Automotive Technology 5th Edition
Chapter 31 VALVE & SEAT SERVICE
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. Discuss intake and exhaust valves. 2. Describe valve seats and the valve fault diagnosis procedure. 3. Explain valve springs, and valve keepers and rotators. 4. Discuss the procedure for valve reconditioning, valve face grinding, and valve seat reconditioning. 5. Discuss valve guide pilots, valve seat grinding stones, and valve seat cutters. 6. Explain valve seat testing and valve seat replacement. 7. Discuss valve stem height and installed height. 8. Describe the procedure of installing the valves and explain valve stem seals.
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 31: ATE5 Chapter Images

ICONS	C31 Valve/Seat Service
	**1. SLIDE 1 CH31 VALVE & SEAT SERVICE**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **VALVE & SEAT SERVICE** **Videos**
	**2. SLIDE 2 EXPLAIN Figure 31-1** Identification of parts of a valve. **3. SLIDE 3 EXPLAIN Figure 31-2** Typical valve spring and related components. Dual valve springs are used to reduce valve train vibrations and a spring seat is used to protect aluminum heads. **4. SLIDE 4 EXPLAIN Figure 31-3** intake valve is larger than the exhaust valve because the intake charge is being drawn into the combustion chamber at a low speed due to differences in pressure between atmospheric pressure and the pressure (vacuum) inside the cylinder. The exhaust is actually pushed out by the piston and, therefore, the size of the valve does not need to be as large, leaving more room in the cylinder head for the larger intake valve.
	**HANDS-ON TASK: Give students an intake valve and have them identify its various parts**
	**DEMONSTRATION: Show some examples of defective valves such as those that are broken, burnt, and cracked.**
	**DEMONSTRATION: Show differences between exhaust and intake valves**
	**5. SLIDE 5 EXPLAIN Figure 31-4** Inertia welded valve stem and head before machining.

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	6. **SLIDE 6 EXPLAIN Figure 31-5** A sodium-filled valve uses a hollow stem, which is partially filled with metallic sodium (a liquid when hot) to conduct heat away from the head of the valve.
	**HANDS-ON TASK: Pass around an alloy valve and a Stellite® valve together with magnet and ask the students to identify which valve is the alloy valve and which is the Stellite® valve.**
	**Sodium Filled Valve 1 (View) (Download)**
	7. **SLIDE 7 EXPLAIN Figure 31-6** Integral valve seats are machined directly into the cast-iron cylinder head and are induction hardened to prevent wear. 8. **SLIDE 8 EXPLAIN Figure 31-7** Insert valve seats are a separate part that is interference fitted to a counterbore in the cylinder head.
	**DEMONSTRATION: Show the students examples of heads with integral seats and insert seats.**
	9. **SLIDE 9 EXPLAIN Figure 31-8** Typical intake valve seat wear. 10. **SLIDE 10 EXPLAIN Figure 31-9** Carbon deposits on the intake valve are often caused by oil getting past the valve stems or fuel deposits. 11. **SLIDE 11 EXPLAIN Figure 31-10** Excessive wear of the valve stem or guide can cause the valve to seat in a cocked position. 12. **SLIDE 12 EXPLAIN Figure 31-11** Valve face guttering caused by thermal shock.
	**DEMONSTRATION: Show the students examples of various valves with defects and explain the causes.**
	**HANDS-ON TASK: Have the students use service information to determine whether the OEM has recommended procedure for removing carbon deposits from valves without removing the cylinder heads from engine.**

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	13. **SLIDE 13 EXPLAIN Figure 31-12** Note broken piston caused by a valve breaking from the stem.
	**DISCUSSION: Ask the students what the best method would be of determining whether a valve is leaking. (Answer: cylinder leakage test)**
	**DEMONSTRATION: Show the students an example of a valve failure caused by thermal shock.**
	**DEMONSTRATION: On an engine with adjustable valves show students how to adjust valve lash.**
	**HANDS-ON TASK: On an engine with adjustable valves have students adjust valve lash to meet specifications.**
	14. **SLIDE 14 EXPLAIN Figure 31-13** A retainer and two split keepers hold the spring in place on the valve. A spring seat is used on aluminum heads. Otherwise, the spring seat is a machined area in the head. 15. **SLIDE 15 EXPLAIN Figure 31-14** Valve spring types (*left to right*): coil spring with equally spaced coils; spring with damper inside spring coil; closely spaced spring with a damper; taper wound coil spring. 16. **SLIDE 16 EXPLAIN Figure 31-15** Valve springs maintain tension in the valve train when the valve is open to prevent valve float, but must not exert so much tension that the cam lobes and lifters begin to wear. 17. **SLIDE 17 EXPLAIN Figure 31-16** All valve springs should be checked for squareness by using a square on a flat surface and rotating the spring while checking. The spring should be replaced if more than 1/16 in. (1.6 mm) is measured between the top of the spring and the square. 18. **SLIDE 18 EXPLAIN Figure 31-17** One popular type of valve spring tester used to measure the compressed force of valve springs. Specifications usually include (1) free height (height without being compressed), (2) pressure at installed height with the valve closed, and (3) pressure with the valve open to the height specified.

