



The ATIEL Code of Practice for Developing Engine Oils Meeting the Requirements of the ACEA Oil Sequences

Issue Number 11, April 5, 2005

This issue supersedes all previous issues.

All new developments initiated after the date of this issue shall use this issue.

This Code of Practice has been devised by members of the European lubricant industry.

The Code is intended to aid continuous improvement in the development of engine lubricants and the consistency and validity of performance claims made for them. In the Code engine tests, procedures, and record keeping are specified.

SPECIAL NOTES

In the event of questions arising from this Code of Practice and its interpretation, then the matter shall be presented by those concerned to the ATIEL Secretary General.

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Marketers, who use readacross or interchange guidelines in place of engine testing should be able to demonstrate that the lubricant would be expected in fact to meet all engine test requirements of the ACEA Oil Sequence for which a claim is made.

The ATIEL Code of Practice for Developing Engine Oils
Meeting the Requirements of the ACEA Oil Sequences

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1. Introduction

The ATIEL Code of Practice is designed to be used by lubricant marketers when developing engine lubricants to meet the minimum performance requirements prescribed by the ACEA Oil Sequences. ATIEL is committed to support the development and marketing of automotive products that fully satisfy the European performance and quality requirements deemed necessary by ACEA for satisfactory engine life and operation.

The contents of this document relate to the application of the ATIEL Code to the ACEA Oil Sequences (refer section 2.1) and stress the importance of testing requirements as a pre-requisite to the generation of consistent and precise test data. Provided in the Code are a series of guidelines to be observed during to the process of lubricant development commencing with the commissioning of the test programme on the lubricant candidate (refer sections 2.2). Explained in the Code are the changes that can be made to the composition of this lubricant (refer sections 2.3 and 2.4) during its development, consistent with the basic principles of best industry practice, also the standards that should be exercised in the reporting of test results and the maintenance of test records (refer section 2.5). It is stressed that all procedures and test reporting should be subject to internal auditing through ISO 9001, QS 9000 or ISO TS 16949 procedures. For blending and manufacture of the final product an accredited auditable quality management system should be used (refer section 4).

In summary, the ATIEL Code of Practice provides lubricant companies with a mechanism, and a commitment, to regularise their practices in developing engine lubricants where ACEA Oil Sequences are to be claimed in the market place. The Code is open to all companies on a voluntary basis, and nothing in the Code forms part of a contract.

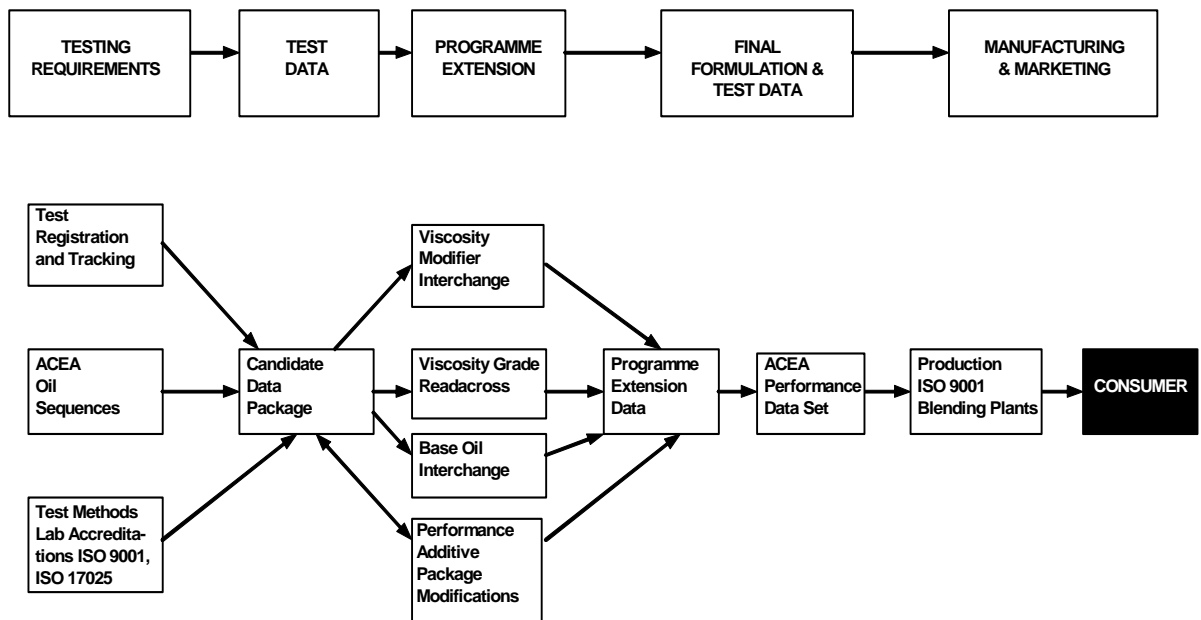
The marketer of an oil claiming to meet ACEA performance requirements is responsible for all aspects of product liability.

2. ATIEL Code of Practice

The ATIEL Code of Practice provides a technical framework within which automotive engine lubricants should be developed - either independently by a lubricant marketer or by a process involving the collaboration of a third party such as a petroleum additive supplier. In either case, the lubricant marketer is fully responsible for the quality of the lubricant reaching the consumer together with the performance claims being made in the market place. The Code provides the lubricant marketer with a set of guidelines and standards considered by ATIEL to be compatible with current industry best practice. The primary aim is to generate an ACEA Performance Data Set to support fully the technical integrity of candidate lubricant relative to the ACEA performance requirements.

The key elements of the Code of Practice are shown in the figure below. All elements are auditable by recognised quality standards such as those described in ISO 9001, QS 9000, ISO TS16949 and ISO 17025. The system is one of self-certification and the development process of ACEA quality engine oils using this Code of Practice must be referred to in the marketer's quality procedures.

Steps for Developing Engine Oils to Meet ACEA Oil Sequences



2.1. ACEA Oil Sequences

Representing the vehicle manufacturers in Europe, ACEA has issued an engine oil classification system setting stringent demands on lubricants to satisfy significant changes in engine hardware technology operating under European conditions.

The ACEA Oil Sequences for service-fill engine oils cover present needs for gasoline and light duty diesel engines, engines with after treatment devices and heavy duty diesel engines - these sequences being sub-divided into individual performance categories.

Each sequence comprises Laboratory Tests and Engine Tests, to be run according to ASTM and CEC test methods. Where appropriate, CEC tests developed to serve the special requirements of European conditions are specified preferentially.

The ACEA Oil Sequences represent minimum standards to be met voluntarily by lubricant marketers. However, ACEA have specified the following:

“Conditions for use of performance claims against the ACEA Oil Sequences”:

- ACEA requires that any claim for oil performance to meet these sequences must be based on credible data and controlled tests in accredited test laboratories.
- All engine performance testing used to support a claim of compliance with the ACEA sequences must be generated according to the European Engine Lubricant Quality Management System (EELQMS). This system, which is described in the ATIEL Code of Practice, 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 ATIEL Code of Practice will be mandatory for any claim to meet the requirements of the 2002 and 2004 issue of these ACEA sequences.
- The marketer of an oil claiming to meet ACEA performance requirements is responsible for all aspects of product liability.

2.2. Testing Requirements

An essential aim of the Code is to ensure a system of statistically valid testing based on current best industry practices. In this regard ATIEL recognises the importance of existing industry practices as provided under other Codes, namely:

- the ACC Code of Practice applied to ASTM test procedures, and
- the ATC Code of Practice applicable to CEC test methods.

ATIEL share with both the ACC and ATC a mutual interest in the operation of practices by which engine lubricant tests are monitored regularly to encourage more consistent and precise operation, and which also act to stimulate the continuous improvement of such test procedures.

Critical aspects of these Codes considered by ATIEL to be essential ingredients of the testing regime, are described next.

2.2.1. Test Methods and Laboratory Accreditation

A cornerstone of the ATIEL Code of Practice is the availability of quality engine and bench test methods, without which lubricants with the required performance cannot be developed. The ATIEL Code of Practice will be applied, therefore, only to those ACEA Oil Sequences specifying the use of test methods conforming to minimum quality and precision standards. The minimum quality/precision requirement for European tests is a CEC designated test with a precision statement; for US tests the requirement is an ASTM test procedure. ATIEL will not apply the Code of Practice to tests deemed to be of a lower quality than CEC tests approved with a precision statement or ASTM tests. Laboratories conducting CEC engine tests must have these tests covered within the scope of their ISO 17025 accreditation. Furthermore, these engine test laboratories must have submitted a letter of intent to comply with the ATC Code of Practice. ASTM tests must be conducted in line with the requirements specified in the ACC Code of Practice.

2.2.2. Test Registration and Tracking

The ATC Code of Practice requires test laboratories to report all reference test data for CEC tests to the European Registration Centre (ERC). This ensures validity of all candidate tests. The reference test data are also made available to the CEC to allow them to monitor and improve test precision.

All candidate and reference oil CEC tests must be pre-registered with the ERC to facilitate an auditable test development procedure.

ASTM tests must be pre-registered with the ACC Monitoring Agency, Registration Systems Inc. (RSI), as described in the ACC Code of Practice.

2.2.3. Test(s) “Out of control and “Test Unavailable” Provisional Data Package requirements

In the event that either ASTM or CEC have declared one of their respective tests required for one or more ACEA Oil Sequences “out of control” or “unavailable” (due to hardware) respectively, ATIEL/ATC has to notify all owners of an officially registered Code of Practice of this fact.

Under these circumstances a data package, that is complete except for the data from this one test may be used on a provisional basis in support of performance claims against a single or multiple ACEA Oil Sequences.

The use of this temporary waiver has to be properly documented in the ATIEL Candidate Data package by ticking the appropriate box on **pages D-2 and D-3 of the data pack (Appendix D)** and inserting the text “out of control” in the appropriate test result field in Part B or **Part C** .

Also, the marketer shall include data based on Fundamental Formulation Knowledge to support the performance of the candidate formulation in the test that was not conducted.

In any case a company using the above mentioned procedure to temporarily support ACEA Oil Sequence(s) will still be responsible for satisfactory performance of engine oils covered by this procedure.

After ATIEL/ATC have notified all owners of an officially registered Code of Practice that ASTM and CEC respectively have declared that the test in question is “no longer out of control” the company using a waived data package must obtain a valid passing result in this test within six (6) months.

If a valid passing result cannot be obtained within six months, the subject data package cannot be used any longer to support the particular ACEA Oil Sequence(s). Hence, the ACEA performance claim(s) has/have to be withdrawn from the product(s) involved.

In the event that in total more than one test required for a product claiming a single (e.g. **A3-02 or A3/B3-04**) or multiple ACEA Sequences (e.g. **A3/B3-04; E7-04**) is declared “out of control” by ASTM and/or CEC, the data package missing these 2 or more test results cannot be used to support that ACEA sequence or the multi-sequence performance claim.

2.3. Readacross and Interchange Guidelines

Readacross and Interchange guidelines have been prepared for CEC engine tests to help establish performance of engine lubricants. For ASTM tests the requirements shown in the latest issue of the Viscosity Readacross Guidelines and Base Oil Interchange Guidelines included in API 1509 shall be applied. Actual performance has to be demonstrated by testing the original formulation in the specific engine test for which readacross will be applied. Only engine test results meeting or exceeding the requirements included in the relevant ACEA Oil Sequence may be used for readacross purposes.

Interchange guidelines restrict changes of base oil as well as of viscosity modifier, and details are given in the following sections. Viscosity Grade Readacross Guidelines may be applied from final formulations as well as from candidate formulations developed during a programme for which Base Oil and/or Viscosity Modifier Interchange Guidelines have been used. Viscosity Grade Readacross may be made after a Base Oil or Viscosity Modifier Interchange. However, more than one interchange or readacross cannot be applied at the same time.

Performance additive package modifications made during the conduct of tests should comply with the ACC and/or ATC Codes of Practice, as applicable.

The guidelines define the minimum acceptable level of testing that every marketer must carry out to ensure that a product conforms to the ATIEL Code of Practice. Following the guidelines, however, does not absolve the marketer of the responsibility for the actual field performance of the product.

The guidelines may be modified by ATIEL as a result of new test data, new or revised test methods or changes in the ACEA Oil Sequences. Such modifications will be in the form of amendments to the guidelines or re-issuing of the guidelines. The current guidelines and most up-to-date amendments must always be used.

Engine testing required to support any interchange and/or readacross must be run in accordance with the ACC and/or ATC Codes of Practice, as applicable.

When applying readacross and interchange principles to extrapolate engine test data it is required to ensure that the appropriate guidelines are applied. Guidelines have been established for the following:

- a) Viscosity Grade Readacross (VGR)
- b) Base Oil Interchange (BOI)
- c) Viscosity Modifier Interchange (VMI)
- d) Performance Additive Package Modifications

2.3.1. Viscosity Grade Readacross Guidelines

ATIEL has established guidelines to allow extrapolation of engine test data from one viscosity grade to another under certain conditions. For ASTM gasoline engine tests used in ACEA Oil Sequences, API Viscosity Readacross Guidelines apply. The API guidelines may be found in the latest edition of API Publication 1509, Engine Oil Licensing and Certification System. Viscosity Grade Readacross tables for CEC engine tests and the ASTM heavy duty diesel tests used in the ACEA Oil Sequences are shown in Appendix A.

2.3.2. Base Oil Interchange Guidelines

Base oils can differ in their physical properties and chemical composition, which may result in differences in the performance of formulated engine oils in engine tests and in service.

The ATIEL Base Oil Interchange Guidelines define the minimum engine tests necessary to ensure that the standard of engine oil performance defined by the ACEA Oil Sequences will be maintained when one base oil is substituted by another. Base Oil Interchange Guidelines have been prepared for the three ACEA Oil Sequences and are shown in Appendix B.

Base stocks which have been approved under the provisions of these guidelines may be commingled without further testing, consistent with provisions of Appendix A.

2.3.3. Viscosity Modifier Interchange Guidelines

Viscosity modifiers can differ in their molecular structure and chemical composition, which may result in differences in the performance of formulated engine oils in engine tests and in service. The ATIEL Viscosity Modifier Interchange Guidelines define the minimum engine tests required to ensure that the standard of engine oil performance defined by the ACEA Oil Sequences will be maintained when substituting one viscosity modifier for another. The guidelines are shown in Appendix C.

2.3.4. Performance Additive Package Modifications

Modifications to the performance additive package may be required during the generation of engine test data. Guidelines which should be followed when making performance additive changes are contained in the ACC and/or ATC Codes of Practice. These Codes also define changes allowed for other additives such as pour point depressants etc. All modifications to the performance additive package must be declared.

2.4. Use of OEM Approvals to Evaluate Lubricant Performance Against ACEA Oil Sequence Requirements

Some of the engine tests and limits included in ACEA Oil Sequences also form part of individual OEM in-house specifications and approvals. By granting approval for a specific lubricant formulation against an in-house specification, the OEM endorses that the lubricant formulation has particular performance capabilities in the specific engine test(s) involved.

The lubricant developer and/or marketer may, therefore, opt to use an OEM approval for a given lubricant formulation in support of an ACEA performance claim for the same formulation in lieu of carrying out a test, solely for the purpose of meeting ACEA requirements. This option may be taken even if the OEM approval is given without the test having been carried out on the specific lubricant formulation, e.g. where a matrix of results on different base oils and/or VM's allows a base oil or VM to be used without additional testing otherwise required in the ATIEL Code of Practice interchange guidelines. However, the following conditions must be met whenever an OEM approval is used in this way:

- a) only OEM's sponsoring engine test(s) included in the ACEA Oil Sequences and having a lubricant approval system are qualified.
- b) OEM approvals used in lieu of testing are only valid for the test(s) which the OEM sponsors.
- c) test procedure and limits for a test involved with an OEM approval are the same or more severe than those specified in the ACEA Oil Sequences.
- d) additive package modifications involved in obtaining the OEM approval must meet the requirements of the ACC and/or ATC Codes of Practice.
- e) once the formulation for the oil to be marketed is defined and identified by a specific formulation code number, the marketer must obtain specific written confirmation of the approval for the oil from the OEM. A generic, package or blanket approval letter cannot be used.
- f) the marketer must include all relevant test data and the OEM approval letter in the documentation supporting the ACEA Oil Sequence claim.

