

WELCOME

Evolving Interchange Guidelines and Tests

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Speaker introduction



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- Member of the ATIEL Executive Committee
- 35-year career in the petroleum industry

Today's session - what we will cover

01

Insights into API and European approaches to interchange guidelines and tests

What are the options for running European interchange projects?

02

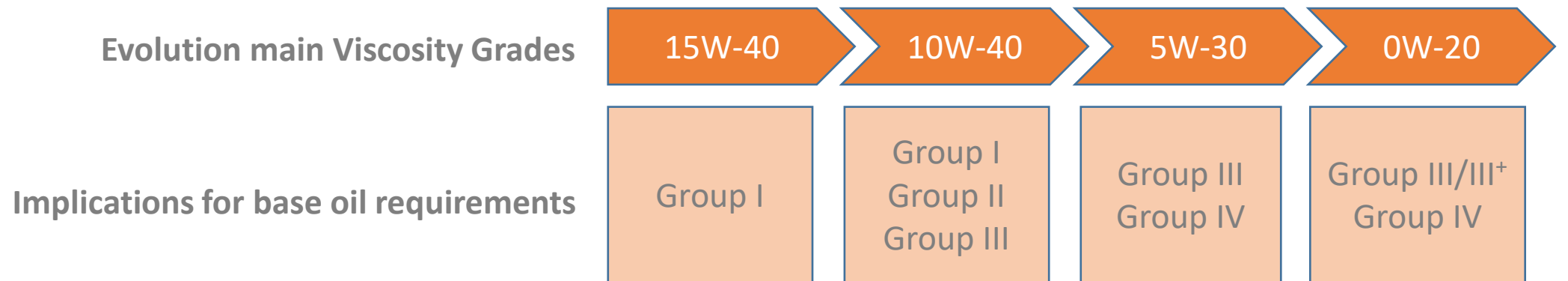
03

Hear a case study as well as views on industry hurdles and future initiatives

A background image showing a white plastic can pouring a golden-yellow liquid, likely motor oil, into a clear glass. The liquid is captured in motion, creating a dynamic splash and ripples. The scene is set against a light gray background.

Evolution of European (ACEA) Specification

Engine Oil Specifications driven by Emission Legislation



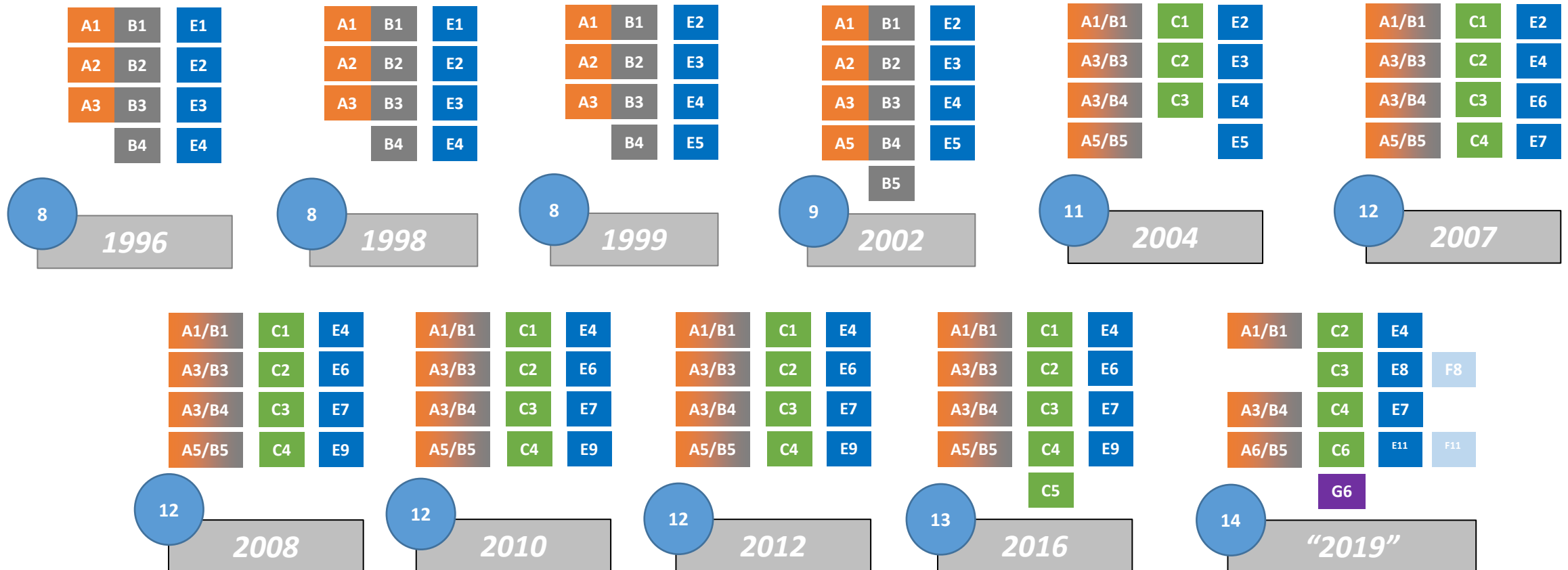
Increased use of Group II and III base oils in Light and Heavy Duty

