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SAE J308 JUN89

Axle and Manual Transmission Lubricants

SAE Information Report
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FUELS AND LUBRICANTS REPORT

SAE J308

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AXLE AND MANUAL TRANSMISSION LUBRICANTS

1. SCOPE:

This SAE Information Report was prepared by the SAE Fuels and Lubricants Technical Committee for two purposes: 1. to assist the users of automotive equipment in the selection of axle[1] and manual transmission lubricants for field use, and 2. to promote a uniform practice for use by marketers of lubricants and by equipment builders in identifying and recommending these lubricants by a service designation.

2. FOREWORD:

In 1943, the U.S. Army Ordnance Department (currently U.S. Army Belvoir Research, Development and Engineering Center) began qualifying gear lubricants against U.S. Army Specification 2-105. This specification has gone through several revisions and is now identified as MIL-L-2105D. The American Petroleum Institute recognizes gear lubricants meeting this latter specification as API Service GL-5 (API GL-5).

In 1977, the U.S. Army terminated direct sponsorship of the qualification process and contracted with SAE to: (1) perform the reviewing activity, and (2) make recommendations relative to the acceptance of candidate products under the military gear lubricant specification. In accordance with its contract with SAE, the U.S. Army retains sole responsibility for approving and qualifying products to its specification.

Following termination of the U.S. Army sponsorship, the SAE Board of Directors established a Lubricants Review Institute (LRI), which in turn has established an LRI Gear Lubricant Review Committee. This committee developed procedures for submitting candidate lubricants for review as well as procedures for reviewing such lubricants. The LRI activities are reviewed by SAE Legal Counsel to ensure compliance with applicable federal and state laws. The LRI Gear Lubricant Review Procedures can be obtained from SAE headquarters in Warrendale, PA.

[1]Axle(s) in this document are defined as drive axles incorporating reduction gearing and/or differential gears.

2. (Continued):

Performance Characteristics--In axles and manual transmissions, gears and bearings of different designs are employed under a variety of service conditions. Therefore, the selection of a lubricant involves careful consideration of the performance characteristics required.

3. LOAD-CARRYING CAPACITY:

One of the most important gear lubricant performance characteristics is load-carrying capacity. Some gears are operated under such loads and speeds that the very low load-carrying capacity of untreated oil[2] is adequate. However, most gears require lubricants of greater load-carrying capacity, which is provided through the use of additives.

Gear lubricants compounded to achieve increased load-carrying capacity are referred to as "extreme pressure" (EP) lubricants. However, when this term is applied to a gear lubricant, it means only that the load-carrying capacity of the lubricant is greater than that of untreated oil, with no distinction as to how much greater it may be. Therefore, to differentiate among EP lubricants of various load-carrying capacities, it is necessary to classify them further. The Coordinating Research Council (CRC) and ASTM have developed tests and the American Petroleum Institute (API) has assigned performance designations to aid in this classification.

The following designations from API Publication 1560, Lubricant Service Designation for Automotive Manual Transmissions and Axles, November, 1981, have been amended with the objective of improving user understanding of intended lubricant application.

API GL-1 Designates the type of service characteristic of manual transmissions operating under such mild conditions of low unit pressures and minimum sliding velocities, that untreated oil may be used satisfactorily. Oxidation and rust inhibitors, defoamers, and pour depressants may be used to improve the characteristics of lubricants intended for this service. Frictional modifiers and extreme pressure additives shall not be utilized.

Ø Due to speeds and loads involved, untreated oil is generally not a satisfactory lubricant for many passenger car manual transmissions[3]. For some truck and tractor manual transmissions, untreated oils may be used successfully. In all cases, the transmission manufacturers' specific lubricant recommendations should be followed.

API GL-2 Designates the type of service characteristic of automotive type worm-gear axles operating under such conditions of load, temperature, and sliding velocities, that lubricants satisfactory for API GL-1 service will not suffice.

[2]Untreated oil is defined as either refined petroleum or synthetic lubricant base oil containing no supplemental performance additives.

[3]Automatic or semiautomatic transmissions, fluid couplings, torque converters, and tractor hydraulic systems usually require special lubricants. For the proper lubricant to be used, consult the manufacturer or lubricant supplier.

3. (Continued):

Products suited for this type of service contain antiwear or very mild extreme-pressure agents which provide protection for worm gears.

API GL-3 Designates the type of service characteristic of manual transmissions and spiral-bevel axles operating under mild to moderate to severe conditions of speed and load. These service conditions require a lubricant having load-carrying capacities greater than those that will satisfy API GL-1 service, but below the requirements of lubricants satisfying the API GL-4 service.

Gear lubricants designated for API GL-3 service are not intended for hypoid gear applications.

API GL-4 Designates the type of service characteristic of spiral-bevel and hypoid[4] gears in automotive axles operated under moderate speeds and loads. These oils may be used in selected manual transmission and transaxle applications. (User should consult axle/transmission manufacturers' specific lubricant recommendations).

