IP65/66/69/69K motors

Installation guide

Important User Information

Warning
The MAC and MIS series of products are used to control electrical and mechanical components of motion control systems. You should test your motion system for safety under all potential conditions. Failure to do so can result in damage to equipment and/or serious injury to personnel.

Please contact your nearest JVL representative in case of technical assistance. Your nearest contact can be found on our web site www.jvl.dk

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Revisions

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Introduction

The following document is a guide to installing IP rated MAC motor® Integrated Servo Motors and MIS ServoStep™ Integrated Stepper Motors. It details the classification and outlines some guidelines for proper installation of IP rated motors.

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1 Precautions for installing high ingress protection motors

When installing MAC motors with high ingress protection, please follow the below guidelines to prevent long-term water or dust ingress.

Warranty notice:
JVL products are not covered by warranty if the installation guidelines are not strictly followed.

While IP65+ motors are often referred to as "waterproof," this classification has limitations. Please take the following into account during installation:

- **Outdoor Installation Without Shielding**
  Direct exposure to sunlight can cause the motor's internal temperature to exceed the maximum rated ambient temperature of 40°C. Always consider appropriate shielding or ventilation.

- **Cold or Fluctuating Temperatures**
  In environments where temperatures drop below 0°C or fluctuate significantly, condensation may form inside the motor. To mitigate this:
  - Order the motor with a coated PCB.
  - For extreme conditions, consider a version with a breather valve to allow moisture to escape.

- **Prolonged Water Exposure**
  Continuous water exposure, such as direct rainfall over several hours, exceeds the protection offered by IP65/66/67 ratings. Refer to IP Classification, Section 1.1 for more details.

- **Ingress Through Mechanical Connections**
  Even small amounts of water on unsealed components (e.g., screws or joints) can lead to water ingress. This scenario is beyond the scope of IP65/66/67/69K protection. Again, see IP Classification, Section 1.1 for further guidance.

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2 IP classification

Often the general IP classification is misunderstood. All JVL IP65+ motors have been tested to ensure that they comply with the specified IP class.
Below is an overview of the IP classifications used for various JVL motors.

IP42 - Standard for JVL MAC050-141 motors and JVL MIS motors

Small object protection	Effective against >1mm/0.039” objects (most wires, slender screws, large ants etc.)
Dripping water when tilted at 15°	The enclosure must remain unaffected by vertically dripping water when tilted at an angle of 15° from its normal upright position. Testing is conducted in four orientations across two axes. **Duration:** 2.5 minutes per tilt direction (total of 10 minutes), simulated rainfall at a rate equivalent to 3 mm (0.12 in) per minute

IP55 - Standard for JVL MAC400-4500 motors

Dust protected	Dust ingress is not fully prevented, but must not enter in sufficient quantity to impair the equipment’s operation.
Water jets	Resistant to water projected from a 6.3 mm (0.25 in) nozzle from any direction. **Duration:** ≥3 min (1 min/m²), **Flow Rate:** 12.5 L/min, **Pressure:** 30 kPa (4.4 psi), **Distance:** 3 m (9.8 ft)

IP65 - High IP rating for JVL MIS motors

Dust-tight	No ingress of dust; complete protection against contact. Tested under vacuum conditions for up to 8 hours, based on airflow.
Water jets	Resistant to water projected from a 6.3 mm (0.25 in) nozzle from any direction. **Duration:** ≥3 minutes (1 min/m²), **Flow Rate:** 12.5 L/min, **Pressure:** 30 kPa (4.4 psi), **Distance:** 3 meters (9.8 ft)

IP66 - High IP rating for JVL MAC400-4500 motors

Dust-tight	No ingress of dust; complete protection against contact. Tested under vacuum conditions for up to 8 hours, based on airflow.
Powerful water jets	Resistant to water projected in powerful jets from a 12.5 mm (0.49 in) nozzle from any direction. **Duration:** ≥3 minutes (1 min/m²), **Flow Rate:** 100 L/min, **Pressure:** 100 kPa (15 psi), **Distance:** 3 meters (9.8 ft)

IP67 - High IP rating for JVL MAC050-141 motors, standard for JVL MAC100/101/231 motors, standard for JVL expansion modules and standard for JVL M12 cables

