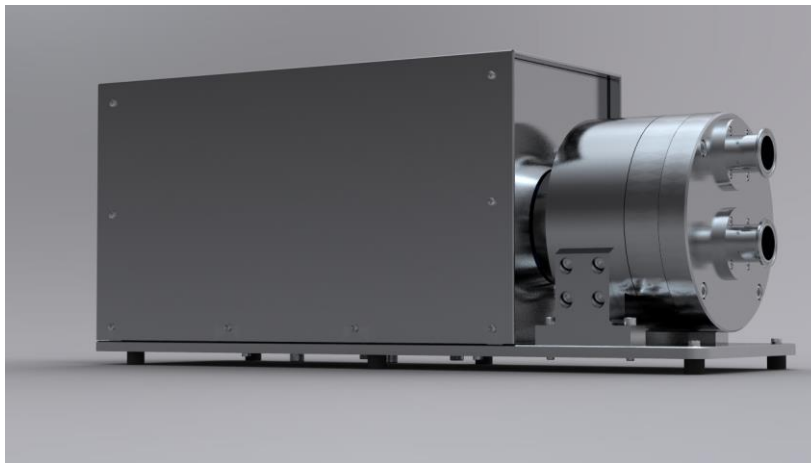


Operating and Installation Instructions

Quattroflow 4400S Quaternary Pump Stainless Steel 4-Piston-Diaphragm Pump (Multiple-Use)



Models without or with control box, motor and housing are possible.

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Quattroflow is a brand of ALMATEC Maschinenbau GmbH.
ALMATEC is constantly working on improvements of the pump. Modifications of the design or materials might be done without prior notice.

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1. General

1.1. Introduction

These operating instructions are valid for the Quattroflow 4400S pump.

No liability will be undertaken for any damages caused by non-compliance with the operating instructions and service conditions! Original spare parts serve safety purposes. The use of other parts may cancel the liability for the consequences and secondary failures resulting thereof.

Manufacturer: ALMATEC Maschinenbau GmbH
Carl-Friedrich-Gauss-Str. 5
47475 Kamp-Lintfort, Germany
Phone: +49 2842 961-0
Fax: +49 2842 961-40
e-mail: quattroflow@almatec.de
Internet: www.quattroflow.com

Quattroflow quaternary diaphragm pumps are constructed according to the state of the art and they are reliable. Imminent danger by operating error or misuse can lead to damages of properties and/or persons. The pumps are to be applied for the intended use and in a safety-related proper condition only.

1.2. Storage

In general the Quattroflow pump is delivered operational and packaged. If the unit is not installed right away, proper storage conditions are important for a trouble free operation later. The pump has to be protected from wetness, coldness, dirtying, UV-radiation and mechanical influences. The following storage conditions are recommended:

- Steady ventilated, dust and vibration free storage room
- Ambient temperature between 15°C (59°F) and 25°C (77°F) with a relative humidity below 65%
- Prevention of direct thermal influences (sun, heating)

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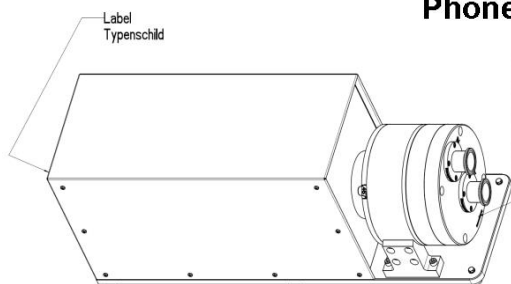
1.3. Labelling

The ALMATEC M to DIN EN ISO 9001 undergo an external audit and can be certified. As a general rule which are determined

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enterprise according to the Quattroflow pump has to be archived in our

before putting into operation, the harmonized standards and the instructions of the operator of the Quattroflow pump



manufactured and delivered properly according to the customers order meets the mentioned requirements.

Therefore make sure, before putting the pump into operation, that the pump and the used materials of construction are suitable for the provided application and the installation site.

The type label of each Quattroflow pump can be seen on the bottom of the base plate. Besides the serial number of the pump head is fixed at the front cover.

2. Description of the QF 4400S pump

2.1. Appropriate use

The Quattroflow 4400S is a 4-piston Diaphragm pump, which is mainly used to pump water-like fluids that are typically handled in research-, pilot plant- or production facilities of the pharmaceutical, biotech, food or cosmetic research centers or plants.

