

Standardised Pump

Etachrom L

Installation/Operating Manual



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Installation/Operating Manual Etachrom L

Original operating manual

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Glossary

ACS

French drinking water regulations (ACS = Attestation de Conformité Sanitaire)

Back pull-out design

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

Back pull-out unit

Pump without pump casing; partly completed machinery

Certificate of decontamination

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

Discharge line

The pipeline which is connected to the discharge nozzle

Hydraulic system

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

Pool of pumps

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

Pump

Machine without drive, additional components or accessories

Pump set

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

Suction lift line/suction head line

The pipeline which is connected to the suction nozzle

UBA

German drinking water regulations to German Environment Agency

WRAS

Approved by all water suppliers in the UK (WRAS = Water Regulations Advisory Scheme)

1 General

1.1 Principles

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

The operating 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 facility to maintain the right to claim under warranty.

1.2 Installation of partly completed machinery

To install partly completed machinery supplied by KSB refer to the sub-sections under Servicing/Maintenance. (⇒ Section 7.5.5, Page 53)

1.3 Target group

This operating manual is aimed at the target group of trained and qualified specialist technical personnel. (⇒ Section 2.3, 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 dimensions 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 ¹⁾	Sectional drawing of the pump
Sub-supplier product literature ¹⁾	Operating manuals and other product literature describing accessories and integrated machinery components
Spare parts lists ¹⁾	Description of spare parts
Piping layout ¹⁾	Description of auxiliary piping
List of components ¹⁾	Description of all pump components
Assembly drawing ¹⁾	Sectional drawing of the installed shaft seal

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

1.5 Symbols

Table 2: Symbols used in this manual

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

¹ If included in agreed scope of supply

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

1.6 Key to safety symbols/markings

Table 3: Definition of safety symbols/markings

Symbol	Description
 DANGER	DANGER This signal word indicates a high-risk hazard which, if not avoided, will result in death or serious injury.
 WARNING	WARNING This signal word indicates a medium-risk hazard which, if not avoided, could result in death or serious injury.
CAUTION	CAUTION This signal word indicates a hazard which, if not avoided, could result in damage to the machine and its functions.
	Explosion protection This symbol identifies information about avoiding explosions in potentially explosive atmospheres in accordance with the <i>Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016</i> .
	General hazard In conjunction with one of the signal words this symbol indicates a hazard which will or could result in death or serious injury.
	Electrical hazard In conjunction with one of the signal words this symbol indicates a hazard involving electrical voltage and identifies information about protection against electrical voltage.
	Machine damage In conjunction with the signal word CAUTION this symbol indicates a hazard for the machine and its functions.



2 Safety

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

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

2.1 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.
- Comply with all the safety instructions given in the individual sections of this operating manual.
- 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 and markings 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.

2.2 Intended use

- The pump (set) must only be operated in the fields of application and within the use limits specified in the other applicable documents. (⇒ Section 1.4, Page 7)
- 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 (set) to handle the fluids described in the data sheet or product literature of the pump model.
- Never operate the pump (set) without the fluid to be handled.
- 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).
- Always operate the pump (set) in the direction of rotation it is intended for.
- Do not throttle the flow rate on the suction side of the pump (to prevent cavitation damage).
- Consult the manufacturer about any use or mode of operation not described in the data sheet or product literature.

2.3 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.

2.4 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

2.5 Safety awareness

In addition to the safety information contained in this operating 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

2.6 Safety information for the operator/user

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

2.7 Safety information for maintenance, inspection and installation

- Modifications or alterations of the pump (set) are only permitted with the manufacturer's prior consent.
- Use only original spare parts or parts/components authorised by the manufacturer. The use of other parts/components can invalidate any liability of the manufacturer for resulting damage.
- The operator ensures that maintenance, inspection and installation are performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.
- Only carry out work on the pump (set) during standstill of the pump.
- Only perform work on the pump set when it has been disconnected from the power supply (de-energised).
- The pump (set) must have cooled down to ambient temperature.
- Pump pressure must have been released and the pump must have been drained.

- When taking the pump set out of service always adhere to the procedure described in the manual. (⇒ Section 6.1.7, Page 37) (⇒ Section 6.3, Page 40)
- Decontaminate pumps which handle fluids posing a health hazard. (⇒ Section 7.3, Page 47)
- 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 35)

2.8 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 2.2, Page 9)

2.9 Explosion protection



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

Pumps/Pump sets must not be used in potentially explosive atmospheres unless marked as explosion-proof **and** identified as such in the data sheet.

Special conditions apply to the operation of explosion-proof pump sets in accordance with the UK's *Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016*.

Especially adhere to the sections in this manual marked with the Ex symbol and the following sections, (⇒ Section 2.9.1, Page 11) to (⇒ Section 2.9.4, Page 12)
The explosion-proof status of the pump is only assured if the pump is used in accordance with its intended use.

Never operate the product outside the limits stated in the data sheet and on the name plate.

Prevent impermissible modes of operation at all times.

2.9.1 Marking

Pump The marking on the pump refers to the pump part only.

Example of such marking:
II 2G Ex h IIC T5-T1 Gb

Refer to the Temperature limits table for the maximum temperatures permitted for the individual pump variants. (⇒ Section 2.9.2, Page 11)

The pump complies with the requirements of type of protection constructional safety "c" to ISO 80079-37.

Shaft coupling An EC manufacturer's declaration is required for the shaft coupling; the shaft coupling must be marked accordingly.

Motor The motor must be considered separately.

2.9.2 Temperature limits

In normal pump operation, the highest temperatures are to be expected at the surface of the pump casing, at the shaft seal and in the bearing areas.

The surface temperature at the pump casing corresponds to the temperature of the fluid handled. If the pump is heated in addition, the operator of the system is responsible for observing the specified temperature class and fluid temperature (operating temperature).

The table (⇒ Table 4) lists the temperature classes and the resulting maximum permissible fluid temperatures. The values shown correspond to the theoretical limits. They include only a general safety margin for the mechanical seal. For single mechanical seals, the safety margin required for specific operating conditions and mechanical seal designs may be substantially higher. If operating conditions differ

from those stated on the data sheet, or if different mechanical seals are used, the actual safety margin required needs to be determined individually. If in doubt please contact the manufacturer.

The temperature class specifies the maximum permissible temperature at the surface of the pump set during operation.

For the permissible operating temperature of the pump in question refer to the data sheet.

Table 4: Temperature limits

Temperature class to ISO 80079-36	Maximum permissible fluid temperature ²⁾
T1	Temperature limit of the pump
T2	280 °C
T3	185 °C
T4	120 °C
T5	85 °C
T6	Only after consultation with the manufacturer

In the following cases, and if ambient temperatures are higher, contact the manufacturer.

Temperature class T5 Based on an ambient temperature of 40 °C and proper maintenance and operation, compliance with temperature class T5 is warranted in the area of the rolling element bearings. If the ambient temperature exceeds 40 °C, contact the manufacturer.

Temperature class T6 If temperature class T6 must be complied with, special measures may be required with regard to bearing temperature.

Misuse, malfunctions or non-compliance with the instructions may result in substantially higher temperatures.

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

2.9.3 Monitoring equipment

The pump (set) must only be operated within the limits specified in the data sheet and on the name plate.

If the system operator cannot warrant compliance with these operating limits, appropriate monitoring devices must be used.

Check whether monitoring equipment is required to ensure that the pump set functions properly.

Contact KSB for further information about monitoring equipment.

2.9.4 Operating limits

The minimum flow rates indicated in (⇒ Section 6.2.3.1, Page 39) refer to water and water-like fluids handled. Longer operating periods with these fluids and at the flow rates indicated will not cause an additional increase in the temperatures at the pump surface. However, if the physical properties of the fluids handled are different from water, it is essential to check whether an additional heat build-up may occur and if the minimum flow rate must therefore be increased. The calculation formula in (⇒ Section 6.2.3.1, Page 39) can be used to check whether an additional heat build-up may lead to a dangerous temperature increase at the pump surface.

² Subject to further limitations for mechanical seal temperature rise

3 Transport/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

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

To transport the pump/pump set or back pull-out unit suspend it from the lifting tackle as shown.

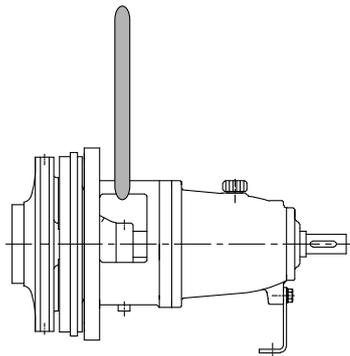


Fig. 1: Transporting the back pull-out unit

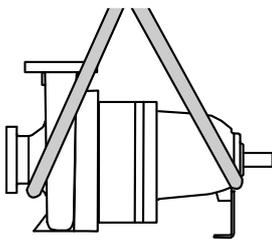


Fig. 2: Transporting the pump

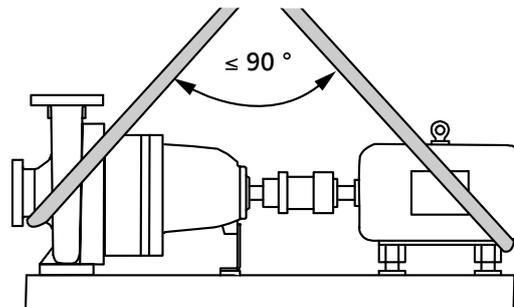


Fig. 3: Transporting the pump set

1212.87/01-EN

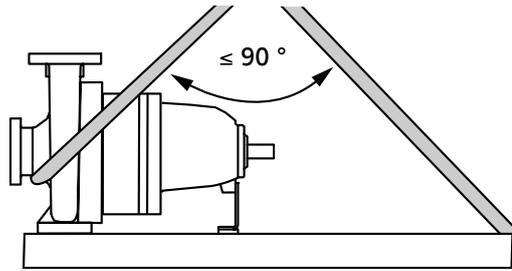


Fig. 4: Transporting the pump on the baseplate

3.3 Storage/preservation

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

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

- 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 40)

3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇒ Section 7.3, Page 47)
2. Flush and clean the pump, particularly if it has been used for handling noxious, explosive, hot or other hazardous fluids.
3. If the pump has handled fluids whose residues could lead to corrosion damage in the presence of atmospheric humidity or could ignite upon contact with oxygen also neutralise the pump and blow through with anhydrous inert gas to ensure drying.
4. Always complete and enclose a certificate of decontamination when returning the pump.
Indicate any safety measures and decontamination measures taken.
(⇒ Section 11, Page 66)

	NOTE
	<p>If required, a blank certificate of decontamination can be downloaded from the following web site: www.ksb.com/certificate_of_decontamination</p>

3.5 Disposal

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

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

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

4.2 Product information

4.2.1 Product information as per Ecodesign for Energy-Related Products Regulations 2010

- Minimum efficiency index: see name plate, key to name plate (⇒ Section 4.4, Page 18)
- The benchmark for the most efficient water pumps is $MEI \geq 0.70$.
- Year of construction: see name plate, key to name plate (⇒ Section 4.4, Page 18)
- Manufacturer's name or trade mark, commercial registration number and place of manufacture: see data sheet or order documentation
- Product's type and size identifier: see name plate, key to name plate (⇒ Section 4.4, Page 18)
- Hydraulic pump efficiency (%) with trimmed impeller: see data sheet
- Pump performance curves, including efficiency characteristics: see documented characteristic curve
- The efficiency of a pump with a trimmed impeller is usually lower than that of a pump with full impeller diameter. Trimming of the impeller will adapt the pump to a fixed duty point, leading to reduced energy consumption. The minimum efficiency index (MEI) is based on the full impeller diameter.
- Operation of this water pump with variable duty points may be more efficient and economic when controlled, for example, by the use of a variable speed drive that matches the pump duty to the system.
- Information on dismantling, recycling and disposal after decommissioning: (⇒ Section 3.5, Page 15)
- Information on benchmark efficiency or benchmark efficiency graph for $MEI = 0.70$ (0.40) for the pump based on the model shown in the Figure are available at: <http://www.europump.org/efficiencycharts>

4.2.2 Product information as per Regulation No. 1907/2006 (REACH)

For information as per chemicals Regulation (EC) No. 1907/2006 (REACH), see <https://www.ksb.com/ksb-en/About-KSB/Corporate-responsibility/reach/>.

