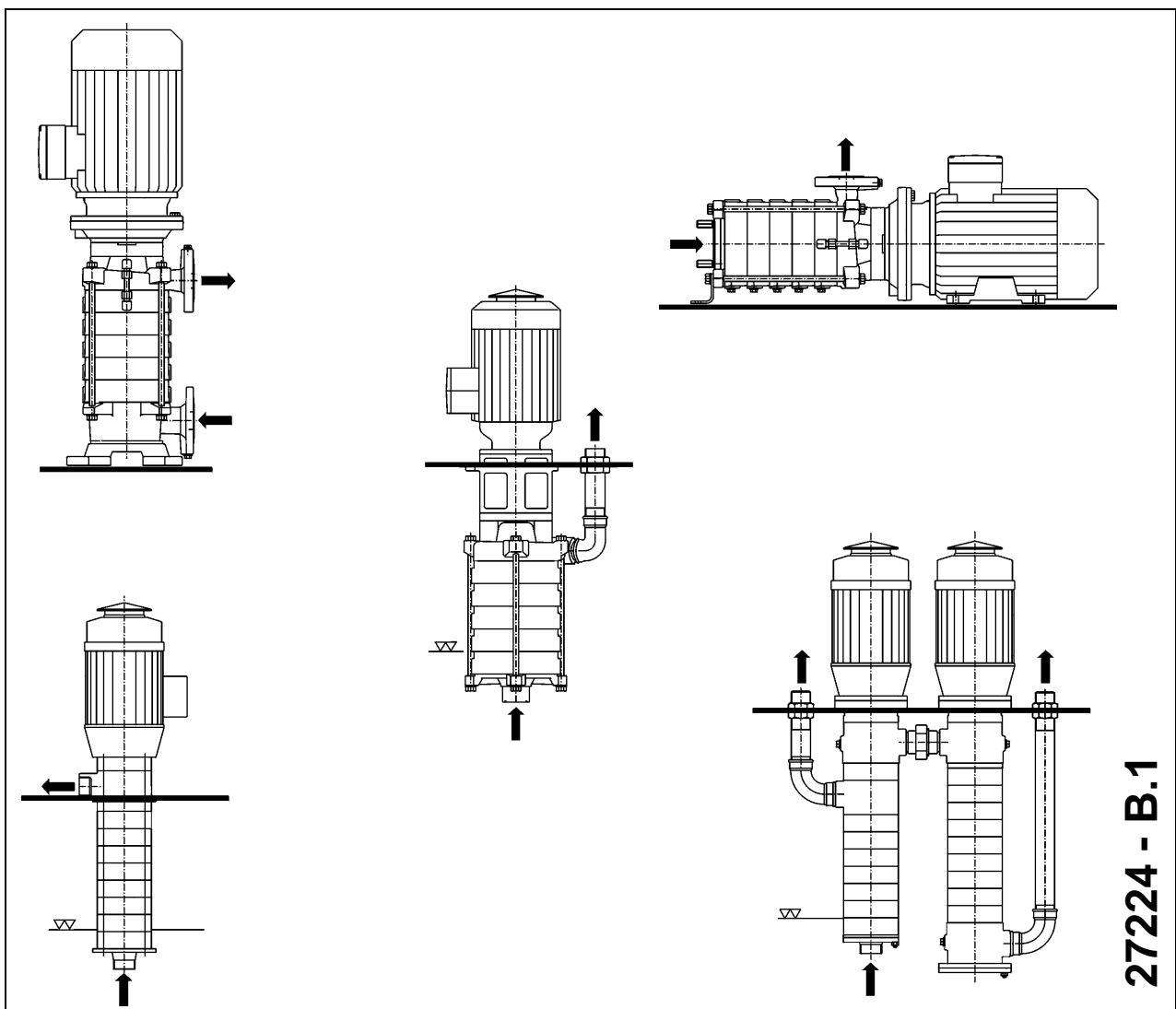


## Circulating pumps

**Model ZHT / ZHB / ZHS / TH / THK / DUO**

**GB**

**Operator's manual**



**27224 - B.1**



**EG-Konformitätserklärung**  
**Déclaration de conformité pour la CEE / EC-Declaration of Conformity /**  
**CEE-Certificado de Conformidad / Dichiarazione CE di conformità**

**Hersteller / fabricant / manufacturer / fabricant / fabrikant**

Schmalenberger GmbH+Co KG  
Strömungstechnologie  
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D-72072 Tübingen / Germany

**Produkt / produit / product / producto / prodotto**

Kreiselpumpen / Pompes centrifuges / Circulating pumps / Bombas centrifugas / Pompe centrifughe

**Typ / modèle / model / modelo / tipo**

ZHT, ZHB, ZHS, TH, THK, DUO, ZHR, DMG

Hiermit erklären wir, dass die spezifische Bauart in Übereinstimmung mit den folgenden Richtlinien hergestellt worden ist:  
Par la présente, nous déclarons, que le type de est produit conforme aux dispositions des directives européennes ci après:  
We hereby declare that the specific type has been produced in accordance with the following standards:  
Por la presente les confirmamos que lo abajo especificado ha sido fabrico en conformidad con las siguientes normas:  
Si dichiara che il modello della è stato in conformità alle sequenti norme:

**EG - Richtlinien / Directives de la CEE / EEC Directives / Normativas de la CEE / Direttive CEE**

- 2006/42/EG
- 2006/95/EG
- 2004/108/EG

Zur sachgerechten Umsetzung der in der EG-Richtlinie genannten Sicherheits- und Gesundheitsanforderungen wurde(n) folgende Norm(en) herangezogen:

Pour mettre en pratique dans les règles de l'art les prescriptions en matière de sécurité et de santé stipulées dans les Directives de la CEE, il a été tenu compte de la /des norme(s):

For the relevant implementation of the safety and health requirements mentioned in the Directives, the following standard(s) must be required:

Con el fin de realizar de forma adecuada las exigencias referentes a la seguridad y a la snidad mencionadas en las normativas de la CEE fuè(ron) consultada(s) la(s) siguiente(s) normativa(s):

Per la verifica della Conformità di cui alle Direttive sopra menzionate, sono state consultate le sequenti, norme Armonizzate EN:

**Harmonisierte Normen / Normes harmonisées / Harmonised Standards / Normas armonizadas / Norme armonizzate**  
EN ISO 12100-1, EN ISO 12100-2, EN 61000-6-2, EN 61000-6-3, EN 809, EN ISO 14121-1

Tübingen, den 21. Dezember 2009



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Leiter Qualitätssicherung / Directeur d'assurance de la qualité /  
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## 1 General Details

### 1.1 User Information

This operator's manual makes it easier to get to know the centrifugal pump and to make full use of its facilities.

The operator's manual contains important instructions how to use the centrifugal pump safely, properly and economically.

The operator's manual does not take account of local regulations. The user is responsible for ensuring that they are complied with.

The label specifies the machine series, the frame size, the most important operating data and the serial number. We request that you always quote it in case of queries, when placing subsequent orders and especially when ordering spare parts.

### 1.2 Usage Instructions

The centrifugal pump must only be used in accordance with the original pump specifications and the operator's manual.

Any other usage or operation where these figures are exceeded is not permitted. The manufacturer is not liable for damage resulting from such improper use.

### 1.3 Relevant Documentation

Various documents are associated with every centrifugal pump that comprise the technical documentation of the pump. These are as follows:

- Operator's manual
- Drive operator's manual
- Manual for accessories listed in the specifications manual
- Acceptance report from the TÜV (Technical Certification Authority) etc.
- Pilot run report
- Performance run report
- Installation drawing (dimensions sheet)
- Declaration of conformity with supplement BA for Ex-model in accordance with the directive 94 / 9 / EG (Atex 95)
- Conformity statement / manufacturer's declaration
- Specification with all data

Not all the above documentation has been produced and supplied in every case. For this please check the details in the specification.

### 1.4 Technical Data / Specifications

The specifications of the centrifugal pump is the most important document in every operator's manual. Contained therein are all the relevant and technical data relating to the centrifugal pump. It is the birth certificate of the centrifugal pump and should be treated accordingly.

As a substitute the order confirmation together with the delivery schedule may also be a source of technical data.

## 2 Safety Instructions

### 2.1 General

It is essential that the relevant safety regulations and laws that apply in the operating company and / or country where the pumps are to be used are observed .

In this operating manual the following symbols are used to draw your attention to sources of danger. The symbols are intended to attract your attention to these instructions!

Symbol      Meaning:



#### Attention! Danger of injury!

This sign warns you of the danger of mechanical effects.



#### Warning! Mortal danger!

This sign warns you of the danger from electric shocks.



#### Information:

It also instructs you in the economic use of the pump.

Notices attached directly to the pump, e.g. arrows indicating direction of rotation and the marking for fluid connections, must always be observed and maintained in a clearly legible condition.

- Use the pump only if it is in perfect technical condition, in accordance with the regulations, observing safety requirements and danger conditions and strictly adhering to all the instructions in the operator's manual!
- Promptly remedy any faults that could influence safety.
- **Prior to starting up, make sure that the operators have read and understood the operator's manual.** Not the operator but the owner is responsible for safety!
- The centrifugal pump is designed to be built into a total machine or plant. The centrifugal pump is delivered without any protection against accidental contact. If necessary, the system supplier must fit appropriate protective covers in integrating the centrifugal pump into the plant (e.g. if hot liquids with a temperature over 60° C are delivered).
- Leaks of hazardous delivery media, (e.g. explosive, poisonous, hot) must be controlled so that no danger occurs to persons or the environment. Comply with legal requirements.
- Danger from electric shocks must be completely excluded (for details see the country specific regulations and / or those of the local power supply company).
- Electrical equipment must be installed and maintained exclusively by qualified electricians in accordance with regulations VDE or IEC.
- Before switching on or starting up the centrifugal pump, make sure that no-one will be endangered by the start-up of the pump!



**Important:**

The centrifugal pump must be immediately stopped if abnormal electrical voltages, temperatures, noises, vibrations, leakages or other faults should arise.

## 2.2 Temperature



**Warning! / Danger of burns!**

The centrifugal pump housing gets hot during operation. If the temperature rises to over +50°C, the centrifugal pump must be protected from direct contact by the operator.

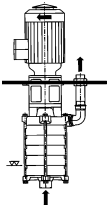
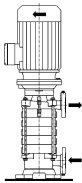
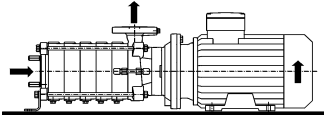
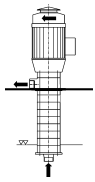
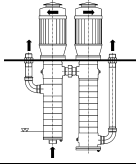
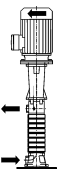
## 2.3 Safety Instructions for Maintenance and Repairs

- Regardless of what nature they may be, repairs must only be carried out by qualified persons and the centrifugal pump must be emptied first.
- The attached pipework must be depressurized.
- Allow the pump to cool off.
- Prior to carrying out repairs to the pump it must be isolated from the electrical supply and protected from unintentional switching on.

### 3 Description of the types of pump

#### 3.1 General Description

Depending on their field of usage, different pumps are offered. In the following overview, the types within the range are described.

