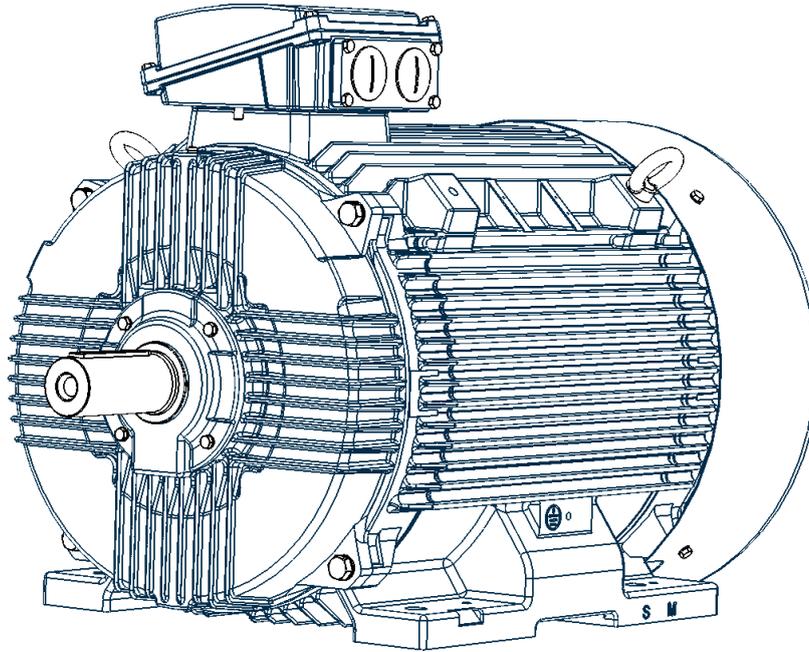


Marathon Motors TerraMAX Series	INSTALLATION, OPERATION & MAINTENANCE INSTRUCTIONS	GES 4.0
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**For Industrial AC Induction Motors
80 – 355 Frames (IEC)**



Regal Beloit America, Inc. 100 E. Randolph Street, Wausau, WI 54401 USA

marathon[®]
Motors

LEESON[®]

cemp[®] **rotor nl**[®]

RegalRexnord

www.regalrexnord.com

TerraMAX Motor Installation, Operation and Maintenance

Product line: SCA / TCA / QCA / TCN / TCT / TCE

The TerraMAX 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 operation throughout the motor life.

Inspection

TerraMAX motors are delivered through safe and reliable transport in appropriate packing to avoid damage during transit. On receipt of the motor thoroughly inspect the unit for any transit damage, if needed be in the presence of an insurance agent. Any equipment damage or shortfall should be immediately advised to the nearest Regal regional 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 energized 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
- 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

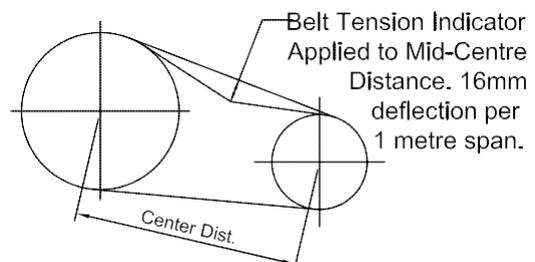
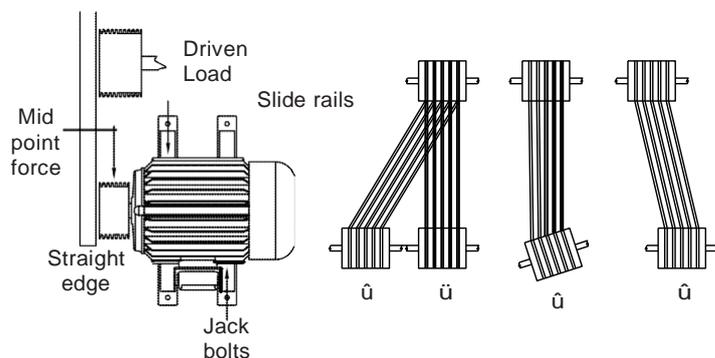
- Great care must be taken in aligning the complete machine, since misalignment can cause rapid deterioration of bearings and lead to other mechanical failures due to the stress produced,
- After final tightening of foundation bolts, machine alignment should be

rechecked as bed plates could move and/or distort during machine mounting,

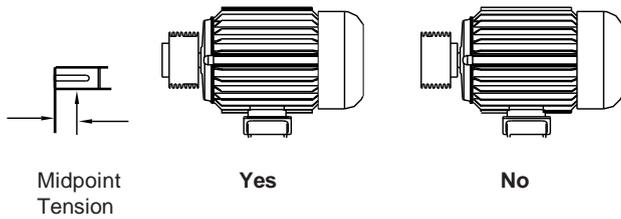
- No end thrust should be applied without express approval
- When slide rails are used in conjunction with pulley drives, the adjusting screw ends should be positioned between the motor and load at drive shaft end and the other diagonally opposite. This helps speedy and accurate belt aligning, tensioning and replacement.

