



















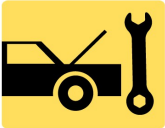






Automotive Maintenance and Light Repair, 1ST Edition












Chapter 65 Drive Shafts and CV Joints

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 “C” (Related Suspension and Steering Service).— Name driveshaft and U-joint parts, and describe their function and operation.— Describe how CV joints work.— Explain how the working angles of the U-joints are determined.— List the various types of CV joints and their applications.— Discuss the proper grease to use in CV joints.
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	Ch65 Drive Shafts and CV Joints
	<p>1. SLIDE 1 CH65 Drive Shafts & CV Joints 2. SLIDES 2-3 EXPLAIN OBJECTIVES</p>
 	<p>Check for ADDITIONAL VIDEOS & ANIMATIONS @ http://www.jameshalderman.com/ WEB SITE REGULARLY UPDATED</p>
	<p>4. SLIDES 4-5 EXPLAIN Introduction</p>
	<p>DRIVE SHAFT OPERATION WWW.MYAUTOMOTIVELAB.COM HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A8_ANIMATION/CHAPTER96_FIG_96_1/INDEX.HTM</p>
	<p><u>RWD Driveshaft Operation</u> <u>RWD Drivetrain</u></p>
	<p>6. SLIDE 6 EXPLAIN Figure 65-1 Typical rear-wheel-drive powertrain arrangement. Engine is mounted longitudinal (lengthwise).</p>
  <p>QUESTION</p>	<p><u>DISCUSSION: DISCUSS THE ADVANTAGES AND DISADVANTAGES OF ALUMINUM DRIVESHAFTS.</u></p>
	<p><u>DEMONSTRATION: SHOW UNIVERSAL JOINTS ON BOTH ENDS OF A DRIVESHAFT LET IT ROTATE EVEN THOUGH THE TWO ENDS OF THE SHAFT ARE OUT OF ALIGNMENT.</u></p>
	<p>7. SLIDES 7 EXPLAIN Figure 65-2 Typical front-wheel-drive powertrain arrangement. The engine is usually mounted transversely (sideways).</p>
	<p>8. SLIDES 8 EXPLAIN Figure 65-3 Typical driveshaft (also called a propeller shaft). The driveshaft transfers engine power from the transmission to the differential.</p>
	<p><u>DEMONSTRATION: SHOW DRIVESHAFT MADE OF STEEL AND ANOTHER ONE MADE OF ALUMINUM. SHOW THEM PARTS OF DRIVESHAFT, INCLUDING TUBE, SLIP YOKE, END YOKE, & BALANCE WEIGHTS.</u></p>

ICONS	Ch65 Drive Shafts and CV Joints
	<p>DEMONSTRATION: SHOW UNIVERSAL JOINTS ON BOTH ENDS OF A DRIVESHAFT LET IT ROTATE EVEN THOUGH THE TWO ENDS OF THE SHAFT ARE OUT OF ALIGNMENT.</p>
	<p>9. SLIDES 9-12 EXPLAIN Driveshaft Design</p>
  <p>QUESTION</p>	<p>13. SLIDE 13 EXPLAIN Figure 65-4 This driveshaft failed because it had a slight dent caused by a rock. When engine torque was applied, the driveshaft collapsed, twisted, and then broke.</p>
	<p>DISCUSSION: DISCUSS THE EFFECTS OF AN OUT-OF-BALANCE DRIVESHAFT. (EXAMPLES: DRIVER COMPLAINTS AND DAMAGE TO OTHER PARTS)</p>
 	<p>HANDS-ON-TASK & DISCUSSION: HAVE THE STUDENTS USE INTERNET TO RESEARCH LIFE OF GIROLAMO CARDANO. DISCUSS HIS LIFE AND HIS INVENTION OF THE CARDAN JOINT, A TYPE OF UNIVERSAL JOINT IN A SHAFT THAT ENABLES THE JOINT TO ROTATE WHEN OUT OF ALIGNMENT.</p>
	<p>14. SLIDE 14 EXPLAIN Figure 65-5 A center support bearing is used on many vehicles with long driveshafts such as long trucks.</p>
	<p>15. SLIDE 15 EXPLAIN Figure 65-6 Some driveshafts use rubber between an inner and outer housing to absorb vibrations and shocks to the driveline.</p>
  <p>QUESTION</p>	<p>DISCUSSION: DISCUSS WHY SOME DRIVESHAFTS HAVE A CENTER SUPPORT BEARING.</p>
	<p>DEMONSTRATION: SHOW CENTER SUPPORT BEARING FOR A TWO-PIECE DRIVESHAFT.</p>
	<p>SEARCH INTERNET: HAVE THE STUDENTS USE THE INTERNET TO RESEARCH HOW A TORQUE TUBE SYSTEM WORKS. ASK THEM TO WRITE A REPORT DESCRIBING HOW A TORQUE TUBE DIFFERS FROM A HOTCHKISS SYSTEM AND PROVIDING REASONS FOR USING THE TORQUE TUBE SYSTEM..</p>

