The most significant changes in the 1998 sequence requirements are summarised as follows:

A1-98
For gasoline engines designed to use low friction oils with high temperature/high shear values down to a minimum of 2.9 mPas. As these oils are more specifically intended to produce fuel economy benefits, a fuel economy test sequence is now included which positively quantifies a minimum requirement. The M111E fuel economy test uses a 4-cylinder, 2 litre, 16 valve engine with electronic multiport fuel injection. It measures fuel economy improvements compared with a SAE 15W/40 reference oil RL 191. ACEA considers this CEC-L-54-T-96 test the only valid comparator against which fuel economy improvements should be made. There is no restriction on the viscosity grade of the oil other than the requirements to meet shear stability and high temperature/high shear requirements. Manufacturers may indicate specific viscosity requirements related to ambient temperature. Data from the 1996 issue may be reassessed to demonstrate compliance with the viscosity increase requirement in the TU3M Test. These oils may be unsuitable for use in some engines.

Sequence IIIE
Higher severity in viscosity increase at 40°C i.e. reduced from 200% to 100%, matching the A3 requirements, although max. cam and lifter wear increased slightly from 60µ to 64µ.

Peugeot TU3M High Temperature test
Increase in severity in the ring sticking and piston varnish requirements.

Data from the 1996 issue may be reassessed to demonstrate compliance with the viscosity increase requirements. Oil consumption to be now reported.

MB 111E Fuel Economy
Oils are now required to demonstrate a minimum improvement of 2.5% compared with a reference oil.

Foaming Tendency
A further measure at 150°C has been introduced.

Oil Elastomer Compatibility
Some slight relaxation has been allowed in certain of the requirements.

A2-96 ISSUE 2
Conventional oils for mainstream gasoline engine use. Again, these oils may not be suitable for use in some high performance engines. There is no restriction on the viscosity grade of the oil other than the requirements to meet shear stability and high temperature/high shear requirements. Manufacturers may indicate specific viscosity requirements related to ambient temperature.

Sequence IIIE
Max. cam and lifter wear increased slightly from 60µ to 64µ.

Peugeot TU3M High Temperature test
No change in severity although oil consumption to be now reported.

Foaming Tendency
A further measure at 150°C has been introduced.

Oil Elastomer Compatibility
Some slight relaxation has been allowed in certain of the requirements.

A3-98
For high performance gasoline engines and/or long drain intervals. There is no restriction on the viscosity grade of the oil other than the requirements to meet shear stability and high temperature/high shear requirements. Manufacturers may indicate specific viscosity requirements related to ambient temperature.

Data from the 1996 issue may be reassessed to demonstrate compliance with the viscosity increase requirement in the TU3M Test.

Peugeot TU3M High Temperature test
No change in severity although oil consumption to be now reported.

Foaming Tendency
A further measure at 150°C has been introduced.

Oil Elastomer Compatibility
Some slight relaxation has been allowed in certain of the requirements.

B1-98
Oils for use in passenger car or light van diesel engines designed to use low friction oils with high temperature/high shear values down to 2.9 mPas. As with A1, as these oils are more specifically intended to produce fuel economy benefits, the M111E fuel economy test sequence is now included which positively quantifies a minimum requirement. There is no restriction on the viscosity grade of the oil other than the requirements to meet shear stability and high temperature/high shear requirements. Manufacturers may indicate specific viscosity requirements related to ambient temperature. In the medium temperature dispersivity test, the XUD 11ATE engine will be replaced by the XUD 11BTE, which is a modern version with an electronic fuel injection system. It is anticipated that the tests for viscosity increase and piston merit on the new engine will be given "T" test status sometime in 1998. These oils may be unsuitable for use in some engines.

MB OM 602A
Fit for purpose limits (see below) have been introduced for viscosity increase at 40°C, bore polishing, cylinder wear and oil consumption.

High Temperature Dispersivity (XUD 11ATE engine then XUD 11BTE)
Data for viscosity increase and piston merit to the 1996 issue of these sequences may be re-assessed to demonstrate compliance with the requirement as detailed in the Equivalency Guidelines in Appendix E of the ATIEL Code of Practice.

MB 111E Fuel Economy
Oils are now required to demonstrate a minimum improvement of 2.5% compared with a reference oil.

