Automotive Chassis Systems 7e
Chapter 33 Drive Axle Shaft & CV Joint 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: 1. Explain how to perform a U-joint inspection. 2. List the steps necessary to replace a U-joint. 3. Explain how to perform a measurement of the working angles of a U-joint. 4. Diagnose problems with CV joints and describe the service procedures for replacing CV joints. **This chapter will help prepare for ASE Suspension and Steering (A4) certification test content area "C" (Related Suspension and Steering Service).**
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 33: Chapter Images

ICONS	Chapter 33 Driveshaft & U-Joint Service
	1. SLIDE 1 Ch17 Drive Axle Shafts & CV Joint Service
	Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE IS CONSTANTLY UPDATED **Drive Axle (41 Links)** **Drive Shaft (27 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)
	
	**DEMONSTRATION:** Show a U-joint yoke and trunnions or a bearing cap. Show students the needle bearings and their placement in the cap.
	**DISCUSSION:** Ask the students to discuss how torque is transmitted through needle bearings on a driveshaft with zero angles. Ask them to discuss how this torque can damage the needle bearings.
	**DISCUSSION:** Ask the students to discuss the relationship of engine speed to driveshaft speed through changing gear ratios.
	2. **SLIDE 2 EXPLAIN FIGURE 33–1** Notice how needle bearings have worn grooves into bearing surface 3. **SLIDE 3 EXPLAIN Figure 33-2** All U-joints and spline collars equipped with a grease fitting should be greased 4 times a year as part of regular lubrication service
	**DEMONSTRATION:** Show an example of several U-joints with grease fittings. Show proper way to access these grease fittings. **FIGURE 33-2**
	**DEMONSTRATION:** Show proper way to grease a U-joint. Too much grease will open or break seals, leaving openings where dirt and water can enter joint. **FIG 33-2**

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	4. **SLIDE 4 EXPLAIN Figure 33-3** Many U-joints require special grease gun tool to reach grease fittings. Alemite is a manufacturer of lubrication equipment so many parts and tools use the Alemite name
	**DISCUSSION: Ask the students to discuss the importance of periodic greasing and inspecting of the U-joints.**
	**HANDS-ON-TASK: Have your students grease a U-joint**
	5. **SLIDE 5 EXPLAIN Figure 33-4** Always mark the original location of U-joints before disassembly
	**DISCUSSION: Ask the students to discuss the importance of marking U-joint components before disassembly FIGURE 33-4. Ask the students to discuss various ways to mark U-joint orientation before disassembly.**
	6. **SLIDE 6 EXPLAIN Figure 33-5** Two types of retaining methods that are commonly used at the rear U-joint at the differential
	**When checking U-joints in the vehicle, you may find it hard to move a worn U-joint. A little pressure with a prybar can make the movement more obvious.**
	7. **SLIDE 7 EXPLAIN Figure 33-6** best way to check any U-joint is to remove the driveshaft from the vehicle and move each joint in all directions. A good U-joint should be free to move without binding
	**DEMONSTRATION: Show the proper way to remove a driveshaft from a rear wheel-drive vehicle that doesn't contain a center support bearing.**
	**GM service text often refers to driveshaft as a "propeller shaft."**

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	**HANDS-ON-TASK:** Have students remove a driveshaft from a RWD vehicle
	**SEARCH INTERNET:** Have students search Internet to research the new technology used in the design and manufacturing of U-joints. Ask them to write down at least 2 innovations in past 10 years that have improved performance of U-joints.
	8. **SLIDE 8 EXPLAIN Figure 33-7** Typical U-joint that uses an outside snap ring. This style of joint bolts directly to the companion flange that is attached to the pinion gear in the differential 9. **SLIDE 9 EXPLAIN Figure 33-8** A U-joint that is held together by nylon and usually requires that heat be applied to remove from the yoke.
	**HANDS-ON-TASK:** Have the students remove an external and an internal clip from U-joint **FIGURE 33-7, (33-8: NYLON RETAINERS)**
	**If a retainer clip is difficult to remove, put pressure on joint to move clip out of contact with housing. This makes removal easier.**
	10. **SLIDE 10 EXPLAIN Figure 33-9** Use a vise and two sockets to replace a U-joint. One socket fits over the bearing cup and one fits on the bearing to press fit the cups from the crosspiece. 11. **SLIDE 11 EXPLAIN FIGURE 33–10** Taping the U-joint to prevent the caps from coming off.
	**DEMONSTRATION:** Show how to remove a U-joint with a vise **FIGURE 33-9**.
	**DEMONSTRATION:** Show how to remove a U-joint from a driveshaft by using a special U-joint press
	**HANDS-ON-TASK:** Have students R&R a U-joint using the vise or press method **FIGURE 33-9**.

