



Engine oil specifications

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Outline

1

What is a lubricant specification?

2

Main drivers for specifications

3

Industry committees and responsibilities

4

North America Specifications Overview –
Heavy duty diesel and passenger car engine oils

5

API Engine Oil Licensing and Certification System (**EOLCS**)

6

ACC code of practice



What is a lubricant specification?

What is a lubricant specification?

Basic Definition: A document outlining the requirements a lubricant must meet to be used in a vehicle.

- **Typical contents:**
 - Scope
 - Testing requirements
 - Registration / Approval Instructions
 - Labelling Guidelines
 - Read Across Guidelines
 - References to test methods, standards, and manuals
- **2 common types:**
Factory Fill (FF) and/or **Service Fill** (SF)



Specification testing requirements

Bench tests Rig simulations Engine tests Field trials Application

Increasing cost and time to generate/acquire data

Diminishing ability to demonstrate REAL performance

Tests are Developed by individual OEMs or industry groups to target specific performance parameters of concern

Formulated oils are assessed relative to reference oil of known field performance

Performance tests are continually monitored by industry

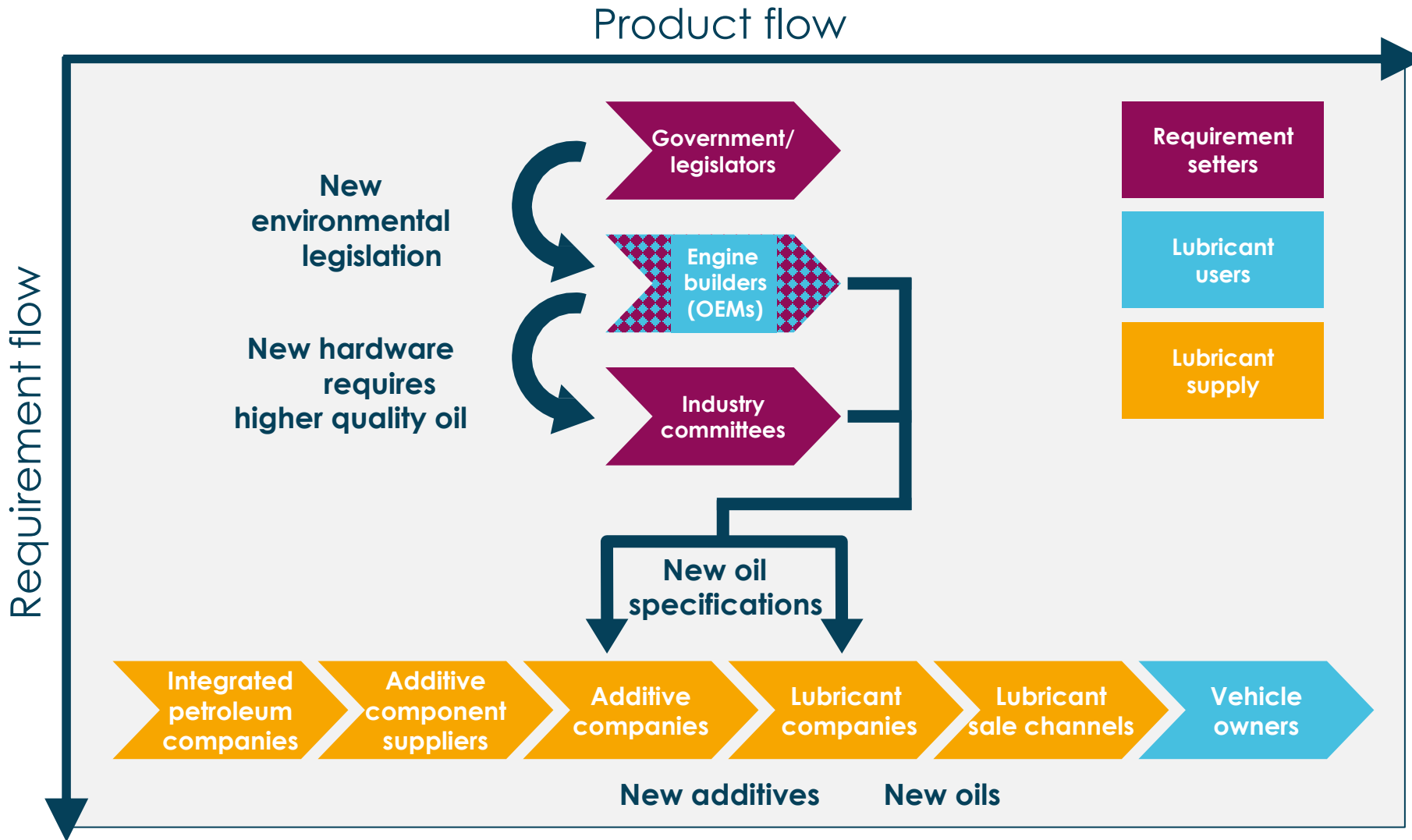
New test development should consider:

- parts availability and quality
- test conditions and duration
- parameters of interest and pass/fail limits
- qualification of test facilities

Industry and OEM specifications are defined as a compilation of tests and limits

Specification drivers & industry players

Oil and additive industry value chain



Organizations classifying engine performance

Industry Associations:

