Shop "Tech Talk" June 2008

WOW!
If you want to see what happens when you over grease a 100 HP electric motor, study these photos below.

Above and below we see what happened at the motor shaft end of the motor. Much too much grease here. Led to motor winding shorting out.

Here we see what happened at the opposite end of the motor. No grease here on winding, same with rotor

Shown on the left is the plastic plug covering the grease fitting, on the right is our mod to show the grease fitting. The original grease fitting was about 2" below the fan cover plug, we extended it out to be flush.

The question that is raised by the above pictures is 'How much grease and how often should we grease elctric motor bearings? . To answer this question we have compiled some great information on the next few pages.

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Considerations in Greasing Electric Motor Anti-Friction Bearings

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Introduction

One of the most important components of any electro-mechanical maintenance program is the lubrication of bearings. Yet, this vital aspect of preventive maintenance remains one of the least understood functions of maintenance. There is constant debate concerning whether a bearing should be 'flushed,' a limited amount of grease added, how often or if the motor should be operating or tagged-out. Many motor manufactures outline the preferred, and safest, method for lubricating electric motor bearings. There are specific physical properties for this process in the motor bearing housing and in order to protect motor windings from contamination.

Table 1: Amount of Grease to Use

Bearing Number	Amount in Cubic Inches	Approximate Equivalent Teaspoons
203	0.15	0.5
205	0.27	0.9
206	0.34	1.1
207	0.43	1.4
208	0.52	1.7
209	0.61	2
210	0.72	2.4
212	0.95	3.1
213	1.07	3.6
216	1.49	4.9
219	2.8	7.2
222	3	10
307	0.53	1.8
308	0.66	2.2
309	0.81	2.7
310	0.97	3.2
311	1.14	3.8
312	1.33	4.4

The general procedure for greasing is as follows:

1. Lock and tag out the electric motor
2. Wipe grease from the pressure fitting, clean dirt, debris and paint around the grease relief plug. This prevents foreign objects from entering the grease cavity.

3. Remove the grease relief plug and insert a brush into the grease relief as possible. This will remove any hardened grease. Remove the brush and wipe off any grease.
4. Add grease per Table 1.
5. Allow the motor to operate for approximately 30 to 40 minutes before replacing the grease relief plug. This reduces the chance that bearing housing pressure will develop.

Bearings should be lubricated at an average frequency as found in Table 2. Operational environment and type of grease may require more frequent lubrication.

Table 2: Bearing Lubrication Frequency

Motor RPM	Motor Frame	8 hours per day	24 hours per day
3600	284T-286T	6 months	2 months
	324T-587U	4 months	2 months
1800	284T-326T	4 years	18 months
	364T-365T	1 year	4 months
	404T-449T	9 months	3 months
	505U-587U	6 months	2 months
1200 and below	284T-326T	4 years	18 months
	364T-449T	1 years	4 months
	505U-587U	9 months	3 months

One concept that has been presented is that grease will eventually fill the bearing housing, causing the same problem as an overgreased bearing. We will be addressing this particular issue, as well as a discussion of why the motor should be de-energized during greasing, through this paper. We are limiting this paper to a standard deep-groove ball bearing without shields or seals.

How a Bearing Works

The most common type of bearing is the AFBMA-7 C-3 rated bearing. C-3 relates to the internal clearances of the surfaces of the bearing. In most motor rated bearings, there is a clearance of between 3-5 mils (thousandths of an inch) in which lubrication flows to reduce friction and wear of the machined surfaces. The bearing, itself, consists of an inner race, an outer race, balls and a cage which evenly distributes the balls. Common bearings are designed to allow for a radial load with some limited axial loading. ALL BEARINGS ARE LUBRICATED WITH OIL.

