



THREE-PHASE TEFC INDUCTION MOTORS

# Installation & Maintenance Manual

Safe handling, installation, commissioning, maintenance and fault finding

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**ABOUT THIS MANUAL**

This manual applies to Motorelli standard three-phase, totally enclosed fan-cooled (TEFC) induction motors. Motors built to a special specification (e.g. hazardous-area, slipring, custom voltage or speed) may have additional documentation — where this differs from the general guidance below, the specific documentation takes precedence. If in doubt, contact your nearest Motorelli branch before proceeding.

## SECTION 01

## Safety Warning

Motorelli three-phase induction motors are manufactured in accordance with strict quality-control procedures, have excellent functional and performance characteristics, and are of robust construction.

Motorelli motors are designed for operation in industrial applications. In normal service there is a potential danger from rotating parts and live terminals. It is essential that these motors are installed and serviced **only by qualified personnel** to avoid injury or death, and/or damage to equipment or buildings.

**WARNING**

If there are any doubts about safety, **do not install the motor and do not attempt to operate it**. Contact your nearest Motorelli branch for assistance.

**BEFORE ANY WORK**

Always isolate and lock out the power supply before working on the motor, its terminal box or the driven equipment, and ensure that the motor cannot be started unintentionally.

## SECTION 02

## Acceptance Inspection

When receiving Motorelli motors, please carry out the following checks:

- Check that the description on the delivery note agrees with your order specification.
- Check that the rating, speed, voltage, etc. are in accordance with your requirements.
- Check for any damage, rust, dirt or foreign substances. All motors should be received with a plastic shaft cover to protect the shaft during transport and storage.
- Check that the direction of rotation, if specified, is correct. Motors with a low-noise (unidirectional) fan have a direction arrow fitted.
- All motors of frame size 160 and above should be received with a shaft clamp. After removing the clamp (if applicable), turn the shaft by hand and check for smooth, quiet operation.

**RE-TRANSPORTING**

If the motor is to be transported again — either on its own or with the driven equipment — the rotor and shaft must be clamped again. Transport without the shaft clamp can cause brinelling of the bearings.

**IF ANY DEFECT IS FOUND — CONTACT YOUR MOTORELLI BRANCH IMMEDIATELY WITH:**

- Full nameplate details, including the serial number
- Your order number and delivery note details
- A full description of the defect, with photographs if possible

## SECTION 03

## Pre-commissioning

Satisfactory operation of an electric motor depends on its location. Please ensure that the following factors have been taken into consideration:

|                            |                                                                                                                                                                                                                                                                                                                                                                           |
|----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ambient temperature</b> | Standard motors operate without problems in an ambient temperature range of <b>-15 °C to +40 °C</b> . If the motor must operate outside this range and was not specifically ordered and supplied for such conditions, contact your Motorelli representative for advice before proceeding.                                                                                 |
| <b>Ventilation</b>         | Install the motor in a suitably ventilated area. Keep the area in front of the air intake clear to allow sufficient airflow. Exhausted air must not recirculate over the motor, as this reduces the effectiveness of the cooling system.                                                                                                                                  |
| <b>Dust</b>                | A high concentration of dust allowed to accumulate on the external surface of the motor may cause overheating. Where dust is a problem, a special motor may be warranted.                                                                                                                                                                                                 |
| <b>Hazardous areas</b>     | Ensure the motor is certified for the area in which it will be used. Hazardous areas require specially certified motors.                                                                                                                                                                                                                                                  |
| <b>Vibration</b>           | Install the motor on a solid floor, foundation or rigid base, free from external vibration.                                                                                                                                                                                                                                                                               |
| <b>Mounting</b>            | Motors are designed for horizontal mounting. Frames 160 and above are provided with suitably positioned condensation drain holes. All motors up to and including frame 280 are mechanically suitable for mounting in any position, provided the drain holes are suitably positioned. For non-horizontal mounting of larger frames, contact your nearest Motorelli branch. |
| <b>Enclosure</b>           | All motors are totally enclosed fan-cooled (TEFC) with a minimum enclosure rating of <b>IP55</b> . Higher protection is available; we recommend that IP56 and IP66 motors are supplied and used with space heaters to prevent condensation.                                                                                                                               |

## SECTION 04

# Fitting Couplings & Alignment

Extreme care must be taken when lining up couplings, as misalignment can damage the shaft and bearings. For direct drives we recommend flexible couplings. Always follow the coupling manufacturer's instructions.

