MODULE CONTENT

| Unit of Competency | **DIAGNOSE AND REPAIR STEERING SYSTEM** |
| --- | --- |
| Module Title | **DIAGNOSING AND REPAIRING STEERING SYSTEM** |
| Module Descriptor | This unit identifies the competence required to diagnose and repair the steering systems. |
| Nominal Duration | **hours** |
| Summary of the Learning Outcomes: | |
| Upon completion of this module the student must be able to: | |
| LO1. Prepare to diagnose and repair steering system | |
| LO2. Diagnose steering system | |
| LO3. Repair steering system | |
| LO4. Complete work processes | |

**LEARNING EXPERIENCES**

**LEARNING OUTCOMES NO. 2**

**DIAGNOSE STEERING SYSTEM**

| **Learning Activities** | **Special Instructions** |
| --- | --- |
| Read Information Sheet 3.1-1 Diagnose steering system | If you have some problem with the content of the information sheet don’t hesitate to approach your Trainer.  If you feel that you are now knowledgeable on the content of the information sheet, you can now answer the self-check provided in the module. |
| Answer Self-Check 3.1-1 on Diagnose steering system | Try to answer the Self-check without looking at the Answer Key  Compare your answer to Answer Key 3.1-1 |
| Observe Trainer’s demonstration on Task Sheet 3.1-1 on Diagnose steering system | Listen carefully and attentively so that you may be able to perform a task correctly  Ask questions if are in doubt for clarification |
| Perform the Task Sheet 3.1-1 on Diagnose steering system | Remember the step-by-step procedure the Diagnose steering system |
| Evaluate the performance using the Performance Criteria Checklist 3.1-1 | Repeat the task in case fail to meet the criteria |

**INFORMATION SHEET 1.1-1**

**DIAGNOSE STEERING SYSTEM**

**Learning Objectives:**

After reading this **Information Sheet**, you must be able to:

1. Made final inspection.
2. Turned-over vehicle.
3. Restored work area.
4. Managed wastes.
5. Checked and stored tools and equipment.
6. Accomplished workplace documents.

**STEERING SYSTEM DIAGNOSIS**

It is important to realize that many steering complaints are caused by problems in areas other than the steering system. A good diagnosis is one that finds the exact cause of the customer’s complaint. Although customers may describe the problem in different ways, the most common complaints and their typical causes are discussed next.

**Common Complaints**

**Excessive Steering-Wheel Play** Excessive play in the steering wheel when there is too much steering-wheel movement before the wheels begin to turn. A small amount of play is normal.

This problem can be caused by the following:

Loose, worn, or damage steering column U-joints

Loose, worn, or damage steering column bearings

Loose or worn steering gear

Loose steering gear bolt

**Feedback** when the driver feels the surface on the road through the steering wheel is called feedback.

This problem can be caused by the following:

Loose, worn, or damaged steering linkages or tie-rod ends

Loose, worn, or damage steering column U-joints

Loose or damaged steering gear mounting bolts

Damage or worn steering column bearings

Loose suspension bushing, fasteners, or ball joints

**Hard Steering** Obviously a complaint of hard steering results when extra effort is needed to turn the steering wheel. This problem may be simply an absence of power assist. Hard steering problems can occur whenever the steering wheel is turned or just when it has been turned close to its limit.

This problem can be caused by the following:

A faulty power-steering pump

Damaged or faulty steering column bearings

Seized steering column bearings

Steering gear set too tight or is binding

Inadequately inflated tires

**Nibble** This feeling is similar to a shimmy. A nibble results from the interaction of the tires with the road’s surface. The customer’s complaint may be describe the nibble problem as slight rotational oscillations of the steering wheel.

This problem can be caused by the following:

Loose, worn, or damaged steering linkages or tie-rod ends

Loose, worn, or damage suspension parts

**Pulling or Drifting** A pull is a tugging sensation felt at the steering wheel. The driver must push the steering wheel in the opposite direction of the pull to keep the vehicle going straight. Drifting is a condition in which the vehicle slowly moves to one side of the road when the driver’s hands are taken off the steering wheel.

