

In-line Twin Pump

Etaline DL

Installation/Operating Manual



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Installation/Operating Manual Etaline DL

Original operating manual

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Contents

	Glossary	5
1	General.....	6
	1.1 Principles	6
	1.2 Installation of partly completed machinery.....	6
	1.3 Target group.....	6
	1.4 Other applicable documents.....	6
	1.5 Symbols	6
	1.6 Key to safety symbols/markings.....	7
2	Safety	8
	2.1 General.....	8
	2.2 Intended use	8
	2.3 Personnel qualification and training.....	9
	2.4 Consequences and risks caused by non-compliance with this manual	9
	2.5 Safety awareness	9
	2.6 Safety information for the operator/user	9
	2.7 Safety information for maintenance, inspection and installation	10
	2.8 Unauthorised modes of operation	10
	2.9 Electromagnetic compatibility.....	10
3	Transport/Storage/Disposal	11
	3.1 Checking the condition upon delivery	11
	3.2 Transport.....	11
	3.3 Storage/preservation	11
	3.4 Return to supplier.....	12
	3.5 Disposal	12
4	Description of the Pump (Set).....	14
	4.1 General description	14
	4.2 Product information.....	14
	4.2.1 Product Information as per Regulation No. 547/2012 (for water pumps with a maximum shaft power of 150 kW) implementing "Ecodesign" Directive 2009/125/EC.....	14
	4.2.2 Product information as per Regulation No. 1907/2006 (REACH)	14
	4.3 Designation.....	15
	4.4 Name plate.....	16
	4.5 Design details.....	16
	4.6 Configuration and function.....	17
	4.7 Noise characteristics	18
	4.8 Scope of supply.....	18
	4.9 Dimensions and weight.....	18
5	Installation at Site	19
	5.1 Safety regulations.....	19
	5.2 Checks to be carried out prior to installation.....	19
	5.3 Installing the pump set	20
	5.4 Piping	20
	5.4.1 Connecting the piping.....	20
	5.4.2 Vacuum balance line.....	21
	5.4.3 Auxiliary connections.....	22
	5.5 Enclosure/insulation	22
	5.6 Electrical connection	23
	5.6.1 Motor connection inside the terminal box	23
6	Commissioning/Start-up/Shutdown.....	26
	6.1 Commissioning/Start-up/Shutdown.....	26
	6.1.1 Prerequisites for commissioning/start-up	26
	6.1.2 Checking earth conductor connection	26

6.1.3	Checking insulation resistance	26
6.1.4	Filling in lubricants.....	27
6.1.5	Priming and venting the pump.....	27
6.1.6	Checking the direction of rotation	27
6.1.7	Start-up.....	28
6.1.8	Checking the shaft seal.....	29
6.1.9	Shutdown	29
6.2	Operating limits.....	30
6.2.1	Ambient temperature.....	30
6.2.2	Frequency of starts.....	31
6.2.3	Fluid handled	31
6.2.4	Voltages and frequencies	32
6.2.5	Maximum permissible speed	32
6.2.6	Altitude.....	32
6.3	Shutdown/storage/preservation	32
6.3.1	Measures to be taken for shutdown	32
6.4	Returning to service	33
7	Servicing/Maintenance.....	34
7.1	Safety regulations.....	34
7.2	Servicing/Inspection.....	35
7.2.1	Supervision of operation	35
7.2.2	Inspection work.....	37
7.2.3	Lubrication and lubricant change	37
7.3	Drainage/cleaning	38
7.4	Dismantling the pump set.....	38
7.4.1	General information/Safety regulations.....	38
7.4.2	Preparing the pump set.....	39
7.4.3	Dismantling the complete pump set	39
7.4.4	Removing the back pull-out unit.....	39
7.4.5	Removing the impeller	40
7.4.6	Removing the mechanical seal.....	40
7.5	Reassembling the pump set.....	40
7.5.1	General information/Safety regulations.....	40
7.5.2	Fitting the mechanical seal.....	41
7.5.3	Fitting the impeller.....	41
7.5.4	Installing the back pull-out unit	42
7.6	Tightening torques.....	42
7.7	Spare parts stock.....	42
7.7.1	Ordering spare parts.....	42
7.7.2	Recommended spare parts stock for 2 years' operation to DIN 24296	43
8	Trouble-shooting.....	44
9	Related Documents	46
9.1	Installation types	46
9.2	General assembly drawing with list of components	48
10	EU Declaration of Conformity	50
11	EU Declaration of Conformity	51
12	EU Declaration of Conformity	52
13	Certificate of Decontamination.....	53
	Index	54

Glossary

Back pull-out unit

Pump without pump casing; partly completed machinery

Certificate of decontamination

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

Close-coupled design

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

Discharge line

The pipeline which is connected to the discharge nozzle

Hydraulic system

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

IE3

Efficiency class to IEC 60034-30: 3 = Premium Efficiency (IE = International Efficiency)

In-line design

A pump whose suction and discharge nozzle are arranged opposite each other and have the same nominal diameter.

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

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, the main operating data and the material number/series code. The material number/series code uniquely describes the product and is used as identification in 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.

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 agreed to be included in the 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.
	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.
- The motor has been designed and constructed in accordance with the requirements of Directive 2014/35/EU ("Low-voltage Directive"). The motor is intended for use in industrial plants.

2.2 Intended use

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

Prevention of foreseeable misuse

- Never open the discharge-side shut-off elements further than permitted.
 - The maximum flow rates specified in the product literature or data sheet would be exceeded.

- Risk of cavitation damage
- Never exceed the permissible operating limits and use limits specified in the data sheet or product literature regarding pressure, temperature, mains voltage, mains frequency, ambient temperature, motor rating, speed, etc.
- Observe all safety information and instructions in this manual.

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 shutting down the pump does not increase potential risk, fit an emergency-stop control device in the immediate vicinity of the pump (set) during pump set installation.

2.7 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 6.1.9, Page 29) (⇒ Section 6.3, Page 32)
- Decontaminate pumps which handle fluids posing a health hazard. (⇒ Section 7.3, Page 38)
- 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.

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.

2.9 Electromagnetic compatibility

When operating the motor on a frequency inverter always observe the frequency inverter manufacturer's information on compliance with the Electromagnetic Compatibility Directive. Take additional measures to ensure compliance with the Directive and obtain a connection approval from the local energy supply company, if necessary.

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 suspend it from the lifting tackle as shown.

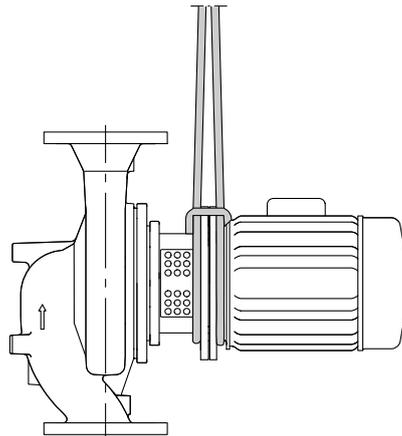


Fig. 1: Transporting the pump set

3.3 Storage/preservation

	CAUTION
	<p>Damage during storage by humidity, dirt or vermin Corrosion/contamination of the pump (set)!</p> <ul style="list-style-type: none"> ▷ For short-term 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.
- Exposed locating surfaces (shaft ends, flange faces, centring spigots, connector contacts) are treated with a layer of temporary corrosion protection (< 6 months) for transport. Take suitable corrosion protection measures for extended storage periods.
- Replace closed rolling element bearings after 48 months of storage.