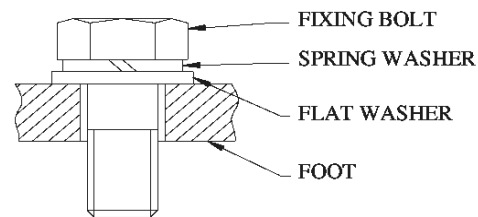
We recommend that couplings and pulleys are bored to an **H7 tolerance**. Never use force (e.g. hammering) when fitting couplings, pulleys, etc. All motors have a threaded hole in the drive-end shaft to assist fitting and removal: use a bolt in this hole, with a nut and large washer, to press the coupling or pulley up against the shaft shoulder.

Ensure the motor bearings are not subjected to end thrust caused by the two coupling halves being squeezed too tightly together. All couplings, belts, pulleys, etc. must be properly and permanently guarded against accidental contact while the motor is running.

## Fixing bolts

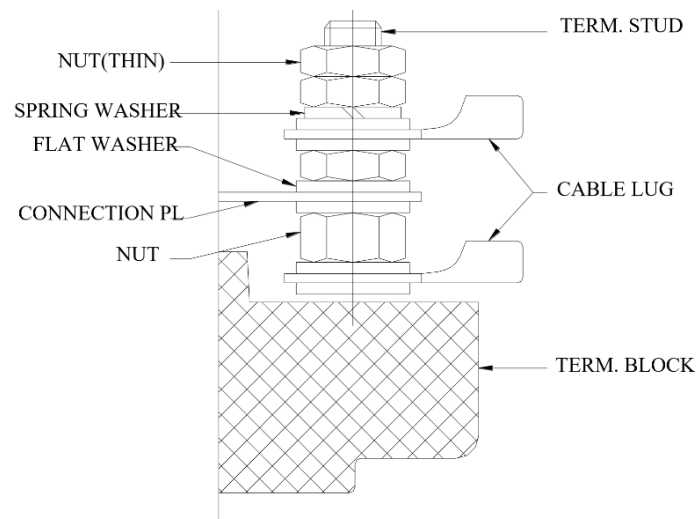
Use a flat washer and a spring washer under each fixing bolt. This prevents excessive stress on the motor foot or flange and stops the bolts working loose.

Use normal hand tools and tighten each bolt only until the spring washer is fully compressed between the flat washer and the bolt head.



Fixing bolt arrangement

## Terminal connections



Typical terminal stud arrangement

## Recommended tightening torques for electrical terminals (Nm)

| Stud size | M5  | M6  | M8  | M10 | M12 | M16 |
|-----------|-----|-----|-----|-----|-----|-----|
| Minimum   | 1.8 | 3.0 | 8.0 | 10  | 20  | 30  |
| Maximum   | 2.5 | 4.0 | 9.0 | 17  | 30  | 50  |

## SECTION 05

## Belt Drives

- All V-belts on a drive must be from the same manufacturer and have the same dimensions.
- Tension belts correctly, in accordance with the belt manufacturer's recommendations. Incorrect tension can cause belt and pulley wear and/or shaft and bearing damage.
- When replacing belts, replace all belts on the drive at the same time.

**NOTE**

2-pole motors are not generally recommended for belt-drive applications. Please refer such requirements to your Motorelli branch.

## SECTION 06

## Commissioning

Before starting the motor, please ensure that the following checks have been carried out.

### Safety & lifting

All motors of frame size 100 and above are fitted with lifting eyebolts as standard. These eyebolts are intended for lifting the motor only — **not** equipment attached to the motor, such as gearboxes or pumps.

### Wiring

Refer to the motor nameplate for the method of connection. A connection diagram is supplied on the inside of the terminal box lid or on the nameplate. Ensure the motor is connected correctly for the starter used.

| Rated output   | Standard connection                                                                                         | Star-delta starting |
|----------------|-------------------------------------------------------------------------------------------------------------|---------------------|
| 3 kW and below | Dual voltage, e.g. 400 V star / 230 V delta. Allows use with a 230 V three-phase variable-frequency supply. | <b>Not suitable</b> |
| 4 kW and above | Delta connection, six leads brought out.                                                                    | <b>Suitable</b>     |

### Terminal box

All motors have a spacious terminal box mounted on top of the motor. Terminal boxes can be rotated in 90° steps.

