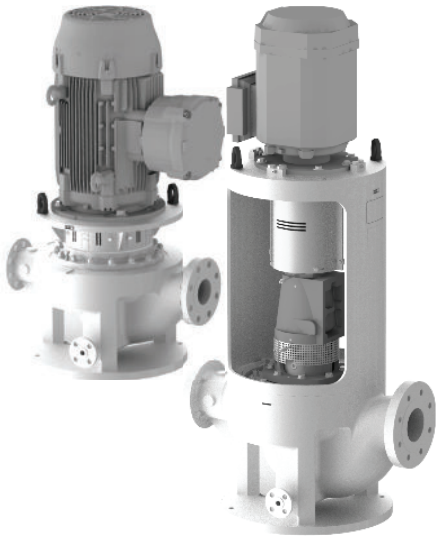
Johnson Pump®

INSTRUCTION MANUAL

CombiProLine

Vertical heavy duty process in-line pump according to API 610 (OH3 & OH5)



REVISION: CRL/EN (2502) 2.4

SPXFLOW®

Orginal instructions

Read and understand this manual prior to operating or servicing this product.

EC Declaration of Conformity

(Directive 2006/42/EC, appendix II-A)

Manufacturer

SPX Flow Technology Assen B.V.
Dr. A.F. Philipsweg 51
9403 AD Assen
The Netherlands

hereby declares that all pumps member of product-families, CombiFlex(U)(B), CombiPrime H, CombiMag, CombiMagBloc, CombiPro(L)(M)(V), CombiPrime V, CombiSump, CombiTherm, CombiWell, FRE, FRES, FREF, FREM, KGE(L), KGEF, MCH(W)(S), MCHZ(W)(S), MCV(S) whether delivered without drive, or delivered as an assembly with drive, are in conformity with the provisions of Directive 2006/42/EC (as altered most recently) and where applicable the following directives and standards:

- EC directive 2014/35/EU, "Electric equipment for use within certain voltage limits"
- EC directive 2014/30/EU, “ElectroMagnetic Compatibility”
- standards EN-ISO 12100, EN 809
- standard EN 60204-1 if applicable

The pumps to which this declaration refers may only be put into operation after they have been installed in the way prescribed by the manufacturer, and, as the case may be, after the complete system of which these pumps form part, has been made to fulfil all applicable essential Health & Safety requirements.

EC Declaration of Incorporation

(Directive 2006/42/EC, appendix II-B)

Manufacturer

SPX Flow Technology Assen B.V.
Dr. A.F. Philipsweg 51
9403 AD Assen
The Netherlands

hereby declares that the partly completed pump (Back-Pull-Out unit), member of product-families CombiFlex(U)(B), CombiPrime H, CombiMag, CombiMagBloc, CombiTherm, CombiPro(L)(M)(V), CombiPrime V, FRE, FRES, FREF, FREM, KGE(L), KGEF is in conformity with the provisions of Directive 2006/42/EC as well as with the following standards:

- EN-ISO 12100, EN 809

and that this partly completed pump is meant to be incorporated into the specified pump unit and may only be put into use after the complete machine of which the pump under consideration forms part has been made and declared to comply with all Directives.

These declarations are issued under the sole responsibility of the manufacturer

Assen, October 1st 2024



H. Hoving,

Director Operations.

Instruction manual

All technical and technological information in this manual as well as possible drawings made available by us remain our property and shall not be used (otherwise than for the operation of this pump), copied, duplicated, made available to or brought to the notice of third parties without our prior written consent.

SPX FLOW is a global multi-industry manufacturing leader. The company's highly-specialized, engineered products and innovative technologies are helping to meet rising global demand for electricity and processed foods and beverages, particularly in emerging markets.

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1 Introduction

1.1 Preface

This manual is intended for technicians and maintenance staff and for those who are in charge of ordering spare parts.

This manual contains important and useful information for the proper operation and maintenance of this pump. It also contains important instructions to prevent potential accidents and damage, and to ensure safe and fault-free operation of this pump.

! **Read this manual carefully before commissioning the pump, familiarize yourself with the operation of the pump and strictly obey the instructions!**

The data published here comply with the most recent information at the time of going to press. However they may be subject to later modifications.

SPXFLOW reserves the right to change the construction and design of the products at any time without being obliged to change earlier deliveries accordingly.

1.2 Safety

This manual contains instructions for working safely with the pump. Operators and maintenance staff must be familiar with these instructions.
Installation, operation and maintenance has to be done by qualified and well prepared personnel.

Below is a list of the symbols used for those instructions and their meaning:

⚠ ***Personal danger for the user. Strict and prompt observance of the corresponding instruction is imperative!***

! **Risk of damage or poor operation of the pump. Follow the corresponding instruction to avoid this risk.**

➢ *Useful instruction or tip for the user.*

Items which require extra attention are shown in **bold print**.

This manual has been compiled by SPXFLOW with the utmost care. Nevertheless SPXFLOW cannot guarantee the completeness of this information and therefore assumes no liability for possible deficiencies in this manual. The buyer/user shall at all times be responsible for testing the information and for taking any additional and/or deviating safety measures. SPXFLOW reserves the right to change safety instructions.

1.3 Guarantee

SPXFLOW shall not be bound to any guarantee other than the guarantee accepted by SPXFLOW. In particular, SPXFLOW will not assume any liability for explicit and/or implicit guarantees such as but not limited to the marketability and/or suitability of the products supplied.

The guarantee will be cancelled immediately and legally if:

- Service and/or maintenance is not undertaken in strict accordance with the instructions.
- The pump is not installed and operated in accordance with the instructions.
- Necessary repairs are not undertaken by our personnel or are undertaken without our prior written permission.
- Modifications are made to the products supplied without our prior written permission.
- The spare parts used are not original SPXFLOW parts.
- Additives or lubricants used are other than those prescribed.
- The products supplied are not used in accordance with their nature and/or purpose.
- The products supplied have been used amateurishly, carelessly, improperly and/or negligently.
- The products supplied become defective due to external circumstances beyond our control.

All parts which are liable to wear are excluded from guarantee. Furthermore, all deliveries are subject to our "General conditions of delivery and payment", which will be forwarded to you free of charge on request.

1.4 Inspection of delivered items

Check the consignment immediately on arrival for damage and conformity with the advice note. In case of damage and/or missing parts, have a report drawn up by the carrier at once.

1.5 Instructions for transport and storage

1.5.1 Weight

A pump or a pump unit is generally too heavy to be moved by hand. Therefore, use the correct transport and lifting equipment. Weight of the pump or pump unit are shown on the label on the cover of this manual.

1.5.2 Use of pallets

Usually a pump or pump unit is shipped on a pallet. Leave it on the pallet as long as possible to avoid damages and to facilitate possible internal transport.

! When using a forklift always set the forks as far apart as possible and lift the package with both forks to prevent it from toppling over! Avoid jolting the pump when moving it!

1.5.3 Hoisting

When hoisting a pump unit OH3 or pump unit OH5 the straps must be fixed in accordance with figure 1 and figure 2.

⚠ ***When lifting a pump unit always use a proper and sound lifting device, approved to bear the total weight of the load! Never go underneath a load that is being lifted!***

! **If the electric motor is provided with a lifting eye, this lifting eye is intended only for the purpose of carrying out service activities to the electric motor! The lifting eye is designed to bear the weight of the electric motor only! It is NOT permitted to lift a complete pump unit at the lifting eye of an electric motor!**

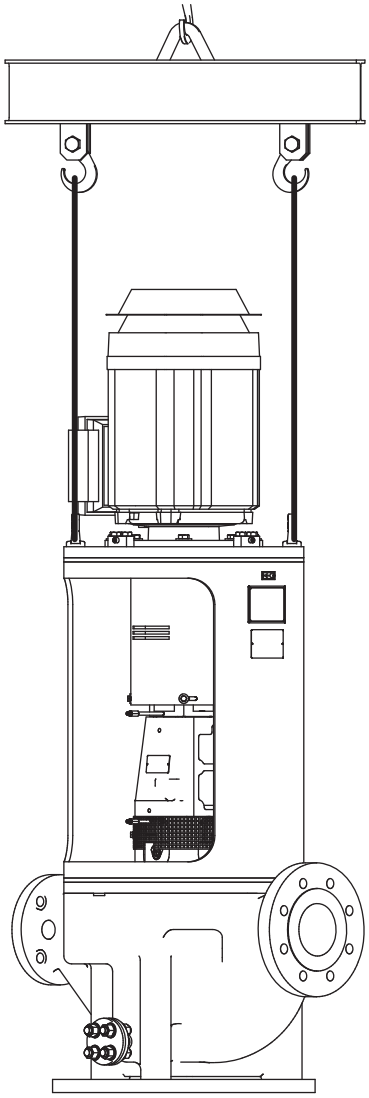


Figure 1: Lifting instructions for OH3 pump unit.

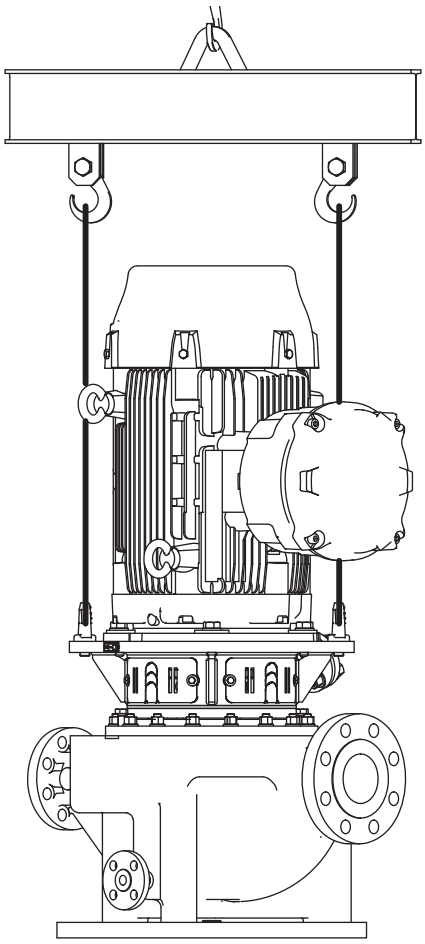


Figure 2: Lifting instructions for OH5 pump unit.

1.5.4 Storage

If the pump is not to be used immediately the pump shaft must be turned by hand twice per week.

1.6 Ordering parts

This manual contains a survey of the spare parts recommended by SPXFLOW as well as the instructions for ordering them. A fax-order form is included in this manual.

You should always state all data stamped on the type plate when ordering parts and in any other correspondence regarding the pump.

➢ *This data is also printed on the label on the front of this manual.*

If you have any questions or require further information with regard to specific subjects, then do not hesitate to contact SPXFLOW.

2 General

2.1 Pump description

The CombiProLine represents a range of vertical "heavy duty" centrifugal pumps. The design of this range of pumps is based on the guidelines for: "Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries" from the "American Petroleum Institute" otherwise known as the API Standard 610 (identical to ISO 13709). The CombiProLine range therefore meets the high requirements which have been set by the refineries and the petrochemical industry.

The API 610 contains important technical guidelines in order to guarantee optimum reliability. This pump amply complies with these requirements. This has been demonstrated through extensive research and can be supported on the basis of advanced methods of calculation.

2.2 Applications

- In general, this pump can be used for thin, clean or slightly polluted liquids. These liquids should not affect the pump materials.
- The maximum allowed system pressure and temperature and the maximum speed depend on the pump type and the pump construction.
- Further details about the application possibilities of your specific pump are mentioned in the order confirmation and/or in the data sheet enclosed with the delivery.
- Do not use the pump for purposes other than those for which it is delivered without prior consultation with your supplier.

⚠ ***Using a pump in a system or under system conditions (liquid, working pressure, temperature, etc.) for which it has not been designed may hazard the user!***

2.3 Type code

Pumps are available in various designs. The main characteristics of the pump are shown in the type code.

Example: **CRL 50A-200 OH3 A-8 1CW-FX**

Pump family	
CRL	**C**ombiP**r**o**L**ine
Pump designation	
OH3	vertical, in-line
OH4	close-coupled, vertical, in-line
Pump size	
50A	discharge connection [mm]. A and B design pump types have the same designation though they have different hydraulic performances
200	nominal impeller diameter [mm]
Pump casing material according to API 610	
S-1	carbon steel
S-6	carbon steel
S-8	carbon steel
C-6	12% CHR
A-8	316 AUS
D-1	duplex
D-2	super duplex
Impeller material according to API 610	
S-1	cast iron
S-6	12% CHR
S-8	316 AUS
C-6	12% CHR
A-8	316 AUS
D-1	duplex
D-2	super duplex
Shaft sealing code according to API 682	
Arrangement 1	
1CW-FX	Contacting single wet seal with a fixed throttle bushing
1CW-FL	Contacting single wet seal with a floating throttle bushing
Arrangement 2	
2CW-CW	Liquid buffer fluid, Dual contacting wet seals
2CW-CS	Gas buffer fluid or no buffer fluid, Contacting wet inner seal with a containment seal
2NC-CS	Gas buffer fluid or no buffer fluid, Non-contacting inner seal with a containment seal
Arrangement 3	
3CW-FB	Liquid barrier fluid, Contacting wet seals in a face-to-back configuration
3CW-BB	Liquid barrier fluid, Contacting wet seals in a back-to-back configuration
3CW-FF	Liquid barrier fluid, Contacting wet seals in a face-to-face configuration
3NC-BB	Gas barrier fluid, Non-contacting seals in a back-to-back configuration
3NC-FF	Gas barrier fluid, Non-contacting seals in a face-to-face configuration
3NC-FB	Gas barrier fluid, Non-contacting seals in a face-to-back configuration

2.4 Serial number

Serial number of the pump or pump unit are shown on the name plate off the pump and on the label on the cover of this manual.

Example: **19-001160**

19	year of manufacture
001160	unique number

2.5 Construction

The pump has a modular design. The main components are:

- Pump casing
- Impeller
- Shaft sealing
- Bearing

In general for each individual pump type there is only one design of the pump casing and the impeller. So, the hydraulic performance is fixed. However for several pump types there has been developed an additional “low’ or “high flow” design. The required capacity and head are obtained by pump speed selection and, if necessary, reduction of the impeller diameter.

The pumps are divided into three bearing groups. The OH3 pumps each bearing group only has one pump shaft and one bearing arrangement. The OH5 pump is provided by the motor bearings. The selection of the pump/motor combination is such that the bearings of the applied electric motors can absorb the axial and radial forces without the bearing life being affected.

