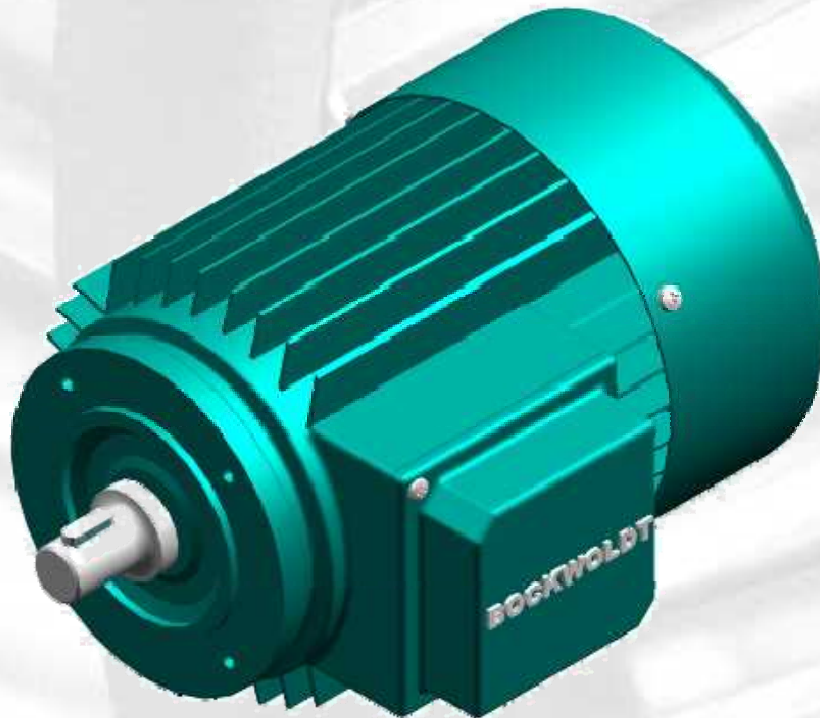




Operating Instructions

Betriebsanleitung

○ Three-phase asynchronous motors





powered by:
Bockwoldt
GmbH & Co. KG

Sehmsdorfer Str. 43-53
23843 Bad Oldesloe

Tel. : + 49 4531 8906-0
Fax : + 49 4531 8906-199
E-Mail : info@bockwoldt.de
Internet : www.bockwoldt.de

1	General	4
2	Description	4
3	Description	4
4	Degree of Protection	5
5	Type of Construction	5
6	Transport & Storage	5
7	Removal of the Transport Safety Device	5
8	Installation and Fitting	5
9	Insulation Check & Replacement of Grease / Bearings	6
10	Motor connection	7
11	Commissioning	7
12	Maintenance	8
13	Bearings and Lubrication	9
14	Long term storage	10
15	Slipring Contact System	10
16	Draining of condensation water	10
17	Cleaning	10
18	Auxiliary devices	11
19	Warranty, Repair, Spare Parts	11
20	Electromagnetic Compatibility	11
21	Trouble Shooting	11
22	Terminal board circuits	12
23	Disposal	13
24	Construction of the motor	14
25	Trouble shooting	15

1. General

To prevent damage to motors and the driven equipment the procedures laid down in the Operating and Maintenance Instructions must be followed. Especially to avoid risk of injury, the separately enclosed Safety Regulations must be adhered to strictly.

Since for reasons of clarity the Operating and Maintenance Instructions cannot contain specific information with regard to all conceivable special applications and areas with special requirements, the user himself has to make appropriate protection arrangements during the installation process.

1.2. Qualified personnel

Installation work, commissioning and operation of motors must only be done by qualified personnel. Installation work shall only be done by qualified personnel who is skilled because of a technical education, expertise and schooling of knowledge about



- security regulations,
- accident prevention regulations,
- standards and approved rules of technique (for example VDE-regulations, standards).

The qualified personnel must have the ability to assess the assigned job, identify possible dangers and avoid them. The qualified personnel must be authorized by the person in charge for security of the plant to carry out the necessary work and tasks.

1.3. Intended use

This motor is only approved for the intended use given by the manufacturer in his catalogue and the corresponding technical documentation. Other or additional use is not intended. This includes consideration of all corresponding product documents. Changes or reconstruction of the motor are not allowed. External products and components that shall be used together with the motor must be approved or recommended by the manufacturer.

1.4. Disclaimer

Observance of this manual and the conditions and methods used for installation, operation, use and maintenance of the electric motor can not be monitored by the manufacturer. An improper installation can result in property damage and thus result in personal injuries. We therefore do not accept responsibility and liability for losses, damages or costs resulting from improper installation, improper or wrong use and maintenance or connected with this in any kind. We strive to improve our products continuously. Consequently technical data and illustrations remain subject to change without prior notice. Specifications may only be considered binding after written confirmation by the supplier.

