

# Centrifugal Pump with Volute Casing

Operating manual

MI / MA series



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# 1 About this document

This manual

- Is part of the pump
- Applies to all pump series listed
- Describes safe and appropriate operation during all operating phases

## 1.1 Target groups

Target group	Duty
Operating company	<ul style="list-style-type: none"> <li>► Keep this manual available at the operation site of the system, including for later use.</li> <li>► Ensure that personnel read and follow the instructions in this manual and the other applicable documents, especially all safety instructions and warnings.</li> <li>► Observe any additional rules and regulations referring to the system.</li> </ul>
Qualified personnel, fitter	<ul style="list-style-type: none"> <li>► Read, observe and follow this manual and the other applicable documents, especially all safety instructions and warnings.</li> </ul>




Tab. 1 Target groups and their duties

## 1.2 Other applicable documents



Document	Purpose
Order data sheet	Technical specifications, conditions of operation
Setup drawing	Setup dimensions, connection dimensions etc.
Technical description	Technical specifications, operating limits
Sectional drawing	Sectional drawing, part numbers, component designations
Automatic aspirator operating manual	Technical documentation
Supplier documentation	Technical documentation for parts supplied by subcontractors
Spare parts list	Ordering spare parts
Declaration of conformity	Conformity with standards

Tab. 2 Other applicable documents and their purpose

### 1.3 Warnings and symbols

Warning	Risk level	Consequences of disregard
 <b>DANGER</b>	Immediate acute risk	Death, grievous bodily harm
 <b>WARNING</b>	Potentially acute risk	Death, grievous bodily harm
 <b>CAUTION</b>	Potentially hazardous situation	Minor bodily harm
<b>CAUTION</b>	Potentially hazardous situation	Material damage

Tab. 3 Warnings and consequences of disregarding them

Symbol	Meaning
	Safety warning sign ► Take note of all information highlighted by the safety warning sign and follow the instructions to avoid injury or death.
►	Instruction
1. , 2. , ...	Multiple-step instructions
✓	Precondition
→	Cross-reference
	Information, advice


Tab. 4 Symbols and their meaning

### 1.4 Technical terms

Term	Meaning
Sealing medium	Medium for blocking or quenching shaft seals
Auxiliary systems	Systems for operating the pump

Tab. 5 Technical terms and their meaning

## 2 Safety

 The manufacturer does not accept any liability for damage resulting from disregard of the entire documentation.


### 2.1 Intended use

- Only use the pump for pumping the agreed pumped media (→ order data sheet).
- Adhere to the operating limits and size-dependent minimum flow rate.
- Avoid dry running:  
Initial damage, such as destruction of the mechanical seal and plastic parts, will occur within only a few seconds.
  - Make sure the pump is only operated with, and never without, a pumped medium.
- Avoid cavitation:
  - Fully open the suction-side fitting and do not use it to adjust the flow rate.
  - Do not open the pressure-side fitting beyond the agreed operating point.
- Avoid overheating:
  - Do not operate the pump while the pressure-side fitting is closed.
  - Observe the minimum flow rate (→ order data sheet).
- Avoid damage to the motor:
  - Do not open the pressure-side fitting beyond the agreed operating point.
  - Note the maximum permissible number of times the motor can be switched on per hour (→ manufacturer's specifications).
- Consult the manufacturer about any other use of the pump.

#### Prevention of obvious misuse (examples)

- Note the operating limits of the pump with regard to temperature, pressure, flow rate and motor speed (→ order data sheet).
- The power consumed by the pump increases with increasing density of the pumped medium. To avoid overloading the pump, coupling or motor, stay within the agreed density (→ order data sheet).  
Lower densities are allowed. Adapt the auxiliary systems accordingly.
- When pumping liquids containing solids, ensure the limits for the proportion of solids and the grain size are maintained (→ order data sheet, technical description).
- When using auxiliary systems, ensure there is a continuous supply of the appropriate operating medium.

### 2.2 General safety instructions

 Take note of the following regulations before carrying out any work.

#### 2.2.1 Product safety

The pump has been constructed according to the latest technology and recognized technical safety rules. Nevertheless, operation of the pump can still put the life and health of the user or third parties at risk or damage the pump or other property.

- Only operate the pump if it is in perfect technical condition and only use it as intended, staying aware of safety and risks, and in adherence to the instructions in this manual.
- Keep this manual and all other applicable documents complete, legible and accessible to personnel at all times.
- Refrain from any procedures and actions that would pose a risk to personnel or third parties.
- In the event of any safety-relevant faults, shut down the pump immediately and have the fault corrected by appropriate personnel.
- In addition to the entire documentation for the product, comply with statutory or other safety and accident-prevention regulations and the applicable standards and guidelines in the country where the pump is operated.

### 2.2.2 Operator's obligations

#### Safety-conscious operation

- Only operate the pump if it is in perfect technical condition and only use it as intended, staying aware of safety and risks, and in adherence to the instructions in this manual.
- Ensure that the following safety aspects are observed and monitored:
  - Adherence to intended use
  - Statutory or other safety and accident-prevention regulations
  - Safety regulations governing the handling of hazardous substances
  - Applicable standards and guidelines in the country where the pump is operated
- Make protective equipment available.

#### Qualified personnel

- Make sure all personnel tasked with work on the pump have read and understood this manual and all other applicable documents, especially the safety, maintenance and repair information, before they start any work.
- Organize responsibilities, areas of competence and the supervision of personnel.
- Ensure that all work is carried out by specialist technicians only:
  - Fitting, repair and maintenance work
  - Work on the electrical system
- Make sure trainee personnel only work on the pump under supervision of specialist technicians.

#### Safety equipment

- Provide the following safety equipment and verify its functionality:
  - For hot, cold and moving parts: safety guarding provided by the customer for the pump
  - For potential build up of electrostatic charge: ensure appropriate grounding.

#### Warranty

- Obtain the manufacturer's approval prior to carrying out any modifications, repairs or alterations during the warranty period.
- Only use genuine parts or parts that have been approved by the manufacturer.

### 2.2.3 Obligations of personnel

- All directions given on the pump must be followed (and kept legible), e.g. the arrow indicating the direction of rotation and the markings for fluid connections.
- Do not remove the safety guarding for hot, cold or moving parts during operation.
- Use protective equipment whenever necessary.
- Only carry out work on the pump while it is not running.
- Isolate the motor from its supply voltage and keep it locked in that state when carrying out any fitting or maintenance work.
- Reinstall the safety equipment on the pump as required by regulations after any work on the pump.

## 2.3 Specific hazards

### 2.3.1 Hazardous pumped media

- Follow the safety regulations for handling hazardous substances when pumping hazardous media (e.g. hot, flammable, poisonous or potentially harmful).
- Use protective equipment when carrying out any work on the pump.



## 3 Layout and function

### 3.1 Labels

#### 3.1.1 Type plate

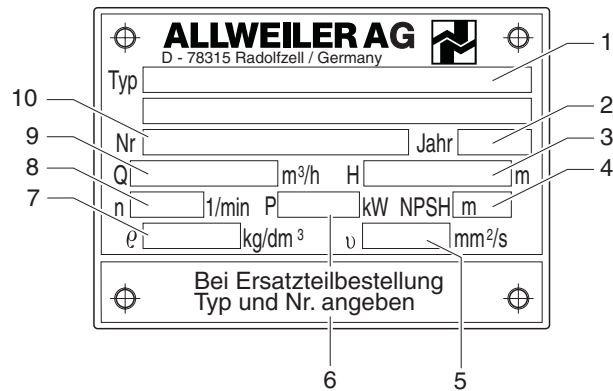


Fig. 1 Type plate (example)

- 1 Pump type
- 2 Year of manufacture
- 3 Differential head
- 4 Pump NPSH value
- 5 Kinematic viscosity
- 6 Power consumption
- 7 Density
- 8 Motor speed
- 9 Flow rate
- 10 Pump number

#### 3.1.2 Pump type code

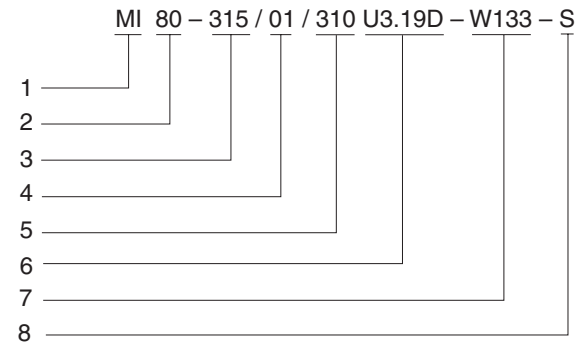


Fig. 2 Pump type code (example)

- 1 Series (MI or MA)
- 2 Pressure flange DN [mm]
- 3 Nominal impeller diameter [mm]
- 4 Hydraulic number
- 5 Actual impeller diameter [mm]
- 6 Shaft seal
- 7 Material key
- 8 Installation type (S = pedestal, W = wall)

