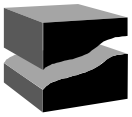

A C E A

European
Automobile
Manufacturers
Association

ACEA EUROPEAN OIL SEQUENCES

2004

SERVICE FILL OILS FOR
GASOLINE ENGINES
LIGHT DUTY DIESEL ENGINES
ENGINES WITH AFTER TREATMENT DEVICES and
HEAVY DUTY DIESEL ENGINES

Laboratory tests for gasoline and light duty diesel engine oils,
Engine tests for gasoline and light duty diesel engine oils,
Laboratory tests for engine with after treatment devices,
Engine tests for engine with after treatment devices.
Laboratory tests for heavy duty diesel engine oils,
Engine tests for heavy duty diesel engine oils,

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This document details the ACEA 2004 European Oil Sequences for Service-fill Oils for Gasoline engines, for Light Duty Diesel engines, for Gasoline & Diesel engines with after treatment devices and for Heavy Duty Diesel engines. **These sequences define the minimum quality level of a product for presentation to ACEA members.** Performance parameters other than those covered by the tests shown or more stringent limits may be indicated by individual member companies.

These sequences will replace the ACEA 2002 sequences as a means of defining engine lubricant quality from 25th october 2004.

CONDITIONS FOR USE OF PERFORMANCE CLAIMS AGAINST THE ACEA OIL SEQUENCES

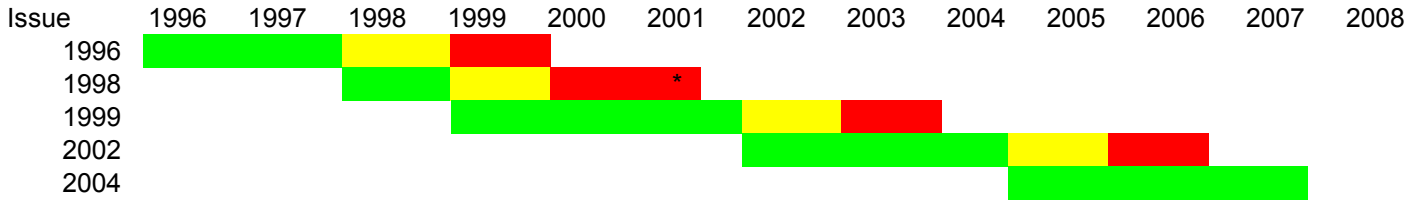
ACEA requires that any claims for Oil performance to meet these sequences must be based on credible data and controlled tests in accredited test laboratories.

All engine performance testing used to support a claim of compliance with these ACEA sequences must be generated according to the European Engine Lubricants Quality Management System (EELQMS). This system, which is described in the ATIEL Code of Practice[1], addresses product development testing and product performance documentation, and involves the registration of all candidate and reference oil testing and defines the compliance process. Compliance with the ATIEL Code of Practice is mandatory for any claim to meet the requirements of 2004 issue of these ACEA sequences.

Issue year*	First allowable use	New claims by	Withdrawn
1996	1st March 1996	1st March 1999	1st March 2000
1998	1st March 1998	1st September 2000	1st March 2002
1999	1st September 1999	1st February 2003	1st February 2004
2002	1st February 2002	1st November 2005	1st November 2006
2004	1st November 2004		

* Issue year of full document

First allowable use means that claims cannot be made against the specification before the date indicated.
New claims by means that from this date all claims for new oil formulations must be according to the latest ACEA release. (For example until 1st November 2005, oil marketers can claim engine oils meeting the ACEA 2002 release even though the 2004 release is active. After 1st November 2005 , any new oil claims must be according to the ACEA 2004 sequences.)
Withdrawn means that no claims can be made against the issue after the date indicated



* Extra six months allowed to give reasonable life of specifiation

New claims allowed during this period to this issue number
New issue in existence, but new claims can still be made according to the old issue
No new claims to this issue number, but oil can still be marketed

[1] The ATIEL Code of Practice is the sole property of ATIEL and is available from ATIEL (Association Technique de l'Industrie Européenne des Lubrifiants), Boulevard du Souverain 165, B-1160 Brussels, Belgium.

The marketer of an oil claiming to meet ACEA performance requirements is responsible for all aspects of product liability.

Where limits are shown relative to a reference oil, then these must be compared to the last valid Reference Result on that test stand prior to the candidate and using the same hardware. Further details will be in the ATIEL Code of Practice.

Where claims are made that Oil performance meets the requirements of the ACEA sequences (e.g. product literature, packaging, labels) they must specify the ACEA Class and Category (see Nomenclature & ACEA Process for definitions).

The categories A2 and B2 are not included in this edition of the ACEA European Oil Sequences because they are unsuitable for some of the current engines and will be unsuitable for many future engines. Misuse may cause engine damage. However, the use of A2/B2 oils for older engines (where owner's or workshop's literature recommends this use) is still appropriate and can be done according to the categories A2-96 Issue 3 and B2-98-Issue 2.

