Component Procedures: Steering

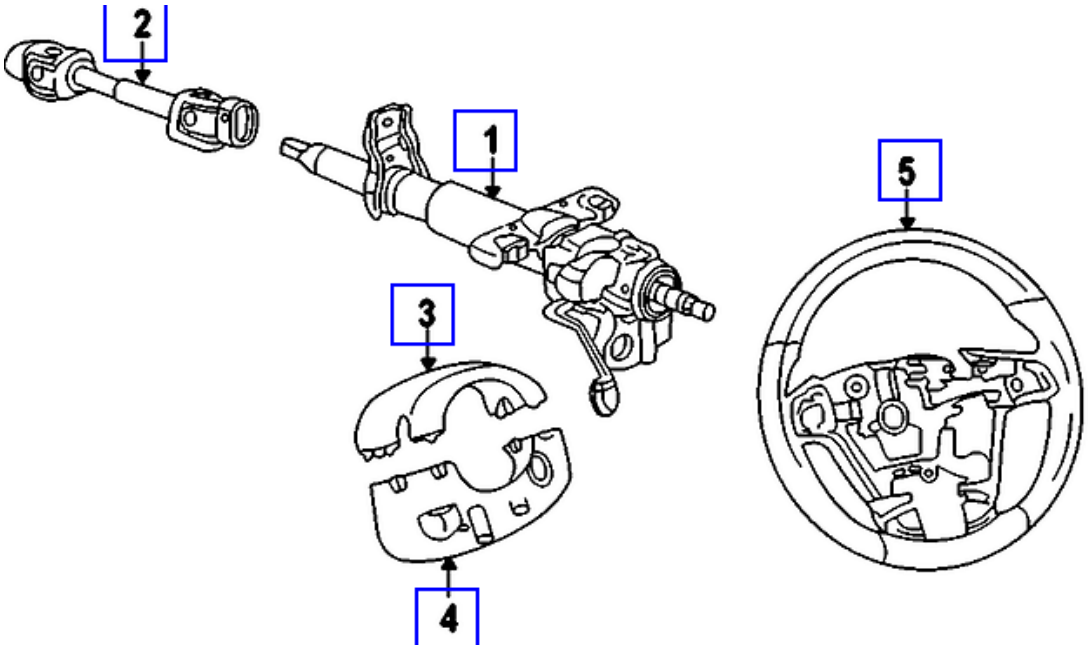
Table of Contents

Component Procedures: Steering

Steering Gear (Article 194686)

Non Standards
- Hydraulic (194687)

Steering Column (Article 194688)



Parts and Labor (itype_189)

Labor

Operation	Qualifier Path	Skill	Std Hrs	Wty Hrs
Remove & Replace	Power Electric > Steering Gear & Linkage > In?	B	0.7	0.0
Remove & Replace	Power Electric > Steering Gear & Linkage > In?	B	1.2	0.0
Remove & Replace	Power Electric > Steering Gear & Linkage > Mo?	B	2.8	0.0
Remove & Replace	Power Electric > Steering Gear & Linkage > Ou?	B	0.4	0.0
Remove & Replace	Power Electric > Steering Gear & Linkage > Ou?	B	0.7	0.0
Remove & Replace	Power Electric > Steering Gear & Linkage > St?	B	4.4	0.0
Remove & Replace	Power Electric > Steering Gear & Linkage > Ti?	B	0.5	0.0
Remove & Replace	Power Electric > Steering Gear & Linkage > Ti?	B	0.8	0.0
Remove & Replace	Power Hydraulic > P/S Pump & Hoses > P/S Pres?	B	0.9	0.7
Remove & Replace	Power Hydraulic > P/S Pump & Hoses > P/S Pump?	B	1.3	0.9
Remove & Replace	Power Hydraulic > P/S Pump & Hoses > P/S Retu?	B	0.9	0.7
Remove & Replace	Power Hydraulic > P/S Pump & Hoses > Reservoi?	B	0.4	0.3
Remove & Replace	Power Hydraulic > P/S Pump & Hoses > Reservoi?	B	0.8	0.0
Remove & Replace	Power Hydraulic > Steering Gear & Linkage > I?	B	0.7	0.0
Remove & Replace	Power Hydraulic > Steering Gear & Linkage > I?	B	1.2	0.0
Remove & Replace	Power Hydraulic > Steering Gear & Linkage > O?	B	0.4	0.4
Remove & Replace	Power Hydraulic > Steering Gear & Linkage > O?	B	0.7	0.6
Remove & Replace	Power Hydraulic > Steering Gear & Linkage > T?	B	0.5	0.0
Remove & Replace	Power Hydraulic > Steering Gear & Linkage > T?	B	0.8	0.0
Remove & Install	Power Electric > Steering Gear & Linkage > St?	B	4.2	0.0
Remove & Install	Power Electric > Steering Gear & Linkage > St?		1.5	
Remove & Install	Power Electric > Steering Gear & Linkage > St?		0.6	
Diagnosis	Power Hydraulic > P/S Pump & Hoses > System, ?	B	0.5	0.0

Specifications Quick Reference (itype_439)

Quick Specifications
- item

Power Steering System Description and Operation (Belt Drive Electronic Power Steering) (Article 13423)

Figure 1: Electric Power Steering Block Diagram
The belt driven electronic power steering system consists of the following components:
- The integrated electromechanical power steering unit , containing the power steering control module , its sensors, the power steering motor , a belt drive and a ball nut mechanism
- The steering gear (rack and pinion)

