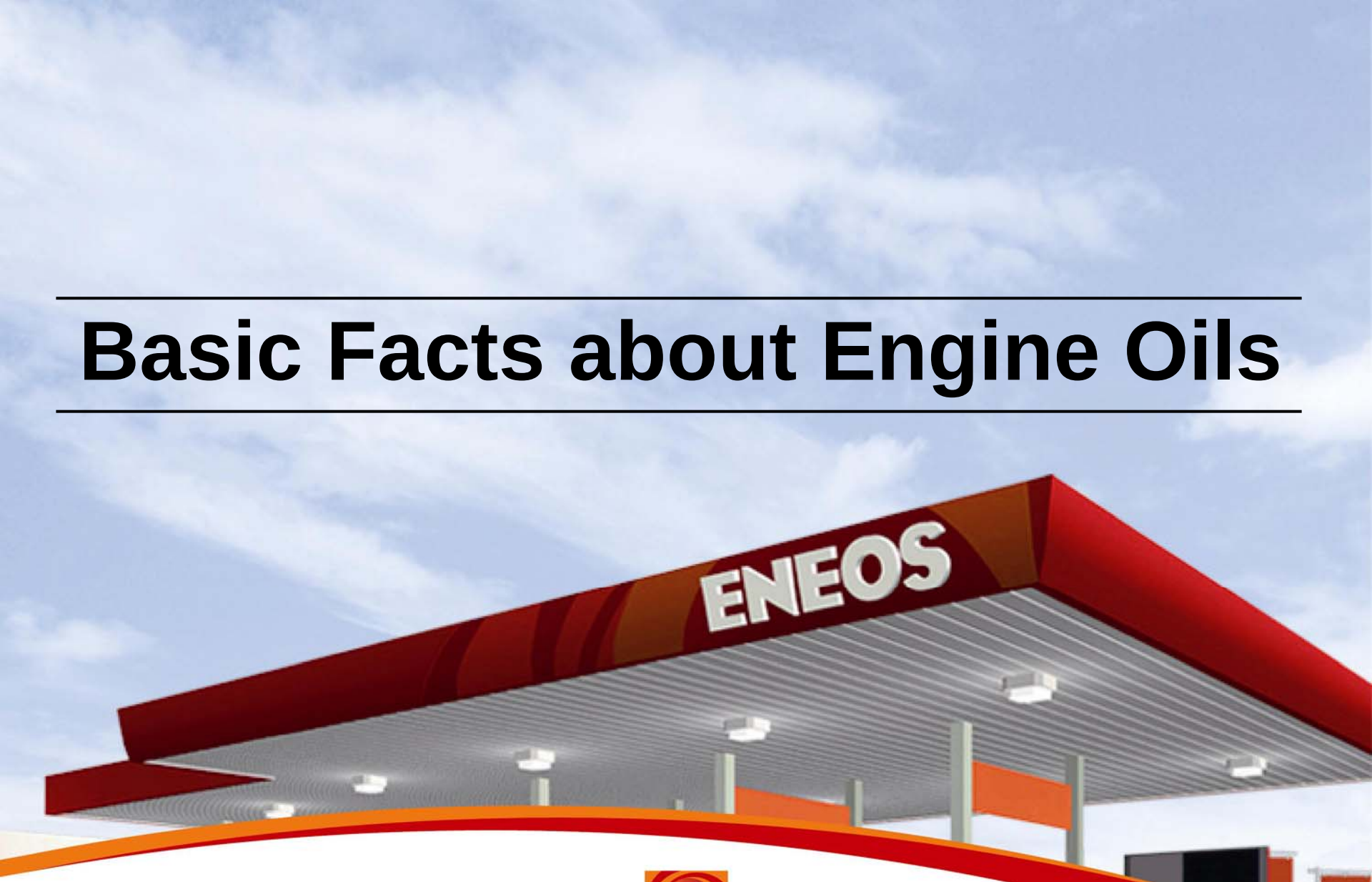
Basic Facts about Engine Oils



ENEOS

NIPPON OIL
Your Choice of Energy

1. Introduction

Items to study in this chapter

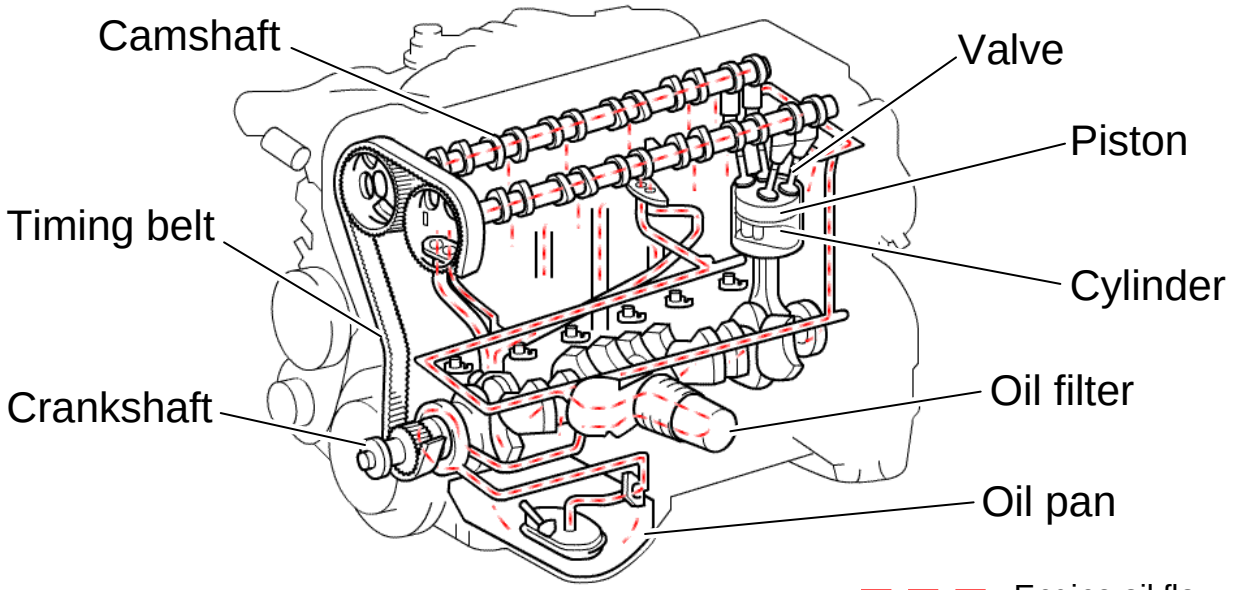
In this chapter, the following points about the basics of engines and engine oil are presented.

1. **Introduction**
2. **Engines and Engine Oil**
3. **Why engine oil must be changed**
4. **How to choose engine oil**
5. **Review Test**
6. **Summary**

2. Engines and Engine Oil

What is Engine Oil?

The engine is composed of the following parts through which the engine oil flows.



Point

If the engine is a heart, the engine oil is its blood. It circulates in the engine and performs various functions.

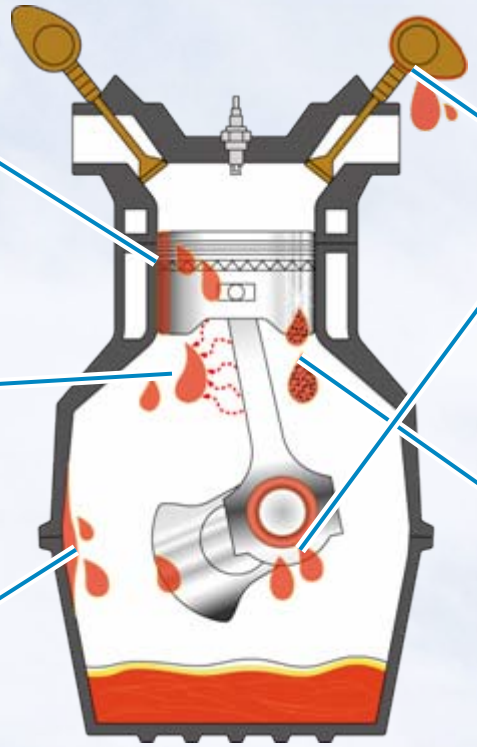
2. Engines and Engine Oil

5 Functions of Engine Oil

Sealing
The oil seals gaps, preventing the escape of gases.

Cooling
The oil absorbs heat, preventing overheating and burning of parts.

Rust Prevention
The oil helps to prevent rust and corrosion.



Lubrication
The oil allows the moving parts to slide smoothly, reducing friction and wear.

Cleaning
The oil picks up and disperses soot, sludge, etc., cleaning the engine.

Point

Engine oil is necessary to maintain the condition of the engine and enable it to function.

2. Engines and Engine Oil

■ Engine Types and Engine Oil

There are primarily two types of engines; gasoline engines and diesel engines.
There are three kinds of engine oil to suit them; gasoline engine oil, diesel engine oil and oil that can be used in either gasoline or diesel engines.

