BEHRAN OIL CO.

# LUBRICANT CLASSIFICATION

## MOTOR OIL

**There are two main classification criteria for motor oils:**

- **Based on Viscosity (SAE)**
- **Based on Performance (API, ACEA, manufacturer's specifications)**

## SAE CLASSIFICATION

**Kinematic viscosity measured at 100°C defines SAE degrees from 20 to 60 for rising levels of viscosity. Dynamic viscosity at low temperatures defines the SAE "W" degrees, from the initial "winter", from 0W to 25W on the basis of viscosity levels measured at temperatures from -35° to -5°C. The temperature represents the lowest possible temperature at which the engine can be started when lubricated with an oil of the corresponding SAE degree (e.g. a 15W oil makes it possible to start the engine at up to -20°C). The minimum pumping temperature is the minimum temperature at which oil, in addition to allowing start up, can flow freely and lubricate the critical parts of the engine.**

### SAE J300 JANUARY 2009 (ENGINE OILS)

**The most widely used system for engine oil viscosity classification is that established by the Society of Automotive Engineers (SAE) in the USA. In this system two series of viscosity grades are defined – those containing the letter W and those without the letter W.**

**Grades with the letter W are intended for use at lower temperatures and are based on a maximum low temperature viscosity and a maximum borderline pumping temperature, as well as a minimum viscosity at 100°C. The low temperature viscosity is measured by means of a multi-temperature version of ASTM D2602 'Method of Test for apparent Viscosity of Motor Oils at Low temperature using the Cold Cranking Simulator'.**

**Viscosities measured by this method have been found to correlate with engine speeds developed during low temperature cranking. Borderline pumping temperature is measured according to ASTM D3829 'Standard Method for Predicting the Borderline Pumping**

**Temperature of Engine Oil'. This provides a measure of an oils' ability to flow to the engine oil pump inlet and provide adequate engine oil pressure during the initial stages of operation.**

**Oils without the letter W, intended for use at higher temperatures, are based on the viscosity at 100°C only. These are measured by ASTM D445 'Method of Test for Kinematic Viscosity of temperature and Opaque Liquids'.**

**'multi-grade' oil is one whose low temperature viscosity and borderline temperature satisfy the requirements of one of the W grades and whose viscosity at 100°C is within the stipulated range of one-W-grades**

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## SAE J300 VISCOSITY GRADES FOR ENGINE OILS[12] (JANUARY 2015)

| SAE Viscosity Grades | Low Temperature (°C) Cranking Viscosity[3], mPa.s Max | Low Temperature (°C) Pumping Viscosity, mPa.s Max With No Yield Stress[4] | Low-Shear-Rate Kinematic Viscosity[5] ($mm^{2/s}$) at 100°CMin. | Low-Shear-Rate Kinematic Viscosity[5] ($mm^{2/s}$) at 100°CMin. | High-Shear-Rate Viscosity[(6)6] (mPa.s) at 150°CMin. |
|---|---|---|---|---|---|
| 0W | 6200 at-35 | 60 000 at-40 | 3.8 | - | - |
| 5W | 6600 at-30 | 60 000 at-35 | 3.8 | - | - |
| 10W | 7000 at-25 | 60 000 at-30 | 4.1 | - | - |
| 15W | 7000 at-20 | 60 000 at-25 | 5.6 | - | - |
| 20W | 9500 at-15 | 60 000 at-20 | 5.6 | - | - |
| 25W | 13000 at-10 | 60 000 at-15 | 9.3 | - | - |
| 8 | - | - | 4.0 | <6.1 | 1.7 |
| 12 | - | - | 5.0 | <7.1 | 2.0 |
| 16 | - | - | 6.1 | <8.2 | 2.3 |
| 20 | - | - | 6.9 | <9.3 | 2.6 |
| 30 | - | - | 9.3 | <12.5 | 2.9 |
| 40 | - | - | 12.5 | <16.3 | 3.5 (0W-40, 5W-40 and 10W-40 grades) |
| 40 | - | - | 12.5 | <16.3 | 3.7 (15W40, 20W-40 , 25W-40, 40 grades) |
| 50 | - | - | 16.3 | <21.9 | 3.7 |
| 60 | - | - | 21.9 | <26.1 | 3.7 |

[1] *1 mPa.s=1cP , $mm^2/_5$ =1 cSt*

[2] *All Values, With the exception of the low-temperature cranking viscosity, are critical specifications as defined by ASTM D3244 (See Text, section 3).*

[3] *ASTM D5293:(Cold - Cranking Simulator) – The non-critical specification protocol in ASTM D3244: shall be applied with a P value of 0.95.*

[4] *ASTM D4684:(apparent viscosity) Note that the presence of any yield stress detectable by this method constitutes a failure regardless of viscosity.*