## 3.2 Layout

### 3.2.1 MI series (radial ingress)

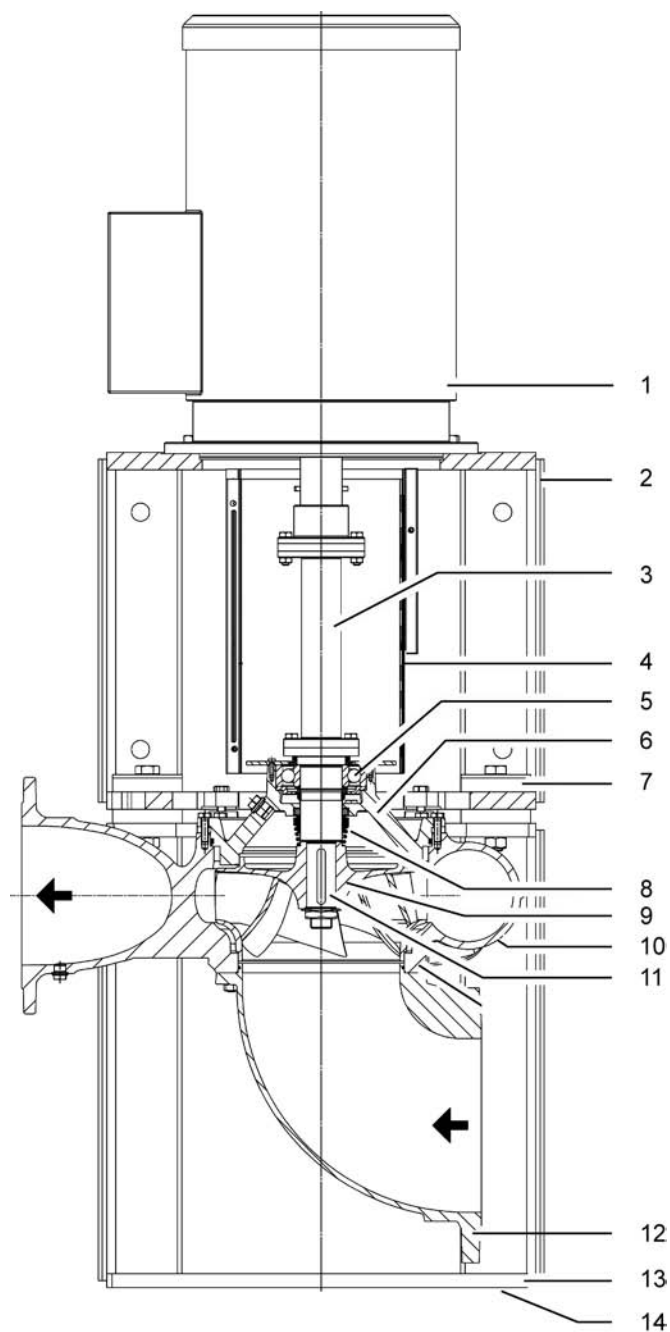


Fig. 3 MI series structure

- |                              |                  |                                |
|------------------------------|------------------|--------------------------------|
| 1 Flanged motor              | 6 Housing cover  | 11 Shaft                       |
| 2 Motor bell housing         | 7 Buffer         | 12 Vacuum flange               |
| 3 Coupling with spacer piece | 8 Shaft seal     | 13 Foot                        |
| 4 Coupling guard             | 9 Impeller       | 14 Earth connection (optional) |
| 5 Storage                    | 10 Volute casing |                                |

### 3.2.2 MA series (axial ingress)

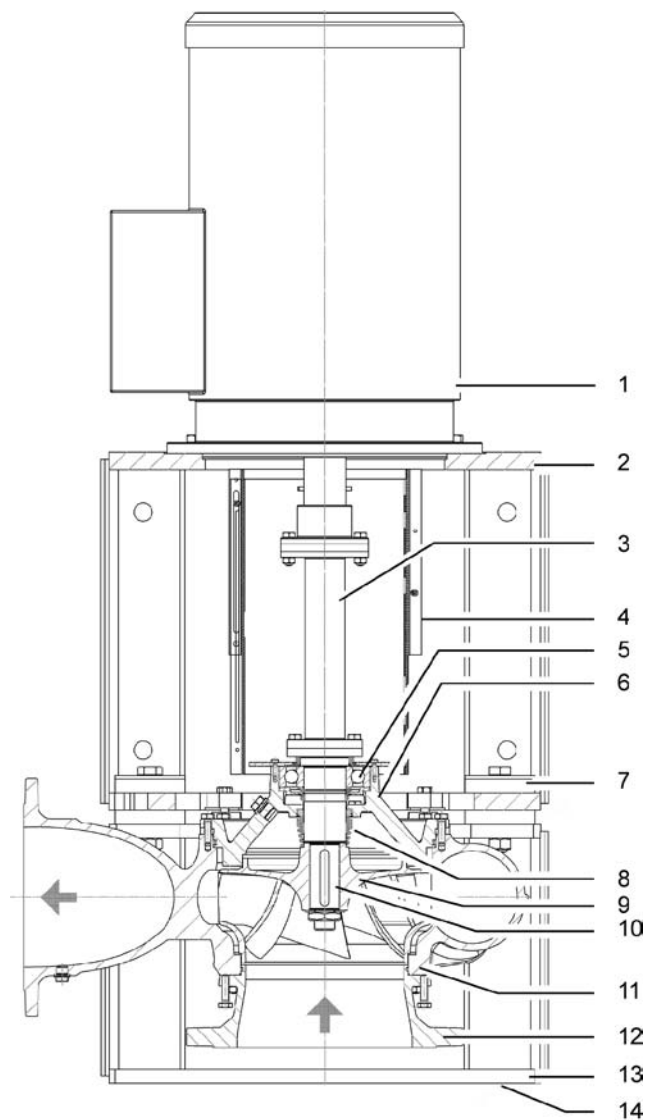



Fig. 4 MA series structure

- |                              |                  |                                |
|------------------------------|------------------|--------------------------------|
| 1 Flanged motor              | 6 Housing cover  | 11 Shaft                       |
| 2 Motor bell housing         | 7 Buffer         | 12 Vacuum flange               |
| 3 Coupling with spacer piece | 8 Shaft seal     | 13 Foot                        |
| 4 Coupling guard             | 9 Impeller       | 14 Earth connection (optional) |
| 5 Storage                    | 10 Volute casing |                                |

## 3.3 Shaft seals


### 3.3.1 Mechanical seals

 Mechanical seals have functional leaks.

- Single mechanical seal

### 3.4 Auxiliary systems

#### 3.4.1 Automatic aspirator (if available)

 Information on the material, functional description and electrical connection (→ A25A automatic aspirator operating manual).

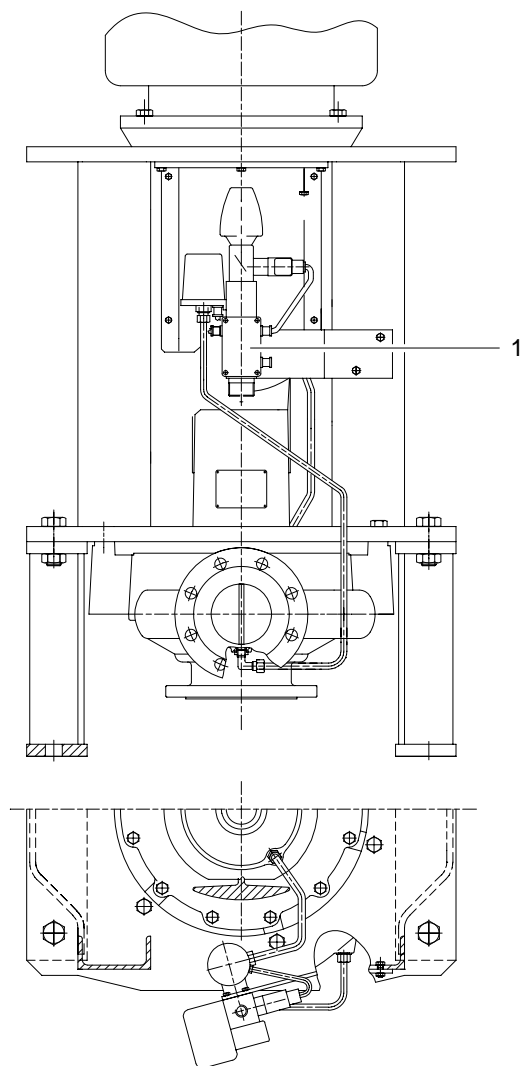


Fig. 5 Automatic aspirator – extension example


1 Automatic aspirator

The maintenance-free A25A automatic aspirator:

- Used for automatic bleeding of pumps and suction pipes
- Operates according to the ejector principle with pressure-dependent control
- Suitable for clean, chemically neutral water

## 4 Transport, storage and disposal

### 4.1 Transport

 For details of weight (→ documents for the particular order).