4.3 Designation

Table 5: Designation example

Position																																											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
E	T	C	L	0	5	0	-	0	2	5	-	1	2	5		C	C	S	A	A	0	7	D	1	0	1	0	0	2	e	x	B	P	D	2		M	K	S	B	I	E	4
See name plate and data sheet																						See data sheet																					

Table 6: Designation key

Position	Code	Description
1-4	Pump type	
	ETCL	Etachrom L
5-16	Size, e.g.	
	050	Nominal suction nozzle diameter [mm]

Position	Code	Description
5-16	025	Nominal discharge nozzle diameter [mm]
	125	Nominal impeller diameter [mm]
17	Pump casing material	
	C	Stainless steel 1.4571
18	Impeller material	
	C	Stainless steel 1.4571/1.4408
19	Design	
	E	Materials in contact with food to Regulation (EC) 1935/2005
	F	Bottle rinser variant
	H	Approved for drinking water to ACS
	K	Approved for drinking water to KSB standard
	S	Standard
	U	Approved for drinking water to UBA
	W	Approved for drinking water to WRAS
20-21	Casing cover	
	AA	Internal circulation (seal chamber only)
	AS	Internal circulation (seal chamber only), casing cover with anti-swirl baffles
22-23	Seal code, single mechanical seal	
	01	Q1Q1VGG 1A (ZN1181)
	07	Q1Q1EGG 1A (ZN1181)
	09	U3U3VGG MG13G60
	10	Q1Q1X4GG 1 (ZN1181)
	11	BQ1EGG-WA (WA = drinking water) 1 (ZN1181)
	12	Q12Q1M1GG1 M37GN83
	17	Q1BVGG M7N
	26	XYHY2VY Roten Uniten 3
	45	BQ7E1GG/Y10 KU 022 S0 - eMG12G6
	46	Q7Q7E1GG/Y10 KU 022 S0 - eMG12G6
	66	Q7Q7EGG/Y10-WA eMG13G6
	67	Q6Q6X4GG MG13G60
	68	BQ7V16GG/Y10 KU 022 S0 - eMG12G6
	69	Q7Q7V16GG/Y10 KU 022 S0 - eMG12G6
24	Scope of supply	
	A	Pump, without motor (figure 0 bare-shaft pump)
	B	Pump, baseplate, without motor
	C	Pump, baseplate, coupling, coupling guard, without motor
	D	Pump, baseplate, coupling, coupling guard, motor
25	Shaft unit	
	1	Shaft unit 25.1
	2	Shaft unit 25.2
	3	Shaft unit 35
26-29	Motor rating P_N [kW]	
	0750	7,50

	0110	11,00
30	Number of motor poles	
31-32	Explosion protection	

Position	Code	Description
31-32	ex	With explosion-proof motor
	--	Without explosion-proof motor
33	Product generation	
	B	Etachrom L 08/2015
34-37	PumpDrive	
	PD2	PumpDrive 2
	PD2E	PumpDrive 2 Eco
38	PumpMeter	
	M	PumpMeter
39-41	Motor manufacturer	
	KSB	KSB
	SIE	Siemens
	LOH	Loher
	HAL	Halter
42-44	Efficiency class	

4.4 Name plate

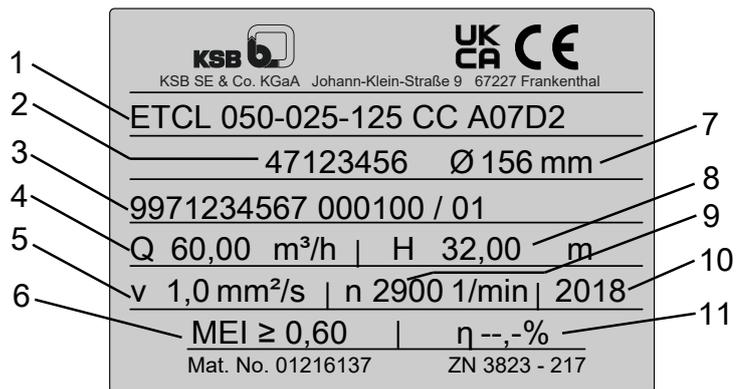


Fig. 5: Name plate (example) Etachrom L

1	Type series, size and version	2	Material number (optional)
3	KSB order number, order item number, consecutive number	4	Flow rate
5	Kinematic viscosity of the fluid handled	6	Minimum efficiency index
7	Impeller diameter	8	Head
9	Speed	10	Year of construction
11	Efficiency (see data sheet)		

4.5 Design details

Design

- Design with materials to Regulation (EC) No. 1935/2004 can be provided.
- Version for potentially explosive atmospheres

Design

- Circular casing pumps
- Back pull-out design
- Flanges to EN 1092-1
- Horizontal installation
- Single-stage
- Dimensions and ratings to EN 733
- Pump and motor connected by shaft coupling

Pump casing

- Circular casing with welded-on or bolted-on pump feet
- Replaceable casing wear rings

Drive

Standard design:

- KSB surface-cooled IEC three-phase current squirrel-cage motor
- Rated voltage (50 Hz) 220-240 V / 380-420 V \leq 2.20 kW
- Rated voltage (50 Hz) 380-420 V / 660 - 725 V \geq 3.00 kW
- Rated voltage (60 Hz) 440-480 V \leq 2.60 kW
- Rated voltage (60 Hz) 440-480 V \geq 3.60 kW
- Type of construction IM B3
- Duty type: continuous duty S1
- Enclosure IP55
- Thermal class F
- 3 PTC thermistors

or

- KSB surface-cooled IEC frame three-phase current squirrel-cage motor as described above, but West European make to our choice

or

Explosion-proof design:

- Surface-cooled IEC three-phase current squirrel-cage motor
- Rated voltage (50 Hz) 220 - 240 V / 380 - 420 V \leq 1.85 kW
- Rated voltage (50 Hz) 380 - 420 V / 660 - 725 V \geq 2.50 kW
- Enclosure IP55 or IP54
- II 3G Ex ec IIC T3 Gc
- II 2G Ex eb IIC T3 Gb
- II 2G Ex db (eb) IIB T4 Gb
- II 2G Ex db (eb) IIC T4 Gb

Shaft seal

- Single mechanical seal to EN 12756
- The shaft is fitted with a replaceable shaft sleeve in the shaft seal area (sizes 080-065-250, 100-080-200, 100-080-250)

Impeller type

- Closed radial impeller with multiply curved vanes

Bearings

- Grease-packed radial ball bearing

Automation

Automation options:

- PumpDrive
- PumpMeter

4.6 Configuration and function

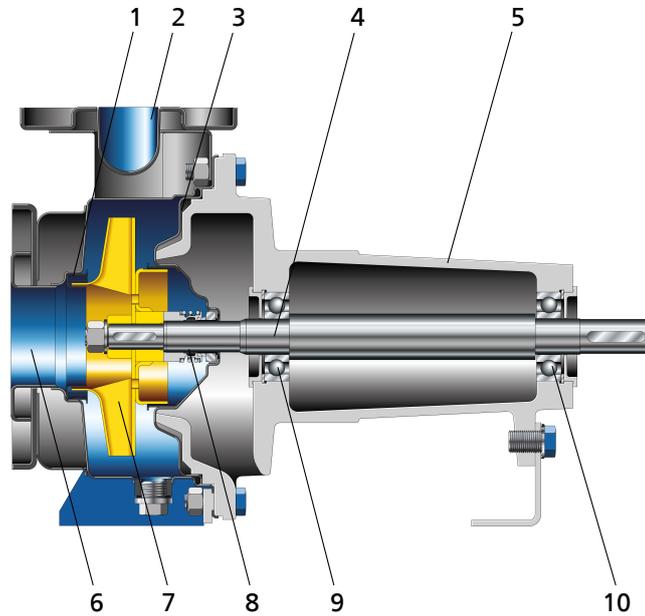


Fig. 6: Sectional drawing

1	Clearance gap	2	Discharge nozzle
3	Casing cover	4	Shaft
5	Bearing bracket	6	Suction nozzle
7	Impeller	8	Shaft seal
9	Rolling element bearing, pump end	10	Rolling element bearing, drive end

Design The pump is designed with an axial fluid inlet and a radial outlet. The hydraulic system runs in its own bearings and is connected to the motor by a shaft coupling.

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

Sealing The pump is sealed by a standardised mechanical seal.

4.7 Noise characteristics

Table 7: Surface sound pressure level L_{pA} ^{3) 4)}

Rated power input P_N [kW]	Pump		Pump set	
	1450 rpm [dB]	2900 rpm [dB]	1450 rpm [dB]	2900 rpm [dB]
0,55	47	48	55	64
0,75	48	50	57	64
1,1	50	52	60	64
1,5	52	54	60	69
2,2	54	56	64	69
3	55	57	64	71
4	57	59	62	73
5,5	59	61	68	72
7,5	60	62	68	72
11	62	64	69	75
15	-	66	-	75
18,5	-	67	-	75
22	-	68	-	78
30	-	70	-	79
37	-	71	-	79
45	-	72	-	79
55	-	73	-	79
75	-	75	-	82

4.8 Scope of supply

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

- Pump

Drive

- Surface-cooled IEC frame three-phase squirrel-cage motor

Coupling

- Flexible coupling with or without spacer

Contact guard

- Coupling guard

Baseplate

- Channel section steel or folded steel plate

Optional:

- Cast baseplate to ISO 3661

Special accessories

- As required

³⁾ Surface sound pressure level as per ISO 3744 and DIN EN ISO 20361 ; valid for a pump operating range of $Q/Q_{BEP} = 0.8 - 1.1$ and non-cavitating operation. If noise levels are to be guaranteed: Add +3 dB for measuring and constructional tolerance.

⁴⁾ Increase for 60 Hz operation: 3500 rpm +3 dB, 1750 rpm +1 dB

4.9 Dimensions and weights

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

5 Installation at Site

5.1 Checks to be carried out prior to installation

Place of installation

	 WARNING
	<p>Installation on a mounting surface which is unsecured and cannot support the load Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▷ Use a concrete of compressive strength class C12/15 which meets the requirements of exposure class XC1 to EN 206-1. ▷ The mounting surface must be set, flat, and level. ▷ Check the indicated weights.

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.

5.2 Installing the pump set

Always install the pump set in a horizontal position.

	 DANGER
	<p>Excessive temperatures due to improper installation Explosion hazard!</p> <ul style="list-style-type: none"> ▷ Install the pump in a horizontal position to ensure self-venting of the pump.
	 DANGER
	<p>Electrostatic charging due to insufficient potential equalisation Explosion hazard!</p> <ul style="list-style-type: none"> ▷ Make sure that the connection between pump and baseplate is electrically conductive.

5.2.1 Installation on the foundation

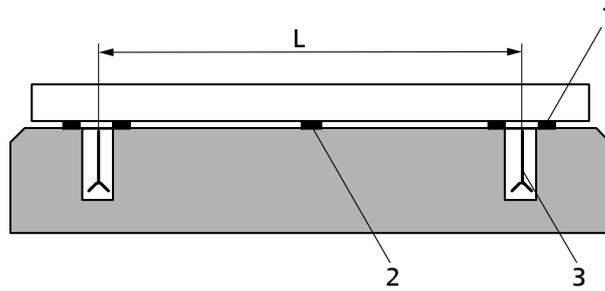


Fig. 7: Fitting the shims

L	Bolt-to-bolt distance	1	Shim
2	Shim if (L) > 800 mm	3	Foundation bolt

- ✓ The foundation has the required strength and characteristics.
 - ✓ The foundation has been prepared in accordance with the dimensions given in the outline drawing/general arrangement drawing.
1. Position the pump set on the foundation and level it with the help of a spirit level placed on the shaft and discharge nozzle.
Permissible deviation: 0.2 mm/m
 2. Use shims (1) for height compensation, if necessary.
Always fit shims, if any, immediately to the left and right of the foundation bolts (3) between the baseplate/foundation frame and the foundation.
For a bolt-to-bolt distance (L) > 800 mm fit additional shims (2) halfway between the bolt holes.
All shims must lie perfectly flush.
 3. Insert the foundation bolts (3) into the holes provided.
 4. Use concrete to set the foundation bolts (3) into the foundation.
 5. Wait until the concrete has set firmly, then level the baseplate.
 6. Tighten the foundation bolts (3) evenly and firmly.

