ENERTECH

# Electric Motor Installation, Operation and Maintenance

*Three phase asynchronous electric motors*

# Enertech Motor Installation, Operation and Maintenance

The Enertech Electric Motors (Australia) are designed and manufactured to be robust and reliable with minimal maintenance. The following items should be taken into consideration to ensure a trouble free installation and reliable running throughout the motor's life.

## Inspection

Enertech Electric Motors (Australia) are delivered through safe and reliable transport in appropriate packing as to remain in as manufactured condition during transit. On receipt of the motor thoroughly inspect the unit for any transit damage, if need be in the presence of an insurance surveyor. Any equipment damage or shortfall should be immediately advised to the nearest Enertech Australia office.

Check the following:
- Rating plate details and enclosure areas ordered.
- Shaft turns freely (in absence of shaft locking clamp).
- Condensation drain holes are in the correct position for the motor mounting application (they should be located at the lowest point of the motor when it is in its operating position).
- If the winding is Insulation Resistance (IR) tested to earth, ensure that the thermal protectors are not inadvertently damaged. (The thermistor leads should be shorted together whilst IR testing takes place).

## Storage

When the motor is not for immediate use store as follows:
- Clean and dry location.
- Free from vibration (vibration can damage bearings).
- Shaft locking clamps, where supplied, are fitted securely.
- Remove shaft locking clamp sand turn rotor by one full rotation at least once a fortnight and replace shaft locking clamps.
- Anti-condensation heaters, where fitted, should be energised if the environment is likely to be damp.

# Installation

The following items should be considered on installation to ensure reliable operation of the motor:

## Surroundings

- Ensure that the motor is properly protected against ingress of oil, water or dust especially if construction work is in progress around the motor.
- Ensure air intake is not obstructed. Refer to dimension BL in the catalogue.
- When in stalling hazardous location motors, make sure that the zone and gas group or dust and temperature classification on motor nameplate are complied with.

## Mounting

- Bed plates or slide rails should be firmly fixed to a solid, level foundation to ensure the motor remains rigid and vibration free.
- Shims or packers (if required) must be of adequate size and placed adjacent to and between base fixing screws.
- Protective transport coatings on shafts and/or flanges must be removed prior to connection to the driven load.
- A light coating of grease to shafts and/ or flanges will inhibit corrosion during service and assist removal of pulleys or couplings.

## Pulleys and couplings

- Pulleys or couplings should be independently balanced with a half key as the motor rotor is balanced with a half key during manufacture.
- In fitting pulleys or couplings to the motor shaft care must be taken to ensure the roller/ball bearings are not damaged. Both shaft and coupling bore should be cleaned and lubricated. If the fit is still too tight, the pulley or coupling should be pre-heated in air or oil to enable easy assembly.
- Shock methods must not be used in fitting or removing pulleys or couplings. Proper wheel or pulley removers should be used to prevent shaft and bearing damage. Tapped holes are provided in shaft extensions to assist in the fitment of couplings and/or pulleys.