2. Description

The motors have been manufactured in accordance with IEC 34-1, EN 60034-1 and other appropriate European standards. Motors can also be supplied complying with special regulations (e.g. classification regulations, regulations for explosion protection).

Separate additional instructions apply for the following motor versions:

- Roller table motors
- Motors in explosion protected design

The details on the relevant order confirmation constitute the scope of supply.

3. Description

The efficiency is determined according to the specifications of EN 60034-2-1. For motors < 1kW the direct measurement method is used. The measurement uncertainty of this method is rated „low“. For motors ≥ 1kW the individual loss method is used. The additional losses of this method are determined from the residual losses. The measurement uncertainty of this method is also rated as “low”. Efficiency and Efficiency class complying with EN 60034-30 are listed on the name plate of energy saving motors.

4. Degree of Protection

The degree of protection of the motors is indicated on their rating plate. The degree of protection of additional devices fitted to the motor can be different than the degree of protection of the motor. This needs to be taken into consideration during the installation of the motors. If motors are installed in the open (degree of protection \geq IP 44), they should be protected against direct effects of the climate (freezing of the fan due to direct fall of rain, snow and formation of ice).

5. Type of Construction

The type of construction of the motors is indicated on the rating plate. The motors can be used in different types of construction only with permission of the manufacturer and if necessary after modification carried out in accordance with the manufacturer's instructions. Especially with types of construction with vertical shaft the user has to ensure that foreign particles cannot fall into the fan cowl.

6. Transport & Storage

If possible the motors should only be stored in closed and dry rooms. Outdoor storage under cover is permitted for a short time only and requires adequate protection against all harmful effects of the climate. The motors also have to be protected against mechanical damage. Never transport or store the motors resting on their fan cowls. The eye bolts/attachment eyes of the motors together with appropriate lifting tackle must be used for transport. The eye bolts/attachment eyes are intended for the lifting of the motors only, without any additional parts such as bed plates, gears etc. If eye bolts/attachment eyes are removed after installation, the tapped holes must be blanked off permanently according to the Protection Standard. For longer periods of storage a low vibration environment shall be provided so that bearing damages due to downtime can be avoided. After a storage period of more than 12 months the condition of the grease must be checked before putting the motor into operation.

7. Removal of the Transport Safety Device

On motors with transport safety device (roller bearing), the hexagon head screw provided for the fastening of the transport safety device is to be loosened and taken off together with the transport safety device. Subsequently the bearing cover bolt packed in a bag inside the terminal box is to be screwed into the bearing cover. If it is necessary for the motor type the bag will also contain a lock washer that is to be placed onto the bearing end shield bolt before screwing it into the bearing cover. After removal of the transport safety device micro movements of the rotor must be prevented by suitable measures (risk of downtime damages).

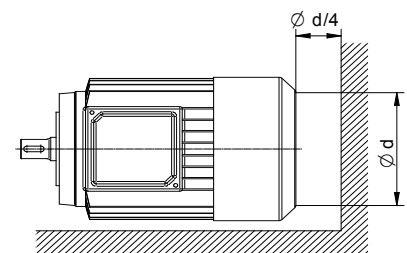
8. Installation and Fitting



Since during normal operation of electric motors, temperatures in excess of 100 °C can occur on their surface, any contact with them must be prevented if the motors are installed in accessible areas. Because of this temperature sensitive parts must never be fitted to them or have contact with them.

In types of construction IM B14 and IM B34 it must be ensured that the maximum usable screw depth specified in the table below is not exceeded, otherwise the winding will be damaged.

Air ventilation openings should be kept free, and minimum distances should be observed, so that the current of the cooling air will not be affected. Care must be taken that the discharged warmed up cooling medium is not sucked up again.



For constructions with shaft end upwards the user must prevent liquid entry from the shaft!



When placing into operation, respectively for trial runs without any driven components, the fitting key is to be safeguarded due to the slip danger. Start-up respectively test run without safeguarding of the fitting key is strictly interdicted.

Transmission components (such as couplings, pinions or belt pulleys) should be drawn onto the shaft by means of pull-on devices or by heating-up the part to be drawn onto the shaft. For the purpose of drawing the transmission components onto the shaft, the shaft ends are provided with tapped centering holes according to DIN 332 Part 2. Transmission components must never be driven onto the shaft using hammer blows because the shaft, the bearings and other components of the motor could be damaged.

All components that are to be fitted to the shaft end must be balanced dynamically according to the balancing system of the motor (full or half key). The rotors of the motor are balanced with half key. If possible the motors are to be installed in such a way that they are free from vibrations. With precision balanced motors special instructions are to be followed. When the installation is completed the user must ensure protection of movable parts and safety of operation.

Direct coupling to the driven machine requires a particularly accurate alignment. The shafts of both machines must be in alignment. The shaft height is to be adjusted to that of the driven machine using appropriate shims.

