

DOCUMENTATION

LSW-2 P25L B FLND160-10 BM5 615-60**Customer: Sumitomo Machinery Corp of America****Mat. no.: 2598102**

	Name	Signature	Date
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Checked	I. Shimelfarb		

List of contents

- 1 Part List**
- 2 Data Sheet**
- 3 Attachments / Drawings**

List of revisions

Revision	Date	Chapter	Remarks
0	7/7/2014	0-3	First revision

1 PART LIST

Item No.	Component	Pcs	Part Number
10	Motor/Pump Group	1	2597910
11	Motor	1	2587937
12	Bell Housing	1	2587969
13	Gear Pump	1	2586711
14	Pump Coupling	1	2588052
15	Motor Coupling	1	2588054
16	Spider Gear	1	2588053
20	Plate Heat Exchanger 615-60	1	2582239
30	Mounting Post	1	2950634
40	Heat Exchanger Bracket	2	3014029
50	FLND160 Filter Assembly	1	2074875
51	Filter Element 10 micron	2	1274539
80	Hose Assembly Pump To Filter	1	2950462
90	Hose Assembly Filter To HE	1	2598418

2 DATA SHEET

System:	LSW-2 P25L B FLND160-10 BM5 615-60
Mat. No.:	2598102

Motor/Pump group	MPG KF25 D15/184TC/2.0HP-6/230-460
Pump Data	
Flow Rate	7.6 GPM
Max Pressure	6 Bar
Max Viscosity	14000 cSt
Motor Data	
Voltage	230/460 V @ 60 Hz 3 Phase
Power	2 HP
Poles	6
Filter Data	FLND 160 Filter
Micron Rating	10 µm
Clogging Indicator	5 Bar Visual
Internal Bypass	7 Bar

For additional data for the components see datasheets / manuals in chapter 3

3 Attachments / Drawings

	Description
1	General Drawing System
2	Filter Manual
3	Motor Manual
4	Heat Exchanger Manual
5	Pump Manual

NOTES:

1. All dimensions shown are for reference and/or inspection only.

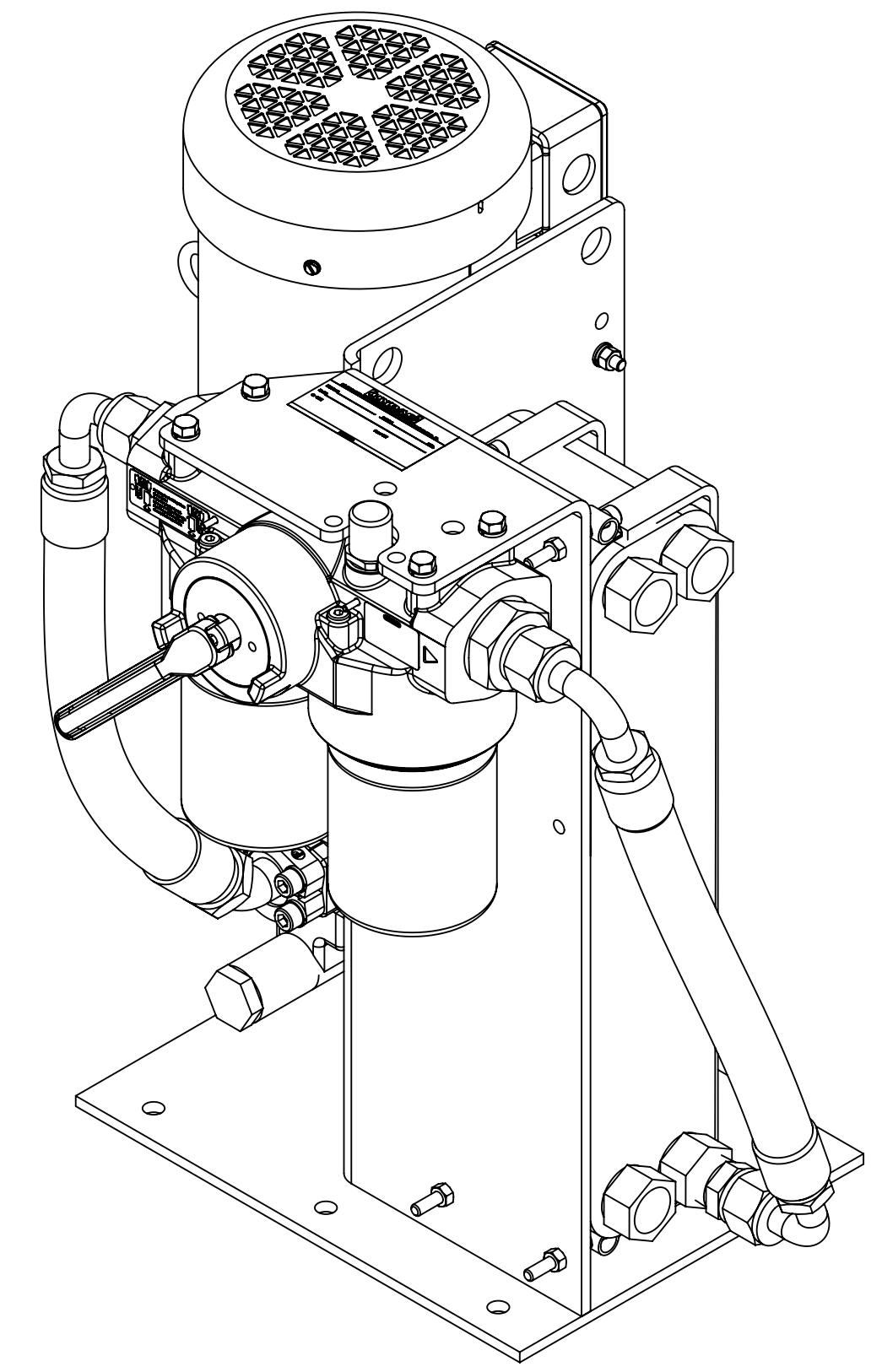
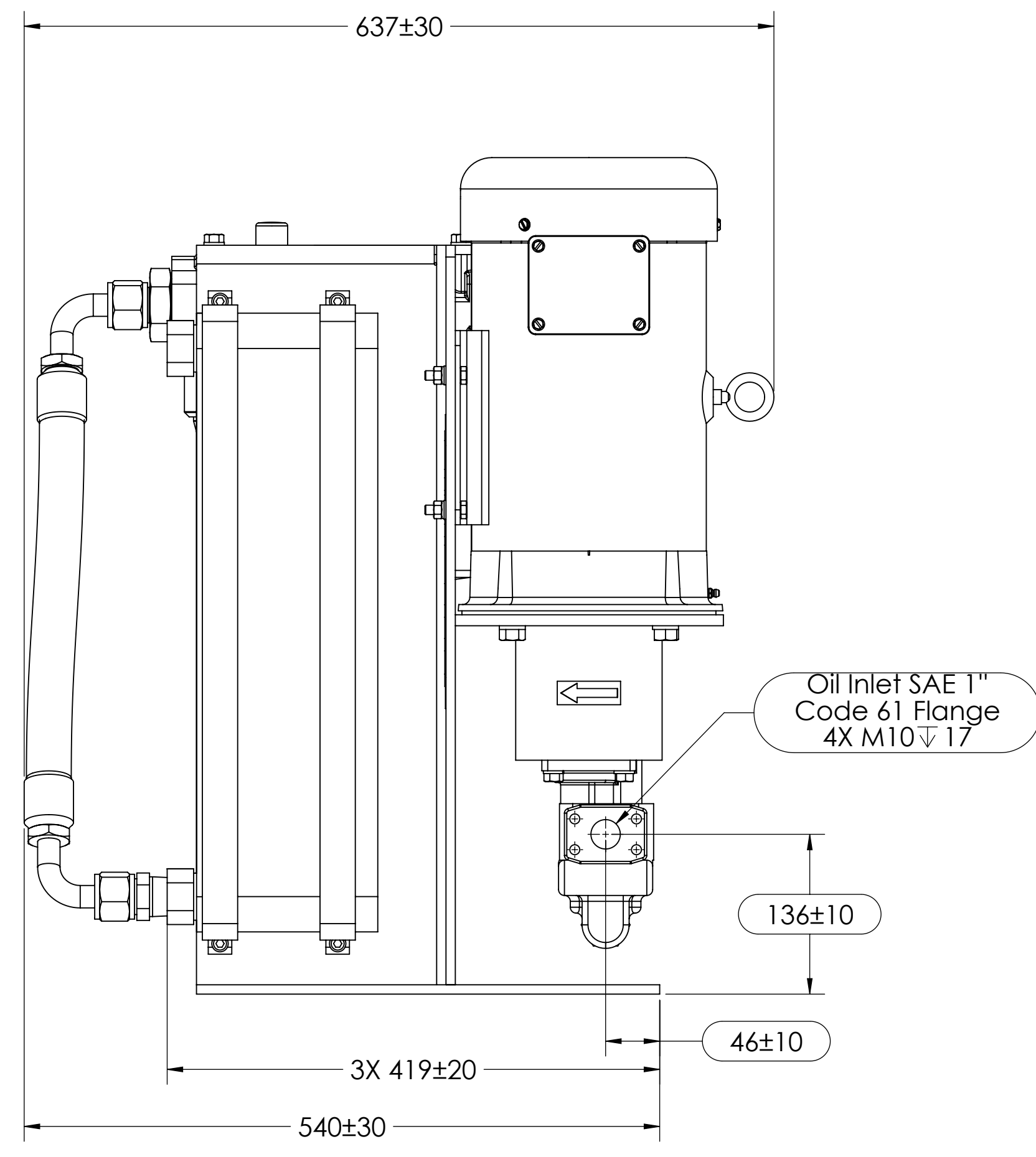
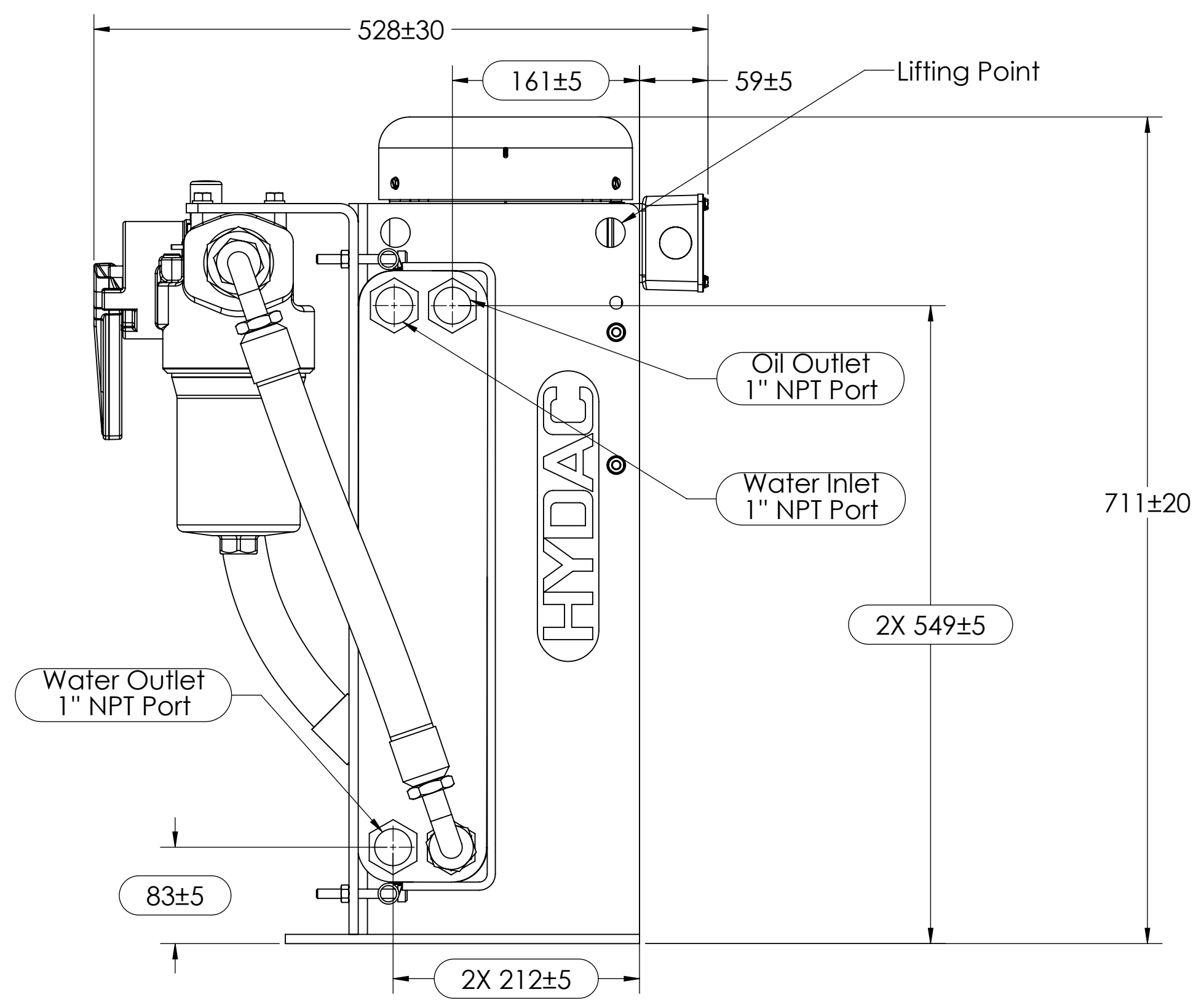
Motor
Power: 2 HP
Voltage: 230/460V @ 60 Hz
Poles: 6

Pump
Max Pressure: 6 bar
Flow: 7.5 GPM

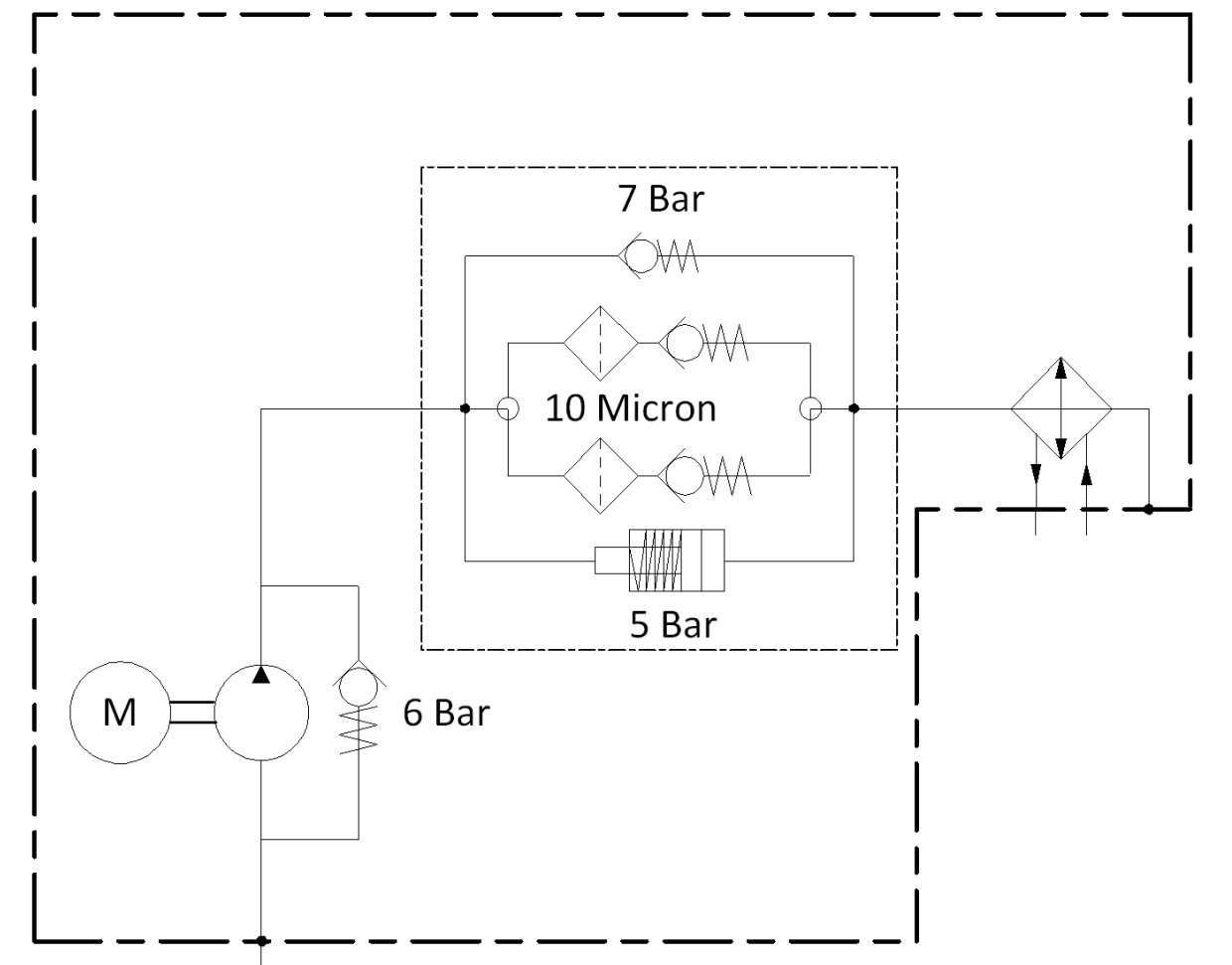
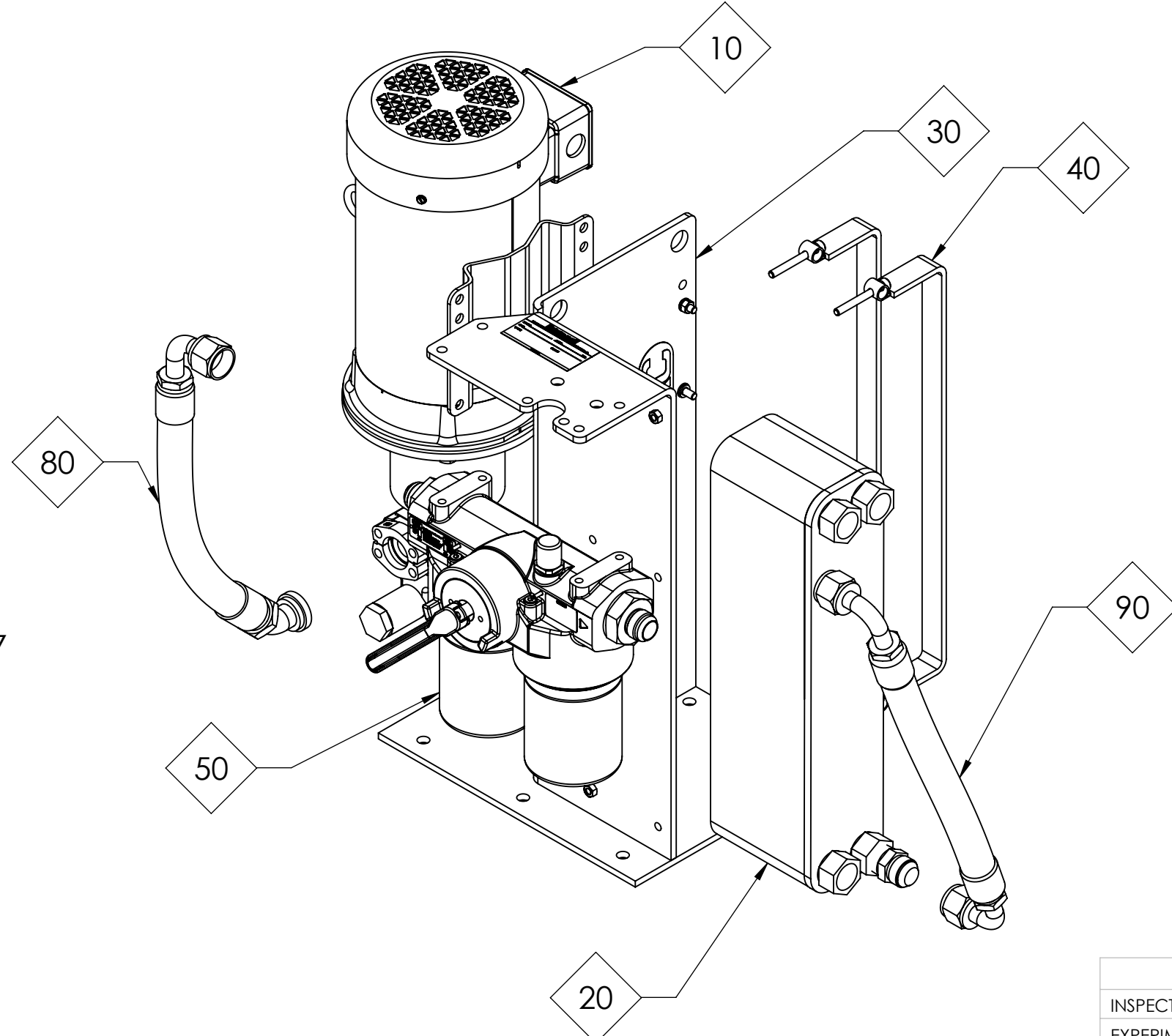
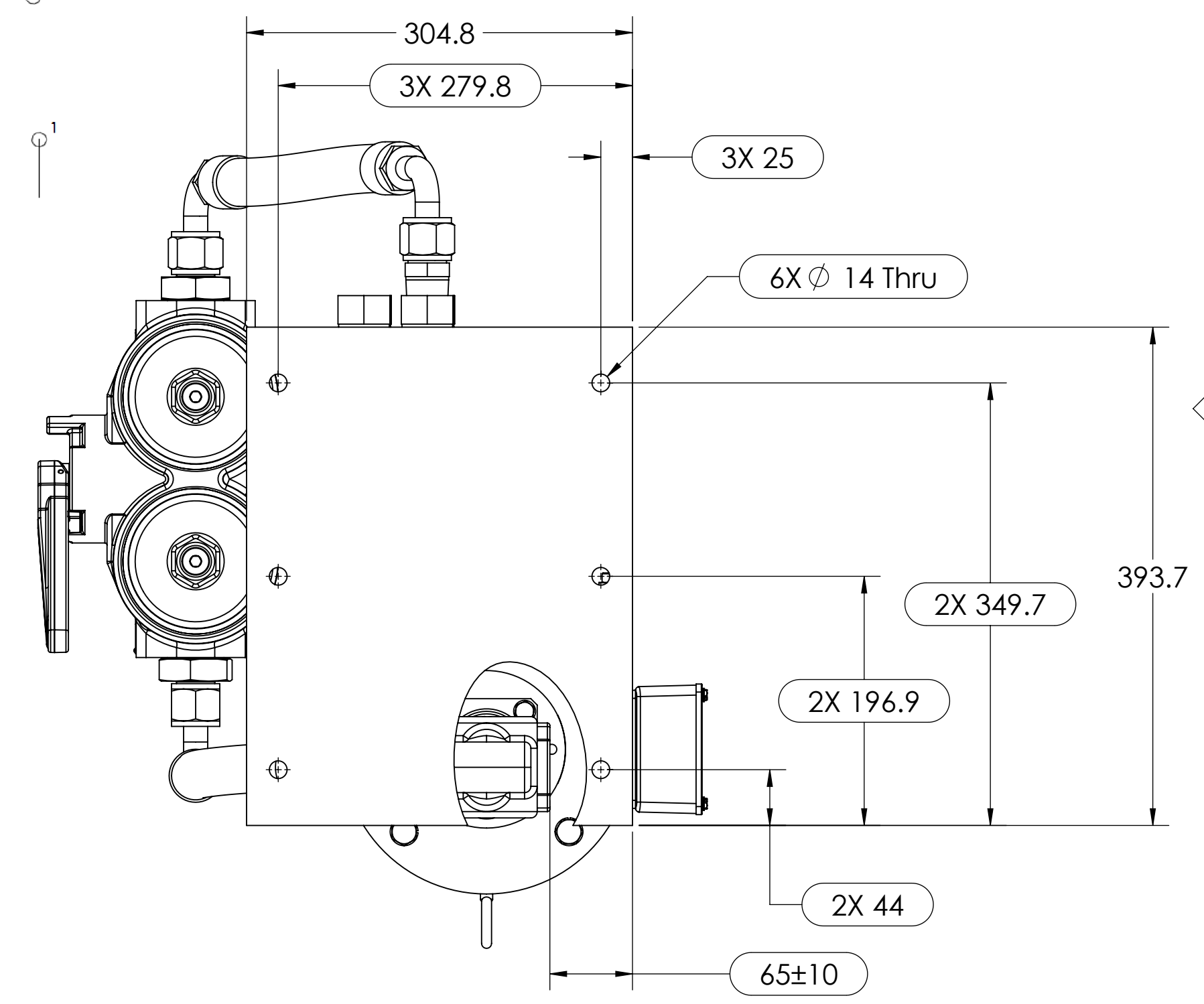
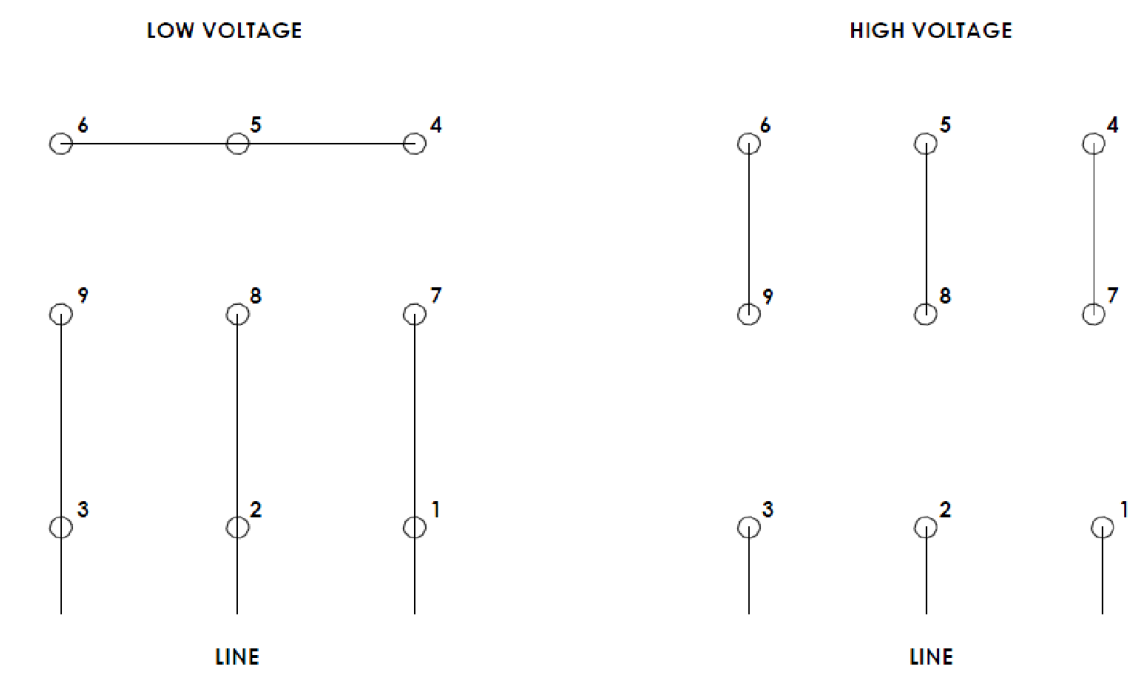
Filter
FLND160 with
absolute filtration 10 micron.

