European Automobile Manufacturers Association

ACEA EUROPEAN OIL SEQUENCES

GENERAL REQUIREMENTS

SERVICE FILL ENGINE OILS
for GASOLINE & LIGHT-DUTY DIESEL ENGINES
and
HEAVY-DUTY DIESEL ENGINES

ACEA
Avenue des Nerviens 85
B-1040 Bruxelles
Tel (32) 2 732 55 50
info@acea.be
communications@acea.be
www.ACEA.be
TVA BE 444 072 631
SGB 210-0069404-04

Date		Update
30 April 2021	Rev. 0	New General Requirements Document for Light-Duty and Heavy-Duty ACEA Oil Sequences. This revision includes the links to the new ACEA Light-Duty Oil Sequence 2021 and the ACEA Heavy–Duty Oil Sequence 2016 Rev3 document

This document details the general requirements for the ACEA European Oil Sequences for Service-fill Oils for Gasoline engines, for Light-Duty Diesel engines, for Gasoline & Light-Duty Diesel engines with aftertreatment devices and for Heavy-Duty Diesel engines. This document should be read in conjunction with:

- The latest version of the ACEA European Oil Sequences for Service-fill Oils for Gasoline engines, for Light-Duty Diesel engines and for Gasoline & Light-Duty Diesel engines with aftertreatment devices,
- https://acea.be/uploads/news_documents/2021_ACEA_oil_sequences_light-duty_engines.pdf, and
- The latest version of the ACEA European Oil Sequences for Service-fill Oils for Heavy-Duty Diesel engines
- https://acea.be/uploads/news_documents/2016_ACEA_oil_sequences_heavy-duty_engines.pdf.

Those two documents detail the periods during which valid claims can be made for oils meeting those specifications and the full specifications of those respective ACEA Oil Sequences.

The ACEA European Oil Sequences for Service-fill Oils comprise currently oil classes for Gasoline, Light-Duty Diesel engines and Heavy-Duty Diesel engines. Within each of the classes there are categories that reflect different performance requirements. Typical applications for each sequence are described in the specific Oil Sequence for guidance only. Specific applications of each sequence are the responsibility of individual engine manufacturers for their own vehicles / engines.

The Oil Sequences define the minimum quality level of an oil product for self-certification to EELQMS and presentation to ACEA members. Individual member companies of ACEA may require performance parameters other than those covered by the tests shown, or more stringent limits.

CONDITIONS FOR USE OF PERFORMANCE CLAIMS AGAINST THE ACEA OIL SEQUENCES

ACEA requires that any claims by oil companies or oil distributors for Oil performance to meet these Oil Sequences must be based on credible data and controlled tests in accredited test laboratories.

ACEA requires that engine performance testing used to support a claim of compliance with these ACEA Oil Sequences should be generated according to the **E**uropean **E**ngine **L**ubricants **Q**uality **M**anagement **S**ystem, EELQMS (available at www.eelqms.eu), but ACEA reserves the right to define alternatives in exceptional cases.

EELQMS 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[1], which forms part of the EELQMS, is mandatory for any claim to meet the requirements of this issue of the ACEA sequences. Therefore, ACEA requires that claims against the ACEA Oil Sequences can only be made by oil companies who have signed the EELQMS oil marketers' Letter of Conformance (for details: www.atiel.org).

The ACEA Oil Sequences are subject to continuous development. Replacement tests and other changes required by the European vehicle manufacturers are integrated and new issues are published on a regular basis. As new editions are published older editions have to be withdrawn. The validity of old and new editions of the ACEA Oil Sequences are shown in the respective ACEA Oil Sequences.

CERTIFICATION and REGISTRATION

Claims against the ACEA Oil Sequences can be made on a self-certification basis. For any Claim being made against these ACEA Oil Sequences, ACEA recommends oil suppliers to register their products with the ACEA Registration System on the ACEA website on their launch into the market. Registration into the ACEA Registration System does not replace the required EELQMS oil marketers' Letter of Conformance registration in SAIL.

All information needed for Registration in ACEA Registration System is available on the ACEA website, see: https://app.acea.be/EOR

After completing the form on the ACEA website, it will be saved on the ACEA server. If claims are no longer needed oil companies are asked to delete their registration. If registered claims continue to be used after three years, re-registration is recommended.

[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), 14b Rue de la Science, 1040, Brussels, Belgium.

NOMENCLATURE & ACEA PROCESS

Each set of Oil Sequences is designated for consumer use by a 2-part code comprising a letter to define the CLASS (e.g. C), and a number to define the CATEGORY (e.g. C2).

In addition, for industry use, each sequence has a two-digit number to identify the YEAR of implementation of that severity level (e.g. A3/B4-21).

Classes may be added in future if, for example, Natural Gas engines, H_2 Combustion engines or engines which operate with alternative Fuels (E-fuels), may 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 category are described in the Light-Duty and Heavy–Duty Sequence documents for guidance only. Specific applications of each category are the responsibility of the individual motor manufacturer for their own vehicles and engines. Oils within a category may also meet the requirements of another category but some engines may only be suited to oils of one category within a class.

The YEAR numbers for ACEA Sequence is intended only for industry use and indicates 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 in 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 Oil Sequences (e.g. product literature, packaging, labels) they must specify the ACEA Class and Category (see Nomenclature & ACEA Process for definitions).

European Automobile Manufacturers Association

ACEA EUROPEAN OIL SEQUENCES FOR LIGHT-DUTY ENGINES

2021

SERVICE FILL ENGINE OILS
for GASOLINE & LIGHT-DUTY DIESEL ENGINES
(A/B Categories),
GASOLINE & LIGHT-DUTY DIESEL ENGINES
with EXHAUST AFTERTREATMENT DEVICES
(C Categories)

ACEA
Avenue des Nerviens 85
B-1040 Bruxelles
Tel (32) 2 732 55 50
Fax (32) 2 738 73 10
(32) 2 738 73 11
info@acea.be
communications@acea.be
www.ACEA.be
TVA BE 444 072 631
SGB 210-0069404-04

Date		Update
30 April 2021	Rev. 0	Initial Release of ACEA 2021 LIGHT-DUTY ENGINE OIL SEQUENCES

ACEA EUROPEAN OIL SEQUENCES, GENERAL REQUIREMENTS
https://acea.be/uploads/news_documents/2021_ACEA_oil_sequences_general_requirements.pdf are an integral constituent for compliance with requirements specified in this document.

VALIDITY OF OLD AND NEW EDITIONS OF ACEA LIGHT-DUTY OIL SEQUENCES

As new sequence editions are published older editions have to be withdrawn. Validities of new and old editions are overlapping for limited periods of time as shown in the following table and the accompanying text below. When a new ACEA Oil Sequence is introduced, oils with claims against the previous issue can be marketed only for another two years.

Sequence Issue	First allowable use	Mandatory for new claims	Oils with this claim may be marketed until
2004	1st November 2004	1st November 2005	31st December 2009
2007	1st February 2007	1st February 2008	23rd December 2010
2008	22nd December 2008	22nd December 2009	22nd December 2012
2010	22nd December 2010	22nd December 2011	22nd December 2014
2012	14th December 2012	14th December 2013	1st December 2018
2016	1st December 2016	1st December 2017	1st May 2023*
2021	1st May 2021*	1st May 2022*	
	*) ACEA LIGHT-DUTY OIL SEQUENCES only		

- First allowable use means that claims cannot be made against the specification before the date indicated.
- Mandatory for new claims means that from this date onward all claims for new oil formulations must be made according to the latest ACEA Oil Sequences issue. Up to that date new claims can also be made according to the previous ACEA Oil Sequences issue. After the date indicated no new claims according to the previous ACEA Sequence can be made. Then all oil formulations must be developed according to the latest ACEA Oil Sequence release.
- Oils with this claim may be marketed until means that no further marketing of oils with claims to this issue is allowed after the date indicated.