If properly stored indoors, the equipment 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, observe the measures to be taken for shutdown. (⇒ Section 6.3.1, Page 32)

3.4 Return to supplier

1. Drain the pump as per operating instructions. (⇒ Section 7.3, Page 38)
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 13, Page 53)

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

3.5 Disposal

	WARNING
	<p>Fluids, consumables and supplies posing a health hazard Hazard to persons and the environment!</p> <ul style="list-style-type: none"> ▸ Collect and dispose of any preservatives, flushing liquids and 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 product.
Collect greases and other lubricants during dismantling.
2. Separate and sort the 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.



Electrical or electronic equipment marked with the adjacent symbol must not be disposed of in household waste at the end of its service life.

Contact your local waste disposal partner for returns.

If the used electrical or electronic equipment contains personal data, the operator is responsible for deleting it before the equipment is returned.

4 Description of the Pump (Set)

4.1 General description

- Non-self-priming in-line pump with low-voltage asynchronous motor to IEC 60034
- 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 Regulation No. 547/2012 (for water pumps with a maximum shaft power of 150 kW) implementing "Ecodesign" Directive 2009/125/EC

- Minimum efficiency index: see name plate, key to name plate
- The benchmark for the most efficient water pumps is $MEI \geq 0.70$.
- Year of construction: see name plate, key to name plate
- 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
- 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:
- 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 <http://www.ksb.com/reach>.

4.3 Designation

Table 4: 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
E	T	L	L	0	2	5	-	0	2	5	-	0	6	3	-	G	G	S	A	V	1	1	D	2	0	0	1	2	2	C		A	A	T	B	I	E	3	P	D	2	E
See name plate and data sheet																																										

Table 5: Designation key

Position	Code	Description
1-4	Pump type	
	ETLL	Etaline L
	ETLD	Etaline DL
5-16	Size, e.g.	
	025	Nominal suction nozzle diameter [mm]
	025	Nominal discharge nozzle diameter [mm]
	063	Nominal impeller diameter [mm]
17	Pump casing material	
	B	Bronze CC491K
	G	Grey cast iron EN-GJL-200 / EN-GJL-250
18	Impeller material	
	B	Bronze G-CuSn10Zn
	G	Grey cast iron EN-GJL-150
	P	Polysulphone PSU-GF30
19	Design	
	P	With casing cover made of polysulphone PSU-GF30
	S	Standard
	W	Approved for drinking water to WRAS
	X	Non-standard (BT3D, BT3)
20	Casing cover	
	A	Conical seal chamber
21	Shaft seal type	
	V	Conical seal chamber with vent
22-23	Seal code, single mechanical seal	
	11	BQ1EGG ≥ -15 - ≤ +120 [°C]
	12	BQ1PGG Available upon request.
	13	BVPGG Available upon request.
	14	Q5Q1EGG Available upon request.
	15	Q5Q1PGG Available upon request.
24	Scope of supply	
	D	Pump, motor
25	Shaft unit	
	2	Shaft unit 12
	4	Shaft unit 14
	6	Shaft unit 16
26-29	Motor rating P _N [kW] (basis 50 Hz)	
	0012	0,12

	0300	3,00
30	Number of motor poles	
31	Motor design	
	C	3-phase AC motor 230 V / 400 V

Position	Code	Description
31	M	1-phase AC motor 230 V
32	-	
33	Product generation	
	A	Etaline L / Etaline DL
34-36	Motor manufacturer	
	ATB	ATB
37-39	Efficiency class	
40-43	Design	
	-	Fixed speed version, without PumpDrive 2 Eco
	PD2E	Variable speed version, with PumpDrive 2 Eco

4.4 Name plate

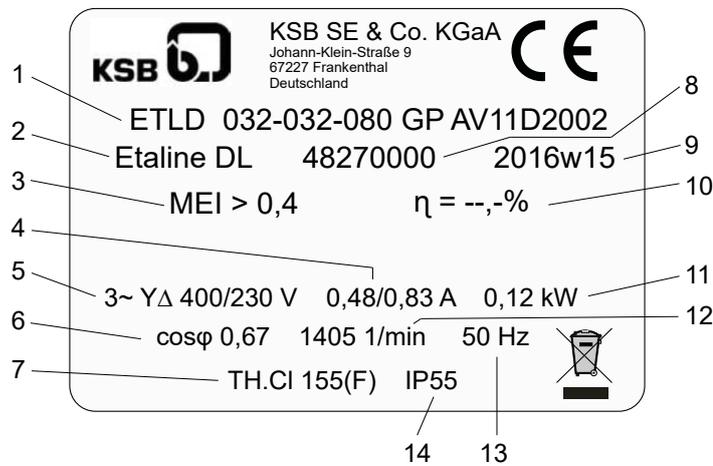


Fig. 2: Name plate (example)

1	Type series code, size and version	2	Type series
3	Minimum efficiency index	4	Phase current
5	Voltage range	6	Power factor
7	Thermal class	8	Material number (if applicable)
9	Year of construction	10	Efficiency
11	Nominal power	12	Speed
13	Frequency	14	Enclosure

4.5 Design details

Design

- Close-coupled design / in-line design
- Single-stage
- Horizontal installation / vertical installation
- Rigid connection between pump and motor

Pump casing

- Radially split volute casing
- In-line design

Drive

- Surface-cooled squirrel-cage motor to KSB standard
- Efficiency class IE3 to IEC 60034-30 (≥ 0.75 kW)
- Rated voltage (50 Hz) 1~ 220 - 240 V / 3~ 220 - 240 V 3~ 380 - 420 V ≤ 1.1 kW

- Rated voltage (50 Hz) 3~ 220 - 240 V / 3~ 380 - 420 V \geq 1.8 kW
- Type of construction IM B14
- Enclosure IP55
- Duty cycle: continuous duty S1
- Thermal class F

Shaft seal

- KSB mechanical seal

Impeller type

- Closed radial impeller

Bearings

- Radial ball bearings in the motor housing
- Grease lubrication

Automation

Automation options:

- PumpDrive

4.6 Configuration and function

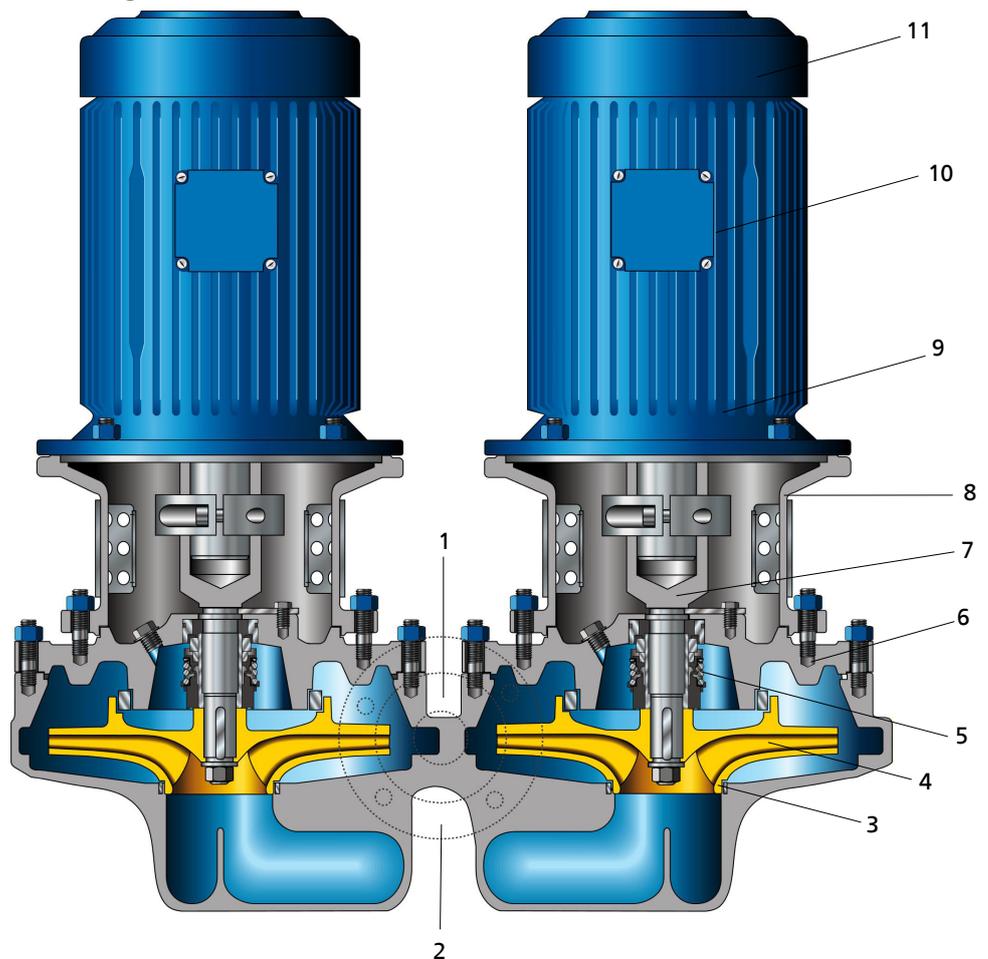


Fig. 3: Sectional drawing

1	Discharge nozzle	2	Suction nozzle
3	Clearance gap	4	Impeller
5	Shaft seal	6	Casing cover
7	Shaft	8	Drive lantern

9	Rolling element bearing	10	Motor housing
11	Rolling element bearing		

Design The pump is designed with a radial fluid inlet (suction nozzle) and a radial outlet (discharge nozzle) arranged on the same axis. The hydraulic system is rigidly connected to the motor by a shaft coupling.

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

Sealing The pump is sealed by a standardised mechanical seal.

4.7 Noise characteristics

Table 6: Surface sound pressure level $L_{pA}^{2)3)}$

Rated power input P_N [kW]	Pump set	
	1450 rpm	2900 rpm
0,12	36	40
0,18	36	40
0,25	-	46
0,37	36	46
0,55	-	46
0,75	37	52
1,1	-	52
1,8	-	53
3	-	53

4.8 Scope of supply

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

- Pump set

or

- Motor incl. casing cover

Accessories

- Pump foot for vertical installation of the drive

4.9 Dimensions and weight

For dimensions and weights please refer to the type series booklet of the pump (set).

² Spatial average; as per ISO 3744 and EN 12639; valid for pump operation in the $Q/Q_{opt} = 0.8 - 1.1$ range and for non-cavitating operation. If noise levels are to be guaranteed: Add +3 dB for measuring and constructional tolerance.

³ Increase for 60 Hz operation: 3500 rpm +3 dB; 1750 rpm +1 dB

5 Installation at Site

5.1 Safety regulations

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

5.2 Checks to be carried out prior to installation

Foundation 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.

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

Protective roof **Protective roof/additional roofing**
For vertical installation with the motor on top, fit a protective roof or additional roofing to prevent foreign objects from falling into the fan hood.

Ventilation **Ventilation**

	 WARNING
	<p>Improper installation Drive overheated!</p> <ul style="list-style-type: none"> ▷ Maintain the specified minimum distances to neighbouring assemblies. ▷ Never restrict the ventilation ducting to/from the drive. ▷ Prevent exhaust air from neighbouring assemblies from being drawn in directly.

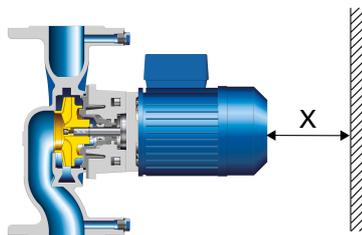


Fig. 4: Minimum distance X

Table 7: Minimum distance X to neighbouring assemblies

Motors with shaft centreline height [mm]	Minimum distance X [mm]
71 - 100	30

5.3 Installing the pump set

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

The pump set may be flanged directly into the piping.

1. Position the pump set on the foundation or in the piping and fasten it.
2. Place a spirit level on the discharge nozzle to align the pump set.

5.4 Piping

5.4.1 Connecting the piping

	⚠ DANGER
	<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. ▷ Take appropriate measures to compensate for thermal expansion of the piping.

	CAUTION
	<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.

	NOTE
	<p>Installing check and shut-off elements in the system is recommended, depending on the type of plant and pump. However, such elements must not obstruct proper drainage or hinder disassembly of the pump.</p>

- ✓ Suction lift lines have been laid with a rising slope, suction head lines with a downward slope towards the pump.
- ✓ A flow stabilisation section having a length equivalent to at least twice the diameter of the suction flange has been provided upstream of the suction flange.
- ✓ The nominal diameters of the pipelines are at least equal to the nominal diameters of the pump nozzles.
- ✓ Adapters to larger diameters have a diffuser angle of approximately 8° to prevent 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 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 7.2.2.1, Page 37) .

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 figure: Filter in the piping).

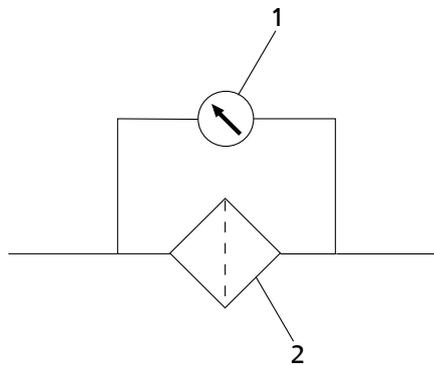


Fig. 5: Filter in the piping

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

5. Connect the pump nozzles to the piping.

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

5.4.2 Vacuum balance line

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

The following rules apply to vacuum balance lines:

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

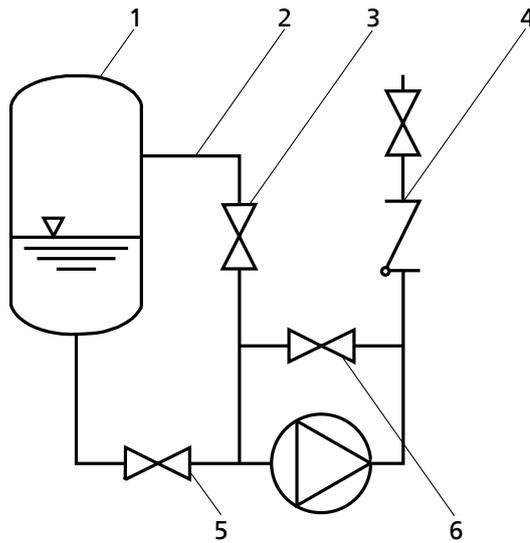


Fig. 6: Vacuum balance system

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

	NOTE
	<p>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.</p>

5.4.3 Auxiliary connections

	WARNING
	<p>Failure to use or incorrect use of auxiliary connections (e.g. barrier fluid, flushing liquid, etc.) Risk of injury from escaping fluid! Risk of burns! Malfunction of the pump!</p> <ul style="list-style-type: none"> ▷ Refer to the general arrangement drawing, the piping layout and pump markings (if any) for the quantity, dimensions and locations of auxiliary connections. ▷ Use the auxiliary connections provided.

5.5 Enclosure/insulation

	WARNING
	<p>The volute casing and casing/discharge cover take on the same temperature as the fluid handled Risk of burns!</p> <ul style="list-style-type: none"> ▷ Insulate the volute casing. ▷ Fit protective equipment.

1515.8/05-EN

	<p>CAUTION</p> <p>Risk of potentially explosive atmosphere due to insufficient ventilation 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.
	<p>CAUTION</p> <p>Heat build-up in the bearing bracket Damage to the bearing!</p> <ul style="list-style-type: none"> ▷ Never insulate the bearing bracket, bearing bracket lantern and casing cover.