ICONS	Ch65 Drive Shafts and CV Joints
	<p>16. SLIDES 16-17 EXPLAIN Driveshaft Balance</p>
	<p>DEMONSTRATION: SHOW HOW TO BALANCE A DRIVESHAFT USING HOSE CLAMPS.</p>
	<p>HANDS-ON-TASK HAVE THE STUDENTS LOCATE SERVICE INFORMATION TO BALANCE A DRIVESHAFT THEN BALANCE THE DRIVESAFT ON A LAB VEHICLE</p>
	<p>18. SLIDES 18-21 EXPLAIN U-Joint Design and Operation</p>
	<p>22. SLIDE 22 EXPLAIN Figure 65-7 A simple universal joint (U-joint).</p>
	<p>SEARCH INTERNET: HAVE THE STUDENTS RESEARCH OTHER INNOVATIONS THAT CORD AUTOMOBILES USED IN THE 1920S. HAVE THE STUDENTS EXPLAIN THE INNOVATIONS THEY FIND.</p>
	<p>23. SLIDE 23 EXPLAIN Figure 65-8 How the speed difference on the output of a typical U-joint varies with the speed and the angle of the U-joint. At the bottom of the chart, the input speed is a constant 1000 RPM, while the output speed varies from 900 RPM to 1100 RPM when the angle difference in the joint is only 10°. At the top part of the chart, the input speed is a constant 1000 RPM, yet the output speed varies from 700 to 1200 RPM when angle difference in joint is changed to 30°</p>
  <p>QUESTION</p>	<p>DISCUSSION: DISCUSS INFORMATION IN FIGURE 65-8. DISCUSS HOW CHANGE IN OUTPUT RPM WOULD AFFECT DRIVABILITY</p>
	<p>24. SLIDES 24-25 EXPLAIN U-Joint Design and Operation</p> <p>26. SLIDE 26 EXPLAIN Figure 65-9 joint angle is the difference between the angles of the joint</p>
	<p>DEMONSTRATION: SHOW HOW TO FIND DRIVESHAFT ANGLE.</p>

ICONS

Ch65 Drive Shafts and CV Joints



QUESTION

HANDS-ON-TASK: HAVE STUDENTS PRACTICE CHECKING DRIVE SHAFT ANGLES & USE INTERNET TO RESEARCH U.S. PATENT 2,010,899.

27. SLIDES 27-31 EXPLAIN U-Joint Design and Operation

32. SLIDE 32 EXPLAIN Figure 65-10 The angle of this rear Cardan U-joint is noticeable.

SEARCH INTERNET CURRICULAR ACTIVITY: MATHEMATICS: DETERMINE THE FOOT-POUNDS OF TORQUE SUPPLIED TO THE WHEELS FOR A GIVEN VEHICLE. THEN HAVE THEM DETERMINE MATHEMATICALLY THE TORQUE APPLIED TO EACH OF THE SIX BALLS IN A FIXED CV JOINT.