The pumps are also standardized into six groups with the same connection for the pump casing and pump cover, depending on the nominal impeller diameters. For each combination of shaft and nominal impeller diameter there is one pump cover, in various materials, and for OH3 pumps one bearing bracket which is made from carbon steel.

The various designs of pumps are created by the addition of shaft seal “cartridges”. These “cartridges” are standardized in the same three groups as the pump shafts and are designed in accordance with API 682 (identical to ISO 21049).

In addition to this various material varieties can be used for components which come into contact with the pumped liquid.

2.6 Pump casing

On the suction side of the impeller the pump casing is provided with a renewable wear ring. An anti-rotation partition is fitted into the inlet. The centering edge for the pump cover is located on the outside of the packing for the pump casing and does not therefore come into contact with the liquid.

The suction and discharge flanges are designed and machined in accordance with ASME B16.5 300 lbs RF (ISO 7005 PN50), and it is also possible to supply the flanges drilled in accordance with the ASME B16.5 150 lbs RF (ISO 7005 PN20). The outside diameter and the thickness of the inlet and outlet flanges are, in this case, in accordance with ASME B16.5 300 lbs. The surface finish of the flanges is according ASME B16.5 requirements. The drain of the pump casing is a “butt-welded” flanged design coherent to the pump casing’s pressure class.

2.7 Impeller

The back of the closed impeller is provided with back vanes in order to limit the pressure on the shaft seal and to allow the flushing liquid to circulate. Contamination of the shaft seal is also prevented. On the inlet side the impeller is provided with an interchangeable wear ring. Running clearances meet the requirements of API 610.

2.8 Pump cover

The pump is designed to fit any seal type in accordance with API 682. In collaboration with various suppliers of mechanical seals the design has been closely evaluated in order to be able to build in the required variants.

2.9 Wear rings

Both the impeller and the pump casing are fitted with a renewable wear ring. The impeller wear ring has a hardness at least 50°Br over the casing wear ring. The rings are secured by three lock screws.

2.10 Mechanical seal

The various designs of pumps are created by the addition of shaft seal "cartridges". These "cartridges" are standardized in the same three groups as the pump shafts and are designed in accordance with API 682.

2.11 Bearing OH3 pump

- The bearing construction consists of two angular contact bearings (in "O" arrangement) combined with a cylindrical roller bearing. The bearings are grease lubricated. The bearings on the coupling side with which the axial force is taken up are retained on the shaft by a shaft nut. The outer ring of these bearings is retained by the bearing cover.
- The cylindrical roller bearing on the impeller side takes up radial forces and is mounted "floating" on the outer ring. As a result of this the machining tolerances and expansions can be easily accommodated. The bearing arrangement is sealed by labyrinth rings.

2.12 Coupling OH3 pump

Pump and motor are coupled by means of a flexible coupling with spacer sleeve ('spacer'). After the guards and spacer have been removed, the rotating part of the pump can be easily dismantled as a whole without having to disconnect the electric motor or the piping. This construction is called the Top Pull Out principle.

2.13 Application area

The application area globally looks as follows:,

Table 1: Application area.

	Maximum value
Capacity	470 m^3/h
Discharge head	160 m
System pressure	5000kPa (50 bar)
Temperature	-30 to +200 °C
Viscosity	300 mm^2/s

However, the maximum allowable pressures and temperatures depend strongly on the selected materials and components. Also working conditions may cause differences.

2.14 Re-use

The pump may only be used for other applications after prior consultation with SPXFLOW or your supplier. Since the lastly pumped medium is not always known, the following instructions should be observed:

1 Flush the pump properly.

2 Make sure the flushing liquid is discharged safely (environment!)

⚠ ***Take adequate precautions and use the appropriate personal protection means like rubber gloves and spectacles!***

2.15 Scrapping

If it has been decided to scrap a pump, the same flushing procedure as described for Re-use should be followed.

3 Installation

3.1 Safety

- Read this manual carefully prior to installation and commissioning. Non-observance of these instructions can result in serious damage to the pump and this will not be covered under the terms of our guarantee. Follow the instructions given step by step.
- Ensure that the pump can not be started if work has to be undertaken to the pump during installation and the rotating parts are insufficiently guarded.
- Depending on the design the pumps are suitable for liquids with a temperature of up to 200°C. When installing the pump unit to work at 65°C and above the user should ensure that appropriate protection measures and warnings are fitted to prevent contact with the hot pump parts.
- If there is danger of static electricity, the entire pump unit must be earthed.
- If the pumped liquid is harmful to men or the environment, take appropriate measures to drain the pump safely. Possible leakage liquid from the shaft seal should also be discharged safely.

3.2 Preservation

Before commissioning the pump remove any preserving agents and flush the pump thoroughly with hot water.

3.3 Environment

- The foundation must be hard, level and flat.
- The area in which the pump is installed must be sufficiently ventilated. An ambient temperature or air humidity which is too high, or a dusty environment, can have a detrimental effect on the operation of the electric motor.
- There should be sufficient space around the pump unit to operate and if necessary repair it.
- Behind the cooling air inlet of the motor there must be a free area of at least ¼ of the electric motor diameter, to ensure unobstructed air supply.

3.4 Mounting OH3 pump

3.4.1 Installation of a pump unit

Pump and motor shafts of complete pump units are adjusted perfectly in line in the works.

1 In case of permanent arrangement place the base plate level on the foundation with the aid of shims.

2 Carefully tighten the nuts on the foundation bolts.

3 Check the alignment of pump and motor shafts and if necessary realign, see paragraph 3.4.3 "Alignment of the coupling".

3.4.2 Assembling a pump unit

If the pump and the electric motor still have to be assembled, do the following:

1 Remove the front guards (0270). Check if there is a key in both shaft ends.

2 Clean the motor and pump shaft. Grease both shaft ends with mounting grease.

3 Fit both halves of the coupling to the pump shaft and the motor shaft respectively. The front of the hub must be flush with the shaft end.

4 Align the coupling in accordance with the following instructions.

3.4.3 Alignment of the coupling

Use bolts (0890) to position the electric motor in such a way that the coupling halves are aligned correctly.

For couplings use a dial indicator as figure 3 shown. The alignment values are maximums for continuous service, see paragraph 3.4.4 "Tolerances for aligning the coupling".

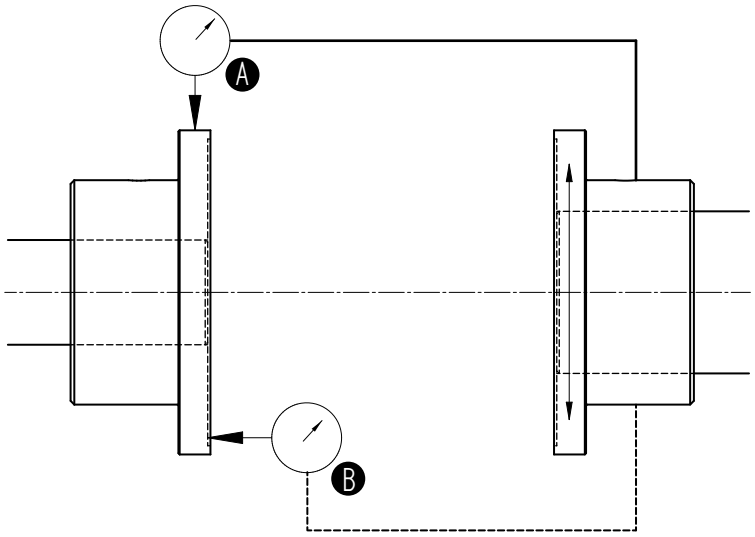


Figure 3: Aligning the coupling, A= Parallel, B= Angular.

Parallel alignment

1 Mount dial gauge (A) on the coupling halve motor side, see figure 3.
2 Make index lines on the two coupling halves.
3 Set the dial gauge pointer to zero, turn motor shaft 360 °.
4 Read dial gauge (A). Add or remove shims under the motor until the reading of the dial gauge is within the allowable tolerance, see paragraph 3.4.4 "Tolerances for aligning the coupling".
5 Repeat the procedure.
6 Remove dial gauge (A).

Angular alignment

1 Mount dial gauge (B) on the coupling halve motor side, see figure 3.
2 Make index lines on the two coupling halves.
3 Set the dial gauge pointer to zero, turn motor shaft 360 °.
4 Read dial gauge (B). Move the motor sideways until the deflection is halved, see paragraph 3.4.4 "Tolerances for aligning the coupling".
5 Repeat the procedure.
6 Remove dial gauge (B).
7 Fit the guard.

3.4.4 Tolerances for aligning the coupling

The maximum allowable tolerances for the alignment of the coupling halves are shown in Table 2.

Table 2: Alignment tolerances

External diameter of coupling [mm]	Axial misalignment [mm]	Max. Parallel misalignment [mm]
86	1,0	0,30
105	1,3	0,35
130	1,5	0,45
152	2,0	0,55

The values are maximums for each type of misalignment. It is recommended that the coupling is initially aligned to 10% of these values to allow for inevitable movements during the life of the pump.

3.5 Piping

- The piping to the suction and delivery connections must fit exactly and must not be subject to stress during operation. For the maximum allowable forces and moments on the pump flanges see paragraph 10.2 "Permissible forces and moments on the flanges".
- The passage of the suction pipe must be amply dimensioned. This pipe should be as short as possible and run towards the pump in such a way that no air pockets can arise. If this is not possible, a venting facility should be provided at the highest point of the pipe. If the inside diameter of the suction pipe is larger than the suction connection of the pump, an eccentric reducer should be applied to prevent air pockets and whirls. See figure 4.

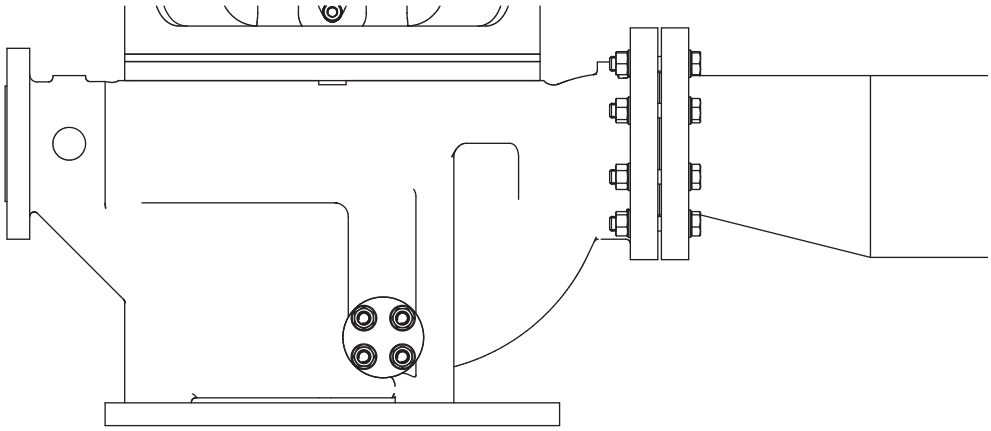


Figure 4: Eccentric reducer to suction flange.

- The maximum allowable system pressure is stated in paragraph 2.13 "Application area". If there is a risk that this pressure might be exceeded, for instance because of an excessive inlet pressure, appropriate measures should be taken by mounting a safety valve in the piping.
- Sudden changes in the rate of flow can lead to high pressure impulses in the pump and the piping (water shock). Therefore, do not use quick-acting closing devices, valves etc.

3.6 Accessories

- Fit any parts that may have been supplied separately.
- If the liquid does not flow towards the pump, fit a foot valve at the bottom of the suction pipe. If necessary, combine this foot valve with a suction strainer to prevent impurities from being drawn in.
- When mounting, place temporarily (for the first 24 operating hours) a fine gauze between suction flange and suction pipe to prevent internal pump parts from being damaged by foreign matter. If the risk of damage continues to exist, fit a permanent filter.
- In case the pump is provided with a cooling chamber, connect the cooling chamber to the supply and return lines of the cooling system.
- In case the pump is provided with an isolation, special attention has to be paid To temperature limits of shaft seal and bearing.

3.7 Connection of the electric motor

⚠ ***The electric motor must be connected to the mains by an approved electrician, according to the locally prevailing regulations of the electricity company.***

- Refer to the instruction manual belonging to the electric motor.
- If possible, fit a working switch as close as possible to the pump.

4 Commissioning

4.1 Inspection of the pump

Check whether the pump shaft turns freely. Do this by turning the shaft end at the coupling a few times by hand.

4.2 Inspection of the motor

Check whether the fuses have been mounted.

4.3 Preparing the pump unit for commissioning

Proceed as follows, both when the unit is put into operation for the first time and after the pump has been overhauled.

1 Fully open the stop valve in the suction pipe. Close the delivery stop valve.

2 Fill the pump and the suction pipe with the liquid to be pumped.

3 Turn the pump shaft a few times by hand and add more liquid, if necessary.

4.4 Checking the sense of rotation

⚠ ***Beware of possible non-screened rotating parts, when checking the sense of rotation!***

1 The sense of rotation of the pump is indicated by an arrow. Check whether the sense of rotation of the motor corresponds with that of the pump.

2 Let the motor run for only a short time and check the sense of rotation.

3 If the sense of rotation is **not** correct, alter the sense of rotation. See the instructions in the user manual belonging to the electric motor.

4 Fit the guard.

4.5 Start-up

1 Open the stop valves in the supply and return lines for flushing or cooling liquid, if the pump is connected to a flushing or cooling system. Ensure these systems are switched on and set at the proper values.

2 Start the pump.

3 As soon as the pump is under pressure, slowly open the delivery stop valve until the working pressure is attained.

4 Open the outlet valve fully until the pump reaches the correct duty point.

⚠ ***Make sure that when a pump is running, rotating parts are always properly screened off by the guard!***

4.6 Pump in operation

When the pump is in operation, pay attention to the following:

- The pump should never run dry.
- Never use a stop valve in the suction line to control pump output. The stop valve should always be fully opened during operation.
- Check whether the absolute inlet pressure is sufficient, to prevent vaporization in the pump.
- Check whether the pressure difference between suction and delivery side corresponds with the specifications of the pump's duty point.

4.7 Noise

The noise production of a pump depends to a great extent on the operating conditions. The values stated in paragraph 10.5 "Noise data" are based on normal operation of the pump, driven by an electric motor. In case the pump is driven by a combustion engine, or in case it is used outside the normal operation area, as well as in case of cavitation, the noise level may exceed 85 dB(A). In that case precautions should be taken, like building a noise-barrier around the unit or wearing hearing protection.

