Guide to Oils and Greases

Lubricating Australia for Over Seventy Five Years

Penrite is a 100% family owned private Australian oil company and has been in continuous operation for over 75 years. Its premium lubricants are developed and manufactured in Melbourne and Brisbane and are exported to Europe, North America, Asia and New Zealand. By maintaining constant liaison with suppliers and international partners the latest technological developments are adapted to Australian conditions, and are continually applied to Penrite products.

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PENRITE LUBRICANTS

PENRITE LUBRICANTS
Obsession with Oil

Guide to Oils and Greases

This booklet is designed to help you understand a little more about oils and greases, their specifications and how they work. The level of detail has been kept fairly basic and can be used as a simple reference.

CONTENTS

Also included, is a large amount of technical data on Penrite products. While correct at the date of printing, it is subject to change as formulations progress. The changes do not impact on the performance of the product.

OIL FUNCTIONS

To properly lubricate, an oil or grease must:

Lubricate Parts and Prevent Wear

This is the basic function of all oils. Keeping the moving parts separated. In general the thicker the oil film, the better the wear protection, but the oil additives also play an important role. Modern additives often allow an oil of slightly lesser viscosity to be used and still provide the same level of protection.

Reduce Friction

The film of oil reduces friction simply because there is no metal-to-metal contact. The heavier the oil though, the greater the drag and hence more heat may be generated. Correct oil selection is therefore a balance of what is needed to protect the component without generating excessive drag.

Protect Against Rust and Corrosion

As oils degrade they form corrosive by-products so the oil contains anti-corrosion and acid neutralising additives to protect components.

Keep Components Clean

Oils need to be very stable under heat and not cause system deposits. Different oils will last different lengths of time in a given application.

Be Compatible with Seals

The oil must lubricate and not cause deterioration of seals.

PENRITE LUBRICANTS Obsession with Oil

Prevent Foam

Foam reduces the lubrication properties of the oil, therefore industrial oils must be resistant to foaming or be able to 'release' any foam quickly.

SPECIAL PROPERTIES FOR ENGINE OILS

Permit Easy Starting

Most wear occurs in an engine at start up. Therefore, the oil must have the correct low temperature viscosity to flow quickly to the bearings and valve train to prevent wear. Some engines require low viscosity oils to start at all, especially some of the new diesel engines found in four wheel drives, where the oil is used to operate the pump to prime the fuel injectors.

Cool the Engine

At least 40% of the engine is cooled by the oil, not the radiator system. This means the oil is always under heat stress (oxidation) as it transfers heat from hot spots back to the sump. This includes main and big end bearings, the crankshaft, rods, other bearings plus timing gear and pistons.

Reduce Combustion Chamber Deposits

Some oil will always reach the combustion chamber – either via the cylinder walls or via the valves. It is then burned off with the fuel. So it must burn clean enough that it does not build up on valve seats or pistons tops which can cause problems.

SPECIAL PROPERTIES FOR AUTOMATIC TRANSMISSION FLUIDS

- They are a power transmission medium for the torque converter.
- Act as a hydraulic fluid for the hydraulic – and electronic – control systems.
- They must transmit sliding friction energy in bands and clutches. This property varies between transmission makes, and is why there are so many ATFs on the market. Friction is the key.
- They transmit this energy in such a way that the shift is always smooth.

SPECIAL PROPERTIES FOR MANUAL TRANSMISSION FLUIDS

- Be capable of providing an easy gearshift for the life of the oil drain. This is a function of both viscosity and friction modifiers.
- Maintain long clutch life and prevent seal leaks.

SPECIAL PROPERTIES FOR GEAR AND DIFFERENTIAL OILS

- Must protect against pitting, spalling, scoring and scuffing caused by the large shear loads placed on the oil by the gear set.
- Protect against copper corrosion. Older technologies were not kind to copper alloys and used to turn them black via chemical attack. Most modern hypoid oils do not tend to do this due to advances in technologies.
- Limited slip oils must enable the cone or clutch to work properly when distributing power to the drive wheels. As such, these contain a friction modifier to achieve this. It should be noted that oils designed for use in limited slip differentials can be used in standard hypoid differentials.

ADDITIVES

There are many types of oils and greases and they use many of the same types of ingredients. However, these are put together a little differently. Not all of these are found in every oil or grease.

Firstly you have base oils, made from either crude oil at a refinery, or man-made (synthetics). To achieve the functions required by finished lubricants, you must then put additives in the oil. These all do different things.

Detergents

Any oil with an API engine rating of SC or above has a level of detergency. This detergency level is not necessarily related to all of the quoted API ratings of the oil, as some high detergent diesel oils may only meet lower petrol engine oil specifications. It is a balance. Detergents are usually metallic compounds and they control deposits and keep engines clean. They can clean up dirty engines depending on the product.

Dispersants

These are usually ashless (non metallic) organic chemicals. They keep contaminants and by-products dispersed in the oil helping to prevent deposits from forming. They are highly effective in controlling low temperature contaminants. They can keep them so fine in suspension, they pass through the oil filter with the oil additives!

Extreme Pressure Additives

API GL-2 and up oils, all contain extreme pressure (EP) additives of some description. They tend to be sulphur-phosphorus based although chlorine is also used. Some types are also found in compressor and hydraulic oils, and especially in slideway oils and chain lubricants.

Friction Modifiers

These reduce friction and vary in chemical nature depending on the type of oil.

Friction Modifiers - Engine Oils

Used to reduce internal engine friction and are common in low viscosity oils where fuel economy is important. They are also effective anti-wear agents. Current technologies do not cause the same problems with bore glazing as in the past.

Friction Modifiers - Transmission and Gear

The most important part of an ATF and a purpose designed MTF is the friction modifier. These enable the transmission to function correctly so the end user has smooth gear changes. In limited slip differentials, these prevent chatter and squawk and ensure the differential works as it should. They are all different types of chemistry.

Oxidation Inhibitors

Reduce oxygen attack on the oil, reducing oil thickening, especially at high temperatures.

Rust and Corrosion Inhibitors

Prevent rust and attack on metal surfaces from acids.

Anti-Wear Agents

Prevent wear due to seizure or scuffing of srubbing surfaces. They are normally zinc, phosphorus or other organo-metallic types.

Foam Depressants/Air Release Agents

Prevent foam from forming, thereby maintaining a lubrication film and the ability of the oil to be pumped at the required rate.

Pour Point Depressants

Reduce the oils tendency to crystallise at low temperatures, ie it's ability to pour.

Viscosity Index Improvers (VII)

These change the oil's rate of thinning out (the VI) as temperatures increase – ie make multigrade oils. They are polymers that expand as temperature increases – think of them as like a slowly uncoiling spring. VIIs change the Viscosity Index (VI) of a product – the higher this number is, the less the oil viscosity will change with temperature. There are many different types and those used in engine oils are very different to those in gear oils, as an example.

So how does all this apply to formulating Penrite products?

Penrite do not skimp on quality. We choose the best additives we can to do all the above. Our choices result in Penrite-only additives being used for many products in our range. When you buy Penrite, you are buying an uniquely Australian product, not only from a physical perspective but potentially a chemical one. Our viscosity modifiers are chosen to minimise shear losses, to help keep the fluid film as thick as possible for the life of the drain.

So what does this mean for Penrite Products?

We recognise that different engine designs required a range of oils to properly lubricate and protect the engine while preserving the fuel economy or power of the engine. Hence we first look at what the original oil requirement is for start up viscosity at typical Australian ambient conditions. We then apply the most appropriate oil grade in our range that would also ensure good protection at operating temperature. This is one of the reasons why Penrite petrol engine oils have some of the widest multigrade ranges of any oil company.

Penrite now has top line oils to cover all engines from 1970s technology to 21st Century technology. There are also special oils (not covered here) to handle Vintage, Veteran and Classic era vehicles.

Our ATFs are chosen to give the best performance in an automatic transmission. We would rather not recommend an oil than recommend one that may cause problems in the transmission.

Our MTFs use specialised additives to ensure a smooth shift – they are not simple downtreats of hypoid oils, which is quite often the case for some companies.

BASE OILS

All oils must contain base oils! They go with the additives mentioned previously. Not all base oils are created equally however. The API classifies these into 6 main groups.

Group	Sulphur %	Saturates %	VI	Manufacturing Method
I	>0.03	<90	80-119	Solvent Refined
II	<0.03	>90	80-119	Hydro-processed
III	<0.03	>90	120 +	Severely hydro-processed
IV	Poly alpha olefins (PAOs)			Oligomerization (man made)
V	All Others (including esters)			Various
VI	Poly internal olefins (PIOs)			Oligomerization (man made)

Group III oils are accepted as being synthetic. Some very high quality Group II oils (called Group II Plus) are also accepted as having synthetic performance. When looking at the table, think of saturate (relates to aromatics and other hydrocarbon molecules) and sulphur levels as the degree of purity of the oil. The Group III products used by Penrite are over 99% pure, and hence as good as the man made PAO products. Group III products have many marketing names such as XHVI (Shell) and VHVI (Petro-Canada). These synthetic base oils are used for two main reasons – greater oxidation stability (for longer oil life) and low volatility (to decrease oil consumption) In order to meet the ACEA specifications on oil volatility, many lighter engine oil viscosity grades must use a percentage of these products, especially in oils made from Australian Group I base oils.

From a Penrite perspective, we choose the combination of the above base oils to ensure maximum performance for a given oil.

INDUSTRY OIL CLASSIFICATIONS

There are many oil industry classifications covering viscosity and other performance criteria. Just a few are quoted in the following pages, and some you will recognise.

SAE Viscosity

SAE stands for Society of Automotive Engineers. The SAE developed a classification system to define the viscosity, or thickness, of the oil. This system has been progressively modified over the years.

It defines "operating" engine oil viscosities for different grades and contains specifications for "cranking" viscosity and pumpability at start up, the "W" grades or winter. A multigrade oil is one that meets both a "W" low temperature viscosity requirement and a 100°C "operating temperature" requirement. For engine oils there is a specification that must be met at 150°C, known as a High Temperature/High Shear (HT/HS) viscosity. This is to simulate what happens in high stress areas of the engine eg bearings. Centipoise (cP) and Centistokes (cSt) are the units each is measured in.

In addition, gear oils require a KRL test. This is a severe oil shear test, and the oil must stay in grade or within a nominated range after shear. Its severity is the main reason why 75W-x gear oils are expensive as these are difficult to make.

SAE Viscosity has little relevance to industrial oils but some compressor oils are stated as meeting SAE 30 for example.

SAE J300 - Engine Oils					
SAE Grade	Cold Cranking MAX Viscosity cP@Temp, °C	Pumpability Max Viscosity cP@ Temp, °C	Viscosity @100 °C		HT/HS@ 150 °C Min cP
			Min cSt	Max cSt	
0W	6200 @ -35	60,000 @ -40	3.8	NA	NA
5W	6600 @ -30	60,000 @ -35	3.8	NA	NA
10W	7000 @ -25	60,000 @ -30	4.1	NA	NA
15W	7000 @ -20	60,000 @ -25	5.6	NA	NA
20W	9500 @ -15	60,000 @ -20	5.6	NA	NA
25W	13000 @ -10	60,000 @ -15	9.3	NA	NA
20	NA	NA	5.6	<9.3	2.6
30	NA	NA	9.3	<12.5	2.9
40	NA	NA	12.5	<16.3	See note
50	NA	NA	16.3	<21.9	3.7
60	NA	NA	21.9	<26.1	3.7

Note: 2.9cP for 0W-40, 5W-40 and 10W-40 grades, 3.7cP for 15W-40, 20W-40, 25W-40 and 40 grades. Penrite define "70" engine oils as above 26.1cSt at 100°C and "30W" as less than 13,000cP at -5°C.

SAE J306 (Jun 2005) Gear Oils			
SAE Grade	Max Temperature for a Viscosity of 150,000cP	Viscosity @100 °C	
		Min cSt	Max cSt
70W	-55	4.1	NA
75W	-40	4.1	NA
80W	-26	7.0	NA
85W	-12	11.0	NA
80	NA	7.0	<11.0
85	NA	11.0	<13.5
90	NA	13.5	<18.5
110	NA	18.5	<24.0
140	NA	24.0	<32.5
190	NA	32.5	<41.0
250	NA	41.0	NA

Note: Limit must also be met after testing in 20 hour KRL Shear Stability Test (CEC-L45-T-93 Method C).

