



## **ELECTRIC DRIVES**

FOR EVERY DEMAND



# **Instruction manual**

**Asynchronous motor  
DKRES 6325-4WG / DKRGS 6325-4WG**

**Tag No. CP-D03  
CP-A71**

**Order-No. AD.08503.00  
Edition 01.2023**



**EXCLUSION OF LIABILITY**

We have checked the contents of this publication for conformity with the described hardware and software. In spite of this, deviations cannot be ruled out, and therefore we cannot guarantee complete conformity. The information in this publication is nevertheless checked regularly and necessary corrections will be included in subsequent editions.

We would appreciate any suggestions for improvement. Distribution or duplication of this document and the utilisation and disclosure of its content are prohibited, unless specifically allowed. Infringements will result in an obligation to pay damages. All rights reserved, especially if a patent is granted or a utility model is registered.

## Modifications

First edition 01.2023

Edition / Index of changes	Chapter	Type of change



# Table of Contents

<b>1</b>	<b>Definition</b>	<b>7</b>
1.1	These Instructions .....	7
1.2	Terms .....	8
1.3	Intended use .....	8
1.4	Warning system .....	9
<b>2</b>	<b>Safety instructions</b>	<b>10</b>
2.1	General information .....	10
2.2	Noise emission .....	12
2.3	Electromagnetic Compatibility .....	12
<b>3</b>	<b>Product description</b>	<b>13</b>
3.1	Function description .....	13
3.2	Main components .....	14
3.2.1	Stator .....	15
3.2.2	Rotor .....	15
3.2.3	Bearing .....	15
3.2.4	Space heater .....	15
3.2.5	Cooling and ventilation .....	16
3.3	Electrical connections .....	17
<b>4</b>	<b>Preparatory measures</b>	<b>18</b>
4.1	Installation site .....	18
4.2	Design of the foundation .....	18
4.3	Cable laying .....	18
<b>5</b>	<b>Transport and storage</b>	<b>19</b>
5.1	Dispatch condition .....	19
5.2	Transport lock .....	20
5.3	Storage .....	21
<b>6</b>	<b>Assembly</b>	<b>22</b>
6.1	De-preservation .....	22
6.2	Removing transport lock .....	23
6.3	Coupling .....	23
6.4	Alignment .....	24
6.4.1	Measuring equipment .....	26
6.4.2	Rough alignment .....	26
6.4.3	Fine alignment .....	30

6.5	Electrical connection .....	33
6.5.1	Cable gland .....	35
6.5.2	Stator, Rotor or Exciter .....	36
6.5.3	Auxiliary circuit .....	36
6.5.4	Earthing conductor connection .....	37
6.5.5	Current transformer (optional) .....	38
6.6	Oil and water connection .....	39
<b>7</b>	<b>Commissioning</b>	<b>40</b>
7.1	I-value measurement .....	40
7.2	Warning and switch-off values .....	44
7.3	Trial operation .....	45
<b>8</b>	<b>Operation</b>	<b>46</b>
8.1	Switching on .....	46
8.2	Normal operation .....	46
8.3	Switching off .....	47
8.4	Operating period intervals .....	47
8.5	Fault .....	47
8.5.1	Fault in electrics .....	48
8.5.2	Mechanical fault .....	49
8.5.3	Fault in brushes / slip rings .....	50
<b>9</b>	<b>Maintenance and inspection</b>	<b>51</b>
9.1	General cleaning / checking .....	52
9.2	Bearing .....	52
9.3	Terminal boxes .....	52
9.4	Cooling and ventilation .....	53
9.5	Coupling .....	53
9.6	Foundation .....	53
9.7	Earth brushes .....	53
9.8	Earth brush holder .....	53
9.9	Earth brushes-running track .....	54
9.10	Spare parts .....	55
<b>10</b>	<b>Disposal</b>	<b>56</b>
<b>11</b>	<b>Annex</b>	<b>57</b>
	A Technical Documents	
	B Quality Documents	
	C Documents of external suppliers	

# 1 Definition

## 1.1 These Instructions

These Instructions describe the electrical machine and provides information on how to handle the electrical machine from delivery to disposal. Please read this instruction manual carefully before mounting and commissioning. This will ensure non-hazardous and smooth functioning and a long service life of the electrical machine.

Please make accurate entries in the logbook.

Observe additional instructions in the annex.

### Technical documents in the Annex

The Annex contains:

- Technical Documents
- Quality Documents
- Documents of external suppliers

### Text features

In addition to the warnings, which you must strictly observe for safety reasons, you will find the following text features in this instruction manual:

1. Instructions for use are presented as a numbered list.

Follow the sequence of the steps.

- Lists in the first level.
  - Lists in the second level.

- (1) Numbers in brackets refer to the corresponding item numbers in the figures given in the respective chapter.

⇒ Cross-reference to a chapter or figure.

] Phone number

@ E-mail address

To ensure clarity, this instruction manual do not contain exhaustive detailed information and cannot include every conceivable application; figures may vary.

If you require further information, or if you encounter special problems which are not dealt with in sufficient detail in this instruction manual, you can request the necessary information from VEM Sachsenwerk GmbH.

### Navigation of PDF

The PDF contains links (blue font) which allow you to go directly to the referred chapter.

Navigation in the PDF is made easier by the bookmark. Click on a heading in the bookmark to display the target page.

## 1.2 Terms

The following terms are used in the instruction manual:

### Electrical machine

Electrical machines within the meaning of this instruction manual are:

- Electric motors or
- Generators (alternators)

### Working machine

A working machine within the meaning of this instruction manual is the customer's system, which is driven by the electrical machine described here. A working machine can also be a:

- Gear unit
- Pump
- Compressor
- Turbine
- Internal combustion engine

### Qualified personnel

Qualified personnel within the meaning of this instruction manual are persons who meet the following requirements:

- They are capable of identifying risks and avoiding possible hazards in their respective field of work due to their training and experience.
- They are instructed by the respective responsible person to carry out work on the electrical machine.
- These personnel should be thoroughly familiar with all warnings given in this instruction manual.

## 1.3 Intended use

This electrical machine is only approved for use as intended by the manufacturer in the catalogue, this technical instruction manual and the technical data sheet. Any other use or any use exceeding this intended use is not in accordance with the intended purpose and is therefore not permitted. Changes or conversions to the electrical machine are not permitted. Third-party products and components which are used together with the electrical machine must be recommended or approved by the manufacturer.

The correct and safe operation of the electrical machine requires proper transport, proper storage, mounting, assembly, installation, commissioning, operation and maintenance.

Please comply with the operating conditions and power limits specified in the technical data sheet!

## 1.4 Warning system

The following warnings must be observed for your own safety.  
These describe the different hazard levels:



---

**HAZARD**

specifies a hazard involving a high level of risk which, if not avoided, will result in death or severe injury.

---



---

**WARNING**

specifies a hazard involving a medium level of risk which, if not avoided, may result in death or severe injury.

---



---

**CAUTION**

specifies a hazard involving a low level of risk which, if not avoided, may result in minor or moderate injury.

---

---

**ATTENTION**

specifies a potential hazard involving a low level of risk which, if not avoided, may result in damage to property.

---

The signal word is always written in capital letters and indicates the severity of the hazard.  
This instruction manual contains general warnings and work-related warnings, please read these warnings carefully.

## 2 Safety instructions

### 2.1 General information

The faultless and safe operation of this electrical machine depends on proper transport, technically appropriate storage, mounting and assembly, as well as careful operation and maintenance.

Any work on the electrical machine should only be carried out by qualified personnel who, on the basis of professional training, experience and instruction, have sufficient knowledge of the following:

- Safety regulations,
- Accident prevention regulations,
- Guidelines and acknowledged rules of technology (e.g. national and international standards).

Please comply with national safety requirements.



---

**WARNING****Dangerous voltage**

When operating electrical equipment, certain parts of the equipment are always under a dangerous voltage.

- Instruct the personnel
- 



---

**HAZARD****Danger to life due to live parts**

During operation, this equipment has bare live parts.

- Do not remove cover
  - Use it properly
  - Operate it correctly
  - Secure against unauthorised access
- 



---

**HAZARD****Risk of injury due to rotating parts**

During operation, rotating parts can cause serious injuries.

- Do not remove cover
  - Use it properly
  - Do not reach into the electrical machine during operation
  - Note the overtravel time
  - Secure free shaft ends and rotating parts against contact
-

**WARNING****Dangerous chemical substances**

Chemical substances can result in health impairments if inhaled or if they come in contact with the skin.

- Observe the instructions given in the product information
- Observe safety regulations

**WARNING****Burns due to hot surfaces**

The electrical machine has hot surfaces during operation. Touching these surfaces can cause severe burns.

- Let the electrical machine cool down
- Use it properly
- Do not remove cover

If the electrical machine is used outside industrial areas, the installation site must be secured against unauthorised access by means of suitable equipment (e.g. safety fences) and appropriate signage.

Those responsible for the safety of the electrical machine are required to ensure that

- the basic planning work for the electrical machine as well as all work relating to transport, assembly, installation, commissioning, maintenance and repairs is carried out by qualified personnel or checked by responsible specialists.
- the instruction manual are always available when work is carried out.
- the technical data and information on the permissible conditions for installation and connection, and the permissible environmental and operating conditions, are consistently observed.
- the system-specific installation and safety regulations and the use of personal protective equipment are complied with.
- non-qualified persons are prohibited from working on these electrical machines or in their vicinity.

Accordingly, this instruction manual contain only the information that is required for qualified personnel when the electrical machines are used as intended.

**ATTENTION**

For planning, assembly, commissioning and service tasks, we recommend that you obtain the support and services of the responsible VEM Sachsenwerk GmbH.

## 2.2 Noise emission

When assessing the noise at any existing workplaces of the system operating personnel, it must be taken into account that when the electrical machine is operated with its nominal load, the A-weighted sound pressure level, measured according to ISO 1680 (Acoustics), of 70 dB(A) is exceeded.



---

**CAUTION****Permanent hearing damage**

Extended periods spent in the immediate vicinity can lead to permanent hearing damage.

- Use ear protection

---

## 2.3 Electromagnetic Compatibility

Electrical machines meet the requirements of Directive 2014/30/EU (Electromagnetic Compatibility) when used as intended and operated on an electrical supply grid which has features according to EN 50160.

In case of very uneven torque (e.g. drive of a reciprocating compressor), a non-sinusoidal motor current is forced, the harmonics of which can cause an impermissible influence on the mains supply and thus impermissible interference emissions via the connecting cables.



### 3 Product description

#### Type identification:

D	Three-phase alternating current
K	Asynchronous cage rotor
S	Asynchronous slip ring-rotor without brush lifting and short-circuiting device (KBAV)
B	Asynchronous slip ring-rotor with brush lifting and short-circuiting device (KBAV)
A	Asynchronous generator (alternator)
R	Air-to-air-cooler, self-ventilated
S	Air-to-air-cooler and additional external fan unit
K	Air-to-water-cooler, self-ventilated
M	Air-to-water-cooler and additional external fan unit
C	Cooling fins, self-ventilated
W	Water jacket
EF	Special information about the design
50	Shaft height x 10
23	Special information about the size
6	Number of poles
WE	Special information about the design

Example:

D K S EF 50 23 - 6 WE

Three-phase alternating current asynchronous cage rotor with air-to-air cooler and additional external fan unit, shaft height 500, number of poles 6

#### 3.1 Function description

##### Asynchronous motor with cage rotor

The terminals in the cable connection stator are connected to the electrical supply grid. When the electrical machine is switched on, the current flow in the stator winding generates a rotating magnetic field. This rotating field induces voltages in the rotor, which is still stationary, and this results in currents in the short-circuit winding.

The interaction between the rotating field in the stator winding and the currents in the short-circuit winding produces a torque due to which the electrical machine is motor-driven.

## 3.2 Main components

### Electrical machine with cage rotor

D-end

ND-end

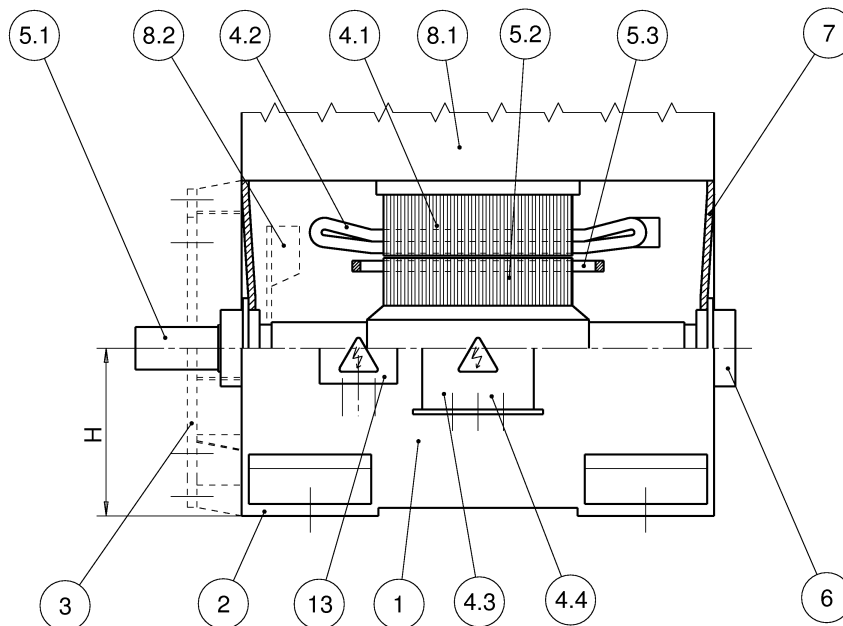


Figure: Electrical machine with cage rotor

- |     |   |
|-----|---|
| 1   | Frame   |
| 2   | Machine foot  |
| 3   | optional: Machine flange in case of IM V1 type of construction                    |
| 4   | Stator  |
| 4.1 | Stator core   |
| 4.2 | Stator winding  |
| 4.3 | Cable connection stator   |
| 4.4 | Star point (neutral box), optional: on the opposite side                          |
| 5   | Rotor   |
| 5.1 | Shaft   |
| 5.2 | Rotor core  |
| 5.3 | Short-circuit winding   |
| 6   | Bearing   |
| 7   | Bearing endshield   |
| 8   | Cooling and ventilation   |
| 8.1 | Cooler hood with heat exchanger   |
| 8.2 | optional: Shaft-mounted fan for inner circulation in case of cooling method IC61X |
| 13  | Auxiliary terminal box  |
| H   | Shaft height  |



### 3.2.1 Stator

The stator core (4.1) is located in the frame (1). The stator core (4.1) is made of layers of insulated magnetic sheet steel which are braced with pressure plates. The stator core (4.1) contains grooves which accommodate the stator winding (4.2). The stator winding (4.2) is fitted with groove wedges. The stator winding (4.2) is a two-layer form-wound winding.

The stator winding is insulated with the VEMoDUR®-VPI-155 insulation system. This insulation system consists of mica tapes. The complete stator core (4.1) with stator winding (4.2) is vacuum-pressure impregnated (VPI) with epoxy resin.

### 3.2.2 Rotor

The rotor core (5.2) is located on the shaft (5.1). The rotor core (5.2) is made of layers of insulated magnetic sheet steel which are braced with pressure plates. The short-circuit winding (5.3) consists of the short-circuit rods and the short-circuit rings which are made of copper or copper alloys. The rotor core (5.2) contains grooves which accommodate the short-circuit rods.

On the front side, the short-circuit rods are hard-soldered at both ends with a short-circuit ring.

### 3.2.3 Bearing

The bearing (6) is equipped with sleeve bearings. The sleeve bearings are lubricated with oil. There are lubricating rings on the shaft (5.1) which coat the shaft with oil from an oil sump during operation. The oil spreads and forms an oil film between the shaft and the lower bearing shell, on which the rotor moves.

### 3.2.4 Space heater

The electrical machine is equipped with a space heater. The space heater is located at the ND-end and D-end in the lower part of the frame (1). It must be switched on when the electrical machine is at a standstill. The space heater keeps the components of the electrical machine at a slight higher temperature with respect to the environment in order to prevent condensation due to humidity.

### 3.2.5 Cooling and ventilation

#### Cooler hood with heat exchanger for cooling method IC611

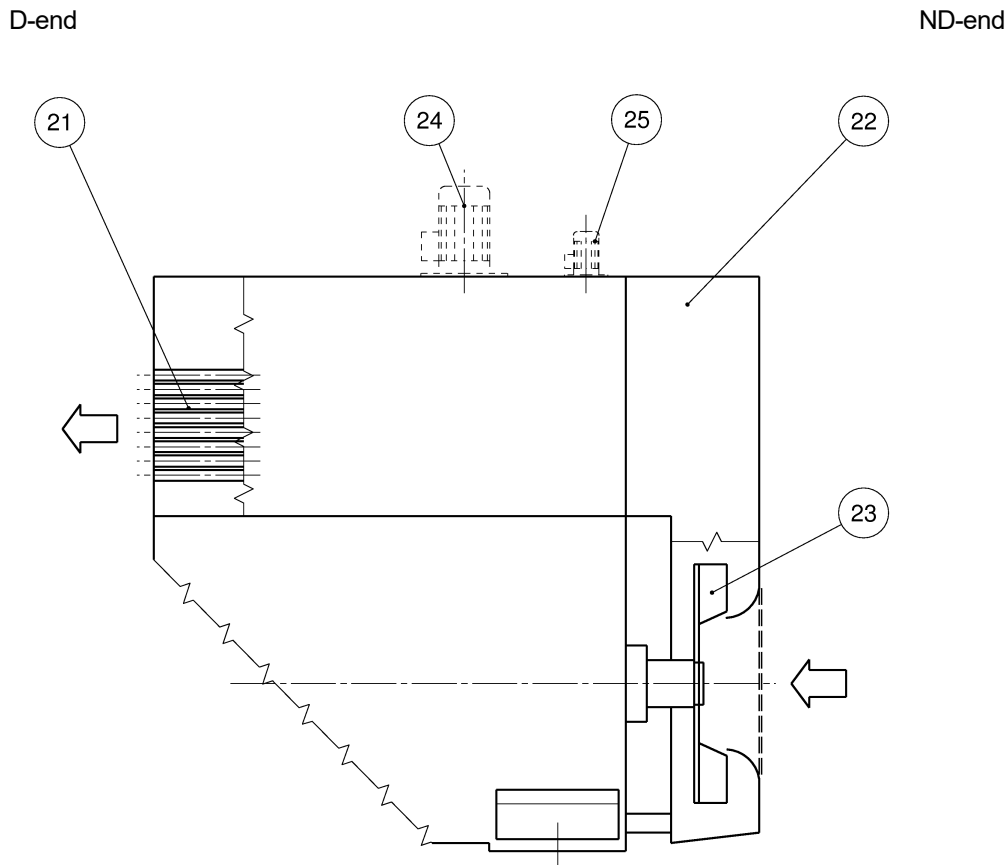


Figure: Cooler IC611

- 21 Air-to-air heat exchanger
- 22 Fan housing
- 23 Shaft-mounted fan for outer circulation
- 24 optional: Fan for inner circulation in case of cooling method IC661
- 25 optional: External fan unit for cooling the slip-ring area of electrical machines with slip ring-rotor

The electrical machine has closed-circuit cooling with air in the inner circulation.

This means that the electrical machine is cooled inside by an air circuit.

The air in the inner circulation is driven by one or two shaft-mounted fans (8.2) on the shaft (5.1) and blown into the cooler hood (8.1).

In the cooler hood (8.1), there is an air-to-air heat exchanger (21) through which the ambient air (outer circulation) flows.

The air in the outer circulation is driven by a shaft-mounted fan (23).

The air-to-air heat exchanger (21) transfers the energy lost by the electrical machine from the inner circulation to the outer circulation and hence the air in the inner circulation can enter the electrical machine after being cooled again.



### 3.3 Electrical connections

#### Stator connection

The input coils of the stator winding (4.2) are connected to the electrical supply grid at the terminals of the cable connection stator (4.3).

The terminals are intended for connection of copper cables with cable lugs.

The customer-side cables are inserted via cable glands.

Further terminals are provided in the cable connection stator, which allow the connection of an earthing conductor or a cable shield.

Optionally, a star point (neutral box) (4.4) can be located opposite the cable connection stator (4.3).

The output coils of the stator winding (4.2) are connected to a busbar at the terminals of the star point (neutral box) (4.4) and thus form the star point of the stator winding (4.2).

The star point (neutral box) can be exchanged with the cable connection stator to connect the electrical machine on the other side.

#### Earthing conductor connection

In addition to the connection of the earthing conductors of the cables in the cable connection stator, there are two more terminals for the earthing conductor connection on both sides of the frame (1).

The earthing conductor connection is for potential equalisation and it is connected to the foundation.

The earthing conductor connection is intended for connecting earthing conductors with cable lugs or for connecting solid circular conductors.

#### Auxiliary connections

Auxiliary connections refer to the connection of measuring equipment, such as the resistance thermometer, or the connection of other components, such as space heaters or external fan units.

These auxiliary connections are routed to terminal blocks.

The terminal blocks are located in separate auxiliary terminal boxes (13).

The customer-side cables are inserted via cable glands.



## 4 Preparatory measures

### 4.1 Installation site

Condensation may occur on cold surfaces inside electrical machines. The condensation can result in corrosion of components. Do not blow cooling air directly into the frame of the electrical machine.

Regardless of the installation site, the cooling air which flows through the interior of the electrical machine must be practically free from aggressive gases and vapours (relative humidity max. 80%, dust content max.  $1 \text{ mg/m}^3$ ,  $\text{SO}_2$  content max.  $1.5 \text{ mg/m}^3$ ).

### 4.2 Design of the foundation

The machine foundation has the function of absorbing the static and dynamic loads of the electrical machine. The foundation design is extremely important for the smooth running of the electrical machine.

Foundations must be designed in accordance with recognised civil engineering rules, e.g. according to DIN 4024 (machine foundations). A static and dynamic calculation must be carried out for this purpose.

The dynamic foundation calculation can be dispensed with in the case of exclusively unbalance excitation if the sum of the rotating weights is less than one hundredth of the weight of the entire system. If the rotor weight is not shown on the dimension drawing, it must be assumed to be 1/3 of the total weight of the electrical machine.

In addition to the unbalance excitation, higher-frequency excitations by the working machine, e.g. number of blades in case of pumps and thrusters, must also be taken into account. Natural frequencies of the system consisting of the working machine and electrical machine should be at least 20% outside the operating speed range.

A concrete foundation is constructed in two steps. First a raw foundation is constructed. After this, the electrical machine is aligned roughly and the steel parts required for mounting are sealed in the raw foundation with concrete.

---

**ATTENTION**

The concrete used must meet a minimum quality of strength class C20/25 according to EN 206 (concrete). In case of aggressive environments, e.g. sea water, severe frost or chemical substances, higher concrete qualities must be selected in accordance with the rules of civil engineering.

---

### 4.3 Cable laying

When laying cable ducts, pay attention to the bending radii and connection heights of the cables. When laying cables on the frame, pay attention to the elevated temperatures there. Drilling into the frame is not permitted.

## 5 Transport and storage

### ATTENTION

The electrical machine should only be transported and lifted in the position that corresponds to its type of construction. Pay attention to the transport signs on the electrical machine.

When selecting the lifting equipment and load carrying equipment, the weight of the electrical machine must be taken into account.

Transport signs - examples

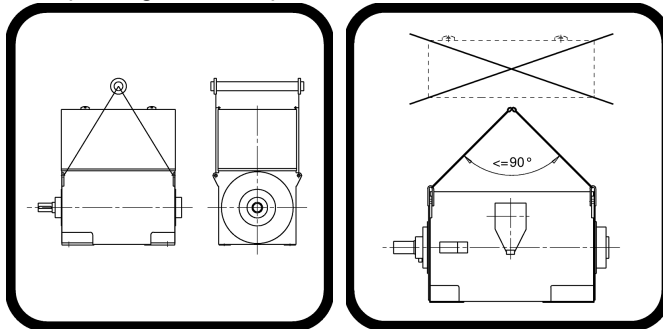


Figure: Transport signs

### The following instructions must be followed

- Use only the lifting eyes or bollards on the stator frame for lifting.
- Lifting at the shaft end or other points is not permitted.
- Connect the load carrying equipment to the lifting eyes with suitable shackles.
- The rope angle on the crane hook must not exceed 90°.
- Avoid damage, if necessary use a rope guide or stays!
- Ropes must not touch the cooler.
- Lift the electrical machine without jerks and set it down on level foundation surfaces without jerks.
- Pay attention to the centre of gravity of the electrical machine.

### Checking after transport

- After transport, check the electrical machine for damage.
- Rectify minor damage immediately.
- Apply paint to repair the areas where the paint is damaged.

## 5.1 Dispatch condition

The electrical machine is preserved by the manufacturing plant. The preservation of the machine parts should only be removed at the start of assembly at the installation site.

In some exceptional cases, the electrical machine is transported with dismantled attachments, such as cooler hoods, fan motors, coupling or speed sensors. These parts must be attached to the electrical machine before assembly in accordance with the dimension drawing using the supplied mounting parts.

## 5.2 Transport lock



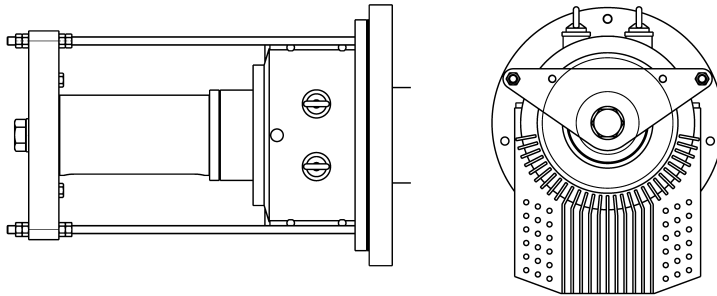
### **WARNING**

#### **Risk of injury due to the parallel key being ejected**

The parallel key is secured against falling out during transport.

- Secure the parallel key against ejection during the trial run

Depending on the type of transport and the bearings used, the rotor can be braced at the D-side shaft end with a crossbar and spindles.



*Figure: Transport lock*

Electrical machines with brushes have oiled paper between the slip ring and carbon brushes.





## 5.3 Storage

If the electrical machine is not intended for storage in the state in which it is delivered and is not mounted within 10 days, it must be stored.

### Storage rooms

The electrical machine must be stored in suitable rooms.

Suitable rooms must meet the following requirements:

- Protected from rain and spray
- Vibration-free
- Temperature 10°C to 50°C
- Humidity <75%
- Room air should not condense  
(i.e. the dew point must be lower than the temperature of the electrical machine. If a space heater is available, it must be switched on if there is a risk of condensation).
- Room air should be free from dust and aggressive gases

Cover ventilation openings with foil or tarpaulins.

### Preservation

- Preserve all machine parts.
- Protect bare areas completely with anti-corrosion paint or by applying anti-corrosion grease or wax.
- Tightly cover coated parts or areas with oiled paper, foil, etc. to prevent damage.
- Renew the grease application after one year as the protective effect has expired after this time.
- Check all stored parts regularly.



## 6 Assembly

All work related to assembly, connection and installation should be carried out by qualified personnel in accordance with the applicable regulations and is subject to the accident prevention regulations applicable at the installation site.

If conductors or other parts are set up on the frame, the elevated temperatures on these frame components during operation must be taken into account.

---

**ATTENTION**

Subsequent drilling of holes in frame components is not permitted without obtaining express permission from VEM.

---

### Contact

VEM Service

☎ +49 351 208 3237  
✉ [service@vem-group.com](mailto:service@vem-group.com)

### 6.1 De-preservation

De-preservation is carried out with commercially available solvents. (e.g. white spirit or cleaning solvent) This applies to bare surfaces such as shaft ends and machine flanges.

---

**ATTENTION****Damage to paintwork**

Do not treat painted surfaces with solvent; the paint may get damaged.

---

The damaged paint areas must be repaired by applying paint.

## 6.2 Removing transport lock

The rotor is braced at the D-side shaft end with a crossbar and spindles.

- Dismantle crossbar and spindles.
- Seal the threaded holes of the spindles on the bearing with screws.  
These screws are located in the crossbar.

Electrical machines with brushes have oiled paper between the slip ring and carbon brushes; this oiled paper must be removed. Ensure that the carbon brushes are correctly positioned on the slip ring when they are reinserted. The carbon brushes must be reinserted in the same position, i.e. they must not be twisted. The brush wires must be capable of free movement.

⇒ see [Transport lock](#) [20]

## 6.3 Coupling

### Fitting

The rotor is dynamically balanced with quality grade G 2.5 according to ISO 21940-11 (mechanical vibrations).

For shaft ends with parallel keys, the type of shaft balancing can be seen from the following marking on the D-end of the shaft end:

- The marking "H" refers to balancing with half parallel key (standard design). The coupling must be balanced before the parallel keyway is cut. If the coupling hub is shorter than the shaft end, the part of the parallel key protruding from the coupling must be machined down to the shaft diameter or a spacer ring containing a parallel keyway must be fitted between coupling hub and shaft collar.  
If there are two shaft ends, the parallel key must be shortened to half its length or a spacer ring with parallel keyway must be used.
- The marking "F" refers to balancing with a full parallel key (special design). The coupling must be balanced after the parallel keyway is cut. No changes are required to the parallel key.

Couplings used must be dynamically balanced with balancing quality grade G 2.5 according to ISO 21940-11 (mechanical vibrations).

The following steps are necessary unless otherwise specified by the coupling manufacturer:

1. Determine the fitting temperature of the coupling. (belongs to the scope of services of coupling dimensioning)
2. Check dimensions and shape of shaft end and coupling bore.
3. Heat the coupling half evenly to the fitting temperature, e.g. inductively, in a furnace or with a ring burner.
4. Fit the coupling half quickly and centrally to the shaft end.  
To avoid damage to the bearing, do not hammer down during this process.

## 6.4 Alignment

If you do not have any experience in mounting electrical machines, please contact VEM Service. The following description refers to the mounting of double-bearing machines with feet. Additional instructions must be followed for special types of construction.

### Single-bearing machines

Single-bearing machines have only one non-locating bearing on the ND-end and are rigidly coupled. The working machine must have a locating bearing and be able to support part of the rotor weight.

- The transport lock, which supports the rotor at the D-end, should not be removed until the rotor can be fixed in its position in some other suitable way or can be supported via the coupling.
- The entire shaft system, including the working machine, must be aligned.
- In addition to maintaining the magnetic central position, the air gap between the stator core and rotor core must also be checked. The check must be carried out on the ND-end at several points on the circumference. The measured values every 90° should not differ by more than 10%.
- The rotor must run centrally in the non-locating bearing. The specifications in the dimension drawing must be followed. The axial clearance of the non-locating bearing must be able to compensate for axial thermal shaft growth.

### Pedestal bearing machines

Pedestal bearing machines are sleeve bearing machines in which the bearings are mounted independently and are not flanged to bearing endshields.

- During all alignment work on pedestal bearing machines, it must be ensured that the rotor is axially in the magnetic central position. The determination of this central position is indicated by an additional label on the stator frame.
- Fine alignment is carried out by means of shims under the foot holes of the stator frame and the pedestal bearing frame.
- In addition to maintaining the magnetic central position, the air gap between the stator core and rotor core must also be checked. The check must be carried out on the D-end and on the ND-end at several points on the circumference. The deviation from minimum to maximum value should not exceed 10%.

### Cardan shaft drives

In the case of cardan shaft drives, the bearing of the electrical machine must be suitable for the additional forces that occur.

- The fine alignment is limited to horizontal positioning of the electrical machine in the longitudinal and transverse axis.
- For correct operation of a cardan shaft, the minimum angle of offset to the working machine must not be less than approx. 3°. (see specifications of the cardan shaft manufacturer)
- The parts of the cardan shaft must be fitted together at the forked sleeve in the position marked by the manufacturer. Failure to do so may result in wobbling that may cause damage to the electrical machine.

### Belt drives

In the case of belt drives, the bearing of the electrical machine must be suitable for the additional forces that occur.

- The belt pulleys of the electrical machine must be aligned with the belt pulley of the working machine.

- A tensioning device is required for the correct operation of the belt drive.

### Electrical machines with two non-locating bearings

During all alignment work on electrical machines with two non-locating bearings, it must be ensured that the rotor is axially in the magnetic central position. This is marked by a pointer on the D-side bearing. The marking on the pointer must correspond to a groove in the shaft, type A.

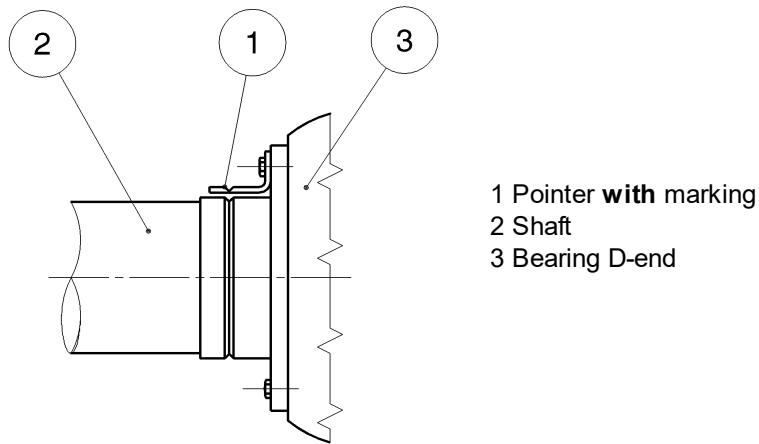


Figure: Detail of shaft with pointer A

The pointer ends at the marking, type B.

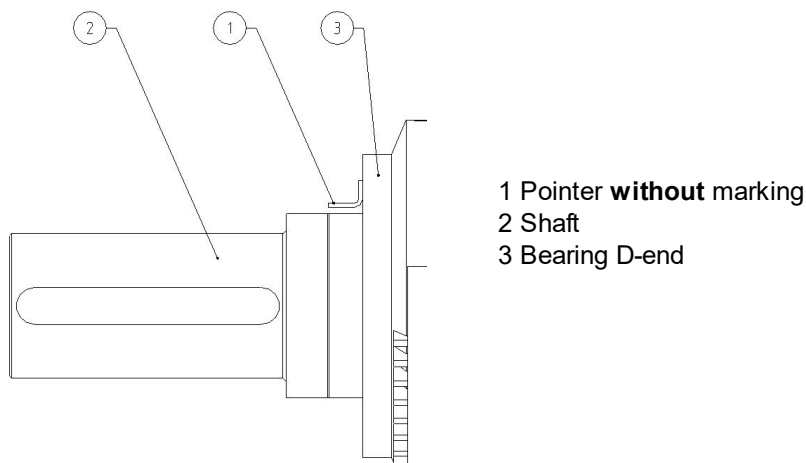


Figure: Detail of shaft with pointer B

## 6.4.1 Measuring equipment

### Spirit level for mechanical engineering

The following surfaces are suitable for longitudinal alignment:

- cylindrical shaft end
- shaft in sleeve bearing seat with open bearing shell
- cylindrical parts of the coupling hub

The following surfaces are suitable for transverse alignment:

- parts of the base slabs or the foundation frame extending beyond the machine feet (only for rough alignment)
- horizontal frame parts

### Electrical machine as gauge

When the foundation parts are set in concrete, the electrical machine can be used as a gauge.

### Dial gauge with stand

Checking the radial runout at the shaft.

### Feeler gauge

Checking the distance at the machine feet.

### Straight edge

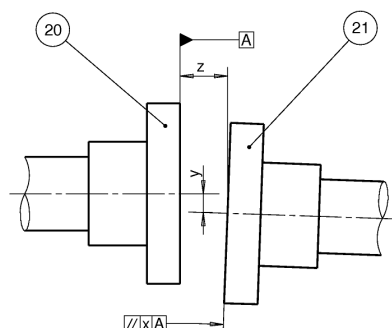
Checking the concentricity between the two coupling halves.

### Laser-based alignment tool

When the foundation parts are set in concrete before the electrical machine is installed, the foundation parts must be positioned very precisely. Laser measurement technology is recommended for this purpose.

## 6.4.2 Rough alignment

The rough alignment takes place when the electrical machine (10) is installed in the raw foundation (1). During rough alignment, the axis of the electrical machine is brought into alignment with the axis of the working machine.



20 Coupling half of the working machine  
21 Coupling half of the electrical machine

Figure: State of the tolerances on the coupling halves

y [mm] vertical	y [mm] horizontal	z [mm]	x [mm]
$2 \pm 1$	$0 \pm 2$	$\pm 2$	0.5
electrical machine at a lower level		as specified by the coupling manufacturer	

As the last step of the rough alignment, the steel parts (5) must be embedded in concrete in the raw foundation (1).

The steel parts (5) must have a flat and machined surface and suitable threaded holes for mounting the machine foot (10). The threaded holes must allow the hexagon screw (12) to be screwed in such a way that the screw-in depth (supporting thread pitches) corresponds at least to the screw diameter (D).

Typical steel parts (5) are:

- Foundation blocks (4 pieces, one piece for each machine foot (10))
- Base slabs (2 pieces, one piece for each longitudinal side of the machine)
- Foundation frame (1 piece)

The following illustrations show examples of different ways to design the foundation.

