

LUBE-TECH

NO.28

WORLDWIDE PERFORMANCE SPECIFICATIONS FOR DIESEL ENGINE OILS - ADDITIONAL SPECIFICATIONS NOW INTRODUCED FOR LIGHT-DUTY OPERATION

An article in the Lubetech section of Issue number 44 February 2001 of 'Lube' referred to the announcement of the development of the world's first truly global worldwide performance specification for vehicle crankcase lubricants, namely, the WWHD-1 diesel engine oil. A draft specification, devised following collaboration between the European Automobile Manufacturers Association (ACEA), the Engine Manufacturers Association (EMA), and the Japan Automobile Manufacturers Association (JAMA), had already been circulated for comment in June 2000 from interested parties, including fuel suppliers, additive suppliers, fuel distributors and others. Comments were due October 1, 2000.

ACEA, EMA and JAMA received several general comments regarding the nature and purpose of the specification, as well as specific questions regarding test procedures and limits. Based on those comments, summarised below, and subsequent discussions with interested parties over the past several months, ACEA, EMA and JAMA clarified certain matters and made a number of other improvements to the specification.

A revised specification, see below, was circulated for final comment, and announced in a Press Release later in 2001. The oil would now be designated 'Global DHD-1'. This specification was considered to be a significant first step towards a structure where a small number of global engine oil specifications replace larger numbers of localized specifications, the advantages being reduced costs for test development and approval tests, as well as improved customer understanding."

Global DHD-1 was described as a performance specification for engine oils used in high-speed, four-stroke heavy-duty diesel engines designed to meet 1998 and newer exhaust emission standards worldwide. Oils meeting this specification would also be compatible with certain older engines, although application of these oils would be subject to the recommendation of individual engine manufacturers.

JAMA welcomed the introduction of this oil since Global DHD-1 would provide an appropriate guideline to the users of Japanese-made engines in choosing engine oils when neither OEM's genuine oils nor JASO DH-1 oils were available.

This recommended guideline was developed from existing specifications of the three

Organizations mentioned above. It does not contain all the elements of the API CH-4, JASO DH-1 or ACEA E5 specifications.

To illustrate further the nature of the consultative process summaries of comments received on WWHD-1 are listed below:

GENERAL

Comment: Recommendation that the Specification have a self certification process (similar to ACEA).

Response: Producers are expected to self-certify to the Specification. ACEA, EMA and JAMA recommend that any producer or marketer claiming that an engine oil meets the Specification have adequate performance data to support such claim and make such performance data reasonably available to interested parties upon request.

Comment: Concern that the Specification does not include a review and approval system, together with the associated bureaucracy and costs.

Response: There is no review or approval process associated with the Specification.

Comment: Proposal - (i) Define WWHD-1 for oils used in older equipment with minimal emission capability and more modern engines at reduced drain

levels; (ii) Define DHD-2 for oils used in current heavy-duty diesel engines meeting current emission standards; (iii) Develop a more cost effective version of WWHD-1 (bearing in mind the current approval status of several products already in the marketplace).

Response: The Specification defines a single oil performance level needed for 1998 and newer emission controlled engines. Oils meeting this Specification may also be used in older non-emission controlled engines. While the development of tiered specifications as suggested was considered, the complexity of such a system was believed to be beyond the scope of this initial effort. As future global specifications are developed, such a proposal may be more appropriate.

Comment: Recommendation that a three-tiered proposal, similar to that made by Ford for passenger cars a few years ago, be developed.

Response: A three-tiered approach was determined to be beyond the scope of the Associations' initial effort.

Comment: Concern that another specification without API endorsement will add to confusion in the marketplace.

Response: There are a number of non-API endorsed specifications currently in the marketplace. The engine manufacturer customer is generally capable of sorting these out properly.

Comment: Concern that, to be successful, WWHD-1 needs support from the OEMs and sufficient publicity.

Response: While individual engine manufacturers have sole discretion as to oil recommendations for their engines, the members of ACEA, EMA and JAMA have approved the Specification.

