

Closed-coupled Pump

## Etabloc GNF

### Installation/Operating Manual



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Installation/Operating Manual Etabloc GNF

Original operating manual

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## Glossary

### **Back pull-out design**

The complete back pull-out unit can be pulled out without having to remove the pump casing from the piping.

### **Back pull-out unit**

Pump without pump casing; partly completed machinery

### **Certificate of decontamination**

A certificate of decontamination is enclosed by the customer when returning the product to the manufacturer to certify that the product has been properly drained to eliminate any environmental and health hazards arising from components in contact with the fluid handled.

### **Close-coupled design**

Motor directly fitted to the pump via a flange or a drive lantern

### **Discharge line**

The pipeline which is connected to the discharge nozzle

### **Hydraulic system**

The part of the pump in which the kinetic energy is converted into pressure energy

### **Pool of pumps**

Customers/operators' pumps which are purchased and stored regardless of their later use.

### **Pump**

Machine without drive, additional components or accessories

### **Pump set**

Complete pump set consisting of pump, drive, additional components and accessories

### **Suction lift line/suction head line**

The pipeline which is connected to the suction nozzle

## 1 General

### 1.1 Principles

This operating manual is valid for the type series and variants indicated on the front cover.

The manual describes the proper and safe use of this equipment in all phases of operation.

The name plate indicates the type series and size, the main operating data, the order number and the order item number. The order number and order item number clearly identify the pump set and serve as identification for all further business processes.

In the event of damage, immediately contact your nearest KSB Service centre to maintain the right to claim under warranty.

### 1.2 Installation of partly completed machinery

To install partly completed machinery supplied by KSB refer to the sub-sections under Servicing/Maintenance. (⇒ Section 7.5.4, Page 40)

### 1.3 Target group

This operating manual is aimed at the target group of trained and qualified specialist technical personnel. (⇒ Section 2.4, Page 9)

### 1.4 Other applicable documents

**Table 1:** Overview of other applicable documents

Document	Contents
Data sheet	Description of the technical data of the pump (set)
General arrangement drawing/ outline drawing	Description of mating and installation dimensions for the pump (set), weights
Drawing of auxiliary connections	Description of auxiliary connections
Hydraulic characteristic curve	Characteristic curves showing head, NPSH required, efficiency and power input
General assembly drawing <sup>1)</sup>	Sectional drawing of the pump
Sub-supplier product literature <sup>1)</sup>	Operating manuals and other product literature describing accessories and integrated machinery components
Spare parts lists <sup>1)</sup>	Description of spare parts
Piping layout <sup>1)</sup>	Description of auxiliary piping
List of components <sup>1)</sup>	Description of all pump components
Drawing for assembly <sup>1)</sup>	Sectional drawing of the installed shaft seal

For accessories and/or integrated machinery components observe the relevant manufacturer's product literature.

### 1.5 Symbols

**Table 2:** Symbols used in this manual

Symbol	Description
✓	Conditions which need to be fulfilled before proceeding with the step-by-step instructions
▷	Safety instructions
⇨	Result of an action
⇔	Cross-references

1) If agreed upon in scope of supply

Symbol	Description
1. 2.	Step-by-step instructions
	Note Recommendations and important information on how to handle the product



## 2 Safety

All the information contained in this section refers to hazardous situations.

In addition to the present general safety information the action-related safety information given in the other sections must be observed.

### 2.1 Key to safety symbols/markings

Table 3: Definition of safety symbols/markings

Symbol	Description
 <b>DANGER</b>	<b>DANGER</b> This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
 <b>WARNING</b>	<b>WARNING</b> This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
 <b>CAUTION</b>	<b>CAUTION</b> This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	<b>Explosion protection</b> This symbol identifies information about avoiding explosions in potentially explosive atmospheres in accordance with EU Directive 2014/34/EU (ATEX).
	<b>General hazard</b> In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	<b>Electrical hazard</b> In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	<b>Machine damage</b> In conjunction with the signal word CAUTION this symbol indicates a hazard for the machine and its functions.

### 2.2 General

This operating manual contains general installation, operating and maintenance instructions that must be observed to ensure safe operation of the system and prevent personal injury and damage to property.

The safety information in all sections of this manual must be complied with.

The operating manual must be read and understood by the responsible specialist personnel/operators prior to installation and commissioning.

The contents of this operating manual must be available to the specialist personnel at the site at all times.

Information attached directly to the product must always be complied with and kept in a perfectly legible condition at all times. This applies to, for example:

- Arrow indicating the direction of rotation
- Markings for connections
- Name plate

The operator is responsible for ensuring compliance with all local regulations not taken into account in this operating manual.

### 2.3 Intended use

- The pump (set) must only be operated in the fields of application and within the use limits specified in the other applicable documents. (⇒ Section 1.4, Page 6)
- Only operate pumps/pump sets which are in perfect technical condition.
- Do not operate the pump (set) in partially assembled condition.
- Only use the pump to handle the fluids described in the data sheet or product literature of the pump model or variant.
- Never operate the pump without the fluid to be handled.
- Observe the minimum flow rates indicated in the data sheet or product literature (to prevent overheating, bearing damage, etc).
- Observe the minimum flow rate and maximum flow rate indicated in the data sheet or product literature (to prevent overheating, mechanical seal damage, cavitation damage, bearing damage, etc).
- Do not throttle the flow rate on the suction side of the pump (to prevent cavitation damage).
- Consult the manufacturer about any use or mode of operation not described in the data sheet or product literature.

### 2.4 Personnel qualification and training

All personnel involved must be fully qualified to transport, install, operate, maintain and inspect the machinery this manual refers to.

The responsibilities, competence and supervision of all personnel involved in transport, installation, operation, maintenance and inspection must be clearly defined by the operator.

Deficits in knowledge must be rectified by means of training and instruction provided by sufficiently trained specialist personnel. If required, the operator can commission the manufacturer/supplier to train the personnel.

Training on the pump (set) must always be supervised by technical specialist personnel.

### 2.5 Consequences and risks caused by non-compliance with this manual

- Non-compliance with these operating instructions will lead to forfeiture of warranty cover and of any and all rights to claims for damages.
- Non-compliance can, for example, have the following consequences:
  - Hazards to persons due to electrical, thermal, mechanical and chemical effects and explosions
  - Failure of important product functions
  - Failure of prescribed maintenance and servicing practices
  - Hazard to the environment due to leakage of hazardous substances

### 2.6 Safety awareness

In addition to the safety information contained in this manual and the intended use, the following safety regulations shall be complied with:

- Accident prevention, health regulations and safety regulations
- Explosion protection regulations
- Safety regulations for handling hazardous substances
- Applicable standards, directives and laws

### 2.7 Safety information for the operator/user

- Fit protective equipment (e.g. contact guards) supplied by the operator for hot, cold or moving parts, and check that the equipment functions properly.
- Do not remove any protective equipment (e.g. contact guards) during operation.
- Provide the personnel with protective equipment and make sure it is used.
- Contain leakages (e.g. at the shaft seal) of hazardous fluids handled (e.g. explosive, toxic, hot) so as to avoid any danger to persons and the environment. Adhere to all relevant laws.
- Eliminate all electrical hazards. (In this respect refer to the applicable national safety regulations and/or regulations issued by the local energy supply companies.)
- If shutting down the pump does not increase potential risk, fit an emergency-stop control device in the immediate vicinity of the pump (set) during pump set installation.

### 2.8 Safety information for maintenance, inspection and installation

- Modifications or alterations of the pump (set) are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts/components authorised by the manufacturer. The use of other parts/components can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that maintenance, inspection and installation is performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.
- Only carry out work on the pump (set) during standstill of the pump.
- Only perform work on the pump set when it has been disconnected from the power supply (de-energised).
- The pump (set) must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.
- When taking the pump set out of service always adhere to the procedure described in the manual. (⇒ Section 6.1.5, Page 28) (⇒ Section 6.3, Page 30)
- Decontaminate pumps which handle fluids posing a health hazard. (⇒ Section 7.3, Page 35)
- As soon as the work has been completed, re-install and re-activate any safety-relevant devices and protective devices. Before returning the product to service, observe all instructions on commissioning. (⇒ Section 6.1, Page 26)

### 2.9 Unauthorised modes of operation

Never operate the pump (set) outside the limits stated in the data sheet and in this manual.

The warranty relating to the operating reliability and safety of the supplied pump (set) is only valid if the equipment is used in accordance with its intended use. (⇒ Section 2.3, Page 9)

### 2.10 Explosion protection

**Always observe the information on explosion protection given in this section when operating the product in potentially explosive atmospheres.**

Only pumps/pump sets marked as explosion-proof **and** identified as such in the data sheet may be used in potentially explosive atmospheres.

Special conditions apply to the operation of explosion-proof pump sets to EU Directive 2014/34/EU (ATEX).

Especially adhere to the sections in this manual marked with the symbol opposite and the following sections, (⇒ Section 2.10.1, Page 11) to (⇒ Section 2.10.4, Page 12)

The explosion-proof status of the pump set is only assured if the pump set is used in accordance with its intended use.



Never operate the pump set outside the limits stated in the data sheet and on the name plate.  
Prevent impermissible modes of operation at all times.

**2.10.1 Marking**

- Pump** The marking on the pump refers to the pump part only.  
Example of such marking: II 2 G c TX  
Refer to the Temperature Limits table for the temperatures permitted for the individual pump variants. (⇒ Section 2.10.2, Page 11)
- Shaft coupling** An EC manufacturer's declaration is required for the shaft coupling; the shaft coupling must be marked accordingly.
- Motor** The motor has its own marking. The marking is maintained on the condition that the temperatures the pump causes to develop at the motor flange and motor shaft are permitted by the motor manufacturer.  
The motors used by KSB on pumps with ATEX certification meet this condition.