Transport the pump unit lying down.

#### 4.1.1 Unpacking and inspection on delivery

1. Unpack the pump/aggregate on delivery and inspect it for damage.
2. Report any damage to the manufacturer immediately.
3. Dispose of packaging material according to local regulations.

#### 4.1.2 Lifting

### DANGER

**Death or crushing of limbs caused by falling or overturning loads!**

- ▶ Use lifting gear appropriate for the total weight to be transported.
- ▶ Fasten the lifting gear as illustrated in the following.
- ▶ Attach the safety rope to the motor or motor lug to prevent the pump from overturning.
- ▶ Do not stand under suspended loads.
- ▶ Set the load down on a level surface.

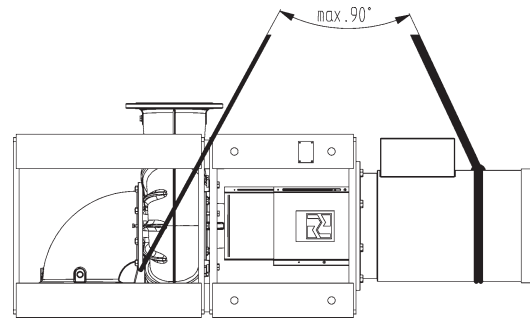


Fig. 7 Fastening the lifting gear to the pump unit in a horizontal position

- ▶ Lift the pump/aggregate properly.

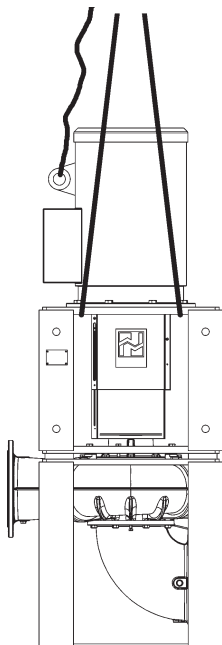



Fig. 6 Fastening the lifting gear to the pump unit in a vertical position

## 4.2 Preservation

 Not necessary for non-rusting materials

### CAUTION

**Material damage due to inappropriate treatment for storage!**

- ▶ Treat the pump properly, inside and outside, for storage.
1. Choose a preservative appropriate for the type and duration of storage (→ 9.2.5 Preservatives, Page 32).
  2. Use the preservative specified by the manufacturer.
  3. All bare metal parts should be treated, inside and outside.


## 4.3 Storage

### CAUTION

**Material damage due to inappropriate storage!**

- ▶ Treat and store the pump properly.
1. Seal all openings with blind flanges, blind plugs or plastic covers.
  2. Make sure the storage room meets the following conditions:
    - Dry
    - Dust-free
    - Frost-free
    - Vibration-free
  3. Turn the shaft once a month.
  4. Make sure the shaft and bearing change their rotational position in the process.

## 4.4 Removing the preservative

 Only necessary for pumps treated with preservative

### WARNING

**Risk of poisoning from preservatives and cleaning agents in the foodstuffs and drinking water sector!**

- ▶ Only use cleaning agents which are compatible with the pumped liquid (→ 9.2.4 Cleaning agents, Page 32).
- ▶ Completely remove all preservative.

### CAUTION

**High water pressure or spray water can damage bearings!**


- ▶ Do not clean the bearing areas with a water or steam jet.

### CAUTION

**Damage to seals due to incorrect cleaning agent!**


- ▶ Ensure the cleaning agent does not corrode the seals.

1. Choose a suitable cleaning agent for the application. (→ 9.2.4 Cleaning agents, Page 32).

 With Tectyl 506 EH: allow benzine to soak in for 10 minutes (recommended).

2. Dispose of preservatives according to local regulations.
3. For storage times in excess of 6 months:
  - Replace the elastomer parts made of EP rubber (EPDM).
  - Check all elastomer parts (O-rings, shaft seals) for proper elasticity and replace them if necessary.

## 4.5 Disposal

 Plastic parts can be contaminated by poisonous or radioactive pumped media to such an extent that cleaning is insufficient.

### WARNING

**Risk of poisoning and environmental damage caused by pumped medium or oil!**

- ▶ Use protective equipment when carrying out any work on the pump.
- ▶ Prior to disposal of the pump:
  - Catch and dispose of any escaping pumped medium or oil in accordance with local regulations.
  - Neutralize residues of pumped medium in the pump.
  - Remove any preservative (→ 4.4 Removing the preservative, Page 14).
- ▶ Remove and dispose of any plastic parts in accordance with local regulations.

- ▶ Dispose of the pump in accordance with local regulations.

## 5 Setup and connection

### CAUTION

#### Material damage caused by dirt!

- ▶ Do not remove any covers and transport and sealing covers until immediately before connecting the piping to the pump.
- ▶ Do not remove the transport seals until immediately before setting up the pump.

### 5.1 Preparing the setup

#### 5.1.1 Checking the ambient conditions

- ▶ Make sure the required ambient conditions are fulfilled (→ 9.2.1 Ambient conditions, Page 31).


#### 5.1.2 Preparing the installation site

- ▶ Ensure the installation site meets the following conditions:
  - Pump is freely accessible from all sides
  - Sufficient space for installation/removal of the pipes and for maintenance and repair work, especially for the removal and installation of the pump and the motor
  - Pump not exposed to external vibrations (damage to bearings)
  - Frost protection

#### 5.1.3 Removing the preservative

- ▶ If the pump is to be put into operation immediately after setup and connection: remove the preservative prior to setup (→ 4.4 Removing the preservative, Page 14).

#### 5.1.4 Installing the heat insulation

-  Only necessary to maintain the temperature of the pumped medium

### CAUTION


#### Material damage caused by overheating!

- ▶ Only install the heat insulation on the volute casing.
- ▶ Install the heat insulation properly.

#### 5.1.5 Fastening the pump

1. Remove any transport seals.
2. Install and fasten the pump (→ installation drawing):
  - Base installation: screw the feet to the floor.
  - Wall attachment: screw the motor bell housing to the wall.

### 5.2 Installing the motor

-  Only necessary if the pump aggregate is assembled on site.

### CAUTION

#### Material damage caused by knocks and bumps!

- ▶ Keep the coupling halves properly aligned when slipping them on.
- ▶ Do not knock or hit any components of the pump.

#### 5.2.1 Attach the motor to the pump.

1. Lift the motor (→ manufacturer's specifications).
2. Place the motor on the bell housing.
3. Screw in the motor bolts and tighten them.

#### 5.2.2 Fit the coupling

1. Smear a very thin coat of molybdenum disulfide (e.g. Molykote) on the shaft end of the motor.
2. Insert shaft key.
3. Push on the motor-end half of the coupling and slightly tighten the grub screw.
4. Fit the spacer and screw it to the pump shaft end.
5. Install the membrane package without tension. Position the coupling hub. Use the distance specified by the coupling manufacturer.
6. Tighten the grub screw on the coupling half.
7. Fit the coupling guard.

### 5.3 Planning the piping


#### 5.3.1 Specifying supports and flange connections

### CAUTION

#### Material damage due to excessive forces and torques exerted by the piping on the pump!

- ▶ Do not exceed the permissible limits (→ 9.2.6 Flange loads, Page 33).
1. Calculate the pipe forces taking every possible operating condition into account:
    - Cold/warm
    - Empty/full
    - Unpressurized/pressurized
    - Shift in position of flanges
  2. Ensure the pipe supports have permanent low-friction properties and do not seize up due to corrosion.

### 5.3.2 Specifying nominal diameters

 Keep the flow resistance in the pipes as low as possible.

1. Specify the nominal suction pipe diameter  $\geq$  nominal suction flange diameter.
2. Specify the nominal pressure pipe diameter  $\geq$  nominal pressure flange diameter.

### 5.3.3 Specifying pipe lengths

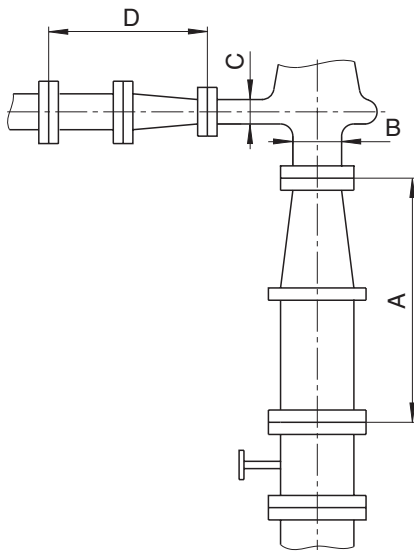



Fig. 8 Straight pipe lengths upstream and downstream of the pump (recommended)

- A > 5 x nominal suction pipe diameter
- B Nominal suction pipe diameter
- C Nominal pressure pipe diameter
- D > 5 x nominal pressure pipe diameter

- Maintain the recommended minimum values when installing the pump.

 Suction side: shorter pipes are possible but may restrict the hydraulic performance.  
Pressure side: shorter pipes are possible but can result in increased operating noise.