The belt driven electric power steering system reduces the amount of effort needed to steer the vehicle utilizing the power steering control module to control the power steering motor to maneuver the steering gear. The power steering control module also uses a combination of the torque sensor , motor rotational sensor, battery voltage circuit and GMLAN serial data circuit to perform the system functions. The power steering control module monitors vehicle speed and engine speed from the engine control module via the GMLAN serial data circuit to determine the amount of steering assist needed to steer the vehicle. At low speeds more assist is provided for easy turning during parking maneuvers. At higher speeds less assist is provided for improved road feel and directional stability.
The power steering control module uses a combination of the torque sensor, motor rotational sensor, vehicle speed, and calculated system temperature inputs to determine the amount of assist needed. The power steering control module continuously monitors the digital torque sensor's torque and index current signals. As the steering wheel is turned and torsional twist is applied to the steering shaft , the steering input and output shafts are monitored via the torque signal circuit and then processed by the power steering control module to calculate the steering torque. The voltage signals of the motor position sensor and the digital torque sensor's index current signal are both processed by the power steering control module to detect and calculate the steering wheel angle.
The power steering control module responds to the change in the digital torque sensor signals as well as the motor rotational sensor's voltage signals by commanding current to the power steering motor. The power steering control module controls the motor drive circuit to drive the alternating current motor. The power steering control module & motor assembly is attached to the base of the steering gear housing and applies power assist directly to the rack with a belt drive and a ball nut mechanism to maneuver the rack laterally depending on the direction the steering wheel is turned.
The power steering control module has the ability to calculate an internal system temperature to protect the power steering system from damage caused by high temperature. To reduce a high system temperature, the power steering control module will reduce the amount of current commanded to the power steering motor, which reduces the amount of steering assist. The power steering control module has the ability to detect malfunctions within the electric power steering system. Any malfunction detected that disables steering assist will cause the SERVICE POWER STEERING message to be displayed on the driver information center.

Power Steering System Description and Operation (Hydraulic Power Steering) (Article 13424)

The hydraulic power steering pump is a constant displacement vane-type pump that provides hydraulic pressure and flow for the power steering gear. The hydraulic power steering pump is either belt-driven or direct cam-driven.
The power steering fluid reservoir holds the power steering fluid . The power steering fluid reservoir may be integral with the power steering pump or remotely located. The vehicle may have a combination of a power steering fluid reservoir integral with the power steering pump and a remotely located power steering fluid reservoir. The following locations are typical locations for the remote reservoir:
- Mounted to the front of the dash panel
- Mounted to the inner fender
- Mounted to a bracket on the engine

The 2 basic types of power steering gear s are listed below:
- A recirculating ball system
- A rack and pinion system

In the recirculating ball system, a worm gear converts steering wheel movement to movement of a sector shaft. A pitman arm attached to the bottom of the sector shaft actually moves one tie rod . An intermediate rod moves the other tie rod.
In the rack and pinion system, the rack and the pinion are the 2 components that convert steering wheel rotation to lateral movement. The steering shaft is attached to the pinion in the steering gear. The pinion

rotates with the steering wheel. Gear teeth on the pinion mesh with the gear teeth on the rack. The rotating pinion moves the rack from side to side. The lateral action of the rack pushes and pulls the tie rods in order to change the direction of the vehicle's front wheels .
The power steering pressure hose connects the power steering pump union fitting to the power steering gear and allows pressurized power steering fluid to flow from the pump to the gear.
The power steering return hose returns fluid from the power steering gear back to the power steering fluid reservoir. The power steering return hose may contain an integral fin-type or line-type power steering fluid cooler.
In a typical power steering system, a pump generates hydraulic pressure, causing fluid to flow, via the pressure hose, to the steering gear valve assembly. The steering gear valve assembly regulates the incoming fluid to the right and left chambers in order to assist in right and left turns.
Turning the steering wheel activates the valve assembly, which applies greater fluid pressure and flow to 1 side of the steering gear piston, and lower pressure and flow to the other side of the piston. The pressure assists the movement of the gear piston. Tie rods transfer this force to the front wheels, which turn the vehicle right or left.

Power Steering Schematics (Article 13476)

Figure 1: NV9

Checking and Adding Power Steering Fluid (Article 13450)

- Run the engine until the power steering fluid reaches about 80°C (170°F).
- Turn the engine OFF.
- If the power steering fluid reservoir is covered by a shield or a cover, remove the shield or the cover, as applicable.
- Clean the power steering fluid reservoir and the reservoir cap.
- Remove the reservoir cap.
- Inspect the power steering fluid level in the reservoir or on the cap stick, as applicable. Ensure that the fluid level is at the HOT/FULL/MAX mark on the cap stick or on the reservoir, as applicable.
- Add power steering fluid if necessary. Refer to Adhesives, Fluids, Lubricants, and Sealers .
- Install the reservoir cap.
- If you removed a shield or a cover, install the shield or the cover, as applicable.

Power Steering System Flushing (Article 13462)

- Raise the vehicle until the front wheels are off the ground. Refer to Lifting and Jacking the Vehicle .
- Place a large drain pan under the vehicle in order to collect the draining fluid.
- Remove the fluid return hose at the power steering fluid reservoir or the pump inlet connection, as applicable.
- Plug the reservoir return hose inlet connection on the power steering fluid reservoir or the pump, as applicable.
- Have an assistant maintain the minimum fluid level in the reservoir using clean, new power steering fluid. Refer to Checking and Adding Power Steering Fluid .
- With the key in the ON position and with the engine OFF, turn the steering wheel fully to the left and to the right. Continue until the fluid from the return hose runs clear.
- Remove the plug and install the fluid return hose to the power steering fluid reservoir or the pump inlet connection, as applicable.
- Bleed the power steering system. Refer to Power Steering System Bleeding .
- Inspect the power steering fluid for the following indications of contamination:
- Milky fluid – water
- Brown fluid – burnt
- Plastic debris or dirt chunks
- If the fluid is contaminated, repeat steps 3–9.
- Remove the drain pan.
- Lower the vehicle.

