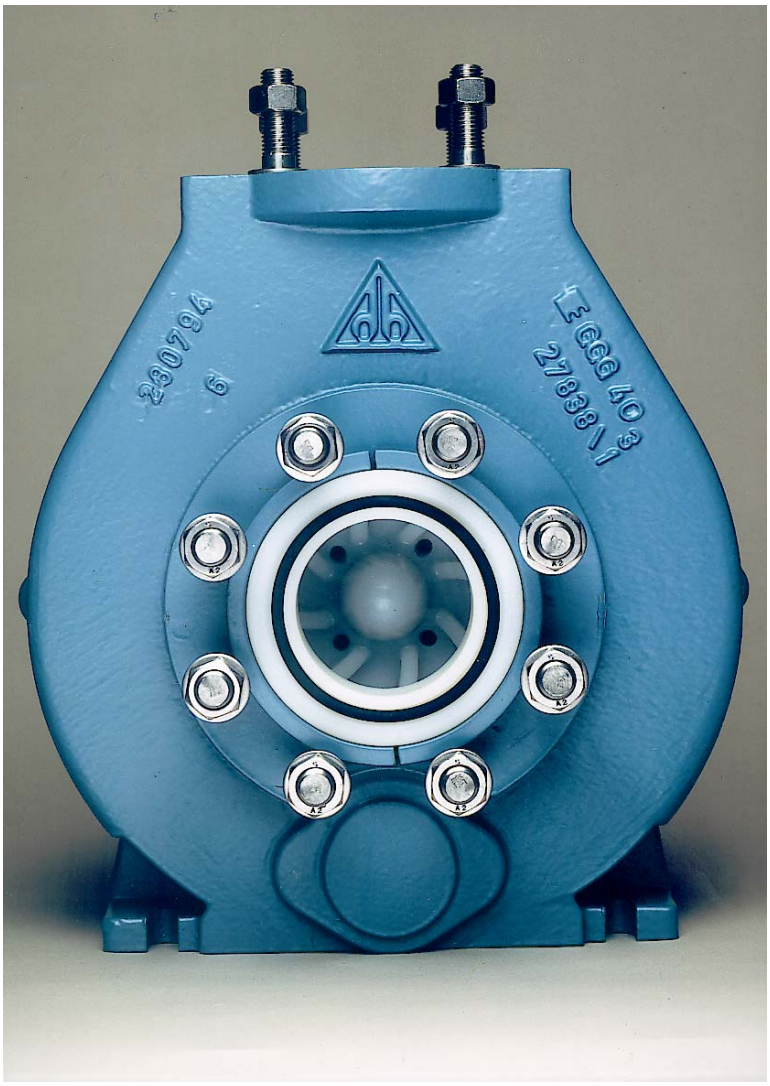
Englisch

Operating instructions

Standard chemical pump of plastic material Type series NE ISO 2858 / DIN EN 22858

Also for pumps according to EC Council Directive 94/9 (ATEX)



WERNERT-PUMPEN

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2006-11

1. General

1.1 Application of the pump

WERNERT chemical standard pumps of the NE series are horizontally positioned machines to pump liquids. They are always and only intended to be installed in a suitable system. As the liquids being pumped are usually dangerous (poisonous, flammable, caustic), it is very important that the safety instructions contained within these operating instructions are adhered to.

1.2 Validity of the operating instructions

These operating instructions only apply to pumps of the NE series in the standard designs. We reserve the right to make technical changes. In the case of special constructions and designs, the documentation specific to the order must be taken note of. If in doubt, please contact the manufacturer.

1.3 Declarations

1.3.1 Manufacturer's declaration

(as defined by EU directive Machines 98/37/EC, Appendix II B)

Manufacturer: WERNERT-PUMPEN GMBH
Oberhausener Str. 67-79
45476 Mülheim an der Ruhr
B. R. Deutschland - Germany

General manufacturer's declaration for standard chemical pumps of the NE series

The manufacturer hereby declares that the pump(s) of the type series NE are meant to be installed in a machine (in this case plant).
The manufacturer would like to point out that starting up the above mentioned pump(s) is/are not permitted until it has been determined whether the machine (here plant), into which the above mentioned pump(s) is/are to be installed conform(s) with the EU directive Machines 98/37/EC.

Applied harmonised standards:
EN 292, Parts 1 and 2
DIN EN 294
DIN EN 394
EN 809
DIN EN 12162
DIN EN 1050
DIN EN 22858

Mülheim an der Ruhr, 30.06.2003

ppa. Christian Wallrodt
Engineering and Sales Manager
WERNERT-PUMPEN GMBH

1.3.2 Declaration of Conformity (Directive 94/9/EC)

(refer 2.9.1)

In accordance with Directive 94/9/EC of the European Parliament and Council of 23 March 1994 concerning the harmonisation of legal regulations of the Member States governing equipment and protective systems destined for used in potentially explosive areas (Annex IX B).

Manufacturer: WERNERT-PUMPEN GMBH
Oberhausener Str. 67-79
45476 Mülheim an der Ruhr
B. R. Deutschland - Germany

Products: WERNERT chemical standard pumps of the NE series are horizontally positioned machines to pump liquids.
qualify as "equipment" in accordance with Article 1, Para. 3a).

The conformity assessment procedure is based on Article 8, Para. 1 b) ii).
The pump is intended for use as equipment of Group II, category 2, gas atmosphere (G), in accordance with Directive 94/9/EC, for use in potentially explosive areas.

II 2 G c (T1-T4) Information on the temperature class and maximum working temperature of the pumped medium can be found in the operating manual. It is presumed that the product is installed and operated in conformity with its intended use. Information on the intended use can be found in the operating manual.

The manufacturer herewith declares that the pump type series NE is intended for installation in a machine (in this case plant).
The manufacturer draws attention to the fact that commissioning of the aforementioned pump is prohibited until it has been established that the machine (in this case plant) in which the pump is to be installed complies with the requirements of Directive 94/9/EC governing equipment and protective systems destined for use in potentially explosive areas, as well as of Directive 1999/92/EC concerning the minimum regulations for improving the health and safety of employees who may be endangered by potentially explosive atmospheres.

Applied Community Directive
and harmonised standards: Directive 94/9/EC governing equipment and protective systems destined for use in potentially explosive areas.

If the pump is delivered as a complete unit with motor and coupling, this unit complies with the requirements of Machine Directive 98/37/EC.

EN 13463-1 EN 13463-5
EN 1127-1

Mülheim an der Ruhr, 30.06.2003

ppa. Christian Wallrodt
Engineering and Sales Manager
WERNERT-PUMPEN GMBH

1.4 Technical design

The pumps of the NE series are horizontal rotary pumps with axial entry PN 16 as defined by standard ISO 2858/ DIN EN 22858. A mechanical seal (MS) is installed as shaft seal.

Pump sizes NE 40-25-160 and NE 250-200-400 have been designed based on ISO 2858/ DIN EN 22858 (trans-standard pumps).

The dimensions "f" and "w" of pumps with torque flow design (hydraulic design identification F) do not comply with the standard ISO 2858/ DIN EN 22858. They are longer in the axial direction: other dimensions are identical.

The letter "D" is added to the type designation of pumps equipped with throttling bush (e.g NEPO 50-32-160 D). This throttling bush, which is not part of the pump, is centrally positioned on the delivery connector and secured between pump and the piping to be connected.

1.5 Type description

The type description is made up of a four letter code and the size as defined by standard ISO 2858/ DIN EN 22858. The letter "D" is added to the type designation of pumps equipped with throttling bush (please refer to 1.4 and 5.3.6).

1st and 2nd letter	Series identification, here NE
3rd letter	Main material : A = PTFE, antistatic or PFA, antistatic B = Polypropylene (PP) E = epoxy resin bound special moulding compound Durapox® K = Polyvinylidenfluoride (PVDF) L = UHMW-PE, antistatic P = ultra high molecular low pressure polyethylene (UHMW-PE) T = Polytetrafluorethylene (PTFE) or Perfluoralkoxy (PFA) W = reinforced mineral cast Wernit®
4th letter	Hydraulic design : F = semi-open impeller in torque flow model G = closed impeller with sealing strips O = semi-open impeller S = closed impeller with front and back vanes X = Special hydraulics

Example: A pump of size 200-150-250 as defined by DIN ISO 2858/ DIN EN 22858 with semi-open impeller, material UHMW-PE, is described as type **NEPO 200-150-250**.

1.6 Type plate

Every pump has a type plate attached to it. It lists the following details:

- Name and address of the WERNERT company as manufacturer
- Type description
- Serial number of the pump
- Impeller diameter, impeller blade height and number of blades
- Diameter of a possibly used throttling bush
- Designed volume flow [m³/h] and associated delivery head [m]
- Necessary coupling power and nominal power of driver [kW]
- Nominal speed
- Density of the liquid to be pumped
- Data regarding the mechanical seal used

The additional name plate for a pump according to EC Council Directive 94/9 (ATEX) contains the following data:

- Marking for the potentially explosive atmosphere with equipment group, equipment category, type of protection and temperature class TX and as additional marking the symbol "X" for the limited ambient temperature of "-10°C Ta +40°C"
- Tech. Doc.: Manufacturer's reference number for the Technical Documentation
- Year of construction

Explanations regarding the name plate can be found in Annex A to this operation manual.

1.7 Liability

No warranty is furnished for any damages due to the following reasons: Unsuitable or improper use, incorrect mounting and/or commissioning by the customer or any third party, natural wear and tear, incorrect or negligent treatment, unsuitable operational equipment, exchange materials, defective construction work, unsuitable subsoil, chemical, electro-chemical or electric influences unless attributable to a fault of the supplier's.

2. Safety

This operation manual contains basic hints to be observed during installation, operation and maintenance. Therefore, prior to mounting and commissioning, this operation manual must by all means be read by the fitter as well as the responsible expert personnel/user and must always be available at the place of installation of the machine/plant.

Not only are the general safety hints listed under this Section "Safety" to be observed, but also the special safety hints added to the other sections.

2.1 Marking of hints in the operation manual

The safety hints contained in this operation manual which, in case of non-compliance, may cause danger to personnel, are particularly marked with the general danger symbol

Safety sign according to DIN 4844 - W9

in case of warning against electric voltage with

Safety sign according to DIN 4844 - W8.

When employed in potentially explosive atmospheres, the safety hints to be additionally observed are marked with

Pumps which, corresponding to EC Council Directive 94/9, are employed in potentially explosive atmospheres, must be marked with this symbol and the CE sign on the name plate (please refer to Annex A).

For safety hints, non-compliance with which may cause danger to the machine and its functions, the word

ATTENTION is added.

Hints directly attached to the machine such as
- rotation arrow
- sign for fluid connections

must by all means be observed and maintained in completely legible condition.

2.2 Personnel qualification and training

The personnel for operation, maintenance, inspection and mounting must have the corresponding qualification for these operations. Range of liability, competence and the supervision of the personnel must be exactly defined by the user. If the personnel do not have the required knowledge, same must be trained and instructed. If required, this may be effected by the manufacturer/supplier on behalf of the machine user. In addition, it must be ensured by the user that the contents of this operation manual and the operation manuals of the plant are fully understood by the personnel.

2.3 Dangers in case of non-compliance with the safety hints

Non-compliance with the safety hints may result not only in danger to personnel, but also to environment and machine. Non-compliance with the safety hints may lead to the loss of any claims for damages.
In detail, non-compliance may, for example, entail the following dangers:

- Failure of important functions of the machine/plant
- Failure of specified methods for maintenance and servicing
- Danger to personnel by electrical, mechanical, magnetic, thermal or chemical influences as well as by explosion
- Danger to the environment by leakage of dangerous substances

2.4 Responsible working

The safety hints mentioned in this operation manual, the current national rules for the prevention of accidents as well as any internal working, operating and safety regulations of the user must be observed.

2.5 Safety hints for the user/operator

If hot or cold machine parts lead to dangers, these parts must be protected by the user against accidental contact at the site according to EN 294. Protection against accidental contact with moving parts (e.g. coupling) must not be removed when the machine is in operation.
Leakages (e.g. of the shaft seal) of dangerous substances to be pumped (e.g. explosive, toxic, hot) must be discharged so as not to result in danger to personnel and the environment. Legal stipulations are to be observed.
Dangers by electrical energy are to be excluded (for details with regard hereto, please refer e.g. to the VDE regulations and the local energy supply associations).
If the pumps are used in potentially explosive atmospheres, any operating conditions must be avoided which may raise the surface temperature of the pump to an unacceptable degree or lead to sparking.

2.6 Safety hints for maintenance, inspection and mounting operations

The user shall see to it that all maintenance, inspection and mounting operations are performed by authorized and qualified expert personnel who have sufficiently informed themselves by thoroughly studying the operation manual. The pump must have taken ambient temperature and be depressurized and emptied. Pumps pumping media injurious to health must be decontaminated. Basically, operations at the machine may be performed during standstill only. The procedure for stopping the machines described in the operation manual must by all means be observed.
Immediately upon completion of the operations, all safety and protective devices must be mounted and/or made operational again. Prior to restarting, the items listed in Section "Initial operation" must be observed.

2.7 Unauthorized conversion and spare parts production

Conversion of or changes to the machine are only admissible on 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 therefrom.

2.8 Inadmissible modes of operation

Safe working conditions of the machine supplied is ensured only in case of intended use in line with this operation manual. The service limits specified in order-related documents and under Item 4.2 below must by no means be exceeded or fallen below. Order-related documents shall prevail.

2.9 Explosion protection

If pumps are used in potentially explosive atmospheres, it is imperative to comply with the measures and hints attached to the pump and described in the following paragraphs and the safety hints provided with the Ex symbol to warrant the explosion protection. **Standard EN 1127-1 (explosion protection) must be complied with.**

2.9.1 Identifying marking

Pumps which are intended to be used in potentially explosive atmospheres must be marked according to EC Council Directive 94/9 (please refer to Annex A.1.1), and the conformity declaration according to EC Council Directive 94/9 must be available. The marking only refers to the pump. Coupling and motor must be marked separately according to EC Council Directive 94/9 and their conformity declarations according to EC Council Directive 94/9 must also be available.

2.9.2 Filling of pump

During pump operation, the interior pump space in contact with the liquid must be constantly filled with the medium pumped.

2.9.3 Modes of operation affecting the explosion protection

Dangers affecting the explosion protection are to be avoided. Unintended use may lead to that the admissible surface temperature is exceeded or sparks are produced which may result in a possible ignition. Friction on non-conducting surfaces is to be avoided.

Operation with closed shut-off devices in the suction and/or discharge line is not admissible. In this state, there is a danger that after a short period of time already, the medium pumped takes inadmissible temperatures and the maximum admissible surface temperature is exceeded. Due to the inadmissible stress, the rapid pressure rise in the pump inside may lead to the destruction and even bursting of the pump. The specified minimum volume flow must by all means be maintained (please refer to 4.2.4 below).

Dry running is not admissible. In case of dry running or lack of lubrication, sufficient lubrication and cooling of the mechanical seal is not possible. In such a case, the maximum admissible temperature limit may also be exceeded. Dry running may be due to an insufficiently filled sealing chamber, excessive gas portions in the medium pumped (please refer to 4.2.5 below) and to operating the pump outside the admissible range of operation. When using shut-off devices or filters, excessive pressure drop on the suction side of the pump must be avoided. At high temperatures of the medium pumped or low supply pressures, the steam pressure in the sealing chamber may be fallen below. As a result hereof, a gas ring may be formed around the mechanical seal. In addition, there is a danger that owing to an insufficient supply pressure, air is drawn through the mechanical seal. With a single-acting mechanical seal, both will result in dry running and thus destruction of the pump. This may be remedied by inserting a double-acting mechanical seal. In principle, insertion of filters in the suction side of a pump must be strongly advised against.

The specified pressure and volume flow of additional connections such as sealing, flushing liquid etc. must be assured by the operator (please refer to 5.4 and 7.2 below). This applies in particular to quenching and sealing liquid. Sufficient cooling and lubrication of the radial shaft sealing ring and the mechanical seal must be assured. Lack of lubrication or dry running result in the maximum admissible surface temperature being exceeded and in the destruction of the parts to be lubricated.

2.9.4 Explosion protection group

Pumps with marking (please refer to 2.9.1 above) correspond to **Group II**, i.e. they are provided for employment in explosive atmospheres. In this group, the employment in underground plants of mines and their above-ground plants is excluded.

2.9.5 Equipment category

Pumps with identifying marking (please refer to 2.9.1 above) correspond to **Category 2G**, thus, they are intended for use in areas where occasional potentially explosive atmosphere of gases, vapours and fogs must be expected.

2.9.6 Temperature class

As the maximum surface temperature mainly depends on the operating conditions (heated liquid in the pump, please refer to the temperature limits 2.9.7), the manufacturer may not provide any marking with a temperature or temperature class (EN 13463-1, 14.2 g).

Possible temperature classes of pumps with marking according to 2.9.1 as follows:

Bearing lubrication	Medium temperature 1)	approved for temperature class
Oil lubrication	≤ 160 °C	T3
Grease, lifetime-lubricated	≤ 160 °C	T3
Grease, with relubrication	≤ 160 °C	T3
Oil lubrication	≤ 100 °C	T3 / T4
Grease, lifetime-lubricated	≤ 100 °C	T3 / T4
Grease, with relubrication	≤ 100 °C	T3

1) The maximum admissible medium temperatures on the basis of the material of the pump housing and the bellows (please refer to 4.2.2 below) are to be observed.

The type of the bearing lubrication can be taken from the piece list or can be inquired at the manufacturer's by indicating the serial number.

2.9.7 Temperature limits

The operation of the pump outside the admissible ambient temperatures is not admissible (please refer to 4.2.3 below). The maximum admissible temperature of the liquid pumped depends on the respective specified temperature class and the material of the pump housing and/or mechanical seal (please refer to 4.2.2 below). Depending upon the material, the maximum admissible temperature of the liquid pumped may be below the following values.

Temperature class as per EN 50014 for electric equipment of Group II	Maximum surface temperature °C	**Maximum temperature of the liquid pumped °C**
T1	450	**165**
T2	300	**165**
T3	200	**160**
T4	135	**100**
T5	100	***)**
T6	85	***)**

Tab. 2.1 Temperature classes *) Please contact manufacturer

The admissible temperature class depends on the lubrication of the bearing (please refer to temperature class 2.9.6).

2.9.8 Pumping of inflammable media

Pumps by means of which inflammable media (Dangerous Goods Ordinance, Article 4 Dangerousness Characteristics) are to be pumped must not be equipped with a single-acting mechanical seal unless the operator, due to suitable control systems, is in a position to assure that no danger can be brought about by the medium pumped. The manufacturer must be contacted. Here, the use of a double-acting mechanical seal is to be preferred. The required sealing pressure system must be designed and operated with pressure, volume flow and temperature, if necessary, according to the requirements of the mechanical seal. The specification of the sealing medium and the operating instructions for the sealing pressure system must be complied with.

Note: Lubricants and/or coolants which are required to avoid explosive hot surfaces (here: medium pumped or sealing medium to cool and lubricate the mechanical seal) or mechanical sparks (please refer to prEN 13463-8) must have an ignition temperature (please refer to IEC 60079-4) of at least 50 K above the maximum surface temperature of the equipment in which the liquid is used (prEN 13463-5).

2.9.9 Maintenance

Only a pump or aggregate appropriately maintained and kept in a technically proper condition assures a safe and reliable operation. The relubrication and exchange intervals (please refer to 7.1 below) of the bearing must be observed by all means. **The lubrication being insufficient or the bearings defective, there is a danger of the maximum admissible surface temperature being exceeded and even of sparking through friction.**

According to the environmental conditions, the bearing bracket must be cleaned at suitable intervals. Proper functioning of the mechanical seal and the supply of the additional connections (please refer to 5.4 and 7.2 below) must be assured by the user through regular controls.

3. Transport and intermediate storage

3.1 Transport of pumps and pump aggregates

Pumps and pump aggregates must always be transported in such a way that the pump parts are not subjected to impact or shock.