Examples:

- Solutions containing proteins (albumin, IgG, Clotting factors, monoclonal antibodies, enzymes, vaccines.)
- Solutions of polymers or suspensions (silicon, latex, chromatography media)
- Cell suspensions (bacteria, yeast, algae, fungi, mammalian cells)
- Colloidal solutions
- Suspensions of viruses or phage
- Dairy products
- Gelatine
- Supplements and ingredients for cosmetic and food

Typical applications for the QF 4400S

- Filtration technology:
 - To recirculate feed/retentate (e.g. membrane cassettes, hollow fibre, spiral wound, ceramic elements)
 - Feed pump for filter cartridges or plate and frame depth filters
- Chromatography:
 - Packing of chromatography columns
 - Feed pump to mix gradients
- Feed pump for centrifuges or separators
- Feed pump for homogenizers
- Feed pump for fi *Provided by:*

2.2. General d

The Quattroflow diaphragm oscillators are arranged on a base plate that is turned 90°.



The stroke of the pump is 10 mm.

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nts of the pump
ector plate that is
or plate does not

etric shafts with 6°

Range of flow rate: 150-5000 L/h (40-1321 gph).

Please note:

The direction of flow can be adjusted by turning the pump chamber in 90° steps.

The Quattroflow 4400S is self-priming and can run dry. Inside the pump chamber there are no rotating parts that might cause heating up of the product or shed particles.

The pump-motor unit is mounted on a stainless steel base plate. In case that the pump will not be mounted on the base plate but in a frame or any other base measures have to be taken that there will be a proper alignment of the motor and the pump.

2.3. Start-up

Before start-up of the pump anyone should acquaint oneself with the explanations of the chapter troubleshooting (see page 15). Only by this the defect quickly can be realized and eliminated in case of trouble. Problems which cannot be solved or with an unknown reason should be passed on to the manufacturer.

Prior to each use we recommend to flush the pump with a proper fluid (e.g. water or buffer).

Prior to the very first use it might make sense to clean and sanitize the pump chamber. A commercial caustic cleaner and/or 0.1N to 0.5N NaOH can be applied. The chosen cleaning agent can be recirculated and also stored inside the pump chamber. For flushing out of any cleaning agent do not recirculate! Check with appropriate analytical methods the success of the flushing procedure..



Recommendation: Test run prior first use!

Before using your pump in your process perform a test run to get used to the specific properties of the pump.

Please note: ALMATEC Maschinenbau GmbH is also building custom-made pumps and set-ups. These modified pumps can be different from this one that is described in here. However the basic information is applicable to all of the Quattroflow 4400S Series pumps. Please do not hesitate to contact us for further information.



Pay attention to a sufficiently dimensioned piping. A too small piping of the suction line can cause cavitation as well as a loss of performance. If hoses were used in the suction line, make sure that they do not collapse due to the negative pressure.

When installing the pump please consider that around the pump enough space is available for operation and maintenance. Pay attention to the required space needed for assembly and disassembly of the pump chamber (see 4.1.1.).

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2.4. Cleaning

Depending on the needs to be adapted
Safety rules and followed and used

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As a general rule

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lure.

1. Pre rinse
2. Cleaning step with 0.5 M NaOH (ca. 50°C) at 80% of the maximum RPM for approximately 30 min. Check before, if surrounding conditions (e.g. pipe diameter, system pressure rating) allow to operate the pump at this speed.
3. Final rinse with pure water, until neutrality has been achieved (e.g. by measuring conductivity or pH of the rinse water).

re been removed.

2.5. Autoclave

For autoclaving of the pump chamber we recommend the following steps.

1. CIP of the pump chamber according to 2.4 or any other suitable process
2. Empty the pump
3. Remove the pump chamber from the pump drive (see 4.1.1)
4. Close in and outlet of the pump e.g. by connecting hoses. Ensure that a free interchange of gas and steam over a sterile barrier (e.g. sterile filter) at in- and outlet is available.
5. Autoclaving of the prepared pump chamber in a vacuum autoclave at max. 130°C (266°F) for max. 30 min. Follow instructions of the autoclave manufacturer.

2.6. Steaming in place (SIP)

For steaming in place the pump chambers needs to be installed on the pump drive. During the steaming process, the temperature in the pump must not exceed 130°C (266°F) and should not last longer than 30 min. The cooling of the pump chamber should be against air. Depending on the SIP conditions it may be necessary to shorten the maintenance intervals for the elastomers significantly. Tightening torques (28 Nm, 20.7 lb-ft) of external bolts of the pump chamber have to be verified after each SIP cycle.

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3. Safety



- **3.1. Labels at the pump**

Marking labels at the pump e.g.

- pmax 6 bar
 - Fluid connections
 - Direction of flow
- must not be removed and has to be readable.

- **3.2. Qualification of the personell**

The customer is responsible for ensuring that all maintenance, inspection and mounting operations are performed by authorized and qualified expert personnel who have sufficiently informed themselves by thoroughly studying the operating instructions.

- **3.3. Responsible working**

Please follow strictly the safety guidelines of this manual, as well as all national and possible internal regulations (e.g. the handling of chemicals, like caustic or acid, the handling of biological materials, the handling of tubing, piping, instrumentation, fittings etc.

