

# Operating Manual

**IP23**

EN

**Three-Phase-Low-Voltage-Squirrel-Cage Machines**



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## Model Sizes 180M-400X

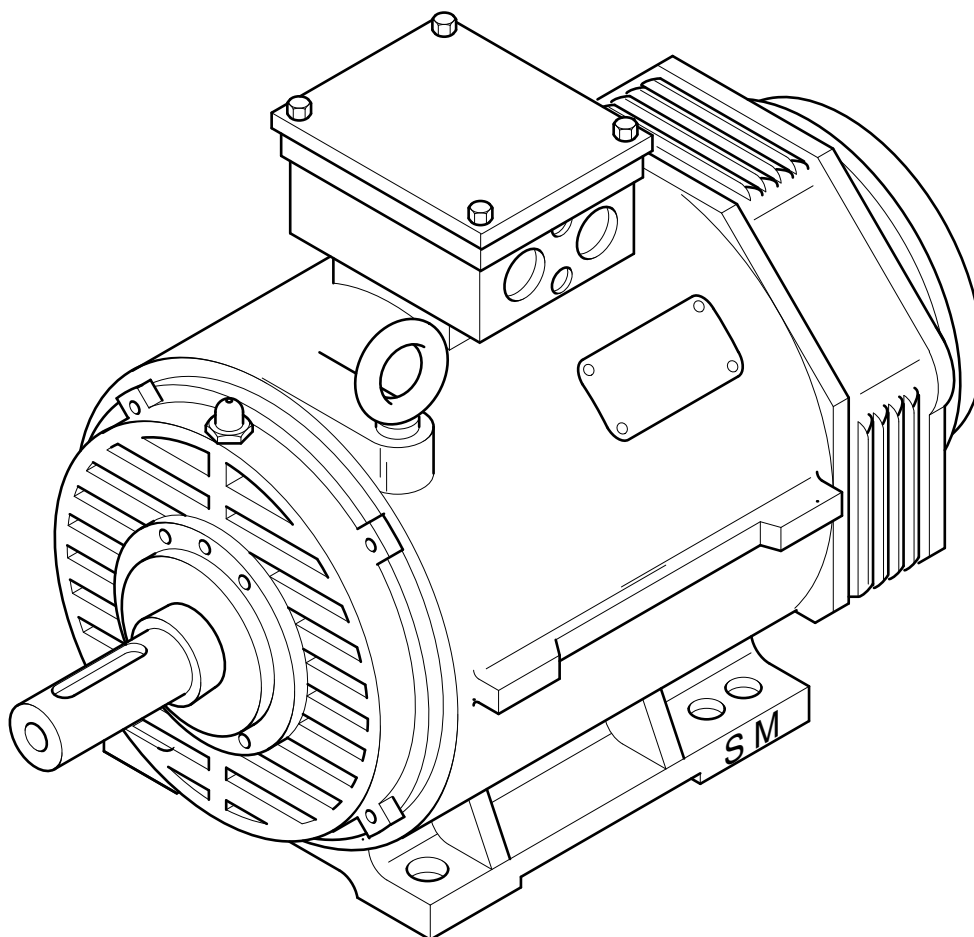
### Squirrel-cage rotors

Type BN7, BX7, KN7, KT7, KX7, KR7, DN7, EN7

Example, Diag.1

**Three phase squirrel-cage motor with squirrel-cage rotor**

**Basic model KN7**



*Diag.1: Model size 180M-400X - Type KN7*

## 1 Safety Instructions

### 1.1 General Instructions

Read the operating manual before transportation, assembly, commissioning, maintenance and repair, and comply with its instructions!

### 1.2 Symbols

In this operating manual 4 symbols are used which must receive special attention:



**Instructions concerning safety and the guarantee:  
The possibility of personal injury is included here.**



**Warns of electrical voltage.**



**Points out that damage to the electrical machine and / or auxiliary fittings can occur.**



**Indicates useful advice and explanations.**

# Safety Instructions

## 1.3 Safety Regulations

Observe

- the safety regulations,
- accident prevention regulations,
- guide lines and acknowledged technical rules,

cited in this operating manual!

Non-compliance with safety regulations will result in the endangering of personnel and damage to the machine.

## 1.4 Regulations, Standards

When working on the electrical machine observe all valid accident prevention regulations and generally acknowledged technical rules!

- EN/IEC 60034, edition 04.2005, Rotating electrical machines
- Harmonized European standards EN 60034
- VDE requirements
- EN 50110, edition 06.2005, Operation of electrical installations
- Industrial Safety Order

## 1.5 Conditions of Connection

Observe the regulations and conditions of connection laid down by the local electrical supply utility when connecting the electrical machine to the mains supply!



**All work on the electrical machine's electrical connections may only be carried out by electricians!**

## 1.6 Inscriptions, Warning Signs

Comply with all instructions located on the electrical machine itself, such as, rotational direction arrows, instruction signs, inscriptions or warning signs, and keep the same in a readable condition.

## 1.7 Working on the Electrical Machine

Only qualified personnel may work on the electrical machine.

Qualified personnel are those persons who, on account of their professional training, experience and instruction, have sufficient knowledge of

- safety regulations,
- accident prevention regulations,
- guide lines and acknowledged technical rules (e.g. VDE requirements, DIN standards).

The qualified personnel must

- be able to assess the work assigned to them and recognize and avoid possible dangers.
- be authorized by those responsible for the safety of the plant to carry out the required work.



# Important Instructions

## 2 Important Instructions

### 2.1 Stipulated Usage

This operating manual is valid for ventilated-enclosures electrical machines designed for low-voltage use and of protection type IP 23, in accordance with EN 60034 - Part V.

In explosive environments only electrical machines which possess a registered explosion-protection type may be used.

Any other usage which goes above and beyond that stipulated is considered as non-stipulated usage. Within the terms of his guarantee the manufacturer accepts no liability for damage resulting from any such usage.

### 2.2 General Instructions

Use of this operating manual alleviates safe and proper transportation, assembly, commissioning, maintenance and repair of the electrical machine.

We reserve the right to technical changes made through further development of the electrical machine dealt with in this operating manual.

Illustrations and drawings presented in this operating manual are simplified portrayals. On account of improvements and changes it is possible that the illustrations do not agree exactly with the electrical machine operated by you. Technical specifications and dimensions are not binding, and any possible claim cannot be based thereupon.

We reserve all copyright to this operating manual and the drawings and other documents contained there in.

The manufacturer accepts no liability for damages,

- which arise during the period covered by the guarantee as a result of
  - negligent maintenance,
  - improper operation,
  - faulty installation,
  - wrong or inexperienced connecting of the electrical machine.
- which result directly or indirectly either from unilateral changes to the machine by the user or from non-compliance with the manufacturer's recommendations.
- which arise from the use of spare parts / accessories not recommended or supplied by the manufacturer.

# Important Instructions

## 2.3 Installation

The electrical machines are suitable for indoor installation.

The machines may be operated at heights of  $\leq 1000$  m above sea level, at ambient temperatures of  $-20$  to  $+40^{\circ}\text{C}$ . Exceptions are specified on the rating plate.

## 2.4 Ventilation

The distance between the air intake and any driven appliances, covers etc., must be at least  $1/4$  of the diameter of the air intake aperture. As a rule, air stream flow is from the drive side to the non-drive side.



The exhausting air stream must not be directly sucked in again. Keep the air intake and exit apertures free from dirt.

Models with upward-facing shaft ends are to be fitted (to be undertaken by the customer) with a suitable cover which prevents foreign objects falling into the ventilation aperture and also protects against water penetration. Cooling of the electrical machine must not be adversely affected by the cover.

For pipe-ventilated electrical machines air intake and exit is effected, as a rule, via a system of pipes. When supplied, the electrical machines correspond to protection type IP 00 (rating plate specification). Protection type IP 54 can be achieved through suitable modifications to the piping system. In doing this, however, the pressure drop in the outer circuit must not exceed the permitted values as stated in the table.

AIR-flow rate „V“ and allowable pressure reduction „p“ in the exterior circuit									
Shaft centre height	Type	3000 [ $\text{min}^{-1}$ ]		1500 [ $\text{min}^{-1}$ ]		1000 [ $\text{min}^{-1}$ ]		750 [ $\text{min}^{-1}$ ]	
		V [ $\text{m}^3/\text{min}$ ]	p [Pa]	V [ $\text{m}^3/\text{min}$ ]	p [Pa]	V [ $\text{m}^3/\text{min}$ ]	p [Pa]	V [ $\text{m}^3/\text{min}$ ]	p [Pa]
180	KN7 180.-	11,0	70	8,0	20	5,5	15	4,5	10
200	KN7 200.-	12,0	70	9,0	20	6,0	20	5,0	10
225	KN7 225.-	15,0	60	14,0	40	7,0	20	6,4	15
250	KN7 250.-	21,0	90	19,0	40	13,0	30	9,0	20
280	KN7 280.-	23,0	60	26,0	50	17,0	40	13,5	30
315S/M	KN7 315.-	28,0	70	34,0	60	23,0	50	17,0	30
315L	KN7 315L-	34,0 <sup>1)</sup>	70	36,0	60	24,0	50	18,0	30
315X	KN7 315X-	39,0	80	38,0	70	25,5	50	19,0	30
355	KN7 355.-	50,0	100	51,0	80	34,0	50	25,0	30
400	KN7 400.-	75,0	130	75,0	120	75,0	110	75,0	100

- 1) Air-flow rate for model KN7318L and KN7319L =  $40\text{m}^3/\text{min}$ ,  
allowable pressure reduction = 50 Pa

# Important Instructions

## 2.5 Electromagnetic Compatibility

The electrical machines correspond at least EN 50081 Part 2 (electromagnetic compatibility, generic commission standard part 2: industrial environment) in accordance with VDE 0839 Part 81-2. This suffices for the operation of electrical machines in industrial areas.

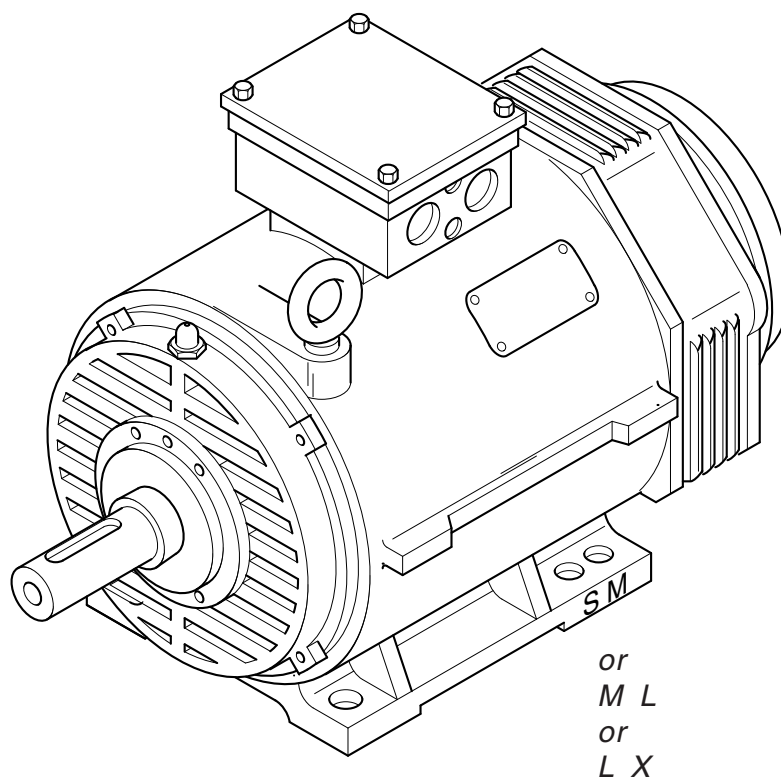
For the operation of electrical machines in residential areas suppression classes N (normal degree of interference) or K (small degree of interference) can be requested. We recommend that, according to local conditions, a measurement of interference voltage is undertaken and suitable means of suppression is fitted accordingly.

