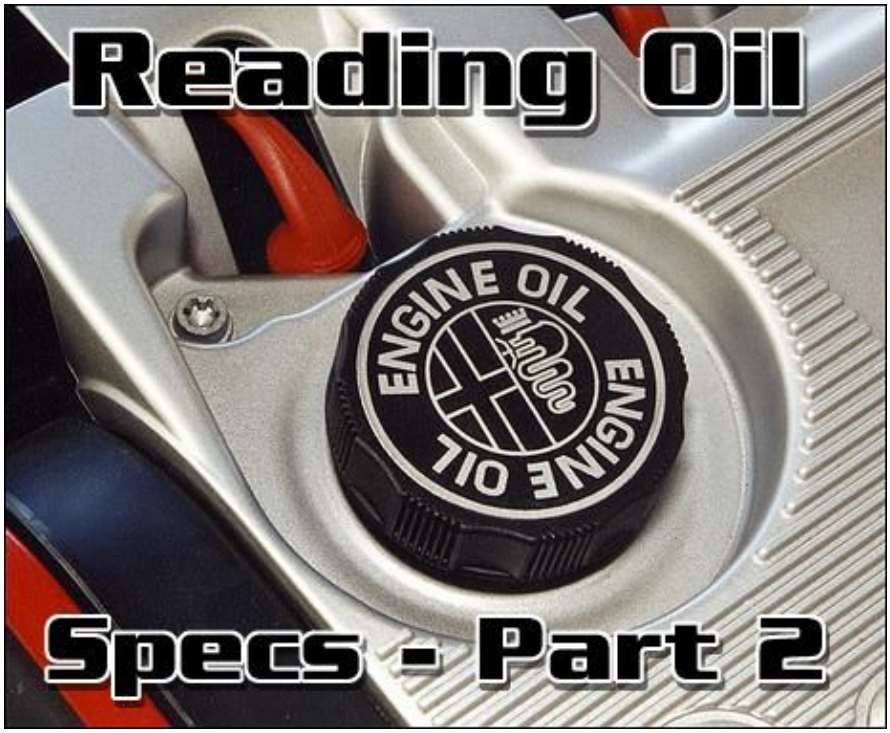


Reading Oil Specs - Part 2

Oil performance - what it is and how it's measured.

By J S Evans

Is One Oil Better Than Another?

In last week's story, the focus was on the viscosity classification systems of lubricants, namely the International Standards Organization (ISO) system for industrial lubricants and the Society of Automotive Engineers (SAE) system for automotive oils.

This article will concentrate on the performance specifications of oils, addressing the following questions:

- What can I use this oil for?
- Which oil is suitable for the different types of equipment?
- Is one product better than another?

Classifying Engine Oils

A number of international organizations govern the classification of oils. This article will discuss two of the better known ones: the International Standard Lubrication System (ISLS) relating to industrial oils, and the American Petroleum Institute (API) system which deals with automotive oils.

The major difference between the two is that the ISLS details the application of the product, while the API is concerned with application and performance.

The International Standard Lubrication System (ISLS)

The ISLS classifies industrial lubricants that are generally used in stationary industrial plant such as conveyor gearboxes, compressors and turbines. This system also classifies automotive oils in a broad sense, but in far less detail than the API system. The ISLS classification is broken down into four categories which denote the properties of an oil. These are:

1. Broad classification: either 'O' for oil, or 'G' for grease.
2. First sub-classification: a letter denoting the type of equipment for which the oil is suitable, eg 'H' for hydraulic.
3. Second sub-classification: a letter denoting the area of application to which the oil is most suited, eg 'C' for circulation.
4. Property class: a number representing the ISO viscosity of the oil

For example, an ISLS oil described as OHC-68 denotes the following: Oil (broad class), Hydraulic (equipment type), Circulating (area of application) with an ISO viscosity of 68 cSt. Another example of an ISLS oil is OCA-46 which indicates Oil, Compressor, Air with a viscosity of 46 cSt.

