

acea

May 2022

# ACEA Oil Sequences

## Heavy-duty engines





# SERVICE-FILL ENGINE OILS FOR HEAVY-DUTY DIESEL ENGINES (E CATEGORIES)

Date	Revision 0	Updated documents
1 May 2022	Revision 0	Initial release of 2022 ACEA Oil Sequences for Heavy-Duty Engines

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As new sequence editions are published older editions have to be withdrawn.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).

## 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, eg significantly extended oil drain intervals according to the manufacturer's recommendations. It is suitable for engines without particulate filters, 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 must be consulted if in doubt.
- E8** 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, eg 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. E8 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 must 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, eg 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 must be consulted if in doubt.
- E11** 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, eg 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. E11 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.



# 2022 ACEA Oil Sequences for Heavy-Duty Engines

May 2022  
Revision 0

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS			
				E4-22	E8-22	E7-22	E11-22
<b>1. LABORATORY TESTS</b>							
<b>1.1 Viscosity</b>		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.			
<b>1.2 Shear stability</b>	CEC L-14-93 or ASTM D6278 or ASTM D7109	Viscosity after 30 cycles measured at 100°C.	mm <sup>2</sup> /s	Stay in grade			
	ASTM D7109	Viscosity after 90 cycles measured at 100°C	mm <sup>2</sup> /s		Stay in grade		
<b>1.3 HTHS viscosity</b>	CEC L-36-90	Dynamic viscosity at 150°C and Shear Rate of 10 <sup>6</sup> s <sup>-1</sup>	mPa·s	≥3.5			
		Dynamic viscosity at 100°C and shear Rate of 10 <sup>6</sup> s <sup>-1</sup>	mPa·s	Report			
<b>1.4 Evaporative loss</b>	CEC L-40-93 (Noack)	Max weight loss after 1h at 250°C	%	≤13			
<b>1.5 Sulphated ash</b>	ASTM D874		% m/m	≤2.0	≤1.0	≤2.0	≤1.0
<b>1.6 Phosphorus</b>	ASTM D5185 or D4951		% m/m		≤0.08		≤0.12
<b>1.7 Sulphur</b>	ASTM D5185 or D4951		% m/m		≤0.3		≤0.4
<b>1.8 Chlorine</b>	ASTM D6443		% m/m	Report			
<b>1.9 Oil / Elastomer Compatibility</b>	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			
<b>1.10 Foaming tendency</b>	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			
<b>1.11 High temperature foaming tendency</b>	ASTM D6082	Tendency - stability	ml	Sequence IV (150°C) 200-50			
<b>1.12 Oxidation</b>	CEC L-85-99 (PDSC)	Oxidation induction time	min.	≥65			
<b>1.13 Corrosion</b>	ASTM D6594	Copper increase	ppm	Report			≤20
		Lead increase	ppm	Report			≤100
		Copper strip rating	max	Report			3
<b>1.14 * TBN</b>	ASTM D2896		mg KOH/g	≥12	≥7	≥9	≥7
<b>1.15 Low Temperature Pumpability</b>	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					
<b>1.16 Oil oxidation with biodiesel</b>	CEC L-109-14	Oxidation increase after 168h	A/cm	≤90	≤80	≤120	≤90
		KV100 increase after 168h	%	≤130	≤130	≤300	≤150

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS			
				E4-22	E8-22	E7-22	E11-22
<b>2. ENGINE TESTS</b>							
<b>2.1 Wear</b>	CEC L-99-08 (OM646LA)	Cam wear outlet (avg max wear 8 cams)	µm	≤140	≤140	≤155	≤155
<b>2.2 * Soot in oil</b>	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
<b>2.31 * Piston cleanliness</b>	CEC L-118-21 (OM471)	Piston cleanliness (grooves and piston undercrown), average	%	≥74	≥74		
		Oil consumption	g/h	Report	Report		
<b>2.32 * Piston cleanliness</b>	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	
<b>2.33 * Piston cleanliness</b>	ASTM D7549 (CAT C13)	Merit rating	Merit				≥1000
		Hot stuck rings					None
	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
<b>2.5 * Wear (liner-ring-bearings)</b>	ASTM D7422 (Mack T-12)	Adj. screw weight loss	mg				≤49
		Merit rating	Merit		≥1000	≥1000	≥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
<b>2.6 Biofuel impacted piston cleanliness and engine sludge</b>	CEC L-104-16 (OM646LA Bio)	Oil consumption (Phase II)	g/h		Report	≤95	Report
		Piston cleanliness, average	Merit		≥RL255 + 6		≥RL255 + 4
		Ring sticking **	ASF		Report		Report
<b>2.7 Oxidation stability</b>	ASTM D8048 (Volvo T-13)	Engine sludge, average **	Merit		Report		Report
		KV increase (300-360h)	%		≤75		≤75
		Oxidation peak high	A/cm		≤125		≤125
		Nitration peak high	A/cm		Report		Report
<b>2.8 Aeration</b>	ASTM D8047 (COAT)	Oil consumption (avg 48-192h)	g/h		Report		Report
		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
- 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
- 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

- 12.7 million Europeans work in the auto industry (directly and indirectly), accounting for 6.6% of all EU jobs
- 11.5% of EU manufacturing jobs – some 3.5 million – are in the automotive sector
- Motor vehicles are responsible for €398.4 billion of tax revenue for governments across key European markets
- The automobile industry generates a trade surplus of €76.3 billion for the European Union
- The turnover generated by the auto industry represents more than 8% of the EU's GDP
- Investing €58.8 billion in R&D per year, automotive is Europe's largest private contributor to innovation, accounting for 32% of the EU total

## ACEA REPRESENTS EUROPE'S 16 MAJOR CAR, VAN, TRUCK AND BUS MANUFACTURERS

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