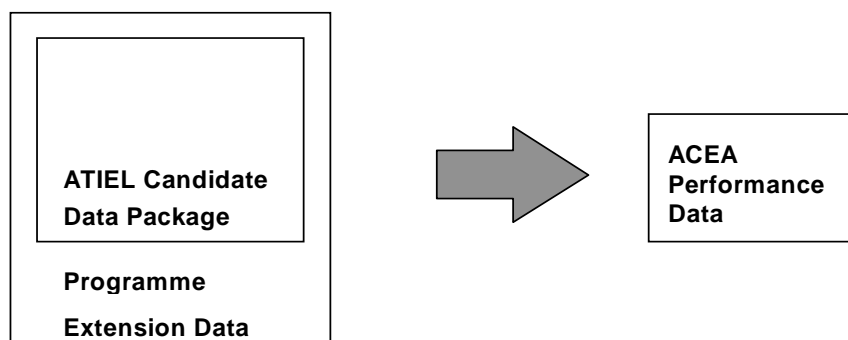
2.5. Data Package Requirements

The test data used to support ACEA Oil Sequence performance claims are the responsibility of the individual marketer. Test data documentation requirements have been divided into three distinct categories:

- 1) ATIEL Candidate Data Package
- 2) Programme Extension Data
- 3) ACEA Performance Data Set

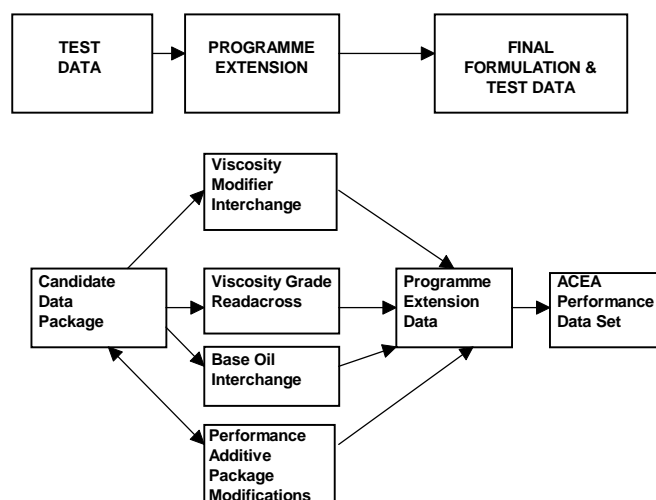
2.5.1. ATIEL Candidate Data Package

As shown in the figure below, the ACEA Performance Data Set is derived from the ATIEL Candidate Data Package and, if appropriate, any Programme Extension Data. The ATIEL Code of Practice requires that all CEC engine tests be conducted according to the ATC Code of Practice. When ACEA Oil Sequences involve ASTM tests, the ACC Code of Practice applies. Information which should be contained within a Candidate Data Package is given in the example checklist in Appendix D. It is recommended that this checklist be adopted for internal audit purposes.



2.5.2. Programme Extension Data

Marketers may apply readacross and interchange guidelines and formulation modifications instead of engine testing to derive Programme Extension Data from the Candidate Data Package (see figure next page). The ACC and/or ATC Codes of Practice provide the guidelines regarding performance additive package modifications. Readacross and interchange guidelines specify the circumstances under which the ATIEL Candidate Data Package may be extended to different viscosity grades, different base oils and different viscosity modifiers. For CEC engine tests, the ATIEL readacross and interchange guidelines described in section 2.3 shall be applied. For ASTM engine tests, API Base Oil Interchange Guidelines and API Viscosity Readacross Guidelines must be used, with the exception of the ASTM Heavy Duty Diesel tests, where ATIEL Viscosity Grade Readacross Guidelines have been developed.



In addition all final formulations have to be tested to demonstrate compliance with the laboratory test requirements, which are included in the ACEA Oil Sequences. For the **2004 sequences** these are:

- Viscosity
- Shear Stability
- High Shear Rate, High Temperature Viscosity
- Sulphated Ash
- Foaming Tendency
- Evaporative Loss
- * Sulfur
- * Phosphorus
- * Chlorine

For the 2002 sequences the tests indicated with "*" are not required

There is also a requirement to demonstrate satisfactory oil elastomer compatibility. Information which should be contained within the Programme Extension Data is given in the example checklist in Appendix D. It is recommended that this checklist be adopted for internal audit purposes.

2.5.3. ACEA Performance Data Set

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 engine oil. This Data Set is company confidential, but will be available for **Quality System** 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

2.6. Revisions and Updates

To allow sufficient time for product development and commercialisation, as well as for revision and/or development of readacross and interchange guidelines, a period of twelve months is given between the issue by ACEA of new Oil Sequences and commercial implementation. Details are shown in the ACEA 2004 Oil Sequences on page 2 of 12.

The situation regarding changes to an existing ACEA Oil Sequence resulting in revised pass/fail limits and severity shifts is discussed in Appendix E.

3. Description of the European Engine Lubricant Quality Management System (EELQMS)

There has been growing participation amongst industry organisations (ACEA, ATC, ATIEL and CEC) to focus effort and activities on the issue of engine lubricant quality in Europe.

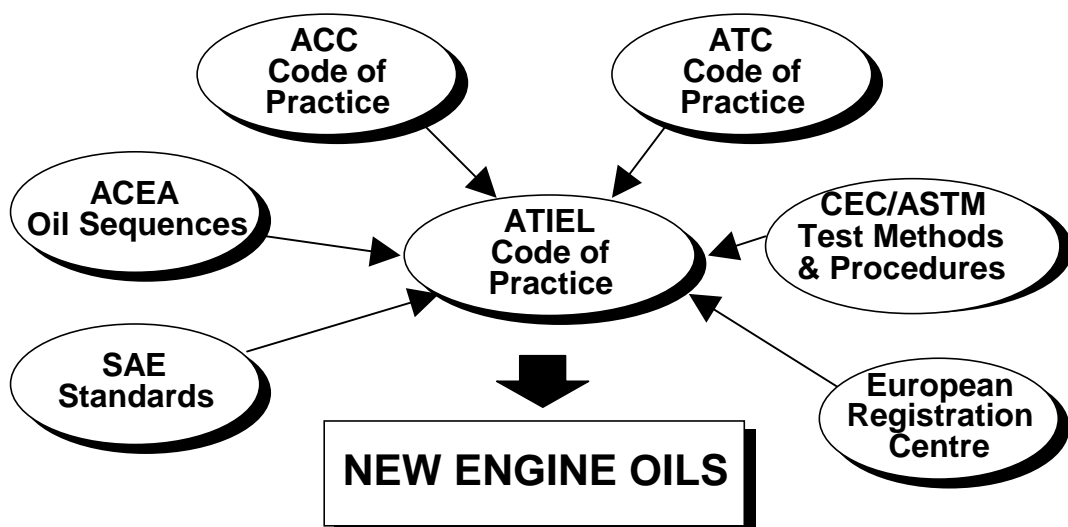
ATIEL share with these organisations a mutual interest in the development of improved lubricants in Europe as required by the automotive industry.

This participation has led to ACEA setting improved standards for service-fill engine oils and to CEC developing new test procedures which offer better discrimination and reproducibility.

ATC has likewise responded with the publication of an ATC Code of Practice intended to encourage the consistent and precise operation of CEC engine testing, coupled with a standardised system for reporting test results.

The EELQMS has been composed in close collaboration between ACEA, ATC, ATIEL and CEC and embraces various standards, test methods and procedures, Codes of Practice and Oil Sequence requirements. The ATIEL Code of Practice is a key element of the EELQMS, providing a practical contribution to regularise engine oil standards in Europe in co-operation with other organisations. An overview of the elements of the EELQMS is shown in the figure below.

Overview of the European Engine Lubricant Quality Management System (EELQMS)



3.1. EELQMS Guidelines

Marketers intending to develop engine oils on which compliance with ACEA Oil Sequences will be claimed shall apply to the guidelines of the EELQMS. These are:

the marketer will incorporate the EELQMS guidelines as described in the ATIEL Code of Practice in his **Quality System** procedures (**ISO 9001, QS 9000 or ISO TS 16949**), to ensure an independent audit of the development process by **Quality System** officers. Incorporation in the **Quality System** procedures does not imply re-typing all EELQMS guidelines in the **Quality System** procedures. By means of proper referencing to the EELQMS guidelines in the **Quality System** procedures it must be ensured that effectively the same result, as with full incorporation of the EELQMS guidelines in the **Quality System** procedures, is obtained.

all engine tests will be conducted in line with the requirements defined in the ACC and/or ATC Codes of Practice.

all performance additive package modifications will be done according to the guidelines included in the ACC and/or ATC Codes of Practice.

all base oil interchanges will be done in accordance with the guidelines included in the ATIEL Code of Practice.

all viscosity modifier interchanges will be done in accordance with the guidelines included in the ATC and ATIEL Codes of Practice.

all viscosity grade readacross will be done in accordance with the guidelines included in the ATIEL Code of Practice.

all requirements included in the checklist for the ATIEL Candidate Data Package will be met and signed off by an authorised company representative.

all requirements included in the checklist for the Programme Extension Data will be met and signed off by an authorised company representative, such as the Product Development Manager.

a full ACEA Performance Data Set will be completed for each product on which a claim against the ACEA Oil Sequences is made. This set will be signed off by an authorised company representative.

the product will be blended in manufacturing plants accredited to auditable quality management systems.

Oil marketer's wishing to declare their participation in EELQMS may do so by submitting the EELQMS Letter of Conformance to ATIEL.

A letter template is given in Appendix F of this Code of Practice.

ATIEL will **publish** a list of Oil Marketers who have submitted EELQMS Letters of Conformance **on their website (www.atiel.org)**.

As an example, a typical ACEA programme will, most likely, consist of the following steps:

- definition of the target ACEA Oil Sequence performance level(s)
- definition of desired viscosity grades
- selection of base stocks to be used in various viscosity grades
- selection of viscosity modifier(s) to be used in various viscosity grades

From the ATIEL Viscosity Grade Readacross guidelines the most critical viscosity grade can be determined for each engine test. In this process also the ATIEL Base Oil Interchange and Viscosity Modifier Interchange guidelines should be considered, as appropriate.

The marketer may decide to develop his own performance additive package or to cooperate with a third party for this purpose. During the development process of the performance additive package the guidelines included in the ACC and/or ATC Codes of Practice need to be strictly followed. This will ensure readacross of engine performance within the restrictions of the guidelines for performance additive package modifications.

All engine tests need to be conducted at accredited test laboratories which comply with the guidelines for testing and registration defined in the ACC and/or ATC Codes of Practice. All candidate and reference oil tests need to be pre-registered to be included in the ATIEL Data Packages.

Once the development of the performance additive package is completed the valid engine test results for the core formulations will be completed with the relevant bench test data. All data requested in the checklist for the ATIEL Candidate Data Package will now be compiled. The checklist will be signed by an authorised company representative.

Using the data of the ATIEL Candidate Data Package the test requirements for other viscosity grades and/or the use of other base stocks and/or viscosity modifiers can be established with the help of the ATIEL Viscosity Grade Readacross , ATIEL Base Oil Interchange and/or ATIEL Viscosity Modifier Interchange guidelines as appropriate.

After completion of all tests required for readacross and/or interchange purposes the checklist for the Programme Extension Data will be completed and signed by an authorised company representative, such as the Product Development Manager.

Finally a full ACEA Performance Data Set will be completed for each product on which an ACEA Oil Sequence claim is made. This data set will be signed by an authorised officer of the marketer.

4. Blending Plant Requirements

The ATIEL Code of Practice requires that all lubricants claiming compliance with the ACEA Oil Sequences are blended in manufacturing plants accredited to auditable quality management systems such as ISO 9001 Quality Standard or recognised certified quality management systems such as QS9000 or ISO TS 16949. The blending plant must ensure that the formulation used for blending the commercial product accurately reflects the formulation used to establish the ACEA Performance Data Set.

For new lube oil blending plants it is a requirement that a commitment is made to complete ISO 9001 certification (or an other quality management system as defined above) within 18 months of the production start up date.

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 9001, 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.

5. Reference Publications

In developing this Code of Practice, ATIEL has reinforced the Guidelines by the incorporation of other published Codes, which are considered to offer best industry practice. These publications are referred to in this document but are not reproduced in detailed form. It is recommended, therefore, that the latest editions of the following are read in conjunction with this publication:

ATC Code of Practice

ACC Product Approval Code of Practice

API Guidelines for SAE Viscosity - Grade Engine Testing

API Base Oil Interchangeability Guidelines for Passenger Car Motor Oils and Diesel Engine Oils

The last two documents are incorporated in **API Publication 1509 - Engine Oil Licensing and Certification System**.

In addition frequent reference is made to the **ACEA European Oil Sequences, Service Fill Oils for Gasoline Engines, Light Duty Diesel Engines, Engines with After treatment Devices** and Heavy Duty Diesel Engines.

6. Appendices

Appendix A	ATIEL Viscosity Grade Readacross Guidelines
Appendix B	ATIEL Base Oil Interchange Guidelines
Appendix C	ATIEL Viscosity Modifier Interchange Guidelines
Appendix D	Data Package Requirements
Appendix E	Revisions to an existing ACEA Oil Sequence
Appendix F	EELQMS
Appendix G	Acronyms, Glossary and Definition of Terms

7. ATIEL Bulletins

ATIEL bulletins will be issued on a regular basis to ensure that the ATIEL Code of Practice is updated in line with industry developments and experience.

Appendix A

ATIEL Viscosity Grade Readacross Guidelines

Issue Number 11, April 5, 2005

This issue supersedes all previous issues.

All new developments initiated after the date of this issue shall use this issue.

ATIEL Viscosity Grade Readacross Guidelines

During the development of a formulation It may be required to rebalance the base stocks and viscosity modifier. Within the same viscosity grade the viscosity modifier treat rate may be adjusted $\pm 15\%$ relative without additional engine testing. Whenever the viscosity grade is changed the Viscosity Grade Readacross Guidelines must be applied.

Viscosity Grade Readacross Guidelines have been developed to allow extrapolation of engine test data from one viscosity grade to another. Tables have been developed for the following engine tests:

TU3MH	CEC L-55-T-95	High temperature deposits, ring sticking and oil thickening
TU572	CEC L-88-02	High temperature deposits, ring sticking and oil thickening
TU3MS	CEC L-38-A-94	Valve train scuffing wear
M111	CEC L-53-T-95	Black sludge
M111 FE	CEC L-54-T-96	Fuel economy
VWICTD	CEC L-46-T-93	Ring sticking and piston cleanliness
XUD11	CEC L-56-T-98	Medium temperature dispersivity
OM602A	CEC L-51-T-95	Wear
OM364LA	CEC L-42-T-99	Bore polishing and piston cleanliness
MACK T8	ASTM D 4485	Soot in oil
MACK T8E	ASTM D 5967	Soot in oil
MACK T9	ASTM D 6483	Wear (liner-ring-bearings)
MACK T10	ASTM D 6987	MACK T-9 test with EGR
Cummins M11	ASTM D 6838	Soot Induced Wear
M11 EGR	ASTM D 6975	Cummins M11 test with EGR
OM441LA	CEC L-52-T-97	Bore polishing, piston cleanliness and turbocharger deposits
VWDI	CEC L-78-T-99	Ring sticking and piston cleanliness
DV4	CEC L-93-04	Medium temperature dispersivity

RA shown in the tables means read across is permitted **provided** the requirements stipulated (refer to TU3MS) are also met. A shaded block means that readacross is not permitted.