Type ZHT	
	<ul style="list-style-type: none"> <li>- Multi-stage submersible pump with block motor</li> <li>- Vertical container installation due to support plate</li> <li>- Shaft seal as mechanical seal</li> <li>- Axial suction connection</li> </ul>
Type ZHS	
	<ul style="list-style-type: none"> <li>- Multi-stage submersible pump with block motor</li> <li>- Vertical installation with suction stand</li> <li>- Shaft seal as mechanical seal</li> <li>- Radial suction connection</li> </ul>
Type ZHB	
	<ul style="list-style-type: none"> <li>- Multi-stage centrifugal pump with block motor</li> <li>- Horizontal installation</li> <li>- Shaft seal as mechanical seal</li> <li>- Axial suction connection</li> <li>- Special model with dry-run-protection / catchment chamber</li> </ul>
Type TH / THK	
	<ul style="list-style-type: none"> <li>- Multi-stage submersible pump with block motor</li> <li>- Vertical container installation to DIN EN 12157</li> <li>- Shaft seal as mechanical seal</li> <li>- Axial suction connection</li> <li>- THK = Plastic model</li> </ul>
Type DUO	
	<ul style="list-style-type: none"> <li>- Two multi-stage submersible pumps with block motor in series</li> <li>- Vertical container installation due to support plate</li> <li>- Shaft seal as mechanical seal</li> <li>- Axial suction connection</li> </ul>
Type ZH (T,S) -L	
	<ul style="list-style-type: none"> <li>- Multi-stage submersible pump with bearing pedestal</li> <li>- Vertical installation like ZHT and ZHS but with coupling and Norm-motor</li> </ul>

## 4 Transport, Storage, Installation

### 4.1 Transport and Storage

#### 4.1.1 Transport

Centrifugal pumps must be transported lying down! The eyebolts on the motor are designed to carry only the weight of the motor. To lift the combined motor and pump aggregate suitable attachments must be made so that both units are catered for!

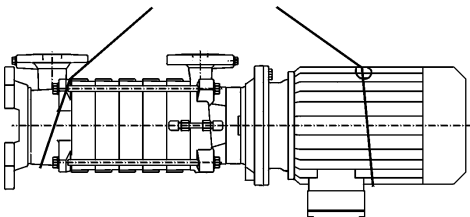
If necessary the centre of mass is indicated on the pump aggregate itself and on the packing material and places for applying hooks are marked.



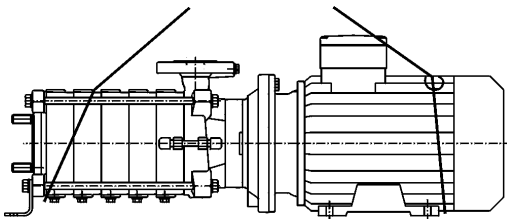
#### **Warning! Risk of injury!**

Use only suitable and technically perfect lifting and load-bearing equipment with sufficient carrying power!

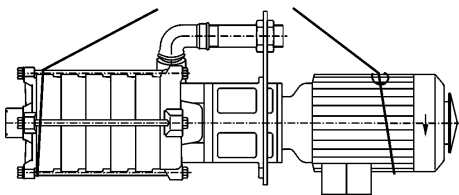
Never stand or work underneath swinging loads.



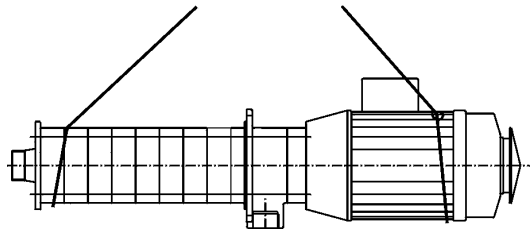
Proper lifting example ZHS



Proper lifting example ZHB



Proper lifting example ZHT



Proper lifting example TH / THK

#### 4.1.2 Storage

##### - Interim storage

Even for short periods of interim storage, store on a wooden base in a dry, well ventilated and vibration free environment at constant temperature.

##### - Unsuitable storage

If unsuitable storage conditions prevail (e.g. high humidity) or if the pump is to be stored for longer than 6 weeks, then the pump housing should be filled with oil (see 4.1.3).

##### - Long periods of storage

After a storage period of more than 2 years the motor roller bearings and bearing supports need to be re-greased or replaced entirely.

#### 4.1.3 Conservation

The centrifugal pumps that we deliver are treated with a conservation material corresponding to the storage time quoted us by the purchaser. This conservation must be removed before start-up. See chapter 4.2.2 "Cleaning". If the pump is to be taken out of service for a longer period of time or if the originally envisaged storage time is going to be considerably exceeded, then conservation must be undertaken as protection against corrosion. For a detailed description of how to proceed under these circumstances, see chapter 7.1 "Shutdown / Storage / Conservation".



## 4.2 Unpacking, Cleaning and Assembling

### 4.2.1 Unpacking

For transportation purposes the pump is fastened to a palette by bands. For transportation over long distances it is packed in crates or boxes. After removing the retaining bands extract the pump out of its packing with the help of suitable lifting equipment. Be sure to observe the instructions under 4.1.1.

### 4.2.2 Cleaning

A number of measures are taken for protection against transportation damage and corrosion. Check your pump for which measures have been taken.

1. Covering lid on the nozzles
2. Shaft protection for deliveries without the motor

3. Protective paint on exposed parts

These protective measures must be removed before the pump is set up or installed.

Under no circumstances must impurities be left inside the pump.



#### **Important:**

Depending on the delivery medium to be used, the interior of the pump should be cleaned of residual traces of oil. Use a cleaning agent that will not be harmful to the mechanical seal and the pump materials. Make sure that the pump is carefully dried after cleaning.

The cleaning agents that can be used include spirit, Ritzol 155 or a strongly alkaline soap solution, for example. If a steam jet cleaner is to be used, then let the solvent work itself in for a time first.

Please do not use a steam jet cleaner. If this is unavoidable, then please take care not to damage the electric motor and bearings.

### 4.2.3 Assembly

In general the pump is delivered fully assembled and can be installed directly.

In special cases the pump is delivered without the drive motor. Prior to installing it in the plant, fit the drive to the pump.



#### **Important:**

Before installation check that the pump runs freely and easily.

Other external accessories such as a blast tank or similar equipment that has not been pre-assembled with the pump at the factory, should be fitted to the pump after it has been installed in the system or on the pump base.

## 4.3 Installing and connecting

### 4.3.1 Safety requirements



#### **Explosion proof / safety instructions**

Electrical appliances that are operated in areas where there is a danger of explosion, must comply with the explosion proof requirements. This is stated on the factory plate of the motor. For installations in areas where there is a danger of explosion, the local explosion regulations and those on the test certificate supplied with the delivery, and which was issued by the responsible inspection authority, must be observed. The test certificate supplied must be kept at the installation location (e.g. the master's office).



#### **Important:**

**For areas where there is a danger of explosion in accordance with directive 94/9 EG (Atex 95), please observe the supplementary operating instructions.**

#### 4.3.2 Check before you start installing

- Have the machine, the system and the container nozzles been properly prepared in accordance with the figures on the dimensions sheet or installation plan?
- Has the concrete base got adequate strength in accordance with DIN 1045?
- Is the concrete base hydrated?
- Is the surface level and even?



##### **Warning! Static stability, Risk of injury!**

Pumps with large drives that are mounted vertically are top heavy. These pumps must be safeguarded against tipping up during installation or removal e.g. with the help of ropes.

#### 4.3.3 Pump installation and removal

Centrifugal pumps type "**ZHB**" may only be installed horizontally, those of type "**ZHS**" may only be installed vertically.

Apart from certain special models, the pumps are always equipped with a pump or motor foot (ZHB) or with a pump stand (ZHS) and must be placed on a base plate and fastened down with screws.

When installed on a foundation the pump must be set up with the aid of a spirit level.

Centrifugal pumps type "**ZHT, TH, DUO**" may only be installed in a vertical position.

Apart from certain special models, these pumps are always placed on the cover plate or the flange and fastened down with screws.

#### 4.3.4 Connecting the pipework



##### **Warning!**

**Under no circumstances must the pump be used as anchor point for the pipework. No forces or moments (e.g. due to twisting or heat expansion) from the pipework must act on the pump.**



The pipes must be supported as close as possible to the centrifugal pump and connected to it free of all tension. Their weight must not be supported by the pump.

The positioning must be undertaken with the greatest care as this is the prerequisite for trouble-free operation of the plant. If these instructions are not observed, then any claims under guarantee will be void.



##### **Warning!**

##### **In the case of hot, caustic or poisonous delivery media!**

If the pipe strength is exceeded leaks can occur in the pump or in the flange connections, for example, that could result in vast amounts of medium being expelled.

In the case of short pipes the nominal bore should be at least the same as the centrifugal pump connections. For long pipes the most economic nominal bore should be determined on a case by case basis.

Connection pieces to larger nominal bores should be carried out with approx. 8° expansion angle to avoid significant loss of pressure.

In order to prevent the formation of air pockets, the suction pipe to the centrifugal pump must be installed to rise continuously, on the pressure side it must fall continuously. Depending on the type of system and centrifugal pump being used, it is recommended that backflow prevention and shut-off devices are installed.

Expansion of the pipes due to temperature must be remedied by suitable measures.

We recommend the installation of compensators immediately between the pump and the pipes.



**Warning! Mortal danger!**

Taps that close very suddenly (abruptly) must be avoided in the pipework. The resulting pressure surges can greatly exceed the maximum permitted housing pressure of the pump!

To prevent too strong pressure surges dampers or blast tanks should be installed.



**Note:**

At the end of installation, before starting up the system the containers, pipes and connections must be thoroughly cleaned, rinsed and blown through.

Often welding beads, scales and other impurities do not get dislodged for some period of time. The should be kept clear of the pump by inserting a sieve in the suction pipe.

The free cross-section of the sieve must be 3 times the cross-section of the pipe so that there is not too large a resistance built up due to foreign bodies that flow in.

Hat-shaped sieves containing a mesh wire net having a mesh size of 2.0 mm and 0.5 mm wire diameter made of corrosion resistant material have proved useful in practice.

### 4.3.5 Electrical connections

The electrical connections to the pump must be carried out by a specialised company in the electrical engineering branch approved by the local energy provider, taking into account the technical connection requirements. The connections must be carried out by a qualified electrician. (see 4.3.1)

The relevant DIN VDE (Association of German Engineers) regulations must be observed.

Compare the available mains voltage with the details on the motor's factory plate and select the appropriate switching.

We recommend the use of a motor protection facility.

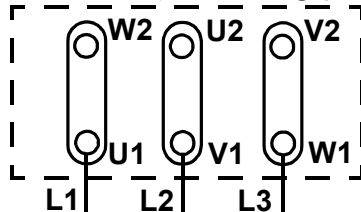


**Risk of explosion!**

Where there is a risk of explosion a motor protection device must be fitted!

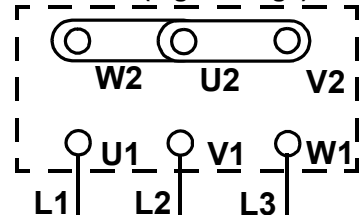
Connect the motor in accordance with the circuit diagram in the terminal box or according to the figures showing delta or star connections.

