Designation: D 5760 – 95ε1

An American National Standard

Standard Specification for Performance of Manual Transmission Gear Lubricants[1]

This standard is issued under the fixed designation D 5760; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—Table 1 was corrected editorially in December 1995.

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 transmission.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 *ASTM Standards:*

D 130 Test Method for Detection of Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test[2]

D 892 Test Method for Foaming Characteristics of Lubricating Oils[2]

D 5182 Test Method for Evaluating the Scuffing (Scoring) Load Capacity of Oils[3]

D 5579 Test Method for Evaluating the Thermal Stability of Manual Transmission Lubricants In a Cyclic Durability Test[4]

D 5662 Test Method for Determining Automotive Gear Oil Compatibility with Typical Oil Seal Elastomers[4]

D 5704 Test Method for Evaluation of the Thermal and Oxidative Stability of Lubricants Used for Manual Transmissions and Final Drive Axles[4]

2.2 *Federal Standards:*[5]

Federal Standard No. 791C, Method 3430.2 Compatibility Characteristics of Universal Gear Lubricants[6]

Federal Standard No. 791C, Method 3440.1 Storage Solubility Characteristics of Universal Gear Lubricants[6]

2.3 *Military Standard:*[6]

MIL-L-2105D Lubricating Oil, Gear, Multipurpose

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 combination thereof.

4. Performance Classification

4.1 *PG-1*—The temporary designation PG-1 has been assigned to identify the category for manual transmissions, apart from API Service Category GL-4. (See Appendix X1 for background information on this category.)

5. Performance Requirements

5.1 PG-1 performance requirements for candidate gear lubricants are provided in Table 1.

6. Number of Tests and Retests

6.1 *Test Method D 5704*—In determining whether an oil meets the required limits the following rules shall apply:

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

6.1.2 L-60 data used for PG-1 approval may not be generated prior to Test Monitoring Center (TMC) calibration of the stand for all PG-1 parameters. Stand bias adjustment factors based on reference oil test results will be applied when appropriate.

[1] This specification is under the jurisdiction of ASTM Committee D-2 on Petroleum Products and Lubricants and is the direct responsibility of Subcommittee D02.B on Automotive Lubricants.

Current edition approved Aug. 15, 1995. Published October 1995.

[2] *Annual Book of ASTM Standards*, Vol 05.01.

[3] *Annual Book of ASTM Standards*, Vol 05.02.

[4] *Annual Book of ASTM Standards*, Vol 05.03.

[5] Information available from Commanding Officer, Army Materials and Mechanics Research Center, Attention: AMXMR-TMS, Watertown, MA 02127.

[6] Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

TABLE 1 PG-1 Category Tests and Acceptance Criteria

Test Item	Minimum	Maximum
Test Method D 5704 for[A]		
Viscosity increase, %	...	100 %
Pentane insolubles, %	...	3.0 %
Toluene insolubles, %	...	2.0 %
Carbon/varnish rating	7.5	...
Sludge rating	9.4	...
Test Method D 5662[B]		
Polyacrylate 150°C, 240 h		
Elongation, change %	no limit	−60
Hardness change, points	−20	+5.0
Volume change, %	−5	+30
Fluoroelastomer 150°C, 240 h		
Elongation change, %	no limit	−75
Hardness change, points,	−5	+10
Volume change, %	−5	+15
Test Method D 5579[C]	better than passing reference oil[D]	...
Test Method D 130	...	2a
Test Method D 5182		
Failing load stage	11	...
Test Method D 892 foam tendency only		
Sequence I, mL	...	20
Sequence II, mL	...	50
Sequence III, mL	...	20
Federal Test Method 791C, Method 3430.2	compatible with MIL-L-2105D oils[E]	...
Federal Test Method 791C, Method 3440.1	pass[F]	...

[A] Test Method D 5704 successfully completed Subcommittee D02.B ballot on June 23, 1994. The evolution of test stands and data used to develop limits is defined in Research Report D02-1353. As stated in 6.1.2/L-60-1 data used for PG-1 approval may not be generated prior to TMC calibration of the stand for all PG-1 parameters.

[B] Test Method D 5662 successfully completed Subcommittee D02.B ballot on June 23, 1994. The evolution of data used to develop limits is defined in Research Report D02-1348.

[C] Test Method D 5579 successfully completed Committee D-2 ballot of June 24, 1994.

[D] Defined by the mean of five prior tests of TMC 151 Reference Oil in observed stand.

[E] Shall be compatible with specific reference oils when tested in accordance with Federal Test Method 791C, Method 3430.2. Reference oils may be obtained from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

[F] Shall pass the performance requirements as specified in the MIL-L-2105D when tested in accordance with 791C, Method 3440.1.

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 D 5662*—This test method includes multiple test samples. No additional rules regarding multiple testing have been defined. Data are to be reported to the Test Monitoring Center. See Annex A1.

6.3 *Test Method D 5579*:

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).

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 TMC.

6.3.4 A test result that meets or exceeds the mean of the last five reference oil (TMC Code 151) test results which have been accepted by the TMC for calibration of the test stand is considered a pass.

7. Keywords

7.1 cyclic durability; manual transmissions; oil seal; PG-1; thermal oxidation; thermal stability

ANNEX

(Mandatory Information)

A1. REFERENCE OIL DATA REPORTING

A1.1 Oil seal compatibility data for all reference oils are to be reported to the TMC. This data will be correlated with dynamic seal test data and field service information that is being gathered by the surveillance panel. This information will be used to revise finite limits for oil seal compatibility that are more consistent with field service performance requirements. Completion of this correlation activity is scheduled for June, 1996.

APPENDIX

(Nonmandatory Information)

X1. PG-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 PG-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 (PG-1) or multipurpose fluids (that is, API GL-5/PG-1). Oils meeting PG-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.