

ACEA Oil Sequences

SERVICE FILL OILS FOR GASOLINE ENGINES, LIGHT-DUTY DIESEL ENGINES,
ENGINES WITH AFTERTREATMENT DEVICES AND HEAVY-DUTY DIESEL ENGINES



Performance you can rely on.

ACEA Oil Sequences

This publication has been derived from the official ACEA Oil Sequences document, the latest version of which can be found at: www.acea.auto

The accuracy of this publication is the responsibility of Infineum, the aforementioned original document on www.acea.auto remains the sole point of reference and will be updated in case of any changes to the ACEA Oil Sequences.

The latest sequences have been designed to address engine developments that are being driven by both regulatory and performance needs, complemented by necessary test maintenance requirements.

2021 ACEA Light-duty Sequences

The new ACEA European Oil Sequences for light-duty engines were issued on 30 April 2021, with first allowable use on 1 May 2021 before they became mandatory for new claims on 1 May 2022.

Here is a summary of the key changes:

- Removal of ACEA A3/B3 and ACEA C1
 - These categories will no longer be maintained to make space for the new categories
- Introduction of ACEA A7/B7 and ACEA C6 with new lubricant performance requirements
 - Low-speed pre-ignition (LSPI) performance
 - Gasoline direct injection chain wear performance
 - Diesel turbocharger compressor deposit performance
 - TBN by ASTM D4739
 - New fuel economy test for ACEA C6
- Maintenance activities
 - Replacement of Sequence VG, M271Classic and TD12 by successor tests
 - Re-introduction of a gasoline engine valvetrain wear test
 - Removal of tests coming to end of life
 - Adjustment of CEC L-112 seals test limits

Some of the new tests are ASTM tests 'borrowed' from the North American API Engine Oil Specifications, the new fuel economy test comes from the Japanese JASO specification and the Coordinating European Council, CEC, also contributed new and replacement tests. The latest ACEA sequences are truly global.

The new ACEA 2021 categories

There are two new categories that introduce the long-awaited low-speed pre-ignition (LSPI) performance as a key feature.

ACEA A7/B7 is a new category building on ACEA A5/B5. The new features are protection against LSPI, a chain wear requirement to address wear concerns with gasoline direct injected engines and finally an all-new turbocharger compressor cleanliness requirement as a preventative measure.

ACEA C6 is the corresponding reduced SAPS category, built on ACEA C5, adding the same engine performance features as ACEA A7/B7, but on top of it a new fuel economy test.

2022 ACEA Heavy-duty Sequences

The new ACEA European Oil Sequences for heavy-duty engines were issued on 1 May 2022, with first allowable use on 1 May 2022 before they become mandatory for new claims on 1 May 2023. Oils with ACEA 2016 HD claims can be marketed until 1 May 2024.

Here is a summary of the key changes:

- Two new categories ACEA E8 and ACEA E11 created, to replace ACEA E6 and ACEA E9 respectively, with new performance requirements:
 - Oxidation stability (Volvo T-13) and aeration (COAT) tests added for both ACEA E8/E11 (aligned with API CK-4 limits)
- Replacement of the OM501LA test for piston cleanliness by:
 - OM471 for both ACEA E4 and ACEA E8 (only piston cleanliness parameter, aligned with Daimler limit)
 - CAT C13 for ACEA E11 (aligned with API CK-4 limits)
 - CAT 1N for ACEA E7 (aligned with API CK-4 limits)
- Adjustment of limits for the ACEA E Categories:
 - Minor change to CEC L-112 seals test limits
 - Foaming Tendency limits harmonized across categories
 - OM646Bio merit limits increased for ACEA E8 and ACEA E11 compared with ACEA E6 and ACEA E9
 - T-12 limits for ACEA E8 aligned with ACEA E11

Conditions for use of performance claims against the ACEA Oil Sequences

ACEA requires that any claims 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 European Engine Lubricants Quality Management System, 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 Practice¹, 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 or oil distributors who have signed the EELQMS oil marketers' Letter of Conformance (**for details: www.atiel.eu**).

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. 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 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	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	1 December 2017	1 May 2023
2016	1 December 2016 ²	1 December 2017	1 May 2024
2021	1 May 2021 ¹	1 May 2022	
2022	1 May 2022 ²	1 May 2023	

¹ACEA Light-duty Sequences (Class A/B & C), ²ACEA Heavy-duty Sequences (Class E)

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 Sequence Issue. Up to that date new claims can also be made according to the previous ACEA Oil Sequence Issue. After the date indicated no new claims to the previous ACEA sequence can be made. Then all oil formulations must be developed according to the latest ACEA 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 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 (e.g. product literature, packaging, labels) they must specify the ACEA Class and Category (see Nomenclature & ACEA Process for definitions).