ISO VISCOSITY

This is the defining category for industrial oils. The table on the next page shows the kinematic viscosity limits for each ISO Viscosity Grade. Each viscosity grade is 50% higher in viscosity than the preceding viscosity grade. These limits are set at a 10 percent tolerance level above and below the mid-point of a grade. Any product with a viscosity outside these tolerance levels is not a recognized ISO Viscosity Grade.

ISO-Viscosity System for industrial lubricants					
ISO Viscosity Grade	Mid Point cSt @ 40°C	Kinematic Viscosity Limits			
		Minimum		Maximum	
		cSt	S.U.S.	cSt	S.U.S.
2	2.2	1.98	32.0	2.42	34.0
3	3.2	2.88	35.5	3.52	37.5
5	4.6	4.14	39.5	5.06	42.5
7	6.8	6.12	46.0	7.48	50.5
10	10	9.00	55.5	11.0	62.5
15	15	13.5	71.5	16.5	83.5
22	22	19.8	97.0	24.2	116
32	32	28.8	136	35.2	165
46	46	41.4	193	50.6	235
68	68	61.2	284	74.8	347
100	100	90.0	417	110	510
150	150	135	625	165	764
220	220	198	917	242	1121
320	320	288	1334	352	1631
460	460	414	1918	506	2344
680	680	612	2835	748	3465
1000	1000	900	4169	1100	5095
1500	1500	1350	6253	1650	7643

AGMA VISCOSITY NUMBERS

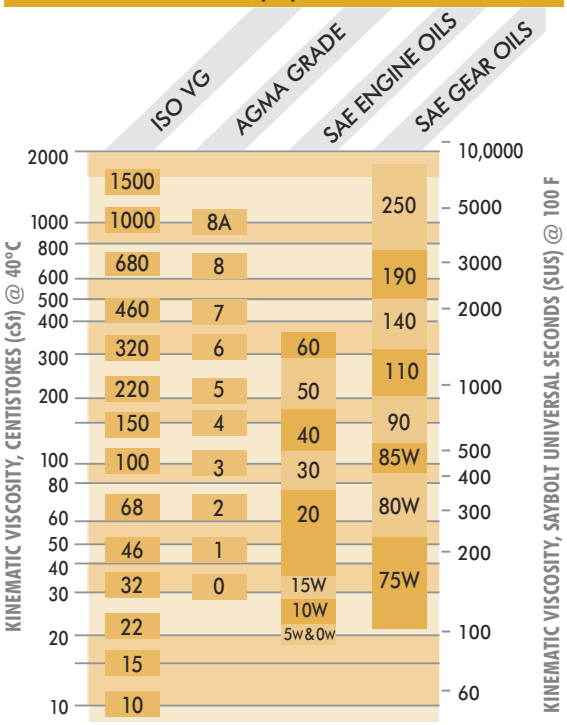
The American Gear Manufacturers Association (AGMA) has set up a numbering system to define gear oil viscosities required for various gear boxes and applications. These AGMA Lubricant Numbers are normally stamped on the manufacturer's metal name plate.

Viscosity Ranges for AGMA Lubricants (ANSI/AGMA 9005-D94)

Rust & oxidation inhibited gear oils	Extreme Pressure Gear Lubricants	Synthetic Gear Oils	Viscosity Range cSt @ 40°c	Equivalent ISO grade
AGMA Lubricant No.	AGMA Lubricant No.			
0	-	0S	28.8-35.2	32
1	-	1S	41.4-50.6	46
2	2EP	2S	61.2-74.8	68
3	3EP	3S	90-110	100
4	4EP	4S	135-165	150
5	5EP	5S	198-242	220
6	6EP	6S	288-352	320
7.7 Comp	7EP	7S	414-506	460
8.8 Comp	8EP	8S	612-748	680
8A Comp	8AEP	-	900-1100	1000
9	9EP	9S	1350-1650	1500
10	10EP	10S	2880-3520	-
11	11EP	11S	4140-5060	-
12	12EP	12EP	6120-7480	-
13	13EP	13S	190-220 cSt @ 100°C	-

So there are three systems of viscosity measurement. However, all is not lost. The next chart shows how you convert from one grade to another.

Viscosity Equivalents



NOTE:

- Read across horizontally
- Assumes 100 VI Single grade oils
- Equivalence is in terms of viscosity at 40°C only
- Viscosity limits are approximate: for precise data consult ISO, AGMA and SAE specifications.
- W grades are represented only in terms of approximate 40°C viscosity. For low temperature limits consult SAE specifications.
- Penrite Technnical Bullettin No 32 has a large version of this chart.
  You will find it on our website.

API SERVICE CLASSIFICATIONS

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.

Designation and Description

SA Oil without additive

SB Some antioxidant and anti scuff properties

SC Meets 1964-1967 requirements of Automotive manufacturers

SD Meets 1968-1971 requirements of Automotive manufacturers

SE Meets 1972-1979 requirements of Automotive manufacturers

SF Meets 1980-1988 requirements of Automotive manufacturers

SG Meets 1989-1993 requirements of Automotive manufacturers

SH Meets 1994-1997 requirements of Automotive manufacturers

SJ Meets 1998-2000 requirements of Automotive manufacturers

SL Meets 2001-2004 on requirements of Automotive manufacturers

SM Meets 2004-on requirements of automotive manufacturers. XW-20 and XW-30 grades have chemical limits

SA to SH are obsolete.

CA Light duty, high quality fuel, for MIL-L-2104A, 1954

CB Moderate duty, lower quality (high sulphur) fuel

CC Moderate to severe duty diesel and gasoline service MIL-L-2104B, 1964

CD Severe duty diesel, including turbo, Caterpillar Series 3, MIL-L-2104C

CD-II API CD plus Detroit Diesel 6V53T approval for two stroke engines

CE Turbo/Supercharged heavy duty diesels from 1983

CF Off road indirect injection diesel engines and others using a broad range of fuel types including high sulphur. May be used to replace API CD oils

CF-2 Severe duty two stroke diesel engine service from 1994

CF-4 Severe Duty four stroke diesel engine service for lower emission diesel engines (from 1988)

CG-4 Severe Duty four stroke engines meeting 1994 emission standards (less than 0.5% fuel sulphur)

CH-4 High speed four stroke engines meeting 1998 emission standards (less than 0.5% fuel sulphur).

CI-4 High speed four stroke engines fitted with cooled EGR (released Dec 2001) and using low-sulphur fuel.

CI-4 PLUS
As per CI-4 but with further restrictions on after shear viscosity and performance. (released September 2004). Aust. 2008.

CJ-4 Released in 2006 for 15ppm maximum fuel sulphur. Enhanced wear, protection 1.0% ash maximum. US EPA '07.

CA to CF-4
Are obsolete.

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

Designation	Description
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-synchronised 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. Now superceded by SAE J2360 (2003).

ACEA ENGINE SERVICE CLASSIFICATIONS

ACEA stands for Association des Contructuers Europeens de l'Automobile. This classification system is the European equivalent of the API classification system, but is stricter and has more severe requirements. Hence an 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.

Designation	Description
A1/B1	For use in gasoline and light duty diesel engines capable of using low friction, low viscosity, and low HT/HS shear (2.9 to 3.5cP) oils. A fuel economy specification, this oil may not be able to be used in all engines.
A3/B3	Stable, stay in grade oil intended for use in high performance gasoline and diesel engines or extended drain intervals.
A3/B4	For use in direct injection diesel engines where special oils may be required, but also suitable for applications described under A3/B3.
A5/B5	Similar to A3/B3 but for engines capable of using low friction, low viscosity and low HT/HS oils. May be unsuitable for use in some engines.
C1	Stable, stay in grade oil of A5/B5 performance level and a phosphorus limit of 0.05% (low SAPS). These oils cannot meet API SM.
C2	Stable, stay in grade oil of A5/B5 performance and mid-SAPs (Phosphorus 0.08%).
C3	Stable, stay in grade oil with mid-SAPs (phosphorus 0.08%). These oils may also meet A3/B4 and API SM. HT/HS >3.5cP
C4	Stable, stay in grade oil similar to C1 but with tighter volatility limits and no lower limit on phosphorus.
E2	General purpose oil for naturally aspirated and turbocharged diesel engines, medium to heavy duty service and mostly normal drain intervals.

E4 Stable, stay in grade oil more severe than E7, for significantly extended oil drain intervals. Usually synthetic or predominantly synthetic. Also for Euro 3 and Euro 4 engines.

E6 As for E4 but with chemical limits to allow use in engines with particulate filters and SCR NOx reduction systems. Only for diesel fuel with<50ppm sulphur. 1.0% ash, 0.08% phosphorus.

E7 Designed for use in Euro 1, Euro 2 and Euro 3 emission diesel engines in severe heavy duty service and extended drain intervals where allowed. More severe than E2/E3 but not as severe as E4.

ACEA specification oils have tighter shear stability and oil volatility requirements than equivalent API specification oils

ILSAC ENGINE SERVICE CLASSIFICATIONS

ILSAC (International Lubricants Standardisation 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

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.

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.

GLOBAL SPECIFICATIONS

Developed by ACEA, API and JAMA for diesel oils with different limits to the 'donor' categories.

Heavy Duty:	DHD-1 = E7/CI–4 + JASO tests
Light Duty:	DLD-1 = B2 + JASO tests
	DLD-2 = B1 + JASO tests
	DLD-3 = B3 + JASO tests

OTHER FOUR STROKE CLASSIFICATIONS

JASO DL-1	Similar to ACEA CI for light duty diesel engines.
JASO MA	Japanese four stroke motorcycles, non-friction modified. Now further split into MA1 and MA2.
JASO MB	Japanese four stroke motorcycles low friction oil.
NMMA FC-W®	Released in 2004 for four stroke outboard oils.

TWO STROKE OILS

These are low ash or ashless 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 with severe restrictions on exhaust smoke, system blocking and detergency

ISO EG-D/JASO FD
Enhanced detergency and varnish protection compared to EGC/FD

TISI
Thai Industrial standard with limits on smoke, generally equivalent to JASO FC

Water Cooled

NMMA TC-W3®
Ashless 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 superceded "G". This specification became obsolete at the end of 2006 and was replaced by;

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.

BTR 5M-52
Special fluid for Ford Australia that uses the BTR 4 speed automatic models, 85/91/95LE. Modified DEXRON®-IID type.

CHRYSLER

ATF+3® (MS-7176F/MS7176E)
Satisfied by modified DEXRON®-IID/IIE type fluids such as MM SP and MM SP2.

ATF+4® (MS-9602)
Synthetic or semi synthetic product with special shift requirements.

MERCEDES BENZ

They have the 236.x series of approvals. Some are DEXRON®-IID/III type and some are not. With some of the newer transmissions, highly specific products are used. Their sheet numbers also may be indicative of a transmission from a supplier such as ZF. The more common ones are shown below.

236.1 For MB, Allison and ZF transmissions.

236.2 Older specification used in power steering and manual transmissions, although it is also used in some MAN automatics and in the Differential Lock in UNIMOG.

236.6, 236.7
most common ones used, and satisfied by DEXRON®-IID.

236.9 long drain fluid usually a DEXRON®-III type with more severe shear stability limits.

236.10 for 5 speed Mercedes EC^3 transmissions (NAG-1)

236.11 for 5 speed ZF automatics used by Mercedes Benz

236.12 For 7 speed Mercedes automatics (NAG-2)

236.20 For CVT

MITSUBISHI

MM SP and MM SP2 – DEXRON®-III fluidity but with different frictional characteristics.

MM SP 3 – a more developed version with better low temperature properties and longer drain life and shift durability. Semi-synthetic at minimum.

ZF

Stands for Zahnradfabrik Friedrichshafen in case you were wondering.

A large transmission maker, it supplies units to many car and truck OEMs.

TE ML-11
: Contains the special products listing for many passenger car automatic transmissions (such as MB 236.11 type) and also for where automatic transmission fluids are used in manual transmissions.

TE-ML 14A
: Full mineral, DEXRON®-IID/III type, 5.3cSt after shear, 30,000km drains.

TE-ML 14B
: Part synthetic, DEXRON®-III type, 5.3cSt after shear, 60,000km drains.

