acea

2023, Revision 0 (September 2023)

ACEA Oil Sequences

Light-duty engines

SERVICE-FILL ENGINE OILS FOR GASOLINE AND LIGHT-DUTY DIESEL ENGINES (A/B CATEGORIES), GASOLINE AND LIGHT-DUTY DIESEL ENGINES WITH EXHAUST AFTERTREATMENT DEVICES (C CATEGORIES)

Date		Updated documents
12 September 2023	Revision 0	New General Requirements document for light-duty ACEA Oil Sequences. This includes the links to the new 2023 ACEA Oil Sequences for Light-Duty Engines

The ACEA Oil Sequences – General Requirements are an integral constituent for compliance with the 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As new sequence editions are published older editions have to be withdrawn.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 overlap for limited periods of time, as shown in the following table and the accompanying text below. When a new ACEA Oil Sequences is introduced, oils with claims against the previous issue can be marketed for another two years only.

Sequence issue	First allowable use	Mandatory for new claims	Oils with this claim may be marketed until
2004	1 November 2004	1 November 2005	31 December 2009
2007	1 February 2007	1 February 2008	23 December 2010
2008	22 December 2008	22 December 2009	22 December 2012
2010	22 December 2010	22 December 2011	22 December 2014
2012	14 December 2012	14 December 2013	1 December 2018
2016	1 December 2016	1 December 2017	1 May 2023*
2021	1 May 2021*	1 May 2022*	1st August 2025*
2023	12 September 2023*	12 September 2024*	

* ACEA Oil Sequences for Light-Duty Engines 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 Oil 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 are 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 (eg product literature, packaging, labels) they must specify the ACEA Class and Category (see nomenclature and ACEA process for definitions).

CONSUMER LANGUAGE

A/B: Gasoline and diesel engine oils – ‘High SAPS’

A3/B4 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.

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 and GPF/DPF compatible engine oils for gasoline and 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 manufacturer’s owner manual/handbook in case of doubt.

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.

C7 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 2.3 mPa·s. C7 is based on C6 performance levels, with the exception of enhanced fuel economy.

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

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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/B4-23	A5/B5-23	A7/B7-23
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		
1.2 Shear Stability	CEC L-14-93 or ASTM D6278 or ASTM D7109	100 °C Viscosity after 30 cycles	mm²/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	
	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 & ≤ 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
		- Elongation at Rupture	%	-70 / +20	-65 / +15	-51 / +9
		- Volume Variation	%	-1.5 / +1.8	-1.8 / +7.7	0.0 / +10.7
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	mPa·s	According to SAE J300 for Fresh Oil		
		Yield stress (MRV at SAE J300 Temperatures, applicable for the Fresh Oil Viscosity Grade)	Pa			
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	
		Oil Oxidation at 216 h (DIN 51453)	A/cm	Report	≤ 120	
		Viscosity Increase, relative at 168 h (Delta KV100)	%	≤ 150	≤ 60	
		Viscosity Increase, relative at 216 h (Delta KV100)	%	Report	≤ 150	

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS A3/B4-23	A5/B5-23	A7/B7-23
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		≤ 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	
2.6 DI Diesel Oil Dispersion at Medium Temperature	CEC L-106-14 (DV6C)	Absolute Viscosity Increase at 100 °C and 5.5 % Soot	mm²/s	≤ 0.9 x RL248		
		Piston Cleanliness **	Merit	≥ 2.5		
2.7 Diesel Engine Wear	CEC L-99-08 (OM646LA)	Cam wear outlet (avg. max. wear 8 cams)	µm	≤ 120		-----
		Cam wear inlet (avg. max. wear 8 cams) **	µm	≤ 100		
		Cylinder wear (avg. 4 cylinders) **	µm	≤ 5.0		
		Bore polishing (13 mm) ** (max. value of 4 cylinders)	%	≤ 3.0		
		Tappet wear inlet ** (avg. max. wear 8 cams)	µm	Report		
		Tappet wear outlet ** (avg. max. wear 8 cams)	µm	Report		
		Piston cleanliness (avg. 4 pistons) **	Merit	≥ 12		
		Engine sludge average **	Merit	≥ 8.8		
2.8 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		
2.9 Turbocharger Compressor Deposit (Diesel)	CEC L-114-19 (Toyota 1KD-FTV)	Turbocharger rating	Merit	-----		≥ 25
2.10 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
2.11 Chain Wear GDI	ASTM D8279 (Sequence X, Ford)	Elongation of Timing Chain	%	-----		≤ 0.085