5.6 Electrical connection

	<p>⚠ DANGER</p> <p>Hazardous voltage Danger of death from electric shock!</p> <ul style="list-style-type: none"> ▷ Have all work performed only by qualified specialist personnel and only when the drive is at a standstill and secured against unintentional start-up. This also applies to auxiliary circuits (e.g. standstill heater). ▷ The drive must not be electrically connected at any point in time when work is performed on the open terminal box. ▷ Ensure that the rotor cannot turn or be turned at any point in time when work is performed on the open terminal box.
	<p>⚠ WARNING</p> <p>Incorrect connection to the mains Damage to the mains network, short circuit!</p> <ul style="list-style-type: none"> ▷ Observe the technical specifications of the local energy supply companies.
	<p>NOTE</p> <p>Always protect three-phase motors with a current-dependent overload protection device with additional phase failure protection.</p>

Select the motor connection cables in accordance with IEC 60364, taking into account the current load of the cable at the given ambient temperature and the requisite heat dissipation to IEC / EN 60204-1 as a result of cable routing.

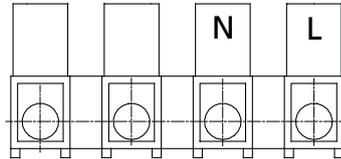
5.6.1 Motor connection inside the terminal box

Observe the following when performing any work on the terminal box:

- Always use the original sealing element to close the terminal box so that it is dust- and watertight.
- Do not damage components on the inside of the terminal box (e.g. terminal board and cable connections).
- Ensure that no foreign bodies, contamination or moisture are present in the terminal box. Terminal box cable entries to DIN 42925.
- Close additional open cable entries, fitting O-rings or suitable gaskets.
- Observe prescribed tightening torques for cable glands and other screws/bolts.
- When retrofitting cable glands to safeguard the required level of enclosure protection, ensure that the gasket is seated properly on the outside of the terminal box.

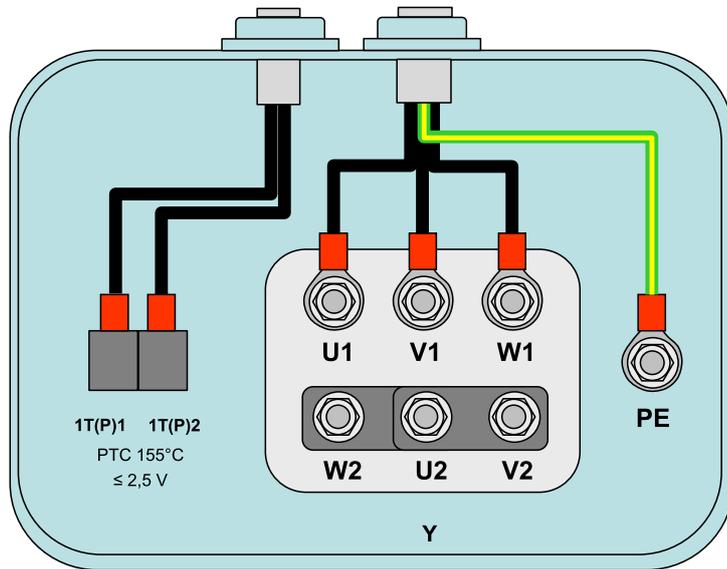
Connecting the motor

1. Check the voltage of the available power supply network against the data on the motor name plate.
2. Knock out any knock-out openings in the terminal box. While doing this, avoid causing damage to the terminal board, cable connections, etc. inside the terminal box.
3. Connect the motor in star or delta configuration in accordance with the rated voltage (see name plate) and the available power supply network.

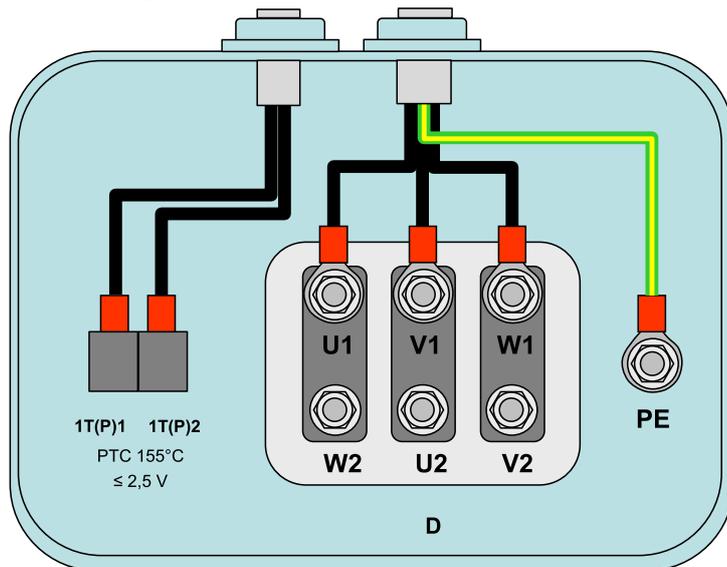


1~, configuration

To connect a single-phase motor to the AC power grid, connect the phase conductor to terminal "L" and neutral to terminal "N".



3~, star configuration



3~, delta configuration

4. Connect the earth conductor (PE).

5.6.1.1 Tightening torques

Unless other tightening torques are indicated on the motor the following torques shall be used:

Table 8: Tightening torques

Thread	[Nm]
M4	1,2
M5	2,0
M6	3,0
M8	6,0
M10	10,0

6 Commissioning/Start-up/Shutdown

6.1 Commissioning/Start-up/Shutdown

	 DANGER
	<p>Hazardous voltage Danger of death from electric shock!</p> <ul style="list-style-type: none"> ▷ Have all work performed only by qualified specialist personnel and only when the drive is at a standstill and secured against unintentional start-up. This also applies to auxiliary circuits (e.g. standstill heater). ▷ The drive must not be electrically connected at any point in time when work is performed on the open terminal box. ▷ Ensure that the rotor cannot turn or be turned at any point in time when work is performed on the open terminal box.

Before commissioning and whenever returning the product to service, perform the electrical safety checks stipulated by EN 60204-1.

6.1.1 Prerequisites for commissioning/start-up

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

- The drive has been mounted and aligned correctly.
- The operating conditions have been verified against the name plate data.
- The earth connection and potential equalisation connections have been made correctly.
- All fastening bolts/screws, connecting elements and electrical connections have been tightened to the specified tightening torques.
- Measures have been taken to prevent accidental contact with moving and live parts.
- Components (cables, etc.) that are sensitive to temperature do not come into contact with the motor housing.
- The pump set has been properly connected to the power supply and is equipped with all protection devices.
- The pump has been primed with the fluid to be handled. The pump has been vented.
- The direction of rotation has been checked.
- All auxiliary connections required are connected and operational.
- After prolonged shutdown of the pump (set), the activities required for returning the equipment to service have been carried out. (⇒ Section 6.4, Page 33)

6.1.2 Checking earth conductor connection

Check that the earth conductor has been correctly connected in accordance with EN60204.

6.1.3 Checking insulation resistance

Prior to commissioning and following prolonged storage or standstill periods, the insulation resistance will need to be checked and verified.

	NOTE
	<p>If windings have been dried after having been repaired or cleaned, bear in mind that the insulation resistance of warm windings is lower. The insulation resistance can only be correctly evaluated after converting to the reference temperature of 25 °C.</p>

The insulation resistance of the stator winding must equal at least 1.5 megohms in motors for 220 -1000 V.

6.1.4 Filling in lubricants

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

6.1.5 Priming and venting the pump

	DANGER
	<p>Formation of a potentially explosive atmosphere inside the pump Explosion hazard!</p> <ul style="list-style-type: none"> ▷ Before starting up the pump set, vent the pump and suction line and prime both with the fluid to be handled.

	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.

