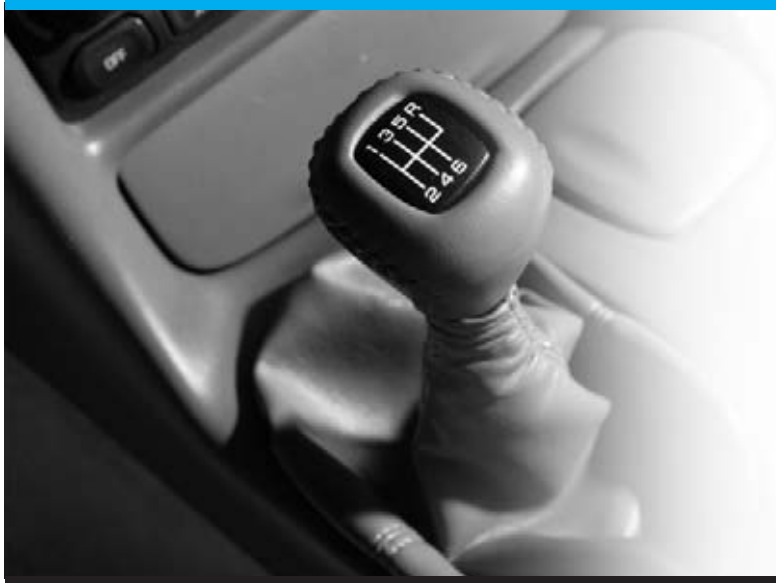
CHAPTER 10



DRIVESHAFT AND UNIVERSAL JOINT SERVICE

OBJECTIVES

After studying Chapter 10, the reader should be able to:

1. Perform the maintenance operations needed to keep a driveshaft operating properly.
2. Diagnose the cause of common FWD driveshaft problems.
3. Recommend the proper driveshaft repair procedure.
4. Correct RWD U-joint angularity and driveshaft balance problems.
5. Remove and replace FWD and RWD driveshafts.
6. Disassemble, inspect, and reassemble the common U-joints.
7. Make normal U-joint and CV joint repairs.
8. Complete the ASE tasks for content area D, Driveshaft and Universal/Constant-Velocity Diagnosis and Repair.

KEY TERMS

Antilock braking system (ABS) (p. 274)
Balancing (p. 268)
Grease spray (p. 258)
Level protractor (p. 267)
Phasing (p. 265)
Plug-in connection (p. 272)
Reluctor (p. 274)
Runout (p. 262)
Speed sensitive (p. 260)
Tone ring (p. 274)
Torque sensitive (p. 260)
U-joint angle (p. 267)
Visual inspection (p. 260)
Wheel speed sensor (WSS) (p. 274)

INTRODUCTION

Driveshaft and U-joint service, also called driveline service, includes lubricating the cross assemblies of some Cardan and double-Cardan U-joints, the centering ball and socket of most double-Cardan U-joints, and the slip splines on some driveshafts. The driveshafts on most FWD vehicles and many modern RWD vehicles are maintenance free as there are no lubrication fittings.

Drivelines should also be checked to find possible failure before it occurs. If a driveline problem occurs, the technician identifies its cause and repairs or replaces the faulty part(s). It should be remembered that the driveline is designed to be a weak link or "fuse" in the drivetrain (Figure 10-1). During severe operation, the driveshaft or U-joint should fail before the transmission or drive axle. Fortunately, it is much easier to service and less expensive to repair.

DRIVELINE LUBRICATION

Lubrication requirements vary greatly, depending on the manufacturer's requirement and the availability of lubrication fittings. The fittings can be a zerk fitting or a flush-type fitting (Figure 10-2). Joints without fittings must be disassembled and repacked for lubrication. Recommended intervals for lubricating joints with fittings can be as short as every 2000 to 3000 miles (3218 to 4827 km) or every month for vehicles operating in severely dusty, dirty, wet, or muddy conditions.

The recommended lubricant for many U-joints is a good-quality lithium soap–based extreme pressure (EP) grease that meets NLGI (National Lubricating Grease Institute) grade 2 specifications. It is recommended that all the seals be purged so that the new grease can flush any dirt, moisture, or air out of the bearings.

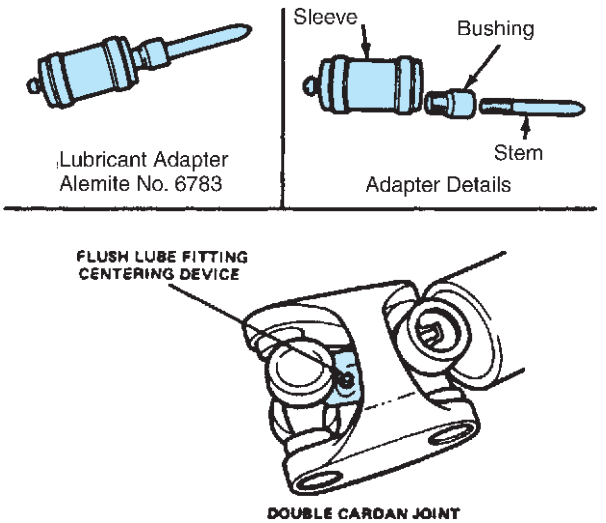


FIGURE 10-2 Some U-joint crosses include a standard zerk fitting to lubricate them; many double-Cardan U-joints use a flush-type fitting that requires a long, thin adapter. *(Courtesy of Ford Motor Company)*

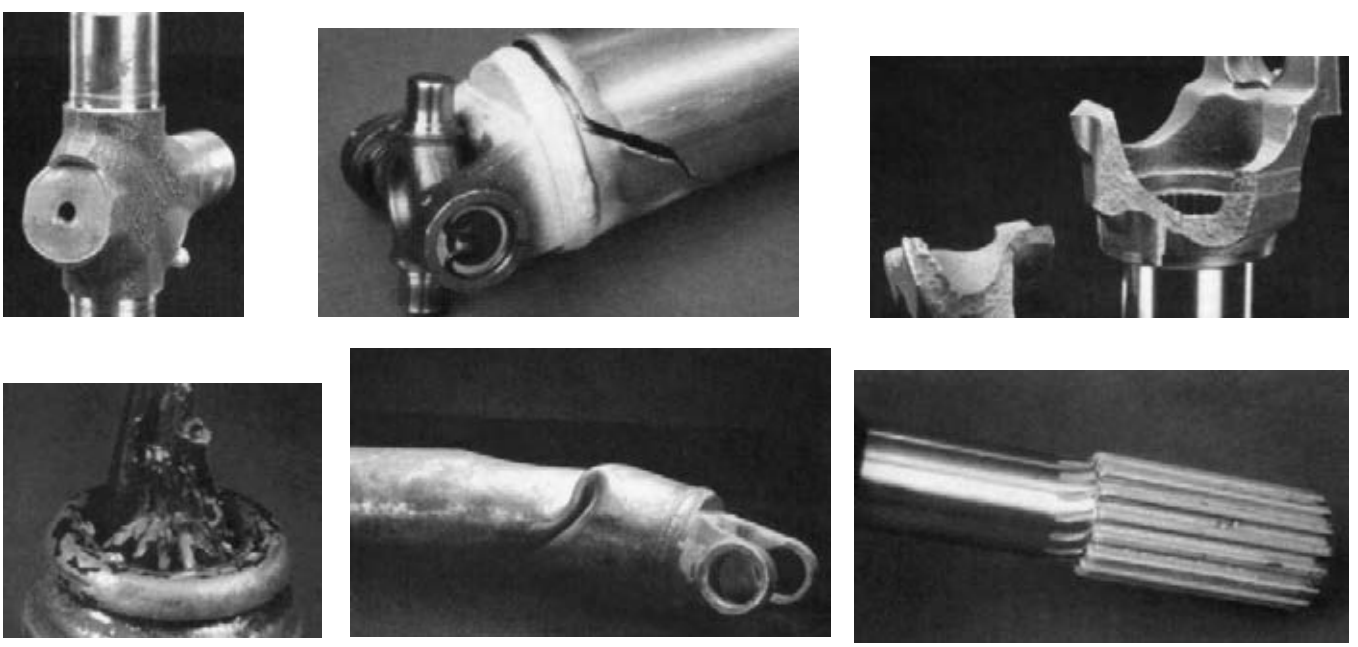


FIGURE 10-1 Many power train engineers consider the driveline to be the "fuse" for the power train. It is less expensive to replace these broken parts than to replace parts inside a transmission or drive axle. *(Courtesy of Dana Corporation)*

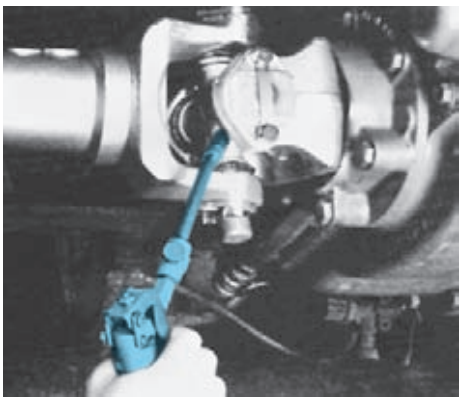


FIGURE 10-3 When lubricating a U-joint, grease is pumped into the cross until it comes out of the seal at each bearing cup. *(Courtesy of Dana Corporation)*

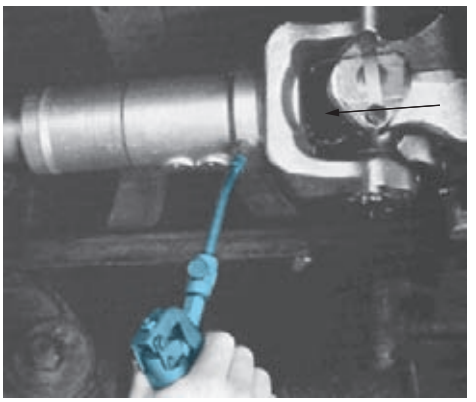


FIGURE 10-4 When grease comes out of the relief hole of this slip joint, the hole should be covered with a finger and grease pumped into the fitting until it comes out the yoke seal. *(Courtesy of Dana Corporation)*

To lubricate a U-joint:

1. Locate the zerk fitting, rotate the shaft for the best access, and wipe the fitting clean.
2. Attach a grease gun to the fitting, and add grease until you see clean grease flow from each seal (Figure 10-3).
3. If any seal fails to take grease and purge, move the driveshaft from side to side and reapply pressure from the grease gun.

To lubricate a double-Cardan U-joint:

1. Locate the fittings (there could be one, two, or three). Check each cross and the center socket. The center socket fitting is often hard to get to and might require a special lube gun attachment (see Figure 10-2).
2. Clean the fittings and lubricate them until clean grease leaves each seal.

To lubricate a slip spline:

1. Locate the lubrication fitting and clean it.
2. Attach a grease gun and add grease until clean grease escapes from the spline seal. Some units have a pressure relief hole that should be covered with your finger when grease starts escaping from it (Figure 10-4). This helps force grease completely through the joint.

PROBLEM DIAGNOSIS

FWD and RWD driveline problems will show different symptoms and are diagnosed using different procedures. Most of the complaints will be noise or vibration oriented (Figure 10-5).

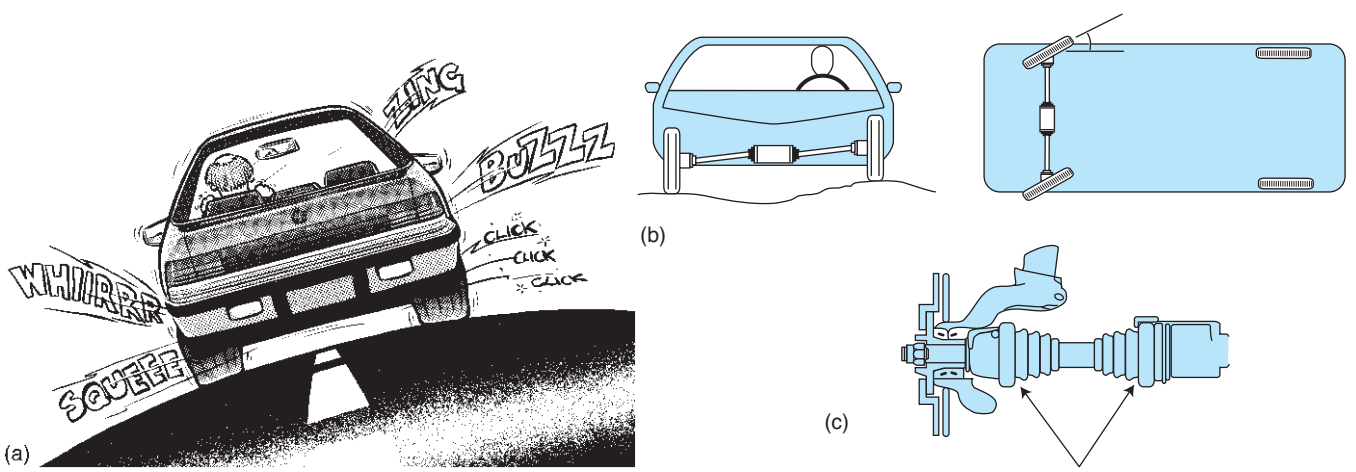


FIGURE 10-5 When diagnosing FWD CV-joint problems, road-test the vehicle, making turning maneuvers (a) so that the CV joints must change vertical as well as turning angles (b) along with throttle changes. Complete the checks with an inspection of the boots and the CV joint for looseness (c).

FWD Problem Diagnosis

Most FWD driveline problems are not speed related; noise or vibrations, which increase as vehicle speed increases, are more likely to be tire or wheel bearing problems than driveline problems. FWD driveline problems tend to fall into one of the following categories:

- A grease spray that is thrown from a torn boot
- Snapping, popping, or clicking noises while turning corners, indicates a worn outboard joint
- Clunking noises during acceleration or deceleration, indicates a worn inboard joint
- Vibration or shudder during acceleration, indicates a worn inboard joint

If the complaint is **grease spray**, a visual inspection of the boots can confirm the cause of the problem. Parts suppliers say that a CV joint, once it begins to spray grease, will operate for 8 to 20 hours before failure.

REAL WORLD FIX

A 1991 Mitsubishi Galant (63,000 mil) had a steering wheel oscillation at speeds below 35 mph. The front tires were rotated and balanced, but this did not help. The front suspension and steering parts were good. A visual inspection of the driveshafts and CV joints showed no problems.

Further checks revealed a faulty left-side, inner CV joint, and replacement of this shaft assembly solved the problem.

REAL WORLD FIX

A 1996 Dodge Avenger (40,000 mil) had a vibration between 55 and 60 mph that was torque sensitive. It did not occur while decelerating. A visual inspection of the driveshafts did not reveal a problem.

Removal of the CV joint boot allowed the technician to feel a wear groove inside of one of the inner CV joints. Replacement of this driveshaft fixed this problem.

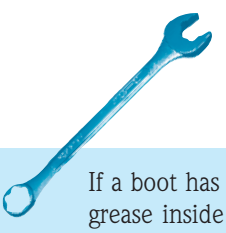
To inspect CV joint boots:

1. Raise and securely support the vehicle on a hoist or jack stands.
2. Turn the front of one wheel outward, and rotate the tire to inspect all of the boot (Figure 10-6). Many technicians will place their finger in a fold to feel for cracks or tears while rotating the tire. It is a good practice to pull apart the folds of the inboard boots for a complete inspection.
3. Repeat this procss on the other driveshaft.

REAL WORLD FIX

A 2004 PT Cruiser (27,000 mil) had an extreme vibration. The right front wheel bearing had excess play so the wheel bearing and driveshaft were replaced, and now the vibration is reduced to below 20 mph. On a hoist, if the brakes are applied at 15–20 mph, there are severe engine and transaxle side-to-side oscillations. The left driveshaft was removed; the inner CV joint was inspected; and since no problem was found, it was not replaced.

Following advice, the technician checked for engine movement, and observed a lot of movement when shifted from neutral to drive. The passenger-side engine mounts were replaced, and this reduced both the engine movement and driveline vibration. The vibration still occured while entering and leaving a right turn so a new left driveshaft was installed. This complex problem was now cured.



TECH TIP

If a boot has a small cut or tear and there is still grease inside the joint, the joint is probably still good, and it should be repaired by installing a boot kit. If there is a large tear or portions of the boot are missing and the grease shows contamination, the joint will probably need to be replaced. A technician can check for grease contamination by rubbing some of the grease between his or her fingers (Figure 10-7). If the grease feels normal, the joint is probably good; if the grease has a gritty feel, the joint is probably damaged.

FIGURE 10-6 When checking a CV joint boot, run your finger around the boot in each of the pleats as you inspect for tears or cuts; the wheel can be turned outward on the outboard joint to get a better view of the boot. *(Courtesy of Moog Automotive)*

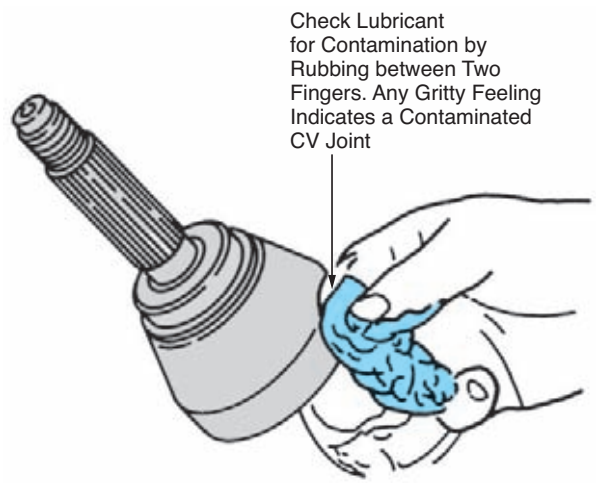


FIGURE 10-7 When checking a CV joint with a torn or suspicious boot, rub a grease sample from the joint between your fingers and feel for grit. Gritty grease indicates a joint that probably needs to be replaced. *(Courtesy of Ford Motor Company)*

If the complaint is of noise or vibration, test-drive the vehicle. Accelerate lightly with the wheels straight and then again with the wheels turned in one direction and then the other. If the noise gets louder when the wheels are turned, the problem is probably a worn outboard joint. A badly worn joint will snap, click, or vibrate when the wheels are straight. Next, accelerate hard while driving straight ahead or up a driveway ramp. A vibration or shudder indicates a sticking inboard joint; a clunking noise indicates a worn joint. Possible worn or sticking joints should be disassembled for visual inspection to confirm the problem and determine the proper repair procedure.

TECH TIP

A fairly quick way to check that the engine and transaxle are centered is to remove both front hub nuts and push both shafts into the hub as far as they go. Measure the distance they are inside the hub. If the measurements are equal, the engine and transaxle are centered.

REAL WORLD FIX

A 1992 Dodge Caravan (130,000 mil) was towed into the shop with the left inner CV joint popped out of the transaxle. The axle was replaced using an OEM part, and two weeks later it returned with the same problem. The motor mounts were inspected; one was found faulty and all were replaced. One week later, the van came back with the same problem.

Close inspection showed front subframe damage. Straightening the subframe and a wheel alignment fixed this problem.

REAL WORLD FIX

A 1987 Dodge Caravan (134,000 mil) had a noise when starting out, turning left, and accelerating. The driveshafts were removed and inspected. Each had a bad CV joint and the left hub bearings were worn. Both driveshafts and the left hub bearings were replaced, but this did not help.

A check of the shaft end-to-hub position showed a side-to-side difference of 5/8 in. The motor mounts were loosened, and the engine was moved sideways to equalize the distances. This fixed the problem.

REAL WORLD FIX

A 2000 Buick LeSabre (23,000 mil) has a complaint of a vibration at 40 mph under light acceleration. This was confirmed on a road test. The tires were checked for excess runout (found good), balanced, and rotated, but this did not help. The vibration could be duplicated with the vehicle on a rack; a light brake application at 40 mph would cause the engine to move sideways, back and forth. The motor mounts and both driveshafts (remanufactured units) were replaced, but this did not help.

Following advice, the driveshafts were replaced with new GM driveshafts, and this fixed the problem.

REAL WORLD FIX

A 1998 Mercedes-Benz C230 (98,000 mil) has a noise like a growling wheel bearing when you make a gradual left turn at 30–50 mph. All four tires were replaced, but this did not help. The front wheel bearings were replaced, but this did not help. Listening with a Chassis Ear picked up a noise only at the right rear, but the noise was not exactly the same. The right rear bearing was replaced, but this did not help.

A fellow technician recommended checking the sound insulation above the driveshaft, and it was found to be rubbing. Removal of a small section of the insulation fixed this noise problem.

RWD Problem Diagnosis

Most RWD driveshaft problems fall into the two categories of noise or vibration, with the vibrations tending to be **speed** and **torque sensitive**. Torque-sensitive vibrations will increase with more torque; a full-throttle acceleration will have greater vibrations than a light-throttle acceleration. The vibrations will either increase as the speed increases or increase at certain speeds and decrease at others. For example, tire imbalance vibrations tend to be the greatest between 45 and 60 mph (72 and 97 kph) (Figure 10-8).

Driveshaft Checks

Five different checks are normally made to locate driveshaft problems. Most of the problems will be found in the first check, which is a **visual inspection** for wear and overall condition. The other four checks are for runout, angle, phasing, and balance.

Visual Inspection. When a driveshaft problem is encountered, a technician normally will test drive the vehicle to confirm the symptoms. Then he or she will inspect the driveshaft for damage and looseness at the U-joints and slip splines.

REAL WORLD FIX

A 1997 Jeep Grand Cherokee (9,000 km) had a vibration between 45 and 55 kph. The vibration went away when the front driveshaft was removed. A new front driveshaft was installed, but this did not help. The front drive and axle yoke were replaced, but this did not help. The U-joint angles on the front shaft were adjusted, but this did not help. The runout of the front shaft was checked, and it was fine: 0.001 in. at the yokes and 0.005 in. at the shaft.

The new front driveshaft was sent out to have the balance checked, and it was out of balance by 21 grams. Rebalancing this shaft fixed this vibration problem.

REAL WORLD FIX

A 1998 Volvo AWD V70R (49,000 mil) had a pop/clang noise coming from the front-to-rear driveshaft. The noise seemed to be coming from the front CV joint when the vehicle was operated on the hoist.

It was determined that the grease in this joint failed because of heat from the catalytic converter next to it. It was also determined that the joint is available from the dealer so the entire driveshaft does not need to be replaced.