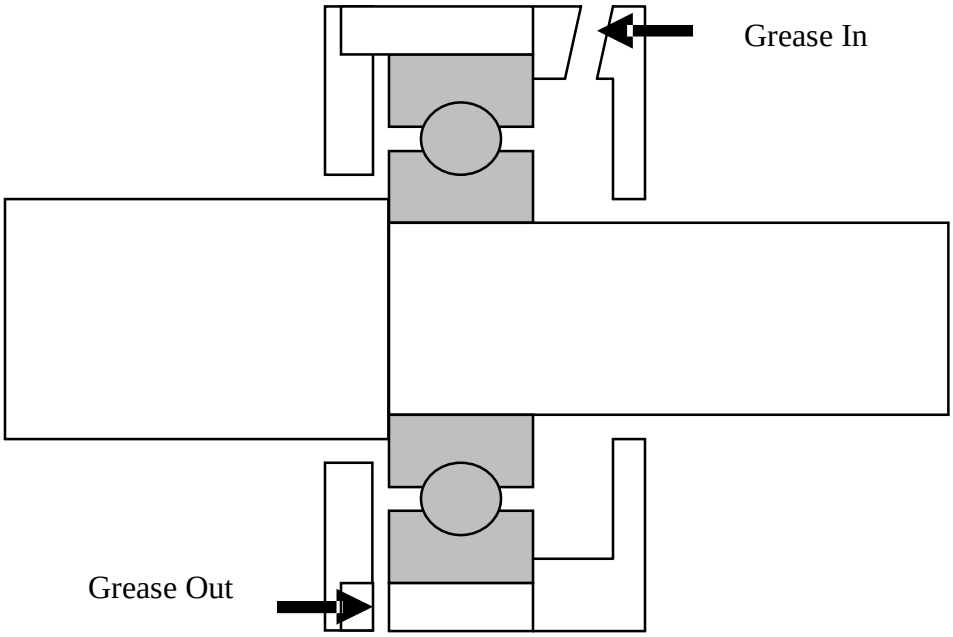
Grease, itself, is an oil sponge. The base (spongy) part of the grease varies depending on the manufacturer, temperature, environment and user preference. The grease holds the oil in suspension and allows the oil to flow during operation. The oil compresses between the bearing balls, inner and outer races and the cage, reducing friction. Ball bearings have small, microscopically rough surfaces on the balls, these surfaces move the oil, holding it to the ball during operation.

When too much grease is added, the grease is compressed between the bearing surfaces, increasing pressure and resulting with heat. Too little grease causes the surface friction to increase, resulting with heat. In any case, once bearing noise is audible, it has failed. Reducing noise by lubrication requires excessive grease, endangering the motor, and giving the technician

the false security of extending the motor life when, in reality, additional damage is occurring to machined surfaces.

Bearings may also have shields or seals mounted on them. Bearing shields are metal fittings that have small clearances between the inner race of the bearing and contact the outer race on either side of the balls and cage. The small clearances near the inner race allows some oil and grease to move into the moving parts of the bearing, but prevents particles of large size from passing into the bearing potentially damaging machined surfaces. Sealed bearings have seal surfaces touching the inner race, while 'non-contact' sealed bearings have extremely close tolerances between the seal surface and the inner race preventing particles under several thousandths of an inch. Sealed, and some shielded, bearings are referred to as non-grease able bearings.

Figure 1: Bearing Greasing



What Happens When The Bearing Is Greased With The Motor Running?

Oil is an 'incompressible' fluid, which is important when considering the developing issues within the bearing housing (Figure 1) while greasing an operating motor. The 'soap,' or grease medium, acts as a suspension in the oil, although grease is normally represented as a base with an oil suspension. This becomes an important issue in the physical world of hydrodynamics.

With the bearing housing partially filled with grease, grease is added to the housing. Some of the grease flows through the operating surfaces of the bearing, causing stress. The reduction of clearances causes an increase in friction within the bearings. This will cause the bearing temperature to increase as the bearing surfaces reject the grease medium. Once the temperature drops, the grease is no longer within the bearing surfaces and oil from the grease provides lubrication. The increase in temperature causes a reduction in grease viscosity, allowing it to

flow freely, albeit slowly, and excess grease is rejected through the grease plug (grease out). The change in viscosity ensures that enough flow should occur, when the grease plug is removed, and the maintainer does not count on 'grease relief plugs,' the housing should remain less than full, regardless of the number of greasing operations.

Grease that comes into contact with the shaft, bearing cap opening or housing opening (usually less than 0.010 inches) becomes pumped through the openings due to Couetti Flow. This process is the result of a turning cylinder (motor shaft) with a close, stationary, cyclinder (shaft openings) and an incompressible fluid. The excess grease is literally pumped into the motor housing.

