



Standard Specification for Performance of Manual Transmission Gear Lubricants¹

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1. Scope

1.1 This specification lists the test methods and acceptance criteria for determining the acceptability of lubricants used in nonsynchronized heavy duty manual transmissions.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

2. Referenced Documents

2.1 ASTM Standards:²

D130 Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test

D892 Test Method for Foaming Characteristics of Lubricating Oils

D5182 Test Method for Evaluating the Scuffing Load Capacity of Oils (FZG Visual Method)

D5579 Test Method for Evaluating the Thermal Stability of Manual Transmission Lubricants in a Cyclic Durability Test

D5662 Test Method for Determining Automotive Gear Oil Compatibility with Typical Oil Seal Elastomers

D5704 Test Method for Evaluation of the Thermal and Oxidative Stability of Lubricating Oils Used for Manual Transmissions and Final Drive Axles

2.2 Federal Standards:³

Federal Standard No. 791C, Method 3430.2 Compatibility Characteristics of Universal Gear Lubricants

Federal Standard No. 791C, Method 3440.1 Storage Solubility Characteristics of Universal Gear Lubricants

2.3 SAE Publications:⁴

SAE J2360 Lubricating Oil, Gear Multipurpose (Metric) Military Use

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *nonsynchronized transmission, n*—a transmission having no means for synchronizing the speeds of engaging elements. Typical heavy-duty manual transmissions have no such means for gear engagement by the shift lever, but may have such means for pneumatic engagement of auxiliary range gears.

3.1.2 *oil seal compatibility, n*—in lubricants for lubricating manual transmissions and final drive axles, prevention of chemical or thermal degradation of seal elastomers typically observed as hardening, cracking, or excessive swelling in a manner which would result in oil leakage.

3.1.3 *thermal oxidation, n*—in lubricants used for lubricating manual transmissions and final drive axles, deterioration of the lubricant under high-temperature conditions which is observed as viscosity increase of the lubricant, insolubles formation in the lubricant, deposit formation on the parts, or a combination thereof.

4. Performance Classification

4.1 *API Category MT-1*—The designation API Category MT-1 identifies the category of lubricants intended for use in nonsynchronized manual transmissions, apart from API Service Category GL-4. See **Appendix X1** for background information on this category.

5. Performance Requirements

5.1 API Category MT-1 performance requirements for candidate gear lubricants are provided in **Table 1**.

6. Number of Tests and Retests

6.1 *Test Method D5704*—In determining whether an oil meets the required limits the following rules shall apply:

⁴ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

¹ This specification is under the jurisdiction of ASTM Committee D02 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.B0.03 on Automotive Gear Lubricants & Fluids.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, <http://www.access.gpo.gov>.

TABLE 1 API Category MT-1 Category Tests and Acceptance Criteria

Test Item	Minimum	Maximum
Test Method D5704		
Viscosity increase, %	...	100 %
Pentane insolubles, %	...	3.0 %
Toluene insolubles, %	...	2.0 %
Carbon/varnish rating	7.5	...
Sludge rating	9.4	...
Test Method D5662		
Polyacrylate @ 150°C, 240 h		
Elongation change, %	-60	+no limit
Hardness change, points	-35	+5
Volume change, %	-5	+30
Fluoroelastomer @ 150°C, 240 h		
Elongation change, %	-75	+no limit
Hardness change, points	-5	+10
Volume change, %	-5	+15
Test Method D5579	better than passing reference oil ^A	...
Test Method D130^B	...	2a
Test Method D5182		
Failing load stage	11	...
Test Method D892 , foam tendency only		
Sequence I, mL	...	20
Sequence II, mL	...	50
Sequence III, mL	...	20
Federal Standard No. 791C, Method 3430.2	compatible with reference oils ^C	...
Federal Standard No. 791C, Method 3440.1	pass ^D	...

^A This is defined by the mean of the last five passing reference oil test results used to calibrate the test stand.

^B Tested for 3 h at 121°C.

^C Shall be compatible with six specific reference oils that may be obtained from the ASTM Test Monitoring Center (TMC).