Comment: Question regarding the intent of the Specification.

Response: Engine oils meeting the minimum performance requirements of the Specification are intended to provide a consistent oil performance worldwide and therefore may be recommended by engine manufacturers to maintain engine durability wherever their engine is being used.

Comment: Question regarding whether the OEMs will use WWHD-1 as the basis for their individual oil drain recommendations.

Response: The manner in which the Specification will be utilized is within the discretion of the individual OEM.

Comment: Recommendation that read-across guidelines and regional codes of practice be applied.

Response: Additional language to that effect has been added to the Specification.

Comment: Concern that WWHD-1 will detract from PC-9, API SL and ILSAC GF-3 development.

Response: The Specification is an effort that is independent of, and should not detract from, these other categories.

Comment: Concern that the stated aim of "common test development" hasn't been achieved in any area.

Response: While common test development was a goal, timing and resource constraints necessitated the use of existing tests. It continues, however, to be a goal for the next specification.

Comment: Concern that the Specification makes no mention of viscosity grades or Noack limits.

Response: Oils claiming to meet the Specification must have the same performance level regardless of the viscosity grade or chemical and physical properties, including Noack.



Volvo D7 engine

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Comment: Clarification requested regarding the manner in which WWHD-1 will be supported by the three organizations.

Response: The three associations expect support, presumably in end use, to come from the engine manufacturers and their customers.

Comment: Question whether WWHD-1 will replace existing systems or be run in parallel.

Response: The Specification is not intended to replace any existing categories, specifications or systems.

Comment: Recommendation that the definition of minimum performance be clarified and made compatible with the details of the Specification (also request that the limits be "critically reviewed").

Response: Minimum performance as used in the Specification refers to the limits, meaning that an oil meeting the Specification must meet or exceed the performance defined. This process of review and comment is intended to provide the "critical review."

Comment: Concern about including single cylinder tests in WWHD-1, as multi-cylinder tests are seen as more reliable indicators of field performance.

Response: Tests selected for the Specification were based on the characteristic measured, test availability and representation of engine hardware in field use. For example, the 1R was selected because of the need to have a ferrous piston deposit test. Although the 1P was the current test in CH-4, the 1R was believed to be more compatible with the performance characteristics sought in the Specification.

Comment: Concern that pass/fail criteria be fully aligned with the local specifications, so that the overall specification presents a consistent approach and occasional need for requalification is avoided.

Response: In most cases the pass / fail limits used are aligned with the local specification. The limits differ where there is a need to satisfy a performance level not covered completely by the selected test or where limits were not in place for the local specification. In those cases, limits were set on current data and best judgment. The limits on the Sequence IIIF and Elastomer Compatibility tests are two examples.

Comment: Doubt expressed as to whether oils meeting WWHD-1 will be suitable, even as a minimum performance level, for US engines equipped with EGR designed to meet 2002 emission limits.

Response: Time will tell.

Comment: Request for a reduction or elimination of the engine tests performed by manufacturers on WWHD-1 approved oils.

Response: Any decision on whether to eliminate or reduce the in-house test requirements for oils meeting the Specification are up to the individual OEM.

Comment: By eliminating the TBN requirement from the proposed JASO DH-1 specification, products are already in the marketplace capable of meeting the three specifications.

Response: For JASO DH-1, JAMA requires the initial TBN higher than 10. However, the requirement can be waived if the oil is tested in the Mack T-9 with an EOT lead result lower than 15 ppm.

Comment: Real benefit is to end users in parts of the world where majority of heavy-duty engines are currently running on monograde oils meeting API CF performance.

Response: In general, engine manufacturers do not supply different engines to different areas of the world. The associations are hopeful that a worldwide performance specification will encourage common test development, which, in turn, may save the engine oil and additive industries significant resources.

REDUNDANCIES

Comment: Concern over test redundancy (3 tests covering Valve Train Wear and 4 tests covering Oxidation). Recommendation that a correlation between tests be conducted that may lead to removal of some tests.