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	**DEMONSTRATION: Show students how to test valve spring tension and height using a valve spring tester.**
	**HANDS-ON TASK: Have the students check various valve springs for squareness and determine whether they meet specifications.**
	**ON-VEHICLE NATEF TASK Inspect valve springs for squareness and free height; determine necessary action. (P-3) Page 86**
	**HANDS-ON TASK: With valve springs and a valve spring tester, have students test springs for tension & height and determine whether they meet specifications.**
	19. **SLIDE 19 EXPLAIN Figure 31-18** Valve keepers (locks) are tapered so they wedge into a tapered hole in the retainer. 20. **SLIDE 20 EXPLAIN Figure 31-19** Notice that there is no gap between 2 keepers (ends butted together). As a result, valve is free to rotate because retainer applies a force, holding keepers in place but not tight against stem of valve. Most engines, however, do not use free rotators and, therefore, have a gap between the keepers. 21. **SLIDE 21 EXPLAIN Figure 31-20** Type of valve rotator operation. Ball-type operation is on the left and spring-type operation is on the right.
	**DISCUSSION: Ask students why rotating valves is beneficial.**
	**DEMONSTRATION: Show students some examples of valve rotators**
	22. **SLIDE 22 EXPLAIN Figure 31-21** Resurfacing face of a valve. Both the valve and the grinder stone or disc are turned to ensure a smooth surface finish on face of valve. 23. **SLIDE 23 EXPLAIN Figure 31-22** Never use a valve that has been ground to a sharp edge. This weakens the valve and increases the chance of valve face burning.

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	24. **SLIDE 24 EXPLAIN** After grinding 45-degree face angle, additional airflow into engine can be accomplished by grinding a transition between face angle and the stem, and by angling or rounding the transition between the margin and top of the valve. 25. **SLIDE 25 EXPLAIN Figure 31-24** Grinding 45-degree angle establishes valve seat in combustion chamber. 26. **SLIDE 26 EXPLAIN Figure 31-25** Some vehicle manufacturers recommend that valve face be resurfaced at a 44-degree angle & valve seat at a 45-degree angle. This 1-degree difference is known as interference angle.
	**DISCUSSION: Ask the students why an interference angle is often used between valve face and valve seat.**
	27. **SLIDE 27 EXPLAIN Figure 31-26** seat must contact evenly around valve face. For good service life, both margin & overhang should be at least 1/32 in (0.8 mm). 28. **SLIDE 28 EXPLAIN Figure 31-27** Grinding a 60-degree angle removes metal from the bottom to raise and narrow the seat. 29. **SLIDE 29 EXPLAIN Figure 31-28** Grinding a 30-degree angle removes metal from the top to lower and narrow the seat. 30. **SLIDE 30 EXPLAIN Figure 31-29** typical three-angle valve job using 30-, 45-, and 60-degree stones or cutters.
	**OPTIONAL DEMONSTRATION: Using a valve grinder, show how to grind the valves ensuring that they meet OEM specifications.**
	**OPTIONAL HANDS-ON TASK: With a valve, and proper tools and equipment have students grind valve according to OEM specifications.**
	**HANDS-ON TASK: Have students look up valve face and valve seat angles in service information.**
	31. **SLIDE 31 EXPLAIN Figure 31-30** valve guide pilot being used to support a valve seat cutter.

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	**DEMONSTRATION: Show difference between tapered pilot and expandable pilot**
	32. **SLIDE 32 EXPLAIN Figure 31-31** Checking valve seat concentricity using a dial indicator. 33. **SLIDE 33 EXPLAIN Figure 31-32** Typical dial indicator type of micrometer for measuring valve seat concentricity. 34. **SLIDE 34 EXPLAIN Figure 31-33** After the valve face and the valve seat are ground (reconditioned), lapping compound is used to smooth the contact area between the two mating surfaces. Notice that the contact is toward the top of the face. For maximum life, the contact should be in the middle of the face.
	**DEMONSTRATION: Show differences between 30-degree, 45-degree, & 60-degree stones**
	**OPTIONAL DEMONSTRATION: Show how to dress the grinding stone.**
	**OPTIONAL HANDS-ON TASK: Have the students dress grinding stone.**
	**OPTIONAL DEMONSTRATION: Show proper procedure to grind the valve seat.**
	**OPTIONAL HANDS-ON TASK: Have the students grind 1 or 2 valve seats**
	**OPTIONAL ON-VEHICLE NATEF TASK Inspect Valves and Valve Seats; Determine necessary action. (P-3) Page 91**
	35. **SLIDE 35 EXPLAIN Figure 31-34** A cutter is used to remove metal and form the valve seat angles.

