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Operating and maintenance instructions

Low – voltage motors

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1. Safety instructions

The operating and maintenance instructions manual contain information on how to design, operate and overhaul the motor types, mentioned in **Chapter 1.1.** The procedures and tasks, shown in this document, are numbered in the order to be followed. The availability of this manual must be guaranteed by the personnel, responsible for the entire drive system, at any time during the system life circle. AC – Motoren GmbH makes this manual available on its homepage in accordance with Machinery Directive. Read the operating instructions carefully before beginning the motor operation. Observe the below mentioned warnings to avoid personal injury or equipment malfunctions AC – Motoren GmbH assumes no liability or warranty for damage and consequential damage caused by non-compliance with this manual.

1.1. Validity

The operating instructions are only valid for the following low-voltage three-phase asynchronous motors (for the single-phase, brake-motors, motors with inverter and ATEX-motors there is a special manual):

- Type ACA (FCA / ARA / ALA / FRPA / FLPA / FCPA)
- Type ACY (FCY / AYR / AYL / FYPR / FYPL / FCPY)
- Type ACM (FCM / ACR / ACL / FCPR / FCPL / FCMP)
- Type AMY (FMY / AYR / AYL / FYMR / FYML / FYMP)
- Type AWM (FWM / AWR / AWL / FWMR / FWML / FWMP)
- Type AOA (FOA / AOR / AOL / FOPR / FOPL / FOPA)
- Type AOM (FOM / FOPR / FOPL / FOPM)
- Type JL1 / JL3 / JL4 / JM1 / JM3 / JM4 / YE1 / YE3 / YE4

1.2. Qualification of the personnel

The design of the entire drive system, project development as well as all activities involving transport, connection to the line, commissioning and regular maintenance of all electric motors must be carried out by suitable, qualified, trained and authorized specialists (the requirements of VDE 0105 and IEC 364 must be observed). Qualified personnel are persons, which due to their training and experience are able to recognize possible risks in their respective area of responsibility and to avoid potential dangers.

1.3. Basic safety rules

The safety risks, originating from the motor, must be re-evaluated after installation as a part of other machinery (end device). In order to avoid damage to property and for the safety of the personnel, the following basic safety rules according to EN 50110-1 must be observed:

1. Activation including auxiliary circuits
2. Secure against being switsched on again
3. Ensure that there is no voltage applied
4. Use earth and short-circuit
5. Cover or cordon off all neighboring parts under voltage

The local industrial safety regulations, specific regulations and agreements of the operator and the area of application as well as safety symbols and instructions on the motor, packaging and

accompanying documentation must be observed at any time while operating or commissioning the motor.

1.4. Electrical potential

Regularly check the electrical equipment of the motor. Immediately replace loose connections and defected cables. Never remove the terminal box cover until the motor is voltage-free. Observe the basic safety rules from **Chapter 1.1**. To avoid electrical shock, use a rubber mat while working on the electrically charged motor.

DANGER
Electric charge on the motor

Open the terminal box only after five minutes from switching off the voltage supply. Ensure appropriate grounding when conducting maintenance.

DANGER
Voltage on terminals by switched off motor

Do not reside in the danger zone of the engine. When working on the motor, switch off the main voltage supply and ensure it against re-activation.

DANGER
Motor restart

When control voltage is applied or the set speed value is stored, the motor restarts automatically after power failure. Ensure restart lockout.

1.5. Mechanical movement

Body parts, which come into contact with rotating parts, can be injured. Clothes, jewelry and similar objects can be caught and pulled into the motor. Ensure the protection against touching. Do not wear loose garments while working on the engine. A test run must be carried out without a feather key (risk of skidding). Never remove the terminal box cover until the motor is voltage-free. Observe the basic safety rules from **Chapter 1.3**.

DANGER
Rotating parts

1.6. Increased surface temperatures

Certain motor parts can become hot during operation. Do not touch any motor part during the motor operation. Ensure sufficient contact protection to avoid burn risks.

DANGER
Surface temperatures

1.7. Noise emission

During the operation, the motor can generate noise emissions that are not permitted for a long-term presence in the immediate vicinity. Take protection measures and secure the personnel with appropriate equipment, such as hearing protection.

DANGER
Sound pressure level

1.8. Electromagnetic fields

The entire drive system generates electromagnetic fields during its operation. These can cause malfunctions in medical implants, e.g. pacemakers. Ensure that no personnel with pacemakers is around the drive system. Protect the personnel with suitable measures.

DANGER
Electromagnetic fields

1.9. Transportation safety

Overturning or falling motors are dangerous to the person and property. Use suitable equipment only and carry out the transportation carefully.

DANGER
Improper transportation and lifting

2. Proper use

The motor types, named in **Chapter 1.1.**, are designed according to the harmonized standards of the IEC 60034 (VDE 0530) and are only approved as industrial drives for the purposes, specified by AC-Motoren GmbH in catalog and in accompanying technical documentation. Any other or additional use is considered improper. This also includes compliance with all associated product regulations. Changes or modifications to the motors are not permitted. Third-party products and components that are used together with the motor and being assembled to the motor must be recommended or approved by AC – Motoren GmbH. Unauthorized changes and modifications to the motors lead to the loss of the corresponding warranty.

Note: All modifications and usage of third-party components must be authorized by AC-Motoren GmbH

When operating motors in the standard configuration, observe the ambient conditions. The motors in the standard configuration are neither suitable for operation in a salty or aggressive atmosphere, nor for installation outdoors. Operation in EX – area is prohibited unless expressly intended for this duty (observe technical documentation to the motor).

2.1. Unauthorized use

In particular, the following operation modes of motors are prohibited and can lead to hazards, loss of warranty and machinery failure:

- Operating the motor with imbalance, for example, caused by dust deposits or icing.
- Resonance operation, operation with strong vibrations, transmitted from the drive system to the motor and that are above the maximum permissible values specified in ISO 10816-3. Periodic shock impacts only up to 1G are permissible. For the higher shock loads contact AC-Motoren GmbH.
- Painting of the motors (if not explicitly approved by AC-Motoren GmbH).
- Release connections, for example, screws during operation.
- Opening the terminal box during operation.
- Operating the motors near combustible materials or components.
- Operating the motors in an explosive atmosphere.
- Operation with fully or partially dismantled or manipulated devices.
- Cleaning the motors or the driven equipment with high-pressure cleaners and applying the pressure to the the sealing surfaces of the motor

2.2. Note to the subsequently and overdue claimed defects and non – compliances

The conformity of the scope of the delivery with the accompanying documents should be checked immediately after receipt of the delivery. AC – Motoren GmbH does not accept any liability for the defects and non – compliances that are being claimed subsequently and overdue.

- Claim the visible transport damage immediately to the delivering company
- Claim the visible defects and incompleteness immediately to AC – Motoren GmbH

3. Transport und storage

3.1. Notes to the transportation

Only motor components (lifting eyes and eye bolts) and suitable lifting equipment must be used. The lifting eyes and eye bolts are only intended for lifting the motors itself without any additional attachments such as base plates, gears etc. Before use, make sure the equipment is properly attached and free of damage. If the lifting eyes or eye bolts are removed after installation, the threaded holes must be permanently sealed in accordance with the degree of protection. Remove any transport locks that may be present before commissioning. Keep the transport lock until you need to transport the motor again.

3.2. Notes to the storage

Store the motors safely against mechanical damage and only in roofed and dry compartments. The storage and transport areas should meet following conditions:

- Temperature range – 20°C to + 50°C
- Maximum humidity 60%

For the short-term storage in the open air, protect the motor against harmful environmental impact. Motors must not be transported or stored on the fan cover. Rotate the motor shaft at least once a

year and ensure a low-vibration environment to avoid damage to the bearings. For longer storage and downtime periods, please note the additional measures from the **Chapter 3.2.1**. After storage or downtime of more than 12 months, the grease condition of all lubricated parts, such as bearings and oil seals, must be checked before commissioning, if necessary by means of vibration measurement. If grease leakage or contamination is observed in the motor with re-greaseable bearings, the lubricating grease should be replaced. The motors with lifetime sealed bearings should have the bearings renewed after 48 months of downtime.

Caution: after longer storage or downtime periods a check of bearings and insulation resistance must be conducted before commissioning.