Belt drives put a lot of stress on the motor because of relatively high radial forces. When dimensioning belt drives, apart from the instructions and calculation programmes issued by the manufacturers of the belts, it must be ensured that the radial force permissible at the shaft end of the motor as stated in our data is never exceeded by the pull and pre-tensioning of the belt. When pre-tensioning the belt during installation the instructions of the belt manufacturers must be strictly adhered to.

The tapped bores of the flange types mentioned in the table are in most cases through-holes (type IMB14, IMB34).

To avoid damage to the winding overhang of the motor winding, **observe the maximum permissible tap depths in conformity with the following table.**

Flange type EN 50347	Old flange type DIN 42948	Tap depth [mm]
FT65	C 80	6,5
FT75	C 90	8
FT85	C105	8,5
FT100	C120	8
FT115	C140	10
FT130	C160	10
FT165	C200	12

If a motor of type IMB34 without flanged attachments is used, the user has to take appropriate **measures** at the through holes to **maintain the specified degree of protection.**

9. Insulation Check & Replacement of Grease / Bearings

When the motor is first commissioned and especially after extended storage, the insulation resistance of the winding is to be measured to earth and between phases. The check must take place using the rated voltage, but at least 500 V.



During and immediately after the measurements dangerous voltages are present at the terminals. Therefore never touch the terminals and follow the operating instructions of the insulation resistance meter closely!

Depending on the rated voltage U_N , the following minimum values must be maintained with a winding temperature of 25 °C:

Rated Power P_N [kW]	Insulation Resistance referred to Rated Voltage [k Ω /V]
$1 < P_N \leq 10$	6,3
$10 < P_N \leq 100$	4
$100 < P_N$	2,5

If the minimum values are lower, the winding must be dried properly until the insulation resistance corresponds to the required value.

When the motor is commissioned after a prolonged period of storage inspect the bearing grease visually and replace it if hardening and other irregularities occur. If the motors are to be commissioned by the manufacturer after more than three years following their delivery then the bearing grease must always be replaced. With motors fitted with covered or sealed bearings the bearings must always be replaced with new bearings of the same type after a storage period of four years.

10. Motor connection



The connection has to be done by qualified personnel according to the valid security regulations. Outside of Germany the required national standards must be applied. Name plate designations have to be observed under all circumstances!

Take extra care when connecting the supply cables in the terminal box of the motor. The nuts of the connection screws have to be fastened without force. Before connecting the power line, the existing motor connections must eventually be retightened.

For the permissible tightening torques for the terminal board bolts refer to the table below:

Rated current [A]	Connecting thread	Tightening torque [Nm]
16	M4	1,2
25	M5	2,0
63	M6	3,0
100	M8	6,0
160	M10	10,0
250	M12	15,5

11. Commissioning

Please follow the Safety Regulations closely. All work is to be carried out only when there is no voltage on the motor. The installation must be carried out according to the valid regulations by qualified skilled personnel. Initially the mains conditions (voltage and frequency) must be compared with the data on the rating plate of the motor. The dimensions of the connecting cables must be adjusted in line with the rated currents of the motor.

The connection points of the motor are marked in accordance with EN 60034-8 (VDE 0530 Part 8). In Section 19 of these instructions the most common circuit diagrams for three phase motors in basic design are provided, according to which the connection will be implemented. For all other versions, the special circuit diagrams are glued to the inside of the terminal box cover or placed in the terminal box. An additional terminal box can be provided for the connection of auxiliary and protection devices (e.g. anti-condensation heaters); the same regulations apply as for the main terminal box.

Always start the motors with an over-current protection device that is set in accordance with the relevant nominal values of the motor ($\sim 1,05 I_{nom}$). Otherwise warranty claims with respect to damaged windings become void. Before the motor is connected for the first time it is recommended to check the insulation resistances between winding and earth and between phases (see Section 9). After prolonged storage it is absolutely essential that the insulation resistance is measured. Before coupling the motor to the driven machine, check the direction of rotation of the motor to prevent possible damage being caused to the driven machine. If the power lines are connected with the phase sequence L1, L2, L3 to U, V, W, the direction of rotation is clockwise (view to shaft end on drive side DS). If two terminals are changed, the direction of rotation is counterclockwise (i.e. L1, L2, L3 to V, U, W). For machines with only one direction of rotation the required sense of rotation is marked by an arrow on the machine.

Tightening torques for bolts (end shield, bearing cover)

Thread Ø	Tightening torque Cast iron/steel [Nm]	Tightening torque Aluminium [Nm]
M4	2,3	1,1
M5	4,6	2,1
M6	7,9	3,7
M8	19	8,9
M10	38	18
M12	66	30
M14	105	49
M16	160	75
M20	330	150
M24	560	260

Before closing the terminal box make absolutely sure that:

- the connection has been made in accordance with the wiring diagram
- all terminal box connections are tightened
- all minimum values of air paths are maintained (larger than 8 mm up to 500 V, larger than 10 mm up to 750 V, larger than 14 mm up to 1000 V)
- the interior of the terminal box is clean and free from foreign particles
- unused cable entries are blanked off and the threaded plugs with seals are tightened
- the seal in the terminal box cover is clean and tightly glued and all sealing surfaces are in the correct state to ensure that the relevant degree of protection is maintained.