- **API** → American Petroleum Institute
- **ILSAC** → International Lubricant Standardization and Approval Committee
- **ACEA** → European Automobile Manufacturers Association
- **JASO** → Japanese Standard Organization

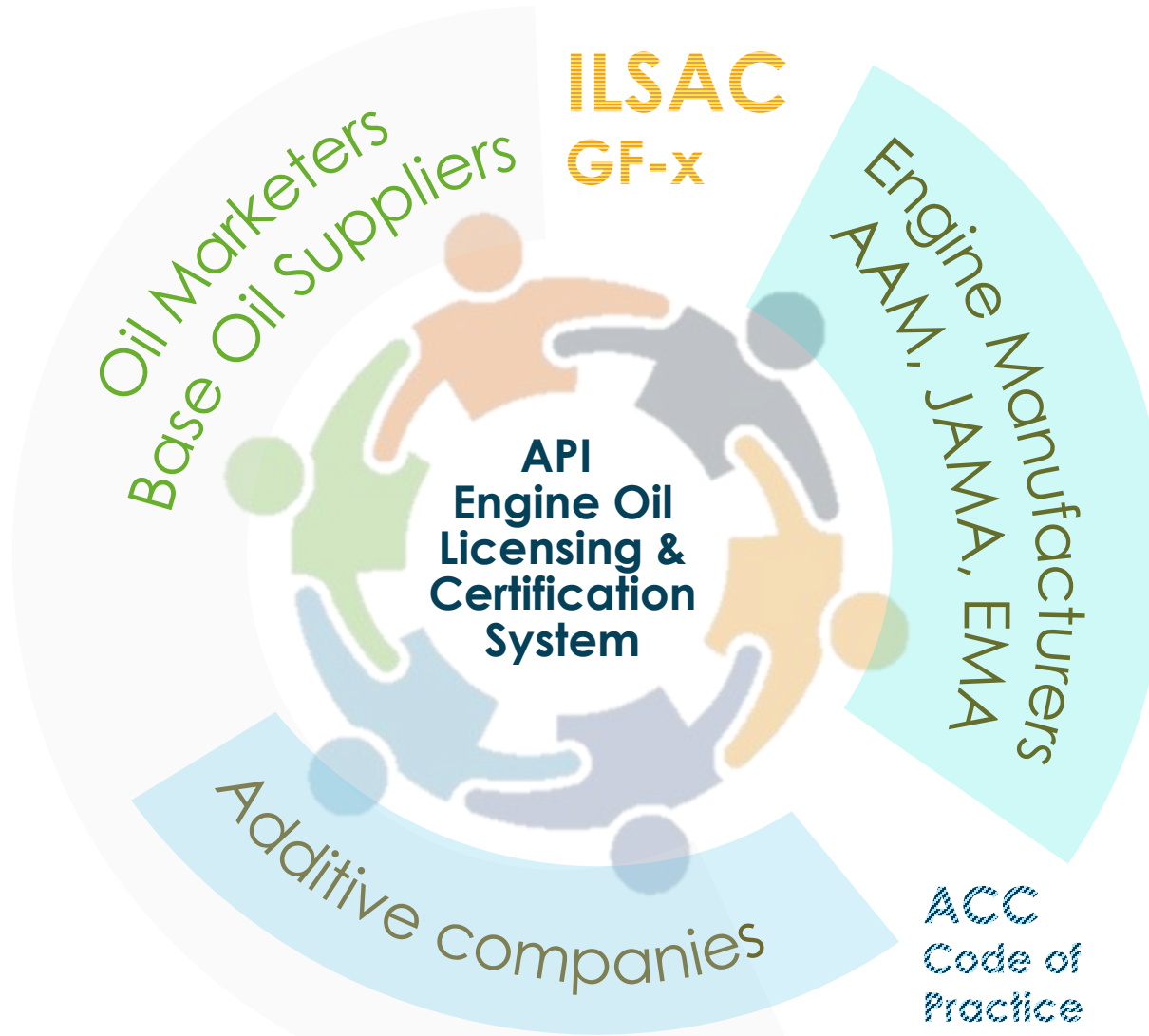
Vehicle or Original Engine Manufacturers (OEMs), such as:

- General Motors (GM)
- Volkswagen (VW)
- Daimler
- Volvo
- Scania

Industry trade organizations and responsibilities (1)



API
C_/S_



How to ensure oils are compatible with engine hardware advances?

- Have oils meet specifications

How to assist customers in choosing quality oils?

- Have system for licensing and certification

How to maintain quality of lubricant development process?