### 5.3.4 Optimizing cross-section and direction changes

1. Avoid radii of curvature of less than 1.5 times the nominal pipe diameter.
2. Avoid abrupt changes of cross-section along the piping system.

### 5.3.5 Provide safety and control devices (recommended)

#### Avoid impurities

1. Integrate a filter into the suction pipe.
2. To monitor impurities, install a differential pressure gauge with a contact manometer.


#### Avoid reverse running

- Install a non-return valve between the pressure flange and the gate valve to ensure the medium does not flow back when the pump is switched off.

#### Avoid running empty

1. For suction operation: install a foot valve in the suction pipe to prevent the pump and suction pipe from running empty during downtimes.
2. Use a suction strainer, depending on the solids content of the pumped fluid.

#### Make provisions for isolating and shutting off the pipes

 For maintenance and repair work.

- Provide shut-off devices in the suction and pressure pipes.

#### Allow the measurement of the operating conditions

1. Provide manometers for pressure measurements in suction and pressure pipes.
2. Provide for motor-side torque measurements.
3. Provide for pump-side temperature measurements.



## 5.4 Connecting the pipes

### 5.4.1 Keeping the piping clean


#### CAUTION

##### Material damage due to impurities in the pump!

- ▶ Make sure no impurities can get into the pump.

1. Clean all piping parts and armatures prior to assembly.
2. Ensure no flange seals protrude inwards.
3. Remove any blind flanges, plugs, protective foils and/or protective paint from flanges.

### 5.4.2 Installing auxiliary pipes (if available)

-  Follow the manufacturers' specifications for any existing auxiliary systems.

1. Connect the auxiliary pipes to the auxiliary connections so that they are stress-free and do not leak (→ setup drawing).
2. To avoid air pockets, run the pipes with a continuous slope up to the pump.

### 5.4.3 Installing the suction pipe

1. Remove the transport and sealing covers from the pump.
2. To avoid air pockets, run the pipes with a continuous slope up to the pump.
3. Ensure no seals protrude inwards.

### 5.4.4 Installing the pressure pipe

1. Remove the transport and sealing covers from the pump.
2. Install the pressure pipe.
3. Ensure no seals protrude inwards.

### 5.4.5 Inspection for stress-free pipe connections

- ✓ Piping installed and cooled down
1. Separate the pipe connecting flanges from the pump.
  2. Check whether the pipes can be moved freely in all directions within the expected range of expansion:
    - Nominal diameter < 150 mm: by hand
    - Nominal diameter > 150 mm: with small lever
  3. Make sure the flange surfaces are parallel.
  4. Reconnect the pipe connecting flanges to the pump.


## 5.5 Electrical connection

#### DANGER

##### Risk of death due to electric shock!

- ▶ Have all electrical work carried out by qualified electricians only.
- ▶ Isolate the motor from its supply voltage and secure it against being switched back on again before working on the electrical system.

### 5.5.1 Connecting the motor

-  Follow the instructions of the motor manufacturer.

1. Connect the motor according to the connection diagram.
2. Make sure that no danger arises due to electrical energy.
3. Install an EMERGENCY STOP switch.

### 5.5.2 Checking the direction of rotation

#### DANGER

##### Risk of death due to rotating parts!

- ▶ Use protective equipment when carrying out any work on the pump.
- ▶ Secure the shaft key from being thrown out when checking the direction of rotation.
- ▶ Keep an adequate distance to rotating parts.

#### CAUTION

##### Material damage caused by running dry or wrong direction of rotation!

- ▶ Uncouple the motor from the pump.
1. Switch the motor on and immediately off again.
  2. Check whether the direction of rotation of the motor corresponds to the rotational direction arrow on the pump.
  3. If the direction of rotation is different:
    - swap two phases (→ 5.5.1 Connecting the motor, Page 17).
  4. Couple the motor to the pump again.
  5. Fit the coupling guard again.

## 6 Operation

### 6.1 Preparations for the initial start-up

#### 6.1.1 Identifying the pump type

- ▶ Identify the pump type (→ order data sheet).



Pump types vary e.g. with regard to bearing lubrication, bearing bracket size, type of shaft seal and auxiliary systems.

#### 6.1.2 Removing the preservative



Only necessary for pumps treated with preservative

- ▶ (→ 4.4 Removing the preservative , Page 14).

#### 6.1.3 Lubricating the bearings



Pumps with grease-lubricated roller bearings are ready for operation upon delivery.

#### 6.1.4 Filling and bleeding

#### **WARNING**

**Risk of injury and poisoning due to hazardous pumped media!**

- ▶ Safely collect any leaking pumped medium and dispose of it in accordance with environmental rules and requirements.

#### **CAUTION**

**Material damage caused by dry running!**

- ▶ Make sure the pump is filled properly.

#### **Without an automatic aspirator**

1. Open the suction-side armature.
2. Open the pressure-side armature.
3. Fill the pump and the suction pipe with pumped medium.
4. Verify that no pipe connections are leaking.

#### **With an automatic aspirator**

1. Open the suction-side armature.
2. Close the pressure-side armature.
3. Suction operation (→ A25A automatic aspirator operating manual).
4. Verify that no pipe connections are leaking.

### 6.2 Start-up

#### 6.2.1 Switching on

- ✓ Pump set up and connected properly
- ✓ Motor set up and connected properly
- ✓ All connections stress-free and sealed
- ✓ All safety equipment installed and tested for functionality
- ✓ Pump prepared, filled and bled properly

#### **DANGER**

**Risk of injury due to running pump!**

- ▶ Do not touch the running pump.
- ▶ Do not carry out any work on the running pump.
- ▶ Allow the pump to cool down completely before starting any work.

#### **DANGER**

**Risk of injury and poisoning caused by pumped medium spraying out!**

- ▶ Use protective equipment when carrying out any work on the pump.

#### **CAUTION**

**Material damage caused by dry running!**

- ▶ Make sure the pump is filled properly.

#### **CAUTION**

**Risk of cavitation when throttling down the suction flow rate!**

- ▶ Fully open the suction-side armature and do not use it to adjust the flow rate.
- ▶ Do not open the pressure-side armature beyond the operating point.

#### **CAUTION**

**Material damage caused by overheating!**

- ▶ Do not operate the pump while the pressure-side armature is closed.
- ▶ Observe the minimum flow rate (→ order data sheet).

1. Open the suction-side armature.
2. Close the pressure-side armature.
3. Switch on the motor and check it for smooth running.
4. Once the motor has reached its nominal speed, slowly open the pressure-side armature until the operating point is reached.
5. Make sure any temperature changes at pumps with hot pumped liquids are below 50 K/h.

6. After the initial stress caused by pressure and operating temperature, check that the pump is not leaking.

### 6.2.2 Switching off

- ✓ Pressure-side armature closed (recommended)

#### **WARNING**

##### **Risk of injury due to hot pump parts!**

- Use protective equipment when carrying out any work on the pump.

1. Switch off the motor.
2. Check all connecting bolts and tighten them if necessary.

## 6.3 Shutting down

#### **WARNING**

##### **Risk of injury and poisoning due to hazardous pumped media!**

- Safely collect any leaking pumped medium and dispose of it in accordance with environmental rules and requirements.

- Take the following measures whenever the pump is shut down:

Pump is	Measure
...shut down for a prolonged period	► Take measures according to the pumped liquid (→ Table 7 Measures depending on the behavior of the pumped medium, Page 19).
...emptied	► Close the suction-side and pressure-side armatures.
...dismounted	► Isolate the motor from its power supply and secure it against unauthorized switch-on.
...put into storage	► Follow the storage instructions (→ 4.3 Storage, Page 14).

Tab. 6 Measures to be taken if the pump is shut down

Behavior of pumped medium	Duration of shutdown (depending on process)	
	Short	Long
Solids sediment	► Flush the pump.	► Flush the pump.
Solidifies/ freezes, non-corrosive	► Heat up or empty the pump and containers.	► Empty the pump and containers.
Solidifies/ freezes, corrosive	► Heat up or empty the pump and containers.	► Empty the pump and containers. ► Treat the pump and containers with preservative.
Remains liquid, non-corrosive	–	–
Remains liquid, corrosive	–	► Empty the pump and containers. ► Treat the pump and containers with preservative.

Tab. 7 Measures depending on the behavior of the pumped medium

## 6.4 Start-up following a shutdown period

1. If the pump is shut down for more than 2 years, take the following measures before restoring it to service:


Shutdown period	Measure
> 2 years	<ul style="list-style-type: none"><li>▶ Replace elastomer seals (O-rings, shaft sealing rings).</li><li>▶ Replace antifriction bearings.</li></ul>

Tab. 8 Measures to be taken after prolonged shutdown periods

2. Carry out all steps as for the initial start-up (→ 6.2 Start-up, Page 18).


## 6.5 Operating the stand-by pump

- ✓ Stand-by pump filled and bled


 Operate the stand-by pump at least once a week.