^D Shall pass the performance requirements as specified in **SAE J2360**.

6.1.1 No more than three operationally valid tests are to be conducted for compliance testing.

6.1.2 L-60-1 data used for API Category MT-1 approval may not be generated prior to ASTM Test Monitoring Center

(TMC)⁵ calibration of the stand for all API Category MT-1 parameters. Stand bias adjustment factors based on reference oil test results will be applied when appropriate.

6.1.3 After applying any appropriate stand bias adjustment factors, the first test shall meet or exceed all limits.

6.1.4 After two tests, the average of the two results on all parameters shall meet or exceed the limits.

6.1.5 After three tests, one test is excluded in its entirety. The average of the two results on all parameters shall meet or exceed the limits.

6.2 *Test Method D5662*—This test method includes testing on two different elastomer materials. No rules regarding multiple testing have been defined.

6.3 *Test Method D5579*:

6.3.1 No more than four operationally valid tests are to be conducted for compliance testing.

6.3.2 The four allowed tests can be conducted on any combination of test stands approved and referenced by the ASTM Test Monitoring Center (TMC).⁵

6.3.3 If two test results are obtained, each of which is equal to or less than the mean minus the pooled standard deviation for all calibrated test stands in the industry, the fluid is disqualified. The pooled standard deviation is available from the ASTM Test Monitoring Center (TMC).⁵

6.3.4 A test result that meets or exceeds the mean of the last five passing reference oil test results used to calibrate the test stand is considered a pass.

7. Keywords

7.1 API Category MT-1; cyclic durability; manual transmissions; oil seal; thermal oxidation; thermal stability

⁵ ASTM Test Monitoring Center (TMC), Carnegie Mellon University, 6555 Penn Avenue, Pittsburgh, PA 15206, <http://astmtmc.cmu.edu>.

APPENDIX

(Nonmandatory Information)

X1. API CATEGORY MT-1 RATIONALE

X1.1 In 1986, Eaton Corporation, through the Society for Automotive Engineers (SAE), outlined the trucking industry's need for a gear lubricant category which would provide performance characteristics essential to ensure optimum service life for heavy-duty manual transmissions. This request was supported by all major North American commercial transmission builders.

X1.2 During the same period user surveys indicated that the class of oils typically used in manual transmissions was not always in compliance with the builder's primary recommendations. API GL-5 gear oils or multigrade engine oils were the popular choice of users due to their desire to inventory and use two shop oils, engine and gear. Some of these oils were found to perform satisfactorily while others presented problems. In extreme cases, some API GL-5 oils were reported to cause oil seal failures due to coking/hard deposits or severe oil sludging

at mileages below realistic drain intervals, or both.

X1.3 Using feedback from equipment builders, SAE outlined several lubricant performance characteristics which they believed were vital to ensure that their goals for optimum transmission service life would be met. These characteristics included the following:

- (1) Fluid thermal stability/component cleanliness,
- (2) Oil seal compatibility, and
- (3) Brass (copper) component compatibility.

X1.4 ASTM was then requested to identify or develop tests suitable to assess the preceding performance characteristics. In the process, the proposed category's performance test matrix was expanded to include properties in addition to those originally defined in order to ensure that a performance balanced lubricant would be provided to users. The added

properties included antiwear, foam control, and lubricant compatibility. A full-scale transmission test was also included to reaffirm the high-temperature lubricant performance capabilities of API Category MT-1. This test correlates with field service and also ensures satisfactory performance with plate-type synchronizers.

X1.5 The tests and acceptance criteria defined by this specification are the result of specification and test method development work within ASTM. The introduction of this new

category will allow OEMs to specify gear oils for manual transmissions that can be made available either as dedicated fluids (API Category MT-1) or multipurpose fluids (that is, API GL-5/API Category MT-1). Oils meeting the API Category MT-1 performance definition will satisfy OEM objectives for optimum transmission performance and service life. This has been achieved by combining in a single lubricant the cleanliness and oil seal life typical of engine oils with the load carrying characteristics of gear oils.

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