acea

October 2023

ACEA Oil Sequences

Heavy-duty engines

SERVICE-FILL ENGINE OILS FOR HEAVY-DUTY DIESEL ENGINES

(E CATEGORIES)

Date		Updated documents
1 October 2023	Revision 1	Changed Footnote 2.5, 2.32, 2.33; deleted consumer language and added table; revised limits for Mack T-12
1 May 2022	Revision 0	Initial release of 2022 ACEA Oil Sequences for Heavy-Duty Engines October

The ACEA Oil Sequences – General Requirements are an integral constituent of compliance with the requirements specified in this document.

VALIDATION OF OLD AND NEW EDITIONS OF ACEA HEAVY-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As new sequence editions are published older editions have to be withdrawn.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 Sequence is introduced, oils with claims against the previous issue can be marketed for another two years only.

Sequences 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 2024*
2022	1 May 2022*	1 May 2023*	

* ACEA Oil Sequences for Heavy-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 marketer 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).

E: Heavy Duty Diesel Engine Oils

The OEM manual is mandatory, the below table gives an overview

For oil drain interval information please refer to the OEM manual

Engine Oil Sequence	Euro VI Stage IIIb, IV, V	Euro I, II, III, IV, V Stage I, II, IIIa	EGR engine compatibility	Exhaust treatment (DPF, SCR & Cathalyst)	Fuel compatibility		How to read the table
					High Sulfur*	Biodiesel**	
E4	X	!	!	X	✓	!	✓ recommended
E7	X	!	✓	X	✓	!	! for some applications
E8	✓	✓	✓	✓	!	✓	X not recommended
E11	✓	✓	✓	✓	!	✓	

* >50 ppm Sulfur

** Recommendations may differ between engine manufacturers, especially with >B7 biodiesel blends; please consult driver manuals and/or dealers if in doubt.

acea

acea	2022 ACEA Oil Sequences for Heavy-Duty Engines	October 2023 Revision 1

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS			
				E4-22	E8-22	E7-22	E11-22
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-14-93 or ASTM D6278 or ASTM D7109	Viscosity after 30 cycles measured at 100°C.	mm^2/s	Stay in grade			
	ASTM D7109	Viscosity after 90 cycles measured at 100°C	mm^2/s		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			
		Dynamic viscosity at 100°C and hear Rate of 10^6 s^{-1}	mPa·s	Report			
1.4 Evaporative loss	CEC L-40-93 (Noack)	Max weight loss after 1h at 250°C	%	≤13			
1.5 Sulphated ash	ASTM D874		% m/m	≤2.0	≤1.0	≤2.0	≤1.0
1.6 Phosphorus	ASTM D5185 or D4951		% m/m		≤0.08		≤0.12
1.7 Sulphur	ASTM D5185 or D4951		% m/m		≤0.3		≤0.4
1.8 Chlorine	ASTM D6443		% m/m	Report			
1.9 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			
		Elongation at break	%	-70/+20, -65/+15, -51/+9, -65/+19			
		Volume change	%	-1.5/+1.8, -1.8/+7.7, 0.0/+10.7, -1.5/+13.8			
1.10 Foaming tendency	ASTM D892 without option A	Tendency – stability	ml	Sequence I (24°C) 10 – nil			
		Tendency – stability	ml	Sequence II (94°C) 20 – nil			
		Tendency – stability	ml	Sequence III (24°C) 10 – nil			
1.11 High temperature foaming tendency	ASTM D6082	Tendency - stability	ml	Sequence IV (150°C) 200-50			
1.12 Oxidation	CEC L-85-99 (PDSC)	Oxidation induction time	min.	≥65			
1.13 Corrosion	ASTM D6594	Copper increase	ppm	Report			≤20
		Lead increase	ppm	Report		≤100	
		Copper strip rating	max	Report			3
1.14 * TBN	ASTM D2896		mg KOH/g	≥12	≥7	≥9	≥7
1.15 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					
1.16 Oil oxidation with biodiesel	CEC L-109-14	Oxidation increase after 168h	A/cm	≤90	≤80	≤120	≤90
		KV100 increase after 168h	%	≤130	≤130	≤300	≤150

