MANUAL TRANSMISSIONS

The only oil recommended for Volvo manufactured transmissions is that which has **quality GL-1.**

The teeth in the Volvo transmissions are so dimensioned that there is no need for any additives of sulphur or phosphor.

The judgement being therefore that there is hardly any advantage in using these additives.

For this reason GL-4 and GL-5 oils are not recommended for Volvo manufactured transmissions.

The seals in the Volvo transmissions are of a very high quality and normally withstand GL-5 oils. Also the steel/molybdenum synchromesh does not appear to be particularly sensitive to this oil.

Problems can however arise at very high temperatures, such as when driving in mountainous terrain or when the power take-off is being used. There is a risk that deposits from the oil form a coating which block the oil filter and oil channels so that the operation of the oil cooler is impaired. We therefore advise against the use of GL-4 and GL-5 oils in Volvo manufactured transmissions. The German transmission manufacturers recommend GL-4 oils. We approve therefore the use of GL-4 oils in Volvo vehicles with ZF manufactured transmissions. However even here we firmly advise against the use of GL-5 oils.

AUTOMATIC TRANSMISSIONS, POWER STEERING

Trucks fitted with Volvo automatic transmissions require **ATF quality Dexron II D** to facilitate smooth gear changing.

Very great demands are made on oil for automatic transmission and power steering installations. The oil must have a very low sensitivity to temperature, that is, temperature variations must have as little influence as possible on the viscosity of the oil. Moreover, the oil must have good cleansing characteristics, since deposits, for example on valves, have an immediate detrimental effect on the functioning of the unit. Foaming must not occur since the function of the unit demands a constant flow of oil. Anti-oxidation and anti-corrosive qualities must also be the very best.

ATF means Automatic Transmission Fluid.

REAR AXLES

Oil to **quality GL-5** (even called MIL-L-2105B or C)

Volvo rear axles, with highly loaded hypoid gears or those axles with hub reduction **must** have oil to GL-5 quality.

WHY MUST THE OIL BE CHANGED?

Wear particles

When the vehicle is being driven the oil must work as a very thin (approx. 1/1000th mm) lubricating film and at a pressure of $10^9 N/m^2$.

As a comparison, this pressure is equivalent to the pressure when working in the ocean at a depth of 100 km.

Sometimes it happens that there is a breakdown in the oil film, due to unevenness in the teeth surface, too high a temperature or too low a speed. When this happens, wear occurs on the teeth material and the oil becomes contaminated with wear particles.

Normally the oil is filtered through the oil filter, but it is not possible for the filter within a reasonable time to remove these particles which are as small as the oil film is thick.

The particles therefore contribute to wear.

The only way to remove these particles is to change the oil. This is very important after running-in, as the oil then contains considerable particle contamination.

The oil filter should always be changed in conjunction with an oil change.

Oil oxidation

Oil reacts with the oxygen in the air and coupled with a high temperature this oxidation process is accelerated. A temperature increase of 10–20°C doubles the reaction speed. The oil becomes more aggressive from the point of view of corrosion, the lubricating effect deteriorates, and the oil gradually becomes darker and thicker. Reclaimed oil, sometimes sold as so-called low price oil, often contains oxidized base oils and for reasons of corro should not be used. Corrosion often works in conjunc with wear, and water in the oil makes the situation even worse.

Oil recommendations

Volvo's oil recommendations are carefully adapted to provide a good margin of safety and contribute to good transport economy. They are given against a background of comprehensive testing in trucks and subsequent analyses of not only the oils, but also wear in transmissions and rear axles.

General

It is important both technically and economically to select the correct oil for each particular purpose. The demands made on the right type of lubricating oil are not merely dependent on the part of the vehicle where the oil is to be used but also on design and operating conditions. The rapid advances made during recent years have made the introduction of standard specifications necessary in order to state the type of oil concerned.

