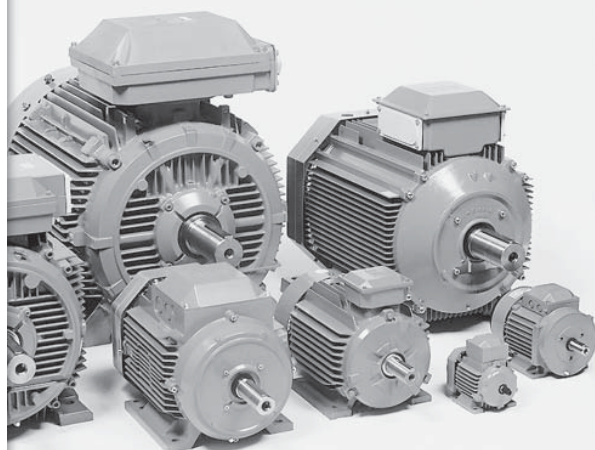


Low Voltage Motors

Manual for Low Voltage Motors

*Installation, operation and
maintenance manual*

GB 3





EC Declaration of Conformity

The Manufacturer :- *(Name and address of the manufacturer)*

hereby declares that

The Products :- *(Product identification)*

are in conformity with provisions of the following Council Directives :

Low Voltage Directive 73/23/EEC (amended by 93/68/EEC),

and, as components, with the essential requirements of the following :

EMC Directive 89/336/EEC (amended by 92/31/EEC and 93/68/EEC), regarding the intrinsic characteristics to emission and immunity levels,

and are in conformity with :

EN 60 034-1

Additional Information :-

By design, the machines, considered as components, comply with the essential requirements of

Machinery Directive 98/37/EEC provided that the installation be correctly realised by the manufacturer of the machinery (for example : in compliance with our Installation Instructions and EN 60 204 "Electrical Equipment of Industrial Machines").

Certificate of Incorporation (Directive 98/37/EEC, Art 4.2 and Annex II, Sub B) :

The machines above must not be put into service until the machinery into which they have been incorporated have been declared in conformity with the Machinery Directive.

Year of CE marking : CE00.

Signed by

Title

Date

Translations into other languages are available from ABB.

Low Voltage Motors

Installation, operation and maintenance manual

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1. General

NOTE!

These instructions must be followed to ensure safe and proper installation, operation and maintenance of the motor. They should be brought to the attention of anyone who installs, operates or maintains this equipment. Ignoring the instruction may invalidate the warranty.

1.1 Declaration of Conformity

Declarations of Conformity with respect to the Low voltage Directive 73/23/EEC amended by Directive 93/68 EEC are issued separately with individual machines.

The Declaration of Conformity also satisfies the requirements of a Declaration of Incorporation with respect to the Machinery Directive 98/37/EEC, Art 4.2 Annex II, sub B

1.2 Validity

The instructions are valid for the following ABB electrical machine types, in both motor and generator operation.

series MT*, MBT*, MXMA,
series M2A*/M3A*, M2B*/M3B*, M2C*/M3C*,
M2F*/M3F*, M2L*/M3L*, M2M*/M3M*, M2Q*,
M2R*/M3R*, M2V*/M3V*

in frame sizes 56 - 450.

There is a separate manual for e.g. Ex motors 'Low voltage motors for hazardous areas: Installation, operation and maintenance Manual' (Low Voltage Motors/Manual for Ex-motors).

Additional information is required for some machine types due to special application and/or design considerations. Additional information is available for the following motors:

- roller table motors
- water-cooled motors
- open drip proof motors
- smoke venting motors
- brake motors
- permanent magnet motors

2. Installation

2.1 Putting into service (starting)

2.1.1 Reception check

Immediately upon receipt check the machine for external damage and if found, inform the forwarding agent without delay.

Check all rating plate data, especially voltage and winding connection (star or delta). The type of bearing is specified on the rating plate of all motors except the smallest frame sizes.

Remove transport locking if employed. Turn shaft by hand to check free rotation.

Do not exceed permissible loading values of bearings stated in the product catalogue.

Motors equipped with roller bearings: Running the motor with no radial force applied to the shaft may damage the roller bearing.

Motors equipped with angular contact bearing: Running the motor with no axial force applied in the right direction to the shaft may damage the angular contact bearing.

Motors equipped with regreasing nipples:

When starting the motor for the first time, or after long storage of the motor, apply the specified quantity of grease until grease is forced out of the grease outlet.

For details see section "Manual lubrication" on page 9.

2.1.2 Insulation resistance check

Measure insulation resistance before commissioning and when winding dampness is suspected.