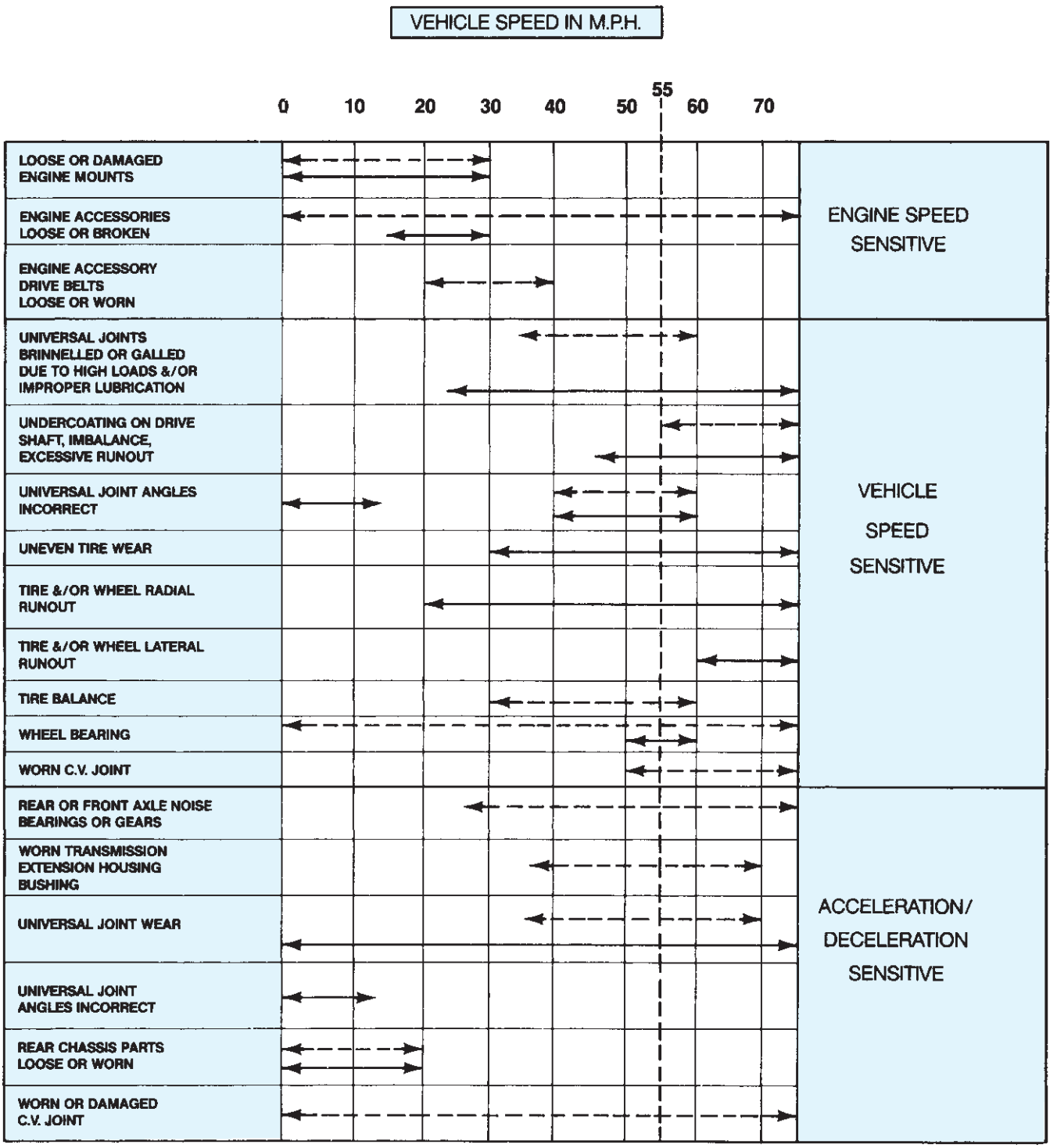


FIGURE 10-8 This chart indicates the speed at which the most commonly encountered vehicle vibrations occur and whether they show up as noise or a vibration that is felt. *(Courtesy of Perfect Circle)*

TECH TIP

If a joint is disconnected, it should swing smoothly through its travel arc in each direction with no catches, roughness, or free play.

To perform a visual inspection:

1. Shift the transmission to neutral and release the parking brake. Raise and securely support the vehicle on a hoist or jack stands so that the drive wheels are free to rotate.
2. Check the overall appearance of the shaft. There should be no buildup of foreign material (such as undercoat), no major dents or damage to the tubing, or missing balance weights.
3. Check each U-joint for looseness in both a rotary and a sideways direction (Figure 10-9). Grip the input and output yokes and try to twist them back and forth in opposite directions; then hold one stationary as you try to move the other one vertically and side to side.

TECH TIP

If the vehicle has been operated recently, carefully feel each joint; the joint should be warm, about the same temperature as the shaft. A hot joint is a sign of failure. Check for reddish dust at each U-joint; that would indicate a dry, unlubricated joint.

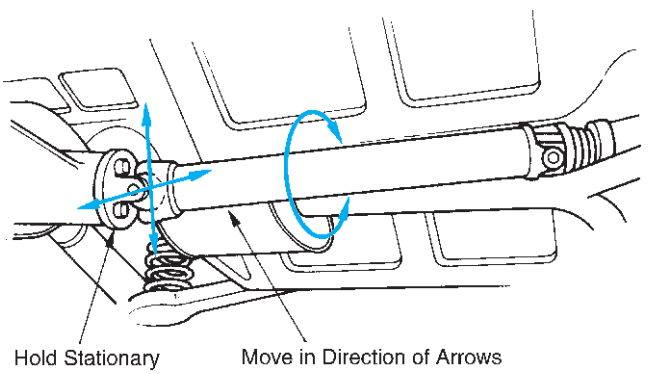
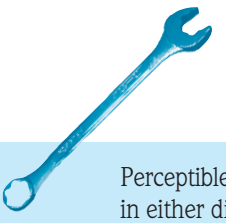
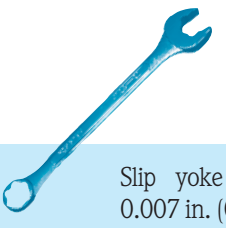


FIGURE 10-9 When checking a U-joint, hold one yoke so that it will not move and try to rotate the other yoke and move it in a direction that is parallel to the legs of the cross; any perceptible motion indicates a worn joint. *(Courtesy of Ford Motor Company)*



TECH TIP

Perceptible rotary motion of 0.006 in. (0.15 mm) in either direction indicates a faulty, loose joint.



TECH TIP

Slip yoke movement should be less than 0.007 in. (0.18 mm). Excessive clearance can be caused by a worn slip yoke or transmission bushing.

REAL WORLD FIX

A 1995 VW Jetta (88,000 mil) came in for front-end work. The right front wheel bearing and the strut bearings were replaced. The CV joint boots were torn, so both driveshafts were replaced. The front wheels were aligned. But there was a side-to-side wobble at the front during acceleration that felt like a bent wheel. An inspection of the front end and engine mounts showed no problem.

A careful of inspection of the remanufactured driveshafts showed a problem on the driver-side axle. Replacement of this driveshaft fixed this problem.

4. Grip the slip yoke where it leaves the transmission and try to move it vertically or side to side. A shaft-mounted slip joint is checked the same way.
5. On driveshafts with a center support bearing, check the bearing for looseness, broken rubber mounting, and effects of excessive heat.

The repair of faulty U-joints is described in on pages 289–298.

Driveshaft Runout. **Runout** is caused by a bent shaft or one in which the cross or a yoke is not centered to the tube. It creates an imbalance, causing the vibration. Runout is usually checked using a dial indicator.

TECH TIP

Runout can be confused with ovality, which occurs if a tube is slightly flattened. Runout will cause one high and one low reading per revolution, and ovality will cause two of each.

TECH TIP

The maximum limits for runout or ovality for passenger cars and light trucks are 0.005 in. (0.12 mm) on a slip yoke, 0.020 in. (0.5 mm) on the tubing 3 in. (76 mm) from each end, and 0.010 in. (0.25 mm) in the center of the driveshaft (Figure 10-10).

To check driveshaft runout:

1. Shift the transmission to neutral and release the parking brake. Raise and securely support the vehicle on a hoist or jack stands so that the drive wheels are free to rotate.
2. Clean any dirt or rust from around the driveshaft at the center and 3 in. from each end.
3. Mount a dial indicator to the vehicle's underbody, and position the stylus so that it points directly toward the center of the driveshaft (Figure 10-11).
4. Rotate the driveshaft until the dial indicator needle is at its lowest reading; adjust the dial to zero and rotate the driveshaft to the highest reading.
5. Record the reading and location of the high point on the driveshaft, and repeat step 4 at the two or three other locations on the driveshaft.

TECH TIP

Acceptable readings at the ends of the drive shaft with an excessively high reading at the center indicate a bent shaft. A bent driveshaft should be replaced or straightened, which is a job requiring specialized equipment and skills. An acceptable reading at the center with an excessively high reading at one end can be caused by a bad driveshaft or a faulty U-joint cross or end yoke.

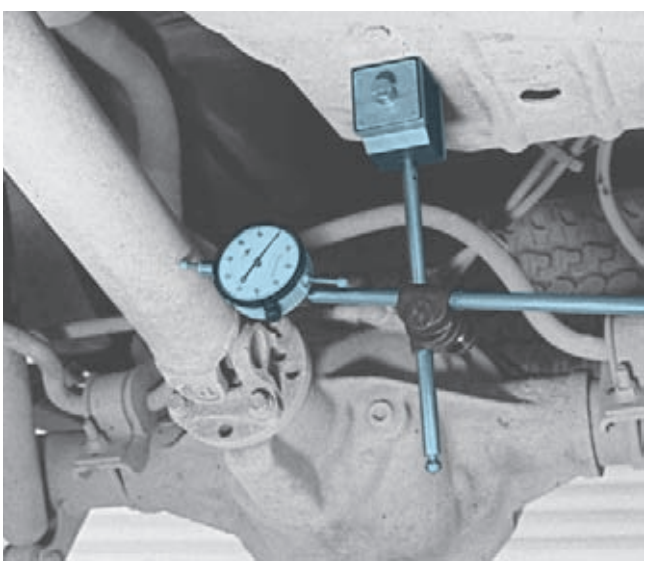


FIGURE 10-11 A magnetic-base dial indicator has been attached to the gas tank skid plate of this light truck with the indicator pointing directly toward the center of the driveshaft. When the driveshaft is rotated, any runout will be shown on the dial indicator.

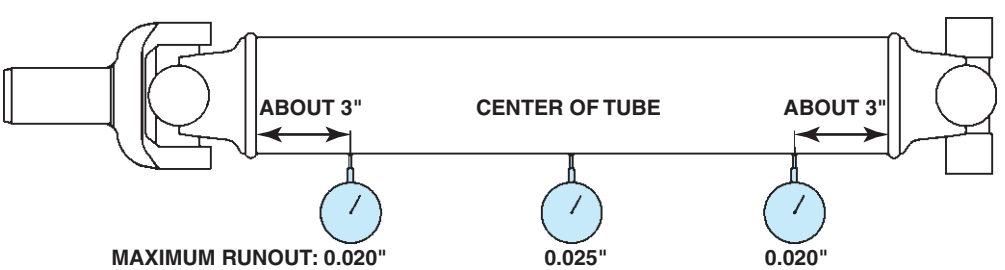


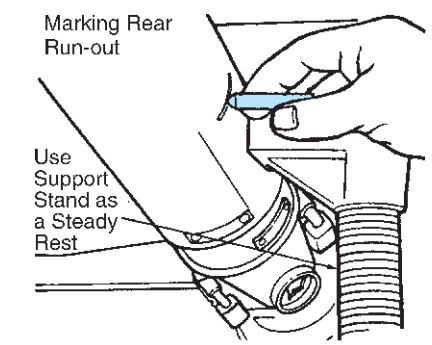
FIGURE 10-10 Driveshaft runout is checked at the center and near the ends of the tube section.

TECH TIP

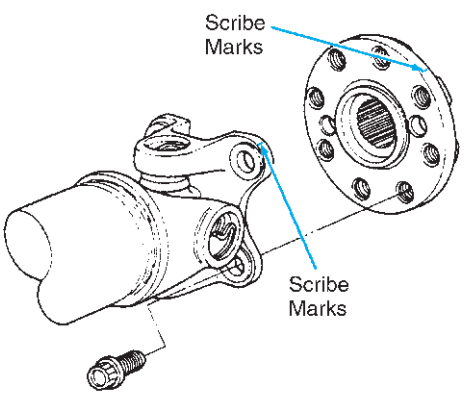
If the high reading is at an end where the U-joint bolts to an end yoke or flange, disconnect the U-joint, rotate the driveshaft one-half turn to the alternate position, and repeat the check to determine if it is a faulty driveshaft or end yoke (Figure 10-12).

TECH TIP

A cross or yoke can be checked by positioning a dial indicator with the stylus positioned on the bearing cap. After ensuring that the stylus is centered on the bearing cap, adjust the dial to zero, carefully withdraw the stylus, rotate the shaft one-half turn, and read the position of the second bearing cap (Figure 10-13). The two readings should be within 0.010 in. (0.25 mm) of each other.



(a)



(b)

REAL WORLD FIX

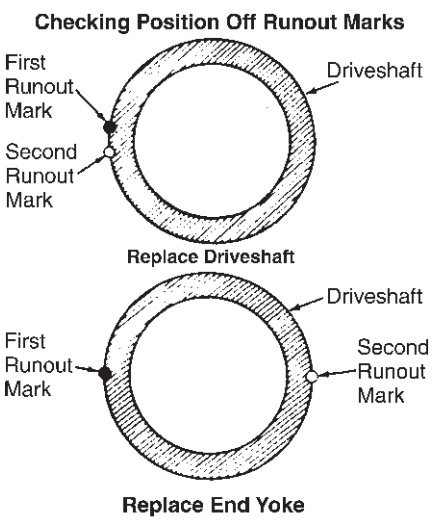
A 1994 Lincoln (70,000 mil) had a vibration under acceleration at 48 mph. The vibration showed up at the same speed with the car on stands. Visual inspection of the driveshaft and rear axle showed no problems.

Checking driveshaft runout showed 0.038 in. After disconnecting the driveshaft, rotating it one-half turn, and reinstalling it,the runout was reduced to 0.008 in. This fixed the vibration problem.

REAL WORLD FIX

A 1996 Dodge R3500 pickup (208,000 mil) keeps breaking the transmission extension housing. It is a diesel, manual transmission, 4×4, dually work truck. A new transmission was installed about 20,000 miles ago, but the extension housing breaks after about 3000 miles. New motor and transmission mounts were installed along with a rebuilt driveshaft.

Following advice from fellow technicians, the driveshaft between the transmission and transfer case was checked, and 0.060 in. of runout was found. Replacement of this driveshaft fixed this transmission problem.



(c)

FIGURE 10-12 A quick runout check is made by holding a marking tool next to the shaft as it is rotated (a). If there is a high spot close to a U-joint, runout can sometimes be corrected by scribing index marks on the shaft, rotating the shaft one-half turn (b), and rechecking runout (c). The location of the second mark indicates the cause of the problem. *(Courtesy of Ford Motor Company)*

REAL WORLD FIX

A 1992 Ranger pickup (108,000 mil) had a bad vibration during acceleration. The rear U-joints were replaced, but this did not help.

It was determined that the rear springs had sagged, which changed the U-joint operating angles. Replacement of the springs fixed this vibration problem.

TECH TIP

Phasing is easy to check; the two yokes at the ends of a shaft should be in line with each other (Figure 10-14). Two straightedges laid across the yoke lugs should be parallel. You can also measure the crosswise angles of the yokes at each end of the shaft; both ends should be at the same angle when measuring across the vehicle.

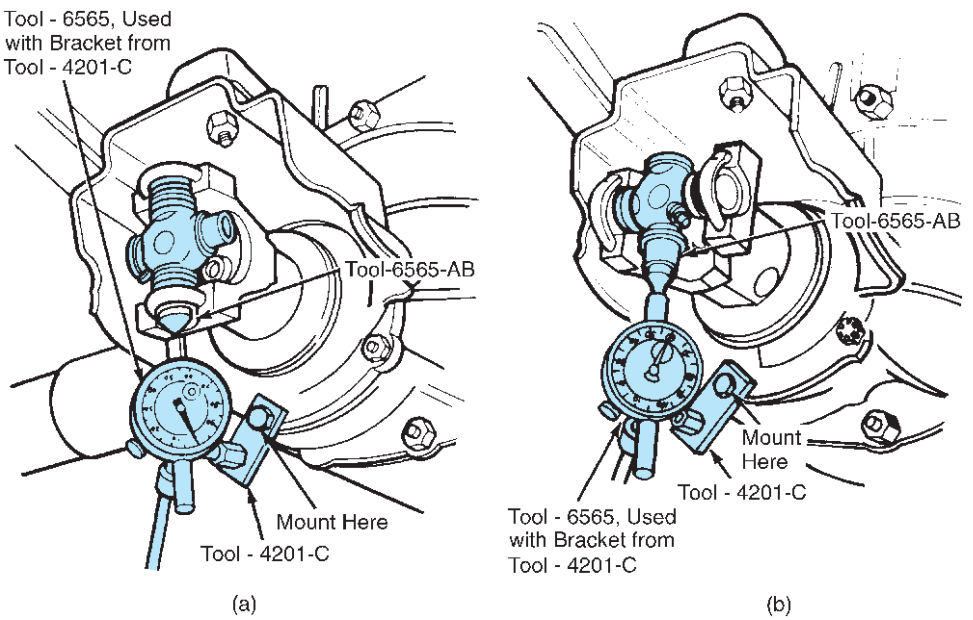


FIGURE 10-13 Pinion shaft flange runout can be measured using a dial indicator and modified cross. The cross has one bearing journal cut off so it can be rotated from one side to the other. *(Courtesy of Ford Motor Company)*

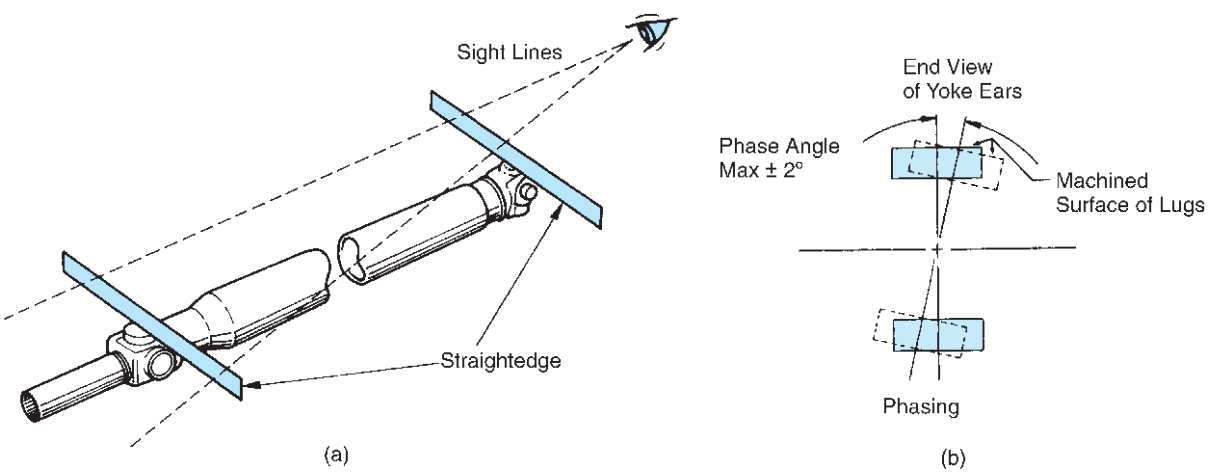
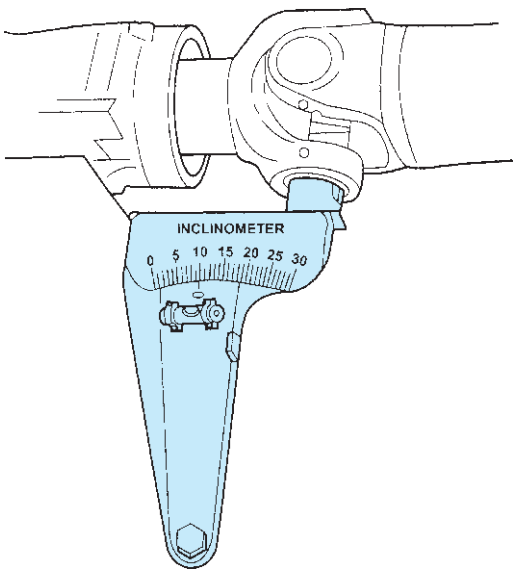
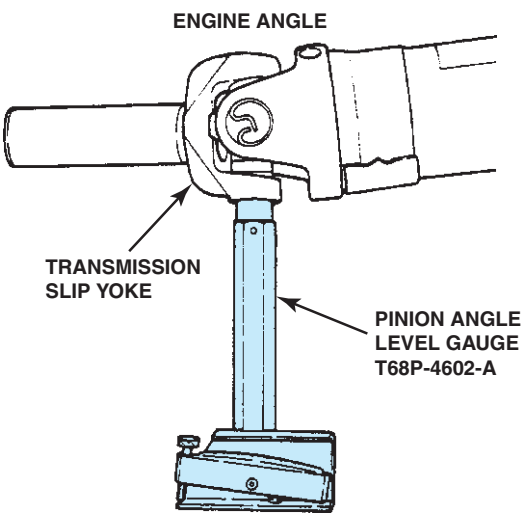


FIGURE 10-14 Checking the phasing of the two U-joints can be done by placing a pair of straightedges across the bearing cups/cup bosses and sighting across them (a). The straightedges should be within 2° of being parallel (b). *(b is courtesy of NEAPCO)*

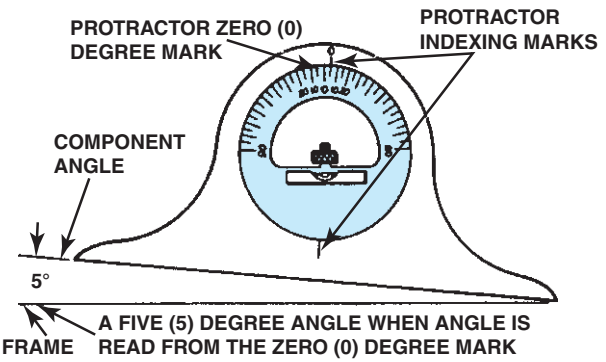
(a)

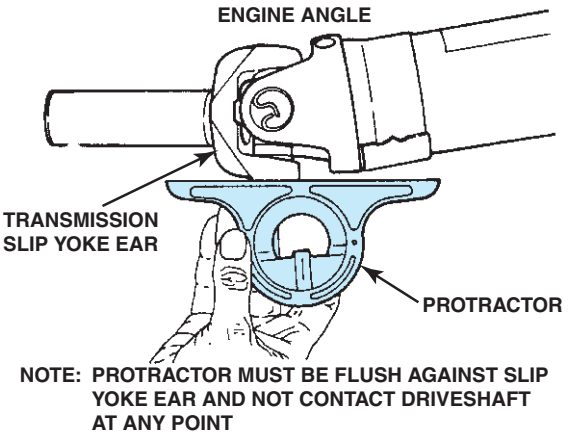


(b)



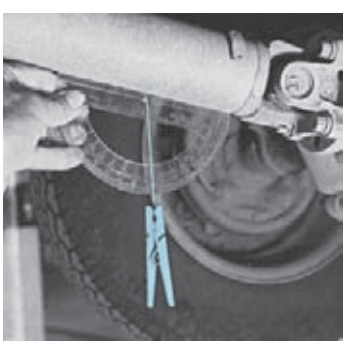
(c)





(d)

(e)



(f)

FIGURE 10-15 U-joint angles can be measured using an electronic angle gauge (a), a bubble-level U-joint angle gauge (b and c), a machinist's protractor (with level) (d), a magnetic protractor (e), or a simple protractor with string and weight (f). *(a is courtesy of Dana Corporation; b is courtesy of DaimlerChrysler Corporation; c and d are courtesy of Ford Motor Company)*

Phasing Checks

Angle Checks. Checking **U-joint angles** requires a method of measuring angles relative to horizontal or vertical. To do this, technicians normally use a special gauge. A **level protractor** or a simple protractor, string, and weight can be used (Figure 10-15).

Usually, the angles of the two shafts for a U-joint are measured, and one angle is subtracted from the other to determine the operating angle of the U-joint. The same is done for the second joint, and the two angles are compared to each other (Figure 10-16).

TECH TIP

Ideally, a single U-joint should operate at an angle between 1/2° and 3°, and the operating angle of the two joints on a shaft should be within 1°.

TECH TIP

A quick and fairly accurate method of making this check is to measure the distance between the top and the bottom of the transmission and rear axle yokes (Figure 10-17). If the distances are equal, the angles are also equal.

To check U-joint angles using an inclinometer:

1. Raise and securely support the vehicle. Support the rear axle so it is in the normal position relative to the frame. The rear wheels must be free to turn. Shift the transmission to neutral and release the parking brake.
2. Clean off the end of a U-joint bearing cup and rotate the driveshaft so that this bearing cup is downward.
3. Attach the inclinometer to the bearing cup, adjust it to center the bubble, and read and record the angle of this bearing cap and the driveshaft to which this yoke is attached (Figure 10-18).
4. Rotate the shaft one-fourth turn and repeat steps 2 and 3 to obtain the angle of the second shaft.
5. Subtract one measured angle from the other angle to get the operating angle for this joint.
6. Repeat steps 2, 3, 4, and 5 to get the operating angle for the second joint.

TECH TIP

An adjustment is necessary if the two angles are not within 1° of each other. Because the angle of the input or leading U-joint is determined primarily by the position of the transmission and engine, it is usually easier to change the operating angle of the rear U-joint, which is controlled primarily by the position of the rear axle (Figure 10-19).

