ATE5 Chapter 113 FRONT SUSPENSIONS & SERVICE

Opening Your Class

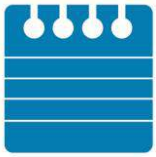
KEY ELEMENT	EXAMPLES
Introduce Content	This course or class provides complete coverage of the components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech Tips, Frequently Asked 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 learning objectives to students as listed below: 1. Describe different front suspension types. 2. Describe short and long arm suspension systems. 3. Explain how to perform a road test, a dry park test, and a visual inspection. 4. Discuss the diagnosis of ball joints. 5. Discuss the diagnosis of shock absorbers and struts. 6. Explain the diagnosis of stabilizer bar link and strut rod bushings. 7. Explain the diagnosis and replacement of front coil springs, steering knuckles, torsion bars, and control arm bushings.
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 113: ATE5 Chapter Images

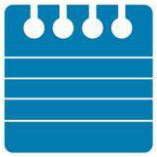
ICONS	Chapter 113 Front Suspension
	**1. SLIDE 1 CH113 FRONT SUSPENSIONS & SERVICE**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED**
	**Videos**
	**Short/Long Arm Suspension (View) (Download)** **Strut Suspension (View) (Download)** **Spring and Shock Absorber (View) (Download)** **Suspension Components (View) (Download)**
	**2. SLIDE 2 EXPLAIN Figure 113-1** Most early vehicles used single straight axles. **3. SLIDE 3 EXPLAIN Figure 113-2** Typical kingpin used with a solid axle.
	**DISCUSSION: Ask the students to discuss why an automobile would use a solid-axle front suspension.**
	**DEMONSTRATION: Show the students examples of kingpins used with a solid axle.**
	**4. SLIDE 4 EXPLAIN Figure 113-3** Twin I-beam front suspension. Rubber bushings are used to support the I-beams to the frame and help isolate road noise **5. SLIDE 5 EXPLAIN Figure 113-4** rubber radius rod bushing absorbs road shocks and helps isolate road noise **6. SLIDE 6 EXPLAIN Figure 113-5** The upper control arm is shorter than the lower control arm on a short/long-arm (SLA) suspension. **7. SLIDE 7 EXPLAIN Figure 113-6** A typical SLA front suspension using coil springs. **8. SLIDE 8 EXPLAIN Figure 113-7** SLA-type suspension with the coil spring placed on top of the upper control arm. **9. SLIDE 9 EXPLAIN Figure 113-8** torsion bar SLA suspension can use either the lower or upper control arm.
	

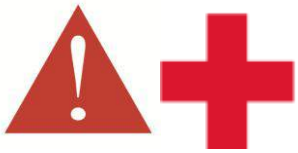
ICONS	Chapter 113 Front Suspension
	**DISCUSSION: Ask the students to discuss what causes radius rod bushing to deteriorate.**
	10. **SLIDE 10 EXPLAIN Figure 113-9** A typical MacPherson strut showing all of the components of the assembly. A strut includes the shock and the spring in one structural assembly. 11. **SLIDE 11 EXPLAIN Figure 113-10** The modified strut front suspension is similar to a MacPherson strut suspension except that the coil spring is seated on the lower control arm and is not part of the strut assembly. 12. **SLIDE 12 EXPLAIN Figure 113-11** Multilink front suspension design varies depending on the vehicle manufacturer.
	**HANDS-ON TASK: Have students label parts of MacPherson strut suspension using sticky notes.**
	**DEMONSTRATION: Show bearing from an upper strut mount**
	**DISCUSSION: Ask the students to discuss what customer complaints will be if the bearing in the upper strut mount goes bad**
	**DISCUSSION: Ask the students to discuss and describe noises made by defective wheel bearings and defective ball joints.**
	**DISCUSSION: Ask the students to discuss why it is recommended to have owner of the vehicle drive the vehicle when conducting a ROAD TEST DIAGNOSIS**
	**ON-VEHICLE NATEF TASK: Identify and interpret suspension concerns; determine necessary action. Page 341**
	**ON-VEHICLE NATEF TASK: Diagnose SLA and strut suspension concerns; determine necessary action. Page 342**

