

L-20 Performance of Gear Lubricants at Low Speed, High Torque

Specifications

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

This procedure is no longer part of U.S. requirements. It has been replaced by the L-37 test, although the L-20 test is used for some foreign clients and for screening and research in the U.S.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.

Test fixture

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

Test parameters

The test 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.

Test parts evaluated

The ring and pinion gears are evaluated.

Pass/failure criteria

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

L-33 Performance of Gear Lubricants While Subjected to Water Contamination and Elevated Temperature

Specifications

This procedure covers Federal Test Method Standard No. 791, MIL-PRF-2105E, GL-5, PG-2, and Federal Test 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.

Test fixture

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

Test parameters

The differential housing assembly is motored 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 test unit is then placed in the storage box and stored for 162 hours at 125°F. At the end of the test, the parts of the assembly are rated for the presence of rust.

Test parts evaluated

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

Pass/failure criteria

The pass/fail criteria requires that there be no rust on "functional" surfaces (i.e. locations with relative motion of 2 pieces), and less than 1% rust on the assembly's cover plate.

L-37 Performance of Gear Lubricants at High Speed, Low Torque, Followed by Low Speed, High Torque (ASTM D 6121)

Specifications

This procedure covers the Federal Test Method Standard No. 791, MIL-PRF-2105E, GL-5, PG-2, Federal Test 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.

Test fixture

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

Test parameters

The test 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.

Test parts evaluated

The ring and pinion gears are evaluated.

Pass/fail criteria

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

L-42 Performance of Gear Lubricants in Axles Under High Speed and Shock Loading

Specifications

This procedure covers the Federal Test Method Standard No. 791, MIL-PRF-2105E, GL-5, PG-2, Federal Test Method 6507.1, and individual original equipment manufacturers' specifications.

Objective

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

Test fixture

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

Test 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.

Test parts evaluated

The ring and pinion gears are evaluated.

Pass/fail criteria

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

L-60-1 Thermal and Oxidative Stability of Gear Lubricants (ASTM D 5704)

Specifications

This procedure covers MIL-PRF-2105E, MT-1, PG-2, and original equipment manufacturers' specifications. This test has replaced the CRC L-60 test, which was part of GL-5, Federal Test Method Standard No. 791, and Federal Test Method 2504.

Objective

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

Test 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 test fixture.

Test parameters

The spur gears are rotated under load at 1750 rpm input for 50 hours. The lubricant temperature is maintained at 325°F. Air flow through the lubricant is controlled at 1.1 liters/hour for the test's duration. The physical and chemical properties of the oil and deposits on the gears are evaluated at the end of test.

Test parts evaluated

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

Pass/fail criteria

The pass/fail criteria is 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)

Specification

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.

Test fixture

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

Test parameters

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

Test parts evaluated

The test gears are evaluated.

Pass/fail criteria

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

FZG Tractor Hydraulic Fluid Wear (ASTM D 4998)

Specification

This procedure covers MIL-L-2104E and Caterpillar TO-4.

Objective

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

Test fixture

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

Test parameters

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

Test parts evaluated

The test gears are evaluated.

Pass/fail criteria

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

Audi B-80 Synchronizer Endurance Test

Specification

This procedure covers the PM-1 and some European OEMs.

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.

Test fixture

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

Test parameters

The test 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.

Test parts evaluated

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

Pass/fail criteria

The test is stopped when the desired number of cycles has been completed or when clashing (un-synchronized shifting) occurs.

High-Temperature Cyclic Durability Test (ASTM D 5579)

Specification

This procedure covers Mack GO-G, GO-H, GO-J, API MT-1, and MIL-PRF-2105E.

Objective

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

Test fixture

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

Test 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 test lubricant temperature is controlled at 250°F, and the tailshaft speed is held at 750 rpm throughout the test. The countershafts speed ranges from 459 rpm to 1756 rpm during the shift.

Test 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 5 passing reference oil results is the pass/fail criteria.

Mack Power Divider Snap Test

Specification

This procedure covers the Mack GO-J.

Objective

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

Test fixture

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

Test parameters

The Mack truck tractor and trailer are driven in a 100 ft. 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.

Test parts evaluated

The cams and wedges are evaluated.

Pass/fail criteria

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

Gear Oil Fleet Tests

Heavy-duty

In-service testing of heavy-duty axles is typically related to MIL-PRF-2105E gear oil qualification programs. Three or four trucks are operated for 100,000 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 50,000 miles.

Custom fleet evaluations

Tests 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 test

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.