
Hitachi Genuine Engine Oil

Super wide DH-1 15W-40

Explanation of Abbreviation

JASO : **J**apan **A**utomobile **S**tandard **O**rganization

PAJ : **P**etroleum **A**ssociation of **J**apan

JAMA : **J**apan **A**utomobile **M**anufacturing **A**ssociation

SAE : **S**ociety of **A**utomotive **E**ngineer

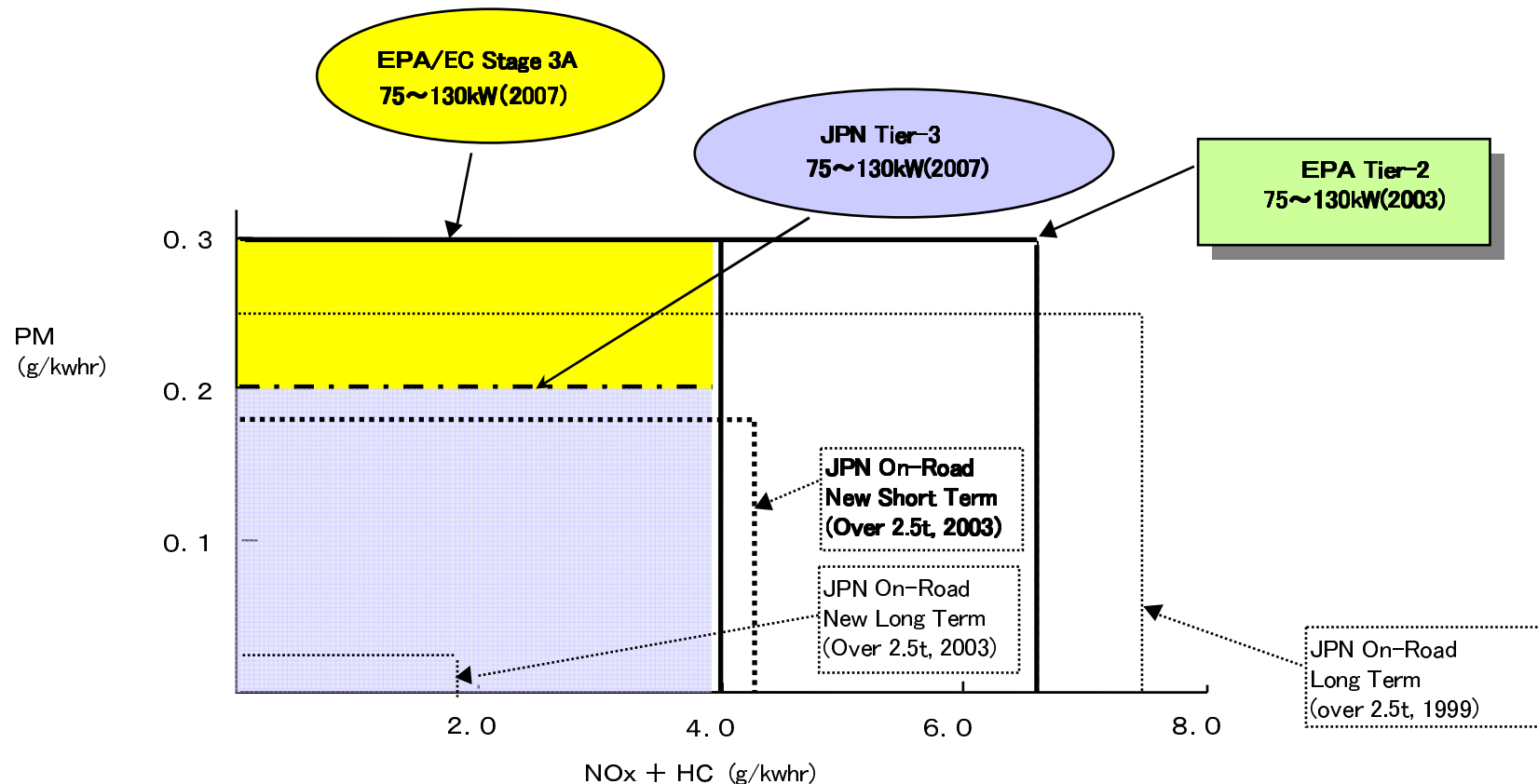
API : **A**merican **P**etroleum **I**nstitute