- **3.4. Dangers in case of noncompliance with the safety instructions**

In case of non-compliance with the safety instructions may cause danger to personnel, equipment and environment.

It can cause for example:

- Failure of the proper function of the pump/system

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• **3.6. Safety instructions for maintenance, inspection and mounting operations**



- Basically, operations at the pump must be performed during standstill only. The motor has to disconnect from the power supply, e.g. by pulling out the power plug or using a repair switch, and has to secure against unintentional switch-on. This can be realized by a lockable emergency switch. To prevent an accidental re-starting a danger sign should be installed.
- The operator must ensure that all maintenance, inspection and installation work is performed by authorized and qualified skilled personnel acquainted themselves with this manual.
- Before starting to disassemble the pump, take care that the pump has been emptied, rinsed, depressurized and disconnected at all phases of the power supply. Both ports piping are to be closed and drained if applicable. If the pump is being deported from the plant, a reference about the delivered liquid has to be attached.
- Pumps or aggregates handling noxious fluids (e.g. caustic, bio hazardous) must be decontaminated. Immediately following completion of the work, all safety-relevant and protective devices must be re-installed and/or re-activated. Before putting the pump back into operation, take care of the mentioned instructions of the chapter "start-up" and check the tightness of the pump.
- Please respect the relevant additional security advices, if the pump has been used for aggressive, dangerous or toxic liquids (e.g. suitable protective equipment according to the safety data sheet of the liquid). In case of a diaphragm rupture, it is possible that residues of the liquid remain behind the diaphragms and in the area of the ring drive. Hence, appropriate safety equipment according to the safety data sheet of the liquid is indispensable.
- Especially when deliver critical liquids, wear parts, like diaphragms, should be replaced within a preventive maintenance.
- Procedure for pump return: According to the requirements of our 14001-certification, every unit which is send to ALMATEC for diagnosis or maintenance reasons has to be accompanied by a filled out decontamination-sheet. Otherwise a processing is not possible. The decontamination-sheet is enclosed to this manual. Please pay attention to the further safety regulations.

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3.9. Further warning and safety instructions

These warning hints are to prevent the user from an inadmissible mode of operation. These warning hints are to be strictly followed to avoid any damage of the pump and/or any danger to personnel



The maximum allowed discharge pressure depends on the temperature of the fluid: **p_{max} at room temperature = 6 bar (>40°C = 4 bar)**. An exceeding of the maximum allowed discharge pressure must avoid in any case (do not remove the warning sign at the pump). As a result – if only temporarily – of an exceeding of the allowed discharge pressure the diaphragm can be damaged. The resulting leakage may lead to a loss of the pumping fluid and damages of properties and/or persons. Pay attention to a sufficiently dimensioned piping on the suction and discharge line to prevent a too high pressure in the pump. The pump chamber may not be set under pressure when it is not mounted on the drive.

- The free cross section of the suction side as well as the length must be measured in such a way to avoid cavitation.
- The use of a safety device (e.g. pressure switch) can be necessary..
- Please make sure that prior to the start of the pump the discharge line is checked. Make sure that there is no flow restriction in the discharge line to avoid any over pressure (e.g. closed valve).
- Flush the pump prior to use with appropriate fluid (e.g. buffer).
- Foundation design: The foundation must be designed so that it can take the weight of the pump aggregate on the entire surface. .
- Please make sure that the pump is operated with the proper mains voltage and frequency to avoid damages and electrical danger.
- Make sure that the slots for the cooling air are not blocked.
- Due to the versatile possibilities to use the Quattroflow pump it is highly recommended to check case by case if the pump will be the right tool for the specific application. The user/operator is responsible to perform a proper method of testing if the pump should be applied for his specific application. The chemical and thermal compatibility of the elastomeric parts of the pump with the fluid that will be pumped are to be checked by the operator before the first process run. E.g. Oily, fatty fluids or solvents might cause a swelling and/or destruction of the elastomeric components. If provided by:
- C o the motor and
- T at sources.
- D escape from the
- P e the optional
- P to be inspected
- C p (mixture of
- d d.
- T (e.g. hood, base plate) with the outer stainless steel surfaces of the pump (e.g. hood, base plate) has to be prevented.
- The Quattroflow pump is a positive displacement pump and can theoretically generate an infinitely high pressure even at low speed (rpm). Prior to each start of the pump check and make sure that the discharge line is not closed or restricted. The design of the discharge line must not build up a pressure of > 6 bar (87 psi).
- If suction and/or discharge line are flexible tubing, then make sure that these tubing do have the proper pressure rating for the full range of temperatures that are applied.
- Please follow the general safety guidelines when handling chemical fluids (wear gloves and/or glasses) before the pump chamber will be opened.
- Never operate the pump without coupling protection and motor housing.