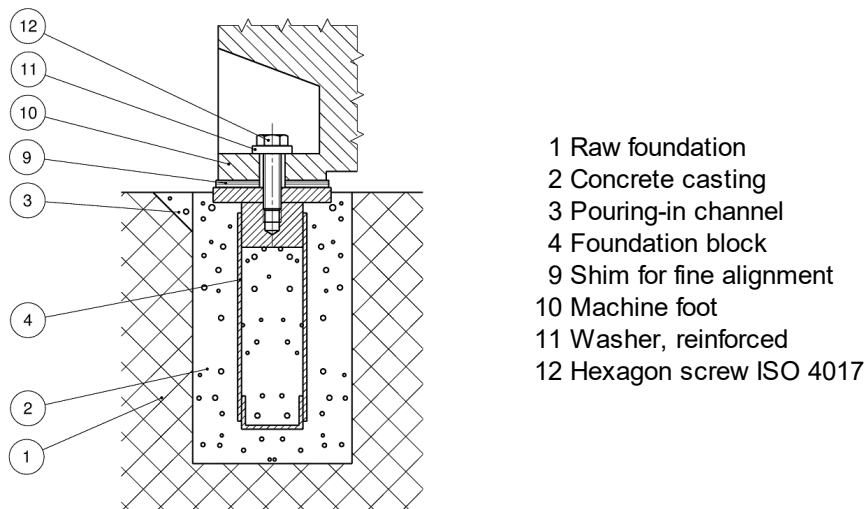
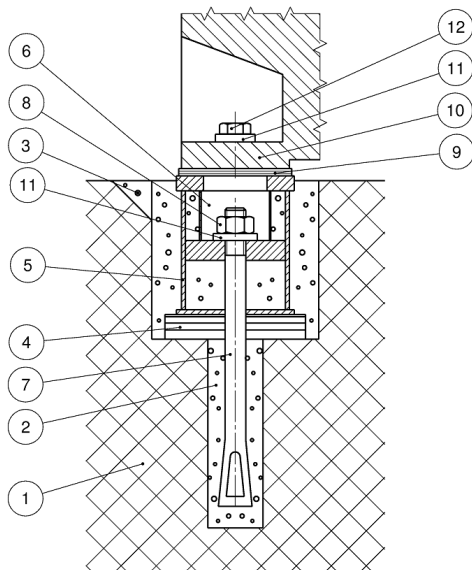


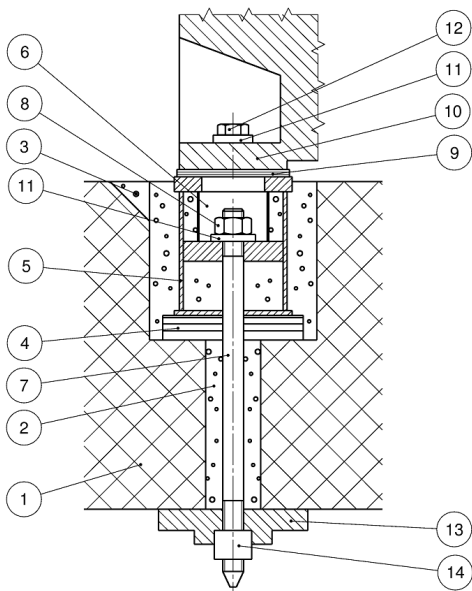
Figure: Detail of foundation block

- 1 Raw foundation
- 2 Concrete casting
- 3 Pouring-in channel
- 4 Foundation block
- 9 Shim for fine alignment
- 10 Machine foot
- 11 Washer, reinforced
- 12 Hexagon screw ISO 4017



- 1 Raw foundation
- 2 Concrete casting
- 3 Pouring-in channel
- 4 Flat bar for rough alignment
- 5 Base slab/Foundation frame
- 6 Foundation anchor bushing
- 7 Stone bolt DIN 529
- 8 Hexagon nut ISO 4032
- 9 Shim for fine alignment
- 10 Machine foot
- 11 Washer, reinforced
- 12 Hexagon screw ISO 4017

*Figure: Detail of base slab or foundation frame with stone bolt*



- 1 Raw foundation
- 2 Concrete casting
- 3 Pouring-in channel
- 4 Flat bar for rough alignment
- 5 Base slab/Foundation frame
- 6 Foundation anchor bushing
- 7 Special foundation bolt DIN 797
- 8 Hexagon nut ISO 4032
- 9 Shim for fine alignment
- 10 Machine foot
- 11 Washer, reinforced
- 12 Hexagon screw ISO 4017
- 13 Anchor plate
- 14 Special foundation nut

*Figure: Detail of base slab or foundation frame with special foundation bolt*



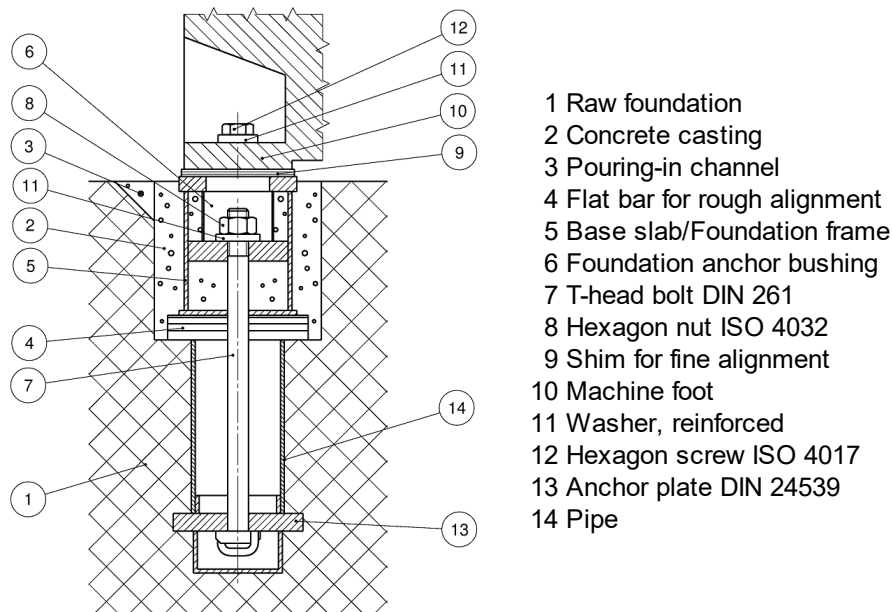


Figure: Detail of base slab or foundation frame with T-head bolt

#### Work steps:

1. Fasten steel parts (5) to the machine feet (10) with hexagon screws (12) and washers (11). Wrap cardboard strips around the hexagon screws (12) so that they are centred.
2. In addition, brace the base slabs or foundation frames with foundation anchors (7).  
Typical foundation anchors are:
  - Stone bolts (DIN 526)
  - Special foundation bolts (DIN 797) with anchor plate and special foundation nut
  - T-head bolt (DIN 261) with anchor plate (DIN 24539)
3. Align the electrical machine vertically to the working machine (y). The electrical machine must be positioned slightly lower. To do this, use additional flat bars (4) between the raw foundation (1) and the steel parts (5) for height compensation. These flat bars (4) should be placed near the foundation anchors (7). The distance between multiple stacks of flat bars (4) should not be more than 500 mm. Check that the electrical machine is in a balanced position in the longitudinal and transverse directions.
4. Align the electrical machine horizontally to the working machine (y). To do this, move the electrical machine.
5. Establish the clearance (z) and plane parallelism (x) between the coupling halves (z). Measure the clearance (z) every 90°.
6. Moisten the raw foundation (1) in the area of the concrete casting (2) with water and do not allow any residual water to remain.
7. Cast steel parts (5) with concrete (2). Keep the area of the nuts (8) and the T-head bolts (7) free of concrete. While the concrete casting (2) is hardening, the foundation must remain loaded with the electrical machine.
8. In the case of normal concrete and temperatures >12°C, the foundation anchors (7) must be re-tightened crosswise after one week with the torques specified in the Table: Tightening Torques, see Annex A. The cardboard strips must be removed from the hexagon screws (12). Fine alignment of the electrical machine can be carried out.

#### ATTENTION

Prior to commissioning the electrical machine, the concrete must harden for at least 28 days in order to achieve its standard strength.

### 6.4.3 Fine alignment

Fine alignment takes place after rough alignment.

During fine alignment, the axis of the electrical machine is brought into alignment with the axis of the working machine.

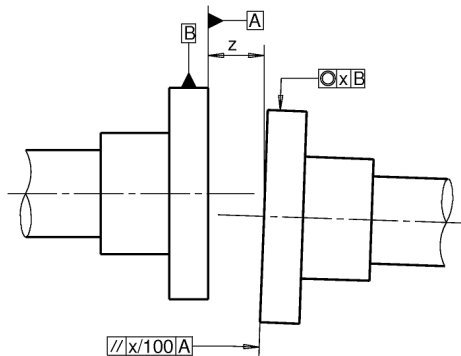


Figure: State of the tolerances on the coupling halves

Speed [min]	x [mm] for rigid coupling	x [mm] for flexible coupling	z
< 1 450	0.03	0.15	as specified by the coupling manufacturer
1 450 ... 2 950	0.02	0.1	
> 2 950	0.01	0.05	

For this purpose, several shim plates (2) in different thicknesses must be available, the thinnest sheet plate must not be thicker than 0.35 mm.

Recommended thickness: 0.35 mm, 0.5 mm, 1 mm and 2 mm

The shim plates must correspond to the foot size so that the entire machine foot area can rest on them. Some electrical machines with feet made of cast iron have areas that are free milled to a depth of 0.2 mm on the contact surfaces. These free-milled areas are used to realize defined clamping conditions. Therefore, during assembly, the contact of the machine feet in relation to the foundation only has to be checked in the area of the machine foot areas lying outside the free-milled area.

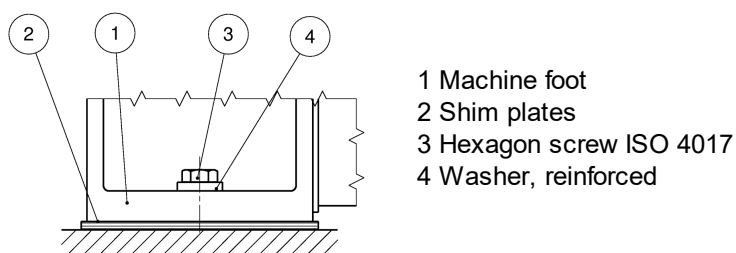


Figure: Detail of fixing of the machine foot

Work steps:

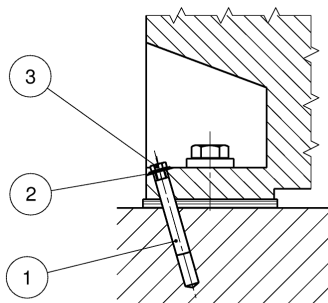
1. Screw the machine feet (1) loosely to the foundation with hexagon screws (3) and washers (4) placed underneath.  
There should be sufficient clearance under the screw head to allow the electrical machine

to be aligned in height.

2. Use a feeler gauge on the shim plates (2) to check that the electrical machine loads all feet evenly. If necessary, correct the number of shim plates (2).
3. Use shim plates (2) on all machine feet (1) to adjust the height until the coupling half of the electrical machine is at the same level as the working machine.  
The height of the electrical machine increases during operation, so this must be taken into account during alignment and the electrical machine should be at a slightly lower position.
  - Bearing endshield machines: about 0.25‰ of the vertical distance from the bottom edge of machine foot to centre of shaft
  - Pedestal bearing machines: no increase in height
  - Sleeve bearing machines: about 0.1 mm due to oil film
  - If there is also an increase in height during operation of the working machine, this increase must be subtracted from the increase in height of the electrical machine.
4. Use a spirit level to check that the electrical machine is horizontal at a right angle to its longitudinal axis. Repeat the previous steps if necessary.
5. Move the electrical machine axially until the gap between the coupling halves (z) corresponds to the dimension specified by the coupling manufacturer or in the system project. Check the gap every 90° (plane parallelism x coupling diameter per 100 mm).
6. Using a dial gauge, check the radial runout of the coupling halves on the shafts (x).
7. The fine alignment is carried out by adding or removing shim plates (2) and moving the electrical machine until the tolerances are reached.
8. Tighten hexagon screws (3) on the machine feet (1) crosswise.
9. Check the alignment once again. The measured values must be documented every 90°!
10. Carry out this check once again after the rotor has been turned by 180°. The measured values must be documented every 90°!

Pinning is not required for the electrical machine.

But it is useful and makes it easier to align this electrical machine when reassembling it.



- 1 Tapered pin EN 28736
- 2 Washer, reinforced
- 3 Hexagon screw ISO 4017

Figure: Detail of pinning of the machine foot

#### Work steps:

1. Drill inclined holes in the steel foundation at the machine foot.
2. Ream the holes with a conical reamer (cone 1:50) until the tapered pin, inserted by hand, is flush at the top.
3. Screw the hexagon screw (3) with shim (2) onto the tapered pin (1) to a depth of approx. 5 mm.
4. Use the hammer to sink the tapered pin (1) in the hole by a few mm.
5. Tighten the hexagon screw (3) by hand.
6. When dismantling the electrical machine, pull out the tapered pin (1) by tightening the hexagon screw (3).



After alignment, connect the coupling halves according to the specifications of the coupling manufacturer. Mount a coupling guard which protects the coupling and the rotating parts against touch.

⇒ see Tightening torque [Annex](#) <sup>57</sup>

## 6.5 Electrical connection

The electrical connections are designed for the connection of copper cables.

Cable lugs should be selected to match the cable cross-section and the connecting bolt.

We recommend compression cable lugs according to DIN 46235, which should be crimped with suitable tools. Cable lugs should lie flat on bare metal surfaces.

Cable lugs should not be hindered by cables that are too short when screwed on. If the cable lugs are screwed on under mechanical tension, there is a risk of vibration fractures.

The minimum distances (clearance) inside the connection boxes should be selected as follows.

- bare conductors to each other: 10 mm per 1 kV rated voltage, e.g. 100 mm for 10 kV
- bare conductors to metal frame: 6 mm per 1 kV rated voltage, e.g. 60 mm for 10 kV

For Ex-machines, the distances specified in EN 60079-7 (potentially explosive atmospheres) apply.

When closing the connection boxes, always ensure that the seals are not displaced or damaged.

For low-voltage electrical machines with speeds greater than  $2\,400\text{ rpm}^{-1}$ , the heavy weights of the connection cables can cause vibrations due to resonance at the cable connection box. Therefore, in this case, the cables have to be secured using suitable additional supports so that they do not exert a pull on the cable junction box with their own weight.

The terminals are suitable for connecting copper cables. If aluminium cables are to be connected, cable lugs with copper brackets and aluminium sleeves (Cupal, Al-Cu, bimetallic) must be used to prevent contact corrosion.

- Technically correct assembly of the system-side cables in the cable connection (cable connection box).
- Have the work carried out by qualified personnel.
- Carefully arrange and insert the cables and connect them with suitable cable lugs in accordance with the rated current.
- For the permissible maximum outside diameter of the cable, see "Dimension drawing for cable connection".
- Maintain minimum clearance distances between bare, live parts in accordance with the rated voltage of the electrical machine.
- Arrange the cables such that no short circuits or electric arcs can occur.
- Seal the cable entry according to the specified degree of protection.
- Pay attention to terminal designation, correct circuit, good contact mode and tight screw connection.

All exposed conductive parts not belonging to the operating circuit are electrically connected to each other and to the terminals for protective earthing conductors or earthing cables. The resistance of these parts to the protective earthing conductors or earthing conductors should not exceed 0.1 Ohm. This must be particularly ensured in case of re-assembly.

Please check that

- the electrical connections in the cable connection boxes are firmly tightened and are made according to the specifications in the above sections.
- the electrical machine is connected according to the specified direction of rotation.
- the inside of the cable connection box is clean and free of cable residues.

Close the cable connection box after this.

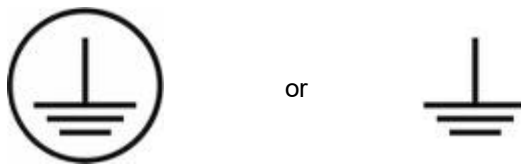
## Stator winding

- According to IEC/EN 60034-8 phase sequence, see connection diagram.
- See rating plate or test certificate for information on direction of rotation.

## Earthing conductor

The cross-section of the earthing conductor of the electrical machine must comply with the installation regulations, e.g. according to IEC/EN 60204-1, for cross-sections  $> 35 \text{ mm}^2$  of the live conductor, it must be at least 50 % of the cross-section of this mains conductor. The contact surface should be clean and protected against corrosion with a suitable agent, e.g. acid-free Vaseline.

All connection points are marked as follows:



The earthing conductor (protective earthing conductor) is connected to the cable connection of the stator winding (cable connection box), if present, to the cable connection of the rotor winding. The position and type of connection is given in "Dimension drawing for cable connection". For potential equalisation, the frame must be earthed at the foundation earth electrode or at the steel foundation. For this purpose, a clamp is provided on the frame or, in the case of vertical machines, on the lower bearing endshield; for position, see "Dimension drawing". The clamp allows the connection of solid circular conductors and multi-stranded conductors with a cross-section of  $16 \text{ mm}^2$  to  $240 \text{ mm}^2$ . Multi-stranded conductors must be fitted with a wire end ferrule. The clamp can also be unscrewed and specially prepared flat conductors or cables with cable lugs can be screwed to two M10 threaded holes. When doing so, locking washers must be located directly under the screw head and not between the contact surface on the frame and the flat conductor or cable lug.

## Auxiliary circuits

The connection terminals for the auxiliary circuits, such as temperature sensors, are arranged in one or two cable connection boxes depending on the order.

- Connect the system-side measuring lines for temperature sensors correctly in the special cable connection box.
- Cable entry with cable gland.

The necessary specifications for connecting the auxiliary circuits are specified in the terminal diagram on the inside of the respective box cover and in the electrical machine documentation. The connection terminals are suitable for conductor cross sections up to  $4 \text{ mm}^2$ . Select the connecting cables taking into account the rated current and the system-dependent conditions (e.g. ambient temperature, type of laying etc. according to IEC/EN 60204-1).

## Connecting RTD to converter-fed electrical machines

VEM cannot be held liable for interference in measurement signals resulting from the laying of cables by the customer.

Please follow these recommendations to avoid interference.

Install the converter as close as possible to the electrical machine. If this is not possible, digitise the

signals close to the electrical machine and feed this to the converter. We recommend the use of fibre optic cables for signal transmission.

For analogue signal transmission, please ensure that:

- the conductors are twisted.
  - for 3-conductor connection: all 3 conductors twisted together
  - for 4-conductor connection: conductors are preferably twisted in pairs or all together
- the cable length is  $\leq 10$  m.
- all conductors have a common shield.
- the shield can be earthed on both sides. When doing so, ensure that the shield covers a large area (360° earthing conductor), ideally using EMC cable glands.
- the signal cables are laid to ensure low interference.
- are laid in separate cable ducts with the greatest possible distance from other cables.
- Intersections with other cables are at an angle of 90°.

Recommended signal cable: LAPP UNITRONIC

### Insulated bearing (optional)

For electrical machines with insulated bearings, the insulation must not be bridged by mounting sensors on bearings, speed sensors or electrical machines coupled to the N-side shaft end. This bridging is often done using shielded cables or by connecting a protective earthing conductor. In this case, the components must be mounted with insulation. Failure to do so can lead to incorrect connection of the rotor potential to the earth potential and compensating currents can destroy the bearing. If you are not sure about the mode of operation of the bearing insulation, please contact VEM Service.

### Final measures

Before closing each cable connection box, please check that

- the conductors are connected according to the pasted terminal diagram.
- the inside of the cable connection box is clean and free of cable residues.
- parts of the cable glands are firmly tightened and are suitable with regard to degree of protection, type of cable installation, permissible cable diameter, etc., and are installed in accordance with the regulations.
- the connecting cables are exposed and the cable insulation is not damaged.
- any unused entries are closed and the closing elements are screwed in tightly (i.e. they can only be loosened using a tool).
- all gaskets and sealing surfaces of the cable connection box are in proper condition.
- if any screw terminals are present, all terminal screws are tightened firmly (also applies to any unused terminals that may be present).

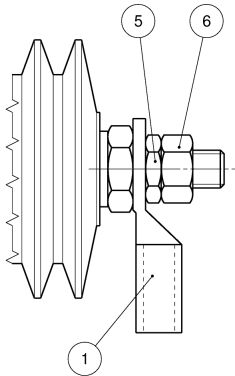
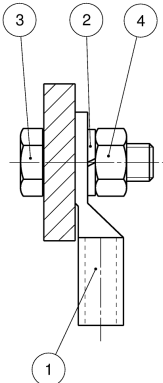
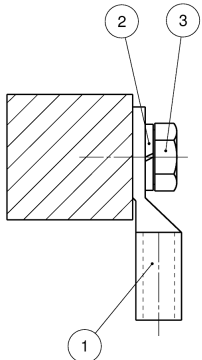
#### 6.5.1 Cable gland

Cable connection boxes are generally supplied with an undrilled plate. Suitable threaded holes or feed-through holes according to EN 62444 (cable gland for electrical installations) must be drilled into this plate. Cable glands must be suitable for the cable type and cable diameter.

In the case of cable glands, the sealing rings must be selected to match the cable diameter in order to ensure the degree of protection. The parts of the cable gland which tighten the sealing rings and ensure strain relief must be tightened. Observe the specifications of the cable gland manufacturer. Cable glands that are not required must be replaced by seal plugs.

## 6.5.2 Stator, Rotor or Exciter

Depending on the voltage and current, the connection is made to bolts or busbars, see "Dimension drawing for cable connection".

	Bolts (e.g. DIN 46265)	Busbar with feed-through hole	Busbar with threaded hole
			
M12	20 Nm	66.1 Nm	30.3 Nm
M16	40 Nm	163 Nm	73.9 Nm
M20	-	331 Nm	143 Nm

Naming the parts

- 1 Cable lug
- 2 Locking washer
- 3 Hexagon screw made of steel
- 4 Nut made of steel
- 5 Half-nut made of brass
- 6 Nut made of brass

The connection must be made according to the connection diagram.

The following applies to the stator connection:

- For clockwise (CW) rotation of the electrical machine, as seen from the shaft end on the D-side, the following applies: L1-U; L2-V; L3-W.
- For counter-clockwise (CCW) rotation, two phases must be exchanged, e.g. L1-V; L2-U; L3-W.

For electrical machines with a pulled out star point, the beginnings of the winding are marked with U1, V1 and W1, and the ends of the winding with U2, V2 and W2.

For electrical machines with several systems in the stator winding, the individual systems are marked with 1U, 1V, 1W and 2U, 2V, 2W, ....

## 6.5.3 Auxiliary circuit

The auxiliary circuits are connected to terminal blocks. The wires have to be inserted under the spring in the terminals.

The terminals are suitable for the following cross-sections:

- Heating up to 4 mm<sup>2</sup> for flexible wire, up to 6 mm<sup>2</sup> for rigid wire
- Monitoring up to 2.5 mm<sup>2</sup> for flexible wire, up to 4 mm<sup>2</sup> for rigid wire



## Connection of resistance thermometer for converter supply

VEM cannot be held responsible for interference in measurement signals resulting from the laying of cables by the customer.

Please follow these recommendations to avoid interference.

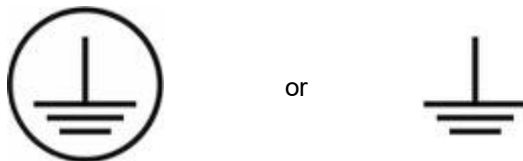
Install the converter as close as possible to the electrical machine. If this is not possible, digitise the signals close to the electrical machine and feed this to the converter. We recommend the use of fibre optic cables for signal transmission.

For analogue signal transmission, please ensure that:

- the conductors are twisted. (for 3-conductor connection: all 3 conductors twisted together for 4-conductor connection: conductors are preferably twisted in pairs or all together)
- all conductors have a common shield.
- the shield can be earthed on both sides. When doing so, ensure that the shield covers a large area (360° earthing conductor), ideally using EMC cable glands.
- the signal cables are laid to ensure low interference.
- are laid in separate cable ducts with the greatest possible distance from other cables.
- Intersections with other cables are at an angle of 90°.
- Recommended signal cable: LAPP UNITRONIC

### 6.5.4 Earthing conductor connection

The earthing conductor of the supply cable, and the shield if present, must be connected to the corresponding terminals. These terminals are marked with "PE" or an earthing symbol.



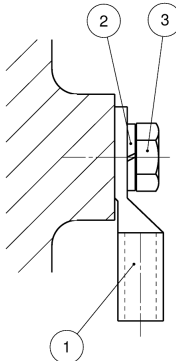
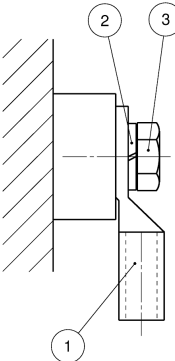
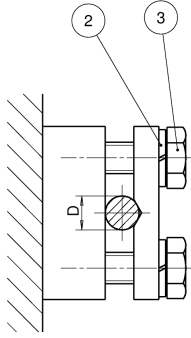
The following minimum cross-sections must be observed:

Cross-section of a phase conductor	Cross-section of the earthing conductor
up to 16 mm <sup>2</sup>	identical to phase conductor
16 mm <sup>2</sup> ... 35 mm <sup>2</sup>	16 mm <sup>2</sup>
from 35 mm <sup>2</sup>	50% of a phase conductor

The resistance between the earthing conductor and exposed bare metal surfaces should not exceed 0.1 Ohm.

The earthing conductor connection on the frame must be connected to a foundation earth electrode in the case of concrete foundations. The earth terminal on the frame must be connected directly to the steel foundation in the case of steel foundations. The available clamps for each solid circular conductor (diameter 5 mm to 15 mm) can be used for this purpose.

If the clamp has been removed prior to this, a cable with cable lug can be screwed to each of the two M10 threads.

	Earthing conductor connection in cast iron	Earthing conductor connection in steel	Earthing conductor connection with clamps for solid circular conductors D = 5 ... 15 mm
			
M 8	11.0 Nm	25.0 Nm	-
M10	17.1 Nm	38.1 Nm	17.1 Nm
M12	30.3 Nm	66.1 Nm	-
M16	73.9 Nm	163 Nm	-
M20	143 Nm	331 Nm	-

Naming the parts

- 1 Cable lug
- 2 Locking washer
- 3 Hexagon screw

If these terminals are equipped with busbars, the following pictures apply ⇔ see [Stator, Rotor or Exciter](#) <sup>[36]</sup>.

If armored cables are used, suitable cable glands are required to connect the armoring.

### 6.5.5 Current transformer (optional)

The electrical machine is delivered with current transformers that are short-circuited at the secondary terminals. The short-circuit must not be removed until the corresponding device (e.g. differential relay) is connected.



## 6.6 Oil and water connection

The oil and water connections are made at the connecting flanges according to the dimension drawing. The contact surfaces should be flat, clean and free from damage.

The oil or water pipe should be connected carefully using a seal and suitable hoses which meet the requirements for temperature, pressure and service life.

---

### ATTENTION

#### Hydraulic Hoses

There should be no buckling, contortion or twisting of hoses when installed.

Mechanical tensions in the hoses, abrasion and vibrations at the hoses should always be avoided.

---

---

### ATTENTION

#### Durability of hydraulic hoses

Check the date of expiry of the hydraulic hoses and replace them if necessary.

---

### Sleeve bearing

Work steps for filling the sleeve bearing with oil:

1. For oil quality, see machine dimension drawing.
2. Fill the sleeve bearings up to the maximum mark on the oil level gauges.

## 7 Commissioning

### 7.1 I-value measurement

Check the insulation resistance before commissioning and after long periods of standstill.

#### Insulation resistance and polarisation index

If you are not familiar with the necessary procedures, please contact VEM Sachsenwerk GmbH.

#### Measurement



##### HAZARD

##### **There is risk of injury due to dangerous voltages at the terminals**

Dangerously high voltages can occur at the terminals during and immediately after the measurement. Touching the terminals may result in death or serious injury.

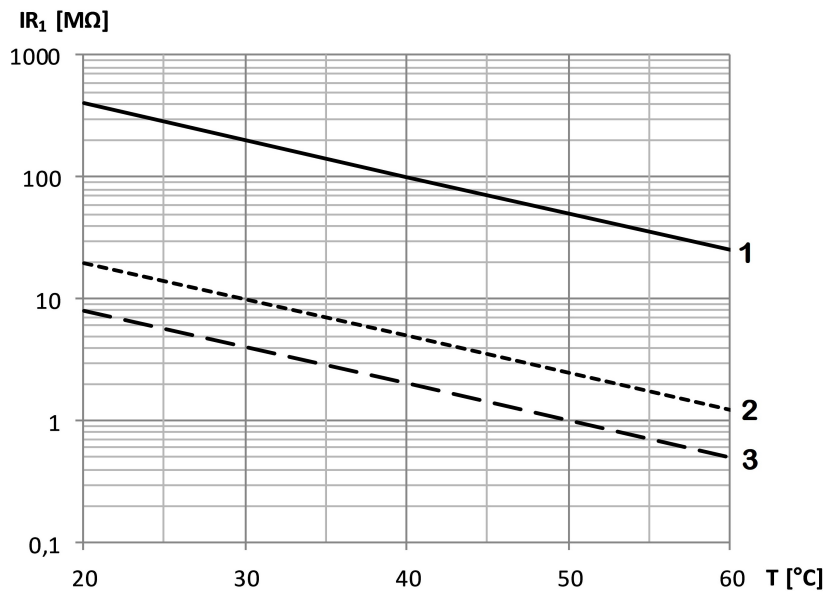
- Switch off the mains voltage and disconnect the power line before measuring
- Avoid touching the terminals
- Earth the terminal immediately after the measurement for at least 4 minutes

The measurement must be carried out by qualified personnel using an insulation resistance meter. Measure the insulation resistance of the terminal connections of the windings against the earth potential of the frame. The measuring time is 1 minute.

Select the measurement voltage according to the following table:

Rated voltage [V] (For slip ring-rotor: rotor standstill voltage)	Measuring DC voltage [V]
< 1 000	500
1 000 ... 2 500	500 ... 1 000
2 501 ... 5 000	1 000 ... 2 500
5 001 ... 12 000	2 500 ... 5 000
> 12 000	5 000 ... 10 000

The following minimum insulation resistances must be obtained:



**Minimum insulation resistance after 1 min**

- |          |                  |           |
|----------|------------------|-----------|
| <b>1</b> | Rated voltage    | ≥ 1 000 V |
| <b>2</b> | Rated voltage    | < 1 000 V |
| <b>3</b> | Exciter windings | < 1 000 V |

Figure: Table for minimum insulation resistance

Please note:

- The insulation resistance is temperature-dependent. To determine the minimum insulation resistance, select the ambient temperature when the electrical machine is cold, and select 60°C when the electrical machine is at its operating temperature.
- Exciter windings refer to the pole windings on salient pole rotors of synchronous machines. For pole windings on non-salient pole rotors and exciters, the curve "Rated voltage < 1 000 V" is applicable.
- For slip ring-rotor windings, the rated voltage is equal to the rotor standstill voltage. The curve "Rated voltage ≥ 1 000 V" is applicable.

For electrical machines with an output > 10 MW, the polarisation index must also be determined to assess the stator winding, provided that the insulation resistance after 1 minute is < 5 000 MΩ, regardless of the temperature.

To do this, measure the insulation resistance after 1 minute and after 10 minutes and determine the quotient:

$$PI = IR_{10} / IR_1$$

PI	Polarisation index
IR <sub>1</sub>	Insulation resistance after 1 min
IR <sub>10</sub>	Insulation resistance after 10 min

The minimum value for the polarisation index is PI= 2.

If the minimum values are not reached, carry out the following measures.



## Measures

The possible causes may be:

- faulty parts in the cable connection box or star point (neutral box), e.g. converters, capacitors, lightning arresters  
Disconnect these parts and repeat the measurement
- Contamination of insulating surfaces
- Moisture on insulating surfaces
- Penetration of moisture in insulations
- Fault in the insulation

## External cleaning of the insulation

Clean possible creepage distances between bare live parts and from bare live parts to the earth potential, e.g. insulators and insulating parts to:

- Terminals
- Current rings and busbars
- Slip rings
- Brush rockers
- Diode bridges

---

### ATTENTION

#### **Risk of destruction of insulation!**

Do not use high-pressure cleaners, water or surfactants for cleaning.

- Use a dry cloth for cleaning
- 

In case of very visible dirt, additionally vacuum the dirt with an industrial vacuum cleaner. For stubborn dirt, use a cleaner such as Revolva S.L.X. Top which is suitable for electrical installations.

Repeat the measurements.

If the minimum values are not obtained, use hot air to dry the insulation.

## Drying the insulation with hot air

For drying with hot air, you will need a sufficiently large hot air blower that is capable of generating a clearly noticeable air flow through the electrical machine. The temperature of the air coming out of the hot air blower should range between 80°C and 100°C.

Typical work steps are described below; however, these are not intended to be exhaustive.

Work steps:

1. Dismantle cooler hoods or cooling ducts, ventilate the interior of the electrical machine axially.  
For electrical machines without cooler hoods or cooling ducts, use the openings in the bearing endshields or dismantle the bearing endshields.
2. For radially cooled electrical machines, remove the cooler hood to find a cooling air opening above the laminated core. These are closed, for example, by covering them with a heat-resistant foil.
3. Connect the fan to an opening on the ND-end or D-end of the electrical machine with temporary ducts or hoses. Use additional heat-resistant tarpaulins to prevent leakage air at the hot air inlet of the electrical machine.
4. Position the thermometer at the hot air inlet of the electrical machine.
5. Switch on the hot air blower and monitor the hot air temperature.  
It must not exceed 100°C.

6. Turn the rotor every ¼ hours by approx. 90° for even heating.
7. Measure the insulation resistance every hour and record this value.
8. When the minimum insulation value is obtained, stop the drying process.
9. End the drying process after 24 hours at the latest.
10. Fit the cooler hood or cooling ducts, see the Dimension drawing.

### Drying the insulation with electricity

This type of drying requires specialist knowledge of the electrical circuit of the electrical machine. For this reason, this type of drying is only permitted to be carried out by VEM Sachsenwerk GmbH or a specialist company with relevant experience.

### Further measures



---

#### CAUTION

#### **Risk of flashover and destruction of insulation!**

If the minimum insulation resistance or the minimum value for the polarisation index is not achieved, operation of the electrical machine can lead to flashovers and destruction of the insulation.

---

The fault location of the insulation must be detected by selectively disconnecting the electrical switching connections in order to determine further suitable measures. This requires specialist knowledge of the electrical circuit of the electrical machine.

Please contact VEM Sachsenwerk GmbH or a specialist company with relevant experience.

If the insulation resistance or the value for the polarisation index is close to the minimum values, the values must be checked at more frequent intervals.

## 7.2 Warning and switch-off values

### Limiting temperatures

The following limiting temperatures apply:

- Operation with warning should be only occasional and for a short time:

Measurement point	Utilisation of the thermal class	Warning	Switch off
Stator winding	B	135°C	140°C
Stator winding	F	160°C	165°C

- Temperature values apply to operating conditions with slow changes in temperature (EN 60034-11)

Measurement point	Warning	Switch off
Bearing shell	85°C	90°C

### Vibrations

The following threshold values are applicable for  $v_{\text{eff}}$  (ISO 10816-3):

- Operation with warning should be only occasional and for a short time.

Measurement point	rigid foundation		flexible foundation	
	Warning	Switch off	Warning	Switch off
Bearing D-end	5.6 mm/s	8.9 mm/s	8.9 mm/s	13.7 mm/s
Bearing ND-end	5.6 mm/s	8.9 mm/s	8.9 mm/s	13.7 mm/s



## 7.3 Trial operation



### HAZARD

#### **Danger to life due to live parts**

Cable connection boxes contain bare live parts during operation.

- Close cable connection boxes



### WARNING

#### **Danger due to loose coupling parts**

If a trial operation is carried out with an uncoupled electrical machine, loose parts on the coupling must be removed or secured against ejection.

- Remove loose parts
- Mount coupling guard

### ATTENTION

#### **Destruction of the sleeve bearings**

In electrical machines with two non-locating bearings, there is no axial guidance.

Trial operation, even in no-load run, should only be carried out with the coupled electrical machine.

Always observe the start data in the technical data sheet if this is specified!

Work steps (if available):

1. Switch off space heater
2. Switch on cooling water and check flow rate
3. Switch on fan motor
4. Switch on oil supply
5. Switch on the electrical machine
6. Check the direction of rotation
7. No-load run
  - Carry out with coupled unloaded working machine
  - Checks: bearing temperature, bearing noise, quiet running
  - Duration: If the results are positive, until equilibrium of the bearing temperatures
8. Load run
  - After fault-free no-load run
  - Load run over a longer trial period under operating conditions, e.g. 72 hours - trial run
  - Current overload see IEC/EN 60034-1

When the electrical machine starts up or shuts down, it will operate briefly at the natural frequency of low-tuned foundations, which can lead to noisy operation for a short time.

## 8 Operation

### 8.1 Switching on



---

**HAZARD****Danger to life due to live parts**

cable connection boxes contain bare live parts during operation.

- Close cable connection box
- 

Always observe the start data in the technical data sheet if this is specified!

Work steps (if available):

1. Switch off space heater
2. Switch on cooling water and check flow rate
3. Switch on fan motor
4. Switch on oil supply
5. Switch on the electrical machine

Start the electrical machine with no load if possible and check that it runs quietly. If the electrical machine runs quietly, load it and check the temperatures of the bearings and stator winding.

#### **Electrical machine with space heater**

Do not operate the space heater during normal operation as this may lead to increased temperatures inside the electrical machine.

#### **Electrical machine with sleeve bearings**

The oil supply to the sleeve bearings must be switched on; observe the lubrication signs.

### 8.2 Normal operation

Changes in relation to normal operation (the condition after commissioning) indicate that the function is impaired.

These changes are, for example:

- higher power consumption, higher temperatures or vibrations
- abnormal noises or odours
- activation of the monitoring devices

Please inform the responsible maintenance personnel immediately to avoid malfunctions.



---

**WARNING****Changes during normal operation**

Any changes that occur during operation of the electrical machine will impair its function.

Comply with the system-specific safety conditions:

- Switch off the electrical machine immediately!
-



## 8.3 Switching off

When switching off, the electrical machine must be unloaded as far as possible and then disconnected from the mains.

### Electrical machine with space heater

---

**ATTENTION**

After switching off the electrical machine, the space heater must be switched on to prevent condensation inside the electrical machine.

---

## 8.4 Operating period intervals

In case of longer operating period intervals (more than 4 weeks), the electrical machine must be preserved, see Storage.

It must be commissioned before being switched on again.

↔ see [Storage](#) 

## 8.5 Fault

---

**ATTENTION**

Inspect the electrical machine immediately after malfunctions or unusual operating conditions that represent an electrical or mechanical overload, such as short circuit or mechanical blockage.

---

The following faults occur as a result of abnormal operating conditions, inadequate maintenance or extreme air circulation conditions. These faults are not expected under normal conditions if the machine is properly maintained and serviced.

The data is provided for information purposes in an emergency.

Further causes may be the result of specific mounting and operating conditions known only to the operator. We request you to inform the manufacturing plant.