Resistance, measured at 25°C, shall exceed the reference value, i.e. 10 M ohm (measured with 500 V dc Megger)

WARNING

Windings should be discharged immediately after measurement to avoid risk of electric shock.

Insulation resistance reference value is halved for each 20°C rise in ambient temperature.

If the reference resistance value is not attained, the winding is too damp and must be oven dried.

Oven temperature should be 90°C for 12-16 hours followed by 105°C for 6-8 hours.

Drain hole plugs, if fitted, must be removed and closing valve, if fitted, must be opened during heating.

Windings drenched in seawater normally need to be rewound.

2.1.3 Direct-on-line or star/delta starting

The terminal box on standard single speed machines normally contains 6 winding terminals and at least one earth terminal.

Earthing must be carried out according to local regulations before the machine is connected to the supply voltage.

The voltage and connection are stamped on the rating plate.

Direct-on-line starting (DOL):

Y or D winding connections may be used.

e.g. 660 VY, 380 VD indicates Y-connection for 660 V and D-connection for 380 V.

Star/Delta starting (Y/D):

The supply voltage must be equal to the rated voltage of the machine in D-connection.

Remove all connection links from the terminal block.

For two-speed, single phase and special machines, supply connection must follow the instructions inside the terminal box.

If direct-on-line starting lasts for more than 10 seconds or Y/D starting more than 30 seconds, consult ABB Sales Office or see the publication 'The Motor Guide' (also available on the internet on www.abb.com/motors&drives).

2.1.4 Terminals and direction of rotation

Direction of rotation is clockwise when viewing the shaft face at the machine drive end, when the line phase sequence L1, L2, L3 is connected to the terminals as shown in the figure 1.

To alter the direction of rotation, interchange the connection of any two line cables.

If the machine has a uni-directional fan, ensure that the direction of rotation is according to the arrow marked on the machine.

2.2 Handling

2.2.1 Storage

The machine should always be stored indoors, in dry, vibration free and dust free conditions.

Unprotected machined surfaces (shaft-ends and flanges) should be protected with anti-corrosive treatment.

It is recommended that shafts be rotated periodically by hand to prevent grease migration.

Anti condensation heaters, if fitted, should preferably be energised.

The characteristics of electrolytic capacitors, if fitted to single-phase motors, will require "reforming" following periods of storage exceeding 1-2 years. Contact ABB Sales Office for details.

2.2.2 Transportation

Machines fitted with cylindrical-roller and/or angular contact bearings must be fitted with locking devices during transport.

2.2.3 Lifting

Lift the motor using the lifting lugs only, if not otherwise stated in the separate lifting instruction.

The center of gravity of motors with the same frame may vary due to different outputs, mounting arrangements and auxiliary equipment.

Check that eyebolts or the lifting lugs integrated with the motor frame are undamaged before lifting. Damaged lifting lugs must not be used.

Lifting eyebolts must be tightened before lifting. If needed the position of the eyebolt must be adjusted with suitable washers.

Ensure that proper lifting equipment is used and that the sizes of the hooks are suitable for the lifting lugs.

Care must be taken not to damage auxiliary equipment and cables attached to the motor.

2.2.4 Machine weights

Total machine weight can vary within the same frame size (center height) depending on different output, mounting arrangements and added features.

The following table shows estimated maximum weights for machines in their basic versions as a function of frame material.

The actual weight of all our motors is stated on the rating plate except the smallest frame sizes.

Frame size	Aluminum		Cast iron	Steel
	Weight kg	Add. for brake	Weight kg	Weight kg
56	4.5	-	-	-
63	6	-	-	-
71	8	5	13	-
80	12	8	20	-
90	17	10	30	-
100	25	16	40	-
112	36	20	50	-
132	63	30	90	-
160	110	30	175	-
180	160	45	250	-
200	220	55	310	-
225	295	75	400	-
250	370	75	550	-
280	405	-	800	600
315	-	-	1700	1000
355	-	-	2700	2200
400	-	-	3500	3000
450	-	-	5000	4500

Table 1

2.3 Installation

2.3.1 Cooling

Normal ambient temperatures should not exceed 40°C (marine standard +45 or +50°C) if standard performance is to be achieved. Check that the motor has sufficient airflow. Ensure that no nearby equipment, surfaces or direct sunshine, radiate additional heat to the motor. For more information about higher ambient temperatures and cooling, see "the Motor Guide" or contact ABB Sales Office.