Before starting up the motor check that all safety regulations are strictly adhered to, that the machine is correctly installed and aligned, that all fixing parts and earthing connections are tightened, that the auxiliary and additional devices are functionally and correctly connected and if a second shaft end is fitted that the key is secured against being thrown aside.

If possible the motor is to be connected without load. If the motor is running smoothly and without any abnormal noises, the load of the driven machine is to be applied onto the motor. When the motor is started up it is recommended to monitor the current consumption if the motor is loaded with its driven machine so that any possible overloads and asymmetries occurring in the mains can be recognised immediately.

The starter must always be in the starting position during starting. With slip ring motors the correct running of the brushes must be monitored. They must be absolutely spark-free. For mountings like encoders, brakes and others please observe the corresponding operating and maintenance instructions of the manufacturer.

12. Maintenance

You are once again referred to the Safety Regulations, in particular to isolation, to securing against reconnection, to checking whether all components connected to a voltage source are in dead state.

If it is necessary to disconnect the motor from the mains for maintenance work particular care must be taken to ensure that any possibly existing auxiliary circuits (e.g. anti-condensation heaters, forced ventilators, brakes) are also disconnected from the mains.

If the motor is to be dismantled during maintenance work, the sealing compound on the centering shoulders is to be removed. When re-assembling the motor these need to be re-sealed using a suitable motor sealing compound. Existing copper sealing washers must always be refitted.

Careful and regular maintenance, inspections and revisions are necessary to detect and clear faults in time, before consequential damages will happen. As individual operating conditions can not be defined for all applications the listed terms represent a general advice for undisturbed operation. Individual local conditions (degree of pollution, load, etc.) must be taken into account when adjusting these terms.

What to do?	Time period	Terms
First inspection	After about 500 operating hours	½ year at the latest
Control of air circulation and surface of motor	Depending on local environmental pollution	
Relubrication (as option)	See name plate or relubrication sign	
Main inspection	After about 10,000 operating hours	Once a year
Remove condensate water	Depending on the local environmental conditions	

13. Bearings and Lubrication

The anti-friction bearings of the motors in standard design are filled with anti-friction bearing grease in the factory (or with sealed bearings by the bearing manufacturer) according to DIN 51825.

Under normal load and climatic conditions, the quality of grease guarantees an operation of the motor for approx. 10,000 service hours with two pole design and 20,000 service hours with multipole design. If not otherwise agreed the grease of anti-friction bearing must never be refilled during this period. However, the condition of the grease should be checked occasionally even before this time limit. The bearing itself or the grease of permanently lubricated bearings should be changed after approximately 3 years independent of operating hours. This is due to the reduction of lubrication properties of the grease. The indicated number of service hours is only valid for operation at rated speed.

When using inverter feeding the indicated relubrication periods are reduced by 25% because of the higher temperature increase. If during operation of the motor via an inverter the nominal speed is exceeded then the regreasing period reduces approximately in the opposite ratio to the increase in the motor speed.

Regrease the bearings only after a thorough cleaning using suitable solvents. The same type of grease must be used. When replacing the grease only the equivalent types specified by the motor manufacturer can be used. Please bear in mind that the bearings should only be filled up to about 2/3 of their free space. A complete filling of the bearings and bearing covers with grease leads to increased bearing temperature and therefore to increased wear.

For bearings with a grease appliance (optional for motors of frame size 160 or bigger), the greasing of the lubrication nipple should be made at running motor. The grease quantity is depending on the respective motor. For the re-greasing intervals please refer to the table below:

Frame size	2-pole design	Design with 4-poles and more
160 - 280	2.000 h	4.000 h

The quantities of grease required for the re-greasing are stated in the below table (Please note that for the first re-greasing approx. twice the amount of grease is required because the grease lubrication pipes are still empty). The used grease is collected in the grease chamber of the external bearing cap. After approx. 5 re-greasings this old grease should be removed, e.g. as part of inspection work.

Frame size	160	180	200	225	250	280
Quantity of grease [g]	20	25	30	35	40	50



Maintenance works (without relubrication) has to be done at standstill of the motor. It has to be assured that the machine is secured against re-connection and labelled with an appropriate sign.

In addition the security advices and accident prevention regulations of the manufacturers for the use of oils, lubricants and detergents has to be observed!



Adjacent live parts have to be covered or secured! It has to be assured that the auxiliary circuits like anti-condensation heating are dead (zero potential).