	<p>NOTE</p> <p>For optimum smooth running, baseplates should be grouted with low-shrinkage concrete in the following cases:</p> <ul style="list-style-type: none"> - For all vibration-critical applications - Baseplates with a width > 400 mm - Baseplates made of grey cast iron
	<p>NOTE</p> <p>For low-noise operation contact the manufacturer to check whether the pump set can be installed on anti-vibration mounts.</p>
	<p>NOTE</p> <p>Expansion joints can be fitted between the pump and the suction line or discharge line.</p>

5.2.2 Installation without foundation

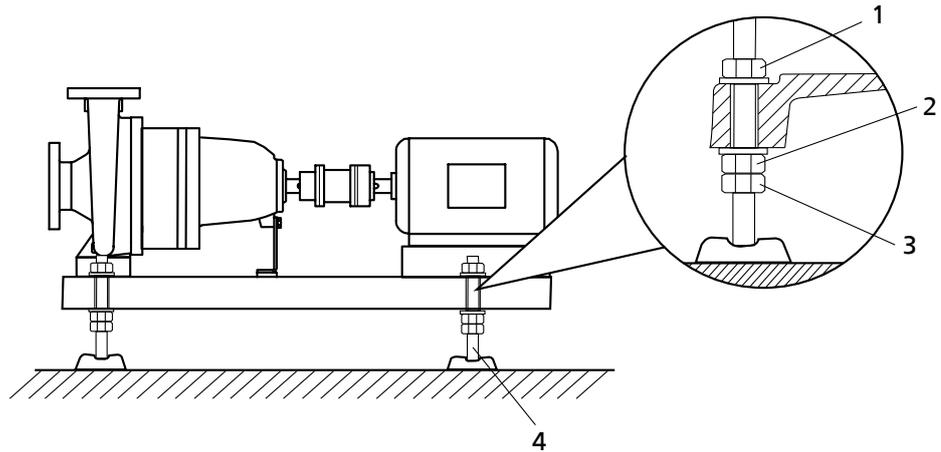


Fig. 8: Adjusting the levelling elements

1, 3	Locknut	2	Adjusting nut
4	Machine mount		

- ✓ The installation surface has the required strength and characteristics.
- 1. Position the pump set on the machine mounts (4) and align it with the help of a spirit level (on the shaft/discharge nozzle).
- 2. To adjust any differences in height, loosen the locknuts (1, 3) of the machine mounts (4).
- 3. Turn the adjusting nut (2) until any differences in height have been compensated.
- 4. Re-tighten the locknuts (1, 3) at the machine mounts (4).

5.3 Piping

5.3.1 Connecting the piping

	<p>! DANGER</p>
	<p>Impermissible loads acting on the pump nozzles Danger to life from escaping hot, toxic, corrosive or flammable fluids!</p> <ul style="list-style-type: none"> ▷ Do not use the pump as an anchorage point for the piping. ▷ Anchor the pipes in close proximity to the pump and connect them properly without transmitting any stresses or strains. ▷ Observe the permissible forces and moments at the pump nozzles. (⇒ Section 5.3.2, Page 27) ▷ Take appropriate measures to compensate for thermal expansion of the piping.
	<p>CAUTION</p>
	<p>Incorrect earthing during welding work at the piping Destruction of rolling element bearings (pitting effect)!</p> <ul style="list-style-type: none"> ▷ Never earth the electric welding equipment on the pump or baseplate. ▷ Prevent current flowing through the rolling element bearings.

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	NOTE
	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.

- ✓ 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.

	CAUTION
	<p>Welding beads, scale and other impurities in the piping</p> <p>Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Remove any impurities from the piping. ▷ If necessary, install a filter. ▷ Observe the information in (⇒ Section 7.2.2.3, Page 46) .

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.
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).

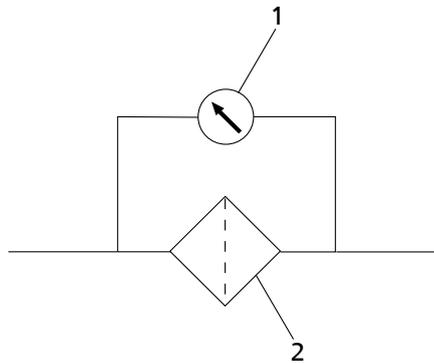


Fig. 9: Filter in the piping

1	Differential pressure gauge	2	Filter
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	NOTE
	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.

5. Connect the pump nozzles to the piping.

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	CAUTION
	<p>Aggressive flushing liquid and pickling agent Damage to the pump!</p> <p>▷ Match the cleaning operation mode and duration of flushing and pickling to the casing materials and seal materials used.</p>

5.3.2 Permissible forces and moments at the pump nozzles

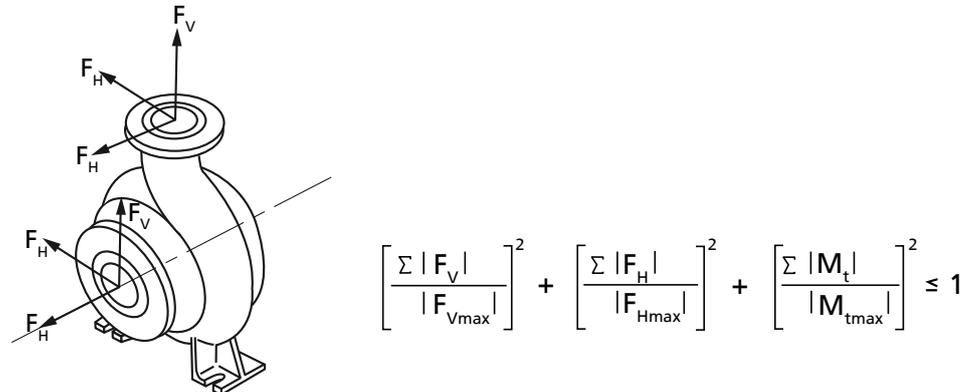


Fig. 10: Forces and moments at the pump nozzles

The following condition must be met:

$\sum |F_{V,i}|$, $\sum |F_{H,i}|$, and $\sum |M_{t,i}|$ are the sums of the absolute values of the respective loads acting on the nozzles. Neither the load direction nor the load distribution among the nozzles are taken into account in these sums.

Table 8: Forces and moments at the pump nozzles⁵⁾

Size	F_{Vmax}	F_{Hmax}	M_{tmx}
	[kN]	[kN]	[kNm]
050-025-125.1	2,6	1,8	0,55
050-025-125	2,6	1,8	0,55
050-025-160	2,5	1,7	0,5
050-025-200	2,5	1,7	0,5
050-025-250	2,5	1,7	0,5
050-032-125.1	2,6	1,8	0,55
050-032-125	2,6	1,8	0,55
050-032-160	2,5	1,7	0,5
050-032-200	2,5	1,7	0,5
050-032-250	2,5	1,7	0,5
065-040-125	2,6	1,8	0,6
065-040-160	2,6	1,8	0,6
065-040-200	2,6	1,8	0,6
065-040-250	2,6	1,8	0,6
065-050-125	2,7	2,0	0,75
065-050-160	2,7	1,9	0,7
065-050-200	2,7	1,9	0,7
065-050-250	2,7	1,9	0,7
080-065-200	3,0	2,2	0,85
080-065-250	3,2	2,4	1,05

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⁵⁾ The indicated values apply to pumps made of chrome nickel molybdenum steel 1.4571 on non-grouted baseplates.

Size	F_{Vmax}	F_{Hmax}	M_{tmax}
	[kN]	[kN]	[kNm]
100-080-200	4,0	2,9	1,45
100-080-250	4,0	2,9	1,45

5.3.3 Vacuum balance line

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

The following rules apply to vacuum balance lines:

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

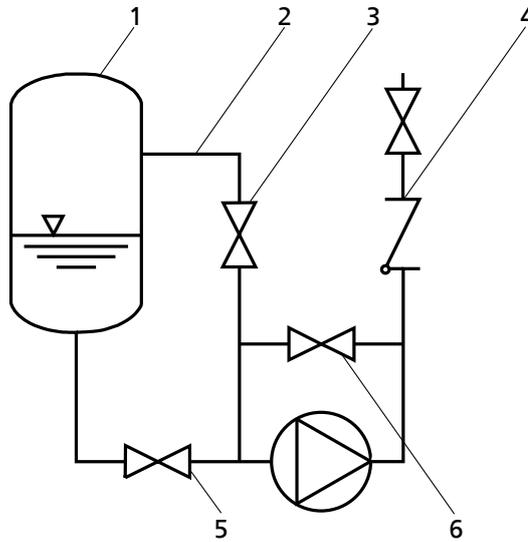


Fig. 11: Vacuum balance system

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

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

5.4 Enclosure/insulation

	⚠ DANGER
	<p>Risk of potentially explosive atmosphere due to insufficient venting Explosion hazard!</p> <ul style="list-style-type: none"> ▶ Make sure the space between the casing cover/discharge cover and the bearing cover is sufficiently vented. ▶ Never close or cover the perforation of the bearing bracket guards (e.g. by insulation).

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	<p>⚠ WARNING</p> <p>The volute casing and casing/discharge cover take on the same temperature as the fluid handled</p> <p>Risk of burns!</p> <ul style="list-style-type: none"> ▷ Insulate the volute casing. ▷ Fit protective equipment.
	<p>CAUTION</p> <p>Heat build-up in the bearing bracket</p> <p>Damage to the bearing!</p> <ul style="list-style-type: none"> ▷ Never insulate the bearing bracket, bearing bracket lantern and casing cover.
	<p>NOTE</p> <p>Pump casings handling fluids at temperatures below freezing point may be insulated at the site, subject to the manufacturer's prior approval.</p>

5.5 Checking the coupling alignment

 	<p>⚠ DANGER</p> <p>Inadmissible temperatures at the coupling or bearings due to misalignment of the coupling</p> <p>Explosion hazard!</p> <p>Risk of burns!</p> <ul style="list-style-type: none"> ▷ Make sure that the coupling is correctly aligned at all times.
	<p>CAUTION</p> <p>Misalignment of pump and motor shafts</p> <p>Damage to pump, motor and coupling!</p> <ul style="list-style-type: none"> ▷ Always check the coupling after the pump has been installed and connected to the piping. ▷ Also check the coupling of pump sets supplied with pump and motor mounted on the same baseplate.

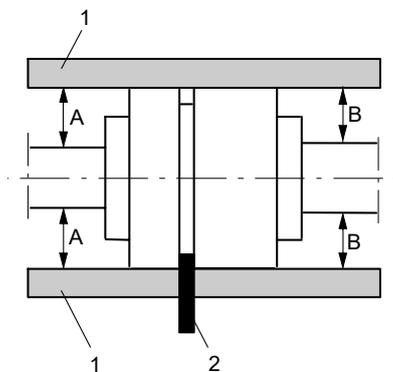


Fig. 12: Non-spacer-type coupling, checking the coupling alignment

1	Straight edge	2	Gauge
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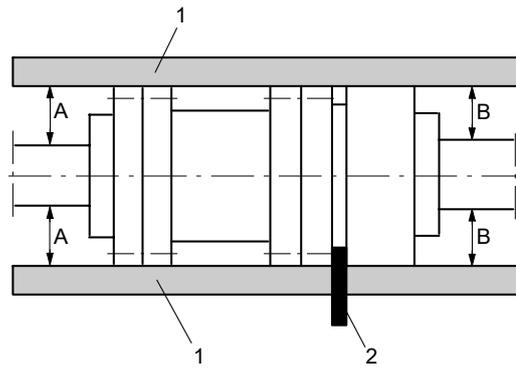


Fig. 13: Spacer-type coupling, checking the coupling alignment

1	Straight edge	2	Gauge
---	---------------	---	-------

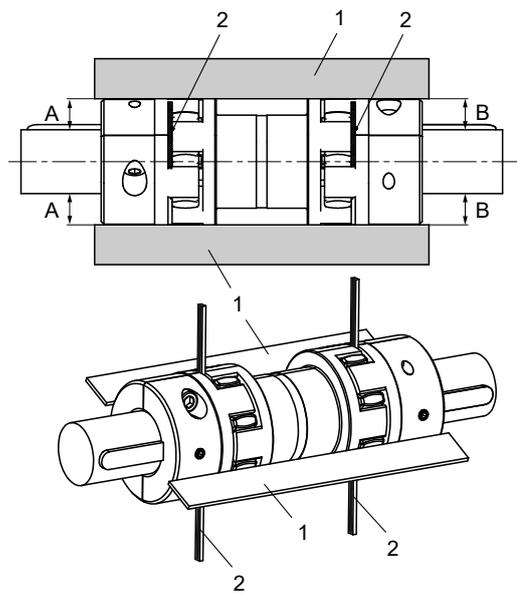


Fig. 14: Double Cardan spacer-type coupling, checking the coupling alignment

1	Straight edge	2	Gauge
---	---------------	---	-------

Table 9: Permissible alignment offset of coupling halves

Coupling type	Radial offset	Axial offset
	[mm]	[mm]
Non-spacer-type coupling (⇒ Fig. 12)	≤ 0,1	≤ 0,1
Spacer-type coupling (⇒ Fig. 13)	≤ 0,1	≤ 0,1
Double Cardan coupling (⇒ Fig. 14)	≤ 0,5	≤ 0,5

- ✓ The coupling guard and its footboard, if any, have been removed.
- 1. Loosen the support foot and re-tighten it without transmitting any stresses and strains.
- 2. Place the straight edge axially on both coupling halves.
- 3. Leave the straight edge in this position and turn the coupling by hand.
The coupling is aligned correctly if the distances A and B to the respective shafts are the same at all points around the circumference.
Observe the permissible radial offset in coupling half alignment (⇒ Table 9) both during standstill and at operating temperature as well as under inlet pressure.
- 4. Check the distance (dimension see general arrangement drawing) between the two coupling halves around the circumference.
The coupling is correctly aligned if the distance between the two coupling

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halves is the same at all points around the circumference.

Observe the permissible axial offset in coupling half alignment (⇒ Table 9) both during standstill and at operating temperature as well as under inlet pressure.

