SULZER

VMS Vertical Multistage Pumps

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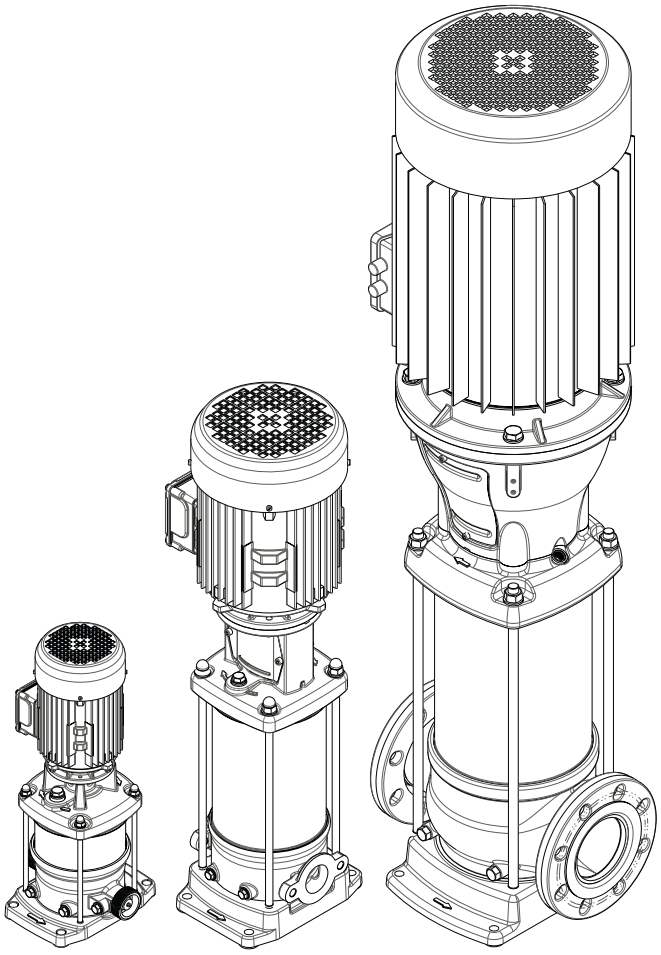

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en **Installation, Operating and Maintenance Instructions**

www.sulzer.com

Vertical Multistage Pumps

VMS VMS H

Contents

1 Manual introduction

1.1 Preface

This manual contains important information for reliable, proper and efficient operation. Compliance with the operating instructions is of vital importance to ensure reliability and a long service life of the product and to avoid any risks.

The first chapters contain information about this manual and safety in general. The following chapters provide information about normal use, installation, maintenance and repairs of the product.

- Make yourself familiar with the content.
- Accurately follow the directions and instructions.
- Never change the sequence of the operations to be carried out.
- Keep this manual or a copy of it together with the logbook in a fixed place near the product which can be accessed by all personnel.

1.2 Icons and symbols

In this manual and in all accompanying documentation the following icons and symbols are used.

Presence of dangerous voltage.

Operations or procedures, if carried out without caution, may cause personal injury or damage to the product.

Remarks with respect to the environment.

ATTENTION! Non-observance may result in damage to the unit or negatively affect its performance.

2 Identification, service, and technical support

2.1 Obtaining data and information from VMS and VMS H6 pumps

The nameplate indicates the type series / size, main operating data, and identification number. Please quote this information in all queries, repeat orders, and particularly when ordering spare parts. If you need any additional information or instructions exceeding the scope of this manual or in case of damage, please contact Sulzer Customer Service.

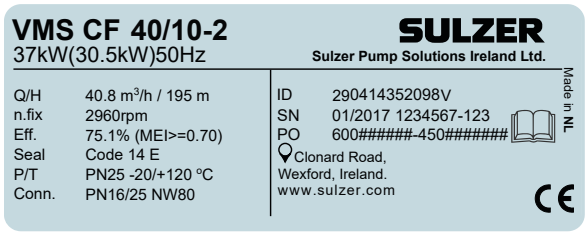

Figure 1. Pump with motor

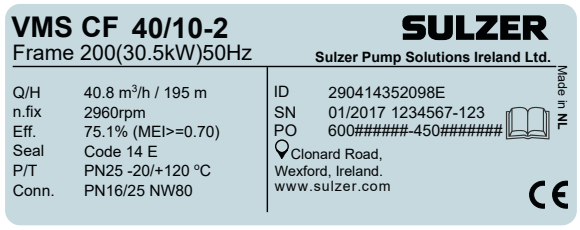

Figure 2. Pump without factory mounted motor

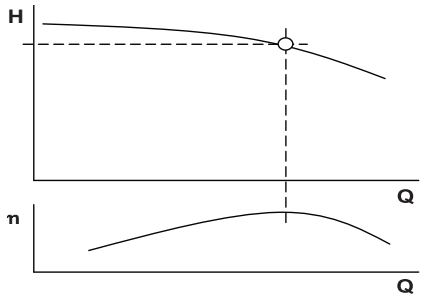

Figure 3. Duty point

Table 1. Nameplate description

Indication		Meaning
VMS CF 40/10-2		Model key
37 kW (30.5 kW)		Installed motor power (required power @ max. curve)[1] [2]
Frame 200		Motor frame size
50 Hz		Nominal frequency
Q[3]	40 m³/h	Optimum capacity running at fixed speed (see Fig. 3, ”Duty point”)
H	195 m	Optimum head running at fixed speed (see Fig. 3, ”Duty point”)
n fix.	2960 rpm	Rotation speed indication at which Q/H are given
Eff.	75.1% (MEI>=0.70)	Efficiency (Minimum Efficiency Index)
Seal.	Code 23 E	Mechanical seal surface code (see Table 7, ”Seal code”)
E	Easy access	Seal construction type: F = Fixed E = Easy access C = Cartridge
P/T	PN 25 -20/+120 °C	Maximum pressure at mentioned temperature range[4]
Conn.	PN16/25 NW80	Pressure class connection and connection size
ID	290414352098V	Pump ID
SN	WW / YYYY 1234567-123	Production week/year and production serial number > as built file
PO	########-##########	Purchase order number

1. For pumps without a factory mounted motor: frame size.
2. When the installed motor power is less than the required power the pump is limited in it’s operating range. Consult your sales representative for details.
3. Optimum capacity of the hydraulics, restricted operating range (note 2.) not taken into account.
4. At lower pressure, a higher temperature is allowed (please consult your supplier).

2.2 Shaft seal material code

Table 2. Shaft seal material code

Code acc. to EN 12756	Description	Material		Note
B Q1 Q6 U3 eCarb-B	Spring loaded ring	Carbon graphite Silicon carbide Tungsten carbide	Ca SiC TuC	Resin impregnated Sintered pressureless CrNiMo-binder
A B Q1 Q6 U3 V eSic-Q7	Seat ring	Carbon graphite Carbon graphite Silicon carbide Tungsten carbide Al-oxide	Ca Ca SiC TuC ALO	Antimony impregnated Resin impregnated Sintered pressureless CrNiMo-binder >99%
E P V X4	Elastomers	EPDM NBR FPM HNBR	EPDM NBR FPM HNBR	Ethylene propylene rubber Nitrile-butadiene-rubber Fluor carbon rubber Hydrogenated nitrile rubber
G F	Spring	CrNiMo steel CrNi steel		
G F	Other metal parts	CrNiMo steel CrNi steel		

Information about seal combinations, types, pressure and temperature (see Table 7, “Seal code”).

2.3 Current

2.3.1 Nominal current VMS

The nominal allowable current of the motor is stated on the motor plate. This shows the nominal working range of the motor and can be used to protect the motor.
Measuring the actual current of the pump during operation can be used to pre-set the motor protection switch to protect the pump/motor combination.
This current value can also be used to determine the proper electrical equipment such as variable frequency drive, main switch, wiring diameter etc.

Not only the motor, but also the pump has to be protected in its application.

2.3.2 Maximum current VMS H6

The maximum allowable current of the motor is mentioned as “I.max.” on the motor plate. This maximum allowable current shows the maximum working range of the motor and can be used to protect the motor.

Be careful in using it this way, because, not only the motor, but also the pump has to be protected in its application.

On the pump nameplate (sleeve sticker) this “required motor current” can be mentioned and it can be used to pre-set the motor protection switch to protect the pump/motor combination.
This current value can also be used to determine the proper electrical equipment such as variable frequency drive, main switch, wiring diameter etc.