The following requirements must be met when the Viscosity Grade Readacross Guidelines are applied:

1. The same performance additive package at equal concentration shall be used for the readacross viscosity grade. If different concentrations are used reference should be made to the ACC and/or ATC Codes of Practice to confirm allowable changes for the alternative viscosity grade.
2. The same viscosity modifier shall be used. The viscosity modifier concentration (polymer content) can be adjusted for the readacross viscosity grades in line with the guidelines included in the ACC and/or ATC Codes of Practice.
3. Base stocks from the same base stock slate shall be used. The base stocks may be rebalanced (and/or replaced within the same base stock slate) to comply with the viscometric requirements. Compliance with the Base Oil Interchange Guidelines included in Appendix B should be ensured.

TU3MS TEST

Test Run On

Can be read across (RA) to:

	0W-20	0W-30	0W-40	5W-20	5W-30	5W-40	5W-50	10W-30	10W-40	10W-50	10W-60	15W-40	15W-50	20W-40	20W-50
0W-20	-	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
0W-30		-	RA		RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
0W-40			-			RA	RA		RA	RA	RA	RA	RA	RA	RA
5W-20		RA	RA	-	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
5W-30			RA		-	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
5W-40						-	RA		RA	RA	RA	RA	RA	RA	RA
5W-50							-			RA	RA		RA		RA
10W-30			RA			RA	RA	-	RA	RA	RA	RA	RA	RA	RA
10W-40							RA		-	RA	RA	RA	RA	RA	RA
10W-50										-	RA		RA		RA
10W-60											-				
15W-40							RA			RA	RA	-	RA	RA	RA
15W-50											RA		-		RA
20W-40							RA			RA	RA		RA	-	RA
20W-50											RA				-

Stipulated Requirement

The KV@100°C of the finished oil of the readacross grade must be greater than or equal to that of the tested grade.

TU3MH & TU572 TEST

Test Run On

Can be read across (RA) to:

	0W-20	0W-30	0W-40	5W-20	5W-30	5W-40	5W-50	10W-30	10W-40	10W-50	10W-60	15W-40	15W-50	20W-40	20W-50
0W-20	-			RA	RA			RA	RA			RA	RA	RA	RA
0W-30	RA	-		RA	RA	RA		RA	RA	RA		RA	RA	RA	RA
0W-40	RA	RA	-	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
5W-20				-				RA				RA		RA	RA
5W-30	RA			RA	-			RA	RA			RA	RA	RA	RA
5W-40	RA	RA		RA	RA	-		RA	RA	RA		RA	RA	RA	RA
5W-50	RA	RA	RA	RA	RA	RA	-	RA	RA	RA	RA	RA	RA	RA	RA
10W-30				RA				-				RA		RA	RA
10W-40	RA			RA	RA			RA	-			RA	RA	RA	RA
10W-50	RA	RA		RA	RA	RA		RA	RA	-		RA	RA	RA	RA
10W-60	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	-	RA	RA	RA	RA
15W-40				RA				RA				-		RA	RA
15W-50	RA			RA	RA			RA	RA			RA	-	RA	RA
20W-40														-	
20W-50				RA				RA				RA		RA	-

Stipulated Requirement

If the viscosity modifier treat rate increase is larger than 10% wt relative, Level 2 technical support data must be available to justify the readacross.

M111 Sludge TEST (Non Dispersant Viscosity Modifier)

Test Run On

Can be read across (RA) to:

	0W-20	0W-30	0W-40	5W-20	5W-30	5W-40	5W-50	10W-30	10W-40	10W-50	10W-60	15W-40	15W-50	20W-40	20W-50
0W-20	-			RA	RA			RA	RA			RA	RA	RA	RA
0W-30	RA	-		RA	RA	RA		RA	RA	RA		RA	RA	RA	RA
0W-40	RA	RA	-	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
5W-20				-				RA				RA		RA	RA
5W-30	RA			RA	-			RA	RA			RA	RA	RA	RA
5W-40	RA	RA		RA	RA	-		RA	RA	RA		RA	RA	RA	RA
5W-50	RA	RA	RA	RA	RA	RA	-	RA	RA	RA	RA	RA	RA	RA	RA
10W-30				RA				-				RA		RA	RA
10W-40				RA	RA			RA	-			RA	RA	RA	RA
10W-50	RA			RA	RA	RA		RA	RA	-		RA	RA	RA	RA
10W-60	RA	RA		RA	RA	RA	RA	RA	RA	RA	-	RA	RA	RA	RA
15W-40				RA				RA				-		RA	RA
15W-50				RA				RA	RA			RA	-	RA	RA
20W-40														-	
20W-50												RA		RA	-

Stipulated Requirement

If the viscosity modifier treat rate increase is larger than 10% wt relative, Level 2 technical support data must be available to justify the readacross

M111 Sludge TEST (Dispersant Viscosity Modifier)

Test Run On

Can be read across (RA) to:

	0W-20	0W-30	0W-40	5W-20	5W-30	5W-40	5W-50	10W-30	10W-40	10W-50	10W-60	15W-40	15W-50	20W-40	20W-50
0W-20	-	RA			RA	RA			RA	RA			RA		
0W-30		-	RA			RA	RA			RA	RA				
0W-40			-				RA				RA				
5W-20	RA			-	RA			RA	RA			RA	RA		RA
5W-30	RA	RA			-	RA			RA	RA			RA		
5W-40		RA	RA			-	RA			RA	RA				
5W-50			RA				-				RA				
10W-30	RA			RA	RA			-	RA			RA	RA		RA
10W-40	RA	RA			RA	RA			-	RA	RA		RA		
10W-50		RA	RA			RA	RA			-	RA				
10W-60			RA				RA				-				
15W-40	RA			RA	RA			RA	RA			-	RA		RA
15W-50	RA	RA			RA	RA			RA	RA			-		
20W-40								RA				RA		-	RA
20W-50	RA				RA			RA	RA			RA	RA		-

Stipulated Requirement

If the viscosity modifier treat rate increase is larger than 20% wt relative, or the decrease is larger than 10% wt relative, Level 2 technical support data must be available to justify the readacross.

XUD11 TEST & DV4 TEST (Non Dispersant Viscosity Modifier)

Test Run On

Can be read across (RA) to:

	0W-20	0W-30	0W-40	5W-20	5W-30	5W-40	5W-50	10W-30	10W-40	10W-50	10W-60	15W-40	15W-50	20W-40	20W-50
0W-20	-			RA	RA			RA	RA			RA	RA	RA	RA
0W-30	RA	-		RA	RA	RA		RA	RA	RA		RA	RA	RA	RA
0W-40	RA	RA	-	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
5W-20				-				RA				RA		RA	RA
5W-30	RA			RA	-			RA	RA			RA	RA	RA	RA
5W-40	RA	RA		RA	RA	-		RA	RA	RA		RA	RA	RA	RA
5W-50	RA	RA	RA	RA	RA	RA	-	RA	RA	RA	RA	RA	RA	RA	RA
10W-30				RA				-				RA		RA	RA
10W-40				RA	RA			RA	-			RA	RA	RA	RA
10W-50	RA			RA	RA	RA		RA	RA	-		RA	RA	RA	RA
10W-60	RA	RA		RA	RA	RA	RA	RA	RA	RA	-	RA	RA	RA	RA
15W-40				RA				RA				-		RA	RA
15W-50				RA				RA	RA			RA	-	RA	RA
20W-40														-	
20W-50												RA		RA	-

Stipulated Requirement

If the viscosity modifier treat rate increase is larger than 10% wt relative, Level 2 technical support data must be available to justify the readacross.

XUD11 TEST & DV4 TEST (Dispersant Viscosity Modifier)

Test Run On

Can be read across (RA) to:

	0W-20	0W-30	0W-40	5W-20	5W-30	5W-40	5W-50	10W-30	10W-40	10W-50	10W-60	15W-40	15W-50	20W-40	20W-50
0W-20	-	RA			RA	RA			RA	RA			RA		
0W-30		-	RA			RA	RA			RA	RA				
0W-40			-				RA				RA				
5W-20	RA			-	RA			RA	RA			RA	RA		RA
5W-30	RA	RA			-	RA			RA	RA			RA		
5W-40		RA	RA			-	RA			RA	RA				
5W-50			RA				-				RA				
10W-30	RA			RA	RA			-	RA			RA	RA		RA
10W-40	RA	RA			RA	RA			-	RA	RA		RA		
10W-50		RA	RA			RA	RA			-	RA				
10W-60			RA				RA				-				
15W-40	RA			RA	RA			RA	RA			-	RA		RA
15W-50	RA	RA			RA	RA			RA	RA			-		
20W-40								RA				RA		-	RA
20W-50	RA				RA			RA	RA			RA	RA		-

Stipulated Requirement

If the viscosity modifier treat rate increase is larger than 20% wt relative, or the decrease is larger than 10% wt relative, Level 2 technical support data must be available to justify the readacross.

VWICTD TEST (Non-dispersant viscosity modifier)

Test Run on:

Can be read across (RA) to:

	0W-20	0W-30	0W-40	5W-20	5W-30	5W-40	5W-50	10W-30	10W-40	10W-50	10W-60	15W-40	15W-50	20W-40	20W-50
0W-20	-			RA	RA			RA	RA			RA	RA	RA	RA
0W-30	RA	-		RA	RA	RA		RA	RA	RA		RA	RA	RA	RA
0W-40	RA	RA	-	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
5W-20				-				RA				RA		RA	RA
5W-30	RA			RA	-			RA	RA			RA	RA	RA	RA
5W-40	RA	RA		RA	RA	-		RA	RA	RA		RA	RA	RA	RA
5W-50	RA	RA	RA	RA	RA	RA	-	RA	RA	RA	RA	RA	RA	RA	RA
10W-30				RA				-				RA		RA	RA
10W-40	RA			RA	RA			RA	-			RA	RA	RA	RA
10W-50	RA	RA		RA	RA	RA		RA	RA	-		RA	RA	RA	RA
10W-60	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	-	RA	RA	RA	RA
15W-40				RA				RA				-		RA	RA
15W-50	RA			RA	RA			RA	RA			RA	-	RA	RA
20W-40														-	
20W-50				RA				RA				RA		RA	-

Stipulated Requirement

If the viscosity modifier treat rate increase is larger than 10% wt relative, Level 2 technical support data must be available to justify the readacross.

VWICTD TEST (Dispersant viscosity modifier)

Test Run on:

Can be read across (RA) to:

	0W-20	0W-30	0W-40	5W-20	5W-30	5W-40	5W-50	10W-30	10W-40	10W-50	10W-60	15W-40	15W-50	20W-40	20W-50
0W-20	-	RA			RA	RA			RA	RA			RA		
0W-30		-	RA			RA	RA			RA	RA				
0W-40			-				RA				RA				
5W-20	RA			-	RA			RA	RA			RA	RA		RA
5W-30	RA	RA			-	RA			RA	RA			RA		
5W-40		RA	RA			-	RA			RA	RA				
5W-50			RA				-				RA				
10W-30	RA			RA	RA			-	RA			RA	RA		RA
10W-40	RA	RA			RA	RA			-	RA	RA		RA		
10W-50		RA	RA			RA	RA			-	RA				
10W-60			RA				RA				-				
15W-40	RA			RA	RA			RA	RA			-	RA		RA
15W-50	RA	RA			RA	RA			RA	RA			-		
20W-40								RA				RA		-	RA
20W-50	RA				RA			RA	RA			RA	RA		-

Stipulated Requirement

If the viscosity modifier treat rate increase is larger than 20% wt relative, or the decrease is larger than 10% wt relative, Level 2 technical support data must be available to justify the readacross.

OM602A TEST

Test Run on:

Can be read across (RA) to:

	0W-20	0W-30	0W-40	5W-20	5W-30	5W-40	5W-50	10W-30	10W-40	10W-50	10W-60	15W-40	15W-50	20W-40	20W-50	30	40
0W-20	-	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
0W-30		-	RA		RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
0W-40			-			RA	RA		RA	RA	RA	RA	RA	RA	RA	RA	RA
5W-20		RA	RA	-	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
5W-30			RA		-	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
5W-40						-	RA		RA	RA	RA	RA	RA	RA	RA	RA	RA
5W-50							-			RA	RA		RA		RA		RA
10W-30			RA			RA	RA	-	RA	RA	RA	RA	RA	RA	RA	RA	RA
10W-40							RA		-	RA	RA	RA	RA	RA	RA	RA	RA
10W-50										-	RA		RA		RA		RA
10W-60											-						
15W-40							RA			RA	RA	-	RA	RA	RA	RA	RA
15W-50											RA		-		RA		RA
20W-40							RA			RA	RA		RA	-	RA	RA	RA
20W-50											RA				-		RA
30																-	RA
40																	-

Stipulated Requirement

The KV@100°C of the finished oil of the readacross grade must be greater than or equal to that of the tested grade (applies to multi-grade oils only).

MACK T8 & T8E TEST (For ACEA Oil Sequences only)

Test Run on:

Can be read across (RA) to:

	0W-30	5W-30	5W-40	5W-50	10W-30	10W-40	15W-40	15W-50	20W-40	20W-50	30	40
0W-30	-											
5W-30	RA	-	RA	RA								
5W-40	RA		-	RA								
5W-50	RA			-								
10W-30	RA	RA	RA	RA	-	RA						
10W-40	RA	RA	RA	RA		-						
15W-40	RA	RA	RA	RA	RA	RA	-	RA				
15W-50	RA	RA	RA	RA	RA	RA		-				
20W-40	RA	RA	RA	RA	RA	RA	RA	RA	-	RA		
20W-50	RA	RA	RA	RA	RA	RA	RA	RA		-		
30	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	-	RA
40	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	-

Note

These readacross guidelines have been produced only for test data to be used to support ACEA claims and must not be used to support API claims where the relevant readacross guidelines from API 1509 must be used.

OM 364 LA TEST

Test Run on:

Can be read across (RA) to:

	0W-30	5W-30	5W-40	5W-50	10W-30	10W-40	15W-40	15W-50	20W-40	20W-50	30	40
0W-30	-	RA	RA		RA	RA	RA	RA	RA	RA	RA	RA
5W-30		-			RA	RA	RA	RA	RA	RA	RA	RA
5W-40		RA	-		RA	RA	RA	RA	RA	RA	RA	RA
5W-50		RA	RA	-	RA	RA	RA	RA	RA	RA		RA
10W-30					-		RA		RA	RA	RA	RA
10W-40						-	RA	RA	RA	RA	RA	RA
15W-40							-		RA	RA	RA	RA
15W-50								-	RA	RA		RA
20W-40									-		RA	RA
20W-50									RA	-		RA
30									RA		-	RA
40											RA	-

M111E Fuel Economy TEST

Test Run on:

Can be read across (RA) to:

	0W-20	0W-30	0W-40	5W-20	5W-30	5W-40	5W-50	10W-30	10W-40	10W-50	10W-60	15W-40	15W-50	20W-40	20W-50
0W-20	-														
0W-30	RA	-													
0W-40	RA	RA	-	RA											
5W-20	RA			-											
5W-30	RA	RA		RA	-										
5W-40	RA	RA	RA	RA	RA	-									
5W-50	RA	RA	RA	RA	RA	RA	-	RA							
10W-30	RA	RA		RA	RA			-							
10W-40	RA	RA	RA	RA	RA	RA		RA	-						
10W-50	RA	RA	RA	RA	RA	RA	RA	RA	RA	-					
10W-60	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	-	RA		RA	
15W-40	RA	RA	RA	RA	RA	RA		RA	RA			-			
15W-50	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA		RA	-		
20W-40	RA	RA	RA	RA	RA	RA		RA	RA			RA		-	
20W-50	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA		RA	RA	RA	-

Stipulated Requirements

The KV@40°C of the finished oil of the readacross grade must be lower than or equal to that of the tested grade.