- If alignment is correct, re-install the coupling guard and its footboard, if any.

Checking the coupling alignment with a laser tool

Coupling alignment may also be checked with a laser tool. Observe the documentation provided by the manufacturer of the measuring instrument.

5.6 Aligning the pump and motor

After having installed the pump set and connected the piping, check the coupling alignment and, if required, re-align the pump set (at the motor).

5.6.1 Motors with adjusting screw

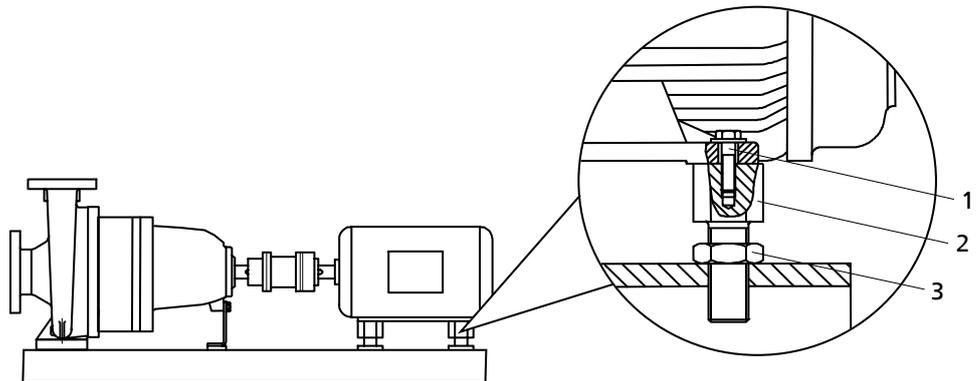


Fig. 15: Motor with adjusting screw

1	Hexagon head bolt	2	Adjusting screw
3	Locknut		

✓ The coupling guard and its footboard, if any, have been removed.

- Check the coupling alignment.
- Unscrew the hexagon head bolts (1) at the motor and the locknuts (3) at the baseplate.
- Turn the adjusting screws (2) by hand or by means of an open-end wrench until the coupling alignment is correct and all motor feet rest squarely on the baseplate.
- Re-tighten the hexagon head bolts (1) at the motor and the locknuts (3) at the baseplate.
- Check proper functioning of coupling/shaft.
Check that coupling/shaft can easily be rotated by hand.

	<p>⚠ WARNING</p>
	<p>Unprotected rotating coupling Risk of injury by rotating shafts!</p> <ul style="list-style-type: none"> ▷ Always operate the pump set with a coupling guard. If the customer specifically requests not to include a coupling guard in KSB's delivery, then the operator must supply one! ▷ Observe all relevant regulations for selecting a coupling guard.

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	DANGER
	<p>Risk of ignition by frictional sparks Explosion hazard!!</p> <ul style="list-style-type: none"> ▷ Choose a coupling guard material that is non-sparking in the event of mechanical contact.

6. Fit the coupling guard and its footboard, if any.
7. Check the distance between coupling and coupling guard.
The coupling guard must not touch the coupling.

5.6.2 Motors without adjusting screw

Any differences in the centreline heights of the pump and motor shafts are compensated by means of shims.

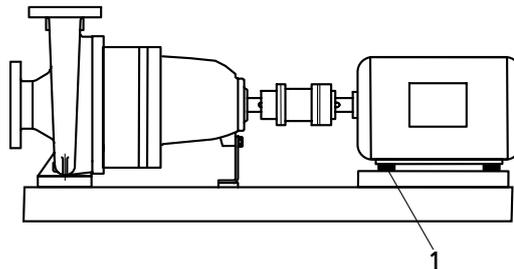


Fig. 16: Pump set with shim

1	Shim
---	------

- ✓ The coupling guard and its footboard, if any, have been removed.
1. Check the coupling alignment.
 2. Loosen the hexagon head bolts at the motor.
 3. Insert shims underneath the motor feet until the difference in shaft centreline height has been compensated.
 4. Re-tighten the hexagon head bolts.
 5. Check proper functioning of coupling/shaft.
Check that coupling/shaft can easily be rotated by hand.

	WARNING
	<p>Unprotected rotating coupling Risk of injury by rotating shafts!</p> <ul style="list-style-type: none"> ▷ Always operate the pump set with a coupling guard. If the customer specifically requests not to include a coupling guard in KSB's delivery, then the operator must supply one! ▷ Observe all relevant regulations for selecting a coupling guard.

	DANGER
	<p>Risk of ignition by frictional sparks Explosion hazard!!</p> <ul style="list-style-type: none"> ▷ Choose a coupling guard material that is non-sparking in the event of mechanical contact.

6. Fit the coupling guard and its footboard, if any.
7. Check the distance between coupling and coupling guard.
The coupling guard must not touch the coupling.

5.7 Electrical connection

	DANGER
	<p>Electrical connection work by unqualified personnel Risk of fatal injury due to electric shock!</p> <ul style="list-style-type: none"> ▷ Always have the electrical connections installed by a trained and qualified electrician. ▷ Observe regulations IEC 60364 and, for explosion-proof models, EN 60079.

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

1. Check the available mains voltage against the data on the motor name plate.
2. Select an appropriate starting method.

	NOTE
	Installing a motor protection device is recommended.

5.7.1 Setting the time relay

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

Table 10: Time relay settings for star-delta starting:

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

5.7.2 Earthing

 	DANGER
	<p>Electrostatic charging Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Connect the PE conductor to the earthing terminal provided. ▷ Provide for potential equalisation between the pump set and the foundation.

5.7.3 Connecting the motor

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

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

5.8 Checking the direction of rotation

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

	⚠ WARNING
	<p>Hands inside the pump casing Risk of injuries, damage to the pump!</p> <ul style="list-style-type: none"> ▷ 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.

	CAUTION
	<p>Incorrect direction of rotation with non-reversible mechanical seal Damage to the mechanical seal and leakage!</p> <ul style="list-style-type: none"> ▷ Separate the pump from the motor to check the direction of rotation.

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

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

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

6 Commissioning/Start-up/Shutdown

6.1 Commissioning/Start-up

6.1.1 Prerequisites for commissioning/start-up

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

- The pump set has been mechanically connected as specified.
- The pump set has been properly connected to the power supply and is equipped with all protection devices. (⇒ Section 5.7, Page 33)
- The pump has been filled with the fluid to be handled. The pump has been vented.
- The direction of rotation has been checked. (⇒ Section 5.8, Page 34)
- All auxiliary connections required are connected and operational.
- The lubricants have been checked. (⇒ Section 6.1.2, Page 35)
- After prolonged shutdown of the pump (set), the activities required for returning the equipment to service have been carried out. (⇒ Section 6.4, Page 40)

6.1.2 Filling in lubricants

Grease-lubricated bearings have been packed with grease at the factory.

6.1.3 Priming and venting the pump

	<p>⚠ DANGER</p>
	<p>Risk of potentially explosive atmosphere inside the pump Explosion hazard!</p> <ul style="list-style-type: none"> ▷ The pump internals in contact with the fluid to be handled, including the seal chamber and auxiliary systems, must be filled with the fluid to be handled at all times. ▷ Provide sufficient inlet pressure. ▷ Provide an appropriate monitoring system.
	<p>CAUTION</p>
	<p>Increased wear due to dry running Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Never operate the pump set without liquid fill. ▷ Never close the shut-off element in the suction line and/or supply line during pump operation.
	<ol style="list-style-type: none"> 1. Vent the pump and suction line and prime both with the fluid to be handled. 2. Fully open the shut-off element in the suction line. 3. Fully open all auxiliary feed lines (barrier fluid, flushing liquid, etc.), if any. 4. Open the shut-off element, if any, in the vacuum balance line and close the vacuum-tight shut-off element, if any. (⇒ Section 5.3.3, Page 28)
	<p>NOTE</p>
	<p>For design-inherent reasons some unfilled volume in the hydraulic system cannot be excluded after the pump has been primed for commissioning/start-up. However, once the motor is started up the pumping effect will immediately fill this volume with the fluid handled.</p>

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6.1.4 Final check

1. Remove the coupling guard and its footboard, if any.
2. Check the coupling alignment; re-align the coupling, if required.
(⇒ Section 5.5, Page 29)
3. Check proper functioning of coupling/shaft.
Check that coupling/shaft can be easily rotated by hand.
4. Fit the coupling guard and its footboard, if any.
5. Check the distance between coupling and coupling guard.
The coupling guard must not touch the coupling.

6.1.5 Start-up

 	<p>⚠ DANGER</p> <p>Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and/or discharge line closed.</p> <p>Explosion hazard! Hot or toxic fluids escaping!</p> <ul style="list-style-type: none"> ▷ Never operate the pump with the shut-off elements in the suction line and/or discharge line closed. ▷ Only start up the pump set with the discharge-side shut-off element slightly or fully open.
 	<p>⚠ DANGER</p> <p>Excessive temperatures due to dry running or excessive gas content in the fluid handled</p> <p>Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Never operate the pump set without liquid fill. ▷ Prime the pump as per operating instructions. ▷ Always operate the pump within the permissible operating range.
	<p>CAUTION</p> <p>Abnormal noises, vibrations, temperatures or leakage</p> <p>Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Switch off the pump (set) immediately. ▷ Eliminate the causes before returning the pump set to service.

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

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

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

	CAUTION
	<p>Misalignment of pump and coupling Damage to pump, motor and coupling!</p> <ul style="list-style-type: none"> ▷ When the operating temperature has been reached, switch off the pump set and check the coupling alignment.

5. Check the coupling alignment and re-align the coupling, if required.

6.1.6 Checking the shaft seal

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

Double mechanical seal

	⚠ DANGER
	<p>Excessive temperature of barrier fluid (pumps with double mechanical seal) Explosion hazard! Excessive surface temperature</p> <ul style="list-style-type: none"> ▷ For pumps with double mechanical seal, make sure that the barrier fluid's temperature does not exceed 60 °C.

6.1.7 Shutdown

	CAUTION
	<p>Heat build-up inside the pump Damage to the shaft seal!</p> <ul style="list-style-type: none"> ▷ 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.

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

	NOTE
	<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 valve in the suction line.
2. Close the auxiliary connections.

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

6.2 Operating limits

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

	⚠ DANGER
	<p>Formation of a potentially explosive atmosphere inside the pump Explosion hazard!</p> <ul style="list-style-type: none"> ▸ When draining tanks take suitable measures to prevent dry running of the pump (e.g. fill level monitoring).

6.2.1 Ambient temperature

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

Observe the following parameters and values during operation:

Table 11: Permissible ambient temperatures

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

6.2.2 Frequency of starts

	DANGER
	<p>Excessive surface temperature of the motor Explosion hazard! Damage to the motor!</p> <p>▷ In case of explosion-proof motors, observe the frequency of starts specified in the manufacturer's product literature.</p>

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.

	CAUTION
	<p>Re-starting while motor is still running down 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 Fluid handled

6.2.3.1 Flow rate

Table 12: Flow rate

Temperature range (t)	Minimum flow rate	Maximum flow rate
-30 to +70 °C	≈ 15 % of Q _{Opt} ⁶⁾	See hydraulic characteristic curves
> 70 to +110 °C	≈ 25 % of Q _{Opt}	

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

$$T_o = T_f + \Delta \vartheta$$

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

Table 13: Key

Symbol	Description	Unit
c	Specific heat capacity	J/kg K
g	Acceleration due to gravity	m/s ²
H	Pump discharge head	m
T _f	Fluid temperature	°C
T _o	Temperature at the casing surface	°C
η	Pump efficiency at duty point	-
Δϑ	Temperature difference	K

6.2.3.2 Density of the fluid handled

The power input of the pump set will change in proportion to the density of the fluid handled.

⁶ Best efficiency point

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

6.2.3.3 Abrasive fluids

When the pump handles fluids containing abrasive substances, increased wear of the hydraulic system and the shaft seal are to be expected. In this case, reduce the commonly recommended inspection intervals.

The fluid handled may contain abrasive particles up to a maximum content of 5 g/dm³ and a maximum particle size of 0.5 mm.

	! DANGER
	<p>Abraded casing wall Explosion hazard!</p> <ul style="list-style-type: none"> ▷ Use a pump with anti-swirl baffle. ▷ Adjust the inspection intervals to the increased abrasion. ▷ For combustible fluids: The fluids must not contain any abrasive particles.

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

The pump (set) is removed from the piping and stored

- ✓ The pump has been properly drained. (⇒ Section 7.3, Page 47)
- ✓ The safety instructions for dismantling the pump have been observed. (⇒ Section 7.4.1, Page 48)
- ✓ The permissible ambient temperature for storing the pump is 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 14)

If the pump set is to be stored temporarily, do not preserve the wetted components made of alloy materials.

