GFT 0060 T3 7000/2	60000	105.5	725	A6VE 107
GFT 0065 T2 1000	65000	55.4	1060	A6VE 160
GFT 0080 T3 1000 • 2000	80000	99.0 • 126.9 • 215.0	1025	A6VE 107 • 160/A2FE 107
GFT 0110 T3 1000	110000	95.8 • 114.8 • 173.9	1025	A6VE 107 • 160 A2FE 107 • 125 • 160
GFT 0110 T3 9000	110000	173.9	1100	A6VE 160/A2FE 160

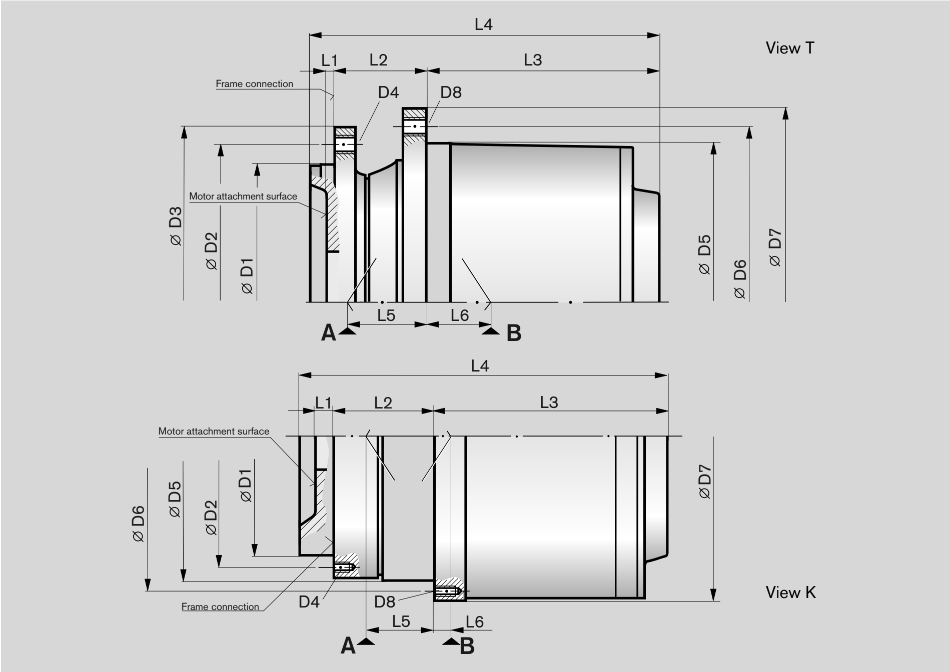
Dimensions, Bearing Load Ratings and Mass

Type/Design Variant GFT	D1	D2	D3	D4	D5	D6	D7	D8
	mm							
GFT 0040 T2 9000	330	370	410	20x M20	360	400	440	16x M20
GFT 0050 T3 1000/1	270	310	350	18x M20x1.5	350	400	430	16x ø22
GFT 0050 T3 1000/2	270	310	350	16x M20	350	400	430	16x M20x1.5
GFT 0050 T3 3000	330	370	410	20x M20	360	400	440	16x M20
GFT 0050 T3 9000 SL	270	310	350	16x M20	350	400	440	16x M20
GFT 0050 T3 9000/1	330	370	408	16x M20	365	405	435	22x M16
GFT 0050 T3 9000/2	330	370	408	16x M20	365	405	435	22x M16
GFT 0050 T3 9000/3	270	310	350	16x M20	350	400	430	16x M20x1.5
GFT 0060 T3 7000/1	330	370	410	20x M20x1.5	400	450	490	20x M20x1.5
GFT 0060 T3 7000/2	330	370	410	20x M20x1.5	400	450	490	20x M20x1.5
GFT 0065 T2 1000	380	430	480	20x M24	430	480	520	24x M24
GFT 0080 T3 1000	420	460	500	24x M20	460	510	550	24x M20
GFT 0080 T3 2000	380	430	480	20x M24	430	480	520	20x M24
GFT 0110 T3 1000	420	460	500	24x M24x3	460	500	540	36x M18x1.5 [1]
GFT 0110 T3 9000	420	460	500	24x M24x3	460	500	530	36x M18x1.5

[1] alternative: 36x ø22

Type/Design Variant GFT	L1	L2	L3	L4	L5	L6	A + B C	A + B Co	Mass	View
	mm						kN		kg	
GFT 0040 T2 9000	25	90	261.5	376.5	38	73	212	425	205	T
GFT 0050 T3 1000/1	39.5	82	281.5	403	56.5	54	212	425	220	T
GFT 0050 T3 1000/2	20	82	281.5	383.5	56.5	54	212	425	220	T
GFT 0050 T3 3000	25	114	276	415	62	48	212	425	220	T
GFT 0050 T3 9000 SL	15	82	318	415	45.5	79.5	393	895	220	T
GFT 0050 T3 9000/1	25	100.5	304	429.5	60.5	50	212	425	220	T
GFT 0050 T3 9000/2	25	100.5	304	429.5	70.5	40	212	425	220	T
GFT 0050 T3 9000/3	20	82	282	383.5	56.5	54	212	425	220	T
GFT 0060 T3 7000/1	-	90	308	423	55	62	250	520	250	T
GFT 0060 T3 7000/2	-	90	331	446	55	62	250	520	250	T
GFT 0065 T2 1000	-	148	245	415	128	20	A 250 B 480	A 480 B 950	340	T
GFT 0080 T3 1000	-	165	300	486.5	108	25	A 509 B 480	A 1080 B 950	370	T
GFT 0080 T3 2000	22	148	295	465	112	18			350	T
GFT 0110 T3 1000	-	165	305	491.5	107	25	A 509 B 480	A 1080 B 950	395	T
GFT 0110 T3 9000	21.5	165	305	491.5	107	24			505	T

Dimensions



Technical Data

Type/Design Variant GFT	Output Torque $T_{max.}$ Nm	Ratio i	Holding Torque $T_{Br\ max.}$ Nm	Hydraulic Motor
GFT 0160 T3 1000	160000	210.8 • 251.0	1020	A6VE 107 • 160/A2FE 125
GFT 0220 T3 9000/2	220000	97.7	-	A6VM 355
GFT 0220 R3 9000/3	220000	145.4	1400	A6VM 200
GFT 0220 T3 9000/4	220000	365.0	1100	A6VE 160
GFT 0330 T3 2000 • 3000	330000	168.9 • 252.0 • 302.4	2500	A2FE 355/A6VE 250
GFT 0330 T4 1000 2)	380000	826.6	-	-
GFT 0330 T4 2000	330000	451.7	625	A6VE 160
GFT 0450 T4 1000/1	450000	421.7	1450	A6VE 250
GFT 0450 T4 1000/2	450000	347.1	1450	A6VE 250

2) Gearbox with angle gear stage on input side

Dimensions, Bearing Load Ratings and Mass

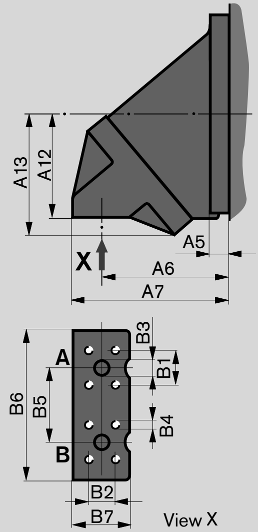
Type/Design Variant GFT	D1	D2	D3	D4	D5	D6	D7	D8
	mm							
GFT 0160 T3 1000	450	510	560	30x M24x2	535	600	650	30x M24x2 [3)]
GFT 0220 T3 9000/2	460	520	570	24x M30	610	680	735	24x ø33
GFT 0220 R3 9000/3	460	600	650	30x M30	610	680	735	24x M30
GFT 0220 T3 9000/4	450	515	568	29x M36x3	570	620	670	42x M30x2
GFT 0330 T3 2000	580	680	735	30x M30	660	730	785	30x M30
GFT 0330 T3 3000	580	680	735	30x M30	660	730	785	30x M30
GFT 0330 T4 1000	580	680	735	30x M30	660	730	785	30x M30
GFT 0330 T4 2000	580	680	735	30x M30	660	730	785	30x M30
GFT 0450 T4 1000/1	450	515	568	29x M36x3	570	620	670	42x M30x2
GFT 0450 T4 1000/2	580	680	735	36x M30x2	680	750	810	36x M30x2

[3)] alternative: 30xø30

Type/Design Variant GFT	L1	L2	L3	L4	L5	L6	A + B C	A + B Co	Mass	View
	mm						kN		kg	
GFT 0160 T3 1000	30	168	340	538	138	26	688	1520	680	T
GFT 0220 T3 9000/2	45	170	350	565	155	35	710	1560	850	T
GFT 0220 R3 9000/3	45	170	350	565	155	35	710	1560	850	T
GFT 0220 T3 9000/4	-	255	305	-	190	17	710	1560	880	K
GFT 0330 T3 2000	150	125	400	675	190	25	1040	2450	1250	T
GFT 0330 T3 3000	87	188	400	675	190	25	1040	2450	1230	T
GFT 0330 T4 1000	-	188	430	1175	190	25	1040	2450	1410	-
GFT 0330 T4 2000	-	188	400	675	190	25	1040	2450	1320	T
GFT 0450 T4 1000/1	13	255	512	810	175	19	1040	2450	1240	K
GFT 0450 T4 1000/2	-	156	532	775	155	39	1040	2450	1250	T

Corresponding Hydraulic Motors: Dimensions and Mass

Fixed-displacement motor A2FE



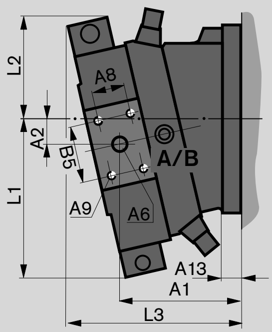
Nominal size	A5	A6	A7	A12	A13	B1	B2	B3	Mass
				mm					kg
28	16	94	114	91	106	40.5	18.2	13	10.5
45	18	109	133	102	119	50.8	23.8	19	15.0
63	18	122	146	107	130	50.8	23.8	19	19.0
80	20	127	157	121	145	57.2	27.8	25	23.0
90	20	127	157	121	145	57.2	27.8	25	25.0
107	20	143	178	136	157	66.7	31.8	32	34.0
125	20	143	178	136	157	66.7	31.8	32	36.0
160	20	169	211	149	188	66.7	31.8	32	47.0
355	30	183	231	148	199	66.7	31.8	32	110.0

Nominal size	B4	B5	B6	B7	A / B
		mm			
28 32	M8x15	59	115	40	SAE 1/2in
45	M10x17	75	147	49	SAE 3/4in
56 63	M10x17	75	147	49	SAE 3/4in
80 90	M12x17	84	166	60	SAE 1in
107 125	M14x19	99	194	70	SAE 1 1/4in
160 180	M14x19	99	194	70	SAE 1 1/4in
355	M14x22	120	*	*	SAE 1 1/4in

For further technical data see bulletin RE 91008

* dimensions to be indicated on request

Variable-displacement motor A6VE



Nominal size	A1	A2	A13	L1	L2	L3	Mass
				mm			kg
28	91	20	14	162	163	153	16
55	123	24	16	151	111	179	26
80	130	28	18	167	116	190	34
107	137	30	18	175	122	208	45
160	171	34	20	200	154	245	64
250	204	44	25	248	188	302	90

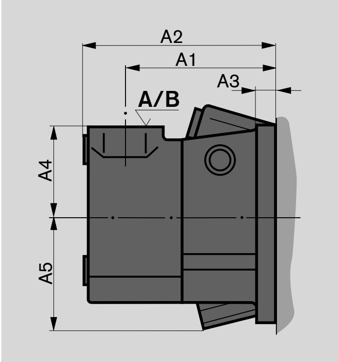
Nominal size	A6	A7	A8	A9	A / B
			mm		
28	19	50.8	23.8	M10x17	SAE 3/4in
55	19	50.8	23.8	M10x17	SAE 3/4in
80	25	57.2	27.8	M12x17	SAE 1in
107	25	57.2	27.8	M12x17	SAE 1in
160	32	66.7	31.8	M14x19	SAE 1 1/4in
250	32	66.7	31.8	M14x19	SAE 1 1/4in

For further technical data see bulletin RE 91606

Corresponding Hydraulic Motors: Dimensions and Mass

Variable-displacement motor A10VE

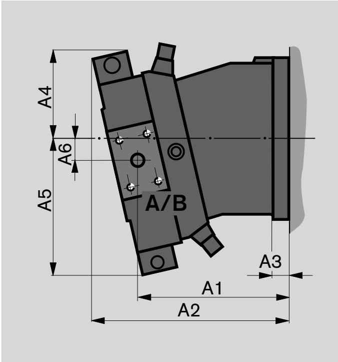
Nominal size	A1	A2	A3 mm	A4	A5	A / B	Mass kg
45	94	125	14	78	87	SAE 3/4in	18
63	111	154	18	101	93	SAE 3/4in	26



For further technical data see bulletin RE 91703

Variable-displacement motor A6VM

Nominal size	A1	A2	A3	A4 mm	A5	A6	A / B	Mass kg
200	267	345	32	143	209	36	SAE 1 1/ 4in	80
355	322	432	28	203	279	49		170



For further technical data see bulletin RE 91604

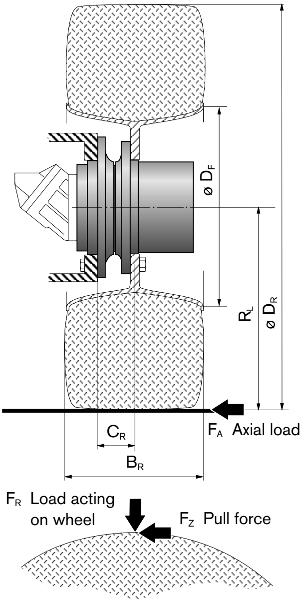
7

You wish to receive an offer for HYDROTRAC GFT as a wheel drive?

To be able to quote, we require the following data from you:
Fax No. +49 2302 877-148.

Please attach relevant drawings, sketches, notes etc.

Contact: ____________________
Company: ____________________
Location: ____________________
Fax: ____________________
Phone: ____________________



Wheel side view

Technical Data

Type of equipment		________	
Equipment weight	empty ______ t	loaded ______	t
Number of driven wheels			
Total number of wheels		________	
Rim size	D_F	________	Inch
Radial load	F_R	________	N
Pull force	F_Z	________	N
Axial load	F_A	________	N
Wheel diameter	D_R	________	mm
Wheel radius, loaded	R_L	________	mm
Width of wheel	B_R	________	mm
Mounting length	C_R	________	mm
Max. output torque	T_2	________	Nm
Max. travel speed	v_{max}	________	km/h
Output speed	n_2	________	rpm
Max. system pressure	p_S	________	bar
Working pressure	Δp	________	bar
Ratio	i	________	
Gradient	s	________	%
Multiplate parking brake	☐ yes	☐ no	
Fixed-displacement motor	☐ type	________	
Variable-displacement motor	☐ type	________	
Type of displacement		________	
Brake valve	☐ yes	☐ no	

Planned annual demand ____________________
Expected implementation time ____________________
Special application conditions ____________________
Other client requirements ____________________
Must legal provisions and/or specifications be observed?
☐ yes ☐ no if affirmative, please specify ____________________

Remarks ____________________

Typical operating states:

State	Output torque (Nm)	Radial load (N)	Output speed (rpm)	Cycle duration (%)
1				
2				
3				
4				

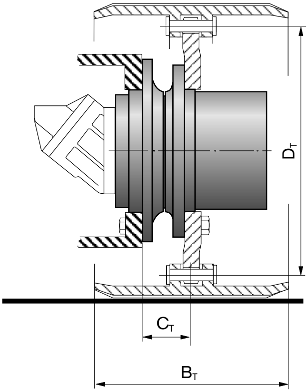
Date: ____________ Name: ____________ Dept.: ____________

You wish to receive an offer for HYDROTRAC GFT in a track-laying drive system?

To be able to quote, we require the following data from you:
Fax No. +49 2302 877-148.

Please attach relevant drawings, sketches, notes etc.

Contact: ____________________
Company: ____________________
Location: ____________________
Fax: ____________________
Phone: ____________________



Technical Data

Type of equipment		________		
Equipment weight	empty	________ t	loaded	________ t
Required total pull force		________ N		
Track type	☐ Rubber track	☐ Steel track		
Sprocket diameter	D_T	________ mm		
Track width	B_T	________ mm		
Radial load, lever arm	C_T	________ mm		
Max. output torque	T_2	________ Nm		
Max. travel speed	v_{max}	________ km/h		
Output speed	n_2	________ rpm		
Working pressure	Δp	________ bar		
Max. system pressure, limited	p_S	________ bar		
Ratio	i	________		
Multiplate parking brake	☐ yes	☐ no		
Fixed-displacement motor	☐ type	________		
Variable-displacement motor	☐ type	________		
Type of displacement		________		
Brake valve	☐ yes	☐ no		

Planned annual demand ____________________
Expected implementation time ____________________
Special application conditions ____________________
Other client requirements ____________________
Must legal provisions and/or specifications be observed?
☐ yes ☐ no if affirmative, please specify ____________________

Remarks ____________________

Typical operating states:

State	Output torque (Nm)	Output speed (rpm)	Cycle duration (%)
1			
2			
3			
4			

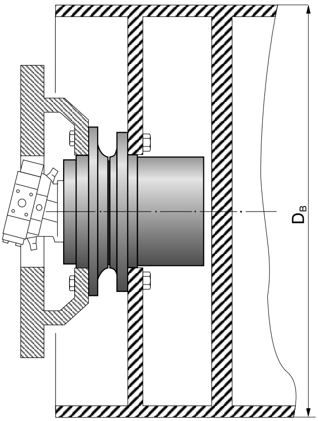
Date: ____________ Name: ____________ Dept.: ____________

You wish to receive an offer for HYDROTRAC GFT in a roller drive system?

To be able to quote, we require the following data from you:
Fax No. +49 2302 877-148.

Please attach relevant drawings, sketches, notes etc.

