

Gear Oil Procedureing

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L20 Performance of Gear Lubricants at Low Speed, High Torque

Specifications

This procedure covers GL-4 and Federal Procedure Method 5317.

This procedure is no longer part of U.S. requirements. It has been replaced by the L37 procedure, although the L20 procedure is used for some foreign clients and for screening and research in the U.S.

Objective

This method is used for determining the load carrying, wear, and extreme pressure characteristics of gear lubricants in hypoid axle assemblies under conditions of low speed and high torque.

Procedure fixture

A specially selected rear axle assembly, engine, transmission, and two large dynamometers serve as the procedure apparatus.

Procedure parameters

The procedure axle is operated at 62 axle rpm and 600 lb-in of torque with no cooling water until the lubricant temperature reaches 140°F. The axle is then operated for 30 hours at 62 axle rpm and 32,311 lb-in of torque with the lubricant temperature being cycled between 200°F and 250°F.

Procedure parts evaluated

The ring and pinion gears are evaluated.

Pass/fail criteria

The pass/fail criteria require that there be no "significant" distress.

L33-1 Performance of Gear Lubricants While Subjected to Water Contamination and Elevated Temperature

Specifications

This procedure covers Federal Procedure Method Standard No. 791, SAE J2360, MIL-PRF-2105E (to be replaced by SAE J2360 as of January 1, 2004), GL-5, PG-2, and Federal Procedure Method 5326, and individual original equipment manufacturers' specifications.

Objective

This method is used for evaluating the rust and corrosion inhibiting properties of a gear lubricant while subjected to water contamination and elevated temperature.

Procedure fixture

An electric motor, specially selected hypoid differential housing assembly, cooling fan, heating lamps, and heated storage box serve as the procedure apparatus.

Procedure parameters

The differential housing assembly is operated for 4 hours at 2,500 input rpm and 180°F lubricant temperature with 1 fl. oz. of distilled water mixed in the lubricant. The procedure unit is then placed in the storage box and stored for 162 hours at 125°F. At the end of the procedure, the procedure parts of the assembly are rated for the presence of rust.

Procedure parts evaluated

All internal moving parts (ring, pinion, bearings, differential gears, etc.) are evaluated.

Pass/fail criteria

API Category GL-5 candidate fluids are only required to have a 9.00 Final Rust Corrosion Merit Rating or greater to be determined a pass. For samples submitted to LRI, candidate fluids to be determined a pass must meet the following: (1) 9.00 Final Rust Corrosion Merit Rating or greater, (2) cannot have a single rated area with a 5.0 merit rating or less, and (3) cannot have more than three rated areas with an 8.0 merit rating or less.

L37 Performance of Gear Lubricants at High Speed, Low Torque, Followed by Low Speed, High Torque (ASTM D 6121)

Specifications

This procedure covers the Federal Procedure Method Standard No. 791, MIL-PRF-2105E (to be replaced by SAE J2360 as of January 1, 2004), GL-5, PG-2, Federal Procedure Method 6507.1, and individual original equipment manufacturers' specifications.

Objective

This method is used for determining the load-carrying, wear, and extreme pressure characteristics of gear lubricants in hypoid axle assemblies under conditions of high-speed, low-torque, and low-speed, high-torque operation.

Procedure fixture

A specially selected rear axle assembly, engine, and transmission, and two large dynamometers serve as the procedure apparatus.

Procedure parameters

The procedure axle is operated for 100 minutes at 440 axle rpm, 295°F lubricant temperature, and 9460 lb-in of torque. The axle is then operated for 24 hours at 80 axle rpm, 275°F lubricant temperature, and 41,800 lb-in of torque.

Procedure parts evaluated

The ring and pinion gears are evaluated.

Pass/fail criteria

The pass/fail criteria require that there be no "significant" distress.