While this service designation is still used commercially to describe lubricants, some test equipment used for performance verification is no longer available. ASTM is investigating the possibility of redefining service designation API GL-4 using modern test equipment.

API GL-5 designates the type of service characteristic of gears, particularly hypoids in automotive axles operated under high-speed and/or low-speed, high-torque conditions. Lubricants qualified under U.S. Military specification MIL-L-2105D (formerly MIL-L-2105C) satisfy the requirements of the API GL-5 service designation. Details of the API GL-5 performance tests are contained in ASTM Publication STP-512A, Laboratory Performance Tests for Automotive Gear Lubricants Intended for API GL-5 Service.

API GL-6 designates the type of service characteristic of gears designed with a very high pinion offset. Such designs typically require (gear) score protection in excess of that provided by API GL-5 gear oils. A shift to more modest pinion offsets coupled with the obsolescence of original API GL-6 test equipment and procedure has greatly diminished the commercial need for API GL-6 gear lubricants.

3.1 Reference Oils: The current reference oils required for each of the API GL-5 tests are listed below:

Performance Test	Reference Oil	
	High Level	Low Level
L-33	RGO 125	RGO 122
L-37	RGO 105	RGO 103
L-42	RGO 110	RGO 108
L-60	RGO 4668	RGO 4669

[4]Frictional requirements for axles equipped with limited slip differentials are normally defined by the axle manufacturer.

3.1 (Continued):

These reference oils are available from the ASTM Test Monitoring Center, 4400 Fifth Avenue, Pittsburgh, PA 15213.

New reference oils for the L-37 test are being developed by ASTM. The timing for their adoption is indefinite.

4. VISCOSITY AND VISCOSITY IMPROVERS:

Refer to SAE J306 for axle and manual transmission lubricant viscosity classification information.

5. STABILITY AND OXIDATION RESISTANCE:

Factors affecting stability and oxidation characteristics while the lubricant is in service include ambient temperature, duty cycle, length of service, and the effects of contamination. Even when lubricants are stored (prior to use), care should be exercised to ensure that they are not exposed to extremes in temperature and are kept free of contaminants. These precautions are intended to ensure optimum lubricant life.

For automotive axles and transmissions in mild service, the temperature of the lubricant may not be sufficiently high to cause oxidation. However, for vehicles in severe conditions of service such as passenger cars pulling trailers or for trucks or buses in service where high temperatures occur, oxidation resistance is an important factor. Accordingly, only oils with a high degree of oxidation resistance should be used in these more severe applications. The vehicle operator should consult the manufacturer's service guide for drain and refill recommendations.

6. FOAMING:

Excessive foaming may interfere with proper lubrication of gear and bearing surfaces and, consequently, should be avoided. Further, foaming can cause leakage via normal venting passages, thereby, reducing lubricant sump volume. Defoamers are used to minimize this potential lubricant problem.

7. CHEMICAL ACTIVITY OR CORROSION:

In order to obtain gear lubricants with adequate load-carrying capacity, chemical additives are usually employed as compounding ingredients. Gear lubricant additives are generally designed to reduce or control corrosion of both ferrous and copper-containing metals. The darkening of brightly polished copper alloys or other metal surfaces in contact with the lubricant does not necessarily indicate that the lubricant will cause harmful corrosion in service. Corrosion may be minimized by the choice of a lubricant containing the proper combination of chemical additives, particularly those stable in the presence of water.

8. SEAL COMPATIBILITY:

While the primary function of a gear lubricant is to protect gears and bearings, consideration must be given to the effect of a lubricant on elastomers or other seal materials used in the design of the component. Simple immersion tests such as those described in ASTM D 471 may be used to establish the relative compatibility of the lubricant and the seal material. Successful performance on such tests does not automatically ensure satisfactory seal performance under field service conditions. ASTM is currently investigating tests suitable for this purpose.

9. MIXING GEAR LUBRICANTS:

As a general practice, the mixing of lubricants should be avoided. Mixing gear lubricants with even small amounts of other types of lubricants can result in antagonistic reactions between the additive chemicals in the mixture. Such reactions may result in a significant loss of gear protection.

As a general practice, the mixing of MIL-L-2105D approved lubricants as in a top-up situation should not impair lubricant performance. MIL-L-2105D lubricants are required to demonstrate satisfactory storage stability when mixed with previously qualified gear lubricants as a condition of the MIL-L-2105D approval process.

The phi (Ø) symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

RATIONALE:

Not applicable.

RELATIONSHIP OF SAE STANDARD TO ISO STANDARD:

Not applicable.

REFERENCE SECTION:

SAE J306 MAR85, Axle and Manual Transmission Lubricant Viscosity Classification

ASTM D 471

ASTM STP-512A

API 1560

APPLICATION:

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COMMITTEE COMPOSITION:

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