5 Maintenance

5.1 Daily maintenance

Regularly check the outlet pressure.

⚠ ***No water should get into the terminal box of the electric motor when the pump room is sprayed clean! Never spray water on hot pump parts! The sudden cooling down may cause them to burst and hot water may flow out!***

! **Flawed maintenance will result in shorter lifespan, possible break down and in any event loss of warranty.**

5.2 Mechanical seal

A mechanical seal generally requires no maintenance, however, **it should never be allowed to run dry**. If there are no problems, do not dismantle the mechanical seal. If a mechanical seal shows any leakage it has to be replaced.

5.3 Lubrication of the bearings

5.3.1 OH3 pump

The bearings requires re-greasing after every 1000 hours of operation. The bearings are filled with grease during assembly. In case the pump is overhauled, the bearing bracket and the bearings have to be cleaned and provided with new grease. For recommended greases see paragraph 10.3 "Grease".

5.3.2 OH5 pump

For maintenance of the motor bearings we refer to the instructions of the motor supplier concerned.

5.4 Environmental influences

- Regularly clean the filter in the suction pipe or the suction strainer at the bottom of the suction pipe, as the inlet pressure may become too low if the filter or the suction strainer is fouled.
- If there is a risk that the pumped liquid expands during solidification or freezing, the pump has to be drained and, if necessary, flushed after it has been put out of service.
- If the pump is out of service for a long time, it has to be preserved.
- Check motor for accumulation of dust or dirt, which might influence motor temperature.

5.5 Noise

If a pump starts making noise, this may point to certain problems with the pump unit. A crackling noise can indicate cavitation or excessive motor noise can indicate deterioration of the bearings.

5.6 Motor

Check motor specifications for start-stop frequency.

5.7 Faults

⚠ ***The pump, of which you want to determine the fault, may be hot or under pressure. Take the appropriate precautions first and protect yourself with the proper safety devices (safety goggles, gloves, protective clothing)!***

To determine the source of the malfunctioning of the pump, proceed as follows:

1 Switch off the power supply to the pump unit. Lock the working switch with a padlock or remove the fuse. In case of a combustion engine: switch off the engine and close the fuel supply to the engine.

2 Close the stop valves.

3 Determine the nature of the fault.

4 Try to determine the cause of the fault with chapter 6 "Problem solving" and take the appropriate measures or contact your installer.

6 Problem solving

Faults in a pump installation can have various causes. The fault may not be in the pump, it may also be caused by the pipe system or the operating conditions. Firstly, always check that installation has been executed in accordance with the instructions in this manual and that the operating conditions still correspond with the specifications for which the pump was purchased.

In general, breakdowns in a pump installation are attributable to the following causes:

- Faults with the pump.
- Breakdowns or faults in the pipe system.
- Faults due to incorrect installation or commissioning.
- Faults due to incorrect choice of pump.

A number of the most frequently occurring failures as well as their possible causes are shown in the table below.

Table 3: Most frequently occurring failures.

Most common faults	**Possible causes, see Table 4.**
Pump delivers no liquid	1 2 3 4 5 6 7 8 9 10 11 13 14 17 19 20 21 27 29
Pump has insufficient volume flow	1 2 3 4 5 6 7 8 9 10 11 13 14 15 17 19 20 21 28 29
Pump has insufficient head	2 4 5 13 14 17 19 28 29
Pump stops after start up	1 2 3 4 5 6 7 8 9 10 11
Pump has higher power consumption than normal	12 15 16 17 18 22 23 24 25 26 27 32 34 38 39
Pump has lower power consumption than normal	13 14 15 16 17 18 20 21 28 29
Pump vibrates or is noisy	1 9 10 11 15 18 19 20 22 23 24 25 26 27 28 29 37 38 39 40
Bearings wear too much or become hot	23 24 25 26 27 37 38 39 40 42
Pump running rough hot or seizes	18 23 24 25 26 27 34 37 38 39 40 42

Table 4: Possible causes of pump failures.

	Possible causes
1	Pump or suction pipe is not sufficiently filled or de-aerated
2	Gas or air coming from the liquid
3	Air lock in the suction pipe
4	Air leak in the suction pipe
8	The manometric suction head is too high
9	Suction pipe or suction strainer is blocked
10	Insufficient immersion of foot valve or suction pipe during operation of the pump
11	NPSH available too low
12	Speed too high
13	Speed too low
14	Wrong sense of rotation
15	Pump does not operate at the right duty point
16	Liquid density differs from the calculated liquid density
17	Liquid viscosity differs from the calculated liquid viscosity
18	Pump operates when the liquid flow is too low
19	Wrong pump selection
20	Obstruction in impeller or pump casing
21	Obstruction in the piping
22	Wrong installation of the pump unit
23	Pump and motor not well aligned
24	Rotating part running out of true
25	Imbalance in rotating parts (for instance: impeller or coupling)
26	Pump shaft is running out of true
27	Bearings faulty or worn out
28	Casing wear ring faulty or worn out
29	Damaged impeller
37	Axial retaining of impeller or pump shaft is defective
38	The bearings have been mounted wrongly
39	Too much or too little bearing lubrication
40	Wrong or polluted lubricant
41	Impurities in the liquid get into the stuffing box packing
42	Too high axial force because of worn dorsal blades or excessive inlet pressure

7 Disassembly and assembly

7.1 Precautionary measures

⚠ ***Take adequate measures to avoid that the motor is started while you are working on the pump. This is especially important for electric motors with remote control:***

- Switch the operating switch near the pump (if available) to "OFF".
- Switch off the pump switch on the switchboard.
- If necessary remove the fuses.
- Hang a danger board near the switchboard cabinet.

7.2 Special tools

Assembly and disassembly work requires no special tools. However, such tools can make certain jobs easier, for instance replacing the shaft seal. If such is the case it will be indicated in the text.

7.3 Position numbers

The position numbers used in the descriptions below refer to the figures shown in the description. These numbers are also used in the general cross section drawings and the corresponding parts lists chapter 9 "Parts".

7.4 Liquid draining

! **Make sure no liquid or oil gets into the environment!**

Before starting any disassembly the pump should be drained.

1 If necessary, close the valves in the suction and delivery pipe and in the flushing or cooling supply lines to the shaft seal.

2 Remove the blind flange (1930).

3 If harmful liquids are pumped wear protective gloves, shoes, glasses, etc., and thoroughly flush the pump.

4 Refit the blind flange. For tightening moment of the studbolts (1900) see paragraph 10.1.3 "Tightening moments stud bolts for drain and seal flushing".

7.5 Disassembly and assembly Top Pull Out unit OH3

➢ *The Top Pull Out unit and the electric motor of large pumps are too heavy to be lifted by hand. Use appropriate hoisting equipment.*

The pumps are designed with a Top Pull Out system. For that reason they are provided with a "spacer"-coupling. The intermediate piece of this coupling can be removed. After that the bearing bracket with the entire rotating part can be removed. This means that almost the whole pump can be dismantled without having to detach the suction and delivery piping. The motor remains in its position.

7.5.1 Disassembling the Top Pull Out unit OH3

1 Remove the guard (0270).

2 Remove the spacer.

3 Disconnect possible flushing and/or cooling lines.

4 Remove the nuts (0810) and washers (0805). Tighten alternately both bolts (0820) until the pump cover (0110) is released.

5 Pull the entire bearing bracket (2100) from the pump casing. The entire bearing bracket of large pumps is very heavy. Support it with a beam or hang it in a pulley sling.

7.5.2 Assembling the Top Pull Out unit OH3

1 Fit a new gasket (0300) into the pump casing and fit the entire bearing bracket back into the pump casing. Place washers (0805) and tighten the nuts (0810) crosswise. For tightening moment of the nuts see paragraph 10.1.4 "Torques settings for nuts for pump casing".

2 Reconnect the flushing and/or cooling lines. For tightening moment of the stud bolts (2000) (2040) see paragraph 10.1.3 "Tightening moments stud bolts for drain and seal flushing".

3 Fit the spacer of the spacer coupling.

4 Check the alignment of pump and motor shaft, see paragraph 3.4.3 "Alignment of the coupling". If necessary, realign.

5 Place the guard (0270) on the coupling.

7.6 Disassembly and assembly Top Pull Out unit OH5

➢ *The Top Pull Out unit and the electric motor of large pumps are too heavy to be lifted by hand. Use appropriate hoisting equipment.*

The pumps are designed with a Top Pull Out system. The electric motor with the lantern piece, the pump cover and the impeller can be dismantled as a whole. This means that almost the whole pump can be dismantled without having to detach the suction and delivery piping.

7.6.1 Disassembly Top Pull Out unit OH5

1 Open the terminal box and loosen the wires.

2 Disconnect possible flushing and/or cooling lines.

! **NEVER start dismantling by loosening the motor bolts (0950). This may result in irrepairable damage to the mechanical seal and the impeller!**

3 Remove the nuts (0810) and washers (0805).

4 Pull the motor together with the entire lantern piece out of the pump casing. The Top Pull Out unit large pumps is very heavy. Support it with a beam or hang it in a pulley sling.

7.6.2 Assembly Top Pull Out unit OH5

1 Mount a new gasket (0300) for the pump casing and lower the Top Pull Out unit in the right position into the pump casing. Take care not to damage the gasket (0300).

2 Place washers (0805) and tighten the nuts (0810) crosswise. For tightening moment of the nuts see paragraph 10.1.4 "Torques settings for nuts for pump casing".

3 Reconnect the flushing and/or cooling lines. For tightening moment of the stud bolts (2000) (2040) see paragraph 10.1.3 "Tightening moments stud bolts for drain and seal flushing".

7.7 Replacing the impeller and the wear ring

If the play has risen to 0,9 mm or greater due to wear then both wear rings are replaced.

7.7.1 Disassembling the impeller

1 Remove the Top Pull Out unit, see paragraph 7.5.1 "Disassembling the Top Pull Out unit OH3" or paragraph 7.6.1 "Disassembly Top Pull Out unit OH5".

2 Unlock the set screw (1825) and remove the cap nut (1820).

3 Remove the impeller (0120) with a pulley puller, or wrest the impeller by inserting for instance 2 big screwdrivers between the impeller and the pump cover (0110).

4 Remove the impeller key (1860).

7.7.2 Mounting the impeller

1 Place the impeller key (1860) in the key way of the pump shaft.

2 Push the impeller onto the pump shaft.

3 Fit the cap nut. For tightening moment of the nut see paragraph 10.1.2 "Tightening moments for cap nut".

4 Fit the set screw (1825).

7.7.3 Disassembling the wear rings

After removing the Top Pull Out unit (see paragraph 7.5.1 "Disassembling the Top Pull Out unit OH3" or paragraph 7.6.1 "Disassembly Top Pull Out unit OH5") the wear rings can be removed. In most cases the ring has been fixed so tightly that it cannot be removed undamaged.

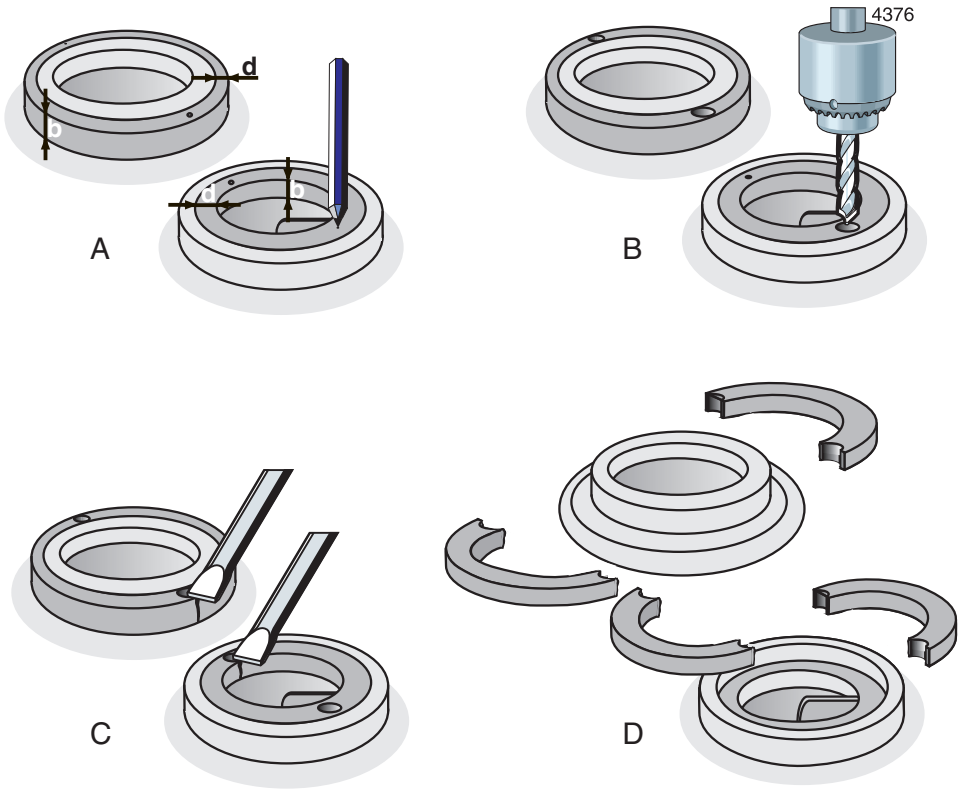


Figure 5: Removal of wear ring.

1 Disassembling the impeller, see paragraph 7.7.1 "Disassembling the impeller"

2 Unlock the set screw (0155) that lock up the impeller wear ring (0150) on the impeller.

3 Unlock the set screw (0135) that lock up the casing wear ring (0130) on the impeller.

4 Measure the thickness (d) and the width (b) of the ring, see figure 5 A.

5 Make a centre hole in the middle of the edge of the ring at two opposite points, see figure 5 B.

6 Use a drill with a diameter just a little bit smaller than the thickness (d) of the ring and drill two holes in the ring, see figure 5 C. Don't drill deeper than the width (b) of the ring. Take care not to damage the fitting edges of the pump casing and impeller.

7 Use a chisel to cut the remaining part of the ring thickness. Now you can remove the ring in two parts from the pump casing, see figure 5 D.

