ALLWEILER

Operating and Maintenance Instructions

VM No.: **460.0008 US**
Edition: **02.03 VS1**
Ident No.: **550 102**

Volute–Casing Centrifugal Pumps

Series NTT and CTT

Retain for future use!

Order No.:

Pump Ident. No.:

Machine No.:

Pump Type:

Operating data, dimensions and other additional information can be found in the order–specific part of the documentation.

These Operating and Maintenance Instructions contain information from the pump manufacturer. They may need to be supplemented by instructions of the operator company for its personnel. These instructions do not take account of specific information relating to operation and maintenance of the process plant into which the pump is integrated. Such information can only be given by the persons responsible for construction and planning of the system (system manufacturer).
Such specific instructions relating to operation and maintenance of the process system into which the pump is integrated have priority over the instructions of the pump manufacturer. The system manufacturer must on principle observe the limits of use!

Refer to the operating instructions of the plant manufacturer!

Contents

1. **General**
2. **Safety**
3. **Transportation and Intermediate Storage**
4. **Description**
5. **Installation/Mounting**
6. **Start–up/Shutdown**
7. **Maintenance/Repair**
8. **Operating Faults, Causes and Remedial Action**
9. **Associated Documentation**

Important note:
This operating manual is to be supplemented by the order–related informations.

1 General

1.1 Pump designation

The exact designation can be found in the order–specific documents (see data sheet).

1.2 Proper use

Information on proper use of the pumps is provided in the technical data sheet.
The pumped liquid must not contain any abrasive constituents nor corrode the pump materials.

1.3 Performance data

The exact performance data can be taken from the order data sheet and/or acceptance test report.

1.4 Warranty

Our warranty for shortcomings in the supply is laid down in our delivery conditions. No liability will be undertaken for damages caused by non–compliance with the operating instructions and service conditions.
If at any later date the operating conditions change (e.g. different fluid conveyed, speed, viscosity, temperature or supply conditions), it must be checked by us from case to case and confirmed, if necessary, that the pump is suited for those purposes. Where no special agreements were made, pumps supplied by us may, during the warranty period, only be opened or varied by us or our authorized contract service workshops; otherwise our liability for any defects will cease.

1.5 Testing

Prior to leaving our factory, all pumps are subjected to a leak test. Additional tests will only be performed on request.

1.6 Availability

As a matter of principle, we recommend stocking replacement pumps and withdrawable units (hydraulic action system) where the supplied pumps are a decisive factor in maintaining a production or delivery process. In this way downtimes can be avoided, or reduced to a minimum.

1.7 Pressure limit

The sum of inlet pressure and maximum delivery pressure must not be greater than the permissible internal pump pressure (see data sheet).

2 Safety

These operating instructions contain basic safety instructions for installation, operation and maintenance. It is therefore essential that they are read by fitters and all specialist staff and customer personnel prior to installation and start–up. They must always be kept at hand at the place of installation.

The special safety instructions contained in the other chapters must be observed in addition to the general safety instructions in this chapter.

2.1 Identification of safety instructions in the operating manual

The safety instructions contained in these operating instructions which represent a danger to personnel if not complied with are specially marked by the general danger symbol:

Warning symbol
as per DIN 4844–W9

Warning of danger from electric voltage is indicated as follows:

Warning symbol
as per DIN 4844–W8.

Instructions which are essential to avoid endangering the machine and its operation are marked by the word

ATTENTION

Instructions affixed directly to the machine such as

- Directional markers
- Signs for fluid connections

must always be observed and maintained in fully legible condition at all times.

2.2 Personnel qualification and training

The operating, maintenance, inspection and mounting personnel must be appropriately qualified for the duties assigned to them. The scope of their responsibilities, competency and supervisory duties must be closely controlled by the customer. If the personnel do not have the required knowledge, they must be trained and instructed. If required, this may be provided by the manufacturer/supplier on behalf of the customer. The customer must additionally ensure that personnel fully understand the content of the operating instructions.

2.3 Dangers in the event of non–compliance with safety instructions

Failure to comply with the safety instructions may result in danger to persons, and place the environment and the machine at risk. Non–compliance with the safety instructions will lead to the loss of any claims for damages.
Non–compliance may result in the following dangers:

- Failure of important functions of the plant
- Failure of specified methods for maintenance and servicing
- Danger to persons resulting from electrical, mechanical and chemical effects
- Danger to the environment resulting from leakage of hazardous substances

2.4 Responsible working practices

The safety instructions contained in these operating instructions, current national accident prevention regulations, as well as internal working, operating and safety rules of the customer, must be observed.

2.5 Safety instructions for the user/operator

- Hot or cold machine parts representing a danger must be protected against accidental contact on site.
- Protection against accidental contact for moving parts (such as the coupling) must not be removed while the machine is in operation.
- When operating pump systems in a dust–laden environment (e.g. milling, chipboard manufacture, bakeries), the surfaces of the pumps and motors must be cleaned at regular intervals, depending on local conditions, in order to maintain the cooling effect and eliminate the possibility of spontaneous combustion. Please also see explosion protection regulations (ZH 1/10).
- Leakage (e.g. from the shaft seal) of hazardous substances being handled, such as explosive, toxic or hot materials, must be discharged in such a way that no danger to persons or the environment is created. Legal regulations must be observed.
- Dangers from electrical energy must be eliminated. For details in this regard, please refer to local power company regulations.

2.6 Safety instructions for maintenance, inspection and installation

The operating company must ensure that all maintenance, inspection and installation tasks are performed by authorized and qualified specialist personnel who have thoroughly studied the operating instructions.

Work on the machine is only to be carried out when the machine is at a standstill. The procedure for shutting down the machine described in the operating instructions must always be followed.

Pumps or systems handling fluids which are detrimental to health must be decontaminated. All safety and protective devices must immediately be refitted and made operational on completion of the work.

The instructions under Section 6.1, “Preparation for start–up”, must be observed before restarting.

2.7 Unauthorized conversion and production of replacement parts

Conversion or modification of the machines is only permissible after consultation with the manufacturer.

Original replacement parts and accessories approved by the manufacturer are required for safe operation. If other parts are used the manufacturer cannot be held liable for the consequences.

2.8 Unacceptable modes of operation

The operational safety of the machine supplied is only ensured when it is used in accordance with *Section 1* of the operating instructions. The limit values given on the data sheet must not be exceeded under any circumstances.

3 Transportation and Intermediate Storage

3.1 Packaging

Attention must be paid to the figurative markings on the packaging.

The suction and discharge side and auxiliary connections must always be closed during transportation and storage.

ATTENTION: The port coverings must only be removed immediately before connecting the pipeline.

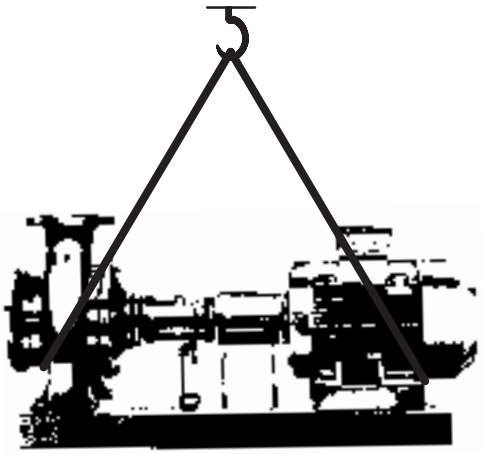
3.2 Transportation

The pump or pump system is to be safely transported to the place of installation, if required by means of lifting gear.

Crane and sling equipment must be adequately dimensioned. Sling equipment must not be secured to the lifting eyes of the motor, except as additional protection against overturning in the event of nose–heaviness.

Transportation to and at the installation site

Make sure that the unit is transported safely and in a stable position. Overturning due to nose–heaviness must be prevented.



Transport damage

ATTENTION: Check the pump for damage on receipt. Any damage detected must be reported immediately.

3.3 Preservation / Storage of centrifugal pumps

3.3.1 Preservation

In the case of storage or prolonged outage, the pumps must be protected against corrosion. In those cases, an outside and inside preservation is to be provided. The durability of the protection against corrosion, which is limited in time, depends on the composition of the preservative to be applied and the storage conditions.

ATTENTION Under normal circumstances the pumps have no special preservative.

At an additional charge we can, however, supply pumps and replacement parts ex factory with a preservative adequate to the planned storage period.

3.3.1.1 Outside preservation

The outside preservative should be applied by painting or spraying with a spray gun.

