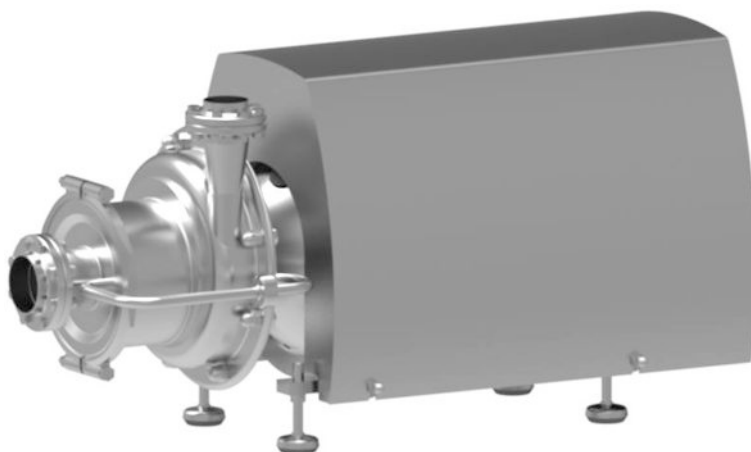




Hygienic Pumps

GEA Hilge TPS (IEC)

Operating instruction (Translation from the original language)
430BAL008663GB_17

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GEA Hilge

Niederlassung der GEA Tuchenhausen GmbH

hereinafter referred to as **Manufacturer** This restriction also applies to the drawings and diagrams included in the documentation.

LEGAL NOTICE

These instructions are part of the technical documentation for the scope of delivery. They contain important information to ensure safe and proper transportation, mounting, commissioning, economic operation, maintenance, and repair of the pump. Following these instructions will help you avoid risks, reduce repair costs and downtime and increase the pump's reliability and service life.

These instructions are aimed at users of the pump and are intended in particular for the operator and its operating and maintenance personnel.

It is mandatory for the operator and its operating and maintenance personnel to read these instructions prior to transport, installation, commissioning, use, maintenance, repair, disassembly and disposal of the pump. The obligation to read these instructions applies also to persons responsible for carrying out activities in the phases of the life of the pump.

The operator is required to complement these instructions with information based on existing national regulations for occupational safety, health protection, and environmental protection.

In addition to these instructions and the mandatory regulations for accident prevention applicable in the country and place of use, the recognised technical rules for safe and proper work must be observed.

These instructions are part of the pump. The entire documentation consists of these instructions and any additional instructions provided. It must always be kept within reach at the pump's location of use. When moving the pump to a different site and upon selling the pump, the entire documentation must be passed on as well.

These instructions were written to the best of our conscience. However, the manufacturer is not liable for any errors that may be contained in this document or for any resulting consequences.

The manufacturer reserves the right to make technical changes by further development of the pump described in these instructions.

Illustrations and drawings in these instructions are simplified representations. Due to enhancements and changes, it is possible that the illustrations do not exactly match the pump used by you. The technical data and dimensions are not binding. Claims cannot be derived from them.

The manufacturer assumes no liability for damages

- arising within the warranty period due to

-
- unintended operation and usage conditions,
 - insufficient maintenance,
 - improper operation,
 - incorrect installation,
 - incorrect or improper connection of electrical components.
- resulting or arising from unauthorised modifications or failure to follow the instructions,
 - caused by use of accessories / spare parts that have not been supplied or recommended by the manufacturer.

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1 General Information

1.1 Information on the Document

The present Operating Instructions are part of the user information for the product. The Operating Instructions contain all the information you need to transport, install, commission, operate and carry out maintenance for the product.

1.1.1 Binding Character of These Operating Instructions

These Operating Instructions contain the manufacturer's instructions to the operator of the product and to all persons who work on or use the product regarding the procedures to follow.

Carefully read these Operating Instructions before starting any work on or using the product. Your personal safety and the safety of the product can only be ensured if you act as described in the Operating Instructions.

Store the Operating Instructions in such a way that they are accessible to the operator and the operating staff during the entire life cycle of the product. When the location is changed or the product is sold make sure you also provide the Operating Instructions.

1.1.2 Notes on the Illustrations

The illustrations in these Operating Instructions show the product in a simplified form. The actual design of the product can differ from the illustration. For detailed views and dimensions of the product please refer to the design documents.

1.1.3 Symbols and Highlighting

In these Operating Instructions, important information is highlighted by symbols or special formatting. The following examples illustrate the most important types of highlighting.



Danger

Warning: Fatal Injuries

Failure to observe the warning can result in serious damage to health, or even death.

► The arrow identifies a precautionary measure you have to take to avoid the hazard.



Warning: Explosions

Failure to observe the warning can result in severe explosions.

► The arrow identifies a precautionary measure you have to take to avoid the hazard.



Warning!

Warning: Serious Injuries

Failure to observe the warning can result in serious damage to health.

- The arrow identifies a precautionary measure you have to take to avoid the hazard.



Caution!

Warning: Injuries

Failure to observe the warning can result in minor or moderate damage to health.

- The arrow identifies a precautionary measure you have to take to avoid the hazard.

Notice

Warning: Damage to Property

Failure to observe the warning can result in serious damage to the component or in the vicinity of the component.

- The arrow identifies a precautionary measure you have to take to avoid the hazard.

Carry out the following steps: = Start of a set of instructions.

1. First step in a sequence of operations.
 2. Second step in a sequence of operations.
 - Result of the previous operation.
- The operation is complete, the goal has been achieved.



Hint!

Further useful information.

1.2 Manufacturer address

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Hilgestraße 37-47
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Phone +49 6135 7016-0
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Phone +49 6135 7016101 (Service)
spareparts.hilge@gea.com

1.4 EU Declaration of Conformity for Machines
in accordance with the EC Machinery Directive 2006/42/EC, Annex II 1. A

Hersteller: **GEA HILGE**
Niederlassung der GEA Tuchenhausen GmbH
Hilgestraße 37-47
D 55294 Bodenheim

We declare under our sole responsibility that the machine

Designation: Centrifugal pump
Model: GEA Hilge TP
GEA Hilge TPS
Type: TP 1020, TP 1540, TP 2030, TP 2050, TP 3050, TP 5060, TP 7060, TP 2575, TP 8050, TP 8080, TP 16040
TPS 2030, TPS 3050, TPS 8050, TPS 8080

conforms with all the relevant provisions of this directive and the following directives:

Relevant EC directives: 2006/42/EC EC Machinery Directive

Applicable harmonized standards, in particular: EN ISO 12100:2010
EN 809:1998 + A1:2009 + AC:2010

Remarks: We also declare that the relevant technical documentation for this machine has been prepared in accordance with Annex VII, Part A, and agree to submit the documentation on justified request of national authorities on a data carrier.

Person authorised for compilation and handover of technical documentation: **GEA HILGE**
Niederlassung der GEA Tuchenhausen GmbH
Hilgestraße 37-47
D 55294 Bodenheim

Bodenheim, 24.10.2022



Karsten Becker
Managing Director



i. V. Dr. Danijel Anciger
Manager Product Development

1.5 UKCA-Declaration of Conformity

We herewith declare,

GEA HILGE
Niederlassung der GEA Tuchenhausen GmbH
Hilgestraße 37-47
D 55294 Bodenheim

that the machinery

Denomination:	Kreiselpumpe
Model:	GEA Hilge TP GEA Hilge TPS
Type:	TP 1020, TP 1540, TP 2030, TP 2050, TP 3050, TP 5060, TP 7060, TP 2575, TP 8050, TP 8080, TP 16040 TPS 2030, TPS 3050, TPS 8050, TPS 8080

is in conformity with the following UK-directives, provided that the site conditions for the commissioning are met as specified in the engineering documents, in particular in the operation manual:

Supply of Machinery (Safety) Regulations 2008, 2008 No. 1597

Designated standards used:	EN 809:1998+A1:2009+AC(D) EN ISO 12100:2010
----------------------------	--

Authorized person for compiling and handing over technical documentation:	Michael Kiely GEA Mechanical Equipment UK Ltd Westfalia House Old Wolverton Road, Old Wolverton, Milton Keynes MK12 5PY, United Kingdom
---	--

Bodenheim, 01.10.2022

Karsten Becker
Managing Director

i. V. Dr. Danijel Anciger
Technical Manager

2 Safety

2.1 Intended use

GEA Hilge TPS centrifugal pump with IEC standard motor (type B35) is suitable for the proper hygienic conveyance of biologically complex and expensive liquids. Therefore they can be used as product pumps in the food industry, pharmaceutical industry and as a cleaning agent pump in CIP cleaning circuits. The TPS pumps are not approved for use in potentially explosive atmospheres. The motors used by GEA have limited axial clearance. If motors from other manufacturers are used, these must be fitted with an A-side fixed bearing and the prescribed axial clearances must be observed (see Section 10.8.4, Page 60).



Hint!

The manufacturer is not liable for damage caused by improper use of the pump. The risk of such misuse lies entirely with the operator of the facility.

2.1.1 Requirements for operation

Prerequisites for trouble-free, safe operation of the pump are proper transport and storage as well as proper installation and assembly. The intended use also includes compliance with the operating, maintenance and service requirements.

2.1.2 Improper operating conditions

The operational safety of the pump can not be guaranteed under improper operating conditions. Therefore avoid improper operating conditions.

The operation of the pump is not permitted if:

- Persons or objects are in the danger zone.
- Safety devices are not working or were removed.
- Malfunctions have been detected on the pump.
- Damage to the pump has been detected.
- Maintenance intervals have been exceeded.

2.2 Operator's Duty of Care

The operating company of the pump has a special responsibility for the proper and safe handling of the pump within their company. Only use the pump when it is in perfect operating condition in order to prevent danger to persons and property.

This operating manual contains information that you and your employees need for safe operation over the life of the pump. Be sure to read these Operating Instructions carefully and ensure that the measures described here are observed.

The operator's duty of care includes planning the necessary safety measures and monitoring that these measures are observed. The following principles apply:

- Only qualified personnel may work on the pump.

- The operator must authorize personnel to carry out the relevant tasks.
- Order and cleanliness must be maintained at the work stations and in the entire area surrounding the pump.
- Personnel must wear suitable work clothing and personal protective equipment. As the operator of the facility make sure that work clothing and personal protective equipment are used.
- Inform personnel regarding any properties of the product which might pose a health risk and the preventative measures to be taken.
- Have a qualified first-aid representative on call during the operation. This person must be able to initiate any necessary first-aid measures in case of an emergency.
- Clearly define procedures, competences and responsibilities for those working in the area of the pump. All personnel must be aware of the actions to be taken in the event of an emergency. Be sure to instruct the personnel at regular intervals.
- The signs on the pump must always be complete and easy to read. Check, clean and replace the signs as necessary at regular intervals.
- Observe the Technical Data specified and the limits of use!



Hint!

Carry out regular checks. This way you can ensure that these measures are actually observed.

2.3 Subsequent changes

No technical modifications should ever be made to this pump. Otherwise you will have to undergo a new conformity process in accordance with the EC Machinery Directive on your own.

Only original spare parts from GEA should be installed. This ensures that the pump is always operating properly and efficiently.

2.4 General safety instructions and dangers

The pump is safe to operate. It was built according to the current state of science and technology.

Nevertheless, dangers can arise from the pump, if:

- the pump is not used as intended,
- the pump is used improperly,
- the pump is operated under impermissible conditions.

2.4.1 Principles for safe operation

Dangerous situations during operation can be avoided by safety-conscious and proactive behaviour of the personnel.

The following principles apply for safe operation of the pump:

- The instructions must be complete and kept in proper legible condition for anyone within the operating area of the pump.
- Only use the pump for its intended purpose.
- The pump must be in working order and function properly. Check the condition of the pump before starting work and at regular intervals.
- Wear tight fitting work clothes for all types of work on the pump.
- Make sure that no one can get injured from the parts of the pump.
- Report malfunctions or detectable changes to the pump immediately to the person in charge.
- Never touch the pipelines and the pump when they are hot! Avoid opening the pump if the process equipment is not drained or still under pressure.
- Observe the accident prevention regulations and all local regulations.

2.4.2 Environmental Protection

Harm to the environment can be avoided by safety-conscious and proactive behaviour of the staff.

For environmental protection the following principles apply:

- Substances harmful to the environment must not be discharged into the ground or the sewage system.
- Always observe the pertinent regulations relating to waste avoidance, disposal and utilization.
- Substances harmful to the environment must be collected and stored in suitable containers. Clearly mark the containers.
- Dispose of lubricants as hazardous waste.

2.4.3 Electrical Equipment

For all work on electrical equipment, the following principles apply:

- Access to electrical equipment should only be allowed to qualified electricians. Always keep unattended switch cabinets locked.
- Modifications of the control system can affect the safe and reliable operation. Modifications are only permitted with the express permission of the manufacturer.
- After completion of all work, check that the protective devices are fully functional.

2.5 Supplementary Regulations

In addition to the instructions in this documentation the following also has to be observed:

- pertinent accident prevention regulations,
- generally accepted safety rules,
- national regulations applicable in the country of use,

- work and safety instructions applicable in the facility,
- installation and operating regulations for use in potentially explosive areas.

2.6 Qualification of personnel

This section provides information on how the personnel working on the pump must be trained.

Operating and maintenance personnel must

- have the necessary qualification to carry out their tasks,
- be instructed with regard to possible dangers,
- know and observe the safety instructions given in the documentation.

Only allow qualified electricians to carry out work on the electrical equipment or have a qualified electrician supervise the work.

Only allow specially trained personnel to carry out work on an explosion-protected system. When working on explosion-protected equipment observe the standards DIN EN 60079-14 for gases and DIN EN 50281-1-2 for dusts.

The following minimum qualifications are required:

- Training as a specialist for working independently on the pump
- Adequate instruction to work on the pump under the supervision and guidance of a trained specialist

Each employee must meet the following requirements to work on the pump:

- Personal suitability for the respective task.
- Sufficient professional qualification for the respective task.
- Received instruction about the functionality of the pump.
- Received instruction about operating sequences on the pump.
- Familiar with the safety devices and their function.
- Familiar with these Operating Instructions, especially with the safety instructions and the information which is relevant for the task on hand.
- Familiar with the basic regulations with regard to occupational health and safety and accident prevention. When working with the pump, a distinction is made between the following user groups:

User groups	
Staff	Qualifications
Operating personnel	Adequate instruction and sound knowledge in the following areas: • Functionality of the pump • Operating sequences on the pump • What to do in case of an emergency • Lines of authority and responsibilities with respect to the task
Maintenance personnel	Appropriate training and a sound knowledge of the structure and functionality of the pump. Sound knowledge in the following areas: • Mechanical equipment • Electrical equipment Authorization with regard to safety engineering standards to carry out the following tasks: • Setting devices into operation • Earthing of devices • Marking of devices The relevant certificates of qualification must be submitted before work can be carried out on ATEX certified machines.

2.7 Safety equipment

2.7.1 Signs

Hazardous locations on the pump are marked by warning signs, prohibition signs and mandatory signs.

The signs and instructions on the pump must always be legible. Any illegible signs must be replaced immediately.

Signs on the pump	
Sign	Meaning
 Fig.1	General hazard warning
 Fig.2	Warning Crushing
 Fig.3	Explosive atmosphere hazard warning

2.8 Residual dangers

Dangerous situations can be avoided by safety-conscious and proactive behaviour of the personnel and by wearing personal protective equipment.

Residual hazards on the pump and preventative measures		
Danger	Cause	Measure
Danger to life	Unintentional switch-on of the pump	Effectively disconnect all components, effectively prevent switch-on.
	Electric power	Observe the following safety rules: 1. Isolate from the power supply. 2. Take appropriate measures to prevent switch on. 3. Test absence of voltage. 4. Earthing and short-circuiting. 5. Cover or safeguard any adjacent live parts.

Residual hazards on the pump and preventative measures		
Danger	Cause	Measure
Danger of injury	Danger presented by moving or sharp-edged parts	The operator must exercise caution and prudence. For all work: • Wear suitable work clothing. • Never operate the machine if the cover panels are not correctly fitted. • Never open the cover panels during the operation. • Never reach into openings. Wear protective clothing in the entire area of the pump as a preventative measure: • Protective gloves • Safety shoes
Environmental damage	Operating materials with properties which are harmful to the environment	For all work: • Collect lubricants in suitable containers. • Dispose of lubricants in accordance with the pertinent regulations.