The correct alignment of the motor pulley with the load pulley is imperative. Both these pulleys must have matched center 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.**



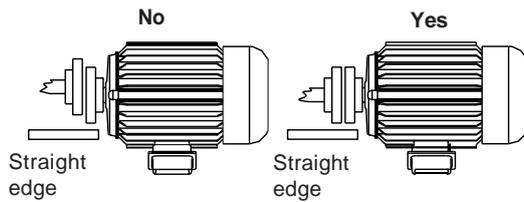
As a general rule the midpoint of the applied force should be at the midpoint of the shaft and it is good engineering practice to mount the motor pulley with hub and locking screw at the shaft end.



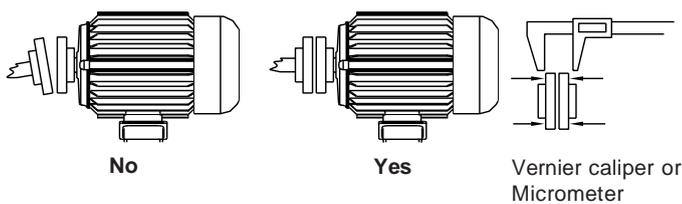
Direct coupled

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.



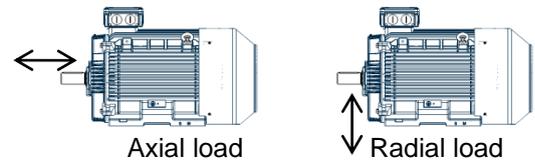
Excessive angular displacement must also be prevented. The recommended method to achieve correct angular alignment is shown below.



Axial load

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.

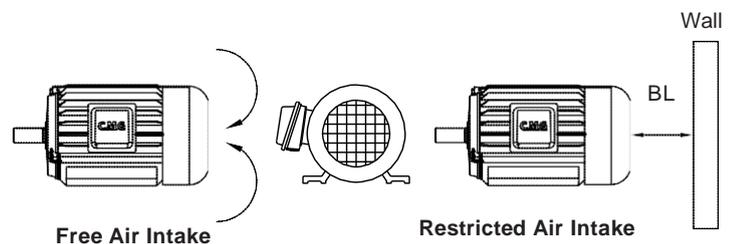
Where higher than recommended axial loads are necessary different bearing types will be required. (Refer to Regal regional location).



There are various cooling formats for electric motors with IC411 (totally enclosed fan cooled) as the most common type that is used on our TerraMAX 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 grill at the rear. Air is drawn in through the grill 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	50
112 - 132	75
160 - 180	125
200 - 280	175
315 - 355	225

Hazardous location motors

Product line: TCN / TCT / TCE

Standard motors in the range of frame sizes 80 to 355 with appropriate modifications are certified for use in hazardous areas as below.

