



## Lubrication

Lubrication plays a vital role in the performance and life of rolling element bearings. The most important task of the lubricant is to separate parts moving relative to one another (balls or rollers and raceways) in order to minimize friction and prevent wear. A lubricant that is designed for specific operating conditions will provide a load bearing wear protective film. The ideal condition is when the friction surfaces are separated by this film. In addition to providing this load bearing film, the lubricant should also allow for the dissipation of frictional heat thus preventing overheating of the bearing and deterioration of the lubricant and provide protection from corrosion, moisture, and the ingress of contaminants.

Lubricants used in rolling element bearings should have the following characteristics:

- Maintains a stable viscosity over a broad range of temperatures
- Good film strength that can support loads
- Stable structure that provides for long service life
- Non-corrosive and compatible with adjacent components
- Provides a barrier against contaminant and moisture, yet does not leak out of the bearing

### ***Types of Lubricants:***

**Oil:** Both petroleum based and synthetic oils are available. Examples of synthetic oils are silicone, diesters, PAO's, and fluorinated compounds. Bearings lubricated with oil will exhibit less start up and running torque and have higher speed capability. Oils are subject to evaporative losses so their service life in a bearing is less than grease. Miniature and instrument bearings are often only lubricated once for the life of the bearing, making the choice of lubricant critical. Larger bearings are subject to re-lubrication as part of the machinery maintenance cycle. These bearings are often lubricated via oil recirculation systems that are designed into the machinery or equipment. Temperature range, viscosity, evaporative rate are key characteristics to consider when selecting an oil.

**Grease:** Grease consists of a base oil with a thickener added. These thickeners consist primarily of metal soaps (lithium, sodium, aluminum, and calcium), organic (ureas), or inorganic compounds. While these thickeners greatly influence the characteristics of the grease, the lubricating properties of the grease are attributable to its base oil. In addition, grease can contain additives that improve its performance. Additive types include antioxidant, anticorrosion, anti-wear, fillers, fortifiers, and extreme pressure fortifiers. Temperature range, base oil viscosity, and stiffness or penetration level are key characteristics to consider when selecting a grease. Most greases used in rolling element bearings are NLGI grade 2

**Solid Films:** These are non-fluid coatings applied to the friction surfaces to prevent wear. They are used in extreme situations where an oil or grease cannot survive and are typically selected as a last resort or option. These include harsh environments such as extreme temperatures, vacuum, or radiation. These coatings include graphite, MoS<sub>2</sub>, silver, gold, or PTFE. Hard coatings include TiC or chrome. Solid films are engineered on a specific application by application basis.

The lubricant (and amount) selected also impacts the maximum operating speed and torque (both starting and running). In miniature bearings the lubricant can impact the noise level. Filtered greases and oils are recommended for use with miniature or instrument bearings.



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### **Lubrication Methods:**

Grease is normally applied with special lubricating equipment with a head that deposits the grease between the balls forcing it into, and around, the ball (or roller) raceway interface. Upon rotation the grease is distributed within the bearing. Miniature and instrument series bearings are typically lubricated in a clean room environment.

The amount of grease is typically specified as a percentage, such as 30% fill. The percentage represents the actual grease volume compared to the free internal space within the bearing. In other words, if the internal space in the bearing is completely filled with grease with no voids, it would be 100% full. Manufacturers of bearings have different amounts that they would consider standard. This typically ranges from 20% to 40%. In small or miniature bearings grease fill amounts can be as little as 10%.

Oil is applied by the manufacturer with special equipment as well. The amount is not normally specified. In torque sensitive applications excess oil can be removed via centrifuging. This is more common with miniature or instrument type bearings.

Grease Plating (MGGP) - The MGGP process starts with carefully mixing the candidate grease with a volatile solvent. The consistency of the grease is thinned considerably. This mixture can be controlled to achieve different coating thicknesses. The mixture is then injected into the bearing coating all of the internal surfaces. A dipping process is also used in some cases. The solvent is then baked off at low temperature. This method is often used in torque sensitive applications and lubricant migration associated with oil lubrication is a undesirable.