ASTM : **A**merican **S**ociety for **T**esting & **M**aterials

EGR : **E**xhaust **G**as **R**e-circulation

ACEA : **A**ssociation des **C**onstrateurs **E**uropeens **A**utomobiles

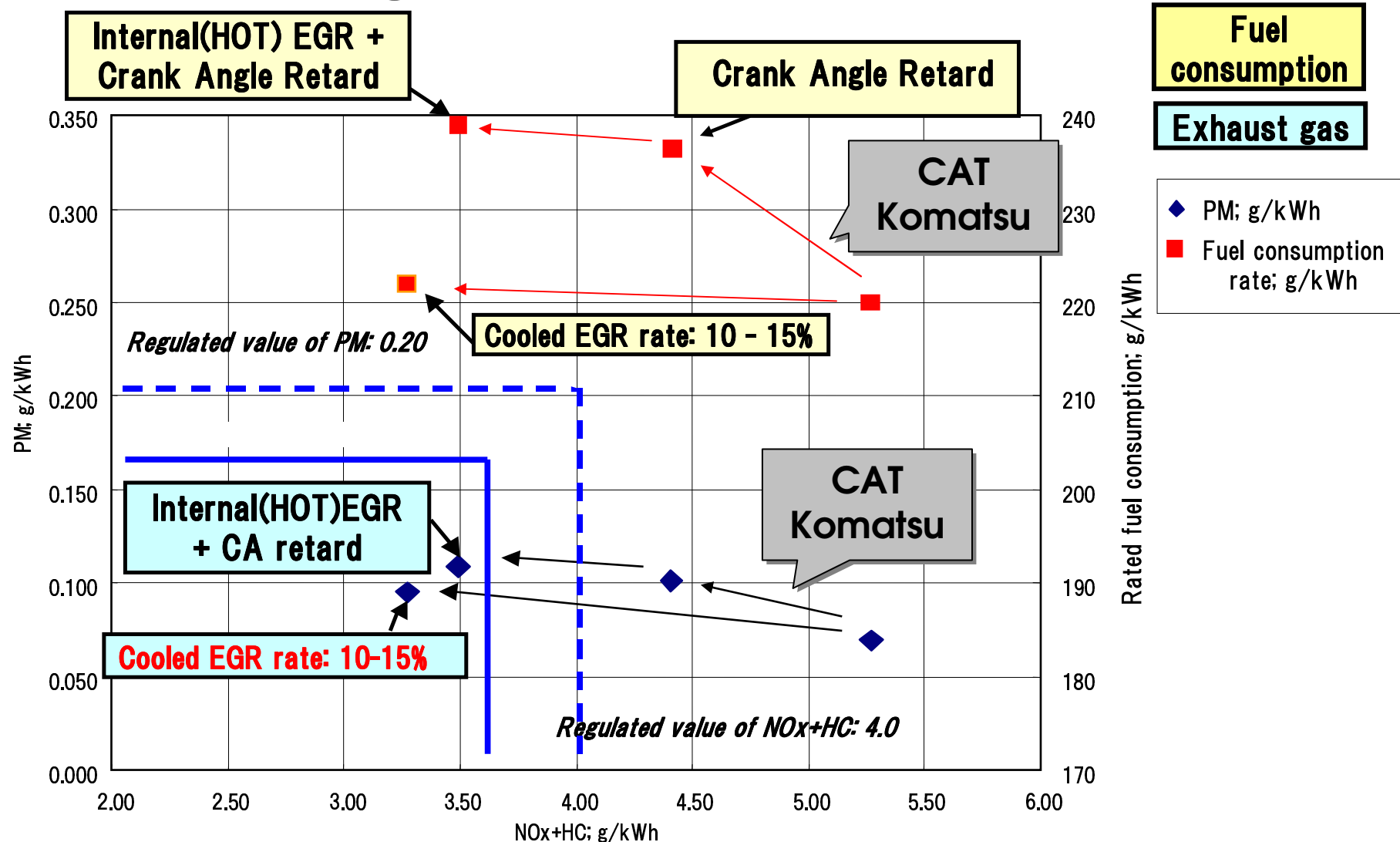
Tier3 Emission Regulation



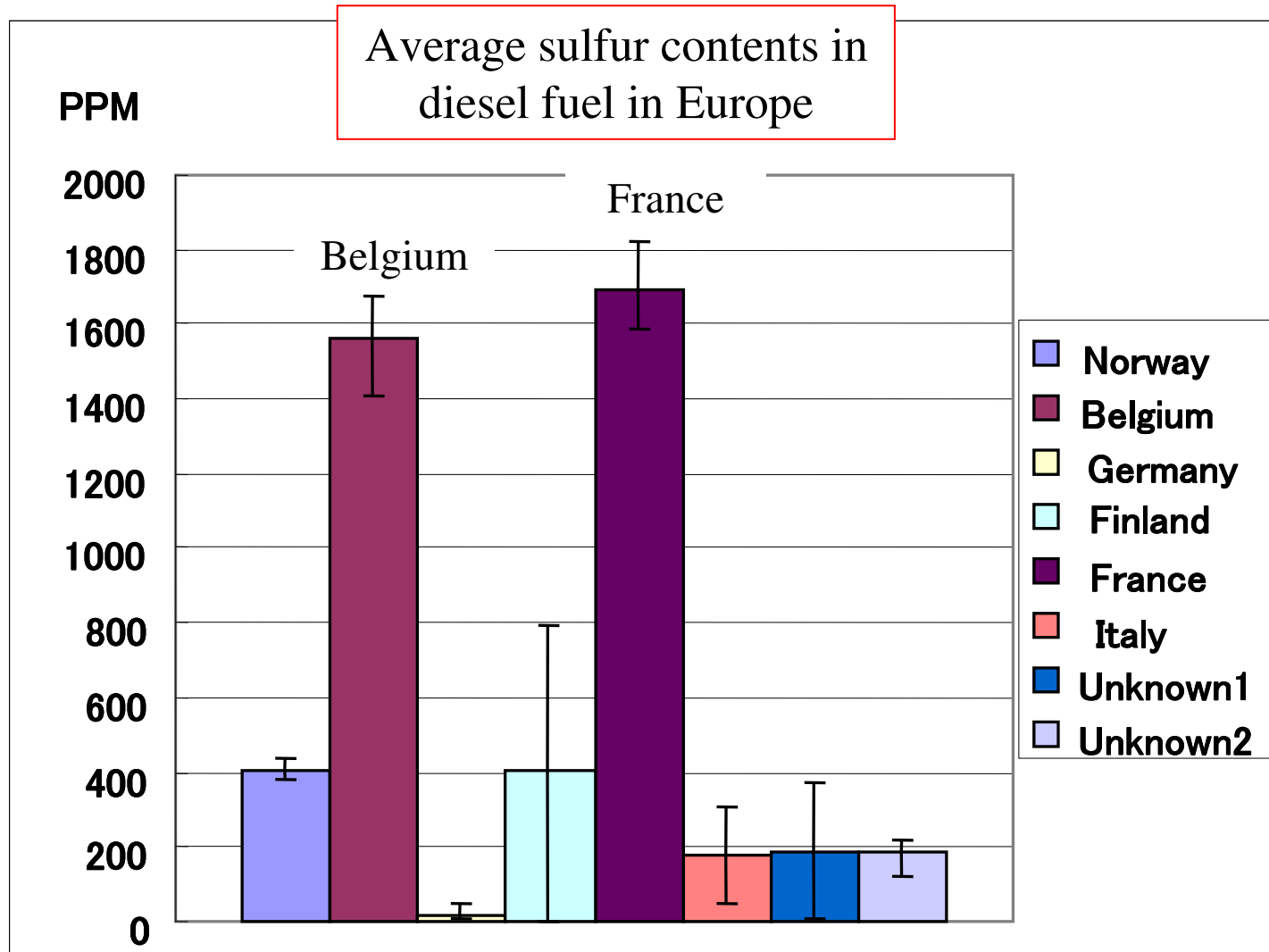
NOx + HC: 40% reduction, PM: Same with Tier-2 from Y2006

JPN Government Proposal: PM 30% lower than EPA, EC T-3

Regulation and Effect



Sulfur contents in diesel fuel for off road in Europe



Sulfur content in diesel fuel for off road in Europe vary in each country and rather higher than one for on road

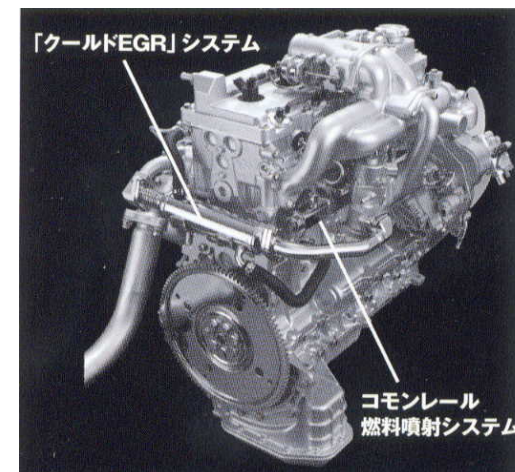
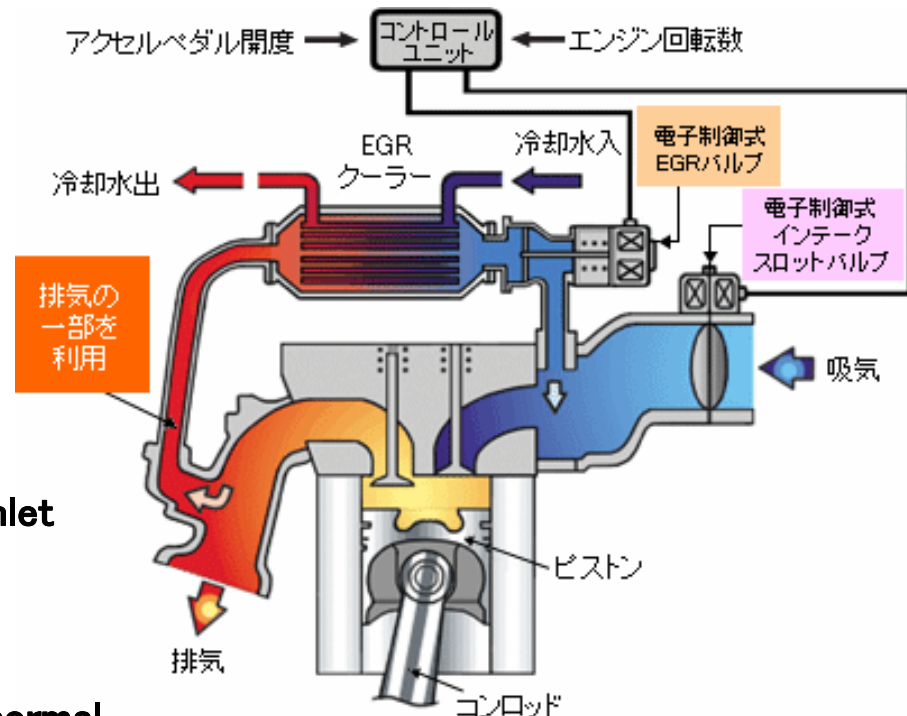
Adoption of cooled EGR system

EGR = Exhaust Gas Re-circulation

This system is to re enter a part of exhaust gas in to inlet manifold through EGR cooler to reduce combustion temperature . As a result, it can be **reduced Nox**.

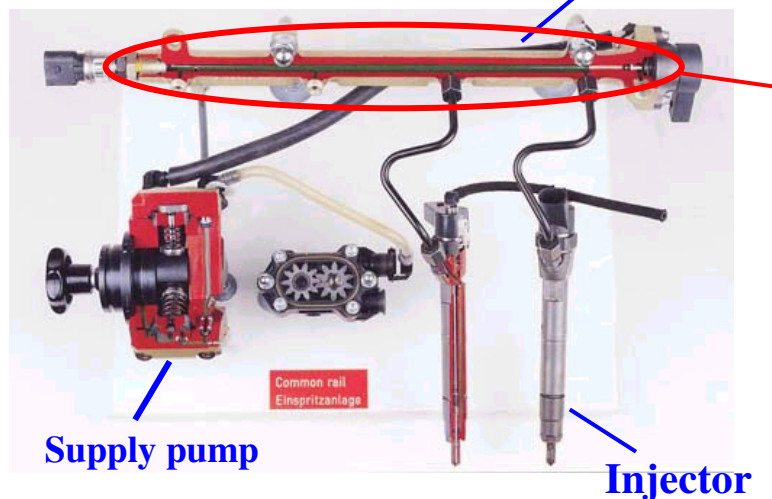
The EGR cooler is located between exhaust and inlet manifold and cooled down exhaust gas by coolant and then re enter in to inlet manifold and mix with normal air from air filter. This system is effective to lower combustion temperature compared with normal EGR system. As a result, **reduce Nox**

Furthermore air density in inlet manifold is increased by cooling down, and volume of air in inlet side is increased. As a result, it is possible to combustion completely. This causes to **reduce PM and black smoke** and then lead to **improve fuel consumption**



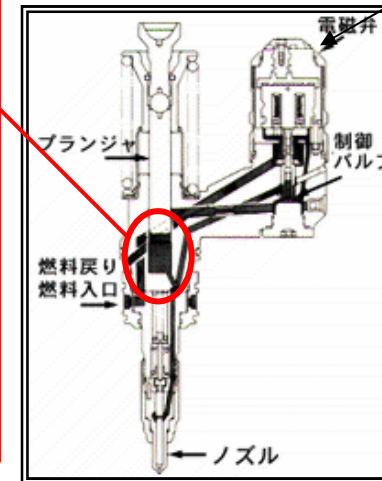
Adoption of high pressure injection system

Common rail system



It is always ready to inject very high pressurized diesel in common rail. By controlling solenoid valve on injector, nozzle will be open. This system can be possible to adjust pressure, injection timing and number of injection

