SAE International

SURFACE VEHICLE RECOMMENDED PRACTICE

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Automotive Lubricating Greases

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 automotive components, and with the selection and marketing of greases for the lubrication of certain of those components on passenger cars, trucks, and buses. The information contained herein will be helpful in understanding the terms related to properties, designations, and service applications of automotive greases.

1.1 Rationale

This document has been revised to include recent tests and information. The sections on transmission joint greases and greases for other vehicle needs have been considerably expanded.

2. References

2.1 Applicable Publications

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

2.1.1 SAE Publications

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 USA.

SAE AMS 3217A—Standard Elastomer Stock—Test Slabs
SAE AMS 3217/2A—Test Slabs, Acrylonitrile Butadiene (NBR-L)—Low Acrylonitrile, 65-75
SAE AMS 3217/3B—Test Slabs, Chloroprene (CR), 67-75

2.1.2 ASTM PUBLICATIONS

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 USA.

ASTM D 128—Analysis of Lubricating Grease
ASTM D 217—Cone Penetration of Lubricating Grease
ASTM D 566—Dropping Point of Lubricating Grease
ASTM D 942—Oxidation Stability of Lubricating Greases by the Oxygen Bomb Method
ASTM D 972—Evaporation Loss of Lubricating Greases and Oils
ASTM D 1092—Apparent Viscosity of Lubricating Greases
ASTM D 1263—Leakage Tendencies of Automotive Wheel Bearing Greases
ASTM D 1264—Water Washout Characteristics of Lubricating Greases
ASTM D 1403—Cone Penetration of Lubricating Grease Using One-Quarter and One-Half Scale Cone Equipment
ASTM D 1404—Test Method for Estimation of Deleterious Particles In Lubricating Grease
ASTM D 1478—Low-Temperature Torque of Ball Bearing Greases
ASTM D 1742—Oil Separation from Lubricating Grease During Storage
ASTM D 1743—Corrosion Preventive Properties of Lubricating Greases
ASTM D 1831—Roll Stability of Lubricating Grease
ASTM D 2265—Dropping Point of Lubricating Grease Over Wide-Temperature Range
ASTM D 2266—Wear Preventive Characteristics of Lubricating Grease (Four-Ball Method)
ASTM D 2509—Measurement of Load-Carrying Capacity of Lubricating Grease (Timken Method)
ASTM D 2595—Evaporation Loss of Lubricating Greases Over Wide-Temperature Range
ASTM D 2596—Measurement of Extreme-Pressure Properties of Lubricating Grease (Four-Ball Method)
ASTM D 3336—Test Method for Life of Lubricating Greases in Ball Bearings at Elevated Temperatures
ASTM D 3337—Test Method for Life and Torque of Lubricating Greases in Small Ball Bearings
ASTM D 3527—Life Performance of Automotive Wheel Bearing Grease
ASTM D 3704—Test Method for Wear Preventive Properties of Lubricating Greases Using the (Falex) Block on Ring Test Machine in Oscillating Motion
ASTM D 4048—Test Method for Detection of Copper Corrosion from Lubricating Grease
ASTM D 4049—Test Method for Determining the Resistance of Lubricating Grease to Water Spray
ASTM D 4170—Fretting Wear Protection by Lubricating Greases
ASTM D 4289—Compatibility of Lubricating Grease with Elastomers
ASTM D 4290—Leakage Tendencies of Automotive Wheel Bearing Grease Under Accelerated Conditions
ASTM D 4425—Standard Test Method for Oil Separation from Lubricating Grease by Centrifuging (Koppers Method)
ASTM D 4693—Low-Temperature Torque of Greased-Lubricated Wheel Bearings
ASTM D 4950—Standard Classification and Specification for Automotive Service Greases
ASTM D 5483—Test Method for Oxidation Induction Time of Lubricating Greases by Pressure Differential Scanning Calorimetry
ASTM D 5706—Test Method for Determining Extreme Pressure Properties of Lubricating Greases Using a High-Frequency, Linear-Oscillation (SRV) Test Machine
ASTM D 5707—Test Method for Measuring Friction and Wear Properties of Lubricating Grease Using a High-Frequency, Linear-Oscillation (SRV) Test Machine
ASTM D 5969—Test Method for Corrosion-Preventive Properties of Lubricating Greases in Presence of Dilute Synthetic Sea Water Environments
ASTM D 6138—Test Method for Determination of Corrosion Preventive Properties under Dynamic Wet Conditions (Emcor Test)

