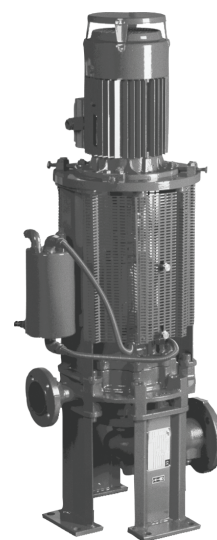
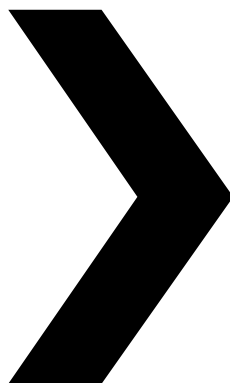


## CombiPrime V

Vertical self-priming centrifugal pump



---

REVISION: CV/EN (2301) 5.6

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## 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

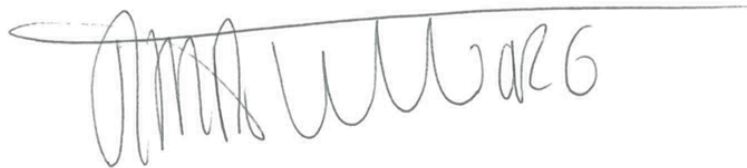
SPX Flow Technology Assen B.V.  
Dr. A.F. Philipsweg 51  
9403 AD Assen  
The Netherlands

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, January 1st 2023



R. van Tilborg,  
Managing Director



## 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 or complete pump units the straps must be fixed in accordance with figure 1.



**When lifting a pump or a complete 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!**

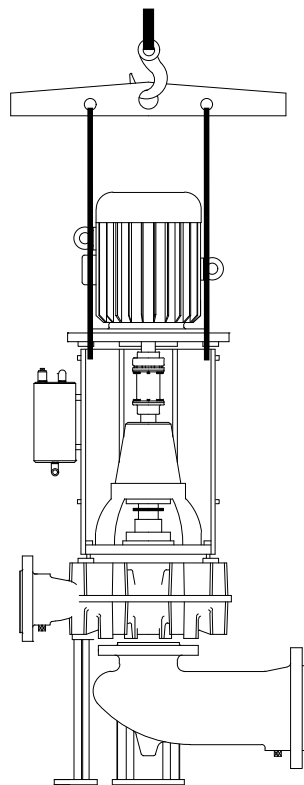


Figure 1: Lifting instructions for pump unit.

## 1.6 **Storage**

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

## 1.7 **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 CombiPrime V is a range of vertical self-priming centrifugal pumps. Hydraulic application area complies with EN 733 (DIN 24255) (with the exception of 250B-315). The flange dimensions, bolt circle and number of holes comply with ISO 7005 ND 10. The CombiPrime V is characterized by the built-in vacuum pump. Thus it is possible to pump fluids mixed with air (gas) or only air during the suction phase. The built-in vacuum pump is based on the liquid ring principle. The pump is driven by a standard IEC flange motor. The power is transmitted through a flexible coupling. Because of their modular layout, constructional components are widely interchangeable, also with other pump types of the Combi system.

### 2.2 Type code

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

Example: **CV 40-200 B2 M2 TL**

Pump family	
<b>CV</b>	CombiPrime V
Pump size	
<b>40-200</b>	diameter discharge connection [mm] - nominal impeller diameter [mm]
Pump casing/pump cover material	
<b>G</b>	cast iron
<b>B</b>	bronze
Impeller material	
<b>1</b>	cast iron
<b>2</b>	bronze
<b>3</b>	aluminium bronze
Shaft sealing	
<b>M2</b>	mechanical seal on shaft sleeve
<b>M4</b>	lip seals on shaft sleeve
De-aerating unit	
<b>TL</b>	service liquid tank + air inlet valve
<b>VL</b>	float de-aerator + air inlet valve

## 2.3 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

## 2.4 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. For relevant data see paragraph 2.6 "Application area".
- 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!***

## 2.5 Construction

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

- Pump casing/impeller/suction bend
- Shaft sealing
- Self-priming unit
- Bearing
- Lantern construction
- Foot pads

The pumps are available in 3 bearing groups, meaning that bearing and shaft sealing are divided into 3 groups. Furthermore, the pumps have been standardized in 5 groups featuring the same connection for pump cover and bearing pedestal, depending on the nominal impeller diameters. The pump covers are clamped between the pump casing and bearing bracket.

### 2.5.1 Pump casing/impeller/suction bend

These are the parts that get into contact with the pumped liquid. For each individual pump type there is only one construction of the pump casing and the impeller. The pump casing and the suction bend are available in cast iron and in bronze, the impeller in cast iron, bronze and aluminium bronze. The pump shaft is available in alloyed and stainless steel. With the available materials the pumps can be supplied in a construction suitable to pump sea water. The square suction bend has been designed in such a way that resistance is low and that all the same a low position of the pump in relation to the floor is possible. The pump types 200-200, 250B-315 have a fabricated suction bend. The suction bend can be mounted in different positions in relation to the discharge flange. This offers a large number of mounting possibilities.



### 2.5.2 Shaft sealing

On both sides of the self-priming part there is a mechanical seal or a number of lip seals. Both are mounted on shaft sleeves, which have been sealed in such a way that the pumped liquid cannot touch the pump shaft. The mechanical seals meet EN 12756 (DIN 24960), with the exception of the mounting length. The lip seals are mounted on stainless steel shaft sleeves which have been provided with a hard chromium oxide wearing layer.

### 2.5.3 Self-priming part

The self-priming part consists of a built-in vacuum pump which is working according to the liquid ring principle, an air-inlet valve with a check valve and a service liquid tank or float controlled air-relief valve. The vacuum pump part is mounted on the pump shaft, but works separately from the centrifugal pump. The service liquid which is supplied to the hub section of the vacuum pump has to maintain the liquid ring. Apart from that, it also serves for cooling and lubrication of the vacuum pump and the shaft seals.

### 2.5.4 Bearing construction

The bearing construction consists of 2 angular contact ball bearings combined with a cylindrical bearing. The bearings are grease lubricated. The angular contact bearings are mounted in an adjusting sleeve, with which the entire pump shaft can be shifted in order to adjust the axial tolerance of the pump wheel.

### 2.5.5 Lantern construction

The construction that supports the motor (the lantern) consists of profiled steel elements. The openings between these elements are sealed with perforated steel plate. 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.

### 2.5.6 Foot pads

If the pump has been constructed with foot pads, the pads have to be fastened to the foundation. The 200-200, 250B-315 are supplied with a feet support made of welded pipe and flanges. It is also possible to construct the pump without foot pads and suction bend. In that case, the pump casing is mounted on the foundation and immediately provided with a vertical suction pipe.

## 2.6 Application area

The application area globally looks as follows:

*Table 1: Application area.*

	<b>Maximum value</b>
Capacity	800 m <sup>3</sup> /h
Discharge head	100 m
System pressure	10 bar
Temperature	80°C

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

## 2.7 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:

- Flush the pump properly.
- Make sure the flushing liquid is discharged safely (environment!)



***Take adequate precautions and use the appropriate personal protection means (rubber gloves, spectacles)!***

## 2.8 Scrapping

If it has been decided to scrap a pump, the same flushing procedure as described for paragraph 2.7 "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 80°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

In order to prevent corrosion, the inside of the pump is treated with a preserving agent before leaving the factory.

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.
- Above the cooling air inlet of the motor there must be a free area of at least 1/4 of the electric motor diameter, to ensure unobstructed air supply.

## 3.4 Mounting

### 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 Mount the flattened coupling part on the pump shaft (2200). Keep the coupling part in line with the pump shaft end and fasten the coupling with the locking screw.
- 4 Fix the other coupling half on the motor shaft.
- 5 Place the electric motor on the flange (0260). Secure the electric motor with bolts (0850) and nuts (0851). Push the coupling half on the motor shaft upward.

➤ *Wherever possible use a hoisting machine and the crane hooks on the electric motor.*

- 6 Mount the distance sleeve on the lower coupling half.
- 7 Push the upper coupling half downward. For the correct distance between the coupling halves, see figure 2 with the corresponding table. Then secure the coupling half on the motor shaft.
- 8 Check whether the coupling can be turned by hand. Check the alignment, see paragraph 3.4.3 "Alignment of the coupling".
- 9 Mount the guards.

3.4.3 Alignment of the coupling

- 1 Use bolts (0890) to position the electric motor in such a way that the coupling halves are aligned correctly.
- 2 Place a ruler against the coupling. The ruler should touch both coupling halves over the entire length, see figure 2A.
- 3 Do this check a couple of times around the entire coupling.

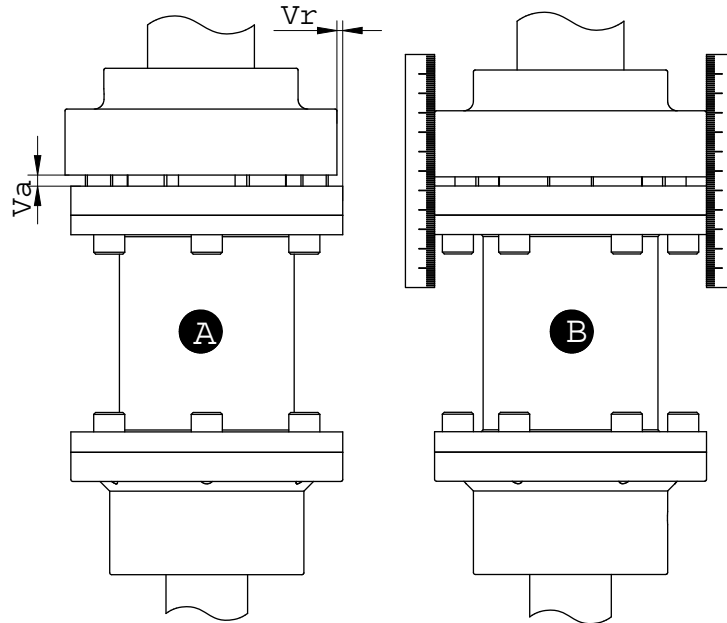


Figure 2: Alignment of the coupling.

3.4.4 Tolerances for aligning the coupling

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

Table 2: Alignment tolerances

External diameter of coupling [mm]	Va		Vr <sub>max</sub> [mm]
	min [mm]	max [mm]	
81-95	5	6	0,15
96-110	5	6	0,18
111-130	5	6	0,21
131-140	5	6	0,24
141-160	6	7	0,27
161-180	6	7	0,30
181-200	6	7	0,34
201-225	6	7	0,38
225-250	7	9	0,42
251-280	7	9	0,47

## 3.5 Piping

- The piping to the suction and delivery connections must fit exactly and must not be subject to stress during operation.
- 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 3.

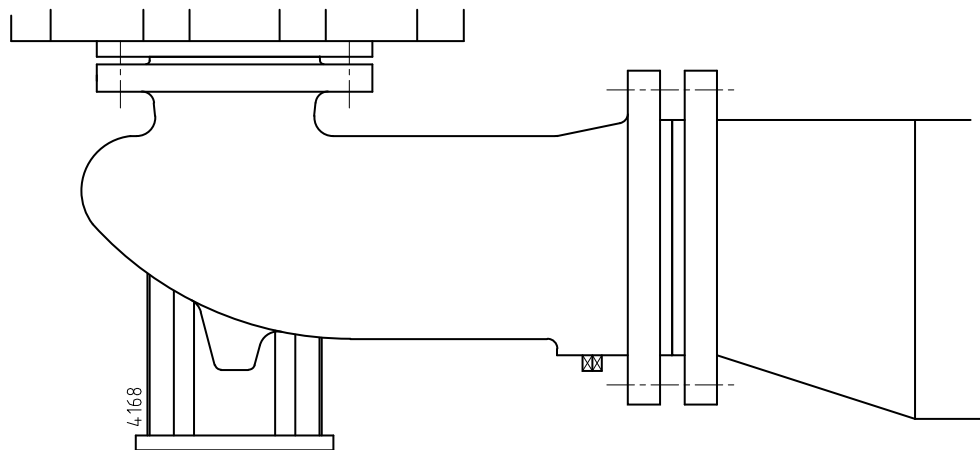


Figure 3: Eccentric reducer to suction flange.

- 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

- It is recommended to always mount a check valve and a shut-off valve in the suction pipe, as close as possible to the pump. If there is no check valve, the pump can only be started with closed delivery valve.
- In case of possible pre-pressure on the suction side, mount a shut-off valve in the suction pipe.
- If necessary, fit a foot valve at the bottom of the suction pipe. 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 so as to prevent internal pump parts from being damaged by foreign matter. If the risk of damage continues to exist, fit a permanent filter.
- Fit any parts that may have been supplied separately.
- 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 Vacuum pump with service liquid tank**

3.7.1 Mounting of accessories

- Connect a pipe to the overflow of the service liquid tank to discharge excess service liquid and extracted air.
- The pump is supplied with the exhaust pipe connected to the pump cover.

3.7.2 Connection diagram with service liquid tank

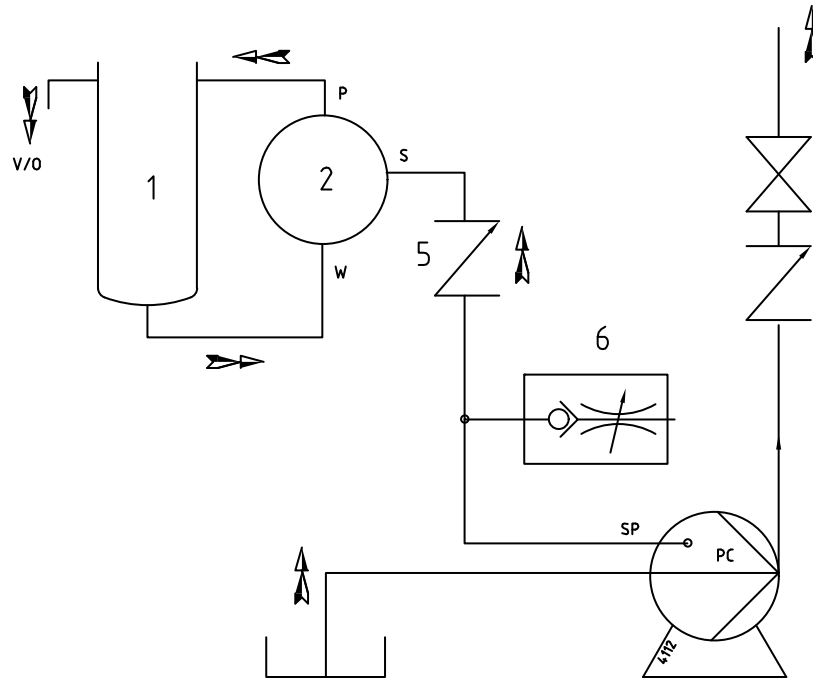


Figure 4: Connection diagram with service liquid tank.

3.7.3 Indication of connections

The suction, delivery and service liquid connections of the vacuum pump are indicated both on the drawings and on the vacuum pump by the letters **S**, **P** and **W**. Suction point **PC** is the connection to the space behind the impeller.

Indications used in figure 4 through figure 8:

<b>V/O</b>	Venting / Overflow
<b>S</b>	Inlet vacuum pump
<b>SP</b>	Exhaust pipe
<b>P</b>	Outlet vacuum pump
<b>W</b>	Service liquid
<b>PC</b>	Pump connection (=air-extraction connection centrifugal pump)
<b>SF</b>	Filter in suction pipe (only in figure 6)
<b>1</b>	Service liquid tank
<b>2</b>	Vacuum pump
<b>5</b>	Check valve
<b>6</b>	Air inlet valve

## 3.7.4 Installation examples with service liquid tank

For a few situations is shown how pumps with a service liquid tank can be installed.

**!** **Excess service liquid must always be discharged to the suction tank separately.**

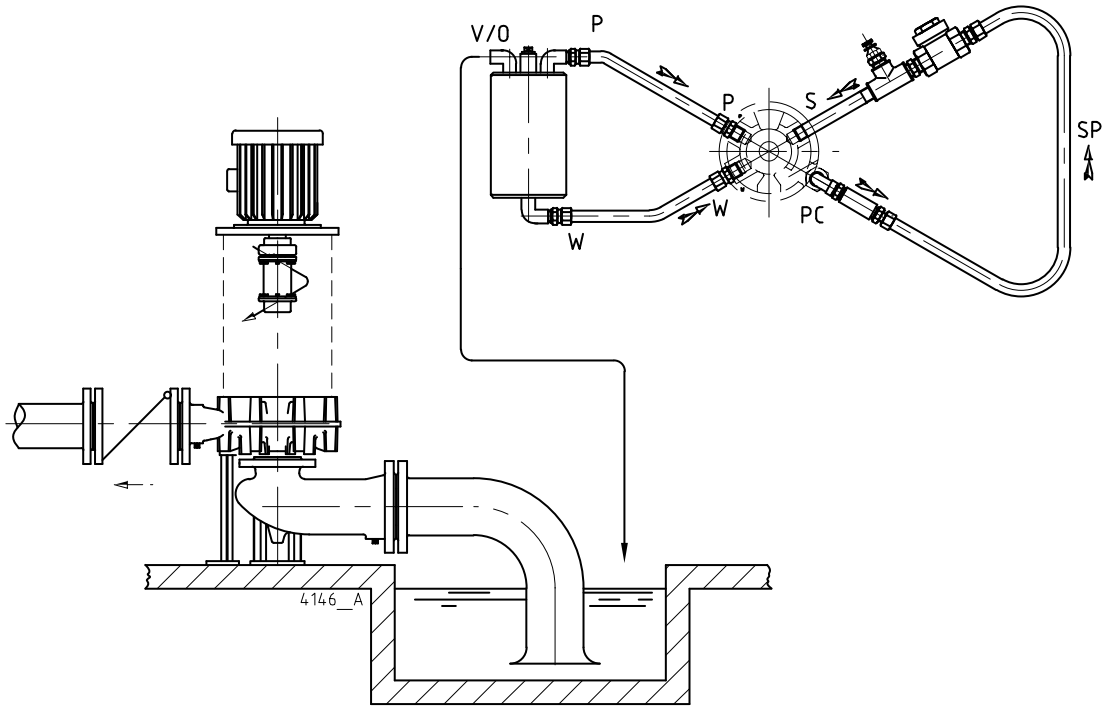


Figure 5: *Medium: thin, clean and slightly polluted liquids.*



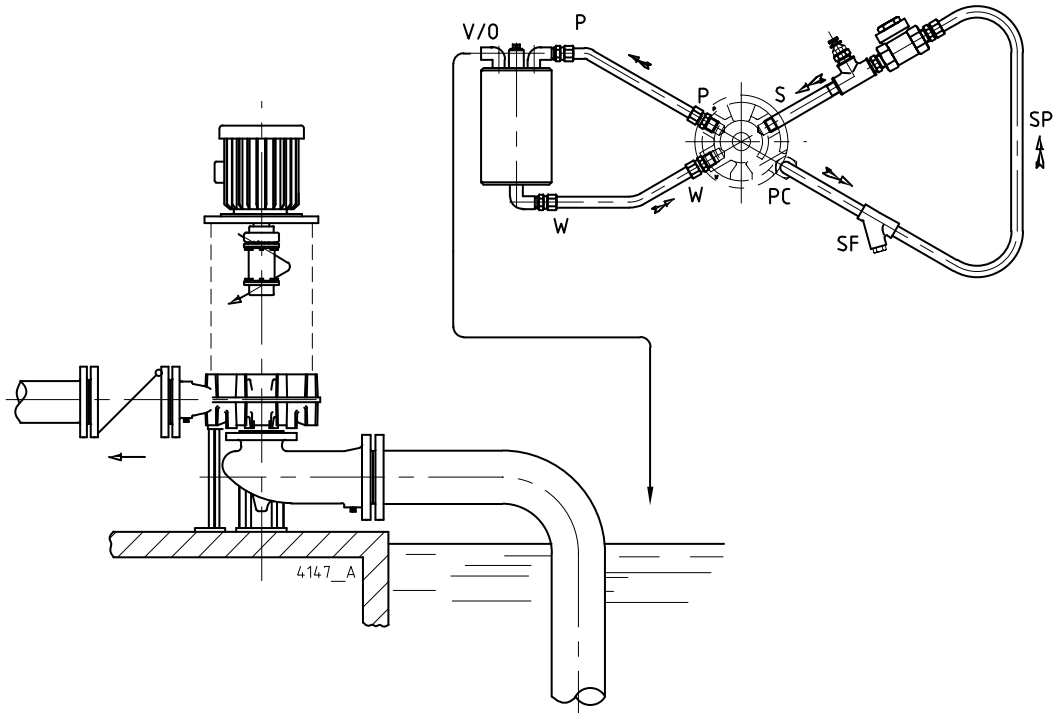


Figure 6: *Medium: thin liquids, polluted with highly abrasive constituents. The back blades on the centrifugal impeller prevent heavy abrasive matter from getting into the suction space behind the impeller. To prevent floating abrasive matter from penetrating the pump, mount a filter in the suction pipe. The straining capacity of the filter should correspond with the nature of the pollutants. If necessary, mount several filters with different sieve sizes behind each other. Use at least one filter with Rp 3/4" connections and a sieve size of 0,6 mm.*

