LubriMatic Greases
LubriMatic Oils
Plews Lube Equipment

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Guide to Greases

LubriMatic's Guide to Greases

What is Grease?

- A solid to semi-fluid product of a fluid lubricant (usually a petroleum oil) and a thickener (usually a soap) dispersed in the oil.
- A lubricant (oil + additives) that is blended with a carrier (soap/thickener) to enhance lubricating properties and hold the lubricant in place.

Common Perceptions / Misconceptions:

- The tackier it is, the longer it lasts.
- If it's "red", it works better.
- The higher the viscosity, the better it is.
- The higher the "Timken", the better it is.
- Greases that don't melt are great.
- "Moly" greases are the best.

What "Should" Determine the Correct Grease to Use?

Appropriate viscosity and best lubricity offered within the limitations & requirements of:

- Dispensing capabilities / methods
- Bearing capabilities
- Performance features (hi-temp, EP/load carrying capability, etc.)
- Product component (thickener, moly, synthetic)
- Temperature requirements / limitations
- Load bearing requirements
- Presence of contaminants
- Elastomer requirements (compatibility)
- Shear stability
- Water resistance
- Oil separation
- Cost
- Lubrication intervals

Grease Terminology:

NLGI: National Lubricating Grease Institute. The organization responsible for setting standards and issuing licenses.

NLGI Grade: This is the "consistency", or "thickness" of the grease. This is determined by dropping a cone from a specific height into a predetermined amount of grease to see how deep the cone penetrates (measured in tenths of millimeters) into the grease. The grease is then rated from 000 (thinnest) to 6 (thickest). Grade #2 is the most common grease (over 90% of all greases). NLGI Grades:

Rating Penetration Depth Characteristics

00	400 to 430	Almost Liquid
0	355 to 385	Very Thin
1	310 to 340	Smooth
2	265 to 295	Most Common
3	220 to 250	Very Tacky

NLGI Rating: Rating assigned after grease is submitted to the NLGI for licensing. The "GC-LB" is the latest & highest auto industry approval rating for wheel bearings & chassis. This is based on a life test of 80 hours.

Viscosity: The measurement of a fluids resistance to flow. The ability to maintain consistency and avoid breakdown.

Lubricity: The ability of an oil or grease to lubricate. Also called "film strength".

Shear Stability: This is the ability of the grease to resist changes in consistency (hardness) during mechanical working. "Extended Penetration" & "Roll Stability" measure the "Shear Stability".

Extended Penetration: Most grease is measured at 10, 10,000 and 100,000 strokes. At 10,000 strokes, good grease will stay within grade. At 100,000 strokes, a 30 – 60 point change is common. Most grease suppliers do not report results at 100,000. Some do not report at 10,000.

Roll Stability : A rating of 5% to 8% equates to very stable. Most "tacky" greases are not very stable.

Drop Point: This is the temperature at which the grease changes from a "semi-fluid" to "fluid" state. The operating temperature is 80 to 100 degrees F below this "drop point".

Timken: The "Timken OK Load" rating (in lbs.) is a test that "broadly" reveals the load carrying capability. EP greases will typically have a Timken of 40 or higher. A Timken of 50 or higher normally degrades grease and/or bearing life performance. The Timken test has poor precision due to inconsistent levels of repeatability & reproducibility.

Four-Ball Weld Test: This is a another test that reveals load carrying (EP) capability of a grease and is much more precise than the Timken test. The test unit is loaded until the four-balls weld together. The results indicate low, medium or high levels of load-carrying capability. Premium greases have a rating of 250 or higher.

Four-Ball Wear Test: Similar to the Four-Ball Weld Test but conducted at a lighter load to avoid welding, yet a high enough load to "scar" the balls. The resulting scar's diameter is then measured. High quality greases yield a scar diameter of less than .6mm.

Water Resistance: There are two tests used, "Water Washout" & "Water Spray-Off". Most grease does not excel in both cases.

Water Washout: The bearings are tested in a shielded, but not sealed housing. Good grease will have less than a 3%-5% loss at 175 degrees F.

Water Spray-Off: The blasting effect measures cohesive strength. Results of less than 30% are excellent.

Oil Separation: This test is designed to measure the predicted amount of bleed from a 35lb. pail stored at room temperature. Premium products can be as high as 3%-5%. Low bleed does not in itself, assure long bearing life. "Controlled Bleed" is often necessary.

Cold Weather Mobility: This determines the low temperature suitability. Low temperature pumpability is most dependant on the base oil used, the additive package and thickener. Typically, calcium complexes, sodium and barium are not good choices for good low temperature pumpability.