The supplier of any oil claiming 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 are in the ATIEL Code of Practice.

Where claims are made that oil performance meets the requirements of the ACEA Oil 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 – "High SAPS"

A3/B3 Category withdrawn with these Oil Sequences. Stable, stay-in-grade engine oil intended for use in passenger car and light-duty gasoline & diesel engines and/or for extended oil drain intervals where specified by the engine manufacturer.

A3/B4 Stable, stay-in-grade engine oil intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines, but also suitable for applications described under A3/B3.

A5/B5 Stable, stay-in-grade engine oil intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed for low viscosity engine oils with HTHS viscosity of 2.9 to 3.5 mPa·s. These engine oils are unsuitable for use in certain engines - consult vehicle-OEM's owner's manual/handbook in case of doubt.

A7/B7 Stable, stay-in-grade engine oil intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed for low viscosity engine oils with HTHS viscosity of 2.9 to 3.5 mPa·s. Relative to A5/B5 these engine oils provide also low speed pre-ignition- and wear protection for turbocharged gasoline DI engines as well as turbocharger compressor deposit (TCCD) protection for modern DI diesel engines. These engine oils are unsuitable for use in certain engines - consult vehicle-OEM's owner's manual/handbook in case of doubt.

C: Catalyst & GPF/DPF compatible Engine Oils for Gasoline & Diesel Engines – "Low SAPS"

Note: These Oils will increase the DPF/GPF and TWC life and maintain the Vehicle's Fuel Economy.
Warning: Some of these Categories may be unsuitable for use in certain Engine Types – consult the vehicle-OEM's owner's manual/handbook in case of doubt.

C1 Category is withdrawn with these Oil Sequences.

C2 Stable, stay-in-grade engine oil with mid-SAPS Level, for aftertreatment system compatibility. Intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed for low viscosity engine oils with a minimum HTHS Viscosity of 2.9 mPa·s.

C3 Stable, stay-in-grade engine oil with mid-SAPS Level, for aftertreatment system compatibility. Intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed for engine oils with HTHS viscosity of minimum 3.5 mPa·s.

C4 Stable, stay-in-grade engine oil with low-SAPS Level, for aftertreatment system compatibility. Intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed for engine oils with HTHS viscosity of minimum 3.5 mPa·s.

C5 Stable, stay-in-grade engine oil for improved fuel economy, with mid-SAPS Level, for aftertreatment system compatibility. Intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed and OEM-approved for engine oils with HTHS viscosity of minimum 2.6 mPa·s.

C6 Stable, stay-in-grade engine oil for improved fuel economy, with mid-SAPS Level, for aftertreatment system compatibility. Intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed and OEM-approved for engine oils with HTHS viscosity of minimum 2.6 mPa·s. Relative to C5 these engine oils provide also low speed pre-ignition- and wear protection for turbocharged gasoline DI engines as well as turbocharger compressor deposit (TCCD) protection for modern DI diesel engines.

SAPS: Sulphated Ash, Phosphorus, Sulphur
HTHS: High Temperature High Shear Viscosity
DI: Direct Injection
DPF: Diesel Particle Filter
GPF: Gasoline Particle Filter
TWC: Three-Way Catalyst

ACEA	ACEA 2021 EUROPEAN OIL SEQUENCES FOR LIGHT-DUTY ENGINE SERVICE-FILL OILS	April 2021 Rev. 0

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

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS A3/B4-21	LIMITS A5/B5-21	LIMITS A7/B7-21
1. Laboratory tests						
1.1 Viscosity Grades		Viscosity Class according to SAE J300 - Latest active issue		No restriction except as defined by HTHS and Shear Stability requirements. Manufacturers may indicate specific Viscosity requirements related to ambient temperature.		
1.2 Shear Stability	CEC L-14-93 or ASTM D6278 or ASTM D7109	100 °C Viscosity after 30 cycles	mm^2/s	All grades to be “stay in grade”		
1.3 HTHS Viscosity	CEC L-36-90	Dynamic Viscosity at 150 °C and Shear Rate of 10^6 s^{-1}	mPa·s	≥ 3.5	≥ 2.9 & ≤ 3.5	≥ 2.9 & ≤ 3.5
	CEC L-36-90	Dynamic Viscosity at 100 °C and Shear Rate of 10^6 s^{-1}	mPa·s	--	Report	
1.4 Evaporative Loss	CEC L-40-93 (Noack)	Max. Weight Loss after 1 h at 250 °C	%	≤ 13		
1.5 TBN	ASTM D2896		mgKOH/g	≥ 10.0	≥ 8.0	Report
	ASTM D4739		mgKOH/g	Report		≥ 6.0
1.6* Sulphur	ASTM D5185 or ASTM D4951		% m/m	Report		
1.7* Phosphorus	ASTM D5185 or ASTM D4951		% m/m	Report		
1.8* Sulphated Ash	ASTM D874		% m/m	≥ 1.0 and ≤ 1.6	≤ 1.6	≤ 1.6
1.9 Chlorine	ASTM D6443		ppm	Report		
1.10 Oil – Elastomer Compatibility	CEC L-112-16	Max. Variation of Characteristics after immersion for 7 days in Fresh Oil without Pre-Ageing:	Elastomer	RE6	RE7	RE8 / RE9
		- Tensile Strength	%	Report	Report	Report / Report
		- Elongation at Rupture	%	-70 / +20	-65 / +15	-51 / +9 / -65 / +19
		- Volume Variation	%	-1.5 / +1.8	-1.8 / +7.7	0.0 / +10.7 / -1.5 / +13.8
1.11 Foaming Tendency	ASTM D892 with or 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	Tendency - stability	ml	Sequence IV (150 °C) 100 – nil		
1.13 Low-Temperature Pumpability	CEC L-105-12	MRV Yield stress (MRV at SAE J300 Temperatures, applicable for the Fresh Oil Viscosity Grade)	mPa·s Pa	According to SAE J300 for Fresh Oil		
1.14 Oil Oxidation with Biodiesel for Engine Oils operating in the presence of Biodiesel Fuel	CEC L-109-14	Oil Oxidation at 168 h (DIN 51453)	A/cm	≤ 120	≤ 100	≤ 100
		Oil Oxidation at 216 h (DIN 51453)	A/cm	Report	≤ 120	≤ 120
		Viscosity Increase, relative at 168 h (Delta KV100)	%	≤ 150	≤ 60	≤ 60
		Viscosity Increase, relative at 216 h (Delta KV100)	%	Report	≤ 150	≤ 150

