# Section 2
# Steering

# Power Steering System

## Specifications

### Fastener Tightening Specifications

| Application | Specification | |
|---|---|---|
| | Metric | English |
| Adjuster Plug (Model 708) | 27 N·m | 20 lb ft |
| Coupling Flange Nuts | 27 N·m | 20 lb ft |
| Coupling Flange Pinch Bolt | 102 N·m | 75 lb ft |
| Intermediate Shaft Pinch Bolt Nuts (Commercial with Model 708) | 102.5 N·m | 76 lb ft |
| Intermediate Shaft Pinch Bolt Nuts (Model 710) | 48 N·m | 35 lb ft |
| Intermediate Shaft Pinch Bolt Nuts(Motorhome with Model 708) | 45 N·m | 33 lb ft |
| Over-Center Adjustment Lock Nut (Model 710) | 89 N·m | 66 lb ft |
| Pitman Arm to Steering Gear (Model 710) | 370 N·m | 275 lb ft |
| Pitman Shaft Adjuster Screw Nut (Model 708) | 47 N·m | 35 lb ft |
| Power Steering Hose Assembly Fittings | 33 N·m | 24 lb ft |
| Power Steering Gear Inlet and Outlet Hose Fittings (Motorhome with 6.5L and 7.4L Engines with Independent Front Suspension) | 30.5 N·m | 23 lb ft |
| Power Steering Hose Clamps | 1.7 N·m | 14 lb in |
| Power Steering Pump Front Bracket-to-Front Pump Bolts (4.3L, 5.7L, 7.4L) and Front Pump Bolts (6.5L) | 50 N·m | 37 lb ft |
| Power Steering Pump-to-Engine Block Bolt (7.4L) | 40 N·m | 30 lb ft |
| Power Steering Pump-to-Engine Stud (4,3L, 5,7L, 7.4L) | 20 N·m | 15 lb ft |
| Power Steering Pump-to-Engine Stud Nut(s) and Front Bracket Mounting Bolts (4.3L, 5.7L) | 41 N·m | 30 lb ft |
| Power Steering Pump-to-Engine Head Stud Nut and Front Bracket Mounting Bolts (7.4L) | 66 N·m | 49 lb ft |
| Power Steering Pump Rear Bracket (Brace)-to-Engine Bolt (6.5L) | 50 N·m | 37 lb ft |
| Power Steering Pump Rear Bracket (Brace)-to-Pump Stud Nut (4.3L, 5.7L, 6.5L, 7.4L) | 50 N·m | 37 lb ft |
| Power Steering Pump Rear Bracket-to-Front Bracket Bolts (7.4L) | 25 N·m | 18 lb ft |
| Rack Adjuster Plug Nut (Model 708) | 109 N·m | 80 lb ft |
| Side Cover to Housing Bolts (Model 708) | 60 N·m | 44 lb ft |
| Side Cover to Housing Bolts (Model 710) | 47 N·m | 35 lb ft |
| Steering Gear to Frame (Commercial with Model 708) | 87.5 N·m | 65 lb ft |
| Steering Gear to Frame (Motorhome with Model 708 and JB8) | 80 N·m | 59 lb ft |
| Steering Gear to Frame (Model 710) | 240 N·m | 177 lb ft |

### Power Steering Pump Specifications (GPM/LPM)

| Part Number | Minimum Output | | Maximum Output | |
|---|---|---|---|---|
| | GPM | LPM | GPM | LPM |
| 26019685 | 1.32 | 5.00 | 3.1 - 3.5 | 11.7 - 13.2 |
| 26020775 | 1.32 | 5.00 | 2.4 - 2.8 | 9.1 - 10.6 |
| 26020779 | 1.32 | 5.00 | 3.1 - 3.5 | 11.7 - 13.2 |
| 26020780 | 1.32 | 5.00 | 3.1 - 3.5 | 11.7 - 13.2 |
| 26020781 | 1.32 | 5.00 | 2.4 - 2.8 | 9.1 - 10.6 |
| 26022229 | 1.32 | 5.00 | 3.1 - 3.5 | 11.7 - 13.2 |
| 26024242 | 1.85 | 7.00 | 3.9 - 4.3 | 14.0 - 15.5 |
| 26042589 | 1.85 | 7.00 | 3.9 - 4.3 | 14.0 - 15.5 |
| 26042592 | 1.32 | 5.00 | 3.1 - 3.5 | 11.7 - 13.2 |

## Power Steering Pump Specifications (GPM/LPM) (cont'd)

| Part Number | Minimum Output | | Maximum Output | |
|---|---|---|---|---|
| | GPM | LPM | GPM | LPM |
| 26042593 | 1.32 | 5.00 | 3.1 - 3.5 | 11.7 - 13.2 |
| 26043562 | 1.32 | 5.00 | 3.1 - 3.5 | 11.7 - 13.2 |

- Minimum Output: output of power steering fluid at 76.6°C (170°F) temperature when operating the pump at 465 RPM against 4585 - 5195 kPa (665 - 753 psi) pressure.
- Maximum Output: output of power steering fluid at 76.6°C (170°F) temperature when operating the pump at 1500 RPM against 345 kPa (50 psi) pressure.

## Power Steering Pump Specifications (PSI/Kilopascals)

| Part Number | Minimum Pressure | | Maximum Pressure | |
|---|---|---|---|---|
| | PSI | kPa | PSI | kPa |
| 26019685 | 1200 | 8274 | 1300 | 8964 |
| 26020775 | 1350 | 9308 | 1450 | 9998 |
| 26020779 | 1200 | 8274 | 1300 | 8964 |
| 26020780 | 1200 | 8274 | 1300 | 8964 |
| 26020781 | 1350 | 9308 | 1450 | 9998 |
| 26022229 | 1200 | 8274 | 1300 | 8964 |
| 26024242 | 1350 | 9308 | 1450 | 9998 |
| 26042589 | 1350 | 9308 | 1450 | 9998 |
| 26042592 | 1200 | 8274 | 1300 | 8964 |
| 26042593 | 1200 | 8274 | 1300 | 8964 |
| 26043562 | 1350 | 9308 | 1450 | 9998 |

The relief valve remains closed against the following minimum and maximum pressure settings at 1500 RPM.

## Adjustment Tightening Specifications

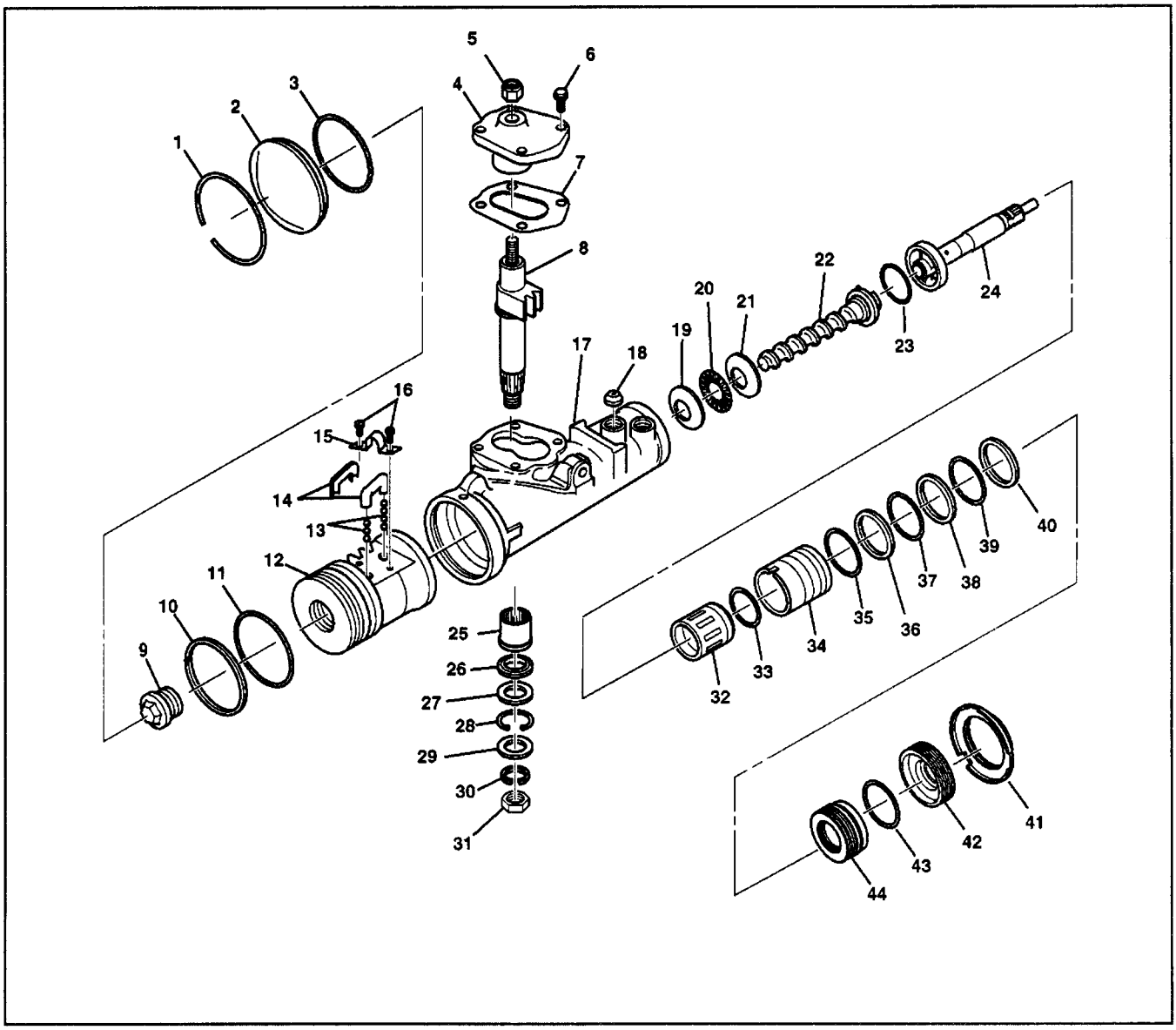
| Application | Specification | |
|---|---|---|
| | Metric | English |
| Saginaw Integral Steering Gear Model 708 | | |
| Final Over Center Reading (Total-Maximum)-New Gear | 2 N·m | 18 lb in |
| Pitman Shaft Over Center Preload-New Gear | 0.6–1.2 N·m | 6–10 lb in |
| Thrust Bearing Preload (In Excess of Valve Assembly and Seal Drag) | 0.3–0.4 N·m | 3–4 lb in |
| Valve Assembly and Seal Drag | 0.1–0.4 N·m | 1–4 lb in |
| Saginaw Integral Steering Gear Model 710-D | | |
| Final Over-Center Reading (Total-Maximum)-New Gear | 2.3 N·m | 20 lb in |
| Pitman Shaft Over-Center Preload*-New Gear | 0.7–1.1 N·m | 6–10 lb in |
| Worm Shaft Thrust Bearing Preload | 0.5–1.1 N·m | 4–10 lb in |

*Figure is in addition to worm shaft thrust bearing preload and valve and seal drag.

# Visual Identification

## Power Steering Gear - Disassembled View (708 Model)

**Power Steering Gear**

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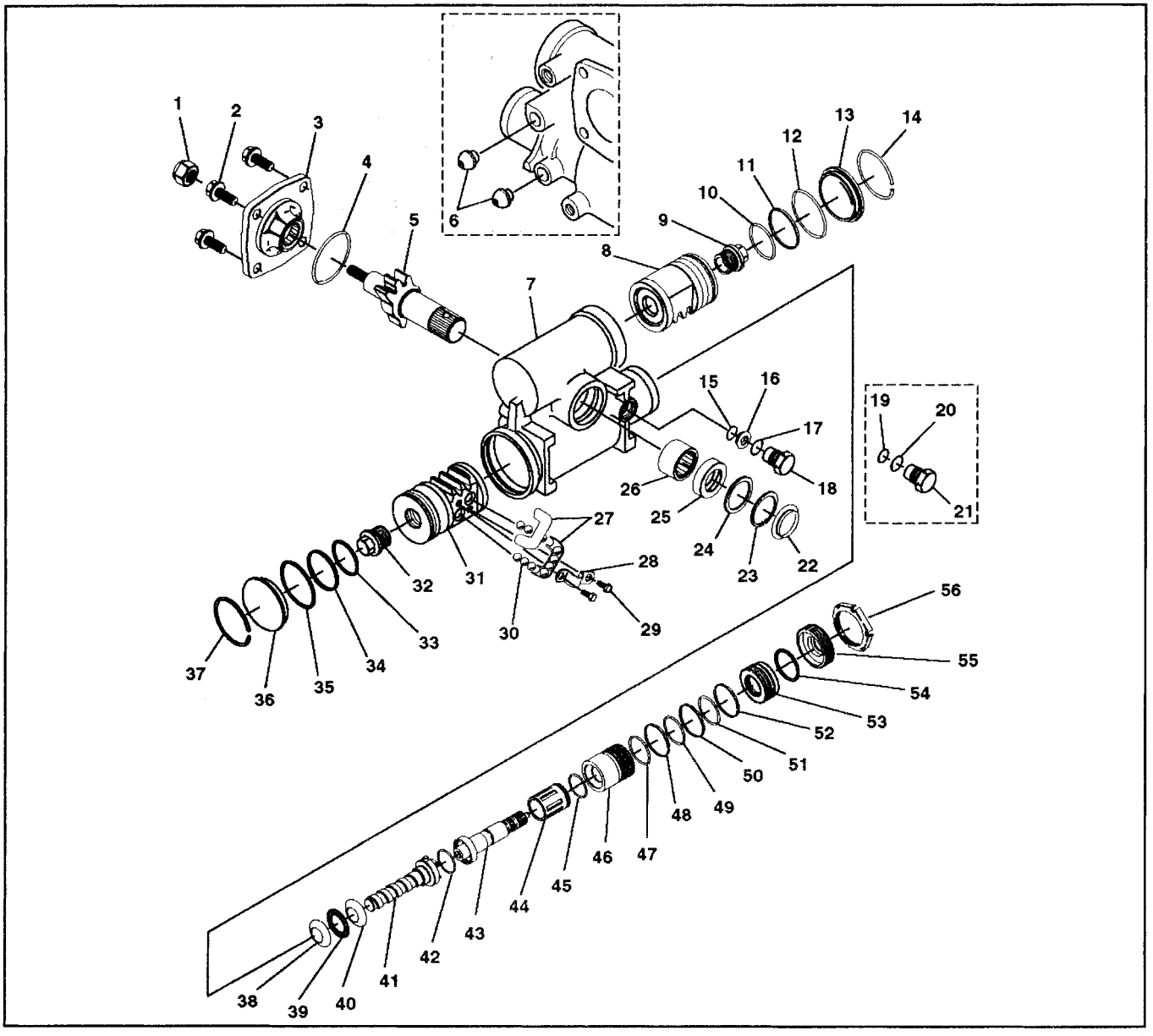
**Legend**

(1) Retaining Ring
(2) Plug
(3) O-ring Seal
(4) Side Cover
(5) Adjuster Lock Nut
(6) Bolt
(7) Gasket
(8) Pitman Shaft
(9) Plug
(10) Teflon Ring
(11) O-ring Seal
(12) Rack Piston
(13) Balls
(14) Ball Guide
(15) Clamp
(16) Screw
(17) Housing
(18) Check Valve
(19) Flat Race
(20) Thrust Bearing
(21) Flat Race
(22) Worm Shaft

(23) Seal
(24) Stub Shaft
(25) Needle Bearing
(26) Pitman Shaft Seal
(27) Backup Washer
(28) Retaining Ring
(29) Dust Seal
(30) Lock Washer
(31) Nut
(32) Valve Spool
(33) Seal
(34) Valve Body
(35) O-ring Valve Body Seal
(36) Ring
(37) O-ring Valve Body Seal
(38) Ring
(39) O-ring Valve Body Seal
(40) Ring
(41) Coupling Shield Retainer and Lock Nut
(42) Adjuster Nut Assembly
(43) O-ring Seal
(44) Thrust Support Assembly

## Power Steering Gear - Disassembled View (710 Model)

Power Steering Gear

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**Legend**

(1) Preload Adjuster Nut
(2) Side Cover Hex Head Bolt
(3) Side Cover
(4) Side Cover O-ring Seal
(5) Pitman Shaft
(6) Inverted Flare Connectors
(7) Steering Gear Housing
(8) Secondary Rack Piston
(9) Secondary Rack Piston Plug
(10) Rack Piston O-ring Seal
(11) Rack Piston Ring
(12) Housing O-ring Seal
(13) Housing End Plug
(14) Housing End Plug Retaining Ring
(15) Relief Valve O-ring Seal
(16) Bypass Plate
(17) Relief Valve O-ring Seal
(18) Relief Valve Assembly
(19) Relief Valve O-ring Seal
(20) Relief Valve O-ring Seal
(21) Relief Valve Assembly
(22) Pitman Shaft Dust Seal
(23) Pitman Shaft Seal Retaining Ring
(24) Pitman Shaft Seal Back-up Washer

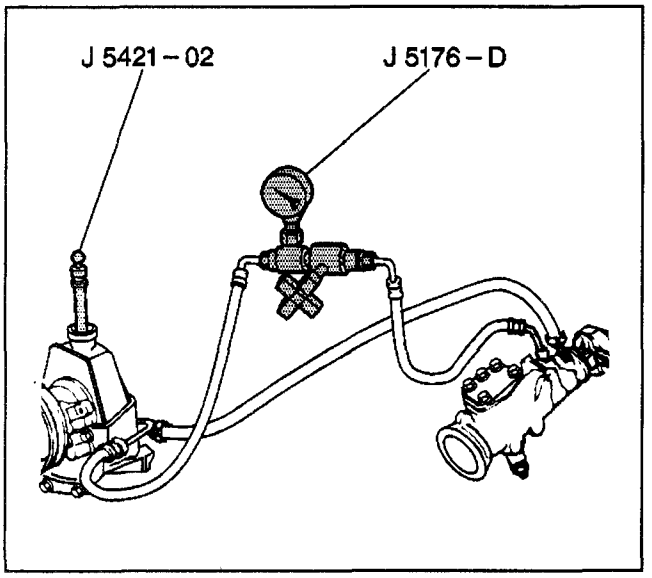
(25) Pitman Shaft Seal
(26) Pitman Shaft Needle Bearing Assembly
(27) Ball Return Guide
(28) Ball Return Guide Clamp
(29) Lockwasher Screw
(30) Balls
(31) Primary Rack Piston
(32) Primary Rack Piston Plug
(33) Rack Piston O-ring Seal
(34) Rack Piston Ring
(35) Housing O-ring Seal
(36) Housing End Plug
(37) Housing End Plug Retaining Ring
(38) Worm Thrust Bearing Race
(39) Worm Roller Thrust Bearing Assembly
(40) Worm Thrust Bearing Race
(41) Pin and Worm Assembly
(42) Stub Shaft O-ring Seal
(43) Stub Shaft
(44) Valve Spool
(45) Valve Spool O-ring Seal
(46) Valve Body
(47) Valve Body Ring
(48) Valve Body O-ring Seal
(49) Valve Body Ring
(50) Valve Body O-ring Seal
(51) Valve Body Ring
(52) Valve Body O-ring Seal
(53) Thrust Support Assembly
(54) O-ring Seal
(55) Adjuster Nut Assembly
(56) Coupling Shield Retainer and Lock Nut

# Diagnostic Information and Procedures

## Power Steering System Test Procedure

**Tools Required**

- *J 5176-E* Power Steering Pressure Tester
- *J 5176 - 20A* Power Steering Gauge Adapter (18 mm)
- *J 5421-O2* Thermometer
- *J 25323-D* Power Steering System Analyzer
- *J 29525* Power Steering Analyzer Adapter (18 mm)



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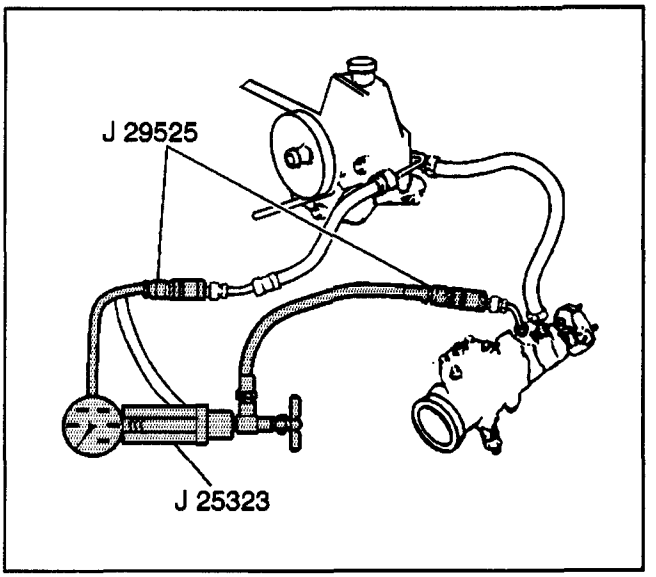
Test the power steering system with either the *J 5176-E* or the *J 25323-D*.



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The *J 25323-D* will measure the flow rate in addition to the pressure.

The power steering system test identifies and isolates hydraulic circuit difficulties. Prior to performing the power steering system test the following inspection and corrections, if needed, must be made:

- Inspect the reservoir for the proper fluid level.
- Inspect the pump belt for the proper tension.
- Inspect the tires for the correct air pressure.
- Inspect the power steering system.
- Replace the parts as needed.

### Test with J 5176–E

**Important:** All tests are made with the engine idling at the normal operating temperature. Check the idle speed adjustment. Adjust the idle speed to the correct specification if appropriate.

1. Place a container under the steering gear or the pump in order to catch the fluid when disconnecting or connecting the hoses.
2. Turn OFF the engine.
3. Disconnect the pressure hose at the steering gear or the steering pump.
4. Use the adapter fitting *J 5176 - 20A* in order to install the *J 5176-E* to both of the hoses.
5. Ensure that the gauge is between the shut off valve and the pump.
6. Open the shut off valve.
7. Remove the filler cap from the pump reservoir.

   Inspect the fluid level.

   Fill the pump reservoir with the power steering fluid to the full mark on the dipstick.

***Notice:*** Do not hold the steering wheel in the full turn position longer than five seconds. To do so may damage the power steering pump.

8. Start the engine.

   Momentarily hold the steering wheel against the stop.

   Inspect the connections at the *J 5176-E* for leakage.
9. Bleed the system. Refer to *Bleeding Power Steering System (Process).*

**Important:** In order to prevent scrubbing flat spots on the tires, do not turn the steering wheel more than 5 times without rolling the vehicle in order to change the tire-to-floor contact area.

10. Insert the *J 5421-O2* thermometer into the reservoir filler opening.
11. Move the steering wheel from stop to stop several times until the thermometer indicates a hydraulic fluid temperature in the reservoir of 65–77°C (150–170°F).
12. Inspect the pump fluid lever.
13. Add power steering fluid if required.

    When the engine is at the normal operating temperature, the initial pressure on the gauge, valve open, should be in the 550–860 kPA (80–125 psi) range. If the pressure is in excess of 1380 kPa (200 psi), inspect the hoses for restrictions. Inspect the poppet valve for proper assembly.

***Notice:*** Do not hold the steering wheel in the full turn position longer than five seconds. To do so may damage the power steering pump.

14. Fully open and close the gauge valve 3 times.

    Record the highest pressures that you attain each time.
15. The pump is functioning within the specifications if the following conditions occur:
    - The pressures are within the specifications at the end of this portion of the test.
    - The range of the readings is within 345 kPa (50 psi).
    - The pressures are high, but each reading repeats the same pressures within 345 kPa (50 psi).
16. If the pressures are high, but do not repeat within 345 kPa (50 psi), the flow control valve is sticking. If the flow control valve is sticking perform the following procedure:
    16.1. Remove the flow control valve.
    16.2. Clean the flow control valve.
    16.3. Use a crocus cloth or a fine hone in order to remove any burrs.
    16.4. Flush the system if the system contains some dirt. If the system is exceptionally dirty perform the following tasks to both the pump and the gear:
    - Disassemble
    - Clean
    - Flush
    - Reassemble

    16.5. Completely flush the fluid reservoir before any further use.
17. If the pump checks within the specifications, leave the valve open. Turn the steering wheel to both stops.

    Record the highest pressures. Compare the pressures with the maximum pump pressure that is recorded. If this pressure cannot build in either (or 1) side of the gear, the gear is leaking internally. Disassemble and repair the gear.
18. Turn OFF the engine.
19. Remove the testing gauge.
20. Reconnect the pressure hose.
21. Inspect the fluid lever and/or make the necessary repairs.
22. If the problem still exists, examine the steering and the front suspension. Refer to the appropriate power steering system diagnostic procedure.

### Testing with J 25323–D

1. Place a container under the steering gear or the pump in order to catch the fluid when disconnecting or connecting the hoses.
2. Turn OFF the engine.
3. Disconnect the pressure hose at the steering gear or the power steering pump.
4. Use the *J 29525* adapter.

   Thread the female adapter into the pressure hose.

   Thread the male adapter into the gear or the pump.

   Connect the *J 25323-D* hoses to the adapters.

5. If the *J 25323-D* has never been used, bleed the power steering system in order to remove all of the air. Refer to *Bleeding Power Steering System (Process)*.

   The analyzer gate must be open during this procedure.
6. Add power steering fluid to the pump or the reservoir if needed.
7. Run the engine at idle speed with the gate valve open.
8. Record the flow (A) and the pressure (B).
   - If the flow is below 1.4 L/min (2 gpm) the pump may need repair. Continue the test before making any repairs.
   - If the pressure is above 1035 kPa (150 psi) inspect the hoses for restrictions. Inspect the steering gear.
9. Partially close the gate valve in order to build to 4278 kPa (620 psi).

   Record the flow (C).
10. If the flow (C) drops more than 3.7 L/min (1 gpm) under flow (A) disassemble the pump. Replace the following items:
    - The ring
    - The rotor
    - The vanes
11. Replace the pressure plates if the plates are worn or have cracks.
12. Replace all of the O-rings when reassembling the pump.
13. Continue the test.

***Notice:*** Do not hold the steering wheel in the full turn position longer than five seconds. To do so may damage the power steering pump.

14. Completely close and partially open the gate valve 3 times. Record the gate-closed pressure (D).
15. Check the pressure specifications at the end of this portion of the test.
    - If the pump pressure is 690 kPa (100 psi) lower than the minimum specification listed, replace the flow control valve in the pump.
    - If the recorded pressure is above the maximum specification listed, perform the following tasks to the flow control valve in the pump:
      - Remove the valve.
      - Clean the valve.
      - Replace the valve, if needed.
    - Completely disassemble and clean the following components before any further use:
      - The steering gear
      - The steering pump
    - Completely flush the fluid reservoir before any further use.
16. Increase the engine speed from idle to approximately 1500 RPM. Record the flow (E).
17. If the flow (E) varies more than 3.7 L/min (1 gpm) from flow (A) perform the following procedure on the flow control valve:
    - Remove the valve.
    - Clean the valve.
    - Replace the valve, if needed.
18. Turn the steering wheel lightly against both of the stops. Record the pressure and the flow (F).
    - The pressure that develops at both of the stops should be nearly the same as the maximum pump output (D). At the same time, the flow should drop below 1.85 L/min (0.5 gpm).
    - If the pressure does not reach the maximum output, or if the flow does not drop below the specified value, excessive internal leakage is occurring.

      Remove and disassemble the steering gear.
    - Remove the control.
    - Repair the steering gear. Refer to the appropriate procedure from the following list:
      - *Power Steering Gear Replacement (708 Model (Motor Home Only))*
      - *Power Steering Gear Replacement (710 Model)*
      - *Power Steering Gear Replacement 708 Model (I-Beam Front Axle))*
      - *Power Steering Gear Replacement (708 (Except I-Beam Front Axle))*
19. Turn the steering wheel in both directions. Quickly release the steering wheel while watching the pressure gauge. The needle should move from the normal pressure reading and snap back as you release the wheel.

    If the steering wheel comes back slowly or sticks, the rotary valve in the steering gear is sticking. Perform the following procedure to the rotary valve:

    19.1. Remove the valve.

    19.2. Clean the valve.

    19.3. Replace the valve, if needed.
20. If the system contains a lot of dirt and foreign materials perform the following operations:
    - Disassemble the pump.
    - Disassemble the gear.
    - Clean the pump.
    - Clean the gear.
21. Completely flush the fluid reservoir before any further use.
22. If the problem still exists, thoroughly examine the steering and the front suspension. Refer to the appropriate power steering system diagnostic procedure.

## External Leakage Check

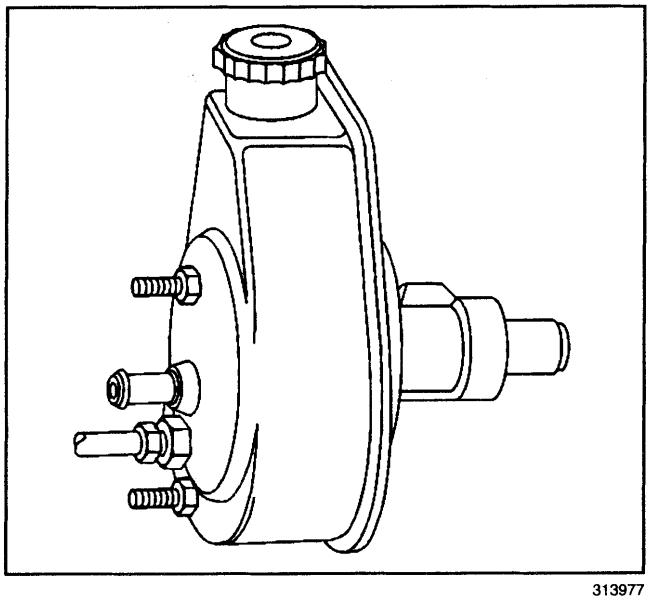
1. Turn OFF the engine.
2. Wipe the following components dry:
   - The gear
   - The pump
   - The hoses
   - The connections
3. Adjust the fluid level in the pump reservoir. Refer to the appropraite procedure from the following list:
   - *Checking and Adding Power Steering Fluid (Standard)*
   - *Checking and Adding Power Steering Fluid (Automatic Apply Parking Brake)*
4. Turn ON the engine.

***Notice:*** Do not hold the steering wheel in the full turn position longer than five seconds. To do so may damage the power steering pump.

5. Turn the steering wheel from stop to stop several times.
6. Find the exact areas of leakage. Refer to *Locating Fluid Leaks (Pump and Remote Reservoir)* and *Locating Fluid Leaks (Steering Gear).*
7. Repair the leak(s).

## Locating Fluid Leaks (Pump and Remote Reservoir)

1. Turn off the engine.
2. Wipe the power steering system dry.



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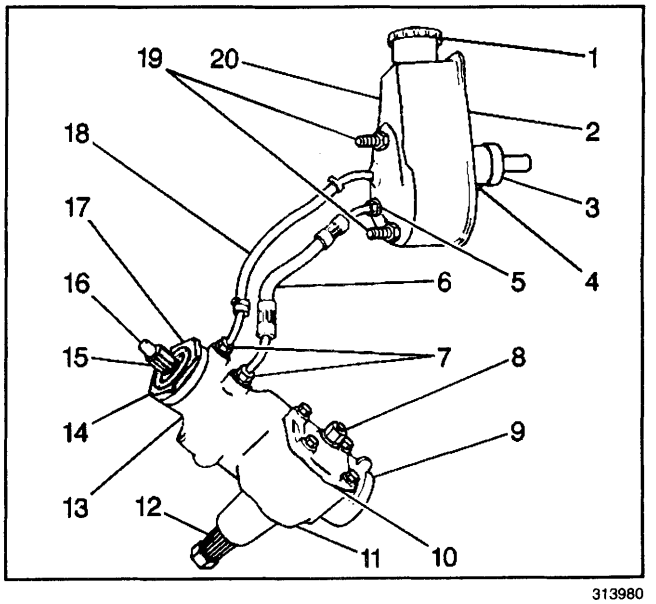
3. Check the fluid level in the reservoir. Adjust as necessary.

***Notice:*** Do not hold the steering wheel against the stop. This may damage the pump.

4. Start the engine. Turn the steering wheel from stop to stop several times.

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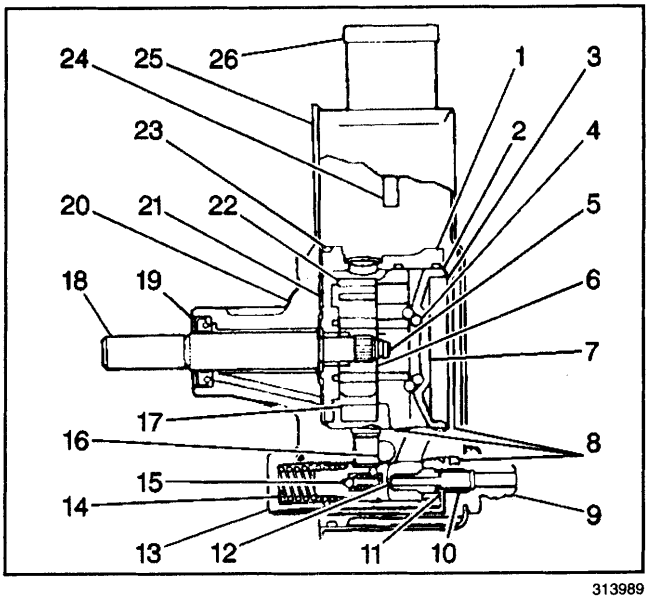
5. Check for leakage around the clamps of each of the hoses (6, 18). Tighten the clamp to stop the leakage.

   **Tighten**

   Tighten the clamp to 1.7 N·m (14 in).
6. Check for leakage around the hose fittings. Tighten the hose fitting.

   **Tighten**

   Tighten the hose fitting to 38 N·m (28 lb ft).

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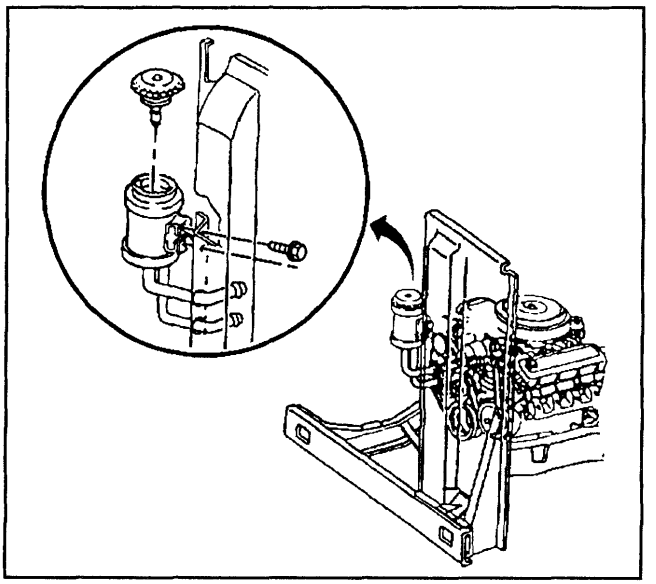
7. Check for leakage around the power steering pump stub shaft (18).
8. Remove the power steering pump. Refer to *Power Steering Pump Replacement (4.3L And 5.7L Engines)*, *Power Steering Pump Replacement (6.5L Diesel Engine)* or *Power Steering Pump Replacement (7.4L Engine).*
9. Replace the pump if it was determined the leak originated from the drive shaft seal (19) area of the pump. The drive shaft should be clean and free of pitting in the seal area.

10. Replace the pump if it was determined the leak is originated from the pump O-ring seal (23) area of the pump.



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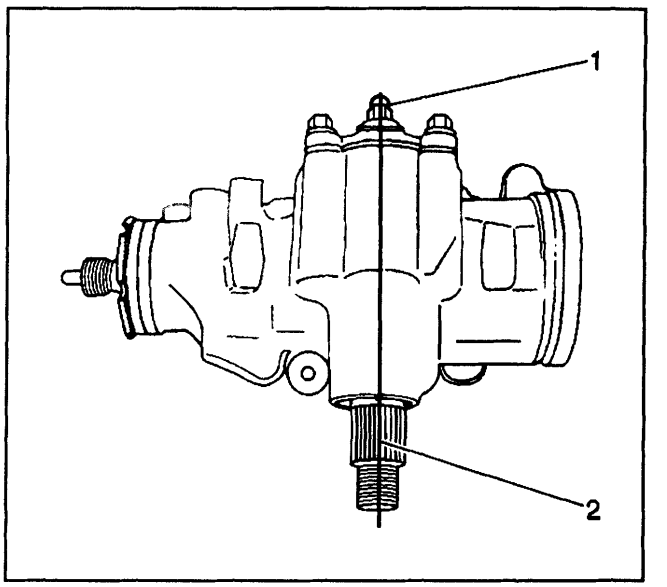
11. Tighten or replace the remote reservoir clamp.
12. Make sure the power steering fluid is at the correct level. Ensure the cap is on tight. Check the cap for leakage.
13. Replace the cap if there is leakage.
14. Check the reservoir for cracks and bends.
15. Replace the reservoir and tighten or replace the clamp if you find cracks or bends.

## Locating Fluid Leaks (Steering Gear)

1. Turn off the engine.
2. Wipe the power steering system dry.
3. Check the fluid level in the reservoir. Adjust as necessary.

***Notice:*** Do not hold the steering wheel against the stop. This may damage the pump.

4. Start the engine. Turn the steering wheel from stop to stop several times.

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5. Check for leakage around the adjuster nut (1). Tighten the nut if the leaking persists. If the leakage persists, replace the nut.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

6. Install the adjuster nut.

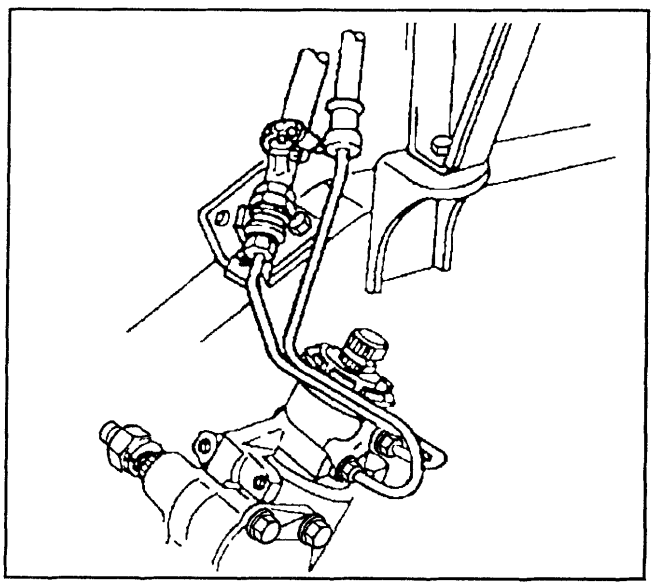
   **Tighten**

   - Tighten the adjuster lock nut on the Model 708 steering gear to 49 N·m (36 lb ft).
   - Tighten the adjuster screw jam nut on the Model 710 steering gear to 90 N·m (66 lb ft).

7. If leakage is discovered by the steering gear side cover, tighten the side cover bolts.

   **Tighten**

   - Tighten the cover bolts on the Model 708 steering gear to 60 N·m (44 lb ft).
   - Tighten the cover bolts on the Model 710 steering gear to 47 N·m (35 lb ft).



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8. Check for leakage around the hose fittings.

   **Tighten**

   - Tighten the gear inlet and outlet hose fittings to 33 N·m (24 lb ft).
   - Tighten the inlet and outlet hose fittings with new O-rings (Motorhome vehicle with the 6.5L and 7.4L engines with independent front suspension) to 30.5 N·m (23 lb ft).
   - Check for seepage between the torsion bar and stub shaft. If it exists, replace the rotary valve assembly.
   - Seat the ball in the housing with a blunt punch. Apply Loctite 75559 solvent and Loctite 290 adhesive, or equivalent, to the ball area.

## Objectionable Hiss

| Problem | Action |
|---|---|
| There is a noisy relief valve in the hydraulic pump. | • There is some noise in all power steering systems.<br>• One of the most common is a hissing sound. The hissing sound is most evident at standstill parking. A hiss is a high frequency noise.<br>• The noise is present in every valve and results from a high velocity fluid passing over the valve orifice edges. There is not a relationship between the hissing noise and the performance of the steering. A hiss may be expected when the steering wheel is at the end of travel or when slowly turning at a standstill.<br>• Do not replace the valve unless the hiss is extremely objectionable. A replacement valve will also exhibit some slight noise and is not always a cure for the objection. |

## Rattle or Chuckle Noise in Steering Gear

| Problem | Action |
|---|---|
| The steering gear mounting is loose. | 1. Inspect the gear mounting bolts.<br>2. Tighten the bolts to specifications. Refer to *Fastener Tightening Specifications.* |
| The steering linkage is loose. | 1. Inspect the linkage pivot points for wear<br>2. Replace any worn component. |
| The pressure hose is touching other parts of the vehicle. | Adjust the hose position. Do not bend the tubing by hand. |
| The Pitman arm is loose. | Tighten the pitman arm nut or the pinch bolt. |
| The over-center adjustment is improper.<br>A slight rattle may occur on turns because of an increased clearance off the High Point. This is a normal condition. Do not reduce the clearance below the specified limit in an attempt to eliminate this slight rattle. | Adjust to specifications. |

## Excessive Wheel Kickback or Loose Steering

| Problem | Action |
|---|---|
| Air is present in the system. | 1. Add power steering fluid to the power steering reservoir. Refer to the appropriate procedure from the following list:<br>• *Checking and Adding Power Steering Fluid (Standard)*<br>• *Checking and Adding Power Steering Fluid (Automatic Apply Parking Brake)*<br>2. Bleed the system. Refer to *Bleeding Power Steering System (Process).*<br>3. Inspect the hose connectors for proper torque. |
| The steering gear mounting is loose. | Tighten the attaching bolts to the specified torque. Refer to *Fastener Tightening Specifications.* |
| The steering linkage joints are worn. | Replace any loose parts. |
| The steering gear is improperly adjusted. | Adjust the steering gear to specifications. |

## Excessive Wheel Kickback or Loose Steering (cont'd)

| Problem | Action |
|---|---|
| Worn or maladjusted front wheel bearings | Adjust or replace the bearings |
| Worn or damaged steering gear | Replace the steering gear. Refer to the appropriate procedure:<br>• *Power Steering Gear Replacement (708 Model (Motor Home Only))*<br>• *Power Steering Gear Replacement (710 Model)*<br>• *Power Steering Gear Replacement (708 Model (I-Beam Front Axle))*<br>• *Power Steering Gear Replacement (708 (Except I-Beam Front Axle))* |

## Increase in Effort While Turning Steering Wheel

| Problem | Action |
|---|---|
| Low oil level in the pump | Add power steering fluid as required. Refer to the appropriate procedure from the following list:<br>• *Checking and Adding Power Steering Fluid (Standard)*<br>• *Checking and Adding Power Steering Fluid (Automatic Apply Parking Brake)* |
| The pump belt is slipping. | Refer to Engine Cooling. |
| High internal leakage (steering gear or pump) | Refer to *Power Steering System Test Procedure*. |

## Poor Return of Steering Wheel

| Problem | Action |
|---|---|
| Under-inflated tires | Inflate the tires to the specified pressure. Refer to *Tire Inflation Pressure Specifications*. |
| The lower coupling flange is rubbing against the steering gear adjuster plug. | Loosen the pinch bolt and assemble properly. |
| The steering wheel is rubbing against the directional signal housing. | Adjust the steering wheel jacket. Refer to *Steering Shaft, Lower Bearing, Jacket- Disassemble (Column Shift)*, *Steering Shaft, Lower Bearing, Jacket- Disassemble (Floor Shift)*, *Steering Shaft, Lower Bearing, Jacket- Assemble (Column Shift)*, and *Steering Shaft, Lower Bearing, Jacket- Assemble (Floor Shift)*. |
| Tight or frozen steering shaft bearings | Replace the bearings. |
| Binding in the steering linkage | Replace any affected components. Refer to *Ball Joint Wear Check (Independent)* in Front Suspension. |
| Misalignment of the steering gear to the column | Align the steering column. |
| A lack of lubrication in the suspension ball joints and the steering linkage | Lubricate the suspension joints and the steering linkage. Refer to *Steering Linkage Inspection* in Steering Linkage. |
| Stuck or plugged steering gear valve spool | Replace the steering gear. |
| Improper front wheel alignment | 1. Inspect the alignment of the front wheels.<br>2. Adjust the alignment to specifications. Refer to *Wheel Alignment Specifications*. |
| A kink in the return hose | Replace the return hose. |
| Rubber spacer is binding in the shift tube. | Make certain the spacer is properly seated. Lubricate inside the diameter with silicone lubricant. |
| The steering gear is adjusted to tightly. | Adjust the over-center and thrust bearing preload to specifications. Refer to *Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (708 Model)* or *Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (710 Model)*. |
| The steering intermediate shaft stone shield is side-loaded against the shaft assembly. | Eliminate the side-load. |

## Steering Wheel Surges/Jerks While Turning

| Problem | Action |
|---|---|
| The power steering fluid is low. | Add an adequate amount of power steering fluid. Refer to *Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (708 Model)* or *Checking and Adding Power Steering Fluid (Automatic Apply Parking Brake).* |
| The pump belt is loose. | Refer to *Drive Belt Tensioner Replacement*, *Drive Belt Tensioner Diagnosis*, *Drive Belt Tensioner Diagnosis*, and *Drive Belt Tensioner Diagnosis.* |
| The flow control valve is sticky. | Replace or clean the control valve. |
| The pump pressure is insufficient. | Refer to *Power Steering System Test Procedure.* |
| The gear pressure relief valve is faulty. | Replace the faulty gear pressure relief valve. |
| The steering linkage is binding. | 1. Inspect the steering linkage for worn components.<br>2. Replace any worn components. |

## Steering Effort Hard in Both Directions

| Problem | Action |
|---|---|
| The tire pressure is low. | Inflate the tires to the specified pressure. Refer to *Tire Inflation Pressure Specifications* in Tires and Wheels. |
| A lack of lubrication in the suspension or ball joint (worn/contaminated joints). | Lubricate and relubricate at the proper intervals or replace the joints. Refer to *Fluid and Lubricant Recommendations* in Maintenance and Lubrication. |
| There is a binding in the steering linkage. | Replace any affected parts. |
| There is a misalignment of the steering gear to the column. | Align the steering column. |
| The power steering fluid is low. | Add an adequate amount of power steering fluid. Inspect the lines and the joints for any external leakage. |
| High internal leakage exists in the steering gear or in the pump. | Refer to *Power Steering System Test Procedure.* |
| Misalignment of the front wheels. | Check and adjust the front wheel alignment to specifications. |

## Vehicle Leads to One Side or the Other

| Problem | Action |
|---|---|
| Poor road or wind conditions | Test drive the vehicle on a flat road.<br>Test drive the vehicle in both directions. |
| Misaligned front wheels | Align the front wheels to specifications. |
| Unbalanced steering gear valve.<br>If the steering gear valve is unbalanced, the steering effort will be very light in the direction of the lead and heavy in the opposite direction. | Replace the steering gear valve. |
| The steering shaft is rubbing the I.D. of the shaft tube. | Align the steering column. |
| Worn or faulty tires | Replace the tires. |
| Low tire pressure | Adjust the tire pressure. |

## Foaming, Milky-Appearing PS Fluid, Low in Level

| Problem | Action |
|---|---|
| Air in the fluid or loss of fluid due to internal pump leakage causing an overflow. | **Important:** Extremely cold temperatures will cause system aeration if the power steering fluid is low. If the oil level is correct and the pump still foams, remove the pump from the vehicle and separate the reservoir from the housing. Check the welsh plug and the housing for cracks. If the plug is loose or the housing is cracked, replace the housing.<br>1. Locate and repair the leak.<br>2. Bleed the power steering system. Refer to *Bleeding Power Steering System (Process).* |

### Low Oil Pressure Due to Restriction in the Hose

| Problem | Action |
|---|---|
| The hoses are kinked. | 1. Remove the kinks.<br>2. Replace the hoses as needed. |
| A foreign object is stuck in the hoses. | 1. Remove the foreign object.<br>2. Replace the hoses as needed. |

### Low Oil Pressure Due to Steering Gear

| Problem | Action |
|---|---|
| A pressure loss due to a worn piston ring or a scored housing bore | 1. Disassemble the steering gear.<br>2. Replace any affected parts. |
| Leakage at the valve rings and the valve body to the worm seal | 1. Disassemble the steering gear<br>2. Replace the defective seals. |
| Leakage at the valve body or a loose fitting spool | Replace the valve. |

### Low Oil Pressure Due to Steering Pump

| Problem | Action |
|---|---|
| Stuck or inoperative flow control valve | Replace or clean the valve. |
| Pressure plate is not flat against the cam ring | Replace the pressure plate. |
| Extreme wear of the cam ring | 1. Replace the cam ring.<br>2. Flush the system. |
| A scored pressure plate, thrust plate, or rotor | 1. Replace any scored parts.<br>If the rotor is scored, replace the rotor with a rotating group.<br>2. Flush the system. |
| The vanes are sticking in the rotor slots. | Free the vanes by removing any burrs, varnish or dirt. |
| Improper installation of the vanes | Properly install the vanes. Ensure that the radius edge is installed to the outside. |
| Air in the fluid | 1. Locate the leak.<br>2. Repair the leak.<br>3. Bleed the system. |
| Low power steering fluid | Add the necessary amount of power steering fluid. |
| The pump belt is slipping. | Refer to Engine Mechanical. |
| Damaged hoses or steering gear | Replace any damaged parts. |

### Chirp Noise in Steering Pump

| Problem | Action |
|---|---|
| Pump belt slipping | Refer to Engine Mechanical. |

### Belt Squeal

| Problem | Action |
|---|---|
| Pump belt slipping | Refer to Engine Mechanical. |

## Groan Noise in Steering Pump

| Problem | Action |
|---|---|
| Low oil level | Add power steering fluid as required. Refer to the appropriate procedure from the following list:<br>• *Checking and Adding Power Steering Fluid (Standard)*<br>• *Checking and Adding Power Steering Fluid (Automatic Apply Parking Brake)* |
| Extreme wear of the cam ring | 1. Tighten the connector.<br>2. Bleed the system. Refer to *Bleeding Power Steering System (Process).* |

## Growl Noise in Steering Pump

| Problem | Action |
|---|---|
| Excessive back pressure in the hoses or the steering gear caused by a restriction, and noticeable with vehicle moving | Locate and repair the restriction. |
| Scoring on the pressure plates, thrust plates, or rotor noticeable with vehicle at a standstill | Replace the parts and flush the system. |
| An excessively worn cam ring noticeable with vehicle at a standstill | Replace the parts. |

## Rattle or Knock Noise in Steering Pump

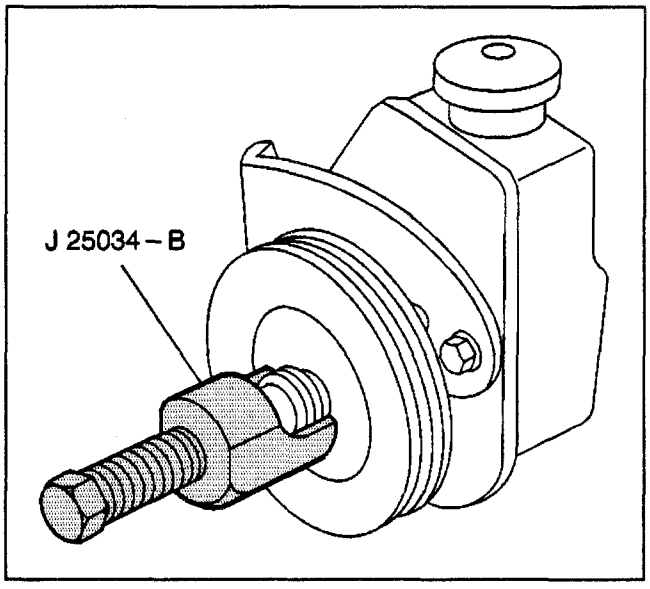
| Problem | Action |
|---|---|
| Loose power steering pump pulley nut | Tighten the pulley nut to specifications. |
| The pump vanes are sticking in the rotor slots. | Free the pump vanes by removing any burrs, varnish, or dirt. |
| The pressure hose is touching other parts of the vehicle. | Adjust the hose position. |

## Swish Noise in Steering Pump

| Problem | Action |
|---|---|
| A faulty flow control valve | Replace the faulty flow control valve. |

## Whine Noise in Steering Pump

| Problem | Action |
|---|---|
| A scored pump shaft bearing | 1. Replace the housing and the shaft.<br>2. Flush the system. Refer to *Flushing the Power Steering System.* |



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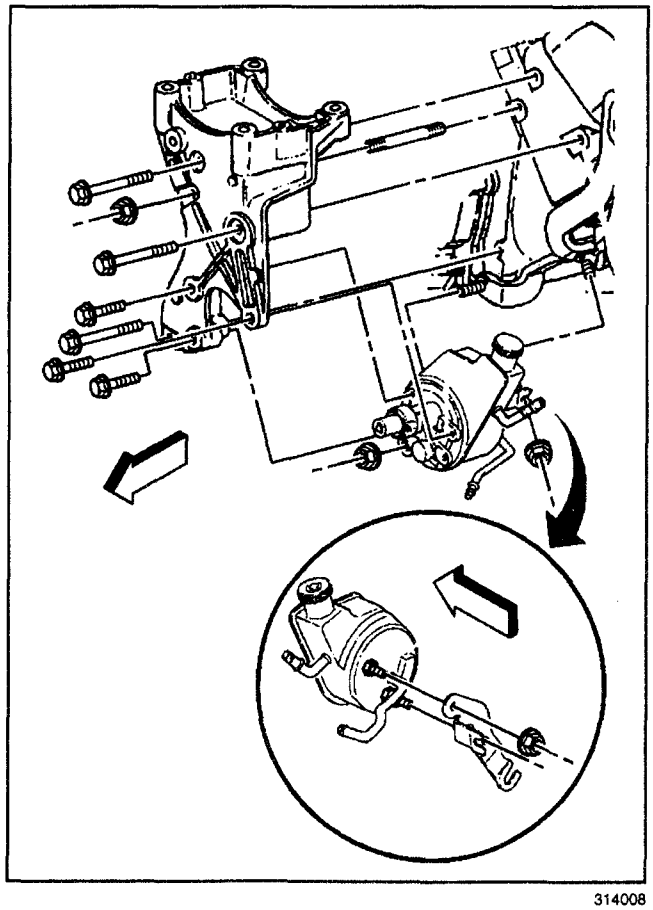
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## Repair Instructions

### Power Steering Pump Replacement (4.3L And 5.7L Engines)

#### Removal Procedure

**Tools Required**

*J 25034-B* Power Steering Pump Pulley Remover

1. Place a drain pan below the pump.
2. Remove the pump drive belt. Refer to *Drive Belt Replacement* or *Drive Belt Replacement.*
3. Disconnect the hoses at the pump.
4. Raise the hose in order to prevent drainage of the oil.
5. Cap the ends of the hose and the pump in order to prevent contamination.
6. Tag the hose locations.
7. Use the *J 25034-B* in order to remove the pulley from the pump.
8. Hold the pilot bolt and turn the nut counterclockwise.
9. Turn the nut on the *J 25034-B* to the top of the pilot bolt in order to ensure that the pilot bolt bottoms in the pump shaft.
10. Remove the pump rear bracket assembly nuts to the engine studs.
11. Remove the front pump bolts to the front bracket, if removal of only the pump assembly is required. If the front bracket assembly is also damaged, remove the front bracket bolts and cylinder head nut.
12. Remove the pump assembly and/or front bracket assembly.
13. Remove the rear bracket assembly from the pump.

## Installation Procedure

### Tools Required

*J 25033-B* Power Steering Pump Pulley Installer

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

1. Install the bracket(s) to the pump.

   **Tighten**

   - Tighten the rear bracket-to-pump stud nuts to 50 N·m (37 lb ft).
   - Tighten the front bracket to front pump bolts to 50 N·m (37 lb ft).

2. Loosely install the pump assembly.

**Important:**

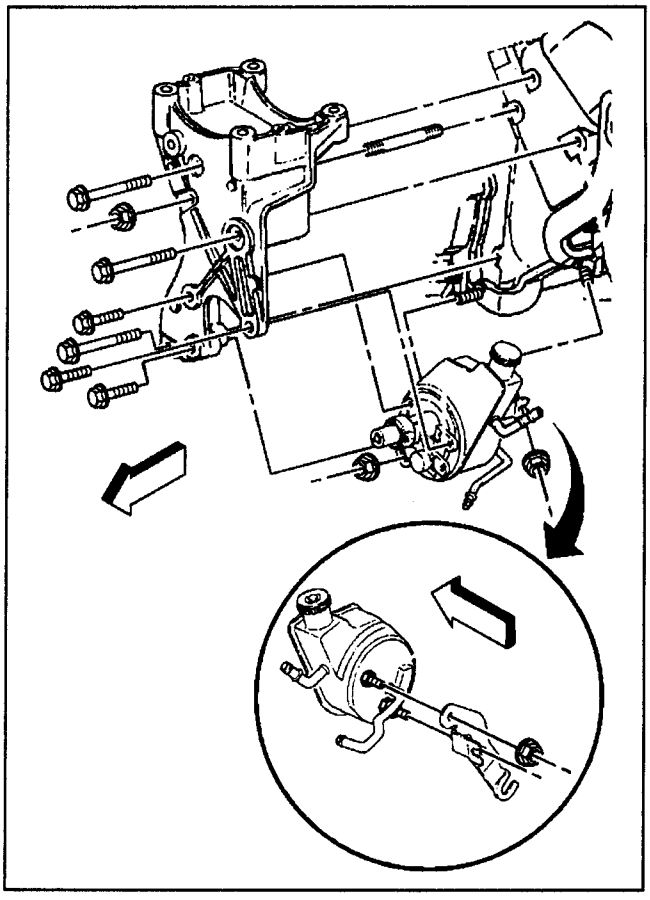
- Do not start the engine with any power steering hoses disconnected. After connecting the power steering hoses, ensure that there is clearance between the hoses and the drive belt, the sheet metal, or any other components where hose chafing or interference may result.
- Improperly installed hoses are subject to chafing and other abuses.

3. Connect the power steering hoses to the pump. Refer to *Power Steering Hoses Replacement (4.3L and 5.7L Engines).*
4. Tighten the pump assembly to the engine.

   **Tighten**

   - Tighten the engine stud nuts to 41 N·m (30 lb ft).
   - Tighten the engine head stud to 20 N·m (15 lb ft) if removed to replace a damaged front bracket.
   - Tighten the engine head stud nut and front bracket assembly mounting bolts to 41 N·m (30 lb ft) if the front bracket assembly was replaced.

5. Place the pulley on the end of the pump shaft.
6. Install the *J 25033-B.*
7. Turn the nut to the top of the pilot bolt in order to ensure that the pilot bolt bottoms in the shaft.
8. Hold the pilot bolt and turn the nut clockwise.
9. Install the pulley flush 0.50 mm (0.020 in) with the end of the power steering pump shaft.
10. Fill the reservoir.
11. Turn the pulley counterclockwise as viewed from the front in order to bleed the pump.
12. Install the pump drive belt. Refer to *Drive Belt Replacement* or *Drive Belt Replacement.*
13. Fill the system with power steering fluid.
14. Bleed the system. Refer to *Bleeding Power Steering System (Process).*



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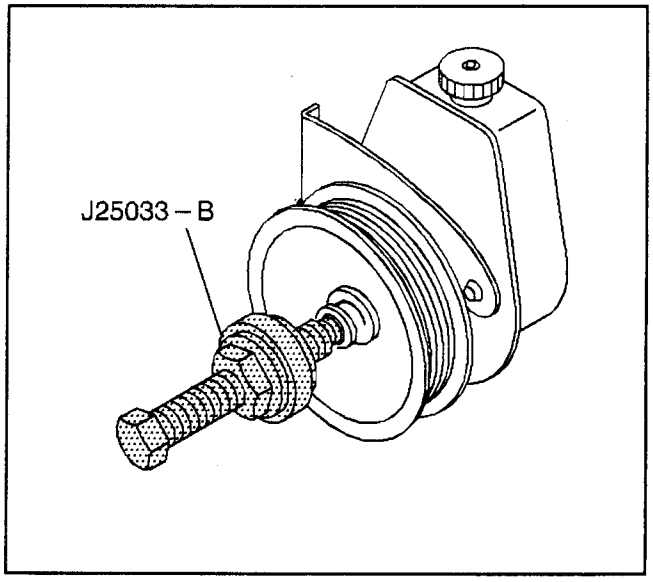


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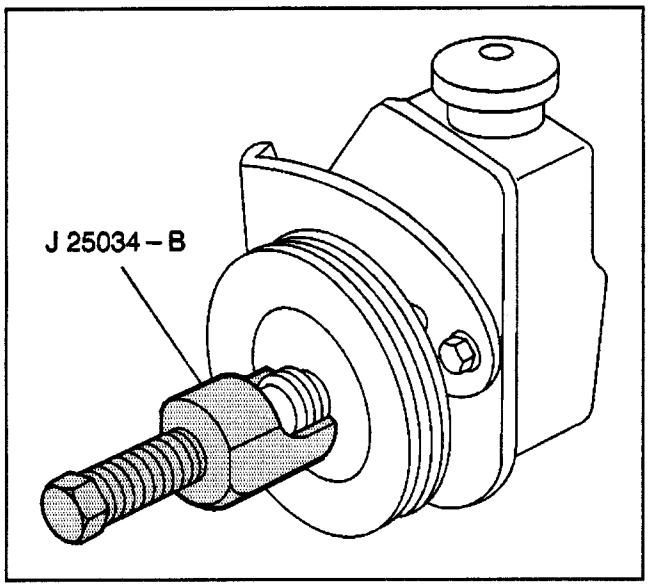


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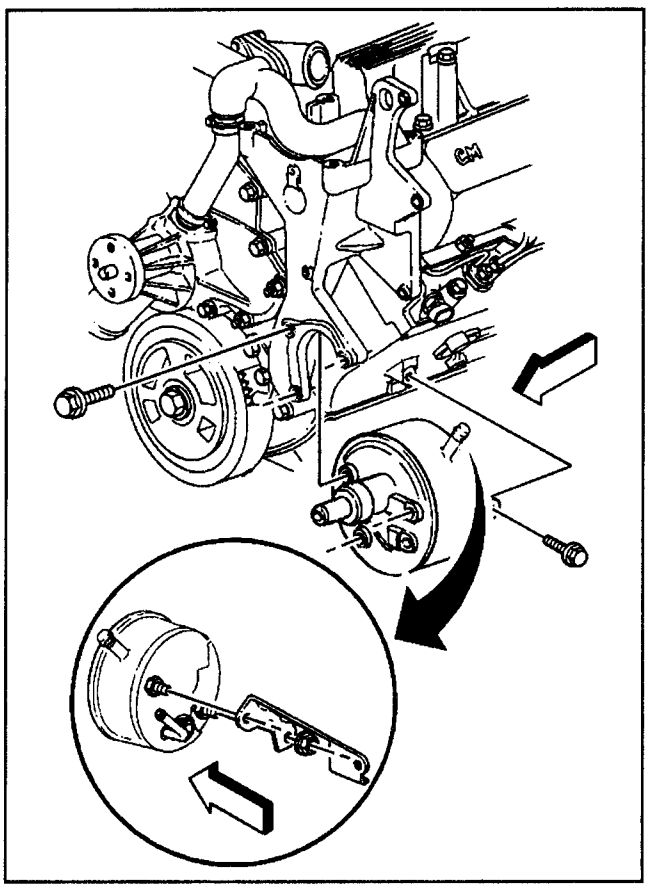

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## Power Steering Pump Replacement (6.5L Diesel Engine)

### Removal Procedure

#### Tools Required

*J 25034-B* Power Steering Pump Pulley Remover

1. Place a drain pan below the pump.
2. Remove the pump drive belt. Refer to *Drive Belt Replacement*.
3. Disconnect the hoses at the pump.
4. Raise the hose in order to prevent drainage of the oil.
5. Cap the ends of the hose and the pump in order to prevent contamination.
6. Tag the hose locations.
7. Use the *J 25034-B* in order to remove the pulley from the pump.
8. Turn the nut on the *J 25034-B* to the top of the pilot bolt in order to ensure that the pilot bolt bottoms in the pump shaft.
9. Hold the pilot bolt and turn the nut counterclockwise.
10. Remove the power steering brace-to-engine bolt.
11. Remove the power steering pump-to-bracket bolts.
12. Remove the pump assembly.
13. Remove the brace from the pump.

## Installation Procedure

### Tools Required

*J 25033-B* Power Steering Pulley Pump Remover

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

1. Loosely assemble the power steering brace to the pump with the two nuts.

   **Tighten**

   Tighten the power steering brace-to-pump nuts to 50 N·m (37 lb ft).
2. Fill the pump housing with as much fluid as possible before mounting the pump to the engine.
3. Finger-start the bolt securing the power steering brace to the engine and the front pump bolts.

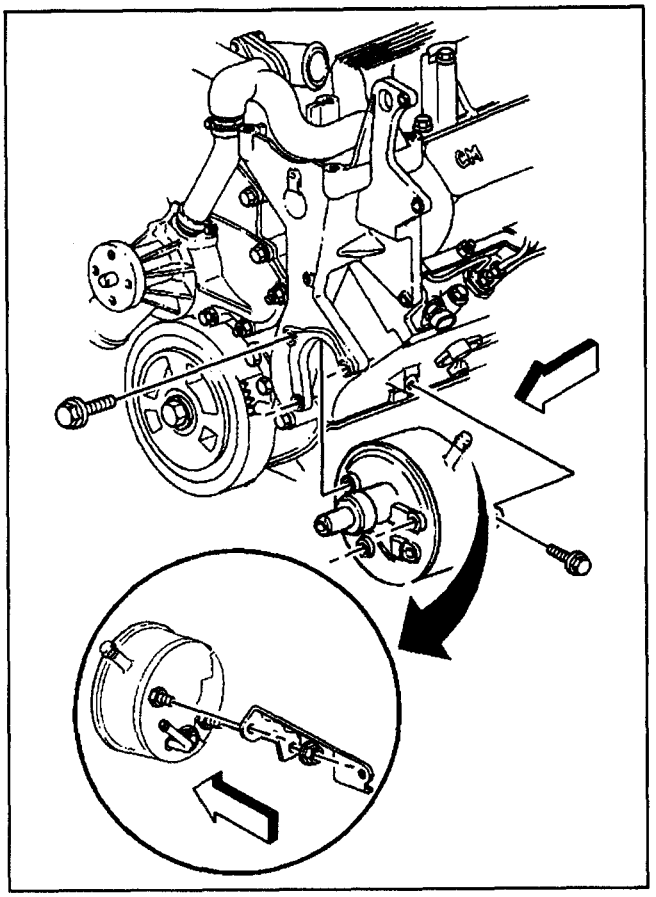
   **Tighten**

   Tighten the power steering front pump bolts and the power steering pump brace-to-engine bolt to 50 N·m (37 lb ft).

**Important:**

- Do not start the engine with any power steering hoses disconnected. After connecting the power steering hoses, ensure that there is clearance between the hoses and the drive belt, the sheet metal, or any other components where hose chafing or interference may result.
- Improperly installed hoses are subject to chafing and other abuses during sharp turns.

4. Connect the power steering hoses to the pump. Refer to *Power Steering Hoses Replacement (6.5L (L57) Independent)* or *Power Steering Hoses Replacement (6.5L (L57) I-Beam)* or *Power Steering Hoses Replacement (6.5L (L65) and (7.4L Engines).*
5. Place the pulley on the end of the pump shaft.
6. Install the *J 25033-B.*
7. Turn the nut to the top of the pilot bolt in order to ensure that the pilot bolt bottoms in the shaft.
8. Hold the pilot bolt and turn the nut clockwise.
9. Install the pulley flush 0.50 mm (0.020 in) with the end of the power steering pump shaft.
10. Fill the reservoir.
11. Turn the pulley counterclockwise as viewed from the front in order to bleed the pump.
12. Install the pump drive belt. Refer to *Drive Belt Replacement.*
13. Fill the system with power steering fluid.
14. Bleed the system. Refer to *Bleeding Power Steering System (Process).*



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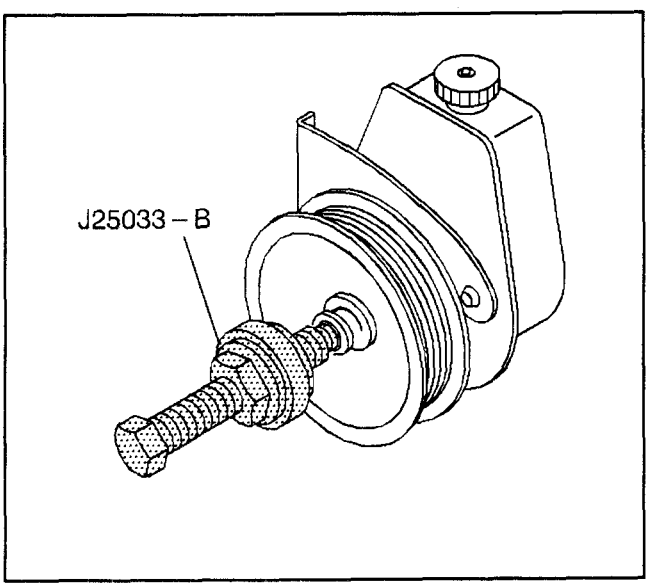


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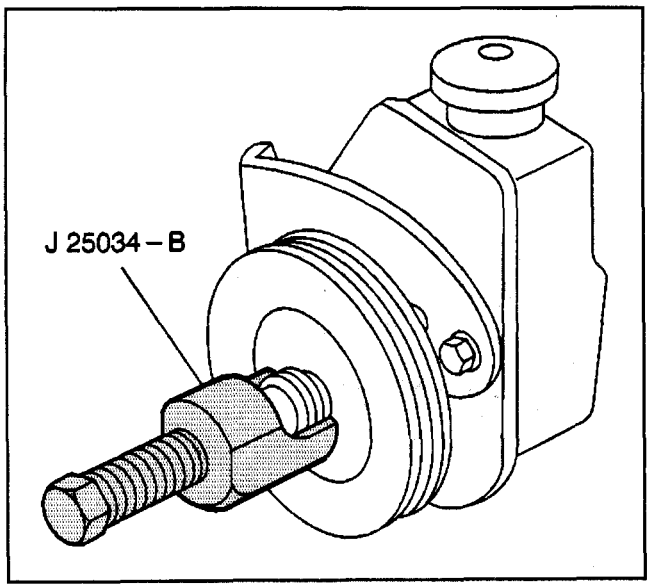


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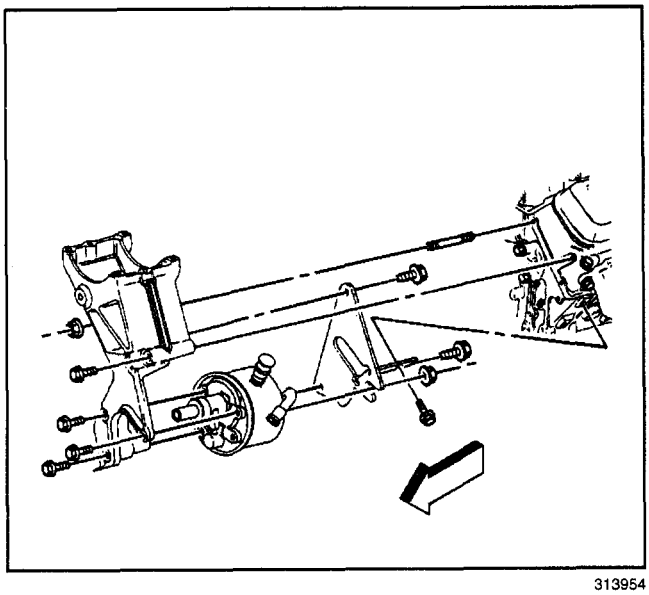

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## Power Steering Pump Replacement (7.4L Engine)

### Removal Procedure

#### Tools Required

*J 25034-B* Power Steering Pump Pulley Remover

1. Place a drain pan below the pump.
2. Remove the pump drive belt. Refer to *Drive Belt Replacement.*
3. Disconnect the hoses at the pump.
4. Raise the hose in order to prevent drainage of the oil.
5. Cap the ends of the hose and the pump in order to prevent contamination.
6. Tag the hose locations.
7. Use the *J 25034-B* in order to remove the pulley from the pump.
8. Turn the nut on the *J 25034-B* to the top of the pilot bolt in order to ensure that the pilot bolt bottoms in the pump shaft.
9. Hold the pilot bolt and turn the nut counterclockwise.
10. Remove the pump rear bracket assembly bolt to the engine block.
11. Remove the rear bracket-to-front bracket attaching bolts and loosen the pump stud nut.
12. Remove the front pump bolts to the front bracket, if removal of only the pump assembly is required. If the front bracket assembly is also damaged, remove the front bracket bolts and cylinder head nut to the engine block.
13. Remove the pump assembly and/or front bracket assembly.

## Installation Procedure

### Tools Required

*J 25033-B* Power Steering Pump Pulley Remover

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

1. Install the bracket(s) to the pump.

   **Tighten**

   - Tighten the rear bracket-to-pump stud nut to 50 N·m (37 lb ft).
   - Tighten the rear bracket to front bracket bolts to 25 N·m (18 ft).
   - Tighten the front bracket to the front pump bolts to 50 N·m (37 lb ft).
2. Fill the pump housing with as much fluid as possible before mounting the pump to the engine.
3. Loosely install the pump assembly.

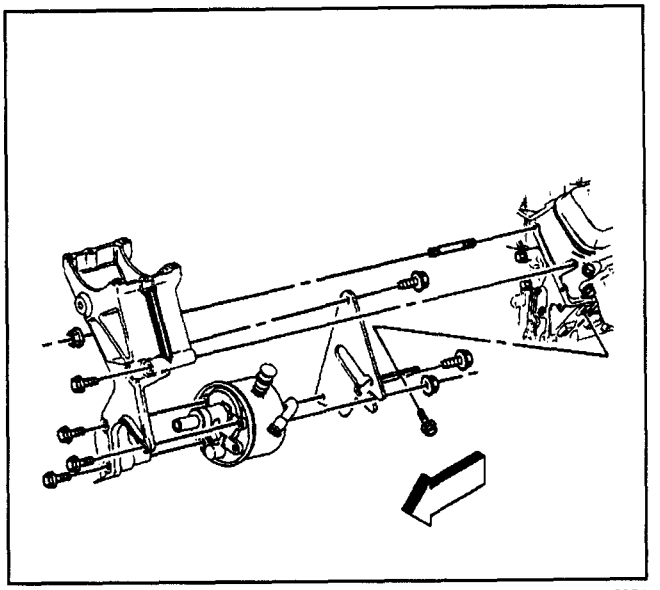
**Important:**

- Do not start the engine with any power steering hoses disconnected. After connecting the power steering hoses, ensure that there is clearance between the hoses and the drive belt, the sheet metal, or any other components where hose chafing or interference may result.
- Improperly installed hoses are subject to chafing and other abuses during sharp turns.

4. Connect the power steering hoses to the pump. Refer to *Power Steering Hoses Replacement (6.5L (L65) and 7.4L Engines).*
5. Tighten the pump assembly to the engine.

   **Tighten**

   - Tighten the stud to the engine head to 20 N·m (15 lb ft) if removed, to replace a damaged front bracket.
   - Tighten the engine head stud nut, and the front bracket mounting bolts to the engine to 66 N·m (49 lb ft) if the front bracket was replaced.
   - Tighten the pump assembly-to-engine block bolt to 40 N·m (30 lb ft).



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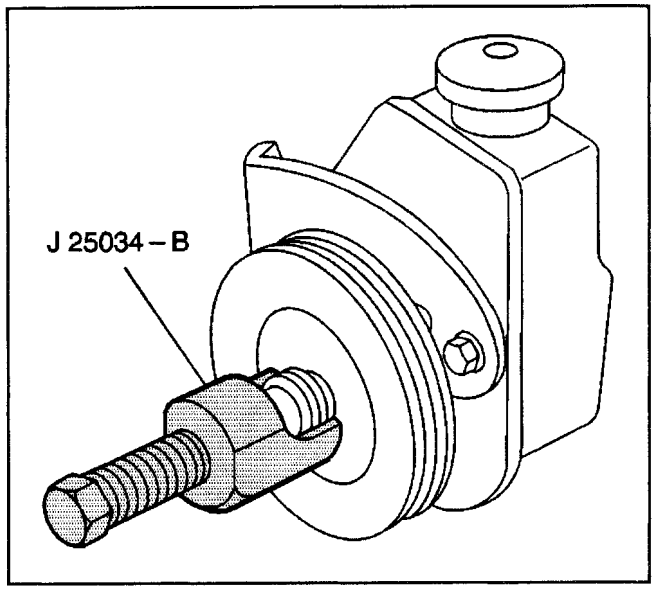


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6. Place the pulley on the end of the pump shaft.
7. Install the *J 25033-B*.
8. Turn the nut to the top of the pilot bolt in order to ensure that the pilot bolt bottoms in the shaft.
9. Hold the pilot bolt and turn the nut clockwise.
10. Install the pulley flush 0.50 mm (0.020 in) with the end of the power steering pump shaft.
11. Fill the reservoir.
12. Turn the pulley counterclockwise as viewed from the front in order to bleed the pump.
13. Install the pump drive belt. Refer to *Drive Belt Replacement*.
14. Fill the system with power steering fluid.
15. Bleed the system. Refer to *Bleeding Power Steering System (Process)*.

## Checking and Adding Power Steering Fluid (Standard)

1. Run the engine until the power steering fluid reaches normal operating temperature, about 80°C (170°F).
2. Turn OFF the engine.
3. Remove the reservoir cap.
4. Verify that the fluid level is at the proper level on the fluid level indicator (dipstick).
5. If the fluid level is low, add power steering fluid to the proper level. Refer to *Fluid and Lubricant Recommendations.*
6. Install the reservoir cap.
7. After you service the steering system, bleed the air from the system after you check the fluid level. Refer to *Bleeding Power Steering System (Process).*

## Checking and Adding Power Steering Fluid (Automatic Apply Parking Brake)

1. Run the engine until the power steering fluid reaches normal operating temperature, about 80°C (170°F).
2. Do not turn OFF the engine in order to check the fluid level.
3. Apply the parking brake manual lever.
4. Place the transmission in neutral.
5. Remove the reservoir cap.
6. Verify that the fluid level is 2 inches from the bottom of the reservoir on the fluid level indicator (dipstick).
7. If the fluid level is low, add power steering fluid to the proper level. Refer to *Fluid and Lubricant Recommendations.*
8. Install the reservoir cap.
9. After you sevice the steering system, bleed the air from the system after you check the fluid level. Refer to *Bleeding Power Steering System (Process).*

## Bleeding Power Steering System (Process)

Bleed the air from the power steering system before operating the vehicle whenever you remove or disconnect any of the following components:

- The power steering pump
- The power steering gear
- The power steering oil lines

If you allow air to remain in the power steering fluid system, noisy and unsatisfactory operation of the system may result. Bleed air from the hydraulic system as follows:

**Important:** When bleeding the system, and any time fluid is added to the power steering system, only use power steering fluid as specified in *Fluid and Lubricant Recommendations.*

1. Make sure that the ignition switch is in the UNLOCK position.
2. Turn the steering full left.
3. Fill the power steering fluid reservoir to the FULL COLD level. Leave the cap off.
4. Raise the front wheels off the ground and support the vehicle using suitable safety stands.
5. Place a drain pan under the vehicle to catch any power steering fluid that may overflow.
6. With an assistant checking fluid level and condition, turn the steering wheel lock-to-lock at least 40 times.
   - Trapped air may cause fluid to overflow. Any fluid that spills out will need to be cleaned off of the outside of the reservoir to allow for a proper leak check.
   - Maintain the fluid level at FULL COLD.
   - Fluid should be free of any air bubbles. If any air bubbles are present, check all of the power steering hose fittings for leaks. Repair any leaks, and repeat step 6.
7. Start the engine and allow it to idle. Maintain the power steering fluid level at FULL COLD.
8. Install the power steering reservoir cap.
9. Return the front wheels to the straight ahead position.
10. Lower the front wheels to the ground.
11. After allowing the engine to idle for two minutes, fully turn the steering wheel in both directions to verify the following:
    - Smooth power assist
    - Noiseless operation
    - Proper fluid level
    - No system leaks
    - Proper fluid condition (no air bubbles, foam, or discoloration)
12. If any of the problems remain, refer to Special Conditions in this section.

## Bleeding Power Steering System (Special Conditions)

### Foam or Bubbles in the Power Steering Fluid

The power steering fluid must be completely free of bubbles. Bubbles in the fluid indicate a loose connection or a leaky O-ring seal.

### Discolored Fluid (Milky, Opaque, or a Light Tan Color)

If the power steering fluid is discolored, wait two minutes, then recheck the hose connections. Refer to *Bleeding Power Steering System (Process)* and repeat steps 7–11. If the conditions exist, replace the O—ring seals, refer to "End Plate and Rotating Group Replacement" in Power Steering System. Fill the system and repeat the bleeding procedure.

### Noise (Pump Whine or Groan)

With the engine running, check the hoses for possible contact with the frame, body, or engine. Allow the system to cool down if no contact is found. After cooling, restart the engine and allow it to idle for two minutes to allow the system to come up to operating temperature. Replace the power steering pump if noise is still present. Refer to *Power Steering Pump Replacement (4.3L And 5.7L Engines)*, *Power Steering Pump Replacement (6.5L Diesel Engine)*, and *Power Steering Pump Replacement (7.4L Engine)*. Repeat the bleeding procedure.

## Flushing the Power Steering System

1. Raise the front of the vehicle off the ground until the wheels are free to turn.
2. Remove the fluid return line at the pump inlet connector.
3. Plug the connector port on the pump.
4. Position the line toward a large container in order to catch the draining fluid.
5. Run the engine at idle while an assistant is filling the reservoir with new power steering fluid. Refer to one of the following procedures:
   - *Checking and Adding Power Steering Fluid (Standard)*
   - *Checking and Adding Power Steering Fluid (Automatic Apply Parking Brake)*

**Important:** DO NOT contact the wheel stops or hold the wheel near a stop position. Fluid will stop and the pump will be in pressure relief mode if the wheel stops are contacted, or if you hold the wheel near a stop position. A sudden overflow from the reservoir may develop if you hold the wheel at a stop.

6. Turn the steering wheel close to each stop.
7. Install all of the lines, the hoses, and the components (if removed) on the vehicle.
8. Fill the system with new power steering fluid. Refer to the appropriate procedure from the following list:
   - *Checking and Adding Power Steering Fluid (Standard)*
   - *Checking and Adding Power Steering Fluid (Automatic Apply Parking Brake)*
9. Bleed the system. Refer to *Bleeding Power Steering System (Process)*.
10. Operate the engine for about 15 minutes.
11. Remove the pump return line at the pump inlet.
12. Plug the connection on the pump.
13. Inspect the draining fluid for contamination, while refilling the reservoir.
14. If foreign material is still evident, replace all lines, and disassemble and clean the power steering system components. Replace any components, as needed. Do not reuse any drained power steering fluid.

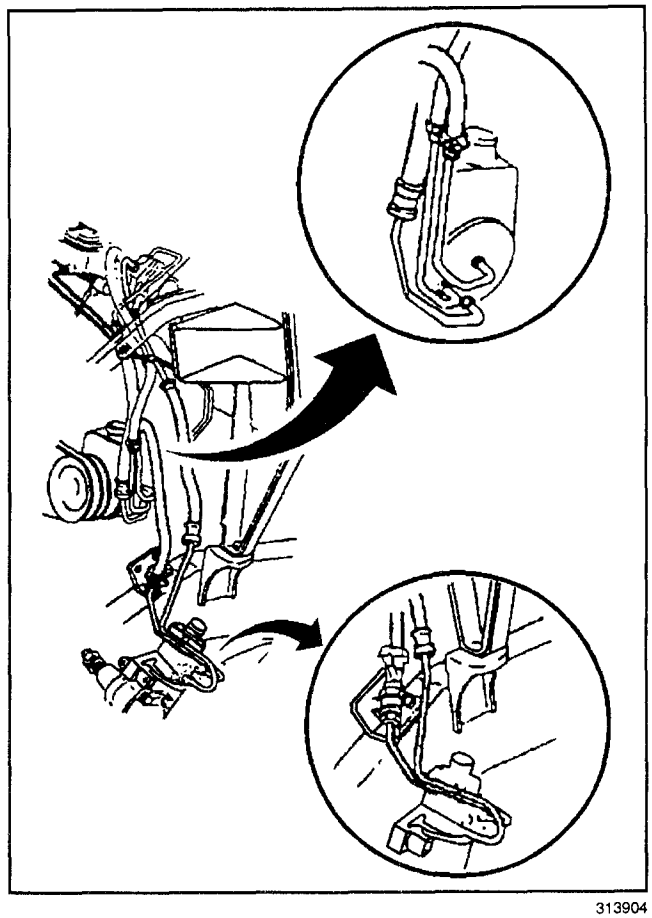
## Power Steering Hoses Replacement (4.3L and 5.7L Engines)

**Important:** Do not start the vehicle with any power steering hoses disconnected.

After replacing or reinstalling a hose, perform the following steps:

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

1. Route the hoses in the original position they were prior to removal.
2. Route the hoses smoothly.
   Avoid sharp bends and kinking.
3. After the hoses are installed, check for leaks while bleeding the system. Refer to *Bleeding Power Steering System (Process)*.
4. Tighten the hose connections.
   **Tighten**
   Tighten the hose connections to 33 N·m (24 lb ft).



313904

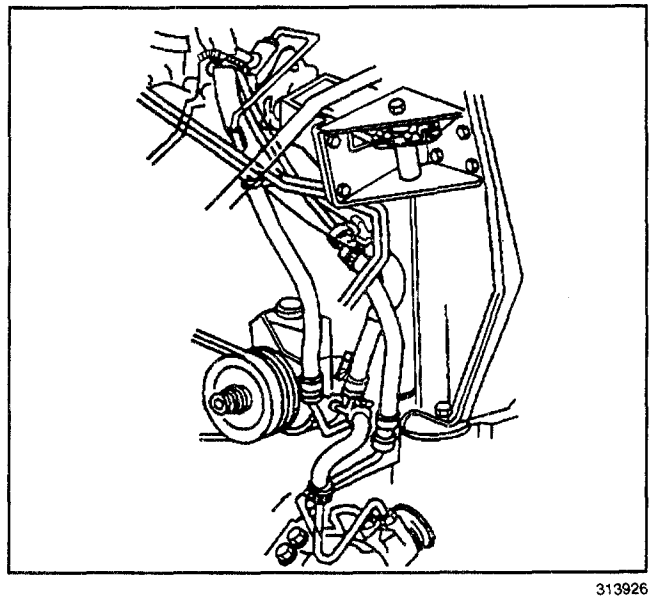
## Power Steering Hoses Replacement (6.5L (L57) Independent)

**Important:** Do not start the vehicle with any power steering hoses disconnected.

After replacing or reinstalling a hose, perform the following steps:

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

1. Route the hoses in the original position they were prior to removal.
2. Route the hoses smoothly.
   Avoid sharp bends and kinking.
3. After the hoses are installed, check for leaks while bleeding the system. Refer to *Bleeding Power Steering System (Process)*.
4. Tighten the hose connections.
   **Tighten**
   Tighten the hose connections to 33 N·m (24 lb ft).



