

# User Manual

## Quattroflow-20k Series 4-Piston Diaphragm Pump



**Pictures of Quattroflow 20k Pump (other designs are optional available)**

### **Safety**

These operating instructions contain precautions to be observed during installation, operation and maintenance. Therefore, prior to mounting and commissioning, these operating instructions must be read by the user and must always be available at the place of installation.

### **Performance Data**

The exact performance data applying to the pump are to be taken from the order data sheet.

These Operating and Maintenance instructions contain information from the pump manufacturer. They may need to be supplemented by instructions of the operator company for its personnel.

Quattroflow Fluid Systems GmbH & Co. KG is constantly working on improvements of the pump. Modifications of the design or materials might be done without prior notice.

## **1. General**

- 1.1 Appropriate Specification
- 1.2 Labelling of the Pump

## **2. Safety**

- 2.1 Marking of precautions in the operating instructions
- 2.2 Personnel qualification and personnel training
- 2.3 Responsible working
- 2.4 Dangers in case of non-compliance with the safety precautions
- 2.5 Safety precautions for the user and/or operator
- 2.6 Safety precautions for maintenance, inspection and mounting operations
- 2.7 Arbitrary reconstruction and spare part production
- 2.9 **Attention! Warning precautions!**
- 2.10 **Attention! Safety precautions!**

## **3. Description of the Quattroflow 20k Pump**

- 3.1 Application and range of utilization of the Quattroflow 20k pump
- 3.2 Typical application of the Quattroflow 20k pump
- 3.3 Description of the function of the Quattroflow 20k pump
- 3.4 Start-up

## **4. Maintenance and servicing of the Quattroflow 20k pump**

- 4.1 Dismounting of the pump chamber and changing of the diaphragms and valves
- 4.2 Mounting of the pump chamber
- 4.3 Dismounting of the shaft bearing cap unit

## **5. Operating troubles, causes and remedial actions**

- 5.1 Pump does not start
- 5.2 Pump does not prime
- 5.3 Delivery is not obtained
- 5.4 Pressure head is not obtained
- 5.5 Irregular pump delivery
- 5.6 Pump operates noisily
- 5.7 Pump is leaky
- 5.8 Motor gets to warm

## **6. Performance chart of the Quattroflow 20k pump**

- 6.1 Diagram 1 Discharge as function of pump rpm

## **7. Technical data of the Quattroflow 20k pump**

## 1. General:

### 1.1 Appropriate specification

This User Manual is valid for the Quattroflow Q20k 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 resulting there from.**

**Manufacturer:** Quattroflow Fluid Systems GmbH & Co KG  
Kampfeldstrasse 13

D-37181 Hardegsen-Hevensen

Germany

Tel: +49 (0) 5503-915 913 0

Fax: +49 (0) 5503-915 913 3

e-mail: [quattroflow@t-online.de](mailto:quattroflow@t-online.de)

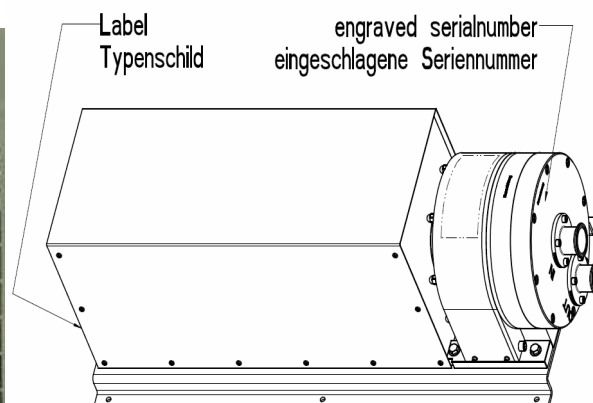
Internet: [www.quattroflow.com](http://www.quattroflow.com)

"Quattroflow" and "Quattroflow Fluid Systems" are registered trade marks of the Quattroflow Fluid Systems GmbH & Co KG.

**Date of issue: February 2009**

### 1.2 Labelling of the pump

The type label of each Quattroflow pump can be seen on the backside of the shroud. See blanket example below. The pump serial number is stamped on the front cover.



## **2. Safety**

The operating instructions are recommended to be followed during installation, operation and maintenance. Prior to mounting and commissioning, the operating instructions must be followed by authorized personnel. The manual should be kept with the pump for future reference. The general safety warnings in Section 2 "Safety" are to be observed, in addition to the safety procedures for the user's site.

