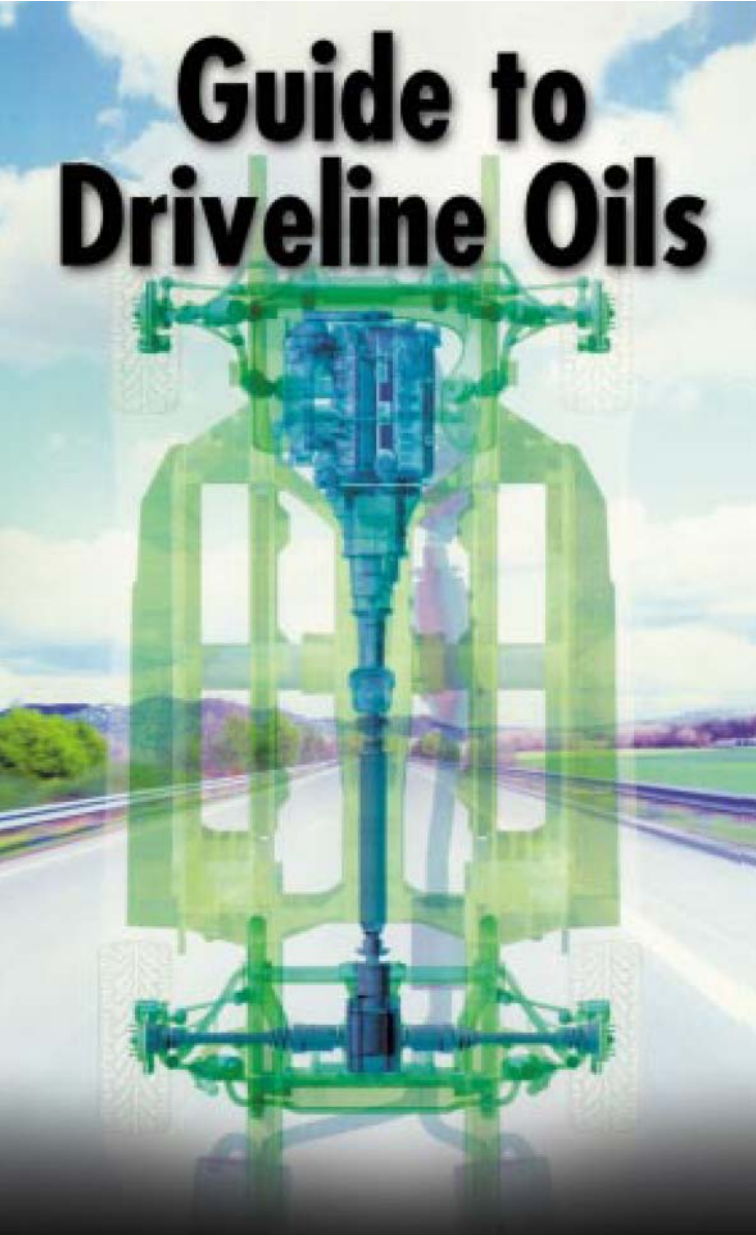
Guide to Driveline Oils



PENRITE LUBRICANTS

Obsession with oil

GUIDE TO DRIVELINE OILS

This booklet is designed to help you understand a little more about driveline oils, their specifications and how they work.

CONTENTS

WHAT ARE DRIVELINE OILS?

We have used the term "Driveline Oils" to describe the oils used to transmit power from the engine to the road. They are the Automatic Transmission Fluids (ATFs), Manual Transmission Fluids (MTFs) and Differential oils. Although these all have different characteristics, they must do a similar job. Engine oils have been used in some cases, especially in manual transmissions.

DRIVELINE OIL FUNCTIONS

To properly lubricate the driveline, an oil 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. This becomes more important as the fuel economy driven changes to the driveline has demanded oils of ever decreasing viscosity. However, for older gearboxes and differentials, oil viscosity is important in controlling wear.

Reduce Friction

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 oil selection is therefore a balance of what is needed to protect the component. However, you will see in the special properties of fluids, that reducing friction is only a part of the battle. Most of these fluids are friction modified – and they all use completely different types of friction modifier.

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 driveline components.

Keep Components Clean

Driveline oils can run very hot, and oil oxidation deposits can cause premature wear. So the oil has to be very stable.

Be compatible with seals

The oils must lubricate and not cause deterioration of seals.