**2.10.2 Temperature limits**

In normal pump operation, the highest temperatures are to be expected on the surface of the pump casing and at the shaft seal.  
The surface temperature at the pump casing corresponds to the temperature of the fluid handled. If the pump is heated in addition, the operator of the system is responsible for observing the specified temperature class and fluid temperature (operating temperature).  
The table below lists the temperature classes and the resulting theoretical temperature limits of the fluid handled (a potential temperature rise in the shaft seal area has been taken into account).  
The temperature class specifies the maximum permissible temperature at the surface of the pump set during operation. For the permissible operating temperature of the pump in question refer to the data sheet.

**Table 4:** Temperature limits

Temperature class as per EN 13463-1	Max. permissible fluid temperature
T1	Temperature limit of the pump
T2	280 °C
T3	185 °C
T4	120 °C
T5	85 °C
T6	Only after consultation with the manufacturer

If the pump is to be operated at a higher temperature, the data sheet is missing or if the pump is part of a pool of pumps, contact KSB for the maximum permissible operating temperature.

- Motor supplied by the operator** If a pump is supplied without motor (as part of a pool of pumps), the motor specified in the pump data sheet must meet the following conditions:
  - The permissible temperature limits at the motor flange and motor shaft must be higher than the temperatures generated by the pump.
  - Contact the manufacturer for the actual pump temperatures.

**2.10.3 Monitoring equipment**

The pump (set) must only be operated within the limits specified in the data sheet and on the name plate.  
If the system operator cannot warrant compliance with these operating limits, appropriate monitoring devices must be used.  
Check whether monitoring equipment is required to ensure that the pump set functions properly.  
Contact KSB for further information about monitoring equipment.

#### **2.10.4 Operating limits**

The minimum flows indicated in (⇒ Section 6.2.3.1, Page 29) refer to water and water-like fluids handled. Longer operating periods with these fluids and at the flow rates indicated will not cause an additional increase in the temperatures at the pump surface. However, if the physical properties of the fluids handled are different from water, it is essential to check whether an additional heat build-up may occur and if the minimum flow rate must therefore be increased. The calculation formula in (⇒ Section 6.2.3.1, Page 29) can be used to check whether additional heat build-up may lead to a dangerous temperature increase at the pump surface.

### 3 Transport/Temporary Storage/Disposal

#### 3.1 Checking the condition upon delivery

1. On transfer of goods, check each packaging unit for damage.
2. In the event of in-transit damage, assess the exact damage, document it and notify KSB or the supplying dealer and the insurer about the damage in writing immediately.

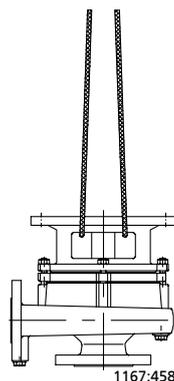
#### 3.2 Transport

	<b>! DANGER</b>
	<p><b>The pump (set) could slip out of the suspension arrangement</b>          Danger to life from falling parts!</p> <ul style="list-style-type: none"> <li>▷ Always transport the pump (set) in the specified position.</li> <li>▷ Never attach the suspension arrangement to the free shaft end or the motor eyebolt.</li> <li>▷ Observe the information about weights, centre of gravity and fastening points.</li> <li>▷ Observe the applicable local accident prevention regulations.</li> <li>▷ Use suitable, permitted lifting accessories, e.g. self-tightening lifting tongs.</li> </ul>
	<b>CAUTION</b>
	<p><b>Incorrect transport of the pump</b>          Damage to the shaft seal!</p> <ul style="list-style-type: none"> <li>▷ For transport, lock the pump shaft with a suitable transport lock to prevent any movement of the shaft.</li> </ul>

When transporting the pump without motor, shaft 210 must be locked.

1. Remove guards 680.
2. Slide discs 550.5 into the shaft groove and fasten them with hexagon head bolt 901.3.

To transport the pump/pump set suspend it from the lifting tackle as shown.



**Fig. 1:** Transporting the pump

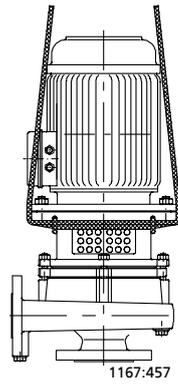


Fig. 2: Transporting the pump set

### 3.3 Storage/preservation

If commissioning is to take place some time after delivery, we recommend that the following measures be taken for pump (set) storage.

	<p style="background-color: #FFD700; padding: 5px;"><b>CAUTION</b></p> <p><b>Damage during storage due to humidity, dirt, or vermin</b> Corrosion/contamination of the pump (set)!</p> <ul style="list-style-type: none"> <li>▷ For outdoor storage cover the packed or unpacked pump (set) and accessories with waterproof material.</li> </ul>
	<p style="background-color: #FFD700; padding: 5px;"><b>CAUTION</b></p> <p><b>Wet, contaminated or damaged openings and connections</b> Leakage or damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Clean and cover pump openings and connections as required prior to putting the pump into storage.</li> </ul>

Store the pump (set) in a dry, protected room where the atmospheric humidity is as constant as possible.

Rotate the shaft by hand once a month, e.g. via the motor fan.

If properly stored indoors, the pump set is protected for a maximum of 12 months. New pumps/pump sets are supplied by our factory duly prepared for storage.

For storing a pump (set) which has already been operated, the shutdown measures must be adhered to. (⇒ Section 6.3.1, Page 30)

### 3.4 Return to supplier

1. Prior to returning the product to the supplier, flush and clean it, particularly if it has been used in noxious, explosive, hot or other hazardous fluids.
2. If the product has been used in fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen, the product must also be neutralised and treated with anhydrous inert gas to ensure drying.
3. Always complete and enclose a certificate of decontamination when returning the product. (⇒ Section 11, Page 49)  
Indicate any safety measures and decontamination measures taken.

	<p style="background-color: #0070C0; color: white; padding: 5px;"><b>NOTE</b></p> <p>If required, a blank certificate of decontamination can be downloaded from the following web site: <a href="http://www.ksb.com/certificate_of_decontamination">www.ksb.com/certificate_of_decontamination</a></p>
--	--

### 3.5 Disposal

	 <b>WARNING</b>
	<p><b>Fluids handled, consumables and supplies which are hot and/or pose a health hazard</b></p> <p>Hazard to persons and the environment!</p> <ul style="list-style-type: none"><li>▷ Collect and properly dispose of flushing fluid and any fluid residues.</li><li>▷ Wear safety clothing and a protective mask if required.</li><li>▷ Observe all legal regulations on the disposal of fluids posing a health hazard.</li></ul>

1. Dismantle the pump (set).  
Collect greases and other lubricants during dismantling.
2. Separate and sort the pump materials, e.g. by:
  - Metals
  - Plastics
  - Electronic waste
  - Greases and other lubricants
3. Dispose of materials in accordance with local regulations or in another controlled manner.

## 4 Description of the Pump (Set)

### 4.1 General description

- Close-coupled pump with shaft seal
- Handling clean or aggressive fluids not chemically and mechanically aggressive to the pump materials.

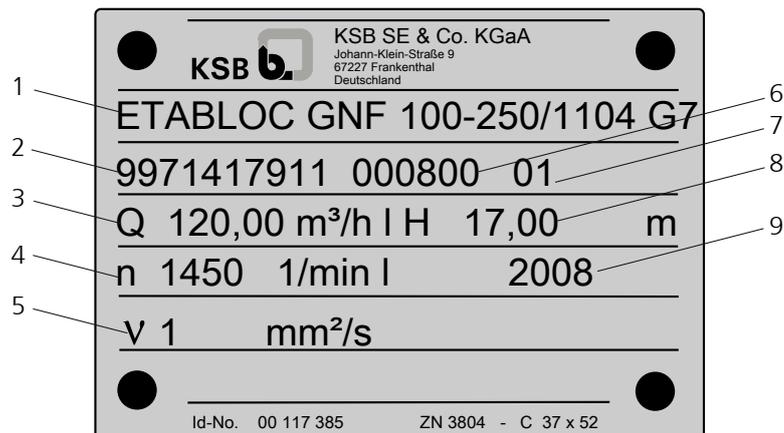
### 4.2 Designation

For example: **Etabloc G N F 200-250/1104**

**Table 5:** Key to the designation

Code	Description
Etabloc	Type series
G	Casing material, e.g. JL 1040 <sup>2)</sup>
N	Stub shaft version with standardised motor
F	Bottle rinser variant
200	Nominal discharge nozzle diameter [mm]
250	Nominal impeller diameter [mm]
110	Motor rating: kW x 10 (example 11 kW)
4	Number of motor poles

### 4.3 Name plate



**Fig. 3:** Etabloc GNF name plate (example)

1	Type series, size and version	2	KSB order number (ten digits)
3	Flow rate	4	Speed
5	Kinematic viscosity of the fluid handled	6	Order item number (six digits)
7	Consecutive number (two digits)	8	Head
9	Year of construction		

2) To EN 1561 = GJL-250

### 4.4 Design

#### Design

- Volute casing pump
- Close-coupled design
- Single-stage
- Back pull-out design
- Rigid connection between pump and motor
- Standardised motor to DIN 42677, constructional design IM V15 to DIN IEC 34, Part 7.