3.2.1. Additional measures for long storage and downtime periods over 12 months

- Check the winding insulation resistances
- Check the terminal box for moisture and foreign objects
- Check the cable connections and tightening torques at the terminal box
- Check the sealing components of the terminal box
- If available, drain the condensate through the drain holes

4. Installation and assembly

4.1. General information

The following points must be observed during installation and assembly:

- This instructions manual is present and considered
- Observe and apply only in standard EN50347 prescribed threaded bolt sizes for feet and flange mounting of the motor and the required tensile strength class of the used screws.
- When installing motors with feet and direct coupling, ensure the even support, precise alignment and the alignment tolerances specified in **Chapter 4.2**. When installing motors with flange, ensure the correct fit and tolerances of the mating flanges and the centering ring during your drive designing process.
- Provide a vibration-free environment. Avoid build-up resonances with rotation frequency and the double frequency of the power supply.
- Turn the rotor by hand, pay attention to unusual grinding noises. Check the direction of rotation in the coupled state.
- Pull the drive elements (belt pulley, clutch etc.) on and off using only suitable devices. Use cover to protect from touching. The part to be pulled on is to be heated. Transmission elements must not be hammered on the shaft by force. Avoid excessive belt tension.
- Airflow must not be prevented. Ensure enough space for the airflow and that the blown-out, heated cooling air is not drawn in back again.
- All components mounted on the shaft end must be carefully balanced. The standard motors are half-key balanced unless explicitly specified.
- Due to the use of cylindrical roller bearings („reinforced NU-Bearing“) relatively high radial forces or masses can be applied at the end of the motor shaft. The minimum radial force at the shaft end must be a quarter of the permissible radial force. The permissible shaft load must be taken into account.

- The user ensures that the condensate water drain holes on motors with increased IP protection (IPX6 / IP6X) are sealed in a water – or dust-tight manner after the condensate has been drained as well as during transport and storage.
- For the IM B14 and IM B34 mounting motors the maximum screw-in depths specified in the **table 1** must be observed. If an IM B14 and IM B34 mounting motor is used, stored or transported without flanged equipment, the user must take appropriate precautions against the intrusion of foreign objects and moisture through the threaded holes.

Frame size	Screw-in depth, mm	Frame size	Screw-in depth, mm
56-63	8	100-112	15
71	10	132	17
80	11	160	24
90	14		

Table 1. Screw-in depths of motor mountings IM B14 and IM B34.

4.2. Alignment tolerances

Correct and careful alignment of the motor prevents increased tension in the fastening parts. Note the generally applicable tolerances given in the **table 2** for proper shaft alignment.

Speed (r/min)	Axial/radial misalignment, mm	Angle error, mm/100
0-1000	0,07	0,06
1000-2000	0,05	0,05
2000-3000	0,03	0,04
3000-4000	0,02	0,03
4000-5000	0,01	0,02
5000-6000	<0,01	0,01

Table 2. General tolerances for shaft alignment.

4.3. Minimum clearance to the wall

Correct installation of the motor prevents increased motor heating due to the insufficient cooling air flow. Observe the minimum clearances from the fan to the wall specified in **table 3.**

Frame size	Clearance, mm	Frame size	Clearance, mm
56	22 – all types	112	42 – all types
63	25 – all types	132	45 – all types
71	28 – all types	160-180	60 – all types
80	32 – all types	200-225	65 – all types
90	34 – all types	250-280	70 – ACM ACY AWM type, 90 – AOA AOM type
100	36 – all types	315-355	75 – ACM ACY AWM type, 110 – AOA AOM type

Table 3. Minimum clearances to the wall.

5. Electrical connection

5.1. General information

All maintenance procedures must only be carried out by the qualified specialists on a motor during downtime with ensured protection against restart, taking into account the basic safety instructions from the **Chapter 1.3**. This also applies to auxiliary circuits (heating). The performance data on the nameplate and connection diagram in the terminal box must be observed.

Caution: follow the performance data on the motor nameplate.

Take into account references from IEC / EN 60034-1 (VDE 0530-1) for the operation at the limits of ranges A (±5% voltage or ±2% frequency deviation) and ranges B, associated heating and deviation of rated performance data. Power supply cables should be selected according to the installation specific conditions specified in DIN VDE 0100 (current, ambient temperature, installation method etc.).
The connection must be made in such a way that a permanently secure electrical contact is maintained. Use appropriate cable lugs for the connections of all main cables. Ensure protective grounding connection. Tightening torques are given in the **Table 4**.

Thread size	Type and frame size	Tightening torque (Nm) Min.	Tightening torque (Nm) Max.
M4	ACA ACY BG56-80	1,9	2,2
	AOA BG80-112	0,8	1,4
M5	ACA ACY BG90-132	3,9	4,5
	AOA BG132	1,5	3,5
M6	ACM AMY AWM BG160-180	6,6	7,5
	AOA BG160-180	3,0	6,0
M8	ACM AMY AWM BG200-225	16,0	18,4
	AOA AOM BG200-225	5,8	8,5
M10	ACM AMY AWM BG250-280	32,0	36,0
	AOM BG250-280	10,0	16,0
M12	AWM BG315	68,0	74,0
	AOM BG315-355	16,0	25,0
M16	ACM BG315	139,0	159,0
	AWM BG355-400		
M20	ACM BG355	273,0	312,0

Table 2. Tightening torques for cable connection.

Caution: ensure the appropriate selection of the power supply cables.

The connection box must not contain foreign objects, dirt or moisture. Motors in standard configuration are equipped with blind plugs in the cable entry openings, which are only suitable for transport and storage in areas with environmental conditions according to the **chapter 3.2**. The blind plugs as well as the remaining unused cable entry openings and terminal box should be sealed dust-tight and water-tight by the responsible for the commissioning personnel. Pay attention to the condition of all seals, which must not be damaged. For the test run without drive elements, ensure the key against expelling.

5.2. Electromagnetic compatibility

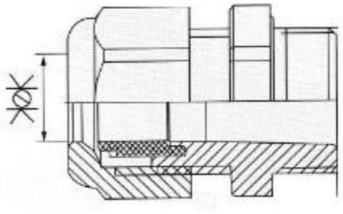
The conformity of the motors as a structural unit of a machinery with the EMC standards is declared in the EU - Declaration of Conformity. The user of the drive system must ensure that suitable measures are taken for the entire drive system being in compliment with relevant EMC Standards. The connection diagram, according to which the connection must be made, is provided with every motor (**Figure 1**).

5.3. Connection of lead out cables

In the motor with a lead out cable the terminal board is removed and the lead out cables are connected to the terminals of the stator winding. To the each lead out cable is a color assigned, the assignment is placed on the frame. For the motor version with terminal box, each individual wire is labeled. The user connects the lead out cables in the control cabinet accordingly.

5.4. Cable diameter and size of the cable glands

Observe the suitable cable diameter for the cable glands, specified in the table 5.



Cable gland size	Motor type and cable diameter, mm
M16 x 1,5	all 3,5 – 8
M20 x 1,5	all 5 – 11
M25 x 1,5	ACA ACY 9 – 16
	AOA 10 – 18
M32 x 1,5	ACA ACY 11 – 20
	AOA 12 – 25
M40 x 1,5	ACM AMY 19 – 29
	AOA AOM 18 – 32
M50 x 1,5	ACM AMY 30 – 35
	AOA AOM 27 – 39
M63 x 1,5	ACM AWM 29 – 40
	AOM 33 – 46

Table 5. Cable diameter and size of the cable glands .

5.5. Minimum air clearances

Maintain the minimum air clearances between non – insulated parts specified in Table 6. These values apply to an installation altitude up to 1000m.

Effektivwert der Spannung, V	Mindestluftabstand, mm
≤500V	3
≤630V	5,5
≤1000	8,0

Table 6. Minimum air clearances.

5.6. Connection of temperature sensor and space heater

Optionally, the temperature sensors can be mounted on the motor stator windings or bearings to monitor the temperature and protect the components. If necessary to re - measure the sensor resistance (at approx. 20°C) before the motor first time commissioning, the applied voltage must not exceed 2.5V DC. The optionally available space heater prevents the formation of condensate and frost damage during downtimes in a cold and humid environment.
The connections for the temperature sensors and space heaters are located in the termination box of the motor or in the separate auxiliary terminal box. Observe and mind the information from the motor data sheets and associated documentation, information on the nameplate and the information below, when connecting the temperature sensors and space heaters:

- Comply with requirements of IEC 60664-1 and IEC 61800-5-1 and the basic safety rules from **Chapter 1.3**.
- Mind the connection diagrams from **Chapter 12**.
- Use an interlock circuit to ensure the space heater being switched off when motor is operating

5.7. Connection of the forced ventilation fan

The Motors of the ACA, ACM and AWM types can be optionally provided with forced ventilation fan (cooling type IC416 according to IEC 60034-6). Observe the information from the motor data sheets and associated documentation, information on the nameplate and the information below, when connecting the forced ventilation fan:

- Comply with requirements of IE C60664-1 and IEC 61800-5-1 and the basic safety rules from **Chapter 1.3**.
- Mind the connection diagrams from **Chapter 12**.
- Do not run the motor without the forced ventilation fan.