Max Viscosity:
14000cst

REVISIONS					
ZONE	REV.	ECN	DESCRIPTION	DATE	APPROVED
-	A	-	Initial Release	02/21/14	GG



MOTOR WIRING



SERVICE PARTS:

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
10	2597910	MPG-KF25-RF2-D15/S/184TC/2.0-6/230-460	1
20	2582239	Hex Plate HE 615-060	1
30	2950634	LS 2 Mounting Post	1
40	3014029	HEX HE Bracket 615	2
50	2074875	FLND Filter	1
80	2950462	Hose Assembly	1
90	2598418	Hose Assembly	1

TORQUE MATRIX:

ITEM	TORQUE (±10%)
90	80 Ft-Lbs
100	80 Ft-Lbs

UNCONTROLLED IF PRINTED

METRIC

INSPECTION DIMENSION: YES NO

EXPERIMENTAL DRAWING: No

PRODUCTION RELEASED DRAWING: Yes

UNLESS OTHERWISE SPECIFIED:

DIMENSIONS ARE IN MILLIMETERS (in)

ANGULAR ± 1 DEGREE

SURFACE FINISH: Ra 3.2 µm

BREAK EDGES: 12 - .05 mm

X ±.2

XX ±1.0

XXX ±0.50

DO NOT SCALE

DRAWN: GG 2/17/2014

CHECKED: B/JG 2/21/2014

APPROVED: ERN 2/25/2014

INTERPRET GEOMETRIC TOLERANCING PER: ASME Y14.5M

THIRD ANGLE PROJECTION

PROJECT:

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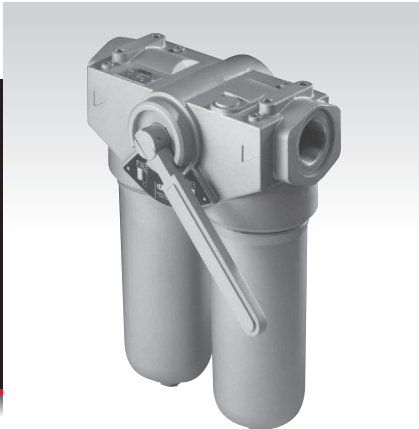
TITLE: LSW-2 P25L B FLND160 10 BM 5 615-60

REF: D

SIZE: DWG. NO. 2598102

Revision: A

SCALE: 1:10 WEIGHT: Kg SHEET 1 OF 3



Filters

FLND Series

Service and Parts

Index

1. General
- 1.4 Tools Required for Maintenance
- 1.5 Torque Requirements
2. Maintenance
3. Changing the Element
4. Spare Parts List
5. Replacement Element Model Code



This symbol is followed by user tips and particularly useful information.

- This pressure unit is for use with hydraulic power or lube systems only.
- All repair, maintenance, installation and commissioning work must be carried out by trained personnel.
- Operate this pressure unit in accordance with hydraulic power or lube system operating instructions.
- Ensure the pressure unit is sufficiently cool before handling.
- This pressure unit is suitable for use with hydraulic or lubricating fluids only.
- It is the responsibility of the operator to comply with local water regulations.

CAUTION!



This symbol denotes safety precautions, the non-observance of which can endanger persons and the environment.

- Filter bowl may be full of hot hydraulic fluid. Collect oil in a suitable container and dispose of properly.
- Observe proper venting procedures to avoid the formation of air pockets.
- Caution: Pressurized unit! Purge system pressure before performing any work on the pressure unit.
- Under no circumstances must any modifications (*welding, drilling, or opening by force...*) be carried out on the pressure unit. Any modifications will void the warranty.
- Statutory accident prevention regulations, safety regulations and safety data sheets for fluids must be observed.
- When working on or near hydraulic systems, avoid exposure to open flames and spark generating equipment. Do not smoke near equipment.
- Comply with all regulations with regard to the disposal of used oil and waste.
- Wear proper protective clothing and guards to avoid injury or scalding due to high pressure or high temperature oil.
- Filter housing must be grounded.
- Disconnect all electrical power to the system and other electrical components, prior to working on filter clogging indicators.

NOTE: All details subject to technical modification

1. General

1.1 Commitment to Quality

HYDAC demonstrates its commitment to quality through the implementation of an ISO 9001: 2008 program, which encompasses not only product design and manufacturing but service and delivery as well.

1.2. Installation

- Before installing the filter in the system, check that the operating pressure of the system does not exceed the maximum allowable operating pressure of the filter.
- Observe type code label on the filter!
- Important: When operating filters without bypass valve above 30 bar, high collapse BH/HC type filter elements must be used to ensure safe operation.

1.3. Commissioning

Unscrew bowl and check that the correct filter element is installed. Screw in bowl again fully and then unscrew by one quarter-turn (*the sealing effect will not be improved by overtightening!*) Switch on hydraulic system and check filter for leakage. Vent filter at an appropriate point in the system.

1.4. Tools Required for Maintenance

Size	Wrench size for filter bowl	Wrench size for clogging indicator
FLND 160/250/400	27 mm	27mm

1.5. Torque Values for Clogging Indicators

Type	Max. Torque
VM...	22 ft-lb
VD... LE/LZ	37 ft-lb

2. Maintenance

2.1. General

This section describes periodic maintenance requirements. Periodic and thorough maintenance will ensure operator safety and the life of the filter.

2.2. Maintenance Procedures

- Only high quality spare parts meeting the technical requirements specified by the manufacturer should be used, quality is always guaranteed with HYDAC original spare parts.
- Keep tools, working area and equipment clean.
- After disassembling the filter, clean all parts and check for damage or wear. Replace parts as required.
- When changing filter elements, a high level of cleanliness must be observed!
- Ultrasonic cleaning is used for cleaning Metal Fiber (V) and Wire Screen (W/HC) elements.

2.3. Interval Between Changing Elements

- To ensure optimum performance, HYDAC recommends replacing filter elements once a year.
- HYDAC recommends installing the filter with a clogging indicator (*visual and/or electric or electronic*) to monitor for excessive filter element pressure drop.
- If the clogging indicator trips, immediately change or clean the filter element. (*Only wire mesh and metal fiber elements can be cleaned*).
- If no clogging indicator is installed, HYDAC recommends changing elements at specified intervals (*depends on filter sizing and conditions*). Higher dynamic loads across the element might necessitate shorter intervals between changes. Shorter intervals can also be expected during commissioning, repairs, oil changes, etc. of the hydraulic system.

3. Changing the Element

3.1. Removing the Element

1. Establish which filter side is in operation – look at pictogram on the filter.
2. Pull the lever away from filter to equalize the pressure internally and turn the lever through 90° – the other filter side is now in operation.
3. Open oil drain plug on the filter side no longer operating.
(Warning: Make sure the off-line housing is depressurized!)
(Collect fluid in a suitable container and clean or dispose of it in accordance with environmental regulations.)
4. Unscrew bowl on the filter side which is to be cleaned.
5. Remove filter element from element location spigot in the filter head *(examine surface of element for dirt residue and larger particles; these can indicate damage to the components).*
6. Replace or clean filter element.
7. Clean bowl and head, paying particular attention to the screw threads.
8. Examine filter, especially sealing surfaces, for damage.
9. Check O-rings and replace parts as necessary.

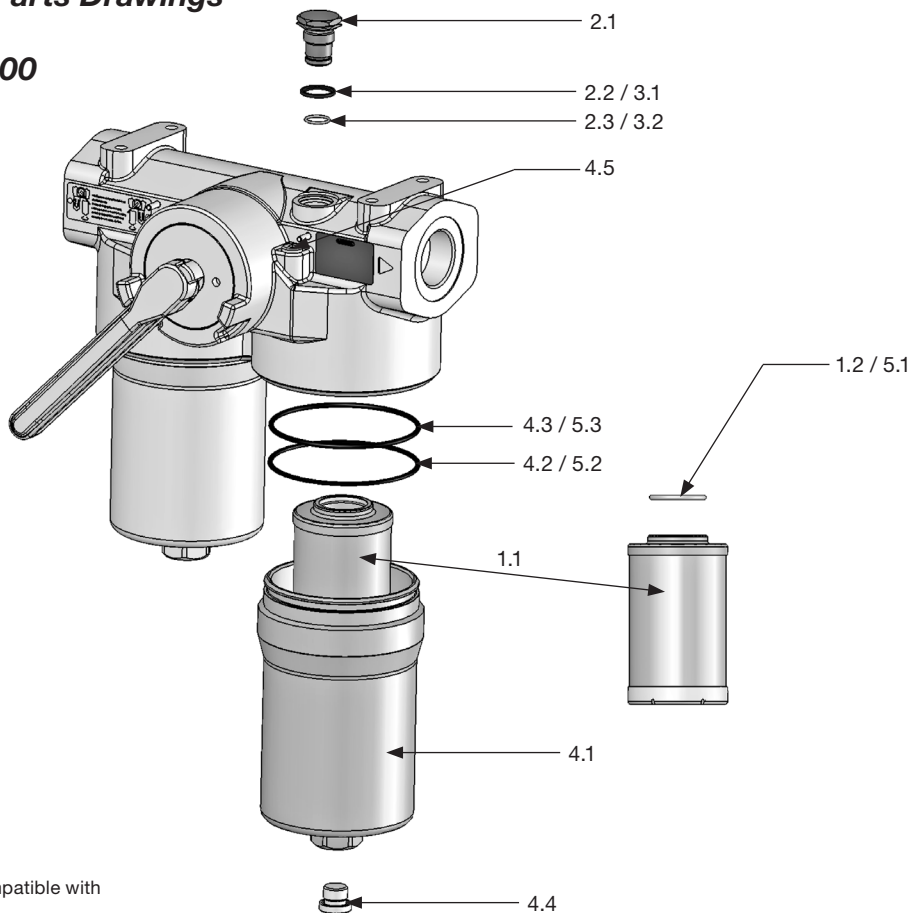
3.2. Fitting the Element

1. Lubricate sealing surfaces on the filter head and bowl, and the seals with clean operating fluid. Apply anti-seize compound to bowl elements.
2. When installing a new element, verify that the designation corresponds to that of the old element.
3. Place filter element carefully onto the element location spigot in the filter head.
4. Screw in bowl fully then unscrew by one quarter-turn.
5. Screw in oil drain plug.
6. Open vent plug on the filter side **not** in use.
(See pictogram on the filter)
7. Pull the lever away from the filter to fill the empty housing.
Caution: Do not rotate the handle.
8. Release handle when fluid appears at vent plug.
9. Tighten vent plug.
10. Lift handle, do not rotate, and check for leaks.

Note: Contamination or incomplete pressure release on disassembly can lead to seizing of the bowl thread. Filter elements which cannot be cleaned must be disposed of in accordance with environmental regulations.

4. Replacement Parts Drawings*

4.1. FLND 160 - 400

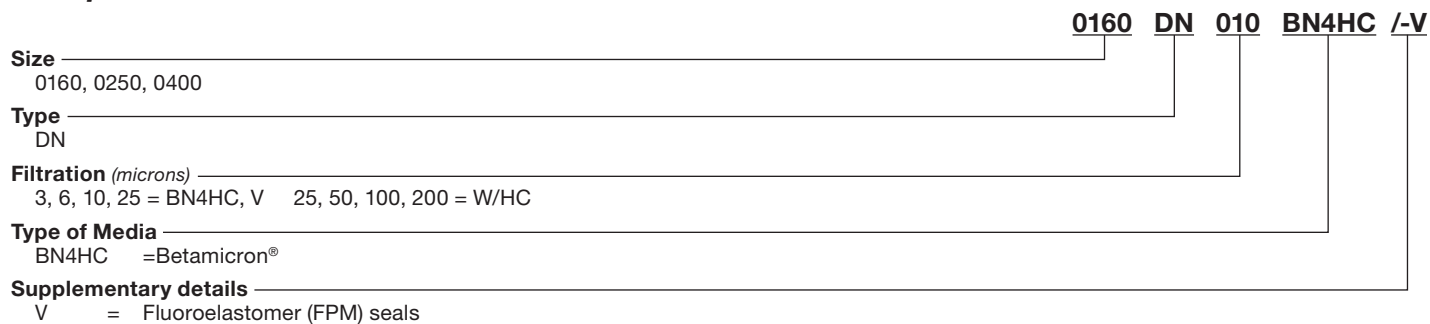


*Service components are compatible with older versions of FLND.

Item	Consists of	Designation	FLND 160	FLND 250	FLND 400
1.		Filter element	See point 5 Replacement elements		
	1.1	Filter element	On request		
	1.2	O-ring	40.87 x 3.53		
2.		Clogging indicator or indicator plug VD 0 A.1 VD 0 A.1 /-V	See Filter Clogging Indicator brochure		
	2.1	Indicator plug	00305932 00305931		
	2.2	Profile seal ring	VD...		
	2.3	O-ring	15 x 1.5		
3.		SEAL KIT-E VD	00319648		
		SEAL KIT-E VD /-V	00319638		
	3.1	Profile seal ring	VD		
	3.2	O-ring	15 x 1.5		
4.		BOWL E	01271028	01271030	01270601
		BOWL E /-V	01274800	01274801	01274950
	4.1	Bowl FLND	FLND		
	4.2	Back-up ring	FLN...		
	4.3	O-ring	102 x 3		
	4.4	Oil drain plug	G 3/8 NA		
	4.5	Vent screw	G 1/8 NA		
5.		SEAL KIT-E FLND...W.0	01271217		
		SEAL KIT-E FLND...W.0 /-V	01277068		
	5.1	O-ring (element)	40.87 x 3.53		
	5.2	Back-up ring (bowl)	FLN...		
	5.3	O-ring (bowl)	102 x 3		

Other spare parts available on request
Bold items can be ordered.

5. Replacement Element Model Code



6. NOTE

The information in this brochure relates to the operating conditions and applications described.
For applications or operating conditions not described, please contact the relevant technical department.
Subject to technical modifications.

Notes

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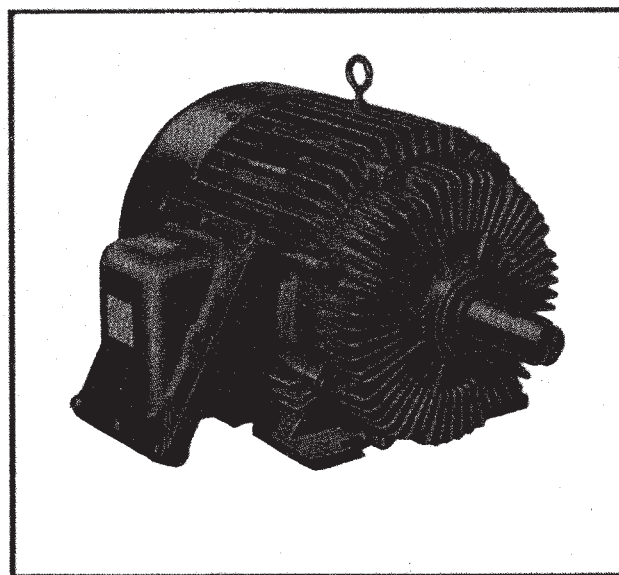
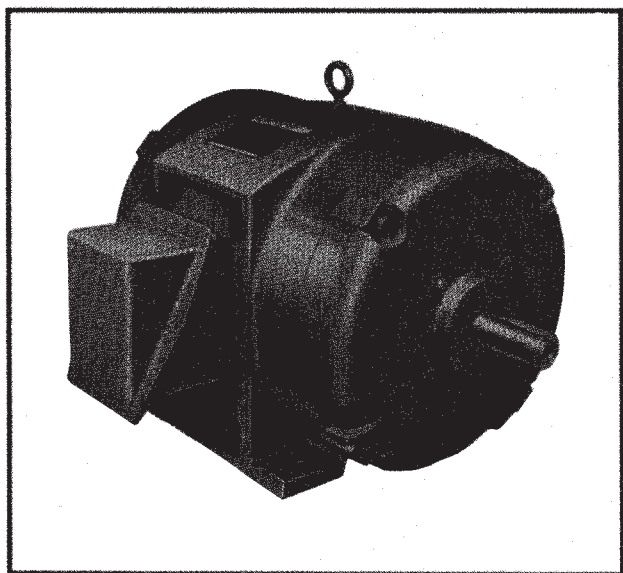
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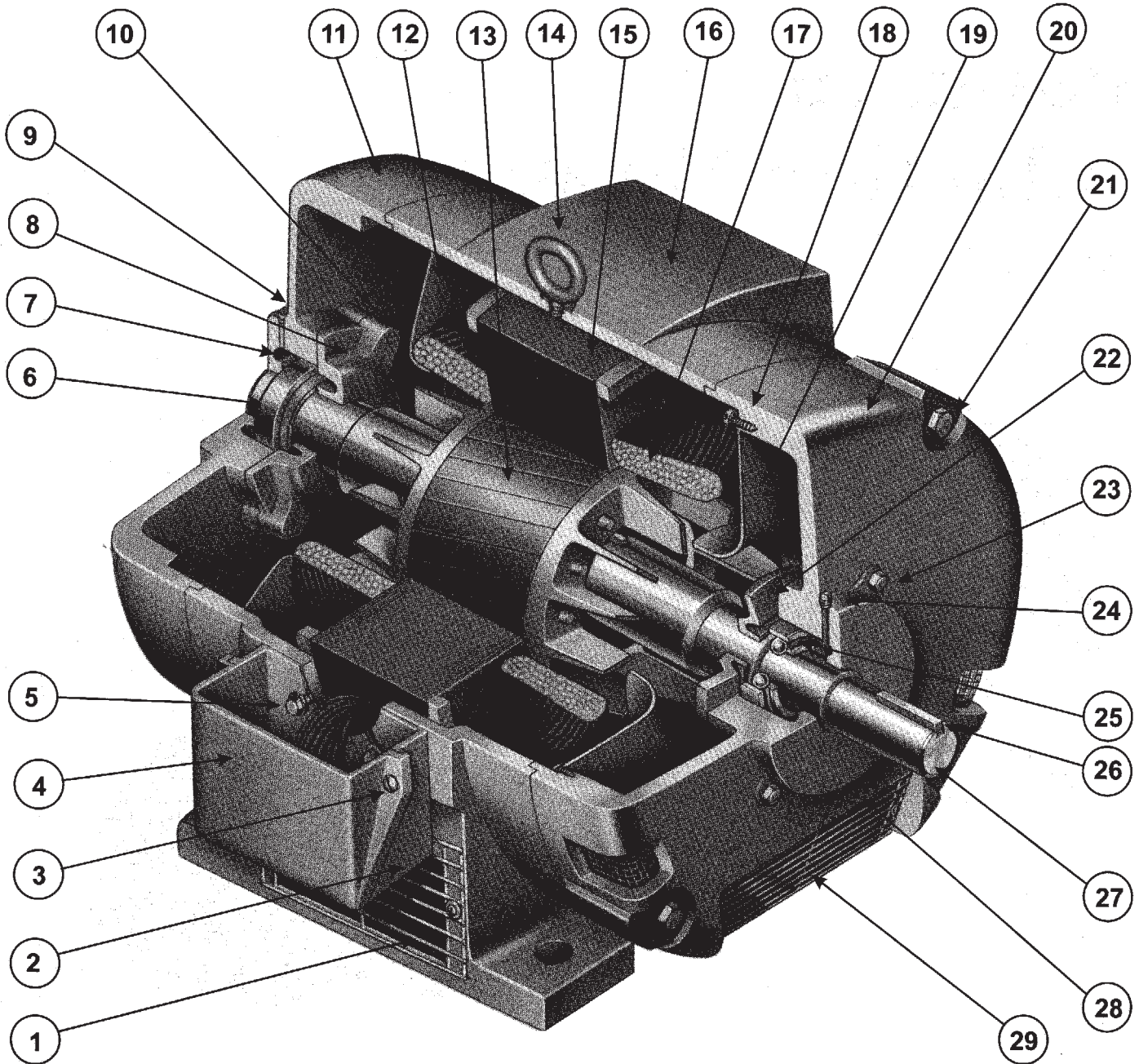


Standard Induction Motors



**Installation, Operation,
& Maintenance Instructions**

**TYPICAL CUTAWAY VIEW
OF A DRIPPROOF, HORIZONTAL
INTEGRAL HORSEPOWER MOTOR & PARTS DESCRIPTION
364 THRU 445 FRAME SIZE**



ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1.	** Frame Vent Screen	11.	Bracket O.P.E.	21.	Bracket Holding Bolt
2.	Conduit Box Bottom	12.	Baffle Plate O.P.E.	22.	Inner Bearing Cap P.E.
3.	Conduit Box Top-Holding Screw	13.	Rotor Core	23.	Inner Bearing Cap Bolt
4.	Conduit Box Top	14.	Lifting Eye Bolt	24.	Grease Plug
5.	Conduit Box Bottom-Holding Bolt	15.	Stator Core	25.	*Ball Bearing P.E.
6.	*Ball Bearing O.P.E.	16.	Frame	26.	Shaft Extension Key
7.	Pre-loading Spring	17.	Stator Winding	27.	Shaft
8.	Inner Bearing Cap O.P.E.	18.	Baffle Plate Holding Screw	28.	Drain Plug (grease)
9.	Grease Plug	19.	Baffle Plate P.E.	29.	**Bracket Screen
10.	Inner Bearing Cap Bolt	20.	Bracket P.E.		

P.E. = Pulley End

O.P.E. = Opposite Pulley End

* = Bearing Numbers are shown on motor nameplate when requesting information or parts always give complete motor description, model and serial numbers.

2 ** = Bracket and frame screens are optional.

WARNING

These instructions must be followed to ensure safe and proper installation, operation and maintenance of the motor. They should be brought to the attention of all persons who install, operate or maintain this equipment.

GENERAL INFORMATION

Motors are all fully factory tested and inspected before shipping. Damage during shipment and storage can occur. Motors not correctly matched to the power supply and/or the load will not operate properly. These instructions are intended as a guide to identify and eliminate these problems before they are overlooked or cause further damage.

ACCEPTANCE

Check carefully for any damage that may have occurred in transit. If any damage or shortage is discovered, do not accept until an appropriate notation on the freight bill is made. Any damage discovered after receipt of equipment should be immediately reported to the carrier.