1. Completely open the suction-side armature.
2. Open the pressure-side armature to an extent that the stand-by pump reaches its operating temperature and is heated through evenly (→ 6.2.1 Switching on, Page 18).

## 7 Maintenance

 Trained service technicians are available for fitting and repair jobs. Present a pumped medium certificate (DIN safety data sheet or safety certificate) when requesting service.

### 7.1 Inspections

 The inspection intervals depend on the operational strain on the pump.

#### **DANGER**

##### **Risk of injury due to running pump!**


- ▶ Do not touch the running pump.
- ▶ Do not carry out any work on the running pump.

#### **WARNING**


##### **Risk of injury and poisoning due to hazardous pumped media!**

- ▶ Use protective equipment when carrying out any work on the pump.
1. Check at appropriate intervals:
    - Maintenance of minimum flow rate
    - Temperature of roller bearings < 120 °C
    - Normal operating conditions unchanged
    - Coupling alignment and condition of elastic parts
  2. For trouble-free operation, always ensure the following:
    - No dry running
    - No leaks
    - No cavitation
    - Suction-side gate valves open
    - Unobstructed and clean filters
    - Sufficient supply pressure
    - No unusual running noises or vibrations
    - No excessive leakage at the shaft seal
    - Proper functioning of auxiliary systems
    - Put the installed stand-by pump into operation at least once a week

### 7.2 Maintenance

 Service life of the antifriction bearings for operation within the permissible operating range: > 2 years

Intermittent operation, high temperatures, low viscosities and aggressive ambient and process conditions reduce the service life of antifriction bearings.

 Mechanical seals are subject to natural wear, which strongly depends on the actual operating conditions. Therefore, general statements regarding their service life cannot be made.

#### **DANGER**

##### **Risk of injury due to running pump!**

- ▶ Do not touch the running pump.
- ▶ Do not carry out any work on the running pump.
- ▶ Isolate the motor from its supply voltage and keep it locked in that state when carrying out any fitting or maintenance work.

#### **DANGER**

##### **Risk of death due to electric shock!**

- ▶ Have all electrical work carried out by qualified electricians only.

#### **WARNING**


##### **Risk of injury and poisoning due to hazardous or hot pumped media!**

- ▶ Use protective equipment when carrying out any work on the pump.
- ▶ Allow the pump to cool down completely before commencing any work.
- ▶ Make sure the pump is unpressurized.
- ▶ Empty the pump, safely collect the pumped medium and dispose of the medium in accordance with environmental rules and requirements.

#### 7.2.1 Antifriction bearings lubricated with grease

- ▶ As a precaution, replace antifriction bearings with lifetime lubrication every 2 years (recommended).

#### 7.2.2 Mechanical seals

 Due to their function, mechanical seals always leak a bit (→ manufacturer's specifications).

- ▶ In the event of a larger leak: replace the mechanical seal and its auxiliary seals.

## 7.3 Dismounting

### DANGER

#### Risk of injury due to running pump!

- ▶ Do not touch the running pump.
- ▶ Do not carry out any work on the running pump.
- ▶ Isolate the motor from its supply voltage and keep it locked in that state when carrying out any fitting or maintenance work.

### DANGER

#### Risk of death due to electric shock!

- ▶ Have all electrical work carried out by qualified electricians only.


### WARNING

#### Risk of injury and poisoning due to hazardous or hot pumped media!

- ▶ Use protective equipment when carrying out any work on the pump.
- ▶ Allow the pump to cool down completely before commencing any work.
- ▶ Make sure the pump is unpressurized.
- ▶ Empty the pump, safely collect the pumped medium and dispose of the medium in accordance with environmental rules and requirements.

#### 7.3.1 Preparations for dismounting

- ✓ Pump unpressurized
- ✓ Pump completely empty, flushed and decontaminated
- ✓ Electrical connections isolated and motor secured against switch-on
- ✓ Pump cooled down
- ✓ Coupling guard dismantled
- ✓ With couplings with a spacer piece: spacer piece removed
- ✓ Auxiliary systems shut down, unpressurized and emptied
- ✓ Auxiliary piping, manometer lines, manometer and fixtures dismantled

 In production, the pumps are constructed to a standard process. The slide-in unit can be removed without removing the motor, volute casing or piping.

- ▶ When dismantling, observe the following:
  - Precisely mark the assembly orientation and position of all components before dismantling.
  - Dismantle components concentrically without canting.
  - Dismount the pump (→ sectional drawing).


#### 7.3.2 Returning the pump to the manufacturer

- ✓ Pump unpressurized
  - ✓ Pump completely empty
  - ✓ Electrical connections isolated and motor secured against switch-on
  - ✓ Pump cooled down
  - ✓ Coupling guard dismantled
  - ✓ With couplings with a spacer piece: spacer piece removed
  - ✓ Auxiliary systems shut down, unpressurized and emptied
  - ✓ Manometer connections, manometer and fixtures dismantled
1. Enclose a truthfully (fully) completed document of compliance when returning pumps or individual parts to the manufacturer (→ 9.4 Safety certificate, Page 35).
  2. Take necessary measures, depending on the required repair work, as listed in the table below when returning the pump to the manufacturer.

Repair carried out	Measure for return
...at the customer's premises	▶ Return the defective component to the manufacturer.
...at the manufacturer's premises	▶ Flush the pump and decontaminate it if it was used to pump hazardous media. ▶ Return the complete pump (not disassembled) to the manufacturer.
...at the manufacturer's premises for warranty repairs	▶ Only if the pumped media is hazardous: flush and decontaminate the pump. ▶ Return the complete pump (not disassembled) to the manufacturer.


Tab. 9 Measures for return

## 7.4 Installing

 Reinstall the components concentrically, without canting, following the markings made.

1. When installing, observe the following:
  - Replace worn parts with genuine spare parts.
  - Replace seals, inserting them so that they cannot rotate.
  - Maintain the specified tightening torques (→ 9.2.3 Tightening torques, Page 32).
2. Clean all parts (→ 9.2.4 Cleaning agents, Page 32). Do not remove the prepared markings.
3. Install the pump (→ sectional drawing).
4. Replace the antifriction bearings.
5. Install the pump in the system (→ 5 Setup and connection, Page 15).

## 7.5 Ordering spare parts

 For trouble-free replacement in the event of any faults, we recommend keeping complete slide-in units or spare pumps available on site.

The application guidelines conforming to DIN 24296 recommend provisioning for two years of continuous use (→ 9.3 Spare parts for two years of continuous operation according to DIN 24296, Page 34).

- Have the following information ready to hand when ordering spare parts (→ type plate):
- Pump type
  - Pump number
  - Year of manufacture
  - Part number
  - Designation
  - Quantity

## 8 Troubleshooting

For faults which are not specified in the following table or cannot be traced back to the specified causes, please consult the manufacturer.

Possible faults are identified by a fault number in the table below. This number identifies the respective cause and remedy in the troubleshooting list.

Fault	Number
Pump not pumping	1
Pumping rate insufficient	2
Pumping rate excessive	3
Pumping pressure insufficient	4
Pumping pressure excessive	5
Pump running roughly	6
Antifriction bearing temperatures too high	7
Pump leaking	8
Motor power uptake excessive	9

Tab. 10 Fault number assignment

Fault number									Cause	Remedy
1	2	3	4	5	6	7	8	9		
X	–	–	–	–	–	–	–	–	Supply/suction pipe and/or pressure pipe closed by armature	► Open the armature.
X	–	–	–	–	–	–	–	–	Automatic aspirator defective	► (→ A25 automatic aspirator operating manual).
X	–	–	–	–	–	–	–	–	Transport and sealing cover still in place	► Remove the transport and sealing cover. ► Dismount the pump and inspect it for dry-running damage.
X	–	–	–	–	X	–	–	–	Supply/suction pipe not bled properly or not filled up completely	► Fill up the pump and/or piping completely and bleed them.
X	–	–	–	–	X	–	–	–	Supply/suction pipe contains air pockets	► Install the armature for bleeding. ► Correct the piping layout.
X	X	–	X	–	–	–	–	–	Motor speed insufficient	► Compare the required motor speed with the specifications on the pump type plate. Replace the motor if necessary. ► Increase the motor speed if speed control is available.
X	X	–	X	–	X	–	–	–	Supply/suction pipe, pump or suction screen blocked or encrusted	► Clean the supply/suction pipe, pump or suction screen.
X	X	–	X	–	X	–	–	–	Air is sucked in	► Seal the source of malfunction.
X	X	–	X	–	X	–	–	–	Excessive amount of gas: pump is cavitating	► Consult the manufacturer.
X	X	–	–	X	X	–	–	–	Pressure pipe blocked	► Clean the pressure pipe.
X	X	–	X	–	X	–	–	–	Pump running in the wrong direction	► Swap any two phases on the motor.