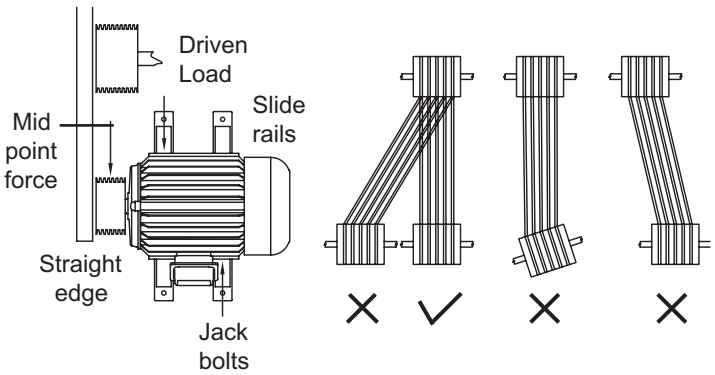
## Pulley and belts

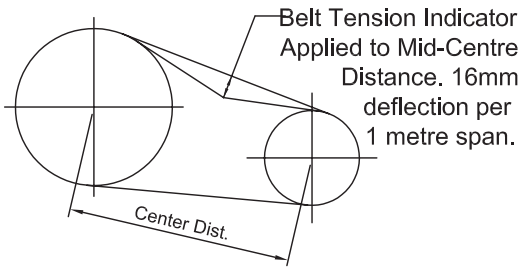
- If the motor is to be coupled to the load using pulleys and belts it is important to ensure that the belt tension does not exceed the safe working radial load of the motor. Excessive radial load will lead to reduced bearing life with the potential of breaking the motor shaft. Because of this care must be taken to ensure the correct selection of pulley size and type (toothed, vee or flat) and this is best done in consultation with the transmission supplier.
- The belt manufacturer's recommendations for installation, alignment and tensioning must be strictly adhered to when fitting belt drives.

## Alignment

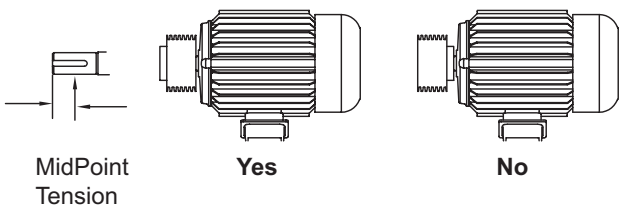
- Great care must be taken in aligning the complete machine, since misalignment can cause rapid deterioration of bearings and lead to other mechanical failures due to the stress produced.
- After final tightening of foundation bolts, machine alignment should be rechecked as bed plates could move and/or distort during machine mounting.
- No end thrust should be applied without express approval.
- When slide rails are used in conjunction with pulley drives, the adjusting screw ends should be positioned between the motor and load at drive shaft end and

the other diagonally opposite. This helps speedy and accurate belt aligning, tensioning and replacement.
The correct alignment of the motor pulley with the load pulley is imperative. Both these pulley's must have matched centre distances between grooves and alignment must be carried out using a suitable metal straight edge or other recommended tools to ensure parallel offset or angular displacement of the pulley's with respect to each other is inside permissible limits as recommended by the transmission supplier.
Correct alignment will result in a uniform distribution of belt tension across the width of the pulley (and the motor shaft) and ensure design life of both the belts and bearings is achieved.
Note: The pulley should always be mounted firmly against the shaft shoulder and should be a firm fit into the shaft.
**Impact force must not be used.**



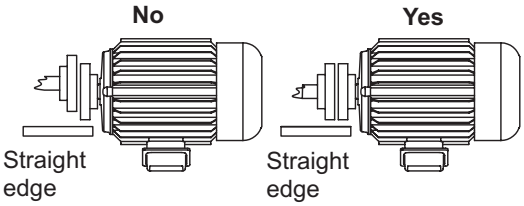

As a general rule the mid point of the applied force should be at the mid point of the shaft and it is good engineering practice to mount the motor pulley with hub and locking screw at the shaft end.



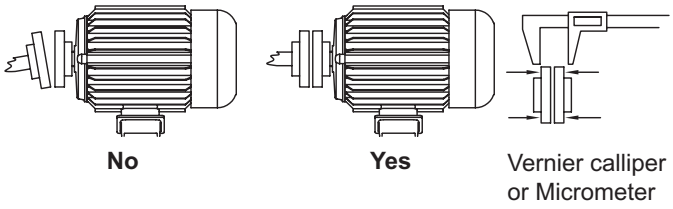

## Direct coupled

Where direct coupling of the motor is required, proper alignment must be achieved to prevent bearing damage to both motor and load.

For parallel offset, use a straight edge or other recommended tools, as shown below.



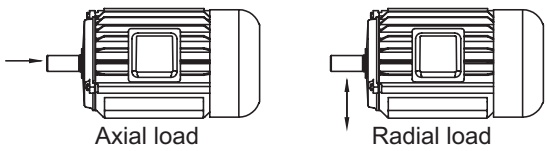

Excessive angular displacement must also be prevented. The recommended method to achieve correct angular alignment is shown below.