Compatibility: Determines whether a grease will be affected if mixed with another grease. To be safe, the general rule of thumb is not to mix any greases with different additives or thickeners. This could actually promote rusting, corrosion, lower operating temperatures or cause oil separation and leaking of grease/oil.

Corrosion Protection: The ability of grease to prevent deterioration of a metal surface. Common test includes rust protection or salt fog. Results are either pass or fail.

How is a Grease Manufactured?

Basically, making grease is a three-step process. You first make a soap or thickener, then add the base oil and finally an additive package. Let's look closer at each step.

Soap/Thickener Process: The recipe is to take a Metal Hydroxide + a Fatty Acid + Oil. Example: LiOH + Stearic Acid + Oil = Lithium Soap. The mixture is then cooked in either an open kettle, or, a contactor, which is done under pressure & high heat. The result is a better batch – to – batch consistency than an open kettle. "Complex Soap" is manufactured by taking the base soap and adding a non-fatty acid. Complexes are generally smooth, stable to heat (drop points usually exceed 500 degrees F), have acceptable oil separation characteristics and have additives for oxidation stability, rust protection & load carrying capacity. Thickener types are:

- Soaps – Lithium, Calcium, Sodium, Aluminum
- Complex Soaps – Lithium, Calcium, Aluminum
- Organic – Ureas, Polyureas
- Inorganic – Clay-Bentone, Microgel, Silica Gels

Base Oils: Viscosity is critical. Base oils are either from mineral oils or synthetics.

- **Mineral Oils -** There are basically two types. A Napthenic Oil, which has a low VI (viscosity index), and Paraffinic Oil, which has a high VI. A "blend" of basestock oils is used when the grease must perform over a broad temperature range, rather than a fairly tight temperature range, where one would use straight Napthenic or Paraffinic oil. A blend will sacrifice a High or Low VI in favor of a broad temperature range.
- **Synthetic Oils -** Synthetics are PAO's (Polyalphaolefins), Esters or Dialkylbenzenes. Most synthetics excel over wide temperature ranges, have greater thermal stability, oxidation stability and low volatility.

Additives: There are seven commonly used additives:

- **Antioxidants** – Used to extend life at elevated temperatures and protect during storage.
- **Rust & Corrosion Inhibitors** – Protects metals from rusting in water and inhibits grease from attacking metals.
- **Extreme Pressure (EP)** – Extends loads carried by the lubricant film. Used when experiencing high loads and/or low speeds.
- **Anti-Wear** – Reduces friction & excessive metal wear.
- **Temperature Performance** – There are two types of additives to change the characteristics. A "VI Improver" will raise the viscosity index of the grease. A "Pour Point Depressant" will lower the temperature at which grease will flow.
- **Tackifiers/Polymers** – Improves water resistance, and allows grease to adhere better to surfaces.
- **Color** – Very important to the end user. This aids him in identifying grease and having a "comfort level" with it. However, there are no industry standards for color identification. Each manufacturer takes it upon themselves to chose which color each of their particular greases are. It does nothing to enhance or detract from the grease, or quality of the grease.

The Evolution of Grease:

1930's

Calcium/Lime Soap

- Resisted water
- Disintegrated at high temperatures
- Used for axle grease

Sodium Soap

- Worked at higher temperatures – if dry
- Possesses a fibrous texture
- Good adhesive properties
- Major drawback – they are soluble in water
- Common applications - first wheel bearing grease, universal joints, anti-friction bearings where low – medium speeds & loads are encountered

1940's & 1950's

Anhydrous Calcium (calcium-12-hydroxy stearates)

- Excellent water resistance
- Good mechanical stability
- Good low temperature properties
- Dropping point usually in excess of 250 degrees F
- Common applications – chassis, mine cars, roll necks, center plate grease, water pump, truck wheel support rollers & truck idlers

Aluminum Stearates

- Clear, transparent & smooth in appearance
- Excellent water resistance
- Texture changes as temperature changes
- Poor mechanical stability
- Very few applications due to high cost to produce & poor properties

Barium Complex

- Fibrous texture, good sealant properties
- Dropping point range of 380 to 475 degrees F
- Excellent adhesion properties
- Fair rust preventative properties
- Good water resistance
- Difficult to manufacture
- Poor low temperature pumpability
- Not shear stable
- Now environmentally outlawed
- Common applications were – chassis, wheel bearing, water pump, universal joint & outside gear lubricant