Points of preservation:

All machined, unpainted surfaces (e.g. shaft ends, couplings, flange facings, valve and manometer connections).

3.3.1.2 Inside preservation

(Not required for pumps made of stainless materials.)

Internal preservation is applied by painting, spraying, filling/dipping and subsequent draining. Finally, the suction and outlet ports as well as all other supply and discharge ports must be sealed with dummy flanges or plugs (plastic caps).

Points of preservation:

All machined parts inside the pump (e.g. pump casing inside, bearing bracket, shafts, impellers and diffusers).

3.3.1.3 Storage times

Depending on the required storage period and the surroundings, we recommend the use of preservatives from Valvoline GmbH, Hamburg.

Storage in a closed, dry and dust–free room

Storage time	up to 6 months	up to 12 months	over 12 months ①
Internal preserrvation	Tectyl 511 M	Tectyl 511 M	Tectyl 506 EH
External preservation	Tectyl 511 M	Tectyl 511 M	Tectyl 506 EH

Storage in the open–air

Storage time	up to 6 months	up to 12 months	over 12 months
Internal preservation	Tectyl 542	Tectyl 542	Tectyl 506 EH
External preservation	Tectyl 542	Tectyl 506 EH	Tectyl 506 EH

Storage in the open–air, tropical climate, aggressive industrial air or proximity to the sea

Storage time	up to 6 months	up to 12 months	over 12 months ③
Intermal preservation	Tectyl 542	Tectyl 542	Tectyl 506 EH
External preservation	Tectyl 506 EH	Tectyl 506 EH	Tectyl 506 EH

Note: The preservatives listed are to be regarded as a recommendation. Alternatively, technically equivalent products from other manufacturers can be used. When handling preservatives, follow the manufacturers recommendations and MSDS.

3.3.1.4 Depreservation

Prior to operating the pump, the inside preservation must be removed.

Environmentally compatible disposal must be ensured.

Preservatives can be removed with wax solvents, petroleum ether, diesel, petroleum or alkaline cleaners. However, the simplest method is to use a steam cleaner.

Recommendation for Tectyl 506 EH: Allow petroleum ether to act for 10 minutes before any further action.

Pumps that are used in the food or drinking water sector must be dismantled and thoroughly cleaned prior to depreservation.

A suitable solvent that is compatible with the liquid to be pumped (drinking water/food) can be used as the cleaning agent, e.g. Spiritus, Ritzol 155 or suds with a high alkaline content. Steam cleaning is ideal.

ATTENTION After a prolonged storage period (more than 6 months), all elastomers (O–rings, shaft seals) must be checked for elasticity of shape. Embrittled elastomers must be replaced. EP rubber elastomers (EPDM) must be replaced.

3.3.2 Storage

During storage of the pump, the suction and outlet flanges and all other supply and discharge openings must always be closed with dummy flanges or plugs. Storage should be in a dry, dust–free room. During storage, the pump shaft should be rotated at least once a month.

3.3.3 Monitoring of preservation

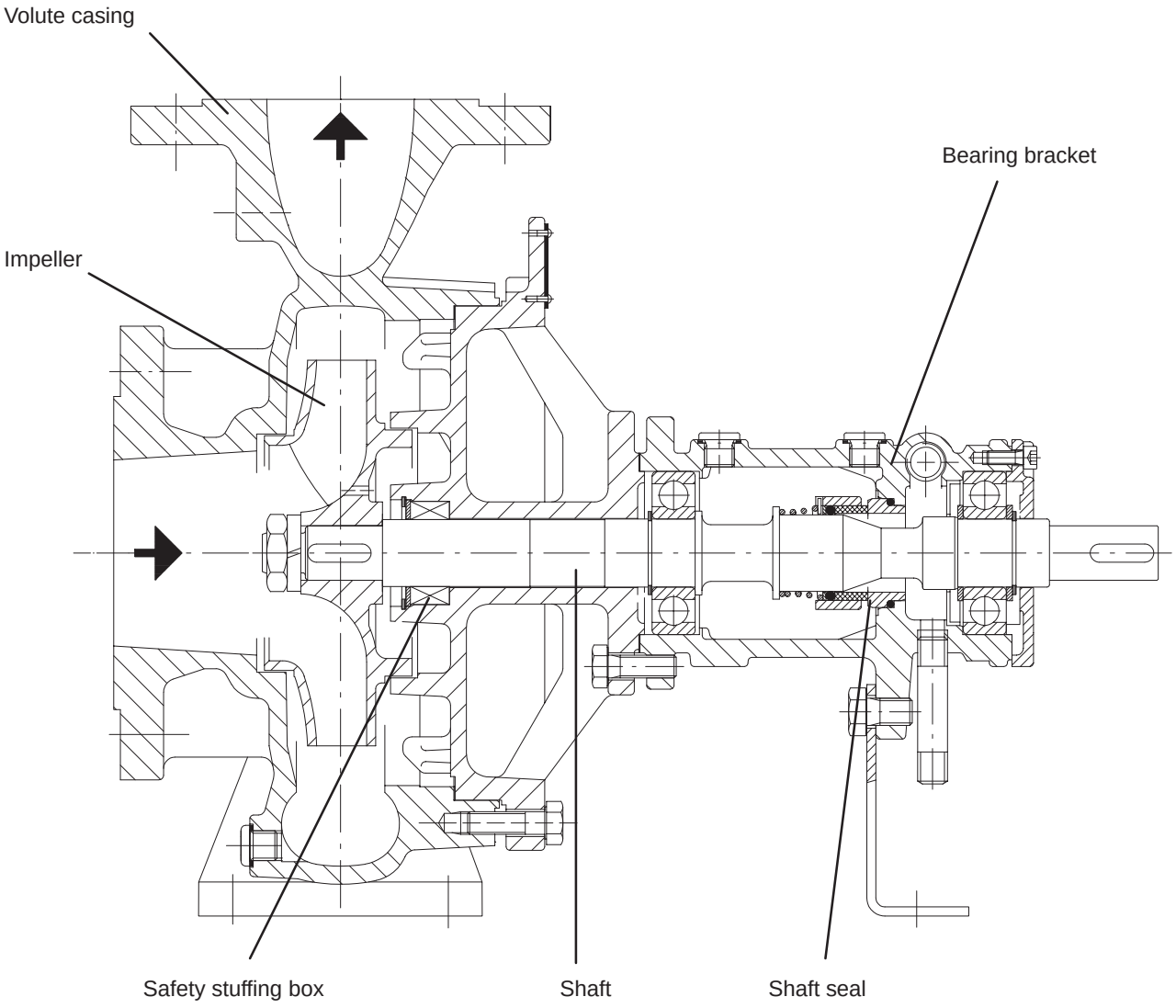
The preservation must be checked at regular intervals. The preserved areas must be inspected every 6 months and re–treated, if necessary.

ATTENTION We cannot accept any liability for defects that arise due to incorrect preservation treatment.

> ① Internal and external preservation must be renewed after 48 months at the latest.
> ② External preservation must be renewed after 18 months at the latest.
> Internal preservation must be renewed after 48 months at the latest.
> ③ External preservation must be renewed after 12 months at the latest.
> Internal preservation must be renewed after 48 months at the latest.

4 Description / Principle design of the pump

The pictorial presentation may not correspond with the pump supplied.
The actual design will be stated in the specific order documents.



Contact protection to EN 809
by coupling guard

Grounding connection to EN 809
at the base plate

5 Installation/Mounting

5.1 Installation

For installation methods and locations, please see installation drawing.

Other methods of installation are not permissible without prior consultation with the manufacturer.

The safety regulations and tests in accordance with DIN 4754 and VDI 3033 must be observed where pumps are installed in heat–transfer plants.

ATTENTION: When installing the pump, please ensure that the cooling air from the motor fan can flow unimpeded over the bearing bracket to the casing cover.

5.1.1 Place of installation

Temperature: min. –4 °F
max. +104 °F

relative air humidity:
permanent max. 85 %
temporary max. 100 %

Installation height: max. 3000 feet above sea level

For data differing from this, please consult the manufacturer.

ATTENTION: Severe vibration in the vicinity of the pump unit can lead to bearing damage and must therefore be avoided.

5.1.2 Protective devices

In order to prevent injuries due to burns, at pumping liquid temperatures higher than 140 °F protective devices in accordance with EN 809 must be provided on site.

Heat insulation

ATTENTION: Only the volute housing may be insulated with heat insulating material. In order to enable optimum heat dissipation no other pump components may be insulated.