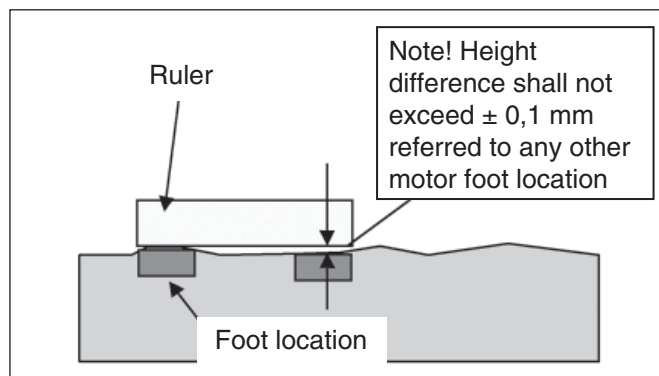
2.3.2 Foundation

The purchaser bears full responsibility for preparation of the foundation.

Metal foundations should be painted to avoid corrosion.

Foundations must be even, and sufficiently rigid to withstand possible short circuit forces. They shall be dimensioned as to avoid the occurrence of vibration due to resonance.

Before mounting the motor, the foundation surface for the shims or for the feet must be clean from thick paint, paint drops and dirt. Then it should be checked in order to discover any height differences between the individual foot locations. Also, the smoothness within each footprint area has to be checked. The requirements are noted in the figure below.



Foundation studs

Bolt the foundation studs to the feet of the motor and place a 1-to-2 mm shim between the stud and the feet.

Align the motor directly using appropriate means. Grout the studs with concrete, check alignment and drill holes for locating pins.

Drain holes

Always check that open drain holes face downward.

In extremely dusty environments, all drain holes should be closed.

2.3.3 Alignment

Correct alignment is essential to avoid bearing failures, vibrations and possible fractured shaft extensions.

2.3.4 Slide rails and belt drives

- Fasten the machine to the slide rails as shown in figure 2.
- Place the slide rails horizontally on the same level.
- Check that the machine shaft is parallel with driven, or driving, shaft.
- Any belt must be tensioned according to the supplier's instructions.

WARNING

Excessive belt tension will damage bearings and can cause shaft breakage.

Do not exceed the maximum belt forces (i.e. radial bearing loading) stated in the relevant product catalogues.

2.4 Connection

Normal machine design has the terminal box on top with cable entry possible from both sides.

Some machines are available with top mounted terminal boxes rotatable 4 x 90°, and some with side mounted terminal boxes.

Availability of these solutions is described in the product catalogues.

Unused cable entries must be closed.

As well as main winding and earthing terminals, the terminal box can also contain connections for thermistors, standstill heating elements, bimetallic, switches, or PT 100 resistance elements.

WARNING

Voltage may be connected at standstill inside the terminal box for heating elements or direct winding heating.

Connection diagrams for auxiliary elements are found inside the terminal box cover or in additional labels on the frame of the machine.

WARNING

The capacitor in single-phase motors can retain a charge that appears across the motor terminals, even when the motor has reached standstill.

2.4.1 Connection for variable speed drive

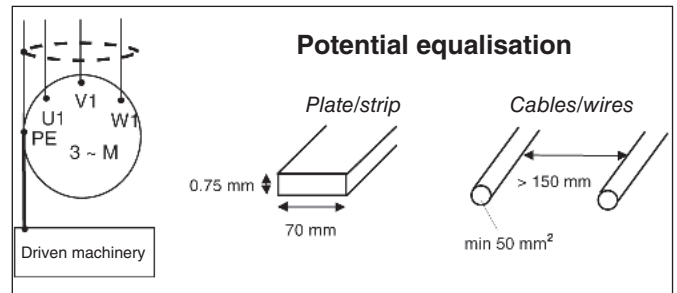
Variable speed drives cause higher voltage stresses than the sinusoidal supply on the winding of the motor and may cause high frequency shaft voltages and bearing currents. Therefore the winding and the bearing insulation of the motor as well as the filter at the converter output must be dimensioned according to "Selection rules for VSD applications/Insulation" (3GZF500930-2), available on request from ABB.

In variable speed drives the motor ($P_n > 30$ kW) must be cabled by using shielded symmetrical cables and cable glands providing 360° bonding (also called EMC glands). More information can be found in ABB's manual "Grounding and cabling of the drive system" (3AFY61201998).

In frequency converter applications motor frame external earthing must be used for equalising the potential between the motor frame and the driven machine, unless the two machines are mounted on the same metallic base.

For motor frame sizes above IEC 280, use 0.75 x 70 mm flat conductor or at least two 50 mm² round conductors. The distance of the round conductors must be at least 150 mm from each other.