ACEA	ACEA 2021 EUROPEAN OIL SEQUENCES FOR LIGHT-DUTY ENGINE SERVICE-FILL OILS	April 2021 Rev. 0

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

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS A3/B4-21	LIMITS A5/B5-21	LIMITS A7/B7-21
2. ENGINE TESTS						
2.1* Gasoline DI Engine Cleanliness Test	CEC L-111-16 (EP6CDT)	Piston Cleanliness	Merit	≥ RL259		
		Turbo Charger Deposits **, average value of zones C, D, E & F	Merit	≥ 6.0		
2.2* Low Temperature Sludge	ASTM D8256 (Sequence VH, Ford)	Average Engine Sludge	Merit	≥ 7.6		
		Rocker Cover Sludge	Merit	≥ 7.7		
		Average Engine Varnish	Merit	≥ 8.6		
		Average Piston Skirt Varnish	Merit	≥ 7.6		
		Compression Ring (hot stuck)		none		
		Oil Screen Clogging	%	report		
2.3* Valvetrain Wear	ASTM D8350 (Sequence IVB, Toyota 2NR-FE)	Average Intake Lifter Volume Loss (8 position average)	mm^3	≤ 3.3	≤ 3.3	≤ 2.7
		End of Test Iron	ppm	≤ 400	≤ 400	≤ 400
2.4* Black Sludge	CEC L-107-19 (M271 EVO)	Engine Sludge, average	Merit	≥ 8.3		
2.5 Fuel Economy	CEC L-54-96 (M111)	Fuel Economy Improvement	%	-----	≥ 2.5	≥ 2.5
2.6* DI Diesel Oil Dispersion at Medium Temperature	CEC L-106-14 (DV6C)	Absolute Viscosity Increase at 100 °C and 5.5 % Soot	mm^2/s	≤ 0.9 x RL248		
		Piston Cleanliness **	Merit	≥ 2.5		
2.7* DI Diesel Piston Cleanliness & Ring Sticking	CEC L-117-20 (VW TDI)	Piston Cleanliness	Merit	≥ RL276 - 5		
		Cylinder-spreading limit**	Merit	≤ 13		
		No Ring Sticking, max for any ring**	ASF	0		
2.8 Turbocharger Compressor Deposit (Diesel)	CEC L-114-19 (Toyota 1KD-FTV)	Turbocharger rating	Merit	-----		≥ 25
2.9 Low Speed Pre-Ignition GDI Turbo	ASTM D8291 (Sequence IX, Ford)	Pre-Ignition events	Average number of events for 4 iterations	-----		≤ 5
			Number of events per iteration	-----		≤ 8
2.10 Chain Wear GDI	ASTM D8279 (Sequence X, Ford)	Elongation of Timing Chain	%	-----		≤ 0.085

*/**: Footnotes see last page

ACEA	ACEA 2021 EUROPEAN OIL SEQUENCES FOR LIGHT-DUTY ENGINE SERVICE-FILL OILS	April 2021 Rev. 0

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

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS				
				C2-21	C3-21	C4-21	C5-21	C6-21
1. Laboratory tests								
1.1 Viscosity Grades		Viscosity Class according to SAE J300 - Latest active issue		No restriction except as defined by HTHS and Shear Stability requirements. Manufacturers may indicate specific Viscosity requirements related to ambient temperature.				
1.2* Shear Stability	CEC L-14-93 or ASTM D6278 or ASTM D7109	100 °C Viscosity after 30 cycles	mm^2/s	All grades to be “stay in grade”				
1.3. HTHS Viscosity	CEC L-36-90	Dynamic Viscosity at 150 °C and Shear Rate of 10^6 s^{-1}	mPa·s	≥ 2.9	≥ 3.5		≥ 2.6 & < 2.9	
	CEC L-36-90	Dynamic Viscosity at 100 °C and Shear Rate of 10^6 s^{-1}	mPa·s	Report				
1.4 Evaporative loss	CEC L-40-93 (Noack)	Max. weight loss after 1 h at 250 °C	%	≤ 13		≤ 11	≤ 13	
1.5 TBN	ASTM D2896		mgKOH/g	-----	≥ 6.0			Report
	ASTM D4739		mgKOH/g	Report				≥ 4.0
1.6* Sulphur	ASTM D5185 or ASTM D4951		% m/m	≤ 0.3		≤ 0.2	≤ 0.3	
1.7* Phosphorus	ASTM D5185 or ASTM D4951		% m/m	≥ 0.07 / ≤ 0.09		≤ 0.09	≥ 0.07 / ≤ 0.09	
1.8*Sulphated Ash	ASTM D874		% m/m	≤ 0.8		≤ 0.5	≤ 0.8	
1.9 Chlorine	ASTM D6443		ppm	Report				
1.10 Oil – Elastomer Compatibility		Max. Variation of Characteristics after immersion for 7 days in fresh oil without pre-ageing:	Elastomer	RE6	RE7		RE8	RE9
		- Tensile Strength	%	Report	Report		Report	Report
		- Elongation at Rupture	%	-70 / +20	-65 / +15		-51 / +9	-65 / +19
		- Volume Variation	%	-1.5 / +1.8	-1.8 / +7.7		0.0 / +10.7	-1.5 / +13.8
1.11 Foaming Tendency	ASTM D892 with or 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	Tendency - stability	ml	Sequence IV (150 °C) 100 – nil				
1.13 Low Temperature Pumpability	CEC L-105-12	MRV Yield stress (MRV at SAE J300 Temperatures, applicable for the Fresh Oil Viscosity Grade)	mPa·s Pa	According to SAE J300 for Fresh Oil				
1.14 Oil Oxidation with Biodiesel for Engine Oils operating in the presence of Biodiesel Fuel	CEC L-109-14	Oil Oxidation at 168 h (DIN 51453)	A/cm	≤ 100	≤ 100	≤ 100	≤ 100	≤ 100
		Oil Oxidation at 216 h (DIN 51453)	A/cm	≤ 120	≤ 120	≤ 120	≤ 120	≤ 120
		Viscosity Increase, relative at 168 h (Delta KV100)	%	≤ 60	≤ 60	≤ 60	≤ 60	≤ 60
		Viscosity Increase, relative at 216 h (Delta KV100)	%	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150

ACEA	ACEA 2021 EUROPEAN OIL SEQUENCES FOR LIGHT-DUTY ENGINE SERVICE-FILL OILS	April 2021 Rev. 0

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

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS C2-21	C3-21	C4-21	C5-21	C6-21
2. ENGINE TESTS								
2.1* Gasoline DI Engine Cleanliness	CEC L-111-16 (EP6CDT)	Piston Cleanliness	Merit	≥ RL259				
		Turbo Charger Deposits **, average value of zones C, D, E & F	Merit	≥ 6.0				
2.2* Low Temperature Sludge	ASTM D8256 (Sequence VH)	Average Engine Sludge	Merit	≥ 7.6				
		Rocker Cover Sludge	Merit	≥ 7.7				
		Average Engine Varnish	Merit	≥ 8.6				
		Average Piston Skirt Varnish	Merit	≥ 7.6				
		Compression Ring (hot stuck)		None				
		Oil Screen Clogging	%	Report				
2.3* Valvetrain Wear	ASTM D8350 (Sequence IVB, Toyota 2NR-FE)	Average Intake Lifter Volume Loss (8 position average)	mm^3	≤ 3.3				≤ 2.7
		End of Test Iron	ppm	≤ 400				≤ 400
2.4* Black Sludge	CEC L-107-19 (M271 EVO)	Engine Sludge, average	Merit	≥ 8.3				
2.5 Fuel Economy	CEC L-54-96 (M111)	Fuel Economy Improvement	%	≥ 2.5	≥ 1.0 (for xW-30 only, no limit for xW-40)		≥ 3.0	-----
	JASO FE M366 (Toyota 2ZR-FXE)	Fuel Economy Improvement	%	-----				≥ 0.0
2.6* DI Diesel Oil Dispersion at Medium Temperature	CEC L-106-14 (DV6C)	Absolute Viscosity Increase at 100 °C and 5.5% Soot	mm^2/s	≤ 0.9 x RL248				
		Piston Cleanliness **	Merit	≥ 2.5				
2.7* DI Diesel piston Cleanliness & Ring Sticking	CEC L-117-20 (VW TDI)	Piston Cleanliness	Merit	≥ RL276 - 5				
		Cylinder-spreading limit**	Merit	≤ 13				
		No Ring Sticking, max for any ring**	ASF	0				
2.8 Turbocharger Compressor Deposit (Diesel)	CEC L-114-19 (Toyota 1KD-FTV)	Turbocharger rating	Merit	-----				≥ 25
2.9 Low Speed Pre-Ignition GDI Turbo	ASTM D8291 (Sequence IX, Ford)	Pre-Ignition events	Average number of events for 4 iterations	-----				≤ 5
			Number of events per iteration	-----				≤ 8
2.10 Chain Wear GDI	ASTM D8279 (Sequence X, Ford)	Elongation of Timing Chain	%	-----				≤ 0.085

