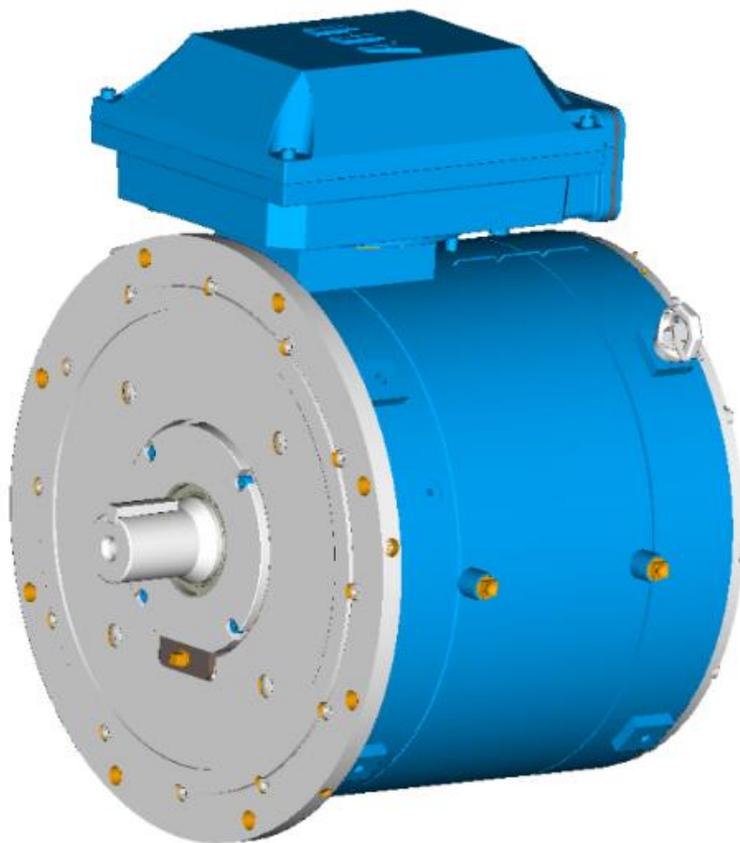


# Permanent magnet water cooled motors

## Additional manual



# Safety Instructions

## 1 General

General safety regulations, safety precautions and specific agreements made for each work site shown in this document must be observed at all times.

## 2 Intended use

Electric machines have dangerous live and rotating parts and may have hot surfaces. All operations serving transport, storage, installation, connection, commissioning, operation and maintenance should be carried out by skilled personnel (in conformity with EN 50 110-1 / DIN VDE 0105 / IEC 60364). Improper handling may cause serious personal injury and damage to property.

These machines are intended for use as components for industrial and commercial installations as defined in the Machinery Directive (MD) 89/392/EEC. Commissioning is prohibited until conformity of the end product with this directive has been established (follow particular local safety and installation rules e.g. EN 60204).

These machines comply with the harmonized series of standards EN 60034 / DIN VDE 0530. Their use in hazardous areas is prohibited unless they are expressly designed for such use.

On no account, should degrees of protection of  $\leq$  IP 23 or less be used outdoors.

Air-cooled models are typically designed for ambient temperatures of  $-20^{\circ}\text{C}$  or  $-25^{\circ}\text{C}$  up to  $+40^{\circ}\text{C}$  and altitudes of  $\leq$  1000 m above sea level, (Please refer to product specific instructions. Ambient temperature for air-/water-cooled models should be no lower than  $+5^{\circ}\text{C}$  (for sleeve-bearing machines, see manufacturer's documentation). Do take note of deviating information on the rating plate. Field conditions must conform to all rating plate markings.

## 3 Transport, storage

Report damage immediately to the transport company if damage is discovered upon delivery and stop commissioning, if necessary. Lifting eyes are only dimensioned for the weight of the machine, therefore do not apply extra loads. Ensure the use of correct lifting eyes and if needed, use suitable lifting equipment (e.g. rope guides). Remove shipping braces (e.g. bearing locks, vibration dampers) before commissioning and store these for further use.

