

Automotive Maintenance and Light Repair, 1ST Edition

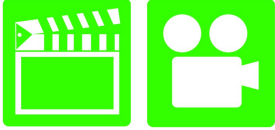
Chapter 48 Front Suspension & Service

Opening Your Class

KEY ELEMENT	EXAMPLES
Introduce Content	This course or class covers Automotive Maintenance and Light Repair . 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 the chapter learning objectives to the students. <ul style="list-style-type: none">— Prepare for ASE Suspension and Steering (A4) certification test content area “B” (Suspension System Diagnosis and Repair).— Explain how to perform a road test, a dry park test, a visual inspection, and a bounce test.— Discuss the procedures for testing load-carrying and follower-type ball joints.— Describe ball joint replacement procedures.— List the steps required to replace control arm and stabilizer bar bushings.— Explain routine service procedures of the suspension system.
Establish the Mood or Climate	Provide a <i>WELCOME</i> , 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.

ICONS

Ch48 Front Suspension & Service



1. SLIDE 1 CH48 Front Suspension & Service
2. SLIDES 2-3 EXPLAIN OBJECTIVES

Check for **ADDITIONAL VIDEOS & ANIMATIONS**
@ <http://www.jameshalderman.com/>
WEB SITE REGULARLY UPDATED

Suspension System (55 Links)

4. SLIDE 4 EXPLAIN Figure 48-1 Most early vehicles used single straight axles.
5. SLIDE 5 EXPLAIN Figure 48-2 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 EXAMPLES OF KINGPINS USED WITH A SOLID AXLE.

6. SLIDE 6 EXPLAIN Figure 48-3 Twin I-beam front suspension. Rubber bushings are used to support the I-beams to the frame and help isolate road noise
7. SLIDE 7 EXPLAIN FIGURE 48-4 The rubber radius rod bushing absorbs road shocks and helps isolate road noise
8. SLIDES 8-9 EXPLAIN SLA SUSPENSIONS
10. SLIDE 10 EXPLAIN Figure 48-5 upper control arm is shorter than lower control arm on short/long-arm (SLA)
11. SLIDE 11 EXPLAIN Figure 48-6 typical SLA front suspension using coil springs.
12. SLIDE 12 EXPLAIN Figure 48-7 SLA-type suspension with coil spring placed on top of upper control arm.
13. SLIDE 13 EXPLAIN Figure 48-8 torsion bar SLA suspension can use either the lower or upper control arm.

DISCUSSION: DISCUSS WHAT CAUSES RADIUS ROD BUSHING TO DETERIORATE.

ICONS

Ch48 Front Suspension & Service



14. **SLIDE 14 EXPLAIN** Figure 48-9 typical MacPherson strut showing all of components of assembly. A strut includes the shock & spring in one structural assembly.
15. **SLIDE 15 EXPLAIN** Figure 48-10 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.
16. **SLIDE 16 EXPLAIN** Figure 48-11 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: DISCUSS WHAT CUSTOMER COMPLAINTS WILL BE IF THE BEARING IN THE UPPER STRUT MOUNT GOES BAD



17. **SLIDES 17-18 EXPLAIN** Servicing the Suspension System

19. **SLIDE 19 EXPLAIN** CHART 48-1

21. **SLIDES 21-22 EXPLAIN** Road Test Diagnosis

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









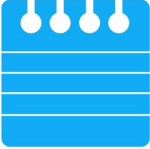


23. **SLIDES 23-25 EXPLAIN** Dry Park Test (Suspension)




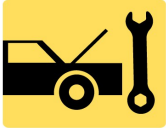




26. **SLIDES 26-28 EXPLAIN** Visual Inspection



29. **SLIDE 29 EXPLAIN** **FIGURE** 48-12 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