**!** **Clean the filters regularly.**

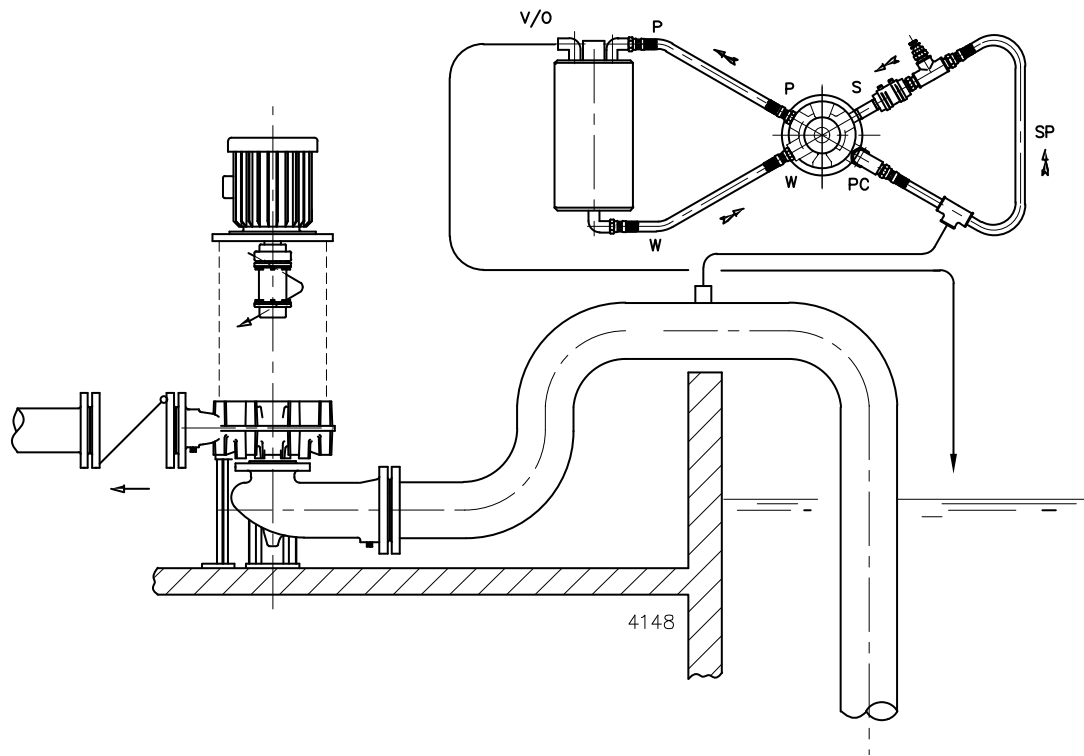


Figure 7: *Medium: thin, clean and slightly polluted liquids. In case part of the suction pipe lies higher than the pump, venting should also be provided in this part. If the suction pipe is short, or the lift in the suction pipe small, venting at the highest point is not necessary. However, the suction time will be longer.*

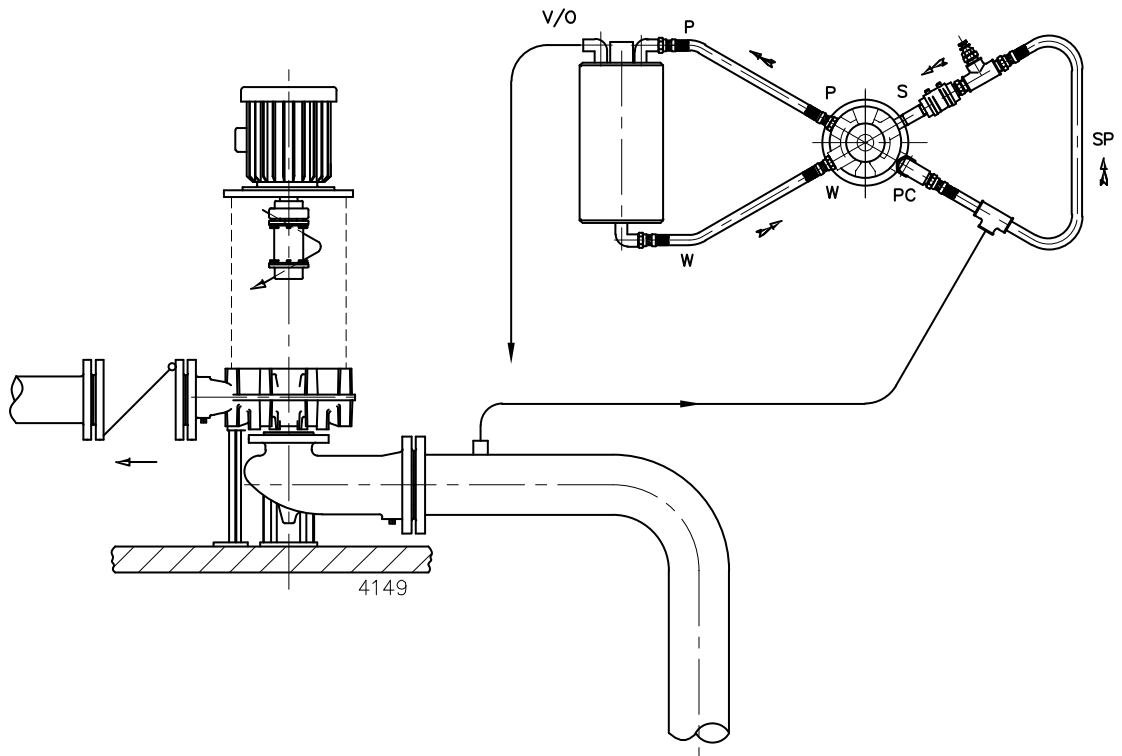


Figure 8: *Medium: thin, clean and slightly polluted liquids. In case of long suction pipes (10 m or more) and a high suction head (4-7 m), also the suction pipe must be vented.*

## 3.8 Vacuum pump with float-controlled de-aerator

### 3.8.1 Mounting of accessories

- Connect the exhaust pipe of the float-controlled de-aerator to the suction pipe. The passage of the exhaust pipe must be approx. 12 mm and the connection to the suction pipe at least G1/2".
- The pump is supplied with the exhaust pipe connected to the pump cover.

### 3.8.2 Connection diagram with float-controlled de-aerator

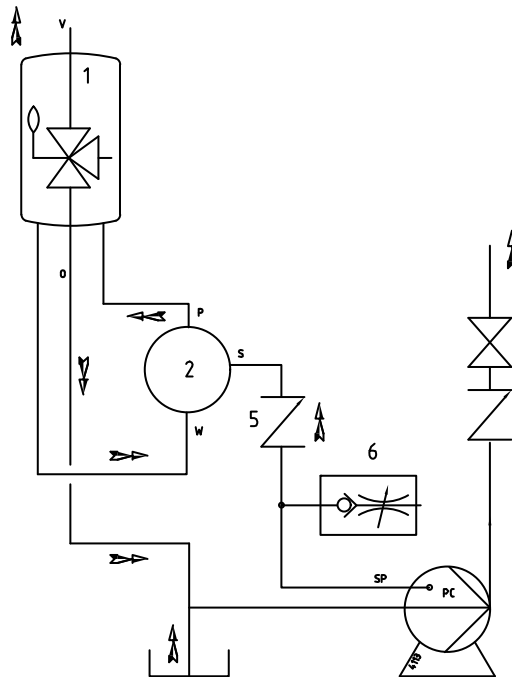


Figure 9: Connection diagram with float-controlled de-aerator.

### 3.8.3 Indication of connections

The suction, delivery and service liquid connections of the vacuum pump are indicated both on the drawings and on the vacuum pump by the letters **S**, **P** and **W**. Suction point **PC** is the connection to the space behind the impeller.

Indications used in figure 9 through figure 13:

<b>V/O</b>	Venting / Overflow
<b>S</b>	Inlet vacuum pump
<b>SP</b>	Exhaust pipe
<b>P</b>	Outlet vacuum pump
<b>W</b>	Service liquid
<b>PC</b>	Pump connection (=air-extraction connection centrifugal pump)
<b>SF</b>	Filter in exhaust pipe (only in figure 11)
<b>1</b>	Float-controlled de-aerator
<b>2</b>	Vacuum pump
<b>5</b>	Check valve
<b>6</b>	Air inlet valve

3.8.4 Installation examples with float-controlled de-aerator

For a few situations is shown how pumps with a float-controlled de-aerator can be installed.

**!** The excess service liquid is always returned to the suction pipe.

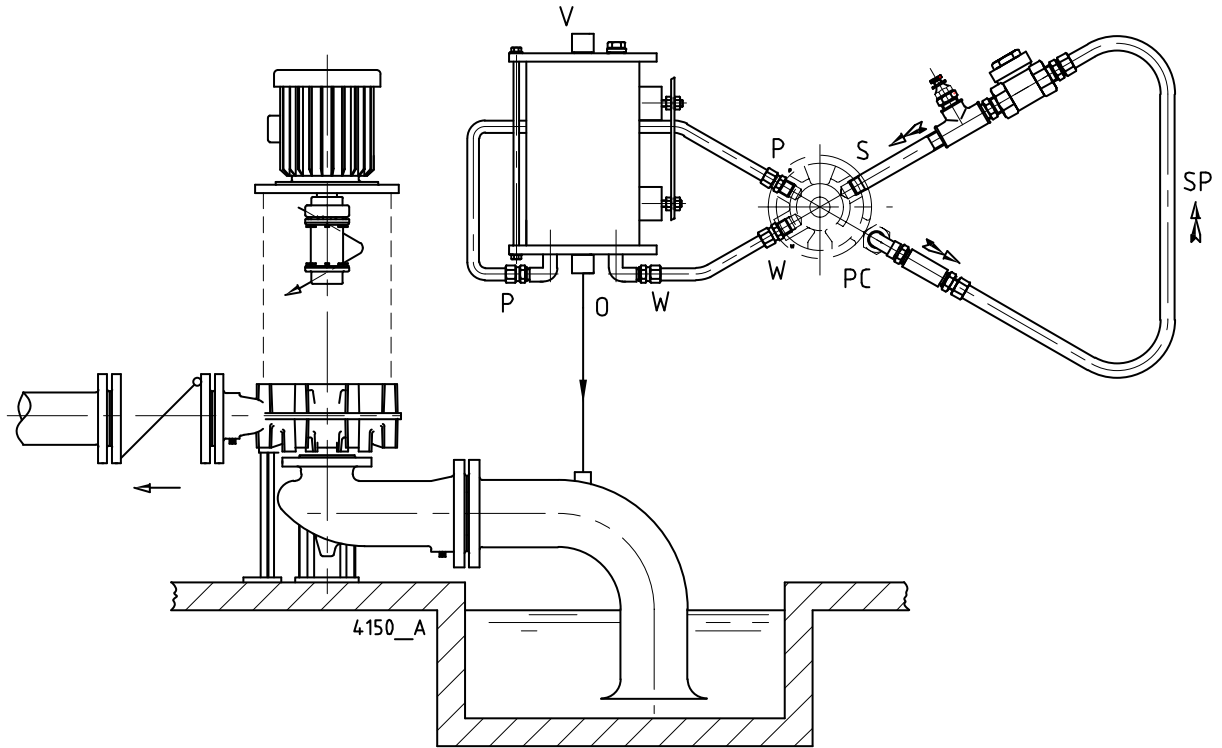


Figure 10: Medium: thin, clean and slightly polluted liquids.

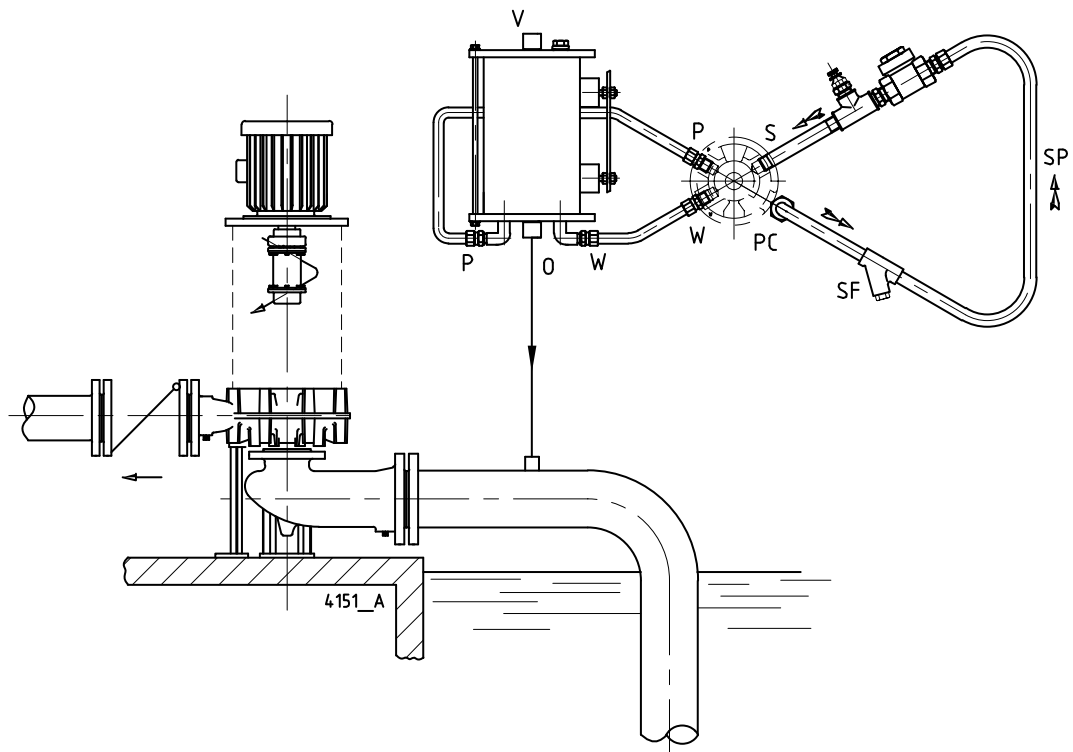


Figure 11: *Medium: thin liquids polluted with highly abrasive matter. The back blades on the centrifugal impeller prevent heavy abrasive matter from getting into the suction space behind the impeller. To prevent floating abrasive matter from penetrating the pump, mount a filter in the suction pipe. The straining capacity of the filter should correspond with the nature of the pollutant. If necessary, mount several filters with different sieve sizes behind each other. Use at least one filter with Rp 3/4" connections and a sieve size of 0,6 mm.*

**!** **Clean the filters regularly.**

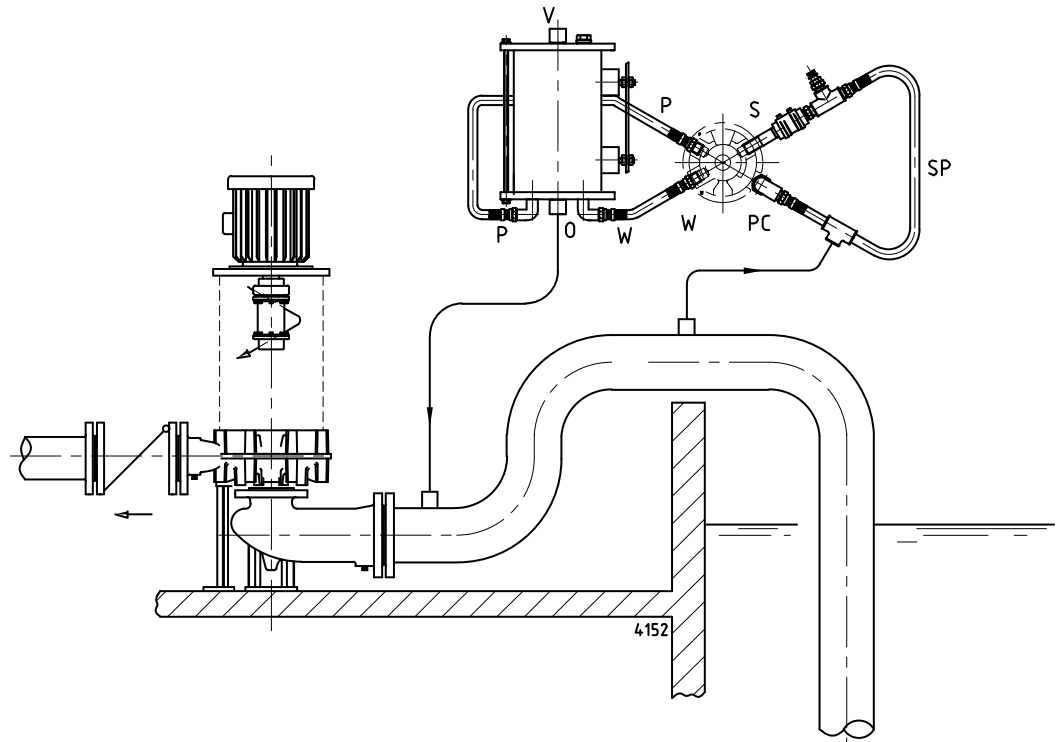


Figure 12: *Medium: thin, clean and slightly polluted liquids. In case part of the suction pipe lies higher than the pump, venting should also be provided in this part. If the suction pipe is short, or the lift in the suction pipe small, venting at the highest point is not necessary. However, the suction time will be longer.*

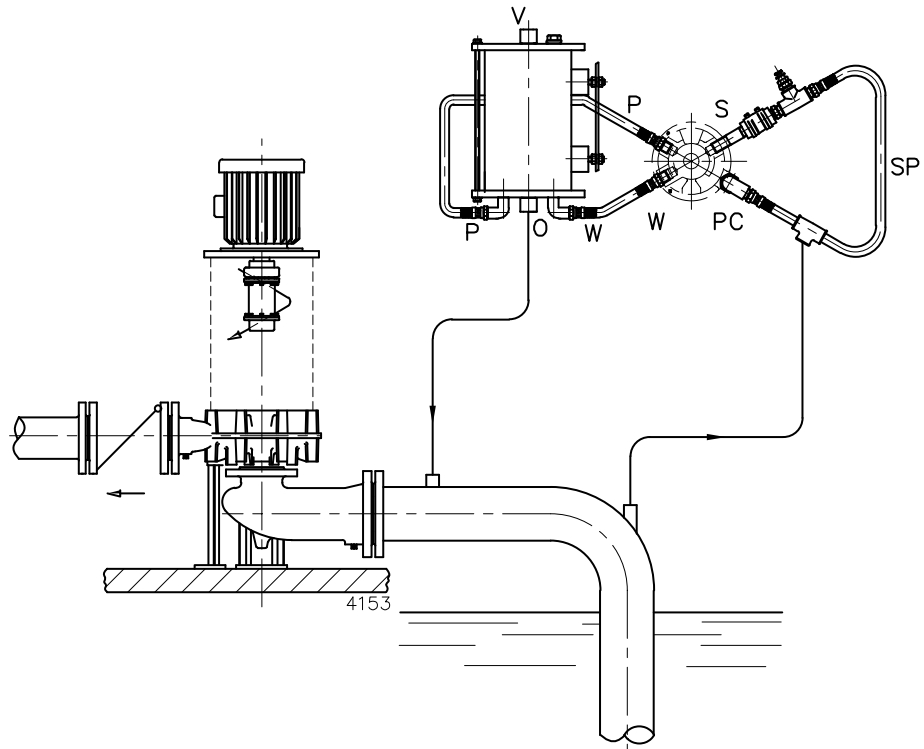


Figure 13: *Medium: thin, clean and slightly polluted liquids. In case of long suction pipes (10 m or more) and a high suction head (4 -7 m), also the suction pipe must be vented.*

### 3.9 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 vacuum pump part

- 1 Check whether all piping between the pump wheel casing and the service liquid tank (version TL) or the float-controlled de-aerator (version VL) have been connected.
- 2 Fill the service liquid tank or the float-controlled de-aerator with liquid and close them with plug (1690) or (3013) respectively.

