SAE International™

SURFACE VEHICLE STANDARD

SAE J306

REV. JUN2005

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Superseding J306 JUL1998

Automotive Gear Lubricant Viscosity Classification

1. Scope

This SAE Standard defines the limits for a classification of automotive gear lubricants in rheological terms only. Other lubricant characteristics are not considered.

1.1 Rationale

Two new viscosity grades were added to the viscosity classification as part of the January 2005 update. The new grades are SAE 110 (100 °C viscosity between 18.5 and 24.0 cSt) and SAE 190 (100 °C viscosity between 32.5 and 41.0 cST). The need for the two additional grades centered on the wide variation in kinematic viscosity possible within the prior version of J306 for SAE 90 and the SAE 140 grades. The effect of such a wide range of kinematic viscosities could result in an axle being serviced with a lubricant that had a viscosity significantly lower or higher than the axle lubricant that the axle had been validated with, even though the same viscosity grade had been employed. OEMs may have been forced to specify a higher viscosity grade than what they may actually desire, because the wide range of kinematic viscosities of the next lower grade could result in customers using a lubricant having too low of a kinematic viscosity. For example: An OEM would like to recommend a lubricant having a 100 °C viscosity of 19.5 cSt, which according to the prior version of J306 requirements would be SAE 90. However, if the OEM had recommended a SAE 90 the actual viscosity could be as low as 13.5 cSt, which may be lower than the OEM is comfortable with. Thus, the OEM recommended a SAE 140, which ensures that the 100 °C viscosity is never lower than the desired 19.5. Unfortunately, that also means that the viscosity could be as high as 41.0 cSt. Under the new limits the OEM could recommend a SAE 110 which would meet the 19.5 cSt requirement and the axle would not be serviced with anything higher in viscosity than 31 cSt.

An additional change to J306 was the inclusion for the use of ASTM D 3244 for resolving any disputes between laboratories as to whether a product conforms with any specification in Table 1.

The test designation for the KRL Shear Stability Test was also updated to the current designation.

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2. References

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. The latest issue of ASTM and CEC publications shall apply.

2.1.1 ASTM PUBLICATIONS

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

ASTM D 445—Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (the Calculation of Dynamic Viscosity)

ASTM D 2983—Standard Test Method for Low-Temperature Viscosity of Automotive Fluid Lubricants Measured by Brookfield Viscometer

ASTM D 3244—Standard Practice for Utilization of Test Data to Determine Conformance with Specifications

ASTM D 5293—Standard Test Method for Apparent Viscosity of Engine Oils Between -5 and -30 °C Using the Cold-Cranking Simulator

2.1.2 CEC TEST METHODS

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

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

3. Significance and Use

This SAE Standard is intended for use by equipment manufacturers in defining and recommending automotive gear, axle and manual transmission lubricants, for oil marketers in labeling such lubricants with respect to their viscosity, and for users in following their owner's manual recommendations. The SAE viscosity grades shown in Table 1 constitute a classification for automotive gear, axle, and manual transmission lubricants in rheological terms only. Disputes between laboratories as to whether a product conforms with any specification in Table 1 shall be resolved by application of the procedures described in ASTM D 3244. For this purpose, all specifications in Table 1 are critical specifications to which conformance based upon reproducibility of the prescribed test method is required. The product shall be considered to be in conformance if the Assigned Test Value (ATV) is within the specification.

TABLE 1—AUTOMOTIVE GEAR LUBRICANT VISCOSITY CLASSIFICATION

SAE Viscosity Grade	Maximum Temperature for Viscosity of 150 000 cP, °C [1,2]	Kinematic Viscosity at 100 °C, cSt [3] Minimum [4]	Kinematic Viscosity at 100 °C, cSt [3] Maximum
70W	-55 [5]	4.1	—
75W	-40	4.1	—
80W	-26	7.0	—
85W	-12	11.0	—
80	—	7.0	<11.0
85	—	11.0	<13.5
90	—	13.5	<18.5
110	—	18.5	<24.0
140	—	24.0	<32.5
190	—	32.5	<41.0
250	—	41.0	—

NOTE—1cP = 1 mPa·s; 1 cSt = 1 mm^2/s

1. Using ASTM D 2983.
2. Additional low-temperature viscosity requirements may be appropriate for fluids intended for use in light duty synchronized manual transmissions. See text.
3. Using ASTM D 445.
4. Limit must also be met after testing in CEC L-45-A-99, Method C (20 hours).
5. The precision of ASTM Method D2983 has not been established for determinations made at temperatures below -40 °C. This fact should be taken into consideration in any producer-consumer relationship.