STORAGE

- A. Keep motors clean
 1. Store indoors
 2. Keep covered to eliminate airborne dust and dirt.
 3. Cover openings for ventilation, conduit connections, etc. to prevent entry of rodents, snakes, birds, and insects, etc.
- B. Keep motors dry
 1. Store in a dry area indoors
 2. Temperature swings should be minimal to prevent condensation.
 3. Space heaters are recommended to prevent condensation.
 4. Treat unpainted flanges, shafts, and fittings with a rust inhibitor.
 5. Check insulation resistance before putting motor into service. (Consult manufacturer for guidelines).
- C. Keep Bearings Lubricated
 1. Once per month, rotate shaft several turns to distribute grease in bearings.
 2. If unit has been stored more than one year, add grease before start-up. (Refer to lubrication procedure).

INSTALLATION

UNCRATING AND INSPECTION

After uncrating, check for any damage which may have been incurred in handling. The motor shaft should turn freely by hand. Repair or replace any loose or broken parts before attempting to use the motor.

Check to be sure that motor has not been exposed to dirt, grit, or excessive moisture in shipment or storage before installation.

Measure insulation resistance (see operation). Clean and dry the windings as required.

Never start a motor which has been wet without having it thoroughly dried.

SAFETY

Motors should be installed, protected and fused in accordance with latest issue of National Electrical Code, NEMA Standard Publication No. MG 2 and local codes.

Eyebolts or lifting lugs are intended for lifting the motor only. These lifting provisions should never be used when lifting or handling the motor with other equipment (i.e. pumps, gear boxes, fans or other driven equipment) as a single unit. Be sure the eyebolt is fully threaded and tight in its mounting hole.

Eyebolt lifting capacity ratings is based on a lifting alignment coincident with the eyebolt centerline. Eyebolt capacity reduces as deviation from this alignment increases. See NEMA MG 2.

Frames and accessories of motors should be grounded in accordance with National Electrical Code (NEC) Article 430. For general information of grounding refer to NEC Article 250.

Rotating parts such as pulleys, couplings, external fans, and shaft extensions should be permanently guarded.

LOCATION

In selecting a location for the motor, consideration should be given to environment and ventilation. A motor with the proper enclosure for the expected operating condition should be selected.

The ambient temperature of the air surrounding the motor should not exceed 40°C (104°F) unless the motor has been especially designed for high ambient temperature applications. The free flow of air around the motor should not be obstructed.

The motor should never be placed in a room with a hazardous process, or where flammable gases or combustible material may be present, unless it is specifically designed for this type of service.

1. Dripproof (open) motors are intended for use indoors where atmosphere is relatively clean, dry and non-corrosive.
2. Totally enclosed motors may be installed where dirt, moisture and corrosion are present, or in outdoor locations.
3. Explosion proof motors are built for use in hazardous locations as indicated by Underwriters' label on motor. Consult UL, NEC, and local codes for guidance.

Refer to manufacturer for application assistance.

FLOOR MOUNTING

Motors should be provided with a firm, rigid foundation, with the plane of four mounting pads flat within .010" for 56 to 210 frame; .015" from 250 through 500 frame. This may be accomplished by shims under the motor feet. For special isolation mounting, contact manufacturer for assistance.

V-BELT DRIVE

1. Select proper type and number of belts and sheaves. Excessive belt load will damage bearings. Sheaves should be in accordance to NEMA Spec. MG-1 or as approved by the manufacturer for a specific application.
2. Align sheaves carefully to avoid axial thrust on motor bearing. The drive sheave on the motor should be positioned toward the motor so it is as close as possible to the bearing.

- When adjusting belt tension, make sure the motor is secured by all mounting bolts before tightening belts.
- Adjust belt tension to belt manufacturers recommendations. Excessive tension will decrease bearing life.
- For more information see Publication SB528.

DIRECT CONNECTED DRIVE

Flexible or solid shaft couplings must be properly aligned for satisfactory operation. On flexible couplings, the clearance between the ends of the shafts should be in accordance with the coupling manufacturer's recommendations or NEMA standards for end play and limited travel in coupling.

MISALIGNMENT and RUN-OUT between direct connected shafts will cause increased bearing loads and vibration even when the connection is made by means of a flexible coupling. Excessive misalignment will decrease bearing life. Proper alignment, per the specifications of the coupling being used, is critical.

Some large motors are furnished with roller bearings. Roller bearings should **not** be used for direct drive.

ELECTRICAL CONNECTIONS

CAUTION

Install and ground per local and national codes. Consult qualified personnel with questions or if repairs are required.

WARNING

- Disconnect power before working on motor or driven equipment.
- Motors with automatic thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.
- Motors with manual thermal protectors may start unexpectedly after protector trips. If manual protector trips, disconnect motor from power line. After protector cools (five minutes or more) it can be reset and power may be applied to motor.
- Discharge all capacitors before servicing motor.
- Always keep hands and clothing away from moving parts.
- Never attempt to measure the temperature rise of a motor by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector, or thermocouple.
- Electrical repairs should be performed by trained and qualified personnel only.
- Failure to follow instructions and safe electrical procedures could result in serious injury or death.
- If safety guards are required, be sure the guards are in use.

- All wiring, fusing, and grounding must comply with National Electrical Codes and local codes.
- To determine proper wiring, rotation and voltage connections, refer to the information and diagram on the nameplate, separate connection plate or decal. If the plate or decal has been removed, contact manufacturer for assistance.
- Use the proper size of line current protection and motor controls as required by the National Electrical Code and local codes. Recommended use is 125% of full load amps as shown on the nameplate for motors with 40°C ambient

and a service factor over 1.0. Recommended use is 115% of full load amps as shown on the nameplate for all other motors. Do not use protection with larger capacities than recommended. Three phase motors must have all three phases protected.

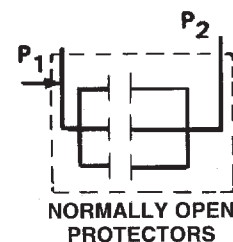
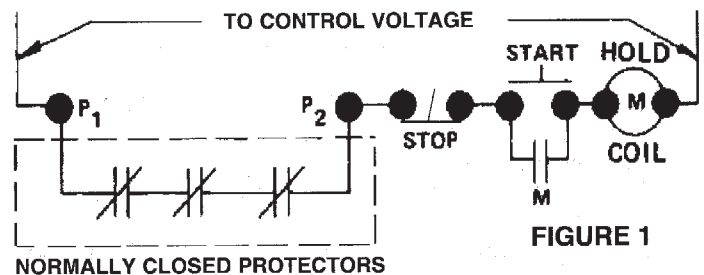
THERMAL PROTECTOR INFORMATION

The nameplate will indicate one of the following:

- Motor is thermally protected
- Motor is not thermally protected
- Motor is provided with overheat protective device

For examples, refer to paragraphs below:

- Motors equipped with built-in thermal protection have "THERMALLY PROTECTED" stamped on the nameplate. Thermal protectors open the motor circuit electrically when the motor overheats or is overloaded. The protector cannot be reset until the motor cools. If the protector is automatic, it will reset itself. If the protector is manual, press the red button to reset.
- Motors without thermal protection have nothing stamped on nameplate about thermal protection.
- Motors that are provided with overheat protective device that does not open the motor circuit directly will indicate "WITH OVERHEAT PROTECTIVE DEVICE".
 - Motors with this type of "Overheat Protective Device" have protector leads brought out in the motor conduit box marked "P1" and "P2". These leads are intended for connection in series with the stop button of the 3-wire pilot circuit for the magnetic starter which controls the motor. See Figure 1.
 - The circuit controlled by the above "Overheat Protective Device" must be limited to a maximum of 600 volts and 360 volt-amps.



Normally Open (N/O) Motor Thermostats may be used in conjunction with controls installed by Original Equipment Manufacturers.

FIGURE 1A

CHANGING ROTATION

- Keep hands and clothing away from rotating parts.
- Before the motor is coupled to the load, determine proper rotation.
- Check rotation by jogging or bumping. Apply power to the motor leads for a short period of time, enough to just get motor shaft to rotate a slight amount to observe shaft rotating direction.
- Three phase - interchange any two (2) of the three (3) line leads. Single phase - reconnect per the connection diagram on the motor.

REDUCED VOLTAGE STARTING

Motors used on reduced voltage starting, should be carefully selected based upon power supply limitations and driven load requirements. The motors starting torque will be reduced when using reduced voltage starting. The elapsed time on the start step should be kept as short as possible and should not exceed 5 seconds. It is recommended that this time be limited to 2 seconds. Refer to manufacturer for application assistance.

OPERATION

WARNING

Disconnect and lock out before working on motor or driven equipment.

BEFORE INITIAL STARTING

1. If a motor has become damp in shipment or in storage, measure the insulation resistance of the stator winding.

$$\text{Minimum Insulation Resistance} \quad \text{Rated Voltage} \\ \text{In Megohms} \quad = 1 + \frac{1000}{\text{Rated Voltage}}$$

Do not attempt to run the motor if the insulation resistance is below this value.

2. If insulation resistance is low, dry out the moisture in one of the following ways:
 - a. Bake in oven at temperature not more than 90°C (194°F).
 - b. Enclose motor with canvas or similar covering, leaving a hole at the top for moisture to escape, and insert heating units or lamps.
 - c. Pass a current at low voltage (rotor locked) through the stator winding. Increase the current gradually until the winding temperature, measured with a thermometer, reaches 90°C (194°F). Do not exceed this temperature.
3. See that voltage and frequency stamped on motor and control nameplates correspond with that of the power line.
4. Check all connections to the motor and control with the wiring diagram.
5. Be sure rotor turns freely when disconnected from the load. Any foreign matter in the air gap should be removed.
6. Leave the motor disconnected from the load for the initial start (see following caution). Check for proper rotation. Check for correct voltage (within ± 10% of nameplate value) and that it is balanced within 1% at the motor terminals. After the machine is coupled to the load, check that the nameplate amps are not exceeded. Recheck the voltage level and balance under load per the above guidelines.

Shut down the motor if the above parameters are not met or if any other noise or vibration disturbances are present. Consult NEMA guidelines or the equipment manufacturer if any questions exist before operating equipment.

CAUTION

For motors nameplated as "belted duty only", do not run motor without belts properly installed.

COLLECTOR RINGS (Wound Rotor Motors Only)

The collector rings are sometimes treated at the factory to protect them while in stock and during shipment. The brushes have been fastened in a raised position. Before putting the motor into service, the collector rings should be cleaned to remove this treatment. Use a cleaning fluid that is made for degreasing electrical equipment. All of the brushes must be released and lowered to the collector surface. Keep the rings clean and maintain their polished surfaces. Ordinarily, the rings will require only occasional wiping with a piece of canvas or non-linting cloth. Do not let dust or dirt accumulate between the collector rings.

BRUSHES (Wound Rotor Motors Only)

See that the brushes move freely in the holders and at the same time make firm, even contact with the collector rings. The pressure should be between 2 and 3 pounds per square inch of brush surface.

When installing new brushes, fit them carefully to the collector rings. Be sure that the copper pigtail conductors are securely fastened to, and make good contact with, the brushholders.

ALLOWABLE VOLTAGE AND FREQUENCY RANGE

If voltage and frequency are within the following range, motors will operate, but with somewhat different characteristics than obtained with correct nameplate values.

1. Voltage: Within 10% above or below the value stamped on the nameplate. On three phase systems the voltage should be balanced within 1%. A small voltage unbalance will cause a significant current unbalance.
2. Frequency: Within 5% above or below the value stamped on the nameplate.
3. Voltage and Frequency together: Within 10% (providing frequency above is less than 5%) above or below values stamped on the nameplate.

CLEANLINESS

Keep both the interior and exterior of the motor free from dirt, water, oil and grease. Motors operating in dirty places should be periodically disassembled and thoroughly cleaned.

CONDENSATION DRAIN PLUGS

All explosion proof and some totally enclosed motors are equipped with automatic drain plugs, they should be free of oil, grease, paint, grit and dirt so they don't clog up. The drain system is designed for normal floor (feet down) mounting. For other mounting positions, modification of the drain system may be required, consult manufacturer.

SERVICE

WARNING

Disconnect power before working on motor or driven equipment. Motors with automatic thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.

CAUTION

Overgreasing bearings can cause premature bearing and/or motor failure. The amount of grease added should be carefully controlled.

NOTE

If lubrication instructions are shown on the motor nameplate, they will supersede this general instruction.

Motors are pregreased with a polyurea mineral oil NGLI grade 2 type grease unless stated otherwise on the motor nameplate. Some compatible brands of polyurea mineral base type grease are: Chevron SRI #2, Rykon Premium #2, Exxon Polyrex EM or Texaco Polystar RB.

Motors are properly lubricated at the time of manufacture. It is not necessary to lubricate at the time of installation unless the motor has been in storage for a period of 12 months or longer (refer to lubrication procedure that follows).

LUBRICATION PROCEDURES

1. Stop motor. Disconnect and lock out of service.
2. Remove contaminants from grease inlet area.
3. Remove filler and drain plugs.
4. Check filler and drain holes for blockage and clean as necessary.
5. Add proper type and amount of grease. See the Relubrication Time Intervals table for service schedule and Relubrication Amounts table for volume of grease required.
6. Wipe off excess grease and replace filler and drain plugs (see following warning).
7. Motor is ready for operation.

WARNING

If motor is nameplated for hazardous locations, do not run motor without all of the grease or drain plugs installed.

RELUBRICATION TIME INTERVAL AND AMOUNTS

(For motors with regreasing provisions).

Service Condition	NEMA FRAME SIZE					
	140-180		210-360		400-510	
	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM
Standard	3 yrs.	6 months	2 yrs.	6 months	1 yr.	3 months
Severe	1 yr.	3 months	1 yr.	3 months	6 months	1 month
Seasonal	See Note 2.					

NOTE

1. For motors nameplated as "belted duty only" divide the above intervals by 3.
2. Lubricate at the beginning of the season. Then follow service schedule above.

SEASONAL SERVICE: The motor remains idle for a period of 6 months or more.

STANDARD SERVICE: Up to 16 hours of operation per day, indoors, 100°F maximum ambient.

SEVERE SERVICE: Greater than 16 hours of operation per day. Continuous operation under high ambient temperatures (100° to 150°F) and/or any of the following: dirty, moist locations, high vibration (above NEMA standards), heavy shock loading, or where shaft extension end is hot.

RELUBRICATION AMOUNTS

(For motors with regreasing provisions).

NEMA FRAME SIZE	VOLUME cu. in. (fluid oz.)
140	.25 (.14)
180	.50 (.28)
210	.75 (.42)
250	1.00 (.55)
280	1.25 (.69)
320	1.50 (.83)
360	1.75 (.97)
400	2.25 (1.2)
440	2.75 (1.5)
500	3.00 (1.7)

TROUBLESHOOTING

WARNING

1. Disconnect power before working on motor or driven equipment.
2. Motors with automatic thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.
3. Motors with manual thermal protectors may start unexpectedly after protector trips. If manual protector trips, disconnect motor from power line. After protector cools (five minutes or more) it can be reset and power may be applied to motor.
4. Discharge all capacitors before servicing motor.
5. Always keep hands and clothing away from moving parts.
6. Never attempt to measure the temperature rise of a motor by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector, or thermocouple.
7. Electrical repairs should be performed by trained and qualified personnel only.
8. Failure to follow instructions and safe electrical procedures could result in serious injury or death.
9. If safety guards are required, be sure the guards are in use.

If trouble is experienced in the operation of the motor, make sure that:

1. The bearings are in good condition and operating properly.
2. There is no mechanical obstruction to prevent rotation in the motor or in the driven load.
3. The air gap is uniform. (Consult manufacturer for specifications).
4. All bolts and nuts are tightened securely.
5. Proper connection to drive machine or load has been made.

In checking for electrical troubles, be sure that:

1. The line voltage and frequency correspond to the voltage and frequency stamped on the nameplate of the motor.
2. The voltage is actually available at motor terminals.
3. The fuses and other protective devices are in proper condition.
4. All connections and contacts are properly made in the circuits between the control apparatus and motor.

These instructions do not cover all details or variations in equipment nor provide for every possible condition to be met in connection with installation, operation or maintenance. Should additional information be desired for the purchaser's purposes, the matter should be referred to the manufacturer.

MOTOR TROUBLE SHOOTING CHART

Your motor service and any trouble shooting must be handled by qualified persons who have proper tools and equipment.

TROUBLE	CAUSE	WHAT TO DO
Motor fails to start	Blown fuses	Replace fuses with proper type and rating
	Overload trips	Check and reset overload in starter.
	Improper power supply	Check to see that power supplied agrees with motor nameplate and load factor.
	Improper line connections	Check connections with diagram supplied with motor.
	Open circuit in winding or control switch	Indicated by humming sound when switch is closed. Check for loose wiring connections. Also see that all control contacts are closing.
	Mechanical failure	Check to see if motor and drive turn freely. Check bearings and lubrication.
	Short circuited stator	Indicated by blown fuses. Motor must be rewound.
	Poor stator coil connection	Remove end bells, locate with test lamp.
	Rotor defective	Look for broken bars or end rings.
Motor may be overloaded	Reduce load.	
Motor stalls	One phase may be open	Check lines for open phase.
	Wrong application	Change type or size. Consult manufacturer.
	Overload	Reduce load.
	Low voltage	See that nameplate voltage is maintained. Check connection.
	Open circuit	Fuses blown, check overload relay, stator and pushbuttons.
Motor runs and then dies down	Power failure	Check for loose connections to line, to fuses and to control.
Motor does not come up to speed	Not applied properly	Consult supplier for proper type.
	Voltage too low at motor terminals because of line drop.	Use higher voltage on transformer terminals or reduce load. Check connections. Check conductors for proper size.
	Starting load too high	Check load motor is supposed to carry at start.
	Broken rotor bars or loose rotor	Look for cracks near the rings. A new rotor may be required as repairs are usually temporary.
	Open primary circuit	Locate fault with testing device and repair.
Motor takes too long to accelerate and/or draws high amp	Excessive load	Reduce load.
	Low voltage during start	Check for high resistance. Adequate wire size.
	Defective squirrel cage rotor	Replace with new rotor.
	Applied voltage too low	Get power company to increase power tap.
Wrong rotation	Wrong sequence of phases	Reverse connections at motor or at switchboard.
Motor overheats while running under load	Overload	Reduce load.
	Frame or bracket vents may be clogged with dirt and prevent proper ventilation of motor.	Open vent holes and check for a continuous stream of air from the motor.
	Motor may have one phase open	Check to make sure that all leads are well connected.
	Grounded coil	Locate and repair.
	Unbalanced terminal voltage	Check for faulty leads, connections and transformers.
Motor vibrates	Motor misaligned	Realign.
	Weak support	Strengthen base
	Coupling out of balance	Balance coupling.
	Driven equipment unbalanced	Rebalance driven equipment.
	Defective bearings	Replace bearing.
	Bearings not in line	Line up properly.
	Balancing weights shifted	Rebalance motor.
	Polyphase motor running single phase	Check for open circuit.
Excessive end play	Adjust bearing or add shim.	
Unbalanced line current on polyphase motors during normal operation	Unequal terminal volts	Check leads and connections.
	Single phase operation	Check for open contacts.
	Unbalanced voltage	Correct unbalanced power supply.
Scraping noise	Fan rubbing air shield	Remove interference.
	Fan striking insulation	Clear fan.
	Loose on bedplate	Tighten holding bolts.
Noisy operation	Airgap not uniform	Check and correct bracket fits or bearing.
	Rotor unbalance	Rebalance.
Hot bearings general	Bent or sprung shaft	Straighten or replace shaft.
	Excessive belt pull	Decrease belt tension.
	Pulleys too far away	Move pulley closer to motor bearing.
	Pulley diameter too small.	Use larger pulleys.
	Misalignment	Correct by realignment of drive.
Hot bearings ball	Insufficient grease	Maintain proper quantity of grease in bearing.
	Deterioration of grease or lubricant contaminated	Remove old grease, wash bearings thoroughly in kerosene and replace with new grease.
	Excess lubricant	Reduce quantity of grease, bearing should not be more than 1/2 filled.
	Overloaded bearing	Check alignment, side and end thrust.
	Broken ball or rough races	Replace bearing, first clean housing thoroughly.

Lubrication Instructions For Ball Bearing Motors

Lubrication

This motor is supplied with pre-lubrication ball bearings. No lubrication required before start up.

Relubrication Intervals

The following intervals are suggested as a guide:

SUGGESTED RELUBRICATION INTERVALS		
HOURS OF SERVICE PER YEAR	H.P. RANGE	RELUBE INTERVAL
5,000	Sub Fractional to 7 1/2 10 to 40 50-200	5 Years 3 Years 1 Year
Continuous Normal Applications	Sub Fractional to 7 1/2 10 to 40 50 to 200	2 Years 1 Year 9 Months
Season Service Motor Idle 6 Months or More	All	1 Year (Beginning of Season)
Continuous High Ambients Dirty or Moist Locations High Vibrations Where Shaft End is Hot (Pumps-Fans)	Sub Fractional to 40 50 to 200	6 Months 3 Months

Lubrication

Use high quality ball bearing lubricant. Use consistency of lubricant suitable for class of insulation stamped on nameplate as follows:

LUBRICATION CONSISTENCY				
INSULATION CLASS	CONSISTENCY	TYPE	TYPICAL LUBRICATION	FRAME TYPE
B & F F & H	Medium	Polyurea	Shell Dolium R and/or Chevron SR1 2	Sub Fractional to 447T All

Procedure

If motor is equipped with Alemite fitting, clean tip of fitting and apply grease gun. Use 1 to 2 full strokes on motors in NEMA 215T frame and smaller. Use 2 to 3 strokes on NEMA 254T thru NEMA 365 T frame. Use 3 to 4 strokes on NEMA 404T frames and larger. On motors having drain plugs, remove drain plug and operate motor for 20 minutes before replacing drain plug.

On motors equipped with slotted head grease screw, remove screw and apply grease tube to hole. Insert 2 to 3 inch length of grease string into each hole on motors in NEMA 215T frame and smaller. Insert 3 to 5 inch length on larger motors. For motors having drain plug and operate motor for 20 minutes before replacing drain plug.

CAUTION: Keep lubricant clean. Lubricate motors at standstill. remove and replace drain plugs at standstill. Do not mix petroleum lubricant and silicone lubricant in motor bearings.



ELECTRIC MOTORS, GEARMOTORS AND DRIVES

LEESON ELECTRIC

GRAFTON, WISCONSIN 53024-0241 U.S.A.
TEL (262)377-8810 FAX (262)377-9025 www.leeson.com

A Subsidiary of Regal-Beloit Corporation

Installation Maintenance Instructions

AC Induction Motors

Installation

After unpacking, check for damage. Be sure that shaft rotates freely. Before making electrical power connections, check for proper grounding of motor and application. All electrical contacts and connections must be properly insulated and enclosed. Couplings, belts, chains or other mounted devices must be in proper alignment, balance and secure to insure safe motor operation.

Electrical Wiring

Prior to connecting to the power line, check nameplate for proper voltage and rotation connection. This motor should be installed in compliance with the National Electrical Code and any other applicable codes. Voltage at motor not to exceed + or -10% of nameplate. Authorized person should make all electrical connections.

Mounting

This motor should be securely mounted to the application. Sufficient ventilation area should be provided to insure proper operation.

RECOMMENDED COPPER WIRE & TRANSFORMER SIZE

SINGLE PHASE MOTORS - 230 VOLTS						
H.P.	TRANSFORMER KVA	DISTANCE - MOTOR TO TRANSF. IN FT.				
		100	150	200	300	500
1 1/2	3	10	8	8	6	4
2	3	10	8	8	6	4
3	5	8	8	6	4	2
5	7 1/2	6	4	4	2	0
7 1/2	10	6	4	3	1	0

THREE PHASE MOTORS - 230 & 460 VOLTS							
H.P.	VOLTS	TRANSFORMER KVA	DISTANCE - MOTOR TO TRANSF. IN FT.				
			100	150	200	300	500
1 1/2	230	3	12	12	12	12	10
1 1/2	460	3	12	12	12	12	12
2	230	3	12	12	12	10	8
2	460	3	12	12	12	12	12
3	230	5	12	10	10	8	6
3	460	5	12	12	12	12	10
5	230	7	10	8	8	6	4
5	460	1/2	12	12	12	10	8
7 1/2	230	7 1/2	8	6	6	4	2
7 1/2	460	10	12	12	12	10	8
10	230	10	6	4	4	4	1
10	460	15	12	12	12	10	8
15	230	15	4	4	4	2	0
15	460	20	12	10	10	8	6
20	230	20	4	2	2	1	000
20	460		10	8	8	6	4
25	230		2	2	2	0	000
25	460	Consult	8	8	6	6	4
30	230	Local	2	1	1	00	0000
30	460	Power	8	6	6	4	2
40	230	Company	1	0	00	0000	300
40	460		6	6	4	2	0
50	230		1	0	00	0000	300
50	460		4	4	2	2	0
60	230		1	00	000	250	500
60	460		4	2	2	0	00
75	230		0	000	0000	300	500
75	460		4	2	0	00	000





ELECTRIC MOTORS
GEARMOTORS AND DRIVES

Motor Trouble-Shooting Chart

Caution:

1. Disconnect power to the motor before performing service or maintenance.
2. Discharge all capacitors before servicing motor.
3. Always keep hands and clothing away from moving parts.
4. Be sure required safety guards are in place before starting equipment.