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	When replacing U-joint, grease Zerk FITTING should face the shaft.
DEMO	**DEMONSTRATION: Show the proper tools and procedure for removing U-joint retainer clips**
	12. SLIDE 12 EXPLAIN Figure 33-11 A special tool being used to press apart a U-joint that is retained by injected plastic. Heat from a propane torch may be necessary to soften the plastic to avoid exerting too much force on the U-joint
	You can remove NYLON retainers by carefully heating the retainer area with Torch. Be careful not to get burned by the synthetic material as it comes out
	13. SLIDE 13 EXPLAIN Figure 33-12 Removing the worn cross from the yoke.
	14. SLIDE 14 EXPLAIN Figure 33-13 When installing a new U-joint, position the grease fitting on the inboard side (toward the driveshaft tube) and in alignment with the grease fitting of the U-joint at the other end.
DEMO	**DEMONSTRATION: Show how to use an inclinometer to measure the angle of driveshaft. FIGURE 33-15**
	15. SLIDE 15 EXPLAIN Figure 33-14 The working angle of most U-joints should be at least 1/2 degree (to permit the needle bearing to rotate in the U-joints) and should not exceed 3 degrees or a vibration can occur in the driveshaft, especially at higher speeds. The difference between the front and rear working angles should be within 1/2 degree of each other.
	16. SLIDE 16 EXPLAIN Figure 33-15 An inclinometer with a magnetic base is being used to measure the angle of the driveshaft at the rear U-joint.
	17. SLIDE 17 EXPLAIN Figure 33-16 Placing a tapered metal wedge between the rear leaf spring and the rear axle pedestal to correct rear U-joint working angles.
QUESTION	**HANDS-ON-TASK: Have the students explain, how bad motor and transmission mounts can affect driveline angles.**
	HANDS-ON-TASK: Have the students use inclinometer

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	to measure the angle of a driveshaft. Have them explain why angle of driveshaft is important **FIGURE 33-15.** Then have them use the results from their measurements to mathematically determine difference between OEM specifications & working angles as measured.
	**DISCUSSION:** Ask students to discuss how lifting vehicles for tire clearance affects driveline angles.
	**Some four-wheel-drive vehicles have kits available to lower the transfer case to correct driveline angles.**
	**18. SLIDE 18 EXPLAIN Figure 33-17** A transmission oil pan gasket leak allowed automatic transmission fluid (ATF) to saturate the rear transmission mount rubber, causing it to collapse. After replacing the defective mount, proper driveshaft angles were restored and the driveline vibration was corrected
	**SEARCH INTERNET:** Have students search Internet to research U-joint technology available for high-performance vehicles. What upgrades can make U-joints stronger. Have a discussion at next class.
	**DISCUSSION:** Ask the students to discuss the advantages and disadvantages of replacing the entire drive axle shaft assembly as compared to rebuilding and rebooting the CV joint.
	**DEMONSTRATION:** Show examples of worn drive axle CV joints. Demonstrate where to look in the CV joint for signs of wear.
	**HANDS-ON-TASK:** Have the students inspect several failed CV joints. Have the students list why each one was taken out of service. Give students credit for each correctly identified failure.
	**DEMONSTRATION:** Show the various boot-attaching methods. Demonstrate tools used to tighten the clamps on boots.
	**DEMONSTRATION:** Show the students how to remove an outer CV joint from the drive axle shaft.

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	**DEMONSTRATION:** Show how to properly disassemble CV Joint. Demonstrate packing joint and resealing the boot with appropriate clamps.
	**HANDS-ON-TASK:** Have the students mark and remove the boot from the CV joint. Have them remove and disassemble CV joint, clean and inspect the CV joint, and reassemble the CV joint and install the boot. Grade them on the completeness and accuracy of their inspection and reassembly.
	**ON-VEHICLE NATEF TASK:** Diagnose constant-velocity (CV) joint noise and vibration concerns; determine necessary action
	**ON-VEHICLE NATEF TASK:** Inspect and replace drive axle shaft wheel studs.
	**When deciding whether to buy a new or a used CV drive axle, remember that used one may not be in any better shape than one you are replacing.**
	**SEARCH INTERNET:** Have the students search Internet to research U-joint changing tools. Have students share the prices and features of the tools with the class.
	**CV Joint**
	**DEMONSTRATION:** Show procedure for removing large axle nut on the end of the drive axle. Demonstrate how to use an impact wrench and a large breaker bar.
	**FIGURE 33-32** **When using an impact wrench to remove an axle retainer nut, have an assistant hold brake pedal. This will take hammer strain off final drive.**
	19. **SLIDE 19 EXPLAIN Figure 33-18** The hub nut must be removed before the hub bearing assembly or drive axle shaft can be removed from the vehicle. 20. **SLIDE 20 EXPLAIN Figure 33-19** knuckles are attached to the ball joint on the lower control arm by a pinch bolt.