TE-ML 14C
: Full synthetic, DEXRON®-IID/III type, 5.7cSt after shear 120,000km drains.

ALLISON

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

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

TES389 Introduced in 2006 to cover DEXRON®-III applications.

CATERPILLAR

TO-4 specialised 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.

Other OEM specifications worth noting:

Honda	ATF 96, Z1
Nissan	Nissanmatic C, D, J, K
Mazda	MIII, MIV, MV
Toyota	TII, TIII, TIV, WS
Voith	G607, G1363

MANUAL TRANSMISSION FLUID AND GEAR OIL CLASSIFICATIONS

Most of these start with a basic API GL-3, GL-4 or GL-5 and add their own requirements. Some started from engine oils.

HONDA MTF-94/ROVER MTF-94

Describes a GL-4 type 10W-30/75W-80 oil that is semi-synthetic for long drain and good low temperature shift feel.

MAN 341

API GL-4 type.

MAN 342

API GL-5 type.

Caterpillar TO-4

Makes an appearance here as the SAE 30, 50 and 60 versions are used in manual transmissions and some final drive units.

MB 235.5

Heavy duty API GL-4.

MB 235.0/235.6

Heavy duty API GL-5 type oils for long drains.

MB 235.10

Light duty, synthetic performance 75W-80 for MB Sinter Synchromesh tranmissions.

Mack GO-J

Designed to deliver 250,000km oil-drain intervals. More severe than API GL-5. GO-J/S is the synthetic version.

Mack TO-A Plus

Specialised manual transmission fluid with long life.

Volvo 1273.07
SAE 30 type (SAE 80) oil based on GL-4.

Volvo 1273.10
API GL-5, SAE 80, 90

Volvo 1273.12
SAE 50 (SAE 90) type usually satisfied by TO-4 type oils.

ZF

TE ML-01
Non-synchro, heavy-duty manual transmissions. SAE 80W to 90, API GL-4 and SAE 30/40 engine oils

TE ML-02
Manual and automatic transmissions for trucks and buses. Various sub-groups.

TE ML-03
Torque converters in off road vehicles.

TE ML-04
Marine transmissions, SAE 30/40 engine oils.

TE ML-05
Axles in off road vehicles. Various sub groups for different grades and types.

TE ML-06
Tractor transmissions and hydraulics.

TE ML-07
Hydrostatic and mechanical drives and electric drive systems.

TE ML-11
Manual and automatic transmissions in cars.

TE ML-12
Axles for cars, commercial vehicles and buses. Various sub-groups

BTR specifications:
5M-42, 5M-31, 5M–36, 5M-41, 5M-50, 5M-48

Ford specifications:
M2C-86A/B/C, M2C 105A, M2C 1013A, M2C 108A, M2C 197A, M2C 1006B, M2C 104A, M2C 200C

Holden specifications:
HN1855, HN1820, HN1046, HN1070, HN1181, HN 386, HN1561, HN1187, HN 2013, HN2040

Rockwell:
O-76A, O-76B, O-76N, O-76D

Eaton Fuller:
PS 164 (Rev. 7)

HOW DOES A DIFFERENTIAL WORK?

The wheels are connected to the differential unit via half shafts. Power from the transmission drives the pinion gear which in turn drives the ring gear.

The ring gear is connected to 1 or 2 pairs of smaller bevel gears (known as spider gears), and ultimately power is transferred to the wheels.

It is these smaller bevel gears that form the heart of the differential unit: a mechanical device that detects when one wheel is turning faster than the other, and uses the spider gears to absorb the different speeds of both wheels and allow smooth cornering.

Types of differential

The most basic type is an :-

Open differential:

- Under good traction, it applies the same torque to both wheels

- However when traction is poor and one wheel slips on ice or mud, the slipping wheel will receive all the torque whilst the other wheel receives none, even though it does have grip.

Limited Slip differentials are better in poor traction conditions:

- Similar to open differentials but they have clutch packs inside the differential carrier, which apply friction between the side gears and the carrier.
- The friction from the clutches encourages the side gears to turn at the same as the differential carrier.
- When torque is applied under slippery conditions, friction from the clutch packs prevents the wheel with little traction from spinning wildly and ensures that some torque is transmitted to the other wheel which has grip.

Locking differentials contain a mechanism to fully lock both halves of the axle at the same speed:

- Must not be locked on a hard surface, but quite common to improve traction in heavy trucks, especially in poor weather conditions and off-road applications.
- Locking differentials may be automatically activated (when the difference in wheel speeds reaches a given point) or driver-actuated.

Torque Sensing or Torsen® differentials

- These tend to be complex arrangements of spur, helical and/or bevel gears, which prevent extreme differences in wheel speeds, therefore maintaining useful traction at each wheel all the time.
- They do not use clutches or electronics, so are both reliable and durable, and are used in many rear, front and centre differentials.

Centre differentials manage the power split between front and rear axles or axle pairs, in vehicles with more than one drive axle:

- Centre differentials can be any of the above mentioned types, or can be a viscous coupling similar to a torque converter in operation.

Limited slip differentials with electronic control

Similar to Limited Slip differentials with clutch packs to prevent slipping of one wheel. The friction of the clutches is controlled externally using sensors at the wheels to detect slipping. The hydraulic pressure needed for the clutches is electronically controlled.

HOW DOES AN AUTOMATIC TRANSMISSION WORK?

Automatic transmissions do not have a solid style conventional clutch like manual transmissions. Instead, they use a fluid coupling called a torque converter to transmit power from the engine to the transmission.

The changes in the ratios by the planetary gear sets (as distinct from hypoid or bevel type used in differentials or manual gear boxes), are done through the combined use of multiple disc clutches, one-way clutches and bands. These are the friction elements. The shift points are now electronically controlled (instead of simple hydraulic pressure) and these electronics in the valve bodies are also reliant on the oil.

A CVT (continuously variable transmission) is different again. There are two types of CVT. They both work on the basis

of keeping the engine at the most efficient rev range for power and economy.

Both types put specific strains on the oil and it must be very shear stable. Penrite CVT Fluid V is our primary recommendation for most CVTs, but there is no Penrite product for European CVTs (that use "Luk" chains, eg VW/Audi), at this stage. General Motors and VW are among those manufacturers who have specifications for these oils.

HOW DOES A MANUAL TRANSMISSION WORK?

The purpose of a transmission is to provide different ratios of speed between the crankshaft of the engine and the output shaft leading to the final drive. A clutch separates the engine from the driveline to allow the vehicle to drive away and change gears. The number of gear sets depends on the number of ratios provided.

The gears on the Main Shaft are free wheeling and in constant mesh with the gears on the Counter Shaft. To select a ratio the respective gear on the main shaft is connected to the shaft after synchronising the speed of the gear to the shaft. Synchronising is necessary to prevent clashing.

In low ratio the speed of the engine is high relative to the speed of the car. This provides power for driving away, acceleration and hill climbing. In direct (4th) gear both input and output shafts are running 1:1. In highest gear (5th, 6th or overdrive) the output shaft is turning faster than the crankshaft providing lower noise and fuel saving but less power.

How does gear selection work?

Following the route of power from the engine, the Input Shaft is connected to the 2nd gear via the dog clutch. As the 2nd gear is in constant mesh with the corresponding gear on the counter shaft the power is transferred to the gear set at the end of the Counter Shaft. Here the power is guided to the Output Shaft.

To engage a gear smoothly the clutch between engine and transmission has to be opened. Then both the Input Shaft and the 2nd gear need to be brought to the same speed. This is the purpose of the Synchroniser Ring. The synchroniser ring builds up friction between the synchroniser hub (connected to the input shaft) and the cone on the 2nd gear. As soon as the speeds of hub and gear are equal full engagement can occur. The clutch can be closed again and power can flow.

Other types of Manual Transmission include: Automated Manual Transmission (AMT) - a manual transmission where shifting and clutch operation is done by hydraulic or electric actuators under electronic control. Double Clutch Transmission (DCT) - an AMT modified to allow shifting without torque interruption . This is achieved through employing 2 clutches and an additional countershaft.

TYPES OF INDUSTRIAL OILS

There are many different types of industrial oils. Let's take a little time to look at some of them.

HYDRAULIC OILS

The primary application of a hydraulic oil is to transmit force applied at one point in a system to another. As well as this it must also protect seals, lubricate and transfer heat.

The viscosity of the oil is important to ensure efficient power transfer. Too heavy, and high-pressure drops may occur, the system becomes sluggish and power usage increases. If too low, then wear can be a problem, efficiency decreases and leaks may occur.

Typically these products contain anti wear, anti rust/ corrosion and anti oxidation inhibitors. These may be ashless (non-metallic) or use a zinc di-thiophosphate type system. Some older higher zinc additives can be corrosive to silver.

Hydraulic oils can be a 'monograde' (HM) or 'multigrade' (HV) type.

INDUSTRIAL GEAR OILS

Typically API GL-3 oils which use low doses of conventional sulphur-phosphorus additives. They tend to be straight grade oils.

COMPRESSOR OILS

Compressors may use a multitude of products, depending on the type of compressor and its service. Types of oils include:

- Conventional motor oils
- Non-metallic hydraulic oils
- Ashless engine oils
- Specialised fluids (mineral or synthetic)
- Automatic transmission fluids
- Refrigeration oils

The use of the wrong oil can cause wear, failure, carbon build up and even reaction with the gas being compressed, so great care must be taken when recommending fluids.

HEAT TRANSFER FLUIDS

As the name suggests they transfer heat in a system. They must be highly oxidatively stable to minimise build up of carbon deposits (which of course inhibit heat transfer).

CUTTING FLUIDS

These are 'neat fluids' which are straight petroleum oils with specialised additives or 'soluble oils' which are designed for use in water. They are used for many different machining applications and come in a wide range of viscosities and additive types. Some are clear, some not. Use of the wrong type of oil can lead to bit wear problems or staining of the metal surfaces.

TRANSFORMER OILS

Highly specialised fluids used in electrical transformers. They are characterised by extremely low water content and good oxidation stability.

WHITE OILS

Ever wonder what baby oil is? Highly refined mineral oil, 100% paraffinic and approved by health and food authorities. Used by the food and cosmetic industry as a lubricant or carrier fluid.

PROCESS OILS

Straight oils used in various industrial processes such as in rubber or as flushing fluids. Large quantities of these are used by heavy industry.

MISCELLANEOUS

There are many special products used by industry that are not covered here. The mining and food industries have some special lubricants for very specific applications. These may be fire resistant fluids, specialised greases, control fluids and many others.

SHELF LIFE OF LUBRICATING OILS

The performance properties of liquid lubricants (oils) will remain intact for many years provided they have been in protected storage and not exposed to severe high/low temperature cycles. Generally, the simpler the oil formulation, the longer the oil will remain satisfactory. The old 'cool dry place' term certainly applies when storing oil products.

Hydraulic Food Grade/Compressor/Turbine and General Purpose Lubricating Oils

These oils contain low but very effective additive treatments. They may be stored for 3 years under protected conditions without any significant deterioration in performance.

Engine/Motor Oils and Transmission Oils

Although these oils contain high additive contents, they are extremely stable. They may be stored for 5 years under protected conditions without any significant deterioration in performance. However, as the industry is always developing new specifications these oils may be out of date by the time they are fully used.

Industrial and Automotive Gear Oils

These highly additised formulations can occasionally exhibit some long term instability. Under protected conditions they should only be stored for 3 years.

Neat (Non-Emulsifiable) Metal Working Fluids/Way Lubricants (eg Honing Oil)

These formulations are often quite delicately balanced. Hence, under protected conditions they should only be stored for 2 years.

Soluble Oil

Should only be stored for 1 year. Storage under unprotected conditions can result in water ingress which causes the oil to become 'milky' or form a 'mayonnaise' and can also cause rust formation/ corrosion in metal containers.

GREASES

Greases are defined as solid or semi-solid materials produced by the dispersion of a thickening agent in a liquid lubricant (like adding a sponge to water).

Greases are manufactured in either a grease kettle or in a contactor. A soap-based grease uses a thickener made by reacting a metallic hydroxide with a fatty acid, which is where we get our basic types from, eg lithium soap.

Non-soap greases include silica, polyurea and clay (bentone).

Depending on what the grease needs to achieve, different thickener and base oils can be used.