### 8.5.1 Fault in electrics

Fault	Possible cause	Detection/Rectification
Electrical machine does not start, no noise	at least 2 supply lines are disconnected electrical machine without voltage	check mains, switches, fuses of the system check terminal connections
Electrical machine does not start, humming sound	a supply line is disconnected	check mains, switches, fuses of the system
Electrical machine does not start under load or starts too slowly	mains voltage too low	check mains voltage
Electrical machine starts with no load, does not start with load	voltage drop in supply line too great	check supply lines on the system side
Electrical machine (stator winding) becomes warm quickly	stator winding disconnected	measure resistances of the winding phases and winding temperatures
	overloaded	Measure current, reduce load
	Runs only single-phase (hums)	Check connection and power supply
	Wrong supply voltage	Check voltage and frequency
	Winding short circuit	Measure and compare the resistances of the strands
	direction of rotation is incorrect	Correct if necessary
	Airways are dirty (fins, cooling tubes, intake and exhaust openings, filter if present)	Check and clean
	Motor of external fan unit with wrong direction of rotation	Correct if necessary
	Motor of external fan unit defective	Exchange
	Water supply disrupted	Check water quantity and inlet temperature
Abnormal noise	electrical causes	noise disappears when the electrical machine is switched off; contact the manufacturing plant
Noisy operation when uncoupled	stator winding phase disconnected	check current consumption of all supply lines



## 8.5.2 Mechanical fault

Fault	Possible cause	Detection/Remedy
Electrical machine does not start, hums	bearings damaged or jammed	check bearing, replace bearing if necessary
Electrical machine does not start under load or runs too slowly	excessive load torque	unload the working machine
Electrical machine hums when running, stator winding gets warm quickly	cooling insufficient due to dirty air ways	carry out cleaning
Abnormal noise	mechanical causes	check foundation, coupling, eliminate faults
Noisy when coupled, quiet when uncoupled	fault in the coupling or driving engine	check coupling alignment; check driving engine
	lowering of the foundation	realign electrical machine, correction of foundation
	poor balancing of the driven parts	rebalance
Noisy operation when uncoupled	unbalance	noise remains when run down without voltage; rebalancing necessary
	rotor grazes due to bearing damage	check bearing, replace bearing if necessary
	fixing screws loose	check and tighten the screw connections
	resonance in the foundation	foundation not tuned properly
	electrical machine deformed	check alignment

### Bearing

Fault	Possible cause	Detection/Remedy
Bearing too warm	bearing damage	check bearing, replace bearing if necessary
	lubricating ring jammed	rework bearings and lubricating ring
	lubricating ring runs too slowly	oil too thick (too cold); oil dirty;
		check oil change or operating conditions of the electrical machine
	bearing shell damaged	scrape out the bearing shell, pour out again or replace
	wrong or unsuitable oil	observe oil specifications, re-fill, change oil



### 8.5.3 Fault in brushes / slip rings

Not applicable

## 9 Maintenance and inspection

Regular maintenance ensures that the electrical machine is always ready for operation and that maintenance costs are kept to a minimum.

For maintenance measures on running electrical machines, instructions or protective measures against escaping hot vapours in the event of possible short circuits of windings or terminals must be specified.

Please contact the manufacturing plant if you need the weights of the individual components.



### **WARNING**

#### **Dangerous voltage**

Before starting any work on the electrical machine, check that the system has been properly disconnected from the mains. In addition to the main circuits, also pay attention to existing additional or auxiliary circuits, in particular heating equipment!

- Disconnect the electrical machine from the mains
- Secure against reconnection
- Verify off-state voltage of the system
- Carry out earthing and short circuiting
- Provide protection from adjacent live parts by using covers or barriers



### **CAUTION**

#### **Swirling up of small parts**

When cleaning with compressed air, small parts (metal chips, dust) can swirl up.

- Wear protective equipment (safety goggles, breathing filter, protective suit)
- Use suction

### Maintenance plan

Component	after initial commissioning	monthly	annually
9.1 General cleaning/checking	X	X	X
9.2 Bearing	X		X
9.3 Cable connection boxes	X		X
9.4 Cooling			X
9.5 Coupling	X		X
9.6 Foundation	X		X
9.7 Earth brushes		X	
9.8 Earth brush holder		X	
9.9 Earth brushes-running track		X	

The operating conditions can be very different; therefore, only general periods in case of trouble-free operation are given here. Depending on the operating conditions and conditions of use, the maintenance periods may have to be reduced.

Comply with the tightening torques of screw connections.

Document the performed maintenance work in the log book in a verifiable manner.

⇒ see [Annex](#) <sup>57)</sup>

## 9.1 General cleaning / checking

### After initial commissioning

- Check temperature
- Check operating behaviour, quiet running

### Monthly

- Check temperature
- Check operating behaviour, quiet running

### Annually

- Vacuum thoroughly with industrial vacuum cleaner
- Brush and wipe with lint-free cloth
- Check seals
- Check insulation resistances

## 9.2 Bearing

### After initial commissioning

- Check oil level
- Check temperature
- Check the operation of the lubricating rings

Please comply with the documentation of the bearing manufacturer.

### Note on hydraulic hoses

- Check regularly for damage and leakages, replace if necessary
- We recommend changing hydraulic hoses every 6 years
- Adjust the replacement interval to environmental conditions and own experience

## 9.3 Terminal boxes

### After initial commissioning

- Check tightness of screws
- Tighten

### Annually

- Check tightness of screws
- Tighten
- Clean, wipe contact points clean
- Check condition of seals

The cable connections in the cable connection boxes must be checked for good contact, tight fit and correct installation. The seals (cable connection box cover, control openings, air ducts) must be checked for their condition and accurate fit and replaced if necessary.





## 9.4 Cooling and ventilation

Depending on the design of the electrical machine, the sound absorbers may have to be removed before checking.

### Annually

- Check condition, clean if necessary
- Check the pipes for visible dirt and deposits

If the deposits are thicker than 0.5 mm, the pipes must be cleaned.

Depending on the environmental conditions and the results of the checks, the periods for checks may be extended.

Work steps:

1. Blow out the pipes with compressed air.
2. Depending on the deposits, it may be necessary to clean with suitable brushes.
3. After cleaning, reassemble all parts.
4. Check for tightness.

## 9.5 Coupling

### 1 week after initial commissioning

- Check alignment

### Annually

- Check alignment

## 9.6 Foundation

### 1 week after initial commissioning

- Check tightness of foot screws

### Annually

- Check tightness of foot screws
- Check the condition of the foundation

## 9.7 Earth brushes

Not applicable

## 9.8 Earth brush holder

Not applicable



## 9.9 Earth brushes-running track

Not applicable



## 9.10 Spare parts

Please quote the material number and the serial number (see rating plate or technical data sheet) of the electrical machine for fast and reliable ordering of spare parts.

For individual advice on ordering spare parts, please send us a picture of the rating plate of the electrical machine.

### Example for spare parts list:

Quantity	Name	Dimensions	Material number
1	Bearing ND-end	6052 M	1234 567 8910
1	Resistance thermometer	RTD	1234 567 8911

The quantity applies to one electrical machine.

The spare parts list of the electrical machine and other spare parts for external suppliers are given in the Annex.

### Contact

VEM Spare Parts

☎ +49 351 208 3237  
✉ [spareparts@vem-group.com](mailto:spareparts@vem-group.com)

## 10 Disposal

The electrical machine does not contain any hazardous substances according to RoHS (Directive 2011/65/EU on the restriction of the use of certain hazardous substances in electrical and electronic equipment).

Before dismantling the electrical machine, the oil in the bearings must be drained off (in the case of sleeve bearings) or the grease feeders must be emptied (in the case of rolling bearings).

The electrical machine must be dismantled after this. This can be done with commercially available tools.

Before removing the windings from the laminated cores, cracking at 400°C is necessary, which is carried out by special suppliers.

The individual parts must be further treated as follows:

Component	Material	Disposal instructions
Bearing	Grease	Hazardous waste for disposal
Bearing	Oil	Waste for recycling
Shaft	Steel	Waste for recycling
Parts of the frame	Cast steel	Waste for recycling
Bearing parts	Cast iron	
Laminated core without winding	Magnetic sheet steel	Waste for recycling
Winding	Copper, partly mixed with insulation	Waste for recycling
Cables	Copper, insulated	Waste for recycling
Busbars	Copper Brass	Waste for recycling
Connecting bolts		
Brush holders		
Optical fibre parts	Various organic materials	Waste for disposal
Windows		
Filter mats		
Corrugated pipe		
Carbon brushes	Graphite	Waste for disposal
Magnets	Alloy	Waste for recycling



## **11    Annex**

**A Technical Documents**

**B Quality Documents**

**C Documents of external suppliers**

## Technical documents

Documents	Designation	Number
Technical data sheet		
Drawings	Dimension drawing machine (Serial No. 2.386.994)	AB.24400.00
	Dimension drawing machine (Serial No. 2.386.995)	AB.24401.00
	Dimension drawing star point	FR.19378.00
	Dimension drawing cable connection stator	FR.19678.00
Plans	Connection diagram (Serial No. 2.386.994)	AN.16068.00
	Connection diagram (Serial No. 2.386.995)	AN.16069.00
Tightening torques		
Spare parts list		
Logbook		

## Definitions

$U_N$  ... Rated voltage  
 $I_N$  ... Rated current  
 $P_N$  ... Rated power  
 $M_N$  ... Rated torque

## General data

Type	Asynchronous machine	
Purpose	Cooling gas compressor DKRES 6325-4WG	Seal gas compressor DKRGS 6325-4WG
VEM Order number	K-2044730	K-2044740
VEM Serialnummer	2.386.994	2.386.995

## Rating

Rated power	2,300 kW	2,200 kW
Mode of operation	S1	
Power factor @ 125% $P_N$ $\cos\phi$	0.89	0.90
Power factor @ 100% $P_N$ $\cos\phi$	0.90	0.91
Power factor @ 75% $P_N$ $\cos\phi$	0.90	0.90
Power factor @ 50% $P_N$ $\cos\phi$	0.88	0.88
Efficiency @ 125% $P_N$	96.40 %	96.40 %
Efficiency @ 100% $P_N$	96.40 %	96.40 %
Efficiency @ 75% $P_N$	96.10 %	96.10 %
Efficiency @ 50% $P_N$	95.20 %	95.20 %
Rated voltage	11,000 V $\pm$ 5 %	11,000 V $\pm$ 5 %
Rated frequency	50 Hz -5/+3 %	50 Hz -5/+3 %
Rated speed	1,493 min <sup>-1</sup>	
Direction of rotation	cw, facing D end	ccw, facing D end
Rated current	139 A	132 A
Rated torque	14,069 Nm	14,069 Nm
Breakdown torque @ 100% $U_N$	2.20 $\times$ $M_N$	2.30 $\times$ $M_N$
Thermal class/utilization	F/B IEC60085 at overload, utilization acc. to F possible	
Service factor	1	

Start characteristics		
Type of start	D.O.L.	
Startup acc. to characteristic	WA additional document Curve C	
Mass moment of inertia, external	180 kgm <sup>2</sup>	56 kgm <sup>2</sup>
Max. operations per year	1,000	
Admissible starts per h, cold/warm	3 / 2	
Starting current @ 100% U <sub>N</sub>	5.19 × I <sub>N</sub>	5.43 × I <sub>N</sub>
Tightening torque @ 100% U <sub>N</sub>	0.59 × M <sub>N</sub>	0.62 × M <sub>N</sub>
Reduced starting voltage	85 × U <sub>N</sub> %	85 × U <sub>N</sub> %
Starting time at reduced starting voltage	7 s	8.3 s
Starting current @ % U <sub>N</sub>	4.35 × I <sub>N</sub>	4.55 × I <sub>N</sub>
Starting torque @ % U <sub>N</sub>	0.41 × M <sub>N</sub>	0.43 × M <sub>N</sub>

Cooling data		
Cooling method	IC 611	IEC60034-6
Cooler	Air-Air-Heat Exchanger	
Volume flow of cooling air (primary cooling circuit)	151 m <sup>3</sup> /min	151 m <sup>3</sup> /min
Volume flow of cooling air (secondary cooling circuit)	211 m <sup>3</sup> /min	211 m <sup>3</sup> /min
Max. cooling air temperature	52 °C	

Ambient data		
Ambient temperature min./max.	-15 / +42 °C	
Max. mounting height	1,720 m	
Degree of protection of machine/terminal box	IP 55 / 55	IEC60034-5
Space heater stator winding	AC 230 V, 960 W	AC 230 V, 960 W

Design data		
Type of construction	IM 1001 IEC60034-7	IM 1002 IEC60034-7
Sound pressure level	75 + 0 dB(A) (no load)	85 + 0 dB(A) (no load)
Total film thickness of external paint coat	240 µm	
Color	RAL 7032	
Max. mounting weight	12,100 kg ± 5%	11,900 kg ± 5%



Monitoring	
Winding temperature	6x RTD in stator winding per motor (2 per phase) 3x PTC (Alarm) in stator winding per motor (1 per phase) 3x PTC (Trip) in stator winding per motor (1 per phase)
Bearing temperature	1x RTD per bearing (2 per motor)
Cooling air	1x RTD for cold air (per motor) 1x RTD for warm air (per motor)

Bearing	D end	ND end
Type of bearing	ZFNLB 18-180	ZFNLQ 18-180
Design	locating bearing	floating bearing
Insulation	none	yes
Shaft earthing brush	none	none
Lubricant	ISO VG 32	
Oil filling quantity	14 l	14 l
Axial bearing clearance	$\pm 0,7$ mm	
Permissible axial forces	0,7 kN	

1 2 3 4 5 6 7 8

A

B

C

D

E

The copyright and utilization of the design as well as the construction of its contents to other without expressed authorization is prohibited. Offenders will be held liable for the payment of damages. All rights reserved, in particular the right to carry out patent, utility model or ornamental design registration.

1 2 3 4 5 6 7 8

[ DIN A2 ]

This document is created to CAD and is therefore valid without signature!

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

E

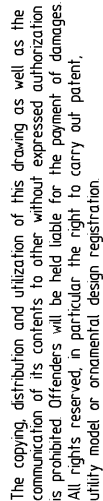
E

E

E

E





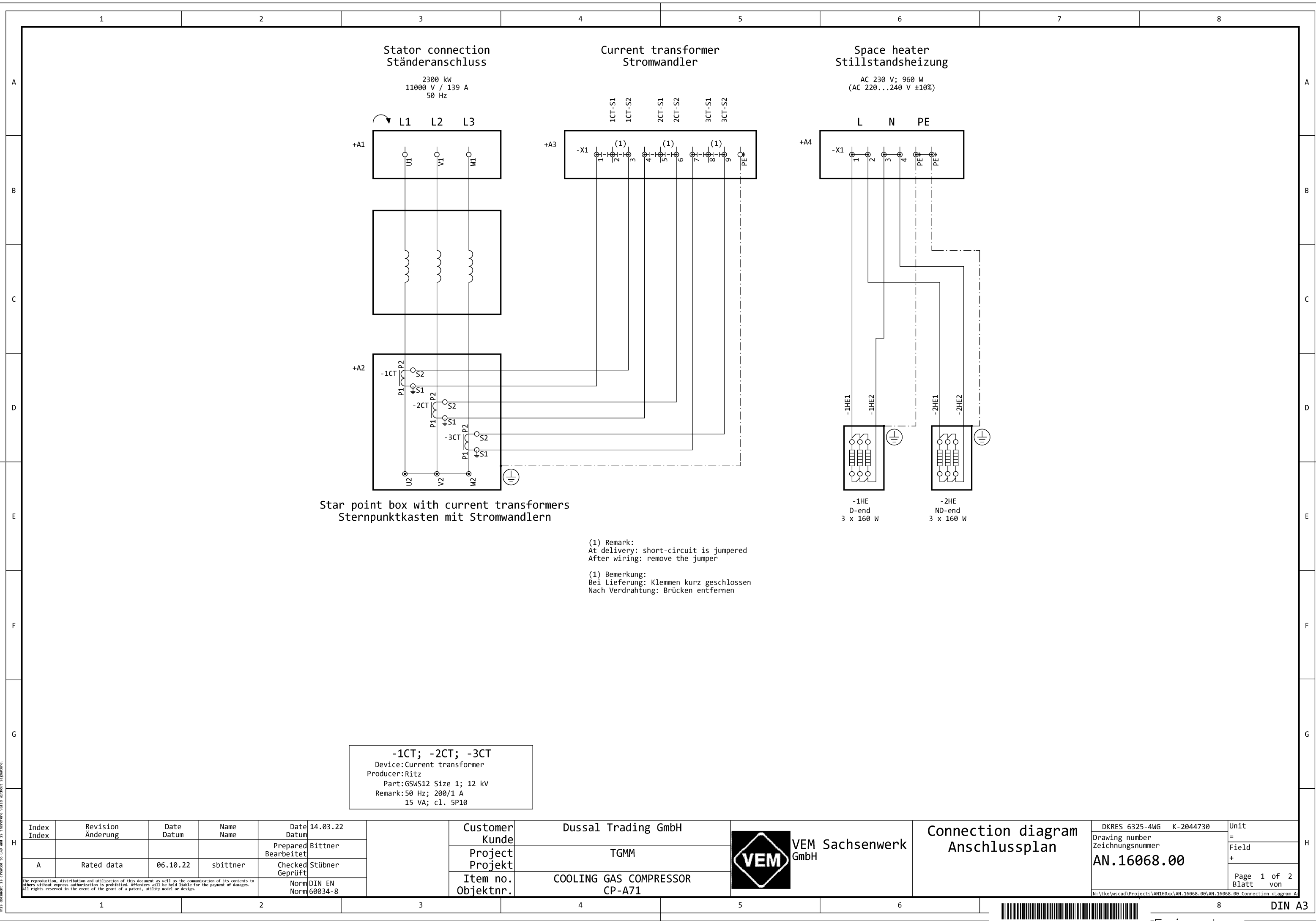
The copying, distribution and utilization of this drawing as well as the communication of its contents to other without expressed authorization is prohibited. Offenders will be held liable for the payment of damages. All rights reserved, in particular the right to carry out patent, utility model or ornamental design registration.

[illegible]

Freigegeben/Released




This document is created to CAD and is therefore valid without signature.

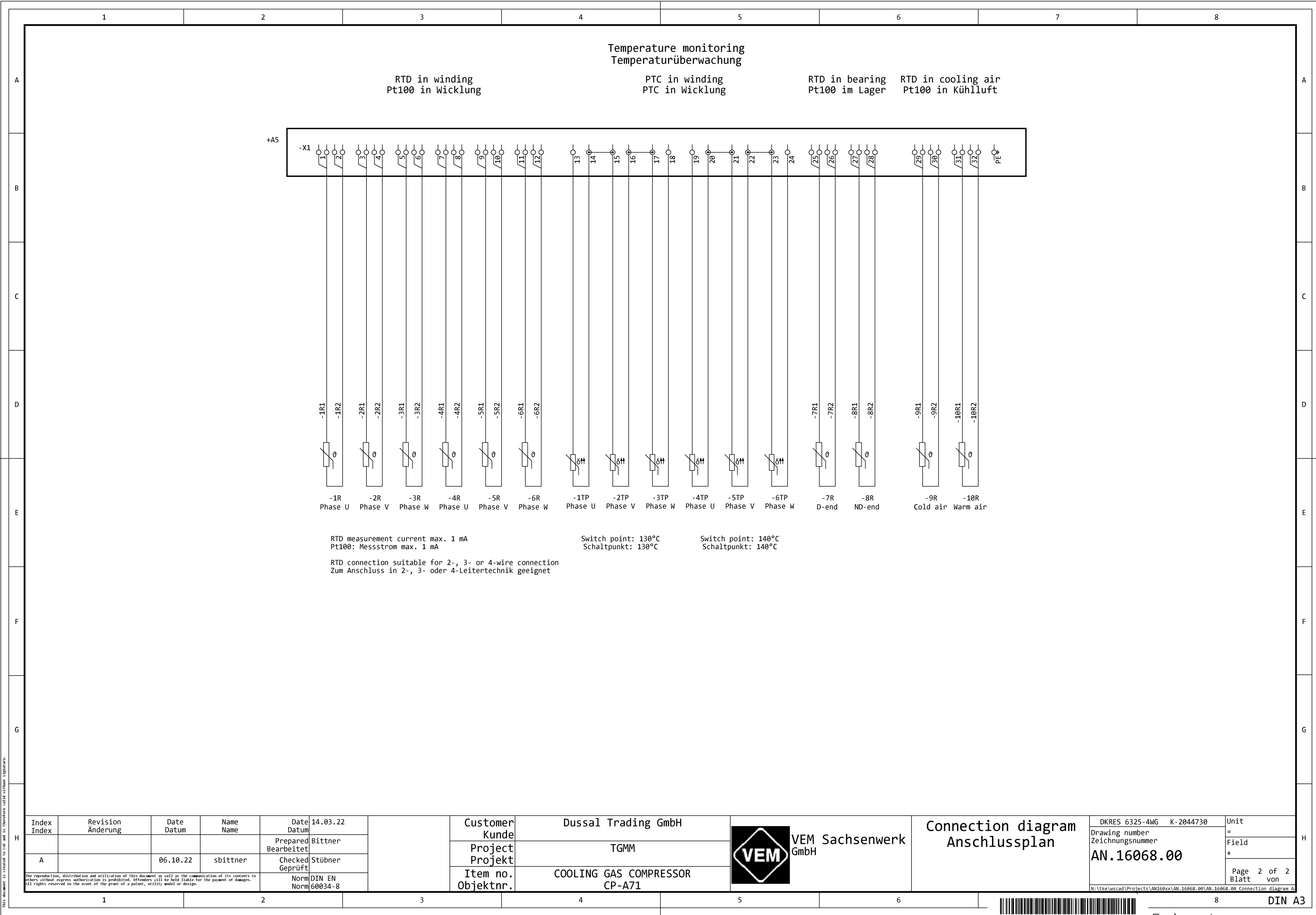


Index Index	Revision Änderung	Date Datum	Name Name	Date Datum	14.03.22
				Prepared Bearbeitet	Bittner
A	Rated data	06.10.22	sbittner	Checked Geprüft	Stübner
The reproduction, distribution and utilization of this document as well as the communication of its contents to others without express authorization is prohibited. Offenders will be held liable for the payment of damages. All rights reserved in the event of the grant of a patent, utility model or design.				Norm Norm	DIN EN 60034-8

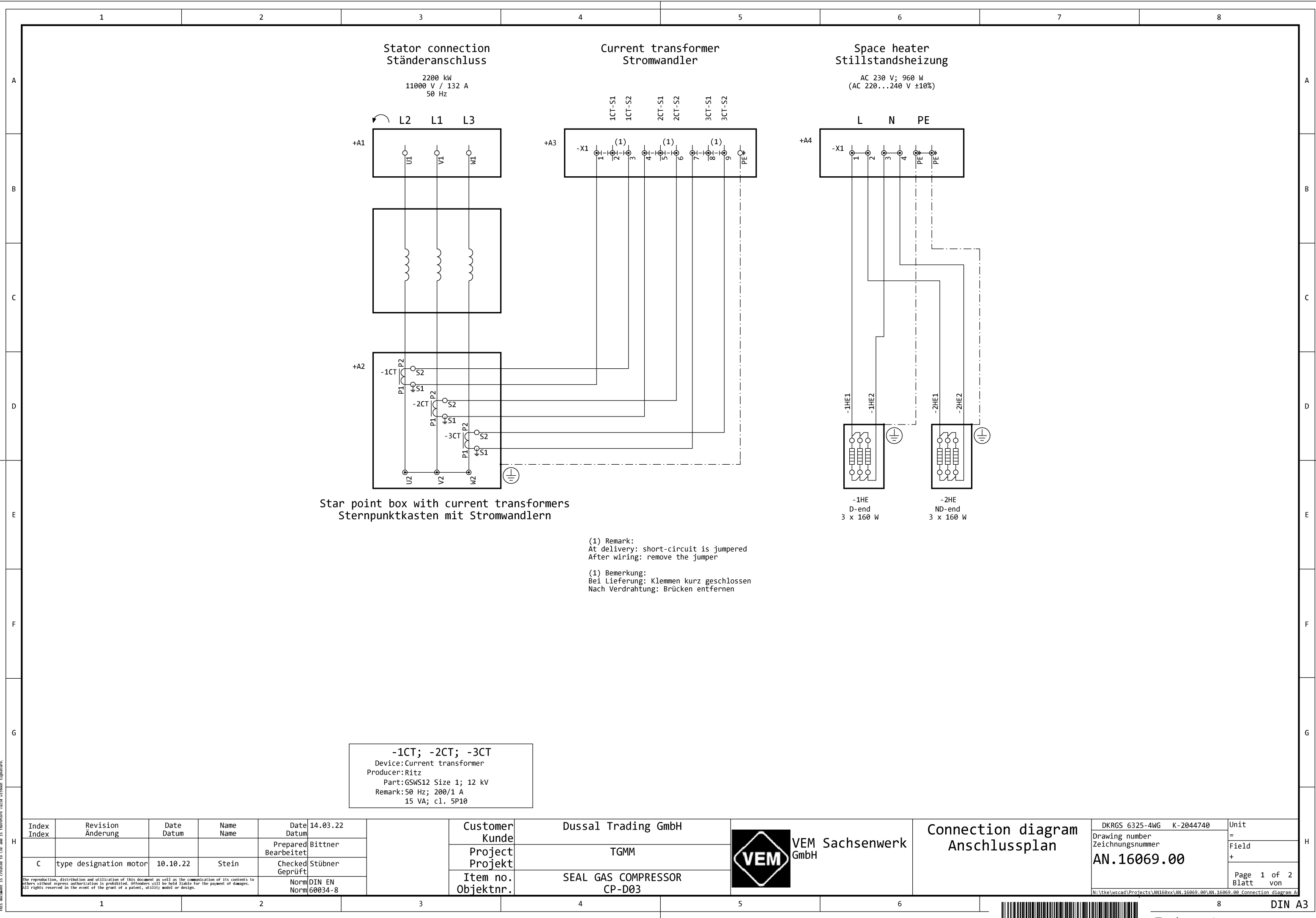
Customer Kunde	Dussal Trading GmbH
Project Projekt	TGMM
Item no. Objektnr.	COOLING GAS COMPRESSOR CP-A71

 VEM Sachsenwerk GmbH	Connection diagram Anschlussplan		DKRES 6325-4WG K-2044730	Unit =
			Drawing number Zeichnungsnummer	Field +
			AN.16068.00	Page 1 of 2 Blatt von
			N:\tke\wscad\Projects\AN160xx\AN.16068.00\AN.16068.00 Connection diagram A	



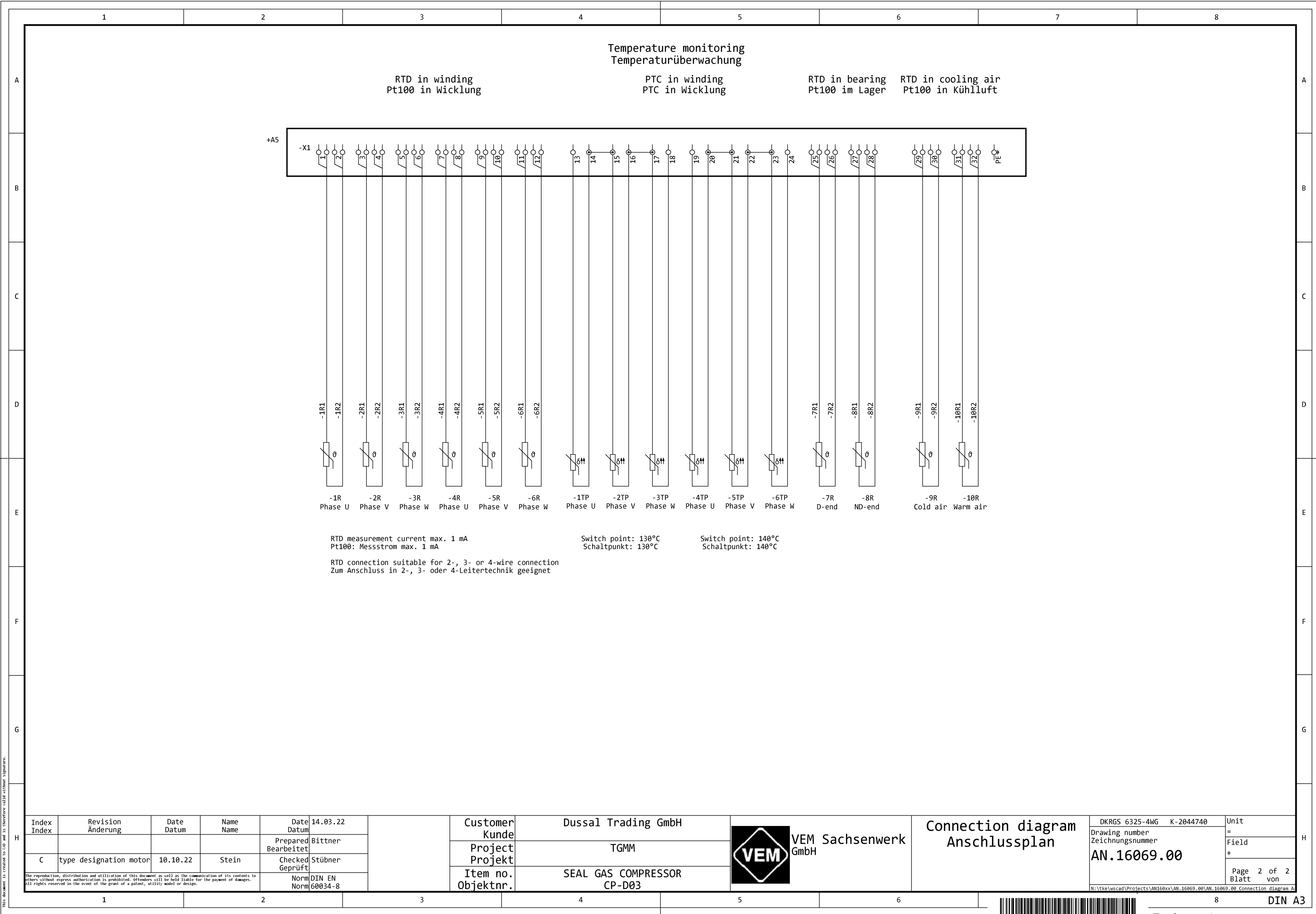


This document is created to CAD and is therefore valid without signature.





This document is created to CAD and is therefore valid without signature.



## Torque of bolt connections

Production and testing torque non-greased bolt connections ( $\mu=0.14$ )								
	Bolt connections Cu / Brass		Strength 4.6 and 5.6 or Cu, Brass, Al, Grey cast screws		Strength 8.8 -mech. unlocked -conductor bars locked		Strength 8.8 -mech. locked	
Dimension	Production [Nm]	Testing [Nm]	Production [Nm]	Testing [Nm]	Production [Nm]	Testing [Nm]	Production [Nm]	Testing [Nm]
M4	1.0	0.7	1.4	1.0	3.0	2.1	3.3	2.3
M5	2.0	1.4	2.7	1.9	5.9	4.2	6.7	4.7
M6	3.5	2.5	4.6	3.2	10	7.0	11.5	8.1
M8	8.4	5.9	11	7.7	25	17.5	27	18.9
M10	13.2	9.2	17.1	12.0	38.1	26.7	54	37.8
M12	22.6	15.8	30.3	21.2	66.1	46.3	92	64.4
M14	-	-	48.2	33.7	105	73.5	145	101.5
M16	55.2	38.6	73.9	51.7	163	114.1	225	157.5
M18	-	-	101	70.7	233	163.1	320	224
M20	107	74.9	143	100.1	331	231.7	460	322
M22	-	-	194	136	451	316	620	434
M24	183	128	245	172	568	398	790	553
M27	-	-	366	256	856	600	1 160	812
M30	369	258	494	346	1 130	791	1 550	1 085
M33	502	385	673	471	1 560	1 092	-	-
M36	840	588	1 120	784	2 020	1 420	-	-
M39	-	-	1 380	966	2 640	1 850	-	-
M42	-	-	1 370	959	3 230	2 260	-	-
M45	-	-	1 700	1 190	3 990	2 800	-	-
M48	-	-	2 050	1 440	4 860	3 400	-	-
M52	-	-	2 630	1 840	6 200	4 340	-	-
M56	-	-	3 280	2 300	7 750	5 430	-	-
M64	-	-	4 890	3 420	11 600	8 120	-	-
M68	-	-	5 890	4 120	13 800	9 660	-	-

## Tightening torques of stone bolts, anchor bolts and hammer bolts in concrete foundations

Dimension	Pitches lubricated by MoS <sub>2</sub> -paste ( $\mu=0.11$ )		Pitches oiled slightly ( $\mu=0.14$ )	
	Assembly [Nm]	Test [Nm]	Assembly [Nm]	Test [Nm]
<b>M24</b>	148	126	182	155
<b>M30</b>	296	252	366	311
<b>M36</b>	509	433	631	536
<b>M42</b>	826	702	1 025	871
<b>M48</b>	1 224	1 040	1 520	1 292
<b>M56</b>	1 983	1 686	2 465	2 095
<b>M64</b>	2 926	2 487	3 641	3 095
<b>M72*6</b>	4 257	3 618	5 309	4 513
<b>M80*6</b>	5 782	4 915	7 223	6 140
<b>M90*6</b>	8 324	7 075	10 419	8 856
<b>M100*6</b>	11 556	9 823	14 488	12 315

## Spare parts

Quantity	Designation	Dimension	Material number
1 *)	sleeve bearing D end	ZFNLB 18-180	35654206050
1 *)	sleeve bearing ND end	ZFNLQ 18-180	35654206051
1	bearing shell for ZFNLB 18-180		35654213257
1	bearing shell for ZFNLQ 18-180		35654213258
2	lubrication ring	Z-L18/DRM.160-200	35654209849
1	floating cutting edge seal	Z-180	35654209818
3	floating cutting edge seal	Z-200	35654209773
2 *)	resistance thermometer for bearing	RTD	38111532287
2 *)	resistance thermometer for cooling air	RTD	38111533362
6 *)	round tubular heater	AC 230 V, 160 W	39292190965
3 *)	support current transformer	GSWS12 GR.1	36232103108

\*) per motor

Serial-Number	____.____.____.____.____.
---------------	---------------------------

[illegible]

## Services

[illegible]

## Trouble shooting

[illegible]

## Amendments

[illegible]



## Quality documents

Documents	Designation
EU declarations	Declaration of incorporation
Certificates	Test certificate 3.1

# ERKLÄRUNG FÜR DEN EINBAU EINER UNVOLLSTÄNDIGEN MASCHINE DECLARATION OF INCORPORATION OF PARTLY COMPLETED MACHINERY

nach Maschinenrichtlinie 2006/42/EG, Anhang II Teil 1B  
acc. to Machinery Directive 2006/42/EG, Annex II Part 1B

---

Hiermit erklärt der Hersteller:

The manufacturer hereby declares:

VEM Sachsenwerk GmbH  
Pirnaer Landstr. 176  
01259 Dresden  
Germany

der unvollständigen Maschine:

for the partly completed machinery:

Hochspannungsmotor  
Typ *DKRES 6325-4WG*  
High voltage motor  
Type *DKRES 6325-4WG*

Maschinen-Nr. 2386994

Serial-No. 2386994

die Anwendung und Einhaltung folgender grundlegender Anforderungen nach Anhang I:

the application and fulfilment of the following essential requirements acc. to annex I:

1.1.2, 1.1.3, 1.1.5, 1.2.6, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.3.8.1,  
1.5.1, 1.5.2, 1.5.4, 1.5.5, 1.5.6, 1.5.7, 1.5.8, 1.5.9, 1.5.10, 1.5.13, 1.5.15,  
1.6.1, 1.6.5, 1.7.2, 1.7.4.1

Die Inbetriebnahme der unvollständigen Maschine ist solange untersagt, bis die Konformität der Maschine, in welche die unvollständige Maschine eingebaut wurde, mit der Maschinenrichtlinie 2006/42/EG festgestellt ist. Wir erklären, dass die speziellen technischen Unterlagen nach Anhang VII Teil B erstellt wurden und verpflichten uns, diese auf Verlangen den Aufsichtsbehörden in digitaler Form zu übermitteln.

The partly completed machinery must not be put into service until the final machinery into which they have been incorporated has been declared in conformity with the provisions of Machinery Directive 2006/42/EC. We declare that the relevant technical documentation acc. to annex VII Part B has been prepared and agree to submit it to the national authorities in digital form on request.

Bevollmächtigter für die Zusammenstellung der speziellen technischen Unterlagen:

Authorised person to compile the relevant technical documentation:

VEM Sachsenwerk GmbH  
Pirnaer Landstr. 176  
01259 Dresden  
GERMANY

---

Dresden, 12.01.2023



Henrik Ender

Leiter Qualitätssicherung

Head of quality assurance

# ERKLÄRUNG FÜR DEN EINBAU EINER UNVOLLSTÄNDIGEN MASCHINE DECLARATION OF INCORPORATION OF PARTLY COMPLETED MACHINERY

nach Maschinenrichtlinie 2006/42/EG, Anhang II Teil 1B  
acc. to Machinery Directive 2006/42/EG, Annex II Part 1B

---

Hiermit erklärt der Hersteller:

The manufacturer hereby declares:

VEM Sachsenwerk GmbH  
Pirnaer Landstr. 176  
01259 Dresden  
Germany

der unvollständigen Maschine:

for the partly completed machinery:

Hochspannungsmotor  
Typ *DKRGS 6325-4WG*  
High voltage motor  
Type *DKRGS 6325-4WG*

Maschinen-Nr. 2386995

Serial-No. 2386995

die Anwendung und Einhaltung folgender grundlegender Anforderungen nach Anhang I:

the application and fulfilment of the following essential requirements acc. to annex I:

1.1.2, 1.1.3, 1.1.5, 1.2.6, 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.7, 1.3.8.1,  
1.5.1, 1.5.2, 1.5.4, 1.5.5, 1.5.6, 1.5.7, 1.5.8, 1.5.9, 1.5.10, 1.5.13, 1.5.15,  
1.6.1, 1.6.5, 1.7.2, 1.7.4.1

Die Inbetriebnahme der unvollständigen Maschine ist solange untersagt, bis die Konformität der Maschine, in welche die unvollständige Maschine eingebaut wurde, mit der Maschinenrichtlinie 2006/42/EG festgestellt ist. Wir erklären, dass die speziellen technischen Unterlagen nach Anhang VII Teil B erstellt wurden und verpflichten uns, diese auf Verlangen den Aufsichtsbehörden in digitaler Form zu übermitteln.

The partly completed machinery must not be put into service until the final machinery into which they have been incorporated has been declared in conformity with the provisions of Machinery Directive 2006/42/EC. We declare that the relevant technical documentation acc. to annex VII Part B has been prepared and agree to submit it to the national authorities in digital form on request.