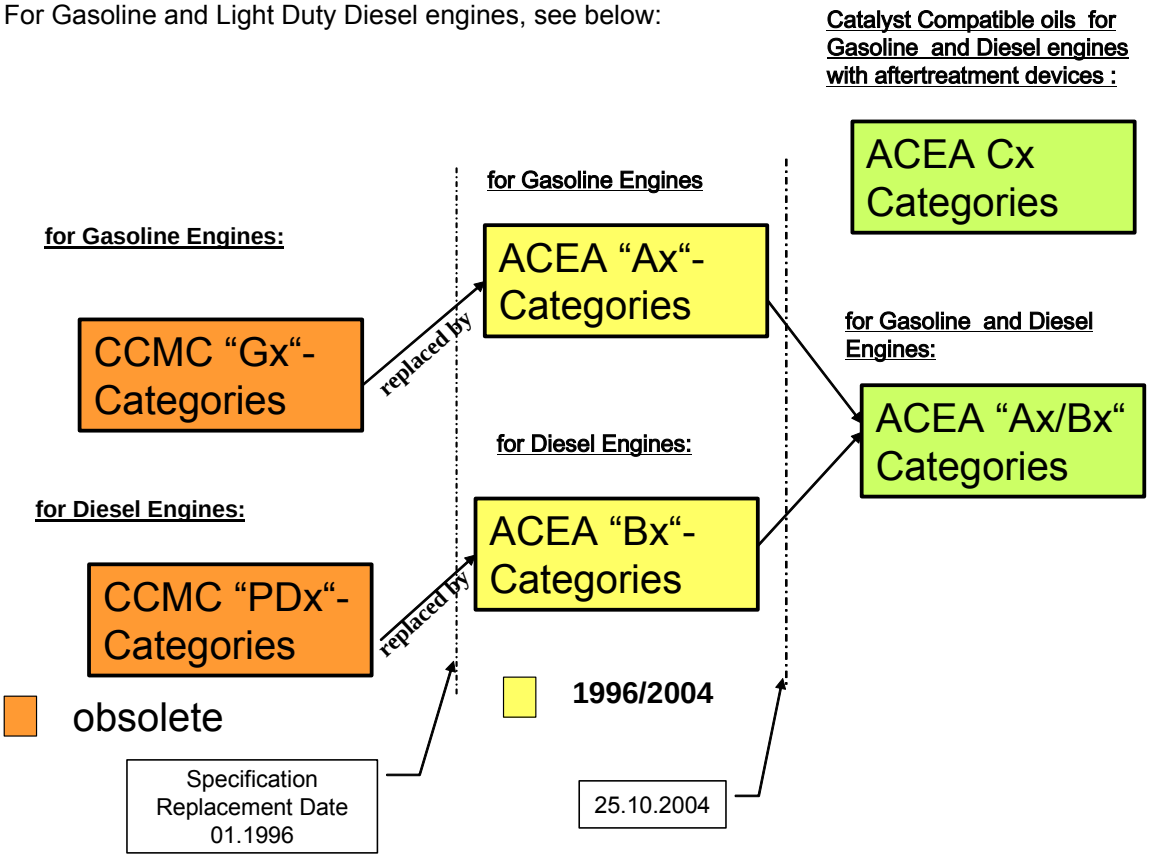
REPLACEMENT of CCMC sequences

The chart below shows the evolution of the engine oil specifications commonly developed by the European Automobile manufacturers. CCMC (Comité des Constructeurs du Marché Commun) was the forerunner organisation to ACEA.

In January 1996 the CCMC European Oil Sequences became obsolete and were replaced by the ACEA European Oil Sequences. This is true for light duty engine oils as well as heavy duty engine oils. CCMC European Oil Sequences are not supported any more by ACEA.

With the 2004 release of the ACEA European Oil Sequences the A and B categories have been combined to the respective A/B categories . At the same time, a new set of categories has been introduced with the intention to create specifications for engine oils being suitable for the latest and future aftertreatment systems for Gasoline and Diesel engines. These categories are designated as Cx-categories.

For Heavy Duty Diesel engines, the CCMC Dx categories were replaced by the ACEA Ex categories as of 1 January 1996. The CCMC Dx categories then became obsolete and are not longer supported by ACEA.
For Gasoline and Light Duty Diesel engines, see below:



X= 1, 2 ,3 or 4 or 5 depending of categories

The ACEA 2004 European Oil Sequences for Service-fill Oils comprise 2 sets (classes) of sequences: one for Gasoline and Light Duty Diesel engines; and one for engines with after treatment devices. Within each of these sets there are categories which reflect different performance requirements - four (A1/B1, A3/B3, A3/B4 & A5/B5) for gasoline and light duty diesel engines; three (C1, C2, C3) for low SAPS oils and engines with after treatment devices. Typical applications for each sequence are described below for guidance only. Specific applications of each sequence are the responsibility of individual motor manufacturers for their own vehicles / engines.

The sequences define the minimum quality level of a product for self-certification to EELQMS and presentation to ACEA members. Performance parameters other than those covered by the tests shown or more stringent limits may be indicated by individual ACEA member companies.

NOMENCLATURE & ACEA PROCESS:

Each set of sequences is designated for consumer use by a 2 part code comprising a letter to define the CLASS (e.g. A), and a number to define the CATEGORY (e.g. A1).