## 2.6 Feet Anchoring Holes (Diag.2)

Electrical machines with shaft heights of 180, 200, 250, 280 and 315 each have only one housing length.

On the non-drive side the securing feet each have 2 drilled holes.

Secure the electrical machine in accordance with the model-size abbreviations, S, M or M, L or L, X, which are cast into the base plate.



*Diag.2: Feet anchoring holes S,M or M,L or L,X*

## 3 Transportation

### 3.1 Safety Instructions



**When raising and transporting the machine observe the applicable accident prevention regulations and any generally acknowledged technical rules!**

### 3.2 Lifting Eyes



Only suspend electrical machines from the lifting eyes provided.

Do not attach any additional load to the electrical machine; the lifting eyes are only designed to take the weight of the electrical machine.

Other supplementary lifting eyes which may possibly be available, e.g. on fan hoods, cooler fittings etc., are only suitable for the lifting of the respective individual parts.

### 3.3 Securing Procedures for Transportation

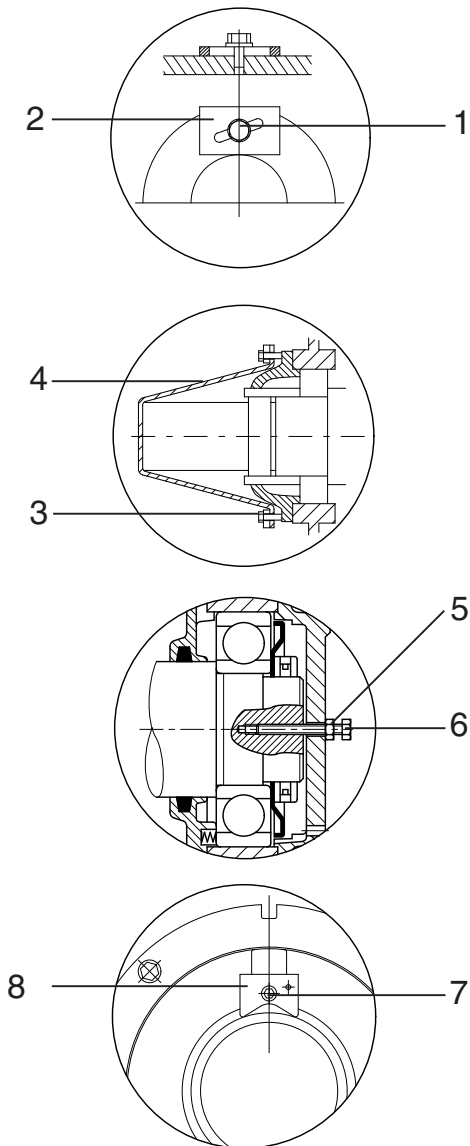
Electrical machines fitted with cylindrical roller bearings are protected against bearing damage by a transportation securing device.



Remove this device before commissioning and pack the securing hole with the plug supplied.

Use the transportation securing device again if further transportation is required.


# Transportation



Diag.3: Example of securing procedures for transportation

## Securing procedures for transportation, examples


- Clamp fixing:
  - Undo bolts (1) and remove clamp fixing (2).
  - Stop up the threaded hole with the plug.

 Plug is attached to the information plate (drive shaft).

- Rod fixing:
  - Undo bolts (3) and remove the rod fixing (4).
  - Screw in and tighten the shorter bolts supplied.

- Clamping screw fixing:
  - Loosen the nut (5) and undo the clamping screw (6).
  - Stop up the threaded holes with the plug.

- Clamp fixing:
  - Undo bolts (7) and remove transportation shackle (8).
  - Stop up the threaded hole with the plug.

 The machine is fitted either with a clamp fixing or a rod fixing.

## 3.4 Transport Damage

Document any transport damage and immediately inform the transport company, insurance company and the manufacturer!

# Assembly and Commissioning

## 4 Assembly and Commissioning

### 4.1 Safety Instructions



During assembly and commissioning observe the following:

- safety instructions pages 5-7,
- important instructions pages 8-10!

Assembly work may only be carried out by qualified personnel who, on account of their professional training, experience and instruction, have sufficient knowledge of

- safety regulations,
- accident prevention regulations,
- guide lines and acknowledged technical rules (e.g. VDE requirements, DIN standards).

The qualified personnel must

- be able to assess the work assigned to them and recognize and avoid possible dangers.
- be authorized by those responsible for the safety of the plant to carry out the required work.



It is recommended that you request the assistance of the manufacturer's assembly personnel.

# Assembly and Commissioning

## 4.2 Mechanical

### 4.2.1 Transmission Components



Only use flexible couplings;  
rigid couplings require special bearings.

The keys located in the shaft ends are not particularly secured against falling out.

Should a machine with two shaft ends have no drive element fitted on one of these shaft ends, ensure that the unused key cannot spin off the shaft. If the machine is of balance type „H“ then the key should be shortened by half!

When using transmission components which cause radial or axial shaft loadings (e.g. drive belt wheels, sprockets etc.), take care that the permitted loading is not exceeded. Refer to the specifications given in our respective applicable technical list.

Each rotor is dynamically balanced according to its balance type with a full, a half or no key and, in accordance with ISO 8821, is labelled thus:

F = full key,  
H = half key,  
N = no key.



Rotors balanced with a full key → balance the drive component with open key groove.



Rotors balanced with a half key → balance the drive component in a ungrooved state.

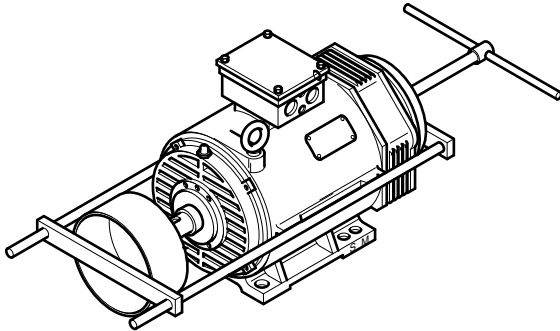
- Balance the drive component in accordance with the type of balance of the rotor. For shorter drive components machine off that part of the key which projects beyond the drive component and above the surface of the shaft.
- Before fitting the drive component onto the shaft remove the anti-corrosion film on the shaft end with a suitable cleaning agent (e.g. naphtha).



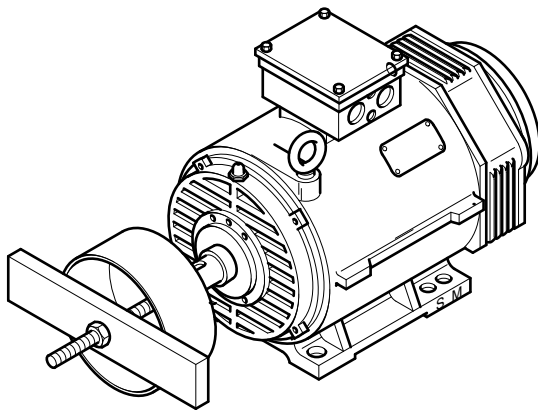
Do not use emery or rub down the shaft to remove the protective film!

# Assembly and Commissioning

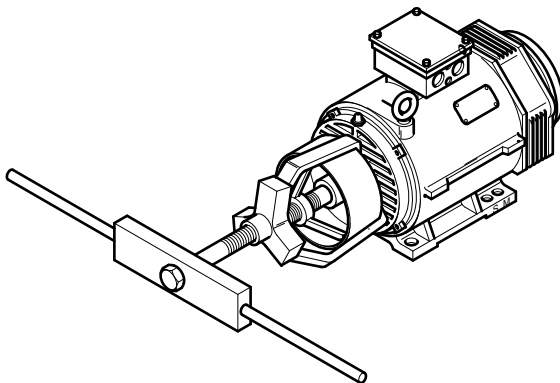
- Lightly grease or oil all seating surfaces and fit the drive element.



*Diag.4: Fitting without a centre bore.*



*Diag.5: Fitting with a centre bore.*



*Diag.6: Dismantling.*



In order to protect the roller bearing, the drive element should only be fitted (→ Diags.4 & 5) / dismantled (→ Diag.6) with the aid of suitable tools.

If necessary heat (according to amount of shrinkage needed) the drive component prior to fitting.



Avoid hard blows and knocks when fitting the drive component. The bearings and / or the shaft will be damaged and the manufacturer's guarantee will be null and void.



# Assembly and Commissioning

## 4.2.2 Machine Base

The kind of supporting surface required for the machine base is one which can ensure machine operation which is shock-free, low in vibration and torsionally rigid.

- Secure the electrical machine on a level shock-free supporting surface.



All securing feet must lie on an even, level plane in order to avoid stress in the housing.

Wrong installation can lead to resonances in rotary frequency and double mains frequency range.

In order to avoid damage to electrical machines in an idle state (stand-by operation) the following maximum rates of vibration must not be exceeded.

Idle Time	Rate of Vibration
up to 500 hrs	0,4 mm/s
more than 500 hrs	0,2 mm/s

### 4.2.2.1 Assessment Criteria for Vibration

With regard to vibration at the site location, the assessment criteria laid down in DIN ISO 3945 are to be complied with.

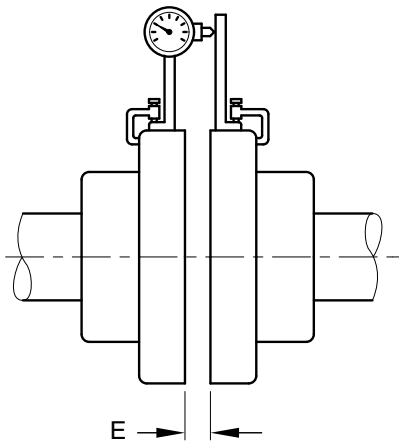
For rigid foundations the following measured values on the bearing housing can be considered as limiting values:

- 5.5 mm/s for the alarm,
- 11 mm/s for switch-off.

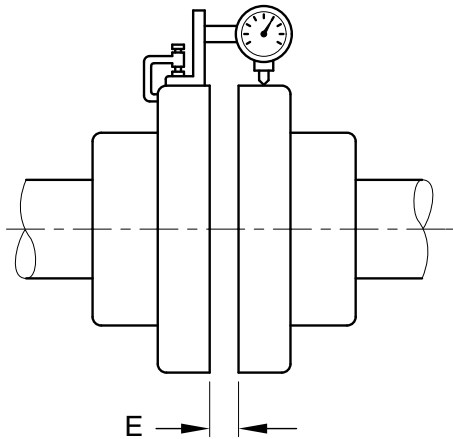


Should vibration values between the alarm and switch-off values become apparent, operation of the electrical machine can continue under observation. The possibility of resultant damage to the electrical machine cannot be excluded. If necessary, inform the manufacturer.

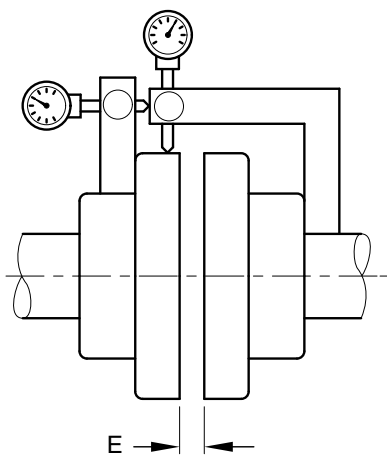
# Assembly and Commissioning



Diag.7: Angular alignment



Diag.8: Parallel alignment



Diag.9: Combined angular and parallel alignment

## 4.2.3 Alignment

- Align the electrical machine precisely in accordance with the already aligned driven appliance.
- Clamp on the dial gauges firmly. Carry out measurements at four measuring points, each separated by 90°, whilst simultaneously turning both halves of the coupling.