This arrangement has no electrical safety function; the purpose is to equalise the potentials. When the motor and the gearbox are mounted on a common steel fundament, no potential equalisation is required.



To comply with EMC-requirements, use only cables and connectors approved for this purpose. (See instruction for frequency converters.)

The highest permissible rotational speed of a cast iron motor used in variable speed drive (M2BA/M3BP) must not exceed maximum permissible speeds as stated in the table 2 below or the speed stamped on the rating plate. For information on the highest permissible rotational speed for other motor sizes and types, please contact ABB. Bearing lubrication should follow the directions mentioned later.

Frame size	Speed r/min	
	2 pole	4 pole
280	3600	2600
315	3600	2300
355	3600	2000
400	3600	1800
450	3600	1800

Table 2

If there is uncertainty concerning the suitability of the motor for the variable speed drive, please contact ABB.

WARNING

The maximum operating temperature of the grease and bearings must not be exceeded.

2.5 Balancing

The rotor of the machine is dynamically balanced.

As standard, balancing has been carried out using **half key**, and the shaft is marked **with a RED tape**, with the text "Balanced with half key". In case of motors delivered without any tape defining the type of balancing, these motors are also balanced with **half key**.

To avoid vibration the coupling-half or pulley must be balanced with half key after the keyway has been machined.

In the event of balancing **with full key** the shaft is marked **with a YELLOW tape**, with the text "Balanced with full key".

In case balancing **without key**, the shaft is marked **with a BLUE tape**, with the text "Balanced without key".

3. Operating

3.1 Use

3.1.1 Operating conditions

The machines are intended for use in industrial drive applications.

Normal ambient temperature limits are -20° to +40°C.

Maximum altitude 1000 m above sea level.

3.2 Safety considerations

The machine is intended for installation and use by qualified personnel, familiar with relevant safety requirements.

Safety equipment necessary for the prevention of accidents at the installation and operating site must be provided in accordance with the local regulations.

WARNING

Small motors with supply current directly switched by thermally sensitive switches can start automatically.

3.2.1 Points to observe

1. Do not use the machine to step on.
2. The temperature of the outer casing of the machine may be hot to the touch during normal operation.
3. Some special machine applications require special instructions (e.g. using frequency converter supplies).
4. Lifting lugs must only be used for lifting the motor. They must not be used to lift the motor when it is attached to other equipment.

3.3 Assembly and dismantling

3.3.1 General

Dismantling and assembly of machines must be carried out by qualified personnel using only suitable tools and working methods. All repairs must be carried out according to the standard IEC-60079-19.

3.3.2 Bearings

Special care should be taken with the bearings. These must be removed using pullers and fitted by heating or using special tools for the purpose.

How to replace bearings is described in detail in a separate instruction leaflet available from ABB Sales Office.

3.3.3 Fitting coupling halves and pulleys

Coupling halves and pulleys must be fitted using suitable equipment and tools that do not damage the bearings.

Never fit a coupling half or pulley by hammering into place or remove it using a lever pressed against the body of the machine.

Mounting accuracy of coupling half:

check that the clearance **b** is less than 0.05 mm and that the difference **a1** to **a2** is also less than 0.05 mm. See figure 3.

4. Maintenance

4.1 Maintenance and lubrication

4.1.1 General inspection

- Inspect the machine at regular intervals.
- Keep the machine clean and ensure free ventilation airflow.
- Check the condition of shaft seals (e.g. V-ring) and replace if necessary.
- Check the condition of connections and mounting and assembly bolts.
- Check the bearing condition by listening for unusual noise, vibration measurement, bearing temperature, inspection of spent grease or SPM bearing monitoring.
 - * When changes of condition occur, dismantle the machine, check the parts and replace if necessary.

4.1.2 Lubrication

WARNING

Beware of all rotating parts!

WARNING

Grease can cause skin irritation and eye inflammation. Follow all safety precautions specified by the manufacturer.

4.1.3 Machines with permanently greased bearings

Bearings are usually permanently greased bearings of either Z or ZZ types.

Bearing types are specified in the respective product catalogues and on the rating plate of all our motors except smaller frame sizes.

As a guide, adequate lubrication for sizes up to 200 can be achieved for the following duration, according to L1 (i.e. that 99 % of the motors are sure to make the interval time) at ambient temperature of 25°C. For duties with ambient temperatures higher than 25°C, see the respective product catalogue.

Frame size	Poles	Duty hours
56-80	2-8	for life
90-112	2-8	40 000
132	2-8	40 000
160	2-8	40 000
180	2-8	40 000
200	2	27 000
200	4	40 000

Table 3

Depending on application and load conditions, see applicable product catalogue.