### **2.1 Warning Symbols**

If the safety warnings contained in the operating instructions are not followed, this may result in danger to personnel or surroundings. The following symbols indicate the necessary precaution for the particular hazard.

#### **Danger Warning:**



Safety sign according to DIN 4844 - W 9

#### **Electrical Shock Warning:**



Safety sign according to DIN 4844 – W8

Safety procedures that are not followed may cause danger to the pump itself or to parts of the system are marked with the word or indication:

- **ATTENTION**
- **P<sub>max</sub> 6 bar**
- **Direction of flow**

Removing or damaging warning labels and signs is prohibited.

### **2.2 Precautions for maintenance, inspection, mounting and operation**

The customer shall see to it that all maintenance, inspection and mounting operations are performed by authorized and qualified personnel. Pump maintenance should be performed only when the pump is stopped and power is disconnected. Pumps handling hazardous materials must be decontaminated.

### **2.3 Operator's Responsibility**

Please follow the safety procedures provided by operator's site or facility. For example, material handling, hazardous materials, biological materials, handling of tubing, piping, instrumentation, and fittings.

### **2.4 Non-compliance of safety warnings**

Failure to follow safety precautions may cause danger to personnel, equipment and environment. Such as:

- Failure of the proper function of the pump/system.
- Danger to personnel by electrical, mechanical, chemical, biological impacts.
- Danger to equipment and environment

## **2.5 Safety precautions for the operation**

Protective measures should be observed while processing hot fluids (i.e. CIP or SIP).

Removing protecting covers of moving parts is prohibited.

Hazardous material spills must be handled in accordance to local codes and procedures

## **2.6 Safety precautions for maintenance, inspection and mounting operations**

The customer should verify that all maintenance, inspection and mounting operations are performed by authorized and qualified personnel.



**Maintenance and service of the pump must be performed while the pump is stopped.**

Pumps or aggregates handling hazardous fluids must be decontaminated.

## **2.7 Arbitrary reconstruction and spare part construction**

Reconstruction of or changes to the machine are only admissible after consultation with the manufacturer. Original spare parts and accessories authorized by the manufacturer serve safety purposes. The use of other parts may cancel the liability for the consequences resulting here from.

## **2.8 Inadmissible modes of operation**

The operating safety of the machine supplied is only ensured with due application according to the operating instructions. Do not exceed the limit values given in the data sheet.

## **2.9 Attention! Warning precautions!**



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

Diaphragm pumps are positive displacement pumps and can theoretically generate an infinitely high pressure. With the discharge line closed, for example by clogging or by incidental closing of a valve, the pressure generated by the pump may reach a multiple of the admissible pressure of the plant. This may lead to bursting of the diaphragm or lines which must be absolutely avoided especially when handling dangerous products.

- ⚠ Diameter of the suction line need to be sufficient to avoid cavitation.
- ⚠ The use of a safety device (i.e. 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 (i.e. closed valve).
- ⚠ Check all seals (i.e. TC clamps) before starting the pump.
- ⚠ The maximum discharge pressure depends on the temperature of the fluid.

$$\begin{aligned} P_{\max} \text{ at room temperature} &= 6 \text{ bar} \\ P_{\max} \text{ at } 90^{\circ}\text{C} &= 3 \text{ bar} \end{aligned}$$



Please allow the pump to cool down after heat treatment (i.e. CIP / SIP).

Flush the pump prior to use with appropriate fluid (i.e. 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 Q20k pump it is highly recommended to check case by case if the Quattroflow Q20k 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.

For example, oily, fatty fluids or solvents might cause a swelling and/or destruction of the elastomers.

If in doubt, please contact the manufacturer!

- ⚠ Operating the pump in humid or aggressive air can cause damages to the motor and control box.
- ⚠ The control box should not be exposed to spray/splash water or to heat sources.
- ⚠

If the Quattroflow Q20k pump is to be used under rough conditions (i.e. high-pressure cleaners, exposed to sea water), the manufacturer can supply special equipment, like motors and controls.

## **2.10 Attention! Safety Precautions!**

**The following safety precautions notify you of the potential of bodily harm or life danger of the user/operators!**

- ⚠ Please read and follow the safety precautions and warnings to avoid any risk of bodily harm, life danger and/or the damage of equipment.
- ⚠ Please keep this User Manual available. Make sure that the operators of the pump have read and understood the User Manual. A training session might be appropriate.
- ⚠ We recommend installing specific warning labels at the system.