Engine

Gasoline Engines

- Gasoline engine oil
- Oil for either gasoline or diesel engines

Diesel Engines

- Diesel engine oil
- Oil for either gasoline or diesel engines

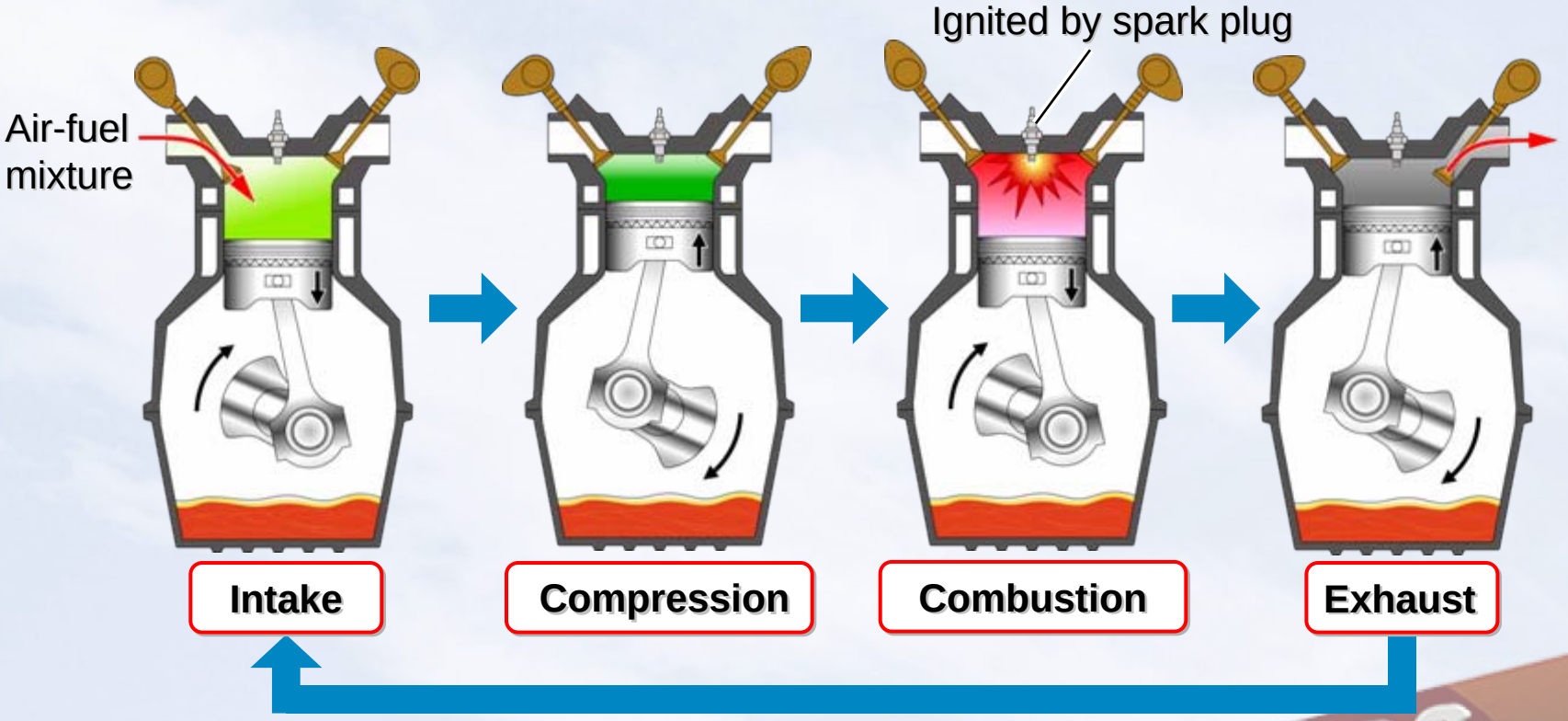
Point

The performance requirements of the engine oil change if the type of engine changes.

2. Engines and Engine Oil

How Gasoline Engines Work

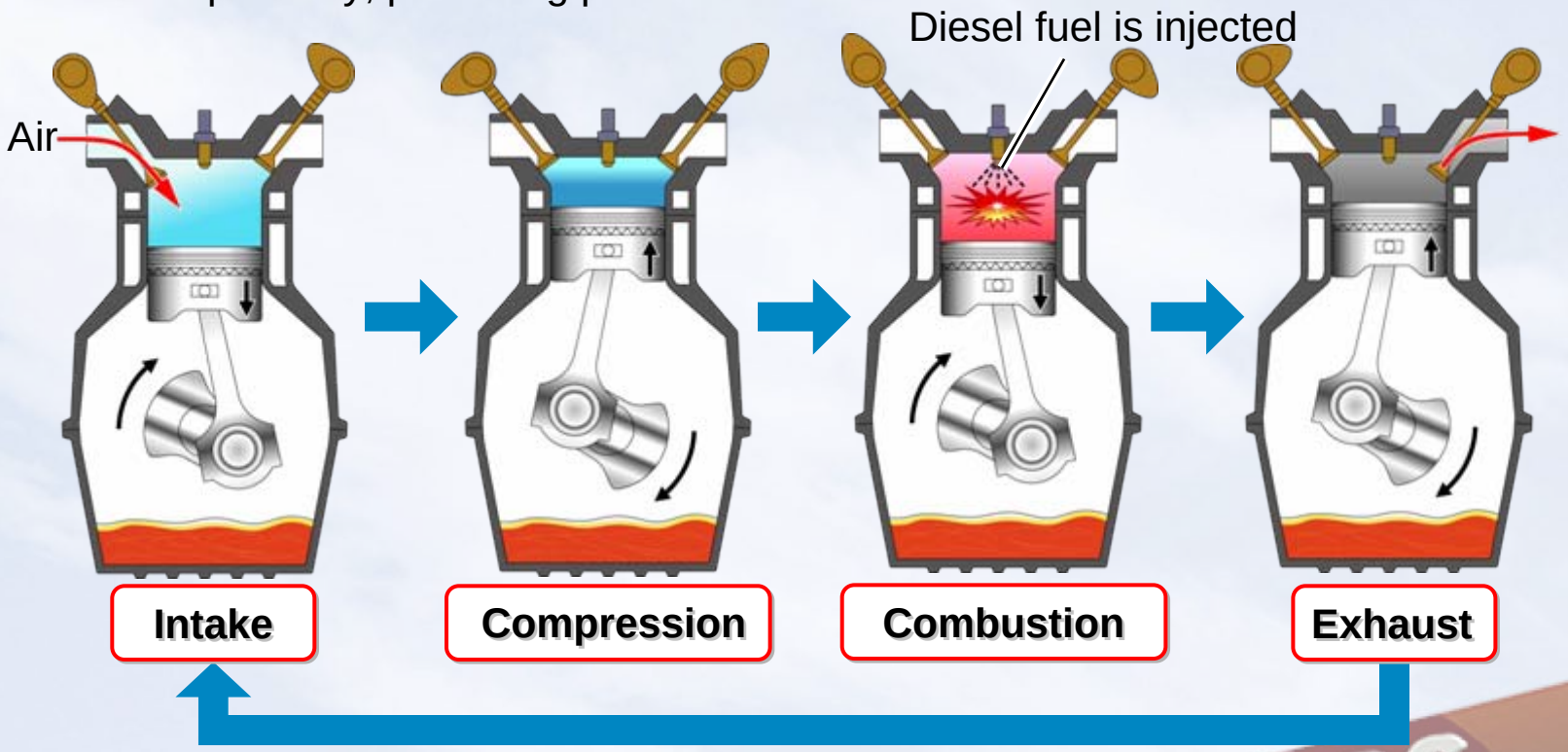
A gasoline engine produces power by the repeated combustion of a mixture of air and fuel. **The air-fuel mixture is ignited by a spark at the spark plug.**



2. Engines and Engine Oil

How Diesel Engines Work

In a diesel engine, **only air is compressed, and this causes the air temperature to rise**. Shortly after this, **diesel fuel is injected, and it ignites due to the heat of compression**. This occurs repeatedly, producing power.



2. Engines and Engine Oil

■ Engine Demands on Engine Oil

The performance requirements of engine oil for gasoline engines and for diesel engines are as follows.

Engine

Gasoline Engines

- Must endure use at high RPMs.

Diesel Engines

- Needs additives to neutralize the sulfur in diesel fuel.
- Needs higher viscosity to suit the higher compression ratio.
- Must remove the soot produced by combustion.

