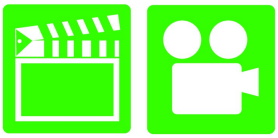
Automotive Maintenance and Light Repair, 1ST Edition

Chapter 50 STEERING LINKAGE & 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. ⁀ Prepare for ASE Suspension and Steering (A4) certification test content area "A" (Steering System Diagnosis and Service). ⁀ Identify steering linkage components. ⁀ Describe how the movement of the steering wheel causes the front wheels to turn. ⁀ Describe how to perform a dry park test to determine the condition of steering system components. ⁀ Perform an under-the-vehicle inspection of the steering system components. ⁀ List the service procedures for under-the- vehicle steering system service. ⁀ Explain how to replace steering linkage parts.
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.

ICONS	Ch50 STEERING LINKAGE & SERVICE
	**1. SLIDE 1 CH50 STEERING LINKAGE & SERVICE** **2. SLIDES 2-3 EXPLAIN OBJECTIVES**
	**Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE REGULARLY UPDATED**
	**Steering System (62 Links)**
	**IF A CUSTOMER COMPLAINS OF A PULL TO ONE SIDE OR OTHER, CHECK THE STEERING LINKAGE. ONE OF THE PARTS COULD HAVE WORKED LOOSE.**
	**4. SLIDES 4-5 EXPLAIN** Steering Linkage **6. SLIDE 6 EXPLAIN Figure 50-1** Steering movement is transferred from the pitman arm that is splined to the sector shaft (pitman shaft), through the center link and tie rods, to the steering knuckle at each front wheel. The idler arm supports the passenger side of the center link and keeps the steering linkage level with the road. This type of linkage is called a parallelogram-type design. **7. SLIDES 7-8 EXPLAIN** Steering Linkage **9. SLIDE 9 EXPLAIN Figure 50-2** most common type of steering is parallelogram. The cross-steer and Haltenberger linkage designs are used on some trucks and vans.
	**DEMONSTRATION: SHOW EXAMPLE OF PARALLELOGRAM STEERING LINKAGE. FIGURE 50-2. SHOW EXAMPLES OF STEERING DAMPENERS USED ON TRUCKS, VANS, & SOME LUXURY CARS. FIGURE 50-3**
	**10. SLIDE 10 EXPLAIN Figure 50-3** Typical steering dampener used on a Hummer H2. **11. SLIDES 11-12 EXPLAIN** Steering Linkage tie rod ends **13. SLIDE 13 EXPLAIN Figure 50-4** (a) A dual bearing design with 2 preload spring. Use of 2 bearing surfaces allows for one surface for rotation (for steering) and another surface for pivoting (allow for suspension up-and-down movement). (b) Nylon wedge bearing type

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	allows for extended lube intervals. Wear is compensated for by tapered design & spring-loaded bearing.
	14. **SLIDE 14 EXPLAIN Figure 50-5** (a) A rubber-bonded socket is constructed of a rubber casing surrounding the ball stud, which is then inserted into the socket of the tie rod end. The hole in the socket allows air to escape as the ball stud is installed and there is not a place for a grease fitting. (b) The socket is crimped over the ball so that part of the socket lip retains the stud.
	15. **SLIDE 15 EXPLAIN Figure 50-6** Rack-&-Pinion steering systems use ball & socket-type inner tie rod end.
	16. **SLIDE 16 EXPLAIN Figure 50-7** variety of methods are used to secure the inner tie rod end socket assembly to the end of the rack
	**DEMONSTRATION: SHOW EXAMPLES OF ROLL PIN, SET SCREW, & SWAGED SOCKET TYPES OF INNER TIE ROD END ASSEMBLIES USED IN RACK-AND-PINION STEERING SYSTEMS: FIG 50-5, 6, & 7**
	17. **SLIDE 17 EXPLAIN Figure 50-8** Exploded view of a center-take-off-style rack-and-pinion steering gear assembly
	**DEMONSTRATION: SHOW EXAMPLES OF CENTER-TAKE-OFF RACK-AND-PINION STEERING GEAR ASSEMBLIES: FIG. 50-8**
	**SOME CENTER-TAKE-OFF RACK-AND-PINION STEERING GEAR ASSEMBLIES ALSO INCLUDE AN ADJUSTER STUD FOR ADJUSTING LINKAGE LENGTH. BE SURE TO CHECK TYPE OF ASSEMBLY BEFORE BEGINNING WORK.**
	18. **SLIDE 18 EXPLAIN Figure 50-9** In rear-steer vehicle, steering linkage is behind the centerline of front wheels, whereas the linkage is in front on a front-steer vehicle.
	**DISCUSSION: DISCUSS WHETHER FRONT STEER OR REAR STEER IS BETTER: FIGURES 50-9**

