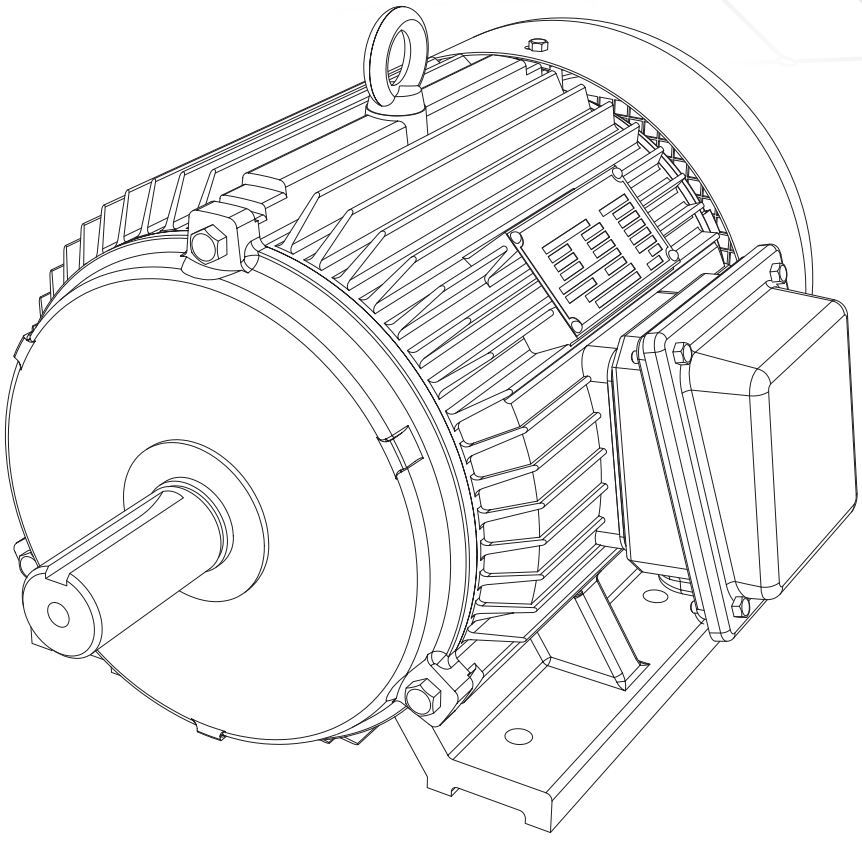
marathon® Motors



HLA SERIES MOTORS

INSTALLATION, OPERATION AND MAINTENANCE INSTRUCTIONS

REGAL®

marathon® Motors

HLA Series Installation, Operation and Maintenance Instructions

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FORM
SB0112E
Revised
April 2018

⚠ WARNING

- Read and follow all instructions carefully.
- Disconnect and lock-out power before installation and maintenance. Working on or near energized equipment can result in severe injury or death.
- Do not operate equipment without guards in place. Exposed equipment can result in severe injury or death.

⚠ CAUTION

- Periodic inspections should be performed. Failure to perform proper maintenance can result in premature product failure and personal injury.

The Regal Australia HLA series motors 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

Regal Australia motors 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 Regal Australia office.

Check the following:

- Rating plate details and enclosure are as 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 clamps and 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 installing 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.

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- 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

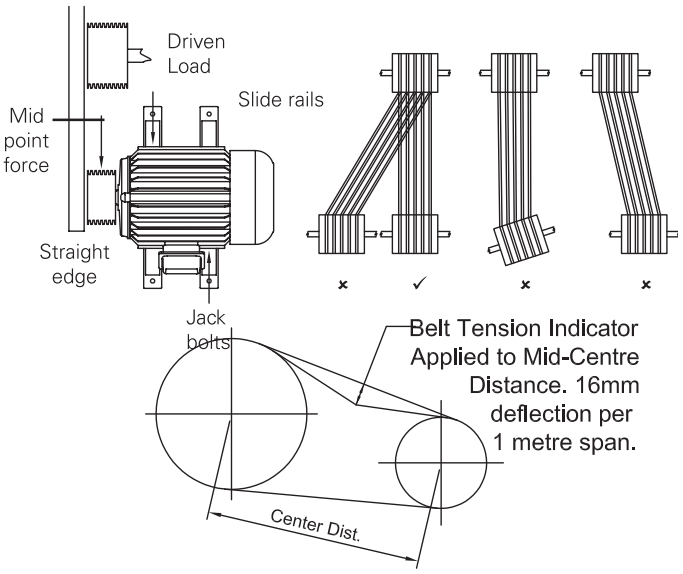
- If the motor is to be coupled to the load using pulleys and belts it is important to ensure that the belt tension does not exceed the safe working radial load of the motor. Excessive radial load will lead to reduced bearing life with the potential of breaking the motor shaft. Because of this care must 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