These problems can be cause by the following:

Improper frame alignment

Brake system problem

Worn or binding suspension components, especially springs

Poor wheel alignment

Unevenly loaded or overloaded valve

Loose, worn, or damaged steering linkages or tie-rod ends

Out of balance steering gear valve

Torque steer

Tire problems

Binding strut bearing

**Shimy** When the wheels shimmy, the driver will feel large, consistent, rotational oscillations at the steering wheel. These motions are caused by the lateral movement of the tires.

This problem can be caused by the following:

Loose, worn, or damage steering linkages or tie-rod ends

Loose, worn, or damaged suspension parts

Out-of-balance tires

A bad time

Loose wheel bearings

**Sticking Steering or Poor Return** Poor returnability and sticky steering bearing describes the steering wheel’s resistance to return to center after a turn.

This problem can be caused by the following:

Binding steering column U-joints

Steering set too high or is binding

Loose, worn, or damaged steering suspension parts

Poor wheel alignment

Binding steering column bearings

**Wandering** when a vehicle wanders, the driver must constantly turn the steering wheel to the left and right to keep the vehicle going on a level road.

This problem can be caused by the following:

Loose or worn suspension components

Poor wheel alignment

Unevenly loaded or overloaded vehicle

Loose or damage steering gear bolts

Loose steering column U-joint bolt

Loose, worn, or binding steering linkages or tie-rod ends

Improper steering gear preload adjustment

**Noise** there may be also abnormal noises that accompany the turning of the steering wheel. The cause of these noises is best indentified by paying close attention to where the noise is coming from. Some noises may be caused by tires or interference between the steering wheel and the steering column covers. Others can result from a faulty power-steering pump or system.

This problem can be caused by the following:

A hissing noise during the low speed turning, such as while parking is normal

A chirping or squealing normally means the drive belt is loose or slipping.

Improperly routed hoses, loose mounting bolts on the power steering pump or the steering gear can cause a rattle.

A groaning or howling can indicate a restriction in the hydraulic system

A sticking control valve will cause a buzzing sound.

**Diagnosing**

As with the diagnosing of any problem, your diagnosis should begin by trying to duplicate the customer’s complaint. For steering problems, this is done on a road test. Make sure you drive carefully and cautiously especially since the vehicle has a control problem. It is very important that during the road test the vehicle is driven under condition similar to the driver’s normal driving. While it may be somewhat 9inconvenient to seek out a particular type of road surface, this may be the only way to verify the condition. Take plenty of time because it could save hours of service time in the final diagnosis. Before going on the road test, do a thorough safety inspection of the vehicle that includes the tires.

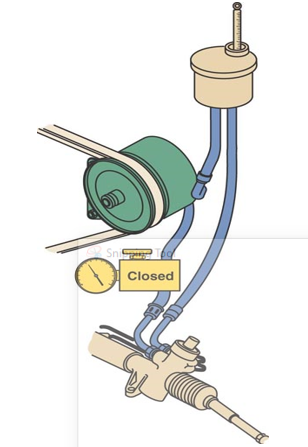
Once the road test has been done completed and it has been determined that there is an abnormal condition, certain tests are necessary to pinpoint the exact cause. In some cases partial disassembly of the system may be required to complete a test. Do not shortcut test steps to save time. Doing so can alter the results, leading to an inaccurate diagnosis and unnecessary replacement of parts. It is also vital that specifications can be confirmed in the service manual. Guessing gives incorrect results. Continue your diagnosis with a thorough visual inspection.

**Power-Steering Pressure Checks**

A power-steering gauge is used to test the power-steering pump pressure. With the engine off, disconnect the pressure hose at the pump. Install the pressure gauge between the pump and the steering gear and bleed system.