For design versions with condensate drain hole please observe that the drain plug screw has to be lubricated with a suitable sealant before relocking.

14. Long term storage (more than 12 months)

Long term storage must be done indoors in vibration-free, dry rooms with temperatures not below -20°C and not above +40°C. The storage environment must not contain aggressive gas, vapours, dusts and salts. Preferably motors shall be moved and stored only in original packing. Storage and transport with motors standing on their fan covers is not allowed. Additionally unprotected metal surfaces like shaft ends and flanges must be protected with a medium for long-time corrosion protection in addition to the existing factory-provided temporary corrosion protection.

If there is a risk of motors being covered by moisture from condensation, please provide precautionary measures against humidity. Than a special packing in airtight sealed plastic foil is necessary or as alternative packing in plastic foil with desiccants. Please put desiccant bags in the terminal box as well.

For the transport please use the eye bolts/attachment eyes of the motors together with suitable lifting accessories. The eye bolts/attachment eyes must only be used for lifting the motors without additional mountings like foundation plates, gears and others.

Motors with reinforced bearings are supplied with a transportation safety device. The transportation safety device at the shaft end must only be removed during installation of the motor and before switching on.

15. Slipping Contact System

The slipping contact system is to be inspected at regular intervals. It is advisable to check the slip rings 2 - 3 times immediately after commissioning, at intervals of approx. 50 operating hours. Subsequently regular maintenance is to be carried out at intervals that depend on the relevant operating conditions.

A thin layer of patina should be formed on the surface of the slip rings. Generally such patina layer is formed after an operation of between 100 to 500 hours. If intensive scoring or burnt spots on the slip ring surface occur they must be removed immediately either by cleaning or if necessary by re-machining. If slight scoring appears it is not necessary to re-machine. The pressure of the carbon brushes must be checked. It should be between 18.5 kPa and 24 kPa. When replacing the brushes the same type of brush must always be used. New carbon brushes must be bedded-in. With box type brush holders care must be taken to ensure that the carbon brushes do not jam due to contamination.

The carbon brushes wear naturally and the abrasion can amount to 3 - 5 mm per 1,000 hours of operation.

16. Draining of condensation water

On installation sites where formation of dew and thus occurrence of condensation water can be expected inside the motor, the accumulated condensation water has to be drained at regular intervals through the opening at the lowest point of the end shield. Subsequently the opening must be closed up again.

17. Cleaning

So that the effects of cooling air are not interfered with, all parts of the motor must be cleaned at regular intervals. In the majority of cases it is sufficient to clean the machine with compressed air that is free from water and oil. Especially the vent holes and the spaces between the ribs must be kept clean. The dust generated by natural wear and deposited in the interior of the motor or in the slip ring space must be removed at regular intervals. It is recommended to include the electric motors in the regular routine inspections of the driven machine.

18. Auxiliary devices

As option the motors can be equipped with auxiliary devices.

18.1 Motors with Thermal Winding Protection

For monitoring the stator winding temperature it is possible to have thermo couples installed in the motor (PTC thermistors, KTY or PT100). For their connection suitable auxiliary clamps for auxiliary circuits are available in the main terminal box or in additional terminal boxes. The connection is done according to the attached connection diagram.

A continuity test of the thermistor sensor circuit using a test lamp, a hand generator and such like is strictly prohibited because this would destroy the sensors immediately. If it becomes necessary to verify the cold resistance of the sensor circuit (at approx. 20°C) then the measuring voltage must never exceed 2.5 V DC. It is recommended to carry out the measurement using a Wheatstone bridge with a 4.5 V DC supply voltage. The cold resistance of the sensor circuit must never exceed 810 Ohms; a measurement of the hot resistance is not necessary.



With motors that are fitted with thermal winding protection, care must be taken that when the thermal winding protection responds and after the cooling down of the motor, no hazards can occur due to spurious automatic reconnection.

18.2 Anti-condensation heating

The input supply voltage is indicated on the name plate of the motor. For their connection either in the main terminal box or in the auxiliary terminal boxes suitable clamps for auxiliary circuits are provided. The connection is done according to the attached connection diagram. The anti-condensation heating has to be switched on only after disconnection of the motor. It shall not be switched on while the motor is in operation.

18.3 Forced ventilation unit

The forced ventilation unit is dissipating the lost heat at operation of the main motor. During operation of the main motor the motor of the forced ventilation unit has to be switched on. After disconnection of the main motor the forced ventilation has to continue depending on the temperature. For motors with forced ventilation units that are dependent of the sense of rotation, the sense of rotation has to be observed unconditionally (see rotation mark). Only manufacturer approved forced ventilation units shall be used. The forced ventilation unit has to be connected according to the connection diagram that is supplied inside of the terminal box.