Lithium Soap

- Combines the high temp qualities of sodium with the water resistance of calcium
- Exceptional shear stability
- Dropping points up to 290 degrees F
- Additive friendly – EP, rust, oxidation
- Excellent sealant properties
- Common applications – general purpose, mill bearings & automotive

Lithium Stearates

- Buttery in texture
- Higher dropping points over 350 degrees F
- Excellent water resistance
- Resists breakdown or softening by working
- Good pumpability, even at low temperatures
- Common applications – general purpose, automotive, industrial & agriculture

1960's & 1970's

Aluminum Complexes

- Smooth gel-like appearance
- Outstanding water spray-off
- Dropping points above 470 degrees F
- Respond well to additives
- Tendency to soften or harden
- Shorter life at high temperatures
- Extremely flammable
- Usage decreasing

Calcium Complexes

- Consistency sensitive to temperature changes

- Good EP & high temperature qualities
- Sensitive to water
- Poor pumpability at low temperatures
- Tendency to separate under pressure
- Can harden in storage
- Common applications – high temperature industrial & automotive bearings

Lithium Complexes

- Superior to high temperature predecessors in shear stability, mobility , oil separation & offer longer service life
- Good EP protection
- Good anti-wear protection
- Moderate water resistance (can be improved with polymeric additives)
- Good cold weather pumpability
- Resists oil separation
- Currently (with lithium) makes up over 50% of the US grease market
- Common applications – general purpose, automotive, industrial & agriculture

1980's

Polyurea –Acetate (1st Generation)

- Good oxidation & rust resistance
- Poor shear stability
- Incompatible with other greases
- Tendency to harden in storage
- Poor pumpability for central systems
- High cost to produce
- Common applications – became niche product for sealed applications (CV joints, electric motors)

1990's

Shear Stable Polyureas (2nd Generation)

- Manufactured without calcium acetate – new specialized manufacturing process with advanced formulation to fit process
- Passive EP protection
- Extremely shear stable
- Extensive storage life
- Very good water & rust protection
- Low oil separation
- Common applications – wheel bearings, chassis, automotive & industrial

Grease Compatibility:

Below is a "Grease Compatibility Chart". No matter what the chart says, the best way to use grease, and to get the maximum performance & life from the grease is to always flush and clean old grease if you are not using the exact same grease.

Grease Compatibility Chart

To determine the compatibility of two greases,

find the type of grease currently used in your application along the left column,

and match it with the new grease you intend to use from the top row.

Note the letter where the 2 greases intersect,

and refer to the key at the bottom of the page for compatibility.

For complete name, please refer to first column.

Thickener Soap Type	Alum. Comp.	Bari. Comp.	Calc. Strate.	Calc. 12Hy	Calc. Comp.	Calc. Sulf.	Clay	Lith. Strate.	Lith. 12Hy	Lith. Comp.	Poly. Gn 1	Poly. L/M
Aluminum Complex		I	I	C	I	N	I	I	I	C	I	C
Barium Complex	I		I	C	I	C	I	I	I	I	I	N
Calcium Stearate	I	I		C	I	C	C	N	N	C	I	C
Calcium 12 Hydroxy	C	C	C		N	N	C	C	C	C	I	C
Calcium Complex	I	I	I	N		I	I	I	I	C	C	C
Calcium Sulfonate Complex	N	C	C	N	I		I	N	N	C	I	C
Clay (no soap)	I	I	C	C	I	I		I	I	I	I	N
Lithium Stearate	I	I	C	C	I	N	I		C	C	I	C
Lithium 12Hydroxy	I	I	N	C	I	N	I	C		C	I	C
Lithium Complex	C	I	C	C	C	C	I	C	C		I	C
Polyurea (1st gen.)	I	I	I	I	C	I	I	I	I	I		C
Polyurea (L/M type)	C	N	C	C	C	C	N	C	C	C	C	

Key to Compatibility

C = Compatible

N = Not Recommended to mix these greases.

I – Incompatible, do NOT mix these types of grease.

LubriMatic Grease Specs:

More complete specifications can be obtained from your Tech Data Sheets. This is simply a quick reference, general guide.