2.9 Danger zones

Please observe the following notes:

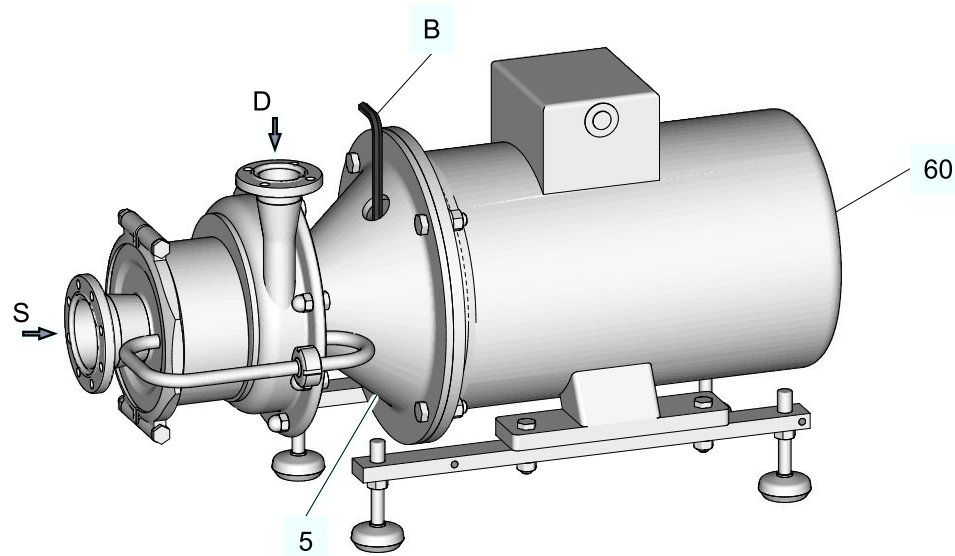


Fig.4

- In case of malfunction, take the pump out of service (separate from the power supply) and secure against restarting.
- Never touch the motor stool (5), the fan housing of the motor (60), the suction (S) or the pump discharge port (D) while the pump is running. Fingers can be crushed or cut off.
- Switch off the pump during all maintenance, repair and service work and secure the it against unintentional restart.
- After maintenance, never forget to remove the hexagon socket screwdriver (B) from the cylinder screw on the shaft.
- Only allow a qualified electrician to carry out any work on the electrical power supply.
- Regularly check the electrical equipment of the pump. Immediately remedy loose connections and molten cables.
- If work on live parts cannot be avoided, call in a second person, who can operate the main switch in case of an emergency.
- The housing sockets have very sharp edges. Wear suitable protective gloves when transporting and installing the pump.

3 Description

3.1 Design

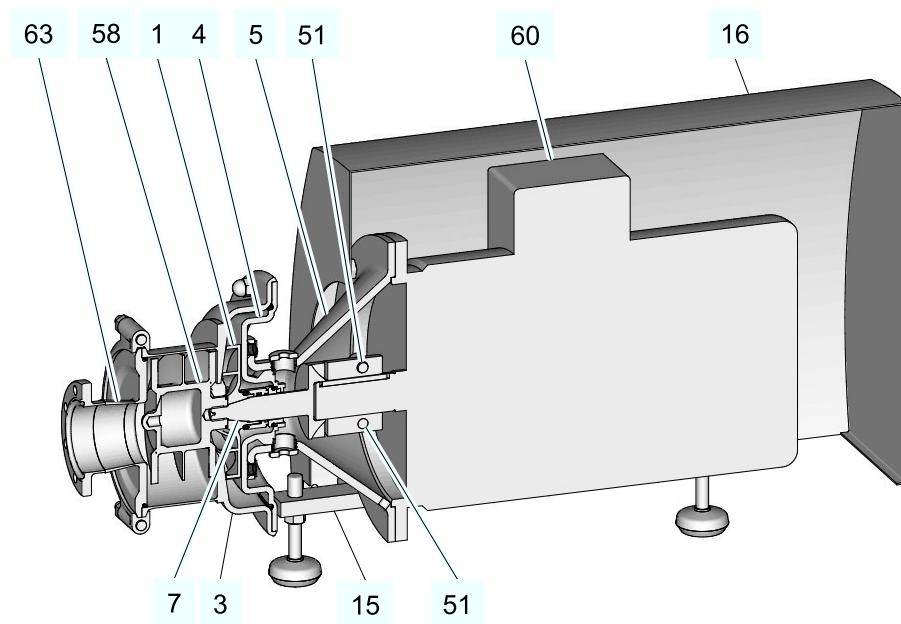


Fig.5: Pump assembly

The pump consists of the following parts:

- Pump housing (4), pump cover (3), motor stool (5)
- Impeller (1), shaft (7), inducer (58), flange (63)
- A three-phase asynchronous motor (60)
- Cup-shaped feet carrier (15)
- Protective hood (16)

The pump shaft (7) is attached on the shaft end of the three-phase asynchronous motor.

The pump shaft is fixed axially by 2 cylinder screws (51).

The motor stool (5) allows the connection of different motor sizes to the pump.

The motor stool (5) connects the motor to the pump housing (4). This features an opening for the leakage display.

Depending on the design, the pump has a single-acting (EW), a single-acting flushed (QU) or a double-acting mechanical seal (DW).

The slide-ring of the mechanical seal is carried along with the impeller.

The impeller is installed between the pump housing and the pump cover.

The inducer is located in the inducer housing and fixes the impeller onto the shaft.

The height and the horizontal orientation of the pump are set with 4 height-adjustable cup-shaped feet.

If necessary, the pump can be equipped with a stainless steel hood to protect the motor.

3.2 Functional description

The centrifugal pump TPS is self-priming. It is also capable of evacuating suction pipelines even at negative liquid levels. The inducer generates a liquid ring in the inducer housing.

This liquid ring seals the inducer and the inducer housing from each other. Incoming gases are conveyed between the inducer hub and the liquid ring through the pump.

The impeller with its blades curved backward, rotates in the pump at the speed of the motor. The rotation of the impeller transmits energy in the form of centrifugal forces and speed increases to the conveying medium which is then pumped from the discharge nozzle.

The suction neck is positioned axially and eccentrically on the pump body.

The discharge nozzle is aligned tangentially upward on the body of the pump.

4 Transport and storage

4.1 Storage conditions

The storage facility must be covered and well-ventilated. Avoid high humidity.

The pump must be drained at temperatures below the freezing point.

4.2 Transport

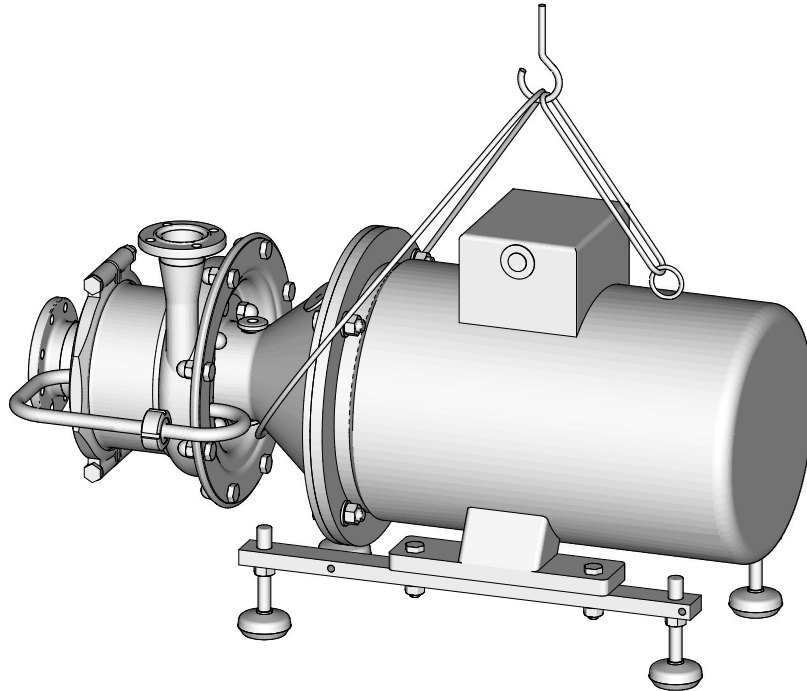


Fig.6: Transporting the pump

For transport, the following principles apply:

- The packaging units/pumps may only be transported with appropriate hoists and lifting devices. Observe the graphic symbols on the packaging.
- The pump must be transported as shown in the figure.
- Observe the pictograms on the package.
- Transport the pump carefully to prevent damage due to external force or careless loading and unloading.
- Only qualified personnel are allowed to transport the pump.
- Movable parts must be properly secured.
- Only use approved, fully functional load lifting devices and lifting accessories which are suitable for the intended purpose. Observe the maximum load-bearing capacities.
- Secure the pump against slipping. Observe the weight of the pump and the center of gravity position.
- Under no circumstances should anyone stand under a suspended load.

- Transport the pump carefully. Do not grip sensitive parts of the unit to lift or push the unit or to support yourself. Avoid putting the unit down with a jerk.

4.2.1 Scope of supply

After taking delivery of the pump, check if

- the details on the type plate correspond to the data in the order and delivery documents,
- the equipment is complete and all components are in good order.

Externally visible transport damage and / or missing packages must be indicated immediately on the freight note with the delivering forwarder. Written recourse must be taken immediately against the freight forwarder by the recipient and GEA must be informed about the process. Claims must be submitted within 6 days to the freight forwarder for transport damage that is not recognized immediately. The recipient will bear the cost of any damage claimed beyond this point.

5 Technical data

5.1 Types of mechanical seals

TP	E	EW	SHJ	C	S	25			
							Shaft diameter	25 / 30	
							Elastomer	S	EPDM
								Q	FKM
							Gasket material	C	C/SIC
								S	SIC/SIC
								B	C/SS
							Design	SHJ	
							Gasket configuration	EW	Single-acting mechanical seal
								QU	Single-acting flushed mechanical seal
								DW	Double-acting mechanical seal
							Use	E	Retrofitting set
								C	Mechanical seal, complete
								V	Wear part set
							Pump type	TP / TPS	

5.2 Typenschild

The following information is given on the name plate:

Pump-Type: Pumpenbezeichnung

P: Motorleistung

Ser.-No.: Seriennummer

n: Drehzahl

Q: Fördermenge

TAG No.: Kundenbezeichnung

H: Förderhöhe

YOM: Herstellungsjahr

5.3 Technical data

Refer to the following tables for the key technical data:

5.3.1 General operating data - nominal values

Sealing liquid pressure (type DW, double-acting slide-ring packing)	Min. 2 bar (29 psi) Max. 3 bar (43.5 psi) over operating pressure
Sealing liquid temperature (type DW, double-acting slide-ring packing)	up to 60 °C (140 °F) Max. 70 °C (158°F) temporarily
Sealing liquid pressure (type QU, single-acting slide-ring packing flushed with shaft sealing ring for barrier liquid)	up to 2000 rpm: Max. 0.35 bar (5 psi) up to 3500 rpm: Max. 0.2 bar (2.9 psi) (according to DIN 3760)

Sealing liquid temperature (type QU, single-acting slide-ring packing with shaft sealing ring for barrier liquid)	up to 60 °C (140 °F) Max. 70 °C (158°F) temporarily
Water consumption of sealing liquid	0.25 ... 0.5 l/min 0.066 ... 0.132 gpm (US)

5.3.2 Specific operating data - nominal values

Operating data - nominal values		TPS 2030	TPS 3050	TPS 8050	TPS 8080
Discharge, nominal	nom.	20 m³/h	30 m³/h	70 m³/h	80 m³/h
Discharge, maximum	max.	35 m³/h	68 m³/h	90 m³/h	112 m³/h
Discharge head, nominal	nom.	28 m	50 m	35 m	80 m
Discharge head, maximum	max.	35 m	64 m	59 m	93.5 m
Maximum permissible operating pressure (MAWP) = supply pressure + max. discharge pressure (pump)	max.	16 bar	16 bar	16 bar	16 bar
Max. permissible supply pressure	max.	16 bar	16 bar	16 bar	16 bar
Switching pressure level	nom.	80 dB (A)	83 dB (A)	84 dB (A)	88 dB (A)



Hint!

TPS 8050 and TPS 8080 may not be operated below 50% of the best point.

Dynamic viscosity	max.	500 mPa*s = 500 cP
Operating speed	max.	3500 rpm
Speed	50 Hz	2900 rpm
Speed	60 Hz	3500 rpm
Permissible operating temperature		- 5 ... +100 ° C, +140 ° C for a temporarily (with corresponding sealing quality)
Permissible ambient temperature		- 16 ... + 40 °C
Switching frequency	max.	15 switching operations

5.3.3 Motor

	TPS 2030	TPS 3050	TPS 8050	TPS 8080
Motor	IEC three-phase AC motor, IM B34 and B35 design, make and version freely selectable, see motor selection table.			
Performance range [kW]	2.2 ... 11	3 ... 22	4 ... 30	15 ... 45
Operating voltage (standard)*	up to and incl. 2.2 kW: Δ230 V and Y 400 V at 50 Hz / Δ265 V and Y 460 V at 60 Hz from incl. 3.0 kW: Δ400 V and Y 690 V at 50 Hz / Δ460 V at 60 Hz			

* Observe different operating voltages if the motors deviate from the standard

5.3.4 Motor selection

The axial forces may not be exceeded by the requirement profile of the motor.

Motor size	Output [kW]	Speed [rpm]	Min. axial forces [N]*	Permissible axial shaft movement [mm]*
90 L	2.2	2900	600	0.1
100 L	3	2900	700	0.1
112 M	4	2900	800	0.1
132 S	5.5	2900	800	0.1
132 S	7.5	2900	1100	0.1
132 M	11	2900	1100	0.1
132 M	15	2900	1100	0.1
160 M	11	2900	1100	0.1
160 M	15	2900	1100	0.2
160 L	18.5	2900	1100	0.2
160 M	22	2900	1400	0.2
200 L	30	2900	1400	0.3
200 L	37	2900	1400	0.3
200 L	45	2900	2000	0.3

* from the direction of the motor

5.3.5 Materials - product contacting

Pump housing	1.4404 / 316L
Pump shaft	1.4404 / 316L
Impeller	1.4404 / 316L

Shaft sealing	
Standard	Carbon - Silicon Carbide (C / SIC)
alternative	Silicon Carbide - Silicon Carbide (SIC / SIC) Carbon - Stainless Steel (C / SS)
Notes	All slide-ring packings are available in single-acting, flushed or a double-acting flushed versions. Double-acting slide-ring packing in the standard program only in SIC/SIC.
Gaskets /seals	EPDM / FKM

5.4 Resistance of Sealing Materials

The resistance of sealing materials depends on the type and temperature of the medium conveyed. The exposure time can adversely affect the service life of the seals. The sealing materials comply with the regulations of FDA 21 CFR 177.2600 or FDA 21 CFR 177.1550.