ASTM D 6184—Test Method for Oil Separation from Lubricating Grease (Conical Sieve Method)
ASTM D 6185—Practice for Evaluating Compatibility of Binary Mixtures of Lubricating Greases
ASTM MNL-1—Manual on Significant Petroleum Tests (Sixth Edition)

2.1.3 NLGI PUBLICATIONS

Available from NLGI, 4635 Wyandotte Street, Kansas City, MO 64112 USA.

NLGI Recommended Practice for Lubricating Passenger Car Wheel Bearings
NLGI Recommended Practice for Lubricating Passenger Car Ball Joint Front Suspensions
Constant Velocity Joint Greases, Fish, G., NLGI Spokesman, December 1999

2.1.4 ELGI PUBLICATIONS

Available from the European Lubricating Grease Institute, Hemonylaan 26, 1074 BJ Amsterdam, The Netherlands.

The Oil Separation Handbook, Miller, D., 2003
The Rheology of Lubricating Grease, Balan, C. ed., 2000

3. Definition of Lubricating Grease

A lubricating grease is a solid to semi-fluid 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 a mineral (petroleum) oil or a synthetic fluid; the thickener may be a metallic soap or soaps or a nonsoap 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

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

1. ASTM D 217 Cone Penetration of Lubricating Grease.

The consistency of a grease is an important factor in its ability to lubricate, seal, and remain in place, and to the methods and ease by which it can be dispensed and applied. Most automotive greases are in the NLGI No. 1, 2, or 3 range, that is, ranging from soft to medium consistency.

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 an increase of either temperature or shear rate. Apparent viscosity greatly influences the ease of handling, dispensing and flow characteristics of a grease. The applied shear rate or applied shear stress needs to be included when the apparent viscosity is reported.

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, oxidation and evaporation resistance, and 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 as 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

A superficial grease property without performance significance.

5.12 Flow

There is, of course, the problem of getting grease to the mechanism to be lubricated. Certain terms, by no means of strict, rigid interpretation, are used to describe the factors involved: feedability, pumpability, and dispensability.

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 automotive service as far as actual performance in bearings is concerned.

6. Grease Testing

Many of the previous grease properties are determined by tests which 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 Chapter 9 of 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 D 128, Analysis of Lubricating Grease	Quantitative determination of specified constituents, such as soap, unsaponifiable matter (mineral oil), water, free alkali, free fatty acid, glycerine, and insolubles. Note—This procedure has a supplementary method useful for greases containing nonsoap thickeners or synthetic fluids.
ASTM D 217, Cone Penetration of Lubricating Grease	Measurement of consistency.
ASTM D 566, Dropping Point of Lubricating Grease	Determination of temperature at which grease generally passes from plastic to liquid state; not regarded as indicative of service suitability; limited to dropping points up to 260 °C (500 °F). (In this test, some greases may release oil before the grease flows which is defined as their dropping points.)
ASTM D 942, Oxidation Stability of Lubricating Greases by the Oxygen Bomb 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.
ASTM D 972, Evaporation Loss of Lubricating Greases and Oils	Evaluation of weight loss by evaporation at temperatures up to 150 °C (300 °F).
ASTM D 1092, 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.
ASTM D 1263, Leakage Tendencies of Automotive Wheel Bearing Greases	Evaluation of leakage tendencies from an unsealed wheel bearing assembly, run for 6 h at 104 °C (220 °F); permits screening candidate greases; not a replacement for longtime service tests. Note—Replaced by ASTM D 4290 in many updated specifications.
ASTM D 1264, Water Washout Characteristics of Lubricating Greases	Evaluation of resistance to water washout from rotating bearings at 38 °C (100 °F) and at 80 °C (175 °F) under prescribed conditions; not a replacement for actual service tests; not suitable for fibrous greases.
ASTM D 1403, Cone Penetration of Lubricating Grease Using One-Quarter and One-Half Scale Cone Equipment	Similar to ASTM D 217, but using reduced-size apparatus to evaluate small grease samples. It should not be used for quality control purposes and is limited to greases of NLGI No. 0 to 4 consistency.
ASTM D 1404, Test Method for Estimation of Deleterious Particles in Lubricating Grease	Detects and estimates abrasive particles in a lubricating grease sample placed between two plastic plates and counting the scratches that occur when they are rotated under load.
ASTM D 1478, Low-Temperature Torque of Ball Bearing Greases	Determination of the extent to which a grease retards the rotation of a slow-speed ball bearing when subjected to temperatures below –18 °C (0 °F). This method was developed using a test temperature of –54 °C (–65 °F) and greases with extremely low torque characteristics. Although higher test temperatures are commonly used, the precision statements may not apply to temperatures other than –54 °C (–65 °F) or to greases with torque characteristics different from those used to establish precision. Note—ASTM D 4693 is better suited for greases having higher torque characteristics.
ASTM D 1742, Oil Separation from Lubricating Grease During Storage	Determination of tendency of oil constituent to separate from parent grease while in containers; suitable for NLGI No. 1 or stiffer greases; results are indicative of oil separation in containers, but not of oil separation under dynamic service conditions.
ASTM D 1743, Corrosion Preventive Properties of Lubricating Greases	Determination of surface damage due to corrosion, such as pitting, etching, rusting, or black stains on raceways and rollers of tapered roller bearings which have been run-in and stored for a prescribed period at 52 °C (125 °F) and 100% relative humidity.