The ISLS classes are listed below:

ISLS Classes	
OHC-V	Oil Hydraulic Circulating (High viscosity index)
OHC	Oil Hydraulic Circulating
OHF	Oil Hydraulic Fire Retardant
OTH	Oil Transfer Heat
OTE	Oil Transformer Electrical
OCA	Oil Compressor Air
OCR	Oil Compressor Refrigerant
OTC	Oil Turbine Circulating
OES	Oil Engine Spark (petrol engines)
OEC	Oil Engine Compression (diesel engines)
OTA	Oil Transmission Automatic
OGA	Oil Gear Automotive
OCI	Oil Circulating Industrial
OGI	Oil Gear Industrial
OCS	Oil Cylinder Steam

The oils in each of these classes come in a variety of viscosities. The viscosity which is selected is determined by the specific application and the type of component under consideration. The OTA class of oils for automatic transmissions does not have specific viscosity grades attached to it. In this case, the various property classes describe the operational characteristics of the transmission.

Drums of industrial oils with the ISLS classification also bear a symbol depicting the class of the oil. For example a drum of OCR-68 carries the symbol of a penguin - an apt illustration for a refrigeration compressor which operates in a cold environment. Oil viscosities are also colour-coded.

The American Petroleum Institute (API)

The most commonly used system of automotive oil classification was developed by the API in the 1930's and is based on the United States military system of oil classification. The API system broadly describes gear and engine oils and then classifies them according to their performance characteristics.

All engine oils should have a specification printed on the can. The most common is the API specification but there are others in use. For example Castrol GTX meets the API specification of SF/CD but can also be specified by the South African equivalent, SABS 1361, or the European CCMC G2/PD1. Be very wary of a product that bears no specification.

What Does 'Performance' Mean And How Is It Measured?

The API system (and others) originated when the engine manufacturers started communicating their needs to the oil companies. When an engine oil is blended, many chemicals (additives) are added to the oil. Additives impart certain properties to the oil, enabling it to function in a desired manner when used to lubricate an engine. It is the additives which impart performance.

Some additives are listed below:

Additive	Property
Antiwear	Reduces wear and friction
Extreme pressure agent	Prevents scoring and seizure
Corrosion inhibitor	Prevents rusting
Detergent	Keeps surfaces free of deposits
Dispersant	Keeps deposits in suspension
Friction modifier	Alters frictional properties
Pour point depressant	Allows oil flow when cold
Seal swell agent	Ensures seals do not leak
Viscosity index improver	Allows viscosity stability
Antifoamant	Retards foaming
Antioxidant	Retards oil oxidation
Metal deactivator	Retards catalytic oil oxidation

Simply put, the higher the API grade, the more additives the oil contains and the more performance tests it has passed.

Four Stroke Engine Oils

The API system for four stroke engine oils has the following format: Sx/Cy where 'x' and 'y' denote the oil class. The full range is as follows:

Petrol Engine	Diesel Engine
SA	CA
SB	CB
SC	CC
SD	CD
SE	CE
SF	CF(CF4)
SG	CG4
SH	

Two systems are used, one for petrol engines (S) and one for diesel engines (C). The 'S' stands for 'spark' and the 'C' for 'compression' indicating the different ignition methods and not 'service' and 'commercial' as is sometimes thought. A 'T' class is used for two-stroke engines, but will not be covered here.

The secondary letter, A B C D, etc. denotes the performance of the oil. The further into the alphabet you go, the better the oil is. An SF oil outperforms an SD oil and a CE oil outperforms a CD oil. Most four-stroke engine oils are graded for both diesel and petrol engines. The best oil for a diesel engine is a CG4 grade and the best oil for a petrol engine is an SH grade. Interestingly enough, although an SG oil has superior qualities to an SF oil, there is basically no difference between an SG and an SH oil for petrol engines. Generally speaking, most oils have grades such as SF/CD where the C class (diesel engines) is lower than the S class (petrol engines). This is because the oil in a diesel engine is far more highly stressed than in a petrol engine.

All the lower API grades are now obsolete. If it were possible to obtain an SA/CA oil, it would be a straight mineral oil with no additives at all. Probably the lowest grade oil available today is an SC/CC oil. It is considered to be a 'running in' oil, as it has a low additive level and has not passed the performance tests that other top of the range oils have passed. This is the only time when the x/y letter suffix is the same. Some of the API classifications have a suffix of '4' such as CF4 and CG4 (there is also a CD II specification). The CF4 class of oils was (and still is in some countries) an intermediate classification of high performance diesel engine oil.