In addition, for industry use, each sequence has a two-digit number to identify the YEAR of implementation of that severity level (e.g. A1 / B1-04).

Please note that from this 2004 release, the A and B categories have now been respectively combined. As an example, where previously we would have had separate A1-02 and B1-02 categories, we now have a combined A1/B1-04 category.

The CLASS indicates oil intended for a general type of engine - currently A / B = gasoline and light duty diesel engines; C = catalyst compatible oils for gasoline and diesel engines with after treatment devices. Other classes may be added in future if, for example, Natural Gas engines prove to require oil characteristics which cannot readily be incorporated into existing classes.

The CATEGORY indicates oils for different purposes or applications within that general class, related to some aspect or aspects of the performance level of the oil. Typical applications for each sequence are described below for guidance only. Specific applications of each sequence are the responsibility of the individual motor manufacturer for his own vehicles and engines. Oils within a category may also meet the requirements of another category, but some engines may only be satisfied by oils of one category within a class.

The YEAR numbers are intended only for industry use and indicate the year of implementation of that severity level for the particular category. A new year number will indicate, for example, that a new test, parameter or limit has been incorporated for the category to meet new / upgraded performance requirements whilst remaining compatible with existing applications. An update must always satisfy the applications of the previous issue. If this is not the case, then a new category is required.

An administrative ISSUE Number is added for industry use where it is necessary to update the technical requirements of a sequence without the intention to increase severity (e.g. when a CEC test engine is updated to the latest version whilst maintaining equivalent severity; or where a severity shift in the test requires modification of the specified limits.).

Where claims are made that Oil performance meets the requirements of the ACEA sequences (e.g. product literature, packaging, labels) they must specify the ACEA Class and Category (see Nomenclature & ACEA Process for definitions).

«Consumer Language»:

A/B : gasoline and diesel engine oils

A1/B1 Oil intended for use in gasoline and car + light van diesel engines specifically designed to be capable of using low friction low viscosity oils with a High temperature / High shear rate viscosity of 2.6 to 3.5 mPas.s. These oils may be unsuitable for use in some engines. Consult owner manual or handbook if in doubt.

A3/B3 Stable, stay-in-grade oil intended for use in high performance gasoline and car + light van diesel engines and/or for extended drain intervals where specified by the engine manufacturer, and/or for year-round use of low viscosity oils , and/or for sever operating conditions as defined by the engine manufacturer.

A3/B4 Stable, stay-in-grade oil intended for use in high performance gasoline and direct injection diesel engines, but also suitable for applications described under B3.

A5/B5 Stable, stay-in-grade oil intended for use at extended drain intervals in high performance gasoline and car + light van diesel engines designed to be capable of using low friction low viscosity oils with a High temperature / High shear rate viscosity of 2.9 to 3.5 mPa.s. These oils may be unsuitable for use in some engines. Consult owner manual or handbook if in doubt.

C : Catalyst compatibility oils

C1 Stable, stay-in-grade oil intended for use as catalyst compatible oil in vehicles with DPF and TWC in high performance car and light van diesel and gasoline engines requiring low friction, low viscosity, low SAPS oils with a HTHS higher than 2.9 mPa.s. These oils will increase the DPF and TWC life and maintain the vehicles fuel economy.

Warning : these oils have the lowest SAPS limits and may be unsuitable for use in some engines. Consult owner manual or handbook if in doubt.

C2 Stable, stay-in-grade oil intended for use as catalyst compatible oil in vehicles with DPF and TWC in high performance car and light van diesel and gasoline engines designed to be capable of using low friction, low viscosity oils with a HTHS higher than 2.9 mPa.s. These oils will increase the DPF and TWC life and maintain the vehicles fuel economy.

Warning : these oils may be unsuitable for use in some engines. Consult owner manual or handbook if in doubt.

C3 Stable, stay-in-grade oil intended for use as catalyst compatible oil in vehicles with DPF and TWC in high performance car and light van diesel and gasoline engines. These oils will increase the DPF and TWC duration.

Warning : these oils may be unsuitable for use in some engines. Consult owner manual or handbook if in doubt.

SAPS : Sulphated Ash, Phosphorus, Sulphur
DPF : Diesel Particulate Filter
TWC : Three way catalyst
HTHS : High temperature / High shear rate viscosity

E : Heavy Duty Diesel engine oils

E2 General purpose oil for naturally aspirated and turbocharged heavy duty diesel engines, medium to heavy duty cycles and mostly normal oil drain intervals.

E4 Stable, stay-in-grade oil providing excellent control of piston cleanliness, wear, soot handling and lubricant stability. It is recommended for highly rated diesel engines meeting Euro 1, Euro 2, Euro 3 and Euro 4 emission requirements and running under very severe conditions, e.g. significantly extended oil drain intervals according to the manufacturer's recommendations. It is suitable for engines without particulate filters, and for some EGR engines and some engines fitted with SCR NOx reduction systems. However, recommendations may differ between engine manufacturers so Driver Manuals and/or Dealers shall be consulted if in doubt.