5.2 Foundation

5.2.1 Installation of pump assembly

To insure adequate flow of liquid to pump's inlet port, place pump near liquid source and preferably place pump centerline below liquid surface. Use short, straight inlet lines.

A dry, clean, well-lit and well-ventilated site should be selected for installing the pump assembly.

Sufficient open space should be provided around pump rotor and/or gear housing to permit routine visual inspection, on-site service and maintenance, and pump replacement. For installation and servicing of large pump units, ample overhead clearance should be provided to allow for lifting device maneuvering.

5.2.2 Foundations and baseplates

Foundations and baseplates must be designed and installed so pump and driver alignment can be maintained at all times. Be sure baseplates are level and rest on smooth flat surfaces. Small pumps may be mounted on baseplates or directly to existing floors that meet the criteria of foundations. Larger pumps and/or drivers must be mounted to baseplates and foundations. It is recommended that pumps and their drivers be mounted on common baseplates.

5.2.3 Mounting of foot mounted pumps and drivers

Some pumps are shipped on baseplates without drivers. For these units, install and tighten each coupling half on driver and pump shafts. Place driver on baseplate and set proper distance between shafts and coupling hubs (See Figure 5.2). Locate driver so pump and driver shafts are in exial alignment.

5.3 Checking the coupling alignment

5.3.1 Adjusting the support foot

Before aligning the coupling, all screws on the support foot (183...) must be loosened, so that the insert unit is stress–free. After aligning the coupling, screw the support foot (183...) down to the base plate. The mounting screw (901...) on the bearing bracket should still be loose. Check that the bearing bracket is not twisted during tightening.For this purpose, the fixing screw (901...) must screw freely into the bearing bracket. If this is not possible, the seat of the support foot on the base plate must be corrected (e.g. by placing shims underneath). Then tighten the mounting screw (901...).

5.3.2 Checking the coupling alignment in case of horizontal setup on base plate

A complete delivered pump assembly has been carefully assembled at the factory. After proper installation and prior to start-up of the pump assembly, the alignment of the coupling must be checked.
The check can be made with a straight–edge and a feeler gauge, or with other suitable equipment (such as a laser alignment device).

The measurements are taken in two planes, each offset by 90, on the circumference of the coupling.

The gap between the two coupling halves must be the same all round the circumference of the coupling. The specified gap is shown in the installation diagram.

The spacing between the straight–edge laid over both coupling halves and the respective shaft must be the same all round the circumference.

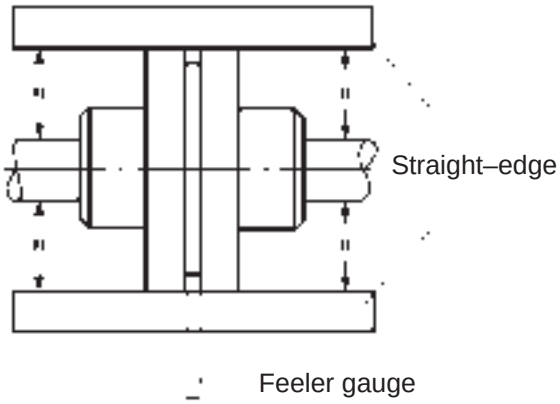


Figure 5.2: Alignment of the coupling with straight–edge and feeler gauge

For couplings with a spool piece (removable couplings) the alignment of the coupling can be checked with dial gauges.

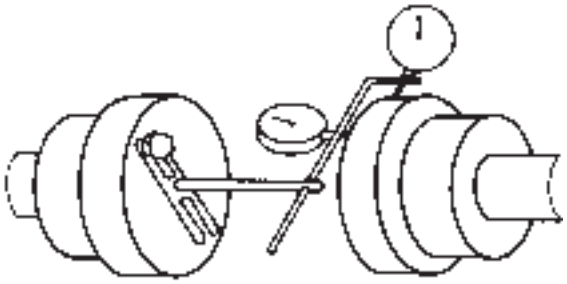


Figure 5.3: Alignment of the coupling with dial gauges

Note: The permissible axial and radial deviation, measured on the front face of the coupling and the coupling circumference respectively, may be max. 0.004”, but as far as possible should be kept below 0.002”.

If a height, lateral or angle offset is detected between the two coupling halves, the drive motor should be realigned such that the coupling halves are flush with each other (level out with flat packing shims as necessary).

When the mounting bolts have been aligned and tighened the pump/drive motor unit must be able to be spun by hand freely.

ATTENTION Alignment errors on the coupling may lead to heavier wear of the coupling, the anti–friction bearing and the shaft seal, and/or breaking of the shaft.

5.3.3 Coupling alignment of special designed couplings (if present)

Refer to the operating instructions of the coupling manufacturer.

5.4 Assembly of pump and drive motor

If the unit is assembled at the place of use, the following work is to be performed:

1. Coat the pump and motor shaft ends with a fine film of molybdenum disulfide (e.g. Molykote) and insert keys.

2. Push on the coupling halves on the pump and motor side with the aid of a pusher device until the shaft end is flush to the coupling hub.
   If no puller is available, heating the coupling halves to approx. 212 °F (without rubber buffer) facilitates pushing.

ATTENTION The possibility of shock and stress on the pump and drive motor components must be eliminated.

3. Tighten the set screw on both coupling hubs.

4. When assembling the pump and motor, make sure the specified gap between the coupling halves is maintained (see our illustration drawings).

5. In the case of horizontally mounted pump and motor on a base plate or directly on the foundation, the coupling must be aligned as described in Section 5.4.

6. Mount the coupling guard.

According to accident prevention regulations, the pump must only be operated with a protection against accidental contact.

Note: When installing pumps with symmetrical feet which are supplied without base plate, make sure that the guide bolt at the volute casing is seated in a guide hole. The hole diameter must be provided according to the representation below. The $^{3}/_{16}$" distance must be observed.

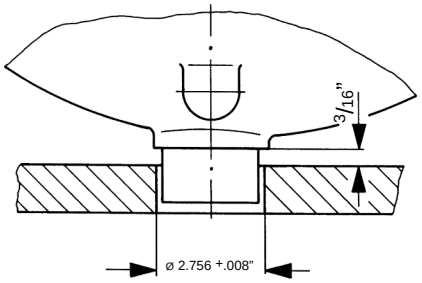


Fig. 5.4: Volute casing with guide bolt in the base plate

5.5 Space required for maintenance and repair

ATTENTION The pump must be accessible from all sides in order to be able to carry out necessary visual inspections.

Adequate space must be provided for maintenance and repair work. It must also be ensured that all pipelines can be attached and removed without hindrance.

5.6 Laying the pipelines

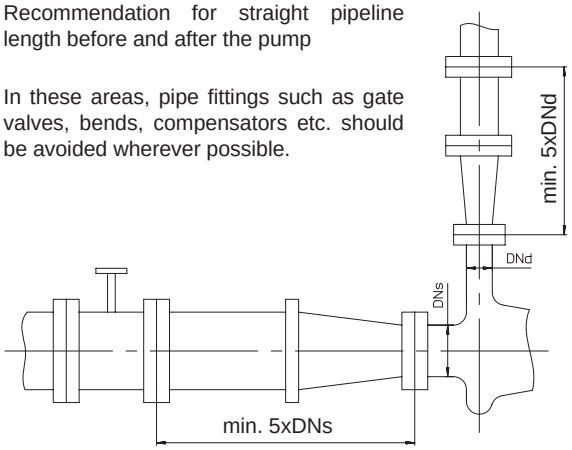
5.6.1 Nominal Pipe Diameter

The nominal diameters of the pipelines need not necessarily correspond to those of the inlet and outlet flange, however, they must not be smaller. Different nominal diameters of suction flanges and suction pipelines are to be compensated by centric transition pieces. Formation of air pockets is to be avoided.

Figure DN 1

Recommendation for straight pipeline length before and after the pump

In these areas, pipe fittings such as gate valves, bends, compensators etc. should be avoided wherever possible.



ATTENTION Shorter pipelines on the suction side are possible, but may lead to a deterioration of the hydraulic performance data. Shorter pipelines on the discharge side are possible, but may lead to increased noise development.

ATTENTION Compensators must not generate any unacceptable additional forces on the pump connection flanges. Special care is needed in cases where compensators are used, whose pressurzed diameter is greater than the nominal width of the pump connection flanges.

5.6.2 Changes in cross–section and direction

Sudden changes in cross–section and direction, as well as bends with a bend radius less than 1.5 times the interior pipe width, must be avoided.