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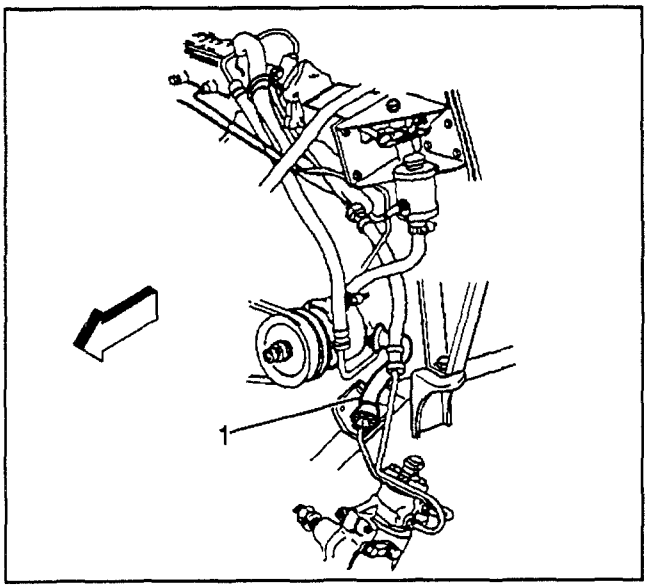


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## Power Steering Hoses Replacement (6.5L (L57) I-Beam)

**Important:** Do not start the vehicle with any power steering hoses disconnected.

After replacing or reinstalling a hose, perform the following steps:

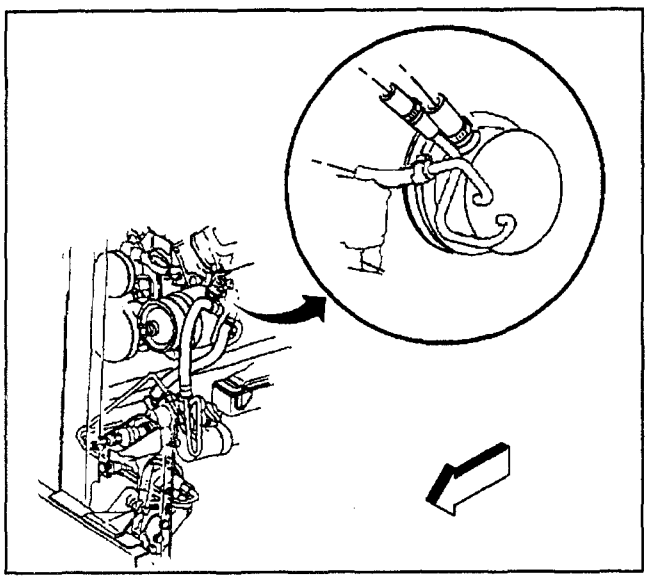
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

1. Route the hoses in the original position they were prior to removal.
2. Route the hoses smoothly.

   Avoid sharp bends and kinking.
3. After the hoses are installed, check for leaks while bleeding the system. Refer to *Bleeding Power Steering System (Process).*
4. Tighten the hose connections.

   **Tighten**

   Tighten the hose connections to 33 N·m (24 lb ft).



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## Power Steering Hoses Replacement (6.5L (L65) and 7.4L Engines)

**Important:** Do not start the vehicle with any power steering hoses disconnected.

After replacing or reinstalling a hose, perform the following steps:

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

1. Route the hoses in the original position they were prior to removal.
2. Route the hoses smoothly.

   Avoid sharp bends and kinking.
3. After the hoses are installed, check for leaks while bleeding the system. Refer to *Bleeding Power Steering System (Process).*
4. Tighten the hose connections.

   **Tighten**

   Tighten the hose connections to 33 N·m (24 lb ft).
5. Tighten the steering gear inlet and outlet hose fittings (motorhomes with the 6.5L and 7.4L engines with independent front suspension).

   **Tighten**

   Tighten the fitting to 30.5 N·m (23 lb ft).

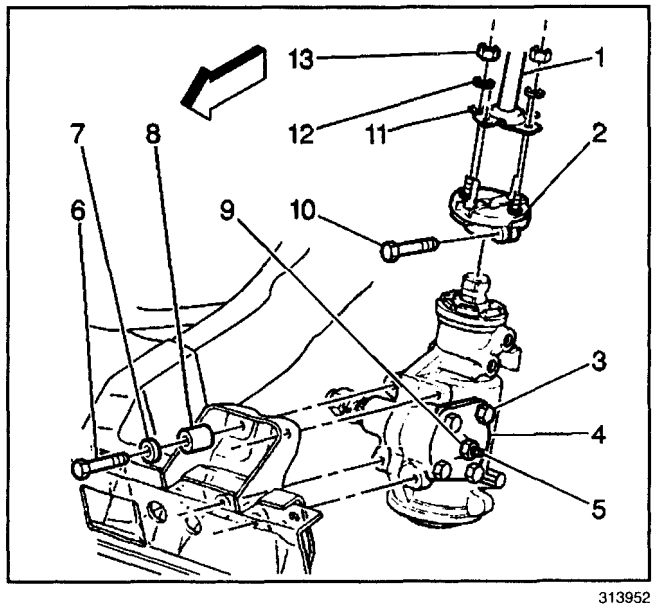
## Power Steering Gear Replacement (708 Model (Motor Home Only))

### Removal Procedure

1. Place a drain pan under the steering gear.

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices.***

2. Disconnect the negative battery cable.
3. Remove the hoses from the steering gear.
4. Raise the hose up in order to prevent any oil drainage.
5. Cap or tape the ends of the hose and the gear fittings in order to prevent contamination.
6. Tag the hose locations.
7. Remove the coupling pinch bolt (10).
8. Mark the relationship of the coupling to the stub shaft.
9. Remove the pitman arm. Refer to *Pitman Arm Replacement (Motorhome )* in Steering Linkage.
10. Remove the steering gear frame bolts (6).
11. Remove the steering gear. Use a soft mallet in order to tap lightly on the coupling in order to remove the steering shaft/coupling from the steering gear stub shaft.



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### Installation Procedure

1. Line up the marks made during the removal procedure in order to guide the stub shaft into the coupling/steering shaft assembly.
2. For JB8 units, install the steering gear to the frame bolts with the washers.

   **Tighten**

   Tighten the bolts to 80 N·m (59 lb ft).
3. Place the steering gear in position.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

Install the steering gear to the frame bolts (6), the spring washers (7), and the spacers (8).

**Tighten**

Tighten the bolts to 87.5 N·m (65 lb ft).

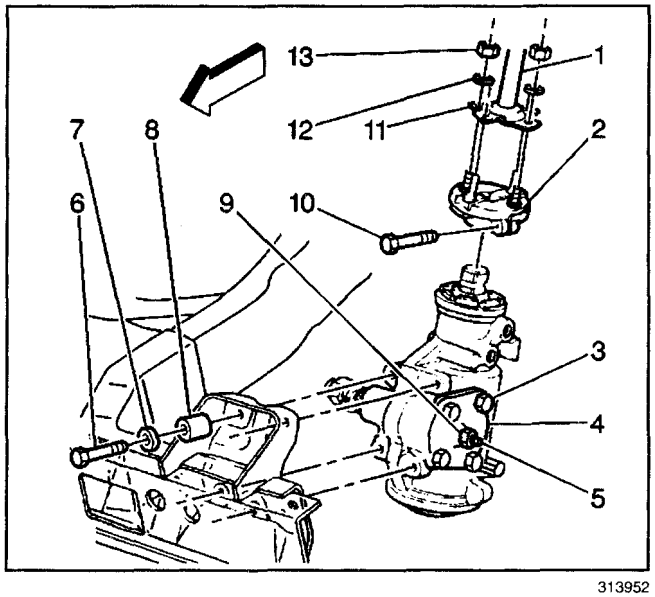
4. Install the coupling pinch bolt.

   **Tighten**

   Tighten the coupling pinch bolt to 102 N·m (75 lb ft).
5. Install the pitman arm. Refer to *Pitman Arm Replacement (Motorhome )* in Steering Linkage.
6. Remove the plugs and the caps from the steering gear and the hoses.
7. Install the hoses to the steering gear.

   **Tighten**

   Tighten the hose fittings to the specifications. Refer to *Fastener Tightening Specifications.*



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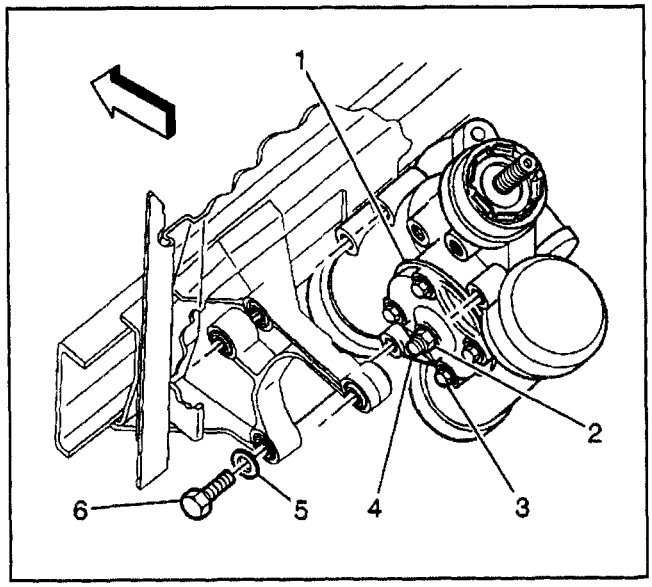

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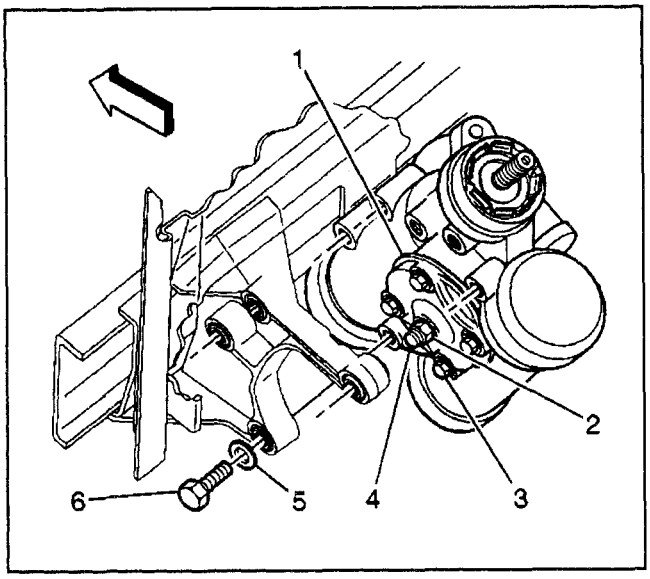

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## Power Steering Gear Replacement (710 Model)

### Removal Procedure

1. Position the front wheels and the steering wheel straight ahead.

***Notice:*** Do not hammer on the pitman arm, pitman arm shaft, or puller. Damage to the pitman or steering gear may result. Pitman arms are non-repairable and must be replaced when damaged or worn.

2. Remove the pitman arm. Refer to *Pitman Arm Replacement (Commercial)* in Steering Linkage.

***Notice:*** Avoid contaminating the power steering system. Cap open hoses and ports to prevent dirt and debris from entering system. Contaminated power steering fluid and dirt can cause early parts failure.

3. Remove the hydraulic hoses from the steering gear.
4. Plug the hoses and the ports in order to prevent contamination.
5. Tag the hose locations.
6. Remove the cardan joint clamp bolt and the nut.
7. Remove the cardan joint from the steering gear stub shaft.
8. Remove the steering gear mounting bolts (6), spacers, and the washers (5).
9. Remove the steering gear.

### Installation Procedure

1. Install the steering gear to the frame rail. Hold the gear in the vertical position (stub shaft up).

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

2. Install the bolts from the directions shown. Install the washers (5) and spacers under the bolt (6) heads.

   **Tighten**

   Tighten the bolts to 240 N·m (177 lb ft).

3. Install the pitman arm. Refer to *Pitman Arm Replacement (Commercial)* in Steering Linkage.

   **Tighten**

   Tighten the nut to 370 N·m (275 lb ft).

4. Install the cardan joint yoke to the steering gear stub shaft.
5. Install the cardan joint bolt.

   **Tighten**

   Tighten the bolt to 48 N·m (35 lb ft).

6. Adjust the cardan joint installed dimension. Refer to *Steering Wheel Replacement* in Steering Wheel and Column.
7. Install the hydraulic hoses to the steering gear.

   **Tighten**

   Tighten the hoses to 38 N·m (28 lb ft).

8. Bleed the system. Refer to *Bleeding Power Steering System (Process).*

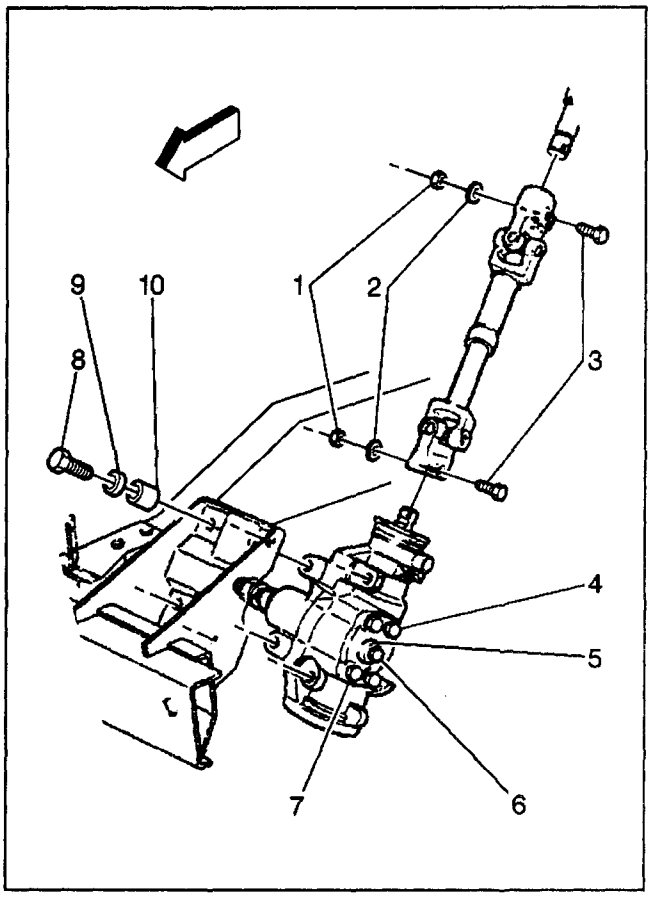
## Power Steering Gear Replacement (708 Model (I-Beam Front Axle))

### Removal Procedure

1. Place a drain pan under the steering gear.

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices.***

2. Disconnect the negative battery cable.
3. Remove the hoses from the steering gear.
4. Raise the hose up in order to prevent any oil drainage.
5. Cap or tape the ends of the hose and the gear fittings in order to prevent contamination.
6. Tag the hose locations.
7. Remove the lower cardan type joint pinch bolt (3).
8. Mark the relationship of the universal yoke to the stub shaft.
9. Remove the pitman arm. Refer to *Pitman Arm Replacement (Commercial (I-Beam Front Axle))* in Steering Linkage.
10. Remove the steering gear frame bolts (8).
11. Remove the steering gear.
12. Use a soft mallet in order to tap lightly on the cardan joint yoke in order to remove the cardan joint from the steering gear stub shaft.



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### Installation Procedure

1. Place the steering gear in position.
2. Line up the marks made during the removal procedure in order to guide the stub shaft into the cardan type joint assembly.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

3. Install the steering gear to the frame bolts (8), the spring washers (9) and the spacers (10).

   **Tighten**

   Tighten the bolts to 87.5 N·m (65 lb ft).
4. Install the intermediate shaft pinch bolt (3).

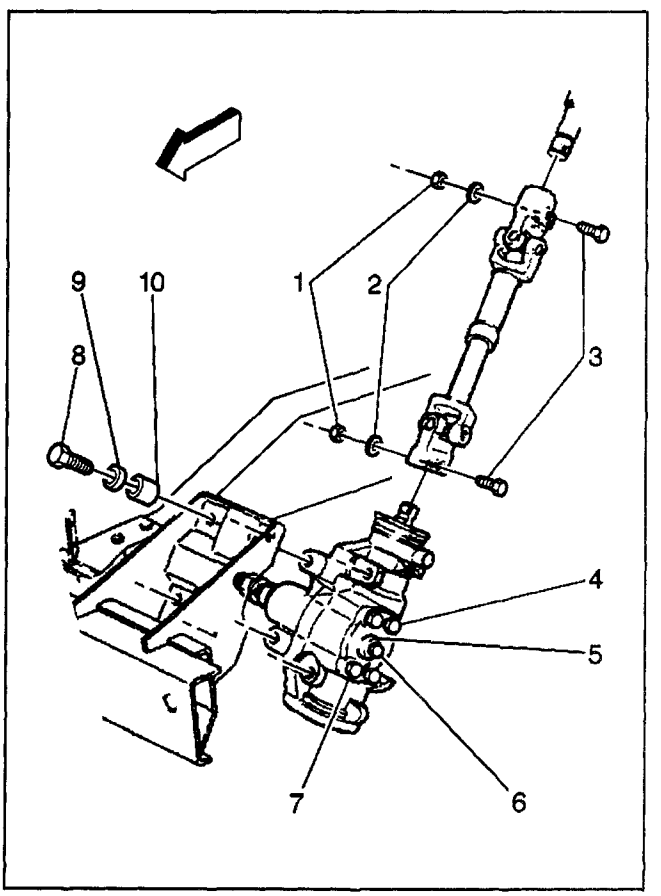
   **Tighten**

   Tighten the pinch bolt to 102 N·m (75 lb ft).

   The pinch bolt (3) must pass through the shaft undercut.
5. Install the pitman arm. Refer to *Pitman Arm Replacement (Commercial (I-Beam Front Axle))* in Steering Linkage.
6. Remove the plugs and the caps from the steering gear and the hoses.
7. Install the hoses to the steering gear.

   **Tighten**

   Tighten the hose fittings to the specifications. Refer to *Fastener Tightening Specifications.*



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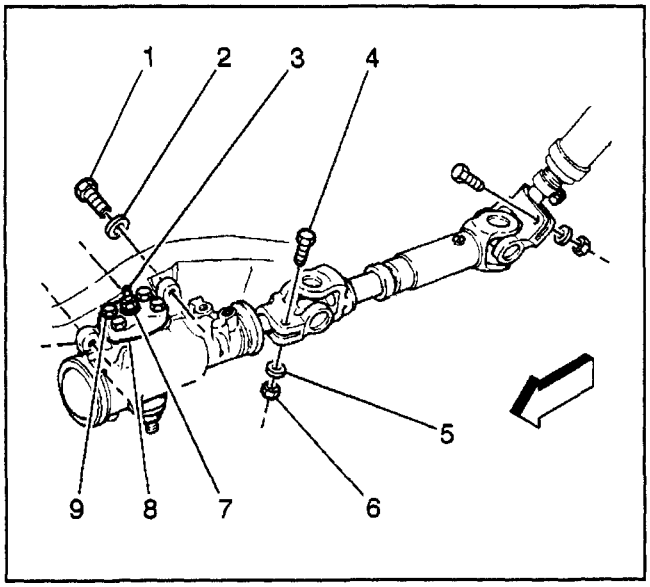

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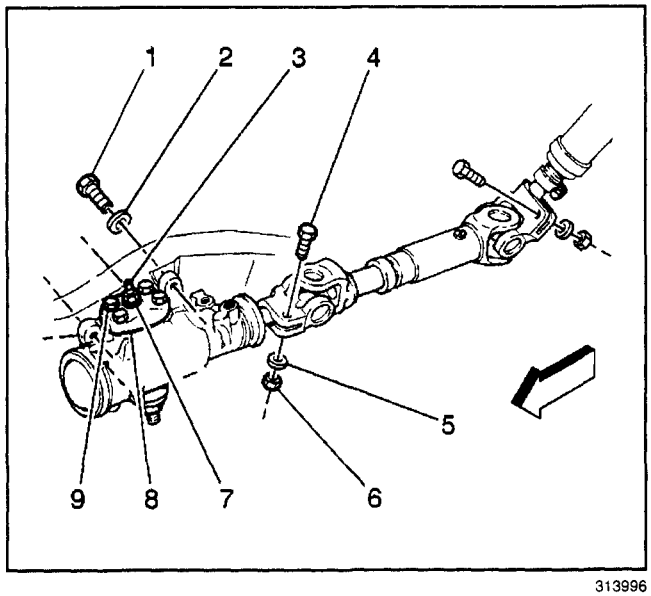
## Power Steering Gear Replacement (708 (Except I-Beam Front Axle))

### Removal Procedure

1. Place a drain pan under the steering gear.

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices.***

2. Disconnect the negative battery cable.
3. Remove the hoses from the steering gear.
4. Raise the hose up in order to prevent any oil drainage.
5. Cap or tape the ends of the hose and the gear fittings in order to prevent contamination.
6. Tag the hose locations.
7. Remove the lower cardan type joint pinch bolt (4).
8. Mark the relationship of the universal yoke to the stub shaft.
9. Remove the pitman arm. Refer to *Pitman Arm Replacement (Motorhome )* in Steering Linkage.
10. Remove the steering gear frame bolts (1) and washers (2).
11. Remove the steering gear.
12. Use a soft mallet in order to tap lightly on the cardan joint yoke in order to remove the cardan joint from the steering gear stub shaft.



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### Installation Procedure

1. Place the steering gear in position.
2. Line up the marks made during the removal procedure in order to guide the stub shaft into the cardan type joint assembly.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

3. Install the steering gear to the frame bolts (1) and the spring washers (2).

   **Tighten**

   Tighten the bolts to 87.5 N·m (65 lb ft).
4. Install the intermediate shaft pinch bolt (4).

   **Tighten**

   Tighten the pinch nut to 102.5 N·m (76 lb ft).

   The pinch bolt (4) must pass through the shaft undercut.
5. Install the pitman arm. Refer to *Pitman Arm Replacement (Commercial)* or *Pitman Arm Replacement (Motorhome )* in Steering Linkage.
6. Remove the plugs and the caps from the steering gear and the hoses.
7. Install the hoses to the steering gear.

   **Tighten**

   Tighten the hose fittings to the specifications. Refer to *Fastener Tightening Specifications.*

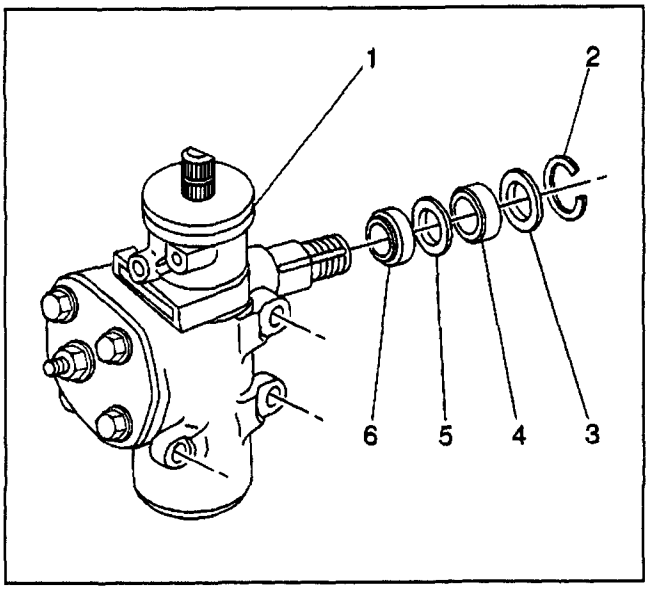
## Pitman Shaft Seal Replacement - On Vehicle (708 Model)

### Removal Procedure

**Tools Required**

*J 4646* Snap Ring Pliers

1. Mark the position of the pitman arm to the pitman shaft.
2. Remove the pitman arm. Refer to the appropriate procedure in Steering Linkage:
   - *Pitman Arm Replacement (Commercial)*
   - *Pitman Arm Replacement (Motorhome )*
   - *Pitman Arm Replacement (Commercial (I-Beam Front Axle))*
3. Remove the dust seal.
4. Use the *J 4646* in order to remove the snap ring (2).
5. Position the drain pan under the steering gear (1).
6. Turn ON the engine.
7. Turn the steering wheel from stop to stop, bouncing the wheel off the stops.
8. Turn OFF the engine.
9. Remove the washers (3, 5).
10. Remove the seals (4, 6).



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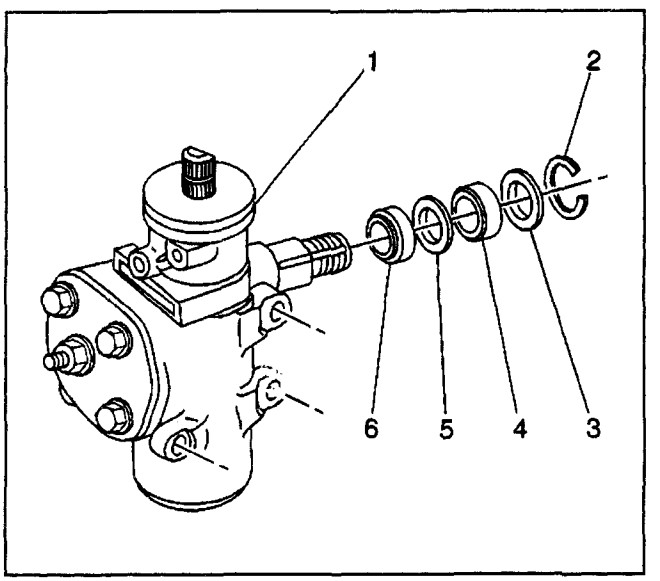
### Installation Procedure

**Tools Required**

*J 6219* Pitman Shaft Seal Installer

1. Lubricate the new seals with power steering fluid.
2. Apply a single layer of tape to the pitman arm shaft in order to avoid damaging the seals.
3. Install the seal (6).
4. Install the washer (5) using *J 6219* to seat the seal.
5. Install the seal (4).



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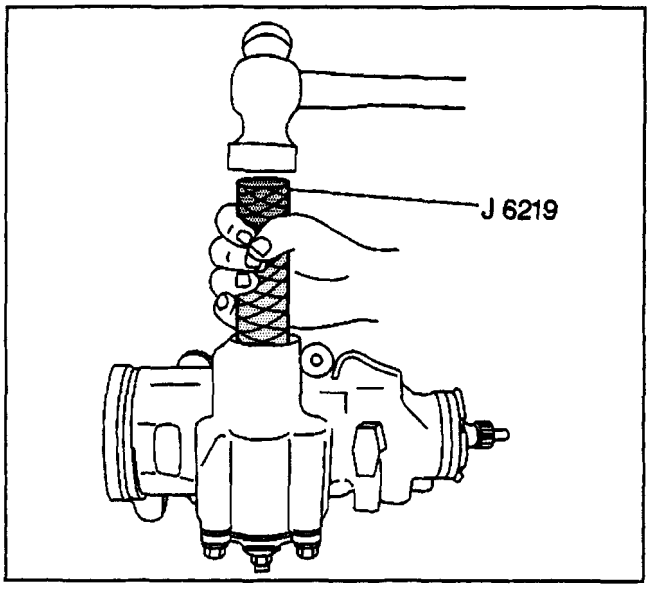


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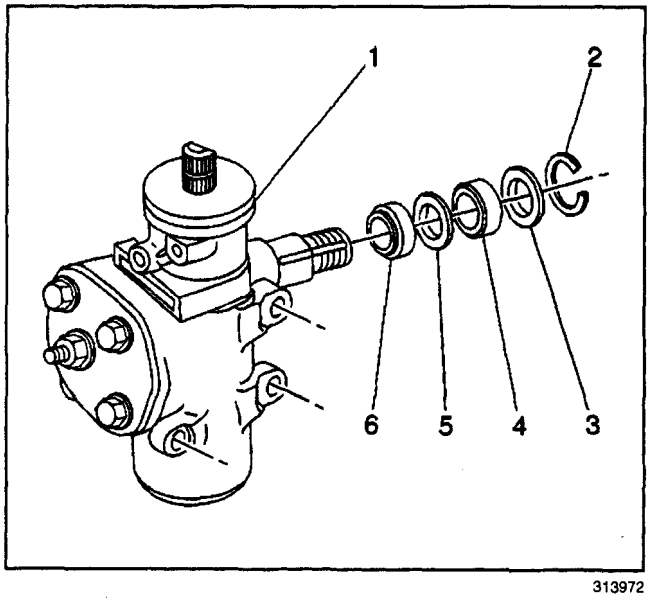
6. Install the washer using the *J 6219* in order to seat the seal. The seal should be in far enough in order to install the snap ring.

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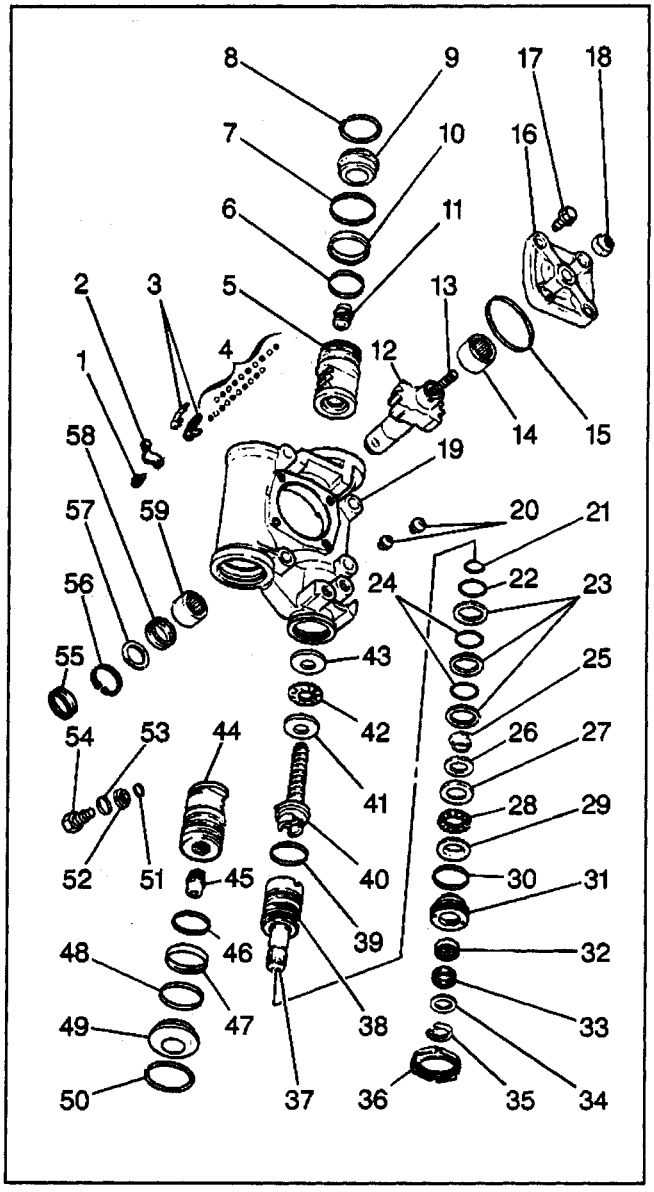
7. Install the snap ring (2).
8. Use the following procedure in order to center the steering gear:
   8.1. Turn the steering wheel until the steering wheel stops.
   8.2. Turn the steering wheel in the opposite direction until the steering wheel stops.
   8.3. Turn the wheel back 1/2 the number of turns in the previous step.
9. Install the dust seal.
10. Install the pitman arm. Refer to the appropriate procedure in Steering Linkage:
    - *Pitman Arm Replacement (Commercial)*
    - *Pitman Arm Replacement (Motorhome )*
    - *Pitman Arm Replacement (Commercial (I-Beam Front Axle))*
11. Bleed the system. Refer to *Bleeding Power Steering System (Process).*

## Pitman Shaft Seal Replacement - On Vehicle (710 Model)

### Removal Procedure

1. Place a pan under the steering gear in order catch the oil.
2. Remove the pitman arm. Refer to *Pitman Arm Replacement (Commercial)*, *Pitman Arm Replacement (Motorhome )*, or *Pitman Arm Replacement (Commercial (I-Beam Front Axle))*.
3. Use a pry tool in order to remove the dust seal (55).
4. Remove the pitman shaft seal snap ring (56).
5. Remove the steel washer (57).
6. Use a pry tool in order to remove the oil seal (58). Do not scratch the bore.
7. Inspect the pitman shaft seal surfaces for roughness or pitting.

   If there is pitting, replace the pitman shaft.
8. Inspect the housing for burrs. Remove the burrs before installing the new seals.

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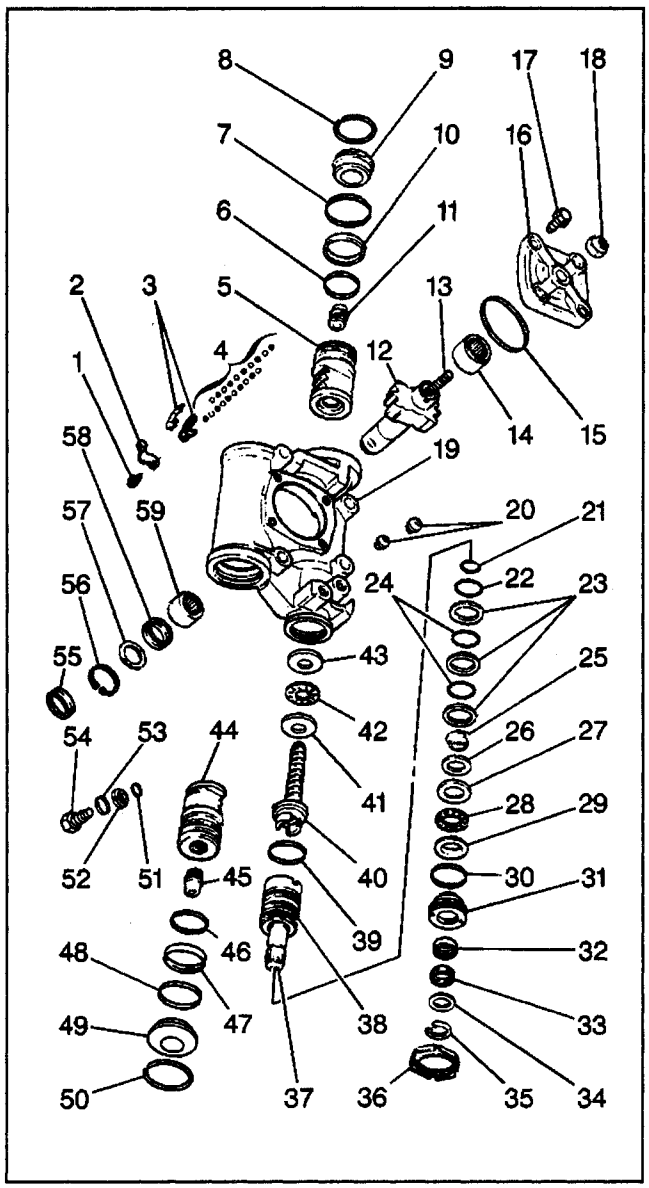


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### Installation Procedure

1. Lubricate the new seals with power steering fluid.
2. Install the seal (58), using a suitable pipe as a driver. If the service kit uses a two-piece seal, be sure to place the nylon inner ring into the recess of the outer seal face.
3. Install the steel washer (57).
4. Install the pitman shaft seal snap ring (56).
5. Install the dust seal (55).
6. Use the following procedure for steering gear centering.
   - 6.1. Turn the steering wheel until it stops.
   - 6.2. While counting the number of turns, turn the steering wheel in the opposite direction until it stops.
   - 6.3. Turn the steering wheel back one-half the number of turns counted in the previous step.
7. Install the pitman arm. Refer to *Pitman Arm Replacement (Commercial)*, *Pitman Arm Replacement (Motorhome )*, or *Pitman Arm Replacement (Commercial (I-Beam Front Axle))*.
8. Bleed the system. Refer to *Bleeding Power Steering System (Process)*.

## Steering Gear Adjustments (708 Model)

Before making any adjustments refer to the power steering diagnostics in order to review the possible steering system problems. Adjust the steering gear only as a correction and not as a periodic adjustment. Adjusting the steering gear in the vehicle is not recommended for the following 2 reasons:

- The complexity involved in adjusting the worm thrust bearing preload
- The friction effect provided by the hydraulic fluid in the steering gear

For the proper adjustment, remove the steering gear from the vehicle. Refer to the appropriate procedure:

- *Power Steering Gear Replacement (708 Model (Motor Home Only))*
- *Power Steering Gear Replacement (708 Model (I-Beam Front Axle))*
- *Power Steering Gear Replacement (708 (Except I-Beam Front Axle))*

1. Drain the power steering fluid from the gear.
2. Mount the gear in a vise.
3. Make the following adjustments:
   - The worm thrust bearing preload
   - The pitman shaft over-center preload

The worm thrust bearing preload is controlled by the amount of compression force exerted on the conical worm bearing thrust races by the adjuster plug.

The pitman shaft over-center preload is controlled by the pitman shaft adjuster screw. The pitman shaft adjuster screw determines the clearance between the rack piston and the pitman shaft sector teeth.

## Steering Gear Adjustments (710 Model)

If there is not enough room in order to swing the torque wrench through the arc required for the accurate preload measurement, remove the steering gear from the vehicle. Adjust the steering gear on the bench if the steering gear is removed from the vehicle. To adjust the steering gear on the bench refer to *Worm Thrust Bearing Preload Adjustment - Off Vehicle (710 Model).* Disregard the steps that pertain to on-vehicle adjustment.

Always check the worm bearing preload adjustment first. Adjust, if necessary, before making the pitman shaft preload over-center adjustment. Refer to *Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (710 Model).*

## Steering Gear Adjustments (High-Point Centering)

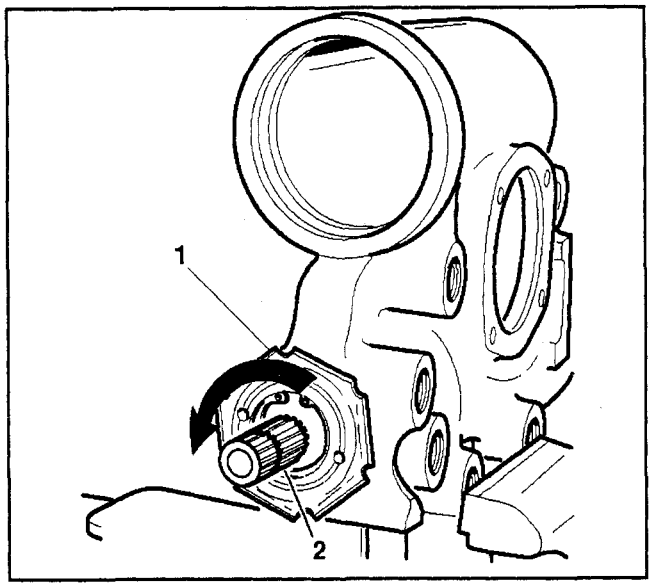
1. Set the front wheels in the straight ahead position. This can be checked by driving the vehicle a short distance on a flat surface.

**Important:** The worm shaft mark should be at the top side of the shaft at the 12 o'clock position and lined up with the mark in the coupling lower clamp.

2. Check the position of the mark on the worm shaft designating the steering gear high point.

**Important:** Turning the adjuster tubes an unequal number of turns or in different directions will disturb the toe setting of the wheels.

3. Loosen the adjuster tube clamps on both the left and right hand tie rods on models equipped with an independent front suspension, if the steering gear has been moved off the high point when setting the wheel in the straight ahead position.
4. Turn both adjuster tubes an equal number of turns in the same direction to bring the gear back on the high point.
5. Loosen the adjuster tube clamps on the connecting rod on models equipped with the I-beam front suspension, if the gear has been moved off the high point when setting the wheels in the straight ahead position.
6. Turn the adjuster tube to bring the gear back on the highpoint.
7. Check and adjust the toe-in. Refer to *Front Toe Adjustment.*
8. Refer to *Tie Rod Replacement (Commercial), Tie Rod Replacement (Motorhome), Tie Rod Replacement (Commercial (I-Beam Front Axle)),* and *Connecting Rod Replacement* in Steering Linkage for adjuster tube clamping instructions.



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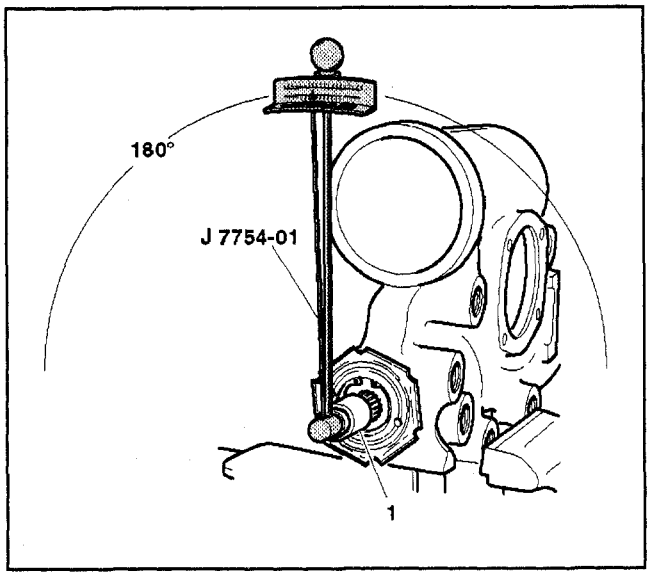
## Steering Gear Adjustments (710 Model)

### Adjustment Procedure

#### Tools Required

*J 7754 - 01* Torque Wrench

1. Drain the oil from the steering gear by rotating the steering gear completely several times.
2. Turn the stub shaft (1) from the right wheel stop to the left wheel stop while counting the number of turns.
3. Rotate the stub shaft (1) back half the number of turns to the center position.



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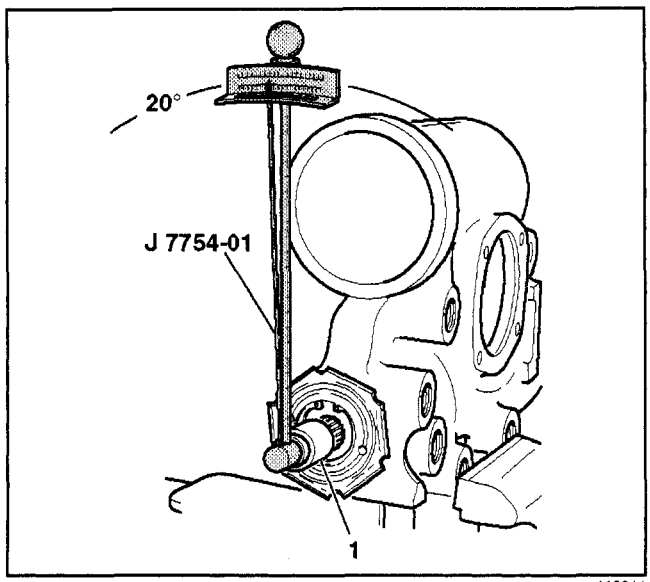
4. Place *J 7754 - 01* and a deepwell ¾ inch 12 point socket (1) over the stub shaft in order to check the total preload torque by rotating *J 7754 - 01* through a 180 degree arc either side of the center.
5. Record the highest reading while turning *J 7754 - 01* back over the center position.
6. Turn the stub shaft ½ turn (180 degrees) right or left from the center.
7. Install *J 7754 - 01* vertically on the stub shaft.



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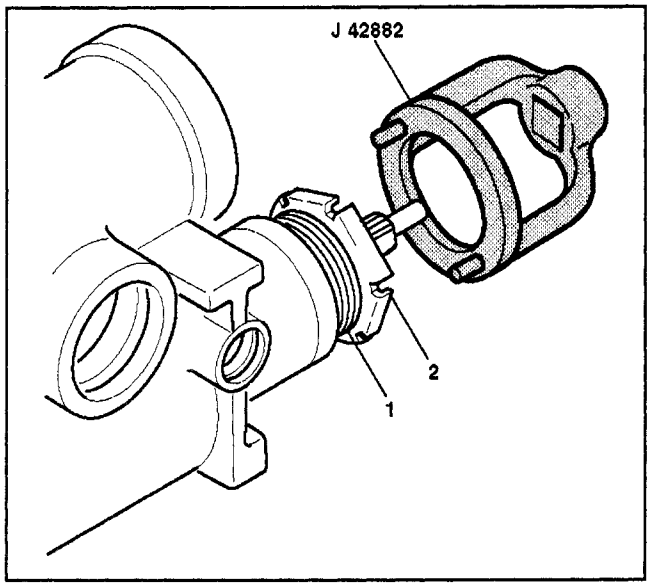
8. Turn *J 7754 - 01* 20 degrees to the left or the right of the vertical position.
9. Record the reading while turning *J 7754 - 01* back to the vertical position.
10. Subtract this reading from the reading in step 5.
11. If the reading in step 5 is 0.23 N·m (2 lb in), then the steering gear is adjusted properly. If the reading in step 5 is less than 0.23 N·m (2 lb in) proceed with the following adjustments:
    - 11.1. If the reading in step 5 is at least 0.23 N·m (2 lb in) and not more than 1.13 N·m (10 lb in), the steering gear is adjusted properly. Proceed to steps 12 through 16.
    - 11.2. If the reading in step 5 is less than 0.23 N·m (2 lb in) or more than 1.13 N·m (10 lb in), proceed to step 12 through 23.
12. Loosen the coupling shield retainer and the lock nut with the steering gear centered.

13. Turn the adjuster nut assembly (1) clockwise using *J 42882*. Torque the adjuster nut assembly (1) to 28–31 N·m (21–23 lb ft) and back off 15–25 degrees.
14. Tighten the coupling shield and lock nut (2). Stabilize the adjuster nut assembly (1) while tightening the coupling shield and lock nut (2).
15. Turn the stub shaft 2 turns right or left from the center position.



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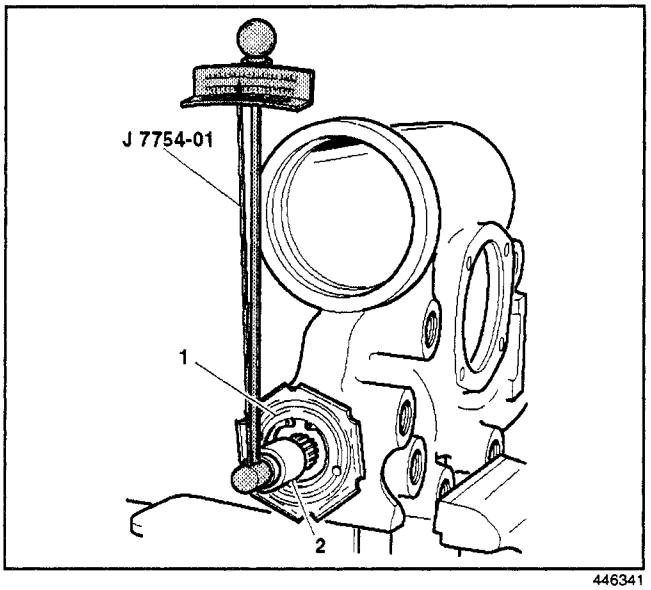
16. Install *J 7754 - 01* near vertical. Record the torque reading. The torque reading should be 1.60 N·m (14 lb in) while turning *J 7754 - 01* in an arc 20 degrees left or right of the vertical position.



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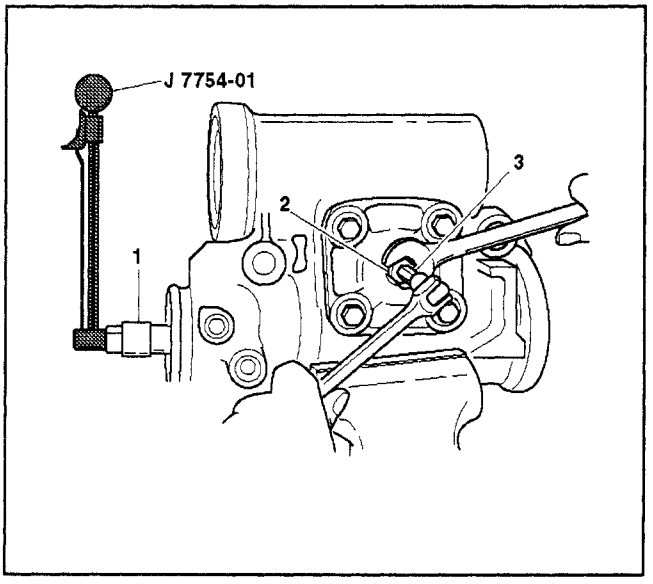
17. With the steering gear in the center position, loosen the preload adjuster nut (2). Ensure the adjusting screw is backed out counterclockwise all the way.
18. Turn the adjuster screw clockwise ½ turn. This prevents the pitman shaft from bottoming out of the side cover.
19. Place *J 7754 - 01* in the vertical position in order to check the preload.
20. Move *J 7754 - 01* 90 degrees to the left or the right of the center position. Record the highest torque reading while moving *J 7754 - 01* back to the center position.
21. Tighten the adjuster screw clockwise until the torque reading is 0.68–1.13 N·m (6–10 N·m) higher than the reading taken in the previous step.
22. Tighten the preload adjuster nut (2) to 90 N·m (66 N·m). Ensure the adjuster screw does not turn during tightening.
23. Reinspect the preload after tightening the preload adjuster nut (2).



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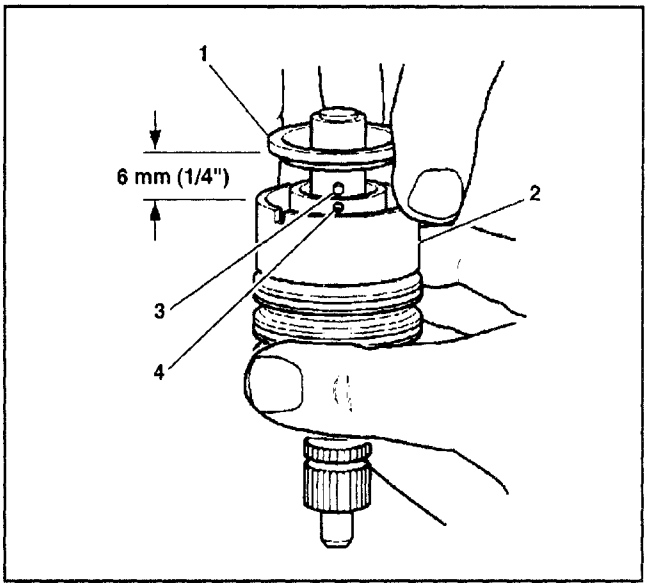
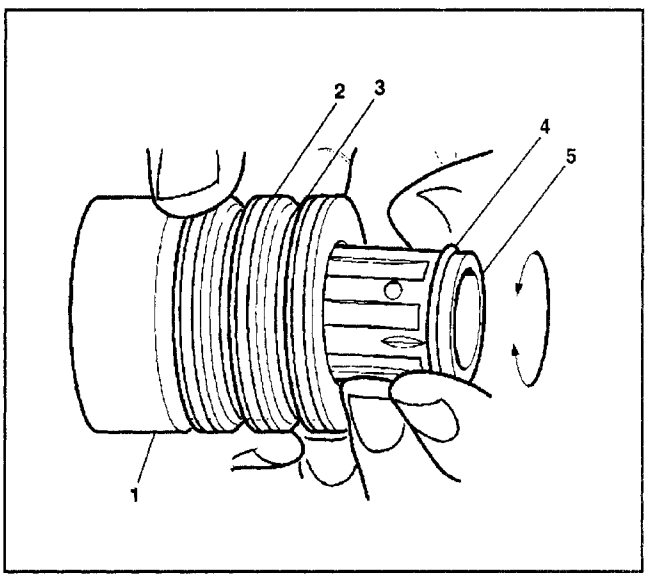


322014

## Steering Gear Stub Shaft Bearing and Seal Replacement

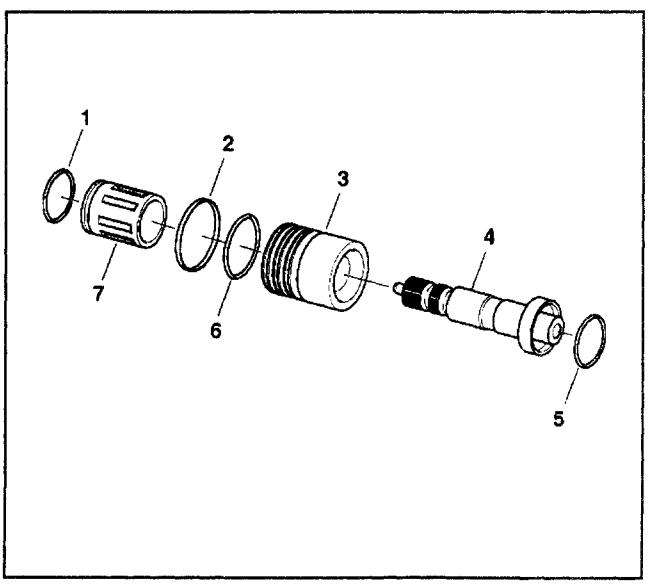
### Disassembly Procedure

1. Remove the stub shaft O-ring seal from the stub shaft cap end (1).
2. Remove the stub shaft from the valve body (2).
3. Tap the stub shaft lightly on a wood block in order to loosen the shaft cap.
4. Pull the shaft cap and the valve spool out from valve body 6 mm (¼ inch).
5. Disengage the stub shaft pin (3) from the hole in the valve spool (4).



322015

6. If the valve assembly needs repair, disassemble the valve as follows:
   6.1. Simultaneously pull and rotate the valve spool (5) in order to remove the valve spool (5) from the valve body (1).
   6.2. Remove the valve spool O-ring seal (4).
   6.3. Alternately remove the valve body valve body rings (2) and the O-ring seals (3).



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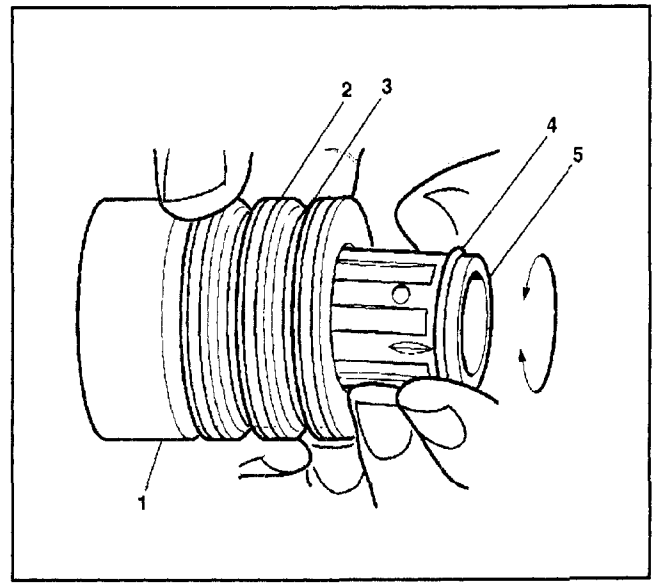
7. Inspect the O-ring seals (2) and the valve body rings (2).
8. If one or more of the following items occur, replace the valve assembly:
   - The torsion bar and the stub shaft leak.
   - The ground surface of the stub shaft contains nicks or burrs.
   - The small notch in the skirt of the valve is worn.
9. If one or more of the following items occur, replace the stub shaft assembly (4) and the valve assembly:
   - The stub shaft pin contains wear or cracks.
   - The outside diameter of the valve spool contains nicks or burrs.
   - The inside diameter of the valve body contains nicks or burrs.
   - The valve spool (7) binds when rotated.

### Assembly Procedure

1. Lubricate the new valve body ring (2) and the O-ring seals (3) with power steering fluid.
2. Install the new O-ring seals (3) in the ring grooves.
3. Install the new valve body rings (2) in the grooves over the O-ring seals (3).
4. Lubricate the valve spool (5) and the valve spool O-ring seal (4) with power steering fluid.
5. Install the valve spool O-ring seal (4) to the valve spool (5).



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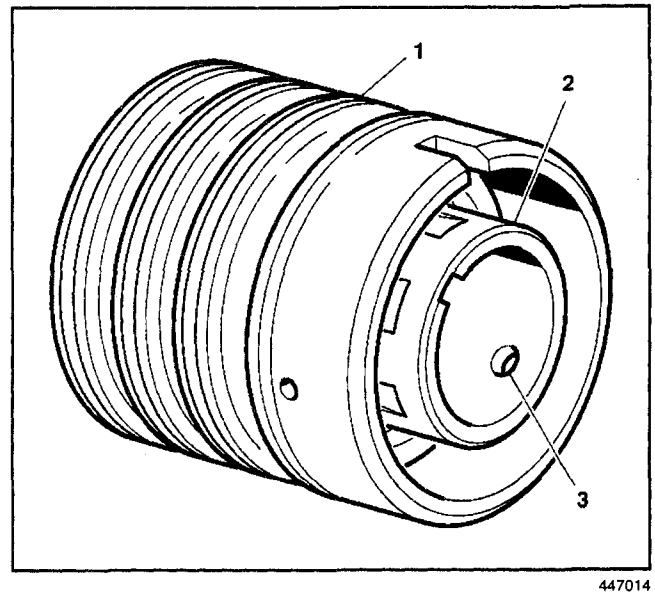
6. Simultaneously push and rotate the valve spool (2) into the valve body (1) until the hole (3) in the valve spool (2) for the stub shaft pin is accessible from the opposite end of the valve body (1).



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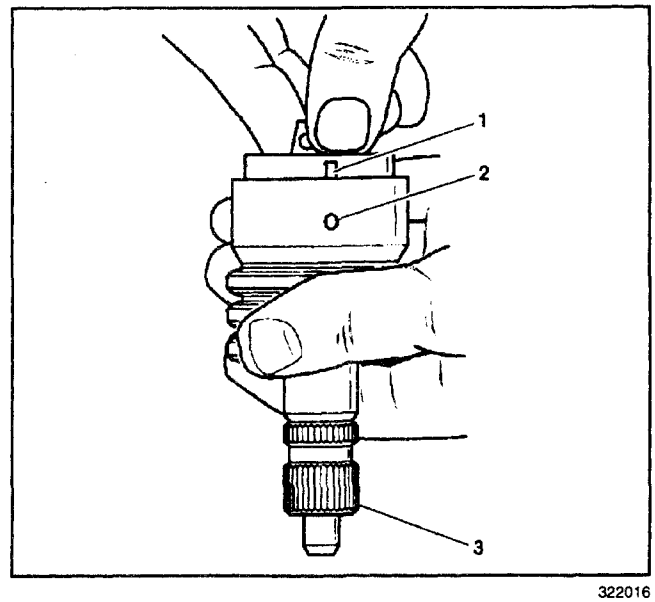
7. Lubricate the stub shaft assembly (3).
8. Install the stub shaft assembly (3) into the valve spool until the stub shaft pin can be place into the valve spool.
9. Align the notch in the stub shaft cap (1) with the pin in the valve body (2).

**Important:** Make sure that the shaft cap notch (1) is mated with the valve body pin before installing the valve body into the steering gear assembly.

10. Install the valve spool and the stub shaft assembly into the valve body. The stub shaft cap should be below the valve body notch (1).
11. Lubricate a new stub shaft cap to the stub shaft O-ring seal.
12. Install the new stub shaft cap and the stub shaft O-ring seal into the valve body.



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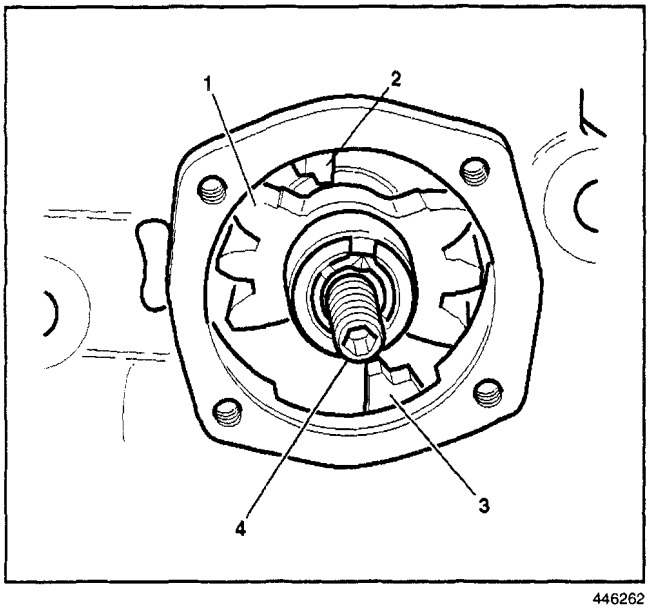


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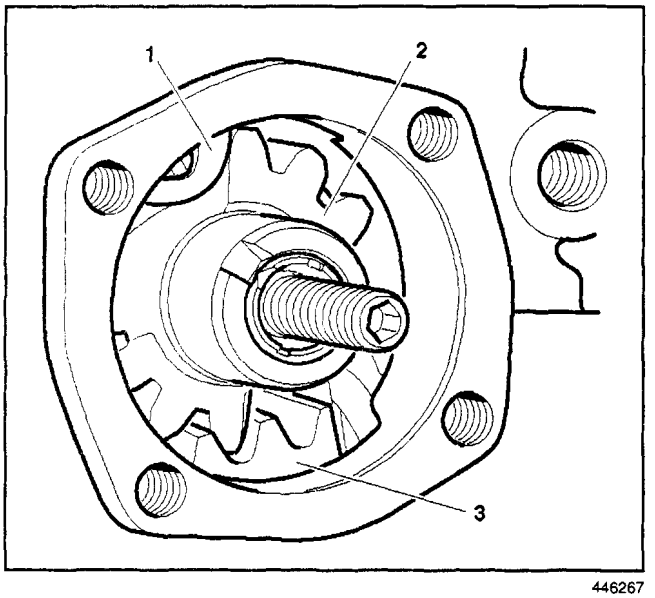



446267

## Steering Gear Disassemble (X)

### Disassembly Procedure

#### Tools Required

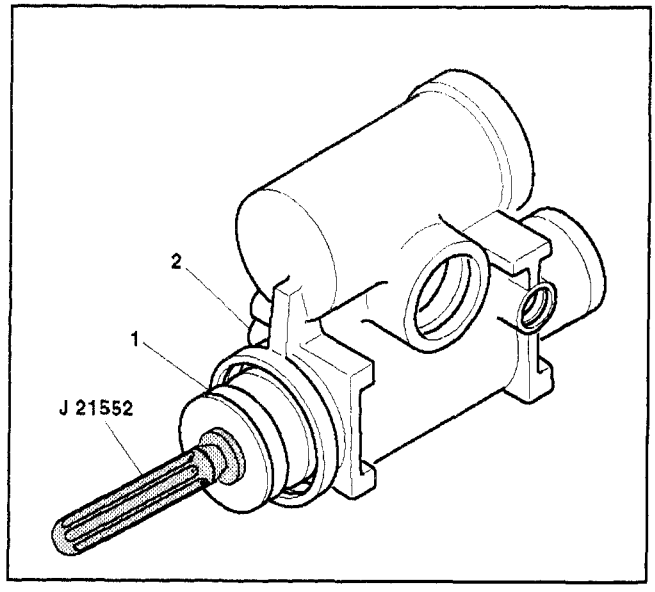
- *J 21552* Rack Piston Arbor
- *J 7624* Spanner Wrench
- *J 6222-A* Seal Shaft Protector

1. Remove the housing end plug. Refer to *Steering Gear Housing End Plug Replacement - Off Vehicle (710 Model).*
2. Remove the side cover. Refer to *Steering Gear Pitman Shaft and Housing Cover Replacement - Off Vehicle (710 Model).*
3. Turn the stub shaft (4) clockwise until the pitman shaft teeth (1) and the primary rack piston (3) and the secondary rack piston (2) are disengaged.
4. Turn the stub shaft (4) clockwise until the primary rack piston (3) bottoms in the steering gear housing.
5. Align the end tooth of the pitman shaft with the center groove of the primary rack piston (1) and the secondary rack piston (1).
6. Turn the stub shaft counterclockwise until the housing end plug separates from the steering gear housing.

**Important:** Do not remove the housing end plug from the secondary rack piston (1) unless replacement of the housing end plug is needed.

7. Remove the secondary rack piston (1).
8. Rotate the stub shaft clockwise until the pitman shaft teeth (2) are free of the rack.
9. Turn the pitman shaft teeth (2) until the teeth (2) are horizontal.

10. Insert *J 21552* into the primary rack piston (1) bore with the pilot of *J 21552* seated into the end of the pin and worm assembly.
11. Hold *J 21552* against the pin and worm assembly while turning the stub shaft counterclockwise. The primary rack piston (1) will be forced onto *J 21552*.
12. Hold *J 21552* while pulling the primary rack piston (1) toward the handle until the primary piston rack touches the tool flange. This prevents the circuit balls from falling out of the primary rack piston (1).
13. Remove the primary rack piston (1) from *J 21552*.
14. Remove the primary rack piston balls.
15. Remove pitman shaft from the steering gear housing (2) by tapping the end of the pitman shaft.



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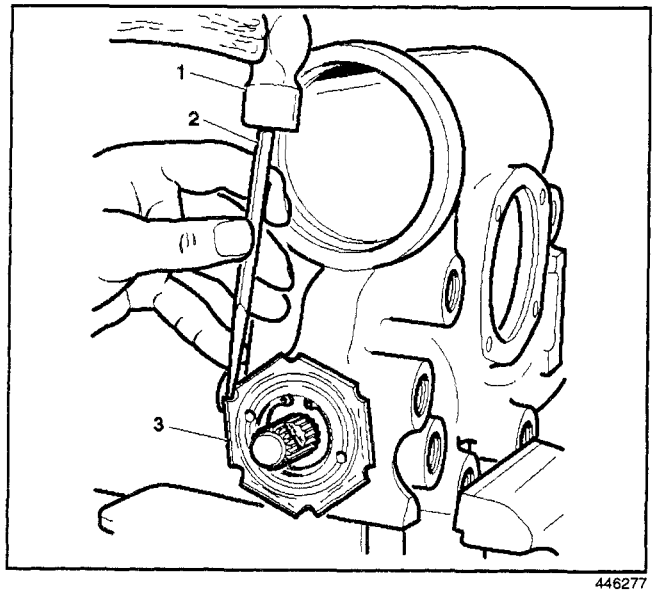
16. Remove the coupling shield retainer and lock nut (3) using a hammer (1) and a drift (2).
17. Slide *J 6222-A* over the end of the stub shaft.



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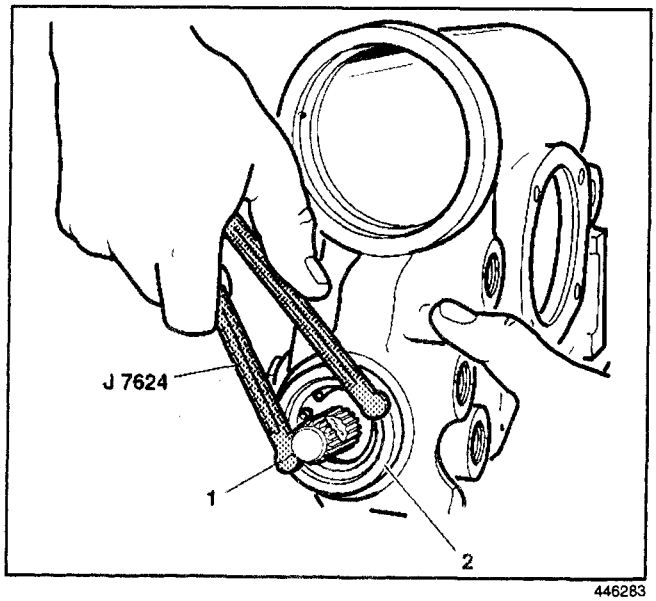
18. Remove the adjuster nut assembly (2) using *J 7624*.
19. Remove the thrust support assembly.



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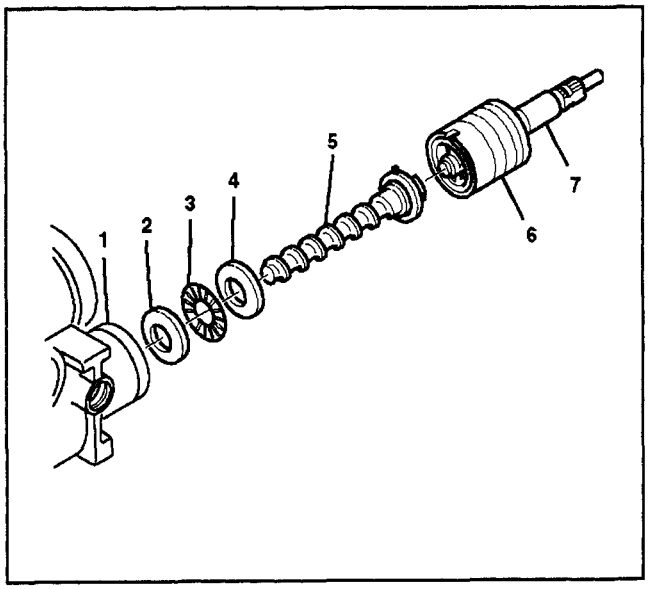


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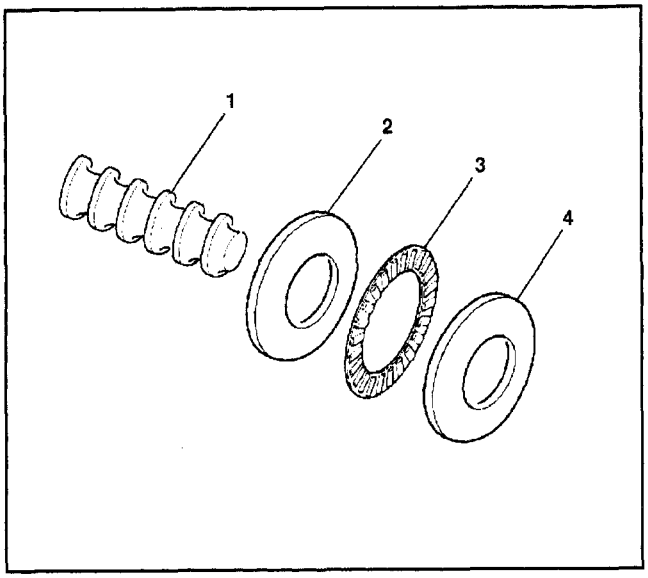
**Important:** Do not reuse damaged or worn parts by welding or straightening. Replace all bent, broken or worn parts.

20. Remove the following items as an assembly from the steering gear housing:
    - The valve body (6)
    - The worm shaft (5)
    - The thrust bearing race (4)
    - The roller thrust bearing (3)
    - The thrust bearing race (1)
21. Remove the worm shaft (5) from the valve body assembly (6).

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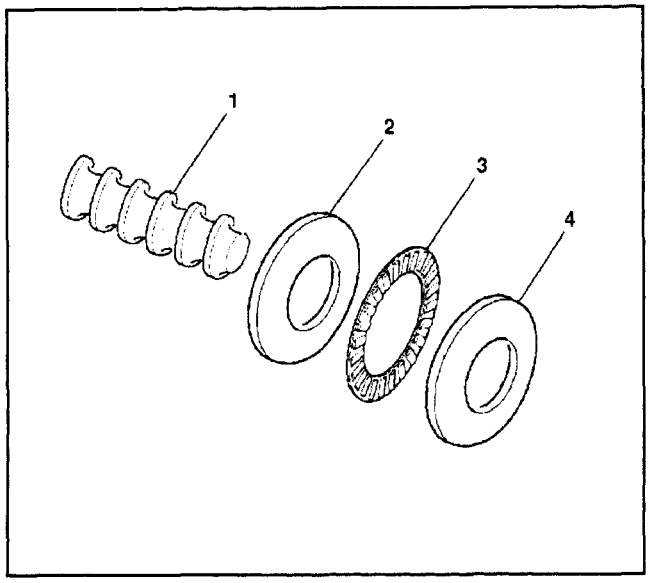
22. Remove the thrust bearing races (2) (4) and the roller thrust bearing (3) from the worm shaft (1).
23. Clean all of the parts in cleaning solvent.
24. Blow dry all of the parts.




322025

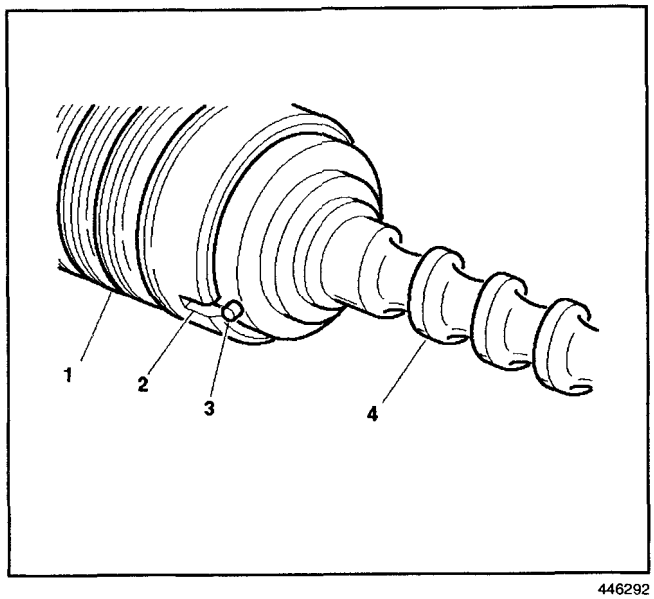
## Steering Gear Assemble (X)

### Assembly Procedure

- *J 21552* Rack Piston Arbor
- *J 6222-A* Seal Shaft Protector
- *J 7754 - 01* Torque Wrench
- *J 42882* Adjuster Nut Socket

1. Lubricate the following items with power steering fluid:
    - The worm shaft (1)
    - The roller thrust bearing (3)
    - The thrust bearing races (2) (4)

2. Install the following items over the end of the worm shaft (1) Ensure that the angled surfaces on the thrust bearing races (2) (4) are parallel to each other:
   - The thrust bearing race (2)
   - The roller thrust bearing (3)
   - The thrust bearing race (4)
3. Lubricate the following items with power steering fluid:
   - The valve body O-ring seals
   - The stub shaft cap
   - The stub shaft O-ring seal
4. Align the narrow notch (2) in the valve body (1) with the pin (3) in the worm shaft cap.



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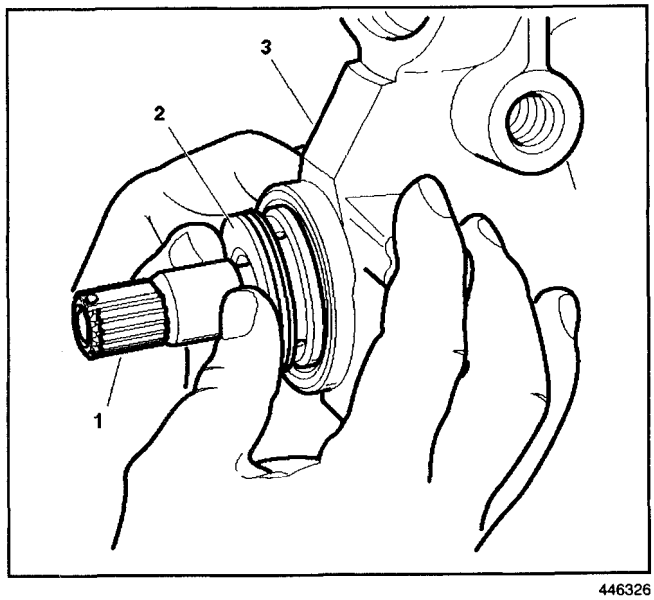
5. Install the following items into the steering gear housing (3) while applying pressure only to the valve body (2):
   - The valve body (2)
   - The worm shaft assembly
6. Ensure that the valve body (2) is properly seated when the oil return hole in the steering gear housing is entirely uncovered.
7. Apply oil to the O-ring seal.
8. Install the O-ring seal onto the thrust support assembly.
9. Place *J 6222-A* over the end of the stub shaft (1).
10. Push the thrust support assembly until the thrust support assembly seats against the valve body.



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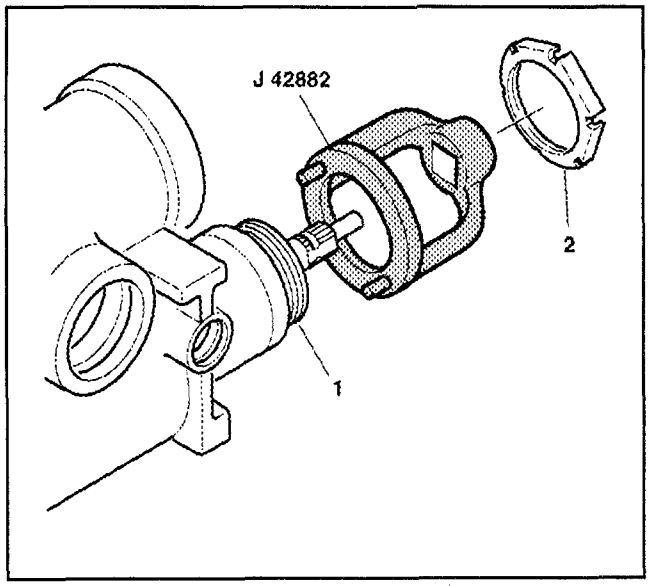


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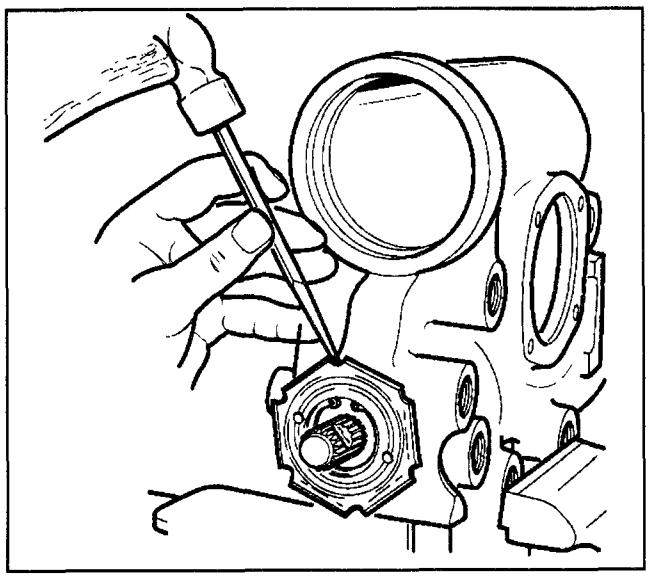
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

11. Install the adjuster nut assembly (1) into the steering gear housing until the adjuster nut assembly (1) seats against the thrust support assembly.

    **Tighten**

    Tighten the adjuster nut assembly (1) to 28–31 N·m (21–23 lb ft) using *J 42882*.

12. Install the coupling shield retainer and lock nut (2).



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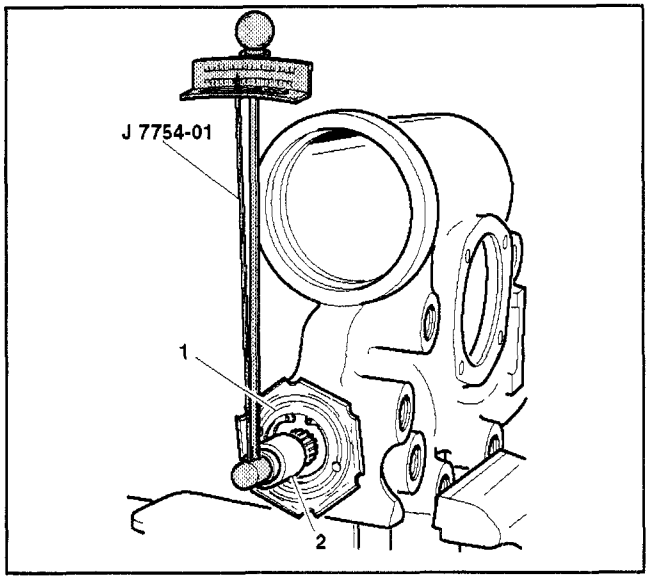
13. Tighten the coupling shield retainer (1) securely using a drift in a notch.
14. Hold the adjuster nut assembly in order to maintain the alignment of the marks while tightening the coupling shield retainer and lock nut (1).

    **Tighten**

    Tighten the coupling shield retainer and lock nut (1) to 108 N·m (80 lb ft).

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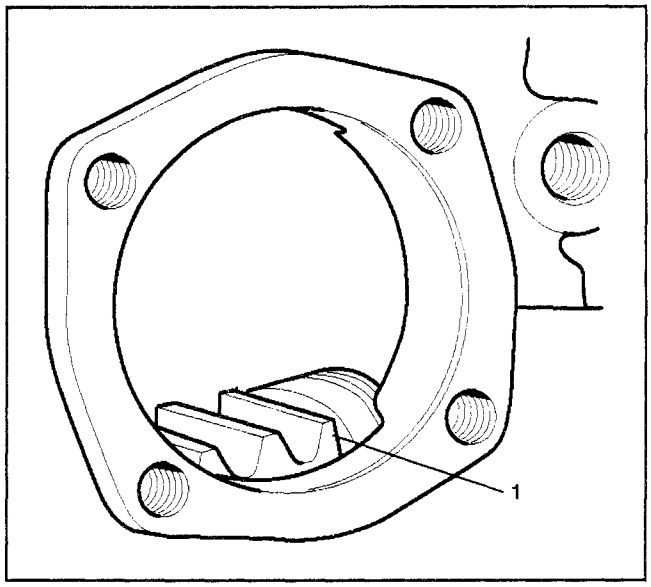
15. Inspect the turning torque using a ¾ inch 12–point socket (2) and *J 7754 - 01*.

16. Insert *J 21552* into the bore of the primary rack piston (1).
17. Push the primary rack piston (1) into the steering gear housing with the teeth facing the pitman shaft opening until *J 21552* contacts the center of the worm shaft.
18. Turn the stub shaft clockwise to thread the primary rack piston onto the worm shaft while holding *J 21552* against the end of the worm.
19. After threading the primary rack piston (1) completely on the worm shaft, remove *J 21552* from the primary rack piston (1).
20. While looking through the side cover opening, center the primary rack piston.



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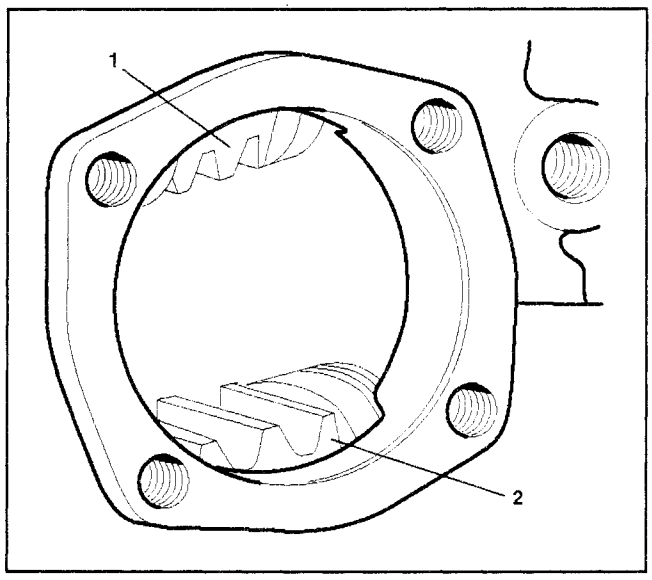
21. Install the secondary rack piston (2) into the steering gear housing with the teeth facing the pitman shaft opening.
22. Align the secondary rack piston teeth (2) with the primary rack piston teeth (1).



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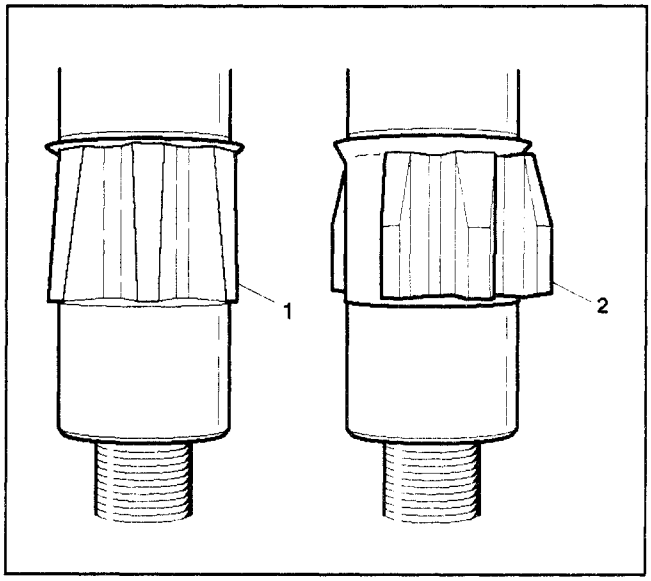
**Important:** The pitman shaft must be installed with the tapered teeth engaging the primary rack piston. If this procedure is not followed, you will be impossible to eliminate the lash between the primary gear teeth.

23. Lubricate the area between the seal lips of the pitman shaft seal with chassis lubricant or an all-purpose grease.



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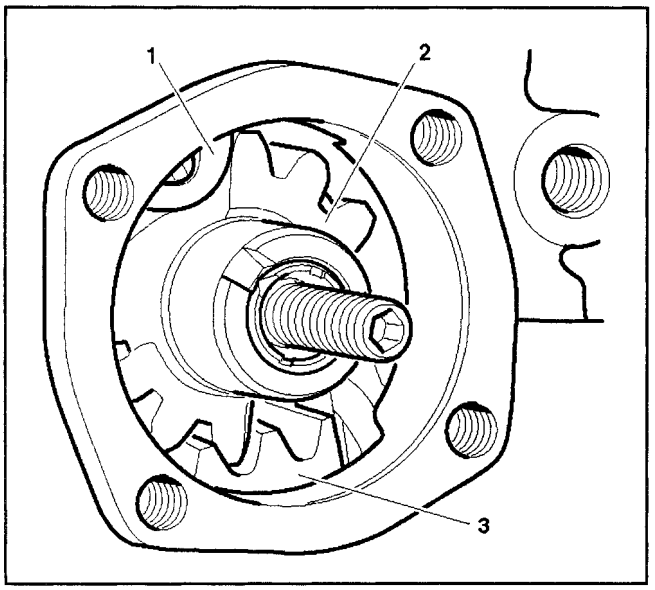


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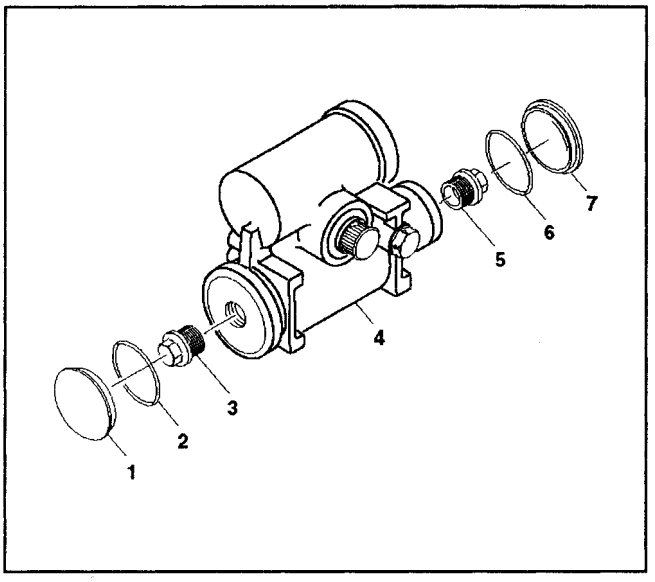
24. Install pitman shaft (2) into the steering gear housing.
25. Install the side cover. Refer to *Steering Gear Pitman Shaft and Housing Cover Replacement - Off Vehicle (710 Model).*

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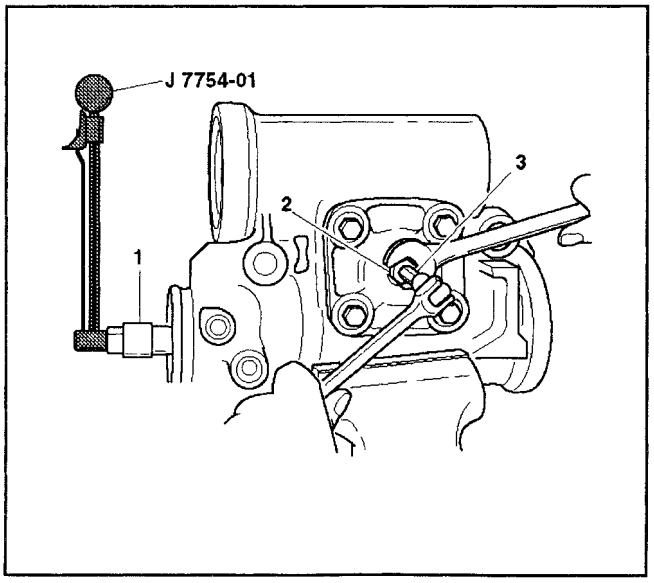
26. Install the rack piston plugs (3) (5) to both cylinders.

