INTRODUCTION

A drive shaft transmits engine torque from the transmission or transaxle (if front wheel drive) to the rear axle assembly or drive wheels. Figure 1.

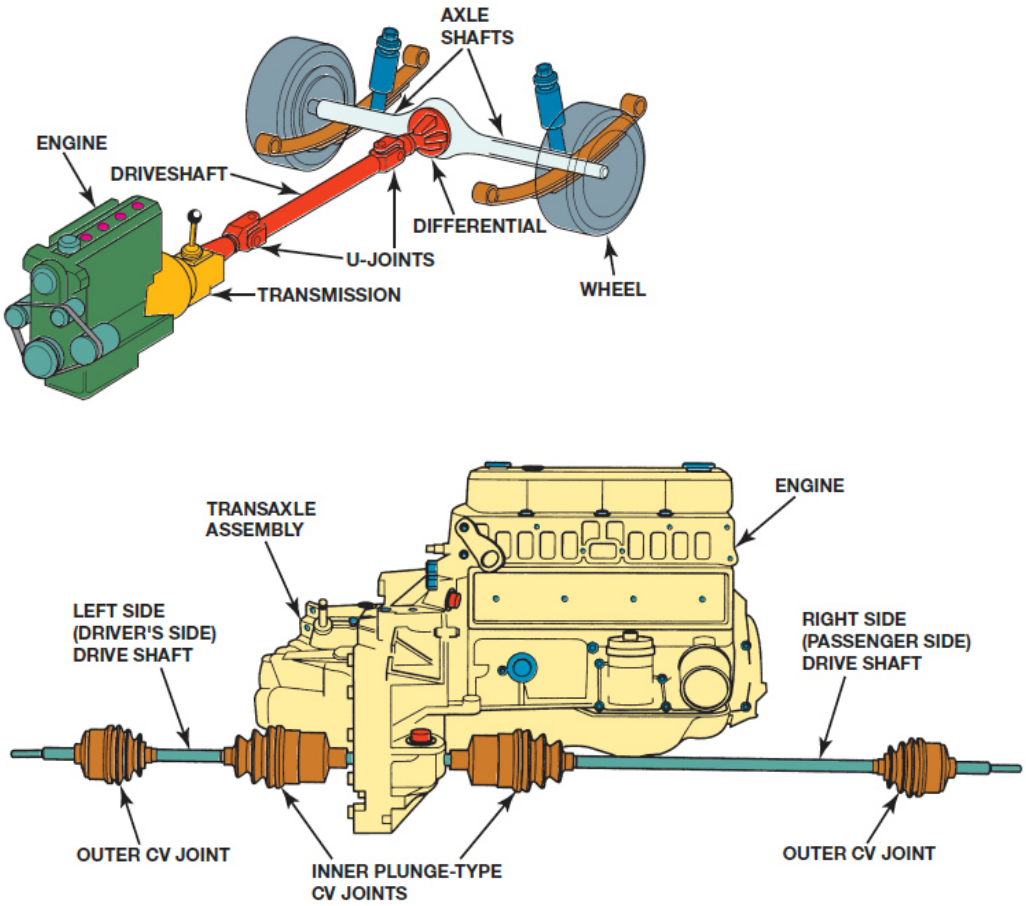

Figure 1. Rear-wheel-drive and front-wheel-drive shafts.

A typical drive shaft is a hollow steel tube. A splined end yoke is welded onto one end that slips over the splines of the output shaft of the transmission. An end yoke is welded onto the other end of the drive shaft. Figure 2.

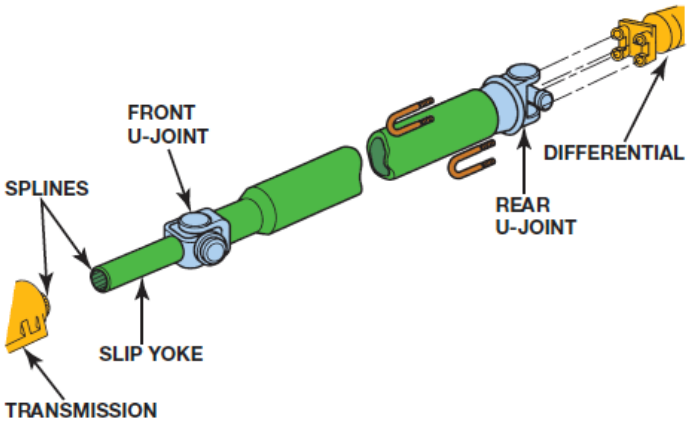

Figure 2. Drive shaft parts.

Some drive shafts use a center support bearing. Figure 3.

