

Automotive Technology 6th Edition

Chapter 22 ENGINE OIL

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 6th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and ASEEducation (NATEF) and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Case Studies, Videos, Animations, and ASEEducation (NATEF) Task Sheets.
Motivate Learners	Explain how the knowledge of how something works translates into the ability to use that knowledge to figure why the engine does not work correctly and how this saves diagnosis time, which translates into more money.
State the learning objectives for the chapter or course you are about to cover and explain this is what they should be able to do as a result of attending this session or class.	Explain the chapter learning objectives to the students as listed: <ol style="list-style-type: none"> 1. Explain the purpose of engine oil and its properties. 2. Discuss the properties of engine oil. 3. Discuss SAE rating , API rating, ILSAC oil rating, European oil rating system, and Japanese oil rating. 4. Describe the purpose of additives in engine oil. 5. Discuss synthetic engine oils and their advantages and disadvantages. 6. Discuss vehicle-specific specifications of oil. 7. Discuss high mileage oils and the purpose. 8. Describe the function of oil filters and the procedure to change the engine oil.
Establish the Mood or Climate	Provide a WELCOME , Avoid put downs and bad jokes.
Complete Essentials	Restrooms, breaks, registration, tests, etc.
Clarify and Establish Knowledge Base	Do a round robin of the class by going around the room and having each student give their backgrounds, years of experience, family, hobbies, career goals, or anything they want to share.

NOTE: This lesson plan is based on the 6th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

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1. SLIDE 1 CH22 ENGINE OIL

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ENGINE OIL Videos

2. SLIDE 2 **EXPLAIN** FIGURE 22–1 Viscosity index (VI) improver is a polymer and feels like finely ground foam rubber. When dissolved in the oil, it expands when hot to keep the oil from thinning.

DEMONSTRATION: Put quart of 10W-30 & a quart of 30W oil in freezer to demonstrate flow characteristics of multigrade vs. single-grade oil in freezing temperatures.

DISCUSSION: Discuss why OEMs do not recommend single-viscosity oil. Ask students why it was OK for single-viscosity oil to be used in older engines & engines designed for high performance

**Internal Combustion Engine (ICE)
lubrication system absorbs 1/3 of heat
produced by engine.**

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3. **SLIDE 3 EXPLAIN FIGURE 22–2** The SAE viscosity rating required is often printed on the engine oil filler cap. Most hybrid electric vehicles specify either SAE 0W-20 or SAE 5W-20 engine oil.
4. **SLIDE 4 EXPLAIN FIGURE 22–3** API doughnut for a SAE 5W-30, SM engine oil. When compared to a reference oil, “energy conserving” designation indicates a 1.1% better fuel economy for SAE 10W-30 oils and 0.5% better fuel economy for SAE 5W-30 oils.

DISCUSS CASE STUDY: The Case of the Wrong Oil Viscosity

A Dodge Durango 5.7 liter Hemi with a multiple displacement system (MDS) had the oil changed at a shop. SAE 10W-30 was used as this was the standard bulk oil in shop. After the oil change, the vehicle was returned to the customer. Within a few minutes, however, the “check engine” light came on. The technician checked for diagnostic trouble codes (DTCs) and found a P0521 DTC stored. The technician checked service information and discovered that the code could be set if incorrect viscosity engine oil had been used. The description of the P0521 read: “Oil pressure not reaching specified at 1250 RPM.” Technician changed the oil and used the specified SAE 5W-20, then cleared the DTC. A test drive confirmed that the change to the correct viscosity oil solved the problem.

Summary:

Complaint—Customer stated that the “check engine” came on after an oil change.

Cause—The incorrect viscosity of oil was used.

Correction—The specified viscosity oil (SAE 5W-20) was used and the code cleared.

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EXPLAIN TECH TIP: Three Oil Change Facts

Three facts that are important to know when changing oil are:

1. **Recommended SAE viscosity (thickness) for the temperature range that is anticipated before the next oil change (such as SAE 5W-30)**
2. **Quality rating as recommended by the engine or vehicle manufacturer, such as API SM, and other specified rating, such as the ILSAC and vehicle manufacturer's specifications**
1. 3. **Recommended oil change interval (time or mileage) (usually every 5,000 miles or every six months)**

DISCUSSION: Ask students to discuss differences between SAE & API ratings. Then have them identify those ratings on different brands and viscosities of oils. Then ask them to compare API, ILSAC, & European oil ratings standards.

Tell the students that oil ratings are constantly updated and newer oil is backward compatible, meaning it can be used in older vehicles.

5. **SLIDE 5 EXPLAIN FIGURE 22-4** The International Lubricant Standardization and Approval Committee (ILSAC) starburst symbol. If this symbol is on the front of the container of oil, then it is acceptable for use in almost any gasoline engine.

DISCUSSION: Have the students discuss why Japanese standards for valve train wear are more stringent

Let students know that vehicles driven in Japan are required to be repowered or replaced at given intervals

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6. **SLIDE 6 EXPLAIN FIGURE 22-5** ACEA ratings are included on the back of the oil container if it meets any of the standards. ACEA ratings apply to European vehicles only, such as BMW, Mercedes, Audi, and VW..

