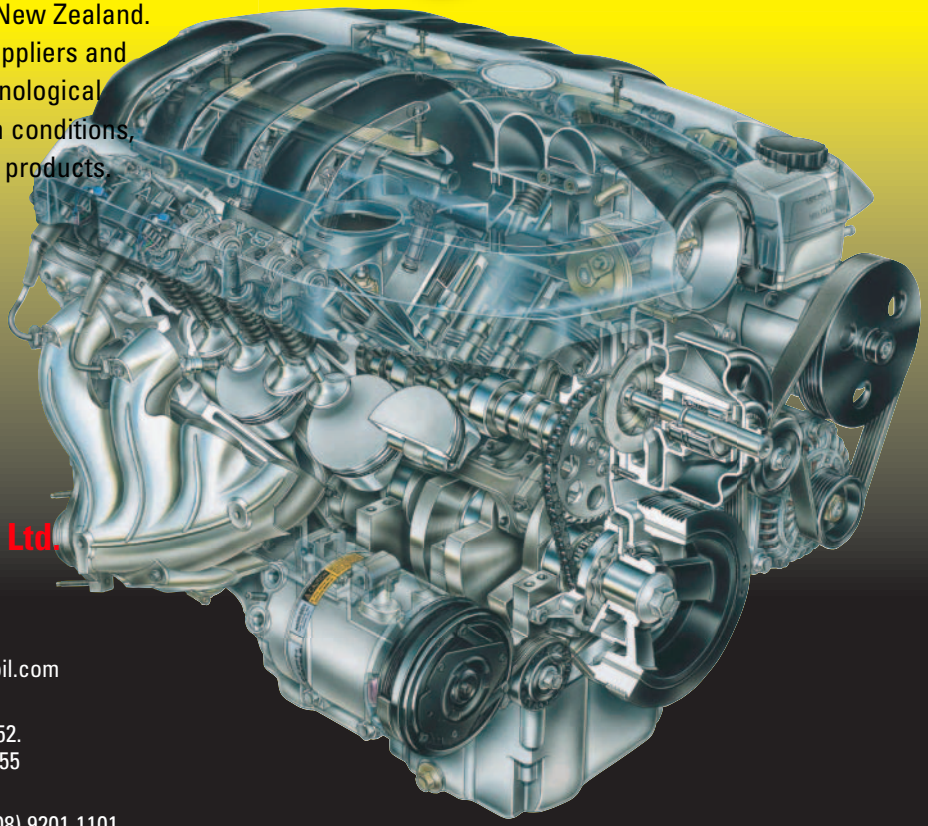
Guide to Engine Oils

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, 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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Obsession with Oil

ENGINE OILS

This booklet is designed to help you understand a little more about engine oils, their specifications, and more importantly, give a full range of technical data on our Top Tier petrol and diesel engine oils.

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ENGINE OIL FUNCTIONS

Modern engine oils must perform a range of functions to properly ensure engines are protected. Penrite carefully choose additives and base oils and then formulate these into finished products that provide the maximum level of engine protection.

To properly lubricate an engine an oil must:

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.

Lubricate 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. This becomes more important as fuel economy driven changes to the engine, require oils of ever decreasing viscosity. However, for older and more conventional engines, engine oil viscosity is important in controlling wear.

Reduce Friction
This does not mean friction modified! The film of oil reduces engine 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 selection of an oil is therefore a balance of what is needed to protect the engine against not creating too much drag (and hence retain power and/or fuel economy). Friction modifiers can further reduce this friction and also act as anti-wear additives.

Protect Against Rust and Corrosion
Water is a by-product of combustion of fuel and ends up in the oil. Therefore oils must contain rust inhibitors. Also, as oils degrade they form corrosive by-products so the oil contains anti-corrosion and acid neutralising additives to protect the engine.

Keep the Engine Clean
This means controlling sludge deposits, soot deposits, varnish (glazing) and dirt. There are additives in the oil to stop the formation of deposits and also to keep contaminants in the oil solution (to be taken out in most cases by the filter) rather than letting them settle inside the engine.

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, 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.

So what does this mean for Penrite Products?
We recognise that different engine designs required a range of oils to properly lubricate the engine while preserving the fuel economy or power of the engine. Hence we look at what the original oil requirement is for start up viscosity. We use that and then go as high as we can for the operating temperature viscosity. This must be done in such a way that the overall lubrication of the engine is not compromised, nor the product be so expensive it becomes un-affordable. That is why Penrite petrol engine oils have some of the widest multigrade ranges of any oil company (apart from fully synthetic products).