**Delta connection  $\Delta$  (lower voltage)**



Connection diagram for 3-phase motors,  
Circuit arrangement  $\Delta$

**Star connection Y (high voltage)**



Connection diagram for 3-phase motors,  
Circuit arrangement Y

**Time relay setting**

For three-phase motors with star-delta connection it must be ensured that the switching points between star and delta follow each other very rapidly. Long switching times can result in damage to the motor. Setting of the time relay for star-delta connection: 3 to 5 seconds depending on the motor performance.

Motor performance  $\leq 30\text{kW}$       3sec  $\pm 30\%$

Motor performance  $> 30\text{kW}$       5sec  $\pm 30\%$

### Direction of rotation check

The direction of rotation of the motor must agree with the direction of the rotation arrow on the spiral housing of the pump. Check by rapidly switching on and off.

If the direction of rotation is wrong, change any two phases L1, L2 or L3 of the power supply in the motor terminal box over.

### Additional motor equipment

If particular control devices are to be used e.g. in connection with the installation of the pump in a process engineering facility, the instructions of the manufacturer of the control device must be strictly observed.

## 5 Pump operation

### 5.1 Initial start-up



Prior to initially starting up the centrifugal pump please make sure that the following prerequisites have been met:

1. The centrifugal pump has been connected properly electrically and with all requisite safety features.
2. The pump is completely filled with delivery medium or that the minimum level of fluid is present in the tank / pool (the pump is covered) and that further supply is available.

**Please observe:** Dry running leads to increased wear and damage to the pump!

3. On the suction side all shut-off devices are open and the suction pipe is vented.
4. The rotating parts of the pump have been covered by a protective shield. (In accordance with UVV (Accident Prevention Regulations) the centrifugal pump may only be operated if a safety shield has been fitted).

5. It has been checked that the pump shaft rotates easily (observe the instructions under 4.2.3 )
6. The direction of rotation has been checked.
7. There is a minimum distance between the suction inlet and the tank wall of 150 mm.

### 5.1.1 Starting the pump

Only switch the pump on when the shut-off device on the pressure side is closed! Once the maximum rotation speed has been reached, slowly open it up and adjust to full operational level.

- An automatic backflow prevention device must constantly open once the operational value has been reached without the production of abnormal noises, vibrations or increased current consumption in the plant.
- Once the operating point has been reached, the power input to the motor and the bearing temperature must be monitored! When first started up the ultimate bearing temperature is attained only after about 48 hours, depending on ambient conditions.

## 5.2 Operating

### 5.2.1 Operation monitoring

In most cases the centrifugal pump is controlled from the central point of the overall facility. A prerequisite for a perfectly functioning centrifugal pump is adherence to the data provided for its installation and use. See the chapter on specifications.



Pay particular attention to the following points for the manual operation of the centrifugal pump:

#### 1. Temperature of the delivery fluid

Never operate the pump at temperatures in excess of those stated in the original specification.

## 2. Switching frequency

In order to avoid a large temperature increase in the motor and excessive strain on the pump, motor and bearings the switching frequency must not exceed the following guideline figures.

Motor power:	Max. no. switches / h
up to 3 kW	20
from 4 to 11 kW	15
from 11 to 45 kW	10

## 3. Minimum amount

If the sort of facility includes the possibility of a run against closed shut-off device on the pressure-end, a minimum delivery rate at t -30 to +70°C 15% of Q<sub>opt</sub>. must be supplied during this time. Over +70 to +110°C it must be 25% of Q<sub>opt</sub>.

## 4. Density of the delivery fluid

The power input of the pump changes in proportion to the density of the delivery fluid. To prevent the motor being overloaded, the density must correspond to the data in the specifications.

## 5. Mechanical seal

The sealing unit has been fitted and set at the factory. The gasket is maintenance free but should be checked for leaks from time to time. During initial start up there may be increased leakage for a brief time. If increased leakage persists then the plant should be switched off at once and the cause determined. The cause could be dirty medium or a prior period of dry running through incomplete venting of the pump, for example.

### 5.2.2 Miscellaneous

Installed reserve pumps must be run briefly once a week to ensure that they are always ready for operation. They should be run each time for approx. 10 minutes. This also applies to any pump that is not in use but must remain ready for operation.

## 5.3 Indications of faulty operation

### 5.3.1 General

When operated via a central control facility faulty operation can be largely ruled out.

In the case of manual operation, but also within a control complex, please make sure that:

- The pump always runs quietly and vibration free.
- The pump does not run dry.
- A longer period of operation with closed shut-off device is avoided to prevent heating up the delivery medium. For the requisite minimum delivery quantity see chapter 5.2.1.
- The maximum permitted room temperature of +40°C is not exceeded.
- The ball bearing temperature does not exceed the room temperature by more than + 50°C and in any event does not exceed + 90°C overall (measured at the exterior of the motor housing).
- During centrifugal pump operation the shut-off device in the supply line is not closed.

### 5.3.2 Faults

In case of faults in the operation of the centrifugal pump, that were not caused by the control facility or other foreign devices, proceed as follows:

1. Locate the site of the fault or defect.
2. Determine the cause.
3. Remedy the fault.

In chapter 5.5 "Fault elimination" there is a table listing the most frequent faults, their cause and the recommended way to eliminate them.

#### 5.4 Shutdown

1. Close shut-off device in the pressure and suction pipes. If backflow prevention is fitted to the pressure pipe the shut-off device can remain open, provided that there is back pressure.
2. Switch motor off. Allow it to come to rest. Depending on the sort of facility, the pump should be allowed sufficient idle run time – with the heat source, if any, switched off to allow the delivery fluid temperature to reduce – to prevent an accumulation of heat within the pump.
3. Close the shut-off device in the suction pipe.



**Warning!**

**Risk of damage!**

If there is a danger that the pump may freeze and / or for occasions where it is to be at a standstill for longer periods of time, the pump must be emptied or protected against freezing up (by auxiliary heating).

## 5.5 Fault elimination

Pump stationary	Pump delivery rate too low	Motor overload	Pump does not deliver, no pump pressure	Increased motor / bearing temperature	Pump leaks	Pump runs noisily, operating noises	Pump temperature too high	Cause of the fault	Elimination of the fault
	x		x				x	Counter-pressure too high, pump working against too much pressure, plant resistance too high, performance too low	Reset operating point, clean the plant out, increase the rpm, install a new impeller, clean the pipes, enlarge the pipes, use a larger pump
	x		x			x		Pump / pipework not completely vented, air being sucked in due to too little covering, gas production, air pockets in the pipes, high level of air content in the medium, supply or impeller blocked	Increase fluid level, correct level control, install the pump lower down, vent the plant, clean the pipework, change the pipework, de-gas the medium, decrease the resistance in the supply pipe, fully open valves in the suction pipe, clean sieves and suction connections, install a venting valve directly before the non-return valve
	x	x	x					Wrong direction of rotation, incorrect electrical connection, too low rpm	Swap over two of the power supply phases in the terminal box, increase the rpm (*) (if necessary, get a new motor)
	x			x		x		Worn internal parts (e.g. the impeller)	Remove foreign bodies out of the pump housing, replace worn parts
		x		x		x		Pump back-pressure is less than stated in the specifications, incorrect electrical connection	Set operating point precisely, increase counter-pressure by throttling the pump on the pressure side for example, turn off impeller if required (*), use larger motor (*), compare electrical supply with that on the motor rating plate; study the circuit diagram, see chapter 4.3.5
		x		x				Higher density or higher viscosity of the delivery medium than specified	Re-adjust the pump (*)
						x		Cavitation	Throttle the pump on the pressure side, correct the suction conditions, use larger pump (*)

Pump stationary	Pump delivery rate too low	Motor overload	Pump does not deliver, no pump pressure	Increased motor / bearing temperature	Pump leaks	Pump runs noisily, operating noises	Pump temperature too high	Cause of the fault	Elimination of the fault
					x			Defective gaskets, pump badly adjusted, connecting screws loose	Replace gaskets, adjust the pump properly, check pipework connections, tighten connecting screws
					x			Shaft seal worn	Replace shaft seal, check catchment liquid, check coolant supply lines, check bypass for clear cross-section
x								Foreign body in the pump, motor bearings defective, circuit breaker tripped due to motor overload, circuit breaker too small, winding defective	Remove foreign body from pump housing, clean or replace pump housing, replace motor bearings, check electrical connection and compare with motor rating plate, if the motor is overloaded: Throttle the pump, smaller impeller (*), larger motor (*)
			x			x		Impeller out-of-balance, bearing defective, too little or too much or the wrong lubricant	Clean the impeller, balance the impeller (*), replace bearings, add or reduce or completely replace the lubricant
			x	x	x			Pump wrongly adjusted, pump distorted or resonance vibrations in the pipework, several pumps on one console	Adjust pump precisely, check pipework connections / pump holder, individual installation, connect pipework via compensators, install vibration damper under the pump, make tank more rigid, clean pressure-relief holes in the impeller
			x			x	x	Delivery rate too low, pipework blocked, closed valve on the pressure side	Re-adjust the pump, for low volumes provide a bypass, clean the pressure pipe, switch pump on only when required, open valve on pressure side; use a smaller pump (*)

(\*) Please consult the manufacturer.



## 6 Maintenance / Repair

### General Instructions

The operator must ensure that all maintenance, service and repair work on the pump is carried out exclusively by authorised and specially trained persons. It must be established beyond doubt that the person has studied the operator's manual in detail.

We recommend the creation and adherence to of a maintenance schedule. That will enable you to avoid expensive repairs and have a reliable and trouble-free pump operation.

Only original spare parts must be used for repairs. This is particularly important for the mechanical seal (GLRD ).

If work has to be carried out on the **motor** the instructions in the manual from the relevant motor manufacturer must be observed.



#### **Warning! Mortal danger!**

In order to prevent electric shocks, work on the terminal box and the machine controller must never be carried out before the electrical connections have been isolated or disconnected.



#### **Warning! Mortal danger!**

The pump must be safeguarded against unintentional switching on (be disconnected) if checking or maintenance work is to be undertaken.

### 6.1 Maintenance / Service

Use the following information to create a maintenance schedule. These are recommendations of minimum requirements that must be adjusted to local conditions of use of the pump and may need amending accordingly.

#### 6.1.1 Checks

Continuous checks:

- Centrifugal pump delivery data (pressure, amount)
- Power take-up

Daily checks:

- Pump running is quiet and vibration free
- Bearing temperature
- Leakage at the mechanical seal (GLRD )
- SKS (catchment chamber system) – check fluid level

Check / replace every 3 months:

- Screws are tight
- In case of SKS change the catchment medium (if not otherwise instructed)

#### 6.1.2 Lubrication and changing lubricant

Pumps of the types "ZH- / TH- / DUO" in the standard models only run on bearings in the drive motors.

The bearings in small motors are designed to last the useful life of the motor and are filled with a grease that cannot be replenished. Defective bearings must be replaced. In this case there are no lubrication nipples on the bearing supports.