### **Shelf Life:**

Synthetic oils are inherently stable materials. Generally, they are not expected to oxidize, polymerize or volatilize at room temperature for 10 years or more. Ester oils, where the ester linkage may be subject to a minute degree of hydrolysis in the presence of moisture, could become more acidic if moisture is present. Fluorinated oils and silicones are not likely to be affected by simple aging.

Greases can "age" in more complicated ways. Grease quality could be affected by a change in the gel structure. If the gel contracts, significant oil bleed would be evident and the remaining grease would stiffen. The gel structure may also become softer over a period of time.

The lubricants that are in the bearings supplied by AST Bearings are high quality lubricants. Many of these lubricants are also qualified to military or other specifications. The type and quantity of lubricant is in many cases specified by the customer, and in those cases where the customer has not made a particular selection, the bearings are lubricated to conform to industry standards.

Shelf life is the period following the lubricant's manufacture during which it is deemed suitable for use without re-testing its physical characteristics. In addition, the manufacturers state that the shelf life applies only if oils and greases are properly stored in their original, unopened containers.

AST purchases the required lubricants from approved suppliers. Our purchasing documents require a Certificate of Analysis to be supplied with the lubricant, and that 75% of the manufacturer's shelf life is remaining upon receipt. With respect to the shelf life of any lubricant, AST must rely on the shelf life specifications of that particular lubricant's manufacturer. In addition, AST has established internal lubricant control procedures that include proper storage of lubricants and applying "use by" dates that



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are consistent with the lubricant manufacturer's specifications. AST does not "certify" the shelf life of the bearings we lubricate for the following reasons:

1. We are not the lubricant manufacturer.
2. Once the lubricant has been applied to the bearing, or other device, factors, which AST can neither predict, or control will govern the lubricant life.

Therefore, the end user should establish their own database or guidelines regarding storage life or functional life of lubricated bearings. AST routinely marks the date of lubrication on our labels and packaging so that customers can apply their internal procedures for age sensitive material.

There are many things to consider when selecting a lubricant such as temperature, loads, speed, environment, and desired life just to name a few. In addition, aside from those already mentioned, there are a variety of characteristics of greases and oils that should be considered such as oil separation, evaporative loss, dropping point, oxidation stability, channeling capability/stiffness, and others. Lubrication is one of the most critical specifications for the designer to consider.

The following Tables list common bearing lubricants and some of their properties. AST stocks hundreds of others.

**Table I – Grease Lubricants**

MANUFACTURER & TRADE NAME	MIL SPEC	OPERATING RANGE °F	BASE OIL	THICKENER	COLOR
<b>American Oil Co.</b>					
Rykon Premium #2		-10/200	Mineral	Arylurea	Reddish
Rykon Premium #3		-20/250	Mineral	Arylurea	Pink
Supermil ASU31052	MILG25013	-100/450	Silicone	Arylurea	Lavender
Supermil ASU72832	MILG23827A	-100/250	Diester	Lithium	Amber
<b>Bray oil co.</b>					
Braycote 627S	MILG23827	-100/300	Ester	Organic	Lt. Brown
Braycote 637S	MILG25537	-65/260	Mineral	Calcium Soap	Lt. Brown
601EF		-100/390	Polyether	Tetrafluor	Off White
<b>Chevron oil co.</b>					
BRB-2	MILG3545C	-20/350	Mineral	Polyurea	Blue/Green
OHT		+20/300	Mineral	Sodium	Greenish
NRRG335		-65/300	Synthetic/Aeromatic	Sodium	Maroon
Poly FM #2	USDA H1 0	-320	White Oil	Polyurea	Apricot
SRI-2	MILG3545G	-20/350	Mineral	Polyurea	Blue/Green
<b>Dow Corning</b>					
Molykote BR2 Plus		-20/300	Mineral	Lithium	Black
Molykote 33		-100/400	Silicone	Lithium	Gray
Molykote 41		-0/550	Silicone	Lithium	Black
Molykote 44	MILG46886A	-100/400	Silicone	Lithium	Dark Amber
Molykote 55M	MILG4343	-65/350	Silicone	Lithium	Tan
<b>Du Pont, E.I.</b>					
Krytox 240AA	MILG27617	-30/450	Fluor Carbon	Vidax	White
Krytox 240AB	MILG27617	-30/450	Fluor Carbon	Vidax	White
Krytox 240AC	MILG27617A	-30/550	Fluor Carbon	Vidax	White
Krytox 240AZ	MILG27617	-65/300	Fluor Carbon	Vidax	White
Krytox 283AC	MILG27617	-30/550	Perfluor	Tetrafluor	White
<b>EXXON CORP.</b>					
Andok B	MILG18709A	-20/250	Mineral	Sodium	Brown
Andok C		-20/250	Mineral	Sodium	Brown
Andok 260	MILG3545C	-20/250	Mineral	Sodium	Amber
Beacon 325		-65/250	Diester	Lithium	Lt.Tan

