

Hygienic Pump

# Vitastage

## Installation/Operating Manual



## **Legal information/Copyright**

Installation/Operating Manual Vitastage

Original operating manual

All rights reserved. The contents provided herein must neither be distributed, copied, reproduced, edited or processed for any other purpose, nor otherwise transmitted, published or made available to a third party without the manufacturer's express written consent.

Subject to technical modification without prior notice.

© KSB SE & Co. KGaA, Frankenthal 15/12/2017

## Contents

	<b>Glossary .....</b>	<b>5</b>
<b>1</b>	<b>General.....</b>	<b>6</b>
	1.1 Principles .....	6
	1.2 Installation of partly completed machinery.....	6
	1.3 Target group.....	6
	1.4 Other applicable documents.....	6
	1.5 Symbols .....	6
<b>2</b>	<b>Safety.....</b>	<b>8</b>
	2.1 Key to safety symbols/markings.....	8
	2.2 General.....	8
	2.3 Intended use .....	8
	2.4 Personnel qualification and training.....	9
	2.5 Consequences and risks caused by non-compliance with this manual .....	9
	2.6 Safety awareness .....	9
	2.7 Safety information for the operator/user .....	10
	2.8 Safety information for maintenance, inspection and installation .....	10
	2.9 Unauthorised modes of operation .....	10
<b>3</b>	<b>Transport/Temporary Storage/Disposal.....</b>	<b>11</b>
	3.1 Checking the condition upon delivery .....	11
	3.2 Transport.....	11
	3.3 Storage/preservation .....	11
	3.4 Return to supplier.....	12
	3.5 Disposal .....	13
<b>4</b>	<b>Description of the Pump (Set).....</b>	<b>14</b>
	4.1 General description .....	14
	4.2 Designation.....	14
	4.3 Name plate.....	15
	4.4 Design details.....	15
	4.5 Configuration and function.....	16
	4.6 Noise characteristics .....	16
	4.7 Scope of supply.....	17
	4.8 Dimensions and weights .....	17
<b>5</b>	<b>Installation at Site .....</b>	<b>18</b>
	5.1 Safety regulations.....	18
	5.2 Checks to be carried out prior to installation.....	18
	5.3 Piping .....	18
	5.3.1 Connecting the piping.....	18
	5.3.2 Permissible forces and moments at the pump nozzles.....	20
	5.4 Enclosure/insulation .....	20
	5.5 Electrical system.....	20
	5.5.1 Operation on a frequency inverter.....	20
	5.6 Electrical connection .....	21
	5.6.1 Setting the time relay .....	21
	5.6.2 Connecting the motor .....	21
	5.6.3 Earthing.....	22
	5.7 Checking the direction of rotation.....	22
<b>6</b>	<b>Commissioning/Start-up/Shutdown.....</b>	<b>23</b>
	6.1 Commissioning/Start-up.....	23
	6.1.1 Prerequisites for commissioning/start-up .....	23
	6.1.2 Priming and venting the pump.....	23
	6.1.3 Start-up.....	23
	6.1.4 Checking the shaft seal.....	24
	6.1.5 Shutdown .....	25

6.2	Operating limits.....	25
6.2.1	Ambient temperature.....	25
6.2.2	Frequency of starts.....	26
6.2.3	Cleaning in place (CIP).....	26
6.2.4	Steaming in place (SIP).....	27
6.2.5	Fluid handled.....	27
6.3	Shutdown/storage/preservation.....	28
6.3.1	Measures to be taken for shutdown.....	28
6.4	Returning to service.....	29
<b>7</b>	<b>Servicing/Maintenance.....</b>	<b>30</b>
7.1	Safety regulations.....	30
7.2	Servicing/inspection.....	31
7.2.1	Supervision of operation.....	31
7.2.2	Inspection work.....	31
7.3	Drainage/cleaning.....	32
7.4	Dismantling the pump set.....	32
7.4.1	General information/Safety regulations.....	32
7.4.2	Preparing the pump set.....	33
7.4.3	Removing the complete pump set from the piping.....	33
7.4.4	Dismantling the pump.....	33
7.5	Reassembling the pump set.....	34
7.5.1	General information/Safety regulations.....	34
7.5.2	Reassembling the pump.....	34
7.6	Spare parts stock.....	35
7.6.1	Ordering spare parts.....	35
7.6.2	Recommended spare parts stock for 2 years' operation to DIN 24296.....	35
<b>8</b>	<b>Trouble-shooting.....</b>	<b>36</b>
<b>9</b>	<b>Related Documents.....</b>	<b>38</b>
9.1	General assembly drawing with list of components, Vitastage 05/1 - 05/8 - horizontal installation.....	38
9.2	General assembly drawing with list of components, Vitastage 05/1 - 05/8 - vertical installation.....	39
<b>10</b>	<b>EU Declaration of Conformity.....</b>	<b>40</b>
<b>11</b>	<b>Certificate of Decontamination.....</b>	<b>41</b>
	<b>Index.....</b>	<b>42</b>

## Glossary

### **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.

### **CIP (cleaning in place)**

Procedure during which the inside of the pump is cleaned with a cleaning agent. The pump does not need to be dismantled.

### **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

### **Noise characteristics**

The noise characteristics are indicated as surface sound pressure level in dB(A).

### **Pump**

Machine without drive, additional components or accessories

### **Pump set**

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

### **SIP (steaming in place)**

Procedure during which the inside of the pump is sterilised with steam. The pump does not need to be dismantled.

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

The pipeline which is connected to the suction nozzle

## 1 General

### 1.1 Principles

This operating manual is supplied as an integral part of 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.

Observe the noise characteristics, indicated as surface sound pressure level.  
(⇒ Section 4.6, Page 16)

### 1.2 Installation of partly completed machinery

To install partly completed machinery supplied by KSB refer to the sub-sections under Servicing/Maintenance.