8 Clean the pump casing and impeller and carefully remove all bore dust and metal splinters.

7.7.4 Assembling the wear rings

1 Clean and degrease the fitting edge of the pump casing and impeller where the wear ring is to be mounted.

2 Fit the casing wear ring in the pump casing. **Take care it is not pushed out of alignment!**

3 Fit the impeller wear ring on the impeller. **Take care it is not pushed out of alignment!**

! **Make sure that they are not inserted obliquely!**

4 Both wear rings then have to be secured. Drill 3 holes Ø5 mm, 9 mm deep, right on the seam between impeller and wear ring c.q. pump casing and wear ring. Subsequently cut screw thread M6 (see figure 6).

5 Fit the set screws (0135 and 0155) in their positions in the impeller and the pump casing respectively.

! **Don’t fasten the set screws too tight, in order to avoid deformation of the wear rings!**

⚠ ***Whenever an impeller has new wear rings fitted it must be dynamically balanced before being reassembled!***

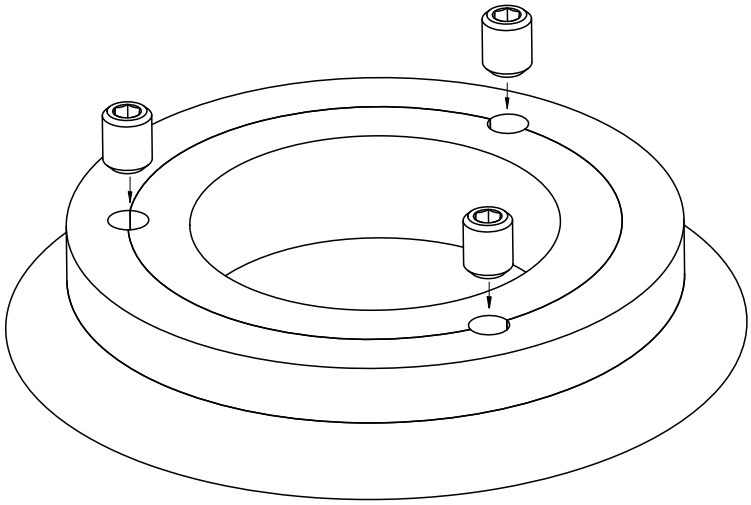


Figure 6: Locking the wear ring.

7.8 Mechanical seal

7.8.1 Instructions for mounting a cartridge seal

➢ *First read the following instructions regarding mounting a cartridge seal. Follow these instructions closely when mounting a cartridge seal.*

- This mechanical seal comes as a 'full cartridge seal'. This means that this mechanical seal must be mounted as one single piece and that it shall NOT be taken apart!
- A cartridge seal is a fragile precision instrument. Leave the cartridge seal in its original packing until you are ready to mount it!
- Clean all receiving parts properly. Make sure your hands and working environment are clean!

7.8.2 Disassembling a cartridge seal

1 Remove the guard (0276).
2 Re-fit the centering tabs on the cover of the seal cartridge into the groove in the seal collar in order to immobilise the cartridge seal.
3 Disassemble the impeller, see paragraph 7.7.1 "Disassembling the impeller".
4 Remove the nuts (1810) and washers (1805) and pull the seal cartridge backwards.
5 Remove the bolts (0850) and washer (0855) and knock the pump cover loose from the bearing bracket (OH3) or lantern piece (OH5).
6 Pull the entire seal cartridge from the shaft.

7.8.3 Mounting a cartridge seal

1 OH3: Put the bearing bracket in upright position (impeller side up).
OH5: Place the electric motor with the shaft upright.
2 Push the seal cartridge onto the shaft.
3 OH3: Mount the pump cover (0110) in the correct position in the fitting edge of the bearing bracket (2100). OH5: Mount the pump cover (0110) in the correct position in the fitting edge of the lantern piece (0250). **Check whether the pump cover is at right angles to the shaft**. Place washers (0855) fasten the pump cover with bolts (0850).
4 Mount the seal cartridge to the pump cover (0110). Check the position in view of the connection points. Place washers (0805) fasten the seal cartridge with nuts (0810).
5 Fit the impeller and other parts, see paragraph 7.7.2 "Mounting the impeller" and paragraph 7.5.2 "Assembling the Top Pull Out unit OH3" or paragraph 7.6.2 "Assembly Top Pull Out unit OH5".
6 Release the centering tabs of the seal cartridge, turn them halfway round and secure them again against the seal cover. The shaft must now be able to rotate freely.
7 Place the guard (0276).

7.9 Bearing OH3

7.9.1 Instructions for assembly and disassembly of bearings

➢ *First read the following instructions regarding assembly and disassembly. Follow these instructions closely when assembling and disassembling bearings.*

Disassembly:

- Use **a proper puller** to remove the bearings from the pump shaft.
- If no proper puller is available, carefully knock at the inner raceway of the bearing. Use an ordinary hammer and a mild steel drift for this.
  Never knock at the bearing with a hammer!

Assembly:

- Make sure your working place is clean.
- Leave the bearings in their original packing as long as possible.
- Make sure the pump shaft and the bearing seats do have a smooth surface, free of burrs.
- Slightly oil the pump shaft and the other relevant parts before assembly.
- **Preheat the bearings to 90°C** before mounting them on the pump shaft.
- If preheating is not possible: knock the bearing onto the pump shaft. **Never knock at the bearing directly!** Use a mounting bush positioned against the inner raceway of the bearing and a normal hammer (a soft hammer might loose some splinters which could damage the bearing).
- **Always apply a new locking washer (2570) when assembling bearings!**

7.9.2 Disassembling bearing

1 Dismantle the impeller and the shaft seal, see paragraph 7.7.1 "Disassembling the impeller" and paragraph 7.8.2 "Disassembling a cartridge seal".
2 Remove the deflector (2220).
3 Remove the coupling with a coupling puller and remove the coupling key (2210).
4 Unscrew the Allen screws (0940) and remove the assembly plate (0275).
5 Remove the deflector (2180).
6 Unscrew the Allen screws (2810 and 2815) and remove the bearing covers (2110 and 2115).
7 Knock at the pump shaft (2200) at the impeller side to loosen the bearings from the bearing bracket. Use a plastic hammer to avoid damage to the thread.
8 Remove the inner circlip (2300).
9 Knock the lip of the locking washer (2570) out of the lock nut (2560) and loosen the lock nut.
10 Remove the bearings from the pump shaft.
11 Remove the adjusting ring (2375), the Nilos rings (2320 and 2310) and the inner circlip (2300).
12 Remove the outer ring of the cylindrical roller bearing (2250).

7.9.3 Assembling bearing

1 Clean the interior of the bearing bracket properly.

1 Subsequently fit the Nilos ring (2310), the inner circlip (2300), the Nilos ring (2320) and the adjusting ring (2375) on the pump shaft. Make sure the Nilos rings are positioned properly!

2 Preheat the angular contact ball bearings and the inner ring of the cylindrical roller bearing and fit them onto the pump shaft. Make sure they are positioned straight on the pump shaft and push them firmly against the shaft shoulder. The cylindrical roller bearing (2250) is fitted at the impeller side. The angular contact ball bearings are fitted **in O-position** at the drive side. Ensure that the bearings are fitted straight on the pump shaft. The Nilos ring (2310) is now fixed between the pump shaft and the inner ring of the cylindrical roller bearing. **Let the bearings cool down!**

3 Fit the locking washer (2570) and screw the lock nut (2560) on the pump shaft. Tighten the lock nut and lock it by knocking a lip of the locking washer into the opening of the lock nut.

4 Fit the inner circlip (2300) into the bearing bracket (2100).

5 Fit the pump shaft with bearings, starting from the motor side, in the bearing bracket. Knock at the shaft end at the coupling side until the foremost bearing (2260) slides through the bearing bore. After each knock rotate the pump shaft one turn to prevent bearing damage.

6 Fit the outer ring of the cylindrical roller bearing. This ring should go into the bearing bracket **straight.**

7 Check to ensure that the oil catchers (2120 and 2125) are undamaged. Replace them if necessary.

8 Fit the bearing covers (2110 and 2115) and fix them with Allen screws (2810 and 2815).

9 Fit the deflector (2180 and 2220).

10 Fit the shaft seal and the impeller, see paragraph 7.8.3 "Mounting a cartridge seal" and paragraph 7.7.2 "Mounting the impeller".

8 Dimensions

For dimension see GAD enclosed with the delivery.

9 Parts

9.1 Ordering parts

9.1.1 Order form

You can use the order form included in this manual for ordering parts.

When ordering parts always quote the following data:

1 Your **address**.

2 The **quantity, the item number and the description** of the part.

3 The **pump number**. The pump number is stated on the label on the cover of this manual and on the type plate of the pump.

4 In the event of different electric motor voltage you should state the correct voltage.

9.1.2 Recommended spare parts

Parts marked with a [1), 2), 3)] are recommended spare parts.

[1)] Start-up spares

[2)] Initial spare parts (one year operation)

[3)] Normal spare parts (two years operation)

9.2 Pump OH3

9.2.1 Sectional drawing pump

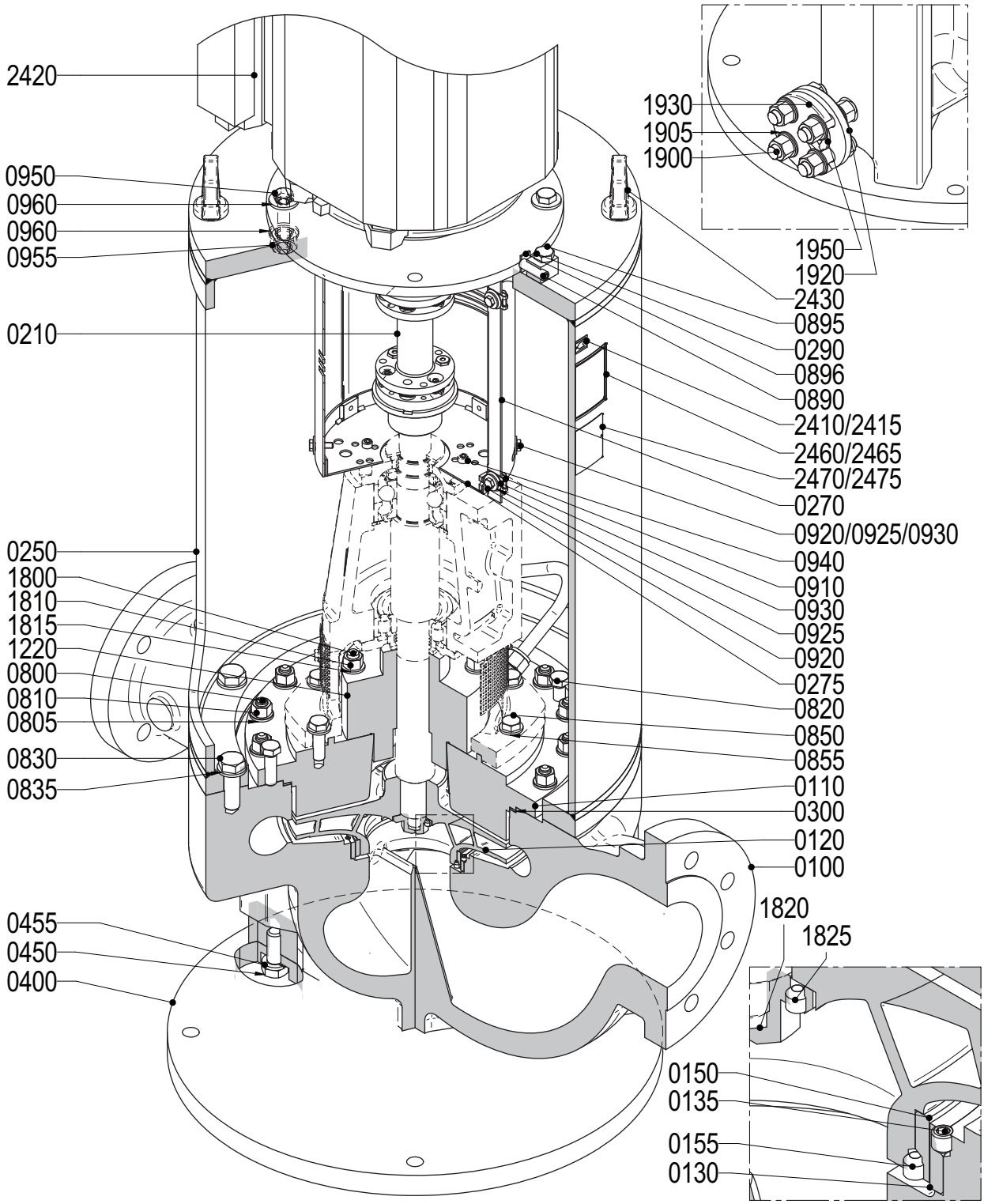


Figure 7: Sectional drawing pump.