When storing machines make sure that the location is dry, and free from dust and vibration to avoid bearing damage. Measure insulation resistance before commissioning. Limit values for the insulation resistance can be found from the product specific manuals. If limit values are not reached, dry the winding according to the manufacturer's instructions.

## 4 Installation

Ensure even support, solid foot or flange mounting and exact alignment in the case of direct coupling. Avoid resonances with rotational and double mains frequency as a result of assembly. Turn rotor and listen for abnormal slip noises and check direction of rotation in uncoupled state.

Follow the manufacturer's instructions when mounting or removing couplings or other drive elements and cover them with a touch guard. To do a trial run without output elements, lock or remove the shaft end key. Avoid excessive radial and axial bearing loads (note manufacturer's documentation). The type of balancing is indicated in the shaft, (see product specific manuals). In case of protruding, visible part of the shaft end key, establish mechanical balance.

Make the necessary ventilation and cooling system connections making sure that the ventilation does not get obstructed and that exhaust air either from the current machine or other machines, is not drawn into the ventilation intake.

## 5 Electrical connection

When the machine shaft is rotating, a permanent magnet machine induces voltage to the terminals. The induced voltage is proportional to the rotational speed, and can be hazardous even at low speeds. Prevent any rotation of the shaft before opening the terminal box and/or working at the unprotected terminals.

### Warning

The terminals of a machine with frequency converter supply may be energized even when the machine is at a standstill.

### Warning

Beware of reverse-power when working at the supply system.

### Warning

Machines covered by this instruction are not suitable for direct online use (DOL).

Operations must only be carried out by skilled persons while the machine is non-operational. Before starting work, the following safety rules must be strictly applied:

- De-energize!
- Provide safeguard against reclosing!
- Prevent any rotation of the shaft before opening the terminal box and/or working at the unprotected terminals.
- Verify safe isolation from supply!
- Connect to earth and short!
- Cover or provide barriers against neighbouring live parts!
- De-energize auxiliary circuits (e.g. anti-condensation heating)!

Rating plate markings and connection diagrams must be followed. Check the compatibility of the machine and the frequency converter.

The connection must be made so that a permanent safe electrical connection is maintained. Use appropriate cable terminals. Establish and maintain safe equipotential bonding.

No foreign bodies, dirt or moisture is allowed in the terminal box. Always close unused cable entrance holes and the box itself in a dust and watertight manner. Lock the key when the machine is run without coupling. For machines with accessories, check that they function before commissioning.

The proper installation (e.g. segregation of signal and power lines, screened cables etc.) lies within the installer's responsibility.

## 6 Operation

### Warning

Do not exceed the maximum allowed speed of the machine. See product specific manuals.

Check the vibration level of the machine regularly. In case of deviations from normal operation - e.g. elevated temperature, noises, vibrations - disconnect the machine. If necessary establish cause and consult manufacturer, if necessary.

Do not override protective devices, not even in trial run. In case of heavy dirt deposits, clean the cooling system at regular intervals. Open closed condensate drain holes from time to time.

Grease the bearings during commissioning before start-up. Follow the regreasing and oil-change instructions mentioned in the product specific manuals. If the machine is equipped with grease automate or oil supply system, make sure the system is working.

## 7 Maintenance and servicing

### Warning

Only qualified personnel familiar with the relevant safety requirements are allowed to open and maintain permanent magnet synchronous machines.

### Warning

It is not allowed to remove the rotor of a permanent magnet synchronous machine without the special tools designed for this purpose.

### Warning

Magnetic stray fields, caused by an open or disassembled permanent magnet synchronous machine or by a separate rotor of such a machine, may disturb or damage other electrical or electromagnetic equipment and components, such as cardiac pacemakers, credit cards and equivalent.

