SURFACE VEHICLE STANDARD

J2360™ MAY2022

Issued 1998-11
Revised 2022-05

Superseding J2360 JUL2021

Automotive Gear Lubricants for Commercial and Military Use

RATIONALE

This SAE J2360 standard has been revised to incorporate three additional requirements for gear lubricants intended for military procurement and use. These requirements have been placed in Appendix A.1 and are not compulsory for commercial gear lubricants covered by this standard. This revision also includes an update to the review cirteria for ASTM D7038 (L-33-1 Test) which the LRI Review Committee has been using for Qualified Products List (QPL) approvals since 2018.

1. SCOPE

The gear lubricants covered by this standard exceed American Petroleum Institute (API) Service Classification API GL-5 and are intended for hypoid-type, automotive gear units, operating under conditions of high-speed/shock load and low-speed/high-torque. These lubricants may be appropriate for other gear applications where the position of the shafts relative to each other and the type of gear flank contact involve a large percentage of sliding contact. Such applications typically require extreme pressure (EP) additives to prevent the adhesion and subsequent tearing away of material from the loaded gear flanks. These lubricants are not appropriate for the lubrication of worm gears.

Appendix A is a mandatory part of this standard. The information contained in Appendix A is intended for the demonstration of compliance with the requirements of this standard and for listing on the Qualified Products List (QPL) administered by the Lubricant Review Institute (LRI). Appendix A contains a summary of key qualification requirements. A complete listing of qualification requirements and procedures can be found in the Program Document (PD4000), Gear Lubricant Review Program, available on the Performance Review Institute (PRI) website, www.p-r-i.org.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J306 Automotive Gear Lubricant Viscosity Classification

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/J2360_202205/

2.1.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D92	Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester
ASTM D130	Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
ASTM D892	Standard Test Method for Foaming Characteristics of Lubricating Oils
ASTM D893	Standard Test Method for Insolubles in Used Lubricating Oils
ASTM D5662	Standard Test Method for Determining Automotive Gear Oil Compatibility with Typical Oil Seal Elastomers
ASTM D5704 (L-60-1)	Standard Test Method for Evaluation of the Thermal and Oxidative Stability of Lubricating Oils Used for Manual Transmissions and Final Drive Axles
ASTM D6121 (L-37 Test)	Standard Test Method for Evaluation of Load-Carrying Capacity of Lubricants Under Conditions of Low Speed and High Torque Used for Final Hypoid Drive Axles
ASTM D6304	Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration
ASTM D6443	Standard Test Method for Determination of Calcium, Chlorine, Copper, Magnesium, Phosphorus, Sulfur, and Zinc in Unused Lubricating Oils and Additives by Wavelength Dispersive X-ray Fluorescence Spectrometry (Mathematical Correction Procedure)
ASTM D7038 (L-33-1 Test)	Standard Test Method for Evaluation of Moisture Corrosion Resistance of Automotive Gear Lubricants
ASTM D7452 (L-42 Test)	Standard Test Method for Evaluation of the Load Carrying Properties of Lubricants Used for Final Drive Axles, Under Conditions of High Speed and Shock Loading
ASTM D7603	Standard Test Method for Determination of Storage Stability and Compatibility in Automotive Gear Oils
ASTM D8165 (L-37-1 Test)	Standard Test Method for Evaluation of Load-Carrying Capacity of Lubricants Used in Hypoid Final-Drive Axles Operated under Low-Speed and High-Torque Conditions

2.1.3 Coordinating European Council Publications

Available from Coordinating European Council, Madou Plaza, 25th Floor, Place Madou 1, B-1030, Brussels, Belgium.

Test Method CEC L-45-A-99	Viscosity Shear Stability of Transmission Lubricants (KRL - Tapered Roller Bearing Test Rig), Shear Stability Test, 1999

2.1.4 Federal Government Publications

Available from U.S. Department of Labor/OSHA, 200 Constitution Avenue, Washington, DC 20210, Tel: 800-321-6742, www.osha.gov/pls/publications/pubindex.list.

OSHA 29 CFR 1910.1200	Hazard Communication Interpretation Regarding Lubricating Oils

Avialable from Defense Standardization Program, ASSIST Quick Search, https://quicksearch.dla.mil/qsSearch.aspx.