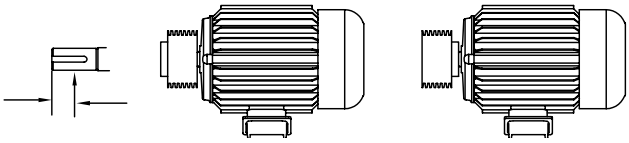
- Great care must be taken in aligning the complete machine, since misalignment can cause rapid deterioration of bearings and lead to other mechanical failures due to the stress produced,
- After final tightening of foundation bolts, machine alignment should be rechecked as bed plates could move and/or 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 onto the shaft. **Impact force must not be used.**



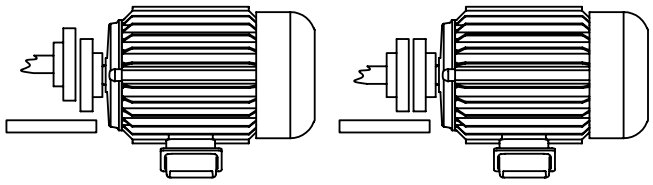
As a general rule the mid point of the applied force should be at the mid point of the shaft and it is good engineering practice to mount the motor pulley with hub and locking screw at the shaft end.



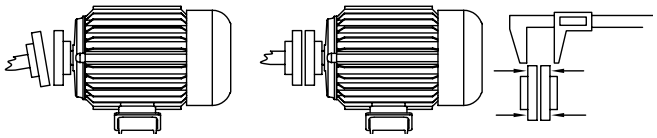
Direct coupled

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.



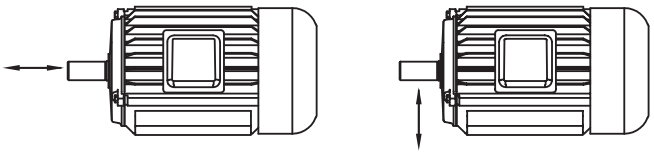
Excessive angular displacement must also be prevented. The recommended method to achieve correct angular alignment is shown below.



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. (Refer to Regal Australia).

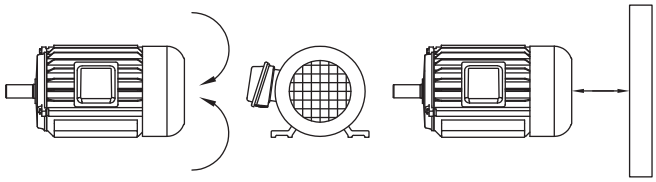


Cooling

There are various cooling formats for electric motors with IC411 (totally enclosed fan cooled) as the most common type that is used on our HGA 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]
80 - 100	15
112 - 132	30
160	40

Cable entries

Cable entries are via appropriate cable glands or conduits fitted to the threaded entries in the wall of the terminal box or the gland plate attached to it. Cable entries for various frame sizes are as per the following table.

Motor frame	No. of entries	Entry size x pitch
80	1	M20 x 1.5
90 - 100	2	M20 x 1.5
132	2	M25 x 1.5
160	2	M32 x 1.5

Cable glands and conduit stops must be of an IP Rating equal to or better than that of main motor as marked on the nameplate.

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]
80 - 132	M5	16
160	M6	50

* 4 or 3 core +E, PVC insulated

Electrical connection

- Ensure all electrical connections are solid and continuous,
- Check motor starter and overloads 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 chatracteristics,
- Supply cables must be appropriately selected considering the voltage drop,
- When using long supply cables with VVVF drive, check with Regal Australia for proper recommendations to avoid high voltage transients occurring at motor terminals,
- Check the connection diagram on 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 enough clearances are provided between supply cable lugs and to earth ,
- Ensure that proper earthing connection is made with all washers as provided,

- If using conduit for the supply leads, ensure the conduit is completely threaded in and seal the threads appropriately,

Initial start up

Prior to initial start-up check the following-

- Insulation resistance of motor winding to earth to be over 1 MΩ for motors up to 600V and over 10 MΩ 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,
- Avoid frequent starting of motor. Refer to motor catalogue or nearest Regal Australia office for recommendation on frequency and duration of starts,
- Check that the running current on no load and full load are reasonably balanced within 10% of the average and 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 fan etc) please refer to your nearest Regal 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 Regal Australia office for advice.

Frame	Starts per hour			
	2 Pole	4 Pole	6 Pole	8 Pole
80	20	40	-	-
90	16	30	40	-
100	16	30	40	40
120	16	30	40	40
132	10	20	25	25
160	10	20	25	25

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
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	D.O.L.	15	15	20	20
160	Star-delta	45	45	60	60

MAINTENANCE

Reliable, trouble free operation of a motor needs regular maintenance. Exact maintenance needs vary based on the site conditions. To obtain reliable service from the motor, the following maintenance schedule may be used as a guide.

A. Ensure air intake space is unobstructed.

B. On a weekly basis use an air hose to ensure all air ways are clear and free of dust.

C. Once every month, check motor for condensation. Replace drain plugs before starting if they are blocked or found missing.