- Very limited BOI interchange guidelines for Grp II and III
- Current guidelines focused around group 1 base stocks

Interchange Guidelines did not hold pace with specification evolution

The Complexity Challenge

From 8 to 14 Categories



Interchange Guidelines help to manage increasing complexity





New Engine Tests Add Complexity

Proposed new engine tests in “ACEA 2019 Sequences”

Heavy Duty

- CEC OM471LS **CEC**
- Mack T-13 

Light Duty

- M271 EVO Sludge **CEC**
- Toyota Turbocharger **CEC**
- Seq IVB Wear 
- Seq. VH Sludge 
- Seq. IX LSPI 
- Seq. X Chain Wear 

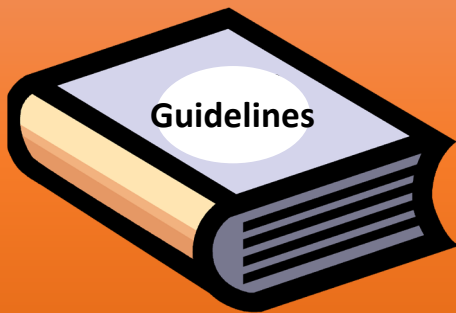
- For new **CEC** Tests no VGRA/BOI interchange guidelines available
- For  tests the North American (API) Interchange guidelines are applied

The Industry Response



Complexity Increase

- Number of ACEA categories increased from 8 to 14
- New and more engine tests in ACEA Sequence for which there are no interchange guidelines
- Changing viscosity grades
- New and more base oils appearing on the market



Interchange Guidelines

- Viscosity Grade Read Across and base oil interchange can contribute to managing the increased complexity and reduce engine oil development costs, while continuing to assure final product performance.
- ATIEL and ATC joined forces to move the development of read across guidelines for (new) CEC tests forward.

A large, faint background image on the left side of the slide shows a white plastic bottle pouring clear water. The water is captured in mid-pour, creating a dynamic splash and several small droplets. The bottle's neck and the initial part of the stream are visible on the left, while the water extends towards the center of the frame.

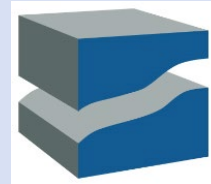
NA vs European Approach

Differences between API and ACEA systems



Engine Oil Licensing & Certification System (EOLCS)

- One organisation (API) representing OEMs, Oil and Additives industries
- API develops and owns lubricant classifications
- Enabled development of licensing system
- Logo and policing system
- Fee-based licensing
- Licensing ('Donut') still voluntary



Voluntary code

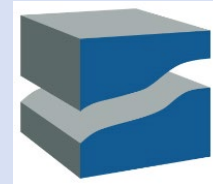
- Different organisations representing OEMs, Oil and Additives industries
- ACEA owns Oil Sequences, but chooses not to license
- Not legally possible for ATIEL to license/police against the Oil Sequences
- Voluntary code, with signatory system (Letter of Conformance) - required by ACEA to make performance claims

Differences between API and ACEA systems (Cont'd)



Read Across Guideline development embedded in test development

- Viscosity Grade Read Across and Base Oil Interchange Guidelines are developed as integral part of new test development.
- Read across guidelines available at start of new category.
- Funding:
 - Light Duty OEMs, ILSAC members
 - Heavy Duty OEMs, EMA members
 - Additive companies, ACC members
 - Oil marketers, API members.