Resistance:

- + = good resistance
- o = reduced resistance
- - = no resistance

Sealing resistance table			
Medium	Temperature	Gasket material (general operating temperature)	
		EPDM -40...+135°C (-40...275°F)	FKM -10...+200 °C (+14...+392°F)
Caustics up to 3%	up to 80 °C (176°F)	+	o
Caustics up to 5%	up to 40 °C (104°F)	+	o
Caustics up to 5%	up to 80 °C (176°F)	+	–
Caustics at more than 5%		o	–
Inorganic acids up to 3%	up to 80 °C (176°F)	+	+
Inorganic acids up to 5%	up to 80 °C (176°F)	o	+
Inorganic acids up to 5%	up to 100 °C (212°F)	–	+
Water	up to 80 °C (176°F)	+	+
Steam	up to 135 °C (275°F)	+	o

Sealing resistance table			
Medium	Temperature	Gasket material (general operating temperature)	
		EPDM -40...+135°C (-40...275°F)	FKM -10...+200 °C (+14...+392°F)
Steam, approx. 30 min	up to 150 °C (302°F)	+	o
Fuels/hydrocarbons		–	+
Product with a fat content of max. 35%		+	+
Product with a fat content of more than 35%		–	+
Oils		–	+

* Depending on the installation conditions

5.5 Lubricants

Lubricants	Material no.
Rivolta F.L.G. MD-2	413-071
PARALIQ GTE 703	413-064

5.6 Pump weights

Weights TPS, 2-pole [kg]						
Motor size	Number of poles	Output [kW]	TPS 2030	TPS 3050	TPS 8050	TPS 8080
80	2	1,1	-	-	-	-
90S	2	1,5	-	-	-	-
90L	2	2,2	54	-	-	-
100L	2	3,0	71	85	-	-
112M	2	4,0	82	96	106	-
112M	2	5,5	87	101	111	-
112M	2	7,5	93	107	117	-
132S	2	5,5	100	114	124	-
132S	2	7,5	115	129	139	-
132M	2	9,0	123	137	147	-
132M	2	11,0	124	138	148	150
132M	2	15,0	-	152	162	164
160M	2	11,0	-	186	196	198

Weights TPS, 2-pole [kg]						
Motor size	Number of poles	Output [kW]	TPS 2030	TPS 3050	TPS 8050	TPS 8080
160M	2	15,0	-	192	202	204
160L	2	18,5	-	201	211	213
160L	2	22,0	-	210	220	222
200L	2	30,0	-	-	328	330
200L	2	37,0	-	-	-	342
200M	2	45,0	-	-	-	375

5.7 Motor weights

Motor size	Number of poles	Output [kW]	Weight [kg] (tolerance +10%)
80	2	1.1	16
90S	2	1.5	22
90L	2	2.2	24
100L	2	3.0	34
112M	2	4.0	40
112M	2	5.5	45
112M	2	7.5	51
132S	2	5.5	54
132S	2	7.5	69
132M	2	9.0	77
132M	2	11.0	78
132M	2	15.0	92
160M	2	11.0	110
160M	2	15.0	116
160M	2	18.5	125
160L	2	22.0	134
200L	2	30.0	223
200L	2	37.0	235
200M	2	45.0	268

5.8 Torques

Pay attention to parts overview Figure 17, Page 46.

Size	Torques [Nm]			
	Cap nut (48)		Inducer (58)	
	M _{min}	M _{max}	M _{min}	M _{max}
TPS 2030	35	39	45	50
TPS 3050	60	74	55	60
TPS 8050	95	100	90	95
TPS 8080	95	100	90	95

Size	Torques [ft lb]			
	Cap nut (48)		Inducer (58)	
	M _{min}	M _{max}	M _{min}	M _{max}
TPS 2030	25.8	28.8	33.2	36.9
TPS 3050	44.2	54.6	40.5	44.2
TPS 8050	70	73.7	66.4	70
TPS 8080	70	73.7	66.4	70

Pay attention to parts overview Section 10.5.1, Page 45.

Torques of the pump shaft		
Cylinder screw (51)	Torques	
	[Nm]	[ft lb]
M8	35	25.8
M10	70	51.6
M12	110	81.1

Torques of the motor stool		
Hex head screw (44)	Torques	
	[Nm]	[ft lb]
M10	39	29
M12	74	55
M16	100	74

6 Assembly and installation

6.1 Safety instructions

Hazardous situations during installation can be avoided by safety-conscious and proactive behaviour of the personnel.

For installation, the following principles apply:

- Only qualified personnel are allowed to set-up, install and commission the pump.
- Ensure that adequate working and traffic areas are available at the place of installation.
- Observe the maximum load-bearing capacity of the installation surface.
- Observe the transport instructions and markings on the part(s) to be transported.
- Remove any nails protruding from transport crates immediately after opening the crate.
- Under no circumstances should anyone stand under a suspended load.
- Safety devices of the pump may not work effectively during installation.
- Reliably secure machine parts which have already been connected against inadvertently being switched on.
- Residue, contamination and dry running can damage the mechanical seal, the pump impeller, inducer and the entire pump. Therefore the entire system must be thoroughly cleaned before operating the pump.

6.2 Setting up the pump

Carry out the following steps:

1. Set up the pump so that there is sufficient air circulation for the motor and sufficient space for maintenance work.
2. Position the pump horizontally. Compensate for any unevenness in the floor with the height-adjustable cup-shaped feet.

→ The pump is now set up.

6.3 Installing the pipelines

Carry out the following steps:

1. Install pump free of stress in the piping system.
2. Install the pump in such a way that air pockets are avoided.

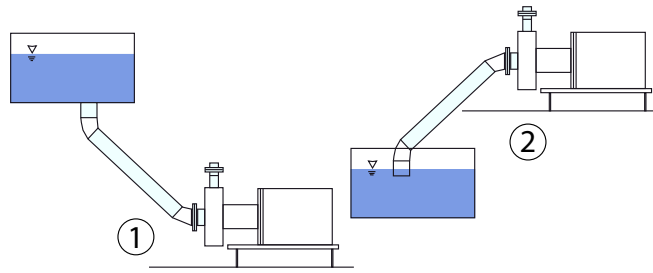


Fig.7: Installing the pipelines
1: Feed system | 2: suction system

Feed system: Lay the pipeline in such a way that it steadily slopes towards the pump.

Suction system: Lay the pipeline in such a way that it steadily slopes towards the pump.

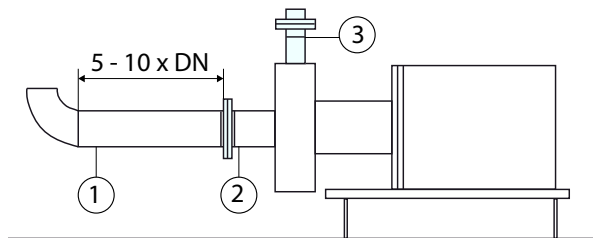


Fig.8: Distance to the intake port
1: Intake pipe | 2: Suction port | 3: Discharge port

Do not install any elbow directly upstream of the pump. The distance should be five to ten times the diameter of the intake port.



Hint!

The suction line should be configured as short as possible and should exhibit minimal pipeline resistances. To avoid any damage due to cavitation (evaporation), the NPSH values of the pump must be observed.

3. For Quench and double-acting mechanical seal: Laying pipelines for supply liquid.

The rinsing and sealing fluid must be clean. The feed at the bottom and the outlet at the top must be connected to vent the liquid chamber.

4. Pay attention to the pressure of the supply liquid:

- Single-acting, flushed mechanical seal (Quench): 0.2 - 0.35 bar (2.9 - 5.07 psi).
- Double-acting mechanical seal: min. 2.0 bar (29 psi), max. 3.0 bar (43.5 psi) over max. possible pump internal pressure.

The max. possible pump internal pressure depends on several factors. They must be taken into consideration when specifying the sealing pressure:

Zero delivery head of the pump (bar) + feed height / system pressure /
steam pressure (bar) + density of the feed medium(t/m^3)

5. Only operate the pump during ongoing flushing.

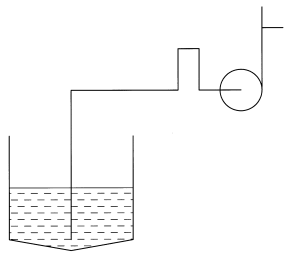
→ Pipeline is installed.

Installation for operation with negative suction lift



Hint!

Like all self-priming centrifugal pumps, the TPS pump requires a certain residual liquid in the pump. The pump must be filled with this liquid before it is started for the first time.

Negative suction lift			
TPS size	Liquid [l]	Speed [rpm]	Figure
2030	2.9	2900	 Fig.9
3050	3.5	2900	
8050	6.4	2900	
8080	6.4	2900	

The pump must be operated at a minimum speed of 2900 rpm to convey gas particles > 10%. To ensure that the liquid remains in the pump and does not drain through the connected pipelines, the suction and pressure side piping must be designed as shown:

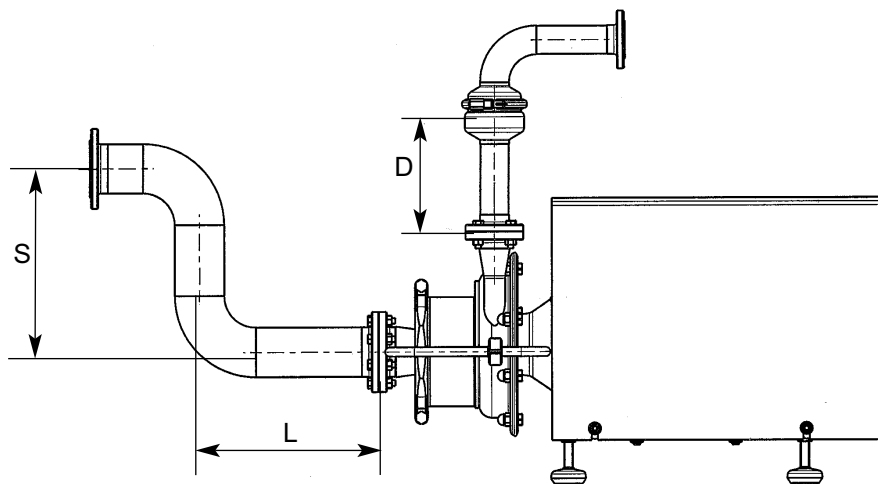


Fig.10: Pipeline for liquid with gas particle

Suction and discharge side pipeline			
TPS size	Suction side (S)	Suction side (L)	Discharge side (D)
2030	0.2 ... 0.5 m	0.5 ... 1.0 m	1.5 m
3050	0.2 ... 0.5 m	0.5 ... 1.0 m	1.5 m
8050	0.2 ... 0.5 m	0.5 ... 1.0 m	1.5 m
8080	0.2 ... 0.5 m	0.5 ... 1.0 m	1.5 m

⚠ Caution!

Danger of damaging the mechanical seal in pumps with a single-acting mechanical seal

If the suction time is longer than $t = 30$ s, dry running and damage to the mechanical seal can occur.

- In this case, a flushed (QU) or a double-acting mechanical seal (DW) must be used.

Installation for operation with positive suction lift

In order for the pump to create suction, some liquid must flow from the tank through the pipeline into the pump after the tank has been completely drained and refilled. The discharge port must always be aligned vertically and upward.

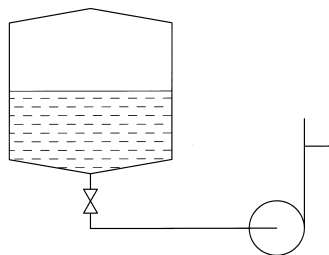


Fig.11: Tank

6.4 Connecting the motor

⚠ Danger

Risk of injury / risk of material damage

- The motor must be connected and properly secured by authorized personnel in accordance with the relevant IEC/VDE regulations.
- During the electrical connection of the pump, ensure that the direction of rotation of the impeller corresponds to the marking (see directional arrow on the pump discharge port)

⚠ Caution!

Exceeded voltage values can overload the drive motor

- ▶ The mains voltage must correspond to the specifications on the nameplate of the motor.
- ▶ Make sure that the specified power values are not exceeded, so that the drive motor is not overloaded.
- ▶ Observe country-specific features.

Carry out the following steps:

1. Connect cable, see wiring diagram in terminal box cover.

→ The motor is connected.



Hint!

When using a protective hood, it is possible that there is insufficient space available between the hood and the side mounted cable guide in the terminal box. In this case, rotate the terminal box 90° so that the connecting cable is routed rearwards over the fan cover of the motor.

Grounding

Motor

The motor must be electrically grounded. An earthing clamp can be found in the terminal box of the motor for this purpose.

Protective hood

The protective hood must be electrically grounded. To do this, the protective hood must be connected to earth with a suitable grounding cable. The borehole (A) provided for connection of the grounding cable is located on the side of the protective hood and is marked with the grounding symbol.

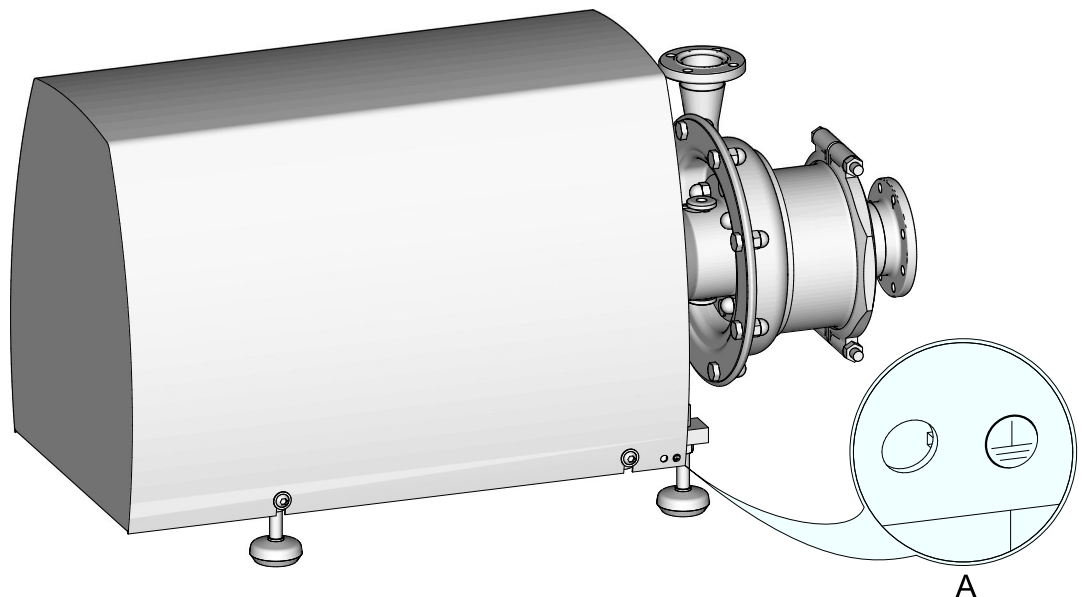


Fig.12: Ground the protective hood

Cup-shaped feet carrier

We recommend grounding the cup-shaped feet carrier. Place a serrated washer (B) under the screw (B) for this purpose.

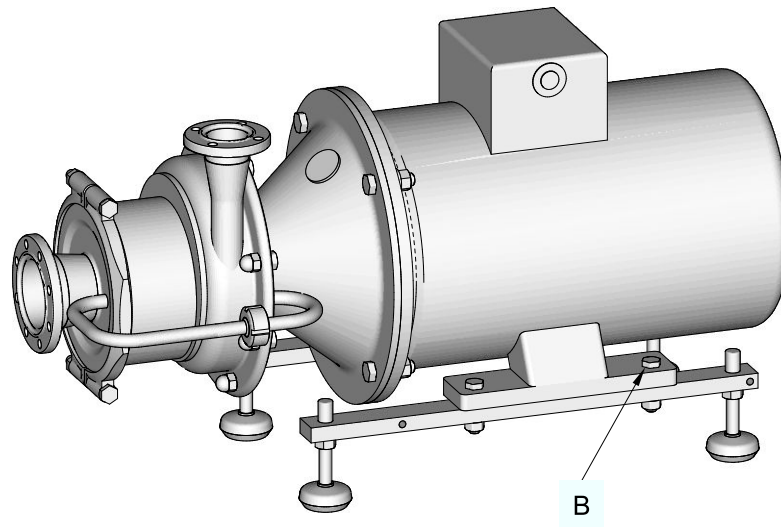


Fig.13: Earthing the machine pad support

Star connection

Connect the motor in accordance with the order data and the specifications on the nameplate.

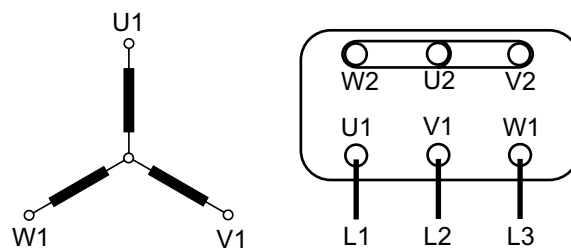


Fig.14: Star connection

Delta connection

Connect the motor in accordance with the order data and the specifications on the nameplate.