Bevollmächtigter für die Zusammenstellung der speziellen technischen Unterlagen:

Authorised person to compile the relevant technical documentation:

VEM Sachsenwerk GmbH  
Pirnaer Landstr. 176  
01259 Dresden  
GERMANY

---

Dresden, 06.02.2023



Henrik Ender

Leiter Qualitätssicherung

Head of quality assurance



Rated data / Bemessungsdaten				General data / Allgemeine Angaben			
3ph Mot.		Typ DKRES 6325-4WG		Project title Projektbezeichnung		TGMM	
DIN EN 60034-1		Nr. 2386994 / 2023		Customer Kunde		Dussal Trading GmbH	
Y ± 5 % 11000 V		-5/+3 % 50 Hz		Internal order no. PSP-Nr.		K-2044730	
139 A				Rotor no. Läufer-Nr.		74262	
2300 kW		-15 / +42 °C		Winding instruction Wickelanweisung		AP.96391.00	
COS φ 0.90		UVW		Exciter machine type Erregermaschinentyp		n/a	
1493 rpm		IP 55 IC 611		Ex-protection data / Ex-Schutz-Angaben			
		11880 kg		Ex-certification Ex-Zertifikat			
				Ex-type Ex-Typ			
Th.cl. 155 (F) used 130 (B)				P <sub>sup</sub> [bar]		n/a	Q <sub>purg</sub> [m³/h]
Altitude 1720 m a.s.l.				P <sub>min</sub> [mbar]		n/a	P <sub>max</sub> [mbar]
				Q <sub>Leak</sub> [m³/h]		n/a	P <sub>ref,Leak</sub> [mbar]
				P <sub>ref,min</sub> [mbar]		n/a	
Machine construction data / Angaben zur Maschinenkonstruktion							
Type of construction Bauform		IM 1001		Brushes per ring Bürsten je Ring		n/a	
Cooling design Kühlart		IC 611		Type of bearing Lagerart		sleeve bearing	
Air gap Luftspalt		[mm] 4.0		Brush grade Bürstenmarke		n/a	
Air-gap exciter machine Luftspalt Erregermaschine		[mm] n/a		Bearing DE Lager DS		ZFNLB 18-180	
				Bearing NDE Lager NS		ZFNQL 18-180	
				x-dimension x-Maß		[mm] 61.5	
				Type of grease Fettsorte		n/a	
				Type of oil Ölart		ISO VG 32	
				Oil quantity DE Ölmenge DS		[l/min] / [l] 14	
				Oil quantity NDE Ölmenge NS		[l/min] / [l] 14	
EA 02, EA 03, EA 44, SE 01 - DC & insulation resistance, Withstand voltage / DC- & Isolationswiderstände, Stehspannung							
Winding Wicklung		Number of poles / Quantity Polzahl / Anzahl		DC resistance Gleichstromwiderstand		Temperature Temperatur	
		4		R <sub>DC</sub> [Ω]		19	
				Insulation resistance to iron Isolationswiderstand gegen Eisen		Withstand voltage for 60 sec Stehspannung für 60 s	
				R <sub>iso, 60s</sub> [MΩ]		U <sub>M, DC</sub> [V]	
				PI		U <sub>p, 60s</sub> [kV]	
Stator system I / Phase Ständer System I / Strang				8430		5000	
				n/a		23.0	
EA 07 - Bearing run / Lagerlauf							
Speed / Drehzahl		1500		rpm / 1/min		at no-load / im Leerlauf	
Temperature rise: Measuring point D-end Temperaturerhöhung: Messstelle D-Seite		ΔΘ [K]		45		Temperature rise: Measuring point ND-end Temperaturerhöhung: Messstelle N-Seite	
						ΔΘ [K]	
						53	
EA 09 - Short-circuit test at locked rotor / Kurzschlussprüfung im Stillstand							
Frequency Frequenz		Voltage Spannung		Current Strom		electrical power elektrische Leistung	
f [Hz]		U <sub>1</sub> [V]		I <sub>1</sub> [A]		P <sub>el</sub> [kW]	
50.06		2657		139.5		73.3	
						0.114	
						0	
						1.00	
						n/a	
EA 15 - Direction of rotation / Drehsinn							
Connection / Anschluss		L <sub>1</sub> -L <sub>2</sub> -L <sub>3</sub>		to / an		U-V-W	
						→	
						clockwise / rechts	
EA 16 - No-load test for motor operation / Leerlaufprüfung als Motor							
Frequency Frequenz		Voltage Spannung		Current Strom		electrical power elektrische Leistung	
f [Hz]		U <sub>1</sub> [V]		I <sub>1</sub> [A]		P <sub>el</sub> [kW]	
50.01		11001		25.3		29.9	
						0.062	
						1500.3	
						UVW	
						n/a	
EA 17 - Bearing housing vibrations / Lagergehäuseschwingungen							
Speed / Drehzahl		1500.0		rpm / 1/min		at no-load / im Leerlauf	
Coordinates / Richtung		x		D-end / D-Seite		ND-end / N-Seite	
		y		z		x	
		z		x		y	
Vibration velocity Schwinggeschwindigkeit		v <sub>eff</sub> [mm/s]		0.7		1.2	
				1.2		0.4	
						0.8	
						1.0	
EZ 03-06 - Check of temperature detectors / Prüfung von Temperatursensoren							
Position Ort		Type Typ		Quantity Anzahl		DC resistance Gleichstromwiderstand	
						R <sub>DC</sub> [Ω]	
Winding Wicklung		Pt100		6		100.0	
						0	
						30000	
						500	
						1.5	
Bearing Lager		Pt100		2		100.0	
						0	
						3000	
						100	
						n/a	
Cooling Kühlung		Pt100		2		100.0	
						0	
						500	
						100	
						n/a	
EZ 16 - Check of space heater / Prüfung Stillstandsheizung							
Quantity Anzahl		Rated data Bemessungsdaten		DC resistance Gleichstromwiderstand		Temperature Temperatur	
		U [V]		P [W]		R <sub>DC</sub> [Ω]	
						θ [°C]	
2		AC 230		960		57.8	
						19	
						30000	
						500	
						n/a	

Issued: Ludewig C. Dussal Checked: Gottschlich S. M. Approved: n/a  
Erstellt Test bay engineer Geprüft Authorized inspection representative Genehmigt Authorized inspection representative

ID number: PB-K-2044730-2386994 Date: 12.01.2023 Revision: 0 from 12.01.2023  
ID-Nummer Datum Revision vom



EZ 23, EZ 24 – Check of current & voltage transformers / Prüfung Strom- & Spannungswandler						
Quantity Anzahl	Manufacturer Hersteller	Type Typ	Serial no. Seriennummer	Transformation ratio Übersetzungsverhältnis	Rated power Bemessungsleistung P [VA]	Accuracy class Genauigkeitsklasse
3	Ritz	GSWS12	22/31346490 22/31346491 22/31346492	200 / 1	15	5P10
Additional accessories / Weiteres Zubehör						
Remarks / Bemerkungen						
The machine was manufactured and tested in compliance with standard DIN EN 60034-1. The machine was found to be in order. Die Maschine wurde hergestellt und geprüft in Übereinstimmung mit DIN EN 60034-1 und für in Ordnung befunden.						
Annex / Anlagen n/a						

This document was created automatically and is also valid without signature! / Dieses Dokument wurde maschinell erstellt und ist auch ohne Unterschrift gültig!

2386994

Issued: Erstellt	Ludewig <i>C. Ludewig</i> Test bay engineer	Checked: Geprüft	Gottschlich <i>G. Gottschlich</i> Authorized inspection representative	Approved: Genehmigt	n/a Authorized inspection representative
ID number: ID-Nummer	PB-K-2044730-2386994	Date: Datum	12.01.2023	Revision: Revision	0 from vom 12.01.2023



Rated data / Bemessungsdaten				General data / Allgemeine Angaben			
3ph Mot.		Typ <b>DKRGS 6325-4WG</b>		Project title Projektbezeichnung <b>TGMM</b>			
DIN EN 60034-1		Nr. <b>2386995 / 2023</b>		Customer Kunde <b>Dussal Trading GmbH</b>			
$\pm 5\%$ <b>11000 V</b>		<b>-5/+3 % 50 Hz</b>		Internal order no. PSP-Nr. <b>K-2044740</b>			
<b>132 A</b>				Rotor no. Läufer-Nr. <b>74263</b>			
<b>2200 kW</b>		<b>-15 / +42 °C</b>		Winding instruction Wickelanweisung <b>AP.96391.00</b>			
COS $\phi$ <b>0.91</b>		<b>VUW</b>		Exciter machine type Erregermaschinentyp <b>n/a</b>			
<b>1493 rpm</b>		<b>IP 55 IC 611</b>		Ex-protection data / Ex-Schutz-Angaben			
		<b>11990 kg</b>		Ex-certification Ex-Zertifikat <b>n/a</b>			
				Ex-type Ex-Typ <b>Ex n/a</b>			
Th.cl. <b>155 (F) used 130 (B)</b>				P <sub>sup</sub> [bar] <b>n/a</b>		Q <sub>purg</sub> [m³/h] <b>n/a</b>	
<b>Altitude 1720 m a.s.l.</b>				P <sub>min</sub> [mbar] <b>n/a</b>		P <sub>max</sub> [mbar] <b>n/a</b>	
				Q <sub>Leak</sub> [m³/h] <b>n/a</b>		P <sub>ref,Leak</sub> [mbar] <b>n/a</b>	
Machine construction data / Angaben zur Maschinenkonstruktion							
Type of construction Bauform <b>IM 1002</b>		Brushes per ring Bürsten je Ring <b>n/a</b>		Type of bearing Lagerart <b>sleeve bearing</b>		Type of grease Fettsorte <b>n/a</b>	
Cooling design Kühlart <b>IC 611</b>		Brush grade Bürstenmarke <b>n/a</b>		Bearing DE Lager DS <b>ZFNLB 18-180</b>		Type of oil Ölsorte <b>ISO VG 32</b>	
Air gap Luftspalt [mm] <b>4.0</b>		Brush dimensions Bürstenmaße [mm] <b>n/a</b>		Bearing NDE Lager NS <b>ZFNLQ 18-180</b>		Oil quantity DE Ölmenge DS [l/min] / [l] <b>14</b>	
Air-gap exciter machine Luftspalt Erregermaschine [mm] <b>n/a</b>		Slip ring serial number Schleifringnummer <b>n/a</b>		x-dimension x-Maß [mm] <b>62.0</b>		Oil quantity NDE Ölmenge NS [l/min] / [l] <b>14</b>	
EA 02, EA 03, EA 44, SE 01 - DC & insulation resistance, Withstand voltage / DC- & Isolationswiderstände, Stehspannung							
Winding Wicklung		Number of poles / Quantity Polzahl / Anzahl		DC resistance Gleichstromwiderstand		Insulation resistance to iron Isolationswiderstand gegen Eisen	
		<b>4</b>		<b>R<sub>DC</sub> [Ω] 0.27530</b>		<b>ϑ [°C] 18</b>	
Stator system I / Phase Ständer System I / Strang				<b>30000</b>		<b>PI n/a</b>	
				<b>5000</b>		<b>U<sub>M,DC</sub> [V] 23.0</b>	
EA 07 - Bearing run / Lagerlauf							
Speed / Drehzahl		<b>1500</b>		rpm / 1/min		at no-load / im Leerlauf	
Temperature rise: Measuring point D-end Temperaturerhöhung: Messstelle D-Seite		<b>ΔΘ [K] 55</b>		Temperature rise: Measuring point ND-end Temperaturerhöhung: Messstelle N-Seite		<b>ΔΘ [K] 46</b>	
EA 09 - Short-circuit test at locked rotor / Kurzschlussprüfung im Stillstand							
Frequency Frequenz f [Hz]	Voltage Spannung U <sub>1</sub> [V]	Current Strom I <sub>1</sub> [A]	electrical power elektrische Leistung P <sub>el</sub> [kW]	Power factor Leistungsfaktor cos $\phi$	Speed Drehzahl rpm / 1/min	s.c. curr. / rated curr. KS-Strom / Nennstr. I <sub>1</sub> / I <sub>N</sub>	Remarks Bemerkungen
<b>49.96</b>	<b>2515</b>	<b>132.1</b>	<b>65.4</b>	<b>0.114</b>	<b>0</b>	<b>1.00</b>	<b>n/a</b>
EA 15 - Direction of rotation / Drehsinn							
Connection / Anschluss		<b>L<sub>1</sub>-L<sub>2</sub>-L<sub>3</sub></b>		to / an		<b>V-U-W</b>	
						<b>→ counter-clockwise / links</b>	
EA 16 - No-load test for motor operation / Leerlaufprüfung als Motor							
Frequency Frequenz f [Hz]	Voltage Spannung U <sub>1</sub> [V]	Current Strom I <sub>1</sub> [A]	electrical power elektrische Leistung P <sub>el</sub> [kW]	Power factor Leistungsfaktor cos $\phi$	Speed Drehzahl rpm / 1/min	Direction of rotation Drehsinn	Remarks Bemerkungen
<b>50.00</b>	<b>10999</b>	<b>25.2</b>	<b>28.9</b>	<b>0.060</b>	<b>1500.0</b>	<b>VUW</b>	<b>n/a</b>
EA 17 - Bearing housing vibrations / Lagergehäuseschwingungen							
Speed / Drehzahl		<b>1500.0</b>		rpm / 1/min		at no-load / im Leerlauf	
Coordinates / Richtung		x		D-end / D-Seite		ND-end / N-Seite	
		<b>0.2</b>		<b>0.2</b>		<b>0.3</b>	
Vibration velocity Schwinggeschwindigkeit v <sub>eff</sub> [mm/s]		<b>0.2</b>		<b>0.2</b>		<b>0.3</b>	
EZ 03-06 - Check of temperature detectors / Prüfung von Temperatursensoren							
Position Ort	Type Typ	Quantity Anzahl	DC resistance Gleichstromwiderstand R <sub>DC</sub> [Ω]	Temperature Temperatur ϑ [°C]	Insulation resistance to iron Isolationswiderstand gegen Eisen R <sub>iso, 60s</sub> [MΩ]		Withstand voltage for 60 sec Stehspannung für 60 s U <sub>p, 60s</sub> [kV]
Winding Wicklung	<b>Pt100</b>	<b>6</b>	<b>100.0</b>	<b>0</b>	<b>30000</b>		<b>500</b>
Bearing Lager	<b>Pt100</b>	<b>2</b>	<b>100.0</b>	<b>0</b>	<b>3000</b>		<b>100</b>
Cooling Kühlung	<b>Pt100</b>	<b>2</b>	<b>100.0</b>	<b>0</b>	<b>3000</b>		<b>100</b>
EZ 16 - Check of space heater / Prüfung Stillstandsheizung							
Quantity Anzahl	Rated data Bemessungsdaten		DC resistance Gleichstromwiderstand R <sub>DC</sub> [Ω]	Temperature Temperatur ϑ [°C]	Insulation resistance to iron Isolationswiderstand gegen Eisen R <sub>iso, 60s</sub> [MΩ]		Withstand voltage for 60 sec Stehspannung für 60 s U <sub>p, 60s</sub> [kV]
<b>2</b>	<b>U [V] AC 230</b>		<b>57.6</b>	<b>18</b>	<b>30000</b>		<b>500</b>
	<b>P [W] 960</b>						<b>n/a</b>

Issued: Ludewig *C. Dussal* Checked: Gottschlich *G. Gottschlich* Approved: n/a  
Erstellt: Test bay engineer Geprüft: Authorized inspection representative Genehmigt: Authorized inspection representative

ID number: PB-K-2044740-2386995 Date: 06.02.2023 Revision: 0 from 06.02.2023  
ID-Nummer: Datum: Revision vom



EZ 23, EZ 24 – Check of current & voltage transformers / Prüfung Strom- & Spannungswandler						
Quantity Anzahl	Manufacturer Hersteller	Type Typ	Serial no. Seriennummer	Transformation ratio Übersetzungsverhältnis	Rated power Bemessungsleistung P [VA]	Accuracy class Genauigkeitsklasse
3	Ritz	GSWS12	22/31346497 22/31346496 22/31346494	200/1	15	5P10
Additional accessories / Weiteres Zubehör						
Remarks / Bemerkungen						
The machine was manufactured and tested in compliance with standard DIN EN 60034-1. The machine was found to be in order. Die Maschine wurde hergestellt und geprüft in Übereinstimmung mit DIN EN 60034-1 und für in Ordnung befunden.						
Annex / Anlagen n/a						

This document was created automatically and is also valid without signature! / Dieses Dokument wurde maschinell erstellt und ist auch ohne Unterschrift gültig!

2386995

Issued: Erstellt	Ludewig <i>C. Ludewig</i> Test bay engineer	Checked: Geprüft	Gottschlich <i>G. Gottschlich</i> Authorized inspection representative	Approved: Genehmigt	n/a Authorized inspection representative
ID number: ID-Nummer	PB-K-2044740-2386995	Date: Datum	06.02.2023	Revision: Revision	0 from vom 06.02.2023

## Documents of external suppliers

Component	Manufacturer	Type
Sleeve bearing	Miba Industrial Bearings Germany	ZFNLB 18-180 ZFNLQ 18-180
Current transformer	RITZ Instrument Transformers GmbH	GSWS12 GR.1



# MIBA INDUSTRIAL BEARINGS

## Plain Bearing

### Instructions for Installation and Operation





## CONTENT

<b>1 INTRODUCTION .....</b>	<b>5</b>
1.1 General notes .....	5
1.2 Bearing nomenclature .....	5
<b>2 SAFETY INSTRUCTIONS .....</b>	<b>6</b>
2.1 Environmental protection .....	7
<b>3 TRANSPORTATION AND STORAGE.....</b>	<b>8</b>
3.1 Delivery .....	8
3.2 Lifting.....	8
3.3 Bearing storage .....	8
3.4 Standard preservation .....	9
3.5 Corrosion protection for extended storage .....	9
<b>4 GENERAL DRAWING .....</b>	<b>10</b>
4.1 Bill of materials.....	11
<b>5 TECHNICAL DESCRIPTION .....</b>	<b>12</b>
5.1 General description .....	12
5.2 Housing.....	12
5.3 Bearing shells .....	13
5.4 Machine seal .....	13
5.5 Sealing .....	13
5.6 Loose oil ring .....	14
5.7 Insulation.....	14
5.8 Additional information on plain bearings with hydrostatic system .....	15
5.9 Additional information on plain bearings with external oil supply system.....	15
5.10 Additional information on plain bearings with water cooler in the oil sump .....	15
<b>6 BEFORE STARTING .....</b>	<b>16</b>
6.1 Tools and equipment .....	16
6.2 Disassembly.....	17
6.2.1 Disassembly of the seals .....	17
6.2.2 Disassembly of the housing and bearing shell.....	18
6.3 Cleaning.....	18
<b>7 ASSEMBLY INSTRUCTIONS.....</b>	<b>19</b>
7.1 Assembly of the machine seal .....	19
7.2 Assembly of the lower part of the housing .....	20
7.3 Assembly of the lower part of the shell .....	20
7.4 Assembly of the floating labyrinth seal - Machine side.....	21
7.5 Assembly of the loose oil ring .....	22
7.6 Assembly of upper bearing shell .....	23
7.6.1 Insulated bearings .....	23
7.7 Assembly of upper part of the housing .....	24
7.8 Assembly of the outboard seals .....	25
7.8.1 Floating labyrinth seal .....	25
7.8.2 Rigid seal.....	27
7.8.3 Bolt-on baffle .....	28
7.8.4 Dust flinger .....	28
7.9 Assembly of the thrust pads.....	29
7.10 Alignment of the shaft with the thrust face .....	30

<b>8 ADDITIONAL INFORMATION.....</b>	<b>31</b>
8.1 Connection description .....	32
8.2 Bearing with external oil supply system.....	32
8.3 Bearings with water cooler in the oil sump.....	33
8.4 Temperature-sensors .....	33
8.5 Bearings with hydrostatic system .....	34
8.6 Final tasks .....	35
<b>9 COMMISSIONING .....</b>	<b>36</b>
9.1 Filling lubricant .....	36
9.2 Oil level .....	36
9.3 Check up .....	36
<b>10 OPERATION .....</b>	<b>37</b>
10.1 Troubleshooting .....	37
<b>11 MAINTENANCE AND SERVICE .....</b>	<b>38</b>
11.1 General maintenance tasks .....	38
11.2 Temperature monitoring .....	39
11.3 Lubrication .....	39
11.4 Examine oil for water content.....	40
11.5 Cleaning the bearing housing.....	40
11.6 Control of bearing clearance .....	40
11.7 Checking the bolts .....	40
11.8 Bearing inspections .....	41
11.9 Lubricants.....	41
11.10 Replacement of hose .....	41
<b>12 SPARE PARTS, SERVICE INFORMATION .....</b>	<b>42</b>
12.1 Spare parts .....	42
12.2 Service information .....	42
<b>13 APPENDIX.....</b>	<b>43</b>
13.1 IP 56 Baffle .....	43
13.2- Assembly of the thrust pads RTD's .....	44
13.2.1- Upper Thrust pads RTD's .....	44
13.2.2- Lower Thrust pads RTD's .....	44
13.3- Special machine seal .....	45
13.4- Tilting pad journal bearing installation.....	46

# 1– INTRODUCTION

## 1.1– General notes

The MIBA type ZF (end flange) horizontal bearing is designed according to DIN 31 693 norm specifications for a wide range of heavy duty applications. Z-bearings are designed as a modular system, allowing for a combination of different modules. The pin positioning in the Z-bearing design simplifies assembly and minimizes mistakes during installation, commissioning, and maintenance procedures.

This installation and operation manual provides information for installation, start up, precautions, assembly, handling and maintenance of the equipment and its components.

Special instructions are given in the beginning of each item, including general notes on safety and operation.

Please pay careful attention to all points covered by this manual to ensure the safe and efficient operation of the bearing.

Everyone engaged in the installation, operation, maintenance and repair of the bearing should read and understand the Operating Instructions. MIBA accepts no liability for any damage or operating faults resulting from a failure to follow the said instructions.

The MIBA Z-bearing referred to in these instructions was developed for static use in general machine manufacture. It fulfils the requirements for mechanical explosion-proofing in compliance with Directive 94/9/EC. Possible uses for plain bearings of this series are electrical machines, fans, turbines, test rigs, etc. The bearing described here complies with the state of the art at for bearings at the time these Operating Instructions were printed. In the interests of further development, we reserve the right to carry out modifications to the individual subassemblies and accessories which, while preserving the essential features, are considered advisable as a means of increasing its efficiency and safety.

Contact MIBA for further information on special bearings. Additional technical documents with detailed information can be supplied in the case of special needs and features. Please have the type (see bearing types table) and the serial number to assist us in helping to solve your issues or concerns.

The reproduction of this operation manual, including texts, drawings and illustrations in it, of whatever nature, without MIBA's authorization is absolutely prohibited, with the infringing party being subjected to the applicable penalties under the copyright laws.

The instructions provided in this assembly, disassembly and maintenance manual were written by qualified professionals. Please read them carefully before starting their assembly or disassembly.

## 1.2– Bearing Nomenclature



### 1 // Type

Z Plain bearing

### 2 // Housing

F End flange mounted bearing, finned

### 3 // Heat dissipation

N Naturally cooled by convection  
 Z Lubrication by oil circulation with external oil cooling  
 X Lubrication by oil circulation with external oil cooling for high oil throughput  
 W Finned water cooler in the oil sump  
 U Recirculating oil pump and natural cooling  
 T Recirculating oil pump and water cooler in the oil sump

### 4 // Shape of bore and type of lubrication

C Plain cylindrical bore without oil ring  
 L Plain cylindrical bore with loose oil ring  
 F Plain cylindrical bore with oil disk  
 Y Two-lobe bore without oil ring  
 V Four-lobe bore without oil ring  
 K Journal tilting pads without oil ring

### 5 // Geometry of thrust bearing

Q Without thrust capability  
 B Plain white metal lined shoulders with oil grooves  
 K Tapered land thrust faces for both sense of rotation  
 D Tapered land thrust faces for one sense of rotation  
 A Round tilting thrust pads, cup spring supported

### 6 // Size

### 7 // Shaft diameter (mm)

## Example of a bearing designation:

**Z F N L B - 11 - 125**

End flange mounted, finned bearing, naturally cooled by convection, plain cylindrical bore with loose oil ring, plain white metal lined shoulders with oil grooves (locating or non-locating bearing), size 11, for shaft diameter 125 mm technology, mechanical engineering elements and steel profiles.

## 2– SAFETY INSTRUCTIONS



### Warning marks

*The operation instructions are basic guidelines that should be followed during the entire process of assembly, operation and maintenance of the equipment. Therefore, it is extremely important to read the information provided in this manual before starting any procedures, as well as making such information readily available for people who handle and operate the equipment, so that accidents and equipment damage can be prevented.*



After use, the bearings will be hot with the risk of skin burns during the maintenance process.

- Loads and speeds shall not exceed the required limits. The bearing should only be used under the technical limits specified.
- Rotating parts should always be blocked for transport to avoid accidental movements that can damage the bearing liners.
- Tighten the bolts with the specified torque values.
- Realize that problems can occur if the bearing is used for different application than it was designed for.
- Accidents can happen if the personnel who handle the product have not been adequately trained.
- People should be instructed to wear protective clothes and equipment.
- The personnel responsible for operating the unit must be familiarized with the procedures of Shut-Down and Emergency Stop, both related to the unit as a whole and to the items that are relevant for the activity being conducted.
- It must be assured that before the bearing is assembled, the bearing and its surroundings are well cleaned.
- Provide the assembly, operation and maintenance manual to the personnel who operate the unit and the assembly teams.
- The person in charge must ensure that all the maintenance, inspection and assembly activities be strictly performed by qualified personnel.
- We are not responsible for cleaning products effects.
- Any work to be performed on the machines shall only be executed while the machines are immobilized and protected against any possible unintentional start up.
- Invariably, upon completion of any work, all the safety devices should be reinstalled and put back in their functional state.
- Do not make any alterations, design modifications, or use non-OEM parts without the express written authorization from Miba.

- All the personnel responsible for operating the unit must be informed on these operation instructions and be familiarized with those parts involved in the relevant activities and their associated hazards.
- For bearings with external oil lubrication the specified oil flows must be used (for minimum oil flows see the calculation sheets or contact the equipment manufacturer ). For use in an emergency or deficient lubrication condition, there must be an alternative oil supply system provided, such as a system like stand-by pump or oil hydraulic accumulator. It is recommended to have loss of oil shutdown controls.
- Any variances in operating conditions, location, or dimensional factors should be reviewed with the manufacturer. This includes, but is not limited to, load, speed, ambient temperatures, oil inlet temperatures, oil viscosity, or shaft dimensional changes.
- At operation such deviations of mentioned characteristics are recognized with different bearing temperatures. In case of deviations new bearings calculations should be made and maybe a new bearing selection must be done by MIBA.



IMMEDIATELY STOP THE EQUIPMENT, INVESTIGATE AND ELIMINATE THE CAUSES IN CASE OF:

- ⇒ The bearing temperature exceeds an acceptable level.
- ⇒ You have noticed unacceptable vibrations.
- ⇒ There are uncommon such as grinding noises or burning smells.
- ⇒ The monitoring equipment sets off an alarm.



*During assembly and disassembly work, no explosive gas mixtures or dust concentrations may be present.*

### **2.1– Environmental protection**

When changing oil, catch the used oil in suitable containers. Any oil spills must be cleaned up immediately. Preservative agents are to be kept separately from used oil. Used oil, preservative agents, oil binding agents and oil-soaked cleaning cloths are to be disposed of in accordance with the applicable environmental regulations.

### 3 - TRANSPORTATION AND STORAGE

Follow all guidelines in Section 2 for Safety Instructions.

#### 3.1– Delivery Documentation

Please review the contents of the packages with the items listed on any packing or delivery notes. Any damage and/or missing parts must be reported immediately in writing to Miba.



- *The bearing must not be put into service if it is damaged in any way.*

#### 3.2– Lifting



- *When moving the bearing, use only lifting gear and slinging equipment with adequate load bearing capacities. When preparing for lifting, observe the instructions on load distribution indicated on the packaging.*
- *The bearing is to be moved in such a way as to prevent personal injury or damage to the bearing.*
- *The bearing may only be lifted with equipment suitable for the purpose.*

Eye bolts are installed in the upper part of the housing for moving the fully assembled bearing. It must be ensured that the eye bolts are tight and subjected only to tensile stress. They should not be used lift the fully or partly assembled machine on which they are being installed.

MIBA plain bearings (also called sleeve bearings) must be moved in such ways that they are not subjected to any major impact stresses, and they should be protected against moisture.

Bearings are delivered fully assembled, but without lubricating oil. The lubricant and any accessories are packed separately. Depending on the place and type of use, bearings are reliably protected against corrosion and other effects by a preservative coating.

Bearings are packed differently depending on their size and the mode of transport employed.

The handling instructions indicated by graphics on the packaging are to be observed.

#### 3.3– Bearing storage

The bearing should be stored and covered in a place protected from the weather and always should be kept upright. Storage is recommended in a wooden crate that is kept in a dry and vibration-free location.

The storage space must be dry and not subject to any major temperature fluctuations. Under such conditions, the bearing can be stored for up to six months.

The anti-corrosion coating must remain intact during the period of storage of the bearing and any individual components supplied with it. The coating must not be damaged to avoid risk of corrosion.



- *Bearings must not be stacked one on top of the other.*
- *If stored in the open air, the bearing must be covered with particular care to ensure that neither moisture nor foreign matter is deposited on the bearing (consult with MIBA if any questions).*
- *Unless otherwise contractually agreed, bearings must not be exposed to any harmful effects such as chemical products, environments with heavily polluted air, atmospheric humidity or extreme ambient temperatures. Any exceptional ambient conditions in transit (e.g. transport by sea) and storage (climate, termite attacks, etc) must be contractually agreed.*




### **3.4– Standard preservation**

Unless otherwise specified in the purchase order, bearings are supplied with a non-hardening protective film on all unpainted external surfaces.

The interior of the bearing is coated with oil in the preassembly stage. This is sufficient as a preservative for temporary storage.

The properties of the external surface coating are that it is resistant to acids, weak alkalis, solvents, the effects of weathering and temperatures up to 120°C, as well as being resistant to tropical conditions.

- *Bearings are supplied primed (MIBA-standard) or fully surface coated.  
In the case of processes generating pronounced electrostatic charges, however, brush discharges can occur. Evidence of this is to be furnished by our customer through the test setup specified in DIN EN 13463-1.*
- 
- *In the case of bearings applied only with a priming coat, our customer has a duty to complete the surface coating in accordance with DIN EN 13463-1, i.e.*
  - *Hazardous category IIC: Additional painting or changing of the MIBA paint in that hazardous category can cause the loss of the approval by the end customer.*
  - *Do not damage the surface coating. Physical (scratches), chemical (acids, alkalis) and thermal (sparks, welding beads, heat) damage can lead to corrosion and the breakdown of the outer protective coating.*

### **3.5– Corrosion protection for extended storage periods**

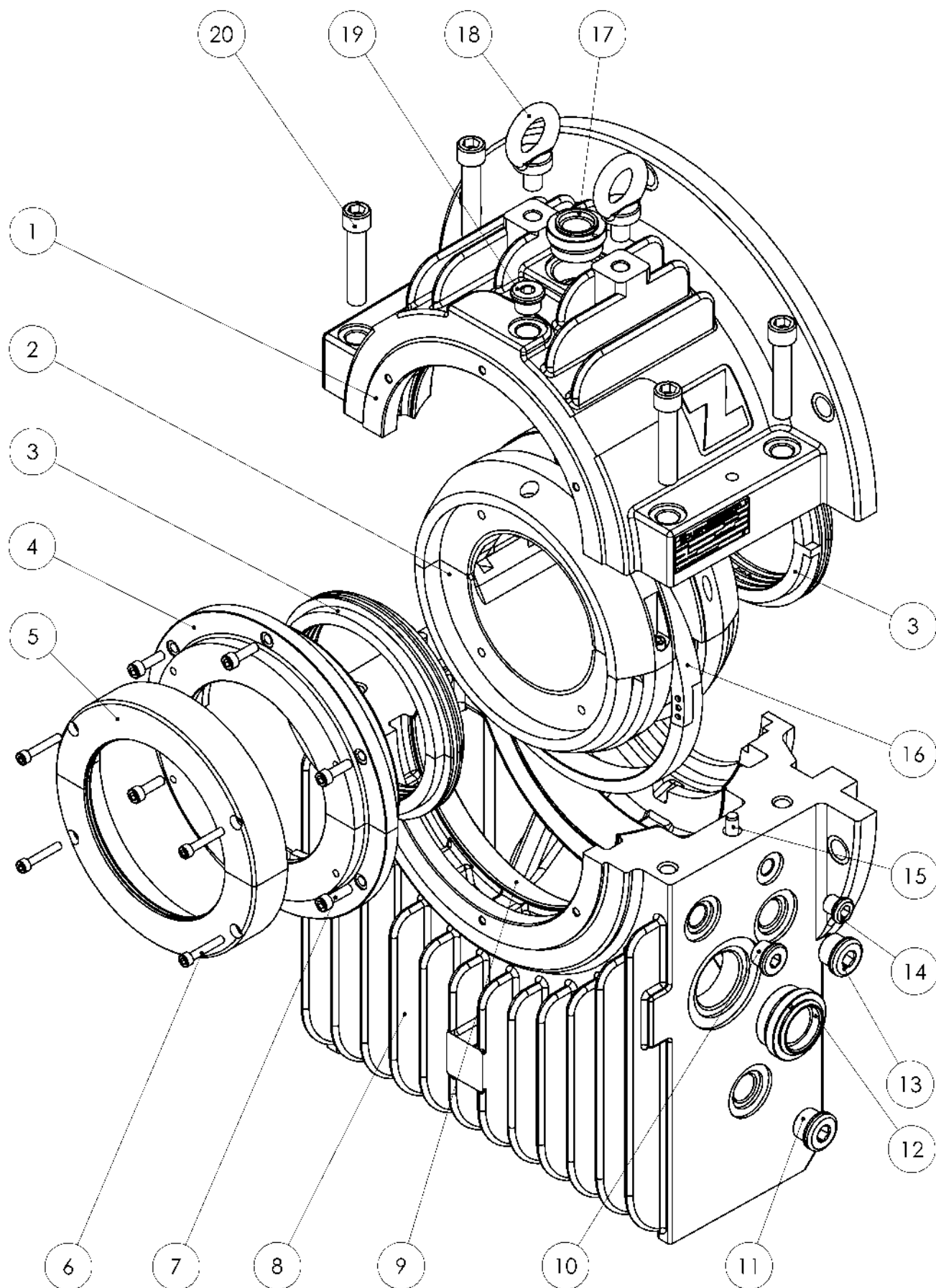
The maximum storage period as shipped is six months. For longer periods of corrosion protection, follow the steps below:

- Coat the inside parts of the bearing with an anti-corrosive oil or other compatible product.
- Coat the exterior surfaces of the bearing with anti-corrosive oil or removable varnish. Inspect the exterior coating and recoat as necessary every four months.
- Close all the housing connection holes with their respective bolts or drain plugs, or adhesive tape.
- Or close all the openings with an adhesive tape.
- For (bearings with forced lubrication), protect the oil entrance flanges with anticorrosive oil or removable varnish, and cover with graphite cardboard blind joint, a wooden plug or a thin aluminum sheet.
- Check surface conditions and reapply anticorrosive oil or removable varnish if needed every four months.
- The identification, preservation, packaging and storage of spare parts should be done in an indoor, dry and clean place.

If prolonged interim storage (> 6 months) is intended, MIBA should be notified in advance if possible, and MIBA can provide additional recommendations for storage, including:

- Disassemble the entire bearing, following the instructions described in this manual.
- Those parts of the bearing at risk of corrosion will be preserved with a hardening protective agent appropriate to the place and period of storage. If the specified protected period is exceeded, the preservation process must be repeated.

4- GENERAL DRAWING



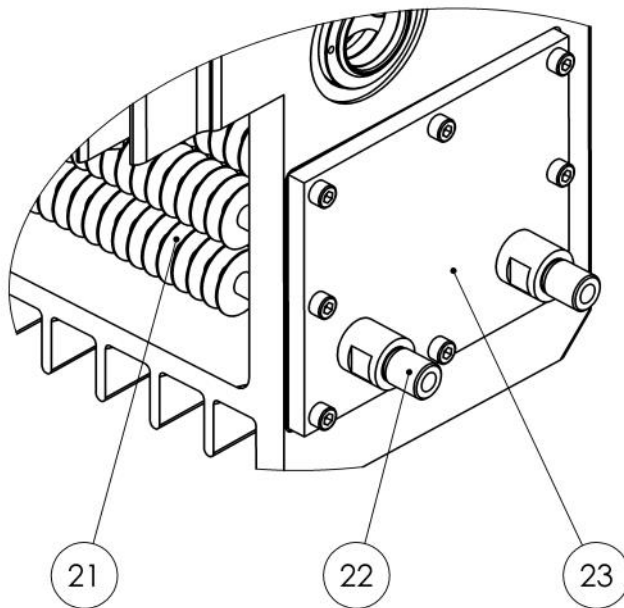


Fig. 1: Water Cooler Detail (For ZFW... Bearing)

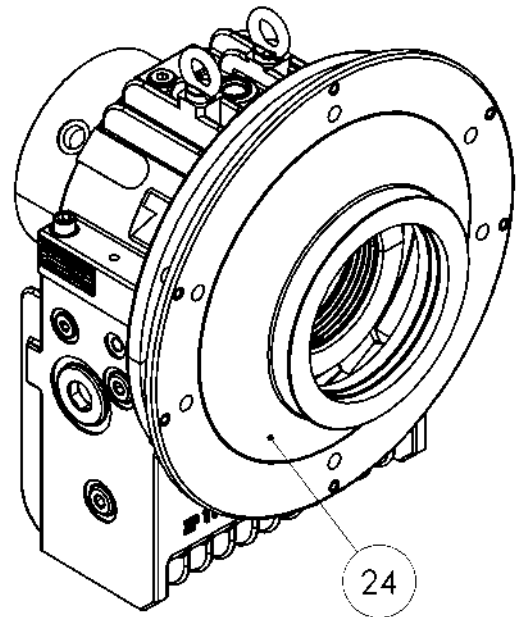


Fig. 2: Machine Seal Detail

#### 4.1– Bill of Materials

- |    |   |
|----|---|
| 1  | Upper housing   |
| 2  | Bearing shell (also called liner)   |
| 3  | Floating labyrinth seal   |
| 4  | Seal carrier  |
| 5  | Bolt on baffle  |
| 6  | Screw   |
| 7  | Screw   |
| 8  | Lower housing   |
| 9  | Spherical seat  |
| 10 | Plug (Oil inlet in case of oil circulation or circulating pump)                                 |
| 11 | Plug (Connection for heater, oil sump thermometer, or suction pipe in case of circulating pump) |
| 12 | Oil sight glass (Oil level indicator or oil outlet in case of oil circulation)                  |
| 13 | Plug (Connection for thermosensor)  |
| 14 | Plug (Cable exit for earthing device)   |
| 15 | Positioning pin   |
| 16 | Oil ring  |
| 17 | Top sight glass (Inspection of the oil ring)  |
| 18 | Eye bolt  |
| 19 | Plug (Oil filling or breather)  |
| 20 | Screw   |
| 21 | Water cooler  |
| 22 | Cooler connection   |
| 23 | Cooler cover  |
| 24 | Machine seal  |

## 5 - TECHNICAL DESCRIPTION

### 5.1– General description

ZF Plain bearing in standard configuration consists of a housing (upper and lower sections), bearing shells, floating labyrinth seals (external and on the machine side) and a loose oil ring. The bearings can also be fitted with a variety of additional and attached parts (see Table 1).