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<b>Houghton E.F.</b>					
Cosmolube 615	MILG4343	-65/375	Silicone	Lithium	Lt. Brown
<b>Kluber</b>					
Asonic GLY 32		-58/284	Ester/PAO	Lithium	White/Beige
Asonic GHY 72		-40/356	Ester	Polyurea	Beige
Barrierta L 55/2		-31/482	PFPE	PTFE	Creamy White
Isoflex Super LDS 18	MILG23827	-76/266	Mineral/Ester	Lithium	Yellow
Isoflex LDS 18 Special A	MILG23827	-76/266	Mineral/Ester	Lithium	Yellow
<b>Kyodo Yushi</b>					
PS #2		-60/230	Diester	Lithium	White
SRL		-40/300	Ester	Lithium	Tan
<b>Mobil Oil</b>					
BRB #23	MILL7711	-0/250	Petroleum	Sodium	Tan
Mobil 24	MILG25013	-100/550	Silicone	Organic	Reddish
Mobil 27	MILG23827	-65/325	Carbon	Non Soap	Tan
Mobil 28	MILG81322A	-65/350	Hydro Carbon	Non Soap	Dark Red
<b>MPB Corp.</b>					
MINAPURE	MILG81937	-65/250	Diester	Lithium	Lt. Tan
<b>Nye Lubricants</b>					
703A		-30/250	Mineral	Sodium	Tan
716B		-60/300	Polyol Ester	Lithium	Tan
Rheolube 703A		-30/250	Mineral	Sodium	Tan
Instrument Grease 706E		-65/300	Polyol Ester	Lithium	Light Brown
Rheolube 716B		-60/300	Polyol Ester	Lithium	Tan
Nyogel 781 D	Replaces GE Versilube G-300	-95/390	Silicone	Lithium	Off White
Fluoroether 899 RP		-130/480	PFPE	PTFE	White
Rheolube 2000		-60/260	Hydrocarbon	Organic	Red
Rheotemp 500	MILG3278A	-65/350	Diester	Sodium	Blue
Rheoplex 6000HT		-40/302	Ester	Sodium	Light Brown
<b>Shell Oil</b>					
Aeroshell #5	MILG3545C	-20/300	Petroleum	Microgel	Dark Brown
Aeroshell #6	MILG24139	-40/250	Mineral	Microgel	Amber
Aeroshell #7	MILG23827A	-100/300	Diester	Microgel	Amber
Aeroshell #14	MILG23827	-65/250	Mineral	Calcium Soap	Tan
Aeroshell #17	MILG21164	-100/300	Diester	Microgel	Dark Gray
Aeroshell #22	MILG81322A	-80/350	Hydrocarbon	Microgel	Dark Gray
Alvania #2	MILG18709	-20/275	Mineral	Lithium	Amber
Alvania #3	MILG81322C	-30/275	Mineral	Lithium	Amber
Cyprina #3	MILG18709	-0/250	Mineral	Lithium	Lt. Tan
Dolium R #2		-30/300	Mineral	Ashless	Amber
Darina	MILG18709	-0/300	Mineral	Microgel	Amber
<b>Royal Lubricant</b>					
Royco 13D	MILG25013	-100/450	Silicone	PTFE	Lavender
Royco 21	MILG7421	-100/250	Diester	Lithium	Brownish
Royco 22MS	MILG81827	-80/360	Diester	Clay	Black
Royco 27A	MILG23827	-100/275	Diester	Lithium	Brownish
Royco 37	MILG25537	-65/250	Mineral	Calcium Soap	Tan
Royco 64C	MILG21164	-65/250	Diester	Lithium	Black
<b>Tenneco Chem. (Huls)</b>					
Anderol 753A		-40/300	Diester	Lithium	Lt. Brown
Anderol 757		-40/300	Diester	Lithium	Lt. Brown
Anderol 761		-40/400	Diester	Silica	Lt. Brown
Anderol 793A		-65/300	Diester	Lithium	Lt. Amber
Anderol 794		-65/250	Diester	Lithium	Lt. Amber
Anderol 795		-65/300	Diester	Lithium	Off White
<b>Texaco Oil Co.</b>					
Premium RB		-30/325	Mineral	Lithium	Orange
Low Temp EP	MILG23827	-65/250	Synthetic Material	Lithium	Purplish Brown
Regal AFB #2	MILG18709	-40/250	Paraffin	Lithium	Green
Unitemp 500		-65/350	Diester	Sodium	Blue