***/**: Footnotes referring to the following Requirements in the A-/B- and C-Classes:**

Footnotes

No. 1.6, 1.7, 1.8	Maximum limits, Values take into account method and production tolerances
No. 2.1, 2.6, 2.7	** Parameter is not an official CEC Parameter
No. 2.1	The CEC L-111-16 (EP6) lifetime is limited. If the test becomes unavailable during the lifetime of these ACEA Engine Oil Sequences, ACEA intends to introduce a successor test on PSA hardware at a similar severity level.
No. 2.2	Alternatively, Sequence VG (ASTM D6593) results meeting ACEA 2016 requirements can be used in place of Sequence VH for all categories. The Sequence VG limits for ACEA 2016 are: Average engine sludge, merits: ≥7.8; Average rocker cover sludge, merits: ≥8.0; Average engine varnish, merits: ≥8.9; Average piston skirt varnish, merits: ≥7.5; Hot-stuck compression rings: None; Oil screen clogging, % area: ≤ 20.
No. 2.3	Alternatively, Sequence IVA (ASTM D6891) data can be used for A3/B4, A5/B5, C2, C3, C4 and C5 categories at the following limit: Cam wear average: max 90 microns.
No. 2.4:	Alternatively to the CEC L-107-19, results of the Daimler M271 Sludge test as described by Daimler AG can be used for A3/B4, A5/B5 and C2, C3, C4, C5. For this test, reference oil changed from RL140 to RL261. Results relative to RL140 or RL261 can be used to demonstrate ACEA performance. The applicable limit with RL261 is ≥ RL261 + 1σ. The applicable limit with RL140 is ≥ RL140 + 4σ. Test results obtained by the Daimler M271 test procedure will be accepted only under the condition that they come from test rigs being referenced and quality controlled by Daimler AG.
No. 2.6	The CEC L-106-14 (DV6C) lifetime is limited. If the test becomes unavailable during the lifetime of these ACEA Engine Oil Sequences, ACEA intends to introduce a successor test on PSA hardware at a similar severity level.
No. 2.7	Alternatively, CEC L-78-99 (TDI2) results can be used as specified in the table below.

CEC L-78-99 limits applicable for:		A3/B4	A5/B5, A7/B7	C2	C3, C4, C5, C6
Piston Cleanliness	Merit	≥ RL206	≥ RL206	≥ RL206	≥ RL206
Ring Sticking (Rings 1 & 2)					
Average of all 8 rings	ASF	≤ 1.0	≤ 1.0	≤ 1.2	≤ 1.0
Max. for any 1st ring	ASF	≤ 1.0	≤ 1.0	≤ 2.5	≤ 1.0
Max for any 2nd ring	ASF	0.0	0.0	0.0	0.0
EoT TBN (ISO 3771) **	mgKOH/g	≥ 6.0	≥ 4.0	Report	Report
EoT TAN (ASTM D664) **	mgKOH/g	Report	Report	Report	Report

European Automobile Manufacturers Association

ACEA EUROPEAN OIL SEQUENCES

GENERAL REQUIREMENTS

SERVICE FILL ENGINE OILS
for GASOLINE & LIGHT-DUTY DIESEL ENGINES
and
HEAVY-DUTY DIESEL ENGINES

ACEA
Avenue des Nerviens 85
B-1040 Bruxelles
Tel (32) 2 732 55 50
info@acea.be
communications@acea.be
www.ACEA.be
TVA BE 444 072 631
SGB 210-0069404-04

Date		Update
30 April 2021	Rev. 0	New General Requirements Document for Light-Duty and Heavy-Duty ACEA Oil Sequences. This revision includes the links to the new ACEA Light-Duty Oil Sequence 2021 and the ACEA Heavy–Duty Oil Sequence 2016 Rev3 document

This document details the general requirements for the ACEA European Oil Sequences for Service-fill Oils for Gasoline engines, for Light-Duty Diesel engines, for Gasoline & Light-Duty Diesel engines with aftertreatment devices and for Heavy-Duty Diesel engines. This document should be read in conjunction with:

- The latest version of the ACEA European Oil Sequences for Service-fill Oils for Gasoline engines, for Light-Duty Diesel engines and for Gasoline & Light-Duty Diesel engines with aftertreatment devices,
- https://acea.be/uploads/news_documents/2021_ACEA_oil_sequences_light-duty_engines.pdf, and
- The latest version of the ACEA European Oil Sequences for Service-fill Oils for Heavy-Duty Diesel engines
- https://acea.be/uploads/news_documents/2016_ACEA_oil_sequences_heavy-duty_engines.pdf.

Those two documents detail the periods during which valid claims can be made for oils meeting those specifications and the full specifications of those respective ACEA Oil Sequences.

The ACEA European Oil Sequences for Service-fill Oils comprise currently oil classes for Gasoline, Light-Duty Diesel engines and Heavy-Duty Diesel engines. Within each of the classes there are categories that reflect different performance requirements. Typical applications for each sequence are described in the specific Oil Sequence for guidance only. Specific applications of each sequence are the responsibility of individual engine manufacturers for their own vehicles / engines.

The Oil Sequences define the minimum quality level of an oil product for self-certification to EELQMS and presentation to ACEA members. Individual member companies of ACEA may require performance parameters other than those covered by the tests shown, or more stringent limits.

CONDITIONS FOR USE OF PERFORMANCE CLAIMS AGAINST THE ACEA OIL SEQUENCES

ACEA requires that any claims by oil companies or oil distributors for Oil performance to meet these Oil Sequences must be based on credible data and controlled tests in accredited test laboratories.

ACEA requires that engine performance testing used to support a claim of compliance with these ACEA Oil Sequences should be generated according to the **E**uropean **E**ngine **L**ubricants **Q**uality **M**anagement **S**ystem, EELQMS (available at www.eelqms.eu), but ACEA reserves the right to define alternatives in exceptional cases.

EELQMS 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[1], which forms part of the EELQMS, is mandatory for any claim to meet the requirements of this issue of the ACEA sequences. Therefore, ACEA requires that claims against the ACEA Oil Sequences can only be made by oil companies who have signed the EELQMS oil marketers' Letter of Conformance (for details: www.atiel.org).

The ACEA Oil Sequences are subject to continuous development. Replacement tests and other changes required by the European vehicle manufacturers are integrated and new issues are published on a regular basis. As new editions are published older editions have to be withdrawn. The validity of old and new editions of the ACEA Oil Sequences are shown in the respective ACEA Oil Sequences.

CERTIFICATION and REGISTRATION

Claims against the ACEA Oil Sequences can be made on a self-certification basis. For any Claim being made against these ACEA Oil Sequences, ACEA recommends oil suppliers to register their products with the ACEA Registration System on the ACEA website on their launch into the market. Registration into the ACEA Registration System does not replace the required EELQMS oil marketers' Letter of Conformance registration in SAIL.

All information needed for Registration in ACEA Registration System is available on the ACEA website, see: https://app.acea.be/EOR

After completing the form on the ACEA website, it will be saved on the ACEA server. If claims are no longer needed oil companies are asked to delete their registration. If registered claims continue to be used after three years, re-registration is recommended.

[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), 14b Rue de la Science, 1040, Brussels, Belgium.

NOMENCLATURE & ACEA PROCESS

Each set of Oil Sequences is designated for consumer use by a 2-part code comprising a letter to define the CLASS (e.g. C), and a number to define the CATEGORY (e.g. C2).

In addition, for industry use, each sequence has a two-digit number to identify the YEAR of implementation of that severity level (e.g. A3/B4-21).

Classes may be added in future if, for example, Natural Gas engines, H_2 Combustion engines or engines which operate with alternative Fuels (E-fuels), may 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 category are described in the Light-Duty and Heavy–Duty Sequence documents for guidance only. Specific applications of each category are the responsibility of the individual motor manufacturer for their own vehicles and engines. Oils within a category may also meet the requirements of another category but some engines may only be suited to oils of one category within a class.

The YEAR numbers for ACEA Sequence is intended only for industry use and indicates 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 in 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 Oil Sequences (e.g. product literature, packaging, labels) they must specify the ACEA Class and Category (see Nomenclature & ACEA Process for definitions).