Response: Much effort was expended to minimize redundancy through reference oil exchange testing. While there may appear to be test redundancy,

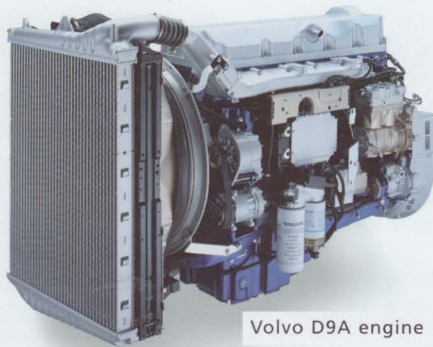
each selected test measures the performance characteristic under different conditions or engine design.

Comment: Request that the correlations of the various tests be reduced, possibly to one.

Response: Wherever possible test requirements were rationalized. For example, the JAMA TD25 piston deposit test was not included because its needs were covered by the ACEA OM 441 LA test.

Comment: Questions regarding multiple tests are as follows: (i) 3 Wear Tests - could either the M-11 or 4D34T4 be removed?; (ii) 2 Oxidation Tests - shouldn't the IIIF suffice?; (iii) 2 High Temperature Foam Tests - why add the Sequence IV foam requirement when the HDEOCP work has shown that HEUI provides a better indication of field performance?

Response: Reference oil exchange testing confirmed that the multiple tests were required to cover the performance requirements adequately. The PDSC test measures thin film oxidation, while the IIIF measures bulk oxidation. Both the Aeration and High Temperature Foam Tests were needed to satisfy the needs of U.S., European, and Japanese engine builders.



Volvo D9A engine

SEAL TEST LIMITS

Comment: Recommendation that seal test limits be identical to those currently in place for the ACEA E sequences (RE2, RE3 and RE4 elastomers are correct — RE1 appears to be inconsistent). Recommendation that ACEA 1999 limits for CE1 elastomers be adopted in WWHD-1.

Response: These limits have not yet been agreed upon. The Specification contains the limits desired by the engine manufacturers; however, a footnote was added to adopt the less stringent limits proposed by the ATC / ATIEL if approved.

READ-ACROSS GUIDELINES

Comment: Recommendation to apply established base oil interchange and viscosity grade read-across guidelines.

Response: The Specification provides that regional guidelines may be used.

SEQUENCE IIIF

Comment: Recommendation to "grandfather" existing Sequence IIIE data.

Response: A footnote has been added to Table 2A allowing a passing API CH-4 IIIE result to satisfy this requirement.

Comment: Recommendation that the Specification include limits for Sequence IIIF based on ASTM correlation study.

Response: The limits established for this requirement were modified to reflect that correlation.

Comment: Viscosity increase needs to be defined at 40 C not 100 C.

Response: The commentators are correct, and the change was made.

Comment: Recommendation that the 100% limit be removed until the HDEOCP proposes an equivalent IIIF CH-4 limit.

Response: The timing for the HDEOCP proposal will be too late for publication of the Specification. An evaluation of the ASTM data was made resulting in a change in the limit to 200%.

Comment: Recommendation that a CMA registered Sequence IIIE test, which meets API CH-4 requirements, be accepted for WWHD-1.

Response: A footnote has been added to Table 2A allowing a passing API CH-4 IIIE result to satisfy this requirement.

Comment: Question regarding which of the 2 tests, the Sequence IIIF or the Sequence IIIG, is to become part of WWHD-1.

Response: Sequence IIIF was chosen.

Comment: Question regarding how a viscosity control limit of 100% can be justified when the current API limit proposal is 275%, and so little experience on this test has been gained.

Response: Based on additional data received, the limit was relaxed to 200%. It was the opinion of the associations that the limit was equivalent to the API CH-4 oxidation level.

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Comment: Question regarding a proposed limit for the Sequence IIF. Opinion expressed that with the Mack T-9 and the PDSC tests, the Sequence IIF could be eliminated from the requirements without compromising field performance.