For an engine that needs a SAE 10W-30 oil, we developed a semi-synthetic SAE 10W-50. Similarly, 15W-40s are catered for by a 15W-60, 20W-40 and 20W-50 by a 20W-60 and for race engines or those with severe oil consumption we have the 25W-70 and 40-70 grades. We do of course go right down to the 5W range and have two products to suit a 5W-40 part synthetic and a 5W-60 full synthetic.

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. More information follows next on our additives.

ADDITIVES

What makes up a Modern Oil?
Firstly you have base oils, both made from crude oil at a refinery, or man-made (synthetics). To achieve the functions required by an engine oil, 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 dispersed in the oil helping 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!

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.

Friction Modifiers
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.

Anti-Wear Agents
Prevent wear due to seizure or scuffing of rubbing surfaces. Usually ZDDP (zinc dialkyl-dithiophosphate, or organic zinc) they form a chemical film over microscopic hot spots. Organic molybdenum is now also finding favour.

Foam Depressants
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. its ability to pour.

Viscosity Index Improvers (VII)
These change the oils rate of thinning out (the VI) as temperatures increase, ie. make multigrade oils. They are polymers which 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.

So how does 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 most products in our range. When you buy Penrite, you are buying an uniquely Australian product, not only from a physical perspective but also 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. All HPR oils and Synthetic oils use European standard additives - these are superior in performance to USA only products. Therefore, better wear protection and oxidation protection are achieved along with our careful selection of base oils.

BASE OILS

All engine oils must contain base oils! They go with the additives mentioned earlier. Not all base oils are created equally however. The API classify these into 5 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	Others (includes esters)			Various

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). The 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.

OIL CLASSIFICATIONS

When selecting the correct oil, the vehicle operator must consider the oil viscosity, and what the vehicle/engine manufacturers specification level is. So you get out the manual and it says SAE, API, ACEA, ILSAC and not to mention their own specification numbers – but what do they mean?

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. In addition, 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.

SAE J300 Revision Dec 1999 (Effective July 1, 2001)

SAE Grade	Cold Cranking Max Viscosity cP @ Temp, °C	Pumpability Max Viscosity cP @ Temp, °C	Viscosity @ 100°C Min cSt	Viscosity @ 100°C Max cSt	HT/HS @ 150°C Min cP
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: 2.9 for 0W-40, 5W-40 and 10W-40 grades, 3.7 for 15W-40, 20W-40, 25W-40 and 40 grades.
We define "SAE 70" as above 26.1 cSt at 100 °C.

API ENGINE SERVICE CLASSIFICATION

API stands for American Petroleum Institute. In 1970 along with the SAE and ASTM (American Society for Testing and Materials), they established the API Service Classification System to define the performance level of a given oil, unrelated in the main, to oil viscosity (some API fuel economy requirements can only be met by oils of certain viscosities). Both API and SAE specifications in combination define what oil is the best for a given purpose.

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-on requirements of Automotive manufacturers

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.

CA to CE are obsolete.

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" for gasoline, "B" for light duty (passenger car, 4WD etc) diesel engines and "E" for heavy duty diesel engines. These can be defined as follows.

Designation and Description

A1	For use in gasoline 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.
A2	General purpose oil for use in most gasoline engines at normal drain intervals. May not be suitable for some high performance engines.
A3	Stable, stay in grade oil intended for use in high performance gasoline engines or extended drain intervals.
A5	As per A3 but for fuel economy.
B1	For use in 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.
B2	General purpose oil for use in most light duty diesel engines (primarily indirect injection) at normal drain intervals. May not be suitable for some high performance engines.
B3	Stable, stay in grade oil intended for use in high performance light duty diesel engines or extended drain intervals.

A GUIDE TO CHOOSING THE CORRECT HPR OIL

The guide below is for vehicles in good engine condition operating in normal Australian urban driving conditions.
Application guide is for passenger cars, light commercial vehicles, four wheel drives and SUVs with a GVM of less than 3.5MT

If the vehicle is either:
Being operated in ambient conditions consistently above 35°C or used for heavy towing such as caravans and boats or subjected to prolonged high speed use or consistently operated in severe off road conditions or suffering from excessive oil consumption due to wear, then use the next higher HPR grade in the scale.