OUTER CV JOINT

[WWW.MYAUTOMOTIVELAB.COM](http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/a8_animation/chapter96_fig_96_13/index.htm)

[HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A8_ANIMATION/CHAPTER96_FIG_96_13/INDEX.HTM](http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/a8_animation/chapter96_fig_96_13/index.htm)

CV Joint




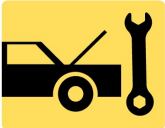








33. SLIDES 33-35 EXPLAIN Constant Velocity Joints

36. SLIDE 26 EXPLAIN Figure 64-11 A double-Cardan U-joint.

DEMONSTRATION: SHOW THE STUDENTS AN EXAMPLE OF A DOUBLE-CARDAN U-JOINT (FIGURE 64-11). SHOW THEM RELATIONSHIP BETWEEN TWO JOINTS AND HOW THE TORQUE IS TRANSMITTED THROUGH CENTER YOKE SUPPORT.

37. SLIDE 37 EXPLAIN Figure 64-12 A constant velocity (CV) joint can operate at high angles without a change in velocity (speed) because the joint design results in equal angles between input and output.

DISCUSSION: DISCUSS THE ADVANTAGE OF A CONSTANT VELOCITY JOINT AS SHOWN IN FIGURE 64-12

ICONS	Ch65 Drive Shafts and CV Joints
	<p>DEMONSTRATION: SHOW OUTER CV JOINT. SHOW THEM THE MAIN COMPONENTS OF THE JOINT. <u>FIGURE 64-12</u></p>
	<p>38. SLIDES 38-42 EXPLAIN Constant Velocity Joints</p>
	<p>43. SLIDE 43 EXPLAIN Figure 64-13 A Rzeppa fixed joint on a front-wheel-drive vehicle. This type of CV joint is commonly used at the wheel side of the drive axle shaft on a front-wheel-drive vehicle. This joint can operate at high angles to compensate for suspension travel and steering angle changes</p>
	<p>HANDS-ON-TASK HAVE THE STUDENTS IDENTIFY THE MAJOR COMPONENTS OF THE CV JOINT ASSEMBLY, USING A DIAGRAM SIMILAR TO <u>FIGURE 64-13</u></p>
	<p>DEMONSTRATION: SHOW OUTER CV JOINT AND DEMONSTRATE HOW IT TRANSMITS TORQUE EQUALLY TO THE DRIVE WHEELS AT ANGLES UP TO 40 DEGREES.</p>
	<p>DEMONSTRATION: SHOW INNER CV JOINT. SHOW HOW THE INNER (PLUNGE) CV JOINT CAN MOVE IN AND OUT, UNLIKE THE OUTER (FIXED) CV JOINT.</p>
	<p>DISCUSSION: DISCUSS THE DIFFERENCE BETWEEN INNER AND OUTER CV JOINTS. WHAT IS THE MAJOR DIFFERENCE?</p>
	<p>44. SLIDE 44 EXPLAIN Figure 65-14 protective CV joint boot has been torn away on this vehicle and all of the grease has been thrown outward onto the brake and suspension parts. The driver of this vehicle noticed a “clicking” noise, especially when turning.</p>
	<p>DEMONSTRATION: SHOW SOME EXAMPLES OF DAMAGED OR TORN CV JOINT BOOTS LIKE THE ONE IN <u>FIGURE 65-14</u></p>
	<p>45. SLIDE 45 EXPLAIN Figure 65-15 A tripod fixed joint. This type of joint is found on some Japanese vehicles. If the joint wears out, it is to be replaced with an entire drive axle shaft assembly.</p>
	<p>46. SLIDES 46-48 EXPLAIN Constant Velocity Joints</p>
	<p>49. SLIDE 49 EXPLAIN Figure 65-16 fixed outer joint is required to move in all directions because the wheels must</p>

ICONS

Ch65 Drive Shafts and CV Joints



QUESTION



turn for steering as well as move up and down during suspension movement. The inner joint has to be able to not only move up and down but also plunge in and out as the suspension moves up and down.