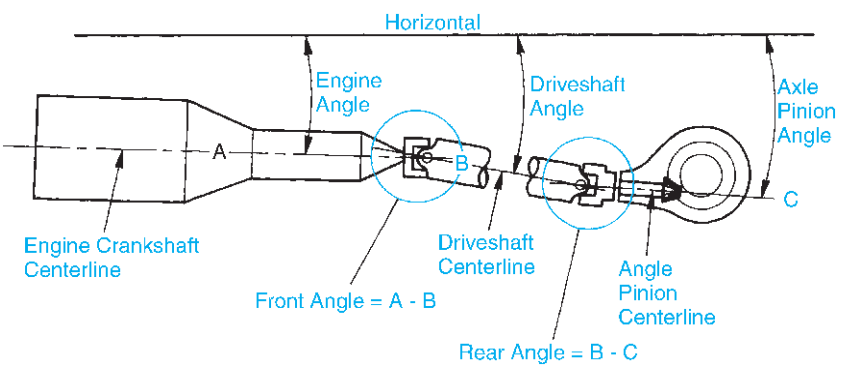


FIGURE 10-16 U-joint angles are normally determined by measuring the angle (with respect to horizontal) of the front yoke, engine crankshaft, or transmission shafts (A), the second and third yokes and driveshaft (B), and the rear yoke and axle driven pinion shaft (C). The difference between A and B is the angle of the front U-joint, and the difference between B and C is the angle of the rear U-joint.

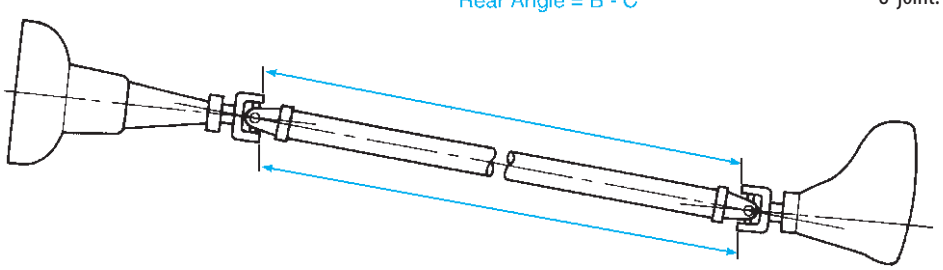
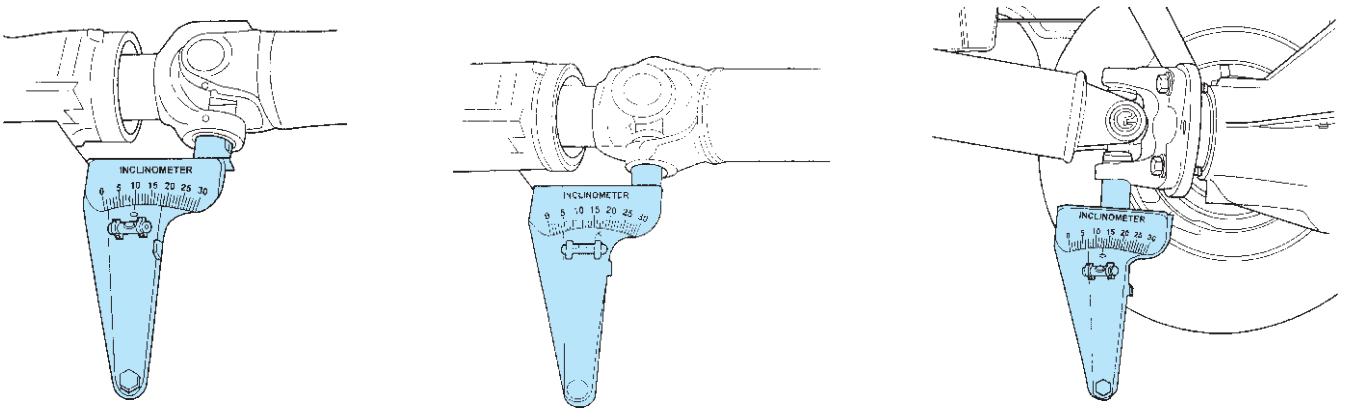
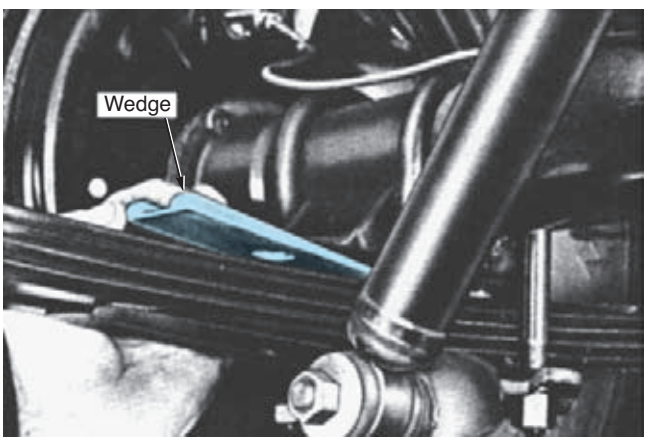


FIGURE 10-17 A quick way of checking U-joint angles is to measure the distance between the front and rear yokes at the top and bottom. If these distances are the same, the U-joints are at the same angle.

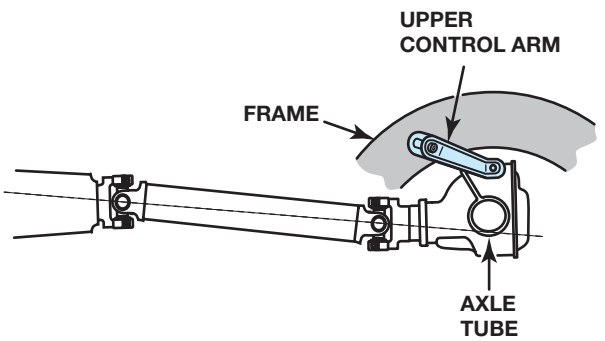


(a) (b) (c)

FIGURE 10-18 U-joint operating angle is measured is two steps with the driveshaft rotated 90°. Step a measures the transmission shaft angle (a); step b measures the driveshaft angle (b); and step c measures axle pinion shaft angle (c). In this case, angle a = 10° and angle b = 16°, so the front joint angle = 6°. Angle b = 16° and angle c = 13°, so the rear joint angle = 3°. This gives a difference of 3° which probably will cause a vibration. *(Courtesy of DaimlerChrysler Corporation)*



(a)



SERVICE CONTROL ARM	REAR AXLE NOSE ANGLE CHANGE	TRANSMISSION ANGLE CHANGE
SHORT-CUTLASS	+1 1/2	-1/2°
LONG-CUTLASS	-1 1/2	+1/2°
SHORT-88 & 98	+2	-1/2°
LONG-88 & 98	-2	+1/2°

(b)

FIGURE 10-19 The angle of the rear U-joint can be adjusted by changing the drive pinion shaft angle by adding a tapered wedge (shim) between the axle and leaf spring (a) or by changing the length of the upper or lower axle control arm (b). *(a is courtesy of DaimlerChrysler Corporation)*

To adjust the rear U-joint operating angle, the front of the rear-axle drive pinion shaft is usually raised or lowered. Pinion shaft angle can be adjusted by using tapered shims between the axle housing and leaf springs on vehicles with leaf springs or by changing the length of the upper control arm(s). Shimming the control arm mounting points on vehicles with coil springs will adjust the operating angle.

Balancing. Driveshaft imbalance will cause a speed-sensitive vibration and will occur during coast-down as well as acceleration or cruising. Usually, **balancing** a driveshaft is an off-vehicle operation, with each end being balanced separately.

REAL WORLD FIX

A 1999 Ford E-250 (9,000 mil) has a driveline vibration between 45 and 55 mph. The driveshaft was replaced using a new one, but this did not help. The engine and transmission mounts were isolated/neutralized, but this did not help either.

A check of the U-joint angles revealed the problem, and shimming the drive axle fixed it. The front and rear U-joint angles should be equal.

TECH TIP

Shops that specialize in driveshaft repair have the ability to properly balance most driveshafts.

TECH TIP

A rather crude but fairly effective method of on-vehicle balancing can be done by a shop equipped with a strobe light, on-vehicle tire balancer, and two or three screw-type radiator hose clamps. The heads of the clamps are used for the balancing weights.

CAUTION: While using this procedure to balance a driveshaft, you will be working close to a rapidly spinning shaft and a pair of brake drums with a running vehicle above you.

To balance a driveshaft:

1. Road-test the vehicle and record the speed at which the vibration is the greatest.
2. Raise and securely support the vehicle by the frame or body so that the drive axle is free to move up and down and the tires are free to turn. Remove both rear wheels and replace two lug nuts on each side to keep the brake drum in place.
3. Using chalk or crayon, mark the rear of the driveshaft with a line and number at four points, every one-fourth turn around the shaft (Figure 10-20).
4. Position the wheel balancer pickup probe under the rear-axle drive pinion shaft so that it is close to the driveshaft flange.
5. Carefully start the engine, shift into high gear, and operate the driveshaft to the speed that was recorded in step 1. Point the strobe light at the spinning shaft. The effect of the light should make the shaft appear to be stopped; note the location of your marks.
6. Stop the engine and driveshaft, and by hand, rotate the shaft to the same position as it appeared in step 5. Place two radiator clamps on the driveshaft next to the end where you are checking. The heads of the clamps should be at the very top of the shaft; tighten the clamps (Figure 10-21).
7. Repeat step 5. If the vibration is gone, you are done; go on to step 8. If the vibration is still present and the strobe light makes the clamp heads appear at the bottom of the shaft, the clamps are too heavy. Stop the shaft and adjust the clamps by rotating them about one-quarter turn away from each other. Repeat this operation until the vibration is gone or the clamp heads are one-half turn from each other.
8. Replace the wheels and tighten the lug nuts to the correct torque.

TECH TIP

From under the vehicle, note the blur around the spinning shaft, which indicates the amount of runout being caused by the imbalance.

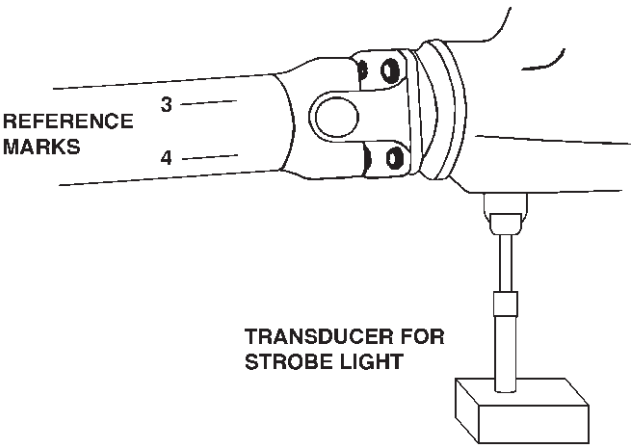


FIGURE 10-20 Driveshaft balance can be checked by attaching a wheel balancer transducer to the front of the axle housing. The strobe light will freeze shaft rotation so you can read the reference marks and determine the heavy part of the shaft.

TECH TIP

If the clamp heads move to positions opposite each other, they are too heavy. Remove one of the clamps, and position the other clamp in the original location.

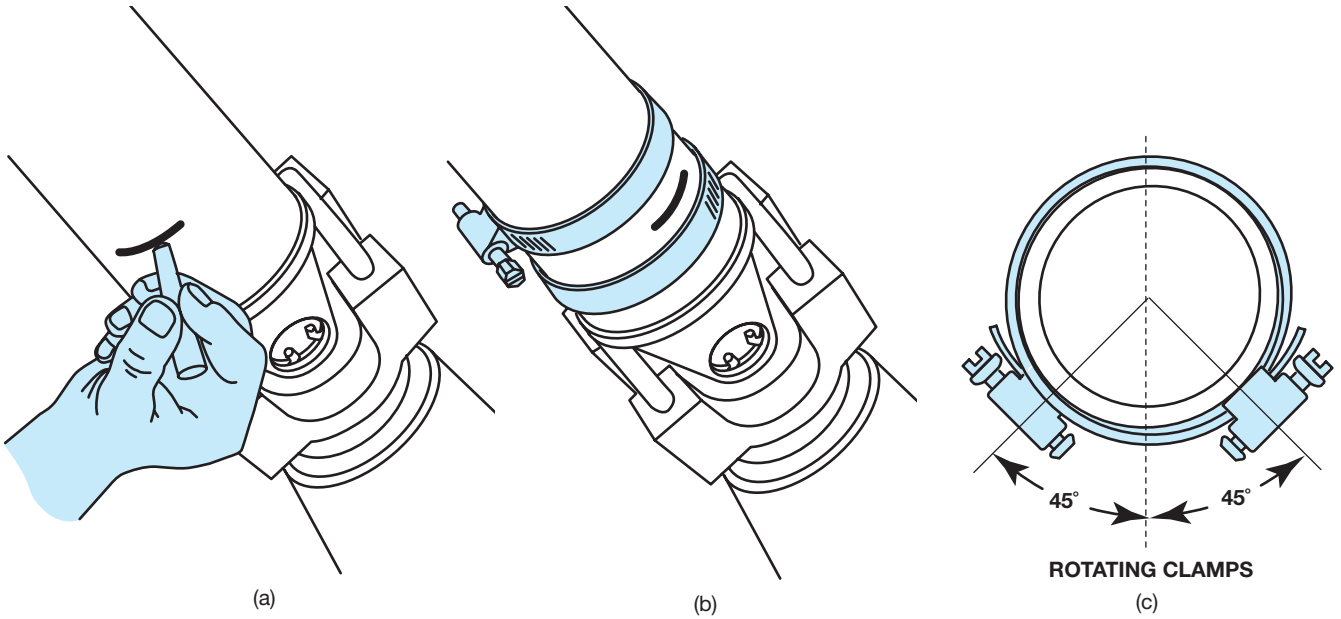


FIGURE 10-21 With the driveshaft spinning at the problem speed, carefully move a marker to just contact the shaft (a). Install two screw-type hose clamps to the shaft with the heads opposite to the mark you made (b). Test the balance by spinning the shaft to the problem speed; if there is still a slight vibration, rotate the clamps (c). *(Courtesy of Ford Motor Company)*

TECH TIP

If the vibration is still present and the strobe light makes the clamp heads appear at the top of the shaft, the clamps are too light. Add a third clamp and repeat this step.

REAL WORLD PROBLEM

Imagine that you are working in a general automotive repair shop and these problems are brought to you.

Case 1

The driver's complaint is a vibration between 15 and 30 mph. Your road test confirms the vibration, but when you lift the vehicle on a hoist, things appear good as far as the U-joint operating angles and clearance. You do notice that the rear U-joint is hotter than the driveshaft. What is probably wrong; what should you do next?

Case 2

The FWD compact vehicle makes a definite clunk sound as you shift into drive or reverse. What is the probable cause? What should you do to locate it?

DRIVESHAFT REMOVAL AND REPLACEMENT

As a driveshaft is removed, do not allow it to hang from one end, bending a still-connected U-joint or CV joint to its limit. If necessary, support the shaft using mechanic's wire or an old V-belt until both joints can be disconnected (Figure 10-22).

FWD Driveshaft Removal and Replacement

Most FWD driveshafts are held in place at the outer end by the nut securing the outboard CV joint to the front hub. After remov-

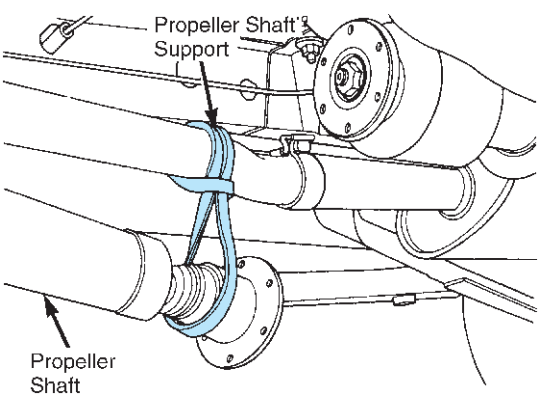
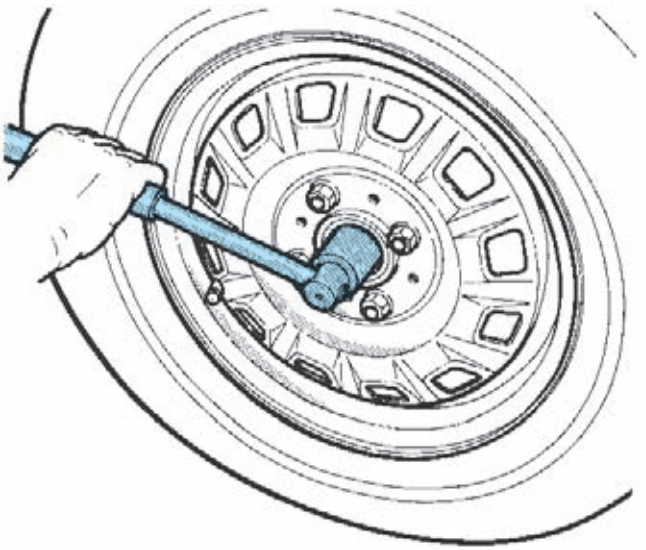
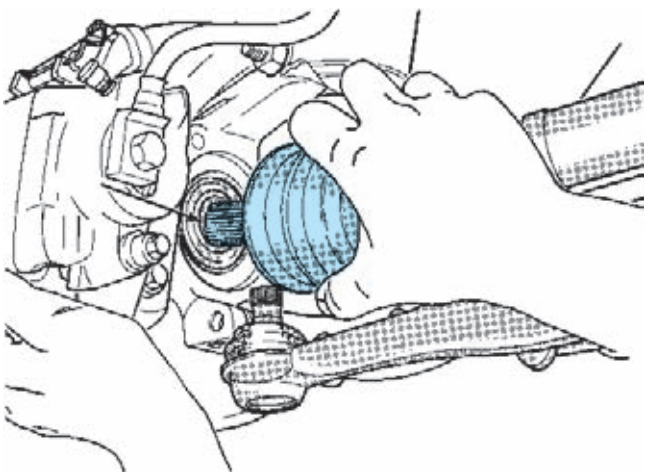


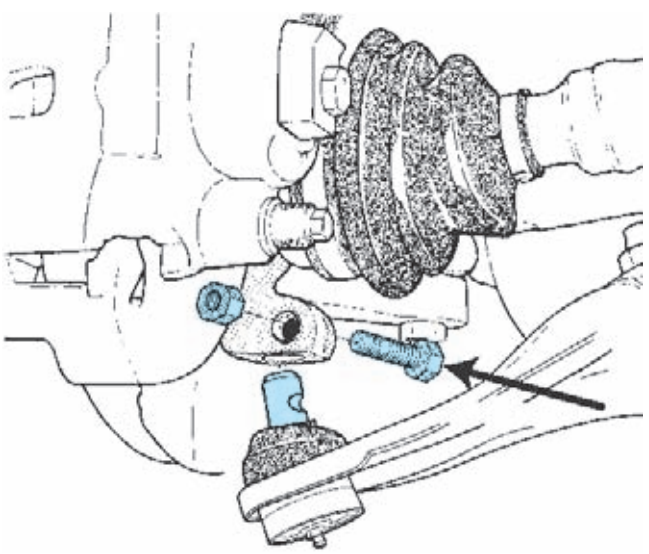
FIGURE 10-22 An old V-belt has been looped around the exhaust pipe and is being used to support the driveshaft. *(Courtesy of DaimlerChrysler Corporation)*



(a) Loosen Hub Nut

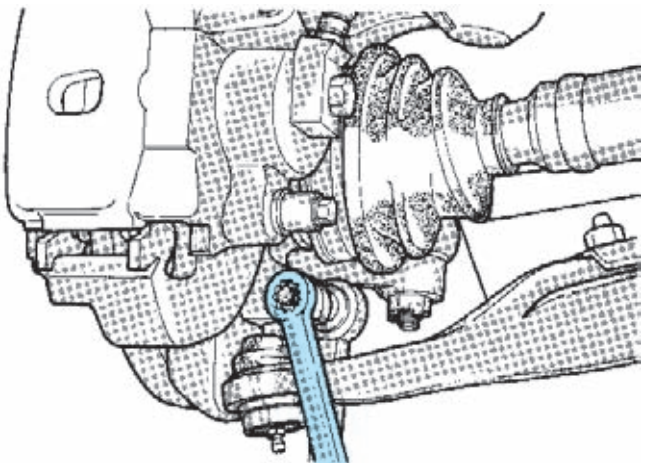


(c) Remove Outboard Joint from Hub/Steering Knuckle

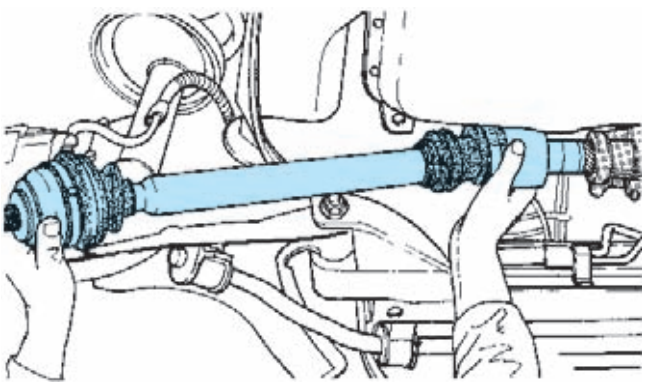


(e) Install Retaining Bolt and Tighten to Correct Torque

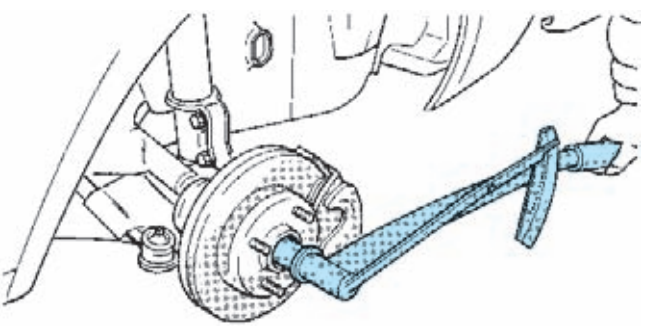
ing this nut, which is normally very tight, the hub and steering knuckle must be moved outward and off the end of the splined section of the CV joint. This usually requires disassembling some portion of the suspension system (Figure 10-23). The driveshaft, along with the front hub and bearing, on General Motors W series vehicles (which include the Chevrolet Lumina) can be removed through the steering knuckle; the hub and bearing can then be removed from the outer CV joint (Figure 10-24).



(b) Disconnect Ball Joint



(d) Remove Inboard Joint from Transaxle



(f) Install New Hub Nut and Tighten to Correct Torque

FIGURE 10-23 Procedure to remove (a–d) and replace (e and f) a FWD driveshaft.

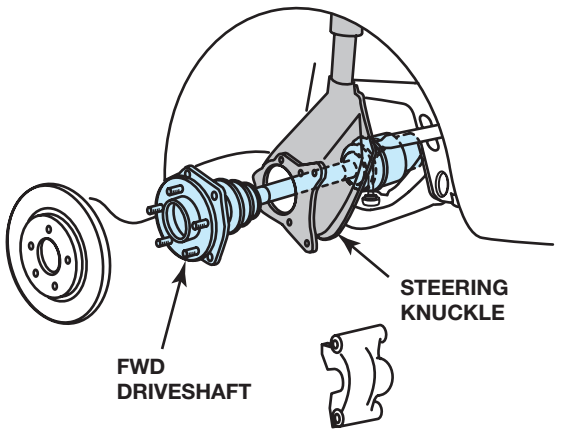


FIGURE 10-24 After the wheel bearing and inner CV joint have been disconnected from the steering knuckle, the hole in the steering knuckle on this FWD vehicle is large enough that the driveshaft with the hub and bearing can be removed through it.