### Warning

Loose metallic parts and waste must be prevented from entering the interior of the permanent magnet synchronous machine as well as getting into contact with the rotor.

### Warning

Before closing an opened permanent magnet synchronous machine, all parts which does not belong to the machine and wastes must be removed from the interior of the machine.

### Note

Beware of magnetic stray fields and possible induced voltages when rotating the separate rotor of a permanent magnet synchronous machine as they may cause damage to surrounding equipment, for example lathes or balancing machines.

Permanent magnet synchronous machines must only be serviced by repair shops qualified and authorised by ABB. For more information concerning service of permanent magnet synchronous machines, please contact ABB.

Follow manufacturer's operating instructions. For further details see product specific manuals or contact ABB.

## Validity

This additional installation, operation, and maintenance manual is valid for **water cooled motors** (M3LJ) and is to be read together with the main manual (Low Voltage Motors/Manual). Additional information may be required for some machines due to special application and/or design considerations.

## Use

Normally, water cooled motors are manufactured to specific customer requirements. However, these instructions refer to 'standard' water cooled motor versions.

## Handling

Should the motor be used or stored in environments with the risk of sub-zero temperatures, freezing of the water inside the motor must be prevented. This can be done either by emptying the water jacket or by using anti-freeze additives.

Before emptying the water jacket, protect it with a corrosion-protective emulsion, e.g. Esso Cutwell 40, Shell Dromus Oil BS, or equivalent, in accordance with the instructions given by the emulsion manufacturer. If the motor has been standing for a long period of time with no water, ensure that water can circulate freely before using the motor again. Remove possible rust blockages by dissolving them with oxalic acid:

1. Empty the frame of water.
2. Fill the frame with water mixed with oxalic acid (100 g/litre).
3. Let the acid take effect for approximately 10 minutes.
4. Empty the frame and wash it with pressurized water.
5. Repeat the treatment if necessary.

If the motor is equipped with a separate bearing fan, ensure that there is free ventilation airflow. Installation of a motor with a bearing fan in a closed flange construction (i.e. flange-mounted motor) is not recommended.

Cleaning of motor cooling system helps to restore system efficiency. ABB recommends using regular flushing and cyclonic or magnetic filters, which should be regularly maintained. Flushing can be done as described above. Check that the water in the system is neutral or near neutral pH after flushing.

## Lifting

Only the main lifting lugs or eyebolts of the motor should be used for lifting the motor. They must not be used to lift the motor when it is attached to other equipment.

Lifting lugs for auxiliaries (e.g. brakes, separate cooling fans) or terminal boxes must not be used for lifting the motor.

Motors with the same frame may have a different center of gravity because of different output, mounting arrangements and auxiliary equipment.

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

Lifting eyebolts must be tightened before lifting. If needed, the position of the eyebolt can be adjusted using suitable washers as spacers.

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 connected to the motor.

## Water cooling

In motors type M3LJ, waste heat is drawn off by water circulating inside the motor housing. The water circulates around the motor in a jacket inside the housing and flows out through an outlet.

Motors usually have one water inlet and one outlet threads in D- and ND-end (see figure 1).

Note! Outlet threads may differ (NPT  $\frac{3}{4}$ ", R  $\frac{3}{4}$ " ...)

Note! Read the cooling water instruction plate as well as the markings for inlet and outlet pipes on the motor!

## Connection

### Requirements for cooling water

Cooling water must be tap water quality. Sea water or water with a proportion of chloride above 120 mg/l should not be used. The highest allowed pressure for cooling water is 5 bar, with a recommended maximum input water temperature of 40 °C. Steel frame water-cooled construction is only to be used with a closed fresh water circulation. The cooling water circulates in ducts integrated in the machine frame. The material of the frame and ducts is carbon steel according to the standard EN 10025-S235JR. This material is prone to corrosion in saline and foul water. The corrosion products and fouling deposits might block the water flow in the ducts. This is why it is important to use pure water in the cooling system.