ICONS	Ch48 Front Suspension & Service
        	<p>considered normal. If oil is dripping, then this means that the rod seal has failed.</p> <p>30. SLIDE 30 EXPLAIN Figure 48-13 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.</p> <p><u>DISCUSSION: DISCUSS WHY IT IS RECOMMENDED THAT BOTH FRONT SPRINGS IN FIGURE 48-13 BE REPLACED</u></p> <p>31. SLIDE 31 EXPLAIN Figure 48-14 It is easy to see that this worn control arm bushing needed to be replaced. The new bushing is shown next to the original.</p> <p><u>DEMONSTRATION: SHOW EXAMPLES OF CONTROL ARM BUSHINGS FIGURE 48-14</u></p> <p>32. SLIDES 32-33 EXPLAIN Ball Joints Diagnosis and Inspection</p> <p><u>NATEF MLR TASK A4B10. INSPECT, REMOVE AND INSTALL UPPER AND LOWER CONTROL ARMS, BUSHINGS, SHAFTS, AND REBOUND BUMPERS</u></p> <p><u>DEMONSTRATION: SHOW EXAMPLES OF THE TOOLS NEEDED FOR REPLACING AND INSTALLING BALL JOINTS.</u></p> <p><u>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.</u></p> <p>34. SLIDE 34 EXPLAIN Figure 48-15 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.</p> <p>35. SLIDE 35 EXPLAIN Figure 48-16 Indicator ball joints should be checked with weight of vehicle on ground.</p> <p>36. SLIDE 36 EXPLAIN FIGURE 48-17 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</p>

ICONS	Ch48 Front Suspension & Service
     	<p>37. SLIDE 37 EXPLAIN Ball Joint Diagnosis and Inspection</p> <p>38. SLIDE 38 EXPLAIN Figure 48-18 If spring is attached to 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 looseness being measured is not due to normal wheel bearing endplay.</p> <p>39. SLIDE 39 EXPLAIN Figure 48-19 jack should be placed under the lower control arm of this modified MacPherson-type suspension.</p> <p>40. SLIDE 40 EXPLAIN Figure 48-20 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.</p> <p>SHOW ANIMATION: BALL JOINT TESTING WWW.MYAUTOMOTIVELAB.COM HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A4_ANIMATION/CHAPTER25_FIG_25_20/INDEX.HTM</p> <p><u>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 48-18 & 48-19</u></p> <p><u>HANDS-ON TASK: HAVE STUDENTS MEASURE SUSPENSION COMPONENT MOVEMENT USING A DIAL INDICATOR</u></p> <p>SHOW VIDEO: INSPECTING BALL JOINTS WWW.MYAUTOMOTIVELAB.COM HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=INSPECTING%20BALL%20JOINTS%20(WITHOUT%20WEAR%20INDICATORS)&CLIP=PANDC/CHET/2012/AUTOMOTIVE/UNDERCAR_SYSTEMS/A4T8.MOV&CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/UNDERCAR_SYSTEMS/XML/A4T8.XML</p> <p>SHOW VIDEO: INSPECTING BALL JOINTS W/O WEAR INDICATORS WWW.MYAUTOMOTIVELAB.COM HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=INSPECTING%20BALL%20JOINTS%20(WITHOUT%20WEAR%20INDICATORS)&CLIP=PANDC/CHET/2012/AUTOMOTIVE/SUSPENSION_STEERING/INSPECTING_BALL_JOINTS.MOV&CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/SUSPENSION_STEERING/XML/INSPECTING_BALL_JOINTS.XML</p>

ICONS

Ch48 Front Suspension & Service



41. **SLIDE 41 EXPLAIN Figure 48-21** jacking point is under the frame for checking the play of a lower ball joint used with a MacPherson strut.
42. **SLIDE 42 EXPLAIN FIGURE 48-22** The jacking point is under the frame for checking the play of a lower ball joint used with a MacPherson strut
43. **SLIDE 43 EXPLAIN Figure 48-23** This worn and rusty ball joint was found by moving the wheel and looking for movement in the joint .
44. **SLIDE 44 EXPLAIN Figure 48-24** 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.
45. **SLIDE 45 EXPLAIN Figure 48-25** pinch bolt attaches the steering knuckle to the ball joint. Remove the pinch bolt by turning the nut, not the bolt
46. **SLIDE 46 EXPLAIN Figure 48-26** 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.

