TECHNI/TIPS

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GEAR OILS

Many changes have taken place in gear oil requirements and gear oil specifications. With the multiviscosity gear oils becoming very popular in the cold temperature regions and the coast-to-coast operation of many vehicles, it was necessary to establish a low temperature specification.

The Society of Automotive Engineers publishes the Axle and Manual Transmission Lubricant Viscosity Classification, SAE J306. This classification is based on the lubricant viscosity measurements and may encompass both high and low temperature variations. The high temperature values (kinematic viscosity, in centistokes) are determined according to ASTM D-445 method. The low temperature values (absolute viscosity, in centipoise) are determined according to ASTM D-2983, using the Brookfield Viscometer.

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

AXLE AND MANUAL TRANSMISSION LUBRICANT VISCOSITY CLASSIFICATION

SAE Viscosity Grades	Maximum Temperature for Viscosity of 150,000 cP°C.	Viscosity 100°C. cSt	
		Minimum	Maximum
70W	-55	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	<24.0
140	--	24.0	<41.0
250	--	41.0	--

The 150,000 cP viscosity value used for the definition of low temperature properties was derived through a series of tests that show pinion bearing failures have occurred at viscosities higher than 150,000 cP. The Brookfield method was shown to give adequate precision at this viscosity level. Each low temperature gear lubricant (SAE grade followed by a W) must not exceed a maximum viscosity of 150,000 cP at the temperature indicated. A 150,000 cP fluid appears like a semifluid grease which will barely pour.

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 SAE 70W, 75W, 80W and 85W are for low temperatures and the SAE 80, 85, 90, 140 and 250 are for the high heat applications. This eliminates spring and fall oil changes.

MIL-L-2105 viscosity grade limits are the same as the SAE J306 classification. To be a MIL-L-2105, the gear lubricant must have low temperature operating characteristics. The gear oils normally meeting this classification are the type used in automotive applications, on-highway and off-highway. Gearbox temperatures do not exceed 230°F. (110°C.) under normal operating conditions. Care should be taken not to exceed this limit since EP additives in some gear oils will become reactive. The viscosities that are specified by MIL-L-2105 are 75W, 80W-90 and 85W-140.

The American Petroleum Institute's (API) "GL-S" designates the type of service characteristics of gears, particularly hypoid in passenger cars and other automotive equipment operated under high speed/shock load, high speed/low torque and low speed/high torque conditions. This is considered an extreme pressure or EP designation. Thus, we have an SAE J306, MIL-L-2105, API GL-5 EP (extreme pressure) gear oil specification.

The requirements of many equipment manufacturers have exceeded the API GL-5 specification. As a result, SAE and ASTM have proposed updated GL categories for present and future needs. This prompted the development of the API MT-1 category.

API MT-1 designates the type of service characteristics of non-synchronized manual transmissions used in buses and heavy-duty trucks. Lubricants that meet the API MT-1 requirements provide protection against the combination of thermal degradation, component wear and oil seal deterioration not provided by lubricants of API GL-1 through GL-5 quality.

Since API MT-1 does not address heavy-duty truck and bus final drives using spiral bevel and hypoid gears, there is ongoing development of a new category for this service. This category is designated PG-2 and may be called API GL-7 when completed.

LE Gear oil that is MIL-L-2105, API GL-5, and API MT-1 is 703-704 MONOLEC Gear Lubricant. LE oils which meet all performance criteria for MIL-L-2105, except for the specified viscosities, are 300 MONOLEC Industrial Lubricant; 604-609 ALMASOL Vari-Purpose Gear Lubricants and 9920 SYNOLEC Gear Lubricant. MIL-L-2105 oils are recommended by Mack Truck, Rockwell International (now Meritor), Eaton Axle, Clark Axle, Navistar, General Motors, Ford, Chrysler and Caterpillar for many applications.

Low temperature characteristics of gear lubricants are not as critical in most industrial gearboxes, therefore, a different classification standard has been designed by the American Gear Manufacturing Association (AGMA). The AGMA has two standards in regard to gear oil lubricants. The standards set by AGMA include viscosity and performance requirements. Each AGMA number may be classified as an R&O (rust and oxidation inhibited) gear lubricant or as an EP (extreme pressure) gear lubricant, or as an S (synthetic) gear lubricant.

The current standard, AGMA 9005-D94 American National Standard, Industrial Gear Lubrication, covers the following types of gearing: helical, herringbone, straight bevel, spiral bevel, worm gear and spur. These lubrication recommendations apply to enclosed gear drives which are designed and rated in accordance with current AGMA standards; however, the AGMA 9005-D94 lubricant number may be substituted for the past AGMA requirements, such as AGMA 250.04. As specifications change, LE will continue to meet the needs of the marketplace.

AGMA STANDARD 9005-D94 VISCOSITY RANGES FOR ENCLOSED GEAR DRIVES

LE Product	Rust and oxidation inhibited gear oils AGMA Lubricant #	Viscosity range [(a)] mm^2/s (cSt) at 40°C	Equivalent ISO grade [(b)]	Extreme pressure gear lubricants [(c)] AGMA Lubricant #	LE Product
6401/6801	0	28.8 to 35.2	32		
6402/6802	1	41.4 to 50.6	46		
640316803	2	61.2 to 74.8	68	2 EP	300
6404/6804	3	90 to 110	100	3 EP	606
6405/6805	4	135 to 165	150	4 EP	604
6406/6806	5	198 to 242	220	5 EP	607
6407/6807	6	288 to 352	320	6 EP	605/9320
	7, 7 Comp [(d)]	414 to 506	460	7 EP	608/9460
680	8, 8 Comp [(d)]	612 to 748	680	8 EP	609
	8A Comp [(d)]	900 to 1100	1000	8A EP	5250

Note: Viscosity ranges for AGMA lubricant numbers will be identical to those of ASTM 2422.

(a) "Viscosity System for Industrial Lubricants" ASTM 2422. Also British Standard SS 4231.
(b) "Industrial Liquid Lubricants-ISO Viscosity Classification" International Standard, ISO 3448.
(c) Extreme pressure lubricants should be used only when recommended by the gear drive manufacturer.
(d) Oils marked "Comp" are compounded with 3% to 10% fatty or synthetic fatty oils.

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