The following concerns some modern standards related to the demands made on the quality of lubricating oil. **It is then the responsibility of the oil manufacturers themselves to ensure that their various products meet the demands made. It is, therefore, advisable to use only well-known makes of oil.**

API-system

ENGINE OILS

API (the American Petroleum Institute) originally divided engine oils up into Regular, Premium and HD oils. Regular indicated a straight mineral oil, Premium indicated that the oil contained a certain amount of protective additives and HD meant that the oil also contained a certain amount of detergent additives. This system is now out of date and has been replaced by a new API system. The new system is not concerned with providing any description of the various oil types but states the different types of operating conditions for both diesel engines and petrol engines. Primary consideration has thereby been given to the type of driving and engine design.

When the range of use of an oil is stated by using the letters of the API-system, these letters may be preceded by the words "API Service". For example, if an oil can be used for many different ranges of use, it is defined as "API Service CC, CD".

The official API text states the following for engine oils for use in both diesel and petrol engines:

Diesel engines

CA, CB

These are older quality designations which are no longer valid, and no detailed description of these qualities are given here.

CC

Typical for aspirated engines with high litre output and light supercharged diesel engines which work under moderately difficult to difficult conditions. Also includes individual petrol engines with extra high special demands. These oils provide protection against high temperature deposits in the above mentioned engines but also protection against corrosion and low temperature deposits in petrol engines.

CD

Typical for high speed, supercharged diesel engines with high output, which demand effective protection against wear and deposits. These oils provide protection against bearing corrosion and against high temperature deposits, irrespective of the quality of the fuel.

Petrol engines

SA, SB, SC, SD

These are older quality designations which are no longer valid, and no detailed descriptions of these qualities are given here.

SE

Typical for petrol engines of **year model 1971 to 1979** and which work under the warranty terms of the engine manufacturers. Oils in this service class provide better protection against oxidation, high temperature deposits and corrosion in petrol engines compared with oils in classes SC and SD and can thus also be used when these are recommended.

SF

Typical for petrol engines in cars and certain trucks of **year model 1980 and later** which are maintained in accordance with the engine manufacturer's recommended service programme. The oils developed for the above mentioned service conditions are more stable where it concerns oxidation. They also provide better protection against wear, compared to those oils which only meet the minimum demands of class SE. In addition, they provide good protection against scaling, rust and general corrosion.

API-system

TRANSMISSION OILS

In its Publication 1560 issued in January 1966, API stated a classification system for transmission oils with the following classification depending on the operating conditions of the oils. If any lubricant is suitable for more than one of the following classes, this will be stated.

The classifications do not however include oils/fluids for automatic transmissions, torque converters, differential brakes, etc. These components require special lubricants.

API-GL-1

Relates to oils for motor vehicles with spiral bevel gears, worm gears and manual transmissions operated under conditions of low surface pressure and sliding velocities that a straight mineral oil can be used satisfactorily. Oxidation and rust inhibitors, foam depressants and pour point depressants are often used to improve the characteristics of these oils.

API-GL-2

Relates to oils for motor vehicles with worm gears operating under such conditions of load, temperature and sliding velocities that lubricants satisfactory for API-GL-1 will not suffice.

API-GL-3

Relates to oils for manual transmissions and rear axles with spiral bevel gears operating under moderately severe conditions of speed and load. These service conditions require a lubricant having load carrying capacities greater than those which will satisfy API-GL-1, but below the requirements of lubricants satisfying API-GL-4.

API-GL-4

Relates to oils for gears, particularly hypoid gears in vehicles operated under high speed/low torque and low speed/high torque conditions.

API-GL-5

Relates to oils for gears, particularly hypoid gears in vehicles operated under high speeds/low torque and low speeds/high torque conditions.

MIL – American military specifications

ENGINE OILS

The original API classification became insufficient in the long run and the American army therefore made its own specifications. This system (MIL) specifies the quality of the oil partly in general terms and partly in engine tests with demands on the chemical characteristics of the oil.

MIL-L-2104A, MIL-L-45199B, CATERPILLAR SERIES 3

These are older quality designations which are no longer valid, and no detailed descriptions of these qualities are given here.