For LPG engines, use the equivalent HPR Gas grades shown.

Penrite Synthetic 5 is available where the use of synthetic oil is desired.

MANUFACTURER	MODEL	Pre 1982	1982-1989	1990-1996	1997-2001	2002-
Alfa Romeo	All	HPR 40	HPR 30	HPR 15	HPR 10	HPR 10
Audi	Petrol	HPR 30	HPR 30	HPR 15	HPR 10	HPR 10
	Diesel				HPR Diesel 5	HPR Diesel 5
BMW	Petrol	HPR 30	HPR 30	HPR 15	HPR 10	HPR 5
	Diesel					HPR Diesel 5
Chrysler	Petrol	HPR 40	HPR 30	HPR 10	HPR 10	HPR 5
	Diesel			HPR Diesel	HPR Diesel 15	HPR Diesel 5
Citroen	All	HPR 30	HPR 30	HPR 15	HPR 10	HPR 10
Daewoo	All			HPR 15	HPR 10	HPR 10
Daihatsu	All	HPR 30	HPR 30	HPR 15	HPR 10	HPR 10
Eunos	All			HPR 10	HPR 10	
Ferrari	All	HPR 40	HPR 30	HPR 15	HPR 10	HPR 10
Fiat	All	HPR 30	HPR 30			HPR 10
Ford	Petrol	HPR 40	HPR 30	HPR 15	HPR 10	HPR 10
	Diesel	HPR Diesel	HPR Diesel	HPR Diesel	HPR Diesel 15	HPR Diesel 5
Ford (F Series 1997-)	Diesel				HPR Diesel 15	HPR Diesel 15
Ford Transit	Diesel	HPR Diesel	HPR Diesel	HPR Diesel 15	HPR Diesel 5	HPR Diesel 5
FTe/FPV	All				HPR 10	HPR 5
Holden	Petrol	HPR 40	HPR 30	HPR 15	HPR 10	HPR 10
	Diesel	HPR Diesel	HPR Diesel	HPR Diesel	HPR Diesel 15	HPR Diesel 15
	Jackaroo Diesel		HPR Diesel	HPR Diesel 15	HPR Diesel 5	HPR Diesel 5
Honda	All	HPR 30	HPR 30	HPR 15	HPR 10	HPR 10
	V-Tec			HPR 10	HPR 10	HPR 10
HSV	All			HPR 15	HPR 10	HPR 10
Hyundai	All			HPR 15	HPR 10	HPR 10
Jaguar (incl Daimler)	All	HPR 40	HPR 40	HPR 30	HPR 10	HPR 5
Jeep	Petrol	HPR 40	HPR 30	HPR 10	HPR 10	HPR 5
	Diesel	HPR Diesel	HPR Diesel	HPR Diesel	HPR Diesel 15	HPR Diesel 5
Kia	Petrol			HPR 15	HPR 10	HPR 10
	Diesel					HPR Diesel 15
Land Rover	Petrol	HPR 40	HPR 30	HPR 15	HPR 10	HPR 10
	Diesel	HPR Diesel	HPR Diesel	HPR Diesel 15	HPR Diesel 5	HPR Diesel 5
Lexus	Petrol			HPR 10	HPR 10	HPR 10
Leyland (incl Austin, Morris)	All	HPR 40				

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For LPG engines, use the equivalent HPR Gas grades shown.

Penrite Synthetic 5 is available where the use of synthetic oil is desired.