    **Tighten**

    If the rack piston plugs (3) (5) are aluminum, tighten the rack piston plugs (3) (5) to 102 N·m (75 lb ft). If the rack piston plugs (3) (5) are steel, tighten the rack piston plugs (3) (5) to 115 N·m (85 lb ft).
27. Install the housing end plug. Refer to *Steering Gear Housing End Plug Replacement - Off Vehicle (710 Model).*

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28. In order to adjust the pitman shaft preload, perform the following steps:
    28.1. Attach *J 7754 - 01* and a 12–point socket (1) on the stub shaft splines.
    28.2. Turn the stub shaft counterclockwise until bottomed. Count the number of turns.
    28.3. Turn the stub shaft back ½ the number of turns counted above to centered position.
    28.4. In order to check the combined ball and bearing preload, turn the torque wrench (3) through the center of travel. Record the highest reading.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

**Tighten**

Tighten the adjuster screw on the pitman shaft until the torque wrench reading is 0.7–1.1 N·m (6–19 lb in) higher than the previous reading. The total reading should not exceed 2.25 N·m (20 lb in) torque.

**Tighten**

Tighten the preload adjuster nut (2) to 90 N·m (66 lb ft).

29. Reinspect the preload after tightening the preload adjuster nut (2).

## Worm Thrust Bearing Preload Adjustment - Off Vehicle (708 Model)

### Tools Required

*J 7624* Bearing Preload Spanner Wrench

**Important:** Adjust the worm thrust bearing preload first before adjusting the pitman shaft-over-center preload.

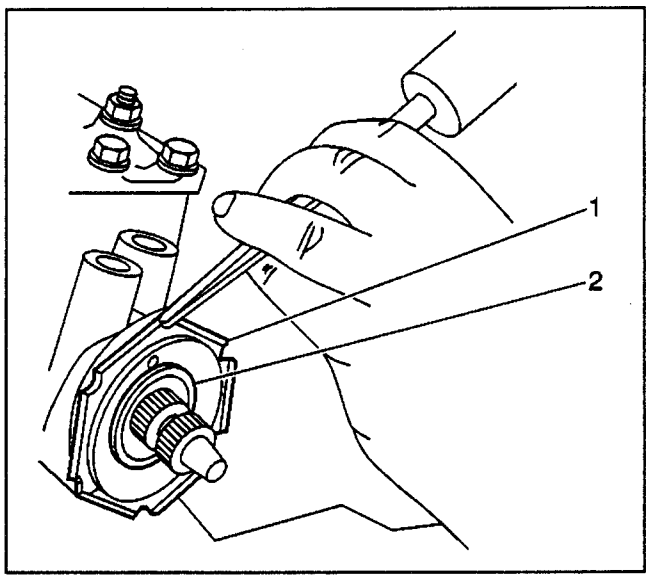
1. Loosen and remove the adjuster plug nut (1).

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

2. Use the *J 7624* in order to turn the adjuster plug (2) in (clockwise). Turn the plug until the plug and the thrust bearing are firmly bottomed in the housing.

   **Tighten**

   Tighten the adjuster plug to 27 N·m (20 lb ft).



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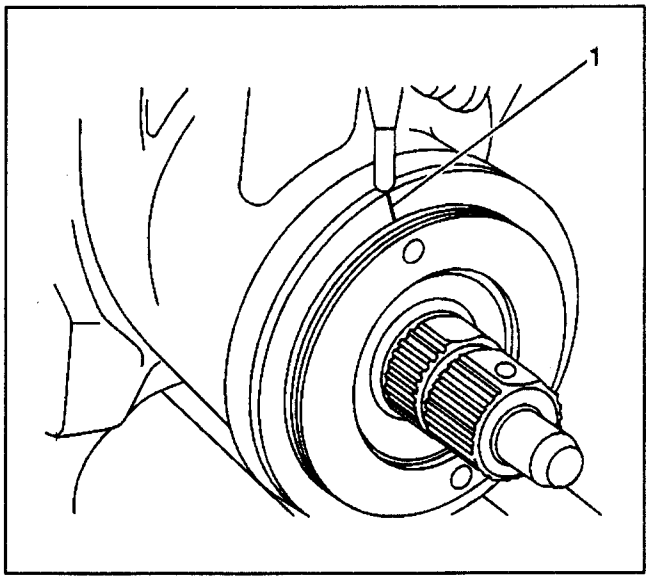
3. Place an index mark (1) on the housing even with one of the holes in the adjuster plug.
4. Measure counterclockwise 4.7–6.3 mm (3/16–1/4 in) from the index mark (1). Mark the housing.
5. Use the *J 7624* in order to rotate the adjuster plug counterclockwise until the hole in the plug is aligned with the second mark on the housing.
6. Install the adjuster plug nut.

   **Tighten**

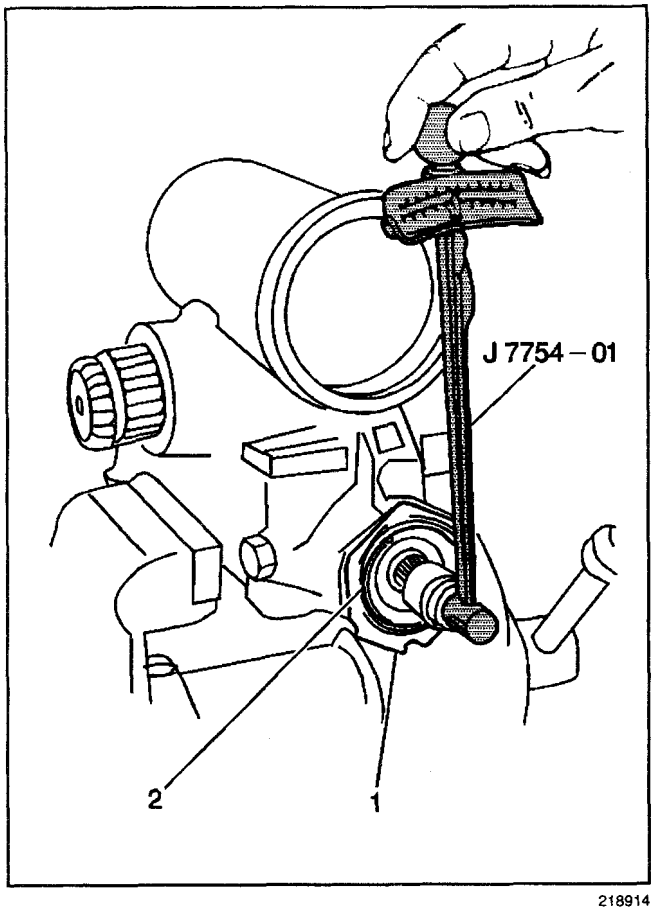
   Tighten the nut to 109 N·m (80 lb ft). Ensure that the adjuster plug does not turn when tightening the nut.

7. Use an inch-pound torque wrench and a 12-point deep socket in order to measure the torque required to turn the stub shaft. Take the reading with the handle of the torque wrench near the vertical position. Turn the stub shaft to the right stop. Turn the stub shaft back (counterclockwise) 1/4 turn at an even rate. Record the torque reading.



313965

8. The torque required to turn the stub shaft should be 0.45–1.13 N·m (4–10 lb in). If the reading is above or below the specified torque the following conditions may be the cause:
   - The adjuster plug may not be tightened properly.
   - The adjuster plug may have turned when the adjuster plug nut was tightened.
   - The thrust bearings and the races may be damaged.



218914

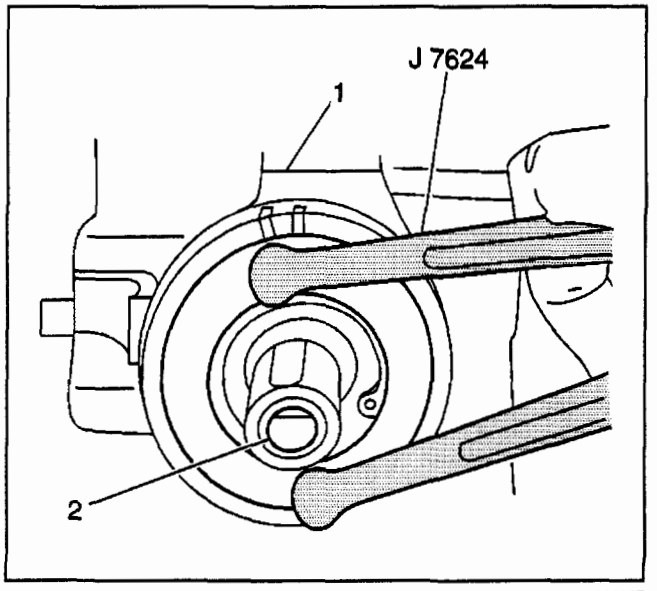
## Worm Thrust Bearing Preload Adjustment - Off Vehicle (710 Model)

### Tools Required

- *J 7624* Bearing Preload Spanner Wrench
- *J 7754 - 01* Torque Wrench

1. Center the front wheels and the steering wheel.
2. Remove the pitman arm. Refer to *Pitman Arm Replacement (Motorhome )* in Steering Linkage.
3. Remove the cardan joint clamp bolt. Refer to Steering Wheel and Column.
4. Remove the cardan joint.
5. Slide the intermediate shaft up until the joint clears the steering gear stub shaft.
6. Use the *J 7754 - 01* in order to loosen the lock nut (1).

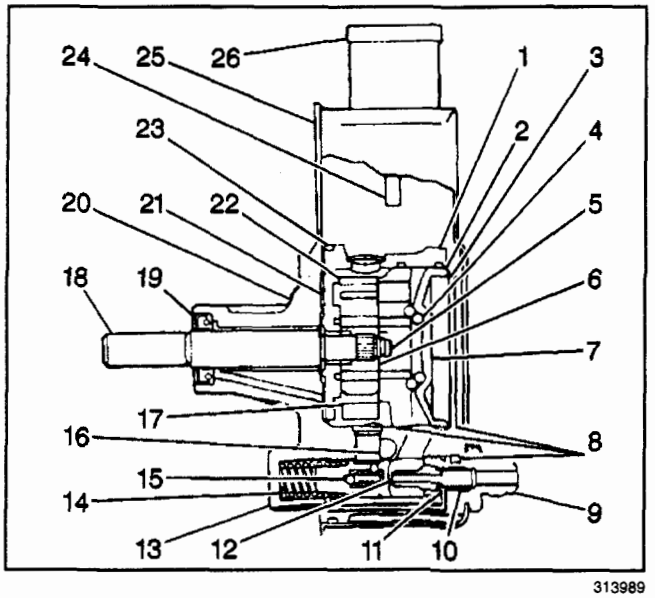
7. Use the *J 7624* in order to turn the pitman shaft preload adjuster (2) clockwise. This will relieve the over-center preload. Turning the pitman shaft preload adjuster provides clearance between the sector gear and the worm ball nut.



218917

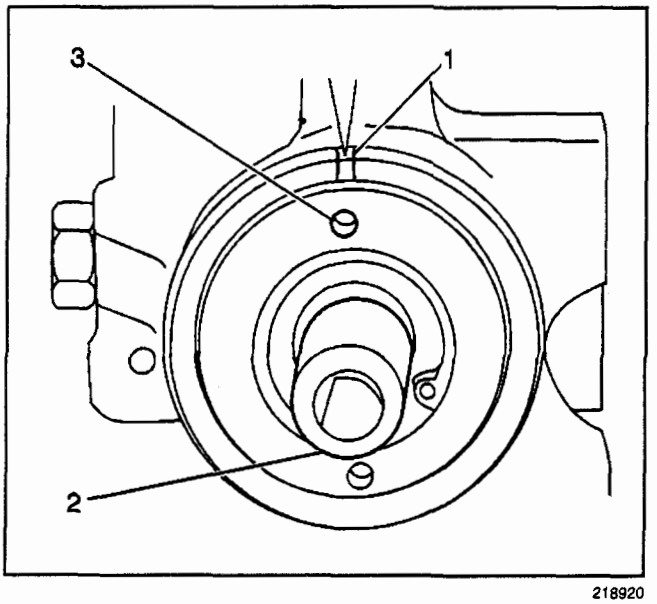
***Notice:*** Avoid contaminating the power steering system. Cap open hoses and ports to prevent dirt and debris from entering system. Contaminated power steering fluid and dirt can cause early parts failure.

8. Disconnect the hydraulic hoses at the pump.
9. Cap the hoses in order to prevent contamination.
10. Tag the hydraulic hose locations.
11. Turn OFF the engine.
12. Turn the stub shaft (18) to the right and to the left until the gear stops draining.

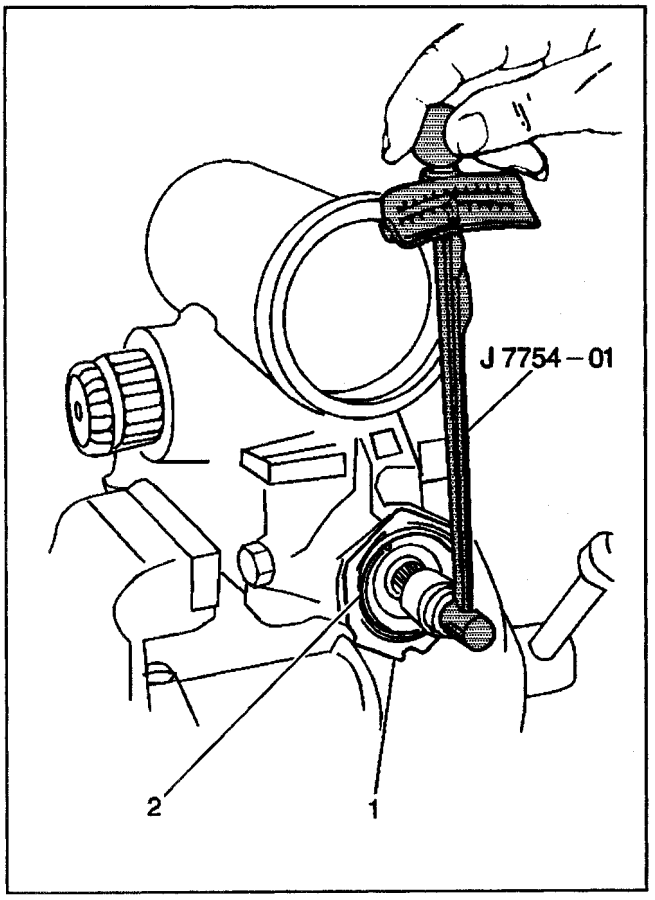


313989

13. Place the torque wrench with a 3/4 inch 12-point socket on the stub shaft (1). Move the torque wrench at a constant speed and through a 90 degree arc. Record the readings. The readings should be taken 90 degrees from the stop.
14. Repeat the procedure several times in order to obtain an average reading. The worm shaft thrust bearing preload should be 0.7–1.3 N·m (6–12 lb in).
    If you notice rough or lumpy action, the bearings may be damaged. Remove and repair the steering gear.
    If the worm shaft bearing preload is within the specifications, perform the Pitman Shaft Over-Center Preload Adjustment. Refer to *Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (710 Model).*
    If a worm shaft bearing preload adjustment is necessary continue with the adjustment procedure.

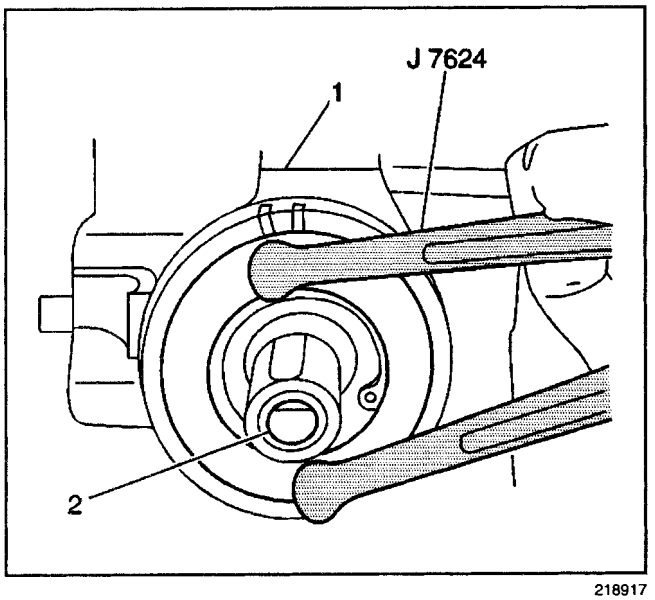


218920




218914

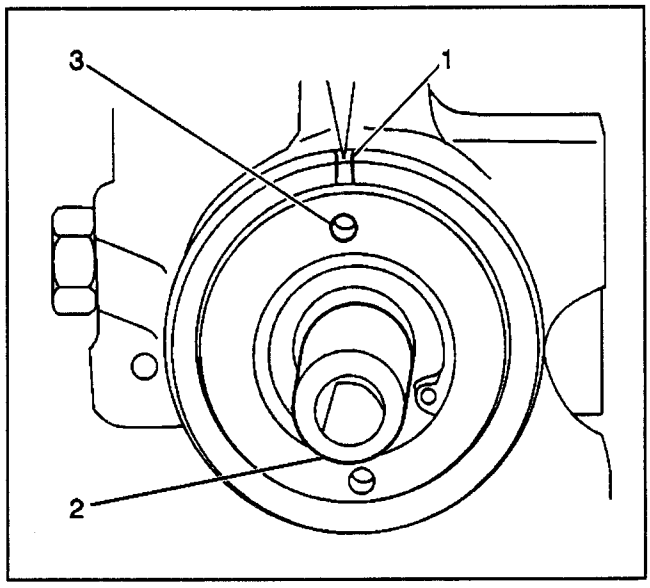
15. Use the *J 7754 - 01* in order to loosen the adjuster plug lock nut (1).




218917

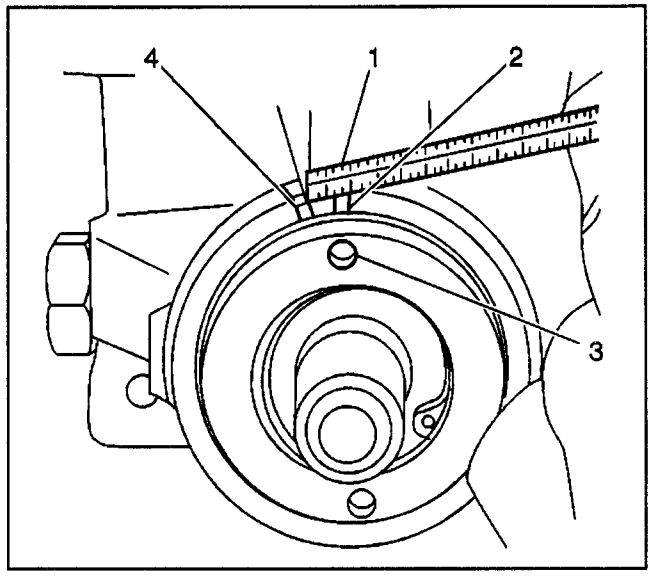
16. Use the *J 7624* in order to turn the adjuster plug (1) clockwise. Turn the adjuster plug (1) until the plug (1) and the worm shaft bearing are firmly bottomed, about 27 N·m (20 lb ft).

17. Mark (3) the housing in line with one of the adjuster plug holes (2).



218920

18. Measure 13 mm (1/2 in) counterclockwise. Mark (4) the housing again.



218928

19. Rotate the adjuster plug (3) until the adjuster plug hole is aligned with the second mark (1).

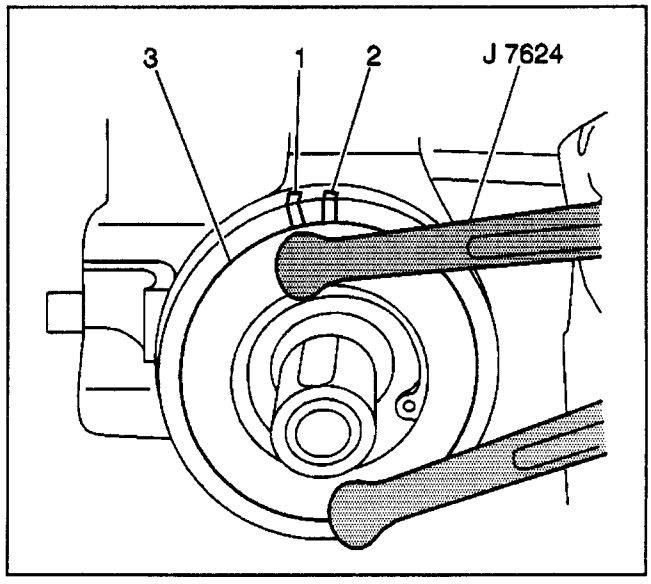
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

20. Install the adjuster plug lock nut, while holding the adjuster plug in order to maintain the adjustment.

    **Tighten**

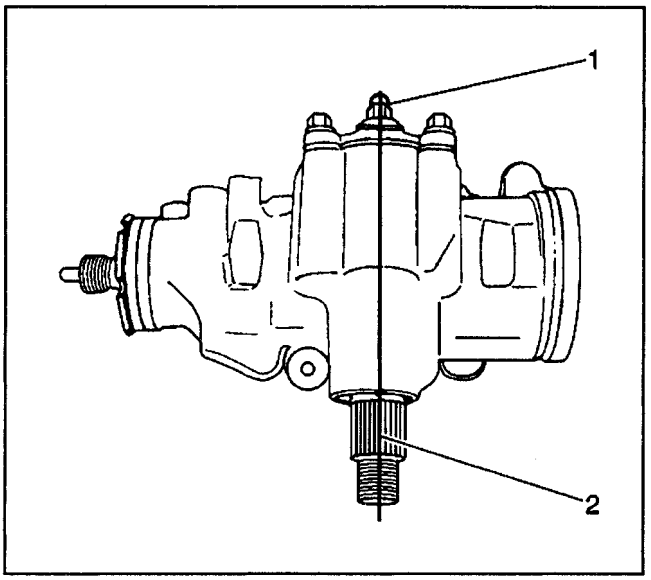
    Tighten the adjuster plug lock nut to 109 N·m (80 lb ft).

21. Repeat step 7. Repeat steps 7 through 11, if necessary, in order to achieve the proper preload. If you cannot achieve the proper worm shaft bearing preload, replace the steering gear. Refer to *Power Steering Gear Replacement (710 Model).*



218930

22. With the worm shaft bearing properly adjusted, adjust the pitman shaft over-center preload. Refer to the appropriate procedure:
    - *Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (708 Model)*
    - *Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (710 Model)*

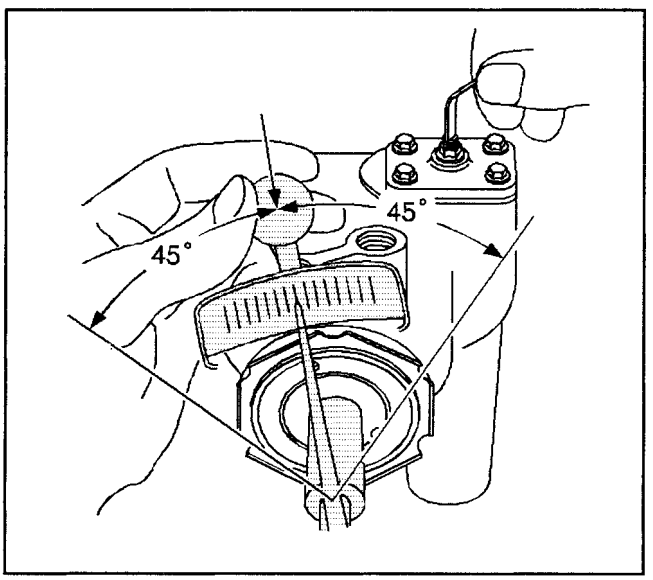


314006

## Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (708 Model)

1. Turn the pitman shaft adjuster screw counterclockwise until the pitman shaft adjuster screw extends fully. Then turn the pitman shaft adjuster screw back 1/2 turn clockwise.
2. Rotate the stub shaft from stop to stop. Count the number of turns.
3. Starting at either stop, turn the stub shaft back 1/2 the total number of turns. This is the center of the gear.

   The flat on the stub shaft should face upward when the gear is in the center. The flat on the stub shaft should be parallel with the side cover.
4. Align the master spine on the pitman shaft (2) with the adjuster screw (1).



666

5. Place the torque wrench, with the handle in the vertical position, on the stub shaft. Rotate the torque wrench 45 degrees to each side of the center. Record the highest drag torque measure on or near the center.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

6. Use the following procedure in order to adjust the over-center drag torque:
   6.1. Loosen the adjuster screw jamb nut.
   6.2. Turn the pitman shaft adjuster screw clockwise until the correct drag torque is obtained.
7. On new steering gears (under 400 miles), add 0.6–1.2 N·m (6–10 lb in) torque to the worm bearing preload torque. Do not exceed a total steering gear preload of 2 N·m (18 lb in).
8. On used steering gears (400 miles or more), add 0.5–0.6 N·m (4.5 lb in) torque to the worm bearing preload torque. Do not exceed a total steering gear preload of 1.5 N·m (14 lb in).

   **Tighten**

   Tighten the adjuster screw jamb nut to 47 N·m (35 lb ft).

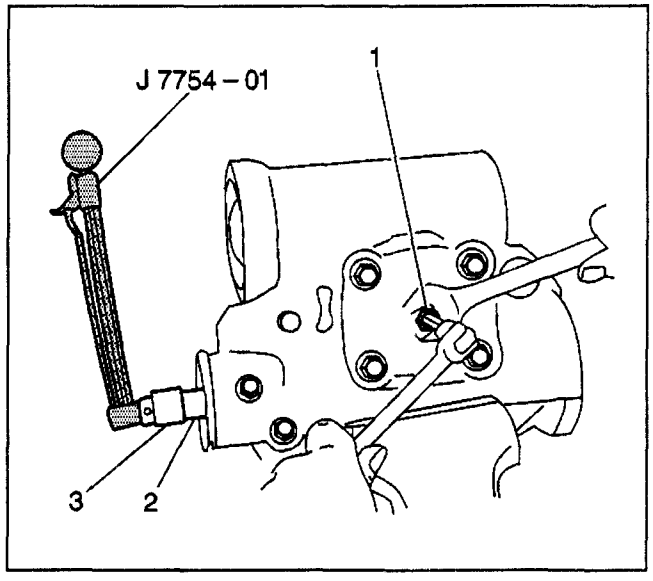
9. Install the steering gear. Refer to the appropriate procedure from the following list:
   - *Power Steering Gear Replacement (708 Model (Motor Home Only))*
   - *Power Steering Gear Replacement (708 Model (I-Beam Front Axle))*
   - *Power Steering Gear Replacement (708 (Except I-Beam Front Axle))*
10. Fill the pump reservoir with the power steering fluid.
11. Bleed the system. Refer to *Bleeding Power Steering System (Process).*

## Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (710 Model)

### Tools Required

*J 7754 - 01* Torque Wrench

1. Always check the worm shaft bearing preload adjustment. Adjust the worm shaft bearing preload, if needed, before performing the pitman shaft over-center preload adjustment.
2. Turn the over-center adjusting screw all the way out clockwise. Then turn the over-center adjusting screw in 1/2 turn.
3. Place the *J 7754 - 01* with a 3/4 inch 12-point socket (3) onto the stub shaft.
4. Rotate the stub shaft from one stop to the other. Count the turns. Turn the stub shaft back to center.
5. Check the over-center preload by rotating the torque wrench through a 180 degree arc on each side of the center. Note the highest readings. The readings must be 0.8–1.9 N·m (7–17 lb in).



218934

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

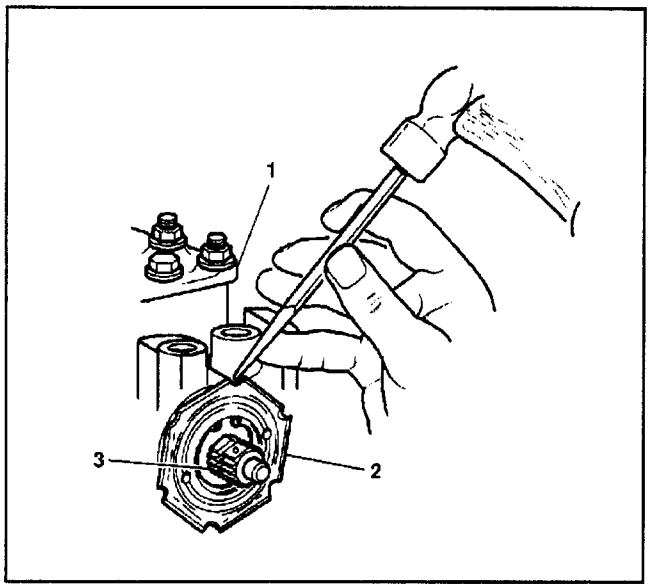
6. Turn the over-center adjusting screw counterclockwise until the torque wrench shows a reading of 0.7–1.1 N·m (6–10 lb in) higher than the previous reading. The total reading must not exceed 3 N·m (27 lb in).

   **Tighten**

   Tighten the adjustment lock nut (1) to 89 N·m (66 lb in).
7. Check the adjustment. Adjust again if necessary.
8. Connect the hydraulic hoses following the tag locations.

   **Tighten**

   Tighten the high pressure connections to 38 N·m (28 lb ft).
9. Connect the cardan clamp.
10. Install the cardan clamp bolt. Adjust the cardan clamp. Refer to Steering Wheel and Column.
11. Connect the pitman arm. Refer to *Pitman Arm Replacement (Motorhome )* in Steering Linkage.




321974

## Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (708 Model)

### Steering Gear Adjustments

**Important:** Any steering gear adjustment is made only as a correction and not as a periodic adjustment.

Remove the gear from the vehicle prior to any adjustments.

1. Drain the power steering fluid from the gear.
2. Mount the gear in a vise.

**Important:**

- Adjust the worm thrust bearing preload first, then adjust the pitman shaft over-center preload.
- The worm thrust bearing preload is controlled by the amount of compression force exerted by the adjuster nut assembly on the flat races.
- The pitman shaft over-center preload is controlled by the pitman shaft adjuster screw, which determines the clearance between the rack piston and the pitman shaft sector teeth.

3. Adjust the following:
   - 3.1. The worm thrust bearing preload
   - 3.2. The pitman shaft over-center preload adjustment

### Worm Thrust Bearing Preload Adjustment

#### Tools Required

*J 42882* Adjuster Nut Socket

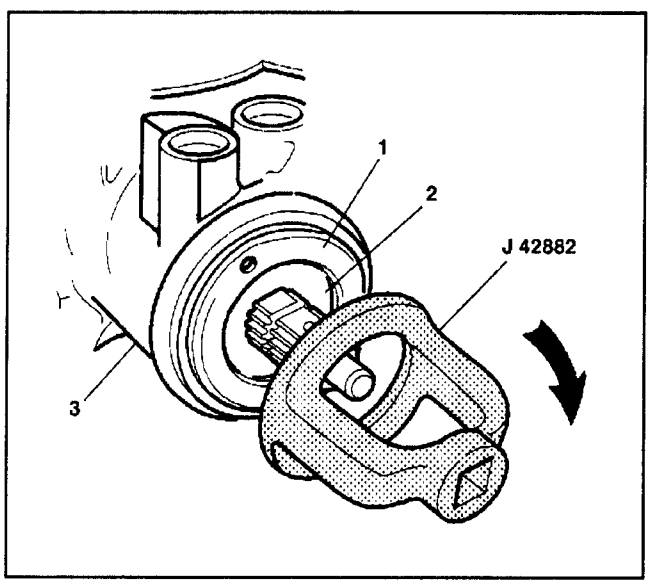
1. Rotate the stub shaft (3) back and forth in order to drain the power steering fluid.
2. Remove the coupling shield retainer and the lock nut (2) from the steering gear housing (1) using a drift and a hammer.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

3. Turn the adjuster nut assembly (1) clockwise using *J 42882* until the adjuster nut assembly (1) and the thrust support assembly (2) are firmly bottomed in the steering gear housing (3).

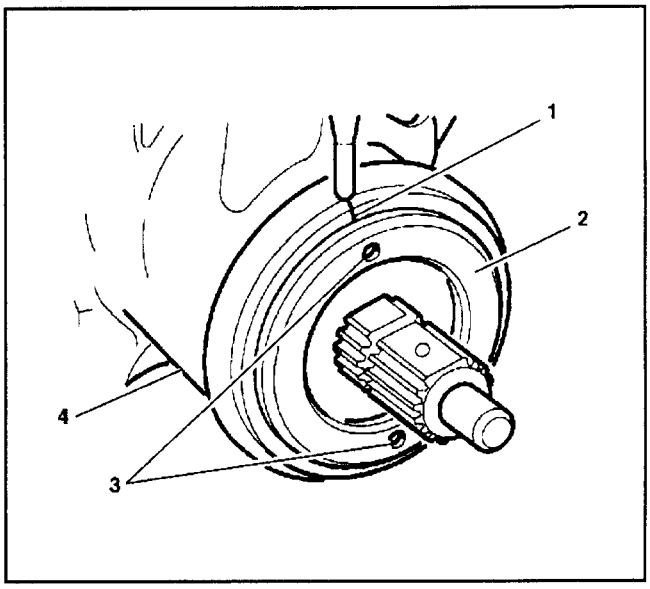
   **Tighten**

   Tighten the adjuster nut assembly (1) to 28–31 N·m (20–23 lb ft).



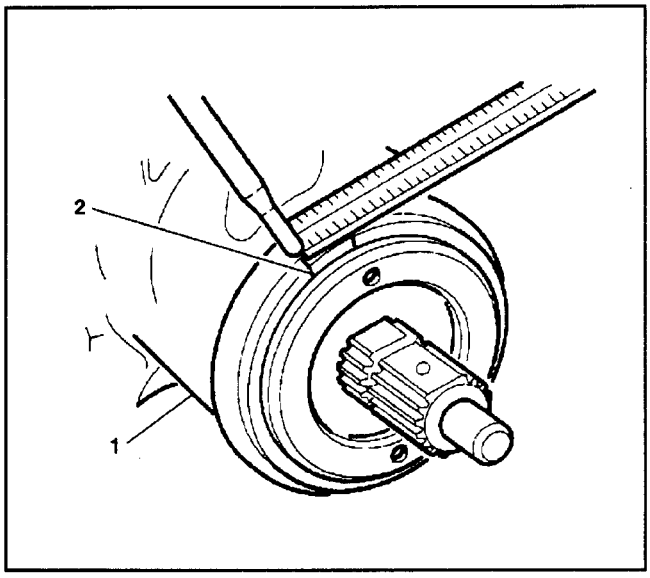

321992

4. Place an index mark (1) on the steering gear housing (4) parallel with one of the holes (3) in the adjuster nut assembly (2).



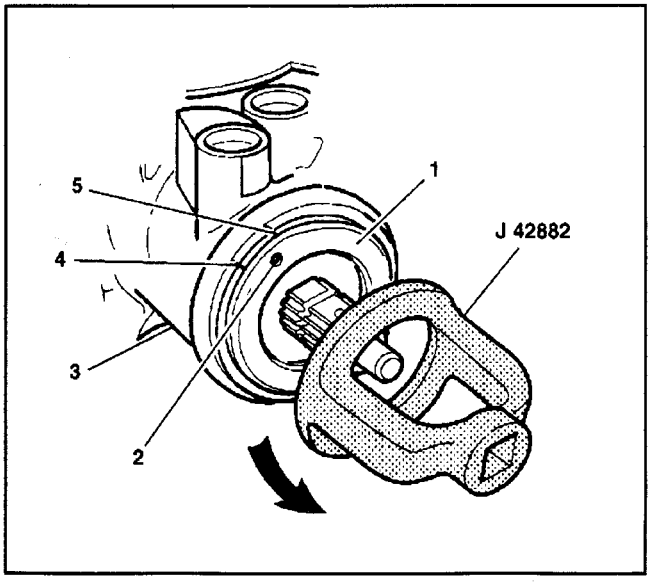

321996

5. Measure back counterclockwise 13 mm (½ inch).
6. Place a second mark (2) on the steering gear housing (1).

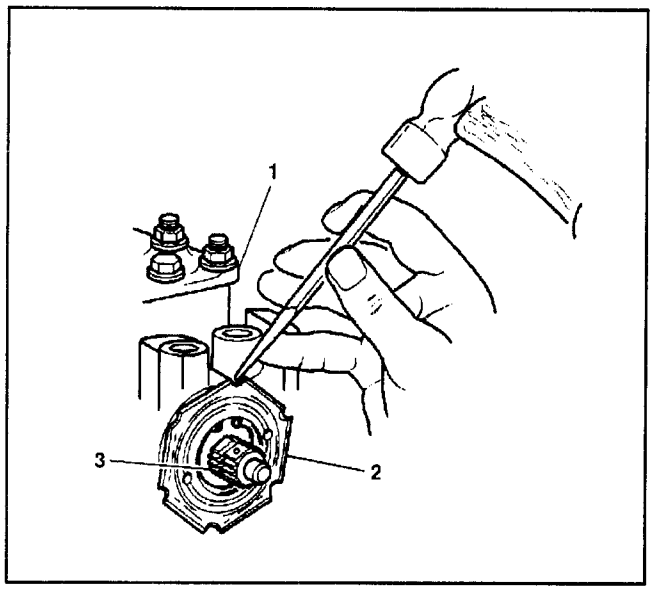



321997

7. Using *J 42882* and a torque wrench, turn the adjuster nut assembly (1) counterclockwise 15–25 degrees in order to align the hole (2) in the adjuster nut assembly (1) with the second mark (4) on the steering gear housing (3).

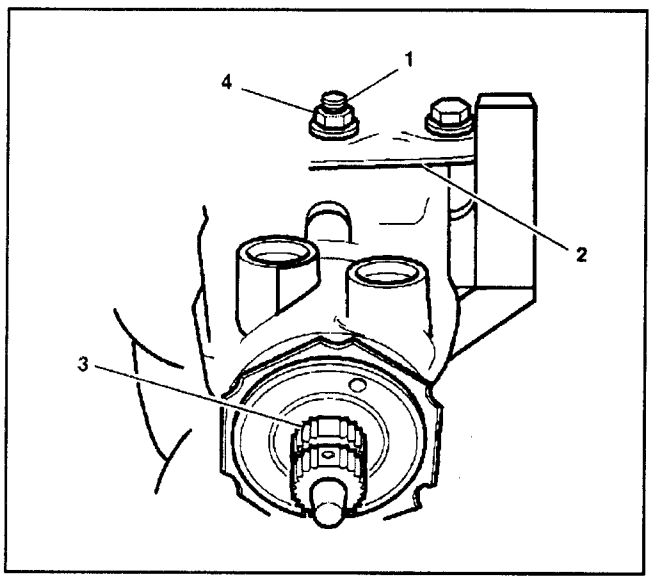



322000




321974

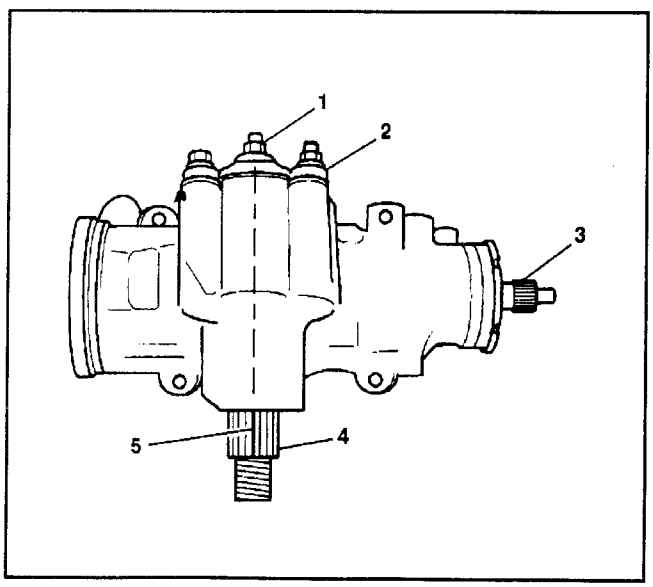
8. Install the coupling shield retainer and the lock nut (2).
9. Hold the adjuster nut assembly in position in order to maintain alignment of the marks.
10. Tighten the coupling shield retainer and the lock nut (2) using a drift in a notch.




322005

### Pitman Shaft Over-Center Preload Adjustment

1. Rotate the stub shaft (3) back and forth in order to drain the power steering fluid.
2. Loosen the adjuster lock nut (4).
3. Turn the pitman shaft adjuster screw (1) counterclockwise until the screw is fully extended.
4. Turn the pitman shaft adjuster screw (1) clockwise 1 full turn.
5. Rotate the stub shaft (3) from stop to stop, using a 12-point socket while counting the number of turns.
6. Starting at either stop, turn the stub shaft (3) back half of the total number of turns. This is the center of the gear.



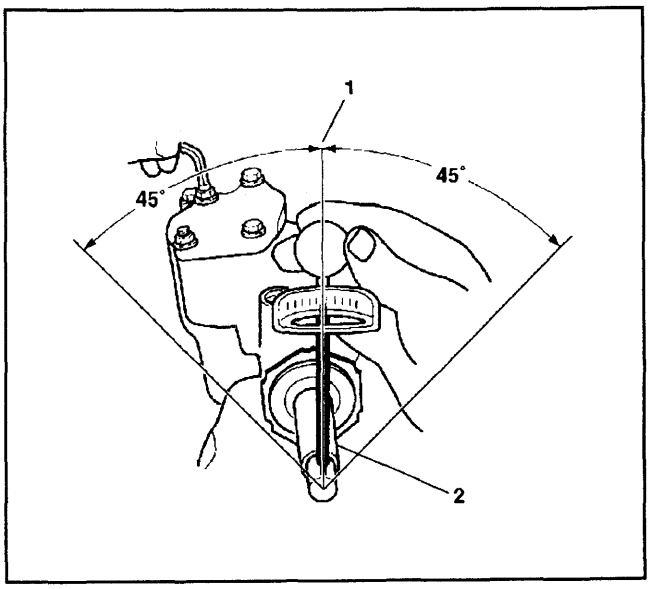

322006

7. Ensure that the gear is centered by verifying the following items:
   - The flat on the stub shaft (3) faces upward.
   - The flat on the stub shaft (3) is parallel with the side cover (2).
8. Align the master spline (5) on the pitman shaft (4) with the adjuster screw (1).

9. Place a torque wrench on the stub shaft (2) with the handle in the vertical position.
10. Rotate the stub shaft (2) 45 degrees from each side of the center of the stub shaft. The stub shaft (2) must rotate smoothly.
11. Record the worm bearing preload measured on or near the center (1). The recorded bearing preload must be 0.7–1.7 N·m (6–15 lb in) with the worm and the ballnut installed. If the torque is outside of this range, readjust or repair the steering gear assembly as required.
12. In order to obtain the correct preload torque, adjust the over-center torque by turning the pitman shaft adjuster screw clockwise.
13. Add 0.7–1.1 N·m (6–10 lb in) torque to the previously measured worm bearing preload torque.

    **Tighten**

    Tighten the adjuster lock nut to 49 N·m (36 lb ft). Prevent the adjuster screw from turning while tightening the adjuster lock nut.

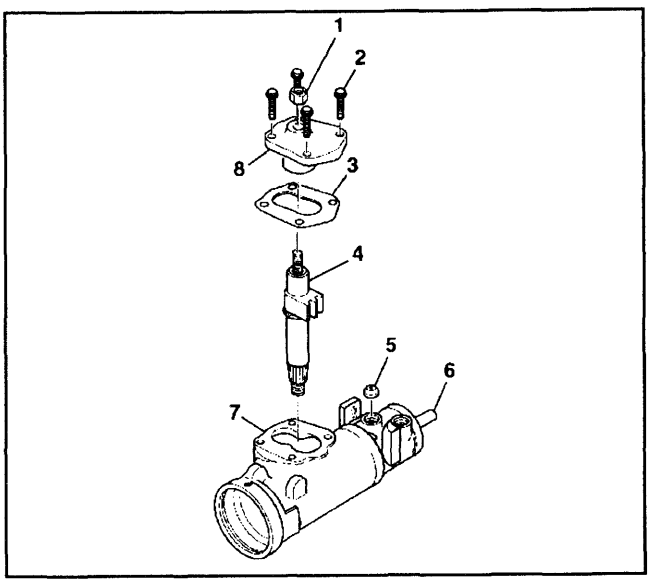


322007

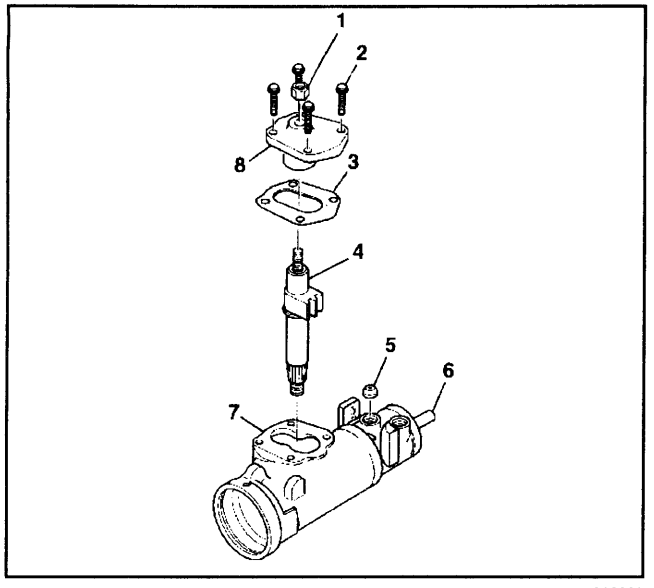
## Steering Gear Pitman Shaft and Housing Cover Replacement - Off Vehicle (708 Model)

### Disassembly Procedure

1. Loosen and remove the adjuster lock nut (1).
2. Remove the bolts (2).
3. Rotate the stub shaft (6) using a 12-point socket in order to center the steering gear (7).
4. Remove the following items as an assembly:
   - The side cover (8)
   - The gasket (3)
   - The pitman shaft (4)
5. Remove the pitman shaft (4) from the side cover (8).



322009




322009

### Assembly Procedure

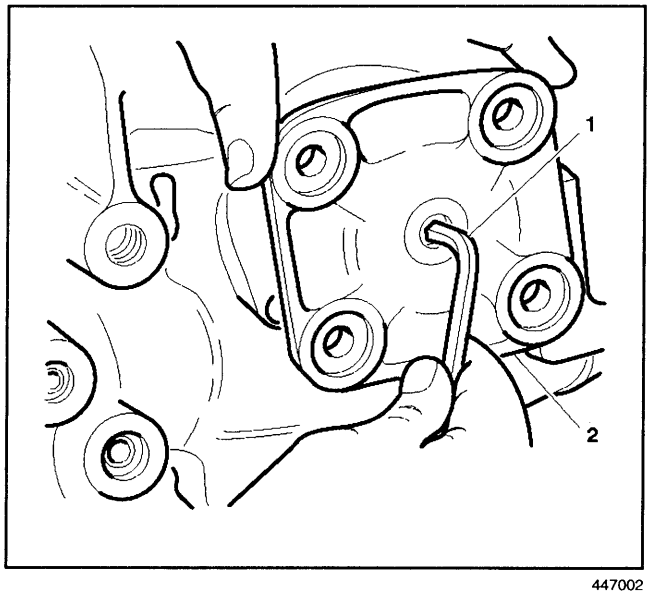
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

1. Screw the pitman shaft (4) to the side cover (8) until it fully seats to the side cover (8).
2. Install the adjuster lock nut (1). Do not tighten the adjuster lock nut (1) until the pitman shaft adjustment is completed.
3. Install the gasket (3) to the side cover (8).
4. Bend the gasket tabs around the edges of the side cover (8).
5. Install the pitman shaft assembly (4) and the side cover (8) to the steering gear housing (7).
6. Install the bolts (2).
   **Tighten**
   Tighten the bolts (2) to 60 N·m (44 lb ft).
7. In order to adjust the pitman shaft (4), refer to *Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (708 Model).*

## Steering Gear Pitman Shaft and Housing Cover Replacement - Off Vehicle (710 Model)

### Disassembly Procedure

1. Remove the preload adjuster nut.
2. Remove the hex head bolts from the side cover (2).
3. Turn the adjuster screw on the pitman shaft clockwise using a ¼ inch hex wrench (1) in order to remove the side cover (2) from the pitman shaft.



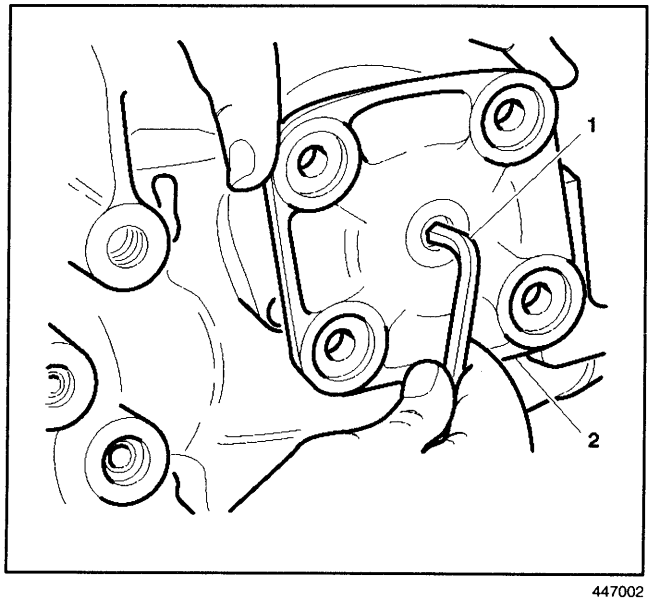

447002

### Assembly Procedure

1. Lubricate a new side cover O-ring seal.
2. Install the new side cover O-ring seal to the side cover (2).
3. Push the side cover (2) onto the steering gear housing until the adjuster screw on the pitman shaft contacts the side cover (2).
4. Insert a hex wrench (1) through the side cover (2) into the adjuster screw. Turn the hex wrench counterclockwise until the side cover (2) bottoms on the steering gear housing, then turn the hex wrench (1) clockwise a ½ turn.
5. Screw the preload adjuster prevailing torque nut on the adjuster screw.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

6. Install the side cover bolts.
   **Tighten**
   Tighten the side cover bolts to 47 N·m (35 lb ft).

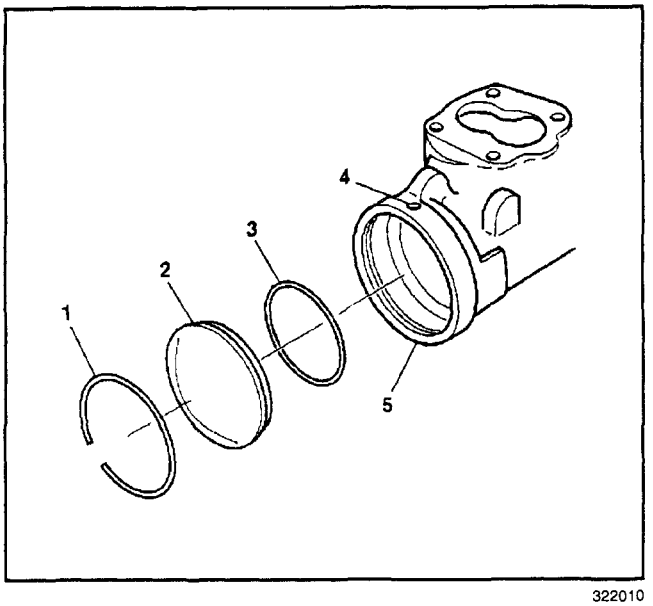



447002

## Steering Gear Housing End Plug Replacement - Off Vehicle (708 Model)

### Disassembly Procedure

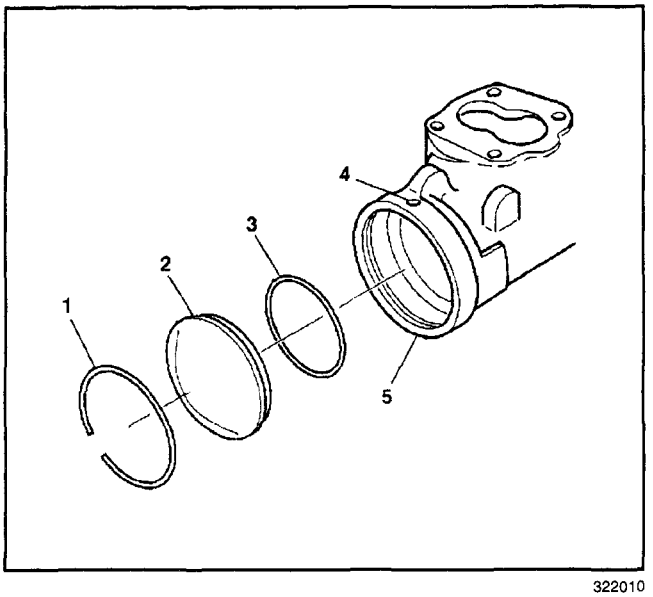
1. Rotate the stub shaft back and forth in order to drain the fluid.
2. Insert a punch into the housing access hole in order to unseat the retaining ring (1).
3. Remove the plug (2).
4. Remove the O-ring seal (3).




322010

### Assembly Procedure

1. Lubricate the O-ring seal (3) with power steering fluid.
2. Install the O-ring seal (3) into the steering gear housing (5).
3. Install the plug (2).
4. Install the retaining ring (1). Ensure that the retaining ring open end is approximately 25 mm (1 inch) from the access hole in the steering gear housing (5).

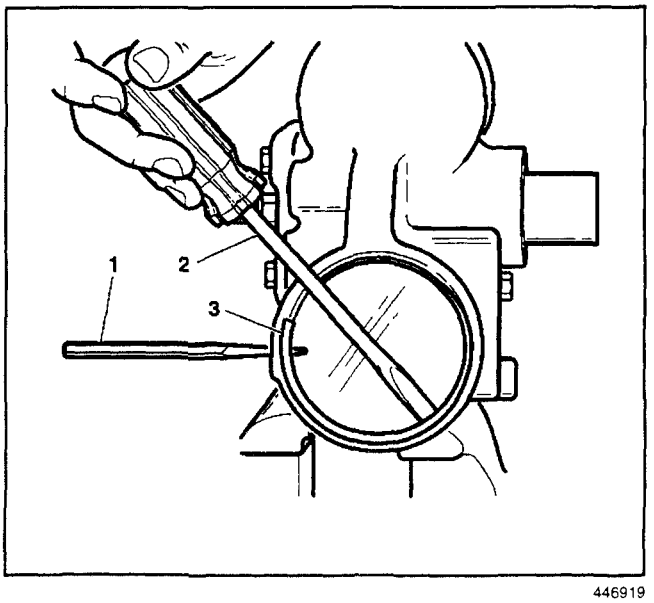



322010

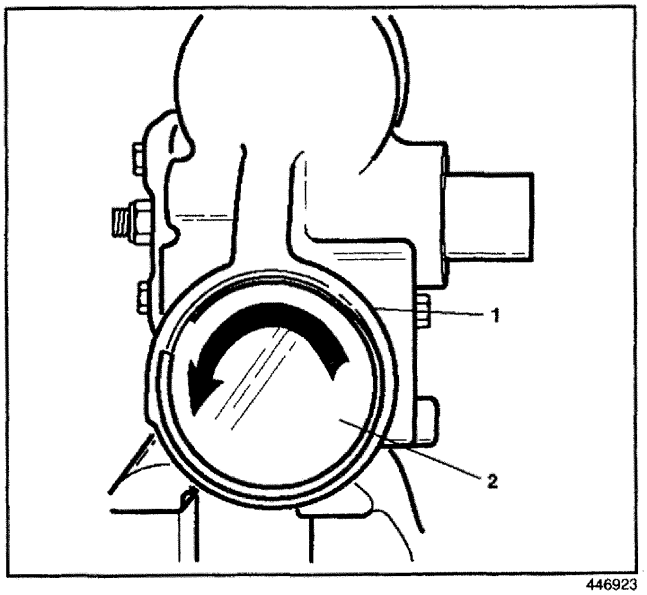
## Steering Gear Housing End Plug Replacement - Off Vehicle (710 Model)

### Disassembly Procedure

1. Unseat the retaining ring (3) from the primary and secondary cylinders using a needle nose punch (1) and a hammer.
2. Pry the retaining ring (3) out of the housing groove using a screwdriver (2).

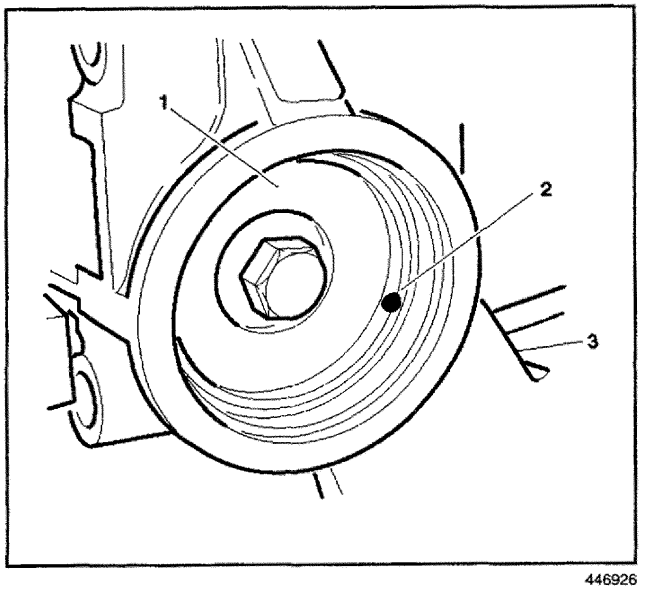



446919



446923

3. Turn the housing end plug (2) counterclockwise until the housing end plug (2) is forced out of the cylinder (1).

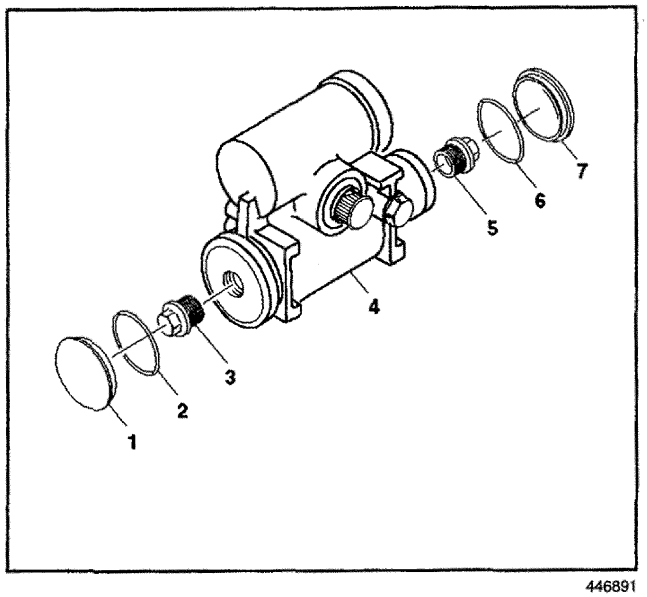


446926

4. In order to remove the housing O-ring seal, turn the stub shaft counterclockwise until the primary rack piston (1) covers the crossover hole (2).

**Important:** Observe the head of the rack piston plug. If the head of the rack piston (1) is an aluminum square drive head, firmly tap the head using a hammer and a brass drift. If the head of the rack piston (1) is a steel hexagon head, remove the rack piston plug with a 1 inch socket.

5. Remove the rack piston plug from the rack piston (1) by turning the rack piston plug counterclockwise.

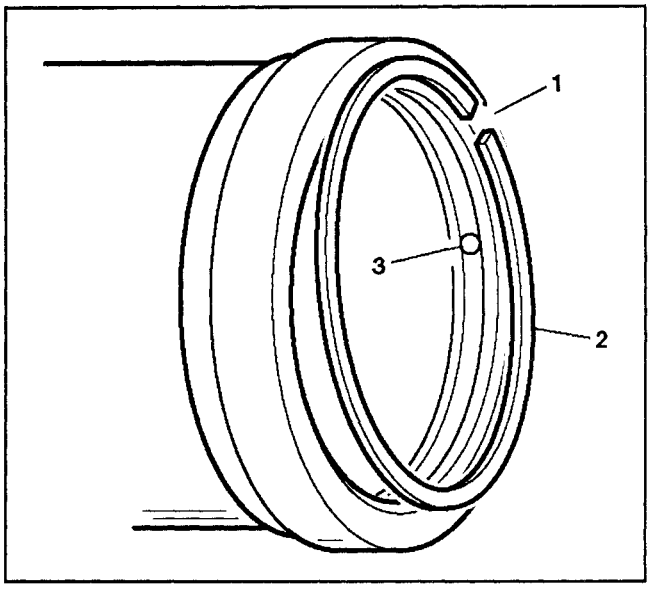


446891

## Assembly Procedure

1. Install the housing O-ring seal (2) (6) to the steering gear housing (4).
2. Install the housing end plug (1) (7).

3. Install the housing end plug retaining ring (2). The ring gap (1) does not line up with the steering gear housing hole (3).

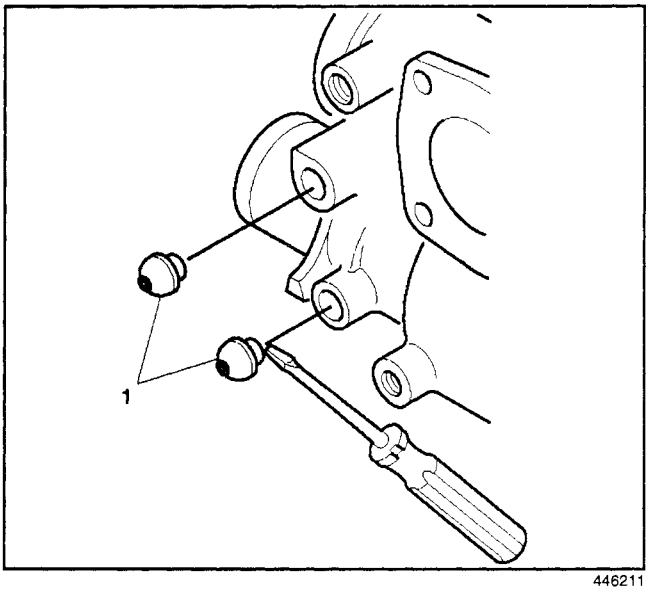


446929

## Steering Gear Hose Connectors

### Disassembly Procedure

1. Inspect brass inverted flare connectors (1) for looseness.
2. Remove the flare connectors (1), if necessary, using a modified No. 4 screw extractor.
3. Discard the flare connectors (1).



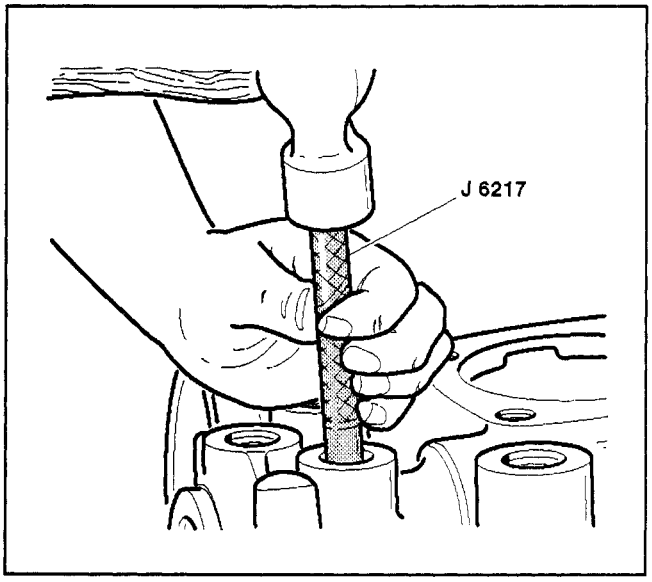
446211

### Assembly Procedure

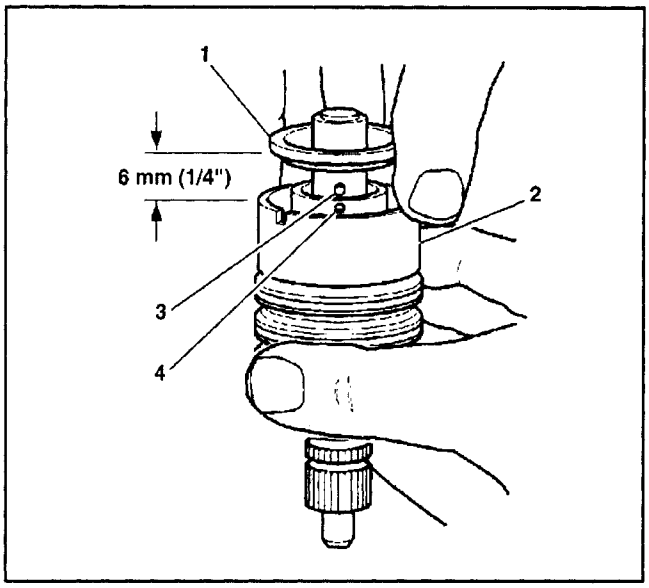
#### Tools Required

*J 6217* Valve Connector Seat Installer

Drive the new brass inverted flare connectors in place using *J 6217*.



446252

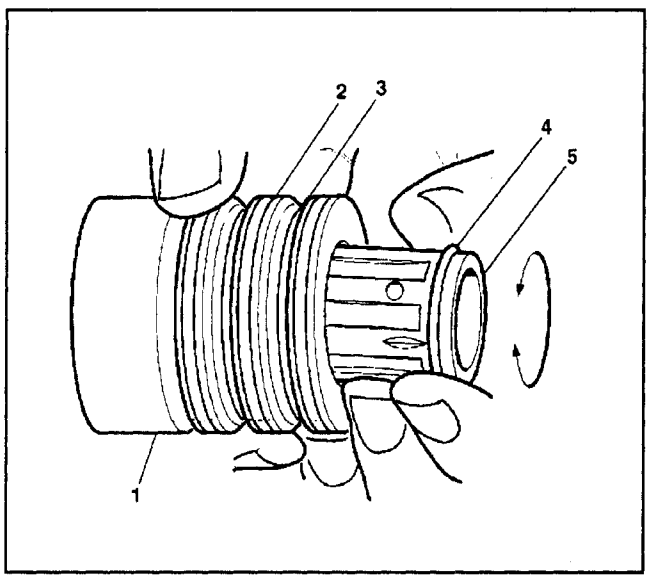



322014

## Steering Gear Valve Replacement - Off Vehicle

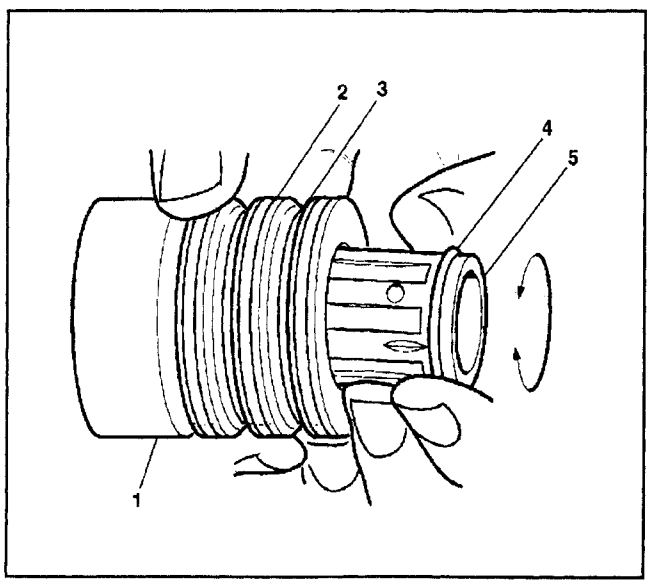
### Disassembly Procedure

1. To remove the thrust support assembly; refer to *Steering Gear Thrust Support Replacement - Off Vehicle (708 Model).*
2. Remove the stub shaft (1).
3. Remove the valve assembly (2).
4. Remove the stub shaft (1) from the valve assembly (2).
5. Tap the stub shaft (1) lightly on a wood block in order to loosen the shaft cap.
6. Pull the shaft cap and the valve spool out from valve body (2) 6 mm (¼ inch).
7. Disengage the stub shaft pin (3) from the hole in the valve spool (4).




322015

8. If the valve assembly needs repair, disassemble the valve as follows:
   - 8.1. Simultaneously pull and rotate the valve spool (5) in order to remove the valve spool (5) from the valve body (1).
   - 8.2. Remove the valve spool O-ring seal (4).
   - 8.3. Alternately remove the valve body teflon rings (2) and the O-ring seals (3).

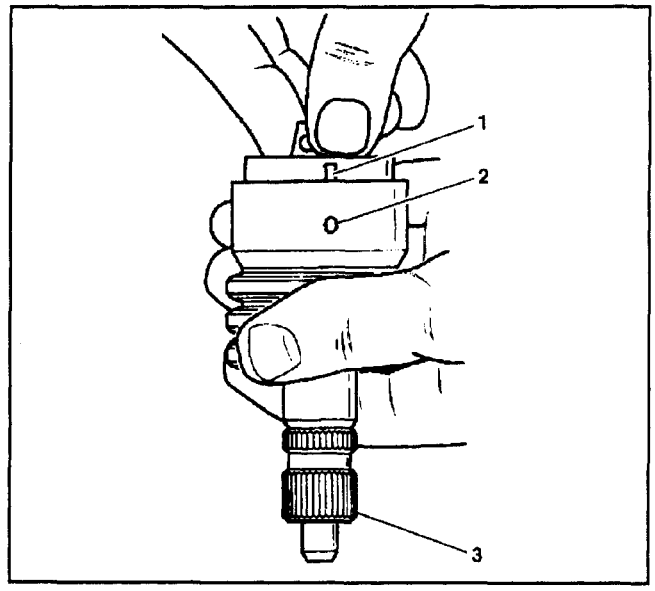



322015

### Assembly Procedure

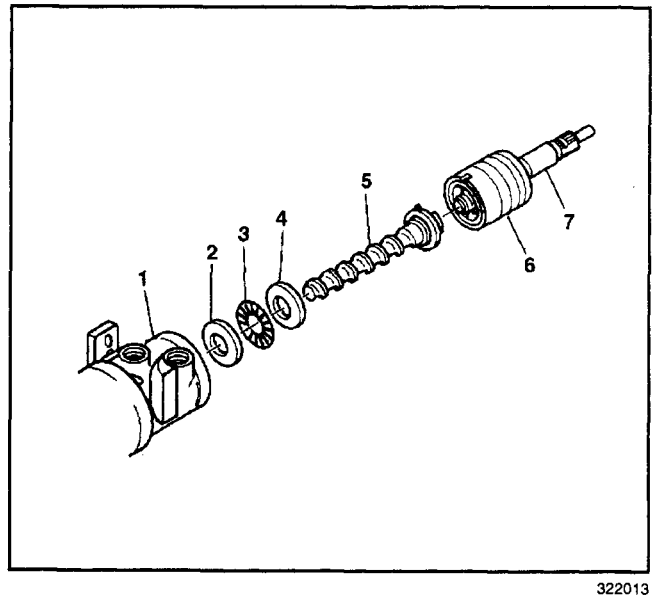
1. If the valve assembly has been disassembled, reassemble the valve as follows:
   - 1.1. Install the valve spool O-ring seal (4) to the valve spool (5).
   - 1.2. Lubricate the valve spool (5) and O-ring seal (4) with power steering fluid.
   - 1.3. Simultaneously push and rotate the valve spool (5) into the valve body (1) until the hole in the valve spool for the stub shaft pin is accessible from the opposite end of the valve body (1).

2. Install the stub shaft to the valve spool as follows:
   2.1. Insert the stub shaft (3) into the valve spool.
   2.2. Insert the pin. The notch in the stub shaft cap (1) must fully engage the valve body pin (2).
   2.3. Seat the stub shaft cap against the valve body shoulder.
   2.4. Alternately install the O-ring seals and the teflon rings to the valve body.
   2.5. Lubricate the O-ring seals and the teflon rings with power steering fluid.



322016

3. Install the stub shaft (7) and valve assembly (6) to the worm shaft (5). Ensure the pin fits in the worm shaft to the slot in the valve assembly.
4. To adjust the thrust support assembly; refer to *Steering Gear Thrust Support Replacement - Off Vehicle (708 Model).*
5. To adjust the pitman shaft over-center sector; refer to *Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (708 Model).*



322013

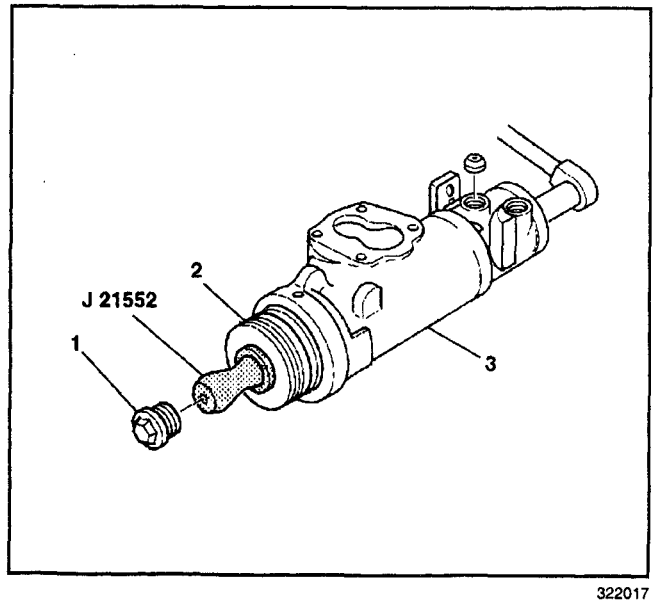
## Rack Piston and Worm Shaft Replacement - Off Vehicle (708 Model)

### Disassembly Procedure

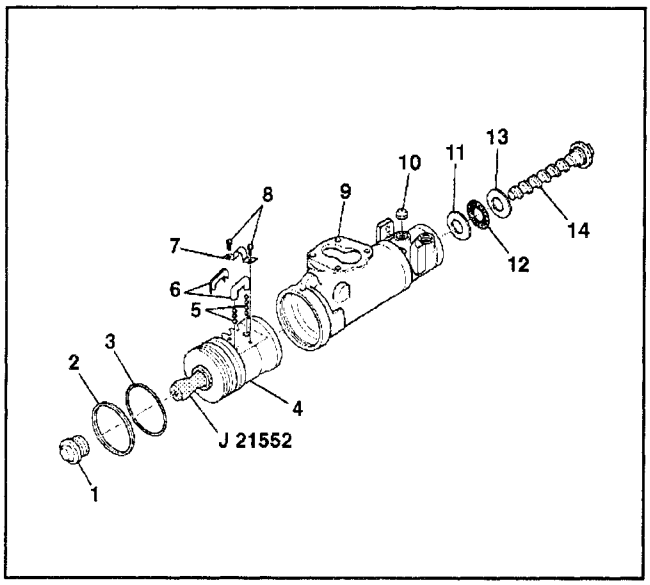
#### Tools Required

*J 21552* Rack Piston Arbor

1. Remove the pitman shaft.
2. To remove the side cover; refer to *Steering Gear Pitman Shaft and Housing Cover Replacement - Off Vehicle (708 Model).*
3. To remove the steering gear housing end plug (1); refer to *Steering Gear Housing End Plug Replacement - Off Vehicle (708 Model).*
4. Turn the stub shaft counterclockwise until the rack piston (2) begins to come out of the steering gear housing.
5. Remove the rack piston plug.

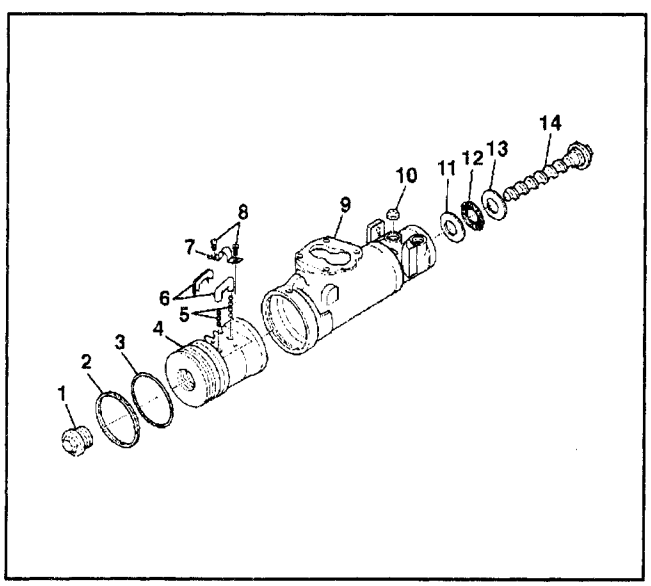


322017



322087

6. Insert *J 21552* into the bore of the rack piston (2).
7. Hold *J 21552* tightly against the worm shaft while turning the stub shaft counterclockwise. Turning the stub shaft forces the rack piston (2) onto *J 21552*. The rack piston balls remain in place.
8. Remove the following items as an assembly from the steering gear housing (9):
   - The rack piston (4)
   - The rack piston balls (5)
   - *J 21552*
9. To remove the valve; refer to *Steering Gear Valve Replacement - Off Vehicle.*
10. Remove the worm shaft (14).
11. Remove the thrust bearing (12).
12. Remove the flat races (11).
13. Remove *J 21552* from the rack piston (4).
14. Remove the rack piston balls (5).
15. Remove the following items from the rack piston (4):
    15.1. The screws (8)
    15.2. The clamp (7)
    15.3. The ball guide (6)
16. Remove the teflon ring (2).
17. Remove the O-ring seal (3).
18. Clean all of the disassembled parts.
19. Inspect all of the disassembled parts for wear.
20. Replace the parts if necessary.



322018

## Assembly Procedure

### Tools Required

- *J 8947* Rack Piston Teflon Ring Compressor
- *J 21552* Rack Piston Arbor

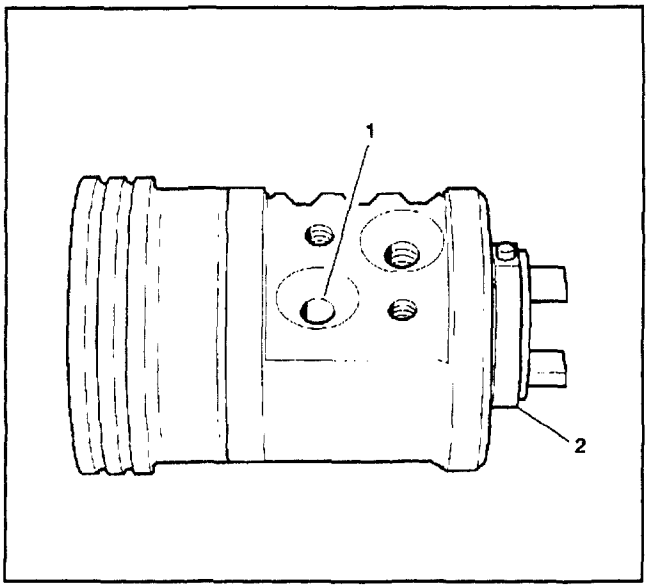
1. Lubricate the following items with power steering fluid while installing to the rack piston (4):
   1.1. The O-ring seal (3)
   1.2. The teflon ring (2)
2. Install the worm shaft (14) to the rack piston (4) outside of the steering gear housing (9).

**Important:** Reinstall all of the rack piston balls in the rack piston. Improper rack piston ball installation may result in personal injury.

3. Fully seat the worm shaft to the rack piston.
4. Align the worm shaft spiral groove with the rack piston ball return guide hole (1).

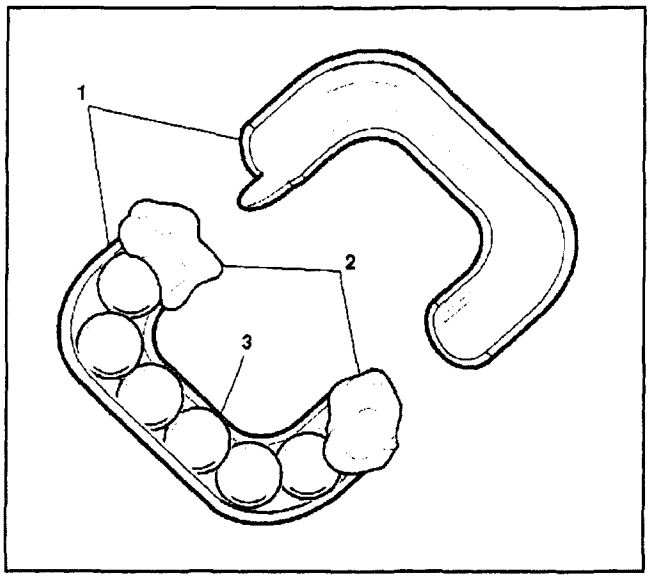
***Notice:*** The black rack piston balls are smaller than the silver rack piston balls. Install the black and the silver rack piston balls alternately into the rack piston and the ball guide to maintain the rack piston to the worm shaft preload.

5. Lubricate the rack piston balls with power steering fluid.
6. Insert the rack piston balls through the ball return guide hole (1) while turning worm shaft (2) counterclockwise in order to install the rack piston balls into the rack piston.



322019

7. Install the remaining rack piston balls (3) into the ball guide (1) using grease at each end (2) in order to retain the rack piston balls (3).

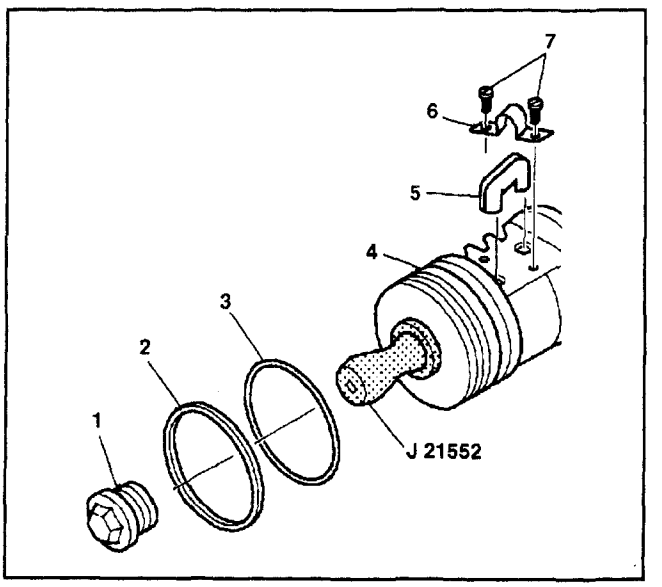


322022

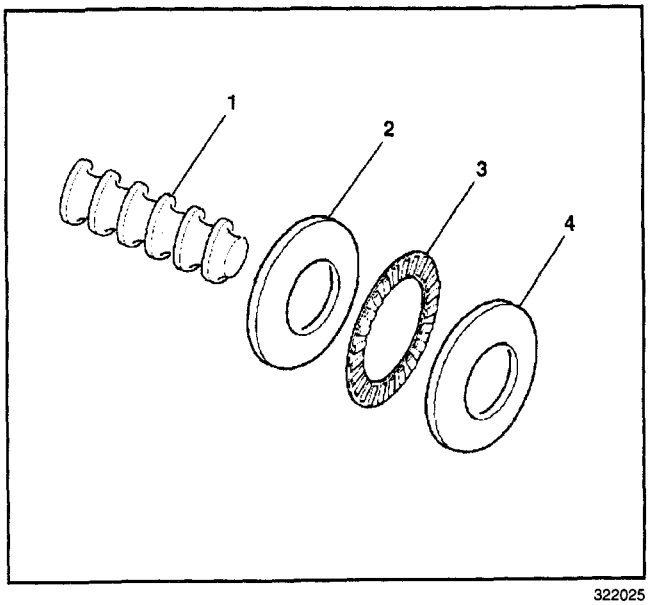
8. Install the ball guide (5) to the rack piston (4).
9. Install the ball guide clamp (6).
10. Install the screws (7).

    **Tighten**

    Tighten the screws (7) to 58 N·m (43 lb in).
11. Insert *J 21552* into the bore of the rack piston while turning the worm shaft counterclockwise. The turning of the worm shaft forces the rack piston onto *J 21552*. The rack piston balls remain in place.

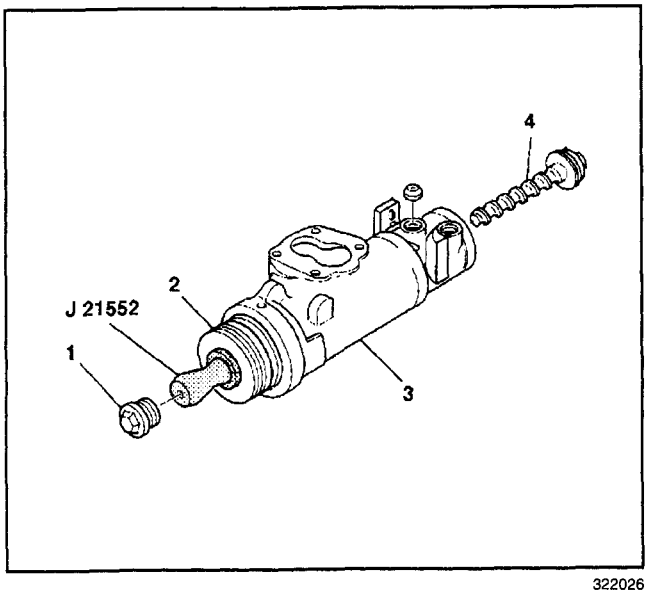


322024




322025

12. Install the flat races (2) (4) and the thrust bearing (3) onto the worm shaft (1).




322026

13. Install the worm shaft (4) to the steering gear housing (3).
14. To install the valve; refer to *Steering Gear Valve Replacement - Off Vehicle.*
15. Install the rack piston (2) to the worm shaft (4) from *J 21552*, using *J 8947* to compress the seals.

**Important:** Reinstall all of the rack piston balls into the rack piston. Improper rack piston ball installation may result in personal injury.

16. Hold *J 21552* tightly against the worm shaft (4).
17. Turn the stub shaft clockwise until the rack piston is seated on the worm shaft.
18. Install the rack piston plug.