TABLE 2—GREASE TESTS (CONTINUED)

Test Designation	Test Purpose
ASTM D 1831, Roll Stability of Lubricating Grease	Determination of changes to consistency after working in tester for 2 h at room temperature. Although test significance has not been determined, changes in worked penetration of a grease after rolling are believed to be an indication of shear stability under low shear conditions. The method is often modified by performing the test at elevated temperatures and for extended periods of time to reflect the conditions in the mechanism to be lubricated. The change in penetration using ASTM D 217 after 10 000 and 100 000 strokes is also used to determine the sear stability of a grease.
ASTM D 2265, Dropping Point of Lubricating Grease Over Wide-Temperature Range	Same purpose as ASTM D 566 but ASTM D 2265 is valid for temperatures up to 330 °C (625 °F).
ASTM D 2266, Wear Preventive Characteristics of Lubricating Grease (Four-Ball Method)	Determination of wear preventive characteristics of grease when a rotating loaded steel ball slides against three similar stationary steel balls, measured by wear-scar diameters on stationary balls after completion of test; not indicative of results in actual service, and cannot distinguish between extreme pressure (EP) and non-extreme pressure (non-EP) greases.
ASTM D 2509, Measurement of Load-Carrying Capacity of Lubricating Grease (Timken Method)	Determination of load-carrying ability of lubricating greases by Timken Lubricant and Wear Tester. In this device, a rectangular steel test block is forced against a rotating steel ring. Scar width and surface conditions are noted. Method differentiates between lubricants of various extreme-pressure levels; not a replacement for actual service tests.
ASTM D 2595, Evaporation Loss of Lubricating Greases Over Wide-Temperature Range	Evaluation of weight loss by evaporation at temperatures between 93 and 316 °C (200 and 600 °F).
ASTM D 2596, Measurement of Extreme-Pressure Properties of Lubricating Grease (Four-Ball Method)	Evaluation of load-carrying properties at high loads. Determines: a. Load-wear index (formerly mean-Hertz load) b. Weld point by Four-Ball EP Tester
ASTM D 3336, Test Method for life of Lubricating Greases in Ball Bearings at Elevated Temperatures	Evaluates the performance of lubricating greases in ball bearings operating under light loads at high speeds and elevated temperatures.
ASTM D 3337, Test Method for Life and Torque of Lubricating Greases in Small Ball Bearings	Determines lubricating-grease life in small bearings and measures the running torque at both low and high speeds. This test predicts relative grease life at high temperature in a reasonable testing time. It is not the equivalent of a long-time field-service test.
ASTM D 3527, Life Performance of Automotive Wheel Bearing Grease	Evaluation of the high-temperature life performance of wheel bearing grease.
ASTM D 3704, Test Method for Wear Preventive Properties of Lubricating Greases using the (Falex) Block on Ring Test Machine in Oscillating Motion	Determines wear properties of lubricating greases using the Falex block-on-ring friction and wear test machine.
ASTM D 4048, Test Method for Detection of Copper Corrosion from Lubricating Grease	Determines the corrosiveness of lubricating grease by rating the color changes of immersed copper strips.
ASTM D 4049, Test Method for Determining the Resistance of Lubricating Grease to Water Spray	Evaluates the Adherence of a grease on a metal surface when subjected to a water spray under prescribed laboratory conditions.
ASTM D 4170, Fretting Wear Protection by Lubricating Greases	Evaluation of fretting wear protection characteristic by measuring mass loss of ball thrust bearings oscillated under load; correlates with fretting protection performance of greases in wheel bearings of passenger cars shipped long distances.
ASTM D 4289, Compatibility of Lubricating Grease with Elastomers	Determination of hardness and volume changes in elastomers caused by contact with lubricating grease at elevated temperatures under static and full immersion conditions.