Bearings in larger motors must be regularly re-lubricated. For more details please see the "Operating instructions for pump drives" in chapter 6 Service and maintenance

The model with IEC Norm motor and bearing pedestal the bearings in the pedestal are provided with a grease that need not be replenished. It is designed to last the useful life of the motor and cannot be re-greased. Defective bearings must be replaced.

### 6.2 Repair

#### General

Always carry out repair work on the removed centrifugal pump in an appropriate workshop. Be sure to observe the general instructions at the beginning of the chapter!

The following instructions will enable you to dismantle the pump and to re-assemble it properly with the requisite spare parts in place.



#### **Note:**

Please also observe the drawing in the chapter "Spare parts / drawing" at the end of this operator's manual!

When a new mechanical seal is fitted special instructions must be observed.

The work can be undertaken with the usual workshop tools. No special tools are needed.

After dismantling thoroughly clean all the individual parts of the centrifugal pump.

Check the individual parts for wear and damage. Parts that are not perfect must be reworked or replaced.

### 6.2.1 Dismantling Preparations

Prior to starting to dismantle it the pump must be safeguarded against accidental switching on (it must be disconnected).



**Warning! Mortal danger!**

Fasten a warning on the switching cabinet.

When used in a facility, inform the shift leader or manager.



**Important:**

For the following work, please be sure to observe local regulations and conditions.

### 6.2.2 Dismantling / Removal of the pump

The pump must be allowed to reach room temperature.

- Disconnect the power supply.
- Close valves (on the suction and pressure sides).
- Empty the pump via the drainage screws 912, 913
- If there is a catchment chamber / pressure chamber empty it via the drainage screws 912. Dispose of the catchment medium in the proper manner.
- Disconnect motor.
- Remove existing additional connections.
- Release pressure and suction nozzles.
- Release pump from its base plate.
- Lift the pump off completely (out of the tank etc.)

When emptying the centrifugal pump please observe the following instructions!



**Warning!**

1. If the pump was used to deliver liquids that are hazardous to health, then great care must be taken in emptying the pump that neither persons nor the environment are placed at risk through the process.
2. If necessary, wear protective clothing and protective mask!
3. The rinsing liquid used and any residual fluid out of the pump must be caught and disposed of properly and without placing persons or the environment in any danger.
4. Pumps that deliver liquids that are hazardous to health must be decontaminated. In draining the delivery medium off care must be taken that neither persons nor the environment are placed in any danger.
5. Legal requirements must be adhered to!

### 6.2.3 Dismantling / Dismantling the pump

Before you begin

Begin the work only once you have checked that:

- The required spare parts are available and that they will fit this pump or your particular model thereof. Or that the suspected damaged parts can be obtained promptly. Make sure that the pump serial number is stated in your spare parts order.
- You have all the required tools and accessories for the work.



**Note:**

Use only original spare parts for the repairs!

All the gaskets must be replaced when the pump is re-installed.

Observing these instructions is a prerequisite for trouble-free operation of the pump and for the acceptance of potential claims under guarantee.

**Customer service:**



Schmalenberger provides a 24 hour service for the delivery of spare parts!

## 6.2.4 Dismantling the pump (from the suction side)

Place the pump on its blower cover and secure against tipping over.

### 1st step:

*Variant 1 = ZHT, ZHB, TH, DUO*

Loosen the nuts 920.01 on the connecting screws 905 on the clamping ring 531 (ZH3208) / suction cover 106/162 (ZH3213). Carefully remove the suction cover.

*Variant 2 = ZHS*

Loosen the nuts 920.01 on the connecting screws 905 on the suction stand 106/187. Carefully remove the suction stand.

### 2nd step:

Loosen the impeller nut 922 and screw it off the motor shaft 819.

Pull the first impeller 233/233.02 off the motor shaft 819 (with removal device).

Dismantle the stage casing together with the pressed-in distributor 147 or 109+171.

Remove the key 940 out of its seat.

Further steps (impeller, distributor, stage casing, distance washer 525, keys) pull off as described above.

The last distributor 171 (ZH 3208) – seen in the direction of flow – is pressed into the housing and prevented from twisting in the housing itself by a locking pin 561.

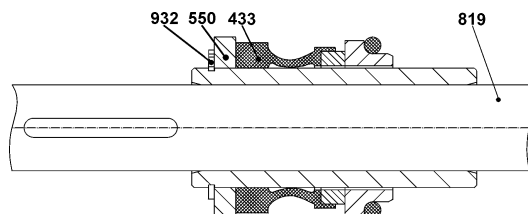
### 3rd step: Dismantling the mechanical seal (GLRD)

The mechanical seals used in the centrifugal pumps are not free of wear. When dismantling the pump check the mechanical seals for damage. Damaged mechanical seals must be completely replaced. Please observe the following instructions for this.

There are two types of GLRD built into the pumps. Please observe the pump specifications.

a) GLRD not relieved – up to max. 13 bar

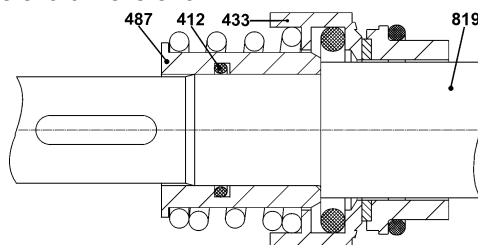
After loosening the locking ring 932 of the GLRD pull the sliding ring packet 433 off the shaft 819.



GLRD not relieved

b) GLRD relieved – up to max. 25 bar

Carefully pull the relieving bush 487 with the mechanical seal packet 433 and O-Ring 412 off the shaft Welle 819.



GLRD relieved

### 4th step:

Loosen lock nut 924, if existing.

Carefully pull off the housing 107/102 (106.02-DUO 3213) together with the pressed-in GLRD counter-ring, without damaging the shaft.

Now the counter-ring can be removed from its seat in the now loose housing 107/102.

### 5th step:

If existing, pull off lubrication ring / gamma ring 423 (ZH3208).

Remove intermediate piece 132.

## 6.2.5 Bearing pedestal

If your pump is equipped with an IEC Norm motor as drive, then there is a bearing pedestal for supporting the pump shaft and the coupling between the cover plate and the motor.

The bearings are enclosed and provided with grease that cannot be replenished.

The coupling is designed to last for the service life of the motor under normal operating conditions.

To replace the coupling or one of the bearings, proceed as follows:

- Loosen the drive from the bearing pedestal. Remove the motor with the upper half of the coupling.  
Now you can replace the inner coupling part.
- To replace the ball bearings the pump must be removed and dismantled as described in chapter 6.2.4 .
- Then remove the bearing pedestal together with the shaft from the cover plate.
- Remove the locking rings from the shaft and out of the bearing pedestal. Take out the ball bearings.

## 6.2.6 Intermediate piece / elongated immersion depth of the pump

Loosen the screws 914 holding the drive motor from the intermediate piece 132.

Dismantle the drive 802, if necessary loosen the cover plate 167 from the intermediate piece 132. Replace the clamp gasket 400 8if existing).

## 6.2.7 Pump re-installation

In principle the re-installation is in the reverse order of dismantling.

Please observe by way of preparation:

- Thoroughly clean all the individual parts of all dirt.
- Check all parts for wear. Damaged parts must be replaced by new ones.
- Clamp gaskets and O-rings must always be replaced by new ones. Grease O-rings prior to installation.

Exception: Do not grease O-rings on the GLRD. See the special instructions for installing the GLRD.

- When fitting the screw connections always tighten alternately cross-wise.  
Use a torque wrench for this.

The following table shows the recommended torque to be applied for standard DIN 13 thread.

Screw category:	5.6	6.9	8.8
<b>Screw M8</b>	10.8	21.6	25.5 NM
<b>Screw M10</b>	21.6	42.0	50.0 NM
<b>Screw M12</b>	38.2	73.5	87.2 NM
<b>Screw M16</b>	93.2	178	211 NM

The figures apply to new, ungreased screws. Use of the screw strain limit of 90%.

## 6.2.8 GLRD installation

### Preparation:

Increased cleanliness must be observed in the immediate area where the GLRD installation is to take place.

### Accessories:

- Propyl alcohol and cellulose cloth (no cleaning rags!)
- O-ring lifter
- Water and detergent

### Work steps:

- Unpack the GLRD and check for any damage.



### Warning! Risk of damage!

Never place sliding rings or their counterparts onto the sliding surface without using a protective cover.

- Thoroughly clean all sliding surfaces with propyl alcohol and cellulose cloths.
- In the case of GLRD with Elastomer bellows, to avoid friction when fitting the gasket, bellows and shaft should be moistened with water whose surface tension has been reduced by the addition of detergent, for example.



### Warning!

Under no circumstances must oil or grease be used to assist with the assembly!

- Cover the sliding surface with cardboard disc.
- Press the counter-ring slowly and steadily into the holding seat.

- Check that the counter-ring is seated at right-angles to the shaft axis.
- Clean the sliding surfaces to be striation free with propyl alcohol and cellulose cloths.



**Important:**

Do not touch the sliding surfaces with bare hands.

Push the rotating unit (bellows unit, sliding ring) onto the shaft by turning gently clockwise until the sliding ring lies against the counter-ring. Then push the set collar further up to the mark and fasten it to maintain the required initial stress. Ensure that the force is only applied via the rear winding of the pressure spring.



Installation of the mechanical seal

In the back-to-back arrangement, as well as for the GLRD without SKS, the required initial stress is produced through the installation of the locking ring 932 and the washer 550.



**Important:**

Use a suitable guide bush to push the GLRD over the keyways, etc. without damaging it.

You can order suitable guide bushes from Schmalenberger GmbH & Co. KG.

- Check that the thrust collar (spring collar), spring and sliding ring sit tightly.

Then continue with the assembly of the pump by fitting the keys, impellers, distributors and stage casings.

### 6.3 Spare parts list / Drawing

On pages 107 - 120 there are the spare parts list and the drawing of your pump.

Please take note of your pump type and the relevant model.

## 7

### 7.1

## Appendix

### Shutdown / Storage / Conservation

Every pump leaves the factory carefully assembled. If initial operation is predicted to be a long time after delivery we recommend the following measures for storage of the centrifugal pump.

#### 7.1.1 Storage of New Pumps

When requested, new pumps receive a conservation protection corresponding to the storage time stated by the purchaser.

If this period of time is considerably exceeded the condition of the pump must be checked and, if required, re-conserved.

#### 7.1.2 Longer Periods of Shutdown >3 months

##### 1. Pump remains installed

To ensure that the pump is always ready for operation and to prevent the formation of deposits inside the pump and in its immediate vicinity, the pump aggregate should be run for a short time (approx. 10 minutes) monthly or quarterly during longer periods of inactivity. Prerequisite for this is that sufficient fluid is supplied to the pump.

##### 2. Pump is removed and stored

To remove the pump proceed as outlined in chapter 6 "Maintenance / Repair" .

Prior to storing the pump it must be thoroughly cleaned and conserved. Conservation must be done both internally and externally.

#### 7.1.3 Restarting after Periods of Storage

##### De-conservation

Before the stored pump is re-installed the conservation agent (covering or filling) must be removed.

Proceed as described in chapter 4.2.2 "Cleaning" .