Foaming Tendency
A further measure at 150°C has been introduced.

Oil Elastomer Compatibility
Some slight relaxation has been allowed in certain of the requirements.

B2-98
Oils for use in most passenger car or light van diesel engines although these oils may not be suitable for use in some high performance engines. There is no restriction on the viscosity grade of the oil other than the requirements to meet shear stability and high temperature/high shear requirements. Manufacturers may indicate specific viscosity requirements related to ambient temperature.

MB OM 602A
Fit for purpose limits have been introduced for viscosity increase at 40°C, bore polishing, cylinder wear and oil consumption.

High Temperature Dispersivity (XUD 11ATE engine then XUD 11BTE)
Data for viscosity increase and piston merit to the 1996 issue of these sequences may be re-assessed to demonstrate compliance with the requirement as detailed in the Equivalency Guidelines in Appendix E of the ATIEL Code of Practice.

Oil Elastomer Compatibility
Some slight relaxation has been allowed in certain of the requirements.

B3-98
Oils for high performance passenger car diesel engines and/or long drain intervals. There is no restriction on the viscosity grade of the oil other than the requirements to meet shear stability and high temperature/high shear requirements. Manufacturers may indicate specific viscosity requirements related to ambient temperature.

MB OM 602A
Fit for purpose limits have been introduced for viscosity increase at 40°C, bore polishing, cylinder wear and oil consumption.
High Temperature Dispersivity (XUD 11ATE engine then XUD 11BTE)
Data for viscosity increase and piston merit to the 1996 issue of these sequences may be re-assessed to demonstrate compliance with the requirement as detailed in the Equivalency Guidelines in Appendix E of the ATIEL Code of Practice.

Foaming Tendency
A further measure at 150°C has been introduced.

Oil Elastomer Compatibility
Some slight relaxation has been allowed in certain of the requirements.

B4-98
This is a new category for oils used in direct injection diesel engines requiring special quality. Compared with the other B series, the VW 1.6 TC Diesel Intercooler requirements in terms of ring sticking and piston cleanliness have been transferred to the VW DI engine, a four cylinder 1.9 litre direct-injection, turbocharged, intercooled diesel engine, with an additional requirement to report the viscosity increase.

E1-96 ISSUE 2
Oils for use in heavy duty diesel engines. There is no restriction on the viscosity grade of the oil other than the requirements to meet shear stability and high temperature/high shear requirements. Manufacturers may indicate specific viscosity requirements related to ambient temperature.

MB OM 364 LA
The MB OM 364 A engine has been replaced by the MB OM 364 LA engine together with requirements for bore polishing, piston merit, cylinder wear, sludge merit and oil consumption. There is no increase in severity levels for the tests. Data for an existing test to the first 1996 issue of the E2 sequences may be reassessed to demonstrate compliance with the requirement as detailed in the Equivalency Guidelines in Appendix E of the ATIEL Code of Practice.

Foaming Tendency
A further measure at 150°C has been introduced.

Oil Elastomer Compatibility
Some slight relaxation has been allowed in certain of the requirements.

E2-96 ISSUE 2
Oils of super high performance diesel (SHPD) qualities intended for more severe use in heavy duty diesel engines including extended drain intervals and in turbocharged engines. There is no restriction on the viscosity grade of the oil other than the requirements to meet shear stability and high temperature/high shear requirements. Manufacturers may indicate specific viscosity requirements related to ambient temperature.

MB OM 364 LA
The MB OM 364 A engine has been replaced by the MB OM 364 LA engine together with requirements for bore polishing, piston merit, cylinder wear, sludge merit and oil consumption. There is no increase in severity levels for the tests. Data for an existing test to the first 1996 issue of the E2 sequences may be reassessed to demonstrate compliance with the requirement as detailed in the Equivalency Guidelines in Appendix E of the ATIEL Code of Practice.

Foaming Tendency
A further measure at 150°C has been introduced.

Oil Elastomer Compatibility
Some slight relaxation has been allowed in certain of the requirements.