2.4 Supplementary documentation

Apart from this manual, the documentation given below is also available:

Table 3. Supplementary documentation

Pump	Document	Code
VMS and VMS H	General terms of delivery	119 / 1998
VMS	Technical data 50 Hz	310 190034 001
	Technical data 60 Hz	310 190035 001
VMS H	Technical data 50/60 Hz	97004434

See also www.sulzer.com

3 Warranty

3.1 Terms of warranty

The warranty period is settled by the terms of your contract or at least by the general terms and conditions of sales.

ATTENTION! ***Modifications or alterations of the product supplied are only permitted after consultation with the manufacturer. Original spare parts and accessories authorized by the manufacturer ensure safety. The use of other parts can invalidate any liability of the manufacturer for consequential damage.***

ATTENTION! ***The warranty relating to the operating reliability and safety of the product supplied is only valid if the product is used in accordance with its designated use as described in the following sections of this manual. The limits stated in the data sheet must not be exceeded under any circumstances.***

The warranty becomes invalid if one or more of the points below occur:

- The buyer makes modifications himself.
- The buyer carries out repairs himself or has them carried out by a third party.
- The product has been handled or maintained improperly.
- The product has non original Sulzer spare parts fitted.

Sulzer repairs defects under warranty when:

- They are caused by flaws in the design, the material, or the production.
- They are reported within the warranty period.

Other terms of warranty have been included in the general terms of delivery, which are available upon request.

4 Safety and environment

4.1 General

This Sulzer product has been developed using state-of-the-art technology; it is manufactured with utmost care and subject to continuous quality control. Sulzer does not accept any liability for damage and injury caused by not observing the directions and instructions in this manual, or in cases of carelessness during the installation procedure, use, and maintenance of the product.
Non-compliance with safety instructions can jeopardize the safety of personnel, the environment, and the product itself. Non-compliance with these safety instructions will also lead to forfeiture of any and all rights to claims for damages.

For example, in particular, non-compliance can result in:

- Failure of important pump/system functions.
- Failure of prescribed maintenance and servicing practices.
- Injury to persons by electrical, mechanical, and chemical effects.
- Hazard to the environment due to leakage of hazardous substances.
- Explosions.

Depending on specific activities, extra safety measures may be required. Contact Sulzer if a potential danger arises during use.

ATTENTION! ***The owner of the product is responsible for compliance with the local safety regulations and internal company guidelines.***

ATTENTION! ***Not only must the general safety instructions laid down in this chapter on safety be complied with, but also the safety instructions outlined under specific headings.***

4.2 Users

All personnel involved in the operation, maintenance, inspection, and installation of the product must be fully qualified to carry out the work involved and be aware of all applicable responsibilities, authorisations and supervisions. If the personnel in question are not already in possession of the required know-how, appropriate training and instruction must be provided. If required, the operator may commission the manufacturer / supplier to take care of such training. In addition, the operator is responsible for ensuring that the contents of the operating instructions are fully understood by the responsible personnel.

4.3 Safety provisions

The product has been designed with the greatest possible care. Original parts and accessories meet the safety regulations. Modifications in the construction, or the use of non-original parts, may lead to a safety risk.

ATTENTION! ***Make sure that the product operates within its working range. Only then is the product performance guaranteed.***

4.3.1 Labels on the product

The icons, warnings, and instructions applied to the product are part of the safety provisions. The labels may not be removed or covered. Labels must remain legible during the entire life of the product. Replace damaged labels immediately.

4.4 Safety precautions

4.4.1 During normal use

- Contact the local electricity company for questions about the power supply.
- Protect the parts that can become hot, making direct contact impossible.
- When applicable, always place undeformed coupling guards to protect the coupling, before putting the pump into use. Make sure that the coupling guards are never in contact with the rotating coupling.
- Always close the terminal box of the motor.
- Always close the control panel where applicable.

4.4.2 During installation, maintenance and repair

Only authorised personnel may install, maintain, and inspect the product and repair electrical components. Observe the local safety regulations.

Before installation, maintenance and repairs, always disconnect the energy supply to the product first. Secure this disconnection.

Surfaces of a pump can be hot after continuous operation.

Make sure that no one can be near rotating components when starting a pump.

Handle a pump with dangerous liquids with the utmost care. Avoid danger for persons or the environment when repairing leakages, draining liquids, and venting. It is strongly recommended to place a leakage tray under the pump.

Immediately following completion of the work, all safety-relevant and protective devices must be re-installed and/or re-activated.

Please observe all instructions set out in the chapter “Commissioning” before returning the product to service.

4.5 Environmental aspects

4.5.1 General

Sulzer products are designed to function in an environmentally friendly way during their entire lifetime. Therefore, when applicable, always use biodegradable lubricants for maintenance.

Always act according to the laws, by-laws, regulations, and instructions, with respect to health, safety, and the environment.

4.5.2 Dismantling

The owner is responsible for the dismantling and environmentally friendly disposal of the product.

Ask at the local government about the re-use or the environmentally friendly processing of discarded materials.

5 Pump introduction

5.1 Description of the product

The vertical, single, or multistage centrifugal pumps are designed for pumping clean, or slightly aggressive, watery mediums.

Suction and discharge connections of the pump are in-line, making the pump easy to install.

The hydraulic assembly is driven by an electric motor.

All hydraulic parts of the pump are made of stainless steel.

5.2 Model key

Table 4. Model key example

	VMS	S	F	40	/10	-L	
Label	VMS						Product label
Material / Construction		C					Cast iron pump foot and top bracket hydraulics; 1.4301 / AISI 304
							All wetted parts; stainless steel 1.4301 / AISI 304
		M					All wetted parts;stainless steel 1.4301 / AISI 304 with closed coupled motor
		S					All wetted parts; stainless steel 1.4401 / AISI 316
Connections			E				Male thread (with non-return valve insert)
							Oval flange with female thread
			F				Round flange
			V				Victaulic connections
			T				Tri-clamp connections
Size				40			Size (capacity in m^3/h at Q_{opt})
Stages					/10		Number of stages
					/10	-2	Number of stages of which one stage with reduced head
					/10	-L	Number of stages of which the first stage has a “Low NPSHr” impeller
	VMS	**H**		**6**	**-200**		
Label	VMS						
		H					Vertical pump in superior grade AISI 316 (1.4401) 40 Bar
Connections							Round flanges DIN or ASME
				6			Size (capacity in m^3/h at Q_{opt})
					-200		Number of stages (x10)

5.3 Ecodesign

Product information according to Regulation 547/2012 and Directive 2009/125/EC ”Ecodesign Directive” (water pumps with maximum shaft power rating of 150 kW, applies only to water pumps marked with the Minimum Efficiency Index MEI, see pump nameplate):

- Minimum Efficiency Index: see nameplate, legend for nameplate. See Table 1, “Nameplate description”.
- The reference value MEI of a water pump with the best efficiency is 0.70.
- Year built: see nameplate, legend for nameplate. See Table1, “Nameplate description”.
- Manufacturer’s name or trademark, official registration number and place of production: See manual or order documentation.
- Information about type and size of the item: see Table 1, “Nameplate description”.
- Performance curves of the pump, including efficiency characteristics: see documented curve.
- The efficiency of a pump with a corrected impeller is usually lower than that of a pump impeller with a full diameter. A pump with a corrected impeller is adapted to a certain duty point, thereby reducing the energy consumption. Minimum Efficiency Index (MEI) refers to the full impeller diameter.
- The operation of this water pump at different operating points can be more efficient and more economical when it is controlled, for example using a variable speed controller which adjusts the pump operation to the system.
- Information for disassembly, recycling or disposal after the final shutdown: see sub chapter 4.5.2, “Dismantling”.
- Information about the efficiency reference value or MEI = 0.7 (0.4) benchmark index for the pump on the basis of the pattern in the picture, please visit: http://www.europump.org/efficiencycharts.

5.4 Intended use

VMS pumps are suited for the transport and increase of pressure of cold and hot water without wear to parts when used within the indicated working range. The transport of liquids with a different viscosity or density than water is possible as well. Please take into account the possible adjusted motor power which might be required for this. Ask Sulzer or your distributor for advice.

Any other or further use of the pump is not in conformity with its intended use. Sulzer does not accept any liability for any damage or injury that results from this. The pump is produced in accordance with the current standards and guidelines. Use the pump only in a perfect technical state, in conformance with the intended use described below.

The *"intended use"* as laid down in ISO 12100:2010 is the use for which the technical product is intended according to the specifications of the manufacturer. The use of the product has been described in the sales brochure and in the user manual. Always observe the instructions given in the user manual. When in doubt the product must be used as becomes evident from its construction, version and function.

5.5 Operation

The rotating impeller causes the pressure at the inlet of the impeller to drop. This decrease in pressure creates the flow through the suction connection (A). Every stage (B) consists of an impeller and a diffusor. The capacity of the pump is determined by the size of the passageway of the stage. The pressure of the stage is determined by the diameter of the impeller.

