FIGURE 50.1 Steering movement is transferred from the pitman arm (that is splined to the sector shaft, attached to the steering column) through the center link and tie rods (attached to the steering knuckles) to each front wheel. The idler arm supports the passenger side of the center link and keeps the steering linkage level with the road. This type of linkage is called a parallelogram design.

FIGURE 50.2 The most common type of steering is the parallelogram. The cross-steer and Haltenberger linkage designs are used on some trucks and vans.
FIGURE 50.3 Typical steering damper used on a Hummer H2.

FIGURE 50.4 (a) A dual bearing design with a preload spring. The use of two bearing surfaces allows one surface to rotate for steering and a second surface for pivoting for shock or suspension up-and-down movement. (b) The nylon wedge bearing type allows for extended lube intervals. Wear is automatically compensated for by the tapered design and spring loaded design.

FIGURE 50.5 (a) A rubber-bonded socket is constructed of a rubber casing surrounding the ball stud, which is then inserted into the socket of the tie rod end. The hole in the socket allows air to escape as the ball stud is installed and there is no place for a grease fitting. (b) The socket is crimped over the ball so that part of the socket lip retains the stud.
Rack-and-pinion steering systems use a ball-and-socket type inner tie rod end.

A variety of methods are used to secure the inner tie rod and socket assembly to the end of the rack.

Exploded view of a center-take-off-style rack-and-pinion steering gear assembly.
In a rear-steer vehicle, the steering linkage is behind the centerline of the front wheels, whereas the linkage is in front on a front-steer vehicle.

Opposite-phase four-wheel steer is usually used only at low vehicle speeds to help in parking maneuvers. Same-phase steering helps at higher speeds and may not be noticeable to the average driver.

Being equipped with four-wheel steer allows a truck to make shorter turns than would otherwise be possible.
**FIGURE 50.12** The Quadrasteer system includes many components that all work together.

**FIGURE 50.13** Rear steer select switch schematic.

**FIGURE 50.14** The dash-mounted select switch showing the three positions for the four-wheel steer system.
FIGURE 50.15 The output of the handwheel sensor digital signal.

FIGURE 50.16 Handwheel analog signal.

FIGURE 50.17 Handwheel position sensor analog signal to control module.
FIGURE 50.18 Handwheel position sensor digital signal to control module.

FIGURE 50.19 A Quadsphere system showing all of the components. The motor used to power the rear steering rack can draw close to 60 amperes during a hard turn and can be monitored using a Tech 2.

FIGURE 50.20 Greasing a tie rod end. Some joints do not have a hole for excessive grease to escape, and excessive grease will destroy the neck.
Part of steering linkage lubrication is applying grease to the steering stops. If these stops are not lubricated, a grinding sound may be heard when the vehicle hits a bump when the wheels are turned all the way one direction or the other. This often occurs when driving into or out of a driveway that has curbs.

Checking for freeplay in the steering.

All joints should be felt during a driver’s test. Even inner tie rod ends (ball socket assemblies) can be felt through the rubber bellows on many rack-and-pinion steering units.
FIGURE 50.24 The steering and suspension arms must remain parallel to prevent the up-and-down motion of the suspension from causing the front wheels to turn inward or outward.

FIGURE 50.25 The center link should be parallel to the ground.

FIGURE 50.26 Typical parallelogram steering linkage. The center link can also be called the relay rod, drag link, or connecting link.
FIGURE 50.27 Some center links have ball joints while others have tapered socket holes to accept ball joints on the steering arm, idler arm, and inner tie rod ends.

FIGURE 50.28 To check an idler arm, most vehicle manufacturers specify that 25 pounds of force be applied to the arm and then up and down to the idler arm. The idler arm should move less than 1/4 inch (6 mm).

FIGURE 50.29 Steering system component(s) should be replaced if any noticeable looseness is detected when moved by hand.

FIGURE 50.29 Steering system component(s) should be replaced if any noticeable looseness is detected when moved by hand.
FIGURE 50.30 All joints should be checked by hand for any lateral or vertical play.

FIGURE 50.31 If a rack-and-pinion or any other steering linkage system is not level, the front tires will be moved inward and/or outward whenever the wheels of the vehicle move up or down.

FIGURE 50.32 The preferred method for separating the tie rod end from the steering knuckle is to use a puller such as the one shown. A pickle-fork-type tool should only be used if the tie rod end is going to be replaced. A pickle-fork-type tool can damage or tear the rubber grease boot.
FIGURE 50.33 Two hammers are used to disconnect a tie rod end from the steering knuckle. One hammer is used as a backing for the second hammer. Notice that the attaching nut has been loosened, but not removed. This prevents the tie rod from falling when the tapered connection is knocked loose.

FIGURE 50.34 A pitman arm puller is used to remove the pitman arm from the pitman shaft.

FIGURE 50.35 Pitman arm and pitman shaft indexing splines.
FIGURE 50.36 Align the hole in the tie rod end with the slot in the retaining nut. If the holes do not line up, always tighten the nut farther toward until the hole lines up.

FIGURE 50.37 Replacement tie rods should be of the same overall length as the originals. Measure from the edge of the tie rod sleeve to the center of the grease fitting. When the new tie rod is threaded to this dimension, the toe setting will be close to the original.

FIGURE 50.38 All tie rod ends should be installed so that the stud is in the center of its operating range, as shown.
FIGURE 50.39 (a) Tie rod adjusting sleeve. (b) Be sure to position the clamp correctly on the sleeve.

FIGURE 50.40 An articulation test uses a spring scale to measure the amount of force needed to move the tie rod in the ball socket assembly. Most manufacturers specify a minimum of 1 pound (4.4 N) and a maximum of 6 pounds (26 N).

FIGURE 50.41 Removing a staked inner tie rod assembly requires two wrenches—one to hold the rack and the other to unscrew the joint from the end of the steering rod.
FIGURE 50.42 When the inner tie rod end is reassembled, both sides of the housing must be driven down onto the flat shoulder of the rack.

FIGURE 50.43 After replacing an inner tie rod end, the socket assembly should be secured with a rivet or set screw depending on the type of thread used.

FIGURE 50.44 Using an inductive heater caused the retaining nut to be cherry red in just a few seconds.
Drive the vehicle onto a drive-on-type hoist and have an assistant gently rotate the steering wheel back and forth about 2 inches (50 mm).

Perform a visual inspection of the steering and suspension system, looking for damage from road debris or other faults.

As the assistant wiggles the steering wheel, grasp the joint at the outer tie rod end on the driver’s side to check for any movement.
Next, check for any freeplay at the pitman arm.

Check the joint between the left inner tie rod end and the center link for play.

Move to the passenger side and check for any looseness at the joint between the center link and the right side inner tie rod end.
Figure 50.7: Check for looseness at the center link to the idler arm and the idler arm at the frame mount.

Figure 50.8: Check for looseness at the passenger-side outer tie rod end. After the inspection, record the results on the work order.