Figs. 3.1 and **3.2** show possible points at which lifting gear can be attached during transport of an individual pump and during transport of a pre-assembled pump aggregate.

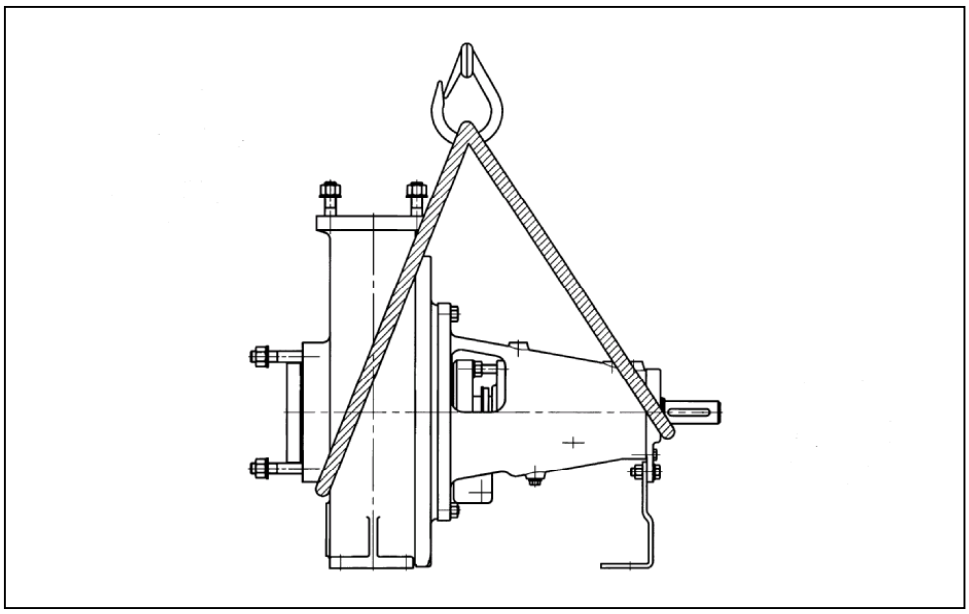


Fig 3.1 Transport of an individual pump

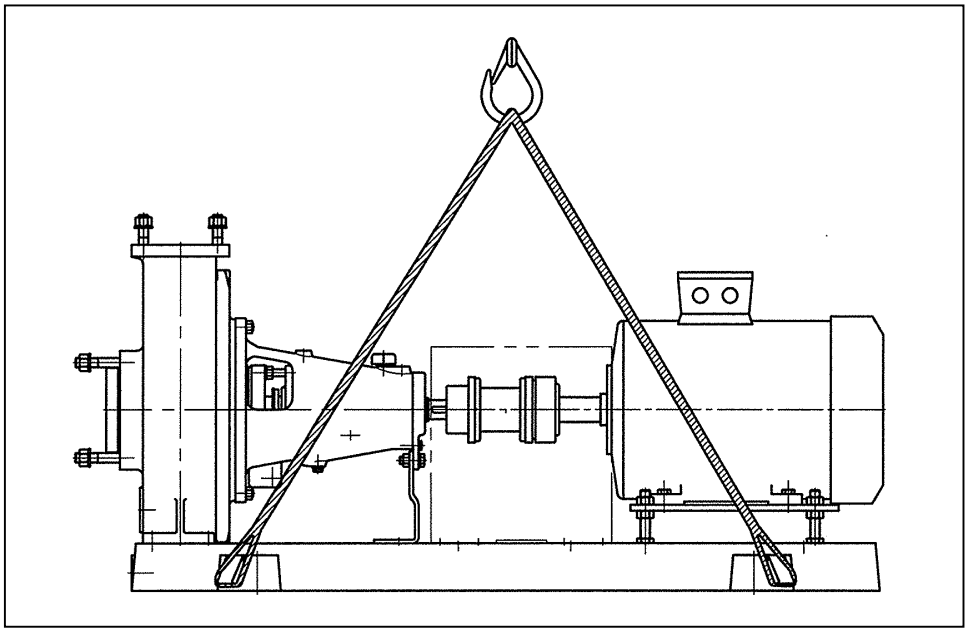


Fig. 3.2 Transport of a pump aggregate

3.2 Intermediate storage under normal environmental conditions

Under normal environmental conditions, i.e. within a temperature range of -10 °C to +40 °C, special provisions need not be made for an intermediate storage. By closing the pump openings with sealing caps or dummy flanges, it must be assured that pollutions or foreign bodies in lumps are prevented from getting into the pump housing. The pumps must be placed in an intermediate storage so as not to be exposed to any shock or impact stresses. If this cannot be excluded, the pumps should be protected by means of solid wooden packings. The pumps should likewise not be exposed to any extraordinary weather and environmental influences.

Plastic pumps need not be filled with liquid preservatives. Acid or lye residues must not remain in the pumps as these crystallize out and lead to damages to the mechanical seal. Water must likewise not remain in the machines. Danger of freezing up.

3.3 Intermediate storage under special environmental conditions

Particular environmental conditions are as follows:
- Ambient temperatures below -10 °C or above +40 °C.
- Intermediate storage or installation in the open.
- Particularly high or very low air humidity (e.g. tropical or desert atmosphere).
- Intermediate storage in an environment with corrosive parts in the atmosphere (e.g. sea air or corrosive gases and aerosols)

The following are to be provided as protective measures:
- Special protection by solid wooden packing against impact and shock influences.
- Storage in areas not directly exposed to atmospheric influences. If necessary, provide protective roofs.
- Separate packing of the pumps with protective films and use of moisture binding agents.
- Anti-corrosive coatings of uncovered metallic parts exposed to the atmosphere.
- Sealing of the suction and delivery-side pump openings.

In each individual case, please contact the manufacturer for any measures to be taken regarding an intermediate storage under special environmental conditions.

3.4 Longer-term storage

In case of storage periods of more than one year make sure that the protection against mechanical and climatic stresses is sufficient. The suction and delivery-side pump openings must be kept closed The condition of the packing (wooden box, packing film and the like) must be checked regularly, at least once a year, and repaired as required. When using moisture-binding agents, these must be exchanged at least once a year. Uncovered pump components such as shaft and coupling must be provided with an anti-corrosive paint.
Prior to starting any pumps which have been stored for an extended period of time, the condition of the bearing grease or oil must be checked. After a storage period of two years, the lubricant of the bearing must be generally exchanged.
Under climatic conditions of a low humidity, the elastic properties of bellows and sealing elements of elastomer materials such as FPM or CSM may be reduced. The replacement of these parts after several years of storage is then required.

If the pump remains out of operation for a minimum period of six months, the pump shaft must be turned into a different position every three months by several manual rotations so as to avoid any pressure marks on the rolling bearings.
The mechanical seal has to be checked after two years.

4. Description of product and accessories

4.1 General description

Pumps of the NE series are horizontal rotatory pumps as defined by standards ISO 2858/ DIN EN 22858 (chemical pump standards) using the process design. This makes it possible to quickly remove or exchange the complete bearing support with running gear and shaft gasket without having to disassemble the pipeline connections and the motor.
The parts which will be covered with liquid are made of plastic materials or other suitable materials, the respective chemical, thermal and mechanical stresses were decisive in their selection. All statical parts made of plastic materials have been surrounded in metal or are supported by metal.
The standard version is equipped with a semi-open impeller (without covering disc), the special version can also be equipped with a closed impeller (with covering disc). The standard version of size IV is equipped with a closed impeller. The axial thrust for semi-open impellers will be reduced by back-vanes and for closed impellers by sealing elements. Usually a WERNERT-bellows-mechanical seal is used as a shaft seal. For special applications, mechanical seals by other manufacturers can also be used.

4.2 Application limits

4.2.1 Maximum permissible testing pressure

Static pressure is determined according to ISO 2858/ DIN EN 22858 as 1.3 to 1.5 times the maximum delivery pressure, and can be used up to the temperature stated in section 4.2.2. The admissible testing pressure depends on the version of the mechanical seal, in this case, the manufacturer should be consulted.

4.2.2 Maximum admissible temperature of the liquid pumped

The maximum admissible temperature of the liquid pumped depends on the materials of the pump housing and bellows (for WERNERT bellows-type mechanical seal). In exceptional cases, it may be exceeded on consultation with the manufacturer.

The maximum admissible temperature of the liquid pumped also depends on the approved temperature class (please refer to 2.9.6 and 2.9.7 above).

Pump housing material	Maximum temperature
UHMW-PE	90 °C
PVDF	115 °C
PP	95 °C
PTFE	165 °C
PFA	165 °C
Wernit®	125 °C
Durapox®	125 °C

For WERNERT bellows-type mechanical seal only:

Bellows material	Maximum temperature
CSM	80 °C
FPM	100 °C
PTFE	115 °C

For the employment of other mechanical seals, the corresponding data in the order confirmation and data sheet are decisive.

4.2.3 Admissible temperature range of the environment

The admissible range of the ambient temperature is -10 °C to +40 °C. The name plate for a pump according to EC Council Directive 94/9 receives the symbol "X" as additional marking for the limited ambient temperature.

4.2.4 Volume flow of the liquid pumped

Unless specified otherwise in the characteristic curves or the documentation, the following shall apply:

Q_{min} = 0.1 x Q_{opt} for short-time operation (approx. 5 min.)

Q_{min} = 0.15 x Q_{opt} for continuous operation, Q_{max} = according to characteristic diagram

Q_{opt} = Volume flow in the optimum efficiency of the characteristic pump curve

In case of a deviating working point, please contact the manufacturer.

4.2.5 Maximum admissible gas portion of the liquid pumped

Gas portions in the liquid pumped are only permissible after consulting the manufacturer. Gas portions in the liquid pumped reduce the capacity and the delivery head of the pump.

4.2.6 Maximum dimensions of sporadic solid matters in the liquid pumped

The dimensions of sporadic solid matters in the liquid pumped must not exceed the dimension of half the blade height and/or half the nominal delivery branch diameter, whatever dimension is smaller.

4.2.7 Maximum admissible supply pressure for WERNERT bellows-type mechanical seal

The maximum admissible excess pressure at the suction branch of the pump with a WERNERT bellows-type mechanical seal depends on the material of the bellows and the speed of the pump.

Bellows material	Speed up to 1800 1/min	Speed over 1800 1/min
CSM	2,5 bar	2 bar
FPM	2,5 bar	2 bar
PTFE	3 bar	2,5 bar

4.2.8 Maximum speeds

The maximum admissible speed must not be exceeded by mechanical transmission ratios or the employment of a frequency converter. For the maximum admissible speed for the respective pump size, please refer to Table B.2 of Annex B.

4.3 Construction

Fig 4.1 shows a pump of the NE series in section, which is representative for all sizes. The naming of the individual parts and the numbering comply with DIN 24250.

4.3.1 Pump casing

The solid pump casing is made of plastic material (part 101) and is completely enclosed by a metal annular casing (part 103). Suction and discharge nozzle are fixed to this pump casing. The suction nozzle is supported by a two part retaining ring (part 506.2), the discharge nozzle is supported by the casing part (part 130) and therefore fixed into the annular casing.
The pump can be designed with an outlet in the area underneath the suction nozzle. This is either closed with a cap or equipped with a valve.

4.3.2 Impeller

Semi-open wheels are used as impellers (part 233). Semi-open impellers are also suitable for transporting media containing solids. The material used is solid plastic. The torque of the shaft is taken up by a metal hub pressed into the impeller. The impeller is fixed on the shaft in an axial direction by the multiple ring (part 501). Closed impellers can also be used in special cases. Closed impellers are used on standard designed pumps size IV.

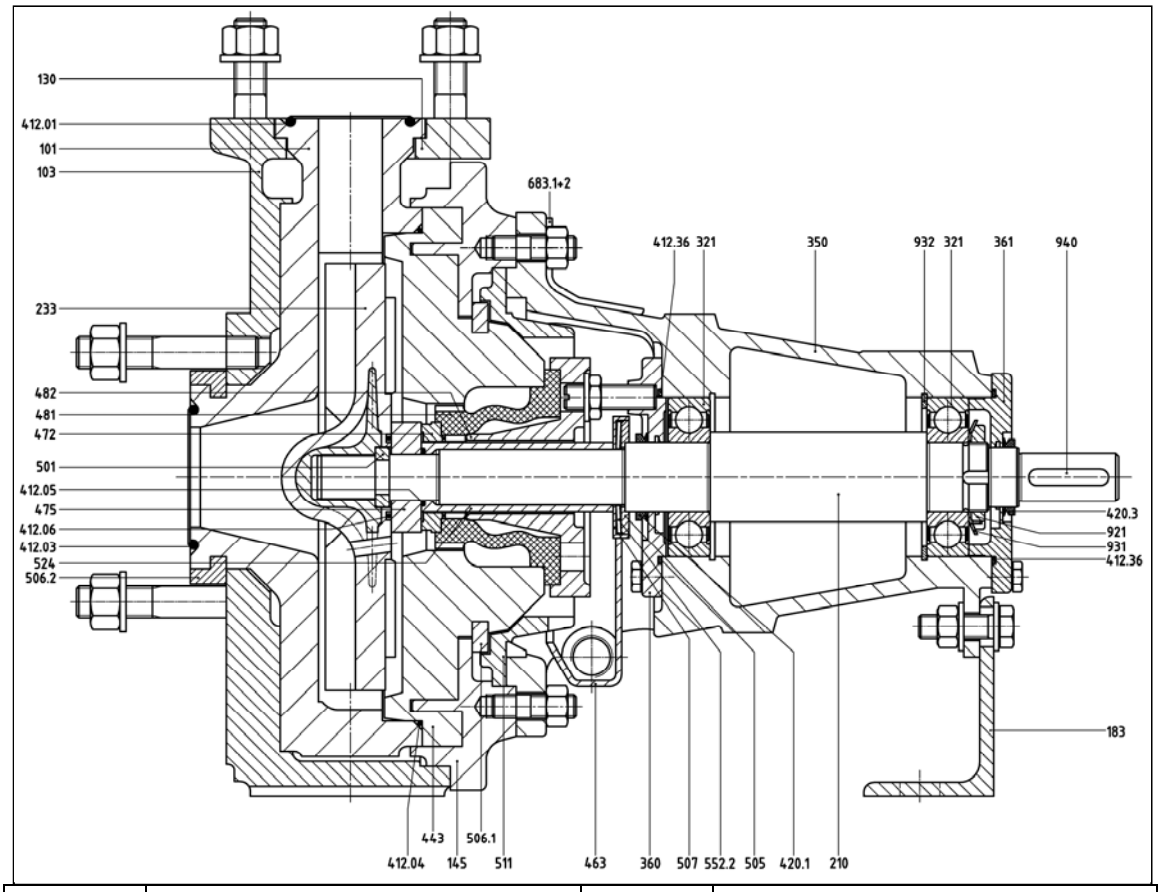
4.3.3 Shaft and bearing

In general, the impeller is connected with the metal shaft (part 210) via a thread. In the sealed area, the shaft is protected by a shaft wearing sleeve (part 524) which is either made of carbon or a ceramic material. This shaft wearing sleeve is tensioned with the rotating seal ring (part 475) via a spanner (part 552.2) which is situated between thrower (part 507) and loose collar (part 505). The shaft's torque is taken up by a feather key connection. The shaft is supported outside the transport area in the bearing housing (part 350). The rolling bearing can consist of grease or oil lubrication and is protected by a bearing cover and bearing end cover (parts 360 and 361) with inserted shaft seal rings (parts 420). As standard version we have installed life-time ball bearings. If requested the pumps can also be provided with bearings for regreasing. Additional grease is added via the grease nipples (parts 636). Oil lubrication is installed upon customer request, or if the temperature of the medium to be pumped is greater than 100°C. As standard version we use an oil level sight glass (part 642) for level monitoring. Alternatively the oil level can be regulated by means of a constant level oiler which will be mounted at the side of the bearing housing (part 350).

4.3.4 Sealing the pump

The shaft is sealed using a mechanical seal (MS). Depending on the application, a number of seals are used. These are described in more detail in section 4.5. The mechanical seal is taken up in every case by the seal insert (part 443) which also seals the pump casing via the O-ring (part 412.04). Discharge and suction nozzles are also sealed using O-rings (parts 412.01 and 412.03). Gaskets are used in the "WERNIT" version. Additional static seals are installed in the area of the mechanical seal and depend on its design. Usually FPM is used for the O-rings.

4.4 Sectional drawing



Part No.	Description	Part No.	Description
101	Pump casing	443	Seal insert
103	Annular casing	463	Drip plate
130	Casing part	472	Stationary seal ring
145	Adapter	475	Rotating seal ring
183	Support foot	481	Bellows
210	Shaft	482	Bellows seat
233	Counter clockwise impeller	501	Multiple ring
321	Radial ball bearing	505	Loose collar
350	Bearing housing	506.1	Retaining ring (seal insert)
360	Bearing cover	506.2	Retaining ring (suction nozzle)
361	Bearing end cover	507	Thrower
412.01	O-Ring	511	Centering ring
412.03	O-Ring	524	Shaft wearing sleeve
412.04	O-Ring	552.2	Spanner (shaft wearing sleeve)
412.05	O-Ring	683	Cap
412.06	O-Ring	921	Shaft nut
412.36	O-Ring	931	Lockwasher
420.1	Shaft seal ring	932	Circlip
420.3	Shaft seal ring	940	Key

Fig. 4.1 Section of a pump of the NE series with single WERNERT-elastomere-bellows mechanical seal.

4.5 Designs of mechanical seals

4.5.1 Single WERNERT-elastomere-bellows-mechanical seal (MS)

Usually the pumps are designed using the single WERNERT-elastomere-bellows-mechanical seal. The different designs of this have been shown in **Fig. 4.2** .