- Outline acceptable practices

Industry trade organizations and responsibilities (2)



Global

Description	North America	Europe	Japan
Engine builders (passenger car)	AAM , JAMA	ACEA	JAMA
Engine builders (commercial)	EMA	ACEA	JAMA
Oil marketers base oil suppliers	API	ATIEL	JASO
Additive companies	API, ACC	ATC	
Specifications	API, ILSAC	ACEA	JASO
Test procedures	ASTM	CEC	JASO, JSA/JIS
Approvals	API		JASO

Industry trade organizations acronyms

Europe

ACEA = European Automobile Manufacturers Association*

ATIEL = Technical Association of the European Lubricants Industry**

ATC = Additive Technical Committee

CEC = Co-ordinating European Council



Japan

JAMA = Japanese Automobile Manufacturers Association

JASO = Japanese Automotive Standards Organization

JSA = Japanese Standards Association

JIS = Japanese Industrial Standards



North America

AAM = Alliance of Automobile Manufacturers

EMA = Engine Manufacturers Association

API = American Petroleum Institute

ACC = American Chemistry Council

ILSAC = International Lubricant Standardisation Advisory Committee

ASTM = American Society for Testing and Materials

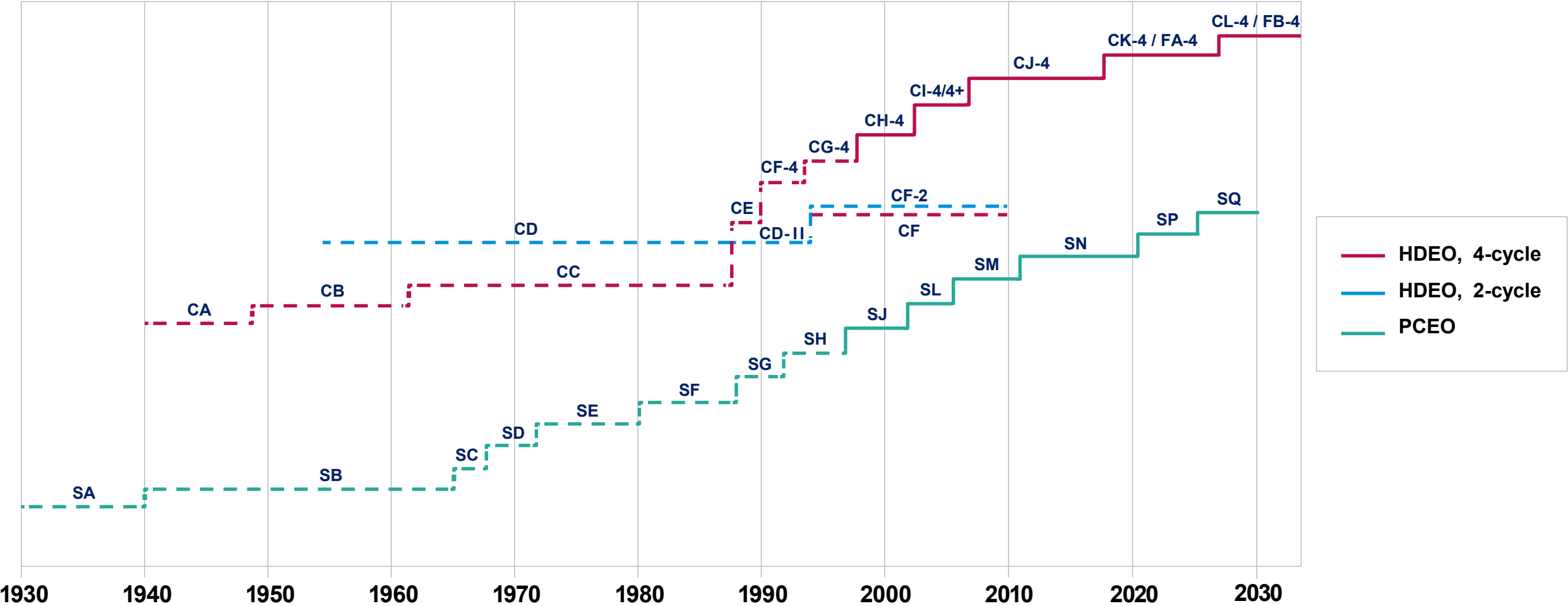


*Association des Constructeurs Européens d'Automobiles

**Association Technique de l'Industrie Européenne des Lubrifiants

North America specifications overview

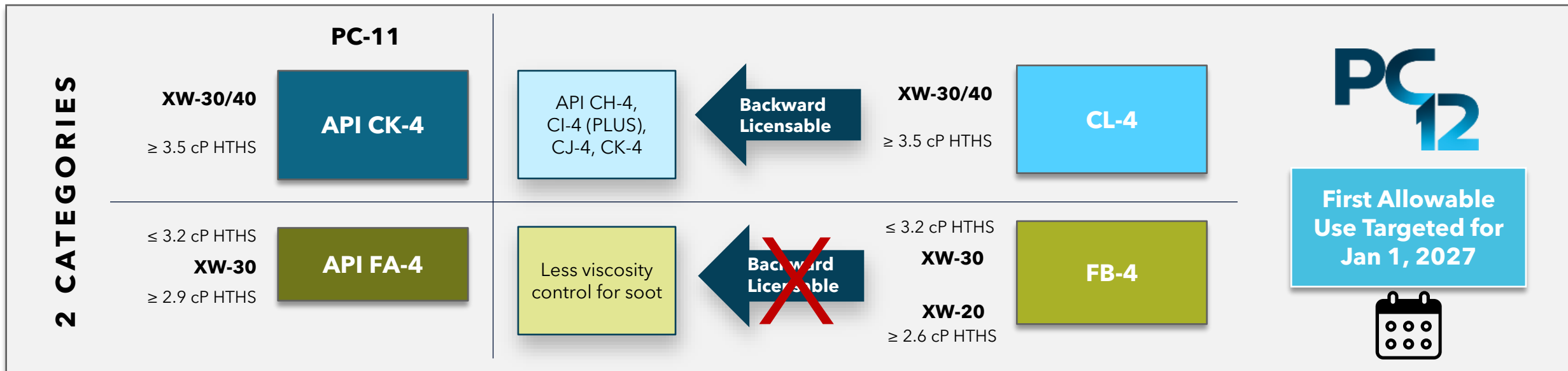
Evolution of API engine oil specifications