Response: The Mack T9 and the PDSC measure different oxidation characteristics from the IIE. The IIF is recommended by ASTM as the replacement test for the IIE. The performance level identified is intended to be equivalent to the API CH-4.

CAT 1-R

Comment: Recommendation that a test provision be included to allow the substitution of CAT 1P test (Lubrizol, ATC; or CAT 1Q) for 1R test.

Response: A footnote has been added to Table 2A allowing a passing API CH-4 1P result to satisfy this requirement. If there is an equivalency between the 1Q and the 1R, the associations could consider using the 1Q to meet this performance requirement.

Comment: Recommendation that a test procedure be developed for 1-R test, which may be adopted by ASTM.

Response: This process is currently underway. In the meantime, the 1R test procedure will be available on the associations' Web sites, along with the Specification.

Comment: The Cat 1R limits for TLC are lower than the data indicates would be required. Comment that a one-test limit of 44 would be more appropriate.

Response: In reviewing the available data, the associations concluded that 40% TLC was the correct one-test number to provide the proper performance level.

Comment: Comment that TLC and TGC should not be in %.

Response: These parameters are measured in terms of percent volume.

Comment: Concern that the oil consumption ratio may restrict some good oils, which start very low. Recommendation that perhaps a max EOT level can be used with, or as an alternative to, the ratio.

Response: The limits have been established such that a passing oil maintains good oil control throughout the test.

Comment: Concern expressed about the inclusion of the CAT 1R test - the test should be developed in accordance with API or ACEA specifications. Recommendation that if the test is not developed properly by the time WWHD-1 is introduced, it should not be included in the Specification.

Response: The test has been submitted for ASTM development and monitoring. It does not need to be part of an API or ACEA specification to become an ASTM test procedure. Until that process is complete this requirement may be met by running the 1P using CH-4 pass / fail limits, or by running the 1R procedure using the method as published by Caterpillar and available on the associations' Web sites, along with the Specification.

D 5968 (CBT)

Comment: Recommendation that for CH-4, it should specify the 275 F temperature (or the new ASTM method). The new limits of 20 Cu 120 Pb and 50 Sn should also be used for CH-4. There is also a limit on the Cu strip rating of 3 max.

Response: Correct. The limits, as set forth in Table 2b and within the test, have been changed accordingly. The test method is ASTM D6594.

MACK T-9

Comment: Question / recommendation regarding whether the Pb limits should be 25 ppm max if CH-4 level is desired or 20 ppm as in the EOM+ spec not 15.

Response: The EOM + specification has no relevance to Global DHD-1. A limit of 15 ppm was selected to accommodate the 10 TBN minimum limit needed for Japanese EGR equipped engines. A footnote has been added to Table 2A

permitting this requirement to be met with either a minimum 10 TBN limit and EOT lead of 25, or an EOT lead result of 15 ppm with no minimum TBN limit.

Comment: Question whether tiered limits should be included in the Specification to align with the "test averaging acceptance criteria" adopted for the other elements of this test.

Response: The methodology described by Test Averaging Acceptance Criteria did not lend itself to setting tiered limits.

Comment: Comment that tightening the limits on certain tests vs. the current regional requirements (i.e., Mack T-9 lead limit) has the potential to result in significant verification costs.

Response: A footnote has been added to Table 2A permitting the higher lead limit of 25 ppm to apply if the oil has a minimum TBN limit of 10.

OM 441LA

Comment: Concern expressed that the test is expensive and provides poor levels of precision, etc. Combination of performance limits and reproducibility values do not allow OM 441 LA test to meet the objective criteria of ISO 4259.

Comment: There was a concern over test repeatability and reproducibility. Recommendation that the associations maintain existing published limits for WWHD-1, and work within the CEC test working group to improve test precision.

Recommendation that the following options be considered:

(i) Reproducibility targets are achieved which correspond to 0.5 or 0.25 of the target ranges specified in WWHD-1;

(ii) limit intervals are expanded to the current levels of reproducibility;

(iii) a passing "result" can be constructed from

the passing portions of repeated tests on the same oil

OR (iv) the test is withdrawn until it has been refined or a suitable alternative identified.