### 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

1) If agreed upon in scope of supply

Symbol	Description
⇒	Cross-references
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.

### 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 within the operating limits described 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.

#### **Prevention of foreseeable misuse**

- Never open the discharge-side shut-off elements further than permitted.
  - The maximum flow rates specified in the product literature or data sheet would be exceeded.
  - Risk of cavitation damage
- Never exceed the permissible operating limits specified in the data sheet or product literature regarding pressure, temperature, etc.
- Observe all safety information and instructions in this manual.

#### **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

- The operator shall fit contact guards for hot, cold and moving parts and check that the guards function properly.
- Do not remove any 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 are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts authorised by the manufacturer. The use of other parts 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 casing 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 6.3, Page 28)
- Decontaminate pumps which handle fluids posing a health hazard.
- 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 23)

### 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 8)

### 3 Transport/Temporary Storage/Disposal

#### 3.1 Checking the condition upon delivery

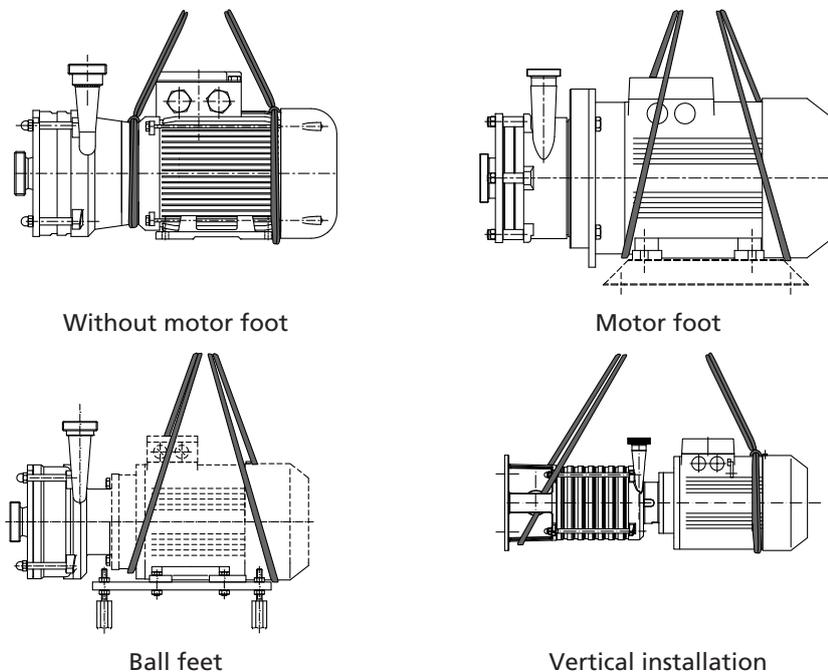
1. On transfer of goods, check each packaging unit for damage.
2. In the event of in-transit damage, assess the exact damage, document it and notify KSB or the supplying dealer and the insurer about the damage in writing immediately.

#### 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>▷ Give due attention to the weight data and the centre of gravity.</li> <li>▷ Observe the applicable local health and safety regulations.</li> <li>▷ Use suitable, permitted lifting accessories, e.g. self-tightening lifting tongs.</li> </ul>
	<b>CAUTION</b>
	<p><b>Deformation of motor shroud during transport</b>            Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Remove motor shroud, if included in scope of supply, for transport.</li> </ul>

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

**Table 4:** 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.

	<b>CAUTION</b>
	<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>
	<b>CAUTION</b>
	<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 28)

### 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 41)  
Indicate any safety measures and decontamination measures taken.

	<b>NOTE</b>
	<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

- Hygienic pump
- Multistage centrifugal pump in ring-section design

Pump for handling fluids which are not chemically aggressive, are free from solids and do not require hermetic sealing.

**Table 5:** Installation type

Installation type	Illustration	Description
B		<ul style="list-style-type: none"> <li>▪ Horizontal close-coupled pump</li> <li>▪ Axial suction nozzle</li> <li>▪ Radial discharge nozzle</li> </ul>
BM		<ul style="list-style-type: none"> <li>▪ Horizontal close-coupled pump</li> <li>▪ Mounted on motor feet</li> <li>▪ Axial suction nozzle</li> <li>▪ Radial discharge nozzle</li> </ul>
V		<ul style="list-style-type: none"> <li>▪ Vertical close-coupled pump</li> <li>▪ Axial suction nozzle</li> <li>▪ Radial discharge nozzle</li> </ul>

All pumps of this type series are fitted with standardised mechanical seals to EN 12756. This ensures reliable operation and interchangeability.

When different standardised mechanical seals are used, verify the axial length of the seal.

Type and material of the mechanical seal are specifically selected to match the nature and composition of the fluid to be handled.

NOTE
<p>Before using the pump for any fluids different to those originally specified, check that the mechanical seals and joint rings are suitable for that fluid. If certified seal types or materials are used, make sure that any replacement seals used also meet the certification requirements.</p>

### 4.2 Designation

**Example:** Vitastage 10/3/75 2 B T

**Table 6:** Designation key

Code	Description
Vitastage	Type series
10	Size
3	Number of stages

Code	Description
75	Motor rating (7.5 kW × 10)
2	Number of poles
B	Installation type
T	Seal design

### 4.3 Name plate



Fig. 1: Vitastage name plate (example)

1	Type series, size and version	2	KSB order number
3	Manufacturer's No.	4	Flow rate
5	Head	6	Speed
7	Year of construction		

### 4.4 Design details

#### Design

- Standard design with materials to Regulation (EC) No. 1935/2004

#### Design

- High-pressure centrifugal pump
- Ring-section design
- Multistage

#### Installation

- Horizontal installation / vertical installation

#### Impeller type

- Closed radial impeller with multiply curved vanes

#### Shaft seal

- Standardised mechanical seal to EN 12756

#### Drive

- Self-cooling IEC squirrel cage motor
- Winding 50 Hz, 230 V/400 V up to 4 kW
- Winding 50 Hz, 400 V/690 V from 5.5 kW
- Type of construction B5/B35
- Enclosure IP55
- Thermal class F
- Other motors on request