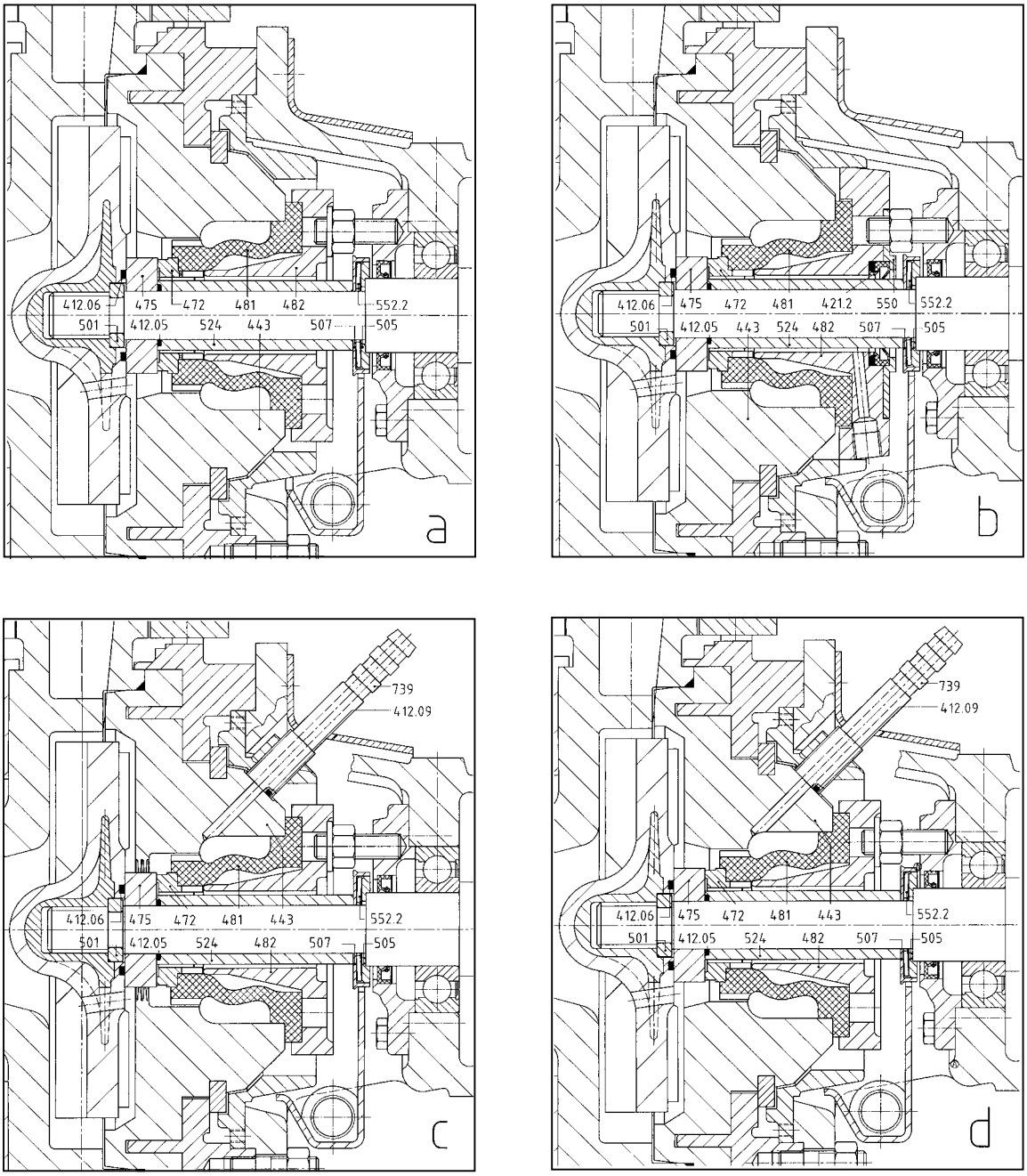
The stationary seal ring (part 472) is positioned in the bellows (part 481) made of CSM or FPM and pressed against the rotating seal ring (part 475) using elastic pretension - supported by the pumping pressure. The static seal of the sealing area is also achieved using the elastic bellows which is positioned between the bellows seat (part 482) and the seal insert (part 443).

a) Interior rinsing - API plan 01 **(Fig. 4.2a)**
The model with interior rinsing (product rinsing) is suitable for non-critical applications. Rinsing holes in the impeller and the conical shape of the seal insert in the area of the stationary seal ring, the MS is rinsed with fresh, cool liquid to be pumped (product).

b) Interior rinsing and Quench - API Plan 62 **(Fig. 4.2b)**
In this model a radial shaft ring (part 421.2) is built into the bellows seat (part 482) on the atmospheric side. Together with the rotating seal ring on the product side, this creates an area which is supplied with so-called quench liquid which is not under pressure. Usually clean, filtered water or water at moderate temperatures or completely desalinated water is used.
The quenching liquid is mean to prevent crystals being formed on the atmospheric side of the MS when pumping media which can form crystals is being used. This could lead to increased abrasion or if crystals grow, the MS can become increasingly leaky.
In the case of excess pressure between 0.7 and 8.5 bar, the flow of quenching liquid is limited to 30 litres per hour by an in-built flow limiter. The quenching device can provide a certain amount of protection against the rotating seal rings overheating in the case of a vacuum in the shaft seal space. This vacuum can be caused by high suction losses or suction heights.

ATTENTION **The quench liquid should drain off freely. If it is drained off through a pipe, the pressure built up in the quench chamber must not exceed 0.5 barg. Too high a counter-pressure will destroy the shaft seal ring.**

Another quench type is the conditional quench where the supply is ensured via a quench tank with connected hose lines to the mechanical seal of the pump. The temperature difference between supply and return line of the conditional quench tank results in different liquid densities. The liquid columns of different heights resulting therefrom lead to a circulation of the quench liquid. The conditional quench tank should be filled to three quarters. The filling level must be checked regularly.



Part No.	Description	Part No.	Description
412.05	O-Ring	482	Bellows seat
412.06	O-Ring	501	Multiple ring
412.09	O-Ring	505	Loose collar
421.2	Radial shaft seal ring	507	Thrower
443	Seal insert	524	Shaft wearing sleeve
472	Stationary seal ring	550	Disc
475	Rotating seal ring	552.2	spanner
481	Bellows	739	Hose coupling

Fig 4.2 Representation of single WERNERT-elastomere-bellows-mechanical seal

a) with interior rinsing (product rinsing) of mechanical seal (API Plan 01)

b) with interior rinsing (product rinsing) and quench (API Plan 62)

c) with rinsing connection and flow control (continuous rinsing) (API Plan 32)

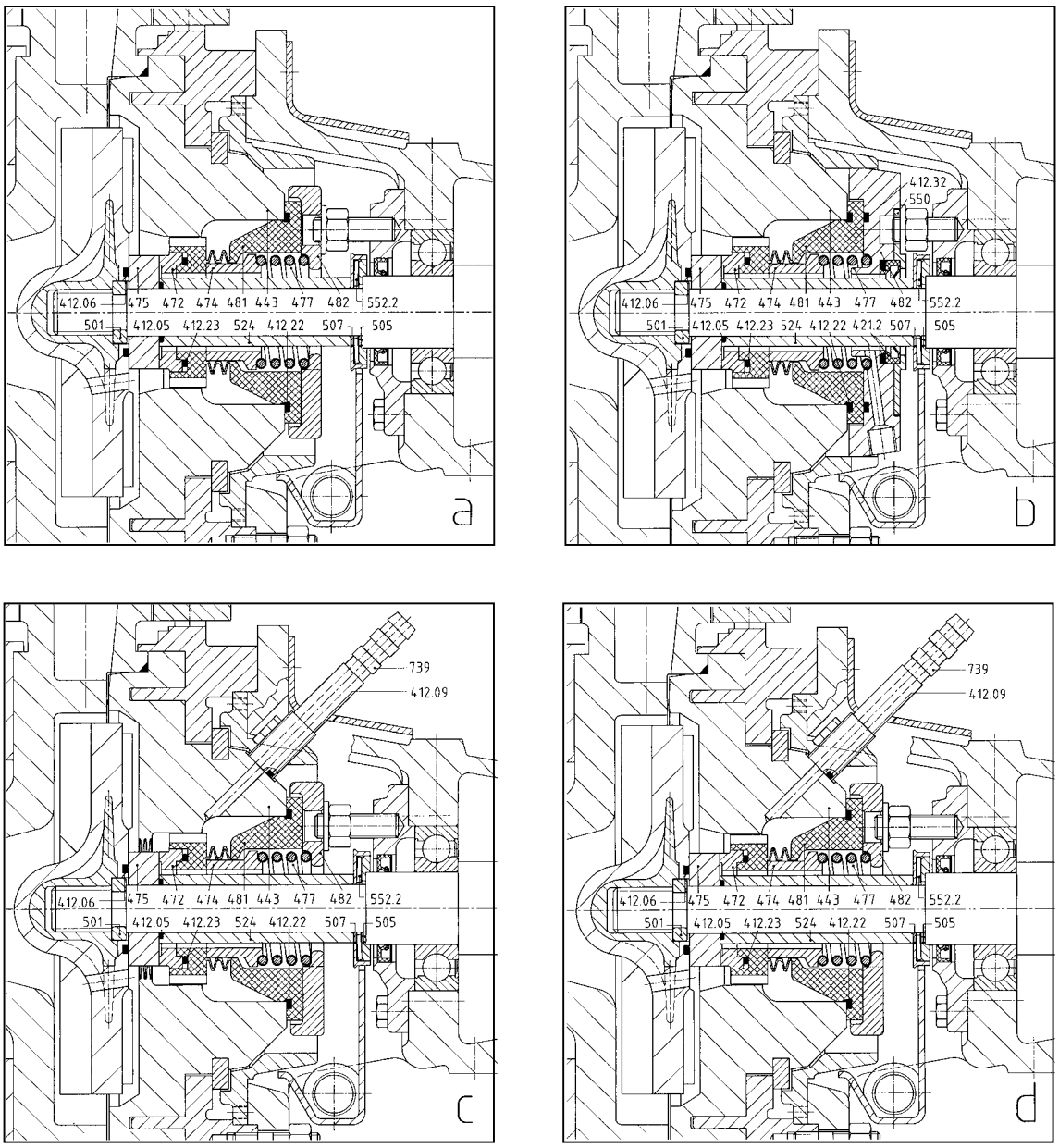
d) with rinsing connection without flow control for rinsing after use (stationary rinsing)

c) Continuous rinsing – API Plan 32 (**Fig.4.2c**)
Pumps to pump polluted liquids can be equipped with a rinsing connection (continuous rinsing) in order to rinse the mechanical seal with clean liquid – usually water – and to keep contaminants away. To limit the flow of rinsing liquid, the shaft sealing space is equipped with a labyrinth seal towards the inside of the pump.
Depending on the size of the pump and the contamination of the liquid to be pumped, 40 to 250 l/h are used for rinsing. The flushing quantity is indicated by the manufacturer in the order confirmation. For the recommended flushing quantities, please also refer to Annex D. If for technical reasons, the recommended flushing quantities must be deviated from, please contact the manufacturer.
The installation of a liquid quantity meter (rotameter) in the flushing liquid line is recommended for the correct quantity to be set. For the regulation of the flushing liquid flow, a valve must be installed. The pressure arising during regulation of the flushing quantity must be checked.

d) Rinsing after use (**Fig. 4.2d**)
Rinsing after use is equivalent to continuous rinsing, the only difference being that there is no labyrinth seal. Stationary rinsing is to be used in those cases where contaminated liquids are to be pumped but where it is not possible to install the continuous flow of rinsing liquid due to system or process constraints. It is used to rinse the pump immediately after it has been switched off. Stationary rinsing is meant to prevent sedimentation and crystallisation processes in the interior of the pump – especially in the area of the mechanical seal, as during longer standing periods the rotating seal ring and the stationary seal ring can stick together. Rinsing volume is 40 l for a rinsing period of 5 minutes (minimum). Normal industrial water can be used for rinsing.

4.5.2 Single WERNERT-PTFE-bellows-mechanical seal

If the fluid excludes the use of bellows made of elastomeres, PTFE bellows-mechanical seals can be used. **Fig. 4.3** shows WERNERT-PTFE-bellows-mechanical seals which can be used in place of elastomere bellows without any constructional changes being made to the seal insert. The function and action of the models shown in **Figs. 4.3a to d** are equivalent to the single WERNERT-elastomere-bellows-mechanical seals shown in **Fig. 4.2** and described in section 4.5.1.



Part no.	Description	Part no.	Description
412.05	O-Ring	477	Spring for mechanical seal
412.06	O-Ring	481	Bellows
412.09	O-Ring	482	Bellows seat
412.22	O-Ring	501	Multiple ring
412.23	O-Ring	505	Loose collar
412.32	O-Ring	507	Thrower
421.2	Radial shaft seal	524	Shaft wearing sleeve
443	Seal insert	550	Disc
472	Stationary seal ring	552.2	spanner
474	Thrust ring	739	Hose coupling
475	Rotating seal ring		

Fig 4.3 Representation of single WERNERT-PTFE-bellows-mechanical seal

a) with interior rinsing (product rinsing) of mechanical seal (API Plan 01)

b) with interior rinsing (product rinsing) and quench (API Plan 62)

c) with rinsing connection and flow control (continuous rinsing) (API Plan 32)

d) with rinsing connection without flow control for rinsing after use (stationary rinsing)

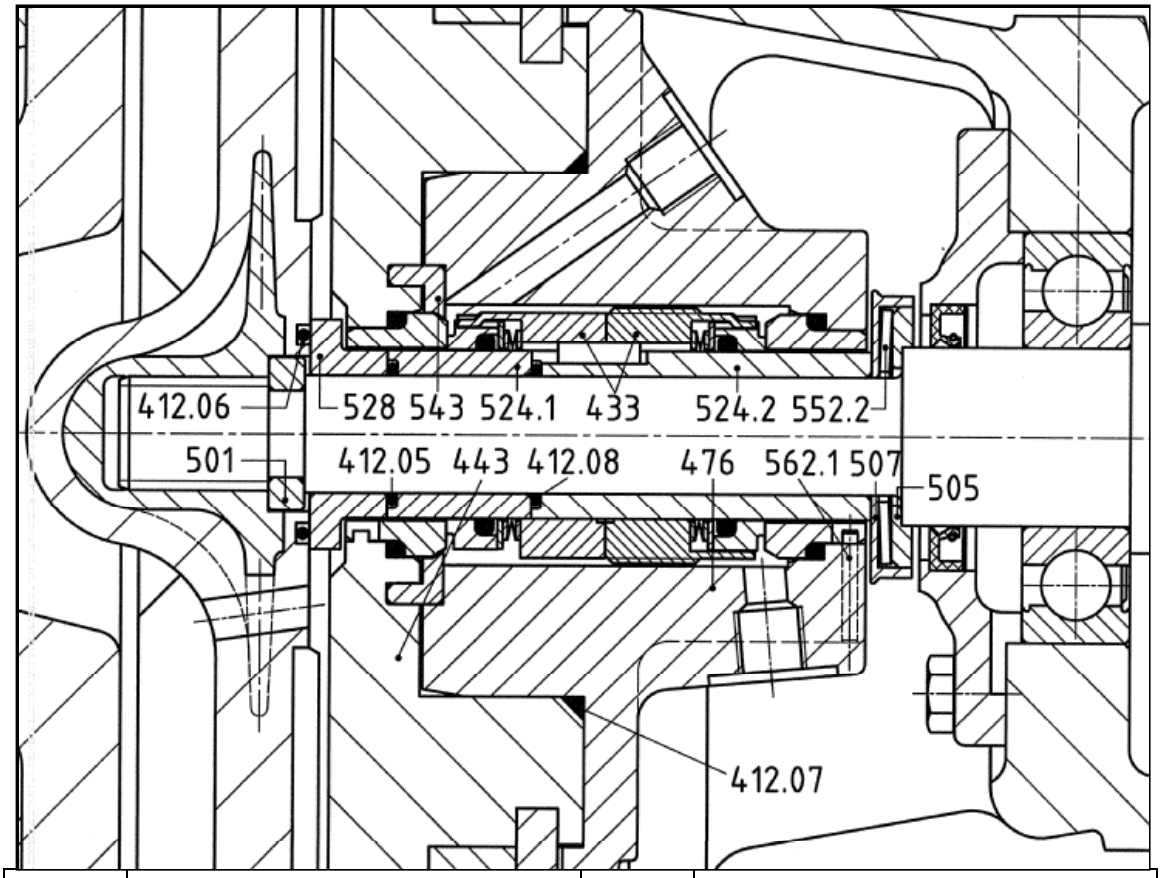
4.5.3 Back-to-back-mechanical seals as defined by DIN EN 12756

Back-to-back mechanical seals as defined by DIN EN 12756 (Fig. 4.4) are usually used for liquid to be pumped which have virtually no or only a small amount of solid material in them,

- which endanger health, water or the environment
- which would vaporise at a very small increase in temperature or if the pressure is decreased
- which tend to crystallisation.

A single mechanical seal is installed back-to-back on the product side and atmospheric side. The so-called sealing chamber is situated between the two pairs of mechanical seals. Usually the seal rings on the product side are secured against inadmissible axial and radial movement.

For further information about double acting mechanical seals please refer to section 4.5.5.



Part No.	Description	Part No.	Description
412.05	O-Ring	505	Loose collar
412.06	O-Ring	507	Thrower
412.07	O-Ring	524.1	Shaft wearing sleeve
412.08	O-Ring	524.2	Shaft wearing sleeve
433	Mechanical seal	528	Locating collar
443	Seal insert	543	Spacer bush
476	Stationary seal holder	552.2	spanner
501	Multiple ring	562.1	Parallel pin

Fig 4.4 Diagram of a back-to-back-mechanical seal as defined by DIN EN 12756 (API Plan 54), lower half with pump thread (API Plan 53).

4.5.4 Stationary double acting mechanical seal

Stationary double acting mechanical seals are usually used for "problematical" liquid to be pumped

- which have a medium to high solid content
- which contain a high proportion of gas or air
- which endanger health, water or the environment
- which would vaporise if the temperature increased only slightly or if the pressure was reduced
- which tend toward crystallisation.

This type of mechanical seal (frequently also referred to as REA design), supports, by means of centrifugal forces, the movement of the sealing liquid from the sealing chamber into the shaft sealing space which in turn is very large and easy to rinse. This design avoids tight gaps and solids being deposited.

Two types are used as standard:
BURGMANN HS HRZ 8, shown in **Fig 4.5.**
PACIFIC Allpac N 2132, shown in **Fig. 4.6.**

These models are also available with single seals or single seals with quench.

For further information about double acting mechanical seals please refer to section 4.5.5.

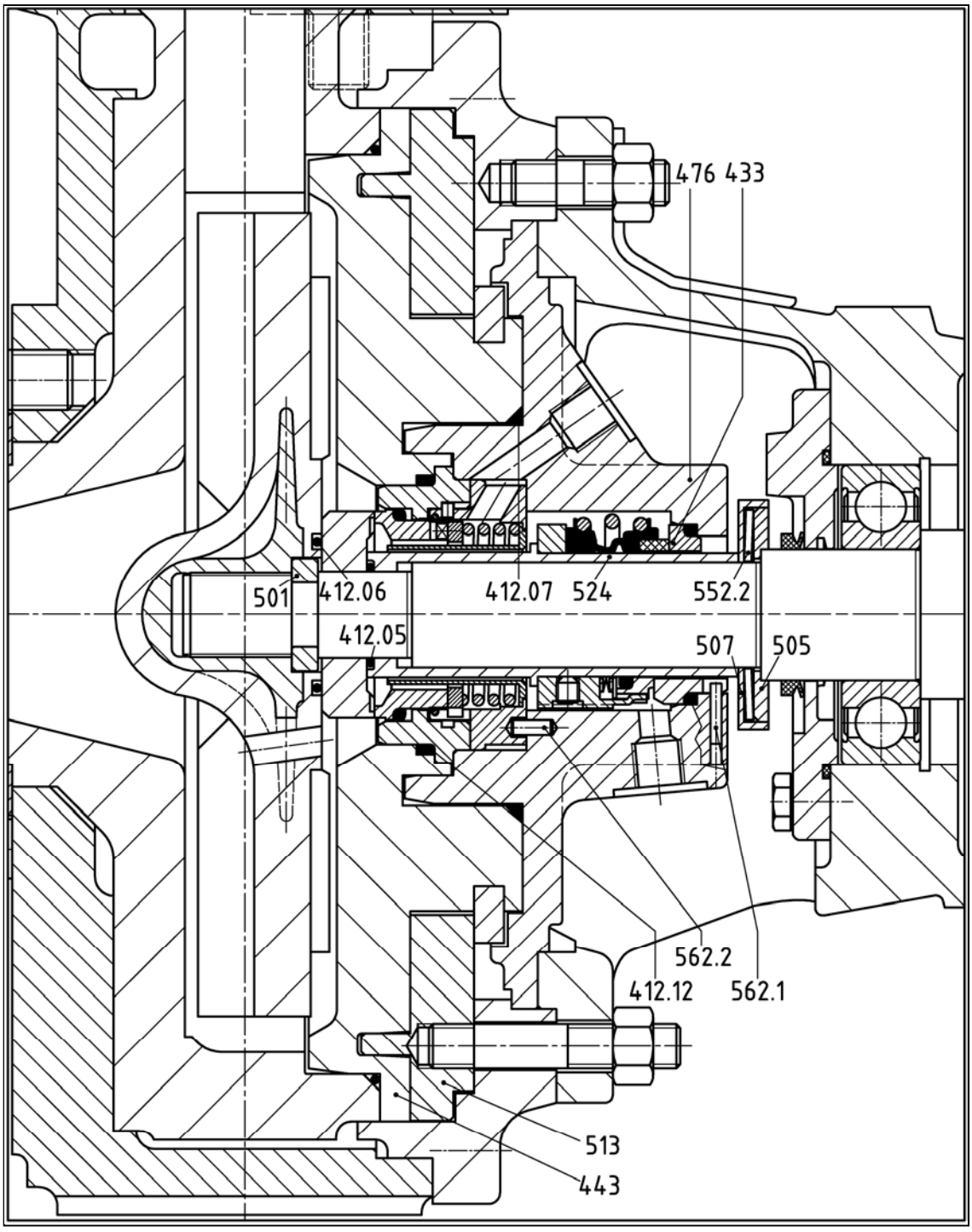
4.5.5 General information about double acting mechanical seals

Double acting mechanical seals must always be impinged with a suitable sealing fluid which is suited to be mixed with the liquid to be pumped. The sealing liquid can also – if the currently valid regulations permit this – be the cleaned fluid which might have to be cooled, but which can only be used if the metal elements within the sealing chamber do not corrode. The sealing liquid must continuously circulate between the two mechanical seals and is removed via an outlet on the opposite side. The sealing fluid must have a pressure of 1 to 1.5 bar above the pressure on the shaft sealing space. However, it must not exceed the pressure limit of the seal on the atmospheric side.