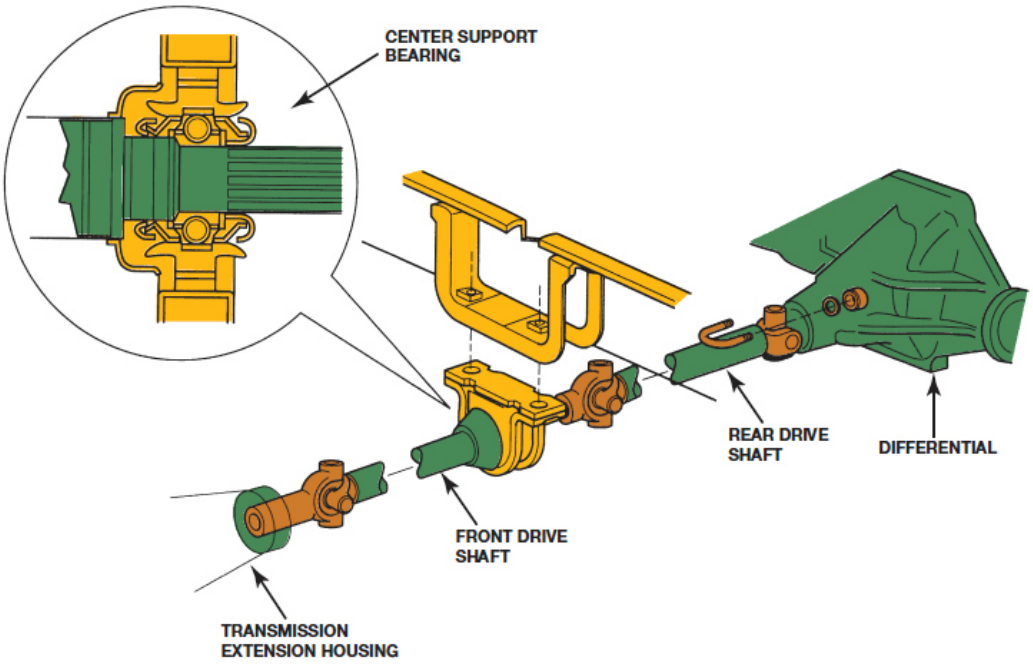

Figure 3. Center support and bearing.

Universal joints (U-joints) are used at both ends of a drive shaft. U-joints allow the wheels and the rear axle to move up and down, remain flexible, and still transfer torque to the drive wheels. Most U-joints are called cross-yoke joints or Cardan joints. Figure 4.

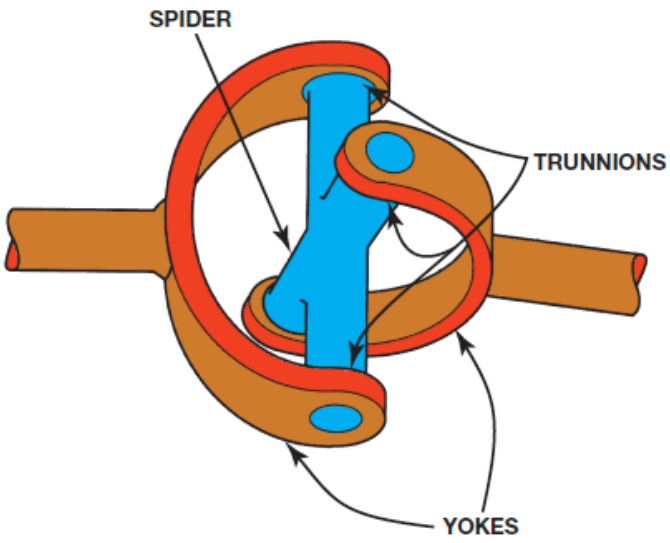

Figure 4. A simple universal joint (U-joint).

Front-wheel-drive vehicles use constant velocity joints, commonly called CV joints or Rzeppa joints, to transfer torque through six round balls that are held in position midway between the two shafts. This design causes the angle between the shafts to be equally split regardless of the angle. This style of joint results in a constant velocity between driving and driven shafts. It can also function at angles greater than simple U-joints can, up to 40 degrees. Figure 5.