GREASE CHARACTERISTICS

The most important factors affecting the properties and characteristics of a grease are:

- Amount and type of thickener
- Additives

A grease is expected to:

- Reduce friction and wear
- Provide corrosion protection
- Seal bearings from water and contaminants
- Resist leakage, dripping and throw-off

- Resist change in structure or consistency during service
- Maintain mobility under conditions of application
- Be compatible with seals
- Tolerate or repel moisture

GREASE DEFINITIONS

Consistency – is the degree of hardness of a grease and may vary considerably with temperature. This has been classified by the National Lubricating Grease Institute (NLGI) into the following categories:

NLGI GRADE PENETRATION @ 25°C (1/10th mm)	
000	445 - 475
00	400 - 430
0	355 - 385
1	310 - 340
2	265 - 295
3	220 - 250
4	175 - 205
5	130 - 160
6 (block grease)	85 – 115

Oil Separation – is the percentage of oil which separates from the grease under static (eg. storage) conditions. It cannot predict separation tendencies in use under dynamic conditions.

High Temperature Stability – is the ability of a grease to retain it's consistency, structure and performance at temperatures above 125°C.

GREASE SERVICE CLASSIFICATION

There are 5 categories for Automotive Service Greases developed by the NLGI. The classification (ASTM D 4950) covers greases designed for the lubrication of chassis components and wheel bearings of passenger cars, trucks and other vehicles. The NLGI classifies automotive service greases into two main groups. Chassis greases, designed by the prefix L and Wheel Bearing greases designated by the prefix G. These are shown in the table.

CATEGORY	SERVICE	PERFORMANCE
LA Chassis	Frequent relubrication intervals (<3200 km). Mild duty (non-critical applications).	Oxidation resistant, shear stable, and corrosion and wear protective.
LB Chassis	Prolonged relubrication intervals (>3200 km). Mild to severe duty (high loads, vibration, exposure to water).	Oxidation resistant shear stable, and corrosion and wear protective even under heavy loads and in presence of aqueous contamination. Temperature range: -40°C to 120°C
GA Wheel Bearings	Frequent lubrication intervals. Mild duty (non-critical applications).	Temperature range: -20°C to 70°C
GB Wheel bearings	Mild to moderate duty (cars, trucks in urban and highway service).	Oxidation and evaporation resistant, shear stable and corrosion and wear protective. Temperature range: – 40°C to 120°C with occasional excursions to 160°C.
GC Wheel Bearings	Mild to heavy duty (vehicles in frequent stop-and-go service, trailer hauling, mountain driving, etc)	Oxidation and evaporation resistant, shear stable, and corrosion and wear protective. Temperature range: – 40°C to 120°C with frequent excursions to 200°C.

GREASE SHELF LIFE

The shelf life of any grease is affected by the type and amount of thickener used, consistency of the grease, manufacturing method employed and the formulation complexity. Generally straight Lithium, Lithium Complex and Calcium Complex greases remain stable for a long time. Aluminium Complex greases tend to set and harden, but remain stable. Bentone and Barium greases tend to soften on aging. Based on these observations:

The shelf life of most Penrite greases is about 5 years. However, Steering Box Lubricant and Semi Fluid Grease only have a 2 year shelf life.

GREASE TYPES

There are many types of greases which are shown below. As can be seen they have different properties which helps to define where they are best suited.

THICKENER	DROP POINT,°C	MAX SERVICE CONTINUOUS OPERATING TEMP,°C	HIGH TEMP USE	STRUCTURE	SHEAR STABILITY	WATER RESISTANCE
Calcium	100	<80	□	□	○	■
Lithium	160 - 200	125	■	□	■	■
Calcium complex	>260	150	■	□◿	■	■
Lithium complex	>240	160	■	□	■	■
Aluminium complex	>260	150	■	□◿	■	■
Barium complex	>200	150	■	◹	○	■
Polyurea	>230	150	■	■	■	■
Bentone	NA	150	■	□	○	■
Sodium	170 - 190	125	■	◹	■	□

□ Very Poor □ Poor ○ Fair ■ Good ■ Excellent

◿ Buttery □ Smooth ◹ Fibrous ◿ Gel

■ Opaque

*(Note that extreme pressure greases are not generally recommended in electric motors.)

GREASE COMPATIBILITY

Occasionally, grease substitution in an application may be necessary to correct problems arising from the original product in service. If the thickeners are incompatible, the mixture will not meet the properties of the individual greases and in some cases, the greases will fall apart. The below table provides a rough guide.

	Calcium	Lithium	Calcium Complex	Lithium Complex	Aluminium Complex	Barium Complex	Polyurea	Bentone	Sodium
Calcium		✔	✔	✔	●	✘	✔	✘	✘
Lithium	✔		✔	✔	●	●	✔	✘	●
Calcium Complex	✔	✔		●	✘	●	●	✘	✘
Lithium Complex	✔	✔	●		●	●	✔	✘	●
Aluminium Complex	✘	●	✘	●		✘	●	✘	✘
Barium Complex	✘	●	●	●	✘		●	✘	✘
Polyurea	✔	✔	●	✔	●	●		✘	✘
Bentone	✘	✘	✘	✘	✘	✘	✘		✘
Sodium	✘	●	✘	●	✘	✘	✘	✘	

✔ Compatible ✘ Incompatible ● Borderline

It is strongly advised that, in all cases, the old grease be purged or cleaned out from the system before a new one is introduced. However, compatibility between greases is temperature dependent. As the temperature rises, the problems associated with incompatibility also increase. With unknown competitors' products, it is strongly advised to treat them as incompatible.

GREASE APPLICATIONS

Greases are used instead of oils in many applications. They find use where:

- a good seal from the elements is required
- leakage is a problem
- exposed gears or chains are used and water wash-off is a problem
- less frequent application of lubricant is possible due to isolation or inaccessibility

Some examples where greases are used include:

- Wheel bearings
- Universal joints
- Chassis lubrication
- Track rollers
- Rolling bearings
- Shackles and pins
- CV Joints
- Electric motor bearings*

PENRITE PRODUCTS TECHNICAL DATA

This section contains technical and application information not always found on the Product Information Sheets, where only essential information is given. This data provides further back up and support for Penrite products to show more clearly what each product has gone through in testing. Not all products have been through all tests – the tests chosen for each are those most specific and most required for the end use. While Penrite choose additives of the highest quality and specification, due to our size we are not able to pursue many specific manufacturer approvals. Therefore, we recommend our products against certain manufacturer specifications and ensure the technology we use meets those same specifications.

HPR ENGINE OILS

Penrite HPR engine oils are tailored to be the best products for a given application in light duty vehicles (<3.5MT GVM) and cover all vehicles from the latest releases to classics of the 1970s. In addition to the HPR range is the SIN engine oil range for maximum performance and the new Enviro+ range for low emissions systems.

HEAVY DUTY TRUCK ENGINE OILS

Penrite truck engine oils have been tailored for two specific end uses. The 10W-40 and 15W-40 grades are for new trucks, under warranty. The 25W-60 grades have been designed for trucks that operate in high ambient temperatures or for older vehicles where oil consumption and/or low oil pressure is becoming a problem. The monogrades are for two cycle diesel engines and other engines that may require this type of oil. Diesel GS and Diesel LA are the best oils to use for mixed fleets.

Guide to Oils and Greases

PRODUCT	SPECIFICATIONS	SPECIFIC VEHICLES
HPR 0 Synthetic Performance	API SM/CF ACEA A3/B4/C3 Mercedes 229.51 BMW LL-04 VW 504.00/507.00 Also if A5/B5 specified.	DPF equipped light duty diesel engines. VW, Mazda Aston Martin Hyundai Santa Fe
HPR 5 Synthetic Performance Semi-Synthetic (use if A1/B1 specified)	API SM/CF ACEA A3/B4 Ford M2C 153G/H Ford M2C 912-A Ford M2C 913-A Ford M2C 917-A Rover RES.22.OL.22 VW 500.00, 503.01 VW 502.00/505.00 MB229.3 Chrysler MS-6395G GM 4718M/LL-B-025 PSA E-02 Opel B040 2095	Nissan (for 7.5W-30) SAAB Porsche Volvo Renault BMW LL-98 MG-F Toyota VVTi Subaru VZ Commodore on BA Falcon on Mazda
HPR 10 Semi-Synthetic	API SM/CF ACEA A3/B4 Holden HN 2100 Ford M2C 153F/G Ford M2C 910-A Ford M2C 905 A3 Rover RES.22.OL.22 VW 500.00, 501.01 VW 502.00/505.00 MB 229.1 Chrysler MS-6395 PSA E-02 GM 9986126	Nissan (for 7.5W-30) Honda Toyota BMW Renault SAAB FTe/FPV Mazda Commodore VT-VY AU to AU-III Falcon Subaru Fiat-Lancia- Alfa Romeo
HPR 15 Semi-Synthetic	API SM/CF ACEA A3/B4 Ford M2C 153E Ford M2C 902-A3 Rover RES.22.OL.22 VW 500.00, 501.01 VW 502.00/505.00 MB 229.1/228.1 Chrysler MS-6395 Opel B0401013	Renault Fiat-Lancia- Alfa Romeo
HPR 30	API SM/CF ACEA A3/B3 Ford M2C 153E Rover RES 22.OL.22 VW 501.01 Chrysler MS-6395 MB 229.1	

PRODUCT	SPECIFICATIONS	SPECIFIC VEHICLES
HPR 40	API SL/CF	
HPR 50	API SL	
HPR Gas 10 Semi-Synthetic	API CG-4/SL ACEA A3/B4 Ford M2C 905-A3 Ford M2C 910-A Holden HN 2314 VW 501.01 MB 229.1/228.1 Peugeot D-02/E-02	Falcon AU - on Commodore VT - on Camry/Avalon/Aurion Magna/380
HPR Gas	API CG-4/SL ACEA A3/B4 Ford M2C 902-A3 VW 501.01 MB 229.1	
HPR Diesel 5 Synthetic Performance	API CI-4/SL ACEA A3/B4 Global DLD-2/3 MB 229.3/228.5 Opel B0402098 Peugeot D-02 VW 505.01/502.00 VW 505.00/506.00 Ford M2C 171-C Ford M2C 913A	Mercedes Benz Ford Transit Holden Jackaroo 3L LandRover Td5 Range Rover Td6 Jeep Iveco
HPR Diesel 15 Semi-Synthetic	API CH-4/SL ACEA A3/B4 Ford M2C 171-C PSA D-02 Global DLD-1/DLD-3	Nissan Toyota Mitsubishi
HPR Diesel	API CH-4/SJ ACEA A3/B3 Ford M2C 911-A1 PSA D-99 Global DLD-1	
SIN Engine Oil 0W-50 Fully Synthetic	API SM/CF ACEA A3/B4 BMW LL-98 GM 4718M MB 229.3 BMW LL-98 VW 505.00 Chrysler MS-6395H	FPV Porsche Boxster Viper Subaru Nissan HSV (GenIV)

Guide to Oils and Greases

PRODUCT	SPECIFICATIONS	SPECIFIC VEHICLES
SIN Engine Oil 5W-60 Fully Synthetic	API SM/CF ACEA A3/B4 Ford M2C 153H Ford M2C 913-A Ford M2C 917-A Ford M2C 903-A3 BMW LL-98 VW 502.00/505.00 Chrysler MS-6395H PSA E-02 MB 229.1/229.3 GM 4718M	Porsche HSV SAAB Jaguar FTe/FPV Renault Rover MG-F
SIN Engine Oil 10W-70 Fully Synthetic	API SM/CF ACEA A3/B4 MB 229.1	
SIN Engine Oil 15W-40 Synthetic Performance	API SL/CF ACEA A3/B4 MB 229.3 JASO MA	Lamborghini
SIN Engine Oil 25W-60 Synthetic Performance	API SL/CF ACEA A3/B4 JASO MA	
Everyday Synthetic 5W-50	API SM/CF ACEA A3/B4 Ford M2C 153G/H Rover RES.22.OL.22 VW 506.00, 506.01 VW 502.00/505.00 MB229.5 Chrysler MS-6395G GM 4718M	SAAB Porsche Volvo Renault BMW LL-01 Subaru VT-VY Commodore AU to AU-III Falcon Mazda
Everday Synthetic 10W-40	API SM/CF ACEA A3/B4 Ford M2C 153G/H Ford M2C 912-A Ford M2C 913-A Ford M2C 917-A Rover RES.22.OL.22 VW 506.00, 506.01 VW 502.00/505.00 MB229.5 Chrysler MS-6395G GM 4718M/LL-B-025 PSA E-02 Opel B040 2095	Nissan SAAB Porsche Volvo Renault BMW LL-01 MG-F Toyota Subaru VZ Commodore on BA Falcon on Mazda
Enviro+ 0W-40 Synthetic	API SM/CF ACEA A3/B4/C3 Mercedes 229.51 BMW LL-04 VW 505.01 Also if A5/B5 specified	DPF equipped light duty diesel engines. Aston Martin BMW Hyundai Santa Fe Mitsubishi Pajero Holden Captiva
Enviro+ 10W-50 Synthetic	API SM/CF ACEA A3/B4/C3 Mercedes 229.51 BMW LL-04 VW 505.01	DPF equipped light duty diesel engines. BMW Mitsubishi Pajero