19. Warranty, Repair, Spare Parts

We are responsible for guarantee repairs, unless otherwise expressly agreed. Other repairs that may potentially be required can also be carried out by skilled personnel in these workshops. Details about Customer Service network can be obtained from the manufacturer on request. The spare parts are listed in Section 24 of these Operating & Maintenance Instructions. Maintenance carried out appropriately (provided it is as described in Section "Maintenance") does not constitute a breach of warranty provisions. The contractual warranty liability on the part of the manufacturer is not prejudiced by this.

20. Electromagnetic Compatibility

The motors, as non-independently working unit, have been checked with regard to their conformity with the EMC Standards. It is the responsibility of the equipment operator to ensure by suitable measures that the apparatus or plant in their entirety comply with the relevant electromagnetic compatibility standards.

21. Trouble Shooting

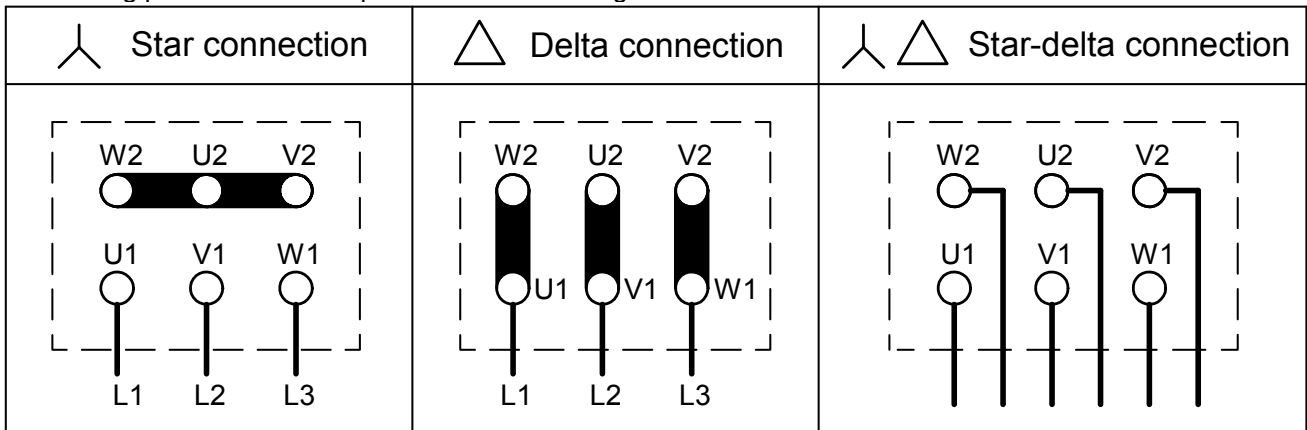
General mechanical and electrical faults are to be rectified according to the Schedule in Section 25. All Safety Regulations must be strictly observed when rectifying faults.

22. Terminal board circuits

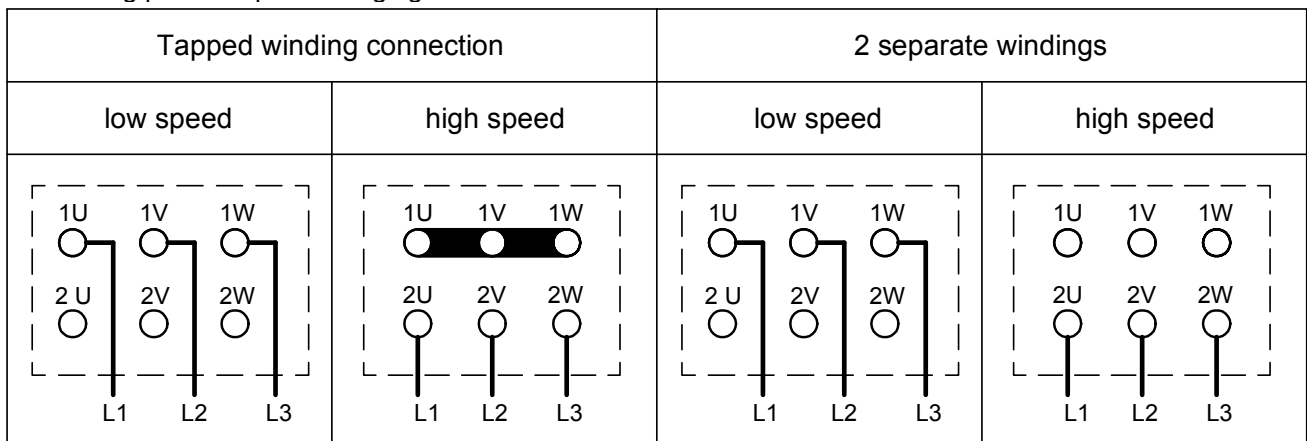
For a machine with only one shaft end or with two shaft ends that have different diameters, the sense of rotation is that rotational direction which is seen, if a person looks at the front end of the only or thicker shaft end.