<u>Problem:</u>	<u>Like Causes:</u>	<u>What To Do:</u>
Motor fails to start upon initial installation.	Motor is miswired. Motor damaged and rotor is striking stator. Fan guard bent and contacting fan.	Verify motor is wired correctly. May be able to reassemble; otherwise, motor should be replaced. Replace fan guard.
Motor has been running, then fails to start.	Fuse or circuit breaker tripped. Stator is shorted or went to ground. Motor will make a humming noise and the circuit breaker or fuse will trip. Motor overloaded or load jammed. Capacitor (on single phase motor) may have failed. Starting switch has failed.	Replace fuse or reset the breaker. Disassemble motor and inspect windings and internal connections. A blown stator will show a burn mark. Motor must be replaced or the stator rewound. Inspect to see that the load is free. Verify amp draw of motor versus nameplate rating. First discharge capacitor. To check capacitor, set volt-ohm meter to RX100 scale and touch its probes to capacitor terminals. If capacitor is OK, needle will jump to zero ohms, and drift back to high. Steady zero ohms indicates a short circuit; steady high ohms indicates an open circuit. Disassemble motor and inspect both the centrifugal and stationary switches. The weights of the centrifugal switch should move in and out freely. Make sure that the switch is not loose on the shaft. Inspect contacts and connections on the stationary switch. Replace switch if the contacts are burned or pitted.
Motor runs but dies down.	Voltage drop. Load increased.	If voltage is less than 10% of the motor's rating contact power company or check if some other equipment is taking power away from the motor. Verify the load has not changed. Verify equipment hasn't got tighter. If fan application verify the air flow hasn't changed.
Motor takes too long to accelerate.	Defective capacitor Faulty stationary switch. Bad bearings. Voltage too low.	Test capacitor per previous instructions. Inspect switch contacts and connections. Verify that switch reeds have some spring in them. Noisy or rough feeling bearings should be replaced. Make sure that the voltage is within 10% of the motor's nameplate rating. If not, contact power company or check if some other equipment is taking power away from the motor.
Motor runs in the wrong direction.	Incorrect wiring.	Rewire motor according to wiring schematic provided.
Motor overload protector continually trips.	Load too high. Ambient temperature too high. Protector may be defective. Winding shorted or grounded.	Verify that the load is not jammed. If motor is a replacement, verify that the rating is the same as the old motor. If previous motor was a special design, a stock motor may not be able to duplicate the performance. Remove the load from the motor and inspect the amp draw of the motor unloaded. It should be less than the full load rating stamped on the nameplate. Verify that the motor is getting enough air for proper cooling. Most motors are designed to run in an ambient temperature of less than 40°C. (Note: A properly operating motor may be hot to the touch.) Replace the motor's protector with a new one of the same rating. Inspect stator for defects, or loose or cut wires that may cause it to go to ground.

Motor Trouble-Shooting Chart

10/13/00 (continued)

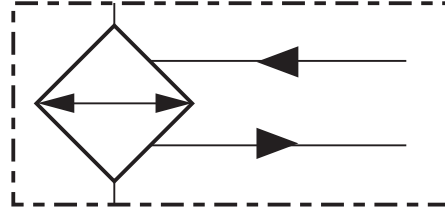
Problem:	Like Causes:	What To Do:
<p>Motor vibrates.</p>	<p>Motor misaligned to load.</p> <p>Load out of balance. (Direct drive application.)</p> <p>Motor bearings defective.</p> <p>Rotor out of balance.</p> <p>Motor may have too much endplay.</p> <p>Winding may be defective.</p>	<p>Realign load.</p> <p>Remove motor from load and inspect motor by itself. Verify that motor shaft is not bent. Rule of thumb is .001" runout per every inch of shaft length.</p> <p>Test motor by itself. If bearings are bad, you will hear noise or feel roughness. Replace bearings. Add oil if a sleeve of bearing. Add grease if bearings have grease fittings.</p> <p>Inspect motor by itself with no load attached. If it feels rough and vibrates but the bearings are good, it may be that the rotor was improperly balanced at the factory. Rotor must be replaced or rebalanced.</p> <p>With the motor disconnected from power turned shaft. It should move but with some resistance. If the shaft moves in and out too freely, this may indicate a preload problem and the bearings may need additional shimming.</p> <p>Test winding for shorted or open circuits. The amps may also be high. Replace motor or have stator rewind.</p>
<p>Bearings continuously fail.</p>	<p>Load to motor may be excessive or unbalanced.</p> <p>High ambient temperature.</p>	<p>Besides checking load, also inspect drive belt tension to ensure it's not too tight may be too high. An unbalanced load will also cause the bearings to fail.</p> <p>If the motor is used in a high ambient, a different type of bearing grease may be required. You may need to consult the factory or a bearing distributor.</p>
<p>The motor, at start up, makes a loud rubbing or grinding noise.</p>	<p>Rotor may be striking stator.</p>	<p>Ensure that motor was not damaged in shipment. Frame damage may not be repairable. If you cannot see physical damage, inspect the motor's rotor and stator for strike marks. If signs of rubbing are present, the motor should be replaced. Sometimes simply disassembling and reassembling motor eliminates rubbing. Endbells are also sometimes knocked out of alignment during transportation.</p>
<p>Start capacitors continuously fail.</p>	<p>The motor is not coming up to speed quickly enough.</p> <p>The motor is being cycled too frequently.</p> <p>Voltage to motor is too low.</p> <p>Starting switch may be defective, preventing the motor from coming out of start winding.</p>	<p>Motor may not be sized properly. Verify how long the motor takes to come up to speed, Most single phase capacitor start motors should come up to speed within three seconds. Otherwise the capacitors may fail.</p> <p>Verify duty cycle. Capacitor manufacturers recommend no more than 20, three-second starts per hour. Install capacitor with higher voltage rating, or add bleed resistor to the capacitor.</p> <p>Verify that voltage to the motor is within 10% of the nameplate value. If the motor is rated 208-230V, the deviation must be calculated from 230V.</p> <p>Replace switch.</p>
<p>Run capacitor fail.</p>	<p>Ambient temperature too high.</p> <p>Possible power surge to motor, caused by lightning strike or other high transient voltage.</p>	<p>Verify that ambient does not exceed motor's nameplate value.</p> <p>If a common problem, install surge protector.</p>

HYDAC Plate Heat Exchangers

HEX Series Plate Heat Exchangers



Hydraulic Symbol



AIB cooler element bypass option for high viscosity applications.

Description

Heat exchangers are used to exchange heat between two fluids. Plate heat exchangers are high performance components and provide a high level of efficiency combined with compact dimensions and low weight. Their efficiency reduces the amount of cooling water required for heat transfer which results in low operating costs.

Features

Plates and connections are manufactured from stainless steel to AISI 316, 1.4401, vacuum-brazed with copper. The special moulding of the plates produces the turbulent flow necessary for effective heat transfer and provides the plate heat exchanger with a high level of mechanical strength.

Operating Details

Medium:

- Water glycol (*coolants*)
- HFC operating fluids
- Water
- Oil

Contamination:

The quantity of particles in suspension should be less than 10 mg/l. Particle size < 0.6 mm (*spherical*).

Thread-like particles cause a rapid rise in pressure drops.

Temperature Range:

- 50° to 437°F (10° to 225°C)
(*freezing point and boiling point must be taken into consideration!*)

Pressure:

- max. 49 psi (3 bar) (*static*) up to 257°F (125°C)
- max. 435 psi (30bar) (*static*) up to 437° (225°C)
- Test pressure: 650 psi

Corrosion:

The following limits refer to a pH value of 7

- free chlorine, CL2 < 0.5 ppm
- chloride ions CL
< 700 ppm at 20 °C
< 200 ppm at 50 °C

Other Limits:

- ph 7 – 10
- sulphate SO4 2- <100 ppm
- [H CO3 -] / [SO4 2-] >1
- ammonia, NH3 <10 ppm
- free CO < 10 ppm

The following ions are not corrosive under normal conditions: phosphate, nitrate, nitrite, iron, manganese, sodium and potassium

Applications



Agricultural



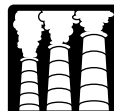
Automotive



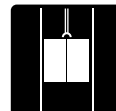
Construction



Gearboxes



Industrial



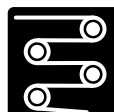
Elevators



Commercial
Municipal



Power
Generation



Pulp & Paper



Railways



Shipbuilding



Steel / Heavy
Industry

Plate Heat Exchangers **HYDAC**

Model Code

HEX 610 - 10 C 27

Series

HEX 610
HEX 615
HEX 422

Number of Plates

	10	20	30	40	50	60	70	80	100	120
610	x	x	x	x	x	x	x		x	x
615	x	x	x	x	x	x		x		
422		x	x	x	x	x		x	x	

Connections

CB 27	=	1" NPT Female X 4] (size 610 only)
C 71	=	1" BSPP Female X 4	
CB 52	=	1" NPT Female X 4] (size 615 only)
C 71	=	1" BSPP Female X 4	
CB 76	=	1 1/2" NPT Female X 4] (size 422 only)
C 72	=	1 1/2" BSPP Female X 4	

Pipes must be connected so that the connections are stress free.

Linear expansion and vibrations from the pipes to the heat exchanger must be avoided.

Pressure drop across heat exchanger

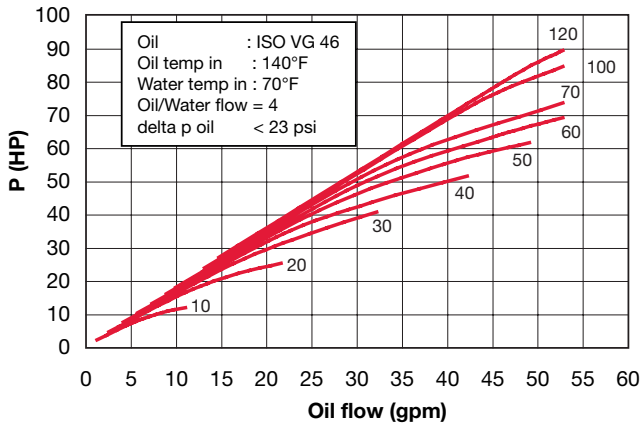
This table is based on an ISO VG45 oil at 130°F and shows the pump flows with the 1,800 RPM motors. If other grades of oil are to be used, consult the sizing software. When using the 72 psi clogging indicator the pressure drop should not exceed 15 psi max across the heat exchanger. When using the 29 psi clogging indicator the pressure drop should not exceed 30 psi max across the heat exchanger.

Heat Exchanger Size	Pump 3.5 1.6 gpm (6.3 l/min)	Pump 7 3.3 gpm (12.6 l/min)	Pump 10 4.75 gpm (18 l/min)	Pump 15 7 gpm (18 l/min)	Pump 20 9.5 gpm (18 l/min)	Pump 30 14.5 gpm (55 l/min)	Pump 40 18.5 gpm (70 l/min)	Pump 50 23.5 gpm (90 l/min)	Pump 70 34 gpm (130 l/min)	Pump 100 47.5 gpm (180 l/min)
610-10	3	5	8	-	-	-	-	-	-	-
610-20	1	2	3	5	7	13.66	-	-	-	-
610-40	-	-	-	2	3	7.35	9.85	13.4	-	-
610-50	-	-	-	-	-	5.64	7.54	10.27	16.19	-
610-70	-	-	-	-	-	4.1	5.2	7	11.1	16.8
610-100	-	-	-	-	-	3	3.8	4.9	7.6	11.66
610-120	-	-	-	-	-	2.55	3.25	4.2	6.35	9.8
615-10	4	9	15	-	-	-	-	-	-	-
615-20	2	3.3	5	9	13	-	-	-	-	-
615-40	-	-	-	4	5	13.25	17.8	-	-	-
615-60	-	-	-	-	-	8.15	10.8	14.75	-	-
615-80	-	-	-	-	-	5.95	7.75	10.5	16.6	-

HEX Series

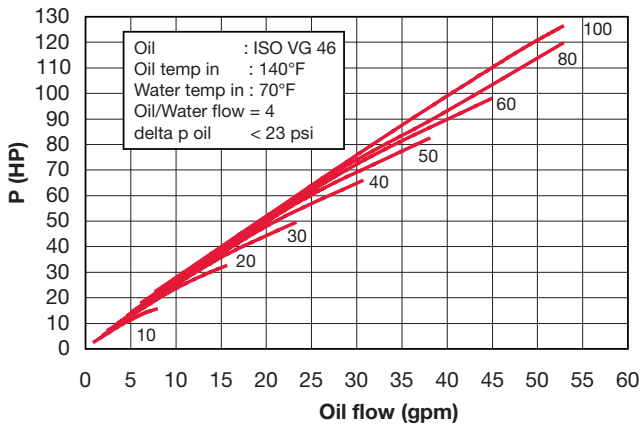
Technical Data

Size 610



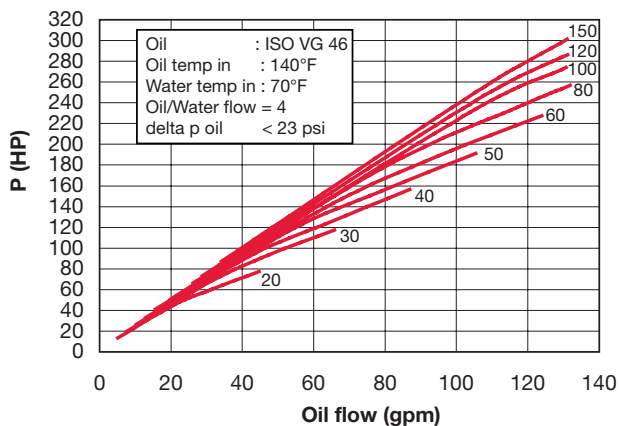
Number of plates (N)	H = 10 + Nx2.4	lbs
10	34	5.5
20	58	8.4
30	82	11.2
40	106	14.0
50	130	17.0
60	154	19.8
70	178	22.6
100	250	31.2
120	298	37.0

Size 615



Number of plates (N)	H = 10 + Nx2.4	lbs
10	34	9.2
20	58	14.3
30	82	19.4
40	106	24.4
50	130	29.7
60	154	35.5
80	202	44.6

Size 422



Number of plates (N)	H = 10 + Nx2.85 (mm)	lbs
20	67	34.7
30	95.5	44.5
40	124	54.1
50	152.5	63.8
60	181	73.5
80	238	92.8
100	295	112.2

The cooling capacity is also dependent on the viscosity class. At a lower viscosity class the cooling capacity increases, at a higher viscosity class it decreases. In order to make an accurate calculation, the following details are required:

- type of oil
- premissible tank temperature
- required outlet temperature of the oil or necessary cooling capacity
- inlet temperature of the water and maximum water quantity.

Selection Program

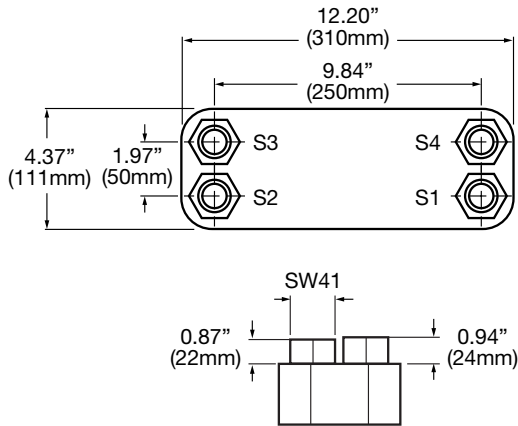
The cooler selection program calculates the correct heat exchanger in the case of non-standard operating data.

Please contact our technical sales department.

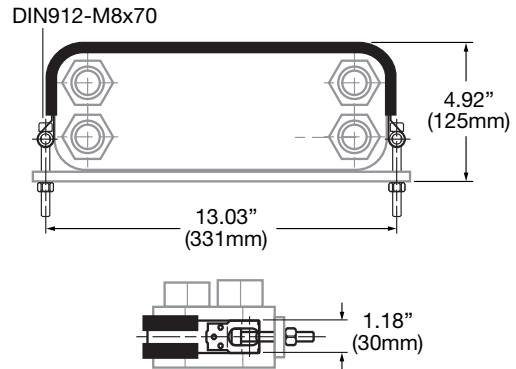
System requirements:

- Windows 95/
- Windows NT/
- Hard disk memory
- 8 MB RAM

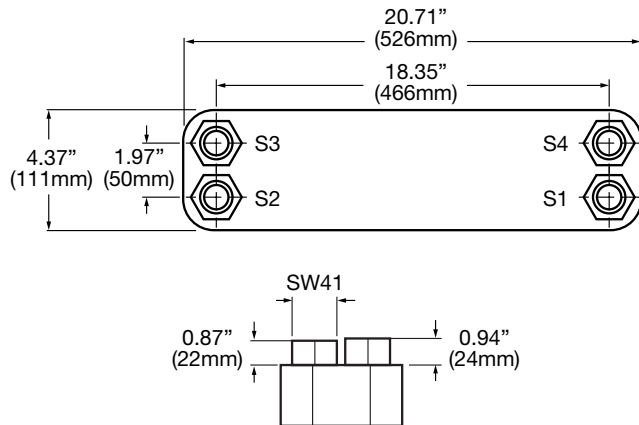
Dimensions Size 610



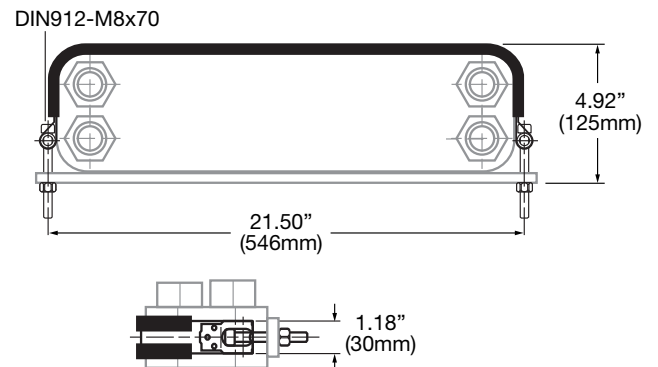
Mounting Bracket 610 Mounting Bracket



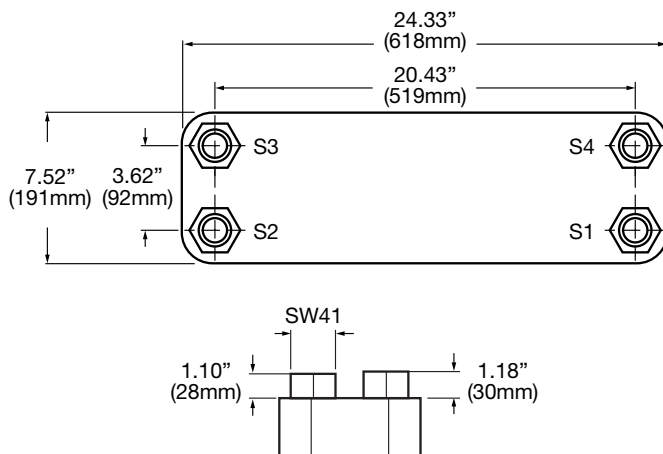
Size 615



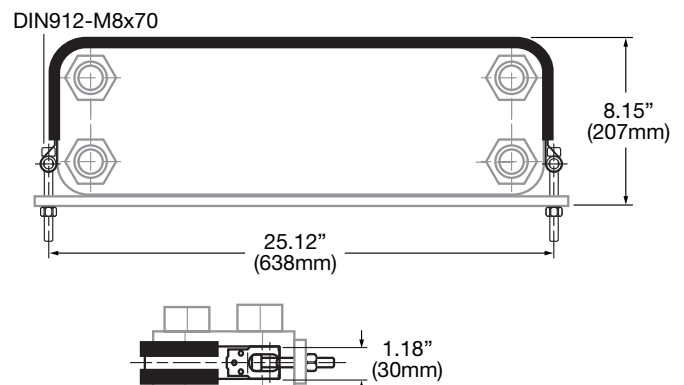
Mounting Bracket 615 Mounting Bracket



Size 422



Mounting Bracket 422 Mounting Bracket

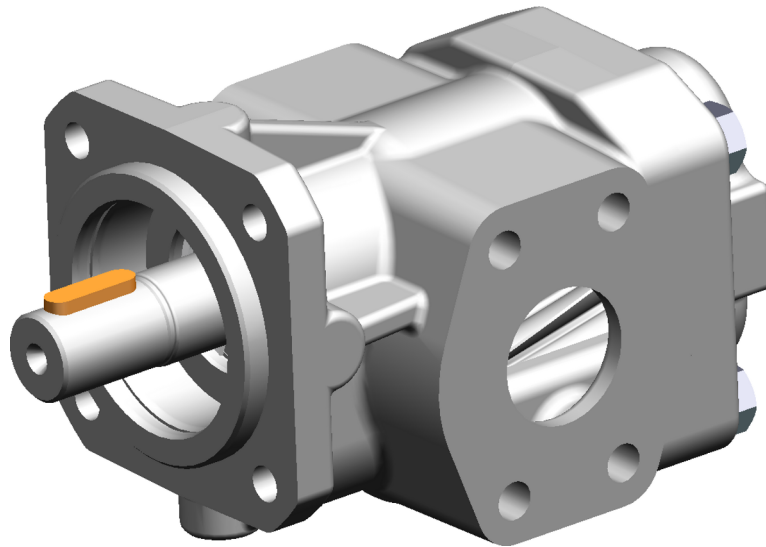


Dimensions are for general information only, all critical dimensions should be verified by requesting a certified print.
Dimensions are in inches.

Please note: For mounting heat exchangers with 60 plates and above, two clamps are recommended.

Operating instructions

BKF0004EN



Gear pump KF 2,5...200

BKF0004EN_D0024710002-09

Englisch

2012-09-25

KRACHT

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1 General points

1.1 About the documentation

These operating instructions describe the installation, operation and maintenance of the gear pumps **KF 2,5...200**, also referred to below as the device.

The device is manufactured in different versions. Information about the version concerned in the individual case can be found on the device's type plate.

The structure of the type designation and a more detailed description of the individual series and nominal sizes can be found in the [chapter 3 "Device description"](#) and in the [chapter 4 "Technical data"](#).

If you have any questions about this operating manual, please contact the manufacturer.

1.2 Manufacturer's address

Kracht GmbH
Gewerbestraße 20
DE 58791 Werdohl
phone: +49 (0) 23 92 / 935-0
fax: +49 (0) 23 92 / 935-209
email: info@kracht.eu
web: www.kracht.eu

1.3 Intended use

The device is a pump for continuous delivery of liquids. The various seal variants and materials enable use with different media.

The device has been designed for operation with fluids. Dry operation is not permitted. The medium must guarantee a minimum lubrication.

The medium must not contain any abrasive constituents.

Petrols, solvents, etc. are **not** permissible.

Use in explosive areas is **not** permissible.

The operator must guarantee that the medium to be conveyed is compatible with the materials used in the device (see "Overview materials" in the [chapter 4 "Technical data"](#)). Chemical expertise is required for that.

The maximum permissible operating data listed in the [chapter 4 "Technical data"](#) must always be observed.

Deviations from the above-mentioned data and operating conditions require express approval by the manufacturer and/or are specified on the type plate.

Type plates or other references on the device must not be removed nor made unlegible or unrecognisable.

In cases of noncompliance, all warranty and manufacturer responsibility shall be void.

2 Safety

2.1 Safety instructions and symbols



The safety notices in these operating instructions are marked with caution symbols.

Non-compliance can lead to hazards for people and the device.

In addition, the safety instructions are marked with signal words. They have the meanings as explained below:

Caution: Identification of a low risk hazard, which could lead to minor or medium bodily injury if not avoided.

Warning: Identification of a potential medium risk hazard, which would lead to death or severe bodily injury if not avoided.

Danger: Identification of an immediate hazard, which would result in death or severe bodily injury if not avoided.



Notice: Flagging of notices to prevent property damage.



Flagging of special user tips and other especially useful or important information.

2.2 Personnel qualification and training

The personnel designated to install, operate and maintenance the device must be properly qualified. This can be through training or specific instruction. Personnel must be familiar with the contents of this operating manual.

2.3 General safety instructions



The operational safety of the device delivered is only guaranteed when it is used for the intended purpose (see [chapter 1 “General points”](#)).

