



SURFACE VEHICLE RECOMMENDED PRACTICE

J2695™

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Heavy-Duty Vehicle Lubricating Greases

RATIONALE

This document is intended to assist in the selection of grease use for servicing commercial vehicle heavy-duty truck applications. It provides definitions and recommended test methods for use in proper grease selection. This revision updates the references to the current standards and test methods recommended.

1. SCOPE

This SAE Recommended Practice was developed by SAE and the section "Standard Classification and Specification for Service Greases" cooperatively with ASTM and NLGI. It is intended to assist those concerned with the design of heavy-duty vehicle components and with the selection and marketing of greases for the lubrication of certain components on heavy-duty vehicles like trucks and buses. The information contained herein will be helpful in understanding the terms related to properties, designations, and service applications of heavy-duty vehicle greases.

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.

AMS3217 Standard Elastomer Stocks, Test Slabs

AMS3217/2C Test Slabs, Acrylonitrile Butadiene (NBR-L), Low Acrylonitrile, 65 - 75

AMS3217/3C Test Slabs, Chloroprene (CR), 70 - 80

SAE J310 Automotive Lubricating Greases

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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 D128	Analysis of Lubricating Grease
ASTM D217	Cone Penetration of Lubricating Grease
ASTM D942	Oxidation Stability of Lubricating Greases by the Oxygen Pressure Vessel Method
ASTM D972	Evaporation Loss of Lubricating Greases and Oils
ASTM D1092	Apparent Viscosity of Lubricating Greases
ASTM D1264	Water Washout Characteristics of Lubricating Greases
ASTM D1403	Cone Penetration of Lubricating Grease Using One-Quarter and One-Half Scale Cone Equipment
ASTM D1404	Test Method for Estimation of Deleterious Particles in Lubricating Grease
ASTM D1478	Low-Temperature Torque of Ball Bearing Greases
ASTM D1742	Oil Separation from Lubricating Grease During Storage
ASTM D1743	Corrosion Preventive Properties of Lubricating Greases
ASTM D1831	Roll Stability of Lubricating Grease
ASTM D2265	Dropping Point of Lubricating Grease Over Wide Temperature Range
ASTM D2266	Wear Preventive Characteristics of Lubricating Grease (Four-Ball Method)
ASTM D2509	Measurement of Load-Carrying Capacity of Lubricating Grease (Timken Method)
ASTM D2595	Evaporation Loss of Lubricating Greases Over Wide-Temperature Range
ASTM D2596	Measurement of Extreme-Pressure Properties of Lubricating Grease (Four-Ball Method)
ASTM D3336	Test Method for Life of Lubricating Greases in Ball Bearings at Elevated Temperatures
ASTM D3527	Life Performance of Automotive Wheel Bearing Grease
ASTM D3704	Test Method for Wear Preventive Properties of Lubricating Greases Using the (Falex) Block on Ring Test Machine in Oscillating Motion
ASTM D4048	Test Method for Detection of Copper Corrosion from Lubricating Grease
ASTM D4049	Test Method for Determining the Resistance of Lubricating Grease to Water Spray
ASTM D4170	Fretting Wear Protection by Lubricating Greases
ASTM D4289	Compatibility of Lubricating Grease with Elastomers
ASTM D4290	Leakage Tendencies of Automotive Wheel Bearing Grease Under Accelerated Conditions
ASTM D4425	Standard Test Method for Oil Separation from Lubricating Grease by Centrifuging (Koppers Method)
ASTM D4693	Low-Temperature Torque of Greased-Lubricated Wheel Bearings