DEMO

DEMO



DEMONSTRATION: SHOW STUDENTS EXAMPLES OF TAPER BREAKER TOOLS













DEMONSTRATION: SHOW 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.

SHOW VIDEO: TORQUING LUG NUTS
WWW.MYAUTOMOTIVELAB.COM

[HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=TORQUING%20OF%20LUG%20NUTS&CLIP=PANDC/CHET/2012/AUTOMOTIVE/A5-C13.MOV&CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/XML/A5-C13.ADB.XML](http://media.pearsoncmg.com/ph/chet/chet_myLABS/akamai/template/video640x480.php?title=torquing%20of%20lug%20nuts&clip=pandc/chet/2012/automotive/a5-c13.mov&caption=chet/chet_myLABS/akamai/2012/automotive/xml/a5-c13.adb.xml)

47. **SLIDE 47 EXPLAIN Figure 48-27** By drilling into the rivet, the holding force is released
48. **SLIDE 48 EXPLAIN Figure 48-28** head of rivet can be removed by using a larger-diameter drill bit as shown.
49. **SLIDE 49 EXPLAIN Figure 48-29** Using a punch and a hammer to remove the rivet after drilling down through the center and removing the head of the rivet

ICONS	Ch48 Front Suspension & Service
	<p>50. SLIDE 50 EXPLAIN FIGURE 48-30 Press-in ball joints are best removed using large C-clamp press</p> <p>DEMONSTRATION: SHOW HOW TO REMOVE A PRESS-IN BALL JOINT BY USING A C-CLAMP PRESS: SEE FIGURE 48-30</p>
 	<p>NATEF MLR TASK A4B13 INSPECT, REMOVE AND INSTALL UPPER AND/OR LOWER BALL JOINTS (WITH OR WITHOUT WEAR INDICATORS)</p>
	<p>51. SLIDE 51 EXPLAIN Figure 48-31 Typical kingpin assembly.</p> <p>52. SLIDE 52 EXPLAIN Figure 48-32 Driving a kingpin out with a hammer.</p>
	<p>53. SLIDE 53 EXPLAIN Figure 48-33 A kingpin being removed showing the worn bushing</p>
	<p>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.</p>
  <p>QUESTION</p>	<p>DISCUSSION: DISCUSS CUPPY TIRE WEAR AND POSSIBLE CAUSES FOR IT. HAVE STUDENTS DISCUSS HOW SHOCK CONDITION & SHOCK MOUNTS CAN INDICATE HOW VEHICLE IS DRIVEN.</p>
 	<p>NATEF MLR TASK A4B21 INSPECT, REMOVE, AND REPLACE SHOCK ABSORBERS; INSPECT MOUNTS AND BUSHINGS.</p>
	<p>NEW SHOCKS ARE STORED FLAT. BEFORE INSTALLING NEW SHOCKS, COMPRESS & EXTEND THEM SEVERAL TIMES.</p>
	<p>54. SLIDE 54 EXPLAIN Figure 48-34 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.</p>
	<p>55. SLIDE 55 EXPLAIN Figure 48-35 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.</p>

ICONS

Ch48 Front Suspension & Service



56. **SLIDE 56 EXPLAIN Figure 48-36** Use a strut spring compressor fixture to compress the spring on a MacPherson strut before removing strut retaining nut.
57. **SLIDE 57 EXPLAIN Figure 48-37** 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 the spring is compressed before the nut is removed.
58. **SLIDE 58 EXPLAIN Figure 48-38** Typical MacPherson strut showing the various components.
59. **SLIDE 59 EXPLAIN Figure 48-39** After installing the replacement strut cartridge, reinstall spring and upper bearing assembly after compressing spring. Notice that strut is being held in a strut spring compressor fixture.
60. **SLIDE 60 EXPLAIN Figure 48-40** Before final assembly, make sure marks you made are aligned. Some struts are manufactured with marks to ensure proper reassembly.
61. **SLIDE 61 EXPLAIN Figure 48-41** 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.