API diesel specifications

API Category	Status	API recommendations
CL-4	Upcoming	First-allowable use (FAU) January 2027 To meet 2027 model year on-highway exhaust emission standards Sulfur content up to 300 ppm (0.03% by weight) Sulfated Ash content up to 0.9% by weight Phosphorous content up to 800 ppm (0.08% by weight) Effective at sustaining durability of emission control system (particulate filters and other advanced aftertreatment systems) Can be used in CH-4, CI-4, CI-4+, CJ-4 and CK-4 applications
FB-4	Upcoming	Similar to CL-4, but for lower HTHS oils (XW-30 and XW-20) Less viscosity control for soot
CK-4	Current	Introduced in 2016 To meet 2017 model year on-highway exhaust emission standards Sulfur content up to 500 ppm (0.05% by weight) > 15 ppm (0.0015% by weight) may impact exhaust aftertreatment system durability and/or drain interval (Consult engine manufacturer) Can be used in CH-4, CI-4, CI-4+, CJ-4 applications
FA-4	Current	Similar to CK-4, but for lower HTHS oils

PC-12 – Proposed Category



Key Changes for PC-12

- Reduction in Chemical Limits to protect after treatment systems (0.08% max P, 0.3% max S, 0.9% max SASH)
- Additional Wear Performance (Detroit Diesel DD13 Scuffing Test)
- Improved Oxidation Performance (Tighter Limits in Volvo T-13)
- Replacement of tests approaching their end-of-life (Cummins ISB Viscosity Test replacing Mack T-11)
- New Seals Compatibility Testing (Addition of HNBR Seal)
- Inclusion of XW-20 viscosity grades
- Removal of older tests through redundancy (CAT 1N, RFWT, Mack T-12)

What is ILSAC?

- International Lubricant Standardization and Approval Committee
- A committee consisting of major US vehicle manufacturers and JAMA formed in 1992:
 - Stellantis, General Motors (GM), and Ford
 - Honda, Isuzu, Mazda, Mitsubishi, Nissan, Subaru, and Toyota

What does ILSAC do?

Sets complementary specs to API passenger car specs to include fuel efficiency and catalyst protection

Goes beyond 'engine protection' which is the basis for the API specifications

- Protects the catalyst system and adds a fuel efficiency measurement

During update of ILSAC specifications the previous specification is only valid during a one year transition period

- API specification become obsolete when no longer required or the tests are unavailable

API and ILSAC gasoline specifications

ILSAC Category	Status	ILSAC Service Recommendations
GF-7A and GF-7B	Current	First allowable use is March 31 st , 2025. Key changes include enhanced fuel economy, improved protection against low-speed pre-ignition (LSPI), stricter limits for piston cleanliness, and better timing chain wear protection. These updates are designed to meet the needs of modern vehicles and engine technology, ensuring better performance and longevity
GF-6A and GF-6B	Current	Meant to be introduced in 2016, but was delayed to May 2020 due to the introduction of 7 new and replacement engine tests. Designed to provide LSPI protection for modern turbocharged engines, improved deposits protection for pistons, more stringent sludge control, improved fuel economy, and enhanced emission control system protection. GF-6A designed to be backwards compatible and GF-6B is meant to accommodate new 0W-16 viscosity grade.
GF-5	Obsolete	Introduced in October 2010 for 2011 and older vehicles.
GF-4, GF-3, GF-2, GF-1	Obsolete	Use GF-5 where GF-4, GF-3, GF-2 or GF-1 is recommended.

API Category	Status	API Recommendations
SQ, SQ with Resource Conserving	Current	First allowable use March 31 st , 2025. Key features of API SQ include enhanced fuel economy, improved protection against low-speed pre-ignition (LSPI), better engine cleanliness, and increased durability. Additionally, API SQ includes new ultra-low viscosity grades like SAE 0W-8 and SAE 0W-12. Sets a maximum sulfated ash content limit of 0.9%. The API SQ-RC designation indicates that the oil meets additional requirements for fuel economy and emission reduction.
SP, SP with Resource Conserving	Current but older	For 2021 and newer vehicles, designed to provide LSPI protection for modern turbocharged engines, timing chain wear protection, improved deposits protection for pistons, more stringent sludge control. API SP with Resource Conserving matches ILSAC GF-6A/B by combining API SP performance with improved fuel economy, emission control system protection and protection of engines operating on ethanol containing fuels up to E85.
SN - SJ	Current but older	For older automotive engines.
SH, SG, SF, SE, SD, SC, SB, SA	Obsolete	Not recommended for modern gasoline engines.