Dust-tight	No ingress of dust; complete protection against contact. Tested under vacuum conditions for up to 8 hours, based on airflow.
Immersion, up to 1 meter (3 ft 3 in)	Prevents ingress of water in harmful quantities when submerged under defined conditions. **Duration:** 30 minutes, **Depth:** Up to 1 meter (3 ft 3 in), **Positioning:** Lowest point 1000 mm (39 in) or highest point 150 mm (5.9 in) below water surface—whichever is deeper

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IP69K - Extreme IP rating for JVL MAC100/101/231 motors

Dust-tight	No ingress of dust; complete protection against contact. Tested under vacuum conditions for up to 8 hours, based on airflow.
High-pressure, high-temperature spray protection	Resistant to close-range high-pressure, high-temperature spray from multiple angles Smaller specimens rotate slowly on a turntable through four specific angles. Larger specimens are tested in their intended mounting position without a turntable, using freehand spray for at least 3 minutes at a distance of 0.15–0.2 meters (5.9–7.9 in). **Duration:** Fixture: 30 sec per angle (2 min total), Freehand: ≥3 minutes (1 min/m²), **Flow Rate**: 14–16 L/min, **Pressure**: 8–10 MPa (80–100 bar), **Distance**: 0.10–0.15 meters (3.9–5.9 in), **Water Temperature**: 80 °C (176 °F)

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3 General rules for installation

3.1 Rule 1 - Connectors

Ensure that all connectors are tightened with high torque to prevent moisture/liquid ingress.

- JVL-supplied cables ensure IP67-rating, provided that they are tightened properly.
- Use protective caps on unused connectors and ensure they are securely fastened.

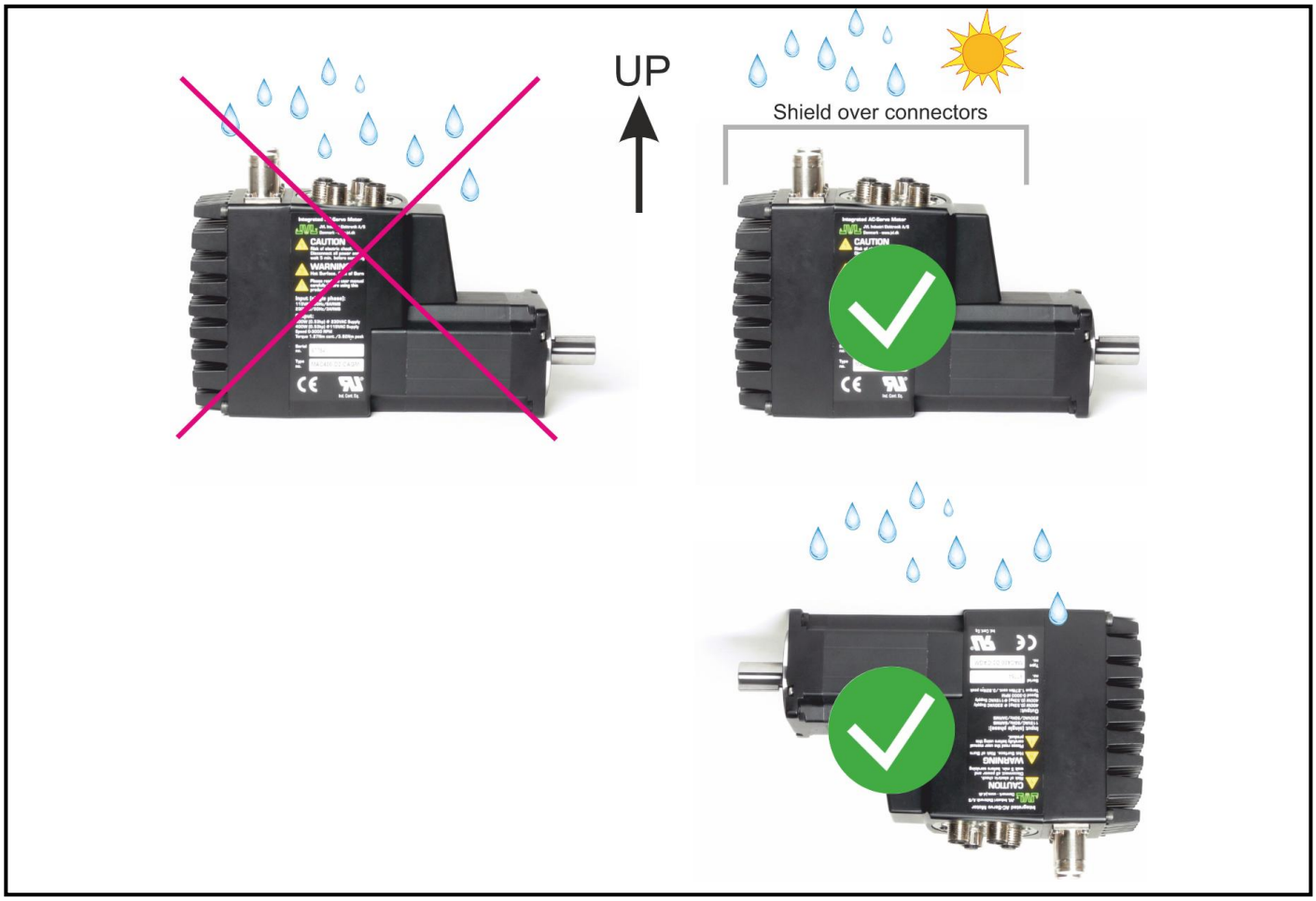
WI1000-M12FCAP1	IP67 Protection Cap for M12 Female
WI1000-M12FCAP2	IP67 Protection metal Cap for M12 for FEMALE
WI1000-M12MCAP1	IP67 Protection Cap for M12 Male
WI1000-M12MCAP2	IP67 Protection Cap Metal M12 for MALE