Because of the modular type of construction it is possible to choose the number of impellers most suited to the required duty point. After leaving the last impeller the medium flows between the pump stages and the outer sleeve (C), and exits the pump at the discharge connection (D).

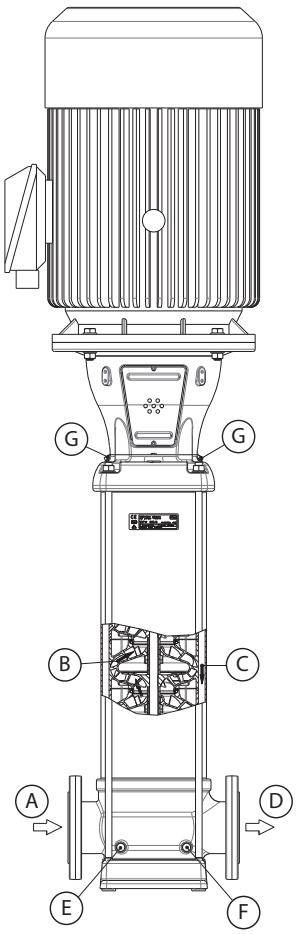

Figure 4. VMSF 85

5.6 Measuring, draining and venting

The pump is provided with plugs for measuring, draining and venting.

Connection (E) is meant to drain the inlet part of the pump, or to measure the inlet / suction pressure using a G ¼" connection.

Connection (F) is meant to drain the outlet part of the pump, or to measure the discharge pressure using a G ¼" connection.

Connections (G) are meant to vent the pump system when the pump is not in operation, or to measure the discharge pressure of the pump using a G ³⁄₈" connection.

5.7 Modular selection

For an optimal match with the application, the pump is assembled out of modules which are selected depending on their specifications.

The basic modules are:

- **Basic pump model:** defines the capacity and head, the basic material and allowable pressures and temperatures.
- **Connections:** defines the connection size, pressure class and allowable temperatures.
- **Sealings:** defines material of the elastomers, shaft seal type and allowable pressures and temperatures.
- **Electric motor:** defines all requirements of the motor such as size, power, supply voltage, frequency and possible motor accessories.

5.8 Working range

The working range depends on the basic hydraulic design, the type of connection, and sealings. The module in the pump with the strictest specification determines the allowable pressure and temperature of the medium in the pump. The general working specifications can be summarised as follows:

Table 5. General working range specification

Pump type	VMS	Note
Ambient temperature [°C]	-20 up to 40	1, 2
Minimum inlet pressure	$NPSH_{req.}$ + 1 m	
Viscosity [cSt]	1 - 100	3
Density [kg/m³]	1000 - 2500	2
Cooling	Forced motor cooling	
Minimum frequency [Hz]	30	
Maximum frequency [Hz]	60	4
Maximum number of starts	See motor data sheet	5
Noise emission	See motor data sheet	6
Allowable size of solids pumped	5 µm to 1 mm	

1. Avoid freezing the pump.
2. If the ambient temperature exceeds this value, or the motor is located more than 1000 m above sea level, the motor cooling is less effective and could require an adapted motor power. Please contact your supplier for more detailed advice.
3. Deviation in viscosity and/or density could require an adapted motor power. Please contact your supplier for more detailed advice.
4. Pumps that are intended for 50 Hz operation, may not be connected to 60 Hz power supply.
5. Frequent start/stops, in particular in combination with higher pressure differences (Δp), may result in a shortened product lifetime. Consult your supplier for such applications.
6. Only the noise emission of the motor is documented.

ATTENTION! ***The temperature difference between the medium and the pump should never exceed 60 °C. To avoid any chance of a thermal shock the pump must be filled / heated up slowly in any case where the difference between the pump and the medium is more than 30 °C.***

For minimum/maximum flow at medium temperature of 20 °C see Table 6, ”Minimum/maximum capacity (Qmin/max)”; for higher temperatures see Figure 5, ”Minimum capacity vs. temperature (in % of Q optimum)”.

Table 6. Minimum/maximum capacity - Qmin/max [m³/hr]

Size			2	4	6	10	15	25	40	60	85	125	H6
50 Hz	2-pole	Min.	0.2	0.4	0.6	1.1	1.6	2.8	4.0	5.3	8.5	30.0	0.8
		Max.	3.3	6.5	9.0	13.2	22.5	35.0	54.0	57.0	110.0	160.0	8.6
	4-pole	Min.	-	-	-	0.5	0.8	1.4	1.9	2.6	4.3	15.0	-
		Max.	-	-	-	6.6	11.3	17.5	27.0	38.0	53.9	80.0	-
60 Hz	2-pole	Min.	0.2	0.5	0.8	1.3	2.0	3.1	4.9	6.4	10.2	36.0	0.7
		Max.	4.0	7.8	10.8	15.8	27.0	42.0	65.0	92.0	132.0	192.0	8.6
	4-pole	Min.	-	-	-	0.6	1.0	1.6	2.3	3.2	5.1	18.0	-
		Max.	-	-	-	7.9	13.5	21.0	32.5	46.0	65.1	96.0	-

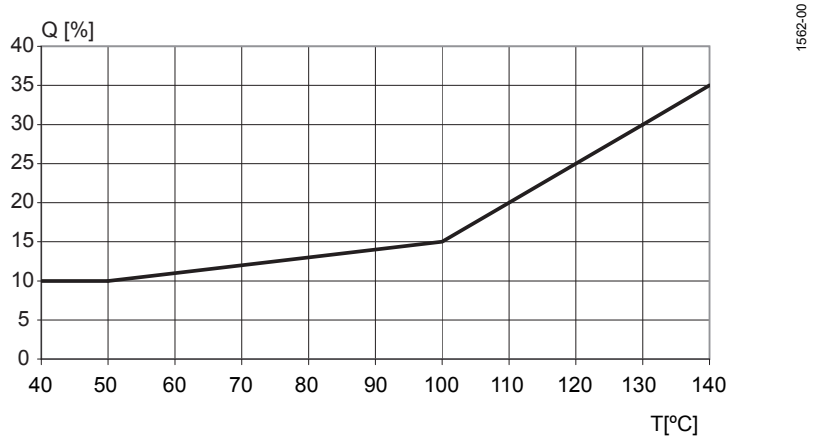

Figure 5. Minimum capacity vs. temperature (in % of Q optimum)

5.8.1 Detailed working range VMS

For the actual working range of the pump see the nameplate.

5.8.2 Detailed working range VMS H 6

Pressure: 40 bar, temperature 120 °C.

5.9 Seal code

Table 7. Seal code

Seal code	Shaft seal type	Mechanical seal material	Shaft seal materials[1]	Pressure class shaft seal	Temperature range shaft seal	Approvals
11	MG12-G60	B Q1 E GG	Ca/SiC/EPDM	PN10	-20/+100 °C	
12	MG12-G60	B Q1 V GG	Ca/SiC/FPM	PN10	-20/+120 °C	
13	RMG12-G606	Q1 B E GG	SiC/Ca/EPDM	PN25	-20/+100 °C	WRAS
14	RMG12-G606	Q1 B V GG	SiC/Ca/FPM	PN25	-20/+120 °C	
15	RMG12-G606	U3 U3 X4 GG	TuC/TuC/HNBR	PN25(PN16)	-20/+120(140) °C	
16	RMG12-G606	U3 U3 V GG	TuC/TuC/FPM	PN25(PN16)	-20/+120(140) °C	
17	M37GN2/16-00-R	U3 B V GG	TuC/Ca/FPM[2]	PN40	-20/+120 °C	
18	RMG12-G606	U3 B E GG	TuC/Ca/EPDM	PN25(PN16)	-20/+120(140) °C	
19	M37GN2/16-00-R	U3 B E GG	TuC/Ca/EPDM	PN40	-20/+120 °C	
20[3]	H7N	Q1 A E GG	SiC/Ca/EPDM	PN40(PN25)	-20/+120(140) °C	
21[3]	H7N	Q1 A V GG	SiC/Ca/FPM	PN40(PN25)	-20/+120(140) °C	
22[3]	H7N	Q1 A X4 GG	SiC/Ca/HNBR	PN40(PN25)	-20/+120(140) °C	
23	RMG12-G606	Q1 B E GG	SiC/Ca/EPDM	PN25	-20/+100 °C	
24	MG12-G60	Q1 Q1 V GG	SiC1/SiC1/FPM	PN10	-20/+120 °C	
28	MG12-G60	Q1 Q1 X4 GG	SiC1/SiC1/HNBR	PN10	-20/+120 °C	
29	MG12-G60	Q1 Q1 E GG	SiC1/SiC1/EPDM	PN10	-20/+100 °C	
30[4]	MG12-G60	Q1 Q1 V GG	SiC1/SiC1/FPM	PN10	-20/+120 °C	
31	107-L60	BVPFF	Ca/Ce/NBR	PN10	-15/+100 °C	
32	107-L60	BVEFF	Ca/Ce/EPDM	PN10	-15/+100 °C	WRAS
33[4]	RMG12-G606	Q1 B E GG	SiC/Ca/EPDM	PN25	-20/+100 °C	WRAS
34[5]	RMG12-G606 DST	Q1 B E FF	SiC/Ca/EPDM	PN25	-20/+100 °C	
35	RMG12-G6	eCarb-B eSic-Q7 E GG	eCa/eSic/EPDM	PN25	-20/+100 °C	WRAS
36	MG12-G6	eCarb-B eSic-Q7 V GG	eCa/eSic/FPM	PN25	-20/+100 °C	
37	RMG12-G606	U3 A V GG	TuC/Ca/FPM	PN25(PN16)	-20/+120(140) °C	
38[4]	RMG12-G606	U3 U3 V GG	TuC/TuC/FPM	PN25(PN16)	-20/+120(140) °C	
39[4]	RMG12-G6	eCarb-B eSic-Q7 E GG	eCa/eSic/EPDM	PN25	--20/+100 °C	WRAS