OEM PCMO specifications

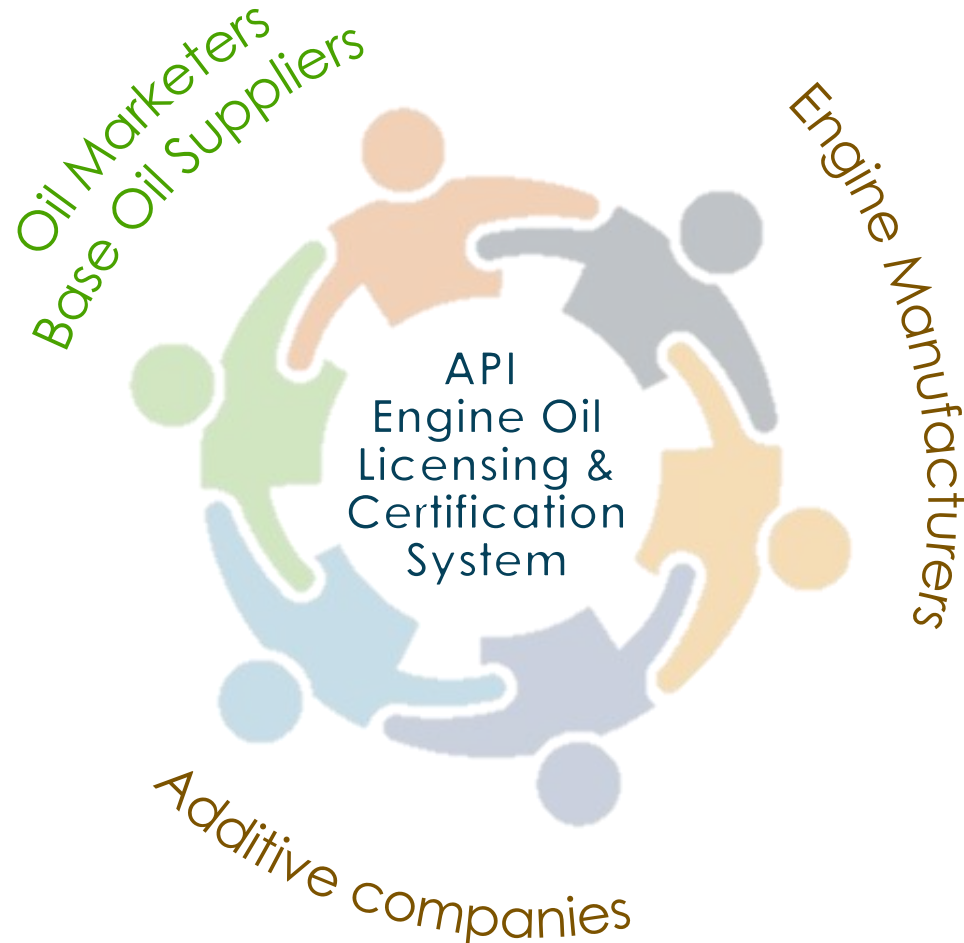
OEM	Specification	Base industry specification	Key Differences
Stellantis	MS-6395	GF-6	Enhanced elastomers; + Las Vegas field trial
Ford	SAE 5W-20: WSS-M2C970-A1 SAE 5W-30: WSS-M2C971-A1 SAE 0W-20: WSS-M2C972-A1 SAE 0W-30: WSS-M2C973-A1	GF-7	
GM	dexos1™ Gen 2* dexos1™ Gen 3**	GF-5/6 GF-6	GMOD instead of IIH, enhanced VH performance; +GMOEE (FE test); + GM Aeration; + GM TC test; GM SPI 3 test; + MTM bench wear test
Honda/Acura	HTO-06	GF-5	+ Hot Tube Test

*Required to upgrade to Gen 3 by September 1, 2022

**First allowable use (FAU): September 1, 2021

EOLCS and ACC code of practice

Engine oil licensing and certification system (EOLCS)



- Voluntary licensing and certification program
- Designed to define, certify, and monitor engine oil performance
- Assist customers in identifying products by licensing certification marks
- Ensure compliance by auditing
 - Verifying physical and chemical properties of oil with licensing data on file at API
 - Subjecting a randomized, limited number of products to engine and bench testing
 - World-wide remit

EOLCS licensing requirements

All engine tests must be conducted per the American Chemistry Council (ACC) code of practice

- Marketer is ultimately responsible for product performance, however they may utilize the following guidelines in lieu of engine testing, when appropriate (fully explained in API 1509 document)

Marketer must disclose:

- Physical and chemical properties
- Bench test data
- Product traceability code

Marketer must agree to monitoring and enforcement procedures

Each viscosity grade and brand requires **an individual license:**

- API Base Oil Interchange (**BOI**)
- API Viscosity Grade Read-Across (**VGRA**)

Comparison of licensing marks



API Service Symbol
'Donut'

API S_ = service categories for cars, vans, and light trucks with gasoline engines

API C_ = commercial category for heavy-duty trucks and vehicles with diesel engines



API Certification Mark
'Starburst'

Current ILSAC performance level

ILSAC GF-6A and GF-6B certification marks



API Certification
Mark

'Starburst'
ILSAC GF-7A



API Certification
Mark

'Shield'
ILSAC GF-7B

ACC code of practice: what is it?