1. Vent the pump and suction line and prime both with the fluid to be handled. Connection 6D can be used for venting (see drawing of auxiliary connections). For vertical installation with the motor on top, use connection 5B (if provided) for venting (see drawing of auxiliary connections).
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.

	WARNING
	<p>Hot water escaping under pressure when the vent plug is opened Risk of electric shock! Risk of scalding!</p> <ul style="list-style-type: none"> ▷ Protect the electric components against escaping fluid. ▷ Wear protective clothing (e.g. gloves).

	NOTE
	<p>For design-inherent reasons some unfilled volume in the hydraulic system cannot be excluded after the pump has been primed for commissioning/start-up. However, once the motor is started up the pumping effect will immediately fill this volume with the fluid handled.</p>

6.1.6 Checking the direction of rotation

	DANGER
	<p>Temperature increase resulting from contact between rotating and stationary components 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.

	<p>⚠ WARNING</p>
	<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.
	<p>⚠ WARNING</p>
	<p>Parts flying off Personal injury and damage to property!</p> <ul style="list-style-type: none"> ▷ When checking the direction of rotation with the coupling removed, secure the respective keys to protect them from being thrown off.
	<p>CAUTION</p>
	<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 anti-clockwise (seen from the motor end).

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

6.1.7 Start-up

	<p>⚠ DANGER</p>
	<p>Non-compliance with the permissible pressure and temperature limits if the pump is operated with the suction and discharge lines closed. Leakage of hot or toxic fluids!</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 gate valve slightly or fully open.
	<p>⚠ DANGER</p>
	<p>Excessive temperatures due to dry running or excessive gas content in the fluid handled 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.

1515.8/05-EN

	CAUTION
	<p>Abnormal noises, vibrations, temperatures or leakage 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.
- ✓ Pump, suction line and inlet tank, if fitted, have been vented and primed with the fluid to be handled.
- ✓ 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 line/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.

	⚠ DANGER
	<p>Seal leakages at operating temperature Leakage of hot or toxic fluid handled!</p> <ul style="list-style-type: none"> ▷ Once the operating temperature has been reached, re-tighten the hexagon socket head cap screws between casing and casing cover.

6.1.8 Checking the shaft seal

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

6.1.9 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.

	CAUTION
	<p>Backflow of fluid handled is not permitted Motor or winding damage! Mechanical seal damage!</p> <p>▷ Close the shut-off elements.</p>

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

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

	CAUTION
	<p>Risk of freezing during prolonged pump shutdown periods Damage to the pump!</p> <p>▷ Drain the pump and the cooling/heating chambers (if any) or otherwise protect them against freezing.</p>

6.2 Operating limits

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

6.2.1 Ambient temperature

	CAUTION
	<p>Operation outside the permissible ambient temperature Damage to the pump (set)!</p> <p>▷ Observe the specified limits for permissible ambient temperatures.</p>

Observe the following parameters and values during operation:

Table 9: Permissible ambient temperatures

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

6.2.2 Frequency of starts

	DANGER
	<p>Excessive surface temperatures of the motor Explosion hazard!</p> <ul style="list-style-type: none"> ▷ The limit value for stopping the pump must never exceed the specified surface temperature of the respective temperature class. ▷ If the specified surface temperature of the respective temperature class is exceeded, immediately switch off the pump set and determine the cause.

The frequency of starts is determined by the maximum temperature increase of the motor. The frequency of starts depends on the power reserves of the motor in steady-state operation and on the starting conditions (DOL starting, star-delta starting, moments of inertia, etc). If the start-ups are evenly spaced over the period indicated, the following limits serve as orientation for start-up with the discharge-side shut-off valve slightly open:

Table 10: Frequency of starts

Material	Maximum frequency of starts
	[Start-ups/hour]
G (EN-GJL-150)	15
B (G-CuSn10Zn)	6
P (PSu-GF30)	6

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

6.2.3 Fluid handled

6.2.3.1 Flow rate

Table 11: Flow rate

Temperature range (t)	Minimum flow rate	Maximum flow rate
-30 to +70 °C	≈ 15 % of $Q_{opt}^{4)}$	See hydraulic characteristic curves
> 70 to +140 °C	≈ 25 % of $Q_{opt}^{4)}$	

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

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

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

⁴ Best efficiency point

Table 12: 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	-
$\Delta\vartheta$	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.

	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

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

6.2.4 Voltages and frequencies

Motor operation off the rated point will cause a rise in motor temperature. A voltage tolerance of $\pm 5\%$ and a frequency tolerance of $\pm 2\%$ are permissible.

Any situation where both the voltage and the frequency tolerance apply simultaneously shall be governed by the provisions of range A as described in EN60034-1. The motors can be operated continuously in range A. In accordance with EN60034-1, prolonged operation in range B is not recommended.

6.2.5 Maximum permissible speed

Comply with the rotational speed indicated on the name plate.

6.2.6 Altitude

- ≤ 1000 m above MSL: without power derating
- > 1000 m above MSL: installation at altitudes of up to 4000 m above MSL is possible with power derated by 3.8 % per 500 m.

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 38)
- ✓ The safety instructions for dismantling the pump have been observed.
 1. Spray-coat the inside wall of the pump casing and, in particular, the impeller clearance areas with a preservative.
 2. Spray the preservative through the suction nozzle and discharge nozzle. It is advisable to then close the pump nozzles (e.g. with plastic caps).
 3. Oil or grease all exposed machined parts and surfaces of the pump (with silicone-free oil or grease, food-approved if required) to protect them against corrosion.
Observe the additional instructions on preservation.

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

6.4 Returning to service

For returning the equipment to service observe the sections on commissioning/start-up and the operating limits.

In addition, carry out all servicing/maintenance operations before returning the pump (set) to service. (⇒ Section 7, Page 34)

	<p>⚠ 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>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

	 DANGER
	<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! ▷ Never open an energised pump set. ▷ Always perform maintenance work on pump sets outside potentially explosive atmospheres only.

	 DANGER
	<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, power cable, bearing assembly and shaft seal.

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

	 WARNING
	<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.

	 WARNING
	<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.

	 WARNING
	<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.

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

	⚠ DANGER
	<p>Rotating or live parts Death, serious injury or damage to property!</p> <ul style="list-style-type: none"> ▷ If covers have to be removed, de-energise the motor beforehand. ▷ Avoid touching live or rotating parts.

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

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

	⚠ DANGER
	<p>Hot surface Risk of burns!</p> <ul style="list-style-type: none"> ▷ Never touch a motor when it is in operation. ▷ Let the motor cool down. ▷ Only remove covers if indicated.

	⚠ WARNING
	<p>Condensing air humidity inside the motor if the motor and/or ambient temperatures frequently change Risk of corrosion by condensation!</p> <ul style="list-style-type: none"> ▷ Always observe the information provided on ambient conditions.

1515.8/05-EN

	<p>CAUTION</p>
	<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.
	<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.

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 6.1.8, Page 29)
- 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).
- Deviations from normal operation such as increased power consumption, temperatures or vibrations, unusual noises or odours, tripping of monitoring devices, etc.

	<p>CAUTION</p>
	<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).
	<p>NOTE</p>
	<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 Fire hazard! Damage to the pump set!</p> <ul style="list-style-type: none"> ▸ Regularly check the cover plates, plastic components and other guards of rotating parts for deformation and sufficient distance from rotating parts.

7.2.2.1 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.

7.2.2.2 Checking the motor

Carry out the following measures:

- Check that the electrical connections are firmly seated.
- Verify that ventilation paths are unobstructed and clean.
- Check that the terminal box is closed safely.

7.2.3 Lubrication and lubricant change

7.2.3.1 Maintenance of rolling element bearings

Maintenance for long-term storage

Extended storage periods decrease the service life of the lubricating grease. This in turn reduces the service life of the bearings.