For each motor the correct connection diagram is attached. The connection must be done accordingly. For the connection of auxiliary circuits please see the additional connection diagram, which is also attached.

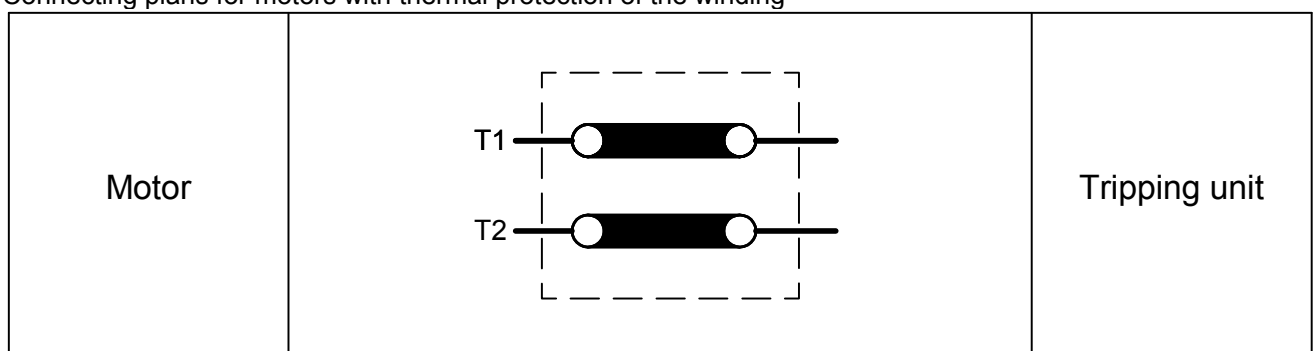
Connecting plans for AC threephase motors with cage rotors



Connecting plans for pole-changing motors



Connecting plans for motors with thermal protection of the winding



23. Disposal

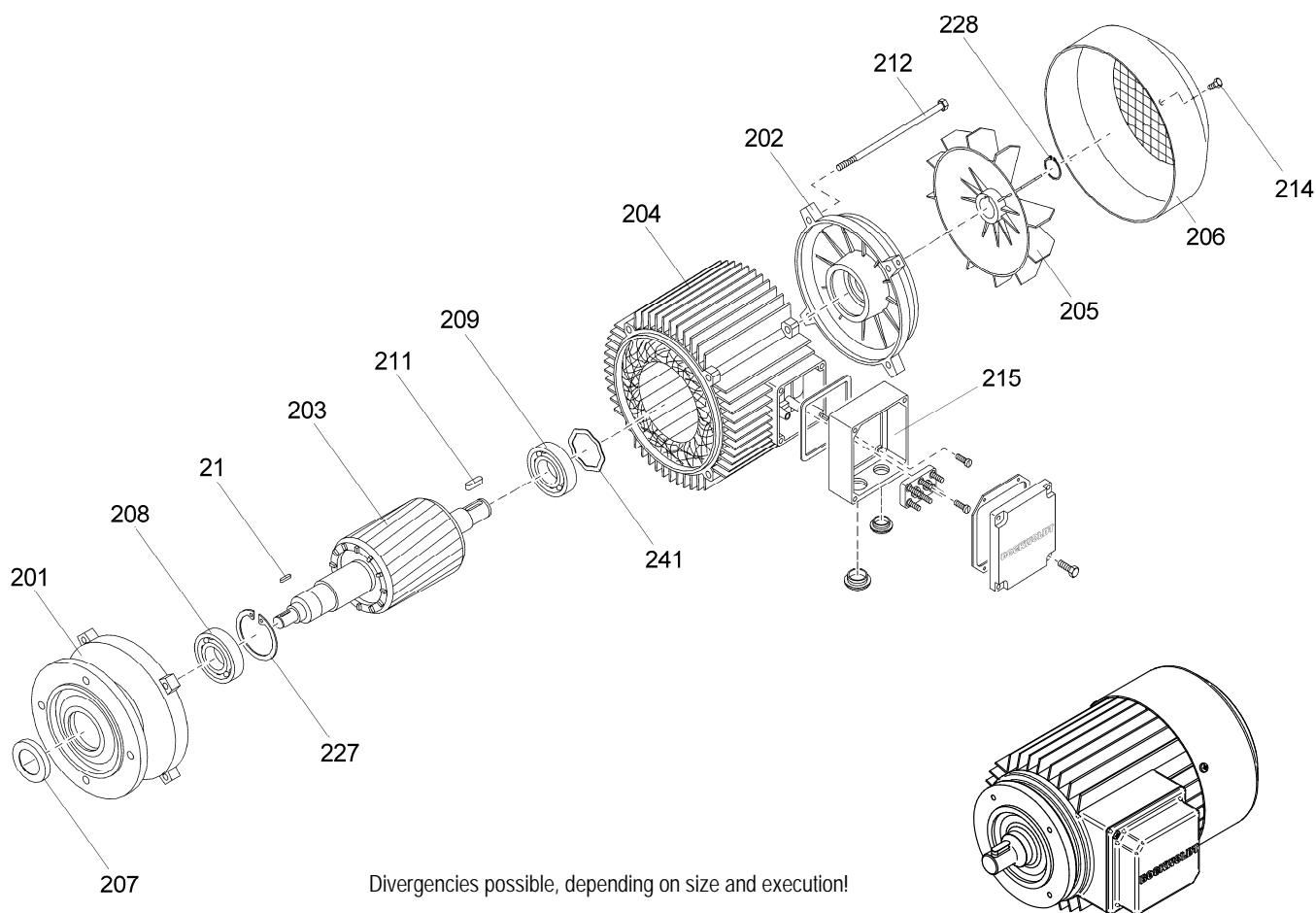
When disposing of the motors please observe applicable national law.