Fault number									Cause	Remedy
1	2	3	4	5	6	7	8	9		
X	X	–	X	–	X	–	–	–	Impeller out of balance or blocked	<ul style="list-style-type: none"> <li>► Dismount the pump and inspect it for dry-running damage.</li> <li>► Clean the impeller.</li> </ul>
–	X	–	X	–	–	–	–	–	Supply/suction pipe not fully opened	<ul style="list-style-type: none"> <li>► Open the armature.</li> </ul>
–	X	–	X	–	–	–	–	–	Geodetic differential head and/or pipe flow resistances too high	<ul style="list-style-type: none"> <li>► Remove sediments from the pump and/or pressure pipe.</li> <li>► Install a larger impeller and consult the manufacturer.</li> </ul>
–	X	–	X	–	X	–	–	–	Supply/suction pipe cross-section too narrow	<ul style="list-style-type: none"> <li>► Increase the cross-section.</li> <li>► Remove any encrustations from the suction pipe.</li> <li>► Open the armature completely.</li> </ul>
–	X	–	X	–	X	–	–	–	Hydraulic parts of the pump dirty, clotted or encrusted	<ul style="list-style-type: none"> <li>► Dismount the pump.</li> <li>► Clean the parts.</li> </ul>
–	X	–	X	–	X	–	–	–	Differential head excessive: $NPSH_{\text{pump}}$ larger than $NPSH_{\text{system}}$	<ul style="list-style-type: none"> <li>► Increase the supply pressure.</li> <li>► Consult the manufacturer.</li> </ul>
–	X	–	X	–	X	–	–	–	Pumped medium temperature too high: pump is cavitating	<ul style="list-style-type: none"> <li>► Increase the supply pressure.</li> <li>► Lower the temperature.</li> <li>► Consult the manufacturer.</li> </ul>
–	X	–	X	–	–	–	–	X	Viscosity or specific gravity of the pumped medium outside the range specified for the pump	<ul style="list-style-type: none"> <li>► Consult the manufacturer.</li> </ul>
–	X	–	–	X	X	–	–	–	Pressure-side armature not opened sufficiently	<ul style="list-style-type: none"> <li>► Open the pressure-side armature.</li> </ul>
–	X	–	X	–	X	X	–	–	Pump parts worn	<ul style="list-style-type: none"> <li>► Replace the worn pump parts.</li> </ul>
–	X	–	X	–	X	–	–	X	Motor running on 2 phases	<ul style="list-style-type: none"> <li>► Check the fuse and replace it if necessary.</li> <li>► Check the cable connections and insulation.</li> </ul>
–	–	X	–	X	–	–	–	–	Viscosity lower than expected	<ul style="list-style-type: none"> <li>► Machine the impeller down. Consult the manufacturer and adjust the impeller diameter.</li> </ul>
–	–	X	–	–	X	–	–	X	Geodetic differential head, pipe flow resistances and/or other resistances lower than specified	<ul style="list-style-type: none"> <li>► Throttle down the flow rate at the pressure-side armature. Observe the minimum flow rate.</li> <li>► Machine the impeller down. Consult the manufacturer and adjust the impeller diameter.</li> </ul>
–	–	X	X	–	X	–	–	X	Pressure-side armature opened too wide	<ul style="list-style-type: none"> <li>► Throttle down at the pressure-side armature.</li> <li>► Machine the impeller down. Consult the manufacturer and adjust the impeller diameter.</li> </ul>
–	–	X	–	X	X	X	–	X	Motor speed too high	<ul style="list-style-type: none"> <li>► Compare the required motor speed with the specifications on the pump type plate. Replace the motor if necessary.</li> <li>► Reduce the motor speed if speed control is available.</li> </ul>

Fault number									Cause	Remedy
1	2	3	4	5	6	7	8	9		
–	–	X	–	X	X	–	–	X	Impeller diameter too large	<ul style="list-style-type: none"> <li>▶ Throttle down the flow rate at the pressure-side armature. Observe the minimum flow rate.</li> <li>▶ Machine the impeller down. Consult the manufacturer and adjust the impeller diameter.</li> </ul>
–	–	–	–	–	X	X	–	X	Antifriction bearings in the pump defective	▶ Replace the antifriction bearing.
–	–	–	–	–	–	X	–	X	Defective antifriction bearing in motor	▶ Replace the antifriction bearing.
–	–	–	–	–	–	X	–	–	Lubricant: too much, not enough or unsuitable	▶ Reduce, top up or replace the lubricant.
–	–	–	–	–	–	–	X	–	Connecting bolts not tightened correctly	▶ Tighten the connecting bolts.
–	–	–	–	–	–	–	X	–	Mechanical seal worn	▶ Replace the mechanical seal.
–	–	–	–	–	–	–	X	–	Housing seal defective	▶ Replace the housing seal.
–	–	–	–	–	X	X	X	X	Pump distorted	<ul style="list-style-type: none"> <li>▶ Check the pipe connections and pump fixings.</li> <li>▶ Check the coupling alignment.</li> <li>▶ Check the fixing of the support foot.</li> </ul>
–	–	–	–	–	X	X	–	–	Coupling not properly aligned	▶ Align the coupling.
–	–	–	–	–	X	–	–	–	Membrane package worn	▶ Replace the membrane package and realign it.

Tab. 11 Troubleshooting list

## 9 Appendix

### 9.1 Sectional drawings

#### 9.1.1 Auxiliary connections

Abbreviation	Connection
FF2	Filling
FV1	Bleeding
PM1	Manometer
PM2	Manometer

Tab. 12 Abbreviations of the connection designations

#### 9.1.2 Part numbers and designations

Part no.	Designation
102.01	Volute casing
153.01	Vacuum flange
161.01	Housing cover
182.01	Foot
210.01	Shaft
230.01	Impeller
321.01	Deep groove ball bearing
341.01	Motor bell housing
360.01	Bearing cover
360.02	Bearing cover
400.06	Gasket
411.03	Seal ring
411.04	Seal ring
411.06	Seal ring
412.01	O-ring
412.11	O-ring
420.01	V-ring
420.02	V-ring
433.01	Mechanical seal
551.01	Spacer disk
565.01	Rivet
595.01	Buffer
681.01	Coupling guard
801.01	Flanged motor
855.01	Coupling with spacer piece
901.01	Hexagon head bolt
901.03	Hexagon head bolt

Part no.	Designation
901.05	Hexagon head bolt
901.06	Hexagon head bolt
901.10	Hexagon head bolt
902.06	Stud bolt
903.03	Screw plug
903.04	Screw plug
903.06	Screw plug
908.01	Jacking screw
908.10	Jacking screw
922.01	Impeller nut
930.01	Circlip
932.01	Circlip
934.01	Spring washer
936.01	Spring ring
940.01	Shaft key
971.01	Type plate
972.01	Information plate