Contact: ______
Company: ______
Location: ______
Fax: ______
Phone: ______



Technical Data

Type of equipment		☐ Tandem roller	☐ Road roller
Equipment weight		______ t	
Total pull force required		______ N	
Drive for		☐ Tire	☐ Rear wheels
Tire	Tamping plate:	☐ with	☐ without
Tire diameter	D_B	______ mm	
Rear wheel diameter	D_R	______ mm	
Weight distribution	front ______ t	rear ______ t	
Output torque, max., front	T_2	______ Nm	
Output torque, max., rear	T_2	______ Nm	
Travel speed, max.	v_{max}	______ km/h	
Output speed	n_2	______ rpm	
Working pressure	Δp	______ bar	
System pressure, max., limited	p_S	______ bar	
Transmission ratio, tire drive	i	______	
Transmission ratio, rear wheels	i	______	
Gradeability	s	______ %	
Multiplate parking brake		☐ yes ☐ no	

Fixed-displacement motor, front	☐ Type ______	Fixed-displacement motor, rear	☐ Type ______
Variable-displacem. motor, front	☐ Type ______	Variable-displacem. motor, rear	☐ Type ______
Type of displacement, front	______	Type of displacement, rear	______
Scavenger valve, front	☐ yes ☐ no	Scavenger valve, rear	☐ yes ☐ no

Planned annual demand ______
Expected implementation time ______
Special application conditions ______
Other client requirements ______
Must legal provisions and/or specifications be observed?
☐ yes ☐ no if affirmative, please specify ______

Remarks ______

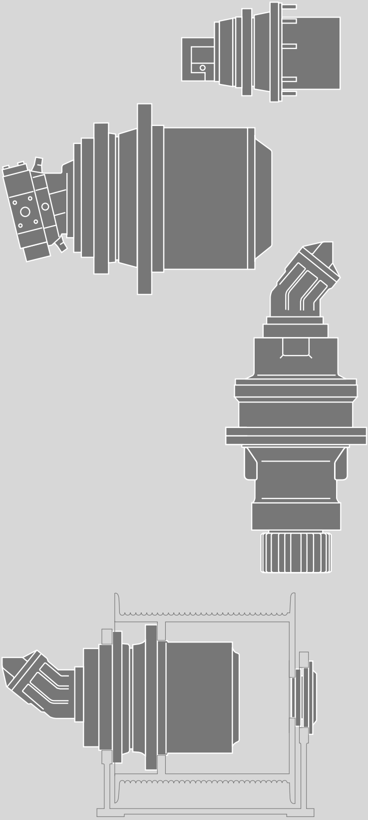
Typical operating states:

State	Output torque (Nm)	Output speed (rpm)	Cycle duration (%)
1			
2			
3			
4			

Date: ______ Name: ______ Dept.: ______

Notes

Products
for Mobile Applications



Planetary Gear Units for Mobile Applications

Hydrostatic Travel Drives

- HYDROTRAC GFT
  for fixed- or variable-displacement motor
  output torques between 9 and 450 kNm
  Technical Documentation RE 77110
- HYDROTRAC GFT
  with integrated hydraulic two-speed motor
- HYDROTRAC GFT
  for use on large tracklaying vehicles
  output torques up to 3250 kNm
  Upon request

Hydrostatic Swing Drives

- MOBILEX GFB
  for fixed- or variable-displacement motors
  output torques between 4 and 115 kNm
  Technical Documentation RE 77201
- MOBILEX GFB
  with swash-plate motor

Hydrostatic Winch Drives

- MOBILEX GFT – W
  for fixed- or variable-displacement motors
  output torques between 14 and 275 kNm
  Technical Documentation RE 77502

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Mannesmannstraße
58455 Witten, Germany
Phone +49 2302 877-0
Fax +49 2302 877-148
info.gears@boschrexroth.de
www.boschrexroth.com/gears

Rexroth
Bosch Group

Hydrostatic Travel Drives HYDROTRAC GFT–N

Data Sheet

Output torques from 600 to 1,300 kNm

Contents

Page

Features

- compact, space-saving planetary/spur gear units
- attached spring-loaded multiplate parking brake system
- robust main bearing system
- easy to install
- convenient way of oil changing

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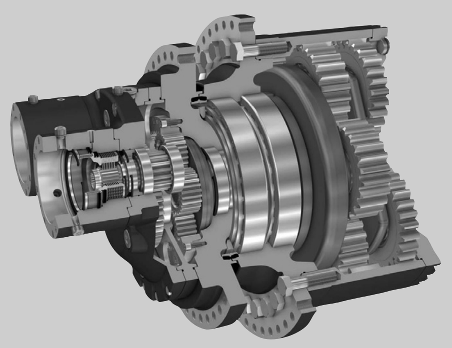
For further information see: www.boschrexroth.com/gears

Description

HYDROTRAC GFT-N travel drives from Rexroth have been built especially for use with hydraulic mining excavators as well as for tracklaying cranes.
The drives can be integrated as a complete unit into the undercarriage frame. The sprocket mounted to the output side transmits the required torque to the track.



Three-stage planetary gear with pre-arranged spur gear stage and spring-loaded multiplate parking brake
Rexroth HYDROTRAC GFT-N

Gearbox Design

Gearbox design is based on long years of experience and reflects not only customary standard design regulations but also satisfies operational strength requirements according to DIN 3990, ISO 6336, AGMA, GL or DNV for example. The output torque values indicated are short-term admissible peak torques meant for excavator travel drive applications. For other applications deviating output torques differing from those specified may apply to the respective gearbox.

To determine the optimum drive configuration we are prepared to offer application-specific consultation to customers even in the project stage.

Hydraulic Motors

Rexroth hydraulic motors are preferably integrated as flanged-on fixed or variable displacement units plugged into the gearbox.

Spring-loaded Multiplate Parking Brake System

As a standard supply feature the gearbox comes with one or two spring-loaded hydraulically released multiplate parking brakes attached on the input side.
The static multiplate parking brake system is only a parking brake.

The parking brake torque will suit the respective motor torque.

Sealing System

An axial mechanical seal is arranged between the stationary and rotating gearbox sections. This prevents moisture and dirt from entering the drive even under extreme operating conditions.

Oil Changes

Apart from regular oil changes the drives do not require maintenance. Oil changes may conveniently be made from the outside. Recommendations as to lube oils are given in the operating manual.

Other Notes

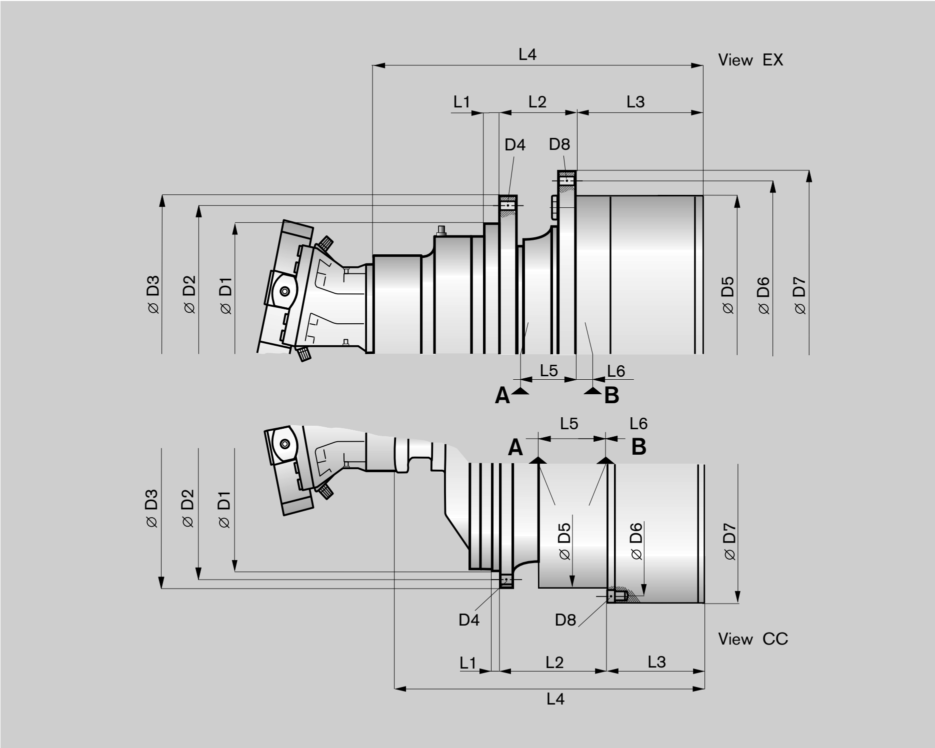
Statutory requirements prescribe that all rotating components must be provided with touch guards.

All safety regulations prescribed for the relevant mounting locations must be observed.

Commissioning and maintenance of the gear units must be in line with the instructions provided in our operating manual.

Should you need a gear variant other than those described in this product bulletin please do not hesitate to contact us.

Dimensions



Technical Data

Type GFT	Output torque T_{max} Nm	Transmission ratio i	Locking torque $T_{Br\ max}$ Nm	Hydraulic motor
GFT 0600 N/1	600,000	243.5	1x* 3,115	A2FM 500
GFT 0600 N/2	614,000	326.5	2x* 1,200	A6VE 160
GFT 0600 N	794,000	289.1 • 520.2	2x* 1,830	A2FE 160 / A6VM 250
GFT 0800 N	792,000	284.8	integrated in motor	2x 250 cm^3
GFT 0800 N	984,000	386.7	2x* 1,830	A2FM 250
GFT 1100 N	1,117,000	401.5	2x* 1,700	A6VM 250
GFT 1300 N	1,300,000	458.5	2x* 1,700	A6VM 250

* Number of brakes

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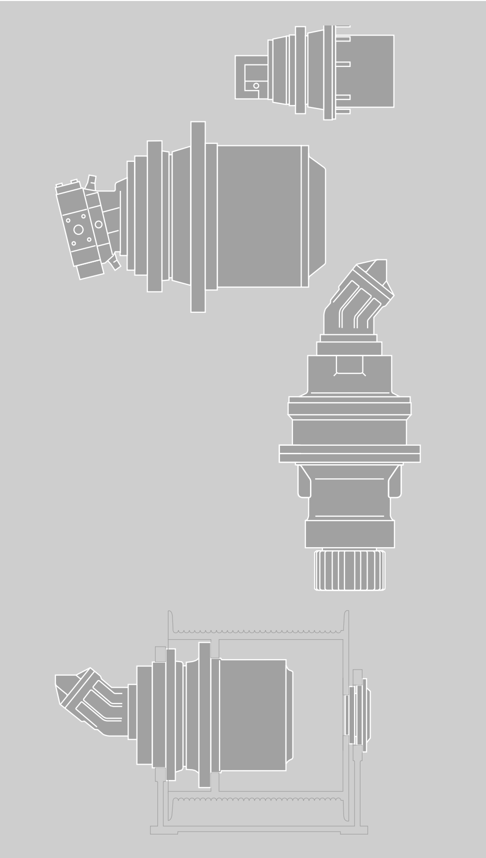
Dimensions, Bearing Load Ratings and Masses

Type GFT	D1	D2	D3	D4	D5	D6	D7	D8
				mm				
GFT 0600 N/1	670	750	815	30x ø39	885	975	1,055	24x ø39
GFT 0600 N/2	730	810	880	41x M30x2	885	965	1,020	48x M30x2
GFT 0600 N	668	726	779	30x M36x1.5	780	850	900	45x M36x1.5
GFT 0800 N	830	980	1,050	48x M30x2	920	976	1,055	48x M30x2
GFT 0800 N	668	726	779	30x M36x1.5	780	850	900	45x M36x1.5
GFT 1100 N	1,110	1,230	1,310	48x M36	1,040	1,170	1,226	52x M30
GFT 1300 N	1,110	1,230	1,310	48x M36	1,040	1,170	1,226	52x M30

Type GFT	L1	L2	L3	L4	L5	L6	A + B C	A + B Co	Mass	View *
							kN	kN	kg	
GFT 0600 N/1	60	242.5	459.5	1,167	186	62	1,320	3,150	2,500	EX
GFT 0600 N/2	57.5	245	464.5	1,161	186	62	1,320	3,150	2,600	EX
GFT 0600 N	33	405	368	1,211.5	248	6	1,320	3,150	2,850	CC
GFT 0800 N	25	229	673	1,332	69	186	2,450	5,200	3,800	EX
GFT 0800 N	66	405	486	1,324	255	2	2,450	5,200	3,320	CC
GFT 1100 N	60	503	585	1,524	318.5	48.5	3,900	7,650	7,050	EX
GFT 1300 N	60	503	593	1,565.5	319	49	3,900	7,650	7,500	EX

* EX = for tracklaying excavators / CC = for tracklaying cranes

Products
for Mobile Applications



Planetary Gear Units for Mobile Equipment

Hydrostatic Travel Drives

- HYDROTRAC GFT
  for fixed- or variable-displacement motors
  output torques between 9 and 450 kNm
  Data sheet RE 77110
- HYDROTRAC GFT 2160
  gear unit for crawler driven equipment
  output torque 42,5 kNm
  Data sheet RE 77125
- HYDROTRAC GFT-N
  for use in mining excavators and tracklaying cranes
  output torques between 600 and 1300 kNm
  Data sheet RE 77719
- HYDROTRAC GFT
  for use on large tracklaying vehicles
  output torques up to 3250 kNm
  On request

Hydrostatic Swing Drives

- MOBILEX GFB
  for fixed- or variable-displacement motors
  output torques between 4 and 115 kNm
  Data sheet RE 77201
- MOBILEX GFB 2160
  gear unit for slewing of the superstructure
  output torque 14,5 kNm
  Data sheet RE 77208

Hydrostatic Winch Gears

- MOBILEX GFT–W
  for fixed- or variable-displacement motors
  output torques between 14 and 275 kNm
  Data sheet RE 77502

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Notes

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Fax +49 2302 877-148
info.gears@boschrexroth.de
www.boschrexroth.com/gears

Rexroth
Bosch Group

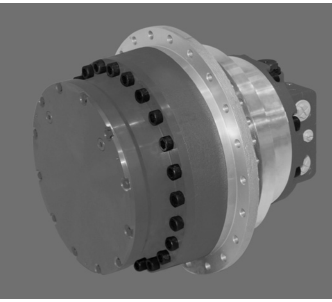
HYDROTRAC GFT

Drive unit for crawler track equipment

Series 2000

RE 77116/06.12 1/2

Data sheet



Contents

Description

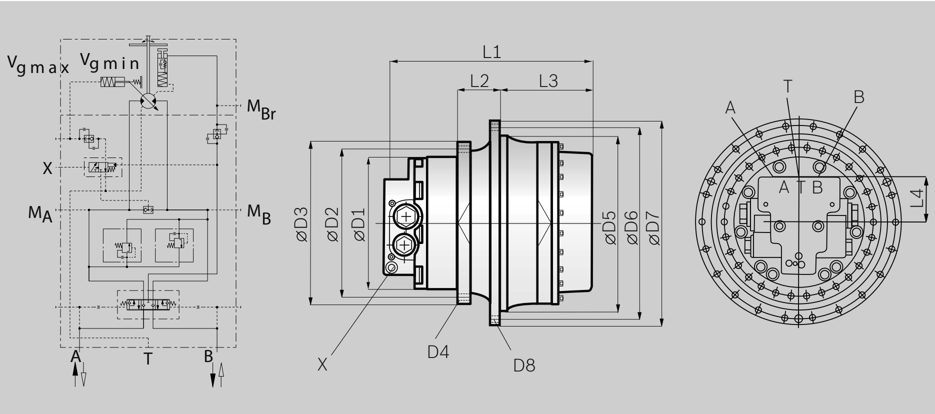
The hydrostatic drive unit of the GFT 2000 series consists of a two-stage planetary gearbox with an integrated hydraulic swash plate axial-piston motor. The complete unit is designed as a drive for tracked vehicles. The integrated dual displacement motor is provided with an automatic shifting function for automatic selection between $V_{g\,min}$ and $V_{g\,max}$. Optionally, the integrated dual displacement motor is provided with an HZ-adjustment.

- Compact, space-saving two-stage drive unit
- Suitable for crawler track equipment
- Open circuit
- Automatic shifting function
- Integrated Multiple disk brake
- Mechanical disconnect mechanism (optional)
- Connection plate with integrated brake valve and pressure relief valve
- Easy installation as a complete unit

For more information: www.boschrexroth.com/getriebe

Technical data • Dimensions

GFT type	Max. output torque	Motor displacement	Max. pressure	Gear ratio	Braking torque, static	Weight approx.	Tonnage class
	Nm	cm^3	bar	i	Nm	kg	to
GFT 2120 E	13,500	54	300	53	129	85	7 - 10
GFT 2140 E	26,500	90	350	53	250	155	10 - 15
GFT 2160 E	42,500	170	350	45	475	250	20 - 25
GFT 2180 E			in preparation				30 - 35



GFT type	D1	D2	D3	D4	D5	D6	D7	D8	L1	L2	L3	L4	A/B*	T*	X*
									mm						
GFT 2120 E	210	250	280	12x M16	265	300	326	12x M14	368.5	80	154.5	76.5	M27x2	M14x1.5	M14x1.5
GFT 2140 E	246	280	308	20x M16	324	364	394	18x M16	410	99.5	176.5	82	M33x2	M16x1.5	M14x1.5
GFT 2160 E	300	340	372	30x M16	402	440	470	22x M16	477.5	98.5	196.5	98	M33x2	M18x1.5	M14x1.5
GFT 2180 E								in preparation							

*JIS connections optional

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Rexroth
Bosch Group

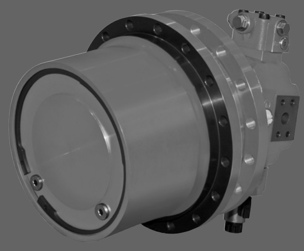
HYDROTRAC GFT

Planetary gearboxes for mobile applications

Series 8000

RE 77117/06.12 1/2

Data sheet



Contents

Page

Description

The hydrostatic compact drive of the 8000 series consists of a two- or three-stage planetary gearbox, providing a space-saving drive unit when it is combined with a hydraulic bent-axis axial piston motor. The complete unit is used as drive component for wheeled and tracked vehicles and other mobile equipment.

Product features

- Compact, space-saving two- or three-stage planetary gearbox
- Integrated multiple disk brake
- Supplied with space-saving hydraulic plug-in motor or with connection for space-saving hydraulic plug-in motor
- Disconnect mechanism (optional)
- Rugged design
- Easy assembly
- For open and closed circuit

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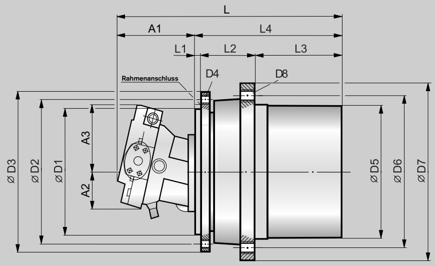
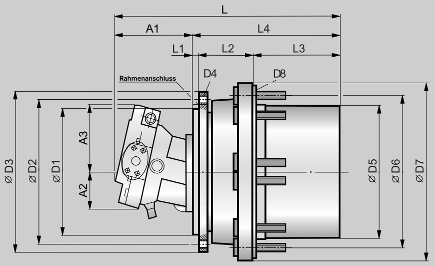
For more information: www.boschrexroth.com/getriebe

Technical data • Dimensions

GFT type	Nominal output torque	Gear ratio	Braking torque, static	Braking torque, dynamic	Weight approx.	compatible hydraulic motors A6VE
	Nm	i	Nm	Nm	kg	Series 71
GFT 8110 E	10.000	17 - 48	depending on motor size	depending on brake pressure		28 • 60
GFT 8120 E	13.000	22 - 32				28 • 60 • 85
GFT 8130 E	20.000	29 - 51			120	60 • 85
GFT 8140 F	30.000	90 - 137			125	60
GFT 8150 E	42.000	23 - 53				60 • 85 • 115 • 170
GFT 8160 F	52.000	80 - 128				60 • 85
GFT 8170 F	70.000	64 - 111				115
GFT 8180 F	100.000	91 - 127				115 • 170
GFT 8190 F	130.000	77 - 102				170



View T
(version with threaded bores)



View W
(version with wheel studs)

GFT type	D1	D2	D3	D4	D5	D6	D7	D8	L	L1	L2	L3	L4	A1	A2	A3	View
	Dimensions mm																
GFT 8110 E	in preparation								depending on motor size					depending on motor size and adjustment			
GFT 8110 E																	
GFT 8120 E																	
GFT 8120 E																	
GFT 8130 E	250	290	320	16x M20	280	305	330	16x M16		14	82	162	258				T
GFT 8130 E	250	305	330	10x M22x1.5	260	300	335	10x M22x1.5		14	82	162	258				W
GFT 8140 F	240	285	320	18x M20	280	305	330	30x M16		14	82	195	291				T
GFT 8140 F																	
GFT 8150 F	in preparation																
GFT 8150 F																	
GFT 8160 F																	
GFT 8170 F																	
GFT 8180 F																	
GFT 8190 F																	

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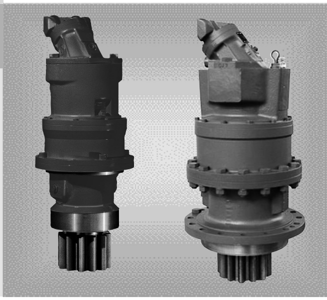
Rexroth
Bosch Group

Swing Drives
MOBILEX GFB
for Mobile Applications

RE 77201 / 06.10 **1**/16
Replaces: 05.06

Data Sheet



Swing Drives with Output Torques of between 4 and 115 kNm

Contents

Features

- Compact, space-saving two or three-stage planetary design
- Easy mounting
- Integrated multiplate parking device
- Low-noise operation
- High efficiency
- Long service life
- Convenient oil change

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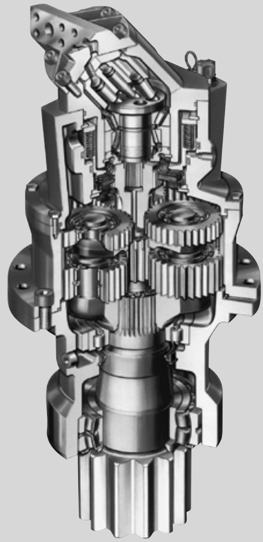
For further information go to: www.boschrexroth.com/gears

Description

Rexroth MOBILEX GFB planetary gearboxes are hydrostatic swing gears.
They are suitable for use in excavators and cranes of all types, in ship unloading equipment, forestry equipment and in all applications where accurate positioning is called for.
The drive consists of a two or three-stage gearbox with an integrated multi-disk parking brake, an output pinion as well as a hydraulic motor, preferably from Rexroth.
A dedicated team of R&D, design and sales engineers makes sure that the clients' wishes and concepts are quickly translated into technically and economically viable solutions.
In their work, they are assisted by modern computer software for gearing design and component optimization. The information provided in this bulletin serves to help you select the planetary gearbox best suited for your application. In addition, our field personnel are available to you to provide advisory services even at the project stage.