### 4.3 Inspection of the motor

Check whether the fuses have been mounted.

### 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

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

- 1 Close the air-inlet valve (1650).
- 2 Fully open the stop valve in the suction pipe. Close the delivery stop valve.
- 3 Start the pump.
- 4 As soon as the pump is under pressure, slowly open the delivery stop valve until the working pressure is attained.



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

## 4.6 **Adjusting the air-inlet valve**

The air-inlet valve (1650) serves to admit small quantities of air into the self-priming system. The vacuum pump has been designed to pump a large quantity of air. After the suction phase, the vacuum pump functions as liquid pump. However, in principle it is not designed to only pump liquid. By adding a small quantity of air through the air-inlet valve, it is possible to avoid problems. After the pump has been started with closed air-inlet valve, the valve is adjusted as follows:

- 1 When the suction phase is over and the centrifugal pump maintains the liquid flow on its own, the pump will start making a crackling noise.
- 2 Slowly open the air-inlet valve until the crackling stops.
- 3 Leave the valve in this position and secure it with a lock nut. The valve is now properly adjusted. Provided the system conditions do not change, the pump can be reconnected after a break without having to readjust the valve.

## 4.7 **Mechanical seal**

- A mechanical seals or the lip seals may never show any visible leakage.

## 4.8 **Pump in operation**

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

- The pump may never run without liquid in the service liquid tank or the float-controlled de-aerator.
- 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.

## 4.9 **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 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 Service liquid

After the pump has been put into operation once, the working-liquid tank and the float-controlled de-aerator don't have to be filled up again: there is constantly a sufficient quantity of pumped liquid in the working-liquid tank and the float-controlled de-aerator.

### 5.3 Shaft sealing

#### 5.3.1 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. As the seal faces have run in on one another dismantling usually implicates replacement of the mechanical seal. If a mechanical seal shows any leakage it has to be replaced.

#### 5.3.2 Lip seal

The lip seals generally require no maintenance. The lip seals run around stainless steel shaft sleeves which are provided with a hard wearing layer. The space between the lip seals is filled with grease when they are mounted, so as to limit wearing to a minimum. When the lip seals are leaking they have to be replaced.

### 5.4 Lubrication of the bearings

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 house and the bearings have to be cleaned and provided with new grease. For recommended greases see paragraph 10.1 "Recommended greases".

## 5.5 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.

## 5.6 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.

## 5.7 Motor

Check motor specifications for start-stop frequency.

## 5.8 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.
- 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.*

<b>Most common faults</b>	<b>Possible causes, see Table 4.</b>
Pump delivers no liquid	1 4 8 9 10 11 13 14 17 19 20 21 29
Pump has insufficient volume flow	2 3 4 8 9 10 11 13 14 15 17 19 20 21 28 29 44
Pump has insufficient head	2 4 13 14 17 19 28 29
Pump stops after start up	1 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	3 14 15 16 17 18 20 21 28 29 44
Mechanical seal has to be replaced to often	23 25 26 30 32 33 34
Pump vibrates or is noisy	9 10 11 15 18 19 20 22 23 24 25 26 27 29 37 38 39 40 43
Bearings wear too much or become hot	23 24 25 26 27 37 38 39 40 42
Pump running rough hot or seizes	23 24 25 26 27 34 37 38 39 40 42

Table 4: Possible causes of pump failures.

	Possible causes
1	Service liquid tank or float de-aerator not filled with liquid
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 works when the liquid flow is too low
19	Wrong pump selection
20	Obstruction in impeller or pump housing
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	Wear ring faulty or worn out
29	Damaged impeller
30	Seal faces of the mechanical seal are worn out or damaged
32	Bad mounting of the mechanical seal or of the lip seals
33	Mechanical seal or lip seals not suitable for the operation liquid or operation circumstances
34	Pump wheel cover not perpendicularly mounted
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
42	Too high axial force because of worn dorsal blades or excessive inlet pressure
43	Air-inlet valve closed
44	Air-inlet valve opened too much

# 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 Liquid draining



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

Before starting any disassembly the pump should be drained through the drain plug (0320). If possible, also drain the suction bend to a certain extent (if provided with a suction bend (0400) through drain plug (0350)).

If necessary, close the valves in the suction and delivery pipe and in the flushing or cooling supply lines to the shaft seal. Also drain the self-priming section by disconnecting the piping P, S and W.

If the pump processes harmful liquids, take the following precautions:

- 1 Wear protective gloves, shoes, glasses, etc.
- 2 Flush the pump properly.
- 3 Make sure no liquid gets into the environment.
- 4 Refit the drain plug.

## 7.4 Item numbers

If no specific figure numbers are stated, then the item numbers used in these instructions refer to the cross section drawings and parts lists, which can be found in chapter 9 "Parts".

The connection markings P, S and W on the self-priming section are explained in paragraph 3.7.3 "Indication of connections" for the Service liquid tank configuration TL or paragraph 3.8.3 "Indication of connections" for the Float de-aerator configuration VL.

## 7.5 Constructive variants

The pumps can be supplied in various constructive variants. Each variant has a code which is stated in the type identification on the name plate on the pump.

Table 5: Constructive variants codes.

<b>M2</b>	mechanical seal on shaft sleeve
<b>M4</b>	lip seals on shaft sleeve
<b>TL</b>	service liquid tank + air inlet valve
<b>VL</b>	float de-aerator + air inlet valve

## 7.6 Top Pull Out system

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 way the pump can be dismantled to a major extent without having to loosen the suction and delivery piping. The motor can remain in its position.

### 7.6.1 Disassembly Top Pull Out unit

- 1 Disconnect the connections **S**, **P** and **W** from the pump wheel casing.
- 2 Remove the guard (0270).
- 3 Remove the spacer (0210) from the spacer coupling.
- 4 Mark the position of the pump cover (0110) and the bearing bracket (2100) in relation to the pump casing (0100).
- 5 Remove the Allen screws (0800) and lift the Top Pull Out unit out of the pump through the opening between the lantern elements (0250).



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

### 7.6.2 Assembly Top Pull Out unit

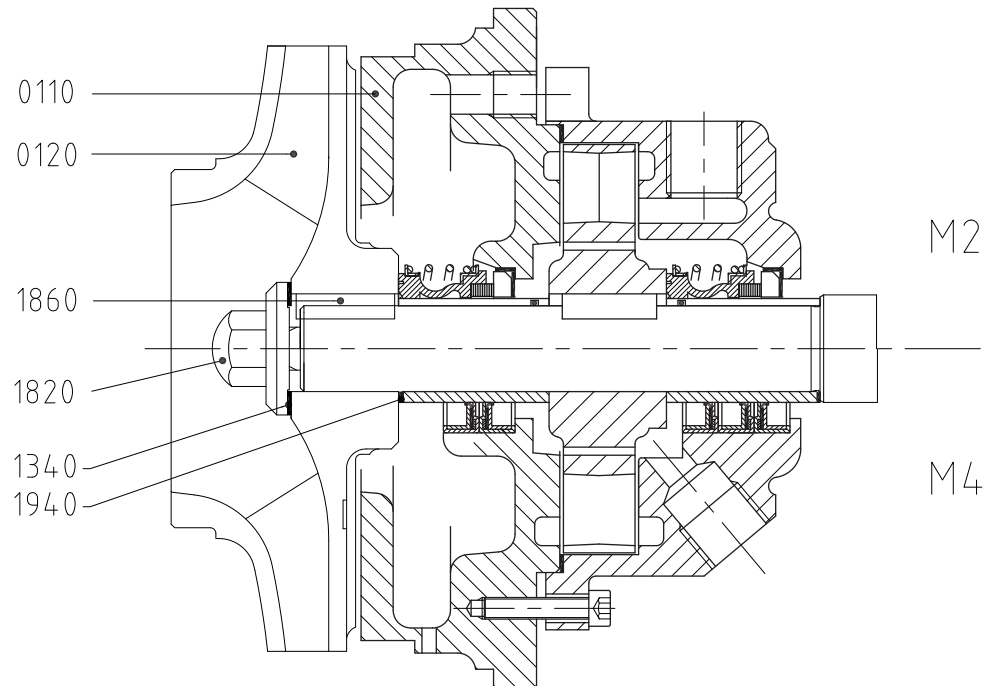
- 1 Mount a new gasket (0300) for the pump casing and lower the Top Pull Out unit in the right position into the pump casing. Take care not to damage the gasket (0300).
- 2 Tighten the Allen screws (0800) crosswise.
- 3 Reconnect the connections **S**, **P** and **W** to the pump wheel casing.
- 4 Mount the spacer of the spacer coupling (0210).
- 5 Check the alignment of pump and motor shaft, see paragraph 3.4.3 "Alignment of the coupling". If necessary, realign.
- 6 Mount the guard (0270).



## 7.7 Replacing the impeller and the wear ring

The play between the impeller and the wear ring is 0,3 mm to the diameter at delivery. In case the play has increased to 0,5-0,7 mm due to wear, the impeller and the wear ring should be replaced.

### 7.7.1 Disassembly of the impeller



Figur 14: Disassembling the impeller.

The item numbers used are referring to figure 14.

- 1 Remove the Top Pull Out unit, see paragraph 7.6.1 "Disassembly Top Pull Out unit".
- 2 Remove the cap nut (1820) and the gasket (1340) (only for bearing group 3). Sometimes the nut has to be heated to break the Loctite-contact.
- 3 Remove the impeller (0120) with a pulley puller or wrest the impeller loose by inserting for instance 2 big screwdrivers between the impeller and the pump cover (0110).
- 4 Remove the impeller key (1860).
- 5 Remove the gasket (1940).

### 7.7.2 Mounting the impeller

- 1 Fit the gasket (1940).
- 2 Place the impeller key (1860) in the key way of the pump shaft.
- 3 Push the impeller onto the pump.
- 4 Degrease the thread on the pump shaft and the thread in the cap nut.
- 5 Fit the gasket (1340) (only for bearing group 3).
- 6 Put a drop of Loctite 243 on the thread and fit the cap nut. For tightening moment of the nut see the table in paragraph 10.3.2 "Tightening moments for cap nut".
- 7 Mount the Top Pull Out unit, see paragraph 7.6.2 "Assembly Top Pull Out unit".

## 7.7.3 Disassembling of the wear ring

After removing the Top Pull Out unit the wear ring can be removed. In most cases the ring has been fixed so tightly that it cannot be removed undamaged.

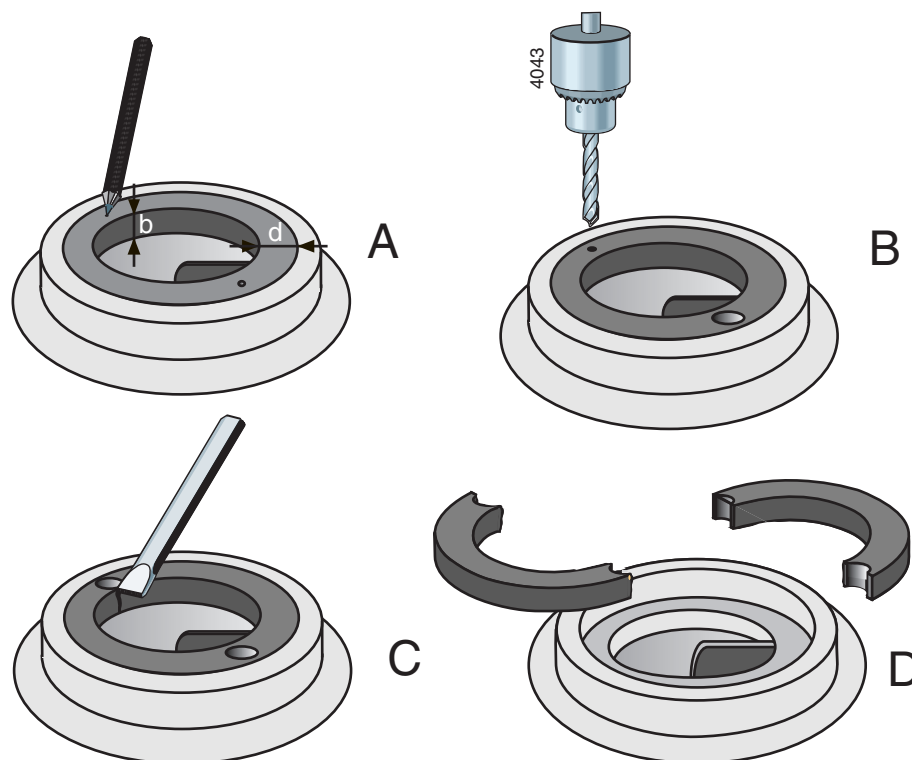


Figure 15: Removal of wear ring.

- 1 Measure the thickness (d) and the width (b) of the ring, see figure 15 A.
- 2 Make a centre hole in the middle of the edge of the ring at two opposite points, see figure 15 B.
- 3 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 15 C. Don't drill deeper than the width (b) of the ring. Take care not to damage the fitting edge of the pump casing.
- 4 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 15 D.
- 5 Clean the pump casing and carefully remove all bore dust and metal splinters.

## 7.7.4 Assembling the wear ring

- 1 Clean and degrease the fitting edge of the pump casing where the wear ring is to be mounted.
- 2 Degrease the outer edge of the wear ring and put a few drops of Loctite 641 on it.
- 3 Fit the wear ring in the pump casing. **Take care it is not pushed out of alignment!**

## 7.8 Shaft sealing

### 7.8.1 Disassembly of the mechanical seal M2

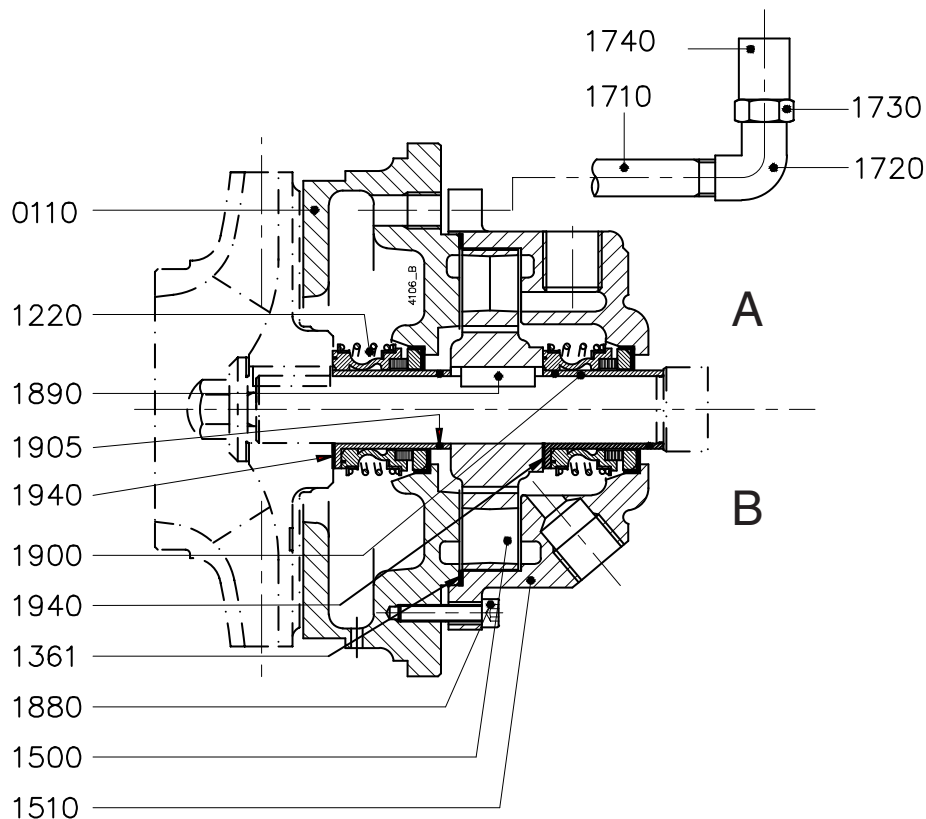


Figure 16: Mechanical seal M2  
(A = bearing groups 1 and 2, B = bearing group 3).

The item numbers used are referring to figure 16.

- 1 Remove the impeller, see paragraph 7.7.1 "Disassembly of the impeller".
- 2 Pull the shaft sleeve (1900) from the pump shaft and remove the rotating part of the mechanical seal from the shaft sleeve.  
Bearing group 3 only: Remove gasket (1940).
- 3 Mark the position of the pump cover (0110) in relation to the bearing bracket (2100).
- 4 Loosen the Allen screws (1880).
- 5 Push the cover of the pump wheel casing (1510) backward.
- 6 Knock the pump cover loose and remove it. Push the counter-ring of the mechanical seal through the shaft passage inward out of the cover.
- 7 Pull the pump wheel (1500) from the pump shaft and remove the key (1890).
- 8 Pull the shaft sleeve (1900) from the pump shaft and remove the rotating part of the mechanical seal from the shaft sleeve.  
Bearing group 3 only: Remove gasket (1940).
- 9 Pull the pump wheel casing (1510) off the pump shaft. Pull the counter-ring of the mechanical seal out of the pump cover.
- 10 Remove gasket (1361).
- 11 Remove O-rings (1905) out of the shaft sleeves (1900).

## 7.8.2 Instructions for mounting a mechanical seal

➤ *First read the following instructions regarding the mounting of a mechanical seal. Follow these instructions closely when mounting a mechanical seal.*

- A mechanical seal is a fragile precision instrument. Leave the seal in its original packing until you are ready to fit it!
- Clean all receiving parts properly. Make sure your hands and working environment are clean!
- **Never touch the sliding surfaces with ones fingers!**
- Take care not to damage the seal during assembly. Never put the rings down on their sliding surfaces!