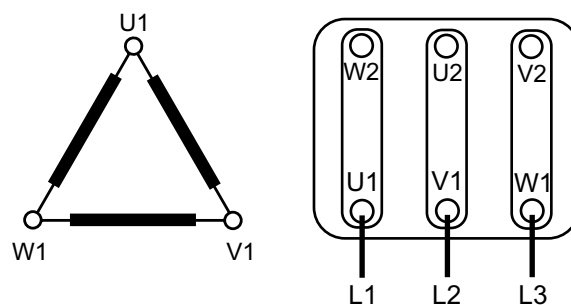


Fig.15: Delta connection

The GEA motor standard includes a PTC thermistor for thermal monitoring. If necessary, these are connected accordingly for frequency converter operation. For this purpose there are 2 connections in the terminal box, which may appear different depending on the motor manufacturer. Please observe the enclosed operating manual of the motor manufacturer for connection of the PTC thermistor.

6.5 Checking the direction of rotation

Caution!

Gasket damage caused by dry running of the mechanical seal

- Check the direction of rotation only when the pump is fully installed and filled with liquid.

Caution!

If the direction of rotation is wrong, there is a risk that the inducer will become loose and the pump will be damaged.

- The inducer must be replaced with the supplied nuts M14 in order to prevent damage during the direction of rotation test period.
- After the test, the inducer must be reinstalled at the correct tightening torque.

Carry out the following steps:

1. Replace the inducer with supplied M14 nuts.
2. Check the connections.
3. Fill the pump.

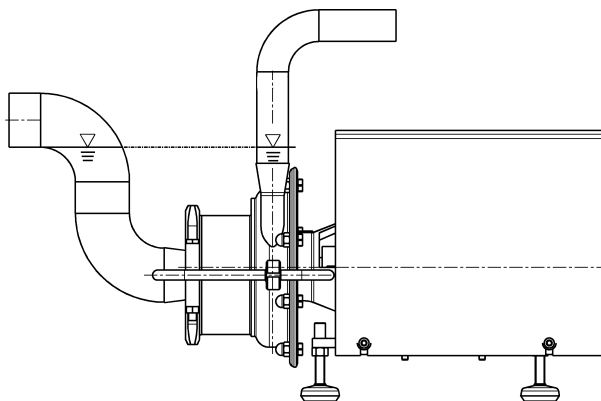


Fig.16

4. Switch on the motor
 5. Observe the direction of rotation.
The direction of rotation is seen from the motor to the pump is clockwise.
Check the direction of rotation on the impeller after removing the cover.
 6. After checking, reinstall the inducer at the correct tightening torque.
- Direction of rotation is checked.



Hint!

! Check the tightening torque of the cap nut on the impeller if the pump has been started in the wrong direction of rotation after the inducer is installed. Failure to do so may result in the impeller becoming loose and damage.

6.6 Checking the sealing liquid

(only for pumps with flushed or double mechanical seal)



Caution!

Sealing damage caused by operation without connecting the sealing fluid.

► Connect the sealing liquid before commissioning.

Carry out the following steps:

1. Check the sealing liquid.

- Sealing liquid must be clean and not contain abrasive components.
- Temperature of sealing liquid max. 60 °C (140 °F); temporarily 70 °C (158 °F).

→ The sealing liquid is now checked.

6.7 Checking the suction side valves



Caution!

Damage caused by vacuum

► The suction side may not be blocked during operation

Carry out the following steps:

1. Check suction side before commissioning.

! Do not close the suction side valves during operation.

→ The valves on the suction side are checked.

7 Start-up

7.1 Safety instructions

Initial commissioning

For initial commissioning, the following principles apply:

- Take protective measures against dangerous contact voltages in accordance with pertinent regulations.
- The pump must be fully assembled and properly adjusted. All screw connections must be securely tightened. All electrical cables must be installed correctly.
- Reliably secure machine parts which have already been connected against inadvertently being switched on.
- Relubricate all lubricating points.
- Make sure lubricants are used properly.
- After a modification to the pump a reassessment of residual risks is required.

Commissioning

For commissioning, the following principles apply:

- Only qualified personnel may commission the pump.
- Make sure that all connections are functioning properly.
- The safety devices on the pump must be completely installed, in working order and function properly. Check the function before starting any work.
- When switching on the pump, the danger zones must be clear.
- Remove any liquids that have escaped without leaving residues.

7.2 Notes on commissioning

Before starting commissioning observe the following:

- Make sure that there are no foreign materials in the system.
- Clean the pipe system prior to the first product run.
- During commissioning, regularly check all sealing points for leaks. Replace defective seals.
- Before commissioning, check that all of the tools, such as the hexagon socket screwdriver (B), have been removed from the assembly opening.

8 Operation and control

8.1 Safety instructions

Dangerous situations during operation can be avoided by safety-conscious and proactive behaviour of the personnel.

For operation, the following principles apply:

- Monitor the pump during operation.
- Safety devices must not be changed, removed or taken out of service. Check all safety devices at regular intervals.
- All guards and hoods must be fitted as intended.
- The installation location of the pump must always be properly ventilated.
- Structural changes to the pump are not permitted. Report any changes to the pump immediately to the person in charge.
- Always keep danger zones clear. Do not leave any objects in the danger zone. Only allow persons to enter the danger zone when the machine is de-energized.
- Regularly check that all emergency stop devices are working correctly.

9 Cleaning

9.1 Cleaning

All parts in contact with product must be cleaned at regular intervals. Always observe the safety data sheets issued by the cleaning agent manufacturers. Only cleaning agents may be used which do not damage the seals and the interior parts of the pump.

The component manufacturer can only make a recommendation on the type of cleaning with respect to cleaning agents, temperature, times and intervals, but no binding information can be given. This should be determined or defined by the operating company according to each process.

The cleaning effect must be checked regularly by the operator!

9.1.1 Cleaning Process Examples

Typical Cleaning Parameters in Dairy Operations

Example of a two-phase cleaning process:

- Sodium hydroxide solution and sodium hydroxide based combination products in concentrations from 0.5% to 2.5% at 75 °C (167 °F) to 80 °C (176 °F).
- Phosphoric or nitric acid, and combination products based thereon in the concentrations of 0.3 % to 1.5% at approx. 65 °C (149 °F).

Example of a cleaning operation in one cleaning step:

- Formic acid and formic acid-based combination products at up to 85 °C (185 °F).

Typical Cleaning Parameters in Breweries

- Sodium hydroxide solution and sodium hydroxide based combination products in concentrations of 1% to 4% at about 85 °C (185 °F).
- Phosphoric or nitric acid, and combination products based thereon in the concentrations of 0.3 % to 1.5% at 20 °C (68 °F).

9.1.2 Cleaning effect

The cleaning effect depends on the following factors:

- Temperature
- Time
- Mechanics
- Chemicals
- Degree of soiling

These factors can be combined in such a way as to make an optimal cleaning result probable.

9.2 Steam sterilization

A steam sterilization of the pumps GEA Hilge TP and TPS is possible under the following conditions:

- Pumps with encapsulated shaft seal type SHJ (EW, QU, DW); type MG1 is not permissible
- The pump may not be operated during steam sterilization
- The pump must be completely drained prior to steam sterilization via the drainage valve
- Steam sterilization is only possible for 30 minutes
- The steam temperature of 140 °C (289 °F) may not be exceeded
- The steam resistance of the sealing materials must be considered:
 - EPDM: good resistance
 - FKM: limited resistance (not recommended)

9.3 Manual exterior cleaning

Notice

Danger due to cleaning agents.

- ▶ Follow the manufacturer's instructions when using cleaning agents.
 - ▶ Wear safety glasses and gloves.
 - ▶ Dispose of cleaning agent properly.
 - ▶ Do not use a high-pressure water jet to clean the pumps.
-

- Regular manual external cleaning of the pump unit facilitates proper operation.
- Always check the impermeability of the motor (terminal box, condensation water holes) before each cleaning.
- Clean the outside of the pump with a soft cloth or brush and use warm water if necessary.
- When using a cleaning agent, make sure that it does not attack the surface of the pump unit.
- Remove dust and debris that may clog the fan and cooling fins of the engine.
- Dry cleaning is preferable to wet cleaning.
- The cleaning intervals depend on the degree of contamination.

10 Maintenance

10.1 Safety instructions

Maintenance and repair

Before carrying out maintenance work and repairs to electrical devices on the pump, the following steps must be carried out according to the "5 safety rules":

- Isolate from the power supply
- Take appropriate measures to prevent switch on
- Test absence of voltage
- Earthing and short-circuiting
- Cover or safeguard any adjacent live parts.

For maintenance and repair, the following principles apply:

- Observe the intervals specified in the maintenance schedule.
- Only qualified personnel may carry out maintenance or repair work on the pump.
- The pump must be switched off and secured against being switched back on before maintenance or repair work. Work may only be started once any residual energy has been discharged.
- Block access for unauthorized persons. Put up notice signs which draw attention to the maintenance or repair work going on.
- Do not climb on the pump. Use suitable access aids and working platforms.
- Wear suitable protective clothing.
- Only use suitable and undamaged tools to carry out maintenance work.
- When replacing parts only use approved, fully functional load lifting devices and lifting accessories which are suitable for the intended purpose.
- Before setting the unit back into operation refit all safety devices as originally provided in the factory. Then check that all safety devices are working correctly.
- Make sure lubricants are used properly.
- Check pipes are firmly secured, also check for leaks and damage.
- Check that all emergency stop devices are working correctly.

Disassembly

For disassembly, the following principles apply:

- Only qualified personnel are allowed to remove the pump.
- The pump must be switched off and secured against being switched back on before it is dismantled. Work may only be started once any residual energy has been discharged.
- Disconnect all power and utility lines.

- Markings, e.g. on lines, must not be removed.
- Do not climb on the pump. Use suitable access aids and working platforms.
- Mark the lines (if unmarked) prior to disassembly to ensure they are not confused when re-assembling.
- Protect open line ends with blind plugs against ingress of dirt.
- Pack sensitive parts separately.
- For longer periods of standstill, observe the storage conditions, see Section 4.1, Page 22.

10.2 Inspections

The pump is maintenance-free for the most part.

In order to prevent possible malfunctions, GEA recommends that regular visual inspections be carried out. Special attention should be paid to the leak tightness and the correct functioning of the pump.

In order to ensure maximum operational safety of the pump wear parts, such as the mechanical seal and O-rings, should be checked after 2000 hours of operation and replaced if necessary.

In any case, all seals must be checked and, if necessary, replaced during disassembly of the pump.

10.2.1 Replacement of O-rings

Notice

Hygiene risk, food safety

Worn out and not fully functional components may lead to the contamination of the pump.

► Pay close attention to the condition of the O-rings during regular inspections.

The O-rings must be replaced if any one of these characteristics are visible:

- The O-ring is deformed at one or more locations.
- The O-ring has cracks.
- The surface of the O-ring is porous and brittle.
- The O-ring has lost its elasticity.

10.3 Maintenance intervals

To ensure the highest operational reliability, all wearing parts should be replaced at longer intervals.

The actual maintenance intervals can only be determined by the user since they depend on the operating conditions, for instance:

- daily period of use,
- switching frequency,
- type and temperature of the product,

- type and temperature of the cleaning solution,
- ambient conditions.

Maintenance Intervals	
Applications	Maintenance intervals (guideline values)
Media at temperatures of 60 °C to 130 °C (140 °F to 266 °F)	approx. every 3 months
Media at temperatures of < 60 °C (< 140 °F)	approx. every 12 months

10.4 Prior to disassembly

Requirement:

- Make sure that during maintenance and repair work no process is in operation in the area concerned.

Carry out the following steps:

1. Close all of the shut-off devices in the suction and pressure line.
2. Drain all piping elements leading to the pump and clean or flush if necessary.
3. Drain the pump completely.
! If hazardous liquids should leak observe the precautions according to data sheet of the hazardous liquid and handle/dispose of the leaked liquid properly.
4. Disconnect the power supply.
5. Disconnect the pump motor from the electrical power supply.
6. Remove the pump from the pipeline, drain and allow to cool down to room temperature.

→ Done

10.5 Disassembly

10.5.1 Removing the inducer and pump cover

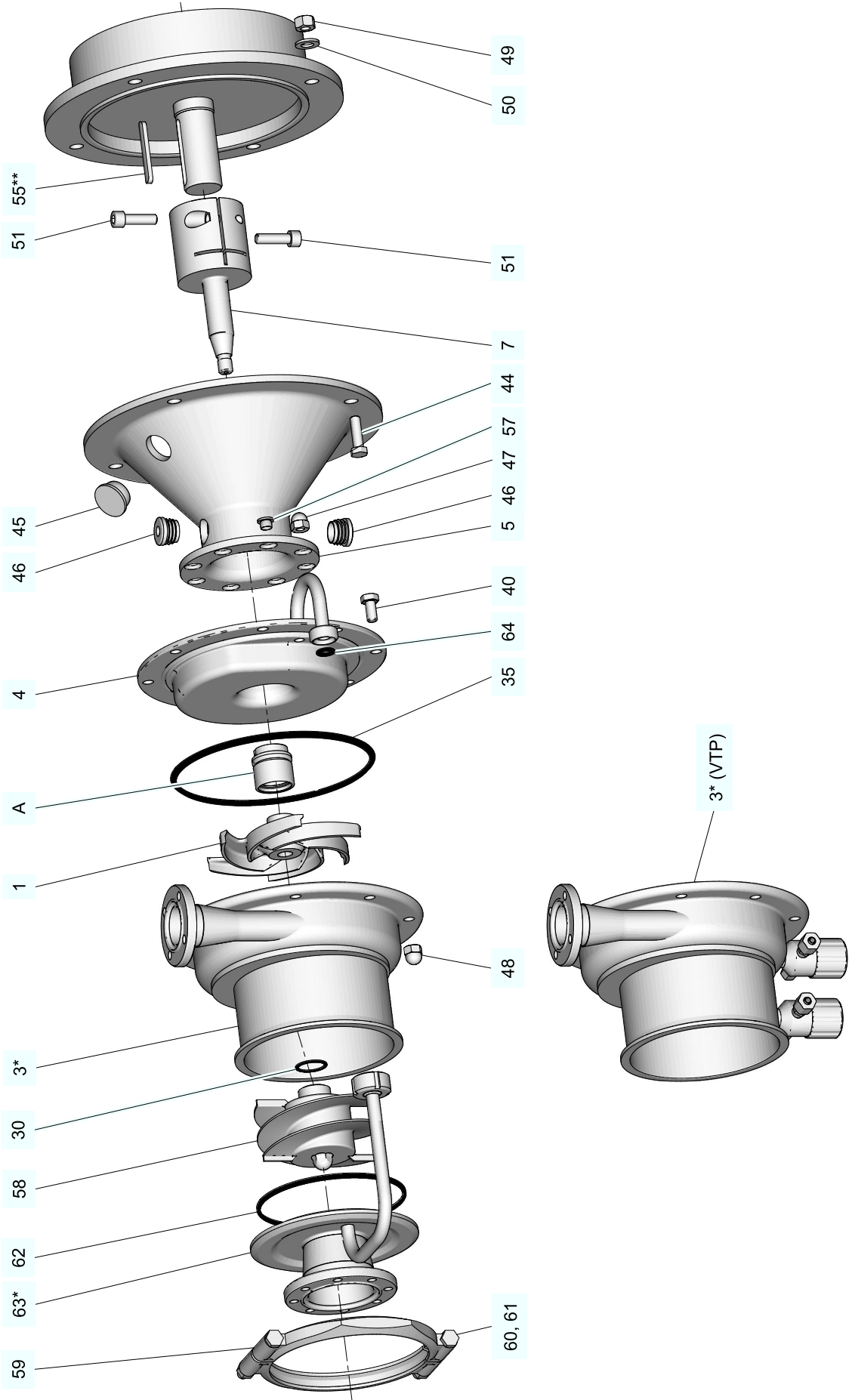


Fig.17: Removing the inducer and pump cover

Prerequisite:

- Pump motor is disconnected from the power supply
- Pump has been removed from the pipeline, drained and cooled down to room temperature.