MIL-L-2104B

During the 1960's this specification replaced MIL-L-2104A. The difference is primarily that the new specification makes greater demands on the cleansing properties of the oil.

MIL-L-46152

This specification replaced MIL-L-2104B in 1972. It has been developed for diverse types of vehicles but does not apply to turbo engines. MIL-L-46152 combines the demand on high class diesel engine oil with the maximum demand on oil for petrol engines.

MIL-L-461528

This specification replaced MIL-L-46152 in 1980, and covers the demands of API class SF.

MIL-L-2104C

This specification replaced MIL-L-45199B in 1972 and has among other things higher demands for rust protection.

MIL-L-2104D

This specification replaced MIL-L-2104C in 1983 and covers the demands of API class CD.

MIL – American military specifications

TRANSMISSION OILS

MIL-L-2105

If an oil is to correspond to this specification, it must be a product which has been tested and found to satisfy certain clearly defined demands based on full scale tests. During the tests checks are made concerning separation, foaming, corrosion, oxidation, bearing capacity and miscibility. The specification concerns primarily final drive oils.

MIL-L-2105B

Development in the motor vehicle industry has resulted in the fact that more and more power is being transmitted through the final drive. In order to meet this, more severe demands must be made also on the lubricant. In 1962 specification MIL-L-2105B was issued and according to this specification oils are subjected to tests which are in the main identical with MIL-L-2105, but with more severe demands.

MIL-L-2105C

This specification came into existence in order to be able to apply MIL-L-2105B to 1970's double and multigrade oils such as SAE 80W/90, SAE 85W/140 etc.

Other quality standards

AUTOMATIC TRANSMISSION FLUIDS

The first, more generally used quality standard for this fluid was General Motors "Automatic Transmission Fluid, Type A" issued in 1951. This standard has been subsequently modified and, among other things, suffix A was added in 1957. Fluid according to this standard has been designated by us in our recommendations as ATF, type A.

In 1967, General Motors issued a new standard "Dexron" which presumes more modern and more extensive tests with rather more stringent demands. Later these demands have been increased further, and the designation for the standard is now Dexron IID.

Ford has its own standards. The earlier M2 C33-F has after altered demands been replaced by M2 C33-G. This standard prescribes, among other things, completely different friction characteristics, when compared to other oils for automatic transmissions, such as ATF type A and Dexron IID. The fluid which meets Ford's standard has been designated by us in our recommendations ATF, type G.

VISCOSITY

General

Viscosity is a measurement of the internal friction of the oil or of its resistance to flow. It does not however give any indication as to the quality of the oil, but is nevertheless perhaps the most significant characteristic of a lubricating oil. The viscosity of the oil should be adapted so that at operating temperature it retains its lubricity between surfaces, irrespective of the amount of loading. The viscosity should not therefore be too high as this causes increased bearing friction and power loss. The viscosity of a liquid is an expression of the product's resistance to flow, or as stated earlier, a measurement of its internal friction. All fluids become thinner when heated and as a result the determining of a viscosity must be carried out at given temperatures, for example, 20, 50, 100 or 150°C.

The viscosity can be divided up into two categories, dynamic and kinematic.

DYNAMIC VISCOSITY

The viscosity of a fluid can be called absolute or dynamic and has unit measurement mPa or centipois (cP).

To precisely produce the dynamic viscosity with the help of a viscosimeter is a complicated and time consuming procedure. The usual way to measure dynamic viscosity at low temperature is to use a "Cold Cranking Simulator" (CCS), a testing method based on ASTM D 2602. The method is used for determining the viscosity of the engine oil at –18°C (0°F) and the measurement unit is expressed in centipois (cP).

KINEMATIC VISCOSITY

Kinematic viscosity, with unit measurement mm^2/s or centistoke (cSt) is the relationship between dynamic viscosity in mPa and the density of the oil in g/cm^3 at the temperature the viscosity is to be measured. Within the oil industry the viscosity is measured by determining the time required for a stipulated amount of oil to flow through a calibrated glass capillary tube. One of the most commonly used instruments for determining the kinematic viscosity is Ubbelohde's viscosimeter.