1. Apart from the shaft seal, other sealings might be assembled with different allowable conditions. If in doubt consult your sales supplier.
2. VMS H 6 only.
3. Mechanical seal can withstand -30 / +140 °C @ PN40.
4. Only for seal options.
5. Equivalent of seal code 13, but with AISI 304 spring material.

5.10 Explosion safety

ATTENTION! ***This sub-chapter contains fundamental information which has to be taken into consideration when installing the pump with ATEX permission in a hazardous environment.***

ATTENTION! ***Because of the probable creation of sparks during loosening and tightening of nuts and bolts, the pump(s) should not be opened, closed, assembled or disassembled, in an explosive hazardous environment.***

ATTENTION! ***When there is an ATEX sticker on the pump, the pump must only be used for pumping a medium with a conductivity higher than 50 pS/m.***

5.10.1 General

Stickers or indicators on the pump sleeve and the motor indicate whether the pump is suitable for use in an environment with risk of explosion.

It is allowed to install the pump in a zone which is classified in directive 1999/92/EC.

When in doubt it is compulsory to check the above directive.

5.10.2 Indication

1563-00

Figure 6. Indication sticker; explosion safety

Table 8. ATEX marking

Indication	Meaning
II	Product group for use above ground, with the exception of mine working where there can be a danger of explosion due to mine gas and/or flammable substances.
2	Category 2: Equipment in this category is intended for use in areas in which explosive atmospheres caused by mixtures of air and gases, vapours or mists, or by air/dusts mixtures are likely to occur.
3	Category 3: Equipment in this category is intended for use in areas in which explosive atmospheres caused by mixtures of air and gases, vapours or mists, or by air/dusts mixtures are likely to occur or, if they do occur, are likely to do so only infrequently and for a short period only.
G	Suitable for an environment that is explosive due to gas, vapour or fumes; not suitable for an environment that is explosive due to dust.
T4 / T3	Temperature class: T4 for maximum surface temperature 135 °C T3 for maximum surface temperature 200 °C

5.10.3 Medium temperature

The applied ATEX motor determines the maximum allowable temperature of the pumped liquid (see Table 9, “Maximum medium temperatures”).

Table 9. Maximum medium temperatures

ATEX marking motor	Maximum allowable medium temperature
Exe T3	60 °C
Exd T4	100 °C
Exde T4	100 °C
Others	Maximum ambient temperature of motor

5.10.4 Commissioning (checklist)

It is compulsory to check these points prior to putting the pump in operation:

- The ATEX code of an ATEX ‘pump with motor’ assembly supplied by Sulzer can be found on the pump shroud. Check if the ATEX code of the ‘pump with motor’ assembly is in accordance with the ATEX specification of the motor. For each part of the code the specification of the assembly may not be higher than the specification of the motor.
- Make sure that the pump is protected against damage from outside.
- Make sure that the medium temperature never exceeds the maximum allowed temperature (see Table 9, “Maximum medium temperatures”). Apply a temperature monitoring and limiting system, meeting the requirements of EN 13463-6, that stops the pump at too high medium temperatures. *Please note that the maximum temperature noted on the nameplate of the pump refers to the technical specification of the pump and does not necessarily match with the maximum allowed medium temperature for ATEX applications*.
- Apply a monitoring and limiting system, meeting the requirements of EN 13463-6, to prevent dry running. It has to check the presence of the medium at the inlet of the pump and stop the pump when no medium is available.
- Apply a monitoring and limiting system to secure that the maximum current for the motor is not exceeded.
- If the motor is suited with a PTC; connect the PTC to a monitoring and limiting system.
- Check if the motor cable is suitable for the current drawn by the motor (see the motor type plate).
- Check if the pump is fully filled with the medium (de-aerated). Do not operate the pump when gas is present in the pump.
- Check the rotational direction of the motor. The motor has to run clockwise (seen from the non-driven side). This direction is indicated with an arrow on the motor stool.
- Do not apply higher pressures in the pump than is allowed at the working temperature of the medium. The allowed pressure can be found on the nameplate of the pump.
- Do not operate the pump at flows lower than specified in performance curve (see the technical documentation).
- Do not operate the pump at flows higher than specified in the performance curve (see the technical documentation).
- Do not operate the pump with inlet pressures lower than specified in the NPSHreq requirements [$NPSH_{req}$ + 1 m] (see the technical documentation).
- Make sure that the maximum particle sizes in the medium does not exceed the values specified at ‘5.8 Working range’.
- The pump has to be de-aerated again when the pump has not operated for a while or gas has gathered in the pump.
- Wrong adjustment of the coupling can cause interference of pump parts. Assembling and adjusting the coupling has to be performed by a certified mechanic from the supplier of the pump.
- Make sure the coupling guards are assembled.
- Wrong assembly of the coupling guards could cause them to vibrate during operation of the pump or cause interference of pump parts. If the coupling guards have to be assembled or reassembled, this has to be done by a certified mechanic from the supplier of the pump. Make sure that the pump and the motor shaft are running smoothly without excessive noise (e.g. no parts are running against each other).
- Wrong assembling of the mechanical seal construction (easy access or cartridge) can cause malfunction of the pump. Assembling of the cartridge/easy access seal construction has to be done by a certified mechanic from the supplier of the pump.
- Make sure that only media is pumped that is compatible with the seals and elastomers that are applied in the pump (see technical documentation).
- Electric installation of the pump has to be done by an ATEX-certified mechanic.
- Make sure the pump is electrically connected (earthed) with the surrounding parts of the installation.

- Regularly examine the condition of the bearings in the motor and/or thrust bearing housing (for example by means of vibrations measurement) in order to detect damage of the bearing raceways/roller elements. Stop the application of the pump when damage in a roller element bearing is found.
- If a flammable medium is pumped, its temperature may not exceed its ignition temperature minus 50 °C.
- Take care with an intensively used pump which is successively not used for a while; when it is started again, leakage can occur at the shroud.
- Do not pump different mediums which can have chemical reactions with each other.

If the pump is supplied without motor, it is compulsory to also check the following additional points prior to putting the pump in operation:

- Apply a motor that is ATEX certified for Equipment Group IIG.
- The determination of the ATEX code and certification of the assembly is the responsibility of the owner of the pump/motor. The different parts of the ATEX code of the assembly are determined by the lowest specification of pump or motor.
- Apply a motor that has a special bearing which is suited to support the high axial loads at the pump shaft. If this is not the case, a thrust bearing housing has to be applied.
- Apply a motor with a nominal power which is suited to drive the pump at the operating frequency.
- Apply a motor that has the proper frame size to connect with the motor stool.

If a pump supplied with thrust bearing housing or a solely supplied thrust bearing housing is supplied, it is compulsory to also check the following additional points prior to putting the pump in operation:

- Wrong adjustment of the axial play between the thrust bearing housing shaft and the motor shaft could result in too high impacts between these shafts and/or increased wear of the roller element bearings. Assembling of the electric motor on the thrust bearing housing has to be done by a certified mechanic from the supplier of the pump.
- When the thrust bearing housing has a grease nipple it can be lubricated. Proper lubrication is important to prevent high temperatures in the bearing. If the thrust bearing housing has grease nipple it is obligatory to take care of adequate lubrication by supplying grease on a yearly basis. This needs to be grease with a melting point and ignition temperature of minimally 200 °C.
- Do not install the pump horizontally or upside down.