ASTM D4950	Standard Classification and Specification for Automotive Service Greases
ASTM D5483	Test Method for Oxidation Induction Time of Lubricating Greases by Pressure Differential Scanning Calorimetry
ASTM D5706	Test Method for Determining Extreme Pressure Properties of Lubricating Greases Using a High-Frequency, Linear-Oscillation (SRV) Test Machine
ASTM D5707	Test Method for Measuring Friction and Wear Properties of Lubricating Grease Using a High-Frequency, Linear-Oscillation (SRV) Test Machine
ASTM D5969	Test Method for Corrosion-Preventive Properties of Lubricating Greases in Presence of Dilute Synthetic Sea Water Environments
ASTM D6138	Test Method for Determination of Corrosion-Preventive Properties under Dynamic Wet Conditions (Emcor Test)
ASTM D6184	Test Method for Oil Separation from Lubricating Grease (Conical Sieve Method)
ASTM D6185	Practice for Evaluating Compatibility of Binary Mixtures of Lubricating Greases
ASTM D7594	Test Method for Determining Fretting Wear Resistance of Lubricating Greases Under High Hertzian Contact Pressures Using a High-Frequency, Linear-Oscillation (SRV) Test Machine.
ASTM MNL-1	Manual on Significant Petroleum Tests (9th Edition)

2.1.3 NLGI Publications

Available from NLGI, 118 N. Conistor Lane, Suite B-281, Liberty, MO 64068 USA, Tel: 816-524-2500, www.nlgi.org.

Recommended Practice for Grease Lubricated Truck Wheel Bearings

NLGI Lubricating Grease Guide (7th Edition, 2022)

2.1.4 Technology & Maintenance Council Publications

Available from American Trucking Associations, 80 M Street SE, Suite 800, Washington, DC 20003, Tel: 703-838-1763, www.trucking.org/Technology_Council.aspx.

TMC Recommended Practice 155	Selection and Application of Corrosion Preventative Materials for Electrical Terminals and Connectors
TMC Recommended Practice 611	Driveline Maintenance Guidelines
TMC Recommended Practice 618	Wheel Bearing Adjustment
TMC Recommended Practice 622	Wheel Seal and Bearing Removal, Installation and Maintenance
TMC Recommended Practice 624	Lubricant Fundamentals
TMC Recommended Practice 631	Recommendations for Wheel End Lubrication
TMC Recommended Practice 638	Heavy Duty Clutch Maintenance Guidelines
TMC Recommended Practice 650	Guidelines for Fifth Wheel Pre-delivery Inspection, Preventative Maintenance and Troubleshooting
TMC Recommended Practice 651	Steer Axle Maintenance Guidelines

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 ELGI Publications

Available from the European Lubricating Grease Institute, Hemonylaan 26, 1074 BJ Amsterdam, "De Malietoren" Bezuidenhoutseweg 12 2594 AV DEN HAAG, Tel: +31-617-36-1962, The Netherlands, www.elgi.org.

Miller, D. (2003). *The Oil Separation Handbook*.

Balan, C. (Ed.) (2000). *The Rheology of Lubricating Grease*.

3. DEFINITION OF LUBRICATING GREASE

A lubricating grease is a solid to semifluid mixture of a liquid lubricant and a thickening agent. Additives to impart special properties or performance characteristics may be incorporated. The liquid component may be from API base stock groups I through V; the thickener may be a metallic soap or a non-soap substance such as an organophilic modified clay, a urea compound, carbon black, or other material. The viscosity of the fluid, the thickener concentration, and the chemical nature of the thickener can vary widely. The properties of the finished grease are influenced by the manufacturing process as well as by the materials used.

4. BASIC PERFORMANCE REQUIREMENTS

Lubricating greases are most often used instead of fluids where a lubricant is required to maintain its original position in a mechanism, especially where opportunities for frequent relubrication may be limited or economically unjustifiable. This requirement may be due to the physical configuration of the mechanism, the type of motion, the type of sealing, or the need for the lubricant to perform all or part of any sealing function in the prevention of lubricant loss or the entrance of contaminants. Because of their essentially solid nature, greases do not perform the cooling and cleaning functions associated with the use of a fluid lubricant. With these exceptions, greases are expected to accomplish all other functions of fluid lubricants.