The maximum pressure in the shaft sealing space, which is immediately behind the impeller, is approx. 25% of the maximum differential pressure which can be achieved in the pump (with decreasing pumping flow) plus the supply pressure (pressure at the pump suction nozzle). If the pump is not working, it must be ensured that the pressure of the sealing liquid is higher than the interior pressure of the pump so that no liquid to be pumped reaches the sealing chamber.

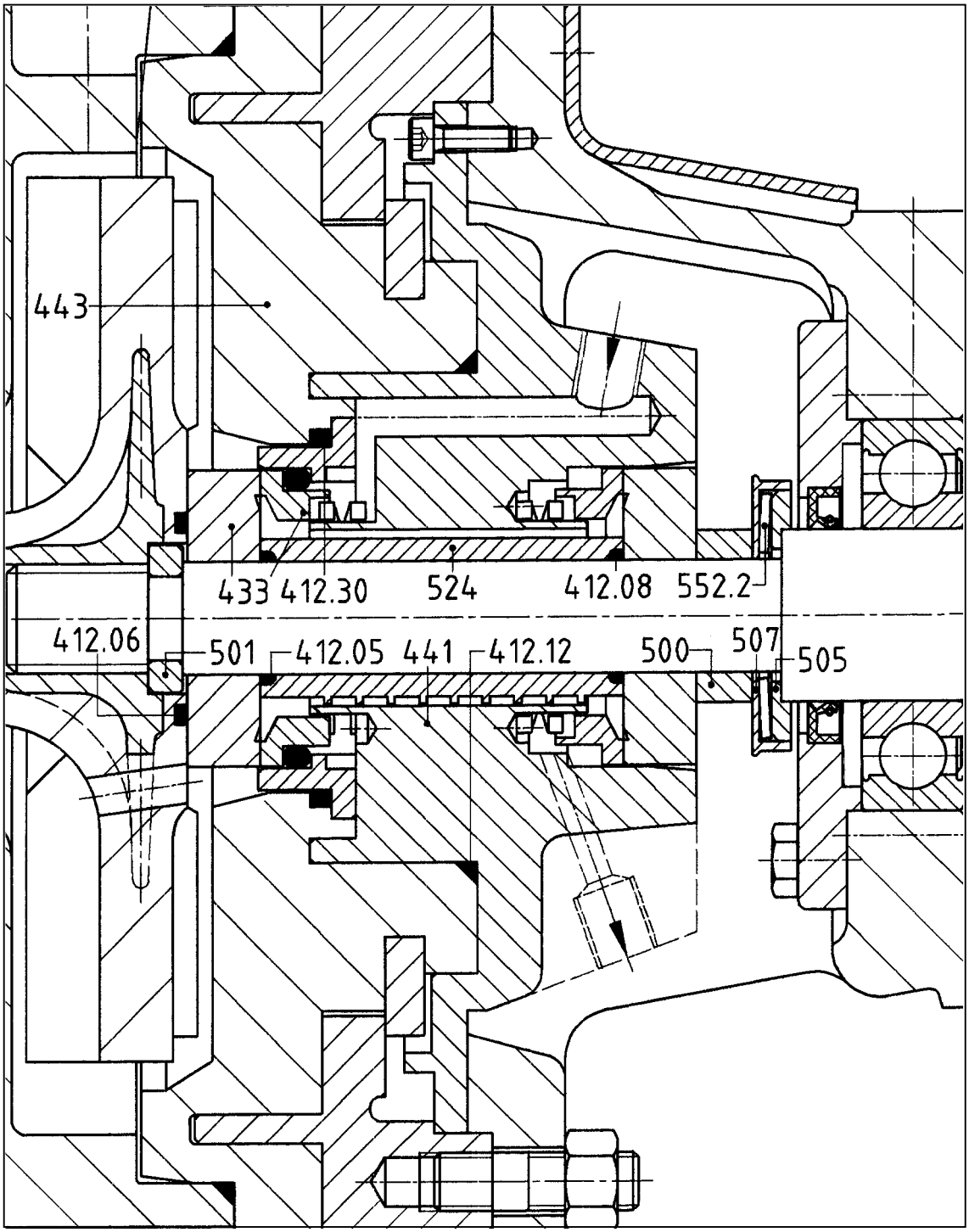
If the sealing chamber is equipped with its own sealing aggregate with limited sealing liquid volume, the sealing liquid must be forcibly cooled and circulated. In this case the circulation of the sealing liquid flow is supported by a pumping thread in the mechanical seal.

If the sealing chamber is supplied with sealing liquid with the appropriate excess pressure and if the sealing liquid can flow freely from the sealing chamber, the liquid flowing off must be throttled in order to maintain the excess pressure in the sealing chamber.



Parts No.	Description	Parts no.	Description
412.05	O-Ring	501	Multiple ring
412.06	O-Ring	505	Loose collar
412.12	O-Ring	507	Thrower
412.30	O-Ring	524	Shaft wearing sleeve
433	Mechanical seal	552.2	spanner
443	Seal insert	562.1	Parallel pin
476	Stationary seal ring holder		

Fig 4.5 BURGMANN HS HRZ 8 (API Plan 54), lower half with pumping thread (API Plan 53).



Part no.	Description	Part no.	Description
412.05	O-Ring	443	Seal insert
412.06	O-Ring	500	Ring
412.08	O-Ring	501	Multiple ring
412.12	O-Ring	505	Loose collar
412.30	O-Ring	507	Thrower
433	Mechanical seal	524	Shaft wearing sleeve
441	Housing for shaft seal	552.2	spanner

Fig 4.6 PACIFIC Allpac N 2132 (API Plan 54), lower half with pumping thread (API Plan 53).

4.6 Special tools

The special tools described below are available from the manufacturer.

4.6.1 Impeller key (Part 051)

Only for bearing support sizes 0 – III:

To disassemble and assemble semi-open impellers with screw attachment onto the drive shaft it is wise to use a so-called impeller key (**Fig. 4.7**). The inside of this key is shaped to be a negative of the impeller blades. The key is placed on the facing side of the impeller which is then removed from the shaft in the direction of rotation of the pump. The shaft must be fixed in order to prevent it turning too.

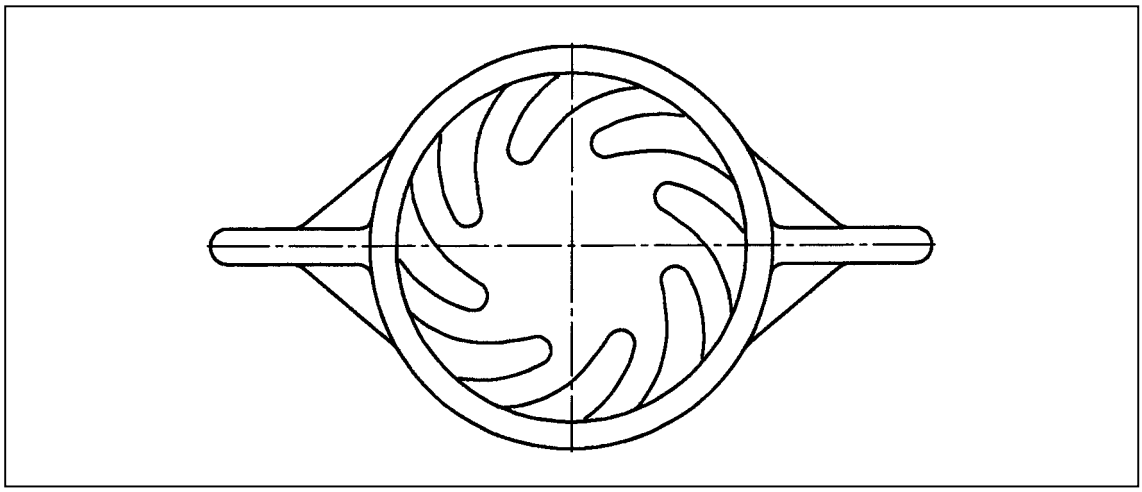


Fig. 4.7 impeller key (part 051)

4.6.2 Tensioning tools (Part 052)

Only for bearing support sizes I – III:

In order to be able to place the multiple ring (Part 501) with zero force behind the threaded stem of the shaft (part 210), the stationary seal ring and the shaft wearing sleeve must be displaced in the direction of the coupling against the force of the face plate. This is done by using a tensioning tool as shown in Fig. 4.8.

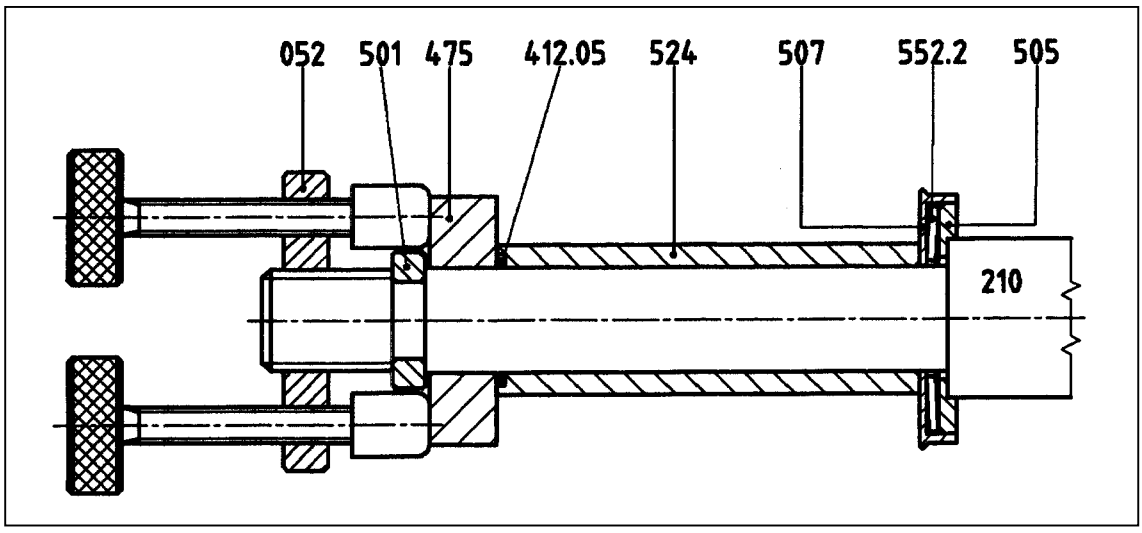


Fig. 4.8 Assembly of the multiple ring

4.7 Noise emission values

The A-weighted equivalent permanent sound level at a one meter (1 m) distance from the reference cuboid according to EN ISO 3744 is below 85 dB(A).

4.8 Accessories

- Coupling: Flexible coupling with or without intermediate coupling sleeve
- Protection against accidental contact for coupling
- Base plate of torsion-resistant design of grey cast iron
- Foundation fastening and/or installation: Levelling elements, stone bolts, shear connectors
- Special accessories, according to order

4.9 Dimensions and weights

For the data on dimensions and weights, please refer to the dimensional drawing and/or installation plan of the pump.

5. Erection

5.1 General

A careful and proper installation is the prerequisite to a subsequent trouble-free operation. Installation errors may cause personal injuries and property damages as well as a premature wear of the pump. In case of work not done by the manufacturer, any liability for improper installation and for the consequences of non-compliance with safety-technical hints is excluded.

The EC Council Directive 1999/92 on minimum regulations for the improvement of the health protection and safety of the employees who may be endangered by explosive atmospheres must be complied with. The EN 1127-1 Standard is to be observed (explosion protection).

5.2 Erection of pumps mounted on base plates

5.2.1 Aligning the base plate

Before delivery, the pump is aligned with the base plate and fixed. If, due to rough transport, the position of the pump to the base plate has changed, then the original position must be attained again by referring to the plans.
Otherwise, the pump is aligned to the plant merely by positioning the base plate.

When installing the plant, the base plates must be aligned so that

1) the level of the discharge nozzle is horizontal in every direction. For example, this can be checked with a machine spirit level.
2) Suction and discharge pipelines must be connected with the pump nozzles in such a way that the admissible nozzle loads are not exceeded. The admissible nozzle loads are listed in Appendix B.

The base plate is aligned according to the means of fixing selected for this aggregate. There are three ways of fixing possible:

1) Simple fixing to the foundations
   The base plate is fixed to the foundations by means of stone bolts or shear connectors which have been anchored into the foundation beforehand and which project through the corresponding holes in the base plate. Before these are tightened, the base plate must be aligned using spacers and thin pieces of metal.
   The base plate is aligned in such a way that it is supported by three aligning spacers. Each spacer is positioned on the left and right longitudinal side in the area of the drive, the third spacer is positioned in the area of the pump on the short side. If the base plate is longer than 1600 mm, more spacers might be necessary. The exact height should be achieved using pieces of thin metal of different thicknesses.
2) Fixing on foundations with subsequent casting
   The base plate is fixed to the foundations by means of stone bolts or shear connectors which have been anchored into the foundation beforehand and which project through the corresponding holes in the base plate. Before casting, the base plate must be aligned using spacers and thin pieces of metal (as described in 1.). The foundation screws are tightened once the casting mass has hardened.
3) Erection on levelling elements without foundation
   The position of the base plate is adjusted using levelling elements. The pump aggregate is supported above the floor on oscillation absorbers. No foundation screws are necessary.

The above three types of fixing are suitable for all pumps of the NE series supplied on base plates.

Pumps of Type NE supplied on base plates are in principle suited for all three fastening types mentioned above. **If the pump aggregate is installed, isolated, as is the case, for example, with the foundation-free installation, a separate earthing is to be provided in order to avoid potential differences.**

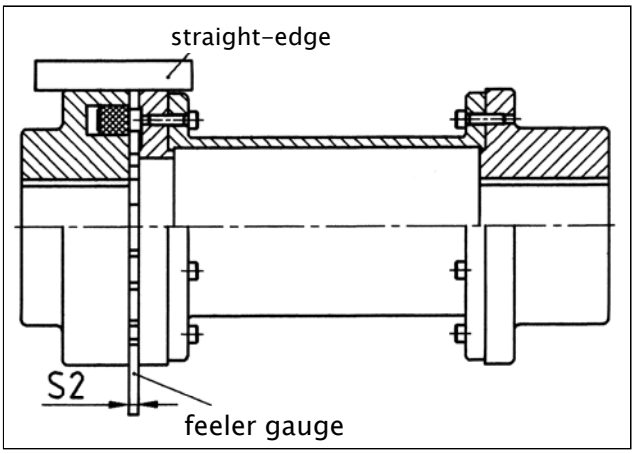
5.2.2 Connecting the pipes

Before aligning the drive, the pump must be connected to the pipes making sure that the pipes do not twist the pump. The admissible nozzle loads listed in Appendix B must not be exceeded! Section 5.3 lists suggestions on the design of the pipeline layout.
If subsidiary pipeline connections have been intended, e.g. for sealing, rinsing or quench media, the necessary pipeline attachments and connections must be made.

5.2.3 Aligning the drive

ATTENTION **The manufacturer's alignment of the drive to the pump must be checked under all circumstances and if necessary it must be corrected. Please refer to the operating instructions for the coupling.**

The position of the drive shaft to the pump shaft is measured via the coupling.



Usually, intermediate sleeve couplings are used for pumps of the NE series. Fig. 5.1 shows this type of coupling, the intermediate sleeve can be removed after loosening the connecting screws. Distance S2 between pin and packet part of the coupling must be 5 mm all around the circumference for smaller couplings (up to size 140) and for larger couplings, it must be 6mm and can be determined using a feeler gauge.

Fig. 5.1 Intermediate sleeve coupling, measurement using feeler gauge and straight-edge.

After checking and if necessary creating this gap by aligning the drive in an axial direction, the angle and height of the drive must be checked. Three procedures are usual here, measurement with a straight-edge, measurement with a dial gauge and measurement with the help of a laser beam. All procedures give correct results. In every case the data regarding the alignment accuracy can be found in the operating instructions for the coupling.

The angle and height of the drive depends on the aggregate supplied and can be adjusted with the help of thin pieces of material or regulating screws. After aligning it, the drive must be fixed.

5.3 Pipes

5.3.1 General

The pipe diameter and the layout of the pipes has usually been determined during the planning stage. The recommendations for pipeline layout can only be basic considering that the final laying of the pipes will have to take the specific local situation, which the pump manufacturer is usually not aware of, into consideration.

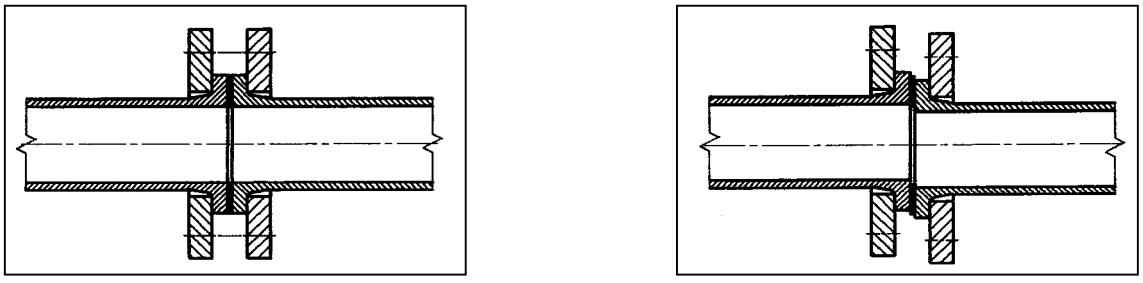
5.3.2 Notes on laying pipes

Make sure that the forces and moments of the pipelines acting on the pump branches do not exceed the admissible branch loads according to **Annex B**. This applies to both, the standstill of the plant and its operation. The pumps must in particular not serve as a fixed support within the pipeline system. If necessary, the pipelines must be supported by mounts so that they can neither distort the pump nor vibrate it during operation.

Any expansions of the pipelines caused by temperature differences and process-conditioned impacts must be compensated for by taking suitable measures. The installation of compensators in front of the suction and delivery branches of the pump is recommended. For any increased flow resistances to be avoided, compensators should have the nominal diameter of the respective pipeline. **The pipeline forces being exceeded, leaks may be caused at the pump resulting in the penetration of the medium pumped. Danger of life in case of toxic or hot media pumped. Inadmissible deformations may furthermore result in problems at the mechanical seal.**

Tightening connection screws on the pump flanges may not cause any twisting. Up to and including DN 125, the torque should be approx. 35 Nm and above that up to and including DN 250, approx. 70 Nm for each screw.

When laying and connecting the pipes care must be taken that seals do not project into the clear diameter. Fig. 5.2 shows the correct arrangement on the left hand side and the incorrect arrangement on the right hand side.



correct incorrect

Fig. 5.2 Connection of pipelines

ATTENTION **The alignment of the drive to the pump must be checked, and if necessary corrected, after the pipes have been connected and before starting up.**

5.3.3 Suction pipe

The suction pipe should be as short as possible and its diameter should never be smaller than that of the suction nozzle. If the suction pipe is larger, an eccentric transition with synchronous upper edge which prevents the formation of air sacs, must be used. **Fig. 5.3**.