**Warning!**

After long periods of storage under conservation conditions check the shape stability and elasticity of the Elastomers (O-rings and mechanical seals). Brittle rings must be replaced. Elastomers made of EPDM should be replaced in any event.

**Restarting**

Re-install the pump according to the procedure described in chapter 4.3 "Installing and connecting".

Immediately after completing the above work, all safety and protective measures must be properly installed and checked that they function.

Before the pump is re-started the checks and maintenance measures stated in chapter 6.1 "Maintenance / Service" must be carried out. For the new re-start the points listed in section 5.1 "Initial start-up" must also be observed.

**Particularities of the mechanical seal:**

Prior to an initial start-up and after longer periods of standstill or after a new mechanical seal is installed it is important to check that the pump runs freely.

The sliding ring and its counterpart ring can stick together very firmly due to adhesive forces. The force of the driving spring is then not enough to break the sliding ring away.

In this case the shaft runs in the static seals and the driving spring, which leads to damage. Remove the blower cover and turn the blower wheel in the direction of the arrow. If there is resistance and the blower wheel feathers back then the mechanical seal has to be removed and the sliding ring and its counterpart ring must be carefully separated.

**Under no circumstances should the shaft be turned by force.**

**7.2 Disposal**

If you want to take the pump completely out of service and never re-use it then please observe the local regulations for the disposal of industrial waste.



**Warning! Mortal danger / poison!**

Pumps that have delivered poisonous, caustic or other chemical substances which are a danger to people and the environment must be thoroughly cleaned and / or decontaminated prior to being disposed of.

The cleaning agents and rests of the delivery medium must also be handled in accordance with legal requirements.

If such legal regulations exist in the area where the pump is operated then the pump must be completely dismantled and sorted into the different materials so that they can be disposed of separately.

**7.3 Supporting documents for pump operation**

The following documents are enclosed:

- Operator's manual
- Dimensional sketch

In case of complaints regarding the pump motor, please contact us or the motor manufacturer.

**7.4 Data sheet**

The enclosed data sheet corresponds to the pump supplied.

You are not allowed to change the dimensions of the pump.



**Important:**

If changes have subsequently been made to the pump supplied then any claims under the guarantee will be void.

Please also be sure to observe the other documentation referred to in these operating instructions, see chapter 1.3 !

## **7.5 Important Instructions**

### **7.5.1 Factory repair**

Please observe the following instructions if the pump is sent back to the factory for repair:

1. If you send the pump back to the manufacturer for repair or an upgrade then please be sure to enclose precise details of the media that were delivered by the pump.



#### **Warning!**

2. If the delivered media were poisonous, caustic, etc. then please be sure to enclose a copy of the safety sheet for the media!

3. Only pumps that are completely empty and clean will be accepted for repair.

### **7.5.2 Ordering Spare Parts**

When ordering spare parts please do not fail to give us the following important information:

- Pump serial number and type description or alternatively the motor serial number
- Delivery medium
- Part number from the spare parts list
- Part description
- Material data from the specifications or the order confirmation

The pump serial number is on the type plate which is fastened to the blower cover of the motor.

The order confirmation or motor serial number may also be of assistance.

With this information you make it much easier for us to deliver the correct spare part for your pump!

**schmalenberger**  
strömungstechnologie

#### **Customer service**

Schmalenberger provides a 24 hour service for the delivery of spare parts!

See our homepage under:  
[www.schmalenberger.de](http://www.schmalenberger.de)

Head office address:  
Schmalenberger GmbH & Co. KG  
Im Schelmen 9 - 11  
D-72072 Tübingen

Telephone:  
+ 49 (0) 7071 - 7008-0

Telefax:  
+ 49 (0) 7071 - 7008-59

## 8 Spare parts list and drawings



**Note:**

The drawings of spare parts are illustrated in the following order:

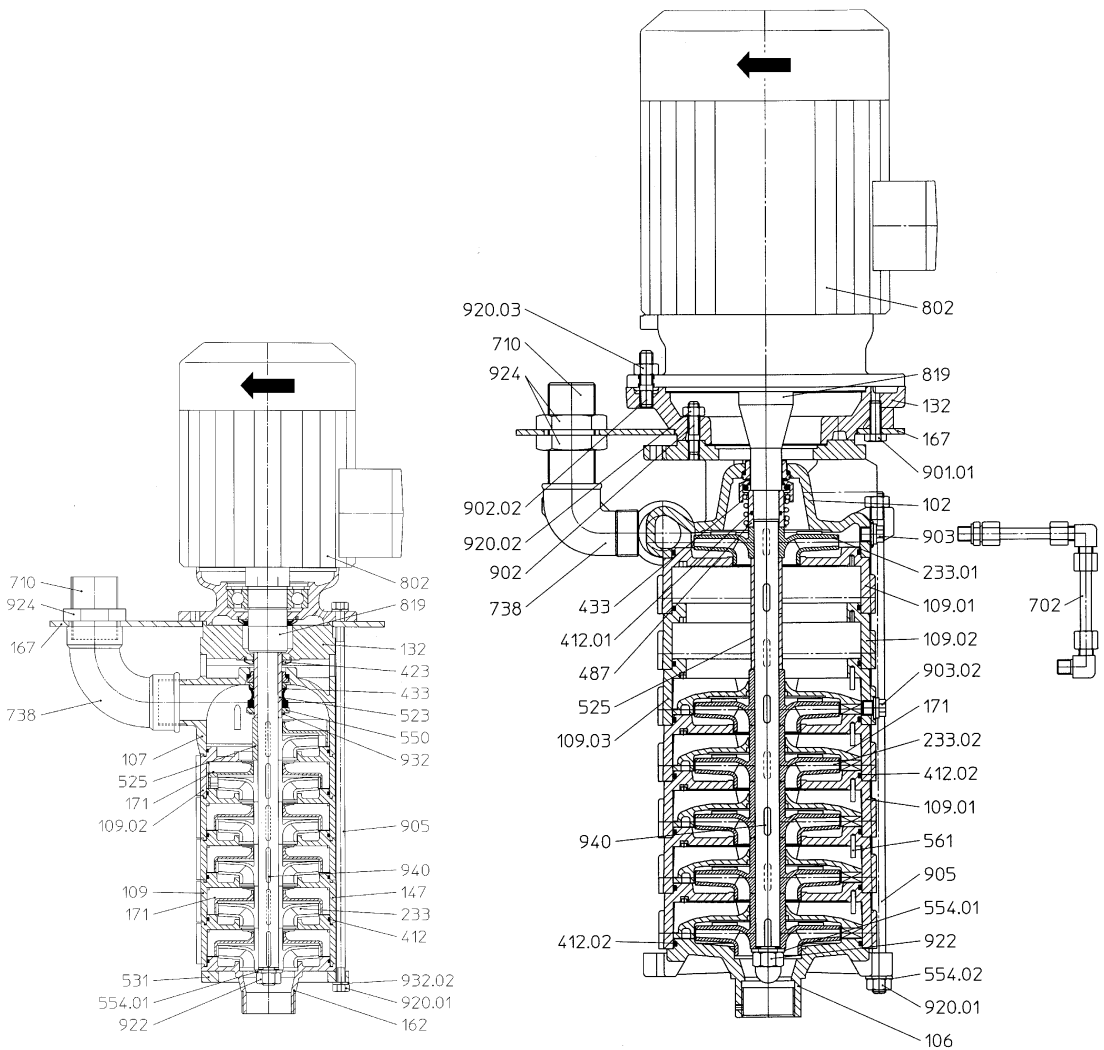
1. ZHT
2. ZHS
3. ZHB
4. TH / THK
5. DUO
6. ZH with additional second pressure outlet
7. ZHT with elongated immersion depth
8. Bearing pedestal for ZH

In the spare parts list (page 118 ff) all parts of all the pump types are listed.  
Not all parts are built into every pump, however.