MANUFACTURER	MODEL	Pre 1982	1982-1989	1990-1996	1997-2001	2002-
Mazda	Petrol	HPR 40	HPR 30	HPR 15	HPR 10	HPR 5
	Diesel	HPR Diesel	HPR Diesel	HPR Diesel	HPR Diesel 15	HPR Diesel 5
Mercedes Benz	Petrol	HPR 30	HPR 30	HPR 15	HPR 10	HPR 10
	Diesel	HPR Diesel	HPR Diesel	HPR Diesel	HPR Diesel 15	HPR Diesel 5
MG	All	HPR 30	HPR 30		HPR 5	HPR 5
Mitsubishi (incl Ralliart)	All	HPR 40	HPR 30	HPR 15	HPR 10	HPR 10
	Diesel	HPR Diesel	HPR Diesel	HPR Diesel	HPR Diesel 15	HPR Diesel 15
Nissan (incl Datsun)	Petrol	HPR 40	HPR 30	HPR 15	HPR 10	HPR 10
	GTR/200SX			HPR 10	HPR 5	HPR 5
	Diesel	HPR Diesel	HPR Diesel	HPR Diesel	HPR Diesel 15	HPR Diesel 15
Peugeot	Petrol	HPR 40	HPR 30	HPR 15	HPR 10	HPR 10
	Diesel	HPR Diesel	HPR Diesel	HPR Diesel	HPR Diesel 15	HPR Diesel 5
Porsche	All	HPR 40	HPR 30	HPR 15	HPR 10	HPR 10
Proton	All				HPR 10	HPR 10
Rambler	All	HPR 40				
Range Rover	Petrol		HPR 30	HPR 15	HPR 10	HPR 10
	Diesel	HPR Diesel	HPR Diesel	HPR Diesel	HPR Diesel 15	HPR Diesel 5
Renault	All	HPR 40	HPR 30	HPR 15	HPR 10	HPR 10
Rover	All	HPR 40	HPR 30	HPR 15	HPR 10	HPR 10
SAAB	All	HPR 30	HPR 15	HPR 10	HPR 10	HPR 10
SEAT	A ll				HPR 10	HPR 10
Skoda	All				HPR 10	HPR 10
Ssangyong	Petrol			HPR 15	HPR 15	HPR 10
	Diesel			HPR Diesel 15	HPR Diesel 15	HPR Diesel 15
Subaru	All	HPR 30	HPR 15	HPR 10	HPR 10	HPR 5
	WRX			HPR 10	HPR 5	HPR 5
Suzuki	All	HPR 40	HPR 30	HPR 15	HPR 10	HPR 10
Toyota	Petrol	HPR 30	HPR 30	HPR 15	HPR 10	HPR 10
	Diesel	HPR Diesel	HPR Diesel	HPR Diesel	HPR Diesel 15	HPR Diesel 15
Triumph	All	HPR 40				
Valiant	All	HPR 40				
Volkswagen	Petrol	HPR 30	HPR 30	HPR 15	HPR 10	HPR 10
	Diesel	HPR Diesel	HPR Diesel	HPR Diesel	HPR Diesel 15	HPR Diesel 5
Volvo	All		HPR 30	HPR 10	HPR 5	HPR 5

ACEA Designation and Description cont...

B4	For use in direct injection diesel engines where special oils may be required.
B5	As per B4 but for fuel economy.
E2	General purpose oil for naturally aspirated and turbocharged diesel engines, medium to heavy duty service and mostly normal drain intervals
E3	Designed for use in Euro 1 and Euro 2 emission diesel engines in severe heavy duty service and extended drain intervals where allowed.
E4	Stable, stay in grade oil more severe than E3, for significantly extended oil drain intervals. Usually synthetic or predominantly synthetic. Also for Euro 3 engines. Not suitable for US diesel engines.
E5	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 E3 but not as severe as E4.

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

E6	Replace E4 in 2004 but with tighter chemical limits.
E7	Will replace E5 in 2004.

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 new for 2004, API SM to follow

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 = E5/CH-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 MA	Japanese four stroke motorcycles, non-friction modified.
JASO MB	Japanese four stroke motorcycles low friction oil.
NMMA FC-W	Released in 2004 for four stroke outboard oils.

PENRITE PRODUCTS

This section contains technical and application information not 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, there is a new product, Penrite Synthetic 5 for use when a full synthetic oil is required.

HEAVY DUTY TRUCK ENGINE OILS

Penrite truck engine oils have been tailored for two specific end uses. The three 15W-40 grades are for new trucks, with the USA and Euro products carrying specific manufacturer approvals. 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. Euro 15 is the best oil to use for mixed fleets.

Product	Base Oil	Specifications	Specific Vehicles <5 Years Old
		(see chart for other recommendations)	
HPR 5 Synthetic Performance Semi-Synthetic (use if A1/B1 specified)	Group 3	API SL/CF ACEA A3/B3 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 MB 229.3 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
HPR 10 Semi-Synthetic	Group 1/3	API SL/CF ACEA A3/B3 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 incl. VVTi BMW Renault SAAB FTe/FPV Mazda VT Commodore on AU Falcon on Subaru Fiat-Lancia-Alfa Romeo
HPR 15 Semi-Synthetic	Group 1/3	API SL/CF ACEA A3/B3 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 Mineral	Group 1	API SL/CF ACEA A3/B3 Ford M2C 153E Rover RES.22.OL.22 VW 501.01 Chrysler MS-6395 MB 229.1	
HPR 40 Mineral	Group 1	API SL/CF	
HPR 50 Mineral	Group 1	API SL	