2. Engines and Engine Oil

The Composition of Engine Oil

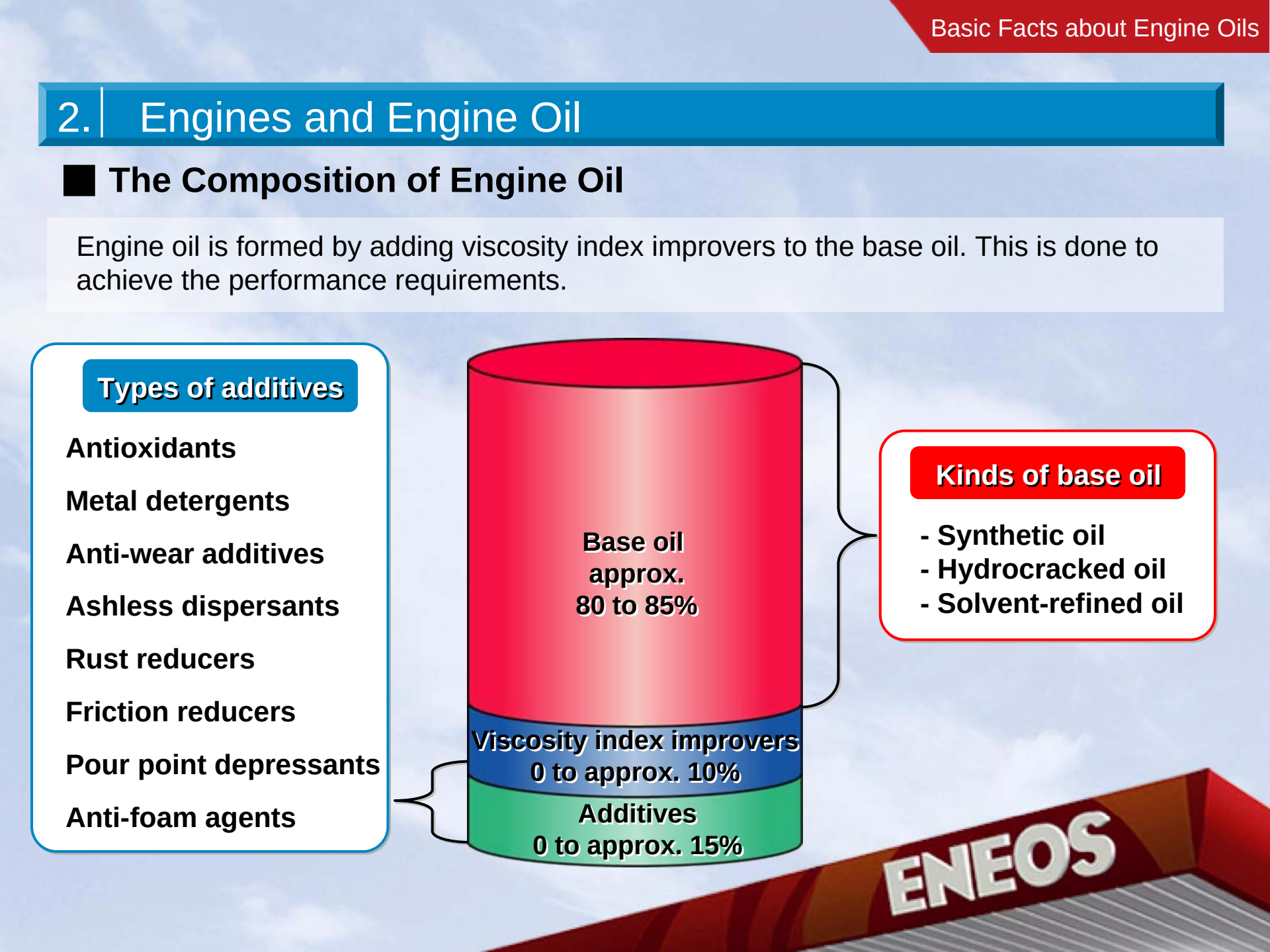
Engine oil is formed by adding viscosity index improvers to the base oil. This is done to achieve the performance requirements.

Types of additives

- Antioxidants
- Metal detergents
- Anti-wear additives
- Ashless dispersants
- Rust reducers
- Friction reducers
- Pour point depressants
- Anti-foam agents

Kinds of base oil

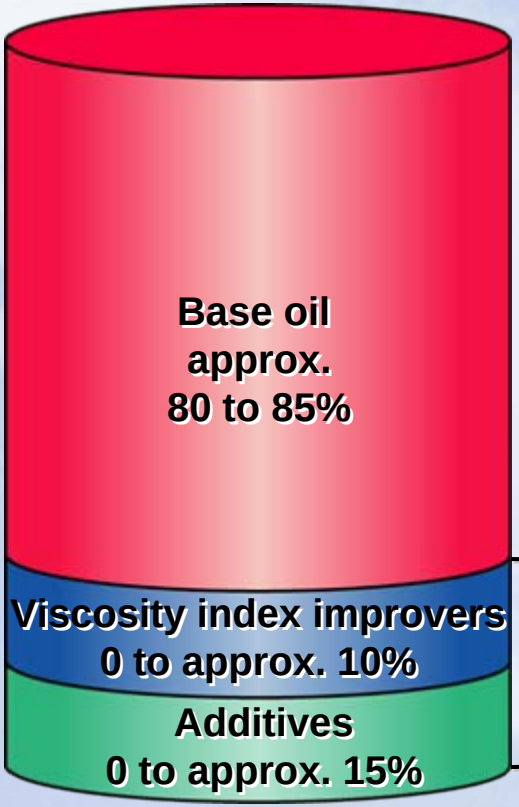
- Synthetic oil
- Hydrocracked oil
- Solvent-refined oil



2. Engines and Engine Oil

■ Engine Oil Additives

Depending on the additives used, there can be significant performance differences, even with the same base oil. In addition, different oil additives are used to suit differences in engines.



Differences between gasoline and diesel engine oils

Type	Gasoline engine oil	Diesel engine oil
Viscosity index improvers	○	○
Antioxidants	◎	○
Metal detergents	○	◎
Anti-wear additives	◎	◎
Ashless dispersants	○	◎
Rust inhibitors	○	○
Friction reducers	◎	—
Pour point depressants	○	○
Anti-foam agents	○	○

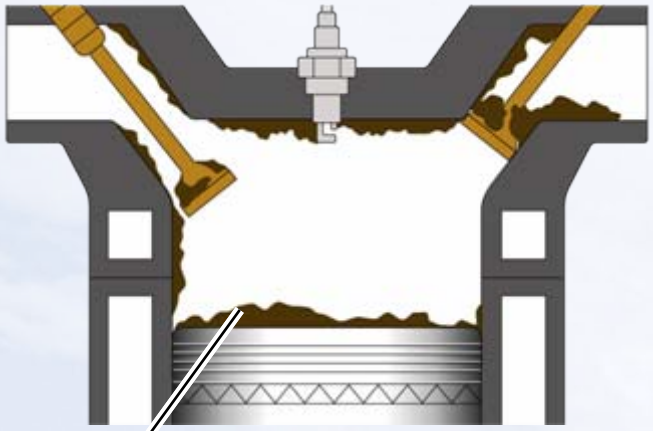
○: indicates this item(s) has been added
◎: indicates a greater quantity of this item(s) has been added

2. Engines and Engine Oil

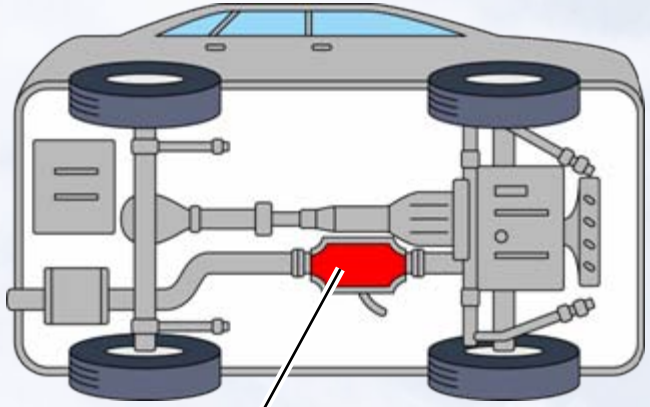
■ Using the Wrong Engine Oil (Case 1)

When diesel engine oil is put in a gasoline engine, the following problems will occur.