Read Across Guideline Development separated from test development

- Viscosity Grade read Across and Base Oil Interchange Guidelines are responsibility of ATIEL
- No read across guidelines available at start of new tests.
- Funding:
 - Oil Marketers, ATIEL members
 - Additive companies, ATC Members

The EP6 VGRA Programme

**First European Industry
Read Across Test Program**

Interchange Guideline development in Europe

First ACEA Sequences

Interchange Guidelines based on agreed technical principles and combined engine test data of ATIEL members

**After
1996**

ATC/ATIEL

ATIEL and ATC workgroup to progress development of interchange guidelines.

2015



EP6 VGRA

ATC/ATIEL established funding mechanism to run a statistically designed full E6 engine VGRA test programme.

2018



Grandfathering

Interchange guidelines since then primarily based on "grandfathering" as most tests were evolution of existing tests.



2012

TU5 VGRA + BOI

ATIEL and ATC cooperation resulted in VGRA and BOI interchange rule based on collective data from ATC/ATIEL members and a full statistical evaluation.



2016

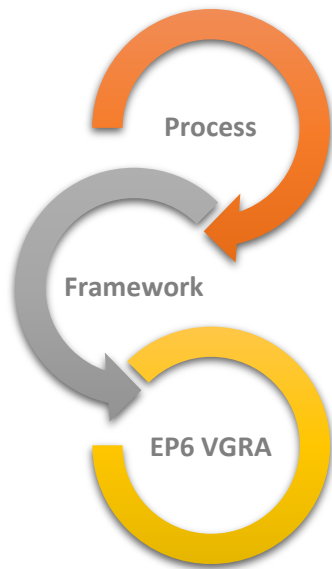
EP6 completed

50/50 funded ATIEL and ATC sponsored test programme was completed resulting in a new VGRA guideline for the EP6 test engine to be published in ATIEL CoP in 2019



1996

EP6 Engine Test Development - joint ATIEL/ATC Initiative



Prior to 2016, there was **no process in place** to develop read-across guidelines for new engine tests

ATIEL/ATC developed a **framework for read-across guideline development**, with plans to apply this framework to the new ACEA 2016 engine tests

Agreement was reached to proceed with **EP6 VGRA** as the first read-across guideline development programme

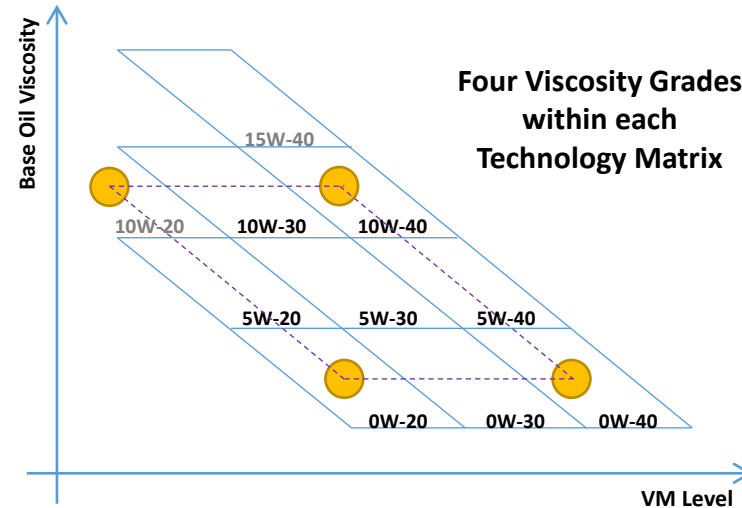
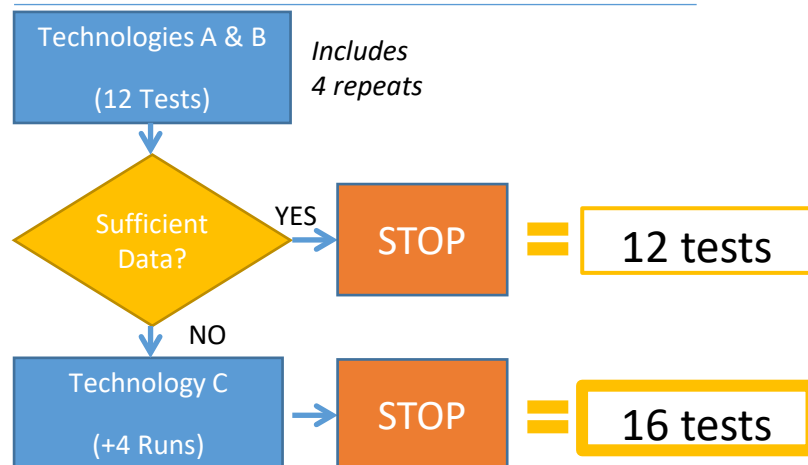
EP6 VGRA Working Group Objectives