Product	Base Oil	Specifications	Specific Vehicles <5 Years Old
		(see chart for other recommendations)	
HPR Gas 10 Semi-Synthetic	Group 1/3	API CG-4/SL ACEA A3/B3/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 - Commodore - VT - Camry/Avalon Magna
HPR Gas Mineral	Group 1	API CG-4/SL ACEA A3/B3/B4 Ford M2C 902-A3 VW 501.01 MB 229.1	
HPR Diesel 5 Semi-Synthetic	Group 2/3	API CH-4/SL ACEA B3/B4/A3 Global DLD-2/3 MB 229.3 Opel B0402098 Peugeot D-02 VW 505.01/502.00/505.00 Ford M2C 171-C	Mercedes Benz BMW X-5 Ford Transit Holden Jackaroo 3-0 LandRover Td5 Range Rover Td6 Jeep
HPR Diesel 15 Semi-Synthetic	Group 1/3	API CH-4/SL ACEA A3/B3/B4 Ford M2C 171-C PSA D-02 Global DLD-1/DLD-3	
HPR Diesel Mineral	Group 1	API CH-4/SJ ACEA A3/B3/B4 Ford M2C 911-A1 PSA D-99 Global DLD-1	
Synthetic 5 Synthetic	Group 4/5	API SL/CF ACEA A3/B3/B4 Ford M2C 153H Ford M2C 913-A Ford M2C 917-A Ford M2C 903-A3 VW 500.00, 501.01 VW 502.00/505.00 Chrysler MS-6395H PSA E -02 MB 229.1/229.3 GM 4718M	Porsche HSV SAAB Jaguar BMW FTe/FPV Renault Rover MG-F

Product	Base Oil	Specifications	
Euro 15	Group 1/3	API CI-4/SL	DAF
Semi-synthetic		ACEA E5/A3/B3	Scania
		Global DHD-1	Deutz
		Mack EO-M Plus (approved)	Iveco
		Mack 'EO-N'	Volvo
		Volvo VDS 2 (approved)	Leyland
		Volvo VDS 3	Perkins
		Cummins CES 20077 (approved)	
		Cummins CES 20072, 20078	
		Mercedes Benz 228.3/229.1	
		MTU Type 2	
		Renault RLD	
		MAN 3275	
		Japanese CD Plus	
		Allison C-4	
USA 15	Group 1/3	API CH-4/SJ	Caterpillar
Semi-synthetic		ACEA E2/A3/B3	Detroit Diesel
		Mack EO-M Plus (approved)	
		Cummins CES 20076 (approved)	
		Cummins CES 20071	
		MTU Type 1	
		Volvo VDS	
		MAN 271	
		Mercedes Benz 228.1/229.1	
		Allison C-4	
Japan 15	Group 1/3	API CF	
Semi-synthetic		JASO DH-1	
		ACEA E-5	
Euro 25	Group 1/3	API CH-4/SJ	
Synthetic-fortified		ACEA E3/A3/B3	
		Volvo VDS	
		Mercedes Benz 228.3	
		MTU Type 2	
		Renault RD	
		MAN 3275	
USA 25	Group 1/3	API CH-4/SJ	
Synthetic-fortified		ACEA E1	
		Mercedes Benz 227.1	
Japan 25	Group 1/3	API CF	
Synthetic-fortified		JASO CD Plus	
Mono	Group 1	API CF-2	
Mineral		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)	

Technical Data

	HPR 5	HPR 10	HPR 15	HPR 30
Viscosity	5W-40	10W-50	15W-60	20W-60
cSt @ 40°C	93	139	204	206
cSt @ 100°C	15.0	20.0	24.5	24.4
Viscosity Index	170	166	150	148
HT/HS Viscosity @ 150°C	4.0	5.4	5.9	6.1
NOACK Volatility	9.9	12.8	9.0	8.5
After Shear Viscosity				
Before cSt @ 100°C	15.0	20.0	24.4	25.4
After cSt @ 100°C	14.7	17.0	21.9	23.1
MRV Pumpability				
cP @ -35°C	32200			
cP @ -30°C		53,700		
cP @ -25°C			45,800	
cP @ -20°C				50,290
Cold Cranking Viscosity				
cP @ -30°C	6300			
cP @ -25°C		6150		
cP @ -20°C			6454	
cP @ -15°C				8783
Pour Point, °C	<-36	-33	-33	-30
Flash Point, °C	200	214	222	225
Calcium, % mass	0.130	0.237	0.245	0.245
Zinc, % mass	0.104	0.132	0.110	0.110
Magnesium, % mass	0.103	0.027	0.000	0.000
Molybdenum, % mass	0.000	0.000	0.023	0.023
Phosphorus, %mass	0.095	0.120	0.100	0.100
Base Number, mgKOH/g	10.3	9.6	7.6	7.6
Density @ 15°C	0.853	0.868	0.879	0.892
Sulphated Ash, mass %	1.16	1.16	1.03	1.03