Disconnect mains before doing any maintenance!  
The housing of the control box is to be opened only by skilled personnel.  
Check the electrical cables before connecting to mains supply.

- ⚠ The Quattroflow Q20k 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.
- ⚠ If suction and/or discharge line are flexible tubing, then make sure that these tubing does have the proper pressure rating for the full range of temperatures that are applied.



**P<sub>max</sub> = 6 bar, Do not exceed! Warning Label: p max: 6 bar! Do not remove!**

If the maximum pressure is exceeded it can happen that the diaphragm of the pump will burst. In this case the fluid will come out of the pump and can cause a danger for the personnel and/or environment (i.e. caustic cleaner).

The Quattroflow 20k pump can pump air which means that most of the fluid inside the pump chamber will be pump out. However there will be a residual amount of fluid (approximately 100-500 ml) inside the pump chamber that should be flushed out of the pump before the pump will be opened.

- ⚠ 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 and motor housing.
- ⚠ The foundation must be designed so that it can take the weight of the pump on the entire surface.



The Quattroflow 20k must not be operated in ATEX zones.

Please contact the manufacturer in case the Quattroflow 20k pump needs to be modified for ATEX applications.

## **Quattroflow Fluid Systems GmbH & Co. KG**

**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.

### **3. Description of the Quattroflow 20k pump**

#### **3.1 Application and range of utilization of the Quattroflow 20k pump**

The Quattroflow 20k 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 centres or plants.

#### **Typical examples of these fluids:**

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

### **3.2 Typical process steps in which the Quattroflow 20k pump is used**

#### **Filtration technology**

- To recirculate feed/retentate (i.e. 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 filling machines

### **3.3 Discription of the working princaple Quattroflow 20k**

The Quattroflow 20k pump is a 4-piston diaphragm pump. The 4 segments of the pump diaphragm oscillate back and forth. This alternate movement is created by a nutation disc that is arranged on a ball bearing. The ball bearing sits on an eccentric shaft. The nutation disc does not turn!

The stroke of the pistons is determined by the angle of the 7° eccentric shaft. Range of flow rate: app r. 750 - 20.000 L/hr

The drive = motor + control needs to be choosen according to application.

#### ***Please note:***

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

The Quattroflow 20k 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.

### **3.4 Start-Up**

Prior to leaving our factory all pumps are subjected to a leakage and performance test. Only properly operating pumps leave the factory achieving the performances assured by us. It is possible that there will be a few milliliters of water inside the pump.

Prior to each use we recommend flushing the pump with a proper fluid (i.e. 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 0.5 to 1 mol of NaOH can be used. 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.



Contact:  
Quattroflow@t-online.de  
Internet:  
www.quattroflow.com

**Quattroflow Fluid Systems  
GmbH Co KG**

Tel.: +49(0)5503 - 915 913 0  
FAX: +49(0)5503 - 915 913 3



Manual Version May, 2009



**Recommendation: Test run prior first use!**

Before using your pump in your process (for example as recirculation pump in a TFF system) perform a test run to get used to the specific properties of the pump.

***Please note:***

Quattroflow Fluid Systems 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 20k Series pumps.

Please do not hesitate to contact us for further information:

## Quattroflow Fluid Systems GmbH & Co KG

Kampfeldstrasse 13  
D-37181 Hardegsen-Hevensen  
Germany

Tel: +49 (0) 5503-915 913 0  
Fax: +49 (0) 5503-915 913 3  
e-mail: [quattroflow@t-online.de](mailto:quattroflow@t-online.de)  
Internet: [www.quattroflow.com](http://www.quattroflow.com)

## **4. Maintenance/Service of the Quattroflow 20k pump**

Due to the robust construction the Quattroflow 20k pump requires only little and easy- to-do maintenance. The ball bearings do not need any extra lubrication.

The diaphragm and the valves are wear parts. These should be checked and if needed be changed once the performance of the pump decreases.

If the diaphragm breaks, it needs to be replaced. It is recommended to check the ball bearings, replace the ball bearings if the ball bearings are hard to turn or are noisy during operation.