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- Quattroflow pumps can lead to bruises when lifting, sinking or assembling them. Appropriate accessories and safety equipments are to be used. Big and heavy modules have to be fixed and secured to lifting gears when transporting/replacing them.
- Disconnect mains before doing any maintenance! The housing of the control box or the motor is to be opened only by skilled personnel. Check the electrical cables before connecting to mains supply.
- During all maintenance work it has to be ensured that no explosive atmosphere can arise. Appropriate protection equipment is recommended. The Quattroflow 4400S **must not be operated in explosion-proof areas**. Special versions for “ATEX” applications are available. Please contact the manufacturer.

Attention! Inadmissible modes of operation, arbitrary reconstruction, spare parts production and/or any changes of the design (without admission of the manufacturer) may cancel the liability for the consequences resulting there from.

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4. Maintenance/Service of the QF 4400S

Due to the robust construction the Quattroflow pump are widely maintenance-free. The ball bearings do not need any extra lubrication.

The diaphragms, valves and o-rings should be checked in regular intervals and if needed they has to be replaced (Service kit diaphragm PSKITDQ04, valves and o-ringd PSKITVQ04). We recommend the following maintenance intervals for the different pump parts:

Component	Maintenance interval	Action
Elastomer parts (diaphragm, valves, o-rings)	1000 h operating hours, at least once a year	Replacement of the elastomer parts (order no. PSKITDQ04 and PSKITVQ04)
Shaft-bearing-cap unit	1000 h operating hours, at least once a year	Replacement of the complete unit (kit order no. PSKITWLC44)
Motor	Pay attention to the maintenance information of the manual of the motor	
Coupling	Pay attention to the maintenance information of the manual of the coupling	
Gear	Pay attention to the maintenance information of the manual of the gear	

Depending on the operation conditions (pressure, temperature, flow rate, SIP, etc.) it may be necessary to shorten the maintenance intervals for the elastomers significantly.

In case that the diaphragm broke it needs to be replaced. Then it is also recommended to check the ball bearings. For corrosion reasons or a clearly audible operating noise the parts of the bearing service kit should be also replaced. (PSKITWLC44). In general it is recommended to replace the elastomer parts whenever the pump chamber is opened.



Please follow the general guidelines and safety advices when handling with chemicals.

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residual

se fluid.

The dismounting and mounting of the pump should be done on a rigid table or work bench. Please note: the pump is heavy.

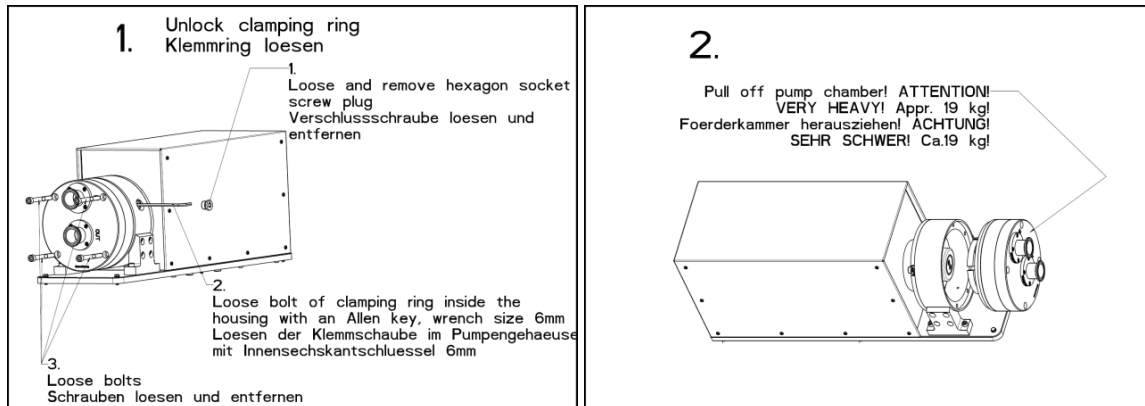
All further warning and safety instruction of chapter 3 has to be respected.