D. Do not wash the motor down unless it is IP66 rated.

E. On a quarterly basis-

i. Check the motor terminals for tightness and proper contact,

ii. If terminal lug/s are discoloured, re-terminate with fresh lugs,

iii. Check operation of starting equipment, ensuring all terminations are tight.

iv. Check mechanical operation of thermal overload relays, if any,

v. Check mechanical operation of thermistor relays, if fitted,

vi. Check operation of anti-condensation heaters, if fitted

F. On a six monthly basis, in addition to the items in 'E'

i. Check winding resistance between supply terminals and compare to original value and enter in log book.

ii. Check supply voltage at motor terminals and record in log book.

iii. Check bearings for abnormal noise/ overheating.

G. On an annual basis, in addition to the items in 'E' and 'F'

i. Completely disassemble stator, rotor apart and clean thoroughly.

ii. Check bearings for wear/damage – replace as necessary.

iii. Check all bolts and nuts for cracks or damage – replace as necessary.

iv. Check all holding down bolts for signs of fatigue or damage – replace as necessary.

v. After re-assembly, check and record in the log book –
Insulation resistance by megger
No load current and voltages
Full load current and voltages
Ensure that these figures compare well with the original records in the log book.

vi. Check and ensure that the cooling fan is operational.

Sealed bearings

The required replacement interval for sealed bearings is generally determined by the grease life which is dependant on operating temperature, operating speed, the limiting speed of the bearing and the type of grease. Under normal operating conditions the following relationship applies:

$$\log t = 6.54 - 2.6\frac{n}{N} - (0.025 - 0.012\frac{n}{N})T$$

Where:

t = Average grease life (hours)

n = Speed (RPM)

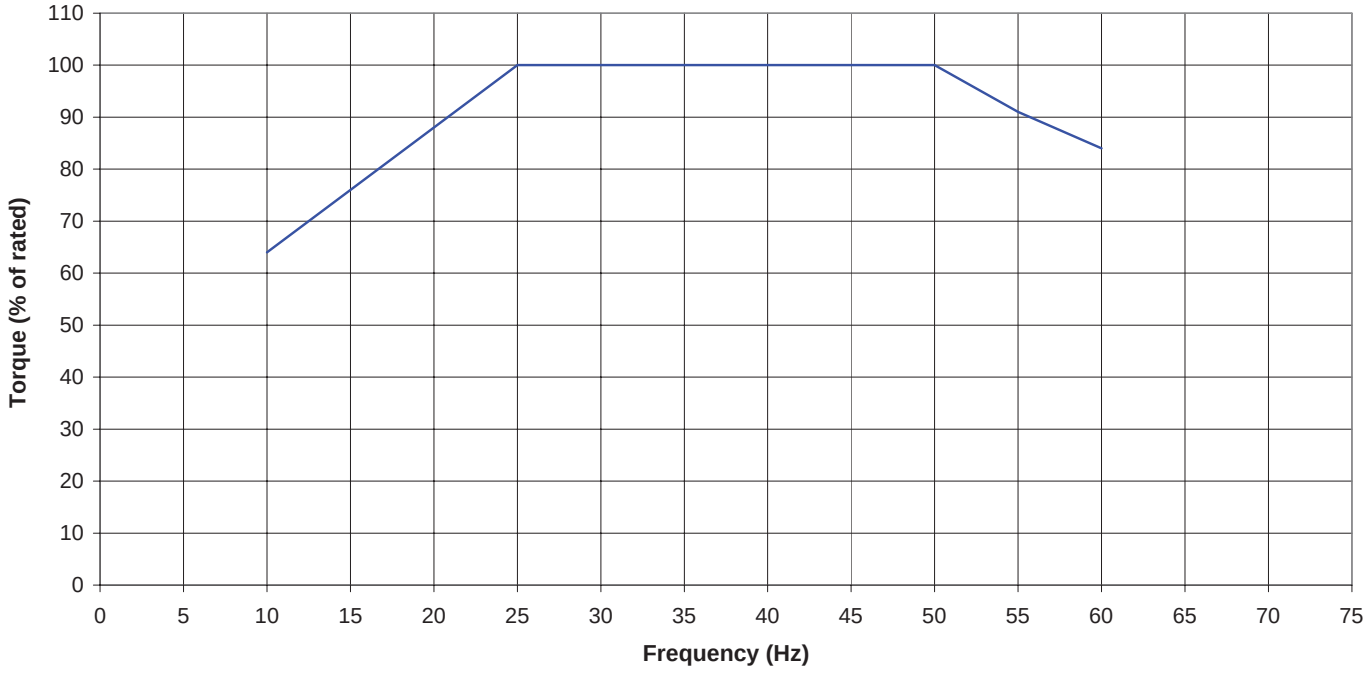
N = Bearing limiting speed with grease lubrication (RPM)

T = Operating temperature (°C)

For further information, please contact your nearest Regal Australia office for advice.

Loadability Curve for VVVF Drive

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



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