## 7.8.3 Assembly of the mechanical seals M2

- 1 Check the shaft sleeves (1900) and the splash ring (2220) for damages. Also, the splash ring should clasp the shaft well. If necessary replace these parts.
- 2 Place the bearing bracket with the shaft upright.
- 3 Place the cover of the pump wheel casing (1510) and the pump cover (0110) flat down and press the counter-rings of the shaft seals straight into the. If necessary use a plastic pressure piece. Never knock them inside! The maximum axial turn of the counter-ring is 0,1 mm.
- 4 Put some glycerine or silicon grease on the O-rings and mount the O-rings into the shaft sleeves.
- 5 Push the cover of the pump wheel casing (1510) over the pump shaft.
- 6 Wet the clean shaft sleeve with some low-surface-tension water (add detergent), feed the bellows with a slight twist in clockwise direction onto the shaft sleeve. **Use no oil or grease!** Apply pressure only on the corner rings.
- 7 Push the shaft sleeve (1900) onto the pump shaft.
- 8 Bearing group 3 only: Fit a new gasket (1940).
- 9 Place the key (1890) in the pump shaft and push the pump wheel (1500) over the pump shaft.
- 10 Mount the gasket (1361).
- 11 Mount the pump cover (0110) in the right position into the fitting edge of the bearing bracket. Check whether the pump cover is at right angles to the pump shaft.
- 12 Mount the cover of the pump wheel casing (1510) against the pump cover. Watch its position in view of the connections. Tighten the Allen screws (1880) crosswise. **The cover should not be oblique.**
- 13 Push the other shaft sleeve (1900) on the pump shaft.
- 14 Bearing group 3 only: Fit a new gasket (1940).
- 15 Fit the impeller and other parts, see paragraph 7.7.2 "Mounting the impeller".

## 7.8.4 Disassembly of the lip seals M4

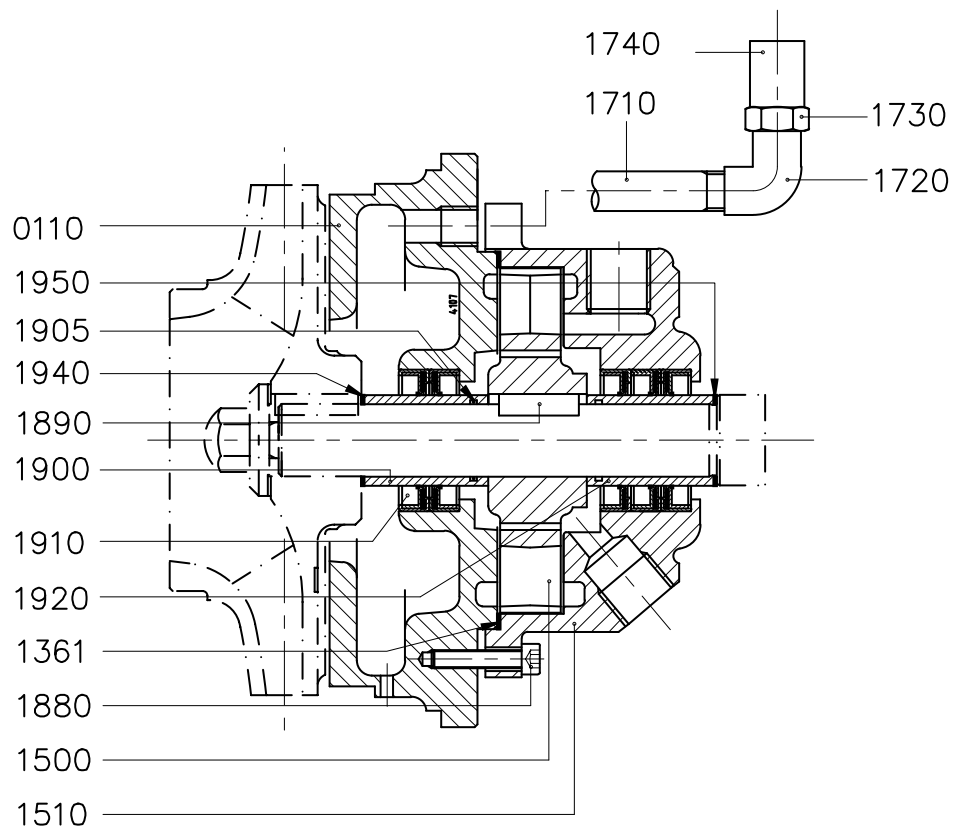


Figure 17: Lip seal M4.

The item numbers used are referring to figure 17.

- 1 Remove the impeller, see paragraph 7.7.1 "Disassembly of the impeller".
- 2 Mark the position of the pump cover (0110) in relation to the bearing bracket (2100).
- 3 Loosen the Allen screws (1880).
- 4 Push the cover of the pump wheel casing (1510) backward.
- 5 Knock the pump cover loose and remove it. Remove the lip seals (1910).
- 6 Pull the shaft sleeve (1900) from the pump shaft and remove the O-ring (1905).
- 7 Pull the pump wheel (1500) from the pump shaft and remove the key (1890).
- 8 Slide the cover of the pump wheel casing (1510) off the pump shaft and remove the tabbed sealing rings.
- 9 Remove gasket (1361).
- 10 Pull the shaft sleeve (1920) from the pump shaft.
- 11 Remove the gasket (1950) from the pump shaft.

## 7.8.5 Instructions for mounting a lip seal

➤ *First read the following instructions regarding the mounting of a lip seal. Follow these instructions closely when mounting a lip seal.*

- A lip seal is a fragile precision instrument. Leave the seal in its original packing until you are ready to fit it!
- Clean all receiving parts properly.
- Make sure your hands and working environment are clean!

## 7.8.6 Assembly of the lip seals M4

- 1 Check the shaft sleeves (1900 and 1920) and the splash ring (2220) for damages. Also, the splash ring should clasp the shaft properly. If necessary, replace these parts.
- 2 Place the bearing bracket with the shaft upright.
- 3 Mount the gasket (1950) around the pump shaft.
- 4 Slide the cover of the pump wheel casing (1510) onto the pump shaft.
- 5 Mount a lip seal on both ends of the shaft sleeve. The pointing direction of the tab should be opposite to the sliding direction. Shaft sleeve (1900) will have 2 lip seals, shaft sleeve (1920) will have 3. **When being mounted, the lip seals and the space between them both must be filled with grease.**
- 6 Slide the shaft sleeve (1920) onto the pump shaft.
- 7 Mount the key (1890) in the pump shaft and slide the pump wheel casing (1500) onto the pump shaft.
- 8 Mount the pump cover (0110) in the right position in the fitting edge of the bearing bracket. Check the position of the pump cover. It should be at right angles to the pump shaft.
- 9 Mount the gasket (1361) between the pump cover and the pump wheel casing.
- 10 Mount the cover of the pump wheel casing (1510) against the pump cover. Watch the position in view of the place for the connections. Tighten the Allen screws (1880) crosswise. The cover should not be oblique.
- 11 Mount the O-ring (1905) into the shaft sleeve (1900) and slide the shaft sleeve onto the pump shaft.
- 12 Fit the impeller and the other parts, see paragraph 7.7.2 "Mounting the impeller".

## 7.9 Bearing

### 7.9.1 Disassembling bearing

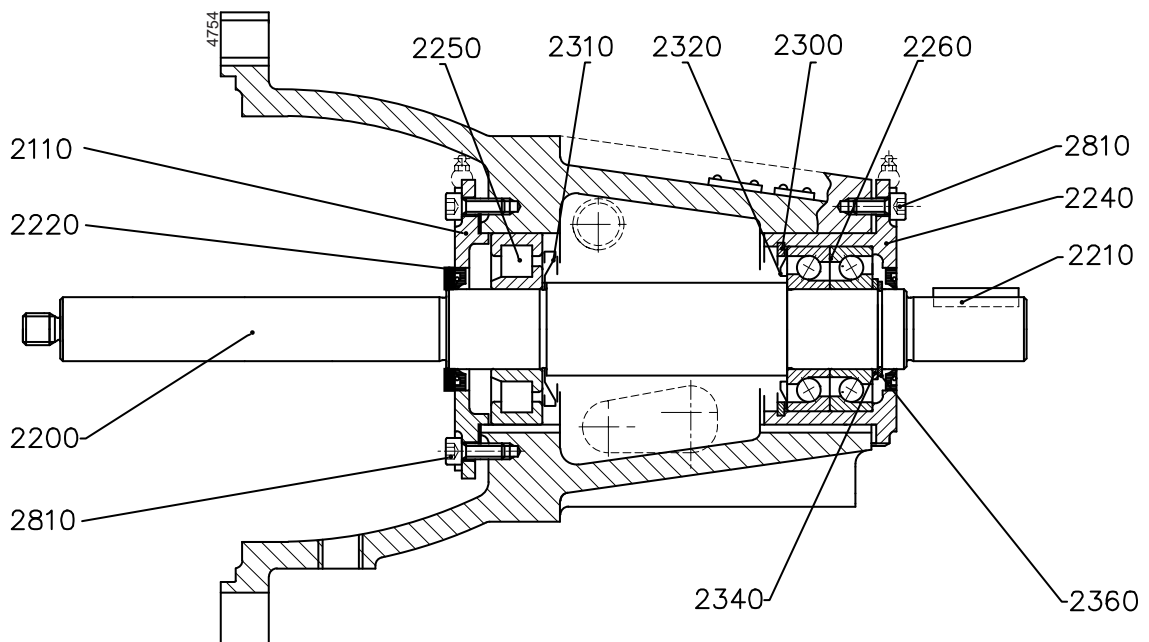


Figure 18: Bearing.

The item numbers used are referring to figure 18.

- 1 Disassemble the impeller and the shaft seal, see paragraph 7.7.1 "Disassembly of the impeller" and paragraph 7.8.1 "Disassembly of the mechanical seal M2" / paragraph 7.8.4 "Disassembly of the lip seals M4".
- 2 Remove the splash ring (2220).
- 3 Remove the Allen screws (2810) and the bearing cover (2110).
- 4 Knock the pump shaft (2200) on impeller side until the adjusting bush (2240) with the bearings (2260) comes out of the bearing bracket. Use a plastic hammer so as to avoid damage to the thread. Remove the pump shaft with the bearings from the bearing bracket.
- 5 Remove the coupling with a coupling puller and remove the coupling key (2210).
- 6 Remove the inner circlip (2300) and pull the adjusting bush (2240) off the bearings.
- 7 Remove the outer circlip (2360) and the adjusting ring (2340) and pull the bearings from the pump shaft with a suitable puller. If such a puller is not available, knock the inner raceway of the bearing carefully. Use a normal hammer and a soft-metal drift.  
**Never knock with a hammer directly on the bearing!**
- 8 Remove the NILOS-Rings (2310 and 2320).

## 7.9.2 Assembling bearing

**!** **Make sure your working environment is clean and leave the bearings in their original packing until you are ready to mount them.**

- 1 Clean the interior of the bearing bracket properly.
- 2 Mount the NILOS-Rings (2310 and 2320) on the pump shaft. Make sure they are in the right place and position.
- 3 If possible, preheat the bearings to 90°C before mounting them on the pump shaft. The cylindrical roller bearing (2250) is fitted at the impeller side. The angular contact ball bearings are fitted in O-position on the drive side. Make sure that all bearings are straight on the pump shaft.

**!** **If preheating is not possible: never knock directly on the bearing! Use a mounting bush which is positioned against the inner raceway of the bearing and a normal hammer. A soft hammer may loose splinters which might damage the bearing.**

- 4 Fit the adjusting ring (2340) and fit the outer circlip (2360).
- 5 Grease the bearings. See paragraph 10.1 "Recommended greases" for recommended grease types.
- 6 Press the adjusting bush (2240) over the two angular contact bearings and fit the inner circlip (2300) in the adjusting bush. Make sure the inner circlip falls into the groove.
- 7 Mount the shaft with the bearings into the bearing bracket from the motor side. Knock the shaft end on the coupling side until the first bearing (2250) slides through the bearing boring.
- 8 Carefully knock the pump shaft further into the bearing bracket until the adjusting bush (2240) is completely inside the bearing bracket. The pump shaft with the bearings has to go straight into the bearing bracket.
- 9 Mount the bearing cover (2110) and the splash ring (2220).
- 10 Mount the set screws (1930) and the Allen screws (2810) and adjust the axial play as described in 7.9.
- 11 Mount the self-priming part and the impeller as described in paragraph 7.8 "Shaft sealing" and paragraph 7.7.2 "Mounting the impeller".



### 7.10 Adjustment of the axial play

After repairs to the pump, the axial play of the pump wheel has to be adjusted. This play has to be equal on both sides. This adjustment can be done in the following way, see figure 19:

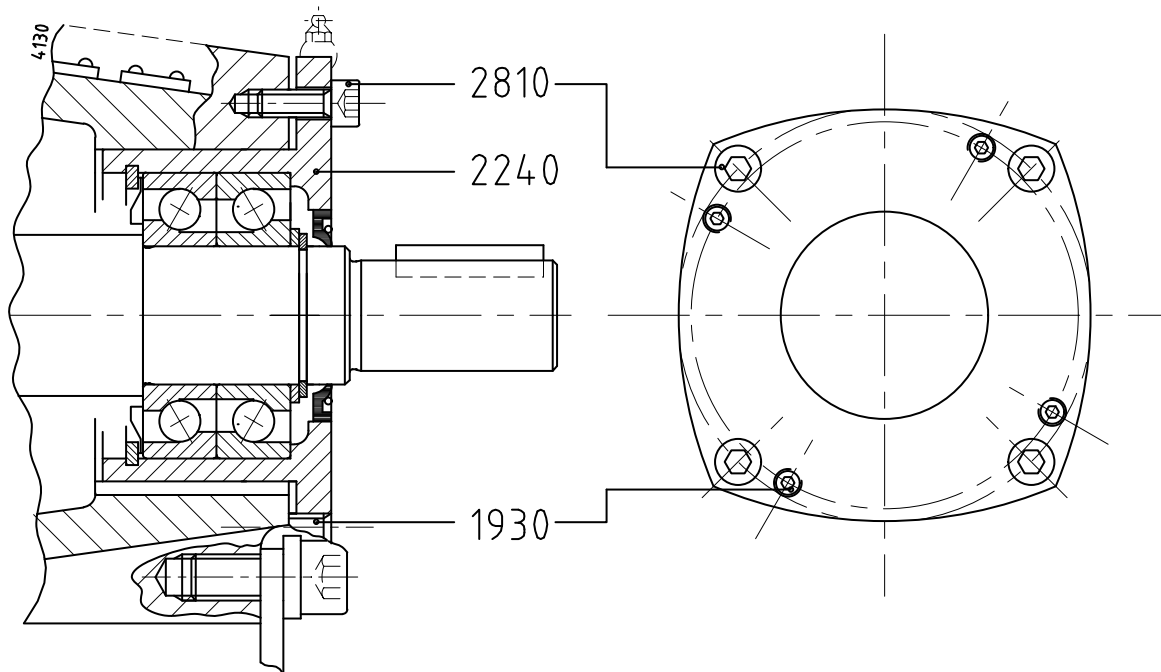


Figure 19: Adjustment of the axial play.

- 1 Loosen the set screws (1930).
- 2 Tighten the Allen screws (2810) crosswise. The adjusting bush (2240) with the bearing, pump shaft and pump wheel is shifting to the left. Turn the pump shaft by hand whilst tightening the screws. Tighten the Allen screws until you feel that the pump wheel starts to drag.
- 3 Screw the set screws (1930) so far into the adjusting bush (2240) until they are just touching the bearing bracket.
- 4 Loosen the Allen screws (2810) again.
- 5 Re-tighten the set screws (1930) crosswise, whilst turning the pump shaft by hand. Count the number of turns you can give the set screws until the pump wheel starts to turn.
- 6 Then loosen the set screws again by half of the number of tightening turns.
- 7 Now tighten the Allen screws (2810) crosswise.
- 8 Check whether all 4 set screws are properly tightened.
- 9 Check whether the pump shaft can easily be turned.

➤ *If you wish you can use a clock gauge instead of counting the number of tightening turns of the screws. Determine the position of the shaft end in the two extreme positions of the shaft. Then adjust the shaft end right in the middle of the measured values.*



# 8 Dimensions

## 8.1 Dimensions delivery flange

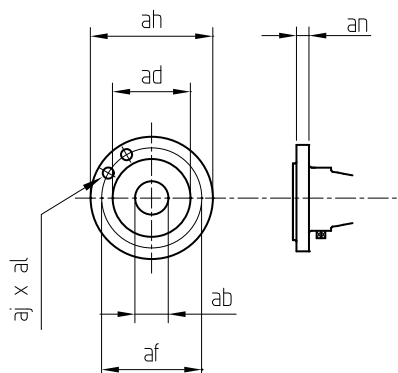


Figure 20: Dimensions delivery flange.

ISO 7005 PN 16					
ab	ad	af	ah	aj x al	an
32	78	100	140	4 x 18	18
40	88	110	150	4 x 18	18
50	102	125	165	4 x 18	20
65	122	145	185	4 x 18	20
80	138	160	200	8 x 18	22
100	158	180	220	8 x 18	22
125	188	210	250	8 x 18	24
150	212	240	285	8 x 23	24

ISO 7005 PN 16					
ab	ad	af	ah	aj x al	an
200	268	295	340	8 x 23	26
250	320	350	395	12 x 23	28

## 8.2 Dimensions suction flange

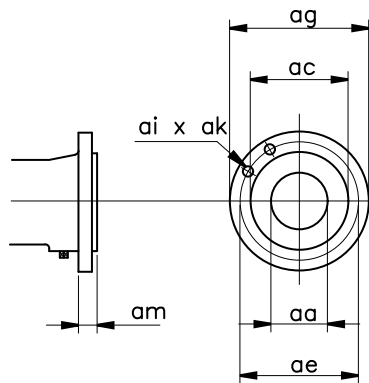


Figure 21: Dimensions suction flange.

ISO 7005 PN 16					
aa	ac	ae	ag	ai x ak	am
65	122	145	185	4 x 18	24
80	138	160	200	8 x 18	25
100	158	180	220	8 x 18	27
125	188	210	250	8 x 18	28
150	212	240	285	8 x 22	29

ISO 7005 PN 10					
aa	ac	ae	ag	ai x ak	am
200	268	295	340	8 x 22	31
250	320	350	395	12 x 22	26

8.3 Dimensions foot pads

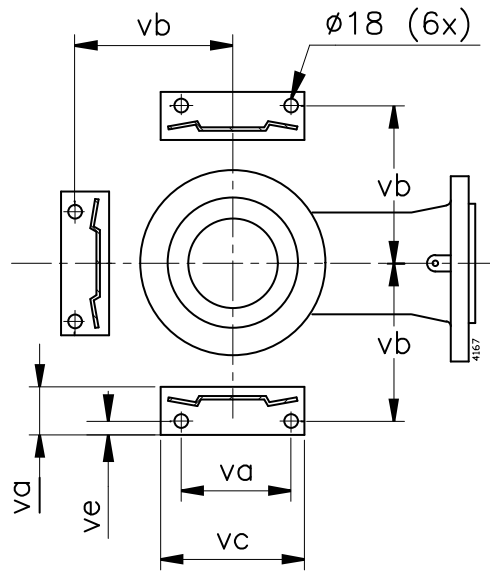


Figure 22: Dimensions foot pads (Top view).