LubriMatic Quick Reference Grease Chart

Grease Type	Grade	Drop Point (^{o} F)	Water Washout	4 Ball Weld (Kgf)	4 Ball Scar (mm)	Timken OK Load	Base Soap/Thickener	Texture	Color
Multi-purpose lithium	1.5	350	Very Good	NA	NA	NA	Lithium 12-Hyd. Stearate	Smooth	Gray-Black
Moly EP	1.5	360	Excellent	250	0.41	30	Lithium 12-Hyd. Stearate	Smooth	Gray
White lithium	2	390	Good	NA	NA	NA	Lithium 12-Hyd. Stearate	Smooth	Ivory
Disc/Drum wheel bearing	2	520	Excellent	500	O.51	60	Polyurea	Smooth	Aqua
LMX "Red"	2	510	Excellent	315	0.50	45	Lithium Complex	Tacky	Red
CV joint	1.5	570	Excellent	250	0.53	40	Polyurea	Smooth	Aqua Blue
Snowmobile	1	365	Very Good	250	0.50	40	Lithium 12-Hyd. Stearate	Smooth	Dark Amber
Marine trailer bearing	2	550	Outstanding	620	0.45	55	Calcium Sul. Complex	Smooth	Aqua Green
Motor assembly white	1	390	Good	250	0.53	NA	Lithium 12-Hyd. Stearate	Smooth	Off White
Synthetic brake caliper	2	500	Excellent	315	0.60	55	Lithium Complex	Smooth	Light Blue
5^{th} Wheel trailer	2	225	Excellent	NA	NA	NA	Lithium / Calcium	Smooth	Black
Red power equipment	2	500	Excellent	200	0.60	50	Lithium Complex	Tacky	Red
Hi-temp food machinery	2	500	Excellent	NA	0.60	40	Aluminum Complex	Smooth	White
Synthetic food machinery	2	650	Excellent	NA	0.50	NA	Silica	Smooth	Clear
Electrical contact	2	572	Outstanding	500	0.39	65	Calcium Sulfonate	Smooth	Tan

Multi-Purpose Lithium:

- General purpose grease
- Recommended for chassis & universal joints
- Around the house, farm & shop
- Works best for rolling parts

Moly EP:

- Molybdenum disulfide added for "EP" (extreme pressure) to reduce scuffing, scoring & seizure with high loads
- Automotive apps include ball joints & universal joints
- Intended for use in ball & roller bearings & conventional sleeve bearings

White Lithium:

- General purpose grease
- Includes a zinc additive for a clean, white color for easy identification of fresh grease when flushing out old grease
- Provides rust & corrosion inhibition & protection against oxidation

Hi-Temp Disc/Drum Wheel Bearing Grease:

- Carries the NLGI "GC/LB" rating
- Meets all OEM specs for wheel bearing, chassis & universal joints
- Gives long service life at high temperatures
- A multi-purpose automotive & industrial grease

LMX "Red":

- Carries the NLGI "GC/LB" rating
- Industrial & Ag formula to lubricate under heavy loads & high temperatures for long periods of time
- Contains polymers to impart tackiness & improved water resistance
- Ideal for extreme pressures, shock loads & high-wear situations

CV Joint:

- Specifically formulated to give longest life possible to metal components & elastomeric seals in CV joints
- Formula approved by GM

Snowmobile:

- Low temperature formula which performs & remains pumpable to –40 degrees F
- Ideal for snowmobile & cold weather equipment

Marine Trailer Bearing & Corrosion Control:

- Carries the NLGI "GC/LB" rating
- Ultimate in water washout, rust resistance & oxidation resistance
- Excellent shear stability & load carrying ability
- Free of heavy metals & resists burning
- Protects even in salt water, salt air & atmospheric chemicals

Motor Assembly:

- Provides rust & corrosion inhibition & protects against oxidation
- Provides initial metal-to-metal protection when rebuilding engines

Synthetic Brake Caliper & Wheel Bearing Grease:

- Carries the NLGI "GC/LB" rating
- Provides the ultimate in wheel bearing/caliper lubrication
- Extremely wide temperature range
- High film strength
- Meets or exceeds all OEM specifications

5th Wheel Trailer Grease:

- Designed for extreme load applications
- Outstanding anti-wear & severe shock load protection

- Outstanding water washout resistance
- Stays in lubrication contact points

Red Power Equipment Grease:

- Designed for pneumatic tools & industrial machinery & equipment
- Ensures maximum retention at high operating temperatures
- Special additives for high film strength
- Contains EP & anti-wear additives
- Outstanding oxidation & corrosion resistance

Hi-Temp Food Machinery Grease:

- Designed for machinery in food processing industry
- USDA H-1 authorized lubricant
- Contains EP additives for excellent anti-wear protection

Synthetic Food Machinery Grease:

- Same as above, but made from a synthetic base
- Synthetic base provides for outstanding pumpability in low temperature conditions
- Outstanding high temperature protection

Electrical Contact Grease:

- Extremely water resistant
- Protects electrical connections for rust & corrosion
- Will not conduct electricity but allows current to flow through to contacts