Non-sparking motors / Dust ignition-proof motors

Ex nA, Zone 2, Group II, Temperature class T3, T_{Amb} -20°C TO +50°C,

CE

Ex tc, Zone 22, Group II, Temperature class T135, T_{Amb} -20°C TO +50°C,

CE

Ex ec, Zone 2, Group II, Temperature class T3, T_{Amb} -20°C TO +50°C,

CE

Brand	Marking Code	Certification #	Contact Details
	 II 3 G Ex nA IIC T3 Gc IP55	IECEX UL 17.0014X	Regal Beloit America, Inc. 100 E. Randolph St. Wausau, WI 54401 USA
	 II 3 D Ex tc IIIC T135 Dc IP66	DEMKO 17	
	 II 3 G Ex ec IIC T3 Gc IP55	ATEX 1836X	
	 II 3 G Ex nA IIC T3 Gc IP55	IECEX UL 17.0104X	CEMP S.r.l. Via Piemonte 16-20030 SENAGO (Milan) - ITALY
	 II 3 D Ex tc IIIC T135 Dc IP66	DEMKO 17	
	 II 3 G Ex ec IIC T3 Gc IP55	ATEX 1952X	
	 II 3 G Ex nA IIC T3 Gc IP55	IECEX UL 17.0111X	Regal Beloit Wuxi Co., Ltd. 6 Xiangge Road, Hudai Town, Wuxi City, Jiangsu, China
	 II 3 D Ex tc IIIC T135 Dc IP66	DEMKO 17	
	 II 3 G Ex ec IIC T3 Gc IP55	ATEX 1963X	
	 II 3 G Ex nA IIC T3 Gc IP55	IECEX UL 17.0112X	Regal Beloit Australia Pty Ltd 19 Corporate Avenue, Rowville, VIC 3178 Australia
	 II 3 D Ex tc IIIC T135 Dc IP66	DEMKO 17	
	 II 3 G Ex ec IIC T3 Gc IP55	ATEX 1964X	
	 II 3 G Ex nA IIC T3 Gc IP55	IECEX UL 17.0114X	Regal Beloit New Zealand Ltd 18 Jomac Place, Avondale Auckland, New Zealand
	 II 3 D Ex tc IIIC T135 Dc IP66	DEMKO 17	
	 II 3 G Ex ec IIC T3 Gc IP55	ATEX 1966X	
	 II 3 G Ex nA IIC T3 Gc IP55	IECEX UL 17.0129X	Rotor BV Mors 1-5, 7151 MX, Eibergen, The Netherlands
	 II 3 D Ex tc IIIC T135 Dc IP66	DEMKO 17	
	 II 3 G Ex ec IIC T3 Gc IP55	ATEX 1968X	

Dust Ignition Proof Motors / Increased Safety Motors

Ex tb, Zone 21, Group II, Temperature class T135, T_{Amb} -20°C TO +50°C, 

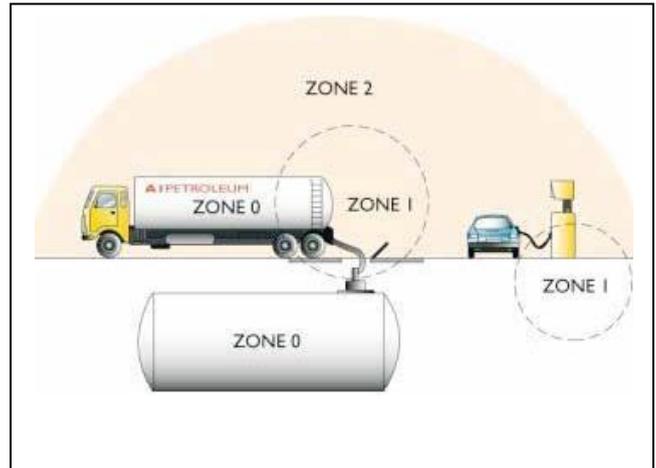
Ex eb, Zone 1, Group II, Temperature Class T3, T_{Amb} -20°C TO +50°C, 

Brand	Marking Code	Certification #	Contact Details
	 II 2 D Ex tb IIIC T135 Db IP66  II 2 G Ex eb IIC T3 Gb IP55	IECEx UL 17.0014X DEMKO 18 ATEX 1982X	Regal Beloit America, Inc. 100 E. Randolph St. Wausau, WI 54401 USA
	 II 2 D Ex tb IIIC T135 Db IP66  II 2 G Ex eb IIC T3 Gb IP55	IECEx UL 17.0104X DEMKO 18 ATEX 2068X	CEMP S.r.l. Via Piemonte 16-20030 SENAGO (Milan) - ITALY
	 II 2 D Ex tb IIIC T135 Db IP66  II 2 G Ex eb IIC T3 Gb IP55	IECEx UL 17.0111X DEMKO 18 ATEX 2073X	Regal Beloit Wuxi Co., Ltd. 6 Xiangge Road, Hudai Town, Wuxi City, Jiangsu, China
	 II 2 D Ex tb IIIC T135 Db IP66  II 2 G Ex eb IIC T3 Gb IP55	IECEx UL 17.0112X DEMKO 18 ATEX 2069X	Regal Beloit Australia Pty Ltd 19 Corporate Avenue, Rowville, VIC 3178 Australia
	 II 2 D Ex tb IIIC T135 Db IP66  II 2 G Ex eb IIC T3 Gb IP55	IECEx UL 17.0114X DEMKO 18 ATEX 2071X	Regal Beloit New Zealand Ltd 18 Jomac Place, Avondale Auckland, New Zealand
	 II 2 D Ex tb IIIC T135 Db IP66  II 2 G Ex eb IIC T3 Gb IP55	IECEx UL 17.0129X DEMKO 18 ATEX 2074X	Rotor BV Mors 1-5, 7151 MX, Eibergen, The Netherlands

Classification of zone, group and temperature category are in accordance with the standards applied in the certificates. A detail explanation of these is available in the product catalogue.