E3-96 ISSUE 2
Oils of super high performance diesel (SHPD) qualities intended for the most severe use in heavy duty diesel engines including extended drain intervals and in turbocharged engines. There is no restriction on the viscosity grade of the oil other than the requirements to meet shear stability and high temperature/high shear requirements. Manufacturers may indicate specific viscosity requirements related to ambient temperature.

MB OM 364 LA
The MB OM 364 A engine has been replaced by the MB OM 364 LA engine together with requirements for bore polishing, piston merit, cylinder wear, sludge merit and oil consumption. There is no increase in severity levels for the tests. Data for an existing test to the first 1996 issue of the E2 sequences may be reassessed to demonstrate compliance with the requirement as detailed in the Equivalency Guidelines in Appendix E of the ATIEL Code of Practice.

Foaming Tendency
A further measure at 150°C has been introduced.

Oil Elastomer Compatibility
Some slight relaxation has been allowed in certain of the requirements.

Additional Information
Equivalency Guidelines (Grandfathering)
ERC registered engine test results generated prior to the revision of test procedures and test limits, which comply with the ACEA 1996 requirements, may be used in place of the new results generated under the new procedure or limit. It has been recognised by ATIEL/ACEA/ATC that for the TU3 MH and the XUD 11ATE tests, the data from the earlier version of the test, assessed versus the ACEA 1996 oil sequence limits, can be read across in place of the later version. This is because the revised procedure/limit does not signify an increase in severity or change of quality level. The intent of this guideline is to save the need to rerun later versions of procedure or report results in revised form when existing prior data are considered to provide the necessary quality assurance.

Data set for 'Fit-for-Purpose' Parameters
Certain parameters in the ACEA 98 Oil Sequences contained within OM 602A and OM 441LA engine tests have been designated with 'Fit-for-Purpose' limits. The parameters in question appear in the B and E sequence and are clearly identified 'FPFL' and a footnote. Theses parameters have been designated as such because they do not conform to CEC T status requirements at the time of issuing the Oil Sequences.

The procedure for defining the Fit-for-Purpose Limits is based on statistical evaluation of reference test oil results employing the ERC database. The limits are subject to regular review, based on ERC database, initiated by either ACEA or ATIEL or ATC via the ACEA WG F&L Group. Alternatively, test acceptance can be obtained by written OEM approval for the specific product/formulation.

An example for the OM 441 Bore Polishing Requirement is as follows:
Using the current appropriate ERC reference oil data, define the mean value and standard deviation for % bore polish parameter. CEC have defined a DP/DA of ≤ 1 as identifying significantly different
performance. Therefore, it is possible to calculate a theoretical mean to establish guidance to unacceptable performance based on available reference oil data. In this case the determination is based on ERC data on RL 133

e.g. we have data on RL 133 Mean = 0.6% bore polish
SD = 0.6% bore polish

If we assume that the SD of the poorer oil is the same as RL 133, then we can calculate the Mean of the poorer oil, M₀:

Then if \( DP/Δ = 1 \)

\[
DP/Δ = 5.15 \times \frac{SD}{M_0 - M_0} = 5.15 \times SD
\]

(M₀=0.6) x 1 = 5.15 x SD

\[
M_0 = 5.15 \times 0.6 + 0.6 = 3.69\% \text{ Bore Polish}
\]

Set a Fit-for-Purpose limit between M₀ and M₁:

i.e. Fit-for-Purpose Limit = (3.69 - 0.6)/2 + 0.6

= 2.15% Bore Polish

In addition to the technical requirements already identified and specified in the Sequences, there are a number of additional requirements which have been identified, and are likely to feature in future updates. Some of these are listed in the following table, although the list is not exhaustive:

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Potential Test Method</th>
<th>Parameters</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrosion</td>
<td>Ball Rust Test</td>
<td>Grey Scale Value</td>
<td>All 'A' &amp; 'B' categories</td>
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<tr>
<td>Longevity of Fuel E Economy Benefit</td>
<td>See note (1) below</td>
<td></td>
<td>A1 and B1</td>
</tr>
<tr>
<td>Catalyst Compatibility</td>
<td>OPEST test</td>
<td></td>
<td>All 'A' categories</td>
</tr>
<tr>
<td>EGR performance</td>
<td></td>
<td></td>
<td>New E5 category</td>
</tr>
<tr>
<td>Soot Induced Wear</td>
<td>Cummins M11</td>
<td>According to PC-7</td>
<td>New E5 category</td>
</tr>
<tr>
<td>Liner and Bearing Wear</td>
<td>Mack T9</td>
<td>Liner, ring and bearing wear, Top ring weight loss Lead content, used oil</td>
<td>New E5 category</td>
</tr>
<tr>
<td>Hot Surface Oxidation</td>
<td></td>
<td></td>
<td>New E5 category</td>
</tr>
<tr>
<td>Fuel Economy</td>
<td></td>
<td></td>
<td>E Categories</td>
</tr>
<tr>
<td>Turbocharger Deposits</td>
<td>CEC-L-52-T-97 (OM441LA)</td>
<td></td>
<td>E4-99 and future E5 category</td>
</tr>
</tbody>
</table>

Note (1) CEC-L-54-T-96 is conducted on fresh oil. A CEC test needs to be developed to demonstrate the longevity of any claimed fuel economy benefit.

**ATIEL CODE OF PRACTICE**

In addition to the technical requirements detailed above, the latest issue of the ATIEL Code of Practice contains a number of organisational requirements, some of which are detailed below.

Section 2.1 - ‘The marketer of an oil claiming to meet ACEA performance requirements is responsible for all aspects of product liability’

Section 2.5.3. – ‘All marketers have the responsibility of maintaining a complete record of each test development programme conducted under the ATIEL Code of Practice. The ACEA Performance Data Set is a summary of the total documentation required by a marketer to confirm the performance of an engine oil against the relevant ACEA Oil Sequence(s). The marketer is required to hold on file a copy of the ACEA Performance Data Set for each brand and viscosity grade of an engine oil. This data set is company confidential, but will be available for ISO 9001 audit purposes, or with the marketer’s consent for review by an external organisation. A standardised format for the ACEA Performance Data Set (see Appendix D) has been developed consisting of the following sections:

- Part A - Details of Marketer and Oils
- Part B - Physical and Chemical Properties and Laboratory Test Results
- Part C - Engine Test Results
- Part D - Checklist and Conformance’

Section 4. – ‘In operations where product is subject to further handling prior to sale (for example re-packaging, re-labelling or filling remotely from the blending plant) and where such actions are considered to be capable of affecting product quality, it is a requirement that such operations are also certified against ISO 9002, or other quality management system as defined above. In cases where products are marketed which have been supplied by third parties, then the marketer has to ensure that the supplier of the product has appropriate qualification systems in place’.

The BLF has certain reservations concerning the appropriateness of some of the ACEA requirements, and is making representation through the appropriate channels. However, there can be no argument over the requirements stipulated above, which are clear-cut and will now hopefully dispel any remaining misconceptions in these particular areas.
MEETING THE NEEDS OF ILSAC GF-3 IN THE USA AND ELSEWHERE

Looking at the latest developments across the Atlantic in the US automotive lubricants industry, an up-rated engine oil formulation ILSAC GF-3 is being introduced. The primary requirements for GF-3 can be classified as environmental - to help meet increased requirements for fuel economy and emission systems protection. Another reason for GF-3 is the need to improve fuel economy, to partially offset auto manufacturers changing vehicle fleet averages. This new specification raises new tests and acceptance criteria for the formulator.

The proposed ILSAC GF-3 / API PS-06 engine oil specification calls for a significant improvement in oil performance over GF-2 / API SJ.

In the United States OEMs are concerned about fuel economy because the vehicle population is undergoing major change from traditional passenger cars toward more small trucks, vans and 4x4s. The resulting engine and vehicle mix is such that overall Corporate Average Fuel Economy (CAFE) may slip. CAFE regulations require manufacturers to meet a specific weighted-average fuel consumption figures for their vehicle fleet, otherwise penalties are imposed. To reverse this trend and avoid penalties, auto manufacturers are seeking an improved fuel economy test that takes into account two factors:

- Oil ageing: in particular, they are requesting lubricants maintain their fuel economy properties as they accumulate mileage.
- The impact of friction modifiers due to the reduced sliding friction in new engines.