Power Steering - Adhesives, Fluids, Lubricants, and Sealers (Article 13478)

Application Type of Material GM Part Number
United States Canada
Electric Belt Drive Rack and Pinion Steering Gear Brake Parts Cleaner 19370704 or 19370705 88901247
Hydraulic System Power Steering Fluid Power Steering Fluid 89020661 89021186

Inner Tie Rod Thread Locking Adhesive 89021297 10953488
Power Steering Assist Motor Wax 19355725 19355726
Power Steering Assist Motor Seal Grease 01051344 00993037
Steering Gear Boot Lithium Grease 12377985 88901242

Power Steering - Fastener Specifications (Article 13480)

Application Specification
Metric English
Power Steering Assist Motor Bolt Refer to procedure for tightening sequence and torque values. Power Steering Assist Motor Replacement
Power Steering Fluid Cooler Hose Bracket Bolt 9 Nm 80 lb in
Power Steering Fluid Reservoir Bracket Bolt 9 Nm 80 lb in
Power Steering Gear Inlet Hose Bracket Bolt 9 Nm 80 lb in
Power Steering Gear Inlet Hose Fitting 34 Nm 25 lb ft
Power Steering Gear Outlet Hose Bracket Bolt 9 Nm 80 lb in
Power Steering Gear Outlet Hose Fitting 34 Nm 25 lb ft
Power Steering Pump Auxiliary Bracket Bolt 20 Nm 15 lb ft
Power Steering Pump Bolt 22 Nm 16 lb ft
Power Steering Pump Bracket Bolt 58 Nm 43 lb ft
Steering Gear Bolt
First Pass 50 Nm 37 lb ft
- First Pass
Second Pass plus 120 degrees
- Second Pass
Steering Linkage Inner Tie Rod (N41) 89 Nm 66 lb ft
Steering Linkage Inner Tie Rod (NV9) 106–126 Nm 79–93 lb ft
Steering Linkage Inner Tie Rod Nut (N41) 75 Nm 55 lb ft
Steering Linkage Inner Tie Rod Nut (NV9) 55–70 Nm 41–52 lb ft
Steering Linkage Outer Tie Rod Nut
First Pass 30 Nm 22 lb ft
1. Use 2 NEW steering gear bolts on the bushing side of the steering gear nearest the power steering gear motor on the right side of the drivetrain and front suspension frame assembly. Only for vehicles with LSA and NV9.

Steering Wheel and Column - Fastener Specifications (Article 13508)

Note: All fasteners listed in this table can be reused after removal.
Application Specification
Metric (English)
Steering Column Bolts 22 Nm (16 lb ft)
Steering Column Shroud Bolts 2.5 Nm (22 lb in)
Steering Gear Pinion Bolt 50 Nm (37 lb ft)
Steering Wheel Bolt 30 Nm (22 lb ft)
Upper Intermediate Steering Shaft Bolt 36 Nm (27 lb ft)

Wheel Alignment - Fastener Specifications (Article 13674)

Application Specification
Metric English
Front Lower Control Arm to Frame Nut 50 Nm + 150 degrees 37 lb ft + 150 degrees
Inner Tie Rod End Nut 75 Nm 55 lb ft
Rear Adjuster Link to Frame Nuts 115 Nm 85 lb ft
Rear Lower Control Arm to Frame Nuts 115 Nm 85 lb ft
Shock to Steering Knuckle 80 Nm + 180 degrees 59 lb ft + 180 degrees

Steering Wheel and Column - Adhesives, Fluids, Lubricants, and Sealers (Article 13505)

Application Type of Material GM Part Number
United States Canada Brazil
Steering Gear Pinion Bolt Thread Locking Adhesive 12345382 10953489 Refer to Electronic Parts Catalog.
Steering Wheel Bolt Thread Locking Adhesive 12345382 10953489
Upper Intermediate Steering Shaft Bolt Thread Locking Adhesive 12345382 10953489

All New Technical Service Bulletins (itype_432)

Tsbs
- Adding Radio Steering Wheel Control Switch (RPO NZL) (PIC5320C, 2025/01/31)

All Technical Service Bulletins (itype_100)

Tsbs
- Adding Radio Steering Wheel Control Switch (RPO NZL) (PIC5320C, 2025/01/31)
- Steering - Power Steering Fluid Leaks (07-02-32-002N, 2013/09/18)
- #17-NA-047 - EBCM Wheel Speed Sensor Diagnostic Aid for ABS Message - Click or Ratchet Noise - Service Traction Message - Service Stabilitrak Message - Service Steering Message - (Feb 20, 2017) (17-NA-047, 2017/02/20)
- Power Steering Fluid Leak at Fluid Reservoir or Reservoir Connection (PI0671A, 2017/03/17)
- Power Steering Noise or Fluid Leak from Power Steering Pump, Gear or High Pressure Hose During Extreme Low Temperature Operation (Replace Power Steering Fluid) (12-02-32-002B, 2020/06/05)

Customer Interest Bulletins (itype_109)

Tsbs
- Steering - Power Steering Fluid Leaks (07-02-32-002N, 2013/09/18)

Power Steering Control Module Scan Tool Information (Article 10790)

The power steering control module scan tool data parameters list contains all power steering related parameters that are available on the scan tool. The list is arranged in alphabetical order. A given parameter may appear in any one of the data lists.
Parameter System State Expected Value Description
Operating Conditions: Ignition ON
Battery Voltage — 9–16 V The scan tool displays the current battery voltage.
Output Control Description
Pressure Control Solenoid Valve Commands the solenoid valve Increase or Decrease.

Suspension General Diagnosis (Article 13601)

Non Standards
- Memory Steer (13602)

Symptoms - Power Steering System (Article 13447)

Visual/Physical Inspection
- Inspect for aftermarket devices which could affect the operation of the power steering system.
- Inspect the easily accessible or visible system components for obvious damage or conditions which could cause the symptom.
- If equipped with hydraulic power steering , inspect for leaking power steering components. If necessary, refer to Power Steering Fluid Leaks .
- If equipped with hydraulic power steering, verify the power steering fluid level is correct. Refer to Checking and Adding Power Steering Fluid .
- If equipped with hydraulic power steering, inspect the power steering fluid for the following indications of contamination:
- Milky fluid – water
- Brown fluid – burnt
- Debris in fluid – plastic or dirt
- If the hydraulic power steering system is contaminated, flush the power steering system. Refer to Power Steering System Flushing .