4.1. Replacement of diaphragm, valves and o-rings

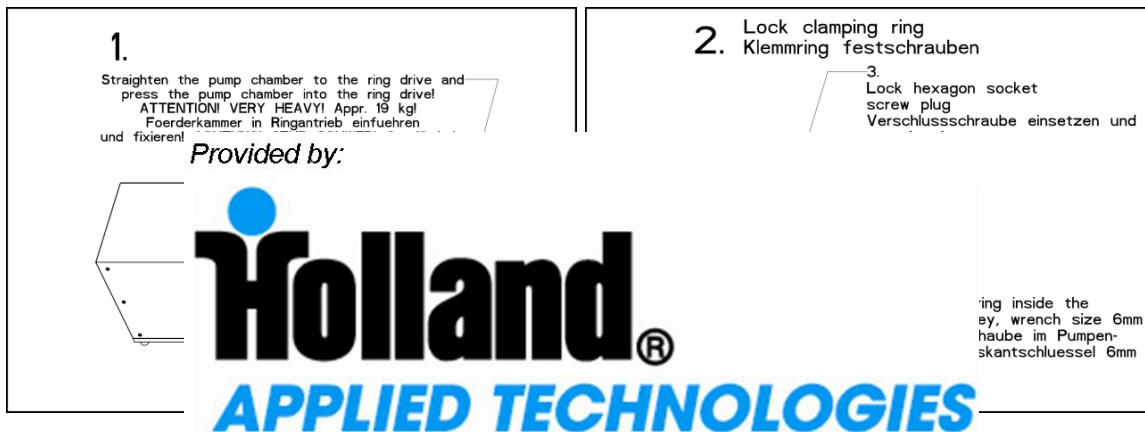
The replacement of the diaphragm and the valves can be conducted by the operator. The following drawings describe it step-by-step (maintenance kit diaphragm PSKITDQ04 and maintenance kit valves/o-rings PSKITVQ04).

In case of bursting diaphragms by overpressure we advice also to change the bearing unit (PSKITWLC44, see chapter 4.2.).

4.1.1. Disassembly of the pump chamber



4.1.2. Assembly of the pump chamber

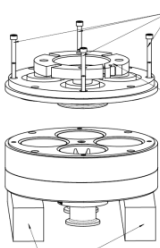

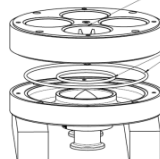
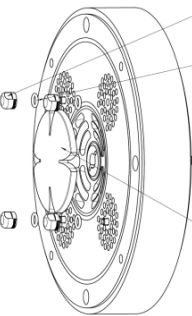
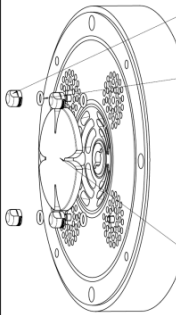



Pay attention to the
Image 2 item 1: B
Image 2 item 2: B

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4.1.3. Exchange of the elastomer

Please see first chapter 4.1.1. to disassembly the pump chamber. Now follow the description below:

<p>1. Remove clamping ring Klemmring entfernen</p>  <p>1. Loose and remove bolts Schrauben loesen und entfernen</p> <p>2. Lift clamping ring incl. supports, pressure plate and diaphragms Klemmring incl. Supports, Membrangehaeuse-deckel und Membranen anheben</p> <p>For safety replacement, please use pads/logs, that are 5mm longer than connectors Zum sicheren Austausch bitte die Foerderkammer auf Kloetze legen (diese sollten mindestens 5mm hoeher als Anschlusse sein)</p>	<p>2. Mounting of diaphragms Montage der Membranen</p>  <p>Loose old diaphragms and lock new diaphragms on supports Alte Membranen loesen und neue Membranen auf Supports schrauben</p>
<p>3. Remove old o-rings Alte Dichtungen entnehmen</p>  <p>1. Lift valve plate Ventilplatte anheben</p> <p>2. Remove old o-ring-seals Alte O-Ringe entfernen</p>	<p>4. Changing valves in the valve plate Ventile wechseln</p>  <p>1. Loose all nuts Loesen Sie die Muttern</p> <p>2. Remove all O-rings Entfernen Sie die O-Ringe</p> <p>3. Pull out the valve Ventil herausziehen</p> <p>4. Unlock the bolt Schraube loesen</p> <p>5. Remove the outlet valve Entfernen Sie das Auslass-Ventil</p>
<p>5. Insert new valves Einbau neuer Ventile</p>  <p>5. Lock all nuts Ziehen Sie die Muttern fest</p> <p>Provided by:</p> <p>Holland® APPLIED TECHNOLOGIES</p>	<p>6. Closing the pump chamber Verschliessen der Foerderkammer</p>  <p>4. ... or with ... erdkammer mit ... e Schrauben an.</p> <p>... il. supports, ... ragsms</p> <p>Membrangehaeuse- auf Ventilplatte legen</p> <p>... r plate ... gehaeuse legen</p> <p>nut basket einlegen</p>