Run the engine for about 2 minutes, and then stop the engine and fluid to the power-steering pump if necessary. Restart the engine, allow it to idle, and observe the pressure reading. The readings should be about 30 to 80 psi (200 to 550 kPa). If the pressure is low, the pump may be faulty. If the pressure if too high, the problem, may be restricted hoses.

Continue for testing by closing the shut-off valve of the tester and observing the pressure reading **(Figure 44 – 24).** Never keep the valve closed for more than 5 seconds. When the valve is closed, the pressure should increase. If the pressure is too high, a faulty pressure relief valve is suggested. If the pressure is too low, the pump may be bad.

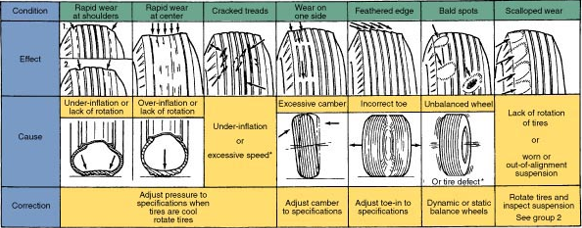


**Figure 44-24** The final step when checking power-steering pump pressure is to close the tester’s valve and observe the pressure in the system. Never keep the valve closed for more than five seconds.

**VISUAL INSPECTION**

Often, as you go over the vehicle’s system, you will run across something that appears to be faulty, worn, or damaged. At that point you may wish to check out the component further before continuing your inspection. These checks and some services to the components are given with the details of the visual inspection. Before actually checking or servicing component, check with the service manual to make sure you are doing it correctly.

Begin your visual inspection of the steering system by inspecting the tires. Check for correct pressure, construction, size, wear, and damage, and for defects that include ply separations, sidewalls knot, concentricity problems, and force problems. Keep in mind that tire wear patterns are good indicators of steering and suspension problems **(Figure 44 – 25).** Tie wear is also a great indicator of wheel alignment problems that will be covered in the next chapter.



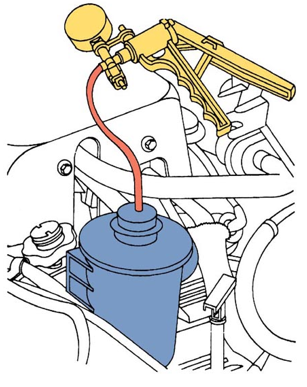
**Figure 44-25** Tire wear patterns.

Also check the tire and wheel assemblies for radial and lateral runout, and static and dynamic imbalance. Check the adjustment of the wheel bearings.

Check the power-steering fluid level and condition. The fluid is checked at the pump reservoir cap. Check the fluid level in the reservoir after the engine has been run at idle for 2 to 3 minutes and the wheel has been cycled from lock to lock several times. This warms the fluids to its normal operating temperature and gives a more accurate reading. Make sure the fluid level is at the full mark.

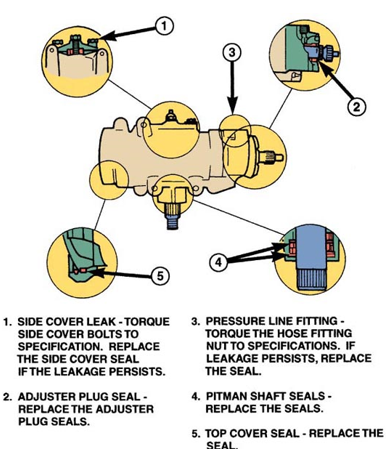
Examine the condition of the fluid carefully. Check for evidence of contamination such as solid particles or water. If either of these conditions is present or the fluid has burnt odor; the system should be flushed before returning to service.