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Table II – Oil Lubricants

MANUFACTURER & TRADE NAME	MIL SPEC	OPERATING RANGE °F	TYPE	POUR POINT °F	FLASH POINT °F	Viscosity CS +75°F +210°F
<b>Anderson Oil Co.</b>						
L245X	MILL6085A	-70/350	Diester	-75	420	20/3.5
LS252	MILL17353A	-65/250	Diester	-75	340	7.6/1.9
<b>Bendix Corp.</b>						
P10	MILL6085A	-70/350	Diester	-80	420	23.4/3.8
<b>Bray Oil Co.</b>						
NPT3A		-65/175	Diester	-90	400	19/3.5
885	MILL6085	-50/400	Diester	-85	410	1875/9
NPT9		-30/350	Ester	-50	495	710/55
<b>Dow Corning</b>						
DC200 VVL1078		-40/550	Silicone	-50	600	Various
DC510	MILL27694	-70/500	Silicone	-80	600	Various
DC550		-40/450	Silicone	-50	600	125/20
FS1265		-50/300	Silicone	-30	500	Various
<b>Du Pont, E.I.</b>						
Krytox 143 AB		-45/450	Perflour	-45	500	85/10.3
Krytox 143 AC		-30/550	Ester	-35	550	270/26
<b>Exxon Corp.</b>						
P15A MILL7808		-65/300	Diester	-75	450	22/3.5
Aviation Inst. Oil	MILL7870	-65/290	Petroleum	-70	300	17/2.6
Univis P12	MILL6085A	-75/300	Diester	-90	410	30/3.6
Univis P38	MILL6085	-65/300	Diester	-70	415	72/37
<b>General Electric</b>						
Versilube F44		-100/500	Silicone	-100	550	70/15
Versilube F50	MILS81087	-100/400	Silicone	-100	550	75/22
Versilube SF81		-40/400	Silicone	-55	600	Various
Versilube SF96		-40/400	Silicone	-50	600	40/16.5
<b>Gulf Oil Company</b>						
Synthetic Fluid #6		-50/275	Mineral	-90	295	3200/12
<b>Houghton OIL</b>						
Cosmolube 270A	MILL6085A	-65/250	Diester	-70	365	15/3.5
<b>Mobil Oil</b>						
SHC824		-50/350	Synthetic	-65	455	100/6.5
XRL743A		-50/350	Synthetic	-65	520	100/6.5
<b>MPB Corp.</b>						
MO119		-30/250	Synthetic	-80	455	119 @ 100°F
<b>Shell Oil Company</b>						
Aeroshell #3	MILL7870	-70/240	Petroleum	-75	275	16.5/2.3
Aeroshell #12	MILL6085A	-70/300	Diester	-70	365	21.5/3.5
Aeroshell #4	MILH5606	-70/500	Petroleum	-85	215	859/10.4
<b>Tenneco Chemical</b>						
Anderol L401D	MILL6085A	-75/260	Diester	-80	430	19.7/3.4
Anderol L423		-80/350	Synthetic	-100	370	200/5.1

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