FED-STD-791	Testing Methods of Lubricants, Liquid Fuels, and Related Products

3. REQUIREMENTS

3.1 Materials

The gear lubricants covered by this standard shall be derived from petroleum fractions, synthetically prepared compounds, or a combination of the two types of products. They may include rerefined stocks. The stocks shall be compounded with such functional additives (e.g., extreme pressure agents, corrosion inhibitors, friction modifiers, etc.) as necessary to meet the performance requirements specified in this standard. The stocks used shall not be considered carcinogenic or potentially carcinogenic as defined under OSHA 29 CFR 1910.1200.

3.2 Physical and Chemical Property Requirements

The gear lubricant shall conform to the physical property and chemical requirements specified in 3.2.1 through 3.2.6.

3.2.1 Viscosity

The gear lubricant shall meet the limits for the classification of automotive gear lubricants in rheological terms, as described in SAE J306, for the appropriate viscosity grade.

3.2.2 Shear Stability

The gear lubricant shall maintain its starting viscosity grade, per SAE J306, when tested in accordance with CEC L-45-A-99 for 20 hours.

3.2.3 Flash Point

The gear lubricant shall have a flash point greater than the minimum temperature indicated by Table 1 when tested in accordance with ASTM D92.

Table 1 - Flash point requirements

Property	SAE 70W-XX*	SAE 75W-XX*	SAE 80W-XX*	SAE 85W-XX*
Flash Point, °C, min	145	150	165	180

* XX signifies the high temperature viscosity grade of the lubricant, and may be left blank or equal to 80, 85, 90, 110, 140, 190, or 250, as indicated in SAE J306.

3.2.4 Pour Point Depressants

The gear lubricant shall contain no more than 2.0% (by volume) of any type of pour point depressant or combination in the final formulation.

3.2.5 Elemental Limitations

3.2.5.1 Chlorine

The gear lubricant chemistry shall limit the amount of chlorine to not more than 0.025 wt% (250 ppm) when tested using ASTM D6443.

3.2.6 Contamination

3.2.6.1 Water

New gear lubricant shall contain no more than 0.1 wt% (1000 ppm) of water using test method ASTM D6304.

3.3 Performance Requirements

The gear lubricant shall conform to the performance requirements specified in 3.3.1 through 3.3.8. Appendix B summarizes the performance requirements.

3.3.1 Foaming

All grades of gear lubricants shall demonstrate the following foaming characteristics when tested in accordance with ASTM D892. Option A of ASTM D892 is not allowed.

a. Initial test at 24 °C ± 0.5 °C: Not more than 20 mL of foam shall remain immediately following the 5-minute blowing period.

b. Intermediate test at 93.5 °C ± 0.5 °C: Not more than 50 mL of foam shall remain immediately following the 5-minute blowing period.

c. Final test at 24 °C ± 0.5 °C: Not more than 20 mL of foam shall remain immediately following the 5-minute blowing period.

3.3.2 Storage Stability

The gear lubricant shall demonstrate the following characteristics for separated solid material, liquid material, or a combination of the two materials, when tested in accordance with ASTM D7603.

a. Solid Material - When the separated material is solid, the average increase in the weight of each centrifuge tube and residue over the initial weight of the clean tube shall not exceed 0.25 mass percent of the additive material originally contained in the sample.

b. Liquid Material - When the separated material is liquid, it shall not exceed 0.50 volume percent of the additive material originally contained in the sample.

3.3.3 Compatibility

The gear lubricant shall demonstrate compatibility with other gear lubricants previously qualified under this standard when tested against selected reference oils in accordance with ASTM D7603. The candidate lubricant shall show no incompatibility with six reference oils to be obtained from the ASTM Test Monitoring Center (TMC), Carnegie Mellon University, 6555 Penn Avenue, Pittsburgh, PA 15206, www.astmtmc.cmu.edu.

3.3.4 Moisture Corrosion

The gear lubricant shall prevent or minimize corrosion to gear unit components in the presence of moisture. Satisfactory performance shall be demonstrated when the oil is tested in accordance with ASTM D7038 (L-33-1 Test) and receives a passing result of 9.0 or better overall rating. It shall not have a rating of 5.0 or less on any individual rating area, and not have more than four areas rated as an 8.0 or less.

3.3.5 Thermal and Oxidative Stability

The gear lubricant shall resist thermal and chemical oxidation. Satisfactory performance shall be demonstrated when the oil is tested in accordance with ASTM D5704 (L-60-1) for 50 hours and meets the criteria in Table 2.