- Buildup of metallic additives in the engine
- Buildup of metallic additives in the catalyst



Metallic additives



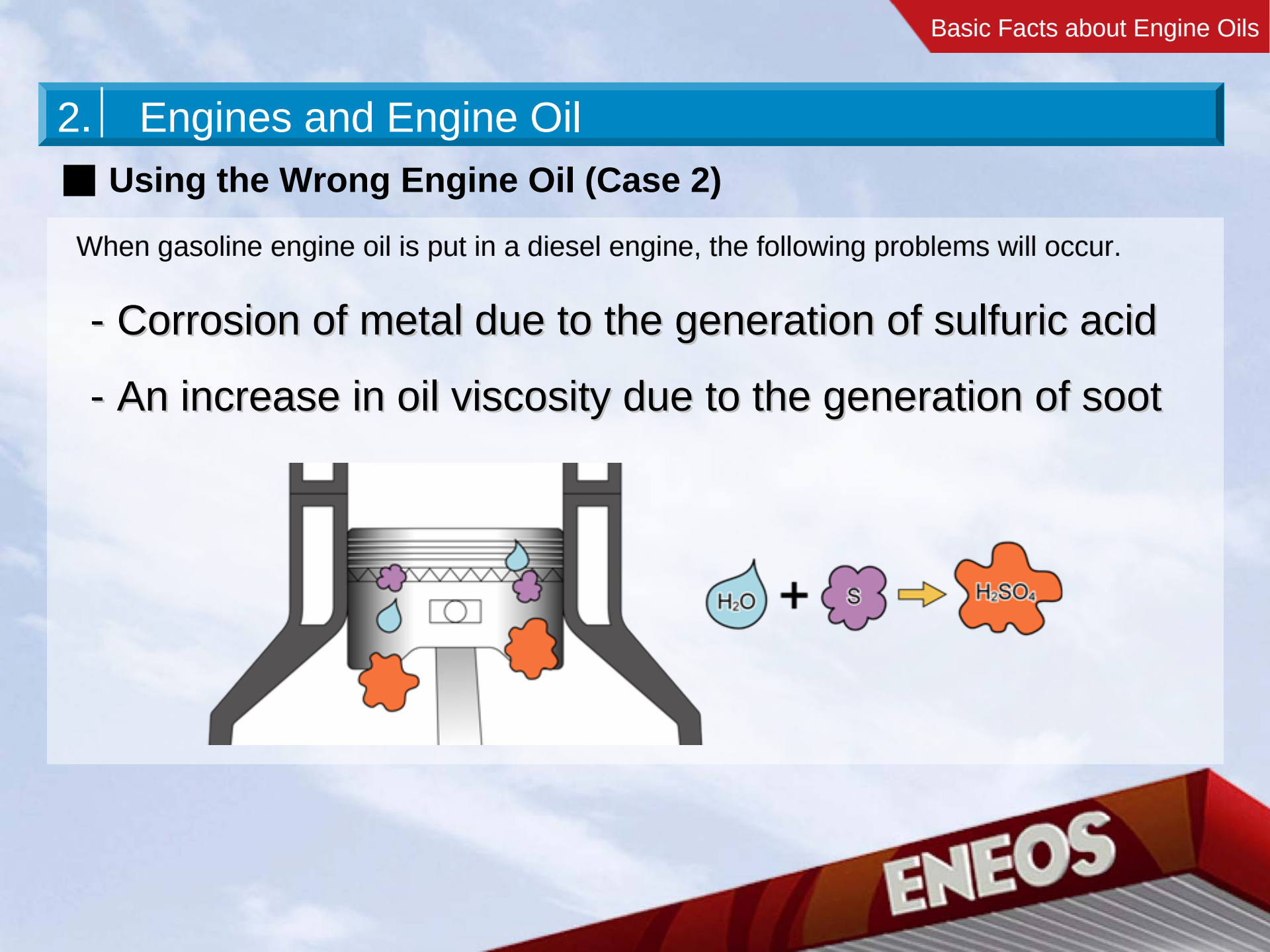
Catalyst

2. Engines and Engine Oil

■ Using the Wrong Engine Oil (Case 2)

When gasoline engine oil is put in a diesel engine, the following problems will occur.

- Corrosion of metal due to the generation of sulfuric acid
- An increase in oil viscosity due to the generation of soot



3. Why engine oil must be changed

■ Engine Oil Deterioration

Engine oil deteriorates for the following reasons.

- Dirt accumulation
- Moisture contamination
- Thermal oxidation of the oil
- Consumption of additives

Point

The temperature of combustion gases in an engine reaches from 2000 to 3000° C.
In such a severe environment, even a very high quality engine oil will deteriorate.

3. Why engine oil must be changed

■ Symptoms Resulting from Deterioration

The following symptoms occur when the engine oil deteriorates.

- Dirt builds up in the engine
- The engine is not protected

→

- Reduced fuel economy
- Engine trouble
- Reduced performance
- Reduced engine longevity

Point

The deterioration of engine oil causes engine trouble.

Periodic replacement of engine oil is necessary in order to keep the engine in its best condition.

4. How to choose engine oil

■ Points to choose engine oil

The quality and viscosity of the engine oil are specified by international standards. By noting these, the appropriate engine oil can be chosen.

- SAE viscosity notation

Sample SAE viscosity notation

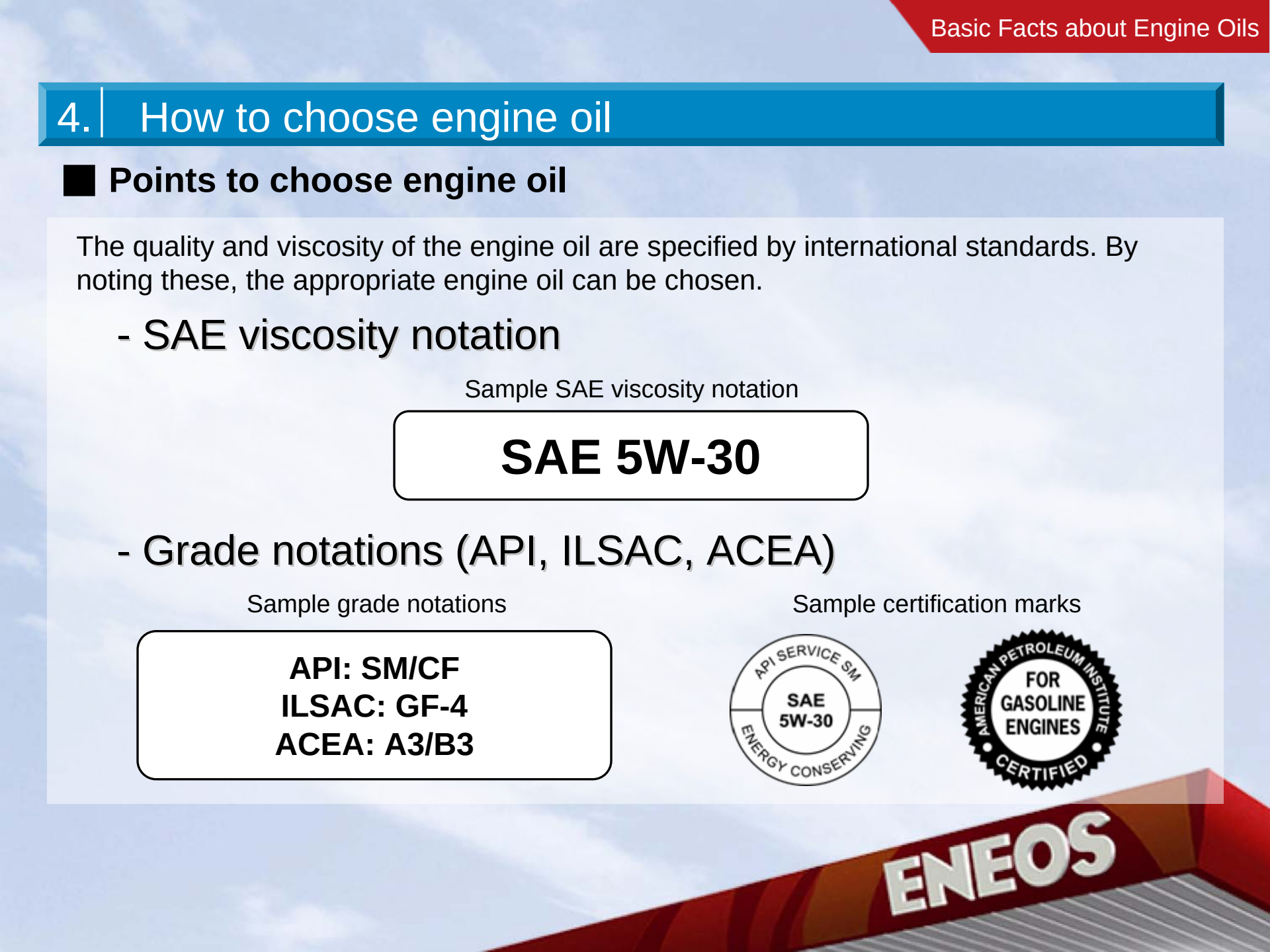
SAE 5W-30

- Grade notations (API, ILSAC, ACEA)

Sample grade notations

API: SM/CF
ILSAC: GF-4
ACEA: A3/B3

Sample certification marks



4. How to choose engine oil

■ How to read SAE viscosity notation (1)

The viscosity of the engine oil is expressed numerically using the **SAE (Society of Automotive Engineers)** developed notation.

5W-30

Low-temperature viscosity

Lower numbers are suitable for cold areas.

0W 5W 10W 15W 20W 25W

soft — hard

High-temperature viscosity

Higher numbers are suitable for warm areas.