### Earth connection

All motors have two earth points to ensure a reliable, permanent connection to the protective earth conductor: an internal point adjacent to the supply terminals inside the terminal box, and an external point on the stator frame.

### Insulation resistance

**≥ 5 MΩ**

Measure between each phase and earth, and between phases, using a **500 V or 1000 V** insulation tester (megger) for **60 seconds**. The reading must not be less than 5 MΩ.

After a long period of storage, or standing idle in a moist environment, the windings should be dried out before the motor is put into service — using the space heaters (where fitted), a drying oven, or by a qualified person applying a reduced voltage (approximately 10–20% of rated voltage) to the stator winding with the rotor stationary, while monitoring current and winding temperature. Re-test the insulation resistance before commissioning.

## Starting

When operating a motor for the first time, run it uncoupled from the load to confirm that the direction of rotation is correct and that there is no undue noise or vibration. Before running, make sure loose items such as shaft keys are removed or secured so that they cannot fly off.

All motors are balanced in the factory with a half key. Motors can be run without the key or with a full key fitted, although this may cause a small amount of vibration.

## Reversing

To reverse the direction of rotation, interchange any two of the three supply leads. If a motor fitted with a unidirectional (low-noise) fan runs in the wrong direction, contact your Motorelli branch.

## Frequency of starting

Standard motors are capable of **two starts in succession from cold** (allowing the motor to coast to rest between starts), or **one start at normal running temperature**. Standard motors are also suitable for up to **6 evenly spaced starts per hour**. If a higher starting frequency is required, contact your Motorelli branch.

## Thermistors

Motors of frame size 160 and above are supplied with thermistors as standard. The thermistors are terminated in the main terminal box unless separate terminal boxes are specified.

### CAUTION

When checking thermistors for continuity, the applied voltage must not exceed **2.5 V DC**. An ohmmeter may be used — **never use a megger** on thermistor circuits.

## Thermistors & PT100 sensors — warranty requirement

Where thermistors and/or PT100 sensors are fitted, they must be connected to a suitable relay and correctly set. When connected, they provide reliable protection for the motor, and their use is **essential to maintain the validity of the warranty**.

### Recommended relay settings

| PT100 location | Alarm  | Trip (cut-off) |
|----------------|--------|----------------|
| Windings       | 135 °C | 140 °C         |
| Ball bearings  | 100 °C | 110 °C         |

The photograph shows a typical installation: one temperature relay per PT100 — drive-end (DE) and non-drive-end (NDE) bearings, and the U, V and W windings — on a 250 kW Motorelli motor.



Example PT100 relay panel

## SECTION 07

# Bearings

Bearings in Motorelli motors are lubricated with lithium-based grease. Motors running in high or low ambient temperatures may require special bearings and almost certainly special grease.

## Standard bearing arrangement

|                         |                                                                                                                                                                                                                      |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Frames 80 – 160</b>  | Sealed deep-groove ball bearings (2Z / 2RZ), <b>lubricated for life</b> . These bearings cannot be re-greased; replace them at overhaul, or earlier if they become noisy or run hot.                                 |
| <b>Frames 180 – 355</b> | Open bearings with <b>C3 internal clearance</b> , grease nipples fitted and <b>re-greasable</b> as standard. 4-pole and slower motors in frames 315 and 355 have a cylindrical roller bearing (NU) at the drive end. |

On re-greasable motors, check the bearings every **3 months** and re-grease if necessary — at the latest by the intervals in the schedule below. We recommend re-greasing while the motor is running, observing safe working procedures around rotating parts.

## Grease relief

- **Grease relief plug:** where fitted, remove the plug before re-greasing so that old grease can purge. Run the motor for approximately **2 hours** with the plug removed after adding new grease, then refit the plug.
- **Automatic grease relief:** where fitted, old grease is expelled automatically during re-greasing.
- **No grease relief:** the old grease must be cleaned out from time to time by removing the bearing cap and/or end shield. Repack the bearing and housing with grease and reassemble. Do not overfill — the housing should be no more than **one-quarter full** of grease after reassembly.

