TSB: DT-2008-03-25

Technical Service Bulletin

Date: 3/25/2008
Product Description: AMSOIL Severe Gear® Synthetic Extreme Pressure (EP) Gear Lubes
Subject: Thermal Runaway

OBJECTIVE:

Explain the condition known as Thermal Runaway and its effect on equipment and demonstrate the superior protection AMSOIL Severe Gear Synthetic Gear Lubes provide against Thermal Runaway.

ISSUES:

Modern turbo diesel pickup trucks, V-10 gasoline pickups and sport utility vehicles (SUVs) and high-horsepower V-8 trucks boast more towing and payload capacities than ever before. In fact, the market has seen a 34 percent increase in engine horsepower over the last decade. In the light truck segment, there has been a 93 percent horsepower increase since 1981.[1] In vehicles such as a fifth-wheel equipped Ford F-350 Super Duty, towing capacities have reached a high of 19,200 lbs.[2] Testing shows that in new axle applications simulating trailer-towing at 88 km/h (55 mph) at a 3.5% grade, temperatures can reach as high as 188°C (370°F).[3] Differential stress has also increased in limousines, conversion vans, and trucks and cars with modified, high-performance engines.

The extreme loads, pressures and temperatures experienced by modern vehicles place increased stress on gear lubricants that can lead to a serious condition known as ***Thermal Runaway***. As temperatures in the differential climb upward, gear lubricants lose viscosity and load-carrying capacity. When extreme loads and pressures break the lubricant film, metal-to-metal contact and increased heat occur. This increased friction and heat, in turn, results in further viscosity loss, which *further* increases friction and heat. As heat spirals upward, viscosity spirals downward. Thermal Runaway is a vicious cycle that leads to irreparable equipment damage from extreme wear, and ultimately catastrophic gear and bearing failure.

TECHNICAL DISCUSSION:

Viscosity Protection

Viscosity is the most important property of a lubricant in its defense against friction and wear. Viscosity correlates to film thickness and film strength, which keep moving parts from contacting each other and creating increased friction, heat and wear. The higher the viscosity of a lubricant, the greater protection it provides. Note, however, that too thick a lubricant is detrimental because it consumes more energy. The SAE J306 classification system identifies viscosity ranges for gear lubes. The original equipment manufacturer determines which SAE viscosity grade is optimum for the application.

Shear Stability

Many gear lubes are formulated with additives called viscosity index improvers (VI). These additives broaden a lubricant's operating temperature range and are used to ensure multi-grade viscosity performance for hot and cold temperatures. VI improvers keep lubricants from becoming too thick to flow in cold temperatures and too thin to protect in high temperatures. However, shearing forces within equipment can cause these additives to break down and lose viscosity. SAE J306 requires that multi-viscosity gear oils be tested for shear stability in the CEC L-45-A-99 (KRL) 20-Hour Shear Test to ensure they do not shear down and fall below the minimum viscosity requirements. The graph on the next page shows initial oil viscosity and viscosity following the test, while the area between the dotted lines indicates SAE J306 high-temperature viscosity requirements for SAE 90 gear lubes.

RECOMMENDATION:

Install the correct viscosity grade of AMSOIL Severe Gear Extreme Pressure Synthetic Lubricants in the differential. AMSOIL Severe Gear provides superior protection against Thermal Runaway with the exclusive AMSOIL "Stay-in-Grade" formulary technology and an overtreatment of extreme pressure additives. Severe Gear Synthetic Gear Lubes combine only the best naturally high VI, shear stable synthetic base oils that guarantee the right film thickness for a given viscosity grade: not too thick, not too thin. As the last line of defense against wear, all Severe Gear Extreme Pressure Lubricants are fortified with 30 percent more extreme pressure additives than are required for standard API GL-5 performance. The AMSOIL high performance additives lay down an iron sulfide barrier film to protect against wear in case of a lubricant film breach. This self sacrificial film is a hard coating that wears off first during metal-to-metal contact before the metal is worn off.

Only AMSOIL offers an extensive line of synthetic gear lubes with viscosities ranging from the most popular SAE 75W-90 to the ultra rare SAE 190 to the heaviest viscosity of SAE 250. AMSOIL is the leader in synthetic gear lubricant technology.

Submitted By: JY **Reviewed By: KM** **Approved By: AA** **Approval Date: 4/3/08**

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Severe Gear Synthetic 75W-90, 75W-110 and 75W-140 Gear Lubes are ideal for severe-duty applications, including towing, hauling, steep hill driving, commercial use, plowing, racing, off-road use, rapid acceleration, frequent stop-and-go operation and high ambient temperatures.