What Happens When The Motor Is Not Running?

In the type of bearing that we are discussing, the grease enters the bearing housing. Some grease comes into contact with the bearing surfaces. When the motor is restarted, this excess grease is ejected from the bearing. The temperature may briefly rise, then fall, once grease has passed through the bearing. The shear stresses and temperature reduce the viscosity of the grease, allowing it to flow.

While some grease is moved into the motor housing, due to Couetti Flow, the amount is considerably less than if the motor is operating.

Conclusion

Electric motor bearing greasing requires the motor to be de-energized during the procedure. The result is reduced risk of excess grease entering the electric motor stator, due to Couetti Flow, and reduced viscosity, due to heat. Combined with safety issues, proper lubrication can maintain the electric motor reliability. Therefore, a limited amount of grease should be added to the bearing housing periodically with the grease plug removed.

About the Author

Dr. Penrose joined T-Solutions, Inc. in January of 2005, and became the Executive Director and a founder of the Institute of Electrical Motor Diagnostics, following over twenty years in the electrical equipment repair, field service and research and development fields. Starting as an electric motor repair journeyman in the US Navy, Dr. Penrose lead and developed motor system maintenance and management programs within industry for service companies, the US Department of Energy, utilities, states, military, and many others. Most recently he led the development of Motor Diagnostic technologies within industry as the General Manager of the leading manufacturer of Motor Circuit Analysis and Electrical Signature Analysis instruments and training. Dr. Penrose taught engineering at the University of Illinois at Chicago as an Adjunct Professor of Mechanical and Industrial Engineering as well as serving as a Senior Research Engineer at the UIC Energy Resources Center performing energy, reliability, waste stream and production industrial surveys. Dr Penrose has coordinated US DOE and Utility projects including the industry-funded modifications to the US Department of Energy's MotorMaster Plus software in 2000 and the development of the Pacific Gas and Electric Motor

System Performance Analysis Tool (PAT) project. Dr. Penrose is a Past Vice-Chair of the Connecticut Section IEEE (Institute of Electrical and Electronics Engineers), a Past-Chair of the Chicago Section IEEE, Past Chair of the Chicago Section Chapters of the Dielectric and Electrical Insulation Society and Power Electronics Society of IEEE, is a member of the Vibration Institute, Electrical Manufacturing and Coil Winding Association, the International Maintenance Institute, NETA and MENSA. He has numerous articles, books and professional papers published in a number of industrial topics and is a US Department of Energy (US DOE) MotorMaster Certified Professional, a US DOE Pump System Specialist, NAVSEA RCM Level 2 certified, as well as a trained vibration analyst, infrared analyst and motor circuit analyst.

US Motors

Table 2
RECOMMENDED GREASES

ENGLISH

THE FOLLOWING GREASES ARE INTERCHANGEABLE WITH THE GREASE AS PROVIDED IN UNITS SUPPLIED FROM FACTORY (UNLESS STATED OTHERWISE ON A LUBRICATION NAMEPLATE PROVIDED ON MOTOR).

MANUFACTURER	GREASE (NLGI No. 2)
EXXON CORP.	POLYREX - EM
CHEVRON U.S.A. INC.	SRI NO. 2

⚠ CAUTION ***Greases of different bases (lithium, polyurea, clay, etc.) may not be compatible when mixed. Mixing such greases can result in reduced lubricant life and premature bearing failure. When necessary, prevent such intermixing by disassembling the motor, removing all old grease from bearings and housings (including all grease fill and drain holes). Inspect and replace damaged bearings. Fill bearing housings and bearing approximately 30% full of new grease. Remove any excess grease extending beyond the edges of the bearing races and retainers. Refer to Table 2 for recommended greases.***

WARRANTY

LIMITED WARRANTY

All U.S.E.M. products are warranted against defects in workmanship and materials for 12 months from date of installation, not to exceed 18 months from date of shipment from EMC. Some of U.S.E.M's products carry a warranty period longer than 12 months. Please refer to the current price catalog or to EMC for details on specific products. This limited warranty does not apply to any product which has been subject to misuse, misapplication, neglect (including without limitation, inadequate maintenance), accident, improper installation, modification, adjustment, or repair. This constitutes EMC's only warranty in connection with this sale and is in lieu of all other warranties, expressed or implied, written or oral. THERE ARE NO IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE THAT APPLY TO THIS SALE. No employee, agent, dealer or other person is authorized to give any warranties on behalf of EMC nor to assume for EMC any other liability in connection with any of its products.