	MONO 30	MONO 40	MONO 50
Viscosity	30	40	50
cSt @ 40°C	105	165	212
cSt @ 100°C	11.7	15.5	18.4
Viscosity Index	95	95	95
Flash Point, °C	205	210	215
Calcium, % mass	0.343	0.260	0.260
Zinc, % mass	0.109	0.083	0.083
Phosphorus, % mass	0.100	0.076	0.076
Base Number, mgKOH/g	9.2	6.9	6.9
Density @ 15°C	0.899	0.901	0.902
Sulphated Ash, mass %	1.31	1.00	1.00

Technical Data cont...

	HPR 40	HPR 50	HPR Gas 10	HPR Gas
Viscosity	25W-70	40-70	10W-50	20W-60
cSt @ 40°C	339	456	135	226
cSt @ 100°C	28.7	33.7	19.3	24.7
Viscosity Index	115	109	163	138
HT/HS Viscosity @ 150°C	NA	NA	5.0	6.2
NOACK Volatility	4.4	3.4	10.0	8.7
After Shear Viscosity				
Before cSt @ 100°C	28.7	33.7	19.3	24.7
After cSt @ 100°C	26.2	31.6	18.9	22.8
MRV Pumpability				
cP @ -30°C			35,000	
cP @ -20°C				36,500
cP @ -15°C	44,300			
cP @ -10°C		35,100		
Cold Cranking Viscosity				
cP @ -25°C			6,260	
cP @ -15°C				7,470
cP @ -10°C	11,820			
cP @ -5°C		12,693		
Pour Point, °C	-27	-24	-33	-30
Flash Point, °C	193	188	200	227
Calcium, % mass	0.240	0.237	0.332	0.332
Zinc, % mass	0.107	0.110	0.128	0.128
Magnesium, % mass	0.000	0.000	0.000	0.000
Molybdenum, % mass	0.022	0.012	0.000	0.000
Phosphorus, %mass	0.097	0.100	0.118	0.118
Base Number, mgKOH/g	7.6	7.6	9.4	9.4
Density @ 15°C	0.903	0.906	0.876	0.890
Sulphated Ash, mass %	1.01	0.99	1.30	1.30

	HPR Diesel 5	HPR Diesel15	HPR Diesel	Synthetic 5
Viscosity	5W-40	15W-50	20W-60	5W-60
cSt @ 40°C	95	158	205	184
cSt @ 100°C	15.4	20.3	24.4	24.8
Viscosity Index	168	149	141	167
HT/HS Viscosity @ 150°C	4.2	5.4	6.2	5.6
NOACK Volatility	11.9	10.1	9.0	6.2
After Shear Viscosity				
Before cSt @ 100°C	15.4	20.2	24.4	24.8
After cSt @ 100°C	15.1	17.1	22.7	24.2
MRV Pumpability				
cP @- 35°C	39,267			36,500
cP @ -25°C		26,000		
cP @ -20°C			38,800	
Cold Cranking Viscosity				
cP @ -25°C	5,440			5,820
cP @- 20°C		5584		
cP @ -15°C			7250	
Pour Point, °C	-36	-30	-24	-42
Flash Point, °C	200	215	219	200
Calcium, % mass	0.291	0.291	0.291	0.290
Zinc, % mass	0.132	0.132	0.132	0.120
Phosphorus, %mass	0.124	0.124	0.124	0.110
Base Number, mgKOH/g	10.3	10.3	10.3	9.5
Density @ 15°C	0.868	0.880	0.889	0.870
Sulphated Ash, mass %	1.18	1.18	1.18	1.17

Technical Data cont...