[5] *ASTM D445: (Kinematic viscosity)*

[6] *ASTM D4683: CEC L-36-A-90 (ASTM D4741),or ASTM D5481 (Tapered bearing or tapered plug methods )*

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# API CLASSIFICATION

**API stands for American Petroleum Institute. In 1970 along with the SAE and ASTM (American Society for Testing and Materials), they established the API Service Classification System to define the performance level of a given oil, unrelated in the main, to oil viscosity.**

**The API requirements "S" for Spark Ignition (petrol) and "C" for Compression Ignition (diesel) can be briefly described as follows. For automotive gasoline engines, the latest engine oil service category includes the performance properties of each earlier category. If an automotive owner's manual calls for API SJ or SL oil, API SM oil will provide full protection. For diesel engines, the latest category usually – but not always – includes the performance properties of an earlier category.**

| GASOLINE ENGINES | | |
|---|---|---|
| **Category** | **Status** | **Service** |
| **SN** | **Current** | **Introduced in October 2010, designed to provide improved high temperature despite protection for pistons, more stringent sludge control, and seal compatibility. API SN with resource Conserving matches ILSAC GF-5 by combining API SN performance with improved fuel economy, turbocharger protection, emission control system compatibility, and protection of engine operating on ethanol-containing fuels up to E85.** |
| **SM** | **Current** | **For all automotive engines currently in use. Introduced in 2004, SM oils are designed to provide improved oxidation resistance, improved deposit protection, better wear protection, and better low-temperature performance over the life of the oil. Some SM oils may also meet the latest ILSAC specification and/or qualify as Energy Conserving<br>For 2010 and older automotive engines.** |
| **SL** | **Current** | **For 2004 and older automotive engines.** |
| **SJ** | **Current** | **For 2001 and older automotive engines.** |
| **SH** | **Obsolete** | **For 1996 and older engines.** |
| **SG** | **Obsolete** | **For 1993 and older engines.** |
| **SF** | **Obsolete** | **For 1988 and older engines.** |
| **SE** | **Obsolete** | **CAUTION: Not suitable for use in gasoline-powered automotive engines built after 1979.** |
| **SD** | **Obsolete** | **CAUTION: Not suitable for use in gasoline-powered automotive engines built after 1971. Use in more modern engines may cause unsatisfactory performance or equipment harm.** |
| **SC** | **Obsolete** | **CAUTION: Not suitable for use in gasoline-powered automotive engines built after 1967. Use in more modern engines may cause unsatisfactory performance or equipment harm.** |
| **SB** | **Obsolete** | **CAUTION: Not suitable for use in gasoline-powered automotive engines built after 1951. Use in more modern engines may cause unsatisfactory performance or equipment harm.** |
| **SA** | **Obsolete** | **CAUTION: Contains no additives. Not suitable for use in gasoline-powered automotive engines built after 1930. Use in more modern engines may cause unsatisfactory performance or equipment harm.** |

*Note: API intentionally omitted "SI" and "SK" from the sequence of categories.*

| DIESEL ENGINES | | |
|---|---|---|
| **Category** | **Status** | **Service** |
| **CJ-4** | **Current** | Introduced in 2006. For high-speed, four-stroke engines designed to meet 2007 model year on-highway exhaust emission standards. CJ-4 oils are compounded for use in all applications with diesel fuels ranging in sulfur content up to 500 ppm (0.05% by weight). However, use of these oils with greater than 15 ppm (0.0015% by weight) sulfur fuel may impact exhaust after treatment system durability and/or oil drain interval. CJ-4 oils are effective at sustaining emission control system durability where particulate filters and other advanced after treatment systems are used. Optimum protection is provided for control of catalyst poisoning, particulate filter blocking, engine wear, piston deposits, low- and high-temperature stability, soot handling properties, oxidative thickening, foaming, and viscosity loss due to shear. API CJ-4 oils exceed the performance criteria of API CI-4 with CI-4 PLUS, CI-4, CH-4, CG-4 and CF-4 and can effectively lubricate engines calling for those API Service Categories. When using CJ-4 oil with higher than 15 ppm sulfur fuel, consult the engine manufacturer for service interval. |
| **CI-4** | **Current** | Introduced in 2002. For high-speed, four-stroke engines designed to meet 2004 exhaust emission standards implemented in 2002. CI-4 oils are formulated to sustain engine durability where exhaust gas recirculation (EGR) is used and are intended for use with diesel fuels ranging in sulfur content up to 0.5% weight. Can be used in place of CD, CE, CF-4, CG-4, and CH-4 oils. Some CI-4 oils may also qualify for the CI-4 PLUS designation. |
| **CH-4** | **Current** | Introduced in 1998. For high-speed, four-stroke engines designed to meet 1998 exhaust emission standards. CH-4 oils are specifically compounded for use with diesel fuels ranging in sulfur content up to 0.5% weight. Can be used in place of CD, CE, CF-4, and CG-4 oils. |
| **CG-4** | **Obsolete** | Introduced in 1995. For severe duty, high-speed, four-stroke engines using fuel with less than 0.5% weight sulfur. CG-4 oils are required for engines meeting 1994 emission standards. Can be used in place of CD, CE, and CF-4 oils. |
| **CF-4** | **Obsolete** | Introduced in 1990. For high-speed, four-stroke, naturally aspirated and turbocharged engines. Can be used in place of CD and CE oils. |
| **CF-2** | **Obsolete** | Introduced in 1994. For severe duty, two-stroke-cycle engines. Can be used in place of CD-II oils. |
| **CF** | **Obsolete** | Introduced in 1994. For off-road, indirect-injected and other diesel engines including those using fuel with over 0.5% weight sulfur. Can be used in place of CD oils. |
| **CE** | **Obsolete** | Introduced in 1985. For high-speed, four-stroke, naturally aspirated and turbocharged engines. Can be used in place of CC and CD oils. |
| **CD-II** | **Obsolete** | Introduced in 1985. For two-stroke cycle engines. |
| **CD** | **Obsolete** | Introduced in 1955. For certain naturally aspirated and turbocharged engines. |
| **CC** | **Obsolete** | CAUTION: Not suitable for use in diesel-powered engines built after 1990. |
| **CB** | **Obsolete** | CAUTION: Not suitable for use in diesel-powered engines built after 1961. |
| **CA** | **Obsolete** | CAUTION: Not suitable for use in diesel-powered engines built after 1959. |