5.8. Connection to the frequency inverter

When operating the standard motor types, mind the maximum permissible voltage peaks in accordance with IEC 60034 – 18 – 41. Follow the EMC instructions of the inverter manufacturer and ensure the drive system to be compliant with EMC requirements.

6. Operation

6.1. Commissioning

The installation must be carried out in a power-supply-free state, in accordance with applicable regulations by appropriately trained personnel in compliance with safety rules and instructions from **Chapters 1 – 6** of the manual. The nameplate date of the motor must be compared to the power supply conditions. The dimensions of the power cables must be adapted to the nominal currents of

the motor. The motors are to be operated with an overcurrent protection, which is adjusted according to the rated data (1.1 times rated current) of the motor. Failure to do so leads to the winding defect and a loss of warranty.

Caution: check the insulation resistance of the winding before commissioning.

Please check the insulation resistance of the winding before starting the motor for the first time. The resistance should be higher than 5MΩ at an ambient temperature of 25°C. After longer storage, the insulation test and vibration measurement must also be carried out.
Following measures are recommended for the normal commissioning of the motors:

1. Check that the connection is done according to the connection diagram
2. Check that all minimum values of the clearance distances between bare, voltage-carrying parts towards the ground and to each other (10mm bus 750V) are complied with
3. Check that all terminal box connections, fasteners, mounting parts and grounding connections are firmly tightened
4. Check that auxiliary devices and additional equipment are functional
5. Check that unused cable entry openings and the condensate drain (if present) are sealed dust-tight and water-tight.
6. Check that the machinery is properly installed and aligned
7. Check that the operating conditions match the nameplate data as well as data from the technical documentation
8. Check that the cooling air supply is guaranteed, if available, perform a test run of the forced ventilation fan
9. Check that the motor does not make any excessive noise or produce excessive vibrations during no-load run
10. Check that the no-load current value is less than the nominal current value on the motor nameplate
11. Check that the direction of rotation is correct
12. Conduct the load run only when the no-load run is faultless
13. Fill out the commissioning report

When commissioning, it is advisable to observe the current consumption under load in order to recognize any possible overload or asymmetries on the line.

6.1.1 Tightening torques

Table 6 shows tightening torques for screws of the end shields, bearing caps and terminal box for the motors of all types.

Frame size	Arrangement	End shield	Bearing cap	Terminal box cap	Terminal box
Thread / Tightening torque (Nm)					
56	B3/B5/B14	M4 / 2,0 Nm	-	M4 / 1,0 Nm	M4 / 2,0 Nm
63			-	M5 / 1,5 Nm	M5 / 3,0 Nm
71			-		
80		M6 / 7,0 Nm	-		
90			-	M5 / 2,5 Nm	M5 / 4,0 Nm
100		M8 / 17 Nm	-		
112			-		
132			-		

160			M6 / 7 Nm	M6 / 3,0 Nm	M6 / 4,5 Nm
180		M10 / 34 Nm	M8 / 17 Nm		
200		M12 / 60 Nm		M8 / 4,0 Nm	M8 / 7,0 Nm
225			M10 / 34 Nm		
250				M8 / 4,5 Nm	M10 / 11,5 Nm
280					
315		M16 / 149 Nm		M10 / 5,5 Nm	M10 / 12,5 Nm
355		M20 / 290 Nm		M12 / 7,0 Nm	M12 / 16,0 Nm
400					

Table 6. Tightening torques for terminal box, end shield and bearing cap.

If a motor has the feet mounting (type B3, B34, B35), the following tightening torques for the screws on the motor feet must be complied with (**Table 7**):

Thread	Tightening torque (Nm) Min.	Tightening torque (Nm) Max.
M4	2,0	3,0
M5	3,5	5,0
M6	6,0	9,0
M8	16,0	24,0
M10	30,0	44,0
M12	46,0	70,0
M16	110,0	165,0
M20	225,0	340,0

Table 7. Tightening torques for motor feet screws.

Tightening torques for the metal and plastic cable glands for the direct attachment to the machine and other glands (such as reducers) shall be in accordance with **Table 8**.

Cable gland	Metal ±10% Nm	Plastic ±10% Nm
M16 x 1,5	10	2
M20 x 1,5	12	4
M25 x 1,5		
M32 x 1,5	18	6
M40 x 1,5		
M50 x 1,5	20	
M60 x 1,5		

Table 8. Tightening torques for cable glands.

6.1.2. Settings for the temperature sensors

If a motor is equipped with a temperature sensor for the winding or bearing temperature monitoring, set the temperature values for the pre-warning and shutdown on your tripping device in accordance with **Table 9** before commissioning:

Sensor position	Pre-warning	Shutdown
Winding (Insulation class F)	130°C	150°C
Bearing	110°C	120°C

Table 9. Settings for the temperature sensors.

6.2. Frequency inverter duty

All motor types from **Chapter 1.1** in the standard design can be operated with a frequency inverter with maximum input voltage of 500V. The special design motors with VFD – windings should be used for higher input voltages. The correlation between the maximum permissible $U_{ph\text{-}gr}$ and the voltage rise time can be found on the **Picture 1** in the figures chapter. Make sure that the parameters of the inverter are set correctly, refer to the relevant information on the nameplate and associated motor documentations. Mind the operating instructions of the inverter manufacturer and the EMC compatibility.
Do not exceed the maximum speed limits specified in the **Table 10**:

Frame size	Pole number	Motor type and max. speed, upm
56-160	2	ACA, ACM, ACY 6000
		AOA 4500
180-355	2	ACM, AMY, AWM 4500
		AOM 3600
56-280	4	All 3000
315-355	4	All 2250
56-280	6	All 2000
315-355	6	All 1500
56-280	8	All 1500
315-355	8	All 1125

Table 10. Maximal possible speed for the inverter duty.

Take the measures to reduce the bearing currents in accordance with recommendations of DIN VDE 0530-25 application guide for rotating electrical machines for use in drive systems. Mind the overall drive system consisting of the inverter, motor and machine. Following measures are suitable:

- Design the grounding system with low impedance
- Use the common mode filter at the inverter output
- Limit the rate of the voltage rise by means of output filter
- Large – scale design of the contacts
- Use of potential compensating connecting cables between motor and machine, between motor and inverter
- Use of symmetrically constructed and shielded power cables
- Shield connections on both motor and inverter
- Use of EMC cable glands
- Use of insulating bearing

7. Maintenance

Maintenance of the motor must only be conducted considering the safety instructions in **Chapters 1 – 6.** Careful and regular maintenance, inspections and revisions are necessary in order to detect and

correct possible malfunctions in good time before consequential damage can occur. General deadlines are given in the **Table 11** below (periods should be adapted to the local conditions, such as pollution, ambience, load etc.). All deviations and abnormalities discovered during the inspections must be corrected immediately.

Function	Time interval	Periods
Initial inspection	After ca. 500 h	At the latest after ½ year
Control of the airways and surface of the motor	Depending on local conditions	
Re-lubrication	Acc. **Table 12** or nameplate	Once a year
Main inspection	10.000 h	Once a year

Table 11. Notifiable maintenance and inspections.

7.1. Initial inspection

If available, drain the condensation water through drain holes and carry out following tests when the machinery is at downtime:

- Check the foundation

Following tests are carried out when the machinery is running:

- Check the electrical characteristics
- Check the bearing temperatures
- Check the running noise

7.2. Main inspection

Following tests are carried out when the machinery is at downtime:

- Check the foundation
- Check the alignment of the motor
- Check the fastening screws and tightening torques
- Check the cables and the insulation material. The test determines whether the cables and the insulating materials are in a proper condition. They must not display discoloration or any burn marks and must not be cracked or otherwise damaged
- Check the insulation resistance
- Depending on the quality of grease, local ambient conditions and the duty, the change of the rolling bearings and the oil seals may be necessary after 10.000 h (but at least after the agreed warranty period has expired)

Following tests are carried out when the machinery is running:

- Check the electrical characteristics
- Check the bearing temperatures
- Check the running noise
- Conducting the bearing vibration analysis

7.3. Lubrication

A grease quality allows the operation of motors with lifetime lubricated bearing types of 20.000 h without renewal of the rolling bearing grease under normal load conditions (axial and radial forces to the motor shaft) and under normal environment conditions, that are specified in the respective motor documentation. The condition of grease should however be controlled even during this period. The specified life expectancy of bearings applies only for operation with nominal speed and bearing operating temperature of 80°C (ambient temperature 40°C). When operating with inverter

or increased ambient temperatures, the specified lubrication periods must be reduced by 25% as a result of the higher heating of the motor. If the nominal speed is exceeded during the operation of the motor with inverter, the re-lubrication periods are reduced in the reverse proportion to the increase in the speed. Re-lubricate the bearings after thorough cleaning with appropriate solvents.