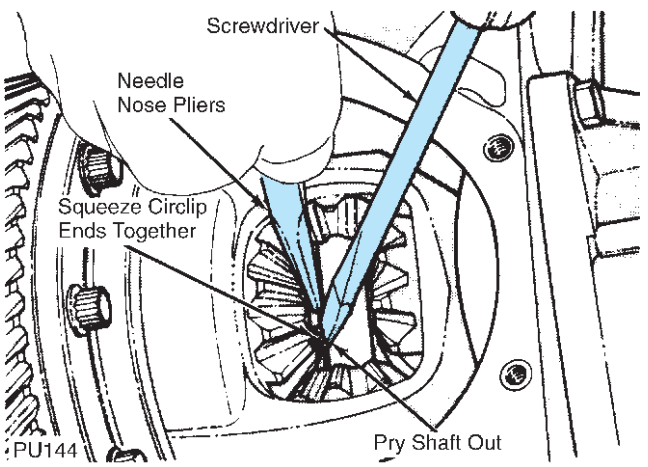


FIGURE 10-25 To remove the inner CV joint from the transaxle on this FWD vehicle, it is necessary to remove the transaxle differential cover and expand the circlip tangs. *(Courtesy of DaimlerChrysler Corporation)*

Most inboard joints are held into the differential pinian gears by a circlip that usually pops free when enough outward pressure is exerted on it. This style is sometimes called a **plug-in connection.** Some inboard joints are bolted to a flange and shaft extending from the differential. Chrysler products from 1981 and earlier retained the CV joint in the differential using a snap ring that must be removed from inside the differential (Figure 10-25). A problem that can be encountered on some makes and models, such as Ford products using an ATX or MTX transaxle, is that the differential pinion gears can roll out of position when both CV joints are removed. Normally, the right driveshaft is removed first, then the left shaft is driven out through the differential using a special tool or 1/4-in. (6.3-mm) rod that is 12 in. (305 mm) long (Figure 10-26). This tool or rod is left in the differential to hold the gears in place until one of the driveshafts is replaced.

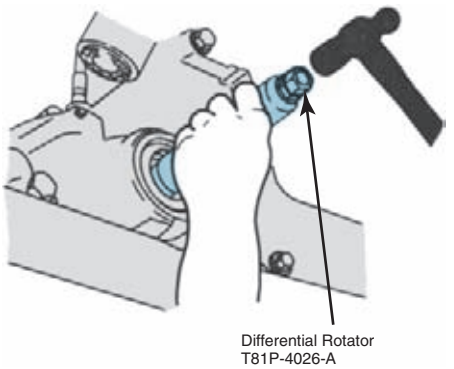
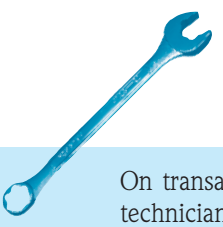


FIGURE 10-26 After the right-side CV joint has been removed, a special tool should be used to drive the left-side inboard CV joint from this transaxle; the tool is then left in place to hold the differential pinion gears in alignment. *(Courtesy of Ford Motor Company)*

TECH TIP

A FWD vehicle should not be moved on the front wheels while the driveshaft is removed. Damage to the front wheel bearings can result. After the driveshaft is replaced, it may be necessary to check the alignment of the front end.



TECH TIP

On transaxles, like the ATX and MTX, some technicians insert a short section of heater hose as a temporary differential pinion shaft to hold the gears in position.

TECH TIP

Special dollies are available, that can be placed under the front of the vehicle to allow it to be rolled to another location (Figure 10-27).

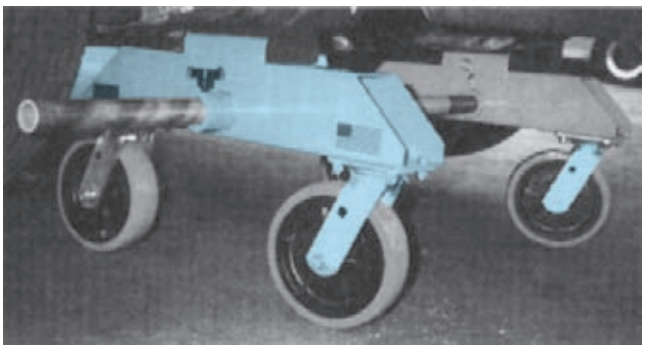


FIGURE 10-27 A special dolly can be placed under the front of the vehicle. This allows the vehicle to be moved while the front driveshafts are removed.

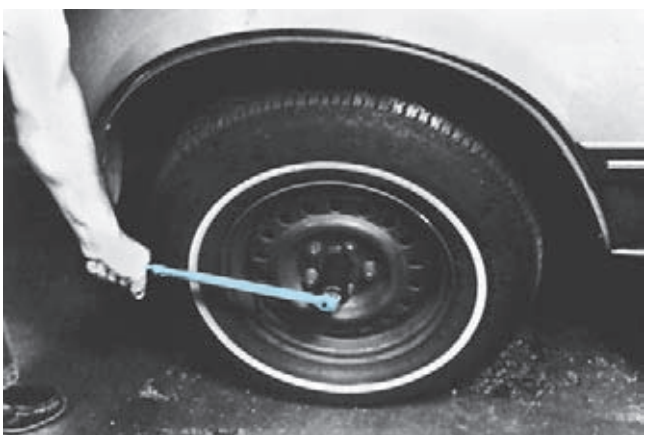


FIGURE 10-28 Front driveshaft removal normally begins by loosening the front hub nuts. Because they are very tight, the wheel is left on the floor with the parking brake applied. *(Courtesy of NEAPCO)*

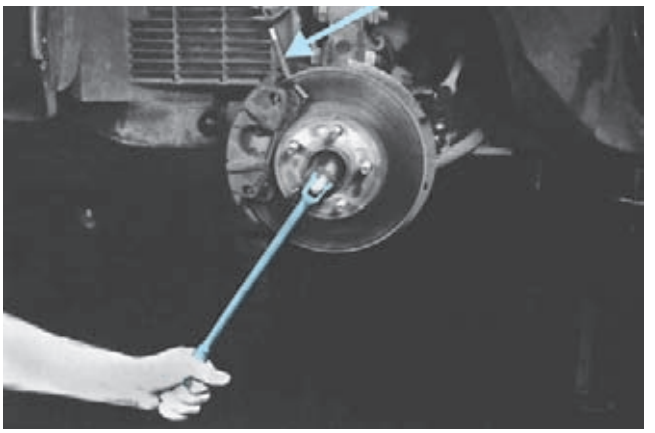


FIGURE 10-29 Once the hub nut has been loosened, the wheel can be removed to allow access for removing the hub nut and other parts. Note the pin to hold the rotor from turning (arrow). *(Courtesy of NEAPCO)*

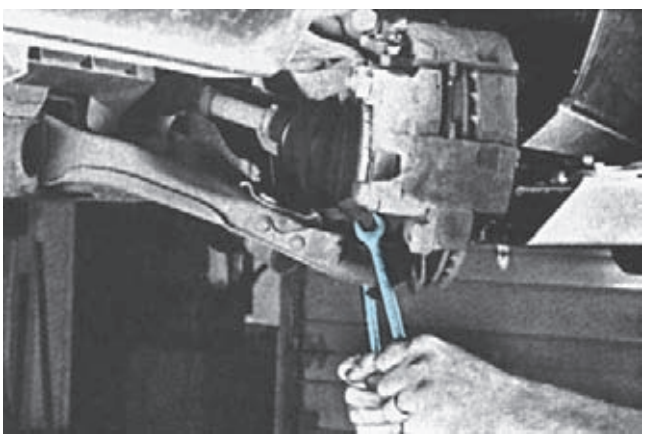


FIGURE 10-30 On most vehicles, the lower control arm is disconnected from the ball joint by removing the clamp bolt and sliding the ball joint stud out of the steering knuckle. This allows for swinging the steering knuckle outward far enough to remove the outboard CV joint from the hub. *(Courtesy of NEAPCO)*

The following description is very general. It is recommended that you follow the procedure given in a service manual for the particular vehicle you are working on.

To remove a FWD driveshaft:

1. Remove the wheel cover and hub nut locking device, and loosen the front hub nut (Figure 10-28). For nuts that have been staked or bent to lock them in place, merely unscrew the nut. Most manufacturers recommend that you do not reuse this nut. Replace it with a new one during driveshaft replacement. Using an air impact wrench to loosen or remove this nut is not recommended.
2. Raise and securely support the vehicle, and remove the front wheel. Finish removing the hub nut (Figure 10-29). On vehicles with ventilated brake rotors, a pin can be placed into one of the ventilation slots to keep the driveshaft from turning as you remove the nut.
3. Remove the lower ball joint clamp bolt (Figure 10-30). Many manufacturers recommend replacing this nut and bolt.
4. Pry the lower control downward to separate it from the steering knuckle as you pull the steering knuckle outward to separate the front hub from the CV joint (Figure 10-31). On some vehicles it is necessary to install a puller to push the CV joint inward (Figure 10-32). Never hammer on the end of the CV joint to drive it inward.

   As you separate the hub and CV joint, be careful not to stretch the brake hose; on some vehicles it will be necessary to disconnect the brake caliper and hang it from the strut assembly using a hook or wire. Be ready to support the driveshaft so that it does not drop.

5. On some vehicles the inner CV joint can be removed from the differential with a quick jerk on the prying tool, but do not put excessive force on the transaxle case (Figure 10-33).

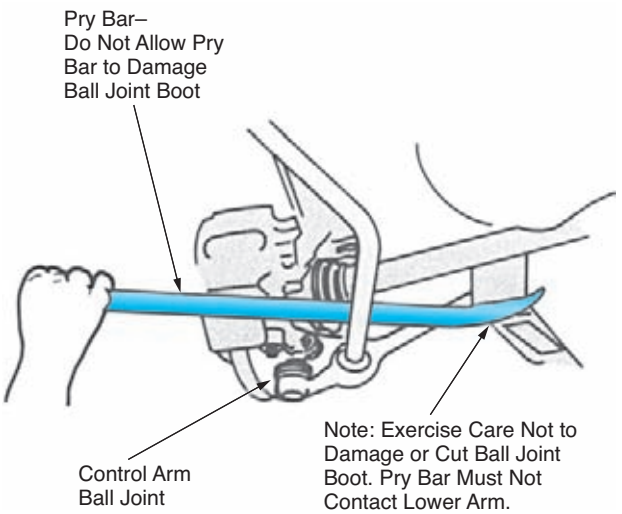


FIGURE 10-31 A pry bar is being used to force the lower control arm downward far enough to remove the ball joint stud from the steering knuckle. *(Courtesy of Ford Motor Company)*

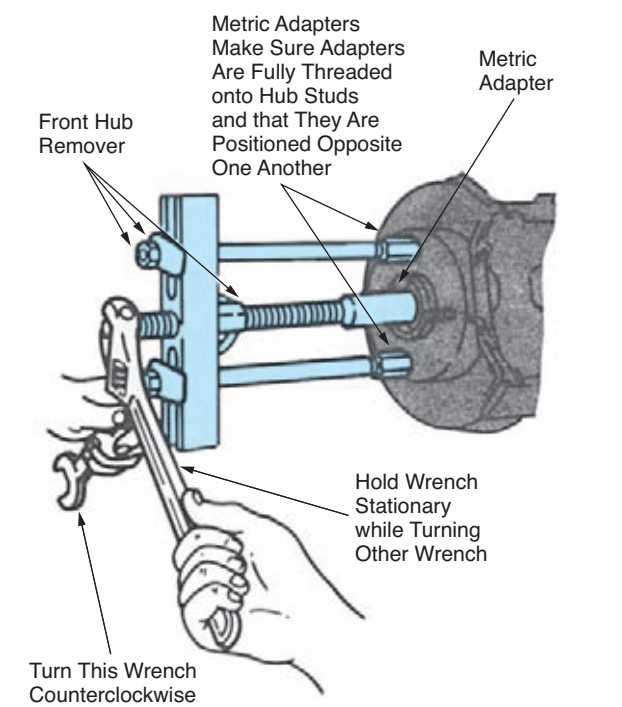


FIGURE 10-32 This puller is being used to pull the hub outward and off the splines of the outboard CV joint. *(Courtesy of Ford Motor Company)*

TECH TIP

In many FWD vehicles with an **antilock braking system (ABS)**, an ABS **reluctor/tone ring** is mounted on the outboard CV joint and a **wheel speed sensor (WSS)** right next to it. Be careful not to damage the speed sensor wire, WSS, or reluctor. Reluctor ring replacement is described on page 282.

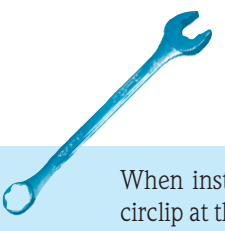
TECH TIP

An attachment for a slide hammer can be used to jerk the CV joint out of the differential. Do not use the outer CV joint and driveshaft as a slide hammer for this purpose.

6. Remove the driveshaft, being careful not to damage the CV joint boots. Keep the shaft horizontal so as not to stress the plunge joint (Figure 10-34).

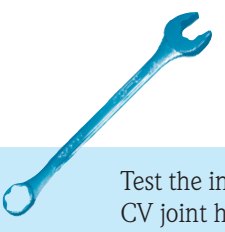
To replace a FWD driveshaft (Figure 10-35):

1. Lubricate the seal area on the inboard CV joint, and being careful not to damage the seal, slide the CV joint completely into the transaxle.



TECH TIP

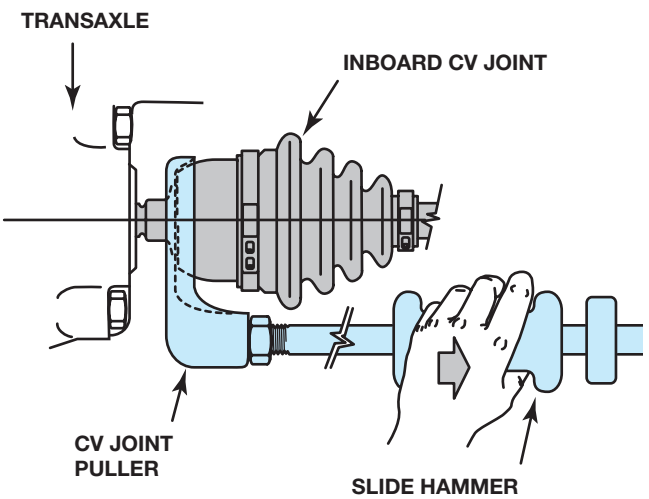
When installing a front driveshaft that uses a circlip at the inner CV joint, sometimes the circlip hangs down and catches during the installation. Partially fill the circlip groove with enough grease so the grease will keep the circlip centered.



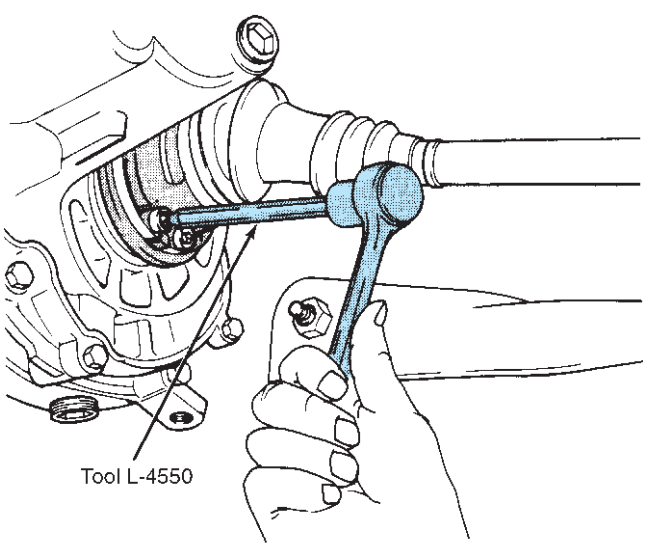
TECH TIP

Test the installation by pulling outward on the CV joint housing; it should not pull free.

(a)



(b)



(c)

FIGURE 10-33 Most inboard CV joints can be pulled from the transaxle by using a slide hammer with a special adapter (a). The adapter is hooked behind the inner CV joint (b). Some inboard joints are bolted to a transaxle flange (c).

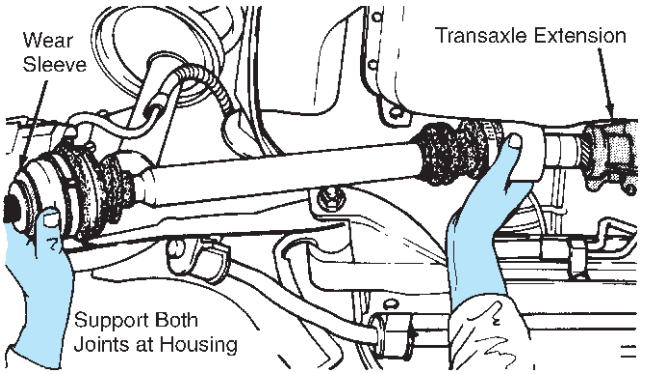


FIGURE 10-34 After a shaft has been disconnected, it should be removed carefully to prevent damaging the boots or CV joints; it should then be carried in a horizontal position. *(Courtesy of DaimlerChrysler Corporation)*

2. Pull the hub and steering knuckle outward as you insert the spline of the outboard CV joint through the hub. Rotate the hub, if necessary, to line up the splines.
3. Thread a new hub nut onto the CV joint and tighten the nut just enough to pull the CV joint into place.
4. Reinstall the lower ball joint using a new bolt where required, and tighten the nut to the correct torque.
5. Torque tighten the hub nut to about 50 ft-lb (70 N-m) of torque. Install the wheel and tire, and lower the vehicle. Set the parking brake and finish tightening the hub nut and lug nuts to the specified torque.
6. Install the hub nut locking device, raise the tire, and check to ensure that the tire rotates freely.

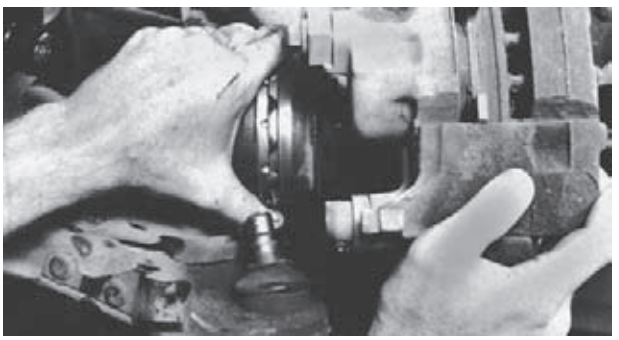
TECH TIP

A special tool is required to pull the CV joint into place on some domestic and imported vehicles; do not use the hub nut for this purpose.

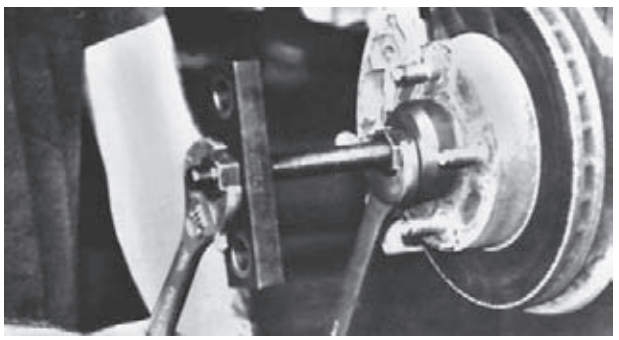
TECH TIP

Be sure to align the notch in the ball joint stud with the clamp hole on those studs that do not have a full grove around them.

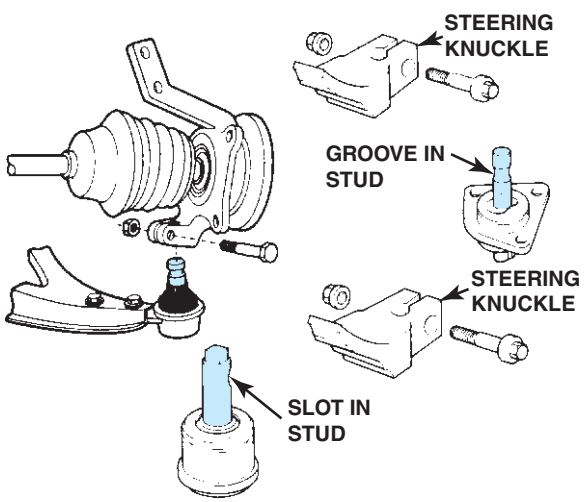
(a)



(b)

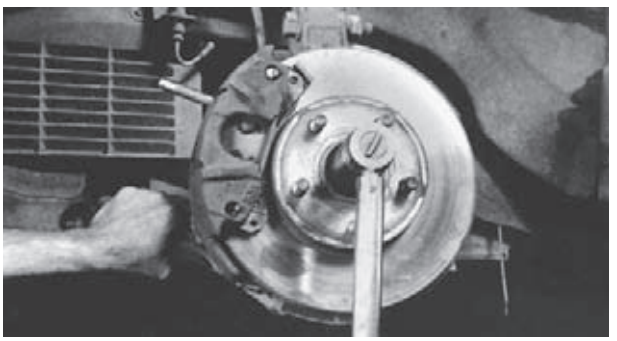


(c)



(d)

(e)



(f)

(g)

FIGURE 10-35 A FWD driveshaft is replaced by installing the inboard joint into the transaxle (a), swinging the steering knuckle outward so that the hub goes onto the splines of the outboard CV joint (b) (in some cases, the CV joint splines must be pulled into the hub [c]), installing the ball joint stud and retaining bolt correctly into the steering knuckle (d), tightening the ball joint nut (e), replacing the hub nut (f), and tightening the nut to the correct torque (g). *(a, b, c, e, f, and g are courtesy of NEAPCO; d is courtesy of Moog Automotive)*

FIGURE 10-36 This stop-off tool is a quick, easy way to keep fluid in the transmission after the driveshaft has been removed. *(Courtesy of K-D Tools)*

FWD Wheel Bearing Service. Wheel bearing service is easier when the CV joint is removed from the steering knuckle. The bearing is usually a sealed bearing or modular assembly that allows the hub to rotate in the steering knuckle while holding the front wheel in proper alignment. A bearing is normally a press fit into the steering knuckle with the hub a press fit into the bearing. The hub is a part of the modular bearing and is bolted onto the steering knuckle; it is easily removed and replaced.

RWD Driveshaft Removal and Replacement

Most driveshaft slip joint splines float in the transmission mainshaft rear bushing. When the driveshaft is unbolted from the rear axle, it will slide right out of the transmission. This allows lubricant to run out of the unsealed opening.

When replacing a driveshaft, be sure to put some grease or transmission oil on the slip yoke to lubricate the seal.

To remove a RWD driveshaft:

1. Raise and securely support the vehicle so that the driveshaft is free to turn.

TECH TIP

To prevent leakage, many shops position a vehicle so that the back end is raised higher than the front. Many technicians use an old slip yoke or stop-off tool to plug the transmission (Figure 10-36). A plastic bag and rubber band can also be used.

2. Place index marks at the rear U-joint flange and rear of the shaft so that the shaft can be replaced in this same position (Figure 10-37).

TECH TIP

Many technicians will wrap tape around the joint or slide an old sock over the U-joint and shaft to hold the bearing cups in place (Figure 10-38). Also, support the shaft so that it doesn't fall.

3. Remove the bolts securing the rear U-joint to the flange. Do not let the two bearing cups fall off the U-joint cross.
4. Slide the slip yoke out of the transmission, plug the back of the transmission, and remove the driveshaft from the vehicle.

Most RWD driveshafts are replaced by sliding the slip yoke into the transmission, aligning the index marks as the rear U-joint is connected to the rear-axle companion flange, and tightening the bolts to the correct torque.