L42 Performance of Gear Lubricants in Axles Under High Speed and Shock Loading

Specifications

This procedure covers the Federal Procedure Method Standard No. 791, MIL-PRF-2105E (to be replaced by SAE J2360 as of January 1, 2004), GL-5, PG-2, Federal Procedure Method 6507.1, and individual original equipment manufacturers' specifications.

Objective

The objective of this procedure is to evaluate the anti-scoring properties of gear lubricants under high-speed and shock conditions. The performance of procedure lubricants is compared to that of reference oils.

Procedure fixture

A specially selected rear axle assembly, engine, transmission, special axle-mounting assembly, and two large dynamometers serve as the procedure apparatus.

Procedure parameters

A break-in is conducted at moderate speed and load at a lubricant temperature of 225°F. This is followed by a series of moderate accelerations and decelerations with temperatures approaching 280°F. The final series of runs consists of high-speed accelerations with rapid decelerations.

Procedure parts evaluated

The ring and pinion gears are evaluated.

Pass/fail criteria

The pass/fail criteria require that there be less quantity of scoring on the ring and pinion gears than on the associated pass reference oil procedure.

L60-1 Thermal and Oxidative Stability of Gear Lubricants (ASTM D 5704)

Specifications

This procedure covers SAE J2360, MIL-PRF-2105 (to be replaced by SAE J2360 as of January 1, 2004), MT-1, PG-2, and original equipment manufacturers' specifications. This procedure has replaced the CRC L-60 procedure, which was part of GL-5, Federal Procedure Method Standard No. 791, and Federal Procedure Method 2504.

Objective

This method is used for determining the deterioration of lubricants under severe thermal and oxidative conditions.

Procedure fixture

A gear case assembly (updated from the L-60 model), two spur gears, two copper strips, a bearing, a temperature control system, an alternator, a motor, and a regulated air supply serve as major parts of the procedure fixture.

Procedure parameters

The spur gears are rotated under load at 1750-rpm input for 50 hours. The lubricant temperature is maintained at 325°F. Airflow through the lubricant is controlled at 22.1 mg/min for the procedure's duration.

The physical and chemical properties of the oil and deposits on the gears are evaluated at the end of procedure.

Procedure parts evaluated

The large and small gears are evaluated, as well as the used oil.

Pass/fail criteria

The pass/fail criteria are as follows:

Viscosity Increase	≤ 100%
Pentane Insolubles	≤ 3.0%
Toluene Insolubles	≤ 2.0%
Carbon/Varnish Rating	≥ 7.5
Sludge Rating	≥ 9.4

FZG Load Stage (ASTM D 5182)

Specifications

This procedure covers API MT-1, US steel 224, MERCON® V, and future ATF specifications (modified D 5182).

Objective

The objective is to evaluate the anti-scuffing properties of a lubricant.

Procedure fixture

Performance of this procedure requires a Strama 4-square electric motor-driven procedure machine and "A" profile FZG procedure gears.

Procedure parameters

The procedure machine is operated at 1446 rpm for 12 different 15-minute load stages. Each load stage is started with the procedure lubricant at 90°C. This procedure can be routinely conducted at higher speeds and temperatures.

Procedure parts evaluated

The procedure gears are evaluated.

Pass/fail criteria

The pass/fail criterion is 20 mm of scuffing total for all pinion teeth.

FZG Tractor Hydraulic Fluid Wear (ASTM D 4998)

Specifications

This procedure covers MIL-L-2104E (to be replaced by SAE J2360 as of January 1, 2004) and Caterpillar TO-4.

Objective

The objective is to evaluate the low-speed anti-wear properties of a lubricant.

Procedure fixture

Performance of this procedure requires a Strama 4-square electric motor-driven procedure machine and "A" profile procedure gears.

Procedure parameters

The procedure machine is operated at 100 rpm, 120°C, and load stage 10 for 20 hours.

Procedure parts evaluated

The procedure gears are evaluated.

Pass/fail criteria

The total weight loss for the pinion and gear wheel must be lower than the specified limits.

SSP 180 Synchronizer Endurance Procedure

Specifications

This procedure is based on CEC L-66-T-99.