Carry out the following steps:

1. Check the gaskets (suction and discharge port) and replace them necessary.
2. Loosen the union nut (63.1).
3. Remove the half rings (59).
4. Pull the flange (63) out of the pump cover (3).
5. Check the O-ring (62, 64) and replace it if necessary.
6. Insert the hexagon socket screwdriver (S) into the motor stool hole (5.2).
7. Turn the inducer (58) until the hexagon socket screwdriver (S) locks into the hexagon socket head.
 - The shaft (7) is then secured against twisting.
8. Unscrew the inducer (58).
9. Check the O-ring of the inducer (30) and replace it if necessary.
10. Screw the supplied nut M 14 onto the shaft (7) instead of the inducer (58).
11. Loosen the cap nuts (48) and remove the pump cover (3).
12. Check the housing-O-ring (35) and replace it if necessary.
 - The inducer and the pump cover are dismantled.
 - The impeller (1) is now loose and can be removed together with the slide-ring in the following work steps.

10.5.2 Removing the single-acting mechanical seal EW

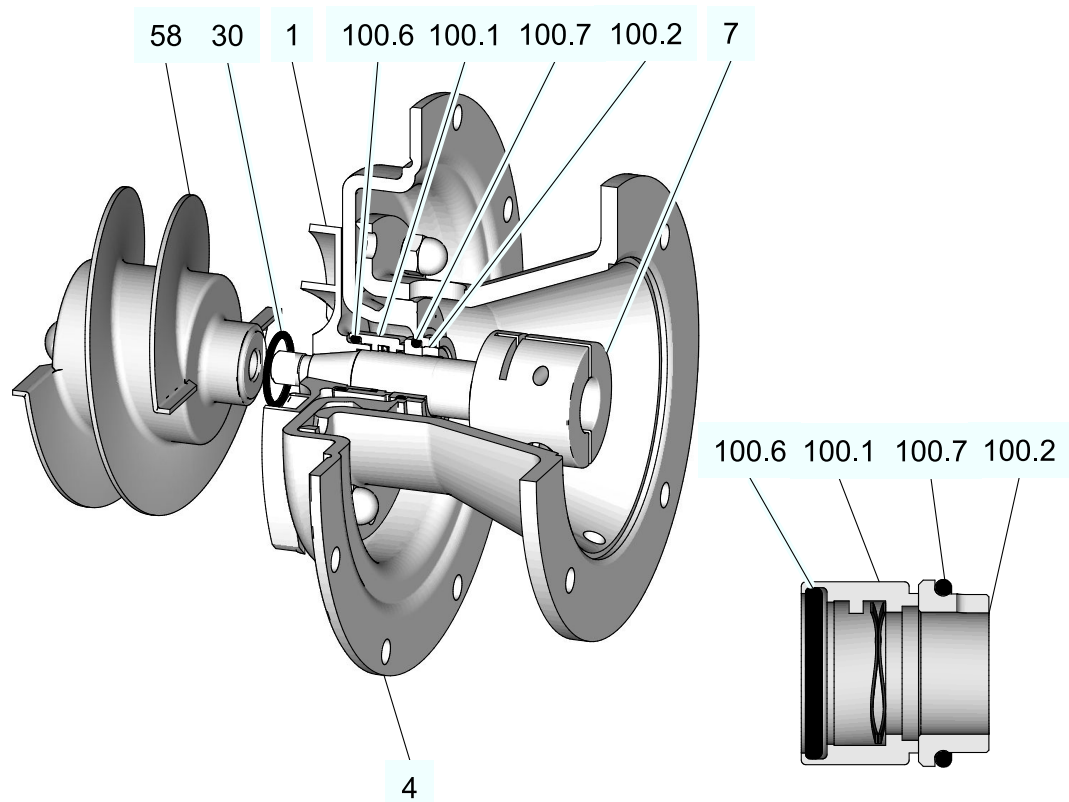


Fig.18: Mechanical seal EW (A) with detail drawing

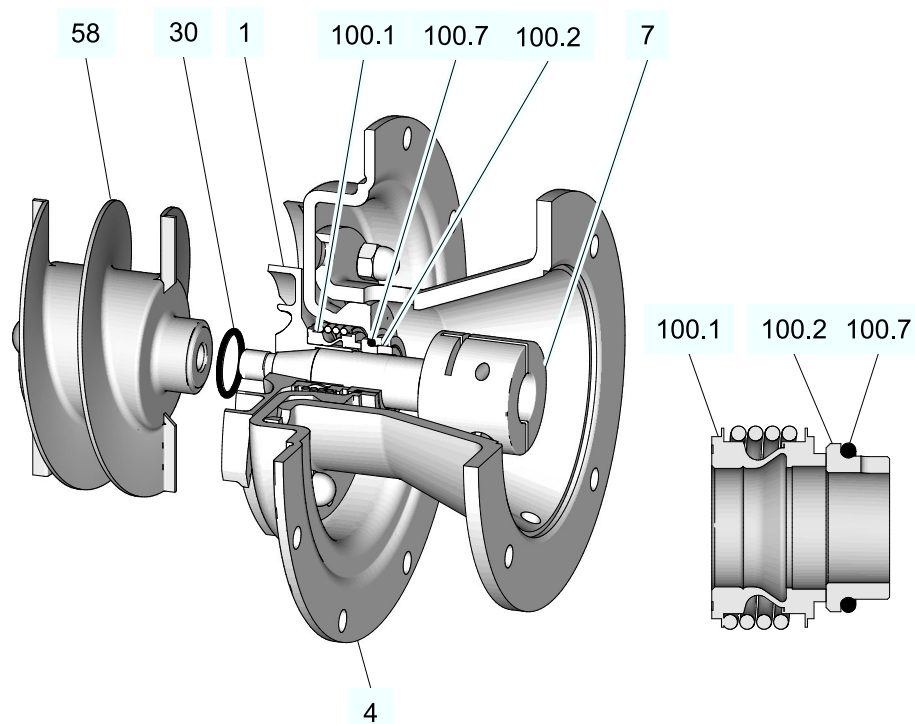


Fig.19: Mechanical seal EW-MG1 with detail drawing

If there are leaks or wear on the mechanical seal, remove and replace it.

Notice

The pump shaft (7) is a sensitive component.

Damage to this part can result in malfunctions.

- Do not damage pump shaft (7) when disassembling the mechanical seal.

Carry out the following steps:

1. Check to see if the hexagon socket screwdriver locks the shaft.
2. Unscrew the inducer (58).
3. Check the O-ring of the inducer (30) and replace it if necessary.
4. **TPS with SHJ mechanical seal:**
Pull the impeller (1) together with the integrated driver ring, slide-ring (100.1), O-ring (100.6) from the shaft (7).
5. Carefully pull the stationary ring and O-ring from the front with a flat or pointy tool (e.g. Phillips screwdriver) out of the pump casing.



Hint!

The further disassembly of the pump is only necessary in certain cases, for example in the case of a defective motor.

See chapter "Removing the pump from the motor". For installation, see chapter "Installation"

→ Single-acting mechanical seal EW is disassembled.

10.5.3 Removing the single-acting flushed mechanical seal QU

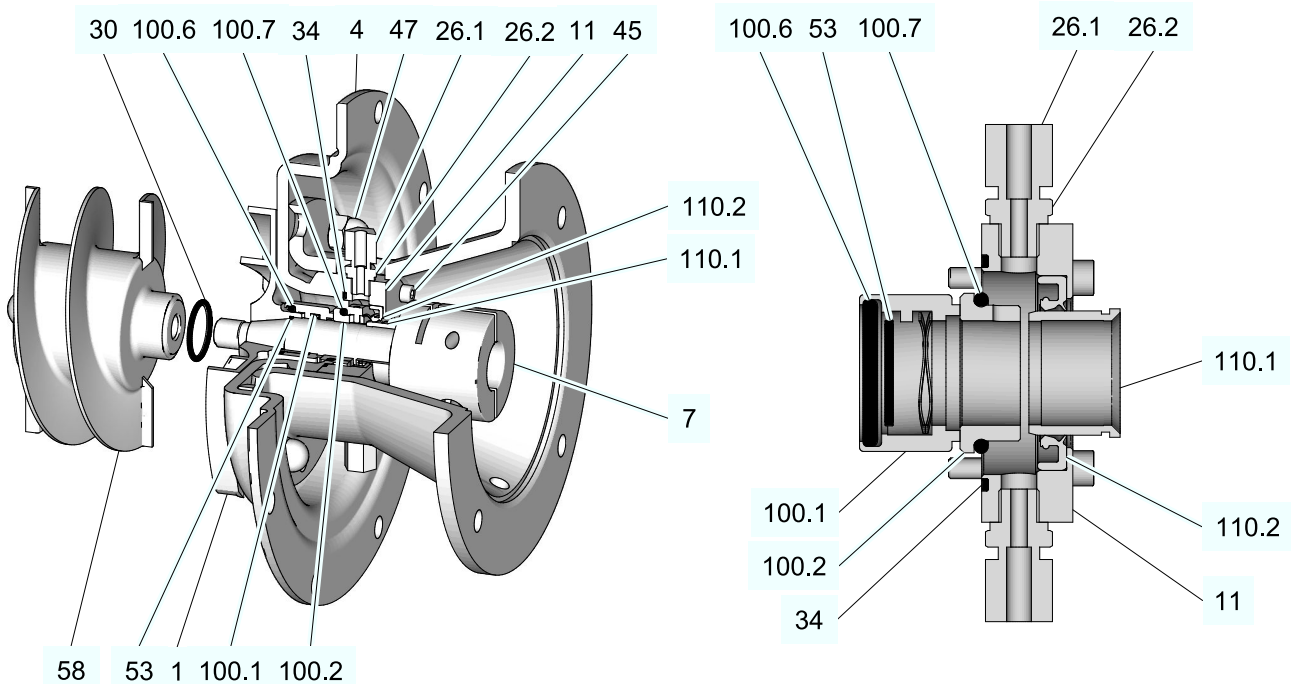


Fig.20: Single-acting flushed mechanical seal QU (A) with detail

If there are leaks or wear on the mechanical seal, remove and replace it.

Notice

The pump shaft (7) is a sensitive component.

Damage to this part can result in malfunctions.

► Do not damage pump shaft (7) when disassembling the mechanical seal.

Carry out the following steps:

1. Pull the impeller (1) together with the integrated driver ring, O-ring (53), slide-ring (100.1), and O-ring (100.6) from the shaft (7).
2. Unscrew the union nut (26.1) from the screwed insert connection (26.2).
3. Unscrew the screwed connections (26.2) from the slide-ring mounting (11).
4. Loosen the cap nut (47) and push the pump housing (4) out forward.
5. Unscrew the hexagon socket screw (45) and remove the pump housing together with the slide-ring mounting (11).
6. Remove the radial shaft gasket (110.2) from the slide-ring mounting (11).
7. Check the surface of the shaft protection sleeve (110.1) and replace if damaged.
8. Remove the O-rings (34) from the slide-ring mounting (11).
9. Carefully pull the stationary ring and O-ring from the front with a flat or pointy tool (e.g. Phillips screwdriver) out of the pump casing.



Hint!

The further disassembly of the pump is only necessary in certain cases, for example in the case of a defective motor.

See chapter "Removing the pump from the motor". For installation, see chapter "Installation"

→ Single-acting flushed mechanical seal QU (A) is dismantled.

10.5.4 Removing the double-acting mechanical seal DW

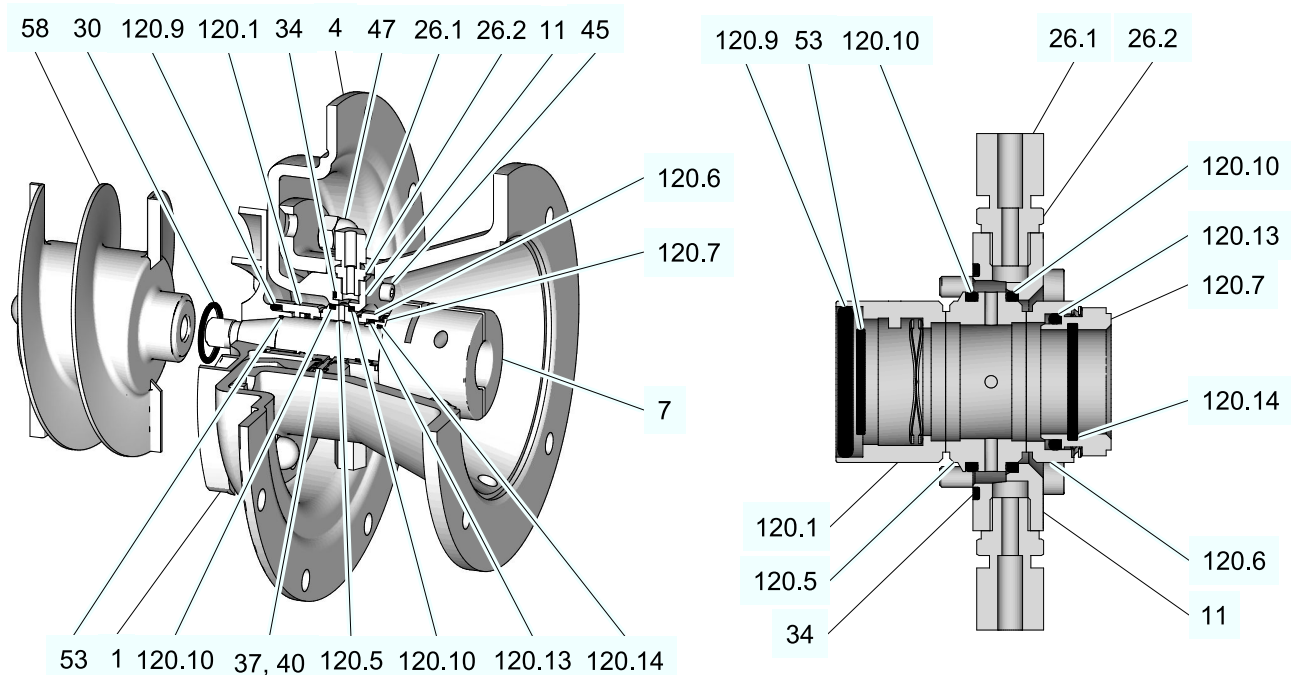


Fig.21: Double-acting mechanical seal DW (A) with detail

If there are leaks or wear on the mechanical seal, remove and replace it.

Notice

The pump shaft (7) is a sensitive component.

Damage to this part can result in malfunctions.

► Do not damage pump shaft (7) when disassembling the mechanical seal.

Carry out the following steps:

1. Check to see if the hexagon socket screwdriver locks the shaft.
2. Unscrew the inducer (58).
3. Pull the impeller (1) together with the integrated driver ring and the O-ring (53) and the slide-ring (120.1) together with the O-ring (120.9) from the shaft (7).
! When using tools, make sure that the slide-ring (120.6) and the counter-ring (120.5) of the atmospheric mechanical seal are not damaged.
4. Unscrew the union nut (26.1) from the screwed insert connection (26.2).
5. Unscrew the screwed connections (26.2) from the slide-ring mounting (11).

6. Loosen the cap nut (47) and push out the pump housing (4) together with slide-ring mounting (11) and the counter-ring (120.5) forward.
7. Unscrew the locking screws (40) with the flat sealing ring (37) and push the counter-ring (120.5) and O-rings (120.10) out of the rotary ring holder (11) forward.
8. Unscrew the hexagon socket screws (45) and take the slide-ring mounting (11) out of the pump housing (4).
9. Remove the O-rings (34) from the slide-ring mounting (11).
10. Remove the slide-ring (120.6) on the atmosphere side and the O-ring (120.13) from the shaft (7).
11. Check driver ring (120.7) and O-ring (120.14) and replace them if damaged.



Hint!

The further disassembly of the pump is only necessary in certain cases, for example in the case of a defective motor.

For this purpose see Section 10.5.5, Page 52, For installation see Section 10.8.1, Page 54.

→ Double-acting mechanical seal DW is dismantled.