## Greases

Recommended greases for normal applications are lithium-based types such as **BP LS3** or **Shell Alvania R3**. Always clean the grease nipples before lubricating so that dirt cannot enter the bearings.

### IMPORTANT

**Do not mix different greases** — not all greases are compatible with each other. If the motor is subject to any axial thrust, contact your nearest Motorelli branch, as special thrust bearings may be required.

### HIGH-HUMIDITY ENVIRONMENTS

- **Frames 80 – 160 (sealed bearings):** inspect the bearings every **12 months** and replace them with new contact-sealed (2RS) bearings when required. Sealed bearings cannot be re-greased.
- **Frames 180 – 355 (re-greasable):** use a moisture-resistant grease and **halve the re-greasing intervals** shown in the schedule below.
- In all cases, regular monitoring of bearing condition and temperature is important.

## Bearing & re-greasing schedule

| Frame | Poles    | DE bearing | NDE bearing | Grease per bearing (g)              | Re-greasing interval (h) |
|-------|----------|------------|-------------|-------------------------------------|--------------------------|
| 80    | All      | 6204-2RZ   | 6204-2RZ    | <i>Sealed — lubricated for life</i> |                          |
| 90    | All      | 6205-2RZ   | 6205-2RZ    | <i>Sealed — lubricated for life</i> |                          |
| 100   | All      | 6206-2RZ   | 6206-2RZ    | <i>Sealed — lubricated for life</i> |                          |
| 112   | All      | 6306-2RZ   | 6306-2RZ    | <i>Sealed — lubricated for life</i> |                          |
| 132   | All      | 6308-2RZ   | 6308-2RZ    | <i>Sealed — lubricated for life</i> |                          |
| 160   | All      | 6309-2Z    | 6309-2RZ    | <i>Sealed — lubricated for life</i> |                          |
| 180   | 2        | 6311C3     | 6311C3      | 30                                  | 4 000                    |
| 180   | 4/6/8    | 6311C3     | 6311C3      | 30                                  | 10 000                   |
| 200   | 2        | 6312C3     | 6312C3      | 40                                  | 3 500                    |
| 200   | 4/6/8    | 6312C3     | 6312C3      | 40                                  | 8 500                    |
| 225   | 2        | 6313C3     | 6313C3      | 50                                  | 3 000                    |
| 225   | 4/6/8    | 6313C3     | 6313C3      | 50                                  | 6 000                    |
| 250   | 2        | 6314C3     | 6314C3      | 55                                  | 2 000                    |
| 250   | 4/6/8    | 6314C3     | 6314C3      | 55                                  | 5 000                    |
| 280   | 2        | 6314C3     | 6314C3      | 55                                  | 1 200                    |
| 280   | 4/6/8    | 6317C3     | 6317C3      | 85                                  | 4 000                    |
| 315   | 2        | 6317C3     | 6317C3      | 85                                  | 1 200                    |
| 315   | 4/6/8/10 | NU319C3    | 6319C3      | 110                                 | 2 000                    |
| 355   | 2        | 6319C3     | 6319C3      | 110                                 | 1 200                    |
| 355   | 4/6/8/10 | NU322C3    | 6322C3      | 125                                 | 1 400                    |

Grease quantities are per bearing, per re-greasing. Intervals are running hours under normal conditions; halve them for high-humidity or severe duty. Where the motor nameplate differs, follow the nameplate.

## SECTION 08

## Maintenance

Where a motor is used continuously, we recommend that it is removed, inspected and dismantled **every 5 years**. The following items should be checked and recorded:

|                              |                                                                                                                           |
|------------------------------|---------------------------------------------------------------------------------------------------------------------------|
| <b>Insulation resistance</b> | Record the reading and the temperature at which it was measured. Expect a lower insulation reading when the motor is hot. |
| <b>Bearings &amp; grease</b> | Inspect the bearings and check the grease for discolouration.                                                             |
| <b>Drive train</b>           | Check V-belt tension and coupling alignment.                                                                              |
| <b>Mounting</b>              | Ensure the holding-down bolts are tight and the base plate or foundation is rigid.                                        |
| <b>Cleanliness</b>           | Check that the motor is clean inside and outside, including cooling fins and fan cover.                                   |

## SECTION 09

## Fault Finding

Use the guide below to identify the likely cause of common problems. Work through the possible causes in order, and always isolate the supply before carrying out mechanical checks.