5.6.3 Supports and flange connections

ATTENTION All pipelines must be connected to the pump stress–free in accordance with VDMA standard sheet 24277.

ATTENTION The permissible pipeline forces must not be exceeded in any operating status.

We therefore recommend on principle that a calculation of the pipeline forces is performed, which takes into consideration all operating status (e.g. cold/warm, empty/full, depressurised/pressurised, etc.).

Pipeline supports must always be free sliding and must not rust in (check regularly).

How to assess a pipeline connection

To conduct an assessment, the pipeline must be depressurised, completely drained and cooled. The pumping liquid must be disposed of with respect for the environment.

Disconnect the pipeline from the pump at the connecting flanges.

After disconnecting the connecting flanges, the pipeline must be freely movable in all directions in the area of expected expansion.

Note:	up to	Ø 5.9"	by hand
	from	Ø 5.9"	with small lever

The flanges must lie parallel.

5.6.4 Cleaning pipelines prior to attachment

Prior to assembly, all pipeline parts and valves must be thoroughly cleaned.

ATTENTION No impurities must reach the pump from the pipeline system (e.g. welding beads, residues from preservatives, etc.).

Flange gaskets must not protrude inwards. Blanking flanges, plugs, protective film and/or protective paint on flanges and seals must be removed completely.

ATTENTION Filters on suction side must be cleaned regularly. We recommend monitoring with differential manometer and/or contact manometer.

5.6.5 NPSH observation

The NPSH conditions of the system must be adapted to the respective pump requirement ($NPSH_{req.}$). An essential condition is fulfilled if the system NPSH value ($NPSH_{avail.}$) is at least $1^1/_2$ feet **above** the pump NPSH value ($NPSH_{req.}$). The $NPSH_{req.}$ can be taken from the characteristic curves of the relevant pumps.

ATTENTION The applicable NPSH values in the characteristic curves are for water with 68˚F. For other media and/or temperatures, the NPSH value may deviate from the characteristic curves.

ATTENTION Uncertainties in the determination of NPSH conditions, particularly for media other than water and/or other temperatures, must be compensated for by increased safety factors (please consult the manufacturer).

5.6.6 Inlet pipeline

In order to avoid the formation of air pockets, the inlet pipeline must be layed raising to the pump.

5.6.6.1 Stop valve (inlet model)

A stop valve is to be installed in the inlet pipeline. It must be fully open during operation (see figure DN 1).

5.6.7 Discharge pipeline

5.6.7.1 Stop valve in the discharge pipeline

A valve should be installed in the discharge pipeline.

5.6.7.2 Check valve in the discharge pipeline

The pump must not run backwards. It is recommened that a check valve is installed between the discharge flange and the stop valve.

5.6.7.3 Bleeding

In the discharge pipeline, a bleed port should be provided at the highest point and in front of the check valve.

5.6.8 Auxiliary connections

The positions of the auxiliary connections on the pump are shown in the installation drawing. All auxiliary pipelines must be connected in accordance with the installation drawing, stress–free and sealed.

5.7 Safety and control devices

5.7.1 Pressure Gauges

We recommend to provide suitable pressure gauges in the inlet and discharge pipelines, and in the pressurized auxiliary pipelines.

5.7.2 Thermometers

Thermometers must be provided to monitor the temperature of the delivery fluid.

5.7.3 Safety devices in the inlet, delivery and auxiliary pipelines

Safety devices in the form of isolation valves must be installed in the pipelines, if not already provided, to allow the pipelines to be shut off and disconnected during maintenance and repair work.

5.8 Electrical connections

The power supply cables of the drive motor must be connected by a trained electrician, according to the motor manufacturer's circuit diagram. The valid VDE regulations, the regulations of the local electricity board and the operating manual for the motor must be complied with.

Danger due to electrical power must be excluded and an EMERGENCY STOP switch in accordance with EN 809 must be provided.

ATTENTION **The pump must not run dry, not even for checking the direction of rotation.**

Refer **6.1... Control of drive motor direction of rotation**

5.9 Checking the pressure of the system with built–in pump

If the whole system with built–in pump is to be subjected to a final pressure test, the test pressure must not be more than the maximum permissible internal pressure of the pump (see data sheet).

6 Start–up/Shutdown

When starting up and shutting down the pump(s), general and special safety requirements for heat conducting equipment (e.g. from DIN 4754, VDI 3033, etc.) must be observed as well as the applicable accident prevention regulations (e.g. UVV/ VBG 64).
Plant manufacturers and operators are responsible for informing personnel of safety requirements, as well as for the implementation and continued observation of the same.

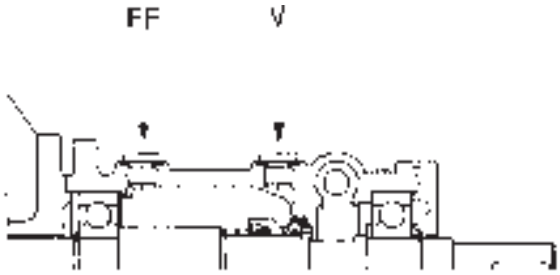
6.1 Preparations for (initial) start–up

6.1.1 Filling and bleeding the pump in the plant

Prior to starting up, the pump must be bled in the system. For this, the system and the pump must be filled with delivery fluid (see plant manufacturer's operating instructions).
During filling with delivery fluid, we recommend slowly rotating the pump shaft by hand to allow air pockets to escape into the piping system.
If the pump fails to build up pressure when started up (see pressure gauges), bleeding must be repeated.

6.1.2 Filling and bleeding the bearing bracket

Due to the sealing effect of the safety stuffing box, the bearing bracket must be separately filled with heat transfer oil.



For bleeding and filling, the screw plugs of connections V and FF are removed at connection FF, clean heat transfer oil of the same quality as the liquid pumped is filled in until fluid emerges at connection V. In order to achieve a good flow it may be required to heat up the heat transfer oil prior to filling.

The connections must be resealed after filling and bleeding.

During bleeding of the pump and system, hazardous or environmentally harmful fluid and gas must be safely collected and disposed of.

6.1.3 Control of drive motor direction of rotation

The direction of rotation of the motor must match the direction of rotation arrow on the pump. To check the direction of rotation, the motor can be switched on briefly when the pump is full.

ATTENTION **The pump must not run dry, not even for checking the direction of rotation.**

In the case of pumps with a mechanical seal that is dependent on the direction of rotation, the motor must al-ways be disconnected in order to check the direction of rotation.
If rotation is incorrect, the direction of rotation of the three phase motor can be reversed by switching any two phases.

6.2 Start–up

6.2.1 General

Before starting, all filling and venting openings must be completely closed.

6.2.2 Checking the coupling alignment

Prior to starting and after the first run–up of the pump to operating temperature, the coupling alignment and mounting of the supporting foot is to be checked. Readjust, if necessary (please refer to Section 5.4 above). The pump shaft must be capable of being rotated freely by hand.

6.2.3 Starting

To avoid overloading the drive motor, the pump should be run up only against a closed pressure isolation valve during starting.
The isolation valve in the inlet pipeline must be fully open.

6.2.4 Drive

Switch on the motor.
Refer to the operating instructions of the drive motor manufacturer.

6.2.5 Minimum rate of flow

Immediately after reaching the operating speed, the discharge isolator valve must be opened and the pump operated up to at least the minimum rate of flow (see data sheet)

Note for pumps in high temperature system:
First, heat the system to 212 ˚F – 266 ˚F with the pump running. For these purposes, the isolation valve on the suction side must be completely opened. Run the pump and system at this temperature until uniformly warmed through and fully de-aerated. Then heat up to operating temperature slowly.

ATTENTION The system manufacturers' instructions concerning heat-up of the system have priority over the above general recommendations.

6.2.6 Setting the pump power output values

The discharge isolation valve must be opened until the required pump power output values are obtained (see data sheet).

ATTENTION! Until the operating temperature has been reached, it may be necessary to run the pump at a reduced capacity. This will compensate for the increased power consumption due to high viscosity.

6.2.7 Temperature

In order to prevent injuries due to burns, at pumping liquid temperatures higher than 140˚F protective devices in accordance with EN 809 must be provided on site.

ATTENTION! It must be ensured that the pump housing is evenly heated. Differences in temperature between the top and bottom of the pump, as well as sudden temperature changes, should be avoided.

Temperature changes in the material of more than 120˚F per minute are not permissible.