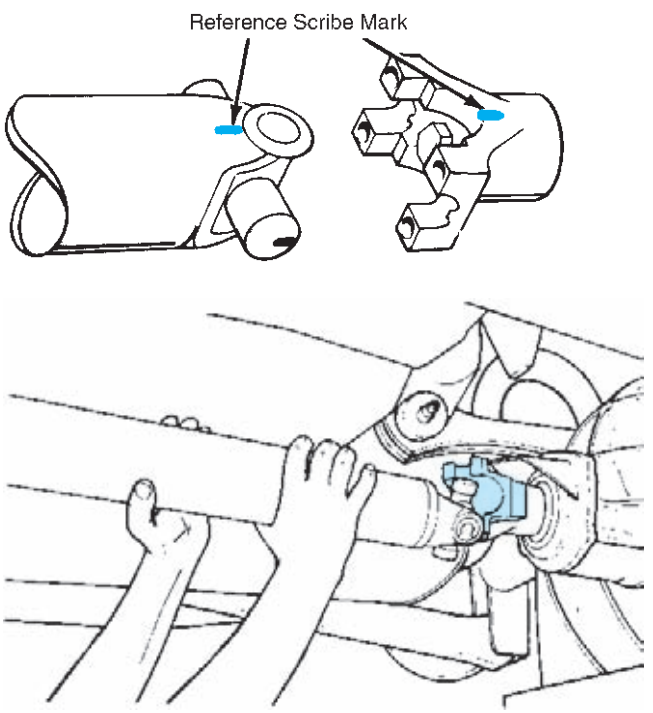


FIGURE 10-37 Before removal, make index marks at the rear U-joint so that the shaft can be replaced in its original position. *(Courtesy of Ford Motor Company)*

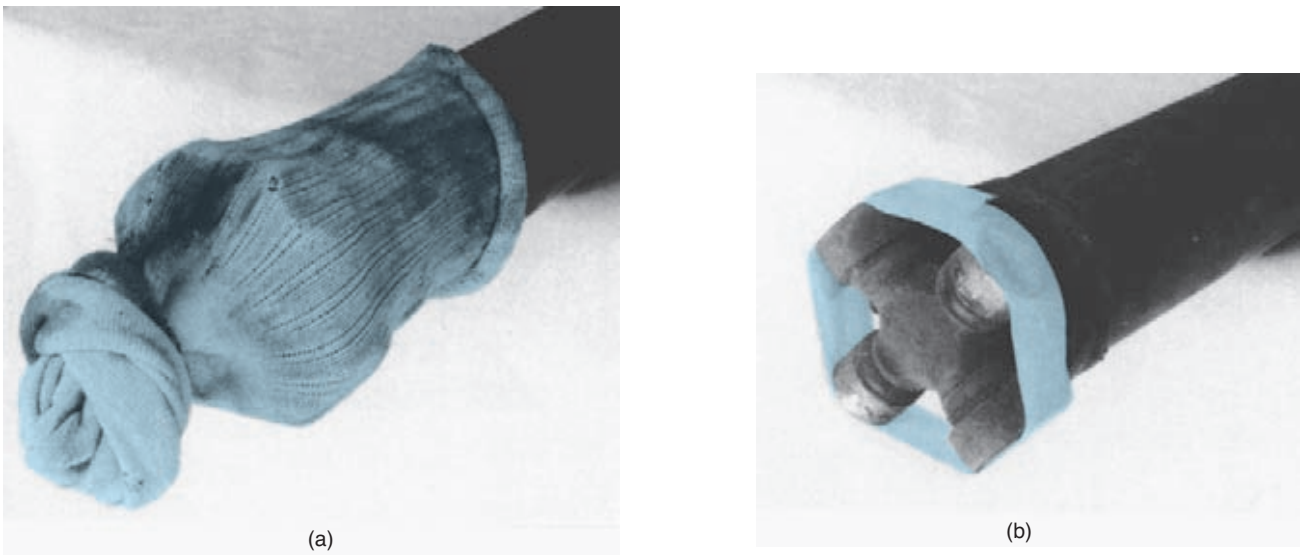


FIGURE 10-38 An old sock has been slid over this driveshaft to hold the bearing cups onto the U-joint (a). Tape can be used for the same purpose (b).

TECH TIP

When installing a driveshaft with the bearing caps held by a U-bolt or strap, make sure that the bearing cups are properly seated inside the locating lugs (Figure 10-39).

REAL WORLD FIX

A 1988 Chevrolet pickup had a clunk in the rear when it was accelerated from a stop. The noise was isolated to the driveshaft slip yoke. The transfer case and slip yoke splines were good, and when the splines were cleaned and regreased, the clunk disappeared. However, the clunk returned in a couple of months. The transfer case bushing was good.

A special lubricant, GM part number 12345789, was put on the splines, and this fixed the recurring problem.

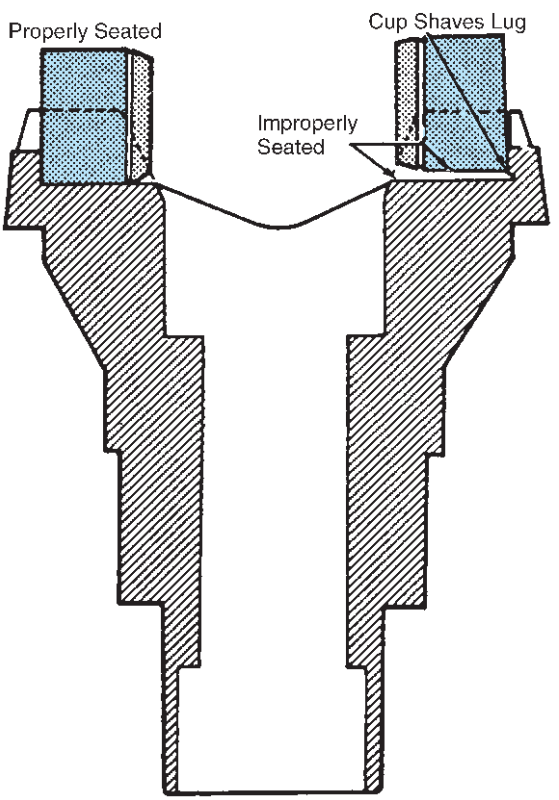


FIGURE 10-39 When replacing a driveshaft, make sure that the bearing cups are properly seated inside the lugs of the flange. *(Courtesy of Ford Motor Company)*

REAL WORLD FIX

A 1986 Suburban (144,000 mil) had a severe vibration from 15 to 30 mph, and the cause could not be found. The U-joints, carrier bearing, rear brake drums, and transmission mount had been replaced, and the driveshaft had been balanced at two different shops.

Many shops balance a driveshaft by single-plane balancing; each end is balanced by adding weight until the vibration smoothes out. The driveshaft was balanced once more, this time at a shop that had the ability to balance by two-plane balancing, which requires more sophisticated equipment. This more complex method solved the problem.

DRIVESHAFT SERVICE

Driveshafts are removed for replacement with a new or rebuilt driveshaft assembly or, more commonly, for repair. U-joint and CV joint service requires only a few special tools. Major driveshaft operations such as balancing, straightening, or tube replacement are done by driveline specialty shops. When FWD CV joint problems are encountered, many repair shops will install new or rebuilt driveshafts that are available at most parts houses.

FWD Driveshaft Service

FWD driveshaft service includes CV joint removal for boot replacement; CV joint cleaning, rebuilding, or replacement; and service to the center bearing and U-joint. When used, most center U-joints are Cardan joints and can be serviced as described on pages 290–296. Replacement driveshafts are available as both new and rebuilt.

A universal-fit boot and quick installation process has been developed by Cosmos International; the UniFit boot is designed so that four part numbers fit all CV joints. The large end of the boot will be too large for some joints, so the excess material is cut off. These boots can be installed in the normal manner by removing the CV joint or quickly by sliding the boot over the CV joint by using a special cone and lubricant.

CV joint boots with a split and locking seam are available to replace a damaged boot without removing the shaft or the joint from the shaft. Many technicians do not use these, however, because they feel it is necessary to remove the joint to clean out any debris that might have entered the joint. Also, to get a reliable seal with early designs, the seam must be perfectly clean and kept stationary for a fairly long period of time. Most technicians believe that the slightly longer period of time used to remove and replace the shaft and joint; to clean, check, and lubricate the joint properly; and to use a factory-approved boot is well worth the time and expense.

On some vehicles it is possible to remove the outboard CV joint with the driveshaft still connected to the transaxle. As a beginner, though, it is a wise practice to remove the entire assembly until you are skilled at the procedure used to remove and replace the joint.

Boot Replacement. In most cases, boot replacement begins with the driveshaft removed and is part of the CV joint removal and replacement procedure. The old boot and clamps are cut off during CV joint removal, and a new boot and clamps are installed during the replacement. If using a Uni-Fit boot and installation cone, the CV joint can be left on the driveshaft. This process uses a cone-shaped device to stretch the boot over the CV joint.

To install a CV boot using the cone method:

1. Clean the driveshaft and CV joint to prevent dirt from entering the boot during installation.
2. Cut the old clamps and boot, and remove them from the shaft.
3. Warm the boot up to 78°F (25°C) (it can be rolled vigorously between your hands) and check the cone to ensure there are no cuts or nicks.
4. Spray the entire outer surface of the cone and boot with wax-type spray (Figure 10-40).
5. Turn the boot inside-out and place it over the waxed cone. Inner boots are installed right-side out, so the inside should be coated with spray and the boots are not turned inside-out.
6. Place the boot over the cone and install the cone onto the 1/2-in. bolt that is held either by the base plate or in a vise.
7. Place the CV joint into the cone, and quickly, with force, pull the boot up and over the cone.
8. Roll the boot right-side out, pack the CV joint with grease, and stretch the boot over the CV joint until a tight fit is formed.
9. Release any trapped air by inserting a blunt screwdriver under the boot.
10. Install a clamp at the large end of the boot in the original location. A special banding tool should be used to tighten the clamp.
11. With the boot at its natural length, install a clamp at the small end of the boot to secure it to the shaft.
12. If excess material extends past the clamp, cut it off using a sharp knife.

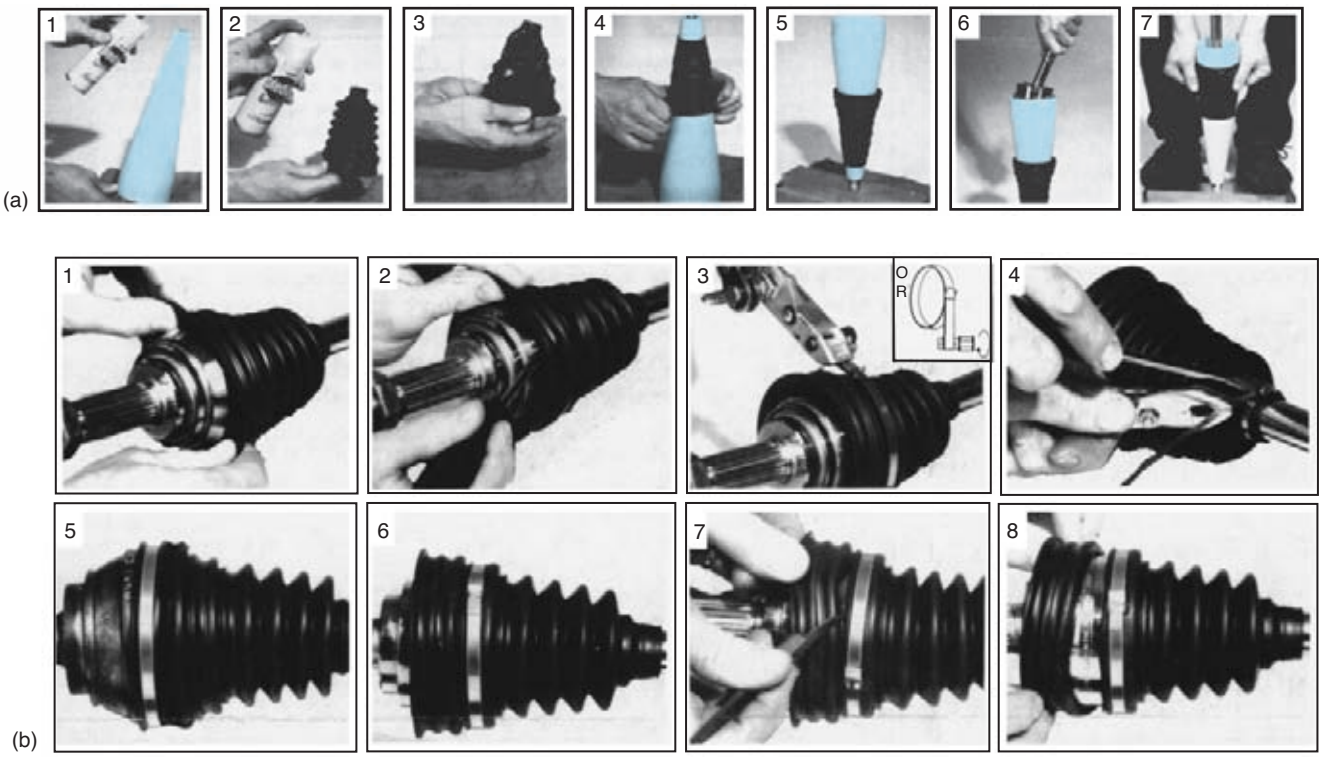


FIGURE 10-40 The procedure to install a new boot over a CV joint using a cone (a), and the procedure used to connect a Uni-Fit boot (b). *(Courtesy of Cosmos International, Inc.)*

Another replacement boot is the Sisuner Quick Replacement Outer CV joint boot, a split-type boot using two unique springs at the closure (Figure 10-41). This boot can be installed over a CV joint with the driveshaft still in place, saving the removal and installation time. This particular boot has been approved by at least seven vehicle manufacturers. If using this style of boot, it is very important to check the condition of the CV joint and its grease to make sure that the grease is not contaminated and the joint is not worn.

To install a Quick Replacement boot:

1. Cut the old clamps and boot, and remove them.
2. Wipe away any grease remaining on the shaft and inspect the CV joint for damage or contamination (Figure 10-42).
3. Adequately lubricate the inner groove of the boot seam with the supplied sealant, and place the boot over the shaft.
4. Starting from the large end, insert the male side of the boot into the corresponding groove. Position the boot opening over the joint; and then complete joining the boot, working from the small end.
5. Install the small clamp, fill the boot with grease, and install the large clamp.
6. Check the joint to ensure that the seam is properly connected and that the boot has the proper shape.

CV Joint Removal. Outboard CV joints are held onto the driveshaft by a snap ring, a plastic retainer, or a circlip. To determine which is used, a technician usually cuts and removes the boot and retaining rings, cleans the inner end of the joint, and looks for a snap ring. If a snap ring or plastic retainer is not visible, a circlip has been used (Figure 10-43).

It is a good practice to install a new circlip; the old one might be weakened and allow the CV joint to change position after installation. When replacing a circlip, use care not to overstretch it; this can prevent the circlip from releasing the next time.

A new boot and retainer clamps are always used when the CV joints are replaced. These are available in a kit, often with a packet of grease (Figure 10-44).

To remove a CV joint:

1. Mark the location of the boot on the shaft to ensure that the new boot and clamp are replaced in the same position (Figure 10-45). Cut the boot and clamps using diagonal cutting pliers, and remove them from the shaft.
2. Wipe the grease from the inner edge of the joint, and check for a snap ring.
3. If you can locate a snap ring or retainer, remove it from its groove and slide the joint off the shaft. If you locate a

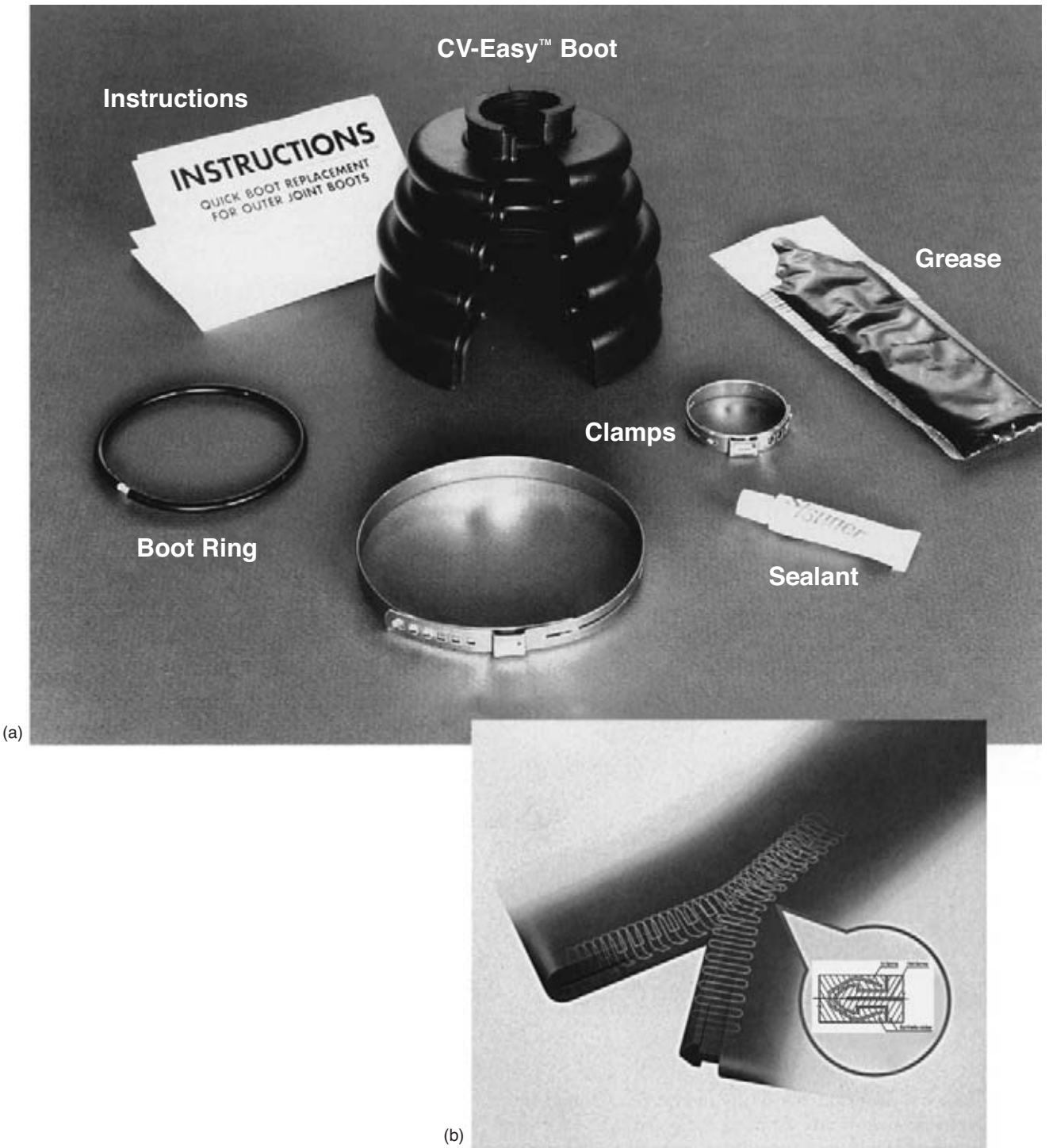
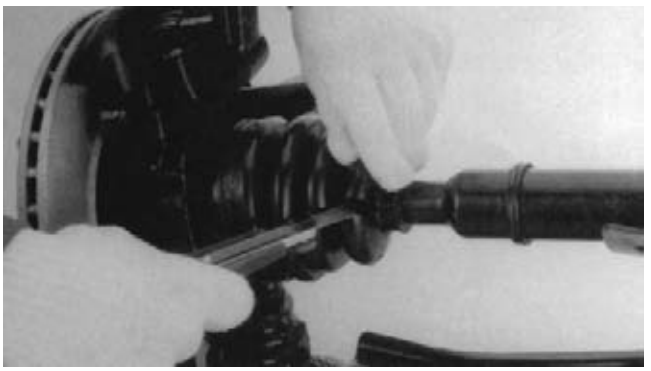


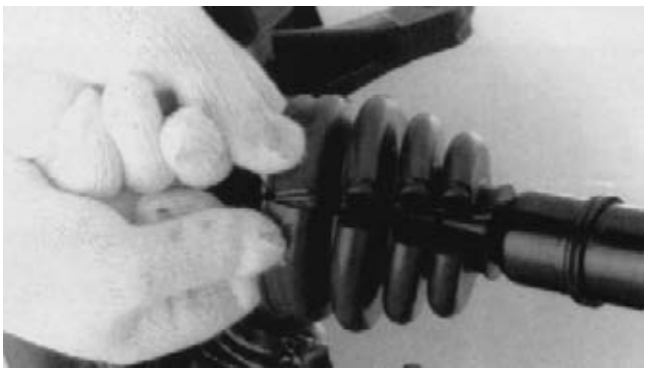
FIGURE 10-41 A Quick Replacement outer CV boot kit (a). This boot has a seam that is held together by two unique springs and the shape of the rubber (b). *(Courtesy of Sisuner International)*

plastic retainer, expand it at the seam, and slide the joint off the shaft.

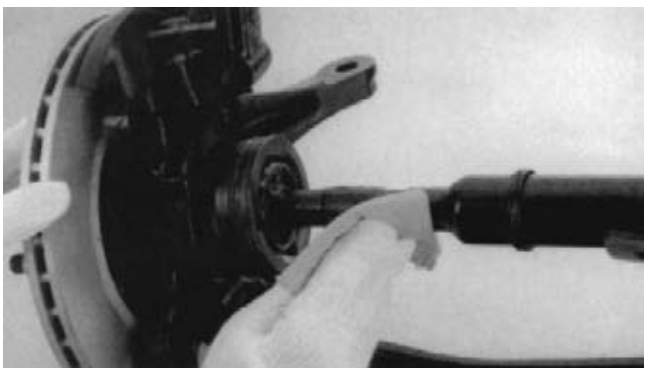
If you cannot locate a snap ring, clamp the driveshaft in a vise equipped with soft jaws so as not to mark the shaft. Using a special driving tool or brass punch, strike a sharp, quick blow on the CV joint (Figure 10-46). The joint should break loose and slide off the shaft; be ready to catch it. Leave the circlip in place on the shaft, unless it is to be replaced with a new one.



(a)



(d)



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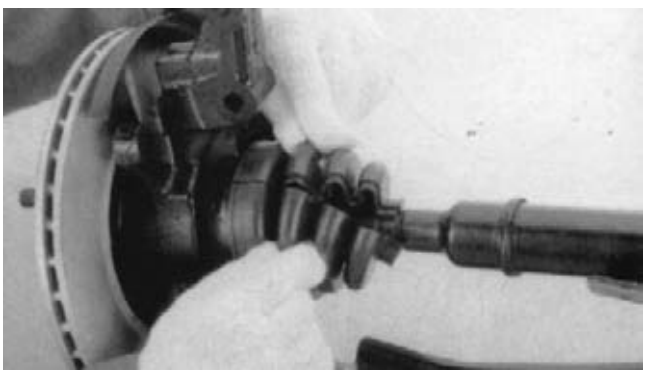

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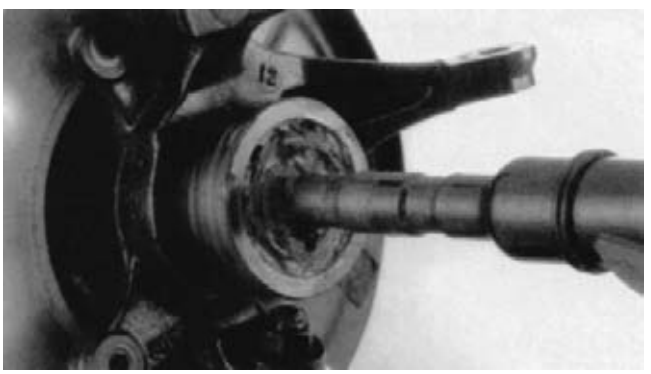


(c)

(f)

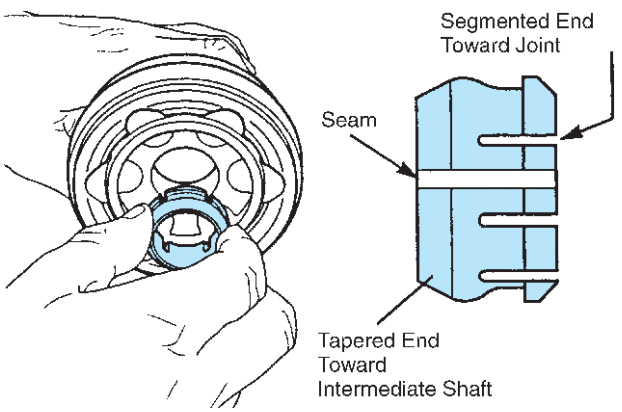
FIGURE 10-42 The installation steps for a Quick Replacement outer CV boot are to cut away the old boot and clamps (a), remove any excess grease and dirt (b), check for wear and grit (c), place the new boot over the shaft and lubricate the seam with sealant (d), then start closing the seam from the big end and positioning it over the CV joint (e). The rest of the seam is closed and the clamps are installed (f). *(Courtesy of Sisuner International)*

ABS Tone Ring Replacement. In most cases, a damaged speed sensor tone ring can be replaced. They are usually pressed onto the CV joint. Special tooling is often required when removing the old ring and installing the new one. Be sure that the replacement ring has the same number of teeth as the old one (Figure 10-47).