CV	va	vb	vc	vd	ve
...-160	120	180	160	80	19
...-200	130	205	180	80	17
...-250	155	230	205	80	20
...-315	175	255	220	80	18
...-400	220	310	270	80	18

8.4 Dimensions foot pads 200-200 / 250B-315

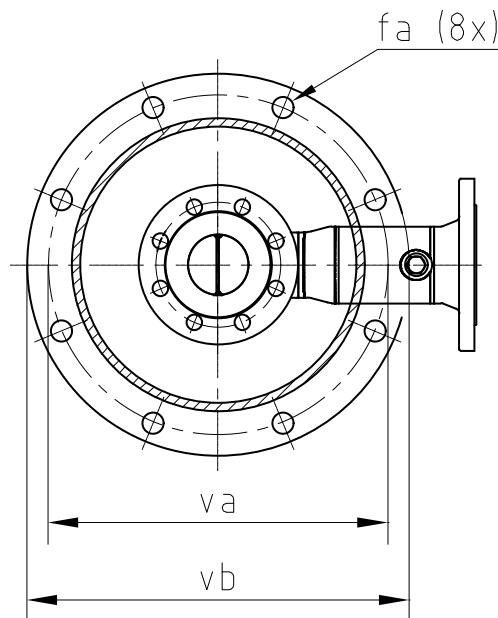


Figure 23: Dimensions foot pads (Top view).

	va	vb	fa
200-200	555	600	18
250B-315	600	650	18

## 8.5 Pump dimensions

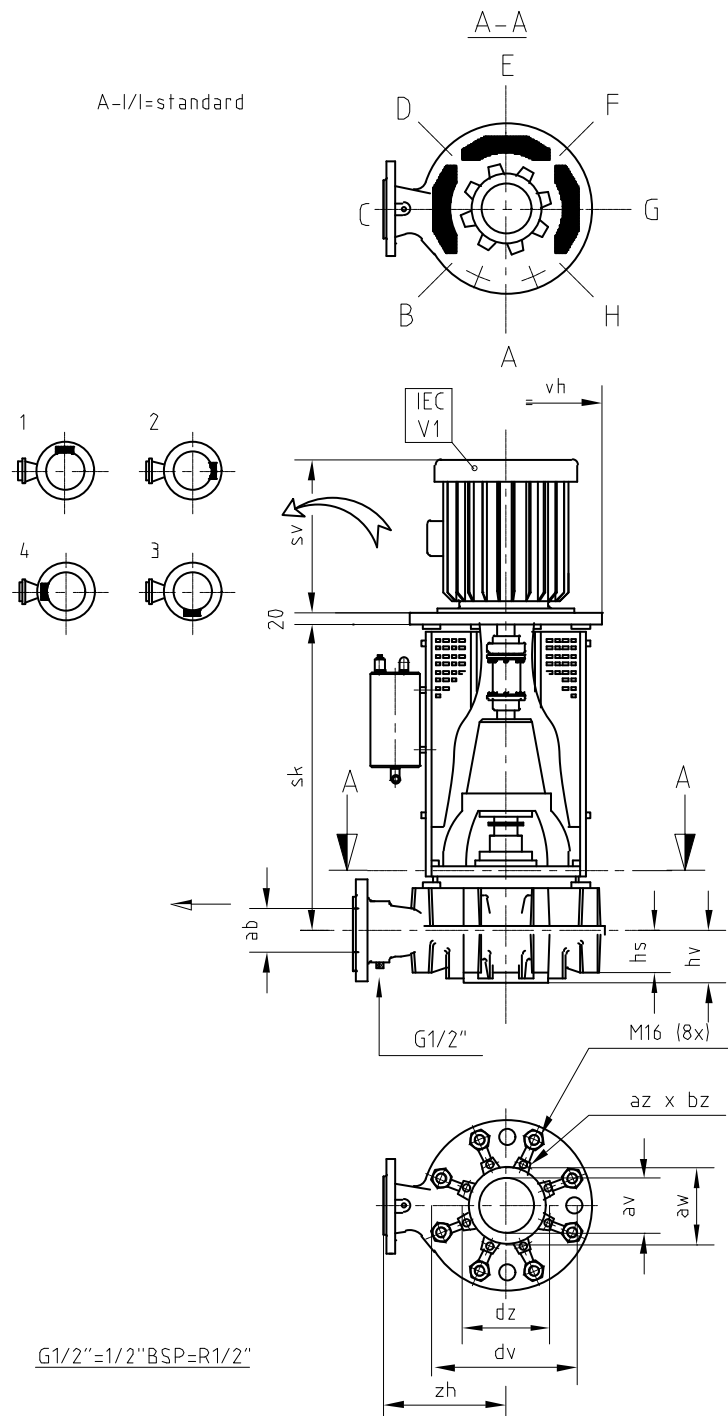


Figure 24: Pump dimensions.

Standard:

- disassembly opening lantern: pos A
- junction box electric motor: pos 1

CV	ab	av	dv	hs	hv	zh	sk			
							90S/L 100L 112M	132S/M	160M/L 180M/L 200L	225S/M 250M 280S/M
32-160	32	50	290	35	65	250	495	515		
32-200	32	65	340	35	65	280	495	520	550	
40-160	40	65	290	35	65	250	495	515		
40-200	40	65	340	35	80	280	495	520	550	
40-250	40	80	400	35	80	315	610	625	660	
50-160	50	65	290	50	80	250	500	525	545	
50-200	50	80	340	35	80	280	495	520	550	
50-250	50	80	400	35	80	315	610	625	660	
65-160	65	100	290	80	100	250		525	545	
65-200	65	100	340	60	80	280		525	550	
65A-250	65	100	400	35	100	315	650	670	700	
65-315	65	100	450	75	100	315	710	720	750	
80-160	80	125	290	95	80	250		565	590	
80-200	80	125	340	85	100	280		670	700	730
80-250	80	125	400	65	100	315	650	670	700	730
80A-250	80	125	400	65	100	315	650	670	700	730
80-315	80	125	450	55	100	315	710	720	750	
80-400	80	125	570	75	100	405		730	760	
100C-200	100	125	340	100	100	280			700	730
100-250	100	125	400	85	100	315	650	665	700	730
100-315	100	125	450	75	100	315		720	750	
100-400	100	125	570	75	100	375		730	760	790
125-250	125	150	400	105	115	355		665	700	
125-315	125	150	450	95	125	355		730	760	790
125-400	125	150	570	75	125	400		730	760	790
150-315	150	200	450	120	140	400			760	790
150-400	150	200	570	120	140	450			760	790
200-200	200	150	400	150	185	400			695	
250B-315	250	200	450	150	135	500			760	790

(200-200 =.....-250)	vh															
	F165		F215		F265		F300				F350	F400		F500		
sv max	283	300	336	386	444	464	564	608	633	653	746	835	835	857	910	1023
CV	90S	90L	100	112M	132S	132M	160M	160L	180M	180L	200L	225S	225M	250M	280S	280M
...-160	350	350	350	350	350		350	350	350		400					
...-200			400	400	400		400	400	400		400		450	550	550	
...-250			450	450	450	450	450	450	450	450	450		450	550	550	550
...-315				550	550	550	550	550	550	550	550	550	550	550	550	550
...-400					620	620	620	620	620	620	620	620	620	620	620	620

av	aw	az x bz	dz
50	102	4 x M16	125
60	122	4 x M16	145
80	138	8 x M16	160
100	158	8 x M16	180
125	188	8 x M16	210
150	212	8 x M20	240
200	268	8 x M20	295

## 8.6 Pump dimensions with suction bend

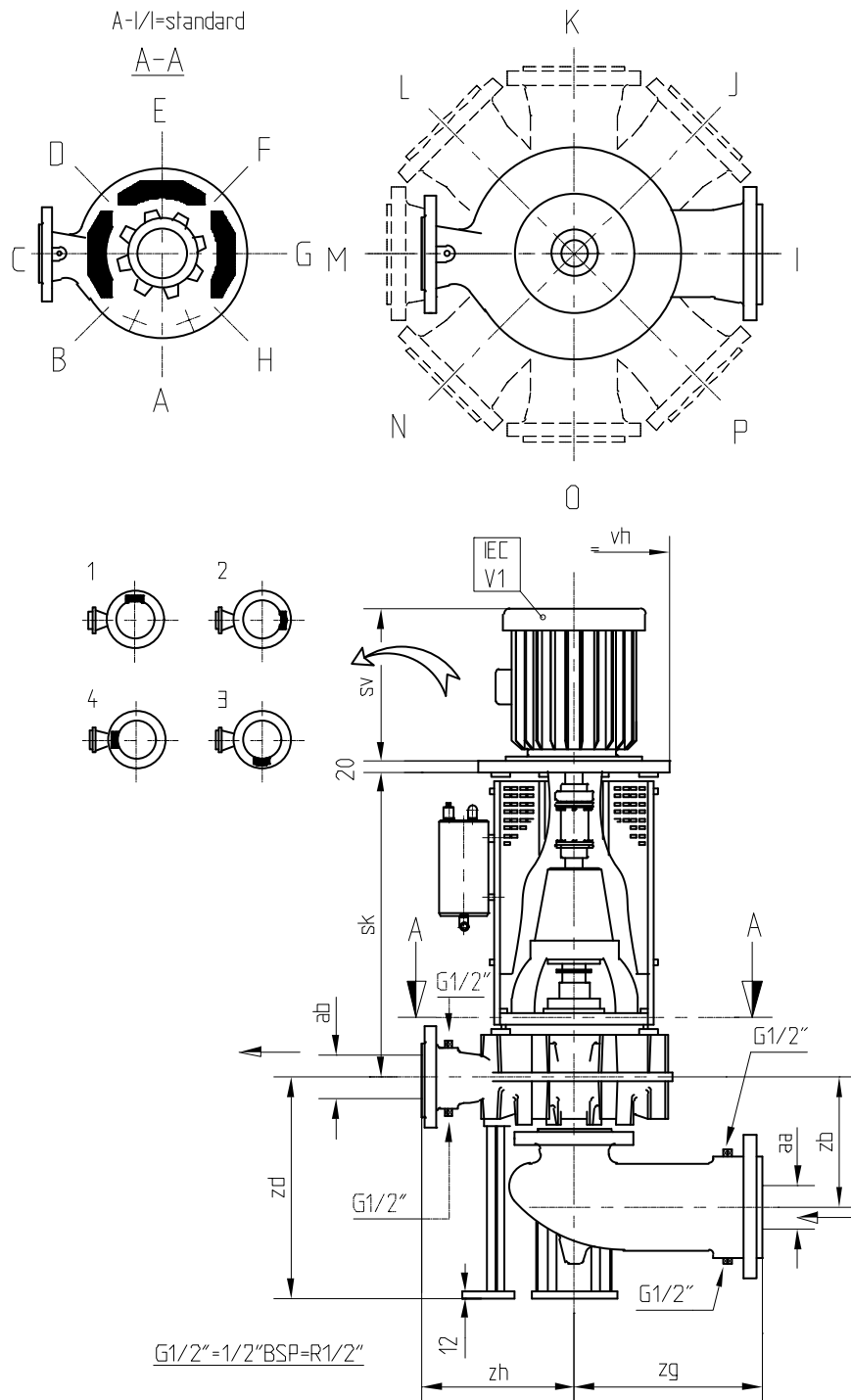


Figure 25: Pump dimensions with suction bend.

Standard:

- disassembly opening lantern: pos A
- suction bend: pos I
- junction box electric motor: pos 1



CV	aa	ab	zb	zd	zg	zh	sk			
							90S/L 100L 112M	132S/M	160M/L 180M/L 200L	225S/M 250M 280S/M
32-160	65	32	167	330	220	250	495	515		
32-200	80	32	177	350	220	280	495	520	550	
40-160	80	40	177	330	220	250	495	515		
40-200	80	40	192	350	220	280	495	520	550	
40-250	100	40	202	370	250	315	610	625	660	
50-160	80	50	192	345	220	250	500	525	545	
50-200	100	50	202	350	250	280	495	520	550	
50-250	100	50	202	370	250	315	610	625	660	
65-160	125	65	242	375	240	250		525	545	
65-200	125	65	222	375	240	280		525	550	
65A-250	125	65	242	370	240	315	650	670	700	
65-315	125	65	242	455	240	315	710	720	750	
80-160	150	80	232	390	350	250		565	590	
80-200	150	80	252	400	350	280		670	700	730
80-250	150	80	252	400	350	315	650	670	700	730
80A-250	150	80	252	400	350	315	650	670	700	730
80-315	150	80	252	455	350	315	710	720	750	
80-400	150	80	252	425	350	405		730	760	
100C-200	150	100	252	415	350	280			700	730
100-250	150	100	252	420	350	315	650	665	700	730
100-315	150	100	252	475	350	315		720	750	
100-400	150	100	252	425	350	375		730	760	790
125-250	150	125	267	440	280	355		665	700	
125-315	150	125	277	495	280	355		730	760	790
125-400	150	125	277	425	280	400		730	760	790
150-315	200	150	342	520	350	400			760	790
150-400	200	150	342	520	350	450			760	790

(200-200 =.....-250)	vh															
	F165		F215		F265		F300				F350	F400		F500		
sv max	283	300	336	386	444	464	564	608	633	653	746	835	835	857	910	1023
CV	90S	90L	100	112M	132S	132M	160M	160L	180M	180L	200L	225S	225M	250M	280S	280M
...-160	350	350	350	350	350		350	350	350		400					
...-200			400	400	400		400	400	400		400		450	550	550	
...-250			450	450	450	450	450	450	450	450	450		450	550	550	550
...-315				550	550	550	550	550	550	550	550	550	550	550	550	550
...-400					620	620	620	620	620	620	620	620	620	620	620	620

## 8.7 Pump dimensions 200-200 / 250B-315 with suction bend

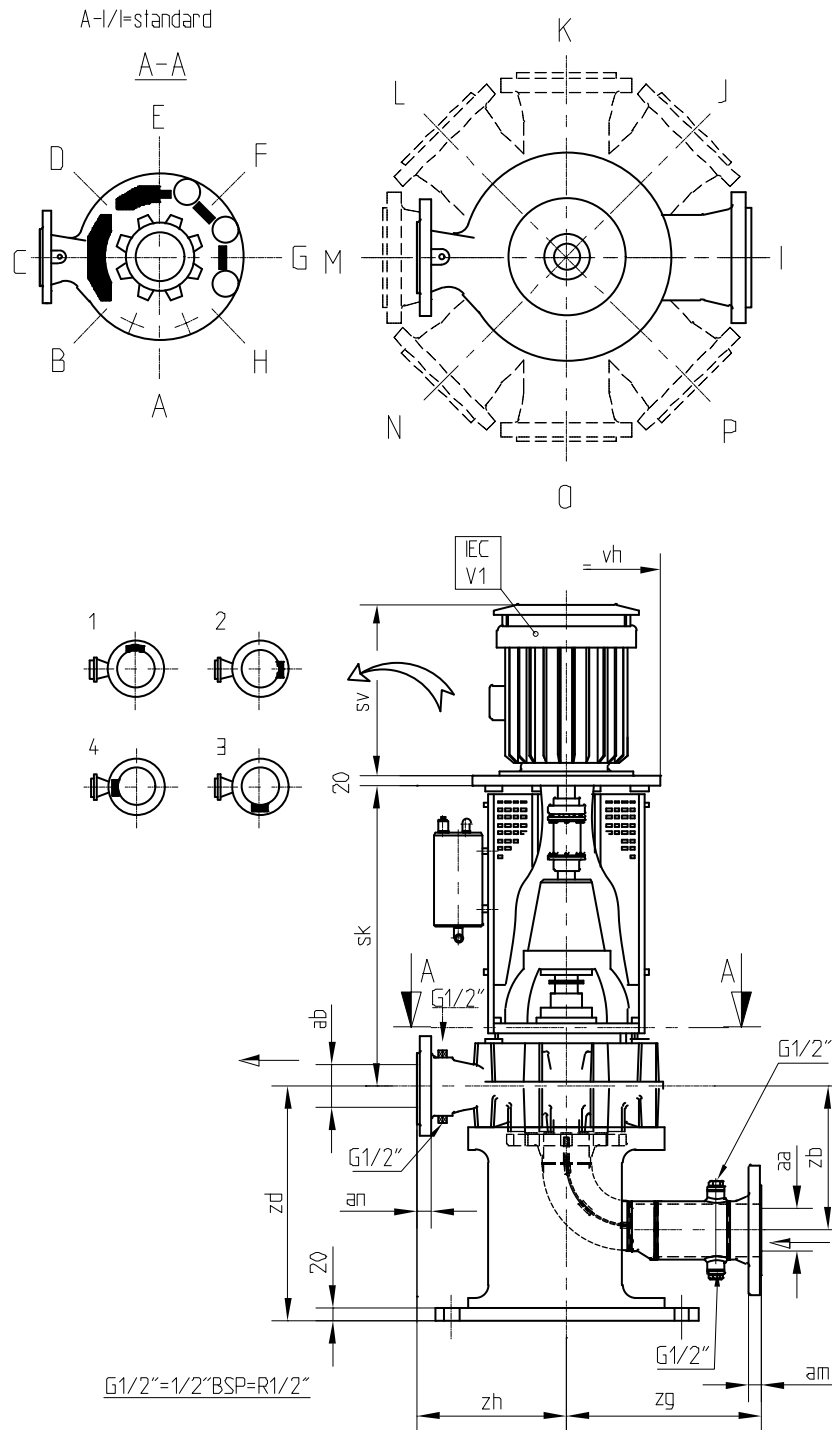


Figure 26: Pump dimensions 200-200 / 250B-315 with suction bend.

Standard:

- disassembly opening lantern: pos A
- suction bend: pos I
- junction box electric motor: pos 1

CV	aa	ab	zb	zd	zg	zh	vh	sk	
								160L 180M/L 200L 225M02	225S/M 250M 280S/M 315S/M2 poles
200-200	200	200	498	700	500	400	18"x9,5	695	
250B-315	250	250	533	800	600	500	20"x9,5	760	790

	vh						
	F300				F350	F400	
sv max	535	535	627	665	737	790	790
CV	160M	160L	180M	180L	200L	225S	225M
200-200	450	450	450	450	450		450
250B-315	550	550	550	550	550	550	550

## 8.8 Pump dimensions with service liquid tank

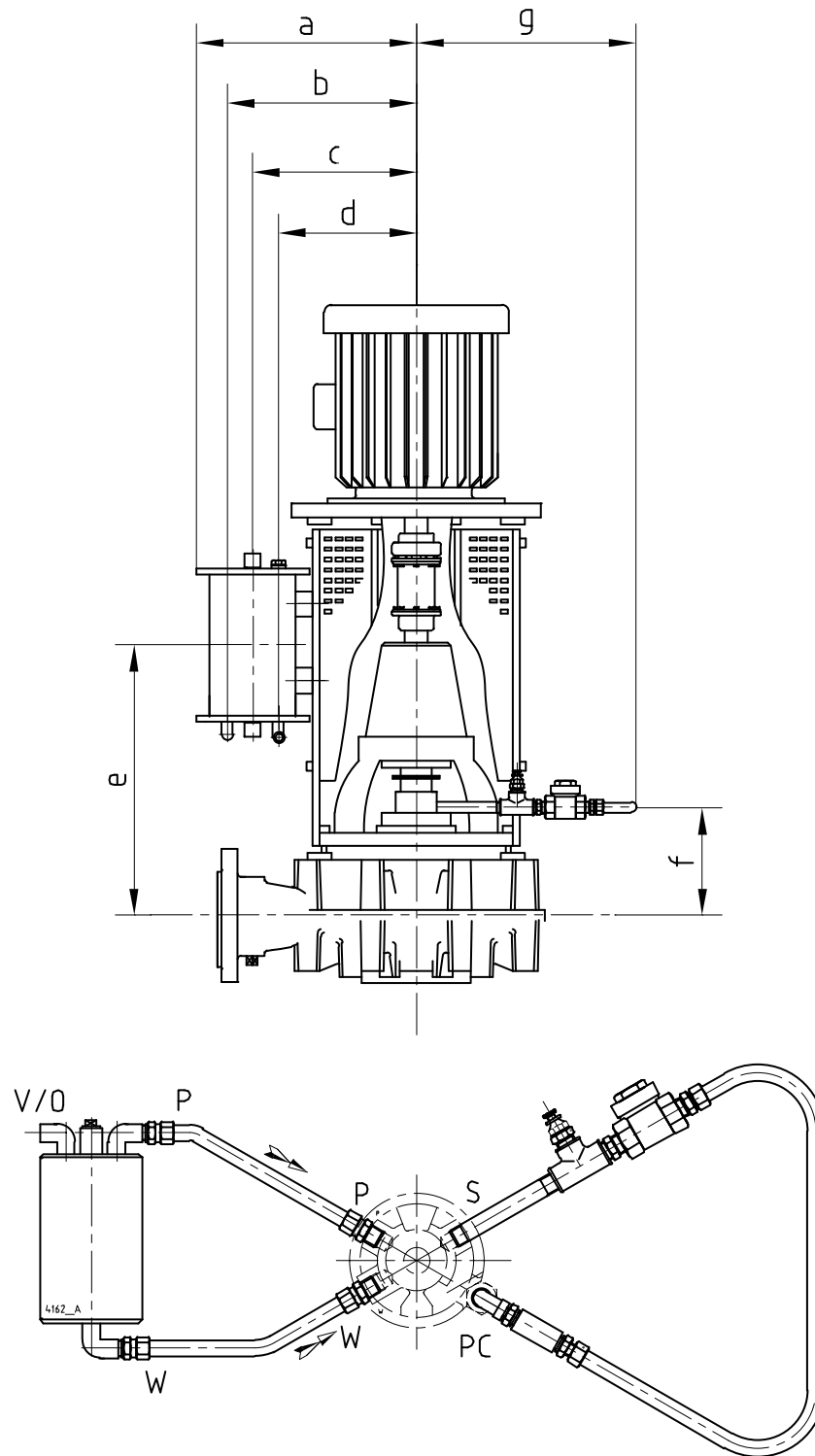


Figure 27: Pump dimensions with service liquid tank.