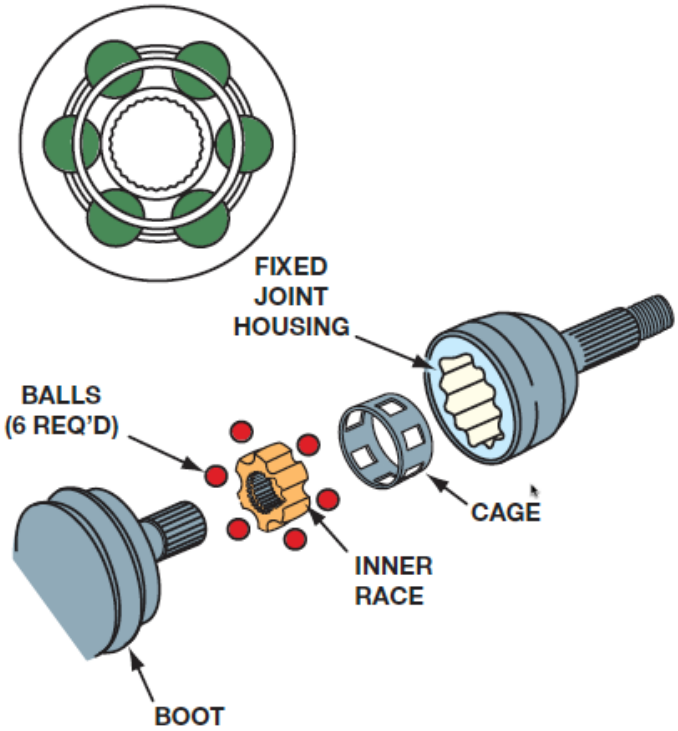

Figure 5. A Rzeppa fixed joint. This type of CV joint is commonly used at the wheel side of the drive axle shaft.

ASE TEST TOPICS

1 . Diagnose drive/half shaft and universal/CV joint noise and vibration problems; determine needed repairs.

The driveshaft and universal joints should be carefully inspected whenever any of the following problems or symptoms occur:

- Vibration or harshness at highway speed
- A clicking sound whenever the vehicle is moving either forward or in reverse
- A clunking sound whenever changing gears, such as moving from drive to reverse

When a CV joint wears or fails, the most common symptom is noise while driving. An outer fixed CV joint will most likely be heard when turning sharply and accelerating at the same time. This noise is usually a clicking sound. To help verify a defective joint, drive the vehicle in reverse while turning and accelerating. This almost always will reveal a defective outer joint.

While inner joint failure is less common, a defective inner CV joint often creates a loud clunk while accelerating from rest.

2. Inspect, service, and replace shafts, slip joints, yokes, boots, and universal/CV/flexible disc joints; verify proper phasing.

Measuring driveshaft U-joint phasing involves checking to see if the front and rear U-joints are directly in line or parallel with each other. If the U-joints are not in line, the drive shaft is out of phase and should be replaced. Incorrect phasing is usually due to a twisted drive shaft or an incorrectly welded end yoke.

U-joints can be defective and still not show noticeable free movement. A proper U-joint inspection can be performed only by removing the drive shaft from the vehicle.

To remove the drive shaft from a rear-wheel-drive vehicle, remove the four fasteners at the rear U-joint at the differential. Push the drive shaft forward toward the transmission and then down and toward the rear of the vehicle. The drive shaft should slip out of the transmission spline and can be removed from underneath the vehicle. Figure 6.

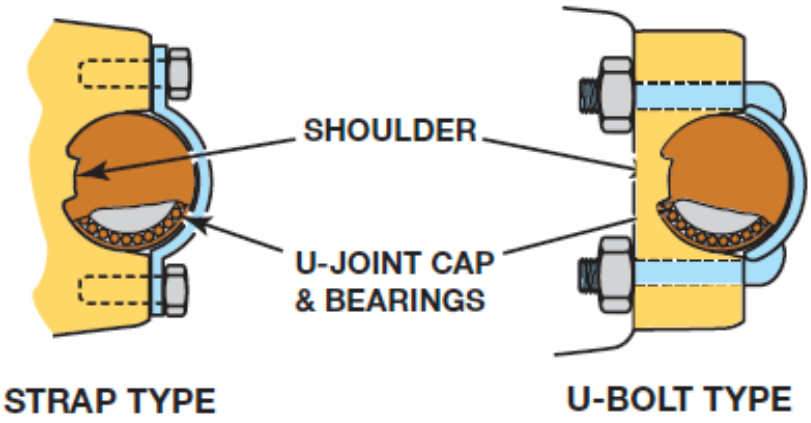

Figure 6. Two types of retaining methods that are commonly used at the rear U-joint at the differential.

To inspect U-joints, move each joint through its full travel, making sure it can move (articulate) freely and equally in all directions. Figure 7.

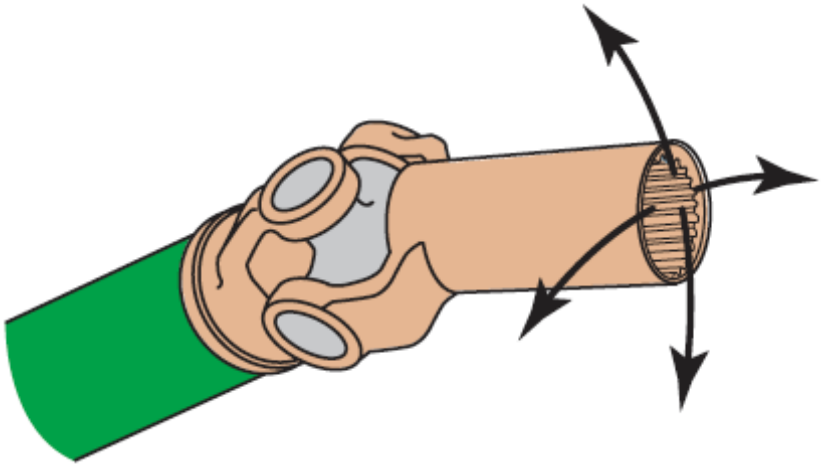

Figure 7. A good U-joint should be free to move without binding.