3.2 Rule 2 - Motor mounting orientation

It is not recommended to mount the motor with the expansion module or connectors facing upward, as this orientation increases exposure to moisture accumulation around the connectors, which may lead to internal leakage over time.

If the application requires this mounting position, a protective shield or cover should be installed over the motor to prevent moisture ingress. Additionally, avoid direct sunlight if the motor is mounted outdoors.

In any outdoor installation where the motor is exposed to rain or sunlight, a shield or cover is strongly recommended. If the motor is subject to high-pressure water jets, a protective shield should also be used to prevent water intrusion.



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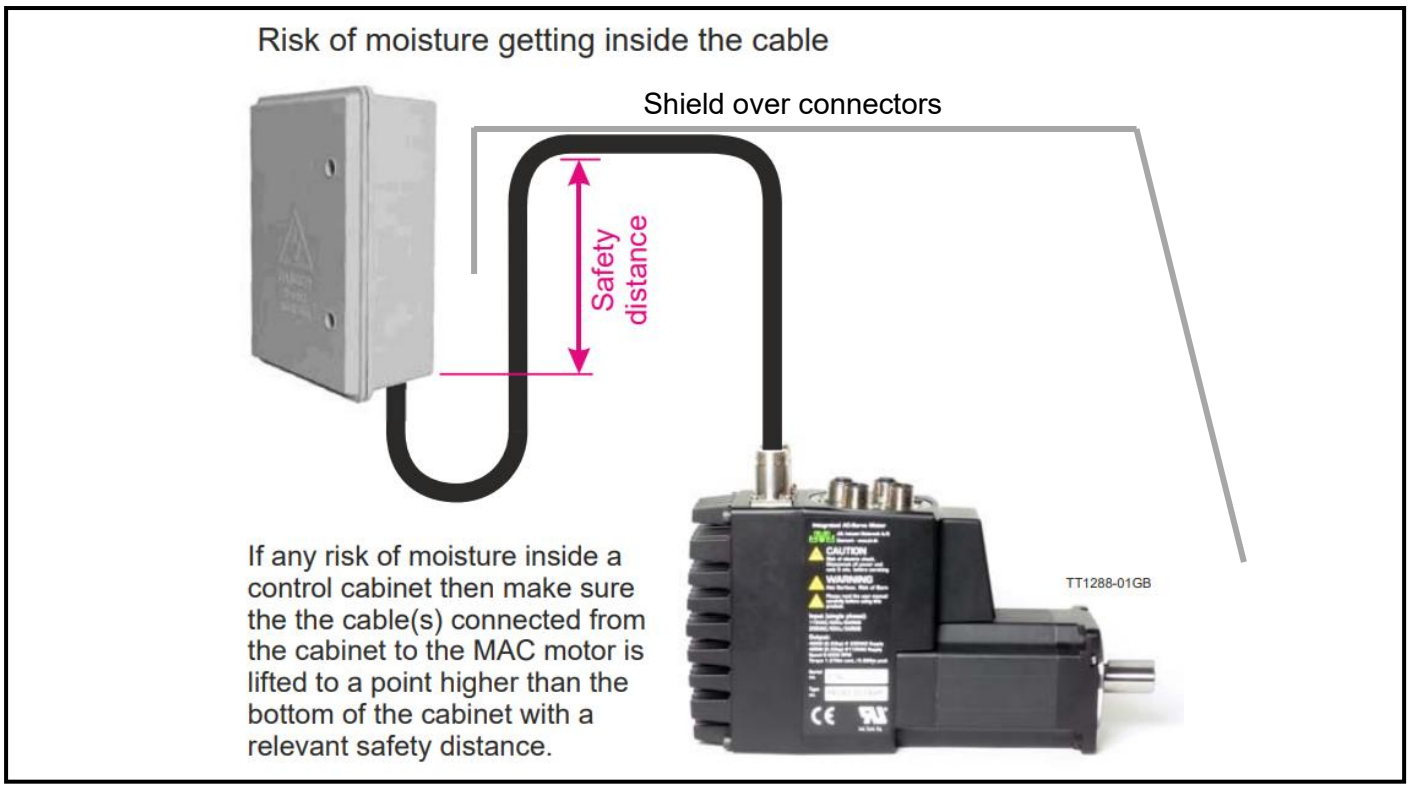
3.3 Rule 3 - Cable placement