The limit values given must never be exceeded (see [chapter 4 “Technical data”](#)).

National regulations concerning accident prevention and health and safety at work must be observed, as well as internal regulations laid down by the operator, even if these are not specifically mentioned in this manual.

The operator must ensure that this operating manual is accessible to the personnel responsible at all times.

2.4 Hazard statements

DANGER

Danger due to breakage or squirting fluids!

Operating the device with impermissibly high pressure can lead to damage to the device and to the up or downstream plant elements. Breakage can lead to parts flying around uncontrolled or to fluids squirting out which can lead to accidents and severe injuries or even result in death.

1. **Never** allow positive displacement pumps to pump against "closed gates".
2. A pressure relief valve or other kind of over-pressure safeguard must be installed as close as possible to the pump pressure connection. The pressure relief device must be dimensioned so that entire delivery volume can be conducted through with the lowest possible pressure or pressureless.
3. Do **not** put the device into operation without a pressure relief device.

DANGER

Danger due to breakage or squirting fluids!

Using unsuitable connections and lines can lead to breakage. Parts flying around uncontrolled or squirting fluids can lead to accidents with severe injuries or even lead to death.

1. Use only connections and lines approved for the expected pressure range.
2. The respective manufacturer's regulations must be heeded.

DANGER

Danger due to breakage or squirting fluids!

Using damaged connections and lines can cause parts to fly around uncontrolled or fluids to squirt out, which can lead to accidents and severe injuries or even result in death.

1. Immediately replace damaged connections, pipes and hose lines.

 **DANGER****Hazard caused by incorrect direction of rotation!**

Operating the device with the incorrect direction of rotation can lead to damage to the device and to the up or downstream plant elements. Breakage can lead to parts flying around uncontrolled or to fluids squirting out which can lead to accidents and severe injuries or even result in death.

1. Always pay attention to the correct direction of rotation when installing the pump.
2. Always pay attention to the correct direction of rotation when connecting the motors.
3. Secure the fitting keys against flying off when monitoring the direction of rotation.

 **DANGER****Danger due to electric voltage!**

Danger of death due to electric shock.

1. Follow the special safety regulations during all work on electrical installations.
2. Only allow electricians to work on electrical systems.

 **WARNING**

Hazard caused by rotating parts and fluid squirting out!

During all work on the device, rotating parts and squirting fluids can lead to accidents and severe injuries or even result in death.

1. Depressurize all connection lines during all work on the device.
2. Depressurize or disconnect the driving motor during all work on the device.
3. Securely prevent the motor and device from restarting during work.
4. Wear suitable protective clothing.

 **WARNING**

Danger due to hazardous fluid!

Danger of death upon contact with hazardous fluids and when inhaling vapours from these liquids.

1. Comply with the safety data sheets and regulations on handling the hazardous liquids!
2. Collect and dispose leaks of hazardous materials so that no hazards arise for people or the environment.
3. Comply with national and international rules at the place of installation.
4. Wear suitable protective clothing.

 **WARNING**

Hazard caused by rotating parts!

Rotating parts can cause accidents with severe injuries or result in death due to body parts, hair or clothing getting caught or wrapped up.

1. Protect rotating parts (e.g., coupling and shaft ends) against unintentional contact.
2. Close any maintenance openings when using bell housings.
3. Do **not** operate the device without safeguards.

 **WARNING**

Danger due to exposed gears!

Gears can pull in and crush or cut off fingers and hands.

1. Do **not** reach into the gears.
2. Put the device into operation with connected lines only.

**WARNING****Danger due to falling and or loads falling over!**

Due to the size and weight of the device, accidents can occur resulting in severe injuries or death during transport and shipping.

1. Compliance with applicable industrial safety requirements is mandatory.
2. Use only suitable means of conveyance and lifting tackle with sufficient load-bearing capacity.
3. Attach lifting tackle only to suitable points (see [table 5.1](#) and [table 5.2](#)).
4. Attach the lifting tackle in such a manner that it cannot slip.
5. The device's centre of gravity must lie between the lifting tackle mounting points on the device.
6. Secure the device so that toppling over and falling down is impossible.
7. Always avoid jerks, impacts and strong vibrations during transportation.
8. Never walk under suspended loads, never work under suspended loads.
9. To prevent damage to the device, be extremely cautious when shipping or transporting.
10. Wear suitable protective clothing.

 **CAUTION****Danger due to hot surfaces!**

When operating the device with hot media, there is a danger of being burned and scalded when touching the hot surfaces.

1. At medium temperatures above 60 °C, take measures against unintended contact.
2. Wear safety gloves.

 **CAUTION****Danger due to hot surfaces!**

When operating the device with hot media, there is a danger of being burned and scalded when touching the hot surfaces.

1. At medium temperatures above 48 °C, let the device cool off.
2. Wear safety gloves.

3 Device description

3.1 General points

KF series pumps are external gear pump types that work according to the positive displacement principle.

When rotated, two gears being engaged with each other cause volume expansion by opening the tooth gaps in the pump inlet (suction side) so that the medium can enter while a corresponding volume is being displaced in the pump outlet (pressure side) through engagement of the teeth into the filled tooth gap. Fluid transport takes place through entrainment in the tooth gaps along the wall of the wheel chamber. The so-called geometric flow rate V_g is being displaced per wheel rotation. A value that is stated in technical documents as rated volume V_{gn} to specify the pump size.

The actually delivered amount of liquid does not correspond with the theoretical value, it is being reduced through losses due to the necessary tolerances. The losses are less the lower the operating pressure and the higher the viscosity.

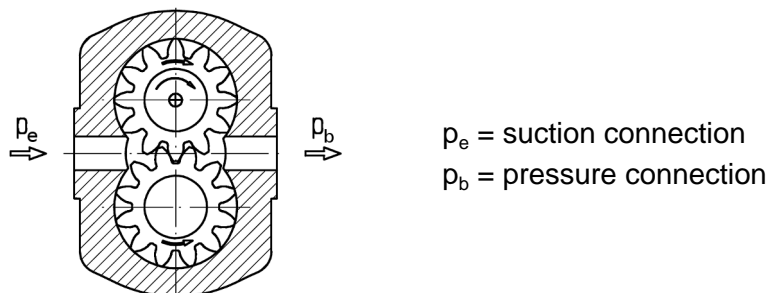
Gear pumps are self-priming within wide limits. The displacement cycle describe initially takes place without exhibiting appreciable pressure build-up. Only after setting external loads, for example, through delivery head, outlet resistance, line elements, etc. the required working pressure will arise to overcome these resistances.

As usual with so-called rigid pumps, i.e. non-axial play compensated pumps, the lateral clearance between gear and front face has been set in such a way that the maximum allowable operating pressure is managed in an adequate and secure way.

The medium lubricates the pump's friction bearings and shaft seal. The pump's operating life will be reduced if the medium contains abrasive ingredients.

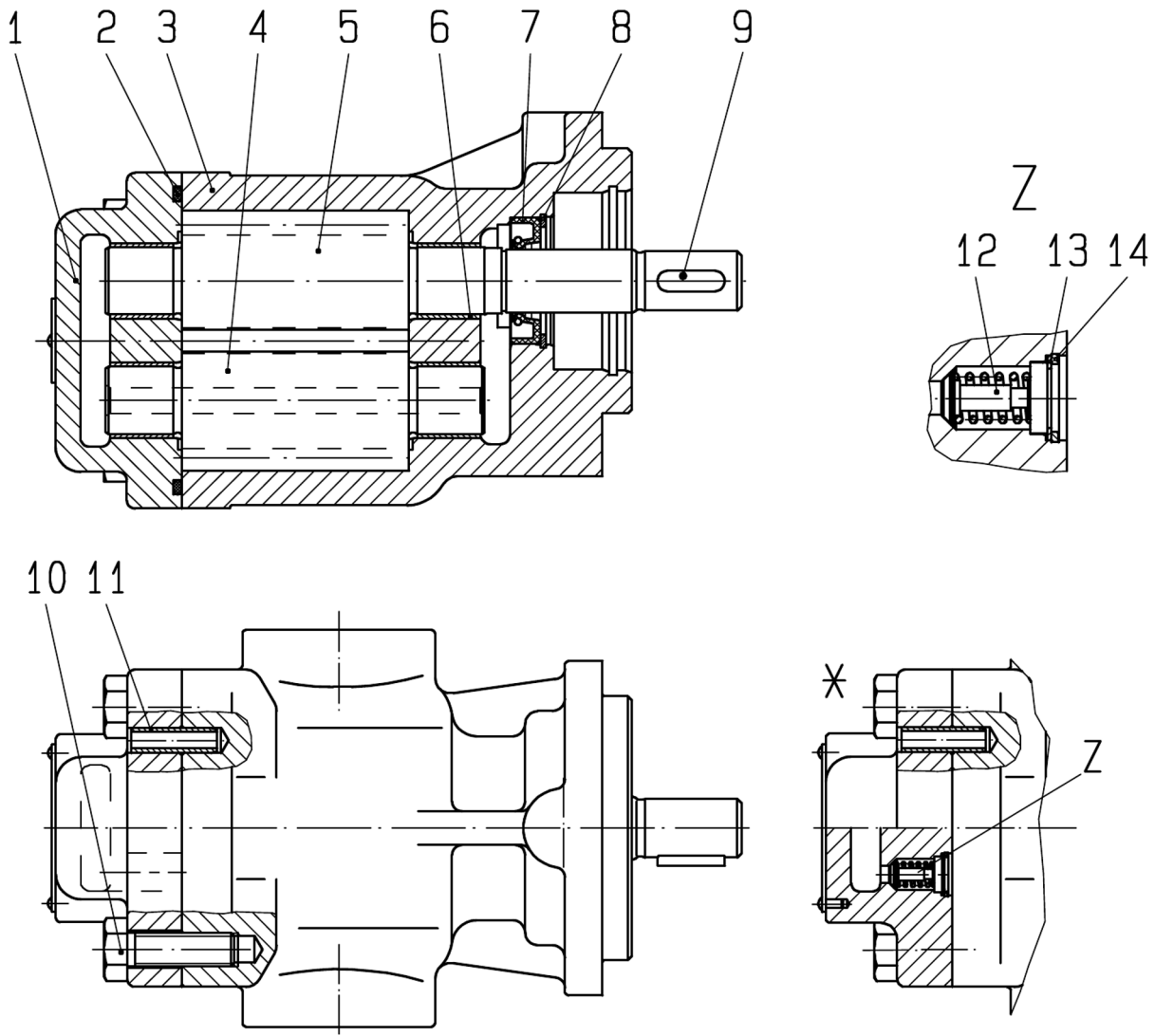
The shaft sealing pocket is connected to the pump's suction side. Therefore, the max. permissible suction-side pressure is dependent on the type of seal.

Functional principle external gear pumps



3.2 Basic construction

3.2.1 KF 2,5...200 R/L/B (with cover)



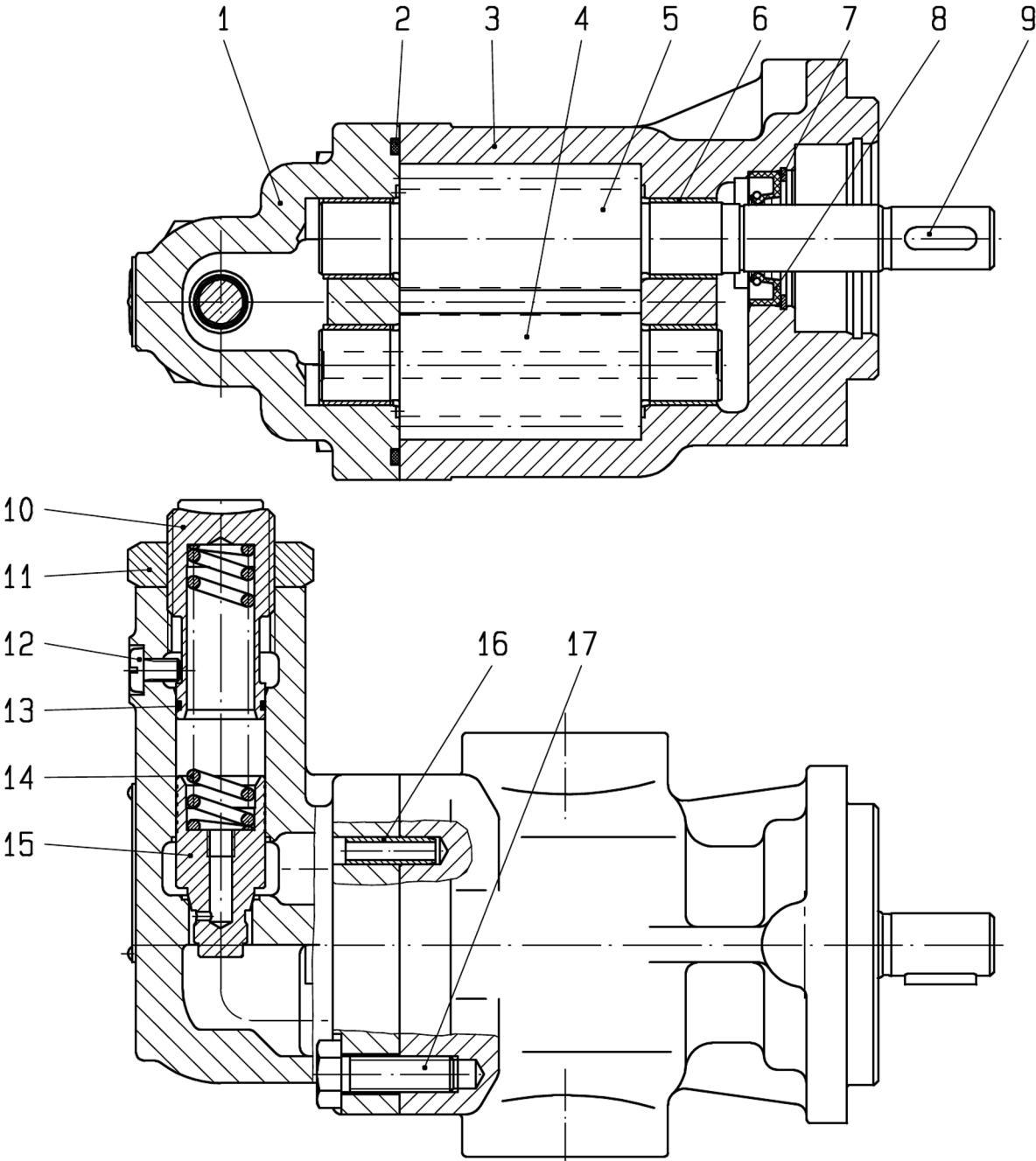
* Direction of rotation "B" (clockwise and counterclockwise)

Description

- | | |
|--------------------------|----------------------|
| 1. Cover | 8. Retaining ring |
| 2. O-Ring | 9. Parallel key |
| 3. Housing | 10. Hexagonal screw |
| 4. Driven shaft | 11. Adapter sleeve |
| 5. Driving shaft | 12. Valve |
| 6. Plain bearing bush | 13. Adjusting washer |
| 7. Rotary shaft lip seal | 14. Retaining ring |

See section [section 3.3 "Types of seals"](#) for further seal types.

3.2.2 KF 2,5...200 R/L - D (with pressure relief valve)

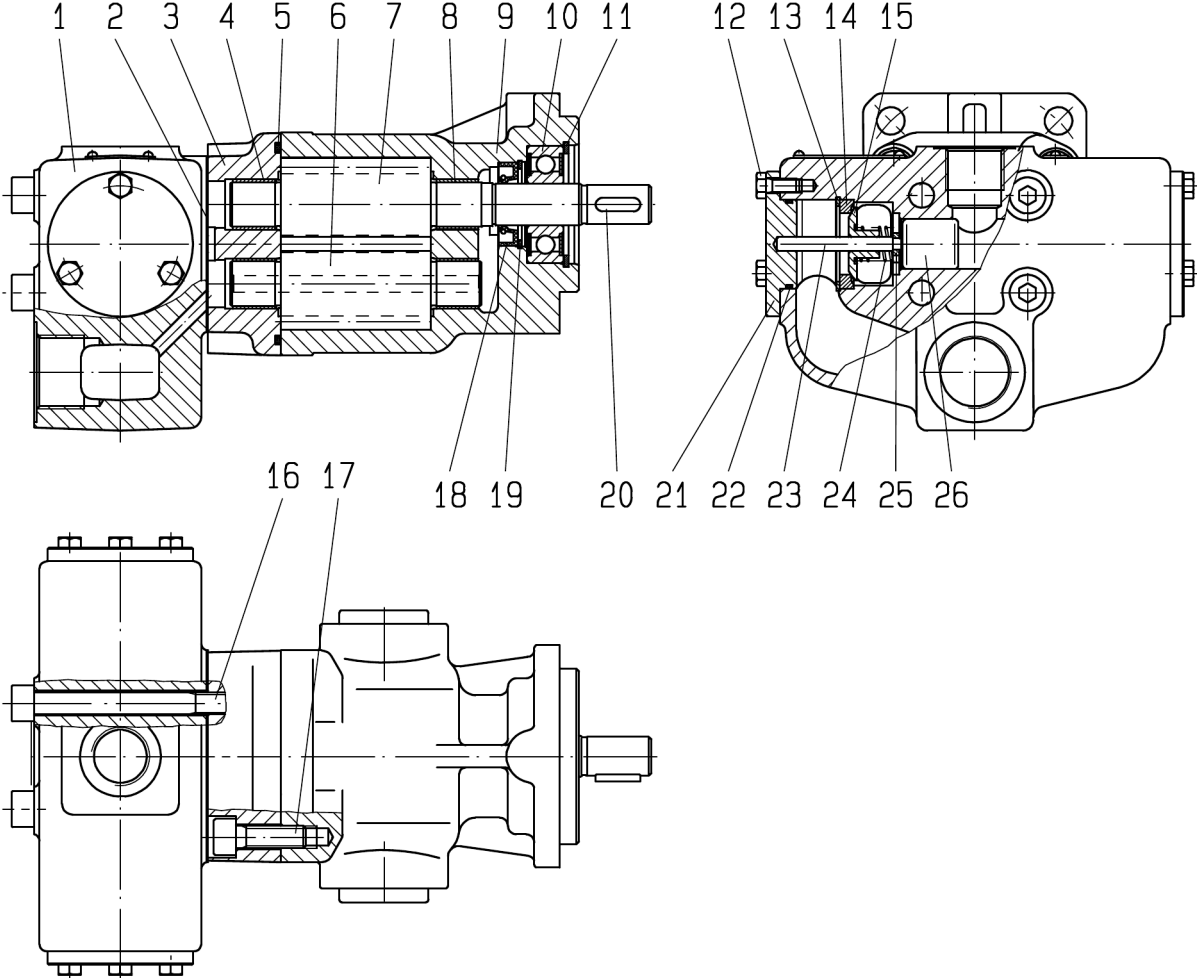


Description

- | | |
|--------------------------|------------------------|
| 1. Valve cover | 10. Set screw |
| 2. O-Ring | 11. Hexagonal nut |
| 3. Housing | 12. Retaining screw |
| 4. Driven shaft | 13. O-Ring |
| 5. Driving shaft | 14. Compression spring |
| 6. Plain bearing bush | 15. Valve cone |
| 7. Retaining ring | 16. Adapter sleeve |
| 8. Rotary shaft lip seal | 17. Hexagonal screw |
| 9. Parallel key | |

See section [section 3.3 "Types of seals"](#) for further seal types.

3.2.3 KF 4...25 U (with universal valve)

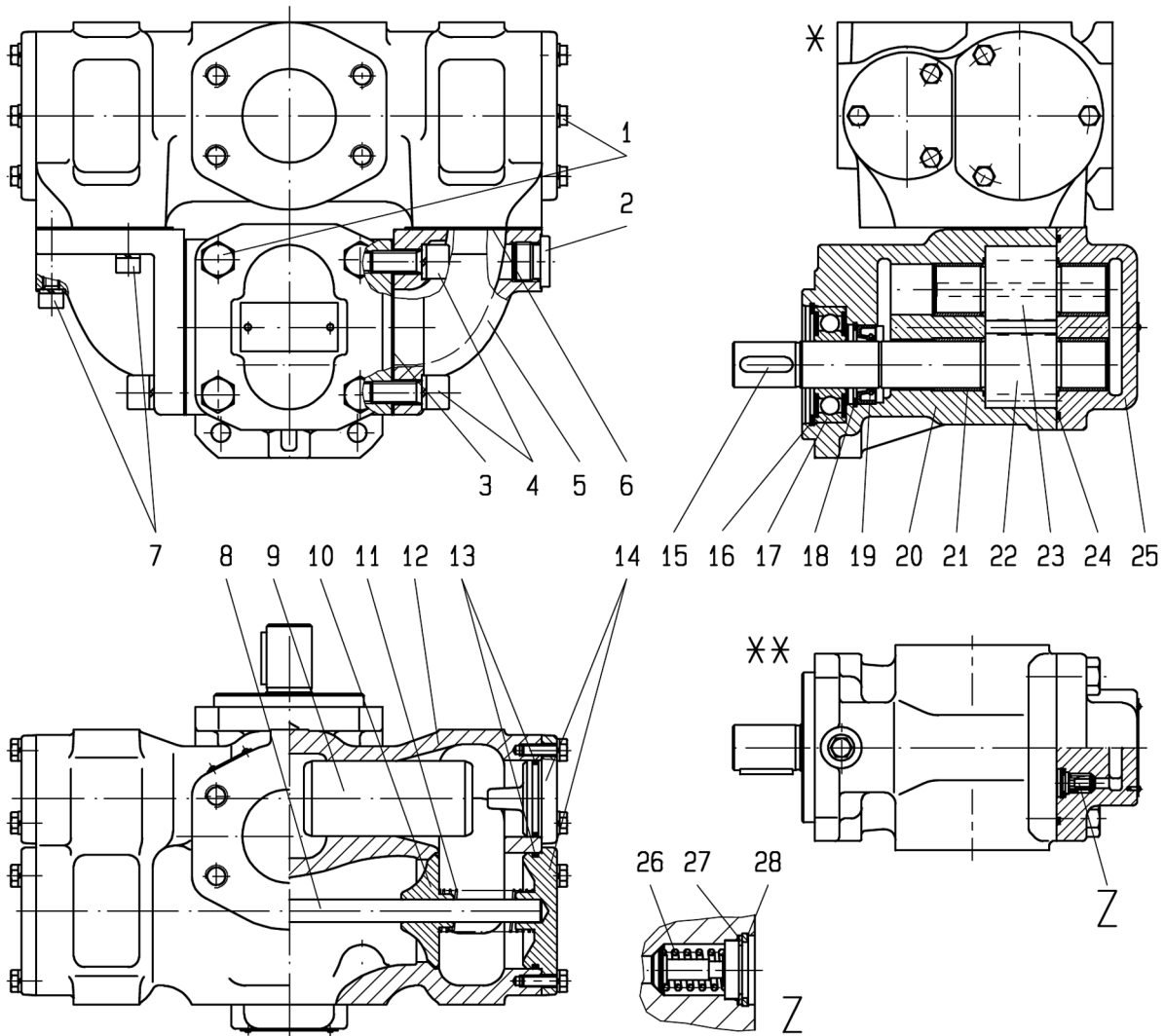


Description

- | | |
|-----------------------|---------------------------|
| 1. Valve housing | 14. Valve washer |
| 2. Gasket | 15. Valve cone |
| 3. Adapter piece | 16. Socket head cap screw |
| 4. Plain bearing bush | 17. Socket head cap screw |
| 5. O-Ring | 18. Rotary shaft lip seal |
| 6. Driven shaft | 19. Retaining ring |
| 7. Driving shaft | 20. Parallel key |
| 8. Plain bearing bush | 21. Cover |
| 9. Housing | 22. O-Ring |
| 10. Roller bearing | 23. Rod |
| 11. Retaining ring | 24. Compression spring |
| 12. Hexagonal screw | 25. Centering star |
| 13. Retaining ring | 26. Piston |

See section [section 3.3 "Types of seals"](#) for further seal types.

3.2.4 KF 32...80 U (with universal valve)



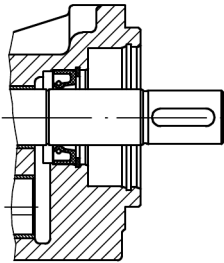
Description

- | | |
|--------------------------|---------------------------|
| 1. Hexagonal screw | 15. Parallel key |
| 2. Screw plug | 16. Retaining ring |
| 3. Gasket | 17. Roller bearing |
| 4. Socket head cap screw | 18. Retaining ring |
| 5. Connection elbow | 19. Rotary shaft lip seal |
| 6. Gasket | 20. Housing |
| 7. Socket head cap screw | 21. Plain bearing bush |
| 8. Rod | 22. Driving shaft |
| 9. Piston | 23. Driven shaft |
| 10. Valve cone | 24. O-Ring |
| 11. Compression spring | 25. Cover |
| 12. Valve housing | 26. Valve |
| 13. O-Ring | 27. Adjusting washer |
| 14. Cover | 28. Retaining ring |

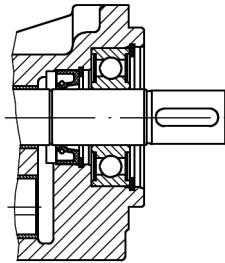
See section [section 3.3 "Types of seals"](#) for further seal types.