Cool the Driveline Component

Unlike the engine, many driveline components rely on the oil and airflow to keep them cool. Some transmissions run external coolers as well, but the oil does most of the work.

Prevent Foam

Foam reduces the lubrication properties of the oil, therefore driveline oils must be resistant to foam.

NOW FOR SOME SPECIFICS:

Special Properties for ATFs:

- 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 MTFs:

- 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

Driveline oils are complex. ATFs can have as many as 15 different components to get the desired result. So what makes up modern driveline oil?

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

Extreme Pressure Additives

These oils (API GL-2 and up) all contain extreme pressure (EP) additives of some description. The level and type used, depends on whether it is an ATF, MTF or differential oil. Differential oils have the highest level of EP additives to cope with the high loads. They tend to be sulphur-phosphorus based although chlorine is also used.

Friction Modifiers

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.

Dispersants

These keep contaminants and by-products dispersed in the oil helping prevent deposits from forming.

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 rubbing surfaces. They are normally zinc, phosphorus or other organo-metallic types.

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 it's ability to pour. They may be required to pass the special Brookfield viscosity measurement that many driveline oils must meet.

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. These are more shear stable than the ones used in engine oils and of a different type of chemistry.

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.

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.

All our differential oils use "clean gear" technology so they last longer, keep the gears clean and therefore extend component life.

BASE OILS

All driveline oils must contain base oils! They go with the additives above. Not all base oils are created equally however. The API classifies 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.

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

INDUSTRY OIL CLASSIFICATIONS

When selecting the correct oil, the vehicle operator must consider the oil viscosity, and what the component manufacturer's specification level is. So you get out the manual and it says SAE and API, and of course, have 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" gear oil viscosities for different grades and contains specifications for 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, a KRL test is required. 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 J306 SAE GRADE	MAX TEMPERATURE FOR A VISCOSITY of 150,00cP °C	VISCOSITY @ 100°C MIN (see note) 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	<24.0
140	NA	24.0	<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).

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. Both API and SAE specifications in combination define what oil is the best for a given purpose.

There are no API standards for automatic transmission fluids. Indeed, it is only is recent times that the Japanese have released a draft general industry standard that stands alongside their individual requirements. (JASO M315-1998)

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

DESIGNATION AND 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 current 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 in normal use 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).

MANUFACTURER OIL CLASSIFICATIONS

There are many individual oil classifications. Some will be gone through in more detail than others, and many are quite specific and usually able to be met by one fluid only.

AUTOMATIC TRANSMISSION FLUID CLASSIFICATIONS

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 and by other European and some Japanese OEMs.

DEXRON®-IIE
A development that had better low temperature properties than IID. Now superseded by the below.

DEXRON®-III
For many years it was in "G" specification mode, which had the same low temperature characteristics as the IIE version, but with modifications to anti-oxidancy and friction material. The new IIIH specification is for 160,000km drain intervals and extended durability and supercedes "G".

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.

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.

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

DAIMLER-CHRYSLER

With the merger or Chrysler Corporation with Mercedes-Benz, there may be some rationalisation in future years. Mitsubishi and Hyundai are also part owned by DaimlerChrysler:

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 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.

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.

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 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.

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:

Nissan – Nissanmatic C, D, J and Z
Mazda – MIII, MIV, MV
Toyota – TII, TIII, TIV
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

PENRITE PRODUCTS

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. 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.

PRODUCT	SPECIFICATIONS *(see chart for other recommendations)*	SPECIFIC VEHICLES
ATF SYNTHETIC	MERCON®-V Ford M2C 202 DEXRON®-III ATF+3® MS 7176E ATF+4® MS 9602 MB236.1/236.9 Allison C-4 ZF TE ML 14C	Ford Explorer Ford North America (Since 1997) Jaguar S and X Type
ATF DX-III (Licence H-36302)	DEXRON®-III Allison C-4 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 AUTO MHP Semi synthetic	Mitsubishi MM SP 2 ES-X64022SP2 Hyundai 05243-330 Proton Kia Chrysler MS-7176E Toyota T-II/T-III	
ATF 95 LE	BTR 5M-52	Ford Falcon etc Maserati 3200GT Ssangyong Musso Ssangyong Rexton

