

ATE5 Chapter 116 STEERING COLUMNS & GEARS

Opening Your Class

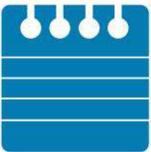
| KEY ELEMENT | EXAMPLES |
|--|--|
| Introduce Content | This course or class provides complete coverage of the components, operation, design, and troubleshooting. It correlates material to task lists specified by ASE and NATEF and emphasizes a problem-solving approach. Chapter features include Tech 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: <ol style="list-style-type: none">1. Discuss steering columns.2. Explain the purpose and function of conventional steering gears.3. Explain how a recirculating ball steering gear works.4. Describe how a rack-and-pinion steering gear works. |
| 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 116: [ATE5 Chapter Images](#)

ICONS



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1. SLIDE 1 CH116 STEERING COLUMNS & GEARS

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

Videos

- 2. SLIDE 2 EXPLAIN Figure 116-1** Most steering columns contain a horn switch. The horn button is a normally open (NO) switch. When the button is depressed, the switch closes, which allows electrical current to flow from the battery to sound the horn. Most horn circuits use a relay to conduct the horn current.
- 3. SLIDE 3 EXPLAIN Figure 116-2** The airbag inflates at the same time the driver moves toward the steering wheel during a front-end collision and supplements the protection of the safety belt.
- 4. SLIDE 4 EXPLAIN Figure 116-3** The airbag module attaches to the steering wheel and is removed as an assembly to service the steering wheel and column

Be careful! Airbags can inflate even if ignition is turned off & battery disconnected. Disconnect negative battery cable before removing airbag. You can damage spiral cable (SIR coil) by turning steering wheel when the column is disconnected from steering gear.

DEMONSTRATION: Show examples of airbag modules. Show the students how to identify vehicles with airbags

- 5. SLIDE 5 EXPLAIN Figure 116-4** The steering shaft links the steering wheel to the steering gear while the column jacket, which surrounds part of the shaft, holds support brackets and switches. This steering shaft has a small intermediate section between the main section and the steering gear.
- 6. SLIDE 6 EXPLAIN Figure 116-5** A pot joint is a flexible coupling used to join two shafts that allow plunging motion.

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7. **SLIDE 7 EXPLAIN Figure 116-6** typical intermediate steering shaft assembly showing a U-joint and related components.
8. **SLIDE 8 EXPLAIN Figure 116-7** flexible coupling is used to isolate road noise and vibration from the steering shaft.
9. **SLIDE 9 EXPLAIN Figure 116-8** Steering column covers are often part of the interior trim.
10. **SLIDE 10 EXPLAIN Figure 116-9** Collapsible steering columns include a mesh design that crushes easily, a bearing design that allows one section of the column to slide into the other, and a breakaway device that separates the steering column from the body of the vehicle in the event of a front-end collision.
11. **SLIDE 11 EXPLAIN Figure 116-10** Tilt mechanisms vary by design and vehicle manufacturer, although most use a ratchet to position top portion of steering column.

DEMONSTRATION: Show examples of universal joints and pot joints used on steering columns

HANDS-ON TASK: Have the students identify the parts of steering column USING POST-IT NOTES

12. **SLIDE 12 EXPLAIN Figure 116-11** Typical steering column showing all of the components from the steering wheel to the steering gear
13. **SLIDE 13 EXPLAIN Figure 116-12** steering shaft splines onto the steering wheel
14. **SLIDE 14 EXPLAIN Figure 116-13** toe plate seals hole from steering shaft and helps seal out noise and moisture.
15. **SLIDE 15 EXPLAIN Figure 116-14** upper section of steering column includes the lock housing and switches.
16. **SLIDE 16 EXPLAIN Figure 116-15** upper section of the steering column contains the steering shaft bearing.
17. **SLIDE 17 EXPLAIN Figure 116-16** lock plate engages an ignition lock pawl to keep the steering wheel in one position when the ignition is off.

DEMONSTRATION: Show how to remove several types of column covers

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HANDS-ON TASK: Have the students remove column covers

DISCUSSION: Ask the students to discuss whether mesh-design collapsible steering column or bearing-design collapsible steering column is better

DEMONSTRATION: Show examples of breakaway support brackets and knee bolsters. Show examples of tilt mechanisms

When replacing wires in steering column, make sure wires are placed in wire trough. This will prevent damage to wires.

When changing turn signal switches, attach a snake wire (a piece of wire used to pull new wires) to switch wires at base of steering column. As old switch is removed, snake wire will be pulled up through column. The snake wire can now be used to pull new switch wires in place.

ON-VEHICLE NATEF TASK: Steering column inspection and diagnosis; determine necessary action. [Page 352](#)

- 18. SLIDE 18 EXPLAIN Figure 116-17** As the steering wheel is turned, the nut moves up or down on the threads, shown using a bolt to represent the worm gear and the nut representing the gear nut that meshes with the teeth of the sector gear
- 19. SLIDE 19 EXPLAIN Figure 116-18** Steering gear ratio is the ratio between the number of degrees the steering wheel is rotated to the number of degrees the front wheel turns.