acea

acea	2022 ACEA Oil Sequences for Heavy-Duty Engines	October 2023 Revision 1

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS			
				E4-22	E8-22	E7-22	E11-22
2. ENGINE TESTS							
2.1 Wear	CEC L-99-08 (OM646LA)	Cam wear outlet (avg max wear 8 cams)	µm	≤140	≤140	≤155	≤155
2.2 * Soot in oil	ASTM D5967 (Mack T-8E)	Test duration 300h relative viscosity at 4.8% soot and 50% shear loss		≤2.1	≤2.1	≤2.1	≤2.1
2.31 * Piston cleanliness	CEC L-118-21 (OM471)	Piston cleanliness (grooves and piston undercrown), average	%	≥74	≥74		
		Oil consumption	g/h	Report	Report		
2.32 * Piston cleanliness	ASTM D6750 (CAT 1N)	Weighted demerits (WDN)	Demerits			≤286.2	
		Top groove fill (TGF)	%			≤20	
		Top land heavy carbon (TLHC)	%			≤3	
		Oil consumption (0-252 h)	g/kWh			≤0.54	
		Piston, ring, and liner scuffing				None	
		Piston ring sticking				None	
2.33 * Piston cleanliness	ASTM D7549 (CAT C13)	Merit rating	Merit				≥1000
		Hot stuck rings					None
2.4 Soot Induced Wear	ASTM D7468 (Cummins ISM)	Merit rating	Merit				≥1000
		Top ring mass loss	mg				≤100
		Crosshead, weight loss	mg			≤7.5	≤7.1
		Oil filter diff. press at 150h	kPa			≤55	≤19
		Engine sludge	Merit			≥8.1	≥8.7
		Adj. screw weight loss	mg				≤49
2.5 * Wear (liner-ring-bearings)	ASTM D7422 (Mack T-12)	Merit rating	Merit		-	≥1000	-
		Cylinder liner wear (CLW)	µm		≤24.0	≤26	≤24.0
		Top ring weight loss (TRWL)	mg		≤105	≤117	≤105
		End of test lead	ppm		Report	≤42	Report
		Delta lead 250-300h	ppm		Report	≤18	Report
		Oil consumption (Phase II)	g/h		Report	≤95	Report
2.6 Biofuel impacted piston cleanliness and engine sludge	CEC L-104-16 (OM646LA Bio)	Piston cleanliness, average	Merit		≥RL255 + 6		≥RL255 + 4
		Ring sticking **	ASF		Report		Report
		Engine sludge, average **	Merit		Report		Report
2.7 Oxidation stability	ASTM D8048 (Volvo T-13)	KV increase (300-360h)	%		≤75		≤75
		Oxidation peak hight	A/cm		≤125		≤125
		Nitration peak hight	A/cm		Report		Report
		Oil consumption (avg 48-192h)	g/h		Report		Report
2.8 Aeration	ASTM D8047 (COAT)	Aeration	%		≤11.8		≤11.8

***/**: Footnotes referring to the following requirements:**

No 1.14	For E7, values < 9.00 are not accepted
No 2	Unless otherwise stated, for ASTM engine tests in these ACEA HD Sequences, data meeting the requirements of API CK-4 are acceptable, including Multiple Test Evaluation Procedures (MTEP)
No 2.2	ASTM D5967 (Mack T-8E): Data meeting the requirements of API CH-4 are acceptable, including Multiple Test Evaluation Procedures (MTEP). Mack T-11 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 T-8E
No 2.31	CEC L-118-21 (OM471): Alternatively, CEC L-101-09 (OM501LA) data meeting the requirements of ACEA E4-16 can be used to support an ACEA E4 claim
No 2.32	ASTM D6750 (CAT 1N): Alternatively, CEC L-101-09 (OM501LA) data meeting the requirements of ACEA E7-16 can be used to support an ACEA E7 claim Alternatively, CEC L 118 21 (OM471) data meeting the requirements of ACEA E4 22 / E8 22 can be also be used to support an ACEA E7
No 2.33	ASTM D7549 (CAT C13): Alternatively, CEC L-101-09 (OM501LA) data meeting the requirements of ACEA E9-16 can be used to support an ACEA E11 claim Alternatively, CEC L 118 21 (OM471) data meeting the requirements of ACEA E4 22 / E8 22 can be also be used to support an ACEA E11 22 claim.
No 2.4	ASTM D7468 (Cummins ISM): For ACEA E7, data meeting the requirements of API CI-4 are acceptable, including Multiple Test Evaluation Procedures (MTEP). For ACEA E11, merit number shall be calculated according to the CK-4 specification
No 2.5	ASTM D7422 (Mack T-12), For ACEA E7 only: Data meeting the requirements of API CI-4 are acceptable, including Multiple Test Evaluation Procedures (MTEP). Merit number shall be calculated according to the API CI-4 specification. Mack T-10 results obtained as part of an API CI-4 or CI-4 plus approval program, can be used in place of Mack T-12. 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.
No. 2.6	** Not CEC approved parameters

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

ACEA
European Automobile
Manufacturers' Association
+32 2 732 55 50
info@acea.auto
VAT: BE 444 072
www.acea.auto

twitter.com/ACEA_auto

linkedin.com/company/acea

youtube.com/c/ACEAauto