Caution: when operating over the rated speed or at increased ambient temperatures, the specified lubrication periods must be reduced by 25%.

Also following factors and special operating conditions also have an influence on the state of bearing and lubrications intervals:

- Vertical motor mounting
- High vibration or shock load
- ON-OFF Frequency and reverse rotation duty
- Pollution and moisture in the ambience

The greases with the same oil base and the same thickener must be used for re-lubrication. The grease quantity and intervals indicated on the nameplate must be observed. The initial lubrication requires about twice as much grease as the lubrication tubes are still empty. The spent grease must be disposed of after 3 re-greasing operations.
In the standard design motors of the type ACM and AMY up to frame size 280, and motors of the type AOM up to frame size 225, are equipped with lifetime greased sealed bearings (type ZZ or 2RZ). If the motors are to be equipped with re-greaseable or roller bearings (current insulated or "reinforced" NU bearings), the corresponding re-greasing intervals can be found in **Table 12**.

Frame size	Pole number	Bearing DE	Bearing NDE	Lubrication interval, h	First lubrication, g	Following lubrications, g
Motor type ACM. Marked with * are the motors with efficiency class IE2 and IE3, with ** - the motors with efficiency class IE4						
160	2	6309.C3* 6209.C3**	6309.C3* 6209.C3**	2000	26	20
	4	6309.C3		5400		
	6,8			6900		
	2	NU309.C3* NU209.C3**		2000		
	4	NU309.C3		5400		
	6,8			6900		
180	2	6311.C3* 6211.C3**	6311.C3* 6211.C3**	2000		
	4	6311.C3		5400		
	6,8			6900		
	2	NU311.C3* NU211.C3**		2000		
	4	NU311.C3		5400		
	6,8			6900		
200	2	6312.C3* 6212.C3**	6312.C3* 6212.C3**	1500	32	25

	4	6312.C3		5000		
	6,8			6500		
	2	NU312.C3* NU212.C3**		1500		
	4	NU312.C3		5000		
	6,8			6500		
225	2	6313.C3* 6312.C3**	6313.C3* 6312.C3**	1500		
	4	6313.C3		5000		
	6,8			6500		
	2	NU313.C3* NU312.C3**		1500		
	4	NU313.C3		5000		
	6,8			6500		
250	2	6314.C3* 6313.C3**	6314.C3* 6313.C3**	1000	45	35
	4	6314.C3		4500		
	6,8			6300		
	2	NU314.C3* NU313.C3**		1000		
	4	NU314.C3		4500		
	6,8			6300		
280	2	6314.C3	6314.C3	1000		
	4	6317.C3	6317.C3* 6314.C3**	4000		
	6,8			6000		
	2	NU314.C3	6314.C3*	1000		
	4	NU317.C3	6317.C3* 6314.C3**	4000		
	6,8			6000		
315	2	6317.C3	6317.C3	1000	65	50
	4	6319.C3	6319.C3	3500		
	6,8			5800		
	2	NU317.C3	6317.C3	1000		
	4	NU319.C3	6319.C3	3500		
	6,8			5800		
355	2	6319.C3	6319.C3	1000	80	60
	4	6322.C3	6322.C3	2800		
	6,8			4800		
	2	NU319.C3	6319.C3	1000		
	4	NU322.C3	6322.C3	2800		
	6,8			4800		
400	2	6320.C3	6320.C3	1000	100	75
	4	6324.C3	6324.C3	2300		
	6,8			4200		
	2	NU320.C3	NU320.C3	1000		
	4	NU324.C3	NU324.C3	2300		

	6,8			4200		

Frame size	Pole number	Bearing DE	Bearing NDE	Lubrication interval, h	First lubrication, g	Following lubrications, g
Motor type AOM						
160	2	6309.C3	6209.C3	8500	18	12
	4			16000		
	6,8			20000		
	2	NU309.C3	6309.C3	3000		
	4			8000		
	6,8			11000		
180	2	6310.C3	6210.C3	7500	23	15
	4			15000		
	6,8			19000		
	2	NU310.C3	6310.C3	2500		
	4			7500		
	6,8			10000		
200	2	6312.C3	6212.C3	6000	30	20
	4			13000		
	6,8			17000		
	2	NU312.C3	6312.C3	1900		
	4			6000		
	6,8			9000		
225	2	6313.C3	6213.C3	5000	32	23
	4			12000		
	6,8			16500		
	2	NU313.C3	6313.C3	1600		
	4			5500		
	6,8			9000		
250	2	6315.C3	6315.C3	4000	45	30
	4			11000		
	6,8			15000		
	2	NU315.C3		1100		
	4			4500		
	6,8			7500		
280	2	6316.C3	6316.C3	3500	50	33
	4			10000		
	6,8			14500		
	2	NU316.C3		900		
	4			4000		
	6,8			7000		
315	2	6316.C3	6316.C3	2500	50	33
	4	6319.C3	6319.C3	8500	60	45
	6,8			13000		
	2	NU316.C3	6316.C3	500	50	33

	4	NU319.C3	6319.C3	3300	60	45
	6,8			6000		
355	2	6319.C3	6319.C3	2000	60	45
	4	6322.C3	6322.C3	6500	90	60
	6,8			11000		
	2	NU319.C3	6319.C3	300	60	45
	4	NU322.C3	6322.C3	2300	90	60
	6,8			4500		

Frame size	Pole number	Bearing DE	Bearing NDE	Lubrication interval, h	First lubrication, g	Following lubrications, g
Motor type AWM						
315 315X	2	6317.C3	6317.C3	2000	74	37
	4,6,8	6319.C3	6319.C3	4000	90	45
	2	NU317.C3	6317.C3	2000	74	37
	4,6,8	NU319.C3	6319.C3	4000	90	45
355	2	6317.C3	6317.C3	2000	74	37
	4,6,8	6322.C3	6320.C3	4000	120	60
	2	NU317.C3	6317.C3	2000	74	37
	4,6,8	NU322.C3	6320.C3	4000	120	60
355X	2	6220.C3	6220.C3	2000	80	40
	4,6,8	6322.C3	6322.C3	4000	120	60
	2	NU220.C3	6220.C3	2000	80	40
	4,6,8	NU322.C3	6322.C3	4000	120	60
400 400X	2	6220.C3	6220.C3	2000	80	40
	4,6,8	6326.C3	6326.C3	4000	170	85
	2	NU220.C3	6220.C3	2000	80	40
	4,6,8	NU326.C3	6326.C3	4000	170	85
450X	2	6221.C3	6221.C3	2000	90	45
	4,6,8	6328.C3	6328.C3	4000	190	95
	2	NU221.C3	6221.C3	2000	90	45
	4,6,8	NU328.C3	6328.C3	4000	190	95

Table 12. Re-greasing intervals for re-greaseable and "reinforced" NU bearings.

Re-greasing on a running machine as well as downtime re-greasing is possible. Following information should be noted:

- When the engine is running, make sure that the grease outlet and grease inlet and channel are open. Inject the intended amount of grease into the bearing and let the machine run for 1 – 2 hours. Close the plug of the grease outlet. There may be a temporary increase in temperature of the bearing for the next 10 hours.
- During the downtime, firstly only half the amount of re-lubrication grease needs to be used. After 1 hour test run and inject the rest of the grease into the bearing. After 2 hours test run the grease outlet can be closed.

For the re-lubrication only ball bearing / roller bearing suitable grease with following properties must be used:

Properties of the grease	2-pole	4-pole	6-pole	8-pole
Motor type AWM				
Oil base	Mineral oil			
Thickener	Polyurethane			
Viscosity 40°C	110			
Consistency	2			
Continuous duty temperature, min.	-30 + 180°C			
Motor type ACM, AMY, AOM				
Oil base	Mineral oil			
Thickener	Lithium			
Viscosity 40°C	100			
Consistency	3			
Continuous duty temperature, min.	-25 + 130°C			

Table 13. Selection of the re-lubrication grease.