DEMONSTRATION: Using saved oil show students the difference between new oil and oil that is dirty. Have students use latex gloves to feel difference between new & contaminated oil

DISCUSSION: Have students discuss reason why oil additives are important. Ask them whether all OEMS use same additives

7. **SLIDE 7 EXPLAIN Figure 22-6** Mobil 1 synthetic engine oil is used by several vehicle manufacturers in new engines.
8. **SLIDE 8 EXPLAIN Figure 22-7** Both oils have been cooled to -20°F (-29°C). Notice that the synthetic oil on the left flows more freely than the mineral oil on the right even though both are SAE 5W-30

EXPLAIN TECH TIP: Synthetic Good and Bad News
In a true synthetic, such as base oils classified by API as a group IV or V, the molecules are all the same, and it does not have any sulfur that is present in crude oil and refined out. That is great, but API group III is also called a synthetic, and because its cost is lower than the other two synthetics, makes selecting an oil more difficult. However, according to lubrication engineers, service technicians and vehicle owners should not be concerned what molecules are in the oil, but instead should use oil that meets the vehicle specifications. For example, if an oil has a zero (0) as the first number, such as SAE 0W-20, the oil HAS to be a synthetic to be able to meet that specification. The synthetic could be a group III, IV, or V, but more likely a combination of all three. Check service information for the exact oil to use for the vehicle being serviced. • **SEE FIGURE 22-8.**

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	<p>9. SLIDE 9 EXPLAIN FIGURE 22-8 A true synthetic is made of a stable molecule that does not vary compared to mineral oils. However, regardless of the molecules, always use an oil that meets the vehicle manufacturer's specifications.</p>
	<p>Synthetic oils 1st developed for Army Air Forces (WWII) to keep their high-perf. turbo radial aircraft engines alive, which could not be done with conventional oils.</p>
	<p>DISCUSSION: Ask students to compare advantages & disadvantages of synthetic and conventional oils included in service intervals</p>
	<p>10. SLIDE 10 EXPLAIN Figure 22-9 European vehicle manufacturers usually specify engine oil with a broad viscosity range, such as SAE 5W-40, and their own unique standards, such as the Mercedes specification 229.51. Always use oil specified by OEM</p>
	<p>DISCUSSION: Ask the students to discuss any advantages & disadvantages that high mileage oils have compared to conventional and synthetic oils</p>
	<p>HANDS-ON TASK: Have students use owner's manual or electronic service information to look up and find OEM specific oil specifications for at least 2 different lab vehicles</p>

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	<p>EXPLAIN TECH TIP: Dirty Engine Oil Can Cause Oil Burning: Service technicians have known for a long time that some of their customers never change the engine oil. Often these customers believe that because their engine uses oil and they add a new quart every week, they are doing the same thing as changing the oil. But dirty, oxidized engine oil could cause piston rings to stick and not seal cylinder. Therefore, when the oil and filter are changed, the clean oil may free the piston rings, especially if the vehicle is driven on a long trip during which the oil is allowed to reach the normal operating temperature. An engine that is mechanically sound, but burning oil, may be “fixed” by simply changing the oil and filter.</p>

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DISCUSS FREQUENTLY ASKED QUESTION: Can Newer Engine Oils Be Used in Engines That Use Flat-Bottom Lifters: No. Newer oil standards are designed to reduce phosphates in the engine oil that may leak past piston rings and end up in the exhaust system. These additives found in oil can then damage the catalytic converter. The levels of phosphate and zinc, commonly referred to as zinc dialkyl dithiophosphate (ZDDP or ZDP), have been reduced because they can cause damage to the catalytic converter. Even though engines consume very little oil, if the oil contains zinc, the efficiency of the catalytic converter is reduced. The use of ZDDP was intended to reduce sliding friction in an engine. Sliding friction is usually found in engines that use flat-bottom lifters. Most, if not all, engines produced over the past 15 years have used roller lifters or cam followers, so using the new oil without ZDDP is not a concern. Even diesel oils have reduced amounts of the zinc, so many camshaft manufacturers are recommending the use of an additive. Older oils had up to 0.15% ZDDP and now SM-rated oils list the zinc at just 0.08%, or 800 parts per million.

- Engine oil had about 1200 PPM zinc prior to 2001.
- In 2001, the zinc was reduced to 1000 PPM; and in 2005, reduced again to the current 800 PPM.
- API ratings do not specify the zinc content, just oil performance.