### 4.2.3.1 Angular Alignment (Diag.7)

Compensate for any differences by inserting plates. Ensure that any residual inaccuracy, in reference to a measured radial diameter of 200 mm, does not exceed 0.03 mm.

### 4.2.3.2 Parallel Alignment (Diag.8)

Compensate for any differences by re-positioning or by inserting suitable plates so that the residual inaccuracy does not exceed 0.03 mm. Adjust the axial air gap between the two halves of the coupling (dimension „E“) in accordance with the specifications given by the coupling manufacturer.



Check alignment when the machine is in an operationally warm state.

### 4.2.3.3 Combined Angular and Parallel Alignment (Diag.9)

Diag.9 shows a method of combining both measurements which is relatively simple in concept. The dial gauges are placed in the corresponding holes of the flat bars (which are screwed or clamped on) and are then fixed by means of, for example, grub screws.

# Assembly and Commissioning

## 4.2.4 Additional Fitted or Attached Parts

In order to protect the electrical machine various accessories may be fitted or attached subject to order, e.g.:

- temperature sensor for monitoring windings and bearings,
- space heater,
- measuring nipple for bearing monitoring.



Special instructions for assembly and operation of fittings and attachments obtained elsewhere than from the manufacturer, are included.

# Assembly and Commissioning

## 4.3 Electrical



**All work on the electrical machine's electrical connections must only be carried out by electricians!**

### 4.3.1 Insulating Resistance



**Do not touch the connection terminals either during or after measuring. The terminal connections can carry high voltages! After carrying out the check earth the terminal connections briefly (5 seconds).**

- Using a hand generator (max. D.C. voltage = 630V) measure the insulating resistance of each individual phase to earth. Continue measuring until the measured value is constant.



The insulating resistance of new windings is  $> 10 \text{ M}\Omega$ .  
Dirty and damp windings have considerably lower resistance values.

A winding is seen to be dry enough when the insulation resistance referred to 75 °C is at least  $1 \text{ M}\Omega$  per 1kV —> Table.

If the values in the table are exceeded, the winding is too dry or has to be cleaned. In this case, the winding temperature may not exceed 75 °C.

Rated voltage	Winding temperature of the cold machine			Reference temperature
$U_N$	15°C	25°C	35°C	75°C
0,5 kV	30 M $\Omega$	15 M $\Omega$	8 M $\Omega$	0,5 M $\Omega$
1,0 kV	60 M $\Omega$	30 M $\Omega$	15 M $\Omega$	1,0 M $\Omega$

Dry it using the standby heating, or a heating device, or by applying an alternating voltage of 5 – 6 % of the nameplate voltage (delta-connection) to the stator terminals U1 and V1.



Insulating resistance values are dependent on temperature.  
Standard values: A rise or fall in winding temperature by 10 K has the effect of respectively halving or doubling the resistance value.

Remove condensed water drops, if present, before drying the winding. After finishing the drying process, close the condensed water openings tightly.

### 4.3.2 Voltage and Circuit

Observe the circuit details given on the rating plate and compare the operating voltage to the mains voltage.

The permitted fluctuation in mains voltage amounts to  $\pm 5\%$ . Exceptions are specified on the rating plate.

# Assembly and Commissioning

## 4.3.3 Connection

**Connect the power connecting cable according to the applicable regulations of the local power supply companies in compliance with the DIN VDE directives, the safety instructions and the accident prevention regulations.**

- Connect mains feeds with care, so that the contact force required for an electrical connection will be maintained over a long period (→ table on tightening torques, terminal layout and special arrangement of securing nuts [see Illustration]).

If no other precise specifications have been made, the following tightening torques are valid for normal connections of securing screws and nuts used for electrical connections.

Tightening torques (Nm with a tolerance of $\pm 10\%$ ) for thread sizes of							
M5	M6	M8	M10	M12	M16	M20	M24
2	3	6	10	15,5	30	52	80

In electrical connecting work, the permitted torque is usually limited by the bolt material and / or the loading capacity of the insulators.



All electrical machines have a connection diagram on the inner side of the terminal box cover.

The cable feed aperture can be turned by 90° or 180° .



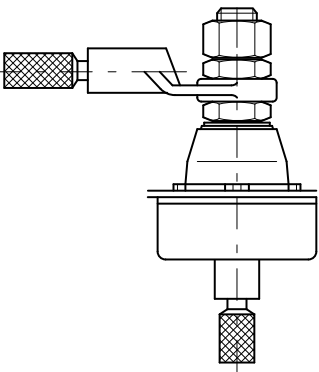
Match the cross-sectional area of the connecting cable to the rated current strength.

To avoid tension in the terminal connections fit the cable so it is not pulling from the connectors.

Take care that there are no foreign bodies, dirt and / or dampness present in the terminal box.

To guarantee the protective type when sealing the terminal box, use original seals.

Seal any unused cable feed apertures so that they are dust- and water-tight.



# Assembly and Commissioning

## 4.3.4 Terminal box position (side)

Swapping the side-fitted terminal box position from RIGHT to LEFT or vice versa, is not possible (with the exception of model size 315X and shaft height 355+400).

## 4.3.5 Direction of Rotation

Under normal conditions the electrical machines are suitable for operation in both directions of rotation. Exceptions are indicated on the rating plate with a corresponding directional arrow. For each respective direction of rotation the following stator connections are given:

Connection of L1, L2, L3	Direction of rotation viewed on the drive side
U1 - V1 - W1	right (cw)
W1 - V1 - U1	left (ccw)

- Check the direction of rotation by quickly switching the electrical machine (which has been connected in accordance with the regulations) „On / Off“ in its uncoupled state.



**When checking the rotary field only the tester may remain in the danger area of the machine / driven appliance. Switch on the machine and check the direction of rotation.**

Reversal of direction of rotation:	
Type of switch-on and winding	Measures
Direct switch-on and pole-shift motors with separate windings	Exchange two supply-cable conductors on the motor terminal board.
Star or delta connection and pole-shift motors with DAHLANDER winding	Exchange two supply-cable conductors at the incoming supply to the contactor combination.

# Assembly and Commissioning

## 4.3.6 Y/Δ -start

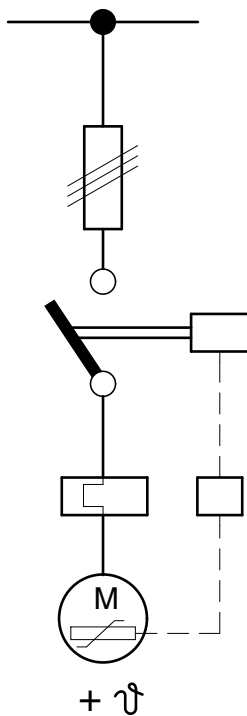


To avoid unpermitted transient current and torque impacts, the cross-over from Y to Δ may only be effected if the start current of the Y stage has decayed.

During the run-up phase the machine should only be switched off in an emergency, in order to protect the switchgear and the machine itself.

## 4.3.7 Electrical Machine Protection

- Connect the built-in semi-conductor temperature sensor to the trigger mechanism in accordance with the circuit diagram.
- Any possibly required continuity check of the temperature sensor should only be carried out using a measuring bridge (max. 5V).



In order to achieve total thermal protection of the machine, fit a supplementary thermally-delayed overload protector (→ Bild 10). Safety fuses alone tend to just protect the mains supply and not the electrical machine.

*Diag.10: Protection using over-current relay, thermistor protector and fuse.*

## 5 Maintenance

### 5.1 Safety Instructions



**Maintenance work (except for greasing work) is only to be carried out when the machine is standing idle.**

**Ensure that the machine is safeguarded against accidental switch-on and is labelled with a corresponding warning sign.**

**Observe the safety regulations and accident prevention regulations of the corresponding manufacturer when using oils and greases, cleaning agents and spare parts!**

**Maintenance work on the machine's electrical power supply or to the electrical auxiliary / control supplies may only be carried out by electricians.**



**Ensure that the machine is switched so that it is not live.**

**Ensure that the machine cannot be switched on again and label it with a warning sign!**

**Ascertain that the machine is not live!**

**Earth and short-circuit!**

**Cover or cordon off any neighbouring parts which are still live!**



**Ensure that the auxiliary power circuits e.g. space heater etc., are switched so as not to be live.**



# Maintenance

## 5.2 Cleaning



Do not wash down the machine with water or other liquids.

- Check the whole cooling airway for dirt annually.
- In the event of severe dirt deposits dismantle the electrical machine and remove the deposits using suitable cleaning agents (e.g. superheated steam).
- Finally dry the winding and measure the insulating resistance.



During these procedures observe the specifications on page 19 given under 4.3.1 Insulating resistance.

## 5.3 Ball and Roller Bearing Maintenance

- Monitor bearing temperature during operation.
- Check the bearing for noise when running.
- Greasing of roller bearings.
- Renewing the bearings.



- Should a rise in temperature or running noises occur during operation, switch off the electrical machine immediately in order to avoid any resulting damage.
- Dismantle the bearing and check for damage.
- Should there be darkly coloured, matt- or polished-effect areas on the bearing, fit a new bearing.



The operational safety of the electrical machine is dependent upon maintenance of the lubrication schedule.

As a standard feature all electrical machines are supplied with a lubricating appliance which has a grease volume regulator.

Initial lubrication of the bearing is carried out at our factory. The lubricating schedule and lubricant volumes are specified on the rating plate.

In the basic model the electrical machines are fitted with a button head grease nipple, M10 x 1, in accordance with DIN 3404.

## 5.3.1 Grease Nipple

The use of special grease, provided that the special operational circumstances were known at the time of ordering, can be taken from the rating plate specifications.

For basic model electrical machines the bearing can be re-filled (without cleaning) using lithium-saponified roller bearing grease K3k in accordance with DIN 51825, for example, SKF LGMT3, Shell Alvania G3, Esso Beacon 3 etc..



Clean the bearing assemblies thoroughly if changing over to a grade of grease with a different saponification base. Take care that the roller bearing grease to be used fulfils the following conditions:

- Drop point            approx. 190°C
- Ash content         4%
- Water content      0,3%



Changing over to a grade of grease with a different saponification base requires consultation with the machine manufacturer (specify lubricant plate).

## 5.3.2 Lubrication



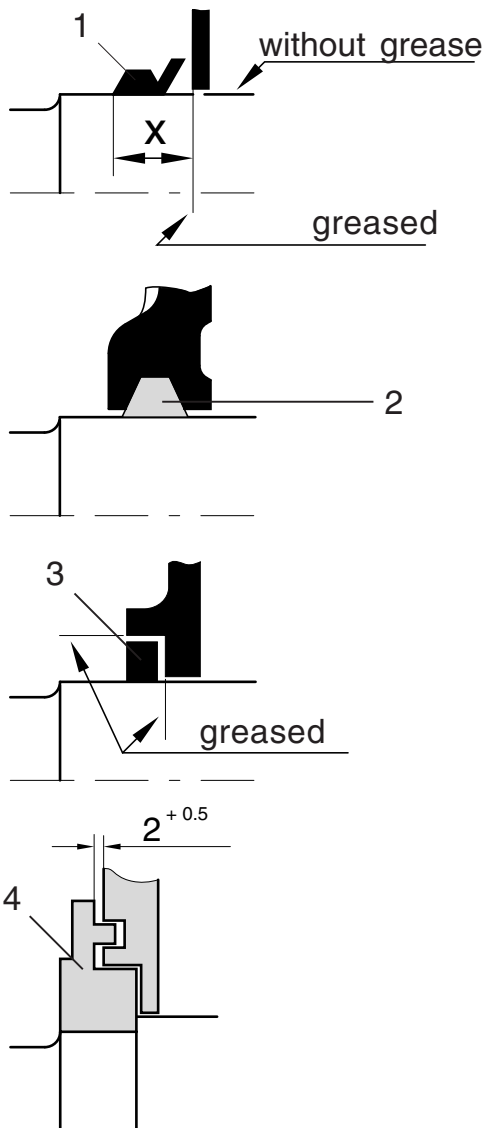
**Only carry out lubricating work when the machine is running:  
Be careful of moving parts!**



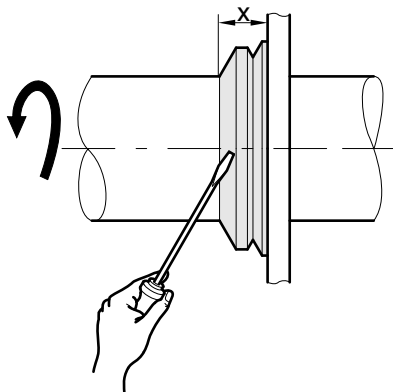
Observe the lubricant specification given on the rating or lubricant plate.