Rexroth MOBILEX GFB two-stage hydrostatic compact drive with a multiplate parking device and a Rexroth plug-in motor

Lubrication

The gearteeth and bearings are splash lubricated. Aside from periodic oil changes, the drive units are maintenance-free. Oil changes are easy to do. The oil brands recommended in the operating manual shall be exclusively used.
The change intervals for the relevant application conditions are also given in the operating manual. The pinion-side antifriction bearing of the output shaft is grease-lubricated for life.

Multiplate Parking Device

The standard supply scope includes a spring-loaded, hydraulically released multiplate parking device arranged on the input side.
The multiplate parking device is not a service brake.

Hydraulic Motors

The gearbox is designed for direct flange attachment of a variable or fixed displacement motor (preferably a Rexroth hydraulic motor). If requested, the motor can be supplied along with the gearbox.

Gearbox Supply

Rexroth MOBILEX planetary gearboxes are delivered ready for installation, but without oil filling. The standard gearbox version comes with a priming coat of grey color (similar to RAL 7032) and is internally protected with a temporary corrosion preventive that preserves the gearbox for 24 months, if stored in a dry location.
External flanges, shaft extensions and mating faces are protected with TECTYL 502 C.

Mass, Oil Volumes, Dimensions

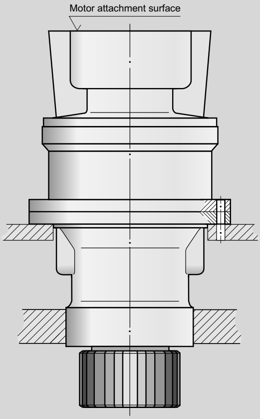
The specified mass are average figures.
As far as oil volumes are concerned, gearbox operators should rely on oil level readings rather than specified oil volumes. Figures and dimensions are not strictly binding. We reserve the right to make changes in line with technical progress.

Further Notes

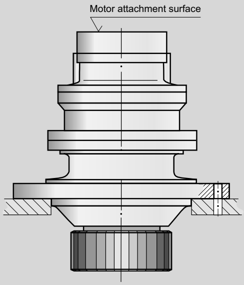
As prescribed by statutory provisions, all rotating parts must be protected by guards against accidental contact. Local safety regulations must be complied with.
Commissioning and maintenance of the gearboxes must be performed in line with the instructions given in our operating manual.

Type of Construction

GFB T2/T3 1000



GFB T2/T3 2000



T2 = 2-stage
T3 = 3-stage

Version 1000:
2 centering seats

Version 2000:
1 centering seat

Ordering Example

MOBILEX GFB 0026 T2 1 . . .

Gearbox Type

Version

e.g. 2 centering seats

Swing Drives MOBILEX GFB - Overview

Type/Version GFB	Output Torque Excavator $T_{2\ max}$ Nm	Crane	Gear Ratio from/to i
GFB 0009 T2	4000	7000	33.4
GFB 0017 T2	7700	12700	32.5 - 45.7
GFB 0024 T3	10600	17500	149.1
GFB 0026 T2	10000	16500	43.9 - 51.5
GFB 0036 T3	17500	28500	117.6 - 153.6
GFB 0050 T2	22000	38000	32.3
GFB 0050 T3	22000	38000	147.4
GFB 0080 T3	38200	68300	186.4
GFB 0084 T2	38200	68300	35.1
GFB 0144 T2	54000	94500	49.3

Application Conditions

The gearboxes are designed for use at ambient temperatures of between -20° C and +40° C. Environmental influences such as salt water, salty air, sand, dust, overpressure, heavy vibrations, extreme shocks and ambient temperatures, aggressive fluids and the like may affect the function of the gearbox. All such conditions must be specified so that the gearbox can be designed for safe operation.

Gearbox Design

The gearbox design is based on many years of practical application experience. The maximum output torques $T_{2\,max}$ indicated under technical data for crane applications relate to FEM Section I, 3rd Edition and Section IX (FEM - Fédération Européenne de la Manutention), as well as DIN 15020, collective load class L2, service time category T5 corresponding to driver group M5. The reference output speed is 25 revolutions per minute maximum. If the swing drive is to be classified in another driver group, the required output torque must be converted using the K factor (see table).
This conversion gives you the maximum admissible output torque for the new driver group selected. Whether or not the chosen overall classification can be met will be determined by the Rexroth gear technology experts.

Higher Torques

For gearboxes transmitting higher torques than those indicated in this product catalog, please contact us.

Gearbox Selection

- T_2 = Output torque
- T_{2K} = Corrected output torque
  K factor according to service time category and collective group given in the table.

$$\mathbf{T_{2\,K} = T_2 \bullet K}$$

- $\mathbf{T_{2\,K}}$ of the gearbox to be selected must be $\leq \mathbf{T_{2\,max}}$ (according to this product catalog).

Multiplate Parking Device

$$\mathbf{T_{Br\ sta.\ min} = 1{,}3 \bullet T_1} \text{ (input torque)}$$

The holding torque multiplies with the selected transmission ratio.

See also Gearbox Design.

A design data sheet for swing drives is reproduced on pages 12 and 13.

Driver Groups and Service Time Categories to FEM, Section I, 3rd Edition 1987

(FEM: Fédération Européenne de la Manutention)

Service time category				T 2	T 3	T 4	T 5	T 6	T 7	T 8
Assumed average service time per day in hours				0.25 - 0.5	0.5 - 1	1 - 2	2 - 4	4 - 8	8 - 16	>16
Theoretic service life in hours				400 - 800	800 - 1600	1600 - 3200	3200 - 6300	6300 - 12500	12500 - 25000	25000 - 50000
Collective load class				**Driver group with K factor**						
Collective groups	L 1	low	Maximum loads occur only in exceptional cases; low loads are present at all times	M 1 0.90	M 2 0.90	M 3 0.90	M 4 0.90	M 5 0.95	M 6 1.05	M 7 1.2
	L 2	medium	Low, medium and high loads are present for roughly equal periods of time	M 2 0.90	M 3 0.95	M 4 0.95	M 5 1	M 6 1.15	M 7 1.30	M 8 1.50
	L 3	high	Loads are always near the maximum	M 3 1.05	M 4 1.05	M 5 1.10	M 6 1.25	M 7 1.40	M 8 1.60	M 8 1.80
	L 4	very high	Always maximum loads	M 4 1.25	M 5 1.30	M 6 1.45	M 7 1.65	M 8 1.85	M 8 2.10	M 8 2.40

Classification Examples

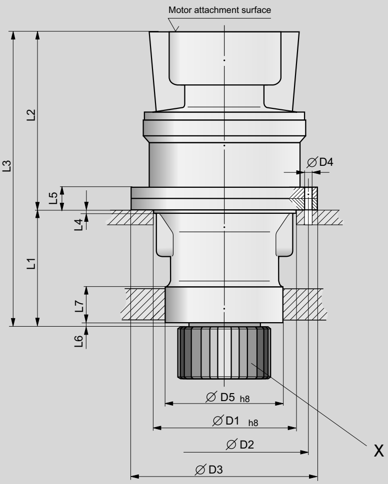
See FEM Section I, 3rd Edition, Table T.2.1.3.5.

Type of Crane (Designation)	**Component Operated** 1)	**Type of Driver** Hoisting	Swinging	Level Luffing	Trolley Travelling	Crane Travelling
Erection cranes		M 2 – M 3	M 2 – M 3	M 1 – M 2	M 1 – M 2	M 2 – M 3
Loading bridges	hook	M 5 – M 6	M 4	–	M 4 – M 5	M 5 – M 6
Loading bridges	grab or magnet	M 7 – M 8	M 6	–	M 6 – M 7	M 7 – M 8
Workshop cranes		M 6	M 4	–	M 4	M 5
Overhead travelling cranes, ram cranes, scrap yard cranes	grab or magnet	M 8	M 6	–	M 6 – M 7	M 7 – M 8
Unloading bridges, container gantry cranes	hook or spreader	M 6 – M 7	M 5 – M 6	M 3 – M 4	M 6 – M 7	M 4 – M 5
Other gantry cranes (with trolley and/or live ring)	hook	M 4 – M 5	M 4 – M 5	–	M 4 – M 5	M 4 – M 5
Unloading bridges, container gantry cranes (with trolley and/or live ring)	grab or magnet	M 8	M 5 – M 6	M 3 – M 4	M 7 – M 8	M 4 – M 5
Berth cranes, shipyard cranes, dismantling cranes	hook	M 5 – M 6	M 4 – M 5	M 4 – M 5	M 4 – M 5	M 5 – M 6
Dockside cranes (slewable, gantry type, ...), floating cranes, floating shearlegs	hook	M 6 – M 7	M 5 – M 6	M 5 – M 6	–	M 3 – M 4
Dockside cranes (slewable, gantry type, ...), floating cranes, floating shearlegs	grab or magnet	M 7 – M 8	M 6 – M 7	M 6 – M 7	–	M 4 – M 5
Floating cranes and floating shearlegs for very high loads (normally above 100 tons)		M 3 – M 4	M 3 – M 4	M 3 – M 4	–	–
Shipboard cranes	hook	M 4	M 3 – M 4	M 3 – M 4	M 2	M 3
Shipboard cranes	grab or magnet	M 5 – M 6	M 3 – M 4	M 3 – M 4	M 4 – M 5	M 3 – M 4
Tower cranes for construction sites		M 4	M 5	M 4	M 3	M 3
Derrick tower gantries		M 2 – M 3	M 1 – M 2	M 1 – M 2	–	–
Railroad cranes, approved for service on trains		M 3 – M 4	M 2 – M 3	M 2 – M 3	–	–
Vehicle-mounted cranes	hook	M 3 – M 4	M 2 – M 3	M 2 – M 3	–	–

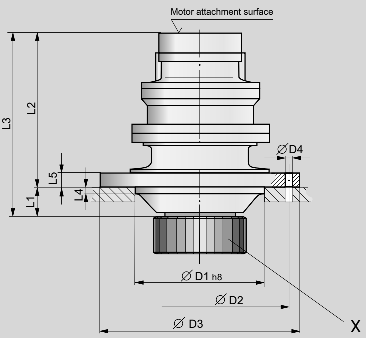
1) This column shows some typical uses for general information

Dimensions

GFB T2/T3 1000



GFB T2/T3 2000



X The gearing of the output pinion (module, number of teeth, tooth width, etc.) is governed by the customer´s ring gear.

Technical Data

Type/Version GFB	Output Torque Excavator	Crane	Gear Ratio	Holding Torque	Hydraulic Motor
	$T_{2\,max.}$ Nm		i	$T_{Br\,max.}$ Nm	
GFB 0009 T2 2000/2	4000	7000	33.4	245	A6VM 55 / A2FM 56
GFB 0017 T2 1000	7700	12700	32.5 • 45.7	390	A2FE 45 • 56
GFB 0017 T2 2000	7700	12700	45.7	390	A2FE 45 • 56
GFB 0024 T3 1000/1	10600	17500	149.1	249	A2FM 32
GFB 0026 T2 1000	10000	16500	43.9 • 51.5	613	A2FE 80
GFB 0026 T2 2000	10000	16500	43.9 • 51.5	613	A2FE 80
GFB 0036 T3 1000/1	17500	28500	117.6 • 153.6	332	A2FM 45
GFB 0036 T3 1000/2	17500	28500	117.6 • 153.6	332	A2FE 45 • 63

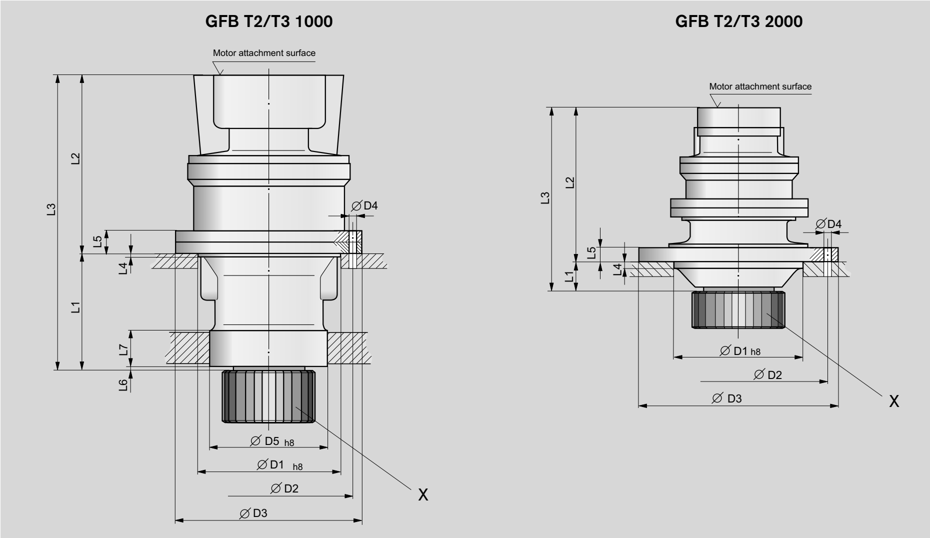
GFB 0009 T2 2000/**2 = Identification number for different overall lengths/diameters and motor attachment variants.**

Dimensions, Mass

Type/Version GFB	D1	D2	D3	D4	D5	Mass
			mm			kg
GFB 0009 T2 2000/2	175	260	288	12x 17.5	-	85
GFB 0017 T2 1000	256	290	320	16x 17.5	225	130
GFB 0017 T2 2000	250	305	340	16x 17.5	-	130
GFB 0024 T3 1000/1	265	315	355	20x 17.5	230	165
GFB 0026 T2 1000	280	350	380	20x 17.5	250	225
GFB 0026 T2 2000	275	335	365	20x 17.5	-	240
GFB 0036 T3 1000/1	280	350	380	20x 17.5	250	210
GFB 0036 T3 1000/2	280	350	380	18x 17.5	280	175

Type/Version GFB	L1	L2	L3	L4	L5	L6	L7
				mm			
GFB 0009 T2 2000/2	40	325.5	365.5	26	22	-	-
GFB 0017 T2 1000	200	300	500	6	38	6	55
GFB 0017 T2 2000	57	443	500	46	23	-	-
GFB 0024 T3 1000/1	245	387	632	15	34	8	75
GFB 0026 T2 1000	250	321	571	12	33	10	85
GFB 0026 T2 2000	55	511	566	20	223	-	-
GFB 0036 T3 1000/1	245	423	668	12	33	5	85
GFB 0036 T3 1000/2	245	332	577	12	33	5	85

Dimensions



X The gearing of the output pinion (module, number of teeth, tooth width, etc.) is governed by the customer's ring gear.