Unit injector



Solenoid valve



Comparison of combustion

Hi Pres Injection

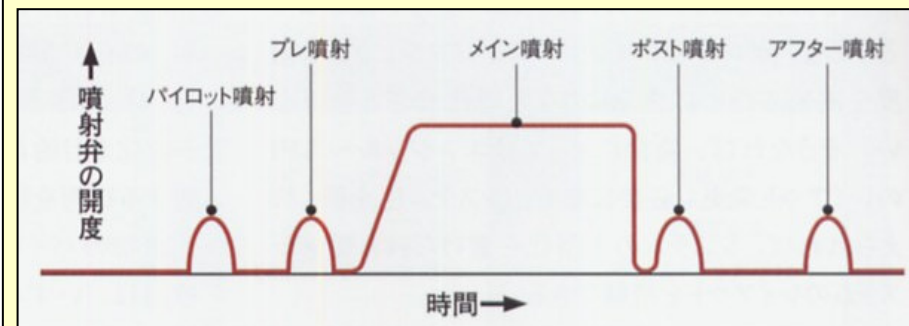


Current injection



Complete and clean combustion → Reduce PM

1 – 2 stages injection by common rail/injection

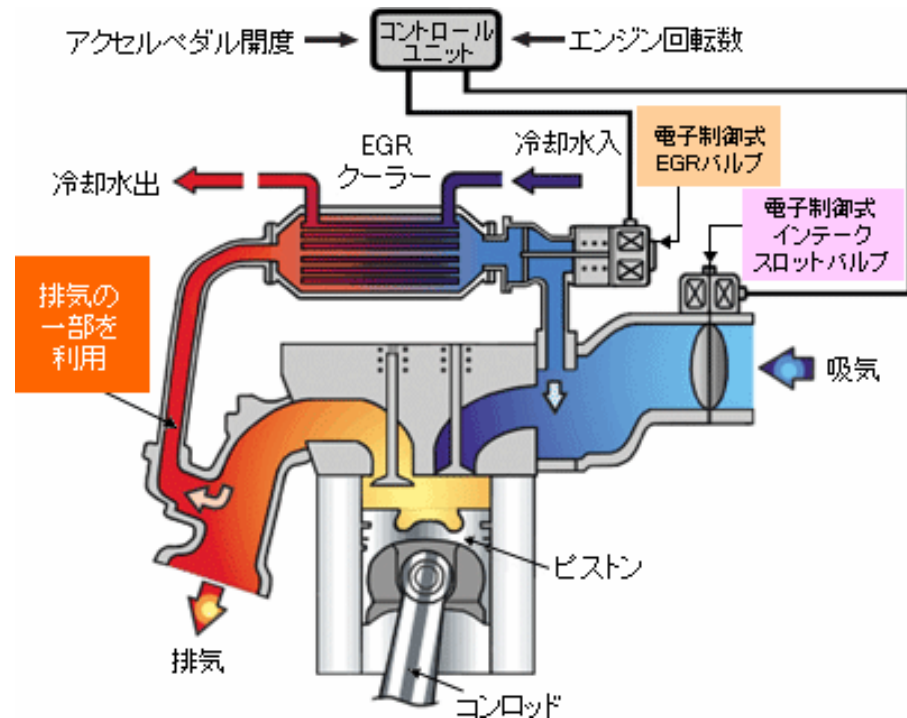


Reduce of initial combustion temperature by 1 – 2 stage injection (→ Reduce NO_x) • More activation of main injection (→ Reduce PM)

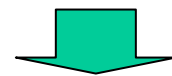
Requirement of engine oil on cooled EGR engine

EGR = Exhaust Gas Re-circulation

The EGR cooler is located between exhaust and inlet manifold and cooled down exhaust gas by coolant and then re enter in to inlet manifold and mix with normal air from air filter. This system is effective to lower combustion temperature compared with normal EGR system. As a result, **reduce Nox , PM and black smoke, and improve fuel consumption .**



Sulfuric acid will be produced in the blow-by gas when higher sulfur content in diesel fuel is used. This causes rust & wear on the engine parts. It is more severe on cooled EGR system



Required performance of engine oil

Acid neutralization/Soot dispersion/Acid stability

History 「JASO DH-1」Standard (1)

A Japanese engine has been tested using new oil of API CH-4, CG-4.

As the test result

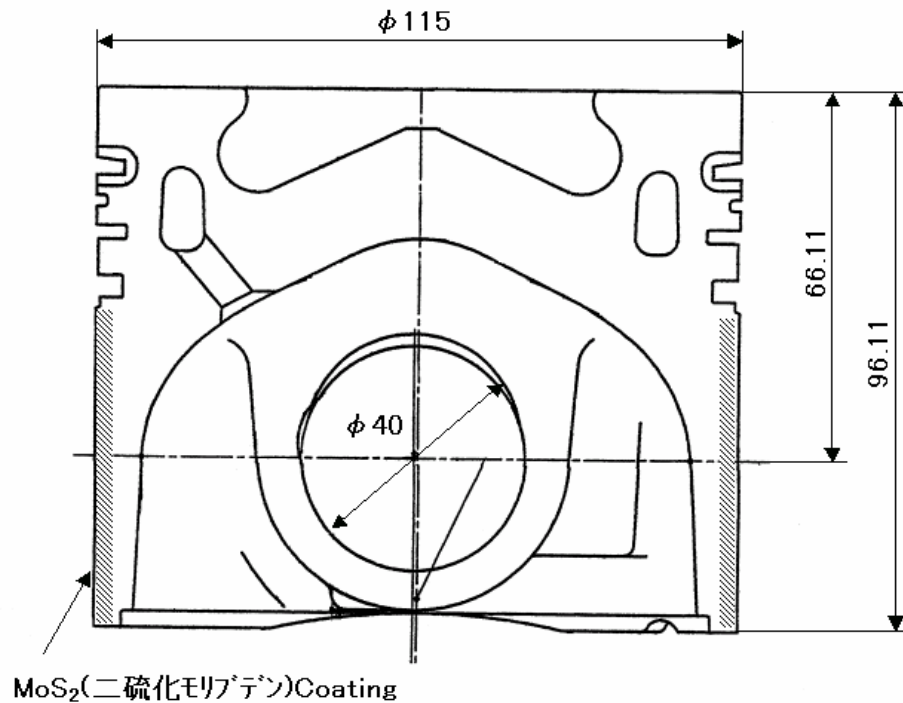
⇒ wear of engine parts has been occurred

Amount of additives on API CH-4 & CG-4 is reduced to meet American engine (high temperature combustion type)

As a result of engine test with API CH-4 & CG-4, wear of engine parts has happened

Japan car maker has requested API to improve anti-wear performance on next standard

API has not taken the request after studying for 2 years and half. (1998)



History 「JASO DH-1」Standard (2)

In 1998, JAMA (Japan Automobile Manufacturing Association), PAJ (Petroleum Association of Japan) & additive makers has started to develop standard of diesel engine oil to meet Japanese engine. It was called “DX-1” then named **“DH-1”**

In 1999～2000, Studied standard and testing method, and notified to all over the world at SAE Asian meeting

In April 2001, started **“DH-1”** standard

Features of JASO DH-1 standard

- ① Superior anti-wear (Less wear of sliding surface)
- ② Superior soot dispersion (Corresponding increasing soot by EGR)
- ③ Superior oxidation stability

「JASO DH-1」Test Standard

Anti wear

Mitsubishi Motor4D34T engine test(JASO M354)

- Evaluate anti wear performance on sliding surface
(For example rocker arm & valve system)

Washing performance
of piston/piston ring

Nissan Diesel TD25 engine test(JASO M 336)

- Evaluate washing performance of piston/piston ring

Soot dispersion

ASTM engine test (Mack t-8A)

- Evaluate soot dispersion on engine with EGR

Oxidation stability

ASTM engine test(SequenceⅢE, ⅢF)

- Evaluate oxidation stability on high temp combustion

ASTM : American Society for Testing & materials

Other test items

Anti rust, evaporation, matching for rubber/seal etc

Comparison of JASO & API standard(1)

Performance	Test method	JASO DH-1 2001	API		
			CD 1972	CG-4 1994	CH-4 1998
Rust of bearing	L-38 gasoline engine	—	○	○	—
Sludge on piston (Detergency)	Caterpillar1G2	—	○	—	—
	Caterpillar1N	—	—	○	—
	Caterpillar1K	—	—	○	○
	Nissan diesel TD25	○	—	—	—
Viscosity increase due to soot	Mack T-8A	○	—	—	—
	Mack T-8	—	—	○	—
	Mack T-8E	—	—	—	○
Wear of valve system	GM 6.5L	—	—	○	○
Soot handling/wear	Mitsubishi 4D34T4	○	—	—	—
	Cummins M11	—	—	—	○
Oxidation at high temp	GM 3.8L Sequence III E, III F	○	—	○	○
Deposit at high temp	Hot-tube test	○	—	—	—
Rust test	Cummins rust test	○	—	○	○
Oxidation/wear	Sequence I、II、III	○	○	—	○
Cutting stability	Bosch Injector ASTM D 3945	○	—	—	○
Evaporation	Noack ASTM D 5800	○	—	—	○
Machining for rubber/seal	CEC-L-39-T-96	○	—	—	—
TBN	ASTM D 4793	○	—	—	—

DH-1 STD has been employed other test items which are not included on ASTM & ACEA

Comparison of JASO & API standard(2)

STD Performance	JASO	API			
	DH-1	CD	CF	CF-4	CH-4
Anti wear	◎	○	○	○	△
Soot dispersion	◎	△	○	○	◎
Stability of oxidation	◎	○	○	○	◎