General response to OM 441 LA comments: Problems with precision levels are recognized and are being addressed by the responsible CEC working group. The

limits are set to reflect the current level of precision. Furthermore, the limits and read across guidelines applied to the Specification also are applied to the ACEA E5 specification.

Demonstration Oils

Comment: Question as to whether demonstration oils conforming to WWHD-1 exist.

Response: Chevron currently claims that DELO 400 meets the performance requirements of the Specification. The associations were not aware of any other such claims.

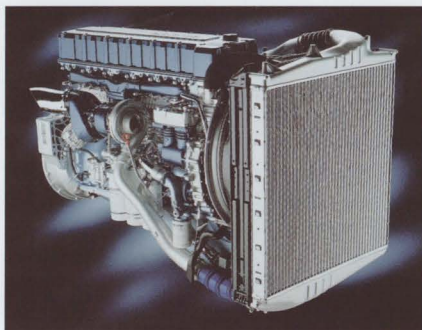
LIGHT DUTY DIESEL ENGINE OILS

SCOPE

These more recent specifications have now also been jointly developed by Association des Constructeurs Européens d'Automobiles (ACEA), members of the Alliance of Automobile Manufacturers (Alliance), Engine Manufacturers Association (EMA) and Japan Automobile Manufacturers Association, Inc. (JAMA). They are performance specifications for engine oils to be used in high-speed, four stroke-cycle light-duty diesel engines designed for older vehicles and those designed to meet year 2000 and newer exhaust emission standards worldwide. Oils meeting these specifications are also compatible with certain older engines. Application of these oils is subject to the recommendation of individual engine manufacturers. Individual engine manufacturers have sole discretion as to oil recommendations for their engines. They may choose to recommend oils meeting these performance specifications, or oils meeting these specifications with additional performance requirements, or oils with other performance requirements.

In a similar way to the heavy-duty engine oil, oils meeting the minimum performance requirements of Global DLD-1,

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Volvo D12 engine

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DLD-2 and DLD-3 are intended to provide consistent oil performance worldwide and therefore may be recommended as appropriate by individual engine manufacturers to maintain engine durability wherever their engine is being used.

These Specifications identify engine oils for use under adverse applications that necessitate wear control, high-temperature stability and soot handling properties. In addition, engine oils meeting the minimum performance requirements of Global DLD-1, DLD-2 and DLD-3 are expected to provide protection against oxidative and insolubles thickening, aeration, and excessive viscosity loss due to shear.

Global DLD-1 is intended to provide a basic level of performance, with particular properties, including corrosion resistance, that make such oils suitable for markets with high sulfur fuels approximating to World Wide Fuel Charter Category 1. Engine oils meeting the minimum performance requirements of **Global DLD-2** are expected to provide a higher level of performance plus a requirement for fuel efficiency, whilst **Global DLD-3** provides the highest level of performance. Both of these are suitable for markets with fuels approximating to World Wide Fuel Charter Category 2. Recommendations of these performance specifications in manufacturer's maintenance guides, owner's manuals, and related documents to describe the engine oils required for their products is voluntary. As before, oil marketers may voluntarily choose whether to market engine oils that meet these specifications. ACEA, Alliance, EMA and JAMA do not certify or license engine oils, are not responsible for individual oil marketer's claims of compliance with the Global DLD-1, DLD-2 and DLD-3 specifications, and make no representation or warranty concerning the appropriateness or performance of any oil alleged to meet these specifications.