**Table 1: Additional and attached parts**

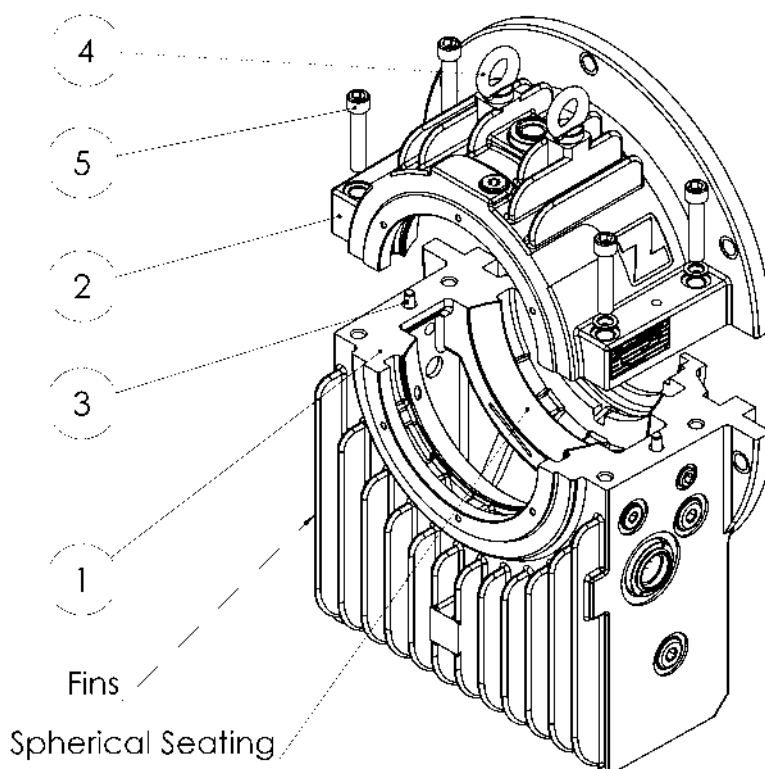
Additional and attached parts for Z-bearings	
Hydrostatic system	Flange (oil drain/inlet flange)
Machine seal	Earthing device
Seals with bolt-on baffle	Earthing device or Ground lug
Labyrinth rigid seal	Float switch
Fixed oil ring	Cooling (internal or external)
Marine specification (oil ring guide)	Heater
etc.	

**Note:** Upon request the oil supply system, flow meters and other type of instruments can be supplied.

### 5.2– Housing

The bearing housings are finned and manufactured from nodular cast iron EN-GJS-400-15 (GGG 40) providing high strength and best heat dissipation. If necessary, they can be supplied also in gray cast iron EN-GJL-300 (GG 30) for natural or water cooled bearings (N or W) or EN-GJS-400-18-LT (GGG 40.3) when the ambient temperature is less than  $-25^{\circ}\text{C}$ . The spherical seat in the housing ensures easy alignment during assembly when the loads are transferred to the lower half of the housing. Therefore these bearings are designed for highest stress. Thread holes for the fitting of thermo sensors in the journal bush and oil sump as well as for oil inlet and outlet pipes are provided on both sides of the housings as a standard. Water cooling tubes and vibration probes can be easily fitted by small modifications of the housings.

- 1 Lower housing
- 2 Upper housing
- 3 Positioning pin
- 4 Eye bolt
- 5 Screw



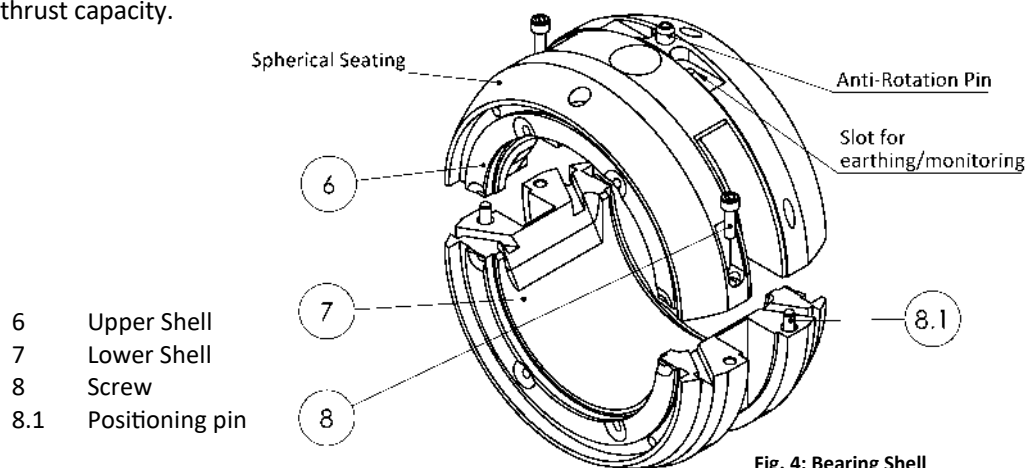
**Note:**

To prevent stray currents conducted by the shaft, Z-bearings can be supplied electrically insulated as an option. In this case, the spherical seat of the housing is coated with a wear-resistant and temperature-resistant synthetic material. Upon request, a grounding wire is provided to short out this insulation, passing through a threaded hole (M12x1.5) in the housing.

**Fig. 3: Housing**

### 5.3– Bearing shells

The shell (liner) is supplied split, with upper and lower halves, and is spherically seated in the housing to ensure easy alignment during assembly. This construction allows easy assembly and a long life cycle. Bearing shells with plain cylindrical bore and loose oil ring are used in most cases, but other bore shapes are possible. The bore is lined with high tin based white metal. When the specific load on start-up is too high, or for very slow speed applications, a hydrostatic jacking system can be incorporated. Bearing shells can be provided without thrust capability, or with either axial white metal lined shoulders (small, temporary thrust loads) with oil grooves, or taper land faces medium thrust loads for one or both senses of rotation depending on the level of the thrust load. The bearing shells can be equipped with thrust tilting pads for additional axial thrust capacity.



### 5.4– Machine seal

ZF bearings should be used with an additional machine seal to avoid interference from inside the machine where negative or positive pressures occur near the internal floating seals. This machine seal is mounted on the inside of the machine housing, creating a chamber next to the bearing housing. This chamber is connected to atmosphere for pressure equalization, which prevents oil leakage from the bearing into the machine enclosure.

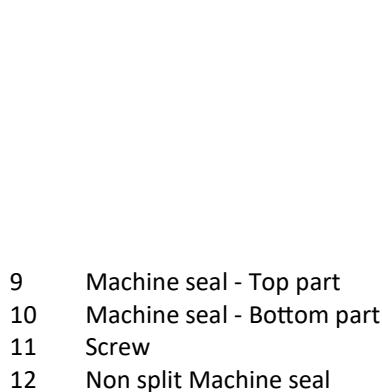


Fig. 5: Non Split Machine Seal  
(Standard)

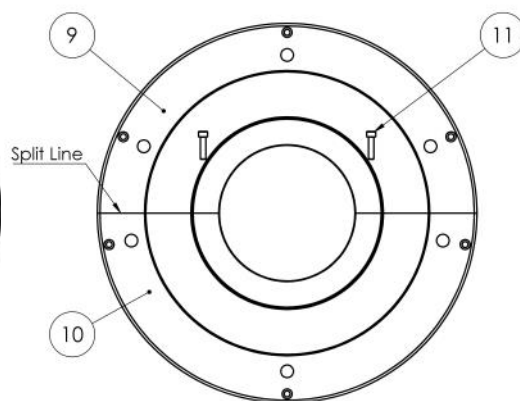
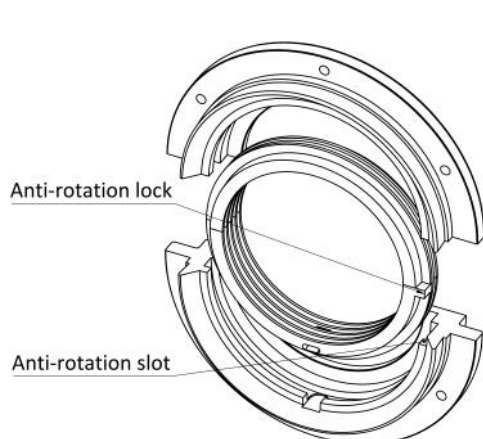


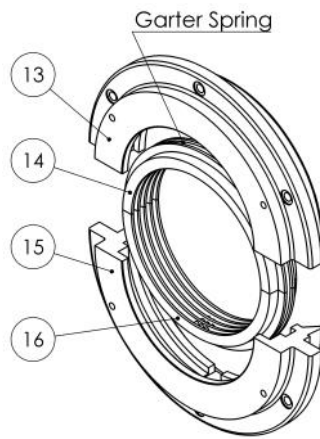
Fig. 6: Split Machine Seal (Under request)

### 5.5– Sealing

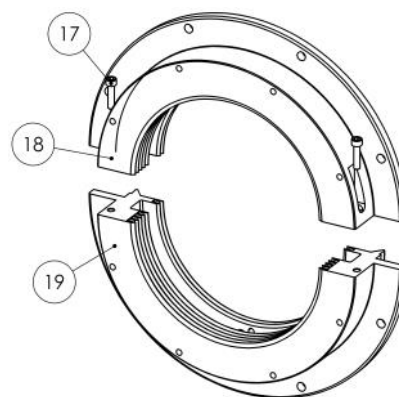
The seals are selected for the specified operation condition environments and for the requested protection level. The standard arrangement is the floating labyrinth seal (IP 44) made of high heat resistant, fiber-reinforced synthetic material (Fig. 8). Bearings for high oil throughput are equipped with adjustable rigid seals (IP 44) made of aluminum alloy (Fig. 9). Both types of seals can be equipped with bolt-on baffles (IP 55) (Fig. 10) or dust flingers (IP 54) (Fig. 11) if the bearing is operating in a dusty or a wet environment or if rotating parts (clutches, couplings, fans etc.) are fitted close to the bearing. Special seals offering higher protection, or pressurized seals etc. can be supplied for special applications upon request. An end cover is used if the non-drive end shaft remains inside the bearing housing.



**Fig. 7: Floating labyrinth seal (IP 44)**  
(Bearing side view)

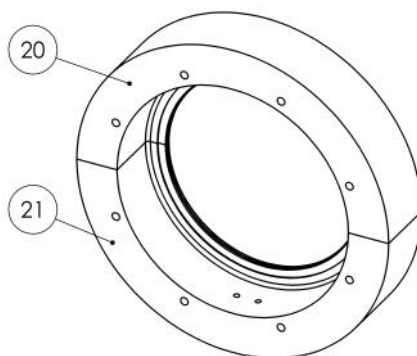


**Fig. 8: Floating labyrinth seal (IP 44)**  
(Outside view)

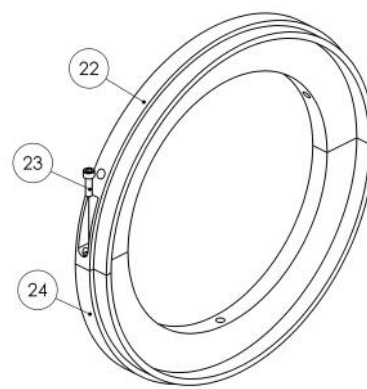


**Fig. 9: Rigid labyrinth seal (IP 44)**

- 13 Seal carrier - top part
- 14 Floating labyrinth seal - top part
- 15 Seal carrier - bottom part
- 16 Floating labyrinth seal - bottom part
- 17 Screw
- 18 Rigid labyrinth seal - top part
- 19 Rigid labyrinth seal - bottom part
- 20 Baffle - top part
- 21 Baffle - bottom part
- 22 Dust flinger - top part
- 23 Screw
- 24 Dust flinger - bottom part



**Fig. 10: Baffle (IP 55)**



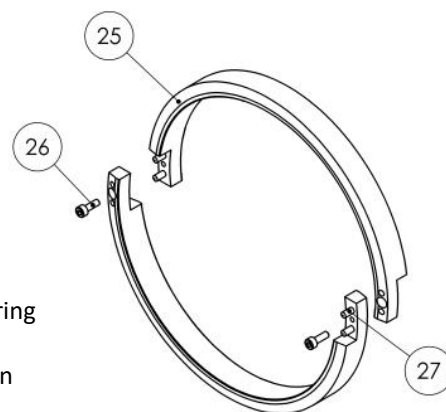
**Fig. 11: Dust Flinger (IP 54)**

**Note:** For IP 56 Baffle seal see section 13.1 for more details.

### 5.6– Loose oil ring

A fully self-contained lubrication is achieved from a loose oil ring (Fig. 12). Alternatively, where bearings are lubricated by an external oil circulation system for cooling the oil, this loose oil ring assures oil reaches the proper bearing surfaces and also provides emergency shutdown without damage in case an oil system failure occurs (oil system should have shutdown protection if oil flow is interrupted).

- 25 Loose oil ring
- 26 Screw
- 27 Parallel pin



**Fig. 12: Loose oil ring**

### 5.7– Insulation

Insulated bearings are supplied with a non-conductive coating on the spherical seating face of the bearing housing. This coating is both wear and temperature resistant. The shaft seals and anti-twist pin are made of non-conductive materials and, as a result, reliably prevent spark erosion of the shell and shaft. The temperature monitoring instruments to be installed by the user should be insulated by suitable measures (e.g. insulated protective tubing, plastic screw fastenings, etc.).

To prevent a closed circuit from occurring through the bearing, machine housing, foundation and a second bearing, through which a damaging bearing current then flows, at least one bearing must be insulated (cf. DIN 31692-4). Depending on requirements, single- or two-stage bearing insulation will be applied.

The shaft should always be grounded. Depending on the type of bearing insulation, care must be taken to ensure that components such as seals, thermometers, oil pipes and screw couplings or anti-twist pins do not cause short-circuits across the insulation.

### **5.8– Additional information on plain bearings with hydrostatic system**

In the case of operations which are frequently started up under a severe load, run in tower mode (low speed) or have prolonged rundown times, an additional hydrostatic booster (oil lift system) is recommended. In this way, wear under these operating conditions is avoided.

The rundown process of a plain bearing is often critical (prolonged rundown times). In particular, this applies to bearings with oil-ring lubrication because, in this case, hot oil of a low viscosity (by contrast with start-up) performs the lubricating function. With the hydrostatic lubrication of bearings, the lubricant pressure is not generated in the narrowing lubricating space, but by a pump outside the bearing. The principle of a hydrostatic bearing is exactly the same as that of the pistons in hydraulic platforms or presses.

The arrangement in plain bearings essentially consists of one or more oil pockets integrated into the radial or axial bearing, a high pressure pump and, a non-return valve.

The oil pressure pump is usually shut down when operating speed is reached and only restarted (if required) when the bearing runs down.

When the pump is switched on, the hydrostatic boost is generated by a pressure surge of up to approx. 200 bar. This causes the shaft to lift off from the shell, so that metal-to-metal contact ceases and contact-free (and, in turn, virtually wear-free) start-ups and rundowns are assured.

### **5.9– Additional information on plain bearings with external oil supply system**

As a rule, the oil supply system consists of an oil tank at the pump, a pressure gauge, a pressure relief valve, filters, an oil level gauge and various monitoring instruments. Depending on operating conditions or customers' specifications, a system of this type can also be fitted with other components (e.g. oil cooler, oil heater). If an external oil supply system is used, the diameters of the oil pipes should be selected such that the flow rate does not exceed 1.5 m/s at the inlet or approximately 0.15 m/s at the outlet. If, for reasons of design or structural constraints, the return pipes cannot be arranged with a down slope of 15 degrees, pipes of correspondingly larger diameters must be laid. Inadequate slopes and/or diameters give rise to back-pressure which can result in the bearing overflowing or leaking.

Heat treated (welded or bent under heat) and/or internally heavily contaminated or rusty pipes must be pickled and flushed through before installation. After they have been installed, the entire oil circuit must be flushed through to prevent any contaminants from penetrating into the bearing or fittings.

Before flushing takes place, therefore, all the measuring and switching fittings (pressure monitor, flow meter) and their connections must be removed prior to flushing. Under no circumstances may the bearings be left in the flushing circuit. After flushing, all the filters must be cleaned. All the connections to the bearing must be free of vibrations and stress.



*During Technical data on the above can be found in the installation drawing and bearing specification relating to the item of equipment. To ensure that the oil supply is adequate, the flow rate must be checked after the first use of the external oil supply system. The shutoff valves in the coolant feed and discharge pipes of the cooling system must be fully opened.*

### **5.10– Additional information on plain bearings with water cooler in the oil sump**

When connecting the oil sump water cooler, take care to ensure that no leaks are present in the housing or the connecting pipes. The seals in the screw couplings must not be damaged. A shutoff valve should be connected up on the inlet side. As far as possible, drainage should take place without pressure. The coolant circuit can flow in either direction.

- Do not change the original specified water flow speed:
  - A high water speed may wear out the pipe.
  - A low water speed may cause oxidation.
  - The worst case is when the water pump is turned off for a long period.
- Water should be filtered and its pH should be neutral (between 7 and 9 ).
- In areas where the temperature reaches below 0°C areas, glycol must be added to the water, so that it does not freeze inside the pipes.

## 6 - BEFORE STARTING

### **6.1– Tools and equipment**

As a first step, the assembler should prepare the location in which the equipment will be assembled or disassembled and arrange the required tools.

The following tools and equipment are required:

- Wrench tool set
- Allen key set
- Shave hook, scrape
- Lifting eye bolts
- Sandpaper or emery cloth
- Lubricant oil as indicated in the calculation
- Lifting chains or lifting belts
- Permanent sealing product (e.g.: Curil-T)
- Cleaning cloths lint-free (not wool)
- Screw locking compound (e.g.: Loctite 243)
- Cleaning product (non-aggressive neutral products PH value between 7 and 9 with lower reaction time)
- Teflon sealing tape and liquid sealing compound
- Caliper
- Rubber mallet
- Torque meters (according to bearing size)
- Feeler gauge



## 6.2– Disassembly



*Before starting the disassembly all dust must be removed from the bearing surface, thus protecting the inside parts.*

### 6.2.1– Disassembly of the seals

Depending on the intended application, MIBA plain bearings can be supplied with various types of seal or sealing system with types of protection complying with DIN 40050 and IEC 529.

Follow the instructions below according to the sealing type to disassembly the seals of the bearing:

#### Floating labyrinth seal (Fig. 13)

- Unscrew the fastening screws (29) that attach the seal carrier (13, 15) to the housing (1).
- Pull in axial direction and then take apart the halves (13, 15) of the seal carrier.
- Remove the labyrinth seals (14) and the protective cardboard.
- Unscrew the fastening screws (28) that attach the baffle\* (20) to the seal carrier (13,15).
- Proceed as the steps above to disassemble the floating labyrinth seal.

#### Rigid labyrinth seal (Fig. 14)

- Unscrew the fastening screws (29) that attach the rigid labyrinth seal to the housing (1).
- Pull in axial direction and then unscrew both halves carefully.
- Unscrew the fastening screws (28) that attach the baffle\* (21) to the rigid labyrinth seal (18,19).
- Proceed as the steps above to disassemble the rigid labyrinth seal.

\* Baffle is optional

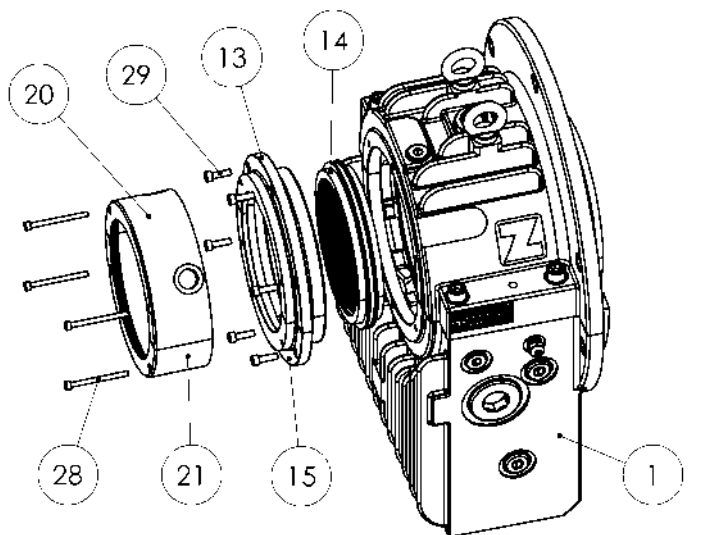


Fig. 13: Floating labyrinth seal with baffle

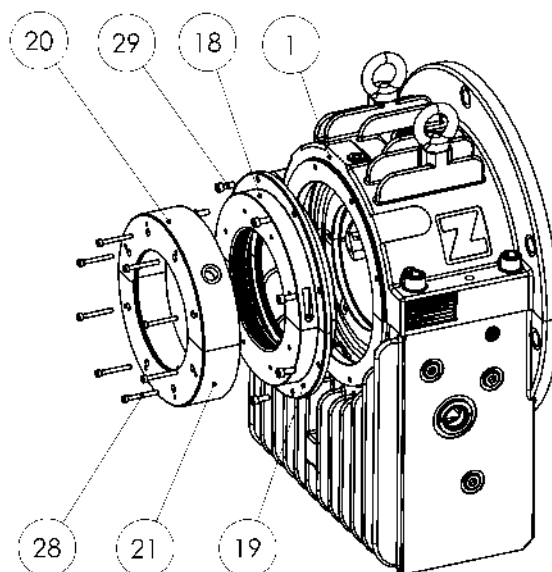


Fig. 14: Rigid labyrinth seal with baffle

### 6.2.2– Disassembly of the housing and bearing shell



*If the bearing has an earthing device, it must be removed before disassembling the housing.*

- Disassembly of housing with hydrostatic system see chapter 8.5.
- Unscrew the screws (5) that attach the upper housing half (2) to the lower housing (1) and lift the upper housing vertical with parallel split lines. (not to damage the floating seal)
- Carefully lift up the both halves of the shell (6, 7) from the bottom half of the housing (1).
- Take care not to damage the thrust and radial surfaces of the shell.
- Unscrew the screws (8) that attach the upper shell half to the lower shell half and separate them.
- If the bearing is delivered with a finned water cooler in the oil sump, the cooler is already assembled. It's not necessary to remove the cooler.
- Remove the labyrinth seal (30) from machine side.

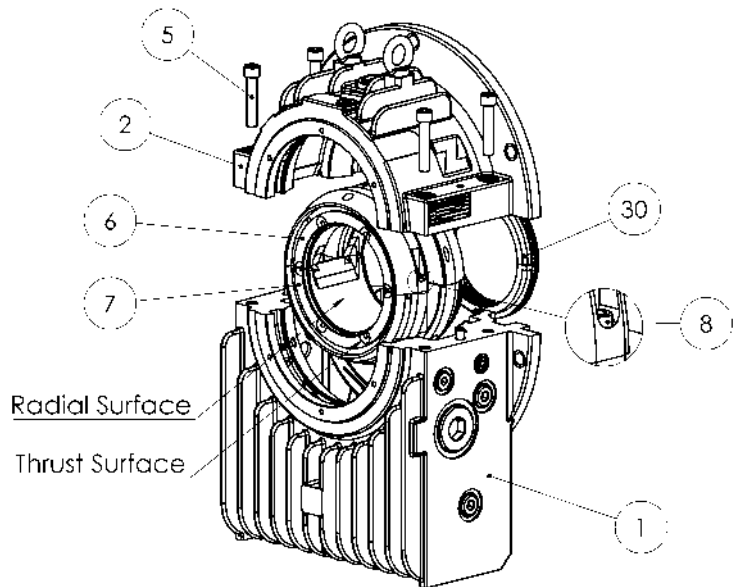


Fig. 15

### 6.3– Cleaning

Clean all parts below, to remove the preservation residues:

- Both parts of the housing (1, 2). Inside the housing, division faces and other machined faces.
- Both parts of the bearing shell (6, 7).
- Both parts of the seal carrier (13, 15) and baffle (20, 21) if it was provide.
- In case of a bearing with a Rigid seal, clean both parts of the rigid labyrinth seal (18, 19) and baffle (20, 21) if it was provided.
- Loose oil ring (25).



- ⇒ *Never use cotton waste , wool, fiber cloth, or other similar cleaning materials to avoid excessive temperature due to cleaning materials residues.*
- ⇒ *It is recommended to use only NON AGGRESSIVE, neutral PH detergents.*

## 7 - ASSEMBLY INSTRUCTIONS



- ⇒ Before starting the assembly all dust and other particles must be removed from inside the bearing.
- ⇒ Store all bearing parts in clean, covered, dry and dust free areas during the works.
- ⇒ Cover and protect the bearing and individual parts during breaks.
- ⇒ Secure all screws of the housing at the split line and flange with a liquid screw locking compound (e.g. LOCTITE 243)

### 7.1– Assembly of the Machine seal

The machine seal is not supplied as standard and must therefore be ordered separately.

The machine seal must be assembled into the machine shield before starting the bearing assembly.

Pay attention if the machine seal is a Split or a Non-Split machine seal. As standard all machine seal are supplied as a non-split machine seal but it can be delivered as a split machine seal upon request.

- Secure the machine seal (12) inside the machine housing (Fig. 16).
- In case of split machine seal, tighten the split line screws (11) by hand.
- Tighten the fastening screw (31) that attached the machine seal to the machine housing.

Torque Table for screw (31)			
Bearing size	Bolt Size	Torque (Nm)	Hex socket
7 - 14	M6	9	5
18 - 28	M8	20	6

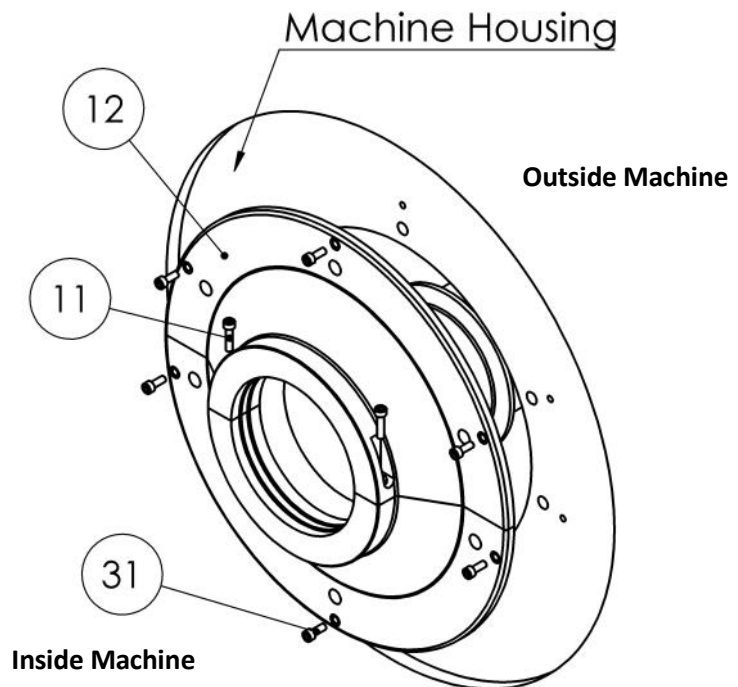


Fig. 16: Assembly of the Machine seal

### 7.2– Assembly of the lower part of the housing

- Align the cleaned lower part of the housing (1) (Fig. 17) with the machine frame and fasten the bolts (33) to the appropriate torque value per the table.
- Tighten the screws into the tapped hole (32) on the bottom half of the housing from the inner part of the machine shield to the appropriate torque values per the table.



Secure the shaft against unintended displacement.

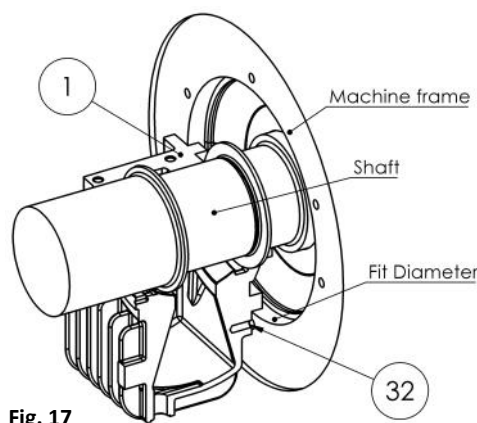


Fig. 17

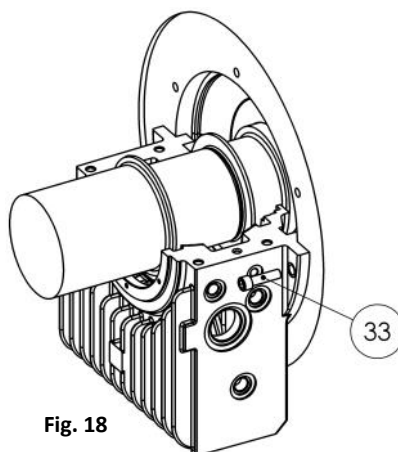


Fig. 18

Torque Table for screws (32, 33)

Bearing size	Bolt Size	Torque (Nm)	Hex socket
7	M10	40	8
9	M12	70	10
11	M12	70	10
14	M16	170	14
18	M20	340	17
22	M24	580	19
28	M30	1150	22

### 7.3– Assembly of the lower part of the shell

- Lift the shaft high enough to give clearance for the assembly works.
- Mind the orientation of the bearing shell according to the assembly drawing.
- If the bearing is provided with a thrust pads (ZF - - A), proceed as described under chapter 7.9 before assembling the shell.
- If the bearing has a provision for a hydrostatic system, see chapter 8.5 before assembling the lower shell.
- If the bearing has a thermo-sensor on lower thrust pads, see chapter 13.2.2 before assembling the lower shell
- If the bearing shell has a tilting radial pads see chapter 13.4 for assembly instructions.
- Apply an oil to the two spherical seats in the lower part of the bearing housing and to the work surface of the shaft (Fig. 19) (use the same oil as for the operation of the bearing).
- Place the lower part of the bearing shell (7) on the shaft seat (Fig. 20) and turn it to the correct position (Fig. 21) in the lower part of the housing (1), taking care to ensure that the thrust bearing surfaces are not damaged when the shell is turned.
- Align shell and housing split surfaces (Fig. 22). Now it is possible to support the shaft in the liner bore.

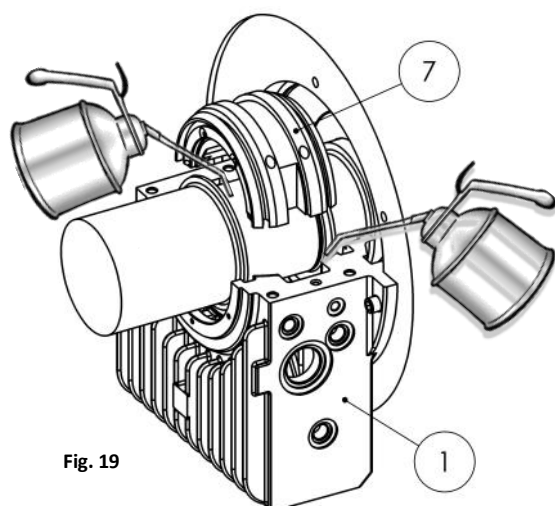


Fig. 19

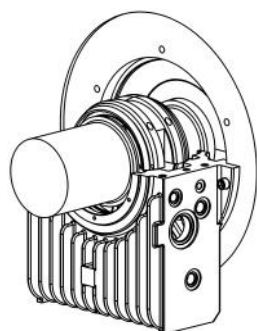


Fig. 20

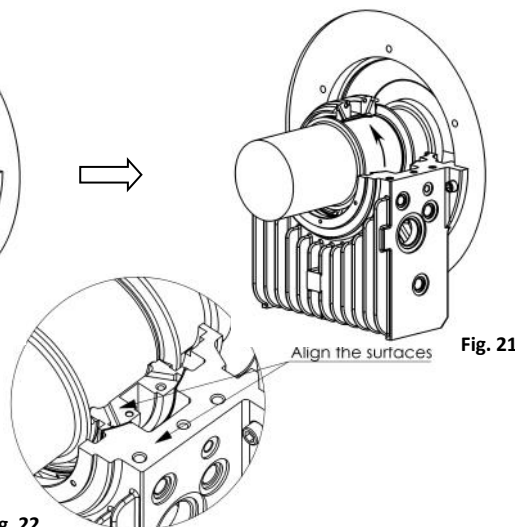


Fig. 21

Fig. 22

Align the surfaces

#### 7.4– Assembly of the floating labyrinth seal - Machine side

Check the movement of the floating labyrinth seal on the shaft (see the note below). If the seal turns easily go ahead with the assembly.

- Apply an elastic sealant compound to the guide surfaces of the seal groove in the bottom half of the housing (Fig. 23).
- Prepare the seal for installation by coating the surface of the split line and the exterior of the spring guide with a thin film of non-hardening sealing compound (Fig. 24).

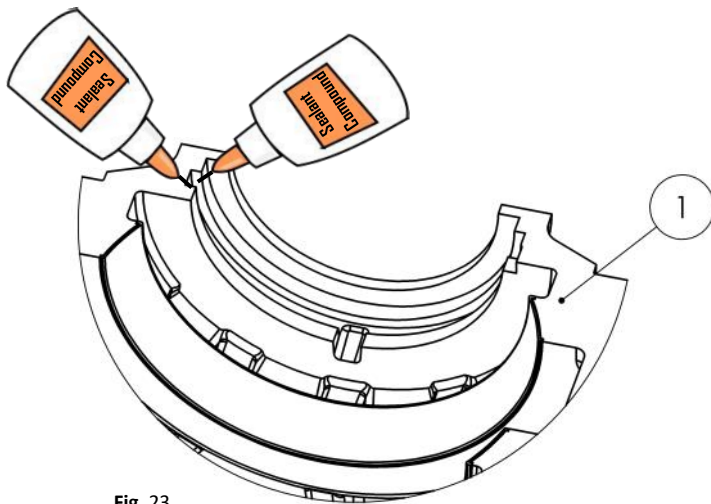


Fig. 23

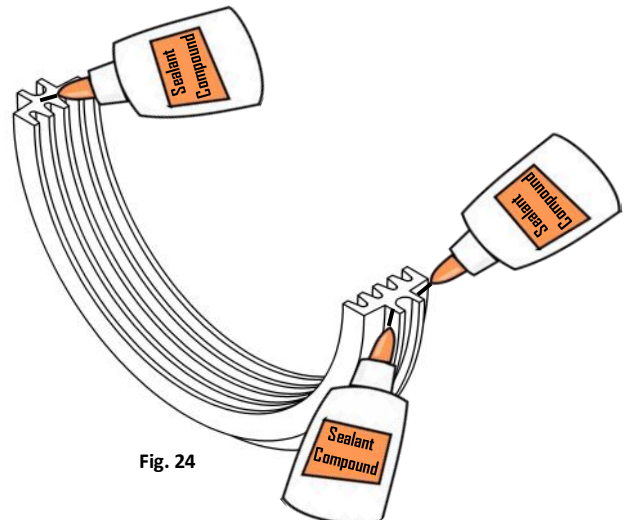


Fig. 24

- Place the lower part of the seal (16) on the shaft (Fig. 25) and turn the seal back and slightly to the correct position to dispense the sealant evenly (Fig. 26) the anti-rotating lug must sit in the groove in the split line).
- Push the garter spring into the seal groove between the lower housing and the seal until both ends are reachable
- Place the upper part of the seal (14) on the lower part (Fig. 27) observing the alignment marking.
- Insert the wire spring through the sealing groove and lock the spring key.
- Check the alignment of the seal and split line of the housing
- Remove the residue of the elastic sealant compound

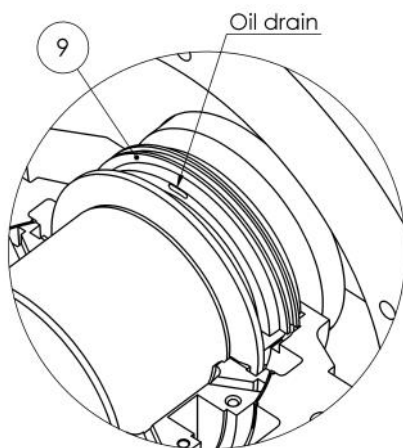
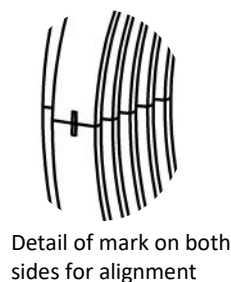


Fig. 25



Detail of mark on both sides for alignment

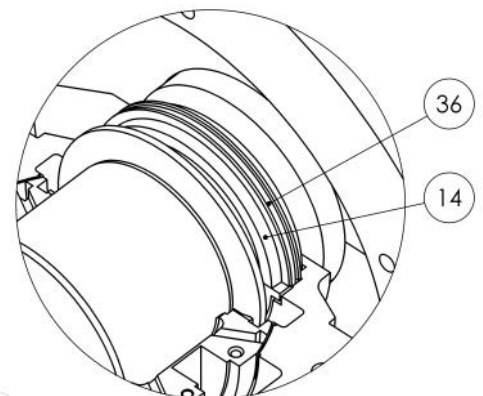


Fig. 27

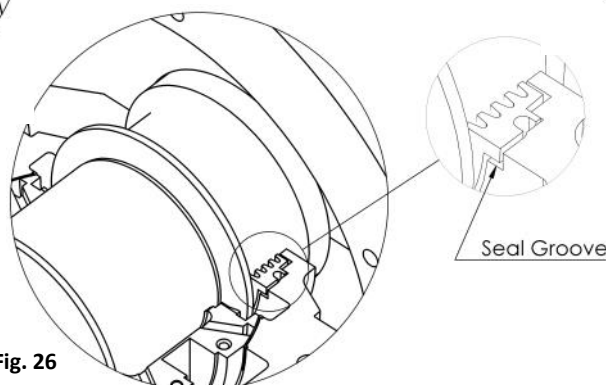


Fig. 26

#### Note:

Floating labyrinth seals must rotate gently around the shaft. Stucked seals may induce overheating when shaft wear. If the floating labyrinth seal stuck.

