Designation: D7450 – 08

Standard Specification for Performance of Rear Axle Gear Lubricants Intended for API Category GL-5 Service[1]

This standard is issued under the fixed designation D7450; 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.

1. Scope

1.1 This specification covers test methods and acceptance criteria for determining the acceptability of gear oils for applications which specify a lubricant meeting the performance requirements of API Category GL-5 service. Lubricants which meet these performance requirements are typically intended for use in automotive axles, particularly those containing hypoid gears, operating under various combinations of high-speed/shock-load and low-speed/high-torque conditions.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

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

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

D6121 Test Method for Evaluation of Load-Carrying Capacity of Lubricants Under Conditions of Low Speed and High Torque Used for Final Hypoid Drive Axles

D7038 Test Method for Evaluation of Moisture Corrosion Resistance of Automotive Gear Lubricants

2.2 *Military Standards:*[3]

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

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

MIL-PRF-2105E Lubricating Oil, Gear, Multipurpose

2.3 *ASTM Test Monitoring Center Documents:*[4]

L-42 Test Procedure

2.4 *SAE Documents:*[5]

J306 Automotive Gear Lubricant Viscosity Classification

J2360 Lubricating Oil, Gear Multipurpose (Metric) Military Use

3. Terminology

3.1 *Definitions:*

3.1.1 *ridging*, *n—on ring and pinion gears*, an alteration of the tooth surface to give a series of parallel raised and polished ridges running diagonally in the direction of sliding motion, either partially or completely across the tooth surfaces of gears. **D6121**

3.1.2 *rippling*, *n—on ring and pinion gears*, an alteration of the tooth surface to give an appearance of a more or less regular pattern resembling ripples on water or fish scales. **D6121**

3.1.3 *pitting*, *n—on ring and pinion gears*, small irregular cavities in the tooth surface, resulting from the breaking out of small areas of surface metal. **D6121**

3.1.4 *spalling*, *n—on ring and pinion gears*, the breaking out of flakes of irregular area of the tooth surface, a condition more extensive than pitting. **D6121**

3.1.5 *scoring*, *n—on ring and pinion gears*, the rapid removal of metal from the tooth surfaces caused by the tearing out of small contacting particles that have welded together as a result of metal-to-metal contact. The scored surface is characterized by a matte or dull finish. **D6121**

3.1.6 *wear*, *n—on ring and pinion gears*, the removal of metal, without evidence of surface fatigue or adhesive wear,

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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 Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.

[4] Available from ASTM Test Monitoring Center, 6555 Penn Avenue, Pittsburgh, PA 15206–4489, Attn: Administrator.

[5] Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.

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TABLE 1 API Category GL-5 Tests and Acceptance Criteria

Test Item	Minimum	Maximum
L-42[A,B]	...	
%Scoring, Pinion		Equal to or better (lower) than the mean scoring value of the passing reference oil test results used to calibrate the stand
Drive Side		
Coast Side		
%Scoring, Ring		
Drive Side		
Coast Side		
Test Method D6121 (formerly L-37) using non-lubrited hardware[B,C]		
Ridging, ASTM merit rating	8	...
Rippling, ASTM merit rating	8	...
Wear, ASTM merit rating	5	...
Pitting/Spalling, ASTM merit rating	9.3	...
Scoring, ASTM merit rating	10	...
Test Method D7038 (formerly L-33-1)[D]		
Final rust merit rating	9.0	
Test Method D5704[E](formerly L-60-1) or L-60		
Viscosity Increase, percent	…	100
Pentane Insolubles, wt percent	…	3.0
Toluene Insolubles, wt percent	…	2.0
Test Method D892, tendency		
Sequence I, mL	...	20
Sequence II, mL	...	50
Sequence III, mL	...	20
Test Method D130[F]		
ASTM rating	...	3

[A] The latest version of this test can be obtained from the ASTM Test Monitoring Center. The Canadian version of the L-42 test follows the procedure of the L-42 test with the modifications detailed in Annex A1, Table A1.1 of the L-42 test procedure.

[B] This test may be conducted under two different sets of operating conditions, commonly referred to as Standard and Canadian. The test conditions to be used are dependant upon the viscosity grade of the lubricant under evaluation. Please see A2.2 and Table A2.1 for details as to which version of this test should be used in the evaluation of a specific lubricant.

[C] The Canadian version of the Test Method D6121 test follows the procedure of the Test Method D6121 test with the modifications detailed in Test Method D6121, Annex A6.2, Table A6.1.

[D] Candidate fluids tested previous to the development of the Test Method D7038 procedure using the L-33 test procedure with a cover plate merit rating of a minimum of 8 and a merit rating for all other areas of a minimum of 10 are considered acceptable results against the performance requirements of this Specification.