20 30 40 50 60

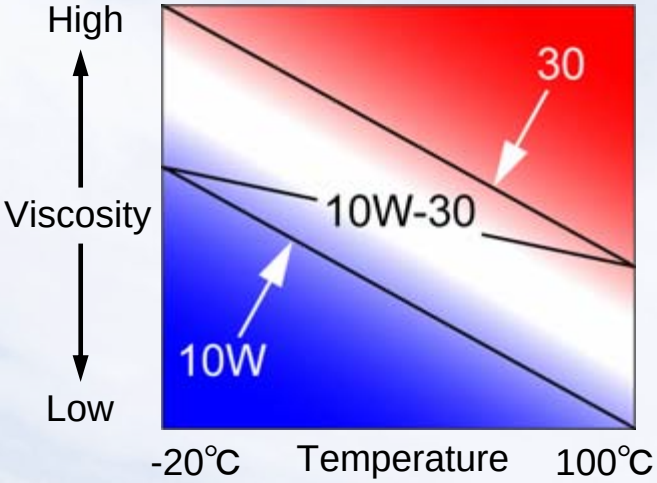
soft — hard

*“W" stands for “Winter".

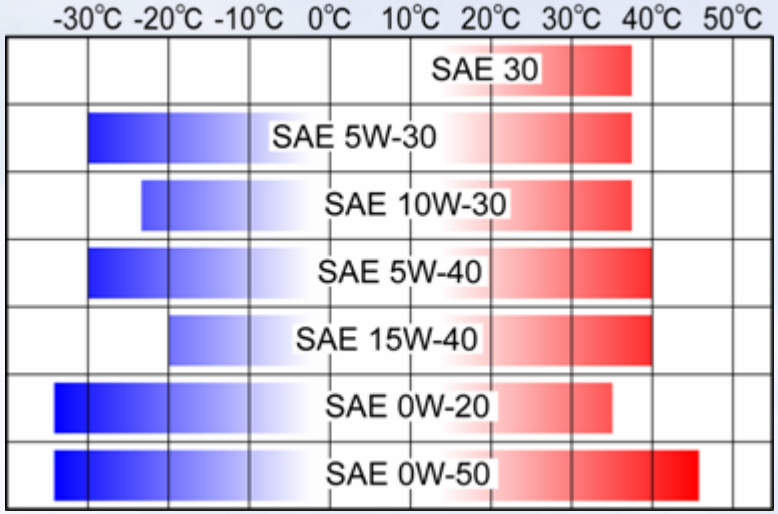
4. How to choose engine oil

■ How to read SAE viscosity notation (2)

The oil viscosity notation shows how well the oil withstands temperature fluctuations.



Temperature change and oil viscosity



Outside temperature and recommended oil viscosity

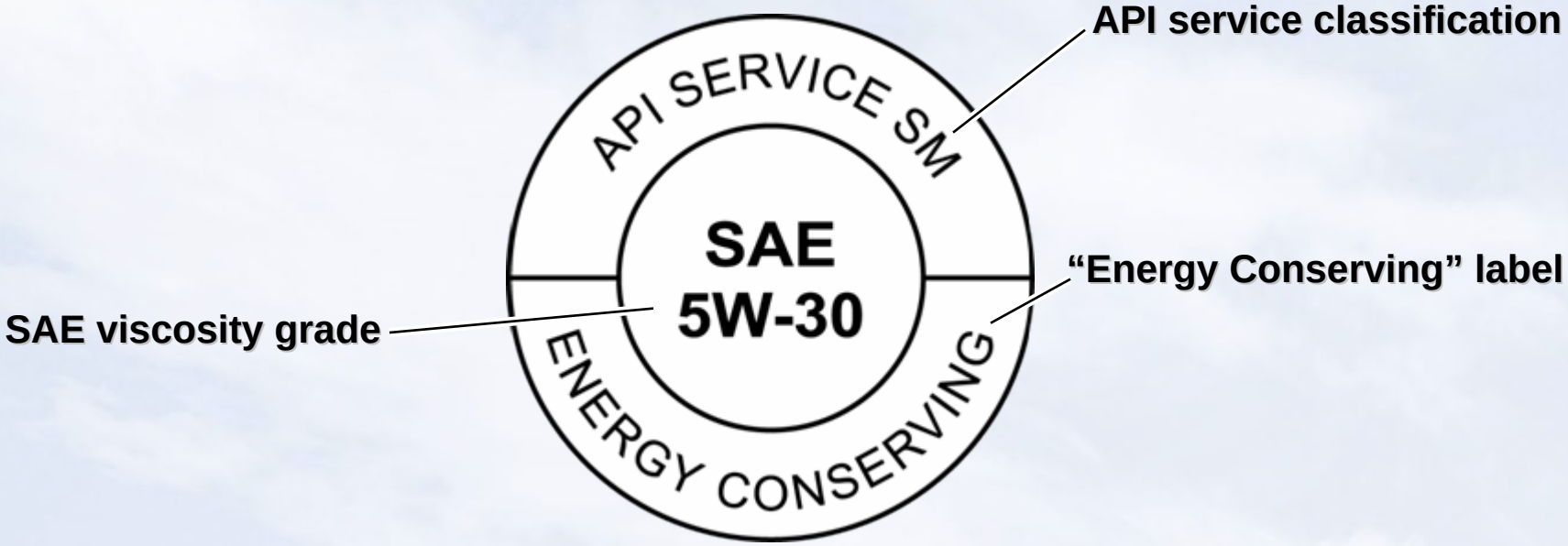
Point

A variety of high quality engine oils have been developed in recent years. According to this trend, how to choose engine oil has changed. Engine oils are now selected to suit vehicle driving conditions or engine type rather than outside temperature.

4. How to choose engine oil

How to read the API service classification (1)

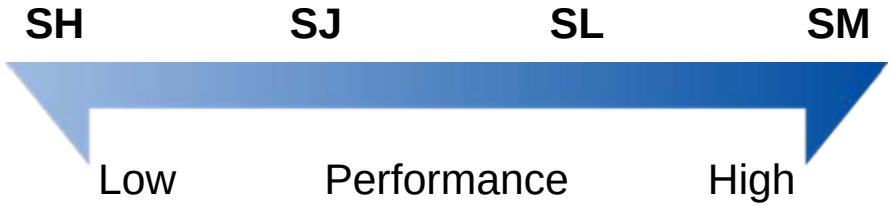
API stands for American Petroleum Institute.
The API doughnut mark is given to oil that meets the API standards. It shows the API service classification, fuel-saving performance and SAE viscosity grade.

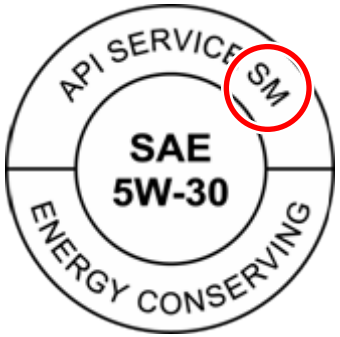


4. How to choose engine oil

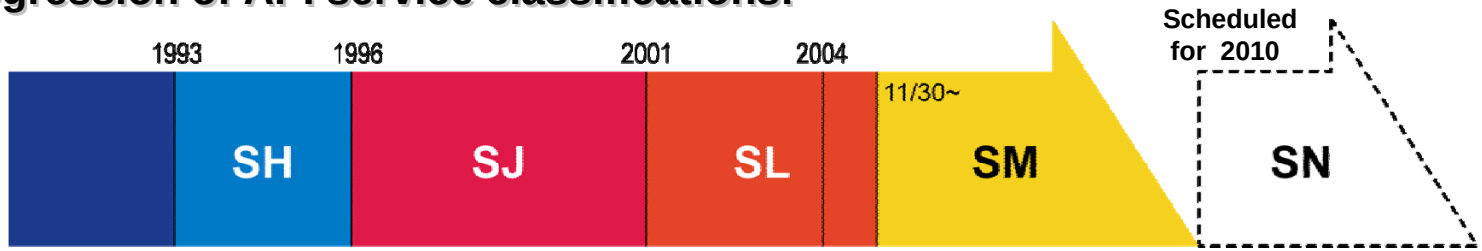
How to read the API service classification (2)

API service classifications for gasoline engine oils:





Progression of API service classifications:



4. How to choose engine oil

How to read the ILSAC service classification

ILSAC stands for International Lubricant Standardization and Approval Committee.
The **ILSAC starburst mark** is given to oil that meets the ILSAC standards.