ICONS	Chapter 113 Front Suspension
	**13. SLIDE 13 EXPLAIN Figure 113-12** A leaking strut. Either a cartridge insert or the entire strut will require replacement. If a light film of oil is seen, this is to be considered normal. If oil is dripping, then this means that the rod seal has failed. **14. SLIDE 14 EXPLAIN Figure 113-13** This front coil spring looks as if it has been heated with a torch in an attempt to lower the ride height of the vehicle. Both front springs will require replacement.
	**DISCUSSION: Ask the students to discuss why it is recommended that both front springs in Figure 113–13 be replaced**
	**15. SLIDE 15 EXPLAIN Figure 113-14** It is easy to see that this worn control arm bushing needed to be replaced. The new bushing is shown next to the original.
	**DEMONSTRATION: Show the students examples of control arm bushings FIGURE 113-14**
	**DEMONSTRATION: Show examples of the tools needed for replacing and installing ball joints.**
	**It's a good idea to include ball joint removal tools, such as a ball joint removal socket or ball joint service kit, in your toolkit.**
	**16. SLIDE 16 EXPLAIN Figure 113-15** Grease fitting projecting down from the surrounding area of a ball joint. The ball joint should be replaced when the area around the grease fitting is flush or recessed. **17. SLIDE 17 EXPLAIN Figure 113-16** Indicator ball joints checked with weight of vehicle on ground. **18. SLIDE 18 EXPLAIN Figure 113-17** dial indicator used to measure the suspension component movement **19. SLIDE 19 EXPLAIN Figure 113-18** If the spring is attached to the lower control arm as in this SLA suspension, the jack should be placed under the lower control arm as shown. A dial indicator should be used to measure the amount of freeplay in the ball joints. Be sure that the looseness being measured is not due to normal wheel bearing endplay.

ICONS	Chapter 113 Front Suspension
	20. SLIDE 20 EXPLAIN Figure 113-19 jack should be placed under the lower control arm of this modified MacPherson-type suspension. **21. SLIDE 21 EXPLAIN Figure 113-20** A special tool or a block of wood should be inserted between the frame and the upper control arm before lifting the vehicle off the ground. This tool stops the force of the spring against the upper ball joint so that a true test can be performed on the condition of the ball joint.
	**DEMONSTRATION: Show examples of new & worn ball joints. Show how to use a dial indicator with locking pliers mount to measure suspension component movement:** **FIGURES 113-18, 19**
	**HANDS-ON TASK: Have students measure suspension component movement using a dial indicator**
	**22. SLIDE 22 EXPLAIN Figure 113-21** jacking point is under the frame for checking the play of a lower ball joint used with a MacPherson strut.
	**23. SLIDE 23 EXPLAIN Figure 113-22** This worn and rusty ball joint was found by moving the wheel and looking for movement in the joint. **24. SLIDE 24 EXPLAIN Figure 113-23** Taper breaker tool being used to separate the upper ball joint from the steering knuckle. This is especially important for vehicles equipped with aluminum alloy control arms. **25. SLIDE 25 EXPLAIN Figure 113-24** A pinch bolt attaches the steering knuckle to the ball joint. Remove the pinch bolt by turning the nut, not the bolt. **26. SLIDE 26 EXPLAIN Figure 113-25** If the pinch bolt is overtightened, the steering knuckle can be deformed. A deformed knuckle can cause the pinch bolt to break and the ball joint could become separated from the steering knuckle. **27. SLIDE 27 EXPLAIN Figure 113-26** By drilling into the rivet, the holding force is released.
	**DEMONSTRATION: Show the students Examples of taper breaker tools**

ICONS	Chapter 113 Front Suspension
	**DEMONSTRATION: Show the students how to use a torque wrench to torque fasteners to factory specifications.**
	**HANDS-ON TASK: Have students torque lug nuts to factory specifications by using torque wrenches.**
	28. **SLIDE 28 EXPLAIN Figure 113-27** The head of the rivet can be removed by using a larger-diameter drill bit as shown. 29. **SLIDE 29 EXPLAIN Figure 113-28** Using a punch and a hammer to remove the rivet after drilling down through the center and removing the head of the rivet. 30. **SLIDE 30 EXPLAIN Figure 113-29** Press-in ball joints are best removed using a large C-clamp press, as shown.
	**DEMONSTRATION: Show the students how to remove a press-in ball joint by using a C-clamp press: SEE FIGURE 113-29**
	**ON-VEHICLE NATEF TASK: Front suspension inspection and component replacement. Page 343**
	31. **SLIDE 31 EXPLAIN Figure 113-30** Typical kingpin assembly. 32. **SLIDE 32 EXPLAIN Figure 113-31** Driving a kingpin out with a hammer. 33. **SLIDE 33 EXPLAIN Figure 113-32** galled kingpin bushing must be replaced.
	**Some kingpins can be removed only by removing one knuckle cap (usually lower one), and using a grease gun. Pumping grease into upper end of kingpin bore will force kingpin out bottom.**
	**DISCUSSION: Discuss cuppy tire wear and possible causes for it. Have the students discuss how the condition of shocks and shock mounts can indicate how the vehicle is driven.**
	**ON-VEHICLE NATEF TASK: Inspect, remove, and replace shock absorbers. Page 347**