Technical Data

Type/Version GFB	Output Torque Excavator	Crane	Gear Ratio	Holding Torque	Hydraulic Motor
	$T_{2\,max.}$		i	$T_{Br\,max.}$	
	Nm			Nm	
GFB 0050 T2 9000	22000	38000	32.3	473	A2FE 63
GFB 0050 T2 9000/1	22000	38000	32.3	473	A2FM 80
GFB 0050 T2 9000/2	22000	38000	32.3	473	A2FM 80
GFB 0050 T3 1000/3	22000	38000	147.4	414	A2FM 63
GFB 0050 T3 1000/4	22000	38000	147.4	414	A2FM 63
GFB 0080 T3 1000/3	38200	68300	186.4	975	A2FM 80 • 90
GFB 0084 T2 2000/1	38200	68300	35.1	1661	A2FM 180 • 200
GFB 0084 T2 2000/2	38200	68300	35.1	1661	AA2FM 180
GFB 0144 T2 2000	54000	94500	49.3	1423	A2FM 180 • 200

GFB 0050 T3 1000/**3 = Identification number for different overall lengths/diameters and motor attachment variants.**

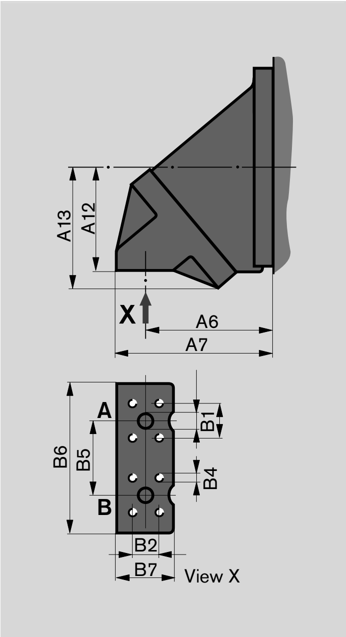
Dimensions, Mass

Type/Version GFB	D1	D2	D3	D4	D5	Mass
			mm			kg
GFB 0050 T2 9000	300	375	410	20x 17.5	280	240
GFB 0050 T2 9000/1	300	375	410	20x 17.5	280	240
GFB 0050 T2 9000/2	300	375	410	20x 17.5	280	240
GFB 0050 T3 1000/3	330	375	411	24x 17.5	300	310
GFB 0050 T3 1000/4	330	375	411	24x 17.5	300	315
GFB 0080 T3 1000/3	440	480	530	24x 26	370	540
GFB 0084 T2 2000/1	400	470	510	24x 26	-	515
GFB 0084 T2 2000/2	400	460	510	24x 26	-	515
GFB 0144 T2 2000	460	520	562	24x 26	-	1050

Type/Version GFB	L1	L2	L3	L4	L5	L6	L7
				mm			
GFB 0050 T2 9000	245	287.5	532.5	12	33	5	-
GFB 0050 T2 9000/1	245	292.5	537.5	12	33	5	-
GFB 0050 T2 9000/2	245	299.5	544.5	12	33	5	-
GFB 0050 T3 1000/3	290	429.5	719.5	15	38	40	75
GFB 0050 T3 1000/4	290	396.5	686.5	15	38	40	75
GFB 0080 T3 1000/3	314	554.5	868.5	14	40	41	121
GFB 0084 T2 2000/1	64	721	785	10	465	-	-
GFB 0084 T2 2000/2	64	710	774	10	465	-	-
GFB 0144 T2 2000	85	857	942	55	655	-	-

Corresponding Hydraulic Motors: Dimensions and Mass

Fixed-displacement motor A2FE, Series 61

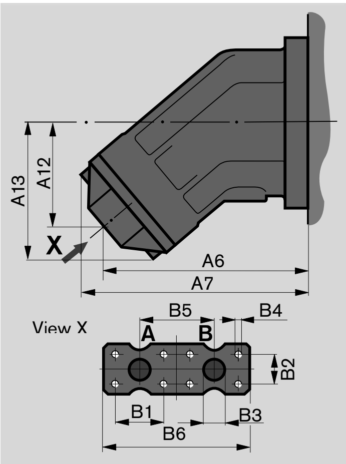


Nominal Size	A6	A7	A12	A13	Mass (kg)
45	109	133	102	119	15
56	122	146	107	130	18
63	122	146	107	130	19
80	127	157	121	145	23
90	127	157	121	145	25

Nominal Size		B1	B2	B3	B4	B5	B6	B7	A / B
45		50.8	23.8	19	M10x17	75	147	49	SAE 3/4"
56	63	50.8	23.8	19	M10x17	75	147	49	SAE 3/4"
80	90	57.2	27.8	25	M12x17	84	166	60	SAE 1"

For further technical data see RE 91008

Fixed-displacement motor A2FM, Series 61 ([1] Series 63)



Nominal Size		A6	A7	A12	A13	Mass (kg)
28	32	153	173	78	106	9.5
45		166	194	89	122	13.5
56	63	182	206	96	130	18
80	90	203	233	104.5	145	23
125		225.5	252	120	159	32
180		252	294	134	188	45
200 [1]		284	309	84	165	66

Nominal Size		B1	B2	B3	B4	B5	B6	A / B
28	32	40.5	18.2	13	M8x15	59	115	SAE 1/2"
45		50.8	23.8	19	M10x17	75	147	SAE 3/4"
56	63	50.8	23.8	19	M10x17	75	147	SAE 3/4"
80	90	57.2	27.8	25	M12x17	84	166	SAE 1"
125		66.7	31.8	32	M14x19	99	194	SAE 1 1/4"
180		66.7	31.8	32	M14x19	99	194	SAE 1 1/4"
200 [1]		66.7	31.8	32	M14x19	99	204	SAE 1 1/4"

For further technical data see RE 91001

Corresponding Hydraulic Motors: Dimensions and Mass

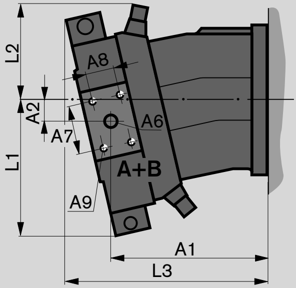
Variable-displacement motor A6VM, Series 63

Nominal Size	A1	A2	L1 *	L2 *	L3 *	Mass (kg)
55	183	24	151	111	238	26

* Dimensions may vary depending on the displacement

Nominal Size	A6	A7	A8	A9	A / B
55	19	50.8	23.8	M10x1.5x17	SAE 3/4"

For further technical data see RE 91604



Design Data Sheet
MOBILEX GFB

To be able to quote, we require the following data from you:

Fax No. +49 2302 877-148

Please attach drawings, sketches, notes, etc.

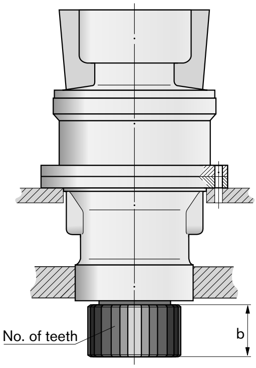
Person in charge: ____________
Company: ____________
Place: ____________
Fax: ____________
Telephone: ____________
E-Mail: ____________

Technical Data

Type of equipment:

☐ **Excavator** ☐ **Crane** Type: ______ ☐ **Other**

Equipm. weight (tons): empty ____ loaded ____ Lifting load (tons): ______ ______



Output shaft housing design (long/short) is to be determined in consultation with us.

Gearbox

Input speed	n_1	______	min^{-1}
Input torque	T_1	______	Nm
Reduction ratio	i	______	: 1
Output torque, nom.	T_2	______	kNm
Output torque, max.	T_2	______	kNm
Output speed	n_2	______	min^{-1}
Duty factor	ED	______	%
FEM Classification	M ____ L ____ T ____		

Machine

Speed, superstructure	n_O	______	min^{-1}
Torque, superstructure	T_O	______	kNm

Drive ☐ Connection for . . . ☐ Attachment of . . .

☐ **Hydraulic motor:**

☐ Fixed-displacement type ☐ Variable-displacement type

Type	______	
Manufacturer	______	
Working pressure DP	______	bar
Secondary valves		
set at	______	bar
Circulating oil volume	______	l/min
$V_{g\,min}$ *	______	cm^3
$V_{g\,max}$ *	______	cm^3
Pressure cut-off *	______	bar
Regulation start/end *	______	bar

☐ **Electric motor:**

☐ Three-phase ☐ DC

Type (of construction)	______	
Manufacturer	______	
Voltage *	______	volts
Frequency *	______	HZ
Type of protection *	______	
Temperature class *	______	

* if gearbox is supplied with the motor

Person in charge: ______________________
Company: ______________________
Place: ______________________
Fax: ______________________
Telephone: ______________________
E-Mail: ______________________

Pinion gearing		☐ milled	☐ ground		
Angle of pressure	a°	________			
Number of teeth	Z	________			
Module	m	________	mm		
Tooth width	b	________	mm		
Addendum modification **	x	________			
Position of pinion		☐ bot-	☐ top	☐ horizontal	
Ambient temperature		________	°C		
Ambient conditions		________			
Number of teeth, ring gear	Z	________			
Tooth width, ring gear	b	________	mm		
Gearing, ring gear		☐ normali-	☐ tempered	☐ hardened	
Manufacturer of ring gear		________	Type ________		
Multi-disk parking brake		☐ yes	☐ no		
Multi-disk parking brake		☐	☐ dry		
With locking device		☐ yes	☐ no		
Braking torque **	T_{brake}	________	Nm		
Release pressure, min. **	$P_{release}$	________	bar		
Release pressure, max. **	$P_{release}$	________	bar		
Gearbox with excentricity		☐ yes	☐ no	if yes, how much (mm) ________	

Splined connection (DIN 5480/SAE)

Number of teeth	Z	________	
Module	m	________	mm
Tooth width	b	________	mm

** if specified by customer

Gearbox design in conformity with the regulations of a classification body ☐ yes ☐ no
If yes, which body or institution: ______________________

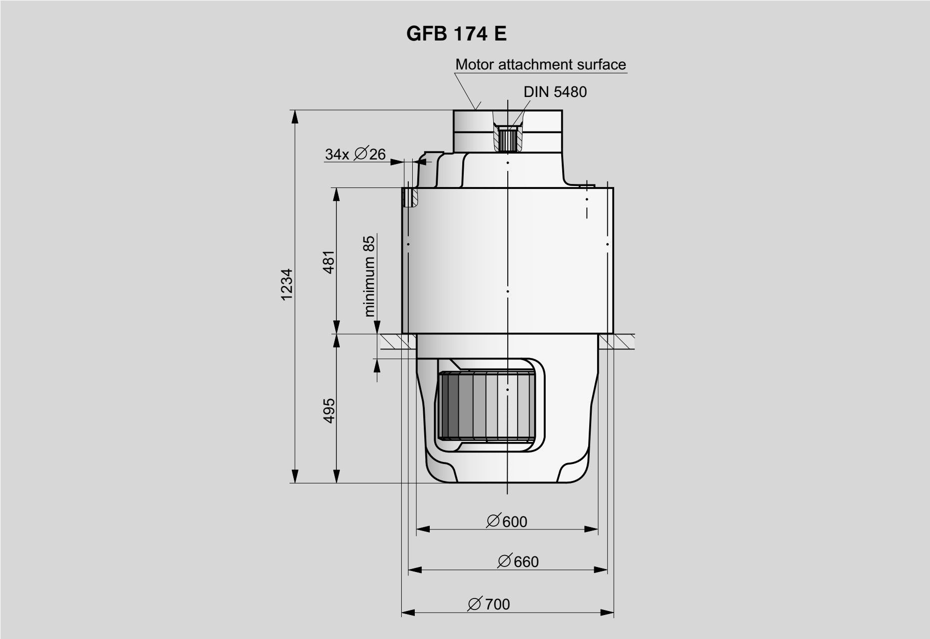
Budgeted annual requirement ______________
Estimated implementation period ______________
Special application conditions ______________________
Further customer-specific requirements ______________________
Are there any legal regulations and/or standards that must be observed?
☐ yes ☐ no If yes, which ______________________

Remarks

Date: ______________ Name: ______________ Dept.: ______________

7

Dimensions



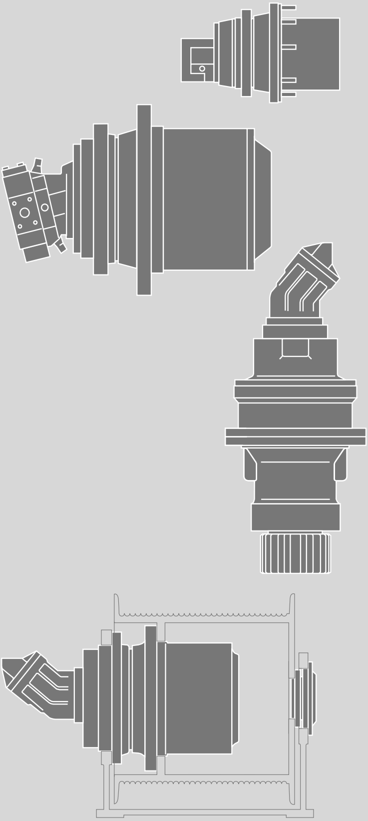
Technical Data

of previously built swing drives MOBILEX GFB, output torques > 94.5 kNm.

Type/Version GFB	Gear Ratio i	Output Torque, max. $T_{2\ max.}$ kNm
GFB 0174 E	63.6	115

Notes

Products
for Mobile Applications



Planetary Gear Units for Mobile Applications

Hydrostatic Travel Drives

- HYDROTRAC GFT
  for fixed- or variable-displacement motor
  output torques between 9 and 450 kNm
  Technical Documentation RE 77110
- HYDROTRAC GFT
  with integrated hydraulic two-speed motor
- HYDROTRAC GFT
  for use on large tracklaying vehicles
  output torques up to 3250 kNm
  Upon request

Hydrostatic Swing Drives

- MOBILEX GFB
  for fixed- or variable-displacement motors
  output torques between 4 and 115 kNm
  Technical Documentation RE 77201
- MOBILEX GFB
  with swash-plate motor

Hydrostatic Winch Drives

- MOBILEX GFT – W
  for fixed- or variable-displacement motors
  output torques between 14 and 275 kNm
  Technical Documentation RE 77502

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Rexroth
Bosch Group

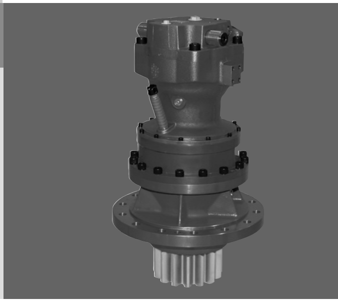
MOBILEX GFB

RE 77206/06.12 1/2

Drive unit for revolving superstructures

Series 2000

Data sheet



Contents

Page

Description

The hydrostatic drive unit of the GFB 2000 series consits of a two-stage planetary gearbox with an attached hydraulic swash plate slew drive motor. This compact drive is designed for swiveling a revolving superstructure of a crawler or wheel excavators. The slew drive motor is provided with an integrated static multiple disk brake and a vibration damping valve.

- Compact, space-saving two-stage drive unit
- Multiple disk brake integrated into the motor
- Built-on brake release valve
- Standard configuration with a vibration damping valve
- Good anti-cavitation method
- Compact design by integrated valves
- Easy installation as a complete unit
- Open circuit

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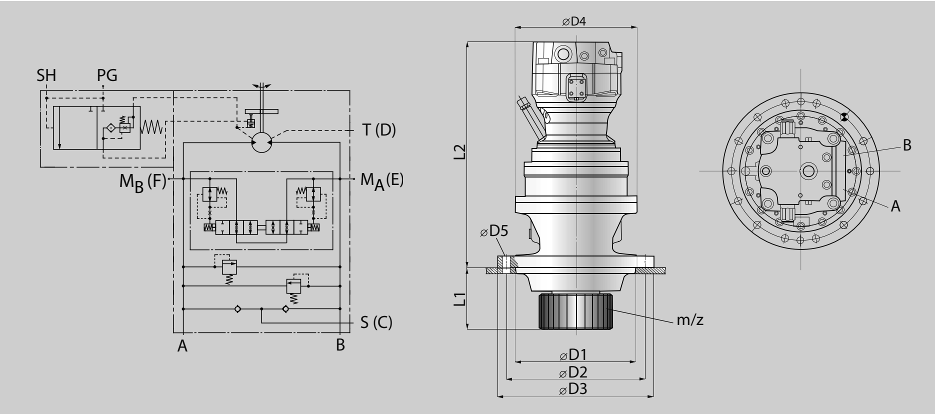
For more information: www.boschrexroth.com/getriebe

Technical data • Dimensions

GFB type	Max. output torque	Motor displacement	Max. pressure	Gear ratio	Max. braking torque, static	Weight approx.	Tonnage class
	Nm	cm^3	bar	i	Nm	kg	to
GFB 2120 E	4,000	45	350	21	215	90	7 - 10
GFB 2140 E	5,500	75	350	18.3	380	120	10 - 15
GFB 2160 E	14,500	150 / 170	350	20.7	650/700	265	20 - 25
GFB 2180 E			in preparation				30 - 35



GFB type	D1	D2	D3	D4	D5	L1	L2	A/B	C	D	E/F	PG	SH	m	z
								mm							
GFB 2120 E	200	275	310	251	8x ø18	104	436.4	Pressure port	Suction connection	Leakage oil connection	Measuring connection	Control pressure port	Control pressure port	Module on request	No. of teeth on request
GFB 2140 E	200	290	323	260	9x ø18 + 1x ø20	136	474.5								
GFB 2160 E	345	400	450	350	13x ø22 + 1x ø24	179	586.5								
GFB 2180 E			in preparation												

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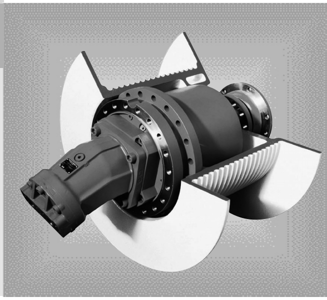
Printed in Germany

Rexroth
Bosch Group

Winch Drives
MOBILEX GFT-W
for Mobile Applications

RE 77502 / 06.10 **1**/16
Replaces: 05.04

Data Sheet



Winch Drives for Rope Pull Forces from 50 - 595 kN

Contents

Features

- Compact, space-saving planetary gearbox design
- Planet wheel carried in full-complement bearings
- Robust bearing system absorbing the forces exerted by the cable pull
- Simple mounting
- Easy oil change
- Integrated multiplate parking device
- Low-noise operation

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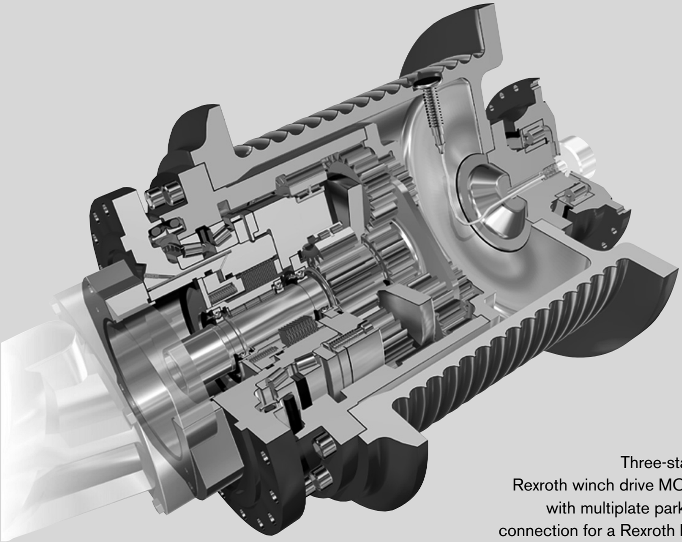
For further information visit www.boschrexroth.com/gears

Description

MOBILEX GFT-W hydrostatic winch drives from Rexroth are ideal drive components for winches. They have proven their worth in the most arduous applications and under tough operating conditions. MOBILEX GFT-W winch drives are used in all kinds of winches - mobile and crawler cranes, railroad cranes, shipboard, dockside and container cranes. Due to their extremely compact design, the gear units can be mounted inside the cable drum in a space-saving manner. They are designed for ease of installation and maintenance. High-quality manufacturing processes and the use of case-hardened gear-wheels as well as quenched, tempered and surface-hardened ring gears warrant outstanding load-carrying capacity, operational safety and low-noise running characteristics.

The teeth of the gearwheels are designed according to standard specifications and our own strength calculations, which have been developed based on our comprehensive know-how and are optimally adapted to our manufacturing processes. The drives provide optimum total efficiency due to the use of Rexroth hydraulic motors, among other things. The gear units described in this document are subject to constant updating and technical advancement. To suit the specific needs of our customers in terms of dimensions and output characteristics, further variants can be supplied. That's why we provide advice and support even in the project stage to help you find the most appropriate solution for your requirement.



Three-stage hydrostatic Rexroth winch drive MOBILEX GFT-W with multiplate parking device and connection for a Rexroth hydraulic motor

Lubrication

The gears and bearings are splash-lubricated. The drive units are maintenance-free save for periodic oil changes, which are convenient to make. Only the oils specified in the operating manual should be used in the gearboxes.
The change intervals for different operating conditions are also specified in the operating manual.

Multiplate Parking Device

A spring-loaded, hydraulic released multiplate parking device arranged on the input side is provided.

$$T_{Br\ sta.\ min} = 1{,}6 \cdot T_1 \text{ (input torque)}$$

The multiplate parking device is not a service brake, but a static holding device. Where required, a service or emergency brake should be provided by the equipment sup-plier/operator.
The static holding torque multiplies in accordance with the transmission ratio selected.

Hydraulic Motors

The gearbox is designed for direct flange-attachment of a variable or fixed-displacement motor (preferably a Rexroth hydraulic motor). If requested, the motor is supplied with the gearbox.