## Axial loads

Where motors with standard bearings are required to be mounted in either vertical shaft up or vertical shaft down orientation, there are limits on the axial forces that must not be exceeded. This also applies to horizontal mounted motors with certain loads that produce axial thrust. Axial loads exceeding those listed in the catalogue will reduce bearing life and may lead to internal motor damage.

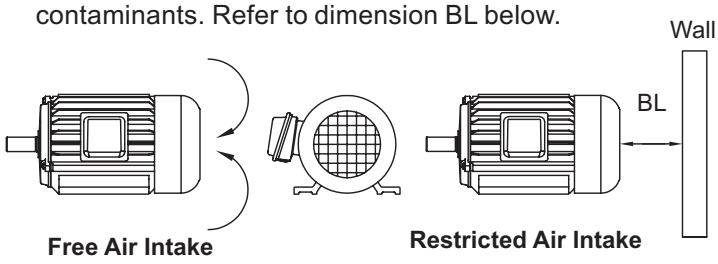
Where higher than recommended axial loads are necessary different bearing types will be required.




There are various cooling formats for electric motors with IC411 (totally enclosed fan cooled) as the most common type that is used on our electric motors. This type of cooling of motor is achieved by a fan mounted at the non-drive end, inside a fan cowl, which has an air inlet grille at the rear. Air is drawn in through the grille and the fan distributes the airflow along the fins of the motor body. The fan is designed for either direction of rotation (unless otherwise indicated on the fan cowl).

With TEFC motors it is important that the cooling fins remain clear of debris to allow the airflow to be fully effective in maintaining motor winding temperature within the design limits.

It is equally important to ensure the installation provides good unrestricted access to normal ambient air at the fan entry point at all times and that inlet grill is clear of contaminants. Refer to dimension BL below.



| Motor frame | Dimensions BL [ mm ] |
|---|---|
| **71 - 100** | 15 |
| **112 – 132** | 30 |
| **160 – 180** | 40 |
| **200 – 280** | 50 |
| **315 - 355** | 65 |

## Supply terminals

Supply terminals are located in the terminal box. They are suitable for receiving crimped lugs on the supply cables. In addition the terminal box also houses an earthing terminal.

| Motor frame | Terminal size | Max supply cable size* [ $mm^2$ ] |
|---|---|---|
| **71 - 132** | M5 | 16 |
| **160 - 180** | M6 | 50 |
| **200 - 225** | M8 | 95 |
| **250 - 280** | M10 | 2 x 95 |
| **315** | M12 | 2 x 185 |

* **4 or 3 core +E, PVC insulated**

## Thermal protection

Motors can be protected against excessive temperature rise by inserting, at various positions within the windings, thermal probes which can either give a warning signal or cut off the supply to the motor in the event of a temperature abnormality. The units fitted to ESC motors, are PTC thermistors. These thermovariable resistors, with frame sizes 160 and above, positive temperature co-efficient, are fitted one per phase, series connected and are terminated in a terminal strip located in the terminal box.

Trip temperature is 160°C (180°C for EHC series).
Additional 130°C thermistors can be fitted as an option for alarm connection.

## Electrical connection

- Ensure all electrical connections are solid and continuous.
- Check motor starter and over loads for correct rating and trip setting.
- All circuit breakers, HRC fuses or protective devices associated with the motor must be rated to suit motor running current and starting characteristics.
- Supply cables must be appropriately selected considering the voltage drop.
- When using long supply cables with VVVFdrive, check with Enertech Australia for proper recommendations to avoid high voltage transients occurring at motor terminal.
- Check the connection diagramon the motor terminal box and make sure the supply leads are properly connected considering the supply phase sequence.
- Ensure that the supply cable termination on to the motor terminal board is firm, without loss of strands while using crimped lugs and all washers are used in the correct order as provided.
- Ensure that proper earthing connection is made with all washers as provided, approved by the standards organisation. Gland plugs to be of approved type.
- If using conduit for the supply leads, ensure the conduit is completely threaded in and seal the threads appropriately.
- If RTDs of hazardous location motors are connected to monitor the winding temperature, the maximum voltage to the RTDs must be kept to 90V(peak) or below.