The KV@100°C of the finished oil of the readacross grade must be lower than or equal to that of the tested grade.

The HTHSV of the finished oil blend of the readacross grade must be lower than or equal to that of the tested grade.

VW DI TEST (Non-dispersant viscosity modifier)

Test Run on:

Can be read across (RA) to:

	0W-20	0W-30	0W-40	5W-20	5W-30	5W-40	5W-50	10W-30	10W-40	10W-50	10W-60	15W-40	15W-50	20W-40	20W-50
0W-20	-			RA	RA			RA	RA			RA	RA	RA	RA
0W-30	RA	-		RA	RA	RA		RA	RA	RA		RA	RA	RA	RA
0W-40	RA	RA	-	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA
5W-20				-				RA				RA		RA	RA
5W-30	RA			RA	-			RA	RA			RA	RA	RA	RA
5W-40	RA	RA		RA	RA	-		RA	RA	RA		RA	RA	RA	RA
5W-50	RA	RA	RA	RA	RA	RA	-	RA	RA	RA	RA	RA	RA	RA	RA
10W-30				RA				-				RA		RA	RA
10W-40	RA			RA	RA			RA	-			RA	RA	RA	RA
10W-50	RA			RA	RA	RA		RA	RA	-		RA	RA	RA	RA
10W-60	RA	RA	RA	RA	RA	RA	RA	RA	RA	RA	-	RA	RA	RA	RA
15W-40				RA				RA				-		RA	RA
15W-50				RA	RA			RA	RA			RA	-	RA	RA
20W-40														-	
20W-50				RA				RA				RA		RA	-

Stipulated requirement

If the viscosity modifier treat rate increase is larger than 10% wt relative, Level 2 technical support data must be available to justify the read across.

OM441LA TEST (Non-dispersant viscosity modifier)

Test Run on:

Can be read across (RA) to:

	0W-30	5W-30	5W-40	5W-50	10W-30	10W-40	15W-40	15W-50	20W-40	20W-50	30	40
0W-30	-											
5W-30		-			RA	RA	RA	RA				
5W-40			-			RA	RA	RA				
5W-50				-				RA				
10W-30					-		RA					
10W-40						-	RA	RA				
15W-40							-					
15W-50								-				
20W-40									-			
20W-50										-		
30											-	
40												-

Note

If the viscosity modifier treat rate increase is larger than 10% wt relative, Level 2 technical support data must be available to justify the read across.

MACK T9 & T10 TEST (For ACEA Oil Sequences only)

Test Run on:	Can be read across (RA) to:											
	0W-30	5W-30	5W-40	5W-50	10W-30	10W-40	15W-40	15W-50	20W-40	20W-50	30	40
0W-30	-	RA	RA	RA	RA	RA	RA	RA	RA	RA		
5W-30		-	RA	RA	RA	RA	RA	RA	RA	RA		
5W-40			-	RA		RA	RA	RA	RA	RA		
5W-50				-				RA		RA		
10W-30					-	RA	RA	RA	RA	RA		
10W-40						-	RA	RA	RA	RA		
15W-40							-	RA	RA	RA		
15W-50								-		RA		
20W-40									-	RA		
20W-50										-		
30											-	
40												-

Stipulated requirements

If the viscosity modifier treat rate increase is larger than 10% wt relative, Level 2 technical support data must be available to justify the read across.

Read across is only allowed when the Sulphur level of the R/A grade is equal or less than in the tested grade

Note

These read across guidelines have been produced only for test data to be used to support ACEA claims and must not be used to support API claims where the relevant readacross guidelines from API 1509 must be used.

Cummins M11 & M11EGR TEST (For ACEA Oil Sequences only)

Test Run on:	Can be read across (RA) to:											
	0W-30	5W-30	5W-40	5W-50	10W-30	10W-40	15W-40	15W-50	20W-40	20W-50	30	40
0W-30	-	RA	RA	RA	RA	RA	RA	RA	RA	RA		
5W-30		-	RA	RA	RA	RA	RA	RA	RA	RA		
5W-40			-	RA		RA	RA	RA	RA	RA		
5W-50				-				RA		RA		
10W-30					-	RA	RA	RA	RA	RA		
10W-40						-	RA	RA	RA	RA		
15W-40							-	RA	RA	RA		
15W-50								-		RA		
20W-40									-	RA		
20W-50										-		
30											-	
40												-

Stipulated requirements

If the viscosity modifier treat rate increase is larger than 10% wt relative, Level 2 technical support data must be available to justify the read across.

Note

These read across guidelines have been produced only for test data to be used to support ACEA claims and must not be used to support API claims where the relevant readacross guidelines from API 1509 must be used.

Appendix B

ATIEL Base Stock Quality Assurance and Interchange Guidelines

Issue Number 11, April 5, 2005

This issue supersedes all previous issues.

All new developments initiated after the date of this issue shall use this issue.

ATIEL Base Stock Quality Assurance and Interchange Guidelines

1 INTRODUCTION

2 DEFINITIONS

3 GUIDELINES FOR BASE STOCK QUALITY ASSURANCE

3.1 Feedstock Approval Procedures

3.1.1 Feedstock screening

3.1.2 Making base stocks for approval

3.1.3 Evaluating candidate base stocks for approval

3.1.4 Approval of feedstock

3.1.5 Mixtures of feedstocks

3.2 Refining Process Control

3.3 Routine Quality Control

4. USING ALTERNATIVE BASE STOCKS IN VALIDATED FORMULATIONS

4.1 Base Stock Interchange Guidelines for Unlinked Slates

4.2. Linking Base Stock Slates

4.2.1 Pre-qualification for linking slates

4.2.2 Qualification to link slates

4.2.3 Use of linked slates for existing engine oil formulations

4.2.4 Development of new engine oils meeting existing ACEA Oil Categories

4.2.5 New ACEA Oil Categories

4.2.6 Introducing a new base stock onto a linked base stock slate

4.2.7 Maintaining linked status

4.2.8 Examples

5. VERIFICATION OF CONFORMANCE WITH DEFINED PROCEDURES

ATIEL Base Stock Quality Assurance and Interchange Guidelines

1. INTRODUCTION

This Appendix B of the ATIEL Code of Practice provides guidelines on base stock quality assurance and on base oil interchange. The guidelines relate specifically to engine lubricants marketed as complying with ACEA Oil Sequences.

It is assumed throughout the guidelines that all performance validation has been carried out in full accordance with requirements of the European Engine Lubricant Quality Management System (EELQMS) described in the ATIEL Code of Practice.

The guidelines are given in outline only. Base stock manufacturers and partner groups remain responsible for detailed operating procedures and parameters. Developers of lubricants are responsible for the content and integrity of development programmes run under these guidelines. Procedures must be in place to ensure that base stock quality remains consistent with that of the initial engine lubricant validation.

The physical and chemical characteristics of base stocks influence their lubrication performance. However, it has not yet proved possible fully to predict the base stock characteristics required for a particular engine oil application. Practical measurements in engine tests remain the only reliable means of validating the performance of engine lubricants.

Base stocks having the same quality control specifications cannot be assumed to be interchangeable.

The ATIEL Code of Practice requires that base stocks, used in lubricants for which compliance with ACEA Oil Sequences is claimed, be produced in manufacturing plants accredited to internationally recognised, externally auditable quality management systems such as ISO 9001, **QS 9000 or ISO TS 16949**.

Producers who intend to manufacture base stocks for use in engine oils for which compliance with ACEA Oil Sequences is to be claimed should submit a Letter of Compliance to ATIEL.

2. DEFINITIONS

The following definitions should be used when interpreting the ATIEL Base Oil Quality Assurance and Interchange Guidelines.

A **base oil** is a fluid that is blended with performance additives to make an engine lubricant.

Base oils may comprise a single component or a blend of components.

A **base stock** is a base oil component that:

- (i) is produced and used in accordance with the ATIEL Base Oil Quality Assurance and Interchange Guidelines given in this Appendix B
- (ii) is produced by a single manufacturer or partner group to the same specification, independently of feed source or manufacturer's location

- (iii) meets the same manufacturer's or partner group's specification and is identified by a unique formula, product identification number or both
- (iv) may be manufactured using a variety of different processes including but not limited to distillation, solvent refining, hydrogen processing, oligomerization, esterification, and re-refining
- (v) is substantially free from materials introduced through manufacturing, contamination, or previous use.

For the purposes of ATIEL Guidelines on Base Oil Quality Assurance and Base Oil Interchange, base stocks are divided into six **base stock groups** according to defined physical and chemical characteristics as follows:

Group I Base stocks containing less than 90 mass percent saturates and/or greater than 0.03 mass percent sulphur and having a viscosity index greater than or equal to 80 and less than 120, measured using the test methods specified in the table below.

Group II Base stocks containing greater than or equal to 90 mass percent saturates and less than or equal to 0.03 % mass percent sulphur and having a viscosity index greater than or equal to 80 and less than 120, measured using the test methods specified in the table below.

Group III Base stocks containing greater than or equal to 90 mass percent saturates and less than or equal to 0.03 mass percent sulphur and having a viscosity index of greater than or equal to 120, measured using the test methods specified in the table below.

Group IV Base stocks are polyalphaolefins (PAO).

Group V All base stocks not included in Groups I,II,III, IV or VI.

Group VI Base stocks are polyinternalolefins (PIO).

The analytical methods to be used in the definition of the above base stock groups are:

PROPERTY	TEST METHOD
SATURATE CONTENT	ASTM D 2007 (*)
VISCOSITY INDEX	ASTM D 2270
SULPHUR CONTENT (use one method listed)	ASTM D 2622 ASTM D 4294 ASTM D 4927 ASTM D 3120

Note: Alternative test methods may be used providing a satisfactory correlation with the specified ASTM method has been demonstrated.

(*) In the base stock group definitions method IP 451 can be used as an alternative for method ASTM D 2007: the <90% mass ASTM D 2007 saturates limit can then be replaced by the >1.7% mole IP 451 aromaticity limit and the ≤1.7% mole IP 451 aromaticity limit (see SAE paper 2001-01-3598 for details)

A **base stock manufacturer** produces, at one or more manufacturing sites, base stock(s) for use in lubricants for which compliance with ACEA Oil Sequences is claimed.

A **feedstock** is the starting material (such as crude oil, refinery intermediate or used lubricating oil) from which base stocks are produced at a manufacturing site. A particular feedstock may originate from a single source or multiple sources.

A **base stock slate** is a product line of base stocks that:

- (i) are produced by the same manufacturer
- (ii) meet the ATIEL definition of base stock
- (iii) are in the same ATIEL Base Stock Group
- (iv) may have different specified viscosities and other properties
- (v) have been demonstrated, in lubricants for which compliance with ACEA Oil Sequences is claimed, to be technically substitutable by other appropriate base stocks on the same slate.

A manufacturer may have more than one base stock slate.

Linked slates are base stock slates that the base stock manufacturer or partner group concerned has demonstrated, according to the requirements of this Appendix B, are interchangeable without the need for further engine testing.

A **partner group** is a voluntary grouping of two or more base stock manufacturers who:

- (i) have base stock slates complying with the ATIEL definition of base stock slate
- (ii) have, on the basis of a written agreement, linked base stock slates.

Base stock interchange is the process of substituting base stock(s) from alternative base stock slates in engine lubricants validated as complying with ACEA Oil Sequence(s).

Experts are individuals having expertise in the manufacturing of base stocks and/or the formulating and performance testing of engine lubricants.

3. GUIDELINES FOR BASE STOCK QUALITY ASSURANCE

ATIEL Base Stock Quality Assurance Guidelines are divided into four main sections:

- Feedstock approval procedures
- Refining process control procedures
- Routine quality control procedures
- Verification of conformance with defined procedures.

These guidelines emphasise the need for base stock manufacturers:

- (i) to have routine access to technical expertise that enables sound judgements to be made on quality assurance matters
- (ii) to maintain documented, externally auditable quality management procedures.

3.1 Feedstock Approval Procedures

Feedstock should be screened for general suitability using verifiable evaluation procedures. Base stocks should then be produced from suitable feedstocks and evaluated for approval.

Procedures should be in place to determine the maximum acceptable proportions of unapproved feedstock, experimental fractions and other unapproved materials that may enter the commercial pool of approved materials.

3.1.1 Feedstock screening

A chemical and physical characterisation of candidate feedstock should be carried out and the results appraised using a database derived from previous feedstock evaluations. An expert assessment should then be made of the nature of the feedstock and its potential as a source of base stock.

3.1.2 Making base stocks for approval

A series of intermediate fractions should be made from the feedstock. Base stocks should be produced from these intermediate fractions using targeted characteristics set jointly by base stock and formulation experts.

The physical and chemical analysis of the base stocks may indicate a need to modify targeted characteristics and to produce new samples under modified processing conditions.

3.1.3 Evaluating candidate base stocks for approval

The evaluation should include study of:

(i) Intrinsic properties of the base stocks, such as:

- chemical composition
- contamination arising from feedstock and processing impurities
- volatility
- flow behaviour at various temperatures
- inherent oxidation stability
- deposit forming tendencies

(ii) Performance in blended lubricants, such as:

- high temperature deposit formation
- low temperature sludge formation
- detergency / deposit control
- soot-handling
- foaming behaviour
- oxidation behaviour
- elastomer compatibility
- finished lubricant viscometry
- homogeneity and stability of formulations

3.1.4 Approval of feedstock

A feedstock may be approved if base stocks made from it have been demonstrated to be suitable for formulating engine oils for which ACEA claims are to be made. Formal approval should be the joint responsibility of manufacturing and product experts.

Base stock manufacturers should maintain a register of the approval status of various feedstocks and corresponding processing conditions.

The approval status should be reviewed at regular intervals.

3.1.5 Mixtures of feedstocks

Mixtures of feedstocks at the manufacturing plant can arise from (a) the cross-contamination that may occur during feedstock changeovers, (b) the intentional scheduling of mixtures or (c) accidental mixing.

A mixed feedstock may be approved even though the components are not themselves approved. Approved feedstocks may be mixed in all proportions up to the maximum approved limits for each component.

3.2 Refining Process Control

The primary aim of refining process control is to ensure that base stocks are reliably and consistently manufactured according to approved processing conditions and base stock specifications. All relevant steps, from feedstock approval to base stock despatch, should be reflected in auditable, documented procedures.

Procedures should define action to be taken if it is planned to make significant changes to approved processing conditions.

Significant changes of operating conditions may be defined as changes that are outside the ranges of conditions specified at the time of the feedstock and/or base stock approval. To safeguard base stock quality, assessment of the level of significance of particular processing changes and actions to be taken should be undertaken by appropriate experts.

Changes typically considered to be significant include:

- change of solvent type
- change of catalyst or catalyst type
- change of reactor operating conditions beyond predefined acceptable range
- change of process sequence
- change to a non-approved feedstock
- unacceptable variations of approved feedstock quality
- unacceptable contamination of feedstock

3.3 Routine Quality Control

Routine quality control should be carried out to confirm that base stock production remains within approved specifications. It is important to recognise that routine quality control tests are indicators of consistency and not absolute measures to predict base stock and lubricant performance.

Written procedures relating to base stock quality control should:

- (i) embody the approved quality control specifications of the base stocks to be produced
- (ii) define responsibilities for maintaining the integrity of those specifications
- (iii) define testing frequencies and sampling requirements
- (iv) embody a requirement routinely to report and interpret quality control test results and statistical assessments

(v) define action to be taken in the event of non-conformances.

Quality control tests for base stocks, and ranges of acceptable results in those tests, should be defined at the time of approving a feedstock. Test requirements may later be amended to reflect changing industry requirements, subject to the agreement of relevant manufacturing and product experts.