AXLE DRIVESHAFT OPERATION

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[HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A8_ANIMATION/CHAPTER96_FIG_96_16/INDEX.HTM](http://media.pearsoncmg.com/ph/chet/chet_myautomotivelab_2/animations/a8_animation/chapter96_fig_96_16/index.htm)

AXLE DRIVESHAFT OPERATION

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50. SLIDES 50-54 EXPLAIN Constant Velocity Joints

TRANSAXLE TORQUE STEER

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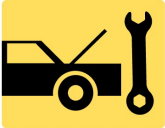
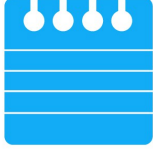




55. SLIDE 55 EXPLAIN Figure 65-17 Unequal-length driveshafts result in unequal drive axle shaft angles to front drive wheels. This unequal angle side-to-side often results in a steering of vehicle during acceleration called torque steer. By using an intermediate shaft, both drive axles are the same angle & torque steer effect is reduced











DEMONSTRATION: SHOW EQUAL LENGTH, HALF SHAFTS AND, AN INTERMEDIATE SHAFT.







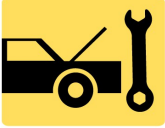
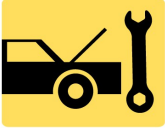
DISCUSSION: DISCUSS WHY THE INNER CV JOINT MUST BE ABLE TO PLUNGE?


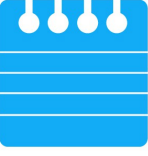






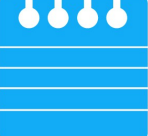


DEMONSTRATION: SHOW EXAMPLES OF NATURAL RUBBER, SILICONE RUBBER, HARD THERMOPLASTIC, AND URETHANE CV BOOTS.






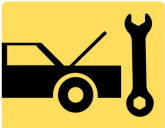




HANDS-ON-TASK HAVE THE STUDENTS IDENTIFY WITH LABELS THE DIFFERENT MATERIALS CV BOOTS ARE MADE FROM.

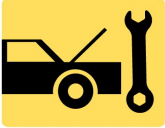








ICONS	Ch65 Drive Shafts and CV Joints
	<p>56. SLIDE 56 EXPLAIN Figure 65-18 typical drive axle shaft with dampener weight.</p> <p>57. SLIDE 57 EXPLAIN Figure 65-19 Many CV points are close to the exhaust system where they are exposed to higher than normal temperatures.</p>
	<p>DISCUSSION: DISCUSS HOW BOOT AROUND THE CV JOINT CAN BE DAMAGED. (EXAMPLES: ROAD HAZARDS, MECHANIC'S ERROR WHEN WORKING AROUND THE BOOT, AND DRYING OUT FROM AGE)</p>
	<p>DISCUSSION: DISCUSS IMPORTANCE OF INSPECTING CV BOOT WHENEVER YOU HAVE AN OPPORTUNITY TO LOOK UNDER VEHICLE. ASK THEM TO LIST SEVERAL OPPORTUNITIES A TECHNICIAN WOULD HAVE TO INSPECT CV BOOT.</p>
	<p>HANDS-ON-TASK HAVE THE STUDENTS INSPECT SEVERAL CV JOINT BOOTS ON LAB VEHICLES</p>
	<p>A SPLIT CV BOOT IS GOOD TO USE IN AN EMERGENCY FOR A TEMPORARY REPAIR. YOU SHOULD THEN REPLACE IT AND CLEAN CV JOINT AS SOON AS POSSIBLE.</p>
	<p>SEARCH INTERNET: HAVE THE STUDENTS SEARCH THE INTERNET FOR WAYS TO REDUCE TORQUE STEER. HAVE STUDENTS SHARE THEIR FINDINGS DURING THE NEXT CLASS.</p>
	<p>DEMONSTRATION: SHOW A U-JOINT YOKE AND TRUNNIONS OR A BEARING CAP. SHOW STUDENTS THE NEEDLE BEARINGS AND THEIR PLACEMENT IN THE CAP.</p>
	<p>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.</p>
	<p>DISCUSSION: DISCUSS THE RELATIONSHIP OF ENGINE SPEED TO DRIVESHAFT SPEED THROUGH CHANGING GEAR RATIOS.</p>