- Clean the grease nipple and apply the corresponding amount of grease (using the correct grade of grease) by means of a grease gun. To achieve this weight the grease gun both before and after use.

# Maintenance



Diag.11: 1 V-ring  
2 Felt ring  
3 Neoprene sealing ring  
4 Labyrinth ring



Diag.12: V-type sealing ring

## 5.4 Bearing Seals (Diag.11)

- Before fitting new felt rings (2) into the bearing cover, soak them in high-viscosity oil heated to 80°C. The shaft must slide easily in the felt ring and be completely sealed radially.
- Lightly grease the running faces.
- Push on the sealing rings (3) and V-rings (1), e.g. using a screwdriver whilst simultaneously turning the shaft (→ Diag. 12).



When fitting V-rings onto flat sealing surfaces the dimension „X“ must be maintained.

Non-compliance will lead to overheating or destruction of the V-ring, or will result in a bad seal.

V-ring type	Fitting dimension X (mm)
V-25 to V-38	9,0 -0,3
V-40 to V-65	11,0 -0,3
V-70 to V-100	13,5 -0,5
V-110 to V-150	15,5 -0,5

- Before assembling the labyrinth ring heat it up to approx. 60 - 80°C and push it against the bearing cover, whilst simultaneously laying spacing plates (2mm) in between.

## 5.5 Bearing Change – Shaft Height (AH) 180 to 315

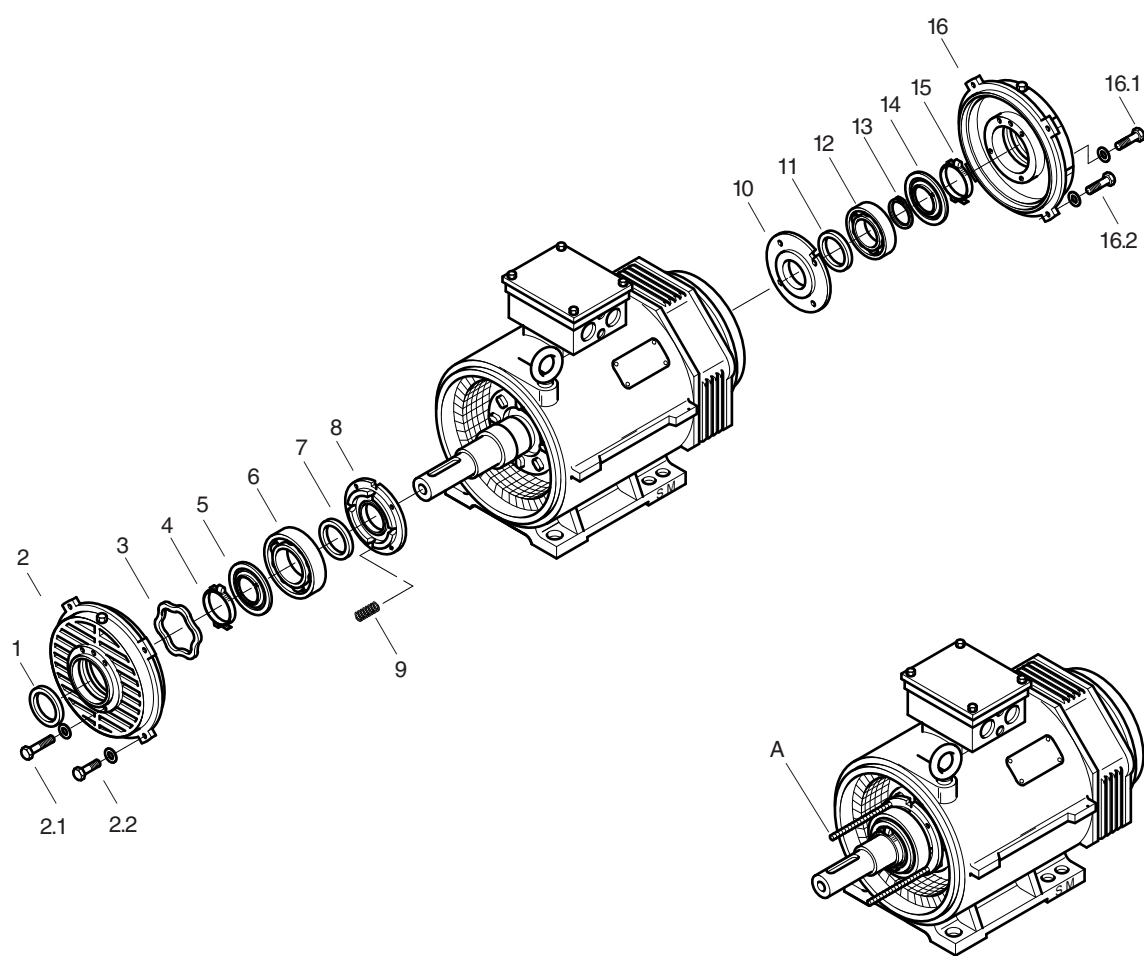


The prior agreement of the electrical machine manufacturer is required for bearing changes undertaken within the warranty period!

### 5.5.1 Dismantling Procedure for Drive and Non-drive Side Deep Groove Ball Bearings (→ Diag. 13) (For drive side cylindrical roller bearing, see 5.5.3)

1. Loosen screws (2.1), (2.2), (16.1) and (16.2). Pull off the bearing shields (2) and (16), together with the bearing seals (1) and (17), taking care not to tilt them.  
Take off the compensation washer (3) – only present on electrical machines  $\leq$  AH200.
2. Loosen and pull off the spring clips (4) and (15) – only present on electrical machines  $\geq$  AH225. Pull off the collar oilers (5) and (14). (Collar oilers fitted in electrical machines of the range AH180 + AH200 have holes in the hub section which can be used for pulling off).
3. Loosen and pull off the securing ring (13).
4. By using a pulling tool and heating the inner ring slightly, remove the deep groove ball bearings (6) and (12).  
Remove the pressure springs (9) – only present on electrical machines  $\geq$  AH225.
5. Pull off the inner bearing covers (8) and (10) together with the seals (7) and (11).
6. The rotor remains in the stator housing.

# Maintenance



Diag. 13: Bearing change AH180 to AH315

## 5.5.2 Assembly Procedure for Drive and Non-drive Side Deep Groove Ball Bearing (→ Diag. 13) (For drive side cylindrical roller bearing, see 5.5.4)



All securing screws must be fitted with the spring washers provided (DIN 6796)

1. Clean off the bearing seats with a suitable cleaning agent, check for any damage and measure the shaft with a micrometer after it has cooled (measurement specifications refer to a temperature of 20°C).
2. Remove the old grease from the inner bearing covers (8) and (10), wash them out using a suitable cleaning agent and allow to dry.  
Fill bearing covers (8) and (10) with new grease (note the correct grade of grease) and push them (along with their seals [7] and [11]) onto the shaft. Grease and set the pressure springs provided (9) into the drilled holes of the bearing cover (8).
3. Heat the new bearing in an oil bath (or using inductive means – de-magnetize afterwards) to a temperature of 80°-90°C .

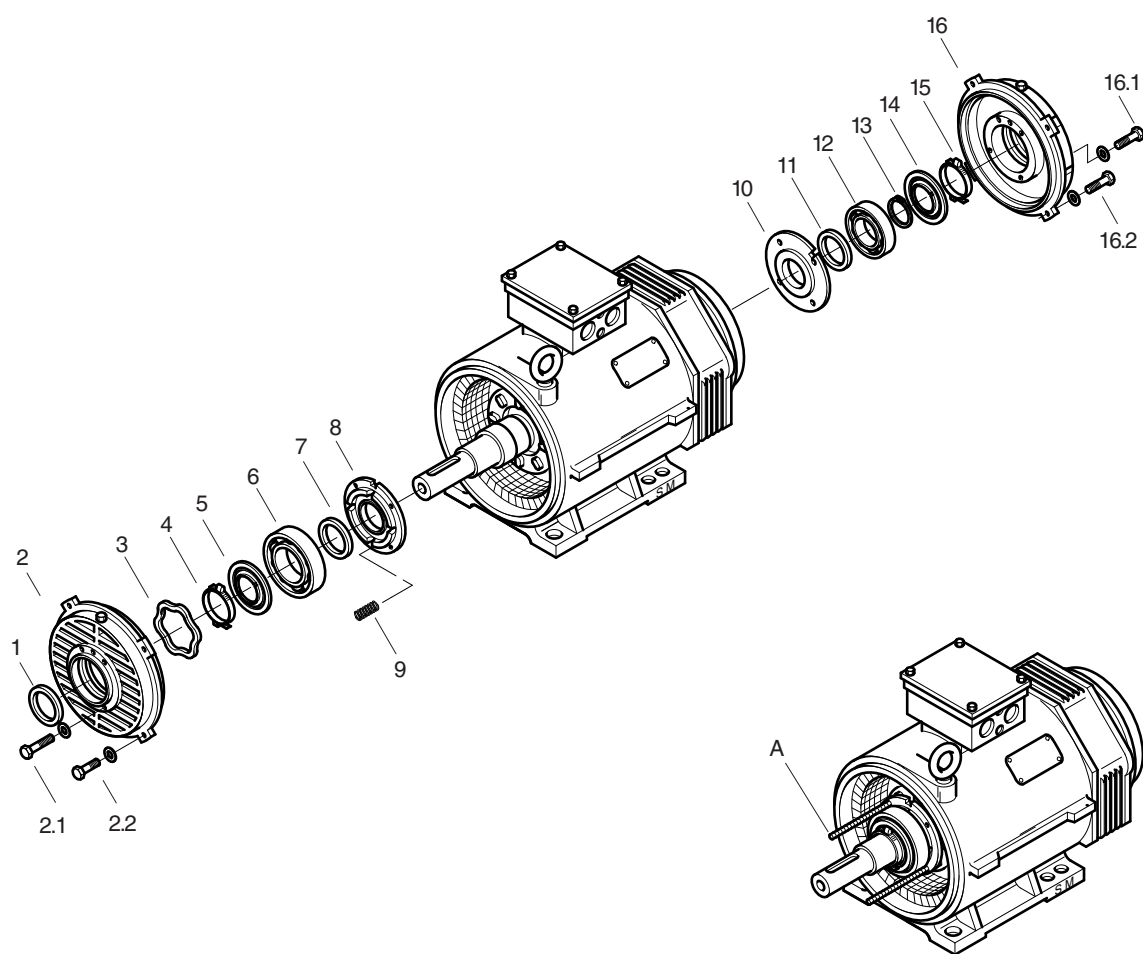


To ensure proper fitting push the heated bearings (6) and (12) onto their shaft seating and press them against the shaft shoulder for approx. 10 secs.