9.2.2 Parts list pump

Item	Quantity	Description	API-610 Material Classes						
			S-1	S-6	S-8	C-6	A-8	D-1	D-2
0100	1	pump casing	carbon steel			chrome steel	stainless steel	duplex	super duplex
0110	1	pump cover	carbon steel			chrome steel	stainless steel	duplex	super duplex
0120[3)]	1	impeller	cast iron	chrome steel	stainless steel	chrome steel	stainless steel	duplex	super duplex
0130[1)2)3)]	1	casing wear ring	chrome steel		stainless steel	chrome steel	stainless steel	duplex	super duplex
0135	3	set screw	stainless steel					duplex	super duplex
0150[1)2)3)]	1	impeller wear ring	chrome steel		stainless steel	chrome steel	stainless steel	duplex	super duplex
0155	3	set screw	stainless steel					duplex	super duplex
0210	1	coupling	- -						
0250	1	lantern piece	steel						
0270	2	guard	brass						
0275	1	assembly plate	brass						
0290	4	adjusting cam	stainless steel						
0300[1)2)3)]	1	gasket	stainless steel/graphite					duplex/ graphite	super duplex/ graphite
0400	1	support	steel						
0450	3	bolt	steel						
0455	3	spring washer	spring steel						
0800	**	stud	carbon steel						
0805	**	washer	steel						
0810	**	nut	carbon steel						
0820	2	bolt	stainless steel						
0830	8	bolt	steel						
0835	8	washer	steel						
0850	***	bolt	steel						
0855	***	washer	steel						
0890	4	set screw	stainless steel						
0895	8	bolt	stainless steel						
0896	4	protection plate	stainless steel						
0910	4	speed nut	spring steel						
0920	8	bolt	stainless steel						
0925	8	washer	stainless steel						
0930	8	washer	stainless steel						
0940	4	allen screw	stainless steel						
0950	4	bolt	carbon steel						
0955	4	nut	carbon steel						
0960	8	washer	steel						
1220	1	cartridge seal	- -						
1800	4	stud	stainless steel						

Item	Quantity	Description	API-610 Material Classes						
			S-1	S-6	S-8	C-6	A-8	D-1	D-2
1810	4	nut	stainless steel						
1815	4	washer	stainless steel						
1820[3)]	1	cap nut	4140 steel		stainless steel	chrome steel	stainless steel	duplex	super duplex
1825[3)]	1	set screw	stainless steel					duplex	super duplex
1900	4	stud bolt	carbon steel						
1905	16	washer	steel						
1920	1	flange	carbon steel			stainless steel		duplex	super duplex
1930	1	blind flange	carbon steel			stainless steel		duplex	super duplex
1950	1	gasket	stainless steel/graphite					duplex/ graphite	super duplex/ graphite
2410	1	arrow plate	stainless steel						
2415	2	rivet	stainless steel						
2420	1	motor	- -						
2430	2	lifting eye bolt	steel						
2460	1	name plate	stainless steel						
2465	4	rivet	stainless steel						
2470	1	name plate	stainless steel						
2475	2	rivet	stainless steel						

** Quantity depends on pump type

*** Quantity depends on bearing group

9.3 Bearing OH3

9.3.1 Sectional drawing bearing

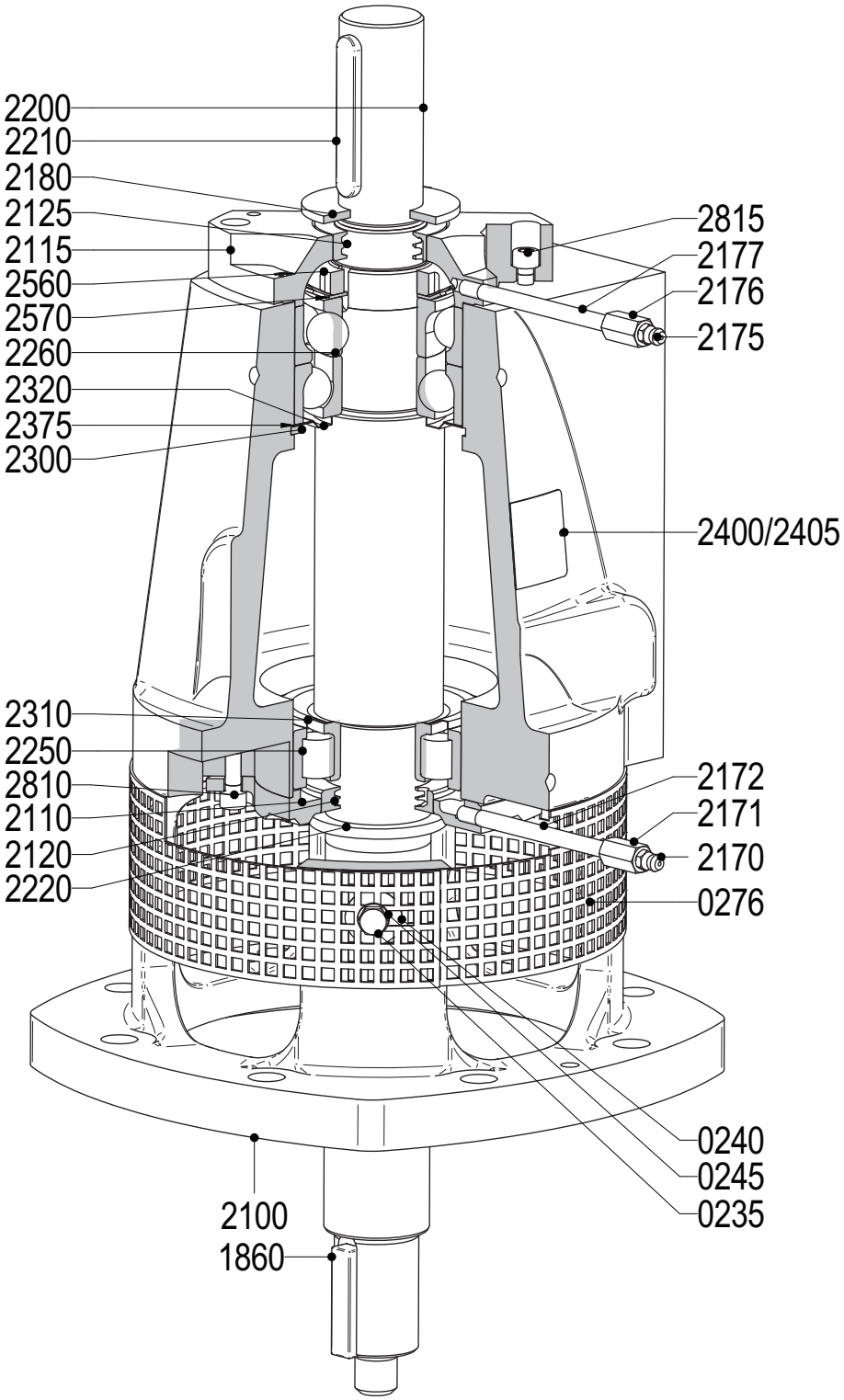


Figure 8: Sectional drawing bearing.

9.3.2 Parts list bearing

Item	Quantity	Description	API-610 Material Classes						
			S-1	S-6	S-8	C-6	A-8	D-1	D-2
0235	1	bolt	stainless steel						
0240	1	washer	spring steel						
0245	1	washer	stainless steel						
0276	1	seal guard	stainless steel						
1860[3)]	1	key	stainless steel					duplex	super duplex
2100	1	bearing bracket	carbon steel						
2110	1	bearing cover	stainless steel						
2115	1	bearing cover	stainless steel						
2120[3)]	1	oil catcher	bronze						
2125[3)]	1	oil catcher	bronze						
2170	1	grease nipple	stainless steel						
2171	1	socket	stainless steel						
2172	1	pipe	stainless steel						
2175	1	grease nipple	stainless steel						
2176	1	socket	stainless steel						
2177	1	pipe	stainless steel						
2180	1	deflector	rubber						
2200[3)]	1	pump shaft	4140 steel[*)]		stainless steel	chrome steel	stainless steel	duplex	super duplex
2210[3)]	1	coupling key	steel						
2220	1	deflector	rubber						
2250[2)3)]	1	cylindrical roller bearing	- -						
2260[2)3)]	2	angular contact ball bearing	- -						
2300	1	inner circlip	spring steel						
2310	1	Nilos ring	steel						
2320	1	Nilos ring	steel						
2375	1	adjusting ring	steel						
2400	1	name plate	stainless steel						
2405	2	rivet	stainless steel						
2560[3)]	1	lock nut	steel						
2570[3)]	1	locking washer	steel						
2810	4	Allen screw	stainless steel						
2815	4	Allen screw	stainless steel						

* For Class S-6, the standard shaft material for boiler feed service and for liquid temperatures above 175°C is chrome steel

9.4 Pump OH5

9.4.1 Sectional drawing pump

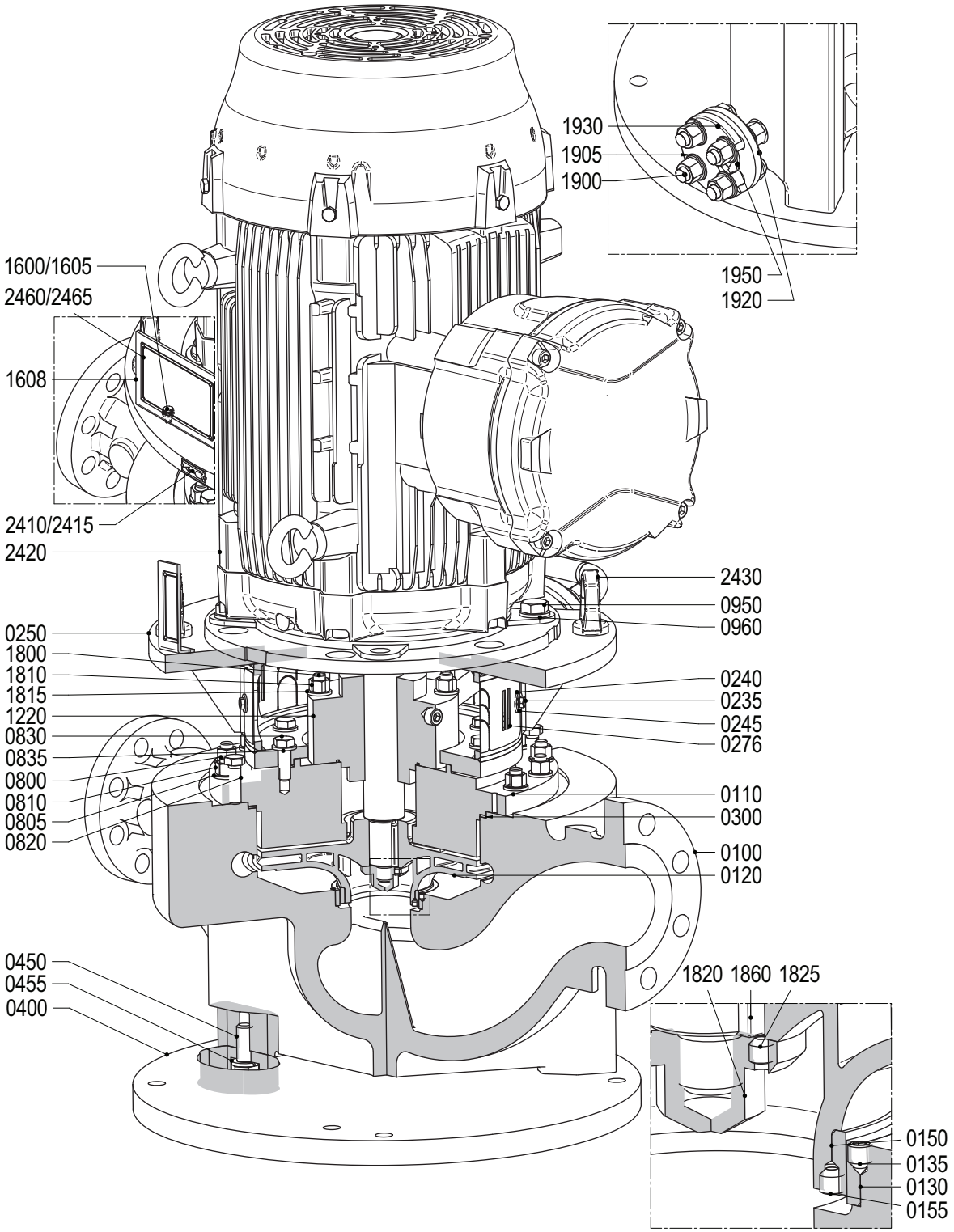


Figure 9: Sectional drawing pump.

9.4.2 Parts list pump

Item	Quantity	Description	API-610 Material Classes						
			S-1	S-6	S-8	C-6	A-8	D-1	D-2
0100	1	pump casing	carbon steel			chrome steel	stainless steel	duplex	super duplex
0110	1	pump cover	carbon steel			chrome steel	stainless steel	duplex	super duplex
0120[3)]	1	impeller	cast iron	chrome steel	stainless steel	chrome steel	stainless steel	duplex	super duplex
0130[1)2)3)]	1	casing wear ring	chrome steel		stainless steel	chrome steel	stainless steel	duplex	super duplex
0135	3	set screw	stainless steel					duplex	super duplex
0150[1)2)3)]	1	impeller wear ring	chrome steel		stainless steel	chrome steel	stainless steel	duplex	super duplex
0155	3	set screw	stainless steel					duplex	super duplex
0235		bolt	stainless steel						
0240		washer	stainless steel						
0245		washer	stainless steel						
0250	1	lantern piece	steel						
0276	2	guard	stainless steel						
0300[1)2)3)]	1	gasket	stainless steel/graphite					duplex/ graphite	super duplex/ graphite
0400	1	support	steel						
0450	3	bolt	steel						
0455	3	spring washer	spring steel						
0800	**	stud	carbon steel						
0805	**	washer	steel						
0810	**	nut	carbon steel						
0820	2	bolt	stainless steel						
0830	8	bolt	steel						
0835	8	washer	steel						
0950	4	bolt	carbon steel						
0960	8	washer	steel						
1220	1	cartridge seal	- -						
1600		bolt	stainless steel						
1605		washer	stainless steel						
1608	1	support plate	stainless steel						
1800	4	stud	stainless steel						
1810	4	nut	stainless steel						
1815	4	washer	stainless steel						
1820[3)]	1	cap nut	4140 steel		stainless steel	chrome steel	stainless steel	duplex	super duplex
1825[3)]	1	set screw	stainless steel					duplex	super duplex
1860	1	key	stainless steel					duplex	super duplex

Item	Quantity	Description	API-610 Material Classes						
			S-1	S-6	S-8	C-6	A-8	D-1	D-2
1900	4	stud bolt	carbon steel						
1905	16	washer	steel						
1920	1	flange	carbon steel			stainless steel		duplex	super duplex
1930	1	blind flange	carbon steel			stainless steel		duplex	super duplex
1950	1	gasket	stainless steel/graphite					duplex/ graphite	super duplex/ graphite
2410	1	arrow plate	stainless steel						
2415	2	rivet	stainless steel						
2420	1	motor	- -						
2430	2	lifting eye bolt	steel						
2460	1	name plate	stainless steel						
2465	4	rivet	stainless steel						