E6 Stable, stay-in-grade oil providing excellent control of piston cleanliness, wear, soot handling and lubricant stability. It is recommended for highly rated diesel engines meeting Euro 1, Euro 2, Euro 3 and Euro 4 emission requirements and running under very severe conditions, e.g. significantly extended oil drain intervals according to the manufacturer's recommendations. It is suitable for EGR engines, with or without particulate filters, and for engines fitted with SCR NO_x reduction systems. E6 quality is strongly recommended for engines fitted with particulate filters and is designed for use in combination with low sulphur diesel fuel (max 50 ppm). However, recommendations may differ between engine manufacturers so Driver Manuals and/or Dealers shall be consulted if in doubt.

E7 Stable, stay-in-grade oil providing effective control with respect to piston cleanliness and bore polishing. It further provides excellent wear and turbocharger deposit control, soot handling and lubricant stability. It is recommended for highly rated diesel engines meeting Euro 1, Euro 2, Euro 3 and Euro 4 emission requirements and running under severe conditions, e.g. extended oil drain intervals according to the manufacturer's recommendations. It is suitable for engines without particulate filters, and for most EGR engines and most engines fitted with SCR NOx reduction systems. However, recommendations may differ between engine manufacturers so Driver Manuals and/or Dealers shall be consulted if in doubt.

This sequence defines the minimum quality level of a product for self-certification to EELQMS and for presentation to ACEA members.
Performance parameters other than those covered by the tests shown or more stringent limits may be indicated by individual member companies.

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS			
				A1 / B1-04	**A3 / B3-04**	**A3 / B4-04**	**A5 / B5-04**
1. LABORATORY TESTS							
1.1 Viscosity grades		SAE J300 Latest active issue		No restriction except as defined by shear stability and HT/HS requirements. Manufacturers may indicate specific viscosity requirements related to ambient temperature.			
1.2 Shear stability	CEC-L-14-A-93 or ASTM D6278	100°C Viscosity after 30 cycles	mm^2/s	Xw-20 stay in grade xW30 ≥ 8.6 xW40 ≥ 12.0	All grades to be stay in grade	All grades to be stay in grade	All grades to be stay in grade
1.3 Viscosity at high temp. & high shear rate	CEC-L-36-A-90 (2nd Edition) (Ravenfield)	Viscosity at 150°C and 10^6 s^{-1} shear rate	mPa.s	max. 3.5. Xw-20 2.6. min All others 2.9 min.	>3.5	>3.5	min 2.9 max. 3.5
1.4 Evaporative loss	CEC-L-40-A-93 (Noack)	Max. weight loss after 1 h at 250°C	%	≤ 15	≤ 13	≤ 13	≤ 13
				NOTE: the following sections apply to all sequences			
1.5 Sulphated ash	ASTM D874		% m/m	≤ 1.3 (2)	≤ 1.5 (2)	≤ 1.6 (2)	≤ 1.6 (2)
1.6 Sulphur (1)	ASTM D5185		% m/m	report			
1.7 Phosphorus (1)	ASTM D5185		% m/m	Report			
1.8 Chlorine	ASTM D6443		% m/m	Report			
1.9 Oil / elastomer compatibility	CEC-L-39-T-96 (see note 3)	Max. variation of characteristics after immersion for 7 days in fresh oil without pre-ageing		RE1	Elastomer RE2-99	type RE3-04	RE4	AEM (VAMAC)
		Hardness DIDC	points	-1/+5	-5/+8	-22 max	-5/+5	As per
		Tensile strength	%	-40/+10	-15/+18	-30/+10	-20/+10	Daimler -
		Elongation at rupture	%	-50/+10	-35/+10	-20/+10	-50/+10	Chrysler
		Volume variation	%	-1/+5	-7/+5	+22 max	-5/+5	
1.10 Foaming tendency	ASTM D892 without option A	Tendency - stability	ml	Sequence I (24°C) 10 - nil Sequence II (94°C) 50 - nil Sequence III (24°C) 10 - nil			
1.11 High temperature foaming tendency	ASTM D6082 High temperature foam test	Tendency - stability	ml	Sequence IV (150°C) 100 - nil			

This sequence defines the minimum quality level of a product for self-certification to EELQMS and for presentation to ACEA members.
Performance parameters other than those covered by the tests shown or more stringent limits may be indicated by individual member companies.