U-joint replacement. All movement in a U-joint should occur between the trunnions and the needle bearings in the end caps. The end caps are press-fit to the yokes, which are welded to the drive shaft. Three types of retainers are used to keep the bearing caps on the U-joints: the outside snap ring, the inside retaining ring, and injected synthetic (usually nylon). Figure 8.

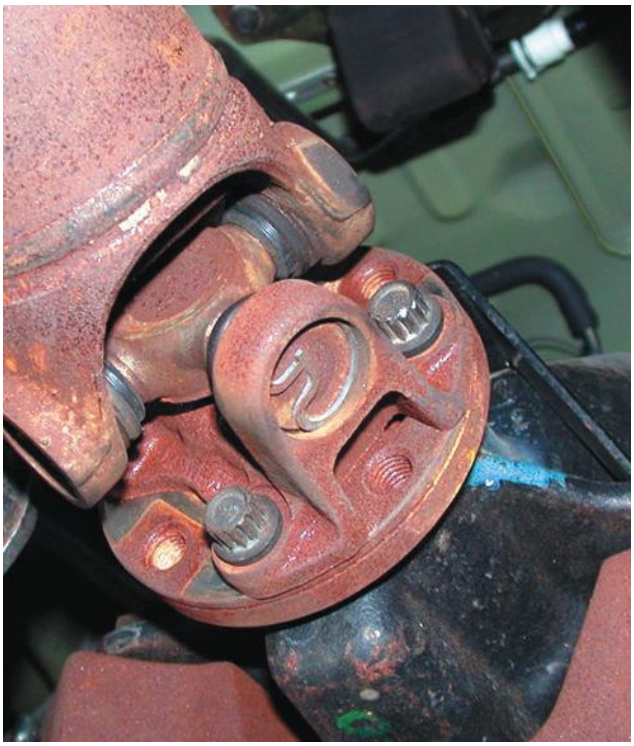

Figure 8. Outside retaining snap ring.

After removing the retainers, use a press or a vise to separate the U-joint from the yoke. Figure 9.

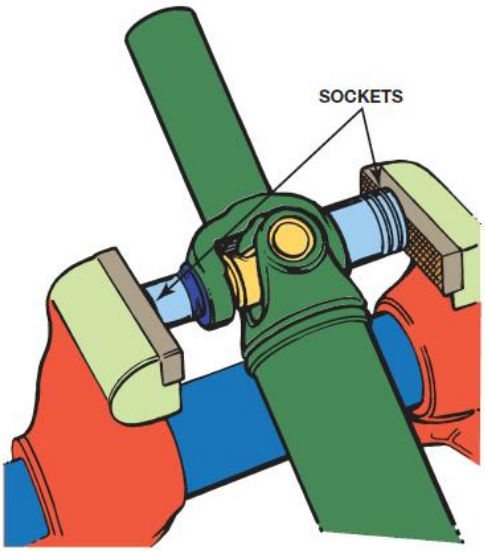

Figure 9. Use a vise and two sockets to remove a U-joint. One socket fits over the bearing cup and the other fits on the bearing to press-fit the cups from the crosspiece.

After removing any dirt or burrs from the yoke, press in a new U-joint. Rotate the new joint after installation to make sure it moves freely, without binding or stiffness. If a U-joint is stiff, it can cause a vibration. Figure 10.

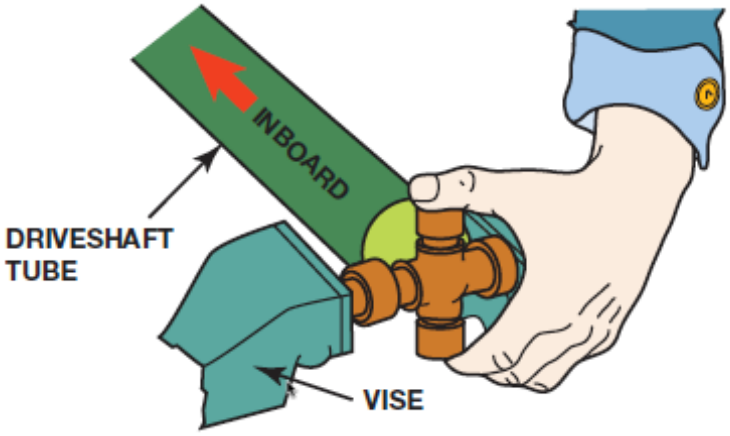

Figure 10. Using the vise to press in the new U-joint caps.

CV joint/drive axle replacement. While it is possible to replace just the CV joint, the standard repair procedure currently used is the replacement of the entire drive axle assembly if there is a CV joint failure.