### **Attention! Safety precautions!**



**After purging the pump with air there might be a small residual amount of fluid inside the pump chamber. Flush the pump chamber thoroughly and check the rinse fluid.**



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



**Disconnect mains supply before opening the pump housing!**



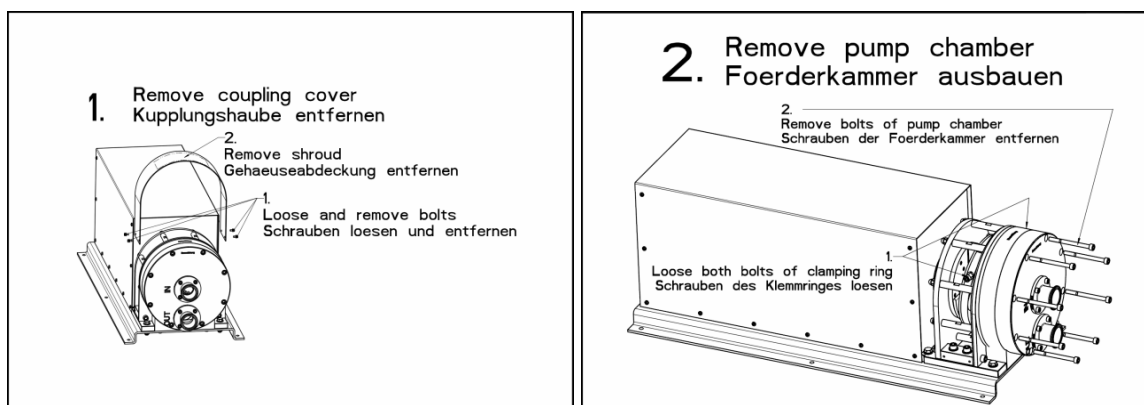
**The dismantling and mounting of the pump should be done on a rigid table or work bench. Please note: the pump is heavy.**