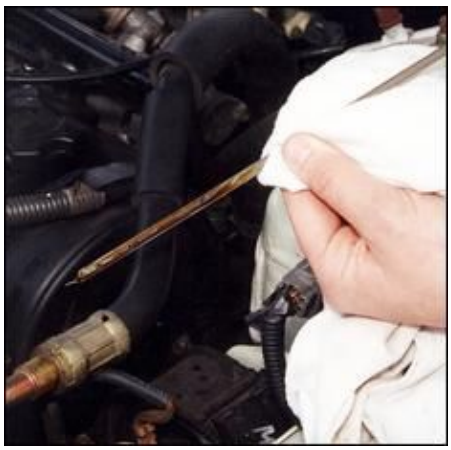
Selecting Oils

Although an SH/CD oil is considered better than an SF/CC oil, it does not necessarily mean that the best oil is the most appropriate oil for your engine. If you have always used a lower grade oil, such as API SF in your motor car, and you switch to the new top of the range SH oil, the higher level of detergents and dispersants in the new oil could create problems. These additives keep metal surfaces clean and keep the contaminants (sludge) in suspension in the oil.

The lower grade SF oil does not contain as many additives as the SH oil, and causes sludge to build up in the engine and remain quiescent. This is not ideal, but will not cause any serious damage. A change to a higher grade SH oil may shift the sludge, causing the filter to block and go into bypass mode with a resultant engine failure. This may only occur infrequently, but it shows how the best oil might not be ideally suited to your engine.

Another example of oil that is 'too good' for an engine is the use of low ash oils in Detroit Diesel two stroke engines. Many of the additives that are blended into engine oils are chemical compounds that contain metals such as zinc and magnesium. The ash content of the oil (derived from the metallic content) indicates the amount of additive present. In other words, the higher the API classification, the more additives are present and hence, the higher the ash content. Detroit Diesel has found that high ash oils (greater than 1.0%) cause deposits to form on the exhaust valve, which can fuse with the valve face at elevated valve temperatures. The result is a burnt valve in the two-stroke engine. Detroit Diesel recommends the use of low ash oils in these engines, because problems could arise if a high ash oil (ie one with a high API specification) were used.

Grading Oils



In order to grade engine lubricants, engine manufacturers have designed a series of tests to be carried out under scientifically controlled parameters. Most major engine manufacturers are involved and in order for an oil to achieve an API specification, all the tests must be passed to the level stipulated by the manufacturers. These performance tests do not look at the overall performance of an oil, but at specific characteristics of the oil under test. For example, the Caterpillar 1G2 test is used to determine the ability of the oil to protect against ring-sticking, wear and accumulation of deposits under high speed turbo-charged conditions; and the Peugeot TU3 test is used to measure the ability of the oil to protect against valve train scuffing.

All tests are defined by the American Society for Testing and Materials (ASTM) which works closely with the API and a third international body, the Society of Automotive Engineers (SAE). The SAE defines the need for a new specification of oil, the ASTM develops the tests and the API defines the new oil category.

After discussions in 1992 the API, in conjunction with the Motor Vehicles Manufacturers Association (MVMA) and the Chemical Manufacturers Association (CMA) agreed to introduce a new oil grade: the API SH for petrol engines, which became effective on July 1st 1993. Whilst the engine tests and specifications remained unchanged from the SG oils, a testing protocol was introduced. This protocol, known as the CMA Code of Practice, aims to guarantee product performance through documented evidence that ensures product integrity with different base oils and viscosity grades. In effect, an SH oil is like an SG oil with an ISO 9000 rating.

Automotive Gear Oils

Automotive gear oils are graded by the API in much the same way as engine oils. The gear oil grades have the following format: GLx where GL stands for gear lubricant, and 'x' is a number representing the amount of Extreme Pressure (EP) additive in the oil. The grades are as follows:

G1

G2

G3

G4

G5

G6*

* technically obsolete

A GL1 gear oil is a straight mineral gear oil with no EP additive, while a GL6 gear oil has a very high concentration of EP (anti-wear) additive. In an automotive application most oils are generally GL4 or GL5. As with engine oils, it is possible to use a gear oil that is too good . Using a top of the range GL6 oil in a synchromesh gearbox could cause accelerated synchro wear due to the oil containing too much EP additive and making the oil too 'slippery' for the synchros to operate properly.

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