Severe Gear Synthetic SAE 190 and SAE 250 Gear Lubes are formulated for racing and off-road applications, including off-road truck racing, rock racing, rock crawling, tractor pulling, funny car racing and dragster racing. Other severe duty applications include heavy duty trucks and equipment where increased lubricant film is necessary.

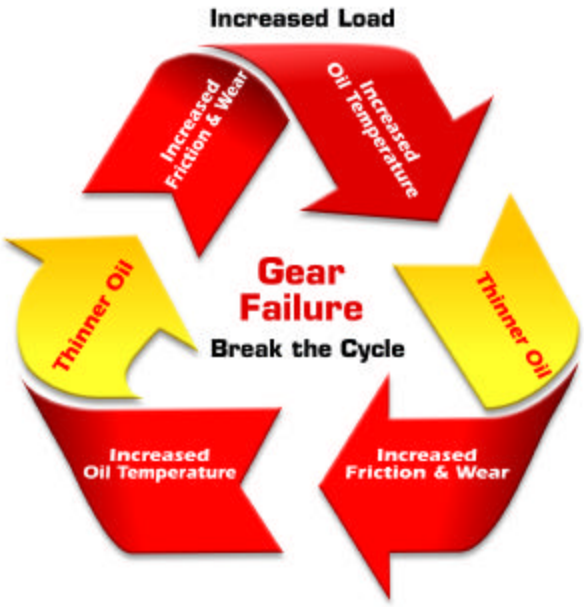
REFERENCES:

1. Baker, Mark R.; Grisso, Bryan A.; Rhoads, Gabe; Schenkenberger, Chris; Qureshi, Ferrukh S. "Breaking the Viscosity Paradigm: Formulating Approaches for Optimizing Efficiency and Vehicle Life," SAE Paper #2005-01-3860. The Lubrizol Corporation, Andrew Gelder, Lubrizol Limited, United Kingdom.

2. 2007 Trailer Life Towing Guide.

3. O'Conner, B.M.; Schenkenberger, C.: "The Effect of Heavy Loads on Light Duty Vehicle Axle Operating Temperature," Powertrain & Fluid Systems Conference and Exhibition, SAE Paper #2005-01-3893, October, 2005.

4. AMSOIL INC.: "A Study of Automotive Gear Lubes," G2457, September, 2007.



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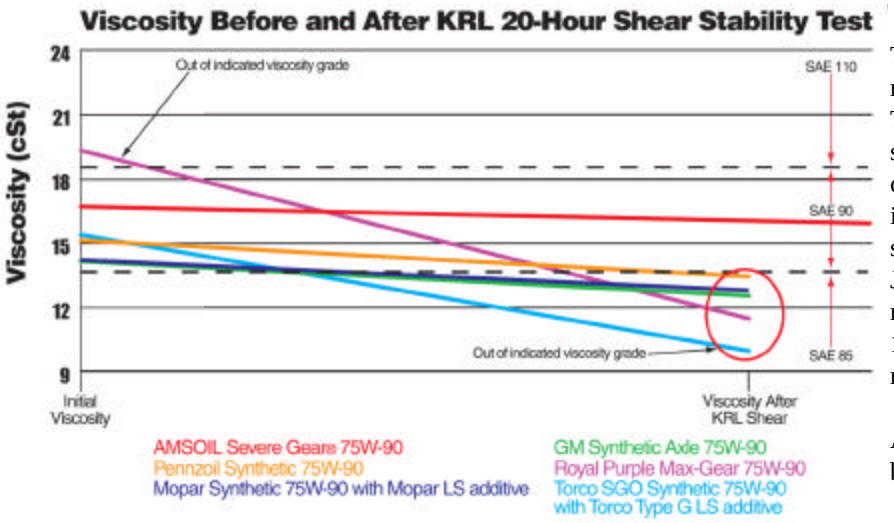

As tested by an independent lab in April 2007.

Break the Cycle.

The KRL 20-Hour Shear Test is an SAE-required test for all automotive gear lubes. This specification requires that gear lubes not shear down and fall below the minimum viscosity for that grade. This graph shows the initial oil viscosity and the viscosity after the shear test of six popular gear lubes. The SAE J306 high-temperature viscosity requirements for SAE 90 gear lubes are between 13.5 cSt and <18.5 cSt @ 100°C (212°F) maximum.

AMSOIL Severe Gear retained its viscosity better than any of the competing brands.

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