Automotive Technology 5th Edition
Chapter 29 Engine Cleaning & Crack Detection
Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This Automotive Technology 5th text provides complete coverage of automotive components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked Questions, Real World Fixes, Videos, Animations, and NATEF Task Sheet references.
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: 1. Explain the mechanical cleaning procedure of engines. 2. Discuss chemical cleaners. 3. Compare spray and steam washing, thermal cleaning, tank and vapor cleaning, and ultrasonic and vibratory cleaning. 4. Explain crack detection and crack repair.
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 5th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 29: ATE5 Chapter Images

ICONS	C29 Clean & Crack Repair
	**1. SLIDE 1 CH29 ENGINE CLEANING & CRACK DETECTION**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **ENGINE CLEANING & CRACK REPAIR** **Videos**
	**2. SLIDE 2 EXPLAIN Figure 29-1** An air-powered grinder attached to a bristle pad being used to clean the gasket surface of a cylinder head. This type of cleaning pad should not be used on the engine block where the grit could get into the engine oil and cause harm when the engine is started and run after the repair.
	**DISCUSSION: Ask students why air powered tools are preferred over electrical tools. (Answer: Air has more energy, so air powered tools weigh less and deliver more power.)**
	**3. SLIDE 3 EXPLAIN Figure 29-2** abrasive disc commonly called by its trade can be engine damaging name, Scotch Brite™ pad.
	4. SLIDE 4 EXPLAIN Figure 29-3 Using baking soda is the recommended way to clean engine parts because any soda that is left on or in the part is dissolved in oil or water, unlike either sand or glass beads, which can be engine damaging.
	**DEMONSTRATION: Show students all of the different types of engine cleaning chemicals and equipment that the shop has & demonstrate how to use them.**
	**DISCUSSION: Have students discuss different types of metals used in an engine. Some examples are steel, aluminum, copper, brass, & magnesium.**
	**DEMONSTRATION: Show students different types of sanding brushes and explain for which jobs each one is used.**

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	5. **SLIDE 5 EXPLAIN Figure 29-4** Small engine parts can be blasted clean in a sealed cabinet
	**DISCUSSION: Have students discuss what would happen if the wrong cleaning method was used on engine part. Would damage occur, or would Cleaning take longer?**
	**Iron blocks rust quickly. If you are not going to assemble them immediately after cleaning, apply a light coat of oil to keep the gasket surfaces from rusting.**
	**DISCUSSION: Ask students whether they know the short term and long-term risks involved with using chemical cleaners.**
	**DEMONSTRATION: Show students how to use a chemical cleaner in shop**
	**HANDS-ON TASK: Assign dirty engine parts to students & have them clean parts with chemical cleaner.**
	**DISCUSSION: Fumes are dangerous when working with chemicals. Ask students what kind of breathing equipment is needed (if any) when working with cleaning chemicals. You can refer to MSDS sheet for more information on safety for particular chemical.**
	**DEMONSTRATION: Show students how to properly clean a cylinder head using solvents. Follow all safety precautions and make sure the students understand the reasons for each.**
	**Many different cleaning processes have same end result, clean engine. However, local laws & environmental friendliness of shop will determine what kind of process will be used.**
	**HANDS-ON TASK: Have students properly clean a cylinder head using solvents. Cylinder heads can be found on old engines and spare ones can be found in salvage yards.**