10.5.5 Removing the motor

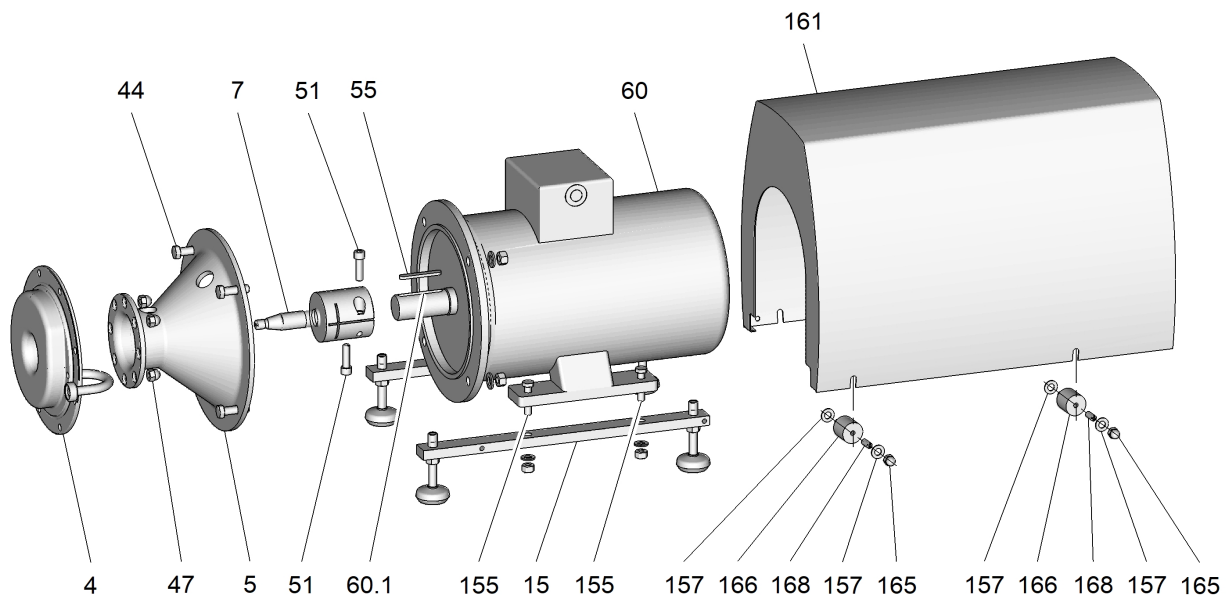


Fig.22: Removing the motor

Notice

The pump shaft (7) is a sensitive component.

Damage to this part can result in malfunctions.

- ▶ Do not damage pump shaft (7) when disassembling the mechanical seal.
- ▶ Make sure to unscrew the cylinder screws (51) before removing the shaft (7) from the motor.

Carry out the following steps:

1. Loosen the screws (165) and lift off the protective hood (161).
 2. Unscrew the 4 cap nuts (47) from the motor stool (5).
 3. Pull the pump housing (4) from the motor stool (5).
 4. Loosen the hexagonal screws (44).
 5. Pull the motor stool (5) down evenly from the motor (60).
 6. Remove the cylinder screws (51) from the shaft (7).
 7. Pull off the shaft (7).
 8. Remove the key (55) from the motor shaft (60.1).
 9. Loosen the screws (155) and separate the cup-shaped feet carrier (15) from the motor (60).
- Motor is disassembled.

10.6 Maintenance

10.6.1 Single-acting slide-ring packing EW

Carry out the following steps:

1. Check the counter-ring (100.2), the slide-ring (100.1) and the O-rings (100.6, 100.7) of the slide-ring packing for wear and replace the entire slide-ring packing if damaged.

For this purpose see chapter Section 10.5, Page 45

→ Done

10.6.2 Single-acting slide-ring packing QU (A)

Carry out the following steps:

1. Check the counter-ring (100.2), the slide-ring (100.1) and the O-rings (100.6, 100.7, 53) of the slide-ring packing for wear and replace the entire slide-ring packing if damaged.
2. Check seals on the slide-ring mounting (34) and replace if necessary.
3. Replace the radial shaft gasket (110.2).
4. Check the shaft protection sleeve (110.1) for damage and, if necessary, replace it. The shaft protection sleeve is shrunk onto the pump shaft in the factory. If the shaft protection sleeve can not be pulled off, it is advisable to contact the GEA service department in this case.

5. Dispose of used slide-ring packing parts appropriately or return them to GEA.
→ Done

10.6.3 Double-acting slide-ring packing DW (A)

Carry out the following steps:

1. Check the counter-ring (120.5), the slip ring (120.1) and the O-rings (120.9, 120.10, 53) of the product-side slide-ring packing for wear and replace completely if necessary.
2. Check the counter-ring (120.5), the slip ring (120.6) and the O-rings (120.13) of the atmospheric-side slide-ring packing for wear and replace if necessary.
3. Check gasket (34) on the slide-ring mounting (11) and replace if necessary.
4. Dispose of used slide-ring packing parts appropriately or return them to GEA.
→ Done

10.7 Prior to installation

Before installation, carefully clean all parts, especially the parts which are in contact with the product. No dirt, grease or other particles may adhere to the parts.

10.7.1 Cleaning the components before assembly

Notice

Hygiene risk, food safety

Contaminated components contaminate the pump and installation.

- Use suitable chemical cleaning agents to remove impurities in the area of the impeller area, the O-rings or the mechanical seal. Use a brush and / or other tools in order not to damage the surface. Plan contact-free cleaning in an ultrasonic bath to clean the mechanical seal.
-

10.8 Installation

Assemble the pump in the reverse order of the disassembly sequence. Observe the notes and instructions given in the following sections when doing so.

10.8.1 Installing the motor

Before installation, it is important to ensure that a motor of IM B35 design (with foot and flange) is used, and that the required axial clearance and the permissible axial forces of the motor are observed.

Also make sure that the motor is equipped with an A-side fixed bearing.

Before installing the pump flange, make sure that the motor flange fits into the open recesses of the pump flange.

The installation is carried out in the reverse order of the disassembly sequence.

Carry out the following steps:

1. Install the cup-shaped feet carrier (15) on the motor (60) with the screws (155).
2. Check shaft end and shaft surface for damage and if necessary eliminate the damage.
3. Degrease the motor shaft (60.1).
4. Insert one half of the key (55) into the groove of the motor shaft (60.1).
5. Push the shaft (7) onto the shaft (60.1) of the motor.
6. Screw the cylinder screws (51) into the prescribed shaft boreholes, initially hand-tight.



Hint!

The axial gaps are adjusted in a later step. Thereafter, the cylinder screw must be tightened to the specified torque.

7. Install the motor stool (5) on the flange (60.2) of the motor with 4 screws (44) together with washers and nuts.



Hint!

Make sure that the drain borehole (5.2) is always pointing downward, see figure.

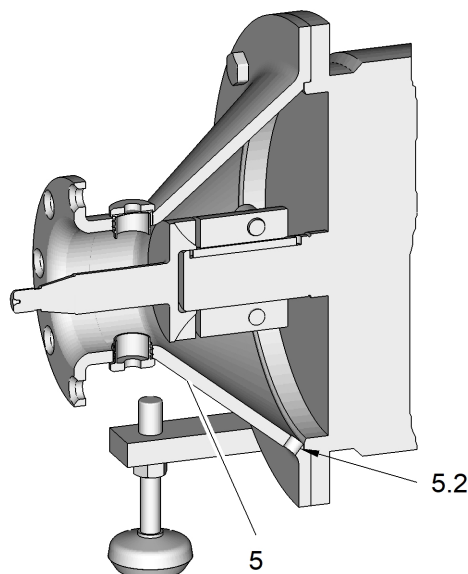


Fig.23: Drain boreholes

→ The motor is installed.

10.8.2 Installing the mechanical seal

Install the mechanical seal in the reverse order of the disassembly sequence. In doing so observe the following instructions:

- Carry out the installation under clean conditions and very carefully.
- Do not apply force! Otherwise there is the risk of permanent deformation and breakage of the ceramic parts.
- To reduce friction during installation, lubricate all sliding surfaces for O-rings with silicone grease.
- The lubricants used must conform to the application requirements and must be food-safe and resistance to media.
- Degrease the sliding surfaces of the mechanical seal before installation.
- Apply a thin layer of silicone grease on the O-ring.
- Make sure that the O-rings are correctly inserted.
- Degrease the sliding surfaces of the mechanical seal with alcohol before installation.
- Tighten the inducer (58) with the specified torque M 20 Nm.
- Fix the lantern (5) with the domed nuts (47) to the pump casing (4). Pay attention to the torques in table Section 5.8, Page 29.

10.8.2.1 Installing the single mechanical seal EW

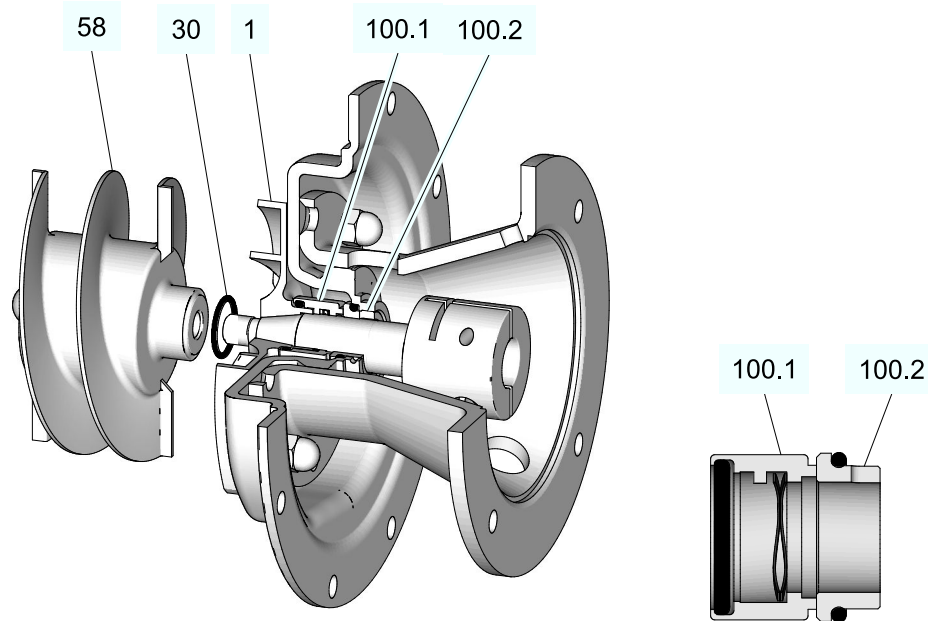


Fig.24: Mechanical seal EW with detail drawing

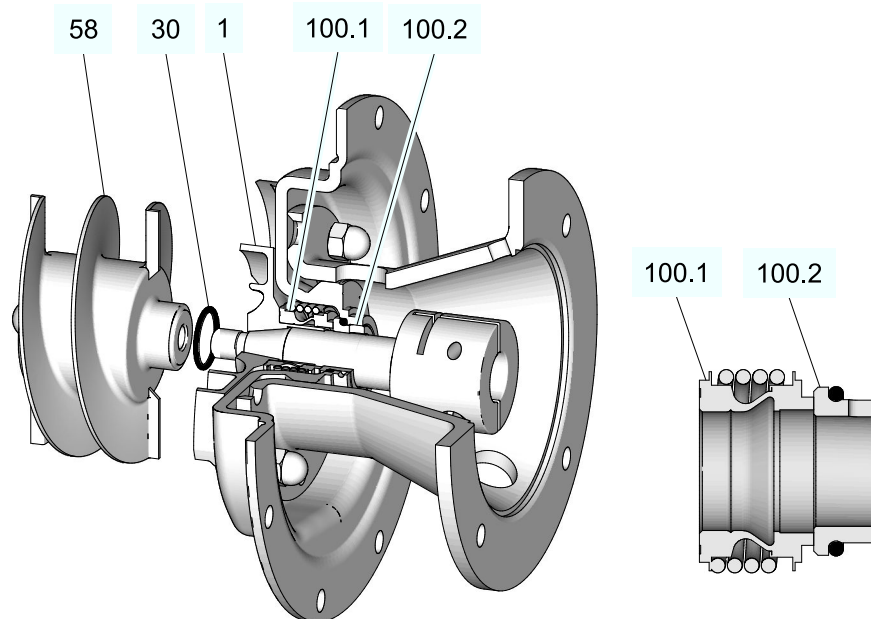


Fig.25: Mechanical seal EW-MG 1 with detail drawing

Observe the following instructions when installing the mechanical seal:

- The 2 driver pins in the slide-ring (100.1) must engage in the grooves of the impeller (1) with integrated driver ring.
- The sliding surfaces of the slide-ring (100.1) and the counter-ring (100.2) must be free of grease.

10.8.2.2 Installing the single-acting slide-ring packing, flushed QU

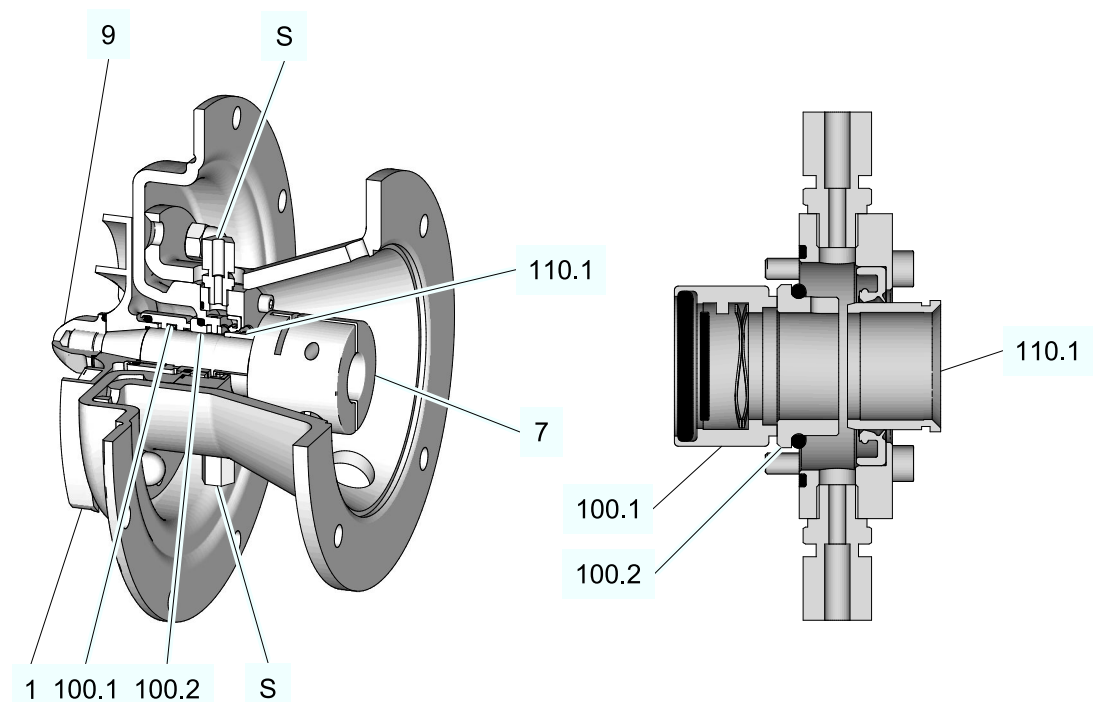


Fig.26: Single-acting slide-ring packing, flushed QU, with detail drawing

Observe the following instructions when installing the slide-ring packing:

- The 2 flushing holes (S) must be in a vertical alignment so that the air can escape from the flushing chamber.
- Check the shaft protection sleeve (110.1) for correct fit. The shaft protection sleeve (110.1) must be pressed on until it rests against the shoulder of the shaft (7).
- The driver pins 2 in the slide-ring (100.1) must engage in the grooves of the impeller (1) with the integrated driver ring.
- The sliding surfaces of the slide-ring (100.1) and the counter-ring (100.2) must be free of grease.