Table 2 - ASTM D5704 (L-60-1) test limits

Parameters	Limits
Kinematic Viscosity Increase %, at 100 °C, cSt	100 max
N-Pentane Insolubles, wt%	3.0 max
Toluene Insolubles, wt%	2.0 max
Carbon/Varnish Rating	7.5 min
Sludge Rating	9.4 min

3.3.6 Load-Carrying and Extreme-Pressure Characteristics

The gear lubricant shall prevent or minimize gear distress and lubricant deposits under conditions of high-speed and shock-loading and conditions of low-speed, high-torque operation.

3.3.6.1 Gear Scoring - High-Speed and Shock-Loading Conditions

Satisfactory performance shall be demonstrated when the oil is tested in duplicate in accordance with ASTM D7452 (L-42) and exhibits scoring equal to or better (lower) than the mean scoring value of the passing reference oil test results used to calibrate the test stand. For grades SAE 70W, 70W-XX, 75W, and 75W-XX oils, the test shall be conducted per ASTM D7452, Annex A1 (i.e., Canadian Version). In addition, 70W-XX and 75W-XX oils require testing be conducted under standard ASTM D7452 conditions.

3.3.6.2 Gear Distress - Low-Speed and High-Torque Conditions

Satisfactory performance shall be demonstrated when the oil is tested in accordance with ASTM D6121 (L-37) or ASTM D8165 (L-37-1) using untreated and phosphate-treated gear assemblies, and prevents gear-tooth ridging, rippling, pitting, welding, spalling, excessive wear, or other surface distress and objectionable deposits. The oil shall not produce excessive wear, pitting, or corrosion of bearing rollers or races. For grades SAE 70W, 70W-XX, 75W, and 75W-XX oils, the test shall be conducted per the Canadian Test Version. In addition, for 70W-XX and 75W-XX viscosity grade oils, the test shall also be conducted per the Standard Test Version. The oil shall meet the criteria in Table 3.

Table 3 - ASTM D6121 (L-37) and ASTM D8165 (L-37-1) test limits

Category	ASTM Rating
Ridging	8 or greater
Rippling	8 or greater
Wear	5 or greater
Spalling/Pitting	9.3 or greater
Scoring	10

3.3.7 Copper Corrosion

The gear lubricant shall minimize copper corrosion. Satisfactory performance shall be demonstrated when the oil is tested in accordance with ASTM D130 for 3 hours at 121 °C ± 1 °C, and exhibits copper strip discoloration not exceeding ASTM No. 2a when compared to ASTM Copper Strip Corrosion Standard.

3.3.8 Elastomer Compatibility

The gear lubricant shall minimize deterioration of elastomer materials. Satisfactory performance shall be demonstrated when the oils are tested and rated in accordance with ASTM D5662 (Elastomer Compatibility) and exhibit test results meeting the nominal criteria in Table 4.

Table 4 - ASTM D5662 (elastomer compatibility) test limits

Parameters	Minimum	Maximum
Polyacrylate at 150 °C, 240 hours:		
Elongation Change, %	-60	No limit
Hardness Change, points	-35	5
Volume Change, %	-5	30
Fluoroelastomer at 150 °C, 240 hours:		
Elongation Change, %	-75	No limit
Hardness Change, points	-5	10
Volume Change, %	-5	15

4. NOTES

4.1 Revision Indicator

A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY SAE FUELS AND LUBRICANTS TC 3 DRIVELINE AND CHASSIS LUBRICATION

APPENDIX A - AUTOMOTIVE GEAR LUBRICANTS FOR COMMERCIAL AND MILITARY USE

A.1 QUALIFICATION REQUIREMENTS

Below are some key qualification requirements. A complete listing of qualification requirements and procedures can be found in the Program Document (PD4000), Gear Lubricant Review Program, available on the Performance Review Institute (PRI) website, www.p-r-i.org.

A.1.1 Companion Lubricants

Testing prescribed in 3.3.6.1 (i.e., L-42) and 3.3.6.2 (i.e., L-37 or L-37-1) are not required for the SAE 85W-140 grades, provided that the lubricant is formulated from base stocks and additives used in a qualified SAE 80W-90.

A.1.2 Qualification Period

Each grade of oil which satisfies all the requirements of this standard will be qualified for a period not to exceed 5 years from the date of its original qualification. The qualification period for each grade of SAE 85W-140 oil qualified in accordance with A.1.1 shall not exceed that of the companion grade SAE 80W-90 product used in the qualification procedure.