PRODUCT	SPECIFICATIONS	SPECIFIC VEHICLES
Enviro+ 5W-30 Synthetic	VW 504.00/507.00 VW 505.01 ACEA A3/B4	DPF equipped light duty diesel engines. VW, Mercedes Benz
Enviro+ 5W-40 Synthetic	ACEA CI/C4 JASO DL-1 Renault RN0720 Ford M2C-934A	DPF equipped light duty diesel engines. Mazda, Ford, Renault
SIN Diesel Oil 5W-40 Fully Synthetic	API CI-4 ACEA E7/E4/"B4" JASO DH-1 GLOBAL DHD-1 Mercedes 228.5 MAN 3277 Cummins CES 20078 MTU Type 3 Renault RXD Volvo VDS-3	
Diesel GS Semi-Synthetic	API CI-4 PLUS/SL ACEA E7 Volvo VDS 2 Volvo VDS 3 Mercedes Benz 228.3 MTU Type 2 Renault RLD MAN3275 Japanese JASO DH-I Allison C-4 Mack EO-N Premium Plus '03 Cummins CES 20078 MAN 271 Mercedes Benz 228.3/229.1 Allison C-4 Global DHD-1 Caterpillar ECF-1-a	DAF Scania Deutz Iveco Volvo Leyland Perkins Caterpillar Detroit Diesel
Diesel SP Synthetic Performance	API CI-4 ACEA E4/E7/E6 MB 228.51 MAN 3277 CRT/3477 Renault RXD Volvo VDS-3 MTU Type 3	

PENRITE LUBRICANTS
Obsession with Oil

Guide to Oils and Greases

PRODUCT	SPECIFICATIONS	SPECIFIC VEHICLES
Diesel LA Semi-Synthetic	API CJ-4/SM ACEA E7 Cummins CES 20081 Mack E0-0 Premium Plus Caterpillar ECF-1-a/ECF-2/ECF-3 Mercedes Benz 228.31 Volvo VDS-4 MTU Type 2 JASO DH-2	
Diesel FX	API CI-4/SL ACEA E7 Mercedes Benz 228.3 Volvo VDS-3	
Euro 25 Synthetic-Fortified	API CH-4/SL ACEA E3 Volvo VDS Mercedes Benz 228.3 MTU Type 2 Renault RD MAN 3275	
USA 25 Synthetic-Fortified	API CH-4/SJ	
Japan 25 Synthetic-Fortified	API CF JASO CD Plus	
Mono SAE 30,40,50	API CF-2/CF/SF (SG SAE 30) ACEA E1 MIL-L-2104F (SAE 30, 40) Mercedes Benz 227.0 Detroit 7SE-270 Caterpillar TO-2 Mack EO-K/2 Allison C-3 (SAE 30)	

PRODUCT	SPECIFICATIONS	SPECIFIC VEHICLES / APPLICATIONS
SIN ATF Synthetic Performance	MERCON®-V Ford M2C 202 DEXRON®-IIIH ATF+3® MS 7176E ATF+4® MS 9602 MB 236.1/236.9 MB236.12(NAG-2) Allison C-4/TES 295 ZF TE ML 14C Honda ATF 89/96/21 JASO 1A	Ford Explorer Ford North America (Since 1997) Jaguar S and X Type Ford Focus MB 7 speed
ATF DX-VI Semi Synthetic	GM DEXRON®-VI (Licence J-60312)	GM 6 speed Autos ZF 6 speed Autos
ATF DX-III Hydrocracked	DEXRON®-IIIH Ford Mercon®-IV Allison C-4/TES-389 Voith G607, G1363 DIWA MB 236.1 ZF TE ML 14A ZF TE ML 03	Holden (US/Aust built)
ATF DX-II	DEXRON®-IID Allison C-4 MB 236.6/236.7 ZF TE ML 11 ZF TE ML 14A Ford M2C 163A Ford M2C 166H Ford M2C 138CJ Toyota D-2/T-II	Holden (Europe)
ATF MHP Semi Synthetic	Mitsubishi MM SP 3 ES-X64022SP3 Hyundai 05243-330 Proton Kia Chrysler MS-7176E (ATF+3®) Chrysler MS-9602 (ATF+4®) MB 236.9 Toyota T-II/T-III/T-IV/WS JASO 1A Nissanmatic C, D, J, K Honda ATF 96/Z1	Holden/Opel Subaru Volvo (-97 on)
ATF 95 LE	BTR 5M-52 DEXRON®-IID	Ford Falcon etc Maserati 3200GT Ssangyong Musso Ssangyong Rexton

Guide to Oils and Greases

PRODUCT	SPECIFICATIONS	SPECIFIC VEHICLES / APPLICATIONS
ATF BMV Semi Synthetic	DEXRON®-IIIH MB 236.10/236.11 BMW LT71141 Ford MERCON®-IV	ZF 4/5-speeds MB 5-speeds VW-Audi 5 speed
ATF 33	Ford M2C33-F	
ATF TOP UP	DEXRON®-IIE MB 236.1/236.3 Allison C-4 Ford M2C 163A Ford M2C 166H Ford M2C 138CJ ZF TE ML 11	
ATF FM5 Synthetic Performance	DEXRON®-III H MERCON®-V (Approved)	
SIN COMP AUTO	M2C-33F	
CVT FLUID V	MB 236.20 DEX-CVT® MERCON® -C Nissan NS-2/11 EZL 799 Volvo 4959	
HYPOID 80W-90	API GL-5/PG-2 API MT-1 MIL-PRF-2105E/SAE J2360 Mack GO-J (Approved) BTR 5M-36 Ford M2C 105A/1013A Ford M2C 108A/197A Chrysler MS 9020 Holden HN1181 Rockwell O-76D	
HYPOID 85W-140	API GL-5/PG-2 API MT-1 MIL-PRF-2105E/SAE J2360 Mack GO-J (Approved) BTR 5M-36 Ford M2C 105A/1017 Holden HN1181 Rockwell O-76A	
HYPOID 140	API GL-5/PG-2 MIL-PRF-2105E Rockwell O-76A Mack GO-J	
LIMSLIP 90	API GL-5/GL-6/PG-2 API MT-1 Mack GO-J Ford M2C 1006B/104A Holden HN 1561/1187 BTR 5M-31	
LIMSLIP 85W-140	API GL-5/GL-6/PG-2 API MT-1 Ford M2C 1006B/104A Holden HN 1561/1187 BTR 5M-41 Mack GO-J	

PRODUCT	SPECIFICATIONS	SPECIFIC VEHICLES / APPLICATIONS
LIMSLIP 140	API GL-5/GL-6/PG-2 Mack GO-J Ford M2C 1006B/104A Nissan 4WD	
SIN GEAR OIL 75 SAE 75W-90 Synthetic	API GL-6/PG-2 API MT-1 MIL-PRF-2015E Mack GO-J/S BTR 5M-50 Ford M2C 200C Holden HN2013 Rockwell O-76N Dana Axle Eaton 90-104	BMW Mercedes
SIN GEAR OIL 80 SAE 80W-140 Synthetic	API GL-6/PG-2 API MT-1 MIL-PRF-2015E Mack GO-J/S BTR 5M-48 Ford M2C 104A Holden HN2040 Rockwell O-76B Dana Axle	Ford Holden Jeep
MANUAL GEAR OIL 70 Synthetic Performance	API GL-4 Plus ZF TE ML 11 BOT 338	Landrover -Freelander 2 -Discovery 3 VW 6 Speed T-56
MANUAL GEAR OIL 75 Synthetic Fortified	API GL-4 Rover MTF 94 Honda MTF 94/7289 ZF TE ML02 MB 235.10	T-5
MANUAL GEAR OIL 80	API GL-4 ZF TE ML 01/02/03 MAN 314 N/ML MB235.5 BTR 5M-42 HN 1855/1046/1070 Volvo 1273.07	

Guide to Oils and Greases

PRODUCT	SPECIFICATIONS	SPECIFIC VEHICLES / APPLICATIONS
TRANSAXLE 75 Semi Synthetic	API GL-5/MT-1 ZF TE ML 01/02/05/07/08 MB 235.6, MB 235.0 Volvo 1273.10 MAN 342 N/ML	
TRANSAXLE 80	API GL-5/MT-1 ZF TE ML 01/05/07/08 MAN 342 N/ML MB 235.6 Volvo 1273.10 BTR 5M-31	
SIN MANUAL TRANS SAE 75W-85 Semi Synthetic	API GL-4 MB 235.10 MB 235.4 MTF 94 MAN 341 Volvo 1273.07	Aisin Warner 6 speed Manual Mitsubishi Nissan 4WD
FLEET TRANS C4	API GL-3/CF Allison C-4 Caterpillar TO-4 ZF TE ML 03	Komatsu
FLEET GEAR 30	API GL-3/CF Allison C-4 Caterpillar TO-4 Tremec TTC ZF TE ML 01	Komatsu
FLEET GEAR 50	API GL-3/CF Caterpillar TO-4 Volvo 1273.13 Rockwell O-81	Eaton/Fuller Road Ranger Spicer
SYNFLEET 50 Fully Synthetic	API GL-3 EATON PS-164 (approved) Volvo Meritor Rockwell O-81 (S) Mack T0-A Plus	Roadranger

	HPR0	HPR5	HPR10	HPR15	HPR30
Viscosity	0W-40	5W-40	10W-50	15W-60	20W-60
cSt @ 40°C	86	97	131	191	232
cSt @ 100°C	14.9	15.1	18.8	24.2	24.5
Viscosity Index	183	164	162	157	133
HT/HS Viscosity @ 150°C, cP	3.7	3.8	5.0	5.1	5.4
NOACK Volatlity	12.5	13.0	10.7	6.8	7.0
After Shear Viscosity @ 100°C	14.4	13.8	17.2	22.7	22.8
MRV Pumpability					
cP @ -40°C	58,450	-	-	-	-
cP @ -35°C	-	40,084	-	-	-
cP @ -30°C	-	-	40,100	-	-
cP @ -25°C	-	-	-	43,990	-
cP @ -20°C	-	-	-	-	51,540
Cold Cranking Viscosity					
cP @ -35°C	5,856	-	-	-	
cP @ -30°C	-	6,154	-	-	-
cP @ -25°C	-	-	6,592	-	-
cP @ -20°C	-	-	-	6,235	-
cP @ -15°C	-	-	-	-	8,187
Pour Point, °C	-45	-39	-39	-33	-24
Flash Point, °C	215	220	214	222	189
Calcium, % Mass	0.193	0.296	0.238	0.305	0.217
Zinc, % Mass	0.084	0.124	0.109	0.122	0.158
Magnesium, % Mass	0.000	0.000	0.000	0.000	0.000
Molybdenum, % Mass	0.000	0.000	0.023	0.012	0.000
Phosphorus, % Mass	0.077	0.113	0.100	0.110	0.144
Base Number, mgKOH/g	7.0	9.5	7.5	9.4	8.0
Density @ 15°C	0.848	0.858	0.870	0.879	0.885
Sulphated Ash, Mass %	0.78	1.17	0.99	1.22	1.09