- Remove the front wheel and hub nut.

Note: Most manufacturers warn against using an air impact wrench to remove the hub nut. The impacting force can damage the hub bearing.

- To allow the knuckle room to move outward enough to remove the drive axle shaft, some or all of the following will have to be disconnected, Figure 11.
    - Lower ball joint or pinch bolt
    - Tie rod end
    - Stabilizer bar link.
    - Front disc brake caliper.

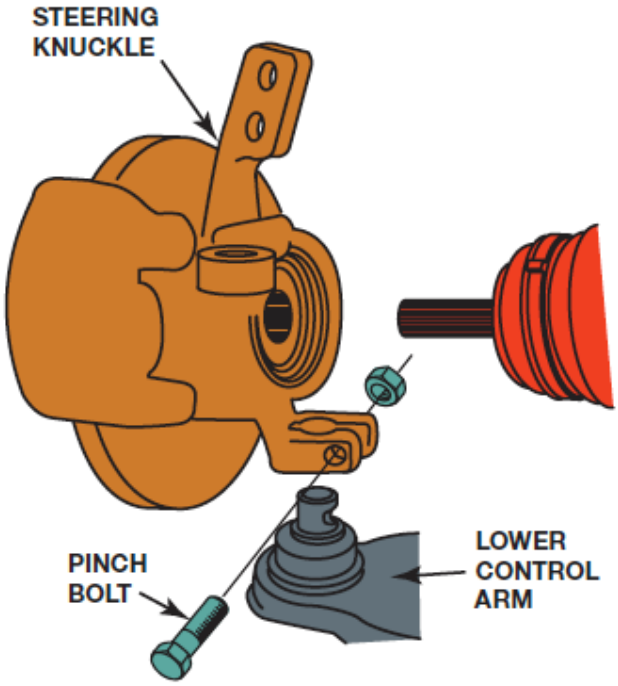

Figure 11. Suspension components need to be removed to remove the drive axle.

- Reinstall the drive axle shaft in the reverse order of removal and torque the drive axle nut to factory specifications. NOTE: Many drive axles are retained by prevailing torque nut that must not be reused. Figure 12.

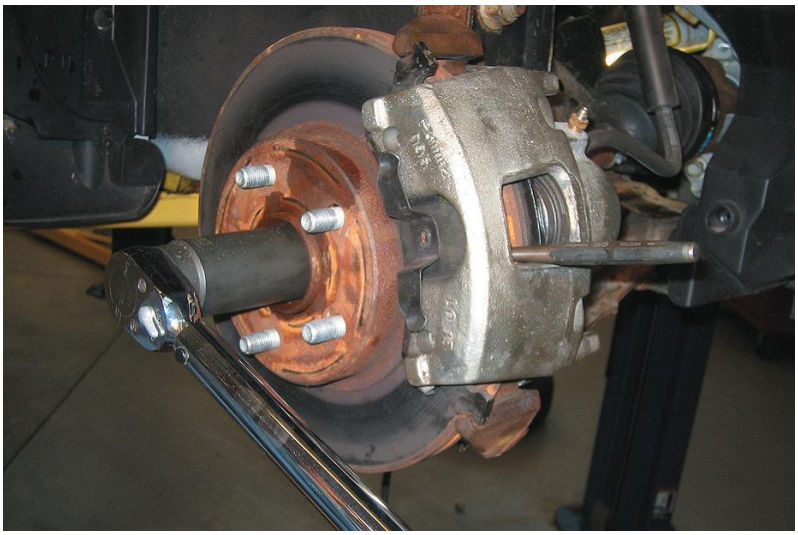

Figure 12. Tighten the drive axle nut with a torque wrench.

3. Inspect, service, and replace center support and intermediate shaft bearings.

The center support is usually a ball bearing mounted in a hard rubber casing. It should be checked for excessive movement and harsh rotational feel. Replacing the mount and/or bearing requires removal of the drive shaft. Figure 13.

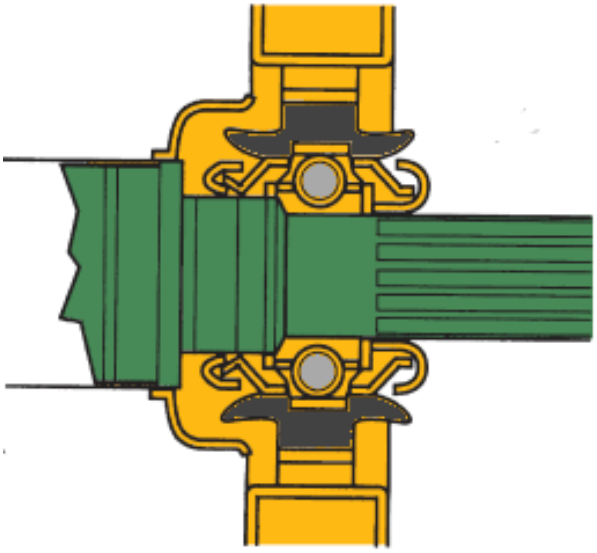

Figure 13. Center support and bearing.