### 4.5 Configuration and function

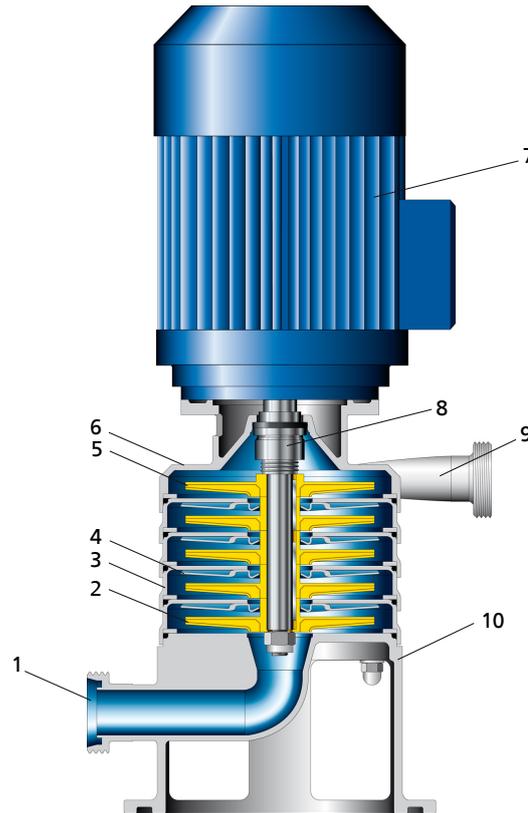


Fig. 2: Sectional drawing of Vitastage

1	Suction nozzle	2	First impeller
3	Stage casing	4	Diffuser
5	Last impeller	6	Discharge casing
7	Motor	8	Shaft seal
9	Discharge nozzle	10	Pump foot

**Design** The pump is installed in either a horizontal or a vertical position. It is designed with an axial fluid inlet and a radial fluid outlet. The hydraulic system is fitted on an extended motor shaft and the casing is directly bolted to the motor.

**Function** The fluid enters the casing via the suction nozzle (1) and is accelerated outward in a cylindrical flow by the first impeller (2). In the flow passage of the stage casing (3) the kinetic energy of the fluid is converted into pressure energy. The fluid is pumped to the next impeller via the diffuser (4). This process is repeated in all stages until the fluid has passed the last impeller (5). The fluid is then pumped through the discharge casing (6) to the discharge nozzle (9), where it leaves the pump. The drive shaft enters the casing at the rear of the last impeller (11). The motor (7) is bolted to the casing. The shaft passage through the casing is sealed by a dynamic shaft seal (8). Pumps installed horizontally are mounted on motor feet, whereas vertically installed pumps are mounted on a pump foot (10).

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

### 4.6 Noise characteristics

Table 7: Surface sound pressure level  $L_{pA}$ <sup>2)</sup>

Size	Motor rating	Noise characteristic
	[kW]	[dB]
VS 05/1	1,5	69 - 70,2
VS 05/2	1,5	69,5 - 71

2) Measured at a distance of 1 m, 1.6 m above the installation surface

Size	Motor rating	Noise characteristic
	[kW]	[dB]
VS 05/3	2,2	69 - 71,4
VS 05/4	3	68 - 71,9
VS 05/5	4	72,1 - 74,1
VS 05/6	5,5	73 - 74,6
VS 05/7	5,5	75,2 - 79,1
VS 05/8	5,5	76,5 - 79,4

#### 4.7 Scope of supply

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

- Pump
- Electric motor
- Installation parts

#### 4.8 Dimensions and weights

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

## 5 Installation at Site

### 5.1 Safety regulations

	 <b>DANGER</b>
	<p><b>Installation in potentially explosive atmospheres</b> Explosion hazard!</p> <ul style="list-style-type: none"> <li>▸ Never install the pump in potentially explosive atmospheres.</li> <li>▸ Observe the information given in the data sheet and on the name plates of the pump system.</li> </ul>

### 5.2 Checks to be carried out prior to installation

#### Place of installation

	 <b>WARNING</b>
	<p><b>Installation on mounting surface which is 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 XC1 to EN 206-1.</li> <li>▸ The mounting surface must be set, flat, and level.</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 Piping

#### 5.3.1 Connecting the piping

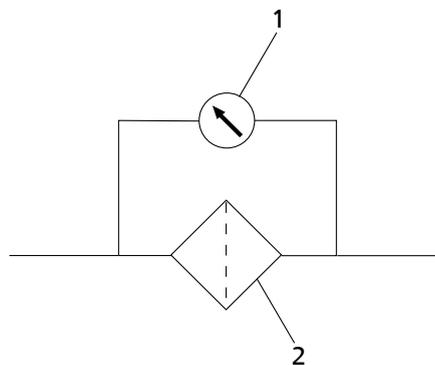
	 <b>DANGER</b>
	<p><b>Impermissible loads acting on the pump nozzles</b> Danger to life from leakage of hot, toxic, corrosive or flammable fluids!</p> <ul style="list-style-type: none"> <li>▸ Do not use the pump as an anchorage point for the piping.</li> <li>▸ Anchor the pipes in close proximity to the 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>
	<b>CAUTION</b>
	<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>

	<b>NOTE</b>
	<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 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.

	<b>CAUTION</b>
	<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 7.2.2.1, Page 32) .</li> </ul>

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. 3: Filter in the piping**

1	Differential pressure gauge	2	Filter
---	-----------------------------	---	--------

	<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>

**5.3.2 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 Enclosure/insulation**

	<b>! WARNING</b>
	<p><b>The volute casing and casing/discharge cover 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 equipment.</li> </ul>

**5.5 Electrical system**

**5.5.1 Operation on a frequency inverter**

The pump set is suitable for operation on a frequency inverter as per IEC 60034-17.