Symptoms List
Refer to a symptom diagnostic procedure from the following list in order to diagnose the symptom:
- Power Steering Fluid Leaks
- Rattle, Clunk, Pop or Shudder Noise from the Power Steering System
- Whine or Growl Noise from the Power Steering System
- Poor Return of Steering Wheel
- Steering Wheel Surges/Jerks While Turning
- Steering Wheel Kickback
- Steering Effort Hard or Too Easy in One or Both Directions

Power Steering System Test (Article 13436)

Figure 1: Rack and Pinion System

Test Description

The numbers below refer to the step numbers on the diagnostic table.

- This step tests the system for restrictions.
- This step tests the following components for the following conditions:
- The pump for internal leaks
- The power steering pipes for kinks
- This step tests the ability of the pump to regulate flow at maximum pressure.
- This step tests the ability of the pump to regulate flow under normal operating conditions.
- This step tests the internal components of the pump and the gear.

Step Action Value(s) Yes No

DEFINITION: The Power Steering System Test Procedure will perform the following functions: Test the operation of the hydraulic power steering system. Test the operation of the power steering pump and power steering gear . Identify restrictions in the system.

- Test the operation of the hydraulic power steering system.
- Test the operation of the power steering pump and power steering gear .
- Identify restrictions in the system.

1 Inspect the power steering fluid for the following indications of contamination: Milky fluid - water Brown fluid - burnt Debris in fluid - plastic or dirt Is the fluid free of contamination? — Go to Step 3 Go to Step 2

- Milky fluid - water
- Brown fluid - burnt
- Debris in fluid - plastic or dirt

2 Flush the power steering system. Refer to Power Steering System Flushing . Did you complete the procedure? — Go to Step 3 —

3 Note: In order to accurately diagnose the system, the malfunction must be present during the test procedure. Attempt to duplicate the condition. Is the condition present? — Go to Step 4 System OK

4 Turn the ignition switch to the OFF position. Place a drain pan under the vehicle in order to catch any power steering fluid. Disconnect the power steering pressure pipe/hose from the power steering pump or the power steering gear as necessary. Install the J-44721 - Power Steering System Analyzer . Fill the power steering system. Refer to Checking and Adding Power Steering Fluid . Did you complete the installation? — Go to Step 5 —

- Turn the ignition switch to the OFF position.
- Place a drain pan under the vehicle in order to catch any power steering fluid.
- Disconnect the power steering pressure pipe/hose from the power steering pump or the power steering gear as necessary.
- Install the J-44721 - Power Steering System Analyzer .
- Fill the power steering system. Refer to Checking and Adding Power Steering Fluid .

5 Fully open the J-44721 - Power Steering System Analyzer valve. Start the engine. Caution: Do not hold the steering wheel in the full turn position longer than 5 seconds, as damage to the steering pump may result. Turn the steering wheel and BRIEFLY hold the steering wheel against the steering stop in order to release any trapped air from the system. Inspect and ensure that all of the power steering pipe/hose connections are not leaking. Making sure the steering wheel is OFF the steering stop, observe the pressure reading. Is the pressure reading greater than the specified value? 1379 kPa (200 psi) Go to Step 6 Go to Step 7

- Fully open the J-44721 - Power Steering System Analyzer valve.
- Start the engine.
- Turn the steering wheel and BRIEFLY hold the steering wheel against the steering stop in order to release any trapped air from the system.
- Inspect and ensure that all of the power steering pipe/hose connections are not leaking.
- Making sure the steering wheel is OFF the steering stop, observe the pressure reading.

6 Note: A restriction may be present in the power steering system. Turn OFF the engine IMMEDIATELY. Locate and repair the restriction. Did you complete the repair? — Go to Step 15 —

7 Allow the engine to run until the engine reaches full operating temperature. Record the pressure reading and flow reading. Partially close the J-44721 - Power Steering System Analyzer valve until the system pressure reaches the specified value, then record the FLOW reading. Subtract second flow reading from the first flow reading. Is the flow DECREASE greater than 3.8 L (1 gal) per minute? 4827 kPa (700 psi) Go to Step 11 Go to Step 8

- Allow the engine to run until the engine reaches full operating temperature.

- Record the pressure reading and flow reading.
- Partially close the J-44721 - Power Steering System Analyzer valve until the system pressure reaches the specified value, then record the FLOW reading.
- Subtract second flow reading from the first flow reading.
8 Note: Do not leave the valve closed for more than 5 seconds, or internal pump damage could accrue. Fully close then open the J-44721 - Power Steering System Analyzer valve 3 times. Record all of the high pressure readings. Refer to Power Steering Pump Specifications for power steering system pressure relief specifications. Are the 3 high pressure readings within specifications? — Go to Step 9 Go to Step 13
9 Are the three high pressure readings within 245 kPa (50 psi) of each other? — Go to Step 10 Go to Step 13
10 Increase the engine speed to approximately 1,500 RPM. Record the flow reading. Refer to Power Steering Pump Specifications for power steering system pressure specifications. Is the actual flow reading within specifications? — Go to Step 11 Go to Step 13
- Increase the engine speed to approximately 1,500 RPM.
- Record the flow reading. Refer to Power Steering Pump Specifications for power steering system pressure specifications.
11 Is the difference between the actual flow reading and the maximum flow specification more than 3.8 L (1 gal) per minute? — Go to Step 13 Go to Step 12
12 Turn the steering wheel from steering stop to steering stop and record the FLOW readings at each stop. Is the flow LOWER than 3.8 L (1 gal) per minute? — Go to Step 15 Go to Step 14
13 Replace the power steering pump. Refer to Power Steering Pump Replacement . Did you complete the replacement? — Go to Step 15 —
14 The power steering gear is leaking across the piston or bypassing the valve circuit. Replace the power steering gear. Refer to Steering Gear Replacement . Did you complete the replacement? — Go to Step 15 —
15 Test the power steering system for the original condition. Does the original condition still exist? — Go to Step 5 Go to Step 16
16 Disconnect and remove the J-44721 - Power Steering System Analyzer from the vehicle. Connect the vehicle power steering pipes/hoses. Fill and bleed the power steering system. Refer to Power Steering System Bleeding . Did you complete the procedure? — System OK —
- Disconnect and remove the J-44721 - Power Steering System Analyzer from the vehicle.
- Connect the vehicle power steering pipes/hoses.
- Fill and bleed the power steering system. Refer to Power Steering System Bleeding .