CV Joint Replacement. Once the joint has been cleaned in a solvent wash, it should be thoroughly dried.

The joint should then be packed with grease of the type and amount recommended by the manufacturer. The packet provided with the boot kit fills this requirement. Never use standard grease to pack a CV joint. Sealing the grease in and dirt and water out is critical.

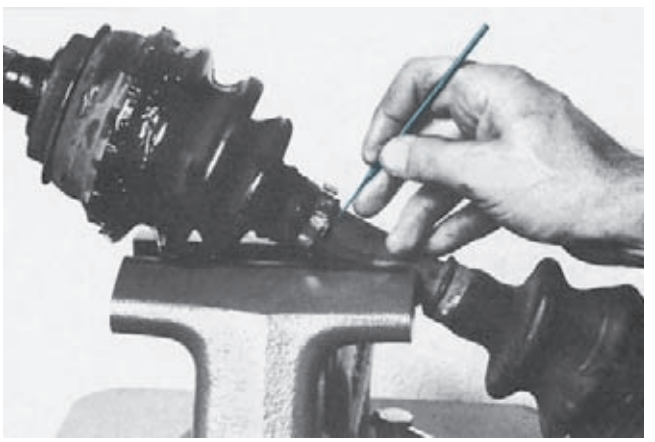
(a)



(b)

FIGURE 10-43 Some outboard CV joints are held in place by a snap ring (a). Most are retained by a circlip (b), sometimes with a spacer ring to help locate the joint. Some joints use a plastic retainer (c). *(a is courtesy of NEAPCO; b is courtesy of Moog Automotive)*

FIGURE 10-44 This CV joint boot replacement kit contains the boot, clamps, grease, and a new circlip. *(Courtesy of Moog Automotive)*



(a)

(b)

FIGURE 10-45 Before the old boot is removed, the shaft should be marked so that the new boot can be clamped in the correct position (a). Next, the clamps and the old boot are cut to allow easy removal (b). *(Courtesy of NEAPCO)*

Several types of retainer rings or clamps are used to lock the boot in place (Figure 10-48). Most boots use either a flat ring clamp or a flat band clamp. The ring clamp is placed onto the boot and then crimped to shorten and lock it in place. A band clamp is placed in position, pulled tight, and then crimped or bent to lock it in place. The boots on many GM vehicles use a preformed retaining ring that must be pressed in place along with the boot onto the CV joint. On newer, nonrubber boots, the clamps must be straight and tight for a good watertight seal.

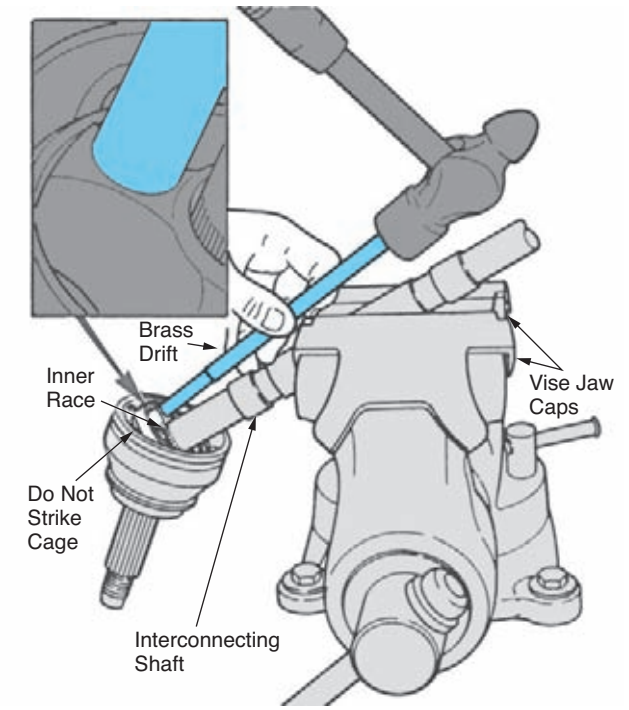


FIGURE 10-46 Most outboard CV joints can be removed from the shaft with a sharp tap from a brass drift punch. Be ready to catch the joint when it comes loose. *(Courtesy of Ford Motor Company)*

REAL WORLD FIX

During an oil change on a 1995 Nissan Quest, a torn boot was noticed on the outboard CV joint. The driveshaft was removed with the plan to remove the CV joint and replace the boot. No retaining ring was found, and a good hammer and brass punch blow did not pop the joint off the shaft. The technician sought advice.

The inner joint and boot were removed. A new boot was slid over the shaft, and installed over the outboard joint. The inboard joint with a new boot was then installed to fix this problem.

TECH TIP

Some technicians use a hot air gun for drying the washed joint and warming the boot.

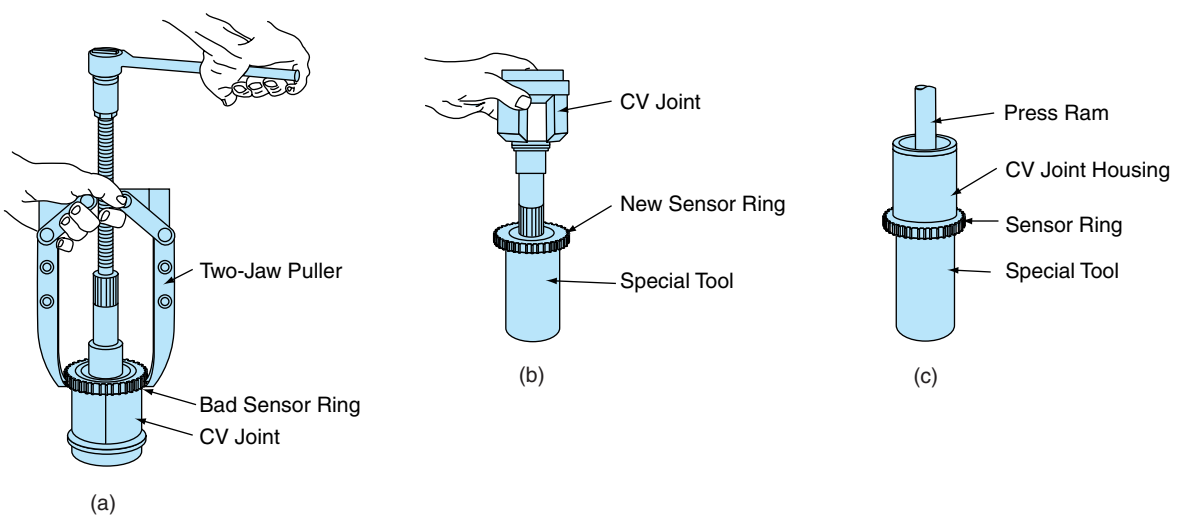


FIGURE 10-47 A damaged speed sensor tone ring can be removed using a puller (a) or special tools. The new ring is placed in position (b) and pressed into place (c) using a special tool.

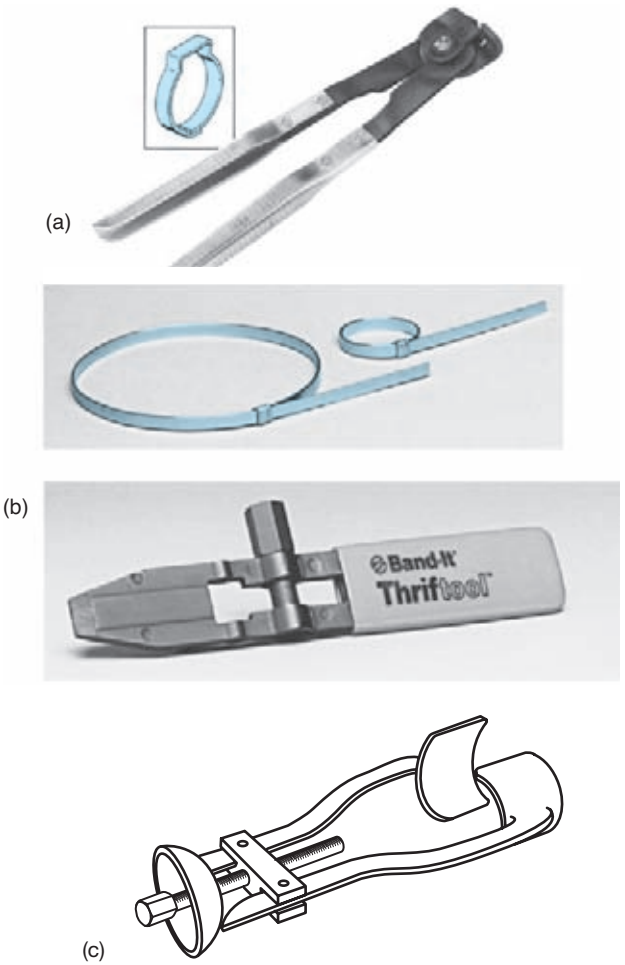


FIGURE 10-48 The major styles of boot clamps (shown with their installation tools) are an adjustable clamp (a), an adjustable band (b), and a fixed-size ring (c). *(a is courtesy of Plews; b is courtesy of Band-It)*

To install a CV joint and boot:

1. Slide the boot and, if used, continuous ring retainers onto the shaft. Band retainers can sometimes be installed after the boot is in place.
2. Pack the CV joint with grease, moving the joint through all of its angles as you fill all the cavities of the joint (Figure 10-49).
3. If a circlip is used, slide the CV joint in place onto the shaft; you can often feel the circlip lock the joint in place.

   If a snap ring is used, slide the CV joint and snap ring onto the shaft, and replace the snap ring in its groove. If a plastic retainer is used, insert the segmented end into the joint, and slide the CV joint onto the shaft until you feel the retainer snap into its groove.
4. Place the small shaft end of the boot in the position marked on the shaft. Place the retainer in position, and lock the retainer and boot in place.

FIGURE 10-49 After the joint has been cleaned thoroughly, it is repacked with grease, working the grease into all parts of the joint. *(Courtesy of NEAPCO)*

5. Place the large end of the boot in position on the CV joint. Work any abnormal folds or bulges out of the boot. Place the retainer in position, and lock the retainer in place (Figure 10-50).

Note: Steps 4 and 5 can be reversed on many joints.

Outboard CV Joint Disassembly, Inspection, and Reassembly. Most Rzeppa joints can be disassembled for cleaning and inspection rather easily and quickly. If the joint is usable, reassembly is also a fairly quick and easy operation. If the inspection reveals damage, the entire joint is normally replaced. A hammer and brass punch can be used to tilt the inner race. Special tools are available.

To disassemble a Rzeppa joint (Figure 10-51):

1. Clean the visible portions of the joint, and check the inner race and cage for identifying features to help you position them correctly during reassembly.
2. Rock one side of the inner race inward as far as possible so that the ball at the opposite side is exposed. To aid disassembly and reassembly, check for slight differences around the CV joint outer race and cage. A wider slot or pair of wider windows allows you to take the joint apart or put it back together.

TECH TIP

Index marks can be placed on the outer race and cage using a permanent marker.

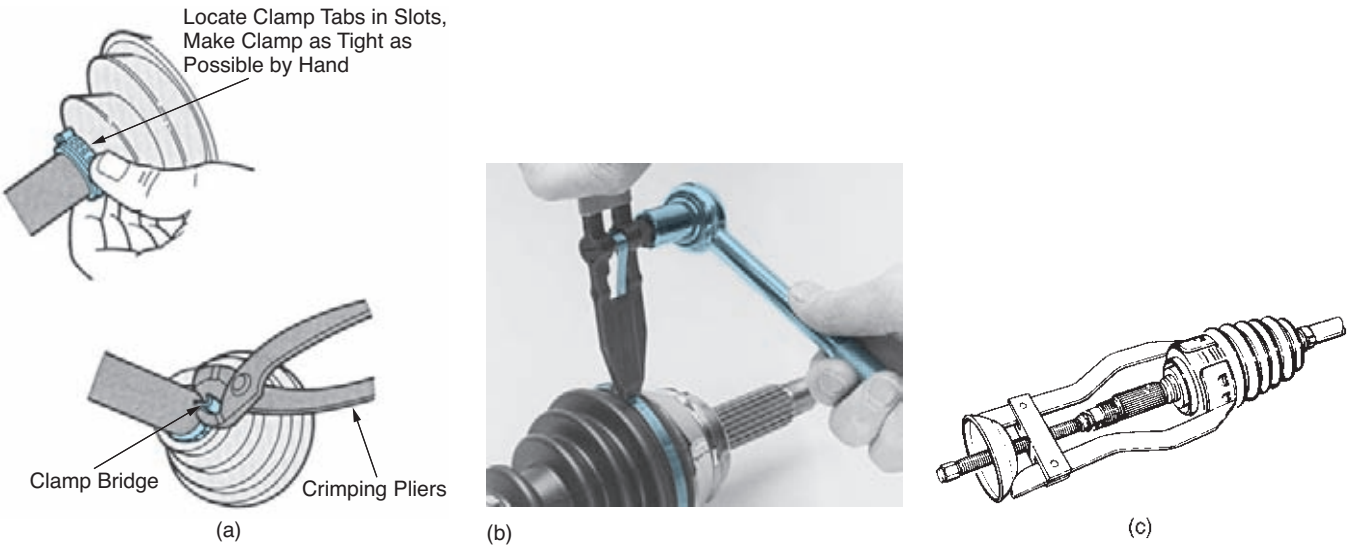


FIGURE 10-50 After the boot has been replaced and positioned properly, the clamps should be tightened using the correct tool. *(a is courtesy of Ford Motor Company; b is courtesy of Band-It; c is courtesy of Plews)*

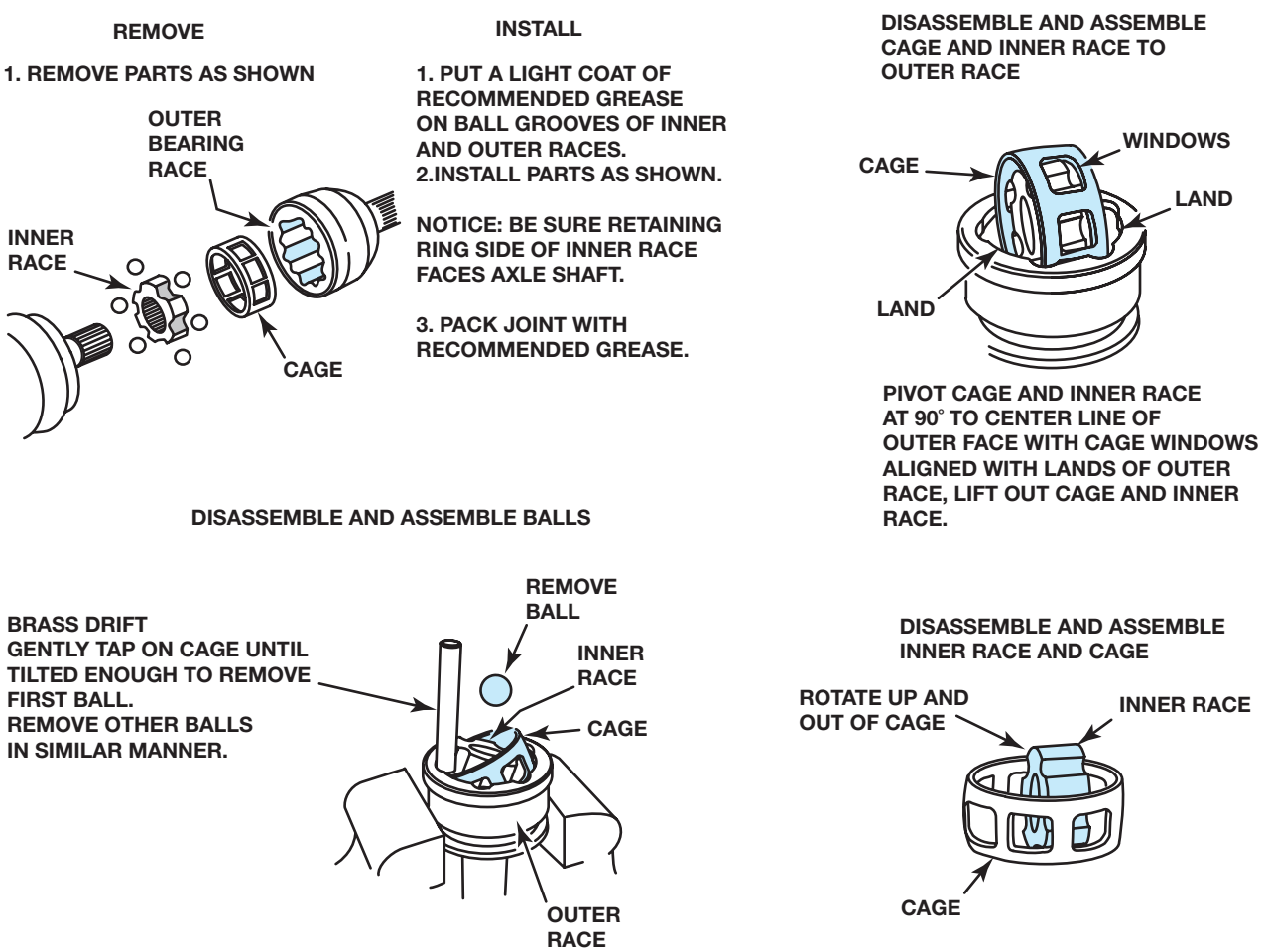


FIGURE 10-51 Procedure to disassemble a Rzeppa CV joint; special tools are available to swing the inner race for ball removal and installation.

3. Remove the exposed ball and then rock this side of the race inward to allow removal of the opposite ball. Repeat these steps to remove the remaining balls.
4. Both the inner race and the cage can now be rotated completely.
   The inner race and cage are removed together by rotating the cage 90° to the outer race and swinging it out.
5. The inner race can be removed from the cage by rotating it 90° to the cage and swinging it out.
6. Clean all the parts in solvent, and thoroughly air-dry them.

After disassembly and cleaning, the balls, cage, and inner and outer races should be inspected for wear or damage (Figure 10-52). Normal damage can appear as chipped or pitted balls, a cracked or pitted cage, and worn grooves or channels in the inner and outer raceways.

To assemble a Rzeppa joint (Figure 10-53):

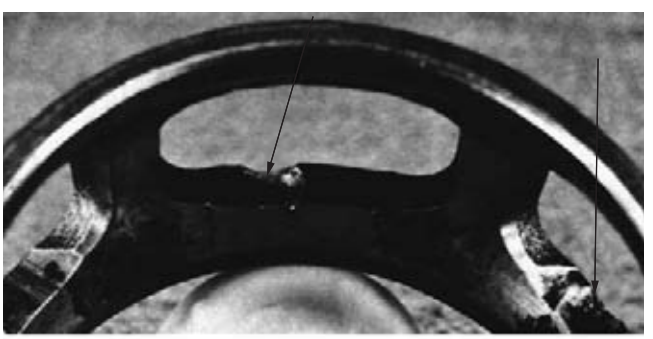
1. Swing the inner race into the cage and rotate it 90° until the inner race and case are aligned.
2. Swing the cage and inner race into the outer race and rotate them until they are aligned. Position the cage and inner race so that the windows and raceways are aligned with the outer raceways.
3. Rock one side of the cage and inner race upward, and place a ball into the cage window and inner raceway. This should be a tight fit.
4. Rock this ball downward, into the outer raceway, so that the window on the opposite side is exposed. Place a ball into this window and ball groove. Repeat this operation to install the remaining balls.

Inboard CV Joint Disassembly, Inspection, and Reassembly. Disassembly procedures vary somewhat between the commonly used double-offset and tripod joints. The following description is very general; it is wise to follow the procedure given in a service manual for the particular joint you are working on.

To disassemble a double-offset inboard joint (Figure 10-54):

1. Cut the clamps and boot, and remove them from the shaft.
2. Remove the retaining ring and the housing/outer race.
3. Remove the stop ring from its groove and slide it and the inner race assembly down the shaft so that you can remove the circlip from the end of the shaft. Slide the inner race assembly off the shaft.

(a)



(b)

(c)

(d)

FIGURE 10-52 After the joint has been cleaned, it should be inspected for damage or wear to the outer race (a), cage (b and c), balls, and inner race (d). Wear problems such as those shown are reason to replace the joint. *(Courtesy of NEAPCO)*

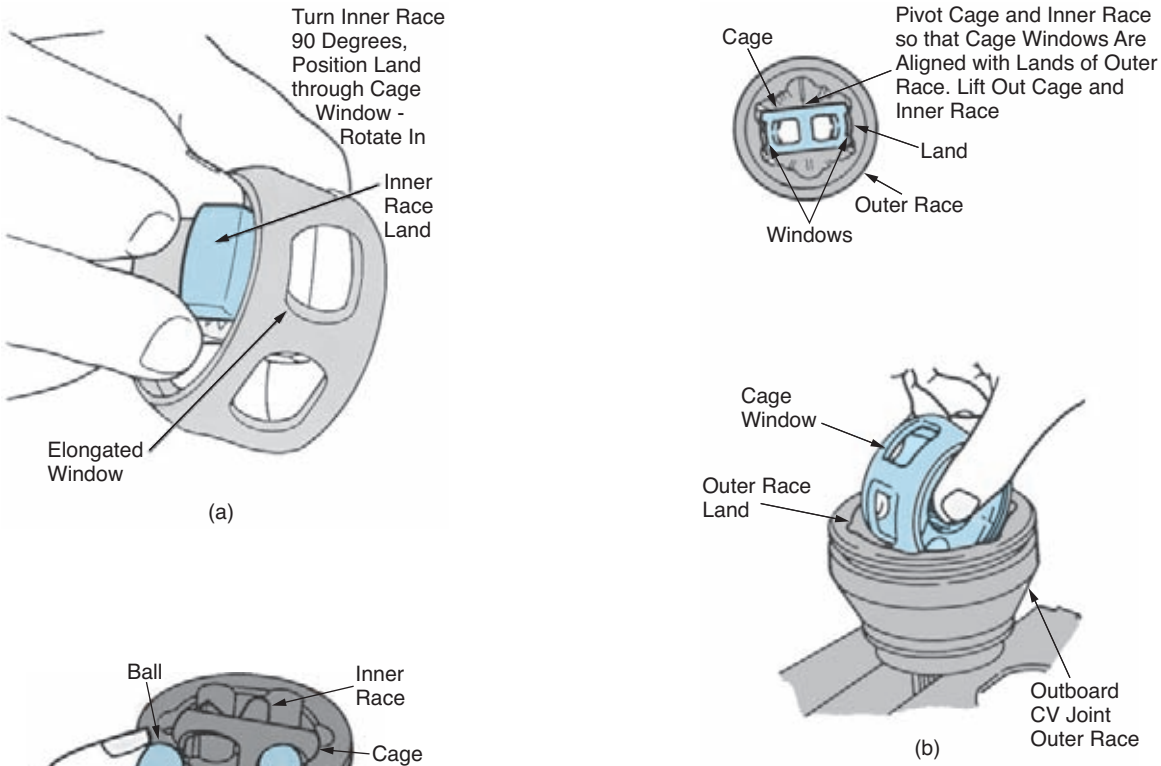


FIGURE 10-53 A joint is reassembled by installing the inner race into the cage in the correct position (a), installing the cage into the outer race in the correct position (b), and replacing the balls into the cage windows (c). *(Courtesy of Ford Motor Company)*

4. The balls can be pried out of the cage windows and the cage can be removed from the inner race.

To disassemble a tripod inboard joint (Figure 10-55):

1. Cut the clamps and boot, and remove them from the shaft.
2. Remove the retainer ring and slide the housing off the tripod assembly.

   Some joints have metal retainers that must be bent or slightly deformed to remove the housing.
3. Remove the snap ring and use a brass punch and hammer to remove the tripod assembly from the shaft.

After the joint has been disassembled, it should be thoroughly cleaned, air-dried, and inspected for wear or damage. A joint with worn parts is normally replaced with a new one.

TECH TIP

The roller and needle bearing assemblies are not retained on the trunnion in many tripod joints. Be ready to tape the rollers in place, if necessary.

TECH TIP

Some Chrysler products use an internal spring in the joint that will force the housing off as soon as the retainer ring is removed.