	<b>! DANGER</b>
	<p><b>Incorrect selection and setting of the frequency inverter</b>            Explosion hazard!</p> <ul style="list-style-type: none"> <li>▷ Observe the following information on selecting and setting a frequency inverter.</li> </ul>

**Selection** When selecting a frequency inverter, check the following details:

- Data provided by the manufacturer
- Electrical data of the pump set, particularly the rated current
- Only voltage source inverters (VSI) with pulse width modulation (PWM) and carrier frequencies between 1 and 16 kHz are suitable.

**Setting** Observe the following instructions for setting a frequency inverter:

- Set the current limit to max. 1.2 times the rated current. The rated current is indicated on the name plate.

**Start-up** Observe the following instructions for starting the frequency inverter:

- Ensure short start ramps (maximum 5 seconds).
- Only start variable speed control after 2 minutes at the earliest.  
 Pump start-up with long start ramps and low frequency may cause clogging.

**Operation** Observe the following limits during operation on a frequency inverter:

- Only utilise up to 95 % of the motor rating  $P_2$  indicated on the name plate.
- Frequency range 25 to 50 Hz

**Electromagnetic compatibility** Operation on a frequency inverter produces interference emissions whose level varies depending on the inverter used (type, interference suppression, make). To prevent the drive system, consisting of a submersible motor and a frequency inverter, from

exceeding any given limits always observe the EMC information provided by the inverter manufacturer. If the inverter manufacturer recommends a shielded power cable, make sure to use a submersible motor pump with shielded power cables.

**Interference immunity** The submersible motor pump generally meets interference immunity requirements. For monitoring the sensors installed the operator must ensure sufficient interference immunity by appropriately selecting and laying the power cables in the plant. No modifications are required on the power/control cable of the submersible motor pump. Suitable analysing devices must be selected. To monitor the leakage sensor inside the motor using a special relay available from KSB is recommended.

### 5.6 Electrical connection

	<b>⚠ DANGER</b>
	<b>Electrical connection work by unqualified personnel</b> Danger of death from electric shock! <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.</li> </ul>

	<b>⚠ WARNING</b>
	<b>Incorrect connection to the mains</b> Damage to the mains network, short circuit! <ul style="list-style-type: none"> <li>▷ Observe the technical specifications of the local energy supply companies.</li> </ul>

1. Check the available mains voltage against the data on the name plate.
2. Select an appropriate start-up method.

	<b>NOTE</b>
	A motor protection device is recommended.

#### 5.6.1 Setting the time relay

	<b>CAUTION</b>
	<b>Switchover between star and delta on three-phase motors with star-delta starting takes too long.</b> Damage to the pump (set)! <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	Y time to be set
$\leq 30 \text{ kW}$	$< 3 \text{ s}$

#### 5.6.2 Connecting the motor

	<b>NOTE</b>
	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.

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

### 5.6.3 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>

### 5.7 Checking the direction of rotation

	 <b>DANGER</b>
	<p><b>Temperature increase resulting from contact between rotating and stationary components</b> 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 set.</li> <li>▸ Separate the pump from the motor to check the direction of rotation.</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>
	<p><b>Incorrect direction of rotation with non-reversible mechanical seal</b> Damage to the mechanical seal and leakage!</p> <ul style="list-style-type: none"> <li>▸ Separate the pump from the motor to check the direction of rotation.</li> </ul>

	<b>CAUTION</b>
	<p><b>Drive and pump running in the wrong direction of rotation</b> Damage to the pump!</p> <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 motor 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

- The pump set has been properly connected to the electric power supply and is equipped with all protection devices.
- The pump has been primed with the fluid to be handled.
- The direction of rotation has been checked. (⇒ Section 5.7, Page 22)
- After prolonged shutdown of the pump (set), the activities described in (⇒ Section 6.4, Page 29) have been carried out.
- The lockwashers, if any, have been removed from the shaft groove.
- The quality of the concrete foundation complies with the regulations.
- The pump set has been installed and aligned in accordance with the tolerances specified.
- The pipelines have been connected without warping the pump nozzles.

#### 6.1.2 Priming and venting the pump

	<b>CAUTION</b>
	<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>

1. Vent the pump and suction line and prime them with the fluid to be handled.
2. Fully open the shut-off element in the suction line.

	<b>NOTE</b>
	<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

	<b>⚠ DANGER</b>
	<p><b>Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and discharge lines closed.</b> Hot 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 against a slightly or completely open discharge-side shut-off element.</li> </ul>

	 <b>DANGER</b>
	<p><b>Excessive temperatures due to insufficient lubrication of shaft seal</b> Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Never operate the pump set without liquid fill.</li> <li>▷ Prime the pump as per operating instructions.</li> <li>▷ Always operate the pump within the permissible operating range.</li> </ul>

	<b>CAUTION</b>
	<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 handled.
- ✓ The lines for priming and venting have been closed.

	<b>CAUTION</b>
	<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. If a mechanical seal with quench is used, make sure that the quench liquid circulates properly.
4. Start up the motor.
5. 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. When the operating temperature has been reached and/or in the event of leakage, check the connection of the individual stage casings with the pump casing and re-tighten, if necessary.

#### 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>

- ✓ 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.

	<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>            Hot fluids escaping!</p> <ul style="list-style-type: none"> <li>▷ Comply with the operating data indicated in the data sheet.</li> <li>▷ Avoid prolonged operation against a closed shut-off element.</li> <li>▷ Never operate the pump at product temperatures exceeding those specified in the data sheet or on the name plate.</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

The frequency of starts is usually determined by the maximum temperature increase of the motor. This largely depends on the power reserves of the motor in steady-state operation and on the starting conditions (DOL, star-delta, moments of inertia, etc). If the starts are evenly spaced over the period indicated, the pump set can be started up six times per hour (h) with the discharge-side gate valve slightly open.