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

6.4 Returning to service

For returning the equipment to service observe the sections on commissioning/start-up and the operating limits. (⇒ Section 6.1, Page 35) (⇒ Section 6.2, Page 38)

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In addition, carry out all servicing/maintenance operations before returning the pump (set) to service. (⇒ Section 7, Page 42)

	<p style="background-color: #f4a460; padding: 2px;">⚠ WARNING</p> <p>Failure to re-install or re-activate protective devices Risk of injury from moving parts or escaping fluid!</p> <ul style="list-style-type: none"> ▸ As soon as the work is completed, properly re-install and re-activate any safety-relevant devices and protective devices.
	<p style="background-color: #0070c0; color: white; padding: 2px;">NOTE</p> <p>If the equipment has been out of service for more than one year, replace all elastomer seals.</p>

7 Servicing/Maintenance

7.1 Safety regulations

	<div style="background-color: #e67e22; color: white; padding: 5px;">⚠ DANGER</div> <p>Improper cleaning of coated pump surfaces Explosion hazard by electrostatic discharge!</p> <ul style="list-style-type: none"> ▷ When cleaning coated pump surfaces in atmospheres of Explosion group IIC, use suitable anti-static equipment.
	<div style="background-color: #e67e22; color: white; padding: 5px;">⚠ DANGER</div> <p>Sparks produced during servicing work Explosion hazard!</p> <ul style="list-style-type: none"> ▷ Observe the safety regulations in force at the place of installation! ▷ Always perform maintenance work at an explosion-proof pump (set) outside of potentially explosive atmospheres.
 	<div style="background-color: #e67e22; color: white; padding: 5px;">⚠ DANGER</div> <p>Improperly serviced pump set Explosion hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Service the pump set regularly. ▷ Prepare a maintenance schedule with special emphasis on lubricants, shaft seal and coupling.
<p>The operator ensures that maintenance, inspection and installation are performed by authorised, qualified specialist personnel who are thoroughly familiar with the manual.</p>	
	<div style="background-color: #f1c40f; padding: 5px;">⚠ WARNING</div> <p>Unintentional starting of the pump set Risk of injury by moving components and shock currents!</p> <ul style="list-style-type: none"> ▷ Ensure that the pump set cannot be started unintentionally. ▷ Always make sure the electrical connections are disconnected before carrying out work on the pump set.
	<div style="background-color: #f1c40f; padding: 5px;">⚠ WARNING</div> <p>Fluids handled, consumables and supplies which are hot and/or pose a health hazard Risk of injury!</p> <ul style="list-style-type: none"> ▷ Observe all relevant laws. ▷ When draining the fluid take appropriate measures to protect persons and the environment. ▷ Decontaminate pumps which handle fluids posing a health hazard.

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

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.

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

Never use force when dismantling and reassembling the pump set.

7.2 Servicing/Inspection

7.2.1 Supervision of operation

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

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

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

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	CAUTION
	<p>Increased wear due to dry running Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Never operate the pump set without liquid fill. ▷ Never close the shut-off element in the suction line and/or supply line during pump operation.
	CAUTION
	<p>Impermissibly high temperature of fluid handled Damage to the pump!</p> <ul style="list-style-type: none"> ▷ Prolonged operation against a closed shut-off element is not permitted (heating up of the fluid). ▷ Observe the temperature limits in the data sheet and in the section on operating limits. (⇒ Section 6.2, Page 38)

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 6.1.6, Page 37)
- Check the static sealing elements for leakage.
- Check the rolling element bearings for running noises.
Vibrations, noise and an increase in current input occurring during unchanged operating conditions indicate wear.
- Monitor the correct functioning of any auxiliary connections.
- Monitor the stand-by pump.
To make sure that stand-by pumps are ready for operation, start them up once a week.
- Monitor the bearing temperature.
The bearing temperature must not exceed 90 °C (measured on the motor housing).

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

7.2.2 Inspection work

 	DANGER
	<p>Excessive temperatures caused by friction, impact or frictional sparks</p> <p>Explosion hazard! Fire hazard! Damage to the pump set!</p> <p>▷ Regularly check the coupling guard, plastic components and other guards of rotating parts for deformation and sufficient distance from rotating parts.</p>
	DANGER
	<p>Electrostatic charging due to insufficient potential equalisation</p> <p>Explosion hazard!</p> <p>▷ Make sure that the connection between pump and baseplate is electrically conductive.</p>

7.2.2.1 Checking the coupling

Check the flexible elements of the coupling. Replace the relevant parts in due time if there is any sign of wear and check the alignment.

7.2.2.2 Checking the clearances

For checking the clearances remove the impeller, if required.

(⇒ Section 7.4.5, Page 49)

If the clearance is larger than permitted, fit a new casing wear ring 502.01 and/or 502.02 and/or 502.06 (WS35).

The clearances given refer to the diameter.

Table 14: Clearances between impeller and casing [mm]

Size	Suction side	Discharge side	Nominal impeller diameter [mm]			
			125	160	200	250
25	X	-	0,6	0,6	0,6	0,5
	-	X	-	-	0,5	0,5
32	X	-	0,6	0,6	0,6	0,5
	-	X	-	-	0,5	0,5
40	X	-	0,6	0,6	0,6	0,5
	-	X	-	0,5	0,5	0,5
50	X	-	0,6	0,6	0,5	0,5
	-	X	-	0,5	0,5	0,5
65	X	-	-	-	0,5	0,5
	-	X	-	-	0,5	0,5
80	X	-	-	-	0,5	0,5
	-	X	-	-	0,5	0,5

Maximum permissible enlargement: 1.2 mm

7.2.2.3 Cleaning filters

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

7.2.2.4 Checking the bearing seals

	⚠ DANGER
	<p>Excessive temperatures caused by mechanical contact Risk of explosion! Damage to the pump set!</p> <ul style="list-style-type: none"> ▷ Check correct seating of axial seal rings mounted on the shaft. Only gentle contact of the sealing lip shall be established.

7.2.3 Lubrication and lubricant change of rolling element bearings

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

7.2.3.1 Grease lubrication

The bearings are supplied packed with high-quality lithium-soap grease.

7.2.3.1.1 Intervals

Under normal conditions the grease-lubricated bearings will run for 15,000 operating hours or 2 years. Under unfavourable operating conditions (e.g. high room temperature, high atmospheric humidity, dust-laden air, aggressive industrial atmosphere etc.), check the bearings earlier and clean and relubricate them if required.

7.2.3.1.2 Grease quality

Optimum grease properties for rolling element bearings

Table 15: Grease quality to DIN 51825

Soap basis	NLGI grade	Worked penetration at 25° C in mm/10	Drop point
Lithium	2 to 3	220-295	≥ 175 °C

- Free of resin and acid
- Not liable to crumble
- Rust-preventive characteristics

If required, the bearings may be lubricated with greases of other soap bases. Make sure to remove any old grease and rinse the bearings thoroughly.

7.2.3.1.3 Grease quantity

Table 16: Grease quantity per grease-lubricated DIN 625 radial ball bearing

Size	Drive end	Pump end	Nominal impeller diameter [mm]							
			125		160		200		250	
			Code	Grease per bearing	Code	Grease per bearing	Code	Grease per bearing	Code	Grease per bearing
				[g]		[g]		[g]		[g]
25	X	-	6305 2Z C3	5	6305 2Z C3	5	6305 2Z C3	5	6305 2Z C3	5
	-	X	6305 2Z C3	5	6305 2Z C3	5	6305 2Z C3	5	6306 2Z C3	8
32	X	-	6305 2Z C3	5	6305 2Z C3	5	6305 2Z C3	5	6305 2Z C3	5
	-	X	6305 2Z C3	5	6305 2Z C3	5	6305 2Z C3	5	6306 2Z C3	8
40	X	-	6305 2Z C3	5	6305 2Z C3	5	6305 2Z C3	5	6305 2Z C3	5
	-	X	6305 2Z C3	5	6305 2Z C3	5	6305 2Z C3	5	6306 2Z C3	8
50	X	-	6305 2Z C3	5	6305 2Z C3	5	6305 2Z C3	5	6305 2Z C3	5
	-	X	6305 2Z C3	5	6305 2Z C3	5	6306 2Z C3	8	6306 2Z C3	8
65	X	-	-	-	-	-	6305 2Z C3	5	6307 2Z C3	10
	-	X	-	-	-	-	6306 2Z C3	8	6307 2Z C3	10
80	X	-	-	-	-	-	6307 2Z C3	10	6307 2Z C3	10
	-	X	-	-	-	-	6307 2Z C3	10	6307 2Z C3	10

7.2.3.1.4 Changing the grease

	CAUTION
	<p>Mixing greases of differing soap bases Changed lubricating qualities!</p> <ul style="list-style-type: none"> ▷ Thoroughly clean the bearings. ▷ Adjust the re-lubrication intervals to the grease used.

- ✓ The pump has been dismantled for changing the grease.
1. Only half-fill the bearing cavities with grease.

7.3 Drainage/cleaning

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

1. Use connection 6B to drain the fluid handled (see drawing of auxiliary connections).
2. Always flush the system if it has been used for handling noxious, explosive, hot or other hazardous fluids.
 Always flush and clean the pump before transporting it to the workshop.
 Provide a certificate of decontamination for the pump. (⇒ Section 11, Page 66)

7.4 Dismantling the pump set

7.4.1 General information/Safety regulations

	<p>⚠ DANGER</p> <p>Insufficient preparation of work on the pump (set) Risk of injury!</p> <ul style="list-style-type: none"> ▷ Properly shut down the pump set. (⇒ Section 6.1.7, Page 37) ▷ Close the shut-off elements in the suction line and discharge line. ▷ Drain the pump and release the pump pressure. (⇒ Section 7.3, Page 47) ▷ Shut off any auxiliary connections. ▷ Allow the pump set to cool down to ambient temperature.
	<p>⚠ WARNING</p> <p>Unqualified personnel performing work on the pump (set) Risk of injury!</p> <ul style="list-style-type: none"> ▷ Always have repair work and maintenance work performed by specially trained, qualified personnel.
	<p>⚠ WARNING</p> <p>Hot surface Risk of injury!</p> <ul style="list-style-type: none"> ▷ Allow the pump set to cool down to ambient temperature.
	<p>⚠ WARNING</p> <p>Improper lifting/moving of heavy assemblies or components Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▷ Use suitable transport devices, lifting equipment and lifting tackle to move heavy assemblies or components.

Always observe the safety instructions and information. (⇒ Section 7.1, Page 42)

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

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

In the event of damage you can always contact our service departments.

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

7.4.2 Preparing the pump set

1. Interrupt the power supply and secure the pump against unintentional start-up.
2. Disconnect and remove all auxiliary pipework.
3. Remove the coupling guard.
4. Remove the coupling spacer, if any.

7.4.3 Removing the motor

	NOTE
	On pump sets with spacer-type couplings, the back pull-out unit can be removed while the motor remains bolted to the baseplate.

	WARNING
	<p>Motor tipping over Risk of crushing hands and feet!</p> <ul style="list-style-type: none"> ▷ Suspend or support the motor to prevent it from tipping over.

1. Disconnect the motor from the power supply.
2. Unbolt the motor from the baseplate.
3. Shift the motor to separate it from the pump.

7.4.4 Removing the back pull-out unit

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 48) to (⇒ Section 7.4.3, Page 49) have been observed/carried out.
- ✓ On pump sets without spacer-type coupling, the motor has been removed.

	WARNING
	<p>Back pull-out unit tilting Risk of crushing hands and feet!</p> <ul style="list-style-type: none"> ▷ Suspend or support the bearing bracket at the pump end.

1. Secure bearing bracket 330 against tipping over, if required, e.g. by supporting or suspending it.
2. Unbolt support foot 183 from the baseplate.
3. Undo nut 920.01 and hexagon head bolt 901.99 at the pump casing.
4. Pull the bearing bracket with the discharge cover and the complete rotor out of the casing (back pull-out unit).
5. Place the back pull-out unit on a clean and level surface.
6. Pull off O-ring 412.35. Check for any damage. Dispose of any damaged O-rings.

7.4.5 Removing the impeller

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 48) to (⇒ Section 7.4.4, Page 49) have been observed/carried out.
 - ✓ The back pull-out unit has been placed in a clean and level assembly area.
1. Undo impeller nut 920.95 (right-hand thread).
 2. Remove impeller 230 with an impeller removal tool.
 3. Place impeller 230 on a clean and level surface.
 4. Remove key 940.01 from shaft 210.

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7.4.6 Removing the mechanical seal

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 48) to (⇒ Section 7.4.5, Page 49) have been observed/carried out.
- ✓ The back pull-out unit has been placed in a clean and level assembly area.
 1. Remove the rotating assembly of the mechanical seal (primary ring) from shaft sleeve 523 (shaft unit 35) or shaft 210.
 2. Remove gasket 400.75, if any, from shaft 210 and dispose of it.
 3. Remove discharge cover 163 from bearing bracket 330 or intermediate piece 132.01.
 4. Remove the stationary assembly of the mechanical seal, consisting of the mechanical seal's mating ring and the elastomer, from discharge cover 163.