6.2.8 Spare pump

It is recommended a spare pump must always be kept ready for operation. For these purposes, the isolation valve on the inlet side must be completely open. The isolation valve on the outlet side must be opened to such a degree that the pump, filled and bleded, can be brought to operating temperature.

ATTENTION! In systems in which impermissible temperature may arise due to failure of the operating pump, a standby pump of sufficient output must be provided.

Two independent energy sources must be provided for the operating and standby pumps.

6.3 Shutdown

- **Discharge pipeline**
  If a check valve is installed in the discharge pipeline, the insolation valve can remain open. Without check valve, the isolation valve must be closed.
- **Drive**
  Switch off the motor. Make sure the pump runs down smoothly and evenly.
- **Inlet line**
  Close isolation valve in inlet line.

It must be ensured that the pump does not run backwards after switching off. Otherwise, the pump may reach unacceptably high speeds, and shaft seals dependent on the direction of rotation will be severely damaged.

6.4 Measures in the event of stoppage

Pumped liquid ...	Measures in the event of brief stoppage	Measures in the event of prolonged stoppage
May solidify + has a preservative effect ①	Hear or drain pump	Drain pump
May solidify + does not have a preservative effect	Hear or drain pump	Drain and preserve pump ①
Does not solidify + has a preservative effect ①	–	–
Does not solidify + does not have a preservative effect	–	Drain and preserve pump ①

① See section 3.3

7 Maintenance/Repair

7.1 Maintenance

- The instructions in Section *2, Safety*, must be observed in maintenance and repair work.
- Regular monitoring and maintenance of the pump and the drive motor are essential for optimum service life and safety.

7.1.1 General monitoring

1. The pump must not run dry.
2. The pump must not run in cavitation mode.
3. The minimum delivery rate must always be maintained (see Section 6.2..).
4. The drive motor must not be overloaded.
5. The bearing temperature of rolling bearings must not exceed 248 °F.
6. The shaft seal must have no excessive leakage.
7. The pump unit must not experience or generate any undue vibrations (e.g. as a result of incorrect alignment). International standard ISO 10816 must be referred to for assessment.
8. Changes to the normal operating data may indicate faults. The causes must be established.
9. Installed standby pumps must be started up once a week.

Note: In addition, the instructions for erection, operation and servicing of heat transfer plants according to **DIN 4754** and **VDI 3033** are to be observed.

7.1.2 Maintenance of components

7.1.2.1 Bearing

The nominal service life of the bearing is designed for a minimum of 2 years continuous operation, in accordance with DIN ISO 281. The actual usable life may be lower, due to intermittent operation, high temperature, low viscosity, vibrations or the like.
The running noises and the temperature in the bearing area must be checked at regular intervals. We recommend monitoring bearings by means of shock pulse measurements. If damage to a bearing is detected, the bearing must be replaced.

The bearing area can become very hot.
Risk of burning if touched!

As a precautionary measure, we recommend that the ball bearings are replaced every 2 years.

The pump side medium–lubricated rolling bearing is maintenance–free.

The drive–side rolling bearing is lubricated with special grease and is filled with grease at the factory.

- **Bearing bracket size 360 and 470:**
  Sealed rolling bearing with guard discs, provided with a lifetime grease filling at the factory.
- **Bearing bracket size 530 and 650:**
  Open rolling bearing with Nilos rings and grease filled at the factory. These bearings must be regularly relubricated.
  For the relubrication periods, please refer to the following listing.

Speed	Bearing bracket size	
	530	650
RPM	Lubrication period in operating hours	
1450	11.400	10.500
1750	10.100	9.300

Notes:

1. At a maximum ambient temperature of 95 °F and maximum admissible operating temperature, the temperature at the drive–side rolling bearing is approx. 158 °F. Higher ambient temperatures or bad ventilation may cause higher temperatures.
2. In case of temperatures **over** 158 °F, the lubrication period for each 59 °F temperature rise, **must** be reduced by one half!
3. Unfavourable operating and ambient conditions such as dust, high air humidity, aggressive atmosphere etc. may require even shorter lubrication periods.

Fill with grease

- Fill hollow spaces between the rolling bodies up to approx. 40% with grease.

Bearing bracket size	Rolling bearing Abbreviation	Grease quantity in grams
530	6410 J C4	35 or 1.2 oz.
650	6413 J C4	65 or 2.3 oz.

- Scrape off excess grease (most suitably with your fingers; do not use metal objects).

Rolling bearing greases:
For the lubrication of the drive–side bearing, the below–listed rolling bearing grease or an equivalent special grease with the following characteristics must be used.

Quality:
The rolling bearing grease must be free from resin and acid and anti–corrosive.

Characteristics:

Worked penetration	250–280 mm/10
Dropping point	> 482 °F
Range of temperature application:	-40 to 356 °F

Manufacturer	Brand
Klüber ①	ASONIC GHY 72

① Manufacturer: KLÜBER LUBRICATION MÜNCHEN KG
Geisenhausenerstr. 7
81379 München
Germany

7.1.2.2 Shaft seal

The built–in mechanical seal is maintenance–free.
A maximum dripping rate of .35 oz. may occur during operation and is normal. If the dripping is heavier, the shaft seal must be replaced.

A defective shaft seal can cause uncontrolled discharge of pumping liquid.
This constitutes a hazard to people (possibility of spraying liquid) and to the environment!

At the site, it must be assured by the operator that the seepages drained through seepage drain LO are safely and completely collected in a closed tank.

7.1.2.3 Coupling

Following initial start–up, after first heating of the pump to operating temperature and at regular intervals, the alignment of the coupling and the condition of the flexible elements in the coupling is to be checked (please refer to Section 5.4 above).
Note: Worn flexible elements are to be replaced.

7.1.2.4 Drive

Refer to the operating instructions of the motor manufacturer.

7.2 Repair

General

The system operator is responsible for ensuring that instruction in safety is provided. The personnel must be made aware of all hazards that can arise in connection with the pumped liquid or the plant.

Mounting and repair work

Trained Service engineers are available on request to supervise repair work.
For all repairs, it must be ensured that the pump is depressurised, completely drained and cool. The motor must be protected against unintended switching on. We must refuse acceptance of repair work on pumps filled with fluid, for the protection of our staff and for environmental reasons. The expenditures for disposal with respect to the environment are the responsibility of the customer/operating company.

Hazardous substances

Where repairs are to be carried out on pumps which have been operated with hazardous substances ① and/or environmentally harmful media, the customer/operator must inform its own personnel on site, or our personnel where repairs are returned to our factory or a service workshop, without being specifically requested to do so.
Together with the request for a Service engineer a verification of system fluid, for example in the form of a MSDS safety data sheet, must be submitted to us.

① **Hazardous substances are:**

- Toxic substances
- Health–endangering substances
- Corrosive substances
- Irritants
- Explosive substances
- Fire–inducing substances
- Highly flammable, easily flammable and normally flammable substances
- Carcinogenic substances
- Substances impairing fertility
- Genetically distorting substances
- Substances in other ways hazardous to humans

Pumps or units which pump hazardous substances or substances that are dangerous to the environment must be completely decontaminated.

7.2.1 Disassembly of the centrifugal pump

Before disassembly, the following work must be carried out:

- Electrical danger must be eliminated! The motor must be secured against being switched on. If necessary, the power supply cable must be disconnected from the motor by an authorized electrician.
- Close all isolation valves in the inlet and discharge pipeline, and in the auxiliary pipelines.
- Allow the pump housing to cool to ambient temperature.
- Drain the fluid in flowable condition from the pump.
  Note: Use a collecting tank.
- The pump must be depressurized and drained.

- Hazardous substances and/or environmentally harmful media must be drained off and collected such that no danger to life and limb is created. Environmentally compatible disposal must be ensured.
- Remove auxiliary pipelines, if installed.
- Pressure guage lines, pressure gauges and holding devices.
- Remove coupling guard.

The pump must be disassembled by a qualified technician using the pertaining drawings.
To prevent damage, it is especially important to ensure that the components are disassembled concentrically and that they are not tilted.

Disassembly instructions:

- The pumps are produced as standard in process design. This means that the insert unit can be dismounted without the need to remove the volute housing and the pipes.
- If a coupling with a spool piece is used, the motor can remain on the base plate during this process.
- The installed position of all components must be accurately marked before disassembly.

7.2.2 Assembly of the centrifugal pump

ATTENTION: Before assembling, check all parts for wear and distress and, as necessary, replace with **original replacement parts**.
Clean all parts before mounting. Always use new gaskets.

