

Automotive Chassis Systems 7E

Chapter 25 FRONT SUSPENSIONS & SERVICE

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers operation and service of Automotive Chassis Systems . 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 below: <ol style="list-style-type: none"> 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 <p>This chapter will help prepare for ASE Suspension and Steering (A4) certification test content area "B" (Suspension System Diagnosis and Repair).</p>
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 Chassis Systems 7th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 7: [Chapter Images](#)

ICONS



Chapter 25 Front Suspension & Service

1. SLIDE 1 CH25 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 \(Microsoft Word\) \(PDF\)](#)

[Spring and Shock Absorber \(View\) \(Download\)](#)

[Suspension Components \(View\) \(Download\)](#)

[Upper Control Arm Remove and Replace \(View\) \(Download\)](#)

2. SLIDE 2 **EXPLAIN** Figure 25-1 Most early vehicles used single straight axles.

3. SLIDE 3 **EXPLAIN** Figure 25-2 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 25-3 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 25-4 The rubber radius rod bushing absorbs road shocks and helps isolate road noise

6. SLIDE 6 **EXPLAIN** Figure 25-5 upper control arm is shorter than lower control arm on short/long-arm (SLA)

7. SLIDE 7 **EXPLAIN** Figure 25-6 typical SLA front

ICONS



QUESTION



QUESTION

Chapter 25 Front Suspension & Service

suspension using coil springs.

8. **SLIDE 8 EXPLAIN** Figure 25-7 SLA-type suspension with coil spring placed on top of upper control arm.

[Short/Long Arm Suspension \(View\) \(Download\)](#)

9. **SLIDE 9 EXPLAIN** Figure 25-8 torsion bar SLA suspension can use either the lower or upper control arm.

10. **SLIDE 10 EXPLAIN** Figure 25-9 SLA-type suspension that uses a coil-over-shock assembly

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 25-10 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 25-11 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 25.12 **HiPer** Strut compared to the traditional MacPherson strut.

14. **SLIDE 14 EXPLAIN** Figure 25-13 Multilink front suspension design varies depending on OEM

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

ICONS



Chapter 25 Front Suspension & Service

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 25-14 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 25-15 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 25-14 be replaced

17. **SLIDE 17 EXPLAIN** Figure 25-16 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 25-14**

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.

ICONS



Chapter 25 Front Suspension & Service

18. **SLIDE 18 EXPLAIN** Figure 25-17 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 25-18 Indicator ball joints should be checked with the weight of vehicle on ground.

20. **SLIDE 20 EXPLAIN** FIGURE 25-19 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

[EPS Torque Sensor \(View\) \(Download\)](#)
[Strut Assembly, Disassemble \(View\) \(Download\)](#)
[Strut Rod, Remove and Replace \(View\) \(Download\)](#)
[Spring and Shock Absorber \(View\) \(Download\)](#)

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 25-19 & 25-20](#)

HANDS-ON TASK: Have students measure suspension component movement using a dial indicator

21. **SLIDE 21 EXPLAIN** Figure 25-20 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 25-21 jack should be placed under the lower control arm of this modified MacPherson-type suspension.
23. **SLIDE 23 EXPLAIN** Figure 25-22 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. 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.

ICONS



Chapter 25 Front Suspension & Service

Upper Control Arm Remove and Replace (View) (Download)

24. **SLIDE 24 EXPLAIN** Figure 25-23 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 25-24 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 25-25 This worn and rusty ball joint was found by moving the wheel and looking for movement in the joint
27. **SLIDE 27 EXPLAIN** Figure 25-26 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 25-27 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 25-28 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 25-29 By drilling into the rivet, the holding force is released
31. **SLIDE 31 EXPLAIN** Figure 25-30 head of rivet can be removed by using a larger-diameter drill bit as shown.
32. **SLIDE 32 EXPLAIN** Figure 25-31 Using a punch and a hammer to remove the rivet after drilling down through the center and removing the head of the rivet

ICONS



Chapter 25 Front Suspension & Service

33. SLIDE 33 **EXPLAIN** FIGURE 25–32 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 25-32

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

34. SLIDE 34 **EXPLAIN** Figure 25-33 Typical kingpin assembly.

35. SLIDE 35 **EXPLAIN** Figure 25-34 Driving a kingpin out with a hammer.

36. SLIDE 36 **EXPLAIN** Figure 25-35 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 25.36 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 25-37 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 25-38 brake hydraulic hose

ICONS

Chapter 25 Front Suspension & Service



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 25-39 Use a strut spring compressor fixture to compress the spring on a MacPherson strut before removing strut retaining nut.
41. **SLIDE 41 EXPLAIN** Figure 25-40 Removing the strut rod nut. The strut shaft is being helped with one wrench while the nut is being removed with other wrench. Notice that the spring is compressed before the nut is removed.
42. **SLIDE 42 EXPLAIN** Figure 25-41 Typical MacPherson strut showing the various components.
43. **SLIDE 43 EXPLAIN** Figure 25-42 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 25-43 Before final assembly, make sure marks you made are aligned. Some struts are made with marks to ensure proper reassembly.
45. **SLIDE 45 EXPLAIN** Figure 25-44 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 25-45 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 25-45**

47. **SLIDE 47 EXPLAIN** Figure 25-46 strut rod as viewed from the front of the vehicle.
48. **SLIDE 48 EXPLAIN** Figure 25-47 Typical strut rod

ICONS



Chapter 25 Front Suspension & Service

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 25-48 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 25-49 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 25-50 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 25-51 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 25-52 Spring insulators

ICONS



Chapter 25 Front Suspension & Service

install between spring seat and coil spring to reduce noise.

54. **SLIDE 54 EXPLAIN Figure 25-53** 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 25-54** 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 25-54

ON-VEHICLE NATEF TASK: Remove, inspect, install, and adjust suspension system torsion bars; inspect mounts

56. **SLIDE 56 EXPLAIN FIGURE 25-55** 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.