Viscosity classification

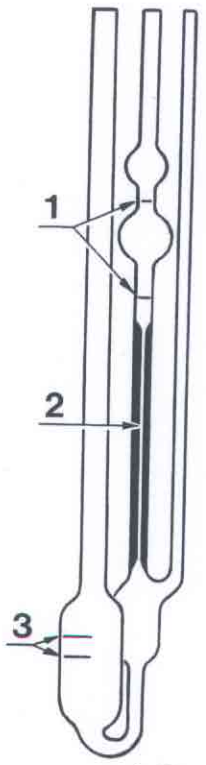
SAE-classes for ENGINE OILS and TRANSMISSIOI .S
(SAE = Society of Automative Engineers)
ISO – classes for INDUSTRIAL LUBRICATING OILS
(ISO = International Standards Organisation)

There have been many different measurement units to express the viscosity of lubricating oils, such as Engler degrees (E°), Saybolt Universal Seconds (SUS), or centistokes (cSt). The temperature was stated at different levels in Celsius (°C) or Fahrenheit (°F). Today, international standards require that the measurement unit is expressed in mm^2/s (cSt) and that the temperature is expressed in Celsius degrees (°C).

By international cooperation, approval was reached in 1975 for the new ISO classes. It meant a simplification of the conception viscosity for industrial lubricating oils. In the same way, the long established and well-known SAE classes for engine oils and transmission oils was created. Every ISO class and SAE class state a fixed clearly defined viscosity range at a certain temperature. In general, the higher the number of the class, the higher the viscosity. The classes do not however give any indication as to the quality of the oil.

SAE-SYSTEM

The SAE system was developed in the USA and ratified in 1926 by the Society of Automotive Engineers (SAE). It is the best known classification system for engine and t mission oils. The SAE system is based on viscosity takes no regard as to quality or composition.



1 Measurement marks, volume 4–6
2 Capillary tube
3 Filling marks

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The tables below indicate the SAE numbers and viscosity ranges for engine oils and transmission oils.

Those SAE numbers followed by the W (Winter) indicate that the oil is suitable for winter use. The viscosity for winter quality is stated in cP. Engine oils are measured with the Cold Cranking Simulator. Transmission oils are measured with the brookfield viscosimeter, and here it applies that the viscosity does not exceed 150,000 cP at the temperatures given in the table.

The other SAE numbers for both engine and transmission oils are stated in mm^2/s or cSt at 100°C (212°F) together with their indicated viscosity limits.