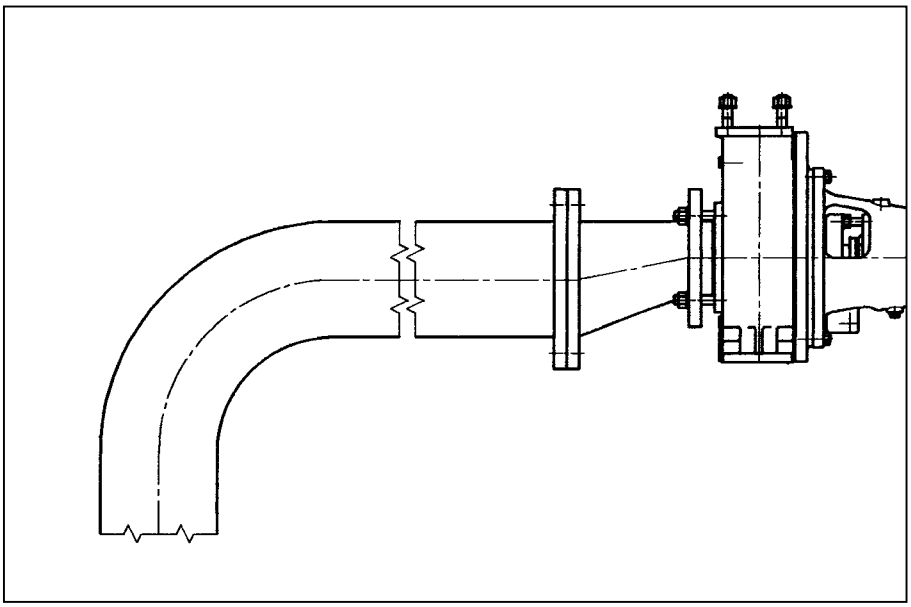


Fig. 5.3 Transition between suction pipe and pump suction nozzle

The diameter of the suction pipe must be selected so that a flow velocity of 2 m/s of water or of liquids of the same viscosity, is not exceeded. Greater losses in pressure due to long pipe lengths or baffles must be avoided.

The pipe must be completely leak-proof (pressure test) and must not contain any air sacs. Horizontal pieces of pipes should have an ascending gradient of at least 1% in the direction of the pump. Sharp corners and bends must be avoided in the pipes, as is "suctioning over the mountain".

In the case of automatic suction pumps, the suction pipe is easier to evacuate if the pump is switched on when the highest possible level of liquid is in the pump sump.

Gassing liquids should not be pumped in suction operation. If in doubt, ask the manufacturer.

5.3.4 Automatic suction by means of liquid provision (attached storage container).

By attaching a liquid provision system (storage container) to the pump suction nozzle, a normal suctioning rotary pump can evacuate the suction pipe.

When using an attachment tank with inflammable media to be pumped (Dangerous Goods Ordinance, Article 4 Dangerousness Characteristics), the user must ensure that an explosive mixture can be developed neither in the pump nor in the attachment tank.

The useful volume of the storage container (between bottom edge – supply nozzle and top edge – outlet nozzle) must be at least 50 % larger than the volume of the suction pipe. Standard storage containers are allocated to the pump models for the following suction ratios:

- Overall length (stretched length) of suction pipe 5 m
- Nominal width of suction pipe according to nominal width of the suction nozzle
- Maximum geodesic suction height 3 m

If the volume of the suction pipe and / or the geodesic suction height is larger than the above figures, the storage containers must be adapted to suit the suction conditions.

When suctioning via the storage container, the pump should be equipped with a reflux valve (refer to 5.3.7 below) on the discharge side in order to avoid the pump and container emptying by siphon effect once the pump has been switched off.

Prior to initial start-up or after draining, the attachment tank must be filled up with liquid at the filling opening. Thereafter, the filling opening must be closed, gas-tight. In addition, it must be assured that the suction line is sufficiently vacuum-resistant.

Pipes which are to be connected to the attached storage container must be secured without tension. They must be supported by brackets or retainers. The pipes must not apply any forces or moments to the container and connectors. The attached storage container must be connected as close to the pump as possible. If possible, pump and attached storage container should be mounted on a common base plate. If the attached storage container is not placed on the base plate, care must be taken to ensure that the bottom of the attached storage container rests fully on a level surface and is properly secured.

5.3.5 Supply line

The supply line is to be laid with a constant inclination towards the pump suction branch and should never be smaller than the suction branch of the pump. The cross section of the supply line must be selected so that a flow speed of 2.5 m/s in case of water or liquids of the same viscosity is not exceeded.

For repair purposes, the installation of a shut-off valve at a sufficient distance to the suction branch (approx. 2 to 3 times the pipeline diameter) is recommended which must be completely opened during the operation of the pump. The shut-off devices in the supply and/or suction line are to be arranged so that according to the valve design, no air pockets may be formed. The control of the flow rate may only be effected by control instruments in the discharge line.

To avoid increased flow resistances, additional instruments which must be installed should have the nominal diameter of the supply line. Sharp edges and bends are to be avoided.

5.3.6 Discharge line, throttling bush

The discharge line should not be smaller than the delivery branch of the pump. In addition, the diameter depends on economic aspects, however, the flow velocity should not be selected above 5 m/s. A shut-off and/or control instrument is to be installed as close as possible to the pump.

Pumps whose type designation bears the supplementary letter "D" (e.g. NEPO 80-50-315 D) are designed with a smaller cross section in the delivery branch. The working point of this pump has been designed with a throttling bush, therefore, the pump must be operated with the same. **In case of changes to the cross-sectional area of the throttling bush, considerable damages to the pump must be expected.**

ATTENTION

5.3.7 Return flow preventer

A return flow preventer must be arranged above the delivery branch of the pump so that during commissioning, the pump is safely filled with the medium pumped even if an air cushion is formed in front of the return flow preventer.

5.4 Additional connections

For the dimensions and position of the additional connections required for the pump (sealing liquid, flushing liquid etc.), please refer to the installation plan.

ATTENTION **These connections are decisive for the function and must therefore be properly attached. The required volume flows and pressures are to be set (please refer to 7.2 below).**

5.5 Coupling protection

The pump may only be operated with a suitable coupling protection. Due to its strength, distance to the coupling and material, a coupling protection contained in the scope of supply of an aggregate corresponds to the employment in a potentially explosive atmosphere.

5.6 Final inspection and testing

The alignment according to Item 5.2 above as well as the proper distance of coupling and coupling protection are to be checked. At the coupling, the shaft must be capable of being turned by hand.

5.7 Electric connection

The electric connection may only be made by an electrical expert. The suitability of the motor for the available mains voltage is to be checked against the data on the name plate. A suitable circuit is to be selected. The employment of a protective motor device is recommended. In potentially explosive atmospheres, DIN EN 60079-14 must be observed.

6. Starting up / Operation / Shutting down

6.1 Measures to be taken before starting up

6.1.1 Cleaning and hydraulic pressure test of pipes

Before starting the pump up for the first time, all foreign bodies which might be left in the pipes from the installation of the pump, must be removed (screws, forging scales, welding drops etc.). Then the pipes are checked for leaks. Suction and discharge pipes must be hydraulically tested in accordance with the respective safety instructions.

Before starting up the pump again after repairs have been made to the pump, all broken parts of any kind – especially duroplastic or ceramic parts – must be removed from the pipelines. These broken parts can be caused when the mechanical seal is broken or if components made of Durapox® or Wernit® break suddenly due to overload or the action of foreign bodies.

ATTENTION **Broken parts or foreign bodies remaining in the pipeline system can cause disastrous damage to the pump or other parts of the plant.**

6.1.2 Ensure bearing lubrication

a) Bearings lubricated with grease

Bearings are lubricated with suitable grease before delivery.

ATTENTION **It is not necessary to re-lubricate before starting up, in fact this could cause damage as too much lubrication can cause the bearings to overheat.**

b) Oil-lubricated bearings

ATTENTION Before starting up the system, the bearing housing must be filled with oil! Filling with oil is effected as described in Section 7.1.2 below.

Operation of the pump with insufficient lubrication of the bearings leads to the maximum admissible temperature of the surface being exceeded through to sparking caused by friction.

6.1.3 Checking the direction of rotation

Pump aggregates with intermediate sleeves are supplied in an uncoupled state. To do this, the cam plate of the coupling is unscrewed, but still projects into the packet part of the coupling. The screws are on the inside of the intermediate sleeve which must be removed before the direction of rotation is checked.

Pump aggregates without intermediate sleeves are – if possible – also supplied in an uncoupled state.

Only check that the direction of rotation of the motor is identical to the direction of rotation of the pump in an uncoupled state.

Please ensure that the motor has been cut off from the electricity supply when the intermediate sleeve is being removed and re-installed.

ATTENTION

Each pump has been given an arrow to indicate the direction of rotation on the top of the bearing housing (part 350) by the factory.

ATTENTION **Even if the motor runs in the wrong direction for only a short time, the pump can be damaged!**

6.1.4 Tightening the WERNERT-elastomere-bellows

The serial shaft seal is a patented WERNERT bellows-type mechanical seal with the bellows made of elastomer (CSM or FPM). The bellows seat (Part 482) acc. to Figure 7.5.2 is to be tightened only to such a degree that the space between bellows and neck of the sealing insert is sealed. A torque of approx. 7.5 Nm is specified as reference value. With the WERNERT PTFE bellows, the tightening torque is approx. 15 Nm. By means of screws (Part 901.76), the hoods removed (Part 683) are to be fixed again to the bearing block. **During cleaning or mounting the hoods or mounting the hoods see to it that there is no static discharge. A non-conducting material may be charged by friction. This must be avoided.**

If leaks occur due to advanced wear of the seal rings, the bellows seat should not be tightened. If a different shaft seal design has been intended, tightening is not possible anyway.

ATTENTION **ONLY FOR WERNERT-ELASTOMERE-BELLOWS:**

The pump is supplied with a relaxed elastomere bellows so that the pre-tension due to longer periods of storage are not decreased. For this reason the elastomere bellows must be pretensioned before starting up by tightening the bellows seat.

6.1.5 Safety devices for the protection of people

Please ensure that before starting up, rotating parts of the pump are not freely accessible.

Make sure that the protective device to prevent machinery being touched, must be attached above the coupling, **Fig. 7.3**, as must the spray protection on the bearing housing, **Fig. 7.55**. If the pump is driven using belts, all respective safety devices must be fixed above the discs and the belts.

Electrical motors and other devices must be installed in accordance with the currently valid safety regulations (refer to 5.6).

6.2 Starting up the pump

When starting up the pump, please follow the following procedures:

1) If a flushing or sealing liquid supply is provided, same must first be started with the required pressure and volume flow (refer to 7.2).
2) The supply and suction line as well as the pump body must be filled with liquid. A complete ventilation of the pump body sufficient in time must be ensured.

ATTENTION **The pump must not run dry.**

3.) Valves on the suction side must be completely opened. Delivery-side shut-off valves should preferably be slightly opened so that the pump is not operated against a closed valve, i.e. operation at zero delivery. However, if due to the plant conditions, the pump must be started against closed shut-off valves, this may result in an inadmissible heating of the pump.

ATTENTION **The pump may be operated against a closed shut-off valve only during starting and only for one minute at the most.**

The manufacturer's consent is required if it is to be operated with closed shut-down fittings for longer periods of time. The pump may be started against a closed non-return-flap.

4.) The drive is started up.
5.) Regulators on the discharge side must be opened so far so that nominal flow is achieved.

If during operation it is expected that the shut-down fittings on the discharge side will be closed down, then a bypass must be installed in front of these and returned to the pump container (not to the suction nozzle!). This is the only way in which overheating of the pump can be avoided.
If the pump is being switched continuously (i.e. more than 3 switching on processes per hour) an auxiliary start-up device should be installed (star- triangle-switch, electronic smooth start up device, hydraulic clutch or similar) in order to reduce mechanical strain. The use of this type of device depends on the utilisation factor of the machine (coupling performance, speed, switching frequency) and should be discussed with the manufacturer.

6.3 Operating the pump

During operation see to it that due to changes no inadmissible operating conditions may occur. These are in particular:

- Delivery-side modifications, for example by opening or closing valves. In this connection, see to it that the required minimum volume flow (please refer to 4.2.4) is maintained. **In this state, there is a danger that after a short time already, the medium pumped takes inadmissible temperatures and the maximum admissible temperature of the surface is exceeded.**
- Suction-side modifications, for example by closing valves, pollution of filters, pipelines, valves or in the medium as such lead to the reduction of the supply pressure. The result hereof may be insufficient lubrication or even dry running of the mechanical seal. **Under these conditions, the maximum admissible temperature limit can be exceeded and the mechanical seal destroyed.**
- The required pressure and volume flow at additional connections such as sealing, flushing liquid etc. must be ensured by the user (refer to 5.4 and 7.2). This applies in particular to quenching and sealing liquid. Here, a sufficient cooling and lubrication of the radial shaft ring and/or mechanical seal must be ensured. **Insufficient lubrication or dry operation results in the maximum admissible surface temperature being exceeded and in the destruction of the parts to be lubricated.**
- When using attached tanks, it must be ensured by the user that the tank is always sufficiently filled. **Here, there is also a danger of dry running.**
- The bearing must be controlled and maintained (please refer to 7.1 below).
- The application limits mentioned under Section 4.2 above are to be observed.

6.4 Switching the pump off for a short period of time

The following procedure is to be performed if the pump is to be switched off for a short period of time:

1) The shut-down fitting on the discharge side must be closed or reduced to minimum flow (close completely after the motor has been stopped).
2) The drive machine is switched off.

ATTENTION **Flushing and sealing liquid supply must continue even after the drive machine has been switched off.**

3) If there is the danger of freezing, the liquid to be pumped must be removed from the pump.

6.5 Shutting the pump down permanently

The following steps must be carried out if the pump is to be shut down permanently:

1) The shut-down fitting on the discharge side is to be closed or turned to minimum volume (after the motor has been switched off, it must be closed completely).
2) The drive is shut down.

3) The entire plant systems, including the pump, must be relaxed and emptied.
4) The rinsing and sealing liquid supply must be turned off.
5) If the liquid to be pumped tends to crystallise, the pump must be rinsed with clean water.

7. Maintenance / Repairs

7.1 Monitoring and maintaining the shaft bearing

The pumps are equipped with rolling bearings. In case of continuous operation, the bearing temperature may be approx. 60°C above the ambient temperature. **If a pump is employed in a potentially explosive atmosphere (refer to 2.9.1 above), the bearings must be exchanged after a maximum of 16.000 operating hours. Bearings must be regularly checked and/or controlled to avoid the risk of an ignition. If the pump is not employed in a potentially explosive atmosphere, the bearings must be checked and exchanged, if necessary, after approx. 16.000 operating hours, at the latest, however, after three years. Insufficient lubrication may lead to an inadmissible temperature increase. Due to an excessive wear, it leads to a reduction of the service life through to the destruction of the bearings. The limitation of the temperature class due to the kind of lubrication must be observed (please refer to 2.9.6 above).**

ATTENTION

7.1.1 Grease lubrication

Unless otherwise specified, lifetime-lubricated bearings are provided. Regreasable bearings may optionally be selected.

7.1.1.1 Lifetime-lubricated bearings

The lifetime-lubricated grooved ball bearings are serially designed with guard disks on both sides. The bearings sealed on both sides are lifetime-lubricated and maintenance-free. Therefore, prior to installation, they should by no means be heated to above 80°C or rinsed. The grooved ball bearings are filled with standard lubricating greases. The lubricating grease has good anti-corrosive properties and contains lithium soap as thickener.

7.1.1.2 Grease lubrication with relubrication

Bearings lubricated using grease are filled with suitable grease at the manufacturer's. It is not necessary to re-lubricate before starting up, in fact this would even be damaging as it can lead to the bearing overheating.

New grease is applied in the spaces of the bearing cage. The grease chambers must only be one third full of grease as too much grease causes the bearings to overheat. All known grease manufacturers can supply suitable grease.

The greases which can be used have the following abbreviation according to DIN 51502: KP 2 K -30.

Attributes of the grease:

Basicoil:	Mineral oil	Basic oil viscosity at 100 °C:	11 mm²/s
Soap:	Lithium-Calcium	Characteristic value of RPM:	600.000 mm/min
Temperature range:	-30 bis 130 °C	Worked penetration at 25 °C:	265-295
Basic oil viscosity at 40 °C:	100 mm²/s	Consistency class:	2

7.1.2 Oil lubrication

Ex factory, the pumps are delivered without oil filling. In case of oil-lubricated bearings, the bearing housing, prior to commissioning, must be filled through the top filling opening until the oil has reached the middle of the oil-level gauge.

ATTENTION **The bearing housing must not be filled with oil beyond this level.**

If preferred, the bearing bracket can be equipped with an oil regulator (constant level oiler) instead of the oil level sight glass. Oil must be filled in via the filling port S1 until the oil appears in the screw-in element of the tilted oil regulator (see **Fig. 7.1**).

ATTENTION **The oil level of the bearing housing must not exceed this level as otherwise oil leaks at the ventilation channel of the constant level oiler.**

Please take great care to ensure that the cork seal under the glass container of the constant level oiler is exactly central under the edge of the glass and that the glass container is screwed on tight. Do not screw it too tight, as this will cause the cork seal to slip and this in turn will cause oil to leak. The glass container should also never be removed from its holder.

If an oil level sight glass is installed, the oil must be visible in the middle of the sight glass. Oil dipsticks must be wetted up to the mark. **A visual inspection must be performed at regular intervals. The oil level being too low, oil must be refilled.**

An oil change should be performed annually, at least, however, after 10,000 operating hours. The lubricating oils are to be selected according to the ambient temperature. In case of ambient temperatures between 0°C and 40°C, C-LP oils of viscosity class ISO VG 68-100, DIN 51517 part III, are used (SAE 20-30). For ambient temperatures deviating herefrom, the required lubricating oil qualities must in each individual case be agreed with the manufacturer.

The volumes of oil required are listed below:

Bearing seat I : approx. 0,8 litres Bearing seat III: approx. 1.6 litres
Bearing seat II: approx. 1.0 litres Bearing seat IV: approx. 2.0 litres

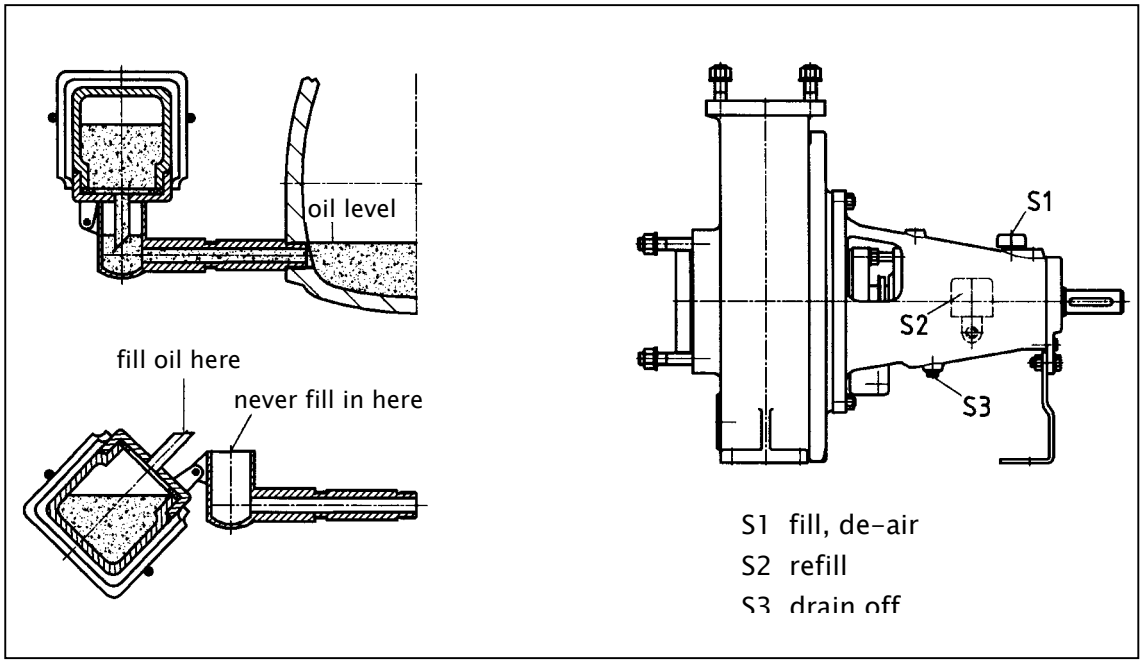


Fig. 7.1 Oil lubrication and constant level oiler

7.2 Supply for mechanical seals

The appropriate rinsing and sealing liquid volumes and pressures have been listed below. Section 4.5 contains detailed descriptions about the different types of mechanical seals. In every case the information on the order confirmation or the data sheets is decisive as the values listed below are for guidance only. When selecting quench, rinsing and sealing media, compatibility with the fluid to be pumped must be ensured.
Rinsing liquid requirements for the mechanical seal:
The liquid has to be selected in accordance to the expected environment-temperature in order to prevent freezing of the fluid. The chemical resistance of the blocking-system of the sealing media must be taken into consideration.