	<b>CAUTION</b>
	<p><b>Re-starting while motor is still running down</b>                      Damage to the pump (set)!</p> <p>▷ Do not re-start the pump set before the pump rotor has come to a standstill.</p>

### 6.2.3 Cleaning in place (CIP)

	<b>CAUTION</b>
	<p><b>Elastomers do not have sufficient resistance</b>                      Damage to the pump!</p> <p>▷ Effect cleaning/sterilisation only if the elastomer components used in the pump (e.g. O-rings, mechanical seals) are made of EPDM or other approved materials.</p>

**Conditions** CIP may be effected with the pump running or with the pump stopped.  
 Recommended flow velocity: between 2.5 and 3 m/s

**Cleaning agent, cleaning process** When performing CIP in the system the pump set is installed in, comply with the concentration limits, temperature limits and contact times given below for the cleaning agents and disinfectants:

**Table 10:** Cleaning sequence

Step	Process	Cleaning agent	Temperature	Contact time
			[°C]	[min]
1	Pre-flushing	Water	+15 to +25	10 to 15
2	Flushing	Water	+45 to +60	10
3	Flushing	Washing lye	+70 to +95	20 to 30
4	Intermediate flushing	Water	+60 max.	5 to 10
5	Flushing	See table below		10 to 15
6	Flushing	Water	+15 to +25	10 to 15

**Table 11:** Agent for cleaning step 5 "Flushing"

Cleaning agent	Concentration	Temperature
	[%]	[°C]
Sodium hydroxide (soda lye)	1 to 3	+70 to +90
Phosphoric acid	0,5	+45
Lye, alkaline	5	+95
Nitric acid	1 to 2.5	+45
Citric acid	0.5 to 3	+70

## 6.2.4 Steaming in place (SIP)

	<b>⚠ WARNING</b>
	<p><b>Pump casing takes on the same temperature as the sterilisation fluid</b> Risk of burns!</p> <ul style="list-style-type: none"> <li>▷ Fit additional protective devices.</li> <li>▷ Observe the general safety rules and regulations for steam applications.</li> </ul>
	<b>CAUTION</b>
	<p><b>Elastomers do not have sufficient resistance</b> Damage to the pump!</p> <ul style="list-style-type: none"> <li>▷ Effect cleaning/sterilisation only if the elastomer components used in the pump (e.g. O-rings, mechanical seals) are made of EPDM or other approved materials.</li> </ul>
	<b>CAUTION</b>
	<p><b>SIP with the pump running</b> Damage to the mechanical seals!</p> <ul style="list-style-type: none"> <li>▷ Effect SIP (cleaning using superheated steam) only during standstill of the pump set.</li> </ul>

**Conditions** Only effect SIP during standstill of the pump set.

**Limits** **Table 12:** SIP temperature requirements

Elastomer	Saturated steam	Chemical
EPDM	121 °C	82 °C
FPM/FKM	149 °C	82 °C

## 6.2.5 Fluid handled

## 6.2.5.1 Flow rate

**Table 13:** Flow rate

Temperature range (t)	Minimum flow rate	Maximum flow rate
0 to +70 °C	≈ 15 % of Q <sub>opt.</sub> <sup>3)</sup>	See hydraulic characteristic curves.
> 70 °C	≈ 25 % of Q <sub>opt.</sub> <sup>3)</sup>	

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.

$$T_0 = T_f + \Delta \vartheta$$

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

**Table 14:** Key

Symbol	Description	Unit
c	Specific heat capacity	J/kg K
g	Gravitational constant	m/s <sup>2</sup>
H	Pump discharge head	m
T <sub>f</sub>	Fluid temperature	°C
T <sub>0</sub>	Temperature at the casing surface	°C

3) Best efficiency point

Symbol	Description	Unit
$\eta$	Pump efficiency at duty point	-
$\Delta\vartheta$	Temperature difference	K

### 6.2.5.2 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 on fluid density in the data sheet.</li> <li>▷ Make sure the motor has sufficient power reserves.</li> </ul>

### 6.2.5.3 Viscosity of the fluid handled

The discharge head, flow rate and power input of the pump are influenced by the viscosity of the fluid handled.

	<b>CAUTION</b>
	<p><b>The fluid handled has a higher viscosity than permitted.</b> Risk of motor overload!</p> <ul style="list-style-type: none"> <li>▷ Observe the viscosity limits for the fluid handled given in the data sheet.</li> <li>▷ Make sure the motor has sufficient power reserves.</li> </ul>

### 6.2.5.4 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. Start up the pump (set) regularly between once a month and once every three months for approximately five minutes during prolonged shutdown periods. 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.
- ✓ The safety instructions for dismantling the pump have been observed.
  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 11)

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

Observe any additional instructions and information provided. (⇒ Section 3, Page 11)

#### 6.4 Returning to service

For returning the equipment to service, observe the sections on commissioning/start-up (⇒ Section 6.1, Page 23) and the operating limits. (⇒ Section 6.2, Page 25)

In addition, carry out all servicing/maintenance operations before returning the pump (set) to service. (⇒ Section 7, Page 30)

	<div style="background-color: #f4a460; padding: 2px;"><b>⚠ WARNING</b></div> <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>
	<div style="background-color: #0070c0; color: white; padding: 2px;"><b>NOTE</b></div> <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>▷ Never open an energised pump set.</li> <li>▷ Always perform maintenance work on pump sets outside potentially explosive atmospheres only.</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, shaft seal and coupling.</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>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>Incorrectly serviced shaft seal</b>          Fire hazard!          Hot fluids escaping!          Damage to the pump set!</p> <ul style="list-style-type: none"> <li>▷ Regularly service the shaft seal.</li> </ul>

	<b>CAUTION</b>
	<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>

	<b>CAUTION</b>
	<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 25)</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 6.1.5, Page 25)
- Check the static seals for leakage.
- Monitor the stand-by pump.  
 To make sure that the stand-by pumps are ready for operation, start them up once a week.