    **Tighten**

    Tighten the rack piston plug to 150 N·m (111 lb ft).
19. To install the steering gear housing end plug (1); refer to *Steering Gear Housing End Plug Replacement - Off Vehicle (708 Model).*
20. Install the pitman shaft.
21. To install the side cover; refer to *Steering Gear Pitman Shaft and Housing Cover Replacement - Off Vehicle (708 Model).*
22. To adjust the steering gear; refer to *Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (708 Model).*

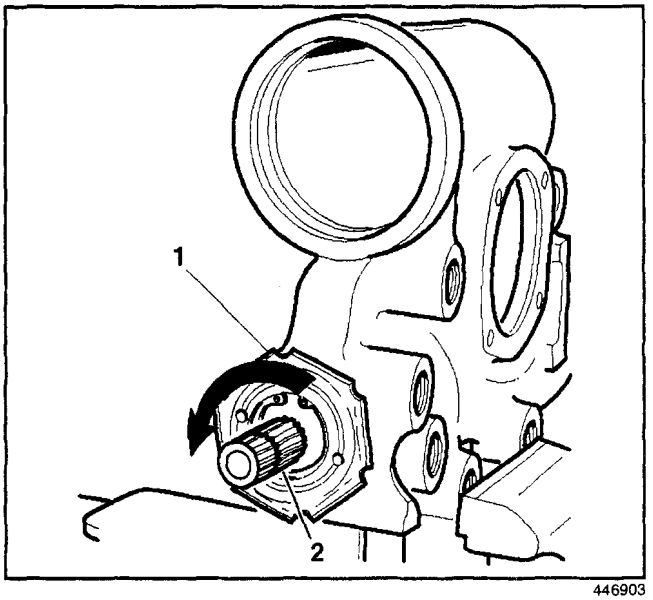
## Rack Piston and Worm Shaft Replacement - Off Vehicle (710 Model)

### Disassembly Procedure

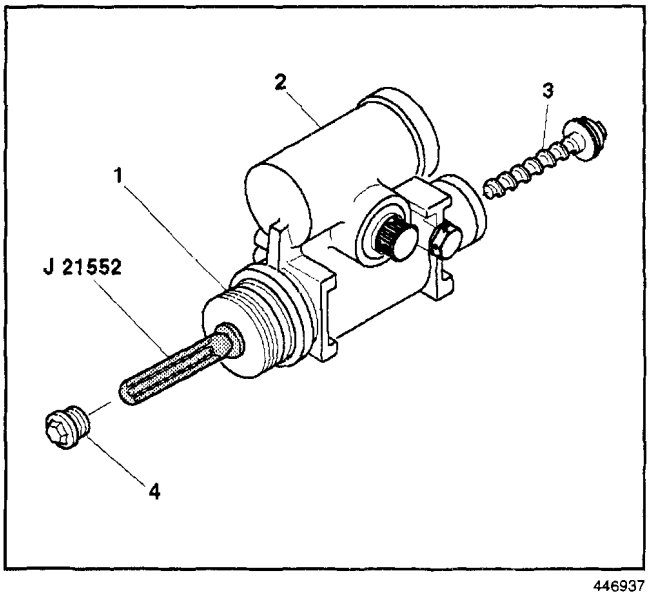
#### Tools Required

*J 21552* Rack Piston Arbor

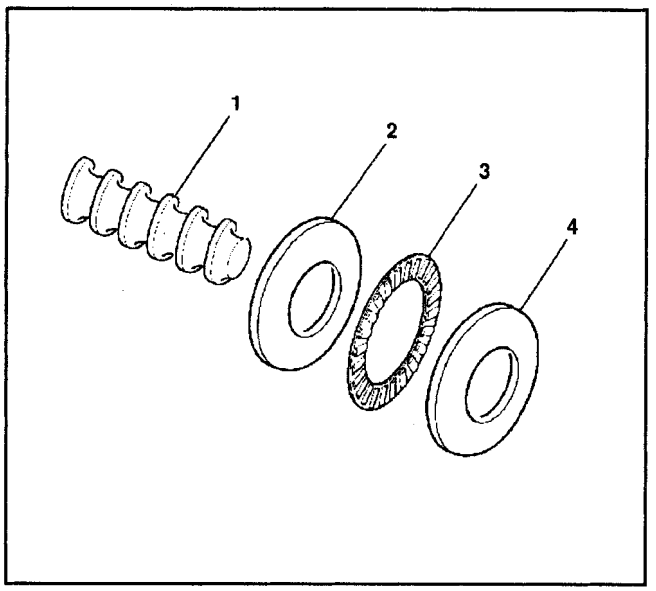
1. Remove the pitman shaft.
2. Remove the side cover. Refer to *Steering Gear Pitman Shaft and Housing Cover Replacement - Off Vehicle (710 Model).*
3. Remove the steering gear housing end plug. Refer to *Steering Gear Housing End Plug Replacement - Off Vehicle (710 Model).*
4. Turn the stub shaft (2) counterclockwise until the rack piston begins to come out of the steering gear housing.
5. Remove the rack piston plug.
6. Insert *J 21552* into the bore of the rack piston.
7. Hold *J 21552* tightly against the worm shaft while turning the stub shaft (2) counterclockwise. Turning the stub shaft (2) forces the rack piston onto *J 21552*. The rack piston balls remain in place.
8. Remove the following items as an assembly from the steering gear housing (2):
   - The rack piston (1)
   - The rack piston balls
   - *J 21552*
9. Remove the valve. Refer to *Steering Gear Stub Shaft Bearing and Seal Replacement.*



446903

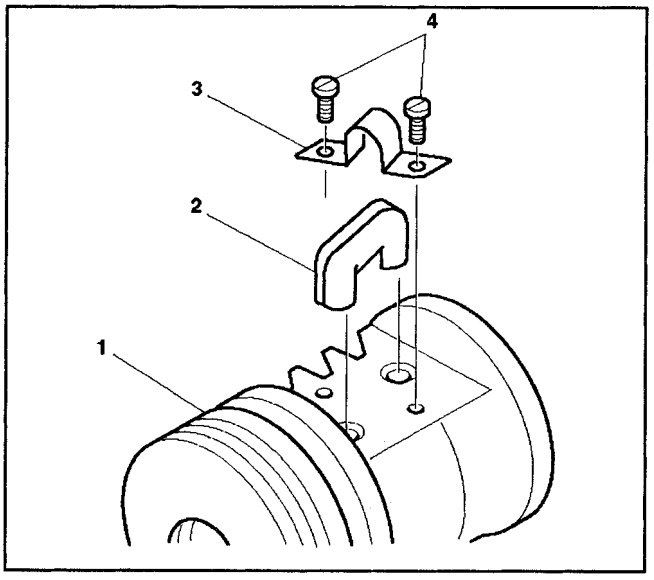


446937



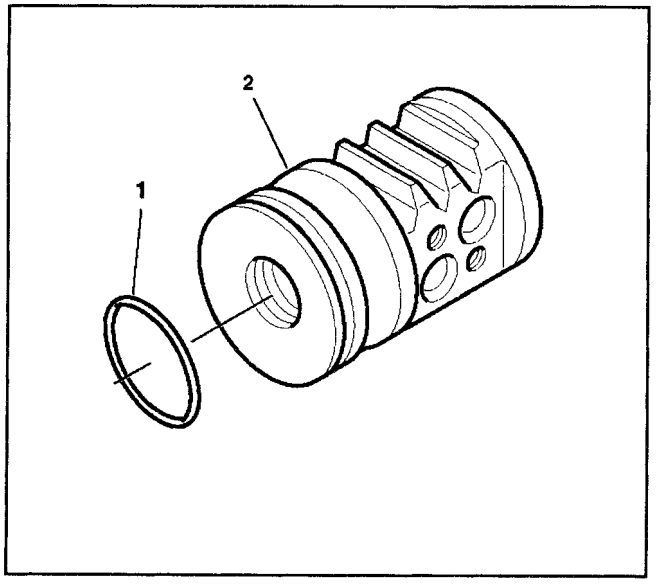

322025

10. Remove the worm shaft (1).
11. Remove the roller thrust bearing (3).
12. Remove the flat races (2) (4).
13. Remove *J 21552* from the rack piston.




446940

14. Remove the rack piston balls.
15. Remove the following items from the rack piston (1):
    - The screws (4)
    - The clamp (3)
    - The ball guide (2)
16. Remove the valve body ring.
17. Remove the O-ring seal.
18. Clean all of the disassembled parts.
19. Inspect all of the disassembled parts for wear.
20. Replace the parts if necessary.




446942

## Assembly Procedure

### Tools Required

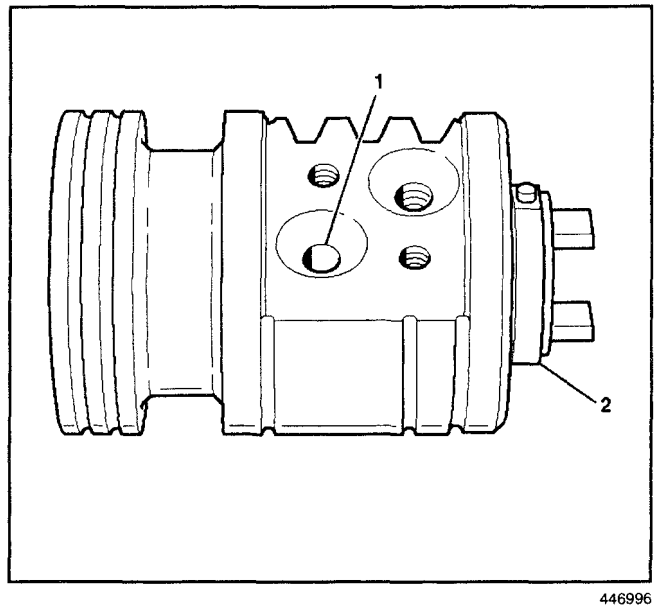
- *J 8947* Rack Piston Valve Body Ring Compressor
- *J 21552* Rack Piston Arbor

1. Lubricate the following items with power steering fluid while installing to the rack piston (2):
    - The O-ring seal (1)
    - The valve body ring

2. Install the worm shaft (2) to the rack piston outside of the steering gear housing.
3. Fully seat the worm shaft (2) to the rack piston.
4. Align the worm shaft (2) spiral groove with the rack piston ball return guide hole (1).

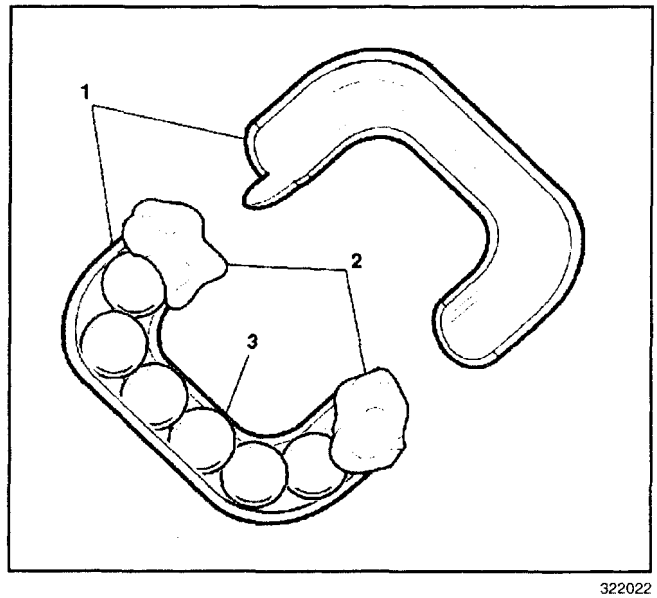
**Important:** Reinstall all of the rack piston balls in the rack piston. Improper rack piston ball installation may result in personal injury. The black rack piston balls are smaller than the silver rack piston balls. Install the black and the silver rack piston balls alternately into the rack piston and the ball guide to maintain the rack piston to the worm shaft preload.

5. Lubricate the rack piston balls with power steering fluid.
6. Insert the rack piston balls through the ball return guide hole (1) while turning worm shaft (2) counterclockwise in order to install the rack piston balls into the rack piston.



446996

7. Install the remaining rack piston balls (3) into the ball guide (1) use grease (2) at each end in order to retain the rack piston balls.



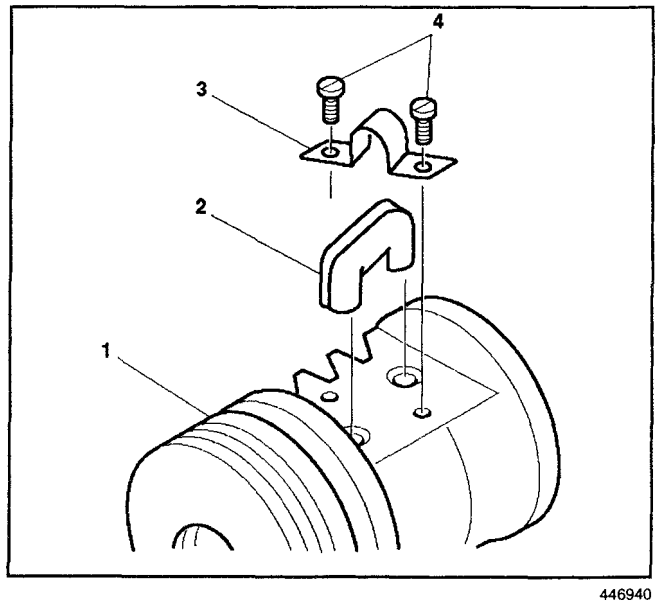
322022

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

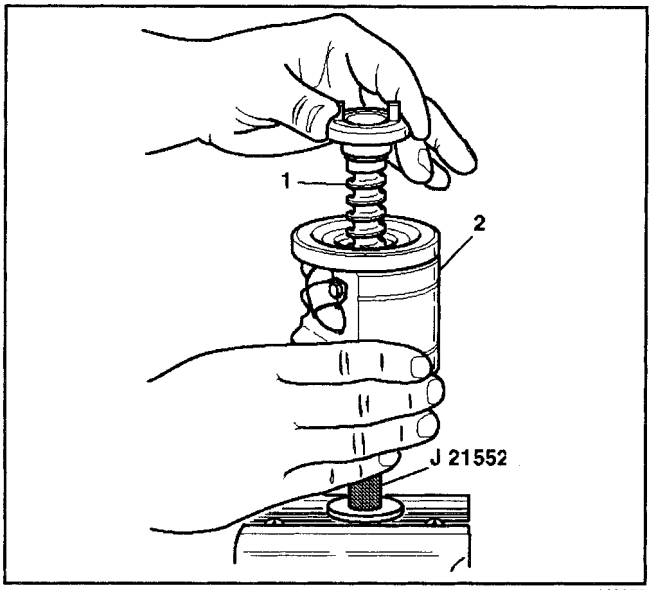
8. Install the ball guide (2) to the rack piston (1).
9. Install the ball guide clamp (3).
10. Install the screws (4).

**Tighten**

Tighten the screws to 58 N·m (43 lb in).

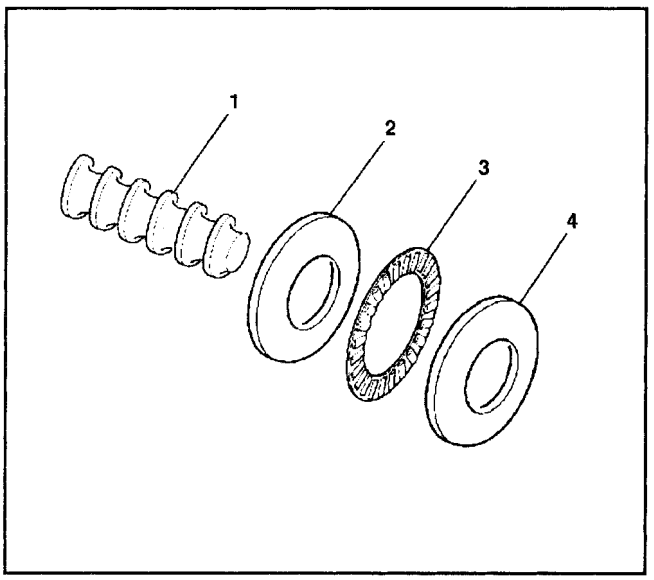


446940



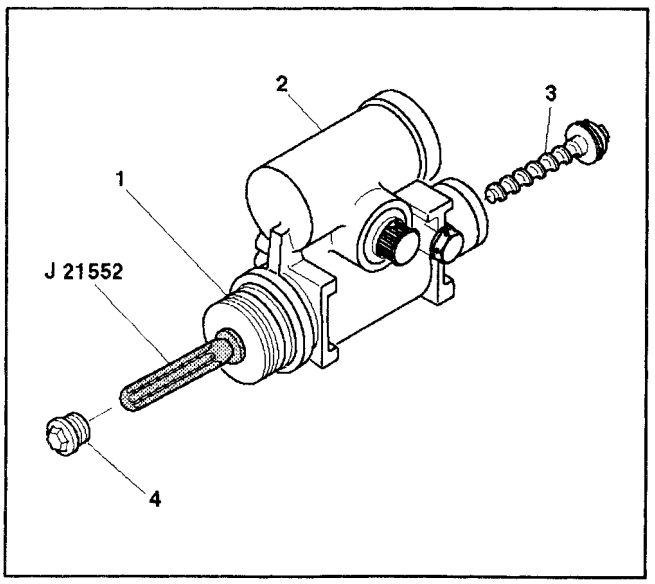
446998

11. Insert *J 21552* into the bore of the rack piston (2) while turning the worm shaft (1) counterclockwise. The turning of the worm shaft (1) forces the rack piston (2) onto *J 21552*. The rack piston balls remain in place.



322025

12. Install the flat races (2) and (4) the roller thrust bearing (3) onto the worm shaft (1).
13. Install the worm shaft (1) to the steering gear housing.
14. Install the valve. Refer to *Steering Gear Stub Shaft Bearing and Seal Replacement*.
15. Install the rack piston to the worm shaft (1) from *J 21552*, using *J 8947* to compress the seals.



446937

**Important:** Reinstall all of the rack piston balls into the rack piston. Improper rack piston ball installation may result in personal injury.

16. Hold *J 21552* tightly against the worm shaft (3).
17. Turn the stub shaft clockwise until the rack piston (1) is seated on the worm shaft (3).
18. Remove *J 21552* from the rack piston (1).
19. Install the rack piston plug (4).
    **Tighten**
    Tighten the rack piston plug (4) to 150 N·m (111 lb ft).
20. Install the steering gear housing end plug. Refer to *Steering Gear Housing End Plug Replacement - Off Vehicle (710 Model)*.
21. Install the pitman shaft.
22. Install the side cover. Refer to *Steering Gear Pitman Shaft and Housing Cover Replacement - Off Vehicle (710 Model)*.

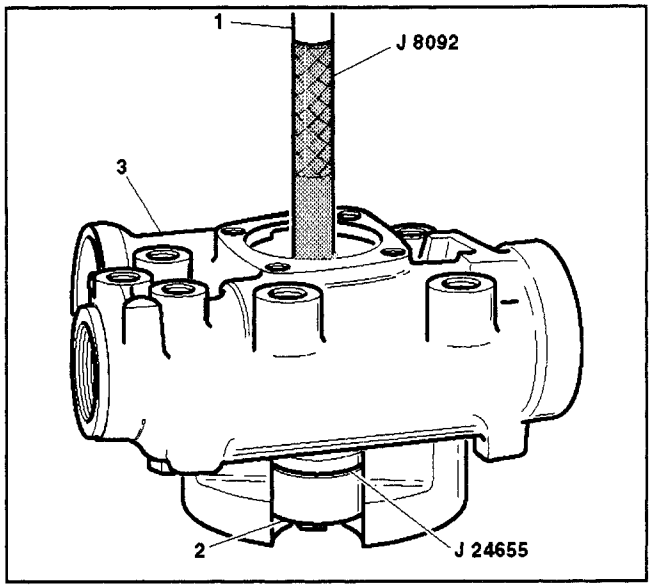
## Pitman Shaft Seals and Bearing Replacement - Off Vehicle

### Disassembly Procedure

- *J 4245* Internal Snap Ring Pliers
- *J 8092* Handle
- *J 24655* Bearing Installer and Remover

**Important:** When removing the seals, be careful not to score the steering gear housing bore or leakage may result.

1. Remove the pitman shaft seal retaining ring using *J 4245*.
2. Pry the pitman shaft dust seal off using a screwdriver.
3. Remove the pitman shaft seal back-up washer.
4. Pry the pitman shaft seal off using a screwdriver.
5. Remove the pitman shaft needle bearing assembly (2), if necessary, using *J 24655* and *J 8092*.

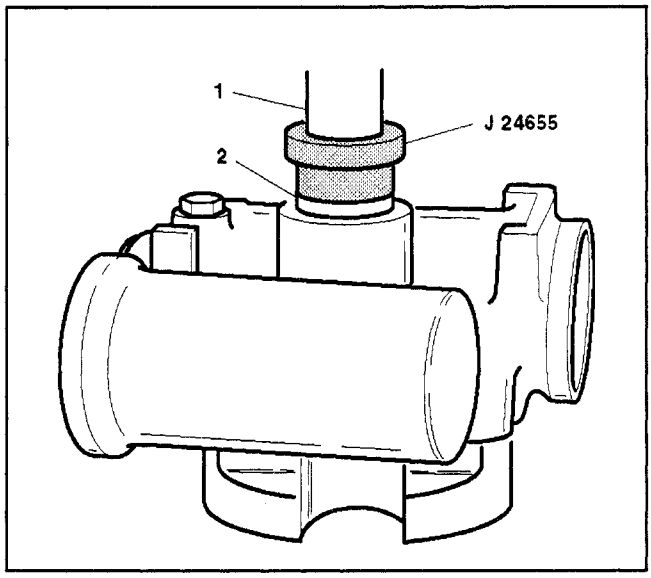


446255

### Assembly Procedure

- *J 8092* Handle
- *J 24655* Bearing Installer and Remover

1. Install the pitman shaft needle bearing assembly (2), using *J 24655* and *J 8092*.
2. Install the pitman shaft seal.
3. Install the pitman shaft seal back-up washer.
4. Install the pitman shaft dust seal.
5. Install the pitman shaft seal retaining ring.



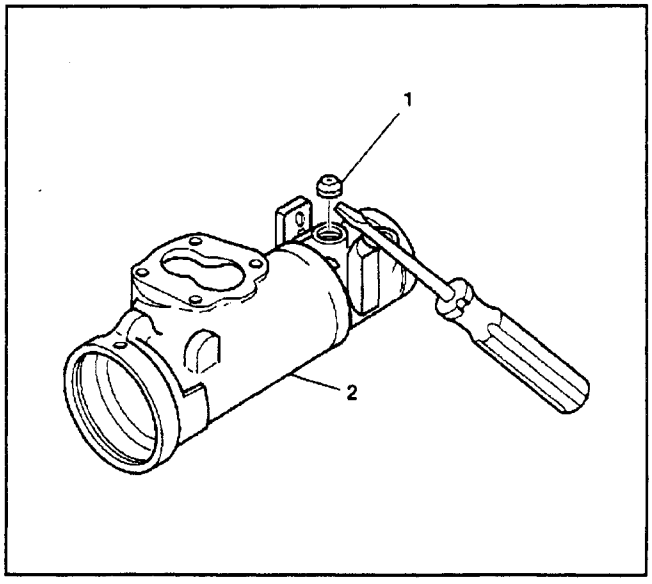
446258

## Steering Gear Check Valve Replacement - Off Vehicle

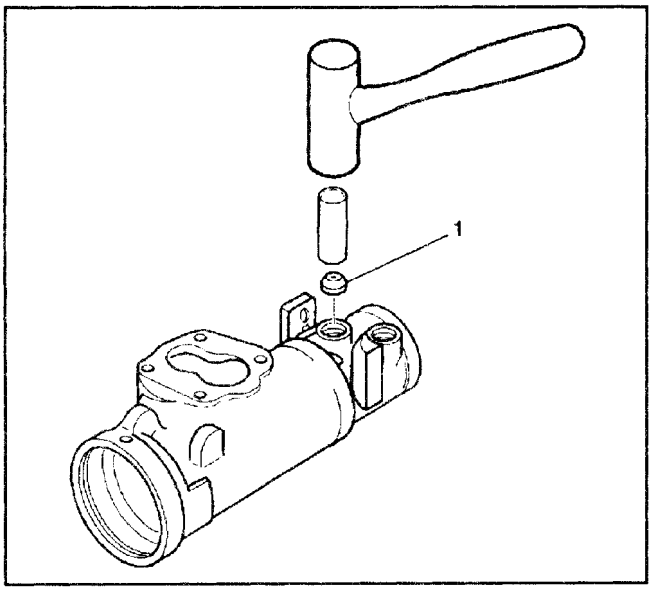
### Disassembly Procedure

**Important:** Do not damage the threads of the steering gear housing when removing the check valve.

1. To remove the check valve proceed to the next step.
2. Remove the check valve (1) by prying the check valve (1) from the steering gear housing (2) using a small screwdriver.



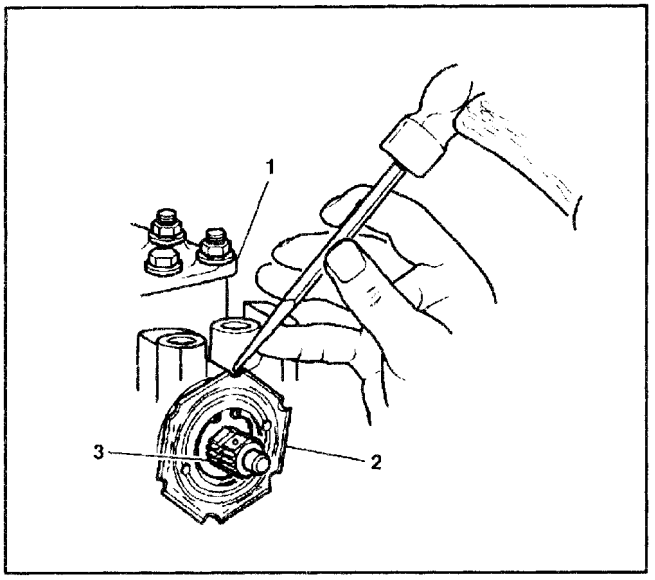
322082




322099

### Assembly Procedure

1. Install the check valve (1).
2. Use a 3/8 inch diameter piece of tubing 100 mm (4 inches) long to drive into the steering gear housing (2).




321974

## Steering Gear Thrust Support Replacement - Off Vehicle (708 Model)

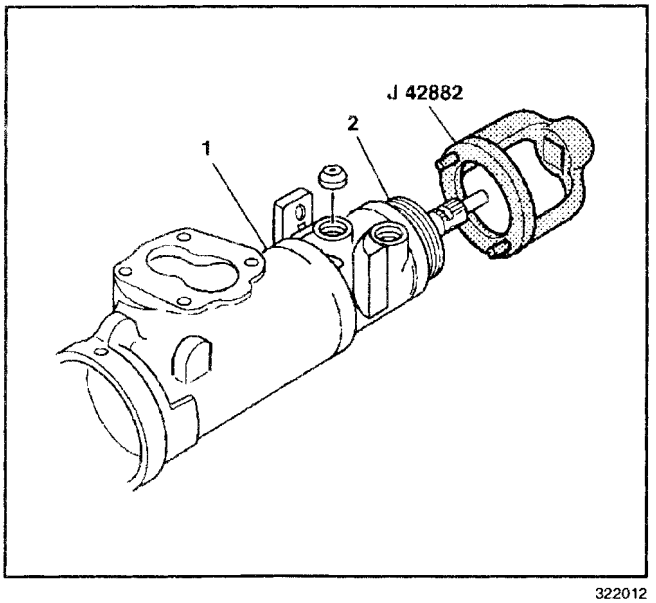
### Disassembly Procedure

#### Tools Required

- *J 42882* Adjuster Nut Socket
- *J 6222-A* Shaft Seal Protector

***Notice:*** *J 6222-A* must be placed over the stub shaft end before removing or replacing the adjuster nut assembly and the thrust support assembly.

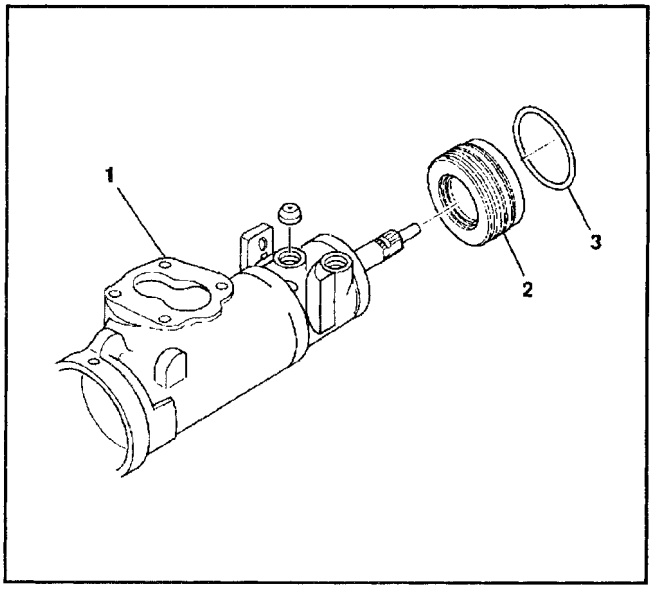
1. Remove the coupling shield retainer and the lock nut (2) from the adjuster nut assembly using a drift and a hammer.




322012

2. Remove the adjuster nut assembly (2) from the steering gear housing (1) using *J 42882*.

3. Remove the thrust support assembly (2) from the steering gear housing (1).
4. Remove the O-ring seal (3).




322011

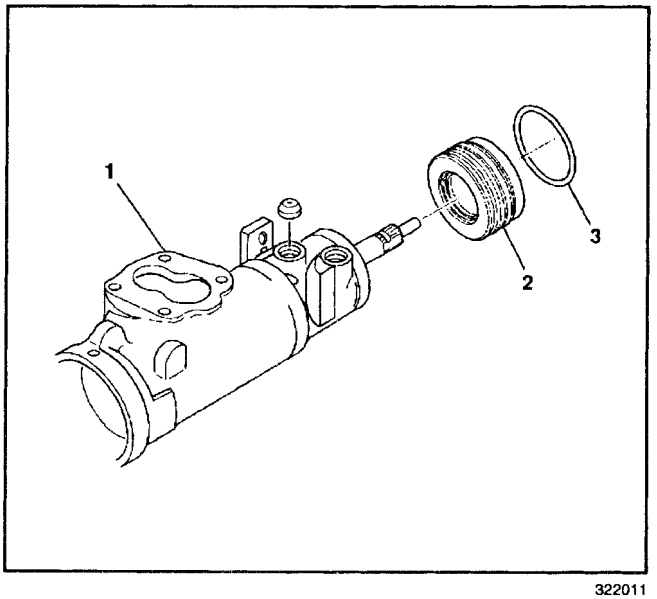
## Assembly Procedure

### Tools Required

*J 42882* Adjuster Nut Socket

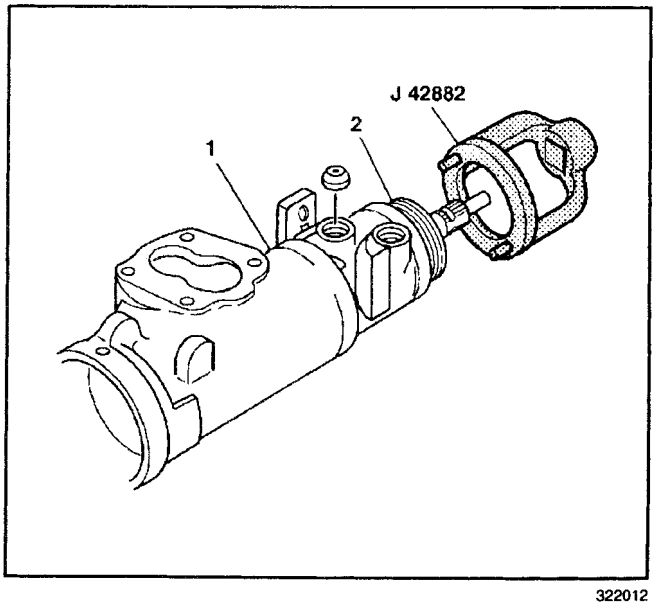
**Important:** Install a new O-ring seal each time the thrust support assembly is removed from the steering gear.

1. Lubricate the new O-ring seal (3).
2. Install the new O-ring seal (3).
3. Install the thrust support assembly (2).

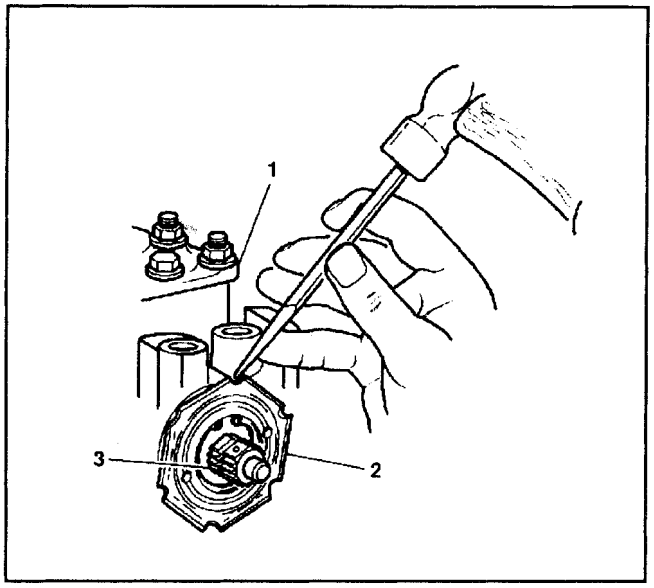



322011

4. Connect the adjuster nut assembly (2) to the steering gear housing (1) using *J 42882*.

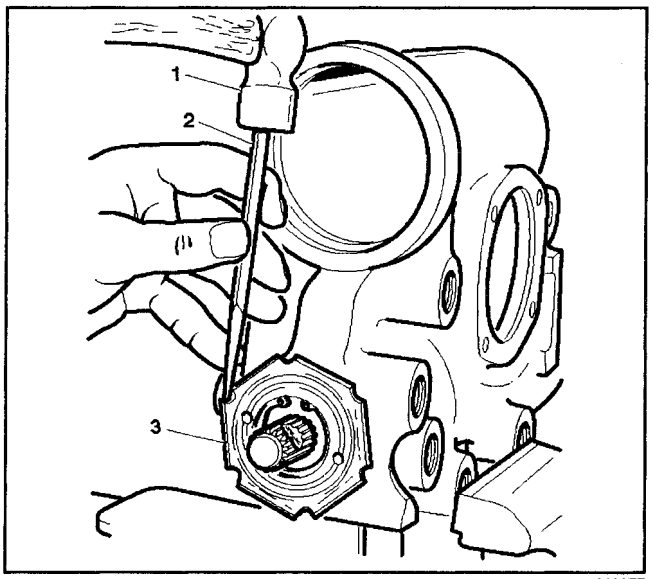



322012




321974

5. Install the coupling shield retainer and the lock nut (2) to the adjuster nut assembly.
6. Using a drift in a notch, install the coupling shield retainer and the lock nut (1).
7. Hold the adjuster nut assembly in order to maintain alignment of the marks while tightening the coupling shield retainer and lock nut (1).
8. Tighten the coupling shield retainer and the lock nut (1) securely.
9. To adjust the pitman shaft over-center preload; refer to *Pitman Shaft Over-Center Preload Adjustment - Off Vehicle (708 Model).*




446277

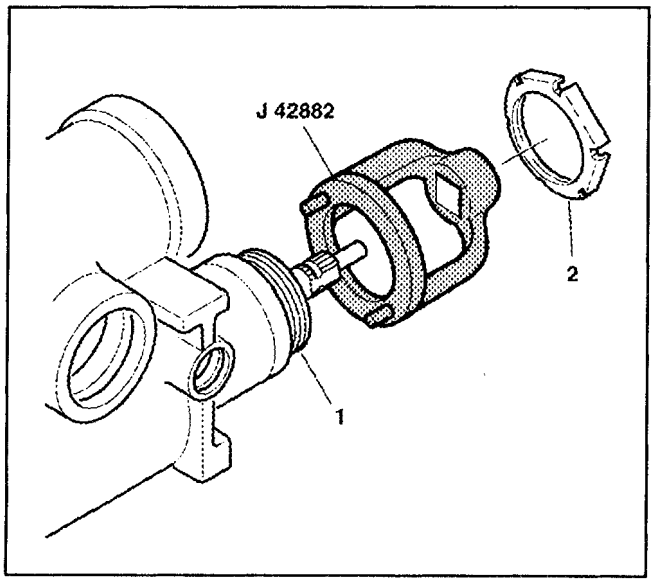
## Steering Gear Thrust Support Replacement - Off Vehicle (710 Model)

### Disassembly Procedure

#### Tools Required

- *J 42882* Adjuster Nut Socket
- *J 6222-A* Shaft Seal Protector

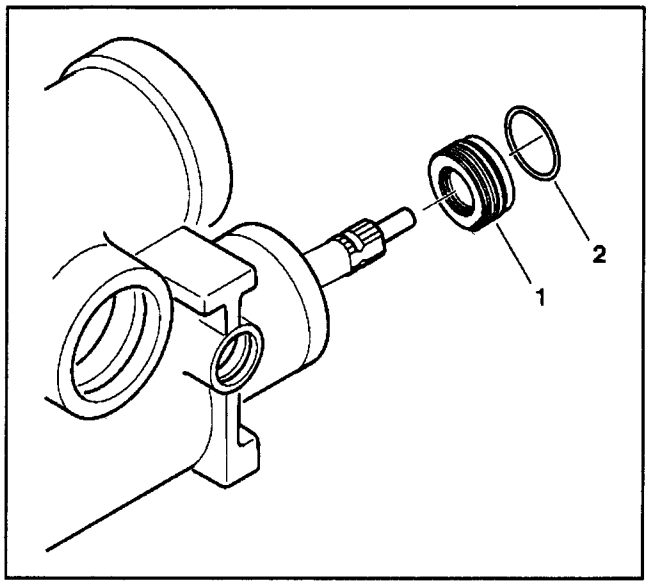
1. Remove the coupling shield retainer and lock nut (3) from the adjuster nut assembly using a drift (2) and a hammer (1).
2. Place *J 6222-A* over the end of the stub shaft.




446331

3. Remove the adjuster nut assembly (1) from the steering gear housing using *J 42882.*

4. Remove the thrust support assembly (1) from the steering gear housing.
5. Remove the O-ring seal (2).



447005

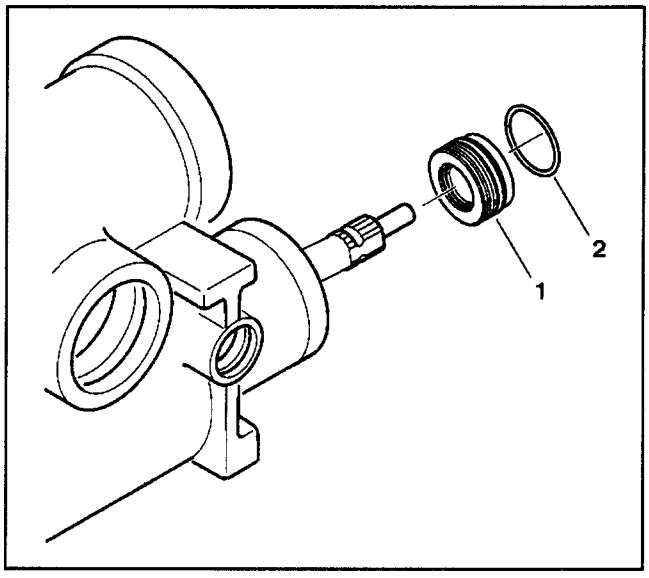
## Assembly Procedure

### Tools Required

*J 42882* Adjuster Nut Socket

**Important:** Install a new O-ring seal each time the thrust support assembly is removed from the steering gear.

1. Lubricate the new O-ring seal (2).
2. Install the new O-ring seal (2).
3. Install the thrust support assembly (1).



447005

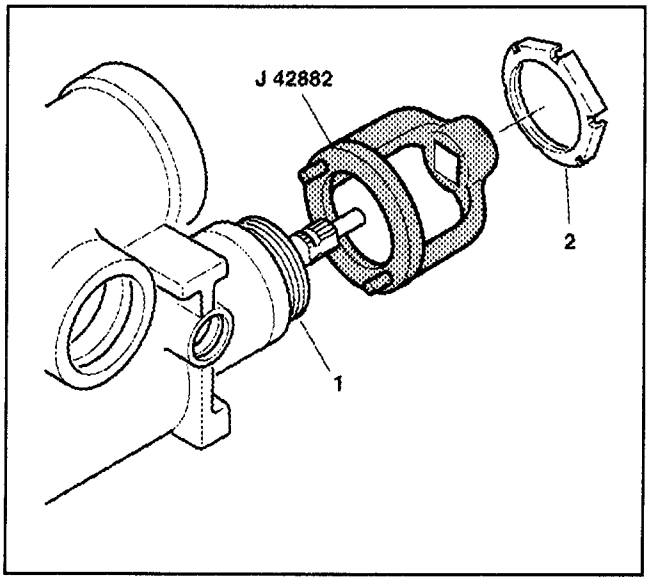
4. Connect the adjuster nut assembly (1) to the steering gear housing using *J 42882*.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices

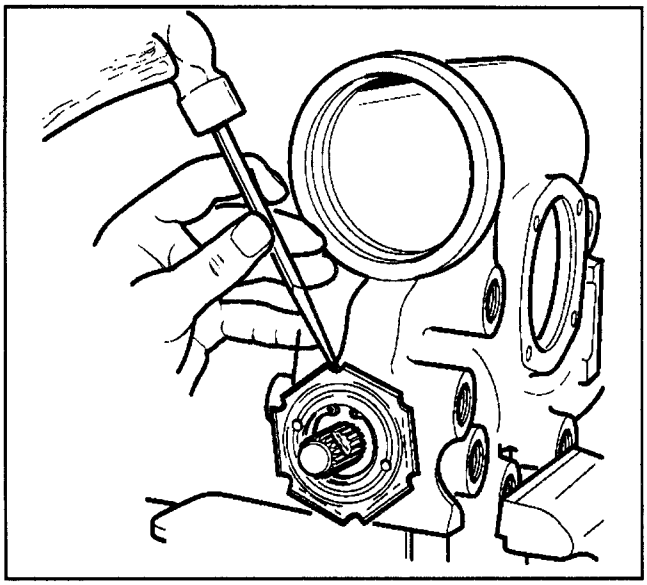
**Tighten**

Tighten the adjuster nut assembly (1) to 28.5–31.2 N·m (21–23 lb ft) and back off 15 degrees–25 degrees.

5. Install the coupling shield retainer and lock nut (2) to the adjuster nut assembly (1).
6. To adjust the thrust bearing preload; refer to *Worm Thrust Bearing Preload Adjustment - Off Vehicle (Saginaw).*



446331

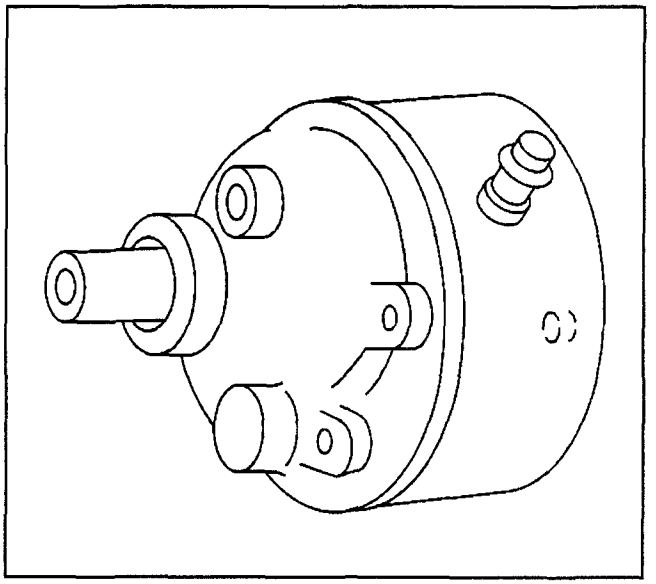


446337

7. Using a drift in a notch, install the coupling shield retainer and lock nut.
8. Hold the adjuster nut assembly in order to maintain alignment of the marks while tightening the coupling shield retainer and lock nut.
9. Tighten the coupling shield retainer and lock nut securely.

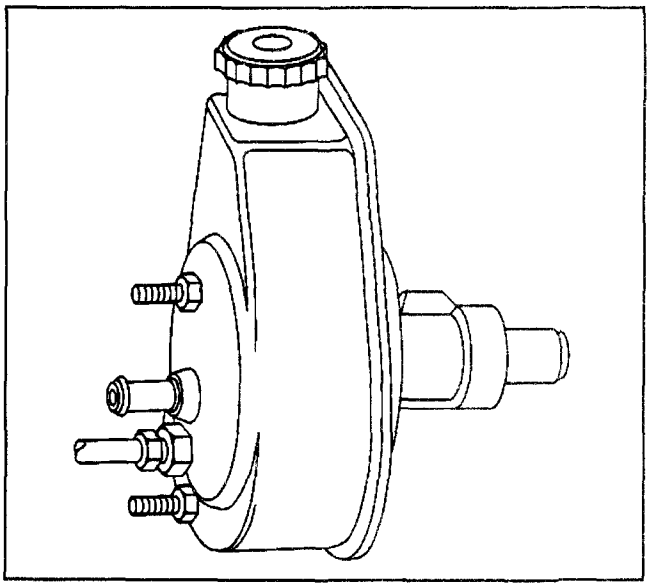
# Description and Operation

## Power Steering Pump Description



313979

The hydraulic pump is a vane-type pump. The fluid reservoir may be separate from the pump depending on the engine application.



313977

There are 2 bore openings at the rear of the pump housing. The larger opening contains the following components:

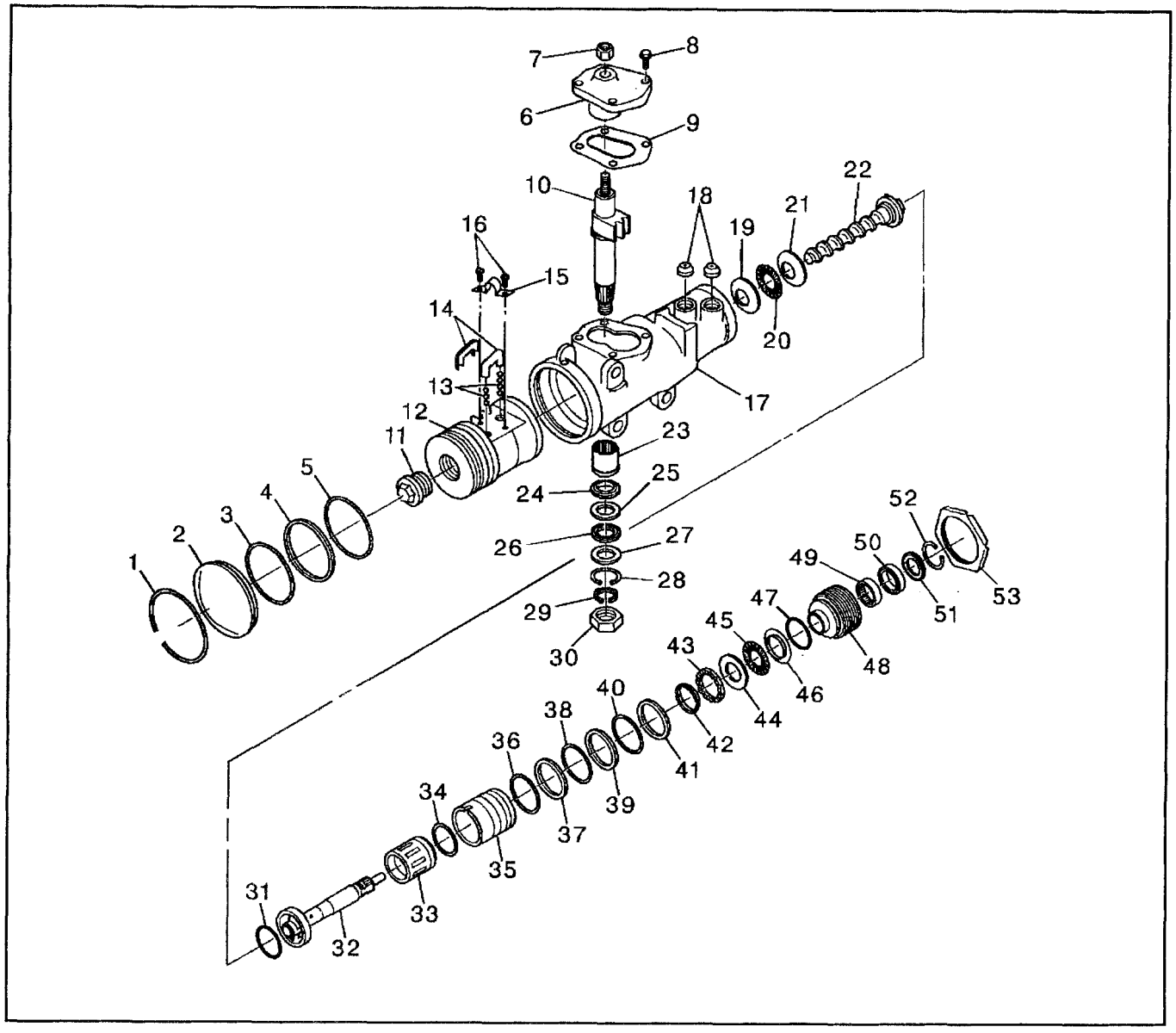
- The cam ring
- The pressure plate
- The thrust plate
- The rotor
- The vane assembly
- The end plate

The smaller opening contains the following components:

- The pressure line union
- The flow control valve
- The spring

The flow control orifice is part of the pressure line union. The pressure-relief valve inside the flow control valve limits the pump pressure.

## Power Steering Gear Description




5857

**Legend**

(1) Housing End Ring
(2) Steering Gear Housing Plug
(3) Housing End Cover O-ring Seal
(4) Power Cylinder Piston Ring
(5) Piston Ring Back-up Seal
(6) Housing Guide Cover Assembly
(7) Steering Gear Stub Shaft Adjuster Nut
(8) Steering Gear Housing Cover Bolt
(9) Housing Side Cover Seal
(10) Pitman Shaft Gear
(11) Steering Gear Rack Plug
(12) Steering Gear Rack w/Piston
(13) Gear Worm Balls
(14) Steering Gear Ball Retaining Guide
(15) Steering Gear Ball Retaining Guide Clamp
(16) Steering Gear Ball Retaining Guide Clamp Bolts
(17) Steering Gear Housing
(18) Housing Valve
(19) Thrust Bearing Race
(20) Lower Thrust Bearing
(21) Thrust Bearing Race
(22) Steering Worm
(23) Steering Gear Pitman Shaft Bearing
(24) Pitman Shaft Oil Seal
(25) Pitman Shaft Seal Back-up Washer

(26) Steering Gear Pitman Shaft Seal
(27) Pitman Shaft Seal Back-up Washer
(28) Retaining Ring
(29) Pitman Arm Washer
(30) Pitman Arm Nut
(31) Stub Shaft Seal
(32) Stub Shaft
(33) Valve Spool
(34) Spool Seal
(35) Valve Body
(36) Valve Body Seal
(37) Valve Body Ring
(38) Valve Body Seal
(39) Valve Body Ring
(40) Valve Body Seal
(41) Valve Body Ring
(42) Adjustable Bearing Retainer
(43) Thrust Bearing Spacer
(44) Upper Thrust Bearing Race
(45) Valve Assembly Bearing
(46) Thrust Bearing Race
(47) Adjuster Plug Seal
(48) Adjuster Plug
(49) Steering Gear Stub Shaft Bearing
(50) End Plug Stub Shaft Oil Seal
(51) Stub Shaft Seal
(52) Retaining Ring
(53) Steering Gear Rack Adjuster Nut

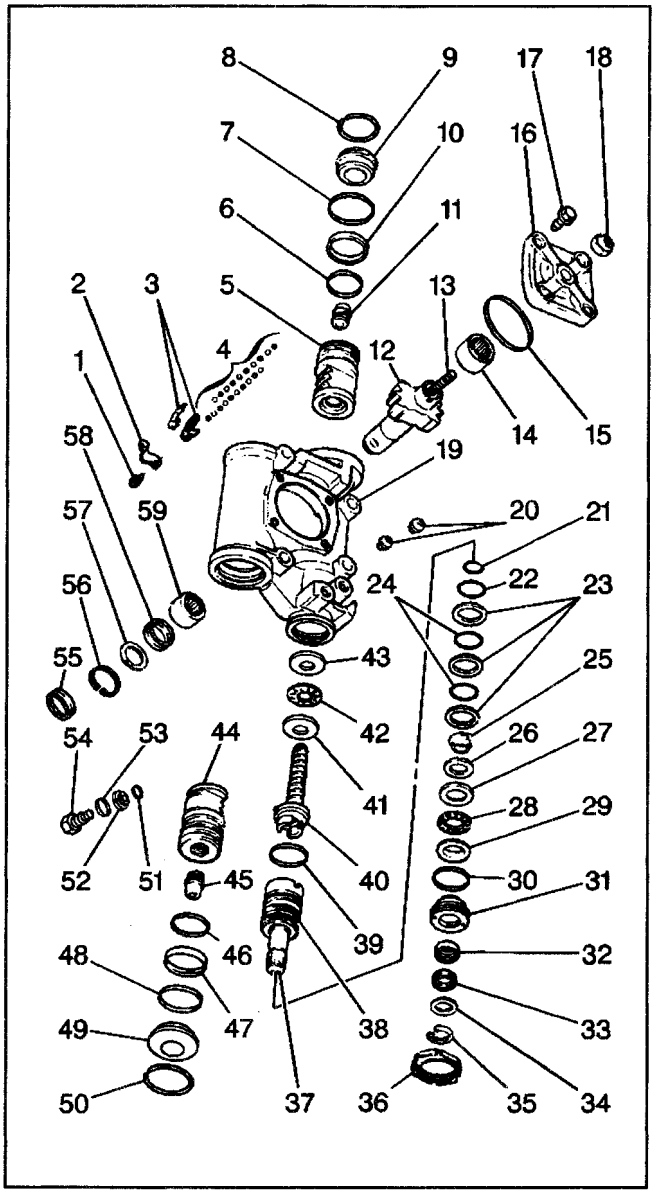
The 708 Series Saginaw power steering gear has a recirculating ball system. The ball system acts as a rolling thread between the worm shaft and the rack piston. The following items support the worm shaft:

- A thrust bearing preload
- 2 conical thrust races at the lower end
- A bearing assembly in the adjuster plug at the upper end

The rack piston moves up in the gear when the worm shaft turns right. The rack piston moves down in the gear when the worm shaft turns left. The rack piston teeth mesh with the sector. The sector is a part of the pitman shaft. Turning the worm shaft turns the pitman shaft. The pitman shaft turns the wheels through the steering linkage.

The control valve in the steering gear directs the power steering fluid to either side of the rack piston. The rack piston converts the hydraulic pressure into a mechanical force. If the steering system becomes damages and loses the hydraulic pressure, the vehicle can be controlled manually.

**Model 710**




313985

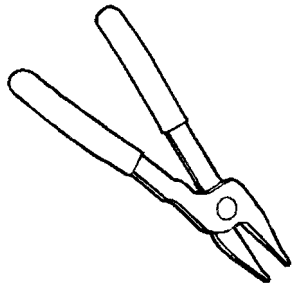
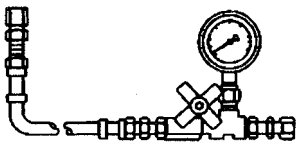
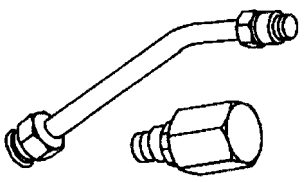
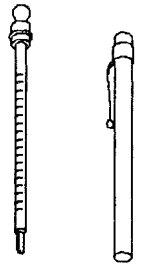
**Legend**

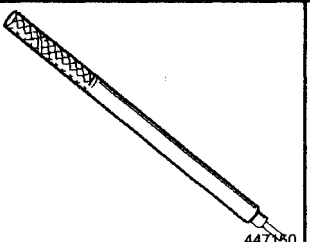
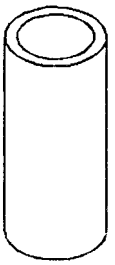
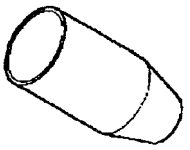
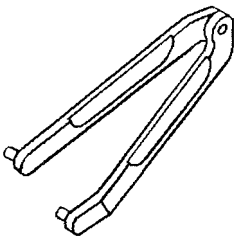
(1) Lockwasher/Screw Assembly
(2) Ball Clamp
(3) Ball Return Guide
(4) Balls
(5) Piston
(6) Seal
(7) Seal
(8) Retaining Ring
(9) Plug
(10) Ring
(11) Plug
(12) Pitman Shaft
(13) Adjuster Screw
(14) Bearing
(15) Seal
(16) Side Cover

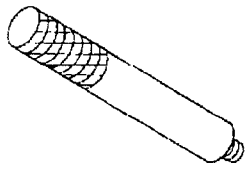
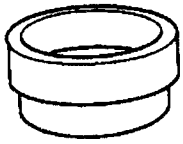
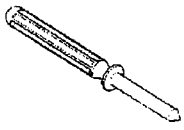
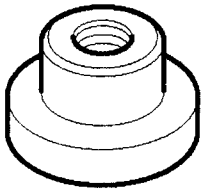
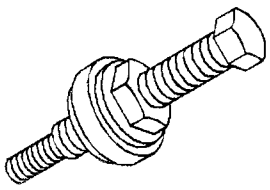
(17) Bolt
(18) Nut
(19) Housing
(20) Connectors
(21) Seal
(22) Seal
(23) Ring
(24) Seal
(25) Bearing Retainer
(26) Spacer
(27) Race
(28) Bearing
(29) Race
(30) Seal
(31) Adjuster Plug
(32) Bearing
(33) Seal
(34) Washer
(35) Retaining Ring
(36) Nut
(37) Stub Shaft
(38) Valve Body
(39) Seal
(40) Worm Shaft
(41) Races
(42) Bearing
(43) Races
(44) Rack Piston
(45) Plug
(46) Seal
(47) Ring
(48) Seal
(49) Plug
(50) Retaining Ring
(51) Seal
(52) Plate
(53) Seal
(54) Relief Valve
(55) Dust Seal
(56) Retaining Ring
(57) Washer
(58) Seal
(59) Bearing

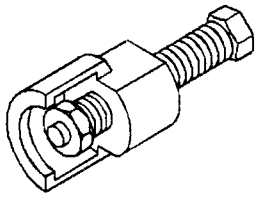
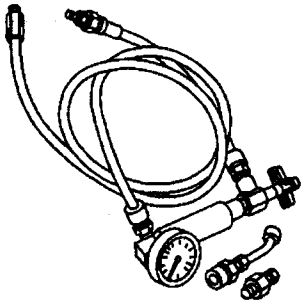
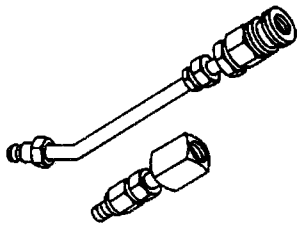
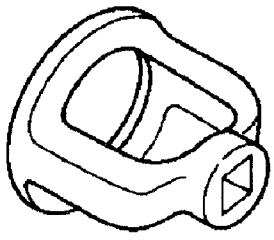
The 710 Series Saginaw integral power steering gear has a constant 17.5 to 1 ratio. The integral power steering gear has an open-center, rotary-type, four-way control valve. The control valve directs the oil to either side of the rack piston. The rack piston converts the hydraulic power into mechanical output. This gear is provided with a 14500 GVW and a 16000 GVW motorhome chassis.

## Special Tools and Equipment

| Illustration | Tool Number/ Description |
|---|---|
|  322143 | J 4245<br>Internal Snap Ring Pliers |
|  57498 | J 4646<br>Snap Ring Pliers |
|  65360 | J 5176-E<br>Power Steering Pressure Tester |
|  315381 | J 5176 - 20A<br>Power Steering Gauge Adapter (18 mm) |
|  670 | J 5421 - 02<br>Thermometer |

| Illustration | Tool Number/ Description |
|---|---|
|  447150 | J 6217<br>Seal and Bearing Remover |
|  672 | J 6219<br>Pitman Shaft Seal Installer |
|  322165 | J 6222-A<br>Seal Shaft Protector |
|  674 | J 7624<br>Bearing Preload Spanner Wrench |
|  226857 | J 7754 - 01<br>Torque Wrench |

| Illustration | Tool Number/ Description |
|---|---|
|  354978 | J 8092<br>Handle |
|  5852 | J 8947<br>Rack Piston Teflon Ring Compresspr |
|  322139 | J 21552<br>Rack Piston Arbor |
|  447147 | J 24655<br>Bearing Installer and Remover |
|  676 | J 25033-B<br>Power Steering Pump Pulley Installer |

| Illustration | Tool Number/ Description |
|---|---|
|  675 | J 25034-B<br>Power Steering Pump Pulley Remover |
|  315384 | J 25323-D<br>Power Steering System Analyzer |
|  309644 | J 29525<br>Power Steering Analyzer Adapter (18 MM) |
|  322149 | J 42882<br>Adjuster Nut Socket |

# Steering Linkage (Non-Rack & Pinion)

## Specifications

### Fastener Tightening Specifications (Commercial )

| Application | Specification | |
|---|---|---|
| | Metric | English |
| Connecting Rod To Adjuster Tube Bolts | 68 N·m | 50 lb ft |
| Idler Arm Frame Support To Frame | 40 N·m | 30 lb ft |
| Idler Arm To Relay Rod | 90 N·m | 66 lb ft |
| Pitman Arm To Relay Rod | 90 N·m | 66 lb ft |
| Pitman Arm To Steering Gear | 250 N·m | 184 lb ft |
| Tie Rod Adjuster Tube Bolts | 19 N·m | 14 lb ft |
| Tie Rod To Relay Rod | 90 N·m | 66 lb ft |
| Tie Rod To Steering Knuckle* | 62 N·m | 46 lb ft |

*Tightening Procedure (Castellated Nuts)

1. Tighten the nuts to the specified torque.
2. Advance the nut in order to align the nut slot with the cotter pin hole. Do not back off the nut in order to align the cotter pin hole.
3. Insert a new cotter pin of the correct size.

### Fastener Tightening Specifications (Motorhome )

| Application | Specification | |
|---|---|---|
| | Metric | English |
| Connector Rod to Pitman Arm* | 95 N·m | 70 lb ft |
| Connecting Rod to Relay Arm* | 95 N·m | 70 lb ft |
| Idler Arm Adjuster Plug Jam Nut | 40 N·m | 30 lb ft |
| Idler Arm And Relay Arm To Support Assemblies | 170 N·m | 125 lb ft |
| Idler Arm To Relay Rod | 90 N·m | 66 lb ft |
| Pitman Arm To Relay Rod | 159 N·m | 117 lb ft |
| Pitman Arm To Steering Gear | 170 N·m | 125 lb ft |
| Pitman Arm (Clamp-Type) To Steering Gear (JF9) | 135 N·m | 100 lb ft |
| Relay Rod To Relay Arm | 159 N·m | 117 lb ft |
| Shock Absorber To Frame | 11 N·m | 8 lb ft |
| Shock Absorber To Idler Arm* | 62 N·m | 46 lb ft |
| Support Assemblies To Frame | 65 N·m | 48 lb ft |
| Tie Rod Adjuster Tube Bolts | 19 N·m | 14 lb ft |
| Tie Rod To Relay Rod | 90 N·m | 66 lb ft |
| Tie Rod To Steering Knuckle* | 62 N·m | 46 lb ft |

*Tightening Procedure (Castellated Nuts)

1. Tighten the nuts to the specified torque.
2. Advance the nut in order to align the nut slot with the cotter pin hole. Do not back off the nut in order to align the cotter pin hole.
3. Insert a new cotter pin of the correct size.

## Fastener Tightening Specifications (Commercial (I-Beam Front Axle))

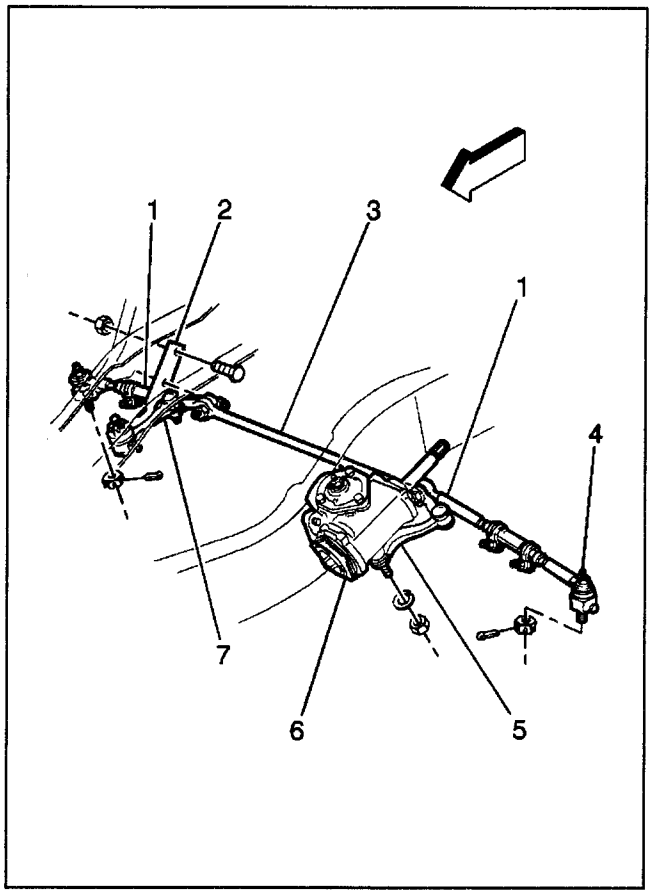
| Application | Specification | |
|---|---|---|
| | Metric | English |
| Connecting Rod Adjuster Tube Bolts | 68 N·m | 50 lb ft |
| Connecting Rod To Pitman Arm* | 159 N·m | 117 lb ft |
| Connecting Rod To Steering Knuckle* | 159 N·m | 117 lb ft |
| Pitman Arm To Relay Rod | 159 N·m | 117 lb ft |
| Pitman Arm to Steering Gear | 255 N·m | 188 lb ft |
| Relay Rod To Relay Arm | 159 N·m | 117 lb ft |
| Shock Absorber To Frame | 47 N·m | 35 lb ft |
| Shock Absorber To Tie Rod* | 62 N·m | 46 lb ft |
| Tie Rod Outer Jam and Inner Nuts | 375 N·m | 277 lb ft |
| Tie Rod To Steering Knuckle* | 220 N·m | 162 lb ft |

*Tightening Procedure (Castellated Nuts)

1. Tighten the nuts to the specified torque.
2. Advance the nut in order to align the nut slot with the cotter pin hole. Do not back off the nut in order to align the cotter pin hole.
3. Insert a new cotter pin of the correct size.

# Component Locator

## Steering Linkage Component Views (Commercial)

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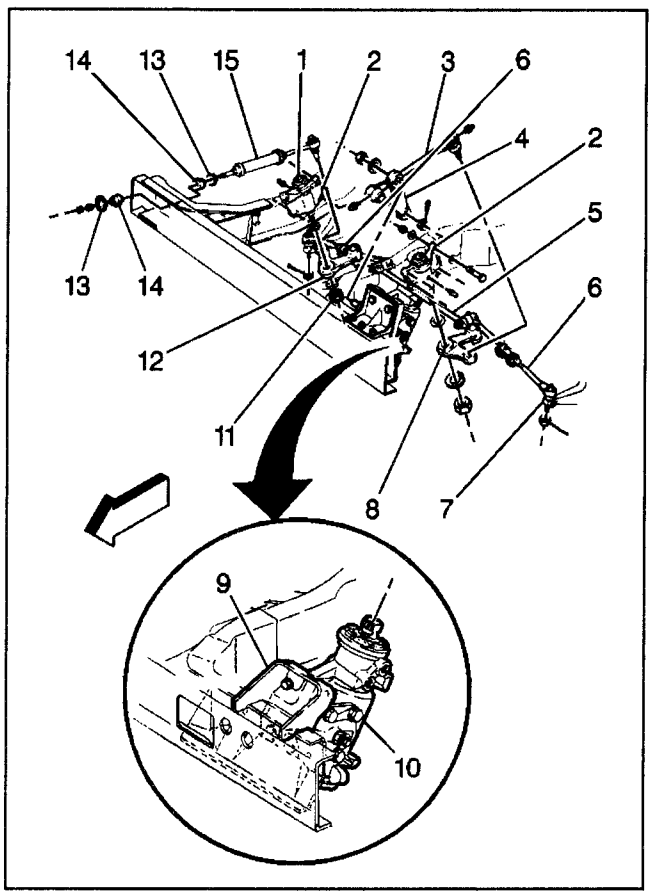
**Legend**

(1) Tie Rod Assembly
(2) Idler Arm Frame Support
(3) Relay Rod
(4) Steering Knuckle
(5) Pitman Arm
(6) Steering Gear
(7) Idler Arm

## Steering Linkage Component Views (Motorhome With JB8)

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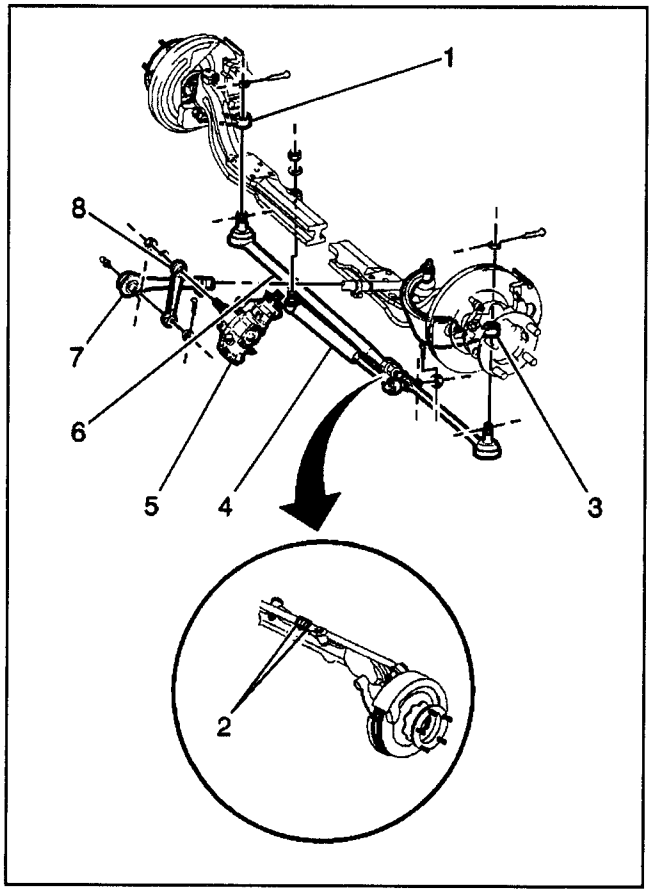
**Legend**

(1) Adjuster Plug
(2) Support Assemblies
(3) Connecting Rod
(4) Pitman Arm
(5) Relay Rod
(6) Tie Rod Assembly
(7) Steering Knuckle
(8) Steering Relay and Connecting Rod Arm
(9) Bracket
(10) Steering Gear
(11) Jam Nut
(12) Steering Idler Arm
(13) Retainer
(14) Grommet
(15) Steering Linkage Shock Absorber

## Steering Linkage Component Views (Commercial (I-Beam Front Axle))

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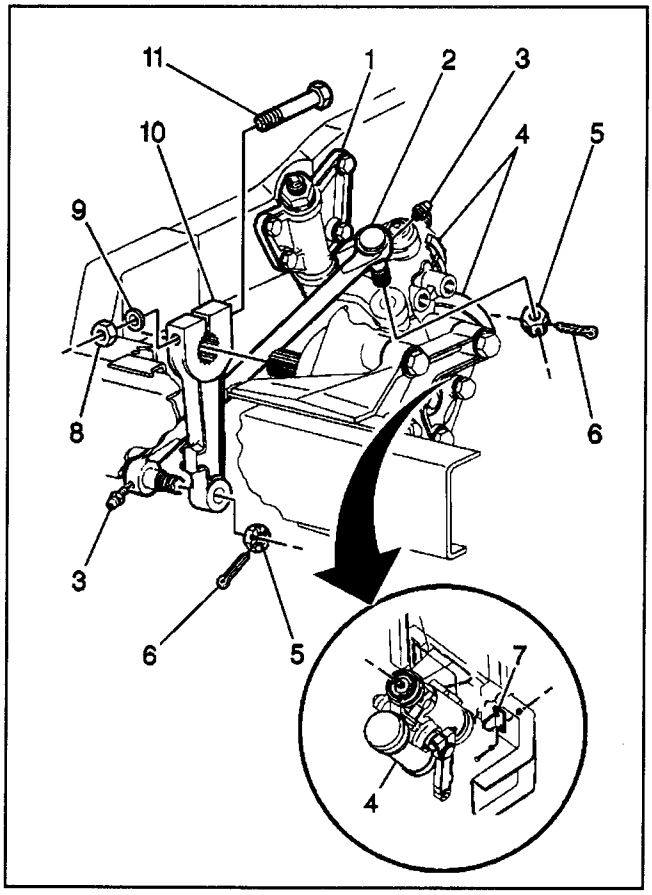
**Legend**

(1) Steering Knuckle (Right)
(2) Tie Rod Jam Nut
(3) Steering Knuckle (Left)
(4) Steering Linkage Shock Absorber
(5) Steering Gear
(6) Tie Rod Assembly
(7) Connecting Rod Assembly
(8) Pitman Arm

## Steering Linkage Component Views (Motorhome With JF9)

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**Legend**

(1) Pivot Shaft Assembly
(2) Rod Assembly
(3) Fitting
(4) Steering Gear (Model 710)
(5) Nut
(6) Cotter Pin
(7) Bracket
(8) Nut
(9) Washer
(10) Pitman Arm
(11) Bolt

# Repair Instructions

## Steering Linkage Inspection

**Important:** Replace worn, damaged or broken steering linkage components. Do not attempt to repair damaged or broken components by welding.

- Check the relay rod and tie rod ends for excessive up-and-down motion and for excessive end play or loss of motion at the ball stud. Refer to *Relay Rod Replacement (Commercial)* and *Relay Rod Replacement (Motorhome)* for relay rod replacement, and for further tie rod inspection guidance, refer to *Tie Rod End Inspection (Commercial)*, *Tie Rod End Inspection (Motorhome)* and *Tie Rod End Inspection (Commercial (I-Beam Front Axle))*.
- Check for a shimmy condition at the idler arm and measure the deflection. Refer to *Idler Arm Inspection*.
- Check for a shimmy condition and/or excessive rust condition at the connecting rod, where applicable; the pitman arm; and the steering damper. Refer to *Connecting Rod Replacement*; *Pitman Arm Replacement (Commercial)*, *Pitman Arm Replacement (Motorhome )*, *Pitman Arm Replacement (Commercial (I-Beam Front Axle))*; and *Steering Damper Replacement (Motorhome)*, *Steering Damper Replacement (With I-Beam Axle Assembly)*.

## Tie Rod End Inspection (Commercial)

**Important:** Replace damaged or broken steering linkage components. Do not attempt to repair broken or damaged components by welding.

There are two tie rod assemblies (1). Each tie rod assembly consists of 5 pieces:

- A sleeve
- 2 clamps
- 2 tie rod ends

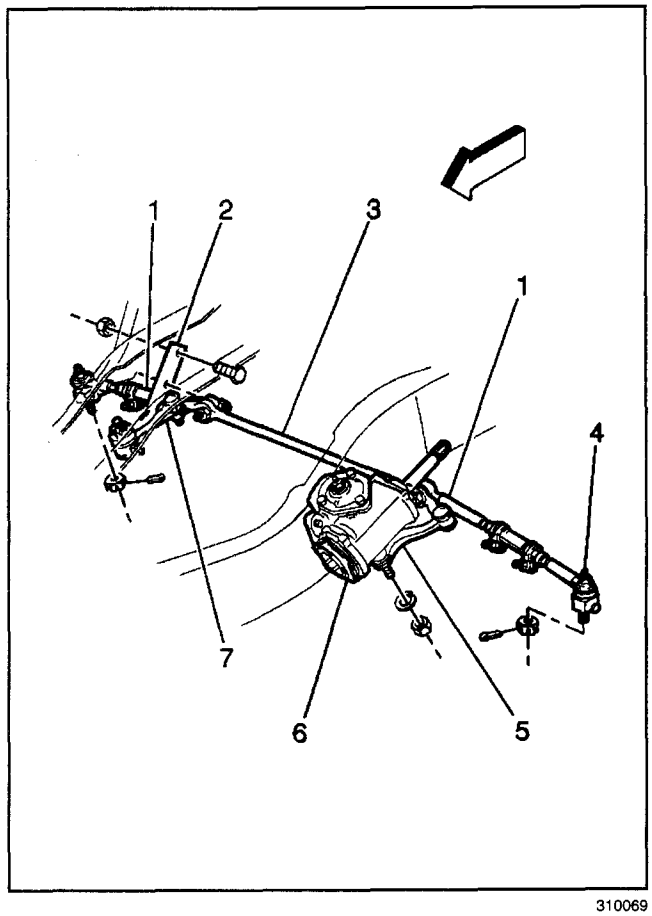
The ends are threaded into the sleeves and are secured with the clamps. Right-hand and left-hand threads are used for toe-in adjustments and for steering gear centering.

The tie rod ends are self-adjusting. The tie rod ends require periodic lubrication. Refer to General Information. Replace the tie rod ends when any of the following conditions are present at the ball stud:

- Excessive up-and-down motion
- Excessive end play
- Loss of motion

Before you undertake any service, note the position of the tie rod adjuster tube, and the direction from which the bolts are installed. The tie rod adjuster tube components may be rusted.

1. If the torque required in order to remove the nut from the bolt exceeds 9 N·m (80 lb in), discard the nuts and the bolts.
2. Apply penetrating oil between the clamp and the tube.
3. Rotate the clamps until they move freely.
4. Inspect the following components:
   - The tie rod ends for damage
   - The tie rod end seals for excessive wear
   - The threads on the tie rod ends for damage
   - The ball stud threads for damage
   - The adjuster tube for bends
   - The adjuster tube for damaged threads
5. Install all parts, with the correct part number, in the proper position.

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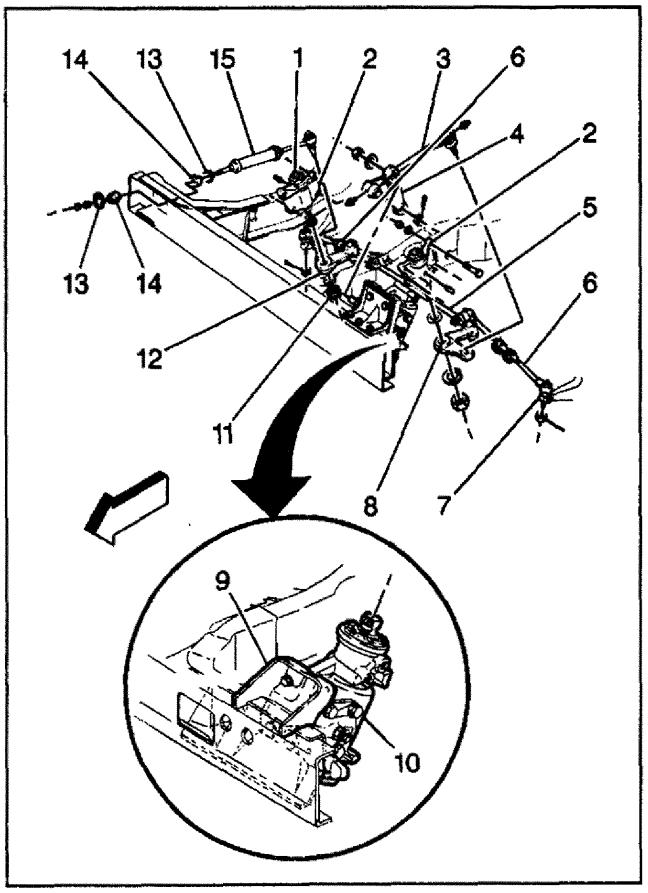


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## Tie Rod End Inspection (Motorhome)

**Important:** Replace damaged or broken steering linkage components. Do not attempt to repair broken or damaged components by welding.

There are two tie rod assemblies (6). Each tie rod assembly consists of 5 pieces:

- A sleeve
- 2 clamps
- 2 tie rod ends

The ends are threaded into the sleeves and are secured with the clamps. Right-hand and left-hand threads are used for toe-in adjustments and for steering gear centering.

The tie rod ends are self-adjusting. The tie rod ends require periodic lubrication. Refer to General Information. Replace the tie rod ends when any of the following conditions are present at the ball stud:

- Excessive up-and-down motion
- Excessive end play
- Loss of motion

Before you undertake any service, note the position of the tie rod adjuster tube, and the direction from which the bolts are installed. The tie rod adjuster tube components may be rusted.

1. If the torque required in order to remove the nut from the bolt exceeds 9 N·m (80 lb in), discard the nuts and the bolts.
2. Apply penetrating oil between the clamp and the tube.
3. Rotate the clamps until they move freely.
4. Inspect the following components:
   - The tie rod ends for damage
   - The tie rod end seals for excessive wear
   - The threads on the tie rod ends for damage
   - The ball stud threads for damage
   - The adjuster tube for bends
   - The adjuster tube for damaged threads
5. Install all parts, with the correct part number, in the proper position.

## Tie Rod End Inspection (Commercial (I-Beam Front Axle))

**Important:** Replace damaged or broken steering linkage components. Do not attempt to repair broken or damaged components by welding.

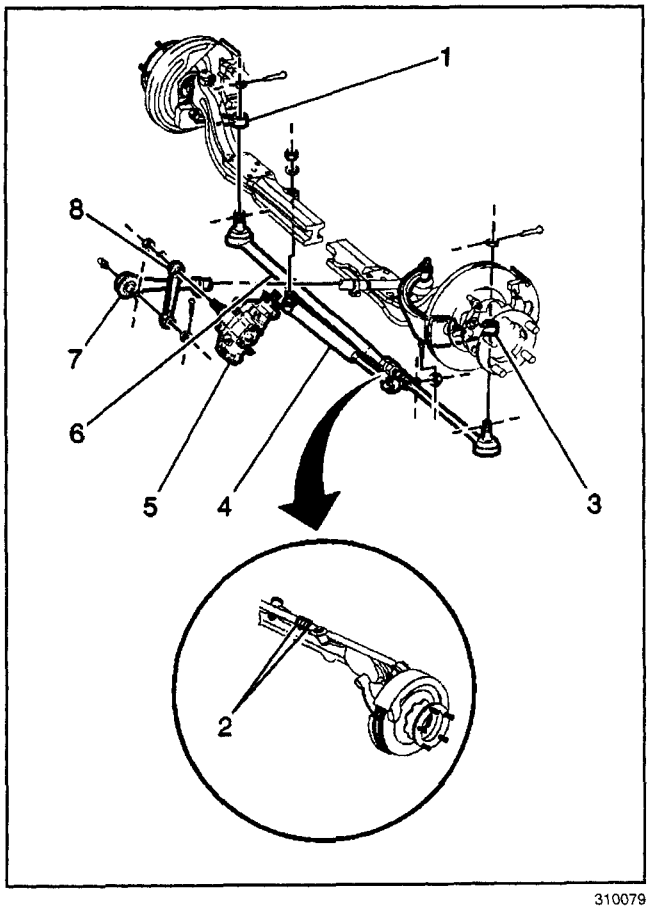
The Commercial I-Beam Front Axle tie rod assembly (6) has two toe-in adjustment nuts (2) on the tie rod. Refer to *Fastener Tightening Specifications (Commercial (I-Beam Front Axle))* for proper tightening specifications after the proper adjustment reading shown in *Wheel Alignment Specifications* is obtained. Inspect the toe-in adjustment nuts for cracks, excessive rounding, or excessive rusting. Replace the nuts if necessary.

Replace the tie rod when any of the following conditions are present at the ball stud:

- Excessive up-and-down motion
- Excessive end play
- Loss of motion

Also inspect the following components:

- The tie rods ends for damage
- The tie rod end seals for excessive wear
- The threads on the tie rod ends for damage
- The ball stud threads for damage



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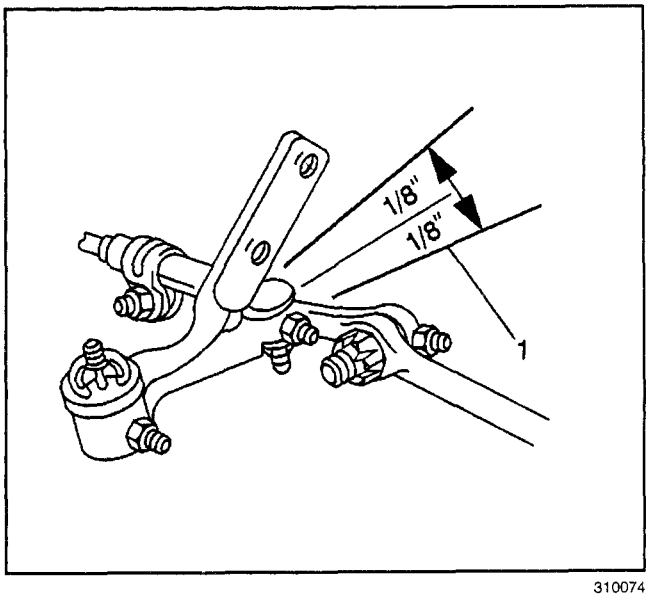
## Idler Arm Inspection

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Ensure that the following conditions exist:
   - The front wheels rotate freely.
   - The steering mechanism turns freely.
   - The wheels are positioned straight ahead.

**Important:**

- Do not jerk the right wheel and tire assembly back and forth in order to cause an up and down movement of the idler arm. This is not an acceptable testing procedure because you cannot control the amount of force that you apply to the idler arm.
- Loose idler arms or other suspension or steering system faults may create a shimmy condition. Shimmy conditions may also originate at the wheel and tire assembly from the following conditions:
  - Dynamic imbalance
  - Runout or force variations
  - Road surface irregularities
- Consider all possible causes of a shimmy complaint. Refer to *Wheel Mounting Surface Check* in Tires and Wheels.



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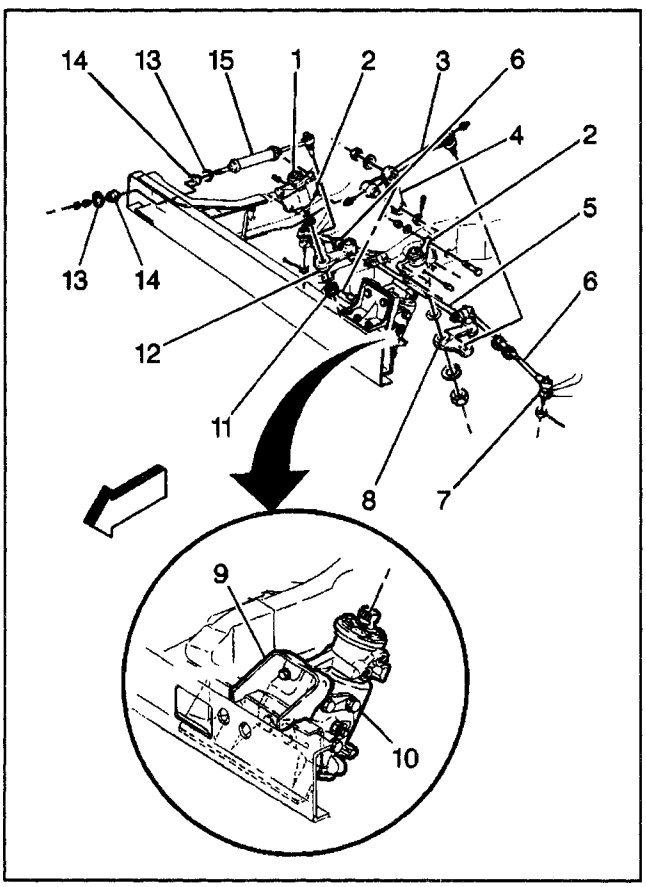
3. Position a dial indicator against the top of the idler arm grease cap.
4. Place a spring scale near the relay rod end of the idler arm.
5. Apply a 110 N·m (25 lb) force.
6. Measure the total distance the idler arm moves under the specified force.