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the diaphragm

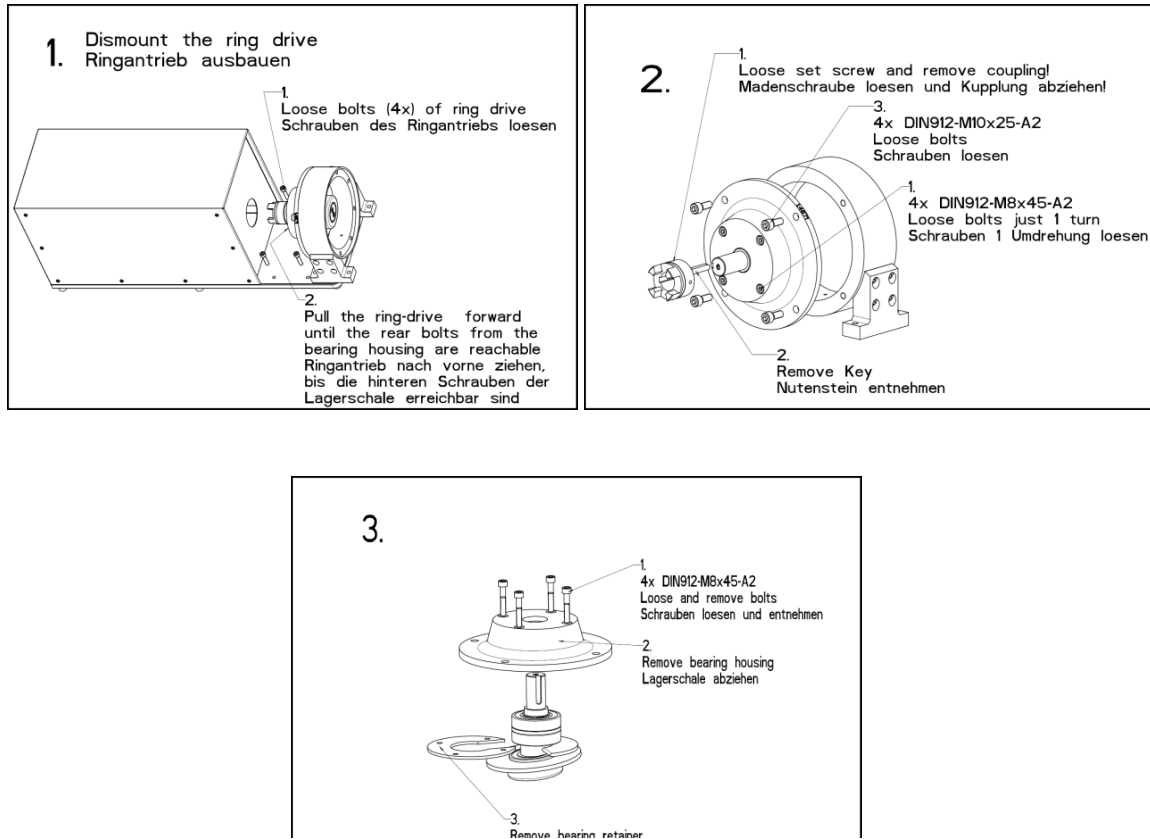
4 bolts 6 Nm (4.4 lb-ft)

For mounting the pump chamber to the ring drive see chapter 4.1.2.

4.2. Replacement bearing unit

Maintenance kit PSKITWLC44

The replacement of the bearing unit can be conducted by the operator. The following drawings describe it step-by-step.



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bearing unit.

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has to be a gap (

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≥ 5 mm



5. For mounting the pump chamber to the ring drive see chapter 4.1.2.

For further questions and ordering of spare parts please contact the manufacturer.

5. Operating troubles, causes and remedial action (Troubleshooting)

No.	Operating troubles								Causes and remedial action
	Pump does not start	Pump does not prime	Delivery is not obtained or reduced	Pressure head is not obtained	Irregular pump delivery	Pump operates noisily	Pump is leaky	Motor gets too warm	
1		X					X		The screws of the pump-chamber maybe not tightened enough. Fix it!
2		X							Check the direction of flow showed by the arrow on the pump, in case of wrong way, turn the pump head.
3		X	X		X				Check suction pipeline and TC- seals for tightness.
4		X	X	X	X				Check suction head-increase suction line cross section.
5		X	X		X				Check viscosity of liquid pumped.
6	X								Check pump speed. Control speed of drive motor. Check voltage and frequency.
7			X	X	X				Avoid air inclusions in the liquid to be pumped.
8			X		X				Check pressure head-open valve in discharge line completely, remove obstruction in discharge line.
9							X		Pressure line completely or partly clogged, diaphragm maybe broken, change diaphragm!
10			X						The diameter of the pipes in suction or pressure line are too small.
11						X			Check the coupling halves. They must be fixed with 5mm space.
12						X			Check longitudinal play of coupling rod pins. The spider might be worn.
13		X	X		X				Check whether foreign bodies in pump. Disassemble pump, remove foreign bodies, reassemble.
14	X								Check thermal circuit breaker. Motor too hot – please cool down – please reassemble.
15	X								Check defective Disassemble pump – bearing – cap unit.
16		X							e.g. not in use for a long time. Change valve or wet pump.
17									Check first (the discharge pressure) and reassemble it.
18		X							Check valve plate and pump housing.
19									Check and reassemble.
20			X			X			The clamping ring screw got loose –fixe it!
21							X		Pump after SIP cooled down too fast – slow cooling with room temperature