4. Check drive/propeller shaft balance; determine needed action.

Checking for drive shaft balance is usually done with a strobe balancer, if available. Some vibration analyzer tools can also balance a drive shaft.

The sensor causes a bright light to flash (strobe) whenever a shock force is exerted on the sensor. The strobe light flashes when the heavy part of the drive shaft is facing downward. If the heavy part of the drive shaft is down, then corrective weight must be added to the opposite side of the drive shaft. Figure 14.

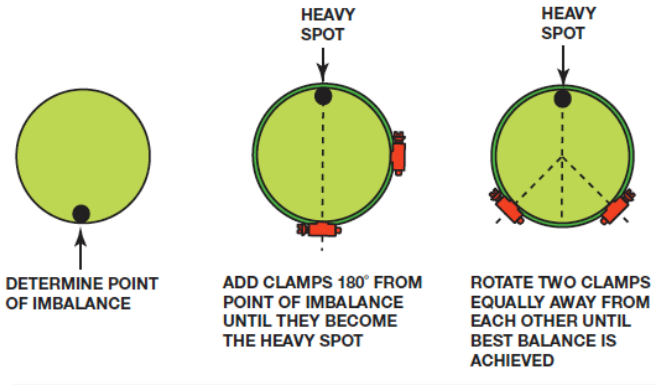

Figure 14. Balancing using hose clamps.

5. Measure drive shaft runout.

Drive shaft runout should be measured at three places along the length of the drive shaft using a dial indicator. The maximum allowable runout is 0.030 inch (0.76 mm).

6. Measure and adjust drive shaft working angles.

The working angle of most U-joints should be at least 1/2 degree (to permit the needle bearing to rotate in the U-joints) and should not exceed 3 degrees or a vibration can occur in the drive shaft, especially at higher speeds. The difference between the front and rear working angles should be within 1/2 degree of each other. Figure 14.

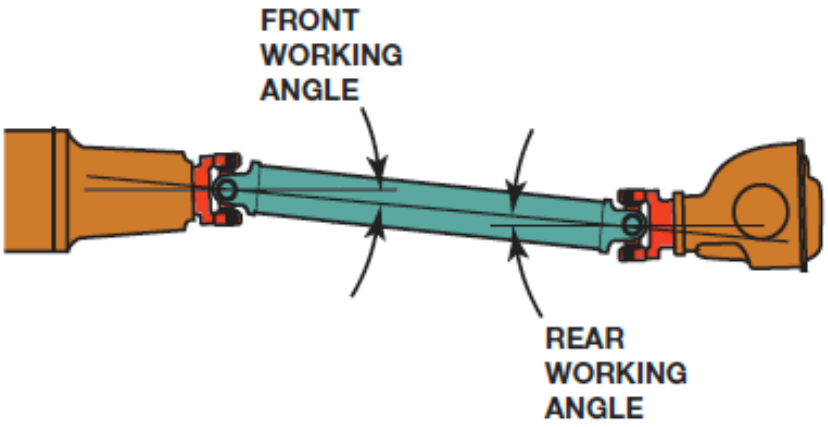

Figure 14. U-joint working angles.

Unequal or incorrect U-joint working angles can cause severe vibrations. Drive shaft and U-joint angles may change from the original factory setting due to one or more of the following:

- Defective or collapsed engine or transmission mounts
- Defective or sagging springs, especially the rear springs due to overloading or other causes
- Accident damage or other changes to the chassis of the vehicle
- Vehicle modification that raises or lowers the ride height

A tapered metal wedge between the rear leaf spring and the rear axle pedestal can be used to correct rear U-joint working angle. Figure 15.

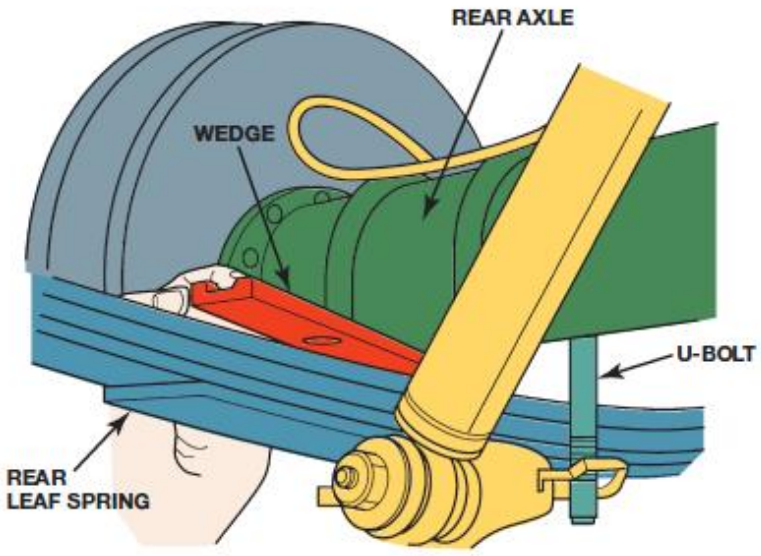

Figure 15. Adjusting rear U-joint working angle.