EXCLUSIVE REMEDY

EMC's liability shall be limited exclusively to repairing or replacing any product found by EMC to be defective, or at EMC's option, to refund the purchase price of its product. Such product shall be returned, freight prepaid, to the nearest U.S.E.M. authorized service station or EMC factory. It is agreed that such replacement, repair, or refund be the sole and exclusive remedies available from EMC. EMC shall not be liable for damages of any sort whatsoever beyond these exclusive remedies including incidental and consequential damages regardless of whether any claim is based upon contract, negligence, strict liability, tort, warranty, or other basis. The repair or replacement of the product, or the refund of the purchase price, at EMC's option, constitutes fulfillment of all liabilities of EMC to the buyer for defective products.

RENEWAL PARTS AND WARRANTY SERVICE

When inquiring for renewal parts, call the nearest U.S. Electrical Motors Parts Stocking Distributor. For warranty service, call the nearest U.S. Electrical Motors Authorized Service Station. Give them complete Nameplate data, including identification number, etc.

Request installation and maintenance manuals by product name.

4.2 MAINTENANCE

A well-designed maintenance program for electric motors, when correctly used, can be summed up as: periodical inspection of insulation levels, temperature rise, wear, bearing lubrication at the occasional checking of fan air flow.
Inspection cycles depend upon the type of motor and the conditions under which it operates.

4.2.1 CLEANLINESS

Motors should be kept clean, free of dust, debris and oil. Soft brushes or clean cotton rags should be used for cleaning. A jet of compressed air should be used to remove non-abrasive dust from the fan cover and any accumulated grime from the fan and cooling fins.
Terminal boxes fitted to motors with IP-55 protection should be cleaned; their terminals should be free of oxidation, in perfect mechanical condition, and all unused space dust-free.
Motors with IP(W) 55 protection are recommended for use under unfavourable ambient conditions.

4.2.2 LUBRICATION

Motors made up to frame 160 are not fitted with grease fitting, while larger frames up to frame 200 this device is optional.
For frame 225 to 355 grease fitting is supplied as standard.
Proper Lubrication extends bearing life.
Lubrication Maintenance Includes:

a) Attention to the overall state of the bearings;
b) Cleaning and lubrication;
c) Careful inspection of the bearings.

Bearing temperature control is also part of routine maintenance.
The temperature of bearings lubricated with suitable grease as recommended under item 4.2.2 should not exceed 70°C.
Constant temperature control is possible with the aid of external thermometers or by embedded thermal elements. WEG motors are normally equipped with grease lubricated ball or roller bearings.
Bearings should be lubricated to avoid the metallic contact of the moving parts, and also for protection against corrosion and wear.
Lubricant properties deteriorate in the course of time and mechanical operation and, furthermore, all lubricants are subject to contamination under working conditions.
For this reason, lubricants must be renewed and any lubricant consumed needs replacing from time to time.

4.2.2.1 LUBRICATION INTERVALS

To apply correct amount of grease is an important aspect for a good lubrication.
Relubrication must be made based on the relubrication intervals Table. However, when a motor is fitted with a lubrication instructions plate, these instructions must be followed.
For an efficient initial bearing lubrication, the motor manual or the Lubrication Table must be followed. If this information is not available, the bearing must be greased up to its half (only the empty space between the moving parts).
When performing these tasks, care and cleanliness are recommended in order to avoid penetration of dust into the bearings.

4.2.2.2 QUALITY AND QUANTITY OF GREASE

Correct lubrication is important!
Grease must be applied correctly and in sufficient quantity as both insufficient or excessive greasing are harmful.
Excessive greasing causes overheating brought about by the greater resistance caused on the rotating parts and, in particular, by the compacting of the lubricant and its eventual loss of lubricating qualities.
This can cause seepage with the grease penetrating the motor and dripping on the coils or other motor components.
A lithium based grease is commonly used for the lubrication of electric motor bearings as it has good mechanical stability, insoluble in water.