#### Pump casing

- Radially split volute casing
- Replaceable casing wear rings

#### Installation types

- Horizontal installation / vertical installation

#### Impeller type

- Closed radial impeller

#### Shaft seal

- Standardised mechanical seal to EN 12756

#### Bearings

- Radial ball bearings in the motor housing
- Grease lubrication

### 4.5 Design and function

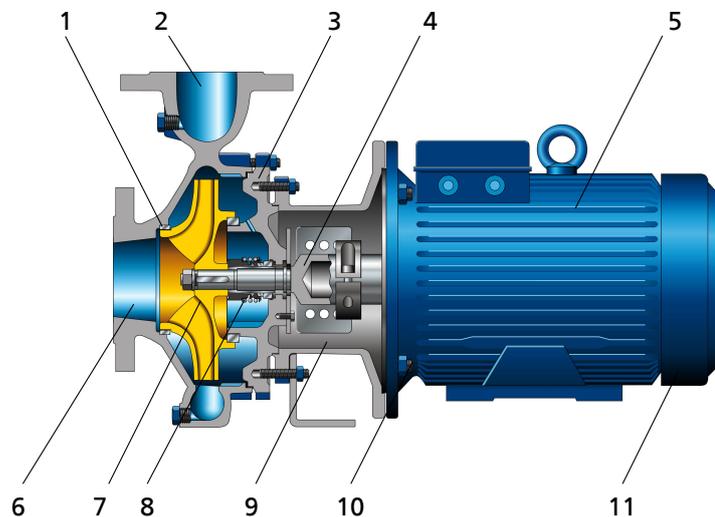


Fig. 4: Sectional drawing

1	Clearance gap	2	Discharge nozzle
3	Casing cover	4	Shaft
5	Motor housing	6	Suction nozzle
7	Impeller	8	Shaft seal
9	Drive lantern	10	Rolling element bearing
11	Rolling element bearing		

**Design** The pump is designed with an axial fluid inlet and a radial outlet. The hydraulic system is rigidly connected to the motor via a stub shaft.

**Function** The fluid enters the pump via the suction nozzle (6) and is accelerated outward by the rotating impeller (7). In the flow passage of the pump casing the kinetic energy of the fluid is converted into pressure energy. The fluid is pumped to the discharge nozzle (2), where it leaves the pump. The clearance gap (1) prevents any fluid from flowing back from the casing to the suction nozzle. At the rear side of the impeller, the shaft (4) enters the casing via the casing cover (3). The shaft passage through the cover is sealed to atmosphere with a dynamic shaft seal (8). The shaft runs in rolling element bearings (10 and 11), which are supported by a motor housing (5) linked with the pump casing and/or casing cover (3) via the drive lantern (9).

**Sealing** The pump is sealed by a standardised mechanical seal.

#### 4.6 Noise characteristics

**Table 6:** Surface sound pressure level  $L_{pA}$  <sup>3)</sup>

Rated power input $P_N$ [kW]	Pump set	
	1450 rpm [dB]	960 rpm [dB]
7.5	-	64
11	70	65
15	71	67
18.5	72	-
22	72	-

#### 4.7 Scope of supply

Depending on the model, the following items are included in the scope of supply:

- Pump
- Surface-cooled IEC three-phase current squirrel-cage motor
- Cover plates at drive lantern to EN 294

#### 4.8 Dimensions and weights

For dimensions and weights please refer to the general arrangement drawing/outline drawing of the pump/pump set.

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3) Spatial average to ISO 3744 and EN 12639. Applies to non-cavitating pump operation in the range  $Q/Q_{opt} = 0.8 - 1.1$ . If noise levels are to be guaranteed: Add +3 dB for measuring and constructional tolerance.

## 5 Installation at Site

### 5.1 Safety regulations

	<b>⚠ DANGER</b>
	<p><b>Improper installation in potentially explosive atmospheres</b> Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▸ Comply with the applicable local explosion protection regulations.</li> <li>▸ Observe the information in the data sheet and on the name plates of pump and motor.</li> </ul>

### 5.2 Checking the site before installation

#### Place of installation

	<b>⚠ WARNING</b>
	<p><b>Installation on mounting surfaces which are unsecured and cannot support the load</b> Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▸ Use a concrete of compressive strength class C12/15 which meets the requirements of exposure class X0 to EN 206-1.</li> <li>▸ The mounting surface must have set and must be completely horizontal and even.</li> <li>▸ Observe the weights indicated.</li> </ul>

1. Check the structural requirements.  
All structural work required must have been prepared in accordance with the dimensions stated in the outline drawing/general arrangement drawing.

### 5.3 Setting up the pump set

	<b>CAUTION</b>
	<p><b>Ingress of leakage into the motor</b> Damage to the pump!</p> <ul style="list-style-type: none"> <li>▸ Never install the pump set with the "motor below".</li> </ul>

#### Fastening

**Table 7:** Fastening

Motor rating	Type of fastening
From 5.5 kW (explosion-proof units from 4.6 kW)	Mount with motor foot

1. Position the pump set on the foundation and fasten it (see table on Fastening).
2. Use a spirit level to align the pump set with the discharge nozzle.

## 5.4 Piping

### 5.4.1 Connecting the piping

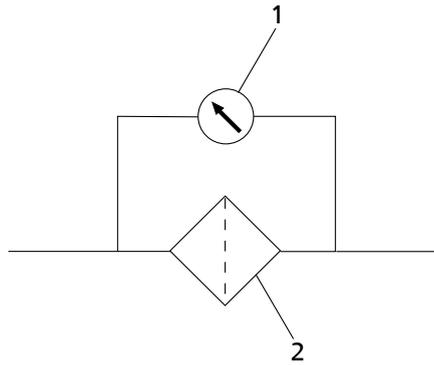
	<p style="background-color: #e67e22; color: white; padding: 5px;"><b>⚠ DANGER</b></p> <p><b>Impermissible loads acting on the pump nozzles</b>            Danger to life from leakage of hot, toxic, corrosive or flammable fluids!</p> <ul style="list-style-type: none"> <li>▷ Do not use the pump as an anchorage point for the piping.</li> <li>▷ Anchor the pipes in close proximity to the pump and connect them properly without transmitting any stresses or strains.</li> <li>▷ Take appropriate measures to compensate for thermal expansion of the piping.</li> </ul>
	<p style="background-color: #f1c40f; padding: 5px;"><b>CAUTION</b></p> <p><b>Incorrect earthing during welding work at the piping</b>            Destruction of rolling element bearings (pitting effect)!</p> <ul style="list-style-type: none"> <li>▷ Never earth the electric welding equipment on the pump or baseplate.</li> <li>▷ Prevent current flowing through the rolling element bearings.</li> </ul>
	<p style="background-color: #2980b9; color: white; padding: 5px;"><b>NOTE</b></p> <p>Installing check and shut-off elements in the system is recommended, depending on the type of plant and pump. However, such elements must not obstruct proper drainage or hinder disassembly of the pump.</p>

- ✓ Suction lift lines have been laid with a rising slope, suction head lines with a downward slope towards the pump.
- ✓ A flow stabilisation section having a length equivalent to at least twice the inside diameter of the suction flange has been provided upstream of the suction flange.
- ✓ The nominal diameters of the pipelines are equal to or greater than the nominal diameters of the pump nozzles.
- ✓ Adapters to larger nominal diameters are designed with a diffuser angle of approx. 8° to avoid excessive pressure losses.
- ✓ The pipelines have been anchored in close proximity to the pump and connected without transmitting any stresses or strains.
  1. Thoroughly clean, flush and blow through all vessels, pipelines and connections (especially of new installations).
  2. Before installing the pump in the piping, remove the flange covers on the suction and discharge nozzles of the pump.

	<p style="background-color: #f1c40f; padding: 5px;"><b>CAUTION</b></p> <p><b>Welding beads, scale and other impurities in the piping</b>            Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Remove any impurities from the piping.</li> <li>▷ If necessary, install a filter.</li> <li>▷ Observe the information in (⇒ Section 7.2.2.2, Page 35) .</li> </ul>
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3. Check that the inside of the pump is free from any foreign objects. Remove any foreign objects.

4. If required, install a filter in the piping (see drawing: Filter in the piping).



**Fig. 5: Filter in the piping**

1	Differential pressure gauge	2	Filter
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	<b>NOTE</b>
<p>Use a filter with laid-in wire mesh (mesh width 0.5 mm, wire diameter 0.25 mm) of corrosion-resistant material. Use a filter with a filter area three times the cross-section of the piping. Conical filters have proved suitable.</p>	

5. Connect the pump nozzles to the piping.

	<b>CAUTION</b>
<p><b>Aggressive flushing liquid and pickling agent</b> Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Match the cleaning operation mode and duration of flushing and pickling to the casing materials and seal materials used.</li> </ul>	

**5.4.2 Permissible forces and moments at the pump nozzles**

No piping-induced forces and moments (from warped pipelines or thermal expansion, for example) must act on the pump.

**5.4.3 Vacuum balance line**

	<b>NOTE</b>
<p>Where fluid has to be pumped out of a vessel under vacuum, installing a vacuum balance line is recommended.</p>	

The following rules apply to vacuum balance lines:

- Minimum nominal line diameter 25 mm.
- The line extends above the highest permissible fluid level in the vessel.