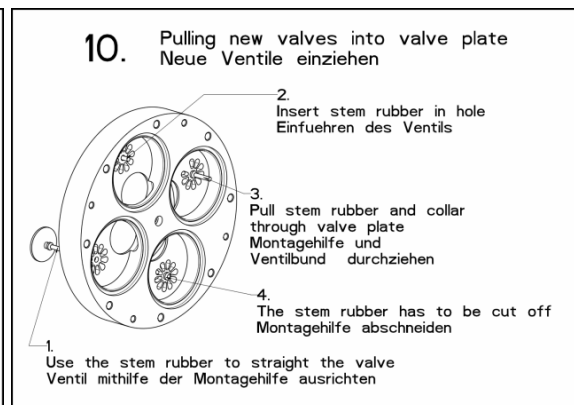
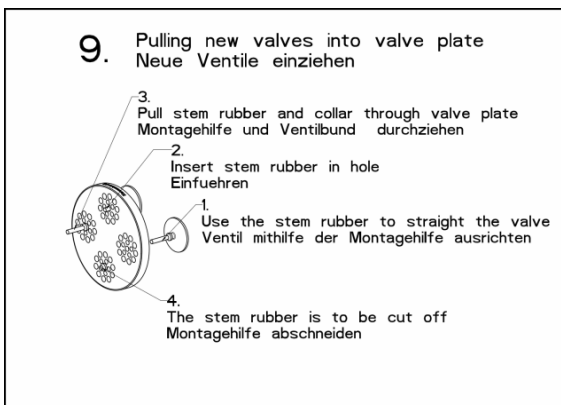
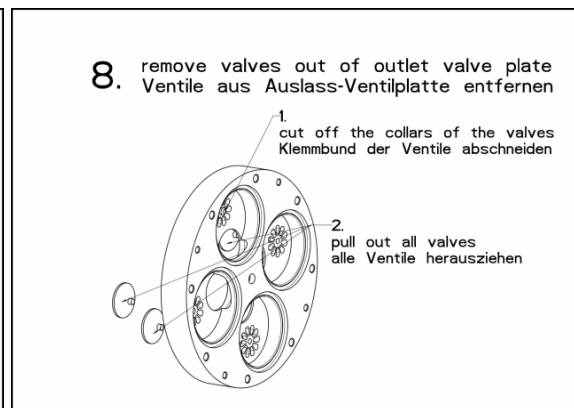
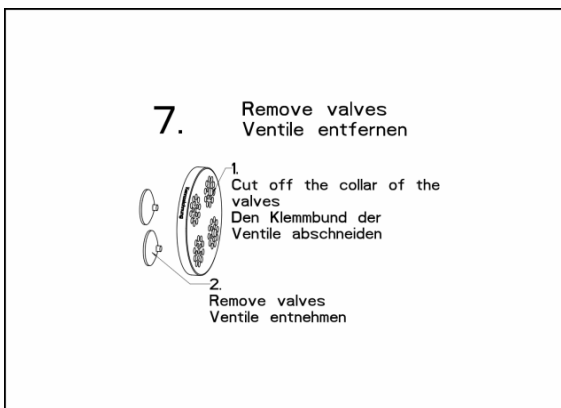
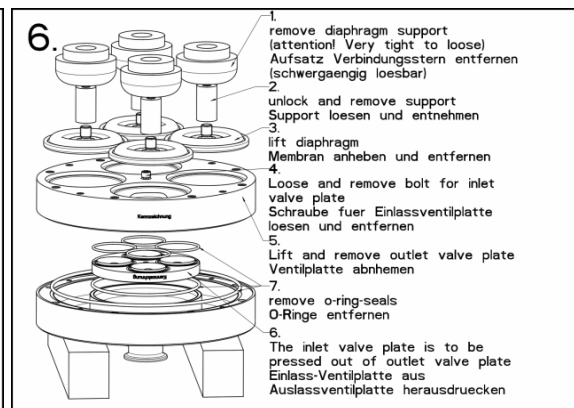
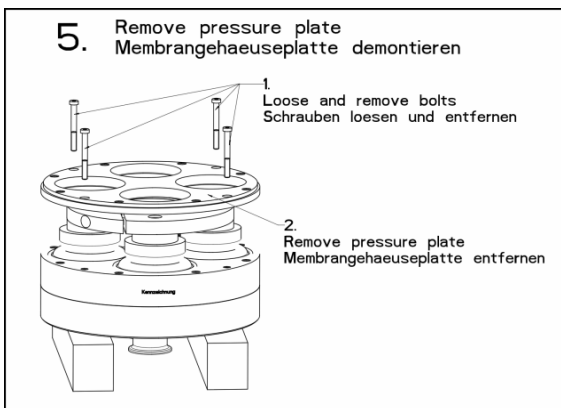
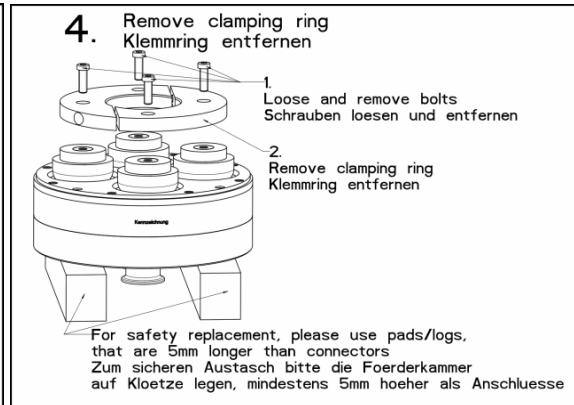
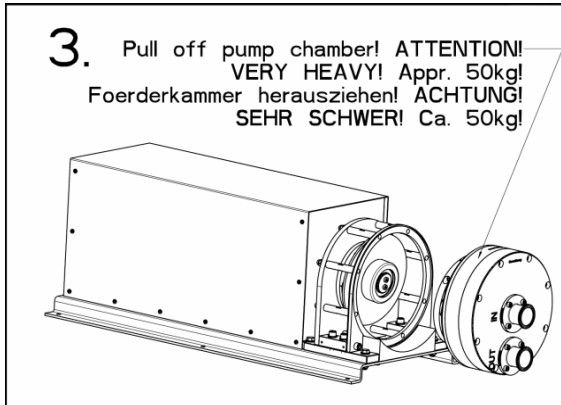
### **4.1 Dismounting of the pump chamber and changing seals and diaphragms:**

The changing of the diaphragm and the valves can be done by the user.


Please follow the schematic drawings "Dismounting of the pump chamber" and "Mounting of the pump chamber"

**Spare part kit: PSKITDQ20 and PSKITVQ20**



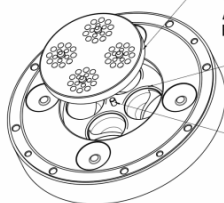


**11. Assembling of supports to diaphragms**  
 Zusammenbau der Membrane und Supports



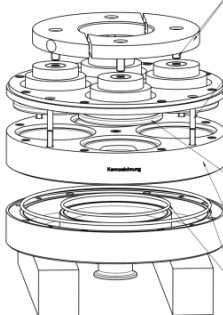
1. Lock support on diaphragm  
Support auf Membran festschrauben
2. Press diaphragm support on support (attention! Very tight)  
Aufsatz Verbindungsstern auf Support pressen (schwergaengig)