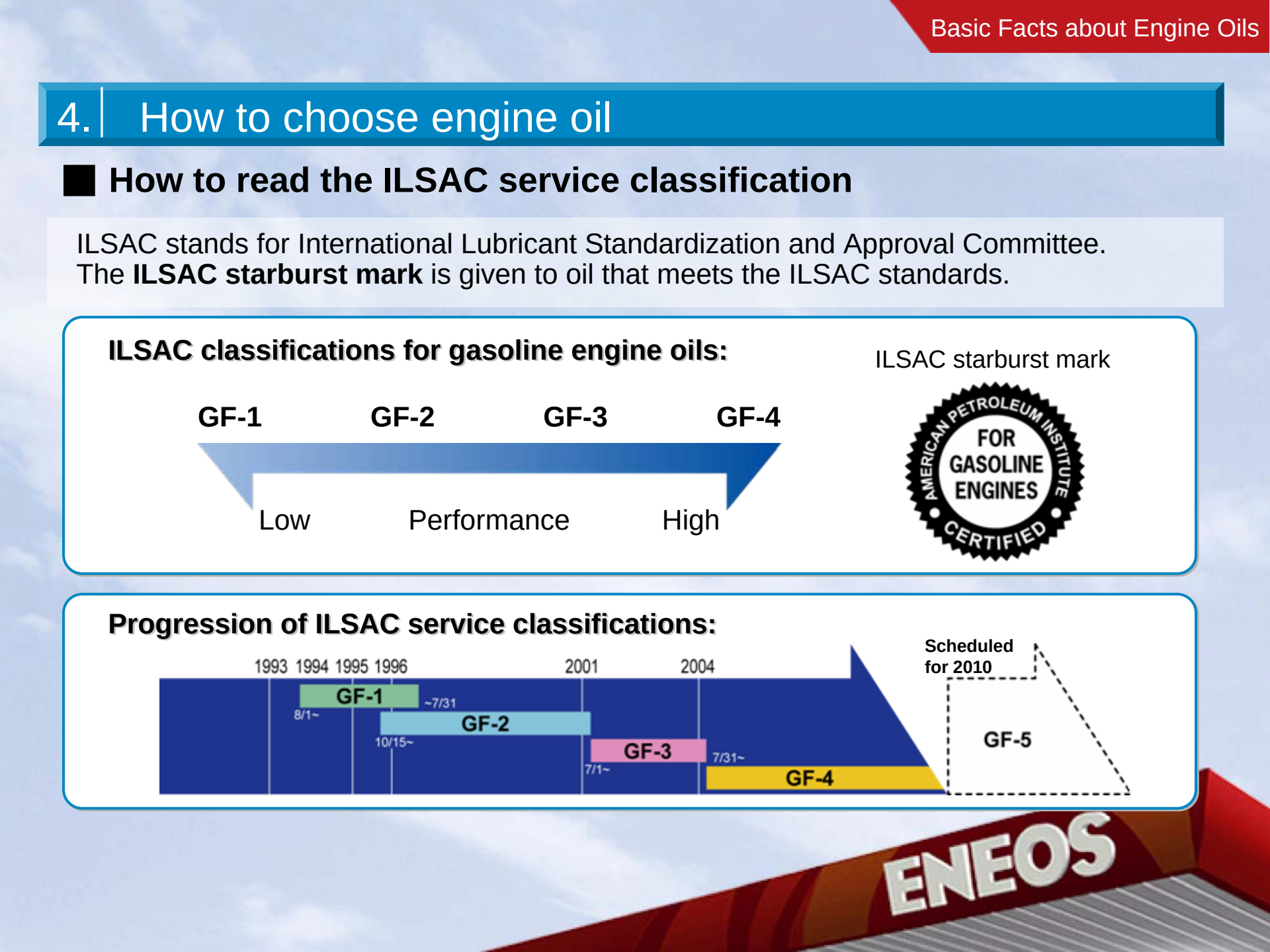
ILSAC classifications for gasoline engine oils:

GF-1 GF-2 GF-3 GF-4

Low Performance High

ILSAC starburst mark

Progression of ILSAC service classifications:



4. How to choose engine oil

How to read the ACEA service classification (1)

The ACEA service classification is certified by European Automobile Manufacturers Association. The grades are divided into categories A/B, C or E depending on the engines they correspond to.

ACEA classification for gasoline and diesel engine oils:

Sample ACEA service classification

C4-07

Year established

Ex.: If revised in 2007, 07 is indicated.

Grade

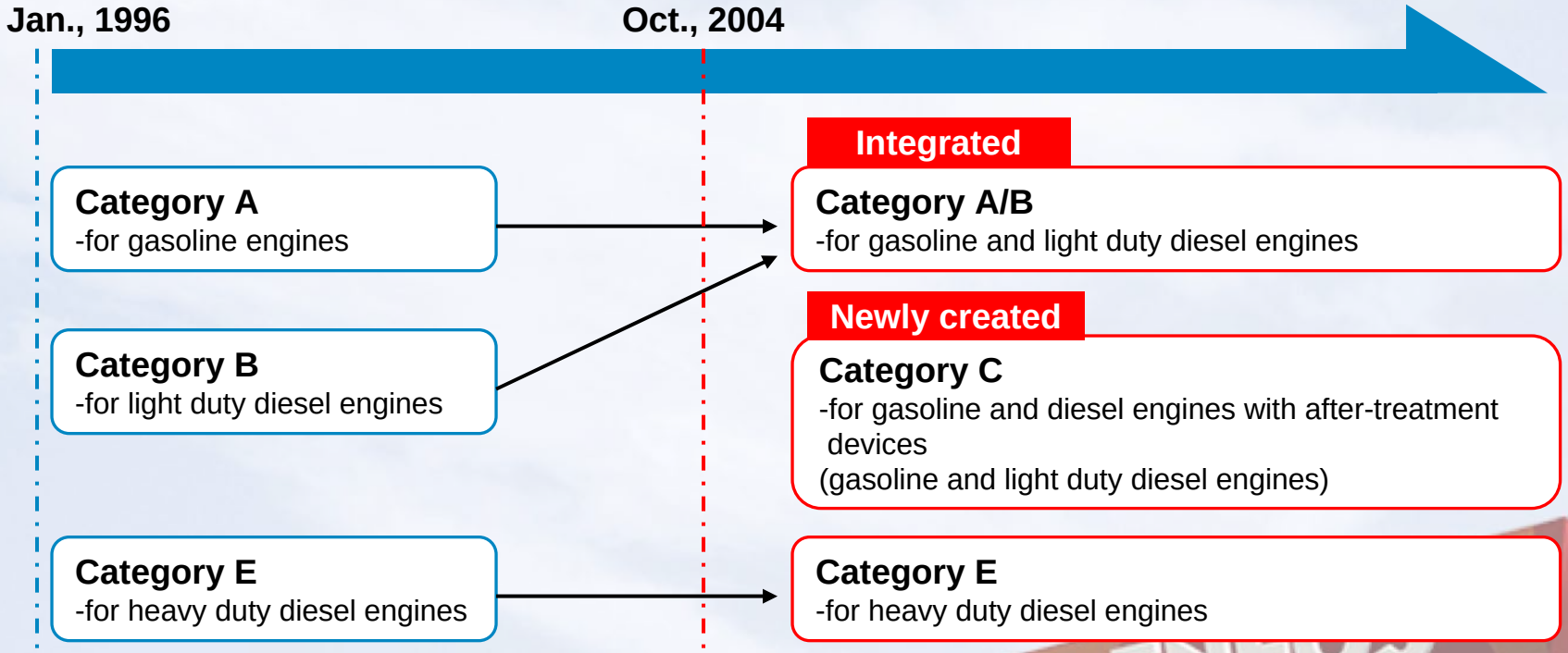
- **Category A/B**
  Applicable engines: Gasoline and light duty diesel engines
  Grade: A1/B1, A3/B3, A3/B4, A5/B5
- **Category C**
  Applicable engines: Gasoline and diesel engines with after treatment devices (gasoline and light duty diesel engines)
  Grade: C1, C2, C3, C4
- **Category E**
  Applicable engine: Heavy duty diesel engines
  Grade: E2, E4, E6, E7

4. How to choose engine oil

How to read the ACEA service classification (2)

The ACEA service classifications were established in 1996. In 2004, they were revised in accordance with emissions regulations and the trend toward high fuel efficiency. Through this, the current categories have been set.