Standard values for the cooling water to be used in the cooling system:

- pH 6.5-9.5
- Alkalinity (CaCO<sub>3</sub>) > 1 mmol/l
- Chloride (Cl) < 120 mg/l
- Conductivity < 1500 µS/cm

In most cases, normal tap water, i.e. water for domestic consumption, meets all these requirements.

The cooling water can also be inhibited with an agent protecting the cooling system against corrosion, fouling and, when necessary, against freezing. All materials in contact with the cooling water (pipes, heat exchanger, etc.) must be taken into account when selecting a suitable inhibitor.

Use only suitable and high-class connection parts and seals to connect the machine to the water circuit.

In environments with risk of sub-zero temperatures, a glycol/water mixture can be used with 40/60 mixture (glycol/water), with a recommended minimum environment temperature of -20 °C.

The lower the cooling water input temperature, the better the cooling of the motor.

For some cases a higher input temperature can be allowed when requested and checked by the manufacturer.

The outlet water temperature rise is from 7-15 K.

The minimum pressure and amount of cooling water for the basic construction of a water cooled motor is shown in the

following table. Please check the requirements for pressure and the amount of cooling water in the case of special constructions.

(If the amount of water varies, its temperature rise will be inversely proportional to the flow rate.)

### Filling or draining cooling water

When filling, open the air plug on top of the motor (fig. 1). Let the cooling water flow into the motor until it comes out of the air gap. Close the air gap with a plug and seal the joint with sealing tape or strip. Filling must be done carefully so that no air is left in the motor's cooling channels. Check for possible leaks after the piping and joints have been connected.

When emptying, turn the motor to a position where the water inlet and outlet are pointing downwards. Open the air plug on top of the motor, the air plug will point to one side in this position. Emptying can be done with pressurized air. After emptying, the plugs must be re-fitted and the seals of the joints must be checked.

#### CAUTION!

The cooling water temperature may be high, possibly exceeding even 70 °C!

## Condensation drain holes

It is of special importance with water cooled motors that the condensation drain holes are located in the correct position (fig. 1). Check that the condensation drain holes face downwards, especially when the mounting arrangement differs from standard.

# Maintenance

## WARNING!

The permanent magnet motor produces voltage when the motor shaft is rotating. Prevent rotation of the shaft before opening the terminal box.  
**STOP! Follow Safety Instructions!**

## General

While washing or defrosting the motor, do not aim water or steam blast at the terminal box and bearing parts.

## Protection

Motors might have unused holes in the D-endshield. These holes should be plugged.

## Lubrication

### Only for motors with re-greasing nipples:

Motors are equipped with a lubrication plate. For more information see the lubrication section in the "Motor manual".

Note! Motors should be lubricated at least once a year even if the duty hours given on the lubrication plate are not reached.

Put the cap back on the grease nipples and SPM-nipples after they have been used.

### For Motors with grease collectors and/or plugs:

If the motor has a grease collector box at the D- and ND-end, or only at the ND-end, the grease box must be emptied at least every fourth time the motor is re-greased.

If the motor has plugs in the grease outlet, they must be dismantled.

1. Empty the grease collector box by dismantling it.
2. Mount the grease collector box and tighten the screws with the proper amount of torque (see table 1).
3. Dismount plug (R ½") during re-greasing (see figure 3).
4. Mount the plug (R ½") after re-greasing.

Table 1.

Screw	Torque
M6	10
M8 CS *)	13
M8	23
M10 CS *)	26
M10	46
M12	79

\*) terminal box cover screw (thinned, partly threaded)  
The screws must be of strength class 8.8.

## Rotary shaft seal

Inspect the condition of the rotary shaft seals (e.g. gamma-seal or radial seal design) and if necessary change the seals every 4 to 8 years.

The wear of radial seal or counter face (bearing cover) is depending on rotational speed. The higher speed the less wear. If the service time motor is mostly over 1000 rpm the wear is

minimized as the contact pressure of seal lip decreases due to centrifugal force. The seals can be inspected at the same time when the grease collector box is emptied, see figure 2.