Power Steering Fluid Leaks (Article 13435)

Special Tools
GE-28431-6 - Fluorescent Dye
For equivalent regional tools, refer to Special Tools .
- If fluid is found on a manual steering gear or on an electronic power steering gear, do not replace steering gear. Vehicles equipped with these systems do not use hydraulic power steering fluid . The fluid may be assembly fluid or another system fluid.
- Clean the components and identify the sources of the leaks before attempting to repair or replace any power steering components. Clearly mark all locations of leaks with paint, marker, or equivalent for warranty identification and engineering root cause analysis.
Some customers may comment on a fluid LEAK or NOISY power steering pump . Upon inspection, the technician may find power steering fluid leaking from the hydraulic power steering system. Use the following inspection procedure in order to diagnose the source of the leak and take appropriate action to correct the condition.
- Inspect the fluid level in the power steering fluid reservoir . Refer to Checking and Adding Power Steering Fluid . If the fluid level is NOT low, a careful analysis of the condition is necessary to confirm that the type of fluid is actually power steering fluid.
- Visually inspect the power steering system and components where the fluid has accumulated.
- Use a clean towel or a rag in order to completely clean off all residual fluid from the power steering components.
- Add 30 cc (1 oz) of GE-28431-6 - dye to the power steering fluid.
- Start the vehicle and warm the steering system by turning to the left steering stop and to the right steering stop 10 times with the weight of the vehicle on the front tires .
- Turn vehicle engine OFF.
- Shine a black light on the area where the residual fluid accumulated. Identify the sources of the leaks.
- Mark all locations of leaks with paint, marker, or equivalent.
- Repair or replace all affected components.

Rattle, Clunk, Pop or Shudder Noise from the Power Steering System (LFX, N41) (Article 13439)

Step Action Yes No
1 Did you review the Power Steering System Description and Operation and perform the necessary inspections? Go to Step 2 Go to Symptoms - Power Steering System
2 Verify that a rattle, clunk or shudder noise is present. Is a rattle, clunk or shudder noise present? Go to Step 3 System OK
3 Inspect the power steering hoses for proper routing and clearance. Is the routing or clearance of a power steering hose incorrect? Go to Step 11 Go to Step 4
4 Inspect the engine drive belt for cracking or excessive wear. Refer to Drive Belt Falls Off and Excessive Wear Diagnosis . Is the drive belt cracked or excessively worn? Go to Step 12 Go to Step 5
5 Inspect the power steering pump pulley for damage. Is the power steering pump pulley damaged? Go to Step 13 Go to Step 6
6 Inspect the power steering pump for the proper installation. Refer to Power Steering Pump Replacement . Is the power steering pump installation incorrect? Go to Step 14 Go to Step 7
7 Inspect the steering gear for the proper installation. Refer to Steering Gear Replacement . Is the steering gear installation incorrect? Go to Step 15 Go to Step 8
8 Inspect in the inner tie rod s and the outer tie rods for looseness. Refer to Steering Linkage Inner Tie Rod Inspection and to Steering Linkage Outer Tie Rod Inspection . Are the inner tie rods or the outer tie rods loose? Go to Step 16 Go to Step 9
9 Inspect the front suspension . Refer to Noise Diagnosis - Front Suspension . Is the front suspension worn? Go to Step 17 Go to Step 10
10 Inspect the intermediate steering shaft . Is the intermediate steering shaft worn? Go to Step 18 Go to Step 3
11 Adjust or replace the hose that is causing the noise. Refer to the appropriate procedure: Fluid Cooler Outlet Hose Replacement Power Steering Fluid Reservoir Outlet Hose Replacement Power Steering Gear Inlet Pipe/Hose Replacement Power Steering Gear Outlet Pipe/Hose Replacement Did you complete the repair? Go to Step 19 —
- Fluid Cooler Outlet Hose Replacement
- Power Steering Fluid Reservoir Outlet Hose Replacement
- Power Steering Gear Inlet Pipe/Hose Replacement
- Power Steering Gear Outlet Pipe/Hose Replacement

12 Replace the drive belt. Refer to Drive Belt Replacement . Did you complete the repair? Go to Step 19 —
13 Replace the power steering pump pulley. Refer to Power Steering Pump Pulley Replacement . Did you complete the repair? Go to Step 19 —
14 Install the power steering pump correctly. Refer to Power Steering Pump Replacement . Did you complete the repair? Go to Step 19 —
15 Install the power steering gear correctly. Refer to Steering Gear Replacement . Did you complete the repair? Go to Step 19 —
16 Replace either the worn inner tie rod or the worn outer tie rod. Refer to Steering Linkage Inner Tie Rod Replacement or to Steering Linkage Outer Tie Rod Replacement . Did you complete the repair? Go to Step 19 —
17 Replace the worn front suspension component. Did you complete the repair? Go to Step 19 —
18 Replace the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement . Did you complete the repair? Go to Step 19 —
19 Operate the system in order to verify the repair. Did you correct the condition? System OK Go to Step 3

Rattle, Clunk, Pop or Shudder Noise from the Power Steering System (NV9) (Article 13441)

Step Action Yes No
1 Did you review the Power Steering System Description and Operation and perform the necessary inspections? Go to Step 2 Go to Symptoms - Steering Wheel and Column
2 Verify a rattle noise is present by driving the vehicle on a rough road. Verify a clunk noise is present by turning the steering wheel to the left and to the right several times with the key in the ON position. Is a rattle or a clunk noise present? Go to Step 3 System OK
3 Inspect the steering gear for the proper installation. Is the steering gear installation incorrect? Go to Step 6 Go to Step 4
4 Inspect the intermediate steering shaft . Is the intermediate steering shaft worn? Go to Step 8 Go to Step 5
5 Inspect the front suspension . Refer to Noise Diagnosis - Front Suspension . Is the front suspension worn? Go to Step 7 Go to Step 3
6 Install the steering gear correctly. Refer to Steering Gear Replacement . Did you complete the repair? Go to Step 9 —