After cooling, pack fresh grease into the bearing spaces (note the grade of grease).

4. Push on the circlip (13) and secure it. Push on the collar oilers (5) and (14). Push on and tighten up the spring clips provided (4) and (15).
5. Remove the old grease from the bearing cover (2) and (16), wash out using a suitable cleaning agent and allow to dry. Pack fresh grease into the grease drain bores and place the compensation washer provided in position on the bearing shield hub.
6. For easy assembly screw in two studs (A) – about 100 mm long – into the threaded holes in the inner bearing cover (8) and (10).  
Push on the bearing shields (2) and (16) and screw down tightly using screws (2.2) and (16.2), together with mounting plate 16.3).  
Tighten up screws (2.1) and (16.1) (at this stage the studs (A) must be removed).
7. Fit the bearing seals (1) and (17) as described on page 26.

# Maintenance




Diag. 13: Bearing change AH180 to AH315


## 5.5.3 Dismantling Procedure for Drive Side Cylindrical Roller Bearing (→ Diag. 14) (For non-drive side deep groove ball bearing, see 5.5.1)

1. Loosen screws (2.1.1) and pull off the bearing cover (2.1) together with the bearing seal (1.1).
2. Loosen and pull off the spring clip (4.1) – only present on electrical machines AH225. Pull off the collar oiler (5.1) (on electrical machines AH180 + AH200 the collar oilers have holes in their hub section which can be used for pulling off).
3. Loosen screws (3.1.1) and pull off the bearing shield (3.1). Press the outer bearing ring (6.1) out of the bearing shield hub.
4. Using a welding torch quickly heat up the inner bearing ring (6.2) and force off using, for example, a screwdriver.
5. Pull off the bearing cover (8.1) together with the bearing seal (7.1).

## 5.5.4 Assembly Procedure for Drive Side Cylindrical Roller Bearing (→ Diag. 14) (For non-drive side deep groove ball bearing, see 5.5.2)

 All securing screws must be fitted with the spring washers provided (DIN 6796).

1. Clean off the bearing seats with a suitable cleaning agent. Check for any damage and measure the shaft with a micrometer after it has cooled (measurement specifications refer to a temperature of 20°C).
2. Remove the old grease from the inner bearing cover (8.1), wash it out using a suitable cleaning agent and allow to dry.  
Fill the bearing cover with new grease (note the correct grade of grease) and push it (complete with bearing seal [7.1]) onto the shaft.
3. Heat the new inner bearing ring (6.2) in an oil bath (or using inductive means - de-magnetize afterwards) to a temperature of 80°-90°C.

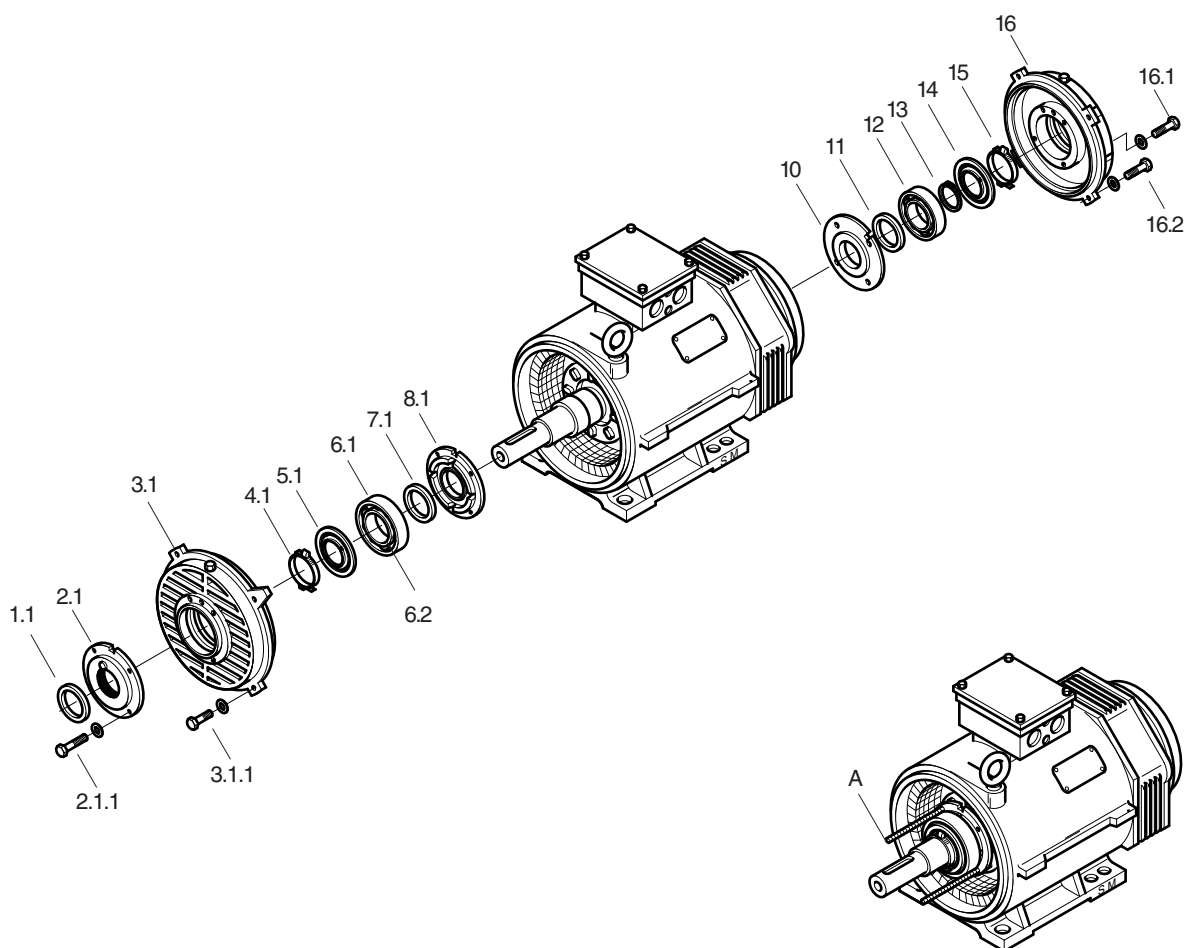
 To ensure proper fitting push the heated inner bearing ring (6.2) onto its shaft seating and press it against the shaft shoulder for approx. 10 secs..  
Lightly grease inner bearing ring (6.2) after cooling.

4. Wash out the hub of the bearing shield (3.1) using a suitable cleaning agent and allow to dry.
5. Press a new outer bearing ring (6.1) into the bearing shield hub and fill the bearing spaces with new grease (note the correct grade of grease).
6. For easy assembly screw in a stud (A) – about 100mm long – into the threaded hole located in the bearing cover (8.1). Push on the bearing shield (3.1) and tighten up using the screws (3.1.1).



# Maintenance

7. Push on the collar oiler (5.1), push on and tighten up the spring clip (4.1) provided.
8. Remove the old grease from the bearing cover (2.1), wash out the cap using a suitable cleaning agent, allow it to dry and pack the grease drain holes with new grease. Push the bearing cover (2.1) onto the shaft and tighten up using screws (2.1.1) (in doing this remove stud [A]).
9. Fit the bearing seal (1.1) as described on page 26.



Diag. 14: Bearing change AH180 to AH315

## 5.6 Bearing Change – Shaft Height (AH) 355+400



The prior agreement of the electrical machine manufacturer is required for bearing changes undertaken within the warranty period!

### 5.6.1 Dismantling Procedure for Drive and Non-drive Side Deep Groove Ball Bearings (→ Diag. 15) (For drive side cylindrical roller bearing, see 5.6.3)

1. Screw in two threaded rods into the threaded holes in the labyrinth plate (1.1) and pull the plate away from the shaft end by means of the threaded rods. Loosen screws (2.1.1/17.1.1) and pull off the bearing covers (2.1/17.1).
2. Loosen the locking screws (shaft nuts), unscrew the shaft nuts (4.1/15.1) using a hook spanner and pull them off the shaft end. Pull off the collar oiler (5.1/14.1), taking care not to damage the torque device (5.1.1/14.1.1) (note fitting position).



Support the rotor at the shaft end! Make sure there is sufficient room to pull out the bearing shield and bearing!

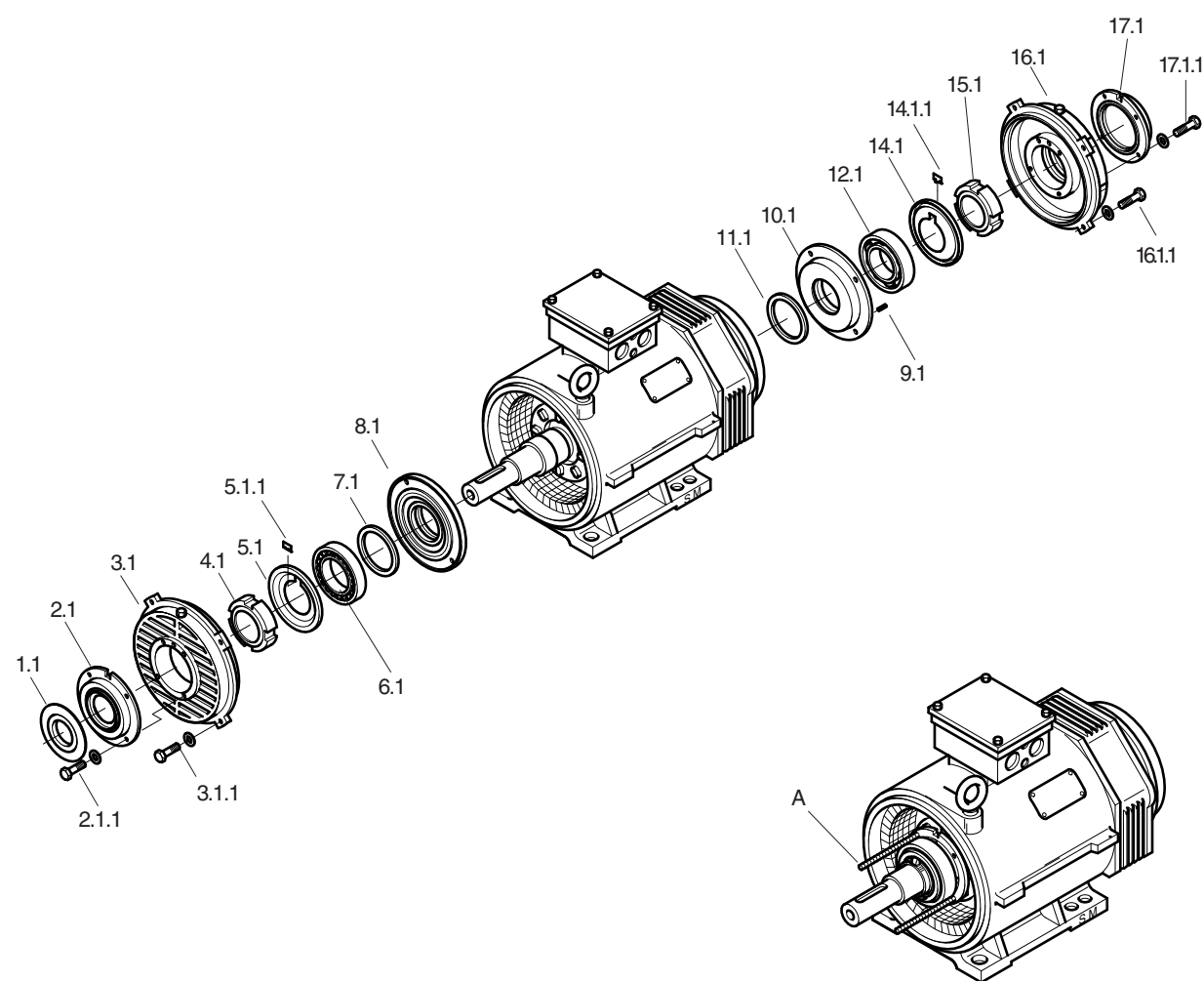
3. Loosen screws (3.1.1/16.1.1) and pull off the bearing shields (3.1/16.1). Dismantle the rotor supports and pull the bearing shield away from the shaft end.