### 7.2.2 Inspection work

	<b>⚠ DANGER</b>
	<p><b>Excessive temperatures caused by friction, impact sparking or frictional sparking</b>          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 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. For draining the fluid handled use the pump connections or a valve for residual drainage, if fitted.
2. Always flush the pump if it has been used for handling harmful, explosive and hot fluids or other fluids posing a risk.  
 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

	<b>! WARNING</b>
	<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>

	<b>! WARNING</b>
	<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>

	<b>! WARNING</b>
	<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.

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.

	<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>⚠ 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 25)</li> <li>▷ Close the shut-off elements in the suction line and discharge line.</li> <li>▷ Drain the pump and release the pump pressure.</li> <li>▷ Shut off any auxiliary feed lines.</li> <li>▷ Allow the pump set to cool down to ambient temperature.</li> </ul>
	<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 an appropriate pull-off device, if possible.</p>

#### 7.4.2 Preparing the pump set

	<p><b>⚠ DANGER</b></p> <p><b>Power supply not disconnected</b> Danger to life!</p> <ul style="list-style-type: none"> <li>▷ Disconnect all electrical connections from the power supply and secure against unintentional start-up.</li> </ul>
---	---

1. De-energise the pump set and secure it against unintentional start-up.

#### 7.4.3 Removing the complete pump set from the piping

1. Disconnect the discharge nozzle and suction nozzle from the piping.
2. Depending on the pump size and motor size, unscrew the bolts that fix the support foot or motor foot to the foundation.
3. Remove the complete pump set from the piping.  
Alternative: Leave pump casing 101 installed in the piping. Undo clamping piece 81-44. Pull the remaining back pull-out unit out towards the back (back pull-out design).

#### 7.4.4 Dismantling the pump

The dismantling procedure is the same for all sizes. It only differs in the number of stages to be dismantled.

See general assembly drawing with list of components (⇒ Section 9.1, Page 38) and (⇒ Section 9.2, Page 39)

1. Undo cap nuts (38) and remove them together with washers (37).
2. Remove suction cover (7) (for vertically installed pumps: remove foot with suction cover (7)). Undo and remove grub screws (36).
3. Remove O-ring (16) and joint ring (30) (suction cover).
4. Undo and remove impeller nut (14).
5. Pull first impeller (5) off shaft (50).

6. Remove first stage casing (3).
7. Remove O-ring (16) and joint ring (30) (first stage casing).
8. Repeat the above steps until all stages have been dismantled.
9. Remove keys (24+28) from shaft (50).
10. Pull primary ring of mechanical seal (13) off shaft (50).
11. Remove the motor shroud if any. To do so, undo bolts/screws (45) and lift off motor shroud (44).
12. Undo bolts (40) and remove washers (42). Separate motor (55) from pump casing (1).
13. Remove mating ring of mechanical seal (13) from pump casing (1).
14. Dismantle the motor feet if necessary:  
Undo nuts (53) and bolts (52). Remove feet (51).

### 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** Always use new O-rings.  
Never use O-rings that have been made by cutting an O-ring cord to size and gluing the ends together.  
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.  
Match the lubricants to the fluid handled (e.g. water for foodstuff applications).

**Tightening torques** For reassembly, tighten all screws and bolts as specified in this manual.  
Tightening torque of the impeller nut: 70-80 Nm

#### 7.5.2 Reassembling the pump

See general assembly drawing with list of components (⇒ Section 9.1, Page 38) and (⇒ Section 9.2, Page 39)

1. Carefully insert the mating ring of mechanical seal (13) into pump casing (1).
2. Pull splash guard (27) onto motor shaft (50).
3. Carefully pull pump casing (1) onto motor shaft (50). Bolt the pump casing to motor (55) using bolts (40) and washers (42). (For versions with motor shroud also fasten adapter (43).)

4. Slide the primary ring of mechanical seal (13) including spring onto shaft (50) until the two mechanical seal assemblies abut each other.
5. Fit keys (24+28) on shaft (50).
6. Slide first impeller (5) onto shaft (50) until it will not go any further, compressing the spring of mechanical seal (13).
7. Place joint ring (30) and O-ring (16) into pump casing and fit first stage casing (3).
8. Repeat the above steps until all stages have been reassembled.
9. After the last impeller (5) has been fitted, screw on and tighten impeller nut (14).
10. Fit grub screws (36).
11. Fit joint ring (30) and O-ring (16) of the last stage and suction cover (7) (vertically installed pumps: foot with suction cover (7)).
12. Fit washers (37). Lock suction cover (7) in position with cap nuts (38).
13. For versions with motor shroud:  
Fasten motor shroud (44) with bolts/screws (45) to adapter (43).
14. Reassemble the motor feet if necessary:  
Fasten motor feet (51) on motor (55) with bolts (52) and nuts (53).

## 7.6 Spare parts stock

### 7.6.1 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.

Also specify the following data:

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

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

**Table 15:** 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
433	Mechanical seal	2	3	4	5	6	7	90%
412	O-ring, casing (set per pump stage)	4	8	8	8	9	12	150%

## 8 Trouble-shooting

	 <b>WARNING</b>
	<p><b>Improper work to remedy faults</b> 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 is running, but does not deliver
- B Insufficient flow rate
- C Discharge pressure below specified value
- D Pump does not withdraw any fluid (pump takes in air)
- E Excessive power input
- F Leakage at mechanical seal.
- G Mechanical seal life too short
- H Mechanical seal damaged
- I Unusual vibrations and/or noises
- J Motor is overloaded