European Automobile Manufacturers Association

ACEA EUROPEAN OIL SEQUENCES FOR LIGHT-DUTY ENGINES

2021

SERVICE FILL ENGINE OILS
for GASOLINE & LIGHT-DUTY DIESEL ENGINES
(A/B Categories),
GASOLINE & LIGHT-DUTY DIESEL ENGINES
with EXHAUST AFTERTREATMENT DEVICES
(C Categories)

ACEA
Avenue des Nerviens 85
B-1040 Bruxelles
Tel (32) 2 732 55 50
Fax (32) 2 738 73 10
(32) 2 738 73 11
info@acea.be
communications@acea.be
www.ACEA.be
TVA BE 444 072 631
SGB 210-0069404-04

Date		Update
30 April 2021	Rev. 0	Initial Release of ACEA 2021 LIGHT-DUTY ENGINE OIL SEQUENCES

ACEA EUROPEAN OIL SEQUENCES, GENERAL REQUIREMENTS
https://acea.be/uploads/news_documents/2021_ACEA_oil_sequences_general_requirements.pdf are an integral constituent for compliance with requirements specified in this document.

VALIDITY OF OLD AND NEW EDITIONS OF ACEA LIGHT-DUTY OIL SEQUENCES

As new sequence editions are published older editions have to be withdrawn. Validities of new and old editions are overlapping for limited periods of time as shown in the following table and the accompanying text below. When a new ACEA Oil Sequence is introduced, oils with claims against the previous issue can be marketed only for another two years.

Sequence Issue	First allowable use	Mandatory for new claims	Oils with this claim may be marketed until
2004	1st November 2004	1st November 2005	31st December 2009
2007	1st February 2007	1st February 2008	23rd December 2010
2008	22nd December 2008	22nd December 2009	22nd December 2012
2010	22nd December 2010	22nd December 2011	22nd December 2014
2012	14th December 2012	14th December 2013	1st December 2018
2016	1st December 2016	1st December 2017	1st May 2023*
2021	1st May 2021*	1st May 2022*	
	*) ACEA LIGHT-DUTY OIL SEQUENCES only		

- First allowable use means that claims cannot be made against the specification before the date indicated.
- Mandatory for new claims means that from this date onward all claims for new oil formulations must be made according to the latest ACEA Oil Sequences issue. Up to that date new claims can also be made according to the previous ACEA Oil Sequences issue. After the date indicated no new claims according to the previous ACEA Sequence can be made. Then all oil formulations must be developed according to the latest ACEA Oil Sequence release.
- Oils with this claim may be marketed until means that no further marketing of oils with claims to this issue is allowed after the date indicated.

The supplier of any oil claiming 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 are in the ATIEL Code of Practice.

Where claims are made that oil performance meets the requirements of the ACEA Oil 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 – "High SAPS"

A3/B3 Category withdrawn with these Oil Sequences. Stable, stay-in-grade engine oil intended for use in passenger car and light-duty gasoline & diesel engines and/or for extended oil drain intervals where specified by the engine manufacturer.

A3/B4 Stable, stay-in-grade engine oil intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines, but also suitable for applications described under A3/B3.

A5/B5 Stable, stay-in-grade engine oil intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed for low viscosity engine oils with HTHS viscosity of 2.9 to 3.5 mPa·s. These engine oils are unsuitable for use in certain engines - consult vehicle-OEM's owner's manual/handbook in case of doubt.

A7/B7 Stable, stay-in-grade engine oil intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed for low viscosity engine oils with HTHS viscosity of 2.9 to 3.5 mPa·s. Relative to A5/B5 these engine oils provide also low speed pre-ignition- and wear protection for turbocharged gasoline DI engines as well as turbocharger compressor deposit (TCCD) protection for modern DI diesel engines. These engine oils are unsuitable for use in certain engines - consult vehicle-OEM's owner's manual/handbook in case of doubt.

C: Catalyst & GPF/DPF compatible Engine Oils for Gasoline & Diesel Engines – "Low SAPS"

Note: These Oils will increase the DPF/GPF and TWC life and maintain the Vehicle's Fuel Economy.
Warning: Some of these Categories may be unsuitable for use in certain Engine Types – consult the vehicle-OEM's owner's manual/handbook in case of doubt.

C1 Category is withdrawn with these Oil Sequences.

C2 Stable, stay-in-grade engine oil with mid-SAPS Level, for aftertreatment system compatibility. Intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed for low viscosity engine oils with a minimum HTHS Viscosity of 2.9 mPa·s.

C3 Stable, stay-in-grade engine oil with mid-SAPS Level, for aftertreatment system compatibility. Intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed for engine oils with HTHS viscosity of minimum 3.5 mPa·s.

C4 Stable, stay-in-grade engine oil with low-SAPS Level, for aftertreatment system compatibility. Intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed for engine oils with HTHS viscosity of minimum 3.5 mPa·s.

C5 Stable, stay-in-grade engine oil for improved fuel economy, with mid-SAPS Level, for aftertreatment system compatibility. Intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed and OEM-approved for engine oils with HTHS viscosity of minimum 2.6 mPa·s.

C6 Stable, stay-in-grade engine oil for improved fuel economy, with mid-SAPS Level, for aftertreatment system compatibility. Intended for use at extended oil drain intervals in passenger car and light-duty gasoline & DI diesel engines designed and OEM-approved for engine oils with HTHS viscosity of minimum 2.6 mPa·s. Relative to C5 these engine oils provide also low speed pre-ignition- and wear protection for turbocharged gasoline DI engines as well as turbocharger compressor deposit (TCCD) protection for modern DI diesel engines.

SAPS: Sulphated Ash, Phosphorus, Sulphur
HTHS: High Temperature High Shear Viscosity
DI: Direct Injection
DPF: Diesel Particle Filter
GPF: Gasoline Particle Filter
TWC: Three-Way Catalyst

ACEA	ACEA 2021 EUROPEAN OIL SEQUENCES FOR LIGHT-DUTY ENGINE SERVICE-FILL OILS	April 2021 Rev. 0

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

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS A3/B4-21	LIMITS A5/B5-21	LIMITS A7/B7-21
1. Laboratory tests						
1.1 Viscosity Grades		Viscosity Class according to SAE J300 - Latest active issue		No restriction except as defined by HTHS and Shear Stability requirements. Manufacturers may indicate specific Viscosity requirements related to ambient temperature.		
1.2 Shear Stability	CEC L-14-93 or ASTM D6278 or ASTM D7109	100 °C Viscosity after 30 cycles	mm^2/s	All grades to be “stay in grade”		
1.3 HTHS Viscosity	CEC L-36-90	Dynamic Viscosity at 150 °C and Shear Rate of 10^6 s^{-1}	mPa·s	≥ 3.5	≥ 2.9 & ≤ 3.5	≥ 2.9 & ≤ 3.5
	CEC L-36-90	Dynamic Viscosity at 100 °C and Shear Rate of 10^6 s^{-1}	mPa·s	--	Report	
1.4 Evaporative Loss	CEC L-40-93 (Noack)	Max. Weight Loss after 1 h at 250 °C	%	≤ 13		
1.5 TBN	ASTM D2896		mgKOH/g	≥ 10.0	≥ 8.0	Report
	ASTM D4739		mgKOH/g	Report		≥ 6.0
1.6* Sulphur	ASTM D5185 or ASTM D4951		% m/m	Report		
1.7* Phosphorus	ASTM D5185 or ASTM D4951		% m/m	Report		
1.8* Sulphated Ash	ASTM D874		% m/m	≥ 1.0 and ≤ 1.6	≤ 1.6	≤ 1.6
1.9 Chlorine	ASTM D6443		ppm	Report		
1.10 Oil – Elastomer Compatibility	CEC L-112-16	Max. Variation of Characteristics after immersion for 7 days in Fresh Oil without Pre-Ageing:	Elastomer	RE6	RE7	RE8 / RE9
		- Tensile Strength	%	Report	Report	Report / Report
		- Elongation at Rupture	%	-70 / +20	-65 / +15	-51 / +9 / -65 / +19
		- Volume Variation	%	-1.5 / +1.8	-1.8 / +7.7	0.0 / +10.7 / -1.5 / +13.8
1.11 Foaming Tendency	ASTM D892 with or 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	Tendency - stability	ml	Sequence IV (150 °C) 100 – nil		
1.13 Low-Temperature Pumpability	CEC L-105-12	MRV Yield stress (MRV at SAE J300 Temperatures, applicable for the Fresh Oil Viscosity Grade)	mPa·s Pa	According to SAE J300 for Fresh Oil		
1.14 Oil Oxidation with Biodiesel for Engine Oils operating in the presence of Biodiesel Fuel	CEC L-109-14	Oil Oxidation at 168 h (DIN 51453)	A/cm	≤ 120	≤ 100	≤ 100
		Oil Oxidation at 216 h (DIN 51453)	A/cm	Report	≤ 120	≤ 120
		Viscosity Increase, relative at 168 h (Delta KV100)	%	≤ 150	≤ 60	≤ 60
		Viscosity Increase, relative at 216 h (Delta KV100)	%	Report	≤ 150	≤ 150