Greases for standard motors

Type	Supplier	Frame
Polyrex®EM	Esso	63 to 355M/L

This grease should never be mixed with different base greases.
More details about the greases mentioned above can be obtained at an authorized service agent or you can contact WEG directly.
For special greases, please contact WEG.

4.2.3. LUBRICATION INSTRUCTIONS

- Inject about half the estimated amount of grease and run the motor at full speed for approximately a minute; switch off the motor and inject the remaining grease.
The injection of all the grease with the motor at rest could cause penetration of a portion of the lubricant through the internal seal of the bearing case and hence into the motor.
Nipples must be clean prior to introduction of grease to avoid entry of any alien bodies into the bearing.
For lubricating, use only a manual grease gun.

BEARING LUBRICATION STEPS

1. Clean the area around the grease nipples with clean cotton fabric.
2. With the motor running, add grease with a manual grease gun until the quantity of grease recommended in Tables 9 or 10 has been applied.
3. Allow the motor to run long enough to eject all excess of grease.

4.2.4 - REPLACEMENT OF BEARINGS

The opening of a motor to replace a bearing should only be carried out by qualified personnel.
Damage to the core after the removal of the bearing cover is avoided by filling the gap between the rotor and the stator with stiff paper of a proper thickness.
Providing suitable tooling is employed, disassembly of a bearing is not difficult (Bearing Extractor).
The extractor grips should be applied to the sidewall of the inner ring to the stripped, or to an adjacent part.

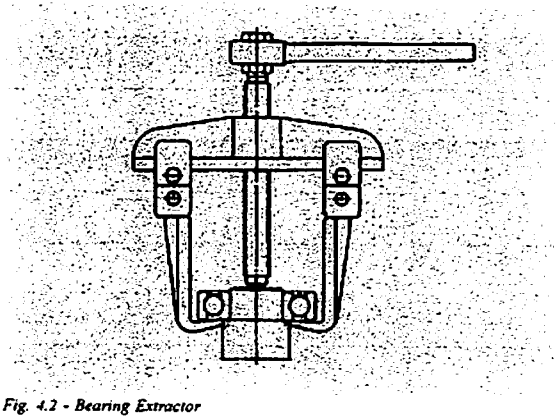


Fig. 4.2 - Bearing Extractor

To ensure perfect functioning and no injury to the bearing parts, it is essential that the assembly be undertaken under conditions of

To avoid failures due to vibration, a few simple checks should be made regularly:

1. Check misalignment which may be caused by foundation settling.

2. Check to see if any pump vibration is being transmitted to the motor.

3. Check the motor mounting bolts and bracket holes to be sure they are tight.

4. Check transmission from adjacent machinery or to flexible motor support structure, as well as by motor unbalance itself.

> ***NOTE: If vibration of 0.005" (0.127mm) or more is experienced under running conditions after above checks have been made, then it is highly probable there is some resonance in the system.***

G. Coils

Revarnishing the windings when motors are overhauled will lengthen their life.

H. Guide Bearing

The guide bearings are vacuum degaussed, single row width Conrad type greasable ball bearings.

> ***Caution: The thrust capacity of these bearings vary with supplier and care should be taken to ensure that replacement bearings are equivalent to the original.***

I. Coupling Maintenance

The condition of non-reverse couplings should be checked periodically by removing the top cap. If dirt has caused the action of the pins or balls to become sluggish, the pin or ball carrier should be removed, disassembled and thoroughly cleaned with a suitable solvent. The parts should then be dried and reassembled in accordance with the instructions given under **NON-REVERSE COUPLINGS.**

Sometimes, after a long period of operation with frequent stops and starts, the surface of the holes in the pin or ball carrier becomes polished, so that friction forces will no longer hold the pins or balls clear of the ratchet teeth when the motor is running. This condition can be remedied by roughening these surfaces with a piece of emery paper wrapped around a rod.

> ***NOTE: Whenever the dismantling of couplings is necessary, the use of witness marks will assure a balanced condition when reassembly is complete.***

Bolts on both bolted couplings and non-reverse couplings should be checked periodically to be sure they are tight. See **RECOMMENDED TIGHTENING TORQUES.**

V. LUBRICATION

A. Frequency of Regreasing

The following table suggests relubrication intervals for motors on normal, steady running, in a relatively clean atmosphere at 40°C ambient (104°F) temperature or less.