Tab. 13 Designations of components according to part numbers

### MI series sectional drawing

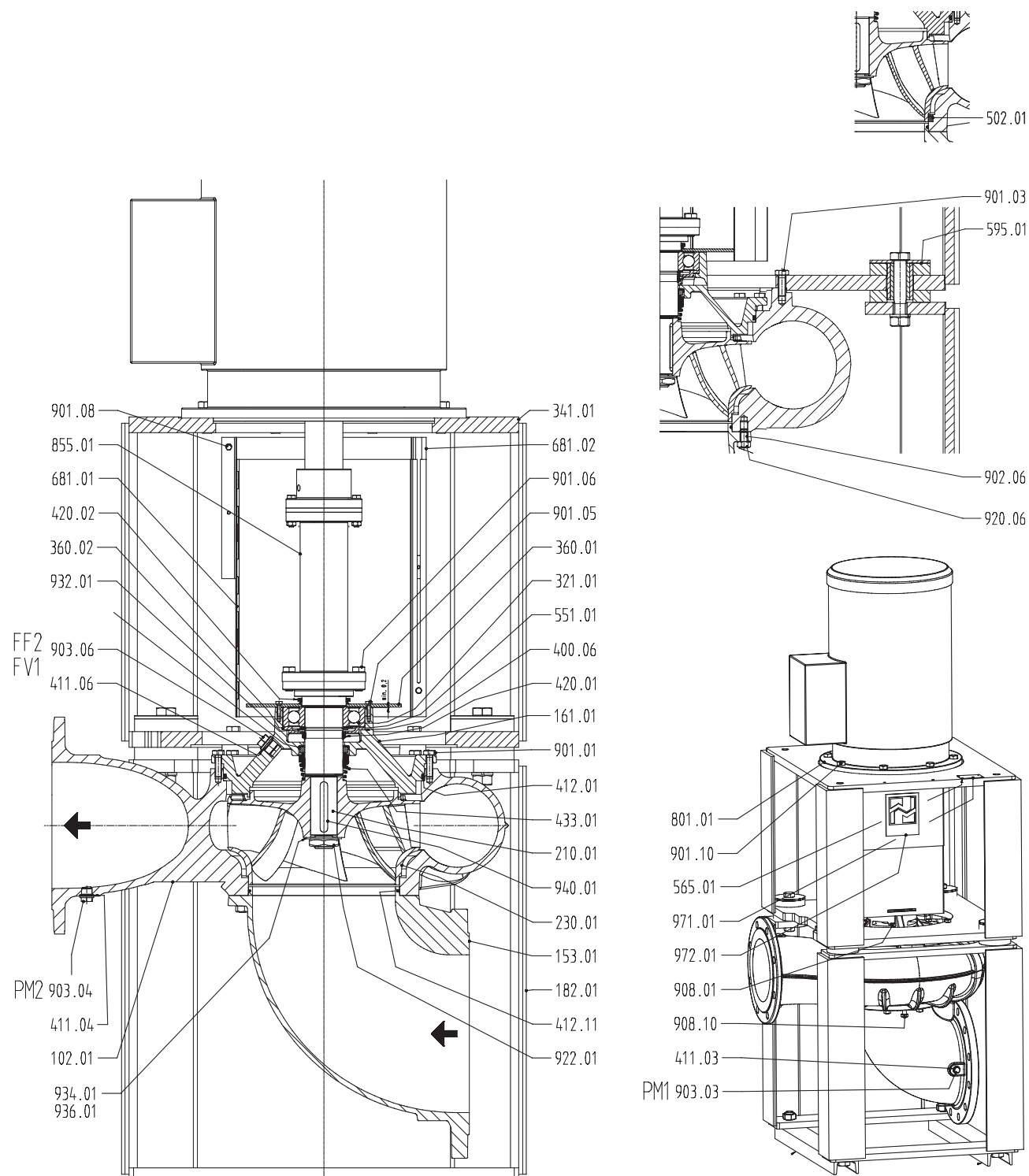
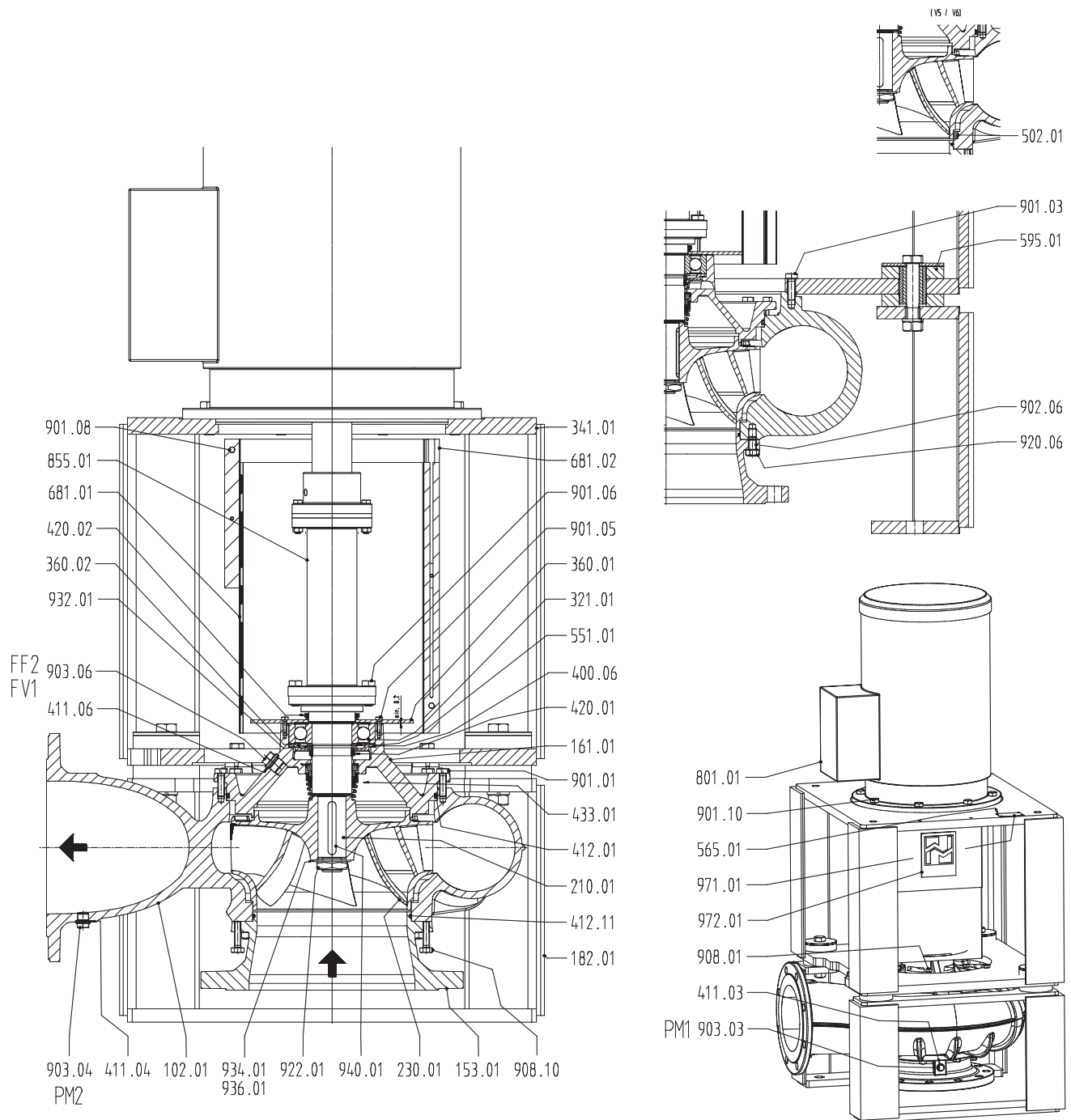
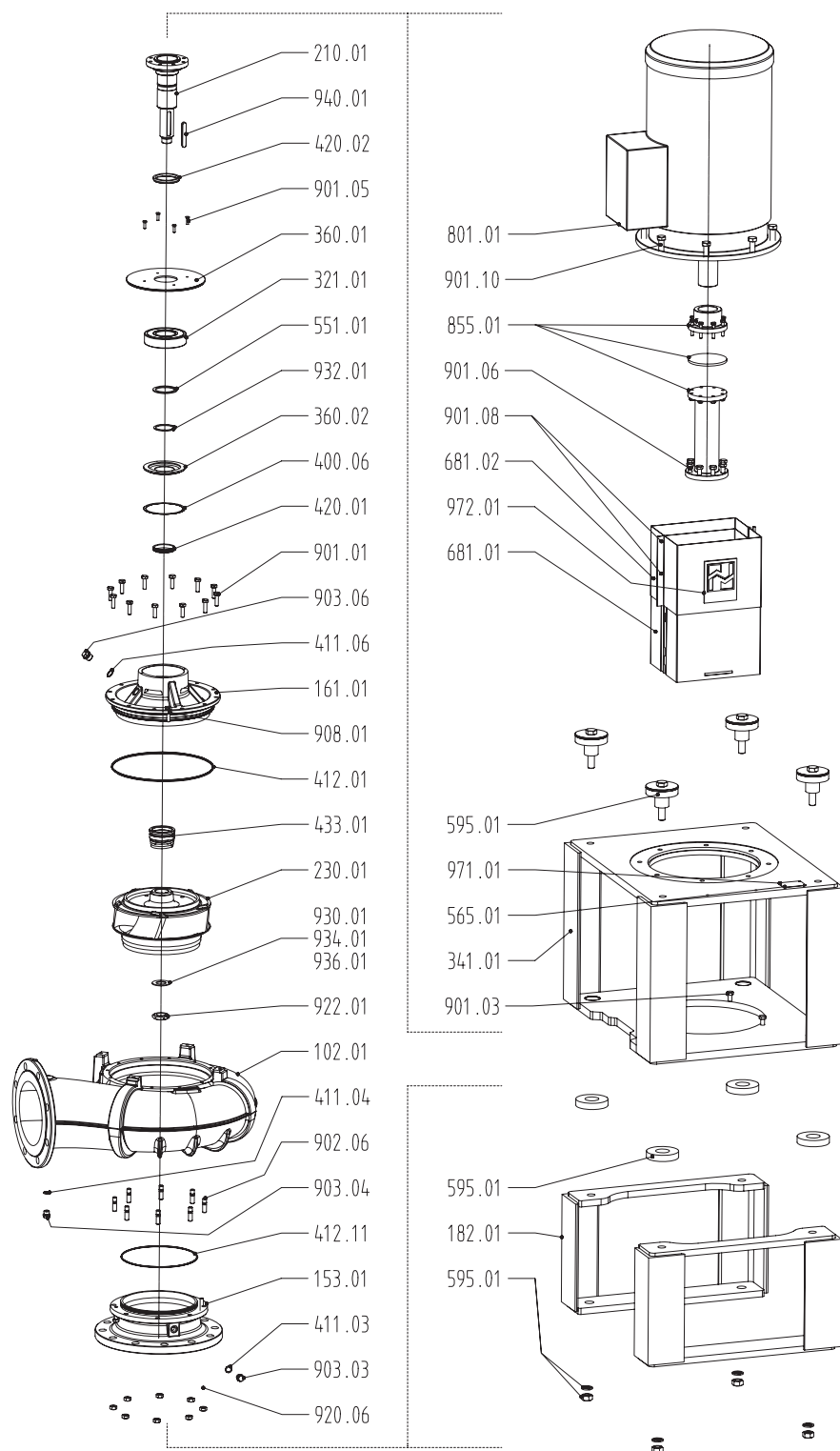


Fig. 9 MI series sectional drawing


**MA series section drawing**




**Fig. 10 MA series section drawing**

**MA series explosion drawing**

**Fig. 11 Explosion drawing**

## 9.2 Technical specifications

 More technical specifications (→ order data sheet).