Objective

The objective is to evaluate a lubricant's ability to protect the brass synchronizer from wear while providing enough friction to allow for proper synchronizer operation.

Procedure fixture

This procedure is conducted in an SSP-180 procedure machine. Inside are adapters that hold the first and second speed gears in place. The synchronizer mechanism is mounted between these gears.

Procedure parameters

The procedure oil is maintained at 80°C while the synchronizer is cycled once every 4.5 seconds. The synchronizer is loaded by a flywheel (mass moment of inertia = 0.04 KgM²) accelerated and decelerated between 0 and 1100 rpm.

Procedure parts evaluated

The synchronizer cone height is measured pre- and post-procedure to determine wear.

Pass/fail criteria

The procedure is stopped when the desired number of cycles has been completed or when clashing (unsynchronized shifting) occurs.

High-Temperature Cyclic Durability Procedure (ASTM D 5579)

Specifications

This procedure covers Mack GO-G, GO-H, GO-J, API MT-1, and MIL-PRF-2105E (to be replaced by SAE J2360 as of January 1, 2004).

Objective

The objective is to evaluate the thermal stability of gear oils by determining number of cycles to unsynchronized shift.

Procedure fixture

Mack synchronizer with new friction and reaction disks, oil heater, Mack T-2180 transmission, and electric motor are required to perform this procedure.

Procedure parameters

The high-low range synchronizer of a Mack T-2180 18-speed transmission is shifted through a 12-second cycle (6 seconds in low range, 6 seconds in high range) until an unsynchronized shift occurs. The shift pressure is held at 90 psi, the procedure lubricant temperature is controlled at 250°F, and the tail shaft speed is held at 750 rpm throughout the procedure. The countershafts speed ranges from 459 rpm to 1756 rpm during the shift.

Procedure parts evaluated

The clutch disks, shifter fork, and synchronizer ring are evaluated.

Pass/fail criteria

Number of cycles to failure greater than the average of the last five passing reference oil results is the pass/fail criterion.

Mack Power Divider Snap Procedure

Specifications

This procedure covers the Mack GO-J.

Objective

The objective is to evaluate the wear protection of a gear lubricant.

Procedure fixture

Mack truck tractor and trailer loaded to 98,000 lbs. are required to perform this procedure.

Procedure parameters

The Mack truck tractor and trailer are driven in a 100-foot diameter circle for 500 laps. Abnormal noise ("snapping", "popping", etc.) is noted and cams and wedges of power divider are rated for wear and distress.

Procedure parts evaluated

The cams and wedges are evaluated.

Pass/fail criteria

No "significant" distress present on parts and no "abnormal" noise during testing are the pass/fail criteria.

Gear Oil Fleet Procedures

Heavy-Duty

In-service testing of heavy-duty axles is typically related to MIL-PRF-2105e (to be replaced by SAE J2360 as of January 1, 2004) gear oil qualification programs. Three or four trucks are operated for 200,000 miles. Performance of the oils is judged from the appearance of gears, bearings, and related components. Periodic oil samples are analyzed for wear metals, additives, and contaminants.

Light-Duty

In-service evaluation of gear oils in light-duty vehicles, such as pickups and full-size passenger sedans are common. Performance of the oils is judged from the appearance of gears, bearings, and related components. Mileage accumulation is 100,000 miles.

Custom Fleet Evaluations

Procedures are designed for the special needs of a client.

GM Big Wheel/Little Wheel

A car equipped with limited slip differential is operated for specified miles with different diameter tires on each side of the drive axle. Periodic checks of axle noise and torque bias retention are conducted.

Rear Axle Scoring Procedure

A Chevrolet sedan equipped with an automatic transmission, 305 CID V-8 engine, and 3.25:1 ratio rear axle is driven for a series of full-throttle accelerations from a standing start. The transmission is shifted into low at 70 mph during the coast-down. The stress on the coast side of axle gear can produce excessive scoring with different lubricants.