Tests will vary from manufacturer to manufacturer and may include:

- density
- colour
- refractive index
- spectroscopic analysis
- viscosity
- viscosity index
- flash point
- pour point
- chemical composition
- detection of contaminants

In some cases, industry standard testing methods may be used but it is common for particular manufacturers to use proprietary methods to examine certain parameters.

4. USING ALTERNATIVE BASE STOCKS IN VALIDATED FORMULATIONS

These guidelines outline measures necessary to support the use of alternative base stocks in engine oils for which compliance with ACEA Oil Sequences has already been validated. The guidelines enable base stocks to be interchanged (a) between unlinked slates in particular formulations and (b) in all formulations where a link between slates has been established.

Base stocks within the same base stock slate or within linked base stock slates may be interchanged without additional testing.

The lubricant developer is responsible for ensuring that interchange test programmes are consistent with the ACEA claims made for the engine oils concerned.

4.1 Base Stock Interchange Guidelines for Unlinked Slates

The following Base Oil Interchange Tables (Tables 4.1.A, 4.1.B, 4.1.A/B, 4.1.C; 4.1.E) identify the passing engine tests required to interchange base stocks in an originally tested engine oil formulation with those from a different base stock slate or linked slates of a partner group. Passing results are required only for those engine tests that are a requirement of the ACEA classes and categories for which support is being established. Complete performance documentation is required for the original formulation.

While applying these tables the performance additive package and treatment rate, the viscosity modifier and the viscosity grade of the formulations must remain the same. Minor re-balancing of the viscosity modifier is allowed to adjust the viscometry of the formulation within the same viscosity grade.

Where base stocks from more than one base stock group are interchanged simultaneously, the most severe testing requirements apply.

Engine testing is not required if the proportions of base oil to be interchanged are less than or equal to permitted maximum levels. These maximum levels depend on the ATIEL base stock groups involved and are defined in Tables 4.1.A, 4.1.B, 4.1.A/B, 4.1.C and 4.1.E

When a base stock or base stock slate is to be changed in a number of different viscosity grades derived from an original oil formulation, these guidelines shall be used in conjunction with the ATIEL Viscosity Readacross Guidelines given in Appendix A.

Minor modifications to the performance additive package that are allowed within the ACC and/or ATC Codes of Practice (as applicable) may be made prior to or subsequent to Base Stock Interchange testing, provided that:

- (i) such minor modifications are supported by the appropriate level of data as specified in the ACC and/or ATC Codes of Practice
- (ii) the marketed oil includes all such minor modifications.

Any changes to the viscosity modifier shall comply with the ATIEL Viscosity Interchange Guidelines given in Appendix C.

Table 4.1.A Base Oil Interchange for ACEA Gasoline Engine Oil Sequences

Base Stock in original Formulation	Interchange Base Stock (1, 3, 4, 5, 6, 7, 8, 9)										
	GROUP I		GROUP II		GROUP III		GROUP IV		GROUP V	GROUP VI	
GROUP I	≤10%	NONE	≤10%	NONE	≤30%	NONE	≤30%	NONE	ALL	≤30%	NONE
	>10%	TU572 VG or M111 M111 FE	>10%	TU572 TU3MS M111 FE	>30%	ALL	>30%	ALL		>30%	ALL
GROUP II	≤10%	NONE	≤10%	NONE	≤30%	NONE	≤30%	NONE	ALL	≤30%	NONE
	>10%	TU572 VG or M111 TU3MS M111 FE	>10%	TU572 VG or M111 TU3MS M111 FE	>30%	ALL	>30%	ALL		>30%	ALL
GROUP III	≤10%	NONE	≤10%	NONE	≤10%	NONE	≤10%	NONE	ALL	≤10%	NONE
	>10%	ALL	>10%	ALL	>10%	TU572 VG or M111 TU3MS M111 FE	> 10%	VG or M111		> 10%	VG or M111
							≤30%			≤30%	
							>30%	ALL		>30%	ALL
GROUP IV	≤10%	NONE	≤10%	NONE	≤10%	NONE	NONE (2)		ALL	NONE	
	>10%	ALL	>10%	ALL	> 10%	VG or M111					
					≤30%	ALL					
							>30%	ALL		>30%	ALL
GROUP V	ALL		ALL		ALL		ALL		ALL	ALL	
GROUP VI	≤10%	NONE	≤10%	NONE	≤10%	NONE	NONE		ALL	NONE (9)	
	>10%	ALL	>10%	ALL	> 10%	VG or M111					
					≤30%	ALL					
							>30%	ALL		>30%	ALL

- Notes:
1. ALL = All tests specified within the ACEA Oil Sequence category.
NONE = No engine tests are required. Laboratory tests must be run and requirements be met.
 2. PAOs (Group IV) can be interchanged one with another without engine testing provided the interchange PAO meets the original PAO manufacturing specification in all physical (e.g. VI, volatility, etc) and chemical (e.g. bromine number, acid number, stability etc) properties.
 3. All percentages are % mass of the formulated oil.
 4. Where a TU572 test is required, TU3MH results can be used in support of A2-96 issue 3 provided the results are passing for A2-96 issue 2.
 5. Where alternative tests are listed, e.g. "VG or M111", the alternative test cannot be run to document readacross if a failing result has already been obtained on the other test.
 6. No M111 FE testing is required if the HTHS and KV 40°C of the interchange formulation are lower or equal to that of the original formulation.
 7. An interchange of up to 30% from Group I, II, III, IV or VI to Group I, II, III, IV or VI is permitted without requirement for M111 FE testing provided the requirements in **Note 6** are also met.
 8. Only the tests included in the ACEA sequence for which read across is required have to be run.
 9. PIOs (Group VI) can be interchanged one with another without engine testing provided the interchange PIO meets the original PIO manufacturing specification in all physical (e.g. VI, volatility, etc) and chemical (e.g. bromine number, acid number, stability etc) properties.

Table 4.1.B Base Oil Interchange for ACEA Light Duty Diesel Engine Oil Sequences

Base Stock in original Formulation	Interchange Base Stock (1, 3, 4, 5, 6, 7, 8)										
	GROUP I		GROUP II		GROUP III		GROUP IV		GROUP V	GROUP VI	
GROUP I	≤10%	NONE	≤10%	NONE	≤30%	NONE	≤30%	NONE	ALL	≤30%	NONE
	>10%	VWICTD M111 FE VW DI	>10%	OM602A VWICTD XUD11 M111 FE VW DI	>30%	VWICTD XUD11 M111 FE VW DI	>30%	VWICTD XUD11 M111FE VW DI		>30%	VWICTD XUD11 M111FE VW DI
GROUP II	≤10%	NONE	≤10%	NONE	≤30%	NONE	≤30%	NONE	ALL	≤30%	NONE
	>10%	OM602A VWICTD XUD11 M111 FE VW DI	>10%	OM602A VWICTD XUD11 M111 FE VW DI	>30%	OM602A VWICTD XUD11 M111 FE VW DI	>30%	OM602A VWICTD XUD11 M111FE VW DI		>30%	OM602A VWICTD XUD11 M111FE VW DI
GROUP III	≤10%	NONE	≤10%	NONE	≤10%	NONE	≤30%	NONE	ALL	≤30%	NONE
	>10%	OM602A VWICTD XUD11 M111 FE VW DI	>10%	OM602A VWICTD XUD11 M111 FE VW DI	>10%	OM602A VWICTD XUD11 M111 FE VW DI	>30%	OM602A VWICTD XUD11 M111 FE VW DI		>30%	OM602A VWICTD XUD11 M111 FE VW DI
GROUP IV	≤10%	NONE	≤10%	NONE	≤30%	NONE	NONE (2)	ALL	ALL	NONE	
	>10%	OM602A VWICTD XUD11 M111 FE VW DI	>10%	OM602A VWICTD XUD11 M111 FE VW DI	>30%	OM602A VWICTD XUD11 M111 FE VW DI					
GROUP V	ALL		ALL		ALL		ALL		ALL	ALL	
GROUP VI	≤10%	NONE	≤10%	NONE	≤30%	NONE	NONE	ALL	ALL	NONE (8)	
	>10%	OM602A VWICTD XUD11 M111 FE VW DI	>10%	OM602A VWICTD XUD11 M111 FE VW DI	>30%	OM602A VWICTD XUD11 M111 FE VW DI					

- Notes:
1. ALL = All tests specified within the ACEA Oil Sequence category.
NONE = No engine tests are required. Laboratory tests must be run and requirements be met.
 2. PAOs (Group IV) can be interchanged one with another without engine testing provided the interchange PAO meets the original PAO manufacturing specification in all physical (e.g. VI, volatility, etc) and chemical (e.g. bromine number, acid number, stability etc) properties.
 3. All percentages are % mass of the formulated oil.
 4. No M111 FE testing is required if the HTHS and KV 40°C of the interchange formulation are lower or equal to that of the original formulation.
 5. An interchange of up to 30% from Group I, II, III, IV or VI to Group I, II, III, IV or VI is permitted without requirement for M111 FE testing provided the requirements in Note 4 are also met.
 6. Only the tests included in the ACEA sequence for which read across is required have to be run.
 7. Where a VWICTD is required for support of BOI fo1 B1, B2 and B3, a VW DI test can be used. In this case a passing result at B4-02 level is required.
 8. PIOs (Group VI) can be interchanged one with another without engine testing provided the interchange PIO meets the original PIO manufacturing specification in all physical (e.g. VI, volatility, etc) and chemical (e.g. bromine number, acid number, stability etc) properties.

Table 4.1.A/B Base Oil Interchange for ACEA Gasoline and Light Duty Diesel Engine Oil Sequences

Base Stock in original Formula	Interchange Base Stock (1, 3, 4, 5, 6, 7, 8)										
	GROUP I		GROUP II		GROUP III		GROUP IV		GROUP V	GROUP VI	
GROUP I	≤10%	NONE	≤10%	NONE	≤30%	NONE	≤30%	NONE	ALL (10)	≤30%	NONE
	>10%	TU572 VG or M111 VWICTD M111 FE VW DI	>10%	TU572 TU3MS OM602A VWICTD XUD11 or DV4 M111 FE VW DI	>30%	TU572 VG M111 TU3MS VWICTD XUD11 or DV4 M111 FE VW DI	>30%	TU572 VG M111 TU3MS VWICTD XUD11 or DV4 M111FE VW DI		>30%	TU572 VG M111 TU3MS VWICTD XUD11 or DV4 M111FE VW DI
GROUP II	≤10%	NONE	≤10%	NONE	≤30%	NONE	≤30%	NONE	ALL (10)	≤30%	NONE
	>10%	ALL (9 - 10)	>10%	ALL (9-10)	>30%	ALL (10)	>30%	ALL		>30%	ALL (10)
GROUP III	≤10%	NONE	≤10%	NONE	≤10%	NONE	≤10%	NONE	ALL (10)	≤10%	NONE
	>10%	ALL (10)	>10%	ALL (10)	>10%	ALL (9 - 10)	>10%	VG or M111		>10%	VG or M111
							≤30%			≤30%	VG or M111
							>30%	ALL (10)	>30%	ALL (10)	
GROUP IV	≤10%	NONE	≤10%	NONE	≤10%	NONE	NONE (2)	ALL (10)	NONE	≤10%	NONE
					>10%	VG or M111				>10%	VG or M111
	>10%	ALL (10)	>10%	ALL (10)	≤30%					≤30%	
				>30%	ALL	>30%	ALL	>30%	ALL		
GROUP V	ALL (10)		ALL (10)		ALL (10)		ALL (10)		ALL (10)	ALL (10)	
GROUP VI	≤10%	NONE	≤10%	NONE	≤10%	NONE	NONE	ALL (10)	NONE (8)	≤10%	NONE
					>10%	VG or M111				>10%	VG or M111
	>10%	ALL (10)	>10%	ALL (10)	≤30%					≤30%	
				>30%	ALL (10)	>30%	ALL (10)	>30%	ALL (10)		

- Notes:
1. ALL = All tests specified within the ACEA Oil Sequence category.
NONE = No engine tests are required. Laboratory tests must be run and requirements be met.
 2. PAOs (Group IV) can be interchanged one with another without engine testing provided the interchange PAO meets the original PAO manufacturing specification in all physical (e.g. VI, volatility, etc) and chemical (e.g. bromine number, acid number, stability etc) properties
 3. All percentages are % mass of the formulated oil.
 4. No M111 FE testing is required if the HTHS and KV 40°C of the interchange formulation are lower or equal to that of the original formulation.
 5. An interchange of up to 30% from Group I, II, III, IV or VI to Group I, II, III, IV or VI is permitted without requirement for M111 FE testing provided the requirements in Note 4 are also met.
 6. Only the tests included in the ACEA sequence for which read across is required have to be run.
 7. Where a VWICTD is required for support of BOI fo1 A1/B1 and A3/B3, a VW DI test can be used. In this case a passing result at A3/B4-04 level is required.
 8. PIOs (Group VI) can be interchanged one with another without engine testing provided the interchange PIO meets the original PIO manufacturing specification in all physical (e.g. VI, volatility, etc) and chemical (e.g. bromine number, acid number, stability etc) properties.
 9. Only one of both tests, a M111 or VG has to be included
 10. Only one of both tests, a XUD11BTE or a DV4 has to be included

Table 4.1.C Base Oil Interchange for ACEA Gasoline and Diesel with After Treatment Devices Engine Oil Sequences

Base Stock in original Formula	Interchange Base Stock (1, 3, 4, 5, 6, 7, 8)										
	GROUP I		GROUP II		GROUP III		GROUP IV		GROUP V	GROUP VI	
GROUP I	≤10%	NONE	≤10%	NONE	≤30%	NONE	≤30%	NONE	ALL (9)	≤30%	NONE
	>10%	TU572 VG or M111 VW DI M111 FE	>10%	TU572 TU3MS OM602A VW DI XUD11 or DV4 M111 FE	>30%	TU572 VG M111 TU3MS VW DI XUD11 or DV4 M111 FE	>30%	TU572 VG M111 TU3MS VW DI XUD11 or DV4 M111FE		>30%	TU572 VG M111 TU3MS VW DI XUD11 or DV4 M111FE
GROUP II	≤10%	NONE	≤10%	NONE	≤30%	NONE	≤30%	NONE	ALL (9)	≤30%	NONE
	>10%	ALL (8-9)	>10%	ALL (8-9)	>30%	ALL (9)	>30%	ALL		>30%	ALL (9)
GROUP III	≤10%	NONE	≤10%	NONE	≤10%	NONE	≤10%	NONE	ALL (9)	≤10%	NONE
	>10%	ALL (9)	>10%	ALL (9)	>10%	ALL (8-9)	>10%	VG or M111		>10%	VG or M111
								≤30%			≤30%
							>30%	ALL (9)		>30%	ALL (9)
GROUP IV	≤10%	NONE	≤10%	NONE	≤10%	NONE	NONE (2)	ALL (9)	ALL (9)	NONE	
					>10%	VG or M111					
	>10%	ALL (9)	>10%	ALL (9)	≤30%						
					>30%	ALL					
GROUP V	ALL (9)		ALL (9)		ALL (9)		ALL (9)		ALL (9)	ALL (9)	
GROUP VI	≤10%	NONE	≤10%	NONE	≤10%	NONE	NONE	ALL (9)	ALL (9)	NONE (7)	
					>10%	VG or M111					
	>10%	ALL (9)	>10%	ALL (9)	≤30%						
					>30%	ALL (9)					