The hazardous location motor nameplates also carry the certification number in addition to the marking codes for the specific protection levels. Details of the standards to which these are certified are available on the actual certificates, copies of which can be accessed from the website or obtained from the nearest Regal regional office.

NOTE: Only motors that carry nameplates indicating Ex nA / Ex t / Ex e can be used in hazardous locations. Check nameplate before installing motors in hazardous locations.



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	Reference drawing for Ex motors
80 - 132	2	M20x1.5-6H (or) M25 x 1.5-6H	TCA0811TB1 TCA13TB1
160 - 180	2	M25 x 1.5-6H (or) M32 x 1.5-6H (or) M40 x 1.5-6H	TCA1618TB1
200 - 280	2	M32 x 1.5-6H (or) M40 x 1.5-6H (or) M50 x 1.5-6H	TCA2022TB1 TCA2528TB1
315	2	M63x1.5-6H	TCA31TB1
355	4	M63x1.5-6H	TCA35TB1

Cable glands used by installer on hazardous location motors must be of IECEx or ATEX certified type as appropriate to the installation requirements. Unused cable entries must be blanked off by installer using IECEx or ATEX certified conduit stops as appropriate.

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.

Vibration sensors and shaft encoders when fitted by the installer are to be appropriately certified by IECEx or ATEX for the same zone protection method(s) and temperature code.

Supply terminals

Supply terminals are located in 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	*Tightening torque- Zn Plated Nm	*Tightening torque- Steel Brass Nm
80 - 132	M5	4	3.2
160 - 180	M6	6	5
200 - 225	M8	12	10
250 - 280	M10	20	16
315	M12	31	25
355	M16		

Above mentioned Tightening Torque is nominal Torque

Terminal Hardware has to be mounted in the following sequence:

- Zn plated steel plain washer
- Motor Terminal Lug
- Ni plated Cu plain washer
- Ni plated Cu hex hd nut
- Connecting plate
- Ni plated Cu plain washer
- Zn plated steel spring washer
- Zn plated steel hex hd nut

Electrical connection

TerraMAX motors are provided with two earthing bolts, one inside the terminal box and other on the motor frame. Depending on the cross-section of the line conductor, the earthing conductor cross-section must be.

LINE CONDUCTOR CROSS-SECTION	EARTH CONDUCTOR CROSS-SECTION
≤ to 25mm ²	Same Section
Between 25mm ² and 50mm ²	25mm ²
> 50mm ²	≥ 50% of the section

- Ensure all electrical connections are solid and continuous
- Check motor starter and overloads for correct rating and trip setting
- All circuit breakers, HRC fuses/ protective devices associated with the motor must be rated to suit motor running current & starting characteristics
- Supply cables must be appropriately selected considering the voltage drop,
- When using long supply cables with Adjustable Speed Drive, check with Regal regional 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 & to earth especially so in case of hazardous location motors
- Ensure that proper earth 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
- 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
- The stator RTDs and thermistors can be connected via a standard industrial controller provided that the controller is located in a safe area

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
- All hazardous area motors must be protected against overload, short circuits, earth faults and locked rotor conditions, see IEC 60079-14. Maximum tripping time of the protective devices must not be longer than the 'tE' time, as shown on the motor nameplate, for Ex eb motors. 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
- Hazardous location motors supplied by an Adjustable Speed Drive must have the thermal protection devices connected into the motor control circuit in such a manner as to disconnect the source of supply in the event of an over temperature thus preventing the nominated temperature class being exceeded
- 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 energizing 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
- If an earthing ring and earth brush are provided, make sure that the earthing ring is clean and the earth brush makes a good contact with the earthing ring. This applies for the Safe Area motors
- 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 40°C or nameplate specification
- Avoid frequent starting of motor. Refer to motor catalogue or nearest Regal regional office for recommendation on frequency and duration of starts
- If an Adjustable Speed Drive is used on Ex nA motor, follow the instructions on additional nameplate for converter supply in respect to applied load and frequency
- 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
- Brake motors used in hazardous locations must have a limited number

of repeat stops to 20 per hour

Maintenance

Reliable, trouble free operation of a motor needs regular maintenance. Exact maintenance needs are based on the site conditions. To obtain reliable service from the motor, the following maintenance schedule may be used as a guide. An authorized service agent must carry out maintenance of hazardous location motors. Clean the surface of the motor with a damp cloth to minimize the risk of electrostatic discharge