The pump must be assembled by a qualified technician using the pertaining drawings. The prescribed tightening torque must be observed.
To prevent damage, it is especially important to ensure that the components are installed concentrically and that they are not tilted.

Assembly instructions:

- The markings applied during disassembly must be observed. The components must be put back in their original installed position.
- When assembling, screws and nuts must be painted with a suitable high–temperature anti seize compound (e.g. Molykote P37).
- After installing the insert unit, the pump shaft must be aligned with the motor shaft.
- After tightening the screws, it must be possible to turn the pump and drive freely by hand.

7.2.3 Tightening torque

Note: With poor and lightly greased surfaces, the values must be increased by 10–15%, in order to reach the required performance.

Part no.	Thread	Quality	Tightening torque
902.1 920.1 901.01 902.01 920 .01	M 10 M 12 M 16	8.8 GA-T2	26 lbs-ft 44 lbs-ft 107 lbs-ft
901.02 902.02	M 12 M 16	8.8 GA-T2	44 lbs-ft 107 lbs-ft
901.03 901.14	M 10	8.8	26 lbs-ft
901.13	M 12 M 16	8.8	23 lbs-ft 107 lbs-ft
903.1 903.2 903.02 903.06 903.07 903.18 903.19	G 1/4 G G	St	89 lbs-in 133 lbs-in 22 lbs-ft
914.4 914.08	M 6 M 8 M 10	8.8	80 lbs-in 16 lbs-ft 26 lbs-ft
922.2 922.01	M 20 x 1.5 M 24 x 1.5 M 30 x 1.5 M 36 x 1.5	1.7139	83 lbs-ft 139 lbs-ft 251 lbs-ft 516 lbs-ft

Following the installation of the centrifugal pump, the following operations are to be performed.

- Align coupling (please refer to Section 5.4 above).
- Attach coupling guard and supporting foot, if any.
- Attach manometer pipelines, manometer and holding devices to the pump.
- Electrical danger must be eliminated! Power supply cables must only be connected by qualified electricians. Pay attention to sense of rotation.

Start up pump as per instructions in Section 6.

7.3 Replacement parts

The application guidelines in accordance with DIN 24 296 can be taken as a basis for spare parts stock holding (see Section 7.3.2).

However, for reasons of operational safety, we recommend the stocking of complete insert units or spare pumps.
Advantage: In the event of damage, a defective unit can be replaced by a spare unit without great expenditure and in a very short space of time.

7.3.1 Ordering spare/replacement parts

The following details are required for handling orders for replacement and spare parts:

- Pump model number ①
- Pump serial number ①
- Year of construction ①
- Part number
- Part description
- Quantity

① refer to name plate

7.3.2 Replacement parts for two–year continuous operation as per DIN 24 296

Part No.	Part Description	Number of identical pumps (including standby pumps)						
		2	3	4	5	6 and 7	8 and 9	10 and more
		Set/Replacement parts quantity						
171.1 / 01	Diffuser (all two–stage pump sizes)	1	1	1	2	2	3	30%
210... ①	Shaft with distance washer 551.1 / 551.04 distance washer 551.3 / 551.05 impeller nut 922.2 / 922.01 circlip 932.2 / 932.02 circlip 932.7 / 932.07 spring ring 930.1 / 936.01 spring washer 930.2 / 934.01 key 940.1 / 940.01 key 940.2 / 940.02	1	1	2	2	2	3	30%
230.1 / 01	Impeller (all single–stage pump sizes)	1	1	1	2	2	3	30%
230.2 / 02 230.3 / 03 514.1 / 01 904.5 / 05	Impeller first stage and Impeller second stage with ① Threaded ring and Hexagon socket with cup point	1	1	1	2	2	3	30%
321.1 / 01 321.2 / 02	Groove ball bearing Groove ball bearing	1 1	1 1	2 2	2 2	3 3	4 4	50% 50%
– ①	Cartridge–unit pump, consisting of: Bearing bracket, casing cover, shaft, groove ball bearing etc.	–	–	–	–	–	1	2
433.1 / 01	Mechanical seal, complete	2	3	4	5	6	7	90%
461.1 / 01	Stuffing box packing (set)	2	2	3	3	3	4	40%
diverse ①	Gaskets for pump casing (set) Other gaskets (set)	4	6	8	8	9	12	150%

① Can be purchased as assembly group/sale group.

8 Operating Faults, Causes and Remedial Action

8.1 Faults with reference number for cause and remedial action

The table below is intended as a guide to identifying faults and their possible causes.

If faults occur which are not listed here, or which cannot be traced back to the listed causes, we recommend consulting the factory, or one of our branch offices or sales offices.

The pump must be depressurized and drained when faults are being rectified.

Centrifugal pump faults	Reference numbers for cause and remedial action
Delivery rate too low	1, 2, 3, 4, 5, 6, 7, 8, 9, 21, 22
Delivery head too low	2, 3, 4, 5, 6, 7, 8, 9, 21, 22
Power consumption of pump too high	9, 11, 12, 16, 17, 21, 22, 25
Delivery pressure too high	9, 12
Bearing temperature increased	16, 17, 18, 20, 25
Pump housing leaky	23
Heavy leakage of shaft seal	10, 13, 16, 17, 27
Pump not operating smoothly	1, 2, 3, 4, 5, 6, 8, 11, 16, 17, 24, 25, 26
Pump gets hot	2, 5, 26

8.2 Causes and remedial action

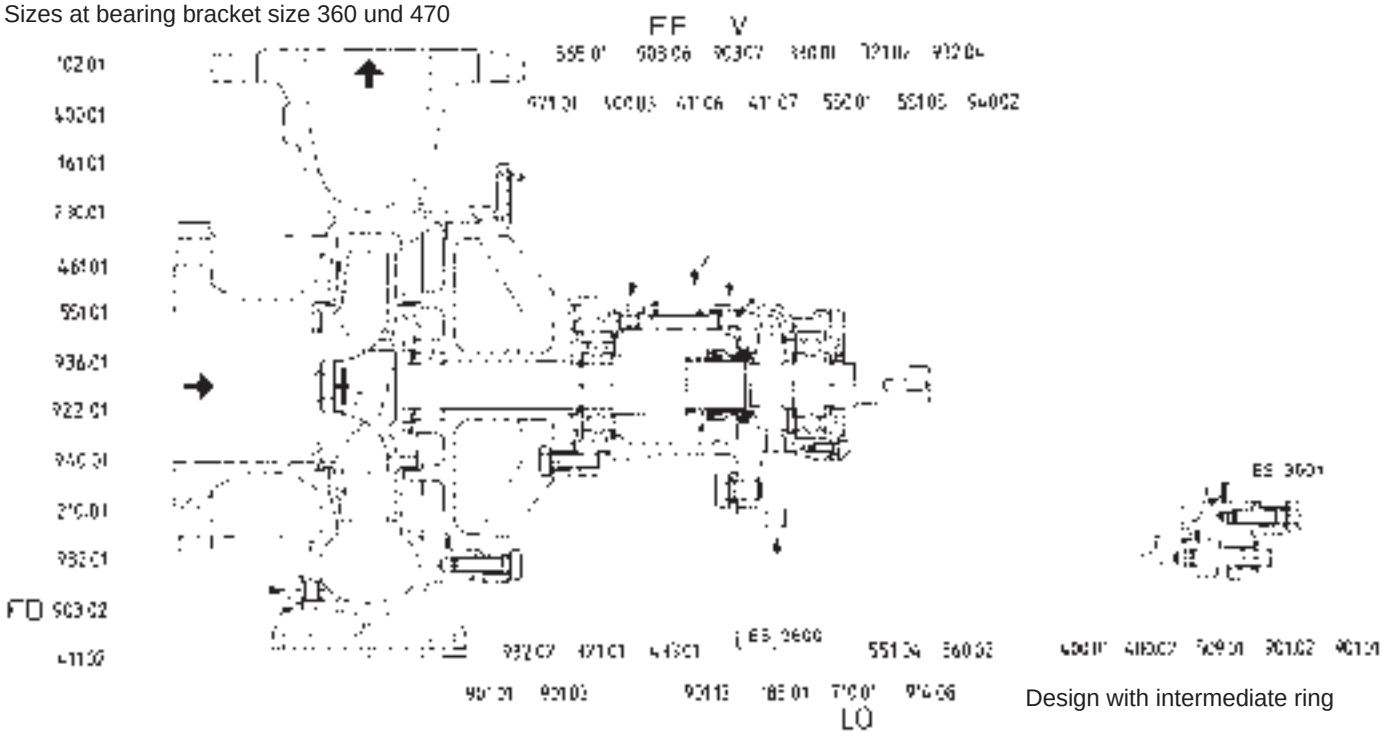
Ref. no.:	Cause	Remedial action
1	Delivery head higher than nominal delivery head of pump.	1. Open isolation valve in discharge pipeline until operating point is reached. 2. Install impeller with larger diameter. 3. Increase rotation speed (turbine, frequency control, ...). ①
2	Pump or pipelines not properly bled or filled.	Bleed and top off pump or pipelines.
3	Inlet pipeline or impeller blocked.	Clean pipelines and impeller.
4	Air pockets forming in pipeline.	Perhaps install a vent valve, or lay pipeline differently.
5	$NPSH_{plant}$ (inlet) too low.	1. Check fluid level in inlet tank. 2. Open stop valve in inlet pipeline fully. 3. Lay inlet pipeline differently if friction losses are too high. 4. Check filter in inlet pipeline, if fitted. 5. Check inlet flow conditions of pump.
6	Wrong direction of rotation of pump.	Reverse polarity of any two phases on motor.
7	Rotation speed too low.	Increase rotation speed (turbine, frequency control, ...) ①
8	Excessive wear on inner pump parts.	Replace worn parts.
9	Density or viscosity of delivery medium does not comply with pump design data.	Consult the factory in the event of faults due to non–compliance with design data. ①
10	Shaft sleeve damaged.	Mount new shaft sleeve.
11	Delivery head lower than nominal delivery head of pump.	1. Regulate operating point with isolation/control valve in discharge pipeline. 2. Turn off impeller in event of continuous overload.
12	Rotation speed too high.	Reduce rotation speed (turbine, frequenzy control, ...). ①
13	Shaft seal damaged.	Check shaft seal parts for wear and replace if necessary.
14	–	–
15	–	–
16	Pump wrongly aligned.	Re–align pump as described.
17	Pump twisted.	Check pipelines for twists in connections.

