OVERVIEW

A grease is a solid to semi-fluid product of dispersion of a thickening agent in a liquid lubricant. Other ingredients imparting special properties may be included as additives. Grease is also applied to a mechanism that is lubricated infrequently. The dispersion of the thickener forms a two-phase system and immobilizes the liquid by surface tension and other physical forces. Other ingredients are commonly included to impart special properties.

PROPERTIES

Grease consists of oil (or some other liquid lubricant) and a thickener (this could be a soap). This combination forms a solid or semi-solid. Grease is a type of pseudo-plastic fluid. Under shear, the viscosity of the grease will decrease with time. Greases are applied under pressure in order to get it into places where a liquid would not maintain itself or flow.

Grease simple soaps can include calcium, sodium and lithium stearates. Complex soap thickeners can include aluminum complex, calcium complex and lithium complex. The addition of a complexing acid imparts high temperature performance over a simple soap. Other grease thickeners are silica, bentonite clay and polyureas. These thickeners are usually used in high-temperature applications. The soap chemistry influences the temperature resistance, water resistance and chemical stability of the grease.

Sodium and complex greases have a higher melting or dropping point. PTFE (polytetrafluoroethylene) can be used for some grease to provide more lubrication. Heavy-duty greases contain solid lubricants like graphite or molybdenum disulfide. Solid lubricants prevent metal-to-metal contact. The table below provides some general information.

<table>
<thead>
<tr>
<th>GREASE TYPE</th>
<th>TEMPERATURE (OF/OC)</th>
<th>ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium</td>
<td>175 / 80</td>
<td>Mild</td>
</tr>
<tr>
<td>Anhydrous Calcium</td>
<td>250 /120</td>
<td>Rolling</td>
</tr>
<tr>
<td>Lithium</td>
<td>385 / 195</td>
<td>Multi-purpose</td>
</tr>
<tr>
<td>Sodium</td>
<td>450 / 230</td>
<td>Corrosion Protection</td>
</tr>
<tr>
<td>Polyurea</td>
<td>500 / 260</td>
<td>High Temperature</td>
</tr>
</tbody>
</table>

Other characteristics for greases are:

» Adhesiveness
» Anti-wear
» Corrosion protection
» Evaporation qualities
» High-temperature performance
» Low-temperature performance
» Oil separation
» Oxidation resistance
» Pour point
» Viscosity
» Water resistance
INDUSTRIAL REGULATION

Greases are regulated by two major industrial groups. They are:

- American Society for Testing and Materials (ASTM)
- National Lubricating Grease Institute (NLGI)

These institutes have a number of test methods that define the greases. Each method is defined by its number. Grease tests can include:

**Penetration (ASTM D-217)**

- Tests the consistency or “hardness” of the grease
- The grades are NLGI from a 0 (softest) to a 6 (hardest). See the table below for more details on consistency
- Most common grades are NLGI #00 through #2

<table>
<thead>
<tr>
<th>GRADE NUMBER</th>
<th>PENETRATION RANGE*</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>000</td>
<td>445-475</td>
<td>Fluid</td>
</tr>
<tr>
<td>00</td>
<td>400-430</td>
<td>Semi-Fluid</td>
</tr>
<tr>
<td>0</td>
<td>355-385</td>
<td>Very Soft</td>
</tr>
<tr>
<td>1</td>
<td>310-340</td>
<td>Soft</td>
</tr>
<tr>
<td>2</td>
<td>265-295</td>
<td>Firm</td>
</tr>
<tr>
<td>3</td>
<td>220-250</td>
<td>Very Firm</td>
</tr>
<tr>
<td>4</td>
<td>175-205</td>
<td>Hard</td>
</tr>
<tr>
<td>5</td>
<td>130-160</td>
<td>Very Hard</td>
</tr>
<tr>
<td>6</td>
<td>85-115</td>
<td>Solid</td>
</tr>
</tbody>
</table>

* Depth in mm for a standard cone sinks in grease at 25°C.