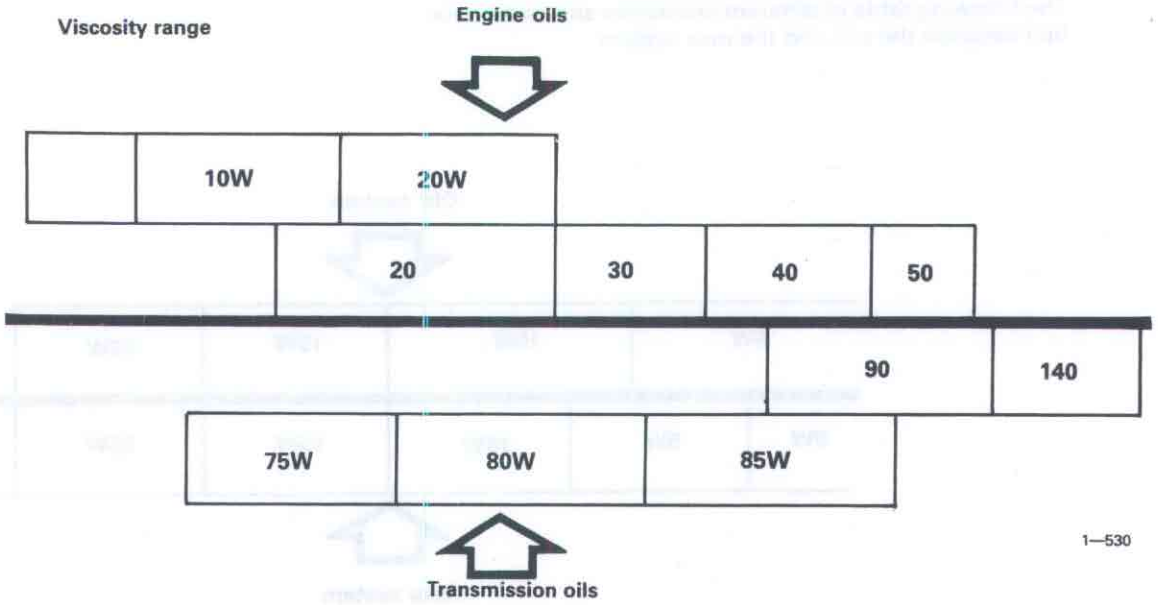
As can be seen from the tables, the SAE numbers for transmission oils are not a direct continuation of the numbers for engine oils. A direct comparison between the different oils is only possible if they are standardized at the same temperature. The figure below, which shows the viscosity range of the oils, gives some idea of the internal placing, on the basis that the viscosity index is approx. 100.

Viscosities for engine oils according to SAE. Older system (applicable to March 1982).

SAE-no. Viscosity	cP at –18°C (0°F)		mm^2/s (cSt) at 100°C (212°F)	
	Min	Max	Min	Max
5W		1250	3.8	
10W	1250	2500	4.1	
15W	2500	5000	4.1	
20W	5000	10000	5.6	
20			5.6	9.3
30			9.3	12.5
40			12.5	16.3
50			16.3	21.9

Viscosities for transmission oils according to SAE

SAE-no. Viscosity	Max. temp. for viscosity at 150,000 cP	mm^2s (cSt) at 100°C (212°F)	
		Min	Max
75W	–40°C	4.1	
80W	–26°C	7.0	
85W	–12°C	11.0	
90		13.5	24.0
140		24.0	41.0
150		41.0	



NEW SAE VISCOSITY CLASSIFICATION OF ENGINE OILS

A new viscosity classification was introduced in March 1982. It was introduced to enable multigrade oils to be more readily identified. The SAE classification system is, as stated earlier, a system which only indicates the viscosity of the oil. Other classification demands, for example, operating conditions are covered by special service classifications as laid out in the API Service System.

The new SAE classifications specify the viscosity in cP and with the temperature as a variable. The viscosity is measured in the Cold Cranking Simulator according to test method ASTM D 2602. The viscosity at high temperatures is specified as earlier with the kinematic viscosity at 100°C. In addition, the new SAE standards have introduced demands concerning the pumpability of the oil. This characteristic is measured with a "mini rotary viscosimeter", and the lowest temperature for "pumpability" is stated.

Viscosities for engine oils according to SAE (from March 1982)