## Initial start up

Prior to initial start-up check the following:

- Insulation resistance of motor winding to earth to be over 1MΩ for motors up to 600V and over 10MΩ for over 600V.
- Thermistors or RTDs if fitted, should be checked for continuity with a multimeter.
- Ensure thermistors are wired up to the motor protection relay as to trip the supply to the motor in the event of an over temperature.
- Do not megger test thermal protective devices across their terminals. Short the entire protector leads together and apply the test voltage between the shorted leads and earth and/or phases.
- Anti-condensation heaters if provided must be so connected as to switch on when the motor supply is disconnected and switch off when the motor supply gets connected.
- Ensure that the supply voltage and frequency correspond to the motor nameplate ratings.
- Ensure shaft turns freely before initial start.
- Measure winding resistance between supply terminals and record in the log book.

# Operation

- Before running the motor make sure that the terminal box lid is closed and secured with appropriate clearance to live parts.
- Make sure that appropriate earthing is done.
- Make sure that the coupling and/or transmission is adequately guarded for safety.
- Check the mounting bolts and/or flanges are firmly secured.
- Make sure of no loose objects around that may be sucked by the cooling fan on the motor.
- Make sure that the load applied is within the nameplate specification.
- Make sure that the ambient temperature is inside 40ºC or nameplate specification, record the figures in the log book for future reference.Note that the current imbalance can be higher, typically 10 times the voltage imbalance if there is an imbalance in supply voltage.

## Number of starts per hour

The number of starts per hour is dependant on the inertia of the driven load and the load torque demand. When high inertia load is applied (flywheel, heavy etc) please refer to your nearest Enertech Australia office for advice. A guide to generally acceptable starts per hour would be as per table.

For greater number of starts per hour, please contact your nearest Enertech Australia office for advice.

| Frame | Starts per hour | | | |
|---|---|---|---|---|
| | 2Pole | 4Pole | 6Pole | 8Pole |
| **71** | - | 40 | - | - |
| **80** | 20 | 40 | 40 | - |
| **90** | 16 | 30 | 40 | - |
| **100** | 16 | 30 | 40 | 40 |
| **112** | 16 | 30 | 40 | 40 |
| **132** | 10 | 20 | 25 | 25 |
| **160** | 10 | 20 | 25 | 25 |
| **180** | 8 | 15 | 20 | 20 |
| **200** | 6 | 12 | 12 | 12 |
| **225** | 5 | 10 | 10 | 10 |
| **250** | 4 | 8 | 8 | 8 |
| **280** | 3 | 6 | 6 | 6 |
| **315** | 3 | 4 | 4 | 4 |

## Permitted starting time

In respect to the temperature rise of the motor, starting time (i.e., from rest to operational speed) should not exceed the time indicated in the following table. Motor must be allowed to cool prior to each start.

| Frame | Starting method | Maximum starting time [sec] | | | |
|---|---|---|---|---|---|
| | | 2 pole | 4 pole | 6 pole | 8 pole |
| 71 | D.O.L. | - | 26 | - | - |
| 80 | D.O.L. | 15 | 26 | 40 | - |
| 90 | D.O.L. | 10 | 15 | 25 | - |
| 100 | D.O.L. | 12 | 13 | 18 | 40 |
| 112 | D.O.L. | 10 | 10 | 18 | 35 |
| 132 | D.O.L. | 14 | 12 | 12 | 25 |
| 160-355 | D.O.L. | 15 | 15 | 20 | 20 |
| 160-355 | star-delta | 45 | 45 | 60 | 60 |

## Bearing lubrication

It should be noted that for motor fitted with Ball and Roller bearing, the lubrication intervals for both bearings should be based on the roller bearing data. There-lubrication intervals recommened are calculate on the basis of nomal working conditions. (operating temperatures up to 70°C).