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS			
				A1 / B1-04	**A3 / B3-04**	**A3 / B4-04**	**A5 / B5-04**
2. ENGINE TESTS							
2.1 High temperature deposits Ring sticking Oil thickening	CEC-L-88-T-02 (TU5JP-L4) 72 Hour test	Ring sticking (each part) Piston varnish (6 elements, average of 4 pistons) Absolute viscosity increase at 40°C between min and max values during test Oil consumption	Merit Merit mm^2/s kg/test	≥ 9.0 ≥ RL 216 ≤ RL216 Report	≥ 9.0 ≥ RL 216 ≤ 0.8 x RL216 Report	≥ 9.0 ≥ RL 216 ≤ 0.8 x RL216 Report	≥ 9.0 ≥ RL 216 ≤ 0.8 x RL216 Report
2.2 Low temperature sludge	ASTM D6593-00 (Sequence VG) Under protocol & requirements for API (See Note 4)	Average engine sludge Rocker cover sludge Average Piston skirt varnish Average engine varnish Comp. ring (hot stuck) Oil screen clogging	merit merit merit merit %	≥ 7.8 ≥ 8.0 ≥ 7.5 ≥ 8.9 none ≤ 20	≥ 7.8 ≥ 8.0 ≥ 7.5 ≥ 8.9 none ≤ 20	≥ 7.8 ≥ 8.0 ≥ 7.5 ≥ 8.9 none ≤ 20	≥ 7.8 ≥ 8.0 ≥ 7.5 ≥ 8.9 none ≤ 20
2.3 Valve train scuffing wear	CEC-L-38-A-94 (TU3M)	Cam wear, average Cam wear, max. Pad merit (Ave. of 8 pads)	µm µm merit	≤ 10 ≤ 15 ≥ 7.5	≤ 10 ≤ 15 ≥ 7.5	≤ 10 ≤ 15 ≥ 7.5	≤ 10 ≤ 15 ≥ 7.5
2.4 Black sludge	CEC-L-53-T-95 (M111)	Engine sludge, average	merit	≥ RL 140	≥ RL 140	≥ RL 140	≥ RL 140
2.5 Fuel economy See Note (5)	CEC-L-54-T-96 (M111)	Fuel economy improvement vs. Reference oil RL191 (15W-40)	%	≥ 2.5	–	–	≥ 2.5
2.6 Ring sticking & Piston cleanliness	CEC L-46-T-93 (VW 1.6 TC D)	Ring sticking Piston cleanliness	merit merit	≥ RL 148 ≥ RL 148	≥ RL 148 ≥ RL 148	--	--
2.7 Medium temperature dispersivity	CEC-L-56-T-98) (XUD11BTE) (see note 6) or CEC-L-093 (DV4TD)	Absolute viscosity increase at 100°C and 3% soot (measurement with CEC L-83-A-97 method) Piston merit (5 elements) (average for 4 pistons) Absolute viscosity increase at 100°C and 6 % soot Piston merit	mm^2/s merit mm2/s merit	≤ 0.50 x RL197 result ≥ (RL197 minus 6 pts.) limits under definition	≤ 0.50 x RL197 result ≥ (RL197) limits under definition	≤ 0.50 x RL197 result ≥ (RL197) limits under definition	≤ 0.50 x RL197 result ≥ (RL197) limits under definition

This sequence defines the minimum quality level of a product for self-certification to EELQMS and for presentation to ACEA members.
Performance parameters other than those covered by the tests shown or more stringent limits may be indicated by individual member companies.

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS			
				A1 / B1-04	**A3 / B3-04**	**A3 / B4-04**	**A5 / B5-04**
2. ENGINE TESTS CONTINUED							
2.8 Wear, Viscosity stability & Oil consumption	CEC-L-51-A-98 (OM602A)	Cam wear. Average (new tappet)	µm	≤ 50.0	≤ 50.0	≤ 50.0	≤ 50.0
		Viscosity increase at 40°C	%	≤ 90	≤ 90	≤ 90	≤ 90
		Bore polishing	%	≤7.0	≤7.0	≤7.0	≤7.0
		Cylinder wear. Average	µm	≤ 20.0	≤ 20.0	≤ 20.0	≤ 20.0
		Oil consumption	kg/test	≤ 10.0	≤ 10.0	≤ 10.0	≤ 10.0
2.9 DI diesel Piston cleanliness & Ring sticking	CEC-L-78-T-99 (VW DI)	Piston cleanliness	merit			≥ RL206 minus 3 points	≥ RL206
		Ring sticking (Rings 1 & 2)					
		Average of all 8 rings	ASF			≤ 1.2	≤ 1.2
		Max. for any 1st ring	ASF			≤ 2.5	≤ 2.5
		Max. for any 2nd ring	ASF			≤ 0.0	≤ 0.0

(1) The internal standard method has to be used.
(2) Maximum limits, Values take into account method and production's tolerances
(3) Use either complete DaimlerChrysler requirements (VDA 675301, 7 days +/- 2h, 4 materials (NBR: NBR34 DIN 53538 T3 (100 ºC +/- 2°C); FPM: AK6 (150 ºC +/- 2°C); ACM: E7503 (150 ºC +/- 2°C); AEM: D 8948/200.1 (150 ºC +/- 2°C)) + RE3, or complete requirements according to 1.10 above + DC requirements for AEM
(4) The limits shown are based upon those applied in U.S. market requirements. ACEA will continuously review the situation to ensure that these limits are appropriate for European vehicles and lubricants.
(5) ACEA considers the CEC L-54-T-96 test the only valid comparator against which claims of lubricant fuel economy improvement should be made.
(6) XUD 11 BTE can be used instead of DV4 (as long as it's available)

This sequence defines the minimum quality level of a product for self-certification to EELQMS and for presentation to ACEA members.
Performance parameters other than those covered by the tests shown or more stringent limits may be indicated by individual member companies.