- Notes:
1. ALL = All tests specified within the ACEA Oil Sequence category.
NONE = No engine tests are required. Laboratory tests must be run and requirements be met.
 2. PAOs (Group IV) can be interchanged one with another without engine testing provided the interchange PAO meets the original PAO manufacturing specification in all physical (e.g. VI, volatility, etc) and chemical (e.g. bromine number, acid number, stability etc) properties.
 3. All percentages are % mass of the formulated oil.
 4. No M111 FE testing is required if the HTHS and KV 40°C of the interchange formulation are lower or equal to that of the original formulation.
 5. An interchange of up to 30% from Group I, II, III, IV or VI to Group I, II, III, IV or VI is permitted without requirement for M111 FE testing provided the requirements in Note 4 are also met.
 6. Only the tests included in the ACEA sequence for which read across is required have to be run.
 7. PIOs (Group VI) can be interchanged one with another without engine testing provided the interchange PIO meets the original PIO manufacturing specification in all physical (e.g. VI, volatility, etc) and chemical (e.g. bromine number, acid number, stability etc) properties.
 8. Only one of both tests, a M111 or VG has to be included
 9. Only one of both tests, a XUD11BTE or a DV4 has to be included

Table 4.1.E Base Oil Interchange for ACEA Heavy Duty Diesel Engine Oil Sequences

Base Stock in original Formulation	Interchange Base Stock (1, 3, 4, 5, 6, 7)										
	GROUP I		GROUP II		GROUP III		GROUP IV		GROUP V	GROUP VI	
GROUP I	≤10%	NONE	≤10%	NONE	≤30%	NONE	≤30%	NONE	ALL	≤30%	NONE
	>10%	OM441LA Mack T8 (8E) OM364LA Mack T9 Mack T10 M11	>10%	OM602A OM441LA OM364LA Mack T10	>30%	OM441LA OM364LA Mack T9 Mack T10 M11	>30%	OM441LA OM364LA Mack T9 Mack T10 M11		>30%	OM441LA OM364LA Mack T9 Mack T10 M11
GROUP II	≤10%	NONE	≤10%	NONE	≤30%	NONE	≤30%	NONE	ALL	≤30%	NONE
	>10%	ALL	>10%	ALL	>30%	OM602A OM364LA OM 441 LA Mack T10 M11	>30%	OM602A OM364LA OM 441 LA Mack T10 M11		>30%	OM602A OM364LA OM 441 LA Mack T10 M11
GROUP III	≤10%	NONE	≤10%	NONE	≤10%	NONE	≤30%	NONE	ALL	≤30%	NONE
	>10%	ALL	>10%	ALL	>10%	OM602A OM364LA OM 441 LA Mack T8E Mack T9 Mack T10 M11	>30%	OM602A OM364LA OM 441 LA Mack T9 Mack T10 M11		>30%	OM602A OM364LA OM 441 LA Mack T9 Mack T10 M11
GROUP IV	≤10%	NONE	≤10%	NONE	≤30%	NONE	NONE (2)	ALL	ALL	NONE	
	>10%	ALL	>10%	ALL	>30%	OM602A OM364LA OM 441 LA Mack T8E Mack T9 Mack T10 M11					
GROUP V	ALL		ALL		ALL		ALL	ALL	ALL		
GROUP VI	≤10%	NONE	≤10%	NONE	≤30%	NONE	NONE	ALL	NONE (8)		
	>10%	ALL	>10%	ALL	>30%	OM602A OM364LA OM 441 LA Mack T8E Mack T9 Mack T10 M11					

Notes:

1. ALL = All tests specified within the ACEA Oil Sequence category
NONE = No engine tests are required. Laboratory tests must be run and requirements be met.
2. PAOs (Group IV) can be interchanged one with another without engine testing provided the interchange PAO meets the original PAO manufacturing specification in all physical (e.g. VI, volatility, etc) and chemical (e.g. bromine number, acid number, stability etc) properties.
3. All percentages are % mass of the formulated oil.
4. Only the tests included in the ACEA sequence for which read across is required have to be run.
5. For the Mack T8, Mack T8E, Mack T9, Mack T10 and M11 tests, the rules described in the latest version of API Publication 1509 apply.
6. Where a Mack T-9 test is required for support of E5, this test can also be replaced by a Mack T-10 test. In this case a passing result at API CI-4 is required
7. Where a Cummins M11 test is required for support of E5 or E7, this can be replaced by a M11EGR test. In this case a passing result at API CI-4 is required.
8. PIOs (Group VI) can be interchanged one with another without engine testing provided the interchange PIO meets the original PIO manufacturing specification in all physical (e.g. VI, volatility, etc) and chemical (e.g. bromine number, acid number, stability etc) properties.

4.2. Linking Base Stock Slates

4.2.1 Pre-qualification for linking slates

Each of the base stock slates to be linked must already have been used in engine oil formulations qualified against one category within each of the ACEA Oil Classes A, B, A/B, C and E.

4.2.2 Qualification to link slates

To qualify for linking slates, passes must be obtained, separately for each of the slates to be linked, in applicable tests for one category in each of the ACEA Oil Classes A, B and E. The applicable tests are those defined in Tables 4.1.A, 4.1.B, 4.1.A/B, 4.1.C and 4.1.E for the category concerned. Qualification tests must be carried out in accordance with the ATC Code of Practice.

The base stocks to be tested in the linkage qualification programme should be suitable for formulating engine lubricants and be those identified, for each of the applicable laboratory and engine tests to be carried out, as the most severe within the respective slates.

Base stocks from each slate to be linked must be separately evaluated using additive packages and SAE viscosity grades agreed by the partners. For qualification tests in a given ACEA Oil Class, the same additive package and viscosity modifier must be used. For different ACEA Oil Classes it is preferable (but not essential) to use different additive packages. The treatment level of individual additive packages must be set at the level normally recommended for the targeted ACEA performance.

The SAE grade of formulations evaluated must be multigrade and the same for each specific test comparison conducted, but may vary between tests. The viscosity modifier treatment level may be varied by up to 15% mass in order to meet viscosity requirements.

If linkage of Group I base stock slates is required, the formulations tested must not contain base stocks from other slates.

If linkage of (a) Group II or (b) Group III slates is required, it is preferable that base stocks from other slates not be used. However, if this is not feasible, mixtures of Group I with Group II or Group I with Group III may be tested. In this case, interchangeability between linked slates may be up to the level of Group II or Group III base stock(s) used in the formulations tested.

Where such mixtures are used in the testing to link Group II or Group III slates, the only variable between tested formulations should be the Group II or Group III base stock. All other components must remain constant.

Providing passing results are obtained against the requirements outlined above, the tested base stock slates may be linked.

4.2.3 Use of linked slates for existing engine oil formulations

Base stocks from linked slates may be used interchangeably in all relevant, previously validated formulations provided (a) the previous validation was based on the most severe base stocks from the linked slates, (b) respective additive treatment rates are set at the levels originally used and (c) levels of Group II and/or Group III base stocks do not exceed those originally approved.

Compliance with the requirements of the relevant ACEA Oil Categories may be claimed for such formulations when using base stocks from a linked slate in place of the original base stocks.

4.2.4 Development of new engine oils meeting existing ACEA Oil Categories

The most severe base stocks from the linked slates identified for each engine test must be used in development of new engine oils to meet existing ACEA Oil Categories. If, in a particular test in the linking programme, base stocks are observed to have equivalent performance, then any of the base stocks concerned may be used for future development work in that test.

Additive treatment rates in marketed formulations must be set at the minimum level established during development as necessary to pass all the relevant qualification tests.

4.2.5 New ACEA Oil Categories

New ACEA Oil Categories may contain new engine tests that are base stock sensitive. These tests would be indicated in the Base Oil Interchange Tables (Tables 4.1.A, 4.1.B, 4.1.A/B, 4.1.C, 4.1.E) of the ATIEL Code of Practice.

For each new test, the impact of base stocks on lubricant performance must be assessed to identify the most severe base stock to be used in product development involving such tests.

4.2.6 Introducing a new base stock onto a linked base stock slate

If a new base stock is to be added to a linked base stock slate, appropriate experts should assess the testing, if any, that must be carried out to confirm interchangeability.

4.2.7 Maintaining linked status

To maintain the linked status all of the above conditions must be complied with.

4.2.8 Examples

The following Examples 4.2.7.A and 4.2.7.B illustrate the use of these guidelines to link base stock slates.

Example 4.2.7.A Linking Three Group I Slates

Group I base stock slates P, Q and R needed to be linked and the most severe base stocks within these slates had been identified. All three slates met the pre-qualification requirements.

Qualification to link slates

Slates P, Q and R, each comprise three Group I base stocks. It was agreed to test SAE 10W-40,15W-40 and 15W-50 formulations against the requirements of ACEA Categories A2-96 issue 3, B2-98 issue 2 and E3-96 issue 4 using additive packages S, T and U set at treatment levels recommended by the additive vendor. The nine formulations involved contained viscosity modifiers G, H and I.

G, H and I could have been the same viscosity modifiers and S, T and U the same additive packages.

The testing was successful as the engine test data met the agreed minimum performance standards (see Table 4.2.7.A).

To obtain passes, it was necessary to repeat the Sequence VG test on oil #2 (Slate Q base stocks) and the Mack T-8 test on oil #9 (Slate R base stocks).

In this example it was assessed that Slate Q base stocks are the most severe in Sequence VE testing and Slate R base stocks the most severe in Mack T-8 testing. In all other tests the performance of each base stock was considered equivalent.

Slates P, Q and R were therefore considered linked.

Using linked slates for existing engine oil formulations

Base stocks from the linked slates could now be used interchangeably in all relevant, previously validated formulations based on slates P, Q and R, provided those formulations were validated using the most severe base stocks in the linked slates.

Development of new engine oils meeting existing ACEA Oil Categories

In new developments, Slate Q base stocks should be used in Sequence VG testing and Slate R base stocks used in Mack T-8 testing. In other tests, any relevant base stock selected from the most severe within the individual slates may be used.

Base stocks from slates P,Q and R may then be used interchangeably in new formulations validated using these most severe base stocks.

Table 4.2.7.A Linking Three Group I Slates

Component		ACEA A2-96 issue 3			ACEA B2-98 issue 2			ACEA E3-96 issue 4		
		Oil #1	Oil #2	Oil #3	Oil #4	Oil #5	Oil #6	Oil #7	Oil #8	Oil #9
Slate P	90 SN	10.0	—	—	—	—	—	—	—	—
	175 SN	68.2	—	—	77.9	—	—	64.5	—	—
	600 SN	—	—	—	—	—	—	10.0	—	—
Slate Q	100 SN	—	20.0	—	—	10.0	—	—	—	—
	200 SN	—	58.0	—	—	67.9	—	—	60.2	—
	500 SN	—	—	—	—	—	—	—	15.0	—
Slate R	100 SN	—	—	25.0	—	—	—	—	—	—
	150 SN	—	—	52.9	—	—	68.2	—	—	64.4
	650 SN	—	—	—	—	—	10.0	—	—	10.0
Additive pack S	13.0	13.0	13.0	—	—	—	—	—	—	
Additive pack T	—	—	—	13.5	13.5	13.5	—	—	—	
Additive pack U	—	—	—	—	—	—	15.0	15.0	15.0	
Viscosity modifier G	8.8	9.0	9.1	—	—	—	—	—	—	
Viscosity modifier H	—	—	—	8.6	8.6	8.3	—	—	—	
Viscosity modifier I	—	—	—	—	—	—	10.5	9.8	10.6	
Formulation, mass percent	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	
SAE GRADE	10W-40	10W-40	10W-40	15W-40	15W-40	15W-40	15W-50	15W-50	15W-50	
TU572	Pass	Pass	Pass	—	—	—	—	—	—	
Sequence VG ^[3]	Pass	Pass ^[1]	Pass	—	—	—	—	—	—	
M111 ^[3]	—	—	—	—	—	—	—	—	—	
Laboratory Tests ^[4]	Pass	Pass	Pass	—	—	—	—	—	—	
VW ICTD	—	—	—	Pass	Pass	Pass	—	—	—	
Laboratory Tests ^[4]	—	—	—	Pass	Pass	Pass	—	—	—	
OM 364LA	—	—	—	—	—	—	Pass	Pass	Pass	
MACK T-8	—	—	—	—	—	—	Pass	Pass	Pass ^[2]	
Laboratory Tests ^[4]	—	—	—	—	—	—	Pass	Pass	Pass	

[1] Repeated to obtain pass

[2] Repeated to obtain pass

[3] Either Sequence VG or M111 should be run

[4] As agreed by Partner Group

Example 4.2.7.B Linking Two Group III Slates Whilst Using a Third Party Group I Base Stock

Group III base stock slates D and E needed to be linked and the most severe base stocks within these slates had been identified. A third party Group I 150N base stock would be used with the linked slates.

(This example would also be applicable to linking Group II base stock slates).

Qualification to link slates

It was agreed to test Slates D and E against the requirements of ACEA A3-02, B3-98 issue 2 and E3-96 issue 4 using SAE 10W-40 formulations. Additive package X was used at 13 mass percent and viscosity modifier M was used at 10 mass percent. Base stock ratios were based on previous performance testing. The level of Group III base stock was fixed at 50 mass percent throughout, the treatment level optimised for this formulation.

The testing was successful as the engine test data met the minimum performance standards (see Table 4.2.7.B).

All tests were passed at the first attempt but slate E base stocks were assessed to be more severe than slate D in all tests and should therefore be used for all future testing to qualify formulations. Base stocks from Slate E were therefore considered to be the more severe.

Slates D and E were therefore considered linked.

Using linked slates for existing engine oil formulations

Base stocks from the linked slates could now be used interchangeably in all relevant, previously validated formulations based on slates D and E, provided (a) those formulations were validated using the most severe base stocks in the linked slates (i.e. slate E base stocks) and (b) the proportion of Group III base stock in the formulation was no greater than that used in the testing to link Slate E and Slate D (i.e. less than or equal to 50 mass percent).

Development of new engine oils meeting existing ACEA Oil Categories

Base stocks from slates D and E may then be used interchangeably at an equivalent treatment level in new formulations validated using slate E base stocks, provided the proportion of Group III base stock in marketed formulations is no greater than that used in the testing to link slates D and E (i.e. less than or equal to 50 mass percent).

Table 4.2.7.B Linking Two Group III Slates Whilst Using Third Party Group I Base Stocks

Component	ACEA A3-02		ACEA B3-98 issue 2		ACEA E3-96 issue 4	
	Oil #1	Oil #2	Oil #3	Oil #4	Oil #5	Oil #6
Third Party Group I 150 SN	27.2	26.5	27.0	27.4	27.0	26.0
Slate D Group III 3	—	—	—	—	—	—
Slate D Group III 5	50.0	—	50.0	—	50.0	—
Slate D Group III 8	—	—	—	—	—	—
Slate E Group III 35	—	10.0	—	10.0	—	10.0
Slate E Group III 55	—	40.0	—	40.0	—	40.0
Slate E Group III 90	—	—	—	—	—	—
Additive pack X	13.0	13.0	13.0	13.0	13.0	13.0
Viscosity modifier M	9.8	10.5	10.0	9.6	10.0	10.3
Formulation, mass percent	100.0	100.0	100.0	100.0	100.0	100.0
Total Group III base stock percent	50.0	50.0	50.0	50.0	50.0	50.0
SAE GRADE	10W-40	10W-40	10W-40	10W-40	10W-40	10W-40
TU572	Pass	Pass	—	—	—	—
TU3MS	Pass	Pass	—	—	—	—
Sequence VG ^[1]	Pass	Pass	—	—	—	—
M111 ^[1]	—	—	—	—	—	—
Laboratory tests ^[2]	Pass	Pass	—	—	—	—
VWICTD	—	—	Pass	Pass	—	—
OM602A	—	—	Pass	Pass	—	—
XUD11	—	—	Pass	Pass	—	—
Laboratory tests ^[2]	—	—	Pass	Pass	—	—
OM 364LA	—	—	—	—	Pass	Pass
OM602A	—	—	—	—	Pass	Pass
Laboratory tests ^[2]	—	—	—	—	Pass	Pass

[1] Either Sequence VG or M111 should be run

[2] As agreed by Partner Group

5. VERIFICATION OF CONFORMANCE WITH DEFINED PROCEDURES

Written procedures should exist for all management processes referred to in the Appendix B of the ATIEL Code of Practice. Such procedures should be externally auditable.