Declaration of design

2000 = oil inlet, oil outlet, oil level at the gearbox cover
4000 = oil inlet, oil outlet, oil level on the motor side
6000 = oil inlet, oil outlet, oil level on the motor side
Assembly of two gearboxes in one rope drum possible
9000 = special design

Options

Upon request, the drives can be equipped with the following accessories:

End Supporting Bearing, Cable Drum, Winch Frame

In addition to the standard scope of supply (Representation A), complete winch drives series can be supplied with:
end supporting bearing
end supporting bearing and cable drum
end supporting bearing, cable drum, and winch frame.

Limit Switches

Upon request, special end supporting bearings can be designed to connect to specific geared cam-type limit switches.

Overview of GFT-W Winch Drives

Type/Design GFT-W	Output Torque [1] $T_{2\,max}$ Nm	Cable Pull, max. [2] kN	Gear Ratio from/to i
GFT 0013 W2 [3]	9500	50	-
GFT 0017 W2	14000	67	45.4
GFT 0017 W3 [3]	14000	74	-
GFT 0024 W3	19000	99	90.1 - 102.6
GFT 0026 W2	18000	84	50.5 - 62.0
GFT 0036 W3 [3]	26000	118	-
GFT 0040 W2 [3]	27000	108	-
GFT 0050 W3 [3]	37500	150	-
GFT 0060 W3 [3]	42500	164	-
GFT 0080 W3	67000	231	61.3 - 79.1
GFT 0110 W3	100000	300	79,5 - 95.8
GFT 0160 W3	140000	373	210.8 - 251.0
GFT 0220 W3	200000	471	246.1
GFT 0330 W3	275000	595	183.2 - 252.0

For our current range of GFT-W winch drives, visit us at www.boschrexroth.com/gears

Should you require a specific winch drive solution that is not covered by our standard range, please contact us. Further dimensions and design variants can be supplied.

1) Design to FEM L2T5M5
2) Based on a theoretical 1st layer winding diameter Dws
3) on request

7

Application Conditions

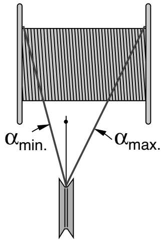
The gearboxes have been designed for use at ambient temperatures of between -20 C and +40 C. Environmental influences such as salt water, salty air, sand, dust, overpressure, heavy vibrations, extreme shocks and ambient temperatures, aggressive media, etc. will affect the function of the product.
Such influences must be specified to ensure that the winch drive is designed to safely meet the requirements.

Gearbox design

The gearbox design is based on many years of practical experience. The maximum output torques $T_{2\,zul}$ indicated under Technical Data relate to FEM Section 1,3rd issue, and Section IX (FEM - Fédération Européene de la Manutention), as well as DIN 15020, collective load class L2, service time category T5 corresponding to driver group M5. The reference output speed is 25 revolutions per minute maximum.
If the winch is classified into a different driver group, the required output torque must be converted by applying factor K (see table).
This results in the maximum permissible output torque for the new classification. Whether or not the selected overall classification is feasible, will be determined by the specialists of Rexroth.
The output torques indicated are peak torques that are permissible for short-term operation only (e.G. unloaded hook, emergencies, etc.) The gear units are not designed for continuous operation.

Fleet Angle

Observing the admissible fleet angle α is prerequisite for proper cable winding.



The fleet angle α should not be smaller than 0.5 to make sure that the cable does not climb the drum flange and properly forms the next layer.

The fleet angle α should not be larger than 1.5 to make sure that the cable, when in the first layer, is not pulled against the groove wall and that, in the case of several cable layers, the cable winds neatly over the full length of the drum to drum flanges.

Gearbox Selection

- T_2 = output torque
  F = cable pull in N
  D_W = relevant winding diameter in m

$$T_2 = \frac{F \cdot D_W}{2}$$

- T_{2K} = corrected output torque
  K factor according to the service time category and collective group given in the table.

$$T_{2\,K} = T_2 \cdot K$$

- $T_{2\,K}$ of the gearbox to be selected must be $T_{2\,max}$ (according to the bulletin).

See also Gearbox Design.

See page 13 for a data sheet relating to the winch drive design.

Driver Groups and Service Time Categories to FEM, Section I, 3rd Issue 1987

(FEM: Fédération Européenne de la Manutention)

Service time category				T 2	T 3	T 4	T 5	T 6	T 7	T 8
Assumed average service time per day in hours				0,25 - 0,5	0,5 - 1	1 - 2	2 - 4	4 - 8	8 - 16	>16
Theoretic service life in hours				400 - 800	800 - 1600	1600 - 3200	3200 - 6300	6300 - 12500	12500 - 25000	25000 - 50000
Collective Load Class				**Driver Group with K Factor**						
Collective groups	L 1	light	maximum loads occuring in exceptional cases only, slight loads constantly	M 1 0,90	M 2 0,90	M 3 0,90	M 4 0,90	M 5 0,95	M 6 1,05	M 7 1,2
	L 2	medium	small, medium and maximum loads about equally distributed over service time	M 2 0,90	M 3 0,95	M 4 0,95	M 5 1	M 6 1,15	M 7 1,30	M 8 1,50
	L 3	heavy	loads always near maximum	M 3 1,05	M 4 1,05	M 5 1,10	M 6 1,25	M 7 1,40	M 8 1,60	M 8 1,80
	L 4	very heavy	always maximum loads	M 4 1,25	M 5 1,30	M 6 1,45	M 7 1,65	M 8 1,85	M 8 2,10	M 8 2,40

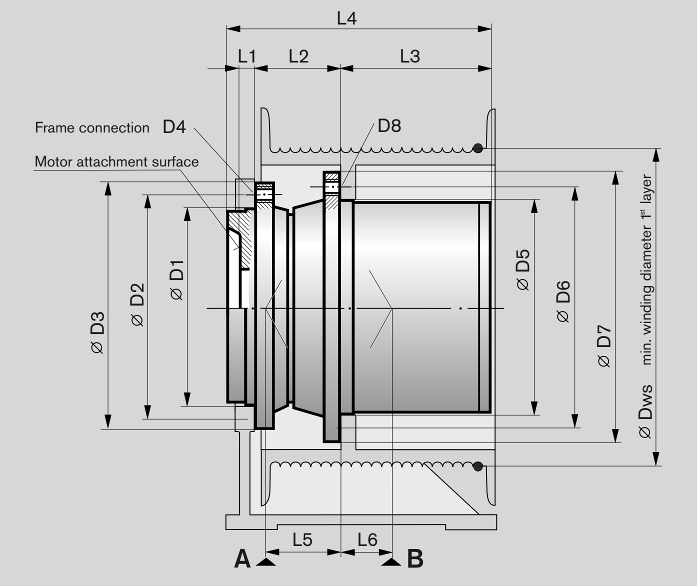
Classification Examples

see FEM Section I, 3rd Issue, Table T.2.1.3.5.

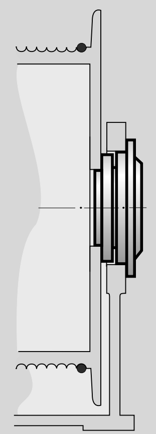
Type of Crane (Designation)	Component Operated 1)	Type of Driver				
		Hoisting	Swinging	Level Luffing	Trolley Travelling	Crane Travelling
Erection cranes		M 2 – M 3	M 2 – M 3	M 1 – M 2	M 1 – M 2	M 2 – M 3
Loading bridges	hook	M 5 – M 6	M 4	–	M 4 – M 5	M 5 – M 6
Loading bridges	grab or magnet	M 7 – M 8	M 6	–	M 6 – M 7	M 7 – M 8
Workshop cranes		M 6	M 4	–	M 4	M 5
Overhead travelling cranes, ram cranes, scrap yard cranes	grab or magnet	M 8	M 6	–	M 6 – M 7	M 7 – M 8
Unloading bridges, container gantry cranes	hook or spreader	M 6 – M 7	M 5 – M 6	M 3 – M 4	M 6 – M 7	M 4 – M 5
Other gantry cranes (with trolley and/or live ring)	hook	M 4 – M 5	M 4 – M 5	–	M 4 – M 5	M 4 – M 5
Unloading bridges, container gantry cranes (with trolley and/or live ring)	grab or magnet	M 8	M 5 – M 6	M 3 – M 4	M 7 – M 8	M 4 – M 5
Berth cranes, shipyard cranes, dismantling cranes	hook	M 5 – M 6	M 4 – M 5	M 4 – M 5	M 4 – M 5	M 5 – M 6
Dockside cranes (slewable, gantry type, ...), floating cranes, floating sheerlegs	hook	M 6 – M 7	M 5 – M 6	M 5 – M 6	–	M 3 – M 4
Dockside cranes (slewable, gantry type, ...), floating cranes, floating sheerlegs	grab or magnet	M 7 – M 8	M 6 – M 7	M 6 – M 7	–	M 4 – M 5
Floating cranes and floating sheerlegs for very high loads (normally above 100 t)		M 3 – M 4	M 3 – M 4	M 3 – M 4	–	–
Shipboard cranes	hook	M 4	M 3 – M 4	M 3 – M 4	M 2	M 3
Shipboard cranes	grab or magnet	M 5 – M 6	M 3 – M 4	M 3 – M 4	M 4 – M 5	M 3 – M 4
Tower cranes for construction sites		M 4	M 5	M 4	M 3	M 3
Derrick tower gantry		M 2 – M 3	M 1 – M 2	M 1 – M 2	–	–
Railroad cranes, approved for service in trains		M 3 – M 4	M 2 – M 3	M 2 – M 3	–	–
Vehicle-mounted cranes	hook	M 3 – M 4	M 2 – M 3	M 2 – M 3	–	–

1) This column only shows some typical areas of winch use for informative purposes.

Dimensions



For dimensions of the end supporting bearing see page 12



optionally
(only with design ≥ 4000)

Technical Data

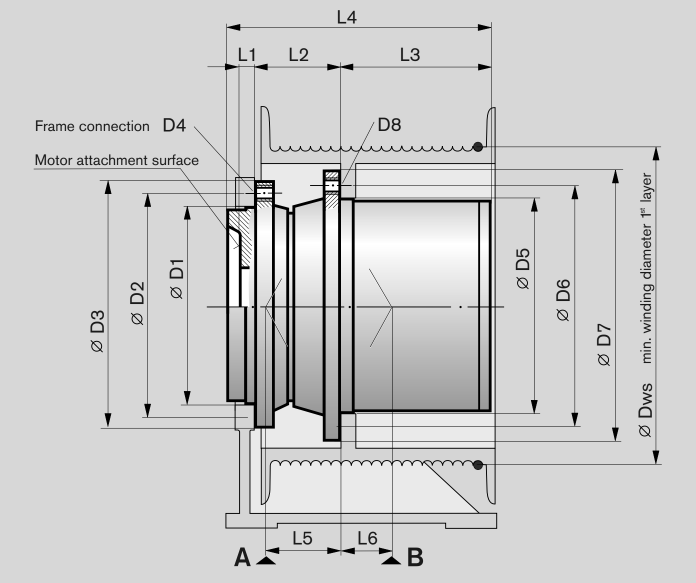
Type/Design GFT-W	Output Torque $T_{2\,max.}$ Nm	Cable Pull max. kN	Transmission Ratio i	Holding Torque $T_{Br\,max.}$ Nm	Hydraulic Motor
GFT 0017 W2 4000	14000	67	45.4	460	A6VE 55/A2FE 56 • 63
GFT 0024 W3 4000	19000	99	90.1 • 102.6	460	A6VE 55/A2FE 56 • 63
GFT 0026 W2 2000	18000	84	62.0	710	A6VE 80/A2FE 80 • 90
GFT 0026 W2 4000	18000	84	50.5	710	A2FE 90
GFT 0080 W3 6000/1	67000	231	61.3 • 79.1	1890	A6VM 160/A2FM 180
GFT 0080 W3 6000/2	67000	231	61.3 • 79.1	1890	A6VM 250

Dimensions, Mass

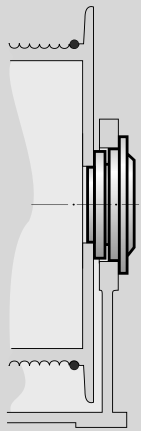
Type/Design GFT-W	D1	D2	D3	D4	D5	D6	D7	D8	Dws
					mm				
GFT 0017 W2 4000	250	290	320	14x M20	280	305	330	16x 17.5	380
GFT 0024 W3 4000	250	290	320	14x M20	280	305	330	20x ø18	385
GFT 0026 W2 2000	270	310	350	16x M20	320	350	380	20x M16	430
GFT 0026 W2 4000	270	310	350	16x M20	320	350	380	20x 17.5	430
GFT 0080 W3 6000/1	380	430	470	28x M24	430	460	495	24x 22	580
GFT 0080 W3 6000/2	380	430	470	28x M24	430	460	495	24x 22	580

Type/Design GFT	L1	L2	L3	L4	L5	L6	A + B C	A + B Co	Mass
			mm				kN		kg
GFT 0017 W2 4000	30	82	152	264	56	47	108	142	105
GFT 0024 W3 4000	30	82	189.5	301.5	56	47	140	290	130
GFT 0026 W2 2000	30	90	220	340	58	49	186	400	145
GFT 0026 W2 4000	30	90	220	340	58	49	186	400	145
GFT 0080 W3 6000/1	69	120	295	484	76	19	212	425	430
GFT 0080 W3 6000/2	69	120	295	484	76	19	212	425	430

Dimensions



For dimensions of the end supporting bearing see page 12



optionally
(only with design ≥ 4000)

Technical Data

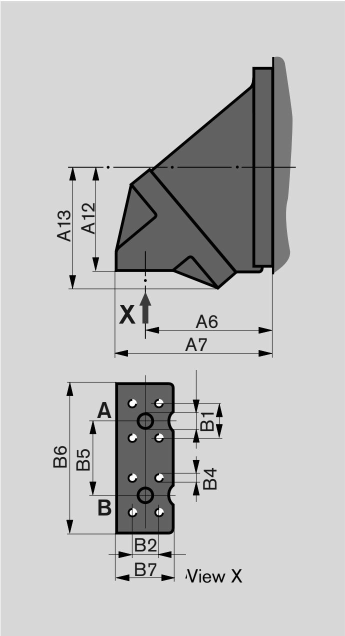
Type/Design GFT-W	Output-Torque $T_{2\ max.}$ Nm	Cable Pull max. kN	Transmission Ratio i	Holding Torque $T_{Br\ max.}$ Nm	Hydraulic Motor
GFT 0110 W3 4000	100000	300	114.8	1100	A6VE 160
GFT 0110 W3 6000/1	100000	300	79.5 • 95.8	1890	A6VM 200 • 250/A2FM 200
GFT 0110 W3 6000/2	100000	300	95.8	1890	A2FM 250
GFT 0110 W3 6000/3	100000	300	95.8	1890	A6VM 160/A2FM 160 • 180
GFT 0110 W3 6000/4	100000	300	79.5	1890	A6VM 250/A2FM 200
GFT 0110 W3 9000	100000	300	79.5	1500	A6VM 200 • 250/A2FM 200
GFT 0160 W3 4000	140000	373	210.8 • 251.0	1360	A2FE 180
GFT 0220 W3 6000	200000	471	246.1	1470	A6VE 160
GFT 0330 W3 9000/1	275000	595	252.0	2860	A6VE 250/A2FE 250
GFT 0330 W3 9000/2	275000	595	183.2	2X 1700	2X A6VM 160

Dimensions, Mass

Type/Design GFT-W	D1	D2	D3	D4	D5	D6	D7	D8	Dws
					mm				
GFT 0110 W3 4000	420	460	500	24x M24	460	500	540	36x 20	640
GFT 0110 W3 6000/1	380	430	470	28x M24	490	530	567	24x 26	650
GFT 0110 W3 6000/2	380	430	470	28x M24	490	530	567	24x 26	650
GFT 0110 W3 6000/3	380	430	470	28x M24	490	530	567	24x 26	650
GFT 0110 W3 6000/4	380	430	470	28x M24	460	500	530	24x 22	650
GFT 0110 W3 9000	380	430	470	28x M24	490	530	567	24x 26	650
GFT 0160 W3 4000	450	510	560	30x M24x2	535	600	650	30x 30	750
GFT 0220 W3 6000	460	600	650	30x M30	610	680	735	24x 33	850
GFT 0330 W3 9000/1	580	680	735	28x M30	660	730	785	30x 33	925
GFT 0330 W3 9000/2	450	515	568	32x M30x2	570	620	668	42x M24	-

Type/Design GFT	L1	L2	L3	L4	L5	L6	A + B C	A + B Co	Mass
			mm				kN		kg
GFT 0110 W3 4000	0	165	305	491.5	107	25	A 509 B 480	A 1080 B 950	440
GFT 0110 W3 6000/1	69	140	280	489	96	- 2	212	425	460
GFT 0110 W3 6000/2	69	140	280	489	96	- 2	212	425	406
GFT 0110 W3 6000/3	69	140	280	489	96	- 2	212	425	515
GFT 0110 W3 6000/4	69	130	291	490	86	8	212	425	515
GFT 0110 W3 9000	69	140	290	498	94	0	212	425	515
GFT 0160 W3 4000	30	168	340	538	138	26	688	1520	680
GFT 0220 W3 6000	45	170	350	565	155	35	710	1560	820
GFT 0330 W3 9000/1	47	188	430	705	190	25	1040	2450	1380
GFT 0330 W3 9000/2	281	255	410	946	180	35	1040	2450	1500

Corresponding Hydraulic Motors: Dimensions and Mass



Fixed-Displacement Motor A2FE, Series 61

Nominal Size	A6	A7	A12	A13	Mass (kg)
56	122	146	107	130	18
63	122	146	107	130	19
80	127	157	121	145	23
90	127	157	121	145	25
160	169	211	149	188	47
250 [1]	*	230	*	172	*

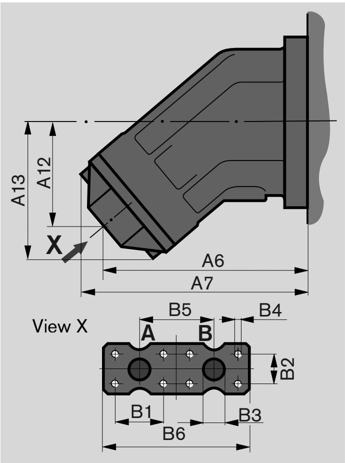
Nominal Size	B1	B2	B3	B4	B5	B6	B7	A / B
56 63	50.8	23.8	19	M10x17	75	147	49	SAE 3/4"
80 90	57.2	27.8	25	M12x17	84	166	60	SAE 1"
160 180	66.7	31.8	32	M14x19	99	194	70	SAE 11/4"
250 [1]	*	*	*	*	*	*	*	*

[1] Series 60

For further technical data see RE 91008

* Missing dimensions upon request

Fixed-Displacement Motor A2FM, Series 61



Nominal Size	A6	A7	A12	A13	Mass (kg)
160 180	252	294	134	188	32
200 [1]	284	309	84	165	45
250 [2]	288	314	93	172	45

Nominal Size	B1	B2	B3	B4	B5	B6	A / B
160 180	66.7	31.8	32	M14x19	99	194	SAE 1 1/4"
200 [1]	66.7	31.8	32	M14x19	99	204	SAE 1 1/4"
250 [2]	66.7	31.8	32	M14x19	100	210	SAE 1 1/4"