   Allow no more than 6.36 mm (¼ in) (1) of deflection.
7. For commercial vehicles: replace the idler arm if the idler arm fails the above test. Refer to *Idler Arm Replacement (Commercial).*
8. For motorhomes: adjust the idler arm if the idler arm fails the above test. Refer to Idler Arm Adjustment-Motorhome. If replacement is necessary, refer to *Idler Arm Replacement (Motorhome).*



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## Steering Damper Inspection (Motorhome)

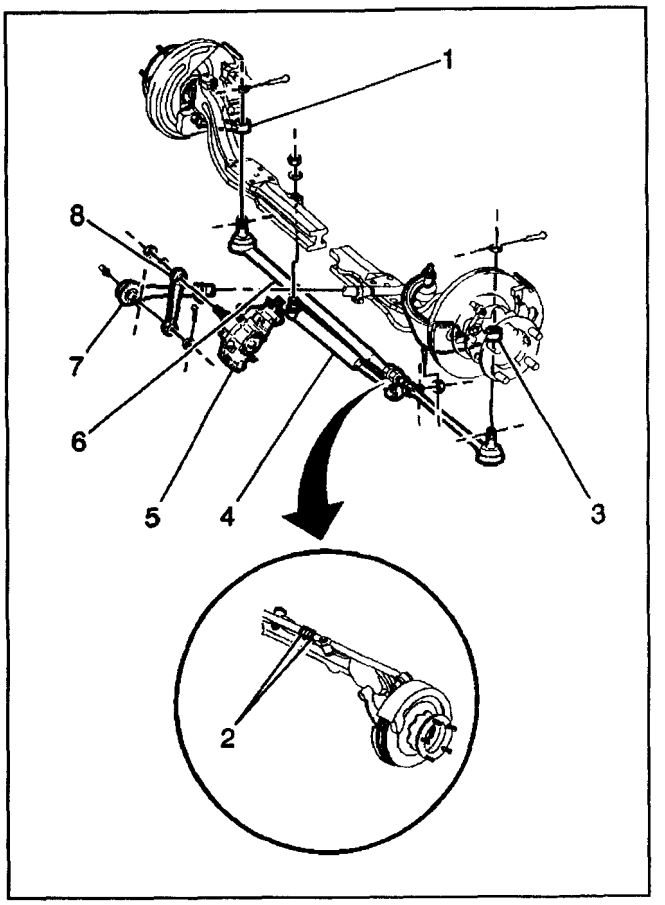
The steering shock absorber is a sealed assembly and is non-repairable. Replace the complete assembly if the steering shock absorber is damaged.

1. Inspect the shock absorber bushing for fluid leakage. A slight film of fluid is allowable near the shaft seal.
2. If there is excessive fluid leakage, verify that the leakage is from the shock absorber (15).
3. Inspect the shock absorber bushing for excessive wear.
4. Use the following procedure in order to test the shock absorber:
   4.1. Disconnect the shock absorber from the frame or the axle end.
   4.2. Extend and compress the shock absorber using as much travel as possible. Resistance should be smooth and constant for each stroking rate.
   4.3. Install the end of the shock absorber. Refer to *Fastener Tightening Specifications (Motorhome )* for the proper torque.
5. Replace the shock absorber if any of the following conditions exist:
   - Excessive fluid leakage
   - Excessive wear at the shock absorber bushing
   - Binding in the shock absorber
   - Unusual noises in the shock absorber

## Steering Damper Inspection (With I-Beam Axle Assembly)

The steering shock absorber is a sealed assembly and is non-repairable. Replace the complete assembly if the steering shock absorber is damaged.

1. Inspect the shock absorber (4) bushing for fluid leakage. A slight film of fluid is allowable near the shaft seal.
2. If there is excessive fluid leakage, verify that the leakage is from the shock absorber.
3. Inspect the shock absorber bushing for excessive wear.
4. Use the following procedure in order to test the shock absorber:
   - 4.1. Disconnect the shock absorber from the frame or the axle end.
   - 4.2. Extend and compress the shock absorber using as much travel as possible. Resistance should be smooth and constant for each stroking rate.
   - 4.3. Install the end of the shock absorber. Refer to *Fastener Tightening Specifications (Commercial (I-Beam Front Axle))* for the proper torque.
5. Replace the shock absorber if any of the following conditions exist:
   - Excessive fluid leakage
   - Excessive wear at the shock absorber bushing
   - Binding in the shock absorber
   - Unusual noises in the shock absorber



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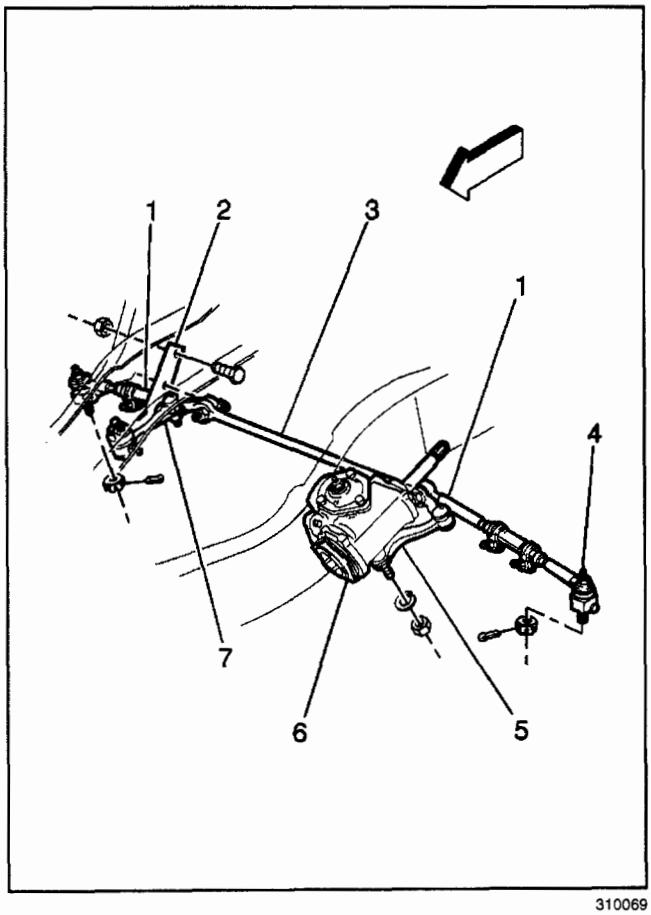


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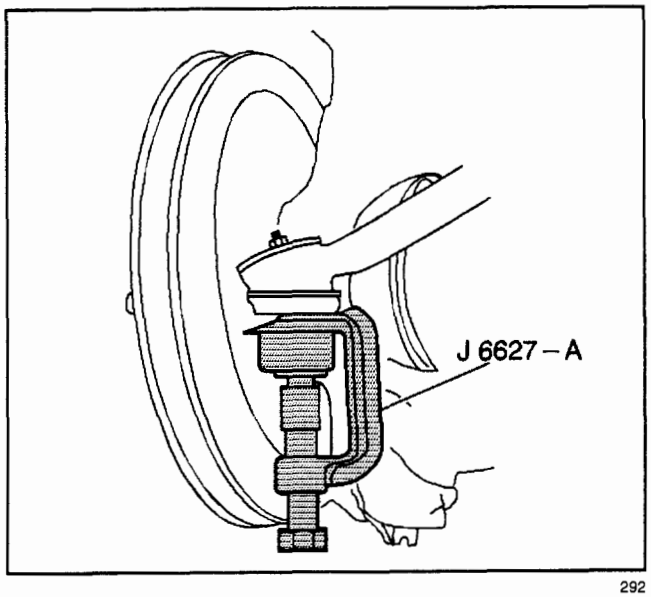
## Tie Rod Replacement (Commercial)

### Removal Procedure

#### Tools Required

*J 6627-A* Tie Rod Puller/Wheel Stud Remover

1. Before undertaking any service, note the position of the tie rod adjuster tube, and the direction from which the bolts are installed. The tie rod adjuster tube components (1) may be rusted:
   - If the torque required in order to remove the nut from the bolt exceeds 9 N·m (80 lb in), discard the nuts and the bolts.
   - Apply penetrating oil between the clamp and the tube.
   - Rotate the clamps until they move freely.
   - Install all parts, with the correct part number, in the proper position.
2. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Remove the cotter pins and the castellated nuts from the outer tie rod ball studs.

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***Notice:*** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

4. Use the *J 6627-A* in order to remove the outer tie rod ball studs from the steering knuckle.
5. Use the *J 6627-A* in order to remove the inner tie rod ball studs from the relay rod.
6. Loosen the clamp bolts from the tie rod end adjuster tubes.
7. Remove the tie rod ends by unscrewing the tie rod ends from the adjuster tubes.
8. Clean the following components:
   - The tapered surfaces
   - The threads on the ball stud
   - The threads in the ball stud nut

## Installation Procedure

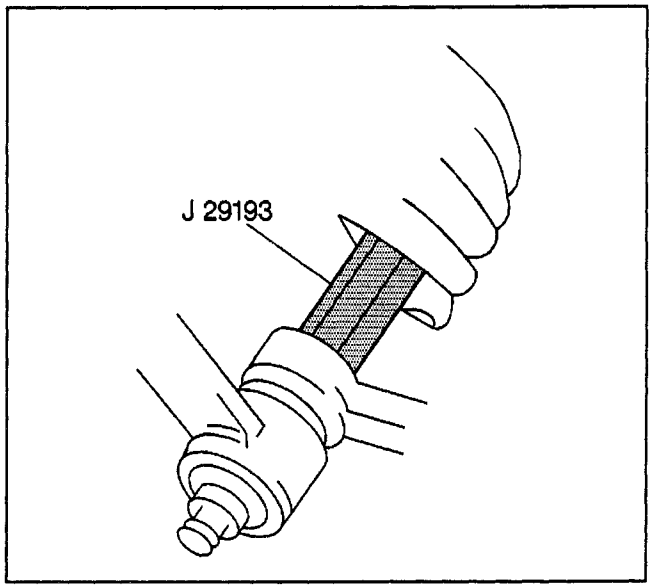
### Tools Required

- *J 29193* Steering Linkage Installer (12 mm)
- *J 29194* Steering Linkage Installer (14 mm)

1. If you removed the tie rod ends, lubricate the tie rod threads with chassis lubricant. Refer to *Fluid and Lubricant Recommendations* in Maintenance and Lubrication.
2. Install the tie rod ends to the adjuster tube.

   The number of threads on both the inner and the outer rod ends must be equal within 3 threads.
3. Install the inner tie rod ball studs to the relay rod.

   Ensure that the seal is on the stud.
4. Tighten the *J 29193* or the *J 29194* to 5 N·m (40 lb ft) in order to seat the tapers.
5. Remove the *J 29193* or the *J 29194*.



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***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

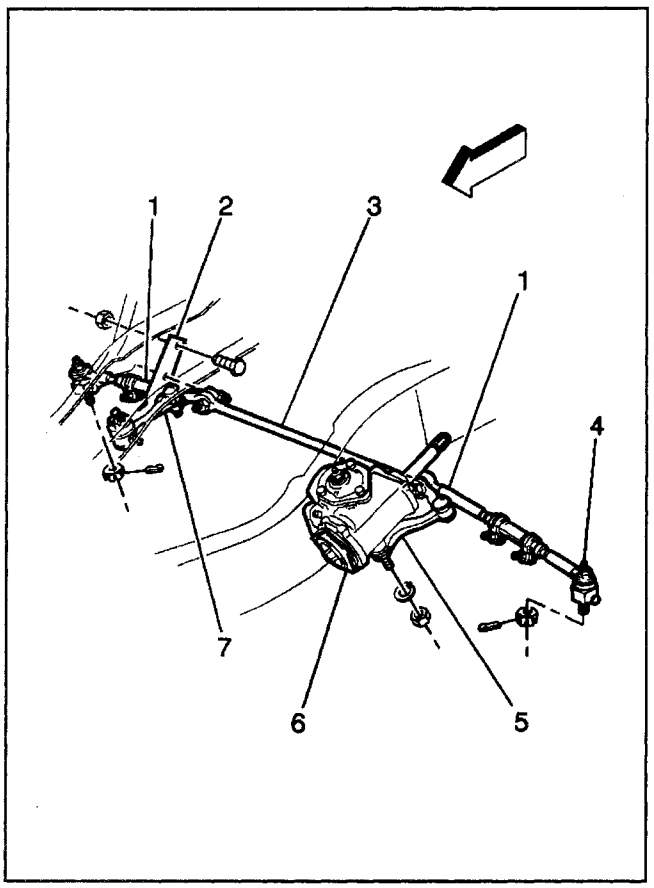
6. Install the prevailing torque nut to the inner tie rod ball stud.

   **Tighten**

   Tighten the torque nut to 90 N·m (66 lb in). Refer to *Fastener Tightening Specifications (Commercial )*.
7. Install the outer tie rod ball studs to the steering knuckle (4).
8. Install the castellated nuts and the cotter pins to the outer tie rod ball studs.

   **Tighten**

   Tighten the castellated nuts to 62 N·m (46 lb ft). Refer to *Fastener Tightening Specifications (Commercial )*.
9. Adjust the toe-in. Refer to *Front Toe Adjustment*.



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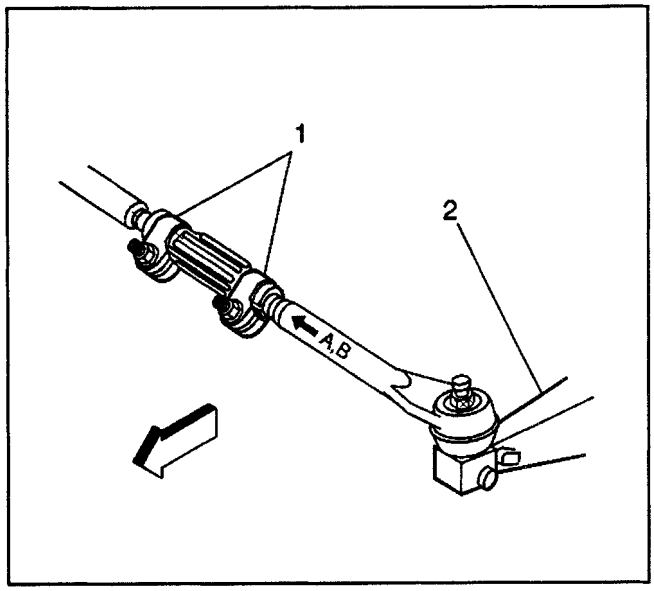


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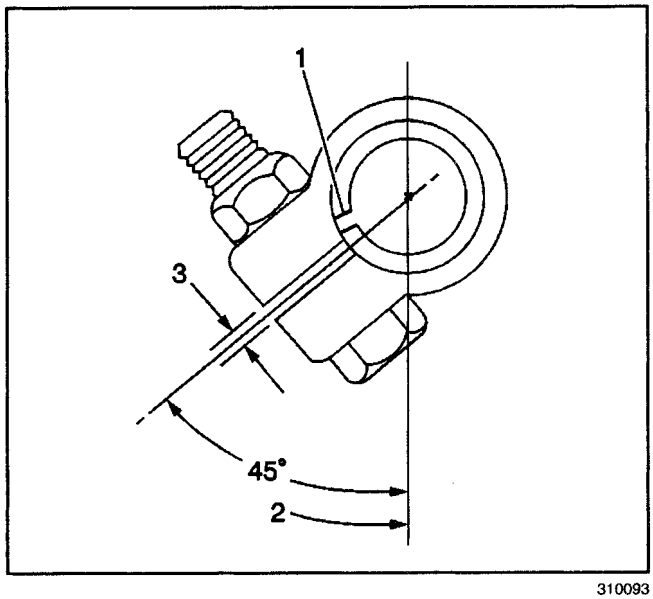
10. Position the clamps on the adjuster tubes between the locating dimples (1) and clear of the dimples at either end of the adjuster tube before tightening the nuts.

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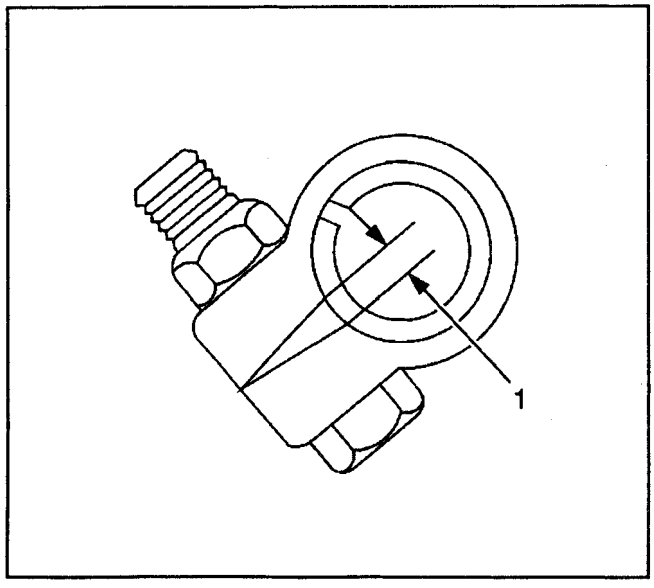
11. Position the clamps within the angular travel as shown with the rearward rotation (2) of 45 degrees. The slot (1) of the adjuster tube must not be within the area (3) of the clamp jaws.
12. Ensure that both outer tie rod ends rotate throughout the full travel of the outer tie rod end.
13. Maintain the position of each tie rod end while you tighten the clamps in order to ensure free movement of each joint.

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14. Ensure that the gap next to the adjuster tube (1) is NOT less than 0.127 mm (0.005 in).
15. The clamp ends may touch when the nuts are tightened to specifications.

    **Tighten**

    Tighten the adjuster tube clamp bolts to 68 N·m (50 lb ft).
16. Lower the vehicle.

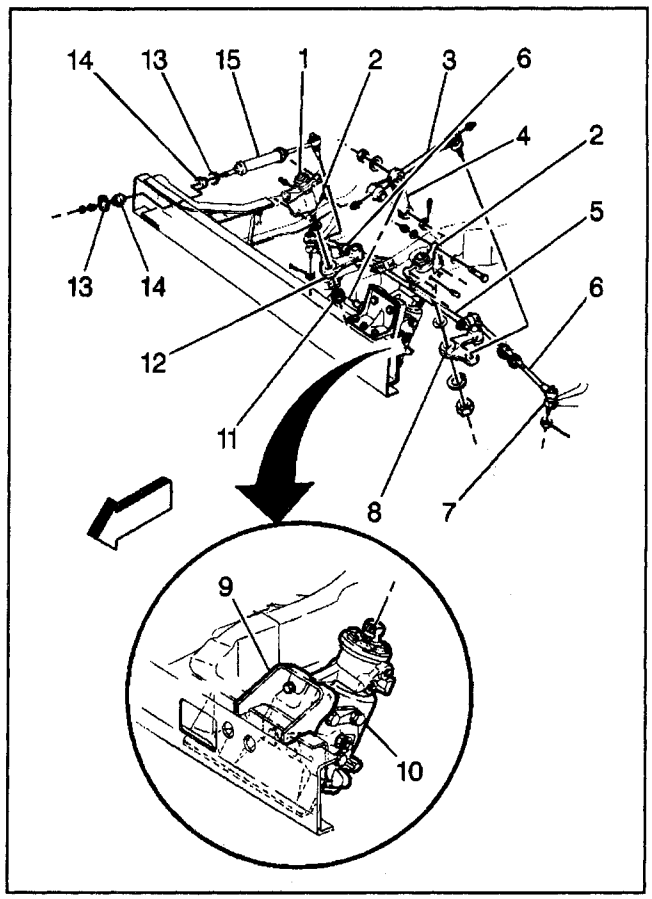
## Tie Rod Replacement (Motorhome)

### Removal Procedure

#### Tools Required

*J 6627-A* Tie Rod Puller/Wheel Stud Remover

1. Before undertaking any service, note the position of the tie rod adjuster tube, and the direction from which the bolts are installed. The tie rod assembly (6) adjuster tube components may be rusted:
   - If the torque required in order to remove the nut from the bolt exceeds 9 N·m (80 lb in), discard the nuts and the bolts.
   - Apply penetrating oil between the clamp and the tube.
   - Rotate the clamps until they move freely.
   - Install all parts, with the correct part number, in the proper position.
2. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Remove the cotter pins and the castellated nuts from the outer tie rod ball studs.

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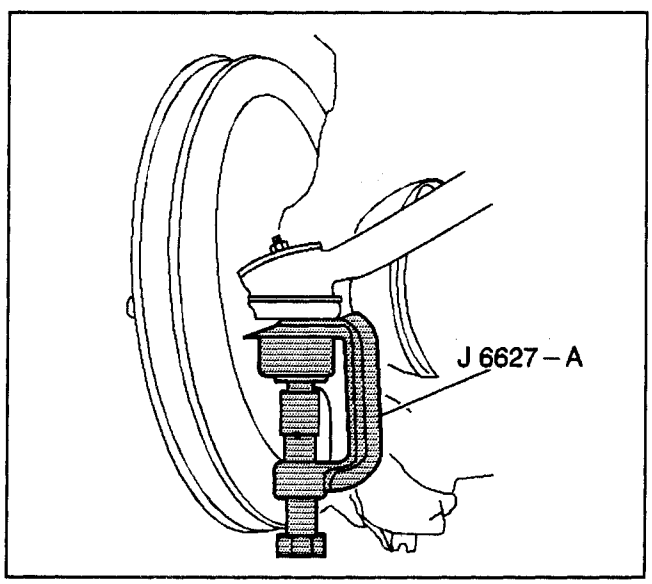
***Notice:*** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

4. Use the *J 6627-A* in order to remove the outer tie rod ball studs from the steering knuckle.
5. Use the *J 6627-A* in order to remove the inner tie rod ball studs from the relay rod.
6. Loosen the clamp bolts from the tie rod end adjuster tubes.
7. Remove the tie rod ends by unscrewing the tie rod ends from the adjuster tubes.
8. Clean the following components:
   - The tapered surfaces
   - The threads on the ball stud
   - The threads in the ball stud nut

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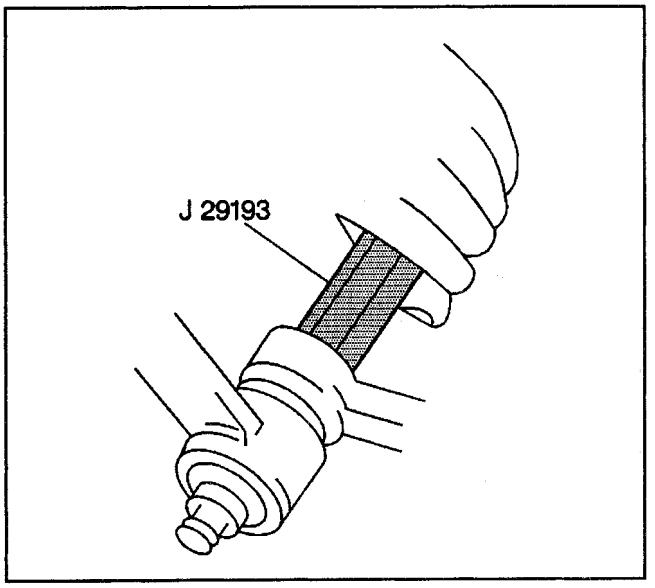


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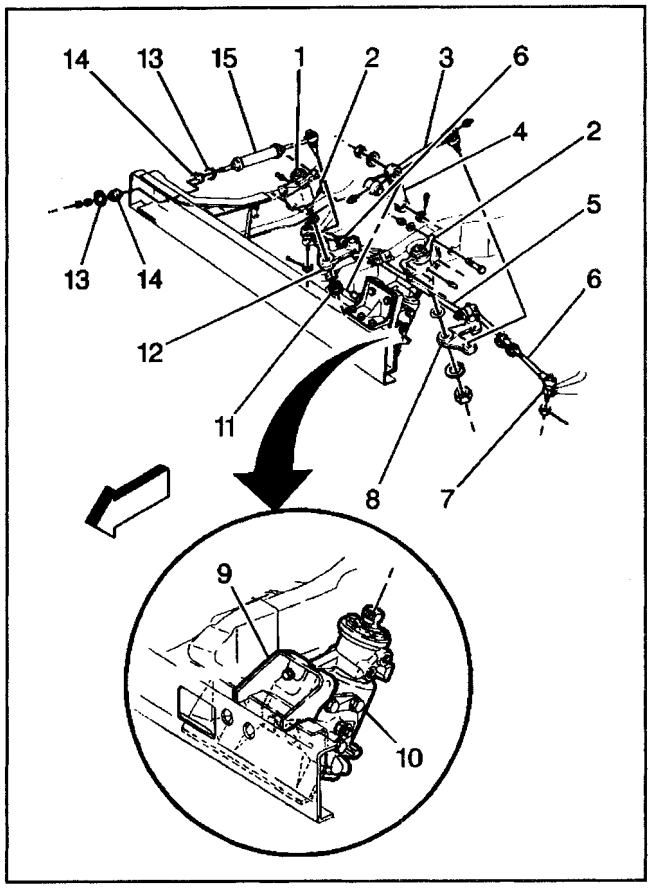


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## Installation Procedure

### Tools Required

- *J 29193* Steering Linkage Installer (12 mm)
- *J 29194* Steering Linkage Installer (14 mm)

1. If you removed the tie rod ends, lubricate the tie rod threads with chassis lubricant. Refer to *Fluid and Lubricant Recommendations* Maintenance and Lubrication.
2. Install the tie rod ends to the adjuster tube.

   The number of threads on both the inner and the outer rod ends must be equal within 3 threads.
3. Install the inner tie rod ball studs to the relay rod.

   Ensure that the seal is on the stud.
4. Tighten the *J 29193* or the *J 29194* to 54 N·m (40 lb ft) in order to seat the tapers.
5. Remove the *J 29193* or the *J 29194*.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

6. Install the prevailing torque nut to the inner tie rod ball stud.

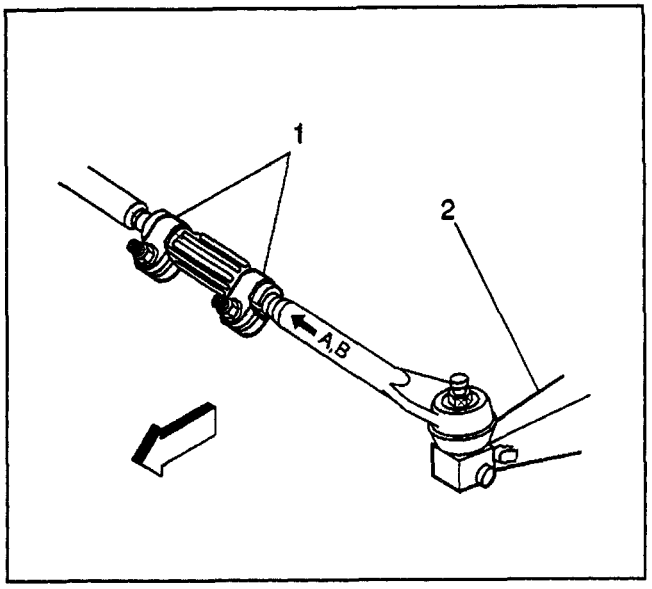
   **Tighten**

   Tighten the nut to 90 N·m (66 lb in). Refer to *Fastener Tightening Specifications (Motorhome )*.
7. Install the outer tie rod ball studs to the steering knuckle (7).
8. Install the castellated nuts and the cotter pins to the outer tie rod ball studs.

   **Tighten**

   Tighten the nuts to 62 N·m (46 lb ft). Refer to *Fastener Tightening Specifications (Motorhome )*.
9. Adjust the toe-in. Refer to *Front Toe Adjustment* in Wheel Alignment.

10. Position the clamps on the adjuster tubes between the locating dimples (1)and clear of the dimples at either end of the adjuster tube before tightening the nuts.



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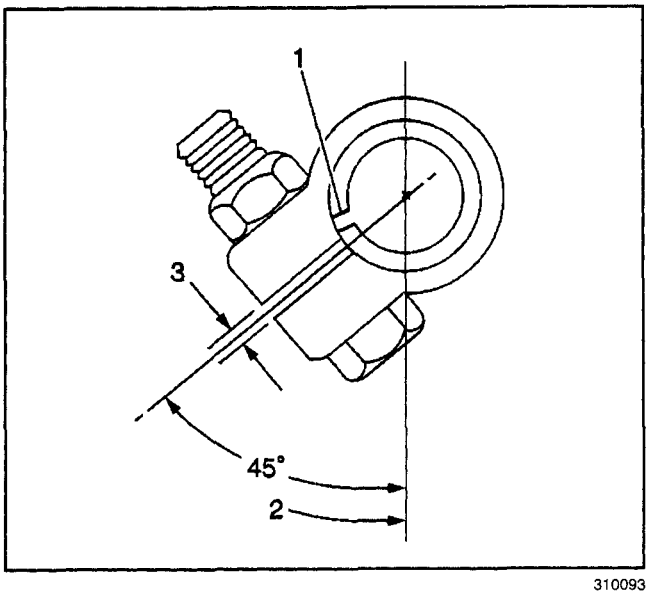
11. Position the clamps within the angular travel as shown with rearward rotation (2) of 45 degrees. The slot (1) of the adjuster tube must not be within the area (3) of the clamp jaws.
12. Ensure that both outer tie rod ends rotate throughout the full travel of the outer tie rod end.
13. Maintain the position of each tie rod end while you tighten the clamps in order to ensure free movement of each joint.



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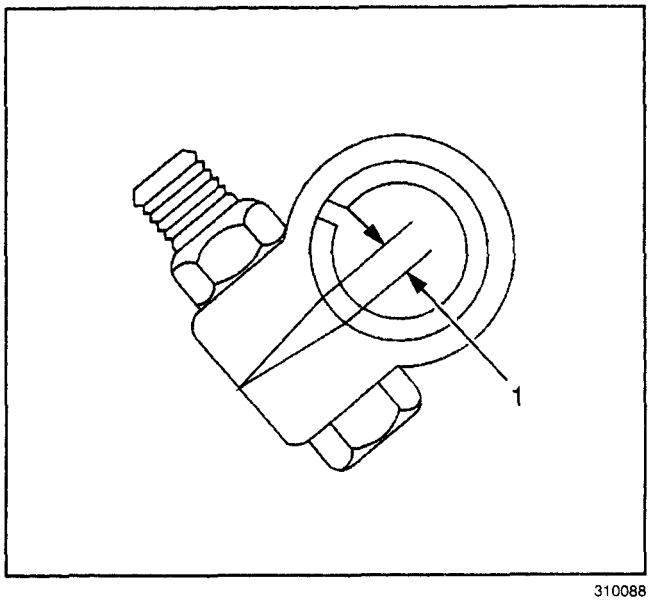
14. Ensure that the gap next to the adjuster tube (1) is NOT less than 0.127 mm (0.005 in).
15. The clamps ends may touch when the nuts are tightened to specifications.

    **Tighten**

    Tighten the adjuster tube clamp bolts to 68 N·m (50 lb ft).
16. Lower the vehicle.



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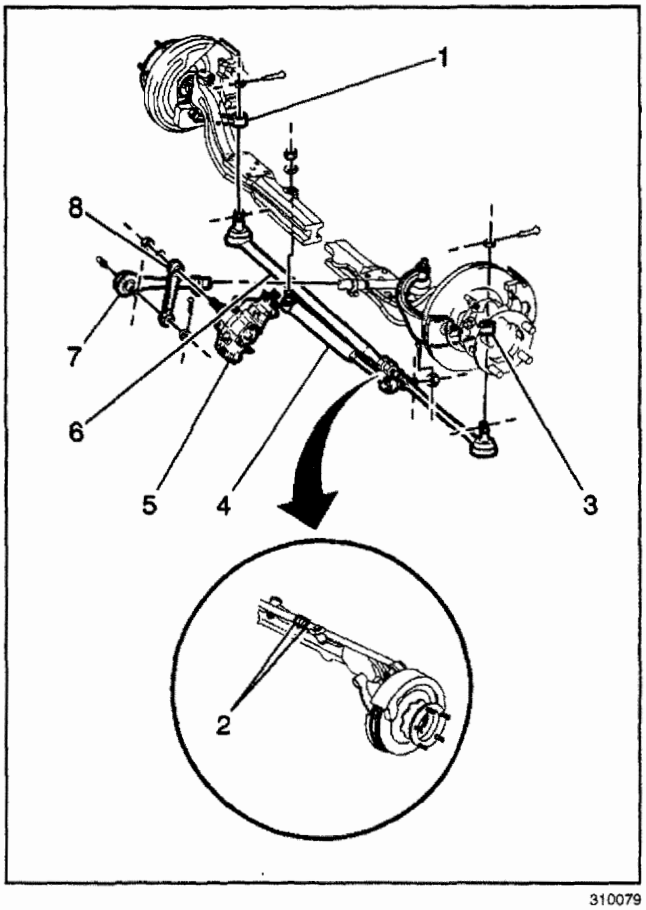


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## Tie Rod Replacement (Commercial (I-Beam Front Axle))

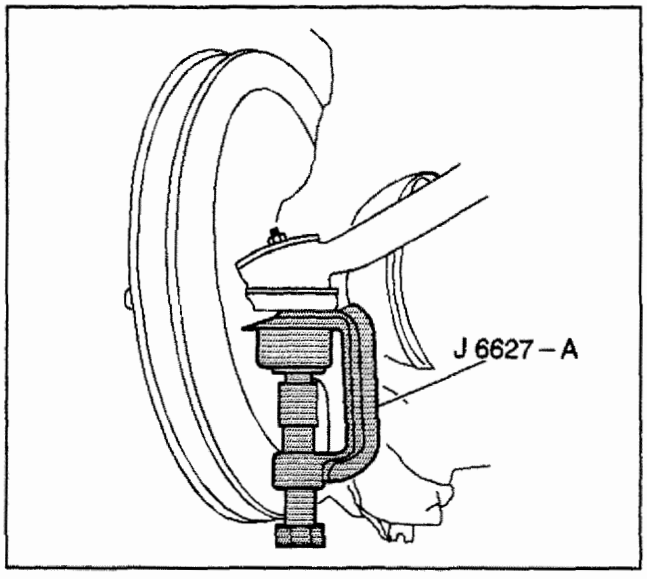
### Removal Procedure

#### Tools Required

*J 6627-A* Tie Rod Puller/Wheel Stud Remover

***Notice:*** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the cotter pins and the castellated nuts from the outer tie rod ball studs.
3. Remove the shock absorber (4) from the tie rod assembly (6) and frame.

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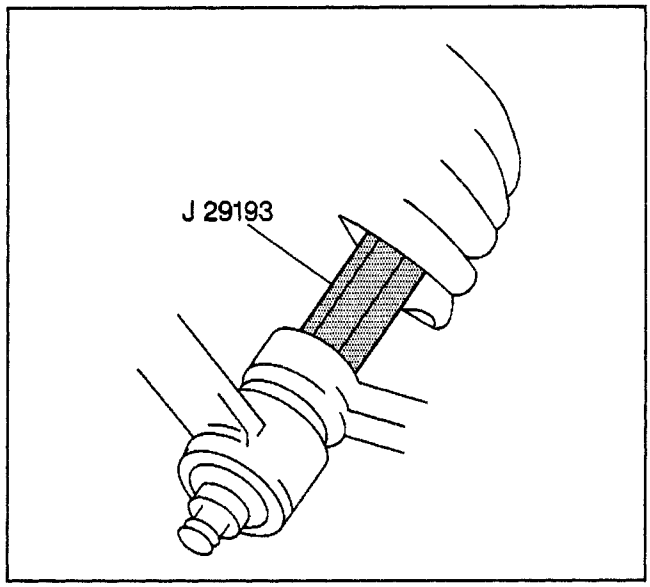
4. Use the *J 6627-A* in order to remove the tie rod ball studs from the steering knuckles.
5. Clean the following components:
   - The tapered surfaces
   - The threads on the ball stud
   - The threads in the ball stud nut
6. Inspect the tie rod assembly components. Refer to *Tie Rod End Inspection (Commercial (I-Beam Front Axle))*.

## Installation Procedure

### Tools Required

- *J 29193* Steering Linkage Installer (12 mm)
- *J 29194* Steering Linkage Installer (14 mm)

1. Lubricate the tie rod threads with chassis lubricant. Refer to *Fluid and Lubricant Recommendations.*
2. Tighten the *J 29193* or the *J 29194* to 54 N·m (40 lb ft) in order to seat the tapers.
3. Remove the *J 29193* or the *J 29194.*

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4. Install the tie rod assembly (6) to the steering knuckles.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

5. Install the castellated nuts and the cotter pins to the tie rod ball studs.

   **Tighten**

   Tighten the nut to 220 N·m (162 lb in). Refer to *Fastener Tightening Specifications (Commercial (I-Beam Front Axle)).*

6. Install the shock absorber (4) to the tie rod assembly (6).

   **Tighten**

   Tighten the nuts to 62 N·m (46 lb ft). Refer to *Fastener Tightening Specifications (Commercial (I-Beam Front Axle)).*

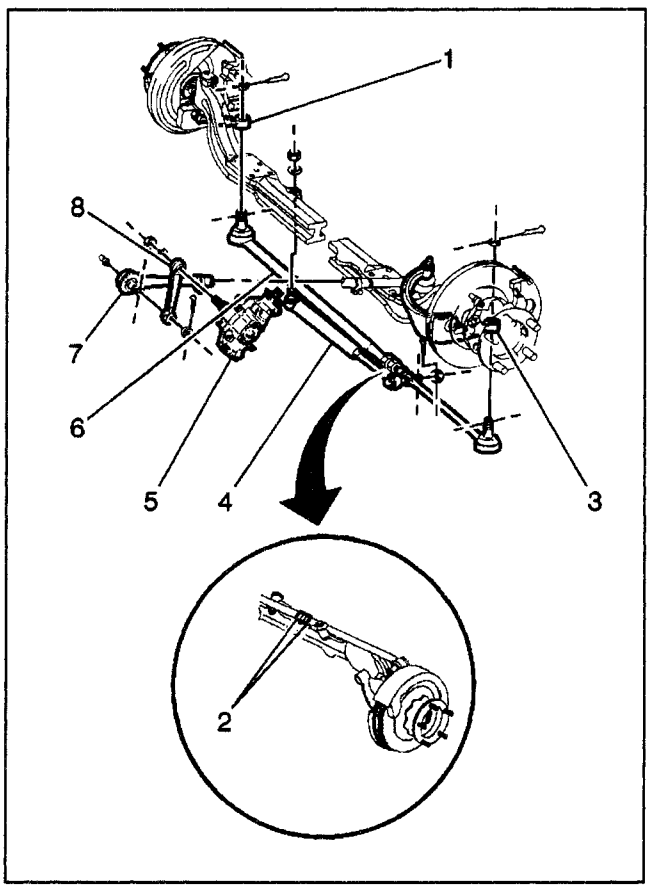
**Important:** When replacing a tie rod assembly, the wheel toe-in adjustment nuts of a new tie rod assembly are only hand tightened and must be tightened to the proper torque upon installation with the wheel toe-in reading corresponding to the recommended wheel toe-in specification.

7. Adjust the toe-in. Refer to *Wheel Alignment Specifications.* When the wheel toe-in reading corresponds to the recommended wheel toe-in figure, tighten the two adjustment nuts (2) on the tie rod.

   **Tighten**

   Tighten the first nut and the jam nut (closest to shock absorber connection) to 375 N·m (277 lb ft).

8. Lower the vehicle.

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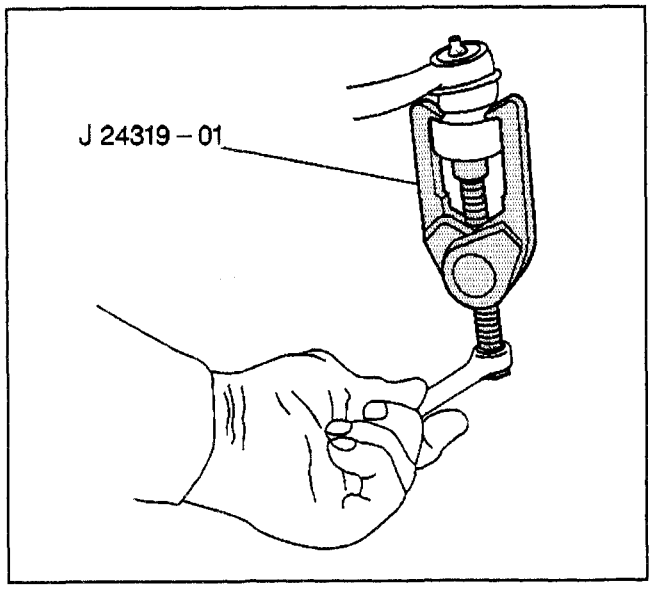


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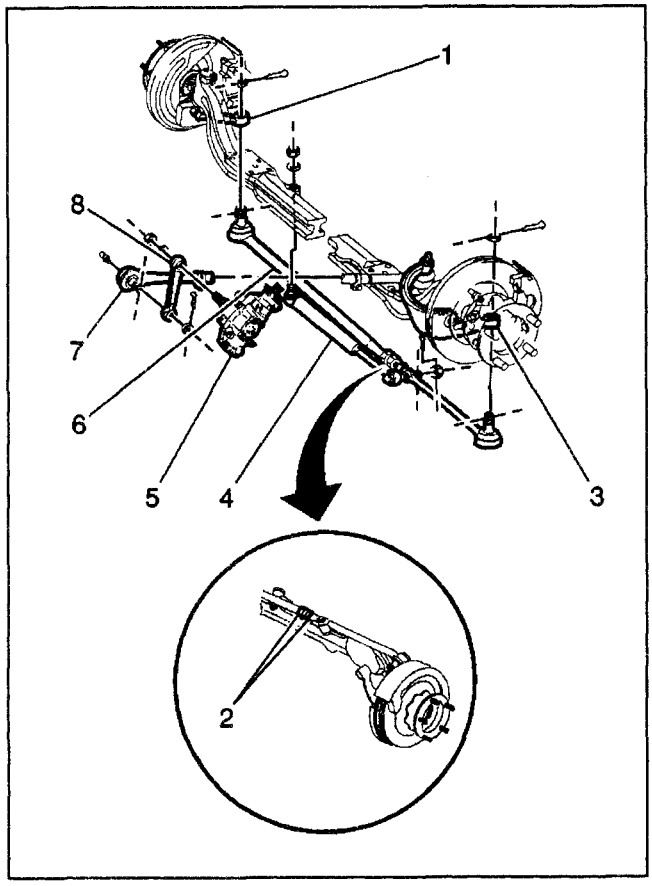


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## Connecting Rod Replacement

### Tools Required

*J 24319-B* Universal Steering Linkage Puller

Use the connecting rod in order to connect the pitman arm to the relay arm. Use the adjustable connecting rod for centering the steering gear with the front axle. Replace the connecting rod if the rod is bent or if the ball stud is loose.

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the cotter pins and the castellated nuts from the connecting rod.

***Notice:*** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

3. Use the *J 24319-B* in order to remove the connecting rod from the pitman arm.
4. Use the *J 24319-B* in order to remove the connecting rod from the steering knuckle.

**Important:** Before you remove the connecting rod (7) adjuster tube, note the position of the connecting rod adjuster tube and the direction from which the bolts are installed.

5. Loosen the adjuster clamp bolts.
6. Discard the nuts and the bolts if you require more than 9 N·m (80 lb in) of torque in order to remove the nut from the bolt. Excessive torque may be required due to rusted components.
7. Apply penetrating oil between the clamps and the tube.
8. Rotate the clamps until the clamps move freely.
9. Unscrew the connecting rod ends from the adjuster tube.
10. Inspect the components for the following conditions:
    - The ball stud threads for damage
    - The ball stud seals for wear
    - The adjuster tube for bending
    - The adjuster tube for damaged threads
11. Clean the following components:
    - The threads on the ball stud
    - The threads on the ball stud nut

## Installation Procedure

1. If you removed the connecting rod ends, lubricate the connecting rod threads with chassis lubricant. Refer to *Fluid and Lubricant Recommendations* in Maintenance and Lubrication.
2. Install the connecting rod (7) ends to the adjuster tube.

   The number of threads on both the inner and the outer connecting rod ends must be equal within 3 threads.
3. Install the inner connecting rod ball stud to the pitman arm (8).

   Ensure that the seal is on the stud.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

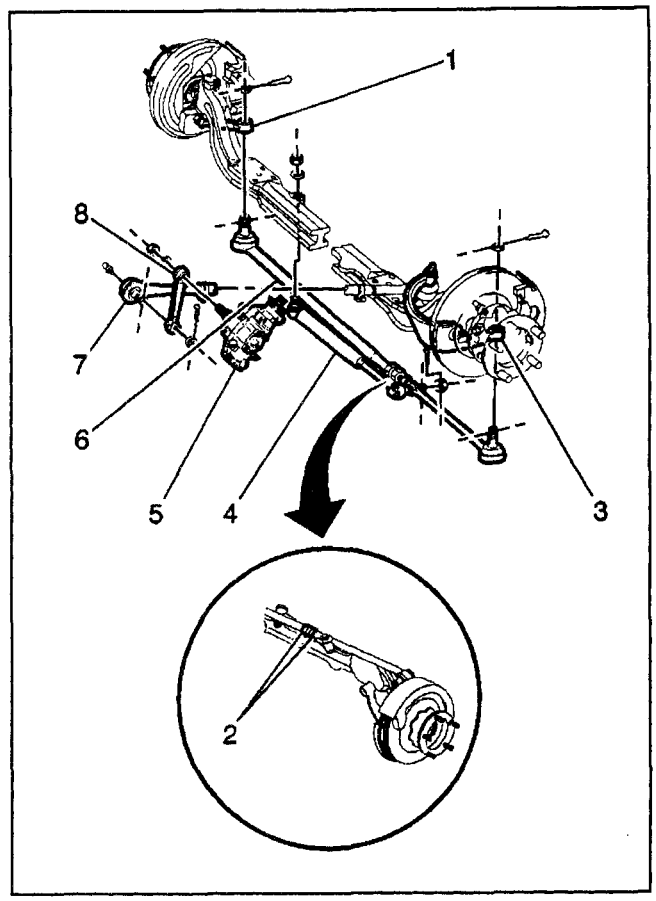
4. Install the castellated nut.

   **Tighten**

   Tighten the nut to 95 N·m (70 lb ft). Refer to *Fastener Tightening Specifications (Commercial (I-Beam Front Axle))*.
5. Install the outer connecting rod ball stud to the inner arm of the steering knuckle (3).
6. Install the castellated nut and the cotter pin to the outer connecting rod ball stud.

   **Tighten**

   Tighten the nut to 159 N·m (117 lb ft). Refer to *Fastener Tightening Specifications (Commercial (I-Beam Front Axle))*.
7. Ensure that the connecting rod ends to the pitman arm and the steering knuckle are in correct relationship to each other after adjustment within 2 degrees.
8. Adjust the steering gear high point centering. Refer to *Steering Gear Adjustments (708 Model)* in Power Steering System.
9. Install the adjuster clamp bolts.
10. Ensure that the clamps are positioned between the locating dimples (1) and clear of the dimples at either end of the adjuster tube before tightening the nuts.



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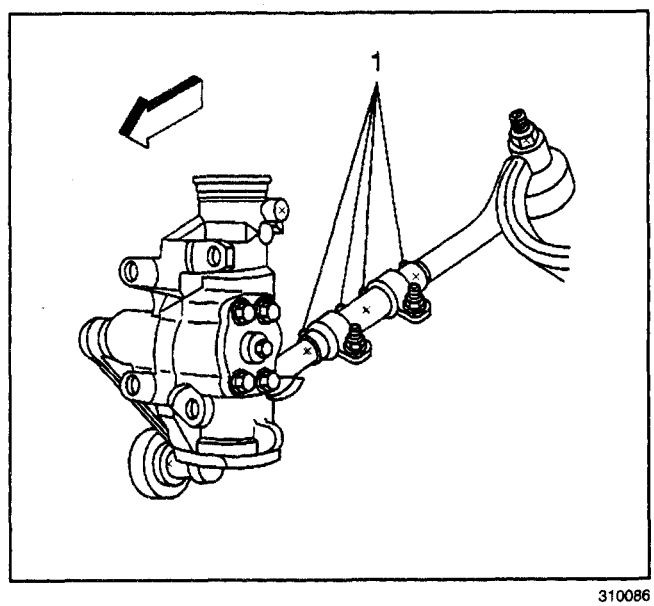

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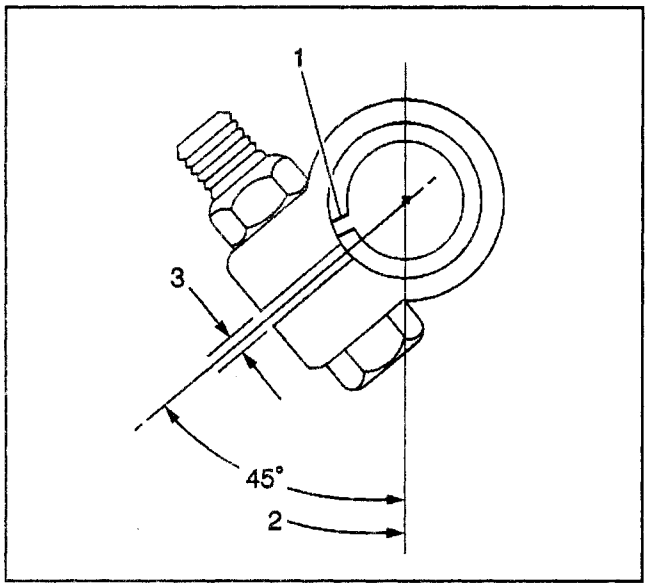


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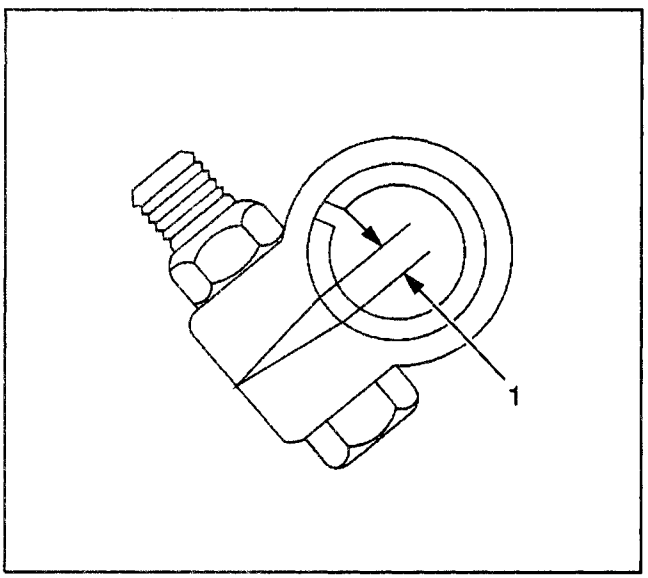
11. Position the clamps within the angular travel as shown with rearward rotation (2) of 45 degrees. The slot (1) of the adjuster tube must not be within area (3) of the clamp jaws.

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12. Ensure that the gap adjacent to the adjuster tube (1) is NOT less than 0.127 mm (0.005 in).
13. The clamp ends may touch when the nuts are tightened to specifications.
14. Ensure that both the inner and the outer connecting rod ends rotate for the full travel of the connecting rod end.
15. Maintain the position of each connecting rod end as you tighten the clamps. This will ensure free movement of each joint.
16. Tighten the adjuster tube bolts.

    **Tighten**

    Tighten the adjuster tube bolts to 68 N·m (50 lb ft).
17. Lower the vehicle.

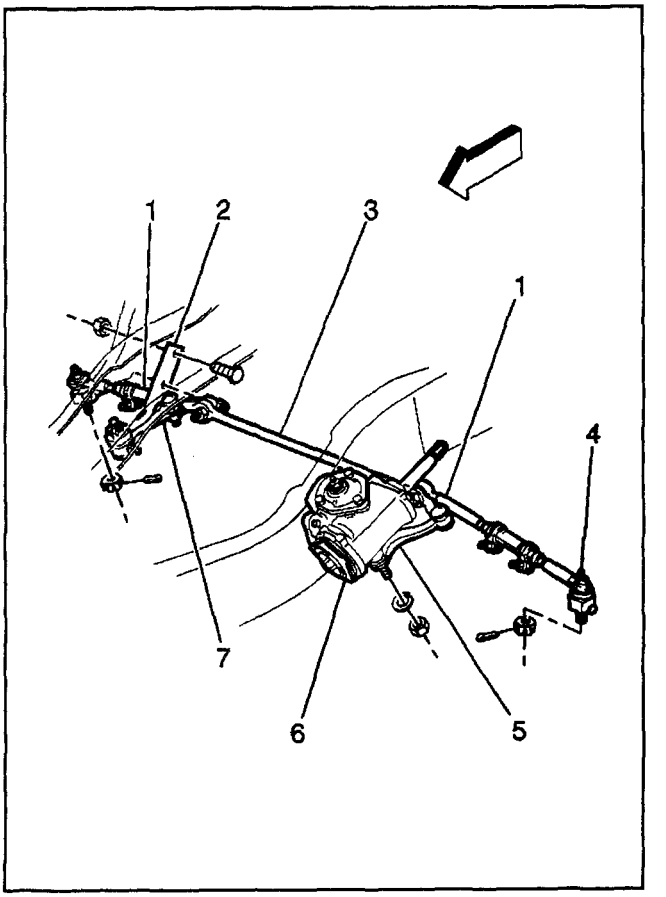
## Idler Arm Replacement (Commercial)

### Removal Procedure

#### Tools Required

*J 24319-B* Universal Steering Linkage Puller

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the idler arm assembly (7) from the frame.
3. Remove the nut from the idler arm ball stud.

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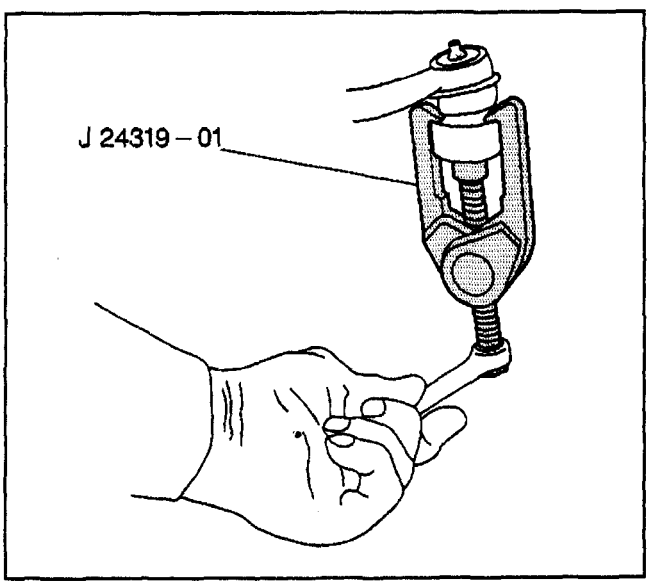
***Notice:*** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

4. Use the *J 24319-B* in order to remove the idler arm from the relay rod.
5. Inspect the ball stud threads for damage.
6. Inspect the ball stud seal for cuts or other damage.
7. Clean the following components:
   - The threads on the ball stud
   - The threads in the ball stud nut.

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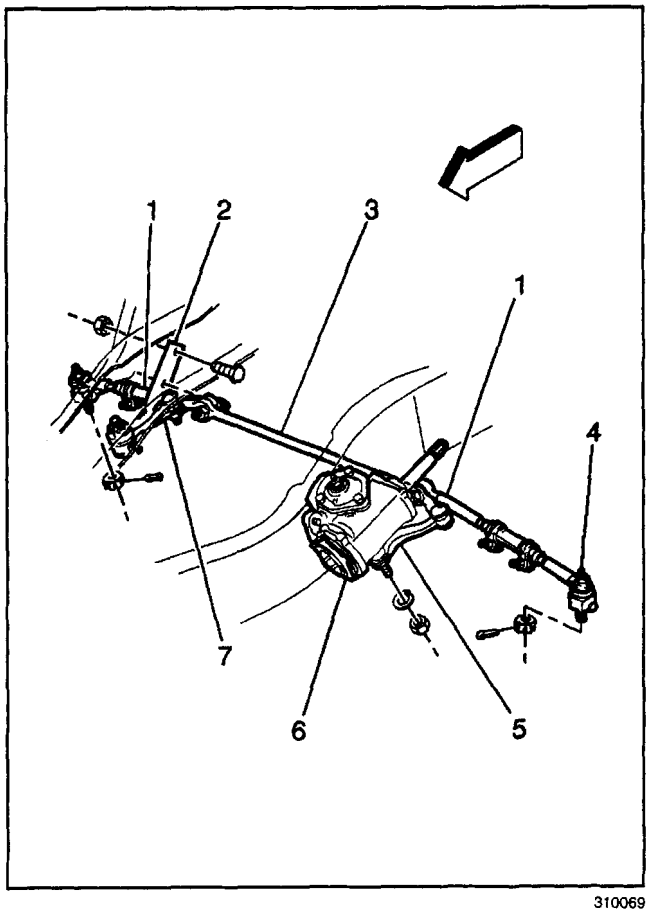


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## Installation Procedure

### Tools Required

- *J 29193* Steering Linkage Installer (12 mm)
- *J 29194* Steering Linkage Installer (14 mm)

1. Install the idler arm frame support (2) to the frame.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

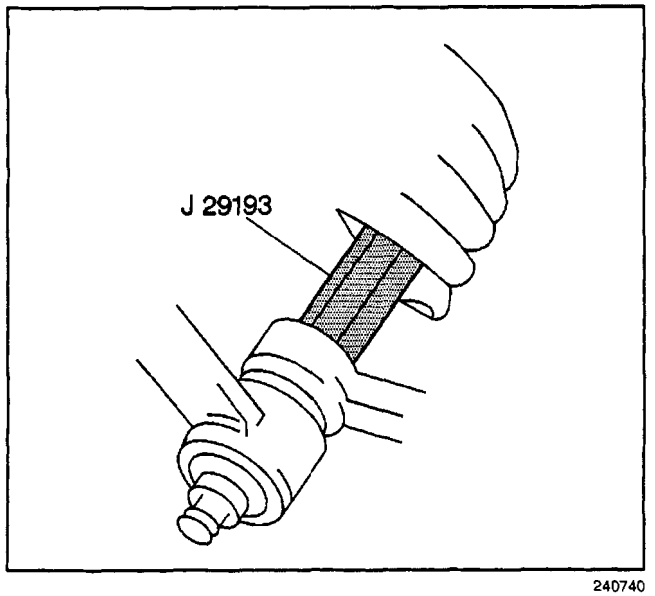
2. Tighten the bolts.

   **Tighten**

   Tighten the bolts to 40 N·m (30 lb ft).

3. Install the relay rod to the idler arm ball stud.

   Ensure that the seal is on the stud.

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4. Tighten the *J 29193* or the *J 29194* to 54 N·m (40 lb ft) in order to seat the tapers.
5. Remove the *J 29193* or the *J 29194*.
6. Install the prevailing torque nut to the idler arm ball stud.

   **Tighten**

   Tighten the nut to 90 N·m (66 lb ft).

7. Lower the vehicle.
8. Adjust the toe-in, if needed. Refer to *Front Toe Adjustment* in Wheel Alignment.

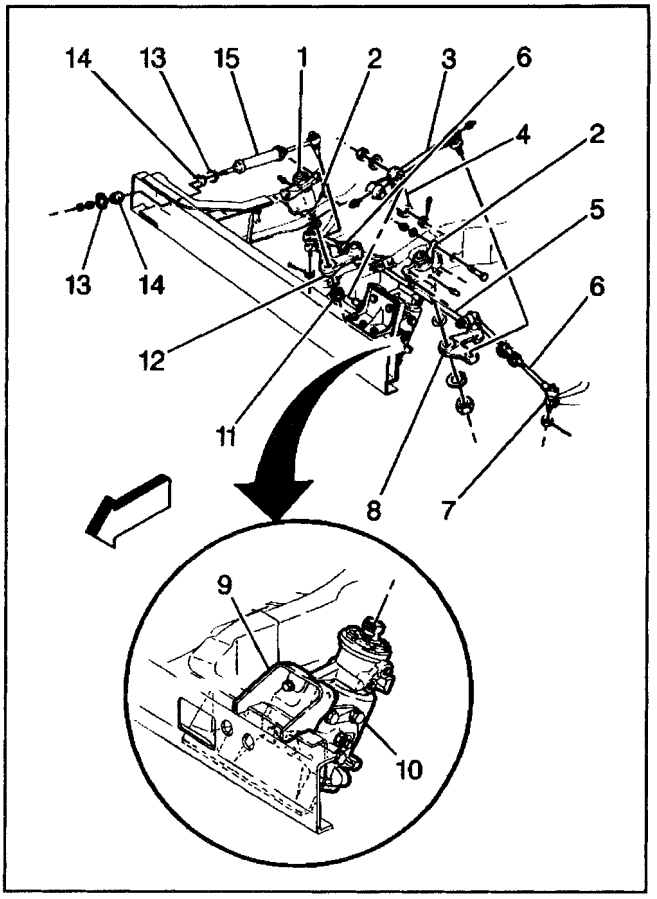
## Idler Arm Replacement (Motorhome)

### Removal Procedure

#### Tools Required

*J 24319-B* Universal Steering Linkage Puller

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the idler arm assembly (12) from the support assembly (2).
3. Remove the nut from the idler arm ball stud.

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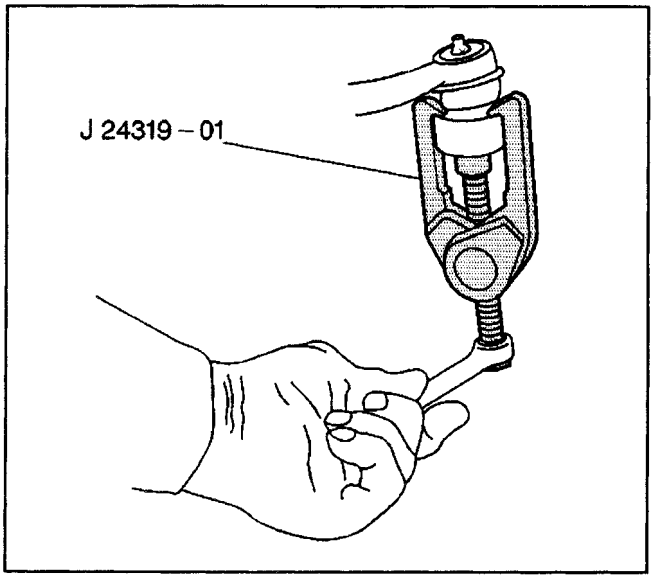
***Notice:*** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

4. Use the *J 24319-B* in order to remove the idler arm from the relay rod.
5. Inspect the ball stud threads for damage.
6. Inspect the ball stud seal for cuts or other damage.
7. Clean the following components:
   - The threads on the ball stud
   - The threads in the ball stud nut

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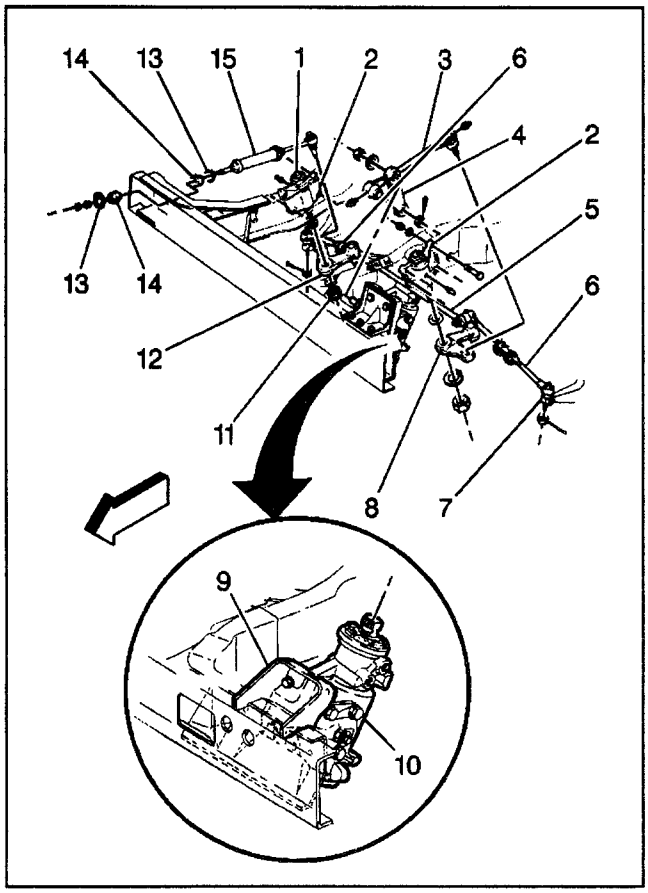


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## Installation Procedure

### Tools Required

- *J 29193* Steering Linkage Installer (12 mm)
- *J 29194* Steering Linkage Installer (14 mm)

1. Install the idler arm (12) to the support assembly (2).

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

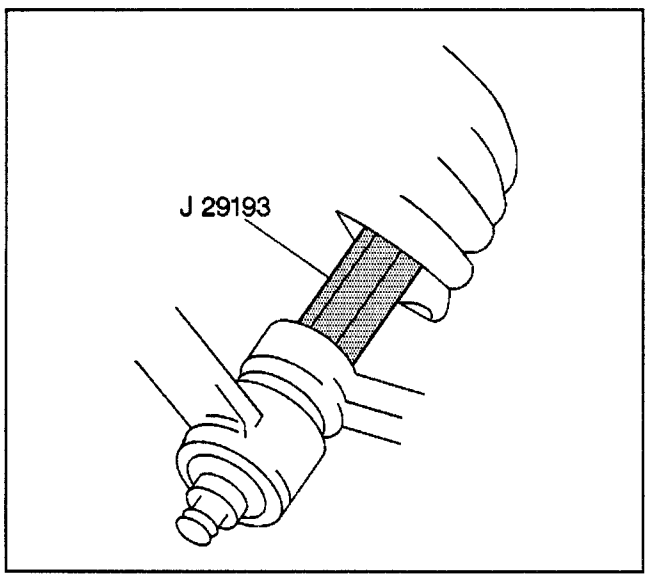
2. Tighten the idler arm to the support assembly.

   **Tighten**

   Tighten the idler arm to the support assembly to 170 N·m (125 lb ft).

3. Install the relay rod to the idler arm ball stud.

   Ensure that the seal is on the stud.

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4. Tighten the *J 29193* or the *J 29194* to 54 N·m (40 lb ft) in order to seat the tapers.
5. Remove the *J 29193* or the *J 29194*.
6. Install the prevailing torque nut to the idler arm ball stud.

   **Tighten**

   Tighten the nut to 90 N·m (66 lb ft).

7. Lower the vehicle.
8. Adjust the toe-in, if needed. Refer to *Front Toe Adjustment* in Wheel Alignment.

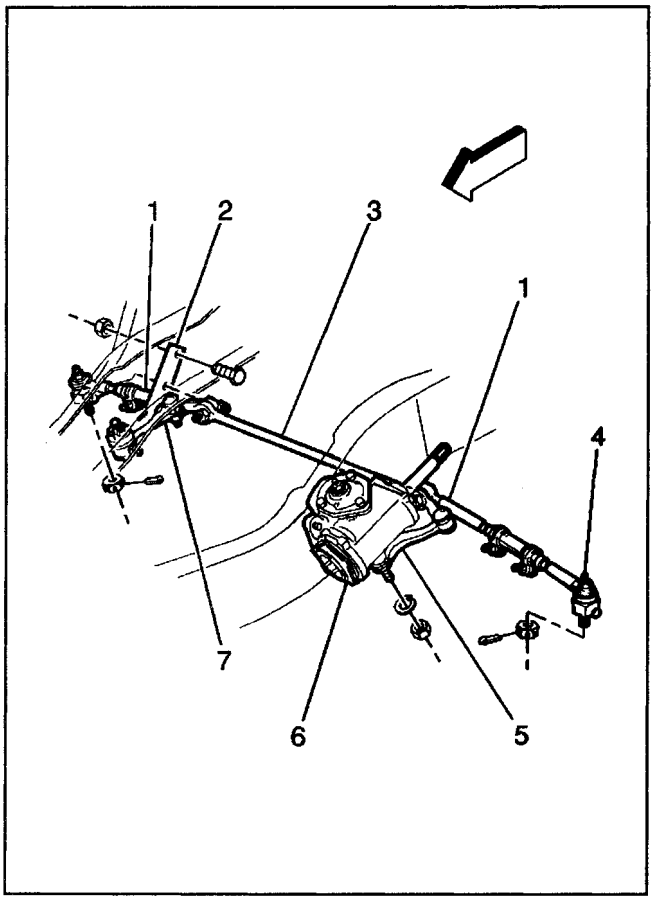
## Relay Rod Replacement (Commercial)

### Removal Procedure

#### Tools Required

*J 24319-B* Universal Steering Linkage Puller

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the inner tie rod (1) from the relay rod (3). Refer to *Tie Rod Replacement (Commercial).*
3. Remove the nuts from the idler arm (7) and the pitman arm (5).

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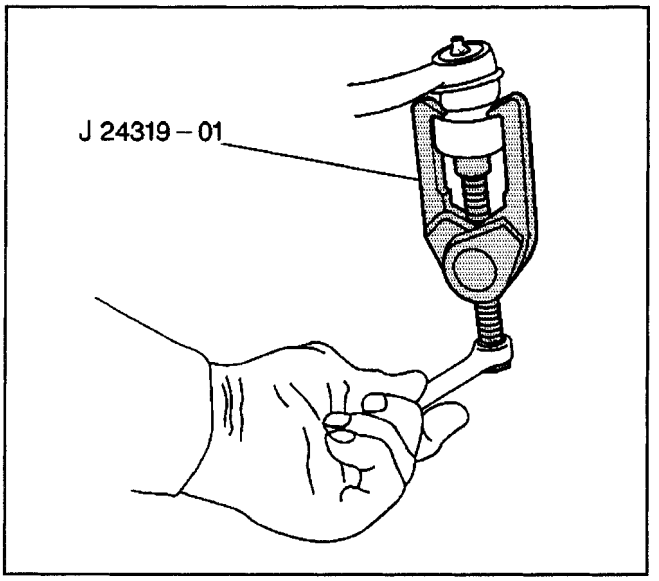
***Notice:*** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

4. Use the *J 24319-B* in order to remove the relay rod from the idler arm.
5. Use the *J 24319-B* in order to remove the relay rod from the pitman arm or the relay arm.
6. Inspect the following components for damage or excessive wear:
   - The threads on the tie rod and the tie rod end
   - The ball stud threads
   - The ball stud seals
7. Clean the following components:
   - The threads on the ball stud
   - The threads in the ball stud nut

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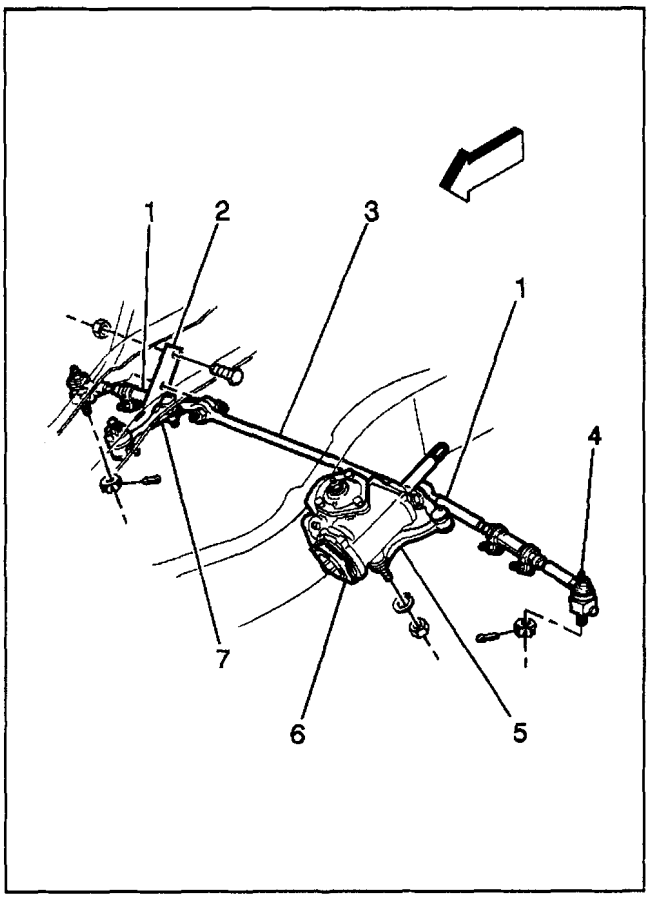


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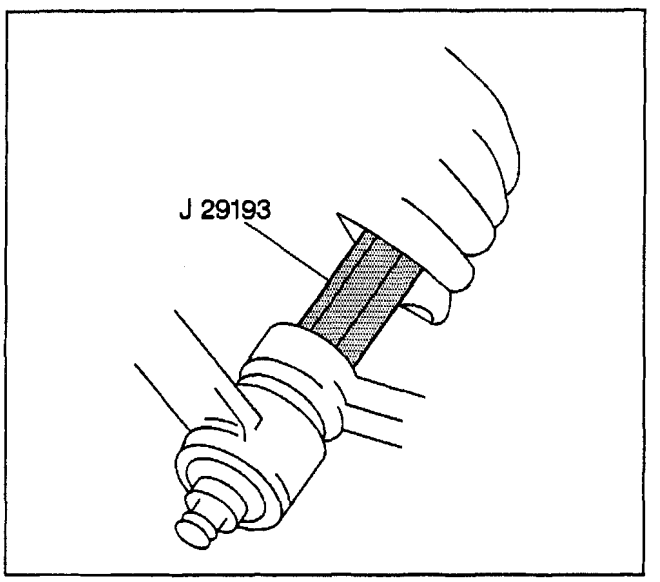


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## Installation Procedure

### Tools Required

- *J 29193* Steering Linkage Installer (12 mm)
- *J 29194* Steering Linkage Installer (14 mm)

1. Install the relay rod (3) to the idler arm (7).
2. Install the relay rod to the pitman arm (5).
   Ensure that the seal is on the stud.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

3. Tighten the *J 29193* or the *J 29194* to 54 N·m (40 lb ft) in order to seat the tapers.
4. Remove the *J 29193* or the *J 29194*.
5. Install the nuts to the idler arm and the pitman arm.

   **Tighten**

   Tighten the nuts to 90 N·m (66 lb ft).
6. Install the inner tie rod end to the relay rod. Refer to *Tie Rod Replacement (Commercial)*.
7. Lower the vehicle.

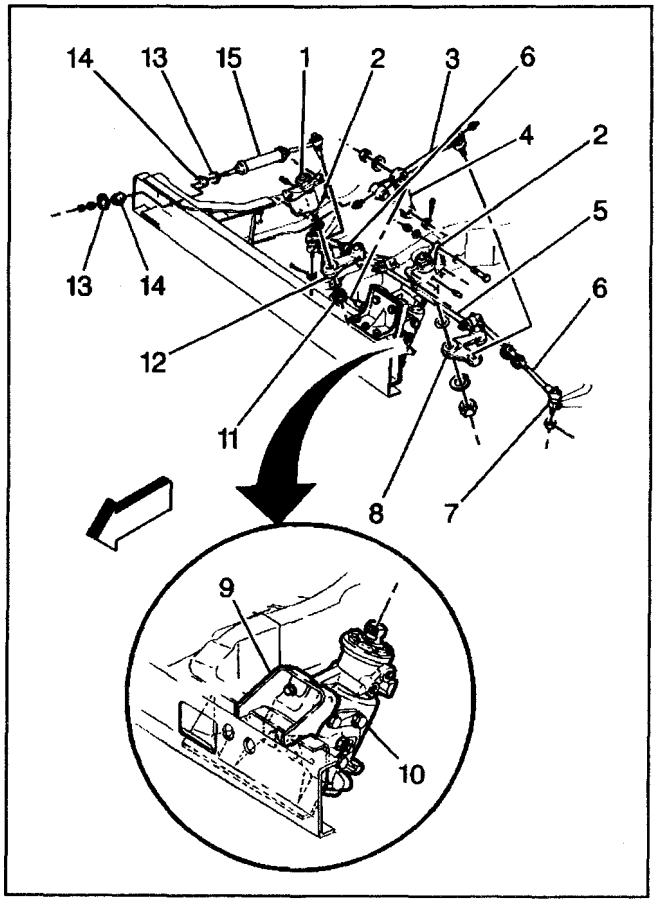
## Relay Rod Replacement (Motorhome)

### Removal Procedure

#### Tools Required

*J 24319-B* Universal Steering Linkage Puller

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the inner tie rod from the relay rod (5). Refer to *Tie Rod Replacement (Motorhome).*
3. Remove the nuts from the idler arm (12) and the pitman arm (4) or the relay arm (8) ball studs at the relay rod (5).

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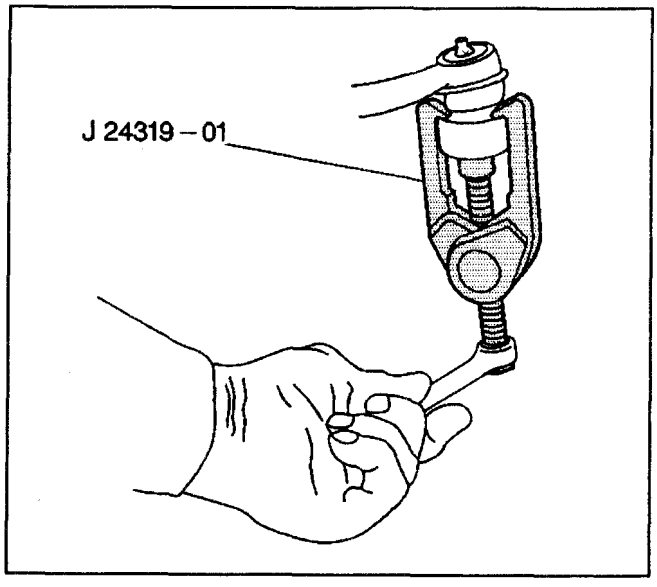
***Notice:*** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

4. Use the *J 24319-B* in order to remove the relay rod from the idler arm.
5. Use the *J 24319-B* in order to remove the relay rod from the pitman arm or the relay arm.
6. Inspect the following components for damage or excessive wear:
   - The threads on the tie rod and the tie rod end
   - The ball stud threads
   - The ball stud seals
7. Clean the following components:
   - The threads on the ball stud
   - The threads in the ball stud nut

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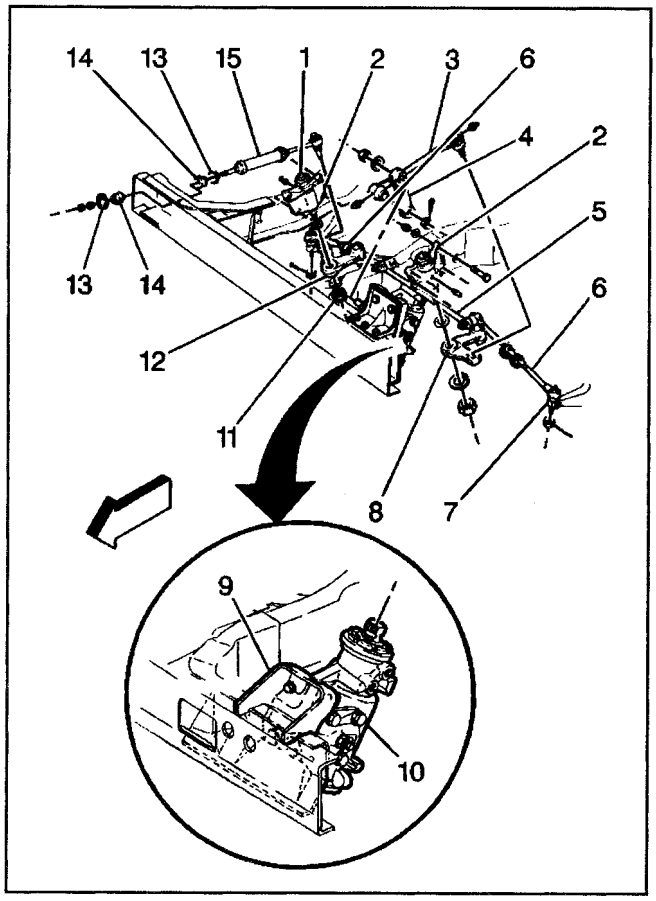


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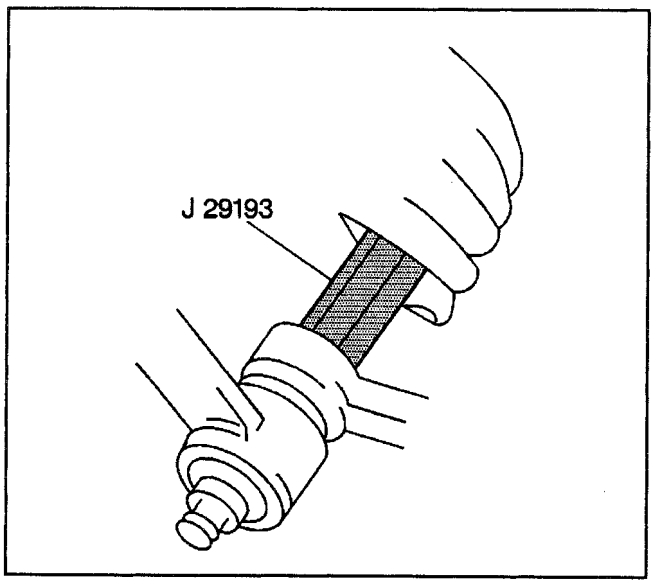
## Installation Procedure

### Tools Required

- *J 29193* Steering Linkage Installer (12 mm)
- *J 29194* Steering Linkage Installer (14 mm)

1. Install the relay rod (5) to the idler arm (12).
2. Install the relay rod (5) to the pitman arm (4) to the relay arm (8) ball stud.
3. Ensure that the seal is on the stud.

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***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

4. Tighten the *J 29193* or the *J 29194* to 54 N·m (40 lb ft) in order to seat the tapers.
5. Remove the *J 29193* or the *J 29194*.
6. Install the nuts to the idler arm and the pitman arm or the relay arm ball stud.

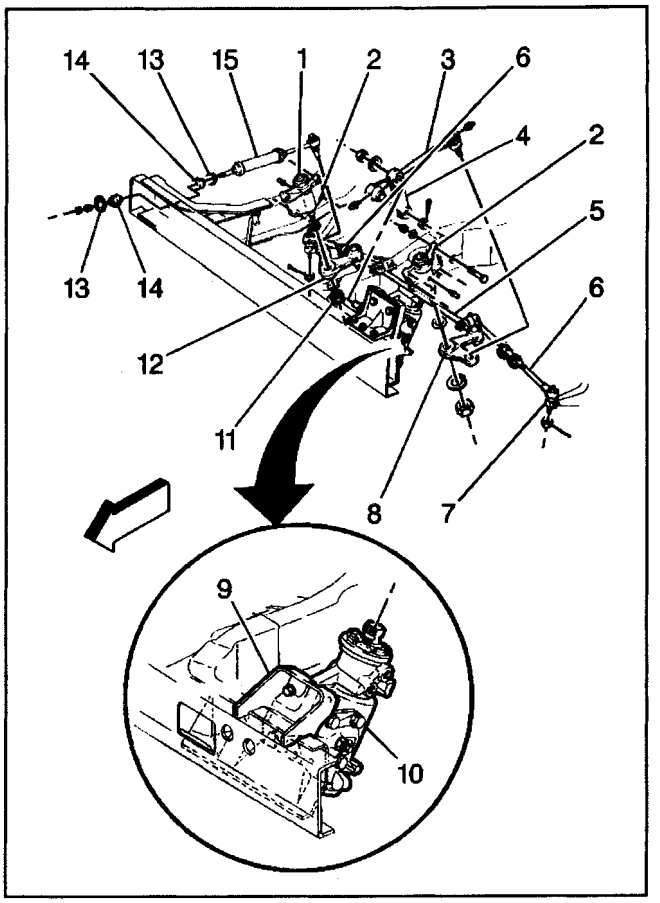
   **Tighten**

   - Tighten the idler arm to the relay rod to 90 N·m (66 lb ft).
   - Tighten the pitman arm to the relay rod to 159 N·m (117 lb ft).
   - Tighten the relay rod to the relay arm to 159 N·m (117 lb ft).
7. Install the inner tie rod end to the relay rod. Refer to *Tie Rod Replacement (Motorhome)*.
8. Lower the vehicle.

## Steering Damper Replacement (Motorhome)

### Removal Procedure

1. Remove the shock absorber mounting nuts.
2. Remove the washer (13) and the grommet (14).
3. Remove the cotter pin and the castellated nut.
4. Remove the shock absorber (15), the grommet (14) and the washer (13).
5. Inspect the shock absorber (15) for leaks and damage.
6. Inspect the grommet for wear.

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### Installation Procedure

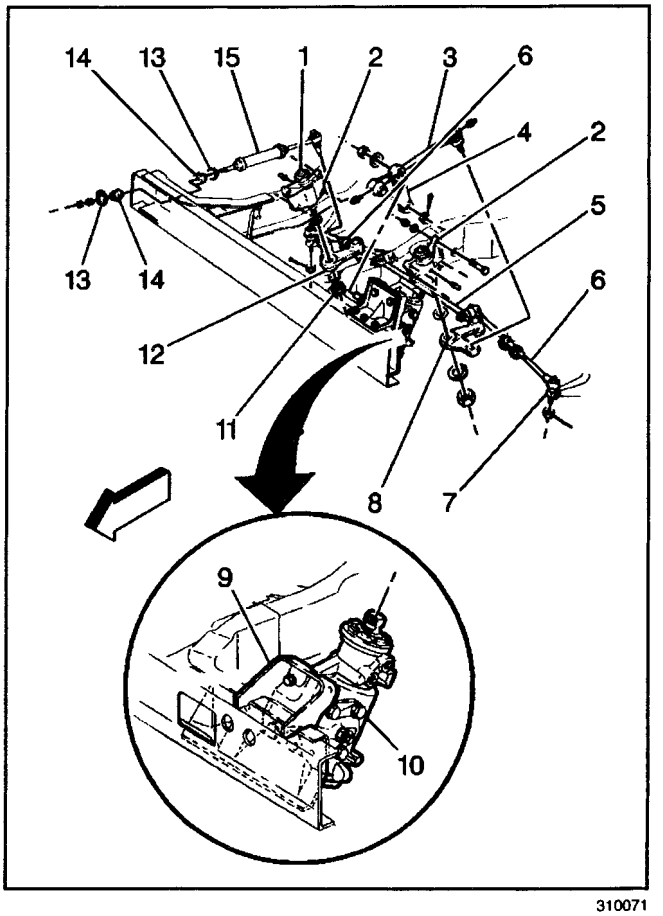
1. Install the shock absorber (15) with the washer and grommet to the frame.
2. Install the washer and the grommet.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

3. Install the shock absorber mounting nuts.
4. Tighten the castellated nuts.

   **Tighten**

   - Tighten the shock absorber to frame to 11 N·m (8 lb ft).
   - Tighten the shock absorber to idler arm to 62 N·m (46 lb ft).
5. Install the cotter pin.