**12. Assembling of valve plates**  
 Zusammenbau der Ventilplatten



1. Put seals into nut basket  
O-Ringe in Nuten einlegen
2. Put Outlet valve plate into inlet valve plate  
Auslass-Ventiplatte in Einlassventiplatte einfuehren
3. Tight bolt into outlet valve plate  
Auslassventiplatte mit Schraube festziehen

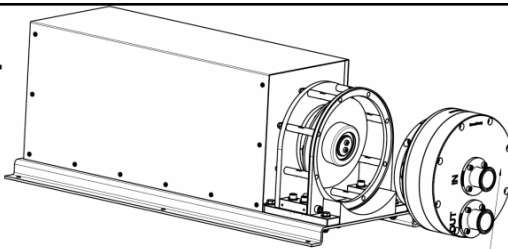
**13. Closing the pump chamber**  
 Verschliessen der Foederkammer



1. Put o-ring-seals in nut basket  
O-Ringe in Nuten einlegen
2. Put valve plate on cover plate  
Ventiplatte auf Ventilgehaeuse legen
3. Put diaphragm in nut basket  
Membran in Nut einlegen
4. Closing the pump chamber with pressure plate and bolts  
Verschliessen Sie die Foederkammer mit der Membrangehaeuseplatte und den Schrauben
5. Bolt the clamping ring to the supports  
Verschrauben Sie den Klemmring mit den Supports

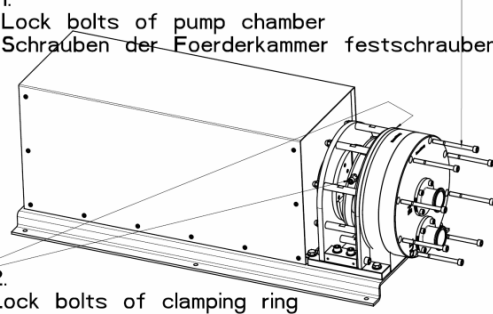
**4.2 Mounting of the pump chamber:**

**1.**



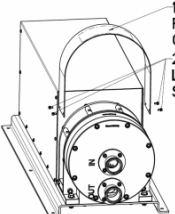
Put pump chamber on the jig! ATTENTION! VERY HEAVY! Appr. 50kg! Straighten the pump chamber to the ring drive an press the pump chamber into the ring drive  
 Foederkammer auf Montagehilfe absetzen!  
 ACHTUNG! SEHR SCHWER! Ca. 50kg! Dann Foederkammer in Ringantrieb einfuehren und fixieren

**2. Mounting of pump chamber**  
 Foederkammer festschrauben



1. Lock bolts of pump chamber  
Schrauben der Foederkammer festschrauben
2. Lock bolts of clamping ring  
Schrauben des Klemmringes festziehen