7. Diagnose, inspect, service, and replace wheel bearings, seals, and hubs.

Many rear-wheel- drive vehicles use an inner and an outer wheel bearing on the front wheels. The inner wheel bearing is always the larger bearing because it is designed to carry most of the vehicle weight and transmit the weight to the suspension through to the spindle. Between the inner wheel bearing and the spindle, there is a grease seal, which prevents grease from getting onto the braking surface and prevents dirt and moisture from entering the bearing. Figure 16.

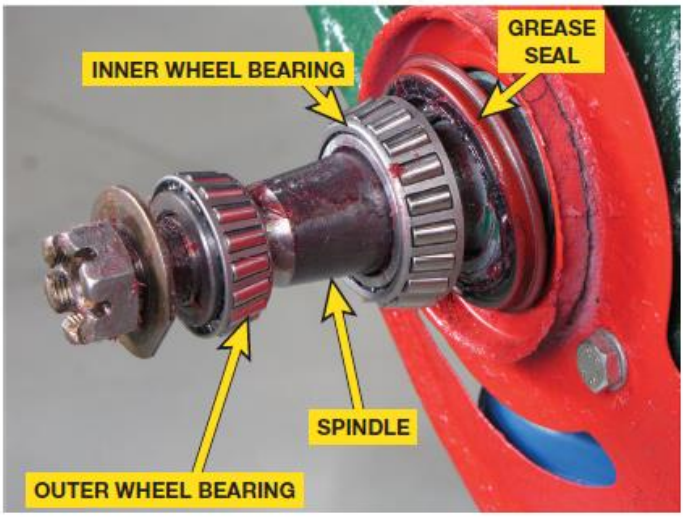

Figure 16. Two-piece wheel bearing requires adjustment when being installed.

Most front-wheel-drive vehicles use a sealed nonadjustable front wheel bearing. This type of bearing can include either two preloaded tapered roller bearings or a double-row ball bearing. This type of sealed bearing is also used on the rear of many front-wheel-drive vehicles. Figure 17.

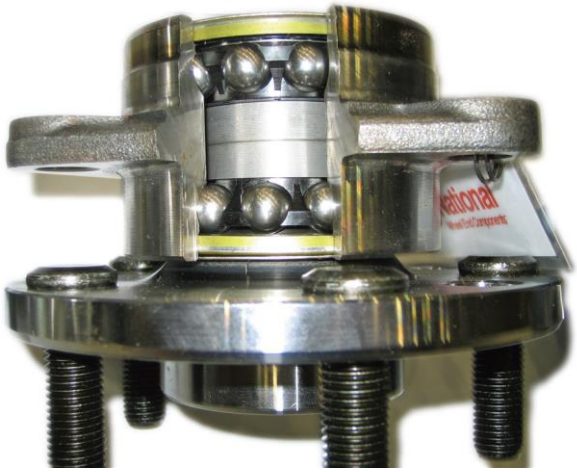

Figure 17. A sealed wheel bearing is replaced as a complete assembly.

Symptoms of defective wheel bearings include the following:

- A hum, rumbling, or growling noise that increases with vehicle speed
- Roughness felt in the steering wheel that changes with the vehicle speed or cornering
- Looseness or excessive play in the steering wheel, especially while driving over rough road surfaces
- A loud grinding noise in severe cases, indicating a defective front wheel bearing

A two-piece wheel bearing (inner and outer) is serviced by removing the bearings, washing out the old grease, cleaning the bearings, and then repacking with new grease. Figure 18.

Figure 18. Cleaning the wheel bearing.

During installation, the bearings require careful adjustment. When the wheel bearing is properly adjusted, the wheel will have about 0.001 to 0.005 inch (0.03 to 0.13 mm) end play. Figure 19.