Table 1
Relubrication Intervals

Enclosure	Insulation	210-320 Frame	360-440 Frame
WP-I	F	1 year	9 months
Enclosed Fan Cooled	F	9 months	6 months

> ***NOTE: For motors over 1800 RPM or extra severe duty, dusty locations, use 1/2 of the period specified in the table.***

B. Type of Grease

For maximum bearing life, use only the grease recommended by GE. Some equivalent greases are:

For Class F insulated motors:

Polyrex EM – Exxon

Chevron BRB-2 – Standard Oil of California

AeroShell #5 – Shell Oil Company,
Hi Temp-Texaco, Inc.

Alvania #3

C. Procedure for Regreasing

When regreasing, stop the motor, remove the grease outlet plug and add grease with a hand-lever operated gun only.

Add only the amount of grease specified in **Table 2.**

Run the motor for about ten minutes before replacing the outlet plug.

Table 2
Reference Table for
Guide Thrust Bearings

Shaft Diameter (at face of bracket)	Amount of Grease to Add*
3/4 to 1-1/4 in	1/8 cu-in or 0.1 oz (3.0 ml)
1-1/4 to 1-7/8 in (Guide)	1/4-cu-in or 0.2 oz (5.9 ml)
1-7/8 to 2-3/8 in (Bearings)	3/4-cu-in or 0.6 oz (17.7 ml)
2-3/8 to 3-3/8 in	2 cu-in or 1.6 oz (47.3 ml)

* 1 oz = 1.3 cu-in by weight

Baldor

Section 3
Maintenance & Troubleshooting

WARNING: **UL rated motors must only be serviced by authorized Baldor Service Centers if these motors are to be returned to a flammable and/or explosive atmosphere.**

General Inspection

Inspect the motor at regular intervals, approximately every 500 hours of operation or every 3 months, whichever occurs first. Keep the motor clean and the ventilation openings clear. The following steps should be performed at each inspection:

WARNING: **Do not touch electrical connections before you first ensure that power has been disconnected. Electrical shock can cause serious or fatal injury. Only qualified personnel should attempt the installation, operation and maintenance of this equipment.**

1. Check that the motor is clean. Check that the interior and exterior of the motor is free of dirt, oil, grease, water, etc. Oily vapor, paper pulp, textile lint, etc. can accumulate and block motor ventilation. If the motor is not properly ventilated, overheating can occur and cause early motor failure.
2. Use a "Megger" periodically to ensure that the integrity of the winding insulation has been maintained. Record the Megger readings. Immediately investigate any significant drop in insulation resistance.
3. Check all electrical connectors to be sure that they are tight.

Lubrication & Bearings

Bearing grease will lose its lubricating ability over time, not suddenly. The lubricating ability of a 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. Good results can be obtained if the following recommendations are used in your maintenance program.

Type of Grease

A high grade ball or roller bearing grease should be used. Recommended grease for standard service conditions is Polyrex EM (Exxon Mobil).

Equivalent and compatible greases include:
Texaco Polystar, Rykon Premium #2, Pennzoil Pen 2 Lube and Chevron SRI.

- Maximum operating temperature for standard motors = 110° C.
- Shut-down temperature in case of a malfunction = 115° C.

Lubrication Intervals

Recommended lubrication intervals are shown in Table 3-1. It is important to realize that the recommended intervals of Table 3-1 are based on average use.

Refer to additional information contained in Tables 3-2 and 3-3.

Table 3-1 Lubrication Intervals *

NEMA / (IEC) Frame Size	Rated Speed - RPM					
	10000	6000	3600	1800	1200	900
Up to 210 incl. (132)	**	2700 Hrs.	5500 Hrs.	12000 Hrs.	18000 Hrs.	22000 Hrs.
Over 210 to 280 incl. (180)		**	3600 Hrs.	9500 Hrs.	15000 Hrs.	18000 Hrs.
Over 280 to 360 incl. (225)			* 2200 Hrs.	7400 Hrs.	12000 Hrs.	15000 Hrs.
Over 360 to 5800 incl. (300)			*2200 Hrs.	3500 Hrs.	7400 Hrs.	10500 Hrs.