TABLE 2—GREASE TESTS (CONTINUED)

Test Designation	Test Purpose
ASTM D 4290, Leakage Tendencies of Automotive Wheel Bearing Grease Under Accelerated Conditions	Evaluation of leakage tendency of a grease from unsealed wheel bearings run 20 h at 1000 rpm and thrust loaded to 111 N (25 lb force). Unlike ASTM D 1263, this method, which is conducted at a higher temperature, 160 °C (320 °F), differentiates among wheel bearing greases having distinctly different high-temperature leakage characteristics.
ASTM D 4425, Standard Test Method for Oil Separation from Lubricating Grease by Centrifuging (Koppers Method)	Determines the tendancy of a lubricating grease to separate oil under high centrifugal forces.
ASTM D 4693, Low-Temperature Torque of Greased-Lubricated Wheel Bearings	Determination of the viscous resistance of a grease in a wheel bearing assembly rotated at low speed in a low-temperature environment; used to evaluate both wheel bearing and chassis greases for performance in low-temperature service. Note—Greases having torque characteristics that permit evaluation in both ASTM D 1478 and ASTM D 4693 will not give the same torque values in the two tests because of differences in bearings and test apparatus.
ASTM D 5483, Test Method for Oxidation Induction Time of Lubricating Greases by Pressure Differential Scanning Calorimetry	Determines the oxidation tendencies of lubricating greases by measuring the oxidation-induction time in a 3.5 MPa oxygen atmosphere at temperatures between 155 and 210 °C.
ASTM D 5706, Test Method for Determining Extreme Pressure Properties of Lubricating Greases Using a High-Frequency, Linear-Oscillation (SRV) Test Machine	Determines the extreme pressure properties of lubricating greases in the SRV test machine operating at high-frequency, linear-oscillation motion conditions. (Can be used to test fluid lubricants, as well.)
ASTM D 5707, Test Method for Measuring Friction and Wear Properties of Lubricating Grease Using a High-Frequency, Linear-Oscillation (SRV) Test Machine	Determines a lubricating grease's coefficient of friction and, from average wear scar dimensions, its ability to protect against wear when the test piece is subjected to high-frequency, linear-oscillation motion. (Can be used to test fluid lubricants, as well.)
ASTM D 5969, Test Method for Corrosion-Preventive Properties of Lubricating Greases in Presence of Dilute Synthetic Sea Water Environments	Determines the pass-fail rating of the corrosion-preventive properties of greases in tapered roller bearings exposed to any of various concentrations of dilute synthetic sea water and stored under wet conditions. (Similar to ASTM D 1743, which uses distilled water.)
ASTM D 6138, Test Method for Determination of Corrosion Preventive Properties under Dynamic Wet Conditions (Emcor Test)	Determines the relative corrosion-preventive ratings of lubricating greases in rotating ball bearings operating partially immersed in aqueous solution.
ASTM D 6184, Test Method for Oil Separation from Lubricating Grease (Conical Sieve Method)	Determines the tendency of oil to separate from lubricating grease held in a conical sieve at an elevated temperature (usually 100 °C for 30 h). This test method is not suitable for greases having a penetration greater than 340 (softer than NLGI No. 1 grade.) This standard test method is the ASTM equivalent of Federal Test Method (FTM) 791C Method 321.3.
ASTM D 6185, Practice for Evaluating Compatibility of Binary Mixtures of Lubricating Greases	A standard protocol to evaluate the compatibility of binary mixtures of lubricating greases by comparing the properties of three different mixture ratios relative to those of the neat constituent greases comprising the mixture. Initially, three test methods are used to evaluate the compatibility: a. Dropping Point (ASTM D 566 or D 2265), b. Shear Stability (ASTM D 217, 100 000-stroke worked penetration); and c. Storage Stability at Elevated Temperature (change in 60-stroke penetration measured by ASTM D 217.) Suggestions for additional tests are included if such are considered necessary for special or critical applications.