	EURO 15	USA 15	JAPAN 15
Viscosity	15W-40	15W-40	15W-40
cSt @ 40°C	119	116	116
cSt @ 100°C	15.5	15.3	15.0
Viscosity Index	137	138	134
HT/HS Viscosity @ 150°C	4.2	4.2	4.0
NOACK Volatility	9.0	9.0	10.9
After Shear Viscosity			
Before cSt @ 100°C	15.2	15.0	15.0
After cSt @ 100°C	13.9	13.8	13.4
MRV Pumpability			
cP @ -25°C	26,700	24,200	29,070
Cold Cranking Viscosity			
cP @ -20°C	6,031	5,597	4,900
Pour Point, °C	-39	-39	-30
Flash Point, °C	220	214	200
Calcium, % mass	0.341	0.291	0.380
Zinc, % mass	0.138	0.127	0.130
Phosphorus, %mass	0.124	0.114	0.120
Base Number, mgKOH/g	11.4	10.3	11.5
Density @ 15°C	0.883	0.881	0.882
Sulphated Ash, mass %	1.43	1.16	1.62
Foaming Characteristics			
Sequence I	0/0	0/0	0/0
Sequence II	0/0	20/0	25/0
Sequence III	0/0	0/0	0/0
Sequence IV	30/0	20/0	130/0
PDSC Oxidation, minutes (>35)	57	NT	NA
Total Acid Number	3.0	NT	NT
Gelation Index (12 max)	NT	5.7	NT

	EURO 25	USA 25	JAPAN 25
Viscosity	25W-60	25W-60	25W-60
cSt @ 40°C	300	288	264
cSt @ 100°C	25.5	24.6	23.7
Viscosity Index	110	109	112
Cold Cranking Viscosity			
cP @ -10°C	11,200	10,980	9,350
Flash Point, °C	226	220	200
Calcium, % mass	0.291	0.053	0.444
Magnesium, % mass	0.00	0.109	0.00
Zinc, % mass	0.132	0.132	0.127
Phosphorus, %mass	0.124	0.121	0.114
Boron, % mass	0.00	0.020	0.00
Base Number, mgKOH/g	10.3	8.1	12.7
Density @ 15°C	0.901	0.897	0.902
Sulphated Ash, mass %	1.18	0.94	1.55

Technical Data cont...

	Small Engine Four Stroke		
SAE Grade	**10W-30**	**20W-50**	**30**
Viscosity			
cSt @ 40°C	78	172	98
cSt @ 100°C	11.5	18.7	12.0
Viscosity Index	139	122	96
Cold Cranking Viscosity			
cP @ -25°C	4247		
cP @ -15°C		7864	
Flashpoint, %	190	198	200
Calcium, % mass	0.240	0.260	0.220
Zinc, % mass	0.107	0.097	0.101
Phosphorus, % mass	0.097	0.089	0.092
Molybdenum, % mass	0.022	0.000	0.020
Density @ 15°C	0.878	0.894	0.894
Sulphated Ash, % mass	1.01	1.02	0.92
Base Number,	7.6	7.0	6.8
Specifications	SL/CF/A2/B2	SG/CF/MA	SG/CC

Technical Data cont...

SAE Grade	**20W-50 Engine Oil**	**Enduro Motorcyle Oil**	**HD Oil (Motorcycles)**
Viscosity			
cSt @ 40°C	168	333	397
cSt @ 100°C	18.6	29.6	31.9
Viscosity Index	124	122	115
Cold Cranking Viscosity			
cP @ -15°C	7,949		
cP @ -10°C		10,900	
cP @ -5°C			10194
Flashpoint, %	224	238	210
Calcium, % mass	0.332	0.260	0.000
Magnesium, % mass	0.000	0.000	0.102
Zinc, % mass	0.128	0.141	0.139
Phosphorus, % mass	0.118	0.129	0.130
Molybdenum, % mass	0.000	0.000	0.000
Density @ 15°C	0.895	0.902	0.900
Sulphated Ash, % mass	1.30	1.09	0.61
Base Number,	9.4	7.0	5.1
Specifications	SJ/CF	SG/MA	SF

Technical Data cont...