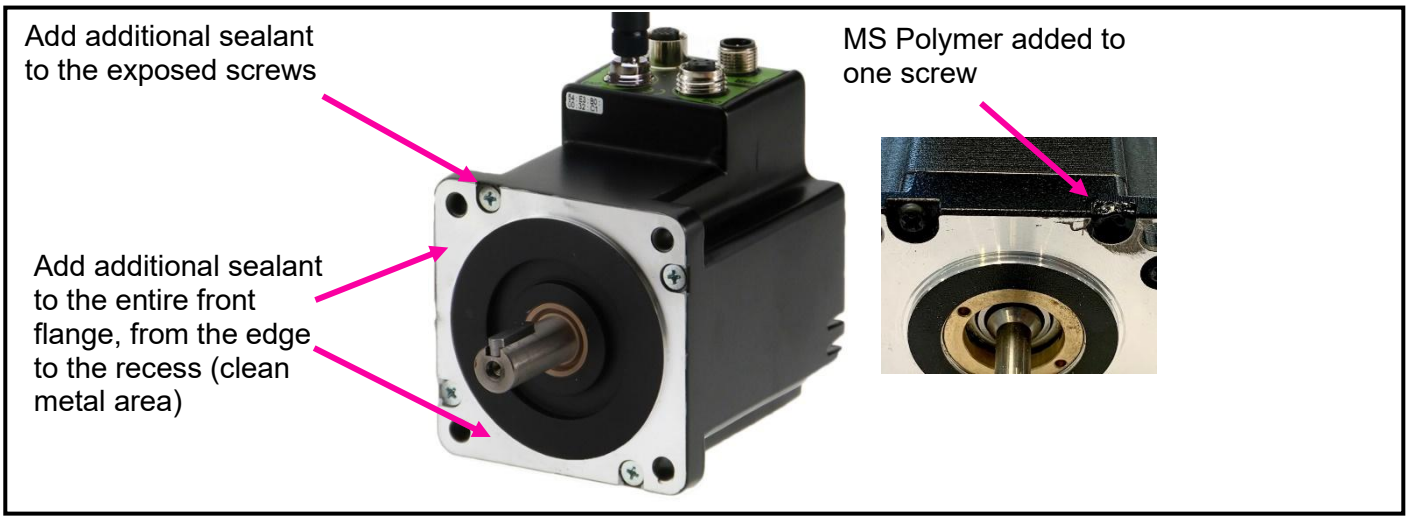
In environments with frequent temperature changes, moisture condensation may occur inside cabinets. To prevent liquid ingress into motor connectors, consider if condensation can occur and is able to travel to the MAC motor from the cabinet. If so:

- Route cables from a high point above the cabinet bottom as shown below.