7. *Designation of Greases*

Greases are commonly classified and designated according to chemical composition, such as lithium-soap grease; by broad type of usage, such as antifriction bearing grease or multipurpose grease; by specific properties such as high-temperature grease; by special additives, such as extreme-pressure grease or graphite grease; and by specific applications, such as automotive-wheel-bearing grease. SAE recognizes the following designations for greases used in servicing passenger cars, trucks, and buses according to their specific applications.

7.1 Wheel Bearing Grease

Designates lubricating greases of such composition, structure, and consistency as to be suitable for longtime use in antifriction wheel bearings. The properties and composition of greases used in ball-type wheel bearings are significantly different than those used in tapered roller-type wheel bearings. Generally, ball-type are sealed-for-life wheel bearings used in modern automotive vehicles are not serviceable.

NOTE—Generally, these greases resist the deteriorating effects of temperature and the separating effects of centrifugal action. They have good antirust properties. They should not exhibit oil-soap separation or excessive softening which could result in leakage that could lead to braking failure.

For re-lubrication of serviceable wheel bearings, follow the manufacturer's recommendations. Generally, tapered-roller wheel bearings of light-duty vehicles (automobiles and small trucks) can be lubricated satisfactorily with greases meeting the requirements of NLGI categories GC or GC-LB. Consult manufacturer's recommendations for service lubrication of wheel bearings of heavy-duty vehicles and all off-road vehicles.

7.2 Transmission Joint Grease

7.2.1 UNIVERSAL JOINT GREASE

Generally, the universal joints used in modern passenger cars and light trucks automotive vehicles contain sealed-for-life grease and are not serviceable. OEM requirements specify lubricating greases of stable structure and consistency, good oxidation and water resistance, fretting and wear resistance and good seal compatibility as to be suitable for the lubrication of those types of automotive universal joints requiring grease lubrication.

For **re-lubrication** of serviceable universal joints, follow the manufacturer's recommendations. For most applications, NLGI categories GC or GC-LB greases can be used.

7.2.2 CONSTANT VELOCITY JOINT GREASE

The constant velocity joints (CVJs) used in modern passenger cars and light trucks automotive vehicles contain sealed-for-life grease and are not serviceable. OEM requirements specify lubricating greases of stable structure and consistency, good oxidation and water resistance, rolling contact fatigue and wear resistance, good thermal and oxidation stability and good seal compatibility as to be suitable for the particular type of CVJ to be lubricated.

For outboard ball joints, greases containing solid lubricants with NLGI consistency classes of 1 to 2 are used. The choice of thickener is typically down to OEM preference, with lithium, lithium complex and polyureas being commonly specified.

For inboard ball-type plunging joints, similar greases are used to outboard ball joints except that high temperature thickeners such as lithium complex or polyurea are preferred.

For inboard tripod type plunging joints high temperature and or low friction greases are specified. They tend to be softer to NLGI 1 to 0 classes.

For high-speed propeller shaft CVJs as used on 4x4 vehicles, high temperature low friction greases are specified.

If a CVJ needs to be serviced, it is best to use OEM offered service kits, which contain appropriate seals and the correct grease type for the joint to be employed. For more information on CVJ greases, consult "Constant Velocity Joint Greases," Fish, G., NLGI Spokesman, December 1999.

7.3 Chassis Grease

Designates lubricating greases of proper consistency to be applied at periodic intervals in accordance with equipment manufacturers' recommendations, with grease guns through grease fittings, into the various parts of automotive chassis requiring grease lubrication.