**Dropping Point (ASTM D-566 and D-2265)**

- The temperature where the thickener system fails
- Grease should not be used above its dropping point temperature

**Rust Preventive Properties (ASTM D-1743)**

- Measures the ability of the grease to protect a bearing when exposed to water

**Water Washout (ASTM D-1264)**

- Measures the grease’s ability to stay in a bearing while being exposed to water washing
- Generally harder greases stand up to this test

**Water Spray Off (ASTM D-4049)**

- Measures the ability of grease to resist the physical spraying of water off of a test plate

**Timken Test (ASTM D-2509) and Four Ball EP Test (ASTM D-2596)**

- Used to assess the extreme-pressure properties of the grease under standard conditions

**Mobility**

- Measures the pumpability of grease at a range of temperatures

Details of these tests can be found in the ASTM or NLGI Methods.
## Greases

<table>
<thead>
<tr>
<th>Thickener</th>
<th>Texture</th>
<th>Dropping Point (°F/°C)</th>
<th>Water Resistance</th>
<th>Max. Temp. (°F/°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lithium</td>
<td>Smooth to buttery</td>
<td>375 / 190</td>
<td>Yes</td>
<td>250 / 121</td>
</tr>
<tr>
<td>Lithium – Complex</td>
<td>Smooth to Buttery</td>
<td>500 / 260</td>
<td>Moderate</td>
<td>300 / 149</td>
</tr>
<tr>
<td>Calcium – Hydrated</td>
<td>Smooth</td>
<td>190 / 88</td>
<td>Yes</td>
<td>150 / 65</td>
</tr>
<tr>
<td>Calcium – Anhydrous</td>
<td>Smooth</td>
<td>290 / 143</td>
<td>Yes</td>
<td>-</td>
</tr>
<tr>
<td>Calcium – Complex</td>
<td>Smooth</td>
<td>500+ / 260+</td>
<td>Yes</td>
<td>300 / 149</td>
</tr>
<tr>
<td>Sodium</td>
<td>Buttery to Fibrous</td>
<td>360 / 182</td>
<td>No</td>
<td>250 / 121</td>
</tr>
<tr>
<td>Aluminum – Normal</td>
<td>Smooth</td>
<td>180 / 87</td>
<td>Yes</td>
<td>150 / 65</td>
</tr>
<tr>
<td>Aluminum – Complex</td>
<td>Smooth</td>
<td>480 / 249</td>
<td>Yes</td>
<td>300 / 149</td>
</tr>
<tr>
<td>Barium</td>
<td>Buttery to Fibrous</td>
<td>400 / 204</td>
<td>Yes</td>
<td>250 / 121</td>
</tr>
<tr>
<td>Clay</td>
<td>Smooth</td>
<td>500+ / 260+</td>
<td>Yes</td>
<td>300 / 149</td>
</tr>
<tr>
<td>Polyurea</td>
<td>Smooth</td>
<td>470 / 243</td>
<td>Yes</td>
<td>300 / 149</td>
</tr>
<tr>
<td>Other</td>
<td>Smooth</td>
<td>470+ / 243+</td>
<td>Yes</td>
<td>300 / 149</td>
</tr>
</tbody>
</table>

Edited from Tool and Manufacturing Engineers Handbook, Volume 1, p. 4-44, Library of Congress, 1983

### Other Greases

There are other types of grease that do not use mineral or vegetable oil. They use silicone, fluoroether-based and CMC (carboxymethyl cellulose) for the lubrication.

Silicone grease is silica-thickened using polysiloxane compounds. This is used where potential attack on rubber's seals could be an issue with oil-based greases.

These greases are good for high-temperature applications and are used in laboratory applications.

Fluoroether-based grease is used where its inertness is required. These greases are inert to solvents, bases, acids and oxidizers. They tend to be expensive.

### Summit Lubricants

Quaker acquired Summit Lubricants in Batavia, New York in 2010. Summit Lubricants has earned a reputation as a premier wholesale lubricant and grease manufacturer. Summit has the following qualifications:

- ISO 9001-2008 Certified
- ISO 21469 Certified
- Produce batch quantities from 200 lbs to 40,000 lbs
- U. S. Army Qualified Manufacturer of Mil-PRF-10924H lubricant
- Recognized for solving difficult problems

Summit Lubricants manufactures the following greases:

- Aluminum Complex
- Calcium 12 Hydroxy
- Calcium Complex
- Calcium Sulfonate Complex
- Lithium Complex
- Lithium 12 - Hydroxy
- Sodium OD-Terephthalamate
- Clay
- Silica
- Polyurea
- PTFE

[quakerchem.com](http://quakerchem.com) | [info@quakerchem.com](mailto:info@quakerchem.com)
GREASES

Performance Requirements:

» Biodegradable
» Extreme Pressure
» Fire Resistant
» Food Grade (Kosher, Halal)
» High Temperature
» Low Noise
» Low Temperature
» MIL-PRF-10924H
» Water Resistance

Summit Lubricants has full laboratory facilities with a focus on innovation, product development and refinement. They have a full range of testing on ASTM grease procedures.

CONCLUSION

Greases are specialized lubricants. Supplying the proper grease requires details of the process so that the grease can handle the performance required. It is very important to make sure that your supplier understands the application so the proper grease can be provided.