** Quantity depends on pump type

*** Quantity depends on bearing group

9.5 Mechanical seal piping plan 11 - tubing

9.5.1 Drawing plan 11 - tubing

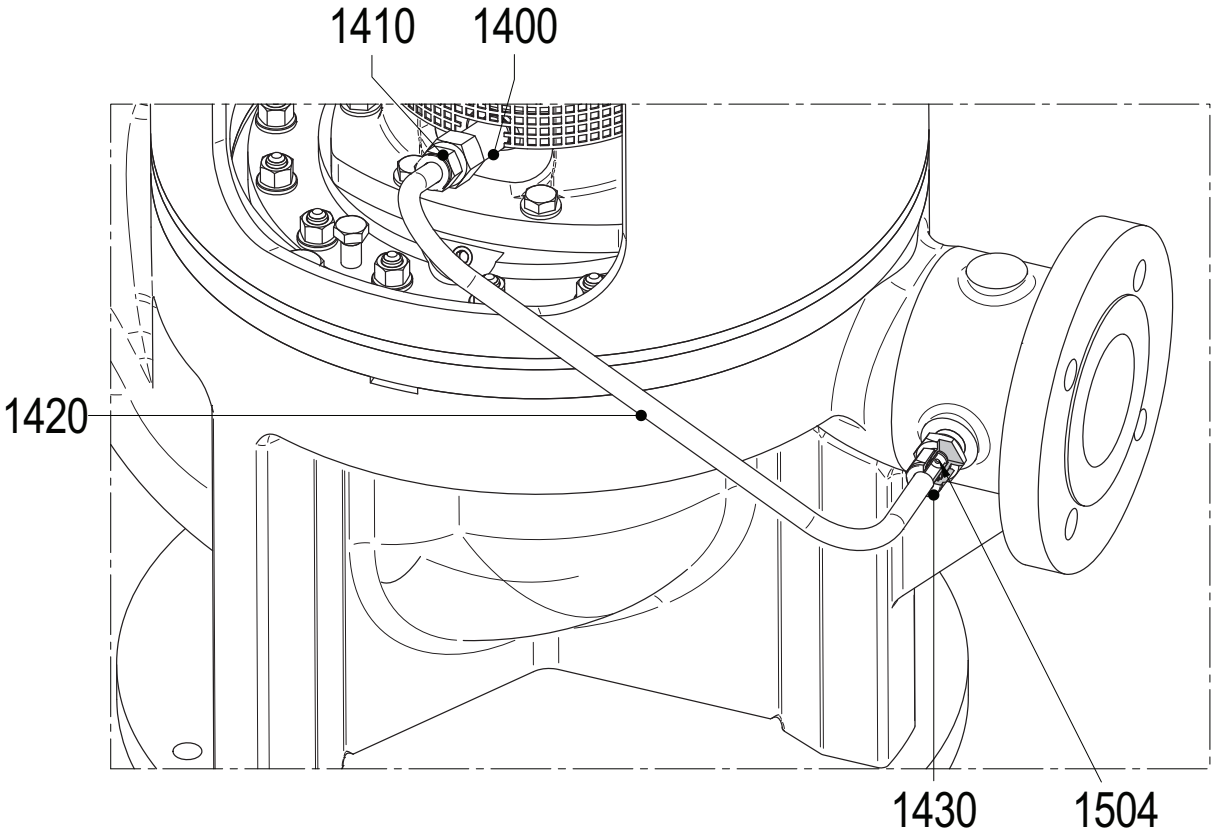


Figure 10: Drawing plan 11 - tubing.

9.5.2 Parts list plan 11 - tubing

Item	Quantity	Description	API-610 Material Classes						
			S-1	S-6	S-8	C-6	A-8	D-1	D-2
1400	1	pipe nipple	stainless steel					duplex	super duplex
1410	1	female connector	stainless steel					duplex	super duplex
1420	1	pipe	stainless steel					duplex	super duplex
1430	1	male connector	stainless steel					duplex	super duplex
1504	1	orifice	stainless steel					duplex	super duplex

9.6 Mechanical seal piping plan 11 - flanged

9.6.1 Drawing plan 11 - flanged

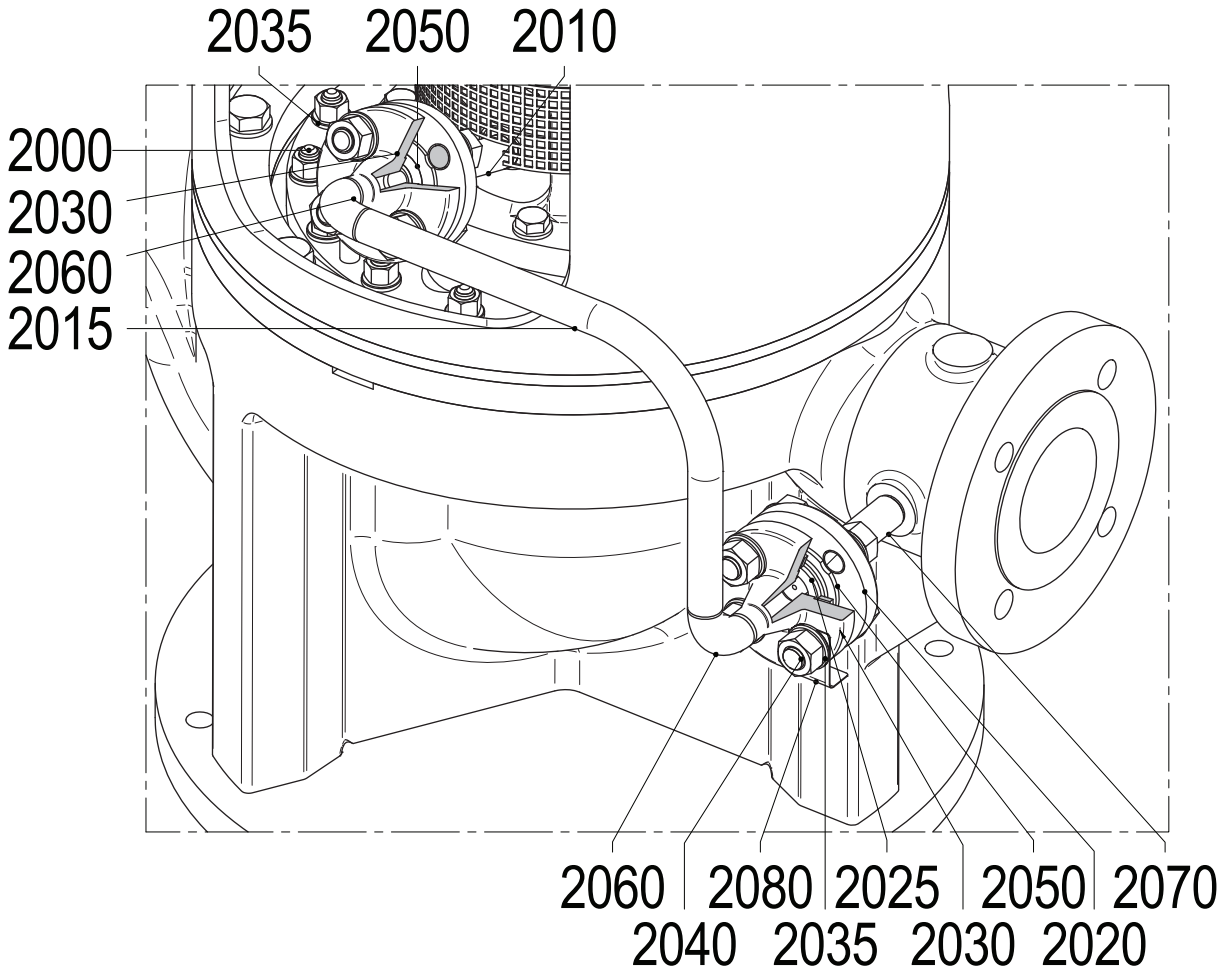


Figure 11: Drawing plan 11 - flanged.

9.6.2 Parts list plan 11 - flanged

Item	Quantity	Description	API-610 Material Classes						
			S-1	S-6	S-8	C-6	A-8	D-1	D-2
2000	4	stud bolt	carbon steel						
2010	1	welding neck flange + pipe nipple	stainless steel					duplex	super duplex
2015	1	pipe	stainless steel					duplex	super duplex
2020	1	welding neck flange	carbon steel			stainless steel		duplex	super duplex
2025	1	orifice	stainless steel					duplex	super duplex
2030	2	welding neck flange	stainless steel					duplex	super duplex
2035	16	washer	carbon steel						
2040	4	stud bolt	carbon steel						
2050[1)2)3)]	3	gasket	stainless steel					duplex	super duplex
2060	2	elbow	stainless steel					duplex	super duplex
2070	1	pipe	carbon steel			stainless steel		duplex	super duplex
2080	1	orifice plate	stainless steel					duplex	super duplex

10 Technical data

10.1 Tightening moments

10.1.1 Tightening moments for bolts and nuts

! For nuts for pump casing (item 0810), see paragraph 10.1.4 "Torques settings for nuts for pump casing"!

Table 5: Tightening moments for bolts and nuts.

Materials	8.8	A2, A4
Thread	Tightening moment [Nm]	
M6	9	6
M8	20	14
M10	40	25
M12	69	43
M16	168	105

10.1.2 Tightening moments for cap nut

Table 6: Tightening moments for cap nut (1820).

Size	Tightening moment [Nm]
M12	43
M16	105
M24	220

10.1.3 Tightening moments stud bolts for drain and seal flushing

Table 7: Tightening moments stud bolts for drain (1900) and seal flushing (2000) (2040).

Size	Tightening moment [Nm]
M14	85
M16	89

10.1.4 Torques settings for nuts for pump casing

Table 8: Torques settings for nuts (0810) for pump casing

	Bearing group	Size	Lubricated	Not-lubricated
			[Nm]	[Nm]
40A-125	1	M12 (8x)	69	80
40A-200	1	M12 (12x)	73	84
40AC-200	1	M12 (12x)	73	84
50A-200	1	M12 (12x)	73	84
50A-250	2	M12 (12x)	73	84
50B-200	1	M12 (12x)	73	84
50BA-200	1	M12 (12x)	73	84
80AA-250	2	M12 (16x)	73	84
100A-160	2	M12 (12x)	69	80
100AC-160	2	M12 (12x)	69	80
100AC-200	2	M12 (12x)	73	84
100A-250	2	M12 (12x)	73	84
100BC-250	3	M12 (16x)	73	84

10.2 Permissible forces and moments on the flanges

Forces and moments acting on the pump flanges due to pipe loads can cause misalignment of the pump and driver shafts, deformation and overstressing of the pump casing, or overstressing of the fixing bolts between the pump and the base plate.

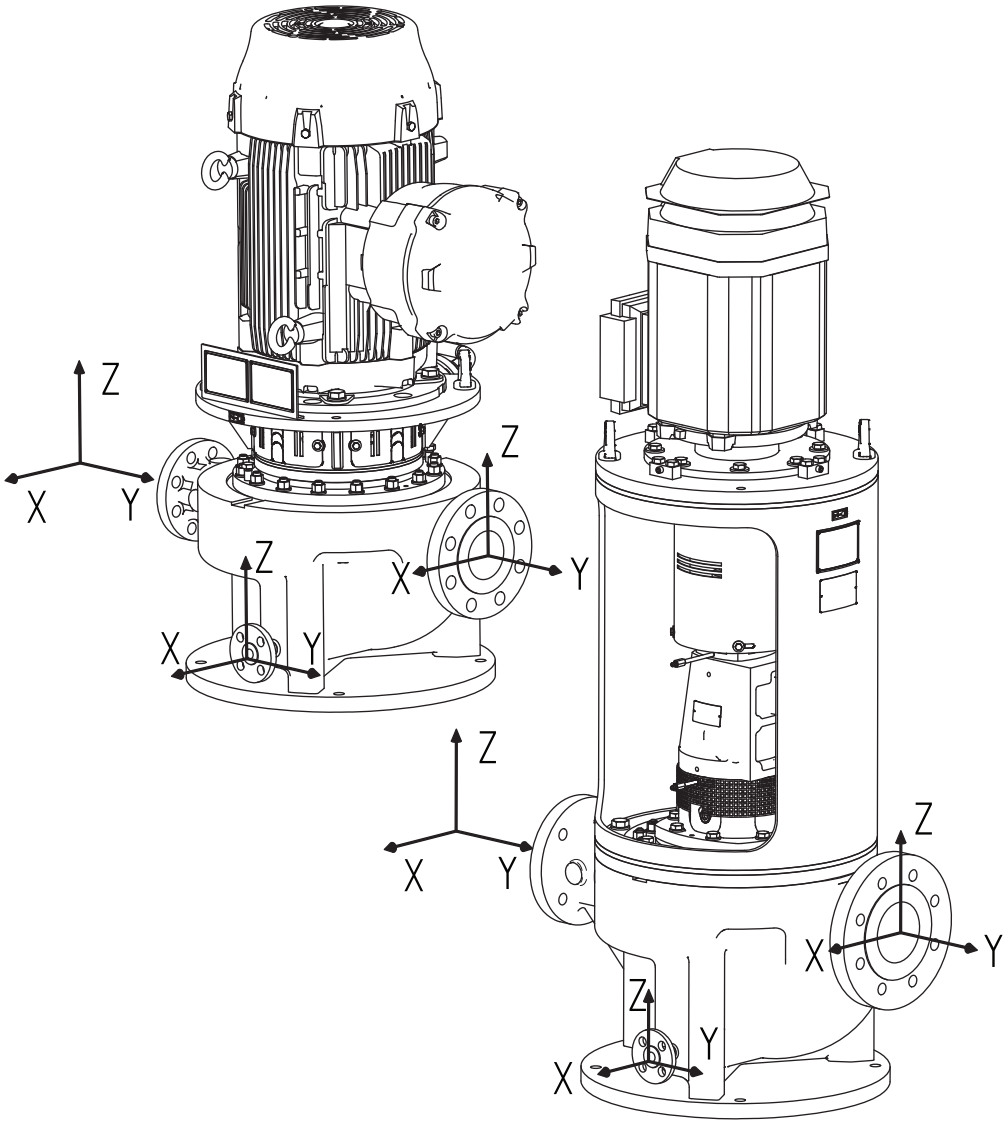


Figure 12: Coordinate system.

10.2.1 Allowable forces and moments on suction and discharge flanges

Table 9: According API 610 - table 4 "Nozzle loadings"

	Allowable forces [N]				Allowable moments [Nm]				Allowable forces [N]				Allowable moments [Nm]			
	Suction								Discharge							
	F_x	F_y	F_z	F_r	M_x	M_y	M_z	M_r	F_x	F_y	F_z	F_r	M_x	M_y	M_z	M_r
40A-125																
40A-200	890	710	580	1280	460	230	350	620	710	580	890	1280	460	230	350	620
40AC-200																
50A-200	1330	1070	890	1930	950	470	720	1280	710	580	890	1280	460	230	350	620
50A-250																
50B-200	1330	1070	890	1930	950	470	720	1280	710	580	890	1280	460	230	350	620
50BA-200																
80AA-250	1780	1420	1160	2560	1330	680	1000	1800	1070	890	1330	1930	950	470	720	1280
100A-160																
100AC-160	2490	3110	2050	4480	2300	1180	1760	3130	1420	1780	1160	2560	1330	680	1000	1800
100AC-200																
100BC-250	2490	3110	2050	4480	2300	1180	1760	3130	1420	1780	1160	2560	1330	680	1000	1800

Pump mounted on a grouted base plate of carbon steel

Fr, Mr = resultant

10.2.2 Allowable forces and moments on the drain flange

Table 10: According API 610 - table 4 "Nozzle loadings"

Allowable forces [N]				Allowable moments [Nm]			
F_x	F_y	F_z	F_r	M_x	M_y	M_z	M_r
890	710	580	1280	460	230	350	620

Pump mounted on a grouted base plate of carbon steel

Fr, Mr = resultant

10.3 Grease

Table 11: Recommended greases according to NLGI-3 classification.