- The rolling element bearings should be completely replaced after a storage period of more than 4 years.

Maintenance for normal operating conditions

Recommended bearing replacement interval under normal operating conditions:

Table 13: Bearing replacement

Ambient temperature	Bearing replacement interval
40 °C	20.000 h

	NOTE
	<p>The bearing service life is reduced e.g. for vertical installations, high vibration and shock loads, frequent reversing duty, higher ambient temperature and higher rotating speeds.</p>

7.2.3.1.1 Grease lubrication

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

7.2.3.1.2 Intervals

The rolling element bearings of the motor are grease-packed and maintenance-free.

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 13, Page 53)

7.4 Dismantling the pump set

7.4.1 General information/Safety regulations

	DANGER
	<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 6.1.9, Page 29) ▸ Close the shut-off elements in the suction line and discharge line. ▸ Drain the pump and release the pump pressure. (⇒ Section 7.3, Page 38) ▸ Shut off any auxiliary feed lines. ▸ Allow the pump set to cool down to ambient temperature.

	WARNING
	<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.

	DANGER
	<p>Hot surface Risk of burns!</p> <ul style="list-style-type: none"> ▸ Never touch a motor when it is in operation. ▸ Let the motor cool down. ▸ Only remove covers if indicated.

	WARNING
	<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.

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

In case of damage you can always contact our service staff.

Prior to dismantling, label the respective assignment of fastening elements as well as the arrangement of internal connections for future reassembly.

- Drive**
- Replace any corroded bolts/screws.
 - Never damage the insulation of live parts.
 - Document position of any rating and additional plates or labels to be removed.
 - Avoid damaging the centring spigots.

Protect rolling element bearings against the ingress of contamination and moisture.

	NOTE
	All maintenance work, service work and installation work can be carried out by KSB Service or authorised workshops.

	NOTE
	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.

7.4.2 Preparing the pump set

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

7.4.3 Dismantling the complete pump set

	NOTE
	The pump casing can remain installed in the piping for further dismantling.

- ✓ The notes and steps stated (⇒ Section 7.4.1, Page 38) into (⇒ Section 7.4.2, Page 39) have been observed/carried out.
1. Disconnect the discharge and suction nozzles from the piping.
 2. Depending on the pump/motor size, remove the supports from the pump set.
 3. Remove the complete pump set from the piping.

7.4.4 Removing the back pull-out unit

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

- ✓ The notes and steps stated (⇒ Section 7.4.1, Page 38) into (⇒ Section 7.4.3, Page 39) have been observed/carried out.
1. If required, suspend or support the back pull-out unit to prevent it from tipping over.
 2. Undo hexagon socket head cap screws 914.42 at the casing cover.
 3. Pull the back pull-out unit out of the volute casing.

4. Remove and dispose of O-ring 412.50.
5. Place the back pull-out unit on a clean and level surface.

7.4.5 Removing the impeller

- ✓ The notes and steps stated (⇒ Section 7.4.1, Page 38) into (⇒ Section 7.4.4, Page 39) have been observed/carried out.
- ✓ The back pull-out unit has been placed in a clean and level assembly area.
 1. Undo hexagon socket head cap screw 914.21 (right-hand thread!). Take safety device 930 and washer 554.03 off the impeller hub.
 2. Remove impeller 230 with an impeller removal tool.
 3. Place impeller 230 on a clean and level surface.
 4. Take key 940.01 out of the shaft of motor 800.

7.4.6 Removing the mechanical seal

- ✓ The notes and steps stated (⇒ Section 7.4.1, Page 38) into (⇒ Section 7.4.5, Page 40) have been observed/carried out.
- ✓ The back pull-out unit has been placed in a clean and level assembly area.
 1. Prise circlip 932 out of the groove with a screwdriver and pull it off the shaft of motor 800.
 2. Remove the rotating assembly of mechanical seal 433 (primary ring) from the shaft of motor 800.
 3. Prise the stationary assembly of mechanical seal 433 (mating ring) out of cap 580 with a screwdriver, taking care not to damage the mating ring!

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.

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

Assembly adhesives Avoid the use of assembly adhesives, if possible.
 Should an assembly adhesive be required after all, use a commercially available contact adhesive (e.g. Pattex) or sealant (e.g. HYLOMAR or Eppl 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.

Tightening torques For reassembly, tighten all screws and bolts as specified in this manual.

7.5.2 Fitting 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 40) 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 the mating ring location in cap 580.

	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.

2. Carefully insert the mating ring. Make sure that pressure is applied evenly.
3. Fit the rotating assembly of mechanical seal 433 (primary ring) on the shaft of motor 800.

7.5.3 Fitting the impeller

- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 40) to (⇒ Section 7.5.2, Page 41) have been observed/carried out.
 - ✓ The pre-assembled unit (motor, cap, drive lantern, casing cover) 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. Slide circlip 932 onto the shaft of motor 800 until it snaps into the groove.
 2. Insert key 940.01 and slide impeller 230 onto the shaft of motor 800.
 3. Fasten hexagon socket head cap screw 914.21 with safety device 930 and washer 554.03. (⇒ Section 7.6, Page 42)

7.5.4 Installing the back pull-out unit

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

- ✓ The notes and steps stated in (⇒ Section 7.5.1, Page 40) to (⇒ Section 7.5.3, Page 41) have been observed/carried out.
- ✓ Any damaged or worn parts have been replaced by original spare parts.
- ✓ The sealing surfaces have been cleaned.
 1. Suspend or support the back pull-out unit to prevent it from tipping over.
 2. Fit a new O-ring 412.50 on cap 580.
 3. Insert the back pull-out unit into volute casing 102.
 4. Tighten hexagon socket head cap screws 914.12 on casing cover 161. (⇒ Section 7.6, Page 42)

7.6 Tightening torques

Table 14: Tightening torques for bolted/screwed connections at the pump

Part No. ⁵⁾	Thread	[Nm]
903.02	1/4	55
903.39	1/4	55
914.21	M4	2,5
	M5	4
	M6	7
914.42	M6	10
	M8	25

7.7 Spare parts stock

7.7.1 Ordering spare parts

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

- Type series
- Size
- Material variant
- Seal code
- Material number
- Series code

Refer to the name plate for all data.

Also specify the following data:

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

⁵⁾ See general assembly drawing.

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

Table 15: Quantity of spare parts for recommended spare parts stock

Part No.	Description	Number of pumps (including stand-by pumps)						
		2	3	4	5	6 and 7	8 and 9	10 and more
230	Impeller	1	1	1	2	2	2	20 %
412.50	O-ring	4	6	8	8	9	10	100 %
433	Mechanical seal	1	1	2	2	2	3	25 %
914.21	Hexagon socket head cap screw	1	1	1	2	2	2	20 %
930	Safety device	1	1	1	2	2	2	20 %

8 Trouble-shooting

	WARNING
	<p>Improper work to remedy faults 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 Motor protection switch / thermistor trip device trips the unit
- 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
- I Drive does not start.

Table 16: Trouble-shooting

A	B	C	D	E	F	G	H	I	Possible cause	Remedy ⁶⁾
X	-	-	-	-	-	-	-	-	Pump delivers against an excessively high pressure.	Re-adjust to duty point. Check system for impurities. Fit a larger impeller. ⁶⁾ Increase the speed (frequency inverter).
X	-	-	-	-	-	X	X	-	Pump and/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 liquid level (open system). Increase system pressure (closed system). Install pump at a lower level. Fully open the shut-off element in the suction line. Change suction line, if the friction losses in the suction line are too high. Check any strainers installed/suction opening. Observe permissible speed of pressure fall.
X	-	-	-	-	-	-	-	-	Wrong direction of rotation	Check the electrical connection of the motor and the control system if any.
X	-	-	-	-	-	-	-	-	Speed is too low. - Operation with frequency inverter - Operation without frequency inverter	- Increase voltage/frequency at the frequency inverter in the permissible range. - Check electrical voltage.
X	-	-	-	-	-	X	-	-	Wear of internal components	Replace worn components by new ones.