- **Develop & validate EP6 VGRA guidelines for the ATIEL Code of Practice.**
 - Plan and run a statistically designed experiment in the EP6, exploring the effect of base oil viscosity and viscosity modifier treatment on test performance.
 - Interpret results and recommend VGRA guidelines for incorporation into the ATIEL Code of Practice.

Test Matrix Design

- Viscosity Grade coverage from **0W-20** to **10W-40**
 - Maximises change in base oil viscosity and VM Level to achieve high statically power to identify effects above the noise of the test
- **Three technologies**, across three suppliers
 - Maximises opportunity to identify unexpected effects and interactions,.
- BOI is **not** being considered – base stock slate will be consistent within each Technology

EP6 Test Order



Technology C will only be required if:

- Analysis of the first two technologies gives neutral results
- Initial conclusions conflict with technical judgement and experience
- Results demonstrate strong interactions and read-across cannot be permitted

Program costs ~ € 1 million for 16 tests

Format of the Current EP6 VGRA Guideline

Issue 20, Appendix A, December 2016

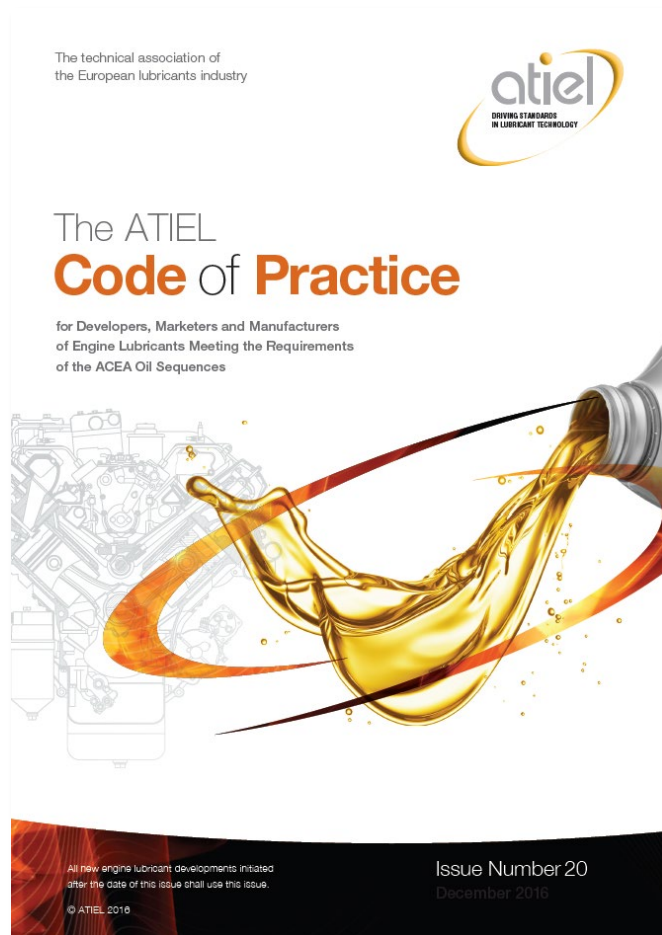


Table VGRA.5 VGRA guidelines for the VW TDI or OM646LA Bio or EP6CDT engine test
(Applicable only to engine lubricant with **non-dispersant type of viscosity modifier**)