Carefully lay down the rotor in the stator plates.

4. Using a pulling tool and whilst heating the inner ring slightly, pull off the deep groove ball bearing (6.2/12.1). Remove the pressure spring (9.1) – only on the non – drive side bearing cover (17.1).
5. Pull off the inner bearing covers (8.1/10.1) together with the seal (7.1/11.1).
6. The rotor remains in the stator housing.

# Maintenance



Diag. 15: Bearing change AH355+400

## 5.6.2 Assembly Procedure for Drive and Non-drive Side Deep Groove Ball Bearing (→ Diag. 15) (For drive side cylindrical roller bearing see 5.6.4)



All bearing shield securing screws must be fitted with the spring washers provided, and bearing cover screws must be fitted with the sealing washers provided!

1. Clean off the bearing seats with a suitable cleaning agent, check for any damage and after allowing it to cool measure the shaft with a micrometer (measurement specifications refer to a temperature of 20°C).
2. Remove the old grease from the inner bearing covers (8.1/10.1), wash them out using a suitable cleaning agent, allow to dry and then fill them with new grease (note the correct grade of grease, → rating plate). Push the bearing covers (8.1/10.1) with their seals (7.1/11.1) onto the shaft. Set the pressure springs provided (greased) into the drilled holes of the inner bearing cover (10.1).
3. Heat the new bearing, either in an oil bath or using inductive means (de-magnetize afterwards) to a temperature of 80°-90°C.

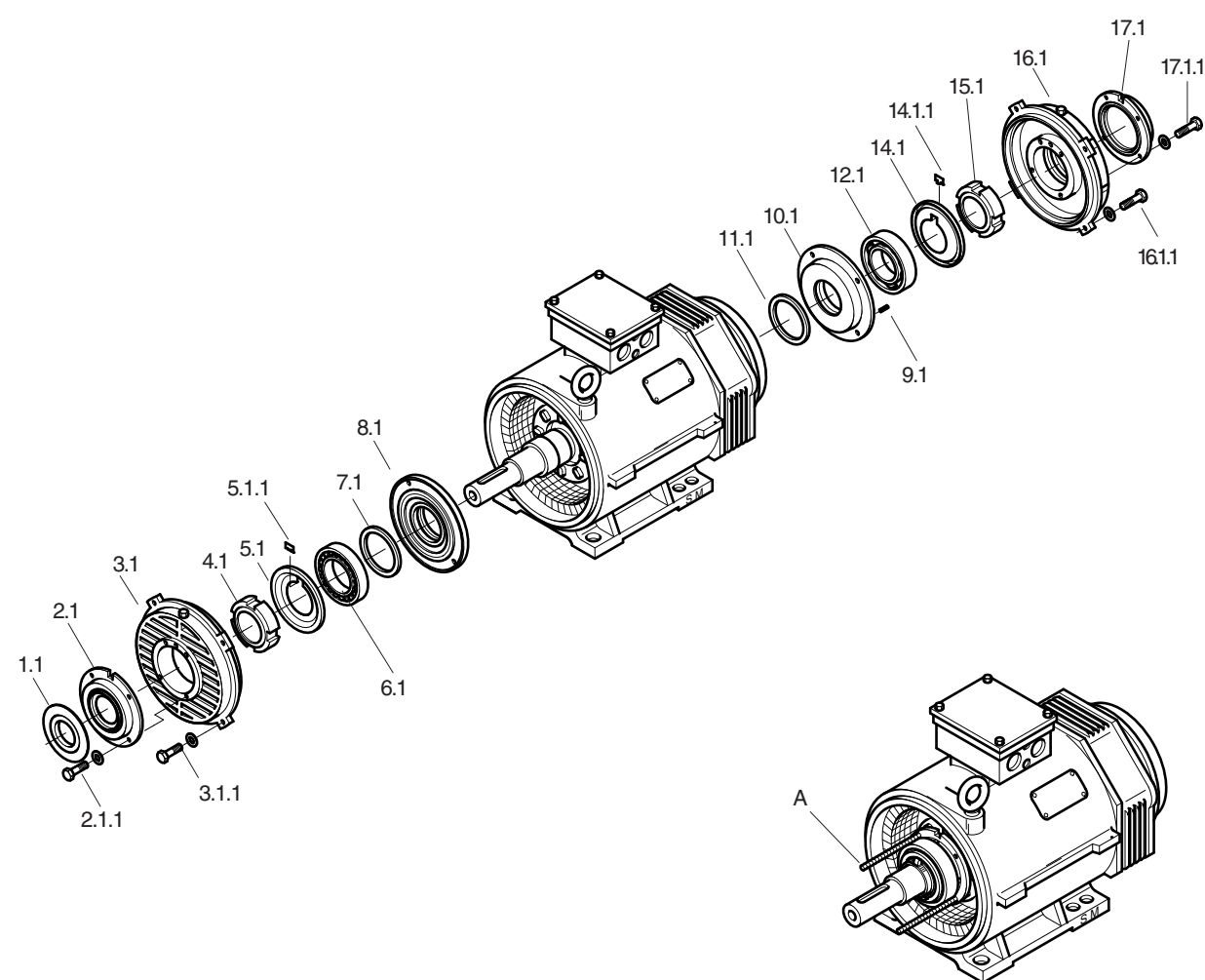


To ensure proper fitting push the heated bearings (6.1/12.1) onto their shaft seatings and press them against the shaft shoulder for approx. 10 secs..

After cooling, pack fresh grease into the bearing spaces (note the grade of grease).

4. Push on the collar oilers (5.1/14.1). Place in the torque devices (5.1.1/14.1.1) (Attention! Angled end towards the bearing!). Screw on the shaft nuts (4.1/15.1), tighten them using a hook spanner and secure the shaft nuts by means of the locking screws.
5. Remove the old grease from the outer bearing cover (2.1/17.1), wash out using a suitable cleaning agent, allow to dry and pack fresh grease into the grease drain bores.
6. For easy assembly screw in two studs (A) – about 100 mm long – into the threaded holes in the inner bearing cover (8.1/10.1). Push on the bearing shields (3.1/16.1) and screw down tightly using screws (3.1.1/16.1.1) (with spring washers). Push the outer bearing covers (2.1/17.1) onto the shaft and screw down tightly using screws (2.1.1/17.1.1) (with sealing washers). Pack the labyrinth ways in the bearing cover (2.1) with a small amount of grease. Heat the labyrinth plate to approx. 60°-80°C, and push it against the bearing cover (2.1). Note the gap between the bearing cover (2.1) and the labyrinth plate (1.1) (→ page 26).

# Maintenance



Diag. 15: Bearing change AH355+400

## 5.6.3 Dismantling Procedure for Drive Side Cylindrical Roller Bearing and Non-drive Side Deep Groove Ball Bearing (→ diag.16)

1. Screw in two threaded rods into the threaded holes in the labyrinth plate (1.1) and pull the plate away from the shaft end with the threaded rods. Loosen screws (2.1.1/17.1.1) and pull off the bearing covers (2.1/17.1).
2. Loosen the locking screws (shaft nuts), undo the shaft nuts (4.1/15.1) using a hook spanner and pull them off the shaft end.  
Pull off the collar oiler (5.1/14.1), taking care not to damage the torque device (5.1.1/14.1.1) (note fitting position).



Support the rotor at the shaft end! Make sure there is sufficient room to pull out the bearing shield and bearing!

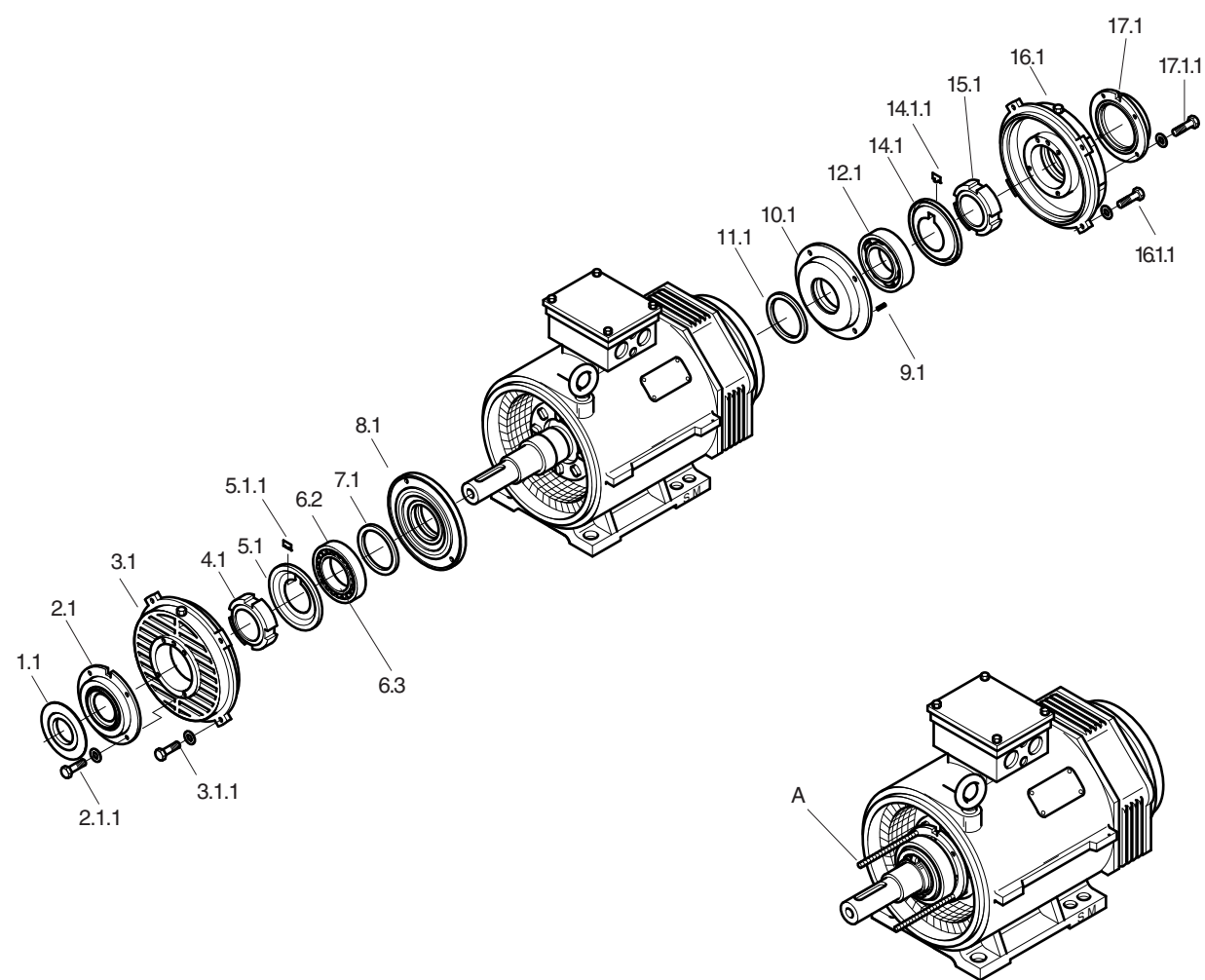
3. Loosen screws (3.1.1/16.1.1) and pull off the bearing shields (3.1/16.1). Dismantle the rotor supports and pull the bearing shield away from the shaft end.