**Through the years, lubricant users have been treated to a number of ways to designate viscosity grades of the lubricants used in manufacturing. There are SAE (Society of Automotive Engineers) grades for gear oils and crankcases (engines), AGMA (American Gear Manufacturers Association) grades for gear oils, SUS (Say bolt Universal Seconds), cSt (kinematic viscosity in centistokes), and absolute viscosity. To add to the confusion, two measures of temperature (Fahrenheit and Celsius) can be applied to most of these, not to mention that viscosity might be presented at either 40°C (104°F) or 100°C (212°F). While all of these have served useful purposes to one degree or another, most lubrication practitioners settle on and use one method as a basis for selecting products. To the new entrant into the lubrication field, the number of options can be confusing, particularly if the primary lubricant supplier does not associate one of the prominent viscosity systems to the product label. To complicate matters, machinery designers must define the lubricant viscosity in such a way that the equipment user understands clearly what is needed without having to consult outside advice.**

**These points to the need for a universally accepted viscosity designation - one that can be used by lubrication practitioners, lubricant suppliers and machinery design engineers simultaneously with minimal confusion.**

## ACEA CLASSIFICATION

**ACEA stands for Association des Constructers Europeans de l'Automobile. This classification system is the European equivalent of the API classification system, but is stricter and has more severe requirements. Hence oil that meets both API and ACEA specifications uses a better additive package than one that is designed to meet only API specifications. Unlike the API, ACEA has three main groups – "A/B" for gasoline and light duty (passenger car, 4WD etc) diesel engines, "C" for light duty three way catalyst (TWC) and diesel particulate filter (DPF) compatible oils and "E" for heavy duty diesel engines. These can be defined as follows.**

**The ACEA 2008 European Oil Sequences for Service-fill Oils comprise 3 sets (classes) of sequences: one for Gasoline and Light-Duty Diesel engines; one specifically for Gasoline and Light-Duty Diesel engines with after treatment devices and one for Heavy-Duty Diesel engines. Within each of these sets there are categories which reflect different performance requirements - four (A1/B1, A3/B3, A3/B4 & A5/B5) for gasoline and light-duty diesel engines; four (C1, C2, C3, C4) specifically for engines with after treatment devices, and four (E4, E6, E7, E9) for heavy-duty diesel engines. Typical applications for each sequence are described below for guidance only. Specific applications of each sequence are the responsibility of individual engine manufacturers for their own vehicles / engines.**

**The sequences define the minimum quality level of a product for self-certification to EELQMS and presentation to ACEA members. Performance parameters other than those covered by the tests shown or more stringent limits may be indicated by individual ACEA member companies.**

**Where claims are made that Oil performance meets the requirements of the ACEA sequences (e.g. product literature, packaging, labels) they must specify the ACEA Class and Category (see Nomenclature & ACEA Process for definitions).**