⁶⁾ Pump pressure must be released before attempting to remedy faults on parts which are subjected to pressure.

A	B	C	D	E	F	G	H	I	Possible cause	Remedy ⁶⁾
-	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. ⁶⁾
-	X	-	-	-	-	-	-	-	Density or viscosity of fluid handled higher than stated in purchase order	Consult the manufacturer.
-	-	-	-	-	X	-	-	-	Use of unsuitable shaft seal materials	Change the material combination. ⁶⁾
-	X	X	-	-	-	-	-	-	Speed is too high.	Reduce speed. ⁶⁾
-	-	-	-	X	-	-	-	-	Tie bolts/sealing element defective	Fit new sealing element between volute casing and casing cover. Re-tighten the bolts.
-	-	-	-	-	X	-	-	-	Worn shaft seal	Fit new shaft seal.
-	-	-	-	-	X	-	-	-	Dismantle to find out.	Correct. Fit new shaft seal, if required.
-	-	-	-	-	X	-	-	-	Vibrations during pump operation	Correct the suction conditions. Re-balance the impeller. Increase pressure at the pump suction nozzle.
-	-	-	X	-	X	X	-	-	Pump is warped or sympathetic vibrations in the piping.	Check the piping connections and secure fixing of pump; if required, reduce distances between the pipe clamps. Fix the pipelines using anti-vibration material.
-	-	-	X	-	-	-	-	-	Increased axial thrust	Clean balancing holes in the impeller.
X	X	-	-	-	-	-	-	-	Motor is running on 2 phases only.	Replace the defective fuse. Check the electric cable connections. Check the motor winding.
-	-	-	-	-	-	X	-	-	Rotor out of balance	Clean the impeller. Re-balance the impeller.
-	-	-	X	-	-	X	X	-	Flow rate is too low.	Increase the minimum flow rate.
-	-	X	-	-	-	-	-	-	Incorrect setting of motor protection switch	Check setting. Fit new motor protection switch.
-	-	-	-	-	-	-	-	X	No electrical voltage	Check mains fuses, mains voltage and operating status of the frequency inverter.
-	-	-	-	-	-	-	-	X	Mains cables connected incorrectly/ Fault in supply line	Check wiring.

9 Related Documents

9.1 Installation types

Horizontal installation

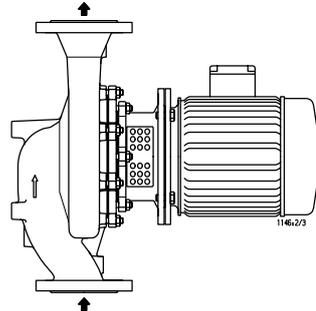


Fig. 7: Horizontal installation, direction of flow from bottom to top

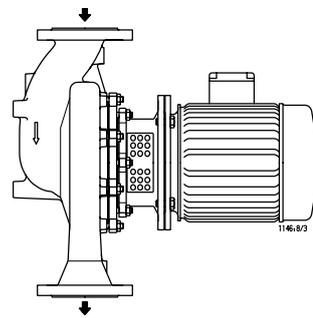


Fig. 8: Horizontal installation, direction of flow from top to bottom

i The volute casing and/or back pull-out unit must be turned by 180° so that the terminal box remains in its current position on top.

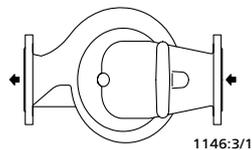


Fig. 9: Horizontal installation (for example under the ceiling)

i The volute casing and/or back pull-out unit must be turned by 90° so that the terminal box remains in its current position on top.

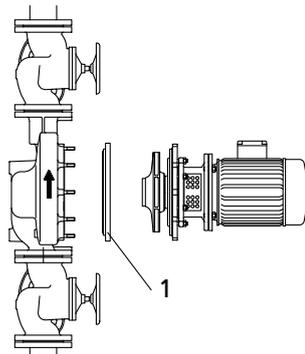


Fig. 10: Horizontal installation with blind flange (1 = blind flange, accessories)

i If one of the pumps needs to be serviced, the pump chamber can be shut off by a blind flange so that the system remains operational.

Vertical installation

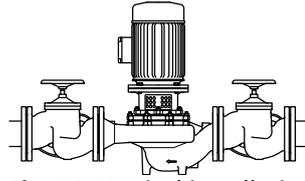


Fig. 11: Vertical installation/fastening without pump foot

 Installed directly in the piping. Always anchor the pipelines in close proximity to the pump in this case.

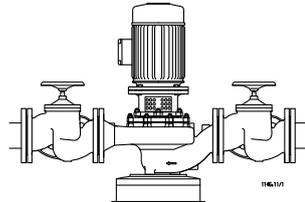


Fig. 12: Vertical installation/fastening with pump foot (accessories, available on request)