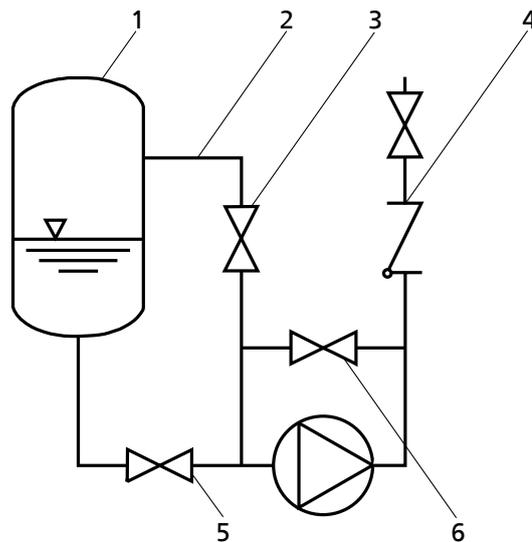


Fig. 6: Vacuum balance system

1	Vessel under vacuum	2	Vacuum balance line
3	Shut-off element	4	Swing check valve
5	Main shut-off element	6	Vacuum-tight shut-off element


**NOTE**

An additional line fitted with a shut-off valve (from the pump discharge nozzle to the balance line) facilitates venting of the pump before start-up.

**5.4.4 Auxiliary connections**

**⚠ DANGER**

**Risk of potentially explosive atmosphere by mixing of incompatible fluids in the auxiliary piping**

Risk of burns!

Explosion hazard!

- Make sure that the barrier fluid or quench liquid are compatible with the fluid handled.


**⚠ WARNING**

**Failure to use or incorrect use of auxiliary connections (e.g. barrier fluid, flushing liquid, etc.)**

Risk of injury from escaping fluid!

Risk of burns!

Malfunction of the pump!

- Refer to the general arrangement drawing, the piping layout and pump markings (if any) for the quantity, dimensions and locations of auxiliary connections.
- Use the auxiliary connections provided.

**5.5 Enclosure/insulation**

	<p><b>⚠ DANGER</b></p> <p><b>An explosive atmosphere develops due to insufficient venting</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Provide sufficient venting in the space between stuffing box housing and motor flange.</li> <li>▷ Do not cover the perforated holes of the contact guards at the drive lantern (e.g. by insulation).</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Volute casing and stuffing box housing take on the same temperature as the fluid handled.</b> Risk of burns!</p> <ul style="list-style-type: none"> <li>▷ Insulate the volute casing.</li> <li>▷ Fit protective guard.</li> </ul>
	<p><b>CAUTION</b></p> <p><b>Heat build-up inside the drive lantern</b> Damage to the bearing!</p> <ul style="list-style-type: none"> <li>▷ Never insulate the casing cover and the drive lantern.</li> </ul>

**5.6 Electrical connection**

	<p><b>⚠ DANGER</b></p> <p><b>Incorrect electrical installation</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ For electrical installation, also observe the requirements of IEC 60079-14.</li> <li>▷ Always use a motor protection switch for explosion-proof motors.</li> </ul>
	<p><b>⚠ DANGER</b></p> <p><b>Electrical connection work by unqualified personnel</b> Risk of fatal injury due to electric shock!</p> <ul style="list-style-type: none"> <li>▷ Always have the electrical connections installed by a trained and qualified electrician.</li> <li>▷ Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Incorrect connection to the mains</b> Damage to the mains network, short circuit!</p> <ul style="list-style-type: none"> <li>▷ Observe the technical specifications of the local energy supply companies.</li> </ul>
<ol style="list-style-type: none"> <li>1. Check the available mains voltage against the data on the motor name plate.</li> <li>2. Select an appropriate start-up method.</li> </ol>	
	<p><b>NOTE</b></p> <p>A motor protection device is recommended.</p>

5.6.1 Setting the time relay

	<b>CAUTION</b>
	<p><b>Switchover between star and delta on three-phase motors with star-delta starting takes too long.</b>                  Damage to the pump (set)!</p> <ul style="list-style-type: none"> <li>▷ Keep switch-over intervals between star and delta as short as possible.</li> </ul>

Table 8: Time relay settings for star-delta starting:

Motor rating [kW]	Y time to be set [s]
≤ 30	< 3
> 30	< 5

5.6.2 Earthing

	<b>⚠ DANGER</b>
	<p><b>Electrostatic charging</b>                  Explosion hazard!                  Fire hazard!                  Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Connect the PE conductor to the earthing terminal provided.</li> </ul>

5.6.3 Connecting the motor

	<b>NOTE</b>
	<p>In compliance with IEC 60034-8, three-phase motors are always wired for clockwise rotation (looking at the motor shaft stub).                  The pump's direction of rotation is indicated by an arrow on the pump.</p>

1. Match the motor's direction of rotation to that of the pump.
2. Observe the manufacturer's product literature supplied with the motor.

5.7 Checking the direction of rotation

	<b>⚠ DANGER</b>
	<p><b>Temperature increases resulting from contact between rotating and stationary components</b>                  Explosion hazard!                  Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Never check the direction of rotation by starting up the unfilled pump.</li> </ul>

	<b>⚠ WARNING</b>
	<p><b>Hands inside the pump casing</b>                  Risk of injuries, damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Always disconnect the pump set from the power supply and secure it against unintentional start-up before inserting your hands or other objects into the pump.</li> </ul>

	<b>CAUTION</b>
	<b>Drive and pump running in the wrong direction of rotation</b> Damage to the pump! <ul style="list-style-type: none"><li>▷ Refer to the arrow indicating the direction of rotation on the pump.</li><li>▷ Check the direction of rotation. If required, check the electrical connection and correct the direction of rotation.</li></ul>

The correct direction of rotation of the motor and pump is clockwise (seen from the drive end).

1. Start the motor and stop it again immediately to determine the motor's direction of rotation.
2. Check the direction of rotation.  
The motor's direction of rotation must match the arrow indicating the direction of rotation on the pump.
3. If the motor runs in the wrong direction of rotation, check the electrical connection of the motor and the control system, if applicable.

## 6 Commissioning/Start-up/Shutdown

### 6.1 Commissioning/Start-up

#### 6.1.1 Prerequisites for commissioning/start-up

Before commissioning/starting up the pump set, make sure that the following conditions are met:

- The pump set has been properly connected to the power supply and is equipped with all protection devices. (⇒ Section 5.6, Page 23)
- The pump has been primed with the fluid to be handled. The pump has been vented.
- The direction of rotation has been checked. (⇒ Section 5.7, Page 24)
- All auxiliary connections required are connected and operational.
- The lubricants have been checked.
- After prolonged shutdown of the pump (set), the activities required for returning the equipment to service have been carried out. (⇒ Section 6.4, Page 30)
- The lock washers, if any, have been removed from the shaft groove.

#### 6.1.2 Priming and venting the pump

	<p><b>⚠ DANGER</b></p>
	<p><b>Risk of potentially explosive atmosphere inside the pump</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▸ Before starting up the pump, vent the suction line and the pump and prime them with the fluid to be handled.</li> </ul>
	<p><b>CAUTION</b></p>
	<p><b>Increased wear due to dry running</b> Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▸ Never operate the pump set without liquid fill.</li> <li>▸ Never close the shut-off element in the suction line and/or supply line during pump operation.</li> </ul>
<ol style="list-style-type: none"> <li>1. Vent the pump and suction line and fill them with the fluid to be handled. Connection 6D can be used for venting (see drawing of auxiliary connections). For vertical installation with the motor on top, use connection 5B (if any) for venting (see drawing of auxiliary connections and .</li> <li>2. Fully open the shut-off valve in the suction line.</li> <li>3. Fully open all auxiliary feed lines (barrier fluid, flushing liquid, etc.), if applicable.</li> <li>4. Open the shut-off valve (3), if any, in the vacuum balance line (2) and close the vacuum-tight shut-off valve (6), if any. (⇒ Section 5.4.3, Page 21)</li> </ol>	
	<p><b>NOTE</b></p>
	<p>For design-inherent reasons some unfilled volume in the hydraulic system cannot be excluded after the pump has been primed for commissioning/start-up. However, once the motor is started up the pumping effect will immediately fill this volume with the fluid handled.</p>

6.1.3 Start-up

 	<p><b>⚠ DANGER</b></p>
<p><b>Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and/or discharge line closed.</b>  Explosion hazard!  Hot or toxic fluids escaping!</p> <ul style="list-style-type: none"> <li>▷ Never operate the pump with the shut-off elements in the suction line and/or discharge line closed.</li> <li>▷ Only start up the pump set with the discharge-side shut-off element slightly or fully open.</li> </ul>	

 	<p><b>⚠ DANGER</b></p>
<p><b>Excessive temperatures due to dry running or excessive gas content in the fluid handled</b>  Explosion hazard!  Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Never operate the pump set without a liquid fill.</li> <li>▷ Prime the pump as per operating instructions.</li> <li>▷ Always operate the pump within the permissible operating range.</li> </ul>	

	<p><b>CAUTION</b></p>
<p><b>Abnormal noises, vibrations, temperatures or leakage</b>  Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Switch off the pump (set) immediately.</li> <li>▷ Eliminate the causes before returning the pump set to service.</li> </ul>	

- ✓ The system piping has been cleaned.
- ✓ The pump, suction line and inlet tank, if any, have been vented and primed with the fluid to be pumped.
- ✓ The lines for priming and venting have been closed.

	<p><b>CAUTION</b></p>
<p><b>Start-up against open discharge line</b>  Motor overload!</p> <ul style="list-style-type: none"> <li>▷ Make sure the motor has sufficient power reserves.</li> <li>▷ Use a soft starter.</li> <li>▷ Use speed control.</li> </ul>	

1. Fully open the shut-off element in the suction head/suction lift line.
2. Close or slightly open the shut-off element in the discharge line.
3. Start up the motor.
4. Immediately after the pump has reached full rotational speed, slowly open the shut-off element in the discharge line and adjust it to comply with the duty point.