| ACEA 2008 European Oil Sequences for Service-Fill Oils | |
|---|---|
| **A/B : gasoline and diesel engine oils** | |
| **A1/B1** | Stable, stay-in-grade oil intended for use at extended drain intervals in gasoline engines and car & light van diesel engines specifically designed to be capable of using low friction low viscosity oils with a high temperature / high shear rate viscosity of 2.6 mPa*s for xW/20 and 2.9 to 3.5 mPa.s for all other viscosity grades. These oils are unsuitable for use in some engines. Consult owner manual or handbook if in doubt. |
| **A3/B3** | Stable, stay-in-grade oil intended for use in high performance gasoline engines and car & light van diesel engines and/or for extended drain intervals where specified by the engine manufacturer, and/or for year-round use of low viscosity oils, and/or for severe operating conditions as defined by the engine manufacturer. |
| **A3/B4** | Stable, stay-in-grade oil intended for use in high performance gasoline and direct-injection diesel engines, but also suitable for applications described under A3/B3. |
| **A5/B5** | Stable, stay-in-grade oil intended for use at extended drain intervals in high performance gasoline engines and car & light van diesel engines designed to be capable of using low friction low viscosity oils with a High temperature / High shear rate (HTHS) viscosity of 2.9 to 3.5 mPa.s. These oils are unsuitable for use in some engines. Consult owner manual or handbook if in doubt. |
| **C : Catalyst compatibility oils** | |
| **C1** | Stable, stay-in-grade oil intended for use as catalyst compatible oil in vehicles with DPF and TWC in high performance car and light van diesel and gasoline engines requiring low friction, low viscosity, low SAPS oils with a minimum HTHS viscosity of 2.9 mPa.s. These oils will increase the DPF and TWC life and maintain the vehicles fuel economy.<br>Warning: these oils have the lowest SAPS limits and are unsuitable for use in some engines. Consult owner manual or handbook if in doubt. |
| **C2** | Stable, stay-in-grade oil intended for use as catalyst compatible oil in vehicles with DPF and TWC in high performance car and light van diesel and gasoline engines designed to be capable of using low friction, low viscosity oils it a minimum HTHS viscosity of 2.9mPa.s. These oils will increase the DPF and TWC life and maintain the vehicles fuel economy.<br>Warning: these oils are unsuitable for use in some engines. Consult owner manual or handbook if in doubt. |
| **C3** | Stable, stay-in-grade oil intended for use as catalyst compatible oil in vehicles with DPF and TWC in high performance car and light van diesel and gasoline engines, with a minimum HTHS viscosity of 3.5mPa.s. These oils will increase the DPF and TWC life.<br>Warning: these oils are unsuitable for use in some engines. Consult owner manual or handbook if in doubt. |
| **C4** | Stable, stay-in-grade oil intended for use as catalyst compatible oil in vehicles with DPF and TWC in high performance car and light van diesel and gasoline engines requiring low SAPS oil with a minimum HTHS viscosity of 3.5mPa.s. These oils will increase the DPF and TWC life.<br>Warning: these oils are unsuitable for use in some engines. Consult owner manual or handbook if in doubt. |

| E : Heavy Duty-Diesel engine oils | |
|---|---|
| **E4** | Stable, stay-in-grade oil providing excellent control of piston cleanliness, wear, soot handling and lubricant stability. It is recommended for highly rated diesel engines meeting Euro I, Euro II, Euro III, Euro IV and Euro V emission requirements and running under very severe conditions, e.g. significantly extended oil drain intervals according to the manufacturer's recommendations. It is suitable for engines without particulate filters, and for some EGR engines and some engines fitted with SCR NOx reduction systems. However, recommendations may differ between engine manufacturers so Driver Manuals and/or Dealers shall be consulted if in doubt. |
| **E6** | Stable, stay-in-grade oil providing excellent control of piston cleanliness, wear, soot handling and lubricant stability. It is recommended for highly rated diesel engines meeting Euro I, Euro II, Euro III, Euro IV and Euro V emission requirements and running under very severe conditions, e.g. significantly extended oil drain intervals according to the manufacturer's recommendations. It is suitable for EGR engines, with or without particulate filters, and for engines fitted with SCR NOx reduction systems. E6 quality is strongly recommended for engines fitted with particulate filters and is designed for use in combination with low sulphur diesel fuel. However, recommendations may differ between engine manufacturers so Driver Manuals and/or Dealers shall be consulted if in doubt. |
| **E7** | Stable, stay-in-grade oil providing effective control with respect to piston cleanliness and bore polishing. It further provides excellent wear control, soot handling and lubricant stability. It is recommended for highly rated diesel engines meeting Euro I, Euro II, Euro III, Euro IV and Euro V emission requirements and running under severe conditions, e.g. Extended oil drain intervals according to the manufacturer's recommendations. It is suitable for engines without particulate filters, and for most EGR engines and most engines fitted with SCR NOx reduction systems. However, recommendations may differ between engine manufacturers so Driver Manuals and/or Dealers shall be consulted if in doubt. |
| **E9** | Stable, stay-in-grade oil providing effective control with respect to piston cleanliness and bore polishing. It further provides excellent wear control, soot handling and lubricant stability. It is recommended for highly rated diesel engines meeting Euro I, Euro II, Euro III, Euro IV and Euro V emission requirements and running under severe conditions, e.g. extended oil drain intervals according to the manufacturer's recommendations. It is suitable for engines with or without particulate filters, and for most EGR engines and for most engines fitted with SCR NOx reduction systems. E9 is strongly recommended for engines fitted with particulate filters and is designed for use in combination with low sulphur diesel fuel. However, recommendations may differ between engine manufacturers so Drivers Manuals and/or Dealers should be consulted if in doubt. |