ICONS	Chapter 113 Front Suspension
	**New shocks are stored flat. Before installing new shocks, compress & extend them several times.**
	**34. SLIDE 34 EXPLAIN FIGURE 113-33** Most shock absorbers used on front suspension can be removed from underneath vehicle after removing attaching bolts or nuts **35. SLIDE 35 EXPLAIN Figure 113-34** Removing the upper strut mounting bolts. Some experts recommend leaving one of the upper strut mount nuts loosely attached to prevent the strut from falling when the lower attaching bolts are removed. **36. SLIDE 36 EXPLAIN Figure 113-35** A brake hydraulic hose is often attached to the strut housing. Sometimes all that is required to separate the line from the strut is to remove a spring clip. **37. SLIDE 37 EXPLAIN Figure 113-36** Use a strut spring compressor fixture to compress the spring on a MacPherson strut before removing strut retaining nut. **38. SLIDE 38 EXPLAIN Figure 113-37** Removing the strut rod nut. The strut shaft is being helped with one wrench while the nut is being removed with the other wrench. Notice that spring is compressed before nut is removed. **39. SLIDE 39 EXPLAIN Figure 113-38** Typical MacPherson strut showing the various components.
	**40. SLIDE 40 EXPLAIN Figure 113-39** After installing the replacement strut cartridge, reinstall the spring and upper bearing assembly after compressing spring. Notice that strut is being held in a strut spring compressor fixture**.** **41. SLIDE 41 EXPLAIN Figure 113-40** Before final assembly, make sure the marks you made are aligned. Some struts are manufactured with marks to ensure proper reassembly. **42. SLIDE 42 EXPLAIN Figure 113-41** strut on a modified MacPherson strut assembly can be replaced by removing the upper mounting nuts
	**DEMONSTRATION: Show examples of strut spring compressor fixtures and manual spring compressors.**

ICONS	Chapter 113 Front Suspension
	**ON-VEHICLE NATEF TASK: Remove, inspect, and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount. Page 346**
	**43. SLIDE 43 EXPLAIN Figure 113-42** Stabilizer bar links should be replaced as a pair.
	**DISCUSSION: Ask the students to discuss why not all manufacturers recommend, as GM does, replacing stabilizer links in pairs and purchasing 2 kits so you can replace links on both left and right sides at same time: FIGURE 113-42**
	**44. SLIDE 44 EXPLAIN Figure 113-43** A strut rod as viewed from the front of the vehicle. **45. SLIDE 45 EXPLAIN Figure 113-44** Typical strut rod bushing with rubber on both sides of the frame to help isolate noise, vibration, and harshness from being transferred to the passengers.
	**DEMONSTRATION: Show the students how to correctly remove strut rod nuts by using two wrenches**
	**ON-VEHICLE NATEF TASK: Remove, inspect and install strut rods and bushings. Remove, inspect, and install stabilizer bar bushings, brackets, and links. Page 344**
	**46. SLIDE 46 EXPLAIN Figure 113-45** if front coil springs are sagging, the resulting angle of the lower control arm causes the wheels to move from side to side as the suspension moves up and down. Note difference between the distance at "A" with good springs and the distance at "B" with sagging springs. **47. SLIDE 47 EXPLAIN Figure 113-46** Spring compressing tool in place to hold the spring as the ball joint is separated. Note that the stabilizer bar links have been removed to allow the lower control arm to move downward enough to remove the coil spring.
	**SAFETY Always pay attention to spring when it is being removed.**

ICONS	Chapter 113 Front Suspension
	48. **SLIDE 48 EXPLAIN Figure 113-47** The steering knuckle has been disconnected from the lower ball joint. The lower control arm and coil spring are being held up by a floor jack. 49. **SLIDE 49 EXPLAIN Figure 113-48** A rubber mallet is being used to support the upper control arm as the lower control is being lowered using a floor jack. After all of the tension has been removed from the coil spring it can be removed and the replacement installed. 50. **SLIDE 50 EXPLAIN Figure 113-49** Spring insulators install between the spring seat and the coil spring to reduce noise. 51. **SLIDE 51 EXPLAIN Figure 113-50** The holes in the lower arm are not only used to allow water to drain from the spring seat, but also are used as a gauge to show the service technician that the coil spring is correctly seated.
	**DEMONSTRATION: Show examples of steering knuckles**
	52. **SLIDE 52 EXPLAIN Figure 113-51** By rotating the adjusting bolt, the vehicle can be raised or lowered. 53. **SLIDE 53 EXPLAIN Figure 113-52** adapter and a press or large clamp are used to remove the old bushing from the control arm and to install a new bushing.
	**DEMONSTRATION: Show the students how to use a torsion bar unloading tool: FIGURE 113-51**
	**ON-VEHICLE NATEF TASK: Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts. Page 345**
	54. **SLIDES 54-73 OPTIONAL EXPLAIN STRUT REPLACEMENT**
	**SEARCH INTERNET: Have students use Internet for spring materials other than spring steel. Have students share their findings during the next class.**

ICONS	Chapter 113 Front Suspension
	Crossword Puzzle (Microsoft Word) (PDF) Word Search Puzzle (Microsoft Word) (PDF)