Base stock manufacturers must undergo regular external auditing by an independent, appropriately accredited (ISO 9001 or equivalent) auditor.

Check lists to assist auditors in the assessment of conformance with the terms of the accreditation are given in Appendix D of this Code of Practice.

Individual manufacturers should submit a Letter of Conformance to ATIEL. Manufacturers signing this letter must ensure that all elements of the guidelines are fully implemented from the date of signing the letter.

A letter template is given in Appendix F of this Code of Practice.

ATIEL will issue a list of base stock manufacturers who have submitted Letters of Conformance.

Appendix C

ATIEL Viscosity Modifier Interchange Guidelines

Issue Number 11, April 5, 2005

This issue supersedes all previous issues.

All new developments initiated after the date of this issue shall use this issue.

ATIEL Viscosity Modifier Interchange Guidelines

Viscosity Modifier Interchange (VMI) is a specific example of Programme Extension and is subject to the minimum requirements given below.

Any VMI must be supported by specific engine tests and rheological testing before implementation is permissible.

A lubricant formulation (VM/performance additive package/base oil) must be fully supported by an ATC Programme and reported in an ATIEL Candidate Data Package for VMI testing to take place.

VMI testing must commence on the same performance additive package at the same treat rate, and should be carried out in the same base stocks and viscosity grade(s) as used for the original programme. Minor re-balancing of the base stocks is permissible to achieve viscometric targets. Selection of viscosity grade(s) for VMI test work should be made based upon the coverage required for the interchange viscosity modifier and with regard to the relevant Viscosity Grade Readacross Guidelines.

VMI may be permissible between products from the same or from different suppliers.

For products from the same supplier, this supplier is responsible for defining those products that are equivalent and interchangeable without testing, and those for which testing is required before interchange is permissible. If the VM polymer content increase is greater than 15% then VMI testing must be carried out.

For products from different suppliers, VMI testing will always be required. However NDOCPs meeting following specifications can be fully interchanged provided a pre-qualification for this NDOCP interchange in a full ACEA A1/B1 or A3/B3 and E3 **program for support of the 2002 sequences or A3/B3 and E7 program for support of the 2004 sequences** is made:

- Ethylene content: 40-70 % mass
- Permanent Shear Stability Index ≤ 33
- Weight average molecular weight by GPC : 90,000-170,000 amu

A complete VMI programme can be used to support other VM's from the same supplier, which are declared by the supplier to be equivalent and interchangeable. No additional interchange testing is required.

A VMI programme is performance additive package specific, but can extend to performance additive package systems of related technology within the formulation modification guidelines of the ACC and/or ATC Codes of Practice.

BOI test work must be separate from VMI testing. One BOI programme run on either the original VM/performance additive package or the interchange VM/performance additive package system will cover both systems.

Engine tests required by the proposed performance claim(s) which include oxidation and/or engine deposit assessment must in general be run for VMI. Specifically, for CEC tests governed by this Code, and included in the ACEA Oil Sequences, the following tests must be run before implementation of the interchange is permissible. Different test requirements have been identified for interchanging non-dispersant viscosity modifiers (NDVM) and/or dispersant viscosity modifiers (DVM):

Performance Category	NDVM to NDVM (1,2, 3, 4)	DVM to DVM or NDVM to DVM (1, 2, 3, 4)
Gasoline	TU572 (8) M111 or VG(9) M111 FE	TU572 (8) M111 or VG (9) M111 FE
Light Duty Diesel	VWICTD (9) VW DI M111 FE	OM602A VWICTD (9) XUD11 (12) VW DI M111 FE
Gasoline/Light Duty Diesel	TU572 (8) M111 or VG(9) VWICTD (9) VW DI M111 FE	TU572 (8) M111 or VG (9) OM602A VWICTD (9) XUD11 (12) VW DI M111 FE
Gasoline/Light Duty Diesel with After Treatment Devices	TU572 (8) M111 or VG(9) VW DI M111 FE	TU572 (8) M111 or VG (9) OM602A XUD11 (12) VW DI M111 FE
Heavy Duty Diesel	OM364LA (10) Mack T8 (6) Mack T8E (7) OM 441 LA M11 (5) (11)	OM364LA (10) OM602A Mack T8 Mack T8E OM 441 LA M11 (5) (11)

- Notes:
1. Full testing **is** required for VMI not listed above.
 2. Physical mixes of NDVM and DVM are treated as DVM.
 3. Only the tests included in the ACEA sequence for which read across is required have to be run.
 4. Where alternative tests are listed, e.g. "M111 or VG", the alternative test cannot be run to document readacross if a failing result has already been obtained on the other test.
 5. Not required if the new oil formulation has the same or a greater HTHS value compared with the original tested formulation
 6. The T8 requirement is waived, if the replacement NDVM has the same or poorer shear stability as determined on candidate test oil formulated to similar viscosity as the original NDVM tested formulation and measured by

- CEC-L-14-A-93 (ASTM D 6278-98), and if the requirements of footnote (7) are also met.
7. The T8 or T8E requirement is waived, if the replacement NDVM is within the same chemical type as the tested NDVM (“chemical type” means chemical family such as, but not limited to, styrene ester, polymethacrylate, styrene butadiene, styrene isoprene, polyisoprene, olefin copolymer and polyisobutylene).
 8. TU3MH results can be used in support of A2-96 issue 3 provided the results are passing for A2-96 issue 2.
 9. The VWICTD maybe replaced by the VWDI (with B4 performance limit)
 10. The OM364LA requirement may be met by a passing OM441LA at E5 level
 11. The M11EGR test may be used in place of the M11
 12. **The XUD11 test can be replaced by the DV4 test**

Appendix D

Data Package Requirements

Issue Number 11, April 5, 2005

This issue supersedes all previous issues.

All new developments initiated after the date of this issue shall use this issue.

**ATIEL CANDIDATE DATA PACKAGE
FOR ACEA OIL SEQUENCE CONFORMANCE**

**Checklist for Engine Oil Development
Core Programme**

Conducted by:

Additive designation :
Viscosity grades :
Oil codes :

Included in this Data package	<u>Yes</u>	<u>No</u>
1. Physical/Chemical properties for formulations listed above	<input type="checkbox"/>	<input type="checkbox"/>
2. Formulations and oil codes for all test oils	<input type="checkbox"/>	<input type="checkbox"/>
3. Results of all bench tests including multiples on the final candidates	<input type="checkbox"/>	<input type="checkbox"/>
4. Results of all ASTM and CEC engine tests registered, including multiples	<input type="checkbox"/>	<input type="checkbox"/>
5. One test has been declared “out of control”	<input type="checkbox"/>	<input type="checkbox"/>
6. Applicable test stand reference data	<input type="checkbox"/>	<input type="checkbox"/>
7. Properties and identity of base oils used	<input type="checkbox"/>	<input type="checkbox"/>
8. Formulation modifications and readacross documentation	<input type="checkbox"/>	<input type="checkbox"/>

Signed on behalf of (company):

Title:

Name:.....Signature:.....Date:.....

PROGRAMME EXTENSION DATA FOR ACEA OIL SEQUENCE CONFORMANCE		
Checklist for Engine Oil Development Programme		
Oil Code(s):		
Viscosity grades covered by this Data Package:		
Included in this Data package	<u>Yes</u>	<u>No</u>
1. Candidate Data Package from core programme	<input type="checkbox"/>	<input type="checkbox"/>
<i>For formulations developed <u>in addition</u> to those in the core programme</i>		
2. Formulations and oil codes for all test oils	<input type="checkbox"/>	<input type="checkbox"/>
3. Results of all bench tests including multiples on the final candidates	<input type="checkbox"/>	<input type="checkbox"/>
4. Results of all ASTM and CEC engine tests registered, including multiples	<input type="checkbox"/>	<input type="checkbox"/>
5. Test has been declared “out of control”	<input type="checkbox"/>	<input type="checkbox"/>
6. Applicable test stand reference data	<input type="checkbox"/>	<input type="checkbox"/>
7. Properties and identity of base oils used	<input type="checkbox"/>	<input type="checkbox"/>
8. Readacross documentation (VGRA, VMI, BOI)	<input type="checkbox"/>	<input type="checkbox"/>
9. Engine Test Summary Matrix	<input type="checkbox"/>	<input type="checkbox"/>
<p>Title:</p> <p>Name:.....Signature:.....Date:.....</p>		

**COMPANY
LOGO OR
STAMP**

COMPANY CONFIDENTIAL INFORMATION

**ACEA PERFORMANCE DATA SET
FOR ACEA OIL SEQUENCE QUALIFICATION**

PART A

1. Details of Marketer

Company _____

Address _____

Contact Person _____ Title _____

Phone No. _____ Fax No. _____

2. Oil Details

Brand Name: _____ SAE Viscosity (a): _____

Oil Code Number: _____ ACEA Performance (b): _____

2a. Details of Any Rebrands

Brand Name(s): _____

^a In accordance with the latest version of SAE J 300

^b List each applicable ACEA Oil Sequence category

Document Ref.
No.

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**ACEA PERFORMANCE DATA SET
FOR ACEA OIL SEQUENCE QUALIFICATION**

PART B

3. Physical and Chemical Properties and Bench Test Results

LABORATORY TEST	PARAMETER	TEST METHOD	UNITS	TEST RESULT	LIMITS
SAE Viscosity	Kinematic Viscosity at 100°C Low temperature cranking viscosity Low temperature pumping viscosity	ASTM D445 ASTM D5293 ASTM D4684	mm ² /s mPa.s mPa.s		
Shear Stability	Viscosity after 30 cycles measured at 100°C	CEC L-14-A-93 (Bosch injector)	mm ² /s		
Shear Stability	Viscosity after 90 cycles measured at 100°C	ASTM D6278	mm ² /s		
HTHS Viscosity	Viscosity at 150°C and 10 ⁻⁸ s ⁻¹ shear rate	CEC L-36-A-97	mPa.s		
Evaporative loss	Weight loss after 1 hour at 250°C	CEC L-40-A-93 Procedure B	%		
Sulphated Ash		ASTM D874	% mass		
Phosphorus		ASTM D 5185	% mass		Report
Sulfur		ASTM D 5185	% mass		Report
Chlorine		ASTM D6443	% mass		Report
TBN		ASTM D2896	mg KOH/g		
Oil / Elastomer Compatibility	Variation of characteristics after immersion for 7 days in fresh oil without pre-ageing Hardness DIDC RE-1 Tensile strength Elongation at rupture Volume variation Hardness DIDC RE-2 Tensile strength Elongation at rupture Volume variation Hardness DIDC RE-3 Tensile strength Elongation at rupture Volume variation Hardness DIDC RE-4 Tensile strength Elongation at rupture Volume variation Hardness DIDC AEM Tensile strength Elongation at rupture Volume variation	CEC L-39-T-96	points % % % points % % % points % % % points % % %		
Foaming Tendency	Tendency - stability	ASTM D892 without Option A Seq. I (24°C) Seq. II (94°C) Seq. III (24°C)	ml ml ml		
High Temp. Foaming	Tendency - stability	ASTM D6082 Seq. IV(150°C)	ml		
Oxidation	Oxidation Induction Time	CEC-L85-T-99	min		
Corrosion	Used oil lead conc (135C test temp)	ASTM D 5968	ppm		
Document Ref. No.					

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COMPANY CONFIDENTIAL INFORMATION

**ACEA PERFORMANCE DATA SET
FOR ACEA OIL SEQUENCE QUALIFICATION**

PART C

3a. Engine Test Results - Gasoline Engines

ENGINE TEST	PARAMETER	TEST METHOD	UNITS	TEST RESULT	REF. OIL RESULT	LIMITS
TU3MH	Ring Sticking (each part) Piston varnish (7 elements, average of 4 pistons) Absolute viscosity increase at 40°C between mini and maxi values during test Oil consumption	CEC L-55-T-95	merit merit mm ² /s kg/test			
TU572	Ring Sticking (each part) Piston varnish (6 elements, average of 4 pistons) Absolute viscosity increase at 40°C between mini and maxi values during test Oil consumption	CEC L-88-02	merit merit mm ² /s kg/test			
Sequence VG	Average engine sludge Rocker cover sludge Average piston skirt varnish Average engine varnish Comp. Ring (hot stuck) Oil screen clogging	ASTM D6593	merit merit merit merit %			
TU3MS	Cam wear, average Cam wear, max. Pad merit (Ave. of 8 pads)	CEC L-38-A-94	µm µm merit			
M111	Engine sludge, average Cam wear, average	CEC L-53-T-95	merit µm			
M111 FE	Fuel economy improvement vs Reference oil RL 191 (SAE 15W-40)	CEC L-54-T-96	%			
Document Ref. No.						

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**ACEA PERFORMANCE DATA SET
FOR ACEA OIL SEQUENCE QUALIFICATION**

PART C

3b. Engine Test Results - Light Duty Diesel Engines

ENGINE TEST	PARAMETER	TEST METHOD	UNITS	TEST RESULT	REF. OIL RESULT	LIMITS
VW TC D	Ring sticking Piston cleanliness	CEC L-46-T-93	merit merit			
XUD11 BTE	Absolute viscosity increase at 100°C and 3% soot (measurement with CEC L-83-A-97 method) Piston merit (5 elements, average of 4 pistons)	CEC L-56-T-95 or CEC L-56-T-98	mm ² /s merit			
DV4	Absolute viscosity increase at 100°C and 6% soot (measurement with CEC L-83-A-97 method)	CEC L-93-04	mm ² /s			
OM602A	Cam wear, average Viscosity increase at 40°C Bore polishing Cylinder wear, average Oil consumption	CEC L-51-A-98	µm % % µm kg/test			
VW DI	Piston cleanliness Ring sticking (Rings 1 & 2) Average of all 8 rings Max. for any 1 st ring Max. for any 2 nd ring	CEC L-78-T-99	merit ASF ASF ASF			
M111 FE	Fuel economy improvement vs Reference oil RL 191 (SAE 15W-40)	CEC L-54-T-96	%			
Document Ref. No.						

**COMPANY
LOGO OR
STAMP**

COMPANY CONFIDENTIAL INFORMATION

**ACEA PERFORMANCE DATA SET
FOR ACEA OIL SEQUENCE QUALIFICATION**

PART C

3c. Engine Test Results - Heavy Duty Diesel Engines

ENGINE TEST	PARAMETER	TEST METHOD	UNITS	TEST RESULT	REF. OIL RESULT	LIMITS
OM364LA	Bore polishing Piston cleanliness Average cylinder wear Sludge Oil consumption	CEC L-42-T-99	% merit μm merit kg/test			
OM602A	Cam wear, average Viscosity increase at 40°C Bore polishing Cylinder wear, average Oil consumption	CEC L-51-A-98	μm % % μm kg/test			
Mack T8E Mack T8	Relative viscosity at 4.8% soot 1 st test 2 test average 3 test average Viscosity increase at 3.8% soot: 1 st test 2 test average 3 test average Filter plugging, Diff. Pressure Oil consumption	ASTM D5967 ASTM D4485	 cSt cSt cSt kPa g/kWh			
Mack T9	Avg. liner wear normalised to 1.75%soot 1 test 2 test average 3 test average Average top ring weight loss 1 test 2 test average 3 test average Used oil lead content increase 1 test 2 test average 3 test average	ASTM D6483	μm μm μm μm μm μm ppm ppm ppm			
Mack T10	Merit Avg. liner wear Average top ring weight loss End of test lead Delta lead 250-300 hrs Oil consumption (Phase II)	ASTM D6987	μm mg ppm ppm g/hr			
Cummins M11	Rocker pad average weight loss at 4.5% soot 1 test 2 test average 3 test average Oil filter diff.press EOT 1 test 2 test average 3 test average Engine sludge 1 test 2 test average 3 test average	ASTM D6838	mg mg mg kPa kPa kPa merit merit merit			
OM 441LA	Bore polishing Piston cleanliness Turbocharger deposits	CEC L-52-T-97	% merit mg			
Document Ref. No.						