- Enertech motors are equipped with bearings from excellent manufactures.We recommend to use SKF, FAG or NSK Brand.
- In general the bearings have C3 clearances.
- Motor of frame size 80-132 are fitted with life-lubricated bearings.
- Motor of frame size 160-355 are fitted with open bearings and regreasing device. Depending on the useful life of grease, open bearings must be regreased in good time so that the scheduled bearing service life is reached. We recommend to use Shell Gadus S2 V220C, Total Multis Complex HV2 and BP Energrease LS2.

| Frame size | Drive end bearing | Non–drive end bearing | Regreasing period hours for operating temperatures up to 70°C | | | Quantity of grease in bearing chamber first time (grams) | Quantity of grease in bearing chamber (grams) |
|---|---|---|---|---|---|---|---|
| | | | rpm<3600 | rpm<1800 | rpm<1200 | | |
| 160 | 6309 C3 | 6309 C3 | 6000 | 12000 | 18000 | 150 | 13 |
| 180 | 6311 C3 | 6311 C3 | 4000 | 11000 | 16000 | 150 | 17 |
| 200 | 6312 C3 | 6312 C3 | 3500 | 8500 | 13000 | 180 | 20 |
| 225 | 6313 C3 | 6313 C3 | 3000 | 6000 | 9000 | 180 | 23 |
| 250 | 6314 C3 | 6314 C3 | 2000 | 5000 | 8000 | 200 | 30 |
| 280* | 6314 C3 | 6314 C3 | 1200 | – | – | 200 | 30 |
| 280 | 6317 C3 | 6317 C3 | – | 4000 | 6000 | 250 | 35 |
| 315* | 6316 C3 | 6316 C3 | 1200 | – | – | 250 | 33 |
| 315 | NU319 C3 | 6319 C3 | – | 2000 | 3000 | 300 | 45 |
| 355* | 6319 C3 | 6319 C3 | 1200 | – | – | 300 | 45 |
| 355 | NU322 C3 | 6322 C3 | – | 1400 | 2200 | 350 | 60 |

Notes:
* 2 Pole motors only.
1. Vertical motors should be greased twice as often as horizontal motors.
2. Regreasing time should be reduced if bearing operating temperature is in excess of 70°C.

## Loadability Curve for VVVF Drive

## VVVF Drives

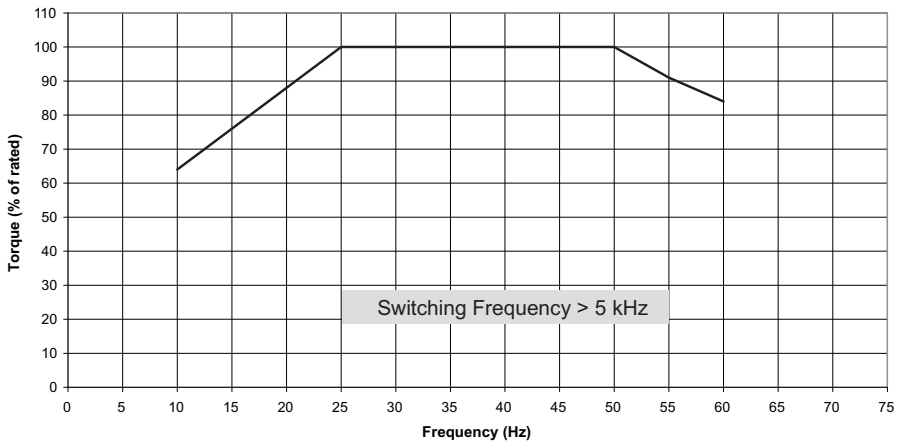
Variable Voltage Variable Frequency drives are primarily recognized for their ability to manipulate power from a constant 3 phase 50/60 Hz supply converting it to variable voltage and variable frequency power. This enables the speed of the motor to be matched to its load in a flexible and energy eficient mannar. The only way of producing starting torque equal to full load torque with full load current is by using VVVF drives. The functionally flexible VVVF drive is also commonly used to reduce energy consumption on fans, pumps and compressor and offer a simple andrepeatable method of changing speeds or flow rates.