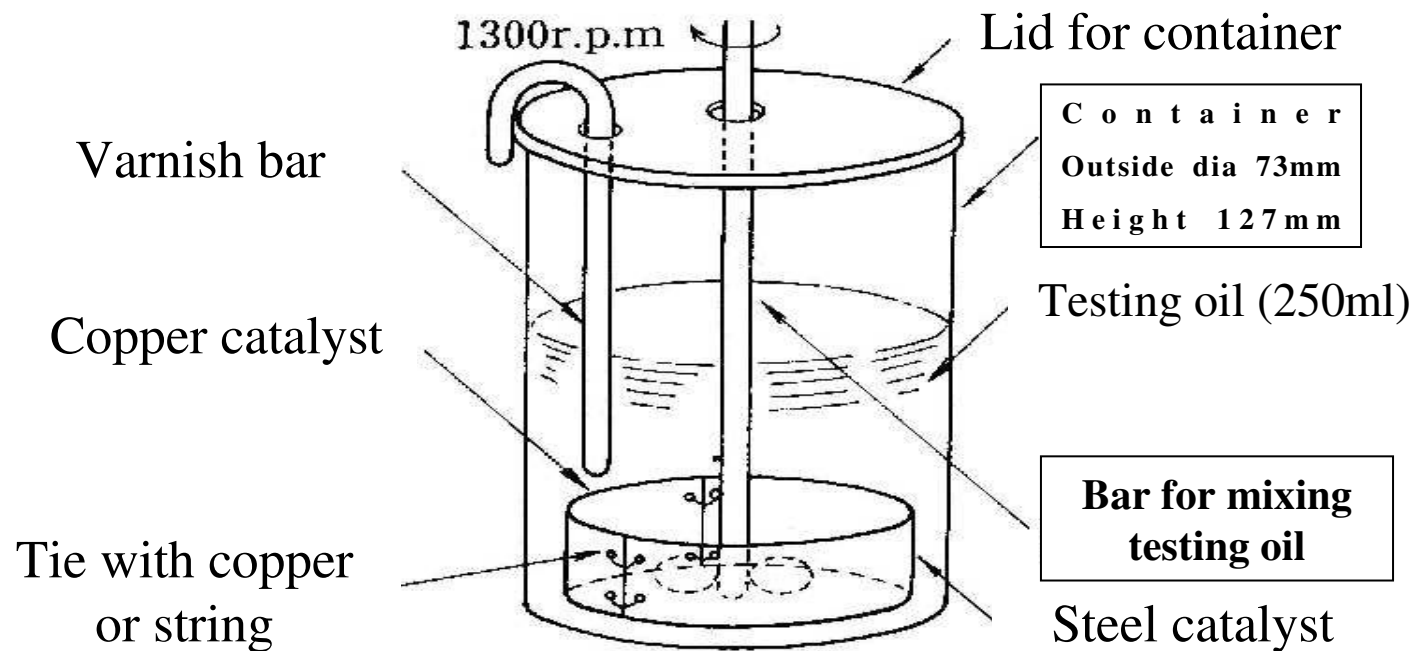
JASO DH-1 is an engine oil to meet Japanese engine with cooled EGR and can be used for both the latest emission control engine and current engines

Outline of Indiana starting oxidation test (ISOT)

○ **Purpose of testing:** Evaluation of oxidization stability of engine oil

○ **Testing condition:**

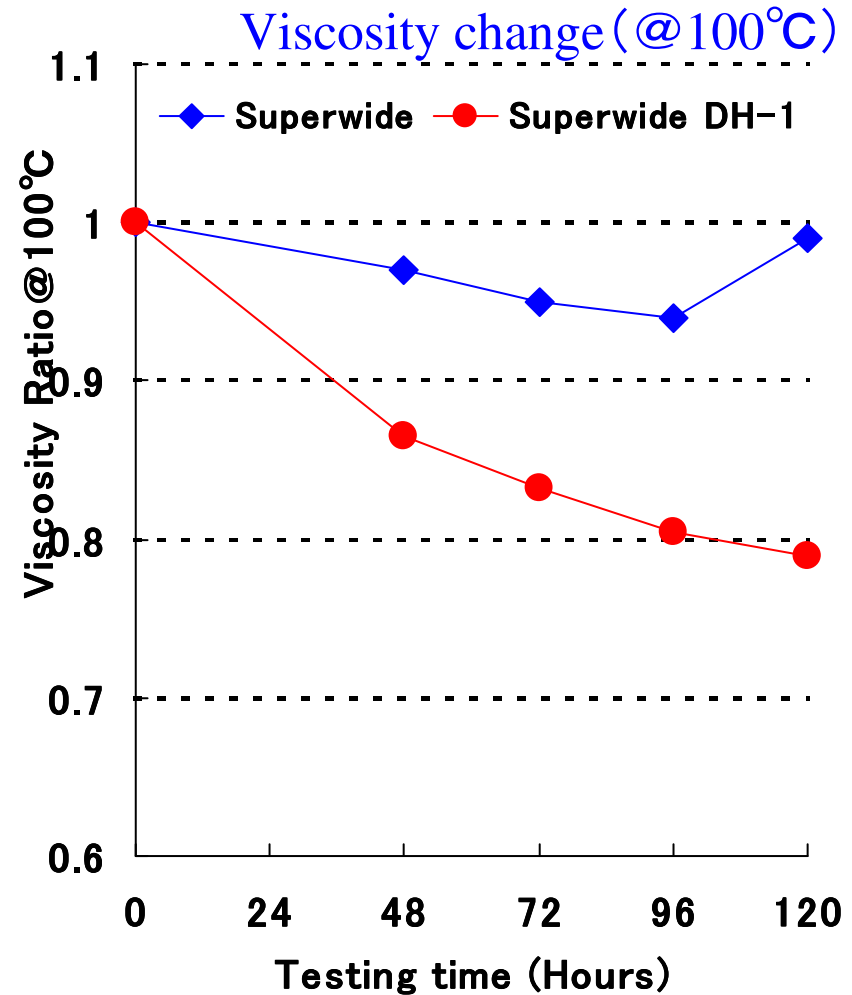
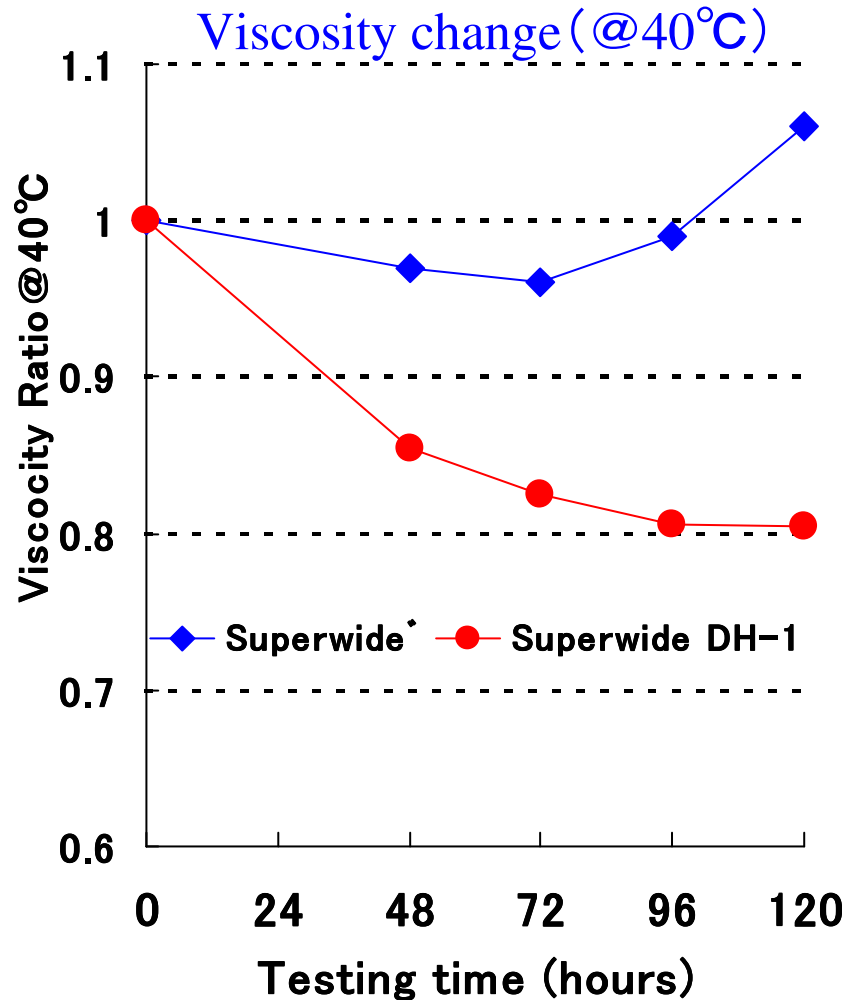
Testing temp. 165.5 °C, Testing time: 24,48,72 hours