Also check the fluid for evidence of air trapped in the system. If the fluid looks foamy, it is likely that air is in the system. To verify this, run the engine until it reaches normal operating temperature. Then turn the steering wheel to the left and to the right several times without hitting the stops. If there is air in the system, bubbles will appear in the fluid reservoir. To remove the air, the system must be bled. The method of bleeding depends on the type of power-steering system. Follow the procedures given in the service manual. The typical procedure involves connecting a vacuum pump to the cap’s opening in the reservoir **(Figure 44 – 26).** While the engine is running, vacuum is then applied to the reservoir and maintained for about 5 minutes. The vacuum is then released and the reservoir refilled with fluid. Vacuum it again applied to the reservoir and the steering wheel is cycled from stop-to-stop every 30 seconds for at least 5 minutes. After this period of time, the vacuum is released and the reservoir cap installed. Then the system is checked for leaks.

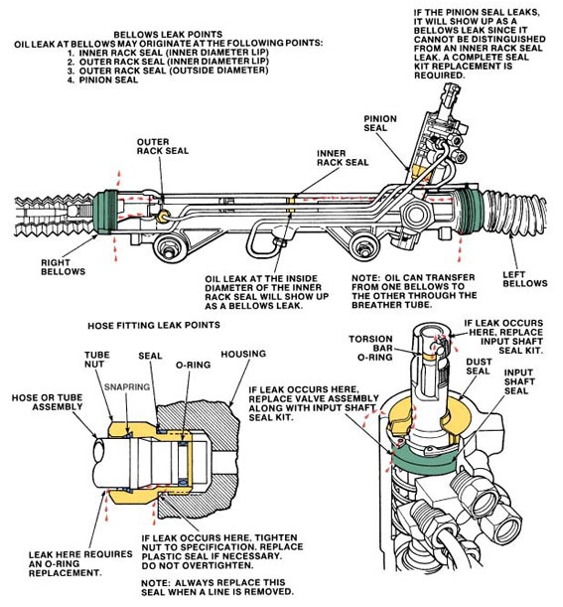


**Figure 44-26** To bleed the system, a vacuum pump is connected to the fluid’s reservoir.

With the ignition OFF, wipe the outside of the power-steering pump, pressure hose, return hose, fluid cooler, and the steering gear **(Figure 44 – 27).** Start the engine and turn the steering wheel several times from stop to stop. Check for leaks **(Figure 44 – 28).** Fluid leakage will not only cause abnormal noises, but may result in unequal and abnormal steering efforts. If no signs of leakage are apparent, repeat the wheel cycling process and inspection several more times. Hoses should also be carefully inspected for swelling and cracks. Always replace power-steeling hoes with an exact replacement hose. Never attempt to patch or seal a leak in a hose or the hose’s fittings.



**Figure 44-27** Points for fluid leaks at a steering geat.



**Figure 44-28** Possible leakage points on power-steering systems.

On all systems, carefully check all of the mechanical parts of the steering and suspension system. Many suspension pasts affects the operation of the steering system. Worm ball joints can cause erratic steering and premature tire wear. Bad suspension bushing will allow excessive wheel movement that can affect braking, handling, and wheel alignment. If any part is found to be defective it should be replaced.

**Power-Steering Pump Belt**

Power-steering belt condition and tension are extremely important for satisfactory power-steering pump operation. A loose belt causes low pump pressure and hard steering. A loose, dry, or worn belt may cause squealing and chirping noises, especially during engine acceleration and cornering. The power-steering pump belt should be checked for tension, cracks, oil soaking, worn or glazed edges, tears, and splits. If any of these conditions are present, the belt should be replaced.

Belt tension can be checked by measuring the belt deflection. Press on the belt with the engine stopped to measure the belt deflection, which should be ½ inch (13 mm) per foot of free span. The belt tension may also be checked with a belt tension gauge placed over the belt.

The tension on the gauge should equal the vehicle manufacturer’s specifications.

To adjust the tension of the belt, loosen the power-steering pump bracket or tension adjusting bolt and the power-steering pump mounting bolts. Pry against the pump ear and hub with a pry bar to tighten the belt. Some pump brackets have ½-inch square opening in which the breaker bar may be installed to move the pump and tighten the belt. Hold the pump in the desired position and tighten the bracket or tension adjusting bolt. Once tightened, recheck the belt tension gauge. If the belt does not have the specified tension, readjust it and tighten the tension adjusting bolt and the mounting bolt to the specified torque.