**Table 16:** Trouble-shooting

A	B	C	D	E	F	G	H	I	J	Possible cause	Remedy <sup>4)</sup>
X	X	-	-	-	-	-	-	-	-	Pump not primed sufficiently	Prime pump and check suction-side conditions. Repeat pump start-up.
X	X	-	X	-	-	-	-	-	-	Pump takes in air.	Check entire piping. Seal it if required.
X	X	-	X	-	-	-	-	-	-	In suction lift operation, air enters via mechanical seal.	Replace mechanical seal or use seal with reinforced spring.
X	X	-	X	-	-	-	-	-	-	Clogged suction line or valves in piping closed/not opened enough	Check suction line, remove any foreign matter and check all valves.
X	X	-	X	-	-	-	-	-	-	NPSHavailable smaller than pump's NPSHrequired.	Improve suction and flow conditions. Reduce flow rate with discharge-side control valve.
X	X	-	-	-	-	-	-	-	-	Suction-side foot valve does not close properly and liquid column drops.	Repair or replace foot valve.
X	X	X	-	-	-	-	-	-	-	Flow losses in system exceed specified discharge head of pump.	Reduce pipe friction losses, fit larger impeller (observe motor rating) or select different pump which is suitable for the new duty point.
X	X	X	-	-	-	-	-	-	-	Wrong direction of rotation or speed too low (operation on a frequency inverter)	Check and correct the direction of rotation or increase speed (observe motor rating).
X	X	X	-	X	-	-	-	-	-	Impeller clogged by foreign matter (on pumps with closed impeller).	Remove foreign matter, clean impeller if required.
-	X	X	-	-	X	-	-	-	-	Excessive wear of mechanical seal	Replace complete mechanical seal.
-	X	X	-	-	-	-	-	X	-	Excessive wear of impeller or clogged impeller	Replace impeller or remove foreign matter.
-	X	X	-	-	-	-	-	-	X	Fluid viscosity higher than expected	Verify suitability of pump selected.
-	-	X	X	-	-	-	-	-	-	Excessive gas content in fluid	Use vent valve.
-	-	-	X	-	-	-	-	-	-	Flow losses in system lower than specified discharge head of pump	Reduce flow rate with discharge-side control valve, reduce impeller diameter or fit orifice plate.

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

A	B	C	D	E	F	G	H	I	J	Possible cause	Remedy <sup>4)</sup>
-	-	-	-	X	-	-	-	-	X	Fluid density higher than expected	Check motor rating and use larger motor (if possible) or reduce flow rate.
-	-	-	-	X	-	-	-	-	-	Fluid viscosity too high for centrifugal pump	Check suitability of different pump.
-	-	-	-	X	-	-	-	X	-	Flow rate too high	Reduce flow rate with discharge-side control valve, reduce impeller diameter or fit orifice plate.
-	-	-	-	X	-	-	-	-	-	Speed too high (operation on a frequency inverter)	Reduce speed.
-	-	-	-	X	-	-	-	X	-	Impermissible friction. Impeller touches inner wall of casing.	Repair and re-adjust pump.
-	-	-	-	X	X	X	-	X	-	Pump set not correctly aligned (radial or angular shaft misalignment), or shaft run-out	Re-align pump and motor or fit new pump shaft.
-	X	X	-	X	-	-	-	-	-	Incorrect electrical installation.	Adjust electrical connection as required (only to be performed by trained specialist personnel).
-	X	X	-	X	-	-	-	-	-	Electrical voltage does not match motor used.	Use motor suitable for electric mains.
-	-	-	-	-	X	X	X	-	-	Fluid or fluid temperature unsuitable for mechanical seal materials used	Select type and material of mechanical seal as required.
-	-	-	-	-	X	X	X	-	-	Pump not cleaned sufficiently after it was used for fluids that tend to crystallise	Drain fluid immediately after pump operation and perform several cleaning cycles.
-	-	-	-	-	X	X	-	-	-	Mechanical seal installed incorrectly	Re-install mechanical seal correctly.
-	-	-	-	-	X	-	-	-	-	Incorrect direction of rotation of pump with non-reversible mechanical seal	Change the direction of rotation.
-	-	-	-	-	X	X	-	-	-	Dry running of pump	Monitor pump and system (flow meter, pressure gauge) to prevent dry running.
-	-	-	-	-	-	X	-	-	-	Fluid contains solids.	Select type and material of mechanical seal as required.
-	-	-	-	-	-	-	-	X	-	Excessive fluid temperature or thermal shock	Observe permissible temperature limits, increase fluid temperature slowly and avoid abrupt temperature changes.
-	-	-	-	-	-	-	-	X	-	Impeller out of balance	Remove foreign matter in the impeller. Replace impeller if required.
-	-	-	-	-	-	-	-	X	-	Flow rate too low	Open discharge-side control valve further to reduce flow losses in discharge line.
-	-	-	-	-	-	-	-	X	-	Insufficiently secured pump and piping system	Check anchoring of pump or pump set. Support and fasten piping sufficiently, use expansion joints if required.
-	-	-	-	-	-	-	-	-	X	Speed too high	Reduce speed.
-	X	-	-	-	-	-	-	X	X	Motor is running on two phases only.	Replace the defective fuse. Check electrical connections.