ACEA	ACEA 2021 EUROPEAN OIL SEQUENCES FOR LIGHT-DUTY ENGINE SERVICE-FILL OILS	April 2021 Rev. 0

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

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS A3/B4-21	LIMITS A5/B5-21	LIMITS A7/B7-21
2. ENGINE TESTS						
2.1* Gasoline DI Engine Cleanliness Test	CEC L-111-16 (EP6CDT)	Piston Cleanliness	Merit	≥ RL259		
		Turbo Charger Deposits **, average value of zones C, D, E & F	Merit	≥ 6.0		
2.2* Low Temperature Sludge	ASTM D8256 (Sequence VH, Ford)	Average Engine Sludge	Merit	≥ 7.6		
		Rocker Cover Sludge	Merit	≥ 7.7		
		Average Engine Varnish	Merit	≥ 8.6		
		Average Piston Skirt Varnish	Merit	≥ 7.6		
		Compression Ring (hot stuck)		none		
		Oil Screen Clogging	%	report		
2.3* Valvetrain Wear	ASTM D8350 (Sequence IVB, Toyota 2NR-FE)	Average Intake Lifter Volume Loss (8 position average)	mm^3	≤ 3.3	≤ 3.3	≤ 2.7
		End of Test Iron	ppm	≤ 400	≤ 400	≤ 400
2.4* Black Sludge	CEC L-107-19 (M271 EVO)	Engine Sludge, average	Merit	≥ 8.3		
2.5 Fuel Economy	CEC L-54-96 (M111)	Fuel Economy Improvement	%	-----	≥ 2.5	≥ 2.5
2.6* DI Diesel Oil Dispersion at Medium Temperature	CEC L-106-14 (DV6C)	Absolute Viscosity Increase at 100 °C and 5.5 % Soot	mm^2/s	≤ 0.9 x RL248		
		Piston Cleanliness **	Merit	≥ 2.5		
2.7* DI Diesel Piston Cleanliness & Ring Sticking	CEC L-117-20 (VW TDI)	Piston Cleanliness	Merit	≥ RL276 - 5		
		Cylinder-spreading limit**	Merit	≤ 13		
		No Ring Sticking, max for any ring**	ASF	0		
2.8 Turbocharger Compressor Deposit (Diesel)	CEC L-114-19 (Toyota 1KD-FTV)	Turbocharger rating	Merit	-----		≥ 25
2.9 Low Speed Pre-Ignition GDI Turbo	ASTM D8291 (Sequence IX, Ford)	Pre-Ignition events	Average number of events for 4 iterations	-----		≤ 5
			Number of events per iteration	-----		≤ 8
2.10 Chain Wear GDI	ASTM D8279 (Sequence X, Ford)	Elongation of Timing Chain	%	-----		≤ 0.085

*/**: Footnotes see last page

ACEA	ACEA 2021 EUROPEAN OIL SEQUENCES FOR LIGHT-DUTY ENGINE SERVICE-FILL OILS	April 2021 Rev. 0

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

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS				
				C2-21	C3-21	C4-21	C5-21	C6-21
1. Laboratory tests								
1.1 Viscosity Grades		Viscosity Class according to SAE J300 - Latest active issue		No restriction except as defined by HTHS and Shear Stability requirements. Manufacturers may indicate specific Viscosity requirements related to ambient temperature.				
1.2* Shear Stability	CEC L-14-93 or ASTM D6278 or ASTM D7109	100 °C Viscosity after 30 cycles	mm^2/s	All grades to be “stay in grade”				
1.3. HTHS Viscosity	CEC L-36-90	Dynamic Viscosity at 150 °C and Shear Rate of 10^6 s^{-1}	mPa·s	≥ 2.9	≥ 3.5		≥ 2.6 & < 2.9	
	CEC L-36-90	Dynamic Viscosity at 100 °C and Shear Rate of 10^6 s^{-1}	mPa·s	Report				
1.4 Evaporative loss	CEC L-40-93 (Noack)	Max. weight loss after 1 h at 250 °C	%	≤ 13		≤ 11	≤ 13	
1.5 TBN	ASTM D2896		mgKOH/g	-----	≥ 6.0			Report
	ASTM D4739		mgKOH/g	Report				≥ 4.0
1.6* Sulphur	ASTM D5185 or ASTM D4951		% m/m	≤ 0.3		≤ 0.2	≤ 0.3	
1.7* Phosphorus	ASTM D5185 or ASTM D4951		% m/m	≥ 0.07 / ≤ 0.09		≤ 0.09	≥ 0.07 / ≤ 0.09	
1.8*Sulphated Ash	ASTM D874		% m/m	≤ 0.8		≤ 0.5	≤ 0.8	
1.9 Chlorine	ASTM D6443		ppm	Report				
1.10 Oil – Elastomer Compatibility		Max. Variation of Characteristics after immersion for 7 days in fresh oil without pre-ageing:	Elastomer	RE6	RE7		RE8	RE9
		- Tensile Strength	%	Report	Report		Report	Report
		- Elongation at Rupture	%	-70 / +20	-65 / +15		-51 / +9	-65 / +19
		- Volume Variation	%	-1.5 / +1.8	-1.8 / +7.7		0.0 / +10.7	-1.5 / +13.8
1.11 Foaming Tendency	ASTM D892 with or 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	Tendency - stability	ml	Sequence IV (150 °C) 100 – nil				
1.13 Low Temperature Pumpability	CEC L-105-12	MRV Yield stress (MRV at SAE J300 Temperatures, applicable for the Fresh Oil Viscosity Grade)	mPa·s Pa	According to SAE J300 for Fresh Oil				
1.14 Oil Oxidation with Biodiesel for Engine Oils operating in the presence of Biodiesel Fuel	CEC L-109-14	Oil Oxidation at 168 h (DIN 51453)	A/cm	≤ 100	≤ 100	≤ 100	≤ 100	≤ 100
		Oil Oxidation at 216 h (DIN 51453)	A/cm	≤ 120	≤ 120	≤ 120	≤ 120	≤ 120
		Viscosity Increase, relative at 168 h (Delta KV100)	%	≤ 60	≤ 60	≤ 60	≤ 60	≤ 60
		Viscosity Increase, relative at 216 h (Delta KV100)	%	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150