- dismount the seal
- if there has been wear of the seal, with draw the worm parts of the seal using a plain scraper or sand paper



7.5– Assembly of the loose oil ring

Now follows the installation of the oil ring, which must first be disassembled.

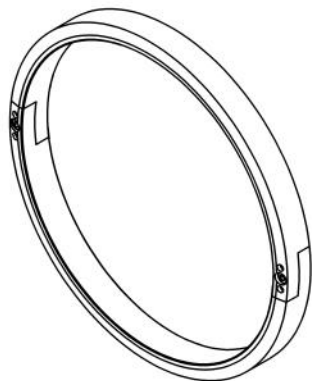


Fig. 28

Separate both halves of the loose oil ring (25)  
by untightening and removing the screws (26)

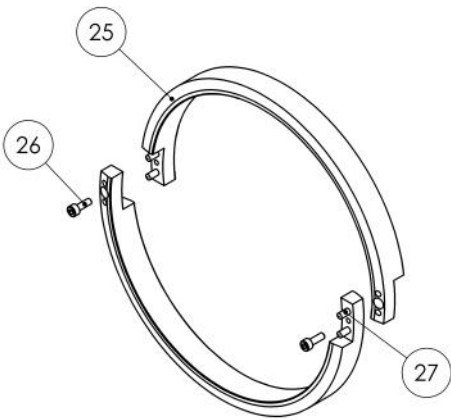
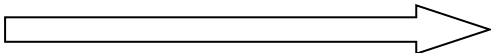


Fig. 29

- Position both halves of the oil ring on the shaft and around the lower half of the shell (in the recess provided) and press both halves together on the positioning pins (27).
- Tighten the screws to the appropriate torque per the table below.

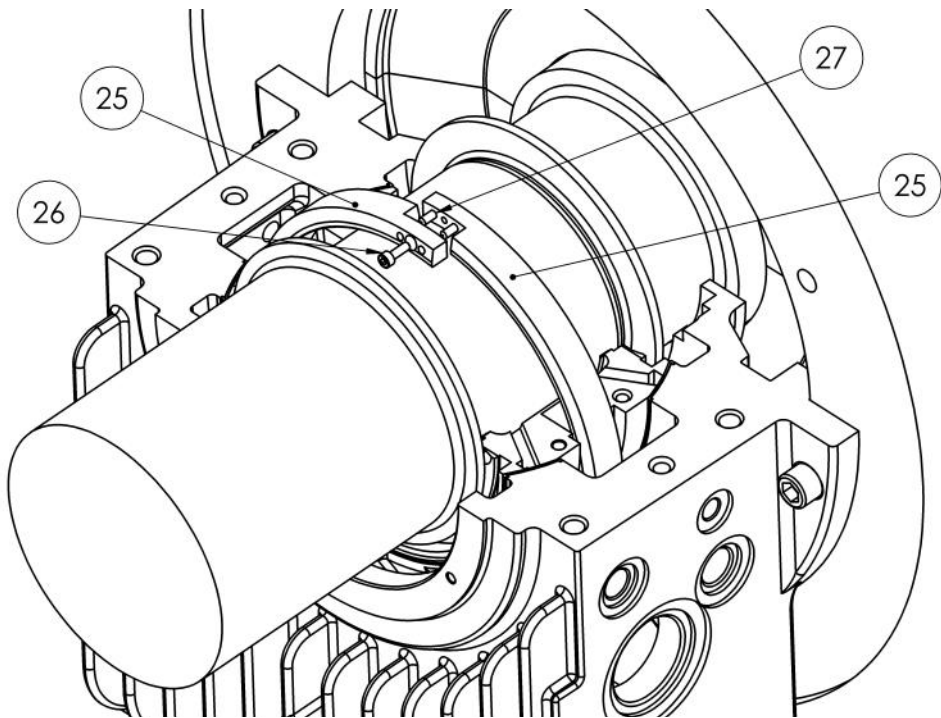


Fig. 30



If your bearing has an earthing cable, please, pay attention to the instructions **7.6.1– Insulated bearings**

Torque Table for screw (26)			
Bearing size	Bolt Size	Torque (Nm)	Hex socket
7	M3	0,6	2,5
9 - 11 - 14	M4	1,4	3
18 - 22 - 28	M5	2,7	4

## 7.6– Assembly of upper bearing shell

- Apply an oil film to both the shaft seat and the upper part of the bearing shell (6) (use the same oil as for the operation of the bearing).
- Place the upper part of the shell (6) on the shaft.



⇒ it is impossible to turn both halves of the shell together as they would become misaligned.  
 ⇒ Be careful when lowering the shell. The contact surfaces between the bearing shell and the shaft have a controlled roughness. Care should be taken to not damage them.

- Screw the bolts (8) to join the bearing shell halves to the following torques.
- Check the gap of the split line of the shell, use a feeler gauge. If it is greater than 0,05mm, disassemble both parts of the shell. Rework the surfaces of the split line of the upper and lower shell with a sharpening stone.
- Check if the oil ring is moving freely. Neither the hydrostatic hose nor the earthing device (if in the scope) should touch the oil ring.
- If your bearing is for a marine application, there is a guide bushing on upper shell and two other guides on lower housing to ensure the loose oil ring purpose.
- If the bearing has a thermo-sensor on lower thrust pads, see chapter 13.2.2 before proceeding.

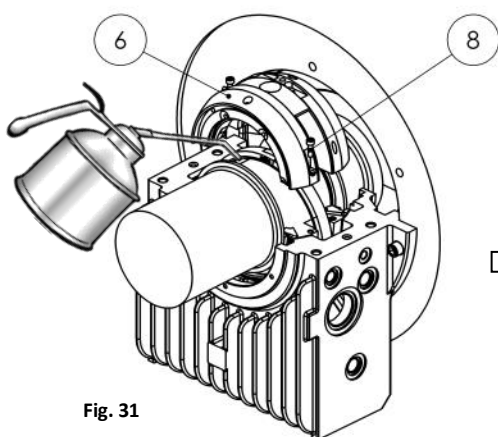


Fig. 31

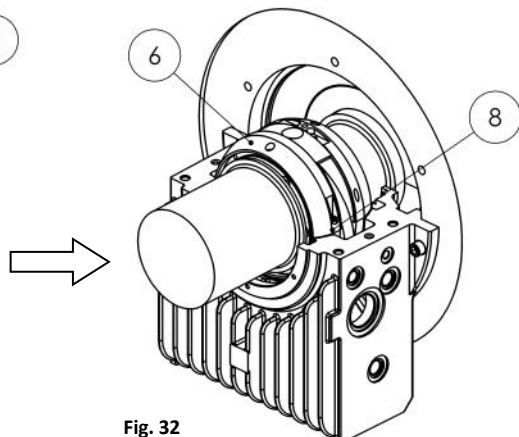


Fig. 32

Torque Table for screw (8)			
Bearing size	Bolt Size	Torque (Nm)	Hex socket
7	M5	5	4
9	M6	9	5
11	M6	9	5
14	M8	20	6
18	M12	70	10
22	M12	70	10
28	M16	170	14

- Shells with taper land (type D) are suitable only for one sense of rotation. They are marked with an arrow on the upper shell. This arrow indicates the allowed direction of shaft rotation.



Before assembling the upper housing, check if the direction of rotation of the shaft match to the direction indicated by the arrow on the upper taper land shell.

### 7.6.1– Insulated bearings

In the case of bearings prepared for insulation, connect the earthing cable to the shell, if it exists in the design scope.

- Screw the cable connector (34) into the slot available on the top of the shell (Fig. 33).
- Lead the cable through the cable gland (35) in the lower housing and then out of the bearing (Fig. 34).
- Tighten the cable gland.
- Make sure that the cable is fully stretched and out of the loose oil ring (25) reach (Fig. 34.1).

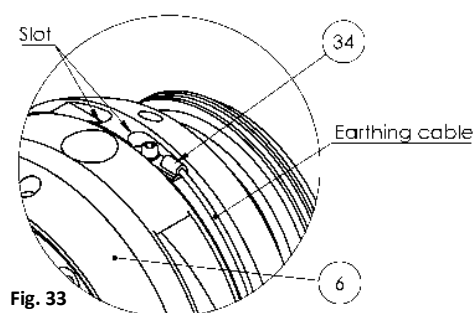


Fig. 33

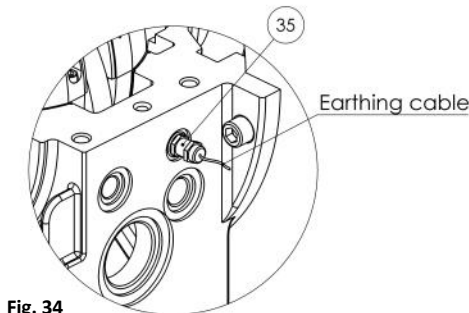


Fig. 34

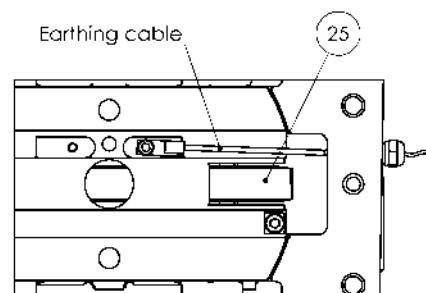


Fig. 34.1

### 7.7– Assembly of upper part of the housing

- Check the alignment of the split lines of the shell and the division face of the housing.
- Clean the split line surfaces of the both halves of the housing (Fig. 35). Apply an uniform layer on the split line of the lower bearing housing (1) of a non-hardening sealing compound.
- Very slowly lower the upper part of the housing (2), rotate it in the machine frame and position it on the flange.
- If the bearing have a thermo-sensor on lower thrust pads, see chapter 13.2.2 before continue.
- The positioning pin (38) in the upper half of the housing fits in the corresponding hole in the lower housing (Fig. 36).
- Taking care to ensure that, during lowering, the preinstalled flange-side seal is not touched.
- The positioning pin (37) in the upper half of the shell fits in the corresponding slot in the upper housing (Fig. 37).
- To this end, the upper part must be correctly aligned if both split lines of the housing touching each other.
- Tighten the cover screws (5) by hand.
- Tighten the flange screws (39) to the following torques specified.
- The cover screws (5) should now be tightened crosswise to the torques specified.



⇒ Avoid jamming at all costs.

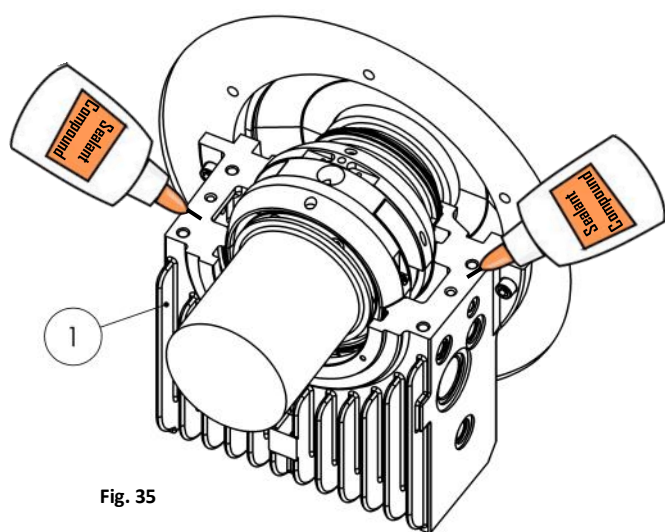


Fig. 35

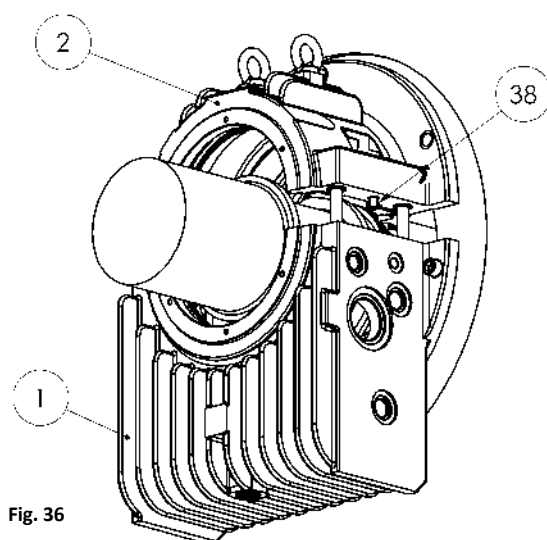


Fig. 36

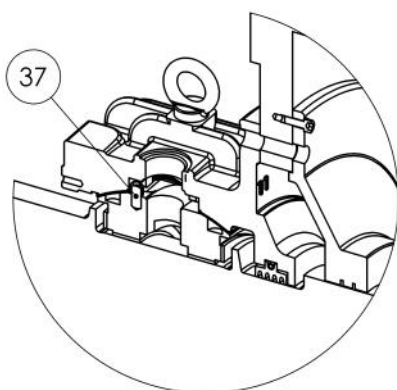


Fig. 37

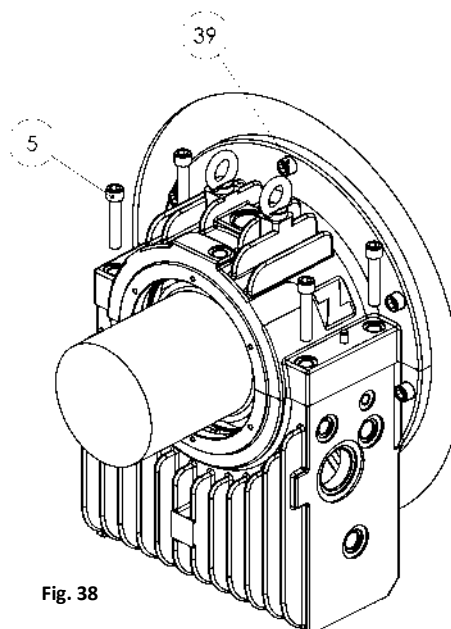


Fig. 38

Torque Table for screws (5 / 39)			
Bearing size	Bolt Size	Torque (Nm)	Hex socket
7	M10	40	8
9 (5)	M10	40	8
9 (39)	M12	70	10
11	M12	70	10
14	M16	170	14
18	M20	340	17
22	M24	580	19
28	M30	1150	22



## 7.8– Assembly of the outboard seals

Depending on the intended application, MIBA plain bearings can be supplied with various types of seal or sealing system with types of protection complying with DIN 40050 and IEC 529. Proceed according to the seal type used.

### 7.8.1– Floating labyrinth seal

Z-bearings are equipped with floating labyrinth seals which float on the shaft and can be used at peripheral speeds up to 100 m/s. They are made of a high strength, unbreakable, high temperature resistant plastic and, with them, the class of protection IP 44 is achieved. The seals are seated within a seal carrier or installed directly in the housing in such a way that they are not affected by radial shaft displacements. An anti-rotation lug on the split line prevents the seal from being incorrectly assembled.

- Build the seals up prior to bearing assembly, so that the hook and eye of the spring key is separated.
- Apply a uniform non-hardening sealing compound to:
  - The face of bearing housing on a seal seat region (Fig. 41)
  - the split line and the exterior of the spring guide of the Seal Carrier (Fig. 39)
  - the surface of the split line and the exterior of the spring guide of the labyrinth seal. (Fig. 40)

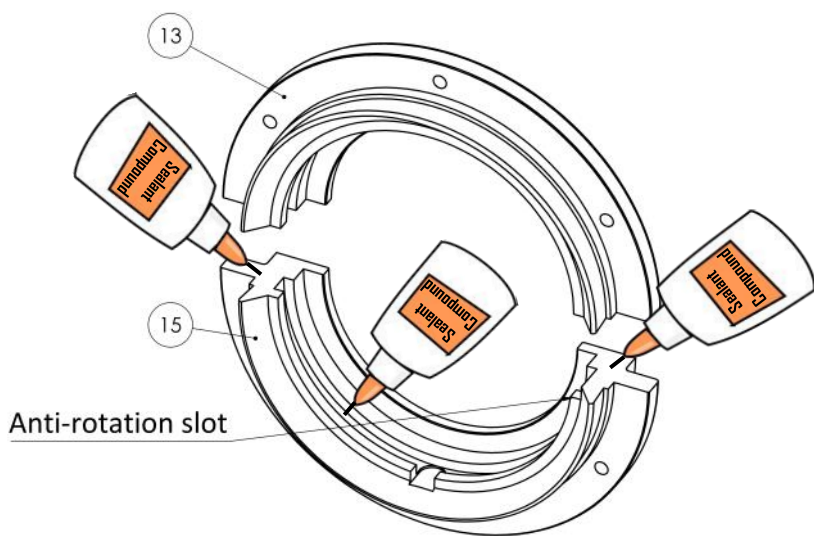


Fig. 39

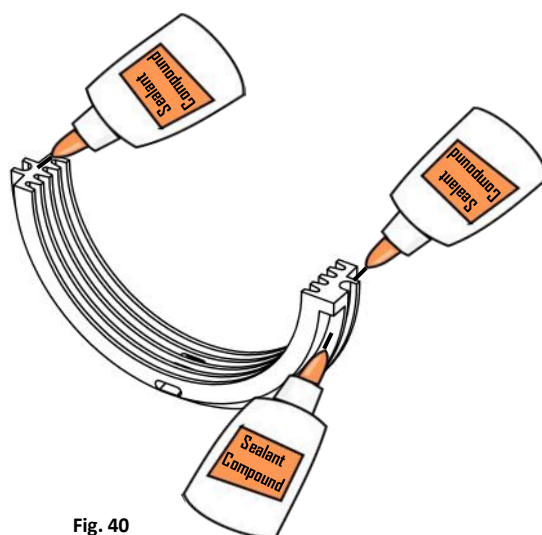


Fig. 40

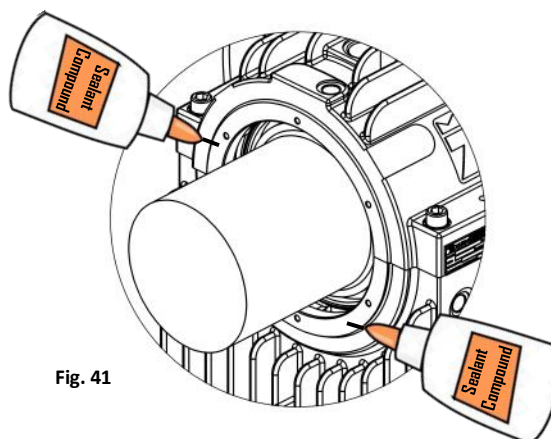


Fig. 41

- Place the lower part of the seal (16) on the shaft and turn it to the correct position (the oil drain holes in the seal must face the bearing and the anti-rotating lug must sit in the groove in the split line).
- Place the upper part of the seal (14) on the lower part. Make sure the mark at the upper part is aligned to the mark at the lower part.
- Insert the spring key through the sealing groove and lock into place
- Check the movability of the seal on the shaft
- Place the top half of the seal carrier (13) on the top half of the seal. Press the bottom half with groove of the seal carrier (15) against it (Fig. 42).
- Assembly the complete seal carrier into the house and attach with the bolts (40) to the appropriate torques (Fig. 43).

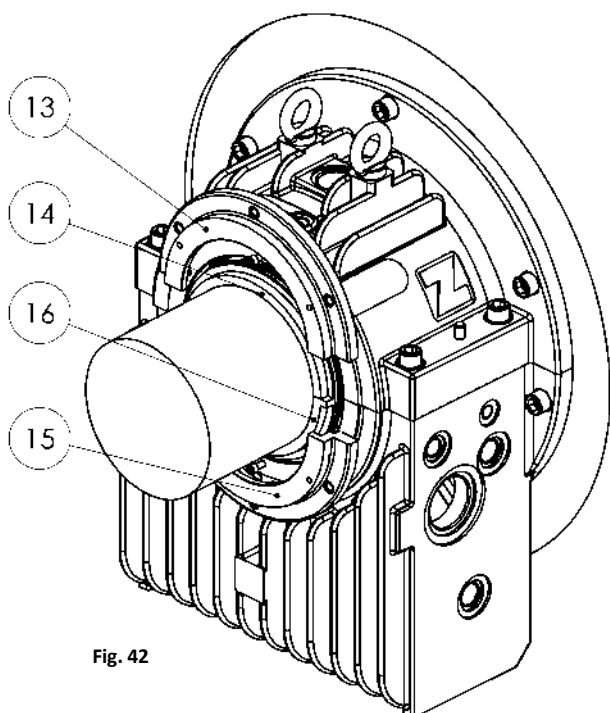
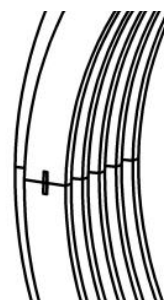


Fig. 42



Detail of mark on both sides for alignment

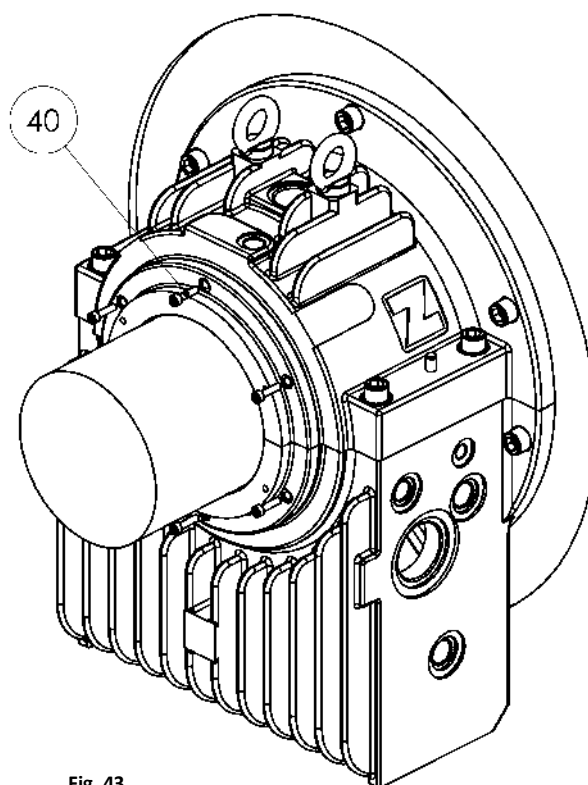


Fig. 43

Torque Table for screws (40)			
Bearing size	Bolt Size	Torque (Nm)	Hex socket
7 - 14	M6	9	5
18 - 28	M8	20	6

### Note!

Floating labyrinth seals must rotate gently around the shaft. Stuck seals may induce overheating when shaft wear. If the floating labyrinth seal sticks:

- dismount the seal
- if there has been wear of the seal, remove or clean the worn parts of the seal using a plain scraper or sand paper

### 7.8.2– Rigid seal

- The rigid seal is mounted directly to the bearing housing with a fine intermediate coat (sealing compound) on following parts:
  - The flange surfaces on both parts.
  - The split line of the lower part.

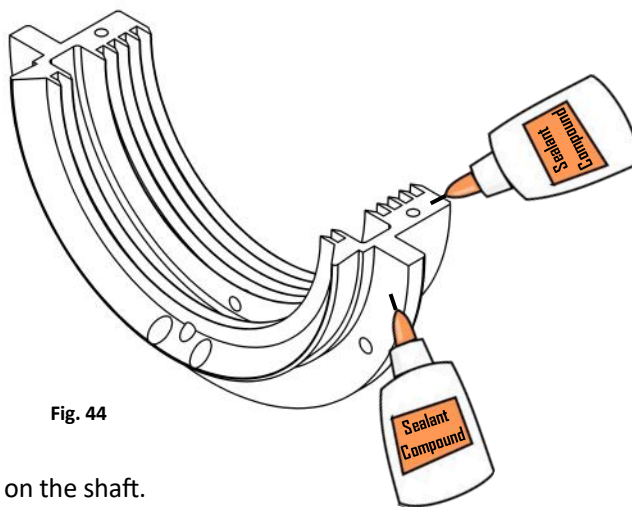


Fig. 44

- Place the upper part of the rigid labyrinth seal (18) on the shaft.
- Lightly press the lower part of the seal (19) onto the shaft from below.
- Carefully push the rigid labyrinth seal completely into the housing.
- Hand-tighten the screws (17) at the split line.
- Align the split surface of the rigid seal with that of the housing in parallel alignment.
- Press the rigid labyrinth seal against the shaft from below slightly.
- Adjust the lateral clearance "s" between the shaft and the rigid labyrinth seal (see fig. 46)
- Tighten the fastening screws (41) to the following torques.
- Tighten the fastening screws (17) of split line to the specified torques.

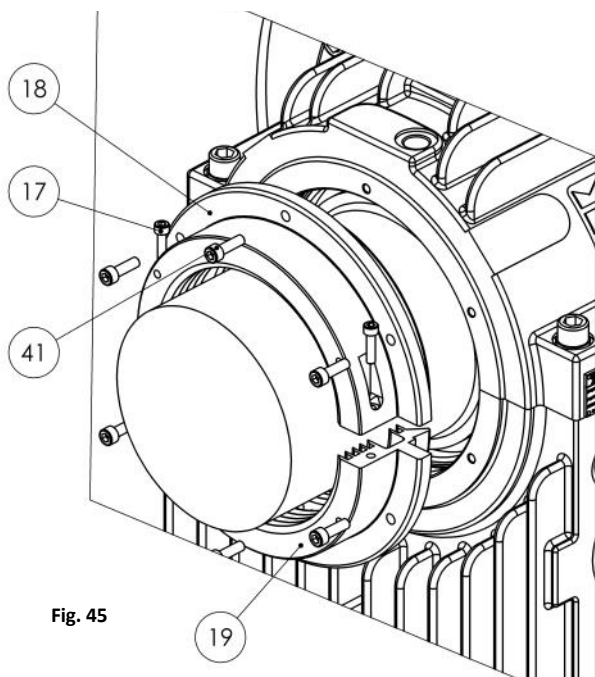


Fig. 45

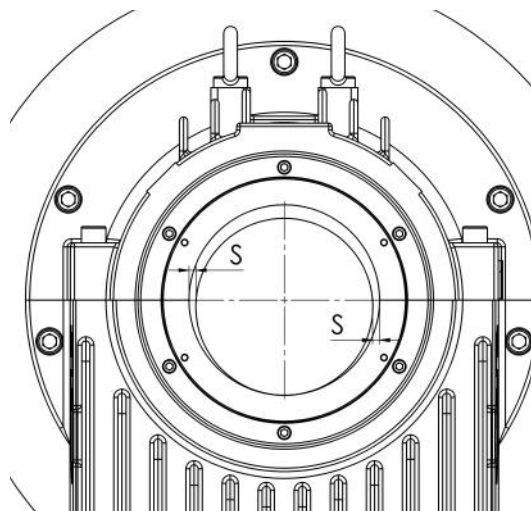


Fig. 46: Alignment of the rigid seal

**Torque Table for screws (41)**

Bearing size	Bolt Size	Torque (Nm)	Hex socket
7 - 14	M6	9	5
18 - 28	M8	20	6

**Torque Table for screws (17)**

Bearing size	Bolt Size	Torque (Nm)	Hex socket
7 - 11	M5	2,7	4
14 - 22	M6	3,7	5
28	M8	9	6

### 7.8.3– Bolt on baffle

The bolt-on baffle can be combined with either a floating labyrinth seal or a rigid seal to achieve IP 55. The inserted sealing strip (42) is temperature resistant and is unaffected by high peripheral speeds. The coefficient of friction is minimal, as is the, stick-slip' coefficient. Electrical insulation properties are outstanding and unaffected by temperature and environmental effects.

The assembly steps to mounting the baffle is the same for both kinds of seals (Rigid or Floating).

- Apply the sealing compound on the surface of the split line and the face making contact with the seal carrier of the floating labyrinth seal or rigid seal (Fig. 47).
- Next, lightly press the lower part (21) (recognizable by the drain hole) onto the shaft from below and tighten the fastening screws.
- Then, position the upper part (20), align with the split line and attach with the screws.
- When the baffle is combined with a seal carrier, follow the torque (A) on the torque table for screw (43).
- When the baffle is combined with an aluminum rigid seal, follow the torque (B) on the torque table for screw (43).

Torque Table for screws (43)				
Bearing size	Bolt Size	Torque (A) (Nm)	Torque (B) (Nm)	Hex socket
7 - 14	M5	5	2,7	4
14 - 28	M6	9	3,7	5

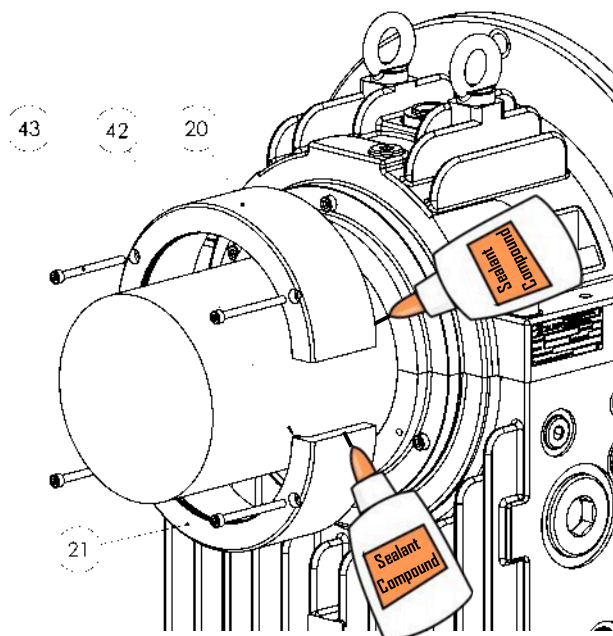


Fig. 47

### 7.8.4– Dust flinger

The Dust flinger also can be combined with either a floating labyrinth seal or a rigid seal.

- Place both parts of the dust flinger around the shaft.
- Slightly screw the bolt at the split line.
- Assemble the dust flinger into the groove of the seal carrier.
- Adjust the clearance "c", see (Fig. 49).

To adjust the clearance see the maximum longitudinal displacement of the shaft in operation. Check the parameters in the technical documentation of the installation. The clearance should be this displacement plus 1mm.

- Screw the bolt at the split line completely.
- Screw the lock bolt (44) placed around the dust flinger.

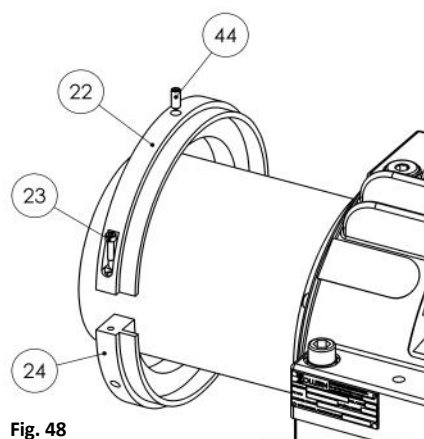


Fig. 48

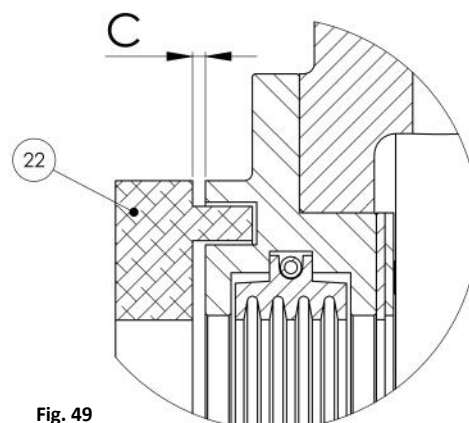


Fig. 49

### 7.9– Assembly of the thrust pads

Assemble both thrust sides of the thrust pad support according to the following instructions:

- Clean all necessary parts
- Place both parts of the Pad Ring (45) (Thrust and counter thrust side) on upper and lower shell (6, 7). The thermo sensor holes on the shell must be aligned with the thermo sensor slot on pad ring (Fig. 50).
- Align the split line of the pad ring with that of the shell.
- Tighten the screws (46) to the torque rates provided in 11.7 table 3.

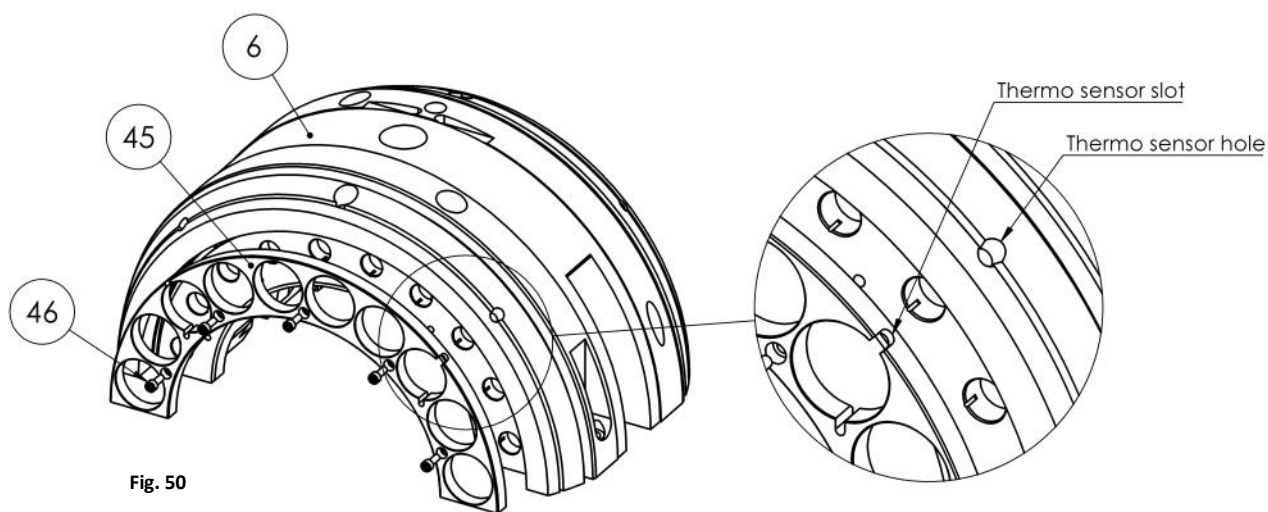


Fig. 50

One or more thrust pads on both sides (Thrust and Counter Thrust) of the upper part has a bore to insert a thermo sensor to measure the thrust part temperature.

- Find the thrust pad (47) with an anti-rotation pin and a hole for thermo sensor. Then locate the corresponding slot in the pad ring (45).
- Insert the thrust pads with the anti-rotation pin into the corresponding thrust pad location hole.
- Insert all other thrust pads into the holes of both halves of the shell (6, 7).
- Check the mobility of all thrust pads. If the thrust pads grips, realign the pad ring (45).

**Note:** The thrust pad set (47) consist of a thrust pad (48), an o’ring (50) and a spring washer (49) (Fig.52).



*An inadequate mobility of the thrust pads will cause injury of the bearing.*

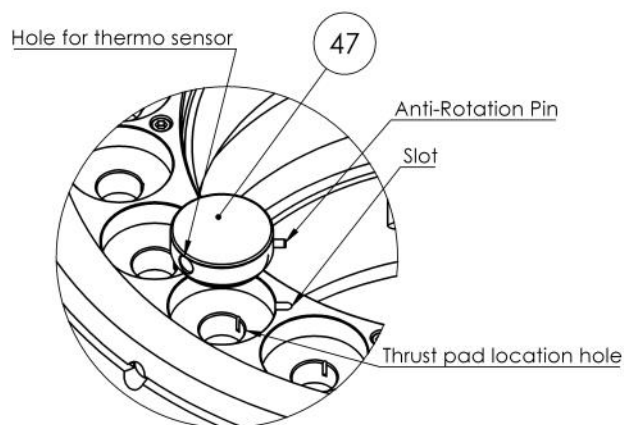


Fig. 51

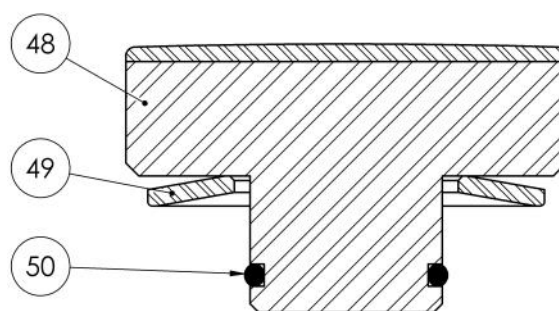


Fig. 52: Thrust pad set



### **7.10– Alignment of the shaft with the thrust face**

With the lower half of the shell assembled and the shaft fully supported. Measure the dimensions A and B according to figure 52.5 below with a thickness gauge. The dimensions should not vary more than 0.05mm per side.

If an alignment is required, lift the shaft and move the shell a little until it is parallel to the shaft.