18	Excessive axial thrust.	Clean relief bore holes in impeller.
19	–	–
20	Specified coupling half gap not complied with.	Set coupling half gap as per installation diagram.
21	Motor voltage incorrect.	Use motor with correct voltage.
22	Motor runs only to two phases.	1. Check cable connection. 2. Replace fuses.
23	Screws not tight.	1. Tighten screws. 2. Replace gaskets.
24	Impeller out–of–balance.	1. Clean impeller. 2. Re–balance impeller.
25	Groove ball bearing defective.	Replace groove ball bearing.
26	Delivery rate below minimum.	Increase delivery rate to minimum.
27	Pumped liquid corroding mechanical seal material.	Check pumped liquid (e.g.: incorrect temperature, concentration, dosing of additives, etc.)

① Consult factory

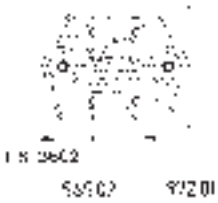
9 Associated Documentation

Sectional drawing NTT
Sizes at bearing bracket size 360 und 470

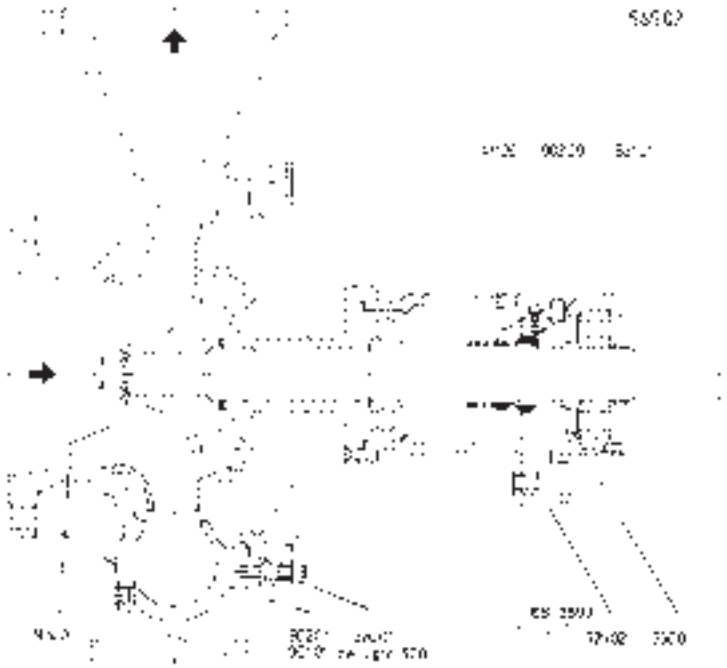


Design with intermediate ring

View X

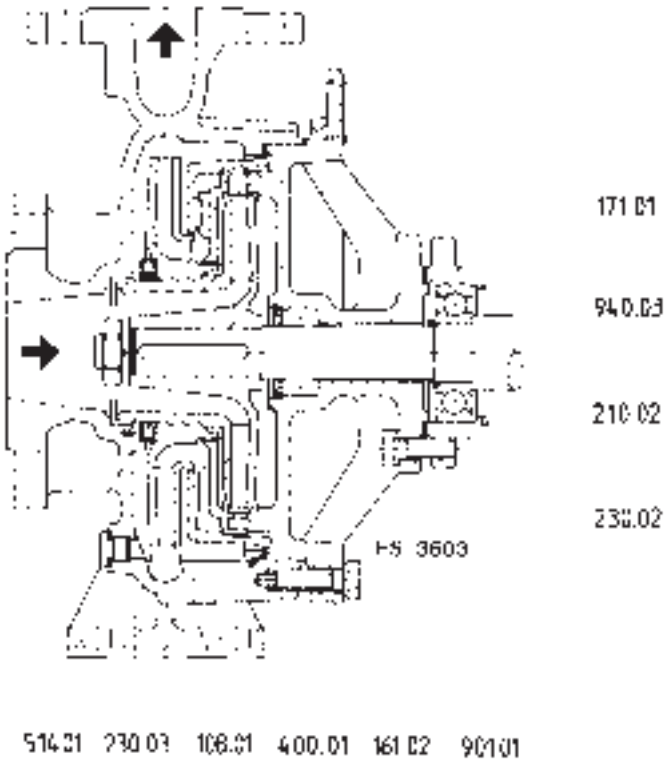


Sectional drawing NTT
Sizes at bearing bracket size 530 und 650



Shaft seal: Uncooled, unbalanced mechanical seal with safety stuffing box
Shaft Seal Design: **U5A**

Sectional drawing NTT
Two–stage sizes at bearing bracket size 360



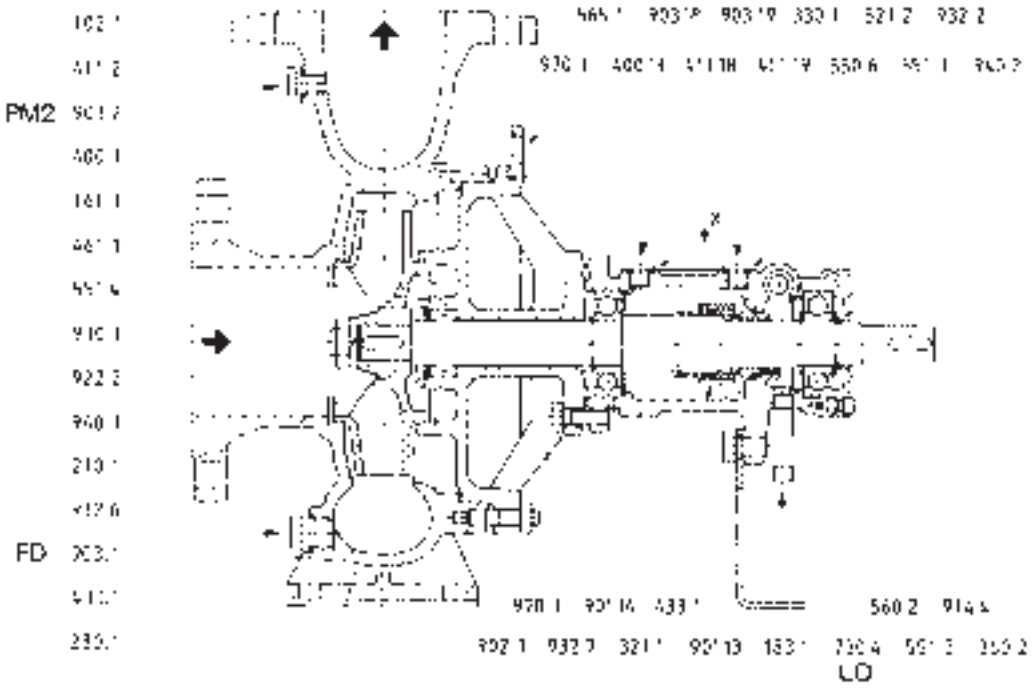
Shaft seal: Uncooled, unbalanced mechanical seal with safety stuffing box
Shaft Seal Design: **U5A**