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS				
				C1-04		**C2-04**		**C3-04**
1. LABORATORY TESTS								
1.1 Viscosity grades		SAE J300 Latest active issue		No restriction except as defined by shear stability and HT/HS requirements. Manufacturers may indicate specific viscosity requirements related to ambient temperature.				
1.2 Shear stability	CEC-L-14-A-93 or ASTM D6278	100°C Viscosity after 30 cycles	mm^2/s	All grades to be stay in grade		All grades to be stay in grade		All grades to be stay in grade
1.3 Viscosity at high temp. & high shear rate	CEC-L-36-A-90 (2nd Edition) (Ravenfield)	Viscosity at 150°C and 10^6 s^{-1} shear rate	mPa.s	≥2.9		≥ 2.9		≥ 3.5
1.4 Evaporative loss	CEC-L-40-A-93 (Noack)	Max. weight loss after 1 h at 250°C	%	≤ 13		≤ 13		≤ 13
1.5 Sulphur (1)	ASTM D5185		% m/m	≤ 0.2		≤ 0.3		≤ 0.3
1.6 Phosphorus (1)	ASTM D5185		% m/m	≤ 0.05 (2)		0.070 ≤ ≤ 0.090 (2)		0.070 ≤ ≤ 0.090 (2)
1.7 Sulphated ash	ASTM D874		% m/m	≤ 0.5 (2)		≤ 0.8 (2)		≤ 0.8 (2)
1.8 Chlorine	ASTM D6443		ppm m/m	report		report		Report
1.9 TBN	ASTM D 2896		mg KOH / g	-		-		≥ 6
				NOTE: The following sections apply to all sequences				
1.10 Oil / elastomer compatibility	CEC-L-39-T-96 (see note 3)	Max. variation of characteristics after immersion for 7 days in fresh oil without pre-ageing		RE1	Elastomer RE2-99	type RE3-04	RE4	AEM (VAMAC)
		Hardness DIDC	points	-1/+5	-5/+8	-22 max	-5/+5	As per Daimler Chrysler
		Tensile strength	%	-40/+10	-15/+18	-30/+10	-20/+10	
		Elongation at rupture	%	-50/+10	-35/+10	-20/+10	-50/+10	
		Volume variation	%	-1/+5	-7/+5	+22 max	-5/+5	
1.11 Foaming tendency	ASTM D892 without option A	Tendency - stability	ml	Sequence I (24°C) 10 - nil Sequence II (94°C) 50 - nil Sequence III (24°C) 10 - nil				
1.12 High temperature foaming tendency	ASTM D6082 High temperature foam test	Tendency - stability	ml	Sequence IV (150°C) 100 - nil				

This sequence defines the minimum quality level of a product for self-certification to EELQMS and for presentation to ACEA members.
Performance parameters other than those covered by the tests shown or more stringent limits may be indicated by individual member companies.

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT			
				C1-04	**C2-04**	**C3-04**
2. ENGINE TESTS						
2.1 High temperature deposits Ring sticking Oil thickening	CEC-L-88-T-02 (TU5JP-L4) 72 Hour test	Ring sticking (each part) Piston varnish (6 elements, average of 4 pistons) Absolute viscosity increase at 40°C between min and max values during test Oil consumption	Merit Merit mm^2/s kg/test	≥ 9.0 ≥ RL 216 ≤ 0.8 x RL216 Report	≥ 9.0 ≥ RL 216 ≤ 0.8 x RL216 Report	≥ 9.0 ≥ RL 216 ≤ 0.8 x RL216 Report
2.2 Low temperature sludge	ASTM D6593-00 (Sequence VG) Under protocol & requirements for API (See Note 4)	Average engine sludge Rocker cover sludge Average Piston skirt varnish Average engine varnish Comp. ring (hot stuck) Oil screen clogging	merit merit merit merit %	≥ 7.8 ≥ 8.0 ≥ 7.5 ≥ 8.9 none ≤ 20	≥ 7.8 ≥ 8.0 ≥ 7.5 ≥ 8.9 none ≤ 20	≥ 7.8 ≥ 8.0 ≥ 7.5 ≥ 8.9 none ≤ 20
2.3 Valve train scuffing wear	CEC-L-38-A-94 (TU3M)	Cam wear, average Cam wear, max. Pad merit (Ave. of 8 pads)	µm µm merit	≤ 10 ≤ 15 ≥ 7.5	≤ 10 ≤ 15 ≥ 7.5	≤ 10 ≤ 15 ≥ 7.5
2.4 Black sludge	CEC-L-53-T-95 (M111)	Engine sludge, average	merit	≥ RL 140	≥ RL 140	≥ RL 140
2.5 Fuel economy See Note (5)	CEC-L-54-T-96 (M111)	Fuel economy improvement vs. Reference oil RL191 (15W-40)	%	≥ 2.5	≥ 2.5	≥ 1.0 (for Xw30 grades)
2.6 Medium temperature dispersivity	CEC-L-56-T-98) (XUD11BTE) (see note 6) or CEC-L-093 (DV4TD)	Absolute viscosity increase at 100°C and 3% soot (measurement with CEC L-83-A-97 method) Piston merit (5 elements, average for 4 pistons) Absolute viscosity increase at 100°C and 6 % soot Piston merit	mm^2/s merit mm^2/s merit	≤ 0.50 x RL197 result ≥ RL197 limits under definition	≤ 0.50 x RL197 result ≥ RL197 limits under definition	≤ 0.50 x RL197 result ≥ RL197 limits under definition
2.7 DI diesel Piston cleanliness & Ring sticking	CEC-L-78-T-99 (VW DI)	Piston cleanliness Ring sticking (Rings 1 & 2) Average of all 8 rings Max. for any 1st ring Max. for any 2nd ring	merit ASF ASF ASF	≥ RL206 ≤ 1.2 ≤ 2.5 ≤ 0.0	≥ RL206 ≤ 1.2 ≤ 2.5 ≤ 0.0	≥ RL206 - *3 points* ≤ 1.2 ≤ 2.5 ≤ 0.0