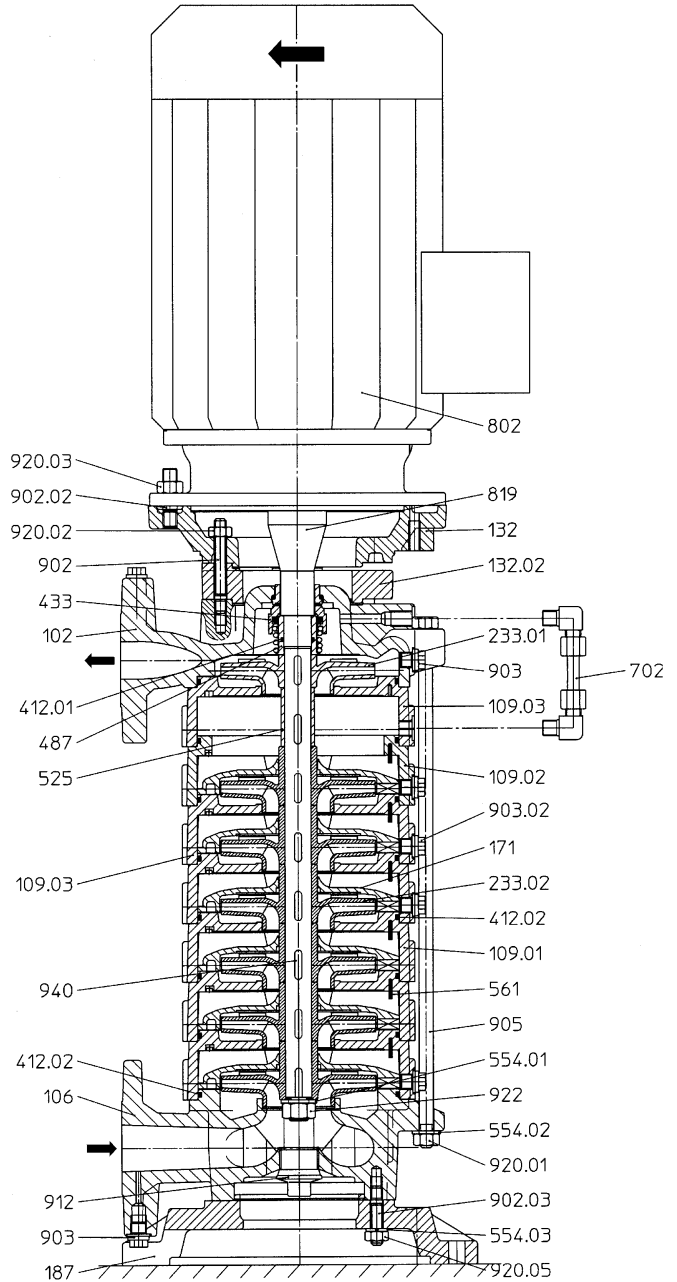


**Typ ZHT 3208**

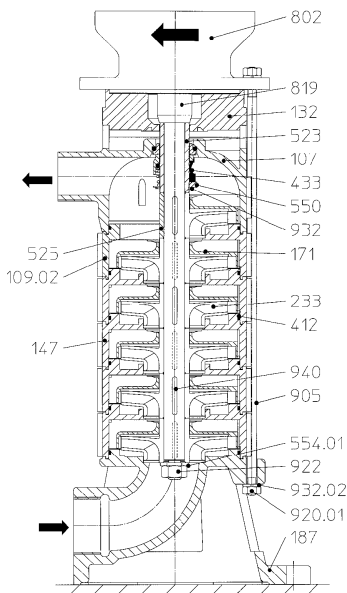
**Typ ZHT 3213 / 4016**



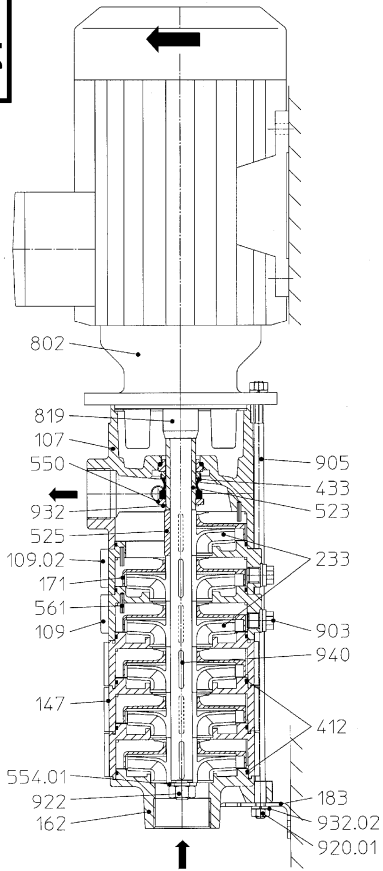
**Typ ZHS 3213 / 4016**



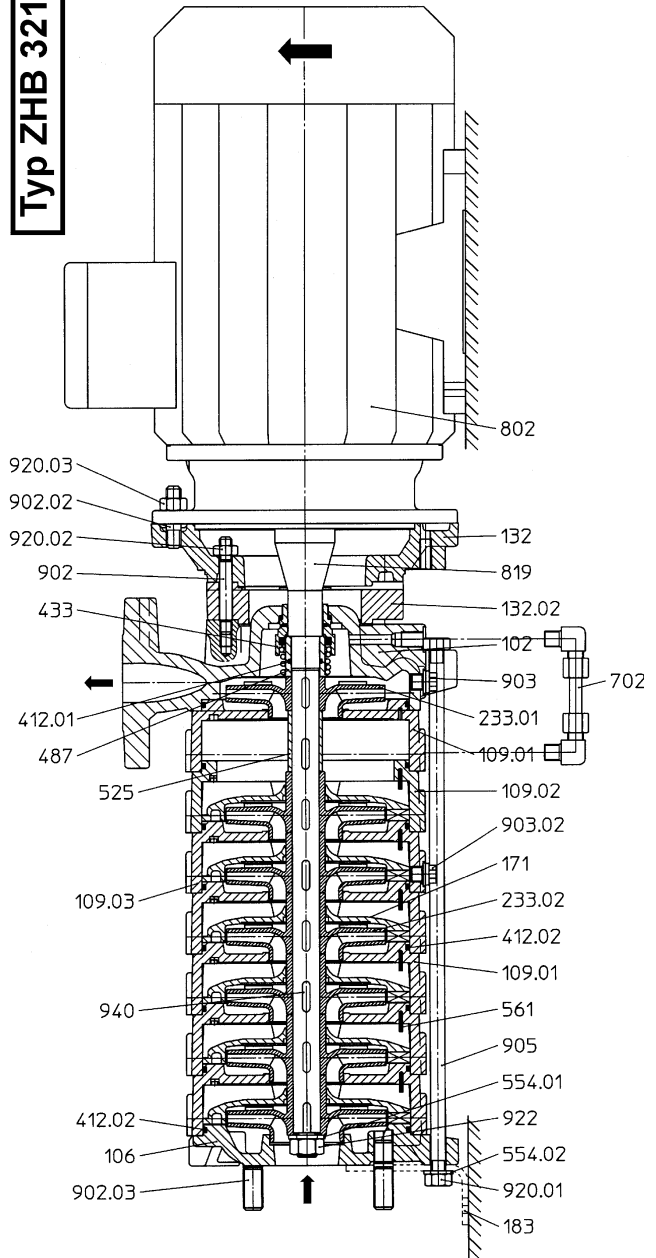
**Typ ZHS 3208**



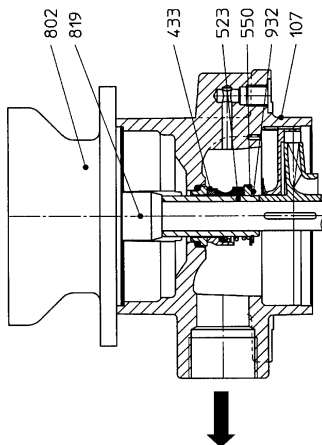
**Typ ZHB 3208**



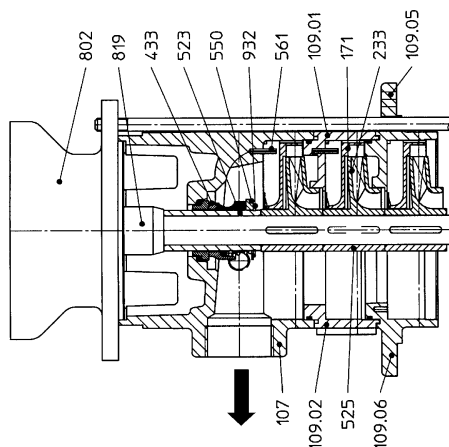
**Typ ZHB 3213 / 4016**



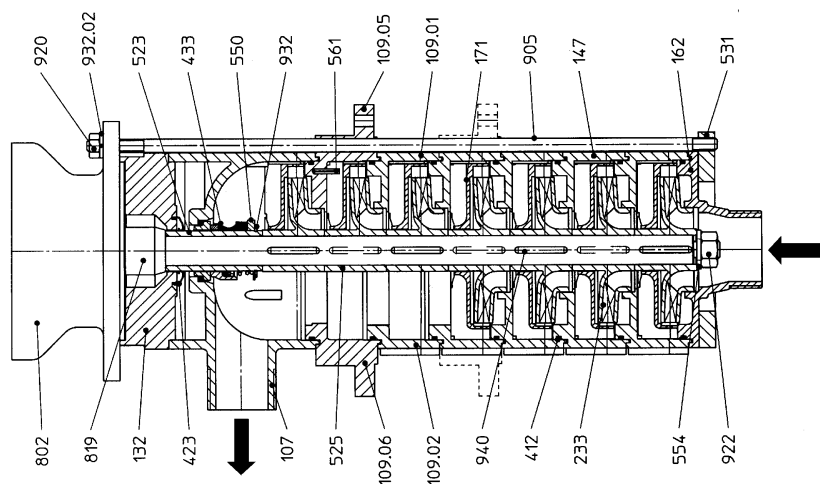
**Typ TH 3208\*\***



**Typ TH 3208\***



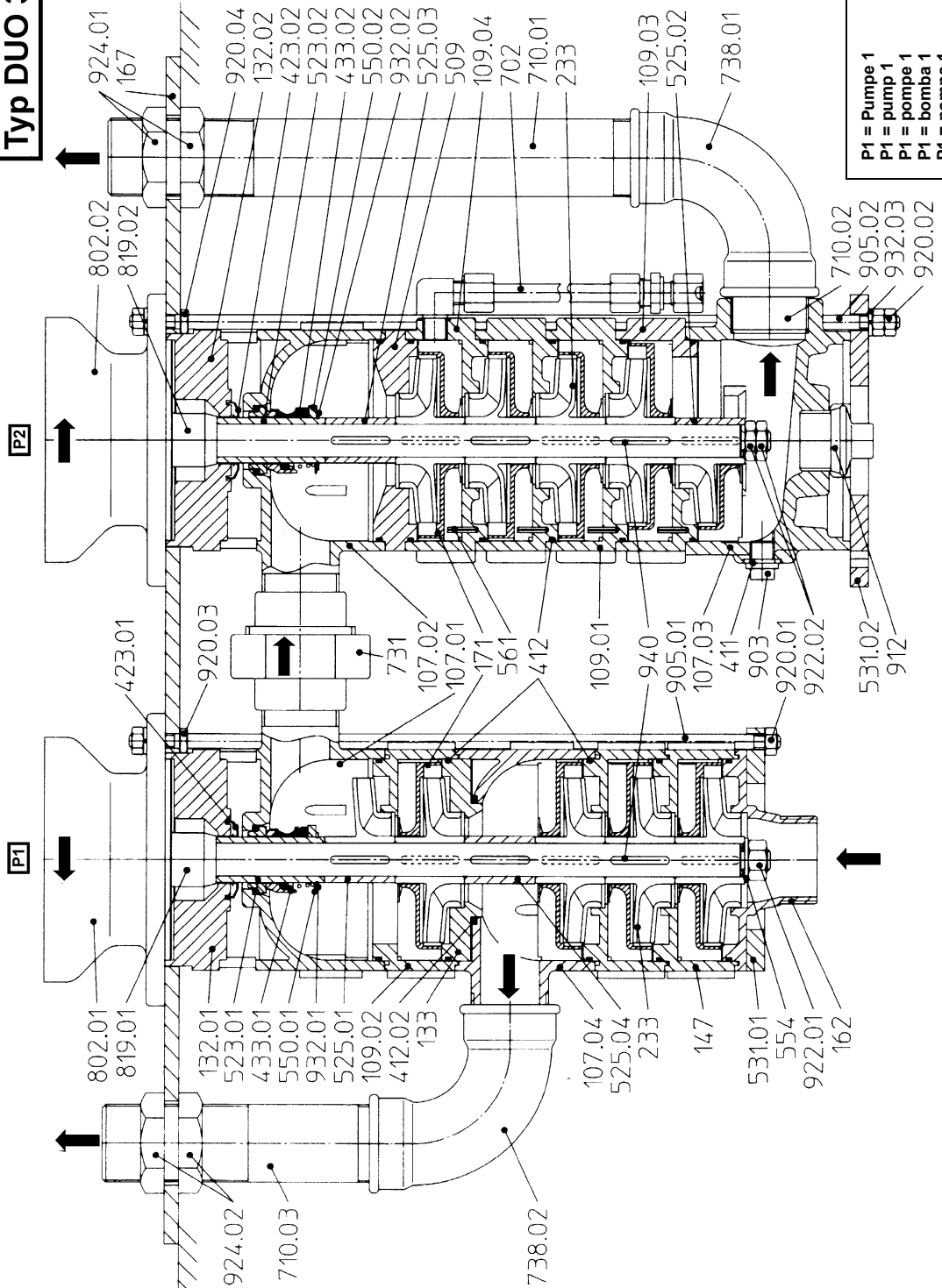
**Typ THK 3208**



\*\* = GG - Pumpengehäuse mit Flansch  
\*\* = carter de pompe en fonte grise avec bride  
\*\* = cast iron pump housing with flange  
\*\* = Diseño de bomba en fundición gris con brida  
\*\* = alloggiamento pompa GG con flangia