In addition please take care that all oil and grease is disposed according to the ordinance of waste oils (Altölverordnung). They must not be contaminated with solvents, cold cleaners and paint residues.

Before recycling the individual materials must be separated. Most important components are grey cast iron (housing), steel (shaft, stator and rotor sheets, consumables), aluminium (rotor), copper (windings) and plastics (insulation materials like for example Polyamide, Polypropylene and others).

Electronic components like printed circuit boards (inverter, encoder, etc.) must be recycled separately.

24. Construction of the motor



Divergencies possible, depending on size and execution!

21	Fitting key	208	Ball bearing
201	End shield A	209	Ball bearing
202	End shield B	211	Fitting key
203	Rotor complete	212	Fixing screw
	a) with toothed motor shaft	214	Fixing screw
	b) with plain motor shaft	215	Terminal box complete
204	Casing complete	227	Locking ring
205	Fan	228	Locking ring
206	Fan housing	241	Compensation disk
207	Shaft seal		

25. Trouble shooting

25.1 Electrical Faults

	Motor doesn't start	
	Motor runs up heavily	
	Humming noise during start	
	Humming noise during operation	
	Hum in time of the double slip frequency	
	Excessive warming up at no-load operation	
	Excessive warming up at rated output	
	Excessive warming up of individual winding sections	
	Possible cause of fault	Remedial measure
● ● ●	Overload	Decrease the load
●	Interruption of a phase in the supply conductor	check the switch and the supply conductor
● ● ●	Interruption of a phase in the supply conductor after switching-on	check the switch and the supply conductor
●	Mains voltage too low, frequency too high	check the mains conditions
●	Mains voltage too high, frequency too low	check the mains conditions
● ● ● ●	Stator winding misconnected	check the winding connections
● ● ●	Turn-to-turn fault	check the winding and the insulation resistance, Maintenance in our company BOCKWOLDT
● ● ●	Phase-to-phase short circuit	check the winding and the insulation resistance, Maintenance in our company BOCKWOLDT
●	Interruption in the squirrel cage winding	Maintenance in our company BOCKWOLDT

25. Trouble shooting

25. 2 Mechanical Faults

		Possible cause of fault	Remedial measure
		Dragging noise	
		Excessive warming up	
		Strong vibrations	
		Bearing warming up excessively	
		Bearing noises	
●	●	Rotary parts are dragging	Determine the cause, re-align parts
	●	Air supply reduced	Check the ventilation passages
	●	Unbalance of the rotor	Take rotor off, re-balance it
	●	Rotor not circular, shaft deformed	Take rotor off, co-ordinate further measures with the manufacturer
	●	Imperfect alignment	Align motor & driven machine, check the coupling
	●	Unbalance of the coupled machine	Re-balance coupled machine
	●	Shocks from the coupled machine	Check the coupled machine
	●	Irregularities from the gear	Check and repair the gear
	●	Resonance with the foundation	Stiffen the foundation after consultation
	●	Changes in the foundation	Determine the cause, eliminate it and re-align the machine
	●	Too much grease in the bearing	Remove excess grease
	●	Coolant temperature higher than 40 °C	Regrease bearing with suitable grease
	●	V-type rotary seal or gamma ring are dragging	Replace V-type rotary seal or gamma ring, maintain the prescribed installation clearance
●	●	Lubrication insufficient	Lubricate according to instructions
	●	Bearing is corroded	Replace bearing
	●	Bearing clearance too small	Use bearing with larger bearing clearance
	●	Bearing clearance too large	Use bearing with smaller bearing clearance
	●	Chatter marks in the bearing track	Replace bearing
	●	Standstill marks	Replace bearing
	●	Cylindrical roller bearing operated at low load	Change the bearing according to manufacturer's
	●	Coupling pushes or pulls	Re-align motor & driven machine
	●	Belt tension too high	Adjust the belt tension according to instructions
	●	Bearing not aligned or stressed	Check the bearing bore, consult the manufacturer