* Lubrication intervals are for ball bearings. For vertically mounted motors and roller bearings, divide the lubrication interval by 2.

** For motors operating in this speed range, contact Baldor for lubrication recommendations based on specific motor and application.

Marathon

CAUTION

Overgreasing bearings can cause premature bearing and/or motor failure. The amount of grease added should be carefully controlled.

NOTE

If lubrication instructions are shown on the motor nameplate, they will supersede this general instruction.

Marathon Electric motors are pregreased with a polyurea mineral oil NGLI grade 2 type grease unless stated otherwise on the motor nameplate. Some compatible brands of polyurea mineral base type grease are: Chevron SRI #2, Rykon Premium #2, Exxon Polyrex EM or Texaco Polystar RB.

Motors are properly lubricated at the time of manufacture. It is not necessary to lubricate at the time of installation unless the motor has been in storage for a period of 12 months or longer (refer to lubrication procedure that follows).

LUBRICATION PROCEDURES

1. Stop motor. Disconnect and lock out of service.
2. Remove contaminants from grease inlet area.
3. Remove filler and drain plugs.
4. Check filler and drain holes for blockage and clean as necessary.
5. Add proper type and amount of grease. See the Relubrication Time Intervals table for service schedule and Relubrication Amounts table for volume of grease required.
6. Wipe off excess grease and replace filler and drain plugs (see following warning).
7. Motor is ready for operation.

WARNING

If motor is nameplated for hazardous locations, do not run motor without all of the grease or drain plugs installed.

RELUBRICATION TIME INTERVAL

(For motors with regreasing provisions).

Service Condition	NEMA FRAME SIZE					
	140-180		210-360		400-510	
	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM	1800 RPM and less	Over 1800 RPM
Standard	3 yrs.	6 months	2 yrs.	6 months	1 yr.	3 months
Severe	1 yr.	3 months	1 yr.	3 months	6 months	1 month
Seasonal	See Note 2.					

NOTE

1. For motors nameplated as "belted duty only" divide the above intervals by 3.
2. Lubricate at the beginning of the season. Then follow service schedule above.

SEASONAL SERVICE: The motor remains idle for a period of 6 months or more.

STANDARD SERVICE: Up to 16 hours of operation per day, indoors, 100°F maximum ambient.

SEVERE SERVICE: Greater than 16 hours of operation per day. Continuous operation under high ambient temperatures (100° to 150°F) and/or any of the following: dirty, moist locations, high vibration (above NEMA standards), heavy shock loading, or where shaft extension end is hot.

RELUBRICATION AMOUNTS

(For motors with regreasing provisions).

NEMA FRAME SIZE	VOLUME cu. in. (fluid oz.)
140	.25 (.14)
180	.50 (.28)
210	.75 (.42)
250	1.00 (.55)
280	1.25 (.69)
320	1.50 (.83)
360	1.75 (.97)
400	2.25 (1.2)
440	2.75 (1.5)
500	3.00 (1.7)

TROUBLESHOOTING

WARNING

1. Disconnect power before working on motor or driven equipment.
2. Motors with automatic thermal protectors will automatically restart when the protector temperature drops sufficiently. Do not use motors with automatic thermal protectors in applications where automatic restart will be hazardous to personnel or equipment.
3. Motors with manual thermal protectors may start unexpectedly after protector trips. If manual protector trips, disconnect motor from power line. After protector cools (five minutes or more) it can be reset and power may be applied to motor.
4. Discharge all capacitors before servicing motor.
5. Always keep hands and clothing away from moving parts.
6. Never attempt to measure the temperature rise of a motor by touch. Temperature rise must be measured by thermometer, resistance, imbedded detector, or thermocouple.
7. Electrical repairs should be performed by trained and qualified personnel only.
8. Failure to follow instructions and safe electrical procedures could result in serious injury or death.
9. If safety guards are required, be sure the guards are in use.

If trouble is experienced in the operation of the motor, make sure that:

1. The bearings are in good condition and operating properly.
2. There is no mechanical obstruction to prevent rotation in the motor or in the driven load.
3. The air gap is uniform. (Consult manufacturer for specifications).
4. All bolts and nuts are tightened securely.
5. Proper connection to drive machine or load has been made.