NOTE—When no means are provided for periodic relubrication, the ability of a grease to retain its performance characteristics over long intervals of time and service becomes critical. This applies to seals as well because only seals in good condition can effectively prevent intrusion of water, dirt, and other contaminants, and minimize loss of grease by leakage.

For the service re-lubrication of chassis components, follow the manufacturer's recommendations. Generally, chassis components can be lubricated satisfactorily with greases meeting the requirements of NLGI categories LB or GC-LB.

7.4 Multipurpose Grease

Designates lubricating greases of such composition, structure, and consistency to meet the performance requirements for chassis grease (more than 3200 km (2000 mile) service life), wheel bearing grease, universal joint grease, and other automotive uses of a miscellaneous nature, such as fifth-wheel service.

NOTE—Some chassis lubricants are satisfactory as multipurpose greases. The grease manufacturer should be consulted as to the multipurpose qualities of his product. Greases designated NLGI GC-LB are multipurpose greases by definition.

TABLE 3—SUMMARY OF NLGI AND ASTM DESIGNATION, DESCRIPTION, AND PERFORMANCE REQUIREMENTS FOR AUTOMOTIVE SERVICE GREASES

NLGI Letter Designation	NLGI Service Description	ASTM D 4950 Performance Description	ASTM D 4950 Performance Requirements
Chassis Service			
LA	Service typical of chassis components and universal joints in passenger cars, trucks, and other vehicles under mild duty only. Mild duty will be encountered in vehicles operated with frequent relubrication in noncritical applications.	The grease shall satisfactorily lubricate chassis components and universal joints where frequent relubrication is practiced (at intervals 3200 km or 2000 miles or less for passenger cars). During its service life, the grease shall resist oxidation and consistency degradation while protecting the chassis components and universal joints from corrosion and wear under lightly loaded conditions. NLGI 2 consistency greases are commonly recommended, but other grades may also be recommended.	Conform to requirements of Table 4.
LB	Service typical of chassis components and universal joints in passenger cars, trucks, and other vehicles under mild to severe duty. Severe duty will be encountered in vehicles operated under conditions which may include prolonged relubrication intervals, or high loads, severe vibration, exposure to water or other contaminants, etc.	The grease shall satisfactorily lubricate chassis components and universal joints at temperatures as low as –40 °C (–40 °F) and at temperatures as high as 120 °C (248 °F) over prolonged relubrication intervals (more than 3200 km or 2000 miles for passenger cars). During its service life, the grease shall resist oxidation and consistency degradation while protecting the chassis components and universal joints from corrosion and wear even when aqueous contamination and heavily loaded conditions occur. NLGI 2 consistency greases are commonly recommended, but other grades may also be recommended.	Conform to requirements of Table 4.
Wheel Bearing Service			
GA	Service typical of wheel bearings operating in passenger cars, trucks, and other vehicles under mild duty. Mild duty will be encountered in vehicles operated with frequent relubrication in noncritical applications.	The grease shall satisfactorily lubricate wheel bearings over a limited temperature range. Many products of this type are limited to bearing temperatures of –20 to 70 °C (–4 to 158 °F). No additional performance requirements are specified for these greases.	Conform to requirements of Table 5.

TABLE 3—SUMMARY OF NLGI AND ASTM DESIGNATION, DESCRIPTION, AND PERFORMANCE REQUIREMENTS FOR AUTOMOTIVE SERVICE GREASES (CONTINUED)

NLGI Letter Designation	NLGI Service Description	ASTM D 4950 Performance Description	ASTM D 4950 Performance Requirements
GB	Service typical of wheel bearings operating in passenger cars, trucks, and other vehicles under mild to moderate duty. Moderate duty will be encountered in most vehicles operated under normal urban, highway, and off-highway service.	The grease shall satisfactorily lubricate wheel bearings over a wide temperature range. The bearing temperatures may range down to 40 °C (–40 °F), with frequent excursions to 120 °C (320 °F). During its service life, the grease shall resist oxidation, evaporation, and consistency degradation while protecting the bearings from corrosion and wear. NLGI 2 consistency greases are commonly recommended, but NLGI 1 or 3 grades may also be recommended.	Conform to requirements of Table 5.
GC	Service typical of wheel bearings operating in passenger cars, trucks, and other vehicles under mild to severe duty. Severe duty will be encountered in certain vehicles operated under conditions resulting in high bearing temperatures. This includes vehicles operated under frequent stop-and-go service (buses, taxis, urban police cars, etc.), or under severe braking service (trailer towing, heavy loading, mountain driving, etc.).	The grease shall satisfactorily lubricate wheel bearings over a wide temperature range. The bearing temperatures may range down to –40 °C (–40 °F), with frequent excursions to 160 °C (320 °F) and occasional excursions to 200 °C (392 °F). During its service life, the grease shall resist oxidation, evaporation, and consistency degradation while protecting the bearings from corrosion and wear. NLGI 2 consistency greases are commonly recommended, but NLGI 1 or 3 grades may also be recommended.	Conform to requirements of Table 5.