## 9 Related Documents

### 9.1 General assembly drawing with list of components, Vitastage 05/1 - 05/8 - horizontal installation

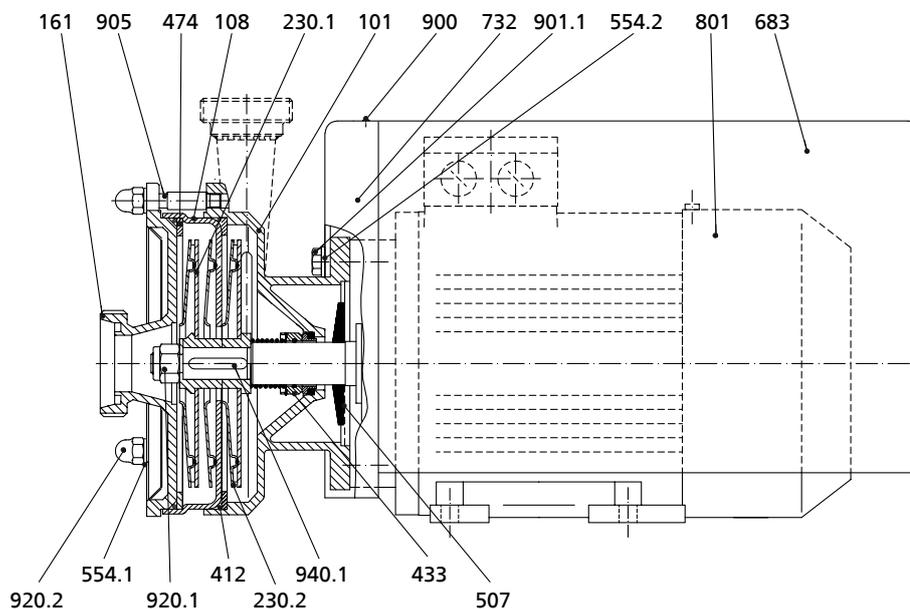
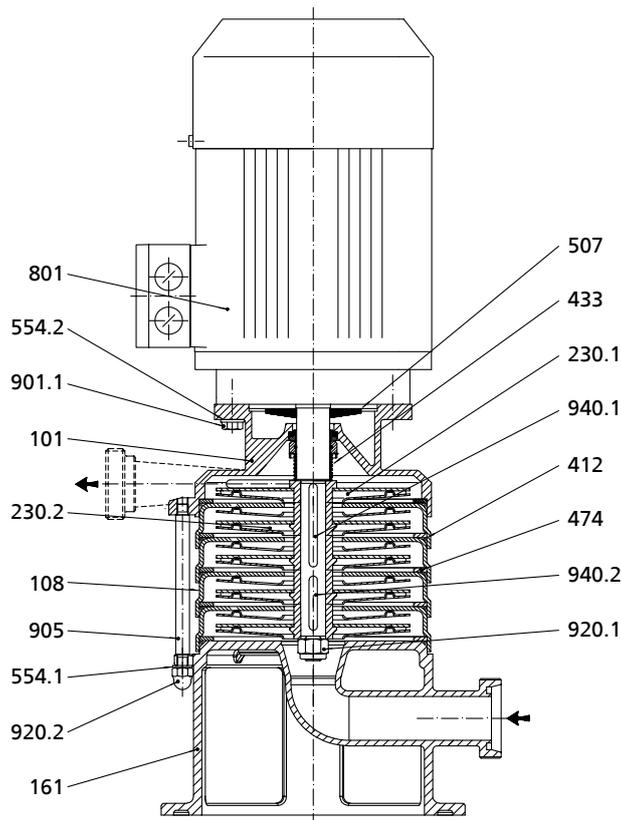


Fig. 4: General assembly drawing, Vitastage 05/1 - 05/8

Table 17: List of components

Part No.	Description	Part No.	Description
101	Pump casing	683	Shroud
108	Stage casing	732	Cover
161	Casing cover	801	Flanged motor
230.1/2	Impeller	900	Bolt/screw
412	O-ring	901.1	Hexagon head bolt
433	Mechanical seal	905	Tie bolt
474	Thrust ring	920.1/2	Nut
507	Thrower	940.1	Key
554.1/2	Washer		

**9.2 General assembly drawing with list of components, Vitastage 05/1 - 05/8 - vertical installation**



**Fig. 5:** General assembly drawing, Vitastage 05/1 - 05/8

**Table 18:** List of components

Part No.	Description	Part No.	Description
101	Pump casing	507	Thrower
108	Stage casing	554.1/.2	Washer
161	Casing cover	801	Flanged motor
230.1/.2	Impeller	901.1	Hexagon head bolt
412	O-ring	905	Tie bolt
433	Mechanical seal	920.1/.2	Nut
474	Thrust ring	940.1/.2	Key

## 10 EU Declaration of Conformity

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

The manufacturer herewith declares that the product:

### **Vitacast, Vitacast-Bloc, Vitaprime, Vitastage**

KSB order number: .....

- is in conformity with the provisions of the following Directives as amended from time to time:
  - Pump (set): EC Machinery Directive 2006/42/EC
  - Pump (set): Regulation 1935/2004/EG on Materials and Articles Intended to Come into Contact with Food

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>5)</sup>.....

Name  
Function  
Company  
Address

---

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

---



## Index

### A

Abrasive fluids 28  
Applications 8

### C

Certificate of decontamination 41  
Cleaning 26, 27

### D

Design 15  
Designation 14  
Direction of rotation 22  
Dismantling 33  
Disposal 13  
Drive 15

### E

Electromagnetic compatibility 20  
Event of damage  
    Ordering spare parts 35  
Explosion protection 22, 30

### F

Faults  
    Causes and remedies 36  
Filter 32  
Filters 19  
Fluid handled  
    Density 28  
Frequency of starts 26

### I

Impeller type 15  
Installation 15  
Installation at site 18  
Intended use 8  
Interference immunity 21

### K

Key to safety symbols/markings 8

### M

Maintenance 31  
Mechanical seal 24  
Misuse 9

### N

Name plate 15  
Noise characteristics 16

### O

Operating limits 25  
Operation on a frequency inverter 20  
Order number 6  
Other applicable documents 6

### P

Partly completed machinery 6  
Permissible forces at the pump nozzles 20  
Piping 19  
Preservation 12, 29  
Product description 14

### R

Reassembly 33, 34  
Return to supplier 12  
Returning to service 29

### S

Safety 8  
Safety awareness 9  
Scope of supply 17  
Shaft seal 15  
Shutdown 29  
Spare part  
    Ordering spare parts 35  
Start-up 24  
Storage 12, 29

### T

Transport 11

### W

Warnings 8





**KSB SE & Co. KGaA**

Johann-Klein-Straße 9 • 67227 Frankenthal (Germany)

Tel. +49 6233 86-0

[www.ksb.com](http://www.ksb.com)