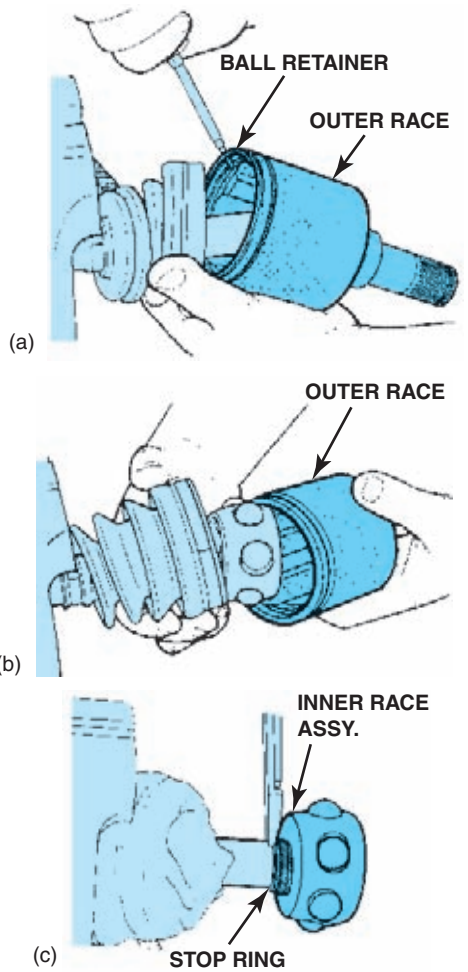


FIGURE 10-54 A double-offset CV joint is disassembled by removing the retainer (a) and the outer race (b) from the shaft, repositioning the stop ring (c), removing the circlip (d), and sliding the inner race off the shaft (e). *(Courtesy of Ford Motor Company)*

REAL WORLD PROBLEM

Imagine that you are working in a general automotive repair shop and these problems are brought to you.

Case 1

The vehicle is an 8-year-old compact in okay condition with 85,000 miles on it. You pulled the driveshaft to replace a torn boot, but while cleaning out the old grease you notice that the cage windows are dimpled. There is no perceptible problems with the rest of the CV joint. What should you do next?

Case 2

The complaint for the 5-year-old Ford Taurus was a snapping noise while turning. When you lift the car, you find a torn boot on the right outboard CV joint. The grease spray indicates that this has been happening for some time. The joint appears dry. What should you do next? What will probably need to be done to fix this vehicle?

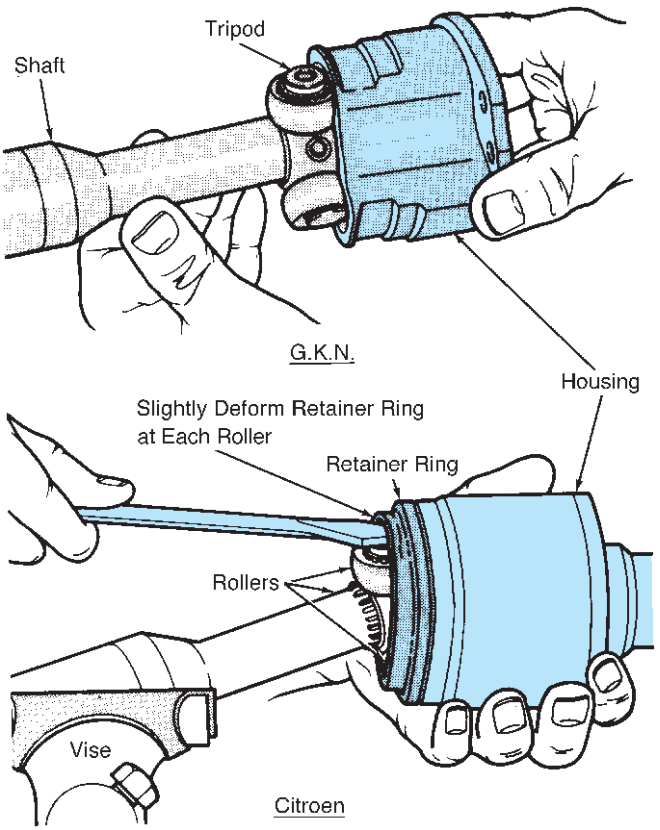
Reassembly of these joints is simply the reverse of the disassembly procedure; be sure to install a new boot and clamps.

RWD Driveshaft Service

Normal RWD driveshaft service includes U-joint rebuilding, CV-joint rebuilding, and the replacement of center bearings. Kits that normally include a new cross, bearing cups and seals, and retaining rings are used when rebuilding U-joints.

TECH TIP

Never clamp a driveshaft in a vise by gripping the tube section.



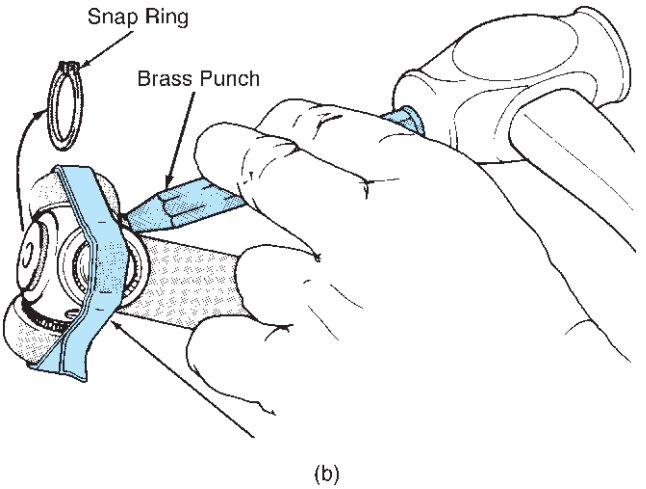


FIGURE 10-55 A tripod CV joint is disassembled by removing the ratiner ring and housing (a) and removing the snap ring and driving the inner race from the shaft (b). *(Courtesy of DaimlerChrysler Corporation)*

TECH TIP

Driveshafts with bearing cups located by swaging can be disassembled and remachined by some driveshaft specialty shops to accept standard U-joints using snap rings (Figure 10-56).

Cardan U-Joint Disassembly, Inspection, and Reassembly. This operation is normally done to rebuild a worn or binding U-joint and usually includes the installation of a replacement kit. In some cases it is also done to repack a joint with lubricant.

A variety of tools can be used to remove the bearing cups, which are pressed into the bosses in the yokes. These include a special U-joint press with adapters, special fixtures or adapters that are used with a shop press, two sockets and a vise, a specialized anvil and driving tool, and two blocks of wood and a hammer (Figure 10-57).

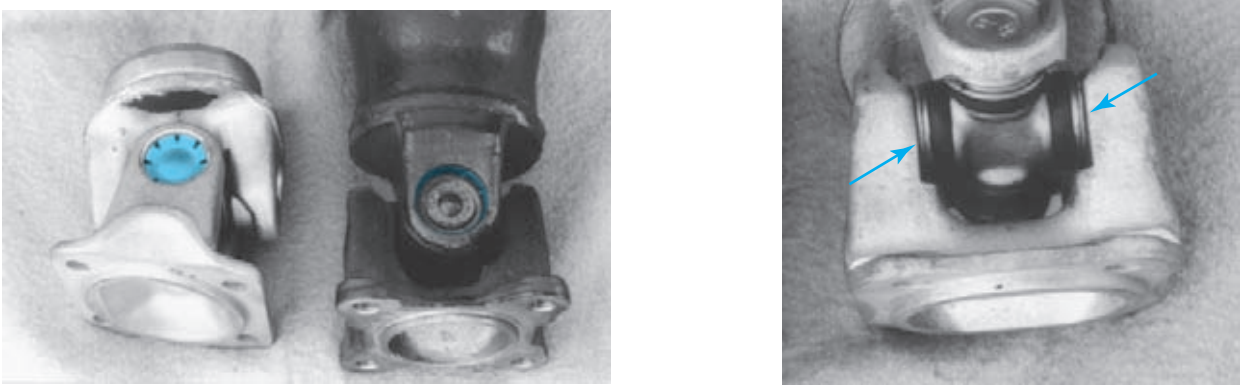
A bearing cup is pressed out of the yoke by either forcing the cross toward the yoke or the yoke toward the cross (Figure 10-58). Usually, the configuration of the yoke prevents complete removal of the bearing cup. Cup removal usually requires gripping it with pliers or a vise and pulling it out with a twisting motion.

TECH TIP

The hammer methods are the quickest way to disassemble a joint but are rather crude for reassembly. The press methods are the most professional and will probably produce fewer errors during reassembly.

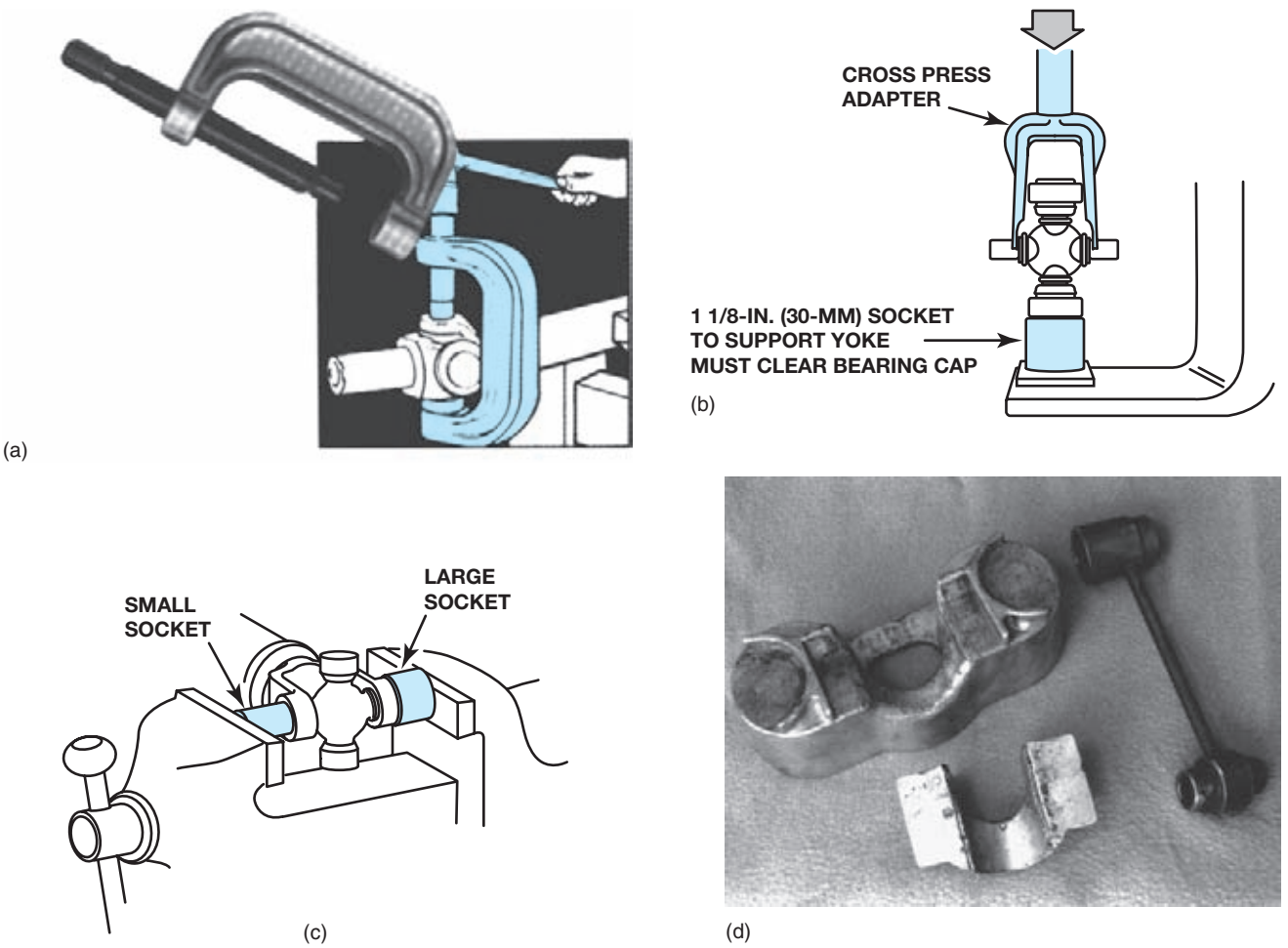
TECH TIP

The most common problems encountered during joint reassembly is the possibility of one or more needles of the bearing getting out of position and lodging between the end of the cross and the bearing cup.



(a) (b)

FIGURE 10-56 Two U-Joints (a) with the bearing cups locked in place by swagings. This joint (b) has been machined to accept retaining rings (arrows) to lock new bearing cups in place. *(Courtesy of Drive Line Service of Sacramento)*



(a) (b) (c) (d)

FIGURE 10-57 A Cardan U-joint can be disassembled using a special tool set (a), a press with special adapters (b), a vice and two sockets (c), or a hammer and special tool set (d). *(a is courtesy of OTC Tools)*

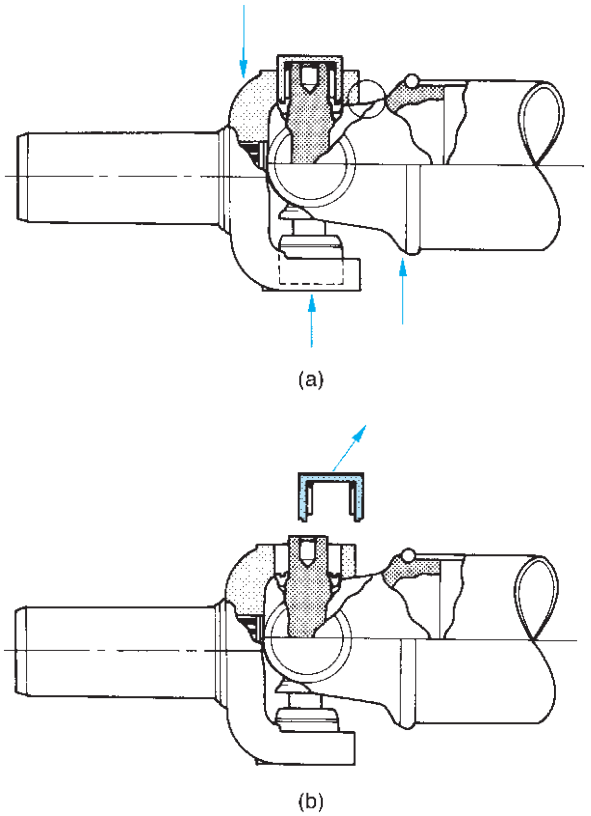


FIGURE 10-58 A Cardan U-joint is disassembled by pushing one yoke and the cross, or a bearing cup and the cross, inward while the other yoke is held. This pushes one bearing cup outward to the point where it can be removed (a). The same process is then used to remove the opposite bearing cup, allowing the cross to be removed from one yoke (b).

Driveshafts using plastic intrusion to secure the bearing cups allow some manufacturing flexibility. When they are assembled, the manufacturer has the ability to align the input and output yokes slightly offcenter to compensate for any yoke runout. Injecting the plastic locks them in this position, and the driveshaft will run vibration free. This is also true with driveshafts using swaged bearing cups. A vibration can occur if a U-joint is replaced on these driveshafts because the two yokes will now be aligned by the new U-joint.

TECH TIP

When joints using a plastic intrusion are rebuilt and replaced with bearing cups located by snap rings, runout and vibration can occur. Rebalancing the driveshaft will usually correct the vibration.

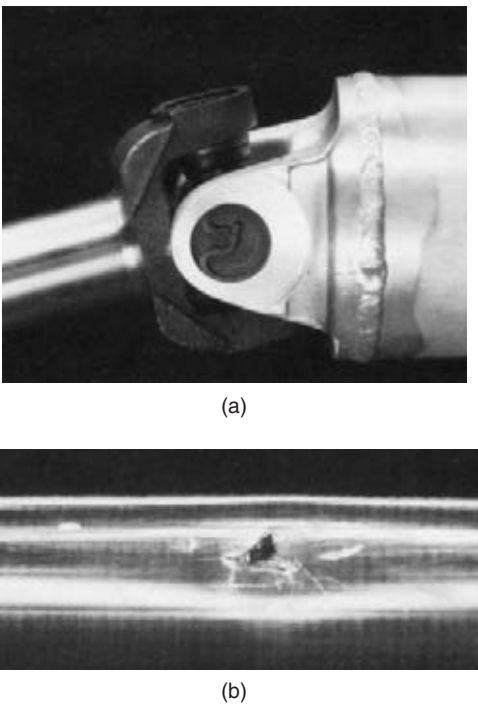


FIGURE 10-59 Aluminum driveshafts should be inspected for cracks in the yokes, weld, or tubing (a). Composite driveshafts should be checked at the aluminum yokes and for scratches in the graphite material and to make sure that there is no movement between the graphite and aluminum sections (b). *(Courtesy of Dana Corporation)*

Aluminum and composite driveshafts use aluminum U-joint yokes. Care should be exercised with these shafts because of the relative softness of the aluminum yokes and tubing. Composite tubes can also be easily damaged. These shafts should be checked for cracks where the yokes are attached to the tube and for damage to the tubing; scratches, gouges, or cracks greater than 0.008 in. (0.2 mm) require replacement of the shaft (Figure 10-59). Scratching a composite shaft creates a stress raiser that could cause failure. If the U-joints in an aluminum or composite driveshaft need to be replaced, you must use a kit designed specifically for aluminum. The bearing cups in these kits have a special coating that will prevent galvanic corrosion.

To disassemble a Cardan U-joint using a pressing tool (Figure 10-60):

1. Locate and remove the retaining rings. If you cannot locate any retainer rings, or swaging marks, or check the side of the yoke for a bit of plastic that will indicate a plastic intrusion or swaging marks. The plastic intrusion will be broken as the bearing cups are removed.
2. Check the cross for a zerk fitting. Remove it if there is one.

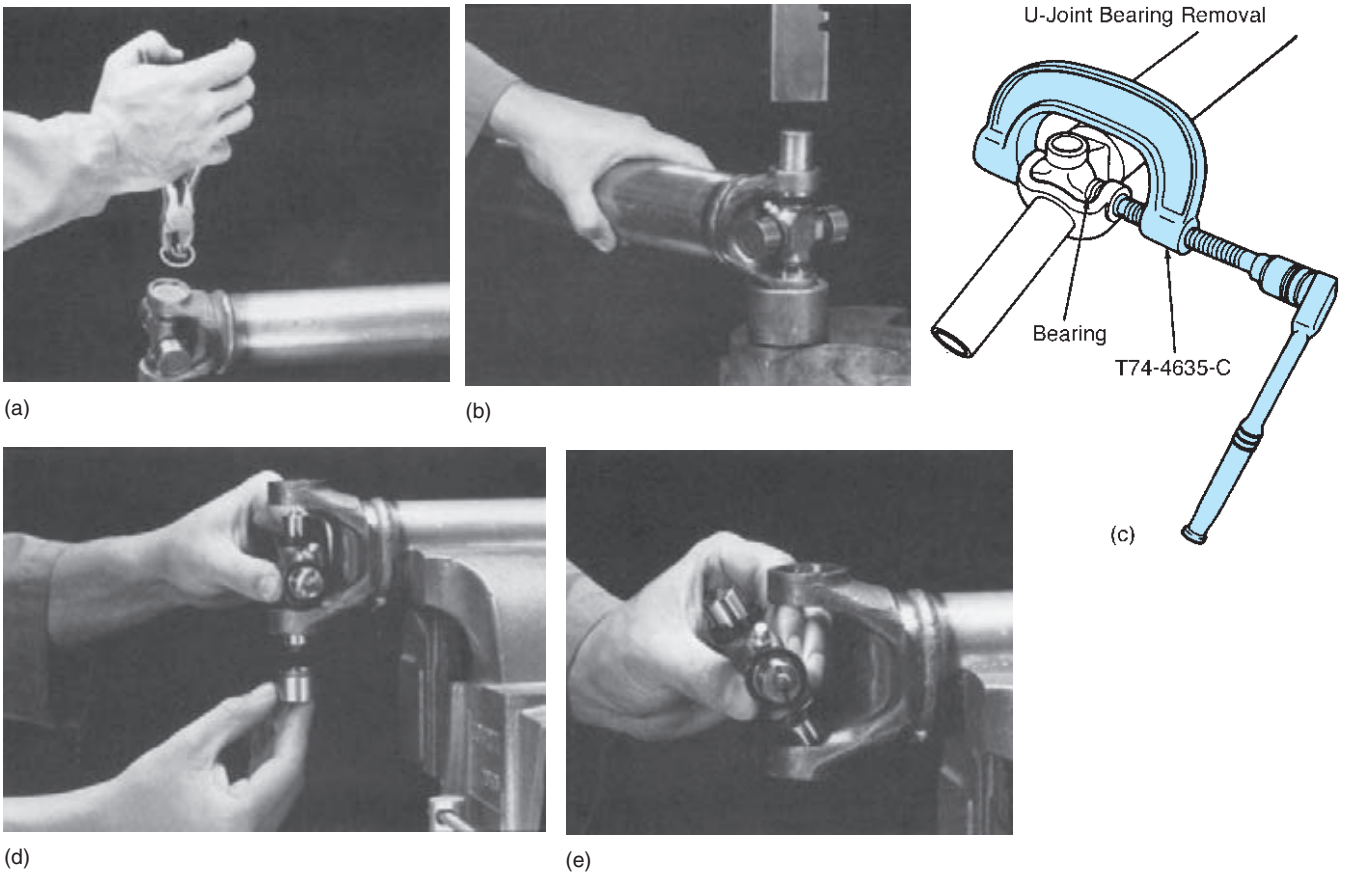


FIGURE 10-60 The procedure to disassemble a Cardan U-joint is to loosen and remove the snap rings (a), press a bearing cup inward until the cross is against the opposite bearing boss using either a press and adapters (b) or a U-joint press (c), remove the protruding bearing cup and repeat step b or c to remove the opposite bearing cup (d), and lift the cross out of the yoke (e). *(a, b, d, and e are courtesy of Dana Corporation; c is courtesy of Ford Motor Company)*

3. Select a press receiver adapter that has a hole larger than the bearing cup diameter. Some presses simply use the boss in the press. Select a pressing adapter that is smaller than the bearing cup diameter, and install it in the press.
4. Place the U-joint in the press so that one bearing cup is aligned with the receiver and the other with the pressing adapter, and tighten the press to force a bearing cup into the receiver adapter as far as possible.
5. Grip the bearing cup with pliers and rotate it as you pull it out of the yoke.
6. Reverse the U-joint in the press and push the opposite bearing cup out the other side. Repeat step 5 to remove the bearing cup.
7. With both cups out, remove the cross from the yoke. Repeat steps 4, 5, and 6 to remove the other two bearing cups and cross from the other yoke, if necessary.

TECH TIP

If you find a zerk fitting, note its position relative to the yoke before removing the fitting.

TECH TIP

Some technicians will place index marks on the yokes to aid in keeping them in the same position during reassembly.

TECH TIP

When using sockets and a vise, one socket is sized to receive and the other to press.

TECH TIP

Many technicians prefer to clamp the U-joint press in a vise so that the driveshaft can be placed on a benchtop.

TECH TIP

If the bearing is too tight to pull using pliers, grip it in the jaws of a vise and pull the driveshaft from the bearing using a rotating motion.

The hammer and anvil method of U-joint disassembly simply supports the boss of one yoke as the top bearing cup or driveshaft yoke is driven downward to force the cross and bearing cup out of the lower yoke (Figure 10-61). This replaces steps 4 and 5 in the procedure just given.

Once the joint is apart, the technician should check the cross for wear or damage (Figure 10-62).

If the cross is good, check the seals in the bearing cups; if the seals are good, the joint can probably be reused. The cost of a new U-joint kit is minimal compared to the labor cost so most technicians will install a U-joint kit with its new parts.

CAUTION: Using excessive force while following the steps described can collapse the yoke.

FIGURE 10-61 In the hammer and anvil method, a U-joint is disassembled by driving the cupped driving tool against the side of one yoke while the anvil supports the other yoke, along with the cross.

To assemble a Cardan U-joint using a pressing tool (Figure 10-64):

1. Check the yoke bosses for burrs or raised metal in the bores and at the ends of the bores. Raised metal can be removed using a file; driveshafts with elongated yoke bosses should be replaced.
2. Place the cross in the yoke with the zerk fitting hole facing the driveshaft and in a compression position.

TECH TIP

Besides doing a visual inspection, rotate the cross with your thumbnail against the bearing journals to feel for brinelling, the most common wear problems.