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	19. **SLIDE 19 EXPLAIN Figure 50-10** Opposite-phase 4-wheel steer is usually used only at low vehicle speed to help in parking maneuvers. Same-phase steering helps at higher speeds & may not be noticeable by average driver 20. **SLIDE 20 EXPLAIN Figure 50-11** Being equipped with four-wheel steer allows a truck to make shorter turns than would otherwise be possible. 21. **SLIDE 21 EXPLAIN Figure 50-12** Quadrasteer includes many components that all work together. 22. **SLIDE 22 EXPLAIN Figure 50-13** Rear steer select switch schematic. 23. **SLIDE 23 EXPLAIN Figure 50-14** The dash-mounted select switch showing the three positions for the four-wheel steer system. 24. **SLIDE 24 EXPLAIN Figure 50-15** The output of the handwheel sensor digital signal. 25. **SLIDE 25 EXPLAIN Figure 50-16** Handwheel analog signal. 26. **SLIDE 26 EXPLAIN Figure 50-17** Handwheel position sensor analog signal to control module. 27. **SLIDE 27 EXPLAIN Figure 50-18** Handwheel position sensor digital signal to control module. 28. **SLIDE 28 EXPLAIN Figure 50-19** Quadrasteer system showing all of the components. Motor used to power rear steering rack can draw close to 60 amperes during a hard turn and can be monitored using a Tech 2.
	**DISCUSSION: DISCUSS STEERING SYSTEMS SIMILAR TO GM QUADRASTEER™ SYSTEM FIGURES 50-12 TO 17**
	29. **SLIDE 29 EXPLAIN Figure 50-20** Greasing a tie rod end. Some joints do not have a hole for excessive grease to escape, and excessive grease can destroy the seal. 30. **SLIDE 30 EXPLAIN Figure 50-21** Part of steering linkage lubrication is applying grease to the steering stops. If these stops are not lubricated, a grinding sound may be heard when vehicle hits a bump when wheels are turned all way one direction or other. This often occurs when driving into or out of a driveway that has a curb.
	**DEMONSTRATION: SHOW EXAMPLES OF ZERK FITTINGS, BOTH IN HAND AND ON THE VEHICLE.**

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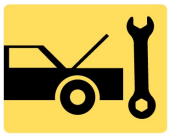
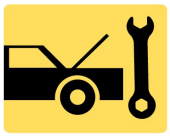
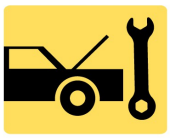
DEMO	**DEMONSTRATION: SHOW EXAMPLES OF GREASE GUNS AND GREASE CARTRIDGES. SHOW HOW TO USE A GREASE GUN AND CARTRIDGE TO GREASE A TIE ROD END FIGURES 50-20, 21**
	**HANDS-ON TASK: LUBRICATE SUSPENSION AND STEERING SYSTEM**
	**31. SLIDES 31-32 EXPLAIN** Dry Park Test
	33. SLIDE 33 EXPLAIN Figure 50-22 Checking for freeplay in the steering
	34. SLIDE 34 EXPLAIN DRY PARK TEST
	**35. SLIDE 35 EXPLAIN Figure 50-23** All joints should be felt during a dry park test. Even inner tie rod ends (ball socket assemblies) can be felt through the rubber bellows on many rack-and-pinion steering units.
DEMO	**DEMONSTRATION: SHOW HOW TO CHECK STEERING COMPONENTS BY USING THE DRY PARK TEST: FIGURES 50-22, 23**
	**HANDS-ON TASK: HAVE THE STUDENTS DO A DRY PARK TEST: FIGURES 50-22, 23**
	**36. SLIDE 36 EXPLAIN FIGURE 50–24** The steering and suspension arms must remain parallel to prevent the up-and-down motion of the suspension from causing the front wheels to turn inward or outward
	37. SLIDE 37 EXPLAIN FIGURE 50–25 The center link should be parallel to the ground
DEMO	**DEMONSTRATION: SHOW HOW TO PERFORM JOUNCE/REBOUND TEST FIGURES 50-24, 25**
	**HANDS-ON TASK: HAVE STUDENTS PERFORM JOUNCE/REBOUND TEST FIGURES 50-24, 25**
	**38. SLIDE 38 EXPLAIN Figure 50-26** Typical parallelogram steering linkage. The center link can also be named the relay rod, drag link, or connecting link.
	39. SLIDE 39 EXPLAIN FIGURE 50–27 Some center links have ball joints while others have tapered socket