6 Lifting, transport and storage

6.1 Lifting

ATTENTION! ***Observe the total weight of the Sulzer units and their attached components! (see nameplate for weight of base unit).***

The duplicate nameplate provided must always be located and visible close to where the pump is installed (e.g. at the terminal boxes / control panel where the pump cables are connected).

NOTE: ***Lifting equipment must be used if the total unit weight and attached accessories exceeds local manual lifting safety regulations.***

The total weight of the unit and accessories must be observed when specifying the safe working load of any lifting equipment! The lifting equipment, e.g. crane and chains, must have adequate lifting capacity. The hoist must be adequately dimensioned for the total weight of the Sulzer units (including lifting chains or steel ropes, and all accessories which may be attached). The end user assumes sole responsibility that lifting equipment is certified, in good condition, and inspected regularly by a competent person at intervals in accordance with local regulations. Worn or damaged lifting equipment must not be used and must be properly disposed of. Lifting equipment must also comply with the local safety rules and regulations

NOTE! ***The guidelines for the safe use of chains, ropes and shackles supplied by Sulzer are outlined in the Lifting Equipment manual provided with the items and must be fully adhered to.***

6.2 Transport

1. Transport the pump in the position as indicated on the pallet or packaging.
2. Make sure the pump is stable.
3. If present, observe the instructions on the packaging.

ATTENTION! ***If necessary, lift the pump using a hoist and suitable slings. Attach the slings to the transport lugs on the packaging, where present.***

ATTENTION! ***The pump must be lifted according to the current hoist guidelines. Only qualified personnel are allowed to lift the pump.***

ATTENTION! ***Do not lift the pump by using the frequency converter (if placed), electrical parts or the motor cover. Be sure that the pump is always in balance.***

ATTENTION! ***Pumps could tilt while lifting. Do not remove the lifting devices from the pump before the pump is placed and mounted correctly.***

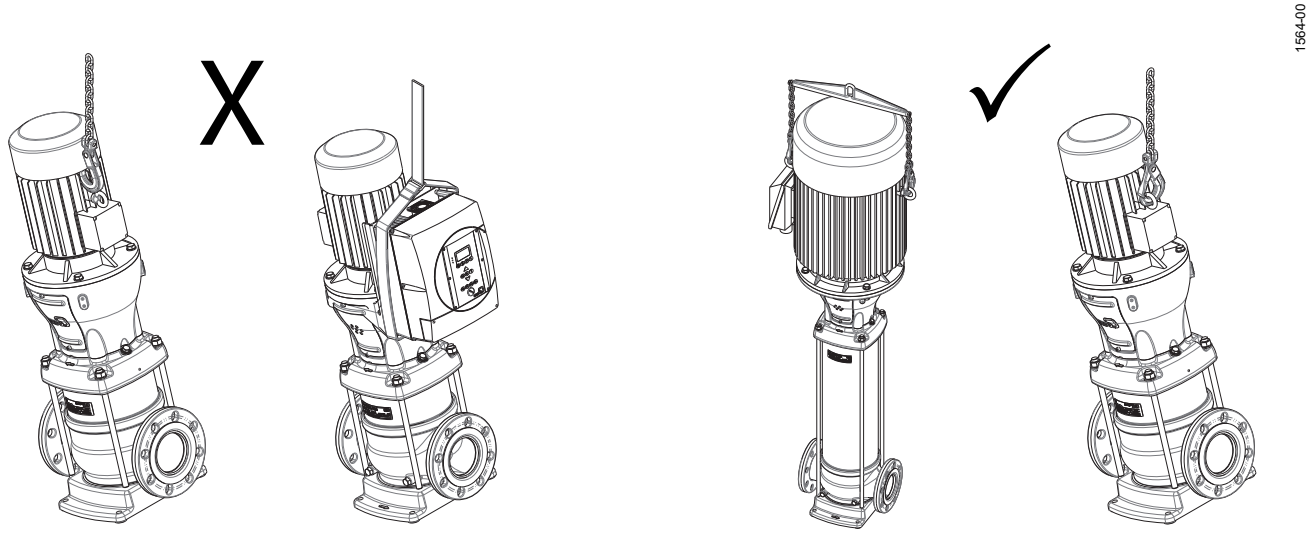

Figure 7. Transport positions

6.3 Storage

Fill the pump with glycol in order to protect it against the risk of frost.

Table 10. Storage

Storage	
$t_{ambient}$ [°C]	-10/+40
Max. rel. humidity	80% at 20 °C not condensing

6.3.1 Inspection during storage

Turn the shaft every three months and just before putting into operation.

7 Installation instructions

7.1 Setting up the pump

ATTENTION! ***Avoid stress in the pump casing caused by misalignment in the piping system. Please see tables below.***

Table 11. Allowable forces VMS(S)F, VMS H and VMSCF

Type	DN [mm]	Force [N]					Type	DN [mm]	Force [N]			
		Fx	Fy	Fz	Σ F				Fx	Fy	Fz	Σ F
(S)F 2 B	25	3300	-2400	1700	4420		**CF 2 B**	25	9400	-3200	3200	10430
(S)F 4 B	25	3300	-2400	1700	4420		**CF 4 B**	25	9400	-3200	3200	10430
(S)F 6 B	32	3300	-2400	1700	4420		**CF 6 B**	32	9400	-3200	3200	10430
(S)F 10 B	40	4000	-3100	3100	5930		**CF 10 B**	40	8000	-2000	3200	8850
(S)F 15 B / C	50	4000	-3100	3100	5930		**CF 15 B / C**	50	8000	-2000	3200	8850
(S)F 25 B	65	3200	-3500	3500	5890		**CF 25 B**	65	5000	-2000	2500	5940
(S)F 40 B PN16/25	80	4000	-1800	2000	4820		**CF 40 B**	80	6000	-3000	3000	7350
(S)F 40 B PN40	80	3700	-3300	3700	6190		**CF 60 B**	100	6000	-3000	3000	7350
(S)F 60 B PN16/25	100	4000	-1800	2000	4820		**CF 85 B**	100	6200	-4100	4100	8490
(S)F 60 B PN40	100	3700	-3300	3700	6190		**CF 125 B 16 Bar**	125	4400	-1700	1700	5010
(S)F 85 B	100	3500	-2500	1000	4420		**CF 125 B 25/40 Bar**	125	7000	-2620	2620	7920
(S)F 125 B 16 Bar	125	4400	-1700	1700	5010							
(S)F 125 B 25/40 Bar	125	7000	-2620	2620	7920							
VMS H 6	32	8000	-2000	3200	8800							

Table 12. Allowable torque VMS(S)F, VMS H and VMSCF

Type	DN [mm]	Moment [Nm]					Type	DN [mm]	Moment [Nm]			
		Mx	My	Mz	ΣM				Mx	My	Mz	Σ M
(S)F 2 B	25	280	95	-210	360		**CF 2 B**	25	600	300	-360	760
(S)F 4 B	25	280	95	-210	360		**CF 4 B**	25	600	300	-360	760
(S)F 6 B	32	280	95	-210	360		**CF 6 B**	32	600	300	-360	760
(S)F 10 B	40	440	180	-200	520		**CF 10 B**	40	460	460	-500	820
(S)F 15 B / C	50	440	180	-200	520		**CF 15 B / C**	50	460	460	-500	820
(S)F 25 B	65	1000	230	-400	1100		**CF 25 B**	65	1000	300	-300	1090
(S)F 40 B PN16/25	80	400	200	-300	540		**CF 40 B**	80	1800	1000	-1000	2290
(S)F 40 B PN40	80	975	240	-450	1100		**CF 60 B**	100	1800	1000	-1000	2290
(S)F 60 B PN16/25	100	400	200	-300	540		**CF 85 B**	100	2000	1200	-1200	2620
(S)F 60 B PN40	100	975	240	-450	1100		**CF 125 B 16 Bar**	125	600	425	-425	850
(S)F 85 B	100	750	500	-625	1100		**CF 125 B 25/40 Bar**	125	1000	650	-650	1360
(S)F 125 B 16 Bar	125	600	425	-425	850							
(S)F 125 B 25/40 Bar	125	1000	655	-655	1360							
VMS H 6	32	460	460	-500	800							

ATTENTION! ***For the values mentioned in the tables above, it is assumed that they occur simultaneously.***

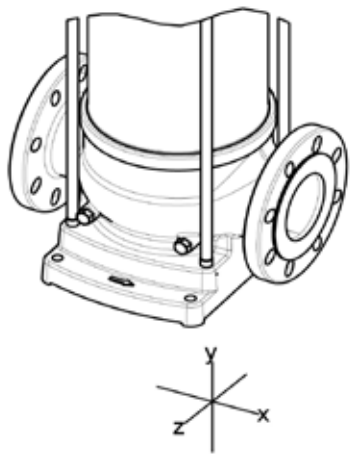

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Figure 8. Allowable forces

ATTENTION! Pumps which do not stand steady or stable on their own, should be mounted on a rigid and stable base.