A satisfactory grease for a given application is expected to:

- a. Provide adequate lubrication to reduce friction and to prevent harmful wear of mating components
- b. Protect against corrosion.
- c. Act as a seal to prevent entry of dirt and water.
- d. Resist leakage, dripping, or undesirable throw-off from the lubricated surfaces.
- e. Resist objectionable change in structure or consistency with mechanical working (in the mechanism) during prolonged service.
- f. Not stiffen excessively to cause undue resistance to motion in cold weather.
- g. Have physical characteristics suitable for the method of application.
- h. Be compatible with elastomer seals and other materials of construction in the lubricated portion of the mechanism.
- i. Tolerate some degree of contamination, such as moisture, without loss of significant characteristics.
- j. Have suitable oxidation and thermal stability for the intended application.
- k. Prevent the premature initiation of surface (rolling contact) fatigue (allow extended life).

5. PROPERTIES OF GREASES

5.1 Consistency

A measure of relative hardness. This property is commonly expressed in terms of the ASTM penetration or NLGI consistency number. The ASTM penetration is a numerical statement of the actual penetration of the grease sample, in tenths of a millimeter, by a standard test cone under stated conditions. The higher the penetration value, the softer the grease. The NLGI, formerly known as the National Lubricating Grease Institute, classifies greases according to their ASTM penetration as shown in Table 1.

Table 1 - NLGI consistency number

NLGI Consistency No.	ASTM Worked (60 Strokes) Penetration at 25 °C (77 °F) Tenths of a Millimeter ⁽¹⁾
000	445 to 475
00	400 to 430
0	355 to 385
1	310 to 340
2	265 to 295
3	220 to 250
4	175 to 205
5	130 to 160
6	85 to 115

⁽¹⁾ ASTM D217 cone penetration of lubricating grease.

The consistency of a grease is an important factor in its ability to lubricate, seal, remain in place, and to the methods and ease by which it can be dispensed and applied. Most truck greases are in the NLGI No. 1, 2, or 3 range; that is, ranging from soft to medium consistency. Greases recommended for use in wheel end bearings and automatic or central lubricating systems will likely be one of the softer NLGI grades, such as 00 or 0. The NLGI grade is an indication of consistency only and should not be interpreted as level of performance.

5.2 Texture and Structure

The appearance and feel of greases. A grease may be described as smooth, buttery, fibrous, long- or short-fibered, stringy, tacky, etc. These characteristics are influenced by the viscosity of the fluid, type of thickener, proportion of each of these components, presence of certain additives, and process of manufacture. There are no standard test methods for quantitative definitions of these properties. Texture and structure are factors in the adhesiveness and ease of handling of a grease.

5.3 Structural Stability

The ability of a grease to retain its as-manufactured consistency and texture despite age, temperature, mechanical working, and other influences; or its ability to return to its original state when a transient influence is removed.

5.4 Mechanical Stability

The resistance of a grease to permanent changes in consistency due to the continuous application of shearing forces. The stability of a grease is important to its ability to provide adequate lubrication and sealing and to remain properly in place during use.

5.5 Apparent Viscosity

The ratio of shear stress to rate of shear at a stated temperature and shear rate. Grease is by nature a non-Newtonian material. Therefore, the usual concept of viscosity valid for simple fluids (that is, internal resistance to flow) is not entirely applicable. The ratio of shear stress to shear rate varies as the shear rate changes. The apparent viscosity of most greases decreases with the increase of either temperature or shear rate. The applied shear rate or applied shear stress needs to be included when the apparent viscosity is reported. The apparent viscosity greatly influences the ease of handling, dispensing, and flow characteristics of a grease.

5.6 Dropping Point

The elevated temperature at which the grease generally passes from a solid to a liquid state or rapidly separates base fluid and flows through an orifice under standard test conditions. The dropping point is incorrectly regarded by some as establishing the maximum temperature for acceptable use. Performance at high temperature also depends on other factors such as duration of exposure, evaporation and oxidation resistance, and the design of the lubricated mechanism.

5.7 Oxidation Resistance

The resistance to chemical deterioration in storage and in service caused by exposure to air. It depends on the stability of the individual grease components and can be improved by use of antioxidants. Oxidation resistance is important wherever long storage or service life is required or where high temperatures prevail even for short periods.

