Automotive Steering, Suspension, & Alignment 7E
Chapter 7 FRONT SUSPENSIONS & SERVICE
Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of **Automotive Steering and Suspension Systems with Wheel Alignment and Drive Axles.** It correlates material to task lists specified by ASE and NATEF
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 on NEXT SLIDE. 1. Describe different front suspension types. 2. Diagnose short- and long-arm suspension systems 3. Explain how to perform a road test, a dry park test, a visual inspection, and a bounce test. 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 bushings **This chapter will help prepare for ASE Suspension and Steering (A4) certification test content area "B" (Suspension System Diagnosis and 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 Automotive Steering, Suspension, & Alignment 7th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com
LINK CHP 7: Chapter Images

ICONS	Chapter 7 Front Suspension & Service
	**1. SLIDE 1 CH7 FRONT SUSPENSIONS & SERVICE**
	**Check for VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED**
	**Suspension System (55 Links)**
	**At the beginning of this class, you can download the crossword puzzle & Word Search from the links below to familiarize your class with the terms in this chapter & then discuss them**
	**Crossword Puzzle (Microsoft Word) (PDF)**
	Word Search Puzzle (Microsoft Word) (PDF)
	**Strut Suspension (View) (Download)** **Strut Assembly, Disassemble (View) (Download)** **Spring and Shock Absorber (View) (Download)** **Suspension Components (View) (Download)** **Upper Control Arm Remove and Replace (View) (Download)**
	**2. SLIDE 2 EXPLAIN Figure 7-1** Most early vehicles used single straight axles. **3. SLIDE 3 EXPLAIN Figure 7-2** 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 7-3** 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 7–4** The rubber radius rod bushing absorbs road shocks and helps isolate road noise **6. SLIDE 6 EXPLAIN Figure 7-5** upper control arm is shorter than lower control arm on short/long-arm (SLA)

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	7. **SLIDE 7 EXPLAIN Figure 7-6** typical SLA front suspension using coil springs. 8. **SLIDE 8 EXPLAIN Figure 7-7** SLA-type suspension with coil spring placed on top of upper control arm. **Short/Long Arm Suspension (View) (Download)**
	9. **SLIDE 9 EXPLAIN Figure 7-8** torsion bar SLA suspension can use either the lower or upper control arm. 10. **SLIDE 10 EXPLAIN Figure 7-9** SLA-type suspension that uses a coil-over-shock assembly
QUESTION	**DISCUSSION: Ask the students to discuss what causes radius rod bushing to deteriorate.**
	Strut Suspension (View) (Download) **Strut Assembly, Disassemble (View) (Download)**
	11. **SLIDE 11 EXPLAIN Figure 7-10** A typical MacPherson strut showing all of the components of the assembly. A strut includes the shock and the spring in one structural assembly. 12. **SLIDE 12 EXPLAIN Figure 7-11** 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. 13. **SLIDE 13 EXPLAIN FIGURE 7.12 HiPer** Strut compared to the traditional MacPherson strut. 14. **SLIDE 14 EXPLAIN Figure 7-13** Multilink front suspension design varies depending on OEM
	HANDS-ON TASK: Have students label parts of MacPherson strut suspension using sticky notes.
DEMO	**DEMONSTRATION: Show bearing from an upper strut mount**
QUESTION	**DISCUSSION: Ask the students to discuss what customer complaints will be if the bearing in the upper strut mount goes bad**

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	**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
	**ON-VEHICLE NATEF TASK:** Diagnose SLA and strut suspension concerns; determine necessary action.
	**15. SLIDE 15 EXPLAIN Figure 7-14** 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.
	16. SLIDE 16 EXPLAIN Figure 7-15 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 7–14 be replaced**
	**17. SLIDE 17 EXPLAIN Figure 7-16** 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 7-14**
	**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.**

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	**18. SLIDE 18 EXPLAIN Figure 7-17** 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.
	**Ball Joint Remove and Replace (View) (Download)** **Bushings Remove and Replace (View) (Download)** **Coil Spring, Remove and Replace (View) (Download)**
	**19. SLIDE 19 EXPLAIN Figure 7-18** Indicator ball joints should be checked with the weight of vehicle on ground. **20. SLIDE 20 EXPLAIN FIGURE 7–19** Typical dial indicator used to measure the suspension component movement. The locking pliers attach the gauge to a stationary part of the vehicle and the flexible coupling allows the dial indicator to be positioned at any angle
	**Coil Spring, Remove and Replace (View) (Download)** **EPS Torque Sensor (View) (Download)** **Strut Assembly, Disassemble (View) (Download)** **Strut Rod, Remove and Replace (View) (Download)** **Spring and Shock Absorber (View) (Download)** **Upper Control Arm Remove and Replace (View) (Download)**
	**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 7-19 & 7-20**
	**HANDS-ON TASK: Have students measure suspension component movement using a dial indicator**
	**21. SLIDE 21 EXPLAIN Figure 7-20** 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. **22. SLIDE 22 EXPLAIN Figure 7-21** jack should be placed under the lower control arm of this modified MacPherson-type suspension. **23. SLIDE 23 EXPLAIN Figure 7-22** 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.