This sequence defines the minimum quality level of a product for self-certification to EELQMS and for presentation to ACEA members.
Performance parameters other than those covered by the tests shown or more stringent limits may be indicated by individual member companies.

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT			
				C1-04	**C2-04**	**C3-04**
2. ENGINE TESTS CONTINUED						
2.8 Wear, Viscosity stability & Oil consumption	CEC-L-51-A-98 (OM602A)	Cam wear. Average (new tappet)	µm	≤ 50.0	≤ 50.0	≤ 45.0
		Viscosity increase at 40°C	%	≤ 90	≤ 90	≤ 70.0
		Bore polishing	%	≤7.0	≤7.0	≤ 4.5
		Cylinder wear. Average	µm	≤ 20.0	≤ 20.0	≤ 15.0
		Oil consumption	kg/test	≤ 10.0	≤ 10.0	≤ 10

(1) The internal standard method has to be used.
(2) Maximum limits, Values take into account method and production's tolerances
(3) Use either complete DaimlerChrysler requirements (VDA 675301, 7 days +/- 2h, 4 materials (NBR: NBR34 DIN 53538 T3 (100 ºC +/- 2°C); FPM: AK6 (150 ºC +/- 2°C); ACM: E7503 (150 ºC +/- 2°C); AEM: D 8948/200.1 (150 ºC +/- 2°C)) + RE3, or complete requirements according to 1.10 above + DC requirements for AEM
(4) The limits shown are based upon those applied in U.S. market requirements. ACEA will continuously review the situation to ensure that these limits are appropriate for European vehicles and lubricants.
(5) ACEA considers the CEC L-54-T-96 test the only valid comparator against which claims of lubricant fuel economy improvement should be made.
(6) XUD 11 BTE can be used instead of DV4 (as long as it's available)

ACEA	ACEA 2004 EUROPEAN OIL SEQUENCE FOR SERVICE-FILL OILS FOR HEAVY DUTY DIESEL ENGINES	Oct. 2004

This sequence defines the minimum quality level of a product for self-certification to EELQMS and for presentation to ACEA members.
Performance parameters other than those covered by the tests shown or more stringent limits may be indicated by individual member companies.

REQUIREMENTS	TEST METHOD	PROPERTIES	UNIT	LIMITS			
				E2-96 **Issue 5**	**E4-99** **Issue 3**	**E6-04**	**E7-04**
1. LABORATORY TESTS							
1.1 Viscosity		SAE J300 Latest Active Issue		No restriction except as defined by shear stability and HT/HS requirements. Manufacturers may indicate specific viscosity requirements related to ambient temperature.			
1.2 Shear stability	CEC-L-14-A-93 or ASTM D6278	Viscosity after 30 cycles measured at 100°C.	mm^2/s	xW-30 ≥ 9.0 xW-40 ≥ 12.0 xW-50 ≥ 15.0 mono grades no req.	Stay in grade		
	ASTM D6278	Viscosity after 90 cycles measured at 100°C	mm^2/s			Stay in grade	
1.3 Viscosity High Temperature High Shear Rate	CEC-L-36-A-90 (2nd Edition) (Ravenfield)	Viscosity at 150°C and 10^6 s^{-1} Shear rate	mPa.s	≥ 3.5			
1.4 Evaporative Loss	CEC-L-40-A-93 (Noack)	Max. weight loss after 1 h at 250°C	%	≤ 13			
1.5 Sulphated Ash	ASTM D874		% m/m	≤ 2.0		≤ 1.0	≤ 2.0
1.6 Phosphorus	ASTM D5185[1]		% m/m			≤ 0.08	
1.7 Sulphur	ASTM D5185[1]		% m/m			≤ 0.3	
1.8 Oil Elastomer Compatibility See Note (2)	CEC-L-39-T-96	Max. variation of characteristics after immersion for 7 days in fresh oil without pre-ageing		Elastomer type RE1	RE2-99	RE3-04	RE4	AEM (VAMAC)
		Hardness DIDC	points	-1/+5	-5/+8	-25/+1	-5/+5	As per Daimler-Chrysler
		Tensile strength	%	-50/+10	-15/+18	-45/+10	-20/+10	
		Elongation rupture	%	-60/+10	-35/+10	-20/+10	-50/+10	
		Volume variation	%	-1/+5	-7/+5	-1/+30	-5/+5	
1.9 Foaming Tendency	ASTM D892 without option A	Tendency – stability	ml ml ml	Sequence I (24°C) 10 – nil Sequence II (94°C) 50 – nil Sequence III (24°C) 10 – nil			
1.10 High temperature foaming tendency	ASTM D6082	Tendency - stability	ml	Sequence IV (150°C) 200-50			
1.11 Oxidation	CEC-L-85-T-99 (PDSC)	Oxidation induction time	min				≥ 35
1.12 Corrosion	ASTM D 6594	Lead increase	ppm				≤ 100