Hours of operation for vertical motors are half of the above values.

Motors with roller bearings have considerably shorter grease life. For continuous operation regreasing nipples should be considered.

4.1.4 Motors with regreasing nipples

Lubrication information plate and general lubrication advice

If the machine is fitted with a lubrication information plate, follow the given values.

On the lubrication information plate, regreasing intervals with regard to mounting, ambient temperature and speed of rotation can be defined.

During the first start or after a bearing lubrication it may appear a temporary temperature rise, appr. 10-20 hours. ABB policy is to have reliability as a vital issue in bearing lubrication intervals. That is why we follow the L1-principle.

A. Manual lubrication

Regreasing while motor is running

- Remove grease outlet plug or open closing valve if fitted.
- Be sure that the lubrication channel is open
- Press the specified amount of grease into the bearing.
- Let the motor run 1-2 hours to ensure that all excess grease is forced out of the bearing. Close the grease outlet plug or closing valve if fitted.

Regreasing while motor is at a standstill

Regrease motors while running. If this is not possible, lubrication can be carried out while the machine is at a standstill.

- In this case, use only half the quantity of grease, then run the motor for a few minutes at full speed.
- When the motor has stopped, press the rest of the specified amount of grease into the bearing.
- After 1-2 running hours close the grease outlet plug or closing valve if fitted.

B. Automatic lubrication

The grease outlet plug must be removed permanently with automatic lubrication or open closing valve if fitted.

Some motors may be equipped with a collector for old grease. Follow the special instructions given for the equipment.

We recommend only the use of electromechanical systems. Contact your local ABB Sales Office.

The amount of grease per each lubrication interval stated in the tables 4-5 should be doubled if an automatic regreasing system is used.

If 2-pole motors are being automatically regreased, the note (NOTE!) concerning lubricant recommendations given for 2-pole motors in the chapter Lubricants shall be followed.

4.1.5 Lubrication intervals and amounts

Frame size	Amount of grease g/bearing	3600 r/min	3000 r/min	1800 r/min	1500 r/min	1000 r/min	500-900 r/min
Ball bearings							
Lubrication intervals in duty hours							
112	10	10000	13000	18000	21000	25000	28000
132	15	9000	11000	17000	19000	23000	26500
160	25	7000	9500	14000	17000	21000	24000
180	30	6000	8000	13500	16000	20000	23000
200	40	4000	6000	11000	13000	17000	21000
225	50	3000	5000	10000	12500	16500	20000
250	60	2500	4000	9000	11500	15000	18000
280	70	2000 ¹⁾	3500 ¹⁾	8000	10500	14000	17000
315	90	¹⁾	¹⁾	6500	8500	12500	16000
355	120	¹⁾	¹⁾	4200	6000	10000	13000
400	120	¹⁾	¹⁾	4200	6000	10000	13000
400 M3BP	130	¹⁾	¹⁾	2800	4600	8400	12000
450	140			2400	4000	8000	8800

Table 4

Roller bearings							
Lubrication intervals in duty hours							
160	25	3500	4500	7000	8500	10500	12000
180	30	3000	4000	7000	8000	10000	11500
200	40	2000	3000	5500	6500	8500	10500
225	50	1500	2500	5000	6000	8000	10000
250	60	1300	2200	4500	5700	7500	9000
280	70	1000 ¹⁾	2000 ¹⁾	4000	5300	7000	8500
315	90	¹⁾	¹⁾	3300	4300	6000	8000
355	120	¹⁾	¹⁾	2000	3000	5000	6500
400	120	¹⁾	¹⁾	2000	3000	5000	6500
400 M3BP	130	¹⁾	¹⁾	1400	2300	4200	6000
450	140			1200	2000	4000	4400

Table 5

¹⁾ Values for IEC sizes 280 to 450 (cast iron and steel motors) in certain motor types (3600 and 3000 r/min), see tables 6-7.

Lubrication intervals and amounts, 2-pole, IEC frame sizes 280 to 450

Frame size	Amount of grease g/bearing	3600 r/min	3000 r/min
Ball bearings			
Lubrication intervals in duty hours			
280	M2B*, M2C*, M3B*	35	2000 3500
315	M2B*, M2C*, M3B*	35	2000 3500
355	M2B*, M2C*	45	1200 2000
355	M3B*	35	1200 2000
400	M2B*, M2C*	45	1200 2000
400	M3B*	40	1000 1600
450	M3B*	40	1000 1600

Table 6

Roller bearings			
Lubrication intervals in duty hours			
280	M2B*, M2C*, M3B*	35	1000 1800
315	M2B*, M2C*, M3B*	35	1000 1800
355	M2B*, M2C*	45	600 1000
355	M3B*	35	600 1000
400	M2B*, M2C*	45	600 1000
400	M3B*	40	500 800
450	M3B*	40	500 800

Table 7

Factors influencing the lubrication intervals

Lubrication intervals for vertical machines are half of the above values.