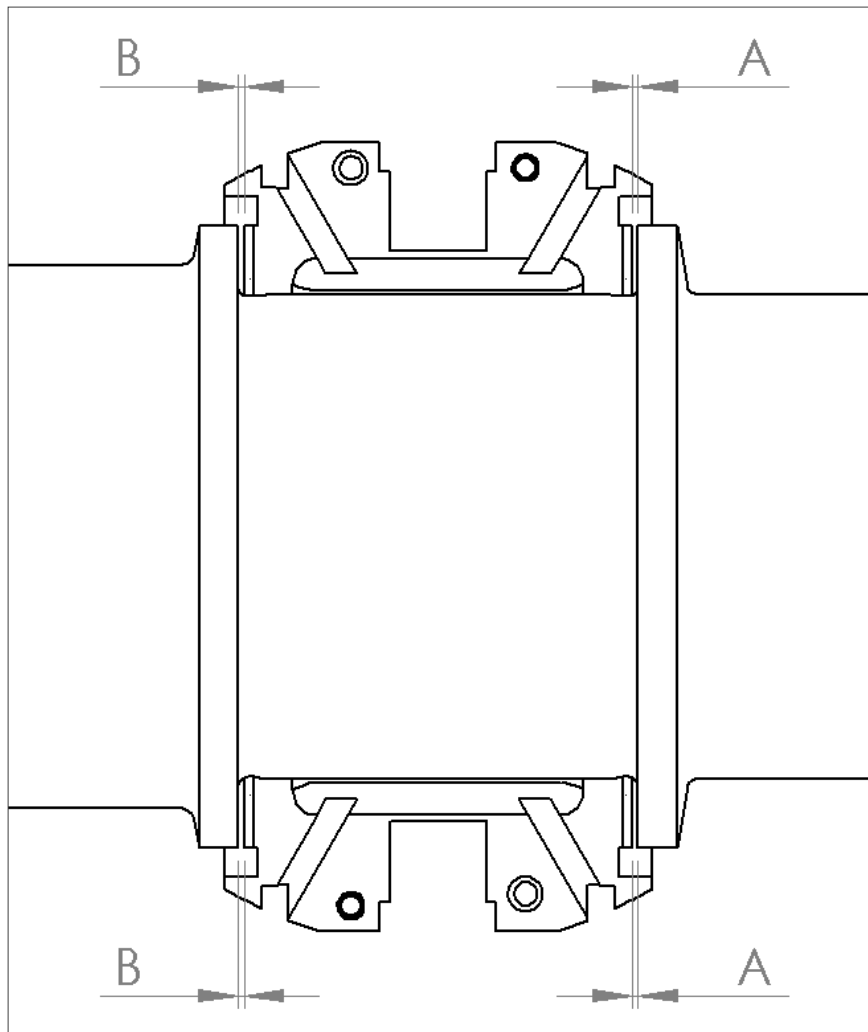


Fig. 52.5

## 8 - ADDITIONAL INFORMATION

### 8.1- Connection description

Standard connections are the same on both sides of the bearing.

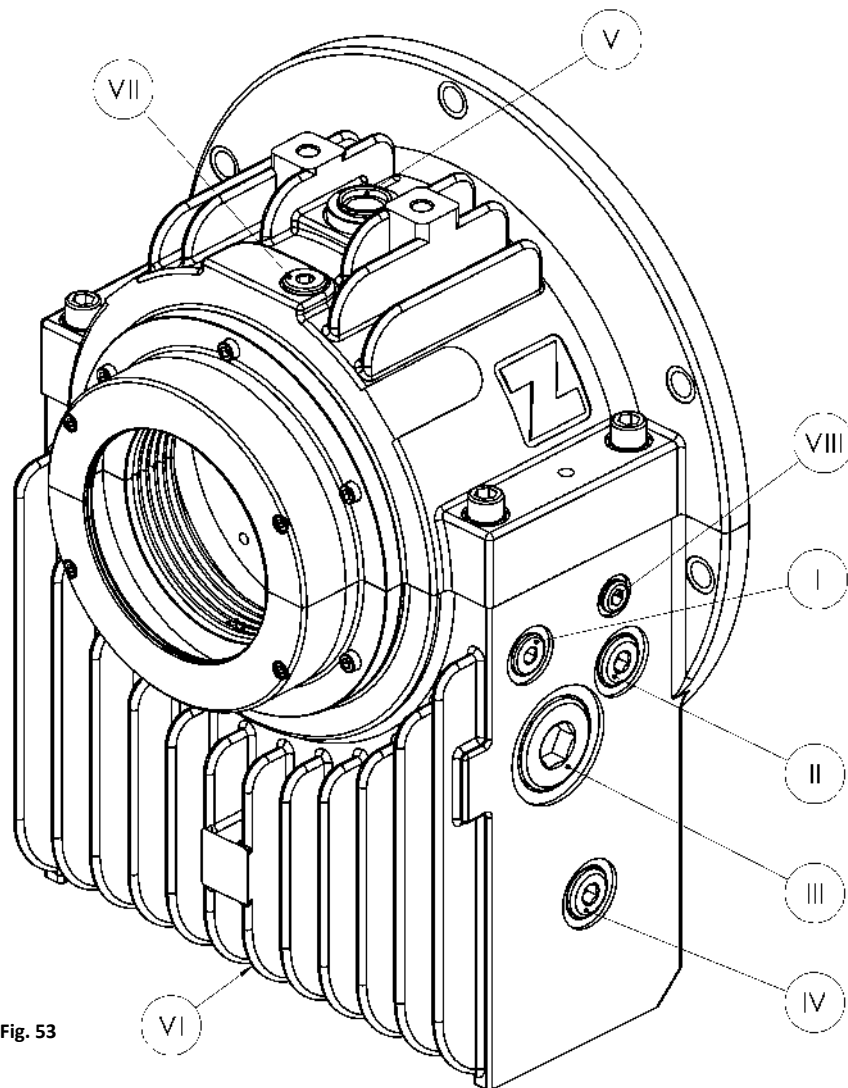


Fig. 53

Connection	Description	Size of the connections						
		7	9	11	14	18	22	28
I	Oil inlet in case of oil circulation or circulating pump	G1/4"	G3/8"	G3/8"	G3/8"	G1/2"	G3/4"	G3/4"
II	Connection for thermosensor	G1/2"	G1/2"	G1/2"	G1/2"	G1/2"	G1/2"	G1/2"
III	Oil level indicator or oil outlet in case of oil circulation	G1"	G1 1/4"	G1 1/4"	G1 1/2"	G1 1/2"	G2"	G2 1/2"
IV	Connection for heater, cooler, oil sump thermometer or suction pipe in case of circulating pump	G1/2"	G1/2"	G1/2"	G1/2"	G1/2"	G1/2"	G1/2"
V	Inspection of the oil ring	G3/4"	G1"	G1"	G1 1/2"	G1 1/2"	G2"	G2"
VI	Oil drain	G1/2"	G1/2"	G1/2"	G1/2"	G1/2"	G3/4"	G3/4"
VII	Oil filling or breather	G1/4"	G3/8"	G3/8"	G1/2"	G1/2"	G3/4"	G3/4"
VIII	Cable exit for earthing device	M12 x 1,5	M12 x 1,5	M12 x 1,5	M12 x 1,5	M12 x 1,5	M12 x 1,5	M12 x 1,5

### 8.2– Bearing with external oil supply system

In general, the oil supply system consists of an oil tank a pump, a pressure gauge, a pressure relief valve, filters, an oil level gauge and various monitoring instruments. Depending on operating conditions or customers' specifications, a system of this type can also be fitted with other components (e.g. oil cooler, oil heater).

The diameters of the oil pipes should be selected such that the flow rate does not exceed 1.5 m/s at the inlet or approximately 0.15 m/s at the outlet.

The return pipe should have an inclination of 15°. If, for reasons of design or structural constraints, the return pipes are arranged with a slope less than 15°, pipes of correspondingly larger diameters must be laid.



Inadequate slopes and/or diameters give rise to back-pressure which can result in the bearing overflowing or leaking.

The connection for the oil inlets and outlets are on both sides of the bearing. Remove only those plugs where pipes will be connected.

Heat treated (welded or bent under heat) and/or internally heavily contaminated or rusty pipes must be pickled and flushed through before installation.

After they have been installed, the entire oil circuit must be flushed through to prevent any contaminants from penetrating into the bearing or fittings.

Before flushing takes place, therefore, all the measuring and switching fittings (pressure monitor, flow meter) and their connections must be removed. Under no circumstances may the bearings be left in the flushing circuit.

After flushing, all the filters must be cleaned. All the connections to the bearing must be free of vibrations and stress.

Assemble the fittings:

- Z Bearings are supplied without oil inlet and outlet flanges. Under request, as additional items, MIBA can supply these flanges according to DIN 2573 or ANSI B16.5 norms.
- Connect the inlet pipe to the tapped hole for the oil inlet, see the indicated tapped hole on assembly drawing.
- If the bearing has an individual oil inlet for the thrust part, connect the inlet pipe to the tapped hole shown on assembly drawing.
- Screw the oil outlet pipe (51) with nut (52) and copper ring (53) into the oil outlet connection hole. Seal with liquid sealing compound (fig.54).
- Oil outlet flanges with weir is to be mounted horizontally top at the bottom. The mark at the flange will be visible vertically up. The weir ensures the minimum oil level in an emergency lubrication by loose oil ring.
- Tighten the nut (52).

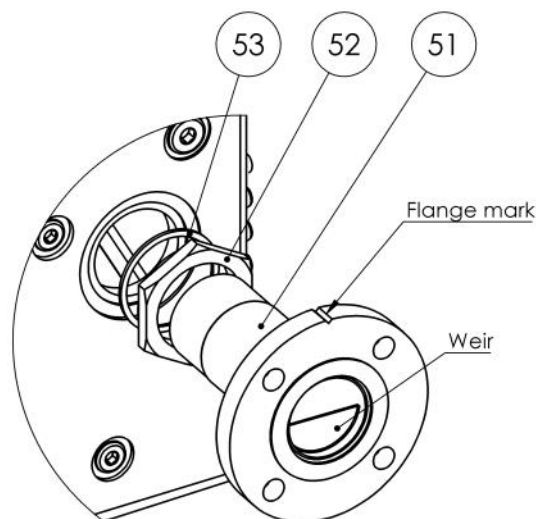


Fig. 54



### 8.3– Bearings with water cooler in the oil sump.

When connecting the oil sump water cooler (55), take care to ensure that no leaks are present in the housing or the connecting pipes. The seals in the screw couplings must not be damaged.

For most industrial applications:

- Clean water should be filtered to 150 µm and conditioned
- Closed, cooling loop systems should be used
- Water speed should be 2 to 3 m/w for copper-nickel tubes in the inlet
- water pressure should be maximum 5 bar

Some times the speed must be reduced because of a filtration of 250 µm in naval applications for example.

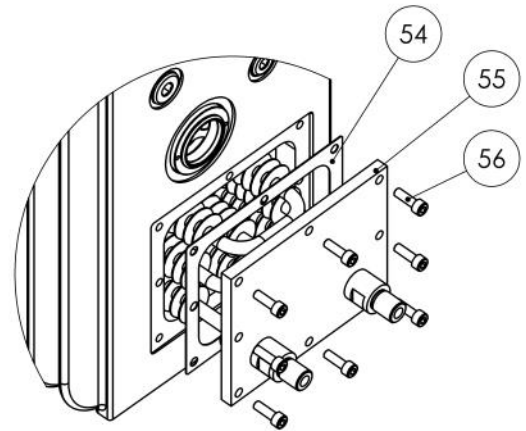


Fig. 55

A shutoff valve should be connected up on the inlet side.

As far as possible, drainage should take place without pressure.

- Water cooler is supplied assembled by MIBA but if by a chance it needs to be reassembled, proceed as follow.
- Insert the water cooler cover (55) with the gasket joint (54) into the window at lower housing.
- Screw the shouldered bolts (56) with Loctite 572.
- The coolant circuit can flow in either direction.

### 8.4– Thermo-sensors

Provisions for the fitting of thermos-sensors in the journal bush and oil sump are provided as standard. The type of sensor is used depends on the type required by the readout equipment used (direct reading, centralized control system, recording instrument, etc.). It is possible to provide two different sensors for the following applications:

- For oil sump temperature measurements, into the tapped hole IV.
- For journal parts temperature measurements, into the tapped hole II.
- For thrust parts temperature measurement, into the tapped hole X (Optional).

Proceed as follow to install all kinds of thermo-sensor (fig. 56):

- Remove the plugs from the connection holes.
  - For non-insulated thermos-sensor:
    - Screw the metal thread of the thermo-sensor (57) with its copper ring (58) into the tapped hole.
  - For insulated thermos-sensor:
    - Screw the plastic thread of the thermo-sensor (57) without any copper ring (58) into the tapped hole.
- Use a Teflon tape or sealing compound.
- See the technical documentation for Installation, connecting and adjustment of the sensor.
- See, chapter 13.2 for more details.

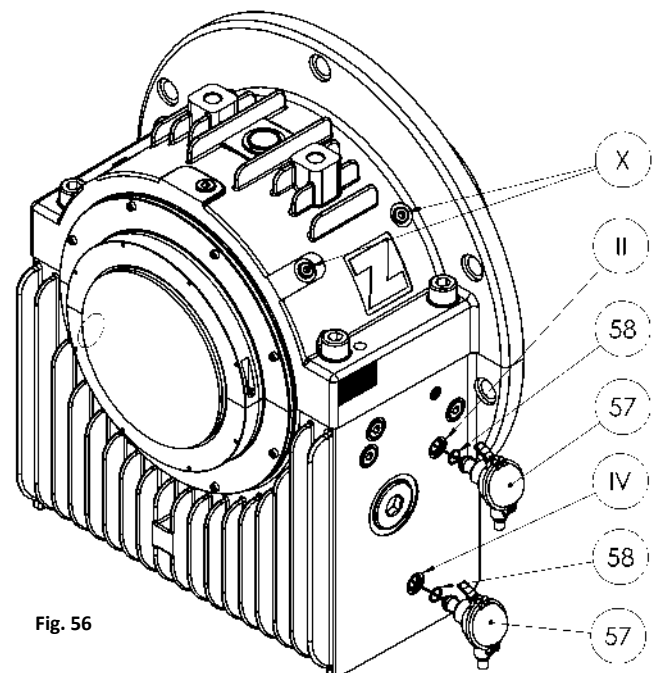


Fig. 56

### 8.5– Bearings with hydrostatic system

In the case of plants which are frequently started up under a severe load, run in tower mode (low speed) or have prolonged run-down times, an additional hydrostatic support (oil lift system) is recommended. In this way, wear under these operating conditions is avoided.

The rundown process of a plain bearing is often critical (prolonged rundown times). In particular, this applies to bearings with oil-ring lubrication because, in this case, hot oil of a low viscosity (by contrast with start-up) performs the lubricating function.

With the hydrostatic lubrication of bearings, the lubricant pressure is generated by a pump outside the bearing. The principle of a hydrostatic bearing is exactly the same as that of the pistons in hydraulic platforms or presses.

The arrangement in plain bearings essentially consists of one or more pockets (containing lubricant) integrated into the radial or axial bearing, a high pressure pump and, a non-return valve. The oil pressure pump is usually shut down when operating speed is reached and only restarted (if required) when the bearing runs down.

When the pump is switched on, the hydrostatic boost is generated by a pressure surge of up to approx. 200 bar. This causes the shaft to lift off from the shell, so that metal-to-metal contact ceases and contact-free (and, in turn, virtually wear-free) start-ups and rundowns are assured.

- The hydrostatic bearing is delivered with connected hose.
- The bearing shell can not be taken out of housing without unfixing the hose connection.
- For disassembling the shell, unfix hollow bolt (60.2) at housing side, so that hose is not fixed any more (Fig. 60). After that the complete bearing shell can be taken out of housing.
- For assembling the hose, connect the jacking adapter (59) with a copper ring (60.3) to the lower housing at connection IX (Fig.57).
- Pre-assemble the hydrostatic hose (60) with two copper rings (60.1) and its fittings to the tapped hole at the lower half of the shell (7) (Fig.58). Attention to the right position of the hose (look on the assembly drawing), so that the oil ring can not touch the hose while machine is running (Fig.59).
- Place the lower half of the shell to the final position (Follow the instructions 7.3, to assemble the lower shell).
- Connect the hydrostatic hose with both sealing rings (60.1) and the hollow bolt (60.2) to the adapter (59) (Fig. 60). Use two wrenches for this. One wrench to tighten the hollow bolt and another to prevent the adapter rotating together.

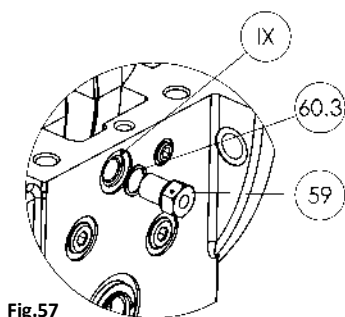


Fig. 57

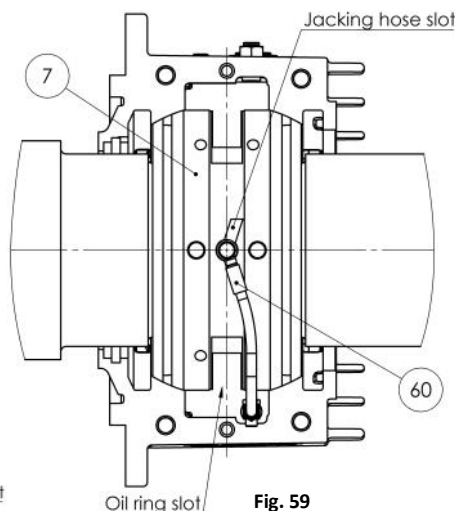


Fig. 59

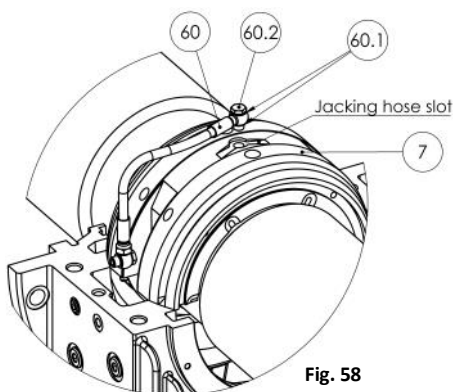


Fig. 58

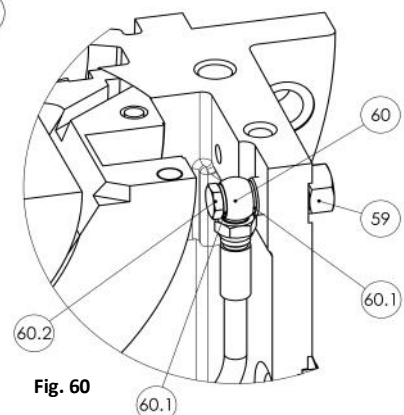
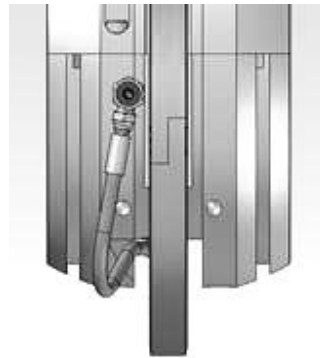


Fig. 60



Caution: Hose must be assembled in such a way that it does not have contact with the oil ring



#### **Disassembling of bearing shell with shaft**

- After having disassembled the upper part of bearing shell, the fitting of hose at housing side can be loosened (Fig. 61).
- The shaft has to be lifted up a little.
- Lower part of bearing shell can be taken out sidewise (Fig 62).

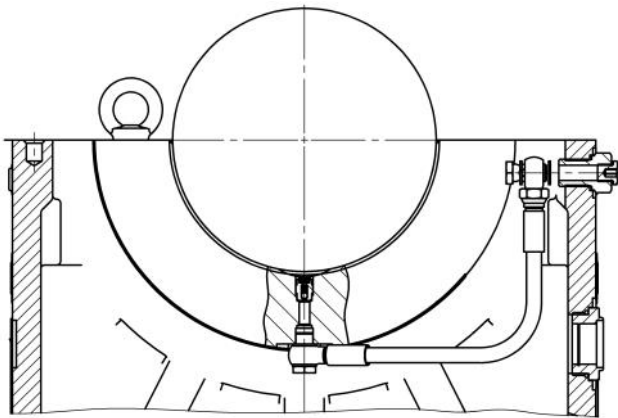


Fig. 61

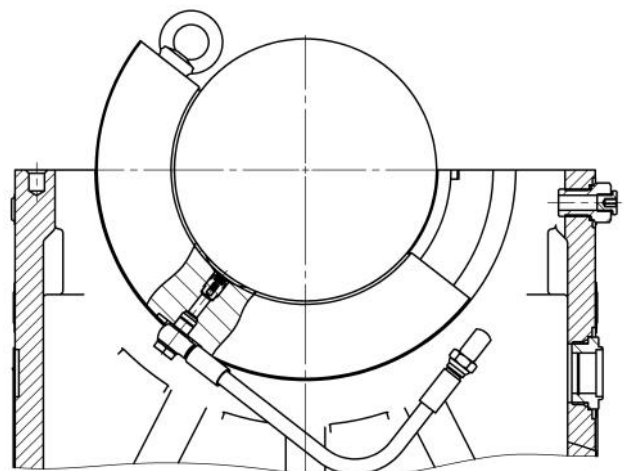


Fig. 62



In case of doubt regarding hose conditions please, see chapter 11.10

#### **8.6– Final tasks**

Having completed the assembly of the bearing, check all the screw fastenings for secure seating.

In addition, after the fastening components have been tightened, a further check must be made to ensure that the alignment has not changed.

By reference to the product documentation and the accompanying installation drawing, compiled as part of the purchase order, carry out a check to ensure that all the items of equipment which may have been disassembled for transporting purposes have been reinstalled.

If an oil gauge/sight glass is used to monitor the oil level, it must be protected against damage.

The bearing must be protected against falling objects.

Protective devices for rotating parts must be checked for correct seating.

Physical contact with rotating parts is not permitted.

## 9 - COMMISSIONING

The instructions contained in the section entitled "Safety instructions" (chapter 2) must be observed.



The commissioning of the bearing without the availability of the requisite operating instruction manual is not allowed.

### 9.1– Filling lubricant

Plain bearings are not filled with oil on delivery.

Having removed the oil sight glass (V) or screw plug (VII), fill oil of the grade prescribed for operation through one of the two apertures, using a filter (mesh size 20 µm).

Oil cleanliness should be 17/15/12 per ISO 4406.

The oil level must reach the lower edge of the oil gauge as a minimum. The correct oil level will be reached when the oil reaches the middle of the gauge (with the machine at a standstill).



An insufficient oil level can lead to ineffective lubrication and the failure of the bearing. Add as a second bullet point to highlight high oil level.

Before the bearing is commissioned, it should be checked to prevent oil leaks. All the ports must be closed and screw fastenings tightened.

Information as to the type of oil to be used and various lubricant manufacturers can be found in the separate product documentation supplied.

Details of the oil grade, viscosity and quantity required can be taken from the rating plate of the bearing, the installation drawing or the performance calculations.

Following the test run, check the oil level again and correct if necessary.

### 9.2– Oil level

Check the oil level in the bearing housing on the oil gauge.

The oil level must be checked by means of the oil level monitoring system. For this process, the bearing must be brought to a standstill. If any problems arise, consult MIBA.

With cool oil, the level should reach the middle of the gauge. If it is hot, the level may be slightly above this mark.



- ⇒ Clean up any spillages of oil with an oil binding agent immediately.
- ⇒ Under no circumstances may the oil level fall below the lower mark (lower edge of the oil gauge). If necessary, top up.

### 9.3– Check up

During commissioning, carry out and record the following visual inspections:

- Oil level
- Oil cooling and supply pipes for leaks
- Shaft seals for leaks
- Contact-free operation of rotating parts
- Cleaned condition of the complete bearing

The record of inspections is to be kept with the Operating Instructions.



- ⇒ If, during the test run, the recorded bearing temperature far exceeds the design temperature, the machine must be stopped and the causes investigated.
- ⇒ Fill the bearing with new oil, using a filter (mesh size 20 µm) with new oil until it reaches the middle of the oil gauge.
- ⇒ The sealing faces must not be contaminated or damaged.

## 10 - OPERATION

During operation, the bearing must be checked for the following:

- Oil temperature



If high temperatures occur, shut down the plant immediately and consult MIBA Customer Services.

- Atypical bearing noises
- Possible oil leaks from the housing and shaft seals
- Bearing inadmissible vibrations with the existing mass arrangement
- Correct oil level (see also the section entitled „Commissioning“)
- If, during operation, irregularities are discovered or a monitoring instrument signals alarm, the drive system must be shut down immediately.
- If the cause cannot be found, call in a service engineer from MIBA Customer Service.

### 10.1– Troubleshooting

General troubleshooting instructions:



- ⇒ Any faults arising during the guarantee period necessitating the repair of the bearing, may only be rectified by MIBA Services.  
If any faults arise after the guarantee period has expired whose cause cannot be clearly determined, we recommend that customers contact our Service Department.
- ⇒ If the bearing is not used in the specified manner, is modified without MIBA's approval or if spare parts other than genuine MIBA spare parts are used, MIBA will not accept any liability under the guarantee for the further operation of the bearing.
- ⇒ Before rectifying any faults, always shut down the plant.  
Make the drive system secure against unintentional start-up.  
Place a warning notice beside the on/off switch!

If an unusual rise in temperature occurs or a change is found in the condition of the oil, the bearing must be inspected. For this purpose, the upper housing must be removed (the lower part can remain on site). Before disassembly, the bearing casing should be cleaned in order to prevent any contamination from entering the bearing itself.

Fault	Cause	Remedy
High bearing temperature	Inadequate lubrication	Check the oil level regularly. Inspect the bearing shell for scoring. If a forced oil system is fitted, check the oil filter.
Scoring of the bearing shell	Dirt particles in the oil	Change the oil (possibly polish out scores in the bearing shell). If a forced oil system is fitted, change the oil filter.
Oil leakage	Incorrectly installed or damaged seals (most common)	Disassemble the seals and check them for damage. Assemble according manual.

For further support please provide the quantity of oil (l/min) at the inlet and the air pressure inside the housing  
Please also check oil level and shaft finishing if they are according to MIBA's recommendations.

## 11 - MAINTENANCE AND SERVICE

### 11.1– General maintenance tasks

All bearings need oil while operation.

The oil level must be checked at regular intervals with the machine at a standstill. The minimum oil level is indicated by the lower edge of the oil gauge. See chart 2: maintenance

The bearing housing must be kept clean, as the transfer of heat and, in turn, the cooling of the bearing can be impaired by dirt and dust, and swirling dust in the air can give rise to a highly explosive atmosphere.

If unusual variations in bearing temperature or oil level occur during operation, the cause must be investigated. If required, our Customer Services can be called on for help in the event of faults at any time. All maintenance and servicing work must be carried out carefully and only by experienced personnel.

The following applies to all maintenance and servicing work:



⇒ Shut down the plant and ancillary equipment. Make the drive system secure against unintentional start-up. Place a warning notice beside the on/off switch!

⇒ The bearing must be protected against falling objects.

Protective devices for rotating parts must be checked for correct seating. Physical contact with rotating parts is not permitted.

For operation and maintenance, the information contained in the accompanying order related product documentation must be observed.

Technical data can be found on the installation drawing compiled in accordance with the purchase order.

Table 2: Maintenance

Measures	Intervals
Check and control oil temperature	Permanent or daily
Check bearing noises or changes	Daily
Check the bearing for leaks	Daily
Check the oil level	Weekly or before re-use
Oil changes	Use only mineral oil according manufacture plate Every 8000 operating hours, for self lubricated bearings Every 20.000 operating hours for bearings with circulating systems.
Clean the bearing housing	As necessary or in conjunction with a routine oil change.
Control of bearing clearance	Every 2 – 3 years

### **11.2– Control and check of oil temperature**

The bearings have preparation for various temperature sensors. The measuring points are in the bearing shell very close to the highest loaded bearing position and the oil sump. According to requirements it is possible to have more preparations for temperature sensors at the housings. Basis for the alarm and shutdown temperature is the MIBA bearing calculation. If there is no other agreement, following is valid.



The alarm temperature should be 10°C above the calculated operating temperature.  
The shutdown temperature should be 20°C above the calculated operating temperature.

Due to mounting of temperature sensors that bearing temperature will be controlled. It is recommended to have a permanent check and control of the bearing temperature that at emergency the machine can be shut down in time and the machine will get still stand as fast as possible. According to requirements it is recommended to have two or more independent temperature sensors for control of the bearing temperature.

Based on a constructive best position of the sensor the highest bearing temperature will be measured and can be directly indicated.

Design of machine respectively application and type of bearings define for the temperature sensors the shut down time (disconnecting time from normal operation to standstill). In particular case it is recommended to have consultation of MIBA for the reaction time of the sensors and to define the best braking period for the machine.

### **11.3– Changing / topping up oil**



Escapes of hot oil present a risk of scald injuries.  
Wear protective gloves.  
Clean up any spillages of oil immediately with an oil binding agent.

The instructions contained in the section entitled „Filling lubricant“ must be observed.

In the case of self lubricated bearings and the use of mineral oil, we recommend flushing and an oil change after approx. 8,000 operating hours; for bearings with circulation systems, after approx. 20,000 operating hours.

Longer intervals may be possible subject to prior checking by MIBA.

Shorter intervals are necessary in the event of e.g. frequent start-ups and shutdowns, high oil temperatures or an excessively polluted environment.

To change the oil, unscrew and remove the drain plug, located in the center of the underside of the bearing (allow the oil to drain while hot). If the oil exhibits unusual changes (color, smell), the cause must be investigated. If cleaning agents which leave residues are used to clean the entire bearing, these must be thoroughly flushed away prior to further operation.



Do not use any cleaning agents to flush the bearing which give rise to an explosive atmosphere or which themselves can ignite, such as substances which are readily combustible or flammable or which give off combustible gases, etc.

Oil is refilled through one of the two ports (sight glass or screw plug) in the upper part of the housing. For filling and topping-up, use an oil filter (max. mesh size 20 µm) and the grade of oil selected by us for your application (see rating plate). The oil is at the correct level when it reaches the middle of the oil gauge. Filling above this level will not impair the function of the bearing but may give rise to escapes of surplus oil.



When changing oil, always use the same grade of oil as previously used. Mixing oils of different grades or manufacturers is not permitted.  
Only mineral oils are permitted for plain bearings.

Check the condition of the seals; use new seals if necessary.

**Caution:** If too little oil is filled or the oil level is not regularly checked, the bearing may be damaged through deficient lubrication.

### **11.4– Examine oil for water content**

For detailed information on inspecting the oil for water content, consult your lubricant manufacturer.

### **11.5– Cleaning the bearing housing**



- ⇒ Cleaning with a high pressure cleaner is not permitted.
- ⇒ The penetration of water into the bearing must be avoided.
- ⇒ Regular cleaning of the housing, particularly the cooling fins and hollows where deposits of dust can easily occur, will counteract any build-up of an explosive atmosphere through swirling dust.

### **11.6– Control of bearing clearance**

Every 2 to 3 years the bearing clearance should be measured for evaluation of the condition of the bearing shell.

If the bearing clearance is too big, the bearing shell must be replaced.

Having an increasing of 40% of the original bearing clearance (Original bearing clearance can be found in the MIBA calculations) a bearing shell replacement must be done or is recommended.

For example: For a defined or original bearing clearance of 0,3 mm the maximum allowable bearing clearance is 0,42 mm (40% of 0,3 mm = 0,12 mm).

The bearing clearance is measured between shaft and inner bore diameter of bearing shell at 12 o'clock position in vertical direction. For making that measurement at the plain bearing the upper part of housing must be dismounted or even the upper part of bearing shell. Depending on type of plain bearing feeler gauges (measuring gauges or lead modelling) can be used.

### **11.7– Checking the screw fastenings**

Check all connecting and fastening screws for secure seating.

If necessary, all the MIBA screw connections which were released on disassembly should be secured with Loctite on reassembly in accordance with the installation drawing (follow the Loctite Directions for Use).

For the strength categories and torque specifications of the screws, refer to the table.

Screws which work loose can cause the bearing to fail. The specified tightening torques must be adhered to without fail.

Tightening torques for fastening screws from M 3 to M 30 for strength categories 8.8 with a friction coefficient of 0.10:

**Table 3: Torque specification**

Size	Class 8.8	Hex socket
M3	1 Nm	2,5
M4	3 Nm	3
M5	5 Nm	4
M6	9 Nm	5
M8	20 Nm	6
M10	40 Nm	8
M12	70 Nm	10
M16	170 Nm	14
M20	340 Nm	17
M24	580 Nm	19
M30	1150 Nm	22



- ⇒ Do not apply the torque values from table 3 to the oil ring halves (§7.5), rigid seal halves (§7.8.2) and baffle with rigid seal (§7.8.3). Follow the local table values.



### **11.8– Bearing inspections**

The results of the bearing inspections should be sent to the MIBA Service Department, where our engineers will use their experience to reliably assess whether any parts of the bearing need to be replaced and, if so, which.

### **11.9– Lubricants**

The sole decisive factor for the choice of oil is the viscosity (VG category) specified on the rating plate and performance calculations for the bearing. The viscosity category applies to the contractually agreed operating conditions.

We must be consulted if the bearing is to be used under other conditions.

- The oil to be used and a list of lubricant manufacturers can be found in the product documentation supplied separately (Lubricating oils for MIBA Z-bearings).

We are familiar with the composition of these lubricants and, according to our current understanding, know that they exhibit those properties on which the design of the bearing was based, i.e. loading capacity, resistance to seizing, grey-spot stability and compatibility with seals and internal coatings.

We accordingly recommend that our customers select a lubricant from the product documentation, taking account of the VG category specified on the installation drawing, rating plate and performance calculations.

- To prevent misunderstandings, we wish to point out that this recommendation does not signify any approval in the sense of a guarantee of the quality of the lubricant obtained from your supplier. Every lubricant manufacturer must guarantee the quality of its product itself.

If you fail to follow our recommendation for any reason of importance to you, the responsibility for the technical suitability of lubricant will devolve upon you.

### **11.10– Replacement of hose**

Hose assemblies must be replaced if one of the following conditions occurs during a visual inspection:

- Damage to the outer layer up to the inner braiding
- Brittleness of outer layer or crack formation
- Change in the natural shape of the hose (reduction or increasing in the cross section)
- Hose fitting damaged or misshapen
- Hose becomes detached from the fitting
- Fitting tightness and function impaired by corrosion
- Installation requirements not complied with
- Leaks



Recommended period of usage of hose assembly: maximum 6 years

## 12 - SPARE PARTS, SERVICE INFORMATION

### 12.1– Spare parts

We only guarantee genuine spare parts supplied by us.



We wish expressly to point out that spare part and accessories not supplied by us have also not been approved or cleared by us. The installation and / or use of such products can, under certain circumstances, accordingly adversely affect the design characteristics of the bearing and, as a result, impair its active and / or passive safety. MIBA accepts no liability or guarantee for any damage resulting from the use of spare parts or accessories not supplied by us

Please note that special manufacturing and supply specifications often apply to individual components, and that we offer spare parts complying with the latest state of the art and the applicable statutory regulations.

### 12.2– Service information

Every plain bearing is marked with an article/drawing number and a serial number on the rating plate. In order to prevent incorrect deliveries, please specify these numbers without fail when ordering spare parts or return the defective part to us which you wish to be replaced.

Our Customer Services are available at all times to provide help in the event of faults or conversions of the plant. To order spare parts or call in a service engineer, please contact the address under 'Copyright' in the first instance.

When ordering spare parts, please give the following information:

	Source	Example
Designation	Product documentation	Bearing shell
Short designation	If known	Z-ZLQ 18 - 180
Art nr. / Drawing nr.	Rating plate, installation drawing, product documentation	
Bearing type	Rating plate, installation drawing, product documentation	ZFNLQ
Size	Rating plate, installation drawing, product documentation	18
Shaft diameter	Rating plate, installation drawing, product documentation	180
Serial No	Rating plate	101
Quantity	Product documentation	1

When ordering other spare parts, e.g. floating labyrinth seals (or short MIBA designation SSD), refer to the installation drawing or product documentation relating to the requisite diameter:

## 13 - APPENDIX

### 13.1- IP 56 baffle

The IP-56 baffle can be combined with either a floating labyrinth seal or a rigid seal to achieve IP 56.

To guarantee the correct positioning of the centrifugal ring see the maximum longitudinal displacement of the shaft in operation. Check the parameters in the technical documentation of the installation.

The assembly steps to mounting the IP-56 baffle is the same for both kinds of seals (Rigid or Floating).

- Place the centrifugal ring on the shaft with the brass cover faces outside the machine.
  - If the centrifugal ring is split. Place both parts of the centrifugal ring around the shaft and screw the bolt at the split line.
- Check the maximum longitudinal displacement (end-play) of the shaft. Then place the centrifugal ring at the center of the displacement as showed on figure 63.
- Screw the two lock bolts (63) placed around the centrifugal ring. Confirm if the centrifugal ring is totally fixed at the shaft.
- Check if radial distance of the centrifugal ring is the same all around the shaft.
- Apply the sealing compound on the face making contact with the seal carrier of the floating labyrinth seal or rigid seal.
  - If the IP-56 baffle is split also apply sealing compound on the surface of the split line
- Finally, place the IP-56 baffle (64) on the shaft and attach with the screws (65) (Fig. 65).



*The longitudinal displacement (end-play) must be smaller than A + B dimension (See fig. 64)*

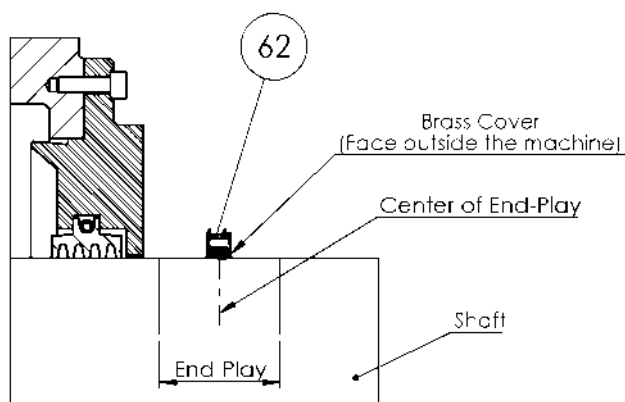


Fig. 63

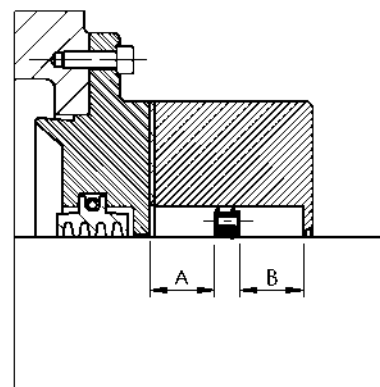


Fig. 64

$$\text{End-play} < A+B$$

$$A \text{ and } B > \frac{\text{END-PLAY}}{2}$$

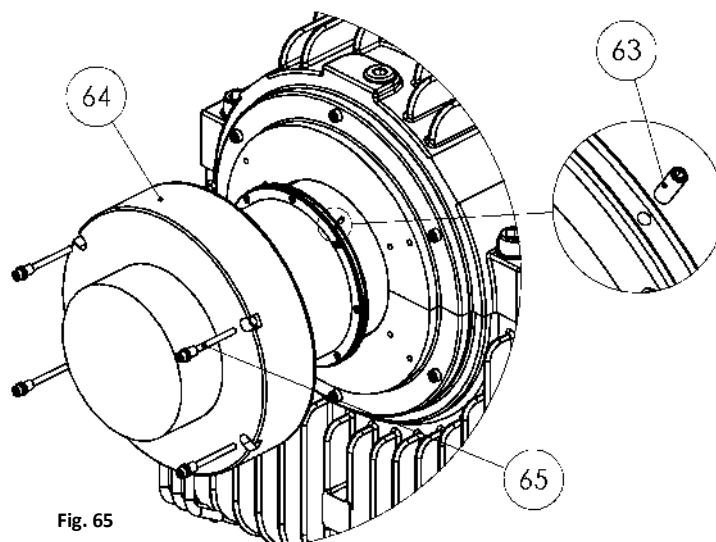


Fig. 65

## 13.2- Assembly of the thrust pads RTD's

### 13.2.1- Upper thrust pads RTD's

If the steps to assembly the thrust pads (chapter 7.9) was correctly followed, all holes of the RTD rod are aligned.