Test run on	Can be read-across 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		no	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	no	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	no	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾
0W-30	yes if ⁽⁷⁾		no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾
0W-40	yes if ⁽⁷⁾	yes if ⁽⁷⁾		yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾
5W-20	no	no	no		no	no	no	yes if ⁽⁷⁾	no	no	no	yes if ⁽⁷⁾	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾
5W-30	yes if ⁽⁷⁾	no	no	yes if ⁽⁷⁾		no	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	no	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾
5W-40	yes if ⁽⁷⁾	yes if ⁽⁷⁾	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾		no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾
5W-50	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾		yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾
10W-30	no	no	no	yes if ⁽⁷⁾	no	no	no		no	no	no	yes if ⁽⁷⁾	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾
10W-40	yes if ⁽⁷⁾	no	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	no	no	yes if ⁽⁷⁾		no	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾
10W-50	yes if ⁽⁷⁾	no	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾		no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾
10W-60	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾		yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾	yes if ⁽⁷⁾
15W-40	no	no	no	yes if ⁽⁷⁾	no	no	no	yes if ⁽⁷⁾	no	no	no		no	yes if ⁽⁷⁾	yes if ⁽⁷⁾
15W-50	no	no	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	no	no	yes if ⁽⁷⁾	yes if ⁽⁷⁾	no	no	yes if ⁽⁷⁾		yes if ⁽⁷⁾	yes if ⁽⁷⁾
20W-40	no	no	no	no	no	no	no	no	no	no	no	no	no		no
20W-50	no	no	no	yes if ⁽⁷⁾	no	no	no	yes if ⁽⁷⁾	no	no	no	yes if ⁽⁷⁾	no	yes if ⁽⁷⁾	

(*) Yes, VGRA is permitted if the **viscosity modifier concentration increase** in the read-across viscosity grade vs the tested viscosity grade is **less than 15% mass fraction relative**.

If the viscosity modifier concentration increase is larger than 15% mass fraction relative, VGRA can be permitted if **technical support data** as defined in Section h.15 of the ATC Code of Practice¹ is available to justify read-across.

The new VGRA Guideline for the EP6CDT test provides more flexibility



VGRA is permitted if the viscosity modifier concentration is decreased, or if the increase in the read-across viscosity grade vs the tested viscosity grade is less than 15% mass fraction relative.



This VGRA guideline is the result of a statistically designed matrix of EP6 test oils run by ATIEL and ATC in a diverse range of technologies.



If the viscosity modifier concentration increase is larger than 15% mass fraction relative, VGRA can be permitted if technical support data as defined in Section h.15 of the ATC Code of Practice is available to justify read-across.

Future Programs

Viscosity Grade Read Across



Next VGRA Program Selection Criteria

Industry currently in the process of selecting the next VGRA program:

- Consensus now forming to develop interchange guidelines for the Toyota Turbocharger test as no interchange guidelines for this new test are available

Are VGRA Guidelines available today ?

Expected in ACEA Heavy Duty Categories ?

Expected Lifetime of tests ?

Expected in ACEA Light Duty Categories ?

Test Costs per run ?

Duration of test?

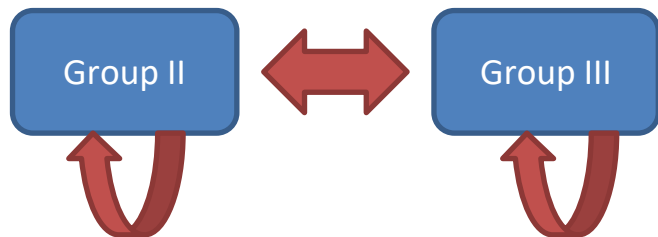
Future Programs

Base Oil Interchange Options



Base Oil Interchange Matrix Design

- Design example for e.g. the EP 6 Engine test (cost per test ~ € 67,300)
- Assumption that two base oil groups, including intra-group read-across is a minimum requirement for BOI to be worthwhile.