*/**: Footnotes see last page

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REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS					
				C2-23	C3-23	C4-23	C5-23	C6-23	C7-23
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		≥ 2.3 & < 2.6
	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	CEC L-112-16	Max. Variation of Characteristics after immersion for 7 days in fresh oil without pre-ageing: - Tensile Strength - Elongation at Rupture - Volume Variation	Elastomer % % %		RE6 Report -70 / +20 -1.5 / +1.8	RE7 Report -65 / +15 -1.8 / +7.7	RE8 Report -51 / +9 0.0 / +10.7	RE9 Report -65 / +19 -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) Oil Oxidation at 216 h (DIN 51453) Viscosity Increase, relative at 168 h (Delta KV100) Viscosity Increase, relative at 216 h (Delta KV100)	A/cm A/cm % %	≤ 100 ≤ 120 ≤ 60 ≤ 150					

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS					
				C2-23	C3-23	C4-23	C5-23	C6-23	C7-23
2. ENGINE TESTS									
2.1 Gasoline DI Engine Cleanliness	CEC L-111-16 (EP6CDT)	Piston Cleanliness Turbo Charger Deposits **, average value of zones C, D, E & F	Merit Merit	≥ RL259 ≥ 6.0					
2.2* Low Temperature Sludge	ASTM D8256 (Sequence VH)	Average Engine Sludge Rocker Cover Sludge Average Engine Varnish Average Piston Skirt Varnish Compression Ring (hot stuck) Oil Screen Clogging	Merit Merit Merit Merit %	≥ 7.6 ≥ 7.7 ≥ 8.6 ≥ 7.6 None Report					
2.3* Valvetrain Wear	ASTM D8350 (Sequence IVB, Toyota 2NR-FE)	Average Intake Lifter Volume Loss (8 position average) End of Test Iron	mm^3 ppm	≤ 3.3 ≤ 400				≤ 2.7 ≤ 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	≥ 0.3
2.6 DI Diesel Oil Dispersion at Medium Temperature	CEC L-106-14 (DV6C)	Absolute Viscosity Increase at 100 °C and 5.5% Soot Piston Cleanliness **	mm^2/s Merit	≤ 0.9 x RL248 ≥ 2.5					
2.7 Diesel Engine Wear	CEC L-099-08 (OM646LA)	Cam wear outlet (avg. max. wear 8 cams) Cam wear inlet (avg. max. wear 8 cams) ** Cylinder wear (avg. 4 cylinders) ** Bore polishing (13 mm) ** (max. value of 4 cylinders) Tappet wear inlet ** (avg. max. wear 8 cams) Tappet wear outlet ** (avg. max. wear 8 cams) Piston cleanliness (avg. 4 pistons) ** Engine sludge average **	µm µm µm % µm µm Merit Merit	≤ 120 ≤ 100 ≤ 5.0 ≤ 3.0 Report Report Report Report	≤ 120 ≤ 100 ≤ 5.0 ≤ 3.0 Report Report ≥ 12 ≥ 8.8				
2.8 DI Diesel piston Cleanliness & Ring Sticking	CEC L-117-20 (VW TDI)	Piston Cleanliness Cylinder-spreading limit** No Ring Sticking, max for any ring**	Merit Merit ASF	≥ RL276 - 5 ≤ 13 0					
2.9 Turbocharger Compressor Deposit (Diesel)	CEC L-114-19 (Toyota 1KD-FTV)	Turbocharger rating	Merit	-----				≥ 25	
2.10 Low Speed Pre-Ignition GDI Turbo	ASTM D8291 (Sequence IX, Ford)	Pre-Ignition events Pre-Ignition events	of events for 4 Number of events per iteration	----- -----				≤ 5 ≤ 8	
2.11 Chain Wear GDI	ASTM D8279 (Sequence X, Ford)	Elongation of Timing Chain	%	-----				≤ 0.085	

acea	2023 ACEA Oil Sequences for Light-Duty Engines	Sep. 2023 Revision 0

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***/**: 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, 2.8	** Parameter is not an official CEC Parameter
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. 2.7	CEC L-99-08 (Diesel Engine wear) is reintroduced in the 2023 sequence for following oil categories: A3/B4, A5/B5, C2, C3, C4 and C5. By reintroduction of this test in 2023 all claims according to ACEA-23 of the before mentioned ACEA categories have to run the test.
No. 2.8	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, C7
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

ABOUT THE EU AUTOMOBILE INDUSTRY

- 13.0 million Europeans work in the auto industry (directly and indirectly), accounting for 7% of all EU jobs
- 11.5% of EU manufacturing jobs – some 3.4 million – are in the automotive sector
- Motor vehicles are responsible for €374.6 billion of tax revenue for governments across key European markets
- The automobile industry generates a trade surplus of €101.9 billion for the European Union
- The turnover generated by the auto industry represents over 7% of the EU's GDP
- Investing €59.1 billion in R&D per year, automotive is Europe's largest private contributor to innovation, accounting for 31% of the EU total

ACEA REPRESENTS EUROPE'S 14 MAJOR CAR, VAN, TRUCK AND BUS MANUFACTURERS

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