Greasing Electric Motors Part 1

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Introduction

The lubrication of electric motors can be a critical maintenance practice for improved motor system reliability. Unfortunately, a significant amount of misinformation is provided within industry. For instance, those with a lack of knowledge of how motors and bearing work will often promote the ‘purging’ of motor grease, frequently. This practice puts undue stress on the motor, reducing its life and increasing the chance for both bearing failure and winding contamination.

Grease purging is the practice of forcing grease completely through the bearing housing and bearing until old grease is removed and new grease shows at the grease relief plug. While this practice is performed in highly contaminated environments, it provides many dangers to the reliability of the motor. There was many a time, as a motor repair journeyman, that I would disassemble or troubleshoot a motor winding or bearing failure in which the motor was full of grease. Some grease additives will react with winding insulation or will just provide a thermal blanket, reducing the life of the winding, when purged grease leaks through the bearing or bearing cap and onto the winding, even when you have the grease relief open.

Bearing lubrication, on the other hand, is the practice of adding enough grease to allow for the lubrication of the bearing friction surfaces and the eventual removal of contaminants from the grease housing. The purpose of this paper is to provide an overview and direction for the proper lubrication of bearings.

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.

Precautions In Motor Greasing

When greasing electric motors, there are a number of precautions that must be considered:

- When electric motors are manufactured, or repaired, grease fittings may be put in place on motors that are not grease able. Your supplier should be able to provide confirmation that the motor may be greased.
- Electric motors must be de-energized and locked/tagged out (LOTO) before greasing.
- There should be no paint on grease fittings.
- The average grease gun will introduce 1 ounce for every 23 strokes.
- Grease compatibility (See Table 1). The additives in some greases do not mix well and can cause the grease to solidify or liquefy.

Table 1: Grease Compatibility[i]

Al Com	Barium	Calcium	Calcium 12	Ca Com	Clay	Lithium	LI 12	LI Com	Poly Urea	
Aluminum Complex	X	I	I	C	I	I	I	I	C	I
Barium	I	X	I	C	I	I	I	I	I	I
Calcium	I	I	X	C	I	C	C	B	C	I
Calcium 12hydroxy	C	C	C	X	B	C	C	C	C	I
Calcium Complex	I	I	I	B	X	I	I	I	C	C
Clay	I	I	C	C	I	X	I	I	I	I
Lithium	I	I	C	C	I	I	X	C	C	I
Lithium 12 Hydroxy	I	I	B	C	I	I	C	X	C	I
Lithium Complex	C	I	C	C	C	I	C	C	X	I
Polyurea	I	I	I	I	C	I	I	I	I	X

I = Incompatible C = Compatible B = Borderline

Greasing Procedure

Following is the standard procedure for greasing ball bearings:

1) 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.
2) 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.
3) Add grease per Table 2.
4) 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.

Table 2: Amount of Grease to Use [ii.]

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

How Often Should Bearings Be Greased?

Bearings should be lubricated at an average frequency as found in Table 3. Operational environment and type of grease may require more frequent lubrication.

Table 3: Bearing Lubrication Frequency [iii.]

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

Conclusion

It is recommended that the type of grease used on each motor is recorded in order to avoid premature bearing failure. In many cases, you may be able to standardize the type of grease used in a majority of your motors. It is also good practice to let your motor repair center know the type of grease in case the standard grease used by the repair center conflicts with your standard grease.

Bibliography

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About the Author

Dr. Penrose joined ALL-TEST Pro in 1999 following fifteen 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, and many others. Dr. Penrose taught engineering at the University of Illinois at Chicago as an Adjunct Professor of Electrical, 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 repaired, troubleshot, designed, installed or researched a great many technologies that have been, or will be, introduced into industry. He 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 the 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 MotorMaster Certified Professional, as well as a trained vibration analyst, infrared analyst and motor circuit analyst.

[i] BPA, 1997, p. 9-4
[ii] EASA, 1993, p.37
[iii] EASA, 1993, p. 36