When inspecting and (or) changing the seals or bearing cover etc., see dismantling and re-assembly section in the "Motor manual".

## Yearly maintenance

- Re-grease the motor while it is running. For details see the chapter "Lubrication".
- Check the paint on the motor and touch up if required.
- Inspect the placement of plastic- and rubber plugs on the motor.
- Corrosion protection treatment should be applied to the shaft ends. Tectyl 8721 or a similar product could be used for corrosion protection treatment.

## Maintenance needed every 4 years

- Follow the instructions given in the section "Yearly Maintenance".
- Empty the D- and ND-end grease collector box. For details see the chapter "Lubrication".
- Inspect and if needed replace the rotary shaft seals (e.g. gamma-seal or radial seal designs). For more details see the chapter "Rotary shaft seal".

## Spare parts

See the spare parts section in "Motor manual"

# Permanent magnet water cooled motors

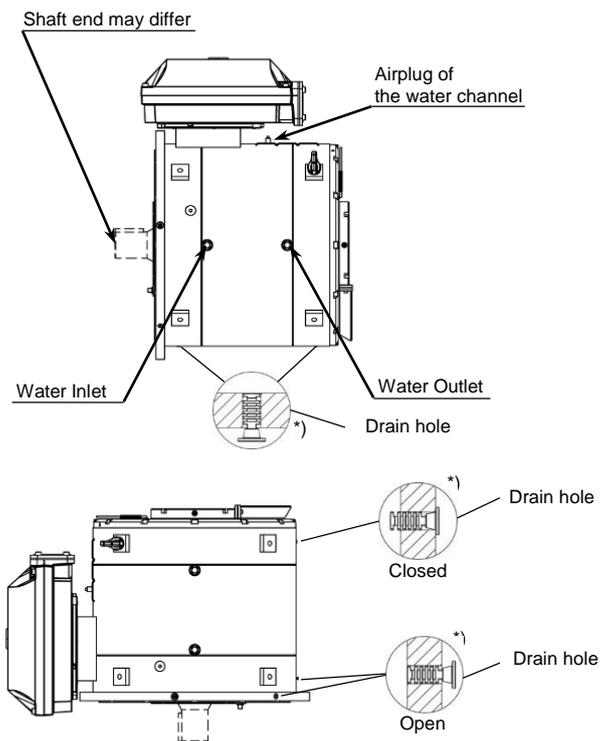


Figure 1. Connection of cooling water, air plug and condensation drain holes.  
 \*) IP65 drain holes plugged with M6 screws.

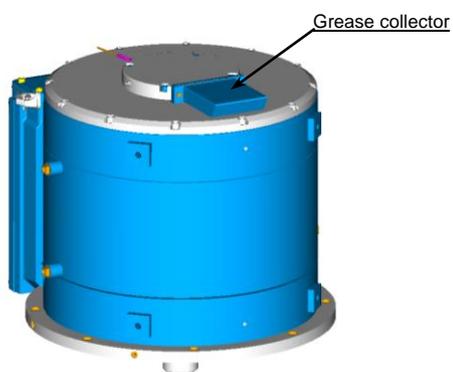


Figure 2. Location of grease collector box in ND-end.

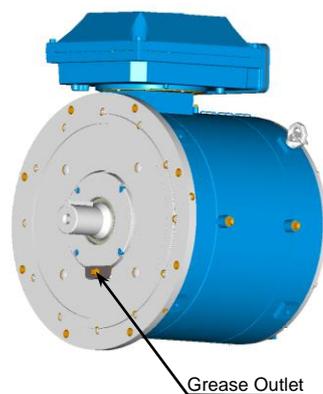


Figure 3. Location of the grease outlet plug in D-end.

# Contact us

[www.abb.com/motors&generators](http://www.abb.com/motors&generators)

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