ATF AUTO 33	Ford M2C33-F
ATF TOP UP	DEXRON®-IIE MB 236.1 Allison C-4 Ford M2C 163A Ford M2C 166H Ford M2C 138CJ ZF TE ML 11
HYPOID 80W-90	API GL-5/PG-2 API MT-1 MIL-PRF-2015E/SAE J2360 Mack GO-J BTR 5M-36 Ford M2C 105A/1013A/108A/197A Chrysler MS 9020 Holden HN1181 Rockwell O-76D
HYPOID 85W-140	API GL-5/PG-2 API MT-1 MIL-PRF-2015E/SAE J2360 Mack GO-J 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 HN1561/1187 BTR 5M-41 Mack GO-J
LIMSLIP 140	API GL-5/GL-6/PG-2 Mack GO-J Ford M2C 1006B/104A Nissan 4WD

10 TENTHS SYNTHETIC GEAR OIL 75W-90	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
10 TENTHS SYNTHETIC GEAR OIL 80W-140	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
MANUAL GEAR OIL 75	API GL-4 Rover MTF 94 Honda MTF 94/7289 ZF TE ML02 MB 235.10
MANUAL GEAR OIL 80	API GL-4 ZF TE ML 01/02/08 MAN 341N/ML MB 235.5 BTR 5M-42 HN 1855/1046/1070 Volvo 1273.07
TRANSAXLE OIL	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
FLEET TRANS C4	API GL-3 Allison C-4 Caterpillar TO-4 ZF TE ML 03

Komatsu

FLEET GEAR 30	API GL-3 Allison C-4 Caterpillar TO-4 Tremec TTC ZF TE ML 01	Komatsu
FLEET GEAR 50	API GL-3 Allison C-4 Caterpillar TO-4 Volvo 1273.13 Rockwell O-81	Eaton/Fuller Road Ranger Spicer
10 TENTHS COMPETITION GEARTRANS SAE 10W-30/85	API GL-4	Motorcycles Lenco

TECHNICAL DATA

HYPOID GEAR OILS

SAE Viscosity	80W-90	85W-140	140
cSt @ 40°C	133	415	487
cSt @ 100°C	14.6	29.9	32.0
Viscosity Index	109	101	96
Brookfield Viscosity			
cP @ -26°C	96,900	NA	NA
cP @ -12°C	NA	57,100	NA
Pour Point, °C	-30	-21	NA
Flash Point, °C	200	214	187
Calcium, % mass	0.00	0.00	0.00
Zinc, % mass	0.00	0.00	0.00
Phosphorus, %mass	0.065	0.065	0.065
Density @ 15°C	0.901	0.911	0.903

LIMSLIP GEAR OILS

SAE Viscosity	80W-90	85W-140	140
cSt @ 40°C	154	392	481
cSt @ 100°C	15.4	27.3	31.0
Viscosity Index	101	95	92
Brookfield Viscosity			
cP @ -26°C	116,000	NA	NA
cP @ -12°C	NA	57,100	NA
Pour Point, °C	-27	-21	NA
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	0.117	0.117
Density @ 15°C	0.905	0.913	0.910

MANUAL TRANSMISSION OILS

MANUAL GEAR OIL	**75**	**80**	**TRANSAXLE OIL**
SAE Viscosity	75W-80	80W-85	80W-85
cSt @ 40°C	59	104	111
cSt @ 100°C	10.3	11.8	13.0
Viscosity Index	164	103	113
Brookfield			
cP @ -40°C	38,500	NA	NA
cP @ -26°C	NA	80,000	133,000
KRL, Viscosity			
cSt @ 100°C AfterShear	9.2	NA	NR
Pour Point, °C	-48	-30	-33
Flash Point, °C	187	187	187
Calcium, % mass	0.337	0.028	0.093
Zinc, % mass	0.123	0.000	0.000
Phosphorus, %mass	0.137	0.059	0.117
Density @ 15°C	0.862	0.896	0.902

10 TENTHS COMPETITION OILS

	SYNTHETIC	**SYNTHETIC**	**GEARTRANS**
SAE Viscosity	75W-90	80W-140	10W-30
cSt @ 40°C	102	219	57
cSt @ 100°C	16.6	27.8	10.5
Viscosity Index	177	164	178
KRL, Viscosity			
cSt @ 100°C After Shear	15.4	26.8	NR
Brookfield			
cP @ -40°C	92,000	NA	NA
cP @ -26°C	NA	40,750	NA
Pour Point, °C	-45	-42	NT
Flash Point, °C	200	210	190
Phosphorus, %mass	0.117	0.236	0.033
Density @ 15°C	0.891	0.902	0.876