- Group II to Group II
- Group III to Group III
- Group II to Group III
- Group III to Group II

Possible Base Oil Interchange Matrix

1	Technology A	10W-30	Group II Slate 1	Group III Slate 1	Technology A	10W-30	10
2	Technology B	5W-40			Technology B	5W-40	11
3	Technology C	5W-30			Technology C	5W-30	12
4	Technology A	10W-30	Group II Slate 2	Group III Slate 2	Technology A	10W-30	13
5	Technology B	5W-40			Technology B	5W-40	14
6	Technology C	5W-30			Technology C	5W-30	15
7	Technology A	10W-30	Group II Slate 3	Group III Slate 3	Technology A	10W-30	16
8	Technology B	5W-40			Technology B	5W-40	17
9	Technology C	5W-30			Technology C	5W-30	18

3 BO slates



2 base oil groups



3 VG's



18 tests



4 duplicates



22 tests

Base Oil Interchnange Matrix

- Assumption that two base oil groups, including intra-group read-across is a minimum requirement for BOI to be worthwhile.
- Testing may become prohibitively expensive very quickly when additional base oil groups are added (see example with EP6 below).

EP6 Test Cost Estimate

~67 300 EUR

This is an estimated value.
Cost structures can vary.

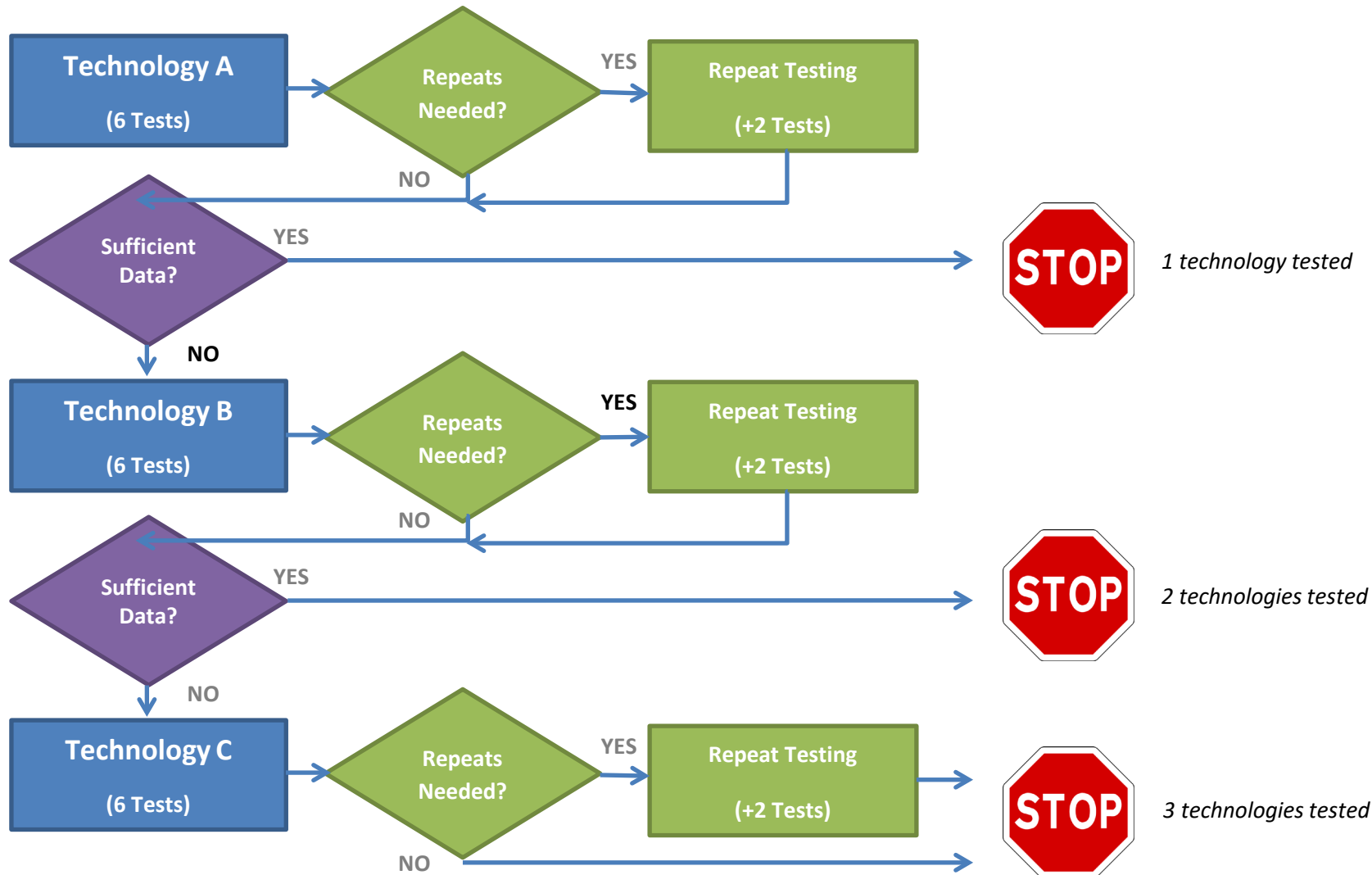
Condition	Number of Tests	Total Cost Estimate
Two base oil groups (including intra-group interchange)	22	<u>1 480 600 EUR</u>
Three base groups (including intra-group interchange)	+ 9 = 31	+ 605 700 EUR <u>2 086 300 EUR</u>