7.2.1 Single mechanical seal as defined by section 4.5.1, 4.5.2

a) Interior rinsing:
No exterior supply necessary

b) Interior rinsing with quench:

Medium :	usually, clean, filtered water
Excess pressure:	0.7 to 0.85 bar before flow regulator
Volume:	30 litres per hour (will adjust itself)

c) Continuous rinsing:

Medium :	usually clean, filtered water
Volume :	70 - 400 litres per hour depending on the size of the pump 20 - 115 LPH (liters per hour) possible for SSIC/SSIC mechanical seal arrangement. In this case the sealing-area is not rinsed completely.

d) Stationary flushing:

Medium :	usually industrial water
Volume :	approx. 40 litres for a flushing period of 5 minutes (minimum)

7.2.2 Back-to-back-mechanical seals - DIN EN 12756 as defined by section 4.5.3

Medium :	usually clean, filtered water
Excess pressure:	0.75 x suction pressure + 0,25 x max. final pressure + 1,5 bar (suction and final pressure measured at pump nozzle)
Volume :	30 - 120 litres per hour, depending on pump size and speed

7.2.3 Stationary double acting mechanical seals as defined by section 4.5.4

Medium :	usually clean, filtered water
Excess pressure:	0,75 x suction pressure + 0,25 x max. final pressure + 1,5 bar (suction and final pressure measures at pump nozzle)
Volume :	30 - 120 litres per hour depending on pump size and speed

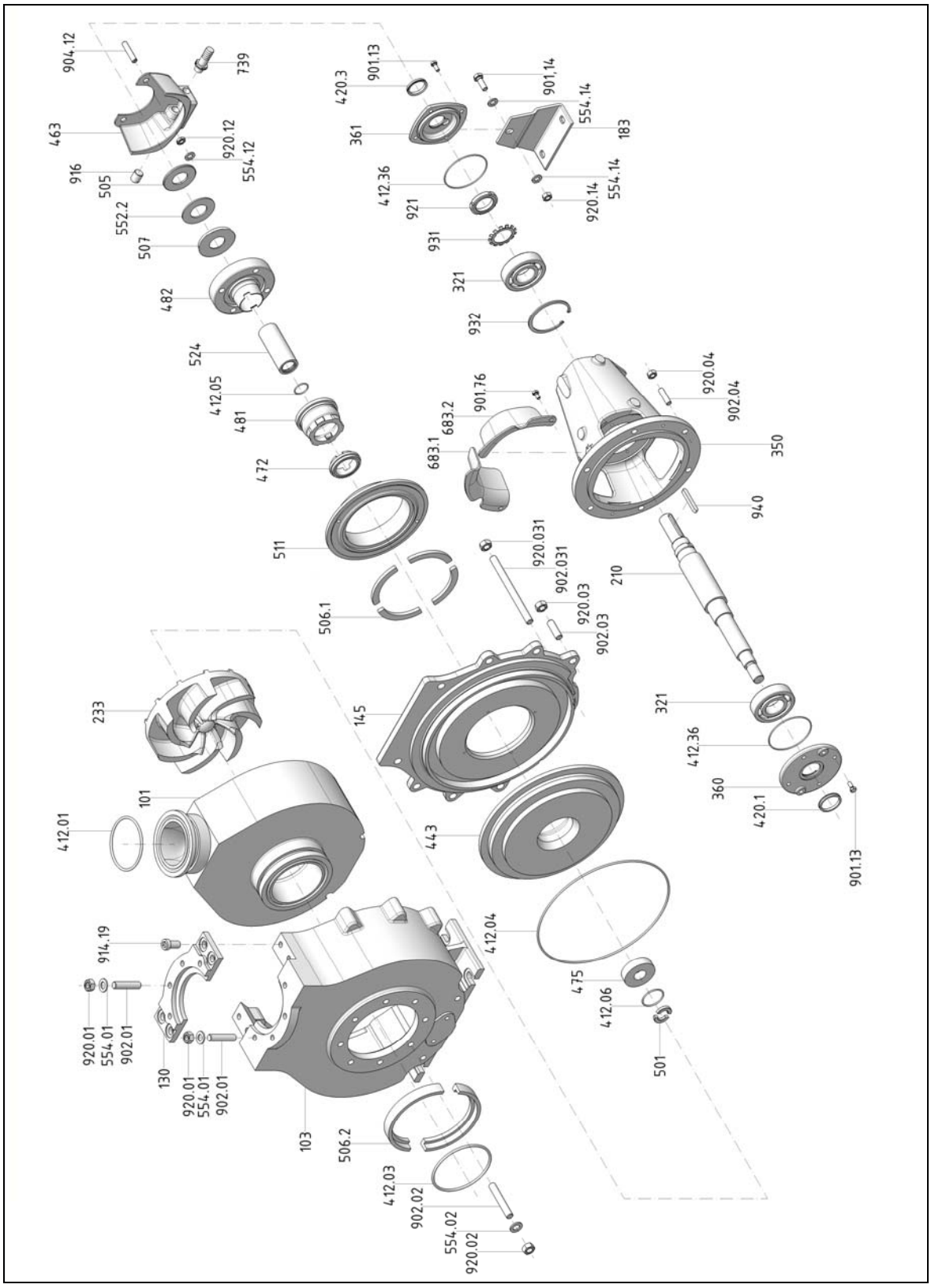


Fig. 7.2 Exploded view of the individual parts of the pump with single WERNERT-elastomere-bellows-mechanical seal and semi-open impeller.

7.3 Disassembly and assembly of the pump

Disassembly and assembly of the pump are explained in two series of photographs. As a standard technical design we have chosen the WERNERT- elastomer bellows mechanical seal and the lifetime ball bearings. If you are disassembling or assembling a pump with different shaft seals, please refer to the drawings in these operating instructions resp. the specific sectional drawing. The manufacturer also provides suitable product training upon request. **Fig. 7.2** shows all the individual parts of this pump in the correct order of assembly. The tightening torques in Annex C must be maintained.

7.3.1 Disassembly of the pump

Any work on the machine may on principle be done only with the electric junctions disconnected. The pump aggregate must be protected from unintended starting.

Prior to being dismounted, the pump must be decontaminated and neutralized. Always wear suitable protective clothing! Contact with the liquid being pumped must be avoided under all circumstances! When draining the medium pumped make sure to avoid any danger to personnel and environment. Statutory provisions must be complied with.

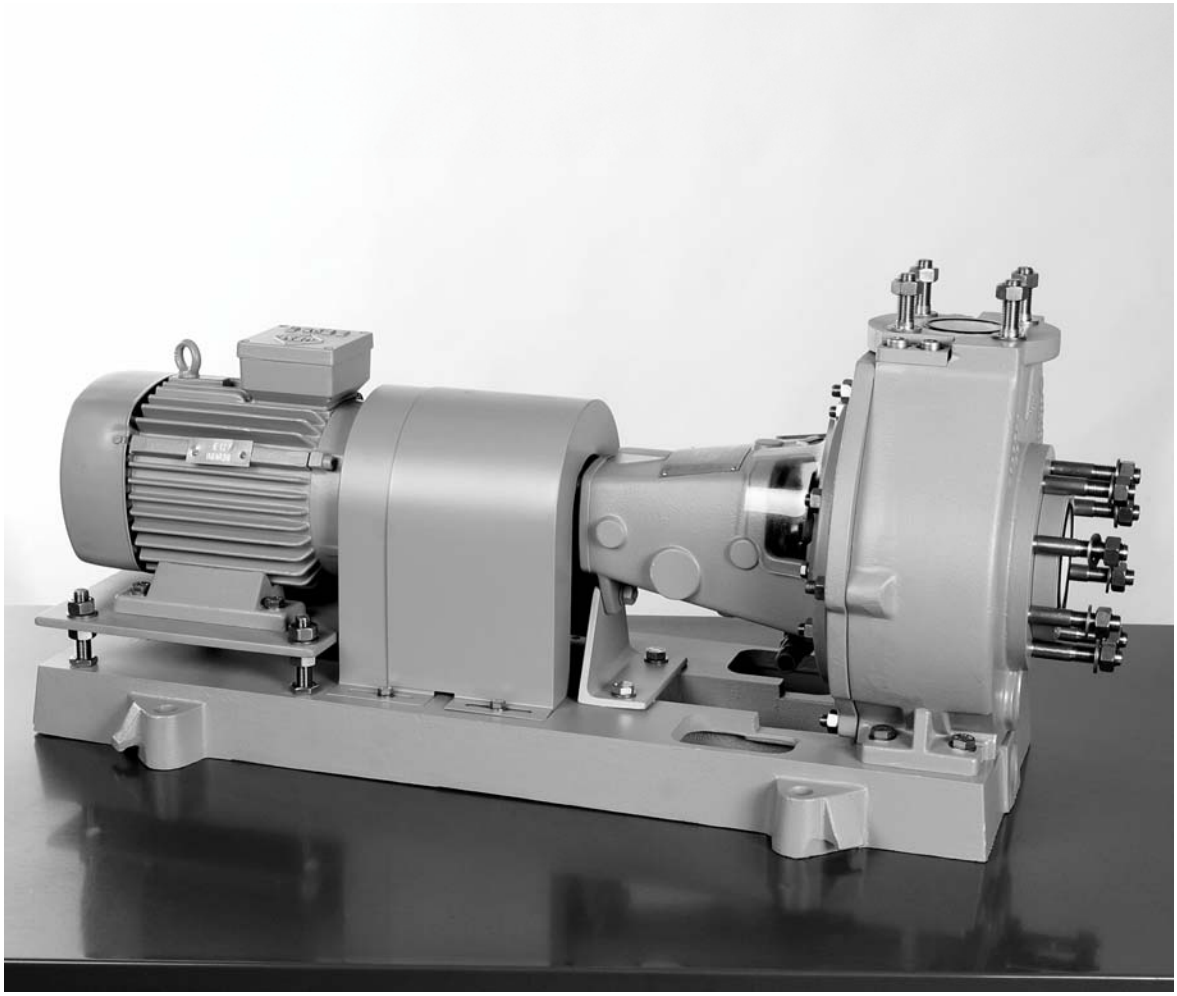


Fig. 7.3
Complete pump aggregate.

Fig. 7.4

Disconnect electric motor from power supply. Remove safety guard.

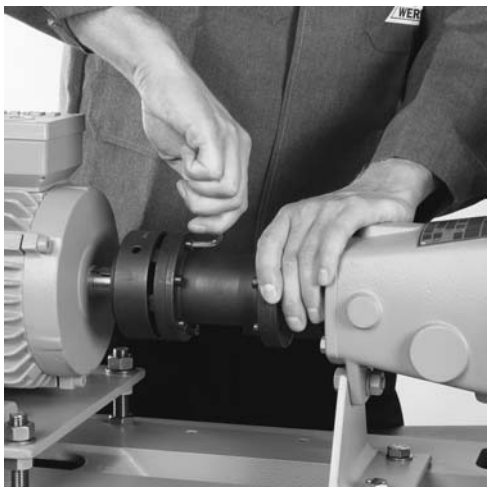


Fig. 7.5

Disassembly coupling between electric motor and bearing housing whilst safety guard is removed. Remove cylindrical screw.

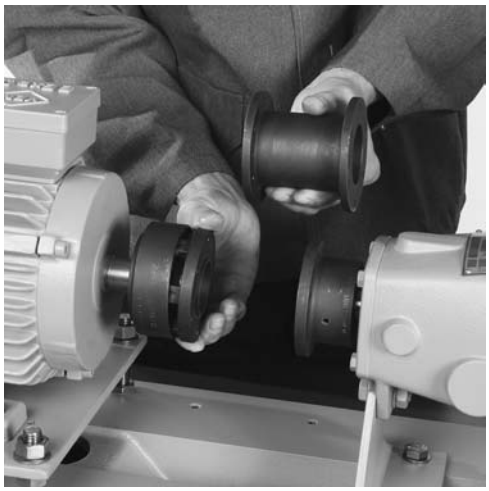


Fig. 7.6

Remove intermediate sleeve of the coupling.

Fig. 7.7

Take away hexagon nuts on adapter / annular casing and hexagon head bolts on support foot.

Fig. 7.8

Take away hexagon head bolts on bearing bracket. Take away caps.

Fig. 7.9

Push off back pull out unit from annular casing. Depending on liquid pumped take safety measures. Protect eyes! Danger of cauterization!

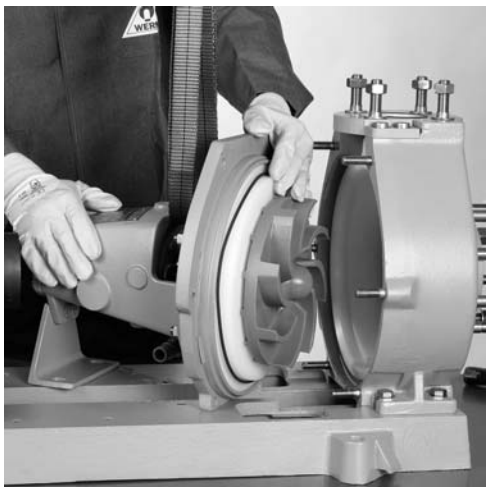


Fig. 7.10

Back pull out unit is in disassembled state. The pump casing / annular casing can be left in the pipework.

Fig. 7.11

Loosen the semi-open impeller in sense of rotation of the pump using special tool (part 051). Fix shaft beforehand.

Fig. 7.12

Remove the multiple ring from the shaft using special tool (part 052) and remove the rotating seal ring.

Fig. 7.13

Remove existing rinsing connections. Loosen hexagon nuts to separate bearing housing from the adapter.

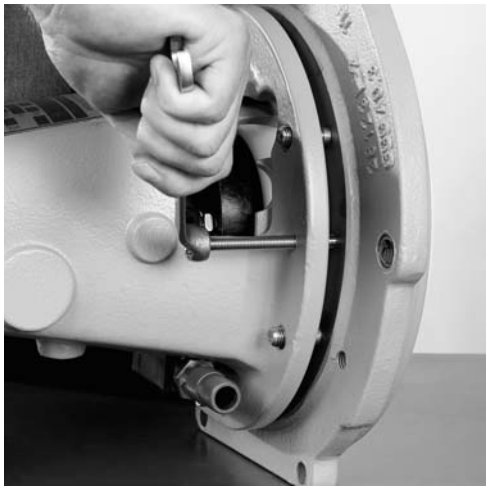


Fig. 7.14

Separate bearing housing and adapter using ejector screws. Pull out bearing housing with the shaft.

Fig. 7.15

Take bellows with stationary seal ring and bellows seat off the seal insert.

Fig. 7.16
Loosen connection of stationary seal ring, bellows and bellows seat by means of easy pulling.

Fig. 7.17
Press the centering ring from the adapter and remove centering ring.

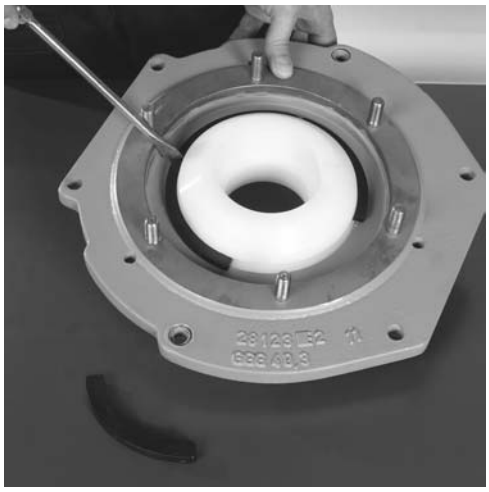


Fig. 7.18
Remove retaining rings from the seal insert.

Fig. 7.19
Separate adapter and seal insert using ejector screws.

Fig. 7.20
Pull shaft wearing sleeve with O-ring and locking disc system from the shaft.

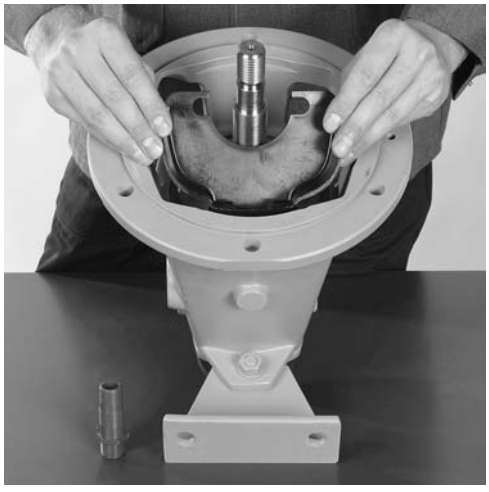


Fig. 7.21
Remove retaining screws of bellows seat and remove drip plate.

Fig. 7.22
Pull coupling part from shaft end. Loosen safety screw first.

Fig. 7.23
Remove key. Take shaft seal ring off the shaft.

Fig. 7.24
Remove screws at bearing end cover.

Fig. 7.25
Take off bearing end cover and O-ring.

Fig. 7.26
Take shaft seal ring off the shaft. Remove the hexagon head bolts from the bearing cover. Remove bearing cover.

Fig. 7.27
Push shaft with radial ball bearings off the bearing housing by carefully beating against the front face of the threaded journal with a plastic hammer.

Fig. 7.28

When the bearing on the side of the motor lies exposed press the circlip together with a round nose pliers and remove it from the nut.

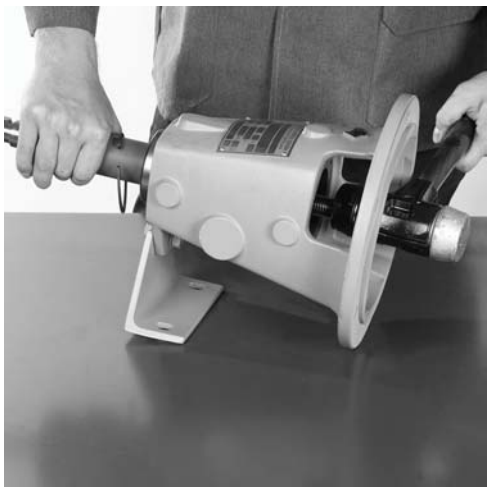


Fig. 7.29

Now the pump shaft with the radial ball bearings can be completely drifted out.

Fig. 7.30

Bearing housing, pump shaft with radial ball bearings and circlip, bearing covers with O-rings and radial shaft seal rings.

Fig. 7.31

Remove radial ball bearings by means of a removal device. The removed shaft nut and circlip are lying beside it.