The lubrication intervals are based on bearing operating temperature 80°C (ambient temperature of about + 25°). Note! An increase in the ambient temperature raises the temperature of the bearings correspondingly. The values should be halved for 15°C increase in bearing temperature and may be doubled for 15°C decrease in bearing temperature.

WARNING

The maximum operating temperature of the grease and bearings must not be exceeded.

4.1.6 Lubricants

WARNING

Do not mix different types of grease.

Incompatible lubricants may cause bearing damage.

When regreasing, use only special ball bearing grease with the following properties:

- good quality grease with lithium complex soap and with mineral- or PAO-oil
- base oil viscosity 100-160 cST at 40°C
- consistency NLGI grade 1.5 - 3 *)
- temperature range -30°C - +120°C, continuously.

*) For vertical mounted motors or in hot conditions a stiffer end of scale is recommended.

Grease with the correct properties is available from all major lubricant manufacturers.

Admixtures are recommended, but a written guarantee must be obtained from the lubricant manufacturer especially concerning EP admixtures, that admixtures do not damage bearings or the properties of lubricants at the operating temperature range.

WARNING

Lubricants containing EP admixtures are not recommended in high bearing temperatures in frame sizes 280 to 450.

If the ambient temperature is below -25°C or above +55°C, or bearing temperature is above 110°C, consult ABB Sales Office regarding suitable grease.

The following high performance grease can be used

- Esso Unirex N2, N3 or S2 (lithium complex base)
- Mobil Mobilith SHC 100 (lithium complex base)
- Shell Albida EMS 2 (lithium complex base)
- SKF LGHQ 3 (lithium complex base)
- Klüber Klüberplex BEM 41-132 (special lithium base)
- FAG Arcanol TEMP110 (lithium complex base)

Lubrication intervals for other grease fulfilling the required properties, contact your local ABB Sales Office.

NOTE!

Always use high speed grease for high speed machines and some other models, e.g. M2BA 355 and 400 2-pole machines, where the speed factor is higher than 400 000 (calculated as $Dm \times n$ where Dm = average bearing diameter, mm; n = rotational speed, r/min).

The following grease can be used:

- FAG L69 (polyurea base)
- Klüber Klüber quiet BH 72-102 (polyurea base)
- Lubcon Turmogrease PU703 (polyurea base)

If other lubricants are used, check with the manufacturer that the qualities correspond to those of the above mentioned lubricants, or if the compatibility of the lubricant is uncertain, contact your local ABB Sales Office.

WARNING

Especially in high rotational speed (the speed factor > 400000) over greasing may cause damage.

4.1.7 Frequency converter drives

Higher speed operation, e.g. in frequency converter applications, or lower speed with heavy load will require shorter lubrication intervals. Consult your local ABB Sales Office in such cases.

Typically a doubling of speed will require a reduction of lubrication intervals to approx. 40 % of values tabulated above.

WARNING

The constructional maximum speed of the motor must not be exceeded (see table 2).

Suitability of bearings for high speed operation must be checked.

4.1.8 Spare parts

When ordering spare parts, the full type designation and product code, as stated on the rating plate, must be specified.

If the machine is stamped with a serial manufacturing number, this should also be given.

For more information, please visit our web site www.abb.com/partsonline.

4.1.9 Rewinding

Rewinding should always be carried out by qualified repair shops.

Smoke venting and other special motors should not be rewound without first contacting ABB.

5. Environmental requirements**5.1 Noise levels**

Most of our motors have a sound pressure level not exceeding 82 dB(A) refer to 50 Hz sinusoidal supply conditions, tolerance ± 3 dB(A).

Values for specific machines can be found in the relevant product catalogues.

For sound pressure levels for 60 Hz sinusoidal supply and with non-sinusoidal supplies, contact ABB Sales Office.

Sound pressure levels for all machines having separate cooling systems and for series M2F*/M3F*, M2L*/M3L*, M2R*/M3R*, M2BJ/M3BJ and M2LJ/M3LJ are indicated in separate Manuals.

6. Troubleshooting

These instructions do not cover all details or variations in equipment nor provide for every possible condition to be met in connection with installation, operation or maintenance. Should additional information required, please contact the nearest ABB Sales Office.