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	**21. SLIDE 21 EXPLAIN Figure 33-20** 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 be used only if the tie rod is going to be replaced. A pickle-fork-type tool can damage or tear the rubber grease boot. Striking the tie rod end with a hammer while holding another hammer behind the joint to shock and break the taper from the steering knuckle can also be used. **22. SLIDE 22 EXPLAIN Figure 33-21** Many drive axles are retained by **torque prevailing nuts** that must not be reused. Torque prevailing nuts are slightly deformed or contain a plastic insert that holds the nut tight (retains the torque) to the shaft without loosening.
	**23. SLIDE 23 EXPLAIN Figure 33-22** A special General Motors tool is being used to separate the drive axle shaft from the wheel hub bearing. **24. SLIDE 24 EXPLAIN Figure 33-23** Most inner CV joints can be separated from the transaxle with a prybar. **25. SLIDE 25 EXPLAIN Figure 33-24** When removing a drive axle shaft assembly, use care to avoid pulling the plunge joint apart. **26. SLIDE 26 EXPLAIN Figure 33-25** If other service work requires that just one end of the drive axle shaft be disconnected from the vehicle, be sure that the free end is supported to prevent damage to the protective boots or allowing the joint to separate. **27. SLIDE 27 EXPLAIN Figure 33-26** With a scribe, mark the location of the boots before removal. The replacement boots must be in the same location. **28. SLIDE 28 EXPLAIN Figure 33-27** Most CV joints use a snap ring to retain the joint on the drive axle shaft. **29. SLIDE 29 EXPLAIN Figure 33-28** After releasing the snap ring, most CV joints can be tapped off the shaft using a brass or shot-filled plastic (dead-blow) hammer.
	**DEMONSTRATION: Show proper way to hang a brake caliper out of the way while working on the drive axle. Explain to them the importance of not letting the caliper hang from the brake hose.**
	**If possible, only remove lower ball joint from steering knuckle. This way the alignment won't be disturbed. Be sure to unplug wheel speed sensor to gain more clearance for CV joint removal.**

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	**30. SLIDE 30 EXPLAIN Figure 33-29** Typical outer CV joint after removing the boot and the joint from the drive axle shaft. This joint was removed from the vehicle because a torn boot was found. After disassembly and cleaning, this joint was found to be OK and was put back into service. Even though the grease looks terrible, there was enough grease in the joint to provide enough lubrication to prevent any wear from occurring. **31. SLIDE 31 EXPLAIN Figure 33-30** The cage of this Rzeppa-type CV joint is rotated so that one ball at a time can be removed. Some joints require that the technician use a brass punch and a hammer to move the cage.
	**32. SLIDE 32 EXPLAIN Figure 33-31** Be sure to use all of the grease supplied with the replacement joint or boot kit. Use only the grease supplied and do not use substitute grease. **33. SLIDE 33 EXPLAIN Figure 33-32** A screwdriver is shown, but a punch would be better, to keep the rotor from rotating while removing or installing the drive axle shaft spindle nut. **34. SLIDE 34 EXPLAIN FIGURE 33–33** The engine had to be raised higher to get the new (non-collapsed) engine mount installed
	**35. SLIDES 35-43 OPTIONAL SLIDES TO EXPLAIN DRIVE AXLE SHAFT REPLACEMENT**
	**ON-VEHICLE NATEF TASK: Remove and replace drive axle shafts.**
	**ON-VEHICLE NATEF TASK: Inspect, service, and replace shafts, shaft center support bearings yokes, boots, and CV joints; check shaft balance and phasing.**
	**SEARCH INTERNET: Have students use Internet to research aftermarket suppliers of complete CV drive axle shaft replacements. Ask them to prepare a table or spreadsheet that includes at least 5 suppliers and their prices. Ask them to compare prices and specifications and determine which supplier is the best choice.**