ACEA	ACEA 2021 EUROPEAN OIL SEQUENCES FOR LIGHT-DUTY ENGINE SERVICE-FILL OILS	April 2021 Rev. 0

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

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS C2-21	C3-21	C4-21	C5-21	C6-21
2. ENGINE TESTS								
2.1* Gasoline DI Engine Cleanliness	CEC L-111-16 (EP6CDT)	Piston Cleanliness	Merit	≥ RL259				
		Turbo Charger Deposits **, average value of zones C, D, E & F	Merit	≥ 6.0				
2.2* Low Temperature Sludge	ASTM D8256 (Sequence VH)	Average Engine Sludge	Merit	≥ 7.6				
		Rocker Cover Sludge	Merit	≥ 7.7				
		Average Engine Varnish	Merit	≥ 8.6				
		Average Piston Skirt Varnish	Merit	≥ 7.6				
		Compression Ring (hot stuck)		None				
		Oil Screen Clogging	%	Report				
2.3* Valvetrain Wear	ASTM D8350 (Sequence IVB, Toyota 2NR-FE)	Average Intake Lifter Volume Loss (8 position average)	mm^3	≤ 3.3				≤ 2.7
		End of Test Iron	ppm	≤ 400				≤ 400
2.4* Black Sludge	CEC L-107-19 (M271 EVO)	Engine Sludge, average	Merit	≥ 8.3				
2.5 Fuel Economy	CEC L-54-96 (M111)	Fuel Economy Improvement	%	≥ 2.5	≥ 1.0 (for xW-30 only, no limit for xW-40)		≥ 3.0	-----
	JASO FE M366 (Toyota 2ZR-FXE)	Fuel Economy Improvement	%	-----				≥ 0.0
2.6* DI Diesel Oil Dispersion at Medium Temperature	CEC L-106-14 (DV6C)	Absolute Viscosity Increase at 100 °C and 5.5% Soot	mm^2/s	≤ 0.9 x RL248				
		Piston Cleanliness **	Merit	≥ 2.5				
2.7* DI Diesel piston Cleanliness & Ring Sticking	CEC L-117-20 (VW TDI)	Piston Cleanliness	Merit	≥ RL276 - 5				
		Cylinder-spreading limit**	Merit	≤ 13				
		No Ring Sticking, max for any ring**	ASF	0				
2.8 Turbocharger Compressor Deposit (Diesel)	CEC L-114-19 (Toyota 1KD-FTV)	Turbocharger rating	Merit	-----				≥ 25
2.9 Low Speed Pre-Ignition GDI Turbo	ASTM D8291 (Sequence IX, Ford)	Pre-Ignition events	Average number of events for 4 iterations	-----				≤ 5
			Number of events per iteration	-----				≤ 8
2.10 Chain Wear GDI	ASTM D8279 (Sequence X, Ford)	Elongation of Timing Chain	%	-----				≤ 0.085

***/**: Footnotes referring to the following Requirements in the A-/B- and C-Classes:**

Footnotes

No. 1.6, 1.7, 1.8	Maximum limits, Values take into account method and production tolerances
No. 2.1, 2.6, 2.7	** Parameter is not an official CEC Parameter
No. 2.1	The CEC L-111-16 (EP6) lifetime is limited. If the test becomes unavailable during the lifetime of these ACEA Engine Oil Sequences, ACEA intends to introduce a successor test on PSA hardware at a similar severity level.
No. 2.2	Alternatively, Sequence VG (ASTM D6593) results meeting ACEA 2016 requirements can be used in place of Sequence VH for all categories. The Sequence VG limits for ACEA 2016 are: Average engine sludge, merits: ≥7.8; Average rocker cover sludge, merits: ≥8.0; Average engine varnish, merits: ≥8.9; Average piston skirt varnish, merits: ≥7.5; Hot-stuck compression rings: None; Oil screen clogging, % area: ≤ 20.
No. 2.3	Alternatively, Sequence IVA (ASTM D6891) data can be used for A3/B4, A5/B5, C2, C3, C4 and C5 categories at the following limit: Cam wear average: max 90 microns.
No. 2.4:	Alternatively to the CEC L-107-19, results of the Daimler M271 Sludge test as described by Daimler AG can be used for A3/B4, A5/B5 and C2, C3, C4, C5. For this test, reference oil changed from RL140 to RL261. Results relative to RL140 or RL261 can be used to demonstrate ACEA performance. The applicable limit with RL261 is ≥ RL261 + 1σ. The applicable limit with RL140 is ≥ RL140 + 4σ. Test results obtained by the Daimler M271 test procedure will be accepted only under the condition that they come from test rigs being referenced and quality controlled by Daimler AG.
No. 2.6	The CEC L-106-14 (DV6C) lifetime is limited. If the test becomes unavailable during the lifetime of these ACEA Engine Oil Sequences, ACEA intends to introduce a successor test on PSA hardware at a similar severity level.
No. 2.7	Alternatively, CEC L-78-99 (TDI2) results can be used as specified in the table below.

CEC L-78-99 limits applicable for:		A3/B4	A5/B5, A7/B7	C2	C3, C4, C5, C6
Piston Cleanliness	Merit	≥ RL206	≥ RL206	≥ RL206	≥ RL206
Ring Sticking (Rings 1 & 2)					
Average of all 8 rings	ASF	≤ 1.0	≤ 1.0	≤ 1.2	≤ 1.0
Max. for any 1st ring	ASF	≤ 1.0	≤ 1.0	≤ 2.5	≤ 1.0
Max for any 2nd ring	ASF	0.0	0.0	0.0	0.0
EoT TBN (ISO 3771) **	mgKOH/g	≥ 6.0	≥ 4.0	Report	Report
EoT TAN (ASTM D664) **	mgKOH/g	Report	Report	Report	Report

ACEA
European
Automobile
Manufacturers
Association

ACEA EUROPEAN OIL SEQUENCES FOR HEAVY DUTY ENGINES

2016

SERVICE FILL ENGINE OILS
HEAVY DUTY DIESEL ENGINES
(E Categories)

ACEA
Avenue des Nerviens 85
B-1040 Bruxelles
Tel (32) 2 732 55 50
info@acea.be
communications@acea.be
www.ACEA.be
TVA BE 444 072 631
SGB 210-0069404-04

Date		Update
30 April 2021	Rev. 0	New document of ACEA Heavy Duty Oil Sequences 2016 Rev 3

ACEA EUROPEAN OIL SEQUENCES, GENERAL REQUIREMENTS https://acea.be/uploads/news_documents/2021_ACEA_oil_sequences_general_requirements.pdf are an integral constituent for compliance with requirements specified in this document.

VALIDITY OF OLD AND NEW EDITIONS OF ACEA HD OIL SEQUENCES

As new editions are published older editions will be withdrawn. Validities of new and old editions are overlapping for limited periods of time as shown in the following table and the accompanying text below. When a new ACEA HD Oil Sequence is introduced, oils with claims against the previous can be marketed only for another two years.

Sequences Issue	First allowable use	Mandatory for new claims	Oils with this claim may be marketed until
2004	1st November 2004	1st November 2005	31st December 2009
2007	1st February 2007	1st February 2008	23rd December 2010
2008	22nd December 2008	22nd December 2009	22nd December 2012
2010	22nd December 2010	22nd December 2011	22nd December 2014
2012	14th December 2012	14th December 2013	1st December 2018
2016	1st December 2016	1st December 2017	
2021			

- First allowable use means that claims cannot be made against the specification before the date indicated.
- Mandatory for new claims means that from this date onward all claims for new oil formulations must be made according to the latest ACEA HD Oil Sequences Issue. Up to that date new claims can also be made according to the previous ACEA HD Oil Sequences Issue. After the date indicated no new claims according to the previous ACEA Sequence can be made. Then all oil formulations must be developed according to the latest ACEA HD release.
- Oils with this claim may be marketed until means that no further marketing of oils with claims to this issue is allowed after the date indicated.

The supplier of any oil claiming 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 are in the ATIEL Code of Practice.