Carefully lay down the rotor in the stator plates!

4. Pull the outer ring of the cylindrical roller bearing (6.2), together with the bearing shield (3.1), from the inner bearing ring (6.3) and then press it out of the bearing shield (3.1). Heat the inner ring of the cylindrical roller bearing and pull it off the rotor shaft. After heating the inner ring slightly, pull off the deep groove ball bearing (12.1) using a pulling tool.
5. Pull off the inner bearing covers (8.1/10.1) together with the seals (7.1/11.1).
6. The rotor remains in the stator housing.

# Maintenance



Diag. 15: Bearing change AH355+400

## 5.6.4 Assembly Procedure for Drive Side Cylindrical Roller Bearing and Non-drive Side Deep Groove Ball Bearing (→ Diag.16)



All bearing shield securing screws must be fitted with the spring washers provided, and bearing cover screws must be fitted with the sealing washers provided!

1. Clean off the bearing seats with a suitable cleaning agent, check for any damage and after the shaft has cooled measure it with a micrometer (measurement specifications refer to a temperature of 20°C).
2. Remove the old grease from the inner bearing covers (8.1/10.1), wash them out using a suitable cleaning agent, allow to dry and then fill them with new grease (note the correct grade of grease, → rating plate). Push the bearing covers (8.1/10.1), together with their seals (7.1/11.1), onto the shaft.
3. Heat the new inner bearing ring (6.3) and deep groove ball bearing (12.1) either in an oil bath or using inductive means (de-magnetize afterwards) to a temperature of 80-90°C.



To ensure proper fitting push the heated inner bearing ring (6.3) and deep groove ball bearing (12.1) onto their shaft seatings and press them against the shaft shoulder for approx. 10 secs..

After cooling lightly grease inner bearing ring (6.3).

4. Clean the hubs of the bearing shields (3.1/16.1).
5. Push on the collar oiler (14.1). Place in the torque device (14.1.1) (Attention! Angled end towards the bearing!). Screw on the shaft nut (15.1), tighten it using a hook spanner and secure the shaft nut with locking screws.
6. For easy assembly screw in two studs (A) – about 100 mm long – into the threaded holes in the inner bearing cover (10.1). Push on the bearing shield (16.1) and screw down tightly using screws (16.1.1) (with spring washers).
7. Remove the old grease from the outer bearing cover (17.1), wash out with a suitable cleaning agent, allow to dry and pack the grease drain bores with fresh grease. Push the outer bearing cover (17.1) into the centring of the bearing shield and screw down tightly using screws (17.1.1) (with sealing washers).
8. Press the new outer bearing ring (6.2) into the bearing shield hub (3.1) and pack the bearing spaces with fresh grease (note correct grade of grease, → rating plate).
9. Screw two studs (A) – about 100 mm long – into the inner bearing cover (8.1) and push the inner bearing cover to the inner bearing ring. Push the bearing shield (3.1) and outer ring (6.2) over the rotor shaft and studs onto the inner ring, whilst simultaneously raising the rotor shaft.



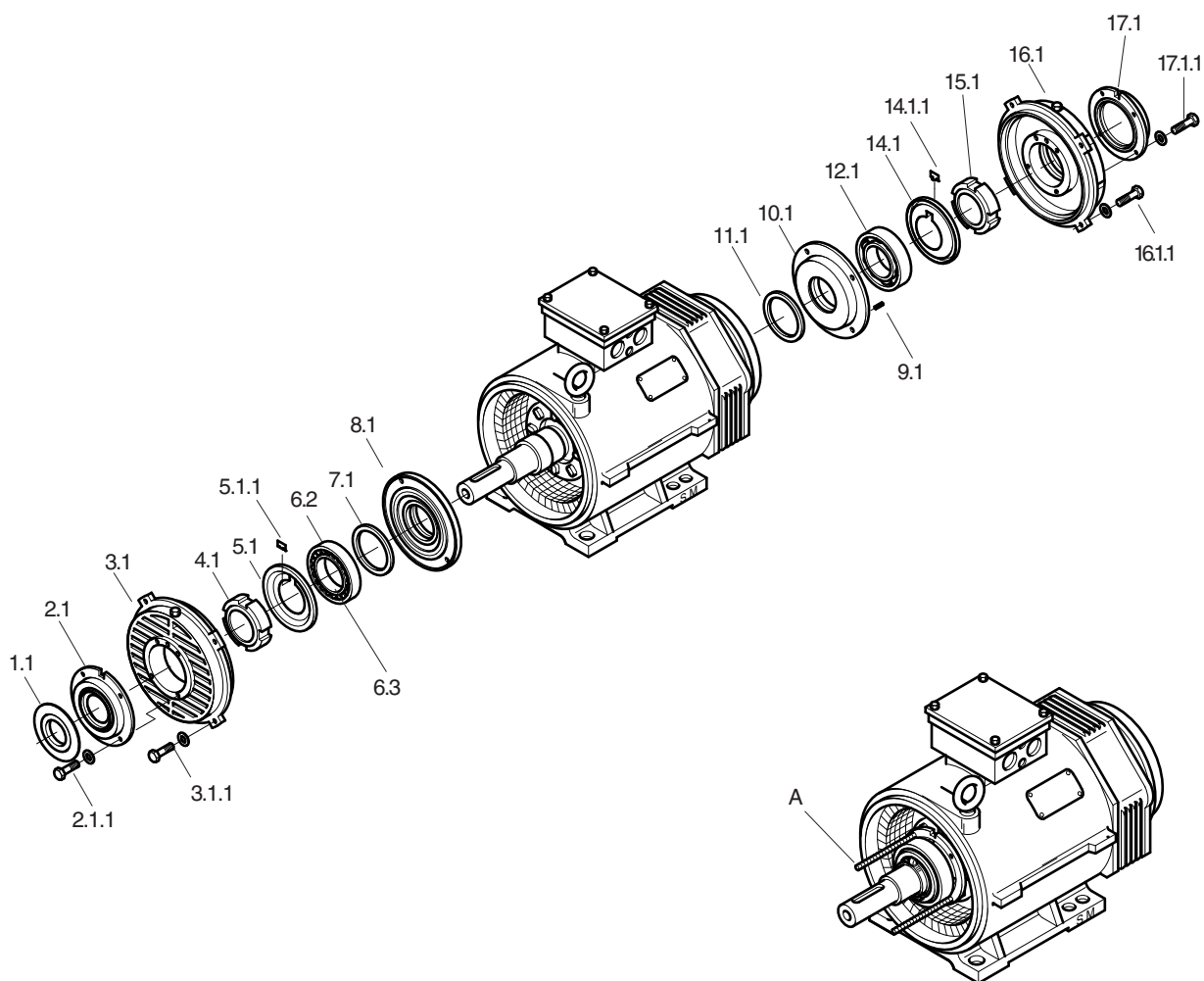
# Maintenance



The rotor shaft should only be raised so far as to allow the bearing shield (with outer ring) and the inner ring of the roller bearing to be pushed on without tilting.

Tighten screws (3.1.1).

10. Push on the collar oiler (5.1). Place in the torque device (5.1.1) (Attention! Angled end towards the bearing!). Screw on the shaft nut (4.1), tighten it using a hook spanner and secure the shaft nut with locking screws.
11. Push the outer bearing cover (2.1) onto the shaft and screw down tightly using screws (2.1.1) (with sealing washers).  
Pack the labyrinth channel with a small amount of grease, heat the labyrinth plate to approx. 60°-80°C, and push it against the bearing cover (2.1). Note the gap between the bearing cover (2.1) and the labyrinth plate (1.1) (→ page 26).



Diag.16: Bearing change AH355+400

## 5.7 Maintenance Schedule – Models Fitted with Roller Bearings

COMPONENT	DAILY	WEEKLY	EVERY 3 MONTHS	ANNUALLY(minor overhaul)	EVERY 5 YEARS (major overhaul)
Bearing			For lubrication deadlines see rating plate		- bearing change, check shaft seals, replace if necessary;- remove old grease;
Heat exchangerAirways	Check			Clean	Clean
Driven appliance (Observe the manufacturer's specifications)			Check alignment and that the machine is secure	Check alignment and make sure that machine is secure	Check alignment and that machine is secure;Change grease / oil
Terminal boxEarth				Clean internally; Re-tighten screws	Clean internally; Re-tighten screws
Stator winding				Measure insulating resistance	Check that feed cables are not torn, that they are firmly seated,check keys; measure insulating resistance
Auxiliary monitoring connections	Record measurement data			Check function	Check function
Motor as a whole	Pay attention to operating noise and quiet running			Re-tighten screws	Dismantle rotor; check that the rotor plates, fan and stator plates are firmly seated; Check that rotor bars are not broken; Clean

# Trouble shooting

## 6 Trouble shooting

### 6.1 Safety Instructions

Malfunctions of the electrical machine may only be rectified by qualified personnel who have been so authorized by those responsible for the plant.

When determining the cause of a malfunction take into consideration all facets of the electrical machine (driven appliance, foundations, type of set-up, switchgear etc.).

Inform the manufacturer when damage occurs during the warranty period.



**When determining the cause of a malfunction, or when rectifying the malfunction, observe the following:**

- **DIN EN 50110**
- **Accident prevention regulations!**



**Ensure that the machine is switched so as not to be live.**

**Make sure the machine cannot be switched on again and label it with a warning sign!**

**Ascertain that the machine is not live!**

**Earth and short-circuit!**

**Cover or cordon off any neighbouring parts which are live!**



**Ensure that the auxiliary circuits, e.g. space heater etc., are switched so as not to be live.**

## 6.2 Malfunctions - Electrical

ELECTRICAL MALFUNCTION CHARACTERISTICS									
									- Motor does not start
									- Motor runs, but with difficulty
									- Droning noise when starting
									- Droning noise during operation
									- Droning noise in time to the doubled induction frequency
									- Rapid rise in temperature when running without load
									- Rapid rise in temperature when running under load
									- Rapid rise in temperature of individual winding sectors
									<b>POSSIBLE CAUSES OF MALFUNCTION</b>
									<b>REMEDIAL MEASURES</b>
●	●		●				●		Overload
●									Reduce load
									Interruption of a phase in the feed
	●	●	●				●		Check switch and feeds
									Interruption of a phase in the feed after switching on
●	●								Check mains supply state
									Mains voltage too low,Frequency too high
							●		Check mains supply state
									Mains voltage too high,Frequency too low
●	●	●	●				●		Stator winding connected up wrongly
									Check the winding circuitry
●	●	●	●				●		Winding or phase break in the stator winding
									Determine winding and insulating resistances; Overhaul after consulting the manufacturer
				●					Asymmetry in short-circuit cage
									Overhaul after consulting the manufacturer
							●		wrong direction of rotation of motor
									Swap the mains connections U and W
							●		Insufficient cooling due to dirty airways
									Clean the airways,Check seals
							●		Voltage too high, hence eddy current loss too high
									Do not exceed 105% of the rated voltage