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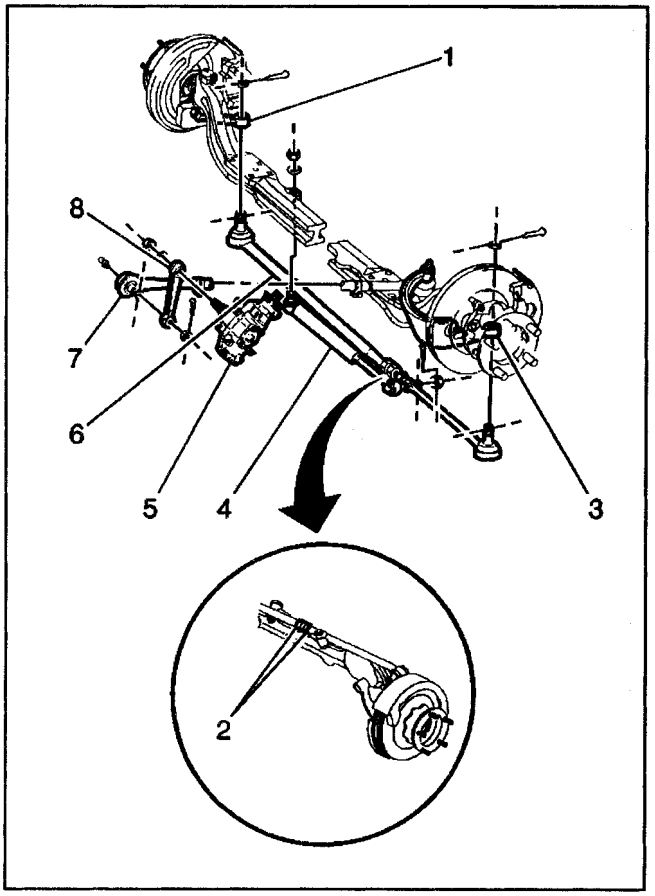


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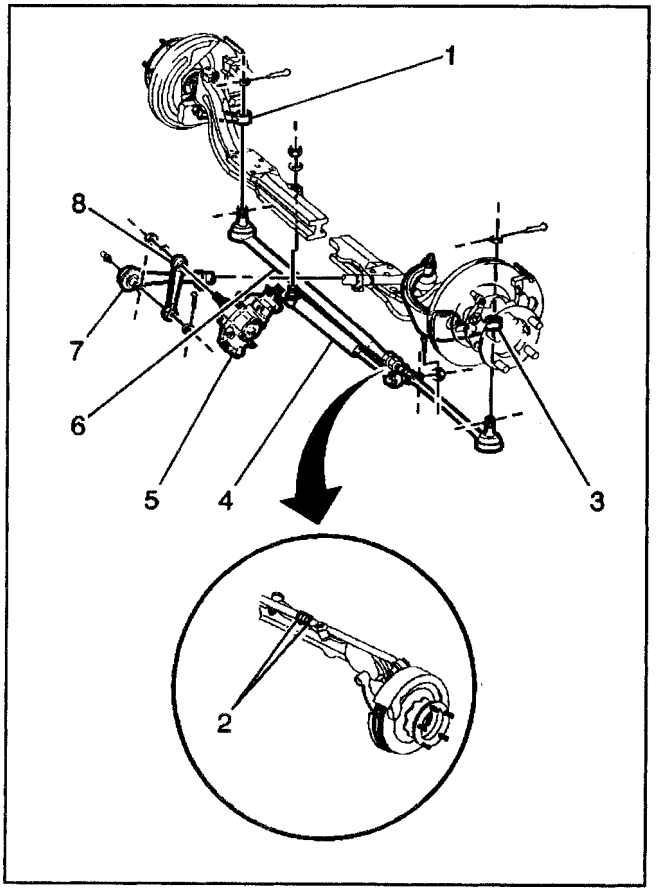
## Steering Damper Replacement (With I-Beam Axle Assembly)

### Removal Procedure

1. Remove the shock absorber mounting nuts and the washers.
2. Remove the cotter pin and the castellated nut.
3. Inspect the shock absorber (4) for leaks and damage.
4. Inspect the shock absorber bushings for wear.
5. Inspect the grommet for wear.




310079

### Installation Procedure

1. Install the shock absorber (4) with the bushings to the axle bracket.
2. Install the shock absorber mounting nuts and washers.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

3. Tighten the castellated nuts. Refer to *Fastener Tightening Specifications (Commercial (I-Beam Front Axle))*.

   **Tighten**

   - Tighten the shock absorber to frame to 47 N·m (35 lb ft).
   - Tighten the shock absorber to tie rod (6) to 62 N·m (46 lb ft).

4. Install the cotter pins.

## Pitman Arm Replacement (Commercial)

### Removal Procedure

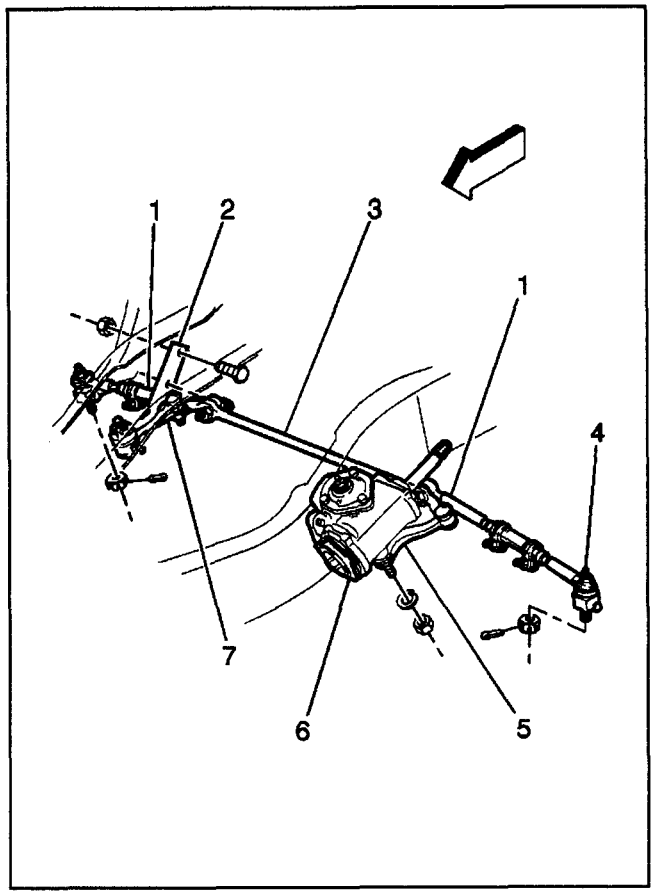
#### Tools Required

- *J 24319-B* Universal Steering Linkage Puller
- *J 29107-A* Universal Pitman Arm Puller
- *J 6632 - 01* Pitman Arm Puller

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the relay rod nut and the cotter pin from the pitman arm ball stud.

***Notice:*** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

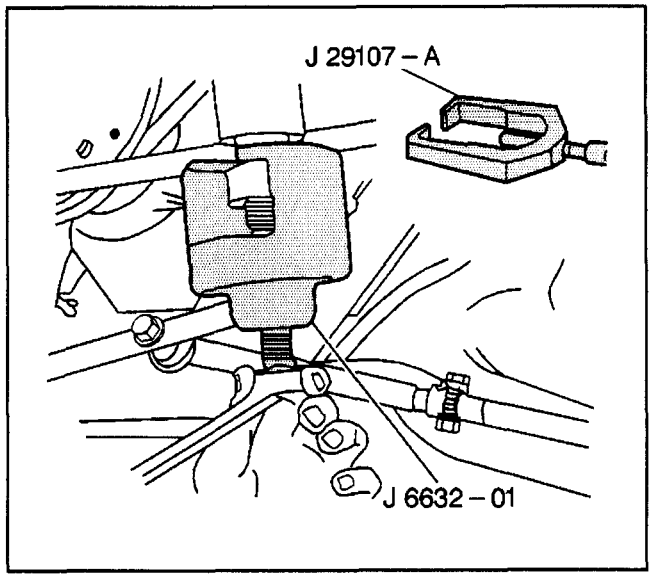
3. Use the *J 24319-B* in order to remove the relay rod (3) from the pitman arm (5).
4. Mark the pitman arm and the pitman shaft. This is to ensure that you properly align the pitman arm and the shaft during assembly.
5. Remove the pitman arm nut and washer.




310069

***Notice:*** Do not hammer on the pitman arm, pitman arm shaft or puller. Damage to the pitman arm or steering gear may result.

6. Use the *J 6632 - 01* or the *J 29107-A* in order to remove the pitman arm.
7. Inspect the ball stud threads for damage.
8. Inspect the ball stud seals for excessive wear.
9. Clean the following components:
   - The threads on the ball stud
   - The threads in the ball stud nut

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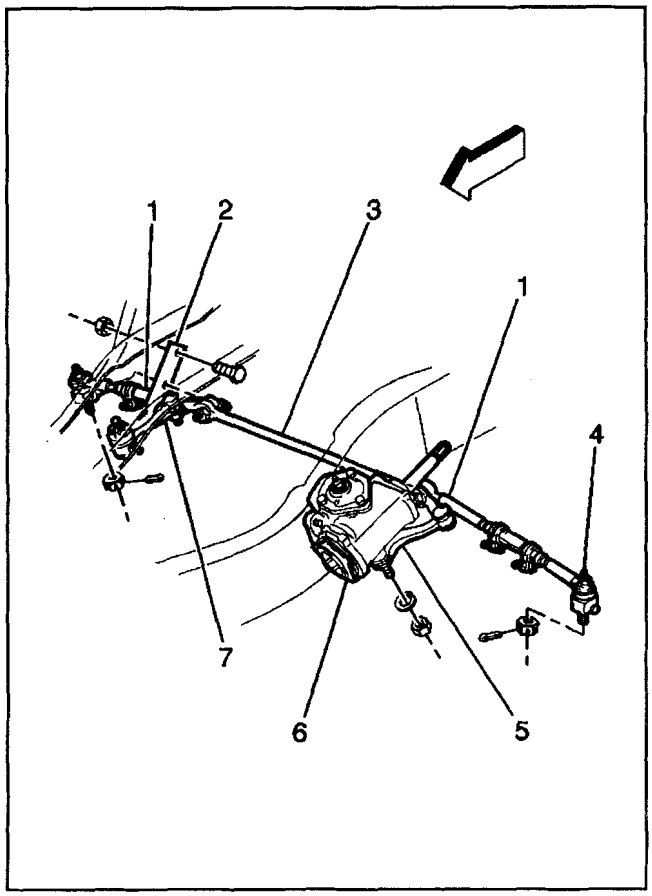



310069

## Installation Procedure

### Tools Required

- *J 29193* Steering Linkage Installer (12 mm)
- *J 29194* Steering Linkage Installer (14 mm)

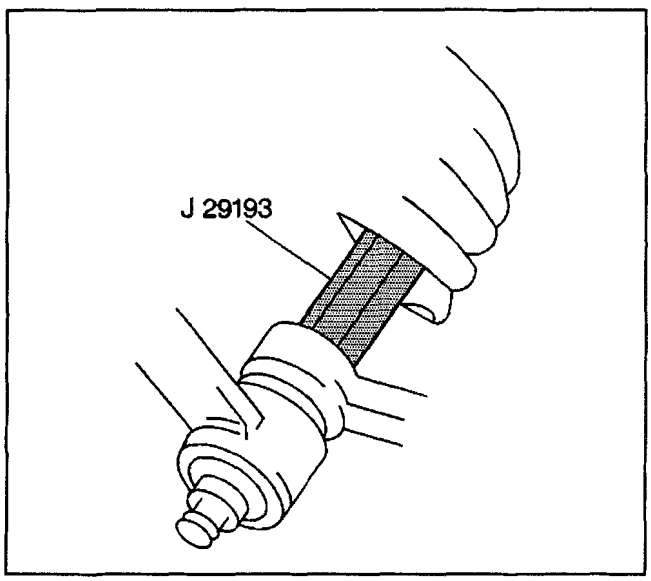
1. Install the pitman arm (5) on the pitman shaft. Align the marks made during disassembly.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

2. Install the pitman arm washer and nut.

   **Tighten**

   Tighten the pitman arm nut to 250 N·m (184 lb ft).




240740

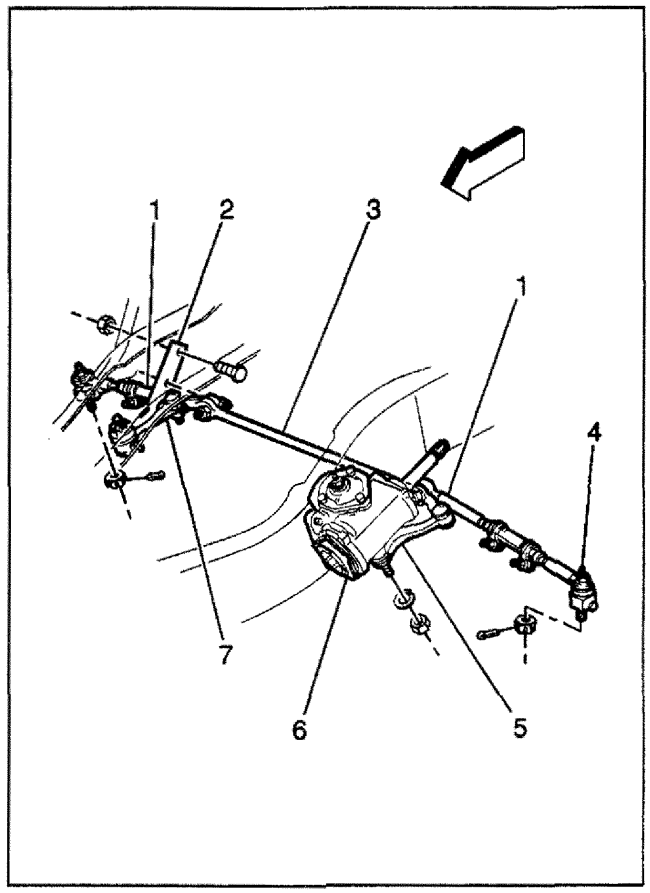
3. Install the relay rod to the pitman arm ball stud.
4. Tighten the *J 29193* or the *J 29194* to 54 N·m (40 lb ft) in order to seat the tapers.
5. Remove the *J 29193* or the *J 29194*.
6. Remove the tool.

7. Install the relay rod nut and the cotter pin to the pitman arm ball stud.

   **Tighten**

   Tighten the pitman arm (5) to the relay rod (3) to 90 N·m (66 lb ft).

8. Lower the vehicle.

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## Pitman Arm Replacement (Motorhome )

### Removal Procedure

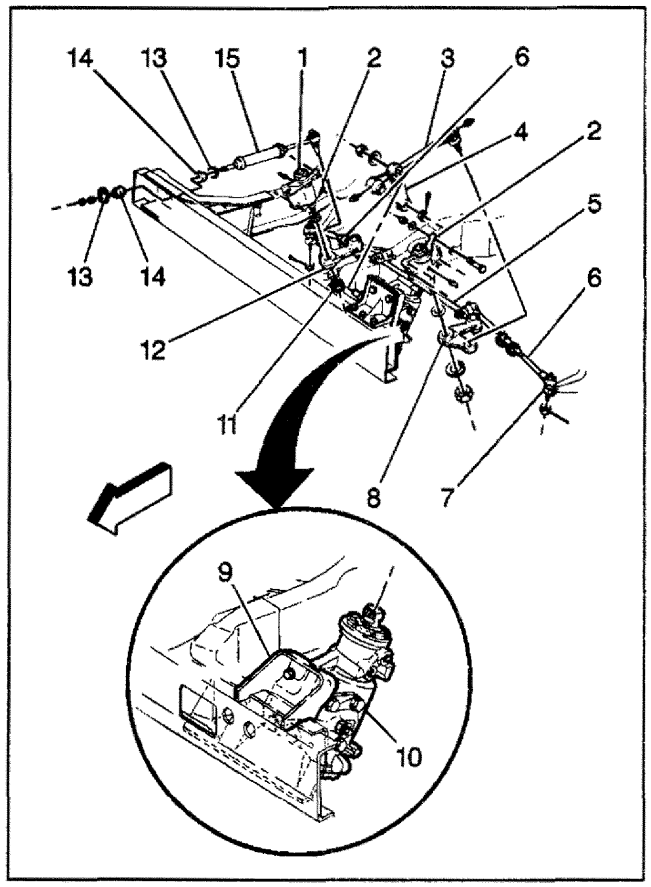
**Tools Required**

- *J 24319-B* Universal Steering Linkage Puller
- *J 29107-A* Universal Pitman Arm Puller
- *J 6632 - 01* Pitman Arm Puller

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the relay rod nut or the connecting rod castellated nut and the cotter pin from the pitman arm ball stud.

***Notice:*** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

3. Use the *J 24319-B* in order to remove the relay rod (5) or the connecting rod (3) from the pitman arm (JB8 configuration shown).
4. Mark the pitman arm (4)and the pitman shaft. This is to ensure that you properly align the pitman arm and the shaft during assembly.
5. Remove the pitman arm nut and washer.

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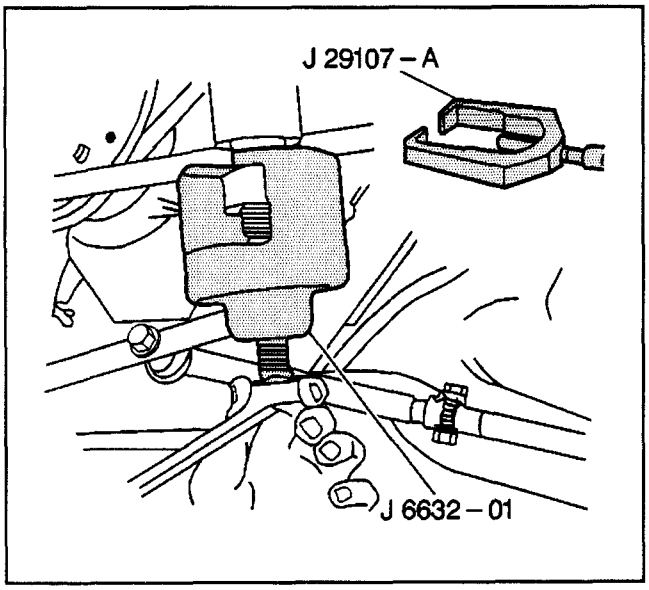


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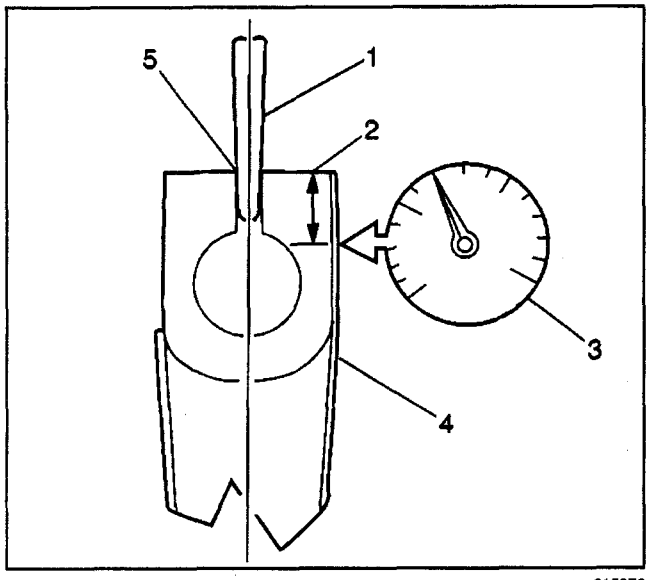
***Notice:*** Do not hammer on the pitman arm, pitman arm shaft or puller. Damage to the pitman arm or steering gear may result.

6. Use the *J 6632 - 01* or the *J 29107-A* in order to remove the pitman arm.
7. Inspect the ball stud threads for damage.
8. Inspect the ball stud seals for excessive wear.
9. Clean the following components:
   - The threads on the ball stud
   - The threads in the ball stud nut

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## Installation Procedure

### Tools Required

- *J 29193* Steering Linkage Installer (12 mm)
- *J 29194* Steering Linkage Installer (14 mm)

1. Install the pitman arm (4) on the pitman shaft. Align the marks made during disassembly.

**Important:** If a clamp-type pitman arm is used, spread the pitman arm just enough with a wedge to slip the arm onto the pitman shaft. Do not spread the pitman arm more than required to slip over the pitman shaft with hand pressure.

2. Use the wedge tool (1) in order to spread the pitman arm (4) at a gap (5) of 7.1 mm (0.28 in) when using a replacement clamp type pitman arm. Maximum expansion with the wedge tool in place should read 0.10 mm (0.004 in) on the dial indicator (3). Distance (2) is 30.2 mm (1.19 in).

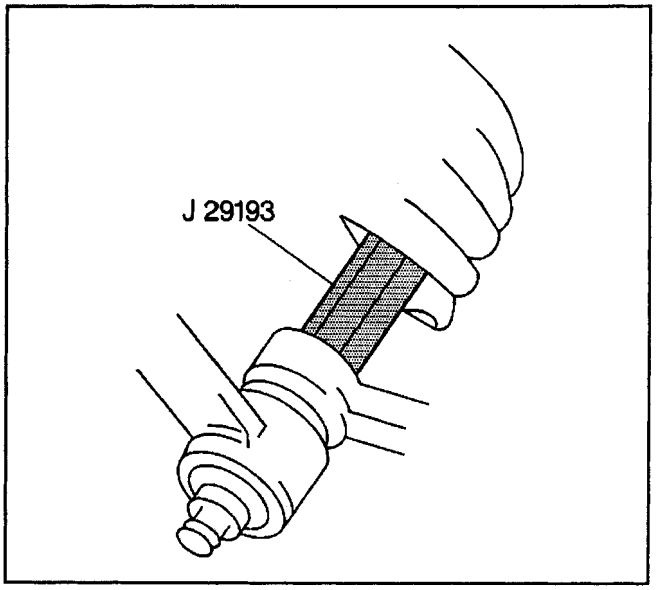
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

3. Install the pitman arm washer and nut.

   **Tighten**

   - Tighten the pitman arm nut with washer for JB8 applications to 170 N·m (125 lb ft).
   - Tighten the clamp-type pitman arm nut with washer for JF9 applications to 135 N·m (100 lb ft).

4. Install the relay rod or the connecting rod to the pitman arm ball stud.
5. Tighten the *J 29193* or the *J 29194* to 54 N·m (40 lb ft) in order to seat the tapers.
6. Remove the *J 29193* or the *J 29194*.
7. Remove the tool.

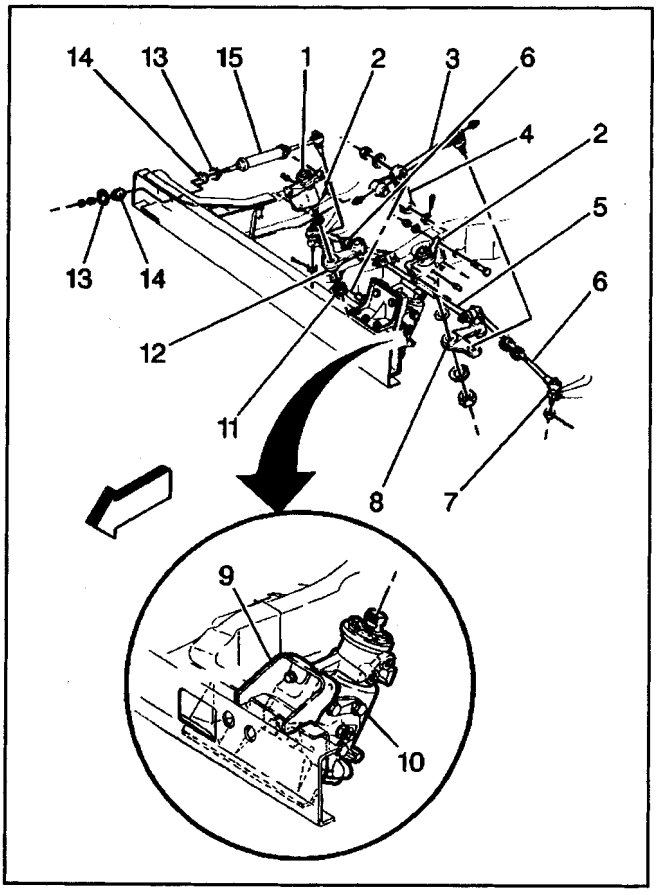



240740

8. Install the relay rod nut or the connecting rod castellated nut and the cotter pin to the pitman arm ball stud. Refer to *Fastener Tightening Specifications (Motorhome )*.

   **Tighten**

   Tighten the pitman arm (4) to the relay rod (5) to 159 N·m (117 lb ft) for JB8 and JF9 applications (JB8 shown).
9. Lower the vehicle.

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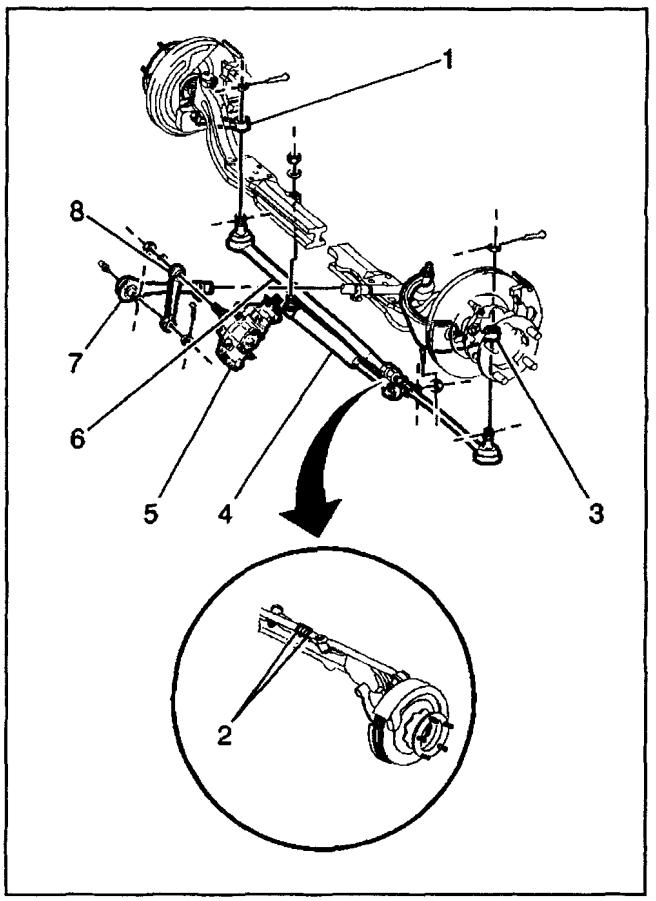


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## Pitman Arm Replacement (Commercial (I-Beam Front Axle))

### Removal Procedure

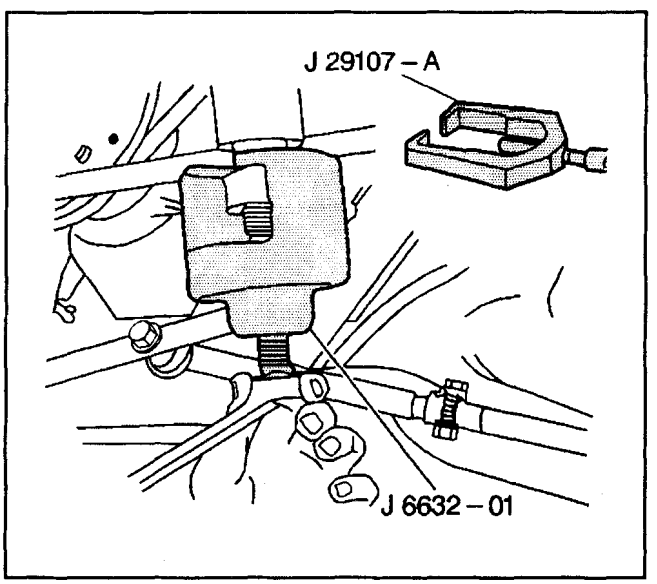
#### Tools Required

- *J 24319-B* Universal Steering Linkage Puller
- *J 29107-A* Universal Pitman Arm Puller
- *J 6632 - 01* Pitman Arm Puller

1. Raise and support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
2. Remove the connecting rod castellated nut and the cotter pin from the pitman arm ball stud.

***Notice:*** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

3. Use the *J 24319-B* in order to remove the connecting rod (7) from the pitman arm (8).
4. Mark the pitman arm and the pitman shaft. This is to ensure that you properly align the pitman arm and the shaft during assembly.
5. Remove the pitman arm nut and washer.

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***Notice:*** Do not hammer on the pitman arm, pitman arm shaft or puller. Damage to the pitman arm or steering gear may result.

6. Use the *J 6632 - 01* or the *J 29107-A* in order to remove the pitman arm.
7. Inspect the ball stud threads for damage.
8. Inspect the ball stud seals for excessive wear.
9. Clean the following components:
   - The threads on the ball stud
   - The threads in the ball stud nut

## Installation Procedure

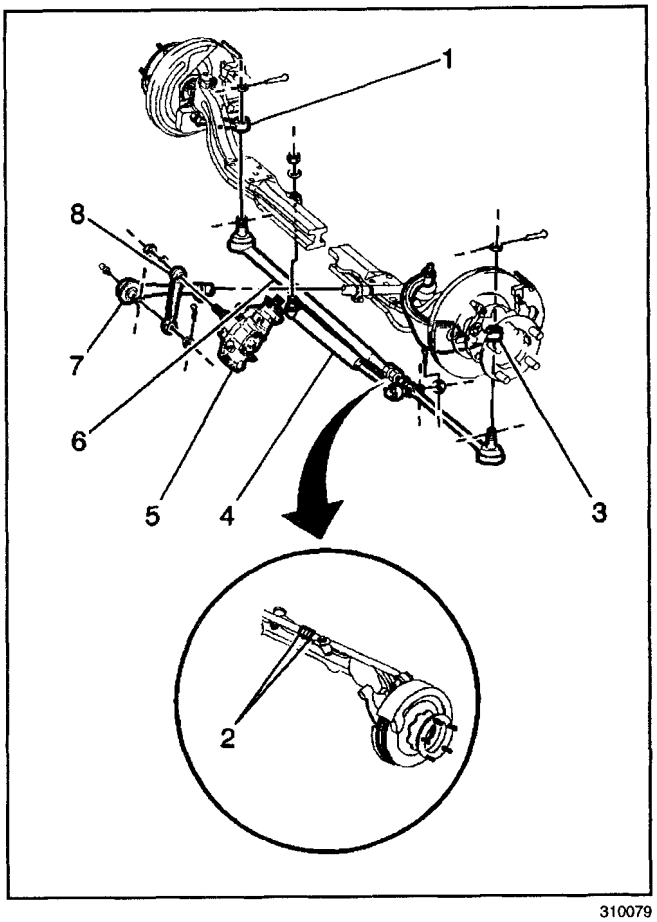
### Tools Required

- *J 29193* Steering Linkage Installer (12 mm)
- *J 29194* Steering Linkage Installer (14 mm)

1. Install the pitman arm (8) on the pitman shaft.
   Align the marks made during disassembly.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

2. Install the pitman arm washer and nut.
   **Tighten**
   Tighten the pitman arm nut to 255 N·m (188 lb ft).



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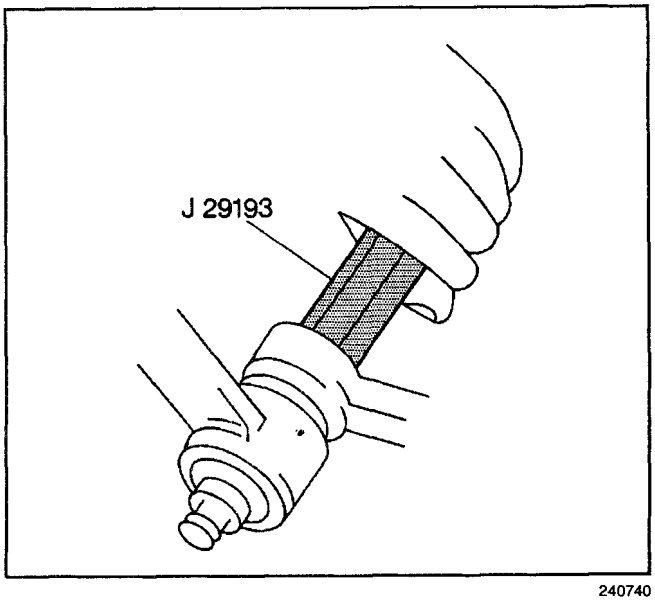
3. Install the connecting rod to the pitman arm ball stud.
4. Tighten the *J 29193* or the *J 29194* to 54 N·m (40 lb ft) in order to seat the tapers.
5. Remove the *J 29193* or the *J 29194*.
6. Remove the tool.



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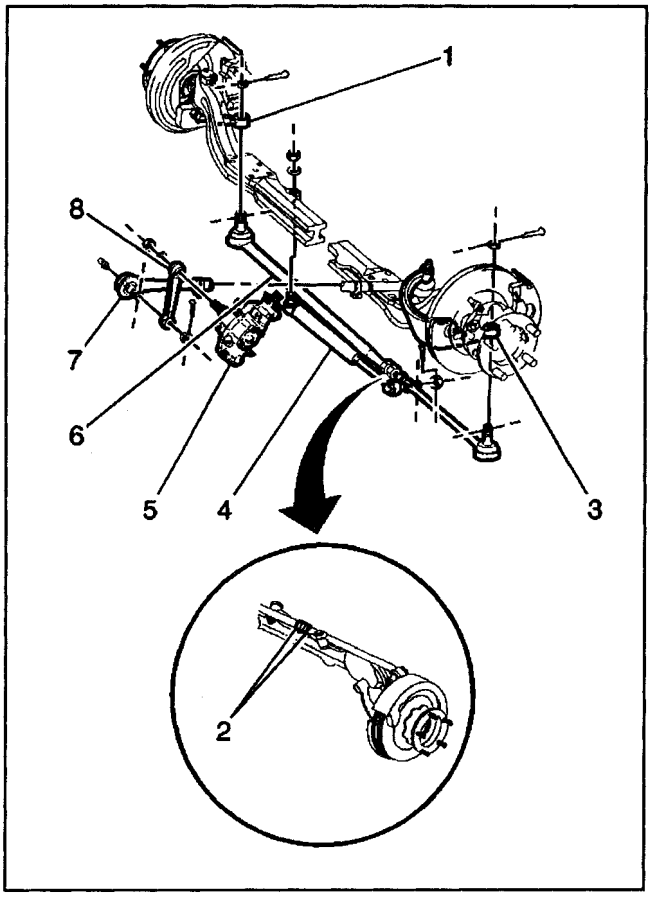


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7. Install the connecting rod castellated nut and the cotter pin to the pitman arm ball stud.

   **Tighten**

   Tighten the connecting rod (7) to the pitman arm (8) to 159 N·m (117 lb ft). Refer to *Fastener Tightening Specifications (Commercial (I-Beam Front Axle))*.

8. Lower the vehicle.

# Description and Operation

## Steering Linkage Description

The steering linkage for commercial models with independent front suspension consists of the following components:

- The pitman arm
- The idler arm
- The relay rod
- Two adjustable tie rods
- The steering shock absorber

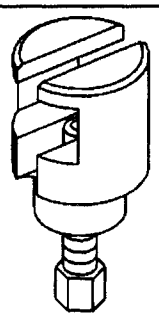
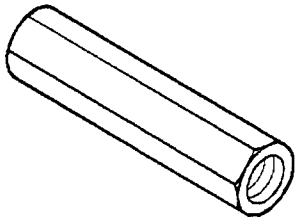
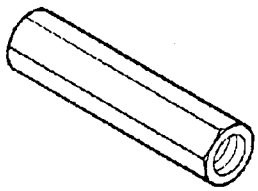
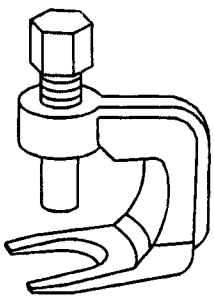
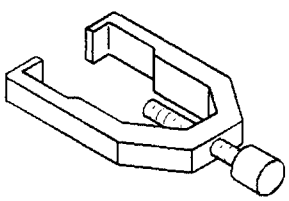
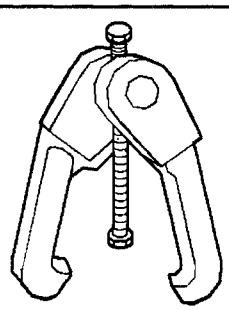
When the steering wheel is turned, the steering gear rotates the pitman, which forces the relay rod to one side. The tie rods, which are connected to the relay rods by ball studs, transfer the steering force to the wheels. The tie rods are adjustable and are used for toe-in adjustments. The relay rod is supported by the pitman arm and idler arm. The idler arm pivots on a support attached to the frame rail.

The motorhome steering linkage has an adjustable tie rod assembly similar to the one described above. When the steering wheel is turned, the steering gear rotates the pitman arm, which forces the non-adjustable connecting rod and relay arm to move the relay rod to one side. The relay arm and idler arm are attached to the frame by support assemblies. The support assemblies are adjustable for shaft end play. The steering shock absorber is attached to the frame and the relay arm.

The steering linkage for the commercial I-Beam front axle models uses a connecting rod to connect the pitman arm to the relay arm. This adjustable connecting rod is used for centering the steering gear with the front axle.

Inspect the steering geometry and the front alignment whenever any steering linkage components are repaired or replaced. Refer to *Front Caster Adjustment* and *Front Camber Adjustment* and *Front Toe Adjustment* in Wheel Alignment.

# Special Tools and Equipment

| Illustration | Tool Number/ Description |
|---|---|
|  245882 | J 6632 - 01<br>Pitman Arm Puller |
|  136 | J 29193<br>Steering Linkage Installer (12 mm) |
|  246309 | J 29194<br>Steering Linkage Installer (14 mm) |
|  153085 | J 6627-A<br>Tie Rod Puller/Wheel Stud Remover |
|  134 | J 29107<br>Universal Pitman Arm Puller |
|  133 | J 24319-B<br>Universal Steering Linkage Puller |

# Steering Wheel and Column - Tilt

## Specifications

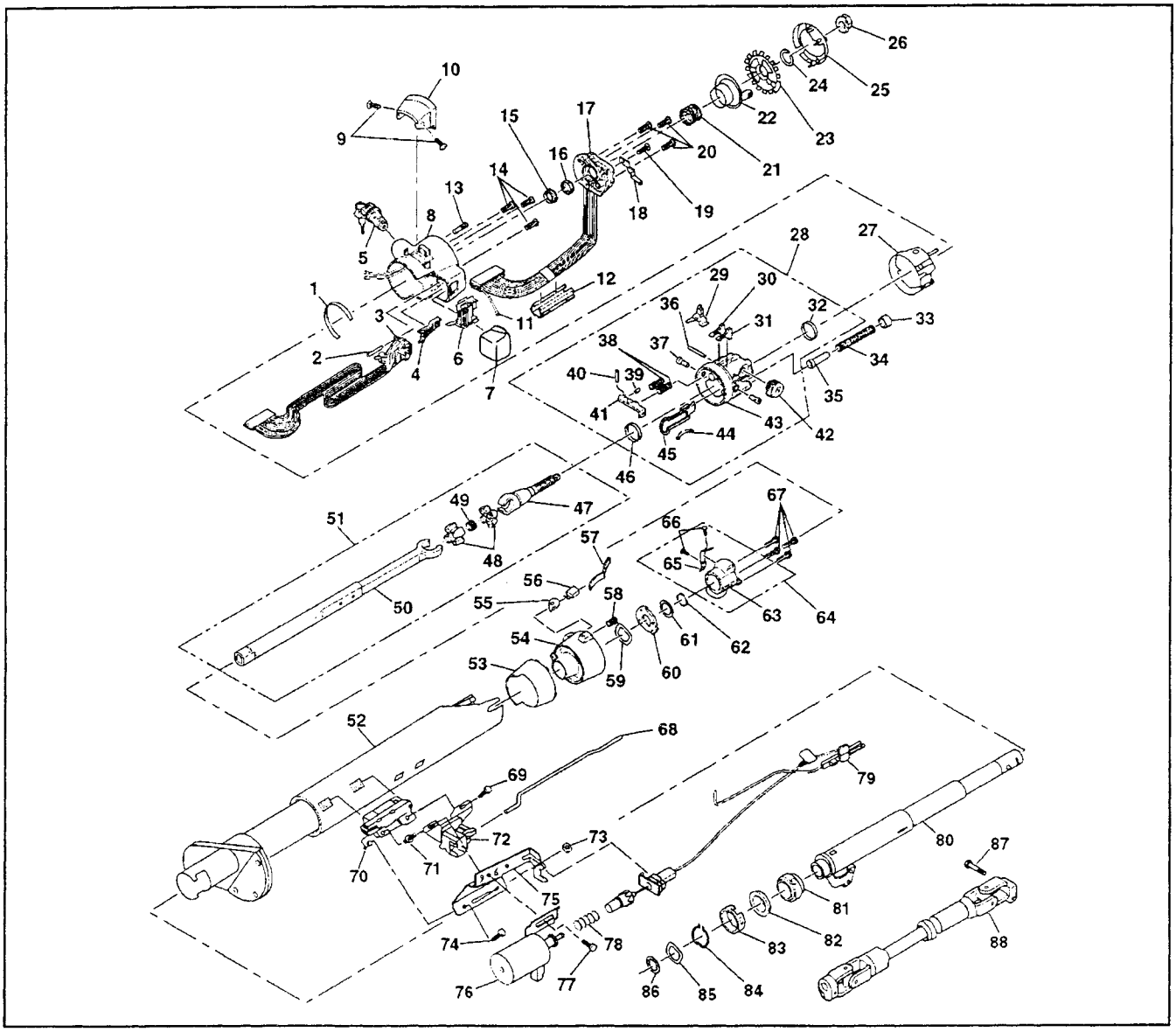
### Fastener Tightening Specifications

| Application | Specification | |
|---|---|---|
| | Metric | English |
| Brake Transmission Shift Interlock System Bracket Screws | 4 N·m | 35 lb in |
| Brake Transmission Shift Interlock Solenoid Assembly Screws | 4 N·m | 35 lb in |
| Dimmer and Ignition Switch Mounting Stud | 4 N·m | 35 lb in |
| Dimmer and Ignition Switch Mounting Stud Hexagon Nut | 4 N·m | 35 lb in |
| Hazard Warning Knob Screw | 0.7 N·m | 6 lb in |
| Ignition Switch Assembly Washer Head Screws | 4 N·m | 35 lb in |
| Ignition Switch Interlock Solenoid Assembly Hexagon Washer Head Screws (Column Shift) | 4 N·m | 35 lb in |
| Ignition Switch Solenoid Bracket Washer Head Screws (Column Shift) | 4 N·m | 35 lb in |
| Intermediate Shaft Pinch Bolt Nuts (Commercial) | 102.5 N·m | 76 lb ft |
| Intermediate Shaft Pinch Bolt Nuts (I-Beam Front Axle) | 102.5 N·m | 76 lb ft |
| Intermediate Shaft Pinch Bolt Nuts (Motorhome-Model 708 Steering Gear) | 45 N·m | 33 lb ft |
| Intermediate Shaft Pinch Bolt Nuts (Motorhome-Model 710 Steering Gear) | 48 N·m | 35 lb ft |
| Lock Cylinder Retaining Screws | 2.5 N·m | 22 lb in |
| Lock Housing Cover Assembly Pan Head Screws | 9 N·m | 80 lb in |
| Parking Brake Lever Assembly Brace-to-Steering Column Bolt | 30 N·m | 22 lb ft |
| Steering Column Cover-to-Floor Panel Assembly Screws (Commercial) | 2.8 N·m | 25 lb in |
| Steering Column Cover-to-Floor Panel Assembly Screws (Motorhome) | 4.7 N·m | 42 lb in |
| Steering Column Housing Support Screws | 8.5 N·m | 75 lb in |
| Steering Column Outer Retaining Bracket Bolts | 30 N·m | 22 lb ft |
| Steering Column Retainer Clamp Nut | 15 N·m | 11 lb ft |
| Steering Column Retaining Bracket-to-Brake Pedal Bracket Assembly Bolts (Commercial) | 25 N·m | 18 lb ft |
| Steering Column Retaining Bracket-to-Dash and Toe Panel Assembly Bolts (Motorhome) | 30 N·m | 22 lb ft |
| Steering Column Shift Lever Gate Oval Head Cross-Recessed Screws (Column Shift) | 3.5 N·m | 31 lb in |
| Steering Wheel Nut | 41 N·m | 30 lb ft |
| Turn Signal Switch Arm Assembly Round Washer Head Screws | 2.5 N·m | 22 lb in |
| Turn Signal Switch Assembly Pan Head Screws | 3.5 N·m | 31 lb in |

# Visual Identification

## Steering Column – Disassembled View (Motorhome Column Shift)

### Tilt Steering Column

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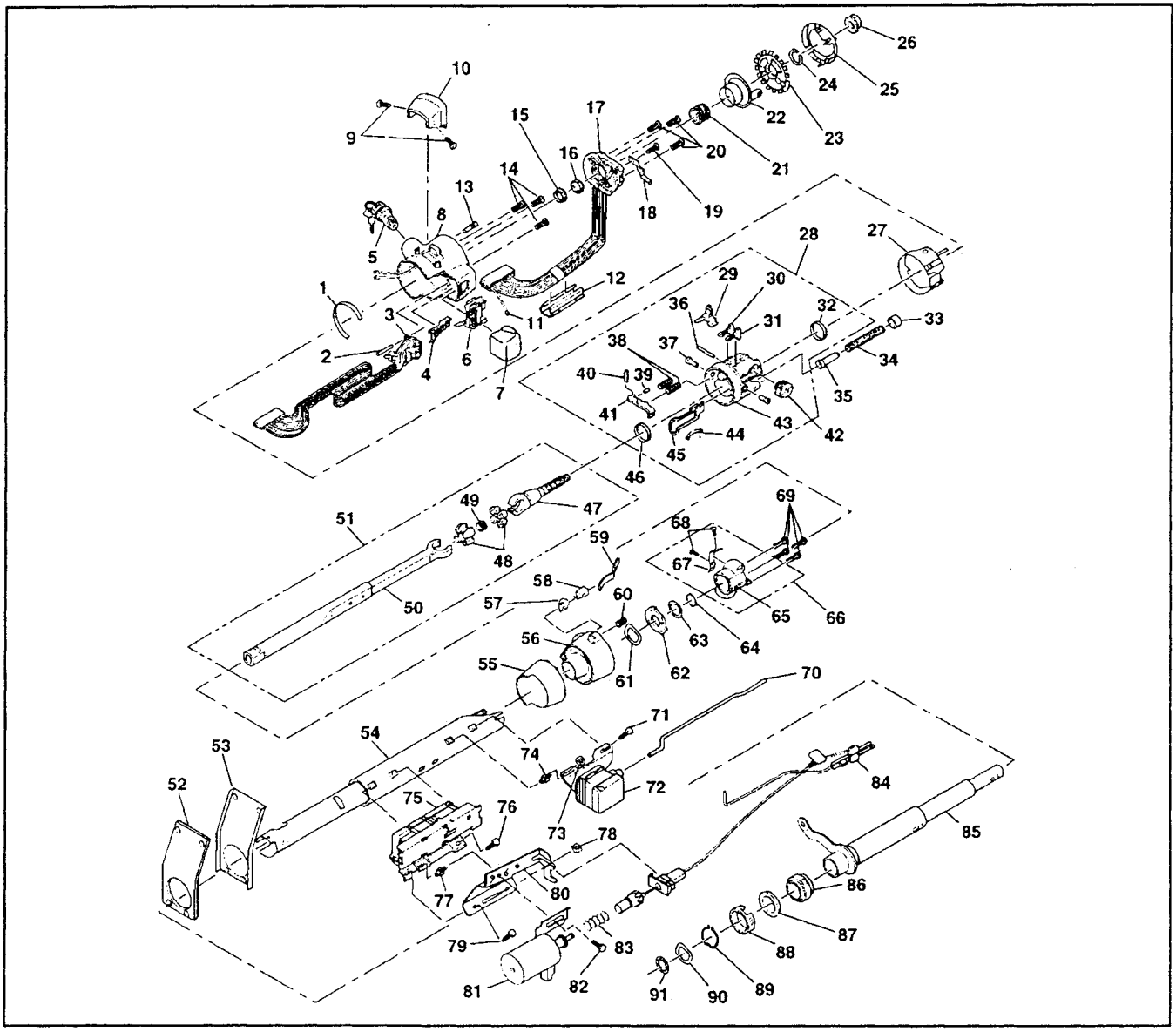
**Legend**

(1) Cover Trim Ring
(2) Switch Actuator Pivot Pin
(3) Pivot and Pulse Switch Assembly
(4) Dimmer Switch Rod Actuator
(5) Steering Column Lock Cylinder Set
(6) Column Housing Cover End Base Plate
(7) Column Housing Cover End Cap
(8) Bracket and Cover Assembly
(9) Round Washer Head Screw
(10) Transmission Indicator Dial and Housing
(11) Horn Pad Group Wiring Assembly
(12) Wiring Protector
(13) Lock Retaining Screw
(14) Pan Head Soc Tap Screw
(15) Inner Race
(16) Upper Bearing Inner Race Seat
(17) Turn Signal Switch Assembly
(18) Signal Switch Arm Assembly
(19) Round Washer Head Screw
(20) Binding Head Cross Recess Screw
(21) Upper Bearing Spring
(22) Turn Signal Cancel Cam

(23) Shaft Lock
(24) Bearing Retainer
(25) Lock Bolt Guard Assembly
(26) Hexagon Jam Nut
(27) Pin and Cover Liner Assembly
(28) Steering Column Housing Assembly
(29) Wire Protector Shield
(30) Steering Wheel Lock Shoe
(31) Steering Wheel Lock Shoe
(32) Bearing Assembly
(33) Spring Retainer
(34) Wheel Tilt Spring
(35) Spring Guide
(36) Dowel Pin
(37) Pivot Pin
(38) Shoe Spring
(39) Release Lever Spring
(40) Release Lever Pin
(41) Shoe Release Lever
(42) Switch Actuator Sector
(43) Steering Column Housing
(44) Rack Preload Spring
(45) Switch Actuator Rack
(46) Bearing Assembly
(47) Race and Upper Shaft Assembly
(48) Centering Sphere
(49) Joint Preload Spring
(50) Yoke and Steering Shaft Assembly
(51) Steering Shaft Assembly
(52) Steering Column Jacket Assembly
(53) Gearshift Bowl Shroud
(54) Gearshift Lever Bowl Assembly
(55) Pointer Retainer Bracket
(56) Pointer Retainer Clip
(57) Transmission Cont Indicator Pointer
(58) Shift Lever Spring
(59) Wave Washer
(60) Lock Plate
(61) Thrust Washer
(62) Shift Tube Retaining Ring
(63) Steering Column Housing Support
(64) Steering Column Housing Support Assembly
(65) Shift Lever Gate
(66) Oval Head Cross Recess Screw
(67) Support Screw
(68) Dimmer Switch Rod
(69) Washer Head Screw
(70) Ignition Switch Assembly
(71) Dimmer and Ignition Switch Mounting Stud
(72) Dimmer Switch Assembly
(73) Hexagon Nut
(74) Hexagon Washer Head Tapping Screw
(75) Solenoid Bracket
(76) Interlock Solenoid Assembly
(77) Hexagon Washer Head Screw
(78) Ball Joint Spring
(79) Cable and Actuator Assembly
(80) Shift Tube Assembly
(81) Lower Bearing Adapter
(82) Bearing Assembly
(83) Bearing Adapter Retainer
(84) Lower Bearing Adapter Clip
(85) Bearing Preload Washer
(86) Lower Spring Retainer
(87) Pinch Bolt
(88) Inter Steering Shaft Assembly

## Steering Column – Disassembled View (Motorhome Floor Shift)

### Tilt Column Shift Steering Column

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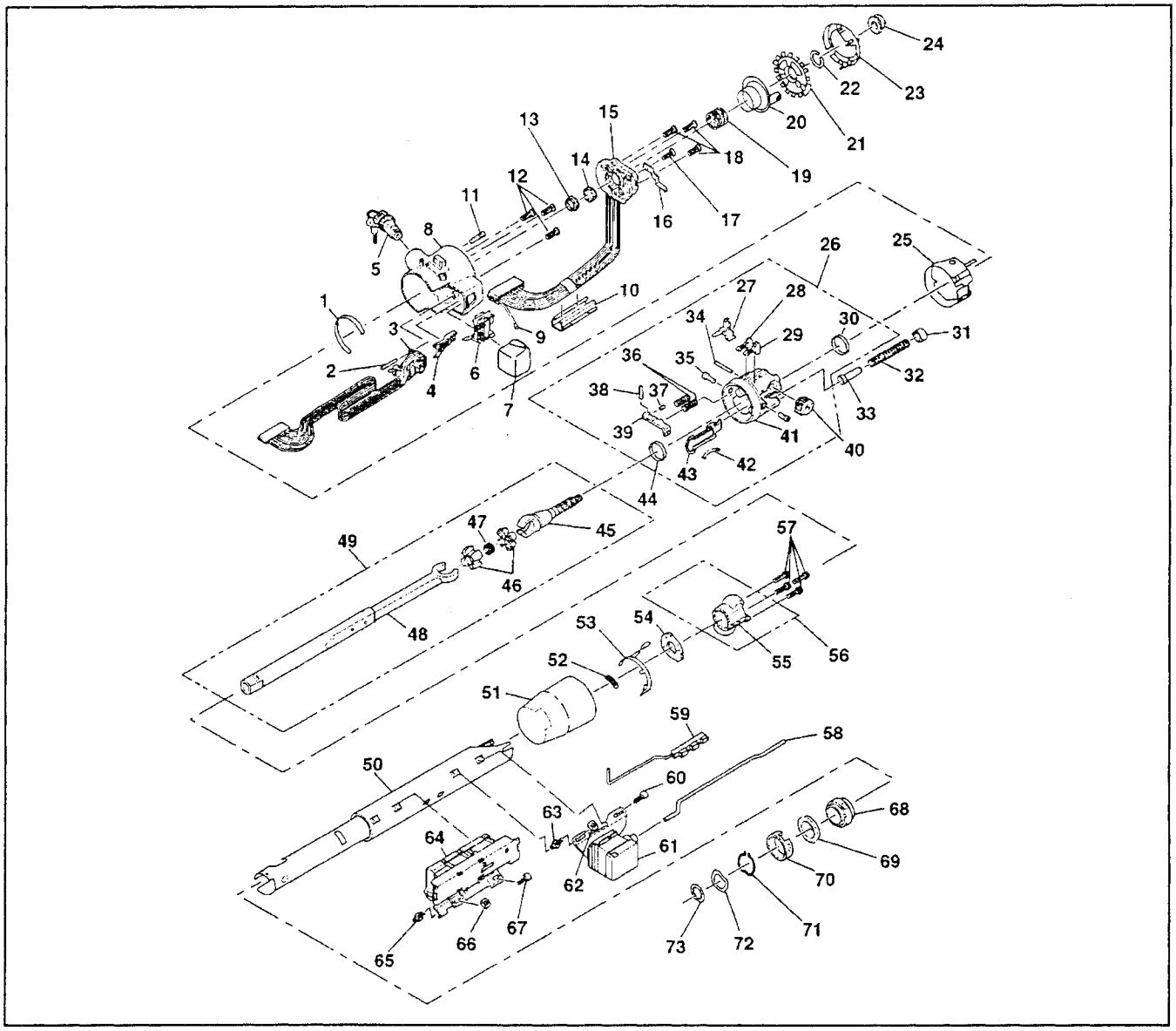
**Legend**

(1) Cover Trim Ring
(2) Switch Actuator Pivot Pin
(3) Pivot and 2–Speed Switch Assembly
(4) Dimmer Switch Rod Actuator
(5) Steering Column Lock Cylinder Set
(6) Column Housing Cover End Base Plate
(7) Column Housing Cover End Cap
(8) Lock Housing Cover and Sleeve Assembly
(9) Round Washer Head Screw
(10) Transmission Indicator Dial and Housing Assembly
(11) Horn Pad Group Wiring Assembly
(12) Wiring Protector
(13) Lock Retaining Screw
(14) Pan Head 6–Lobed Soc Tap Screw
(15) Inner Race
(16) Upper Bearing Inner Race Seat
(17) Turn Signal Switch Assembly
(18) Signal Switch Assembly
(19) Round Washer Head Screw
(20) Pan Head 6–Lobed Socket Screw
(21) Upper Bearing Spring
(22) Turn Signal Cancel Cam
(23) Shaft Lock
(24) Bearing Retainer
(25) Lock Bolt Guard Assembly

(26) Flange Prevail Torque Nut
(27) Pin and Cover Liner Assembly
(28) Steering Column Housing Assembly
(29) Wire Protector Shield
(30) Steering Wheel Lock Shoe
(31) Steering Wheel Lock Shoe
(32) Bearing Assembly
(33) Spring Retainer
(34) Wheel Tilt Spring
(35) Spring Guide
(36) Dowel Pin
(37) Pivot Pin
(38) Shoe Spring
(39) Release Lever Spring
(40) Release Lever Pin
(41) Shoe Release Lever
(42) Switch Actuator Sector
(43) Steering Column Housing
(44) Rack Preload Spring
(45) Switch Actuator Rack
(46) Bearing Assembly
(47) Race and Upper Shaft Assembly
(48) Centering Sphere
(49) Joint Preload Spring
(50) Yoke and Steering Shaft Assembly
(51) Steering Shaft Assembly
(52) Steering Column Dash Seal
(53) Steering Column Dash Cover
(54) Steering Column Jacket Assembly
(55) Gearshift Bowl Shroud
(56) Gearshift Lever Bowl Assembly
(57) Pointer Retaining Bracket
(58) Pointer Retaining Clip
(59) Transmission Cont Indicator Pointer
(60) Shift Lever Spring
(61) Wave Washer
(62) Lock Plate
(63) Thrust Washer
(64) Shift Tube Retaining Ring
(65) Steering Column Housing Support
(66) Steering Column Housing Support Assembly
(67) Shift Lever Gate
(68) Oval Head Cross Recess Screw
(69) Support Screw
(70) Dimmer Switch Rod
(71) Washer Head Screw
(72) Dimmer Switch Assembly
(73) Hexagon Nut
(74) Dimmer and Ignition Switch Mounting Stud
(75) Ignition Switch Assembly
(76) Washer Head Screw
(77) Dimmer and Ignition Switch Mounting Stud
(78) Hexagon Nut
(79) Hexagon Washer Head Tapping Screw
(80) Solenoid Bracket
(81) Interlock Solenoid Assembly
(82) Hexagon Washer Head Screw
(83) Ball Joint Spring
(84) Cable and Actuator Assembly
(85) Shift Tube Assembly
(86) Lower Bearing Adapter
(87) Bearing Assembly
(88) Bearing Adapter Retainer
(89) Lower Bearing Adapter Clip
(90) Bearing Preload Washer
(91) Lower Spring Retainer

## Steering Column – Disassembled View (Commercial Floor Shift)

Tilt Floor Shift Steering Column




375965

### Legend

(1) Cover Trim Ring
(2) Switch Actuator Pivot Pin
(3) Pivot and 2–Speed Switch Assembly
(4) Dimmer Switch Rod Actuator
(5) Steering Column Lock Cylinder Set
(6) Column Housing Cover End Base Plate
(7) Column Housing Cover End Cap
(8) Lock Housing Cover Assembly
(9) Horn Pad Group Wiring Assembly
(10) Wiring Protector
(11) Lock Retaining Screw
(12) Pan Head Soc Tap Screw
(13) Inner Race
(14) Upper Bearing Inner Race Seat
(15) Turn Signal Switch Assembly
(16) Signal Switch Arm Assembly
(17) Round Washer Head Screw
(18) Pan Head 6–Lobe Soc Tap Screw
(19) Upper Bearing Spring
(20) Turn Signal Cancel Cam
(21) Shaft Lock
(22) Bearing Retainer
(23) Lock Bolt Guard Assembly
(24) Hexagon Jam Nut
(25) Pin and Cover Liner Assembly
(26) Steering Column Housing Assembly

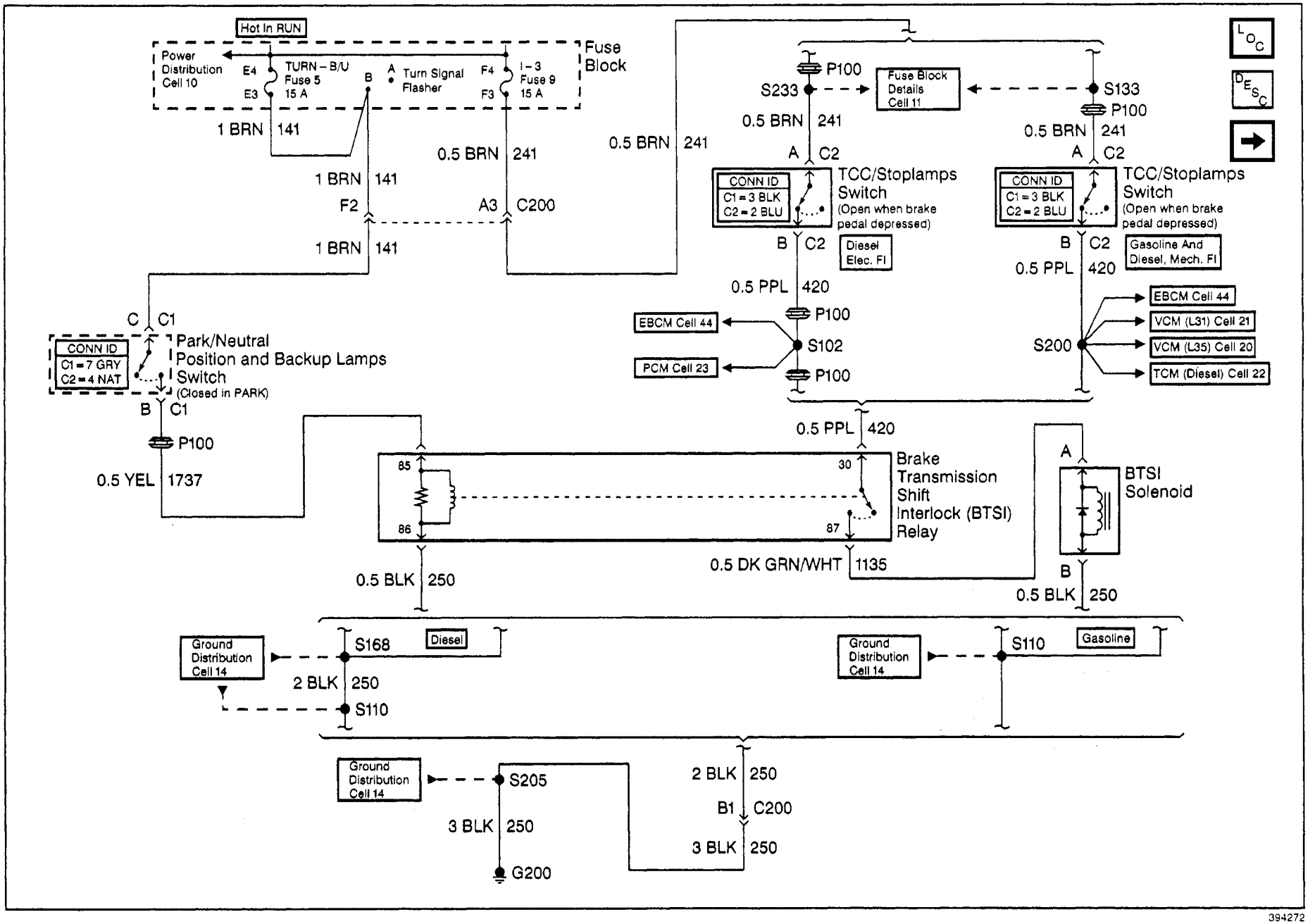
(27) Wire Protector Shield
(28) Steering Wheel Lock Shoe
(29) Steering Wheel Lock Shoe
(30) Bearing Assembly
(31) Spring Retainer
(32) Wheel Tilt Spring
(33) Spring Guide
(34) Dowel Pin
(35) Pivot Pin
(36) Shoe Spring
(37) Release Lever Spring
(38) Release Lever Pin
(39) Shoe Release Lever
(40) Switch Actuator Sector
(41) Steering Column Housing
(42) Rack Preload Spring
(43) Switch Actuator Rack
(44) Bearing Assembly
(45) Race and Upper Shaft Assembly
(46) Centering Sphere
(47) Joint Preload Spring
(48) Yoke and Steering Shaft Assembly
(49) Steering Shaft Assembly
(50) Steering Column Jacket Assembly
(51) Steering Column Housing Shroud
(52) Key Release Spring
(53) Key Release Lever
(54) Lock Plate
(55) Steering Column Housing Support
(56) Steering Column Housing Support Assembly
(57) Support Screw
(58) Dimmer Switch Rod
(59) Ignition Switch Actuator Assembly
(60) Washer Head Screw
(61) Dimmer Switch Assembly
(62) Hexagon Nut
(63) Dimmer and Ignition Switch Mounting Stud
(64) Ignition Switch Assembly
(65) Dimmer and Ignition Switch Mounting Stud
(66) Hexagon Nut
(67) Washer Head Screw
(68) Lower Bearing Adapter
(69) Bearing Assembly
(70) Bearing Adapter Retainer
(71) Lower Bearing Adapter Clip
(72) Bearing Preload Washer
(73) Lower Spring Retainer

## Schematic and Routing Diagrams

### Tilt Wheel/Column Schematic References

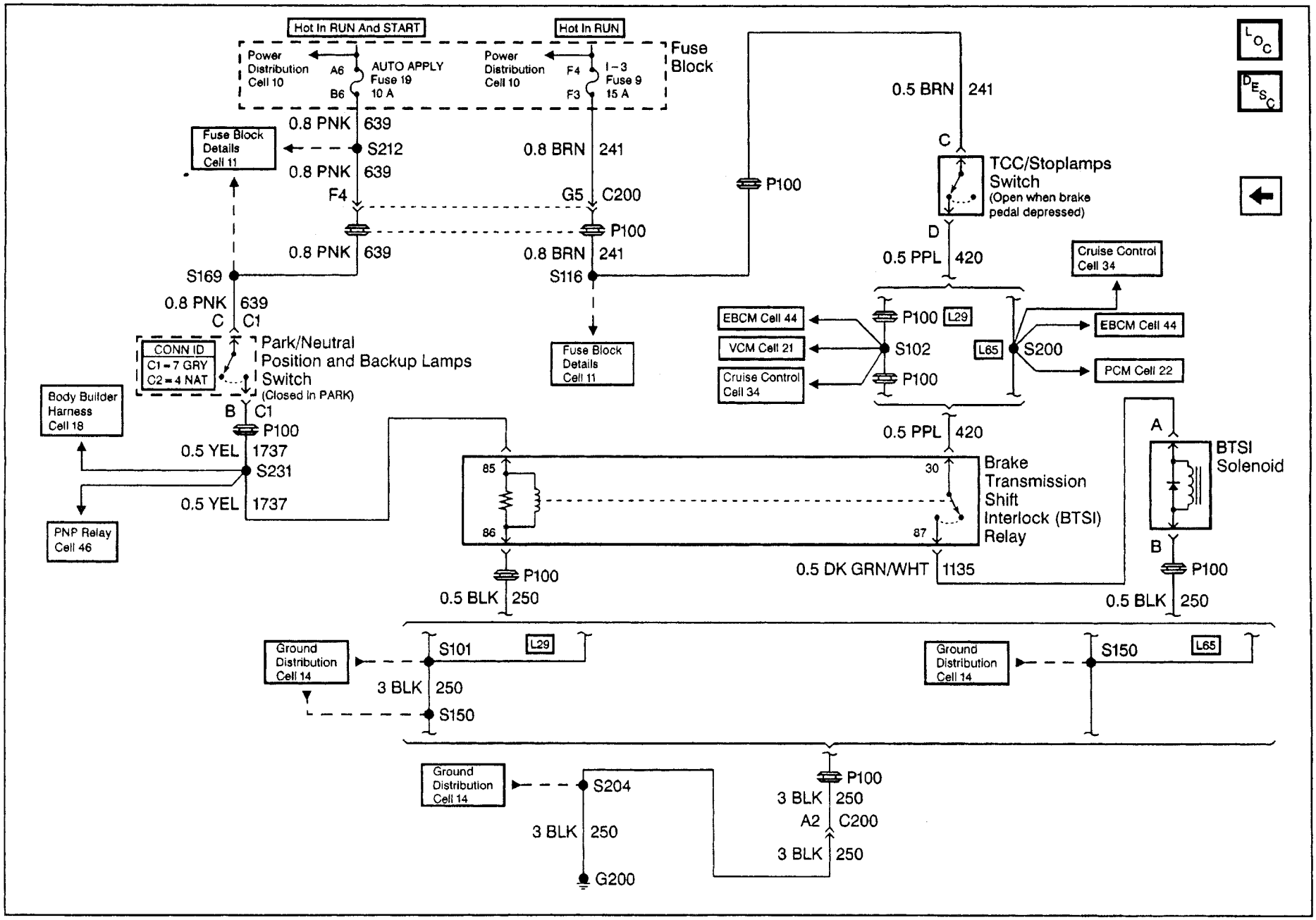
| Reference on Schematic | Section Number - Subsection Name |
|---|---|
| ABS Schematics Cell 44 | 5 — Antilock Brake System |
| Cruise Control Cell 34 | 8 — Cruise Control |
| Engine Controls Cell 21 | 6 — Engine Controls |
| Engine Controls Cell 22 | 6 — Engine Controls |
| Fuse Block Details Cell 11 | 8 — Wiring Systems |
| Ground Distribution Cell 14 | 8 — Wiring Systems |
| Park Brake Cell 46 | 5 — Park Brake |
| Power Distribution Cell 10 | 8 — Wiring Systems |
| Upfitter Provision Cell 18 | 8 — Wiring Systems |

## Auto Trans Shift Lock Control Schematics (Cell 138: Commercial BTSI Circuit)




394272

# Auto Trans Shift Lock Control Schematics (Cell 138: Motorhome BTSI Circuit)




394269

## Component Locator

### Tilt Wheel/Column Components (Commercial)

| Name | Location | Locator View | Connector End View |
|---|---|---|---|
| Brake/Transmission Shift Interlock (BTSI) Relay | LH interior bulkhead on the relay bracket | *Tilt Wheel/Column Component Views* | *Tilt Wheel/Column Connector End Views* |
| Brake/Transmission Shift Interlock (BTSI) Solenoid | On the lower portion of the steering column below the column support bracket | *Tilt Wheel/Column Component Views* | *Tilt Wheel/Column Connector End Views* |
| Electronic Brake Control Module (EBCM) | Below the radiator on the lower crossmember | *Antilock Brakes System Component Views* in Antilock Brake System | *Antilock Brakes System Connector End Views* in Antilock Brake System |
| IP Fuse Block | Located by the body builder | *Electrical Center Identification (Commercial)* in Wiring Systems | *Power and Grounding Connector End Views* in Wiring Systems |
| Park/Neutral Position and Backup Lamps Switch | On the LH side of the transmission near the middle | *Lighting Systems Component Views (Commercial)* in Lighting Systems | *Lighting Systems Connector End Views (Commercial)* in Lighting Systems |
| Powertrain Control Module (EFI Diesel) | At the LH side of the drivers island on the relay bracket | *Engine Controls Component Views* in Engine Controls | *PCM Connector End Views (EFI)* in Engine Controls |
| Torque Converter Clutch (TCC) and Stoplamps Switch | Above the brake pedal at the RH side of the steering column | *Lighting Systems Component Views (Commercial)* in Lighting Systems | *Lighting Systems Connector End Views (Commercial)* in Lighting Systems |
| Vehicle Control Module (Gasoline) | At the LH side of the radiator support | *Engine Controls Component Views* in Engine Controls | *VCM Connector End Views* in Engine Controls |
| C200 | Engine harness to the IP harness, in the bulkhead near P100 | *Harness Routing Views (Commercial)* in Wiring Systems | *Inline Harness Connector End Views (Commercial)* in Wiring Systems |
| G200 | LH interior bulkhead near the relay bracket | — | — |
| P100 | LH bulkhead left of the steering column | *Harness Routing Views (Commercial)* in Wiring Systems | — |
| S102 (EFI Diesel) | In the engine harness, approximately 32 cm (13 in) from the breakout for the battery junction block | — | — |
| S110 (Gasoline) | In the engine harness, approximately 4 cm (2 in) from the breakout for C200 towards P100 | — | — |
| S110 (Diesel) | In the engine harness, approximately 4 cm (2 in) from the breakout for the ABS harness connectors C110 and C111 | — | — |
| S133 (Gasoline) | In the engine harness breakout for the VCM, approximately 8 cm (3 in) from the main harness | — | — |
| S133 (MFI Diesel) | In the engine harness, approximately 17 cm (7 in) from the breakout for C200 | — | — |
| S168 (EFI Diesel, Auto Trans) | In the engine harness, approximately 17 cm (7 in) from P100 | — | — |
| S200 (Gasoline) | In the IP side of the engine harness, approximately 19 cm (8 in) from P100 toward the ignition switch | — | — |
| S205 | In the IP harness, approximately 4 cm (2 in) before the fuse block breakout towards C200 | — | — |
| S233 (EFI Diesel) | In the IP side of the engine harness, approximately 31 cm (13 in) from P100 toward the ignition switch | — | — |

## Tilt Wheel/Column Components (Motorhome)

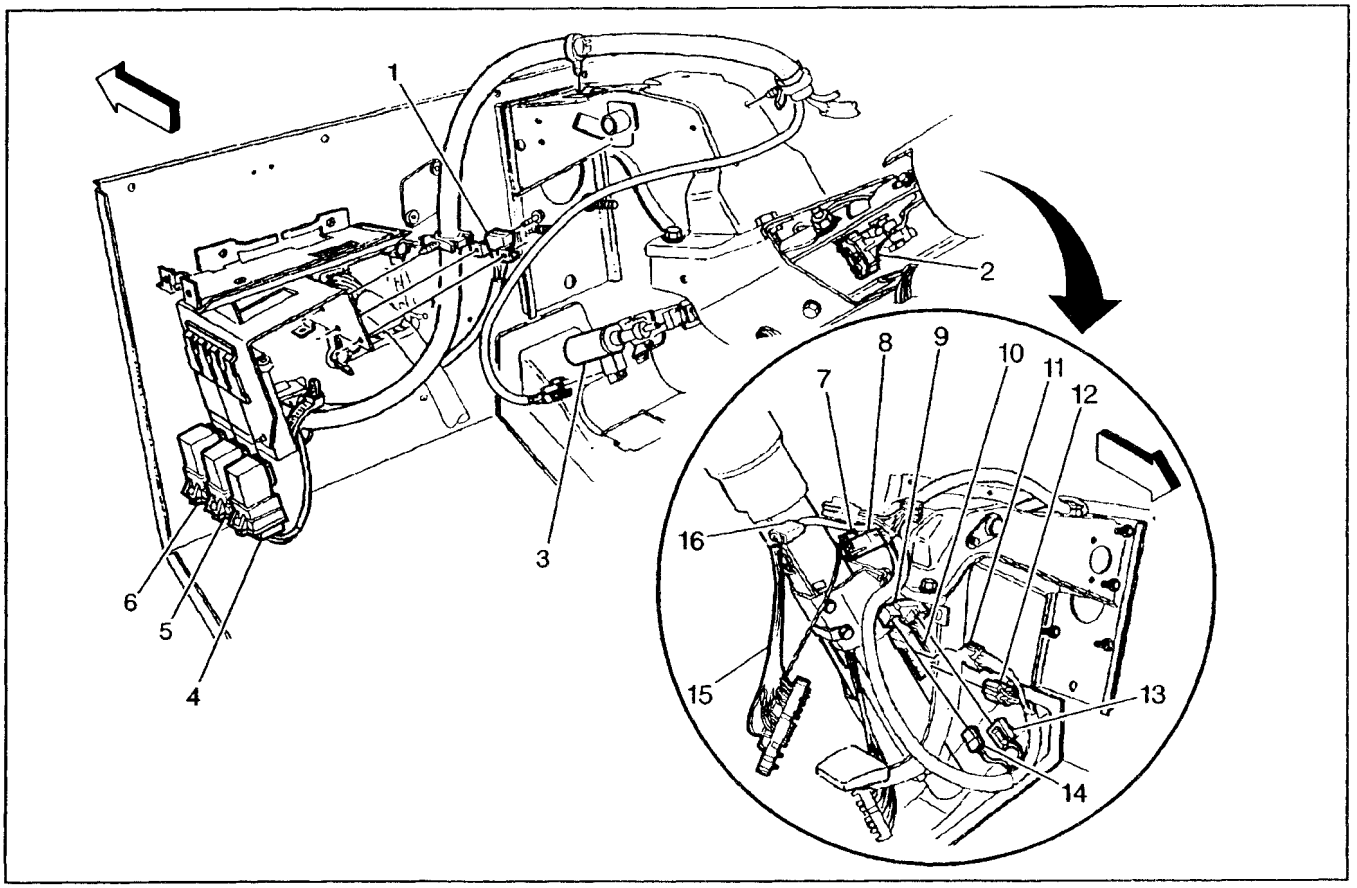
| Name | Location | Locator View | Connector End View |
|---|---|---|---|
| Brake/Transmission Shift Interlock (BTSI) Relay | Mounted on top of the steering column support at the driver's island | *Tilt Wheel/Column Component Views* | *Tilt Wheel/Column Connector End Views* |
| Brake/Transmission Shift Interlock (BTSI) Solenoid | On the lower portion of the steering column below the column support bracket | *Tilt Wheel/Column Component Views* | *Tilt Wheel/Column Connector End Views* |
| Electronic Brake Control Module (EBCM) | Below the radiator on the lower crossmember | *Antilock Brakes System Component Views* in Antilock Brake System | *Antilock Brakes System Connector End Views* in Antilock Brake System |
| IP Fuse Block | Located by the body builder | *Electrical Center Identification (Motorhome)* in Wiring Systems | *Power and Grounding Connector End Views* in Wiring Systems |
| Park/Neutral Position (PNP) and Backup Lamps Switch | On the LH side of the transmission near the middle | *Lighting Systems Component Views (Motorhome)* in Lighting Systems | *Lighting Systems Connector End Views (Motorhome)* in Lighting Systems |
| Park/Neutral Position (PNP) Switch Relay | Above the engine mounted to the RH side of the driver's island | *Engine Controls Component Views* in Engine Controls | *Engine Controls Connector End Views (6.5L, L65)* in Engine Controls |
| Powertrain Control Module (Diesel) | On the LH side of the driver's island | *Engine Controls Component Views* in Engine Controls | *PCM Connector End Views* in Engine Controls |
| Torque Converter Clutch (TCC) and Stoplamps Switch | Above the brake pedal at the RH side of the steering column | *Lighting Systems Component Views (Motorhome)* in Lighting Systems | *Lighting Systems Connector End Views (Motorhome)* in Lighting Systems |
| Vehicle Control Module (Gas) | Mounted on top of the radiator support | *Engine Controls Component Views* in Engine Controls | *VCM Connector End Views* in Engine Controls |
| C200 | At the top front of the steering column support near the park brake pull button switch | *Harness Routing Views (Motorhome)* in Wiring Systems | *Inline Harness Connector End Views (Motorhome)* in Wiring Systems |
| G200 | Mounted to the top front of the steering column support plate | — | — |
| P100 | Main wiring pass through at the bulkhead | *Harness Routing Views (Motorhome)* in Wiring Systems | — |
| S101 (Gas) | In the engine harness, 39 cm (14 in) from P100 | — | — |
| S102 (Gas) | In the engine harness, 45 cm (16 in) from P100 | — | — |
| S116 (Gas) | In the engine harness, 32 cm (12 in) from the breakout for the MAF sensor toward P100 | — | — |
| S150 (Diesel) | In the engine harness, 14 cm (6 in) from P100 | — | — |
| S150 (Gas) | In the engine harness, 4 cm (2 in) from the breakout for the battery junction block | — | — |
| S169 (Diesel) | In the engine harness, 8 cm (3 in) from the breakout for the engine coolant level switch toward the starter relay breakout | — | — |
| S169 (Gas) | In the engine harness, 58 cm (23 in) from P100 | — | — |
| S200 (Diesel) | In the IP side of the engine harness, 8 cm (3 in) from the breakout for the turn signal switch connector, toward P100 | — | — |
| S204 | In the IP harness, 26 cm (11 in) from the breakout for connector C200 toward the IP fuse block | — | — |

### Tilt Wheel/Column Components (Motorhome) (cont'd)

| Name | Location | Locator View | Connector End View |
|---|---|---|---|
| S212 | In the IP harness, 10 cm (4 in) from the breakouts for the IP cluster connector and the IP dimmer switch connector toward the IP fuse block | — | — |
| S231 (Diesel) | In the IP side of the engine harness, 13 cm (5 in) from the breakout for the turn signal switch connector toward P100 | — | — |
| S231 (Gas) | In the IP side of the engine harness, 7 cm (4 in) from the breakout for the turn signal switch connector toward P100 | — | — |

## Tilt Wheel/Column Component Views

### IP Side of Engine Wiring – All Engines (Commercial)

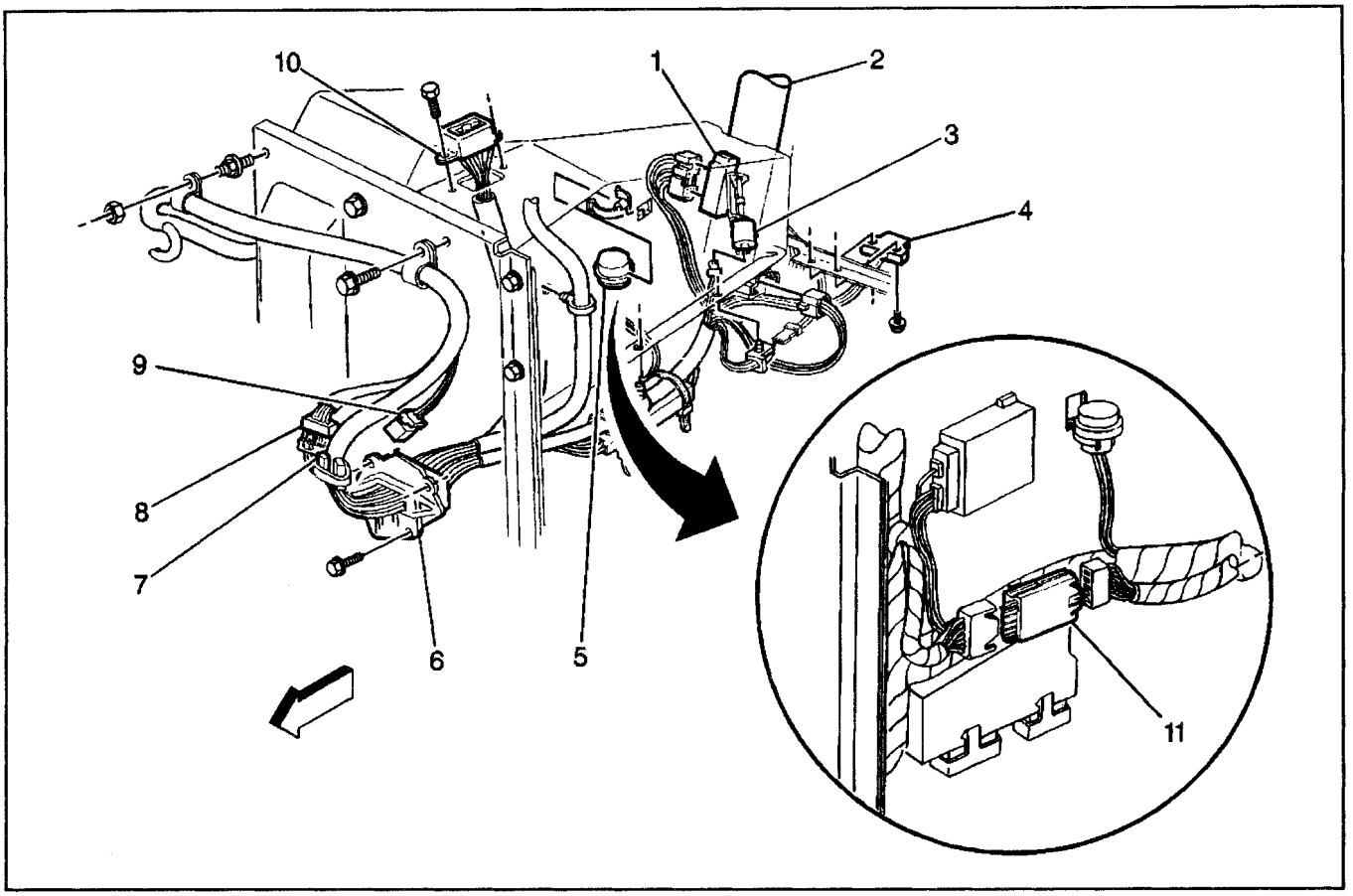



180085

**Legend**

(1) Data Link Connector (DLC)
(2) Headlamps Dimmer Switch
(3) Brake Transmission Shift Interlock (BTSI) Solenoid
(4) Brake Transmission Shift Interlock (BTSI) Relay
(5) Horn Relay
(6) Daytime Running Lamps (DRL) Relay
(7) C210
(8) C211
(9) Torque Converter Clutch (TCC) and Stoplamps Switch
(10) Ignition Switch
(11) C1
(12) C2
(13) C1
(14) C2
(15) Turn Signal Switch Connector
(16) Crank Fuse

## Engine to Dash and Steering Column

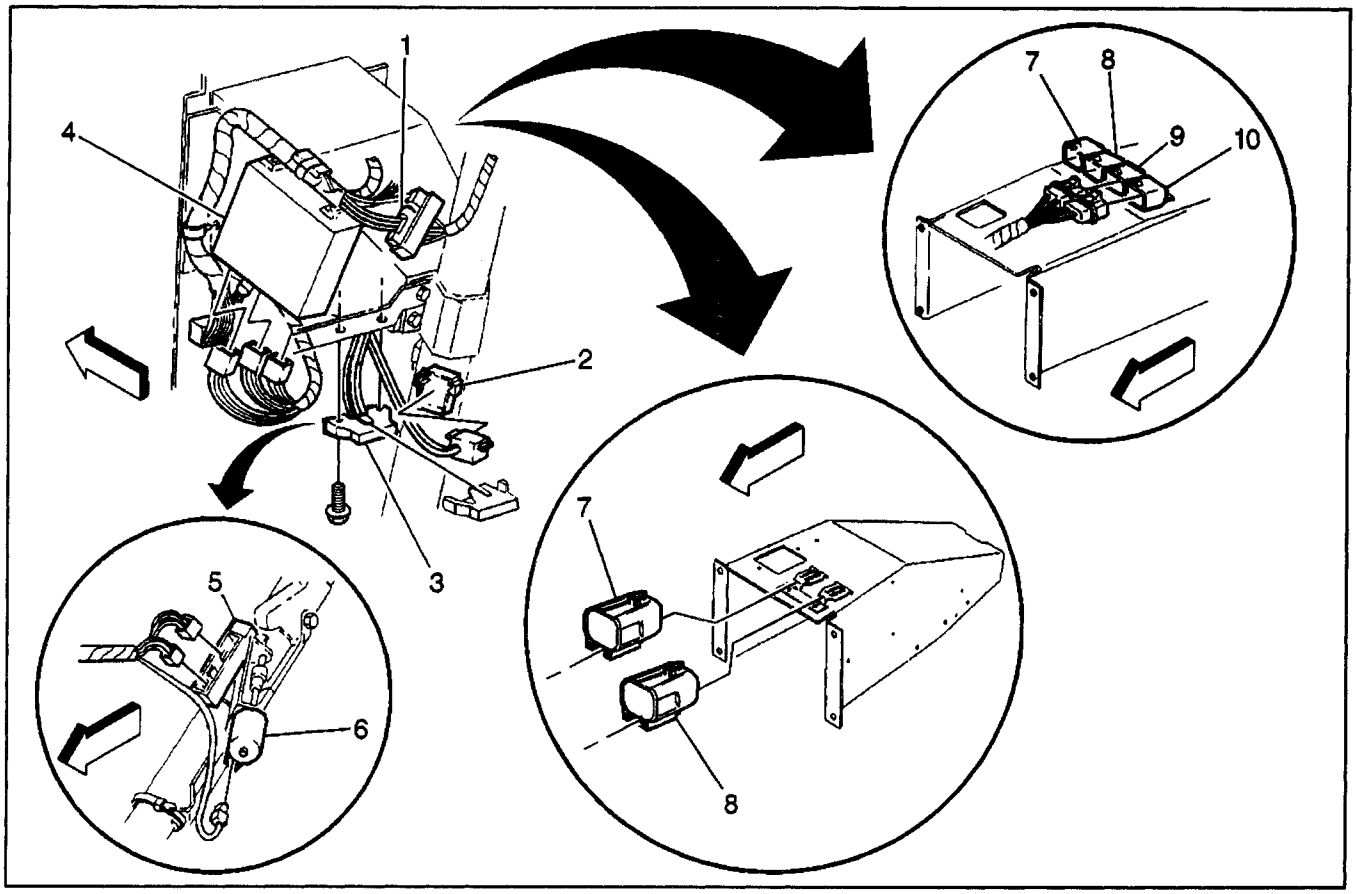



186178

**Legend**

(1) Ignition Switch
(2) Steering Column
(3) Brake Transmission Shift Interlock (BTSI) Solenoid
(4) Data Link Connector (DLC)
(5) Hazard Lamps Flasher
(6) P100
(7) Fuel Pump Prime
(8) C100
(9) C207
(10) C200
(11) Windshield Wiper Pulse Control Module

**Engine Wiring Harness to Dash and Steering Column**



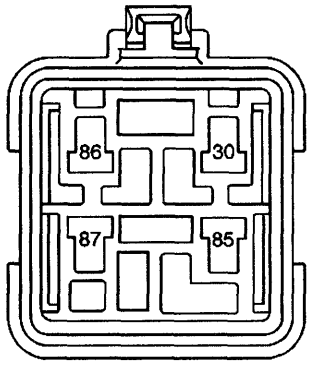

186174

**Legend**

(1) Turn Signal Switch Connector
(2) Headlamps Dimmer Switch
(3) Data Link Connector (DLC)
(4) Powertrain Control Module (Diesel)
(5) Ignition Switch
(6) Brake Transmission Shift Interlock (BTSI) Solenoid
(7) Daytime Running Lamps (DRL) Relay
(8) Horn Relay
(9) Brake Transmission Shift Interlock (BTSI) Relay
(10) Fan Control Relay

## Tilt Wheel/Column Connector End Views

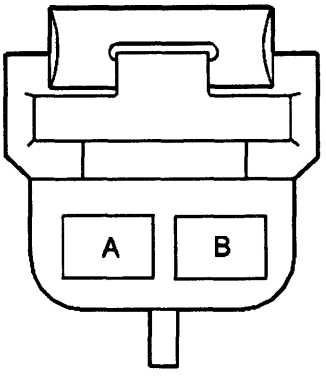
### Brake Transmission Shift Interlock (BTSI) Relay




39670

| Connector Part Information | • 12129716<br>• 4 Way F Metri-Pack 280 Series, Flexlock (GRY) | | |
|---|---|---|---|
| **Pin** | **Wire Color** | **Circuit No.** | **Function** |
| 30 | PPL | 420 | Brake Pedal Switch Output-Torque Converter Clutch |
| 85 | YEL | 1737 | Transmission Mounted Neutral Safety Switch Output-Park/Neutral |
| 86 | BLK | 250 | Ground |
| 87 | DK GRN / WHT | 1135 | Brake Transmission Shift Interlock Solenoid Feed |

### Brake Transmission Shift Interlock (BTSI) Solenoid




280768

| Connector Part Information | • 12052832<br>• 2 Way F Metri-Pack 150 Series (BLK) | | |
|---|---|---|---|
| **Pin** | **Wire Color** | **Circuit No.** | **Function** |
| A | DK GRN / WHT | 1135 | Brake Transmission Shift Interlock Solenoid Feed |
| B | BLK | 250 | Ground |

# Diagnostic Information and Procedures

### Lock System Does Not Unlock

| Cause | Action |
|---|---|
| The lock bolt is damaged. | Replace the lock bolt. |
| The lock cylinder is faulty. | Replace or repair the lock cylinder. |
| The housing is damaged. | Replace the housing. |
| The sector is damaged or collapsed. | Replace the sector. |

### Lock System Does Not Lock

| Cause | Action |
|---|---|
| The lock bolt spring is broken. | Replace the spring. |
| The sector tooth is damaged. | Replace the sector tooth. |
| The lock cylinder is faulty. | Replace the lock cylinder. |
| The housing is damaged. | Replace the housing. |
| The ignition switch is stuck. | Adjust or replace the ignition switch. |

### Lock System Sticks in Start

| Cause | Action |
|---|---|
| The lock cylinder exhibits a high effort condition. | Replace the lock cylinder. |

### Key Cannot Be Removed in the Off Lock Position

| Cause | Action |
|---|---|
| The lock cylinder is faulty. | Replace the lock cylinder. |

### Lock Cylinder Can Be Removed Without Depressing Retainer

| Cause | Action |
|---|---|
| The retainer is faulty. | Replace the lock cylinder. |
| A burr is over the retainer slot in the housing cover. | Remove the burr. |

### High Lock Effort Between the Off Lock Positions

| Cause | Action |
|---|---|
| A burr is on the tang of the shift gate. | Remove the burr. |
| Other problems excluding a burr on the tang of the shift gate | Replace the lock cylinder. |

### High Lock Effort

| Cause | Action |
|---|---|
| The lock cylinder is faulty. | Replace the lock cylinder. |
| The ignition switch is faulty. | Replace the ignition switch. |
| The sector shaft is bent. | Replace the shaft. |
| The ignition switch mounting bracket is bent. | Straighten or replace the bracket. |

## Noise in Steering Column

| Cause | Action |
|---|---|
| The flexible coupling is pulled apart. | 1. Align the column.<br>2. Replace the flexible coupling. |
| The column is not correctly aligned. | Align the column. |
| One click is audible in the Off-Unlock position and when the steering wheel is moved. | No action is necessary. The click indicates the normal seating of the lock bolt. |
| The horn contact ring is not lubricated. | Lubricate the horn contact ring. |
| A lack of grease on the bearings or the bearing surface | Lubricate the bearings. |
| The lower shaft bearing is tight or frozen. | 1. Replace the bearing.<br>2. Inspect the shaft.<br>3. Replace the shaft if scoring is present. |
| The upper shaft bearing is tight or frozen. | Replace the housing assembly. |
| The lock plate retaining ring is not seated. | 1. Replace the retaining ring.<br>2. Inspect for proper seating of the retaining ring in the groove. |
| The steering shaft snap ring is not seated. | 1. Replace the snap ring.<br>2. Inspect for proper seating of the snap ring in the groove. |
| The shroud or the housing is loose. | Tighten the mounting screws. |
| The steering shaft plastic joint is sheared. | 1. Repair or replace the steering shaft.<br>2. Align the column. |

## High Steering Shaft Effort

| Cause | Action |
|---|---|
| The column assembly is misaligned in the vehicle. | Correctly align the column assembly. |
| The upper or the lower bearings are tight/frozen. | Replace the bearings. |
| The intermediate shaft joints are binding. | Repair or replace the intermediate shaft. |

## Looseness in Steering Column

| Cause | Action |
|---|---|
| The column mounting bracket bolts are loose. | Tighten the bolts to specifications. Refer to *Fastener Tightening Specifications*. |
| The weld nuts on the jacket are broken. | Replace the jacket assembly. |
| The column bracket capsule is sheared. | Replace the bracket assembly. |
| The support screws are loose. | Tighten the support screws to specifications. Refer to *Fastener Tightening Specifications*. |

## Dimmer Switch Does Not Function

| Cause | Action |
|---|---|
| There is a loose connector at the dimmer switch. | Tighten or replace the connector. |
| The switch is internally damaged or worn. | Replace the switch. |

### Turn Signal Does Not Indicate Lane Change

| Cause | Action |
|---|---|
| The lane change pressure pad or the spring hanger is broken. | Replace the switch. |
| The lane change spring is broken, missing or misplaced. | Replace or reposition the spring as required. |
| The wires or the base is jammed. | 1. Loosen the mounting screws.<br>2. Reposition the base or the wires.<br>3. Tighten the screws. |

### Turn Signal Does Not Stay in Turn Position

| Cause | Action |
|---|---|
| Foreign material or loose parts are impeding the movement of the yoke. | Remove the obstruction. |
| The detent or the cancelling springs are broken or missing. | Replace the spring. |
| All other causes, excluding the above. | Replace the switch. |

### Turn Signal Does Not Cancel

| Cause | Action |
|---|---|
| The switch mounting screws are loose. | Tighten the screws. |
| The switch or the anchor bosses are broken. | Replace the switch. |

### Turn Signal Difficult to Operate

| Cause | Action |
|---|---|
| The switch actuator arm is loose. | Tighten the screw. |
| The yoke is broken or distorted. | Replace the switch. |
| The springs are loose or misplaced. | Reposition or replace the springs. |
| Foreign parts and/or materials | Remove the foreign parts and/or materials. |
| The switch is mounted loosely. | Tighten the screws. |

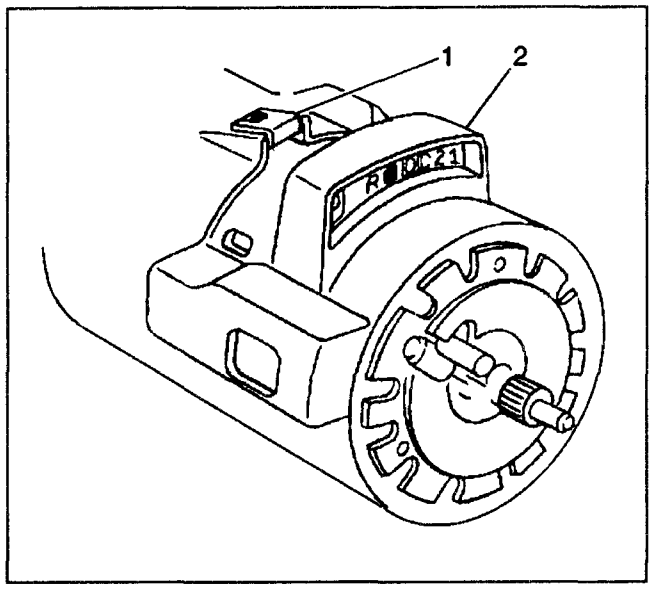
### Hazard Switch Does Not Stay On

| Cause | Action |
|---|---|
| The switch mounting screws are loose. | Tighten the mounting screws. |
| There is interference with other components. | Remove the interference. |
| There is foreign material. | Remove the foreign material |
| Any other cause, excluding the above | Replace the switch. |

# Repair Instructions

## Shift Indicator Adjustment

1. Position the shift lever in the neutral (N) notch.
2. Move the pointer clip (1) on the edge of the shift bowl in order to centrally position the pointer on N.
3. Push the clip onto the bowl.
4. Ensure that the clip is tight on the bowl and does not slip.
5. Move the shift lever though all of the positions and then back to N. This will verify proper adjustment of the shift indicator.
6. Ensure that the pointer covers a portion of each graphic.