## ILSAC ENGINE SERVICE CLASSIFICATIONS

**ILSAC (International Lubricants Standardization and Approval Committee) includes the major automobile manufacturers that manufacture vehicles in the USA. This includes the Japanese manufacturers. Effectively, ILSAC specifications are the fuel economy version of the API specifications.**

**GF-1 is obsolete**

**GF-2 is equivalent to API SJ**

**GF-3 is equivalent to API SL**

**GF-4 is equivalent to API SM**

**GF-5 is equivalent to API SN**

**ILSAC grades only apply to viscosities XW-20 and XW-30. GF-4 has introduced a phosphorus limit of 0.08% maximum and a sulphur limit of 0.2% maximum, GF-5 is similar, but it introduced new requirements relating to phosphorus volatility and compatibility with ethanol fuels.**

**ILSAC, API and ACEA specifications require a large range of engine tests and laboratory tests on the oil. Parameters such as high and low temperature wear, oxidation, soot control, oil thickening, deposit control, volatility, stay in grade performance, fuel economy, chemical composition and many others are tested against limits and rated.**

**In the case of the API, the oil specifications become more severe as the letters climb the alphabet, eg SL is more severe than SJ. This is not necessarily the case with ACEA as their specifications are more application specific.**

# TWO STROKE OILS

## AIR COOLED

**These are low ash or ash less oils depending on the end use. Products can be used in oil injection systems or premixed with the fuel. As they are consumed with the fuel, two stroke**

**oils must not cause excessive combustion chamber or piston deposits, or engine failure may result. The most common two stroke specifications are air cooled.**

### API TC

**ISO EG-B/JASO FB provides good protection against scuffing and varnish.**

**ISO EG-C/ JASO FC as per EG-B/FB but it has severe restrictions on exhaust smoke, system blocking and detergency.**

**ISO EG-D/JASO FD enhanced detergency and varnish protection compared to EG-C/FD.**

## WATER COOLED

**NMMA TC-W3® is ash less oil for two stroke outboard engines. Oils can be licensed to this category**.

# AUTOMATIC TRANSMISSION FLUID CLASSIFICATIONS

**There are no API standards for automatic transmission fluids. Indeed, it is only in recent times that the Japanese have released a general industry standard that stands alongside their individual requirements. (JASO-1A)**

## GENERAL MOTORS

### TYPE A AND TYPE A SUFFIX A

**The original fluids. They came out on 1949 and 1957 respectively and are long obsolete**.

### DEXRON®-IID

**Now obsolete as far as General Motors is concerned, it was the closest we had to an industry specification. Indeed, it formed the basis of many other OEM (Original Equipment Manufacturer) ATFs specifications. It is still used by GM Europe up until recently and by other European and some Japanese OEMs.**

### DEXRON®-IIE

**A development that had better low temperature properties than IID. Now superseded.**

### DEXRON®-III

**For many years it was in "F" and "G" specifications, which had the same low temperature characteristics as the IIE version, but with modifications to antioxidancy and friction material. The 2003 IIIH specification was for 160,000km drain intervals and extended durability and superseded "G". This specification became obsolete at the end of 2006 and was replaced by DEXRON®-VI .**

### DEXRON®-VI

**Initially released in 2005, this is a special low viscosity fluid which will replace DEXRON®-III in all GM manufactured automatic transmissions. It has a very long oil drain capability of up to 400,000km.**

### DEX-CVT®

**Special specification for CVTs.**

## FORD MOTOR COMPANY

### M2C33-F and M2C33-G

**F came out for the USA and G for Europe. These are non-friction modified fluids and as such cannot be used in most transmissions.**

### M2C138-CJ and M2C166-H

**Introduced to deal with problems with the C-6 and C-5 transmissions, these are satisfied by DEXRON®-IID.**

### MERCON®

**The original MERCON® fluids were again satisfied by DEXRON®-IID and the revised MERCON®-IV fluids by DEXRON®-IID/E and DEXRON®-III. (Now obsolete)**

### MERCON®-C

**Special specification for CVTs.**

### MERCON®-V

**This is the first MERCON® fluid not satisfied by a standard DEXRON® type fluid. Usually semi or fully synthetic, it has more severe requirements on friction, fluidity, shear loss and oil drain. While fluids meeting MERCON®-V must pass DEXRON®-III initially, they are then subjected to many other tests. Updated in mid 2008.**

**MERCON®-SP and MERCON®-LV**

**Both fluids are low viscosity fluids. MERCON®-SP was based around a ZF specification and was used in six speed automatic transmissions, for both front and rear wheel drive. LV was introduced in 2007 and Ford plan to make it backwards compatible.**