PENRITE LUBRICANTS
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	HPR40	HPR50	HPR GAS10	HPR GAS
Viscosity	25W-70	40-70	10W-50	20W-60
cSt @ 40°C	272	298	134	236
cSt @ 100°C	27.8	30.0	19.7	24.3
Viscosity Index	135	137	168	129
HT/HS Viscosity @ 150°C, cP	T	T	5.0	5.5
NOACK Volatlity	6.0	6.0	11.7	8.7
After Shear Viscosity @ 100°C	T	T	18.0	22.8
MRV Pumpability				
cP @ -30°C	-	-	54,219	-
cP @ -20°C	-	-	-	38,800
cP @ -15°C	T	-	-	-
cP @ -10°C	-	T	-	-
Cold Cranking Viscosity				
cP @ -25°C	-	-	5,906	-
cP @ -15°C	-	-	-	8,577
cP @ -10°C	5,211	5,557	-	-
Pour Point, °C	-21	-15	-39	-30
Flash Point, °C	250	230	210	227
Calcium, % Mass	0.000	0.033	0.239	0.259
Zinc, % Mass	0.108	0.176	0.132	0.108
Magnesium, % Mass	0.136	0.091	0.029	0.000
Molybdenum, % Mass	0.011	0.000	0.000	0.012
Phosphorus, % Mass	0.098	0.160	0.120	0.099
Base Number, mgKOH/g	7.6	6.2	9.7	8.0
Density @ 15°C	0.885	0.885	0.866	0.886
Sulphated Ash, Mass %	0.83	0.88	1.20	1.04

	HPR DIESEL 5	HPR DIESEL 15	HPR DIESEL	SIN DIESEL
Viscosity	5W-40	15W-50	20W-60	SW-40
cSt @ 40°C	96	146	233	86
cSt @ 100°C	14.6	18.9	24.5	14.2
Viscosity Index	159	147	132	171
HT/HS Viscosity @ 150°C, cP	3.8	5.4	6.2	TBA
NOACK Volatlity	11.9	9.6	9.0	TBA
After Shear Viscosity @ 100°C	12.6	16.6	22.5	TBA
MRV Pumpability				
cP @ -35°C	35,195	-	-	TBA
cP @ -25°C	-	26,000	-	-
cP @ -20°C	-	-	38,000	-
Cold Cranking Viscosity				
cP @ -30°C	5,723	-	-	5894
cP @ -20°C	-	6,535	-	-
cP @ -15°C	-	-	8,361	-
Pour Point, °C	-45	-30	-24	TBA
Flash Point, °C	220	215	218	220
Calcium, % Mass	0.315	0.305	0.305	0.345
Zinc, % Mass	0.110	0.122	0.122	0.148
Phosphorus, % Mass	0.101	0.110	0.110	0.134
Base Number, mgKOH/g	11.9	9.4	9.4	12.5
Density @ 15°C	0.860	0.877	0.887	0.867
Sulphated Ash, Mass %	1.23	1.22	1.22	1.62

	SIN0	SIN5	SIN10	SIN15	SIN25
Viscosity	0W-50	5W-60	10W-70	15W-40	25W-60
cSt @ 40°	104	157	215	106	247
cSt @ 100°	18.9	24.1	29.2	15.0	23.9
Viscosity Index	197	186	176	148	121
Cold Cranking Viscosity					
cP @ -35°C	5,137	-	-	-	-
cP @ -30°C	-	5,247	-	-	-
cP @ -25°C	-	-	5,913	-	-
cP @ -20°C	-	-	-	6,178	-
cP @ -10°C	-	-	-	-	9,662
Viscosity After Shear					
cSt @ 100°C	17.0	23.3	27.8	14.9	23.8
Flash Point, °C	200	200	200	217	217
Calcium, % Mass	0.294	0.290	0.290	0.239	0.239
Magnesium, % Mass	0.000	0.000	0.000	0.027	0.027
Zinc, % Mass	0.123	0.120	0.120	0.132	0.132
Phosphorus, % Mass	0.111	0.110	0.110	0.120	0.120
Molybdenum, % Mass	0.000	0.000	0.000	0.000	0.000
Boron, % Mass	0.063	0.061	0.061	0.000	0.000
Density @ 15°C	0.866	0.865	0.875	0.875	0.884
Sulphated Ash, % Mass	1.18	1.17	1.17	1.20	1.20
Base Number	9.7	9.5	9.5	9.7	9.7

	ENVIRO+			
Viscosity	0W-40	10W-50	5W-30	5W-40
cSt @ 40°C	76	130	74	93
cSt @ 100°C	13.7	19.4	12.2	15.3
Viscosity Index	186	170	159	175
HT/HS Viscosity @ 150°C, cP	3.6	tba	3.5	tba
NOACK Volatlity	12.5	7.0	8.0	13.0
After Shear Viscosity cSt @ 100°C	13.1	tba	tba	tba
Cold Cranking Viscosity				
cSt @ -35°C	5,851	-	-	5,666
cSt @ -30°C	-	-	6,160	-
cSt @ -25°C	-	5,519	-	-
Pour Point, °C	-45	tba	-45	tba
Flash Point, °C	214	215	218	210
Calcium, % Mass	0.183	0.183	0.140	0.123
Zinc, % Mass	0.089	0.089	0.067	0.050
Phosphorus, % Mass	0.080	0.080	0.060	0.047
Magnesium, % Mass	0.000	0.000	0.000	0.000
Boron, % Mass	0.000	0.007	0.000	0.000
Base Number, mgKOH/g	7.9	7.9	5.2	6.0
Density @ 15°C	0.846	0.858	0.853	0.853
Sulphated Ash, Mass %	0.80	0.80	0.60	0.49

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	PRO5	PRO10	PRO15 PLUS	PRO20	PRO22
SAE Grade	5W-30	10W-30	15W-50	20W-50	25W-50
Viscosity					
cSt @ 40°C	68	72	158	173	184
cSt @ 100°C	11.5	10.9	20.1	18.8	19.0
Viscosity Index	164	141	148	123	117
Cold Cranking Viscosity					
cP @ -30°C	5,320	-	-	-	-
cP @ -25°C		5,732	-	-	-
cP @ -20°C	-	-	5,340	-	-
cP @ -15°C	-	-	-	8,747	-
cP @ -10°C	-	-	-	-	5,529
Flash Point, °C	217	190	218	235	230
Calcium, % Mass	0.215	0.215	0.259	0.215	0.215
Zinc, % Mass	0.085	0.085	0.108	0.085	0.085
Phosphorus, % Mass	0.077	0.077	0.099	0.077	0.077
Magnesium, % Mass	0.000	0.000	0.000	0.000	0.000
Molybdenum, % Mass	0.000	0.000	0.012	0.000	0.000
Boron, % Mass	0.025	0.025	0.000	0.025	0.025
Density @ 15°C	0.855	0.868	0.873	0.884	0.888
Sulphated Ash	0.86	0.86	1.06	0.86	0.86
Base Number	7.9	7.9	8.0	7.9	7.9
Specifications	SM/CF/ GF-4	SM/CF/ GF-4	SM/CF-4/ A3/B3	SM/CF	SM/CF

	EVERYDAY FULL SYNTHETIC	
SAE Grade	10W-40	5W-50
Viscosity		
cSt @ 40˚C	100	116
cSt @ 40˚C	15.1	19.1
Viscosity Index	159	186
Cold Cranking Viscosity		
cP @ -30˚C	-	6,012
cP @ -25˚C	5,379	-
Flash Point, ˚C	222	214
Calcium, % mass	0.226	0.226
Zinc, % mass	0.104	0.104
Phosphorus, % mass	0.095	0.095
Magnesium, % mass	0.000	0.000
Molybdenum, % Mass	0.000	0.000
Boron, % Mass	0.007	0.007
Density @ 15˚C	0.868	0.856
Sulphated Ash	0.95	0.95
Base Number	9.2	9.2
Specifications	SM/CF/A3/B4	SM/CF/A3/B4

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	EVERYDAY DRIVING		STOPS OIL BURNING
SAE Grade	15W-40	20W-50	30-70
Viscosity			
cSt @ 40˚C	112	174	284
cSt @ 100˚C	14.6	19.1	28.8
Viscosity Index	134	125	136
Cold Cranking Viscosity			
cP @ -20˚C	6,248	-	-
cP @ -15˚C	-	7,331	-
cP @ -10˚C	-	-	5,499
Flash Point, ˚C	218	236	224
Calcium, % mass	0.198	0.198	0.033
Magnesium, % mass	0.000	0.000	0.091
Zinc, % mass	0.091	0.091	0.176
Phosphorus, % mass	0.083	0.083	0.160
Molybdenum, % Mass	0.009	0.009	0.000
Boron, % Mass	0.000	0.000	0.000
Density @ 15˚C	0.880	0.886	0.885
Sulphated Ash	0.81	0.81	0.88
Base Number	6.3	6.3	6.2
Specifications	SL/CF-4	SL/CF-4	SJ

	Diesel LA	Diesel GS	Diesel SP	Diesel FX
Viscosity	15W-40	15W-40	10W-40	15W-40
cSt @ 40°C	119	120	100	106
cSt @ 100°C	15.2	15.1	15.1	14.6
Viscosity Index	133	130	155	142
HT/HS Viscosity @ 150°C, cP	tba	4.01	3.73	tba
HT/HS After Shear	tba	3.87	tba	tba
NOACK Volatlity	11	12	9.5	11.0
After Shear Viscosity cSt @ 100°C	tba	13.9	tba	tba
MRV Pumpability				
cSt @ -30°C	-	-	tba	-
cSt @ -25°C	tba	29,430	-	tba
Cold Cranking Viscosity				
cSt @ -25°C	-	-	6,336	-
cSt @ -20°C	4,224	5,536	-	5,254
Pour Point, °C	tba	-30	-33	tba
Flash Point, °C	214	200	226	210
Calcium, % Mass	0.215	0.262	0.174	0.239
Zinc, % Mass	0.112	0.145	0.088	0.132
Phosphorus, % Mass	0.100	0.131	0.081	0.120
Magnesium, % Mass	0.000	0.032	0.072	0.027
Base Number, mgKOH/g	9.7	10.7	12.3	9.7
Density @ 15°C	0.872	0.873	0.864	0.873
Sulphated Ash, Mass %	0.98	1.31	1.05	1.20

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	EURO 25	USA 25	JAPAN 25
Viscosity	25W-60	25W-60	25W-60
cSt @ 40°C	245	245	245
cSt @ 100°C	25.2	25.2	25.2
Viscosity Index	131	131	131
Cold Cranking Viscosity			
cP @ -10°C	6,077	6,077	6,077
Flash Point, °C	226	226	226
Calcium, % mass	0.239	0.239	0.239
Magnesium, % mass	0.027	0.027	0.027
Zinc, % Mass	0.132	0.132	0.132
Phosphorus, % Mass	0.120	0.120	0.120
Boron, % mass	0.000	0.000	0.000
Base Number, mgKOH/g	9.7	9.7	9.7
Density @ 15°C	0.891	0.890	0.812
Sulphated Ash, Mass %	1.20	1.20	1.20
MRV Pumpability, cP @ -15°C	40,100	40,100	40,100
Pour Point, °C	-24	-24	-24
HT/HS Viscosity @ 150°C, cP	6.5	6.5	6.5

	MONO 30	MONO 40	MONO 50
Viscosity	30	40	50
cSt @ 40°	104	131	205
cSt @ 100°	12.1	14.6	19.1
Viscosity Index	107	112	105
Flash Point, °C	200	240	238
Calcium, % Mass	0.176	0.176	0.176
Magnesium, % Mass	0.021	0.021	0.021
Zinc, % Mass	0.098	0.098	0.098
Phosphorus, % Mass	0.088	0.088	0.088
Boron, % Mass	0.000	0.000	0.000
Base Number, mgKOH/g	7.2	7.2	7.2
Density @ 15°C	0.894	0.896	0.899
Sulphated Ash, % Mass	0.88	0.88	0.88

	SMALL ENGINE FOUR STROKE		
SAE Grade	10W-30	20W-50	30
Viscosity			
cSt @ 40°C	79	176	90
cSt @ 100°C	11.5	18.9	11.3
Viscosity Index	138	121	113
Cold Cranking Viscosity			
cP @ -25°C	4,874	-	-
cP @ -15°C	-	9,065	-
Flash Point, °C	216	226	231
Calcium, % Mass	0.239	0.033	0.029
Magnesium, % Mass	0.027	0.091	0.082
Phosphorus, % Mass	0.120	0.160	0.144
Zinc, % Mass	0.132	0.176	0.158
Molybdenum, mass %	0.000	0.000	0.000
Density @ 15°C	0.867	0.884	0.888
Sulphated Ash, Mass %	1.20	0.88	0.79
Base Number	9.7	6.2	5.5
Specifications	SL/CF/A3/B3	SG/CF/MA	SG/CC