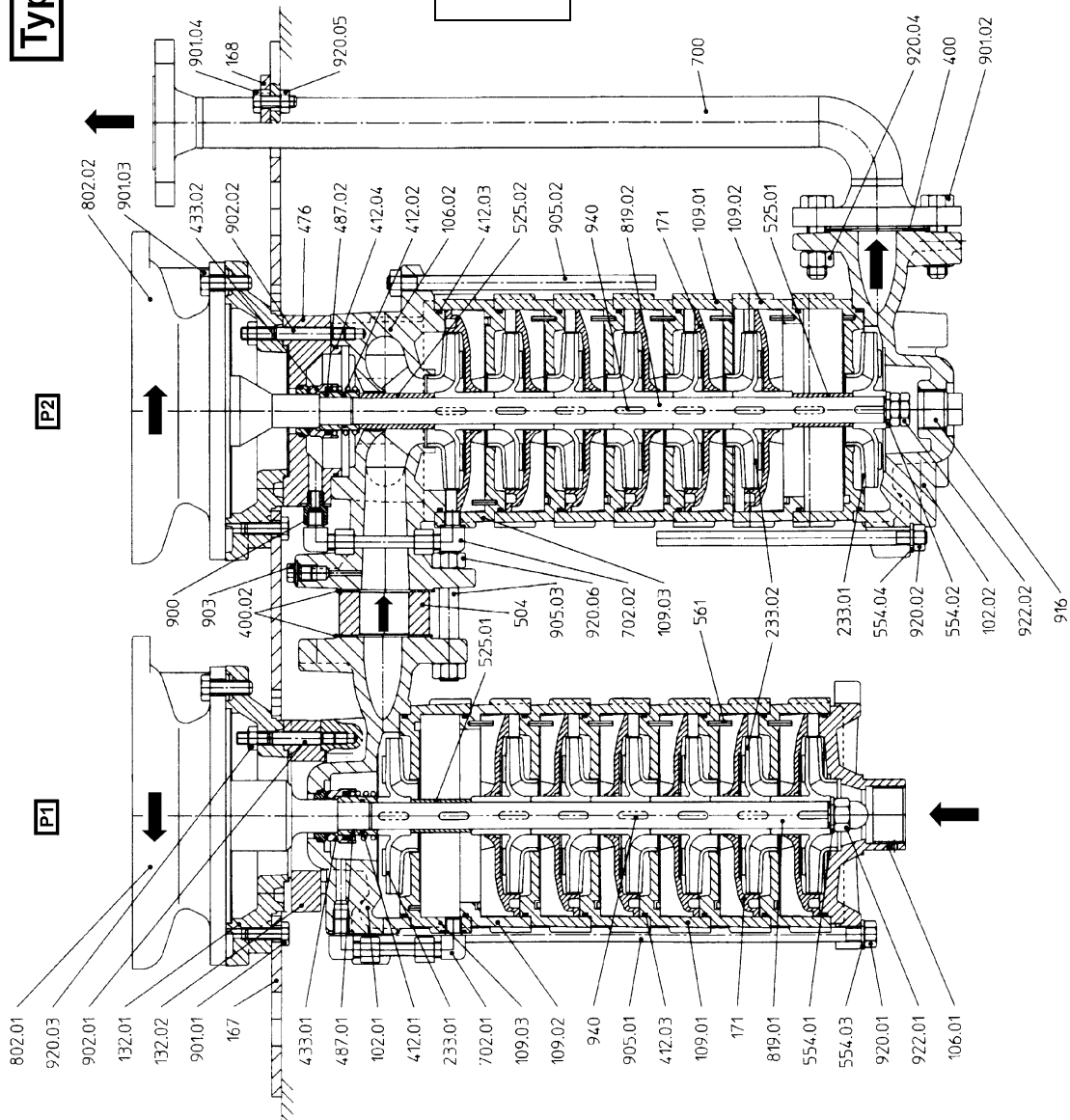
\* = GG - Ausführung  
\* = exécution en fonte grise  
\* = cast iron model  
\* = Diseño en fundición gris  
\* = modello GG

**Typ DUO 3208**



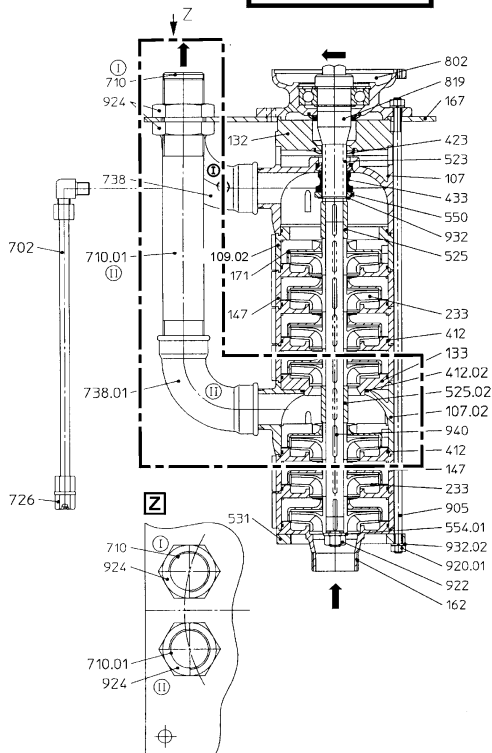
P1 = Pumpe 1  
P1 = pump 1  
P1 = pompe 1  
P1 = bomba 1  
P2 = Pumpe 2  
P2 = pump 2  
P2 = pompe 2  
P2 = bomba 2

**Typ DUO 3213**

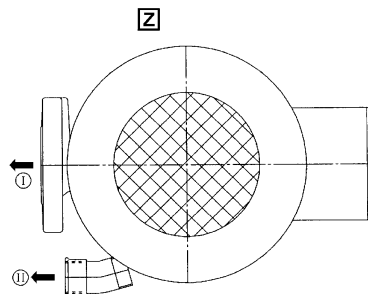
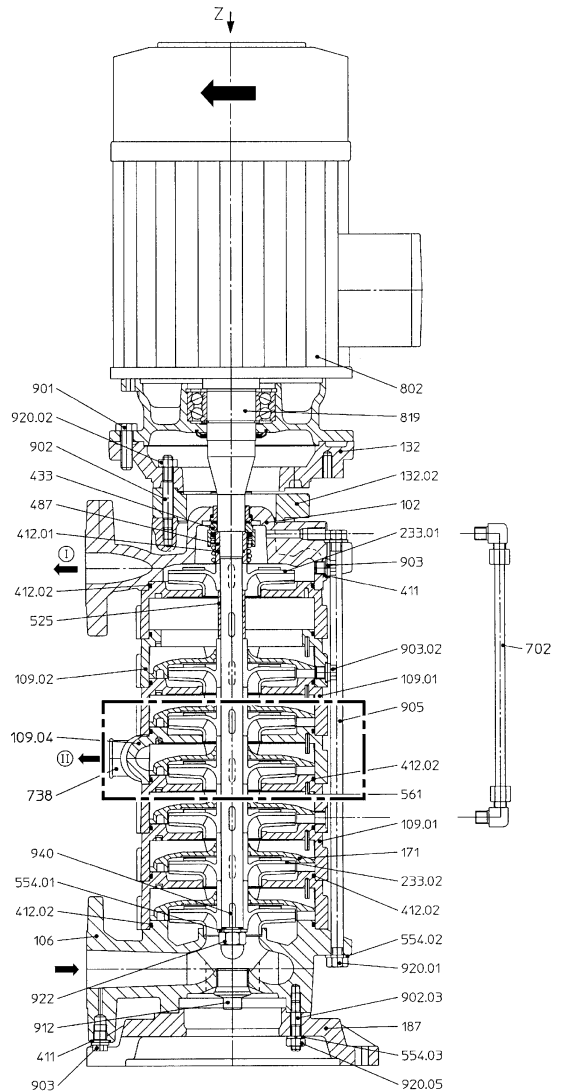


\* = mit zusätzlichem Druckausgang  
 \* = avec sortie de pression additionnelle  
 \* = with additional pressure outlet  
 \* = con salida adicional de bomba  
 \* = con uscita di pressione addizionale

### Typ ZHT\*

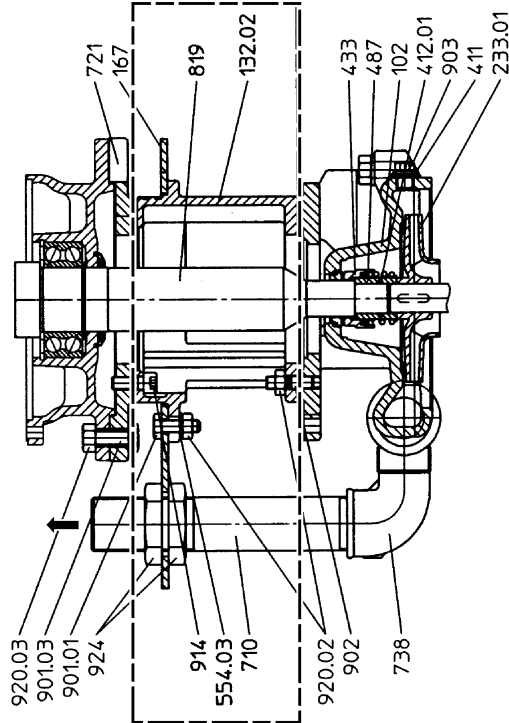


### Typ ZHS / ZHB\*

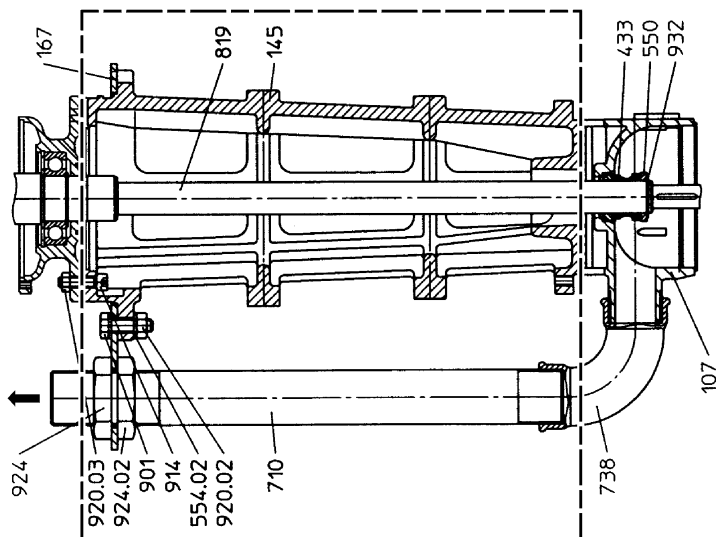


## Typ ZHT 3213\*

\* = verlängerte Eintauchtiefe  
 \* = profondeur de plongée augmentée  
 \* = elongated immersion depth  
 \* = profundidad prolongada de inmersión  
 \* = pescante accresciuto