## ALLISON

**C-4 Designed for heavy-duty transmissions in off-highway vehicles. ATFs and special fluids are qualified against it. Supersedes C-3.**

**TES295 Special formulation-specific, PAO based fluid for heavy duty applications.**

**TES389 Introduced in 2006 to cover DEXRON®-III applications. Now required for all on-highway transmissions instead of C-4.**

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## CATERPILLAR

**TO-4 specialized fluid for Caterpillar units. Oils meeting TO-4 and C-4 find wide application in heavy-duty construction equipment manufactured by many OEMs such as Komatsu. Also used in manual transmissions.**

# GEAR OIL CLASSIFICATIONS

**Like motor oils, there are two main classification criteria for gear oils:**

- **Based on Viscosity (SAE)**
- **Based on Performance (API, manufacturer's specifications)**

## SAE CLASSIFICATION

| SAE J306 Automotive Gear Viscosity Classifications Axle and Manual Transmission Lubricant Viscosity Classifications | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 70W | 75W | 80W | 85W | 80 | 85 | 90 | 110 | 140 | 190 | 250 |
| Viscosity at 100°C | Min,$mm^2/s$ | 4.1 | 4.1 | 7.0 | 11.0 | 7.0 | 11.0 | 13.5 | 18.5 | 24.0 | 32.5 | 41.0 |
| | Max,$mm^2/s$ | -- | -- | -- | -- | 11.0 | 13.5 | 18.5 | 24.0 | 32.5 | 41.0 | -- |
| Viscosity of 150,000 mPa.s max. temp°C | | -55 | -40 | -26 | -12 | -- | -- | -- | -- | -- | -- | -- |
| 20hr. KRL Shear (CRCL-45-t-93) , KV100, after Shear $mm^2/s$, min. | | 4.1 | 4.1 | 7.0 | 11.0 | 7.0 | 11.0 | 13.5 | 18.5 | 24.0 | 32.0 | 41.0 |

| SAE J2360 Automotive Gear Viscosity Classifications | | | | |
|---|---|---|---|---|
| | | 75W | 80W-90 | 85W-140 |
| Viscosity at 100°C | Min,$mm^2/s$ | 4.1 | 13.5 | 24.0 |
| | Max,$mm^2/s$ | -- | 18.5 | 32.5 |
| Viscosity of 150,000 mPa.s max. temp. °C | | -40 | -26 | -12 |
| Channel Point, Min. °C | | -45 | -35 | -20 |
| Flash Point, Min. °C | | 150 | 165 | 180 |

## API CLASSIFICATION

**For gear oils (loosely including MTFs), there is the below set of standards:**

**GL-1 Oil without additive**

**GL-2 usually contains fatty materials**

**GL-3 contains a mild EP additive**

**GL-4 Equivalent to MIL-L-2105B and is usually satisfied by a 50% GL-5 additive level.**

**GL-5 Equivalent to MIL-PRF-2105E. Primary field service recommendation for Passenger cars and trucks worldwide.**

**GL-6 for severe service involving high offset hypoid gears. Often used to describe oils used in limited slip differentials.**

**MT-1 For non-synchronized manual transmissions in buses and trucks at a higher level than GL-4. GL-2, GL-3, and GL 6 are not normally used for automotive applications.**

**MIL-PRF-2105E – designed by the US military it takes conventional GL-5 and adds more demands to the specification. Most hypoid oils conform to this standard.**

## AGMA SPECIFICATIONS FOR GEAR LUBRICANTS

**The American Gear Manufacturers Association (AGMA) has issued specifications and recommendations for gear lubricants used in various types of gear application. AGMA Standard 250.04 details specifications for rust and oxidation inhibited (R and O) and extreme –pressure (EP) Lubricants used in enclosed gear drives.**

**The viscosity brackets correspond to those given in ASTM D 2422 'Standard Recommended Practice for Viscosity System for Industrial Fluid Lubricants'.**

| Viscosity Ranges for AGMA Lubricant Numbers | | | |
|---|---|---|---|
| **Rust and Oxidation Inhibited Gear Oils** | **Viscosity Ranges** | **Equivalent ISO Grade** | **Extreme Pressure Gear Lubricants** |
| **AGMA Lubricant No.** | **cSt ($mm^2/s$) at 40 °C** | | **AGMA Lubricant No.** |
| **1** | **41.4 to 50.6** | **46** | |
| **2** | **61.2 to 74.8** | **68** | **2 EP** |
| **3** | **90 to 110** | **100** | **3 EP** |
| **4** | **135 to 165** | **150** | **4 EP** |
| **5** | **198 to 242** | **220** | **5 EP** |
| **6** | **288 to 352** | **320** | **6 EP** |
| **7Compounded** | **414 to 506** | **460** | **7 EP** |
| **8 Compounded** | **612 to 748** | **680** | **8 EP** |
| **8A Compounded** | **900 to 1100** | **1000** | **8A EP** |

