WEAR CHECK AFRICA

TECHNICAL BULLETIN

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How to read a can of oil (Part 2)

The ISLS defines oil application; the API system also covers performance.

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Is one oil better than another ?

In part one of 'How to read a can of oil', the focus was on the viscosity classification systems of lubricants, namely the International Standards Organisation (ISO) system for industrial lubricants and the Society of Automotive Engineers (SAE) system for automotive oils. This technical bulletin 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 organisations govern the classification of oils. This bulletin 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 (see 'How to read a

can of oil - Part 1' for further information on viscosities).

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

Application and component type determine the ISLS viscosity that is used.

The oils in each of these classes come in a variety of viscosities. The viscosity 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.

Greases are classified by the ISLS in exactly the same way, but this technical bulletin is limited to a discussion of oils and their properties.

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. A poster showing all the classes, codes, symbols and colours is produced by the South African Bureau of Standards.

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 ("a can of the best"), 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,

Additives determine performance.

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 engines	Diesel engines
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 this is beyond the scope of this bulletin.

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.

The 'best' oil might not be ideally suited to your engine.

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 (see 'Oils used in clean-burn engines' {lower right} for more details on these oils).

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 have 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 recommend the use of low ash oils in these engines, because problems could arise if a high ash oil (i.e. one with a high API specification) were used.

Oil used in clean-burn engines

As engines with higher and higher performance levels are developed, so pollution constraints are legally enforced. This, in conjunction with the growing demand for longer oil drain periods, has made the work of engine oil harder and more stressed.

In 1988 the major world governments met in Montreal, Canada and signed what is now known as the Montreal Protocol, in an attempt to reduce atmospheric pollution. Their chief concern was CFCs (chloro-fluoro-carbons), mainly used as refrigerants and believed to be responsible for the depletion of the earth's ozone layer. Also under scrutiny at the meeting were the emissions from internal combustion engines. The emissions, containing aggressive chemicals such as nitrogen oxides, sulphur oxides and a variety of

Low emission engines stress oil.

noxious carbon-containing compounds, were deemed to be doing irreparable atmospheric damage through the greenhouse effect and acid rain.

When fuel is burnt, exhaust gases are emitted which create what is known as the greenhouse effect. Solar radiation heats the earth's surface by day and this heat is supposed to be radiated back into the atmosphere at night when the sun sets. However, exhaust gases trap the heat on the surface of the earth resulting in the greenhouse effect and global warming. In order to lessen this effect the Montreal Protocol decrees that engine manufacturers should produce cleaner burning engines or 'low emission engines'. In most parts of North America, Western Europe and Japan, these types of clean engines are a legal requirement and the engines must undergo strict testing to ensure they meet the required standards.

Caterpillar USA was instrumental in producing a new series of low emission engines. The low emission status was achieved by raising the level of the compression ring in the upper cylinder, and feeding some of the exhaust gases back into the engine, thus reducing exhaust emissions that could enhance the greenhouse effect and acid rain. This may bode well for the Montreal Protocol but it is the worst possible thing one can do to engine oil - it simply puts the oil under too much stress, shortening its lifespan drastically.

This necessitated the development of CF4 grade oils with a higher level of detergency and dispersancy to deal with the increased level of combustion contaminants. The new API specification, CG4, is available on the South African market (Shell Rimula Super is an example) and these oils perform under the strict environmental regulations laid down in other parts of the world.

Many engines used in this country are imported from countries where strict environmental laws apply. Although the laws are not yet written into the South African statute books, it is strongly recommended that companies use oils which are capable of taking the kind of punishment meted out by these engines.

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.

Oils are graded via performance tests.

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:

GL1
GL2
GL3
GL4
GL5
GL6*

* 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.

This concludes the two part series on 'How to read a can of oil' which was produced to give meaning to the classification codes displayed on oil containers, bearing in mind that the 'best' or most expensive product is not necessarily the right oil for a particular application. No matter how common and everyday, how unusual and severe an application, there is always a lubricant that is ideally suited to a particular purpose. The key is to select the right product.

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