[1] Series 63
[2] Series 60

For further technical data see RE 91001

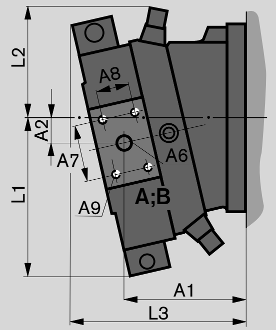
Corresponding Hydraulic Motors: Dimensions and Mass

Variable-Displacement Motor A6VE, Series 63

Nominal Size	A1	A2	L1 *	L2 *	L3 *	Mass (kg)
55	123	24	151	111	179	26
80	130	28	167	116	190	34
160	171	34	200	154	245	64
250	204	44	248	188	302	90

* Dimensions vary, depending on type of displacement

Nominal Size	A6	A7	A8	A9	A / B
55	19	50.8	23.8	M10x17	SAE 3/4"
80	25	57.2	27.8	M12x17	SAE 1"
160	32	66.7	31.8	M14x19	SAE 11/4"
250	32	66.7	31.8	M14x19	SAE 11/4"



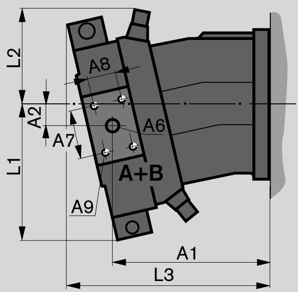
For further technical data see RE 91606

Variable-Displacement Motor A6VM, Series 63

Nominal Size	A1	A2	L1 *	L2 *	L3 *	Mass (kg)
160	254	34	197	137	329	64
200	267	36	209	143	345	80
250	287	44	248	188	383	90

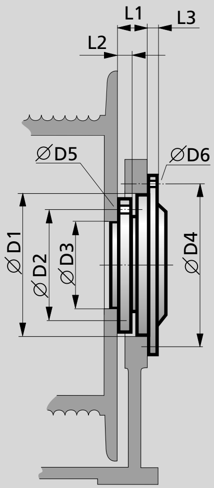
* Dimensions vary, depending on type of displacement

Nominal Size	A6	A7	A8	A9	A / B
160	32	66.7	31.8	M12x1.75	SAE 1 1/4"
200	32	66.7	31.8	M12x1.75	SAE 1 1/4"
250	32	66.7	31.8	M12x1.75	SAE 1 1/4"



For further technical data see RE 91604

Standard End Supporting Bearing



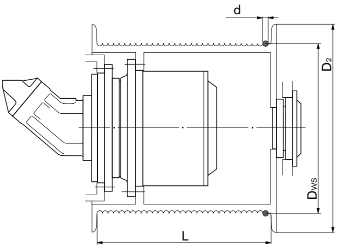
Gearbox Size	D1 H7/j6	D2	D3 H7/j6	D4	D5
GFT 0013 W GFT 0017 W	140	115	90	157	12 x ø 14
GFT 0024 W GFT 0026 W	175	145	115	198	12 x ø 18
GFT 0036 W GFT 0040 W	200	170	140	230	12 x ø 18
GFT 0050 W GFT 0060 W GFT 0080 W	225	190	150	260	12 x ø 22
GFT 0110 W GFT 0160 W GFT 0220 W	260	220	180	295	12 x ø 22
GFT 0330 W	Dimensions upon request				

Gearbox Size	D6	L1	L2	L3	Mass appr. (kg)
GFT 0013 W GFT 0017 W	6 x ø 9	76	13	10	9
GFT 0024 W GFT 0026 W	6 x ø 11	76	20	15	15
GFT 0036 W GFT 0040 W	6 x ø 14	77	20	15	21
GFT 0050 W GFT 0060 W GFT 0080 W	6 x ø 18	91	25	17	30
GFT 0110 W GFT 0160 W GFT 0220 W	8 x ø 18	102	25	20	30
GFT 0330 W	Dimensions upon request				

You wish to receive an offer?
to be able to quote, we require the following data from you:
Fax No. +49(0)2302-8 77-1 48.

Please attach drawings, sketches, notes, etc.

Person in charge: ______
Company: ______
Place: ______
Fax: ______
Telephone: ______



Standard scope of supply:
Gearbox, with end supporting bearing, if required

Upon request:
Gearbox with drum and winch frame

Technical Data

Design to FEM T ______ L ______ M ______

Machine ______

☐ Hoisting Winch ☐ Level-Luffing Winch
☐ Auxilliary Winch ☐ Pull Winch ☐ Other: ______

Equipment weight ______ t
Lifting capacity, max. (crane) ______ t

Cable Pull	F	______	N
Cable velocity, max.	V_2	______	m/min
Cable diameter	d	______	mm
Groove: no gr., DIN, Lebus		______	
Cable pitch / pitch direction	p	______	mm
Number of cable layers, max.		______	
Winding diameter, 1st layer	D_{WS}	______	mm
Drum flange diameter	D_2	______	mm
Length between flanges	L	______	mm
Cable drum capacity		______	m
Output torque, max.	$T_{2\,max}$	______	Nm
* Output speed, max.	$n_{2\,max}$	______	rpm
* Transmission ratio	i	______	
* Input torque, max.	$T_{1\,max}$	______	Nm
* Input speed, max.	$n_{1\,max}$	______	rpm
* Gearbox size		______	
Working pressure	Δp	______	bar
Inlet flow rate, max.	Q_{max}	______	l/min
Fixed-displacement motor	☐ Type	______	
Variable-displacement motor	☐ Type	______	
Type of displacement		______	
Brake valve	☐ yes ☐ no		
Backstop	☐ yes ☐ no		

* To be defined by Bosch Rexroth

Budgeted annual requirement ______
Expected implementation period ______
Special application conditions ______
Further customer-specific requirements ______
Are there any legal regulations or standards that must be observed?
☐ yes ☐ no if yes, which: ______

Remarks

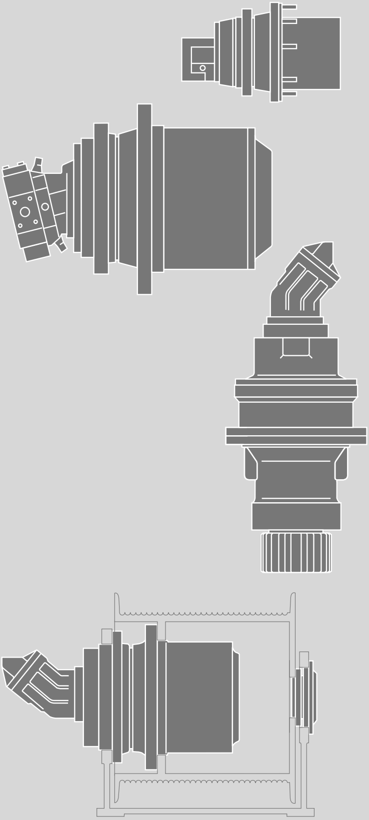
Date: ______ Name: ______ Dept.: ______

7

Notes

Notes

Products
for Mobile Applications



Planetary Gear Units for Mobile Applications

Hydrostatic Travel Drives

- HYDROTRAC GFT
  for fixed- or variable-displacement motor
  output torques between 9 and 450 kNm
  Technical Documentation RE 77110
- HYDROTRAC GFT
  with integrated hydraulic two-speed motor
- HYDROTRAC GFT
  for use on large tracklaying vehicles
  output torques up to 3250 kNm
  Upon request

Hydrostatic Swing Drives

- MOBILEX GFB
  for fixed- or variable-displacement motors
  output torques between 4 and 115 kNm
  Technical Documentation RE 77201
- MOBILEX GFB
  with swash-plate motor

Hydrostatic Winch Drives

- MOBILEX GFT – W
  for fixed- or variable-displacement motors
  output torques between 14 and 275 kNm
  Technical Documentation RE 77502

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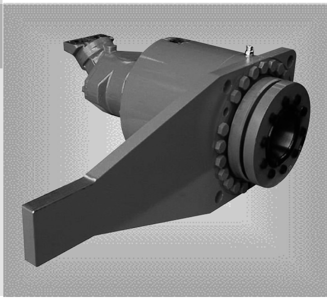
www.boschrexroth.com/gears

Gears
Planetary gear units for stationary applications

For the latest information on gears, please visit our website:
www.boschrexroth.com/gears

Planetary Gear Units
REDULUS GMH/GME



Data Sheet

Continuous Output Torque
from 78,6 to 3,300 kNm

Ratios
from 19 to 2,334

for hydraulic and electric motor drives

Contents

Description

Rexroth's REDULUS GMH / GME planetary gearboxes are reliable transmission components that have proved successful in a wide range of operating conditions.
Due to our long years of experience and our wide spectrum of products and applications we know exactly what industrial requirements planetary gearboxes must meet. Our quality management system to DIN EN ISO 9001:2000 is the base and guarantor of a consistently high quality level.
A dedicated team of R&D, design and sales engineers makes sure that the clients' wishes and concepts are quickly translated into technically and economically viable solutions. In their work, they are assisted by modern computer software for gearing design and component optimization.

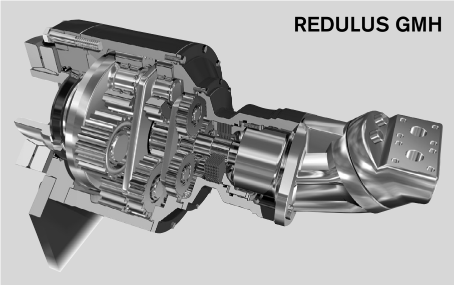
The information provided in this documentation serves to help you select the planetary gearbox best suited for your application. In addition, our field personnel are available to you to provide advisory services even at the project stage.

For further information go to: www.boschrexroth.com/gears

General Notes

REDULUS GMH / GME

REDULUS GMH / GME planetary gearboxes are characterized by compact construction and extremely high mechanical efficiency.
REDULUS GMH hydraulic drive units are optimum combinations of a hydraulic motor (preferably of Rexroth make) and a planetary gearbox for hydrostatic power transmission and mechanical torque multiplication.



Design Example

Design Variants

The ordering code explained on pages 4/5 provides an overview of the available design variants.

Precise Transmission Ratios

The calculated precise transmission ratios can be seen from the table on page 8.
The transmission ratio ranges for the various gearbox sizes are shown on page 7.

Housing

Housings of nodular cast iron are standard.
Where the ring gears are part of the gearbox housing, they are made of quenched-and-tempered steel.
Other materials are available upon request.

Output

Where the gearbox design features a shrink disk, this disk is included in the scope of supply. The hollow shaft is supported inside the gearbox such that it can safely absorb the weight of the unit and the reaction forces exerted by the torque arm.

Input

For direct motor attachment, the input shaft has been designed as a sleeve with an internal profile to DIN 5480 to accommodate the motor shaft.

Seals

The standard scope of supply includes input and output shafts sealed with radial shaft seal rings running on replaceable wearing sleeves.

Mounting Position

The gearboxes can be mounted in any position. However, the desired mounting position must be specified so that we can ensure proper lubrication.

Bearing System

Gear wheels, planet carriers and shafts are carried exclusively in antifriction bearings.

Gearbox Supply

Rexroth REDULUS gearboxes are delivered ready for installation, but without oil filling. An external paint coat (blue, RAL 5015) is applied and the gearbox interior is provided with a temporary corrosion preventive that protects the unit for a period of 24 months, if stored in a dry place.
External flanges, shaft extensions and mating faces are protected with TECTYL 502 C.

Weights, Oil Volumes, Dimensions

The specified weights and oil volumes are average figures. Gearbox operators should rely on oil level readings rather than the specified oil volumes. Figures and dimensions are not strictly binding. We reserve the right to make changes in line with technical progress.

Noise Characteristics

The gearbox design has been optimized with respect to noise generation. The noise levels produced are in conformity with the relevant provisions of VDI 2159.

Gear Teeth

Spur and planet gear wheels have straight teeth and are case-hardened and correctively ground. The ring gears are made of quenched and tempered nitrided material. Bevel gears are of case-hardened and ground quality or provided with HPG gear teeth.

All gear teeth are designed for adequate fatigue strength at the rated torque indicated.

Lubrication

The gearboxes are designed for splash lubrication.
Where gearboxes are mounted in inclined or vertical position, appropriate measures are taken to ensure that the units are properly lubricated.
Proprietary gear oils with EP additives are suitable for lubrication. Recommended brands are those which have successfully passed the 12th load stage of FZG testing (A/8, 3/90) according to DIN 51354.
Consult the operating manual for recommended oils.

Cooling

Up to the thermal power limit P_T (see page 11), cooling is achieved by heat dissipation through the gearbox housing. Where this limit is exceeded, cooling fans or water coolers are used. Please consult us for cooling in vertical mounting position.

Further Notes

As prescribed by statutory provisions, all rotating parts must be protected by guards against accidental contact. Local safety regulations must be complied with.
Commissioning and maintenance of the gearboxes must be performed in line with our operating manuals.
In the case of shaft-mounted gearboxes with torque arm, care must be taken to ensure that the torque arm is attached to the foundation in a manner to allow the gearbox to move with machine shaft displacements without restraining forces acting on it. Any coupling arranged between the gearbox and the prime mover must also be designed to allow such movement.

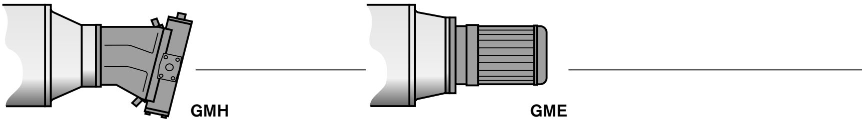
Hydraulic Motors

For proper operation of hydraulic motors, make sure to follow the motor manufacturer's instructions.

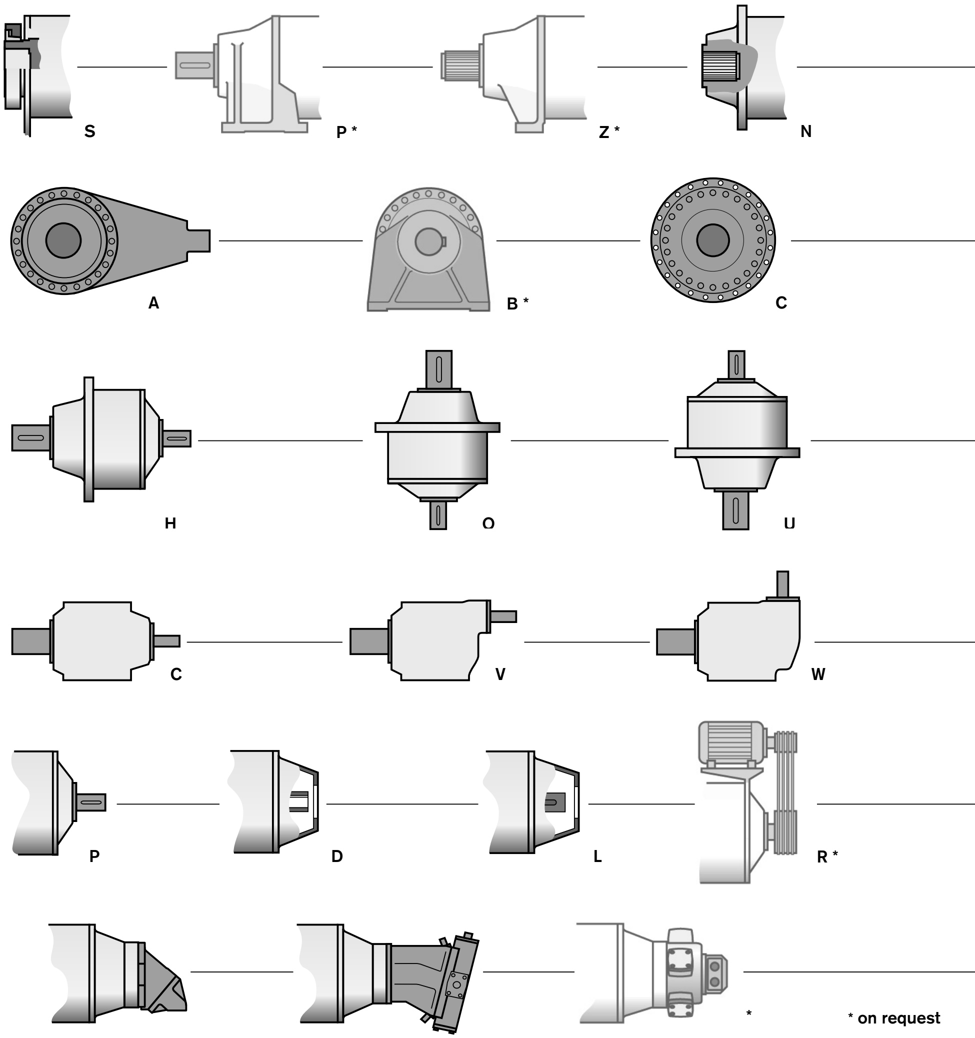
Electric Motors (Direct Attachment)

Please note that this mounting variant requires the motor to be oil-tight and the motor locating bearing to be arranged on the near side of the gearbox.

Ordering Code



0200R	0220T	0300R	0330T	0425R	0600T	0615R	0870R
1100R	1500R	2300R	2800R	3400R	4600R	7000R	



* on request

REDULUS GME 0220T 3 Z C O 64.4 H C O P

Type
GMH Hydraulic Drive
GME Electric Drive

Gearbox Size

Number of gear stages

Output Side
S hollow shaft for shrink disk
P shaft with key
Z male splined shaft
N female splined shaft

Housing Design
A torque arm
B foot-mounted
C flange-mounted

Brake
O without brake
B with brake

Gear ratio

Mounting Position
H horizontal
O vertical, output on top
U vertical, output on bottom

Position of Input Shaft
C coaxial (standard)
V offset (spur gear stage)
W angle-type (bevel gear stage)

Cooling
O no cooling
W oil/water cooling compartment
E external cooling

Electric Drive
P shaft with key
D direct-attached motor
L motor bell housing and coupling
R belt transmission

Hydraulic Drive
by Rexroth products,
preferably A2FE; A2FM; A6VE; A6VM; (MR; MRE) *

Gearbox Selection

$$T_{2\,Dauer} \geq f_S \times T_{Betr.}$$

$T_{2\,Dauer}$ = Gearbox continuous output torque (Nm), see table on page 7

f_S = Service factor, see table page 6

$T_{Betr.}$ = Operating torque of driven machine (Nm)

Service Factor f_S

Load Classification		Hydraulic Motor	Electric Motor
Uniform, no shock	U	0.75	0.75 - 0.90
Reversing operation, moderate shock	M	0.75 - 0.90	0.90 - 1.10
Reversing operation, heavy shock	H	0.90 - 1.10	1.10 - 1.30

A gear unit design which is **finite-life fatigue-resistant** can be sufficient for certain applications.
We are at your disposal to check your selection and service life determination.