Caution: use appropriate grease for re-lubrication.

Table 13 displays a grease specification and is only valid for ambient temperatures of – 30°C to +60°C, bearing temperature up to 110°C and operation with the rated speed. When operating above the rated speed, special high-speed greases may be used.

7.4. Fremdlüfter warten

Check the condition of the forced ventilation fan with every inspection and observe the safety rules from **Chapter 1 – 6**. Check the electrical connections and airways. Pay attention to irregular foreign particles deposits and remove those immediately as those can lead to imbalances. The lifetime sealed bearings of the forced ventilation fan must be replaced after 20.000 operating hours.

8. Troubleshooting

Table 14 addresses the causes of errors that may occur and the action to be taken. All procedures are only allowed to be carried out by qualified personnel using suitable tools and instruments. For the further information please contact AC-Motoren GmbH.

Failure	Cause	Actions
The machinery doesn't start	Overload	Reduce the load
	Wrong stator connection	Check the connection
	Fault power supply	Check that power supply complies with information on nameplate
	Interruption of one phase	Check connection and switches
	Mechanical fault	Check that motor rotates freely. Check the bearing and lubrication.

	Rotor defect	Check the broken bars and end rings.
	Fuses burnt	Use suitable fuses
The machinery is accelerating slow / doesn't accelerate	Load inertia at start to high	Reduce the load
	Under-voltage at motor terminals due to the voltage drop	Use higher voltage or higher transformer stage or reduce the load. Use appropriate cable cross-section.
	Defect rotor / broken rotor bars	Check the broken bars and end rings.
	Windung / phase short circuit	Motor overhaul is needed
Overheating of the machinery during operation with load	Overload	Reduce the load
	Cooling is prevented by dust accumulation	Ensure proper cooling and cleanliness
	Interruption of one phase	Check connection and switches
	Short circuit on the ground	Repair in workshop needed
	Imbalance of the power supply	Check the cables and transformer for faults
Motor vibrations	Wrong allignment	Allign the motor
	Substrucutre is unstable	Reinforce substructure
	Imbalance in clutch / gearbox	Balance clutch / gearbox
	Imbalance in driven machinery	Re-balanced the machinery system
	Defect bearing	Exchange the bearing
	Multi-phase motor runs single-phase	Check the circuit
Operation noise	Circulating parts grinding	Correct the mounting
	Windung / phase short circuit	Motor overhaul
	Interruption of one phase	Check connection and switches
High bearing temperature	Motor shaft bent or damaged	Straighten or replace the shaft
	Wrong belt drive	Reduce belt tension, arrange pulley closer to the bearing
	Wrong allignment	Allign the machinery
	Inadequate / excess grease	Note the amount of re-grease

Table 14. Troubleshooting

9. Disposal

The electric motors consist of components and materials that can be recovered. Observe the respective country – specific legal regulations and regulations on disposal of electric and electronic devices. The motors must be disassembled considering the safety rules and instructions from **Chapters 1 – 6.** Separate the motor components to the following groups:

- Steel and iron
- Aluminum
- Non – ferrous metal

- Cables and wires
- Chemicals such as oil, grease and paint residue
- Packaging

Dispose the separated components only in professional waste disposal company.

10. Motor components and spare parts

Index	Description
1	Flange / End shield DE
2	Flange / End shield bolt DE
3	Oil seal
4	Rotor
5	Bearing DE / NDE
6	Motor housing with stator
7	Terminal box base seal
8	Terminal board
9	Terminal box
10	Terminal box cap seal
11	Terminal box cap
12	Terminal box cap screw
13	Fan cover
14	Fan
15	Flange / End shield bolt NDE
16	End shield NDE
17	Wave washer
18	Cable gland
19	Blind plug
20	Fan cover fixing material
21	Feet fixing material
22	Motorfeet
23	Lifting – eye with fixing material

Table 15. Components of motors: ACA – ACY – JL (**Picture 3a**).

Index	Description
1	Flange / End shield DE
2	Flange / End shield bolt DE
3	Oil seal
4	Rotor
5	Bearing DE / NDE
6	Motor housing with stator
7	Terminal box base seal
8	Terminal board
9	Terminal box
10	Terminal box cap
11	Terminal box cap screw
12	Fan cover
13	Fan
14	Flange / End shield bolt NDE
15	End shield NDE
16	Wave washer
17	Cable gland
18	Fan cover fixing material
19	Bearing cap outer DE, NDE
20	Bearing cap screw
21	Regreasing device
22	Grease drain cap
23	Eye - bolt
24	Bearing cap inner DE, NDE
25	Circlip

Table 16. Components of motors: ACM – AMY – AWM – JM – YE (**Picture 3b**).

Index	Description
1	Stator
2	Rotor
3	End shield DE
4	End shield NDE
5	Flange DE
6	Key
7	Oil seal
8	Bearing DE
9	Bearing NDE
10	Wave washer
11	Fan
12	Terminal box cover with sealing
13	Terminal board
14	Cable gland
15	Fan cover
16	Connector vor vibration sensor
17	Drain sealing screw
18	Nameplate

Table 17. Components of motors: AOA frame size 80 - 112 (**Picture 3c**).

Index	Description
1	Stator
2	Rotor
3	End shield DE
4	End shield NDE
5	Motor feet
6	Flange DE
7	Key
8	Oil Seal
9	Bearing DE
10	Bearing NDE
11	Wave washer
12	Fan
13	Fan cover
14	Terminal box
15	Terminal box cover with sealing
16	Terminal board
17	Cable glands
18	Name plate
19	Circlip inner
20	Circlip outer
21	Connector vor vibration sensor
22	Drain sealing screw
23	Grease holder
24	Grease nipple
25	Grease nipple extra length
26	Bearing cap outer
27	Bearing cap inner

Table 18. Components of motors: AOA frame size 132 - 225 (**Picture 3d**).

Index	Description
1	Stator
2	Rotor
3	End shield DE
4	End shield NDE
5	Helical spring
6	Flange DE
7	Key
8	Oil Seal
9	Bearing DE
10	Bearing NDE
11	Wave washer
12	Fan
13	Fan cover
14	Terminal box
15	Terminal box with sealing
16	Terminal board
17	Cable glands
18	Name plate
19	Circlip inner
20	Circlip outer
21	Connector vor vibration sensor
22	Drain sealing screw
23	Grease holder
24	Grease nipple
25	Grease nipple extra length
26	Bearing cap outer
27	Bearing cap inner

Table 19. Components of motors: AOM frame size 250 - 355 (**Picture 3e**).

11. Declaration of conformity

Declaration of Conformity

AC-Motoren
Wir treiben Sie an!

Manufacturer: AC-Motoren GmbH
Adress: Einsteinstr. 17
D-64859 Eppertshausen
Homepage: www.ac-motoren.de

Herewith we confirm, that the below listed asynchronous motors

Types: ACA, FCA, FCPA, ACM, FCM, FCMP, ACR, ACL, FCPR, FCPL, ACY, FCY, FCPY, AMY, FMY, FYMP, AYR, AYL, FYMR, FYML, AGS, FGS, FGSP, AWM, FWM, FWMP, AWL, AWR, FWMR, FWML, AD, FD, FDP, AF, FF, FFP, AY, FY, FYP, ABA, FBA, FBPA, ABS, FBS, FBSP, AH, FH, FHP, AHR, AHL, FHPR, FHPL, AOA, FOA, AOR, AOL, FOPR, FOPL, FOPA, AOM, FOM, FOPM

regarded as a component in accordance with the following standards and rules:

- Council directive 2014/35/EU
- Council directive EMC 2014/30/EU
- Council directive 2009/125/EC, EC640/2009

The accordance with the directives of this directive is verified through the compliance of the following standards:

European Standards, German Version:

- EN 55014-1: 2017
- EN 55014-2: 2020
- EN 60034-1: 2010+AC: 2010
- EN 60034-2-1: 2014
- EN 60034-5: 2001+A1: 2007
- EN 60034-6: 1993
- EN 60034-7: 1993+A1: 2001
- EN 60034-9: 2005+A1: 2007
- EN 60034-30-1: 2014
- EN IEC 60034-14: 2018
- EN 60038: 2011
- EN 60204-1: 2018
- EN IEC 61000-3-2: 2019
- EN 61000-3-3: 2013+2019
- EN IEC 61000-6-1: 2019
- EN IEC 61000-6-2: 2019
- EN 61000-6-3: 2007+A1: 2011
- EN IEC 61000-6-4: 2019
- EN IEC 61800-3: 2018

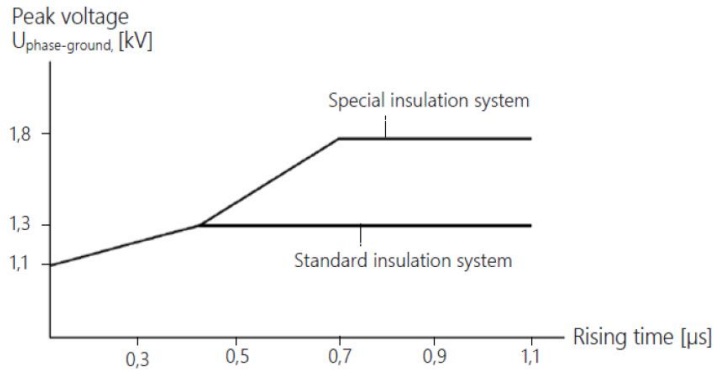
The commissioning is forbidden as long as the conformity of the final product according to the rule 2006/42/EC is established.
This declaration is no assurance of characteristics in terms of product liability.
The security advices product documentation has to be considered.