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	holes to accept ball joints on the pitman arm, idler arm, and inner tie rod ends
	**40. SLIDES 40-41 EXPLAIN** Under-Vehicle Inspection
	42. SLIDE 42 EXPLAIN Figure 50-28 To check an idler arm, most vehicle manufacturers specify that 25 pounds of force be applied by hand up and down to the idler arm. The idler arm should be replaced if the total movement (up and down) exceeds 1/4 in. (6 mm).
	**DEMONSTRATION: SHOW HOW TO CHECK AN IDLER ARM TO DETERMINE IF IT NEEDS TO BE REPLACED FIGURE 50-28**
	**DISCUSSION: DISCUSS SYMPTOMS THAT WOULD SUGGEST THAT A TIE ROD SHOULD BE REPLACED**
	**43. SLIDE 43 EXPLAIN Figure 50-29** Steering system component(s) should be replaced if any noticeable looseness is detected when moved by hand.
	44. SLIDE 44 EXPLAIN Figure 50-30 All joints should be checked by hand for any lateral or vertical play
	45. SLIDE 45 EXPLAIN FIGURE 50–31 If a rack-and-pinion or any other steering linkage system is not level, the front tires will be moved inward and/or outward whenever the wheels of the vehicle move up or down
	**DISCUSSION: DEFINE BUMP STEER. ASK STUDENTS TO DISCUSS HOW LOWERING VEHICLE, OR MIXING AND MATCHING STEERING COMPONENTS MAY FIX BUMP STEER**
	**BUMP STEER CAN BE FOUND BY PLACING VEHICLE ON THE ALIGNMENT RACK. PULL VEHICLE DOWN ON SPRINGS (BY ADDING WEIGHT OR CHAINING THE CAR DOWN) AND MEASURE TOE CHANGE. REPEAT THE PROCEDURE, BUT LIFT ONE SIDE OF FRONT CROSS MEMBER, THEN THE OTHER. THEN LIFT BOTH SIDES TOGETHER. CHANGES IN TOE ARE BUMP STEER. FIGURE 50-31**
	**46. SLIDES 46-50 EXPLAIN Steering Linkage Replacement: Parallelogram Type**
	51. SLIDE 51 EXPLAIN Figure 50-32 The preferred method for separating the tie rod end from the steering knuckle is to use a puller such as the one shown. A pickle-fork-type tool should only be used if the tie rod