10.8.2.3 Installing the double-acting slide-ring packing DW

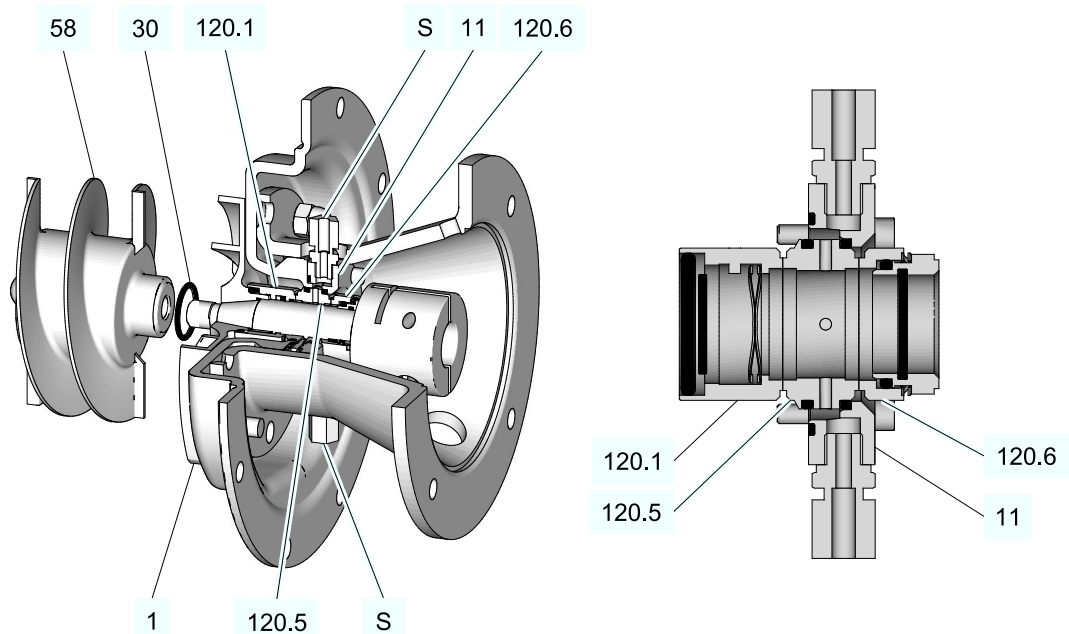


Fig.27: Double-acting slide-ring packing DW with detail drawing

Observe the following instructions when installing the slide-ring packing:

- The 2 flushing holes (S) must be in a vertical alignment so that the air can escape from the flushing chamber.
- The atmospheric side-ring (120.6) must be pressed through the pump housing (4) and into the slide-ring mounting (11) so that the locking borehole of the slide-ring mounting (11) coincides with the borehole of the atmospheric side slide-ring (120.6).
- The 2 driver pins in the slide-ring (120.1) must engage in the grooves of the impeller (1) with integrated driver ring.
- The sliding surfaces of the slide-ring (120.1, 120.6) and the counter-ring (120.5) must be free of grease.

10.8.3 Converting the mechanical seal

10.8.3.1 Convert single-acting mechanical seal EW to mechanical seal, flushed QU

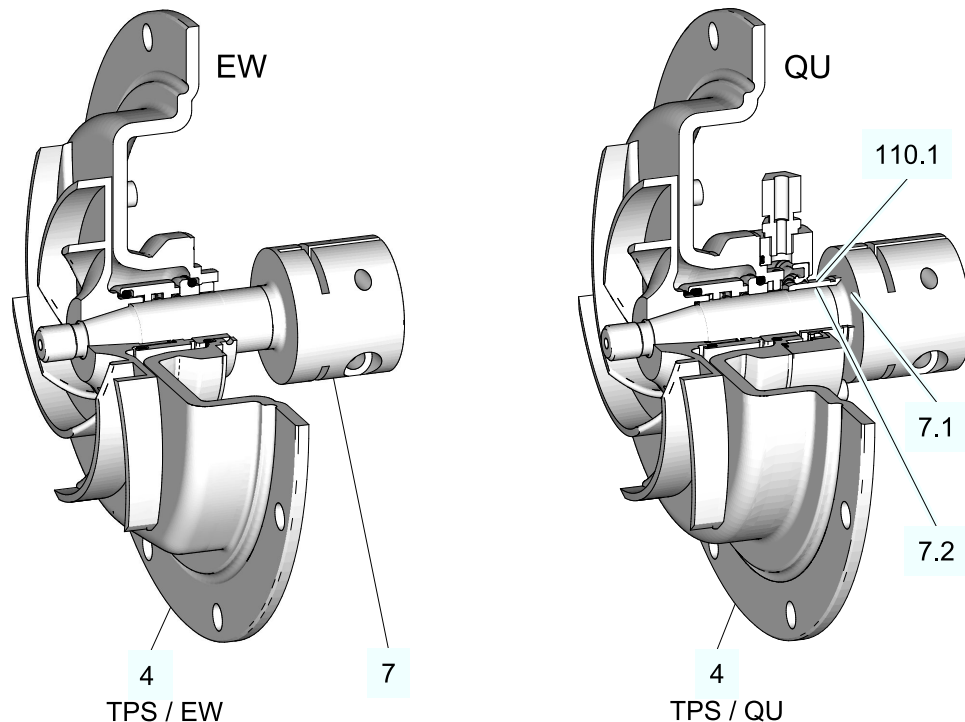


Fig.28: Converting the mechanical seal

7.2	Press fit
-----	-----------

The slide-ring packing of the centrifugal pump TPS can be converted from the version EW to the version QU.

In doing so the following must be observed:

- Replace the pump housing TPS/EW (4) with the TPS/QU version of the pump housing or convert the existing housing. Additional information in this regard is provided by the manufacturer.
- The pump shaft (7) must be equipped with the shaft protection sleeve (110.1). The shaft protection sleeve must be pressed on until it rests against the shoulder of the shaft (7.1). The press-fit is carried out the easiest by heating the shaft protection sleeve and by uniformly raising it with a suitable soft hollow mandrel, for example one made of brass. We recommend having this carried out at GEA if these options are not available.
- The existing mechanical seal EW can be used completely, if undamaged.

The removal and installation of the mechanical seal is carried out as described in the previous pages.

10.8.3.2 Convert single-acting mechanical seal EW to double-acting mechanical seal DW

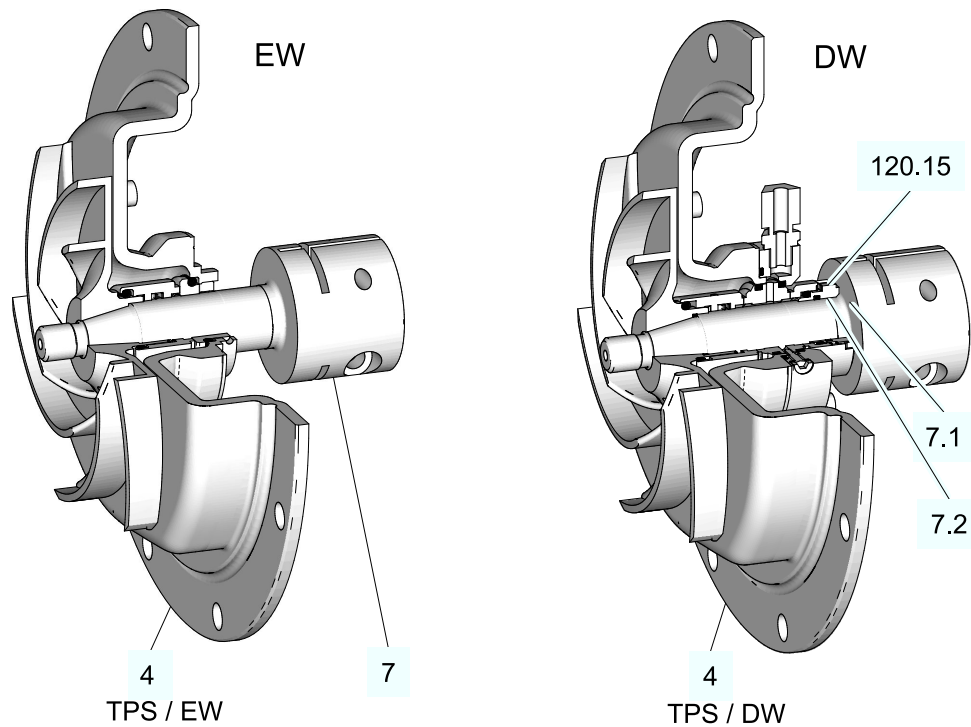


Fig.29: Converting the mechanical seal

7.2	Press fit
-----	-----------

The slide-ring packing of the centrifugal pump TPS can be converted from the version EW to the version DW.

In doing so the following must be observed:

- The pump housing TPS/EW (4) must be replaced with the version TPS/DW pump housing.
- The pump shaft (7) must be equipped with the driver ring (120.15). The driver ring must be pressed on until it rests against the shoulder of the shaft (7.1). The press-fit is carried out the easiest by heating the driver ring (120.15) and by uniformly raising it with a suitable soft hollow mandrel, for example one made of brass. We recommend having this carried out at GEA if these options are not available.
- The existing mechanical seal EW cannot be used. It is replaced by the mechanical seal DW.

The removal and installation of the mechanical seal is carried out as described in the previous pages.

10.8.4 Adjusting the axial gap

Caution!

If the axial gap is not adjusted correctly, the impeller may come in contact with the pump housing and damage both parts.

► Each time the pump shaft (7) is loosened the axial gap (S1) between the impeller (1) and the pump cover (3) must be adjusted according to the table.

Pump type	Axial gap S1 between cover (3) and impeller (1)	
	[mm]	[inch]
TPS 2030	0.3	0.0118
TPS 3050	0.5	0.0196
TPS 8050	0.5	0.0196
TPS 8080	0.5	0.0196

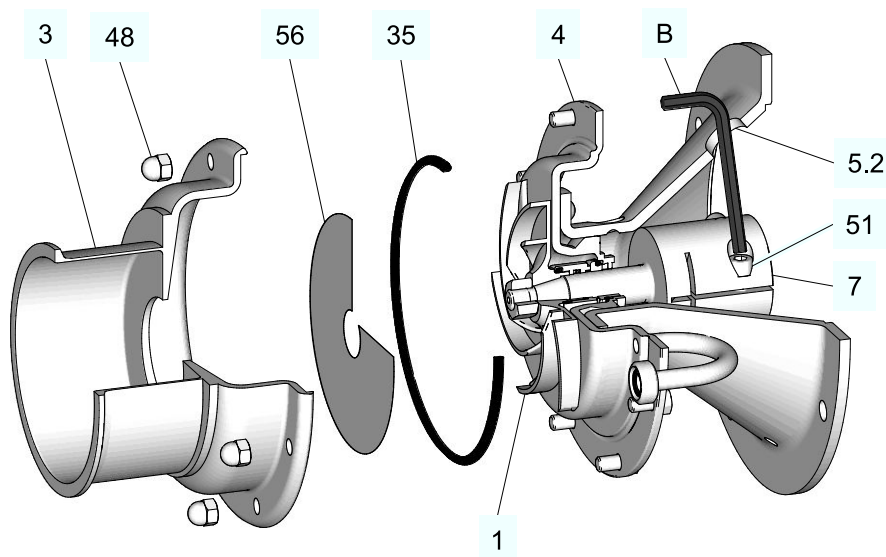


Fig.30: Pump TPS

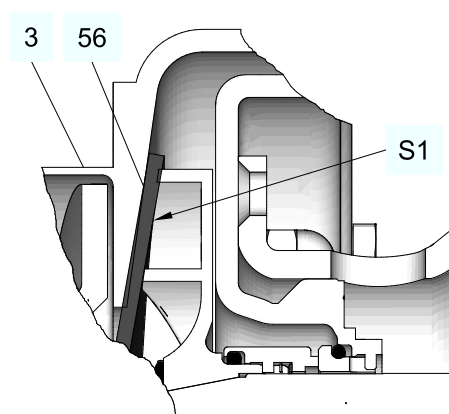


Fig.31: Pump TPS, detail

Tools required:

- Spacer disc for adjusting the axial gap (S1)

Carry out the following steps:

1. Insert the hexagon socket screwdriver (B) into the motor stool hole (5.2) and turn the impeller (1) until the hexagon socket screwdriver (B) engages the hexagon socket head (51).
2. Unscrew the cylinder bolts (51) to separate the shaft (7) from the motor shaft.

3. Screw the inducer (58) or nut (9) supplied onto the shaft to the specified tightening torque (see Section 5.8, Page 29) in order to secure the impeller
4. Pull the impeller (1) together with the shaft (7) forward by a few millimetres.
5. Place the spacer disc (56) in front of the impeller and secure the pump cover (3) without the O-ring (35) - with 4 screws (48) evenly distributed over the hole circle. As a result, the impeller and the shaft are pushed into the correct setting position.
6. Tighten the cylinder screws (51) of the pump shaft (7) to specified torque, see table .



Hint!

The cylinder screws for the required torque have a strength class of A4-80. The use of lower strength class crews is not permitted.

7. Remove the screws (48) and take off the pump cover (3).
 8. Remove the spacer disc (56).
- Done.

10.8.5 Installing the pump cover

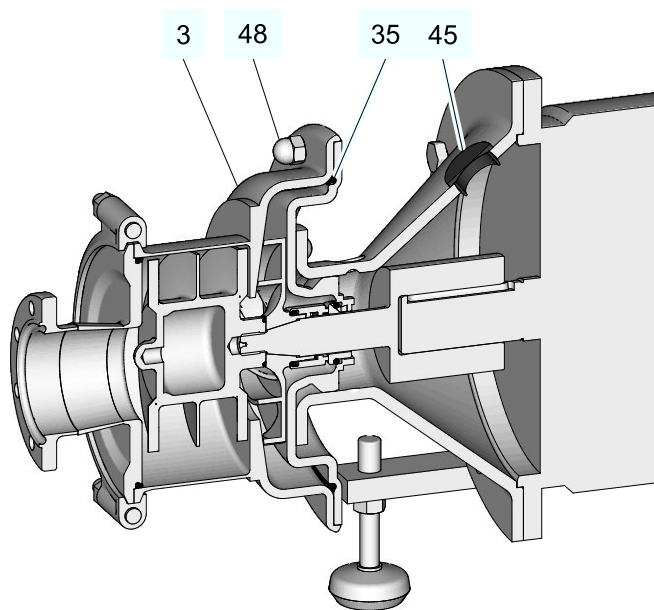


Fig.32: Installing the pump cover

Carry out the following steps:

1. Grease O-ring (35) and install on the pump housing.
2. Install the pump cover (3). In doing so, tighten all cap nuts (48) evenly crosswise and observe the corresponding torques, see Section 5.8, Page 29.
3. Push the round stopper (45) into the motor stool hole.
4. Insert the hexagon socket screwdriver (S) into the motor stool hole (5.2).

Turn the impeller (1) until the hexagon socket screw device (S) locks into the hexagon socket head. The shaft (7) is then secured against twisting.

Unscrew the nut (9) from the shaft (7).

Grease the O-ring (30) and insert it into the groove provided on the inducer (58).

Screw the inducer (58) onto the shaft (7) and tighten at the appropriate torque, see Section 5.8, Page 29.

5. Remove the hexagon socket screwdriver (S) from the motor stool hole (5.2).
6. Grease the O-ring (64) and insert it into the screwed pipe joint DN 10 from the flange (63).

Grease the O-ring (62) and insert it into the groove provided on the flange (63).

Insert the flange (63) into the pump cover (3). In doing so, make sure that the pipe connection DN 10 is correctly installed. Tighten the union nut (63.1) by hand.

Install the half rings so that the screws (60) are level.