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	MARINE FOUR STROKE OIL	ENDURO MOTORCYCLE OIL	HD OIL (MOTORCYCLES)
Viscosity	10W-50	25W-70	50-70
cSt @ 40°C	127	284	311
cSt @ 100°C	19.0	28.8	32.3
Viscosity Index	169	136	144
Cold Cranking Viscosity			
cP @ -25°C	5,856	-	-
cP @ -10°C	-	5,499	5,985
HT/HS @ 150°C, cP	4.3	6.0	7.1
Flash Point, °C	224	238	210
Calcium, % mass	0.168	0.033	0.034
Magnesium, % mass	0.000	0.091	0.093
Zinc, % mass	0.131	0.176	0.180
Phosphorus, % mass	0.120	0.160	0.164
Molybdenum, % mass	0.000	0.000	0.000
Density @ 15°C	0.868	0.885	0.887
Sulphated Ash, Mass %	0.77	0.88	0.90
Base Number	5.6	6.2	7.0
Specifications	FC-W®/MA	SG/MA	SF
Boron, mass %	0.000	0.000	0.000
MRV Pumpability			
cP @ -10°C	-	-	29,400
cP @ -15°C	-	28,700	-
cP @ -30°C	53,146	-	-
Pour Point	-36	-15	-18
Viscosity After Shear			
cSt @ 100°C	16.7	26.0	27.5

PRODUCT	MARINE OUTBOARD TWO STROKE OIL	SYNMARINE OUTBOARD TWO STROKE
Viscosity		
cSt @ 40˚C	52	45
cSt @ 100˚C	8.6	7.9
Viscosity Index	142	147
Flash Point, ˚C	115	140
Calcium, % mass	0.000	0.000
Zinc, % mass	0.000	0.000
Phosphorous, % mass	0.000	0.000
Density @ 15˚C	0.873	0.960
Sulphated Ash, % mass	0.00	0.00
Base Number	10.4	
Specifications	NMMA TC-W3® JASO FB	NMMA TC-W3®
Type	Mineral	Fully Synthetic

PRODUCT	SMALL ENGINE GREENKEEPERS TWO STROKE OIL	SMALL ENGINE HI-PER TWO STROKE OIL	SIN TWO STROKE
Viscosity			
cSt @ 40˚C	71	57	54
cSt @ 100˚C	9.7	9.0	9.1
Viscosity Index	116	136	150
Flash Point, ˚C	115	97	90
Calcium, % mass	0.027	0.039	0.017
Zinc, % mass	0.000	0.000	0.000
Phosphorous, % mass	0.000	0.000	0.000
Density @ 15˚C	0.880	0.862	0.874
Sulphated Ash, % mass	0.09	0.09	0.12
Base Number	1.7	1.6	1.6
Specifications	JASO FB API TC	ISO EG-C JASO FC Husqvarna API TC	ISO EG-D JASO FD API TC Piaggo
Type	Mineral	Semi-Synthetic	Fully Synthetic

SIN HIGH PERFORMANCE GEAR OILS				
	75	80	MANUAL TRANS	RACE GEAR 110
SAE Viscosity	75W-90	80W-140	75W-85	85W-110
cSt @ 40˚C	108	241	72	306
cSt @ 100˚C	15.7	28.2	11.7	23.8
Viscosity Index	154	153	158	98
KRL Viscosity				
cSt @ 100˚C AfterShear	13.6	26.5	11.0	23.8
Brookfield Viscosity				
cP @ -40˚C	NA	NA	88,250	NA
cP @ -26˚C	122,00	NA	NA	NA
cP @ -12˚C	NA	44,650	NA	TBA
Pour Point, ˚C	-47	-41	-42	-18
Flash Point, ˚C	200	210	218	254
Phosphorus, % mass	0.247	0.262	0.130	0.XX
Density @ 15˚C	0.887	0.896	0.871	0.920

HYPOID GEAR OILS			
SAE Viscosity	80W-90	85W-140	140
cSt @ 40˚C	142	389	473
cSt @ 100˚C	14.6	27.7	31.6
Viscosity Index	102	97	98
Brookfield Viscosity			
cP @ -26˚C	129,200	NA	NA
cP @ -12˚C	NA	57,100	85,000
Pour Point, ˚C	-21	-21	-9
Flash Point, ˚C	203	214	187
Calcium, % mass	0.00	0.00	0.00
Zinc, % mass	0.00	0.00	0.00
Phosphorus, % mass	0.065	0.065	0.082
Density @ 15˚C	0.901	0.911	0.907

LIMSLIP GEAR OILS			
SAE Viscosity	80W-90	85W-140	140
cSt @ 40˚C	154	356	490
cSt @ 100˚C	15.4	26.5	31.5
Viscosity Index	101	99	95
Brookfield Viscosity			
cP @ -26˚C	116,000	NA	NA
cP @ -12˚C	NA	46,500	619,500
Pour Point, ˚C	-27	-21	-9
Flash Point, ˚C	200	214	187
Calcium, % mass	0.00	0.00	0.00
Zinc, % mass	0.00	0.00	0.00
Phosphorus, % mass	0.117	0.125	0.110
Density @ 15˚C	0.896	0.908	0.907

MANUAL TRANSMISSION OILS					
MANUAL GEAR OIL	**70**	**75**	**80**	**TRANS-AXLE 75**	**TRANS-AXLE 80**
SAE Viscosity	70W-75	75W-80	80W-85	75W-90	80W-85
cSt @ 40°C	36	59	104	103	111
cSt @ 100°C	7.1	10.3	11.8	16.6	12.2
Viscosity Index	165	164	103	175	100
Brookfield Viscosity					
cP @ -55°C	46,250	NA	NA	NA	NA
cP @ -40°C	NA	38,500	NA	109,000	NA
cP @ -26°C	NA	NA	80,000	NA	90,500
KRL, Viscosity					
cSt @ 100°C AfterShear	NA	9.2	NA	14.0	NR
Pour Point, °C	<-54	-48	-30	-42	-30
Flash Point, °C	190	200	200	200	187
Magnesium % mass	0.090	0.000	0.000	0.000	0.000
Calcium, % mass	0.000	0.337	0.028	0.093	0.028
Zinc, % mass	0.131	0.123	0.00	0.00	0.00
Phosphorus, % mass	0.119	0.137	0.059	0.117	0.082
Density @ 15°C	0.896	0.862	0.882	0.873	0.895

HEAVY DUTY TRANSMISSION OILS				
	FLEET TRANS C4	**FLEET GEAR 30**	**FLEET GEAR 50**	**SYN FLEET 50**
SAE Viscosity (engine)	10W	30	50	50
SAE Viscosity (gear)	NA	85	90	90
cSt @ 40°C	34	98	235	132
cSt @ 100°C	6.0	11.1	20.0	17.5
Viscosity Index	123	98	98	146
Cold Cranking Viscosity				
cP @ -25°C	3,005	NA	NA	NA
Brookfield Viscosity				
cP @ -26°C	NA	NA	NA	104,000
Flash Point, °C	200	214	240	221
Calcium, % mass	0.242	0.242	0.242	
Zinc, % mass	0.109	0.109	0.109	
Phosphorus, % mass	0.092	0.092	0.092	
Density @ 15°C	0.860	0.882	0.901	0.860

AUTOMATIC TRANSMISSION FLUIDS			
	SIN ATF	**ATF DX-VI**	**ATF DX-III**
Viscosity			
cSt @ 40°C	38	30	35
cSt @ 100°C	8.3	6.0	7.4
Viscosity Index	203	151	186
Brookfield Viscosity			
cP @ -40°C	12,140	12,030	10,960
Pour Point, °C	-42	-54	-53
Flash Point, °C	178	200	185
Calcium, % mass	0.000	0.000	0.008
Zinc, % mass	0.000	0.000	0.000
Phosphorus, % mass	0.019	0.019	0.022
Boron, % mass	0.010	0.000	0.009
Density @ 15°C	0.844	0.846	0.851

	ATF MHP	**ATF BMV**	**ATF DX-II**
Viscosity			
cSt @ 40°C	39	35	48
cSt @ 100°C	7.7	7.4	8.9
Viscosity Index	176	183	166
Brookfield Viscosity			
cP @ -40°C	20,000	8,940	38,150
Pour Point, °C	-47	-54	-45
Flash Point, °C	226	226	210
Calcium, % mass	0.012	0.000	0.007
Zinc, % mass	0.000	0.000	0.000
Phosphorus, % mass	0.020	0.029	0.019
Boron, % mass	0.007	0.013	0.009
Density @ 15°C	0.850	0.852	0.859

AUTOMATIC TRANSMISSION FLUIDS			
	ATF 33	ATF 95LE	ATF TOP UP
Viscosity			
cSt @ 40°C	42	43	52
cSt @ 100°C	7.8	8.3	9.3
Viscosity Index	157	172	165
Brookfield Viscosity			
cP @ -40°C	NA	24,150	NA
Pour Point, °C	NA	-48	NA
Flash Point, °C	196	204	200
Calcium, % mass	0.000	0.000	0.000
Zinc, % mass	0.000	0.000	0.000
Phosphorus, % mass	0.021	0.029	0.030
Boron, % mass	0.000	0.013	0.013
Density @ 15°C	0.857	0.856	0.861

	ATF FM5	SIN COMP AUTO	CVT FLUID V
Viscosity			
cSt @ 40°C	35	42	34
cSt @ 100°C	7.9	7.8	7.1
Viscosity Index	209	157	178
Brookfield Viscosity			
cP @ -40°C	9,300	NA	14,000
Pour Point, °C	-46	NA	NA
Flash Point, °C	204	196	190
Calcium, % mass	0.000	0.000	0.024
Zinc, % mass	0.000	0.000	0.000
Phosphorous, % mass	0.023	0.021	0.038
Boron, % mass	0.000	0.000	0.027
Density @ 15°C	0.858	0.857	0.852

POWER STEERING FLUIDS

	POWER STEERING FLUID	PAS FLUID	LHM PLUS	SSF	HPSO
Viscosity					
cSt @ 40°C	58	25.6	18.6	18.5	73
cSt @ 100°C	10.3	6.4	6.4	6.3	12.1
Viscosity Index	166	196	346	340	163
Flash Point, °C	218	185	150	132	190
Sodium, % mass	0.000	0.000	0.007	0.017	0.000
Zinc, % mass	0.139	0.000	0.000	0.000	0.139
Phosphorus, % mass	0.130	0.021	0.007	0.000	0.130
Colour	Natural	Green	Green	Orange	Natural
Density @ 15°C	0.872	0.860	0.846	0.830	0.889

HYDRAULIC OILS

	INDUS HV		
ISO Viscosity	46	68	100
cSt @ 40°C	45	73	98
cSt @ 100°C	8.4	10.6	13.9
Viscosity Index	166	133	144
DIN 51382 30 Cycle Viscosity After Shear			
cSt @ 100°C	8.37	10.39	13.48
Pour Point, °C	-36	-27	-27
Flash Point, °C	205	228	208
FZG Pass Stage	11	11	11
Calcium, % mass	0.00	0.00	0.00
Zinc, % mass	0.00	0.00	0.00
Phosphorus, %mass	0.00	0.00	0.00
Density @ 15°C	0.873	0.883	0.887
Colour	Green	Green	Green

	PRO HYDRAULIC OILS		
ISO Viscosity	32	46	68
cSt @ 40°C	30.2	44.6	72.1
cSt @ 100°C	5.1	6.7	9.0
Viscosity Index	94	103	98
Flash Point, °C	210	225	245
Calcium, % mass	0.00	0.00	0.00
Zinc, % mass	0.00	0.00	0.00
Phosphorus, %mass	0.00	0.00	0.00
Density @ 15°C	0.869	0.877	0.885