This classification is based on the lubricant viscosity measured at both high and low temperatures. The high-temperature kinematic viscosity values are determined according to ASTM D 445, with the results reported in centistokes (cSt). The low-temperature viscosity values are determined according to ASTM D 2983 and these results are reported in centipoise (cP). These two viscosity units are related as follows in Equation 1:

$$\frac{\text{cP}}{\text{Density, g/cm}^3} = \text{cSt} \qquad \text{(Eq. 1)}$$

Density is measured at the test temperature. This relationship is valid for Newtonian fluids; it is an approximation for non-Newtonian fluids.

High temperature viscosity is related to the hydrodynamic lubrication characteristics of the fluid. Some gear lubricants may contain high molecular weight polymers, known as viscosity modifiers or viscosity index improvers, which function to increase the viscosity of the fluids. During use, these polymers may shear to a lower molecular weight, thereby resulting in a fluid with a lower viscosity than that of the new fluid. In order to ensure that the designated high temperature viscosity grade is retained during use, lubricants must meet the 100 °C viscosity limits listed in Table 1 not only when new, but also following evaluation in CEC L-45-A-99, Viscosity Shear Stability of Transmission Lubricants, Method C (20 hours).

Low temperature viscosity requirements are related to the ability of the fluid to flow and provide adequate lubrication to critical parts under low ambient temperature conditions. The 150 000 cP viscosity value used for the definition of low-temperature properties is based on a series of tests in a specific rear axle design. These tests have shown that pinion bearing failure has occurred at viscosities higher than 150 000 cP and the Brookfield method was shown to give adequate precision at this viscosity level. However, it should be pointed out that other axle designs may tolerate higher viscosities or fail at lower viscosities.

Other applications may require additional low temperature limits. For example, shifting ease at low temperature in light duty synchronized manual transmissions may be related to viscosity at higher shear rates than that provided by the Brookfield method. For such applications, use of the Cold Cranking Simulator (CCS) per ASTM D 5293 should be considered. A CCS viscosity of 5000 cP, maximum, at -30 °C may ensure satisfactory low temperature shiftability.

Automotive gear lubricant SAE viscosity grades should not be confused with engine oil SAE viscosity grades. (Compare Table 1 in this report with Table 1 in SAE J300.) A gear lubricant and an engine oil having the same viscosity will have widely different SAE viscosity grade designations as defined in the two viscosity classifications. For instance, an SAE 75W gear lubricant can have the same kinematic viscosity at 100 °C as an SAE 10W engine oil; and an SAE 90 gear lubricant viscosity can be similar to that of an SAE 40 or SAE 50 engine oil.

4. Labeling

In properly describing the viscosity grade of an automotive gear lubricant according to this document, a lubricant may use one W grade numerical designation, one non-W grade numerical designation, or one W grade in combination with one non-W grade. In all cases the numerical designation must be preceded by the letters “SAE”. In addition, when both a W grade and a non-W grade are listed (multigrade) the W grade shall be listed first and the two designations shall be separated by a hyphen (i.e., SAE 80W-90). Other forms of punctuation or separation are not acceptable.

A lubricant which meets the requirements of both a low-temperature and a high-temperature grade is commonly known as a multiviscosity-grade lubricant. For example, an SAE 80W-90 lubricant must meet the low-temperature requirements for SAE 80W and the high-temperature requirements for SAE 90. Since the W grade is defined on the basis of maximum temperature for a Brookfield viscosity of 150 000 cP and minimum kinematic viscosity at 100 °C, it is possible for a lubricant to satisfy the requirements of more than one W grade. In labeling either a W grade or a multiviscosity grade lubricant, only the lowest W grade satisfied may be referred to on the label. Thus a lubricant meeting the requirements of both SAE 75W and SAE 85W as well as SAE 90 would be labeled as SAE 75W-90, and not SAE 75W-85W-90.

5. Notes

5.1 Marginal Indicia

The change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

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