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	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.
	**Upper Control Arm Remove and Replace (View) (Download)**
	**24. SLIDE 24 EXPLAIN Figure 7-23** A special tool or a block of wood should be inserted between the frame and the upper control arm before lifting vehicle off ground **25. SLIDE 25 EXPLAIN FIGURE 7–24** The jacking point is under the frame for checking the play of a lower ball joint used with a MacPherson strut
	**26. SLIDE 26 EXPLAIN Figure 7-25** This worn and rusty ball joint was found by moving the wheel and looking for movement in the joint . **27. SLIDE 27 EXPLAIN Figure 7-26** 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. **28. SLIDE 28 EXPLAIN Figure 7-27** pinch bolt attaches the steering knuckle to the ball joint. Remove the pinch bolt by turning the nut, not the bolt **29. SLIDE 29 EXPLAIN Figure 7-28** If the pinch bolt is overtightened, the steering knuckle can be deformed. A deformed knuckle can cause pinch bolt to break and the ball joint could become separated from steering knuckle.
	**DEMONSTRATION: Show students Examples of taper breaker tools**
	**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.**
	**30. SLIDE 30 EXPLAIN Figure 7-29** By drilling into the rivet, the holding force is released **31. SLIDE 31 EXPLAIN Figure 7-30** head of rivet can be removed by using a larger-diameter drill bit as shown.

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32. **SLIDE 32 EXPLAIN Figure 7-31** Using a punch and a hammer to remove the rivet after drilling down through the center and removing the head of the rivet
33. **SLIDE 33 EXPLAIN FIGURE 7–32** 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 7-32

ON-VEHICLE NATEF TASK: Front suspension inspection and component replacement

34. **SLIDE 34 EXPLAIN Figure 7-33** Typical kingpin assembly.
35. **SLIDE 35 EXPLAIN Figure 7-34** Driving a kingpin out with a hammer.
36. **SLIDE 36 EXPLAIN Figure 7-35** A kingpin being removed showing the worn bushing

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

New shocks are stored flat. Before installing new shocks, compress & extend them several times.

37. **SLIDE 37 EXPLAIN FIGURE 7.36** Most shock absorbers used on front suspension can be removed from under vehicle after removing the attaching bolts or nuts.
38. **SLIDE 38 EXPLAIN Figure 7-37** 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.

39. **SLIDE 39 EXPLAIN Figure 7-38** 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.
40. **SLIDE 40 EXPLAIN Figure 7-39** Use a strut spring compressor fixture to compress the spring on a MacPherson strut before removing strut retaining nut.
41. **SLIDE 41 EXPLAIN Figure 7-40** 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 the spring is compressed before the nut is removed.
42. **SLIDE 42 EXPLAIN Figure 7-41** Typical MacPherson strut showing the various components.

43. **SLIDE 43 EXPLAIN Figure 7-42** After installing the replacement strut cartridge, reinstall the spring and upper bearing assembly after compressing the spring. Notice that the strut is being held in a strut spring compressor fixture**.**
44. **SLIDE 44 EXPLAIN Figure 7-43** Before final assembly, make sure marks you made are aligned. Some struts are manufactured with marks to ensure proper reassembly.
45. **SLIDE 45 EXPLAIN Figure 7-44** 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.

ON-VEHICLE NATEF TASK: Remove, inspect, and install strut cartridge or assembly, strut coil spring, insulators (silencers), and upper strut bearing mount

46. **SLIDE 46 EXPLAIN Figure 7-45** 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 7-45

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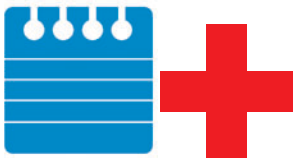
	**47. SLIDE 47 EXPLAIN Figure 7-46** strut rod as viewed from the front of the vehicle. **48. SLIDE 48 EXPLAIN Figure 7-47** Typical strut rod bushing with rubber on both sides of the frame to help isolate noise, vibration, and harshness from being transferred to the passengers.
	**DEMONSTRATION:** Show 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.**
	**Coil Spring, Remove and Replace (View) (Download)**
	**49. SLIDE 49 EXPLAIN Figure 7-48** 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. **50. SLIDE 50 EXPLAIN Figure 7-49** 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.**
	**51. SLIDE 51 EXPLAIN Figure 7-50** steering knuckle has been disconnected from lower ball joint. Lower control arm and coil spring are being held up by a floor jack. **52. SLIDE 52 EXPLAIN Figure 7-51** 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. **53. SLIDE 53 EXPLAIN Figure 7-52** Spring insulators install between spring seat and coil spring to reduce noise.

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	**54. SLIDE 54 EXPLAIN Figure 7-53** 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 **55. SLIDE 55 EXPLAIN Figure 7-54** By rotating the adjusting bolt, the vehicle can be raised or lowered
	**DEMONSTRATION: Show examples of steering knuckles**
	**DEMONSTRATION: Show the students how to use a torsion bar unloading tool: FIGURE 7-54**
	**ON-VEHICLE NATEF TASK: Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts**
	**56. SLIDE 56 EXPLAIN FIGURE 7-55** An adapter and a press or large clamp are used to remove the old bushing from the control arm and to install a new bushing
	**57. SLIDES 57-76 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.**