Outline of testing device

Evaluation test of Super wide DH-1

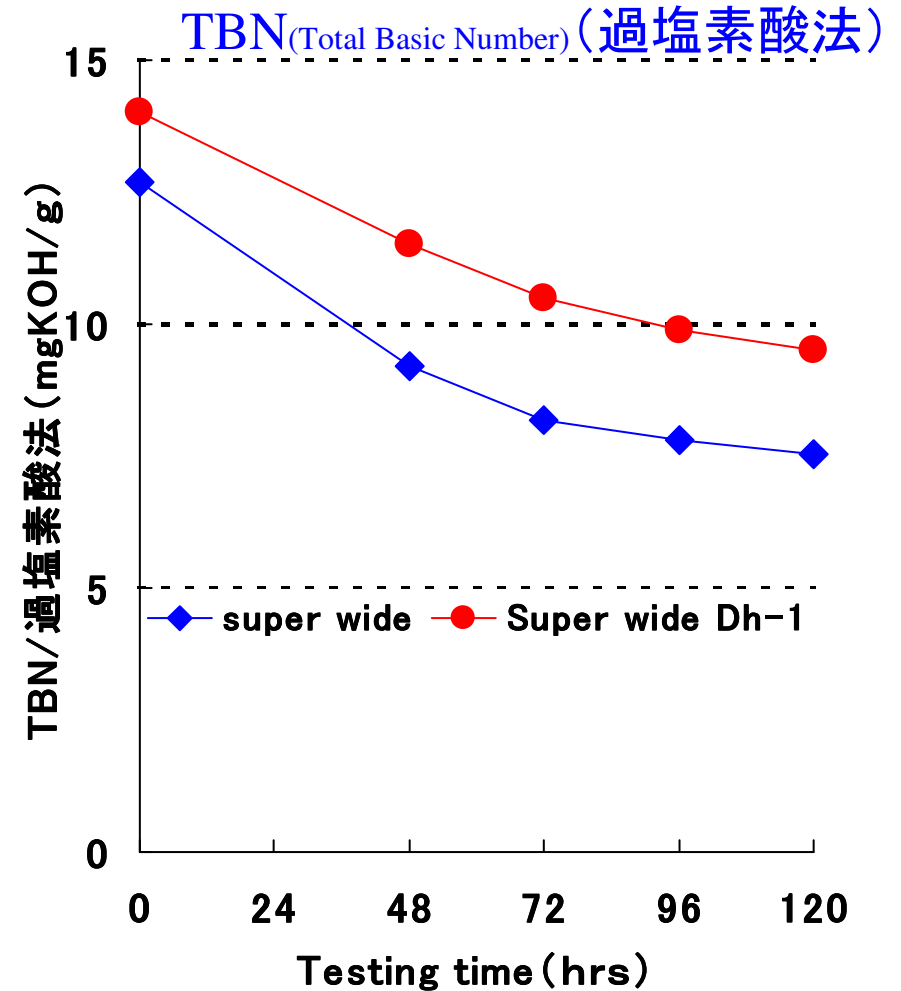
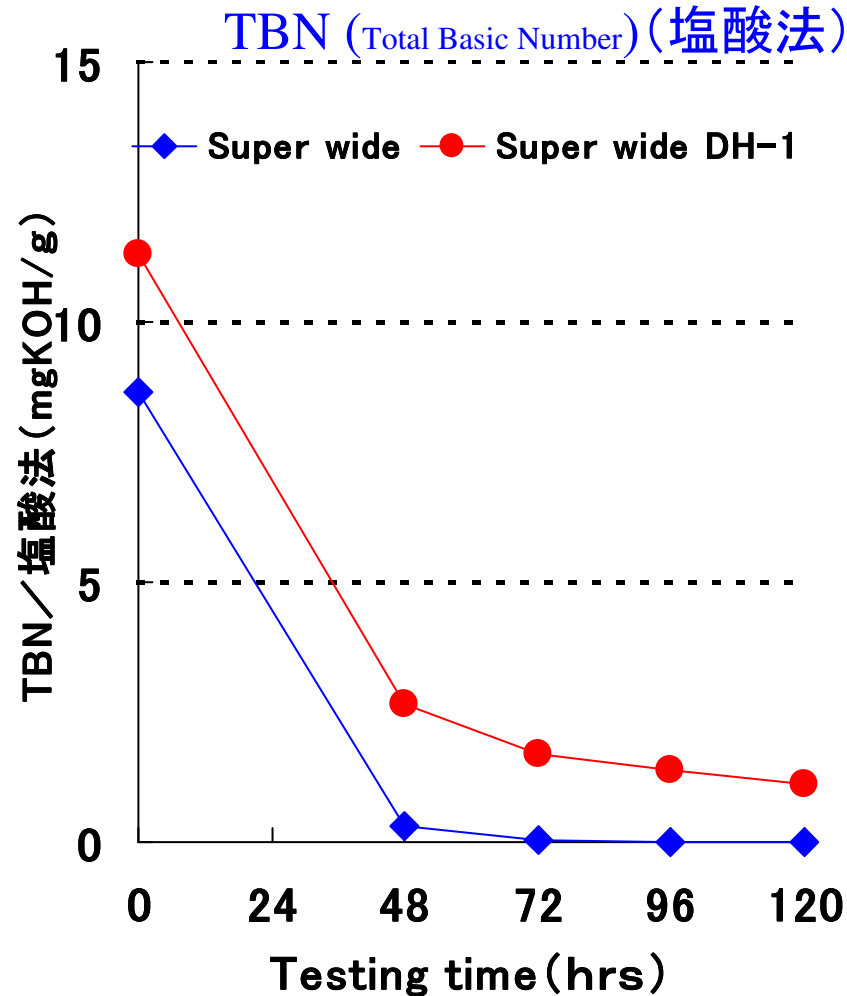
2 ISOT Test result(Stability of oxidization)



Super wide DH-1 is superior than current one on viscosity changes

Evaluation test of super wide DH-1

2 ISOT Test Result(Stability of oxidization)



Super wide DH-1 is remained higher TBN and superior for longer performance

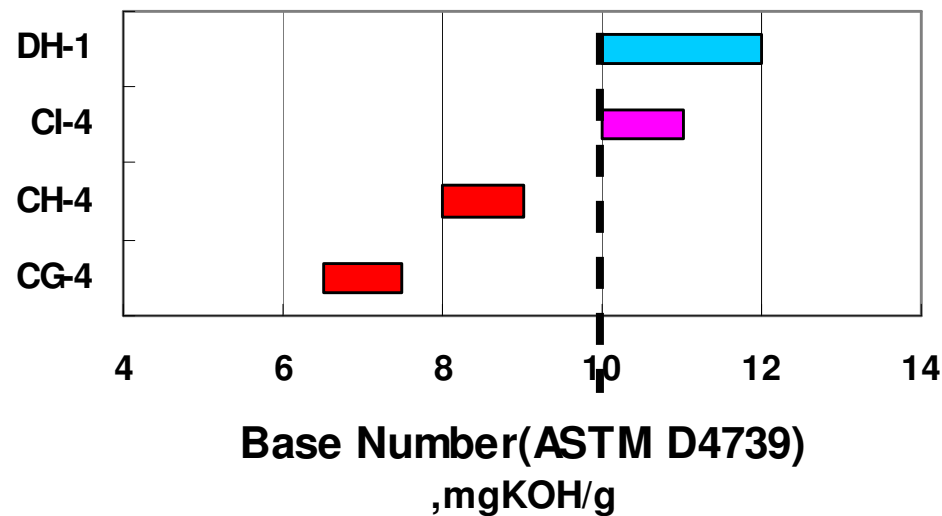
Comparison of Additives of TBN

>JASO DH-1 Oils on anti-corrosion performance are advantageous to API Oils.

(Corrosive wear on cylinder-liners, bearings etc.)

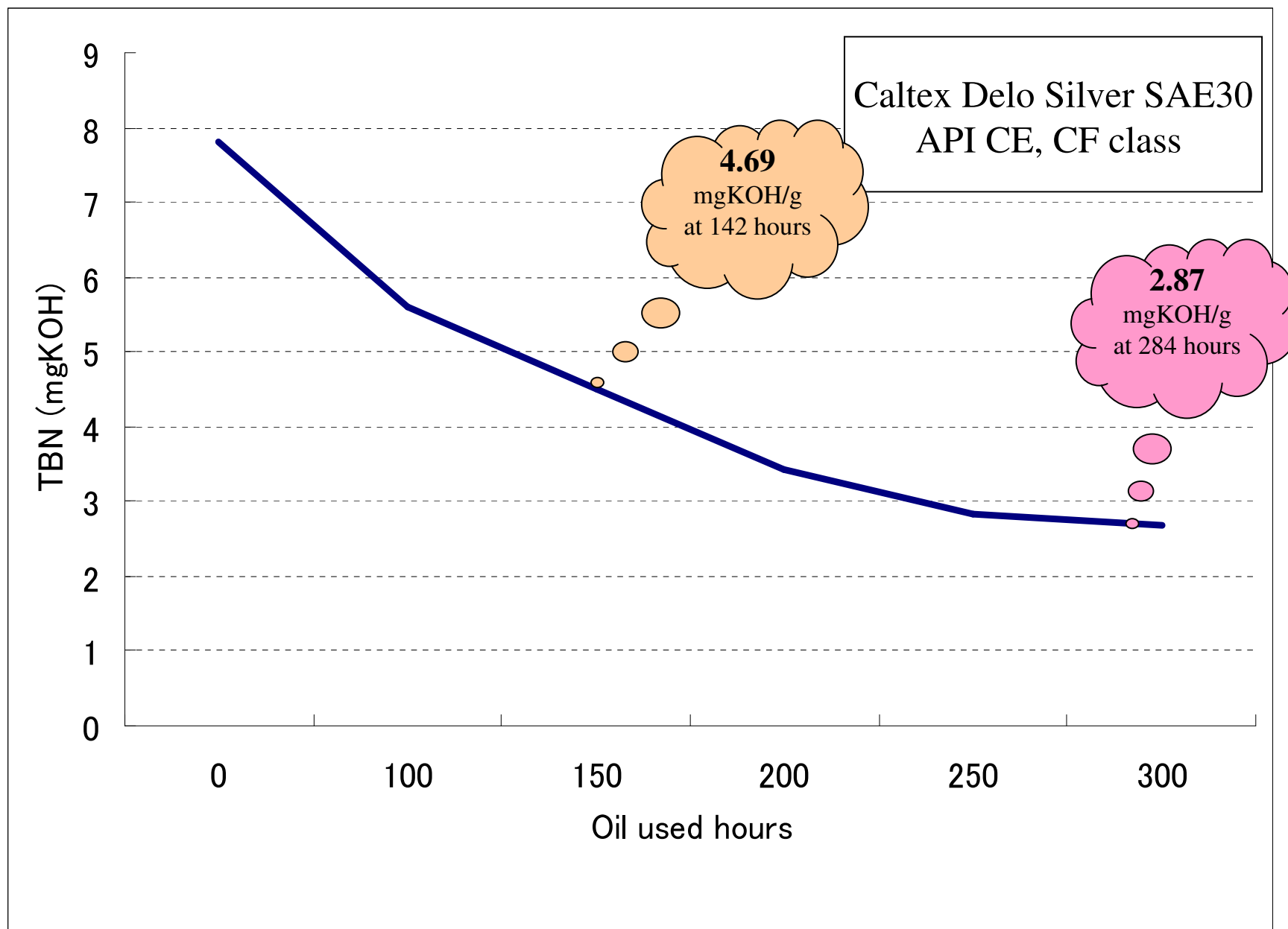
>Because of higher TBN than API Oils

>Minimum TBN requirement for DH-1: 10.0 mgKOH/g
(JIS K2501 6 : 1992 or ASTM D4739-96)