ACC is the American Chemistry Council, which is involved in a wide spectrum of activity affecting the chemical industry in North America

- For our purposes, the **ACC represents the North American lube additive industry**

Officially called the **ACC ‘Petroleum Additives Product Approval Code of Practice’**

- **Maintains consistent quality of the lubricant development process** through guidelines for program management
- Outlines the **minimum standards** covering lubricant additive validation and reporting
- Code **does not** establish needs or develop tests; set limits; deal with labelling or licensing; after market testing

ACC code of practice: main features

Engine Testing:

- Test stands are calibrated, referenced & monitored with ASTM Test Monitoring Centre (TMC)
- Scheduled tests are pre-registered with monitoring agency (TMC) and can only be run in stands meeting acceptance criteria
- Scheduled tests can be placed at a laboratory of choice, but test stands are randomly assigned
- Test results are severity adjusted then judged against criteria for averaging results known as MTEP (multiple test evaluation procedures)

Additive package formulation:

Minor formulation modifications are controlled against allowed limits and criteria (16 detailed sets of guidelines in Appendix H and I of the ACC code)

Presentation of results:

Results are communicated to customer via a Candidate Data Package (CDP)

Compliance:

Annual internal and external audits

Base oil interchange (BOI) guidelines

Not all base oils have similar physical or chemical properties or provide equivalent engine oil performance in engine testing. During engine oil manufacture, marketers and blenders have legitimate needs for flexibility in base oil usage. The API Base Oil Interchangeability Guidelines (BOI) were developed to ensure that the performance of engine oil products is not adversely affected when different base oils are used interchangeably by engine oil blenders.

(API 1509)

- Contained in API 1509 Annex E
- Developed to improve efficiency while maintaining confidence in engine oil performance when interchanging base stocks
- Based on engine test data demonstrating that base stock changes within a defined range have no significant impact on the tests/parameters of interest
- May be quite simple (i.e. no restriction among API groups) or subject to numerous criteria on saturates, sulfur content, viscosity index (VI) and base oil viscosity (BOV)

BOI example – Seq. IVA

Table E-6—Sequence IVA Tests Required for Interchanging the Base Stock

Base Stock in Original Test Oil	Interchange Base Stock				
	Group I	Group II	Group III	Group IV	Group V
Group I	Not Required if BOV @ 100°C ≥ original	Not Required if BOV @ 100°C ≥ original	≤30% Not Required ----- > 30% Not Required if BOV @ 100°C ≥ original	≤30% Not Required ----- > 30% and ≤ 50% Not Required if BOV @ 100°C ≥ original ----- > 50% Required	Required
Group II	Not Required if BOV @ 100°C ≥ original	Not Required if BOV @ 100°C ≥ original	≤30% Not Required ----- > 30% Not Required if BOV @ 100°C ≥ original	≤30% Not Required ----- > 30% and ≤ 50% Not Required if BOV @ 100°C ≥ original ----- > 50% Required	Required
Group III	Not Required if BOV @ 100°C ≥ original	Not Required if BOV @ 100°C ≥ original	Not Required if BOV @ 100°C ≥ original	≤ 30% Not Required if BOV @ 100°C ≥ original ----- > 30% Required	Required
Group IV	Required	Required	≤ 30% Not Required ----- > 30% Required	Not Required provided the interchange Group IV meets original manufacturer's specifications in all physical and chemical properties	Required
Group V	Required	Required	Required	Required	Required

Note: BOV refers to the base oil blend viscosity measured by ASTM D445.

(API 1509)

BOI example – Seq. IVA

Exercise: Which candidate oils can I cover with my Sequence IVA test oil?

	Test Oil	Oil A	Oil B	Oil C	Oil D	Oil E
Viscosity Grade	SAE 5W-30	SAE 5W-30	SAE 5W-30	SAE 5W-30	SAE 5W-30	SAE 5W-30
Additive package, m%	8.0	8.0	8.0	8.0	8.0	8.0
Viscosity modifier, m%	7.0	7.4	7.4	8.0	6.8	6.5
Pour Point depressant, m%	0.4	0.4	0.4	0.4	0.4	0.4
Base oil A (Group II), m%	37.0	-	-	83.6	7.2	-
Base oil B (Group II), m%	47.6	-	-	-	47.6	42.0
Base oil C (Group II), m%	-	84.2	79.2	-	-	-
Base oil D (Group III), m%	-	-	-	-	30.0	43.1
Base oil E (Group V), m%	-	-	5.0	-	-	-
Base oil viscosity @ 100°C	4.0 mm2/s	4.5 mm2/s	4.4 mm2/s	3.2 mm2/s	3.8 mm2/s	4.2 mm2/s

Is BOI allowed?	Yes	No	No	Yes	Yes
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Viscosity grade read-across (VGRA) guidelines

In certain situations, data generated from one viscosity grade of a given engine oil formulation may be extrapolated to another viscosity grade that uses the same additive technology by means of a practice commonly referred to as “read-across” (See Table F-1 through Table F-21).).

These Viscosity-Grade Engine Testing Guidelines can be used to complete a testing program using the most severe viscosity grade for each individual test for the grades being licensed. Engine tests shall be registered using the ACC Code of Practice. No read-across or substitute data are permitted for physical and chemical analyses or for bench tests (except as allowed in F.1.4 and F.4); that is, all specified physical and chemical analyses must be run on the final formulation. Proposed changes to the read-across tables or F.1.4 should be sent to the Chair of API’s Base Oil Interchange (BOI)/Viscosity Grade Read-Across (VGRA) Task Force or API. The proposal must include a justification and supporting data for such change.