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6. Performance charts of the QF 4400S

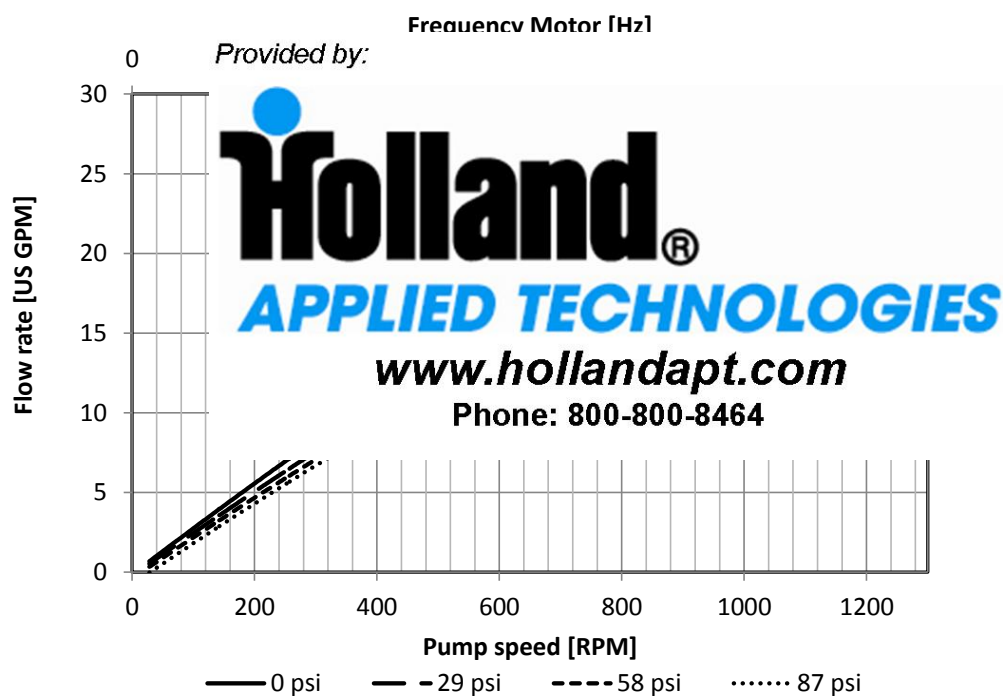
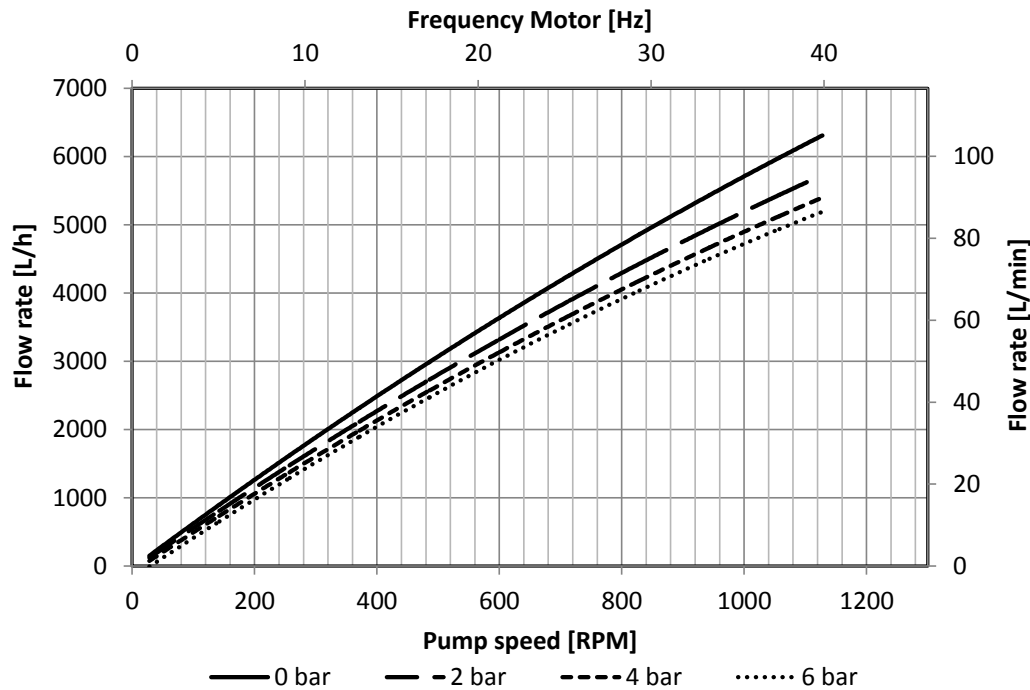
Testmedia: Water at ambient temperature
Type of eccentric shaft: 6°
Discharge pressure: 0 to 6 bar (0 to 87 psi)

Shows approximate flow rates as function of pump rpm.