CV	a	b	c	d	e	f*	f**	g*	g**
32-160	263	237	204	188	285	115	--	330	--
32-200	286	260	227	211	285	114	--	330	--
40-160	263	237	204	188	301	116	--	330	--
40-200	286	260	227	211	285	116	--	330	--
40-250	314	288	255	239	285	131	146	330	440
50-160	263	237	204	188	315	118	--	330	--
50-200	286	260	227	211	315	116	--	330	--
50-250	314	288	255	239	285	133	148	330	440
65-160	263	237	204	188	315	126	--	330	--
65-200	286	260	227	211	315	120	--	330	--
65A-250	314	288	255	239	310	133	148	330	440
65-315	446	328	328	328	325	--	155	--	440
80-160	263	237	204	188	335	125	--	330	--
80-200	286	260	227	211	340	131	--	330	--
80-250	314	288	255	239	310	136	151	330	440
80A-250	314	288	255	239	310	136	151	330	440
80-315	337	311	278	262	325	--	155	--	440
80-400	392	366	333	317	335	--	154	--	440
100C-200	286	260	227	211	340	128	--	330	--
100-250	314	288	255	239	340	137	152	330	440
100-315	337	311	278	262	325	--	157	--	440
100-400	392	366	333	317	335	--	154	--	440
125-250	314	288	255	239	285	--	158	--	440
125-315	337	311	278	262	335	--	162	--	440
125-400	392	366	333	317	335	--	158	--	440
150-315	337	311	278	262	335	--	166	--	440
150-400	392	366	333	317	335	--	158	--	440
200-200	314	288	255	239	310	--	169	--	440
250B-315	337	311	278	262	325	--	176	--	440

\* n = 3000-3600 min<sup>-1</sup>\*\* n = 1500-1800 min<sup>-1</sup>

## Connections

<b>V/O</b>	De-aeration / Overflow	Rp 1/2
<b>S</b>	Inlet self-priming pump	Rp 1/2
<b>SP</b>	Air-intake line	Rp 1/2
<b>P</b>	Outlet self-priming pump	Rp 1/2
<b>W</b>	Inlet service liquid	Rp 1/2

## 8.9 Pump dimensions with float de-aerator

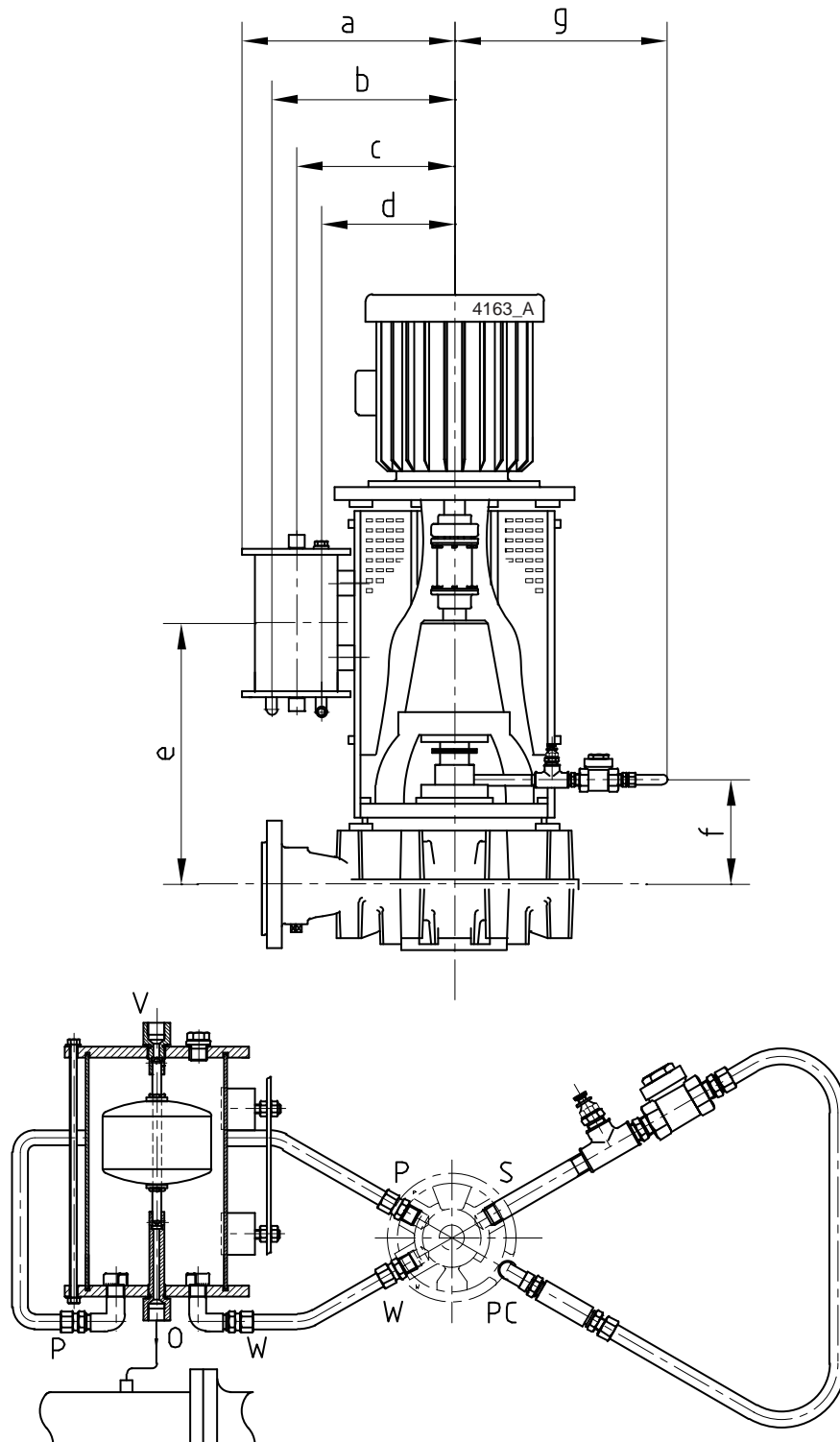


Figure 28: Pump dimensions with float de-aerator.

CV	a	b	c	d	e	f*	f**	g*	g**
32-160	372	254	254	254	285	115	--	330	--
32-200	395	277	277	277	285	114	--	330	--
40-160	372	254	254	254	301	116	--	330	--
40-200	395	277	277	277	285	116	--	330	--
40-250	423	305	305	305	285	131	146	330	440
50-160	372	254	254	254	315	118	--	330	--
50-200	395	277	277	277	315	116	--	330	--
50-250	423	305	305	305	285	133	148	330	440
65-160	372	254	254	254	315	126	--	330	--
65-200	395	277	277	277	315	120	--	330	--
65A-250	423	305	305	305	310	133	148	330	440
65-315	446	328	328	328	325	--	155	--	440
80-160	372	254	254	254	335	125	--	330	--
80-200	395	277	277	277	340	131	--	330	--
80-250	423	305	305	305	310	136	151	330	440
80A-250	423	305	305	305	310	136	151	330	440
80-315	446	328	328	328	325	--	155	--	440
80-400	501	383	383	383	335	--	154	--	440
100C-200	395	277	277	277	340	128	--	330	--
100-250	423	305	305	305	340	137	152	330	440
100-315	446	328	328	328	325	--	157	--	440
100-400	501	383	383	383	383	--	154	--	440
125-250	423	305	305	305	285	--	158	--	440
125-315	446	328	328	328	335	--	162	--	440
125-400	501	383	383	383	335	--	158	--	440
150-315	446	328	328	328	335	--	166	--	440
150-400	501	383	383	383	335	--	156	--	440
200-200	423	383	383	383	310	--	169	--	440
250B-315	446	328	328	328	325	--	176	--	440

\* n = 3000-3600 min<sup>-1</sup>\*\* n = 1500-1800 min<sup>-1</sup>

## Connections

<b>V</b>	De-aeration	Rp 1/2
<b>O</b>	Drain waste water	Rp 1/2
<b>S</b>	Inlet self-priming pump	Rp 1/2
<b>SP</b>	Air-intake line	Rp 1/2
<b>P</b>	Outlet self-priming pump	Rp 1/2
<b>W</b>	Inlet service liquid	Rp 1/2





## 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 \* are recommended spare parts.

## 9.2 Pump

### 9.2.1 Sectional drawing

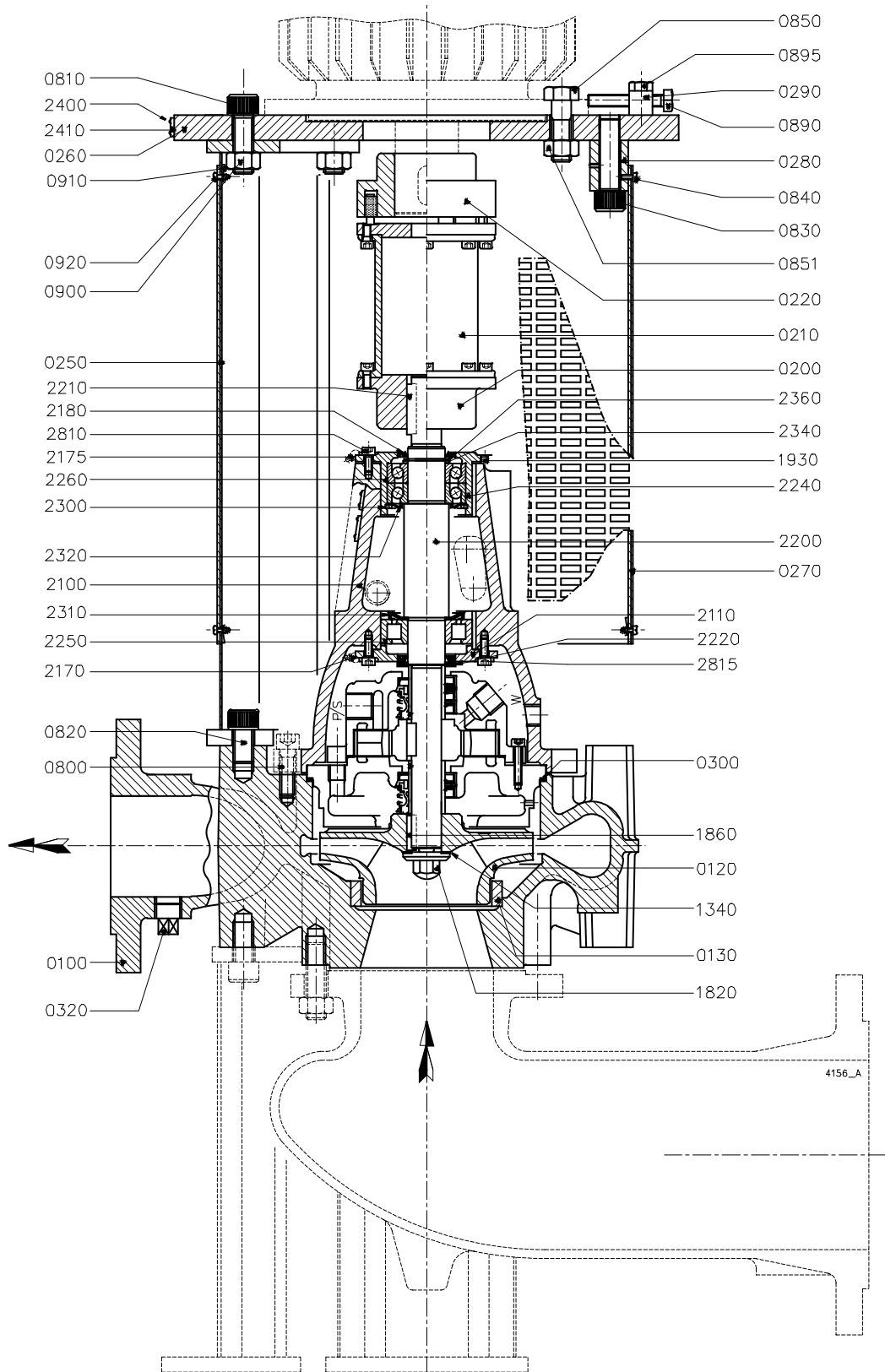


Figure 29: Sectional drawing.

## 9.2.2 Parts list

Item	Quantity	Description	Material				
			G1	G2	G3	B2	B3
0100	1	pump casing	cast iron			bronze	
0120*	1	impeller	cast iron	bronze	aluminium bronze	bronze	aluminium bronze
0130*	1	wear ring	cast iron	bronze			
0200	1	coupling half, pump side	cast iron				
0210	1	spacer	cast iron				
0220	1	coupling half, motor side	cast iron				
0250	3	lantern element	steel				
0260	1	flange	steel				
0270	5	guard	steel				
0280	2	assembling bush	steel				
0290	4	adjusting cam	stainless steel				
0300*	1	gasket	--				
0320	1	plug	cast iron			bronze	
0800	8/12 <sup>1)</sup>	Allen screw	steel			stainless steel	
0810	6	Allen screw	steel				
0820	6	Allen screw	steel				
0830	2	Allen screw	steel				
0840	2	Allen screw	brass				
0850	4/8 <sup>2)</sup>	bolt	steel				
0851	4/8 <sup>2)</sup>	nut	steel				
0890	4	bolt	stainless steel				
0895	8	bolt	steel				
0900	6	nut	steel				
0910	14	speed nut	spring steel				
0920	14	tapping screw	stainless steel				
1340*	1	gasket	--				
1820*	1	cap nut	stainless steel				
1860*	1	key	stainless steel				
1930	4	set screw	stainless steel				
2100	1	bearing bracket	cast iron				
2110	1	bearing cover	cast iron				
2170	1	grease nipple	steel				
2175	1	grease nipple	steel				
2180	2	oil seal	rubber				
2200*	1	pump shaft	steel alloy			stainless steel	
2210*	1	coupling key	steel				
2220*	1	deflector	rubber				
2240*	1	adjusting bush	cast iron				
2250*	1	cylindrical roller bearing	--				
2260*	2	angular contact ball bearing	--				
2300*	1	inner circlip	spring steel				

Item	Quantity	Description	Material				
			G1	G2	G3	B2	B3
2310*	1	NILOS-Ring			steel		
2320	1	NILOS-Ring			steel		
2340	1	adjusting ring			steel		
2350	1	spacer sleeve			steel		
2360*	1	outer circlip			spring steel		
2400	1	name plate			stainless steel		
2410	1	arrow plate			aluminium		
2810	4	Allen screw			steel		
2815	4	Allen screw			steel		

1) Quantity dependent on pump type.

2) Quantity dependent on motor type.

9.3 Shaft sealing group M2

9.3.1 Mechanical seal MG1-G60

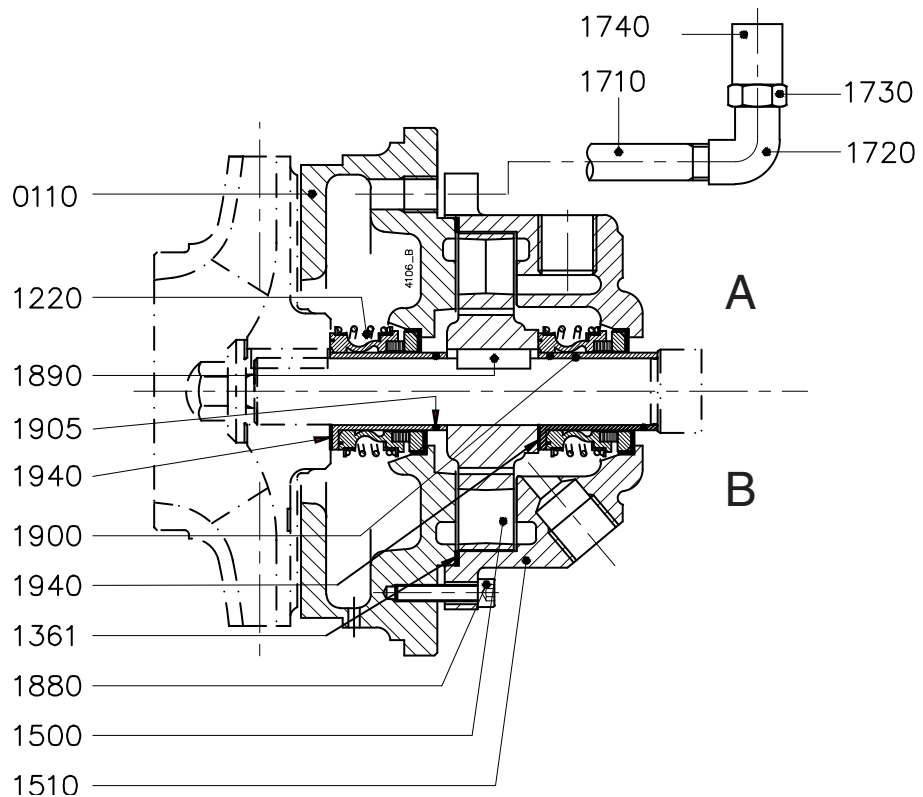


Figure 30: Mechanical seal MG1-G60  
(A = bearing group 1 and 2, B = bearing group 3).