9.2 General assembly drawing with list of components

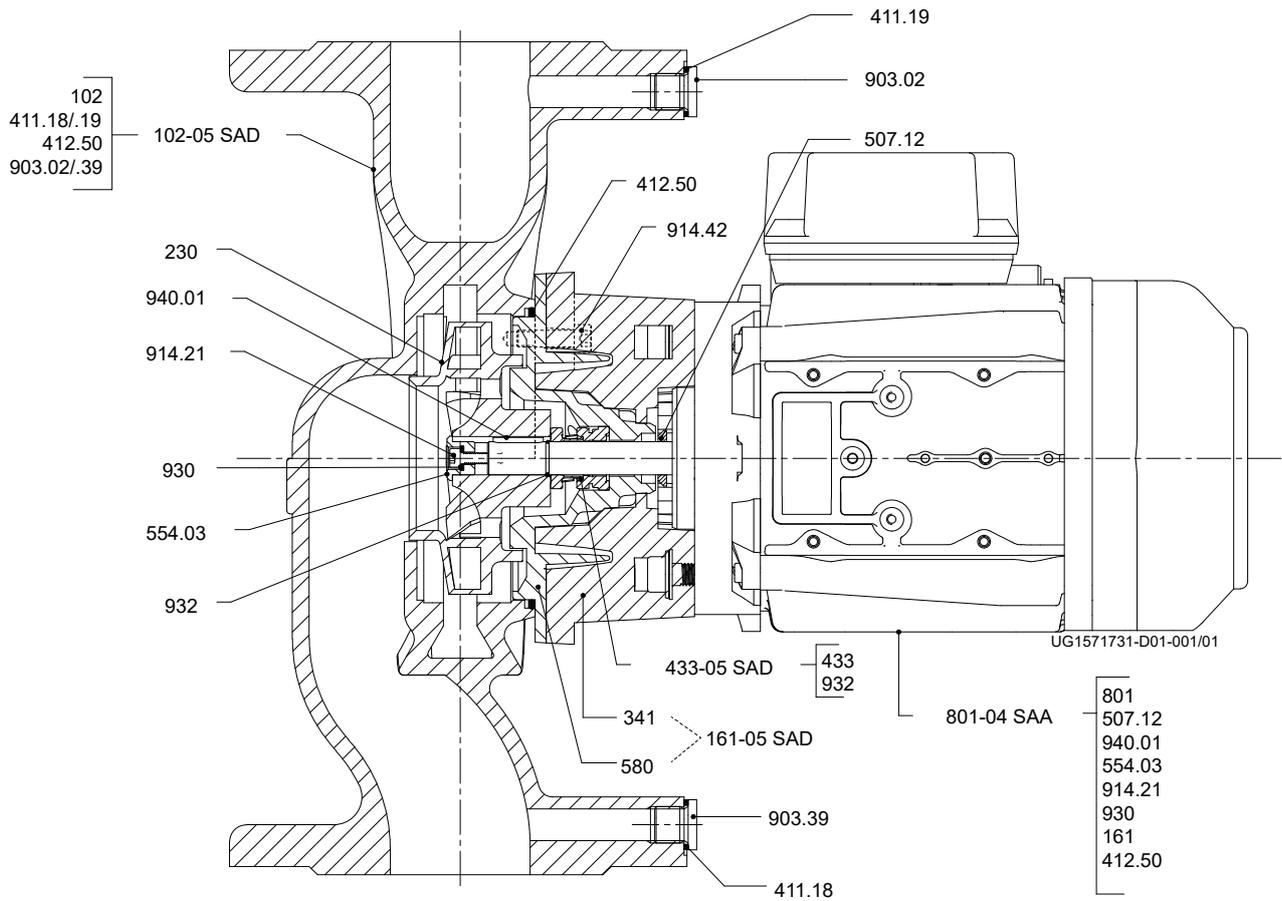


Fig. 13: General assembly drawing

Table 17: List of components

Part No.	Description	Part No.	Description
102	Volute casing	554.03	Washer
161	Casing cover	580	Cap
230	Impeller	801	Flanged motor
341	Drive lantern	903.02/.39	Screw plug
411.18/.19	Joint ring	914.21/.42	Hexagon socket head cap screw
412.50	O-ring	930	Safety device
433	Mechanical seal	932	Circlip
507.12	Thrower	940.01	Key

Table 18: Spare parts kits

Part No.	Description	Part No.	Description
102-05 SAD	Volute casing	102	Volute casing
		411.18/.19	Joint ring
		412.50	O-ring
		903.02/.39	Screw plug
161-05 SAD	Casing cover	341	Drive lantern
		580	Cap
230	Impeller	230	Impeller
433-05 SAD	Shaft seal	433	Mechanical seal
		932	Circlip
801-04 SAA	Motor	161	Casing cover
		412.50	O-ring

1515.8/05-EN

Part No.	Description	Part No.	Description
801-04 SAA	Motor	507.12	Thrower
		554.03	Washer
		801	Flanged motor
		914.21	Hexagon socket head cap screw
		930	Safety device
		940.01	Key

10 EU Declaration of Conformity

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

The manufacturer herewith declares that the product:

Etaline L, Etaline DL (1~, 230 V)

Serial number range: 2020w01 to 2020w52

- is in conformity with the provisions of the following directives / regulations as amended from time to time:
 - 2006/42/EC: Machinery Directive
 - Electrical components⁷⁾: 2011/65/EU Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

The manufacturer also declares that

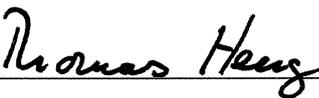
- the following harmonised international standards have been applied:
 - ISO 12100
 - EN 809
 - EN 60034-1, EN 60034-5/A1
 - EN 60335-1/A1, EN 60335-2-41

Person authorised to compile the technical file:

Dr. Lutz Urban
Head of Product Development Standardised Water Pumps
KSB SE & Co. KGaA
Johann-Klein-Straße 9
67227 Frankenthal (Germany)

The EU Declaration of Conformity was issued in/on:

Frankenthal, 1 January 2020



Thomas Heng
Head of Product Development Series Pumps
KSB SE & Co. KGaA
Johann-Klein-Straße 9
67227 Frankenthal

⁷ Where applicable

11 EU Declaration of Conformity

24006800907

Manufacturer:

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

The manufacturer herewith declares that the product:

Etaline L, Etaline DL (3~, Y Δ 400/230 V)

Serial number range: 2020w01 to 2020w52

- is in conformity with the provisions of the following directives / regulations as amended from time to time:
 - Pump set: 2006/42/EC Machinery Directive
 - Electrical components⁸⁾: 2011/65/EU Restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

The manufacturer also declares that

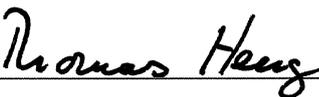
- the following harmonised international standards have been applied:
 - ISO 12100
 - EN 809
 - EN 60034-1, EN 60034-5/A1

Person authorised to compile the technical file:

Dr. Lutz Urban
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The EU Declaration of Conformity was issued in/on:

Frankenthal, 1 January 2020



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67227 Frankenthal

⁸ Where applicable

12 EU Declaration of Conformity

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

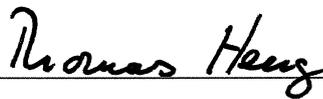
The manufacturer herewith declares that the product:

Etaline L, Etaline DL

- is in conformity with the provisions of the following Directives as amended from time to time:
 - Pump (set): Ecodesign Directive 2009/125/EC, Regulation 547/2012
(for water pumps with a maximum shaft power of 150kW)

The EU Declaration of Conformity was issued in/on:

Frankenthal, 1 February 2018



Thomas Heng
Head of Product Development Series Pumps
KSB SE & Co. KGaA
Johann-Klein-Straße 9
67227 Frankenthal

13 Certificate of Decontamination

Type:
 Order number/
 Order item number⁹:
 Delivery date:
 Applications:
 Fluid handled⁹:

Please tick where applicable⁹:



Corrosive



Oxidising



Flammable



Explosive



Hazardous to health



Seriously hazardous to health



Toxic



Radioactive



Bio-hazardous



Safe

Reason for return⁹:
 Comments:

The product/accessories have been carefully drained, cleaned and decontaminated inside and outside prior to dispatch/ placing at your disposal.

We herewith declare that this product is free from hazardous chemicals, biological and radioactive substances.

For mag-drive pumps, the inner rotor unit (impeller, casing cover, bearing ring carrier, plain bearing, inner rotor) has been removed from the pump and cleaned. In cases of containment shroud leakage, the outer rotor, bearing bracket lantern, leakage barrier and bearing bracket or intermediate piece have also been cleaned.

For canned motor pumps, the rotor and plain bearing have been removed from the pump for cleaning. In cases of leakage at the stator can, the stator space has been examined for fluid leakage; if fluid handled has penetrated the stator space, it has been removed.

- No special safety precautions are required for further handling.
- The following safety precautions are required for flushing fluids, fluid residues and disposal:

.....

We confirm that the above data and information are correct and complete and that dispatch is effected in accordance with the relevant legal provisions.

.....
 Place, date and signature

.....
 Address

.....
 Company stamp

1515.8/05-EN

⁹ Required fields

Index

A

Abrasive fluids 32
Applications 8
Automation 17
Auxiliary connections 22

B

Bearing temperature 36
Bearings 17

C

Certificate of Decontamination 53
Commissioning 26

D

Design 16
Direction of rotation 28
Dismantling 38, 39
Disposal 12
Drive 16

E

Event of damage 6
 Ordering spare parts 42
Explosion protection 23, 28, 30, 34

F

Filter 21, 37
Fluid handled
 Density 32
Frequency of starts 31

I

Impeller type 17
Installation at site 19
Intended use 8

K

Key to safety symbols/markings 7

M

Maintenance 35
Mechanical seal 29
Misuse 8

N

Name plate 6, 16
Noise characteristics 18

O

Operating limits 30
Other applicable documents 6

P

Partly completed machinery 6
Piping 20
Preservation 12, 33
Product description 14
Pump casing 16

R

Reassembly 39, 40
Return to supplier 12
Returning to service 33

S

Safety 8
Safety awareness 9
Scope of supply 18
Shaft seal 17
Shutdown 33
Spare part
 Ordering spare parts 42
Spare parts stock 43
Start-up 29
Storage 12, 33

T

Tightening torques 25, 42
Transport 11
Trouble-shooting
 Trouble-shooting 44

W

Warnings 7
Warranty claims 6



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