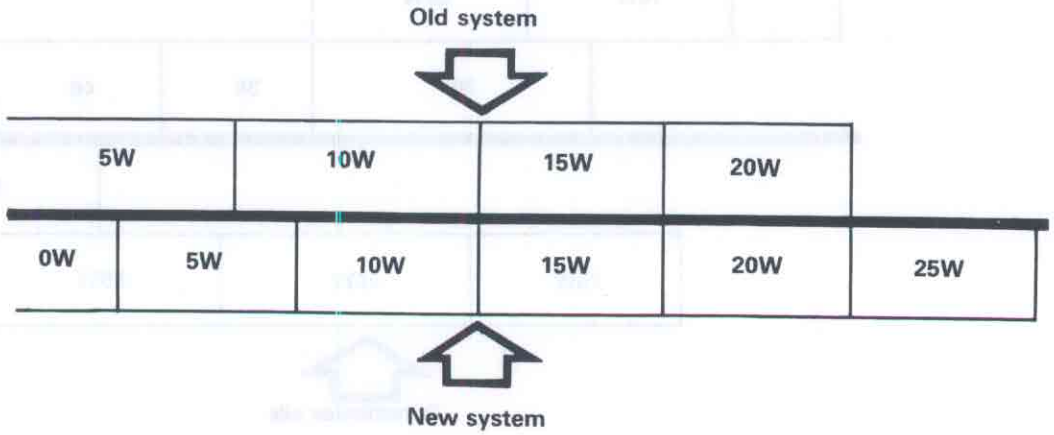
SAE-no. Viscosity	Viscosity at given temp. °C Max.[1]		Borderline pump[3] Temp. °C Max.[2]	Viscosity cSt 100°C	
				Min	Max
0W	3250	–30	–35	3.8	–
5W	3500	–25	–30	3.8	–
10W	3500	–20	–25	4.1	–
15W	3500	–15	–20	5.6	–
20W	4500	–10	–15	5.6	–
25W	6000	– 5	–10	9.3	–
20				5.6	9.3
30				9.3	12.5
40				12.5	16.3
50				16.3	21.9

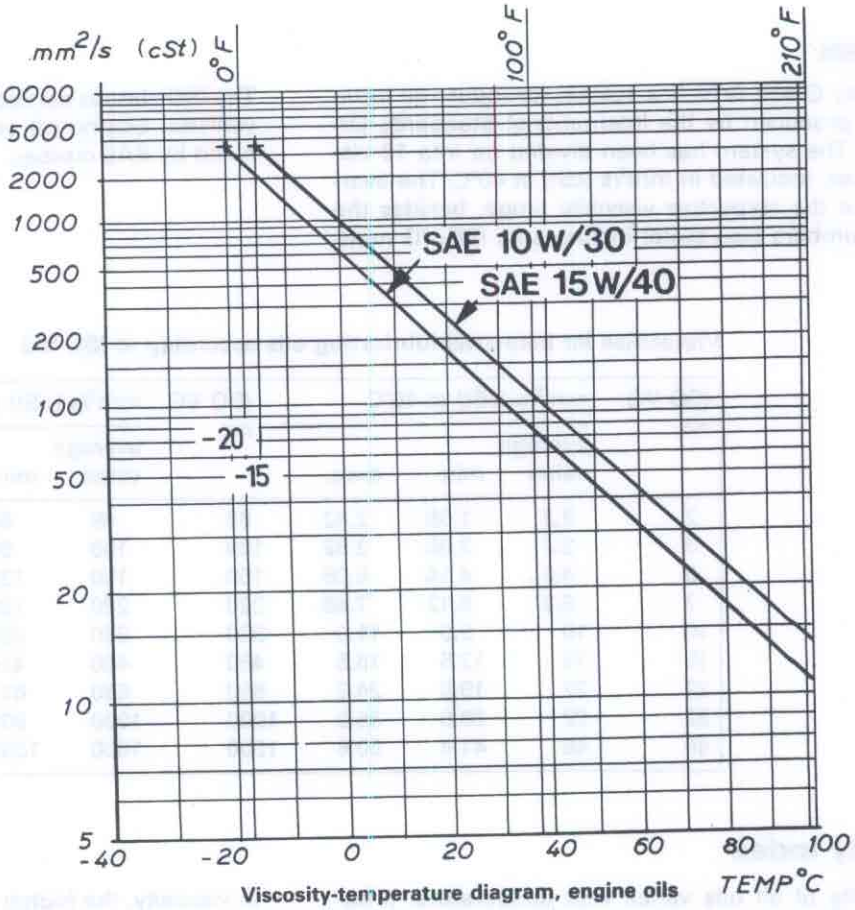
[1] ASTM D 2602
[2] ASTM D 3829
[3] Limit value for pumpability

The new system, which corresponds to temperature limits, gives details on both the pumpability and viscosity of the engine oil. Note that the viscosities at 100°C (212°F) apply even now as they did previously in the old system.