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	6. **SLIDE 6 EXPLAIN Figure 29-5** pressure jet washer is similar to a large industrial sized dishwasher. Each part is then rinsed with water to remove chemicals or debris that may remain there while it is still in the tank. 7. **SLIDE 7 EXPLAIN Figure 29-6** microbial cleaning tank uses microbes to clean grease and oil from parts. 8. **SLIDE 8 EXPLAIN Figure 29-7 (a)** pyrolytic (high-temperature) oven cleans by baking the engine parts. After the parts have been cleaned, they are then placed into an airless blaster. This unit uses a paddle to scoop stainless steel shot from a reservoir and forces it against the engine part. The parts must be free of grease and oil to function correctly. 9. **SLIDE 9 EXPLAIN Figure 29-7 (b)** This cleaned engine block has been baked and shot blasted 10. **SLIDE 10 EXPLAIN Figure 29-8** ultrasonic cleaner being used to clean fuel injectors
	11. **SLIDE 11 EXPLAIN Figure 29-9** top deck surface of a block is being tested using magnetic crack inspection equipment. 12. **SLIDE 12 EXPLAIN Figure 29-10** If the lines of force are interrupted by a break (crack) in the casting, then two magnetic fields are created and the powder will lodge in the crack.
	13. **SLIDE 13 EXPLAIN Figure 29-11** This crack in a vintage Ford 289, V-8 block was likely caused by the technician using excessive force trying to remove the plug from the block. The technician should have used heat and wax, not only to make the job easier, but also to prevent damaging the block. 14. **SLIDE 14 EXPLAIN Figure 29-12** To make sure that the mark observed in the cylinder wall was a crack, compressed air was forced into the water jacket while soapy water was sprayed on the cylinder wall. Bubbles confirmed that the mark was indeed a crack. 15. **SLIDE 15 EXPLAIN Figure 29-13** cylinder head is under water and being pressure tested using compressed air. Note that the air bubbles indicate a crack.
	**DISCUSSION: discuss what happens when a head is milled or machined in order to correct warpage. Does this change compression of the engine? (ANS: Yes, it does. However, in most cases it is such a small change that it will not affect engine)**

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	**DEMONSTRATION: Show students how to check for cracks in engine components using compression gauge & cylinder leak-down test. Also show them that a few drops of oil will increase compression.**
	**HANDS-ON TASK: Have students use compression tester and cylinder leak-down tool to verify that an engine is holding compression.**
	**Welding is another way to fix cracks in outside of engine block**
	**DISCUSSION: Ask students how strong weld should be. The weld should be stronger than metal that it bonds to. A weld that fails is considered to be of poor quality and workmanship.**
	**DISCUSSION: Ask students whether it is possible to repair a cracked cylinder head using an oil or coolant additive.**
	16. **SLIDE 16 EXPLAIN Figure 29-14 (a)** Before welding, the crack is ground out using a carbide grinder. 17. **SLIDE 17 EXPLAIN Figure 29-14 (b)** technician is practicing using the special cast-iron welding torch before welding the cracked cylinder head. 18. **SLIDE 18 EXPLAIN Figure 29-14 (c)** This is the finished welded crack before final machining. 19. **SLIDE 19 EXPLAIN Figure 29-14 (d)** Note the finished cylinder head after the crack has been repaired using welding.
	**DISCUSSION: Ask students whether they can tell difference between damaged head gasket & cracked head. Head gasket more likely to fail than cylinder head. Only way to know for sure is to remove head and have it inspected.**
	20. **SLIDE 20 EXPLAIN Figure 29-15** Reaming a hole for a tapered plug 21. **SLIDE 21 EXPLAIN Figure 29-16** Tapping a tapered hole for a plug 22. **SLIDE 22 EXPLAIN Figure 29-17** Screwing a tapered plug in hole 23. **SLIDE 23 EXPLAIN Figure 29-18** Cutting the plug with a hacksaw

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	24. **SLIDE 24 EXPLAIN Figure 29-19** Interlocking plugs 25. **SLIDE 25 EXPLAIN Figure 29-20 (a)** hole is drilled and tapped for the plugs 26. **SLIDE 26 EXPLAIN Figure 29-20 (b)** plugs installed 27. **SLIDE 27 EXPLAIN Figure 29-20 (c)** After final machining, the cylinder head can be Returned to useful service
	**DISCUSSION: Have students discuss reasons why a cylinder head would crack. ANSWER: overheating, lack of proper maintenance, & over revving engine.**
	**ON-VEHICLE NATEF TASK Inspect for cracks in cylinder head (P-2) Check for cracks in engine block (P-2) Page 83**
	**DISCUSSION: Ask students to discuss their preferred method of repairing a crack and have them explain their reasons.**
	**SEARCH INTERNET: There are many different products that are supposed to clean engine parts. Have students search Internet for at least 5 products that clean engine parts and read the reviews from customers who purchased them. Then have students see whether class carries any of products and whether they would buy the products if they had a choice.**
	**HOMEWORK** **Crossword Puzzle (Microsoft Word) (PDF** **Word Search Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF)**

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