6.1.4 Checking the shaft seal

**Mechanical seal** The mechanical seal only leaks slightly or invisibly (as vapour) during operation. Mechanical seals are maintenance-free.

6.1.5 Shutdown

	<b>CAUTION</b>
	<p><b>Heat build-up inside the pump</b> Damage to the shaft seal!</p> <ul style="list-style-type: none"> <li>▷ Depending on the type of installation, the pump set requires sufficient after-run time – with the heat source switched off – until the fluid handled has cooled down.</li> </ul>

	<b>CAUTION</b>
	<p><b>Backflow of fluid handled is not permitted</b> Motor or winding damage! Mechanical seal damage!</p> <ul style="list-style-type: none"> <li>▷ Close the shut-off elements.</li> </ul>

- ✓ The shut-off element in the suction line is and remains open.
  1. Close the shut-off element in the discharge line.
  2. Switch off the motor and make sure the pump set runs down smoothly to a standstill.

	<b>NOTE</b>
	<p>If the discharge line is equipped with a non-return or check valve, the shut-off element may remain open provided that the system conditions and system regulations are considered and observed.</p>

For prolonged shutdown periods:

1. Close the shut-off element in the suction line.
2. Close any auxiliary lines.  
If the fluid to be handled is fed in under vacuum, also supply the shaft seal with barrier fluid during standstill.

	<b>CAUTION</b>
	<p><b>Risk of freezing during prolonged pump shutdown periods</b> Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Drain the pump and the cooling/heating chambers (if any) or otherwise protect them against freezing.</li> </ul>

6.2 Operating limits

	<b>⚠ DANGER</b>
	<p><b>Non-compliance with operating limits for pressure, temperature, fluid handled and speed</b> Explosion hazard! Hot or toxic fluid could escape!</p> <ul style="list-style-type: none"> <li>▷ Comply with the operating data indicated in the data sheet.</li> <li>▷ Never use the pump for handling fluids it is not designed for.</li> <li>▷ Avoid prolonged operation against a closed shut-off element.</li> <li>▷ Never operate the pump at temperatures, pressures or rotational speeds exceeding those specified in the data sheet or on the name plate unless the written consent of the manufacturer has been obtained.</li> </ul>

### 6.2.1 Ambient temperature

	<b>CAUTION</b>
	<p><b>Operation outside the permissible ambient temperature</b>                  Damage to the pump (set)!</p> <ul style="list-style-type: none"> <li>▷ Observe the specified limits for permissible ambient temperatures.</li> </ul>

Observe the following parameters and values during operation:

**Table 9:** Permissible ambient temperatures

Permissible ambient temperature	Value
Maximum	40 °C
Minimum	See data sheet.

### 6.2.2 Frequency of starts

	<b>⚠ DANGER</b>
	<p><b>Excessive surface temperature of the motor</b>                  Explosion hazard!                  Damage to the motor!</p> <ul style="list-style-type: none"> <li>▷ In case of explosion-proof motors, observe the frequency of starts specified in the manufacturer's product literature.</li> </ul>

To prevent high temperature increases in the motor and excessive loads on the pump, motor, seals and bearings, do not exceed the switching frequency of 12 starts per hour (h).

	<b>CAUTION</b>
	<p><b>Re-starting while motor is still running down</b>                  Damage to the pump (set)!</p> <ul style="list-style-type: none"> <li>▷ Do not re-start the pump set before the pump rotor has come to a standstill.</li> </ul>

### 6.2.3 Fluid handled

#### 6.2.3.1 Flow rate

**Table 10:** Flow rate

	Minimum flow rate	Maximum flow rate
For a short period (approximately 2 minutes)	25 % of $Q_{opt.}^{4)}$	See hydraulic characteristic curves
Continuous duty	$Q_{part\ load} \geq 45\ %\ of\ Q_{opt.}^{4)}$	

The calculation formula below can be used to check if an additional heat build-up could lead to a dangerous temperature increase at the pump surface.

$$T_O = T_f + \Delta \vartheta$$

$$\Delta \vartheta = \frac{g \times H}{c \times \eta} \times (1 - \eta)$$

**Table 11:** Key

Symbol	Description	Unit
c	Specific heat capacity	J/kg K
g	Gravitational constant	m/s <sup>2</sup>

4) Duty point at maximum efficiency

Symbol	Description	Unit
H	Pump discharge head	m
$T_f$	Fluid temperature	°C
$T_o$	Temperature at the casing surface	°C
$\eta$	Pump efficiency at duty point	-
$\Delta\vartheta$	Temperature difference	K

### 6.2.3.2 Density of the fluid handled

The pump input power changes in proportion to the density of the fluid handled.

	<b>CAUTION</b>
	<p><b>Impermissibly high density of the fluid handled</b> Motor overload!</p> <ul style="list-style-type: none"> <li>▷ Observe the information about fluid density in the data sheet.</li> <li>▷ Make sure the motor has sufficient power reserves.</li> </ul>

### 6.2.3.3 Abrasive fluids

Do not exceed the maximum permissible solids content specified in the data sheet. When the pump handles fluids containing abrasive substances, increased wear of the hydraulic system and shaft seal are to be expected. In this case, reduce the commonly recommended inspection intervals.

## 6.3 Shutdown/storage/preservation

### 6.3.1 Measures to be taken for shutdown

#### The pump (set) remains installed

- ✓ Sufficient fluid is supplied for the operation check run of the pump.
  1. For prolonged shutdown periods, start up the pump (set) regularly between once a month and once every three months for approximately five minutes.
    - ⇒ This will prevent the formation of deposits within the pump and the pump intake area.

#### The pump (set) is removed from the pipe and stored

- ✓ The pump has been properly drained. (⇒ Section 7.3, Page 35)
- ✓ The safety instructions for dismantling the pump have been observed. (⇒ Section 7.4.1, Page 36)
  1. Spray-coat the inside wall of the pump casing and, in particular, the impeller clearance areas with a preservative.
  2. Spray the preservative through the suction nozzle and discharge nozzle. It is advisable to then close the pump nozzles (e.g. with plastic caps).
  3. Oil or grease all exposed machined parts and surfaces of the pump (with silicone-free oil and grease, food-approved if required) to protect them against corrosion.
    - Observe the additional instructions on preservation. (⇒ Section 3.3, Page 14)

If the pump set is to be stored temporarily, only preserve the wetted components made of low-alloy materials. Commercially available preservatives can be used for this purpose. Observe the manufacturer's instructions for application/removal.

Observe any additional instructions and information provided. (⇒ Section 3, Page 13)

### 6.4 Returning to service

For returning the equipment to service, observe the sections on commissioning/start-up (⇒ Section 6.1, Page 26) and the operating limits.

In addition, carry out all servicing/maintenance operations before returning the pump (set) to service. (⇒ Section 7, Page 32)

	<p><b>⚠ WARNING</b></p> <p><b>Failure to re-install or re-activate protective devices</b>          Risk of injury from moving parts or escaping fluid!</p> <ul style="list-style-type: none"> <li>▷ As soon as the work is completed, re-install and re-activate any safety-relevant devices and protective devices.</li> </ul>
	<p><b>NOTE</b></p> <p>If the pump has been out of service for more than one year, replace all elastomer seals.</p>

## 7 Servicing/Maintenance

### 7.1 Safety regulations

	<b>DANGER</b>
	<p><b>Sparks produced during servicing work</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Observe the safety regulations in force at the place of installation!</li> <li>▷ Always perform maintenance work on explosion-proof pump sets outside potentially explosive atmospheres.</li> </ul>

  	<b>DANGER</b>
	<p><b>Improperly serviced pump set</b> Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Service the pump set regularly.</li> <li>▷ Prepare a maintenance schedule with special emphasis on lubricants and shaft seal.</li> </ul>

The operator ensures that maintenance, inspection and installation is performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.

	<b>WARNING</b>
	<p><b>Unintentional starting of the pump set</b> Risk of injury by moving components and shock currents!</p> <ul style="list-style-type: none"> <li>▷ Ensure that the pump set cannot be started unintentionally.</li> <li>▷ Always make sure the electrical connections are disconnected before carrying out work on the pump set.</li> </ul>

	<b>DANGER</b>
	<p><b>Improper cleaning of coated pump surfaces</b> Explosion hazard by electrostatic discharge!</p> <ul style="list-style-type: none"> <li>▷ When cleaning coated pump surfaces in atmospheres of Explosion group IIC, use suitable anti-static equipment.</li> </ul>

	<b>WARNING</b>
	<p><b>Fluids handled, consumables and supplies which are hot and/or pose a health hazard</b> Risk of injury!</p> <ul style="list-style-type: none"> <li>▷ Observe all relevant laws.</li> <li>▷ When draining the fluid take appropriate measures to protect persons and the environment.</li> <li>▷ Decontaminate pumps which handle fluids posing a health hazard.</li> </ul>

	 <b>WARNING</b>
	<p><b>Insufficient stability</b>            Risk of crushing hands and feet!</p> <ul style="list-style-type: none"> <li>▷ During assembly/dismantling, secure the pump (set)/pump parts to prevent tilting or tipping over.</li> </ul>

A regular maintenance schedule will help avoid expensive repairs and contribute to trouble-free, reliable operation of the pump, pump set and pump parts with a minimum of servicing/maintenance expenditure and work.

	<b>NOTE</b>
	<p>All maintenance work, service work and installation work can be carried out by KSB Service or authorised workshops. For contact details please refer to the enclosed "Addresses" booklet or visit "<a href="http://www.ksb.com/contact">www.ksb.com/contact</a>" on the Internet.</p>

Never use force when dismantling and reassembling the pump set.