TABLE 4—"L" CHASSIS GREASE CATEGORIES

Category	Test	Property	Acceptance Limit
LA	D 217	Consistency, worked penetration, mm/10	220 to 340[1]
	D 566 or D 2265	Dropping Point, °C, min	80
	D 2266	Wear Protection, scar diameter, mm, max	0.9
	D 4289	Elastomer SAE AMS 3217/3B Compatibility:	
		volume change, %	0 to 40
		hardness change, Durometer-A points	–15 to 0
LB	D 217	Consistency, worked penetration, mm/10	220 to 340[1]
	D 566 or D 2265	Dropping Point, °C, min	150
	D 2266	Wear Protection, scar diameter, mm, max	0.6
	D 4289	Elastomer SAE AMS 3217/3B Compatibility:	
		volume change, %	0 to 40
		hardness change, Durometer-A points	–15 to 0
	D 1742	Oil Separation, mass %, max	10
	D 1743	Rust Protection, rating, max	Pass
	D 2596	EP Performance:	
		load wear index, kgf, min	30
		weld point, kgf, min	200
	D 4170	Fretting Protection, mass loss, mg, max	10[2]
	D 4693	Low-Temperature Performance, torque at –40 °C, N·m, max	15.5

1. Vehicle manufacturer's requirement may be more restrictive; grease containers should display NLGI Consistency Number as well as category designation.
2. The fretting wear requirement is significant in passenger car and light-duty truck service, but it has not been shown to be significant in heavy-duty truck applications.

TABLE 5—"G" WHEEL BEARING GREASE CATEGORIES

Category	Test	Property	Acceptance Limit
GA	D 217	Consistency, worked penetration, mm/10	220 to 340[1]
	D 566 or D 2265	Dropping Point, °C, min	80
	D 4693	Low-Temperature Performance, torque at –20 °C, N·m, max	15.5
GB	D 217	Consistency, worked penetration, mm/10	220 to 340[1]
	D 566 or D 2265	Dropping Point, °C, min	175
	D 4693	Low-Temperature Performance, torque at –40 °C, N·m, max	15.5
	D 1264	Water Resistance at 80 °C, %, max	15
	D 1742	Oil Separation, mass %, max	10
	D 1743	Rust Protection, rating, max	Pass
	D 2266	Wear Protection, scar diameter, mm, max	0.9
	D 3527	High-Temperature Life, hours, min	40
	D 4289	Elastomer SAE AMS 3217/2A Compatibility:	
		volume change, %	–5 to +30
		hardness change, Durometer-A points	–15 to +2
	D 4290	Leakage Tendencies, g, max	24
GC	D 217	Consistency, worked penetration, mm/10	220 to 340[1]
	D 566 or D 2265	Dropping Point, °C, min	220
	D 4693	Low-Temperature Performance, torque at –40 °C, N·m, max	15.5
	D 1264	Water Resistance at 80 °C, %, max	15
	D 1742	Oil Separation, mass %, max	6
	D 1743	Rust Protection, rating, max	Pass
	D 2266	Wear Protection, scar diameter, mm, max	0.9
	D 3527	High-Temperature Life, hours, min	80
	D 4289	Elastomer SAE AMS 3217/2A Compatibility:	
		volume change, %	–5 to +30
		hardness change, Durometer-A points	–15 to +2
	D 4290	Leakage Tendencies, g, max	10
	D 2596	EP Performance:	
		load wear index, kgf, min	30
		weld point, kgf, min	200

1. Vehicle manufacturer's requirement may be more restrictive; grease containers should display NLGI Consistency Number as well as category designation.