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	**DEMONSTRATION: how to ensure that valve seat is concentric using dial indicator.**
	**DEMONSTRATION: Show students how to use a valve seat cutter to recondition valve seat.**
	**HANDS-ON TASK: Have students cut a valve seat using a valve seat cutter.**
	36. **SLIDE 36 EXPLAIN Figure 31-35** All aluminum cylinder heads use valve seat inserts. If an integral valve seat (cast-iron head) is worn, it can be replaced with a replacement valve seat by machining a pocket (counterbore) to make a place for the new insert seat 37. **SLIDE 37 EXPLAIN Figure 31-36** Insert valve seats are rings of metal driven into the head
	
	**HANDS-ON TASK: Have students remove a valve seat insert without damaging cylinder head.**
	38. **SLIDE 38 EXPLAIN Figure 31-37 V**alve stem height is measured from the spring seat to the tip of the valve after the valve seat and valve face have been refinished. If the valve stem height is too high, up to 0.02 in. can be ground from the tips of most valves.
	39. **SLIDE 39 EXPLAIN Figure 31-38** Installed height is determined by measuring the distance from the spring seat to the bottom of the valve spring retainer. 40. **SLIDE 40 EXPLAIN Figure 31-39** Valve spring inserts are used to restore proper installed height.
	**DEMONSTRATION: Show the students how to correctly measure installed valve spring height.**
	**HANDS-ON TASK: Have the students measure installed valve stem height and determine whether it meets specifications.**

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 	**ON-VEHICLE NATEF TASK Check valve spring assembled height and valve stem height; determine necessary action (P-3) Page 92**
	41. **SLIDE 41 EXPLAIN Figure 31-40** Engine vacuum can draw oil past the valve guides and into the combustion chamber. The use of valve stem seals limits the amount of oil that is drawn into the engine. If the seals are defective, excessive blue (oil) smoke is most often observed during engine start-up. 42. **SLIDE 42 EXPLAIN Figure 31-41** Engine oil can also be drawn past the exhaust valve guide because of a small vacuum created by the flow of exhaust gases. Any oil drawn past the guide would simply be forced out through the exhaust system and not enter the engine. Some engine manufacturers do not use valve stem seals on the exhaust valves.
	**DISCUSSION: Ask the students what function of the valve stem seal is.**
	**Leaking valve stem seals usually cause a vehicle to exhibit excessive blue smoke Immediately after startup due to the oil leaking down the valve stems while the engine is off.**
	43. **SLIDE 43 EXPLAIN Figure 31-42** Umbrella seals install over the valve stems and cover the guide.
	**DEMONSTRATION: Show difference between an umbrella seal & O-ring type seal.**
	**HANDS-ON TASK: Have the students search service information on a given vehicle for the correct procedure for replacing valve stem seals with the cylinder head on the engine.**
	**Valve Seals (View) (Download)**
	**DISCUSSION: Ask the students what advantages are of using Viton valve stem seals versus Nitrile.**

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	**DEMONSTRATION: Show the students examples of Nitrile, Viton, & polyacrylate valve stem seals.**
	**44. SLIDE 44 EXPLAIN Figure 31-43** A small square cut O-ring is installed under the retainer in a groove in the valve under the groove(s) used for keepers (locks). **45. SLIDE 45 EXPLAIN Figure 31-44** Positive valve stem seals are the most effective type because they remain stationary on the valve guide and wipe the oil from the stem as the valve moves up and down. **46. SLIDE 46 EXPLAIN Figure 31-45** The positive valve stem seal is installed on the valve guide.
	**47. SLIDE 47 EXPLAIN Figure 31-46** An assortment of shapes, colors, and materials of positive valve stem seals. **48. SLIDE 48 EXPLAIN Figure 31-47** metal valve spring seat must be used between the valve spring and Aluminium cylinder head **49. SLIDE 49 EXPLAIN Figure 31-48** Assembling a race engine using heavy-duty valve spring compressor.
	**DEMONSTRATION: Show the students how to install the valve, stem seal, valve spring, and valve keepers on a cylinder head using correct tools.**
	**HANDS-ON TASK: Have the students practice installing valve seals on a cylinder head using the correct service procedure and tools.**
	**ON-VEHICLE NATEF TASK Replace valve stem seals; inspect components; determine necessary action (P-3) Page 90**
	**50. SLIDES 50-64 EXPLAIN OPTIONAL INSTALLING A NEW VALVE SEAT**
	**SEARCH INTERNET: Have students search Internet and find examples of valve failures. Have the students search Internet to find equipment used to grind valves**
	**HOMEWORK** **Crossword Puzzle (Microsoft Word) (PDF)** **Word Search Puzzle (Microsoft Word) (PDF)**

Crossword

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