3.4 Rule 4 – Protecting the flange

When mounting the motor flange to the machine, additional sealant may be applied between the motor flange and the machine's mounting surface to enhance moisture protection. If sealant is used, it is essential to ensure a reliable ground connection between the motor housing and the machine chassis.
If any screws are exposed, sealant should also be applied to prevent prolonged contact with water, which could lead to corrosion or leakage. We recommend using MS Polymer-based sealants, such as SikaHyFlex® 220 Window, for optimal performance.



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3.5 Rule 5 - Protecting the shaft

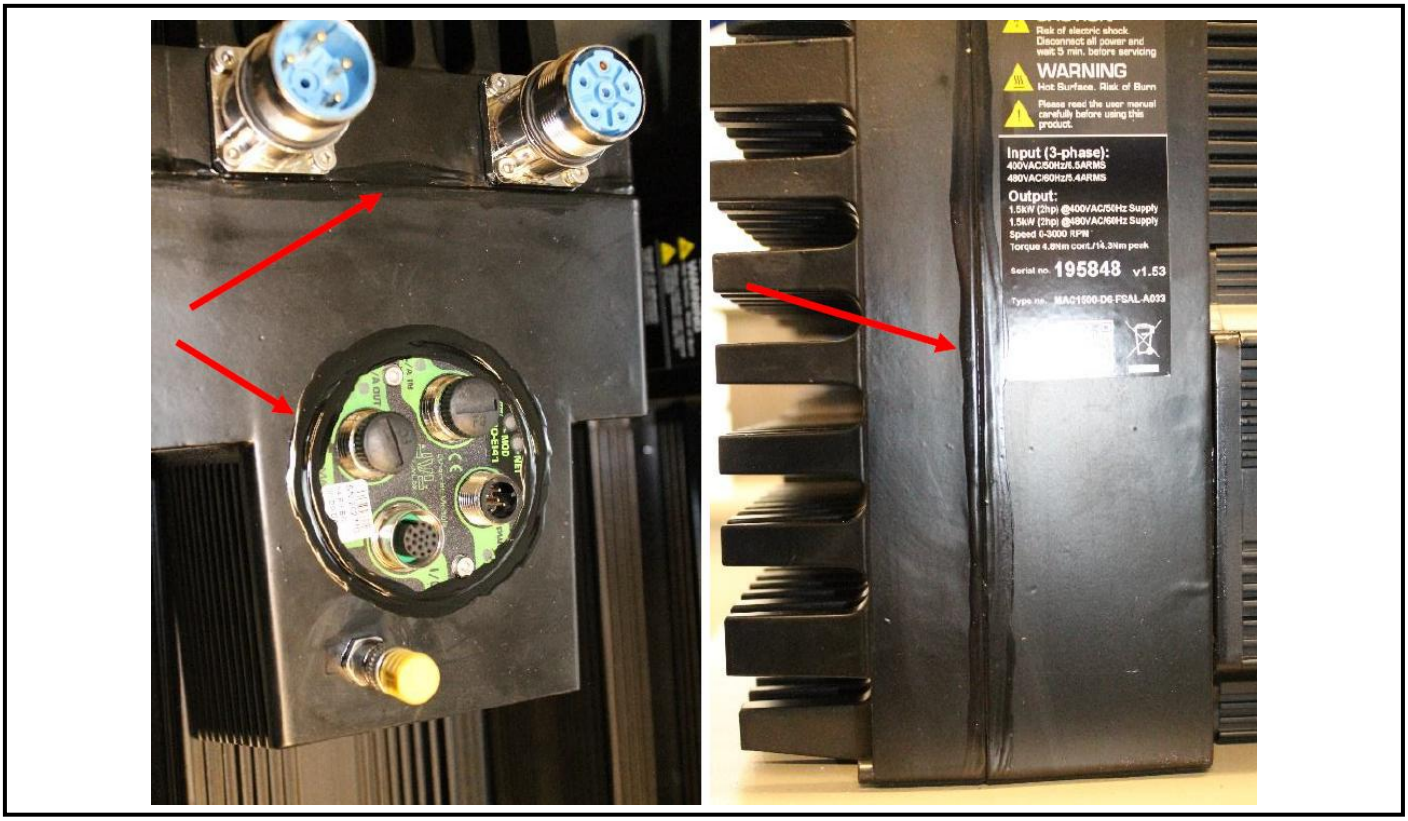
Even when equipped with an IP67-rated shaft seal, it is not recommended to expose the shaft to water. Prolonged exposure, especially while the shaft is rotating, may eventually allow water to enter the motor. In cold and wet conditions, the shaft seal may freeze to the shaft, potentially causing permanent damage.
To prevent this, one of the following solutions is recommended:

- Apply a thin layer of silicone spray to the shaft seal
- Remove the shaft seal entirely — this is only acceptable if the motor is mounted to a gearbox with an IP rating equal to or higher than the motor, and the flange connection between motor and gearbox is properly sealed

3.6 Rule 6 - Additional protection for connectors, screws and joining points

If the motor is exposed to water—especially in outdoor applications—it is recommended to apply additional sealing around screws, modules, and connection points to gearboxes or other equipment. These materials help prevent moisture ingress and corrosion, ensuring long-term reliability of the motor assembly.
Depending on the installation environment, the following sealing materials are recommended:

- Metal Paint: e.g. Hammerite or other alkyd-based paints
- Grease: SuperLube Multi-purpose Synthetic Grease



3.7 Rule 7 - Protecting against condensation

If the motor is installed in environments where temperatures can drop below 0 °C or fluctuate significantly, condensation may form inside the motor. To mitigate this risk, we recommend the following:

- Coated PCB: Order the motor with a conformal coating on the PCB to protect against moisture.
- Breathing Valve: In extreme conditions, consider ordering the motor with a valve that allows internal moisture to escape and the motor to “breathe.”
- Control Voltage (CVI): Keep the control voltage continuously applied to maintain a higher internal temperature, which helps prevent condensation.

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4 Precautions for MAC motors with expansion modules

Mounting the expansion module (MAC00-xxx)
All expansion modules are IP67 rated but under the condition that its mounted correctly:

- Add synthetic grease around the top edge of the module prior to installation.
- Ensure the module surface is flush with the motor housing.
- Tighten the two M2.5 hex screws to **0.8–1.0 Nm** using a torque screwdriver.

Tighten these two screws to 0.8-1.0 Nm

Mandatory:
Add synthetic grease around the edge of the module before mounting.

Use protective caps on unused connectors. Tighten properly.

Grease around this edge

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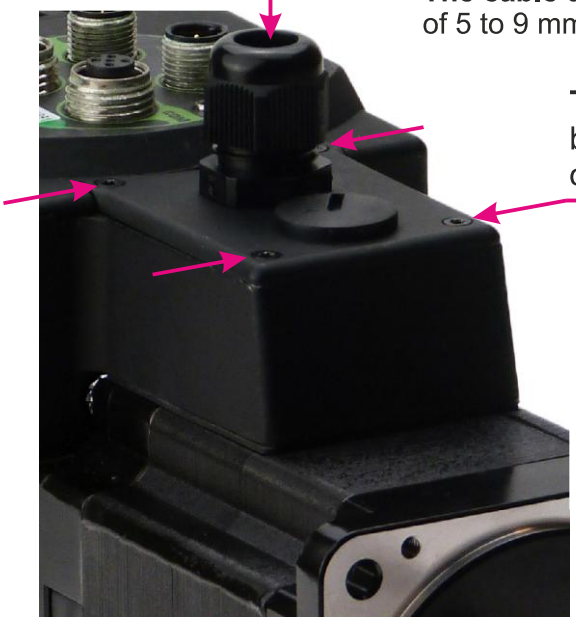
4.1 Precautions for MAC800-D3 and -D6

The MAC800-D3 and MAC800-D6 motors offer IP66 protection. To ensure this level of protection is maintained, it is essential that all components are mounted and fastened correctly, exactly as shown in the installation illustration below.



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5 MAC100/101/231 stainless-steel motors assembly

To ensure proper assembly and maintain the high IP rating, it is strongly recommended to order the MAC100/101 motor with factory-mounted modules and cables. If it becomes necessary to open the stainless-steel tube, extreme care must be taken during reassembly. All components must be reassembled in the correct order, grease must be applied to cables and O-rings, and all screws and cable glands must be tightened to the specified torque.

The warranty does not cover any damage caused by water ingress if the stainless-steel tube or cable glands have been opened after delivery.

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