



A Better Class of Oil

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
- SN Meets MY2010 requirements of automotive manufacturers. XW-20 and XW-30 grades have chemical limits SA to SJ 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 CG-4 are obsolete.



A Better Class of Oil

History of API Specifications

Originally it used an "M" and "D" system but in the 1960s, this changed to the one we are familiar with today. Specifications exist for petrol and "heavy duty" diesel engines only.

CURRENT	OLD OR YEAR OF RELEASE
SA	ML
SB	MM
SC	MS (1964) and AMA ASTM G IV
SD	MS (1968) and AMA ASTM G IV
SE	MS (1972) and AMA ASTM G IV
CA	DG (1954, MIL-L-2104A)
CB	DM
CC	DM (1964, MIL-L-2104B)
CD	DS (MIL-L-45199/2104C Caterpillar Series 3)

Acce Engine Service Classifications

ACEA stands for Association des Constructeurs 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 and 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/SN.
- 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 SN. 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. (Obsolete by 2010)
- 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.



A Better Class of Oil

- E6 As for E4 but with chemical limits to allow use in engines with particulate filters and SCR NO_x reduction systems. Only for diesel fuel with <50ppm sulphur. 1.0% ash, 0.08% phosphorus. Euro 4 and 5.
- 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.
- E9 Designed for Euro 5 engines with DPFs. SAPS limits line up with API CJ-4 and 7BN minimum. ACEA specification oils have tighter shear stability and oil volatility requirements than equivalent API specification oils *ACEA 2010 specification oils can no longer meet both C3 and A3/B4.

History of european specifications

Prior to ACEA, the CCMC was the issuing body for Europe up until 1990's. A rough comparison is shown on the right.

ACEA	Old CCMC (not in absolute terms, a guide only)
A2	G1, G2
A3	G4, G5
B2	PD1
B3/B4	PD2
E2	D4
E3	D5

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
- GF-5 is equivalent to API SN

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, GF-5 is similar, but it introduced new requirements relating to phosphorus volatility and compatibility with ethanol fuels.

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



A Better Class of Oil

Other four stroke classifications

- JASO DL-1 Similar to ACEA CI for light duty diesel engines.
- JASO DH-1 Heavy duty diesel, higher ash formulation with performance superior to API CF-4. Has additional valve train wear and piston cleanliness requirements.
- JASO DH-2 Heavy duty diesel, similar to API CJ-4 and ACEA E9.
- 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 EG-C/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.



A Better Class of Oil

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 superseded "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.



A Better Class of Oil

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 EC3 transmissions (NAG-1)
236.11	For 5 speed ZF automatics used by Mercedes Benz
236.12	For 7 speed Mercedes automatics (NAG-2)(now replaced)
236.13	Issued as an in-service 'fix' oil for transmissions specifying 236.12
236.14	New initial and service fill specification for NAG-2 transmissions
236.20	For CVT

MITSUBISHI

MM SP and MM SP2 MM SP 3	DEXRON®-III fluidity but with different frictional characteristics. 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 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. Now required for all on-highway transmissions instead of C-4.

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.
------	---



A Better Class of Oil

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

Gear Oil Designation and Description

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

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 superseded by SAE J2360 (2003).