7.4.7 Dismantling the bearings

- ✓ The notes and steps stated in (⇒ Section 7.4.1, Page 48) to (⇒ Section 7.4.6, Page 50) have been observed and carried out.
- ✓ The bearing bracket has been placed in a clean and level assembly area.
 1. Undo the grub screw in the coupling hub.
 2. Pull the coupling hub off pump shaft 210 with a puller or, for split-hub coupling designs, undo the screws and take off the hub halves.
 3. Remove key 940.02.
 4. Remove axial seal rings 411.77 and 411.78.
 5. Remove pump-end bearing cover 360.01 and drive-end bearing cover 360.02.
 6. Remove circlips 932.01 and 932.02.
 7. Press shaft 210 out of the bearing seats.
 8. Remove radial ball bearings 321.01 and 321.02, and place them on a clean and level surface.

7.5 Reassembling the pump set

7.5.1 General information/Safety regulations

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

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

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

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- Assembly aids** Avoid the use of assembly adhesives if possible.
 Should an assembly adhesive be required after all, use a commercially available contact adhesive (e.g. Pattex) or sealant (e.g. HYLOMAR or Epple 33).
 Only apply adhesive at selected points and in thin layers.
 Never use quick-setting adhesives (cyanoacrylate adhesives).
 Coat the locating surfaces of the individual components with graphite or similar before reassembly.
 Prior to reassembly, screw back any forcing screws and adjusting screws.
- Tightening torques** For reassembly, tighten all screws and bolts as specified in this manual. (⇒ Section 7.6, Page 54)

7.5.2 Installing the bearing assembly

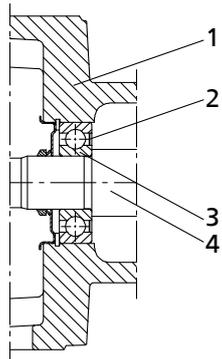


Fig. 17: Installing the radial ball bearing

1	Bearing bracket	2	Shield
3	Radial ball bearing	4	Shaft

- ✓ The individual parts have been placed in a clean and level assembly area.
 - ✓ All dismantled parts have been cleaned and checked for wear.
 - ✓ Any damaged or worn parts have been replaced by original spare parts.
 - ✓ The sealing surfaces have been cleaned.
1. Press radial ball bearings 321.01 and 321.02 onto shaft 210.
 Make sure the bearing side with the shield rests against the shaft shoulder (see illustration: Installing the radial ball bearings).
 2. Slide the pre-assembled shaft into bearing bracket 330.
 3. Fit circlips 932.01 and 932.02.
 4. Fit bearing covers 360.01 and 360.02.
 5. Fit axial seal rings 411.77 and 411.78.
 6. Insert key 940.02.
 7. Fit the coupling hub on pump shaft 210. For split-hub coupling designs, fit the hub halves on pump shaft 210. Fit and tighten the screws clamping the hub halves together. Observe the tightening torques. (⇒ Section 7.6, Page 54)
 8. Secure the coupling hub with a grub screw.

7.5.3 Installing the mechanical seal

Installing the mechanical seal

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

- Work cleanly and accurately.
- Only remove the protective wrapping of the contact faces immediately before installation takes place.
- Prevent any damage to the sealing surfaces or O-rings.
- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 50) to have been observed/ carried out.
- ✓ The bearing assembly as well as the individual parts have been placed in a clean and level assembly area.
- ✓ All dismantled parts have been cleaned and checked for wear.
- ✓ Any damaged or worn parts have been replaced by original spare parts.
- ✓ The sealing surfaces have been cleaned.
 1. Clean shaft sleeve 523⁷⁾ or shaft 210, and touch up any score marks or scratches with a polishing cloth.
If the score marks or scratches are still visible, replace shaft sleeve 523⁷⁾ or shaft 210.
 2. Slide shaft sleeve 523 (if any) onto shaft 210 with new gasket 400.75.
 3. Clean the mating ring location in discharge cover 163.

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

4. Carefully fit the stationary ring of the mechanical seal.
Make sure to apply pressure evenly.

	NOTE
	<p>Fit the double PTFE encapsulated O-ring with the joint of the outer sheath pointing outwards.</p>

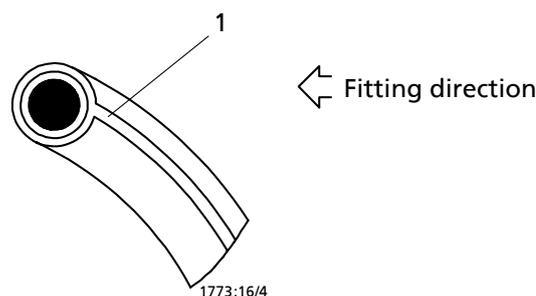


Fig. 18: PTFE encapsulated O-ring

1	Joint of the outer PTFE sheath
---	--------------------------------

5. Fit discharge cover 163 into the locating fit of bearing bracket 330 or intermediate piece 132.01.

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

⁷ If any

6. Fit the rotating assembly of the mechanical seal (primary ring) on shaft sleeve 523⁷⁾ or shaft 210.

7.5.4 Fitting the impeller

- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 50) to (⇒ Section 7.5.3, Page 52) have been observed/carried out.
 - ✓ The assembled bearing bracket as well as the individual parts have been placed in a clean and level assembly area.
 - ✓ All dismantled parts have been cleaned and checked for wear.
 - ✓ Any damaged or worn parts have been replaced by original spare parts.
 - ✓ The sealing surfaces have been cleaned.
1. Insert key 940.01. Slip impeller 230 onto shaft 210.
 2. Fasten impeller nut 920.95 and safety device 930.95. Observe the tightening torques.

7.5.5 Installing the back pull-out unit

	 WARNING
	<p>Back pull-out unit tilting Risk of crushing hands and feet!</p> <ul style="list-style-type: none"> ▷ Suspend or support the bearing bracket at the pump end.

- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 50) to (⇒ Section 7.5.4, Page 53) have been observed/carried out.
 - ✓ Any damaged or worn parts have been replaced by original spare parts.
 - ✓ The sealing surfaces have been cleaned.
 - ✓ For back pull-out units without coupling, fit the coupling in accordance with the manufacturer's instructions.
1. Prevent the back pull-out unit⁸⁾ from tipping over, e.g. by suspending or supporting it. Then fit new or undamaged O-ring 412.35 on discharge cover 163.
 2. Tighten nut 920.01 and hexagon head bolt 901.99 at the volute casing.
 3. Bolt support foot 183 to the baseplate.

7.5.6 Mounting the motor

	NOTE
	<p>Steps 1 and 2 do not apply to versions with spacer-type coupling.</p>

1. Shift the motor to connect it to the pump via the coupling.
2. Fasten the motor to the baseplate.
3. Align pump and motor. (⇒ Section 5.6, Page 31)
4. Connect the motor to the power supply (refer to manufacturer's product literature).

⁸ If any

7.6 Tightening torques

7.6.1 Tightening torques for the pump

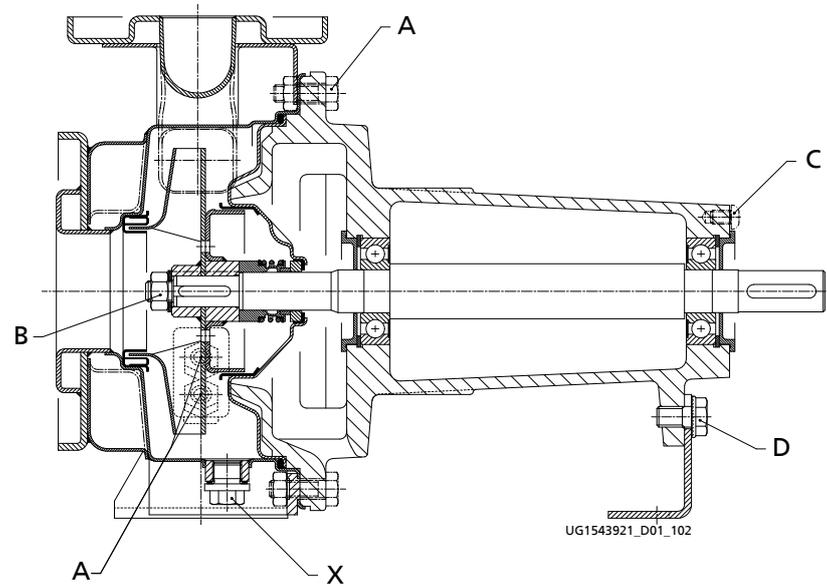


Fig. 19: Tightening points for impeller diameters 125, 160, 200, except 065-050-200, 080-065-200, 100-080-200

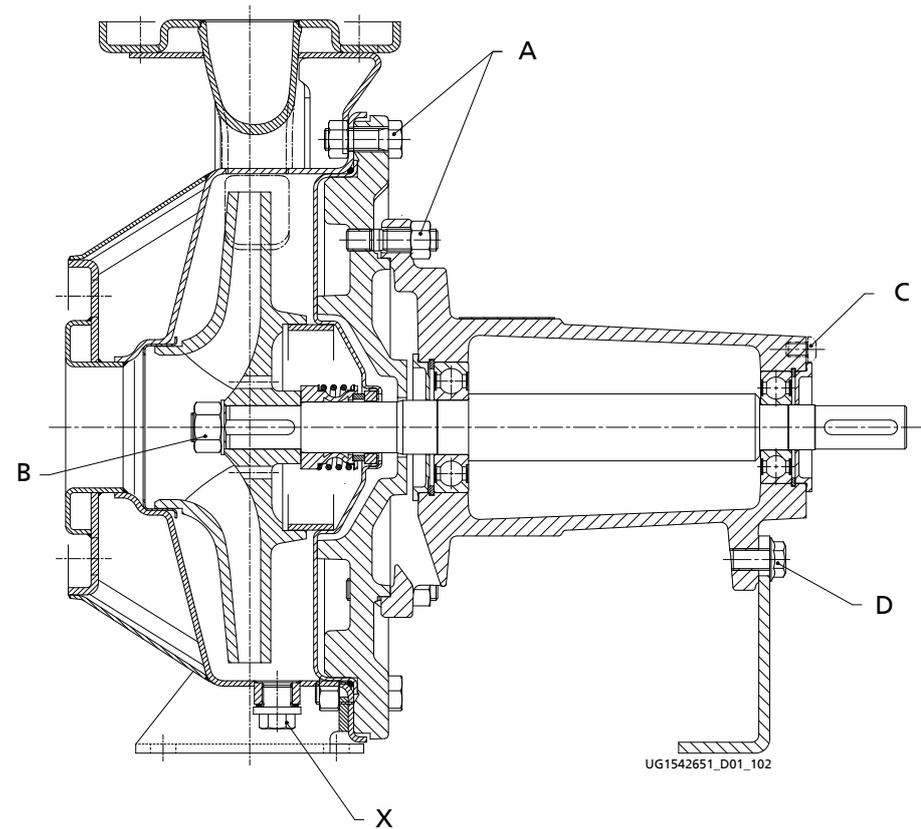


Fig. 20: Tightening points for impeller diameter 250 and sizes 065-050-200, 080-065-200, 100-080-200

Table 17: Tightening torques for bolted/screwed connections at the pump

Position	Thread	Tightening torque
		[Nm]
A	M10	38
	M12	55

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Position	Thread	Tightening torque
		[Nm]
B	M12 × 1,5	55
	M16 × 1,5	55
	M24 × 1,5	130
	M30 × 1,5	170
C	M8	20
	M10	38
D	M12	125
E	M8	20
	M10	38
	M12	55
	M16	130
F	M6	15
	M8	38
	M10	38
	M12	55
X	1/8	25
	1/4	55
	3/8	80
	1/2	130
	3/4	220