### 9.2.1 Ambient conditions

 Operation under other ambient conditions to be agreed with the manufacturer

Temperature [°C]	Relative humidity [%]		Setup height above sea level [m]
	Long-term	Short-term	
–20 to +40	≤ 85	≤ 100	≤ 1000

Tab. 14 Ambient conditions

### 9.2.2 Sound pressure levels

Measuring conditions:

- Distance to the pump: 1 m
- Operation: cavitation-free
- Motor: IEC standard motor
- Tolerance ±3 dB

Lower-noise versions of the motors are available if the expected noise levels exceed the permissible limits.

Nominal motor power PM [kW]	Sound pressure level [dB] for pump with motor at speed [min <sup>-1</sup> ]			
	1450	1750	2900	3500
1.5	58	58.5	63	64
2.2	60	60.5	66	67
3.0	62	62.5	68	69
4.0	63	63.5	69	70
5.5	65	65.5	71	72
7.5	66	66.5	72	73
11.0	68	68.5	74	75
15.0	69	69.5	75	76
18.5	70	70.5	76	77
22.0	71	71.5	77	78
30.0	72	72.5	78	79
37.0	73	73.5	79	80
45.0	74	74.5	80	81
55.0	75	75.5	80	81
75.0	76	76.5	81	82
90.0	76	76.5	82	83
110.0	77	77.5	82	83
132.0	78	78.5	83	84
160.0	79	79.5	84	85
200.0	80	80.5	85	86

Tab. 15 Sound pressure levels

### 9.2.3 Tightening torques

Part no.	Thread gage	Quality	Tightening torque [Nm]
901.01	M10	A4	11.3
	M12		19.5
	M16		47.0
901.03	M12	A4	23.0
	M16		55.0
	M20		110.0
901.05	M6	8.8	2.8
	M8		6.5
901.06	M10	8.8	13.5
	M12		23.0
901.10	M12	8.8	20.0
	M16		55.0
	M20		110.0
920.06	M12	A4	23.0
	M16		55.0
922.01	M20 x 1.5	A4	100.0
	M24 x 1.5		175.0
	M30 x 1.5		365.0
	M36 x 1.5		615.0
	M42 x 1.5		1000.0
	M48 x 1.5		1700.0
595.01 (Nut)	M20	8.8	110.0
Foundation fastening	M20	8.8	110.0
	M24		190.0
	M30		380.0


Tab. 16 Tightening torques

### 9.2.4 Cleaning agents

Application area	Cleaning agents
Foodstuffs and drinking water sector	E.g. spirit, Ritzol 155, strong alkaline soapy solution, steam jet (for individual parts only)
Other	Benzine, wax solvents, diesel, paraffin, alkaline cleaners

Tab. 17 Cleaning agents

### 9.2.5 Preservatives


 Use Valvoline preservatives or similar (recommended).

Type of storage	Storage duration [months]	Preservative inside/ outside	Renew [months] inside/ outside
In closed, dry and dust-free room	< 6	Tectyl 511 M	–
	6–12	Tectyl 511 M	–
	> 12	Tectyl 506 EH	48/48
In open air, central European climate	< 6	Tectyl 542	–
	6–12	Tectyl 542/ Tectyl 506 EH	–
	> 12	Tectyl 506 EH	48/18
In open air, tropical climate, aggressive industrial atmosphere or close to sea	< 6	Tectyl 542/ Tectyl 506 EH	–
	6–12	Tectyl 542/ Tectyl 506 EH	–
	> 12	Tectyl 506 EH	48/12

Tab. 18 Valvoline preservatives



### 9.2.6 Flange loads

 Definition of the pipe forces and torques on the basis of EN ISO 5199.

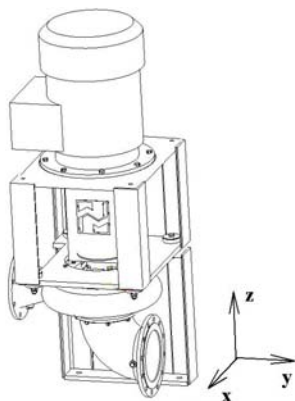


Fig. 12 Flange loads at the pump

Pump size	Nominal flange diameter [mm]		Forces [N]				Torques [Nm]			
			$F_{\max}(x)$	$F_{\max}(y)$	$F_{\max}(z)$	$\Sigma F$	$M_{\max}(x)$	$M_{\max}(y)$	$M_{\max}(z)$	$\Sigma M$
65-250/01	S	125	1350	1500	1200	2350	800	500	700	1200
	D	65	700	800	650	1250	500	250	350	650
80-250/01 80-315/01	S	150	1700	1900	1500	2950	1000	600	750	1400
	D	80	850	950	750	1500	550	300	400	750
100-250/01	S	150	1700	1850	1500	3000	1000	600	750	1400
	D	100	1100	1250	1000	2000	600	350	450	850
100-315/01	S	200	2250	2500	2000	3900	1350	900	1050	2000
	D	100	1100	1250	1000	1950	600	350	450	850
125-250/01 125-315/01	S	200	2250	2500	2000	3900	1350	900	1050	1900
	D	125	1300	1500	1200	2300	800	500	700	1200
150-250/01	S	200	2250	2500	2000	3900	1400	900	1100	2000
	D	150	1700	1900	1500	2950	1000	650	800	1450
150-315/01	S	250	2800	3150	2550	5000	2000	1350	1600	2900
	D	150	1700	1900	1500	3000	1000	650	800	1450
200-250/01 200-315/01 200-500/02	S	250	2800	3100	2500	4850	2000	1300	1600	2900
	D	200	2250	2500	2000	3900	1400	900	1100	2000
250-315/02 250-500/01	S	300	3350	3750	3000	5850	2800	1900	2200	4050
	D	250	2800	3150	2550	4950	2000	1350	1600	2900
350-315/01	S	400	4500	5000	4000	7850	4600	3200	3750	6750
	D	350	3900	4400	3500	6850	3650	2500	2950	5300

Tab. 19 Maximum flange loads

### 9.3 Spare parts for two years of continuous operation according to DIN 24296

Part no.	Part designation	Number of identical pumps (including stand-by pumps)						
		2	3	4	5	6 or 7	8 or 9	> 9
		Set/quantity of spare parts						
230.01	Impeller	1	1	1	2	2	3	30 %
210.01	Shaft							
922.0	Impeller nut							
930.01	Circlip	1	1	2	2	2	3	30 %
934.01	Spring washer or							
936.01	Spring ring							
940.01	Shaft key							
321.01	Groove ball bearing							
400.06	Gasket	1	1	2	2	3	4	50 %
412.01	O-ring							
420.01	V-ring S							
420.02	V-ring A							
433...	Mechanical seal	2	3	4	5	6	7	90 %
Various	Seal set with							
400.06	Gasket	4	6	8	8	9	12	150 %
411.03	Seal ring							
411.04	Seal ring							
411.06	Seal ring							
412.01	O-ring							
412.11	O-ring							
420.01	V-ring							
420.02	V-ring							

Tab. 20 Spare parts for two years of continuous operation

1) Delivered as a mechanical unit (BG) or sales unit (VG)

## 9.4 Safety certificate

## Document of compliance

The pump, together with additional equipment, we (as signed person) sent for inspection or repair,

Type:

Delivery date:

Item-no.:

Order-no.:

Reason for the inspection / repair order:

have never been used for harmful / environmentally hazardous substances.

☐ have been used for application of

and have been in contact with fluids for which a liability of labeling occur, or which have toxic ingredients.

Last fluid which has been pumped:

The pump has been carefully drained, as well as cleaned inside and outside before shipping / allocation.

	Specific safety arrangements are not necessary for further handling.
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Following safety arrangements concerning flushing medium, fluid left over and waste disposal are necessary:

**!** If any critical medium has been inside the pump please necessarily enclose a **safety data sheet** to

We confirm, that the made statements are correct and complete, and that the shipment will be made due to legal requirements.

Company / Address: \_\_\_\_\_ Phone: \_\_\_\_\_

Fax:

Customer-no.: 

--	--	--	--	--	--	--

Name of drawer:  
(in block letters)

Position:

Date \_\_\_\_\_

**Company stamp / Signature**