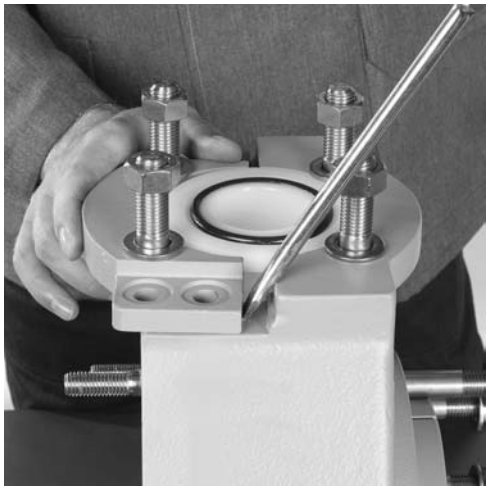


Fig. 7.32

Loosen hexagon head bolts on the casing part and remove casing part.

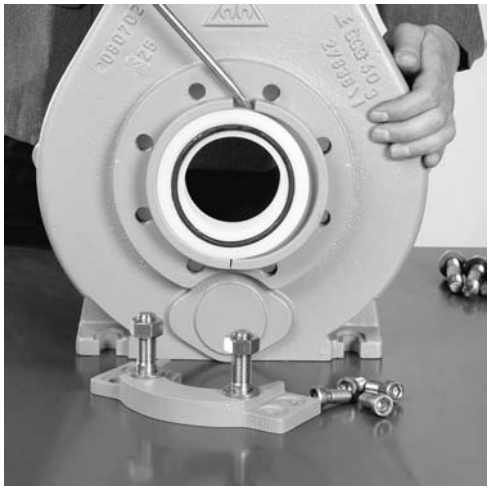


Fig. 7.33

Lever the retaining rings on pump casing. Remove locking screws beforehand.

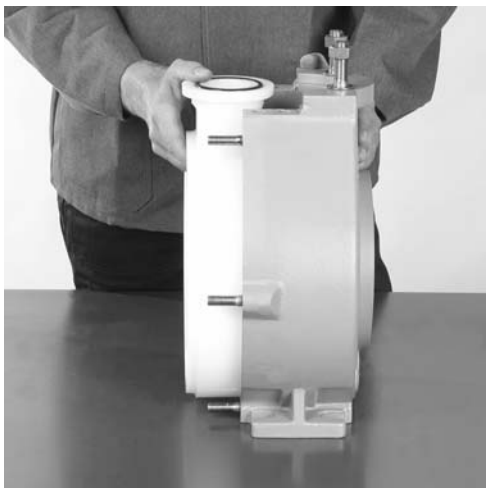


Fig. 7.34
Remove pump casing from annular casing.

7.3.2 Assembly of the pump

Fig. 7.35
Insert pump casing into annular casing.

Fig. 7.36
Insert retaining rings on suction nozzle, then tighten locking screws.

Fig. 7.37
Insert O-rings into nuts on suction and discharge nozzle. Slide pump casing under the discharge nozzle and screw it on. Attach all studs.

Fig. 7.38 Slide circlip over the antinode, heat radial ball bearings and pull them onto shaft. In case of grease lubrication sealing discs must point inwards. Lubricate bearings according to operating instructions.

Fig. 7.39
Slide lockwasher onto shaft. Tighten shaft nut with spanner. Lock shaft nut and lockwasher.

Fig. 7.40
Bearing housing, pump shaft with radial ball bearings and circlip, bearing covers with O-rings and radial shaft seal rings.

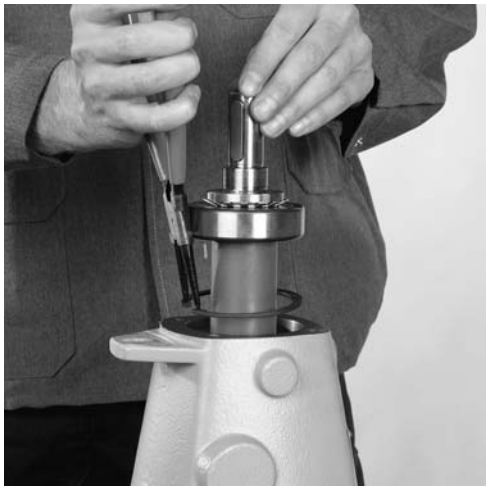


Fig. 7.41
Push shaft into bearing housing. Press circlip together with a round nose pliers and insert it into nut in bearing housing.

Fig. 7.42
When the shaft has reached its stop screw the bearing end cover with O-ring onto bearing housing.

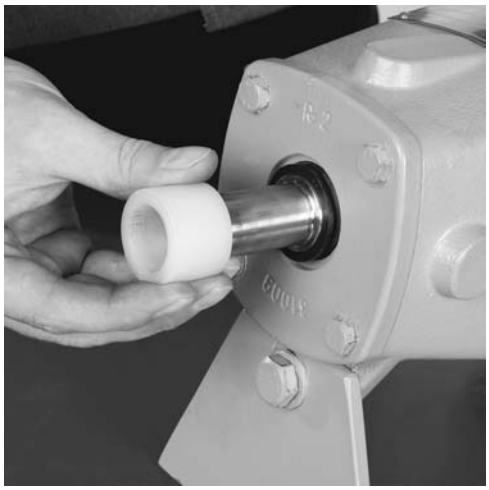


Fig. 7.43 At bearing end cover slip radial shaft seal ring over shaft. Grease lip of radial shaft seal ring beforehand. For exact positioning use a special tool if necessary.

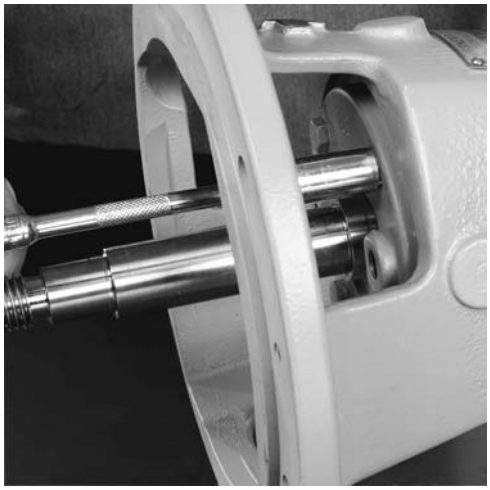


Fig. 7.44
Fit bearing cover with inserted O-ring into bearing housing and screw it on. Oil groove must be orientated downward!

Fig. 7.45 Slip radial shaft seal ring over shaft at bearing cover. Grease lip of radial shaft seal ring beforehand. For exact positioning use a special tool if necessary.

Fig. 7.46
Fasten the support foot to bearing housing.

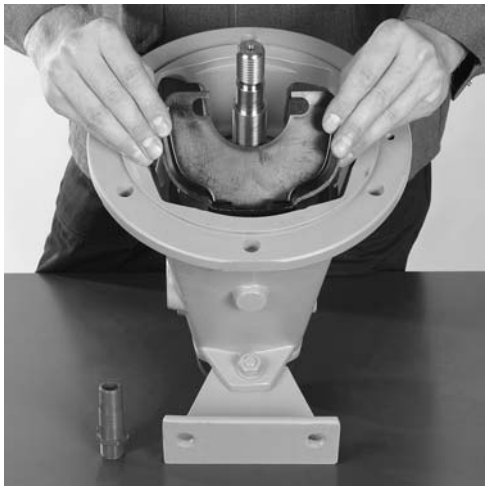


Fig. 7.47
Insert drip plate into bearing housing. Screw grub screws into bearing cover and screw on nuts. Fit washers.

Fig. 7.48 Pull locking disc system and then shaft wearing sleeve with O-ring onto shaft. Pay attention to orientation of the locking disc system!

Fig. 7.49
Assemble bellows with stationary seal ring and bellows seat. Take care to line up grooves and cams on all three components.

Fig. 7.50
Place pre-assembled bellows seat onto the pins.

Fig. 7.51
Insert seal ring into adapter and secure it with the retaining ring made up in four-parts.

Fig. 7.52
Fit the centering ring which secures the four-part retaining ring into the adapter. Align nut for flushing connection.

Fig. 7.53
Carefully slide the pre-assembled adapter over the bellows into the bearing housing centre and screw together.

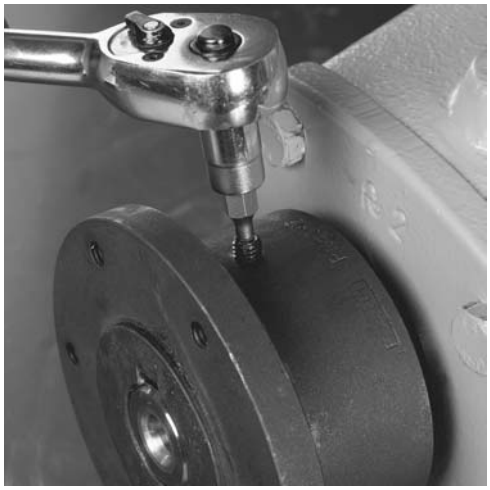


Fig. 7.54
Insert key into shaft, pull on coupling part and secure with grub screw. Grub screw must not project out.

Fig. 7.55
Place casing seal (O-ring) onto the seal insert, make sure it is correctly positioned.

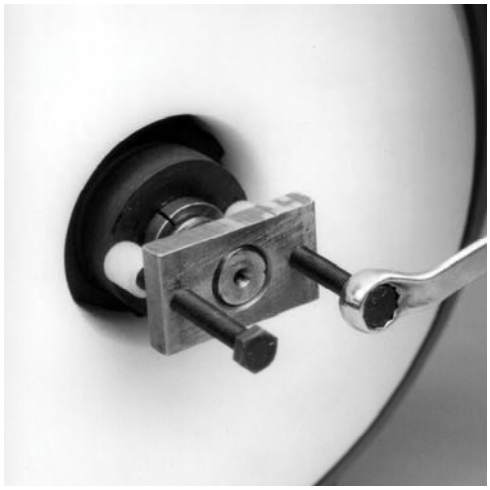


Fig. 7.56
Push rotating seal ring onto shaft, insert multiple ring using special tool (part 051) and remove assembly aid.

Fig. 7.57
Screw semi-open impeller with inserted O-ring onto shaft and tighten with special tool (part 051). Fix shaft beforehand.

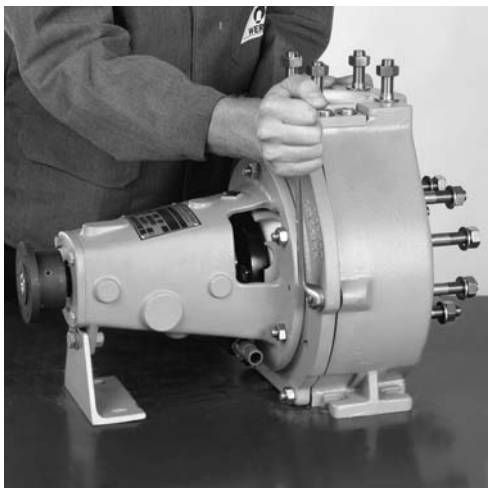


Fig. 7.58
Insert back pull-out unit into pump casing and screw it to annular casing using locking screws and hexagon nuts.

Fig. 7.59 Tighten hexagon nuts on bellows seat following instructions (section 6.1.4.). Avoid excessive tightening!

Fig. 7.60
Close pump nozzles tightly. Perform leakage test.

Fig. 7.61
Empty pump. If the pump is to go into storage, loosen hexagon nuts on the bellows. By loosening the nuts the bellows is keeping its elasticity.

Fig. 7.62
Assemble caps.

7.4 Spare parts

On principle, replacement parts should only be ordered according to a parts list belonging to the pump stating the identification number of the part and / or the serial number of the pump. On principle, every individual part can be supplied. Standard parts are always in stock at the manufacturer's or his representatives and this guarantees short delivery periods. However, we recommend that the client should also keep the parts listed below in his stores.

All parts of the mechanical seal, i.e. for the single WERNERT-elastomere-bellows-mechanical seal, which come into contact with liquid need to be replaced after one year (9,000 operating hours):

- Part 472 Stationary seal ring
- Part 475 Rotating seal ring
- Part 481 Bellows

The following O-rings should also be replaced regularly:

- Part 412.04 O-ring (casing seal)
- Part 412.05 O-ring (shaft wearing sleeve)
- Part 412.06 O-ring (impeller)

For the single WERNERT-elastomere-bellows-mechanical seal, the following parts are regarded as replacement parts after two years of operation of the pump:

- Part 210 Shaft
- Part 233 Left hand impeller
- Part 321 Radial ball bearing (2 pieces)
- Part 412.01 O-ring (discharge nozzle)
- Part 412.03 O-ring (suction nozzle)
- Part 412.36 O-ring (bearing)
- Part 420.1 Shaft seal ring (on bearing cover)
- Part 420.3 Shaft seal ring (on bearing end cover)
- Part 482 Bellows seat
- Part 501 Multiple ring
- Part 505 Loose collar
- Part 507 Thrower
- Part 524 Shaft wearing sleeve
- Part 552.2 Spanner (in locking system for shaft wearing sleeve)
- Part 921 Shaft nut
- Part 931 Lockwasher
- Part 932 Circlip
- Part 940 Key

In case of oil lubrication:

- Part 322 Radial rollerbearing
- Part 323 Thrust ball bearing

The manufacturer can at any time - if the serial number of pump is stated - provide an offer for the replacement parts required for the pump in question.

8. Faults; causes and remedies

Fault		Possible cause	Rectification
8.1 Pump not pumping even though engine is working.	8.1.1	Pump not filled sufficiently before starting up.	Refill again and de-air.
	8.1.2	Storage container empty or liquid level below inlet nozzle of suction line, therefore no liquid is flowing.	Install automatic monitoring device. Train personnel.
	8.1.3	Suction height too great, therefore liquid does not flow.	Position pump lower, and / or position liquid level higher.
	8.1.4	Pump sucking in additional air, therefore liquid does not flow.	Check suction pipe and shaft seal for leaks.
	8.1.5	Air sac formation in the pipes, therefore no liquid flow.	Lay pipes correctly. Check position of fittings. If necessary fit de-airing fittings.
	8.1.6	The overall delivery head is greater than that stated.	Adapt plant to suit pump or vice versa, otherwise use different pump.
	8.1.7	Impeller melted open in the hub region or has been destroyed due to faults as described in 8.6, 8.7 or 8.8.	Repair pump, check operational conditions. Train personnel.
	8.1.8	Shaft broken in the pump.	Repair pump, check operational conditions, train personnel.
8.2 Flow and / or delivery head to small.	8.2.1	Direction of rotation of pump is incorrect.	Change direction of motor to ensure pump rotates in the right direction. Check pump for damage before starting up again.
	8.2.2	Plant conditions do not agree with pump design.	Adapt plant to suit pump or vice versa, if necessary use a different pump.
	8.2.3	High pressure losses in unfavourably laid pipes.	Increase diameter of pipes and fittings, avoid bends, create favourable transitions.
	8.2.4	Pipes or pump blocked.	Clean sieve, filter, pipes, fittings and pump.
	8.2.5	High pressure loss in suction pipe, therefore cavitation.	Clean suction basket or suction pipe, possibly increase diameter of suction pipe. Check foot valve to see if it opens fully.
	8.2.6	Suction height too great, therefore cavitation.	Position pump lower and / or position level of liquid higher.
	8.2.7	Temperature of liquid to be pumped too high, therefore cavitation.	Reduce temperature of liquid to be pumped and / or increase initial pressure.
	8.2.8	High proportion of gas in liquid to be pumped.	Calm liquid to be pumped. Prevent water spouts using guide crosses. Lengthen circulation times. Make gassing out possible.
	8.2.9	Viscosity of liquid to be pumped higher than originally assumed.	Adapt pump, if necessary use a different pump. Alternative: Dilute or heat liquid to be pumped.
	8.2.10	Impeller worn due to abrasion.	Replace impeller.

Fault		Possible cause	Rectification
8.3 Motor is overloaded.	8.3.1	Pump cannot generate intended pressure due to system design. Actual operating point is reached at a higher volume than was intended with original design. This leads to increased power requirement.	Close fittings on discharge side until intended pressure achieved. If no regulators have been fitted, pump must be adapted to suit actual system (Impeller correction, adjusting speed, install throttle flaps).
	8.3.2	Only if speed regulation: no. of revs. too high.	Reduce no. of revs. Remove causes which led to increased speed (e.g. clean filter, remove deposits in pipes).
	8.3.3	Density of liquid to be pumped greater than originally assumed.	Fit motor with greater power.
	8.3.4	Viscosity of liquid to be pumped greater than originally assumed.	Fit motor with more power. Alternatively dilute liquid or preheat liquid to be pumped.
	8.3.5	Increased friction in double acting mechanical seal.	Check sealing pressure and if possible reduce it. Otherwise check seal for correct installation or wear and tear.
	8.3.6	Damage to pump. Therefore increased friction.	Repair pump.
8.4 WERNERT-Elastomere-bellows-mechanical seal leaks immediately after starting up.	8.4.1	WERNERT-Elastomere-bellows not tightened before starting up.	Tighten bellows according to section **6.1.4** and **Fig. 7.52.**
8.5 Mechanical seal leaks after longer period of operation.	8.5.1	Rotating seal ring, stationary seal ring , bellows and / or seal elements worn, slightly damaged or attacked by chemicals.	Mechanical seals are wearing parts! Install spare parts. If necessary, plane surface on impeller for rotating seal ring (0.1 - 0.2 mm). If chemical attack, check material used.
	8.5.2	Pump not running evenly. Shaft banging.	Check shaft for roundness and check rolling bearings.
	8.5.3	Only exterior PTFE-bellows-MS: leak between clamping point of seal and shaft sleeve due to creeping of PTFE.	Slightly tighten screws of clamping ring.

Fault		Possible cause	Rectification
8.6 Single mechanical seal is destroyed spontaneously and therefore leaks.	8.6.1	The pump has run dry, i.e. there is no liquid in the entire pump. Hence the sliding faces overheat and they are thermally / mechanically destroyed plus frequently plastic parts nearby such as impeller and bellows are destroyed by the heat (so-called running hot).	Running dry is a typical operating error. The pump must be filled completely and de-aired before it is started up. Fittings on the suction side must be completely open. Train personnel accordingly. Repair pump.
	8.6.2	Semi- running -dry in case of stall, i.e. even though a liquid ring is rotating with the impeller, it does not reach the interior sliding faces. Therefore the seal runs hot.	Take measures to prevent flow being interrupted. Install automatic monitoring device. Train personnel. Repair pump. Equip single mechanical seal with continuous rinsing or if necessary install double acting mechanical seal.
	8.6.3	Due to increased gas particles in liquid being pumped, a gas ring is formed around the rotating and stationary seal rings. This gas is pressed through the sliding surfaces by the excess pressure on the pump. Therefore the seal runs hot.	Calm liquid being pumped. Prevent water spout by using guiding crosses. Lengthen circulating times. Make de-gassing possible. Repair pump. Equip single mechanical seal with continuous rinsing or if necessary equip with double acting mechanical seal.
	8.6.4	The liquid is virtually being pumped at boiling temperature. Due to the increase in temperature in the seal gap, due to friction and simultaneous decrease in pressure, the liquid being pumped evaporates in the seal gap. Possible crystals in the liquid might crystallise out. Therefore the seal runs hot.	Repair pump. Equip single mechanical seal with continuos rinsing or possibly equip with double acting mechanical seal.
	8.6.5	High pressure losses on the suction side due to blockage or throttled fittings cause a low pressure at the mechanical seal. Air is sucked from the atmosphere through the sliding surfaces. Seal runs hot.	Minimise losses on suction size. Train personnel accordingly. Possibly decrease diameter of vane on the back of the impeller. Equip single mechanical seal with quench or possibly equip with double acting mechanical seal.
	8.6.6	Due to pressure losses on the suction side due to increased volume of liquid being pumped with simultaneous pressure decrease on pressure nozzle causes low pressure in the area of the mechanical seal. Air is sucked from the atmosphere through the sliding areas. Seal runs hot.	Throttle pressure side fittings in order to get into the admissible operational range. Train personnel accordingly. Repair pump. Possibly decrease diameter of vane on the back of the impeller. Equip single mechanical seal with quench or possibly equip with double acting mechanical seal.