Progression of ACEA service classifications:



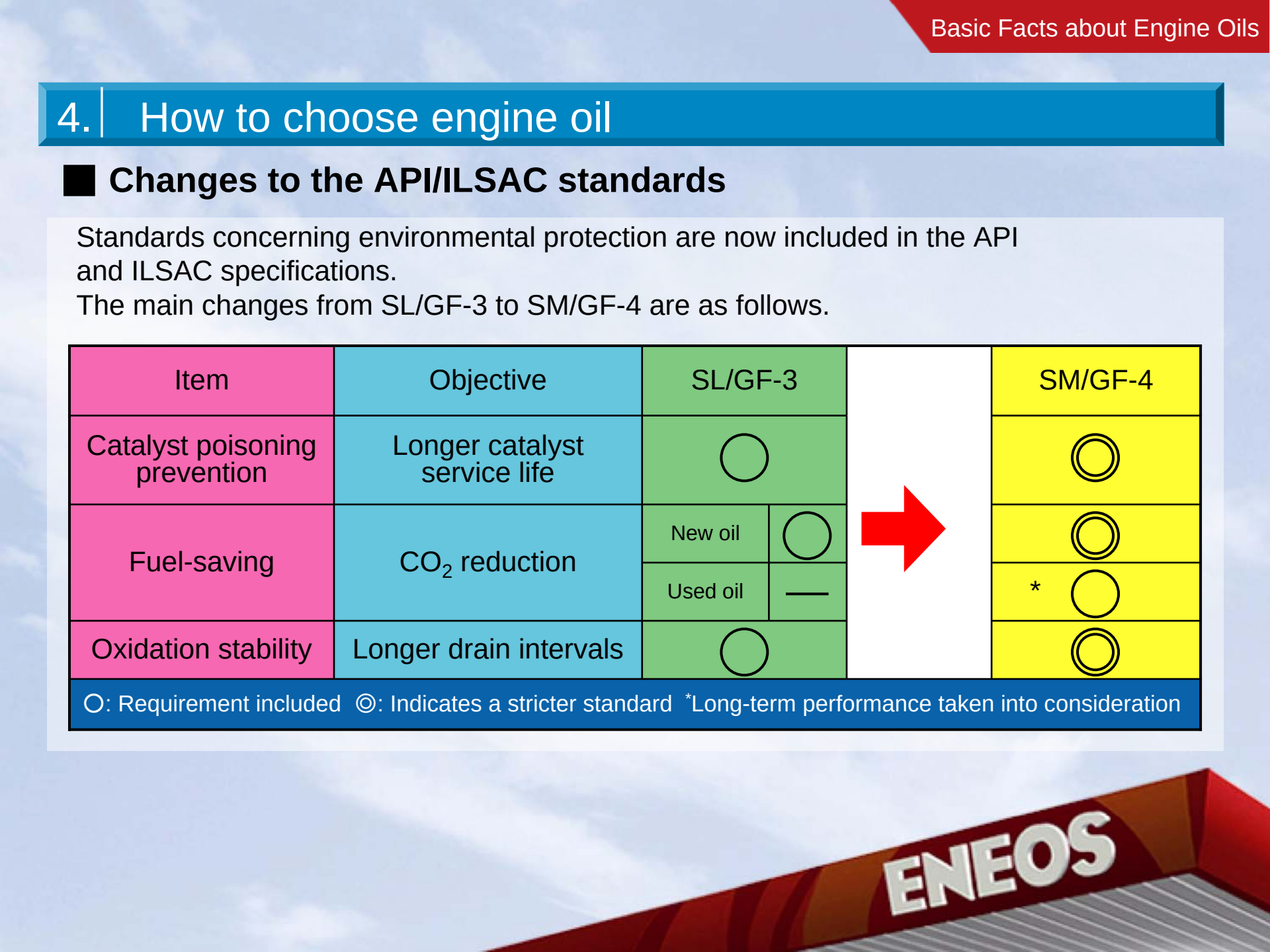
4. How to choose engine oil

■ Changes to the API/ILSAC standards

Standards concerning environmental protection are now included in the API and ILSAC specifications.
The main changes from SL/GF-3 to SM/GF-4 are as follows.

Item	Objective	SL/GF-3		SM/GF-4
Catalyst poisoning prevention	Longer catalyst service life	○		◎
Fuel-saving	CO_2 reduction	New oil	○	◎
		Used oil	—	* ○
Oxidation stability	Longer drain intervals	○		◎

○: Requirement included ◎: Indicates a stricter standard *Long-term performance taken into consideration



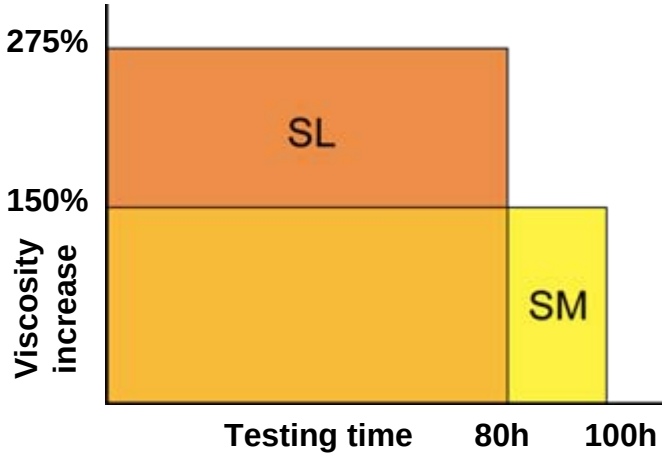
4. How to choose engine oil

API SL vs. API SM

API SM has the following differences compared with API SL.

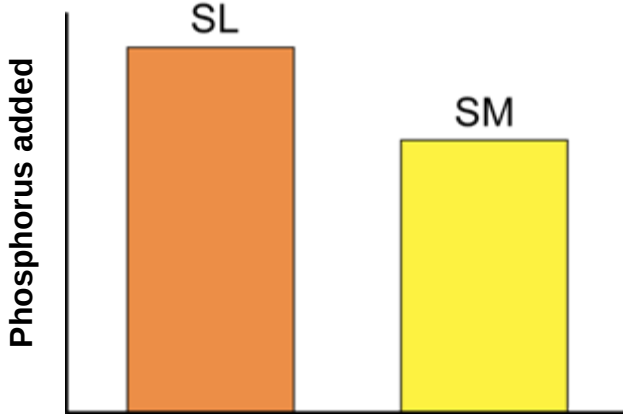
High-level of oxidation stability

→ Longer interval between oil changes



Reduction of phosphorus (P) additives

→ Maintaining catalyst performance, and reducing harmful exhaust emissions



Point

API SM is an environmentally-friendly oil. Furthermore, API SM/Energy Conserving and ILSAC GF-4 have improved fuel-saving performance compared to the characteristics of the base API SM grade.

5. Review Test

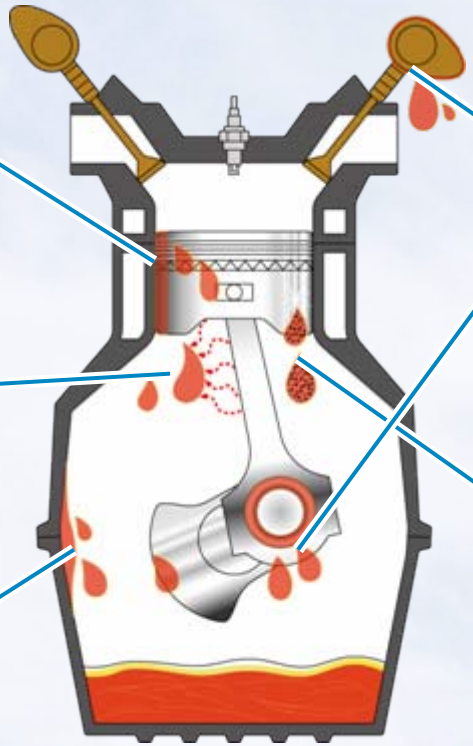
Review Test

Now, we are going to do the review test.

Let’s think about what we have studied, and consider our answers.

5. Review Test

Question 1. What are the 5 functions of engine oil?