3.3 Types of seals

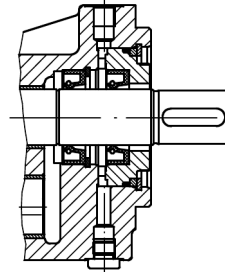
Types of seals KF 2,5...200



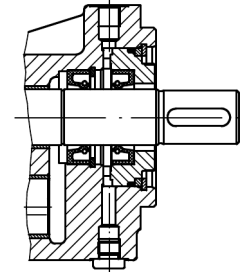
Pump with single rotary shaft lip seal
 Fixing type: F / W
 Seal type:
 1: NBR
 2: FKM
 3: PTFE
 9: EPDM
 23, 31: FKM (low temperature)



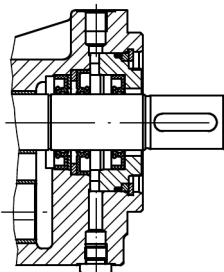
Pump with single rotary shaft lip seal and out-board bearing
 Fixing type: G / X
 Seal type:
 1: NBR
 2: FKM
 3: PTFE



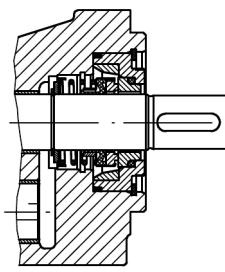
Pump with double rotary shaft lip seal with connection borehole G 1/8 for liquid seal (quench)
 Fixing type: F / W
 Seal type:
 4: PTFE
 7: FKM
 19: NBR
 32: EPDM



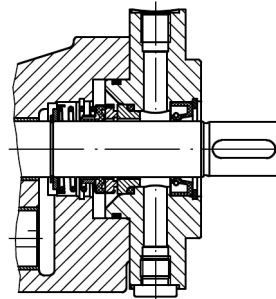
Pump with double rotary shaft lip seal for vacuum operation with connection borehole G 1/8 for liquid seal (quench)
 Special number 74
 Fixing type: F / W
 Seal type:
 4: PTFE
 7: FKM
 19: NBR
 32: EPDM



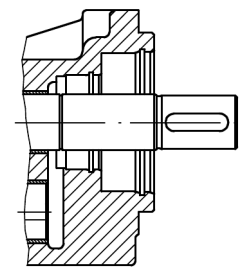
Pump with triple rotary shaft lip seal for vacuum and normal operation with connection borehole G 1/8 for liquid seal (quench)
 Fixing type: F / W
 (on request)



Pump with mechanical seal
 Fixing type: F / W
 Seal type:
 5: FKM
 6: PTFE
 20: EPDM



Pump with mechanical seal and connection borehole G 1/8 (KF 2,5-25) or G 1/4 (KF 32-80) for liquid seal (quench)
 Special number 198
 Fixing type: F / W
 Seal type:
 5: FKM



Pump without shaft seal
 Fixing type: F / W
 Seal type:
 30: FKM (O-Ring)
 36: NBR (O-Ring)

3.4 Type key

Ordering example KF 2,5...200									
KF	40	R	F	1	/...	-	D 15	-	...
1.	2.	3.	4.	5.	6.		7.		8.

Explanation of type key KF 2,5...200			
1.	Product name		
2.	Nominal size		
	Vg	Size 1: 2,5; 4; 5; 6; 8; 10; 12; 16; 20; 25 cm ³ Size 2: 32; 40; 50; 63; 80 cm ³ Size 3: 100; 112; 125; 150; 180; 200 cm ³	
3.	Direction of rotation		
	R	Clockwise	B Clockwise and counterclockwise
	L	Counterclockwise	U Universal (Direction of rotation clockwise and counterclockwise, direction of discharge consistent)
4.	Fixing type		
	F	DIN flange without outboard bearing	W Mounting angle without outboard bearing
	G	DIN flange with outboard bearing	X Mounting angle with outboard bearing
5.	Seal type		
	1	Rotary shaft lip seal BABSL NBR	18 Rotary shaft lip seal BAUMX7 FKM
	2	Rotary shaft lip seal BABSL FKM	19 Double rotary shaft lip seal BABSL NBR
	3	Rotary shaft lip seal PTFE	20 Mechanical seal with EPDM secondary seal (not resistant to mineral oil)
	4	Double rotary shaft lip seal PTFE	23 Rotary shaft lip seal MSS-1 FKM (low temperature)
	5	Mechanical seal with FKM secondary seal	30 Without shaft seal, O-Ring FKM (external leak oil discharge)
	6	Mechanical seal with PTFE secondary seal	31 Rotary shaft lip seal BABSL FKM (low temperature)
	7	Double rotary shaft lip seal BABSL FKM	32 Double rotary shaft lip seal EPDM (not resistant to mineral oil)
	9	Rotary shaft lip seal EPDM (not resistant to mineral oil)	36 Without shaft seal, O-Ring NBR (external leak oil discharge)
6.	Special number for special versions		
		See section 3.5 "Important special numbers"	
7.	Pressure relief valve (only for direction of rotation R or L)		
	D 15	Adjustable from 0 - 15 bar	D 25 Adjustable from 15 - 25 bar

Explanation of type key KF 2,5...200	
8.	Housing and cover material
	No specification: EN-GJL-250 (GG-25)
	GJS EN-GJS-400-15 (GGG-40)

3.5 Important special numbers

Special number	Description
74	Pump with double rotary shaft lip seal for vacuum operation and connection for liquid seal (quench), inner rotary shaft lip seal mounted with sealing lip towards shaft end
158	SAE 3/4 connections for KF 2,5...12, SAE 1 connections for KF 16...25
197	Noise-optimized version for aerated oils and vacuum
198	Mechanical seal with connection for liquid seal (quench)
232	SAE 2 connection for KF 50...80, SAE 2 1/2 connections for KF 100...112, SAE 3 connections for KF 125...150, SAE 3 1/2 connections for KF 180...200
304	Bearing bushings Iglidur® X, $\Delta p_{\max} = 10$ bar
317	Noise-optimized version for aerated oils and vacuum, bearing bushings Iglidur® X, $\Delta p_{\max} = 10$ bar
332	Version for low-viscous media (only in connection with material GJS), bearing bushings Iglidur® X, $v_{\min} = 4$ mm ² /s at $\Delta p_{\max} = 10$ bar
353	Noise-optimized version for aerated oils and vacuum, bearing bushings DP4 (leadfree)
355	Bearing bushing Iglidur® X, SAE 3/4 connections for KF 2,5...12, SAE 1 connections for KF 16...25, $\Delta p_{\max} = 10$ bar
363	Version for low-viscous media (only in connection with material GJS), bearing bushings Iglidur® X, $v_{\min} = 4$ mm ² /s at max. $\Delta p_{\max} = 10$ bar, SAE 3/4 connections for KF 2,5...12, SAE 1 connections for KF 16...25
391	Noise optimized version for aerated oils and vacuum, SAE 2 connections for KF 50...80, SAE 2 1/2 connections for KF 100...112; SAE 3 connections for KF 125...150, SAE 3 1/2 connections for KF 180...200



Particularities in noise-optimized pumps

1. Air trapped in the medium or too high negative pressure can result in delivery rate reduction for pumps in noise-optimized version.
2. Measures for noise optimisation are only feasible for one rotational direction and only effective for aerated oils or vacuum.

4 Technical data

4.1 General characteristics

General characteristics KF 2,5...200		
Construction	External gear pump	
Material	See section 4.4 "Overview materials"	
Fixing type	Flange DIN ISO 3019	
End of drive shaft	ISO R 775 short-cylindrical	
Connection type	KF 2,5...12	Whitworth thread G 3/4
	KF 4...12/158	Flange connection SAE 3/4
	KF 16...25	Whitworth thread G 1
	KF 16...25/158	Flange connection SAE 1
	KF 32...80	Flange connection SAE 1 1/2
	KF 50...80/232	Flange connection SAE 2
	KF 100...112	
	KF 100...112/232	Flange connection SAE 2 1/2
	KF 125...150	
	KF 125...150 /232	Flange connection SAE 3
	KF 180...200	
	KF 180...200 /232	Flange connection SAE 3 1/2
Installation position	KF ...R/L/B... without quench	Arbitrary*
	KF ...R/L/B... with quench	Horizontal, quenching connection on top
	KF ...U...	Horizontal, pressure connection on top
Viscosity	v_{\min}	12 mm ² /s**
	v_{\max}	20000 mm ² /s
Ambient temperature	$\vartheta_{u \min}$	-20 °C
	$\vartheta_{u \max}$	60 °C
Speed n	See section 4.2 "Overview nominal sizes"	
Fluid temperature ϑ	See section 4.5 "Operating pressure and fluid temperature"	
Operating pressure p_e and p_b		
Filtering	Filter porosity $\leq 60 \mu\text{m}$	
Permissible media	Fluids without abrasive components which are compatible with the pump materials used. The fluids must guarantee minimum lubrication. Media-specific characteristics must be taken into account. Petrols, solvents, etc. are not permissible.	

General characteristics KF 2,5...200

* A reduced service life must be expected for the shaft seal when vertically installed.

** Lower viscosities only on connection with GJS housings and reduced pressures (consult manufacturer).

4.2 Overview nominal sizes

Nominal size*	Geom. displacement V_g cm^3	Speed		Perm. radial force** F_{radial} N (n=1500 rpm)	Sound pressure level***** L_{pA} db(A)	Weight kg		
		n_{min} rpm	n_{max} rpm			with cover	with D-valve	with uni-versal valve
2,5	2,55	200	3000	700	≤ 67	2,9*** 4,2****	3,7*** 5,0****	6,9
4	4,03							
5	5,05							
6	6,38							
8	8,05							
10	10,11							
12	12,58							
16	16,09							
20	20,10							
25	25,10							
32	32,12	200	3000	1500	≤ 68	7,7	9,5	27,5
40	40,21							
50	50,20							
63	63,18							
80	80,50	200	3000	1500	≤ 69	16,0	18,7	-
100	101,5							
112	113,5							
125	129,4							
150	155,6							
180	186,6	200	3000	1500	≤ 70	22,2	26,5	-
200	206,2							

* See type key and type designation at device

** Radial forces only at version with outboard bearing (F_{radial} on central shaft end)

*** Valid for nominal size 2,5...25 with Whitworth pipe thread

**** Valid for nominal size 2,5...25 with flange connection SAE

***** $n=1500$ rpm ; $v=34$ mm²/s ; $p=5...25$ bar

4.3 Permissible speed

Kinematic viscosity ν in mm ² /s								
< 300	300	500	1000	2000	3000	6000	10000	20000
≥ 1450	1250	1000	750	600	500	400	300	200
Maximal permissible speed n_{\max} in rpm								

4.4 Overview materials

Seal type*	Housing / cover	Gear	Bearing	Shaft seal	O-rings
1	EN-GJL-250 (GG-25) EN-GJS-400-15** (GGG-40)	case-hard- ened steel (1.7139)	DU, P10 (Steel, sintered bronze, PTFE, Pb) Iglidur® DP4 (Steel, sintered bronze, PTFE)	NBR	NBR
2				FKM	FKM
3				PTFE	FEP
4				PTFE	FEP
5				CrMo-cast- ing/Carbon in synthetic resin, FKM, 1.4571, 1.4401	FKM
6				SiC-Si/SiC- Si (KF 4...25), SiC- Si/Carbon in synthetic resin (KF 32...80), FFKM, 1.4571	FEP
7				FKM	FKM
9				EPDM	EPDM
18				FKM	FKM
19				NBR	NBR
20				SiC-Si/Car- bon, CrNi- Steel, CrNi- Mo-Steel	EPDM
23				FKM (low temperature)	FKM (low tem- perature)
30				Without shaft seal	FKM
31				FKM (low temperature)	FKM (low tem- perature)
32				EPDM	EPDM
36				Without shaft seal	NBR

* See type key and type designation at device
 ** For version in EN-GJS-400-15 type designation: KF ... - GJS

4.5 Operating pressure and fluid temperature

Seal type*	Operating pressure				Fluid temperature					
	Suction side		Pressure side		ϑ_{\min} °C	ϑ_{\max} °C				
	$p_{e\min}$ bar abs.**	$p_{e\max}$ bar	p_b bar (perm. continuous pressure)	$p_{b\max}$ bar (Pressure peaks)						
1	0,6 ***	...6****	25*****	40	-10	90				
2						150				
3						200				
4		2				150				
5		10				200				
6		...6****				150				
7		0,5				120				
18		...6****				150				
19		10				90				
20		0,5				120				
23		25				-30	150			
30		1				-10				
31		0,5				-30				
32		0,1				0,2			-10	120
4/74										200
7/74	150									
19/74	90									
32/74						120				

* See type key and type designation at device

** Head restrictions of $p_{e\min} = 0,65$ bar absolute for universal design (KF .. U.).

*** Temporary during starting state: 0,4 bar absolute.

**** Permissible pressure see [table 4.1](#)

***** For size 3 (KF 100...200) type of seal 31: $p_b = 20$ bar

Tab. 4.1: Permissible operating pressure $p_{e\ max}$ for seal type 1, 2, 7 and 19

Max. speed n_{\max} in rpm	KF 2,5...80	KF 100...200
	Permissible pressure $p_{e\ max}$ in bar	Permissible pressure $p_{e\ max}$ in bar
750	6	6
1000	5	5
1500	4	3,5
2000	3	2,5
3000	2	1,5

Permissible differential pressure	
Bearing	Δp_{\max} bar
Standard: DU, P10	25
Iglidur®	10
White metal	10



NOTICE

Danger of device damage due to overload

The device bearings can prematurely wear out under overload.

1. **Never** exceed the maximum permissible differential pressure.



NOTICE

Danger of property damage when simultaneously utilizing multiple operating limits

When simultaneously utilizing multiple operating limits (see [chapter 4 "Technical data"](#)), the pump could become damaged or prematurely wear.

1. Do not use minimum and maximum parameters at the same time.
For example, maximum operating pressure is not permissible in connection with low speed and/or low viscosity.

**NOTICE****Danger of property damage when pumping aqueous fluids**

When pumping aqueous dispersions or solvents, low pressure on the inlet port can lead to cavitation damage on the pump.

1. Comply with the media-specific attributes.
2. When designing the inlet line, make sure the inlet port pressure on the pump inlet during operation is always higher than the steam pressure of the pumping fluid. While doing so, also take the altitude of the site of the device over mean sea level into consideration.
3. For aqueous dispersions and solvents, limit the operating temperature to max. 50 °C, install the pump underneath the liquid level and limit the rotational speed to maximal 1500 rpm.

4.6 Dimensions

Dimensions of the device can be found in the relevant technical data sheets.

5 Transport and storage

5.1 Transport damage

Inspect the device for shipping damage as soon as the delivery has been received.

If shipping damage is discovered, inform the shipping company.

If proper operation of the device is impaired by the damage, the device must be replaced or repaired. In that case, contact the manufacturer.

5.2 Transport



WARNING

Danger due to falling and or loads falling over!

Due to the size and weight of the device, accidents can occur resulting in severe injuries or death during transport and shipping.

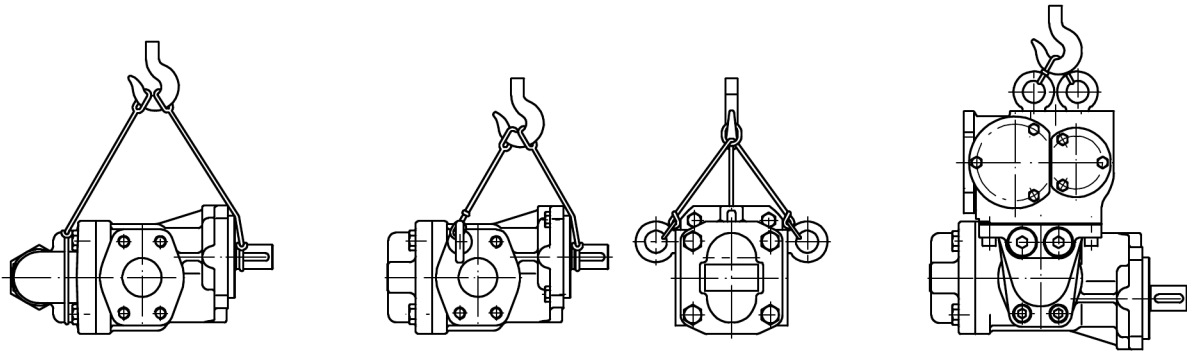
1. Compliance with applicable industrial safety requirements is mandatory.
2. Use only suitable means of conveyance and lifting tackle with sufficient load-bearing capacity.
3. Attach lifting tackle only to suitable points (see [table 5.1](#) and [table 5.2](#)).
4. Attach the lifting tackle in such a manner that it cannot slip.
5. The device's centre of gravity must lie between the lifting tackle mounting points on the device.
6. Secure the device so that toppling over and falling down is impossible.
7. Always avoid jerks, impacts and strong vibrations during transportation.
8. Never walk under suspended loads, never work under suspended loads.
9. To prevent damage to the device, be extremely cautious when shipping or transporting.
10. Wear suitable protective clothing.



Handling aid

1. When transporting individuals devices, the eyebolts can be screwed into the connecting flanges as a handling aid.

Tab. 5.1: Example for safe transport of pumps



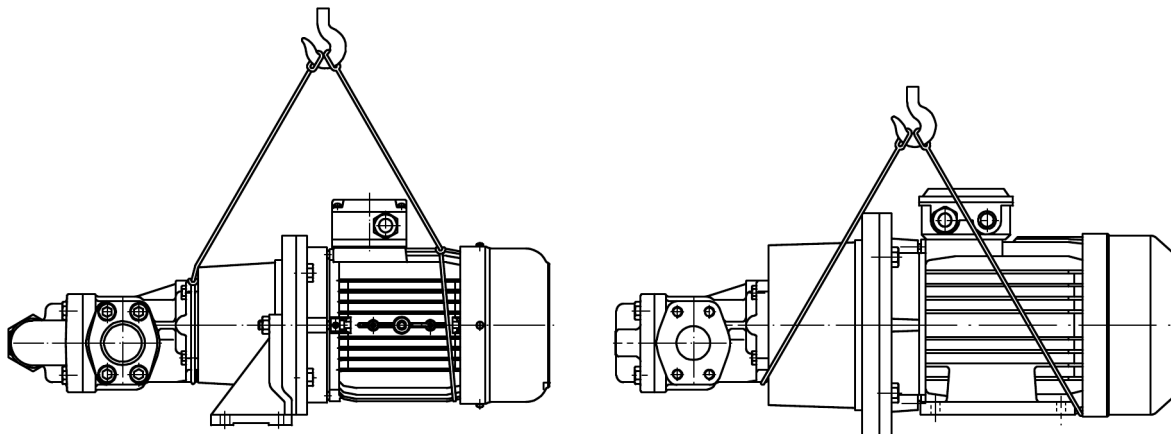
! WARNING

Danger due to falling and or loads falling over!

Due to the size and weight of the device, accidents can occur resulting in severe injuries or death during transport and shipping.

1. For pump aggregates: do **not** use eyebolts on the motor to transport the pump aggregates. They can only support the weight of the motor.

Tab. 5.2: Examples for safe transport of pump units



5.3 Corrosion protection

The device's function is tested in the plant with mineral hydraulic oil. Then all connections are closed. The remaining residual oil protects the interior parts for about 6 months.

Clean bare outer metal parts have also been protected by anti-corrosive oil or protective metal paint for a period of 6 months against corrosion.

The device must not be exposed in the influence of the weather and major fluctuations in temperature during transport and storage and must be stored in a dry place.

If the device is stored over a longer period, it must be treated on the inside and outside with a suitable corrosion protecting oil. In addition, it must be protected from humidity by a humidity-absorbing agent.

If high air humidity or aggressive atmosphere is to be expected during transport, suitable corrosion prevention measures must be carried out.



NOTICE

Corrosion damage on devices with EPDM seals

The functionality of devices with EPDM seals is not tested. There is no preservation of the interior parts. If the device is not put into operation immediately, corrosion damage can occur.

1. Protect the device by using suitable corrosion-preventing measures.



NOTICE

Chemical impact on the device and the sealing materials

Incompatibility between the preservation agents and the materials and elastomers used in the device can lead to damage of the device and the seals being used.

1. Check to make sure the preservation agent is compatible with the materials and elastomers used in the device.
2. Check to make sure the preservation agent is compatible with the media to be pumped.

6 Installation

6.1 General points



WARNING

Hazard caused by rotating parts and fluid squirting out!

During all work on the device, rotating parts and squirting fluids can lead to accidents and severe injuries or even result in death.

1. Depressurize all connection lines during all work on the device.
2. Depressurize or disconnect the driving motor during all work on the device.
3. Securely prevent the motor and device from restarting during work.
4. Wear suitable protective clothing.



NOTICE

Danger of property damage due to insufficiently qualified personnel

Improper work can lead to damages and malfunctions in the device and in the plant.

1. Permit only expert and technically qualified personnel to work on the device.



NOTICE

Danger of property damage due to a lack of cleanliness

During installation, foreign bodies can get into the interior of the device or the plant due to a lack of cleanliness and cause malfunctions there.

1. Pay attention to cleanliness during all work.

6.2 Noise reduction



Measures for sound optimizing

1. In view of optimising noise protection, it is advisable to mount a vibration damper between pump and motor as well as vibration damper between motor and mounting surface. Suction and pressure piping must be able to move freely or it needs to be elastically suspended.
2. Installation of suction and pressure hoses diminishes the noise level of hydraulic systems. Some hoses manufacturers offer special, highly flexible suction hoses for this purpose.
3. Installation of the pump above the liquid level diminished the noise level of hydraulic systems. The pressure p_e on the pump's intake should be approx. 0.8...0.9 bar absolute.

6.3 Definition of the direction of rotation and pumping flow

**Hazard caused by incorrect direction of rotation!**

Operating the device with the incorrect direction of rotation can lead to damage to the device and to the up or downstream plant elements. Breakage can lead to parts flying around uncontrolled or to fluids squirting out which can lead to accidents and severe injuries or even result in death.

1. Always pay attention to the correct direction of rotation when installing the pump.
2. Always pay attention to the correct direction of rotation when connecting the motors.
3. Secure the fitting keys against flying off when monitoring the direction of rotation.

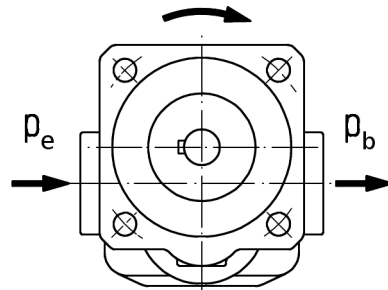
6.3.1 KF 2,5...200 (with cover or pressure relief valve)

The following definition shall apply with respect to the rotation and delivery direction of external gear pumps in case of pump connections being positioned below the drive shaft:

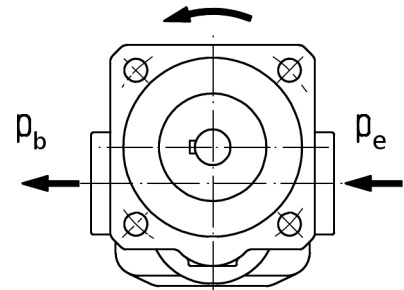
Looking at the pump shaft end, the pumping flow is from left to right when the shaft is moving **clockwise**.

Looking at the pump shaft end, the pumping flow is from right to left when the shaft is moving **counter-clockwise**.