*NOTE: Viscosity ranges for AGMA Lubricant Numbers will henceforth be identical with those of the ASTM System oils compounded with 39% to 10% fatty or synthetic fatty oils.*

# INDUSTRIAL LUBRICANT CLASSIFICATIONS

## ISO (INTERNATIONAL STANDARDS ORGANIZATION) VISCOSITY CLASSIFICATION

**The ISO viscosity classification uses $mm^2/s$ (cSt) units and relates to viscosity at 40° C. It consists of series of 18 viscosity bracts between 1.98 $mm^2/s$ and 1650$mm^2/s$, each of which is defined by a number .The numbers indicate to the nearest whole number, the mind point of their corresponding brackets. For example, ISO viscosity grade 32relates to the viscosity bracket 28.8 to 35.2 $mm^2/s$, the midpoint of which is 32.0$mm^2/s$. This is illustrated in the table below, which shows the ISO viscosity grade number, the mid-points of each break, and the viscosity limits. This system is now used to classify all industrial lubricating oils where viscosity is an important criterion in the selection of the oil. Cutting oil and some other specialized products are more important in relation to grade selection.**

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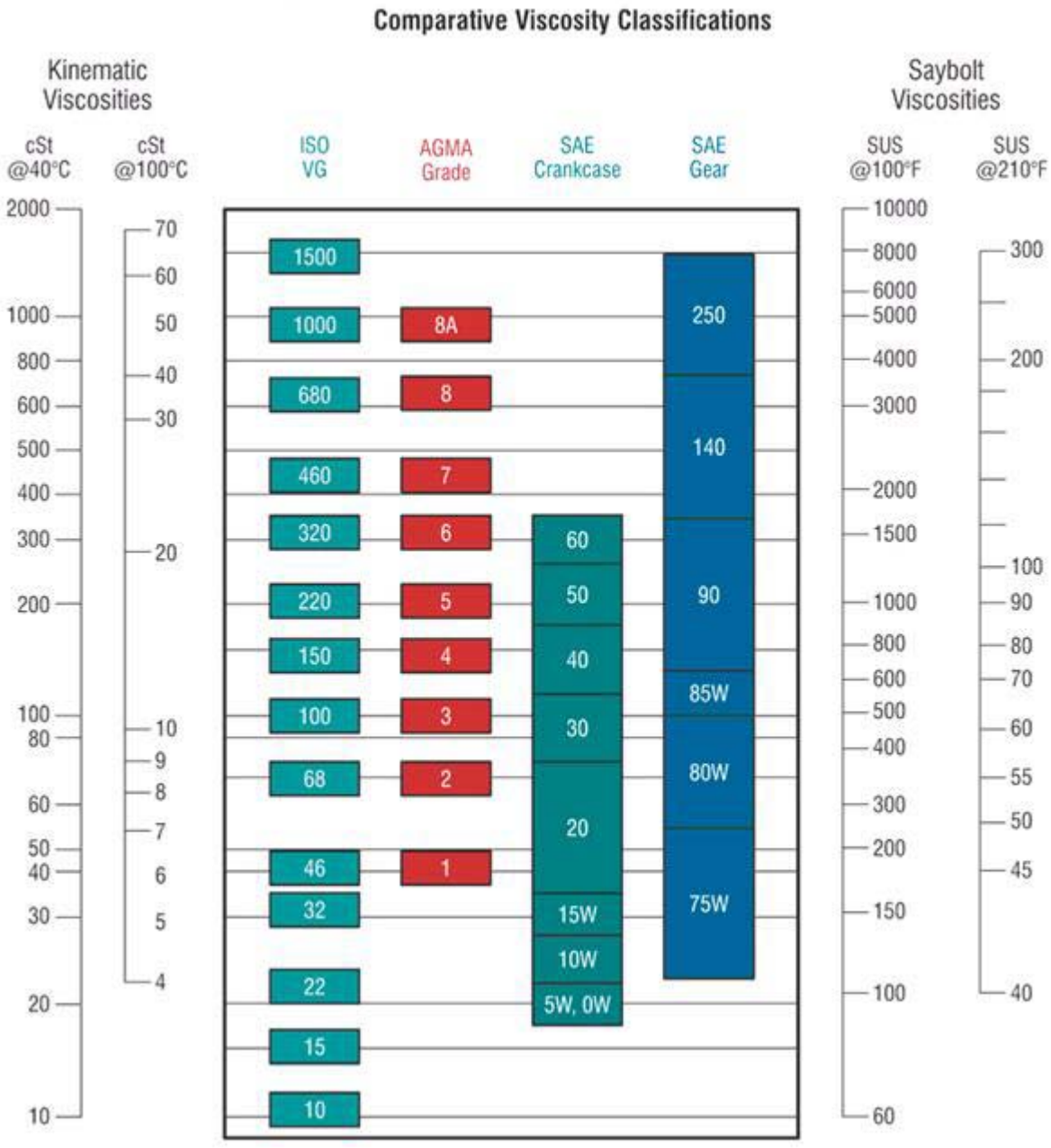
| ISO VISCOSITY GRADE CONVERSIONS | | | | | | |
|---|---|---|---|---|---|---|
| ISO Viscosity Grade | Mid-point Kinematic Viscosity | Kinematic Viscosity Limits cSt at 40 °C(104 °F) | | ASTM, Say bolt Viscosity Number | Say bolt Viscosity SUS 100 °F(37.8 °C) | |
| | | MIN | MAX | | MIN | MAX |
| 2 | 2.2 | 1.98 | 2.42 | 32 | 34 | 35.5 |
| 3 | 3.2 | 2.88 | 3.52 | 36 | 36.5 | 38.2 |
| 5 | 4.6 | 4.14 | 5.06 | 40 | 39.9 | 42.7 |
| 7 | 6.8 | 6.12 | 7.48 | 50 | 45.7 | 50.3 |
| 10 | 10 | 9 | 11 | 60 | 55.5 | 62.8 |
| 15 | 15 | 13.5 | 16.5 | 75 | 72 | 83 |
| 22 | 22 | 19.8 | 24.2 | 105 | 96 | 115 |
| 32 | 32 | 28.8 | 35.2 | 150 | 135 | 164 |
| 46 | 46 | 41.4 | 50.6 | 215 | 191 | 234 |
| 68 | 68 | 61.2 | 74.8 | 315 | 280 | 345 |
| 100 | 100 | 90 | 110 | 465 | 410 | 500 |
| 150 | 150 | 135 | 165 | 700 | 615 | 750 |
| 220 | 220 | 198 | 242 | 1000 | 900 | 1110 |
| 320 | 320 | 288 | 352 | 1500 | 1310 | 1600 |
| 460 | 460 | 414 | 506 | 2150 | 1880 | 2300 |
| 680 | 680 | 612 | 748 | 3150 | 2800 | 3400 |
| 1000 | 1000 | 900 | 1100 | 4650 | 4100 | 5000 |
| 1500 | 1500 | 1350 | 1650 | 7000 | 6100 | 7500 |