ATTENTION! Locate the pump at the place with the lowest risk for noise nuisance.

1. Place and install the pump on a level, stable surface in a dry and frost-free room.
2. Make sure that sufficient air can reach the cooling fan of the motor. For this purpose the free space above the cooling fan should be at least one quarter of the diameter of the fan cover air intake.
3. Install the pump with counter flanges. For pumps with non-standardised connections, counter flanges are delivered separately.
4. It is advised to install a shut off valve on the supply and on the delivery connection of the pump.
5. To avoid medium flowing back through the pump, when idle, make sure a non-return valve is installed.
6. Make sure that the inlet of the pump is never clogged.

7.1.1 Indicators

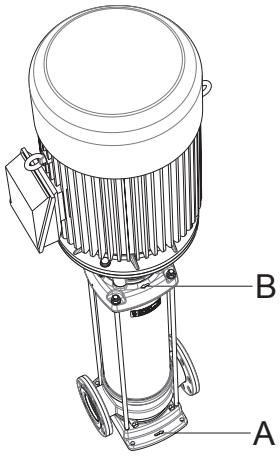

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Figure 9. Pump indicators

The arrow (A) on the pump foot indicates the flow direction of the liquid. The arrow (B) on the top bracket indicates the rotating direction of the motor.

7.1.2 Install bypass

Install a bypass if the pump operates against a closed valve. The required capacity of the bypass is at least 10% of the optimum volume flow. At high operating temperatures a higher volume flow is required. Refer to the table ”Minimum volume flows” in the paragraph 5.8 ”Working range”, and Fig. 5, ”Minimum capacity vs. temperature (in % of Q optimum)”.

7.2 Mounting a motor on the pump

ATTENTION! ***It is to be advised to use a special designed Sulzer motor. Before installing another brand/standard IEC-norm motor, Sulzer has to be consulted to judge the applicability.***

The following motor specifications are required:

- Increased power output (when applicable).
- Reinforced bearing at driven end (to withstand the axial force).
- Fixed bearing at driven end (to minimize the axial play).
- Smooth shaft, no key way (to improve the coupling grip and to improve the motor balance).

The advised bearings per motor type are:

Table 13. Minimum required driven-end motor bearing

Power output [kW]	1-phase 50 Hz	3-phase 50/60 Hz	
		2 pole	4 pole
0.25			6202-2Z-C3
0.37	6202-2Z-C3	6203-2Z-C3	6202-2Z-C3
0.55	6202-2Z-C3	6203-2Z-C3	6202-2Z-C3
0.75	6204-2Z-C3	6204-2Z-C3	6202-2Z-C3
1.1	6204-2Z-C3	6204-2Z-C3	6205-2Z-C3
1.5	6305-2Z-C3	6305-2Z-C3	6205-2Z-C3
2.2	6305-2Z-C3	6305-2Z-C3	6206-2Z-C3
3.0		6306-2Z-C3	6206-2Z-C3
4.0		6306-2Z-C3	6208-2Z-C3
5.5		6308-2Z-C3	6208-2Z-C3
7.5		6308-2Z-C3	6208-2Z-C3
11.0		7309	
15.0		7309	
18.5		7309	
22.0		7311	
30.0		7312	
37.0		7312	
45.0		7313	

7.2.1 Install the motor on pumps supplied without motor

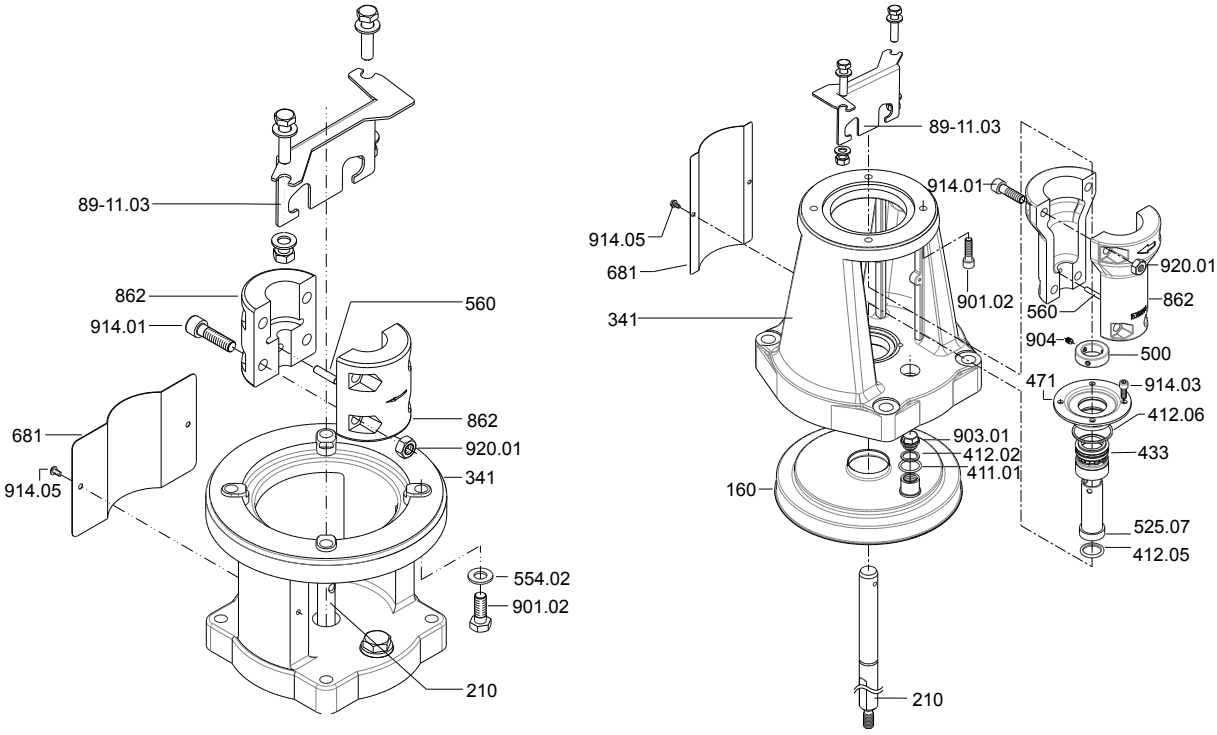


Figure 10. **Standard mechanical seal** **Cartridge seal**

1. Remove the coupling guards (681) and the coupling shells (862).
2. Remove the seal protection bracket (89-11.03) and its mounting material. For pumps with a taper piece (722), with motor of 5.5 kW or higher, the two bolts (914.02 or 901.02) have to be placed back to connect the taper piece to the motor stool. Thoroughly clean the motor stool (341), the shaft (210), the coupling shells (862) and the motor shaft.
3. Loosely fasten the coupling shells (862) with the coupling pin (560) on the shaft (210). Use the hexagon socket head cap screw (914.01) and the nut (920.01) for this. When the pump is equipped with a steel coupling, never use the same coupling twice but order a new one.
4. Place the motor on the motor stool (341).
5. **Pump with cartridge seal:**
   - Loosen the three cartridge grub screws (904) one turn.
   - Push the hydraulic pump assembly in the lowest position.
   - Tighten the three cartridge grub screws (904) firmly to the shaft.
6. Tighten the lower bolts of the coupling shells (862) in such a way that the coupling slightly clamps around the motor shaft.
7. **For pump series VMS:** use a sufficient tyre iron to lift the coupling (and hydraulic assembly) 1.5 mm higher then the lowest position. For easy and accurate adjustment of the coupling contact your supplier for the appropriate toolkit for hydraulics adjustment.