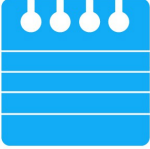
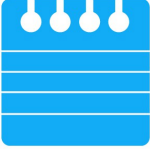


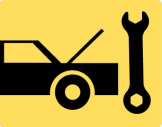
ICONS	Ch65 Drive Shafts and CV Joints
	<p>58. SLIDE 58 EXPLAIN Figure 65-20 All U-joints and spline collars equipped with grease fitting should be greased 4 times a year as part of regular service.</p>
	<p>59. SLIDE 59 EXPLAIN Figure 65-21 Many U-joints require a special grease gun tool to reach the grease fittings. Alemite is a manufacturer of lubrication equipment so many parts and tools use the Alemite name</p>
	<p>DEMONSTRATION: SHOW AN EXAMPLE OF SEVERAL U-JOINTS WITH GREASE FITTINGS. SHOW PROPER WAY TO ACCESS THESE GREASE FITTINGS. FIGURE 65-20</p>
	<p>DEMONSTRATION: SHOW PROPER WAY TO GREASE A U-JOINT. EXPLAIN THAT TOO MUCH GREASE WILL OPEN OR BREAK THE SEALS, LEAVING OPENINGS WHERE DIRT AND WATER CAN ENTER THE JOINT. FIGURE 65-20</p>
	<p>DEMONSTRATION: SHOW AN EXAMPLE OF CV JOINT GREASE AND AN EXAMPLE OF COMMON CHASSIS GREASE. COMPARE VISCOSITY AND TEXTURE OF THE TWO GREASES.</p>
	<p>DISCUSSION: DISCUSS THE IMPORTANCE OF CLEAN AND CORRECT GREASE IN A CV JOINT. ASK THEM TO DISCUSS HOW THE GREASE CAN BECOME CONTAMINATED.</p>
	<p>DISCUSSION: DISCUSS PROBLEMS THAT MIGHT OCCUR IF THE WRONG GREASE IS USED IN A CV JOINT.</p>
	<p>AFTER CLEANING A CV JOINT WITH SOLVENT, THE SOLVENT MUST BE REMOVED. ANY SOLVENT LEFT BEHIND WILL CONTAMINATE THE NEW GREASE.</p>
	<p>DISCUSSION: DISCUSS THE IMPORTANCE OF PERIODIC GREASING AND INSPECTING OF THE U-JOINTS.</p>
	<p>HANDS-ON-TASK: HAVE YOUR STUDENTS GREASE A U-JOINT</p>