Motor troubleshooting chart

Your motor service and any troubleshooting must be handled by qualified persons with proper tools and equipment.

TROUBLE	CAUSE	WHAT TO DO
Motor fails to start	Blown fuses	Replace fuses with proper type and rating.
	Overload trips	Check and reset overload in starter.
	Improper power supply	Check to see that power supplied agrees with motor rating plate and load factor.
	Improper line connections	Check connections with diagram supplied with motor.
	Open circuit in winding or control switch	Indicated by humming sound when switch is closed. Check for loose wiring connections. Also, ensure that all control contacts are closed.
	Mechanical failure	Check to see if motor and drive turn freely. Check bearings and lubrication.
	Short circuited stator Poor stator coil connection	Indicated by blown fuses. Motor must be rewound. Remove end bells, locate with test lamp.
	Rotor defective	Look for broken bars or end rings.
	Motor may be overloaded	Reduce load.
Motor stalls	One phase may be open	Check lines for open phase.
	Wrong application	Change type or size. Consult manufacturer.
	Overload	Reduce load.
	Low voltage	Ensure the rating plate voltage is maintained. Check connection.
	Open circuit	Fuses blown, check overload relay, stator and push buttons.
Motor runs and then dies down	Power failure	Check for loose connections to line, to fuses and to control.
Motor does not come up to speed	Not applied properly	Consult supplier for proper type.
	Voltage too low at motor terminals because of line drop	Use higher voltage or transformer terminals or reduce load. Check connections. Check conductors for proper size.
	Starting load too high	Check load motor is supposed to carry at start.
	Broken rotor bars or loose rotor	Look for cracks near the rings. A new rotor may be required, as repairs are usually temporary.
	Open primary circuit	Locate fault with testing device and repair.
Motor takes too long to accelerate and/or draws high amp	Excessive load	Reduce load.
	Low voltage during start	Check for high resistance. Adequate wire size.
	Defective squirrel cage rotor	Replace with new rotor.
	Applied voltage too low	Get power company to increase power tap.
Wrong rotation	Wrong sequence of phases	Reverse connections at motor or at switchboard.

TROUBLE	CAUSE	WHAT TO DO
Motor overheats while running underloaded	Overload	Reduce load.
	Frame or bracket vents may be clogged with dirt and prevent proper ventilation of motor	Open vent holes and check for a continuous stream of air from the motor.
	Motor may have one phase open	Check to make sure that all leads are well connected.
	Grounded coil	Locate and repair.
	Unbalanced terminal voltage	Check for faulty leads, connections and transformers.
Motor vibrates	Motor misaligned	Realign.
	Weak support	Strengthen base.
	Coupling out of balance	Balance coupling.
	Driven equipment unbalanced	Rebalance driven equipment.
	Defective bearings	Replace bearings.
	Bearings not in line	Line up properly.
	Balancing weights shifted	Rebalance motor.
	Contradiction between balancing of rotor and coupling (half key - full key)	Rebalance coupling or motor.
	Polyphase motor running single phase	Check for open circuit.
	Excessive end play	Adjust bearing or add shim.
Scraping noise	Fan rubbing fan cover	Remove interference.
	Fan striking insulation	Clear fan.
	Motor loose on bedplate	Tighten holding bolts.
Noisy operation	Airgap not uniform	Check and correct bracket fits or bearing.
	Rotor unbalance	Rebalance.
Hot bearings ball	Bent or sprung shaft	Straighten or replace shaft.
	Excessive belt pull	Decrease belt tension.
	Pulleys too far away	Move pulley closer to motor bearing.
	Pulley diameter too small	Use larger pulleys.
	Misalignment	Correct by realignment of drive.
	Insufficient grease	Maintain proper quality of grease in bearing.
	Deterioration of grease or lubricant contaminated	Remove old grease, wash bearings thoroughly in kerosene and replace with new grease.
	Excess lubricant	Reduce quantity of grease, bearing should not be more than 1/2 filled.
	Overloaded bearing	Check alignment, side and end thrust.
Broken ball or rough races	Replace bearing, first clean housing thoroughly.	