7.6.2 Tightening torques for the pump set

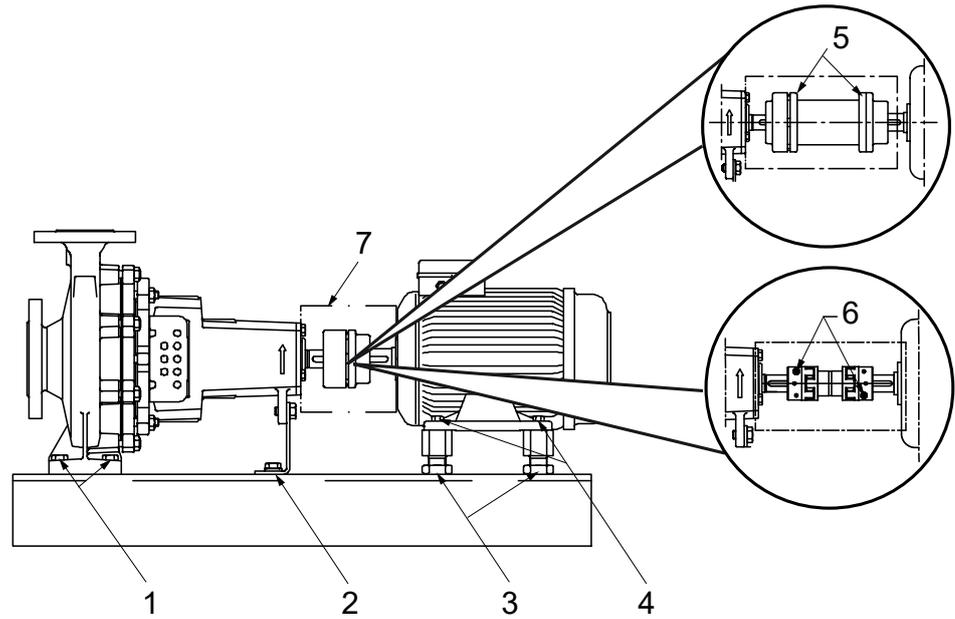


Fig. 21: Position of bolts/screws at the pump set

Table 18: Tightening torques for bolted/screwed connections at the pump set

Position	Thread size	Tightening torque	Notes
		[Nm]	
1	M12	30	Pump on baseplate
	M16	75	
	M20	75	
2	M12	30	
3	M24 × 1,5	140	Adjusting screws in baseplate
	M36 × 1,5	140	
4	M6	10	Motor on baseplate or motor on adjusting screws or bases
	M8	10	
	M10	15	
	M12	30	
	M16	75	
	M20	140	
	M24	140	
5	M6	13	Coupling (only for spacer-type coupling made by Flender)
	M8	18	
	M10	44	
6	M8	34	Coupling (only for double Cardan spacer-type coupling and split-hub coupling design, make: KTR)
	M10	67	
	M12	115	
	M16	290	
	M20	560	
7	M6	10	Coupling guard

7.7 Spare parts stock

7.7.1 Ordering spare parts

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

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

Refer to the name plate for all data. (⇒ Section 4.4, Page 18)

Also specify the following data:

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

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

Table 19: Quantity of spare parts for recommended spare parts stock

Part No.	Description	Number of pumps (including stand-by pumps)							10 and more
		2	3	4	5	6 and 7	8 and 9		
210	Shaft	1	1	1	2	2	2	20 %	
230	Impeller	1	1	1	2	2	2	20 %	
321.01/0 2	Radial ball bearing (set)	1	1	2	2	2	3	25 %	
330	Bearing bracket	-	-	-	-	-	1	2 pcs.	
400.75 ⁹⁾	Gasket	4	6	8	8	9	10	100 %	
412.35	O-ring	4	6	8	8	9	12	150 %	
433	Mechanical seal	1	1	2	2	2	3	25 %	
502.01	Casing wear ring, suction side	2	2	2	3	3	4	50 %	
502.02 ¹⁰⁾	Casing wear ring, discharge side	2	2	2	3	3	4	50 %	
502.06 ¹¹⁾	Casing wear ring, impeller	2	2	2	3	3	4	50 %	
523 ⁹⁾	Shaft sleeve	2	2	2	3	3	4	50 %	

⁹⁾ Only for Etachrom L 080-065-250, 100-080-200, 100-080-250

¹⁰⁾ Not for Etachrom L 050-025-125.1, 050-025-125, 050-025-160, 050-032-125.1, 050-032-125, 050-032-160, 065-040-125, 065-050-125

¹¹⁾ Only for Etachrom L 080-065-250, 100-080-250

7.7.3 Interchangeability of Etachrom L and Etachrom B pump components

Table 20: Pump components¹²⁾ Etachrom L

Size	Pump casing	Intermediate piece	Discharge cover	Foot	Support foot	Shaft	Impeller	Radial ball bearing Drive end	Radial ball bearing Pump end	Bearing bracket	Bearing cover Drive end	Bearing cover Pump end	Gasket	Joint ring	Joint ring	O-ring	Mechanical seal	Casing wear ring Suction side	Casing wear ring Discharge side	Shaft sleeve
	101	132.01	163	182	183	210	230	321.02	321.01	330	360.02	360.01	400.75	411.77	411.78	412.35	433	502.01	502.02	523
050-025-125.1	1	X	1*	1	1	1	1*	1	1	1	1	1	X	X	X	1*	1*	1*	X	X
050-025-125	1	X	1*	1	1	1	2*	1	1	1	1	1	X	X	X	1*	1*	1*	X	X
050-025-160	o	X	5*	2	2	1	3*	1	1	2	1	1	X	X	X	2*	1*	1*	X	X
050-025-200	o	X	2*	3	3	1	4*	1	1	3	1	1	X	X	X	3*	1*	7*	1*	X
050-025-250	o	1*	3*	X	4	2	5*	1	3	4	1	3	X	X	X	4*	2*	6*	2*	X
050-032-125.1	2	X	1*	1	1	1	1*	1	1	1	1	1	X	X	X	1*	1*	1*	X	X
050-032-125	2	X	1*	1	1	1	2*	1	1	1	1	1	X	X	X	1*	1*	1*	X	X
050-032-160	o	X	5*	2	2	1	3*	1	1	2	1	1	X	X	X	2*	1*	1*	X	X
050-032-200	o	X	2*	3	3	1	4*	1	1	3	1	1	X	X	X	3*	1*	7*	1*	X
050-032-250	o	1*	3*	X	4	2	5*	1	3	4	1	3	X	X	X	4*	2*	6*	2*	X
065-040-125	o	X	1*	o	1	1	o*	1	1	1	1	1	X	X	X	1*	1*	2*	X	X
065-040-160	o	X	o*	2	2	1	o*	1	1	2	1	1	X	X	X	2*	1*	8*	1*	X
065-040-200	o	X	2*	o	3	1	o*	1	1	3	1	1	X	X	X	3*	1*	8*	1*	X
065-040-250	o	1*	3*	X	4	2	o*	1	3	4	1	3	X	X	X	4*	2*	3*	2*	X
065-050-125	o	X	o*	2	2	1	o*	1	1	2	1	1	X	X	X	2*	1*	2*	X	X
065-050-160	o	X	o*	o	3	1	o*	1	1	2	1	1	X	X	X	2*	1*	8*	1*	X
065-050-200	o	o*	o*	X	3	2	o*	1	3	4	1	3	X	X	X	o*	2*	3*	2*	X
065-050-250	o	1*	3*	X	4	2	o*	1	3	4	1	3	X	X	X	4*	2*	3*	2*	X
080-065-200	o	1*	o*	X	4	2	o*	1	3	4	1	3	X	X	X	4*	2*	4*	o*	X
080-065-250	o	2*	4*	X	5	3	o*	2	2	5	2	2	1*	1	1	4*	3*	4*	3*	1*
100-080-200	o	2*	4*	X	o	3	o*	2	2	5	2	2	1*	1	1	4*	3*	5*	3*	1*
100-080-250	o	2*	4*	X	5	3	o*	2	2	5	2	2	1*	1	1	4*	3*	5*	3*	1*

Table 21: Symbols key

Symbol	Description
*	Component interchangeable with Etachrom B
o	Components differ
X	Component not fitted

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¹²⁾ Pump components featuring the same number in a column are interchangeable, i.e. same number = same component

8 Trouble-shooting

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

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

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

Table 22: Trouble-shooting

A	B	C	D	E	F	G	H	Possible cause	Remedy ¹³⁾
X	-	-	-	-	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point. Check system for impurities. Fit a larger impeller. ¹⁴⁾ Increase the speed (turbine, I.C. engine).
X	-	-	-	-	-	X	X	Pump or piping are not completely vented or primed.	Vent or prime.
X	-	-	-	-	-	-	-	Supply line or impeller clogged	Remove deposits in the pump and/or piping.
X	-	-	-	-	-	-	-	Formation of air pockets in the piping	Alter piping layout. Fit vent valve.
X	-	-	-	-	-	X	X	Suction lift is too high/NPSH _{available} (positive suction head) is too low.	Check/alter fluid level. Install pump at a lower level. Fully open the shut-off element in the suction line. Change suction line, if the friction loss in the suction line is too high. Check any strainers installed/suction opening. Observe permissible speed of pressure fall.
X	-	-	-	-	-	-	-	Air intake at the shaft seal	Fit new shaft seal.
X	-	-	-	-	-	-	-	Wrong direction of rotation	Check the electrical connection of the motor and the control system, if any.
X	-	-	-	-	-	-	-	Speed is too low. ¹⁴⁾ - Operation with frequency inverter - Operation without frequency inverter	- Increase voltage/frequency at the frequency inverter in the permissible range. - Check voltage.
X	-	-	-	-	-	X	-	Wear of internal components	Replace worn components by new ones.
-	X	-	-	-	-	X	-	Pump back pressure is lower than specified in the purchase order.	Re-adjust to duty point. In the case of persistent overloading, turn down impeller. ¹⁴⁾
-	X	-	-	-	-	-	-	Density or viscosity of fluid handled higher than stated in purchase order	Contact KSB.

¹³⁾ Pump pressure must be released before attempting to remedy faults on parts which are subjected to pressure.

¹⁴⁾ Contact KSB.

A	B	C	D	E	F	G	H	Possible cause	Remedy ¹³⁾
-	-	-	-	-	X	-	-	Use of unsuitable shaft seal materials	Change the material combination. ¹⁴⁾
-	X	X	-	-	-	-	-	Speed is too high.	Reduce speed. ¹⁴⁾
-	-	-	-	X	-	-	-	Tie bolts/sealing element defective	Fit new seal between volute casing and discharge cover. Re-tighten the bolts.
-	-	-	-	-	X	-	-	Worn shaft seal	Fit new shaft seal.
X	-	-	-	-	X	-	-	Score marks or roughness on shaft sleeve	Fit new shaft sleeve. Fit new shaft seal, if required.
-	-	-	-	-	X	-	-	Dismantle to find out.	Correct. Fit new shaft seal, if required.
-	-	-	-	-	X	-	-	Vibrations during pump operation	Correct the suction conditions. Re-align the pump set. Re-balance the impeller. Increase pressure at the pump suction nozzle.
-	-	-	X	-	X	X	-	Pump set is misaligned.	Re-align pump set.
-	-	-	X	-	X	X	-	Pump is warped or sympathetic vibrations in the piping.	Check piping connections and secure fixing of pump. Reduce distances between pipe clamps. Fasten the pipes using anti-vibration material.
-	-	-	X	-	-	-	-	Increased axial thrust ¹⁴⁾	Clean balancing holes in the impeller. Replace the casing wear rings.
-	-	-	X	-	-	-	-	Insufficient or excessive quantity of lubricant or unsuitable lubricant	Top up, reduce or change lubricant.
-	-	-	X	-	-	-	-	Non-compliance with specified coupling distance	Correct the distance according to general arrangement drawing.
X	X	-	-	-	-	-	-	Motor is running on 2 phases only.	Replace the defective fuse. Check the electric cable connections.
-	-	-	-	-	-	X	-	Rotor out of balance	Clean the impeller. Re-balance the impeller.
-	-	-	-	-	-	X	-	Defective bearing(s)	Replace.
-	-	-	X	-	-	X	X	Flow rate is too low.	Increase the minimum flow rate.