5.8 Protection Against Friction and Wear

A protection greatly influenced by the viscosity and type of the fluid component and by grease structural and consistency characteristics. This performance characteristic can be altered by use of additives.

5.9 Protection Against Corrosion

A protection of ferrous components achieved primarily by the inclusion of suitable additives in the grease. The effectiveness of the protection is influenced also by the chemical and physical properties, such as interactions with other additives, consistency and base oil viscosity (both of which will determine how effectively the grease will seal out corrosive and other undesirable material), and the interaction with water. The effect of water on the grease can be significant. Some greases are water-resistant or waterproof, which means that they resist the washing effect of water and do not absorb it to any significant extent. Other greases can absorb varying amounts of water without appreciable damage to their structure or consistency and may provide better rust protection than waterproof greases, which can permit the accumulation of free water in bearings.

5.10 Bleeding or Oil Separation

The separation of liquid lubricant from a grease. Slight bleeding is regarded as desirable by some and indicative of good lubricating ability in rolling element bearings. It also helps the grease to flow through pipes in centralized systems by lubricating the pipe walls.

5.11 Color

While the color itself does not provide information about the grease's performance, it can play a vital role in the field, serving as a visual cue.

For instance, color may indicate whether the previous shift applied the correct type of grease to a component. A quick glance can alert technicians to potential mixing issues if incompatible greases are used or signal an over-greasing situation that could lead to equipment problems. This aspect of maintenance - where visual properties like color aid in identifying maintenance practices - enhances the overall efficiency of service operations, ensuring that machinery is kept in optimal working condition and extending its operational life span.

5.12 Flow

The ability to move grease to, or within, bearings and other components. Certain terms such as feedability, pumpability, and dispensability may be used to describe the factors involved.

5.12.1 Feedability or Slumpability

The ability to flow to the suction of the grease-dispensing equipment or mechanism to be lubricated.

5.12.2 Pumpability

The ability to flow through the grease-dispensing lines at a satisfactory rate without the necessity of using excessively high pressure.

5.12.3 Dispensability

The ease with which a grease may be transferred from its container to the point of application. For practical purposes, it is a combination of feedability and pumpability.

5.13 Significance

Of these properties, oxidation resistance, protection against friction and wear, protection against corrosion, and structural stability are probably of most importance in truck service as far as actual performance in bearings is concerned.

6. GREASE TESTING

Many of the previous grease properties are determined by tests that have been standardized or otherwise accorded industry recognition. These, in conjunction with simulated performance tests, permit some approximate judgment for the proper selection of greases for a given application. They are, however, not considered to be replacements for, or equivalent to, longtime service tests. A fuller discussion of grease tests and their significance can be found in ASTM MNL-1. Table 2 shows some of the more important tests identified as to sponsor, title, and purpose.

Table 2 - Grease tests

Test Designation	Test Purpose
ASTM D128, Analysis of Lubricating Grease	Quantitative determination of specified constituents such as soap, unsaponifiable matter (mineral oil), water, free alkali, free fatty acid, glycerin, and insolubles. NOTE: This procedure has a supplementary method useful for greases containing non-soap thickeners or API group III, IV, or V base stocks.
ASTM D217, Cone Penetration of Lubricating Grease	Measurement of consistency.
ASTM D942, Oxidation Stability of Lubricating Greases by the Oxygen Pressure Vessel (PVOT) Method	Determination of resistance to oxidation under static conditions in a sealed system at elevated temperatures; not indicative of the stability of greases under dynamic service conditions, nor the stability of greases stored in containers for long periods, nor the stability of films of grease on machine parts. It should not be used to estimate the relative oxidation resistance of different grease types.
ASTM D972, Evaporation Loss of Lubricating Greases and Oils	Evaluation of weight loss by evaporation at temperatures up to 150 °C (300 °F). For temperatures above 150 °C, use ASTM D2595.
ASTM D1092, Apparent Viscosity of Lubricating Greases	Determination of apparent viscosity in temperature range of -54 to 38 °C (-65 to 100 °F); results relatable to ease of handling and dispensing.