The following table of different viscosities shows the relation between the old and the new system.

Another example of the difference between the old and new system is that an engine oil which was previously specified SAE10W/40, is classified in the new system as SAE 5W/40 and SAE 5W/30 as OW/30 etc.





Viscosity-temperature diagram, engine oils

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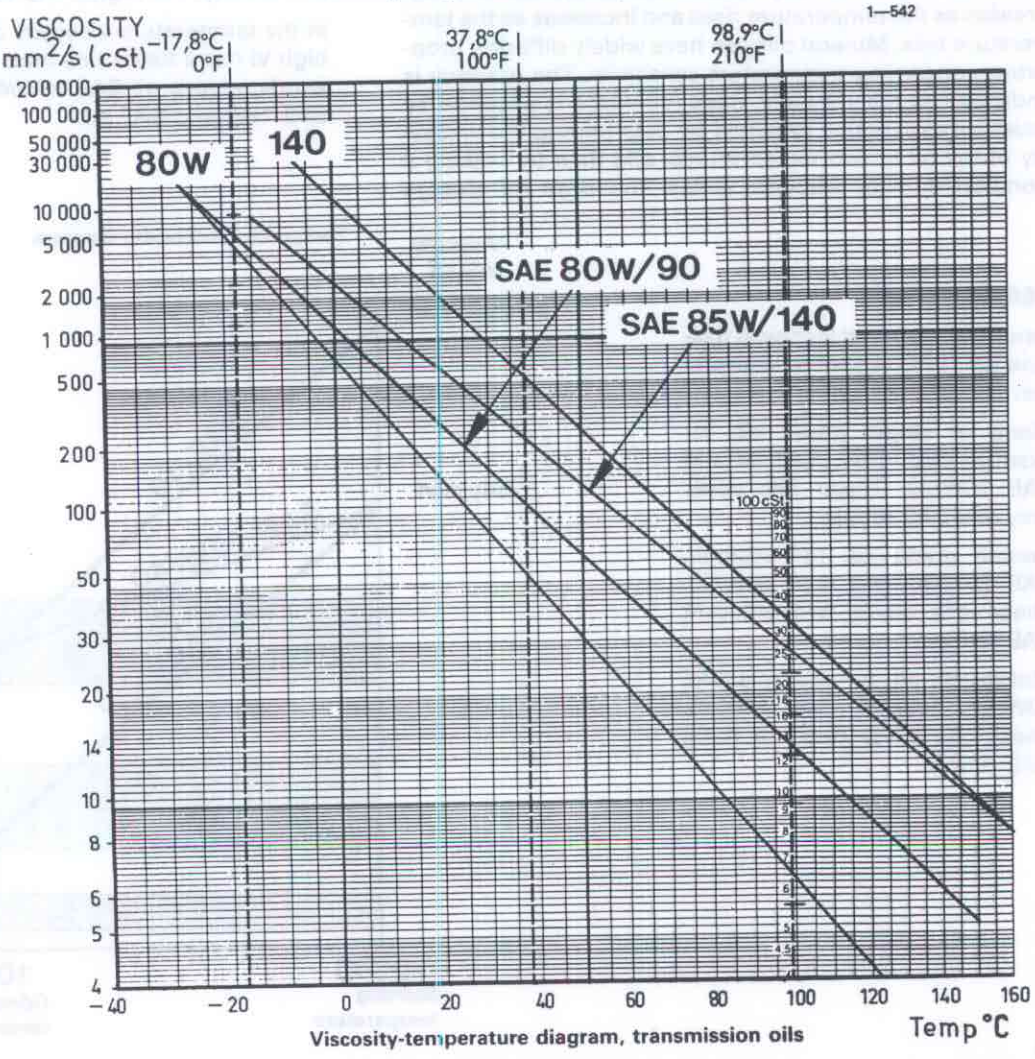

Viscosity-temperature diagram, transmission oils

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