Eppertshausen, 13.04.2021

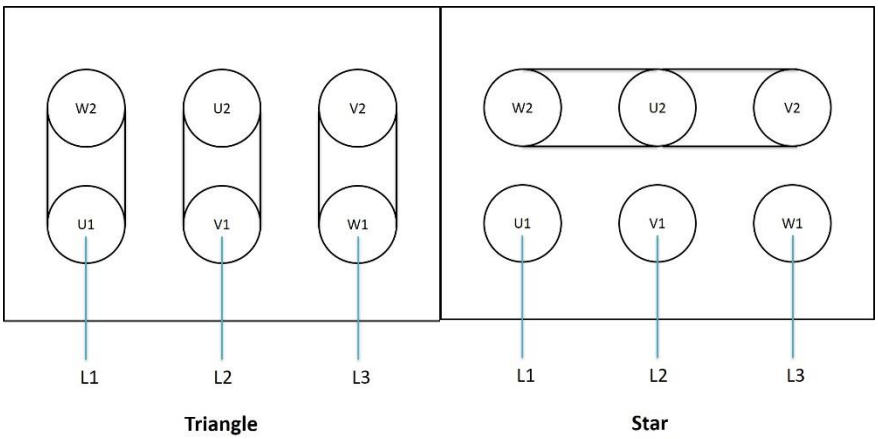
Timo A. Klussmann
-General Manager-

Katja Deißler
- Head of technical dep.-

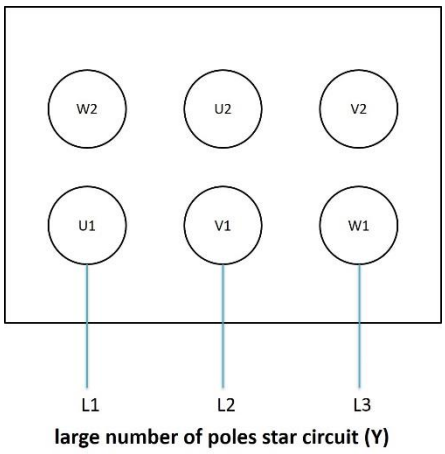
12. Pictures

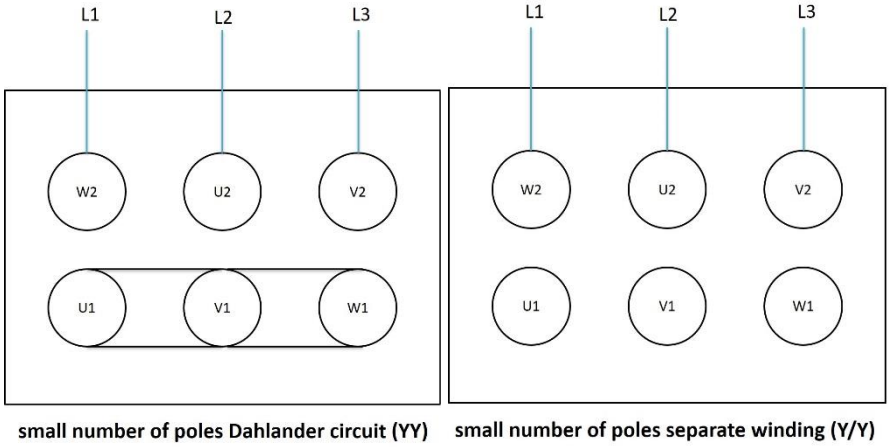


Picture 1. Maximal possible $U_{phase\text{-}ground}$ in dependence of the voltage rise time

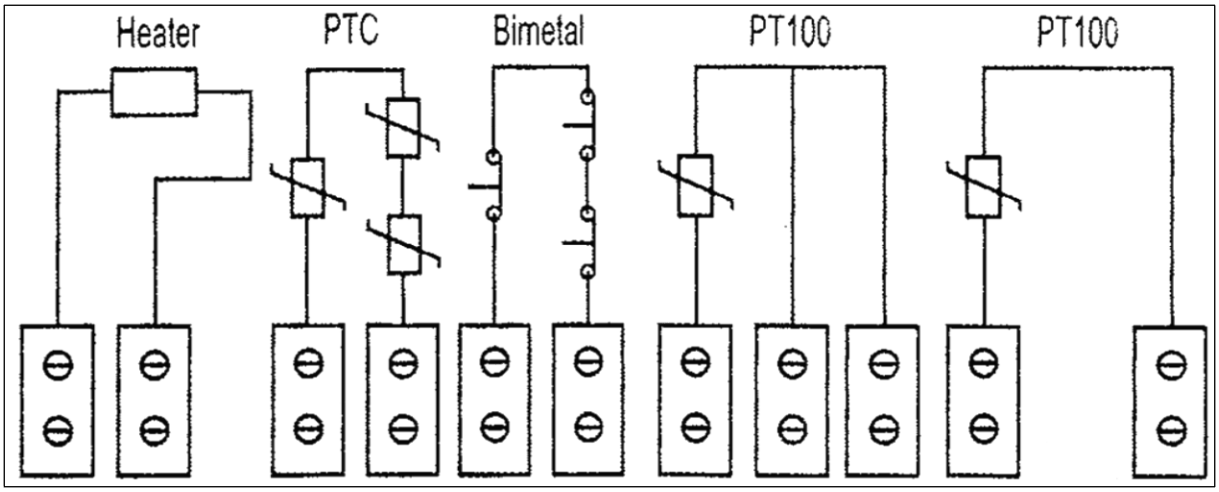


Picture 2a. Connection plan single-speed motors.

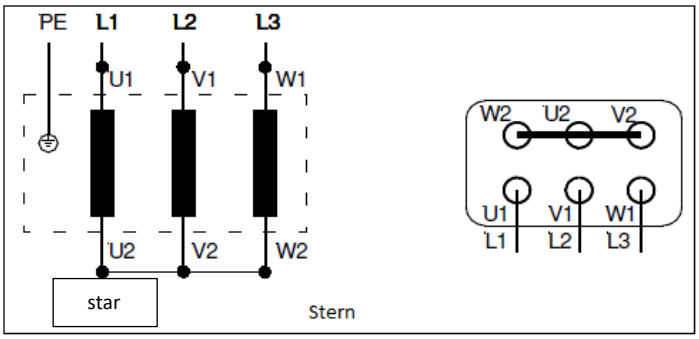




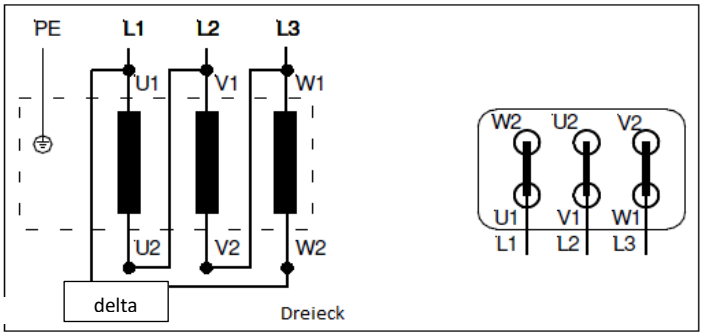
Picture 2b. Connection plan multi-speed motors.



