Axle and Manual Transmission Lubricant Viscosity Classification—SAE J306c

SAE Recommended Practice
Last revised November 1977

THIS IS A PREPRINT WHICH IS SUBJECT TO REVISIONS AND CORRECTIONS. THE FINAL VERSION WILL APPEAR IN THE 1979 EDITION OF THE SAE HANDBOOK.

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LAND SEA AIR SPACE

PREPRINT

AXLE AND MANUAL TRANSMISSION LUBRICANT VISCOSITY CLASSIFICATION—SAE J306c

SAE Recommended Practice

Report of Lubricants Division approved February 1924 and last revised by Fuels and Lubricants Committee November 1977.

This SAE Recommended Practice is intended for equipment manufacturers in defining and recommending axle and manual transmission lubricants, for oil marketers in labeling such lubricants with respect to viscosity, and for users in following their owner's manual recommendations. The SAE φ viscosity grades shown in Table 1 constitute a classification for axle and transmission lubricants in terms of viscosity only; the change in viscosity with use, or other gear lubricant qualities, are not considered. φ Axle and transmission 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 80W gear lubricant can have the same viscosity characteristics as an SAE 20W-20 engine oil; and an SAE 90 gear lubricant viscosity can be similar to that of an SAE 40 or SAE 50 engine oil.

This classification is based on the lubricant viscosity measured at both high and low temperatures. The high-temperature values are determined according to ASTM D 445, Method of Test for Viscosity of Transparent and Opaque Liquids, with the results reported in centistokes (cSt)[b]. The low-temperature values are determined according to ASTM D 2983, Method of Test for Apparent Viscosity at Low Temperature Using the Brookfield Viscometer, and these results are reported in centipoises (cP)[a]. These two viscosity units are related as follows:

$$\frac{\text{cP}}{\text{Density, kg/dm}^3} = \text{cSt}$$

Density is measured at the test temperature.

This relationship is valid for Newtonian fluids; it is an approximation for non-Newtonian fluids.

A multiviscosity graded lubricant, such as SAE 80W-90, meets both the low and high-temperature requirements shown in Table 1. That is, it conforms to the SAE 80W requirement at low temperature and is in the range provided for SAE 90 at high temperature.

φ The selection of an axle or transmission lubricant should be based on the lowest and highest service temperatures. The multiviscosity graded lubricants may be satisfactory at both temperature extremes. 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. The Brookfield low-temperature viscosity curves for several gear lubricants, made with conventional petroleum base stocks, are shown in a viscosity-temperature chart in Fig. 1. It must be recognized that some gear lubricants can have viscosity-temperature relationships different than those shown in this chart.

Other applications may require considerably different Brookfield viscosity limits. For example, experience has indicated that, for satisfactory ease of shifting, many manual transmissions require a lubricant viscosity not exceeding 20 000 cP at the shifting temperature.

In recommending axle and transmission lubricants by SAE viscosity grade, the following temperatures are suggested as a uniform practice: -40°C, -26°C, and -12°C.

Note: [a] and [b] refer to footnotes in Table 1.

The φ symbol is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. If the symbol is next to the report title, it indicates a complete revision of the report.

TABLE 1—AXLE AND MANUAL TRANSMISSION LUBRICANT VISCOSITY CLASSIFICATION [c]

SAE Viscosity Grade	Maximum Temperature for Viscosity of 150 000 cP [a] °C	Viscosity at 100°C [b] cSt Minimum	Maximum
75W	-40	4.1	–
80W	-26	7.0	–
85W	-12	11.0	–
90	–	13.5	<24.0
140	–	24.0	<41.0
250	–	41.0	–

[a] Centipoise (cP) is the customary absolute viscosity unit and is numerically equal to the corresponding SI unit of millipascal-second (mPa·s).

[b] Centistokes (cSt) is the customary kinematic viscosity unit and is numerically equal to the corresponding SI unit of square millimetre per second (mm^2/s).

[c] The new viscosity classification represents a conversion to international SI units using degrees Celsius and with a minimum change in viscosity limits relative to prior practice. By early 1982, it is the aim to define the low temperature requirements at suitable multiples of 5°C while retaining 100°C for the high temperature range. The proposed revision will necessitate considering changes of the viscosity limits for the high and/or low temperatures used to define the new system.

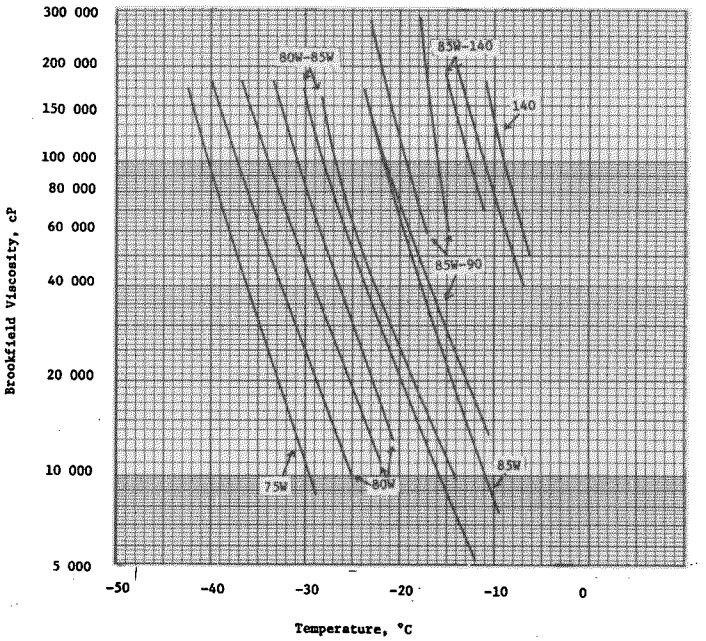

FIG. 1—BROOKFIELD VISCOSITY VERSUS TEMPERATURE FOR TYPICAL GEAR LUBRICANTS (SAE VISCOSITY GRADES INDICATED)