SAE Grade	**Pro 10 10W-30**	**Pro 15 plus 15W-50**	**Pro 20 20W-50**	**Pro 22 25W-50**
Viscosity				
cSt @ 40°C	70	151	175	224
cSt @ 100°C	10.7	19.4	18.7	19.5
Viscosity Index	141	147	120	99
Cold Cranking Viscosity				
cP @ -25°C	6,650			
cP @ -20°C		5,933		
cP @ -15°C			8,875	
cP @ -10°C				12243
Flashpoint, %	190	195	221	232
Calcium, % mass	0.220	0.263	0.220	0.220
Zinc, % mass	0.103	0.121	0.103	0.103
Phosphorus, % mass	0.095	0.110	0.095	0.095
Molybdenum, % mass	0.010	0.013	0.010	0.010
Boron, % mass	0.015	0.000	0.015	0.015
Density @ 15°C	0.880	0.883	0.895	0.903
Sulphated Ash, % mass	0.91	1.10	0.91	0.91
Base Number,	7.0	8.5	7.0	7.0
Specifications	SL/CF/GF-3	SL/CF-4	SL/CF	SL/CF

PENRITE HEAVY DUTY DIESEL ENGINE OIL RECOMMENDATIONS

For mixed fleet operations, use EURO 15 or EURO 25.

ENGINE	WARRANTY SERVICE 2003 ON	WARRANTY SERVICE PRE 2003	SEVERE SERVICE OR OLDER ENGINES PRE 1998	SEVERE SERVICE OR OLDER ENGINES 1998-2002
Bedford		EURO 15	USA 25	
Case	USA 15	USA 15	USA 25	
Caterpillar	USA 15	EURO 15	USA 25	EURO 25
Cummins	EURO 15	USA 15	EURO 15	USA 25	EURO 25
Daewoo	EURO 15	JAPAN 15	EURO 15	JAPAN 15	JAPAN 25	
DAF	EURO 15	EURO 15	EURO 25	
Detroit Diesel (four-stroke)	EURO 15	USA 15	EURO 15	USA 25	EURO 25
Detroit Diesel (two-stroke)	MONO 40	MONO 50	MONO 40	MONO 50	MONO 50	
Deutz	EURO 15	EURO 15	EURO 25	
Dorman	MONO 30	MONO 40	MONO 30	MONO 40	USA 25	
Fiat	EURO 15	EURO 15	EURO 25	
Ford	USA 15	USA 15	USA 25	
Gardner		MONO 30	MONO 40	USA 25	
Hino	JAPAN 15	EURO 15	JAPAN 15	EURO 15	JAPAN 25	
Hitachi	JAPAN 15	EURO 15	JAPAN 15	EURO 15	JAPAN 25	
International	USA 15	USA 15	USA 25	
Isuzu	JAPAN 15	EURO 15	JAPAN 15	EURO 15	JAPAN 25	
Iveco	EURO 15	EURO 15	EURO 25	
John Deere	USA 15	EURO 15	USA 15	EURO 15	USA 25	
Komatsu	JAPAN 15	EURO 15	JAPAN 15	EURO 15	JAPAN 25	
Kubota	JAPAN 15	EURO 15	JAPAN 15	EURO 15	JAPAN 25	
Liebherr	EURO 15	EURO 15	EURO 25	
Leyland	EURO 15	EURO 15	EURO 25	
Lister Petter		MONO 30	MONO 40	EURO 25	
Lombardini	EURO 15	EURO 15	EURO 25	
Mack	EURO 15	USA 15	EURO 15	USA 25	EURO 25
MAN	EURO 15	EURO 15	EURO 25	
Mercedes Benz	EURO 15	EURO 15	EURO 25	
Mitsubishi	JAPAN 15	EURO 15	JAPAN 15	EURO 15	JAPAN 25	
MTU	EURO 15	EURO 15	EURO 25	
Onan	EURO 15	EURO 15	EURO 25	
Perkins	USA 15	EURO 15	USA 15	EURO 15	EURO 25	
Renault	EURO 15	EURO 15	EURO 25	
Rolls Royce	EURO 15	EURO 15	EURO 25	
Ruston	MONO 30	MONO 40	MONO 30	MONO 40	EURO 25	
Scania	EURO 15	EURO 15	EURO 25	
Toyota	JAPAN 15	EURO 15	JAPAN 15	EURO 15	JAPAN 25	
UD Nissan	JAPAN 15	EURO 15	JAPAN 15	EURO 15	JAPAN 25	
Volvo	EURO 15	EURO 15	EURO 25	
Waukesha	MONO 40	MONO 50	MONO 40	MONO 50	USA 25	
Yanmar	EURO 15	JAPAN 15	EURO 15	JAPAN 15	JAPAN 25	