¹The ATIEL Code of Practice is the sole property of ATIEL and is available from ATIEL (Association Technique de l'Industrie Européenne des Lubrifiants), ATIEL, Rue Belliard 40, 1040 Brussels, Belgium.

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	A5/B5-21	A7/B7-21	
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 and ≤ 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: - Tensile strength - Elongation at rupture - Volume variation		Elastomer type			
				RE6	RE7	RE8	RE9
				Report	Report	Report	Report
				-70/+20	-65/+15	-51/+9	-65/+19
				-1.5/+1.8	-1.8/+7.7	0.0/+10.7	-1.5/+13.8
1.11 Foaming tendency	ASTM D892 with and 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	≤ 100	
		Oil oxidation at 216 h (EOT) (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 at EOT 216 h)	%	Report	≤ 150	≤ 150	

*/**: Footnotes referring to the following Requirements in the A-/B- and C-Classes:
No 1.6, 1.7, 1.8 Maximum limits, values take into account method and production tolerances

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.

2. ENGINE TESTS

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS		
				A3/B4-21	A5/B5-21	A7/B7-21
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 piston skirt varnish	Merit	≥ 7.6		
		Average engine varnish	Merit	≥ 8.6		
		Compression ring (hot stuck)		none		
2.3 Valve train 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	Merit	≤ 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	
		Pre-ignition events	Average number of events for 4 iterations	—	≤ 5	
2.9 Low-speed pre-ignition GDI turbo	ASTM D8291 (Sequence IX, Ford)	Pre-ignition events	Number of events per iteration	—	≤ 8	
		Elongation of timing chain	%	—	≤ 0.085	

*/**: Footnotes referring to the following requirements in the A-/B- and C-classes:

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 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: ≤ 2.0.

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-106-16 (DV6C) lifetime is limited. If the test becomes unavailable during the lifetime of these ACEA 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

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.

1. LABORATORY TESTS

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS				
				C2-21	C3-21	C4-21	C5-21	C6-21
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 and < 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: - Tensile strength - Elongation at rupture - Volume variation		Elastomer type				
				RE6	RE7	RE8	RE9	
				Report	Report	Report	Report	Report
				-70/+20	-65/+15	-51/+9	-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	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 168h (DIN 51453)	A/cm	≤ 100	≤ 100	≤ 100	≤ 100	≤ 100
		Oil oxidation at 216h (EOT) (DIN 51453)	A/cm	≤ 120	≤ 120	≤ 120	≤ 120	≤ 120
		Viscosity increase, relative at 168h (Delta KV100)	%	≤ 60	≤ 60	≤ 60	≤ 60	≤ 60
		Viscosity increase, relative at 216h (Delta KV100)	%	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150

*/**: Footnotes referring to the following Requirements in the A-/B- and C-Classes:
No 1.6, 1.7, 1.8 Maximum limits, values take into account method and production tolerances

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
2.1 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 piston skirt varnish	Merit	≥ 7.6				
		Average engine varnish	Merit	≥ 8.6				
		Compression ring (hot stuck)		none				
		Oil screen clogging	%	Report				
2.3 Valve train 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-109-19 (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	Merit	—			≤ 0.085	

*/**: Footnotes referring to the following requirements in the A-/B- and C-classes:

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 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-106-16 (DV6C) lifetime is limited. If the test becomes unavailable during the lifetime of these ACEA 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

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.

1. LABORATORY TESTS

REQUIREMENT	TEST METHOD	PROPERTIES	UNIT	LIMITS			
				E4-22	E8-22	E7-22	E11-22
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 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 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 - Tensile strength - Elongation at break - Volume change		Elastomer type			
				RE6	RE7	RE8	RE9
				Report	Report	Report	Report
				-70/+20 -1.5/+1.8	-65/+15 -1.8/+7.7	-51/+9 0.0/+10.7	Report -65/+19 -1.5/+13.8
1.10 Foaming tendency	ASTM D892 without option A	Tendency - stability	ml ml ml	Sequence I (24 °C) 10 – nil Sequence II (94 °C) 20 – nil 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 Lead increase Copper strip rating	ppm ppm max.	Report Report Report		Report ≤ 100 Report	≤ 20 ≤ 100 3
1.14 TBN*	ASTM D2896		mg KOH/g	≥ 12	≥ 7	≥ 9	≥ 7
1.15 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			
1.16 Oil oxidation with biodiesel	CEC L-109-14	Oxidation increase after 168 h KV100 increase after 168 h	A/cm %	≤ 90 ≤ 130	≤ 80 ≤ 130	≤ 120 ≤ 300	≤ 90 ≤ 150

*/**: Footnotes referring to the following requirements:
No 1.14 For E7, values < 9.00 are not accepted.