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

«Consumer Language»:

E: Heavy Duty Diesel Engine Oils

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 I, Euro II, Euro III, Euro IV and Euro V 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 I, Euro II, Euro III, Euro IV, Euro V and Euro VI 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 NOx 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. 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 control, soot handling and lubricant stability. It is recommended for highly rated diesel engines meeting Euro I, Euro II, Euro III, Euro IV and Euro V 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.

E9 Stable, stay-in-grade oil providing effective control with respect to piston cleanliness and bore polishing. It further provides excellent wear control, soot handling and lubricant stability. It is recommended for highly rated diesel engines meeting Euro I, Euro II, Euro III, Euro IV, Euro V and Euro VI emission requirements and running under severe conditions, e.g. extended oil drain intervals according to the manufacturer's recommendations. It is suitable for engines with or without particulate filters, and for most EGR engines and for most engines fitted with SCR NOx reduction systems. E9 is strongly recommended for engines fitted with particulate filters and is designed for use in combination with low Sulphur diesel fuel. However, recommendations may differ between engine manufacturers so driver manuals and/or dealers should 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.
Individual member companies may indicate performance parameters other than those covered by the tests shown or more stringent limits.

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS			
				E4-16	E6-16	E7-16	E9-16
1. LABORATORY TESTS							
1.1 Viscosity		SAE J300 Latest Active Issue		No restriction except as defined by shear stability and HTHS requirements. Manufacturers may indicate specific viscosity requirements related to ambient temperature.			
1.2 Shear stability	CEC L-014-93 or ASTM D6278 or ASTM D7109	Viscosity after 30 cycles measured at 100 °C.	mm²/s	Stay in grade			
	ASTM D7109	Viscosity after 90 cycles measured at 100 °C after 90 cycles	mm²/s		Stay in grade		
1.3 HTHS Viscosity	CEC L-036-90	Dynamic Viscosity at 150 °C and Shear Rate of 10^6 s^{-1}	mPa×s	≥ 3.5			
		Dynamic Viscosity at 100 °C and hear Rate of 10^6 s^{-1}	mPa×s	Report			
1.4 Evaporative Loss	CEC L-040-93 (Noack)	Max. weight loss after 1 h at 250 °C	%	≤13			
1.5 Sulphated Ash	ASTM D874		% m/m	≤2.00	≤1.00	≤2.00	≤1.00
1.6 Phosphorus	ASTM D5185		% m/m		≤0.08		≤0.12
1.7 Sulphur	ASTM D5185		% m/m		≤0.30		≤0.40
1.8 * Oil / Elastomer Compatibility	CEC L-112-16	Max. variation of characteristics after immersion for 7 days in fresh oil without pre-ageing		RE6	RE7	RE8	RE9
		Tensile Strength	%	Report	Report	Report	Report
		Elongation at Break	%	-70/+20	-65/+15	-51/+9	-65/+19
		Volume Change	%	-5.5/+2.1	-1.8/+8.9	0.0/+12.0	-2.5/+16
1.9 Foaming Tendency	ASTM D892 without option A	Tendency – stability	ml	Sequence I (24 °C) 10 – nil			Seq I 10/0
			ml	Sequence II (94 °C) 50 – nil			Seq II 20/0
			ml	Sequence III (24 °C) 10 – nil			Seq III
							10/0
1.10 High Temperature Foaming Tendency	ASTM D6082	Tendency - stability	ml	Sequence IV (150 °C) 200-50			
1.11 Oxidation	CEC L-085-99 (PDSC)	Oxidation induction time	min.	≥ 65			
1.12 Corrosion	ASTM D 6594	Copper increase	ppm	Report		Report	≤20
		Lead increase	ppm	Report		≤100	≤100
		Copper strip rating	max	Report		Report	3
1.13 * TBN	ASTM D2896		mg KOH/g	≥12	≥ 7	≥ 9	≥7
1.14 Low Temperature Pumpability	CEC L-105-12	MRV	mPa×s	According to SAE J300 for fresh oil			
		Yield stress	Pa				
		(MRV at SAE J300 Temperatures applicable for the fresh oil viscosity grade)					
1.15 Oil Oxidation with Biodiesel	CEC L-109-16	Oxidation increase after 168 h	A/cm	≤90	≤80	≤120	≤90
		KV100 increase after 168 h	%	≤130	≤130	≤300	≤150

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

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS			
				E4-16	E6-16	E7-16	E9-16
1. ENGINE TESTS							
2.1 * Wear	CEC L-099-08 (OM646LA)	Cam wear outlet (avg. max. wear 8 cams)	µm	≤ 140	≤ 140	≤ 155	≤ 155
2.2 * Soot in Oil	ASTM D 5967 (Mack T-8E)	Test duration 300 h Relative viscosity at 4.8% soot and 50% shear loss 1 test / 2 test / 3 test average		≤ 2.1/2.2/2.3	≤ 2.1/2.2/2.3	≤ 2.1/2.2/2.3	≤ 2.1/2.2/2.3
2.3 * Bore Polishing Piston Cleanliness	CEC L-101-08 (OM501LA)	Piston cleanliness, average	Merit	≥ 26	≥ 26	≥ 17	≥ 17
		Bore polishing, average **	%	≤ 1.0	≤ 1.0	≤ 2.0	≤ 2.0
		Oil consumption **	kg/Test	≤ 9	≤ 9	≤ 9	≤ 9
		Engine sludge, average **	Merit	Report	Report	Report	Report
2.4 * Soot Induced Wear	ASTM D7468 (Cummins ISM)	Merit					≥1000
		Crosshead, weight loss					
		1 test/ 2 test/ 3 test average	mg			≤ 7.5/7.8/7.9	≤ 7.1
		Oil Filter Diff. Press at 150h					
		1 test/ 2 test/3 test average	kPa			≤ 55/67/74	≤ 19
		Engine sludge					
		1 test /2 test /3 test average	Merit			≥ 8.1/8.0/8.0	≥ 8.7
		Adj. screw weight loss	mg				≤49
2.5 * Wear (liner-ring-bearings)	ASTM D7422 (Mack T12)	Merit			≥ 1000	≥ 1000	≥ 1000
		Cylinder liner wear (CLW)	µm		≤26	≤26	≤24
		Top ring weight loss (TRWL)	mg		≤117	≤117	≤105
		End of test lead	ppm		≤42	≤42	≤35
		Delta lead 250-300 hrs	ppm		≤18	≤18	≤15
		Oil consumption (Phase II)	g/hr		≤95	≤95	≤85
2.6 Biofuel Impacted Piston Cleanliness and Engine Sludge	CEC L-104-16 (OM646LA Bio)	Piston cleanliness, average	Merit		≥ RL255 + 4		≥ RL255 + 2
		Ring sticking **	ASF		Report		Report
		Engine sludge, average **	Merit		Report		Report

*/**: <u>Footnotes referring to the following requirements in the E-Class:</u>

No. 1.8 Full Data sets being obtained on CEC L-039-96 + the Daimler requirements for DBL-AEM as specified by Daimler AG can be used instead of CEC L-112-16, provided the requirements as specified in ACEA 2012 are met.

No. 1.13 For E7, values < 9.00 are not accepted.

No. 2.1 Additional parameters may be included once approved by CEC

No. 2.2 Mack T11 results obtained as part of an API CI-4, CI-4 plus, CJ-4, CK-4 or FA-4 approval program, can be used in place of Mack T8E.

No. 2.3, 2.6 ** Not CEC approved parameters.

No. 2.4 Merit number shall be calculated according to the API CI-4 specification

No. 2.5 For E6 & E7 Merit number shall be calculated according to the API CI-4 specification.
For E6 & E7 Mack T10 results obtained as part of an API CI-4 or CI-4 plus approval program, can be used in place of Mack T12.
Mack T-12 Cylinder Liner Wear and Top Ring Weight Loss results obtained as part of an API CK-4 or FA-4 approval program, which includes a passing Volvo T-13 at the API CK-4 or API FA-4 level, may be used to satisfy the requirements of the Mack T-12 in the ACEA Oil Sequences.