9.3.2 Parts list mechanical seal MG1-G60

Item	Quantity	Description	Material				
			G1	G2	G3	B2	B3
0110	1	pump cover	cast iron		bronze		
1220*	2	mechanical seal	--				
1361*	1	gasket	--				
1500*	1	air-wheel	bronze				
1510	1	self-priming casing	cast iron		bronze		
1710	1	pipe nipple <sup>1)</sup>	steel		stainless steel		
1720	1	elbow <sup>1)</sup>	ductile cast iron		stainless steel		
1730	1	reducing nipple <sup>1)</sup>	stainless steel				
1740	1	socket <sup>1)</sup>	steel		stainless steel		
1880	8	Allen screw	steel		stainless steel		
1890	1	key	stainless steel				
1900*	2	shaft sleeve	stainless steel				
1905*	2	O-ring	viton				
1940**	2	gasket	--				

<sup>1)</sup> Items 1710, 1720, 1730 and 1740 only for the pump types with a nominal impeller diameter of 160 and 250 mm ( $n = 1500 / 1800 \text{ min}^{-1}$ )

\*\* only for bearing bracket group 3

## 9.4 Shaft sealing group M4

### 9.4.1 Lip seal

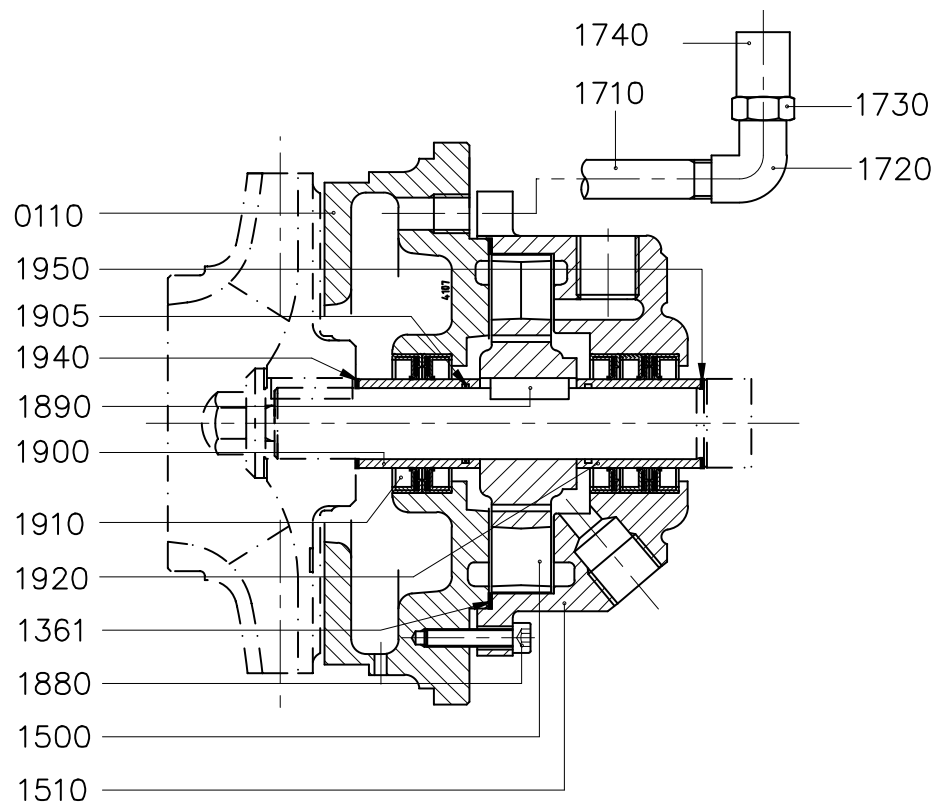


Figure 31: Lip seal.

### 9.4.2 Parts list lip seal

Item	Quantity	Description	Material				
			G1	G2	G3	B2	B3
0110	1	pump cover	cast iron		bronze		
1361*	1	gasket	--				
1500*	1	air-wheel	bronze				
1510	1	self-priming casing	cast iron		bronze		
1710	1	pipe nipple <sup>1)</sup>	steel		stainless steel		
1720	1	elbow <sup>1)</sup>	ductile cast iron		stainless steel		
1730	1	reducing nipple <sup>1)</sup>	stainless steel				
1740	1	socket <sup>1)</sup>	steel		stainless steel		
1880	5	Allen screw	steel		stainless steel		
1890	1	key	stainless steel				
1900*	1	shaft sleeve	stainless steel with wearing layer				
1905*	1	O-ring	viton				
1910*	5	lip seal	PTFE				
1920*	1	shaft sleeve	stainless steel with wearing layer				
1940*	1	gasket	--				
1950*	1	gasket	--				

<sup>1)</sup> Items 1710, 1720, 1730 and 1740 only for the pump types with a nominal impeller diameter of 160 and 250 mm ( $n = 1500 / 1800 \text{ min}^{-1}$ )

9.5 Service liquid tank TL

9.5.1 Service liquid tank TL

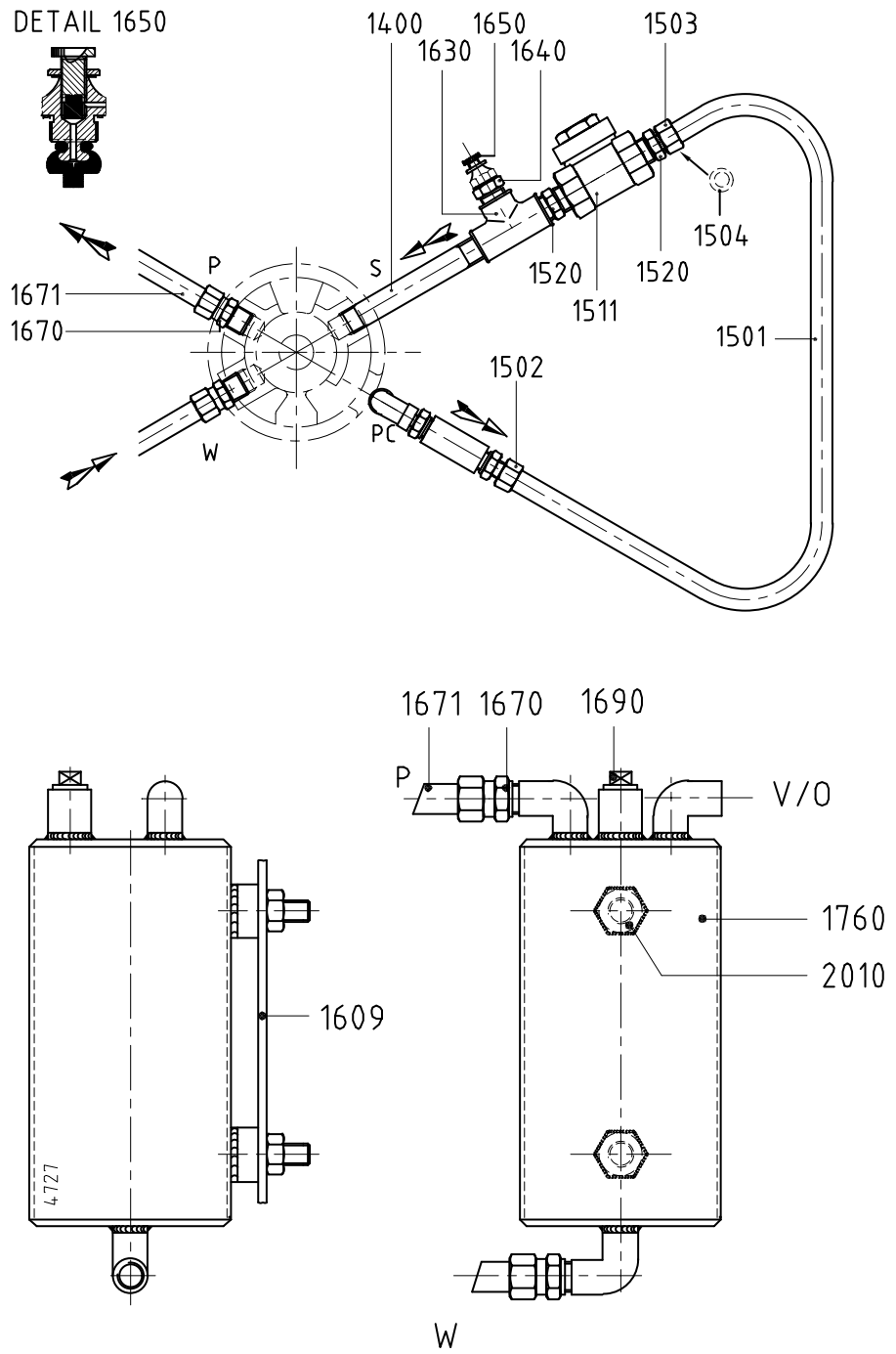


Figure 32: Service liquid tank TL.

## 9.5.2 Parts of service liquid tank TL

Item	Quantity	Description	Material				
			G1	G2	G3	B2	B3
1400	1	pipe nipple	stainless steel				
1501	1	pipe	stainless steel				
1502	1	male connector	stainless steel				
1503	1	male connector	steel		stainless steel		
1504**	1	washer	stainless steel				
1511	1	non-return valve	NBR/brass		stainless steel		
1520	1	double nipple	ductile iron		stainless steel		
1609	1	tank support	steel				
1630	1	tee	ductile iron		stainless steel		
1640	1	reducing ring	ductile iron		stainless steel		
1650	1	air inlet valve	brass				
1670	4	male connector	steel		stainless steel		
1671	1	pipe	stainless steel				
1690	1	plug	ductile iron		bronze		
1760	1	tank	stainless steel				
2010	2	nut	steel		stainless steel		

\*\* If the delivery head is over 30 m throttling is applied in order to create a vacuum behind the air inlet valve.



9.6 Float de-aerator VL

9.6.1 Float de-aerator VL

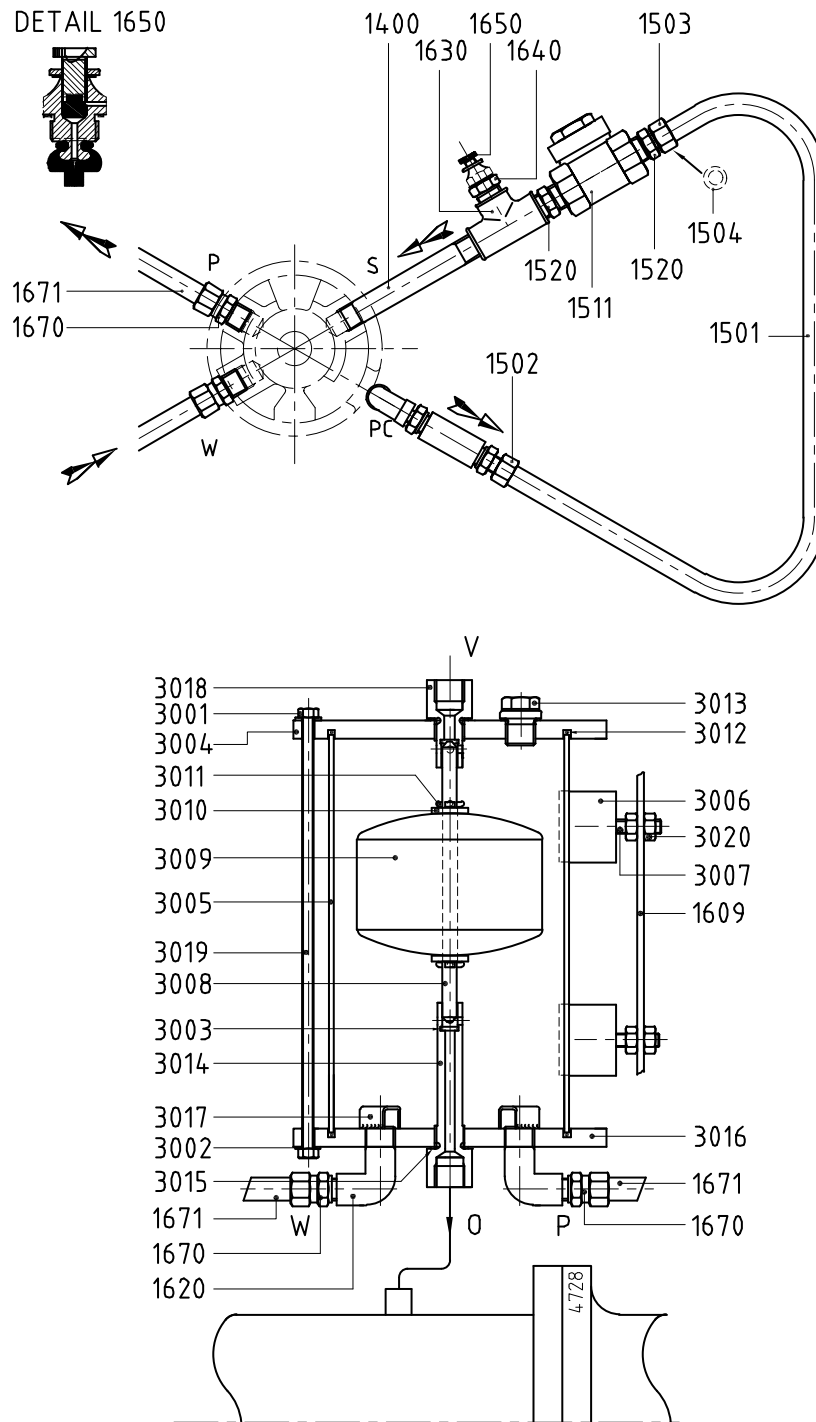


Figure 33: Float de-aerator VL.

## 9.6.2 Parts of float de-aerator VL

Item	Quantity	Description	Material				
			G1	G2	G3	B2	B3
1400	1	pipe nipple	stainless steel				
1501	1	pipe	stainless steel				
1502	1	male connector	stainless steel				
1503	1	male connector	steel		stainless steel		
1504**	1	washer	stainless steel				
1511	1	non-return valve	NBR/brass		stainless steel		
1520	1	double nipple	ductile iron		stainless steel		
1609	1	tank support	steel				
1630	1	tee	ductile iron		stainless steel		
1640	1	reducing ring	ductile iron		stainless steel		
1650	1	air inlet valve	brass				
1670	4	male connector	steel		stainless steel		
1671	1	pipe	stainless steel				
2010	2	nut	steel		stainless steel		
3001	8	nut	stainless steel				
3002	8	washer	stainless steel				
3003*	2	O-ring	NBR				
3004	1	cover	stainless steel				
3005	1	jacket	stainless steel				
3006	2	bow	stainless steel				
3007	2	bolt	stainless steel				
3008*	1	float needle	POM				
3009*	1	float	stainless steel				
3010*	2	washer	stainless steel				
3011*	2	split pin	stainless steel				
3012*	2	O-ring	Viton				
3013	1	plug	stainless steel				
3014	1	long valve seat	stainless steel				
3015	3	sealing ring	gylon				
3016	1	bottom	stainless steel				
3017	2	bow	stainless steel				
3018	1	short valve seat	stainless steel				
3019	4	tie rod	stainless steel				
3020	4	nut	stainless steel				

\*\* If the delivery head is over 30 m throttling is applied in order to create a vacuum behind the air inlet valve.

9.7 Suction bend

9.7.1 Sectional drawing suction bend

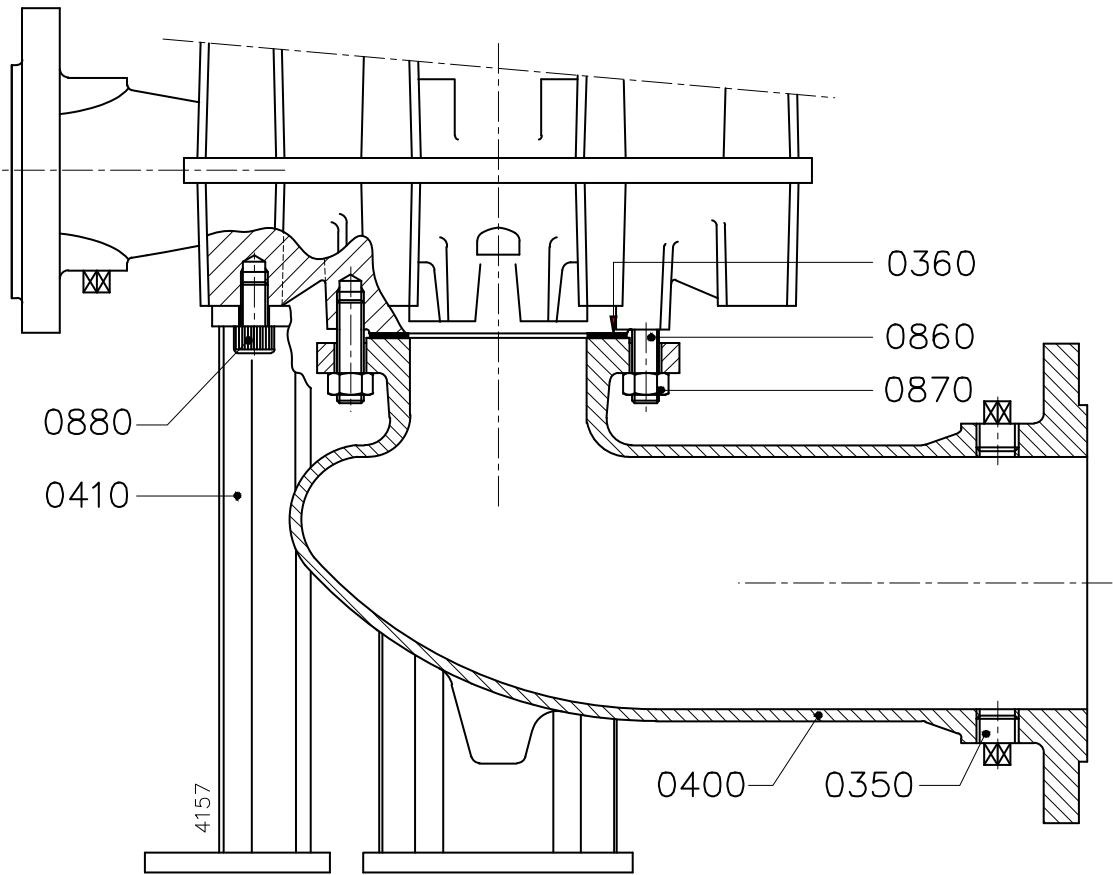


Figure 34: Sectional drawing suction bend.

9.7.2 Parts of suction bend

Item	Quantity	Description	Material	
			cast iron	bronze
0350	2	plug	steel	stainless steel
0360	1	gasket	rubber	
0400	1	suction bend	cast iron	bronze
0410	3	support	steel	
0860	4/8 <sup>1)</sup>	stud	steel	stainless steel
0870	4/8 <sup>1)</sup>	nut	steel	stainless steel
0880	6	Allen screw	steel	

<sup>1)</sup> Quantity dependent on pump type.

## 9.7.3 Sectional drawing suction bend 200-200 / 250B-315

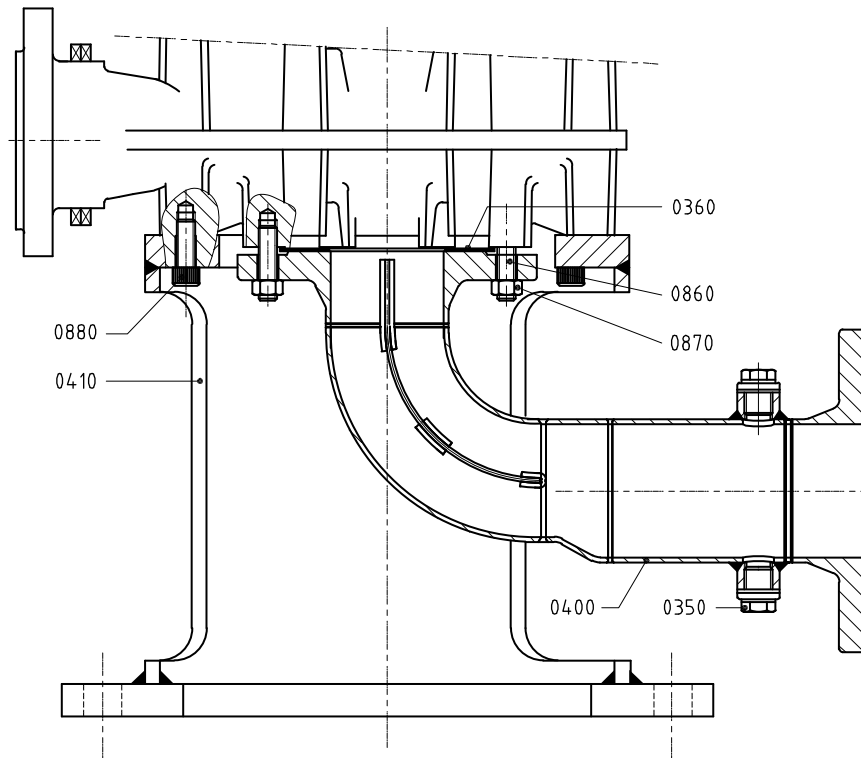


Figure 35: Sectional drawing suction bend 200-200 / 250B-315.