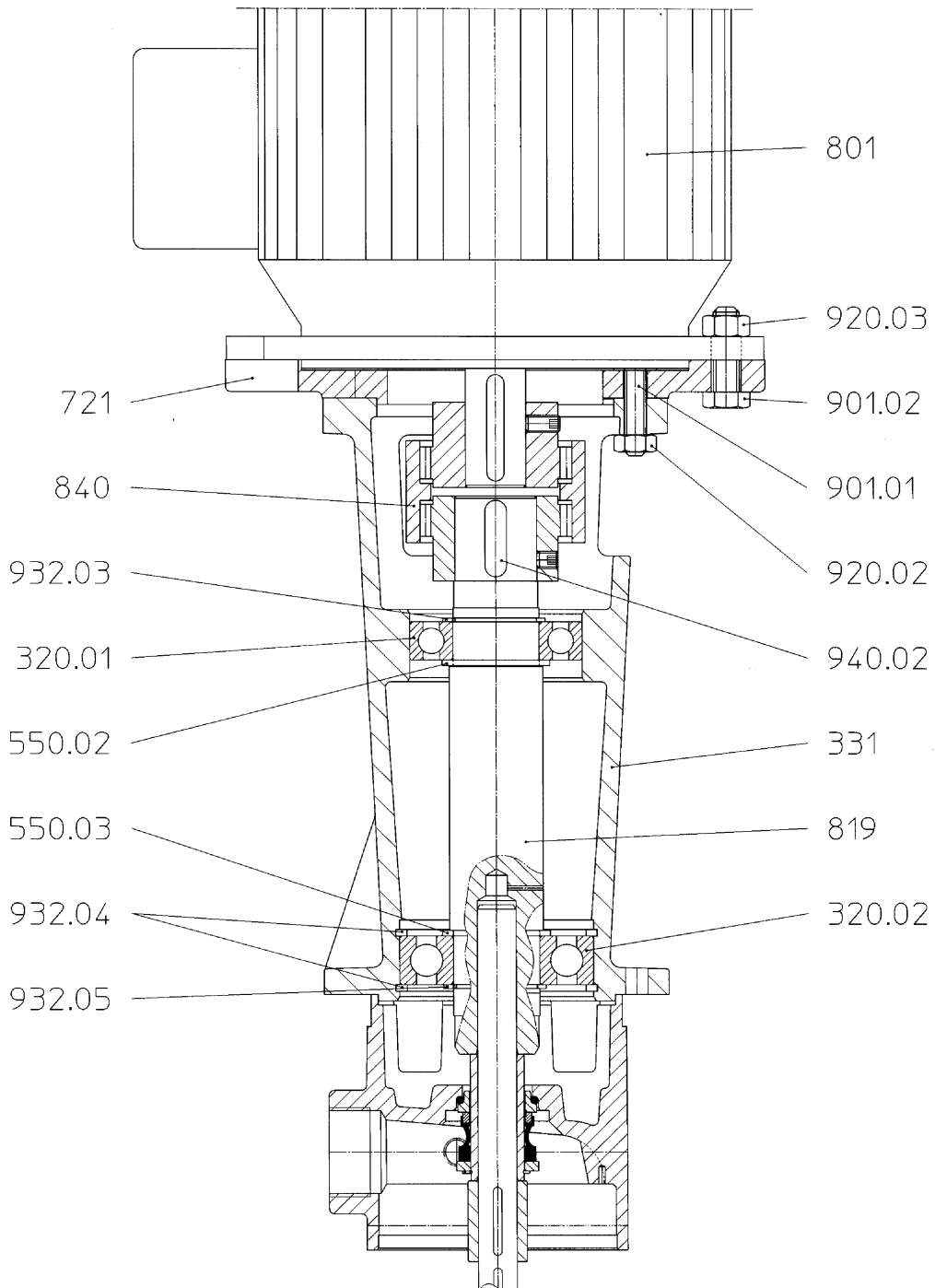


## Typ ZHT 3208\*





**Typ ZH...-L**



**8.1 Ersatzteilliste / Liste des pièces détachées / Spare parts list / Listado de piezas de repuesto /  
Lista dei pezzi di ricambio**

<b>Pos.:</b>	<b>D</b> <b>Benennung:</b>	<b>F</b> <b>Désignation</b>	<b>GB</b> <b>Denomination</b>	<b>E</b> <b>Denominación</b>	<b>I</b> <b>Descrizione</b>
102/01/02	Spiralgehäuse	carter spirale	spiral housing	carter espiralado	chiocciola
106/01/02	Sauggehäuse	suction housing	suction housing	carter de succion	coperchio aspirante
107/01/02/03	Druckgehäuse	carter	housing	carter de presion	carcassa
107.04	Druckgehäuse für 2. Druck- ausgang	carter pour 2. sortie de pres- sion	housing for 2nd pressure output	carter de presion para segunda descarga de pre- sión	carcassa per la 2ª uscita di pressione
109/01/02/03/04	Stufenmantel	carter d'étage	stage casing	Envoltura escalonada	rivestimento stadi
109.05	Stufenmantel mit Flansch ausgedreht	carter d'étage avec bride alésé	stage casing with bored flange	Envoltura escalonada con brida, mandrilado	rivestimento stadi con flan- gia, svitata
132/01/02	Zwischenstück	Elément intercalaire	Intermediate piece	Pieza intermedia	Pezzo intermedio
133	Spaltwand für 2. Druckaus- gang	Paroi à fente pour 2. sortie de pression	Partitioning wall for 2nd pressure output	Pared de intersticio para segunda descarga de pre- sión	Parete di intervallo per la 2ª uscita di pressione
145	Verbindungsstück	pièce raccord	connecting piece	pieza de connexion	raccordo du collegaento
147	Stufenmantel mit Leitrad komplett (Kunststoff)	Carter d'étage avec distribu- teur complet (plastique)	Stage casing complete with distributor (plastic)	Envoltura escalonada con rueda guía, completo (plá- stico)	Rivestimento stadi con dis- tributore, completo (pla- stica)
162	Saugdeckel	carter aspiration	suction cover	tapa de succion	coperchio aspirante
167	Abdeckplatte	plaque couverture	cover plate / blanking plate	tapa covertora	piastra d'appoggio
168	Verschlussplatte	Plaque de fermeteure	Sealing plate	Placa de cierre	Piastra di chiusura
169	Verschlussdeckel	Couvercle	Sealing cover	Cubierta de cierre	Coperchio di chiusura
171	Leitrad	distributeur	distributor	distribuidor	distributore
183	Stützfuß	support	support	Pie de apoyo	Piede di supporto
187	Saugständer	Console d'aspiration	Suction stand	Soporte de aspiración	Montante di aspirazione

Pos.:	D	F	GB	E	I
Benennung:	Désignation	Denomination	Denominación	Descrizione	
233/01/02	Laufrad	turbine	impeller	turbina	girante
320/01/02	Wälzlager	Roulement	Roller bearing	Rodamiento	Cuscinetto a rullo
331	Lagerbock	Support	Bearing pedestal	Soporte del cojinete	Supporto cuscinetto
400/01/02	Flachdichtung	joint plat	clamp gasket	empaquetadura plana	tenuta piatta
411	CU-Ring	Bague CU	CU-ring	Anillo CU	Anello CU
412/01/02/03/04	O-Ring	joint torique	o-ring	anillo-o	Anello O
420	V-Ring	bague en V	v-ring	anillo -V	Anello V
423/01/02	Gamma-Ring	Anneau gamma	Gamma ring	Anillo gamma	Anello gamma
433/01/02	Gleitringsdichtung	joint mécanique	mechanical seal	retén frontal	tenuta ad anello scorrevole
473	Dichtungsträger	Porte-joint	Gasket support	Portador de empaquetadura	Supporto tenuta
476	Gegenringträger	Support de contre-anneau	Counter-ring support	Portador de contraanillo	Supporto controanello
487	Entlastungshülse	Douille de décharge	Relieving bush	Manguito de descarga	Manicotto di scarico
504	Abstandsring	Bague d'écartement	Distance ring	Anillo distanciador	Anello distanziatore
509	Zwischenring	Bague intercalaire	Intermediate ring	Anillo intermedio	Anello intermedio
523/01/02	Wellenhülse	Douille d'arbre	shaft sleeve	Manguito del árbol	Manicotto albero
525/01/02/03/04	Abstandhülse	Douille d'écartement	Distance sleeve	mango de distancia	Manicotto distanziale
531/01/02	Spannring	Bague de serrage	Clamping ring	Anillo tensor	Anello elastico
550/01/02/03	Scheibe	rondelle	distance washer	arandela	rondella distanziatrice
554/01/02/03/04	Unterlegscheibe	rondelle	distance washer	arandela	rondella distanziatrice
561	Zylinderkerbstift / Spannstift	goupille encochée cylindrique / Goupille de serrage	locking pin / Locking pin	Manguito de sujeción	Coppiglia di serraggio
700	Rohrleitung	tuyauterie	pipework	tuberia	tubatura
702/01/02	Bypass	bypass	bypass	bypass	bypass
710/01/02/03/04	Druckrohr	tuyau pression	pressure pipe	tubo de presion	tubo di pressione
712	Zwischenrohr	Douille d'écartement	Spacer pipe	Tubo intermedio	Tubo intermedio

Pos.:	D	F	GB	E	I
	Benennung:	Désignation	Denomination	Denominación	Descrizione
721	Übergangsfansch, Übergangsstück	Bride-raccord, raccord	Transition flange, transition piece	Brida de acoplamiento, pieza de acoplamiento	flangia di giunzione, pezzo di giunzione
726	Düse zu 702	buse pour 702	nozzle for 702	inyector para 702	ugello per 702
731	Rohrverschraubung	Raccord fileté pour tube	Screwed pipe joint	Unión roscada de tubos	Raccordo a vite per tubi
738/01/02	Bogen, Winkel	Coude, angle	Bend, angle	Curva, ángulo	Arco, angolare
801	Normmotor	moteur à normes	norm-Motor	motor normal	motore normale
802/01/02	Blockmotor	block motor	block motor	motor en bloque	motore a blocco
819	Motonwelle	arbre de moteur	motor shaft	cigüenal	Albero motore
840	Kupplung	accouplement	coupling	acoplamiento	giunto
900	Verlängerung zu 702	Allonge pour 702	Extension for 702	Prolongación para 702	Prolunga per 702
901/01/02/03/04	Sechskantschraube	vis six pans	hexagon screw	vite esagonale	vite esagonale
902/01/02/03	Stiftschraube	bouton fileté	locking screw	tornillo de cierre	perno filettato
903/01/02	Verschlußschraube	bouchon	plug screw	tornillo de cierre	Tappo otturatore
905/01/02/03	Verbindungsschraube	vis raccord	connecting screw	tornillo de coneccion	Vite di connessione
912	Entleerungsstopfen	Bouchon de vidange	Outflow stopper	Tapón de descarga	Tappo di svuotamento
914	Zylinderschraube mit Innensechskant	Vis à tête cylindrique à six pans creux	Cylinder screw with hexagon socket	Tornillo cilíndrico con hexagona interior	Vite a testa cilindrica con esagona cavo
916	Stopfen	Bouchon	Stopper	Tapón	Tappo
920/01/02/03/04/05/06	Sechskantmutter	ecrou six pans	hexagon nut	tuerca hexagonal	dado esagonale
922/01/02	Laufadmutter	écrou turbine	impeller cap nut	tuerca turbina	Dado girante
924/01/02	Gegenmutter	Contre-écrou	Lock nut	Contratuerca	Controdado
932/01/02/03/04/05	Sicherungsring	Circlip	Retaining ring	Anillo de empaquetadura	Anello di sicurezza
940/01/02	Paßfeder	ressort d'ajustage	key	lengueta	linguetta



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