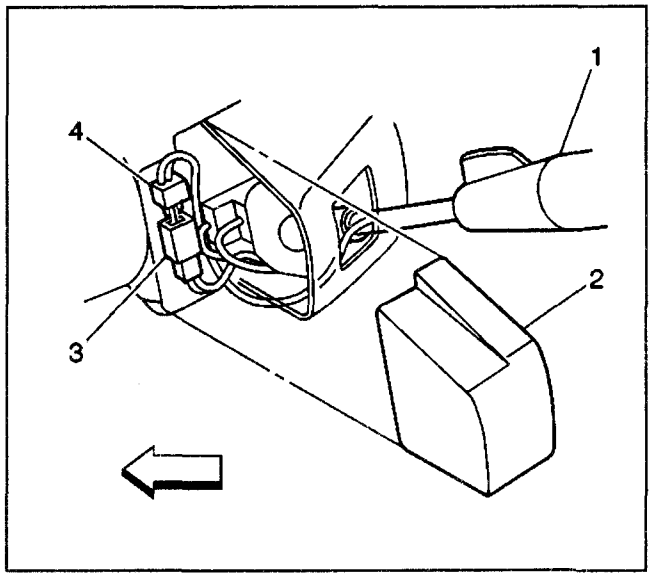



309266

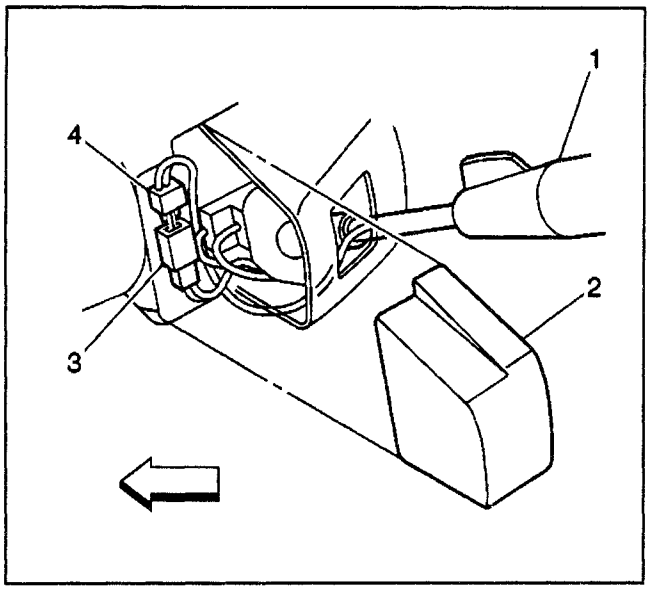
## Multifunction Turn Signal Lever Replacement - On Vehicle

### Removal Procedure

1. Ensure that the lever (1) is in the OFF position.
2. Unsnap the housing cover (2) from the steering column housing.
3. Disconnect the cruise control wiring connector (4) from the connector that is installed in the column (3).
4. Pull the lever straight out of the turn signal switch.



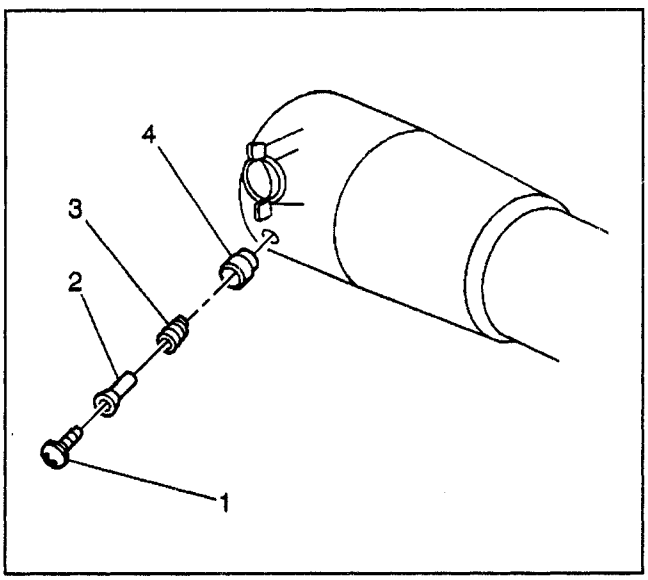

215632




215632

### Installation Procedure

1. Ensure that the lever is in the OFF position.
2. Push the lever (1) into the turn signal switch.
3. Connect the cruise control wiring connectors (3,4).
4. Snap the housing cover cap (2) off of the steering column housing.

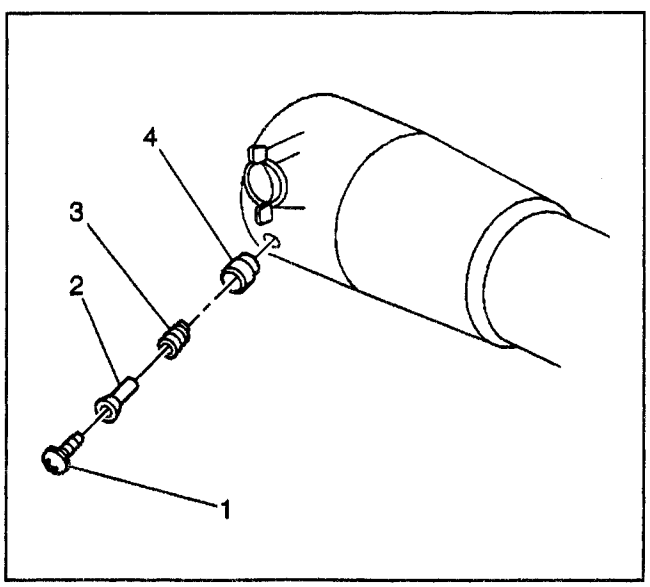



215645

## Hazard Warning Switch Replacement - On Vehicle

### Removal Procedure

1. Remove the screw (1).
2. Remove the button (2).
3. Remove the spring (3).
4. Remove the knob (4).




215645

### Installation Procedure

1. Install the knob (4).
2. Install the spring (3).
3. Install the button (2).

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

4. Install the screw (1).

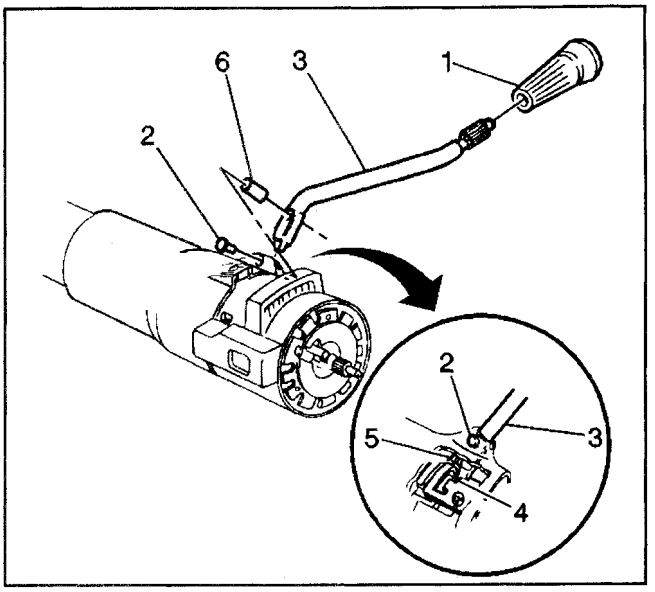
   **Tighten**

   Tighten the screw to 0.7 N·m (6 lb in).

## Shift Lever Replacement - On Vehicle

### Removal Procedure

1. Remove the pivot pin (2) from the bowl assembly.
2. Remove the shift lever (3) from the bowl assembly.
   Ensure that you do not lose the spring (5) or the insulator (6).
3. Remove the insulator (6) from the shift lever (3).
4. Remove the spring (5).

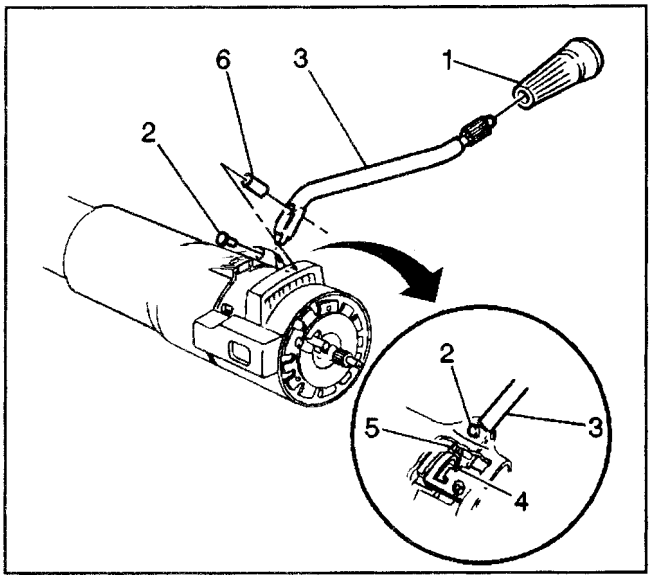


309268

### Installation Procedure

Use a shim as a guide if you experience problems while installing the shift lever over the spring.

1. Install the spring (5).
2. Install the shim over the top of the spring.
3. Install the insulator (6).
4. Install the shift lever (3).
5. Install the pivot pin (2).
6. Remove the shim.
7. Ensure that the shift lever positively engages the shift gate in all positions.



309268

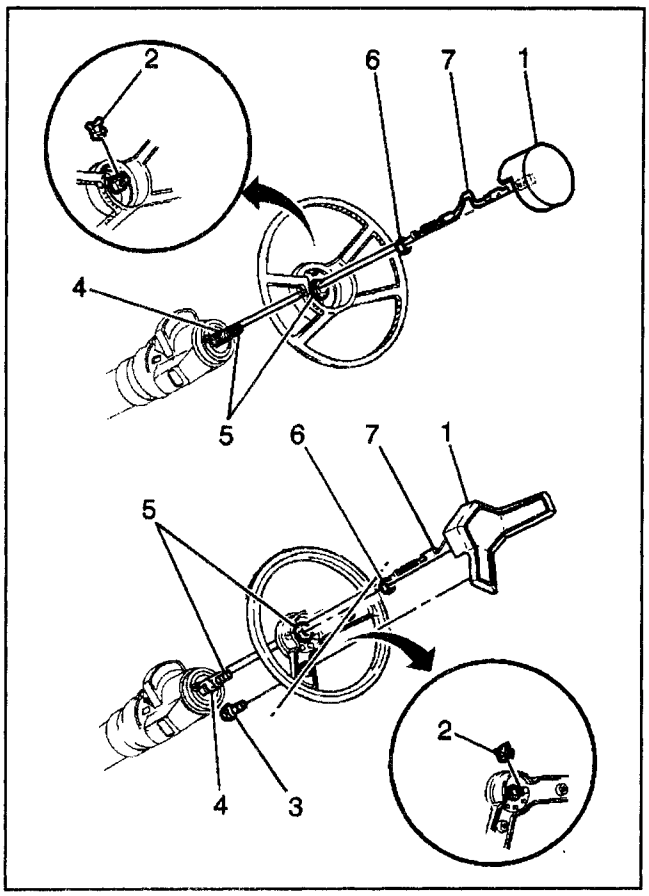
## Tilt Lever Replacement - On Vehicle

### Removal Procedure

Twist the lever counter clockwise in order to remove the lever.

### Installation Procedure

Twist the lever clockwise in order to install the lever.



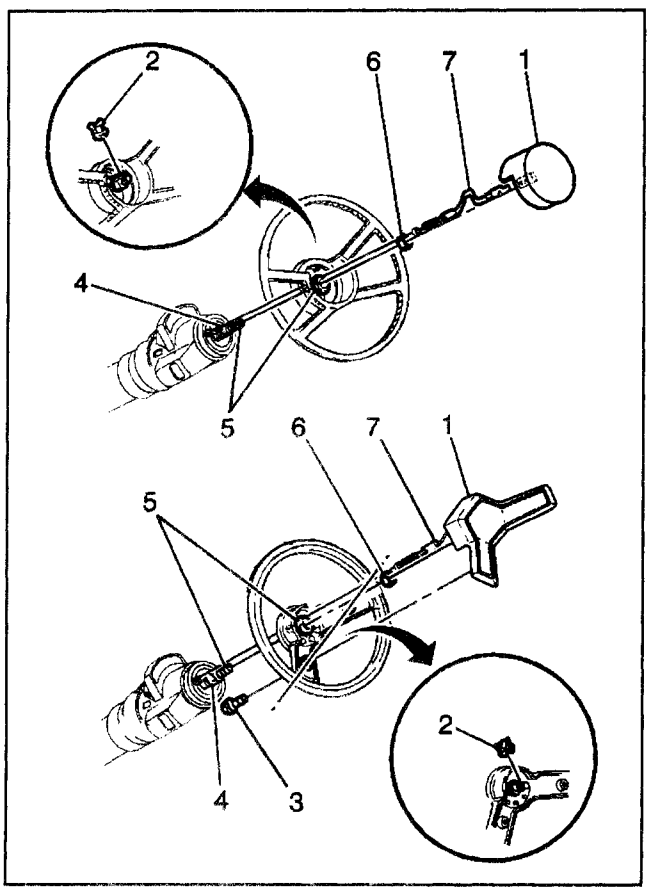

309271

## Horn Switch Replacement - On Vehicle

### Removal Procedure

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices.***

1. Disconnect the negative battery cable.
2. Remove the screw (3) (commercial model).
3. Remove the horn pad assembly (1).
4. Remove the horn wire assembly (7).




309271

### Installation Procedure

1. Install the horn wire assembly (7).
2. Install the horn pad assembly (1).
3. Install the screw (3) (commercial model).
4. Connect the negative battery cable.

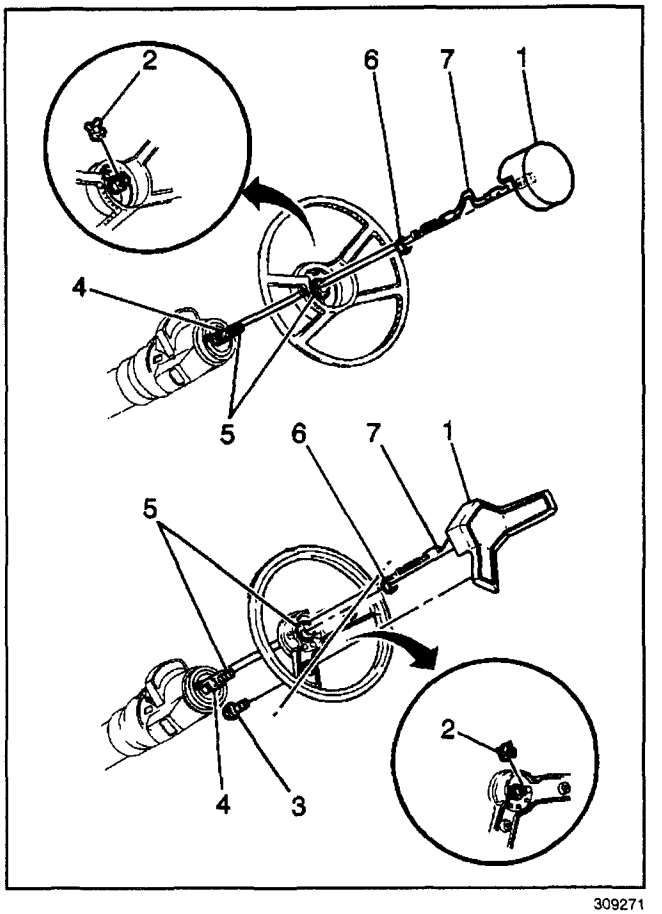
## Steering Wheel Replacement

### Removal Procedure

#### Tools Required

*J 1859-A* Steering Wheel Puller

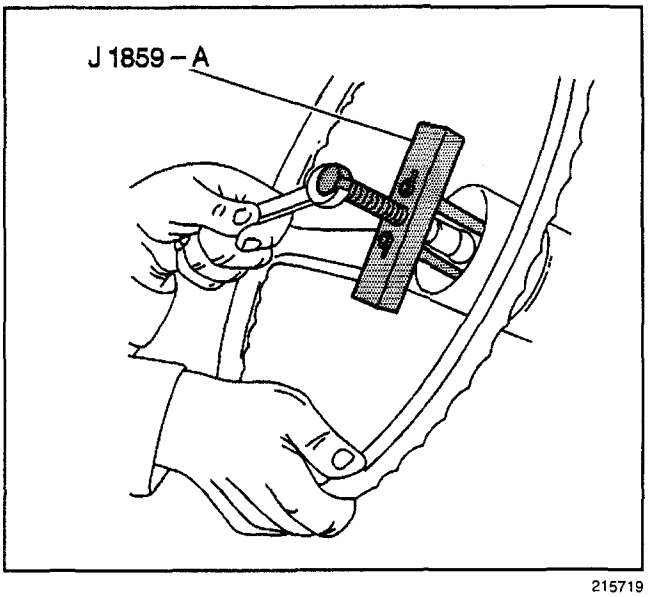
1. Remove the horn pad assembly including the horn wire (7). Refer to *Horn Switch Replacement - On Vehicle.*
2. Remove the retainer (2).
3. Observe the alignment mark which shows the relationship of the steering wheel to the steering shaft.
4. Remove the steering wheel nut (6).




309271

***Notice:*** When removing the steering wheel, use only the specified steering wheel puller. Do not hammer on the end of the steering column shaft. Hammering could loosen the plastic injections which maintain the steering column rigidity.

5. Use the *J 1859-A* in order to remove the steering wheel.

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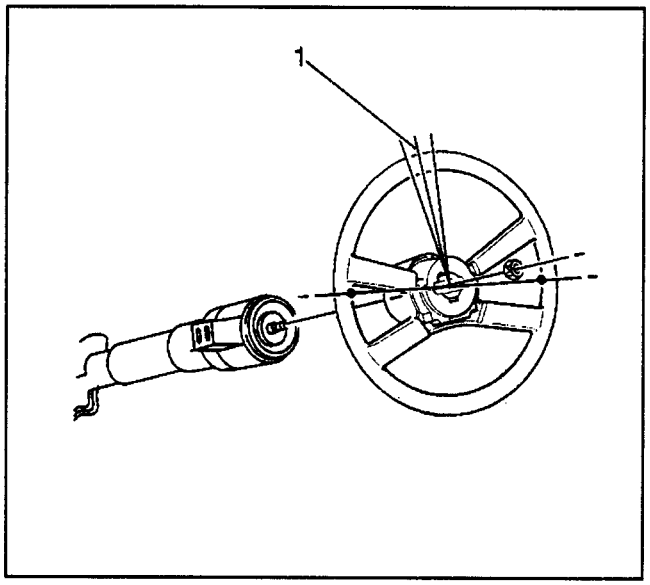


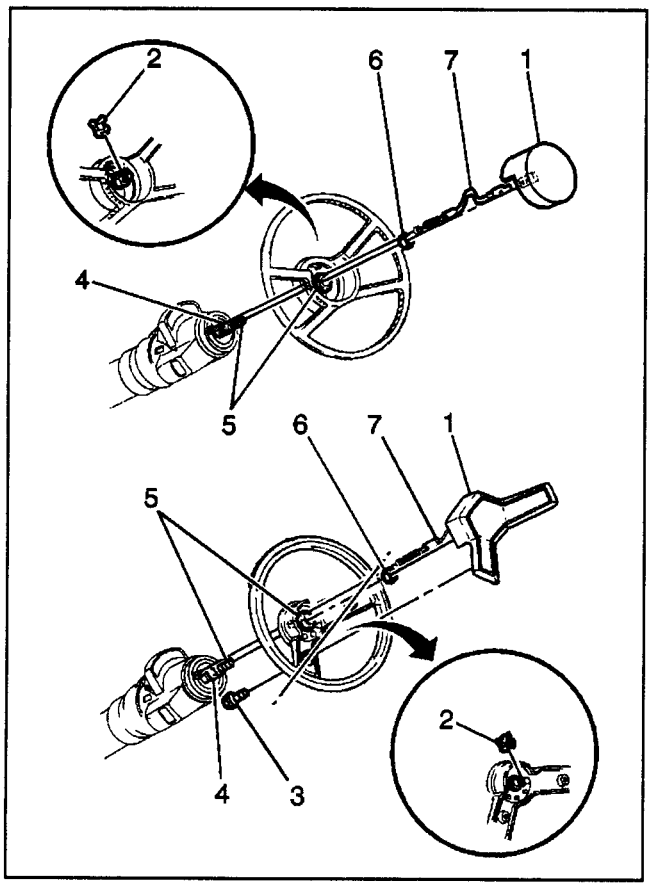

309274

## Installation Procedure

1. Ensure that the turn signal control assembly is in the neutral position when assembling the steering wheel.

**Important:** Do not misalign the steering wheel more than 25.4 mm (1 in) from the horizontal centerline (1).

2. Align the marks on the steering shaft and the steering wheel.
3. Install the steering wheel onto the steering shaft.




309271

4. Install the horn lead assembly (7).

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

5. Install the steering wheel nut (6).

   **Tighten**

   Tighten the steering wheel nut (6) to 41 N·m (30 lb ft).

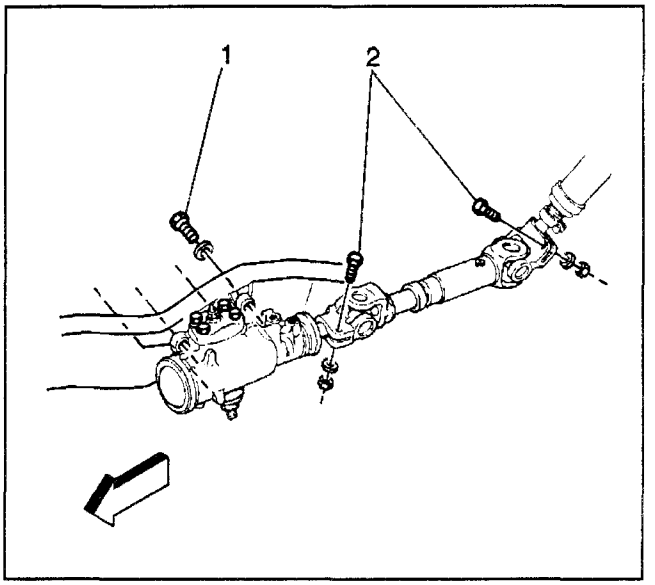
6. Install the retainer (2).
7. Install the horn pad assembly. Refer to *Horn Switch Replacement - On Vehicle.*

## Lower/Upper Intermediate Strg Shaft Replacement (Commercial)

### Removal Procedure

1. Set the front wheels in the straight-ahead position.
2. Set the steering wheel in the locked position.
3. Mark the relationship of the following components in order to ensure proper installation:
   - The steering gear coupling shaft to the steering shaft
   - The cardan joint yoke to the steering gear input shaft
4. Remove the upper and the lower pinch bolts (2) and nuts at the cardan joint yoke.
5. Remove the steering gear coupling shaft assembly by compressing the shaft up (toward the steering column) in order to clear the cardan joint yoke from the steering gear input shaft.
6. Slide the shaft down off of the upper steering shaft.

   You may have to tap on the yoke with a small hammer in order to free the yoke from the shaft.



309279

### Installation Procedure

1. Align the marks on the steering gear coupling and the steering shaft.
2. Install the upper end of the steering gear coupling shaft onto the upper steering shaft.
3. Install the lower end of the steering gear coupling shaft onto the steering gear input shaft.

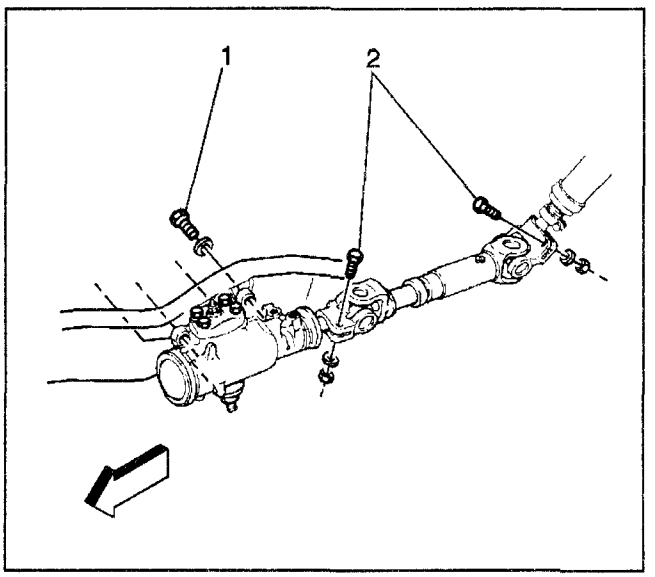
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

4. Install the upper and the lower pinch bolts (2) and nuts at the cardan joint yokes.

   Ensure that the pinch bolts pass through the shaft undercut.

   **Tighten**

   Tighten the pinch bolts to 102.5 N·m (76 lb ft).



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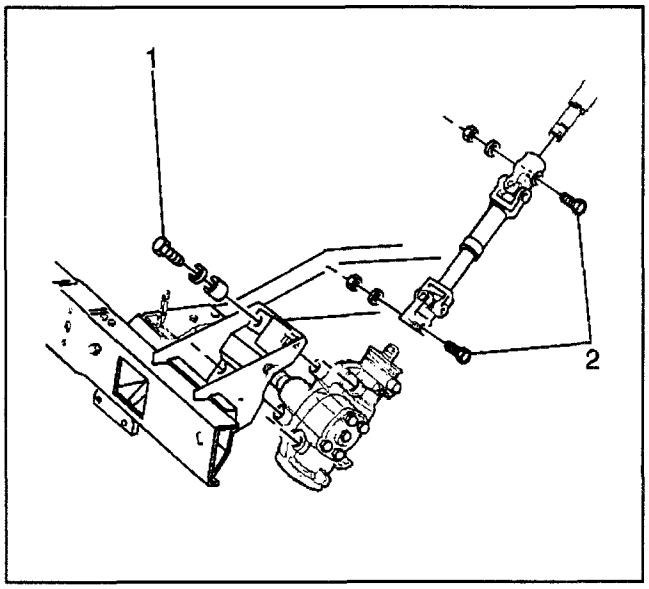


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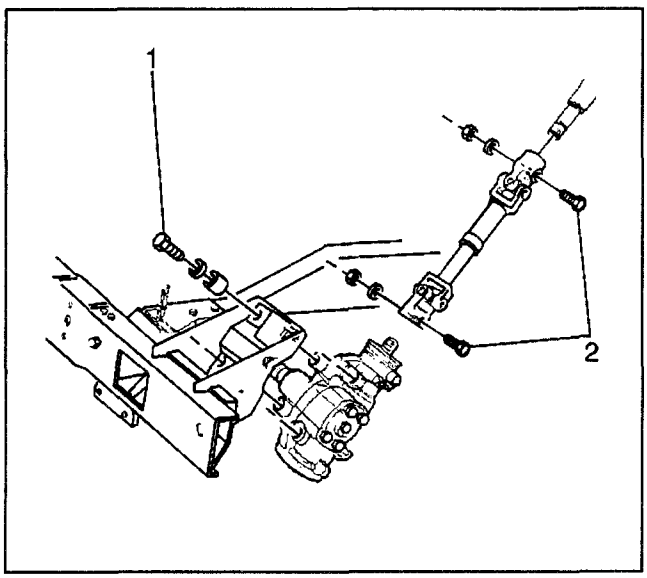



309277

## Lower/Upper Intermediate Strg Shaft Replacement (Commercial I-Beam Front Axle)

### Removal Procedure

1. Set the front wheels in the straight-ahead position.
2. Set the steering wheel in the locked position.
3. Mark the relationship of the following components in order to ensure proper installation:
   - The steering gear coupling shaft to the steering shaft
   - The cardan joint yoke to the steering gear input shaft
4. Remove the upper and the lower pinch bolts (2) and nuts at the cardan joint yoke.
5. Remove the steering gear coupling shaft assembly by compressing the shaft up (toward the steering column) in order to clear the cardan joint yoke from the steering gear input shaft.
6. Slide the shaft down off the upper steering shaft.

   You may have to tap on the yoke with a small hammer in order to free the yoke from the shaft.

### Installation Procedure

1. Align the marks on the steering gear coupling and the steering shaft.
2. Install the upper end of the steering gear coupling shaft onto the upper steering shaft.
3. Install the lower end of the steering gear coupling shaft onto the steering gear input shaft.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

4. Install the upper and the lower pinch bolts (2) and nuts at the cardan joint yokes.

   Ensure that the pinch bolts pass through the shaft undercut.

   **Tighten**

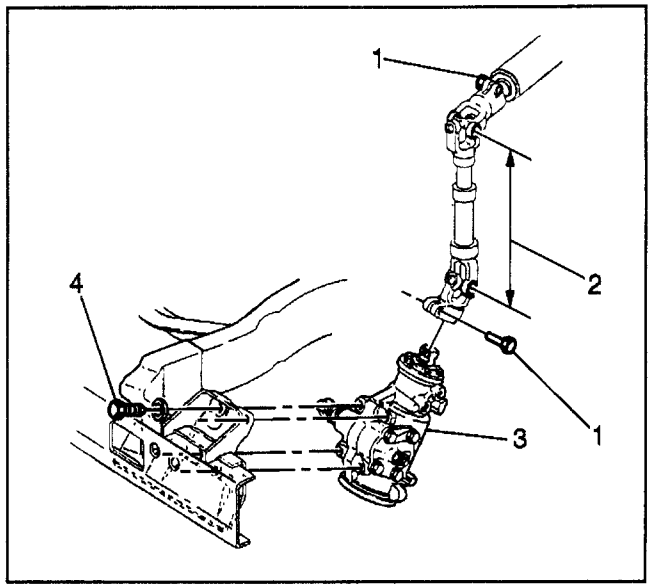
   Tighten the pinch bolts to 102.5 N·m (76 lb ft).

## Lower/Upper Intermediate Strg Shaft Replacement (Motorhome)

### Removal Procedure

1. Set the front wheels in the straight-ahead position.
2. Set the steering wheel in the locked position.
3. Mark the relationship of the following components in order to ensure proper installation:
   - The steering gear coupling shaft to the steering shaft
   - The cardan joint yoke to the steering gear input shaft
4. Remove the upper and the lower pinch bolts (1) at the cardan joint yoke.
5. Remove the steering gear coupling shaft assembly by compressing the shaft up (toward the steering column) in order to clear the cardan joint yoke from the steering gear input shaft.
6. Slide the shaft down off the upper steering shaft.

   You may have to tap on the yoke with a small hammer in order to free the yoke from the shaft.



309275

### Installation Procedure

1. Align the marks on the steering gear coupling and the steering shaft.
2. Install the upper end of the steering gear coupling shaft onto the upper steering shaft. Distance (2) should be 203 millimeters (8.0 inches).
3. Install the lower end of the steering gear coupling shaft onto the steering gear (3) input shaft.

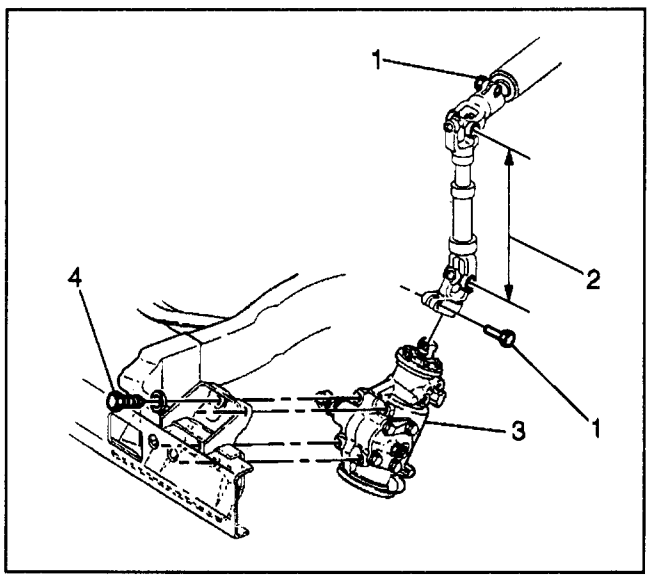
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

4. Install the upper and the lower pinch bolts (1) at the cardan joint yokes.

   Ensure that the pinch bolts pass through the shaft undercut.

   **Tighten**

   Tighten the pinch bolts to 45 N·m (33 lb ft).



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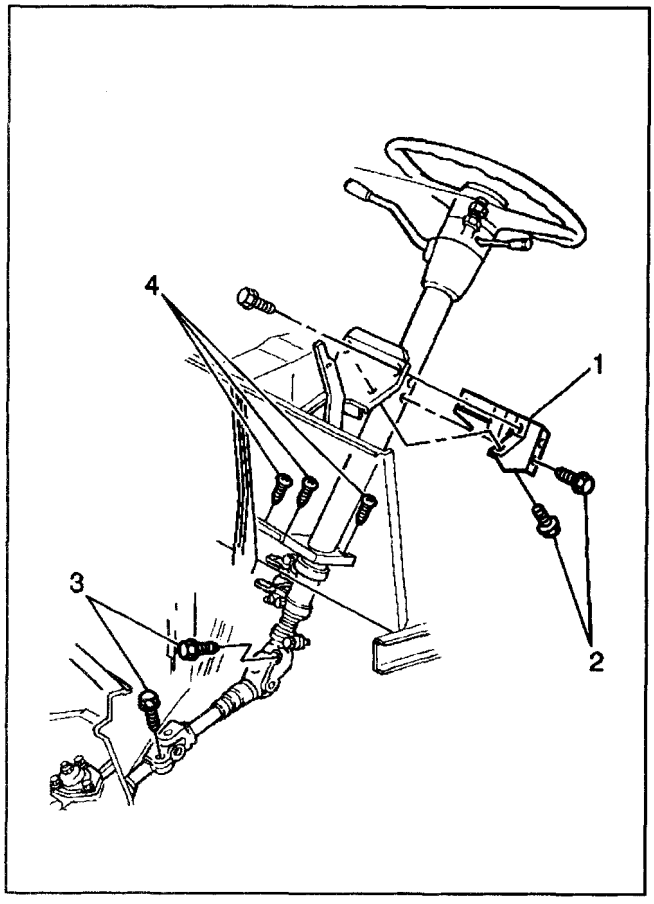



309280

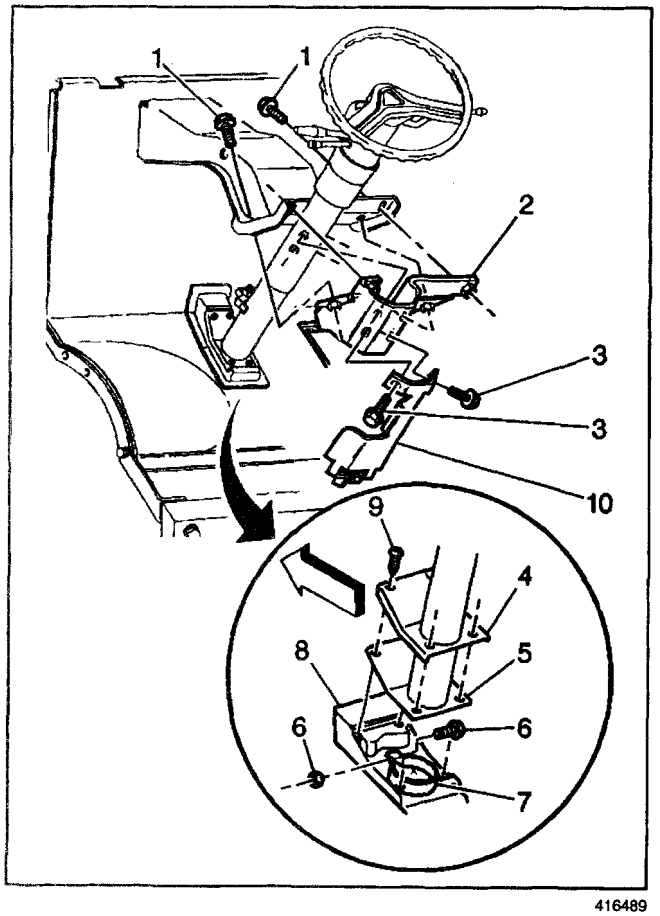
## Steering Column Replacement (Commercial)

### Removal Procedure

1. Set the front wheels in the straight-ahead position.
2. Set the steering wheel in the locked position.

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices.***

3. Disconnect the negative battery cable.
4. Remove the steering wheel, if required. Refer to *Steering Wheel Replacement.*
5. Disconnect the transmission control linkage from the column. Refer to *Shift Cable Replacement* in Automatic Transmission.
6. Mark the relationship of the upper cardan joint yoke to the steering shaft.
7. Remove the upper cardan joint pinch bolt nut from the steering gear coupling shaft.
8. Remove the upper pinch bolt (3) and washer.




416489

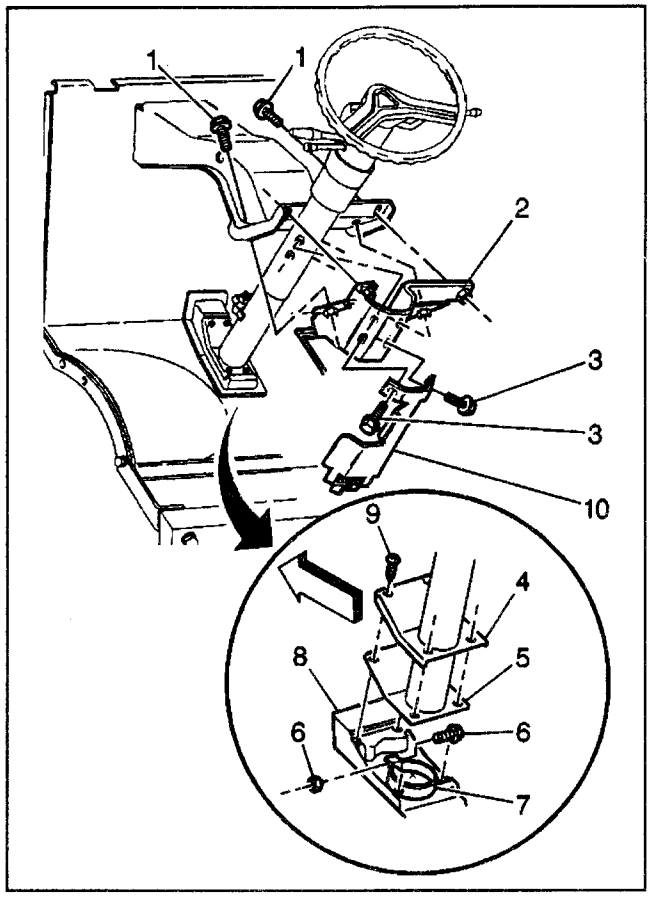
9. Remove the outer steering column support bracket bolts (3).
10. Remove the outer support bracket and the inner steering column support bracket bolts (1) and remove the inner bracket (2).
11. Remove the screws (9) from the cover (4) and the seal (5).
12. Remove the nut (6) from the steering column retainer.
13. Disconnect the steering column harness at the connectors.

***Notice:*** Once the steering column is removed from the vehicle, the column is extremely susceptible to damage. Dropping the column assembly on its end could collapse the steering shaft or loosen the plastic injections that maintain column rigidity. Leaning on the column assembly could cause the jacket to bend or deform. Any of the above damage could impair the columns collapsible design. If it is necessary to remove the steering wheel, refer to Steering Wheel in this section. Under no condition should the end of the shaft be hammered on, as hammering could loosen the plastic injections which maintain column rigidity.

14. Remove the steering column assembly. Rotate the column so that the shift lever clears the floor opening.

## Installation Procedure

1. Lower the end of the steering column through the floor opening passing through the loosely positioned floor panel cover (4), the seal (5), and the retainer (7).

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2. Guide the steering shaft into the cardan joint yoke by lining up the marks made during removal.
3. Loosely install the inner support bracket (1) with the bolts, and the outer bracket with the bolts.
4. Tighten the bolts finger tight.

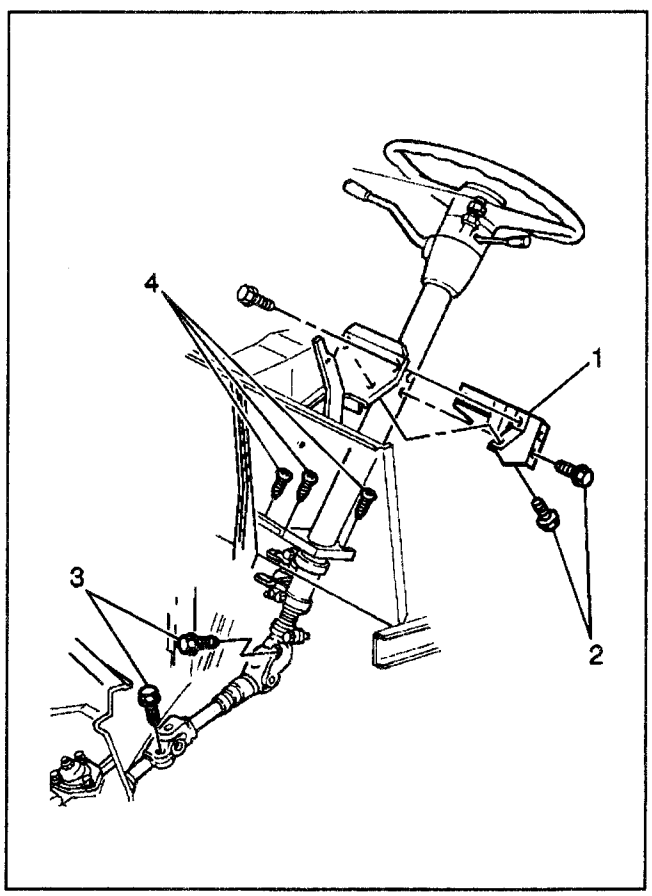
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

5. Install the upper cardan joint pinch bolt (3) and washer.

   Ensure that the pinch bolt passes through the shaft undercut.

   **Tighten**

   Tighten the pinch bolt nut to 102.5 N·m (76 lb ft).

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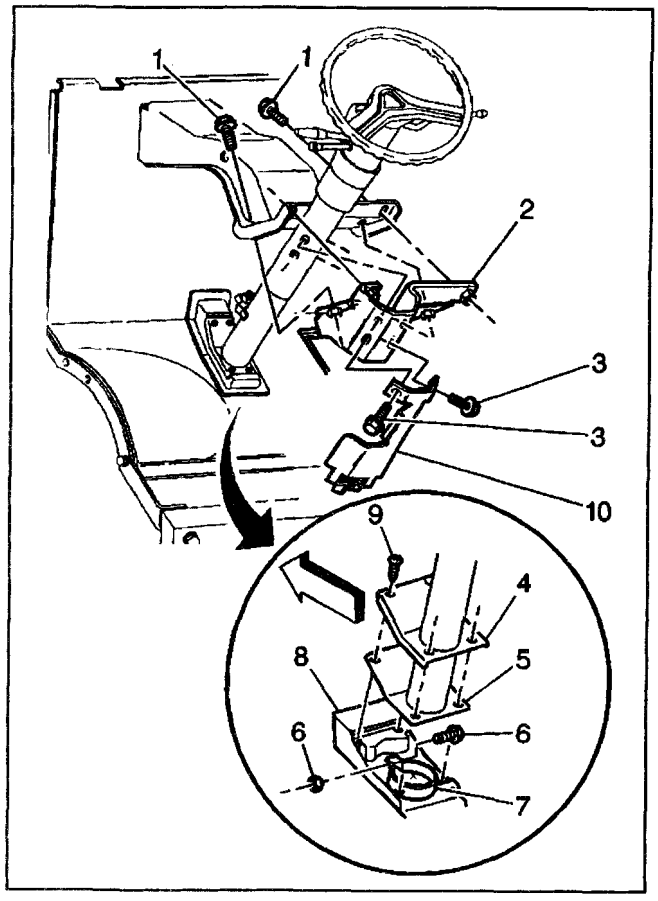

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6. Tighten the steering column inner support bracket (2) bolts.

   **Tighten**

   Tighten the bolts (1) to 25 N·m (18 lb ft).
7. Tighten the steering column outer support bracket (10) bolts.

   **Tighten**

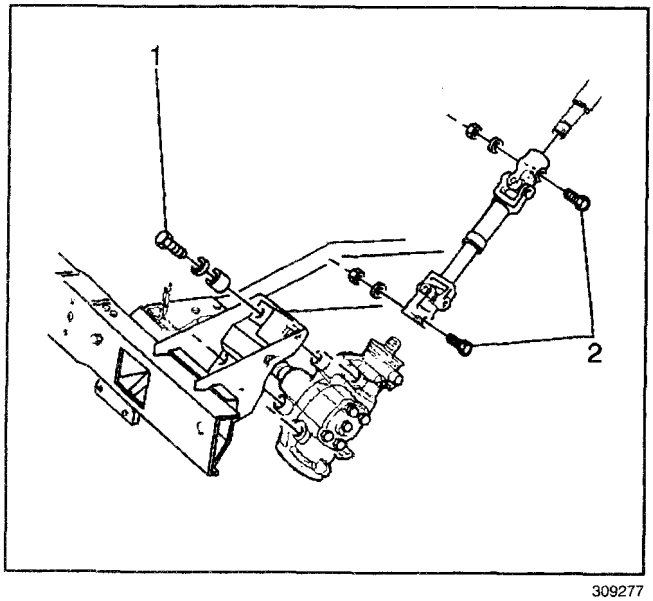
   Tighten the bolts (3) to 30 N·m (22 lb ft).
8. Secure the steering column with the retainer (7) and bolt (6).

   **Tighten**

   Tighten the nut (6) to 15 N·m (11 lb ft).
9. Install the screws (9) through the cover (4) and the seal (5) to the floor panel.

   **Tighten**

   Tighten the screws (9) to 2.8 N·m (25 lb in).
10. Connect the steering column harness.
11. Connect the transmission control linkage. Refer to *Shift Cable Replacement* and *Shift Cable Adjustment* in Automatic Transmission.
12. Install the steering wheel. Refer to *Steering Wheel Replacement.*
13. Connect the negative battery cable.



309277

## Steering Column Replacement (Commercial I-Beam Front Axle)

### Removal Procedure

1. Set the front wheels in the straight-ahead position.
2. Set the steering wheel in the locked position.

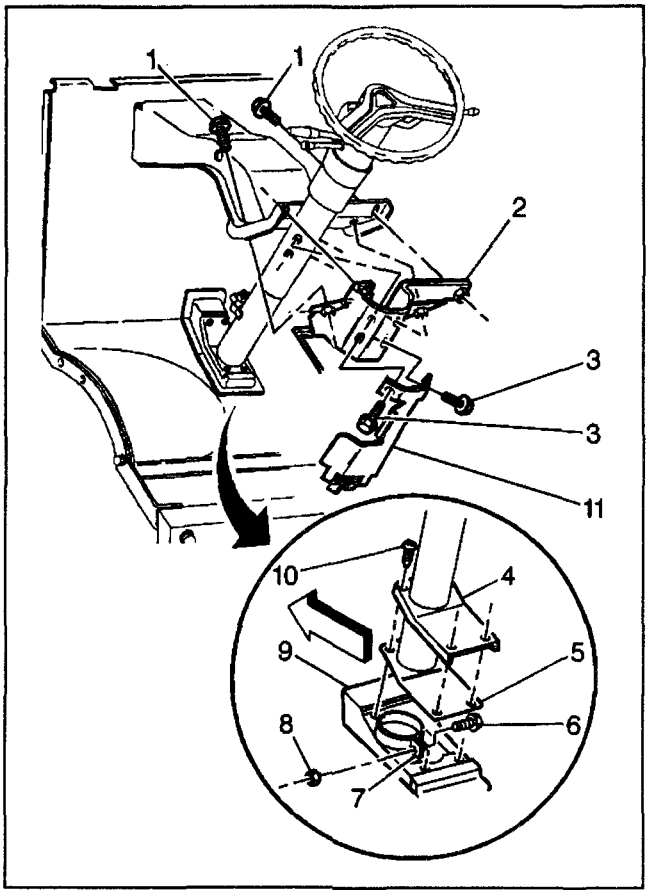
***Caution: Refer to Battery Disconnect Caution in Cautions and Notices.***

3. Disconnect the negative battery cable.
4. Remove the steering wheel, if required. Refer to *Steering Wheel Replacement.*
5. Disconnect the transmission control linkage from the column. Refer to *Shift Cable Replacement* in Automatic Transmission.
6. Mark the relationship of the upper cardan joint yoke to the steering shaft.
7. Remove the upper cardan joint pinch bolt nut from the steering gear coupling shaft.
8. Remove the upper bolt (2).

9. Remove the bolts (3) of the steering column bracket (11) and the bolts (1) of the inner steering column support bracket (2).
10. Remove the screws (10) from the cover (4) and the seal (5).
11. Remove column retainer nut (8).
12. Disconnect the steering column harness at the connectors.

***Notice:*** Once the steering column is removed from the vehicle, the column is extremely susceptible to damage. Dropping the column assembly on its end could collapse the steering shaft or loosen the plastic injections that maintain column rigidity. Leaning on the column assembly could cause the jacket to bend or deform. Any of the above damage could impair the columns collapsible design. If it is necessary to remove the steering wheel, refer to Steering Wheel in this section. Under no condition should the end of the shaft be hammered on, as hammering could loosen the plastic injections which maintain column rigidity.

13. Remove the steering column assembly. Rotate the column so that the shift lever clears the floor opening.



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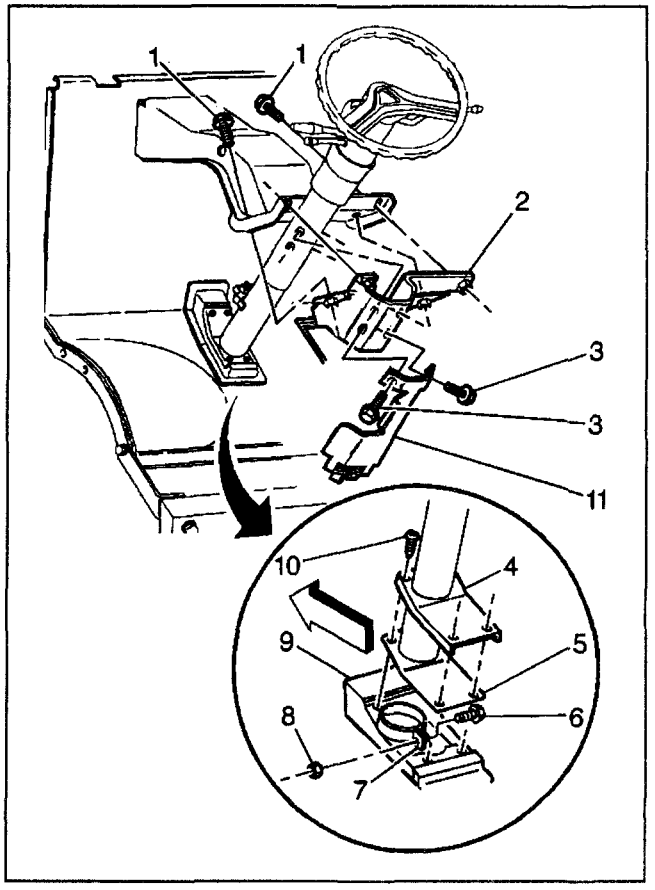
## Installation Procedure

1. Lower the end of the steering column through the floor opening passing through the loosely positioned floor panel cover (4), the seal (5), and the retainer (7).



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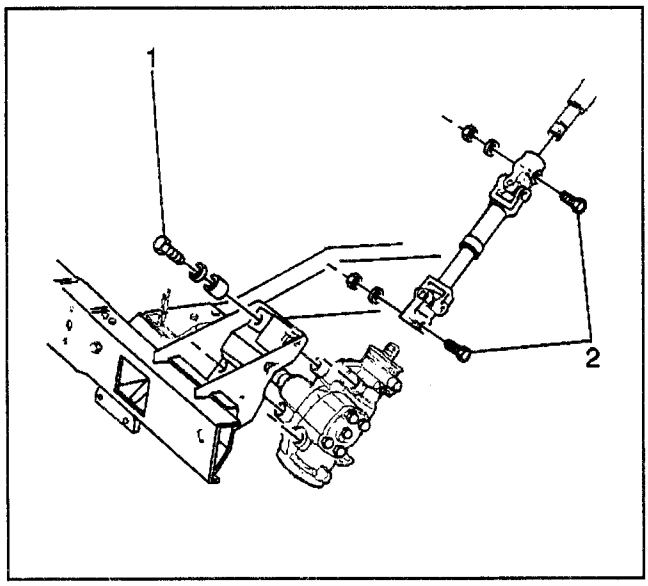


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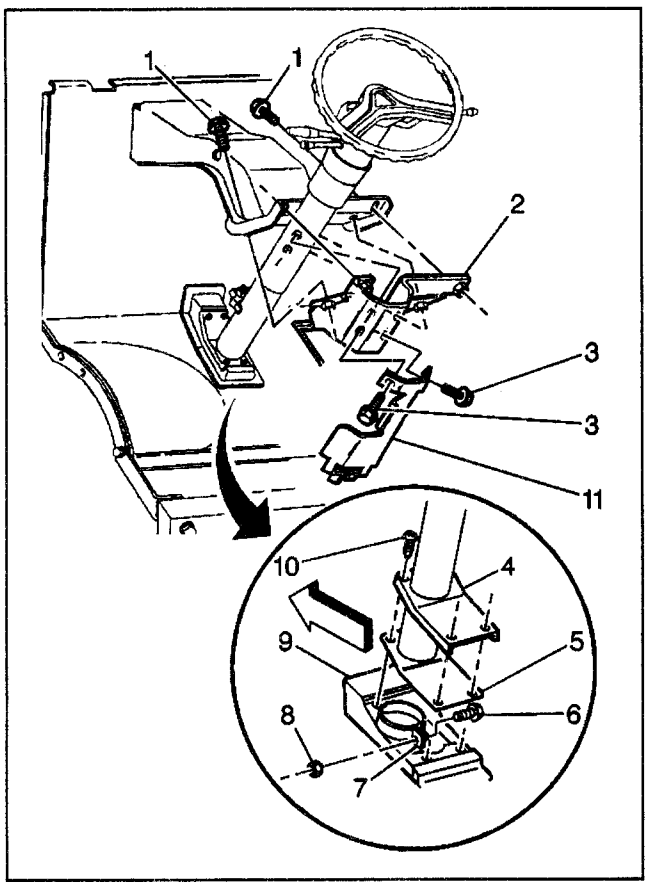
2. Guide the steering shaft into the cardan joint yoke by lining up with the marks made during removal.

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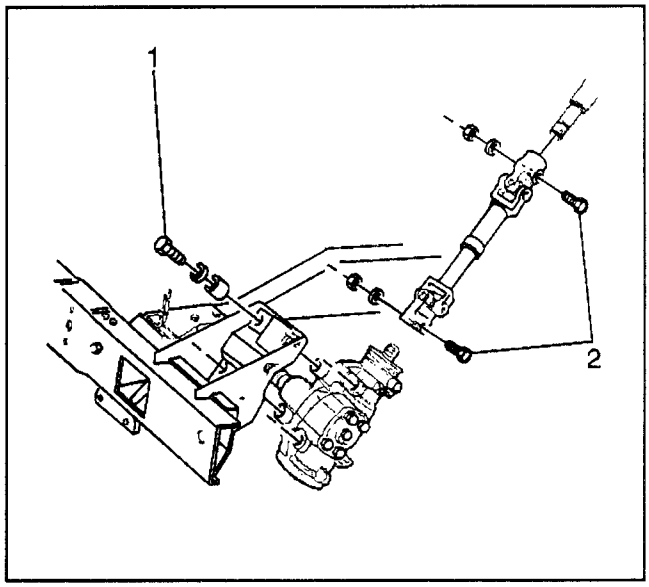
3. Loosely install the steering column inner support bracket (2) with bolts (1) and outer bracket (11) with bolts (3).
   Tighten the bolts finger tight.

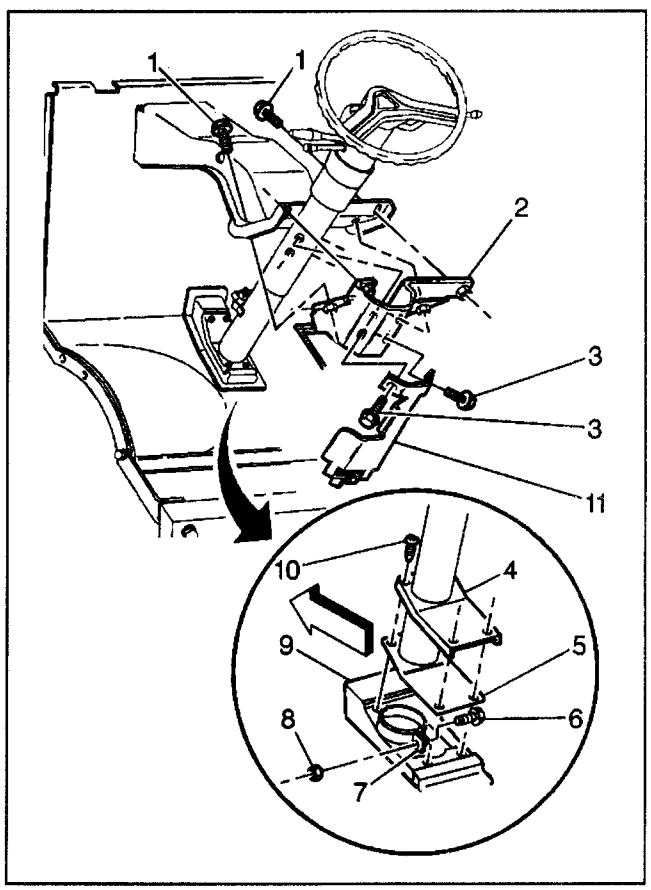
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

4. Install the upper cardan joint pinch bolt (2).
   Ensure that the pinch bolt passes through the shaft undercut.
   **Tighten**
   Tighten the pinch bolt nut to 102.5 N·m (76 lb ft).



309277

5. Install the steering column support bracket assembly (2) to the brake pedal bracket assembly with the bolts (1)
   **Tighten**
   Tighten the bolts to 25 N·m (18 lb ft).
6. Tighten the steering column outer support bracket bolts (3).
   **Tighten**
   Tighten the bolts to 30 N·m (22 lb ft).
7. Secure the steering column retainer (7) with nut (8) and bolt (6).
   **Tighten**
   Tighten the nut to 15 N·m (11 lb ft).
8. Secure the screws (10) through the cover (4) and the seal (5) to the dash panel.
   **Tighten**
   Tighten the cover screws to 2.8 N·m (25 lb in).
9. Connect the steering column harness.
10. Connect the transmission control linkage to the steering column. Refer to *Shift Cable Replacement* and *Shift Cable Adjustment* in Automatic Transmission.
11. Install the steering wheel if removed. Refer to *Steering Wheel Replacement.*
12. Connect the negative battery cable.



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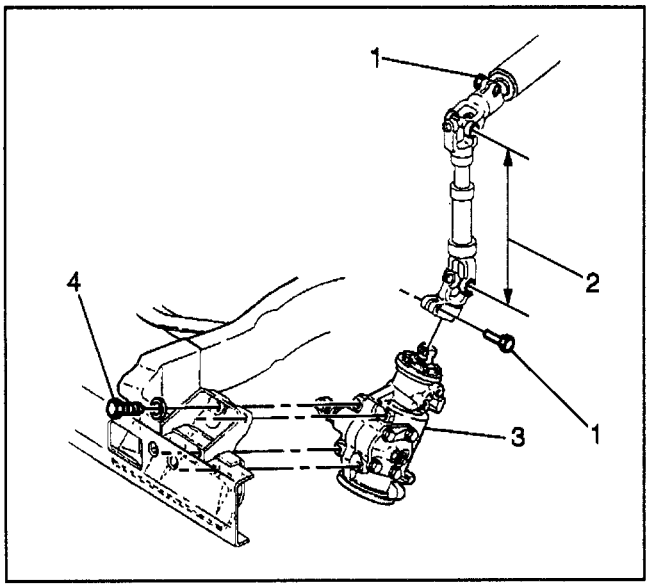


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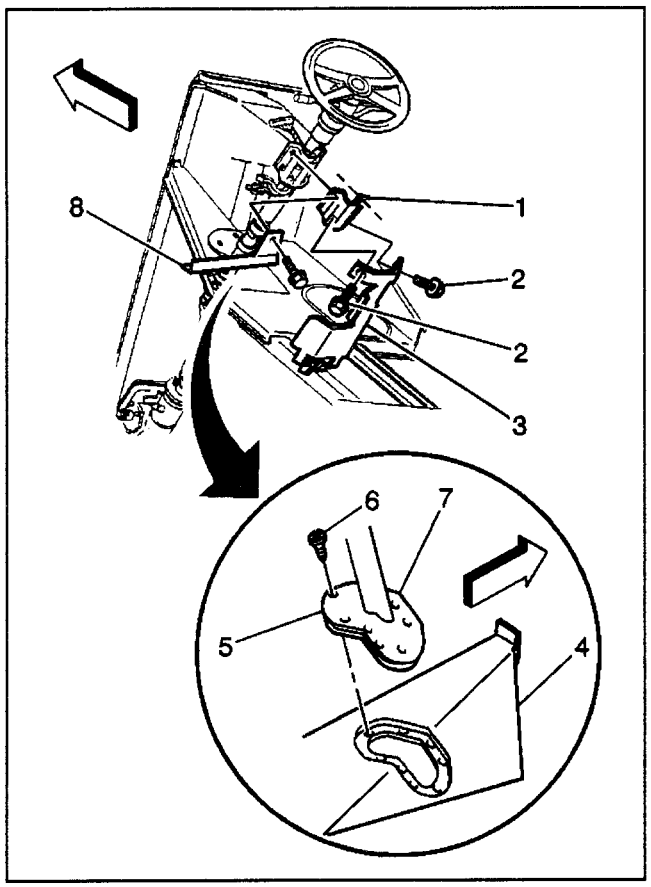



416687

## Steering Column Replacement (Motorhome)

### Removal Procedure

1. Set the front wheels in the straight-ahead position.
2. Set the steering wheel in the locked position.

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices.***

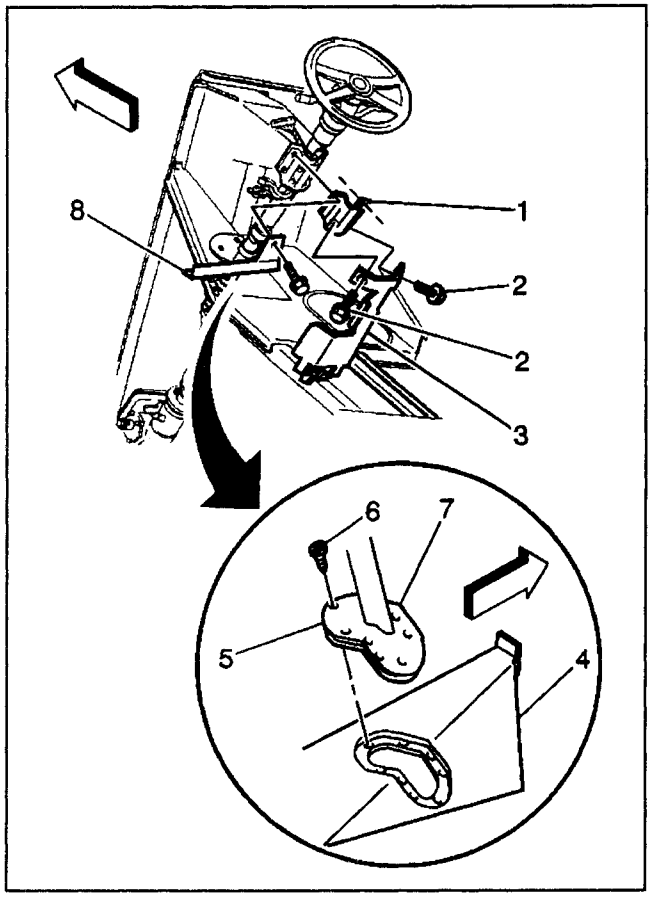
3. Disconnect the negative battery cable.
4. Remove the steering wheel, if required. Refer to *Steering Wheel Replacement.*
5. Disconnect the transmission control linkage from the column. Refer to *Shift Cable Replacement* in Automatic Transmission.
6. Mark the relationship of the upper cardan joint yoke to the steering shaft.
7. Remove the upper cardan joint pinch bolt nut from the steering gear coupling shaft and remove the pinch bolt (1).
8. Remove the steering column support bracket bolts (2) and remove the bracket (3).
9. Remove the bolts securing the steering column support bracket (1) including the bolt that secures the parking brake lever brace (8) to the steering column.
10. Swing the parking brake lever assembly brace (if so equipped) away from the steering column. Loosen the left bolt if necessary.
11. Remove the screws (6) from the cover (7) and the seal (5) attached to the floor panel (4).
12. Disconnect the steering column harness at the connectors.

***Notice:*** Once the steering column is removed from the vehicle, the column is extremely susceptible to damage. Dropping the column assembly on its end could collapse the steering shaft or loosen the plastic injections that maintain column rigidity. Leaning on the column assembly could cause the jacket to bend or deform. Any of the above damage could impair the columns collapsible design. If it is necessary to remove the steering wheel, refer to Steering Wheel in this section. Under no condition should the end of the shaft be hammered on, as hammering could loosen the plastic injections which maintain column rigidity.

13. Remove the steering column assembly. Rotate the column so that the shift lever clears the floor opening.

### Installation Procedure

1. Lower the end of the steering column through the floor opening and through the loosely positioned seal (5) and cover (7).
2. Guide the steering shaft into the cardan joint yoke by lining up the marks made during removal.
3. Loosely secure the steering column support bracket (1) with the parking brake lever brace (8), if so equipped, and the outer bracket (3) with the bolts (2).
   Tighten the bolts finger tight.



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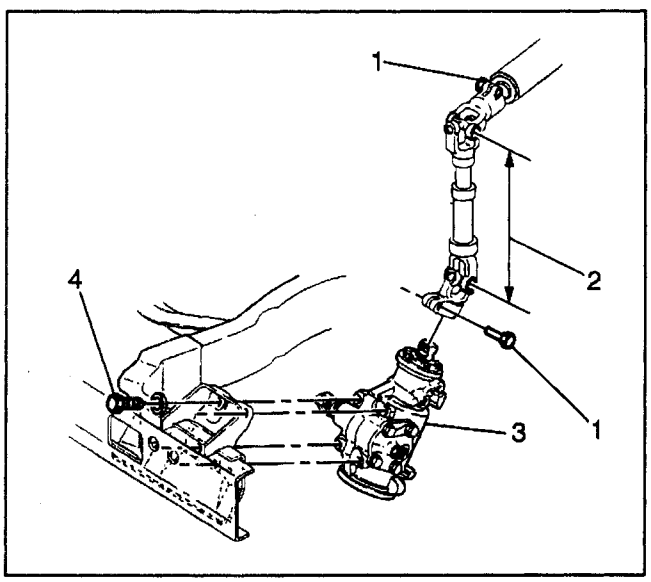
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

4. Install the upper cardan joint pinch bolt.
   Ensure that the pinch bolt passes through the shaft undercut.
   **Tighten**
   Tighten the pinch bolt nut to 45 N·m (33 lb ft).



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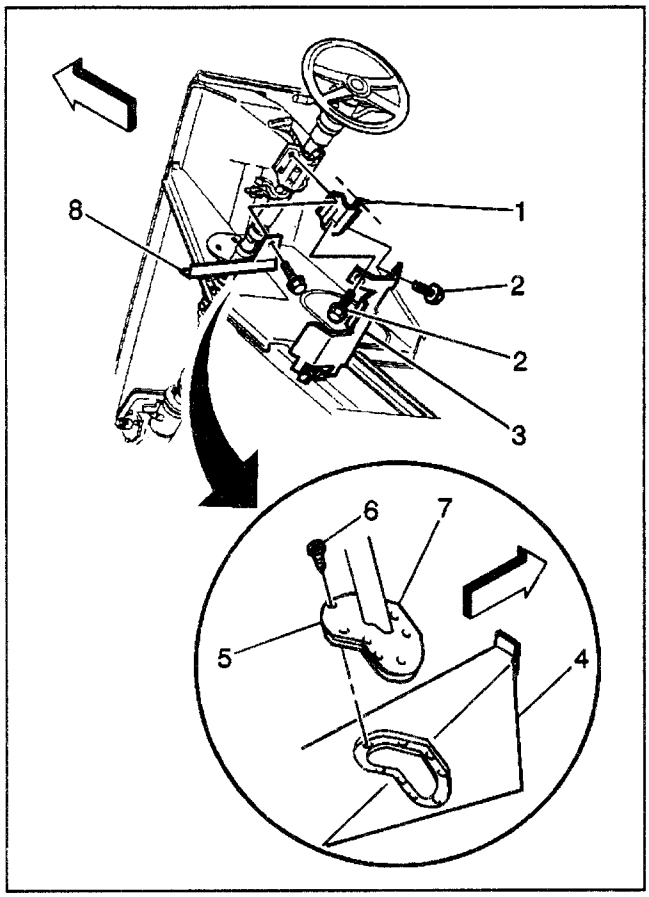



416687

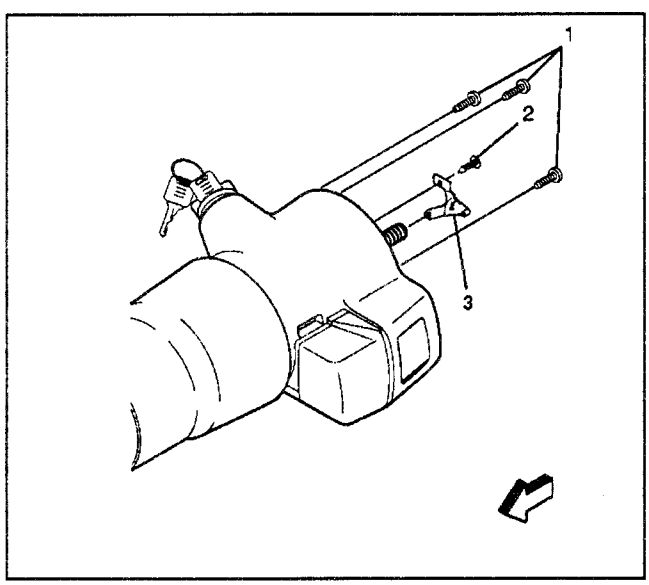
5. Tighten the steering column brackets bolts.

   **Tighten**

   Tighten the bolts to 30 N·m (22 lb ft).
6. Install the screws (6) through the cover (7) and the seal (5) to the floor panel (4).

   **Tighten**

   Tighten the screws to 4.7 N·m (42 lb in).
7. Connect the steering column harness.
8. Connect and adjust the transmission control linkage. Refer to *Shift Cable Replacement* and *Shift Cable Adjustment* in Automatic Transmission.
9. Install the steering wheel, if required. Refer to *Steering Wheel Replacement.*
10. Connect the negative battery cable.



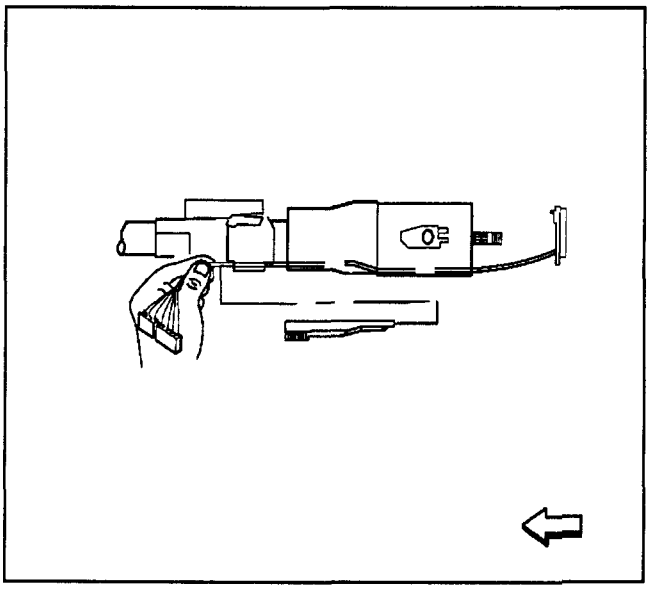

354112

## Turn Signal and Multifcn Switch Assembly - Disassemble - Off Vehicle (Column Shift)

### Disassembly Procedure

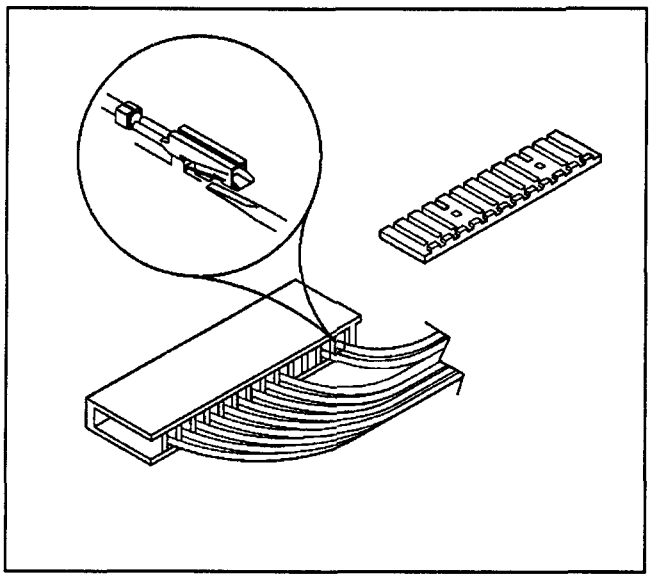
1. Remove the tilt lever. Refer to *Tilt Lever Replacement - On Vehicle.*
2. Remove the multifunction lever. Refer to *Multifunction Turn Signal Lever Replacement - On Vehicle.*
3. Remove the hazard knob. Refer to *Hazard Warning Switch Replacement - On Vehicle.*
4. Remove the shift lever. Refer to *Shift Lever Replacement - On Vehicle.*
5. Remove the turn signal cancel cam assembly. Refer to *Turn Signal Cancel Cam, Upper Bearing Inner Race Disassemble (Column Shift).*
6. Remove the round washer head screw (2) from the signal switch arm assembly (3).
7. Pry out the signal switch arm assembly (3) from the lock housing cover assembly.
8. Remove the 3 pan head 6 lob soc tap screws (1) from the turn signal switch assembly.

9. In order to remove the turn signal switch assembly, use the following steps.
   9.1. Remove the steering column wire harness strap.
   9.2. Remove the wiring protector.




354116

10. Disconnect the terminal connector from the turn signal switch assembly connector.
11. Remove the terminal connector from the dimmer switch assembly.
12. Pull the turn signal switch assembly connector through the steering column, if needed.

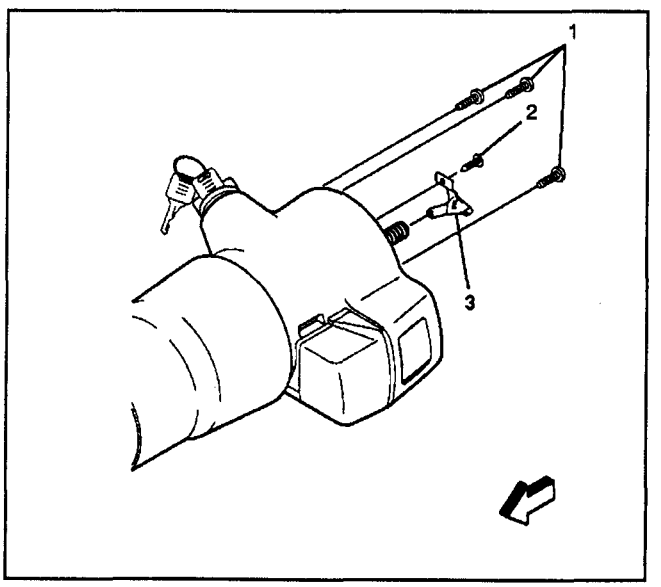


343824

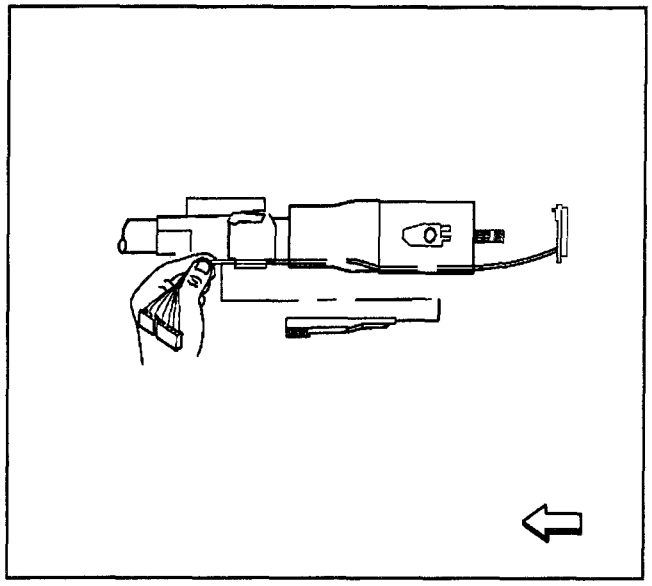
## Turn Signal and Multifcn Switch Assembly - Disassemble - Off Vehicle (Floor Shift)

### Disassembly Procedure

1. Remove the tilt lever. Refer to *Tilt Lever Replacement - On Vehicle.*
2. Remove the multifunction lever. Refer to *Multifunction Turn Signal Lever Replacement - On Vehicle.*
3. Remove the hazard knob. Refer to *Hazard Warning Switch Replacement - On Vehicle.*
4. Remove the turn signal cancel cam assembly. Refer to *Turn Signal Cancel Cam, Upper Bearing Inner Race Disassemble (Floor Shift).*
5. Remove the round washer head screw (2) from the signal switch arm assembly (3).
6. Pry out the signal switch arm assembly (3) from the lock housing cover assembly.
7. Remove the 3 pan head 6 lob soc tap screws (1) from the turn signal switch assembly.