7 Replace the worn front suspension component that is causing the noise. Did you complete the repair? Go to Step 9 —
8 Replace the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement . Did you complete the repair? Go to Step 9 —
9 Operate the system in order to verify the repair. Did you correct the condition? System OK Go to Step 3

Whine or Growl Noise from the Power Steering System (N41) (Article 13448)

Step Action Yes No
Special Tools CH-39570 - Chassis Ear For equivalent regional tools, refer to Special Tools .
Special Tools
CH-39570 - Chassis Ear
1 Did you review the Power Steering System Description and Operation, check fluid level and perform the necessary inspections? Go to Step 2 Go to Symptoms - Power Steering System
2 Verify that a whine or growl noise is present with the engine running. Is a whine or growl noise present? Go to Step 3 System OK
3 Verify that a whine or growl noise is present with the engine off while turning the steering wheel . Is a whine or growl noise present? Go to Step 7 Go to Step 4
4 Inspect the power steering fluid for the following indications of contamination: Milky fluid – water Brown Fluid – burnt Debris in fluid – plastic or dirt Is the fluid free of contamination? Go to Step 14 Go to Step 5
- Milky fluid – water
- Brown Fluid – burnt
- Debris in fluid – plastic or dirt
5 Flush the power steering system. Refer to Power Steering System Flushing . Did you complete the procedure? Go to Step 6 —
6 Operate the system in order to verify the repair. Did you correct the condition? System OK Go to Step 14
7 Inspect the power steering gear fasteners for looseness. Is the steering gear loose? Go to Step 20 Go to Step 8
8 Inspect the steering gear for loose or worn bushings. Are the steering gear bushings loose or worn? Go to Step 21 Go to Step 9
9 Verify that steering column dash outer seal is in position. Is the steering column dash outer seal damaged or out of position? Go to Step 22 Go to Step 10
10 Verify that steering column dash inner seal is in position. Is the steering column dash inner seal damaged or out of position? Go to Step 23 Go to Step 11
11 Disconnect the outer tie rod s and individually turn the steering knuckle assembly right to left. Refer to Steering Linkage Outer Tie Rod Replacement . Is a whine or growl noise present? Go to Step 12 Go to Step 13
12 Disconnect the lower ball joint s from the steering knuckle and rotate the steering knuckle and strut . Refer to Front Lower Control Front Arm Replacement and Front Lower Control Rear Arm Replacement . Is the whine or growl present? Go to Step 24 Go to Step 25
13 Note: Position the wheels straight ahead. Do NOT rotate the steering wheel more than one complete revolution from center for this procedure. Disconnect the intermediate shaft from the steering column. Refer to Intermediate Steering Shaft Replacement . Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions. Rotate the steering wheel back to the original position. Is the whine or growl present? Go to Symptoms - Steering Wheel and Column —
- Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions.
- Rotate the steering wheel back to the original position.
14 Using the CH-39570 - ear , inspect the power steering hoses for a whine or growl noise. Is the noise present at the power steering hose s? Go to Step 17 Go to Step 15
15 Using the CH-39570 - ear , inspect the power steering gear for a whine or growl noise. Is the noise present at the power steering gear? Go to Step 18 Go to Step 16
16 Using the CH-39570 - ear , inspect the power steering pump for a whine or growl noise. Is the noise present at the power steering pump ? Go to Step 19 Go to Step 1
17 Check the hoses for damage or ground outs. Adjust the routing of the power steering hoses or replace if damaged. Did you complete the repair? Go to Step 26 —
18 Replace the power steering gear. Refer to Steering Gear Replacement . Did you complete the repair? Go to Step 26 —
19 Replace the power steering pump. Refer to Power Steering Pump Replacement . Did you complete the repair? Go to Step 26 —
20 Replace the power steering gear fasteners. Refer to Steering Gear Replacement . Did you complete the repair? Go to Step 26 —
21 Replace the power steering gear bushings. Did you complete the repair? Go to Step 26 —

22 Reposition or replace the steering column dash outer seal. Did you complete the repair? Go to Step 26 —
23 Reposition or replace the steering column dash inner seal. Did you complete the repair? Go to Step 26 —
24 Replace the strut top mount. Refer to Strut, Strut Component, or Spring Replacement . Did you complete the repair? Go to Step 26 —
25 Replace the front lower control front arm or the front lower control rear arm. Refer to Front Lower Control Rear Arm Replacement and Front Lower Control Front Arm Replacement . Did you complete the repair? Go to Step 26 —
26 Operate the system in order to verify the repair. Did you correct the condition? System OK Go to Step 1

Whine or Growl Noise from the Power Steering System (NV9) (Article 13449)