62. **SLIDE 62 EXPLAIN Figure 48-42** Stabilizer bar links should be replaced as a pair












DISCUSSION: DISCUSS WHY NOT ALL OEMS RECOMMEND, AS GM DOES, REPLACING STABILIZER LINKS IN PAIRS & PURCHASING 2 KITS SO YOU CAN REPLACE LINKS ON BOTH LEFT AND RIGHT SIDES AT SAME TIME: FIGURE 48-42







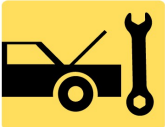
63. **SLIDES 62-66 EXPLAIN** Stabilizer Bar Link and Bushings: Diagnosis



67. **SLIDE 67 EXPLAIN Figure 48-43** A strut rod as viewed from the front of the vehicle.
68. **SLIDE 68 EXPLAIN Figure 48-44** Typical strut rod bushing with rubber on both sides of the frame to help isolate noise, vibration, and harshness from being



ICONS	Ch48 Front Suspension & Service
     	<p>transferred to the passengers.</p> <p>DEMONSTRATION: SHOW THE STUDENTS HOW TO CORRECTLY REMOVE STRUT ROD NUTS BY USING TWO WRENCHES</p> <p>NATEF MLR TASK A4B11 INSPECT, REMOVE & INSTALL STRUT RODS AND BUSHINGS</p> <p>NATEF MLR TASK A4B12 INSPECT, REMOVE AND INSTALL TRACK BAR, STRUT RODS/RADIUS ARMS, AND RELATED MOUNTS AND BUSHINGS</p> <p>69. SLIDE 69 EXPLAIN Figure 48-45 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.</p> <p>70. SLIDE 70 EXPLAIN Figure 48-46 Notice that if the 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 the difference between the distance at “A” with good springs and the distance at “B” with sagging springs.</p> <p>71. SLIDE 71 EXPLAIN Figure 48-47 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</p>
  	<p>SAFETY ALWAYS PAY ATTENTION TO SPRING WHEN IT IS BEING REMOVED.</p> <p>72. SLIDE 73 EXPLAIN Figure 48-48 steering knuckle has been disconnected from lower ball joint. Lower control arm and coil spring are being held up by a floor jack.</p> <p>73. SLIDE 73 EXPLAIN Figure 48-49 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</p>

ICONS	Ch48 Front Suspension & Service
	<p>the tension has been removed from the coil spring it can be removed and the replacement installed.</p> <p>74. SLIDE 74 EXPLAIN Figure 48-50 Spring insulators install between spring seat & coil spring to reduce noise</p> <p>75. SLIDE 75 EXPLAIN Figure 48-51 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</p> <p>76. SLIDE 76 EXPLAIN Figure 48-52 By rotating the adjusting bolt, the vehicle can be raised or lowered</p>
	<p><u>DEMONSTRATION: SHOW EXAMPLES OF STEERING KNUCKLES</u></p>
	<p><u>DEMONSTRATION: SHOW THE STUDENTS HOW TO USE A TORSION BAR UNLOADING TOOL: FIGURE 47-52</u></p>
	<p><u>NATEF MLR TASK: REMOVE, INSPECT, INSTALL, AND ADJUST SUSPENSION SYSTEM TORSION BARS; INSPECT MOUNTS</u></p>
	<p>77. SLIDES 77-78 EXPLAIN Control Arm Bushings Diagnosis</p> <p>79. SLIDES 79-80 EXPLAIN Control Arm Bushings Replacement</p> <p>81. SLIDE 81 EXPLAIN FIGURE 48-53 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</p>
	<p>82. SLIDES 82-84 EXPLAIN Control Arm Bushings Replacement</p> <p>85. SLIDES 85-104 OPTIONAL EXPLAIN STRUT REPLACEMENT</p>
	<p><u>SEARCH INTERNET: HAVE STUDENTS USE INTERNET FOR SPRING MATERIALS OTHER THAN SPRING STEEL. HAVE STUDENTS SHARE THEIR FINDINGS DURING THE NEXT CLASS.</u></p>