In checking for electrical troubles, be sure that:

1. The line voltage and frequency correspond to the voltage and frequency stamped on the nameplate of the motor.
2. The voltage is actually available at motor terminals.
3. The fuses and other protective devices are in proper condition.
4. All connections and contacts are properly made in the circuits between the control apparatus and motor.

3. **STANDARD SERVICE *(-cont.)***

5. Remove relief plug or plate and using a low pressure hand held grease gun, pump the required amount of grease.

6. For Frames 143T to 365T allow motor to run for 20 to 30 minutes and for Frames 405T and larger allow motor to run for 30 to 60 minutes before replacing hardware.

7. Grease may not relieve from drain. Use volumes recommended to avoid overgreasing.

Fig. 2

SERVICE CONDITIONS	
Standard Duty	Eight hours per day; Light to normal loading; Clean condition, free from dust.
Severe Duty	24 hours per day; Light to normal shock loading, vibration; Exposure to dirt or dusty conditions.
Very Severe Duty	24 hours per day; High ambient; Normal to high shock loading, vibration; Dusty conditions; Confined mounting conditions

4. **RECOMMENDED GREASES:**

Confirm if the motor nameplate has specified the grease used.

Standard, Severe Duty and 841 motors greased at the factory will use:

Grease Name:	Chevron SRI
Manufactured By:	Chevron U.S.A., Inc.
Operating Ambient Temp.:	-30°C to 50°C

5. **RECOMMENDED GREASES for STANDARD APPLICATIONS**

Use the following greases listed for the given temperature range, unless otherwise shown by the motors grease nameplate:

Operating Ambient Temp. -30°C to 50°C	
Chevron SRI	Chevron U.S.A., Inc.
Exxon Unirex #2	Exxon Corp.
Exxon Polyrex	Exxon Corp.
Shell Dolium R Discontinued	Shell Oil Co.
Polystar RB 2	Texaco

Lubrication Instructions For Ball Bearing Motors

Lubrication
This motor is supplied with pre-lubrication ball bearings. No lubrication required before start up.

Relubrication Intervals
The following intervals are suggested as a guide:

SUGGESTED RELUBRICATION INTERVALS		
HOURS OF SERVICE PER YEAR	H.P. RANGE	RELUBE INTERVAL
5,000	Sub Fractional to 7 1/2 10 to 40 50-200	5 Years 3 Years 1 Year
Continuous Normal Applications	Sub Fractional to 7 1/2 10 to 40 50 to 200	2 Years 1 Year 9 Months
Season Service Motor Idle 6 Months or More	All	1 Year (Beginning of Season)
Continuous High Ambients Dirty or Moist Locations High Vibrations Where Shaft End is Hot (Pumps-Fans)	Sub Fractional to 40 50 to 200	6 Months 3 Months

Lubrication

Use high quality ball bearing lubricant. Use consistency of lubricant suitable for class of insulation stamped on nameplate as follows:

LUBRICATION CONSISTENCY				
INSULATION CLASS	CONSISTENCY	TYPE	TYPICAL LUBRICATION	FRAME TYPE
B & F F & H	Medium	Polyurea	Shell Dolium R and/or Chevron SR1 2	Sub Fractional to 447T All

Procedure

If motor is equipped with Alemite fitting, clean tip of fitting and apply grease gun. Use 1 to 2 full strokes on motors in NEMA 215T frame and smaller. Use 2 to 3 strokes on NEMA 254T thru NEMA 365 T frame. Use 3 to 4 strokes on NEMA 404T frames and larger. On motors having drain plugs, remove drain plug and operate motor for 20 minutes before replacing drain plug.

On motors equipped with slotted head grease screw, remove screw and apply grease tube to hole. Insert 2 to 3 inch length of grease string into each hole on motors in NEMA 215T frame and smaller. Insert 3 to 5 inch length on larger motors. For motors having drain plug and operate motor for 20 minutes before replacing drain plug.

CAUTION: Keep lubricant clean. Lubricate motors at standstill. remove and replace drain plugs at standstill. Do not mix petroleum lubricant and silicone lubricant in motor bearings.

LEESON®
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