## 7.2 Servicing/inspection

### 7.2.1 Supervision of operation

	 <b>DANGER</b>
	<p><b>Risk of potentially explosive atmosphere inside the pump</b>            Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ The pump internals in contact with the fluid to be handled, including the seal chamber and auxiliary systems must be filled with the fluid to be handled at all times.</li> <li>▷ Provide sufficient inlet pressure.</li> <li>▷ Provide an appropriate monitoring system.</li> </ul>

 	 <b>DANGER</b>
	<p><b>Incorrectly serviced shaft seal</b>            Explosion hazard!            Hot, toxic fluid escaping!            Damage to the pump set!            Risk of burns!            Fire hazard!</p> <ul style="list-style-type: none"> <li>▷ Regularly service the shaft seal.</li> </ul>

 	 <b>DANGER</b>
	<p><b>Excessive temperatures as a result of bearings running hot or defective bearing seals</b>            Explosion hazard!            Fire hazard!            Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Regularly check the rolling element bearings for running noises.</li> </ul>

 	<p><b>⚠ DANGER</b></p> <p><b>Incorrectly serviced barrier fluid system</b>                  Explosion hazard!                  Fire hazard!                  Damage to the pump set!                  Hot and/or toxic fluids escaping!</p> <ul style="list-style-type: none"> <li>▷ Regularly service the barrier fluid system.</li> <li>▷ Monitor the barrier fluid pressure.</li> </ul>
	<p><b>CAUTION</b></p> <p><b>Increased wear due to dry running</b>                  Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Never operate the pump set without liquid fill.</li> <li>▷ Never close the shut-off element in the suction line and/or supply line during pump operation.</li> </ul>
	<p><b>CAUTION</b></p> <p><b>Impermissibly high temperature of fluid handled</b>                  Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Prolonged operation against a closed shut-off element is not permitted (heating up of the fluid).</li> <li>▷ Observe the temperature limits in the data sheet and in the section on operating limits. (⇒ Section 6.2, Page 28)</li> </ul>

While the pump is in operation, observe and check the following:

- The pump must run quietly and free from vibrations at all times.
- Check the shaft seal. (⇒ Section 6.1.4, Page 27)
- Check the sealing elements for leakage.
- Check the rolling element bearings for running noises.  
 Vibrations, noise and an increase in current input occurring during unchanged operating conditions indicate wear.
- Monitor the correct functioning of any auxiliary connections.
- Monitor the stand-by pump.  
 To make sure that the stand-by pumps are ready for operation, start them up once a week.
- Monitor the bearing temperature.  
 The bearing temperature must not exceed 90 °C (measured at the motor housing).

	<p><b>CAUTION</b></p> <p><b>Operation outside the permissible bearing temperature</b>                  Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ The bearing temperature of the pump (set) must never exceed 90 °C (measured on the outside of the motor housing).</li> </ul>
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	<b>NOTE</b>
	After commissioning, increased temperatures may occur at grease-lubricated rolling element bearings due to the running-in process. The final bearing temperature is only reached after a certain period of operation (up to 48 hours depending on the conditions).

### 7.2.2 Inspection work

	<b>! DANGER</b>
	<p><b>Excessive temperatures caused by friction, impact or frictional sparks</b>                  Explosion hazard!                  Fire hazard!                  Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▸ Regularly check the cover plates, plastic components and other guards of rotating parts for deformation and sufficient distance from rotating parts.</li> </ul>

#### 7.2.2.1 Checking the clearances

For checking the clearance gaps remove the impeller, if required.  
 The clearances given refer to the diameter.

**Table 12:** Clearance gaps between impeller and casing / between impeller and casing cover

	Etabloc GNF
New	0.4 mm
Maximum permissible expansion	1.0 mm

#### 7.2.2.2 Cleaning filters

	<b>CAUTION</b>
	<p><b>Insufficient inlet pressure due to clogged filter in the suction line</b>                  Damage to the pump!</p> <ul style="list-style-type: none"> <li>▸ Monitor contamination of filter with suitable means (e.g. differential pressure gauge).</li> <li>▸ Clean filter at appropriate intervals.</li> </ul>

### 7.3 Drainage/cleaning

	<b>! WARNING</b>
	<p><b>Fluids handled, consumables and supplies which are hot and/or pose a health hazard</b>                  Hazard to persons and the environment!</p> <ul style="list-style-type: none"> <li>▸ Collect and properly dispose of flushing fluid and any fluid residues.</li> <li>▸ Wear safety clothing and a protective mask if required.</li> <li>▸ Observe all legal regulations on the disposal of fluids posing a health hazard.</li> </ul>

1. Use connection 6B to drain the fluid handled (see auxiliary connections).
2. Always flush the pump if it has been used for handling noxious, explosive, hot or other hazardous fluids.  
 Always flush and clean the pump before transporting it to the workshop.  
 Provide a certificate of decontamination for the pump.

## 7.4 Dismantling the pump set

### 7.4.1 General information/Safety regulations

	<p><b>⚠ DANGER</b></p> <p><b>Insufficient preparation of work on the pump (set)</b> Risk of injury!</p> <ul style="list-style-type: none"> <li>▷ Properly shut down the pump set. (⇒ Section 6.1.5, Page 28)</li> <li>▷ Close the shut-off elements in the suction line and discharge line.</li> <li>▷ Drain the pump and release the pump pressure. (⇒ Section 7.3, Page 35)</li> <li>▷ Shut off any auxiliary feed lines.</li> <li>▷ Allow the pump set to cool down to ambient temperature.</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Unqualified personnel performing work on the pump (set)</b> Risk of injury!</p> <ul style="list-style-type: none"> <li>▷ Always have repair work and maintenance work performed by specially trained, qualified personnel.</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Hot surface</b> Risk of injury!</p> <ul style="list-style-type: none"> <li>▷ Allow the pump set to cool down to ambient temperature.</li> </ul>
	<p><b>⚠ WARNING</b></p> <p><b>Improper lifting/moving of heavy assemblies or components</b> Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.</li> </ul>

Always observe the safety instructions and information. (⇒ Section 7.1, Page 32)

For any work on the motor, observe the instructions of the relevant motor manufacturer.

For dismantling and reassembly observe the exploded views and the general assembly drawing.

In case of damage you can always contact KSB Service.

	<p><b>NOTE</b></p> <p>All maintenance work, service work and installation work can be carried out by KSB Service or authorised workshops. For contact details please refer to the enclosed "Addresses" booklet or visit "<a href="http://www.ksb.com/contact">www.ksb.com/contact</a>" on the Internet.</p>
	<p><b>NOTE</b></p> <p>After a prolonged period of operation the individual components may be hard to pull off the shaft. If this is the case, use a brand name penetrating agent and/or - if possible - an appropriate puller.</p>

#### 7.4.2 Preparing the pump set

1. De-energise the pump set and secure it against unintentional start-up.
2. Reduce pressure in the piping by opening a consumer installation.
3. Disconnect and remove all auxiliary pipework.

#### 7.4.3 Dismantling the complete pump set

	<b>NOTE</b>
	The pump casing can remain installed in the piping for further dismantling.

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 36) to (⇒ Section 7.4.2, Page 37) have been observed/carried out.

1. Disconnect the discharge and suction nozzle from the piping.
2. Depending on the pump/motor size, unscrew the bolts that fix the support foot and/or motor foot to the foundation.
3. Remove the complete pump set from the piping.

#### 7.4.4 Dismantling the motor

	<b>WARNING</b>
	<b>Motor tilting</b> Risk of crushing hands and feet! ▷ Suspend or support the motor to prevent it from tilting.

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 36) to (⇒ Section 7.4.2, Page 37) have been observed/carried out.

1. Depending on the pump/motor size, unscrew the bolts that fix the motor foot to the foundation.
2. Undo bolts 901.2.
3. Remove guard 680 from drive lantern 341.
4. Undo hexagon head bolts 901.3.
5. Insert both discs 550.5 into the groove in shaft 210. (⇒ Section 7.5.5, Page 40)
6. Tighten hexagon head bolts 901.3.
7. Remove socket head cap screws 914.1 from taper lock ring 515.
8. Undo hexagon nuts 920.2 of screws 901.1.
9. Remove the motor.

#### 7.4.5 Removing the back pull-out unit

	<b>WARNING</b>
	<b>Back pull-out unit tilting</b> Risk of squashing hands and feet! ▷ Suspend or support the back pull-out unit at the pump end.

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 36) to (⇒ Section 7.4.4, Page 37) have been observed/carried out.

1. If required, suspend or support the back pull-out unit to prevent it from tipping over.
2. Undo hexagon nut 920.2 at the volute casing.
3. Pull the back pull-out unit out of the volute casing.

4. Remove and dispose of gasket 400.1.
5. Place the back pull-out unit on a clean and level surface.

**7.4.6 Removing the impeller**

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 36) to (⇒ Section 7.4.5, Page 37) have been observed/carried out.
- ✓ The back pull-out unit has been placed in a clean and level assembly area.
  1. Undo impeller nut 920.1 (right-hand thread).
  2. Remove impeller 230 with an impeller removal tool.
  3. Place impeller 230 on a clean and level surface.
  4. Remove keys 940.2 from shaft 210.

**7.4.7 Removing the mechanical seal**

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 36) to (⇒ Section 7.4.6, Page 38) have been observed/carried out.
- ✓ The back pull-out unit is kept in a clean and level assembly area.
  1. Remove the rotating part of the mechanical seal (primary ring) from shaft 210.
  2. Undo screws 901.1 at the drive lantern (pump end).
  3. Remove stuffing box housing 451 from drive lantern 341.
  4. Remove the stationary part of the mechanical seal (mating ring) from stuffing box housing 451.