HEAVY DUTY TRANSMISSION OILS

	FLEET TRANS C4	**FLEET GEAR 30**	**50**
SAE Viscosity (engine)	10W	30	50
SAE Viscosity (gear)	NA	85	90
cSt @ 40°C	36	108	229
cSt @ 100°C	6.1	11.0	19.2
Viscosity Index	116	84	95
Cold Cranking Viscosity			
cP @ -20°C	3,200	NA	NA
Flash Point, °C	200	214	187
Calcium, % mass	0.31	0.31	0.31
Zinc, % mass	0.125	0.125	0.125
Phosphorus, %mass	0.111	0.111	0.111
Density @ 15°C	0.879	0.900	0.901

AUTOMATIC TRANSMISSION FLUIDS

	ATF SYNTHETIC	ATF DX-III
Viscosity		
cSt @ 40 °C	37	34
cSt @ 100 °C	7.8	7.7
Viscosity Index	199	210
Brookfield Viscosity		
cP @ -40 °C	10,000	12,000
Pour Point, °C	-48	-51
Flash Point, °C	204	185
Calcium, % mass	0.000	0.059
Zinc, % mass	0.000	0.000
Phosphorus, %mass	0.023	0.025
Boron, % mass	0.011	0.019
Density @ 15 °C	0.838	0.865

	ATF AUTO MHP	ATF DX-II
Viscosity		
cSt @ 40 °C	34	42
cSt @ 100 °C	7.3	7.5
Viscosity Index	188	150
Brookfield Viscosity		
cP @ -40 °C	15,993	NA
Pour Point, °C	-52	NA
Flash Point, °C	186	210
Calcium, % mass	0.000	0.077
Zinc, % mass	0.000	0.000
Phosphorus, %mass	0.029	0.017
Boron, % mass	0.014	0.018
Density @ 15 °C	0.852	0.872

	ATF AUTO 33	ATF LE	ATF TOP UP
Viscosity			
cSt @ 40 °C	42	48	47
cSt @ 100 °C	7.8	8.5	9.3
Viscosity Index	157	154	185
Brookfield Viscosity			
cP @ -40 °C	NA	NA	NA
Pour Point, °C	NA	NA	NA
Flash Point, °C	196	200	200
Calcium, % mass	0.000	0.060	0.000
Zinc, % mass	0.000	0.016	0.000
Phosphorus, %mass	0.021	0.028	0.029
Boron, % mass	0.000	0.024	0.012
Density @ 15°C	0.882	0.877	0.873

APPENDIX

WHAT MAKES A LIMITED SLIP DIFFERENTIAL DIFFERENT?

Conventional differentials apply the same torque loads to both wheels. So if one wheel is on a slippery surface, that wheel will continue to spin until it is revolving at twice the speed of the ring gear. At that point, no power is delivered top the wheel with traction – so you go nowhere!

Limited Slip (or spin resistant, torque biasing) differentials were developed to overcome this as they proportion torque to the wheel that needs it so that traction is regained.

Clutches are inserted between the side gears and the case. When they are engaged, they lock the side gears to the case and prevent to differential action. Either stacked plate or cone type clutches are used. These need friction modifiers to work properly.

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. Apart from recommending ATF DX-II in the original Nissan Micra CVT, Penrite does not have a CVT suitable oil. General Motors are among manufacturers developing a specification for these oils.