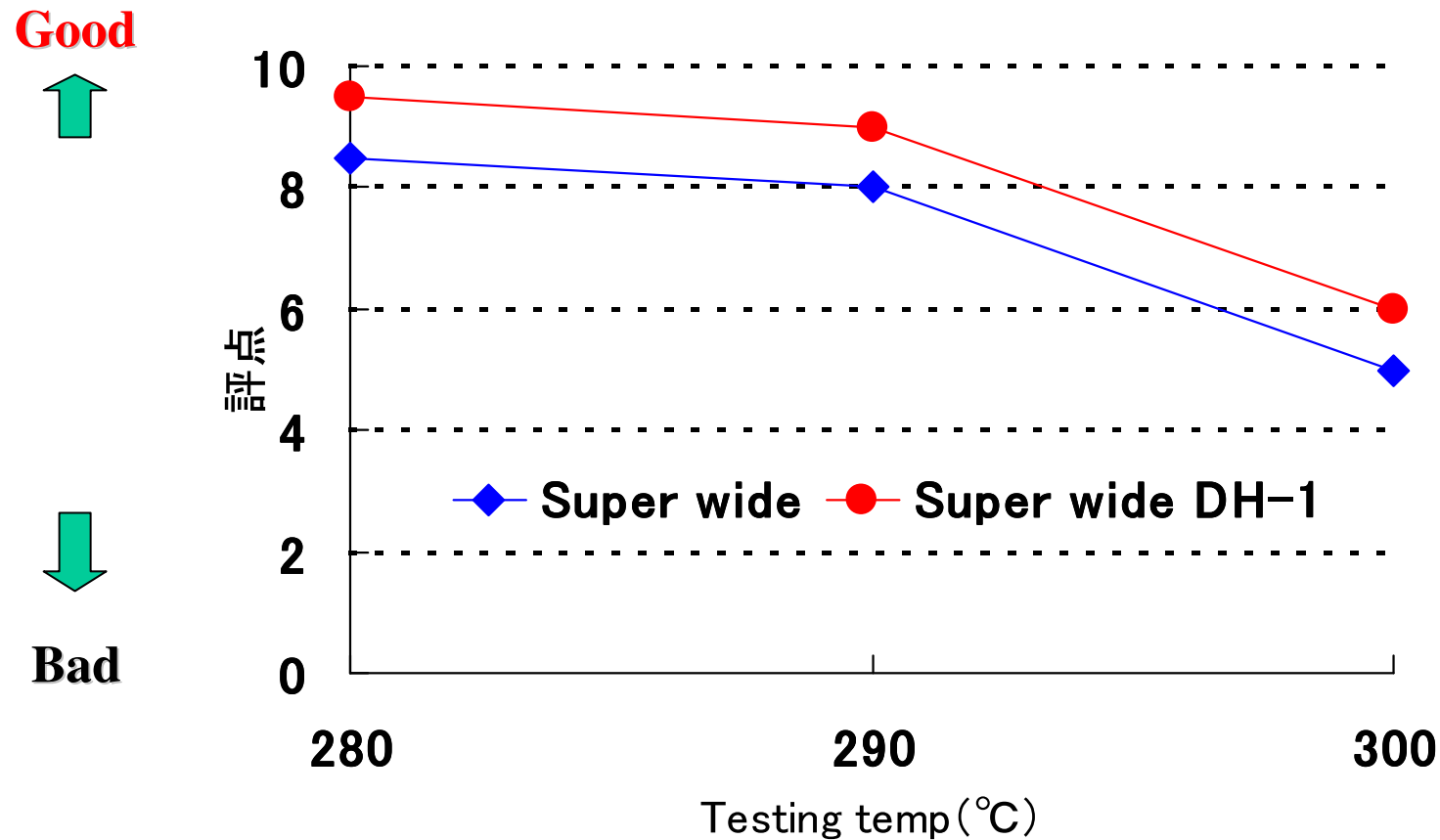
Hitachi genuine
Super wide 15W-40
is more than
14 mgKOH/g