**7.5 Reassembling the pump set**

**7.5.1 General information/Safety regulations**

	<p><b>⚠ WARNING</b></p>
	<p><b>Improper lifting/moving of heavy assemblies or components</b>          Personal injury and damage to property!</p> <ul style="list-style-type: none"> <li>▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.</li> </ul>
	<p><b>⚠ CAUTION</b></p>
	<p><b>Improper reassembly</b>          Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Reassemble the pump (set) in accordance with the general rules of sound engineering practice.</li> <li>▷ Use original spare parts only.</li> </ul>

**Sequence** Always reassemble the pump in accordance with the corresponding general assembly drawing or exploded view.

**Sealing elements** Check O-rings for any damage and replace by new O-rings if required.  
 Always use new gaskets, making sure that they have the same thickness as the old ones.  
 Always fit gaskets of asbestos-free materials or graphite without using lubricants (e.g. copper grease, graphite paste).

**Assembly adhesives** Avoid the use of assembly adhesives if possible.  
 Should an assembly adhesive be required after all, use a commercially available contact adhesive (e.g. Pattex) or sealant (e.g. HYLOMAR or Epple 33).  
 Only apply adhesive at selected points and in thin layers.  
 Never use quick-setting adhesives (cyanoacrylate adhesives).

Coat the locating surfaces of the individual components with graphite or similar before reassembly.

Prior to reassembly, screw back any forcing screws and adjusting screws.

**Tightening torques** For reassembly, tighten all screws and bolts as specified in this manual. (⇒ Section 7.6, Page 42)

**7.5.2 Installing the mechanical seal**

**Installing the mechanical seal** The following rules must be observed when installing the mechanical seal:

- Work cleanly and accurately.
- Only remove the protective wrapping of the contact faces immediately before installation takes place.
- Prevent any damage to the sealing surfaces or O-rings.
- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 38) have been observed/ carried out.
- ✓ The bearing assembly as well as the individual parts are kept in a clean and level assembly area.
- ✓ All disassembled parts have been cleaned and checked for wear.
- ✓ Any damaged or worn parts have been replaced by original spare parts.
- ✓ The sealing surfaces have been cleaned.
  1. Clean shaft sleeve 523, and touch up any score marks or scratches with a polishing cloth, if necessary.  
If score marks or scratches are still visible, fit new shaft sleeve 523.
  2. Clean the mating ring location in stuffing box housing 451.

	<b>CAUTION</b>
	<p><b>Elastomers in contact with oil/grease</b> Shaft seal failure!</p> <ul style="list-style-type: none"> <li>▷ Use water as assembly lubricant.</li> <li>▷ Never use oil or grease as assembly lubricant.</li> </ul>

3. Carefully insert the mating ring into the stuffing box housing. Make sure that pressure is applied evenly.
4. Fit stuffing box housing 451 into the recess of drive lantern 341.
5. Tighten screws 901.1. (⇒ Section 4.6, Page 18)

	<b>NOTE</b>
	<p>To reduce friction forces when assembling the seal, wet the shaft and mating ring location with water.</p>

6. Fit the rotating part of the mechanical seal (primary ring) on shaft 210.

### 7.5.3 Fitting the impeller

- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 38) to (⇒ Section 7.5.2, Page 39) have been observed/carried out.
- ✓ The pre-assembled unit (motor, shaft, drive lantern, stuffing box housing) as well as the individual parts are kept in a clean and level assembly area.
- ✓ All disassembled parts have been cleaned and checked for wear.
- ✓ Any damaged or worn parts have been replaced by original spare parts.
- ✓ The sealing surfaces have been cleaned.
  1. Guide ring 500 and discs 500.2 to 500.4 onto shaft 210.
  2. Insert key 940.2 and push impeller 230 onto shaft 210.
  3. Fasten impeller nut 920.1 and disc 550.1 (see table: Tightening torques for bolted/screwed connections on the pump).

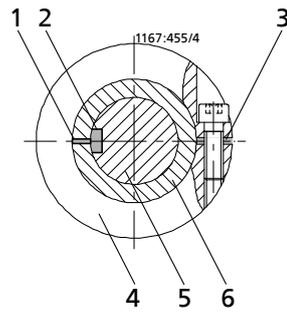
### 7.5.4 Installing the back pull-out unit

	 <b>WARNING</b>
	<p><b>Back pull-out unit tilting</b> Risk of squashing hands and feet!</p> <ul style="list-style-type: none"> <li>▸ Suspend or support the back pull-out unit at the pump end.</li> </ul>

- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 38) to (⇒ Section 7.5.3, Page 40) have been observed/carried out.
- ✓ Any damaged or worn parts have been replaced by original spare parts.
- ✓ The sealing surfaces have been cleaned.
  1. If required, suspend or support the back pull-out unit to prevent it from tipping over.
  2. Fit new gasket 400.1 into the recess of volute casing 102.
  3. Push the back pull-out unit into volute casing 102.
  4. Fasten hexagon nut 920.2 at volute casing 102. (⇒ Section 7.5.1, Page 38)

### 7.5.5 Mounting the motor

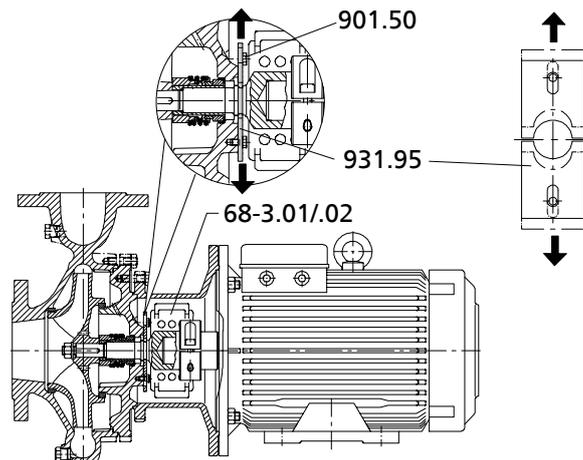
	 <b>DANGER</b>
	<p><b>Incorrect shaft connection</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▸ Connect the shafts between pump and motor as described in this manual.</li> </ul>


**Fig. 7: Mounting the motor shaft stub on the shaft**

1	Shaft slot	2	Keyway of the motor shaft end
3	Slot of the taper lock ring	4	Taper lock ring
5	Motor shaft	6	Shaft

✓ The notes and steps stated in (⇒ Section 7.5.1, Page 38) to (⇒ Section 7.5.4, Page 40) have been observed/carried out.

1. Fit motor shaft stub on shaft 210 and make sure that the keyway of the motor shaft end aligns with the slot in shaft 210 and that both are located opposite the slot of taper lock ring 515 (see illustration: Fitting the motor shaft stub on the shaft).
2. Tighten socket head cap screws 914.1. (⇒ Section 7.5.1, Page 38)
3. Unscrew hexagon head bolts 901.3.


**Fig. 8: Removing the lock washers**

901.3	Hexagon head bolts	931	Lock washer
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4. Pull both lock washers 550.5 out of the groove in shaft 210.
5. Tighten hexagon head bolts 901.3.
6. Insert screws 901.1 into motor flange and drive lantern 341.
7. Fit and tighten hexagon nuts 920.2.

## 7.6 Tightening torques

### 7.6.1 Tightening torques for the pump

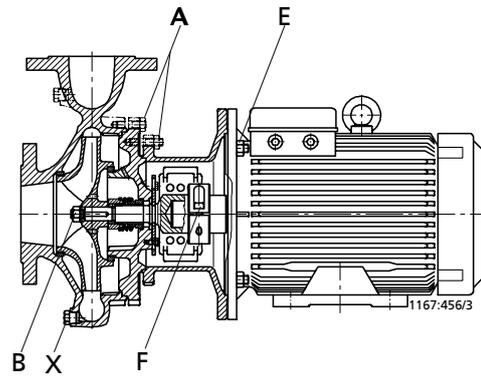


Fig. 9: Tightening points

Table 13: Tightening torques [NM] for bolted/screwed connections at the pump

Position	Thread	
A	M10	38
	M12	55
B	M10	38
	M12	55
	M16	130
C	M12 × 1,5	55
	M24 × 1,5	130
	M30 × 1,5	170
D	M6	21
	M8	28
	M10	53
E	M8	20
	M10	38
	M12	55
	M16	130
	M20	250

## 7.7 Spare parts stock

### 7.7.1 Ordering spare parts

Always quote the following data when ordering replacement or spare parts:

- Order number
- Order item number
- Consecutive number
- Type series
- Size
- Material variant
- Seal code
- Year of construction

Refer to the name plate for all data. (⇒ Section 4.3, Page 16)

Also specify the following data:

- Part number and description (⇒ Section 9.1, Page 46)
- Quantity of spare parts
- Shipping address
- Mode of dispatch (freight, mail, express freight, air freight)

#### 7.7.2 Recommended spare parts stock for 2 years' operation to DIN 24296

**Table 14:** Quantity of spare parts for recommended spare parts stock

Part No.	Description	Number of pumps (including stand-by pumps)						
		2	3	4	5	6 and 7	8 and 9	10 and more
210	Shaft	1	1	1	2	2	2	20 %
230	Impeller	1	1	1	2	2	2	20 %
400	Gasket	4	6	8	8	9	12	150 %
433	Mechanical seal	1	1	2	2	2	3	25 %
502.1	Casing wear ring	2	2	2	3	3	4	50 %

## 8 Trouble-shooting

	 <b>WARNING</b>
	<p><b>Improper work to remedy faults</b></p> <p>Risk of injury!</p> <p>▷ For any work performed to remedy faults, observe the relevant information given in this operating manual and/or in the product literature provided by the accessories manufacturer.</p>

If problems occur that are not described in the following table, consultation with the KSB customer service is required.

