FIGURE 29.1 Steering movement is transferred from the pitman arm that is splined to the sector shaft (pitman shaft), through the center link and tie rods, to the steering knuckle at each front wheel.

FIGURE 29.2 The most common type of steering is the parallelogram.
FIGURE 29.3 Typical steering dampener used on a Hummer H2.

FIGURE 29.4 (a) A dual bearing design with a preload spring. (b) The nylon wedge bearing type allows for extended lube intervals.

FIGURE 29.5 (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. (b) The socket is crimped over the ball so that part of the socket lip retains the stud.
FIGURE 29.6 Rack-and-pinion steering systems use a ball-and-socket-type inner tie rod end.

FIGURE 29.7 A variety of methods are used to secure the inner tie rod end socket assembly to the end of the rack.

FIGURE 29.8 Exploded view of a center-take-off-style rack-and-pinion steering gear assembly.
FIGURE 29.9 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.

FIGURE 29.10 Opposite-phase four-wheel steer is usually used only at low vehicle speed to help in parking maneuvers.

FIGURE 29.11 Being equipped with four-wheel steer allows a truck to make shorter turns than would otherwise be possible.
FIGURE 29.12 The Quadrasteer system includes many components that all work together.

FIGURE 29.13 The dash-mounted select switch showing the three positions for the four-wheel steer system.

FIGURE 29.14 A Quadrasteer system showing all of the components.
FIGURE 29.15 Greasing a tie rod end. Some joints do not have a hole for excessive grease to escape, and excessive grease can destroy the seal.

FIGURE 29.16 Part of steering linkage lubrication is applying grease to the steering stops.

FIGURE 29.17 Checking for freeplay in the steering.
FIGURE 29.18 All joints should be felt during a dry park test. Even inner tie rod ends (ball socket assemblies) can be felt through the rubber bellows on many rack-and-pinion steering units.

FIGURE 29.19 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 29.20 The center link should be parallel to the ground.
FIGURE 29.21 Typical parallelogram steering linkage. The center link can also be named the relay rod, drag link, or connecting link.

FIGURE 29.22 Some center links have ball joints while others have tapered socket holes to accept ball joints on the pitman arm, idler arm, and inner tie rod ends.

FIGURE 29.23 To check an idler arm, most vehicle manufacturers specify that 25 pounds of force be applied by hand up and down to the idler arm.
FIGURE 29.24 Steering system component(s) should be replaced if any noticeable looseness is detected when moved by hand.

FIGURE 29.25 All joints should be checked by hand for any lateral or vertical play.

FIGURE 29.26 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 29.27 The preferred method for separating the tie rod end from the steering knuckle is to use a puller such as the one shown.

FIGURE 29.28 Two hammers being used to disconnect a tie rod end from the steering knuckle.

FIGURE 29.29 A pitman arm puller is used to remove the pitman arm from the pitman shaft.
FIGURE 29.30 Pitman arm and pitman shaft indexing splines.

FIGURE 29.31 Align the hole in the tie rod end with the slot in the retaining nut.

FIGURE 29.32 Replacement tie rods should be of the same overall length as the originals.
FIGURE 29.33 All tie rod ends should be installed so that the stud is in the center of its operating range, as shown.

FIGURE 29.34 (a) Tie rod adjusting sleeve. (b) Be sure to position the clamp correctly on the sleeve.

FIGURE 29.35 An articulation test uses a spring scale to measure the amount of force needed to move the tie rod in the ball socket assembly.
FIGURE 29.36 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 rack.

FIGURE 29.37 When the inner tie rod end is reassembled, both sides of the housing must be staked down onto the flat shoulder of the rack.

FIGURE 29.38 After replacing an inner tie rod end, the socket assembly should be secured with a rivet or set screw depending on the style of the replacement part.
FIGURE 29.39 Using an inductive heater caused this 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.

Check for looseness at the idler arm connector to the center link and the idler arm at the frame mount.

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