## 9.7.4 Parts of suction bend 200-200 / 250B-315

Item	Quantity	Description	Material	
			cast iron	bronze
0350	2	plug	steel	stainless steel
0360	1	gasket	rubber	
0400	1	suction bend	steel	duplex
0410	1	support	steel	
0860	4/8 <sup>1)</sup>	stud	steel	stainless steel
0870	4/8 <sup>1)</sup>	nut	steel	stainless steel
0880	8	Allen screw	steel	

<sup>1)</sup> Quantity depends on pump type

## 10 Technical data

### 10.1 Recommended greases

Table 6: Recommended greases according to classification NLGI-3.

BP	Energrease LS-EP 3
CHEVRON	MultifaK Premium 3
EXXONMOBIL	Beacon EP 3
	Mobilux EP 3
SHELL	Gadus S2 V100 3
SKF	LGMT 3
TOTAL	Total Lical EP 2
Quantity grease/bearing [gr] = 0,005 * Outer diameter of bearing [mm] * Bearing width [mm]	

### 10.2 Recommended locking liquids

Table 7: Recommended locking liquids.

Description	Locking liquid
cap nut (1820)	Loctite 243
wear ring (0130)	Loctite 641

### 10.3 Tightening moments

#### 10.3.1 Tightening moments for bolts and nuts

Table 8: 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

#### 10.3.2 Tightening moments for cap nut

Table 9: Tightening moments for cap nut (1820).

Size	Tightening moment [Nm]
M12 (bearing group 1)	43
M16 (bearing group 2)	105
M24 (bearing group 3)	220

## 10.4 Hydraulic performance

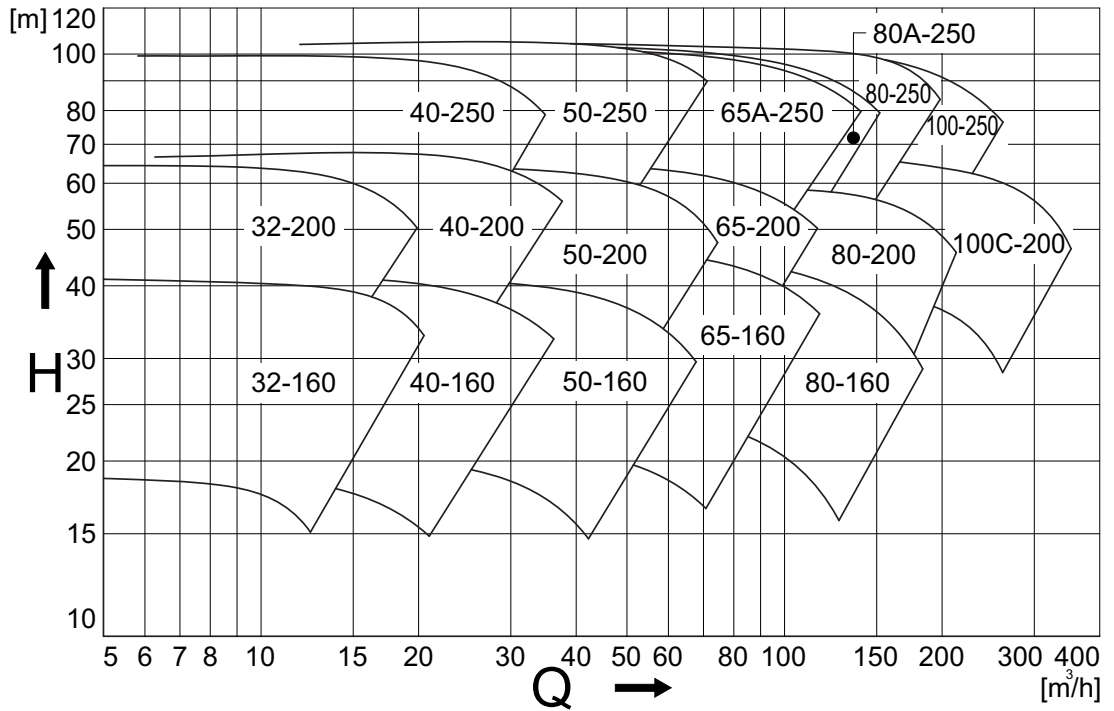


Figure 36: Performance overview 3000 min<sup>-1</sup>.

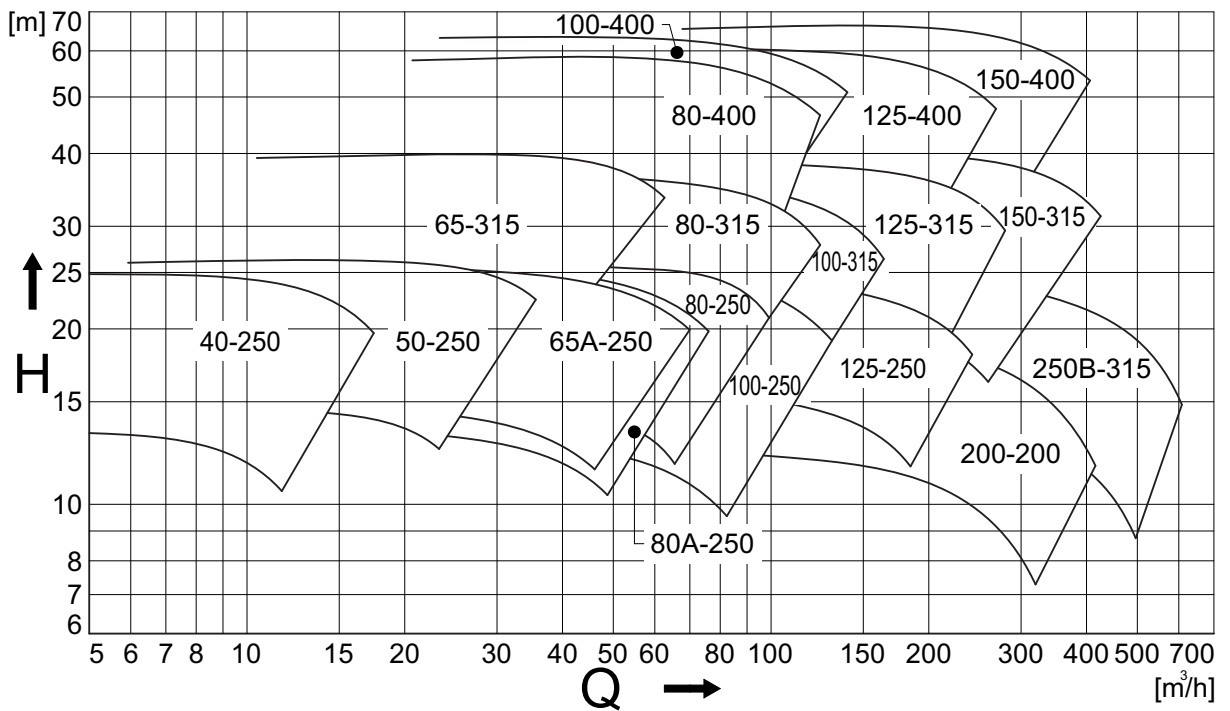


Figure 37: Performance overview 1500 min<sup>-1</sup>.

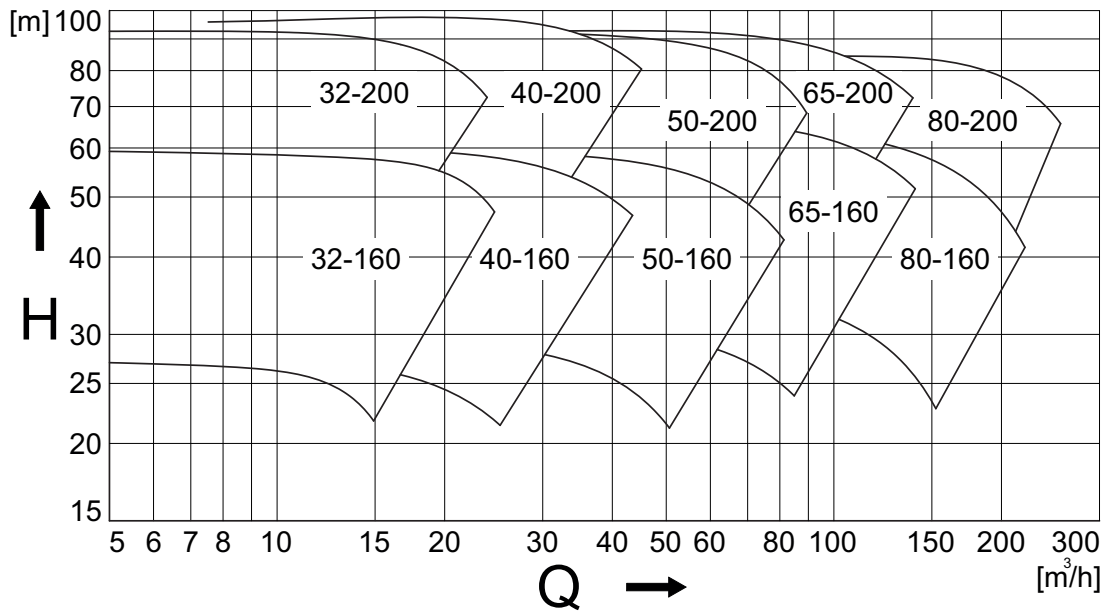


Figure 38: Performance overview 3600 min<sup>-1</sup>.

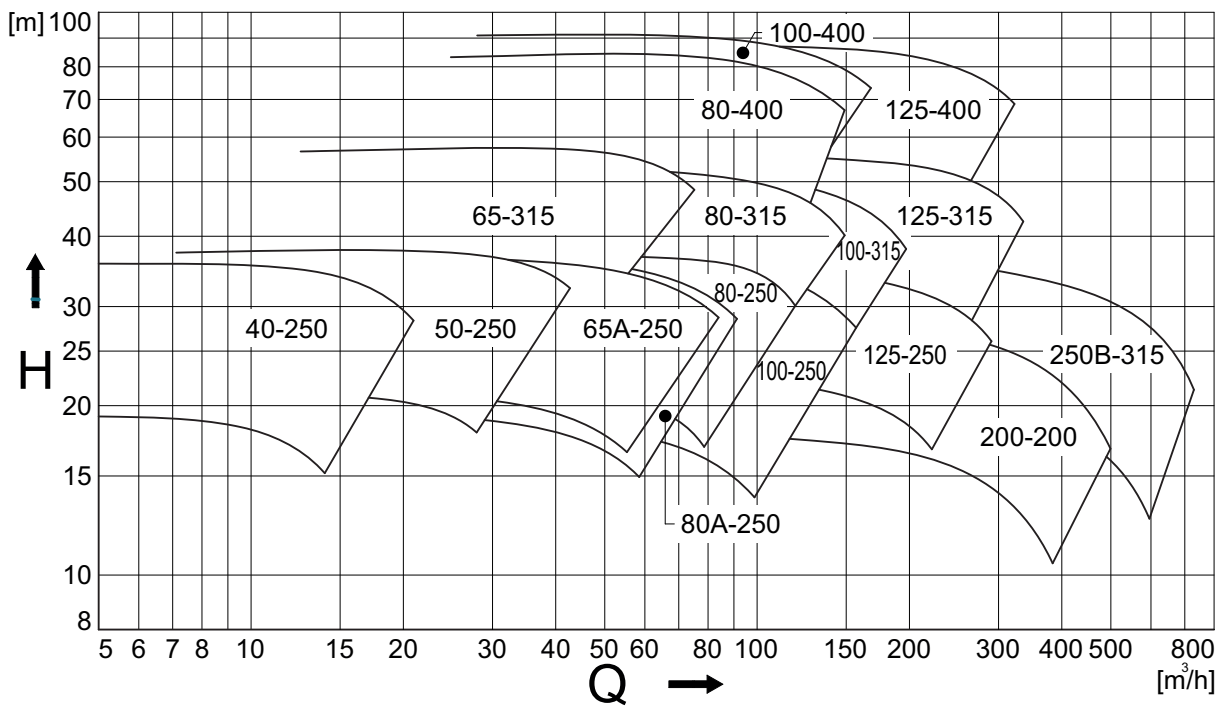


Figure 39: Performance overview 1800 min<sup>-1</sup>.

## 10.5 Noise data

### 10.5.1 Pump noise as a function of pump power

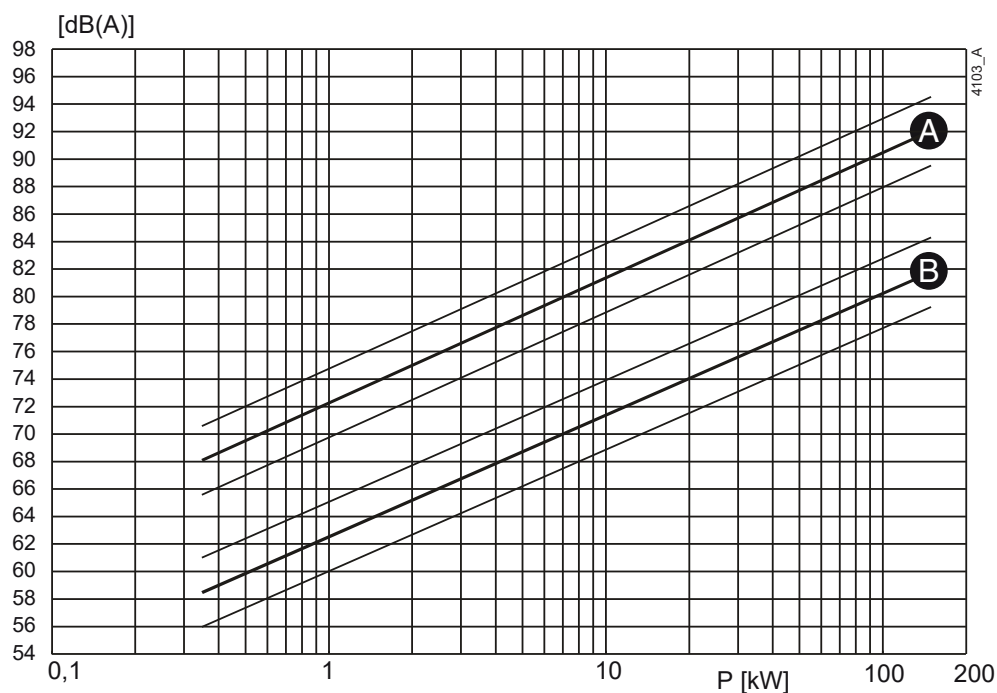


Figure 40: Noise level as function of pump power [kW] at 1450 min<sup>-1</sup>  
A = sound power level, B = sound pressure level.

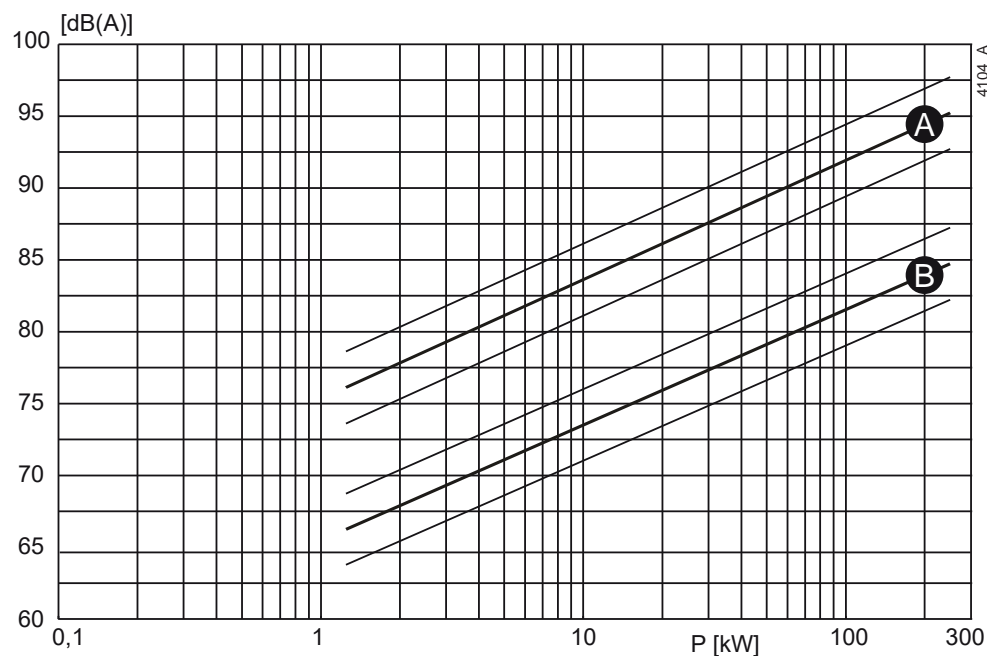


Figure 41: Noise level as function of pump power [kW] at 2900 min<sup>-1</sup>  
A = sound power level, B = sound pressure level.



## 10.5.2 Noise level of entire pump unit

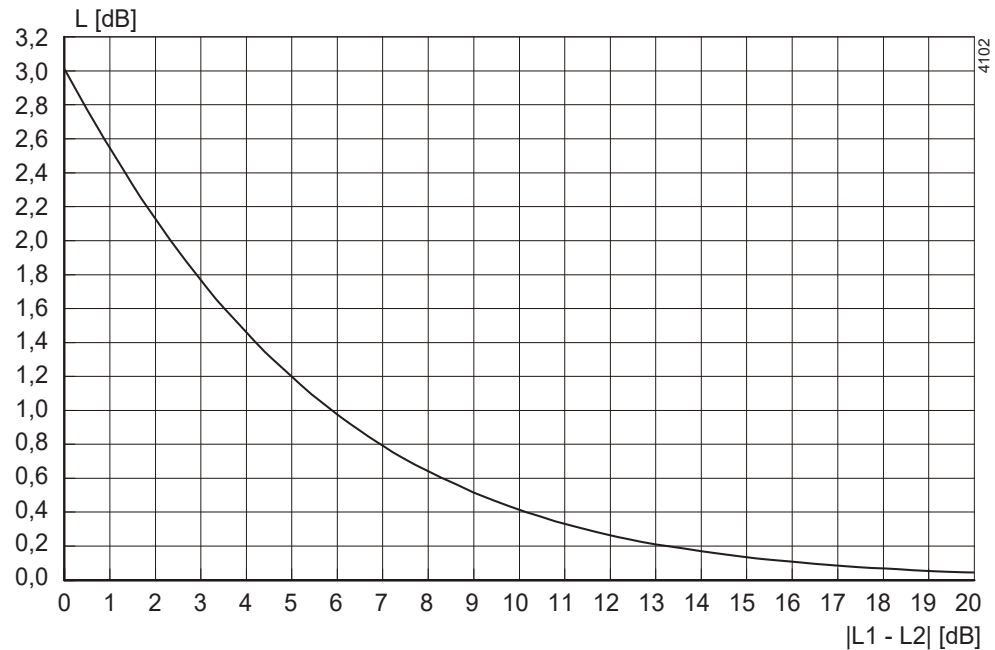


Figure 42: Noise level of entire pump unit.

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 40 or figure 41.
- 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 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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Your order will only be dealt with if this order form has been correctly completed and signed.

<b>Order date:</b>	
<b>Your order number:</b>	
<b>Pump type:</b>	
<b>Execution:</b>	

Quantity	Item. No.	Part	Article number pump

<b>Delivery address:</b>	<b>Invoicing address:</b>

<b>Ordered by:</b>	<b>Signature:</b>	<b>Telephone:</b>



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