### 01 Motor will not start

| POSSIBLE CAUSE                              | TEST                                              | SOLUTION                                    |
|---------------------------------------------|---------------------------------------------------|---------------------------------------------|
| <b>Fault with the supply</b>                | Check for correct voltage at the motor terminals. | Fit new fuses, reset circuit breakers, etc. |
| <b>Motor or load locked up</b>              | Make sure the motor and load are free to turn.    | Remove clamps, locks, etc.                  |
| <b>Wrong connections in control circuit</b> | Check that the contactors operate.                | Correct the control circuit.                |

### 02 Supply or starter trips at start

| POSSIBLE CAUSE                                              | TEST                                                                       | SOLUTION                                              |
|-------------------------------------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------|
| <b>Wrong or loose connections</b>                           | Check all lugs are properly crimped or soldered and connections are tight. | Correct the connections.                              |
| <b>Motor overloaded</b>                                     | Check load performance data against motor performance data.                | Fit a correctly sized motor.                          |
| <b>Load inertia too high</b>                                | Check load performance data against motor performance data.                | Fit a correctly sized motor.                          |
| <b>Low voltage due to volt drop in cables</b>               | Measure voltage at the motor terminals while starting.                     | Fit correctly sized cables.                           |
| <b>Overload or circuit breaker incorrectly set or sized</b> | Check overload and breaker settings, allowing for starting current.        | Correct the setting, or replace the overload/breaker. |

### 03 Motor starts but has no torque, does not reach full speed, or accelerates slowly

| POSSIBLE CAUSE                                | TEST                                                        | SOLUTION                                        |
|-----------------------------------------------|-------------------------------------------------------------|-------------------------------------------------|
| <b>Incorrect connection</b>                   | Check the connection diagram and nameplate data.            | Correct the connections at the motor terminals. |
| <b>Delta-wound motor connected in star</b>    | Check the connection diagram and nameplate data.            | Correct the connections at the motor terminals. |
| <b>Star-delta starter staying in star</b>     | Check that the starter changes over to delta.               | Check the timer and starter control circuit.    |
| <b>Load inertia too high</b>                  | Check load performance data against motor performance data. | Fit a correctly sized motor.                    |
| <b>Motor overloaded</b>                       | Check load performance data against motor performance data. | Fit a correctly sized motor.                    |
| <b>Low voltage due to volt drop in cables</b> | Measure voltage at the motor terminals while starting.      | Fit correctly sized cables.                     |

### 04 Motor is overheating

| POSSIBLE CAUSE                             | TEST                                                               | SOLUTION                                                        |
|--------------------------------------------|--------------------------------------------------------------------|-----------------------------------------------------------------|
| <b>Motor overloaded</b>                    | Check load and performance data.                                   | Correct the load problem or fit a larger motor.                 |
| <b>Ineffective cooling</b>                 | Check fan, airflow and air temperature. Look for build-up of dirt. | Clean the motor; correct cooling-air temperature and flow.      |
| <b>Excessive ambient temperature</b>       | Check fan, airflow and air temperature.                            | Correct cooling-air temperature and flow.                       |
| <b>Wrong connection</b>                    | Check the connection diagram and nameplate data.                   | Correct the connections.                                        |
| <b>Delta-wound motor connected in star</b> | Check the connection diagram and nameplate data.                   | Correct the connections.                                        |
| <b>Motor single-phasing</b>                | Check volts and amps in all three phases.                          | Restore the supply to all phases.                               |
| <b>Wrong voltage or frequency</b>          | Check the nameplate.                                               | Correct the voltage or frequency.                               |
| <b>Supply voltage unbalanced</b>           | Measure phase-to-phase voltage accurately.                         | Balance the supply. If this is not possible, consult Motorelli. |