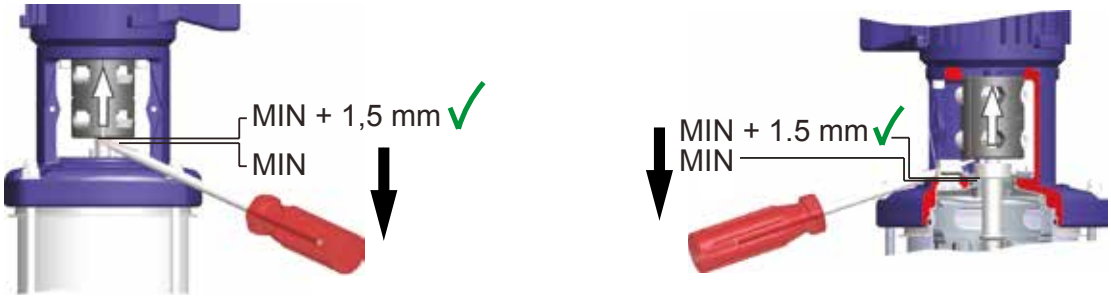


Figure 11. **Standard mechanical seal** **Cartridge seal**

Correct seal adjustment max. 1.5 mm higher than the lowest position.

ATTENTION! ***For motors of 11 kW or higher, block the rotor when adjustments are made to the coupling. This ensures that the rotor is not lifted out of its bearings.***

8. **For pump series VMS H 6:** use a sufficient tyre iron to lift the coupling (and hydraulic assembly) to the maximum upwards position and lower it 1 mm from this position.

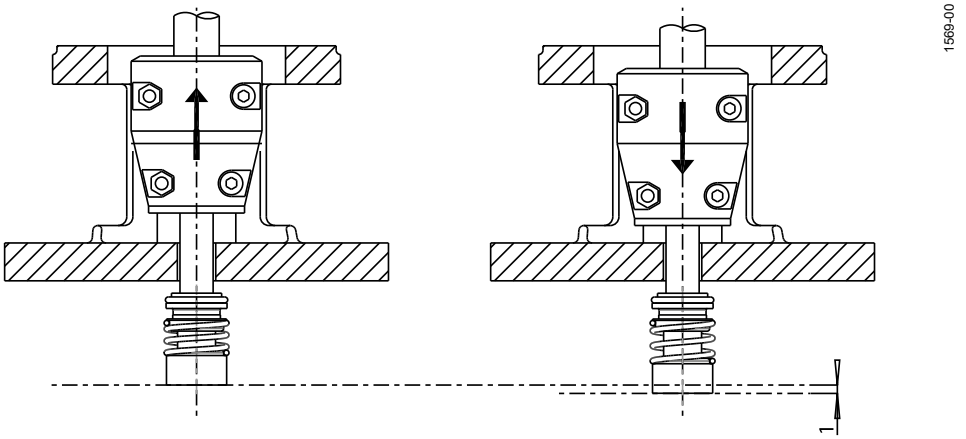


Figure 12. Positioning the seal

Correct seal tension max. -1.0 mm lower than the maximum upwards position.

ATTENTION! ***For motors of 11 kW or higher, block the rotor when adjustments are made to the coupling. This ensures that the rotor is not lifted out of its bearings.***

9. Fully tighten the couplings at the given torque (see Table 15, “Torques”). Make sure that the gaps between the couplings are equally divided on both sides (see drawing).

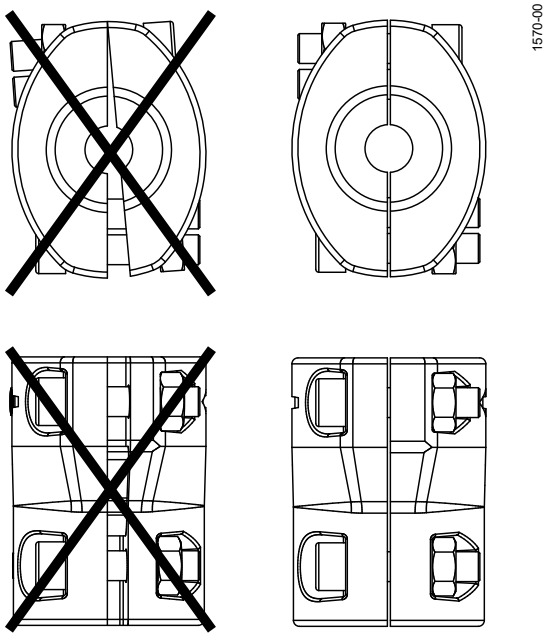


Figure 13. Position of the coupling

10. Attach the coupling guards (681) with the socket head cap screws (914.05) to the motor stool (341).
11. Connect the power supply. see § 7.3 Electrical installation.

7.3 Electrical installation

In accordance with the local regulations only authorised personnel are allowed to make electrical connections to the motor.

ATTENTION! ***Connect the motor according to Figure 14, ”Motor connections”, and always check the rotation direction.***

Electrical connections:

- Make sure that the motor specifications correspond with the power supply to which the pump motor is connected. Consult electrical diagrams for the correct connection diagram.
- Connect the motor using a motor safety switch.

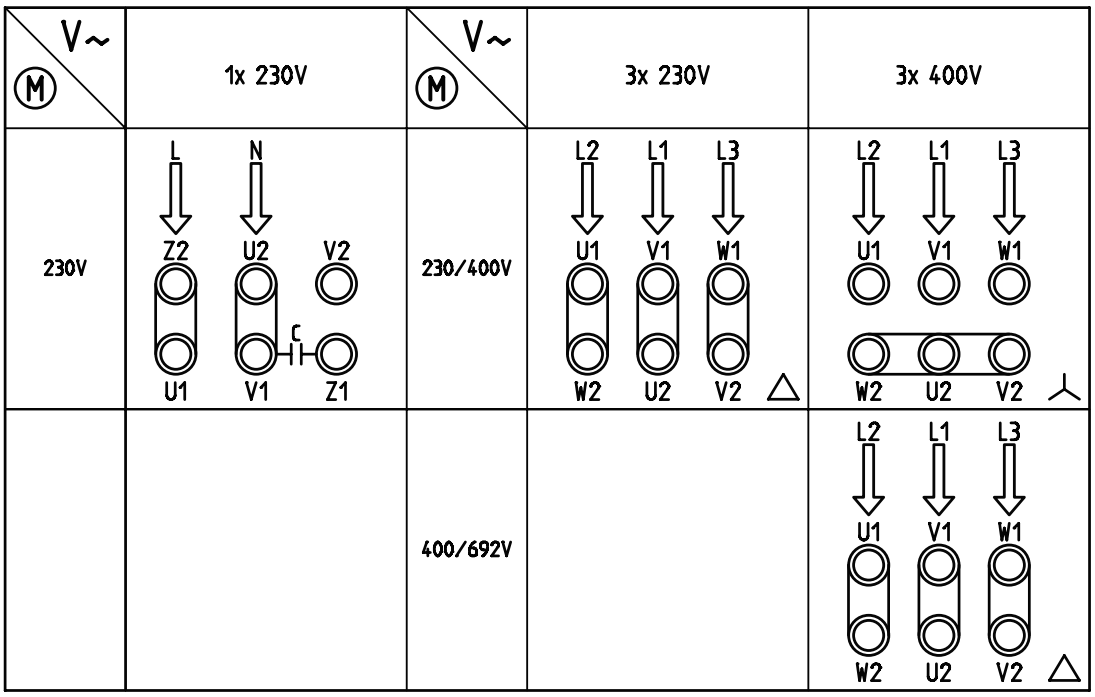


Figure 14. Motor connections - (example may differ upon chosen motor)

PTC connection STM 140 EK:

- Standard motors 3 kW and up are equipped with a PTC thermistor. Consult Table 14, “Technical specifications” PTC STM 140 EK.
- Connect the PTC to a thermistor relay.

Table 14. Technical specifications PTC STM 140 EK

	Value
t_n [°C]	140
R_{20} °C [Ω]	~ 20
R_{tn}-20 °C [Ω]	~ 250
R_{tn}-5 °C [Ω]	< 550
R_{tn}+5 °C [Ω]	> 1330
R_{tn}+15 °C [Ω]	> 4000
U_n [VDC]	2.5 < U < 30

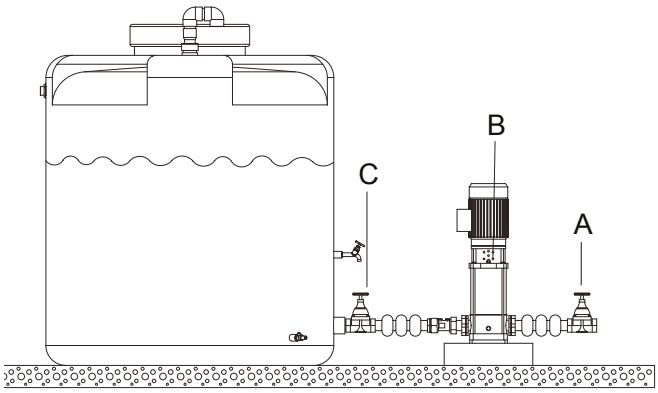
7.4 Commissioning

The pump must be switched off when it is not completely filled up.