**NOTE:**

1. Applied load on the motor shall be inside the limits specified by this loadability curve.

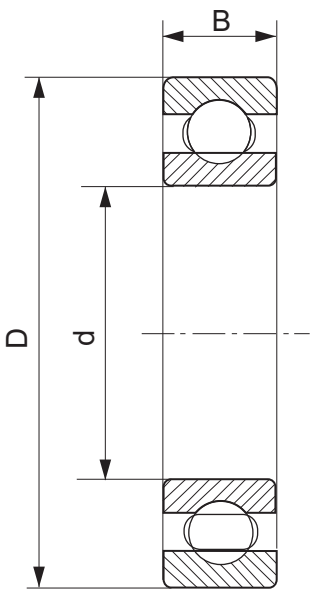
2.Enertech motor are suitable for operation with Schneider Electric brand variable frenquency drive types ATV61, ATV71, ATV 312 or drives of equivalent characteristics.

3.These motor supplied by frequency converters must be fitted with thermal protection devices such as thermistor in winding so as to cut the supply to the motor in the event of an over temperature.
Recommended protection by using thermistor protection feature in the variable speed drive.




## Bearing and oil seal

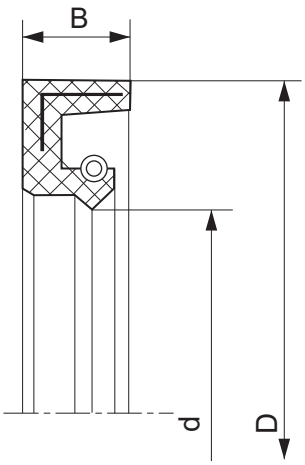
Bearing data




| Frame size | DE | NDE | d | D | B |
|---|---|---|---|---|---|
| 80 | 6204 ZZ C3 | 6204 ZZ C3 | 20 | 47 | 14 |
| 90 | 6205 ZZ C3 | 6205 ZZ C3 | 25 | 52 | 15 |
| 100 | 6206 ZZ C3 | 6206 ZZ C3 | 30 | 62 | 16 |
| 112 | 6306 ZZ C3 | 6306 ZZ C3 | 30 | 72 | 19 |
| 132 | 6308 ZZ C3 | 6308 ZZ C3 | 40 | 90 | 23 |
| 160 | 6309 C3 | 6309 C3 | 45 | 100 | 25 |
| 180 | 6311 C3 | 6311 C3 | 55 | 120 | 29 |
| 200 | 6312 C3 | 6312 C3 | 60 | 130 | 31 |
| 225 | 6313 C3 | 6313 C3 | 65 | 140 | 33 |
| 250 | 6314 C3 | 6314 C3 | 70 | 150 | 35 |
| 280 2P | 6314 C3 | 6314 C3 | 70 | 150 | 35 |
| 280 4-8P | 6317 C3 | 6317 C3 | 85 | 180 | 39 |
| 315 2P (Horizontal) | 6316 C3 | 6316 C3 | 80 | 170 | 39 |
| 315 2P (Vertical) | 6316 C3/7316 | 7317/6316 | 80 | 170 | 39 |
| 315 4-8P (Horizontal) | NU319 C3 | 6319 C3 | 95 | 200 | 45 |
| 315 4-8P (Vertical) | NU319 C3 /7319 | 7319/6319 | 95 | 200 | 45 |
| 355 2P (Horizontal) | 6319 C3 | 6319 C3 | 95 | 200 | 45 |
| 355 2P (Vertical) | 6319 C3 /7319 | 7319 /6319C3 | 95 | 200 | 45 |
| 355 4-8P (Horizontal) | NU322 C3 | 6322 C3 | 110 | 240 | 50 |
| 355 4-8P (Vertical) | NU322 C3 /7322 | 7322 /6322 | 110 | 240 | 50 |