Without pressure relief valve

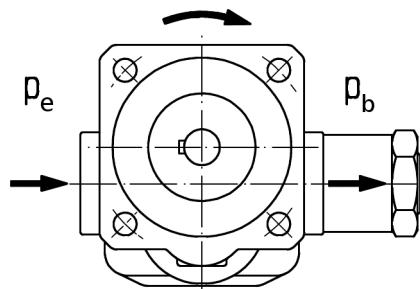


p_e = suction connection

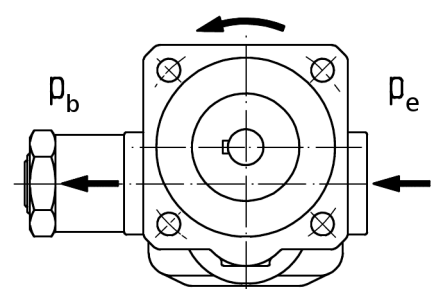


p_b = pressure connection

With pressure relief valve



p_e = suction connection



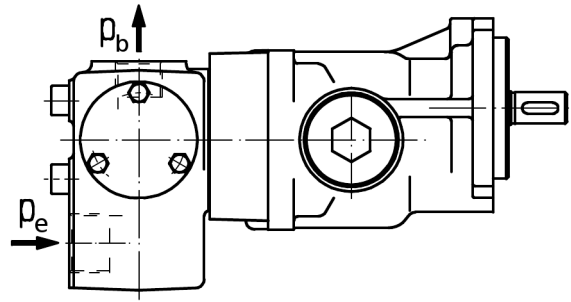
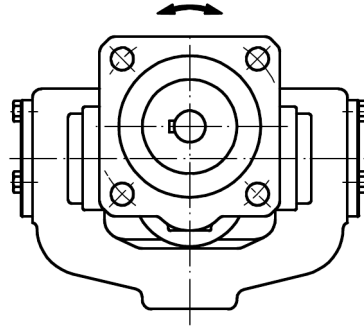
p_b = pressure connection

6.3.2 KF 2,5...25 U (with universal valve)

With regard to the direction of rotation and pumping flow of pumps **with universal valve** the following definition shall apply when looking at the pump shaft end:

Direction of rotation clockwise **and** counterclockwise

Direction of discharge **consistent**



p_e = suction connection

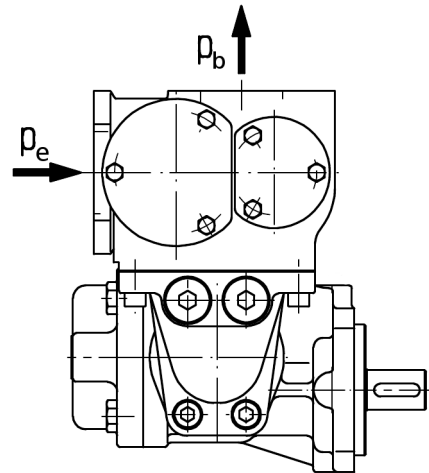
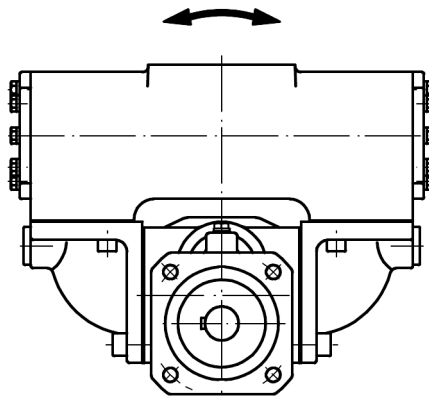
p_b = pressure connection

6.3.3 KF 32...80 U (with universal valve)

With regard to the direction of rotation and pumping flow of pumps **with universal valve** the following definition shall apply when looking at the pump shaft end:

Direction of rotation clockwise **and** counterclockwise

Direction of discharge **consistent**



p_e = suction connection

p_b = pressure connection

6.4 Change of the direction of rotation

Change of the direction of rotation in the case of **KF...R...** and **KF...L...** pump types, i.e. pure clockwise or counterclockwise rotating pumps, is only possible by converting the pump.

The manufacturer normally carries out the conversion work and the customer should do this only in case of an emergency.

Pumps in noise-optimized version cannot be converted.



Guarantee and manufacturer responsibility

1. All warranty claims and manufacturer responsibility shall be void when improper conversion work takes place.



NOTICE

Danger of property damage due to incorrect installation

Improper retrofitting can lead to damage and malfunctions in the device and in the plant.

1. Permit only expert and technically qualified personnel to work on the device.



NOTICE

Danger of leaks on the device

When altering the device, seals that are removed, damaged or jammed can lead to leaks during operation.

1. Do **not** remove, damage or jam seals.

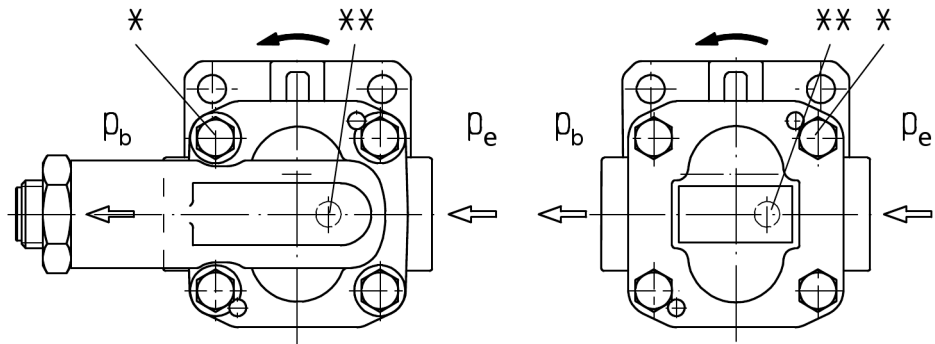


NOTICE

Danger of damage on the device

The cover or pressure relief valve and housing are fixed to each other with adapter sleeves or dowel pins. If the bearings are damaged when assembling or dismantling the cover or pressure relief valve, e.g. by bending out of line, there could be malfunctions and a decrease of the service life. Furthermore, the seal faces on the cover or pressure relief valve could be damaged. That can lead to leaks during operation.

1. When mounting and dismantling the cover or pressure relief valve, do **not** damage the bearings, e.g. by bending out of line.
2. When dismantling the cover or pressure relief valve, do **not** lever in the joint with a screwdriver or similar tools.



p_e = suction connection

p_b = pressure connection

* Attachment screws

** Leak oil hole

In case of a pump's change of the direction of rotation the cover and/or pressure relief valve must be rotated through 180°.

- Loose fastening screws.
- Remove the cover or the pressure relief valve respectively from the pump housing and put it back on rotated by 180°.
- Tighten all fastening screws applying the below mentioned tightening torques (see [table 6.1](#))

When checking, pay attention to the following points:

- Pumps without pressure relief valve must have their leak oil hole on the interior cover side at the pump's suction side.
- Pumps with pressure relief valve must have their pressure relief valve adjusting screw point toward the pump's pressure side.

Tab. 6.1: Tightening torques for fastening screws

Nominal size *	2,5 ... 25	32 ... 80	100 ... 200
Tightening torque	25 Nm	49 Nm	79 Nm
* See type key and type designation at device			

In the case of pumps having **seal type 6**, the mechanical seal must be replaced in addition. During this process, the spring coiling direction must be observed. Heed the assembly instructions of the respective manufacturer when replacing the mechanical seal.

6.5 Design of suction and pressure line

DANGER

Danger due to breakage or squirting fluids!

Using unsuitable connections and lines can lead to breakage. Parts flying around uncontrolled or squirting fluids can lead to accidents with severe injuries or even lead to death.

1. Use only connections and lines approved for the expected pressure range.
2. The respective manufacturer's regulations must be heeded.

NOTICE

Danger of property damage due to distortion

The load on the device due to impermissible external loads can lead to malfunctions or to breakage of the flange or housing.

1. Pipelines must be fitted absolutely tension-free to the device connections.
2. Pipelines must be designed in such a way that no tension e.g. caused by changes in length due to fluctuations in temperature can be transferred to the device.

NOTICE

Danger of property damage caused by foreign bodies in the device

During installation, when using unsuitable sealing materials foreign bodies can get into the interior of the device or the plant due to a lack of cleanliness and cause malfunction there.

1. During installation, do not use **any** hemp or filler as sealing material.



Suction and pressure hoses

1. Installation of suction and pressure hoses diminishes the noise level of hydraulic systems. Some hoses manufacturers offer special, highly flexible suction hoses for this purpose.
2. Lay pressure hoses in sufficiently large radii.

6.5.1 Suction line

NOTICE

Malfunction due to incorrectly designed inlet line

Due to excessive underpressure, an incorrectly designed inlet line can lead to a reduction of the delivery rate, increased noise emissions and cavitation.

1. Design the inlet line with extreme care since it will strongly influence the pump's performance.

The suction line must be piped as short as possible and in a straight line.

Avoid large suction heights.

Additional line resistance such as formed parts, fittings and closed meshed suction filters increase the pipe resistance of the suction line and must be avoided.

The negative pressure in the suction line is calculated from the sum of all suction-side resistances and the suction height considering the media-specific data.



Check the underpressure

1. The negative pressure can be controlled by fitting a vacuum gauge to the pump suction line connector.

Ensure proper suction when piping the suction line and the distances to the floor and to the bulkhead partitions must be sufficiently large.

The inlet port must have a sufficient distance to the lowest fluid level.



Nominal width of the suction line

1. The nominal width of the suction line may actually be selected to be larger than the pump connection.



Expansion of the suction cross section

1. Funnel-shaped formation of the suction port at the pump suction side or obliquely cutting the suction pipe end is recommended of enlargement of the suction cross section.

When hose lines are used on the pump suction side, care must be taken to ensure that the hoses are sufficient stability so that they will not be constricted through the sucking action.

The media-specific data need to be observed, for example, the device must be arranged below the fluid level in case of aqueous dispersions and solutions.



NOTICE

Danger of property damage when pumping aqueous fluids

When pumping aqueous dispersions or solvents, low pressure on the inlet port can lead to cavitation damage on the pump.

1. Comply with the media-specific attributes.
2. When designing the inlet line, make sure the inlet port pressure on the pump inlet during operation is always higher than the steam pressure of the pumping fluid. While doing so, also take the altitude of the site of the device over mean sea level into consideration.
3. For aqueous dispersions and solvents, limit the operating temperature to max. 50 °C, install the pump underneath the liquid level and limit the rotational speed to maximal 1500 rpm.

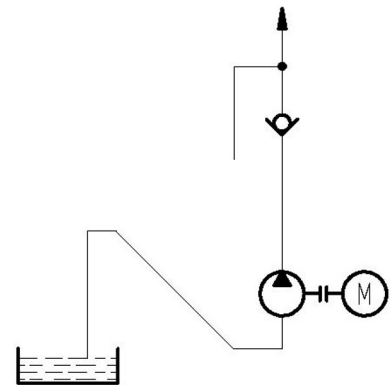
The recommended flow velocity in the suction line is max. 1,5 m/s.

Piping the suction line as siphon

If there is a possibility that the suction line can run dry of the pump stops, piping the suction line as siphon is an option to avoid suction problems. This way, the pump will remain permanently filled after initial commissioning.

The air in the pressure line can be conducted directly into the tank via a nozzle (see section 6.5.2 "Pressure line").

It is appropriate to employ a foot valve or a non-return valve in case of longer suction lines that can run dry while the pump is at rest. These must have been designed for use in suction lines and should offer as low a flow resistance as possible.

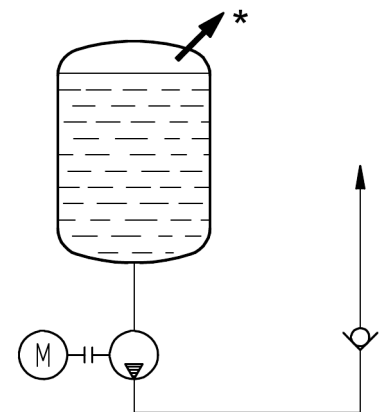


Suction line at vacuum operation

If the pump is to intake from a tank under vacuum, the pump must be arranged approx. 0.8 m below the tank. The suction line must run in a straight line and without any resistances.

The tank may be subjected to vacuum only then when the pipework and the pump have been filled with liquid.

For this application, only pumps designed as a vacuum system may be employed.



* = Vacuum

NOTICE

Malfunction due to excessive underpressure

Undercutting the permissible underpressure can lead to a decrease in the delivery rate (due to short filling of the pump), high noise emission and cavitation. Furthermore, in shaft seals the sealing lip can lift up allowing air to be sucked in.

1. The permissible pressure at the pump inlet shall not be lower than value $p_{e\ min}$ as stated in the chapter 4 "Technical data".

An exception to this is the pump's starting state during which a pressure of 0.4 bar absolute is tolerable for max. 30 minutes.



NOTICE

Damage or failure of the shaft seal due to high supply pressure

Exceeding the permissible supply pressure can lead to a failure of the shaft seal or to impermissible heating and increased wear.

1. The permissible pressure at the pump inlet must not exceed the value $p_{e\ max}$ as stated in the [chapter 4 "Technical data"](#).

6.5.2 Pressure line



DANGER

Danger due to breakage or squirting fluids!

Operating the device with impermissibly high pressure can lead to damage to the device and to the up or downstream plant elements. Breakage can lead to parts flying around uncontrolled or to fluids squirting out which can lead to accidents and severe injuries or even result in death.

1. **Never** allow positive displacement pumps to pump against "closed gates".
2. A pressure relief valve or other kind of over-pressure safeguard must be installed as close as possible to the pump pressure connection. The pressure relief device must be dimensioned so that entire delivery volume can be conducted through with the lowest possible pressure or pressureless.
3. Do **not** put the device into operation without a pressure relief device.

The nominal width of the pressure line must be selected such that the maximum permissible pressure are not exceeded.

The pressure must be checked by a manometer installed as closely as possible to the pressure connection.

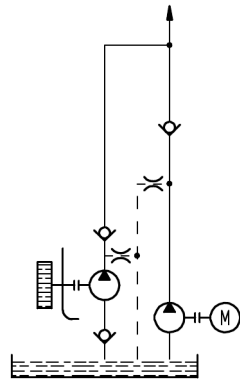
To avoid pump overload caused by an impermissibly high pressure, a pressure relief valve or rupture disc with return to the supply tank must be installed as closely as possible to the pump's pressure connection.

Another option of pressure limiting is to mount a pressure relief valve directly to the pump.

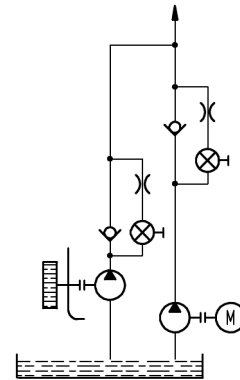
During operation of a pump that has to pump media via a non-return valve in a pressurized circuit (e.g. reserve pump in a lubricant circuit), intake problems can occur if the inlet pipe is filled with air. In this case the pressure pipe must be bled directly upstream of the non-return valve.

This can be carried out by a bleeding valve with return or a throttled bypass, for example.

Bleeding valve and throttled bypass



Bleeding valve with return



Throttled bypass

If none of the measures described is carried out, the volume of the pressure pipe between the pump and the non-return valve must be at least 75 % of the inlet pipe volume.

6.6 Mounting the clutch



NOTICE

Danger of property damage due to falsely dimensioned coupling

An incorrect design can lead to premature failure on the coupling due to breakage or wear.

1. When dimensioning the coupling, pay attention to safe dimensioning to be able to transfer the expected maximum torque reliably and permanently.
2. Take the vibrations, peak torques and temperatures into consideration. The permissible values from the coupling manufacturer must **not** be exceeded.
3. Comply with the coupling manufacturer's installation rules.

When mounting the clutch, keeping the "E" measure exactly is of the essence so that the clutch will remain axially movable when used. In order to avoid any frontal pressure against the elastic gear rim, measure "E" should each be considered as minimum in the case of an axial displacement.

If the shaft clearance is less than clutch clearance "E", one of the shaft ends can easily extend into the gear rim. Size "d_w" corresponds to the max. shaft diameter that may extend with the parallel key into the gear rim, size "d_H". If there is the chance to offset the parallel key, i.e. only the shaft extends into the gear rim, the size of the shaft may be increased up to 2 mm below the specified "d_H" size in order not to obstruct the gear rim in its axial movability.

The permissible displacement values of the elastic clutches stated represent general guide values taking a clutch loading up to the clutch nominal torque and an operating speed n = 1500 rpm as well as an occurring ambient temperature of +30 °C into account. **Consultation with the manufacturer is necessary for deviating operating conditions.**

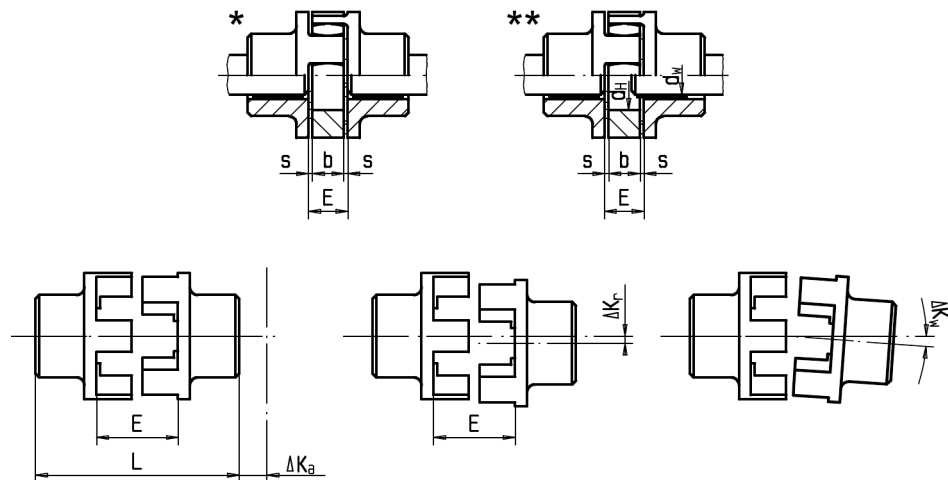
The displacement data may only be used individually in each case and in case of simultaneous appearance in proportion only.



Increasing the service life of the coupling

1. Careful and exact shaft alignment increases clutch life!

Fig. 6.1: Displacements - aligning the clutch



* Clutch clearance "E"

** Shaft with parallel key extends into the gear rim (d_w)

Tab. 6.2: Types of coupling

Type of coupling*		19	24	28	38	42	48	55	65	75
		19/24	24/28	28/38	38/45	42/55	48/60	55/70	65/75	75/90
Clutch clearance**	E	16	18	20	24	26	28	30	35	40
Dimension**	s	2	2	2,5	3	3	3,5	4	4,5	5
Dimension**	d_H	18	27	30	38	46	51	60	68	80
Dimension**	d_w	12	20	22	28	36	40	48	55	65
Max. axial displacement**	ΔK_a	1,2	1,4	1,5	1,8	2,0	2,1	2,2	2,6	3,0
Max. radial displacement** n=1500 1/min	ΔK_r	0,20	0,22	0,25	0,28	0,32	0,36	0,38	0,42	0,48
Max. angular displacement n=1500 rpm	ΔK_w	1,2°	0,9°	0,9°	1,0°	1,0°	1,1°	1,1°	1,2°	1,2°

* Example: RA19-Z25/14-Z25/19 or RA19/24-Z25/14-Z25/24
 ** Dimensions in mm



NOTICE

Danger of property damage when mounting other types of couplings
 If other coupling types are used, when mounting the coupling the instructions from the respective manufacturer is binding.

1. The respective manufacturer's installation instructions must be complied with when using other coupling types.



NOTICE

Danger of property damage if installation is not correct

When installing the respective coupling halves, there is a hazard of damaging the integrated bearing or the components.

1. Do not knock onto the shafts during installation of the clutch halves!



Easing coupling installation

1. The hubs should be heated for mounting the clutch and slide onto the shaft while hot.
Using a pinion gear drive, it must also be heated and slide onto the shaft end while hot.



NOTICE

Danger of property damage due to displacement of the coupling halves

When the coupling hub is not secured against axial displacement on each shaft, there is a danger that the coupling hub will shift during operation. That can lead to a failure of the coupling.

1. Prevent axial displacement on every coupling hub on cylindrical shafts with a threaded pin that presses against the fitting key or the shaft.

6.7 Mechanical installation



WARNING

Hazard caused by rotating parts and fluid squirting out!

During all work on the device, rotating parts and squirting fluids can lead to accidents and severe injuries or even result in death.

1. Depressurize all connection lines during all work on the device.
2. Depressurize or disconnect the driving motor during all work on the device.
3. Securely prevent the motor and device from restarting during work.
4. Wear suitable protective clothing.



NOTICE

Malfunction due to leaking lines and connections

Leaks can occur and air can be sucked if lines or connections are not tight. Suctioned air leads to a decrease of the delivery rate and foams up the medium.

1. Make sure all lines and connections are tight.
- Before installation, the device must be checked for transport damage and soiling.
 - Any preserving agents must be removed before installation using benzine or solvent.
 - Clean the pipework of dirt, scale, sand, swarf, etc. prior to installation. Welded pipes in particular must be pickled or flushed. Cotton waste must not be used for cleaning.
 - Mount clutch and clutch halves respectively to pump and drive (see [section 6.6 "Mounting the clutch"](#)).



WARNING


Hazard caused by rotating parts!

Rotating parts can cause accidents with severe injuries or result in death due to body parts, hair or clothing getting caught or wrapped up.

1. Protect rotating parts (e.g., coupling and shaft ends) against unintentional contact.
2. Close any maintenance openings when using bell housings.
3. Do **not** operate the device without safeguards.


- Mount pump to bellhousing, foot or housing and pay attention to careful alignment and correct fitting position (see [chapter 4 "Technical data"](#)).
- Tighten all fastening screws applying the torque as prescribed by the manufacturer of the bellhousing avoiding any twisting of the pump in the process without fail.

- Remove the protective plugs in the pump's suction and pressure connections.

 **WARNING**

Danger due to exposed gears!
Gears can pull in and crush or cut off fingers and hands.


1. Do **not** reach into the gears.
2. Put the device into operation with connected lines only.

 **WARNING**

Danger due to hazardous fluid!
Danger of death upon contact with hazardous fluids and when inhaling vapours from these liquids.


1. Comply with the safety data sheets and regulations on handling the hazardous liquids!
2. Collect and dispose leaks of hazardous materials so that no hazards arise for people or the environment.
3. Comply with national and international rules at the place of installation.
4. Wear suitable protective clothing.

- Wet devices interiors with fluid being pumped.

 **DANGER**

Danger due to breakage or squirting fluids!
Using unsuitable connections and lines can lead to breakage. Parts flying around uncontrolled or squirting fluids can lead to accidents with severe injuries or even lead to death.

1. Use only connections and lines approved for the expected pressure range.
2. The respective manufacturer's regulations must be heeded.

 **NOTICE**

Danger of property damage due to distortion
The load on the device due to impermissible external loads can lead to malfunctions or to breakage of the flange or housing.

1. Pipelines must be fitted absolutely tension-free to the device connections.
2. Pipelines must be designed in such a way that no tension e.g. caused by changes in length due to fluctuations in temperature can be transferred to the device.

- Connect suction and pressure side according to the marking on the pump or the information on the type plate (see [section 6.3 “Definition of the direction of rotation and pumping flow”](#)).
- Connect the pipework to the suction and pressure piping. Always heed the respective manufacturer's instructions.
- When operating the pump with liquid seal (quench) mount a suitable tank for the liquid seal (see [chapter 7 “Operation start-up”](#)).


DANGER
Danger due to breakage or squirting fluids!

Operating the device with impermissibly high pressure can lead to damage to the device and to the up or downstream plant elements. Breakage can lead to parts flying around uncontrolled or to fluids squirting out which can lead to accidents and severe injuries or even result in death.

1. **Never** allow positive displacement pumps to pump against "closed gates".
2. A pressure relief valve or other kind of over-pressure safeguard must be installed as close as possible to the pump pressure connection. The pressure relief device must be dimensioned so that entire delivery volume can be conducted through with the lowest possible pressure or pressureless.
3. Do **not** put the device into operation without a pressure relief device.


CAUTION
Danger due to hot surfaces!

When operating the device with hot media, there is a danger of being burned and scalded when touching the hot surfaces.

1. At medium temperatures above 60 °C, take measures against unintended contact.
2. Wear safety gloves.


NOTICE
Danger of malfunctions through polluted medium

When filling the storage tank with the medium, impurities or small parts can get into the tank and cause damage or malfunctions on the device or in the system.

1. When filling the storage tank pay attention to the greatest possible cleanliness.

- Before opening, clean filler screw and shutoff on fluid transport and storage tank.
- Check media tank for contamination and clean if necessary. On no account remove the filter screen on the filler neck or the filter insert during the filling process.

- Filling the media tank with the prescribed fluid.
- Ensure sufficient filling of the media tank!

6.8 Assembly with further components and devices



NOTICE

Danger of property damage if installation is not correct

Incorrect assembly with components or devices from other manufacturers can lead to breakdowns.

1. Comply with each manufacturer's operating instructions when assembling with additional components or devices..

6.9 Electrical connection



DANGER

Danger due to electric voltage!

Danger of death due to electric shock.

1. Follow the special safety regulations during all work on electrical installations.
2. Only allow electricians to work on electrical systems.



DANGER

Hazard caused by incorrect direction of rotation!

