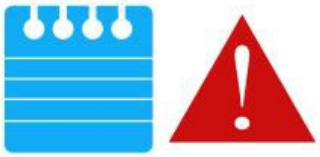
Automotive Chassis Systems 7e
Chapter 28 STEERING COLUMNS & GEARS
Opening Your Class

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: 1. Describe the operation of steering wheels. 2. Discuss steering columns and intermediate shafts. 3. Explain purpose and function of conventional steering gears. 4. Explain how a recirculating ball steering gear works. 5. Describe how a rack-and-pinion steering gear works. **This chapter will help prepare for ASE Suspension and Steering (A4) certification test content area "A" (Steering 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 Chassis Systems 7th Edition Chapter Images found on Jim's web site @ www.jameshalderman.com

LINK CHP 28: Chapter Images

ICONS	Chapter 28 Steering Columns & Gears
	**1. SLIDE 1 CH28 STEERING COLUMNS & GEARS**
	**Check for VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/** **WEB SITE IS CONSTANTLY UPDATED** **Steering System (62 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)**
	2. **SLIDE 2 EXPLAIN Figure 28-1** 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 28-2** airbag inflates at same time driver moves toward steering wheel during a front-end collision and supplements the protection of safety belt. 4. **SLIDE 4 EXPLAIN Figure 28-3** The airbag module attaches to the steering wheel and is removed as an assembly to service the steering wheel and column
 **AIR BAG CAUTION**	**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 Clock Spring Coil) by turning steering wheel when column is disconnected from steering gear.**
	**DEMONSTRATION: Show examples of airbag modules. Show the students how to identify vehicles with airbags**

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	5. **SLIDE 5 EXPLAIN Figure 28-4** 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 28-5** A pot joint is a flexible coupling used to join two shafts that allow plunging motion. 7. **SLIDE 7 EXPLAIN Figure 28-6** typical intermediate steering shaft assembly showing a U-joint and related components.
	8. **SLIDE 8 EXPLAIN Figure 28-7** flexible coupling is used to isolate road noise and vibration from the steering shaft. 9. **SLIDE 9 EXPLAIN Figure 28-8** Steering column covers are often part of the interior trim
	10. **SLIDE 10 EXPLAIN Figure 28-9** 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 28-10** 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**
	12. **SLIDE 12 EXPLAIN FIGURE 28–11** Typical steering column showing all of the components from the steering wheel to the steering gear. 13. **SLIDE 13 EXPLAIN FIGURE 28–12** The steering shaft splines onto the steering wheel. 14. **SLIDE 14 EXPLAIN Figure 28-13** The toe plate seals the hole from the steering shaft and helps seal out noise and moisture. 15. **SLIDE 15 EXPLAIN Figure 28-14** upper section of the steering column includes the lock housing and switches.
	16. **SLIDE 16 EXPLAIN Figure 28-15** upper section of the steering column contains the steering shaft bearing. 17. **SLIDE 17 EXPLAIN Figure 28-16** lock plate engages an ignition lock pawl to keep the steering wheel in one position when the ignition is off.

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	**HANDS-ON TASK:** Have the students identify the parts of steering column USING **POST-IT NOTES**
	**DEMONSTRATION:** Show how to remove several types of column covers
	**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. DEMO how to inspect the steering column per the below NATEF task
	**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 snake wire (wire used to pull new wires) to switch wires at base of steering column. As old switch removed, snake wire will be pulled up though column. Snake wire can be used to pull new switch wires in place.**
	**ON-VEHICLE NATEF TASK:** Steering column inspection and diagnosis; determine necessary action
	18. **SLIDE 18 EXPLAIN Figure 28-17** 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 28-18** Steering gear ratio is the ratio between number of degrees the steering wheel is rotated to number of degrees the front wheel turns.

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	**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 28-19** Constant-ratio steering gear sector shaft. All 3 gear teeth are same size. 21. **SLIDE 21 EXPLAIN Figure 28-20** Variable-ratio steering gear sector shaft. Notice larger center gear tooth. 22. **SLIDE 22 EXPLAIN Figure 28-21** 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**
	**DEMONSTRATION: Show examples of constant ratio steering gear sector shafts and variable-ratio steering gear sector shafts** **FIGURES 28-19, 28-20**
	**DEMONSTRATION: Show the students examples of typical manual recirculating ball steering gears.**
	23. **SLIDE 23 EXPLAIN Figure 28-22** typical manual recirculating ball steering gear.
	**DISCUSSION: Have a discussion of problems with upper and lower bearings FIGURES 28-22**
	24. **SLIDE 24 EXPLAIN Figure 28-23** sector shaft is supported by bushings, one in the housing and one in the side cover
	25. **SLIDE 25 EXPLAIN Figure 28-24** 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 28-25** first step to adjust worm gear freeplay is to bottom the worm gear nut, using a spanner wrench designed to fit into the two holes in the nut 27. **SLIDE 27 EXPLAIN Figure 28-26** After the worm gear nut has been tightened, measure 1/2 inch (13 mm) and mark the case.

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	**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 ruler or tape measure to adjust worm gear freeplay. FIGURES 28-25, 26, 27**
	**28. SLIDE 28 EXPLAIN Figure 28-27** Performing an overcenter adjustment requires use of beam-type inch-lb torque wrench. After worm bearing preload procedure has been completed, use the torque wrench to measure rotating torque, which should be 6 to 15 lb-in. If 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 retaining nut. **29. SLIDE 28 EXPLAIN Figure 28-28** Sector shaft endplay is measurement of how far sector shaft can move axially and measured in fractions of an inch or millimeters
	**HANDS-ON TASK:** **Have the students adjust worm gear freeplay. FIGURES 28-25, 26, 27**
	**ON-VEHICLE NATEF TASK:** **Adjust non-rack and pinion worm bearing preload and sector lash; Remove and replace rack and pinion steering gear**
	**30. SLIDE 30 EXPLAIN Figure 28-29** 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 28-30** A typical manual rack-and-pinion steering gear used in a small front-wheel-drive vehicle
	**Rack and Pinion Steering**
	**DEMONSTRATION:** **Show components of a typical manual rack-and-pinion steering gear. FIGURE 28-30**
	**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 28-31** The spring-loaded rack support positions the rack to keep it from rubbing against the housing and establishes the pinion torque. **33. SLIDE 33 EXPLAIN Figure 28-32** To adjust rack-and-pinion gear preload, loosen 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 28-33** A small air tube is used to transfer air between the boots as they extend and compress during turns. **35. SLIDE 35 EXPLAIN Figure 28-34** manual rack-and-pinion steering gear mounts to bulkhead (firewall), whereas others mount to engine cradle or frame
	**36. SLIDE 36 EXPLAIN Figure 28-35** 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 28-36** 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 rack-and pinion gear preload: FIGURES 28-35, 36**