Denomination	Part No.
Volute casing	102.01
Stage casing	108.01
Casing cover	161.01
Casing cover	161.02
Diffuser	171.01
Supporting foot	183.01
Shaft	210.01
Shaft	210.02
Impeller	230.01
Impeller first stage	230.02
Impeller second stage	230.03
Groove ball bearing	321.01
Groove ball bearing	321.02
Bearing bracket	330.01
Bearing cover	360.02
Gasket	400.01
Gasket	400.02
Gasket	400.03
Joint ring	411.02
Joint ring	411.06
Joint ring	411.07
Joint ring	411.09
Mechanical seal	433.01
Stuffing box packing	461.01
Intermediate ring	509.01
Threaded ring	514.01
Spacer sleeve	525.02
Claming sleeve	531.01
Washer	550.01

Denomination	Part No.
Distance washer	551.01
Distance washer	551.04
Distance washer	551.05
Rivet	565.01
Rivet	565.02
Pipe	710.01
Hexagon screw	901.01
Hexagon screw	901.02
Hexagon screw	901.03
Hexagon screw	901.13
Stud bolt	902.01
Screw plug	903.02
Screw plug	903.06
Screw plug	903.07
Screw plug	903.09
Grub screw	904.05
Socket–head cap screw	914.08
Nut	920.01
Impeller nut	922.01
Circlip	932.01
Circlip	932.02
Circlip	932.04
Spring washer	934.01
Spring ring	936.01
Key	940.01
Key	940.02
Key	940.03
Name plate	971.01
Information plate	972.01

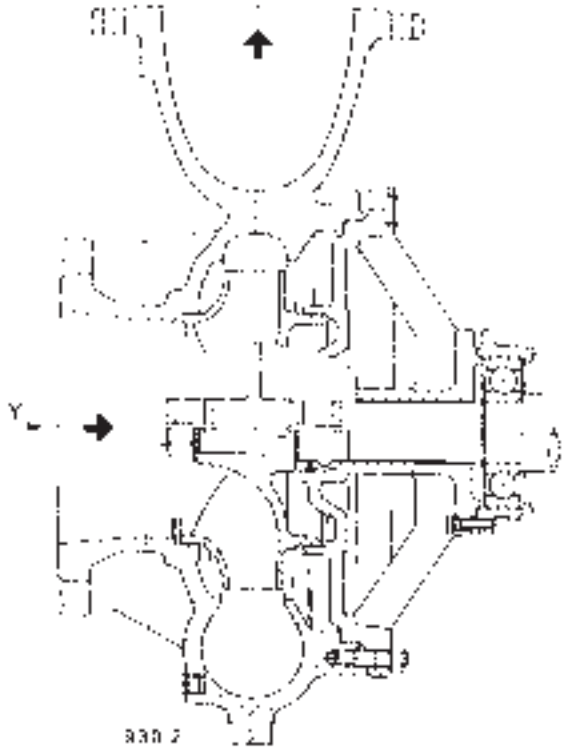
Connections	
FD	Draining
FF	Filling
LO	Leakage outlet
V	Bleeding

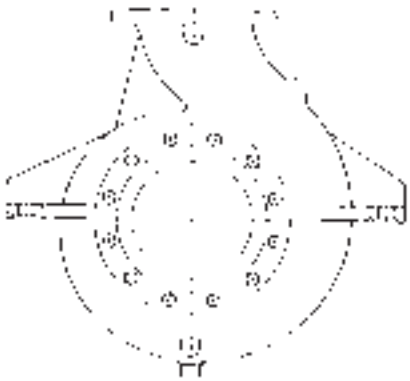
Sectional drawing CTT
Sizes at bearing bracket size 360 und 470



Shaft seal: Uncooled, unbalanced mechanical seal with safety stuffing box
Shaft Seal Design: **U5.1A**

Sectional drawing CTT
Sizes at bearing bracket size 530 und 650

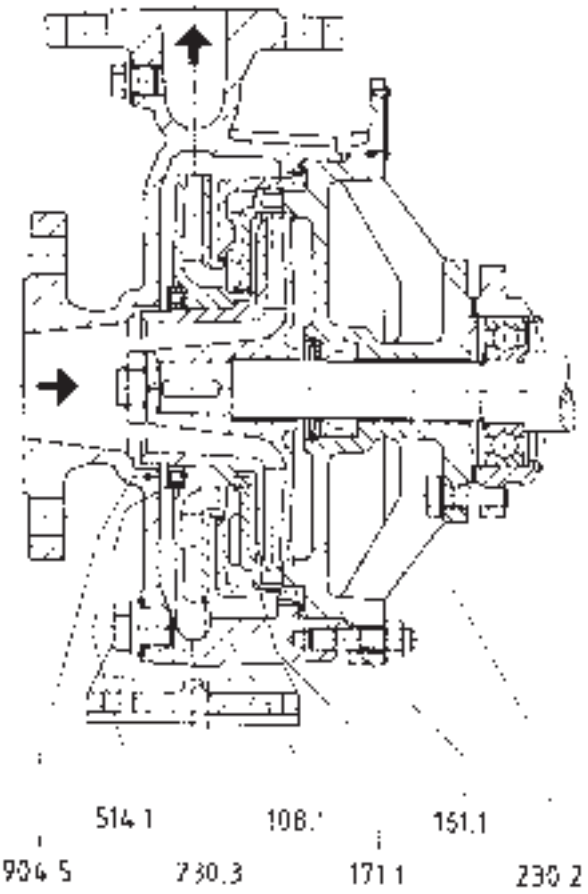




View Y
symmetrical feet

Shaft seal: Uncooled, unbalanced mechanical seal with safety stuffing box
Shaft Seal Design: **U5.1A**

Sectional drawing CTT
Two–stage sizes at bearing bracket size 360



Shaft seal: Uncooled, unbalanced mechanical seal with safety stuffing box
Shaft Seal Design: **U5.1A**

Denomination	Part No.
Volute casing	102.1
Stage casing	108.1
Casing cover	161.1
Diffuser	171.1
Supporting foot	183.1
Shaft	210.1
Impeller	230.1
Impeller first stage	230.2
Impeller second stage	230.3
Groove ball bearing	321.1
Groove ball bearing	321.2
Bearing bracket	330.1
Bearing cover	360.2
Gasket	400.1
Gasket	400.13
Joint ring	411.1
Joint ring	411.2
Joint ring	411.18
Joint ring	411.19
Mechanical seal	433.1
Stuffing box packing	461.1
Threaded ring	514.1
Washer	550.6
Distance washer	551.1
Distance washer	551.3

Denomination	Part No.
Distance washer	551.4
Spring dowel	560.2
Rivet	565.1
Rivet	565.2
Pipe union	730.4
Hexagon screw	901.13
Hexagon screw	901.14
Stud bolt	902.1
Screw plug	903.1
Screw plug	903.2
Screw plug	903.18
Screw plug	903.19
Grub screw	904.5
Socket–head cap screw	914.4
Hexagon nut	920.1
Impeller nut	922.2
Spring ring	930.1
Spring washer	930.2
Circlip	932.2
Circlip	932.6
Circlip	932.7
Key	940.1
Key	940.2
Name plate	970.1
Information plate	970.2

Connections	
FD	Draining
FF	Filling
LO	Leakage outlet
PM2	Pressure measurement
V	Bleeding

Order–specific Documentation

These operating instructions are supplemented by the following documents:

	Acceptance of order	No.
	Data sheet	No.
	Installation drawing	No.
	Sectional drawing	No.
	Part list	No.

ALLWEILER

HOUTTUIN

IMO PUMP

WARREN

COLFAX PUMP GROUP

A MEMBER OF THE
COLFAX PUMP GROUP

Imo Pump
1710 Airport Road
PO Box 5020
Monroe, NC USA
28111.5020

tel 704.289.6511
fax 704.289.9273
email Imo.Pump@ColfaxCorp.com
web WWW.IMO-PUMP.COM

VM 460.0008 US/02.03