Lubrication

Lubrication performs the multi-purpose role of preventing metal-to-metal contact of the mating surfaces, thus reducing friction, heat losses and carrying away from the mesh any wear debris, and excess heat generated. Gearless will sometimes run without a lubricant in slow speed applications or where a short life is anticipated. Lubricants fall broadly into the following groups namely:

(a) Solid Phase
(b) Grease
(c) Oils

Except in very special applications gas or air bearings do not normally merit further consideration.

Note
Compatibility of extreme pressure (EP) additives with bronze or brass components is essential. Plastic parts can be subject to stress cracking resulting from acidic conditions especially where temperatures are above 60°C.

Solid Phase Lubricants
The mechanism by which these work is one where their (enabling sliding) takes place within the substance and by so doing lubricates the surfaces. In this group of lubricants are molybdenum disulphide, graphite, and PTFE. They are sometimes added to greases and to oil in order to improve their load bearing characteristics. Otherwise they are usually only used when the speed is low or the operating cycle short as they do not carry heat away from the gear mesh.

Manganese phosphate surface treatment of steel is extremely good at preventing surface deterioration of steel or steel gear combinations under dry or extreme load conditions.

Greases
These commonly consist of a mineral or synthetic oil which is carried in a metallic soap base, e.g. lithium soap. The action is one where the oil is gradually released from the base on to the working surfaces. Their consistency varies from semi fluid to that of rigid and therefore the choice made must strike a balance between the ability of the grease to fall back into the gear mesh and the necessity to prevent leakage. Low numbers, e.g. 0.1, indicate greater fluidity and higher numbers greater stiffness. If too stiff, channels are merely cut by the moving parts which alter a short time will run dry.

Conversely if too soft then excessive churning and heat build-up can result.

Greases vary by the type of base, choice of oil and choice of additive. The addition of extreme pressure additives is common when arduous conditions exist as with metal spiral bevel and spiral bevel gears.

Synthetic greases of the polyglycol type can have superior oxidation resistance and do operate successfully over wider temperature ranges as well as offering lower frictional losses, but they are not generally used for extreme pressure applications.

Oil Lubrication
An oil can carry away heat from a mesh and bearings, prevent metal to metal contact at the mesh, and carry away wear debris. Straight mineral oils are most generally used and are satisfactory for most gear applications but they do require an extreme pressure additive for hypoid, spiral bevel, and spiral drive applications where both members are of hard steel.

The viscosity should be thick enough to maintain an effective oil film but not so thick as to generate excessive drag.

Oil lubrication can be effected by spray or by splash feed where the limiting critical surface speed is generally 2000 ft/minute [10m/sec]. With splash lubrication the gear cases should be designed to provide a smooth circulation of oil without excessive turbulence but the presence of a pocket to trap debris is a useful feature. Sufficient oil level for the lowest gear of a mesh to dip into the oil is usually satisfactory. In some instances the addition of a stopper to the oil to reach all bearings and gears will be necessary. Except in a few low speed applications effective shaft seals will be necessary. Breathers are also necessary where there is a likelihood of pressure build up.

Oil Temperature
Working oil temperatures may vary over a considerable range.

At the lower temperatures an oil must be thin enough not to present excessive drag and to flow satisfactorily into the gear mesh. The oil “pour point” is the lowest practical temperature limit at which oil will function properly.

During high ambient temperatures and/or during normal use the oil temperature may rise to a level above which the unit is too hot to touch (60-70°C). This is not necessarily detrimental for a practical maximum oil temperature is usually 100°C. It is prudent however to check out the reason for high oil temperature.

Recommended lubricants

The precise choice of lubricant and lubricant viscosity will depend upon the particular application but the chart below gives some of the possible alternatives. There are many excellent lubricants which for brevity have not been included in this list and the reference to one of the major oil companies or to Davall Gears Co. regarding application will in many instances be worthwhile.

Recommended lubricants

<table>
<thead>
<tr>
<th>Class of application</th>
<th>Notes</th>
<th>Shell</th>
<th>Mobil</th>
<th>Castrol</th>
<th>Gulf</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spur/bevel Hybrid Spur/Bevel Offset/Bevel</td>
<td>Extreme pressure additives necessary</td>
<td>Spindel 908P</td>
<td>Omega 71 oil</td>
<td>Avanza EP / grease</td>
<td>Multipurpose gear EP70C</td>
</tr>
<tr>
<td>Straight Bevel Spur Bevel</td>
<td>Straight oil usually satisfactory</td>
<td>Vitronol</td>
<td>Mesanoil</td>
<td>Avanza II 460</td>
<td>Multipurpose gear EP70C</td>
</tr>
<tr>
<td>Instrument gears</td>
<td>Straight oil usually satisfactory, good oxidation resistance needed</td>
<td>Aerolube Fluid 12</td>
<td>Trivec A-40</td>
<td>Trivec A-40</td>
<td>Alpha AFE</td>
</tr>
<tr>
<td>Plastic/Unsintered Bronze/Unsintered Metal</td>
<td>Taken care to avoid acid or solvent attack on plastic</td>
<td>Avanza II 460</td>
<td>Trivec A-40</td>
<td>Glycol grease 00</td>
<td>Multipurpose gear EP70C</td>
</tr>
</tbody>
</table>

Guide To Lubricant Choice (approximation)

Actual choice to depend upon individual application.

Note: The alternative makes of oil shown horizontally on the chart are not necessarily equivalent greases.