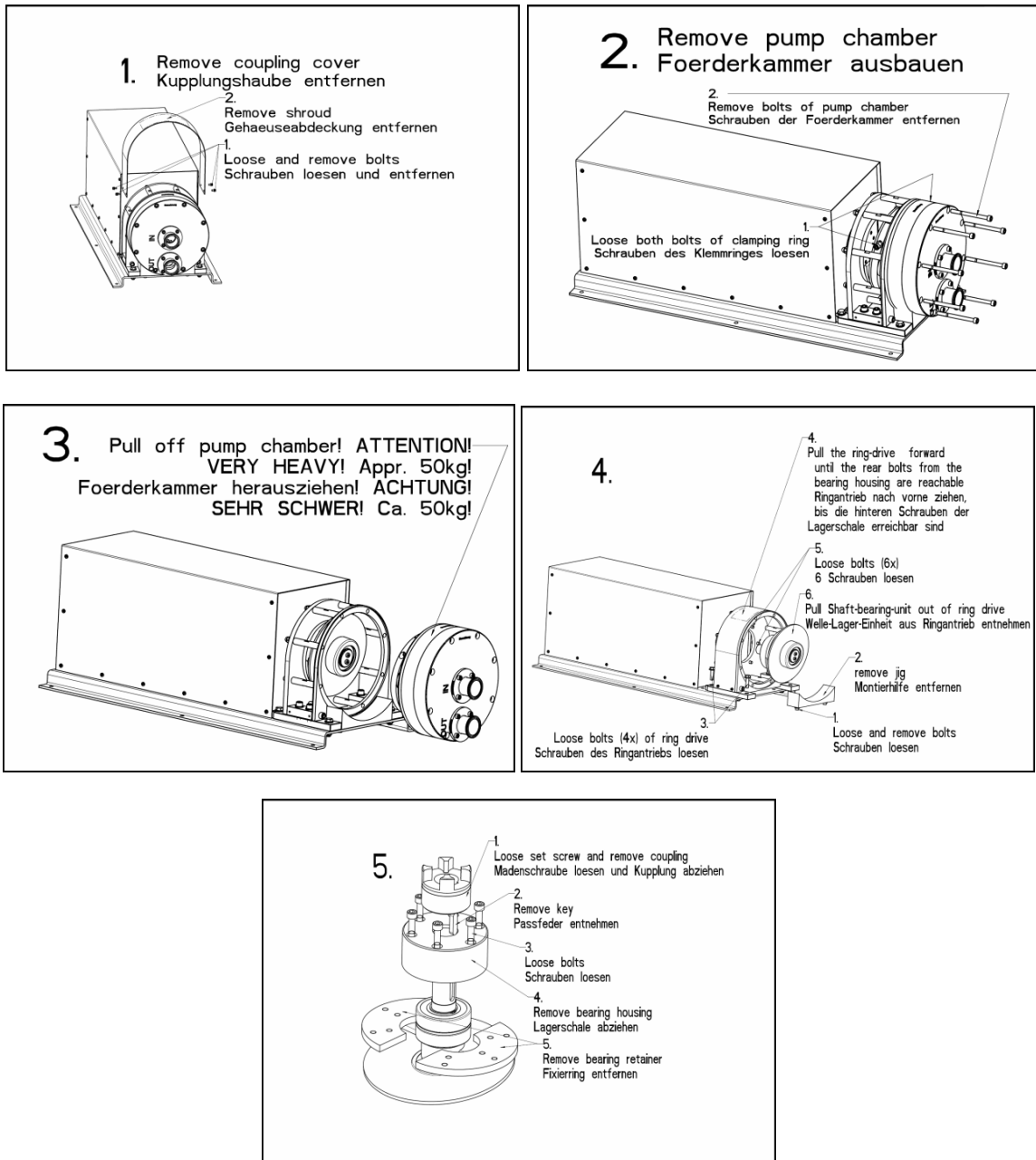
**3. Mounting of coupling cover**  
 Kupplungshaube anbringen



1. Put shroud over coupling  
Gehaeuseabdeckung aufsetzen
2. Lock bolts  
Schrauben festschrauben

### 4.3 Changing of the shaft-bearing-cap unit

The changing of the shaft-bearing unit can be done by the user by using the spare parts **PSKITWLC20**:



## 5. Operating troubles, causes and remedial action

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	Display show Error code	
	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	
										The 4-piston diaphragm pump operates trouble-free at any time provided they are applied according to the operating conditions mentioned in this manual. If you have any questions, please contact Quattroflow.
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 to small
11						X				Check the coupling halves. They must be fixed with at least 2-3mm 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, replace defective parts
14	X							X		Pump stopped by the Thermistor switch. Please allow the motor to cool down – please reduce the power consumption.
15	X					X				Bearings are worn or defective. Disassemble pump, replace the shaft – bearing unit
16		X								The valves are dry (i.e. not in use for a long time), deformed or worn. Change valve or wet the pump.
17							X			The diaphragm is burst ( the discharge pressure was too high) - replace it with PSKITQ20k
18		X	X	X			X			O – rings between valve plate and pump housing are defective - replace it with PSKITQ20k
19						X				Align coupling accurately
20			X			X				The clamping ring screw got loose – fix it! See 4.2 Mounting of the pump chamber ( picture 2 )