ATTENTION! ***Vent the pump and suction line. Fill the pump and suction line with the medium.***

ATTENTION! ***Seen from the top of the motor the pump should rotate clockwise. See § 7.1.1, Indicators (B). In case of a 3-phase motor the rotating direction can be changed by exchanging two of the three phases.***

7.4.1 In an open or closed circuit with sufficient supply pressure



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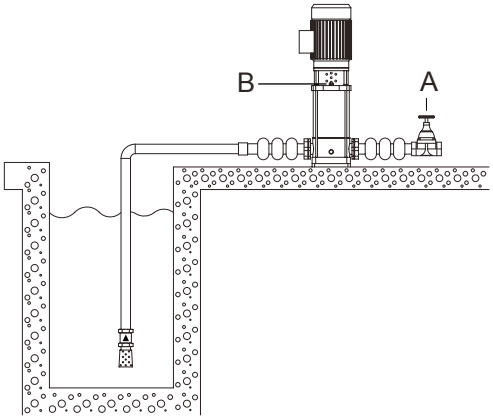
1. Close the suction shut-off valve (C) and the outlet shut-off valve (A).
2. Open the fill plug (B).
3. Gradually open the suction shut-off valve until the liquid flows from the fill plug (B).
4. Close the fill plug.
5. Fully open the suction shut-off valve.
6. Check the rotational direction of the pump.
7. Fully open the outlet shut-off valve (A).

Figure 15. Example: pump with open or closed circuit

7.4.2 In an open circuit with a liquid level lower than the pump



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1. Remove the fill plug (B) from the top bracket.
2. Close the outlet shut-off valve (A).
3. Fill the pump housing to the maximum through the fill plug with the liquid that is to be pumped.
4. Insert the fill plug (B) in the top bracket.
5. Check the rotational direction of the pump.
6. Open the outlet shut-off valve (A).

Figure 16. Example: liquid level lower than pump

7.4.3 After an extended period of non-operation or storage

During first start-up, check the mechanical seals for leakage due to seizure or dehydration of the lubricating film. If so, please proceed as follows:

1. Turn shaft manually.
2. Check if the mechanical seal is still leaking.

If the mechanical seal is still leaking:

1. Disassemble the mechanical seal.
2. Thoroughly clean and degrease the running surfaces.
3. Assemble the mechanical seal again and retry start-up.

If this doesn't solve the shaft leakage, replacement of the mechanical seal is necessary.

8 Operation

8.1 Operation

The pump is controlled externally and therefore does not need any operation guidance.

9 Maintenance

9.1 Introduction

Observe the general safety precautions for installation, maintenance and repair.

Regular maintenance is necessary for the correct operation of a pump. Please contact your supplier for maintenance of the pump.

9.2 Lubrication

Standard motors, with a maximum power of 7.5 kW, are provided with maintenance-free sealed bearings.

Motors with lubricating nipples must be lubricated after 2000 hours. If the pump works under extreme conditions, such as high vibrations and temperatures, the motors must be lubricated more often.

Use a lithium-based -30 °C / 160 °C bearing lubricant (about 15 grams).

When the pump is delivered without a motor and fitted with another brand, or the standard motor is replaced by another brand than Sulzer, please consult the maintenance instructions of the motor supplier.

ATTENTION! Also follow the instructions in § 7.2 Mounting a motor on the pump.

9.3 Maintaining the pump for an extended period of non-operation

To protect the seals from seizure, turn the shaft every three months[1].

Protect the pump if there is a risk of frost. Proceed as follows:

1. Close all pump valves.
2. Drain each pump and/or the system.
3. Remove all plugs from the pump.
4. Open the shut-off and fill/air vent plug, if present.

[1]Period may vary per application or medium. Please consult your sales representative for application details.

9.4 Torques of coupling shell - pos. 914.01

Table 15. Torques

Material	Dimensions	Torques [Nm]
Steel	M6	16
Steel / Cast iron	M8	30
Aluminium	M8	22
Cast iron	M10	70

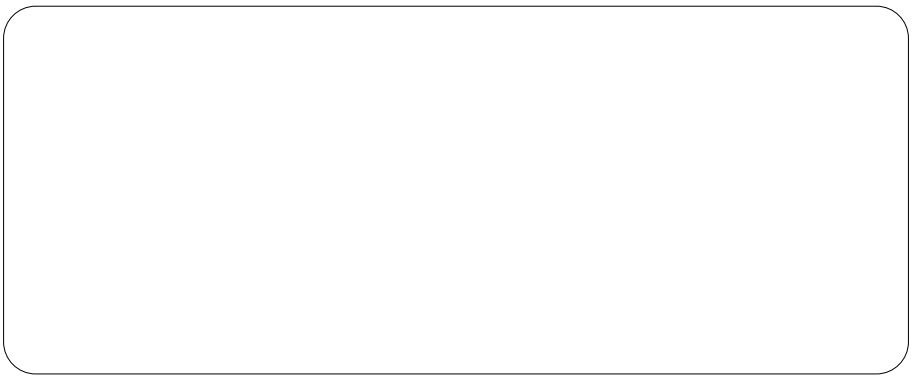
10 Failures

10.1 Failure table

Observe the general safety precautions before installation, maintenance and repair.

Problem	Possible cause	Possible solution	Checkpoints
Leakage along the shaft.	Running surfaces of the mechanical seal are worn or damaged.	Replace the mechanical seal.	Check the pump for dirt / abrasive parts.
	New pump: seal stuck due to assembly.	Open and close the outlet shut-off valve quickly during operation.	
	Mechanical seal mounted incorrectly.	Install the mechanical seal correctly. Use water and soap as a lubricant.	
	Elastomers affected by medium.	Use the right rubber compound for the mechanical seal.	
	Pressure too high.	Use the right type of mechanical seal.	
	Shaft worn.	Replace shaft and mechanical seal.	
	Pump has been operating without water.	Replace the mechanical seal.	
Leakage along the shroud at the top bracket or at the pump casing.	O-ring worn	Replace the o-ring.	
	O-ring not resistant to the medium to be pumped.	Replace o-ring by one with better resistance.	
	Too much stress on the pump casing; it becomes oval.	Decrease stress on piping. Mount the pump casing without stress. Support the connections.	
Pump is vibrating or noisy.	Coupling mounted incorrectly.	Install the coupling in parallel.	
	Faulty setting of the hydraulic assembly.	Adjust the assembly according to the manual.	
	There is no water in the pump.	Fill and vent the pump.	
	No supply of medium.	Make sure there is sufficient supply. Check for blockages in the supply line.	
	Bearings of pump and/or motor worn.	Have the bearings replaced by a certified company.	
	Available NPSH too low (cavitation).	Improve suction condition.	
	Pump does not work in its working range.	Select another pump or adjust the system to work within its working range.	
	Pump is standing on an uneven surface.	Level the surface.	

Problem	Possible cause	Possible solution	Checkpoints
Malfunction.	Internal blockage in the pump.	Have the pump inspected by a certified company.	
Pump does not start.	No voltage on the power terminal.	Check the power supply.	• Circuit • Main switch • Fuses
		Check the motor safety relay	• Earth leakage switch • Protective relay
	Thermal motor safety switch triggered.	Reset the thermal motor safety. Contact the supplier if this problem occurs more often.	Check if the correct value is set. Find the correct value (I_{nom}) on the motor nameplate.
The motor is running, but the pump does not work.	The coupling between pump and motor shaft is loose (when applicable).	Tighten the connecting screws to the required torque.	
	The pump shaft is broken.	Contact the supplier.	
Pump supplies insufficient capacity and/or pressure.	Outlet and/or inlet shut-off valve is closed.	Open both shut-off valves.	
	There is air in the pump.	Vent the pump.	
	The suction pressure is insufficient.	Increase the suction pressure.	
	Pump rotates in the wrong direction.	Change over L1 and L2 of the three phase supply.	
	The suction line has not been vented.	Vent the suction line.	
	Air bubble in the suction line.	Install the suction line with pump end higher than the other end.	
	Pump sucks air because of leakage in the suction line.	Repair the leakage.	
	Water flow too low. So air bubbles clog up in the pump.	Make sure the flow increases or use a smaller pump.	
	The diameter of the suction line is too small.	Increase the diameter of the suction line.	
	Capacity of water meter in the supply line is too small.	Increase the capacity of the water meter.	
	Foot valve blocked.	Clean the foot valve.	
	The impeller, the diffuser or stage is blocked.	Clean the inside of the pump.	
	O-ring between impeller and diffuser is gone.	Replace the o-rings.	
	O-ring not resistant to the medium to be pumped.	Replace o-ring by one with better resistance.	



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