ZX330-3 User Test in Malaysia



Evaluation test of super wide DH-1

3 Hot tube test result(Washing performance at high temp)



API CH-4



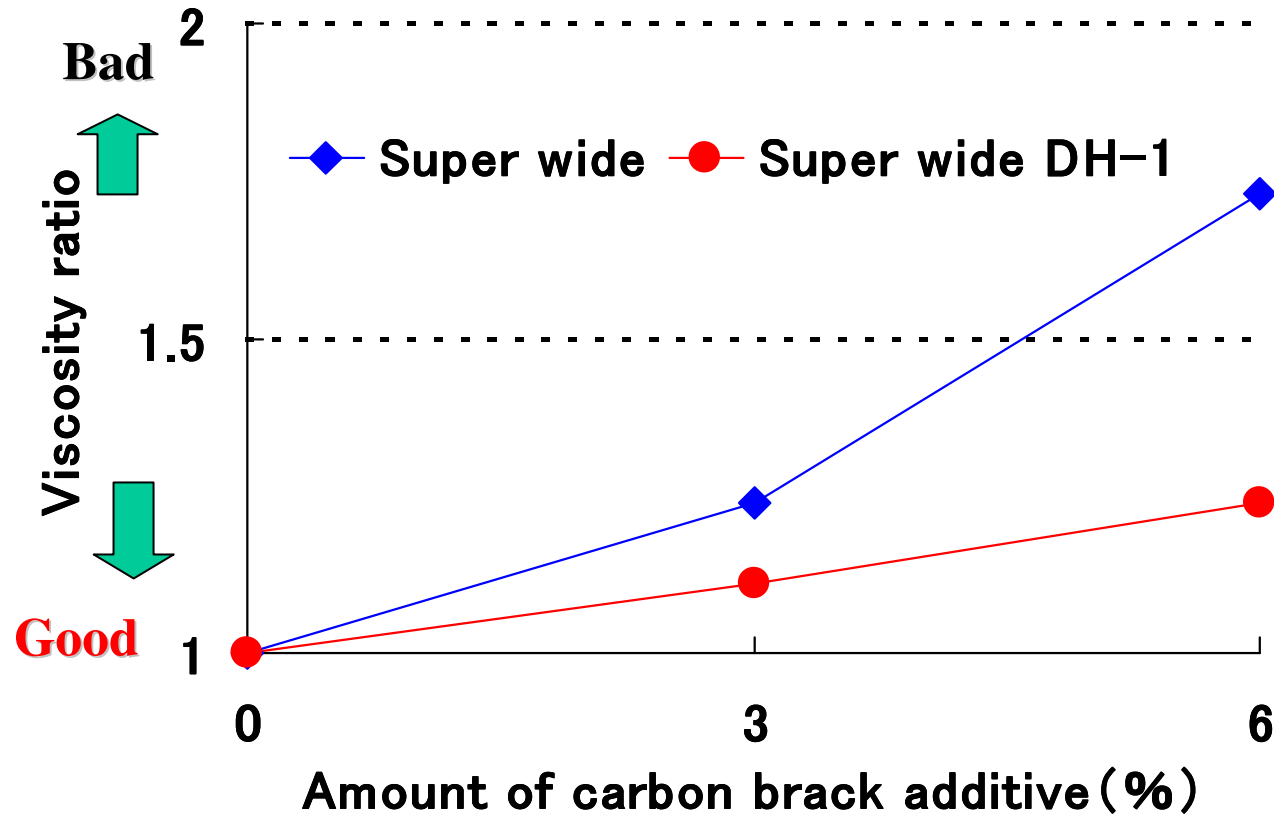
Super Wide DH-1



Super wide DH-1 is superior on washing performance at high temp

Evaluation test of super wide DH-1

4 Viscosity changes when adding soot dispersion/carbon black additive



Super wide DH-1 is superior on soot dispersion

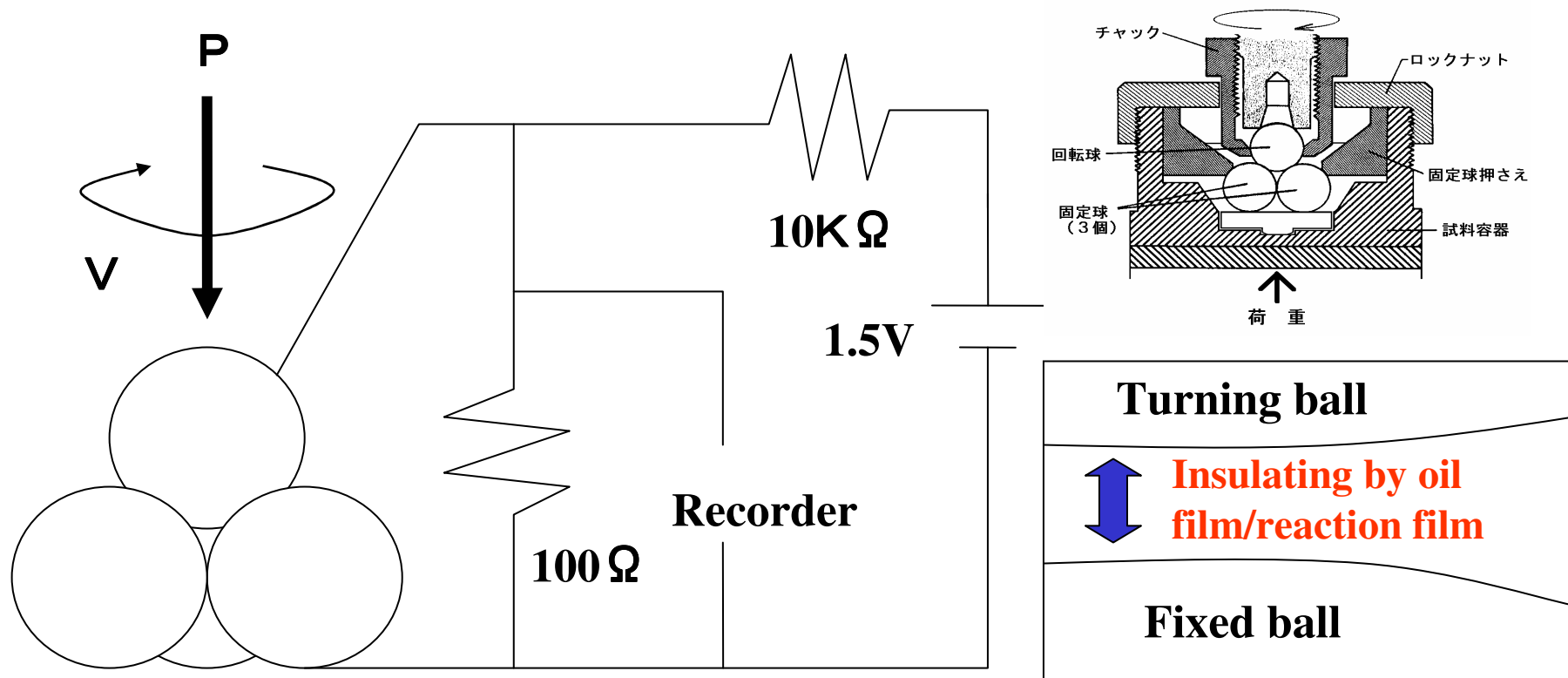
Outline of 4 balls test

○Purpose of testing

It is to evaluate lubricating performance of diesel engine oil. Insulating fixed balls and by measuring contacting condition of friction area between fixed balls and turning ball, and indicate by insulating ratio.

○Testing condition

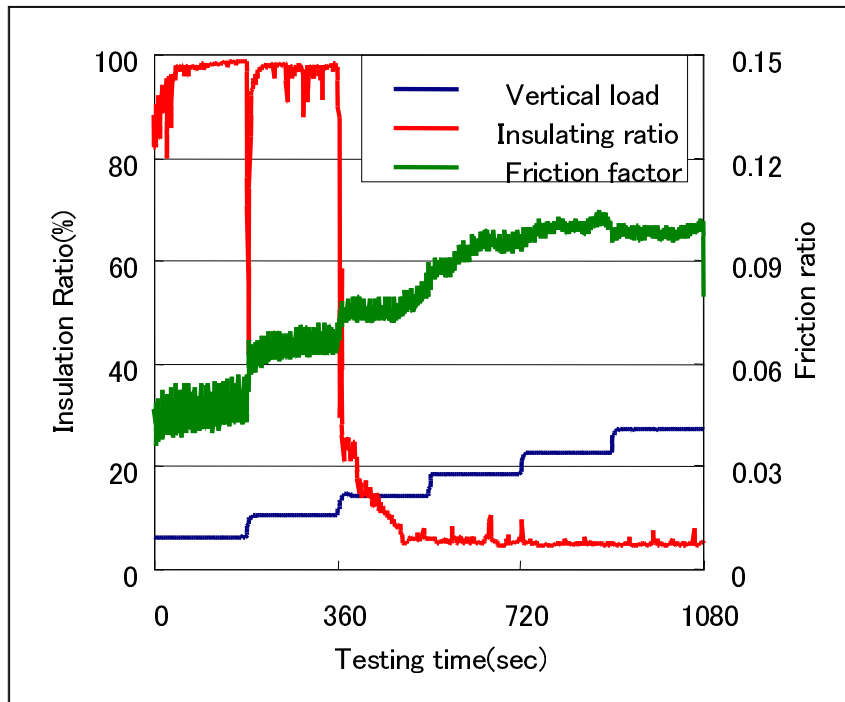
Oil temp :80 °C, Max load :1.9 ~3.1GPa, Sliding speed :0.3m/s



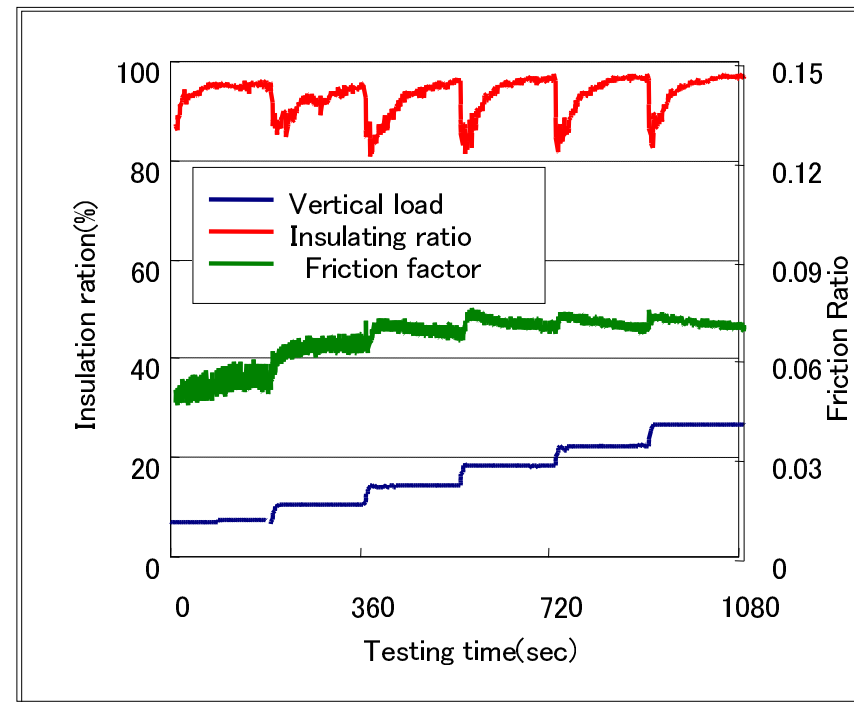
Evaluation test of super wide DH-1

4 4 balls test result (Anti wear)