- Remove the plugs from the connection holes X.
- Insert the RTD rod (71) through the upper housing tapped hole (X), the hole of the bearing shell (Y) and then place the rod into the thrust pads hole (Z).
- Screw the thermo-sensor head block (72) or by a cable gland into the tapped hole (X). Use a Teflon tape or sealant compound.

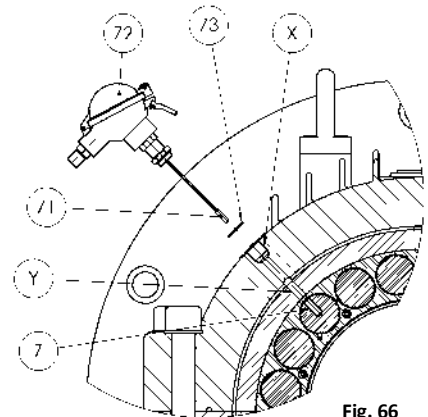


Fig. 66

### 13.2.2- Lower thrust pad RTD

The assembly of the thermo-sensor on the lower thrust pads begins at the chapter 7.3. (Assembly of the lower shell):

- Place the lower part of the bearing shell (7) on the shaft seat.
- Insert the RTD rod through the hole of the bearing shell and then place the rod into the thrust pads hole (see fig. 67).
- Insert the RTD cable (77) into the channel on the bearing shell (Fig. 68). Insert the cable into the whole channel extension.
- Turn the lower bearing shell to the correct position in the lower part of the housing. (see chapter 7.3)



Take care! Do not damage the RTD Cable.

- Proceed with the assembly of the bearings.
- After mounting the top half of the shell (6), Insert the thermo-sensor cable (77) into the corresponding channel in the upper half of the shell (fig. 69).
- Move the housing until close to the shell. Insert the cable of thermo-sensor through the tapped hole (X) on the top half of the housing.
- Conclude the assembly of upper the housing, following the Chapter 7.7
- Screw the thermo-sensor head block (72) with copper ring (73) or by a cable gland into the tapped hole (X). Use a Teflon tape or sealant compound

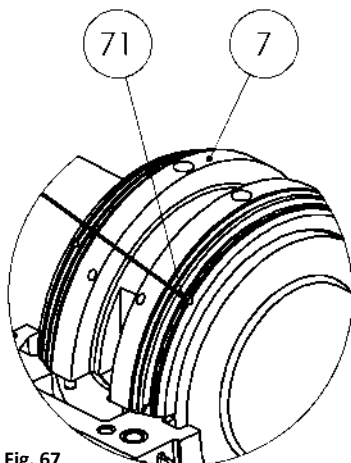


Fig. 67

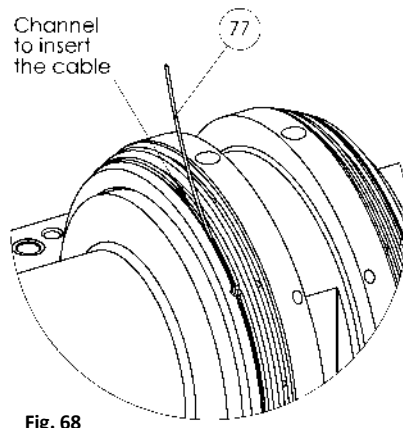


Fig. 68

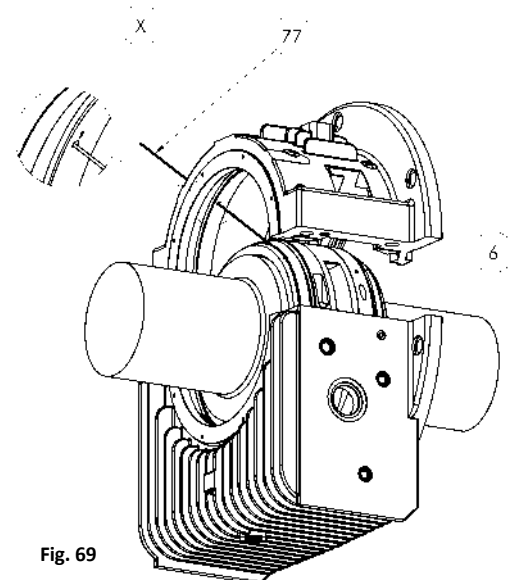


Fig. 69

### 13.3- Special machine seal

Assembly the gap seal halves direct onto the shaft. Then assemble the machine seal upon it:

- Apply sealant compound to the split surfaces in the special machine seal (82) (Fig. 72).
- Prepare the seal to installation by coating the surface of the split line with a thin film of non-hardening sealant compound (Fig.70).
- Joint the halves of the labyrinth seal (78) by the positioning pin (79), present in some seal bore diameters, placed at the split line.
- Insert the wire spring (80) in the sealing groove and lock the spring key (81) (Fig.71).
- Remove the residue of sealant compound.



Both halves of the labyrinth seal are held together by a garter spring. Do not mix up the halves of the labyrinth seal.

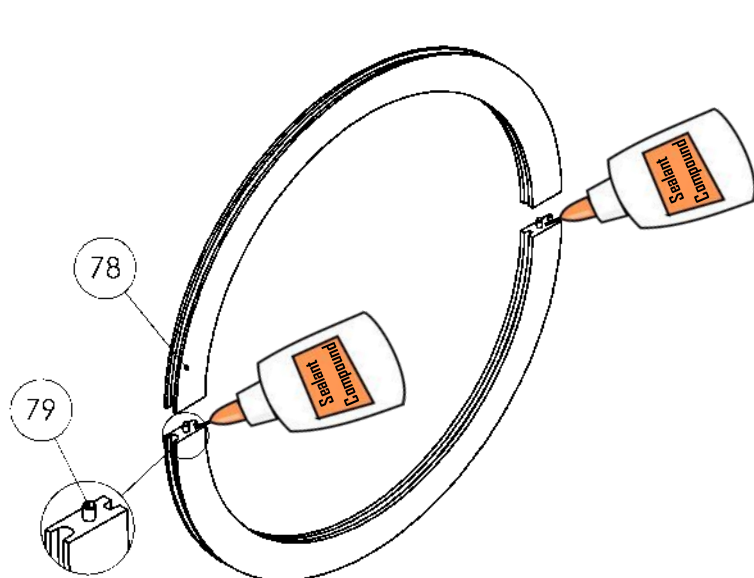


Fig. 70

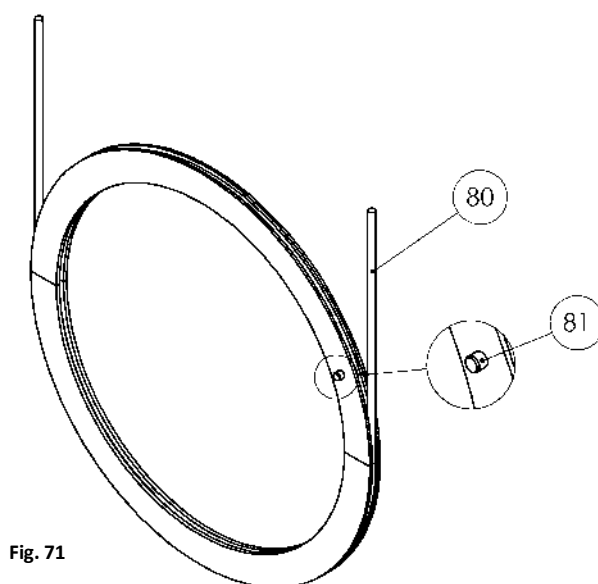


Fig. 71

- Apply a thin layer of sealant compound at both sides of the gap seal.
- Insert the seal into the groove of the machine seal.
- The locking pin (81) must be into the slot in the machine seal.
- Tighten the split line screws (11) by hand tight.
- Assembly the machine seal as described on chapter 7.1.

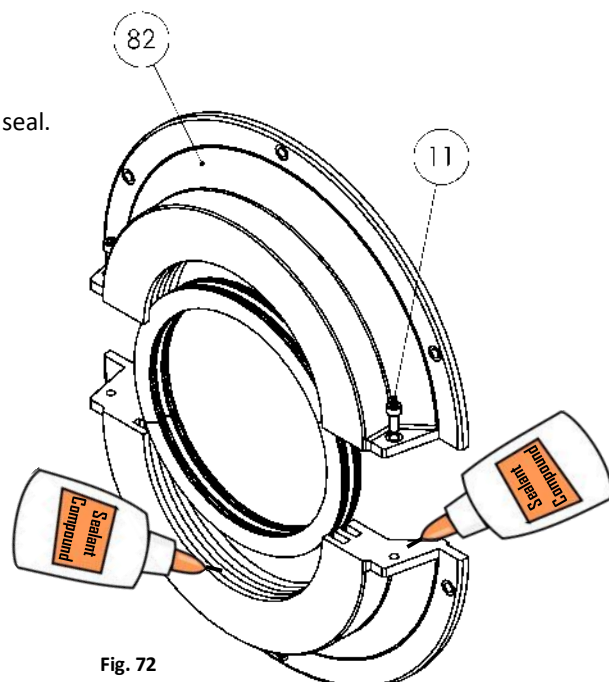


Fig. 72

### 13.4– Tilting pad journal bearing installation

- Lift the shaft high enough to give distance for the assembly works.
- Mind the orientation of the bearing shell according the assembly drawing.
- Apply an oil to the two spherical seats in the lower part of the bearing housing and to the work surface of the shaft (use the same oil as for the operation of the bearing).
- Assembly the journal pads (83) separately on the upper and lower part of the bearing shell (84 and 86). The pads are held in place by the guide pins (Fig. 73).
- Screw the lock bolts (85) around the both halves of the bearing shell to lock the pads (Fig. 74).



The bottom pads have sensors holes. Take care to do not invert them.

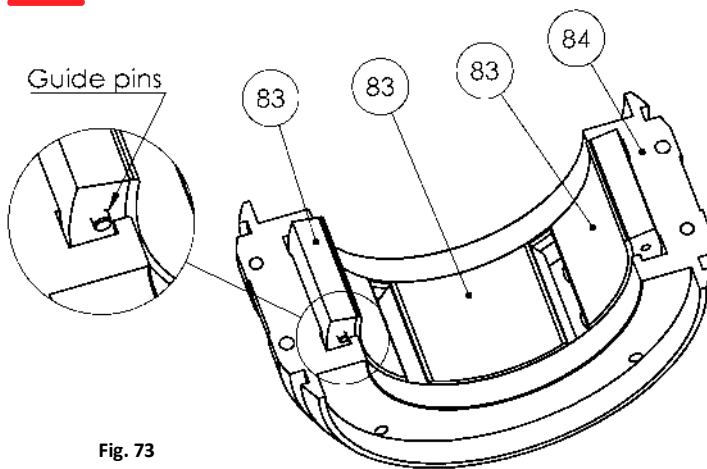


Fig. 73

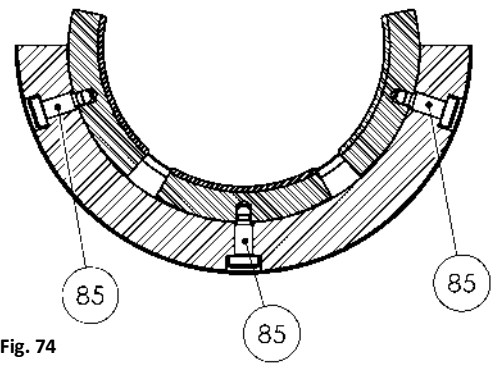


Fig. 74

- Place the lower part of the bearing shell (86) on the shaft seat (Fig. 76) and turn it to the correct position (Fig. 77) in the lower part of the housing (1), taking care to ensure that the thrust bearing surfaces are not damaged when the shell is turned.
- Align shell and housing split surfaces (Fig. 78). Now it is possible to support the shaft in the liner bore.

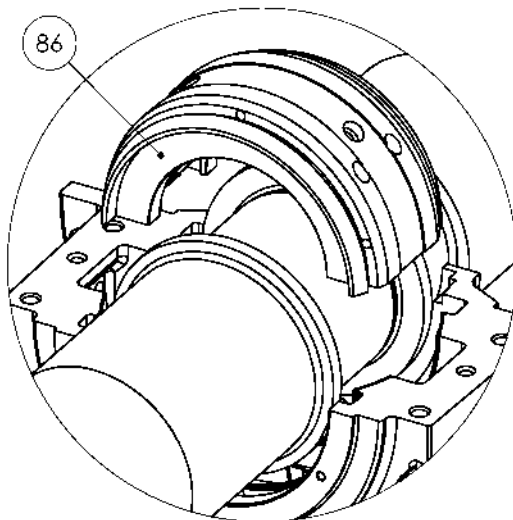


Fig. 75

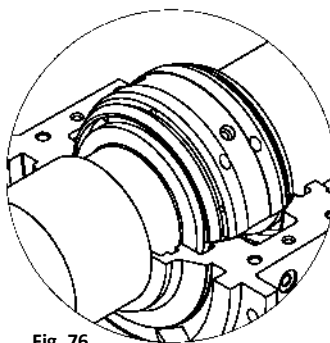


Fig. 76

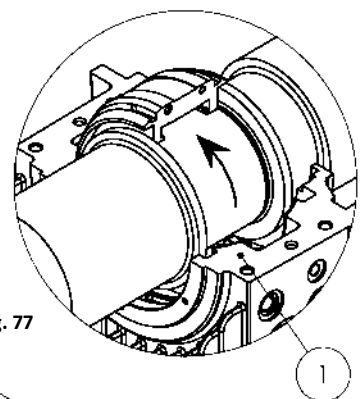


Fig. 77

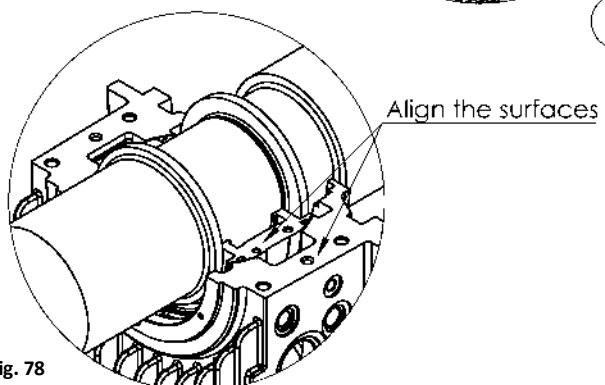


Fig. 78

- Apply an oil film to both the shaft seat and the upper part of the bearing shell (84) (use the same oil as for the operation of the bearing).
- Place the upper part of the shell (84) on the shaft (Fig. 80).



⇒ it is impossible to turn both halves of the shell together as they would become misaligned.

⇒ Be careful when lowering the shell. The contact surfaces between the radial pads and the shaft have a controlled roughness. Care should be taken not to damage them.

- Screw the bolts (8) to join the bearing shell halves with the suitable torques.
- Check the gap of the split line of the shell, use a feeler gauge. If it is greater than 0,05mm, disassembly both parts of the shell. Rework the surfaces of the split line of the upper and lower shell with a sharpening stone.

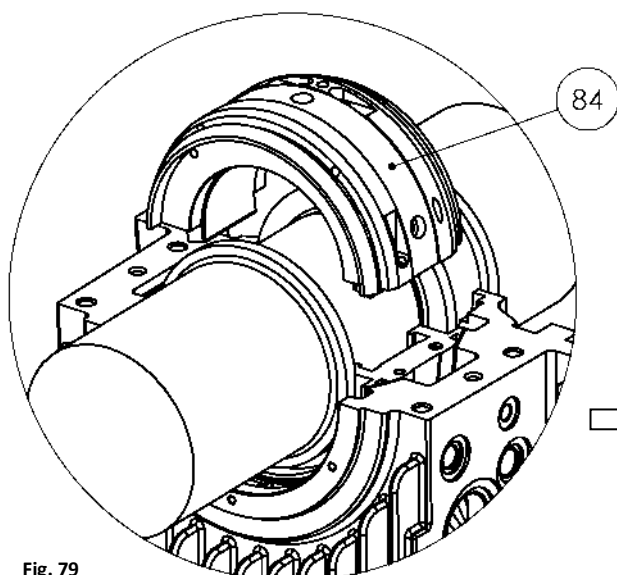


Fig. 79

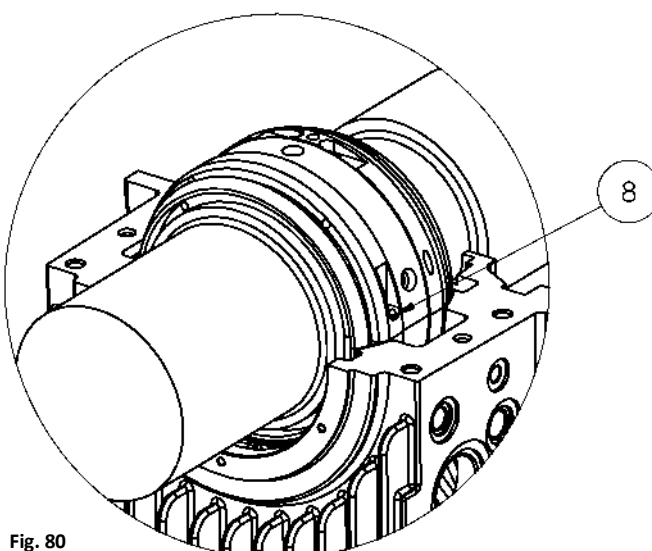
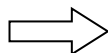


Fig. 80

Torque Table for screw (8)			
Bearing size	Bolt Size	Torque (Nm)	Hex socket
7	M5	5	4
9	M6	9	5
11	M6	9	5
14	M8	20	6
18	M12	70	10
22	M12	70	10
28	M16	170	14





## Miba Industrial Bearings

The Industrial Bearing Branch of the Miba Bearing Group produces hydrodynamic bearings and labyrinth seals for use in mechanical and plant engineering which are used in a wide range of high-performance applications. Our highly inspired teams, work diligently to serve our customers the best bearing solutions for each and every application.

Our products are subject to constant technical alterations and developments and thus revisions may occur without prior or subsequent notice. This catalog is a preliminary version. A new version will be published soon, but all dimensions here shown will be kept.

Last release: Sep/2020





**Contacts:**

**Germany**

Miba Industrial Bearings Germany  
Osterode GmbH  
Rolandsweg 16-20  
37520 Osterode, Germany  
[MIBG\\_sales@miba.com](mailto:MIBG_sales@miba.com)

**USA**

Miba Industrial Bearings U.S. LLC  
1111 Cedar Creek Rd,  
Grafton, WI 53024, USA  
[MIBUSG\\_Sales@miba.com](mailto:MIBUSG_Sales@miba.com)

**USA**

Miba Industrial Bearings U.S. LLC  
3300 E 8th St.  
Columbus, NE 68601, USA  
[MIBUSG\\_Sales@miba.com](mailto:MIBUSG_Sales@miba.com)

**USA**

Miba Industrial Bearings U.S.  
(Houston) LLC  
1800W 13th St, Deer Park,  
TX 77536, USA  
[Houston.Sales@miba.com](mailto:Houston.Sales@miba.com)

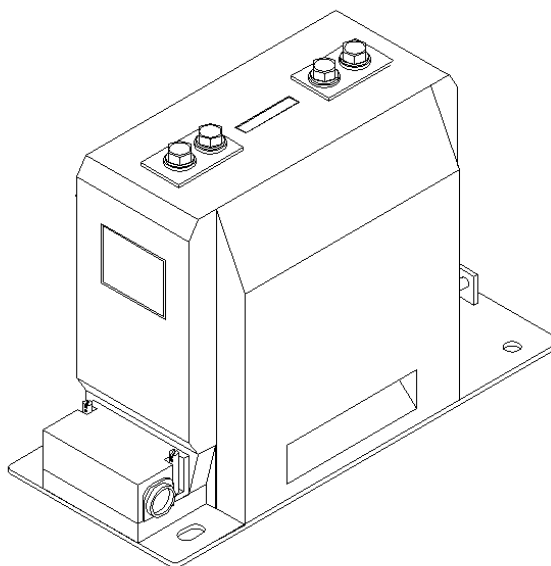
**Brazil**

Miba Industrial Bearings Brasil Ltda  
Av. Manoel Inácio Peixoto, 2147  
36.771-000 Cataguases, Brazil  
[Vendas.MIBCAT@MIBA.COM](mailto:Vendas.MIBCAT@MIBA.COM)

---

**Betriebsanleitung / operating instructions**  
**Innenraum-Stützerstromwandler / Indoor Current Transformers; Support Type**  
**GIS12/GSWS12(D) GIS24/GSWS24(D)**

---



**Technische Daten**

Primär-Nennstrom  
Primär-Nennstrom umschaltbar  
Sekundär-Nennstrom  
Sekundäranszapfungen für  
Primärnennströme  
Thermischer Nenn-  
Kurzzeitstrom  
Dynamischer Nennstrom  
Nennfrequenz  
Isolierstoffklasse  
Aufstellort

**Technical data**

rated primary current  
rated primary current reconnectable  
rated secondary current  
secondary taps for several primary  
rated current  
rated thermal short-time current  
rated dynamic current  
rated frequency  
class of insulation  
site of installation  
ambient temperature

5 A bis/to 2500 A  
2x5 A bis/to 2x750 A  
1 A oder/or 5 A  
  
bis / to 1000xI<sub>n</sub>;  
max.100 kA/1s  
max. 120 kA  
16,7; 50; 60Hz  
E  
bis / to 1000m über NN  
/ above sea level  
-5°C .... +40°C

Der Einsatz von Stromwandlern  
unter abweichenden  
Bedingungen erfordert  
Rückfragen beim Lieferanten.

The use of current transformers under  
deviating conditions is subject to prior  
consultation of the supplier.

---

## Betriebsanleitung / operating instructions

Innenraum-Stützerstromwandler / Indoor Current Transformers; Support Type

GIS12/GSWS12(D) GIS24/GSWS24(D)

---



### WARNUNG

Beim Betrieb von Messwandlern stehen zwangsläufig bestimmte Teile dieser Geräte unter gefährlicher Spannung. Bei Nichtbeachten der Warnhinweise können deshalb schwere Körperverletzungen oder Sachschäden auftreten. Nur entsprechend qualifiziertes Personal sollte an diesem Gerät arbeiten. Der einwandfreie und sichere Betrieb dieses Gerätes setzt sachgemäßen Transport, fachgerechte Lagerung, Aufstellung und Montage voraus.

### WARNING

Hazardous voltages are present during operation of measurement transformers. Non-observance of the safety instructions can result in severe personal injury or property damage. Only qualified personnel should work on or around this equipment after becoming thoroughly familiar with all warnings, safety notices and maintenance procedures contained herein. The successful and safe operation of this equipment is dependent on proper handling, installation, operation and maintenance.

### QUALIFIZIERTES PERSONAL

sind Personen, die mit Aufstellung, Montage, Inbetriebsetzung und Betrieb des Produktes vertraut sind und über die ihrer Tätigkeit entsprechenden Qualifikationen verfügen, wie z. B.

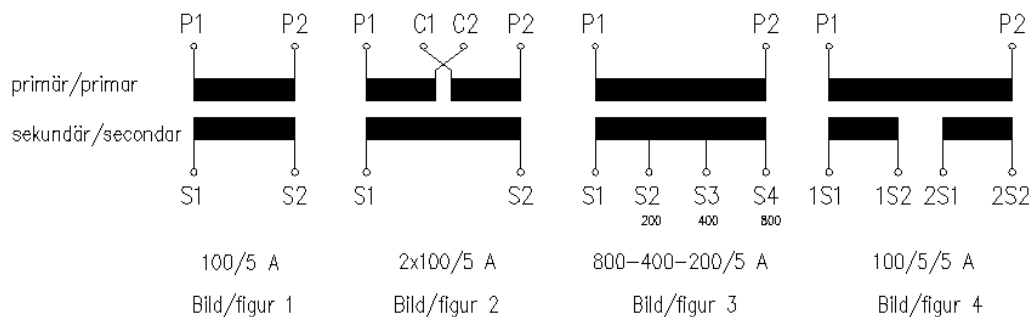
- Ausbildung oder Unterweisung bzw. Berechtigung, Stromkreise und Geräte/Systeme gemäß den Standards der Sicherheitstechnik ein- und auszuschalten, freizuschalten, zu erden und zu kennzeichnen.
- Ausbildung oder Unterweisung gemäß den Standards der Sicherheitstechnik in Pflege und Gebrauch angemessener Sicherheitsausrüstung.
- Schulung in erster Hilfe.

### QUALIFIED PERSONNEL

A „qualified person“ is one who is familiar with the installation, construction and operation of the equipment and the hazards involved. In addition, he or she has the following qualifications:

- Is trained and authorised to energise, de-energise, clear, ground and tag circuits and equipment in accordance with established safety practices.
- Is trained in the proper care and use of protective equipment in accordance with established safety practices.
- Is trained in rendering first aid.

## Klemmenbezeichnungen / terminal designations (IEC61869-2)



	primär/primar				sekundär/secondar							
	Bild/figur 1		Bild/figur 2		Bild/figur 1+2				Bild/figur 3			
IEC+DIN VDE	P1	P2	P1	C1 C2 P2	S1	S2	S1	S2	S3	S4	1S1	1S1 1S1 1S1

## Montage / Installation

Gießharzstromwandler können in jeder Lage montiert werden.

Cast-resin current transformer may be mounted in any position.

### Primäranschluss

Die Primärschienen auf Anschlusslänge (Überlappungslänge) mit einer Stahlbürste oder Schmirgelpapier reinigen und sofort mit einer säurefreien Vaseline leicht einfetten. Bei Verwendung von Primärschienen aus Aluminium ein Cupal-Blech zwischen Schiene und Anschlussstück legen. Die zum Festziehen der Schienen und der primären Umschaltung vorgesehenen Befestigungselemente möglichst verwenden. Bei Schienendicken >10mm entsprechend längere Schrauben verwenden. Das Anzugsdrehmoment der Primärschrauben M12 beträgt 40Nm.

### Primary connection

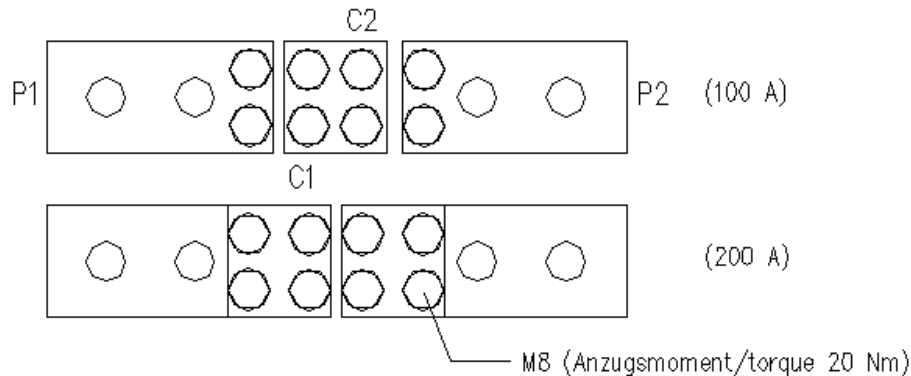
Clean the contact surface (overlapping areas of the primary busbars) with a wire brush or emery cloth and immediately coat them with acid-free Vaseline.

If primary busbars are of aluminum, a copper-coated aluminum sheet should be placed between the busbar and the connecting piece. Use should be made of the securing elements supplied for tightening the bars and for primary-reconnection if it all possible. In the case of bar thickness >10mm, use correspondingly longer of the same strength.

The torque moment for the primary screws is 40Nm.

Primär Umschaltung (Bsp. 2x100 A)

Primary reconnection (example 2x100 A)



Einfacher Primärstrom: Die Schaltlaschen liegen aufeinander. Die Primärwicklung ist in Reihe geschaltet.

Doppelter Primärstrom: Die Schaltlaschen liegen nebeneinander. Die Primärwicklung ist parallel geschaltet.

Single primary current: The links are located on top of each other, the primary winding is connected in series.

Double primary current: The links are located side by side, the primary winding is connected in parallel.

### Sekundäranschluss

Der Anschluss erfolgt über eindrängige Leiter oder Litzen. Sie können als Kabel in einem flexiblen oder starren Rohr eingeführt werden. Stopfbuchsen oder Rohre mit Gewinde PG16 in das vorhandene Gewinde schrauben, glatte Rohre einstecken und mit Befestigungsschellen abfangen.

Die Anschlussklemmen (Anzugsdrehmoment für M5: max. 3,5 Nm) können eindrängige Leiter von ca. 2,5 mm<sup>2</sup> bis 10 mm<sup>2</sup>, Litzen nur bis 6 mm<sup>2</sup> aufnehmen. (Reihenklemme eindrängige Leiter max. 4 mm<sup>2</sup> und Litze max. 2,5 mm<sup>2</sup>).

Litzen vor dem Einstecken mit Kabelendhülsen bzw. Quetschkabelschuhen versehen.

Bei Nichtbenutzung eines Kernes ist dieser kurzzuschließen.

### Secondary connection

Solid or stranded conductors may be used. They can be introduced as cables in a flexible or rigid tube. Cable glands or threaded tubes PG16 are screwed into the thread provided for this purpose. Plain tube ends are inserted and secured with a clip.

The terminals (torque moment for M5: max. 3,5 Nm) can take single-core-conductors from 2,5 mm<sup>2</sup> to 10 mm<sup>2</sup> while stranded conductors should only have up to 6 mm<sup>2</sup>. (mountable terminal block for single-core-conductors 4 mm<sup>2</sup> max. and stranded conductor 2,5 mm<sup>2</sup> max.)

In case of no using of a core is this short-circuiting.

## Betriebsanleitung / operating instructions

Innenraum-Stützerstromwandler / Indoor Current Transformers; Support Type  
GIS12/GSW12(D) GIS24/GSW24(D)



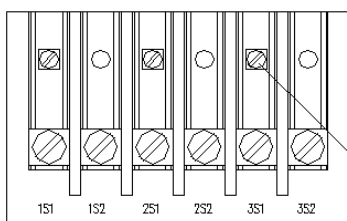
### Erdung

Für die Erdung der Sekundärwicklung ist unter jeder Sekundärklemme ein Gewinde vorgesehen. Durch Einschrauben einer je Kern lose mitgelieferten Spezialschraube wird die erforderliche Erdverbindung hergestellt

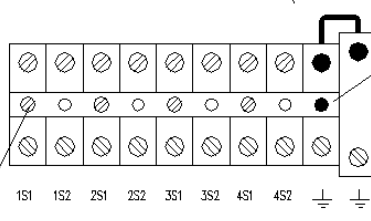
### Earthing

A thread for earthing the secondary winding is provided on each secondary terminal. Earthing is accomplished by inserting a special screw, one being supplied loose for each core.

Rillenklemmen  
Groove terminals



Reihenklemmen (max. 10 Stck.)  
Mountable terminals blocks (max. 10 No.s)



Spezialschraube/  
special screw

Erdschiene beim Wechsel der Spezialschraube von S1 nach S2 nicht entfernen. with exchange special screw from S1 to S2 earth bus not remove.

### WARNUNG

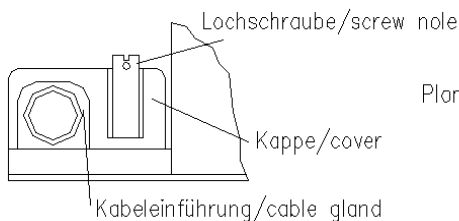
Stromwandler dürfen niemals mit offenem Sekundärkreis betrieben werden!  
Es können gefährlich hohe Spannungen auftreten!

### WARNING

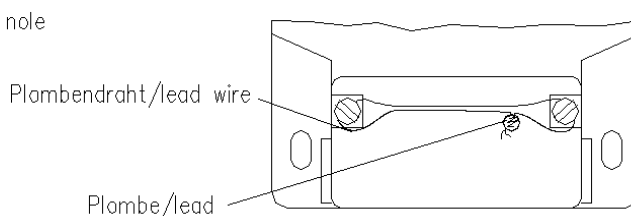
It's not allowed to operate current transformers with secondary windings open!  
Dangerously high voltage may be occur!

### Plombierung für Wandler mit Zulassung

### Lead sealing for transformers with certificate

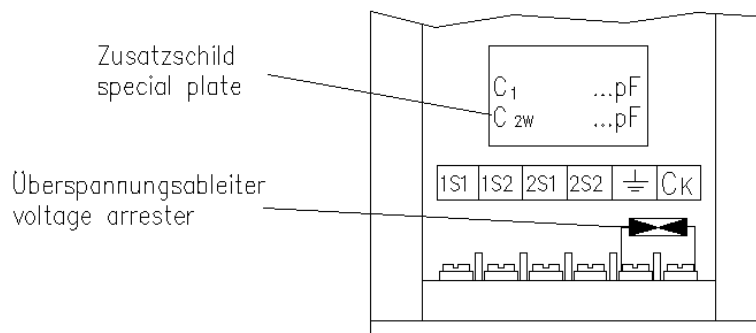


Der Plombendraht ist, wie in der Skizze gekennzeichnet, durch die Lochschrauben auf dem Klemmenkasten zu fädeln. Der Plombendraht ist nun durch Verdrehen straff zu spannen und mit der Plombe zu versehen.

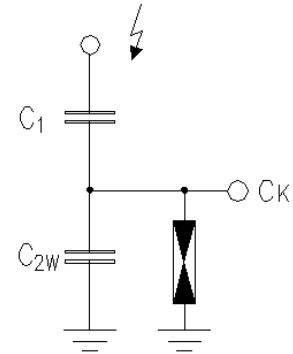


The sealing wire must be fed through the screw hole on the junction box as shown in the illustration. Then tighten the wire by twisting and seal on both sides.

### Kapazitiver Abgriff



### Capacitive tab



Die tatsächliche Betriebsspannung  $U_N$  bestimmt die Werte des Spannungsteilers. Bei Nichtbenutzung ist die Klemme  $C_K$  zu erden. Der Überspannungsableiter darf nicht entfernt werden.

The capacitance values of the voltage divider are determined by the actual operating voltage  $U_N$ . In case of no using of the capacitive tap the terminal  $C_K$  must be earthed. You must not remove the voltage arrester.

### Schutzleiteranschluss

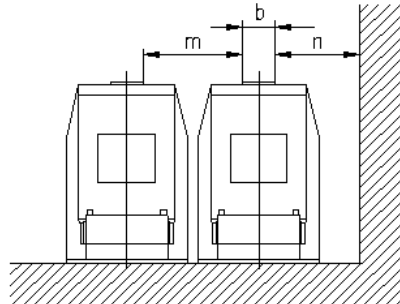
Am Wandlersockel befindet sich eine Schraube M8 mit Scheibe und Federring für den Schutzleiteranschluss. Der Querschnitt des Schutzleiters muss mindestens  $16\text{mm}^2$  Cu oder  $50\text{mm}^2$  Fe feuerverzinkt betragen. Wird Flachmaterial verwendet, soll dessen Breite mindestens 20mm sein, um der Erdungsschraube genügend Auflagefläche zu bieten.

### Connection of the protective conductor

A screw M8 with washer and lockwasher is provided for connection of the protective conductor on the transformer base. The cross section of the protective conductor must be at least  $16\text{mm}^2$  of copper or  $50\text{mm}^2$  of hot-dip-galvanized steel. If flat material is used, the width should be at least 20mm to provide sufficient contact area for the M8 earth screw.

## Anschlusszonen / Terminal zones

Mit Stoß- und Wechselspannung geprüfte Anschluß-  
zonen.

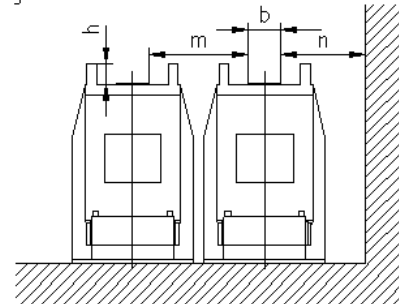


ohne Barriere/without barrier

Maße in mm  
dimensions in mm

Typ type	mit B. with b.			ohne B. without b.		
	h	m	n	m	n	
GIS12/GSWS12D	26	110	110	110	110	
GIS24/GSWS24D	60	210	230	210	230	
GSWS12				110	110	
GSWS24				210	230	

terminal zones being tested by impulse and a.c.  
voltage.



mit Barriere/with barrier

b=Breite der spannungsführenden  
Teile; Anschluß oder Schiene  
b=width of live parts terminals  
or current bar



## **Vor Inbetriebnahme / before installation**

Bei Ankunft einer Lieferung die Verpackung auf äußere Beschädigung kontrollieren. Falls eine Beschädigung erkennbar ist, in Gegenwart des Transportbeauftragten feststellen ob der Wandler selbst beschädigt ist und in diesem Fall ein Protokoll (Lieferscheinvermerk) aufnehmen. Im Normalfall den Wandler nicht auspacken bevor er montiert wird.

The packing case should be inspected for visible transportation damage immediately on arrival. If the case exhibits damage, the current transformer should be unpacked and inspected for possible damage in the presence of the carrier's representative, and, if necessary, a damage report (comment in delivery note) should be prepared. Under normal circumstances, however, the transformer should not be unpacked before installation.

## **Wartung / Maintenance**

Die Stromwandler bedürfen keiner besonderen Wartung.

Bei geringer Verschmutzung die Gießharzoberfläche mit einem trockenen Lappen abwischen. Ist die Verschmutzung stärker, kann diese mit einem Lappen beseitigt werden, der mit handelsüblichem Reinigungsmittel getränkt ist.

The current transformer does not require any special maintenance.

If the cast resin surface is slightly soiled, it should be wiped clean with a dry cloth. In case of more severe soiling, a cloth soaked in commercially available detergent should be used.