(API 1509)

- Contained in API 1509 Annex F
- Similar to BOI, developed to improve efficiency
- General principles of VGRA include read-across from most difficult to less-difficult viscosity grades
 - From high viscosity modifier (VM) treat to low VM treat
 - From high volatility base stock to low volatility base stocks

VGRA example – Seq. IVA

Table F-8—Groups I, II, III and IV Viscosity Read-Across: Sequence IVA Test

Test Run on	Can Be “Read-Across” to:												
	5W-20	5W-30	10W	10W-30	10W-40	15W-40	15W-50	20W	20W-40	20W-50	30	40	50
5W-20	NA	—	X	X	—	—	—	X	X ^a	X ^a	X	X	X
5W-30	X	NA	X	X	X	X	X	X	X	X	X	X	X
10W	—	—	NA	—	—	—	—	X	—	—	X	X	X
10W-30	—	—	—	NA	—	X	—	X	X	X	X	X	X
10W-40	—	—	—	X	NA	X	X	X	X	X	X	X	X
15W-40	—	—	—	X	—	NA	X	X	X	X	X	X	X
15W-50	—	—	—	—	—	—	NA	—	X	X	X	X	X
20W	—	—	—	—	—	—	—	NA	—	—	X	X	X
20W-40	—	—	—	—	—	X	—	—	NA	X	X	X	X
20W-50	—	—	—	—	—	—	—	—	—	NA	X	X	X
30	—	—	—	—	—	—	—	—	—	—	NA	X	X
40	—	—	—	—	—	—	—	—	—	—	—	NA	X
50	—	—	—	—	—	—	—	—	—	—	—	—	NA

Notes for Table F-8:

1. X = read-across is permitted for the viscosity grades identified based on data and some applications of the technical principles approved by API BOI/VGRA Task Force and API Lubricants Standards Group.
2. A dash (—) means that read-across is not permitted; NA = not applicable.
3. New viscosity grades and associated read-across are allowed if the requirements described in F.1.4
4. Tested formulations containing Group V stocks must contain an equal amount of the same Group V base stock (e.g., ester) in the finished oil blend for application of viscosity grade read-across.

^a Read-across permitted if requirements in F.1.4 are met

(API 1509)

VGRA example – Seq. IVA

(API 1509)

Table F-8—Groups I, II, III and IV Viscosity Read-Across: Sequence IVA Test

Test Run on	Can Be “Read-Across” to:												
	5W-20	5W-30	10W	10W-30	10W-40	15W-40	15W-50	20W	20W-40	20W-50	30	40	50
5W-20	NA	—	X	X	—	—	—	X	X ^a	X ^a	X	X	X
5W-30	X	NA	X	X	X	X	X	X	X	X	X	X	X
10W	—	—	NA	—	—	—	—	X	—	—	X	X	X
10W-30	—	—	—	NA	—	X	—	X	X	X	X	X	X
10W-40	—	—	—	X	NA	X	X	X	X	X	X	X	X
15W-40	—	—	—	X	—	NA	X	X	X	X	X	X	X
15W-50	—	—	—	—	—	—	NA	—	X	X	X	X	X
20W	—	—	—	—	—	—	—	NA	—	—	X	X	X
20W-40	—	—	—	—	—	X	—	—	NA	X	X	X	X
20W-50	—	—	—	—	—	—	—	—	—	NA	X	X	X
30	—	—	—	—	—	—	—	—	—	—	NA	X	X
40	—	—	—	—	—	—	—	—	—	—	—	NA	X
50	—	—	—	—	—	—	—	—	—	—	—	—	NA

SAE 5W-30 may be read across to all viscosity grades shown

SAE 10W-40 may be read across to all viscosity grades shown except SAE 5W-20, 5W-30, 10W

SAE 50 may not be read across to any viscosity grades shown

SAE 20W-40 may be read across to SAE 15W-40, 20W-50, 30, 40, and 50

VGRA for diesel engine oils

Different layout for VGRA of HDD engine tests:

Table F-17—Groups I, II, III and IV Viscosity-Grade Read Across for Diesel Engine Oils
Read-across for viscosity grades not covered explicitly by this table are not allowed unless permitted by Table F-1.

Performance Test	From SAE	To SAE
1K	10W-40	10W-30, 15W-40, 15W-50
	15W-40	10W-30, 20W-40, 20W-50
	30	10W, 20W, 40, 10W-30, 15W-40, 20W-50
	40	10W, 20W, 30, 10W-30, 15W-40, 20W-50
1N	15W-40	10W-30, 20W-40, 20W-50
	20W-20 ^a	10W
	30	10W, 20W-20 ^a
	40	10W, 20W-20 ^a , 30
	50	10W, 20W-20 ^a , 30, 40
1P	10W-30	15W-40, 20W-40, 20W-50
	10W-40	10W-30, 15W-40, 15W-50, 20W-40, 20W-50
	15W-40	20W-40, 20W-50
	15W-50	15W-40, 20W-40, 20W-50

(API 1509)

Putting it all together

BOI and VGRA principles are often applied **together** to extend product claims to new base stock slates and viscosity grades.