**COMPANY
LOGO OR
STAMP**

COMPANY CONFIDENTIAL INFORMATION

**ACEA PERFORMANCE DATA SET
FOR ACEA OIL SEQUENCE QUALIFICATION**

PART D

4. Checklist Requirements

I hereby attest to using and satisfying the following criteria and/or guidelines as defined in ATIEL Code of Practice.

5. Qualification Conformance

I certify and claim that the oils listed in PART A meet the qualification criteria stipulated in the ATIEL Code of Practice.

Name of Authorised
Company Representative

Telephone

Title

Signature of Authorised
Company Representative

Date

ATIEL Base Oil Quality Assurance and Interchange Guidelines		
Feedstock Approval Procedures (Refer to Guidelines Section 3.1)		
CHECK LIST FOR AUDITORS		
Confirmed seen :	<u>Yes</u>	<u>No</u>
1. Documented feedstock evaluation and approval process		
2. Roles and responsibilities for feedstock approvals clearly defined and assigned		
3. Register of approved feedstocks		
4. Defined triggers for feedstock re-evaluation		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
Title: Name:.....Signature:.....Date:.....		

ATIEL Base Oil Quality Assurance and Interchange Guidelines		
Refinery Process Control (Refer to Guidelines Section 3.2)		
CHECK LIST FOR AUDITORS		
Confirmed seen :	<u>Yes</u>	<u>No</u>
1. Documented refinery process control system for base stock manufacture		
2. Roles and responsibilities for refinery process controls clearly defined and assigned		
3. Documented process to handle significant changes to processing conditions		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
Title: Name:.....Signature:.....Date:.....		

ATIEL Base Oil Quality Assurance and Interchange Guidelines		
Routine Quality Control (Refer to Guidelines Section 3.3)		
CHECK LIST FOR AUDITORS		
Confirmed seen :	<u>Yes</u>	<u>No</u>
1. Documented system for routine base stock quality control		
2. Roles and responsibilities for base stock quality control clearly defined and assigned		
3. Documented responsibilities for actions in the event of non-conformances		
4. Certificates of analysis routinely produced for base stock shipments		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
Title: Name:.....Signature:.....Date:.....		

ATIEL Base Oil Quality Assurance and Interchange Guidelines		
Using alternative base stocks in validated formulations (Refer to Guidelines Section 4.2)		
CHECK LIST FOR AUDITORS		
Confirmed seen :	<u>Yes</u>	<u>No</u>
1. Manufacturer's defined base stock slate		
2. Where slate linkage is claimed, validated formulations against one category in each of ACEA Classes A, B and E exist for each base stock slate (i.e. pre-qualification data)		
3. Partner Group written agreement to link slates, if applicable		
4. Slates linked in accordance with Appendix B 4.2 (i.e. qualification data exist)		
5. The most severe base stocks in the linked slates have been identified for development purposes		
6. Application of linked slates to current products in accordance with Appendix B 4.2		
7.		
8.		
9.		
10.		
11.		
Title: Name:.....Signature:.....Date:.....		

ATIEL Base Oil Quality Assurance and Interchange Guidelines		
Verification of conformance with defined procedures (Refer to Guidelines Section 5)		
CHECK LIST FOR AUDITORS		
Confirmed seen :	<u>Yes</u>	<u>No</u>
1. Quality system for base stock manufacture		
2. Letter of Compliance to ATIEL		
3. Accreditation to recognised quality standard		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11.		
Title: Name:.....Signature:.....Date:.....		

Appendix E

Revisions to an Existing ACEA Oil Sequence

This section describes the mechanism for updating ACEA performance claims for engine oils following revisions to Oil Sequence requirements.

Issue Number 11, April 5, 2005

This issue supersedes all previous issues.

All new developments initiated after the date of this issue shall use this issue.

Equivalency Guidelines (Grandfathering)

The intent of this guideline is to describe acceptable so called “grandfathering” of CEC engine test results. The ACEA Sequences identify those tests which ACEA have identified as suitable for application of grandfathering principles.

ERC registered engine test results generated prior to the revision of test procedures and test limits, which comply with ACEA 2002 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 tests specified below, the data from the earlier version of the test, assessed versus the ACEA '02 oil sequence limits, can be readacross 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.

Test equivalency applies to certain test parameters contained in specific Oil Sequence categories. The scope of the application is shown below.

1. TU3MH CEC-L-55-T-96

The TU3MH can be used in lieu of the required TU572 in support of ACEA 2-96 issue 3, when passing results for all parameters are available for the TU3MH at A2-96 issue 2 level.

2. Sequence VE

Sequence VE with passing results for ACEA 1999 requirements can be used in lieu of Sequence VG

3. Evaporative loss (CEC-L-040-93 procedure A)

Volatility measured by CEC-L-040-A-93 procedure A, can be used in lieu of results obtained by CEC-L-040-A-93 procedure B, if they meet the ACEA requirements after conversion to equivalent Procedure B results, using following conversion factor for formulated lubricants:

$$\text{Volatility (Procedure B)} = 1.027 \times \text{Volatility (Procedure A)}$$

4. XUD11 BTE

The DV4 test can be used in support of the B sequences of ACEA 2002, in lieu of the XUD11BTE test, when passing DV4 results at the ACEA 2004 A3/B3 level are available

Appendix F

Letters of Conformance

- a) **Template for EELQMS Letter of Conformance and List of Signatories**
- b) **Template for Base Stock Manufacturer's Letter of Conformance and List of Signatories**

Issue Number 11, April 5, 2005

This issue supersedes all previous issues.

All new developments initiated after the date of this issue shall use this issue.

Template for EELQMS Letter of Conformance (for use by oil marketers)

(Letter to be addressed to ATIEL and sent by registered mail)

[Name of the participating company], duly represented by the undersigned acting for *[name of participating company]* and entities acting under its brand, hereby formally declares to participate in the European Engine Lubricants Quality Management Systems (EELQMS). In this respect, *[Name of the participating company]* undertakes the following commitments:

- to apply the EELQMS guidelines, as described in the ATIEL Code of Practice, to develop and manufacture those engine oils for which compliance with ACEA Oil Sequences requirements will be claimed.
- to inform its auditors of its agreement to implement EELQMS
- to ensure that its ISO 9001 or equivalent procedures include conformance with the ATIEL Code of Practice and to identify this to external ISO 9001 (or equivalent) auditors
- to provide such auditors with a copy of the ATIEL Code of Practice
- in case the development process, or parts of it, is conducted by a third party it will require that this third party, having signed a Letter of Intent themselves, will apply the EELQMS guidelines, as described in the ATIEL Code of Practice, to ensure the independent audit of the development process.
- in case the engine oils are blended by a third party, it will require and ensure that this third party will comply with the quality requirements for blending included in the ATIEL Code of Practice.

The commitments referred to in this letter will be valid for a maximum period of two years as from the date of this letter. *[Name of the participating company]* is entitled to withdraw from its EELQMS commitments at any time prior to that date, by registered letter to ATIEL. Renewal of the participation in the EELQMS is possible for subsequent periods of two years. A renewal should be notified in writing to ATIEL, on the basis of the standard Letter of Conformance applicable at that time.

[Name of the participating company] mandates ATIEL to:

- include its company name in the ATIEL List of Participants in the EELQMS which will be made available by ATIEL to any interested party.

[Name of the participating company] will be solely responsible for compliance with the obligations defined in this letter. It will not assert, in any way, that any of its automotive lubricants or related products qualify under the ACEA Oil Sequences, unless all tests and analyses of such products carried out prove that they merit the claimed qualifications of the ACEA Oil Sequences have been performed in strict compliance with and observance of all applicable or relevant procedures.

List of companies who have signed the EELQMS (oil marketer's) Letter of Conformance

Participation in the European Engine Lubricant Quality Management System (EELQMS) implies a commitment to develop and manufacture those engine oils for which compliance with ACEA Oil Sequences will be claimed, or to have such engine oils developed or blended by third parties, in accordance with the guidelines, described in the ATIEL Code of Practice as well as a commitment to ensure an independent audit of the development and manufacturing process. These commitments are made in a "Letter of Conformance", issued by the participating entity to ATIEL.

See Section "Code of practice" on the ATIEL website (www.atiel.org) for the current list* of entities registered by ATIEL as having declared their participation in EELQMS by signing the Oil Marketer's Letter of Conformance (see page F-2 and F-3 for template).

The appearance of an entity on the ATIEL list only means that ATIEL has entered in its register, as of the date of the list, a valid Letter of Conformance of the entity concerned, appearing, on the face of it, to be genuine. ATIEL assumes no responsibility for the implementation by the entities identified above of their obligations, as defined in such Letter of Conformance, or for any damage that a breach thereof may cause to third parties. ATIEL can not be held responsible for any claims resulting from inclusion and non-inclusion of entities in this list. ATIEL also declines any responsibility with regard to the external audit procedure, which belongs to the domain of the relevant auditor.

* Any queries concerning this list should be addressed to the ATIEL office (tel. +32 2 566 91 37; fax. +32 2 566 91 36)

Template for Base Stock Manufacturer's Letter of Conformance

(Letter to be addressed to ATIEL and sent by registered mail)

To: ATIEL
[Insert current address]
Subject: ATIEL Base Stock Quality Assurance Guidelines
Letter of Conformance

[Name of participating company] hereby declares its undertaking to implement the ATIEL Base Stock Quality Assurance Guidelines as described in Appendix B of the ATIEL Code of Practice.

For the purposes of this Letter of Conformance, [Name of the participating company] represents all associated companies operating under its brand and is duly represented by the undersigned.

[Name of the participating company] in particular makes the following commitments:

- (a) to inform its auditors of its agreement to implement the ATIEL Base Stock Quality Assurance Guidelines
- (b) to ensure that its ISO 9001 or equivalent procedures include conformance with ATIEL Code of Practice and to identify this to external ISO 9001 (or equivalent) auditors
- (c) to provide such auditors with a copy of Appendix B of the ATIEL Code of Practice
- (d) to apply the ATIEL Base Stock Quality Assurance Guidelines to the production of base stocks by [Name of the participating company] where such base stocks are intended for use in lubricants for which compliance with ACEA Sequences is to be claimed
- (e) to ensure that, where base stocks produced by a third party are re-branded for sale under the [Name of the participating company] brand and where such base stock are intended for use in lubricants for which compliance with ACEA Sequences will be claimed, the third party concerned has (a) applied the ATIEL Base Stock Quality Assurance Guidelines to the production of the base stocks supplied and (b) has itself submitted a letter of conformance to ATIEL

It is understood by [Name of the participating company] that the commitments referred to above:

1. will remain valid for a period of two years from the date that this Letter of Conformance is received by ATIEL
2. may be revalidated for a further period of two years by submitting to ATIEL a new Letter of Conformance based on the template letter current at that time
3. may be cancelled at any time by notifying ATIEL by registered mail of the withdrawal of any or all of the undertakings made in this Letter of Conformance.

[Name of the participating company] hereby agrees that ATIEL may include its name in a list of companies that have agreed wholly or in part to implement Appendix B of the ATIEL Code of Practice. This list may be made available to ATIEL members or to any interested party.

[Name of the participating company] further agrees that it will be solely responsible for compliance with the undertakings it makes in this letter. It will not assert, in any way, that base stocks have been produced in compliance with Appendix B of the ATIEL Code of Practice unless all relevant procedures and test have been carried out.

Important note:

Base stock manufacturers signing this Letter of Conformance must ensure that all elements of the guidelines are fully implemented from the date of signing the letter.

List of Companies who have signed the Base Stock Manufacturer's Letter of Conformance

Signing the Base Stock Manufacturer's Letter of Compliance implies a commitment by base stock manufacturers and partner groups to the quality assurance guidelines described in Appendix B for the manufacture of base stocks to be used in engine oils for which compliance with ACEA Oil Sequences is to be claimed.

See Section "Code of practice" on the ATIEL website (www.atiel.org) for the current list* of entities registered by ATIEL as having declared their participation in EELQMS by signing the Base Stock Manufacturer's Letter of Conformance (see page F-5 and F-6 for template).

The appearance of an entity on the ATIEL list only means that ATIEL has entered in its register, as of the date of the list, a valid Letter of Conformance of the entity concerned, appearing, on the face of it, to be genuine. ATIEL assumes no responsibility for the implementation by the entities identified above of their obligations, as defined in such Letter of Conformance, or for any damage that a breach thereof may cause to third parties. ATIEL can not be held responsible for any claims resulting from inclusion and non-inclusion of entities in this list. ATIEL also declines any responsibility with regard to the external audit procedure, which belongs to the domain of the relevant auditor.

* Any queries concerning this list should be addressed to the ATIEL office (tel. +32 2 566 91 37; fax. +32 2 566 91 36)

Appendix G

Acronyms, Glossary and Definition of Terms

Issue Number 11 April 5, 2005

*This issue supersedes all previous issues.
All new developments initiated after the date of this issue shall use this
issue.*

ACRONYMS, GLOSSARY AND DEFINITION OF TERMS

ACC	American Chemistry Council
ACEA	Association des Constructeurs Européens d'Automobiles
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
ATC	Technical Committee of Petroleum Additive Manufacturers in Europe (Additive Technical Committee)
ATIEL	Association Technique de l'Industrie Européenne des Lubrifiants
BOI	Base Oil Interchange
CEC	Coordinating European Council for the Development of Performance Tests for Transportation Fuels, Lubricants and other Fluids
CMA	Formerly Chemical Manufacturers Association
DVM	Dispersant Viscosity Modifier
EELQMS	European Engine Lubricant Quality Management System
ERC	European Registration Centre
F.F.K.	Fundamental Formulation Knowledge .Technical support requirements according to ATC code of Practice (section H)
HTHSV	High Temperature High Shear Viscosity
KV	Kinematic Viscosity
Level 2 Support	Technical support requirements as defined according to ACC Code of Practice (appendix H).
NDVM	Non Dispersant Viscosity Modifier
RSI	Registration Systems Inc.
SAE	Society of Automotive Engineers
VMI	Viscosity Modifier Interchange
VE	Sequence VE test According to ASTM D 5302
VG	Sequence VE test According to ASTM D 6593
Mack T8	Test According to ASTM D4485
Mack T8E	Test According to ASTM D5967
Mack T9	Test According to ASTM D6483

Mack T10	Mack T9 test with EGR according to ASTM D6987
M11	Cummins M11 test according to ASTM D6838
M11 EGR	Cummins M11 test with EGR according to ASTM D6975
M111	M111 Black Sludge Test According to CEC L-53-T-95
M111FE	M111 Fuel Economy Test According to CEC L-45-T-96
OM364LA	OM 364A Bore Polishing and Piston Cleanliness Test According to CEC L-42-T-99
OM602A	OM 602A Wear Test According to CEC L-51 -T-95
OM441LA	OM 441 LA Test for Bore Polishing, Piston Cleanliness and Turbocharger Deposits Test According to CEC L-52-T-97
TU3MH	TU3M High Temperature Deposits, Ring Sticking and Oil Thickening Test According to CEC L-55-T-95
TU3MS	TU3M Valve train Scuffing Wear Test According to CEC L-38-A-94
TU572	High Temperature Deposits, Ring Sticking and Oil Thickening Test According to CEC L-88-02
VGR	Viscosity Grade Readacross
VWICTD	VW Intercooled Turbo-Diesel Ring Sticking and Piston Cleanliness Test According to CEC L-46-T-93
VW DI	VW Direct Injected Diesel Piston Cleanliness and Ring Sticking Test According to CEC L-78-T-99
XUD11	XUD1 1 BTE Medium Temperature Dispersivity Test According to CEC L-56-T-98
DV4	DV4 Medium Temperature Dispersivity Test According to CEC L-93-04