Load Classification[1)] of Driven Machines

Dredgers and sidecast. equipment
Endless bucket excav. . H
Travel gear
- tracklaying . . . . . . H
- rail . . . . M

Bucket wheel
- overburden . . . . . H
- coal . . . . H

Slewing units . . . . M
Sand mixers . . . . M

Mining and building equipment
Crushers . . . . H
Briquetting presses . . H
Rotary tubular kilns . . . H
Roller press . . . . H
Clay mixers . . . . M

Chemical industry
Mixers . . . . M
Agitators
- pure liquids . . . . . U
- liquids and solids M

Drying drums . . . . M

Conveyors and handling equipment
Load
- uniformly . . . . U
- medium . . . . M
- heavy . . . . M

Bucket . . . . M
Assembly . . . . M
Belt . . . . M
Chain . . . . M
Apron . . . . M
Screw . . . . M
Inclined hoists . . . . H
Discharge . . . . M
Car dumpers . . . . H

Rubber/plastics industry
Extruders
- rubber . . . . H
- plastic . . . . .M

Calenders . . . . M
Rubber kneaders . . . . H
Mixers . . . . M
Rubber mills . . . . M
Rolling mills - rubber . H

Metallurgical industry
Revolving furnace . . . . M
Converters . . . . H
Slag ladle car . . . . U
Sinter conveyors . . . . M
Toothed roll crushers . H
Torpedo mixers . . . . . . M

Cranes
Luffing gear . . . . U
Travel gear . . . . M
Hoisting gear . . . . M
Slewing gear . . . . M
Winches . . . . M

Metal working machinery
Folding presses . . . . . . H
Plate bending machines M
Plate straightening machines . . . . H
Eccentric presses . . . . H
Hammers . . . . H
Crank presses . . . . . . H
Shears . . . . .M
Forging presses . . . . . . H
Machine tools
- main drives . . . . . M
- auxiliary drives . . U

Mills, rotary type
Pan grinders . . . . H
Ball mills . . . . H
Tube mills . . . . H
Bowl mill crushers . . . H

Food industry
Bottling machinery . . . U
Kneading machines . . M
Mash tubs . . . . M
Presses . . . . H
Cane crushers . . . . . . M
Cane mills . . . . H
Cane knives . . . . M
Beet slicers . . . . M

Rolling mills
Plate turnover gear . . . M
Ingot pushers . . . . H
Ingot conveying equipm. H
Scale breakers . . . . . . H
Walking beam conveyors . . . . H
Chain tractors . . . . M
Cooling banks . . . . . . M
Ladle turnables . . . . . . M
Skid traverses . . . . . . M
Tube welders . . . . H
Tube drawing machines M
Roller straightening machines . . . . M
Shears
- plate . . . . H
- wire . . . . .M
- billet . . . . .H
- cropping . . . . H
- trimming . . . . M

Conveying straighteners M
Manipulators . . . . H
Roll adjusting equipm. . M

Sewage treatment equipm.
Filter presses . . . . M
Rotary aerators . . . . . . M
Lifting screws . . . . M
Screening equipm. . .U
Thickener . . . . H

1) The load classifications indicated are based on experience. For driven machines other than listed or in case of operating conditions deviating from normal please consult Factory.

Gearbox Selection

Standard Transmission Ratio Ranges
(Coaxial Gearbox Design)

$$i = \frac{n_1}{n_2}$$

i = Desired gearbox transmission ratio
n_1 = Drive motor speed in min^{-1}
n_2 = Driven machine speed in min^{-1}

Gearbox Size Type GMH / GME	Continuous Output Torque $T_{2\ Dauer}$ Nm	Ratio Ranges 2-stage	3-stage	4-stage
0200 R	78,600	28 - 56	87 - 265	514 - 2334
0220 T	105,000	19 - 28	64 - 366	*
0300 R	117,000	28 - 56	87	514 - 1506
0330 T	150,000	21 - 24	89 - 303	*
0425 R	162,000	28 - 56	121 - 265	469 - 981
0600 T	300,000	24	*	*
0615 R	245,000	29 - 55	123 - 265	478 - 981
0870 R	328,000	29 - 55	154 - 502	529 - 1137
1100 R	470,000	29 - 55	154 - 502	529 - 1137
1500 R	670,000	29 - 55	154 - 502	529 - 1137
2300 R	1,000,000	25 - 50	*	*
2800 R	1,300,000	26 - 50	*	*
3400 R	1,500,000	28 - 56	*	*
4600 R	2,050,000	*	*	*
5500 R	2,675,000	*	*	*
7000 R	3,300,000	*	*	*

* on request

Gearbox Selection

Precise Ratios

Preferable ratios = printed in bold / * on request

GMH / GME	2-stage	3-stage	4-stage
0200 R	**28.23 • 30.53 • 33.33 • 47.37**	**109.02 • 265.26**	**1136.84 • 1504.34**
0220 T	19.14 • 28.00	**64.43 • 81.23** • 98.69 • **106.92 • 144.38** • 146.43 • 156.41 • 189.91 • **247.06 • 366.00**	*
0300 R	**30.53 • 33.33 • 36.84 • 39.47 • 47.37**	**87.41 • 312.42**	**794.31**
0330 T	20.71	**113.93** • 169.86 • 210.86 • 253.01 • 303.43	*
0425 R	**28.23 • 47.37**	**265.26**	*
0600 T	*	*	*
0615 R	**33.84**	*	*
0870 R	**33.84**	**203.01**	*
1100 R	*	**214.29**	*
1500 R	*	*	*
2300 R	*	*	*
2800 R	*	**141.48**	*
3400 R	*	*	*
4600 R	*	*	*
5500 R	*	*	*
7000 R	*	*	*

Gearbox Design

Mechanical Review

Gearbox Size Type GMH / GME	Continuous Output Torque $T_{2\ Dauer}$ Nm	Output Speed for L_{h10} = 10,000 n_{Lh} min
0200 R	78,600	80.9
0220 T	105,000	37.1
0300 R	117,000	115.5
0330 T	150,000	16.2
0425 R	162,000	89.4
0600 T	300,000	27.8
0615 R	245,000	50.7
0870 R	328,000	91.4
1100 R	470,000	42.1
1500 R	670,000	40.7
2300 R	1,000,000	21.7
2800 R	1,300,000	19.7
3400 R	1,500,000	43.4
4600 R	2,050,000	12.5
5500 R	2,675,000	16.0
7000 R	3,300,000	8.1

The continuous output torques shown in this table relate to:

- no-shock operation
- up to five starts per hour with start-up factor $C_{zul.}$ as high as 3 times the rated torque being possible.

The exact admissible start-up factor for a specific gearbox size and type can be seen from the table on page 9.
In the case of more frequent starts and higher start-up factors, you should consult us for advice.

Gearbox Design

Review of Maximum Starting Torque T_M

$$T_M \times i_{nenn} \times f_M \,/\, T_{2\,Dauer} = C \leq C_{zul}$$

T_M = Rated motor torque
i_{nenn} = Transmission ratio
f_M = Motor start-up factor

$T_{2\,Dauer}$ = Continuous output torque of gearbox
C = Start-up factor
C_{zul} = Admissible start-up factor

Gearbox Size Type GMH / GME	Rated Output Torque in Nm T_N	Admissible Start-up Factor Related to Output Side Attachment Flange-mounted/ Foot-mounted $C_{zul.}$	Admissible Start-up Factor Related to Output Side Attachment Hollow Shaft with Shrink Disk $C_{zul.}$
0200 R	78,600	2.6	2.3
0220 T	105,000	3.0	2.3
0300 R	117,000	2.3	2.1
0330 T	150,000	2.5	1.6
0425 R	162,000	2.4	2.4
0600 T	300,000	3.0	*
0615 R	245,000	2.0	2.0
0870 R	328,000	2.6	2.2
1100 R	470,000	2.5	2.1
1500 R	670,000	2.7	2.2
2300 R	1,000,000	2.2	1.9
2800 R	1,300,000	*	*
3400 R	1,500,000	*	*
4600 R	2,050,000	*	*
5500 R	2,675,000	*	*
7000 R	3,300,000	*	*

* on request

Determination of Bearing Life L_{10h}

$$L_{10h} = (T_{2\,Dauer} \,/\, T_{Lh})^{10/3} \times (n_{Lh} \,/\, n_2) \times 10{,}000\ h$$

L_{10h} = Nominal bearing life in h
$T_{2\,Dauer}$ = Continuous output torque of gearbox in Nm see page 7
T_{Lh} = Operating torque for determination of bearing life in Nm

n_{Lh} = Gearbox output speed for L_{10h} = 10,000 h in min^{-1} see page 8
n_2 = Operating output speed of gearbox in Nm (speed of driven machine)

Additional Forces

If there are additional radial or axial forces acting on the input and/or output shaft, the shaft and bearing selection needs to be reviewed by your Rexroth partner.

The following information is required for this review:
- dimensioned drawings with force application points
- specification of radial and/or axial forces
- lever arm, in the event of circumferential forces

(see design data sheet REDULUS GMH / GME, page 19)

Review of Thermal Loads

Besides mechanical loads, thermal loads need to be checked as well.

Additional cooling is required, if

$$P_T \text{ is } < P_{erf}.$$

Additional cooling options:
- Oil or water compartment on gearbox
- Built-on or separate fan
- Connected oil/air or oil/water cooler

Admissible thermal power limit P_T

$$P_T = P_{th} \times f_W \times f_A$$

Additional cooling is **not** required if:

$$P_T \text{ is } > P_{erf}.$$

P_{erf} = required power of driven machine in kW
P_T = admissible thermal power of gearbox in kW
P_{th} = thermal limit rating in kW (see table on page 11)
f_W = thermal factor (see table on page 10)
f_A = utilization factor (see table on page 10)

Thermal Factor f_W

Relative Duty per Hour in %	Ambient Temperature 10°	20°	30°	40°	50°
100	1.13	1.00	0.87	0.74	0.60
80	1.20	1.07	0.92	0.79	0.64
60	1.31	1.16	1.02	0.86	0.71
40	1.53	1.35	1.18	1.01	0.82
20	2.00	1.78	1.55	1.32	1.08

Utilization Factor f_A

$$T_{Betr.} / T_{2\ Dauer} \times 100 = \text{Utilization in \%}$$

%	20	30	40	50	60	70	80	90	100
f_A	0.52	0.66	0.77	0.83	0.88	0.92	0.95	1.00	1.00

T_{Betr} = Operating torque of driven machine
$T_{2\ Dauer}$ = Continuous output torque of gearbox

Gearbox Design

Nominal Thermal Power Limit P_{th} in kW

Gearbox Size Type GMH / GME	Location Small Rooms			Large Rooms			Outdoors		
	Transmisson Stages								
	2-st	3-st	4-st	2-st	3-st	4-st	2-st	3-st	4-st
0200 R	59	45	37	81	63	52	113	87	71
0220 T	58	44		81	61		112	84	
0300 R	80	60	48	110	84	68	153	116	94
0330 T	69	52		97	73		133	100	
0425 R	100	80	66	138	111	92	192	154	127
0600 T	120			168			232		
0615 R	130	100	81	179	139	114	249	193	157
0870 R	156	121	96	216	170	134	301	235	186
1100 R	197	153	124	273	215	173	379	296	239
1500 R	303	227	182	419	314	251	582	436	349
2300 R	331	258	219	458	357	303	636	496	420
2800 R	370	291	248	512	403	344	712	560	478
3400 R	433	334	280	600	462	388	833	641	538
4600 R	494			691			955		
5500 R	744			1030			1434		
7000 R	877			1228			1695		

The figures shown are average values. We will be pleased to check your selection in questionable cases.

Applicable to:

- Gearbox utilization: 90 - 100 %
- Relative duty factor: ED = 100 %
- Ambient temperature: T_u = 20° C
- Max. oil temperature: $t_{\text{Öl max.}}$ = 90° C
- Horizontal mounting position

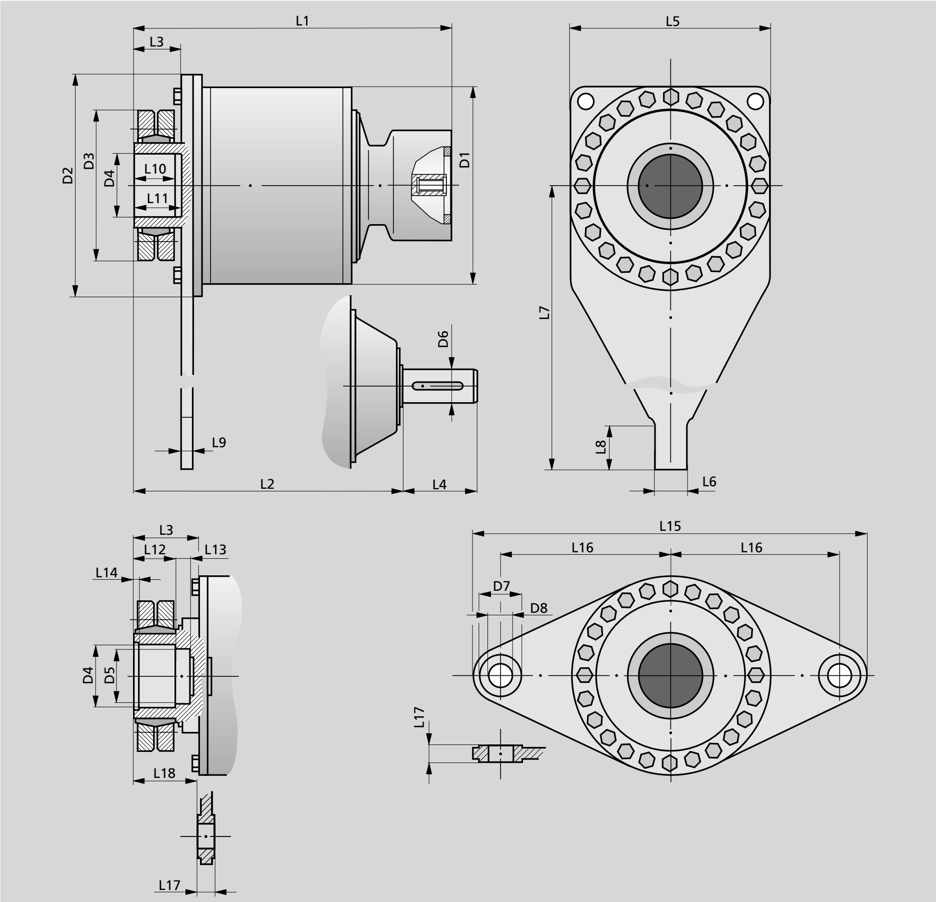
Heat transmission into the foundation has been assumed to be 10 %.

For a gearbox with a direct-attached hydraulic motor, the thermal limit rating given in the table must be multiplied by a factor of **1.25** for **two-stage** types and **1.2** for **three-stage** types.
(Assumed: appr. 60° C oil temperature in the hydraulic circuit)

2-st = 2-stage
3-st = 3-stage
4-st = 4-stage

Dimensions

Type:
Hollow Shaft with Shrink Disk, Coaxial Design



Strength of machine shaft

$R_e \geq 500$ N/mm^2

Surface roughness of machine shaft

$R_a \leq 3{,}2$ mm

Tolerance range for shaft diameter D_6

≤ Diameter 50 mm: k6

> Diameter 50 mm: m6

Keys to DIN 6885, sheet 1

Splined shaft profile to DIN 5480

Drawings and dimensions are not strictly binding. We reserve the right to make changes in line with technical progress.

Missing dimensions on request.

Dimensions (in mm)

Weights and oil volumes see page 16

2-st = 2-stage, 3-st = 3-stage, 4-st = 4-stage

Gearbox Size Type	D_1	D_2	D_3	D_4 H7	D_5 H7	D_6 2-st	D_6 3-st	D_6 4-st	D_7	D_8	L_1 2-st	L_1 3-st	L_1 4-st	L_2 2-st	L_2 3-st	L_2 4-st	L_3
0200 R	600	600	430	200	180						790						243
0220 T	610	735	460	220								870.5					288.5
0300 R	705	705	460	220	200		60				885		1038,		1039		262.5
0330 T	660	785	460	220	200							951	5				
0425 R	790	790	570	260	240						1010	1151					315
0600 T	885																
0615 R	900																
0870 R	990	900	650	290	260							1516					320
1100 R	1100	990	660	310	280					130		1188					
1500 R	1140	1100	770	360	330		80		180			1698			1502		
2300 R	1270								*	160							
2800 R	1365	1170	850	400	360				*			1727					350
3400 R	1550								*								
4600 R	1670								*								
5500 R	1770								*								
7000 R	1970								*								

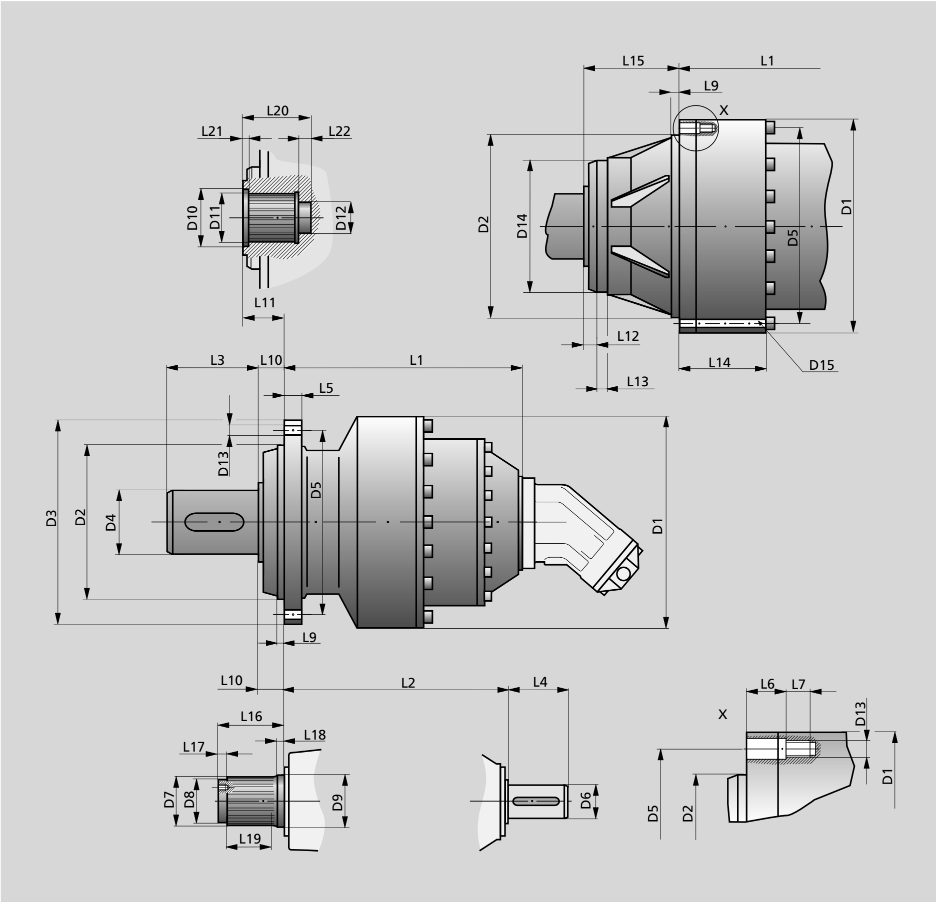
* on request

Gearbox Size Type	L_4 2-st	L_4 3-st	L_4 4-st	L_5	L_6	L_7	L_8	L_9	L_{10}	L_{11}	L_{12}	L_{13}	L_{14}	L_{15}	L_{16}	L_{17}	L_{18}
0200 R				600	120	1050	100	30			158	117	38				
0220 T				735	120	1050	100	30	140	155							
0300 R		85		705	140	1355	110	30			176	128	40				
0330 T											176	128	40				
0425 R				790	160	1460	120	40			201	150	43				
0600 T																	
0615 R				900	170	1765	130	50			216	164	46				
0870 R											216	164	46				
1100 R		140					160	50			247	198	42	2040	900	70	352.5
1500 R				1170	240	2230					275	235	21	2350	1000		
2300 R									*								
2800 R									*								
3400 R									*								
4600 R									*								
5500 R									*								
7000 R									*								

* on request

Dimensions

Type:
Flange-mounted Type, Coaxial Design
Internal Spline, Solid Shaft, Splined Shaft Profile



Tolerance range for shaft diameter D_6

≤ Diameter 50 mm: k6

> Diameter 50 mm: m6

Keys to DIN 6885, sheet 1

Splined shaft profile to DIN 5480

Internal spline to DIN 5480

Drawings and dimensions are not strictly binding. We reserve the right to make changes in line with technical progress.