Step Action Yes No
Special Tools CH-39570 - Chassis Ear For equivalent regional tools, refer to Special Tools .
Special Tools
CH-39570 - Chassis Ear
1 Did you review the Power Steering System Description and Operation and perform the necessary inspections? Go to Step 2 Go to Symptoms - Power Steering System
2 Verify that a whine or growl noise is present. Is the steering gear quiet? System OK Go to Step 3
3 Perform the Diagnostic System Check — Vehicle. Refer to Diagnostic System Check - Vehicle Are any codes present? Go to Diagnostic Trouble Code (DTC) List - Vehicle Go to Step 4
4 Inspect the power steering gear fasteners for looseness. Is the steering gear loose? Go to Step 13 Go to Step 5
5 Inspect the power steering gear for loose or worn bushings. Are the steering gear bushings loose or worn? Go to Step 14 Go to Step 6
6 Verify that steering column dash outer seal is in position. Is the steering column dash outer seal damaged or out of position? Go to Step 15 Go to Step 7
7 Verify that steering column dash inner seal is in position. Is the steering column dash inner seal damaged or out of position? Go to Step 16 Go to Step 8
8 Inspect the power steering motor for a whine or growl noise using the CH-39570 - ear . Is the noise present at the power steering motor? Go to Step 19 Go to Step 9
9 Inspect the power steering gear for a whine or growl noise using the CH-39570 - ear . Is the noise present at the power steering gear? Go to Step 20 Go to Step 10
10 Disconnect the outer tie rod s, refer to Steering Linkage Outer Tie Rod Replacement , and individually turn the steering knuckle assembly right to left. Is a whine or growl noise present? Go to Step 11 Go to Step 12
11 Disconnect the lower ball joint s from the steering knuckle , refer to Front Lower Control Rear Arm Replacement and Front Lower Control Front Arm Replacement , and rotate the steering knuckle and strut . Is a whine or growl noise present? Go to Step 17 Go to Step 18
12 Note: Position the wheels straight ahead. Do NOT rotate the steering wheel more than one complete revolution from center for this procedure. Disconnect the intermediate shaft from the steering column, refer to Intermediate Steering Shaft Replacement . Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions. Rotate the steering wheel back to the original position. Is a whine or growl noise present? Go to Symptoms - Steering Wheel and Column Go to Step 20
- Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions.
- Rotate the steering wheel back to the original position.
13 Replace the power steering gear fasteners. Refer to Steering Gear Replacement . Did you complete the repair? Go to Step 21 —
14 Replace the power steering gear bushings. Did you complete the repair? Go to Step 21 —
15 Reposition or replace the steering column dash outer seal. Did you complete the repair? Go to Step 21 —
16 Reposition or replace the steering column dash inner seal. Did you complete the repair? Go to Step 21 —
17 Replace the strut top mount. Refer to Strut, Strut Component, or Spring Replacement . Did you complete the repair? Go to Step 21 —
18 Replace the front lower control front arm or the front lower control rear arm. Refer to Front Lower Control Rear Arm Replacement and Front Lower Control Front Arm Replacement . Did you complete the repair? Go to Step 21 —
19 Replace the power steering gear. Refer to Steering Gear Replacement . Did you complete the repair? Go to Step 21 —
20 Replace the power steering gear. Refer to Steering Gear Replacement . Did you complete the repair? Go to Step 21 —
21 Operate the system in order to verify the repair. Did you correct the condition? System OK Go to Step 2

Poor Return of Steering Wheel (Article 13434)

Step Action Yes No
DEFINITION: After completing a turn, extra steering input is required for the steering wheel to return to center.
1 Did you review the Power Steering System Description and Operation and perform the necessary inspections? Go to Step 2 Go to Symptoms - Power Steering System
2 Verify that poor return of the steering wheel is present. Does the system operate normally? System OK Go to Step 3
3 Raise and support the vehicle. Lifting and Jacking the Vehicle Lubricate the tie rod end s and ball joint s, if applicable. Inspect the suspension system for worn or damaged components. Repair as necessary. Did you find and correct the condition? Go to Step 12 Go to Step 4
- Raise and support the vehicle. Lifting and Jacking the Vehicle
- Lubricate the tie rod end s and ball joint s, if applicable.
- Inspect the suspension system for worn or damaged components.
- Repair as necessary.
4 Rotate the steering wheel ONE revolution in both directions. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to rotate in either direction? Go to Step 5 Go to Step 10
- Rotate the steering wheel ONE revolution in both directions.
- Rotate the steering wheel back to the original position.
5 Note: Position the wheels straight ahead. Do NOT rotate the steering wheel more than one complete revolution from center. Disconnect the intermediate shaft from the steering column . Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions. Rotate the steering wheel back to the original position. Was the steering wheel abnormally difficult to rotate in either direction? Go to Step 11 Go to Step 6
- Disconnect the intermediate shaft from the steering column .
- Note the position of the steering wheel and rotate the steering wheel ONE revolution in both directions.
6 Inspect the intermediate shaft for stiff or loose joints. Repair or replace as necessary. Did you find and complete the repair? Go to Step 12 Go to Step 7
7 Remove the front tire and wheel assemblies. Tire and Wheel Removal and Installation Disconnect both outer tie rod ends from the steering knuckle s. Use your hands in order to move the tie rod end studs. If abnormally difficult to move, replace the tie rod end. If equipped with recirculating ball steering, ensure that idler and pitman arm joints are not to stiff. Repair as necessary. Did you find and complete the repair? Go to Step 12 Go to Step 8
- Remove the front tire and wheel assemblies. Tire and Wheel Removal and Installation
- Disconnect both outer tie rod ends from the steering knuckle s.
- Use your hands in order to move the tie rod end studs.
- If abnormally difficult to move, replace the tie rod end. If equipped with recirculating ball steering, ensure that idler and pitman arm joints are not to stiff. Repair as necessary.
8 Use your hands to rotate the steering knuckle inboard and outboard in order to inspect for a binding strut bearings, ball joints, or axle. Repair or replace any abnormally stiff or loose components. Did you find and complete the repair? Go to Step 12 Go to Step 9
- Use your hands to rotate the steering knuckle inboard and outboard in order to inspect for a binding strut bearings, ball joints, or axle.
- Repair or replace any abnormally stiff or loose components.
9 Inspect for binding in the steering gear . If a binding is present, repair or replace the steering gear. Did you find and complete the repair? Go to Step 12 Go to Step 10
10 Inspect the wheel alignment and adjust as necessary. Wheel Alignment Measurement Did you find and complete the repair? Go to Step 12 —
11 Inspect the steering column for a binding. If a binding is present, repair or replace the steering column as necessary. Did you find and complete the repair? Go to Step 12 —
12 Operate the system in order to verify the repair. Did you correct the condition? System OK —

Steering Wheel Surges/Jerks While Turning (NV9) (Article 13446)