# Trouble shooting

## 6.3 Malfunctions - Mechanical

MECHANICAL MALFUNCTION CHARACTERISTICS					
– Rubbing noise					
– Rapid rise in temperature					
– Strong vibration					
– Bearings overheating					
– Bearing noise					
		POSSIBLE CAUSES OF MALFUNCTION		REMEDIAL MEASURES	
●				Rotating parts rubbing	Determine cause, readjust parts *
	●			Air feed choked, filter dirty, if applicable, wrong direction of rotation	Check airways, clean filter, if necessary, replace fan *
		●		Rotor out of balance	Uncouple rotor and re-balance *
		●		Rotor out of true, shaft distorted	Consult the manufacturer
		●		Faulty alignment	Align machine group, check coupling
		●		Driven appliance out of balance	Re-balance coupled machine
		●		Impact from the driven appliance	Check the coupled machine
		●		Noisy gearbox	Repair the gearbox
		●		Resonance with foundations	After consultation, alter the rigidity of the foundations
		●		Changes in the foundations	Determine the cause of the change, if applicable, eliminate; align machine anew
		●		Too much grease in the bearings	Remove excess grease
			●	Bearing dirty	Clean or renew bearing *
			●	Ambient temperature > 40°C	Use grease which is suitable for high temperatures*
		●	●	Felt rings pressing on the shaft	Replace felt rings
		●	●	Insufficient lubrication	Grease according to instructions
		●	●	Bearing corroded	Renew bearing *
		●	●	Too little play in the bearing	Fit a bearing with more play *
			●	Too much play in the bearing	Fit a bearing with less play *
			●	Areas of rubbing on bearing track	Renew bearing *
			●	Furrows on the bearing	Renew bearing, avoid shocks when the machine is standing idle
		●		Coupling pressing or pulling	Align the machine more accurately
		●		Too much belt tension	Reduce drive belt tension
		●	●	Bearing twisted or skew	Check the bearing hub bore *
* if necessary, inform the manufacturer					

## 7 Repair Instructions



**Only carry out repair work when the machine is standing idle.**

**Ensure that the machine cannot be accidentally switched on and that it has been labelled with a corresponding warning sign.**

**Repair work may only be carried out by qualified personnel who, because of their professional training, experience and instruction, possess a comprehensive knowledge of**

- **safety regulations,**
- **accident prevention regulations,**
- **guidelines and acknowledged technical rules (e.g. VDE requirements, DIN standards).**

**The qualified personnel must**

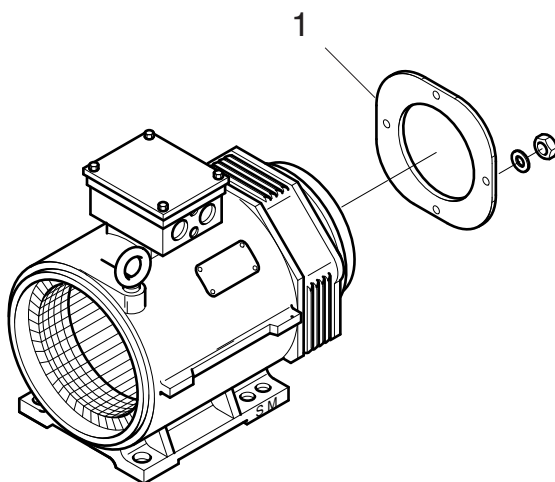
- **be able to assess the work assigned to them, and to recognise and avoid possible dangers;**
- **be authorized by those responsible for the safety of the machine / plant to carry out the required work and activities.**



**Repair work carried out within the warranty period requires the prior agreement of the electrical machine manufacturer.**



**We recommend that only original replacement parts be used for overhauls.**



When winding damage occurs it is possible that the air guide plate (1) could be partially or totally destroyed.

When replacing a winding take care that the new winding specification corresponds to the original. If necessary, fit a new air guide plate in the prescribed manner.

*Diag.17: Air guide plate*

# Spare Parts

## 8 Spare Parts

### 8.1 Order Details



When ordering spare parts be sure to specify the electrical machine type, electrical machine number (→ rating plate) and the exact description of the parts (part numbers if applicable).

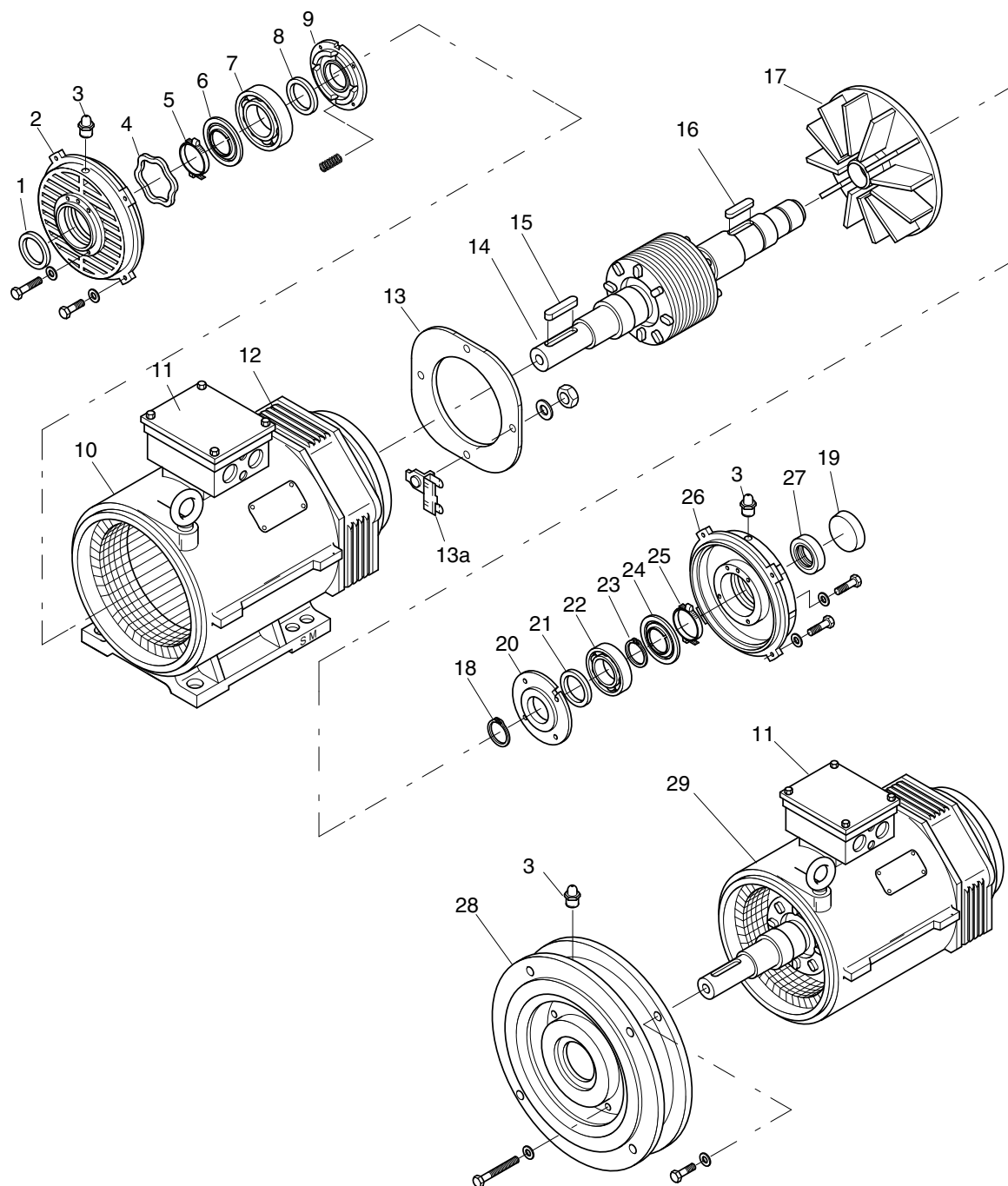
When replacing bearings, in addition to the bearing type, please note also the engraved symbol for the bearing designation (can be read off from the bearing when fitted, e.g. C3 or C4)!

### 8.2 Exploded View, IP23, Model Size 180M-400X

- 1 Sealing ring DE, outer or labyrinth plate
- 2 Bearing shield DE
- 3 Grease nipple
- 4 Compensation washer
- 5 Spring clip DE or shaft nut
- 6 Grease slinger DE
- 7 Antifriction bearing DE
- 8 Sealing ring DE, inner
- 9 Bearing cover, DE inner
- 10 Stator housing IMB3 with core and windings
- 11 Terminal box, complete
- 12 Fan cover
- 13 Air baffle
- 13a Securing clamp
- 14 Rotor with core and windings
- 15 Key
- 16 Key for fan
- 17 Fan
- 18 Fan safety ring
- 19 Sealing cover
- 20 Bearing cover NDE, inner
- 21 Sealing ring NDE, inner
- 22 Antifriction bearing NDE
- 23 Safety ring for NDE bearing

## Spare Parts

- 24 Grease slinger NDE
- 25 Spring clip NDE or shaft nut
- 26 Bearing shield NDE
- 27 Sealing ring NDE, outer or labyrinth plate
- 28 Flange bearing shield
- 29 Stator housing without feet, complete



Diag.18: Exploded view, IP23, Model Size 180M-400X



# Instructions for Electrical Machines Which Are To Be Stored

## 9 Instructions for Electrical Machines Which Are To Be Stored



Electrical machines which will be stored for long periods of time before use are to be dealt with as follows:

### 9.1 Storage Site

Store the machine (complete with its transportation packing) in a dry place which can be heated and which is free from shock, and protect it from mechanical damage.



After long periods of standing (more than 1 year) check the bearings for corrosion damage. Even the smallest amount of corrosion damage can reduce the bearing's serviceable life.

### 9.2 Securing the Machine for Transportation

If the electrical machine is fitted with cylindrical roller bearings, fix the rotor by means of a suitable transportation securing device (for protection against scoring of the rotor by shock see chapter 3.3).

If the electrical machines are despatched on vibration dampers, then they should not be removed during the period of standing.

If drive sprockets, couplings etc. are already assembled onto the shaft ends, then fit the transportation securing devices where possible or place the machine onto vibration dampers.



Any further transportation should only be carried out using transportation securing devices or by placing the machine onto vibration dampers.

### 9.3 Checks before Commissioning

#### 9.3.1 Bearings

After long periods of standing (> 1 year) check the bearings. For dismantling and assembly of the bearings → pages 27 – 40.



Even the smallest amount of corrosion damage considerably reduces the bearing's serviceable life. If bearing change is not necessary, re-grease the bearing.

# Instructions for Electrical Machines Which Are To Be Stored



The specifications for type / amount of grease can be taken from the rating plate or lubricating plate (on the electrical machine). Observe the specifications given in the operating instructions on page 25, Bearing Lubrication, Grease Nipple. The measures specified above can be ignored if the period of standing has been relatively short (< 1 year) and storage has been carried out in the proper manner.

## 9.3.2 Insulating Resistance



**All work on the electrical machine's electrical connections may only be carried out by electricians!**



**Do not touch the connection terminals either during or after measurement. The connection terminals can carry high-voltages! After checking, earth the connection terminals for a short time (5 seconds).**

- Using a hand generator (max. DC voltage = 630V), measure the insulating resistance of each individual phase to earth continuously until the measured value is constant.



The insulating resistance of new windings is > 10 MΩ. Dirty and damp windings demonstrate considerably lower resistance values.



Should a measurement of less than 0.5 MΩ be registered in the air space, clean and / or dry the winding. During this process the winding temperature must not exceed 80°C. Dry by means of a space heater or heating appliance or by applying an alternating voltage with a value equivalent to 5-6% of the rated voltage (make the Δ – circuit) at the stator terminal connections U1 and V1.

- Repeat the measurement. With resistance values of > 0.5 MΩ the electrical machine can be put into operation.



Insulating resistance values are dependent on temperature. Standard values: A rise or fall in winding temperature by 10 K has the effect of respectively halving or doubling the resistance value.



# **SCHORCH**

**SCHORCH Elektrische Maschinen und Antriebe GmbH**

Breite Straße 131

D-41238 Mönchengladbach

Phone: +49 (0) 2166-925-0

Fax: +49 (0) 2166-925-100

E-mail: [mail@schorch.de](mailto:mail@schorch.de)

Internet: <http://www.schorch.de>