Fault		Possible cause	Rectification
8.7 Pump is destroyed by "running in its own juice".	8.7.1	Pump running "in its own juice", i.e. drive performance is completely transformed into increased pump temperatures if liquid cannot be exchanged properly. This occurs if fittings on pressure side remains closed after pump has been started up...	After starting up pump open fittings on pressure side at least so far that the minimum pumping volume is achieved. Train personnel accordingly. If necessary install automatic device. Repair pump.
	8.7.2	or the pipe lines are blocked...	Clean pipelines, repair pump.
	8.7.3	or the static head of the system is not achieved by the pump.	Adapt system to suit pump or vice versa, possibly use different pump.
8.8 Pump is destroyed because it was rotating the wrong way.	8.8.1	Pump rotating in the wrong direction. (Impeller started up, hub thread torn out of impeller, bearing cover destroyed, liquid no longer being pumped.)	Change poles on motor in order to achieve correct direction of rotation for the pump. Repair pump.
8.9 Increased bearing temperature.	8.9.1	Motor aligned badly (Coupling halves are displaced in an axial, radial, angled direction).	Realign motor. Ensure axial coupling distance of 5 – 6 mm.
	8.9.2	Increased axial and / or radial forces because pump is being operated with volumes which are too small or too large.	Operate pump with permissible volumes.
	8.9.3	Pump body is twisted by pipes.	Change position of pipes or position of pump to remove tension. Then align motor. Possibly position aggregate freely.
	8.9.4	Not sufficient, too much, used or unsuitable grease or oil.	Correct this situation.
8.10 Uneven running (noises, vibrations)	8.10.1	Motor aligned badly (Coupling halves are displaced in an axial, radial, angled direction).	Realign motor, make sure axial coupling distance is 5 – 6 mm.
	8.10.2	Coupling packets worn.	Replace coupling packets.
	8.10.3	Bearing is damaged.	Replace roller bearings and shaft seal rings.
	8.10.4	Not fixed tightly to foundation.	Tighten fixing screws and anchors.
	8.10.5	Cavitation.	Take measure to avoid cavitation: – reduce volume being pumped – increase preliminary pressure – reduce losses on suction side

9. Associated documentation

Each pump of the NE series is supplied with these operating instructions.

Other documentation which describes the pump is not included in delivery as standard. The scope of the documentation to be delivered is agreed for each order separately.

10. Annex A: Name Plate

10.1 Design of the name plate

The design of the name plate is explained by means of code letters a – o.

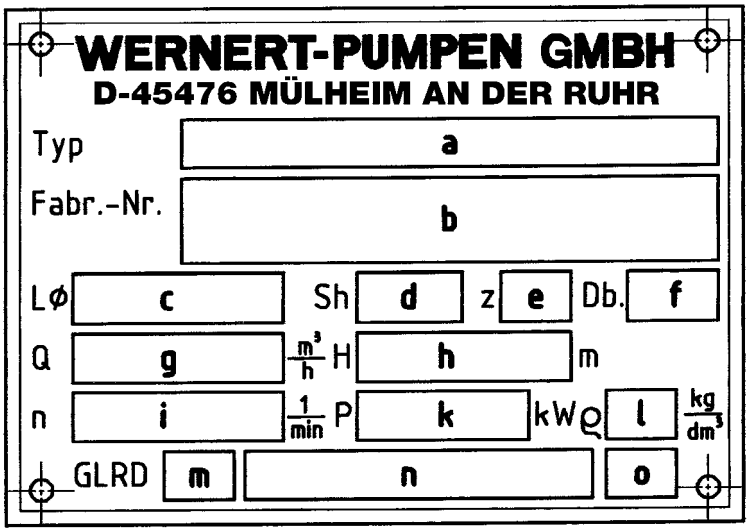


Figure A.1 Name plate with code letters

Field a = Type designation
Field b = Serial number
Field c = Impeller: Diameter in mm
Field d = Impeller: Blade height in mm
Field e = Impeller: Blade number
Field f = Possible throttling bush: Diameter in mm
Field g = Nominal flow rate Q in m³/h
Field h = Nominal delivery head H in m
Field i = Nominal speed in 1/min
Field k = Coupling power with density as per Field l / nominal drive power, each in kW
Field l = Liquid density in kg/dm³
Field m = WERNERT mechanical seal code (WGC), please also refer to Section A.2
Field n = Mechanical seal materials, product-side, please also refer to Section A.3
Field o = Material of the shaft sleeve, product-side, please also refer to Section A.3

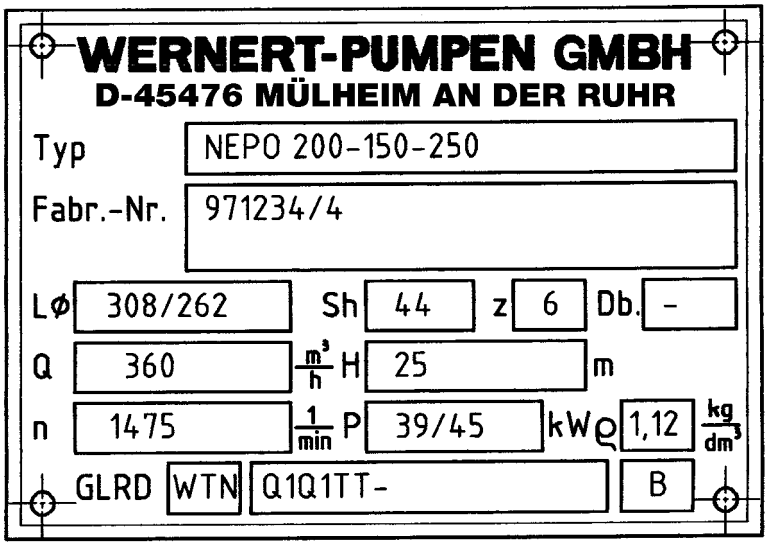


Figure A.2 Exemplary name plate

10.1.1 Additional name plate for pumps according to EC Council Directive 94/9/EC

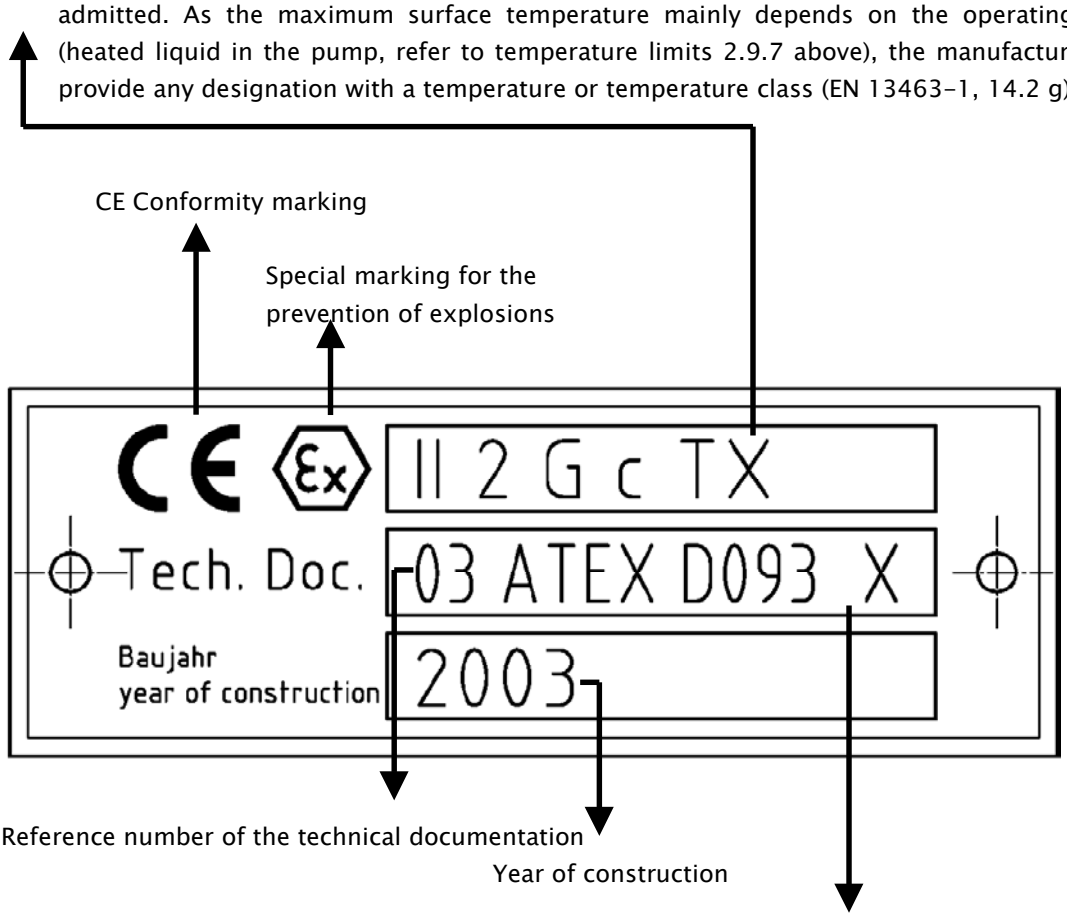
Degree of explosion protection

II **Equipment group II** applies to equipment for application in areas which may be endangered by an explosive atmosphere. Except for underground workings of mines and their surface installations which may be endangered by fire damp and/or combustible dust.

2G **Category 2** comprises machines of such a structural design that they can be operated in agreement with the characteristic quantities specified by the manufacturer assuring a high degree of safety. Machines of this category are intended for use in areas where an explosive atmosphere of gases, vapours, fogs may be occasionally expected. Even in case of frequent equipment troubles or fault conditions which are normally to be expected, the explosion protection measures of this category of equipment assure the required degree of safety.

c **Constructional-safety type of protection "c"** is a type of explosion protection where structural measures are taken to assure protection against potential ignition due to hot surfaces, sparks and adiabatic compressions (EN 13463-5).

TX **Temperature classes** T1 - T6 of which only temperature classes T1 to T4 are currently admitted. As the maximum surface temperature mainly depends on the operating conditions (heated liquid in the pump, refer to temperature limits 2.9.7 above), the manufacturer must not provide any designation with a temperature or temperature class (EN 13463-1, 14.2 g).



X The admissible area of the ambient temperature is -10 °C up to +40 °C. Behind the number of the technical documentation, the name plate is provided with the symbol "X" as an additional marking for the limited ambient temperature.

10.2 WERNERT mechanical seal code (WGC)

In the field m of the name plate, the design of the mechanical seal is entered by means of a code which always consists of three capital letters.

The first letter encrypts the general design:
C = Cartridge sealing according to EN 12756, metal-free design within the liquid area
D = Double seal according to EN 12756 (back-to-back), design K, shape UU
E = Single-acting mechanical seal with stationary spring suspension and secondary O-ring seal
F = Single-acting external mechanical seal with rotating PTFE bellows
K = Single-acting mechanical seal with rotating tapered ring
R = Single-acting mechanical seal with rotating spring suspension and secondary O-ring seal
S = Stationary double seal
W = WERNERT bellows-type mechanical seals
X = Special design

The second letter encrypts the manufacturer of the mechanical seal:
B = Burgmann
C = Crane
D = Durametallic
H = WERNERT -CSM bellows
M = Merkel
P = Pacific
T = WERNERT-PTFE bellows
V = WERNERT-FPM bellows

The third letter then distinguishes the special designs. More detailed information is available from the manufacturer.

The following codes apply to WERNERT bellows-type mechanical seals:

	WERNERT CSM bellows	WERNERT FPM bellows	WERNERT PTFE bellows
Internal flushing	WHN	WVN	WTN
Permanent flushing	WHD	WVD	WTD
Conditional flushing	WHS	WVS	WTS
Quench	WHQ	WVQ	WTQ
Quench, permanent flushing	WHP	WVP	WTP
Quench, conditional flushing	WHR	WVR	WTR
Conditional quench	WHA	WVA	WTA
Conditional quench, permanent flushing	WHB	WVB	WTB
Conditional quench, conditional flushing	WHC	WVC	WTC
Special design	WHX	WVX	WTX

10.3 Mechanical seal materials

The mechanical seal materials are coded according to the material code in EN 12756, for double-acting mechanical seals, however, only the side facing the liquid is mentioned. In field n, 5 materials must be indicated:

1st figure: Material of the rotating seal ring (this is always the spring-suspended ring)
2nd figure: Material of the stationary seal ring
3rd figure: Material of the auxiliary gaskets (any additional material in parentheses)
4th figure: Material of the spring (if available)
5th figure: Material of the other structural parts

Field o: Material of the shaft sleeve

The following materials are used for WERNERT bellows-type mechanical seals:

1st/2nd figure:

B = Carbon (synthetic-resin impregnated)
C = Special carbon
Q1 = SSiC (Silicon carbide, sintered at zero pressure)
V = Aluminum oxide ceramics
Y1 = PTFE, glass-reinforced
Y2 = PTFE, carbon-reinforced

3rd figure:

H = CSM
T = PTFE
V = FPM

4th figure:

- = Spring not available in case of WERNERT elastomer bellows
T = 1.1200 / Halar (other materials according to standard), in case of WERNERT PTFE bellows

5th figure:

- = Other structural parts not available

Field o :

B = Carbon (synthetic-resin impregnated)
C = Special carbon
G = 1.4571
M1 = Hastelloy B
M2 = Hastelloy C
Q1 = SSiC (Silicon carbide, sintered at zero pressure)
Ti = Titanium
V = Aluminum oxide ceramics

Fur further material identifications, please refer to Standard EN 12756.

11. Annex B: Admissible Branch Loads, Speeds

The admissible branch loads listed in **Table B.1** are in line with API 610. The x axis is coaxial to the pump shaft, the y axis is the vertical line, and the z axis the horizontal line. The forces and moments listed can be taken up irrespective of their direction.

Type series NE	Size Bearing housing/ Max. speed	Vertical forces		Horizontal forces		Moments		
	Size [–] / speed	Suction branch	Delivery branch	Suction branch	Delivery branch	Suction br./ Delivery br.	Suction br./ Delivery br.	Suction br/ Delivery br.
Size	[1/min]	Fy [N]	Fy [N]	Fx/Fz [N]	Fx/Fz [N]	Mx [Nm]	My [Nm]	Mz [Nm]
40-25-160	0 3500	±467	±601	±779/ ±579	±423/ ±334	±366/ ±203	±271/ ±149	±176/ ±81
50-32-160	1 3500	±579	±690	±890/ ±712	±512/ ±401	±461/ ±271	±353/ ±210	±230/ ±129
50-32-200	1 3500	±579	±690	±890/ ±712	±512/ ±401	±461/ ±271	±353/ ±210	±230/ ±129
50-32-250	2 3500	±579	±690	±890/ ±712	±512/ ±401	±461/ ±271	±353/ ±210	±230/ ±129
65-40-200	1 3500	±712	±779	±1113/ ±890	±579/ ±467	±705/ ±366	±664/ ±271	±353/ ±176
65-40-250	2 3500	±712	±779	±1113/ ±890	±579/ ±467	±705/ ±366	±664/ ±271	±353/ ±176
80-50-200	1 3500	±890	±890	±1335/ ±1068	±712/ ±579	±949/ ±461	±719/ ±353	±475/ ±230
80-50-250	2 3500	±890	±890	±1335/ ±1068	±712/ ±579	±949/ ±461	±719/ ±353	±475/ ±230
80-50-315	2 1750	±890	±890	±1335/ ±1068	±712/ ±579	±949/ ±461	±719/ ±353	±475/ ±230
100-65-250	2 3500	±1157	±1113	±1780/ ±1424	±890/ ±712	±1329/ ±705	±1003/ ±664	±678/ ±353
125-80-200	2 3500	±1558	±1335	±2403/ ±1891	±1068/ ±890	±1763/ ±949	±1356/ ±719	±922/ ±475
125-80-250	2 3500	±1558	±1335	±2403/ ±1891	±1068/ ±890	±1763/ ±949	±1356/ ±719	±922/ ±475
125-80-315	3 1750	±1558	±1335	±2403/ ±1891	±1068/ ±890	±1763/ ±949	±1356/ ±719	±922/ ±475
125-100-200	2 3500	±1558	±1780	±2403/ ±1891	±1424/ ±1157	±1763/ ±1329	±1356/ ±1003	±922/ ±678
125-100-250	3 3500	±1558	±1780	±2403/ ±1891	±1424/ ±1157	±1763/ ±1329	±1356/ ±1003	±922/ ±678
125-100-315	3 1750	±1558	±1780	±2403/ ±1891	±1424/ ±1157	±1763/ ±1329	±1356/ ±1003	±922/ ±678
150-125-315	3 1750	±2047	±2403	±3115/ ±2492	±1891/ ±1558	±2305/ ±1763	±1763/ ±1356	±1180/ ±922
200-150-250	3 1750	±3115	±3115	±4895/ ±3783	±2492/ ±2047	±3525/ ±2305	±2576/ ±1763	±1763/ ±1180
200-150-400	4 1750	±3115	±3115	±4895/ ±3783	±2492/ ±2047	±3525/ ±2305	±2576/ ±1763	±1763/ ±1180
250-200-400	4 1750	±4450	±4895	±6675/ ±5340	±3783/ ±3115	±5016/ ±3525	±3796/ ±2576	±2440/ ±1763

Tabelle B.1 Admissible branch loads and maximum speeds for Type NE

12. Annex C: Tightening Torques

Thread size	Strength class	Tightening torque [Nm]	
		min.	max.
M4	8.8	1,7	2,8
M5	8.8	3,5	5,5
M6	8.8	6	9,5
M8	8.8	15	23
M10	8.8	30	46
M12	8.8	50	79
M14	8.8	90	125
M16	8.8	150	195
M18	8.8	225	280
M20	8.8	320	390
M22	8.8	440	530
M24	8.8	550	670
M27	8.8	810	1000
M30	8.8	1090	1350

Thread size	Strength class	Tightening torque [Nm]	
		min.	max.
M4	A2/A4 70	1,5	2
M5	A2/A4 70	2,5	3,5
M6	A2/A4 70	5	7
M8	A2/A4 70	9	14
M10	A2/A4 70	20	30
M12	A2/A4 70	33	50
M14	A2/A4 70	57	87
M16	A2/A4 70	84	120
M18	A2/A4 70	115	196
M20	A2/A4 70	190	275
M22	A2/A4 70	260	370
M24	A2/A4 70	330	476
M27	A2/A4 70	460	680
M30	A2/A4 70	650	930

Table C.1 Tightening torques for screw connections

Size of Bearing housing	Tightening torque [Nm]
Size. 0	20 Nm
Size. 1	80 Nm
Size. 2	195 Nm
Size. 3	300 Nm
Size. 4	300 Nm (Wellenmutter)

Table C.2 Tightening torques of the impellers

The following applies to the "outlet" variant:
The screws for fastening the flange, Part 723 and the cap, Part 580 must be tightened with a tightening torque of 15 Nm.

13. Annex D: Permanent Flushing

The recommended flushing quantity for permanent flushing is listed in **Table D.1**. These data apply to all material pairings of the mechanical seal, however, except for SSiC/SSiC. For the material pairing SSiC/SSiC, half the flushing quantity of the values stated in the table must be considered. A tolerance of ±10 % is admissible for the flushing quantity.

Type NE Baugröße	Flushing quantity up to speed 1750 1/min [l/h]	Flushing quantity up to speed 3500 1/min [l/h]
40-25-160	40	60
50-32-160	70	120
50-32-200	70	120
50-32-250	100	140
65-40-200	100	140
65-40-250	100	140
80-50-200	100	140
80-50-250	100	140
80-50-315	100	-
100-65-250	100	140
125-80-200	100	140
125-80-250	100	140
125-80-315	120	-
125-100-200	100	140
125-100-250	120	160
125-100-315	120	-
150-125-315	120	-
200-150-250	120	-
200-150-400	250	-
250-200-400	250	-

Table D.1 Required flushing quantity for one or both parts of the mechanical seal of carbon