Super wide



Super wide DH-1



Super wide DH-1 is superior on anti wear performance

Summary

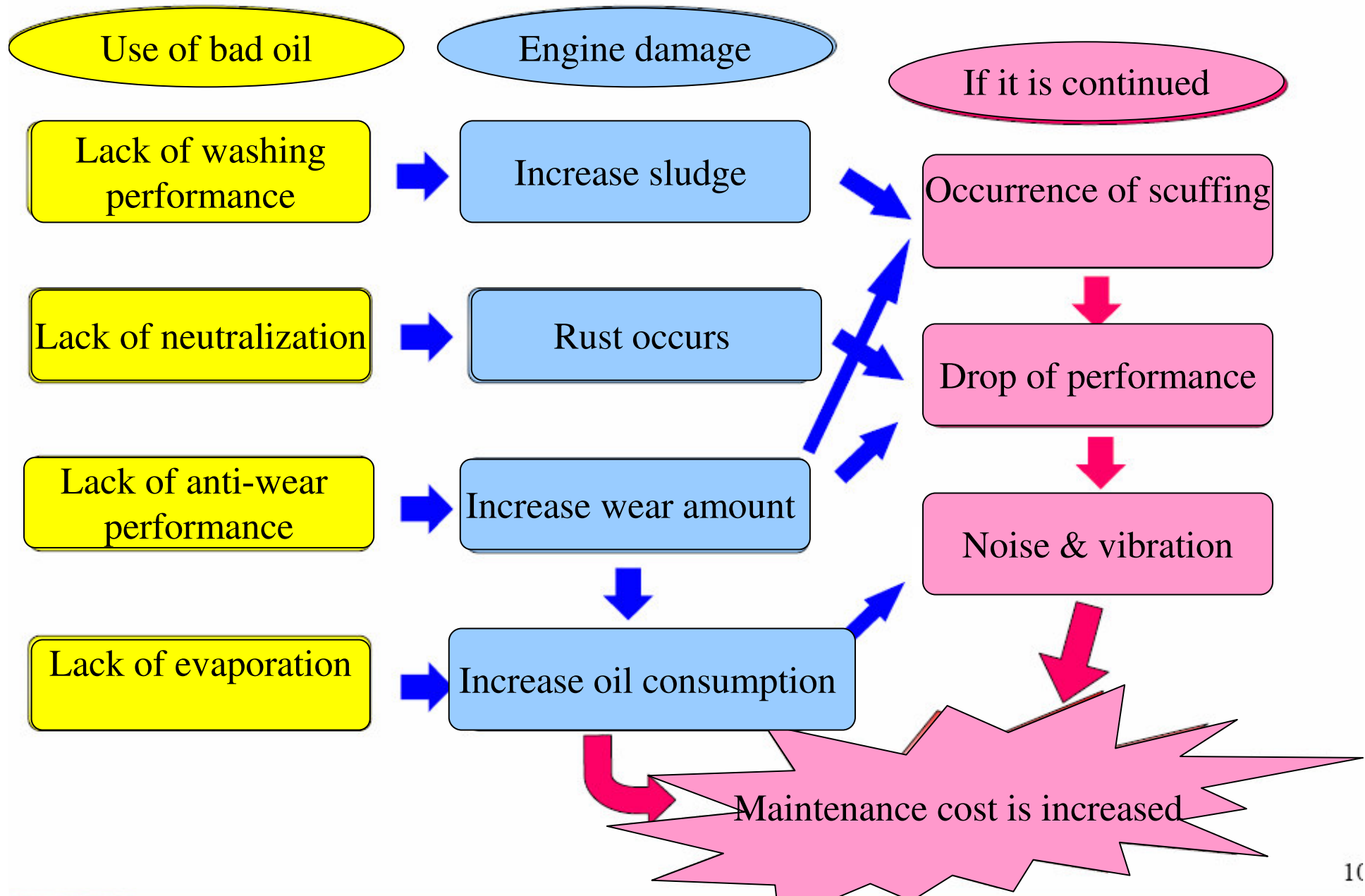
(1) Hitachi genuine oil has been developed to meet Tier3 engine with cooled EGR

(2) Hitachi genuine oil is superior for oxidation stability performance, and increased performance of long life use compare with current super wide engine oil.

(3) Hitachi genuine oil is also superior performance of anti-wear, soot dispersion and washing performance at high temperature

Therefore Hitachi genuine oil is a new superior engine oil extremely increased each performance required for Tier3 engine with cooled EGR.

If you use a bad quality of engine oil ? . . .



Test result of test piece in sulfuric acid (1)

Super wide DH-1

Other make 10W-30 CD class

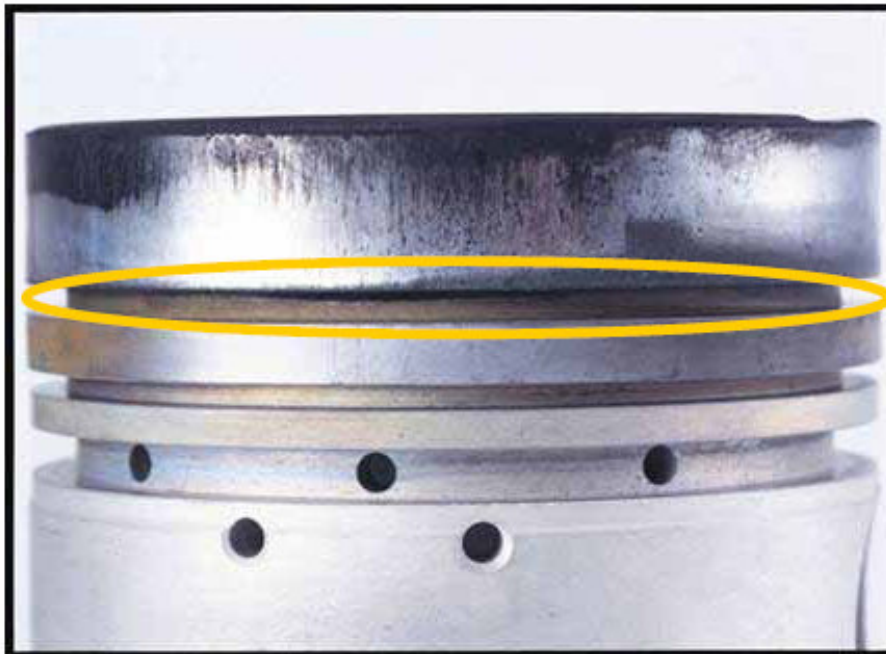


Super wide DH-1 is less rust by acid, and superior on durability when high sulfur content in diesel fuel is used

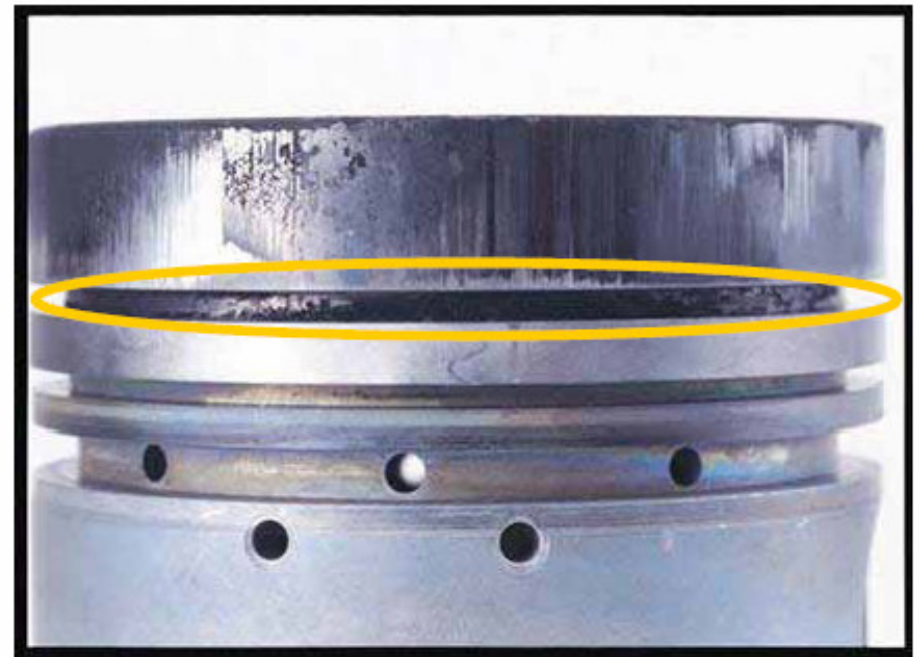
Example of advanced anti wear performance (2)

Test result as per JASO TD25

Super wide DH-1



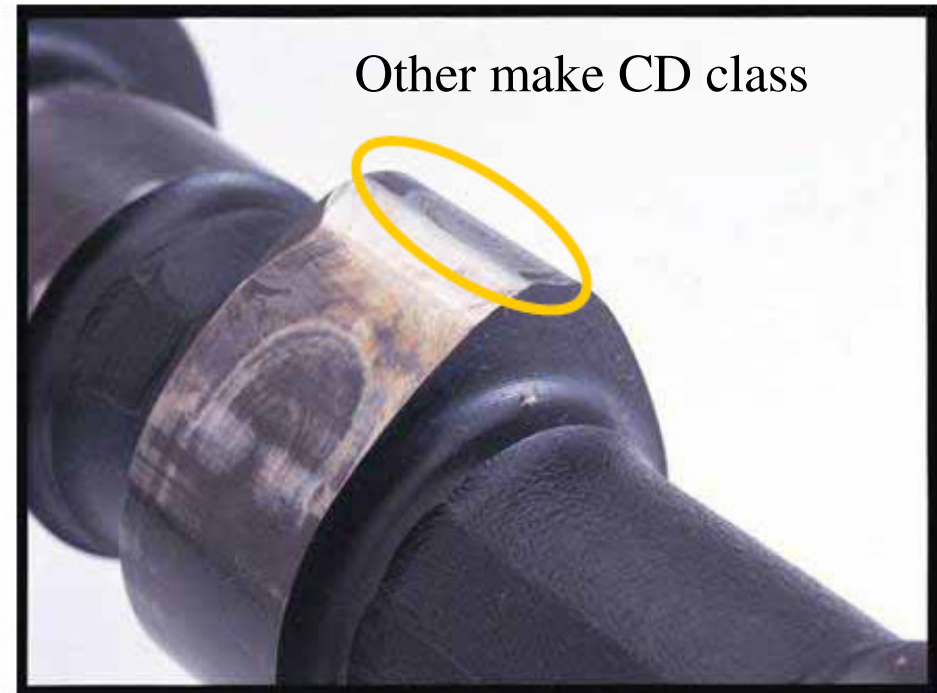
Other make CD class



Super wide DH-1 is superior on washing performance of piston ring (High temperature)

Example of advanced anti wear performance (3)

Test result as per JASO 4D34T



Super wide DH-1 is less wear on can shaft

4HK1-TC: 20.5 liter

6HK1-TC : 38 liters

When the machine is used for **5000 hours**

4HK : 5000 hours / 500 hours x 20.5 = 205 liters

6HK : 5000 hours / 500 hours x 38 = 380 liters

If new Hitachi Engine oil is **1.00 Euro** per liter higher than of current engine oil

4HK : 205 x 1.0 = Euro 205 (205/5000=**4 cent/Hour**)

6HK : 380 x 1.0 = Euro 380(380/5000=**8 cent/Hour**)

Let's use Hitachi Genuine Engine Oil

Super wide DH-1

Thank you