BEHRAN OIL CO.




## *Viscosity Equivalents at Same Temperature*

BEHRAN OIL CO.

# BASE STOCK VISCOSITY

| GRADE | Neutrals | | | |
|---|---|---|---|---|
| | 40°C | | 100°C | |
| | cSt | SUS | cSt | SUS |
| 70N | 13.3 | 70.8 | 3.0 | 37.0 |
| 80N | 15.6 | 80.3 | 3.35 | 37.3 |
| 90N | 18.0 | 89.0 | 3.4 | 37.5 |
| 100N | 21.5 | 104.0 | 4.0 | 39.0 |
| 140N | 30.7 | 144.0 | 4.5 | 41.0 |
| 150N | 31.6 | 148.0 | 4.9 | 42.4 |
| 160N | 33.7 | 158.0 | 5.2 | 43.3 |
| 170N | 34.0 | 159.0 | 5.4 | 44.0 |
| 180N | 38.5 | 181.0 | 5.7 | 44.9 |
| 200N | 44.5 | 204.0 | 6.2 | 46.0 |
| 250N | 56.1 | 257.0 | 6.5 | 47.0 |
| 300N | 61.3 | 285.0 | 7.0 | 49.0 |
| 315N | 70.0 | 315.0 | 7.9 | 52.0 |
| 330N | 70.9 | 328.0 | 8.4 | 53.7 |
| 350N | 76.0 | 358.0 | 8.8 | 55.0 |
| 400N | 86.0 | 398.6 | 9.8 | 58.0 |
| 450N | 98.0 | 454.0 | 10.5 | 61.0 |
| 500N | 107.0 | 496.0 | 11.0 | 64.0 |
| 600N | 130.4 | 604.0 | 12.1 | 66.0 |
| 650N | 141.0 | 665.0 | 14.8 | 71.0 |
| 700N | 151.0 | 668.0 | 14.0 | 73.0 |
| 135Brt | 413.2 | 1875.0 | 28.6 | 135.0 |
| 145 Brt | 523.3 | 2425.0 | 30.9 | 145.0 |
| 150 Brt | 568.0 | 2632.0 | 33.0 | 155.0 |
| 160 Brt | 600.0 | 2800.0 | 35.2 | 166.0 |
| 175 Brt | 616.0 | 2855.0 | 36.0 | 169.7 |
| 185 Brt | 654.7 | 3034.0 | 37.6 | 177.0 |
| 225 Brt | 1030.0 | 4800.0 | 49.3 | 229.0 |