PENRITE PASSENGER CAR, LIGHT COMMERCIAL AND 4WD AUTOMATIC TRANSMISSION FLUID RECOMMENDATIONS

Manufacturer	Pre 1984	1985-1992	1993-1997	1998-2003
Alfa Romeo	ATF DX-II	ATF DX-II	ATF DX-II	Refer Dealer
Audi	ATF DX-II	ATF DX-II	ATF Synthetic	ATF Synthetic
BMW	ATF DX-II	ATF DX-II	ATF DX-II	ATF DX-II
BMW 5 Speed GM and ZF Autos			ATF Synthetic	ATF Synthetic
Chrysler	ATF DX-II		ATF Synthetic	ATF Synthetic
Citroen	ATF Auto 33	ATF DX-II	ATF DX-II	ATF Synthetic
Daewoo			ATF DX-II	ATF DX-II
Daewoo Musso				ATF 95LE
Daihatsu	ATF Auto 33	ATF DX-II	ATF DX-II	ATF DX-II
Daimler	ATF Auto 33	ATF DX-II	ATF DX-II	ATF DX-II
Eunos		ATF DX-III	ATF DX-III	ATF DX-III
Fiat	ATF DX-II	ATF DX-II		Refer Dealer
Ford Capri, Telstar, TX5, Laser, Festiva, LCVs, 4WDs	ATF Auto 33	ATF DX-III	ATF DX-III	ATF DX-III
Ford Cougar, Probe		ATF DX-III	ATF DX-III	ATF DX-III
Ford EA/NA/DA Series II Falcon/LTD/Fairlane and on including FTe		ATF 95LE	ATF 95LE	ATF 95LE
Ford Explorer, new F-Series, Mustang, Taurus			ATF Synthetic	ATF Synthetic
Ford (BW C4 Serial No: C19B)	ATF DX-II			
Ford Falcon/LTD/Fairlane pre 1982 (V8) and all others	ATF Auto 33			
Ford Laser/Meteor (pre 1985 refer to handbook for correct oil)	ATF Auto 33	ATF DX-III	ATF DX-III	ATF DX-III
Ford Mondeo, Transit	ATF Auto 33		ATF DX-II	ATF DX-II
Holden	ATF DX-II	ATF DX-II	ATF DX-III	ATF DX-III
Holden Barina, Vectra, Astra, Frontera, Zafira		ATF DX-II	ATF DX-II	DX-II MHP
Honda	ATF DX-II	Refer Dealer	Refer Dealer	Refer Dealer
HSV		ATF Synthetic	ATF Synthetic	ATF Synthetic
Hyundai		ATF Auto MHP	ATF Auto MHP	ATF Auto MHP
Jaguar	ATF Auto 33	ATF DX-II	ATF DX-II	ATF Synthetic
Jeep		ATF DX-III	ATF DX-III	ATF Synthetic
Kia Carens, Shuma, Spectra and Rio				ATF Auto MHP

Manufacturer	Pre 1984	1985-1992	1993-1997	1998-2003
Kia (others)			ATF DX-II	ATF DX-II
Land Rover	ATF Auto 33	ATF DX-II	ATF DX-II	ATF DX-II
Leyland	ATF Auto 33			
Lexus		ATF Synthetic	ATF Synthetic	ATF Synthetic
Maserati 3200GT				ATF 95LE
Mazda	ATF Auto 33	ATF DX-III	ATF DX-III	ATF DX-III
Mercedes Benz (check application guide - some models use special fluid)	ATF DX-II	ATF DX-II	ATF DX-II	ATF DX-II
Mitsubishi (except MM SP 3, refer to dealer)	ATF DX-II	ATF Auto MHP	ATF Auto MHP	ATF Auto MHP
Nissan (some post 2000 4WD require ATF Synthetic)	ATF DX-II	ATF DX-III	ATF DX-III	ATF DX-III
Peugeot	ATF DX-II	ATF DX-II	ATF DX-II	ATF DX-II
Porsche	ATF DX-II	ATF DX-II	ATF Synthetic	ATF Synthetic
Proton			ATF Auto MHP	ATF Auto MHP
Rambler	ATF DX-II			
Range Rover	ATF Auto 33	ATF DX-II	ATF DX-II	ATF Synthetic
Renault	ATF DX-II	ATF DX-II	ATF DX-II	ATF Synthetic
Rover	ATF Auto 33	ATF DX-II	ATF DX-II	ATF Synthetic
SAAB	ATF Auto 33	ATF Auto 33	ATF DX-III	ATF DX-III
SEAT			ATF DX-II	ATF DX-II
Ssangyong Musso, Rexton			ATF 95LE	ATF 95LE
Subaru	ATF DX-II	ATF DX-II	ATF DX-II	ATF DX-II
Suzuki	ATF DX-II	ATF DX-II	ATF DX-II	ATF DX-II
Suzuki Alto, Mighty Boy		ATF Auto 33		
Triumph	ATF Auto 33			
Toyota	ATF DX-II	ATF DX-II	ATF DX-III	DX-III MHP
Toyota RAV4, T4 applications				ATF Synthetic
Valiant	ATF DX-II			
Volkswagen	ATF DX-II	ATF DX-II	ATF Synthetic	ATF Synthetic
Volvo	ATF Auto 33	ATF DX-II	ATF DX-II	ATF Synthetic

ATF DX-II | ATF Synthetic | ATF Auto 33 | ATF DX-III | ATF 95LE | ATF Auto MHP

The above is a guide only. Always check the owner's handbook for verification of oil type.

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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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