Step Action Yes No
1 Did you review the Power Steering System Description and Operation and perform the necessary inspections? Go to Step 2 Go to Symptoms - Power Steering System
2 Verify that the steering wheel surges or jerks while turning. Does the steering wheel surge or jerk while turning? Go to Step 3 System OK

3 Inspect the front suspension for worn or binding components. Did you find and correct the condition? Go to Step 15 Go to Step 4
4 Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle . Inspect the steering linkage outer tie rod for wear or a binding condition. Is the steering linkage outer tie rod worn or binding? Go to Step 10 Go to Step 5
- Raise and support the vehicle. Refer to Lifting and Jacking the Vehicle .
- Inspect the steering linkage outer tie rod for wear or a binding condition.
5 Inspect the intermediate steering shaft for wear or a binding condition. Is the intermediate steering shaft worn or binding? Go to Step 11 Go to Step 6
6 Inspect the steering gear for wear or a binding condition. Is the steering gear worn or binding? Go to Step 12 Go to Step 7
7 Inspect the steering column for wear or a binding condition. Is the steering column worn or binding? Go to Step 13 Go to Step 8
8 Inspect the power steering assist motor for an indication of excessive heat. Does the power steering assist motor appear to be overheated? Go to Step 9 Go to Step 14
9 Note: Do not perform excessive parking lot maneuvers during testing. Excessive parking lot maneuvers can cause the power steering motor to heat up. Allow the power steering motor to cool and retest the system. Did you correct the condition? Go to Step 15 Go to Step 14
10 Replace the steering linkage outer tie rod. Refer to Steering Linkage Outer Tie Rod Replacement . Did you complete the repair? Go to Step 15 —
11 Replace the intermediate steering shaft. Refer to Intermediate Steering Shaft Replacement . Did you complete the repair? Go to Step 15 —
12 Replace the steering gear. Refer to Steering Gear Replacement . Did you complete the repair? Go to Step 15 —
13 Replace the steering column. Refer to Steering Column Replacement . Did you complete the repair? Go to Step 15 —
14 Replace the steering gear. Refer to Steering Gear Replacement . Did you complete the repair? Go to Step 15 —
15 Operate the system in order to verify the repair. Did you correct the condition? System OK Go to Step 3

Steering Wheel Kickback (NV9) (Article 13445)

Condition Action
The steering column mounting bolts are loose. Tighten the pivot bolt and the mounting bolts to specification.
The steering gear is loosely mounted. Tighten the steering gear mounting bolts to specification.
The tie rod end s are loose or damaged. If necessary, inspect for damage and replace the tie rod ends. Refer to Steering Linkage Outer Tie Rod Replacement .

Steering Effort Hard or Too Easy in One or Both Directions (N41) (Article 13443)

Step Action Yes No
1 Did you review the Power Steering System General Description and perform the necessary inspections? Go to Step 2 Go to Symptoms - Power Steering System
2 Verify that the steering effort is hard or too easy in one or both directions. Does the system operate normally? System OK Go to Step 3
3 Perform the power steering test procedure. Refer to Power Steering System Test . Did you complete the procedure? Go to Step 4 —
4 Operate the system in order to verify the repair. Did you correct the condition? System OK Go to Step 3

Steering Effort Hard or Too Easy in One or Both Directions (NV9) (Article 13444)

Condition Action
The battery power is low. Ensure proper battery voltage.
The intermediate shaft dash seal is binding. Adjust the dash seal or replace the intermediate shaft if necessary. Refer to Intermediate Steering Shaft Replacement .
The intermediate shaft joints are loose or worn. Inspect the joints and the pinch bolts for damage, and replace the intermediate shaft if necessary. Refer to Intermediate Steering Shaft Replacement .
The steering gear is binding. If necessary, inspect and replace the steering gear. Refer to Steering Gear Replacement .
The upper steering shaft is bent. If necessary, replace the steering column . Refer to Steering Column Replacement .
The connectors to the assist motor are damaged or disconnected. Verify the connectors are properly connected.

Verify the connectors are not damaged. If the connectors are damaged, replace the connectors.
The sensor wire is damaged. Replace the steering gear. Refer to Steering Gear Replacement .
The controller is malfunctioning. Confirm the DTC. If necessary, replace the steering gear. Refer to Steering Gear Replacement .
The motor shaft is binding. Confirm the DTC. If necessary, replace the steering gear. Refer to Steering Gear Replacement .

Power Steering - Special Tools (Article 13477)

Illustration Tool Number/ Description
Click for full-size image GE-28431-6 J-28431-6 Fluorescent Dye
Click for full-size image GE-8001 J-8001 Dial Indicator Set
Click for full-size image CH-22610 J-22610 Keystone Clamp Pliers
Click for full-size image G-23738-A J-23738-A J-35555 Vacuum Pump
Click for full-size image CH-25033–C J-25033-C Pulley Installer
Click for full-size image CH-25034–C J-25034-C Pulley Remover
Click for full-size image CH-6321 J-34028 Inner Tie Rod Wrench
Click for full-size image CH-39750 J-39570 Chassis Ear
Click for full-size image J-42188-B Ball Joint Separator
Click for full-size image CH-4385 J-43485 Power Steering Bleeder Adapter
Click for full-size image CH-354–B CH-44721 J-44721 Power Steering Analyzer

Leaks (itype_149)

Tsbs
- Steering - Power Steering Fluid Leaks (07-02-32-002N, 2013/09/18)
- Power Steering Fluid Leak at Fluid Reservoir or Reservoir Connection (PI0671A, 2017/03/17)
- Power Steering Noise or Fluid Leak from Power Steering Pump, Gear or High Pressure Hose During Extreme Low Temperature Operation (Replace Power Steering Fluid) (12-02-32-002B, 2020/06/05)

Noise (itype_156)

Tsbs
- Power Steering Noise or Fluid Leak from Power Steering Pump, Gear or High Pressure Hose During Extreme Low Temperature Operation (Replace Power Steering Fluid) (12-02-32-002B, 2020/06/05)