- A** Pump delivers insufficient flow rate
- B** Motor is overloaded
- C** Motor protection switch trips the pump
- D** Increased bearing temperature
- E** Leakage at the pump
- F** Excessive leakage at the shaft seal
- G** Vibrations during pump operation
- H** Impermissible temperature increase in the pump

**Table 15:** Trouble-shooting

A	B	C	D	E	F	G	H	Possible cause	Remedy <sup>5)</sup>
X	-	-	-	-	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point. Check system for impurities. Fit a larger impeller. <sup>6)</sup> Increase the speed (turbine, I.C. engine).
X	-	-	-	-	-	X	X	Pump and/or piping are not completely vented and/or primed.	Vent and/or prime.
X	-	-	-	-	-	-	-	Supply line or impeller clogged	Remove deposits in the pump and/or piping.
X	-	-	-	-	-	-	-	Formation of air pockets in the piping	Alter piping layout. Fit vent valve.
X	-	-	-	-	-	X	X	Suction lift is too high/NPSH <sub>available</sub> (positive suction head) is too low.	Check/alter fluid level. Fully open the shut-off element in the suction line. Change suction line, if the friction losses in the suction line are too high. Check any strainers installed/suction opening.
X	-	-	-	-	-	-	-	Wrong direction of rotation	Check the electrical connection of the motor and the control system if any.
X	-	-	-	-	-	X	-	Wear of internal components	Replace worn parts by new ones.
-	X	X	-	-	-	X	-	Pump back pressure is lower than specified in the purchase order	Re-adjust to duty point.
-	X	-	-	-	-	-	-	Density or viscosity of fluid handled higher than stated in purchase order	Contact the manufacturer.
-	-	-	-	X	-	-	-	Defective gasket	Fit new seal between volute casing and stuffing box housing.
-	-	-	-	-	X	-	-	Worn shaft seal	Fit new shaft seal.
-	-	-	-	-	X	-	-	Vibrations during pump operation	Correct the suction conditions. Increase the pressure at the pump suction nozzle.

5) Pump pressure must be released before attempting to remedy faults on parts which are subjected to pressure.

6) Contact KSB.

A	B	C	D	E	F	G	H	Possible cause	Remedy <sup>5)</sup>
-	-	-	✗	-	✗	✗	-	Pump is warped or sympathetic vibrations in the piping.	Check the piping connections and secure fixing of pump; if required, reduce distances between the pipe clamps. Fix the pipelines using anti-vibration material.
-	-	-	✗	-	-	-	-	Increased axial thrust <sup>6)</sup>	Clean balancing holes in the impeller. Replace the casing wear rings.
-	-	-	✗	-	-	✗	-	Insufficient or excessive quantity of lubricant or unsuitable lubricant.	Top up, reduce or change lubricant.
✗	✗	-	-	-	-	-	-	Motor is running on two phases only.	Replace the defective fuse. Check the electric cable connections.
-	-	-	-	-	-	✗	-	Rotor out of balance	Clean the impeller. Re-balance the impeller.
-	-	-	-	-	-	✗	-	Defective bearing(s)	Replace.
-	-	-	-	-	-	✗	✗	Flow rate is too low.	Increase the minimum flow rate.
-	-	✗	-	-	-	-	-	Incorrect setting of motor protection switch	Check setting. Fit new motor protection switch.
-	✗	✗	-	-	-	-	-	Transport lock has not been removed from the shaft groove.	Remove.

## 9 Related Documents

### 9.1 General assembly drawing with list of components

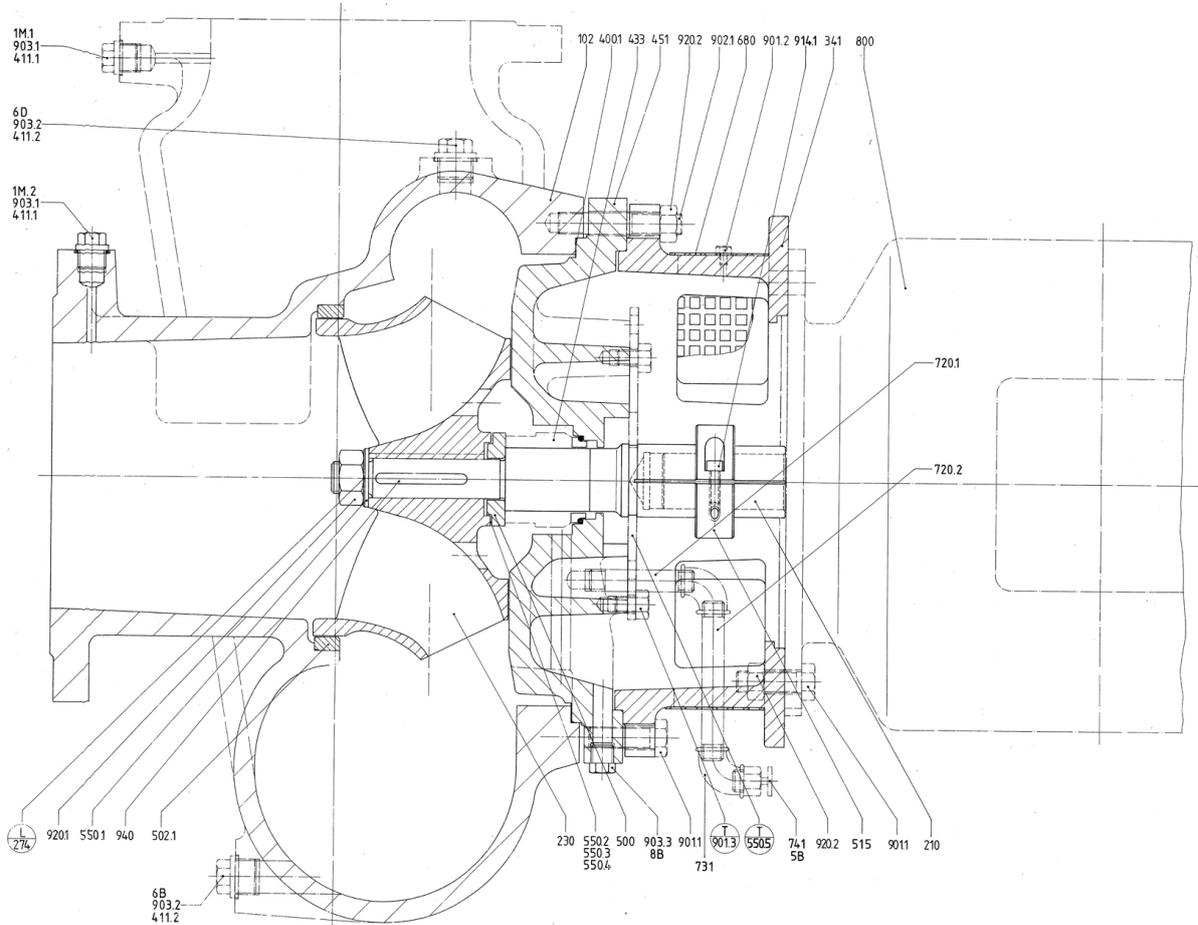


Fig. 10: General assembly drawing

= Secured with LOCTITE 274

= Transport lock for delivery without motor

Part No.	Designation	Part No.	Designation
102	Volute casing	680	Guard
210	Shaft	720.1/2	Fitting
230	Impeller	731	Pipe union
341	Drive lantern	741	Valve
400.1	Gasket	800	Motor
411.1/2	Joint ring	901.1-3	Hexagon head bolt
433	Mechanical seal	902.1	Stud
451	Stuffing box housing	903.1-3	Screwed plug
500	Ring	914.1	Socket head cap screw
502.1	Casing wear ring	920.1/2	Nut
515	Taper lock ring	940	Key
550.1-5	Disc		

1M.1/2	Connection for pressure gauge	G 1/2 <sup>7)</sup>
5B	Venting	
6B	Fluid drain	G 3/4 <sup>7)</sup>
6D	Fluid filling and venting	G 3/4 <sup>7)</sup>
8B	Leakage drain	G 3/8 <sup>7)</sup>

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7) G = ISO 228/1

## 10 EU Declaration of Conformity

Manufacturer: **KSB SE & Co. KGaA**  
**Johann-Klein-Straße 9**  
**67227 Frankenthal (Germany)**

The manufacturer herewith declares that the product:

### **Etabloc, Etabloc SYT, Etaline, Etaline SYT, Etaline Z, Etachrom B, Etachrom L, Etanorm, Etanorm SYT, Etanorm V, Etaprime L, Etaprime B, Vitachrom**

KSB order number: .....

- is in conformity with the provisions of the following Directives as amended from time to time:
  - Pump (set): Machinery Directive 2006/42/EC

The manufacturer also declares that

- the following harmonised international standards have been applied:
  - ISO 12100
  - EN 809

Person authorised to compile the technical file:

Name  
Function  
Address (company)  
Address (Street, No.)  
Address (post or ZIP code, city) (country)

The EU Declaration of Conformity was issued in/on:

Place, date

.....<sup>8)</sup>.....

Name  
Function  
Company  
Address

---

8) A signed, legally binding EU Declaration of Conformity is supplied with the product.

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