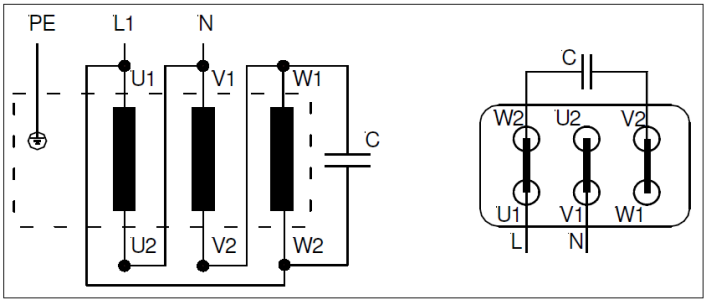
Picture 2c. Connection diagram space heater, temperature sensors PTC – Bimetal (PTO) – PT100 (PT1000).



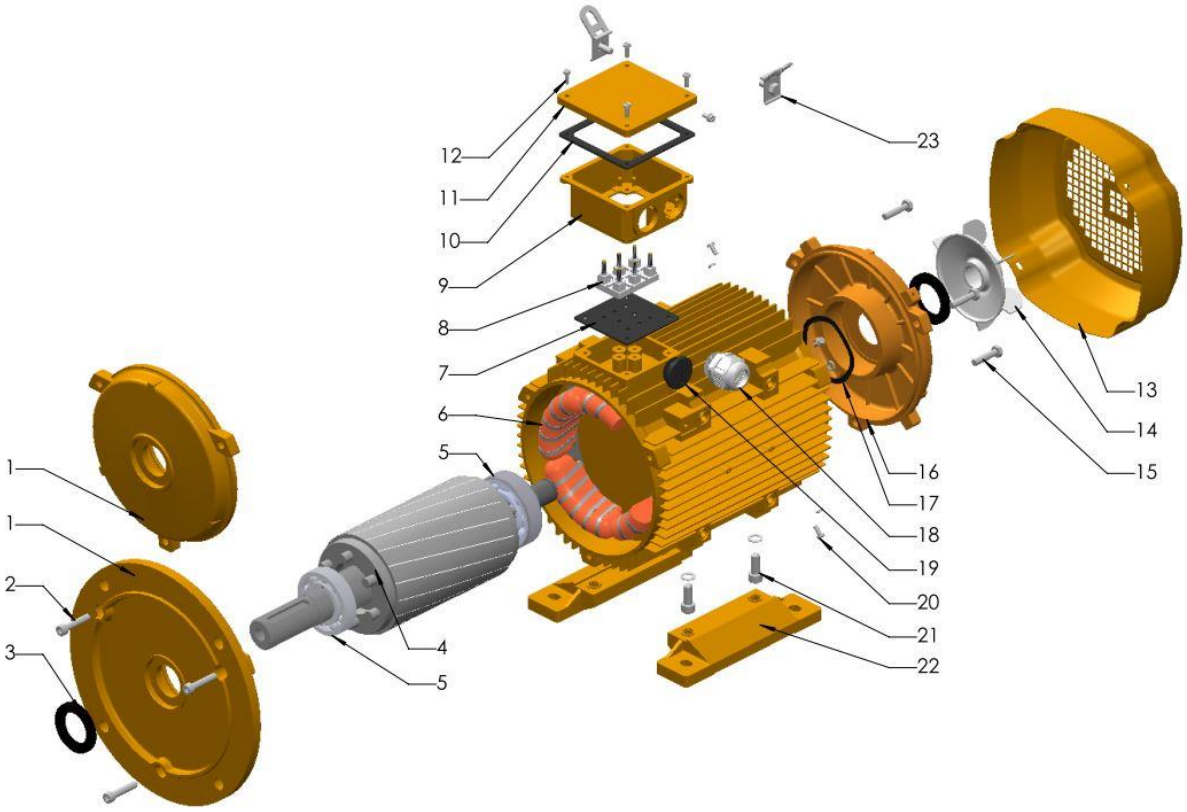
Picture 2d. Connection diagram forced ventilation fan – Star.



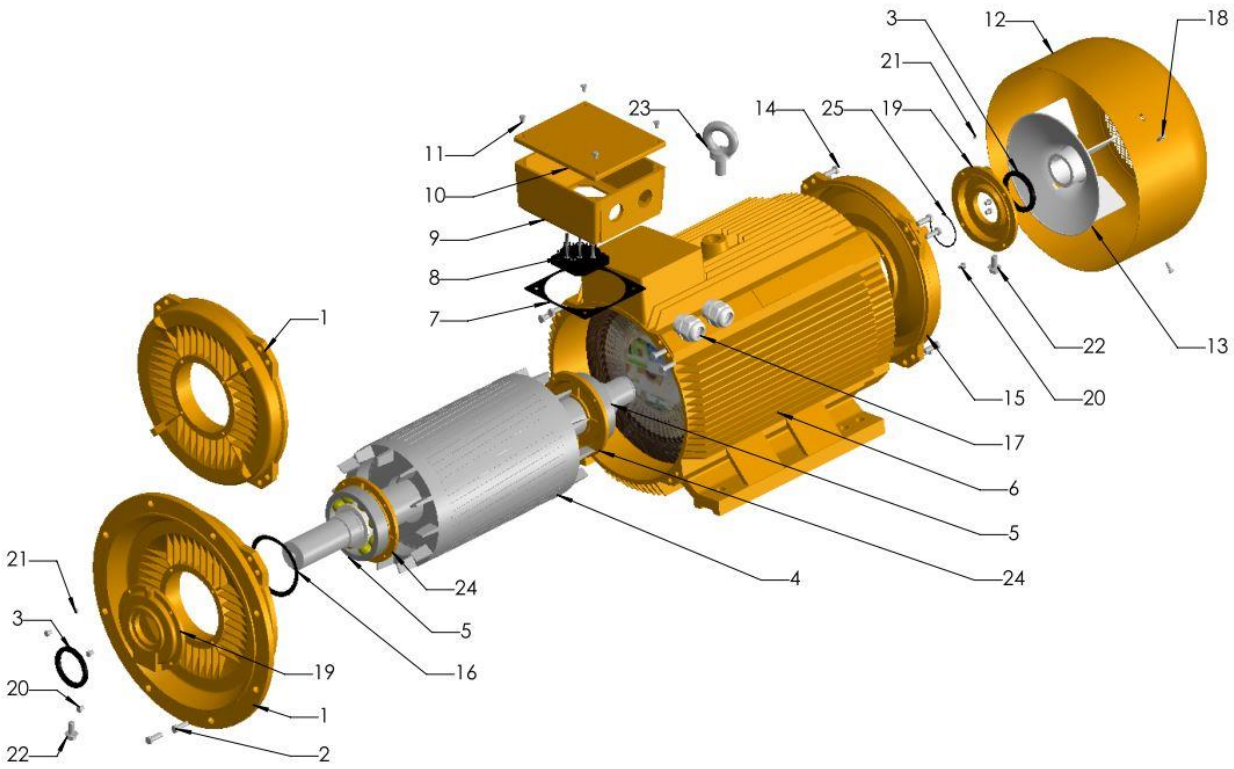
Picture 2e. Connection diagram forced ventilation fan – Delta.



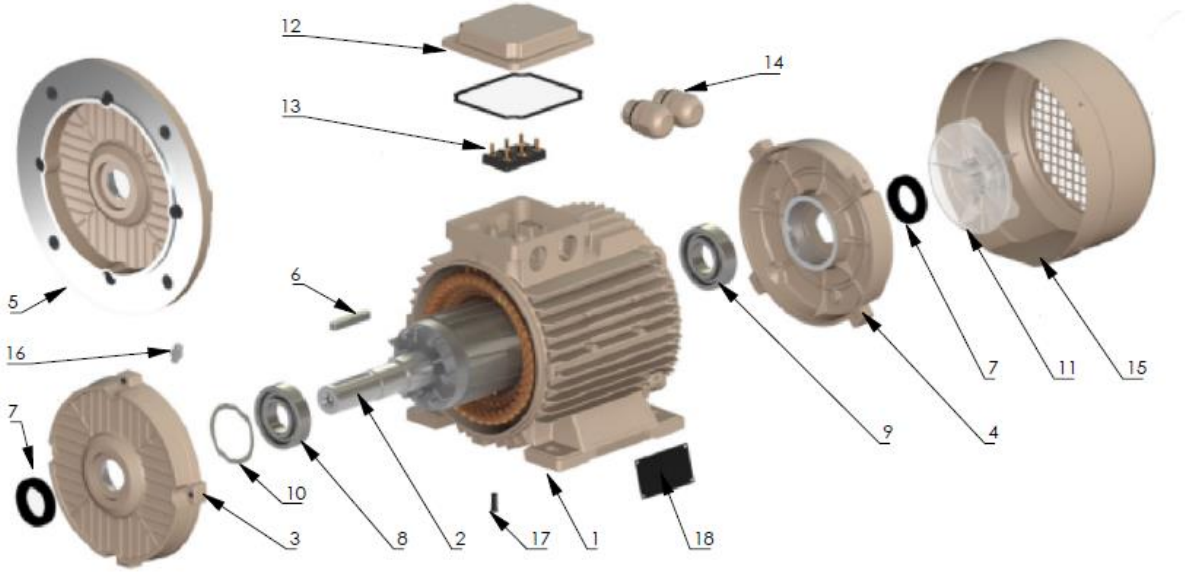
Picture 2f. Connection diagram forced ventilation fan – 1~.