Missing dimensions on request.

Dimensions (in mm)

Weights and oil volumes see page 20

2-st = 2-stage, 3-st = 3-stage, 4-st = 4-stage

Gearbox Size Type	D1	D2 h7	D3	D4 m6	D5	D6 2-st	D6 3-st	D6 4-st	D7	D8 k6	D9 k6	D10 H7	D11	D12 H7	D13	D14 h7	D15
0200 R	600	520			560	65						205	N 200x5x30x38x9H	180	30xM20x1.5		30xø22
0220 T	610	500	730		675							202	N 200x5x30x38x9H		30xø26		
0300 R	705	710	860		810	80						225	N 220x5x30x42x9H	200	36xø26		
0330 T									*								
0425 R									*								
0600 T									*								
0615 R									*								
0870 R									*								
1100 R									*								
1500 R									*								
2300 R									*								
2800 R									*								
3400 R									*								
4600 R									*								
5500 R									*								
7000 R									*								

* on request

Gearbox-Size Type	L1 2-st	L1 3-st	L1 4-st	L2 2-st	L2 3-st	L2 4-.	L3	L4 2-st	L4 3-st	L4 4-.	L5	L6	L7	L9	L10	L11	L12	L13	L14	L15	L16	L17	L18	L19	L20	L21	L22
0200 R				670	685			140				35	38	10		195			260						200	50	30
0220 T		750									41			10		157.									120	20	
0300 R			774	861				105			48			15		5									230	50	30
0330 T														*		155											
0425 R														*													
0600 T														*													
0615 R														*													
0870 R														*													
1100 R														*													
1500 R														*													
2300 R														*													
2800 R														*													
3400 R														*													
4600 R														*													
5500 R														*													
7000 R														*													

* on request

Weights and Oil Volumes

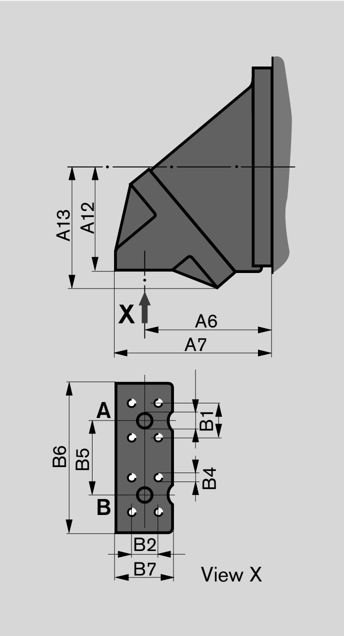
Gearbox Size Type	Shrink Disk and Torque Arm						Flange-mounted Type					
	2-stage		3-stage		4-stage		2-stage		3-stage		4-stage	
	Weight kg	Oil-Vol. l	Weight kg	Oil-Vol. l	Weight kg	Oil-Vol. l	Weight kg	Oil-Vol. l	Weight kg	Oil-Vol. l	Weight kg	Oil-Vol. l
0200 R	900	20.0					760	22.0	800	17.0		
0220 T			1075	20.0						30.0		
0300 R	1150	35.0	1450	30.0	1250	25.0	1050	35.0	1000		1100	25.0
0330 T			1350*	30.0								
0425 R	2050	50.0	2150	48.0								
0600 T												
0615 R			3100	50.0								
0870 R			4100	90.0								
1100 R			5700	140.0								
1500 R			6500	250.0								
2300 R							–					
2800 R							–					
3400 R							–					
4600 R							–					
5500 R							–					
7000 R							–					

The oil volume indicated applies to horizontal mounting position and mid-gearbox oil level.
Gearbox weights do not include oil filling and motor.
Weight and oil volume values are approximate.

* Design without torque arm

Corresponding Hydraulic Motors: Dimensions and Mass

Fixed-displacement Plug-in Motor A2FE, Series 61



Nominal	A6	A7	A12	A13	Mass (kg)
45	109	133	102	119	15
56	122	146	107	130	18
63	122	146	107	130	19
80	127	157	121	145	23
90	127	157	121	145	25
107	143	178	136	157	34
125	143	178	136	157	36
160	169	211	149	188	47
180	169	211	149	188	48
250 1)	*	230	*	172	*

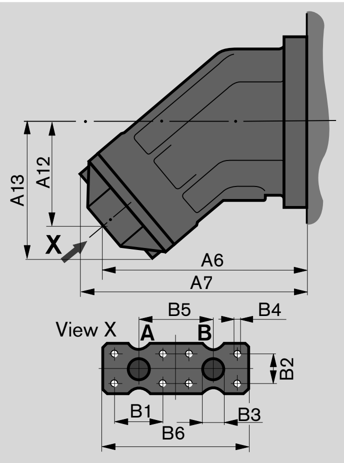
Nominal	B1	B2	B3	B4	B5	B6	B7	A / B
45	50.8	23.8	19	M10x17	75	147	49	SAE 3/4"
56 63	50.8	23.8	19	M10x17	75	147	49	SAE 3/4"
80 90	57.2	27.8	25	M12x17	84	166	60	SAE 1"
107 125	66.7	31.8	32	M14x19	99	194	70	SAE 11/4"
160 180	66.7	31.8	32	M14x19	99	194	70	SAE 11/4"
250 1)	*	*	*	*	*	*	*	*

1) Series 60

* Dimensions not indicated are available upon request

For further technical data see RE 91008

Fixed-displacement Motor A2FM, Series 61



Nominal	A6	A7	A12	A13	Mass (kg)
107 125	225.5	252	120	159	32
160 180	252	294	134	188	32
200 1)	284	309	84	165	45
250 2)	288	314	93	172	45

Nominal	B1	B2	B3	B4	B5	B6	A / B
107 125	66.7	31.8	32	M14x19	99	194	SAE 1 1/4"
160 180	66.7	31.8	32	M14x19	99	194	SAE 1 1/4"
200 1)	66.7	31.8	32	M14x19	99	204	SAE 1 1/4"
250 2)	66.7	31.8	32	M14x19	100	210	SAE 1 1/4"

1) Series 63

2) Series 60

For further technical data see RE 91001

Corresponding Hydraulic Motors: Dimensions and Mass

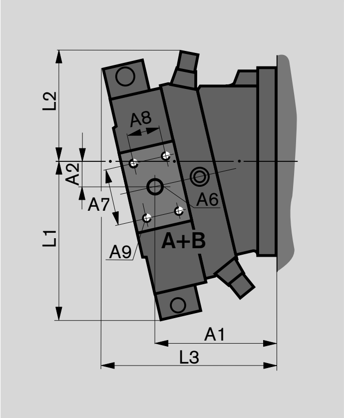
Variable-displacement Motor A6VE, Series 63

Nominal Size	A1	A2	L1 *	L2 *	L3 *	Mass (kg)
55	123	24	151	111	179	26
80	130	28	167	116	190	34
107	137	30	175	122	208	45
160	171	34	200	154	245	64
250	204	44	248	188	302	90

* Dimensions vary depending on displacement

Nominal Size	A6	A7	A8	A9	A / B
55	19	50.8	23.8	M10x17	SAE 3/4"
80	25	57.2	27.8	M12x17	SAE 1"
107	25	57.2	27.8	M12x17	SAE 1"
160	32	66.7	31.8	M14x19	SAE 11/4"
250	32	66.7	31.8	M14x19	SAE 11/4"

For further technical data see RE 91606



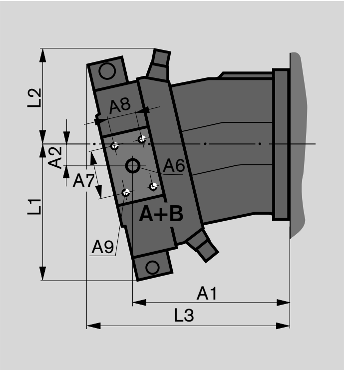
Variable-displacement Motor A6VM, Series 63

Nominal Size	A1	A2	L1 *	L2 *	L3 *	Mass (kg)
107	220	30	175	122	290	47
160	254	34	197	137	329	64
200	267	36	209	143	345	80
250	287	44	248	188	383	90

* Dimensions vary depending on displacement

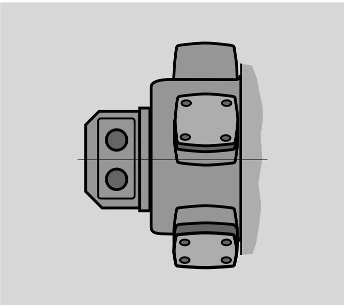
Nominal Size	A6	A7	A8	A9	A / B
107	25	57.2	27.8	M12x1.75	SAE 1"
160	32	66.7	31.8	M12x1.75	SAE 1 1/4"
200	32	66.7	31.8	M12x1.75	SAE 1 1/4"
250	32	66.7	31.8	M12x1.75	SAE 1 1/4"

For further technical data see RE 91604



Radial Piston Motor MR / MRE (on request)

For technical data see RE 15228



You wish to receive an offer?
REDULUS GMH / GME

To be able to quote, we require the following data from you:
Fax-No. +49 2302 877-148

Please attach drawings, sketches, notes, etc.

Person in charge: ____________________
Company: ____________________
Place: ____________________
Fax: ____________________
Telephone: ____________________
E-Mail: ____________________

Technical Data

Driven machine / application		____________	
Drive Unit		____________	
Drive power	P	______ kW ______	bar
Input speed	n_1	____________	min^{-1}
Output speed	n_2	____________	min^{-1}
Transmission ratio	i	____________	
Output torque	$T_{2\,Dauer}$	____________	Nm
Output torque, max.	$T_{2\,max.}$	____________	Nm
Duty factor	ED	____________	
Number of starts in succession, starting impact		____________	
Gearing calculation (e.g. DIN 3990 AGMA)		____________	
Service factor		____________	
Bearing life	Lh_{10}	____________	h
Ambient temperatures	t_u	____________	°C
External forces acting on input and output journals (radial, axial)	F_R	____________	N
	F_a	____________	N

Fig. 1

Gear unit mounting position (Fig. 1) ☐ H ☐ U ☐ O

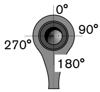
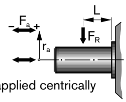


Fig. 2

Mounting position of reaction arm (Fig. 2) in case of shaft-mounted gearboxes (looking towards output shaft) ☐ 0° ☐ 90° ☐ 180° ☐ 270°

Additional forces on input and output shafts (Fig. 3)

F_a (kN)	r_a (mm)	F_R (kN)	L (mm)



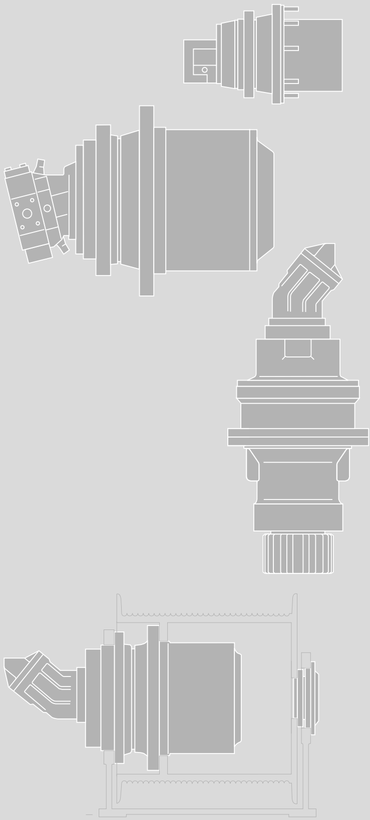
with load applied centrically
$r_a = 0$
Fig. 3

Budgeted annual requirement ____________
Estimated implementation period ____________
Special application conditions ____________
Further customer-specific requirements ____________
Are there any legal regulations and/or standards that must be observed?
☐ Yes ☐ No If yes, which: ____________

Remarks ____________

Date: ____________ Name: ____________ Dept.: ____________

Products for Mobile Applications



Planetary Gear Units for Mobile Applications

Hydrostatic Travel Drives

- HYDROTRAC GFT
  for fixed- or variable-displacement motor
  output torques between 9 and 450 kNm
  Technical Documentation RE 77110
- HYDROTRAC GFT
  with integrated hydraulic two-speed motor
- HYDROTRAC GFT
  for use on large tracklaying vehicles
  output torques up to 3250 kNm
  Upon request

Hydrostatic Swing Drives

- MOBILEX GFB
  for fixed- or variable-displacement motors
  output torques between 4 and 115 kNm
  Technical Documentation RE 77201
- MOBILEX GFB
  with swash-plate motor

Hydrostatic Winch Drives

- MOBILEX GFT – W
  for fixed- or variable-displacement motors
  output torques between 14 and 275 kNm
  Technical Documentation RE 77502

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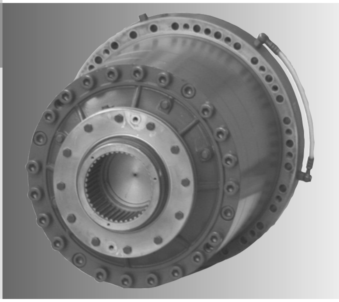
Planetary Gears
for Tunnel Boring Machines (TBM)
REDULUS GMH/GME

Data Sheet



Continuous output torques from 70 to 150 kNm

Contents

Features

- Compact, space-saving two- or three-stage planetary gearboxes
- Gears suited for optional mounting positions
- Variable input and output side configuration
- Gears can be powered by Rexroth hydraulic motors, direct attachment of electric motors possible
- Integrated water compartment for gear oil cooling
- High-grade seals installed on input and output side
- Integrated spring-loaded multiplate locking device

For further information see: www.boschrexroth.com/gears

Description

REDULUS GMH/GME planetary gears for tunnel boring machines (TBM) transform the rotational speed and torque of hydraulic or electric motors into the relevant output speed and torque rates required for cutting shield driving. They thus produce the necessary input torque and optimum speed needed for the rotation of the cutter head of tunnel boring machines.

Gearbox Design Types

Please refer to relevant information on page 3 of the present data sheet.

Hydraulic Motors

To make sure the hydraulic motor operates properly observe the instructions issued by the manufacturer.

Electric Motors (Direct Attachment)

This attachment method calls for an oil-tight motor design and the locating bearing of the motor bearing system is to be arranged on the side facing the gear.

Mounting Position

For proper and sufficient cooling and lubrication the gearboxes must be mounted in horizontal position.

Should other mounting positions be required this must expressly be specified in the project stage.

Gear Teeth

Spur and planetary gearwheels are straight-cut, case-hardened and ground as necessary. Annulus gears are quenched and tempered and nitrogen hardened. The gearteeth are fatigue resistant at nominal torque rates.

The design is based on established standard specifications such as, for instance, DIN 3990, ISO 6336 and AGMA.

Bearing System

Exclusively antifriction bearings of adequate size are used for gearwheels and shafts.

Seals and Gaskets

Included in the supply are radial seal rings on input and output shafts. They run on replaceable wear bushes.

Lubrication

The gears have a splash lubrication system.

In the event of inclined or vertical mounting situations suitable measures are taken with respect to lubrication.

Cooling

Up to the thermal limit heat dissipation for cooling takes place via the gearbox casing. If this limit is exceeded additional water coolers (integrated water chamber) are used.

In case of inclined or vertical mounting positions the Factory is to be consulted.

Other Notes

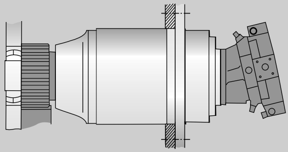
Statutory requirements provide that all rotating components must be provided with touch guards.

All safety regulations prescribed for the relevant mounting locations must be observed. Commissioning and maintenance of the gear units to be in line with the instructions provided in our operating manual.

Dimensions

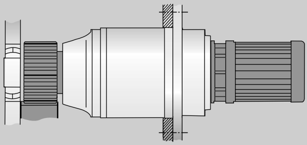
REDULUS GMH

Design A

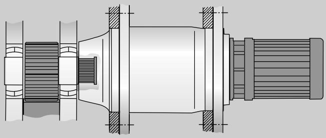


REDULUS GME

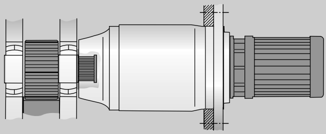
Design B



Design D



Design C

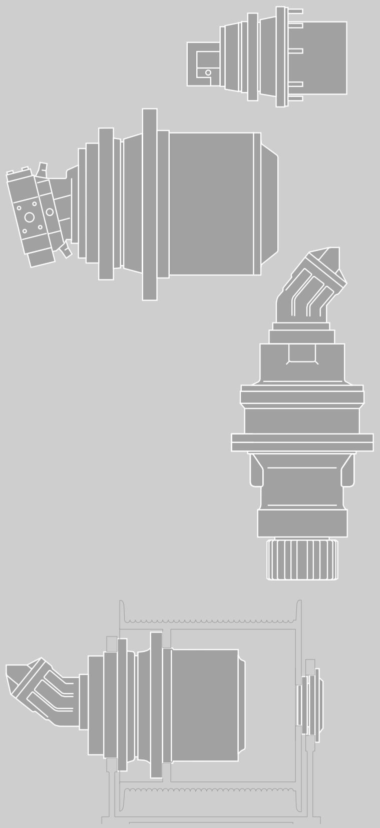


Technical Data

Type GMH / GME	Continuous Output Torque Nm	Motor attachment	Design type	Number of gear stages	Ratio i	D mm	L mm	Weight, appr. kg
GME 200 *	78,600	Electr. motor	C	2	28 - 36	740	805	1,150
GME 200 *	78,600	Electr. motor	D	2	47	740	805	1,150
GME 300 *	117,000	Electr. motor	C	2	28 - 47	820	900 / 820	1,500
GME 300 *	117,000	Electr. motor	D	3	87	740	89	1,500
GMH/GME 330	150,000	Hydr./electr. motor	A / B	3	113,9	780	1,141 / 1,170	1,500

* alternative with brake

Products
for Mobile Applications



Planetary Gear Units for Mobile Equipment

Hydrostatic Travel Drives

- HYDROTRAC GFT
  for fixed- or variable-displacement motors
  output torques between 9 and 450 kNm
  Data sheet RE 77110
- HYDROTRAC GFT 2160
  gear unit for crawler driven equipment
  output torque 42,5 kNm
  Data sheet RE 77125
- HYDROTRAC GFT-N
  for use in mining excavators and tracklaying cranes
  output torques between 600 and 1300 kNm
  Data sheet RE 77719
- HYDROTRAC GFT
  for use on large tracklaying vehicles
  output torques up to 3250 kNm
  On request

Hydrostatic Swing Drives

- MOBILEX GFB
  for fixed- or variable-displacement motors
  output torques between 4 and 115 kNm
  Data sheet RE 77201
- MOBILEX GFB 2160
  gear unit for slewing of the superstructure
  output torque 14,5 kNm
  Data sheet RE 77208

Hydrostatic Winch Gears

- MOBILEX GFT–W
  for fixed- or variable-displacement motors
  output torques between 14 and 275 kNm
  Data sheet RE 77502

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