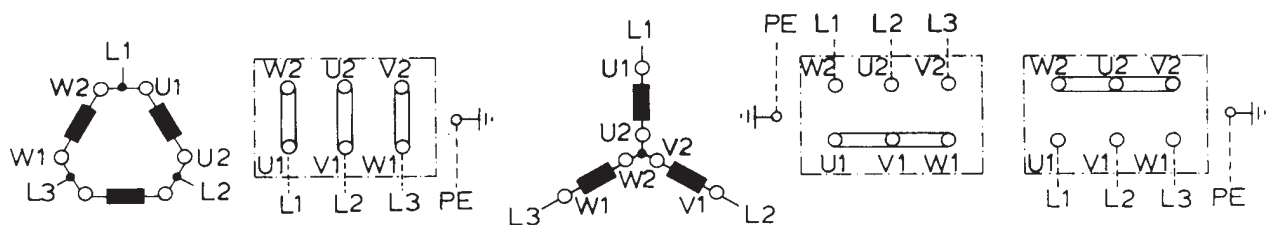


Figure 1. Connection diagram

Bild 1. Anschlußdiagramm

Figure 1. Connection

Figura 1. Conexión

Figura 1. Collegamento

Figur 1. Anslutningdiagramm

Kuva 1. KytKentäkaavio

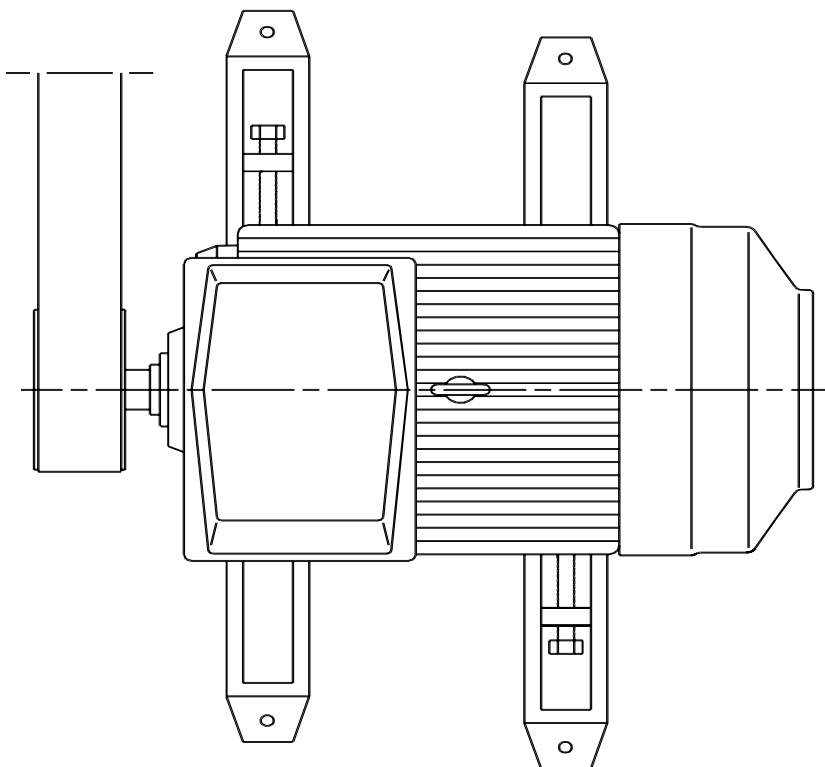


Figure 2. Belt drive

Bild 2. Riemetrieb

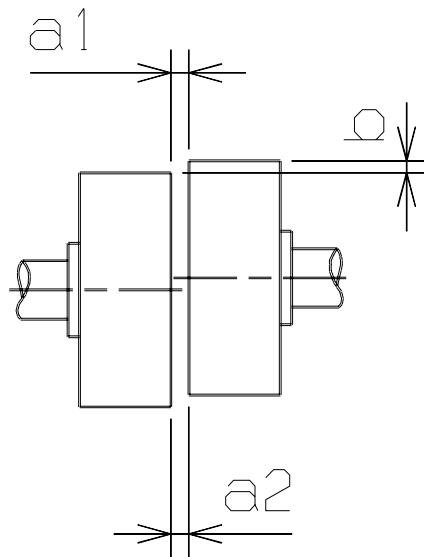
Figure 2. Glissières et entraînements à courroie

Figure 2. Carriles tensores y correas

Figura 2. Slitte tendicinghia e pulegge

Figur 2. Remdrift

Kuva 2. Hihnakäyttö



- Figure 3. Mounting of half-coupling or pulley
 Bild 3. Anbau von Kupplungshälften und Riemenscheiben
 Figure 3. Montage des demi-accouplements et des poulies
 Figura 3. Montaje de mitades de acoplamiento y poleas
 Figura 3. Montaggio di semigiunti e pulegge
 Figur 3. Montering av kopplinshalvor och drivskivor
 Kuva 3. Kytinpuolikkaan ja hihnapyörän asennus

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