Metalworking fluid formulators are challenged to provide products to their end customers that respond to the manufacturing industry’s changing demands. Performance demands on metalworking fluid formulations are increasing in response to more exotic metal alloys, higher production speeds and intricate tool and part geometries. Simultaneously, metalworking fluid compositions must adhere to more stringent health, safety and environmental regulations and meet machine operator expectations for clean working conditions.

In response to that need, Lubrizol Metalworking Additives developed Lubrizol 5333. Features include:
- Light color
- Low odor
- Unusually strong film strength
- Soluble in a wide variety of naphthenic, paraffinic and vegetable oils as well as synthetic base stocks
- Made from vegetable oil, a renewable resource

These features provide metalworking formulators with a useful tool to build next-generation metalworking fluids that meet the performance requirements of engineers, the health and safety requirements of the workplace, the low environmental impact standards of disposal and the aesthetic qualities desired by machine workers. Lubrizol 5333 provides an exceptional mix of features not available from traditional sulfurized extreme pressure additive chemistry.

**Applications**

Lubrizol 5333 can be used in a wide variety of oil-based formulations. One application is as a non-staining extreme pressure agent for metal removal and metal-forming lubricants (for both ferrous and non-ferrous metals) such as cutting oils, screw machine oils, multi-purpose metalworking oils, drawing and stamping compounds, cold heading and rolling oils. The color and odor profile of Lubrizol 5333 enables the formulation of modern, high-performance neat cutting fluids with excellent appearance and low odor, allowing the work piece to be highly visible to machine operators during operations. Lubrizol 5333 also serves as a good replacement for traditional, dark-colored, approximately 10 percent inactive sulfur fatty additives in any application where improved product aesthetics are desired.
Lubrizol 5333 is inherently oil soluble but can be emulsified. Its inactive sulfur chemistry allows use in such industrial applications as machine tool oils, tri-purpose oils, worm gear oils and waylubes.

**Slideway Lubricants Application**

When Lubrizol 5333 is used to make light-colored slideway lubricants, formulations meet or exceed the latest industry requirements. Cincinnati Lamb P-47 requirements can be met with treat levels as low as two percent. Lubrizol 5333’s unique balance of boundary and extreme pressure lubrication can provide elevated Timken results without sacrificing stick/slip performance, an uncommon benefit from extreme pressure additives in these applications.

We subjected an ISO 68 slideway lubricant formulation treated with five percent Lubrizol 5333 to Bijur Lubricating Corporation’s Oil Filtration Test, designed to identify problem lubricant formulations in their lubricant application equipment (using 40 micron filters at the lubricator inlet). The Lubrizol 5333 formulation passed the evaluation, unlike other light-colored slideway lubricant chemistries on the market that have exhibited problems in the Bijur test and in the field.

**How 5333 Stacks Up**

We compared Lubrizol 5333 to two commercially available, dark-colored, approximately 10 percent sulfur additives.

<table>
<thead>
<tr>
<th>Neat Additive Properties</th>
<th>Lubrizol 5333</th>
<th>Additive A</th>
<th>Additive B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color – ASTM D1500</td>
<td>2.0</td>
<td>&gt;8.0</td>
<td>&gt;8.0</td>
</tr>
<tr>
<td>Viscosity – cSt @ 40°C</td>
<td>700</td>
<td>100</td>
<td>350</td>
</tr>
<tr>
<td>Viscosity – cSt @ 100°C</td>
<td>65</td>
<td>35</td>
<td>36</td>
</tr>
</tbody>
</table>

Lubrizol 5333’s dramatically higher viscosity provides unique film-forming properties not found in traditional, dark-colored sulfurized additives designed for similar applications.
At 10% dilutions, Lubrizol 5333 provides lower coefficient of friction readings throughout the test period, and the functional lubricant film persists nearly 50% longer than traditional sulfurized additives.

At 20% dilutions, Lubrizol 5333 provides similar or lower coefficient of friction readings throughout the test period, and the functional lubricant film persists nearly 50% longer than Additive A and 30% longer than Additive B.

The coefficient of friction is calculated over time from the torque data and interfacial pressure. Performance is evaluated through hydrodynamic and boundary lubrication zones and into extreme pressure zones where lubricant depletion occurs and lubricant films break down.

Lubrizol 5333 offers formulators a new tool to achieve high performance from sulfurized fatty additives with improved aesthetic qualities. Its exceptional film strength and extreme pressure properties outperform traditional dark-colored alternatives. The backbone of the product is vegetable oil, a renewable resource consistent with environmentally responsible metalworking fluid design. The product is currently compliant and registered for use globally except in Canada, where full registration on the Domestic Substances List is expected in early 2006.

Lubrizol High-Performance Metalworking Additives

Lubrizol's Metalworking Additives' state-of-the-art research facility, located in Spartanburg, South Carolina, is one of the best equipped in the U.S. Additional support labs in Europe and Asia are devoted exclusively to helping customers find answers to difficult technical questions and to developing products that meet the needs of an ever-changing environment.

Our analytical labs include standard wet tests as well as FTIR, X-ray fluorescence and gas chromatography. Performance tests include:

- Falex #8 Tapping Torque tester
- CNC Machining Center – Tapping, Drilling and Milling tests
- Modified Timken Aquarium Emulsion Stability test
- Draw Bead Simulator
- Twist Compression Tester for Drawing, Stamping and Hydroforming
- LDH Cup Forming
- Humidity Cabinet and Q-Panel Corrosion tests
- Salt Spray Corrosion tests
- Fluid Mist testing
- Fluid Dynamic Foam test
- Quenchalzyer – Wolfson Probe
- 4-Ball Wear and EP
- Falex Pin and Vee Block

When coupled with Lubrizol's corporate research and development in Wickliffe, Ohio, we have comprehensive analytical testing capabilities second to none.

Lubrizol Metalworking Additives supplies the broadest range of products in the industry. Our products are available where you want them, when you need them, and our global team is available to support your business.