- 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 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 discolored, re-terminate with fresh lugs
 - (iii) Check operation of starting equipment, ensuring all terminations are tight
 - (iv) Check mechanical operation of thermal overload if any.
 - (v) Check mechanical operation of thermistor relays, if fitted
 - (vi) Check operation of anti-condensation heaters, if fitted
 - (vii) Check the earth ring and earth brush Length, if fitted. (For Safe Area Motors)
- 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 bearing for abnormal noise/overheating

- G. On an annual basis, in addition to the items in 'E' and 'F' -
- (i) Re-grease the bearings as recommended under Lubrication & Bearings.
 - (ii) Completely disassemble stator, rotor apart and clean thoroughly.
 - (iii) Check bearings for wear/damage – replace as necessary.
 - (iv) Check all bolts and nuts for cracks or damage – replace as necessary.
 - (v) Check all holding down bolts for signs of fatigue or damage – replace as necessary.
 - (vi) 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 records in the log book.
 - (vii) Check and ensure that the cooling fan is operational.

Lubrication & Bearings

Sealed bearings

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

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

where,

t = Average grease life(hours)

N = Bearing limiting speed with grease lubrication (RPM)

T= Operating temperature (°C)

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

Open (re-greaseable) bearings

It should be noted that for motors fitted with Ball and Roller bearings, the lubrication intervals for both bearings should be based on the roller bearing data.

The re-lubrication intervals recommended are calculated on the basis of normal working conditions.

Note: Under hazardous conditions please contact Regal regional or the bearing manufacturers catalogue. Air operated grease guns should not be used.

Replenishment of grease media should be by means of a hand-held grease gun while motor is running with relief plate removed.

The lubricating ability of grease (over time) depends primarily on the type of grease, the size of the bearing, the speed at which the bearing operates and the severity of the operating conditions. Longer bearing life can be obtained if the listed recommendations are followed:

NOTE: If lubrication instructions are provided on the motor nameplate, the nameplate instructions will supersede these instructions. Motors marked "Permanently Lubricated" do not require additional service.

CAUTION: BEARING/MOTOR DAMAGE WARNING

Lubricant should be added at a steady, moderate pressure. If added under heavy pressure, bearing shield(s) may collapse. Over greasing bearings greatly increases bearing friction and can cause premature bearing and/or motor failure.

GREASE TYPE (unless nameplate states otherwise):

Use lithium-based grease such as Mobil Polyrex-EM or equivalent unless otherwise specified. Motors requiring extra high temperature for use in ambient temperatures, use grease such as Magnalube G or equivalent.

When re-greasing bearings ensure that the correct type of grease is used. If in doubt about the existing grease type, clean out the old grease thoroughly from bearings and bearing housing, prior to re-greasing

WARNING:

NEVER MIX GREASE OF DIFFERENT TYPES

LUBRICATION PROCEDURE:

NOTE: Frames 80 through 180 use sealed bearings and are not re-greaseable.

Frames 200 through 355 use open re-greaseable bearings.

CAUTION: BEARING DAMAGE

WARNING

Added grease must be compatible with the original equipment's grease. If a grease other than those stated herein is to be used, contact the motor manufacturer. Nameplate information supersedes grease type referenced in this section. New grease must be free of dirt. Failure to follow these instructions and procedures may result in bearing and/or motor damage. For an extremely dirty environment, contact the motor manufacturer for additional information.

Step 1: Clean the grease inlet and drain plugs prior to re-greasing.

Step 2: Remove grease inlet and drain plugs

Step 3: Add grease per below Table.

Step 4: Re-install grease inlet and drain plugs and ensure plugs have at least 5 full threads of engagement with motor.

CAUTION: GREASE DRAIN PLUGGED

Old grease may completely block the drain opening and must be mechanically removed prior to re-greasing. Forcing a blocked drain open by increased greasing pressure may collapse bearing shields and/or force excess grease through the bearings and into the motor.