If driving a vehicle with flat-bottom lifters, use engine oil specifically designed for older

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11. **SLIDE 11 EXPLAIN FIGURE 22–10** Using a zinc additive is important when using SM-rated oil in an engine equipped with a flat-bottom lifter, especially during the break-in period.
12. **SLIDE 12 EXPLAIN FIGURE 22–11** A rubber diaphragm acts as an antidrainback valve to keep the oil in the filter when the engine is stopped and the oil pressure drops to zero..
13. **SLIDE 13 EXPLAIN FIGURE 22–12** cutaway of a typical spin-on oil filter. Engine oil enters filter through small holes around center of filter and flows through pleated paper filtering media, and out large hole in center of filter. The center metal cylinder with holes is designed to keep paper filter from collapsing under pressure. The bypass valve can be built into center on the oil filter, or is part of oil filter housing and located in engine.

DEMONSTRATION: Taking a name brand filter and a cheap oil filter that have been cut open, show the students difference between the two

14. **SLIDE 14 EXPLAIN FIGURE 22–13** A typical filter crusher. The hydraulic ram forces out most of the oil from the filter. The oil is trapped underneath the crusher and is recycled.

DISCUSSION: Ask students to discuss difference between name brand filter and cheaper filter and what it could mean to them as consumers

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DISCUSS FREQUENTLY ASKED QUESTION:

Why Change Oil If the Oil Filter Can Trap

All the Dirt?: Many believe that oil filters will remove all dirt from oil being circulated. Most oil filters will filter particles that are about 10 to 20 microns in size. A micron is one-millionth of a meter or 0.000039 inch. Most dirt and carbon particles that turn engine oil black are less than a micron in size. Takes about 3 million of these carbon particles to cover a pin head. Consider that a typical human hair is 60 microns in diameter. In fact, anything smaller than 40 microns is not visible to the human eye. The dispersants added to engine oil prevent dirt from adhering together to form sludge. It is the same dispersant additive that prevents dirt from being filtered or removed by other means. If an oil filter could filter particles down to 1 micron, it would be so restrictive that the engine would not receive sufficient oil through the filter for lubrication. Oil recycling companies use special chemicals to break down the dispersants, which permit the dirt in the oil to combine into larger units that can be filtered or processed out of the oil.



14. **SLIDE 14 EXPLAIN Figure 22-13** Many vehicle manufacturers can display the percentage of oil life remaining, whereas others simply turn on a warning lamp when it has been determined that an oil change is required.
15. **SLIDE 15 EXPLAIN FIGURE 22-14** Many vehicle manufacturers can display the percentage of oil life remaining, whereas others simply turn on a warning lamp when it has been determined that an oil change is required.

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	<p><u>EXPLAIN TECH TIP: Follow the Seasons</u> Vehicle owners often forget when they last changed the oil. This is particularly true of the person who owns or is responsible for several vehicles. A helpful method for remembering when the oil should be changed is to change it at the start of each season of the year.</p> <ul style="list-style-type: none">• Fall (September 21)• Winter (December 21)• Spring (March 21)• Summer (June 21) <p>Remembering that the oil needs to be changed on these dates helps owners budget for the expense and the time needed.</p>
	<p><u>EXPLAIN TECH TIP: The Pick Trick</u> Removing an oil filter that is installed upside down can be a real mess. When this design filter is loosened, oil flows out from around the sealing gasket. To prevent this from happening, use a pick to poke a hole in the top of the filter. This small hole allows air to get into the filter, thereby allowing the oil to drain back into the engine rather than remain in the filter. After punching a hole in the filter, be sure to wait several minutes to allow time for the trapped oil to drain down into the engine before loosening the filter.</p>

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EXPLAIN TECH TIP: Change Oil Every Month?

A vehicle less than one year old came back to the dealer for some repair work. While writing the repair order, the service advisor noted that the vehicle had 88,000 miles on the odometer and was, therefore, out of warranty for the repair. Because the owner approved the repair anyway, the service advisor asked how he had accumulated so many miles in such a short time. The owner said that he was a traveling salesperson with a territory of “east of the Mississippi River.”

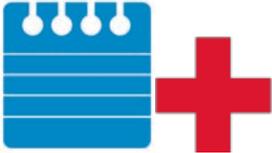
Because the vehicle looked to be in new condition, the technician asked the salesperson how often he had the oil changed. The salesperson smiled and said proudly, “Every Month.” Many fleet vehicles put on over 2,000 miles per week. How about changing their oil based on the time since last changed instead of by mileage?

WARNING: Used engine oil has been determined to be harmful. Rubber gloves should be worn to protect the skin. If used engine oil gets on the skin, wash thoroughly with soap and water.

16. SLIDES 16-33 ENGINE OIL CHANGE SHOW

DISCUSSION: Ask students to find out if their vehicles have a service monitor and at what intervals that light comes on. Have them write down procedure to reset light

ON-VEHICLE ASE EDUCATION TASK Perform oil and filter change (P-1)

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	<p><u>SAFETY:</u> Make sure students are aware that hot oil causes burns and is carcinogenic, and use of latex gloves is highly recommended</p>
	<p><u>SEARCH INTERNET:</u> Have students use Internet to research difference between high mileage & synthetic oils & what makes high mileage oil different from regular oil. Answer question "Are high mileage oils worth the extra cost?" & "Do high mileage oils really work?" and report their findings at the beginning of the next class in a discussion</p>