## 05 No-load current higher than full-load current

| POSSIBLE CAUSE                                             | TEST                                                     | SOLUTION                                                    |
|------------------------------------------------------------|----------------------------------------------------------|-------------------------------------------------------------|
| <b>Incorrect connection</b>                                | Check the connection diagram and nameplate data.         | Correct the connections at the motor terminals.             |
| <b>Star-wound motor connected in delta</b>                 | Check the connection diagram and nameplate data.         | Correct the connections at the motor terminals.             |
| <b>Supply voltage higher than nameplate</b>                | Measure voltage at the motor terminals.                  | Correct the supply voltage.                                 |
| <b>Motor supplied for a different voltage or frequency</b> | Compare supply voltage and frequency with the nameplate. | Replace with a motor for the correct voltage and frequency. |

## 06 Mechanical noise or vibration; noisy or overheating bearings

| POSSIBLE CAUSE                                                            | TEST                                                                                                      | SOLUTION                                                                      |
|---------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| <b>Thrust from load, or misalignment</b>                                  | Check the gap between coupling halves and the alignment.                                                  | Re-align the coupling.                                                        |
| <b>Damaged bearings; too much, no, or contaminated grease</b>             | Turn the shaft slowly by hand and feel for roughness or stiffness. Check for a bent shaft or fan rubbing. | Clean the bearing housing, replace the bearings and repack with fresh grease. |
| <b>Rotor pulling over (rotor poling) or foreign matter in the air gap</b> | As above.                                                                                                 | As above.                                                                     |
| <b>Out-of-balance load, coupling or pulley</b>                            | Run the motor disconnected from the load, then with the pulley or coupling removed.                       | Correct the out-of-balance items.                                             |
| <b>Excessive belt pull</b>                                                | Run the motor without belts.                                                                              | Reduce belt tension to the manufacturer's recommendation.                     |
| <b>Motor foundations not rigid</b>                                        | Check the design and construction of the foundations.                                                     | Strengthen the foundations.                                                   |

## 07 Motor current higher than nameplate full-load current (on load)

| POSSIBLE CAUSE                         | TEST                                                       | SOLUTION                                          |
|----------------------------------------|------------------------------------------------------------|---------------------------------------------------|
| <b>Motor overloaded</b>                | Check load and performance data.                           | Correct the load problem or fit a larger motor.   |
| <b>Low supply voltage</b>              | Measure voltage at the motor terminals.                    | Correct the supply — larger cables may be needed. |
| <b>Wrong voltage or frequency</b>      | Check the nameplate.                                       | Correct the voltage or frequency.                 |
| <b>Wrong connections</b>               | Check the connection diagram and nameplate data.           | Correct the connections.                          |
| <b>Motor single-phasing</b>            | Check volts and amps in all three phases.                  | Restore a balanced supply to all three phases.    |
| <b>Supply voltage unbalanced</b>       | Check volts and amps in all three phases.                  | Restore a balanced supply to all three phases.    |
| <b>Motor speed not matched to load</b> | Measure motor speed and check the load speed requirements. | Match the motor speed / drive ratio to the load.  |

## 08 Excessive electrical noise

| POSSIBLE CAUSE              | TEST                                      | SOLUTION                                |
|-----------------------------|-------------------------------------------|-----------------------------------------|
| <b>Wrong connections</b>    | Check the connections.                    | Correct the connections.                |
| <b>Wrong voltage</b>        | Check the voltage against the nameplate.  | Correct the voltage.                    |
| <b>Motor single-phasing</b> | Check volts and amps in all three phases. | Restore the supply to all three phases. |

## 09 Unbalanced current between phases

| POSSIBLE CAUSE           | TEST                                       | SOLUTION                                                        |
|--------------------------|--------------------------------------------|-----------------------------------------------------------------|
| <b>Unbalanced supply</b> | Measure phase-to-phase voltage accurately. | Balance the supply. If this is not possible, consult Motorelli. |

## 10 Motor runs in the wrong direction

| POSSIBLE CAUSE                            | TEST                      | SOLUTION                                                            |
|-------------------------------------------|---------------------------|---------------------------------------------------------------------|
| <b>Wrong phase sequence (connections)</b> | Watch the shaft rotation. | Swap any two supply phases. For unidirectional fans, see Section 6. |

## SECTION 10

## Contact Us

Motorelli supplies electric motors, variable speed drives and gearboxes nationwide, backed by 24/7 technical support. For technical assistance, spares or service, contact your nearest branch.

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