5. Review Test

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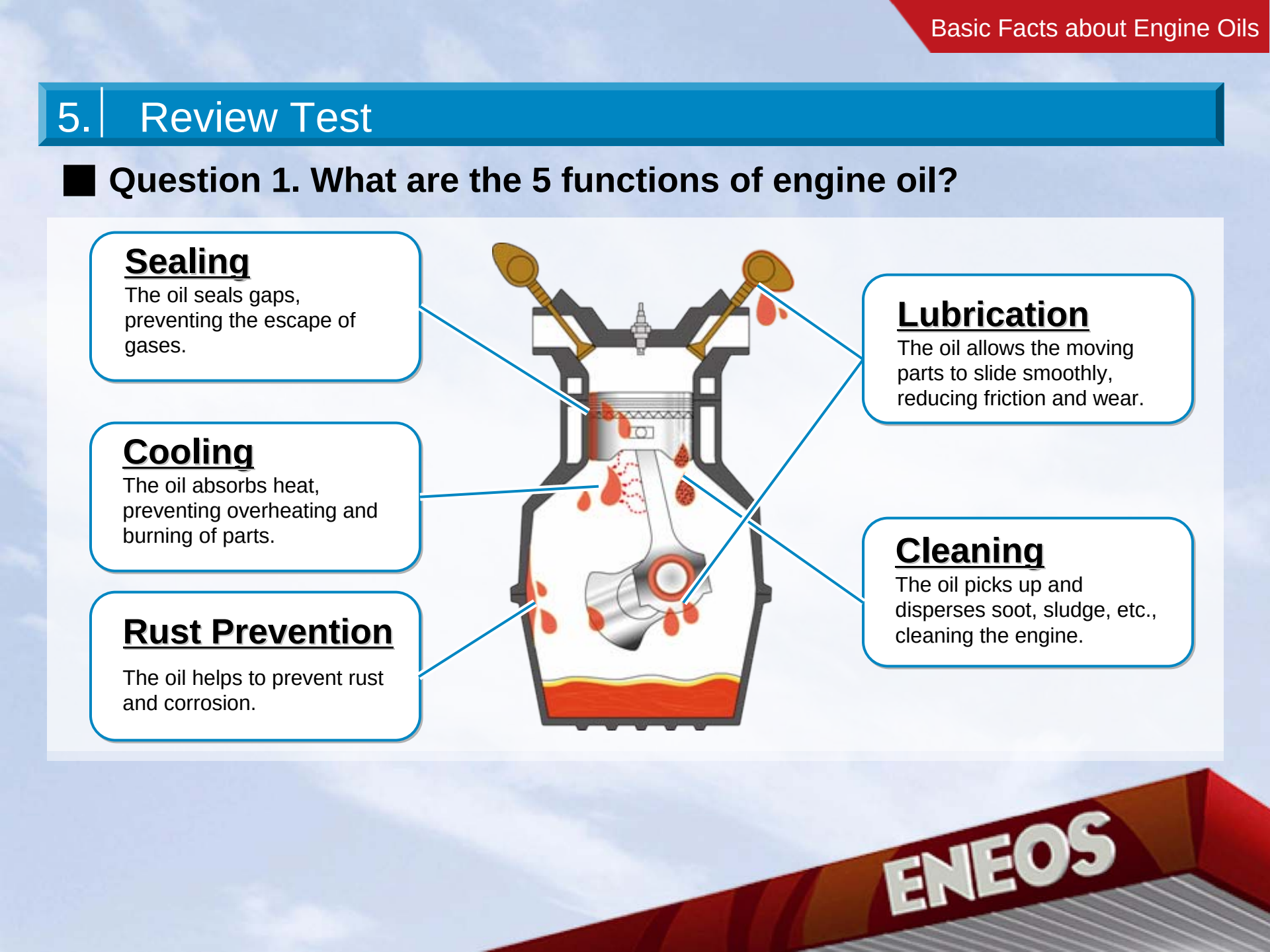
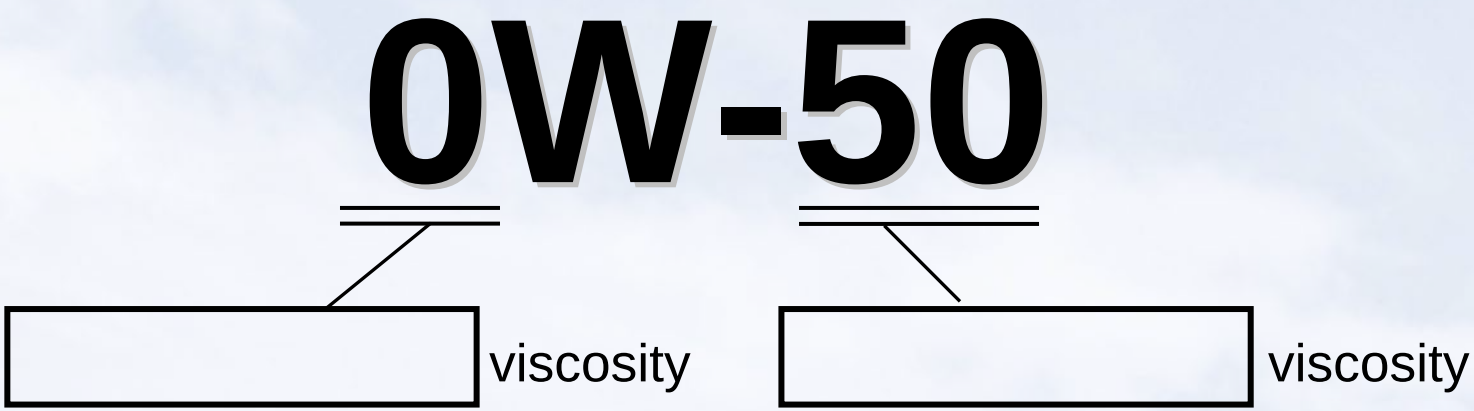


5. Review Test

Question 2. What do the following numbers in the SAE viscosity notation mean?



5. Review Test

■ Question 2. What do the following numbers in the SAE viscosity notation mean?

0W-50

Low-temperature viscosity

High-temperature viscosity

Lower numbers are suitable for cold areas.

0W 5W 10W 15W 20W 25W

soft — hard

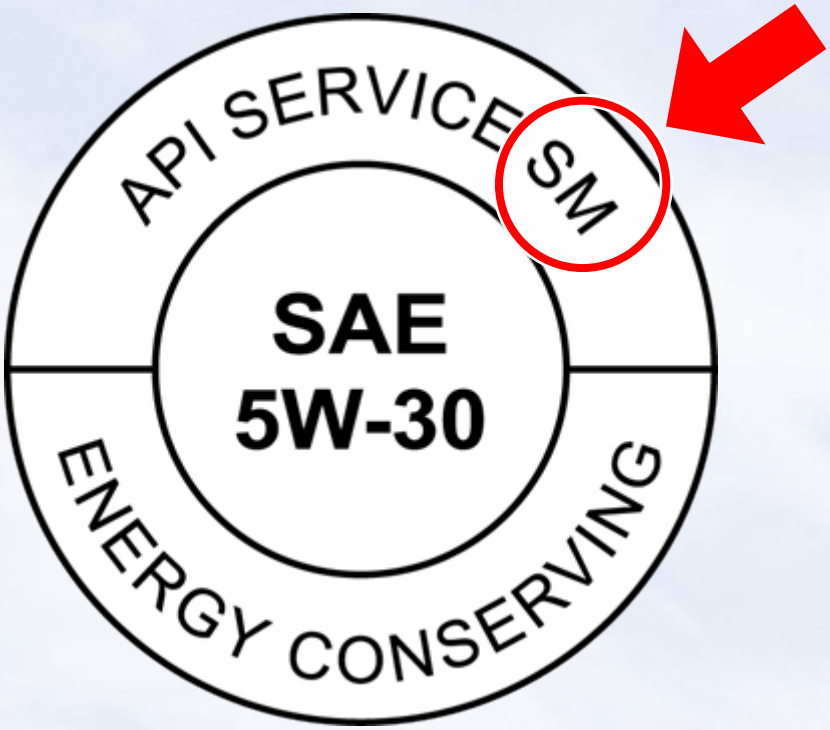
Higher numbers are suitable for warm areas.

20 30 40 50 60

soft — hard

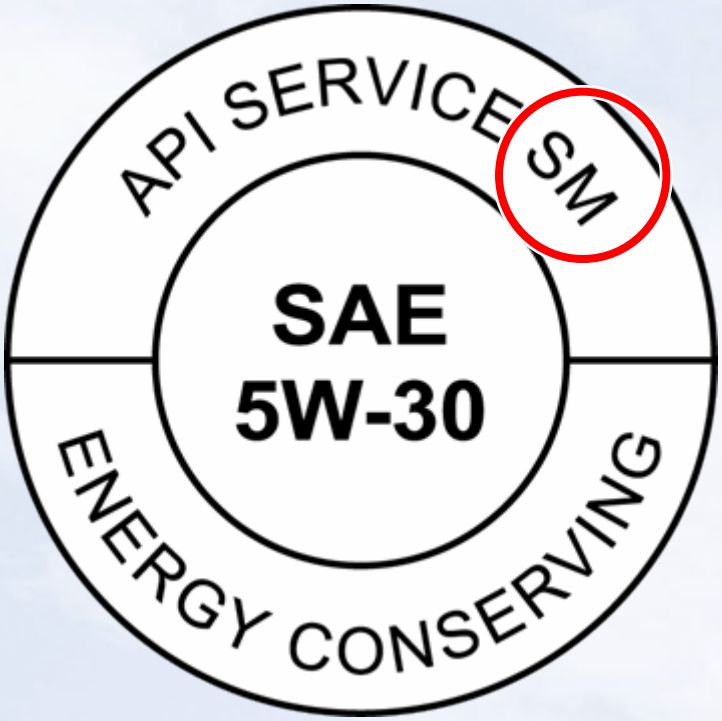
5. Review Test

■ **Question 3. What is this mark? What does “SM" indicate?**



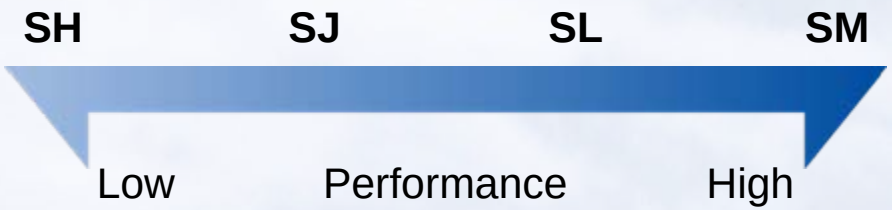
5. Review Test

■ **Question 3. What is this mark? What does “SM" indicate?**



API doughnut mark

It shows the grade of the engine oil:



6. Summary

■ Summary of this chapter

We have studied the following 3 points in this chapter.
I hope this content proves to be useful knowledge for you at work.

1. **Basic facts about engines and engine oils**
2. **Why engine oil must be changed**
3. **How to choose engine oil**