9 Related Documents

9.1 Exploded views with list of components

9.1.1 Design for shaft unit 25.1

This view applies to the following pump sizes:

050-025-125.1	050-032-125.1	065-040-125	065-050-125
050-025-125	050-032-125	065-040-160	065-050-160
050-025-160	050-032-160	065-040-200	
050-025-200	050-032-200		

[Supplied in packaging units only

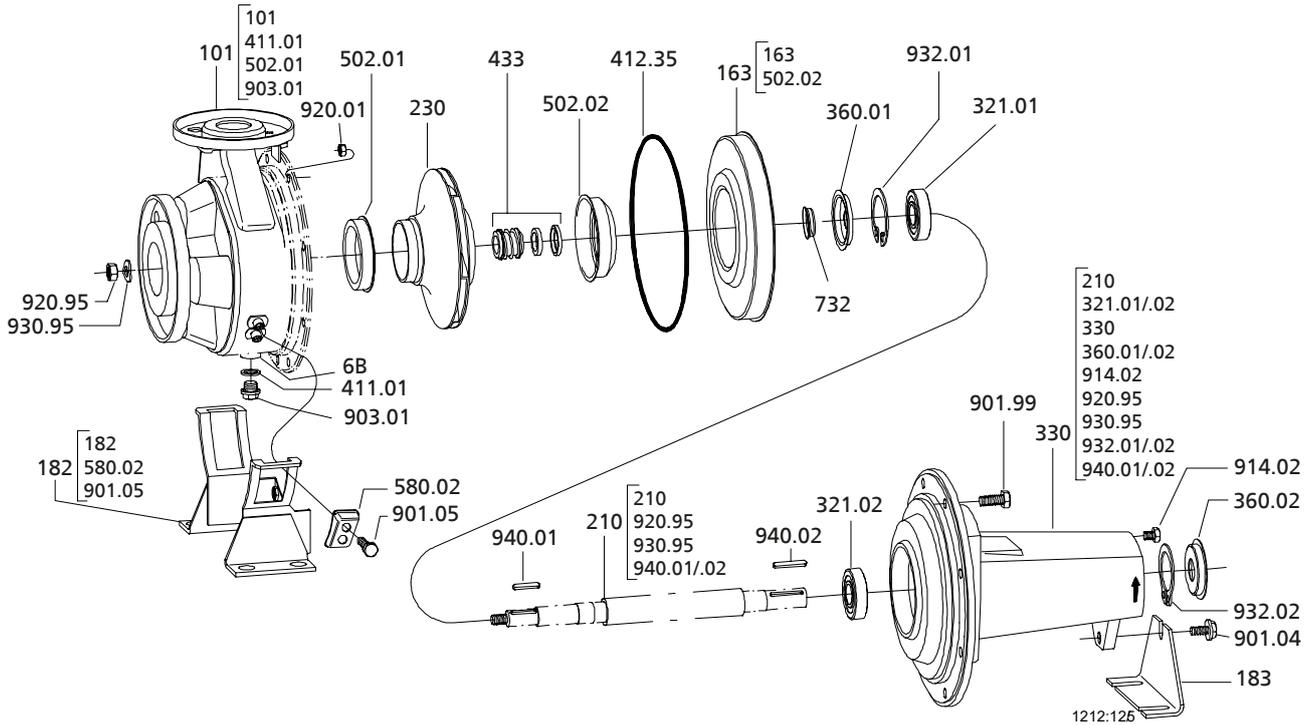


Table 23: List of components

Part No.	Description	Part No.	Description
101	Pump casing	580.02	Cap
163	Discharge cover	732 ¹⁵⁾	Holder
182	Foot	901.04/.05/.99	Hexagon head bolt
183	Support foot	903.01	Screw plug
210	Shaft	914.02	Round-head screw
230	Impeller	920.01/.95	Nut
321.01/.02	Radial ball bearing	930.95	Safety device
330	Bearing bracket	932.01/.02	Circlip
360.01/.02	Bearing cover	940.01/.02	Key
411.01	Joint ring		
412.35	O-ring		
433	Mechanical seal	Connections	
502.01/.02 ¹⁶⁾	Casing wear ring	6B	Fluid drain

¹⁵ Only for versions with mechanical seal type C19

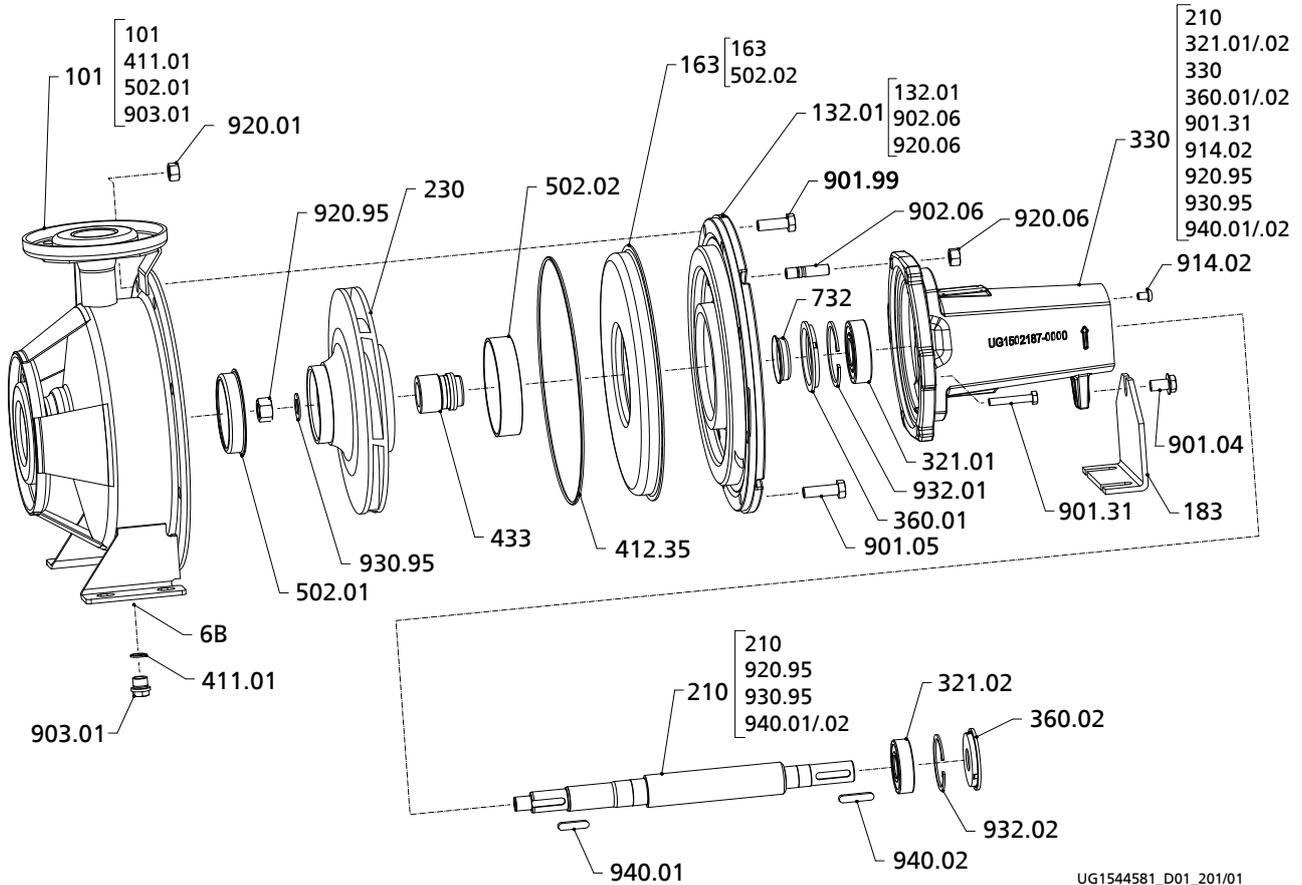
¹⁶ Not for Etachrom L 050-025-125.1, 050-025-125, 050-025-160, 050-032-125.1, 050-032-125, 050-032-160, 065-040-125, 065-050-125

9.1.2 Design for shaft unit 25.2

This view applies to the following pump sizes:

- 050-025-250 050-032-250 065-040-250 065-050-200 080-065-200
 065-050-250

[Supplied in packaging units only



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Table 24: List of components

Part No.	Description	Part No.	Description
101	Pump casing	732 ¹⁷⁾	Holder
132.01	Intermediate piece	901.04/.05/.31/.99	Hexagon head bolt
163	Discharge cover	902.06	Stud
183	Support foot	903.01	Screw plug
210	Shaft	914.02	Round-head screw
230	Impeller	920.01/.06/.95	Nut
321.01/.02	Radial ball bearing	930.95	Safety device
330	Bearing bracket	932.01/.02	Circlip
360.01/.02	Bearing cover	940.01/.02	Key
411.01	Joint ring		
412.35	O-ring		
433	Mechanical seal	Connections	
502.01/.02	Casing wear ring	6B	Fluid drain

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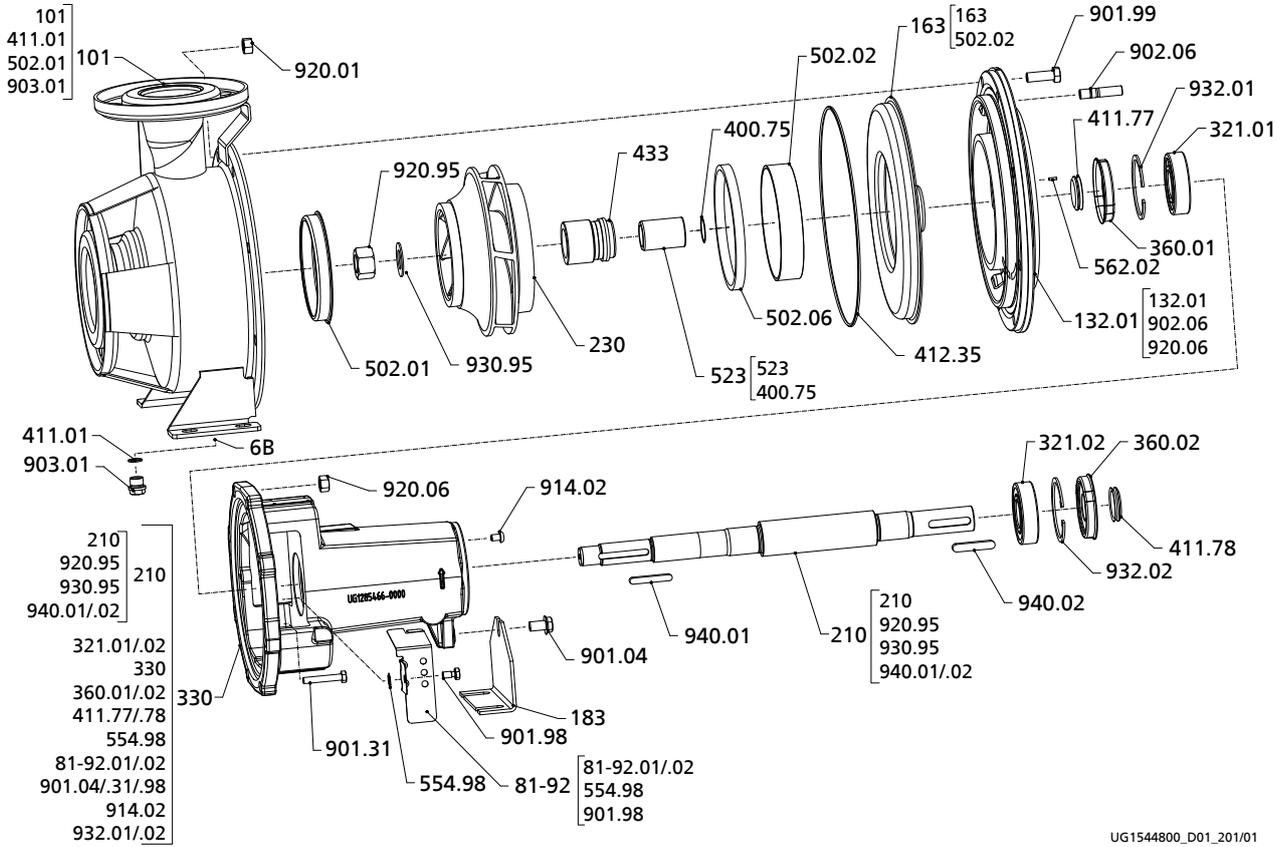
¹⁷⁾ Only for versions with mechanical seal type C19

9.1.3 Design for shaft unit 35

This view applies to the following pump sizes:

- 080-065-250 100-080-200
- 100-080-250

[Supplied in packaging units only



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Table 25: List of components

Part No.	Description	Part No.	Description
101	Pump casing	554.98	Washer
132.01	Intermediate piece	562.02 ¹⁸⁾	Parallel pin
163	Discharge cover	81-92.01/.02	Cover plate
183	Support foot	901.04/.31/.98/.99	Hexagon head bolt
210	Shaft	902.06	Stud
230	Impeller	903.01	Screw plug
321.01/02	Radial ball bearing	914.02	Round-head screw
330	Bearing bracket	920.01/.06/.95	Nut
360.01/02	Bearing cover	930.95	Safety device
400.75	Gasket	932.01/02	Circlip
411.01/.77/.78	Joint ring	940.01/02	Key
412.35	O-ring		
433	Mechanical seal		
502.01/02/.06 ¹⁹⁾	Casing wear ring	Connections	
523	Shaft sleeve	6B	Fluid drain

¹⁸ Only for versions with mechanical seal type C19

¹⁹ Only for Etachrom L 080-065-250, 100-080-250

10 UK Declaration of Conformity

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

This UK Declaration of Conformity is issued under the sole responsibility of the manufacturer.

The manufacturer herewith declares that **the product:**

Etabloc, Etabloc SYT, Etaline, Etaline SYT, Etaline Z, Etachrom B, Etachrom L, Etanorm, Etanorm SYT, Etanorm V, Etaprime L, Etaprime B

KSB order number:

- is in conformity with the provisions of the following directives / regulations as amended from time to time:
 - Pump (set): Supply of Machinery (Safety) Regulations 2008
 - Electrical components²⁰⁾: The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012

The manufacturer also declares that

- the following harmonised international standards²¹⁾ 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)

Place, date

.....²²⁾.....

Name
Function
Company
Address

²⁰ Where applicable

²¹ Apart from the standards listed here referring to the *Supply of Machinery (Safety) Regulations 2008*, further standards are observed for explosion-proof versions (*Equipment and Protective Systems Intended for use in Potentially Explosive Atmospheres Regulations 2016*) as applicable and are listed in the legally binding UK Declaration of Conformity.

²² A signed, legally binding UK Declaration of Conformity is supplied with the product.

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