INDUSTRIAL GEAR OILS

	GEAR OIL EP					GEAR OIL SYN
ISO Viscosity	150	220	320	460	680	220
AGMA No	4EP	5EP	6EP	7EP	8EP	5EP
cSt @ 40°C	146	227	329	453	726	220
cSt @ 100°C	14.4	19.4	24.3	30.3	38.1	23.0
Viscosity Index	96	96	95	96	88	124
Flash Point, °C	260	262	252	255	250	238
Pour Point, °C	-33	-27	-21	-12	-9	-37
TIMKEN, OK Load kg	32	32	32	32	32	32
FZG Pass Stage	12 +	12 +	12 +	12 +	12 +	12+

SLIDEWAY AND AIRTOOL OILS

	ROCKSLIDE	
ISO Viscosity	68	320
cSt @ 40°C	64	27.7
cSt @ 100°C	10.1	31.3
Viscosity Index	143	119
Flash Point, °C	192	250
Phosphorus, %mass	0.027	0.027

OTHER

	HYDRAULIC JACK OIL	MB15 LEVELLING FLUID
ISO Viscosity	46	15
cSt @ 40°C	44.6	15.3
cSt @ 100°C	6.7	4.0
Viscosity Index	103	170
Flash Point, oC	225	200
Calcium, % mass	0.00	0.00
Zinc, % mass	0.00	0.00
Phosphorus, %mass	0.00	0.00
Density @ 15°C	0.877	0.835

CUTTING FLUIDS

	SOLUBLE OIL	HONING OIL
Type	Emulsifiable	Neat
Viscosity, cSt @ 40°C	36	13
Flash Point, °C	200	168
Density @ 15°C	0.884	0.880
Colour	White(emuls)	Brown
Odour	Bland	Bland

GREASES

	SIN GREASE	HIGH TEMP. WHEEL BEARING GREASE
Type	Calcium Complex	Lithium Complex
NLGI Grade	2	2
NLGI Performance	GC/LB	GC/LB
Base Oil ISO Viscosity	100	220
Drop Point, °C	314	270
Colour	Burgundy	Blue
TIMKEN OK Load, kg	27	18
Four Ball Weld Load, kg	500	250

	EXTREME PRESSURE GREASE	QCA GREASE MX9
Type	**Lithium**	**Mixed**
NLGI Grade	2	2
Base Oil ISO Viscosity	220	680
Drop Point, °C	190	>250
Colour	Brown	Grey
TIMKEN OK Load, kg	18	NA
Four Ball Weld Load, kg	200	>800

	MOLYGREASE EP 3%	GRAPHITE GREASE
Type	**Lithium**	**Calcium**
NLGI Grade	2	3
Base Oil ISO Viscosity	220	220
Drop Point, °C	190	80
Colour	Grey-Black	Grey-Black
TIMKEN OK Load, kg	18	NA
Four Ball Weld Load, kg	250	NA
Solids Content	3%	15%

	COPPER-EZE	WATER PUMP GREASE
Type	**Bentone**	**Calcium**
NLGI Grade	1.5	4
Base Oil ISO Viscosity	460	NA
Drop Point, °C	Non-melt	80
Colour	Copper	Yellow
TIMKEN OK Load, kg	NA	NA
Four Ball Weld Load, kg	NA	NA

	SEMI FLUID GREASE	RUBBER GREASE
Type	**Polymer**	**Bentone**
NLGI Grade	00	2
Base Oil ISO Viscosity	880	320
Drop Point, °C	105	275
Colour	Brown	Red
TIMKEN OK Load, kg	18	NA
Four Ball Weld Load, kg	250	NA

INDUSTRY TERMS

ACID NUMBER – (see NEUT NUMBER)

AGMA – American Gear Manufacturers Association, one of whose activities is the establishment and promotion of standards for gear lubricants.

ANTI-FOAM AGENT – (see FOAM INHIBITOR)

ANTI-WEAR AGENT – An additive that minimises wear caused by metal-to metal contact during conditions of mild boundary lubrication (e.g. stops and starts, oscillating motion). The additive reacts chemically with, and forms a film on, metal surfaces under normal operating conditions.

ANTI-OXIDANT – (see OXIDATION INHIBITOR)

API – (American Petroleum Institute) – society organised to further the interests of the petroleum industry.

ASH CONTENT – non-combustible residue of a lubricating oil (also fuels) determined in accordance with ASTM D582 – also D874 (sulphated ash).

ASTM – (American Society for Testing and Materials) – organisation devoted to "the promotion of knowledge of the materials of engineering, and the standardisation of specifications and methods of testing

AUTO IGNITION TEMPERATURE – See description under FLASH POINT.

BASE NUMBER – (see NEUT NUMBER)

BOUNDARY LUBRICATION – a state of lubrication characterised by partial contact between two metal surfaces, and partial separation of the surfaces by a fluid film of lubricant. Due to metal-metal contact, severe wear can take place during boundary lubrication.

BROOKFIELD VISCOSITY – viscosity, in centipoises, as determined on the Brookfield viscometer (ASTM D2983). The operating principle for the Brookfield viscometer is the torque resistance on a spindle rotating in the fluid being tested.

CARBON RESIDUE – percent of coked material remaining after a sample of lubricating oil has been exposed to high temperatures under ASTM Method D189 (Conradson) or D524 (Ramsbottom).

CENTISTOKE (cSt) – (see VISCOSITY)

CENTIPOISE (cP) – (see VISCOSITY)

CHANNELLING – formation of a 'groove' in grease (or in oil too viscous to flow readily under existing conditions).

COMPOUNDED OIL – a blend of petroleum oil with small amounts of fatty or synthetic fatty oils

COPPER STRIP CORROSION – evaluation of a product's tendency to corrode copper or copper alloys, ASTM D130.

CORROSION INHIBITOR – a lubricant additive for protecting surfaces against chemical attack from contaminants in the lubricant.

DEMULSIBILITY – test time required for a specified oil-water emulsion to break, using ASTM D1401 test method.

DETERGENT – an additive in crankcase oils generally combined with dispersant additives. A detergent chemically neutralises acidic contaminants in the oil before they become insoluble and fall out of the oil, forming sludge.

DISPERSANTS – operate to break up insoluble contaminant particles already formed. Particles are kept finely divided so that they can remain 'dispersed' or colloidally suspended in the oil.

DROPPING POINT – the temperature at which a grease changes from semisolid to a liquid state under test conditions.

EMULSION – a mechanical mixture of two mutually insoluble liquids (such as oil and water).

EP AGENT – an additive to improve the extreme pressure properties of a lubricant.

FIRE POINT - the minimum sample temperature at hich vapor is produced at a sufficient rate to sustain combustion.

FLASH POINT – minimum temperature of a petroleum product or other combustible fluid at which vapor is produced at a rate sufficient to yield a combustible mixture.

FOAM INHIBITOR – an additive which causes foam to dissipate more rapidly. It promotes the combination of small bubbles into large bubbles which burst more easily.

FOUR BALL TESTS – two test procedures based on the same principle – the Four-Ball EP Test (ASTM D2596) and Four-Ball Wear Test (ASTM D2266). The three lower balls are clamped together to form a cradle upon which the fourth ball rotates in a vertical axis. The balls are immersed in the lubricant under investigation. The FOUR BALL WEAR TEST is used to determine the relative wear-preventing properties of lubricants operating under boundary lubrication conditions. The FOUR-BALL EP TEST is designed to evaluate performance under much higher unit loads Two values are generally reported – LOAD WEAR INDEX (formerly mean Hertz load) and WELD POINT.

HYDROCRACKING – is a process which is used by a few manufacturers of superior quality lubricant basestock. In the process, a petroleum feedstock is reacted with hydrogen, in the presence of a catalyst, at very high temperatures (400-425°C) and pressures (3000 plus psi). Under these severe conditions, virtually all the aromatic hydrocarbons present are isomerised and saturated to yield a basestock containing 96% to 99.5+% saturated hydrocarbons. The process also virtually eliminates all traces of sulphur, nitrogen and oxygen-containing impurities.Hydrocracking produces very high quality, synthetic-like basestocks, which when blended with carefully selected additives, give extremely stable lubricants of a synthetic level performance.

HYDROFINISHING – (see HYDROTREATING)

HYDROTREATING – a generic name for a refinery process for treating fuels and lubricant feedstocks, at elevated temperatures, in the presence of pressurised hydrogen and a catalyst. This relatively mild process is sometimes called 'Hydrofinishing' and is used to improve the colour and odour of fuels and lubricant basestocks.

HYDRODYNAMIC LUBRICATION – a lubrication regime characterised by a full fluid film between two moving surfaces.

INHIBITOR – additive for the control of an undesirable phenomenon in grease, oils, or fuels, etc., for example: oxidation inhibitors, rust inhibitors, foam inhibitors, etc.

ISO – (International Organization for Standardisation) – an organisation which establishes internationally recognised standards for products and test methods.

NEUT NUMBER – or NEUTRALIZATION NUMBER: the specific quantity of reagent required to 'neutralise' the acidity or alkalinity of a lube oil sample

OXIDATION – A form of chemical deterioration to which petroleum products like most other organic materials are subject.

OXIDATION INHIBITOR – chemical added in small quantities to a petroleum product to increase its oxidation resistance and hence to lengthen its service or storage life.

POISE – CGS unit of absolute viscosity: shear stress (in dynes per square centimetre) required to move one layer of fluid along another, over a total layer thickness of one centimetre at a shear rate of one centimetre per second. The CENTIPOISE (cP) is 1/100 of a poise and is the unit of absolute viscosity most commonly used.

POUR POINT – is a widely used low-temperature flow indicator and is 3°C above the temperature to which a normally liquid petroleum product maintains fluidity.

RUST INHIBITOR – a lubricant additive for protecting ferrous (iron and steel) components from rusting caused by water contamination or other harmful materials from oil degradation.

SAPS – Sulphated Ash, Phosphorus and Sulphur. Basic chemical specifications in engine oils that are being further limited as emissions requirements tighten.

SCR – Selective Catalytic Reduction. Exhaust emissions treatment system used mainly on heavy duty trucks

SCUFFING – engine wear resulting from the localised welding and fracture of rubbing surfaces.

SOLVENT EXTRACTION – a traditional refinery process that is used to upgrade chemical and physical properties in the manufacture of lube oil basestocks.

STLE – Society of Tribologists and Lubrication Engineer.

SULPHATED ASH – (see ASH)

SYNTHETIC LUBRICANTS - lubricants manufactured by a process where a chemical conversion or transformation of one complex mixture of molecules into another complex mixture takes place. Common types of synthetic base oil include:

- Polyalpha olefins
- Hydrocracked/HydroIsomerised Unconventional Base Oils (UCBOs)
- Organic esters
- Polyglycols

TIMKEN OK LOAD – measure of the extreme pressure properties of a lubricant.

TOTAL BASE NUMBER – (see NEUT NUMBER)

VISCOSITY – measure of a fluid's resistance to flow. It is ordinarily expressed in terms of the time required for a standard quantity of the fluid at a certain temperature to flow through a standard orifice.

VISCOSITY INDEX (V.I.) – an indicator of the rate of change of viscosity with temperature.

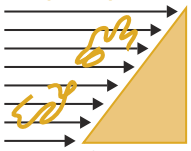
VOLATILITY – that property of a liquid that defines its evaporation characteristics.

PERMANENT VS TEMPORARY SHEAR

The below diagrams show the two types of shear that can occur with viscosity index improvers (VII). Permanent Shear is defined as the physical breaking apart of the polymer into smaller pieces and hence the oil suffers from a permanent loss of viscosity. Temporary shear occurs when the polymer is squashed but does not break apart and hence "springs back" to its original size after going through the area of high stress.

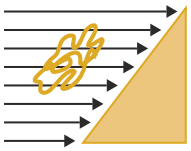
Normal polymer coil in oil

Reversible (Temporary Shear)



Rupture of coil under permanent shear

Non-reversible (Permanent Shear)



Polymer coil is squashed under temporary shear forces

The shearing effect occurs when the oil is forced through areas of tight clearances or is "squashed" (eg cam lobe to follower) and if the gap is too small, then the polymer will rupture.

Penrite SIN 15 and 25 are formulated "shear free" and do not use any polymers but use special base oil combinations to achieve the desired viscosity grades. As such, there are no components in the oil that can suffer from Permanent shear so the oil holds its original viscosity for the life of the oil drain.

References

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