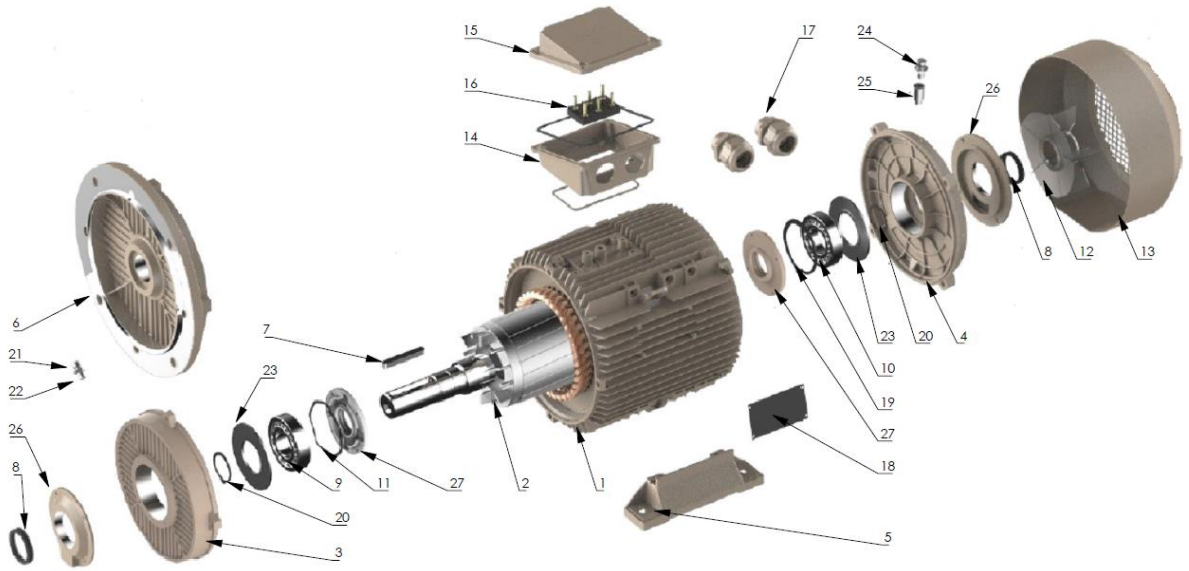
Picture 2. Motor spare parts: ACA – ACY – JL



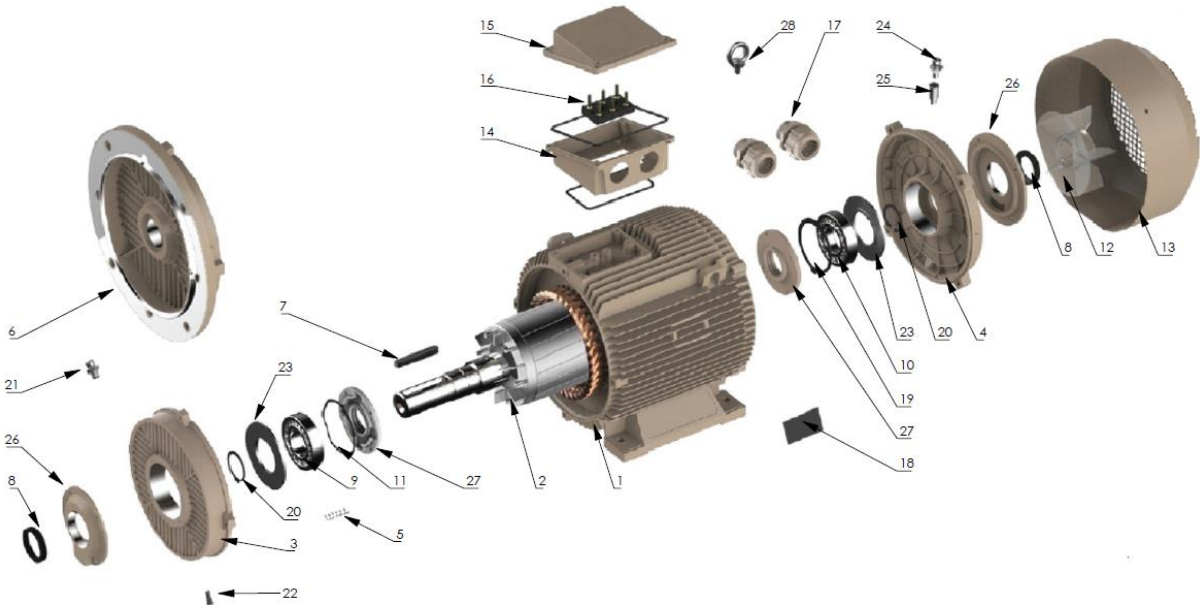
Picture 3b. Motor spare parts: ACM – AMY – JM – AWM – YE



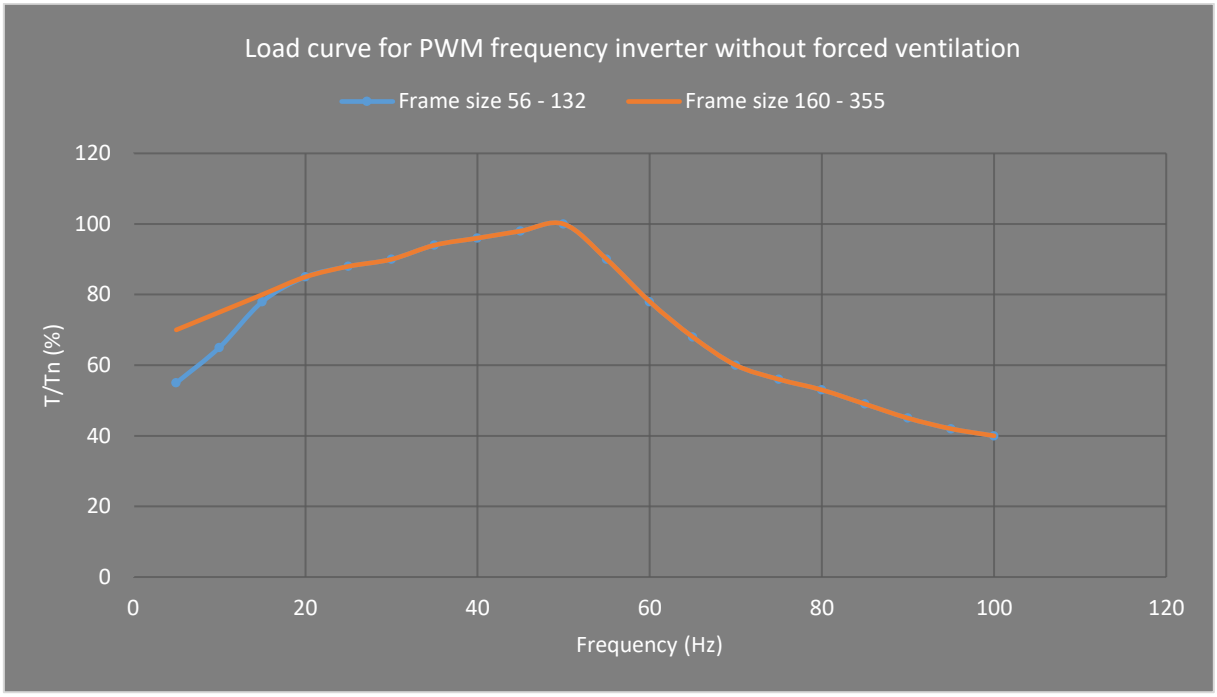
Picture 3c. Components of motors: AOA frame size 80 - 112



Picture 3d. Components of motors: AOA frame sizes 132 - 225



Picture 3e. Components of motors: AOM frame size 250 - 355



Picture 4. Load curve for PWM frequency inverters without forced ventilation