Base Oil Interchange Matrix Simplification

- BOI Experimental Matrix is much more expensive than the VGRA Matrix
 - Approximately at least twice as expensive
- How can we reduce the costs ?
 - Take a more practical approach
 - Is it necessary to include Group II <-> Group III interchange ?
 - Is interchange in same group not sufficient ?
 - Step by step including stopping rules



BOI Matrix/Stopping rules - Stepwise Approach



Base Oil Interchange Matrix/Stopping rules

Application to EP6

	No Repeats	All Repeats
Technology A	403 800 EUR	538 400 EUR
Technology A+B	807 600 EUR	1 076 800 EUR
Technology A+B+C	1 211 400 EUR	1 615 200 EUR

- Opportunity to stop testing after Technology A if:
 - Confidence is sufficiently high in read-across
 - No read-across is possible

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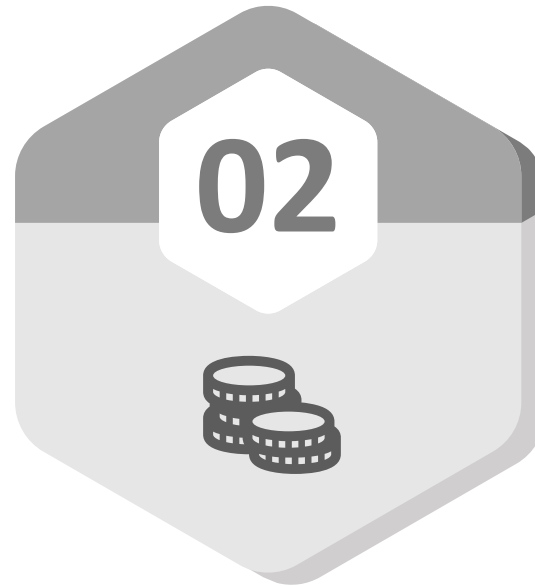
Industry Challenges

Main Industry Challenges



Alignment

Industry alignment within and across organisations (ATC and ATIEL)



Cost

- Especially Base Oil Interchange Programs require significant level of funding
- Currently only PCMO
- HDDO will be even more expensive



Funding

- Funding mechanism
- How to distribute costs amongst beneficiaries ?



Test Engines

Availability of test engines

Main Industry Challenges

- It is ATIEL's position that ultimately the best option is to include VGRA and/or BOI in the CEC test development phase (similar to API approach)
 - Most cost effective overall solution
 - Possibly delays engine test development
- This will require further industry alignment and funding



ATIEL is committed to progress the development of interchange guidelines for the benefit of its members and the industry

Thank you!

For more information visit:

www.atiel.org
www.eelqms.eu

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