[E] Carbon or Varnish and Sludge ratings are reported in Test Method D5704 but are not an acceptance criterion for API Category GL-5.

[F] Tested for 3 h at 250°F (121°C).

resulting in partial or complete elimination of tool or grinding marks or development of a discernible shoulder ridge at the bottom of the contact area near the root or at the toe or heel end of pinion tooth contact area (abrasive wear). **D6121**

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *lubrited*, *adj*—having its surface coated with phosphate.

4. Performance Classification

4.1 *API Category GL-5*—The designation API Category GL-5 is designed to identify the category of lubricants intended for gears, particularly those in automotive axles equipped with hypoid gears, operating under various combination of high-speed/shock-load and low-speed/high-torque conditions. Approved lubricants under the SAE J2360 Standard, the MIL-L-2105C Specification, the MIL-L-2105D Specification, and the MIL-PRF-2105E Specification satisfy the requirements of API Category GL-5. Note that these standards and specifications contain performance requirements that exceed those of API Category GL-5.

5. Performance Requirements

5.1 API Category GL-5 performance requirements for candidate gear lubricants using the most current test methods and procedures are provided in Table 1.

6. Keywords

6.1 axle lubricants; gear lubricants; high-speed/shock-load; hypoid gear lubricants; hypoid gears; low-speed/high-torque

ANNEXES

(Mandatory Information)

A1. USE OF CALIBRATED TEST STANDS FOR API CATEGORY GL-5 PERFORMANCE EVALUATION

A1.1 The latest versions of the Test Methods D5704, D6121, D7038, and the L-42 test procedure require test stand calibration by the ASTM TMC. The use of calibrated test stands is required for evaluation of a lubricant against the performance requirements of this specification.

A2. AUTOMOTIVE GEAR LUBRICANT VISCOSITY

A2.1 The SAE J306 Standard describes the system of viscosity classifications used for automotive gear lubricants.

A2.2 The Test Method D6121 and L-42 tests procedure may be conducted under two different sets of operating conditions commonly referred to as Standard and Canadian. The test conditions to be used are dependent upon the viscosity grade of the lubricant under evaluation. Table A2.1 lists the API Category GL-5 testing requirements for candidate gear lubricants, according to their viscosity grade.

TABLE A2.1 API Category GL-5 Testing Requirements According to the Viscosity Grade of the Candidate Gear Lubricant

Test Item	SAE 70W & SAE 75W	SAE 70W-XX & SAE 75W-XX[A]	All Other SAE Viscosity Grades
Standard Version of L-42	Not Required	Required	Required
Canadian Version of L-42	Required	Required	Not Required
Standard Version of Test Method D6121 (formerly L-37)	Not Required	Required	Required
Canadian Version of Test Method D6121 (formerly L-37)	Required	Required	Not Required
Test Method D7038 (formerly L-33-1) or L-33	Required	Required	Required
Test Method D5704 (formerly L-60-1) or L-60	Required	Required	Required
Test Method D892, tendency	Required	Required	Required
Test Method D130	Required	Required	Required

[A] XX—May be 80, 85, 90, 110, 140, 190, or 250 as indicated in SAE J306.

APPENDIXES

(Nonmandatory Information)

X1. API CATEGORY GL-5 SPECIFICATION RATIONALE

X1.1 API Category GL-5 is routinely referenced around the world. There has not been, however, an ASTM Standard that defined the performance requirements of gear oils intended for API Category GL-5 service. This absence of a readily available ASTM standard may have resulted in confusion in the marketplace, and made it difficult to communicate updates or changes in test procedures and pass or fail criteria used to evaluate the performance of lubricants against the performance requirements of API Category GL-5. To address this issue, ASTM D02.B0.03 created a task force whose purpose was to document the test methods and procedures and performance requirements of API Category GL-5 as an ASTM standard.

X2. READ ACROSS

X2.1 Neither STP 512A[6] nor this specification provides guidelines for read across of test results from one formulation to another.

[6] STP 512A, *Laboratory Performance Tests for Automotive Gear Lubriants Intended for API GL-5 Service*, ASTM International, W. Conshohocken, PA, 1986.

BIBLIOGRAPHY

(**1**) Publication 1560, *Lubricant Service Designations for Automotive Manual Transmissions, Manual Transaxles, and Axles,* 7th Edition, July 1995.

(**2**) *CRC Distress Rating Manual No. 21,* Coordinating Research Council, Alpharetta, GA.

(**3**) SAE J308, *Axle and Manual Transmission Lubricants*, January 1996.

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