## **6. Performance chart of the Quattroflow 20k pump**

### **Performance Diagram Quattroflow 20k Pump**

**Test media: Water at ambient temperature**

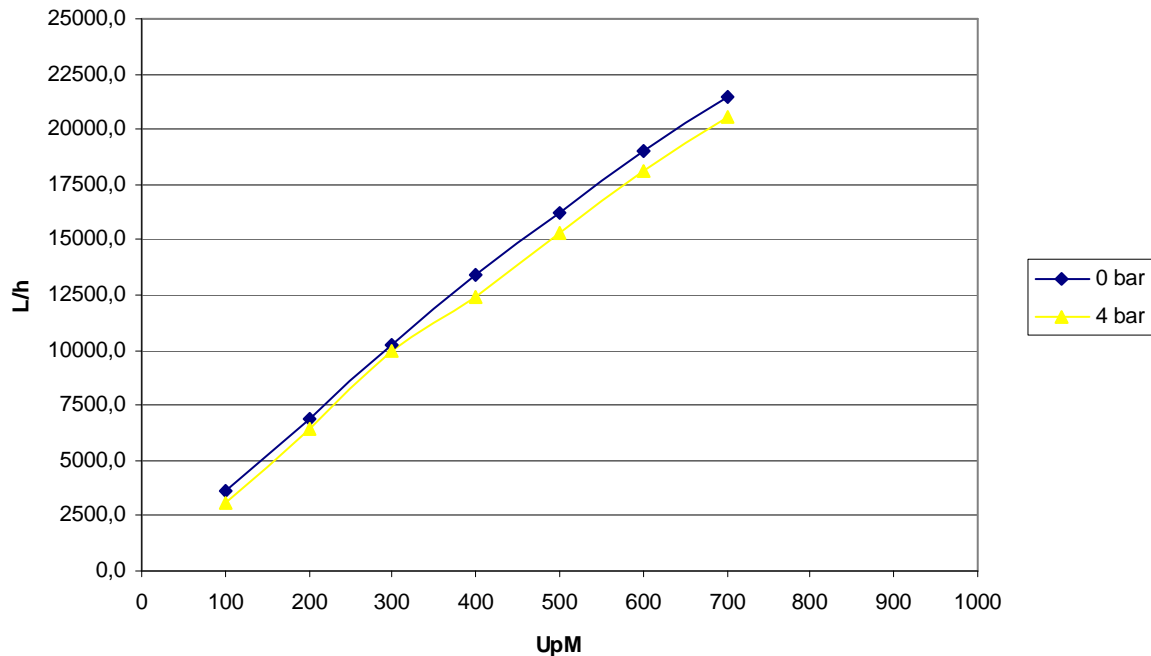
**Discharge pressure: 0 to 6 bar**

#### **6.1 Diagram 1: Approximate flow rate 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

**Kennlinie Quattroflow-20k**  
**Antrieb: VEM, 4kW**  
**Testmedium: Wasser bei RT**



## 7. Technical data of the Quattroflow 20k pump

<b>4-piston-diaphragm pump:</b>	
Eccentric shaft:	7°
Flow rate max:	appr. 23000 L/h at 0 bar appr. 20000 L/h at 4 bar
Flow rate min 5°:	appr. 750 L/h at 0 bar appr. 500 L/h at 4 bar
Pressure ( temperature of fluid < 40 °C) max:	6 ba r
Pressure ( temperature of fluid > 40 °C) max:	4 ba r
Volume of pump chamber without connectors:	appr. 2950ml
Residual volume, depends on position of ports:	150-200ml
Temperature of fluid:	CIP 90°C, SIP 125 °C, Autoclave 125°C
Speed range:	60 - 1000 rpm
Diaphragm:	EPDM/PP compound (Santoprene)
Valves:	EPDM
O-rings:	EPDM
Available certificates for elastomer parts:	FDA 177.2600, USP Class VI, ADIfree
Inlet Valve plate (small)	Stainless steel 1.4435 optional 1.4539 e-polished, Ra < 0,4µm, Ferrite < 1%
Outlet Valve plate (big) made of Stainless Steel	Stainless steel 1.4435 optional 1.4539 e-polished, Ra < 0,4µm, Ferrite < 1%
Outlet Valve plate (big) made of Polypropylen	PP-DWST nature colored with certificates: FDA 177.2600, USP Class VI
Pump housing:	Stainless steel 1.4435 optional 1.4539 e-polished, Ra < 0,4µm, Ferrite < 1%
Connector inlet (standard ) other dimensions are available:	TC-clamp 2", Stainless steel 1.4435 optional 1.4539, e-polished Ra<0,4µm
Flange diameter inlet:	ø64 mm
Internal diameter inlet:	ø47,5mm
Connector outlet ( standard ): other dimensions are available:	TC-clamp 2", Stainless steel 1.4435 optional 1.4539, e-polished Ra<0,4µm
Flange diameter outlet:	ø64 mm
Internal diameter outlet:	ø47,5mm
Available certificates for stainless steel parts:	DIN EN 10204 3.1 B, Ra / Ferrite
Position of connectors:	front

<b>German custom tariff number:</b>	84138190
-------------------------------------	----------