In addition, there are other tools that may allow for additional flexibility and performance upgrades, such as:

- Minor Modifications (ACC CoP App H)
- Program Guidelines (ACC CoP App I)

Our Infineum Customer Technical Service colleagues are experts on these topics and are available to help.

Exercise: Which of the candidate oils below can I cover with my test oil?

	IVA Test Oil	Oil A	Oil B
Viscosity Grade	SAE 10W-30	SAE 5W-30	SAE 15W-40
Additive package, m%	8.0	8.0	8.0
Viscosity modifier, m%	6.2	5.1	7.4
Pour Point depressant, m%	0.4	0.4	0.4
Base oil A (Group II), m%	37.8	-	-
Base oil B (Group II), m%	47.6	-	-
Base oil C (Group II), m%	-	81.5	30.5
Base oil D (Group II), m%	-	-	53.7
Base oil E (Group II), m%	-	5.0	-
Base oil viscosity @ 100°C	5.0 mm ² /s	4.5 mm ² /s	4.9 mm ² /s

Is BOI allowed?	No	No
Is VGRA allowed?	No	Yes

Summary

Summary

1

OEMs and new legislation continue to challenge the oil and additive industries with increased quality level requirements

2

Marketers must offer oils that meet both industry and OEM specifications

3

The number and complexity of industry and OEM specifications increase as OEMs introduce new hardware and emission system solutions

4

Diversity in specification requirements cause increased fragmentation of products in the marketplace

Appendix – OEM specification tables

OEM PCMO specifications

OEM	Specification	Base industry specification	Key Differences
Stellantis	MS-6395	GF-6	Enhanced elastomers; + Las Vegas field trial
Ford	SAE 5W-20: WSS-M2C960-A1 SAE 5W-30: WSS-M2C961-A1 SAE 0W-20: WSS-M2C962-A1 SAE 0W-30: WSS-M2C963-A1	GF-6	
GM	dexos1™ Gen 2* dexos1™ Gen 3**	GF-5/6 GF-6	GMOD instead of IIIH, enhanced VH performance; +GMOEE (FE test); + GM Aeration; + GM TC test; GM SPI 3 test; + MTM bench wear test
Honda/Acura	HTO-06	GF-5	+ Hot Tube Test

*required to upgrade to Gen 3 by September 1, 2022

**First allowable use (FAU): September 1, 2021

OEM heavy-duty diesel specifications (1)

OEM	Specification	Base Industry Specification	Key Differences
Caterpillar	ECF-1-a	CH-4	+ Caterpillar 1P; SASH restrictions
	ECF-2	CI-4/CI-4 PLUS	+ Caterpillar C13; SASH restrictions
	ECF-3	CJ-4	
Cummins	CES 20076	CH-4	enhanced Mack T-8E performance
	CES 20078	CI-4 PLUS	+ Seq. IIIF wear; + Mitsubishi 4D34T4; + min TBN
	CES 20081	CJ-4	enhanced Cummins ISM, ISB, and Mack T-12 performance
	CES 20086	CK-4	enhanced Cummins ISM, ISB, Mack T-12 and Volvo T-13 performance
	CES 20087	FA-4	enhanced Cummins ISM, ISB, Mack T-12 and Volvo T-13 performance

OEM heavy-duty diesel specifications (2)

OEM	Specification	Base Industry Specification	Key Differences
Detroit Diesel	DFS 93K215	CH-4	+ Mitsubishi 4D34T4; - Mack T-9 + Mack T-10; + OM501LA
	DFS 93K214	CI-4 PLUS	+ OM501LA
	DFS 93K218	CJ-4	+ OM501LA; + OM646LA
	DFS 93K222	CK-4	+ OM501LA; + OM646LA +DD13 Scuff
	DFS 93K223	FA-4	+ OM501LA; + OM646LA +DD13 Scuff

OEM heavy-duty diesel specifications (3)



OEM	Specification	Base Industry Specification	Key Differences
Ford	WSS-W2C171-C	CH-4 / SJ	+ CBT (ASTM D130)
	WSS-W2C171-D	CI-4 / SL	+ CBT (ASTM D130)
	WSS-W2C171-E	CJ-4	
	WSS-W2C171-F1	CK-4	+ Ford Valve-Train Wear test
	WSS-M2C214-B1	FA-4	+ Physical Property Data (density, KV, specific heat)

OEM heavy-duty diesel specifications (4)

OEM	Specification	Base Industry Specification	Key Differences
Mack / Volvo	EO-N / VDS-3	CI-4	enhanced Mack T-10, T-8E performance; + Volvo D12D; +OM501LA
	EO-O Premium Plus / VDS-4	CJ-4	enhanced Cummins ISM, ISB, and Mack T-12 performance; + Volvo D12D; + Seq. IIIG
	EOS-4.5 / VDS-4.5	CK-4	enhanced Cummins ISM, ISB, Mack T-12 and Volvo T-13 performance; + Volvo D12D
	VDS-5	FA-4 (5W-30 only)	enhanced Cummins ISM, ISB, and Volvo T-13 performance; + Volvo D13K4*, + 12x truck field test

*when available, replaces Volvo D12D

Thank you



Formulating tomorrow together

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