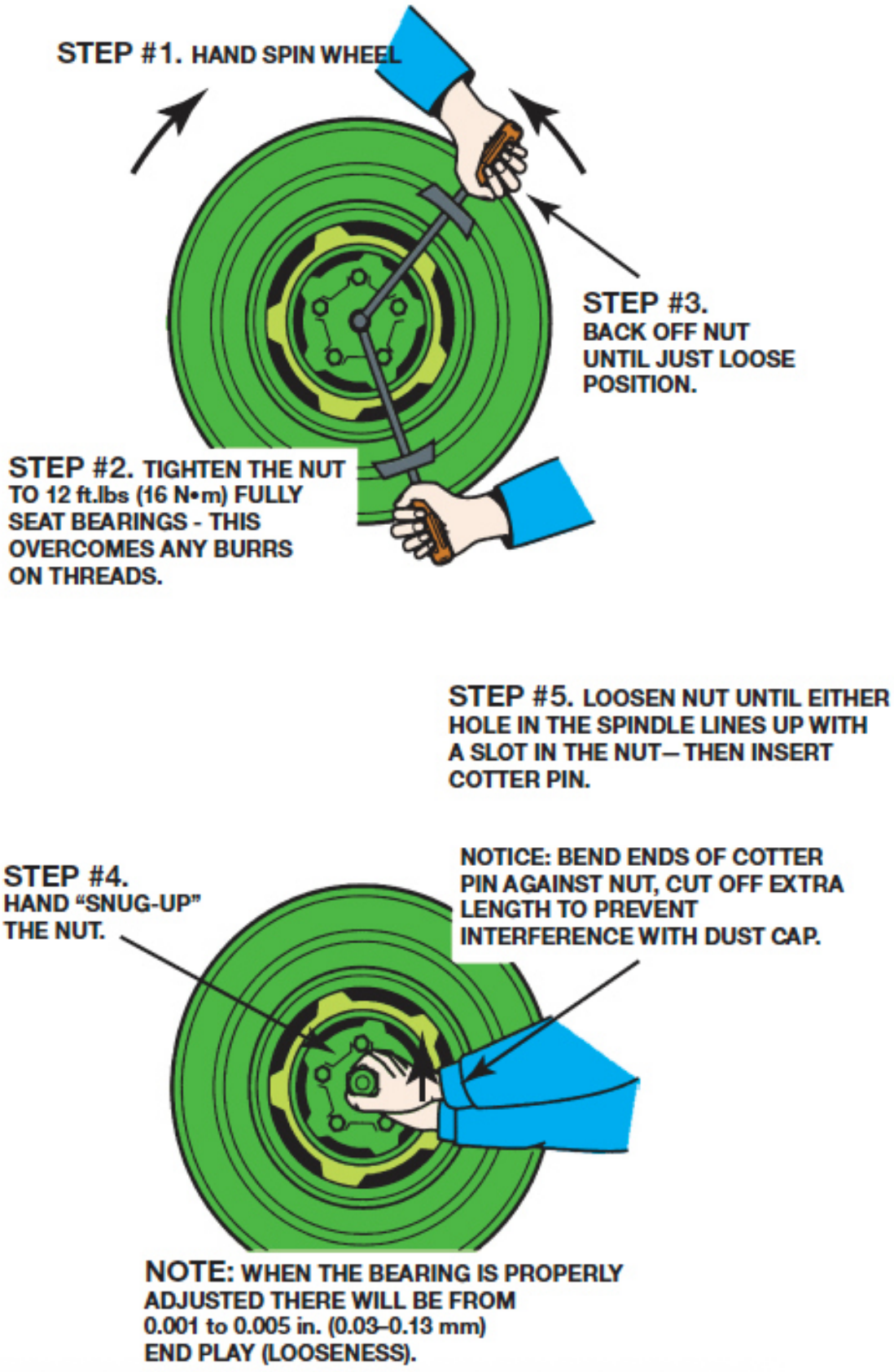

Figure 19. Wheel bearing adjustment.

Most front-wheel-drive vehicles use a sealed bearing assembly that is bolted to the steering knuckle. A sealed bearing/hub assembly may also be used on the rear wheels or a FWD vehicle. The bearing/hub assembly is replaced as a unit after removing the caliper, rotor, and mounting bolts. Figure 20.

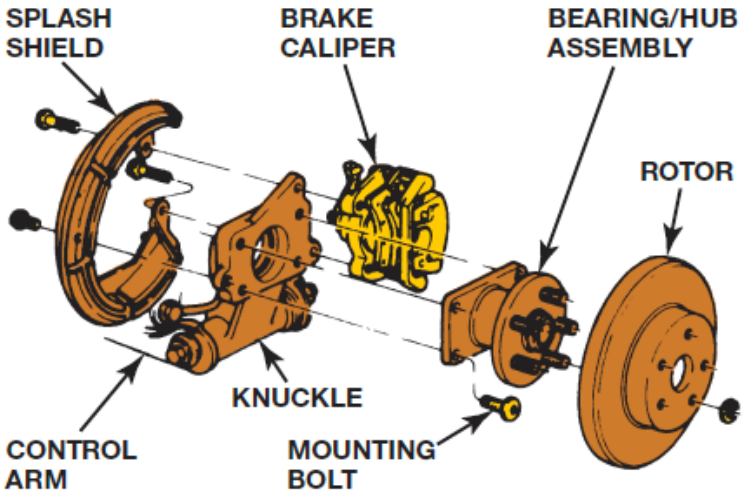

Figure 20. Rear wheel sealed bearing/hub assembly replacement.