A.1.3 Requalification

When the qualification period has expired, each product must be re-qualified. If a product is submitted for requalification, and there has been no change in the standard requirements, the LRI Gear Lubricant Review Committee may, at its discretion, waive complete retesting or require only partial retesting of the product to determine its continued acceptability. Whenever there is a change in the base stock, refining treatment, or additives used in the formulation, requalification shall be required. When the proposed changes are minor and may not be expected to significantly affect performance, the LRI Gear Lubricant Review Committee may, at its discretion, waive complete requalification or may require only partial requalification in order to determine the significance and acceptability of the proposed changes.

A.1.4 Field Testing

Qualification tests consist of tests for all of the requirements specified in Section 3. These tests have been correlated with field performance. New lubricant technology must have demonstrated correlation with field performance for these tests to apply. The Lubricant Review Institute Program Document (PD4000) outlines the requirements for field testing. Copies of these procedures may be obtained by contacting the secretary of the LRI at the Performance Review Institute (see Section 1). Once correlation has been demonstrated, only the tests specified herein will be required for further requalification.

A.1.5 Thermal and Oxidative Stability

A maximum of three tests may be conducted in accordance with ASTM D5704 (L-60-1 Test). If more than one test is conducted, the average of any two test results must meet the limits described in Table 2, and the results from the third test, if conducted, may be excluded.

A.1.6 Additional Requirements for Gear Lubricants Intended for the U.S. Military

For those suppliers intending to sell lubricant products to the U.S. military, only lubricant grades 75W-90, 80W-90, 75W-140, and 85W-140 have been adopted for use. SAE 75W-90 and 75W-140 grade lubricants meeting the additional requirements in this section will be indicated by a unique military identifier on the qualified products list. See the Performance Review Institute's Program Document (PD4000) for further information.

In addition to the requirements outlined in Section 3 of this standard, SAE grades 75W-90 and 75W-140 shall meet the following additional requirements:

A.1.6.1 Efficiency of Axle Gear Lubricants

The 75W-90 and 75W-140 gear lubricant shall provide a measurable improvement in efficiency compared to reference 80W-90 and 85W-140, respectively. Satisfactory performance shall be demonstrated when the oil is tested in accordance with FED-STD-791 method 7504.0 and meeting the criteria in Table A1.

Table A1 - FED-STD-791 method 7504.0 test limits

Parameters	Limits
75W-90 Difference of 10 Step Average of Mean Efficiency (Candidate – Baseline), %	0.70 min
75W-140 Difference of 10 Step Average of Mean Efficiency (Candidate – Baseline), %	0.90 min

A.1.6.2 Compatibility with Limited Slip Differential Clutches

The 75W-90 and 75W-140 gear lubricant shall be compatible with the wet clutch limited slip differential used in the Stryker vehicle (all variants). Compatibility is assessed through the lubricants ability to mitigate stick-slip during clutch slip events. Satisfactory performance shall be demonstrated when the oil is tested in accordance with FED-STD-791 method 7506.0 and meeting the criteria in Table A2.

Table A2 - FED-STD-791 method 7506.0 test limits

Parameters	Limits
Chatter	0.83 max
Average Ramp Down Dynamic Coefficient of Friction for any Cycle	0.10 min

A.1.6.3 Extended Thermal and Oxidative Stability

The 75W-90 and 75W-140 gear lubricant shall resist thermal and chemical oxidation. Satisfactory performance shall be demonstrated when the oil is tested in accordance with an extended version of ASTM D5704 (L-60-1) for 150 hours (instead of 50 hours) and meets the criteria in Table A3.

Table A3 - Extended (150 hours) ASTM D5704 (L-60-1) test limits

Parameters	Limits
Kinematic Viscosity Increase %, at 100 °C, cSt	100 max
N-Pentane Insolubles, wt%	3.0 max
Toluene Insolubles, wt%	2.0 max
Carbon/Varnish Rating	7.5 min
Sludge Rating	9.4 min

A.1.7 Test Stand Calibration

The latest versions of ASTM test methods D5662, D5704, D6121, D7038, D7452, and D8165 require test stand calibration by the ASTM Test Monitoring Center. The use of calibrated test stands is required for evaluation of a lubricant against the performance requirements of this standard.