Some power-steering pumps have a ribbed V-belt, which has an automatic tensioning pulley; therefore, a tension adjustment is not required. The belt, however, should be checked to make sure it is installed properly in each pulley in the belt drive system and that it is in good condition.

**Pitman Arm**

Because of its function, the pitman arm is the most heavily stressed in the system. To inspect the pitman arm, grasp it and vigorously shake it to detect any looseness. Check the socket to reveal any damage or looseness. Either condition must be corrected be placing the worn part. Their removal normally requires the use of a special puller **(Figure 44 – 29).**

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**Figure 44-29** a pitman arm puller.

**Idler Arm**

A worn or damage idler arm can cause steering instability, uneven tire wear, front-end shimmy, hard steering, excessive play in steering, poor returnabilty. Because an idler arm is the weakest in the link in a parallelogram steering system, it wears more quickly than the rest of the system.

The procedure is simple for checking an idler arm for looseness or wear. The suspension should be normally loaded on the ground or on an alignment rack. When raised by a frame contact hoist, the vehicle’s steering linkage is allowed to hang, and proper testing cannot be done. Check the idler arm ends for worn sockets or deteriorated bushings. Grasp the center link firmly with your hand at the idler arm ends. Push up with approximately a 25-pound (110 N) load. Pull down with the same load. The allowable movement of the idler arm and support assembly in one direction is 1/8 inch (3 mm), for a total acceptable movement is ¼ inch (6 mm). The total load can be accurately measured by using a dial indicator or pull-spring scale located as near the center link end of the idler arm as possible. Keep in mind that the test forces should not exceed 25 pounds (110 N), as even a new idler arm might be forced to show movement due t steel flexing when excessive pressure is applied. It is also necessary that a scale or ruler be rested against the frame and use to determine the amount of movement. Observes tends to overestimate the actual movement when scale is not used. The idler arm should always be replaced if it fails this test. Jerking the right front wheel and tire assembly back and forth (causing an up-and-down movement in the idler arm) is not an acceptable method of checking, as there is no control on the amount of force being applied.

**Center Link**

Worn or bent links can cause front-end shimmy, vehicle pull to one side, or change in the toe setting, causing excessive tire wear.

When inspecting the center link, look closely to insure it has not been bent or damaged. Grasp the center link firmly and try moving it in all directions. Any movement, or sign of damage, is reason for replacement. Tapered openings seldom wear but should be check for enlargement caused by loose connection. If necessary, replace the center link.

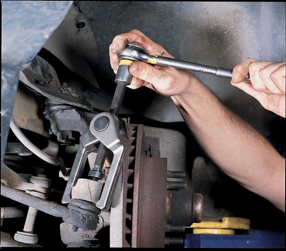
**Tie-Rod Assembly**

Worn tie-rod ends result in incorrect toe-in-settings, scalloped and scuffed tires, wheel shimmy, understeering, or front-end noise and tire squeal on turns.

Tie-rod end center link inspections are similar. Grasp the tie-rod end firmly. Push vertically with the stud, and inspect for movement at the joint with the steering knuckle. Any movement over 1/8 inch (3 mm) or observation of damaged or missing parts, such as seals, is sufficient evidence that replacement is necessary.

Adjusting sleeves resembles a piece of internally threaded pipe. They have a slot or separation that runs either their entire length or just part ways. Adjusting sleeves also have two crimping or squeezing clamps located at each to lock to toe adjustment. Badly rusted, worn, or damaged adjusting sleeves should be replaced.