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	end is going to be replaced. A pickle-fork-type tool can damage or tear the rubber grease boot. **52. SLIDE 52 EXPLAIN Figure 50-33** Two hammers being used to disconnect a tie rod end from the steering knuckle. One hammer is used as a backing for the second hammer. Notice that the attaching nut has been loosened, but not removed. This prevents the tie rod end from falling when the tapered connection is knocked loose.
	**DEMONSTRATION: SHOW HOW TO DISCONNECT A TIE ROD FROM STEERING KNUCKLE. SHOW EXAMPLES OF A PULLER TOOL & PICKLE-FORK TOOL USED TO SEPARATE THE TIE ROD FROM STEERING KNUCKLE: FIGURE 50-32 WHEN A PITMAN ARM IS BEING STUBBORN, PUT TENSION ON IT WITH A PULLER AND THEN HIT PITMAN ARM WITH A HAMMER. THEN RETIGHTEN PULLER. DO THIS SEVERAL TIMES; AND THE PITMAN ARM SHOULD FALL OFF. FIGURE 50-34**
	**53. SLIDE 53 EXPLAIN Figure 50-34** pitman arm puller is used to remove the pitman arm from the pitman shaft. **54. SLIDE 54 EXPLAIN Figure 50-35** Pitman arm and pitman shaft indexing splines. **55. SLIDE 55 EXPLAIN Figure 50-36** Align the hole in the tie rod end with the slot in the retaining nut. If the holes do not line up, always tighten the nut farther (never loosen) until the hole lines up
	**56. SLIDE 56 EXPLAIN Figure 50-37** Replacement tie rods should be of same overall length as originals. Measure from the edge of the tie rod sleeve to center of the grease fitting. When new tie rod is threaded to this dimension, the toe setting will be close to the original. **57. SLIDE 57 EXPLAIN Figure 50-38** tie rod ends should be installed so that stud is in center of its range **58. SLIDE 58 EXPLAIN Figure 50-39** (a) Tie rod adjusting sleeve. (b) Be sure to position the clamp correctly on the sleeve. **59. SLIDES 59-60 EXPLAIN** Steering Linkage Replacement: Service of Ball Socket Assemblies **61. SLIDE 61 EXPLAIN Figure 50-40** An articulation test uses a spring scale to measure the amount of force needed to move the tie rod in the ball socket assembly. Most manufacturers specify a minimum of 1 lb (4.4 N) of

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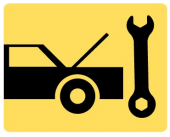
	force and a maximum of 6 lb (26 N). 62. **SLIDE 62 EXPLAIN Figure 50-41** Removing a staked inner tie rod assembly requires two wrenches—one to hold the rack and the other to unscrew the joint from the end of the steering rack. 63. **SLIDE 63 EXPLAIN Figure 50-42** When the inner tie rod end is reassembled, both sides of the housing must be staked down onto the flat shoulder of the rack. 64. **SLIDE 64 EXPLAIN Figure 50-43** After replacing inner tie rod end, socket assembly should be secured with a rivet or set screw depending on style of part. 64. **SLIDE 64 EXPLAIN FIGURE 50–44** Using an inductive heater caused this retaining nut to be cherry red in a just a few seconds.
	**DEMONSTRATION: SHOW HOW TO REMOVE A STAKED INNER TIE ROD ASSEMBLY BY USING 2 WRENCHES. FIGURE 50-41. SHOW HOW TO REMOVE THE ROLL PIN FROM PINNED RACK-AND PINION UNIT BY USING TWO METHODS: USING A PULLER, AND DRILLING OUT PIN FIGURE 50-42**
	**HANDS-ON TASK: HAVE STUDENTS REMOVE ROLL PINS FROM PINNED RACK-AND-PINION UNITS BY DRILLING OUT THE PINS.**
	**NATEF MLR TASK A4A2: DISABLE & ENABLE SUPPLEMENTAL RESTRAINT SYSTEM (SRS)**
	**NATEF MLR TASK A4B1 INSPECT RACK AND PINION STEERING GEAR INNER TIE ROD ENDS (SOCKETS) AND BELLOWS BOOTS; REPLACE AS NEEDED.**
	**NATEF MLR TASK A4B8: INSPECT & REPLACE PITMAN ARM, RELAY (CENTERLINK INTERMEDIATE) ROD, IDLER ARM & MOUNTINGS, & STEERING LINKAGE DAMPER.**
	**NATEF MLR TASK A4B9 INSPECT, REPLACE, AND ADJUST TIE ROD ENDS (SOCKETS), TIE ROD SLEEVES, AND CLAMPS.**

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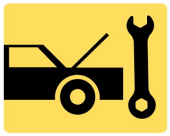
	66. SLIDES 66-73 EXPLAIN OPTIONAL STEERING LINKAGE SERVICE
	**SEARCH INTERNET:** HAVE STUDENTS USE INTERNET TO RESEARCH THE HISTORY OF AIRBAGS. ASK STUDENTS TO PREPARE PRESENTATIONS ON THE HISTORY OF AIRBAGS.