Operating the device with the incorrect direction of rotation can lead to damage to the device and to the up or downstream plant elements. Breakage can lead to parts flying around uncontrolled or to fluids squirting out which can lead to accidents and severe injuries or even result in death.

1. Always pay attention to the correct direction of rotation when installing the pump.
2. Always pay attention to the correct direction of rotation when connecting the motors.
3. Secure the fitting keys against flying off when monitoring the direction of rotation.

- All data stated on the motor type plate must be checked for conformity to the required operating data.
- Adjust the overload protection to the correct value.
- Check the rotational drive direction of the pump before switching on.

7 Operation start-up

7.1 Preparation

WARNING

Hazard caused by rotating parts!

Rotating parts can cause accidents with severe injuries or result in death due to body parts, hair or clothing getting caught or wrapped up.

1. Protect rotating parts (e.g., coupling and shaft ends) against unintentional contact.
2. Close any maintenance openings when using bell housings.
3. Do **not** operate the device without safeguards.

WARNING

Danger due to exposed gears!

Gears can pull in and crush or cut off fingers and hands.

1. Do **not** reach into the gears.
2. Put the device into operation with connected lines only.

WARNING

Danger due to hazardous fluid!

Danger of death upon contact with hazardous fluids and when inhaling vapours from these liquids.

1. Comply with the safety data sheets and regulations on handling the hazardous liquids!
2. Collect and dispose leaks of hazardous materials so that no hazards arise for people or the environment.
3. Comply with national and international rules at the place of installation.
4. Wear suitable protective clothing.

CAUTION

Danger due to hot surfaces!

When operating the device with hot media, there is a danger of being burned and scalded when touching the hot surfaces.

1. At medium temperatures above 60 °C, take measures against unintended contact.
2. Wear safety gloves.

**NOTICE****Danger of property damage due to incorrect commissioning**

Improper commissioning can lead to damages and malfunctions in the device and in the plant.

1. Permit only expert and technically qualified personnel to work on the device.
 2. Comply with the permissible operating data such as rotational speed, pressure temperature, permissible media, etc. (see [chapter 4 "Technical data"](#)).
 3. Pay attention to cleanliness during all work.
 4. Before starting the system make sure that a sufficient quantity of the operating fluid is extant to avoid dry running.
 5. Before starting the plant, pumps and inlet line must be filled with operating fluid to prevent damage to the pump and the shaft seal during dry runs. That also guarantees pump suction.
 6. For pumps with liquid seal (quench), fill the sealing cavity with a suitable confining fluid before it is used for the first time.
 7. Make sure that all lines and connections are tight and that no leakages can occur or air can be sucked.
- Check the permissible operating data against the operating states to be expected.
 - Check all fastening screws on the device.
 - Fill the pump and suction line with the operating fluid.
 - In the case of pumps with liquid seal (quench), fill the sealing cavity using an appropriate confining fluid (see [section 7.2 "Pumps with liquid seal \(quenching connection\)"](#)).
 - Checking the direction of rotation. See section "Change of the direction of rotation" in [chapter 6 "Installation"](#) for any change in rotational direction.

7.2 Pumps with liquid seal (quenching connection)

7.2.1 General points



NOTICE

Danger of failure of the seal due to a lack of sealing fluid

A lack of sealing fluid can lead to a failure of the shaft seal and to increased temperatures and increased wear.

1. Fill the pump's sealing cavity with a suitable sealing medium. The sealing fluid must be compatible with the seals and materials used as well as with the pumping medium.
2. The confining fluid's minimum and maximum filling level must be ensured using appropriate technical and/or organisational measures.
3. The liquid seal in the quenching connection must not be subjected to pressure or vacuum.

If fluids are delivered,

- that cure in air,
- crystallise in contact with air humidity,
- the leakage of which must not be released into the environment,
- are under vacuum and their seal shall be gastight,

than the employment of a double seal with liquid seal is necessary.

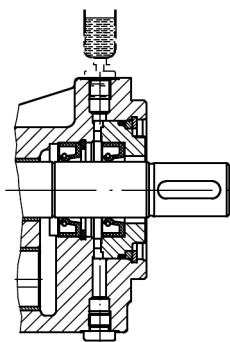
- A tank for the liquid seal is to be connected to the quenching connection. Suitable tanks are available from the manufacturer.
- The tank for the liquid seal must be placed above the pump.
- The installation position is restricted and the quenching connection shall be directed upward.
- Check of the fluid level in the tank must be possible at any time.



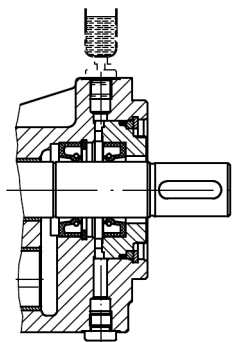
Flushing connection sealing cavity

1. A second port on the device enables purging of the sealing cavity and draining of the seal liquid.

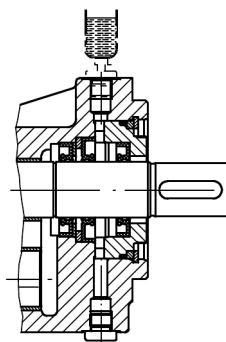
7.2.2 Seal variants with liquid seal



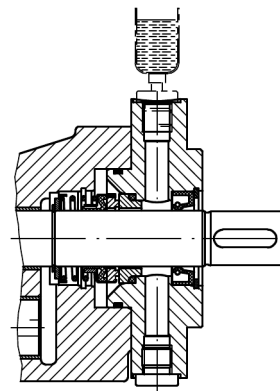
Types of seals:
4, 7, 19, 32



Types of seals:
4, 7, 19, 32
Special number 74



Triple rotary shaft lip
seal
(on request)

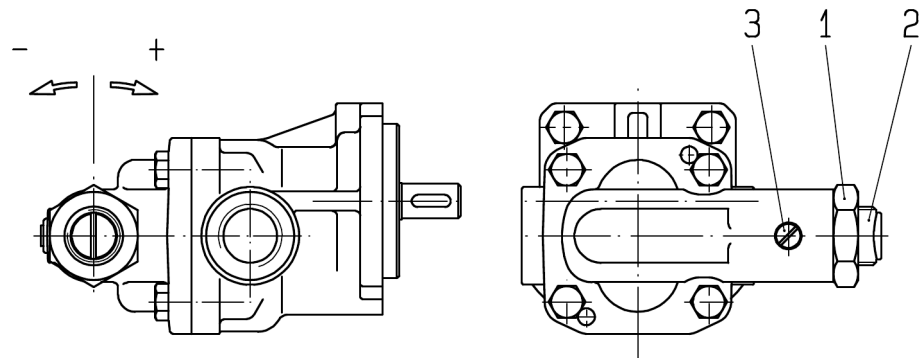


Seal type: 5
Special number 198

7.3 Setting the pressure relief valve

Applies for pumps with built-on pressure relief valve
(Type designation: KF ... - D15 or KF ... - D25)

Fig. 7.1: Pressure setting KF 2,5...200 - D..



- response pressure lower
+ response pressure higher



NOTICE

Danger of the pump overheating

The series D.. pressure relief valve are exclusively used to protect the pump. The valves must only respond for short durations. Permanent draining of the volumetric flow through the valve will destroy the pump through overheating.

- Make sure the valve responds only briefly.

For pressure setting on the pressure relief valve see [figure 7.1](#):

- loosen the hexagon nut (1)
- adjust set screw (2)
clockwise = response pressure higher
counterclockwise = response pressure lower
- secure the set screw (2) using hexagon nut (1) once the desired pressure has been adjusted.

**Danger due to breakage or squirting fluids!**

When securing screw (3) is loose, set screw (2) can be screwed into the valve device until the valve device is completely shut. That can result in inadmissibly high pressures in the system if there is no other pressure relief device. Breakage can lead to parts flying around uncontrolled or to fluids squirting out which can lead to accidents and severe injuries or even result in death.

Fluid can spurt out from the valve if set screw (2) is completely screwed out. That can lead to accidents with severe injuries or result in death.

1. Never operate the device with securing screw (3) or set screw (1) loosened.
2. Never completely screw set screw (2) into the valve.
3. Never completely unscrew set screw (2) out of the valve.

7.4 Further operation start-up

- The pumps may only start without or with low pressure load. For this purpose, open the existing shut-off elements and adjust the pressure relief valve incorporated in the pressure pipe to the lowest opening pressure.
- Start-up takes place by repeated quick on-off switching of the driving motor (jog mode) without reaching full speed until proper operation of the device is evident. This applies particularly when a cold pump is to start with already heated medium. The reason for this is to achieve slow heating of the pump and prevent the pump seizing through thermal shock.
- Proper function indicated by noise generation or on the pressure gage should be reached after max. 30 seconds.
- First of all, run the pump at zero pressure or low pressure for a couple of minutes after switching on the motor.
- Bleed the plant on the distribution pipes, preferably at the highest point.
- Pressure loading can be gradually increased up to the desired operating pressure (max. permissible pressures, see [chapter 4 "Technical data"](#))
- Check the temperature of the medium and that of the pump after the intended operating characteristics have been reached. Checkpoints on the pump are the bearing locations, the housing and the shaft seal. The temperatures observed on the pump surface may be approx. 10 °C above medium temperature.
- Check the fluid level of the plant once more and top up if necessary.
- Check the final operating temperature after several hours running time (see [chapter 4 "Technical data"](#) for max. permissible temperatures).
- Check the static seals on the suction and pressure connections and the pump's joints for leakages.
- Check the threaded connections for leakages. Such leakages can be easily eliminated by simply retightening the threaded connections.
- Also check all motor and pump fastening screws after a few hours of operation.

8 Removal

8.1 General points



NOTICE

Danger of property damage due to insufficiently qualified personnel
Improper work can lead to damages and malfunctions in the device and in the plant.

1. Permit only expert and technically qualified personnel to work on the device.



NOTICE

Danger of property damage due to a lack of cleanliness
A lack of cleanliness can lead to damages and malfunctions in the device and in the plant.

1. Pay attention to cleanliness during all work.
2. Close all openings with protective caps to prevent dirt from penetrating into the system.

8.2 Removing the pump



WARNING

Hazard caused by rotating parts and fluid squirting out!
During all work on the device, rotating parts and squirting fluids can lead to accidents and severe injuries or even result in death.

1. Depressurize all connection lines during all work on the device.
2. Depressurize or disconnect the driving motor during all work on the device.
3. Securely prevent the motor and device from restarting during work.
4. Wear suitable protective clothing.

**WARNING****Danger due to hazardous fluid!**

Danger of death upon contact with hazardous fluids and when inhaling vapours from these liquids.

1. Comply with the safety data sheets and regulations on handling the hazardous liquids!
2. Collect and dispose leaks of hazardous materials so that no hazards arise for people or the environment.
3. Comply with national and international rules at the place of installation.
4. Wear suitable protective clothing.

**CAUTION****Danger due to hot surfaces!**

When operating the device with hot media, there is a danger of being burned and scalded when touching the hot surfaces.

1. At medium temperatures above 48 °C, let the device cool off.
2. Wear safety gloves.

- Remove the depressurised pipelines from the pump.
- Seal the pump connections and pipelines to prevent dirt penetration.
- Disassemble the pump
- Pull off clutch hub resp. the driving pinion from shaft end using an extractor.

**NOTICE****Danger of malfunction due to curing medium**

Curing medium can engage the device mechanically and make it unusable.

1. Immediately clean the pump or store it in such a way that curing is definitely prevented in cases where the pump was operated with curing medium.

9 Maintenance

9.1 General points



NOTICE

Danger of property damage due to insufficiently qualified personnel
Improper work can lead to damages and malfunctions in the device and in the plant.

1. Permit only expert and technically qualified personnel to work on the device.



NOTICE

Danger of damages and malfunctions due to a lack of maintenance
If the device is not regularly maintained, damage that is not discovered or not repaired can lead to malfunctions and to the failure of the device.

1. Maintain the device regularly.
2. Check the device initially right after commissioning.
3. Adapt the extent and time between maintenance intervals to the demands posed by the location.
4. During visual inspections, look purposefully for possible damages.
5. The device must not be used if visible damages are found.
6. Document the type and extent of the maintenance work. That allows the fastest possible detection of a change in operating performance.

When designed to the conditions of use and fitted correctly, the devices are able to be used for long and problem-free operation. They only require a little maintenance. This is absolutely essential for problem-free operation, however. Experience shows that a high percentage of the problems and damage that occur can be traced back to dirt and lack of maintenance.

The extent and time intervals for inspections and maintenance are generally specified by the operator in a respective plan.



Barriers and instructions

1. All removed barriers and warning signs must be put back to their original position on completing maintenance and/or repair.



Checking the operating data

1. Regular checking of all operating data such as pressure, temperature, current consumption, degree of filter soiling etc. contributes to early problem detection.

**NOTICE****Danger of property damage due to a lack of cleanliness**

A lack of cleanliness can lead to damages and malfunctions in the device and in the plant.

1. Pay attention to cleanliness during all work.
2. Close all openings with protective caps to prevent dirt from penetrating into the system.

**NOTICE****Malfunction due to leaking lines and connections**

Leaks can occur and air can be sucked if lines or connections are not tight. Suctioned air leads to a decrease of the delivery rate and foams up the medium.

1. Make sure all lines and connections are tight.

**DANGER****Danger due to breakage or squirting fluids!**

Using damaged connections and lines can cause parts to fly around uncontrolled or fluids to squirt out, which can lead to accidents and severe injuries or even result in death.

1. Immediately replace damaged connections, pipes and hose lines.

**DANGER****Danger due to electric voltage!**

Danger of death due to electric shock.

1. Follow the special safety regulations during all work on electrical installations.
2. Only allow electricians to work on electrical systems.

**WARNING****Hazard caused by rotating parts and fluid squirting out!**

During all work on the device, rotating parts and squirting fluids can lead to accidents and severe injuries or even result in death.

1. Depressurize all connection lines during all work on the device.
2. Depressurize or disconnect the driving motor during all work on the device.
3. Securely prevent the motor and device from restarting during work.
4. Wear suitable protective clothing.

 **DANGER**

Danger due to breakage or squirting fluids!

Operating the device with impermissibly high pressure can lead to damage to the device and to the up or downstream plant elements. Breakage can lead to parts flying around uncontrolled or to fluids squirting out which can lead to accidents and severe injuries or even result in death.

1. **Never** allow positive displacement pumps to pump against "closed gates".
2. A pressure relief valve or other kind of over-pressure safeguard must be installed as close as possible to the pump pressure connection. The pressure relief device must be dimensioned so that entire delivery volume can be conducted through with the lowest possible pressure or pressureless.
3. Do **not** put the device into operation without a pressure relief device.

 **WARNING**

Danger due to hazardous fluid!

Danger of death upon contact with hazardous fluids and when inhaling vapours from these liquids.

1. Comply with the safety data sheets and regulations on handling the hazardous liquids!
2. Collect and dispose leaks of hazardous materials so that no hazards arise for people or the environment.
3. Comply with national and international rules at the place of installation.
4. Wear suitable protective clothing.

 **CAUTION**

Danger due to hot surfaces!

When operating the device with hot media, there is a danger of being burned and scalded when touching the hot surfaces.

1. At medium temperatures above 48 °C, let the device cool off.
2. Wear safety gloves.

9.2 Unusual noise

Some damage is indicated by unusual noises. If there is a change in the device's operating noise, a thorough examination of the cause must always take place.

9.3 Cleaning

The pump shaft as well as the associated hardware must not run in dust accumulations.

Regular cleaning of the device and its environment is therefore necessary.

Cleaning the device using a steam jet cleaner is not permissible.

9.4 Static seals

The static seals on the device's separation joints and the connection lines must be periodically checked for leakproofness.

If there are any visible leaks, immediately stop plant operation.

If the leaks cannot be stopped by simply retightening the connection, replace all affected seals.

9.5 Confining fluid level

Checking the confining fluid filling level is mandatory for safe pump operation. Top up the confining fluid as required.

If there is no automatic monitoring, the filling level must be checked at least before each shift begins.

The outer but also the inner shaft seal could be leaking if the filling level should drop unusually fast within a short period of time. The confining fluid will then leak into the coupling space or it will be sucked into the pump thereby mixing with the medium.

If the filling level should rise, the inner shaft seal may probably be leaking and the confining fluid is begin mixed with the pressurised medium.

Stop plant operation immediately in both cases.

9.6 Rotary shaft lip seal

Rotary shaft lip seals are particularly prone to wear for functional reasons and must accordingly be carefully checked. Excessively high supply pressure or negative suction pressure, wrong rotational direction or pollution leads to increased wear, increased and impermissible temperature rises.

Small amounts of leakage, however, are indispensable for function. The permissible amount of leakage, though, is highly dependent on the operational conditions and cannot be quantified.

If there are excessive amounts of leakage, stop pump operation immediately. Replace the rotary shaft lip seal.

Increased wear on the rotary shaft lip seal should be taken into account in the case of vertical pump installation.

9.7 Mechanical seal

Mechanical seals are particularly prone to wear for functional reasons and must accordingly be carefully checked. Too high admission pressure, wrong rotational direction, frequent star-ups, gas or air portions in the oil or contamination lead to increased wear, increased leakage and impermissible temperature rises.

Small amounts of leakages, however, are indispensable for mechanical seal function. The permissible amount of leakage, though, is highly dependent on the operational conditions and cannot be quantified.

If there are excessive amounts of leakage, stop pump operation immediately. Replace the mechanical seal. In so doing, heed the assembly instructions of the mechanical seal manufacturer.

Increased wear on the mechanical seal should be taken into account in the case of vertical pump installation.

9.8 Clutch

Clutches must be maintained according to the specifications of the respective manufacturer.

9.9 Screw joints

All the screw joints must be checked at regular intervals to make sure they are tight fit. Loose screw joints must be tightened and, if necessary, secured against loosening by e.g. Loctite (medium strength).

9.10 Damage

Check the pump as well as its environment regularly for damage such as dents in the clutch guard.

9.11 Surface temperature

For identifying premature wear or pump overload, it is useful to check the temperatures on the pump surface at regular intervals.

This temperatures should never be much higher (max. 10 °C) than the media temperature at the pump inlet. Checkpoints on the pump are the bearing locations, the housing and the shaft seal.

If the measured temperatures are higher than the permissible values, this is an indication of wear or bearing damages. The pump must be replaced in this case.

9.12 Bearing, gear, wheel chamber housing

Like shaft seals, bearings, gear and wheel chamber housings are wear items. Wear largely depends on the occurring loads, life cycle as well as type and proportion of solids in the medium. Wear cannot be identified from the outside.

The condition of a pump, however, can be analysed by the volumetric efficiency factor. Decrease of the efficiency factor would normally indicate wear. Therefore, a check on all operating data such as delivery, pressure, temperature, drive data, degree of filter contamination should also be carried out during maintenance work.

Further investigations into the cause are necessary in the event of major deviations (> 10 %) to the reference values. This helps detecting premature pump failure in time. The pump must immediately be taken out of service at a drop of delivery or pressure to 80 % of the original values. The achieved values at initial commissioning serve as reference in this case.

10 Repairs

10.1 General points

The term repairs covers:

- *Troubleshooting*, in other words establishing damage, determining and localising the reason of the damage.
- *Elimination of damage*, in other words eliminating the primary causes and replacing or repairing faulty components.

10.2 Troubleshooting

Leaks are the most frequent problem. If these occur on the pipelines, they can be eliminated by straightforward tightening of the screw joints.

If the device itself is leaking, the respective seals have to be replaced.

10.3 Elimination of damage

Repair damage onsite, predominantly by replacing the defective device. The device itself is generally repaired by the manufacturer.

If corresponding expertise and sufficient equipment is available, the consumer or OEM can also make the repairs. For support, **spare part lists** and **sectional drawings** are available. They can be requested from the manufacturer.



NOTICE

Danger of property damage due to incorrect work and use of non-original spare parts

Improper work can lead to damages and malfunctions in the device and in the plant. That also applies to the use of non-original spare parts.

1. Permit only expert and technically qualified personnel to work on the device.
2. Use only genuine original spare parts.

10.4 Return

If the device has to be repaired or checked over the manufacturer's permits, it must be packed suitably for transport. In addition, a safety data sheet for the medium used must be enclosed with the device. In case of well-known mineral oils, at least the exact type description is required.

If harding or agglutinative media are involved, the device must be cleaned before it is returned.

Cleaning is also necessary if the device has been operated with hazardous fluids.

Any openings must be closed.

10.5 Disposal

Disposal of the packaging and used parts must be carried out according to the regulations valid in the country where the device is installed.

10.6 Detecting and eliminating problems

The following table lists the possible causes of the most frequently occurring malfunctions and notes on possible remedies.

If the problems cannot be identified, please request help from the manufacturer.

Fault	Potential causes	
Increased noise	Pump cavitation	<ul style="list-style-type: none"> ● Negative pressure too high causing pump short filling ● Suction height too high ● Suction filter plugged or too small ● Inner diameter of suction line too small ● Suction line too long ● Too many bends in the suction line ● Too many local constrictions in the suction line ● Suction line plugged or leaking ● Too high viscosity ● Temperature too low ● Wrong direction of rotation ● Place of installation too high
	Foaming or trapped air in medium	<ul style="list-style-type: none"> ● Suction line leaking ● Fluid level in supply tank too low ● Too little oil supply ● Return line to tank leaking ● Wrong tank dimensioning ● Shaft seal or seal on suction line leaking ● Return line end above the fluid level in the supply tank ● Insufficient venting ● Too strong foaming in the gear

Fault	Potential causes	
	Mechanical vibrations	<ul style="list-style-type: none"> ● Incorrectly aligned or loose clutch ● Magnetic coupling defective ● Faulty or insufficient line fastening ● Wobbling pressure relief valve ● No noise-optimized design (missing dampers) ● Unfavourable place of pump installation ● Pump worn out, tooth flanks worn out ● Disturbances in pump operation
Pump does not suck		<ul style="list-style-type: none"> ● Too high negative pressure ● Fluid level in supply tank too low ● Magnetic coupling torn off ● Wrong direction of rotation ● Throttled shut-off element in the suction line ● Suction line too long ● Suction line leaking ● Suction resistance too high ● Foreign objects in suction line ● Volume of pressure pipe between pump and non-return valve too little, pump cannot compress the air contained in the suction line ● Non-return valve not bled ● Too high start-up pressure if suction line is filled with air ● Speed too low ● Place of installation too high
Insufficient delivery		<ul style="list-style-type: none"> ● Too high negative pressure ● Throttled shut-off element in the suction line ● Fluid level in supply tank too low ● Suction filter plugged or too small ● Too high viscosity ● Too low viscosity ● Too high speed ● Too high pressure ● Pressure relief valve set too low ● Pump sucks air ● Pump worn out ● Too high proportion of air in the oil ● Universal valve defective ● Place of installation too high

Fault	Potential causes	
Insufficient pressure	Delivery too low, work drags in pressure pipe too low	<ul style="list-style-type: none"> ● Too low viscosity ● Pressure relief valve set too low or does not shut ● Too low speed ● Driving power too low ● Pump worn out
Excessive power consumption		<ul style="list-style-type: none"> ● Too high pressure ● Too high viscosity ● Driving power too low ● Motor winding defective
Excessive operating temperature		<ul style="list-style-type: none"> ● Pressure relief valve set too high ● Speed too high ● Cooling and heat dissipation insufficient ● Supply of fluid too low ● Fluid is being delivered into the supply tank via pressure relief valve under load
Impermissible pump heating		<ul style="list-style-type: none"> ● Delivery-side valve cone not completely shut ● Directly mounted pressure relief valve set too low (does not apply for the "universal valve" and "T-valve" versions) ● Too high pressure ● Too low viscosity ● Gland lid overtightened ● Separating can insufficiently bled ● Admission pressure impermissibly high ● Pump worn out
Leakages on shaft seal		<ul style="list-style-type: none"> ● Admission pressure impermissibly high ● Wrong direction of rotation ● Too high radial shaft loading ● Temperature at sealing point too high ● Wrong seal material ● Missing confining fluid ● Separating can defective ● Sealing wear due to poorly lubricating medium ● Sealing wear through abrasive components in medium ● Sealing wear through curing medium ● Gland lid not sufficiently tightened
Clutch wear		<ul style="list-style-type: none"> ● Incorrectly aligned or loose clutch ● Axial clutch clearance insufficient ● Clutch overloaded ● Temperature too high

Fault	Potential causes	
Magnetic coupling torn off		<ul style="list-style-type: none"> ● Magnetic coupling under-dimensioned ● Pressure too high ● Driving motor oversized ● Too high starting torque ● Too high operating temperature ● Pump is blocking due to foreign objects
Short operational lives	Wear on bearing, gear and housing parts	<ul style="list-style-type: none"> ● Wear through abrasive components ● Wear due to poorly lubricating medium ● Too low viscosity ● Check corrosion, material compatibility ● Too high operating pressure for the media properties