ICONS	Ch65 Drive Shafts and CV Joints
	<p>60. SLIDES 60-63 EXPLAIN Constant Velocity Joints</p>
	<p>64. SLIDE 64 EXPLAIN Figure 65-22 Always mark the original location of U-joints before disassembly</p> <p>DISCUSSION: DISCUSS MARKING U-JOINT COMPONENTS BEFORE DISASSEMBLY FIGURE 65-22. DISCUSS WAYS TO MARK U-JOINTS</p>
	<p>65. SLIDE 65 EXPLAIN Figure 65-23 Two types of retaining methods that are commonly used at the rear U-joint at the differential</p>
<p>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.</p>	<p>66. SLIDE 66 EXPLAIN Figure 65-24 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</p>
	<p>DEMONSTRATION: SHOW THE PROPER WAY TO REMOVE A DRIVESHAFT FROM A REAR WHEEL-DRIVE VEHICLE THAT DOESN'T CONTAIN A CENTER SUPPORT BEARING.</p>
	<p>GM SERVICE TEXT OFTEN REFERS TO DRIVESHAFT AS A "PROPELLER SHAFT."</p>
	<p>HANDS-ON-TASK: HAVE STUDENTS REMOVE A DRIVESHAFT FROM A RWD VEHICLE</p>
	<p>SEARCH INTERNET: HAVE THE STUDENTS SEARCH THE INTERNET TO RESEARCH THE NEW TECHNOLOGY USED IN THE DESIGN AND MANUFACTURING OF U-JOINTS. ASK THEM TO WRITE DOWN AT LEAST TWO INNOVATIONS IN THE PAST 10 YEARS THAT HAVE IMPROVED THE PERFORMANCE OF U-JOINTS.</p>
	

ICONS	Ch65 Drive Shafts and CV Joints
	<p>67. SLIDES 67 EXPLAIN Figure 65-25 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</p>
	<p>IF A RETAINER CLIP IS DIFFICULT TO REMOVE, PUT PRESSURE ON JOINT TO MOVE CLIP OUT OF CONTACT WITH HOUSING. THIS MAKES REMOVAL EASIER.</p>
	<p>68. SLIDE 68 EXPLAIN Figure 65-26 A U-joint that is held together by nylon and usually requires that heat be applied to remove from the yoke.</p>
	<p>69. SLIDE 69 EXPLAIN Figure 65-27 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.</p>
	<p>HANDS-ON-TASK: HAVE STUDENTS REMOVE AN EXTERNAL AND AN INTERNAL CLIP FROM U-JOINT FIGURE 65-26</p>
	<p>DEMONSTRATION: SHOW HOW TO REMOVE A U-JOINT WITH A VISE FIGURE 65-27.</p>
	<p>DEMONSTRATION: SHOW HOW TO REMOVE A U-JOINT FROM A DRIVESHAFT BY USING A SPECIAL U-JOINT PRESS</p>
	<p>HANDS-ON-TASK: HAVE STUDENTS R&R A U-JOINT USING THE VISE OR PRESS METHOD FIGURE 65-27</p>
	<p>WHEN REPLACING U-JOINT, GREASE ZERK FITTING SHOULD FACE THE SHAFT.</p>
	<p>DEMONSTRATION: SHOW THE PROPER TOOLS AND PROCEDURE FOR REMOVING U-JOINT RETAINER CLIPS</p>
	<p>70. SLIDE 70 EXPLAIN Figure 65-28 Taping the U-joint to prevent the caps from coming off</p> <p>71. SLIDE 71 EXPLAIN Figure 65-29 special tool being used to press apart a U-joint that is retained by injected</p>

ICONS	Ch65 Drive Shafts and CV Joints
	<p>plastic. Heat from propane torch may be necessary to soften plastic to avoid exerting force on U-joint</p> <p>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</p>
	<p>72. SLIDE 72 EXPLAIN Figure 65-30 Removing the worn cross from the yoke.</p> <p>73. SLIDE 73 EXPLAIN Figure 65-31 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.</p>
  <p>QUESTION</p>	<p>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.</p>
	<p>DEMONSTRATION: SHOW EXAMPLES OF WORN DRIVE AXLE CV JOINTS. DEMONSTRATE WHERE TO LOOK IN THE CV JOINT FOR SIGNS OF WEAR.</p>
	<p>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.</p>
	<p>AXLE DRIVESHAFT OPERATION WWW.MYAUTOMOTIVELAB.COM</p>
<p><small>HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A8_ANIMATION/CHAPTER96_FIG_96_16/INDEX.HTM</small></p>	
	<p>DEMONSTRATION: SHOW THE VARIOUS BOOT-ATTACHING METHODS. DEMONSTRATE TOOLS USED TO TIGHTEN THE CLAMPS ON BOOTS.</p>
	<p>DEMONSTRATION: SHOW THE STUDENTS HOW TO REMOVE AN OUTER CV JOINT FROM THE DRIVE AXLE SHAFT.</p>
	<p>DEMONSTRATION: SHOW HOW TO PROPERLY DISASSEMBLE CV JOINT. DEMONSTRATE PACKING JOINT AND RESEALING THE BOOT WITH APPROPRIATE CLAMPS.</p>