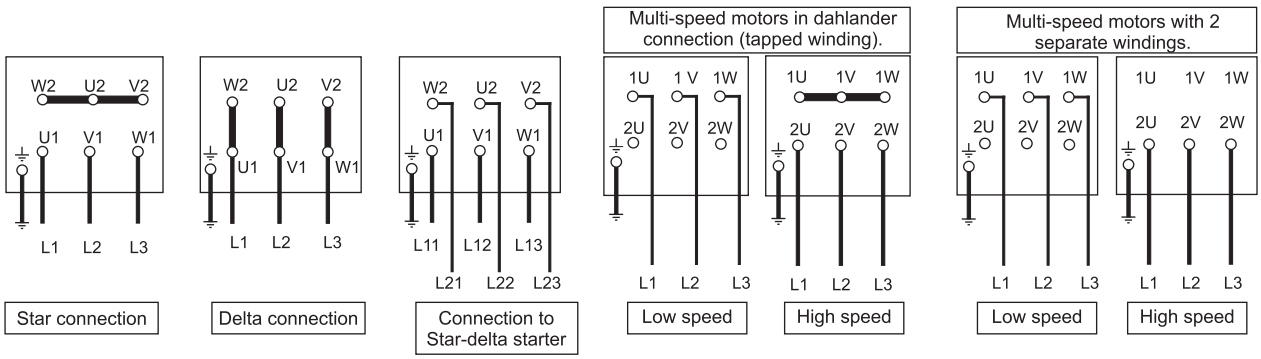
## Bearing and oil seal

Oil seal data
(Option)




| Frame size | DE | | | NDE | | |
|---|---|---|---|---|---|---|
| | d | D | B | d | D | B |
| 80 | 20 | 35 | 7 | 20 | 35 | 7 |
| 90 | 25 | 45 | 7 | 25 | 45 | 7 |
| 100 | 30 | 55 | 10 | 30 | 55 | 10 |
| 112 | 30 | 55 | 10 | 30 | 55 | 10 |
| 132 | 40 | 65 | 10 | 40 | 65 | 10 |
| 160 | 45 | 70 | 10 | 45 | 70 | 10 |
| 180 | 55 | 82 | 10 | 55 | 82 | 10 |
| 200 | 60 | 90 | 11 | 60 | 90 | 11 |
| 225 | 65 | 90 | 12 | 65 | 90 | 12 |
| 250 | 70 | 100 | 10 | 70 | 100 | 10 |
| 280 2P | 70 | 100 | 10 | 70 | 100 | 10 |
| 280 4-8P | 85 | 115 | 12 | 85 | 115 | 12 |
| 315-2P | 80 | 100 | 10 | 80 | 100 | 10 |
| 315 4-8P | 95 | 120 | 12 | 95 | 120 | 12 |
| 355 2P | 95 | 120 | 12 | 95 | 120 | 12 |
| 355 4-8P | 110 | 140 | 14 | 110 | 140 | 14 |

## Connection diagrams three phase motors with cage rotor




# Maintenance Schedule for Motors

| Description | Comments | Maintenance Frequency |
|---|---|---|
| Motor use/sequencing | Turn off or sequence unnecessary motors. | Weekly |
| Overall visual inspection | Verify equipment is operating and safety systems are in place. | Weekly |
| Check bearings and drive belts | Inspect for wear, and adjust, repair, or replace as necessary. | Weekly |
| Motor alignment | Look for rubber or steel savings under couplings, or listen for odd noises, as these may indicate a problem). | Weekly |
| Motor condition | Check condition by analyzing temperature or vibration, and compare to baseline values. | Quarterly (or as needed on weekly inspections) |
| Cleaning | Remove dust and dirt to facilitate cooling. | Quarterly |
| Check lubrication | Ensure bearings are lubricated as recommended by manufacturer. | Annually (or based on run hours) |
| Check mountings | Secure any loose mountings. | Annually |
| Check terminal tightness | Tighten any loose connections. | Annually |
| Check for balanced three-phase power | Troubleshoot unbalanced motor circuit and fix problems if the voltage imbalance exceeds 1%. | Annually |
| Check for over- or under-voltage conditions | Troubleshoot motor circuit and fix problems if the supply voltage differs significantly from rated voltages. | Annually |

## HEAD OFFICE

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