CASTROL	Spheerol AP3
CHEVRON	MultifaK Premium 3
EXXONMOBIL	Beacon EP 3
	Mobilux EP 3
SHELL	Gadus S2 V100 3
SKF	LGMT 3
TOTAL	Total Lical EP 2

10.4 Hydraulic performance

10.4.1 Performance overview cast steel material class S-1

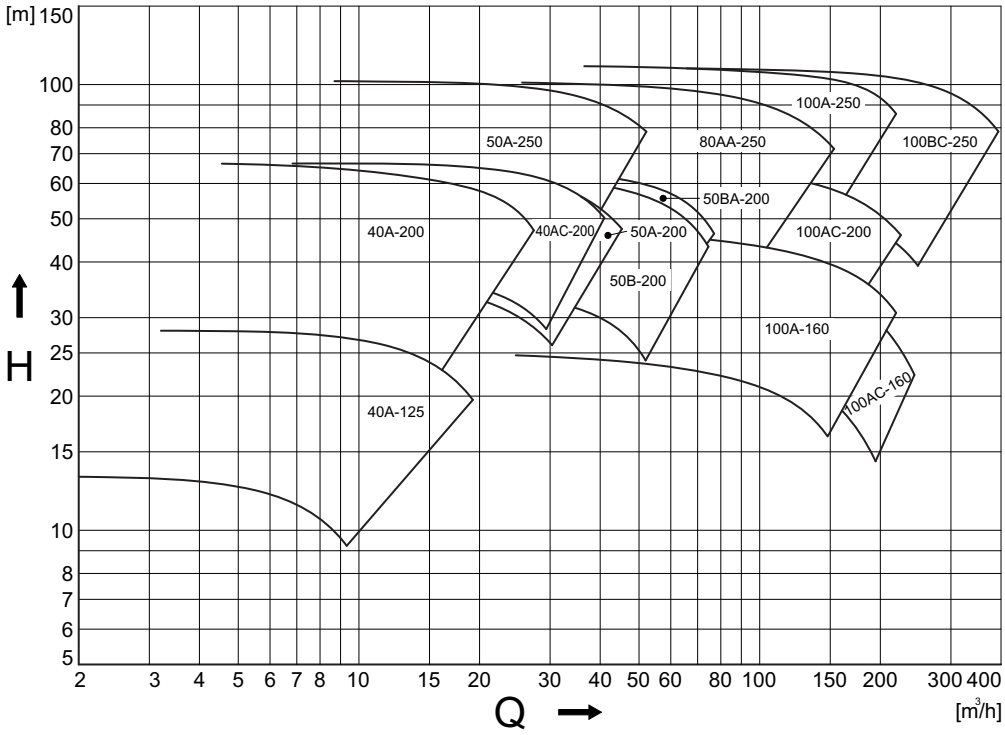


Figure 13: Performance overview 3000 min^{-1}.

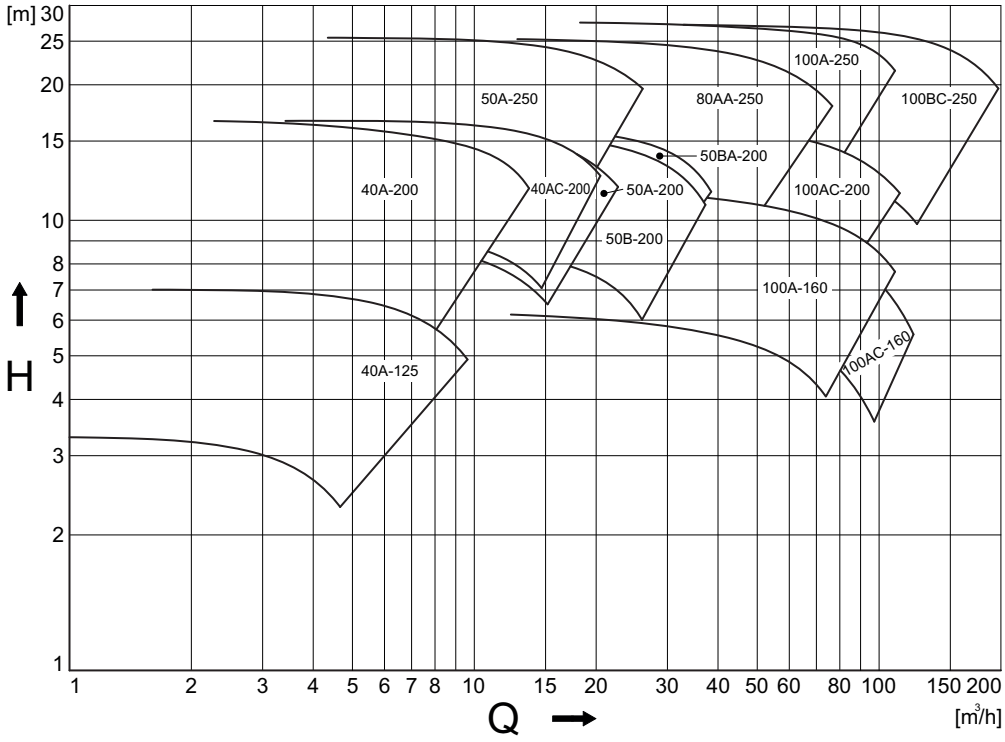


Figure 14: Performance overview 1500 min^{-1}.

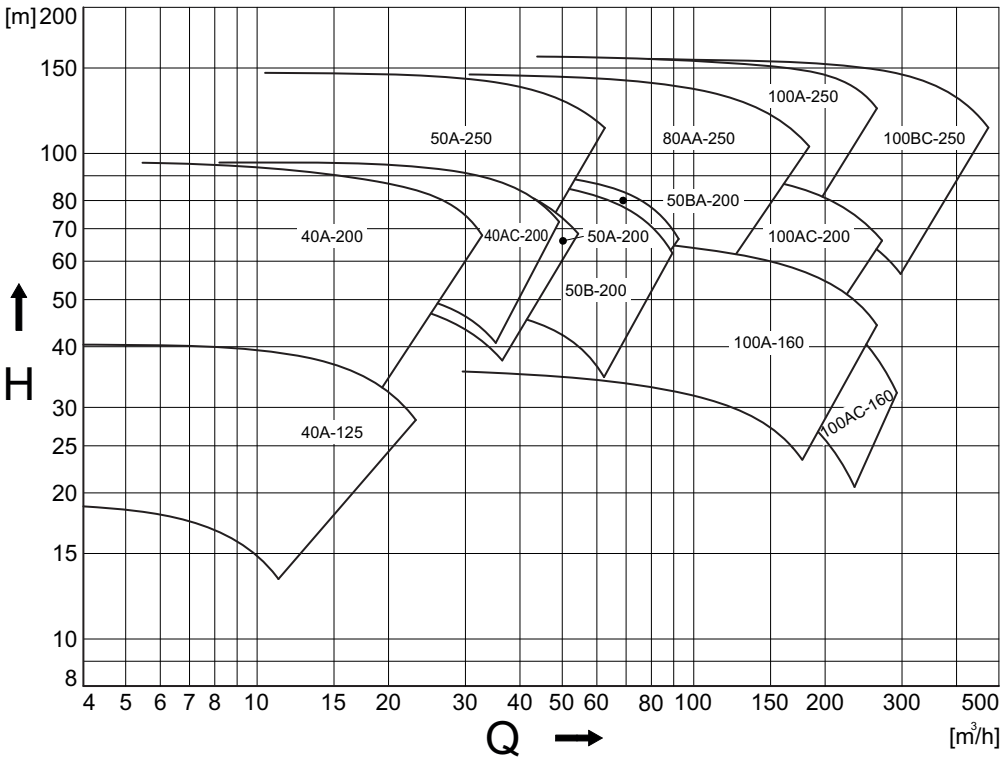


Figure 15: Performance overview 3600 min^{-1}.

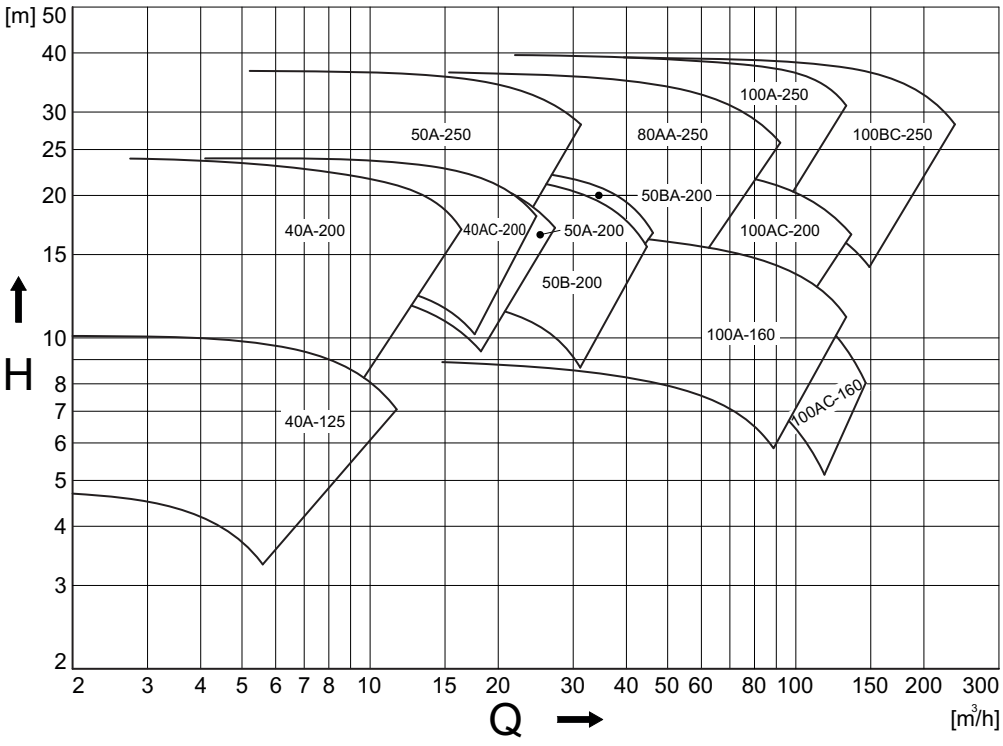


Figure 16: Performance overview 1800 min^{-1}.

10.4.2 Performance overview material classes S-6, S-8, C-6, A-8, D-1, D-2

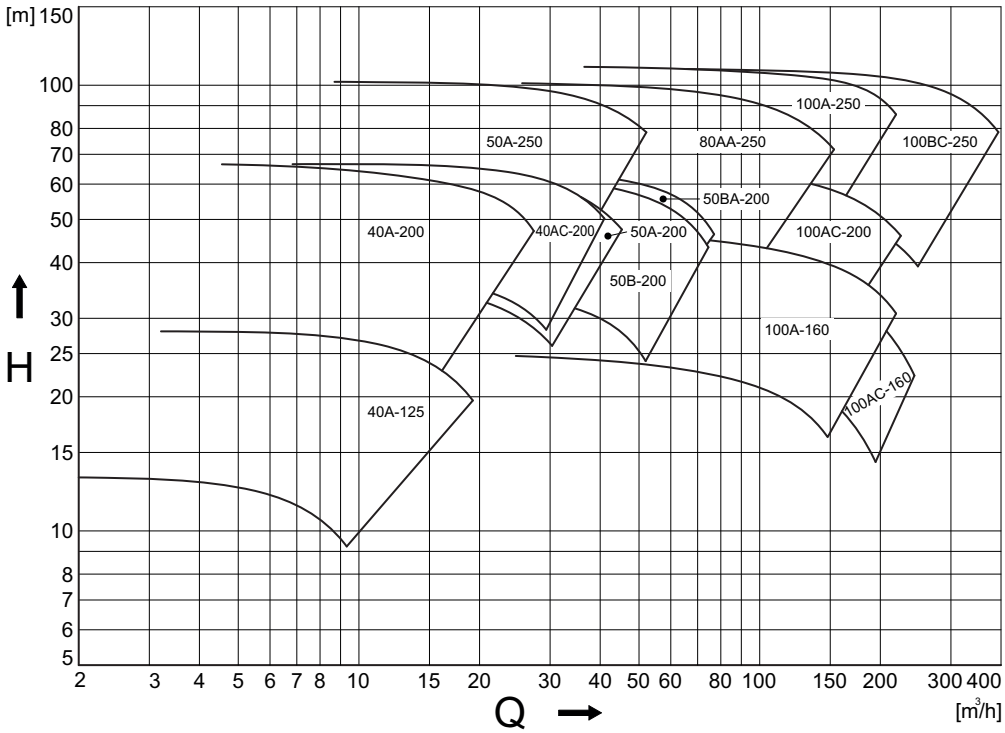


Figure 17: Performance overview 3000 min^{-1}.