In addition, auto manufacturers want to ensure compliance with emission legislation over a vehicles useful life. The GF-2 phosphorus limit (0.10% max maximum) will remain for GF-3; however, the industry is also developing a performance-based test to measure the actual impact of emissions on catalyst efficiencies. The test, Oil Protection for Emission Systems Test (OPEST) evaluates changes in catalyst performance due to the engine oil formulation.

The proposed GF-3 specification includes all new engine tests in the approval process, and no one in the industry knows how current oils will perform in these tests. Proposed new tests are:

Sequence VG replaces the sludge portion of the Sequence VE - The test bias of the new engine with regard to sludge, varnish and deposits must be determined.

Sequence IIIF replaces the Sequence IIIE - Besides a new engine, there is a move to unleaded fuel, which may change test severity from that of the Sequence IIIE. This test will evaluate wear, oxidation and deposit forming tendencies at high temperature.

A ball rust test replaces the Sequence IID - This is a bench test that uses lifter balls to determine the rust protection provided by the oil.

Sequence VI-B replaces the Sequence VI-A - Evaluations are under way to determine the relationship of the new test to field test data being generated by automobile manufacturers. The Sequence VI-B measures the fuel economy characteristics of an oil aged to the equivalent of 4000 miles. This test indicates the fuel economy retention of an oil over its projected useful life.

Nissan KA24E replaces the wear portion of the Sequence VE test - The Sequence VG test has no wear measurement because the engine uses roller cam followers, so the new test was adopted to measure valve train wear.

OPEST - A new test under development designed to evaluate how engine oils affect catalyst efficiency.

Unleaded L-38 - Traditional hardware using unleaded fuel to measure bearing corrosion.

One of the major areas of debate in the industry is high-temperature deposit control. ASTM has formed a task force to study ways to meet the need for significant improvement in high temperature deposit control. Current test protocols no longer include a test focused primarily on examining oil deposit formation in the high-temperature zone. The industry is assessing whether an existing test can be used for this evaluation or whether a new test is needed. Tests currently under consideration are a Sequence IIIIF ring land deposit rating, a modified TESST, the Caterpillar IM-PC test (API CF) and the Peugeot TU-3 high-temperature scuffing test (which is part of the ACEA sequences).

Auto manufacturers are concerned about high-temperature deposits because the move to ILSAC GF-2 removed the incentive for oil marketers to provide commercial category performance (API "C") in a passenger car motor oil. As a result, treatment rates were reduced by an average of more than 10%. This drop was due primarily to reduced detergent levels. At the same time, some engine designs will have higher sump temperatures and hotter piston operating temperatures under normal operating conditions. Since a primary function of detergents is to keep high-temperature areas of the engine clean, lower detergent levels may lead to increased piston deposits and ring sticking.

A second important function of detergents is to prevent rust. Therefore, reduced detergent levels in oils could make it more difficult to provide adequate rust protection.

The present timeline calls for the GF-3 specification to be issued on 1st January 2000, with commercial use beginning twelve months later. The development of the new tests has raised a number of issues in the industry. In the time leading up to final release of the specification, we will examine these issues and the factors influencing performance.

Rod Parker

Much of the information used in this article was kindly supplied by Lubrizol.

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**ILSAC Specification**

<table>
<thead>
<tr>
<th>ILSAC Specification</th>
<th>GF-1</th>
<th>GF-2</th>
<th>GF-3</th>
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<tbody>
<tr>
<td>Antikblase</td>
<td>Seq. VE/VE</td>
<td>Seq. VE</td>
<td>KA24E??, Seq.IIIF</td>
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<tr>
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<td>Seq. VE</td>
<td>Seq. VE</td>
<td>Seq. VE</td>
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<td>Cat.1G2</td>
<td>Seq. IID</td>
<td>Seq. IIE</td>
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<td>Antioxidant</td>
<td>Seq.IIE</td>
<td>Seq. IIE</td>
<td>Seq. III</td>
</tr>
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<td>Seq. VIA</td>
<td>Seq. VIA/B</td>
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<td>L-38</td>
<td>L-38</td>
<td>L-38/Unleaded L-38</td>
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<td>0.10% Phos</td>
<td>0.10% Phos + OPES</td>
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<td>22% NOACK</td>
<td>15% NOACK</td>
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<tr>
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<tr>
<td>High Temperature Deposit Control</td>
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