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			
				E4-22	E8-22	E7-22	E11-22
2.1 Wear	CEC L-99-08 (OM646LA)	Cam wear outlet (avg. max. wear 8 cams)	µm	≤ 140		≤ 155	
2.2 Soot in oil*	ASTM D5967 (Mack T-8E)	Test duration 300 h Relative viscosity at 4.8% soot and 50% shear loss		≤ 2.1			
2.31 Piston cleanliness*	CEC L-118-21 (OM471)	Piston cleanliness (grooves and piston undercrown), average	%	≥ 74			
		Oil consumption	g/h	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 Piston ring sticking				None 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 T12)	Merit	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 250-300 hrs	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 height	A/cm		≤ 125		≤ 125
		Nitration peak height	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 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 GH-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.

Certification and registration

Claims against the ACEA Oil Sequences can be made on a self-certification basis. For any claim being made, ACEA recommends that oil suppliers register their products with the ACEA registration system on the ACEA website after their launch into the market. Registration does not replace the required EELQMS oil marketers' letter of conformance registration in SAIL (Services to Associations and Industry in the Lubricants sector) www.sail-europe.eu/.

All information needed for registering in ACEA's registration system is available on ACEA's website - <https://app.acea.be/EOR>. After the form is completed, 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.



Nomenclature and ACEA process:



Each set of ACEA Oil Sequences is designated for consumer use by a two-part code comprising a letter to define the class (eg C), and a number to define the category (eg C2).

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

Classes may be added in future if, for example, natural gas engines, H2 combustion engines or engines which operate with alternative fuels (e-fuels), 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 each ACEA Oil Sequences document are intended only for industry use and indicate the year of implementation of that severity level for the particular category. A new year number will indicate, for example, that a new test, parameter or limit has been incorporated 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 (eg 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 (eg product literature, packaging, labels), they must specify the ACEA class and category (see nomenclature and ACEA process for definitions).



Consumer language

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).

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

A3/B3 Category withdrawn with these ACEA Oil Sequences. Stable, stay-in-grade engine oil intended for use in passenger car and light-duty gasoline and 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 and 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 and 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 manufacturers' owner 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 and 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 manufacturers' owner 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.*

C1 Category is withdrawn with these ACEA 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, and 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, and 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, and 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, and 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, and 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 also provide 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.

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.

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

INFINEUM REGIONAL SALES OFFICES

Europe/Middle East/Africa
PO Box 1
Milton Hill
Abingdon
Oxfordshire OX13 6BB
United Kingdom
Tel: + (44) 1235 54 9501
Fax: + (44) 1235 54 9523

Americas
1900 East Linden Avenue
PO Box 717
Linden NJ 07036
USA
Tel: + (1) 800 654 1233
Fax: + (1) 908 474 6117

Asia Pacific
Infineum Singapore Pte Limited
1, Harbourfront Avenue
#08-01/08 Keppel Bay Tower
Singapore 098632
Tel: + (65) 6899 1661
Fax: + (65) 6895 6900

Infineum (Shanghai) Additives Co. Ltd.
China Business and Technology Centre
Building 12, Jinqiao Office Park
27 XinJinQiao Road
Pudong
Shanghai 201206
China
Tel: + (86) 21 31583940
Fax: + (86) 21 31583802

Not all offices are listed.

To locate your local sales office please contact the nearest address above or visit our website:

Infineum.com

Permission is given for storage of one copy in electronic means for reference purposes. Further reproduction of any material is prohibited without prior written consent of Infineum International Limited.

The information contained in this document is based upon data believed to be reliable at the time of going to press and relates only to the matters specifically mentioned in this document. Although Infineum has used reasonable skill and care in the preparation of this information, in the absence of any overriding obligations arising under a specific contract, no representation, warranty (express or implied), or guarantee is made as to the suitability, accuracy, reliability or completeness of the information; nothing in this document shall reduce the user's responsibility to satisfy itself as to the suitability, accuracy, reliability, and completeness of such information for its particular use; there is no warranty against intellectual property infringement; and Infineum shall not be liable for any loss, damage or injury that may occur from the use of this information other than death or personal injury caused by its negligence. No statement shall be construed as an endorsement of any product or process. For greater certainty, before use of information contained in this document, particularly if the product is used for a purpose or under conditions which are abnormal or not reasonably foreseeable, this information must be reviewed with the supplier of such information.

Links to third party websites from this document are provided solely for your convenience. Infineum does not control and is not responsible for the content of those third party websites. If you decide to access any of those websites, you do so entirely at your own risk. Please also refer to our Privacy Policy.

'INFINEUM', the interlocking Ripple Device, the corporate mark comprising INFINEUM and the interlocking Ripple Device and 润英联, are trademarks of Infineum International Limited.

© 2022 Infineum International Limited. All rights reserved

2022503