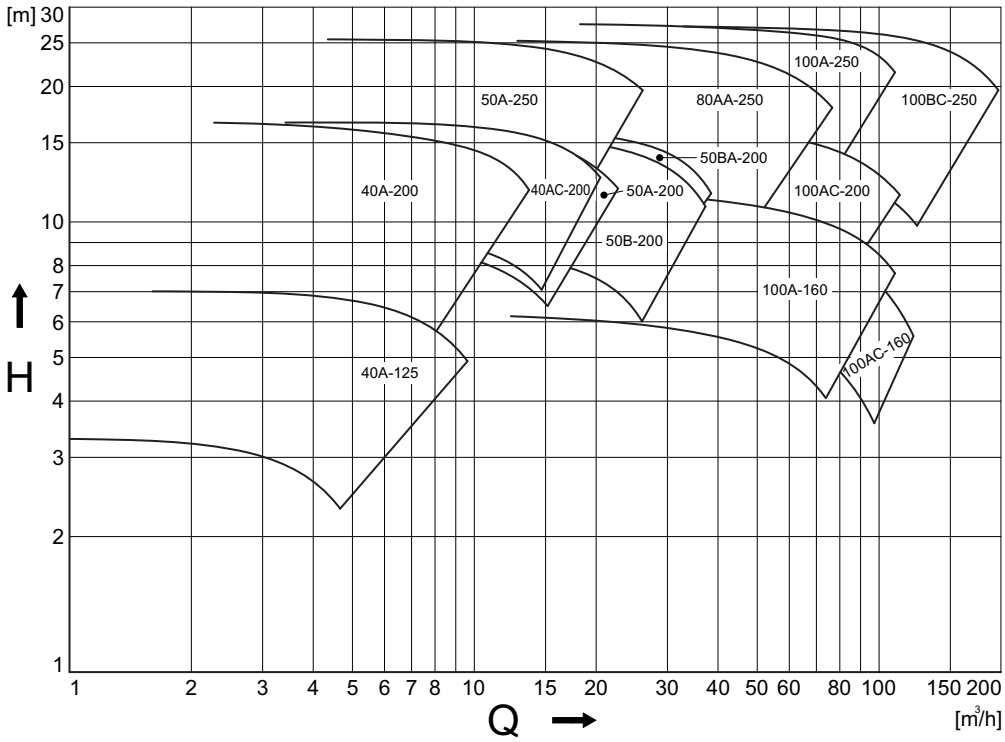


Figure 18: Performance overview 1500 min^{-1}.

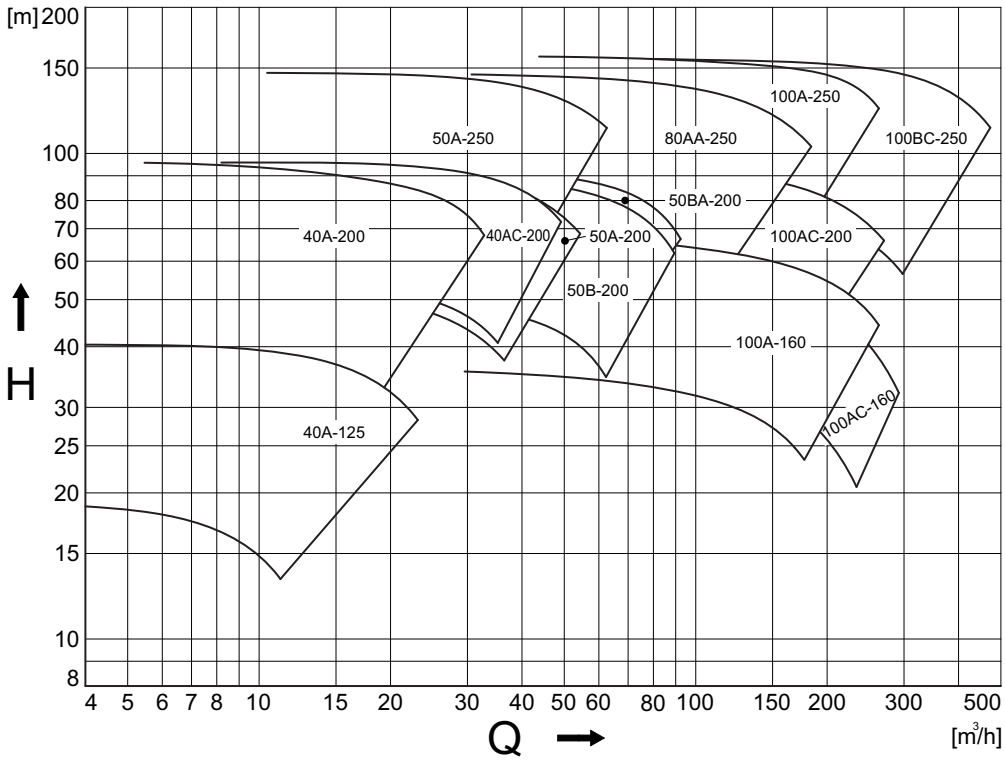


Figure 19: Performance overview 3600 min^{-1}.

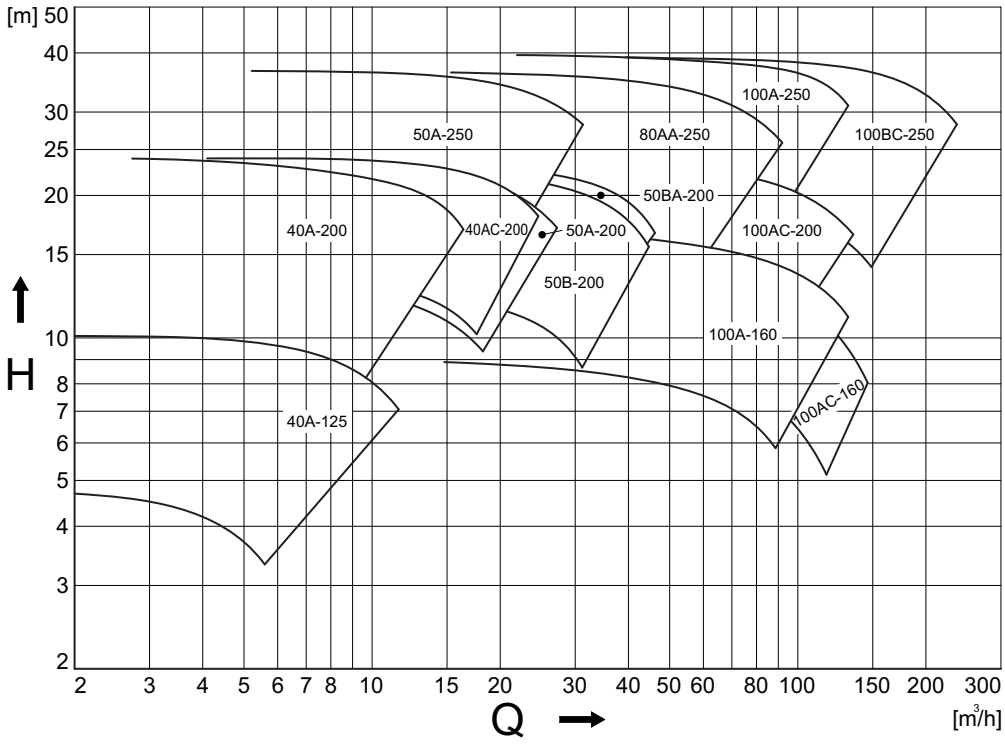


Figure 20: Performance overview 1800 min^{-1}.

10.5 Noise data

10.5.1 Pump noise as a function of pump power

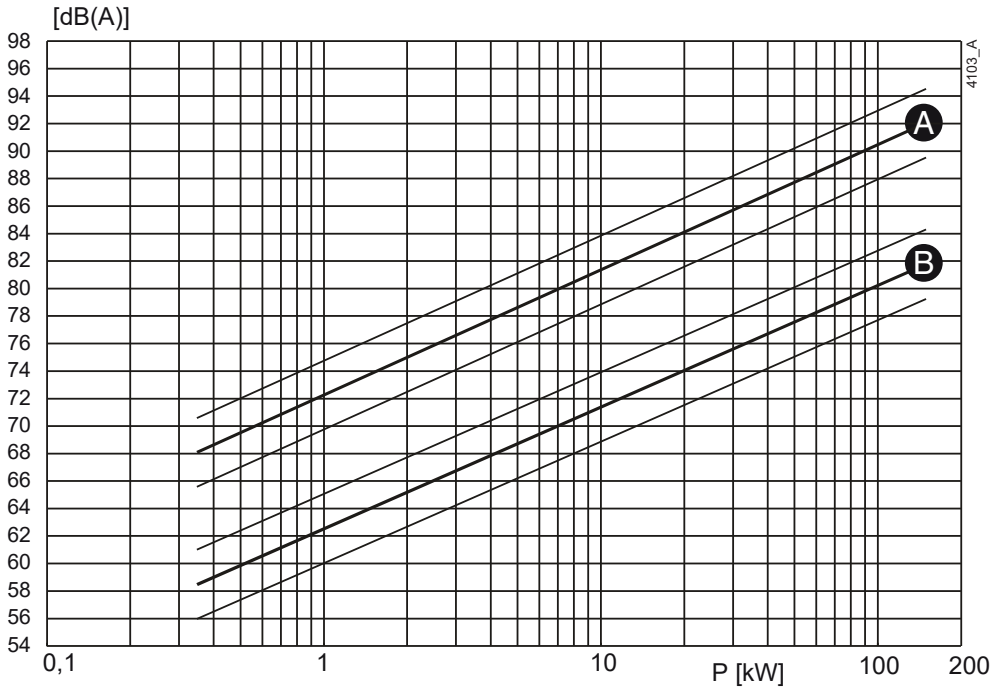


Figure 21: Noise level as function of pump power [kW] at 1450 min^{-1}
A = sound power level, B = sound pressure level.

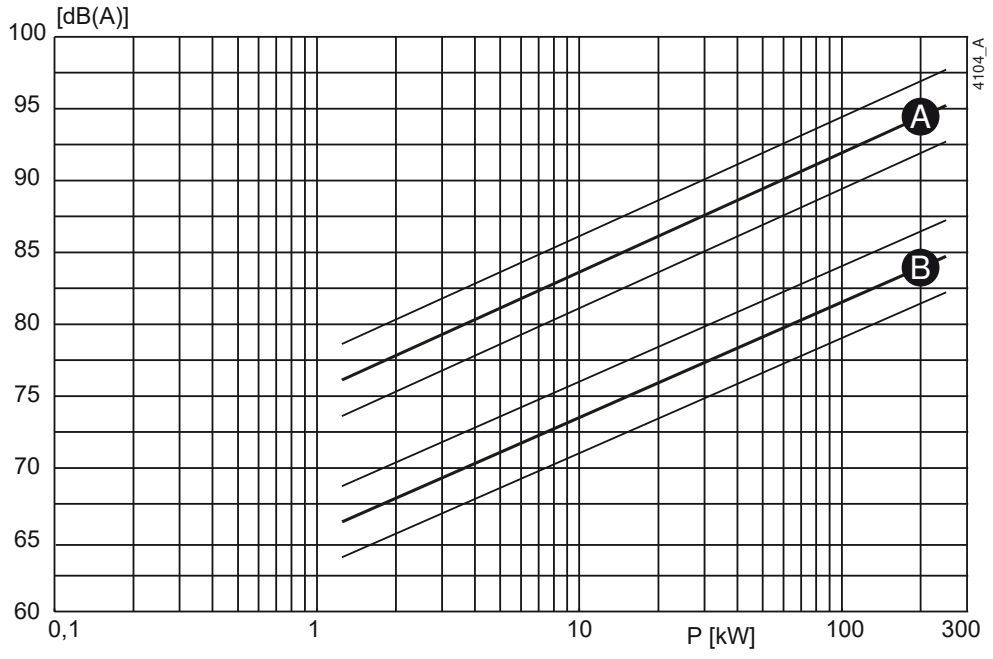


Figure 22: Noise level as function of pump power [kW] at 2900 min^{-1}
A = sound power level, B = sound pressure level.

10.5.2 Noise level of entire pump unit

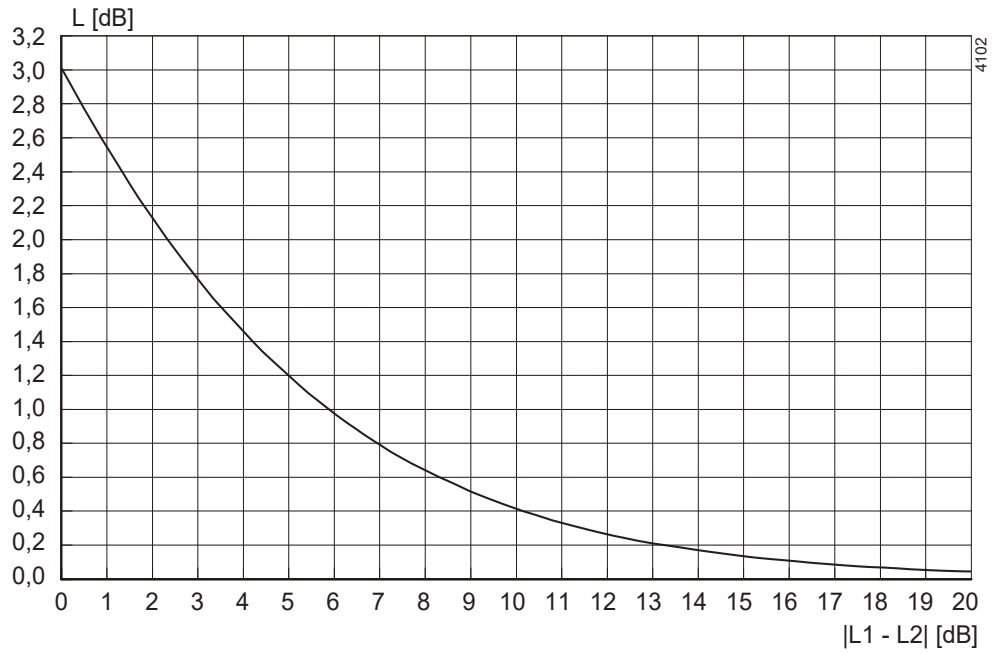


Figure 23: Noise level of entire pump unit.

In order to determine the total noise level of the entire pump unit, the noise level of the motor must be added to that of the pump. This can be easily done by using the graph above.

1 Determine the noise level (L1) of the pump, see figure 21 or figure 22.
2 Determine the noise level (L2) of the motor, see documentation of the motor.
3 Determine the difference between both levels |L1 - L2|.
4 Find the differential value on the |L1 - L2|-axis and go up to the curve.
5 From the curve go left to the L[dB] -axis and read out the value.
6 Add this value to the highest value of both noise levels (L1 or L2).

Example:

1 Pump 75 dB; motor 78 dB.
2 |75-78| = 3 dB.
3 dB on the X-axis = 1,75 dB on the Y-axis.
4 Highest noise level + 1,75 dB = 78 + 1,75 = 79,75 dB.

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Order form for spare parts

FAX Nr.	
ADDRESS	

Your order will only be dealt with if this order form has been correctly completed and signed.

Order date:	
Your order number:	
Pump type:	
Execution:	

Quantity	Item. No.	Part	Article number pump

Delivery address:	Invoicing address:

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