This sequence defines the minimum quality level of a product for self-certification to EELQMS and for presentation to ACEA members.
Performance parameters other than those covered by the tests shown or more stringent limits may be indicated by individual member companies.

REQUIREMENTS	TEST METHOD	PROPERTIES	UNIT	LIMITS			
				E2-96 Issue 5	**E4-99** Issue 3	**E6-04**	**E7-04**
2. ENGINE TESTS							
2.1 Bore polishing / Piston cleanliness See note (3)	CEC L-42-T-99 (OM364LA)	Bore polishing Piston cleanliness Average Cylinder wear Sludge Oil consumption	% merit µm merit kg/test	≤ 3.5 ≥ 40.0 ≤ 3.5 ≥ 9.4 ≤ 16.0			
2.2 Wear	CEC L-51-A-97 (OM602A)	Cam wear Viscosity increase at 40°C Bore polishing Cylinder wear Oil consumption	µm % % µm kg/test	≤ 50.0	≤ 50.0 ≤ 90 ≤ 7.0 ≤ 20.0 ≤ 10	≤ 50.0 ≤ 90 ≤ 7.0 ≤ 20.0 ≤ 10	≤ 50.0 ≤ 90 ≤ 7.0 ≤ 20.0 ≤ 10
2.3 Soot in oil	ASTM D 5967 (Mack T-8E) ASTM D4485 (Mack T-8)	Test duration: Relative viscosity at 1 test/2 test/3 test average Viscosity increase at 1 test/2 test/3 test average Filter plugging, Diff. pressure Oil consumption	Hours mm^2/s kPa g/kWh		300 4.8% soot ≤ 2.1/2.2/2.3 3.8% soot ≤11.5/12.5/13.0 ≤ 138 ≤ 0.304	300 4.8% soot ≤ 2.1/2.2/2.3 3.8% soot ≤11.5/12.5/13.0 ≤ 138 ≤ 0.304	300 4.8% soot ≤ 2.1/2.2/2.3 3.8% soot ≤11.5/12.5/13.0 ≤ 138 ≤ 0.304
2.4 Bore polishing Piston Cleanliness Turbocharger deposits	CEC L-52-T-97 (OM441LA)	Bore polishing Piston Cleanliness Boost pressure loss at 400 hrs Oil consumption	% merit % kg/test		≤ 2.0 ≥ 40.0 ≤ 4 ≤ 40	≤ 2.0 ≥ 40.0 ≤ 4 ≤ 40	≤ 2.0 ≥ 25.0 ≤ 4 ≤ 40
2.5. Soot induced wear See note (4)	Cummins M11	Rocker pad average weight loss at 4.5% soot 1 test/2 test/3 test average Oil filter diff.press @ EOT 1 test/ 2 test/3 test average Engine sludge 1 test/2 test/3 test average	 mg kPa merit				 ≤ 6.5/7.5/8.0 ≤ 79/93/100 ≥ 8.7/8.6/8.5
2.6. Wear (liner-ring-bearings) See note (5)	Mack T10	Merit Avg.liner wear Average top ring weight loss End of test lead Delta lead 250-300 hrs Oil consumption (Phase II)	 µm mg ppm ppm g/hr			≥ 1000 ≤ 32 ≤ 158 ≤ 35 ≤ 14 ≤ 65	≥ 1000 ≤ 32 ≤ 158 ≤ 35 ≤ 14 ≤ 65

(1) The internal standard method has to be used.

(2) Use either the most recent complete Daimler-Chrysler requirements (VDA 675301, 7 days, 4 materials (NBR: NBR34 DIN 53538 T3 (100 ºC); FPM: AK6 (150 ºC); ACM: E7503 (150 ºC); AEM: D 8948/200.1 (150 ºC)) + RE3 according to requirement 1.8 above, or complete requirements according to 1.8 above + DC requirements for AEM.

(3) Results from a CEC L-52-T-97 (OM441LA) test as part of a DaimlerChrysler sheet 228.1 approval can be used as an alternative. Only tests according to CEC L-42-T-99 are acceptable.

(4) The requirements for these characteristics may be met with a passing Cummins M11 EGR test in an API CI-4 qualification. These requirements may be replaced by the Cummins ISM test once test development is completed. Limits will be set at an equivalent performance level.

(5) Results obtained using Mack T10-ULSD according to ASTM D 6987, are allowed (subject to Mack T10-ULSD test method being approved by ASTM).