DISCUSSION: Ask the students to discuss whether a 22:1 steering gear ratio or a 14:1 steering gear ratio is better

- 20. SLIDE 20 EXPLAIN Figure 116-19** Constant-ratio steering gear sector shaft. Notice that all three gear teeth are the same size.
- 21. SLIDE 21 EXPLAIN Figure 116-20** Variable-ratio steering gear sector shaft. Notice larger center gear tooth.

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DEMO



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22. **SLIDE 22 EXPLAIN** Figure 116-21 The sector gear meshes with the gear teeth on the ball nut.

ON-VEHICLE NATEF TASK: Disable and enable airbag system and center/replace the clockspring. **Page 351**

DEMONSTRATION: Show examples of constant ratio steering gear sector shafts and variable-ratio steering gear sector shafts

FIGURES 116-19, 116-20

DEMONSTRATION: Show the students examples of typical manual recirculating ball steering gears.

23. **SLIDE 23 EXPLAIN** Figure 116-22 typical manual recirculating ball steering gear.

DISCUSSION: Have a discussion of problems with upper and lower bearings **FIGURES 116-22**

24. **SLIDE 24 EXPLAIN** Figure 116-23 sector shaft is supported by bushings, one in housing & one in side cover

25. **SLIDE 25 EXPLAIN** Figure 116-24 Worm bearing preload is a turning force measured in in.-lb or N-M, and worm endplay is axial movement measured in fractions of an inch or millimeters.

26. **SLIDE 26 EXPLAIN** Figure 116-25 first step to adjust worm gear freeplay is to bottom the worm gear nut, using a spanner wrench designed to fit into 2 holes in the nut

27. **SLIDE 27 EXPLAIN** Figure 116-26 After the worm gear nut has been tightened, measure 1/2 inch (13 mm) and mark the case. Using the spanner wrench, rotate the worm gear nut counterclockwise 1/2 inch, align the marks, and then tighten the retaining nut. This procedure gives the proper worm gear endplay

DEMONSTRATION: Show how to use a beam-type inch-pound torque wrench to perform an overcenter adjustment. Show how to adjust worm bearing preload by installing selectively sized shims. Show how to use a spanner wrench and a

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ruler or tape measure to adjust worm gear freeplay. **FIGURES 116-25, 26, 27**

HANDS-ON TASK: Have the students adjust worm gear freeplay. **FIGURES 116-25, 26, 27**

28. **SLIDE 28 EXPLAIN Figure 116-27** Performing an overcenter adjustment requires the use of a beam-type inch-lb torque wrench. After the worm bearing preload procedure has been completed, use the torque wrench to measure the rotating torque, which should be 6 to 15 lb-in. If the rotating torque is within the specified range, adjust the overcenter adjustment screw until you achieve 6 to 10 lb-in. additional rotating torque and then tighten the retaining nut.
29. **SLIDE 29 EXPLAIN Figure 116-28** Sector shaft endplay is the measurement of how far the sector shaft can move axially and is measured in fractions of an inch or millimeters.

ON-VEHICLE NATEF TASK: Adjust non-rack and pinion worm bearing preload and sector lash; Remove and replace rack and pinion steering gear
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30. **SLIDE 30 EXPLAIN Figure 116-29** Rack-and-pinion steering gear operation is simple, direct, and the rack is in a straight line to the front wheels.
31. **SLIDE 31 EXPLAIN Figure 116-30** A typical manual rack-and-pinion steering gear used in a small front-wheel-drive vehicle.

Rack and Pinion Steering (View)
(Download)

DEMONSTRATION: Show components of a typical manual rack-and-pinion steering gear.
FIGURE 116-30

DISCUSSION: Ask the students to discuss whether a rack and-pinion steering gear or a conventional steering gear is better

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32. **SLIDE 32 EXPLAIN Figure 116-31** The spring-loaded rack support positions the rack to keep it from rubbing against housing and establishes pinion torque.
33. **SLIDE 33 EXPLAIN Figure 116-32** adjust rack-and-pinion gear preload, loosen the retaining nut and tighten adjuster nut until it bottoms. Then loosen 60 degrees (one “flat” of the six-sided retainer). Tighten retaining nut.
34. **SLIDE 34 EXPLAIN Figure 116-33** A small air tube is used to transfer air between the boots as they extend and compress during turns.
35. **SLIDE 35 EXPLAIN Figure 116-34** This manual rack-and-pinion steering gear mounts to the bulkhead (firewall), whereas others mount to the engine cradle or frame of the vehicle.
36. **SLIDE 36 EXPLAIN Figure 116-35** Pinion torque is a turning torque force measured in inch-pounds or Newton-meters. Tightening the rack support against the rack increases the pinion torque.
37. **SLIDE 37 EXPLAIN Figure 116-36** Pinion bearing preload is a measurement of the turning force required to overcome the resistance of the pinion shaft bearings.

DEMONSTRATION: Show how to adjust the rack-and pinion gear preload:

FIGURES 116-35, 36

[Crossword Puzzle \(Microsoft Word\) \(PDF\)](#)
[Word Search Puzzle \(Microsoft Word\) \(PDF\)](#)