ICONS	Ch65 Drive Shafts and CV Joints
	<p>HANDS-ON-TASK: HAVE STUDENTS MARK AND REMOVE BOOT FROM 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.</p>
	<p>AXLE DRIVESHAFT OPERATION WWW.MYAUTOMOTIVELAB.COM <small>HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYLABS/AKAMAI/TEMPLATE/VIDEO640X480.PHP?TITLE=DRIVE%20AXLES%20AND%20CV%20JOINTS&CLIP=PANDC/CHET/2012/AUTOMOTIVE/AUTO_PARTS_SPECIALIST/EXP22.MOV&CAPTION=CHET/CHET_MYLABS/AKAMAI/2012/AUTOMOTIVE/AUTO_PARTS_SPECIALIST/XML/EXP22.XML</small></p>
	<p>NATEF MLR TASK A3D1 INSPECT, REMOVE, AND REPLACE FRONT WHEEL DRIVE (FWD) BEARINGS, HUBS, AND SEALS.</p>
	<p>NATEF MLR TASK A3D2 INSPECT, SERVICE, AND REPLACE SHAFTS, YOKES, BOOTS, AND UNIVERSAL/CV JOINTS.</p>
	<p>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.</p>
	<p>SHOW ANIMATION: OUTER CV JOINT WWW.MYAUTOMOTIVELAB.COM <small>HTTP://MEDIA.PEARSONCMG.COM/PH/CHET/CHET_MYAUTOMOTIVELAB_2/ANIMATIONS/A8_ANIMATION/CHAPTER96_FIG_96_13/INDEX.HTM</small></p>
	<p>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</p>
	<p>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.</p>
	<p>74. SLIDE 74 EXPLAIN Figure 65-32 The hub nut must be removed before the hub bearing assembly or drive axle shaft can be removed from the vehicle.</p> <p>75. SLIDE 75 EXPLAIN Figure 65-33 Many knuckles are attached to ball joint on lower control arm by pinch bolt.</p>

ICONS	Ch65 Drive Shafts and CV Joints
	<p>76. SLIDE 76 EXPLAIN Figure 65-34 preferred method for separating tie rod end from steering knuckle is to use a puller such as one shown. A “pickle-fork”-type tool should be used only if tie rod is going to be replaced. A pickle-fork-type tool can damage or tear the rubber grease boot. Striking tie rod end with a hammer while holding another hammer behind joint to shock and break the taper from the steering knuckle can also be used.</p>
	<p>77. SLIDE 77 EXPLAIN Figure 65-35 Most inner CV joints can be separated from the transaxle with a prybar.</p>
	<p>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.</p>
	<p>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.</p>
	<p>78. SLIDE 78 EXPLAIN Figure 65-36 A punch being used to keep the rotor from rotating while torquing the axle shaft spindle nut.</p>
	<p>79. SLIDES 79-83 EXPLAIN Constant Velocity Joints</p> <p>84. SLIDES 84-92 OPTIONAL 9 SLIDES TO EXPLAIN DRIVE AXLE SHAFT REPLACEMENT</p>
	<p>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.</p>