PERFORMANCE LIMITS

The performance limits for these specifications are summarized in Table 2a below. **Tables 2b and 2c will be included in the next issue.**

While ACEA, Alliance members, EMA, and JAMA believe that in order to meet the performance limits of Global DLD-1, DLD-2 and DLD-3 engine oils should undergo a full test program, it is recognized that commercial practice often

includes the use of base oil and viscosity modifier interchangeability and viscosity grade readacross guidelines. Therefore the use of interchangeability and readacross guidelines generally applied to the respective engine tests included is acceptable. ACEA, Alliance members, EMA and JAMA recommend that any producer or marketer claiming that an engine oil meets the Global DLD-1, DLD-2 and DLD-3 specifications have adequate performance data to support such claim and make such performance data reasonably available to interested parties upon request.

TEST AVERAGING ACCEPTANCE CRITERIA (TAAC)

Any data based approach for evaluation of the performance of an oil formulation where more than one test is run on an oil formulation, and the results are averaged. If three or more tests are conducted one test may be discarded from the average. All parameters must average to a passing result. TAAC only applies to those performance characteristics that are shown in Tables 2a and 2b with a single limit. Characteristics with more than one limit are based on the number of runs made and reflect the test's precision without further averaging.

CONDITIONS FOR USE OF PERFORMANCE CLAIMS

Any claims of oil performance meeting these sequences must be based on credible data and controlled tests in accredited test laboratories. The quality control and registration systems generally applied to the respective engine tests should also be used. Where limits are shown relative to a reference oil, these must be compared to the last valid Reference Result on that test stand prior to the candidate and using the same hardware.

CURRENT STATUS

The specifications detailed in the accompanying tables are the final versions and were published on the ACEA website (see below) last December. They have already been subjected to a consultational review process (4Q 2002).

Full details of all of these new specifications are available on a number of websites, for example, www.acea.be/ACEA/publications/html as mentioned above.

David Margaroni

Table 2a Global Engine Oil Service Specification DLD-1, DLD-2, DLD-3

Characteristic	Test Method	Test Name	Requirements	Limits			
				DLD-1	D	LD-2	DL
Engine Tests							
Ring sticking & Piston cleanliness (1)	CEC L-46-T-93	VW 1.6 TC D	Ring sticking, merit Piston cleanliness, merit.	RL 148 RL 148		RL 148 RL 148	
Medium temperature dispersivity	CEC L-56-T-98	Peugeot XUD11BTE	Absolute viscosity increase at 100°C and 3% soot (measurement with CEC L-83-A-97 method) Piston merit (5 elements) (average for 4 pistons)	0.90 x RL197 result. (RL197 minus 6 pts)		0.50 x RL197 result. (RL197 minus 6 pts.)	0.50 x RL197 result. RL197
Wear, Viscosity stability & Oil consumption	CEC L-51-A-98	Mercedes Benz OM602A	Cam wear. Average, m Viscosity increase at 40°C, % Bore polishing, % Cylinder wear. Average, m Oil consumption, kg/test	50.0 90 7.0 20.0 10.0		50.0 90 7.0 20.0 10.0	50.0 90 7.0 20.0 10.0
Wear, Valvetrain	JASO M354-1999	Mitsubishi 4D34T4 160 Hrs	Cam Lobe Wear, m Average	95.0		95.0	95.0
DI diesel Piston cleanliness & Ring sticking	CEC L-78-T-99	VW DI	Piston cleanliness, merit Ring sticking (Rings 1 & 2), ASF Average of all 8 rings Max. for any 1 st ring Max. for any 2 nd ring	----- ----- ----- -----		----- ----- ----- -----	RL206 minus 3 pts 1.2 2.5 0.0
Fuel economy	CEC L-54-T-96	Mercedes Benz M111E	Fuel economy improvement vs. Reference oil RL191 (15W-40), %	--		2.5	--
Oxidation	CEC L-88-T-02	Peugeot TU5JP	Ring sticking (each part), merit Piston varnish (5 elements) (average of 4 pistons) Absolute viscosity increase at 40°C between min and max values during test Oil consumption	9.0 RL216 1.5 x RL216 Report		9.0 RL216 RL216 Report	9.0 RL216 0.8 x RL216 Report

(1). A passing result in the CEC L-78-T-99 test (VW DI) to the DLD-3 requirements may be used in place of the CEC L-46-T-93 test.