Please note:

If motor is directly coupled to pump: Pump rpm = motor rpm

If reducer gear drives are used: Pump rpm = motor rpm x reduction ratio



The flow rates showing at the charts above were ascertained with new diaphragms and new valves under standard conditions after the final assembly of the pump.

7. Technical data of the QF 4400S

Description	Unit	QF4400S Standard Motor	QF4400S Gear
Flow rate max.:			
Eccentric shaft 6°	l/h (gph)	5000 (1321)	2000 (528)
Flow rate min.:			
Eccentric shaft 6°	l/h (gph)	150 (40)	60 (16)
Pressure:			
Temperature of fluid < 40°C	bar (psi)	6 (87)	6 (87)
Temperature of fluid > 40°C	bar (psi)	4 (58)	4 (58)
Temperature max.:			
Fluid	°C (°F)	80 (176)	80 (176)
CIP	°C (°F)	90 (194)	90 (194)
SIP (only with stainless steel valve plate)	°C (°F)	130 (260)	130 (260)
Autoclave (only with stainless steel valve plate)	°C (°F)	130 (260)	130 (260)
Suction lift dry at:		1200rpm	1200rpm
Eccentric shaft 6°	m (ft)	4-4,5 (13.1-14.7)	4-4,5 (13.1-14.7)
Volume specifications:			
Approximated volume per revolution at free output	ml	95	95
Filling volume without connectors	ml	820	820
Residual volume (after idle with high-speed motor)	ml	ca. 80	ca. 80
Product wetted surface (approx.)	cm² (inch²)	1669 (259)	1669 (259)
Speed range pump	rpm	20-1200	7-400
Connection specification inlet (standard)			
Connector	"	1,5" TC	1,5" TC
Flange diameter	mm (inch)	50,5	50,5
Internal diameter	mm (inch)	34	34
Connection specification outlet (standard)			
Connector	"	1,5" TC	1,5" TC
Flange diameter	mm	50,5	50,5
Internal diameter	mm (inch)	34 (1.34)	34 (1.34)
Position of connectors		Front	Front
Diameter drive shaft	mm	28	28
Product wetted material: <i>Provided by:</i>			
			SS316L
			SS316L
			TPE
			EPDM
			EPDM
Non-product wetted			
			SS316L
			SS316L
			SS316
			SS316
Dimensions pump v			
			985 (38.78)
			256 (10.08)
	Height	mm (inch)	330 (12.99)
Weight pump with motor and housing	kg (lb)	96 (212)	variable
Custom tariff number		84138100	84138100
Certificates/proofs (optional):			
Elastomere (product wetted)		USP <88> Cl. VI; FDA21CFR177; BSE/TSE Safe	USP <88> Cl. VI; FDA21CFR177; BSE/TSE Safe
Stainless steel parts (product wetted)		3.1; Surface Roughness; Ferrite Content	3.1; Surface Roughness; Ferrite Content

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Description	Unit	QF4400S Standard Motor	QF4400S Gear
Motor/Gear:			
Manufacturer (standard)		VEM	SEW
Type		K20 F90 L4	R27DRE100M
Rated speed	min-1	1410 (50 Hz)	1425/423 (50 Hz)
Voltage	V	230/400	230/400
Ampacity	A	8,6/4,95	8,6/4,95
Power	KW	2,2	2,2
Shaft diameter	mm	24	25
IP protection class	IP	55	55
Color	RAL	7031	9001
Forced ventilation built-on the motor		yes	yes
Coupling		KTR (Rotex)	KTR (Rotex)
Gear ratio		n/a	3:1
Control box (optional):			
Type		Frequency Converter	Frequency Converter
Manufacturer (standard)		Lenze/ AC-tech	Lenze/ AC-tech
Designation		SMVector; 2.2kW	SMVector; 2.2 kW
Analog input (optional)		4-20 mA oder 0-10 V	4-20 mA oder 0- 10 V
Protection class		IP54	IP54
Power supply		400V, 3P	400V, 3P
Housing material		SS316	SS316
Dimensions (length x width x height)	mm (inch)	210 x 380 x 390 (8.27 x 14.96 x 15.35)	210 x 380 x 390 (8.27 x 14.96 x 15.35)
Weight approx.	kg (lb)	20 (44.09)	20 (44.09)

All technical data relate to a Quattroflow pump in the standard version. Special designed pumps (e.g. special product connections) may have different data that can be found in the advanced documentation for each Quattroflow pump.

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Subject to change without notice, 2014-10



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