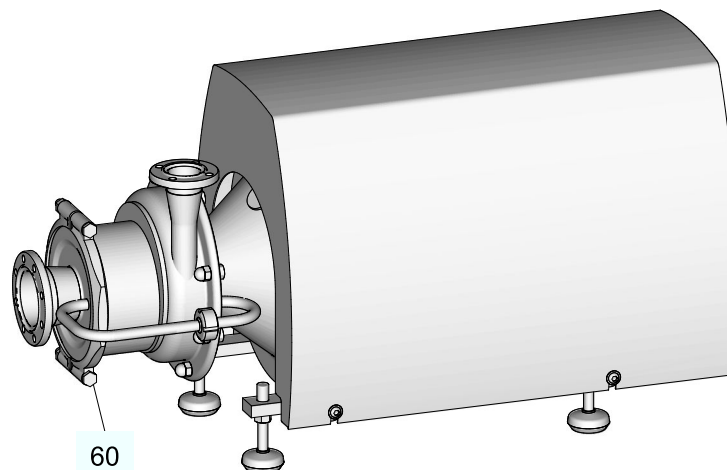


Fig.33: Install the half rings

7. Tighten the nuts on the half rings (59) to a torque of 45 Nm (33 lbft).
 8. Tighten the union nut (63.1).
- Pump cover is installed.

11 Drainage valve VTP

11.1 Intended use - drainage valve VTP

The drainage valve VTP is used for residual draining (complete draining) of GEA Hilge centrifugal pumps. The drainage valve can be operated manually or pneumatically.

11.2 Retrofitting of the drain valve VTP

Requirement:

- Pump motor is disconnected from the power supply
- Pump has been removed from the pipeline, drained, cleaned and flushed.

Carry out the following steps:

1. Replace the pump cover with one that is designed for the installation of the drainage valve, see replacement parts.
2. Install the drainage valve on the lowest point of the corresponding pump cover, see figure.

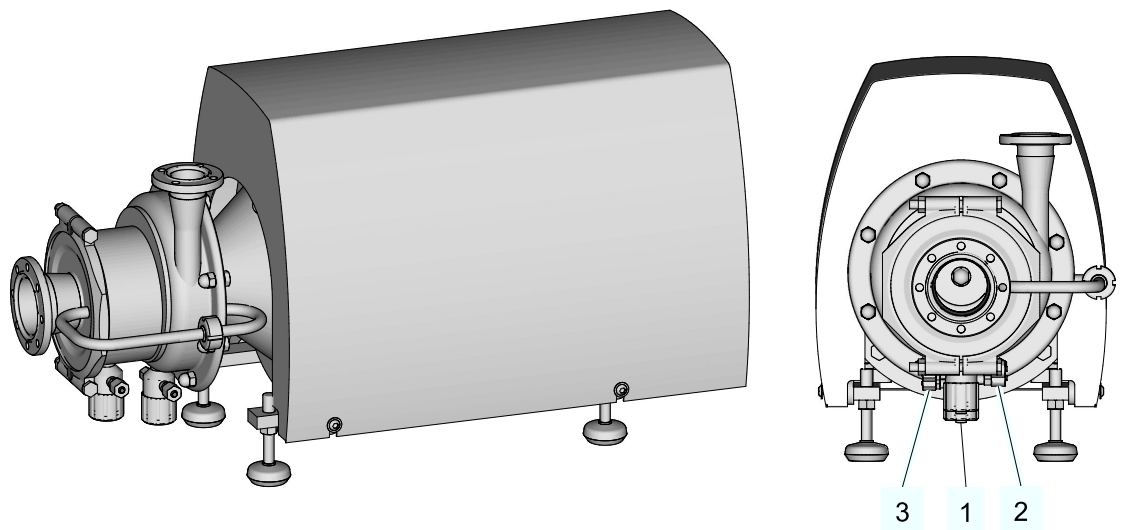


Fig.34: Pump with drainage valve

1	Drainage valve
2	Drainage connection
3	Air connection

→ Drainage valve VTP is installed.

11.3 Troubleshooting - drainage valve VTP

In the event of a malfunction, the drainage valve must be switched off immediately and secured against being switched back on. Malfunctions may only be remedied by qualified personnel, who must observe the safety instructions.

Malfunction	Cause	Remedy
Drainage valve is not working	Fault in the control system	Check the system configuration
	No compressed air Compressed air pressure too low	Check the compressed air supply Check air hoses for free passage and air tightness
	Fault in the electrical system	Check the control / external regulator and the electrical power supply
	O-rings in the drive defective	Replace the O-rings
Drainage valve does not close	Dirt and foreign objects between the valve seat, valve plate, and the O-ring	Clean valve seat, valve plate and O-ring
Drainage valve closes too slowly	O-rings in drive (8) and valve housing (9) are dry (friction losses)	Grease O-rings
Leakage at the outlet	O-ring (10) on the valve seat is defective	Replace the O-ring (10) on the valve seat

11.4 Maintenance - drainage valve VTP

Inspections

The drainage valves must be monitored for leakage and proper functioning between the maintenance intervals.

Maintenance intervals

See chapter Section 10.3, Page 44

Disassembly

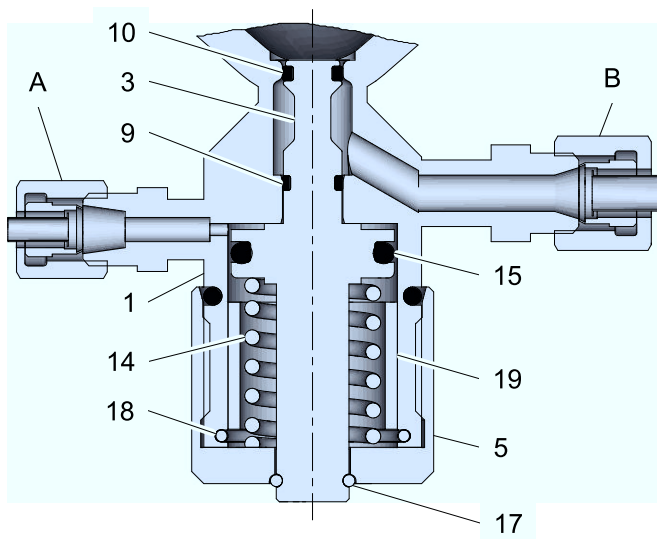


Fig.35: Drainage valve VTP

Carry out the following steps:

1. Open the valve pneumatically.
2. Remove the spring-lock washer (17).

3. Close the valve.
4. Disconnect the air hose from the pneumatic connector (A).
5. Disconnect the drainage hose - if present - to the drainage connection (B).



Hint!

The pressure spring (14) is preloaded. It must be carefully relaxed when the drive cover is loosened.

6. Unscrew drive cover (5) by hand in the counter-clockwise direction.
 7. Remove the pressure spring (14).
 8. Push the spring-lock washer (18) out of the housing through the borehole for disassembly.
 9. Pull the valve plate (3) together with the sleeve (19) out of the housing (1).
 10. Take off the O-rings (9, 10, 15).
- Drainage valve VTP is disassembled.

Assembly

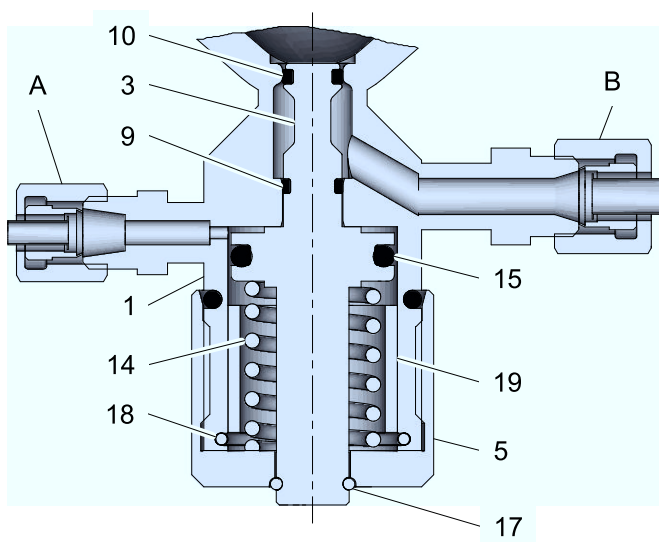


Fig.36: Drainage valve VTP



Caution!

Damage to valve parts in the precision component area

- The valve stem, valve plate (3) and valve seat are precision parts. They may not be damaged!

Carry out the following steps:

1. Grease the parts.

GEA recommends Rivolta F.L.G. MD-2, PARALIQ GTE 703 and grease BARRIERTA L 55/3*. These lubricants are approved for foodstuff and are resistant to beer froth. They have the NSF-H1 (USDA H1) registration. They do not affect the taste or the consistency of the products and are compatible with the seals in contact with product. PARALIQ GTE 703 can be ordered under the material no. 413-064, Rivolta F.L.G. MD-2 under the material no. 413-071 and grease BARRIERTA L 55/3* under the material no. 413-137 from GEA.

2. Install the O-rings (9, 10, 15) in the valve plate (3).
 3. Carefully insert the valve plate (3) into the housing (1).

! The valve stem, valve plate (3) and valve seat are precision parts. They may not be damaged!
 4. Install the sleeve (19).
 5. Insert the spring-lock washer (18) into the groove provided in the housing (1).
 6. Insert the spring (14) into the housing (1).
 7. Preload the pressure spring (14) together with the cover (5) until the thread engages. Screw on the cover as far as it will go.

! Preload the pressure spring (14) slowly.
 8. Connect the air hose to pneumatic connector (A).
 9. Connect the drainage hose - if present - to the drainage connection (B).
 10. Open the valve pneumatically.
 11. Install the spring-lock washer (17).
 12. Close the valve.
- Drainage valve VTP is installed.

11.5 Technical data - drainage valve VTP

Refer to the following tables for the key technical data of the valve:

Technical data: Drainage valve VTP	
Designation	Description
Size	DN 10
Weight	0.3 kg (0.661 lb)
Material of product contact parts	Stainless steel 1.4404
Installation position	Headover to allow the valve to drain
Ambient temperature	0 to 60 °C (32 ... 140 °F), standard < 0 °C (32 °F): use control air with a low dew point. Protect valve stems against freezing.

Technical data: Drainage valve VTP	
Designation	Description
Product temperature and operating temperature	Depending on the sealing material
Draining (pressure free)	1.2 l/min (0.32 gpm)
Product pressure	Max. 16 bar (232 psi) during sealing Max. 6 bar (87 psi) during opening
Control air pressure	Min. 6 bar (87 psi) max. 8 bar (116 psi)
Control air	acc. to ISO 8573-1
- Solid particle content:	Quality class 6 Particle size max. 5 µm (1.969x10 ⁻⁴ inch) Particle density max. 5 mg/m ³ (1.8 x 10 ⁻¹¹ lb/inch ³)
- Water content:	Quality class 4 Max. dew point +3 °C (37.4 °F) If the unit is used at higher altitudes or at low ambient temperatures, the dew point must be adapted accordingly.
- Oil content:	Quality class 3, preferably oil free Max. 1 mg oil to 1 m ³ air
Air hose	
- Metric	Material PE-LD Outer Ø 6 mm (0.236 inch) Interior-Ø 4 mm (0.157 inch)
- Inch	Material PA Outer Ø 6.35 mm (0.25 inch) Interior-Ø 4.3 mm (0.169 inch)

Tool list / lubricant

Tools	
Designation	Material no.
Open-ended wrench size 14, 17	408-045

Lubricants, see chapter Section 5.5, Page 28

12 Alarms

12.1 Malfunctions and remedies

In the event of a malfunction, the pump must be switched off immediately and secured against being switched back on. Malfunctions may only be remedied by qualified personnel, who must observe the safety instructions.

Malfunction	Cause	Remedy
Motor does not start	No power supply to the motor	Switch off the pump, check the cable connections and the fuse
	Motor protection has tripped	Check the power consumption of the motor
	Motor protection or residual current circuit breaker has tripped or fuses are blown because cables, motors or control devices are damaged	Measure parts and repair or replace defective parts
	Contact of the switchgear are defective	Check the switchgear, remove, clean and replace any defective parts
Power consumption of the motor is too high	Viscosity of material being conveyed too high	Check pump system, throttle if necessary, unscrew impeller, change pump or motor
	Gap between the housing and the impeller not adjusted properly	Adjust the gap
	Resistance in the pressure line too low (delivery flow too high)	Check pump system, throttle if necessary, unscrew impeller, change pump or motor
	Impeller diameter too large	Install smaller impeller Unscrew the impeller
Noise emission too high (also cavitation)	Resistance in the suction line too high	Check suction line, shorten or enlarge
	Fluid level in the suction tank is too low	Fill the suction tank
	impeller is rubbing	Measure the axial gap and re-adjust according to chapter "Check axial gap"
	Bearing damage of the motor	Replace the bearings
	Mechanical seal has run dry	Switch off the pump immediately, check the mechanical seal and replace if necessary Check the cause of running dry and eliminate the fault
Discharge head or delivery flow too low	Wrong direction of rotation of the motor	Reverse the phases
	Motor speed too low (wrong voltage, frequency); number of poles wrong	Apply the correct voltage change the motor
	Impeller diameter too small	Install a larger impeller
	The impeller is worn out	Replace the Impeller
	Too much resistance in the suction and/or pressure line	Check the lines
	Viscosity of material being conveyed too high	Check the pump system, install the larger impeller
The pump leaks	Mechanical seal defective	Replace the mechanical seal
	O-ring defective	Replace the O-ring
The pump does not produce suction	No residual liquid in the pump	Fill the pump with a minimum amount of liquid
	Installation not implemented according to specifications	Install the system on the suction and pressure side according to specifications

13 Decommissioning

13.1 Safety instructions

For shutting down, the following principles apply:

- Switch off the pump with the main switch.
- Padlock the main switch (if fitted) in the off position to prevent it from being switched back on. The key to the padlock must be deposited with the person responsible until the machine is restarted.
- For long-term decommissioning, observe storage conditions, see storage Section 4.1, Page 22.

13.2 Disposal

13.2.1 General notes

Dispose of the pump in an environmentally friendly manner at the end of its life cycle. Observe the statutory waste disposal regulations applicable at the place of installation.

The pump consists of the following materials:

- Metals
- Synthetic materials
- Electronic parts
- Lubricants containing oil and grease

The shaft seal each comprise ceramic (SiC), graphite (carbon) or stainless steel, depending on the version.

Separate the different materials and dispose of them correctly sorted. Also observe the instructions regarding disposal in the operating instructions for the individual components.

14 Appendix

14.1 Lists

14.1.1 Abbreviations and terms

Abbreviation	Explanation
1/min	Unit of measurement for the speed Revolutions per minute
bar	Unit of measurement for the pressure All pressure data [bar] are for overpressure [bar _g] unless this is specifically described otherwise.
C	Carbon
approx.	approximately
°C	Unit of measurement for the temperature Degree Celsius
dB(A)	Sound level DN DIN nominal width
DIN	German standard DIN German Institute for Standardization e.V.
DW	Double-acting slide-ring packing DW EN European Standard
EPDM	Material specification Short description according to DIN/ISO 1629 EPDM rubber
EW	Single-acting slide-ring packing
FKM	Material specification Short description according to DIN/ISO 1629 Fluorine rubber
h	Unit of measurement for time hour
HNBR	Material specification Short description according to DIN/ISO 1629 Hydrogenated Acrylonitrile Butadiene Rubber
IEC	International Electrotechnical Commission International Electrotechnical Commission (valid worldwide)
IP	Protection class
ISO	International standard of the International Organization for Standardization
kg	kilogram Unit of measurement for the weight
kN	Unit of measurement for the force kilonewton
l	Unit of measurement for the volume litre
max.	maximum
mm	Unit of measurement of length millimetre
µm	Unit of measurement of length micrometre
M _{min} watt	Torque (Nm)
M _{max}	Torque (Nm)
m ³ /h flow rate	1 m ³ /h = 4.409 gpm

Abbreviation	Explanation
Nm	Unit of measurement for work Newton meter Torque specification 1 Nm = 0.737 lbft Pound-Force (lb) + Feet (ft)
NPSH	Holding pressure height (m) (Net Positive Suction Head)
QU	Single-acting flushed slide-ring packing (quench)
SIC	Silicon carbide
SS	Molybdenum steel
AF	Indicates the size of spanners width across flats
s. Chapt.	see Chapter
s. Fig.	see Figure
V DC	Volt direct current
V AC	Volt alternating current
kW	Unit of measurement for performance
Inch OD	Tube measurement according to British Standard (BS), outside diameter
Inch IPS	American pipe measurement, iron pipe size

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