An additional check of the tie rods can be made by rotating each tie-rod end to feel for roughness of binding, which could indicate that the socket has probably rusted internally. A special puller is often required to separate a tie-rod end from the steering knuckle **(Figure 44 – 30-).**

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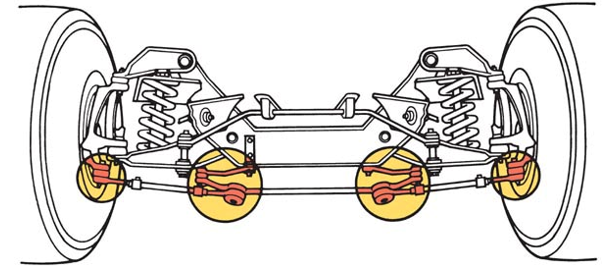
**Figure 44-30** A tie-rod-end-separating tool.

**Steering Damper**

The steering dampers found in some steering linkage designs are generally nonadjustable, nonrefillable, and not repairable. At each inspection interval, inspect the mountings and check the assembly for damage (such as being bent) and fluid leaks. A light film of fluid is evidence of fluid leakage. However, a light film of fluid is permissible on the body of the damper near the shaft seal. A dripping damper should be replaced. A bad steering damper may cause wheel shimmy even though the rest of the suspension and steering system is fine.

**Dry Park Check**

An excellent overall check for worn or loose conventional steering components is the **dry park check.**  With the full weight of the vehicle on the wheels, have an assistant rock the steering wheel back and forth. Start your inspection from one side to the other side. Note any looseness in tie-rod, center link, idler arm, or pitman arm sockets **(Figure 44 – 31).** If a second person is not available, reach up under the vehicle and grasp the flexible coupling on the steering shaft. Rock the linkage.

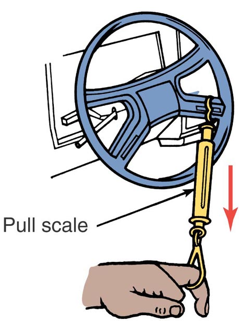


**Figure 44-31** Circled areas indicate where a dry park check of steering linkage should be made.

Before assembling any steering linkage parts, thoroughly check all tapered holes for out-of-roundness and wear. Thoroughly clean all bores that the stud tapers mount in. On new and reused parts, firmly install the tapered stud into its tapered hole. The stud must set firmly without e\rocking. Only thread should protrude from the hole. If the parts do not meet these requirements, the mating part is worn and must be replaced, or the correct parts are not being used. Always follow the manufacturer’s stud and mounting bolt torque specifications when installing chassis parts.

**Turning Effort**

If an owner’s concern indicates excessive turning effort, a pull scale should be used to read the actual force required to turn the wheel **(Figure 44 – 32).** Compare the test results to the specifications in the service manual. Is the effort exceeds the maximum, carefully inspect the entire steering system before performing a pressure test.



**Figure 44-32** A pull scale is used to measure steering effort.

**Tie-Rod Articulation Effort**

The effort required to move the tie rod or its inner ball socket should be checked with a pull scale id excessive steering effort or looseness is noted during the road test. If the effort is not within the specified limits, the tie rod must be replaced.

**Worn and Roller Steering**

Since the worn and roller steering linkage components are almost identical to those of a parallelogram linkage, the same methods of inspection are done.

**Rack and Pinion Steering**

Rack and pinion system has no idler or pitman arms and no center link. Instead, they are replaced with a rack. Because the rack has no wear points, the number of wear points on rack and pinion system is reduced to four each of the tie-rod ends. Tie-rod ends are also wear points on the parallelogram steering system. Power rack and pinion assemblies should be carefully checked for leaks. If leaks cause the pump to run out of fluid, the pump will be damaged.

In order to solve customer’s complaints, a very thorough inspection of the entire system is needed. Everything, including ball joints, tires, outer tie rods, bellow, boots, inner tie rods, rack-mounting bushings, mounting bolts, steering couplings, and gearbox adjustments must be checked. Rack and pinion steering inspection must be very thorough because of the system’s sensitivity.