TECH TIP

When installing a joint with a cross that is drilled for a zerk fitting, the zerk fitting should be placed in a compression-loaded position rather than a tension-loaded position (Figure 10-63). Visualize the torque transfer. As one yoke drives the other, two sectors of the cross are squeezed together under a compression load; the other two sectors are under a tension load, which is trying to pull them apart. Because the zerk fitting hole is a weak point where cross breakage can begin, the zerk fitting should be located in a sector that is under a compression load and on the side of the cross that is toward the driveshaft. If the cross does not include a zerk fitting, each bearing cup should be lubricated before assembly.

TECH TIP

Bend the joint through its two different directions; it will often feel tight. Strike a quick, sharp hammer blow on the heavy part of the yoke near the bearing bosses and feel the joint's resistance again. Many joints will free up as the jar of the hammer blow realigns the needle bearings in a straight position. Lubricate the joint as described earlier on pages 256–257.

FIGURE 10-62 Commonly encountered U-joint faults are a cross with a burned journal (a); broken cross (b); a cross journal with end galling (c), brinelling (d), or spalling (e); a fractured yoke (f); a yoke with a broken tang (g); and a bent yoke (h). A special checking gauge is being used to check the yoke (h) for distortion. *(Courtesy of Dana Corporation)*

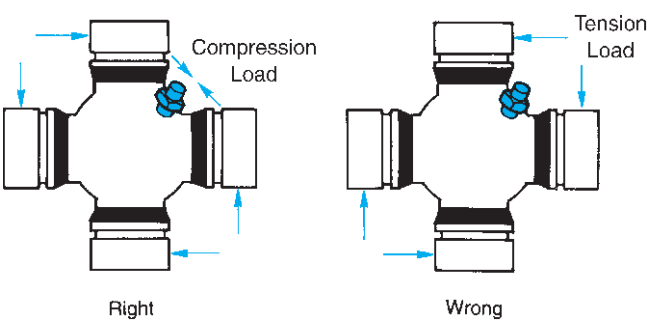
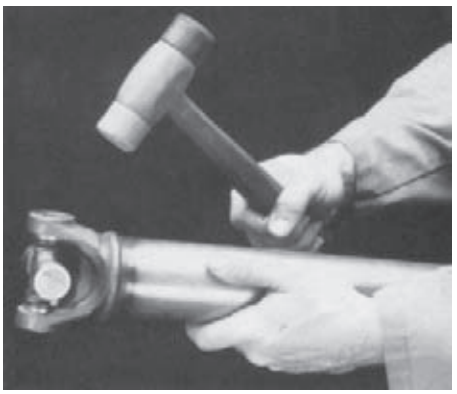
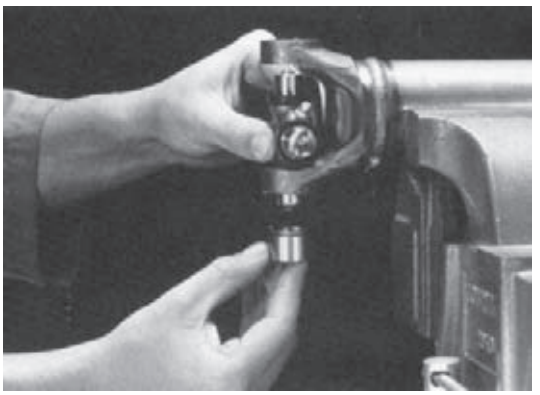


FIGURE 10-63 A U-joint should be assembled so that the cross is positioned with a compression load at the zerk fitting. The cross will fracture more easily if it is positioned with a tension load.

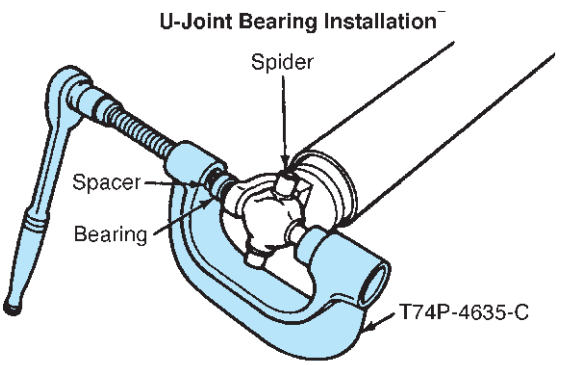
3. Move the cross so that one journal extends into the yoke boss as far as possible, and place a bearing cup over the journal. Be careful not to dislodge a needle bearing as the cup is placed on the journal.
4. Keep the cross in position in the bearing as you press the bearing cup into the yoke, and install the snap ring.
5. Rotate the yoke one-half turn and start inserting the second bearing cup into the yoke.
   Press this bearing cup into place and install the snap ring.
6. Make sure that the retaining rings are completely seated into their grooves.
7. Repeat steps 3, 4, 5, and 6 to install the second yoke and its bearing cups.



(a)



(b)



(c)

FIGURE 10-64 A Cardan U-joint is assembled by placing the cross in a yoke (a); starting a bearing cup onto a cross journal (b); pressing that bearing cup into position using a U-joint press or press with adapters (c). *(a, b, are courtesy of Dana Corporation; c is courtesy of Ford Motor Company)*

TECH TIP

As the bearing cup approaches the cross, slide the cross over so it is halfway into each of the bearings, being careful not to knock any of the needle bearings out of position.

REAL WORLD FIX

A 1999 Chevrolet Suburban (126,000 mil) has a clang/pop noise when shifted into drive or reverse. The front and rear driveshafts were rebuilt 10,000 miles ago.

Following advice, the technician checked the U-joints in the rear shaft and found one of the bearing cups was extremely loose. Checking further, he found that the grease hole in the cross was not drilled completely so that cup was not getting grease. Replacement of this worn U-joint fixed this problem.

Double-Cardan CV Joint Disassembly, Inspection, and Reassembly. This procedure is essentially the same as the one just described. The same tools are used (Figure 10-65).

To disassemble a double-Cardan CV joint (Figure 10-66):

1. Remove all of the snap rings and note the relative position of the various parts. Some technicians will place index marks on each of the yokes to aid in keeping each part in the same position during reassembly.
2. Select press adapters as described on page 293, Cardan U-joint disassembly, step 3.

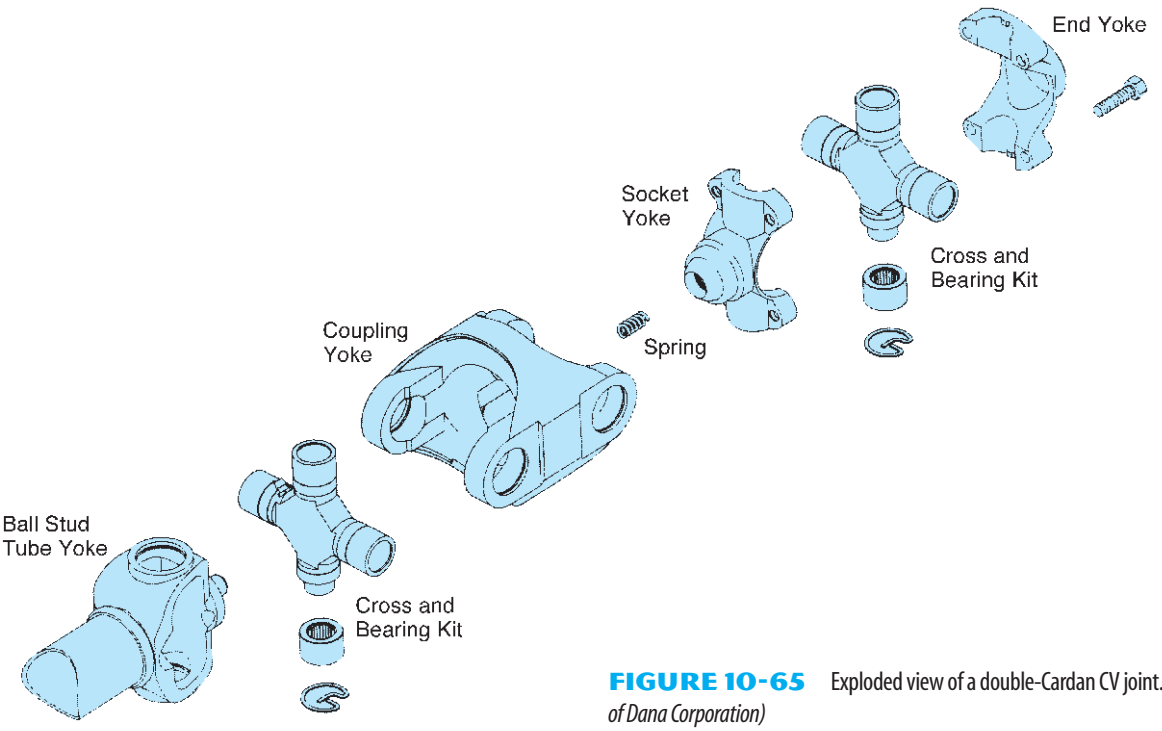


FIGURE 10-65 Exploded view of a double-Cardan CV joint. *(Courtesy of Dana Corporation)*

FIGURE 10-66 Disassembly of a double-Cardan CV joint begins with placing alignment marks on the coupling yoke and the two end yokes. The snap rings are removed (a); the bearing cups are pressed out (b) and removed (c); one cross and the socket yoke are removed (d); steps a and b are repeated to remove the coupling yoke (e) and the second cross (f). *(Courtesy of Dana Corporation)*

3. Press one of the bearing cups at the yoke end of the centering yoke inward until the bearing cup on the opposite side is moved outward far enough to be gripped.
4. Grip the bearing cup in a vise and tap the yoke off the bearing cup.
5. Rotate the yoke one-half turn and repeat steps 3 and 4 to remove the opposite bearing cup. Now remove the cross and the socket yoke.
6. Repeat steps 3, 4, and 5 to remove the other four bearing cups, cross, and coupling yoke.

A double-Cardan joint can be inspected as if it were a simple Cardan joint with an additional cross and centering assembly. Normally, a double-Cardan joint will show the most wear at the centering ball. Replacement kits include two crosses with bearing assemblies, snap rings, and a center kit.

To assemble a double-Cardan CV joint (Figure 10-67):

1. Check the yoke bosses for burrs or raised metal in the bores and at the ends of the bores. Raised metal can be removed using a file; driveshafts with elongated yoke bosses should be replaced.
2. Place a cross in the tube yoke so that one journal extends into the yoke boss as far as possible, and place a bearing cup over the journal.
3. Keep the cross in position in the bearing as you press the bearing cup into the yoke, and install the snap ring.
4. Rotate the yoke one-half turn and start inserting the second bearing cup. Press this bearing cup into place and install the snapring.
5. Repeat steps 2, 3, and 4 to install the center yoke onto the cross you just installed. Align the index marks as the joint is assembled.
6. Install the centering kit and socket yoke, making sure that the spring is in place and that the lube fitting is aligned properly.
7. Repeat steps 2, 3, and 4 to install the remaining cross into the center yoke.
8. Make sure that every snap ring is installed completely into its groove, and tap each yoke near the bearing cups to align the needle bearings.
9. Test the joint by bending it in its two directions. It should bend smoothly and snap over center because of the action of the centering mechanism. Lubricate the joint as described earlier on page 257.

Center Support Bearing Removal and Replacement. Most center support bearings are mounted in rubber in a bracket bolted to the vehicle's frame and positioned on the driveshaft near the slip spline (Figure 10-68).

To remove a center support bearing:

1. Disconnect the bearing bracket from the frame cross member. Some bearing supports will have shims that must be reinstalled in the same position.
2. Remove the driveshaft as described earlier on page 277.

REAL WORLD FIX

A 2001 Dodge R2500 pickup (88,000 mil) has a whirring/whine noise in 4 high and 4 low. An inspection of the transfer chain in the transfer case shows no problem.

Following advice, the technician removed the front driveshaft and visually inspected the double-Cardan joint. Replacement of the center support ball and spring fixed this noise problem.

TECH TIP

Be sure not to dislodge a needle bearing as you install the cross. Also, make sure that the zerk fitting in the cross will be in the proper position.

TECH TIP

Some slip joints will have a blind or master spline, which makes the index-mark step unnecessary (Figure 10-69).

(a)

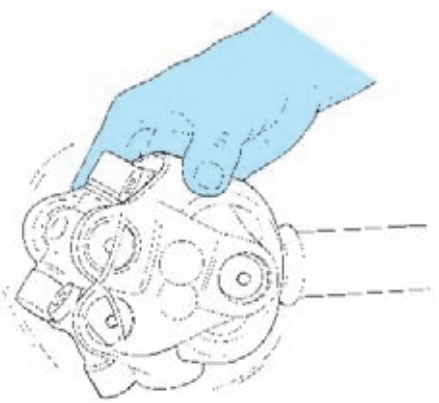
(b)

(c)

(d)

(e)

(f)



(g)

FIGURE 10-67 A double-Cardan CV joint is assembled by installing the first cross (a) and pressing the bearing cups in place (b), installing the coupling yoke onto the cross (c) along with its bearing cups, installing the centering kit and coupling yoke (d) and the second cross (e) and its bearings (f), and after installation of the snap rings, checking for proper operation (g). The assembled CV joint should snap over center in both directions when it is flexed. *(a–f are courtesy of Dana Corporation; g is courtesy of DaimlerChrysler Corporation)*

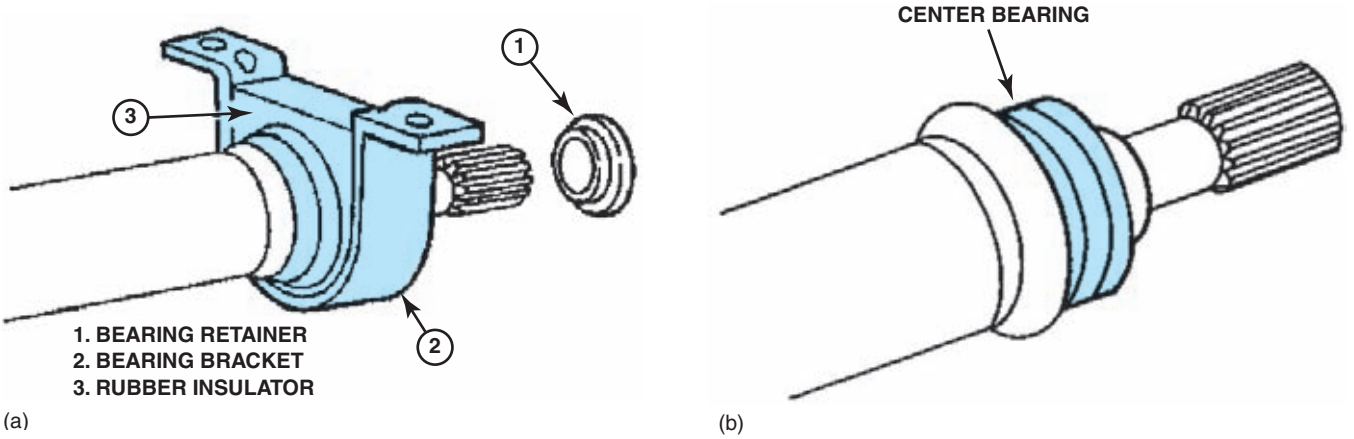


FIGURE 10-68 With the drive shaft removed and separated, the bearing retainer and bracket (a) and a faulty center bearing can be removed (b).

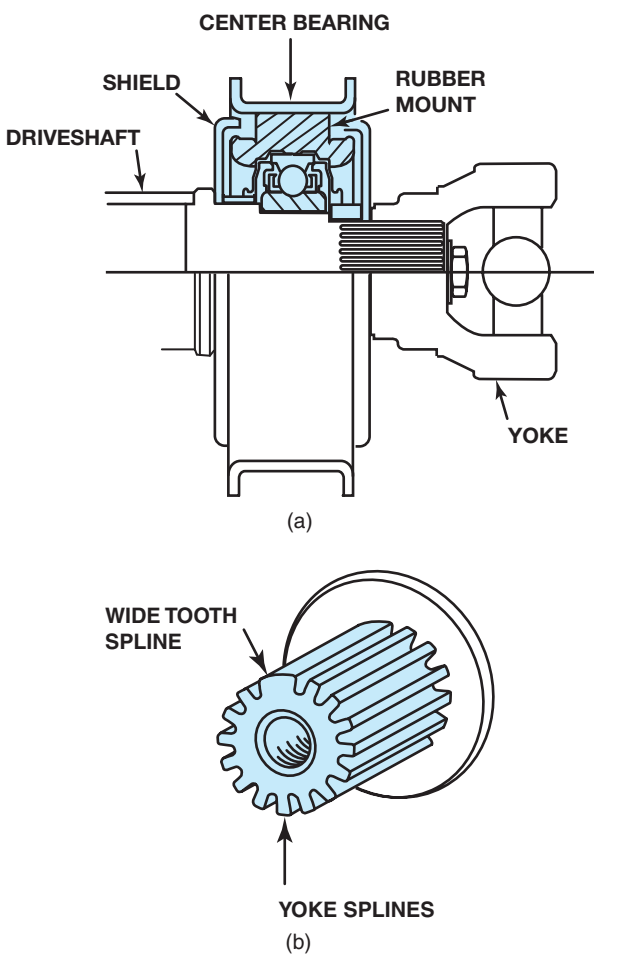


FIGURE 10-69 Most slip yokes can be slid apart after the driveshaft is removed (a). Many of them have wide or master spline to aid realignment as they are assembled (b).

3. Check the slip joint for index marks. If there are none, mark both sides of the joint so that you can align them to keep the U-joints in phase when reassembling the shaft.
4. Unscrew the collar and seal, and slide the slip joint apart.
5. Pull the bearing off the shaft.

Before reassembly, the cavity alongside the bearing, inside the dust shields, should be filled with a waterproof lithium soap grease (Figure 10-70). Some grease should be put on the slip joint splines as well. The rest of the reassembly procedure is the reverse of the disassembly procedure.

REAL WORLD PROBLEM

Imagine that you are working in a general automotive repair shop and these problems are brought to you.

Case 1

You've just assembled a U-joint and installed the last retaining ring, and it was very tight. Now the joint is locked up and won't bend in one of the directions. What went wrong? What should you do to correct it?

Case 2

You rebuilt the U-joints on the compact pickup last week, and it seemed okay when you reinstalled it. But the customer brought it back with a complaint of a vibration at 50 mph that wasn't there before you repaired the driveshaft. What might have gone wrong? What should you do next?

FIGURE 10-70 Before reassembling a center support bearing, waterproof grease should be packed into the cavity around the bearing to shield it from water and other contaminants. *(Courtesy of Dana Corporation)*

REAL WORLD FIX

A 1999 GMC K2500 long bed pickup had a vibration problem, and an inspection showed that the U-joints were not properly indexed.

Disassembly of the slip joint revealed that the filler piece between two of the splines (for indexing) was installed in the wrong location. Removal of this filler allowed reassembly of the driveshaft with the proper indexing, and this fixed the vibration problem.

SUMMARY

1. Some driveshafts require periodic U-joint and slip joint lubrication.
2. The cause of improper driveshaft operation is determined using several diagnostic steps.
3. RWD driveshafts are fairly easy to remove for repair, FWD driveshafts removal is more difficult.
4. With the proper tools and boot, the outboard CV joint boot can be replaced without removing the driveshaft
5. Several types of retainers are used to hold the CV joints onto the driveshaft.
6. U-joints and CV joints can be disassembled for inspection and repair.

REVIEW QUESTIONS

1. Most of the customer concerns relating to driveshaft problems are _____ or _____ oriented.
2. Front-wheel-drive driveshaft problems include _____ spray, _____ noise while turning, _____ noise on acceleration, or a _____ during acceleration.
3. The _____ spray from a constant-velocity joint is the result of a damaged _____.
4. A _____ noise while turning a vehicle equipped with CV joints indicates a damaged _____ joint.
5. A _____ or shudder indicates a sticking inboard joint and a _____ indicates a worn CV joint.
6. A quick way to check U-joint angles is to measure the distance between the _____ and _____ yokes at the top and bottom of the yokes. If the measurements are the same, the U-joint angles are the same.
7. A _____ _____ can be used as a weight to balance a driveshaft.
8. Most inboard CV joints are held into the transmission by a _____ that usually releases when enough outward pressure is placed on it.
9. When replacing a CV joint circlip, use care not to _____ it. This can prevent the circlip from releasing the next time the driveshaft needs to be removed.
10. The most common wear problem for Cardan U-joints is _____.

CHAPTER QUIZ

Two students are discussing FWD driveshaft removal.

1. While discussing driveshaft problems, Student A says that the most common cause of vehicle vibrations at 50 mph is a faulty U-joint or CV joint. Student B says that all driveshaft caused problems are torque sensitive. Who is correct?
   - **a.** Student A
   - **b.** Student B
   - **c.** Both A and B
   - **d.** Neither A nor B
2. A FWD vehicle makes a clicking noise while the vehicle is turning but not while going straight. This is probably caused by a faulty (A) inboard CV joint; (B) outboard CV joint. Which is correct?
   - **a.** A only
   - **b.** B only
   - **c.** Both A and B
   - **d.** Neither A nor B
3. A FWD vehicle has a spray of grease inside the front wheel well. This is probably caused by a (A) torn CV joint boot; (B) faulty wheel bearing seal. Which is correct?
   - **a.** A only
   - **b.** B only
   - **c.** Both A and B
   - **d.** Neither A nor B
4. Student A says that a vibration may result if the rear U-joint operating angle is more than 1° different from that of the front joint. Student B says that a tight, binding U-joint can cause vibration during acceleration. Who is correct?
   - **a.** Student A
   - **b.** Student B
   - **c.** Both A and B
   - **d.** Neither A nor B
5. Student A says that the removal of the driveshaft usually requires partial disassembly of the front suspension. Student B says that the first step in driveshaft removal is to loosen the front hub nut. Who is correct?
   - **a.** Student A
   - **b.** Student B
   - **c.** Both A and B
   - **d.** Neither A nor B
6. Student A says that the outer portion of the driveshaft can be used as a slide hammer to pop the inboard CV joint out of the transaxle. Student B says that you should not hammer on the outer end of the outboard CV joint to get it out of the hub. Who is correct?
   - **a.** Student A
   - **b.** Student B
   - **c.** Both A and B
   - **d.** Neither A nor B
7. Student A says that index marks should be placed at the rear of the driveshaft and rear-axle pinion shaft flange before disconnecting the U-joint. Student B says that a vibration might result if the front slip yoke is installed onto the transmission mainshaft in the wrong position. Who is correct?
   - **a.** Student A
   - **b.** Student B
   - **c.** Both A and B
   - **d.** Neither A nor B
8. When a driveshaft is removed from the transmission, the gear oil leak can be stopped by using a
   - **a.** commercial stop-off tool.
   - **b.** old slip yoke.
   - **c.** plastic bag and rubber band.
   - **d.** any of these.
9. Most outboard CV joints are held onto the driveshaft by a _____ at the end of the shaft.
   - **a.** cap screw
   - **b.** snap ring
   - **c.** circlip
   - **d.** any of these
10. While discussing CV joint boot clamps, Student A says that all clamps can be locked in place using ordinary combination pliers. Student B says that a plastic tie wrap can be used for a boot clamp. Who is correct?
    - **a.** Student A
    - **b.** Student B
    - **c.** Both A and B
    - **d.** Neither A nor B

11. Student A says that a Rzeppa joint is disassembled by tilting the inner race and removing the balls, one at a time. Student B says that the cage of a Rzeppa joint must be rotated to the correct position before it can be removed from the outer race and housing. Who is correct?

a. Student A

b. Student B

c. Both A and B

d. Neither A nor B

12. The inboard CV joint is usually held onto the shaft by a (A) snap ring; (B) circlip. Which is correct?

a. A only

b. B only

c. Both A and B

d. Neither A nor B

13. Striking the yokes of a Cardan joint with a hammer after assembly is done to (A) align the needle bearings; (B) free up the joint. Which is correct?

a. A only

b. B only

c. Both A and B

d. Neither A nor B

14. Student A says that the parallel wear marks along the bearing journals of a Cardan U-joint cross are called brinelling. Student B says that the cross can be used if the marks are not too deep. Who is correct?

a. Student A

b. Student B

c. Both A and B

d. Neither A nor B