Recommended Grease Replenishment Intervals (Hours) ¹⁾

Bearing number ⁽²⁾	Bearing bore [mm]	Grease Qty [g]	3000 r/min		1500 r/min		1000 r/min		750 r/min	
			Ball	Roller	Ball	Roller	Ball	Roller	Ball	Roller
6312/NU312	60	22	3000	1500	9000	4500	12000	6000	12000	6000
6313/NU313	65	24	2000	1000	8000	4000	10000	5000	10000	5000
6314/NU314	70	26	1500	750	4000	2000	7000	3500	7000	3500
6316/NU316	80	38	1000	500	-	-	-	-	-	-
6317/NU317	85	38	1000	500	4000	2000	7000	3500	7000	3500
6319/NU319	90	45	-	-	3000	1500	5000	2500	5000	2500
6322/NU322	95	60	-	-	3000	1500	5000	2500	5000	2500

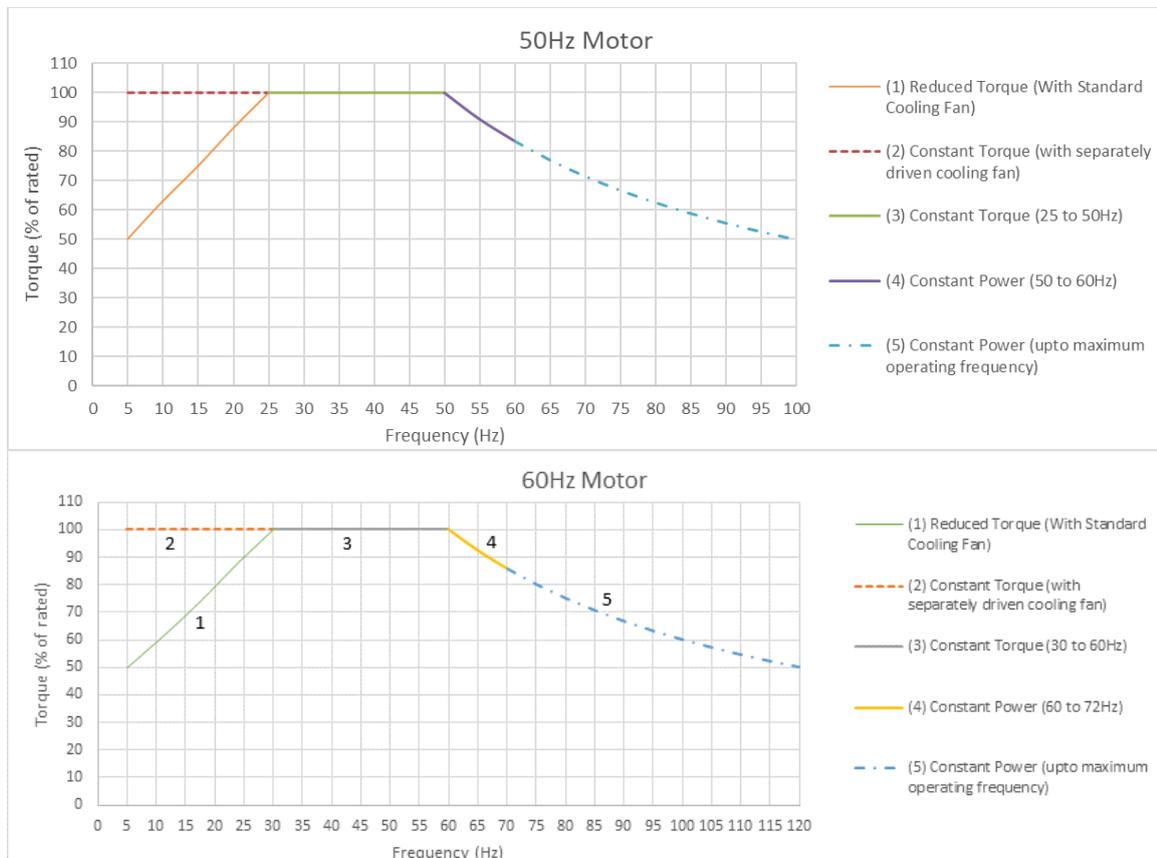
¹⁾ Based on maximum grease service life of 20,000 hours ²⁾ Refer to motor nameplate to confirm bearing size.

Motors – PWM Drives

The TerraMAX motor performs excellently without cogging at low speeds when operating in conjunction with a PWM (Pulse-Width Modulated) type Variable Frequency Drive (frequency converter).

If motor is to be used with a frequency converter, only a PWM type shall be used.

The graph below shows the TerraMAX motor's loadability with a frequency converter.



Refer to motor nameplate data for suitability on VFD supply, speed & torque range.
Regal recommends use of dv/dt or sinusoidal filters when motors are operated on a VFD.