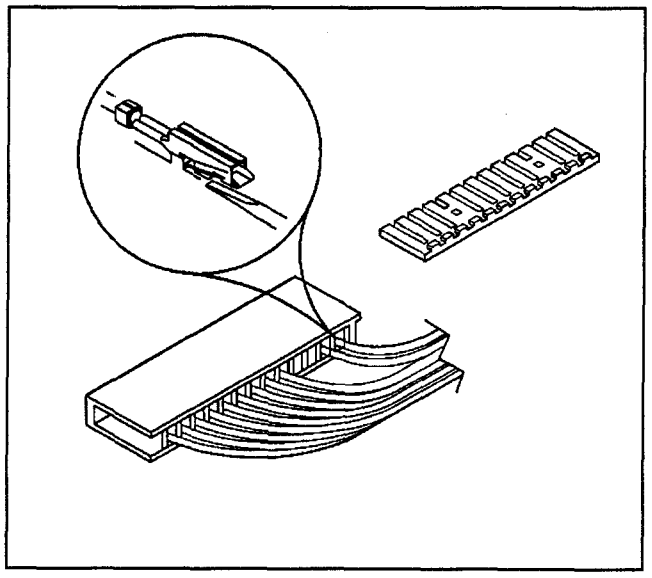



354112



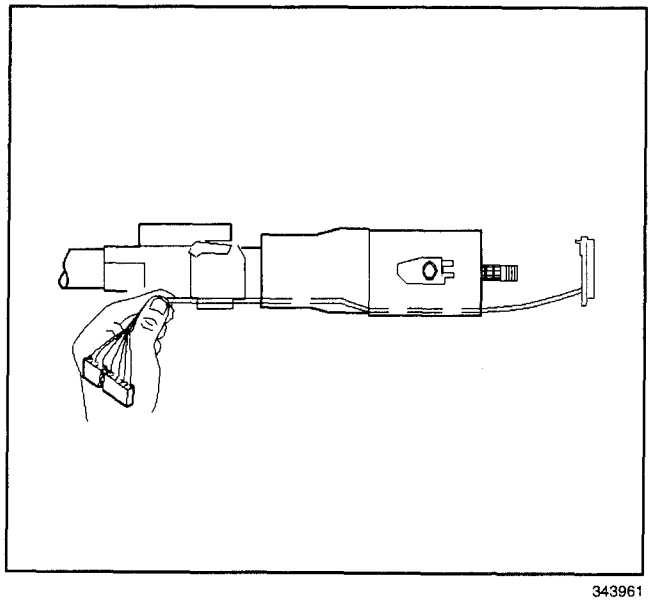
354116

8. In order to remove the turn signal switch assembly, use the following steps.
   8.1. Remove the steering column wire harness strap.
   8.2. Remove the wiring protector.



343824

9. Disconnect the terminal connector from the turn signal switch assembly connector.
10. Remove the terminal connector from the dimmer switch assembly.
11. Pull the turn signal switch assembly connector through the steering column, if needed.



343961

## Turn Signal and Multifcn Switch Assembly - Assemble - Off Vehicle (Column Shift)

### Assembly Procedure

1. Thread the turn signal switch assembly connector through the lock housing cover assembly, if the connector is hanging.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

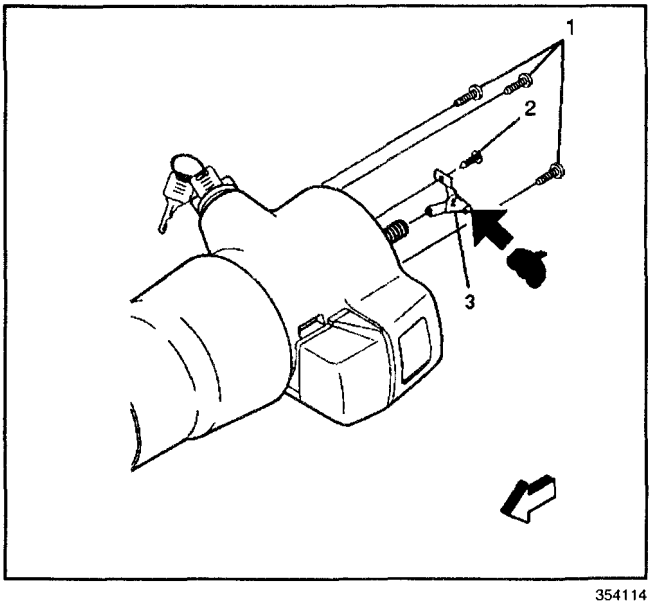
2. Install the turn signal switch assembly and secure using 3 pan head 6 lobe soc tap screws (1).

   **Tighten**

   Tighten the 3 pan head 6 lobe soc tap screws to 3.5 N·m (31 lb in).
3. Lubricate the signal switch arm assembly (3) with lithium grease.
4. Install the signal switch arm assembly (3) onto the turn signal switch assembly.
5. Secure the signal switch arm assembly (3) using the round washer head screw (2).

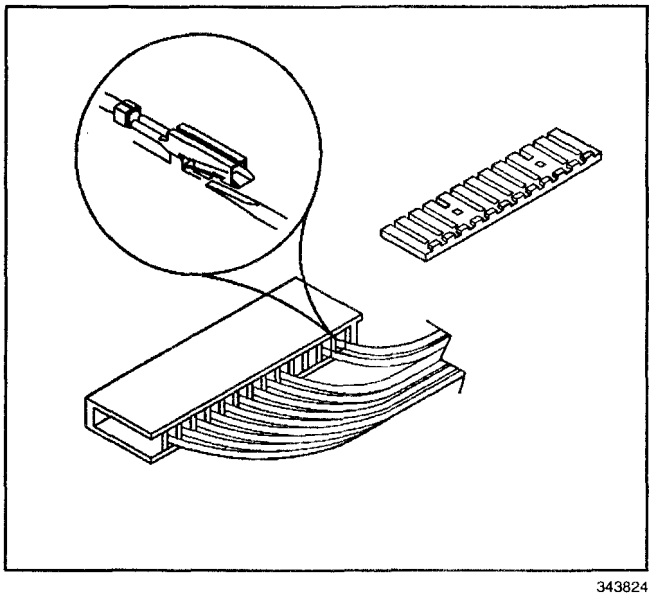
   **Tighten**

   Tighten the round washer head screw to 2.5 N·m (22 lb in).

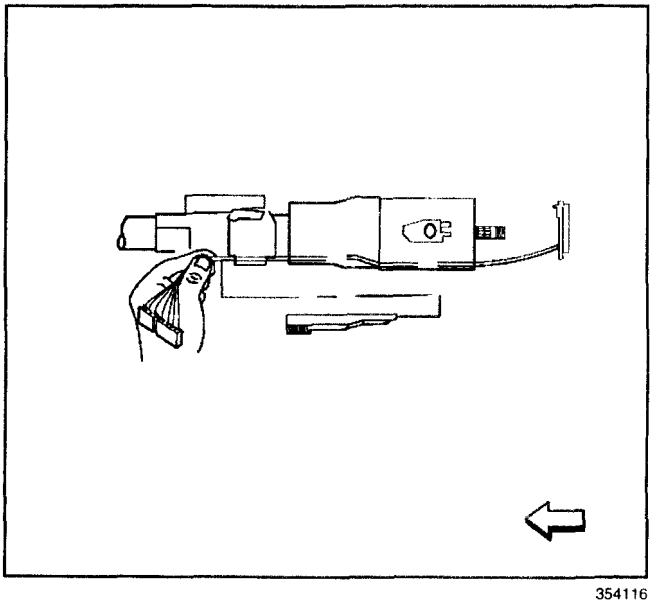


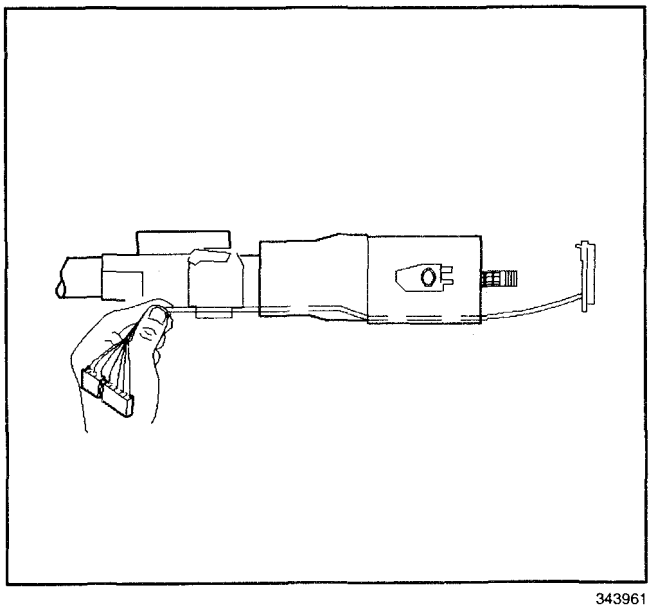
354114

6. Install the terminal connector to the turn signal switch assembly connector.
7. Install the terminal connector to the dimmer switch assembly.


343824

8. Pull the turn signal switch assembly connector towards the base of the column.
9. Insert the wire protector into the steering column bracket.
10. Insert the steering column wire harness into the steering column wire harness strap.
11. Install the tilt lever. Refer to *Tilt Lever Replacement - On Vehicle.*
12. Install the multifunction lever. Refer to *Multifunction Turn Signal Lever Replacement - On Vehicle.*
13. Install the shift lever. Refer to *Shift Lever Replacement - On Vehicle.*
14. Install the hazard knob. Refer to *Hazard Warning Switch Replacement - On Vehicle.*
15. Install the turn signal cancel cam assembly. Refer to *Turn Signal Cancel Cam, Upper Bearing Inner Race Assemble - Off Vehicle (Column Shift).*


354116

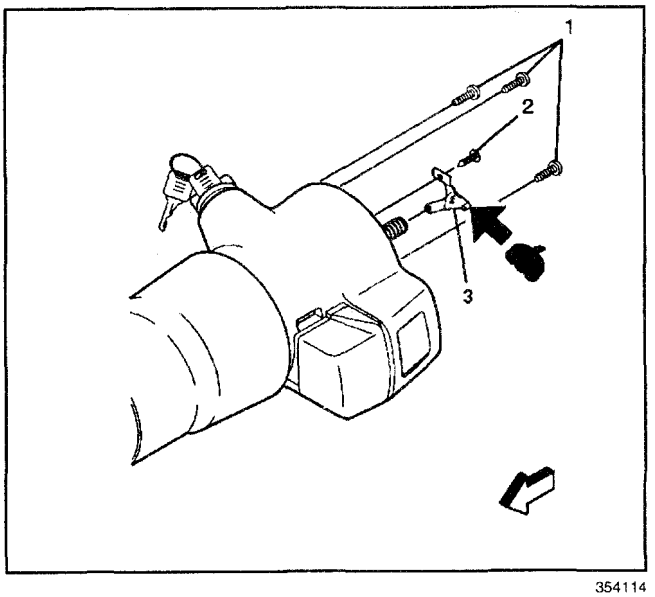


343961

## Turn Signal and Multifcn Switch Assembly - Assemble - Off Vehicle (Floor Shift)

### Assembly Procedure

1. Thread the turn signal switch assembly connector through the lock housing cover assembly, if the connector is hanging.




354114

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

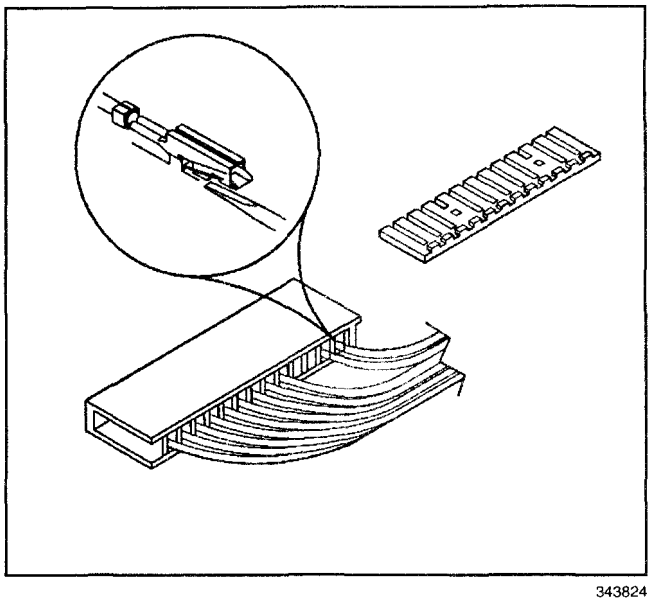
2. Install the turn signal switch assembly and secure using 3 pan head 6 lobe soc tap screws (1).

   **Tighten**

   Tighten the 3 pan head 6 lobe soc tap screws to 3.5 N·m (31 lb in).
3. Lubricate the signal switch arm assembly (3) with lithium grease.
4. Install the signal switch arm assembly (3) onto the turn signal switch assembly.
5. Secure the signal switch arm assembly (3) using the round washer head screw (2).

   **Tighten**

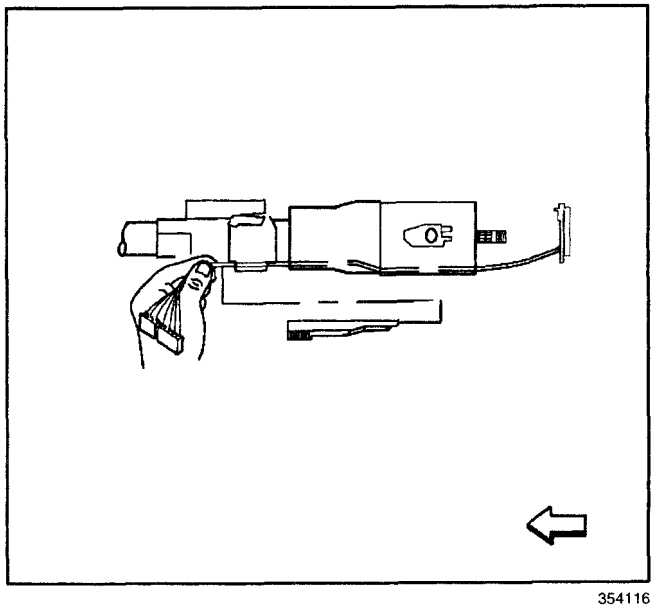
   Tighten the round washer head screw to 2.5 N·m (22 lb in).



343824

6. Install the terminal connector to the turn signal switch assembly connector.
7. Install the terminal connector to the dimmer switch assembly.

8. Pull the turn signal switch assembly connector towards the base of the column.
9. Insert the wire protector into the steering column bracket.
10. Insert the steering column wire harness into the steering column wire harness strap.
11. Install the tilt lever. Refer to *Tilt Lever Replacement - On Vehicle*.
12. Install the multifunction lever. Refer to *Multifunction Turn Signal Lever Replacement - On Vehicle*.
13. Install the hazard knob. Refer to *Hazard Warning Switch Replacement - On Vehicle*.
14. Install the turn signal cancel cam assembly. Refer to *Turn Signal Cancel Cam, Upper Bearing Inner Race Assemble - Off Vehicle (Floor Shift)*.



354116

## Ignition Switch Assembly - Disassemble (Column Shift)

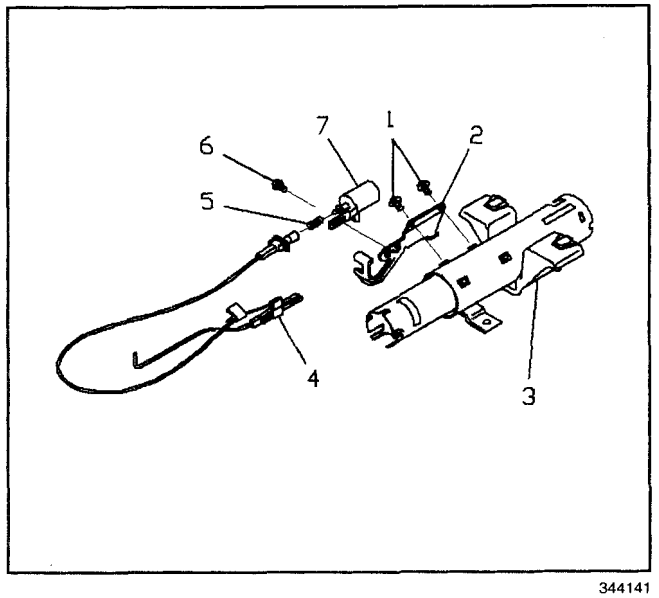
### Tools Required

*J 41352* Modular Column Holding Fixture

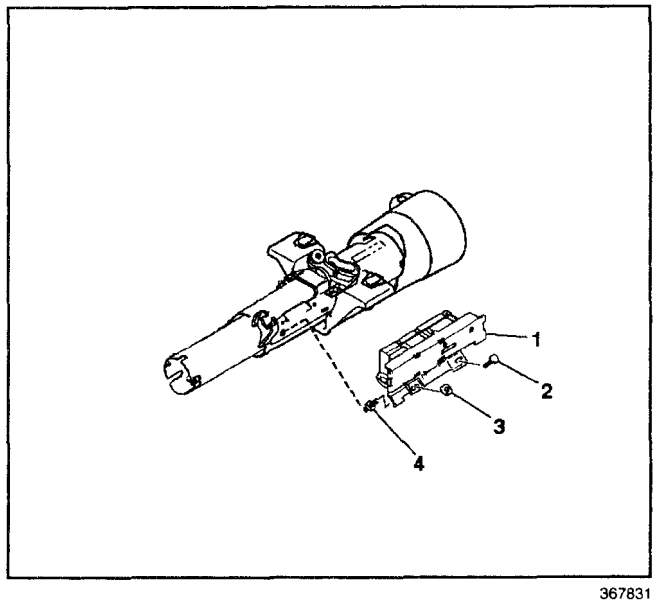
1. Put the steering column and *J 41352* into a vise.

**Important:** Remove only those components necessary to do the repairs.

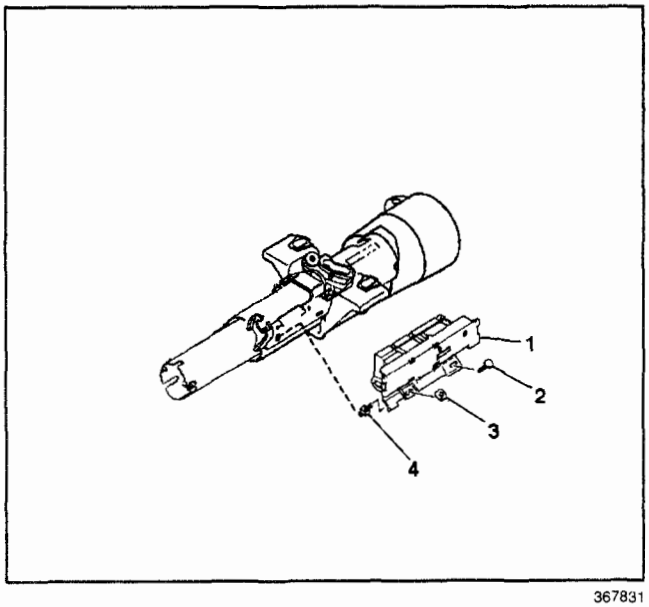
2. Remove the cable assembly with ignition switch actuator assembly (4).
   Remove the cable mounting clip from solenoid bracket (2).
   Remove the ball joint spring (5) from interlock solenoid assembly (7).
   Remove the hex washer head screw (6).
   Remove the interlock solenoid assembly (7).
   Remove the 2 washer head screws (1).
   Remove the solenoid bracket (2).
3. Remove the hexagon nut (3).
4. Remove the washer head screw (2).
5. Remove the ignition switch assembly (1).
6. Remove the ignition switch assembly (5) from the ignition switch actuator assembly.
7. Remove the dimmer and ignition switch mounting stud (1).




344141




367831




367831

## Ignition Switch Assembly - Disassemble (Floor Shift)

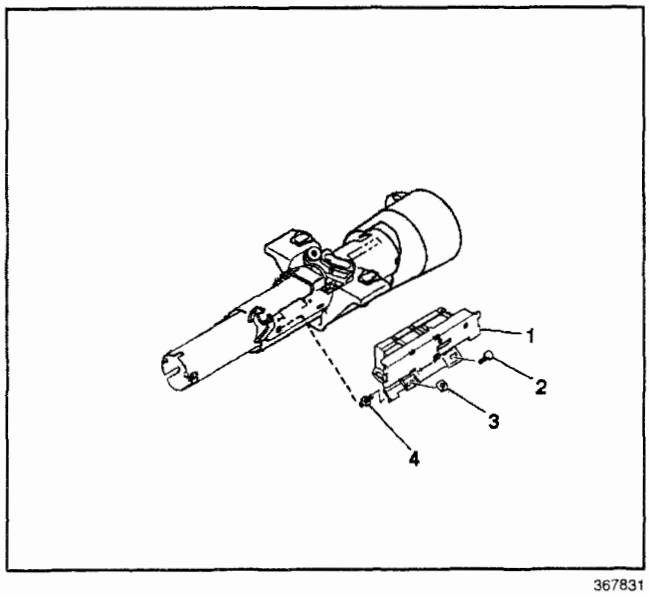
**Tools Required**

*J 41352* Modular Column Holding Fixture

1. Put the steering column and *J 41352* into a vise.

**Important:** Remove only those components necessary to do the repairs.

2. Remove the hexagon nut (3).
3. Remove the washer head screw (2).
4. Remove the ignition switch assembly (1).
5. Remove the ignition switch assembly (5) from the ignition switch actuator assembly.
6. Remove the dimmer and ignition switch mounting stud (1).




367831

## Ignition Switch Assembly - Assemble (Column Shift)

**Tools Required**

*J 41352* Modular Column Holding Fixture

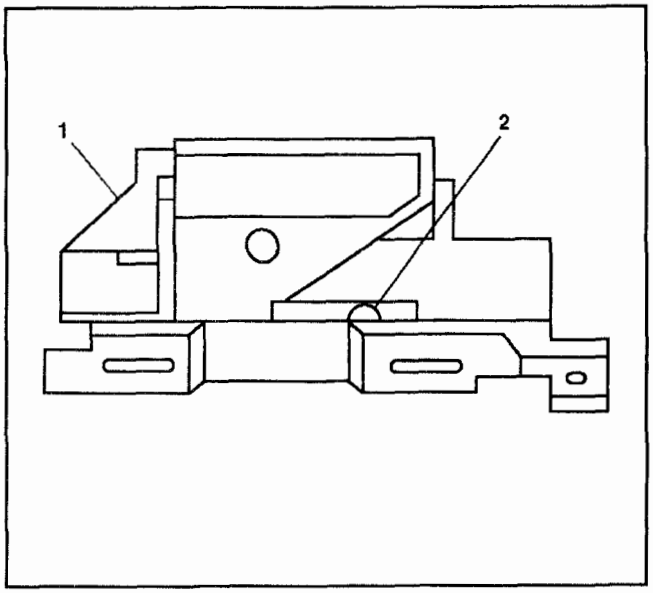
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

1. Install the dimmer and ignition switch mounting stud (4).

   **Tighten**

   Tighten the dimmer and ignition switch mounting stud to 4 N·m (35 lb in).
2. Install the ignition switch assembly (1) to the ignition switch actuator assembly.
3. Install the ignition switch assembly (1) onto the dimmer and ignition switch mounting stud (4).
4. Install the washer head screw (2) into the ignition switch assembly (1).
5. Tighten the washer head screw (2) finger tight.
6. Install the hexagon nut (3) onto the dimmer and ignition switch mounting stud (4)
7. Tighten the hexagon nut (3) finger tight.

8. Move the ignition switch assembly slider (2) to the far right position.
9. Move the ignition switch assembly slider (2) detent to the left. This is the "OFF LOCK" position.
10. Install a 3/32 inch drill bit into the hole on the ignition switch assembly (1) to limit travel.
11. Push against the ignition switch actuator assembly to limit all the lash.



358702

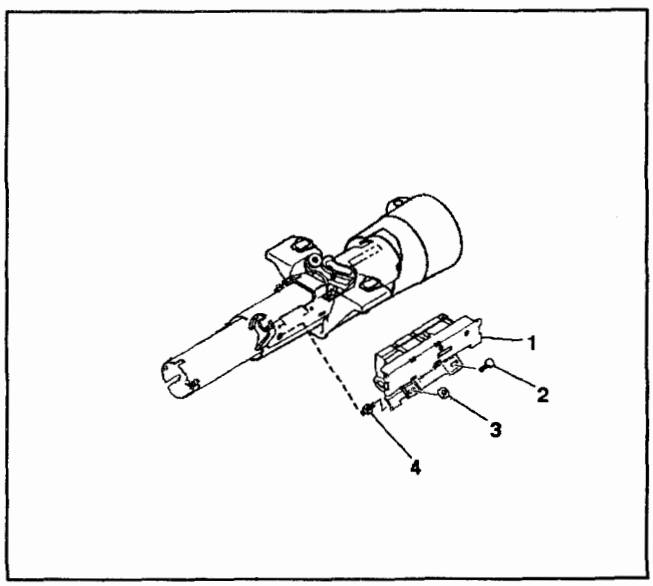
12. Secure the washer head screw (2) into the ignition switch assembly (1).

    **Tighten**

    Tighten the washer head screw to 4 N·m (35 lb in).
13. Secure the hexagon nut (3) onto the dimmer and ignition switch mounting stud (4).

    **Tighten**

    Tighten the hexagon nut to 4 N·m (35 lb in).
14. Remove the 3/32 inch drill bit.



367831

15. Install the solenoid bracket (2).
16. Install the 2 washer head screws (1).

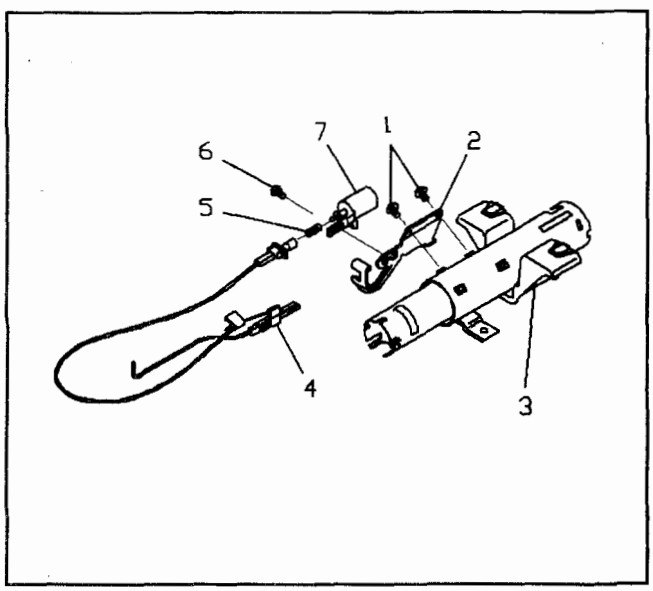
    **Tighten**

    Tighten the screws to 4 N·m (35 lb in).
17. Install the interlock solenoid assembly (7).
18. Install the hex washer head screw (6).

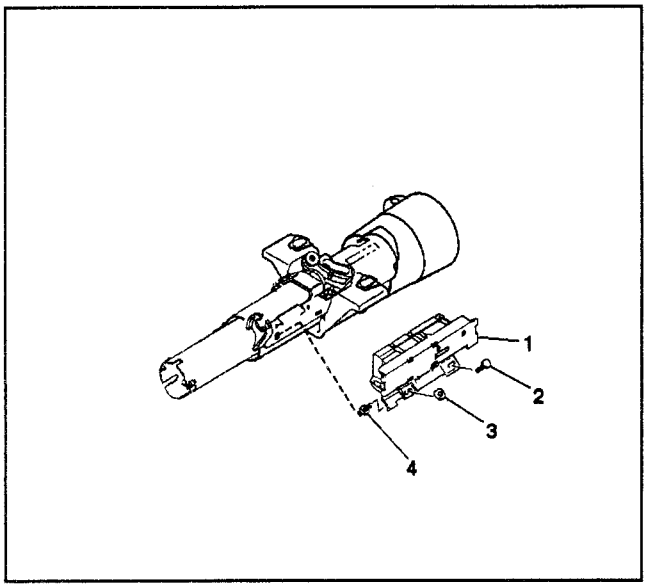
    **Tighten**

    Tighten the screw to 4 N·m (35 lb in).
19. Install the ball joint spring (5) to the interlock solenoid assembly (7).
20. Install the cable mounting clip from solenoid bracket (2).
21. Install the cable assembly with ignition switch actuator assembly (4).

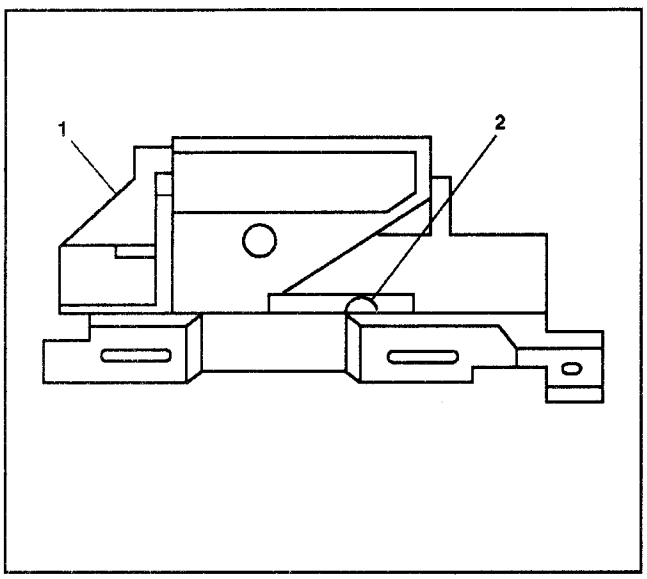
    Remove the steering column and *J 41352* from the vise.



344141




367831




358702

## Ignition Switch Assembly - Assemble (Floor Shift)

### Tools Required

*J 41352* Modular Column Holding Fixture

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

1. Install the dimmer and ignition switch mounting stud (4).

   **Tighten**

   Tighten the dimmer and ignition switch mounting stud to 4 N·m (35 lb in).
2. Install the ignition switch assembly (1) to the ignition switch actuator assembly.
3. Install the ignition switch assembly (1) onto the dimmer and ignition switch mounting stud (4).
4. Install the washer head screw (2) into the ignition switch assembly (1).
5. Tighten the washer head screw (2) finger tight.
6. Install the hexagon nut (3) onto the dimmer and ignition switch mounting stud (4)
7. Tighten the hexagon nut (3) finger tight.
8. Move the ignition switch assembly slider (2) to the far right position.
9. Move the ignition switch assembly slider (2) detent to the left. This is the "OFF LOCK" position.
10. Install a 3/32 inch drill bit into the hole on the ignition switch assembly (1) to limit travel.
11. Push against the ignition switch actuator assembly to limit all the lash.

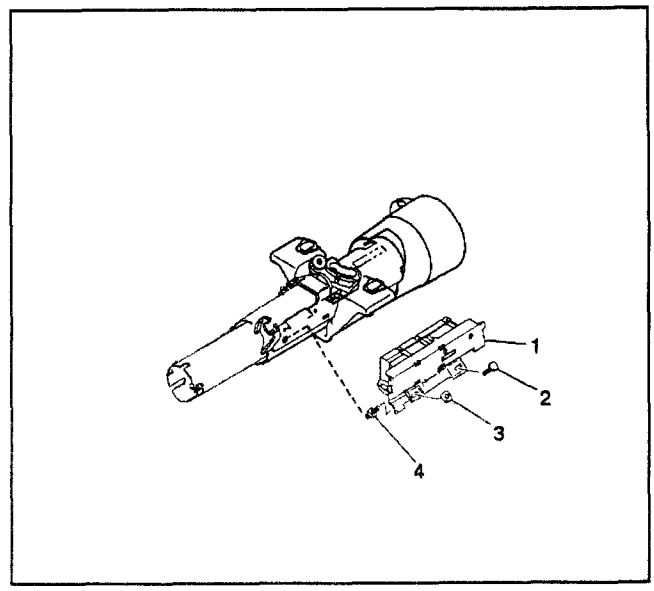
12. Secure the washer head screw (2) into the ignition switch assembly (1).

    **Tighten**

    Tighten the washer head screw to 4 N·m (35 lb in).
13. Secure the hexagon nut (3) onto the dimmer and ignition switch mounting stud (4).

    **Tighten**

    Tighten the hexagon nut to 4 N·m (35 lb in).
14. Remove the 3/32 inch drill bit.
15. Remove the steering column and *J 41352* from the vise.




367831

## Dimmer Switch Assembly - Disassemble (Column Shift)

**Tools Required**

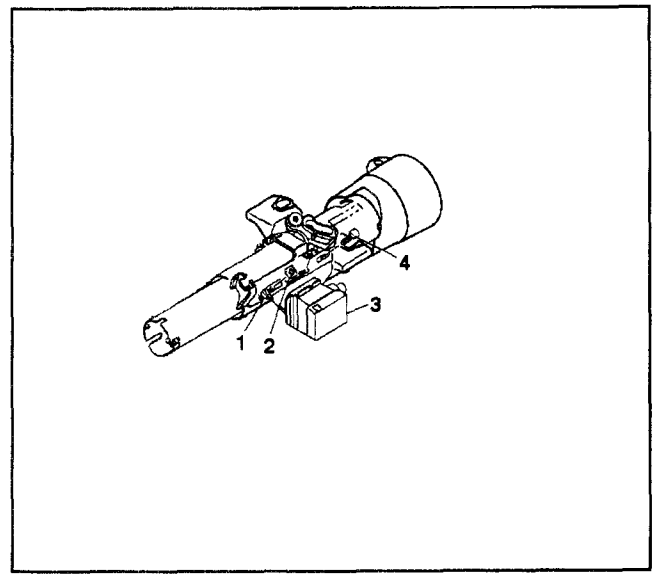
*J 41352* Modular Column Holding Fixture

1. Put the steering column and *J 41352* into a vise.

**Important:** Remove only those components necessary to do the repairs.

2. Remove the ignition switch assembly. Refer to *Ignition Switch Assembly - Disassemble (Column Shift)*.

   Remove the hexagon nut (2).
3. Remove the washer head screw (4).
4. Remove the dimmer switch assembly (3) from the dimmer and ignition switch mounting stud (1).
5. Remove the dimmer and ignition switch mounting stud (1).




367816

## Dimmer Switch Assembly - Disassemble (Floor Shift)

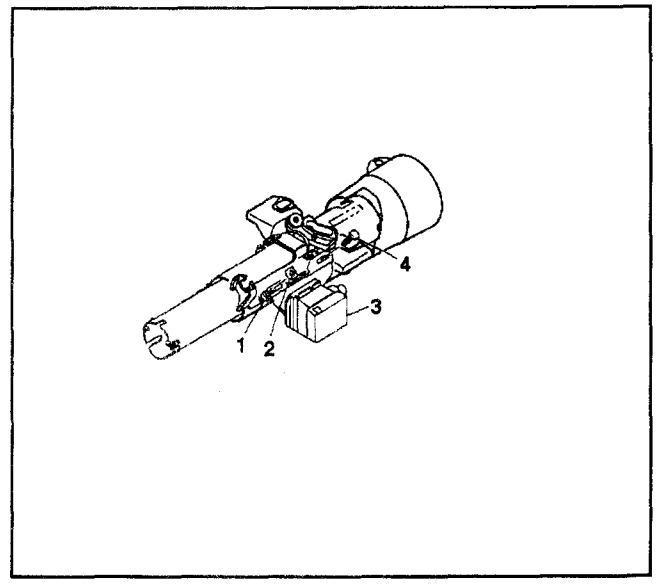
**Tools Required**

*J 41352* Modular Column Holding Fixture

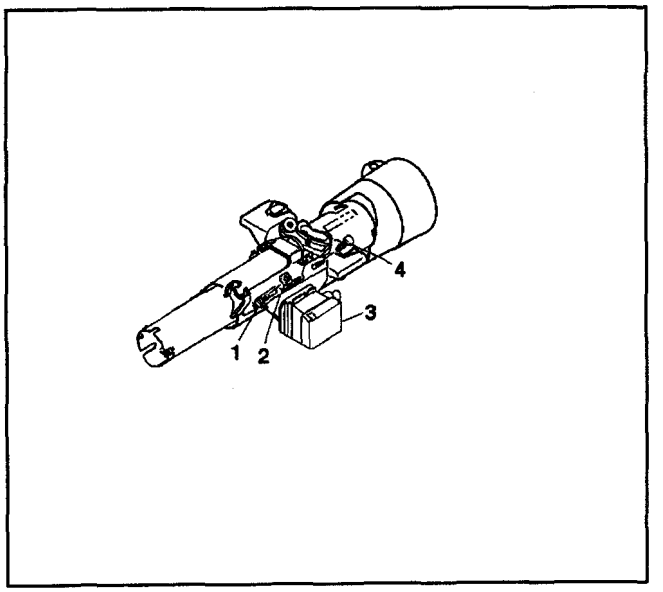
1. Put the steering column and *J 41352* into a vise.

**Important:** Remove only those components necessary to do the repairs.

2. Remove the hexagon nut (2).
3. Remove the washer head screw (4).
4. Remove the dimmer switch assembly (3) from the dimmer and ignition switch mounting stud (1).
5. Remove the dimmer and ignition switch mounting stud (1).




367816



367816

## Dimmer Switch Assembly - Assemble (Column Shift)

### Tools Required

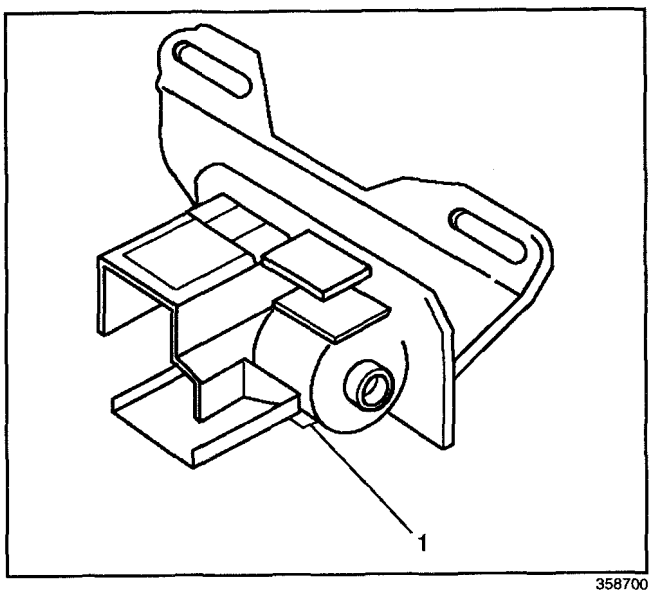
*J 41352* Modular Column Holding Fixture

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

1. Install the dimmer and ignition switch mounting stud (1).

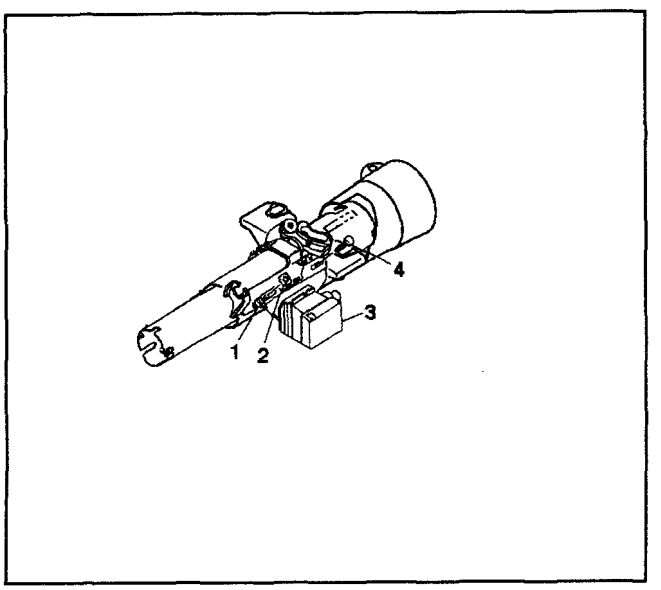
   **Tighten**

   Tighten the dimmer and ignition switch mounting stud (1) to 4 N·m (35 lb in).
2. Install the dimmer switch assembly (3) onto the ignition and dimmer switch mounting stud (1).
3. Install the end of the dimmer switch actuator rod into the dimmer switch assembly (3).
4. Install the hexagon nut (2).
5. Tighten the hexagon nut (2) finger tight.
6. Install the washer head screw (4).
7. Tighten the washer head screw (4) finger tight.



358700

8. Install a 3/32 inch drill bit into the hole (1) on the dimmer switch assembly to limit travel.
9. Position the dimmer switch assembly onto the column and push it against the dimmer switch actuator rod to remove all the lash.



367816

10. Secure the washer head screw (4) into the dimmer switch assembly (3).

    **Tighten**

    Tighten the washer head screw to 4 N·m (35 lb in).
11. Secure the hexagon nut (2) onto the dimmer and ignition switch mounting stud (1).

    **Tighten**

    Tighten the hexagon nut to 4 N·m (35 lb in).
12. Remove the 3/32 inch drill bit from the dimmer switch assembly (3).
13. Install the ignition switch assembly. Refer to *Ignition Switch Assembly - Assemble (Column Shift).*
14. Remove the steering column and *J 41352* from the vise.

## Dimmer Switch Assembly - Assemble (Floor Shift)

**Tools Required**

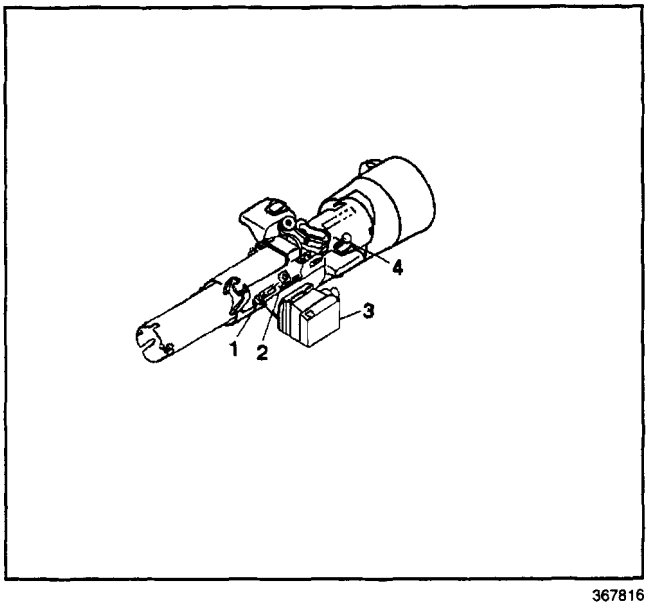
*J 41352* Modular Column Holding Fixture

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

1. Install the dimmer and ignition switch mounting stud (1).

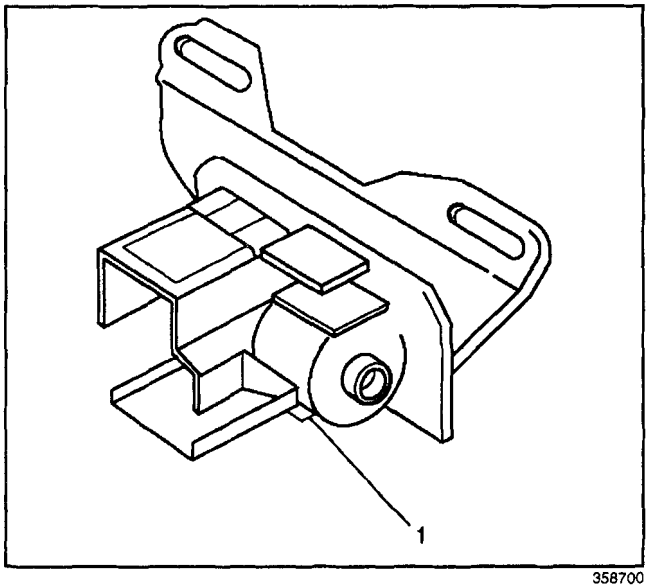
   **Tighten**

   Tighten the dimmer and ignition switch mounting stud (1) to 4 N·m (35 lb in).
2. Install the dimmer switch assembly (3) onto the ignition and dimmer switch mounting stud (1).
3. Install the end of the dimmer switch actuator rod into the dimmer switch assembly (3).
4. Install the hexagon nut (2).
5. Tighten the hexagon nut (2) finger tight.
6. Install the washer head screw (4).
7. Tighten the washer head screw (4) finger tight.



367816

8. Install a 3/32 inch drill bit into the hole (1) on the dimmer switch assembly to limit travel.
9. Position the dimmer switch assembly onto the column and push it against the dimmer switch actuator rod to remove all the lash.



358700

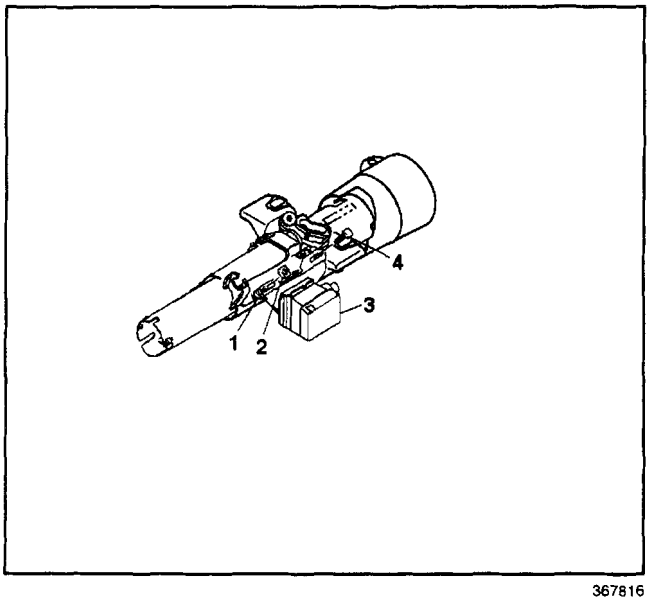
10. Secure the washer head screw (4) into the dimmer switch assembly (3).

    **Tighten**

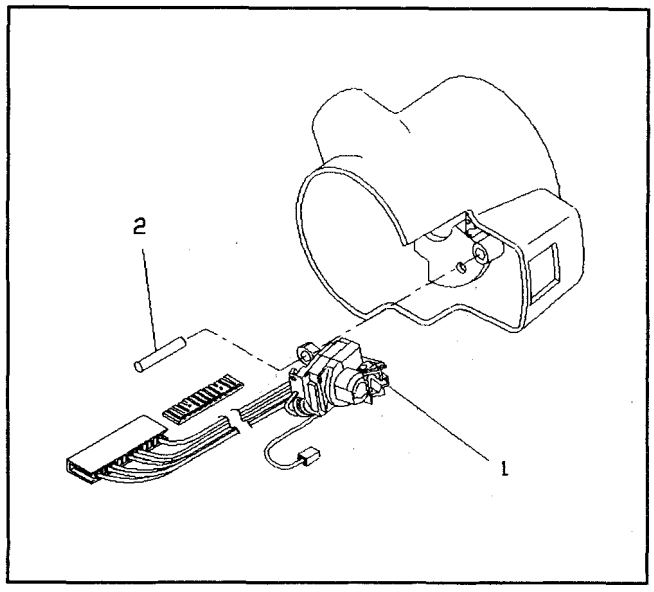
    Tighten the washer head screw to 4 N·m (35 lb in).
11. Secure the hexagon nut (2) onto the dimmer and ignition switch mounting stud (1).

    **Tighten**

    Tighten the hexagon nut to 4 N·m (35 lb in).
12. Remove the 3/32 inch drill bit from the dimmer switch assembly (3).
13. Remove the steering column and *J 41352* from the vise.



367816

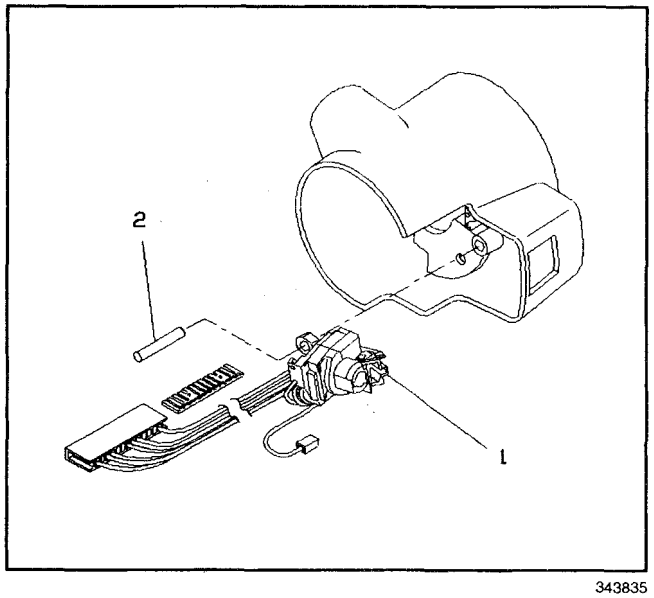



343835

## Pivot and Pulse Switch Assembly - Disassemble - Off Vehicle (Column Shift)

### Disassembly Procedure

1. Remove the lock housing cover assembly. Refer to *Lock Housing Assembly - Disassemble (Column Shift)*.
2. Remove the switch actuator pivot pin (2) from the pivot and pulse switch assembly (1).
3. Remove the pivot and pulse switch assembly (1) from the lock housing cover assembly.
4. Pull the pivot and pulse switch assembly connector through the steering column, if needed.

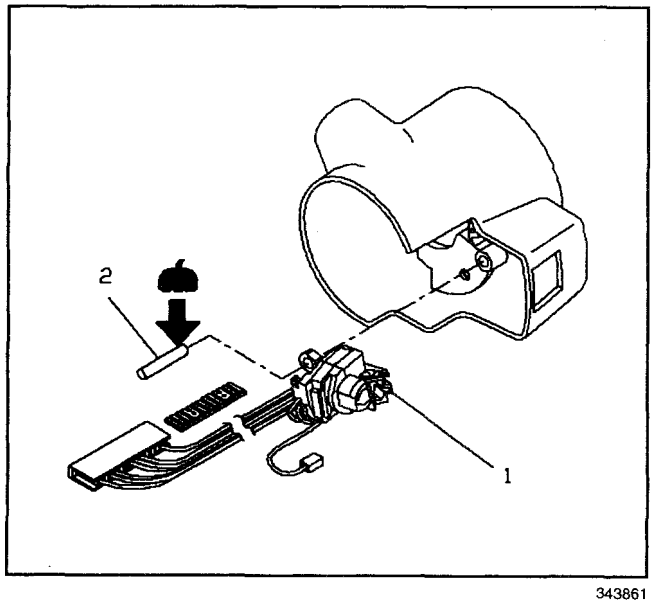



343835

## Pivot and Pulse Switch Assembly - Disassemble - Off Vehicle (Floor Shift)

### Disassembly Procedure

1. Remove the lock housing cover assembly. Refer to *Lock Housing Assembly - Disassemble (Floor Shift)*.
2. Remove the switch actuator pivot pin (2) from the pivot and pulse switch assembly (1).
3. Remove the pivot and pulse switch assembly (1) from the lock housing cover assembly.
4. Pull the pivot and pulse switch assembly connector through the steering column, if needed.




343861

## Pivot and Pulse Switch Assembly - Assemble - Off Vehicle (Column Shift)

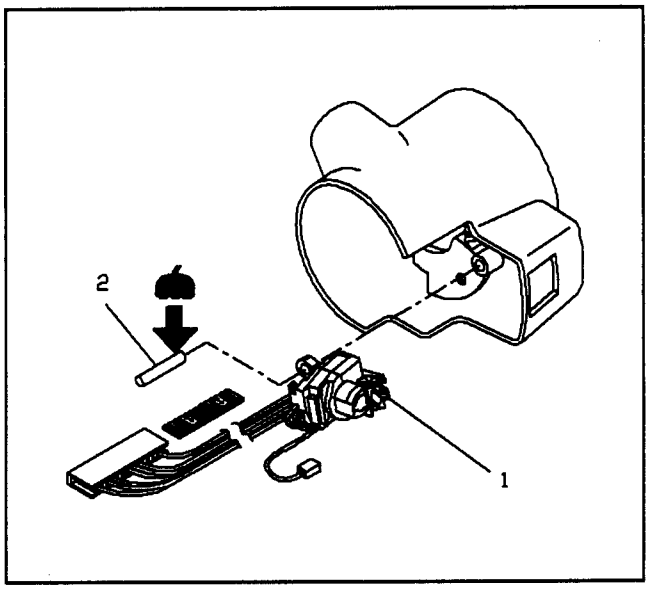
### Assembly Procedure

1. Lubricate the switch actuator pivot pin (2) with lithium grease.
2. Install the switch actuator pivot pin (2) into the pivot and pulse switch assembly (1).
3. Insert the pivot and pulse switch (1) assembly connector through the steering column housing assembly, if needed.
4. Install the lock housing cover assembly. Refer to *Lock Housing Assembly - Assemble (Column Shift)*.

## Pivot and Pulse Switch Assembly - Assemble - Off Vehicle (Floor Shift)

### Assembly Procedure

1. Lubricate the switch actuator pivot pin (2) with lithium grease.
2. Install the switch actuator pivot pin (2) into the pivot and pulse switch assembly (1).
3. Insert the pivot and pulse switch (1) assembly connector through the steering column housing assembly, if needed.
4. Install the lock housing cover assembly. Refer to *Lock Housing Assembly - Assemble (Floor Shift).*

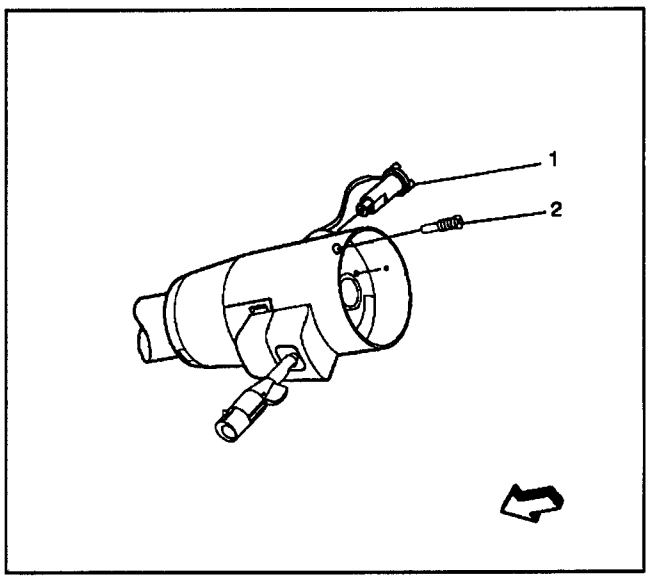



343861

## Steering Column Lock Cylinder Set - Disassemble (Column Shift)

### Disassembly Procedure

1. Remove the turn signal switch assembly. Refer to *Turn Signal and Multifcn Switch Assembly - Disassemble - Off Vehicle (Column Shift).*
2. Put the key in the "LOCK" position.
3. Remove the lock retaining screw (2) from the lock housing cover assembly.
4. Remove the steering column lock cylinder set (1) from the lock housing cover assembly.

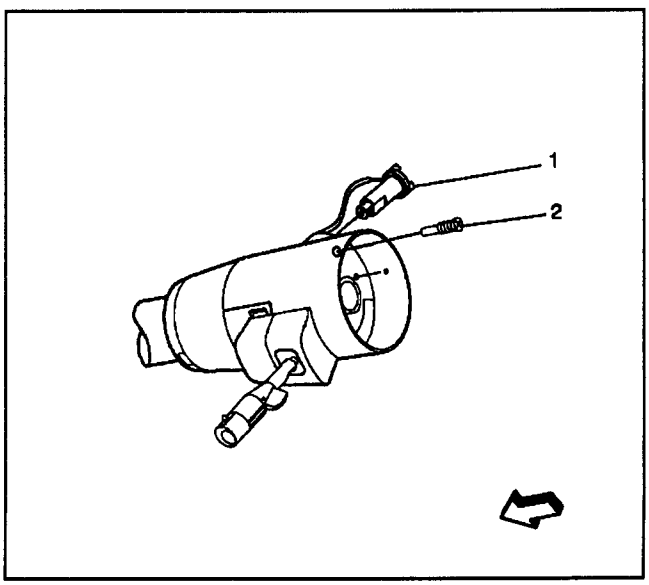



354104

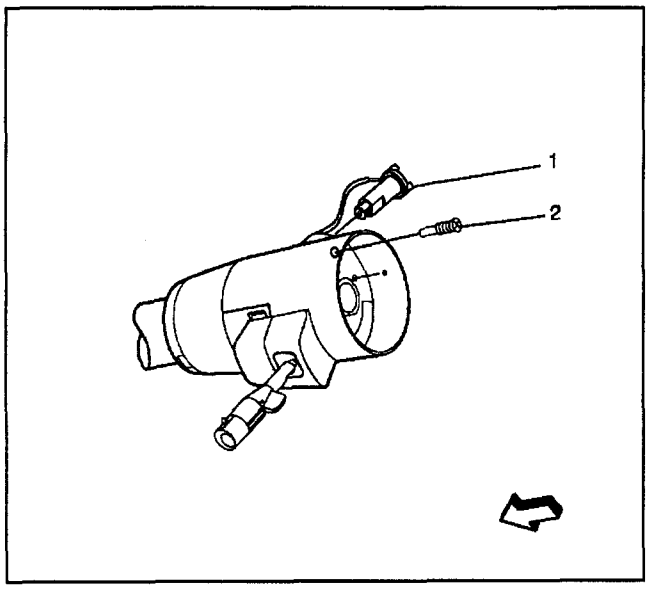
## Steering Column Lock Cylinder Set - Disassemble (Floor Shift)

### Disassembly Procedure

1. Remove the turn signal switch assembly. Refer to *Turn Signal and Multifcn Switch Assembly - Disassemble - Off Vehicle (Floor Shift).*
2. Put the key in the "LOCK" position.
3. Remove the lock retaining screw (2) from the lock housing cover assembly.
4. Remove the steering column lock cylinder set (1) from the lock housing cover assembly.




354104




354104

## Steering Column Lock Cylinder Set - Assemble (Column Shift)

### Assembly Procedure

1. Install the steering column lock cylinder set (1) into the lock housing cover assembly.

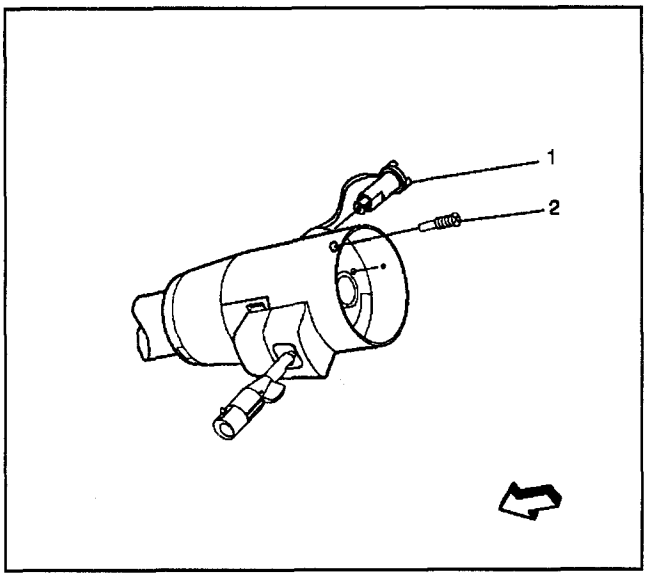
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

2. Install the lock retaining screw (2) into the lock housing cover assembly.

   **Tighten**

   Tighten the lock retaining screw (2) to 2.5 N·m (22 lb in).

3. Install the turn signal switch assembly. Refer to *Turn Signal and Multifcn Switch Assembly - Assemble - Off Vehicle (Column Shift).*




354104

## Steering Column Lock Cylinder Set - Assemble (Floor Shift)

### Assembly Procedure

1. Install the steering column lock cylinder set (1) into the lock housing cover assembly.

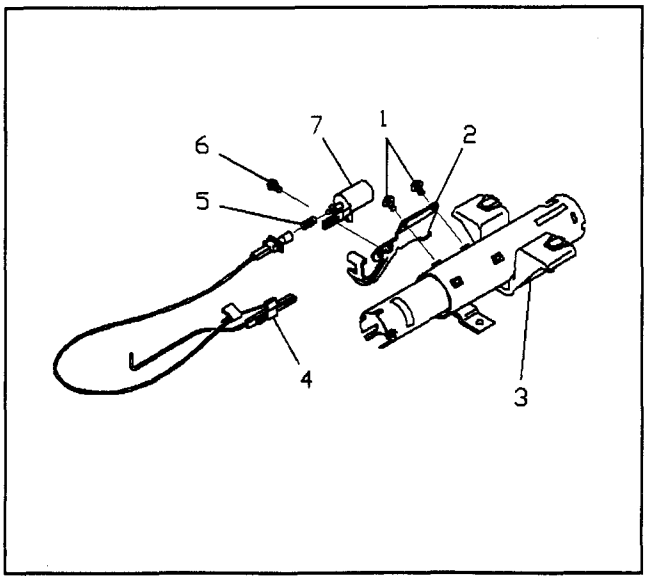
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

2. Install the lock retaining screw (2) into the lock housing cover assembly.

   **Tighten**

   Tighten the lock retaining screw to 2.5 N·m (22 lb in).

3. Install the turn signal switch assembly. Refer to *Turn Signal and Multifcn Switch Assembly - Assemble - Off Vehicle (Floor Shift).*




344141

## Auto Trans Shift Lock Control - Disassemble

**Tools Required**

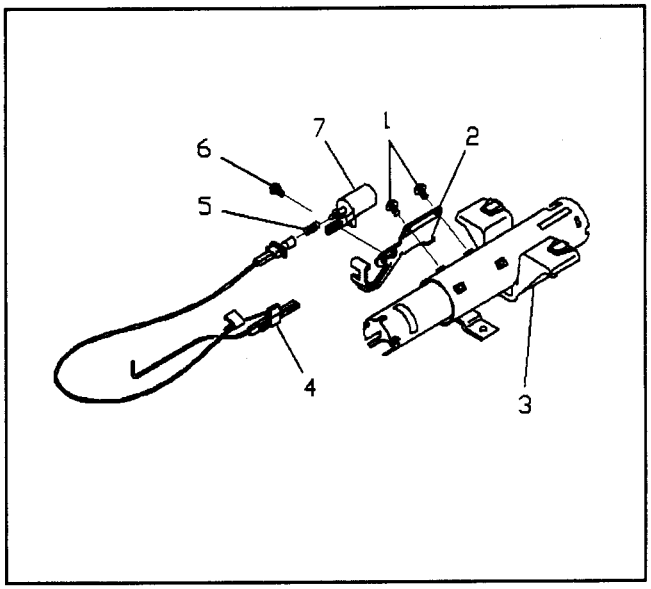
*J 41352* Modular Column Holding Fixture

1. Put the steering column and *J 41352* into a vise.

**Important:** Remove only those components necessary to do the repairs.

2. Remove the cable assembly with ignition switch actuator assembly (4).
   Remove the cable mounting clip from solenoid bracket (2).
   Remove the ball joint spring (5) from interlock solenoid assembly (7).
   Remove the hex washer head screw (6).
   Remove the interlock solenoid assembly (7).
   Remove the 2 washer head screws (1).
   Remove the solenoid bracket (2).

## Auto Trans Shift Lock Control - Assemble - Off Vehicle



344141

### Tools Required

*J 41352* Modular Column Holding Fixture

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

1. Install the solenoid bracket (2).
2. Install the 2 washer head screws (1).

   **Tighten**

   Tighten the screws to 4 N·m(35 lb in).
3. Install the interlock solenoid assembly (7).
4. Install the hex washer head screw (6).

   **Tighten**

   Tighten the screw to 4 N·m(35 lb in).
5. Install the ball joint spring (5) to the interlock solenoid assembly (7).
6. Install the cable mounting clip from solenoid bracket (2).
7. Install the cable assembly with ignition switch actuator assembly (4).

   Remove the steering column and *J 41352* from the vise.

## Tilt Spring - Disassemble (Column Shift)

### Disassembly Procedure

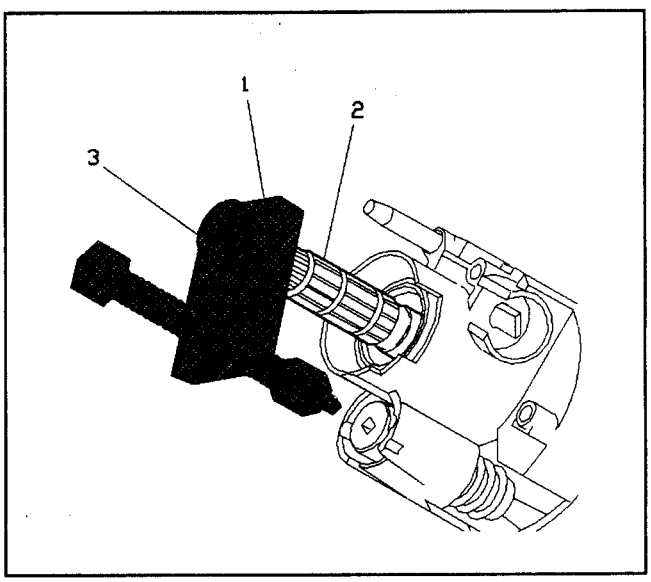
### Tool Required

*J 39246* Tilt Spring Compressor

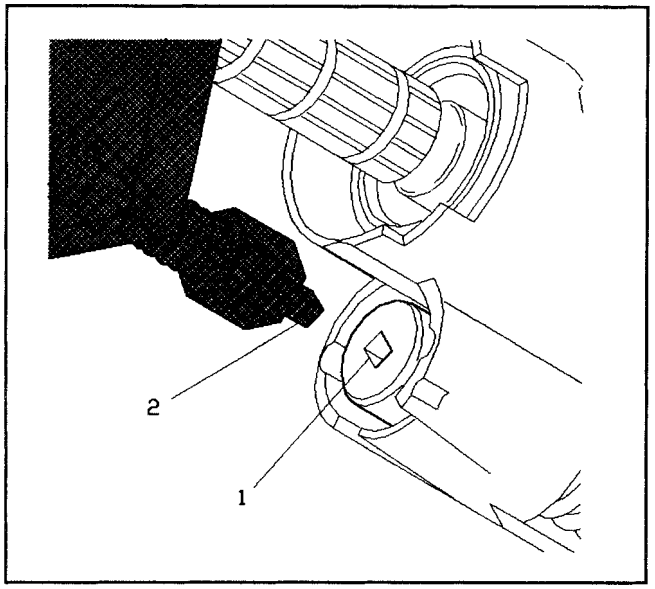
1. Remove the lock housing cover assembly. Refer to *Lock Housing Assembly - Disassemble (Column Shift).*
2. Seat the counterbore of *J 39246* over the steering shaft assembly (1).

***Caution: The tilt spring and spring guide are under pressure and could become a projectile. Exercise caution when removing or installing the tilt spring and spring guide as bodily injury may result.***

3. Thread and seat the standard hexagon nut (2) onto the steering shaft assembly (1).
4. Thread the hexagon nut (2) until it contacts the block of *J 39246.*

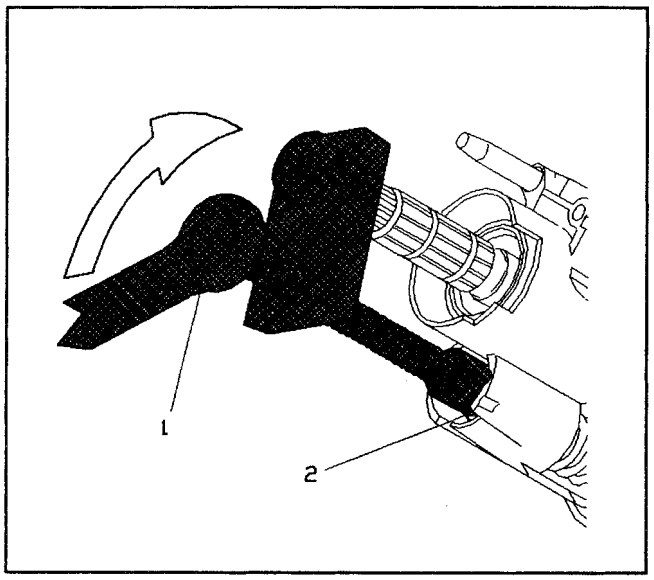


343839



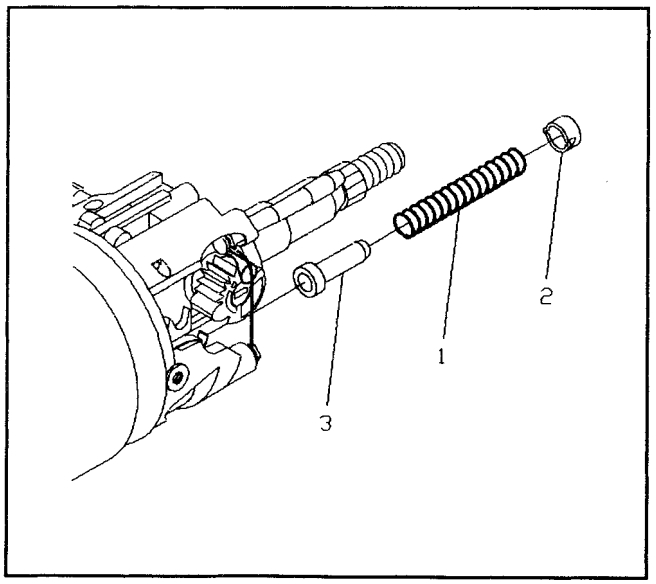

343842

5. Insert the square end (2) of *J 39246* into the spring retainer (1) and seat.




343845

6. Rotate the tool bolt clockwise with the wrench until it contacts the surface of the tool block.
7. Make a ¼ turn counter clockwise to the hexagon section on the end of the tool bolt.
8. Unscrew the tool bolt until the wheel tilt spring and the spring retainer (1) are free.




343856

9. Remove the spring retainer (2) from the steering column housing assembly.
10. Remove the wheel tilt spring (1) from the steering column housing assembly.
11. Remove the spring guide (3) from the steering column housing assembly.

## Tilt Spring - Disassemble (Floor Shift)

### Disassembly Procedure

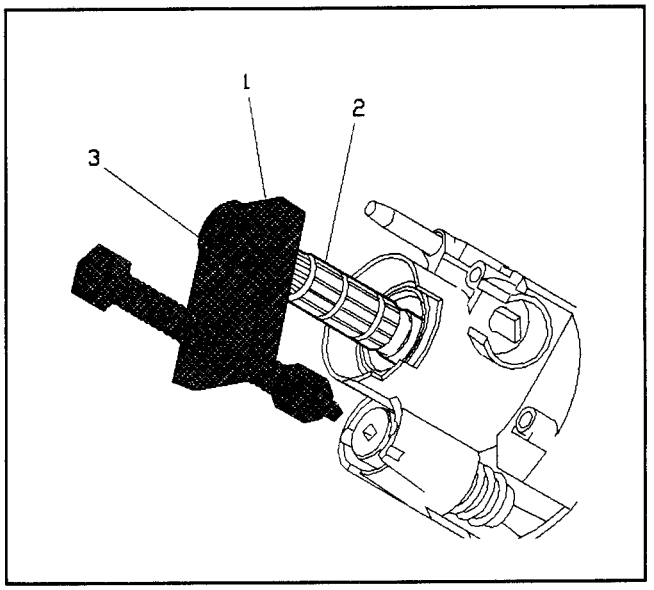
#### Tool Required

*J 39246* Tilt Spring Compressor

1. Remove the lock housing cover assembly. Refer to *Lock Housing Assembly - Disassemble (Floor Shift).*
2. Seat the counterbore of *J 39246* over the steering shaft assembly (1).

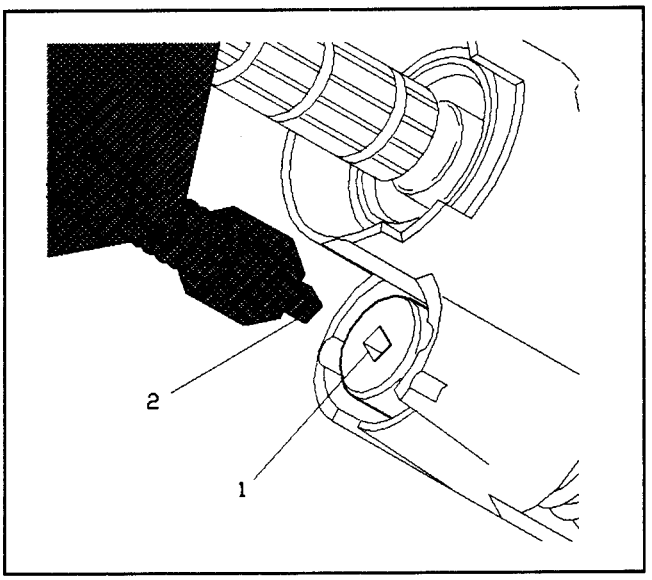
***Caution: The tilt spring and spring guide are under pressure and could become a projectile. Exercise caution when removing or installing the tilt spring and spring guide as bodily injury may result.***

3. Thread and seat the standard hexagon nut (2) onto the steering shaft assembly (1).
4. Thread the hexagon nut (2) until it contacts the block of *J 39246.*



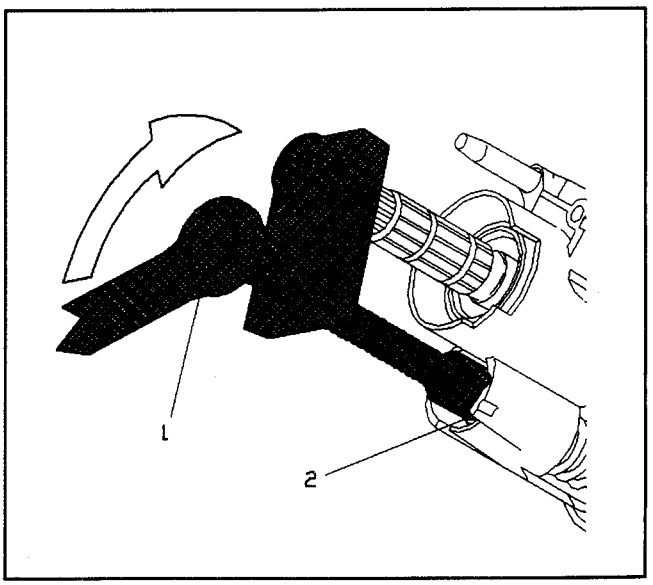
343839

5. Insert the square end (2) of *J 39246* into the spring retainer (1) and seat.

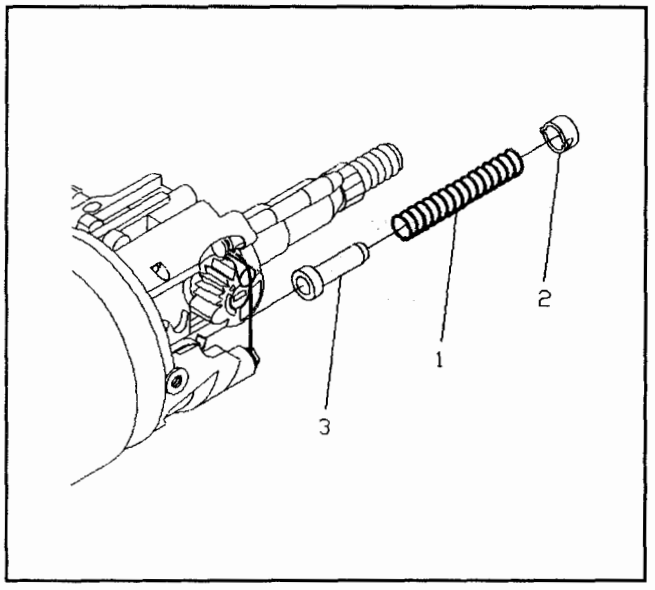


343842

6. Rotate the tool bolt clockwise with the wrench until it contacts the surface of the tool block.
7. Make a ¼ turn counter clockwise to the hexagon section on the end of the tool bolt.
8. Unscrew the tool bolt until the wheel tilt spring and the spring retainer (1) are free.

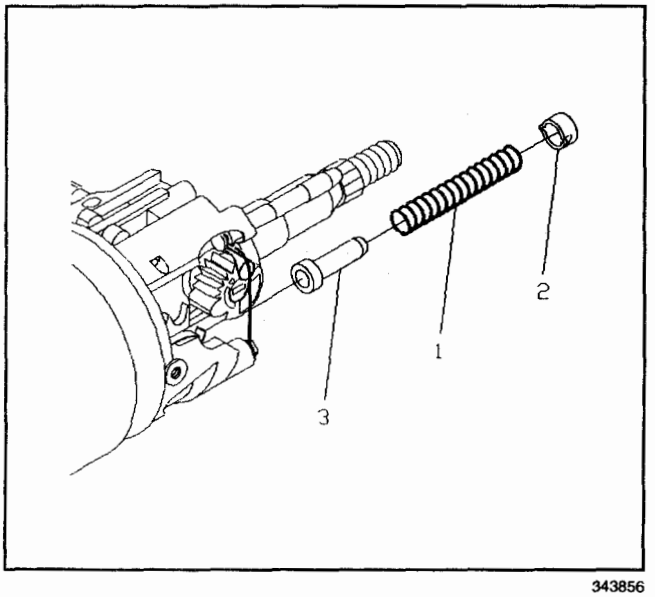


343845




343856

9. Remove the spring retainer (2) from the steering column housing assembly.
10. Remove the wheel tilt spring (1) from the steering column housing assembly.
11. Remove the spring guide (3) from the steering column housing assembly.




343856

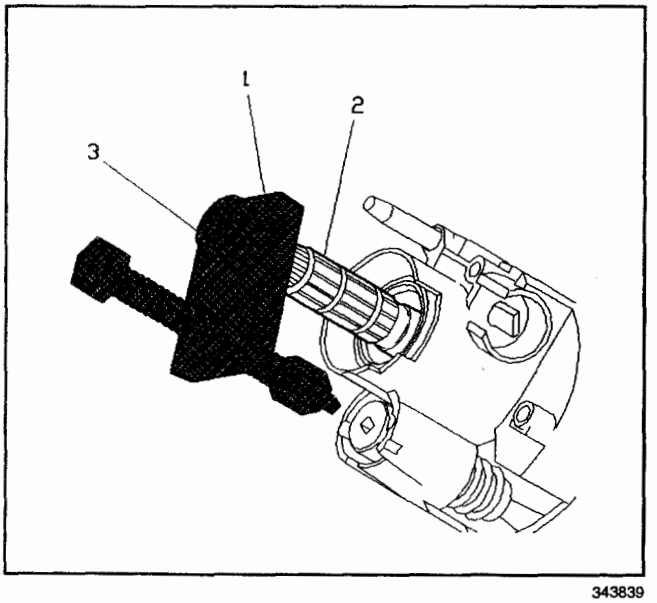
## Tilt Spring - Assemble (Column Shift)

### Assembly Procedure

**Tool Required**

*J 39246* Tilt Spring Compressor

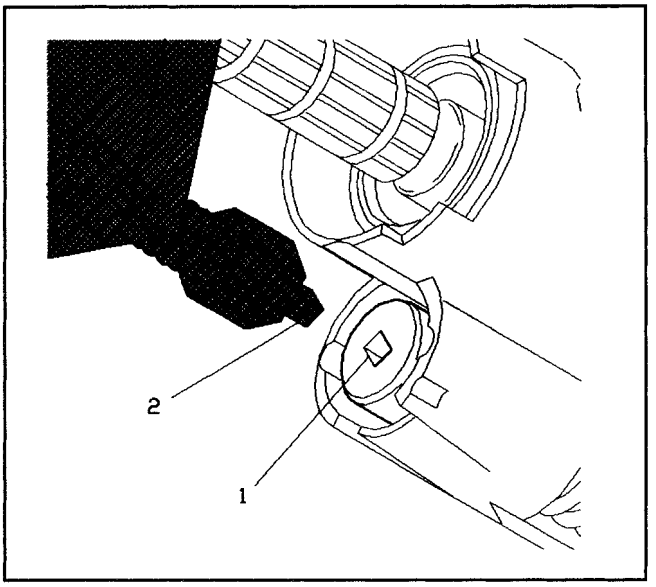
1. Install the spring guide (3) to the steering column housing assembly.
2. Lubricate the wheel tilt spring with lithium grease.
3. Install the wheel tilt spring (1) to the steering column housing assembly.
4. Install the spring retainer (2) to the steering column housing assembly.




343839

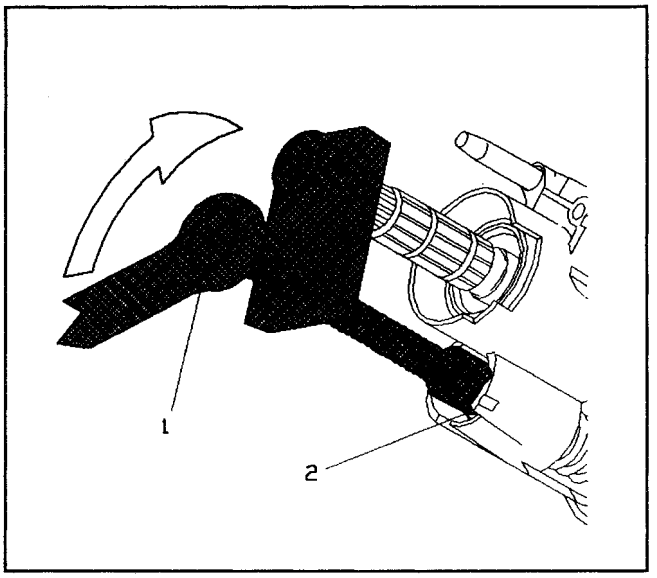
5. Seat the counterbore of *J 39246* over the steering shaft assembly (1).
6. Thread and seat the standard hexagon nut (2) onto the steering shaft assembly (1).
7. Thread the hexagon nut (2) until it contacts the block of *J 39246*.

8. Insert the square end (2) of *J 39246* into the spring retainer (1) and seat.




343842

9. Rotate the tool bolt clockwise with a wrench until it contacts the surface of the tool block.
10. Make a ¼ turn counter clockwise to the hexagon section on the end of the tool bolt.
11. Unscrew the tool bolt until the wheel tilt spring and the spring retainer (1) are free.
12. Remove *J 39246*.
13. Install the lock housing cover assembly. Refer to *Lock Housing Assembly - Assemble (Column Shift)*.




343845

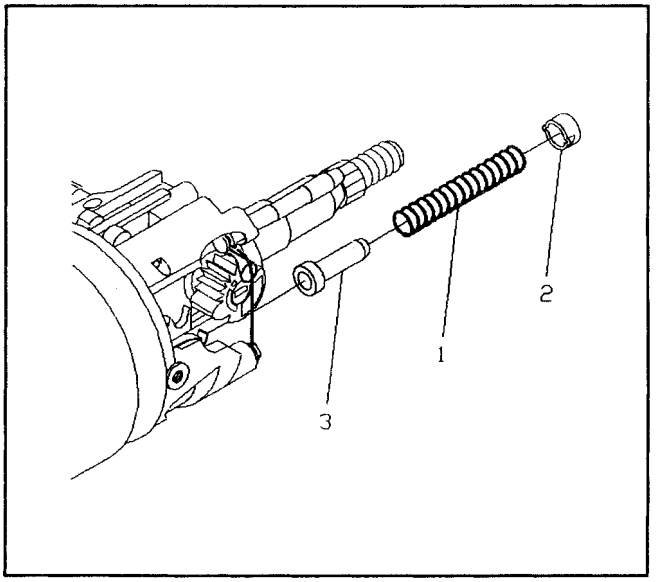
## Tilt Spring - Assemble (Floor Shift)

### Assembly Procedure

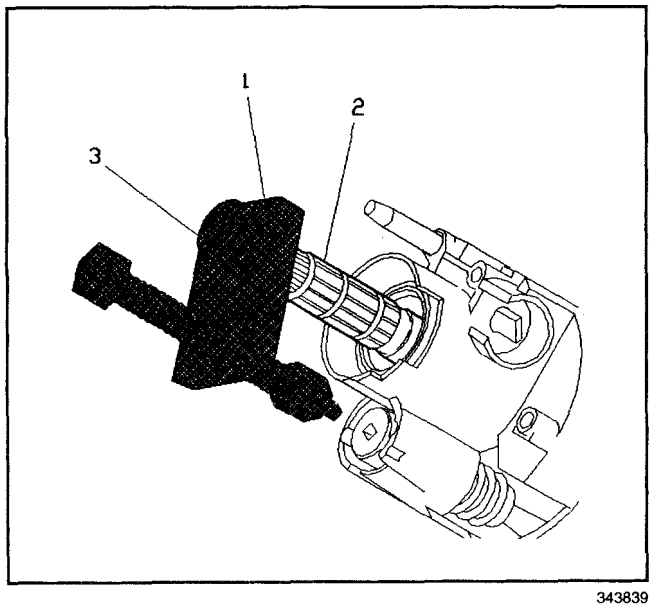
#### Tool Required

*J 39246* Tilt Spring Compressor

1. Install the spring guide (3) to the steering column housing assembly.
2. Lubricate the wheel tilt spring with lithium grease.
3. Install the wheel tilt spring (1) to the steering column housing assembly.
4. Install the spring retainer (2) to the steering column housing assembly.

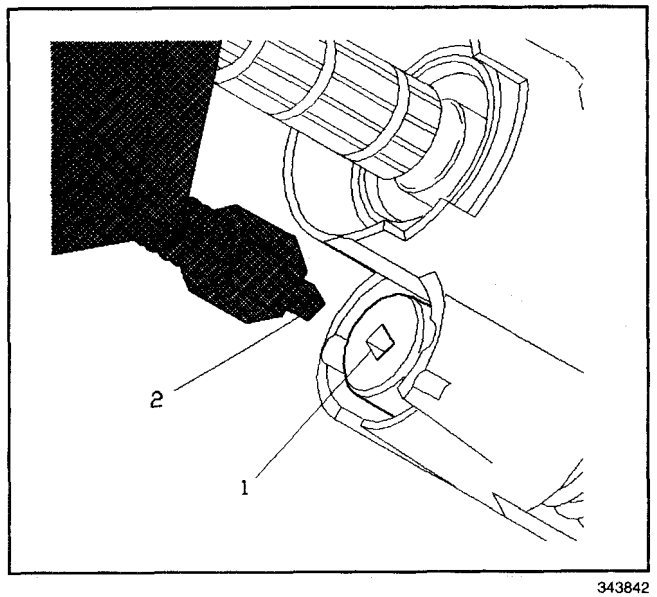



343856



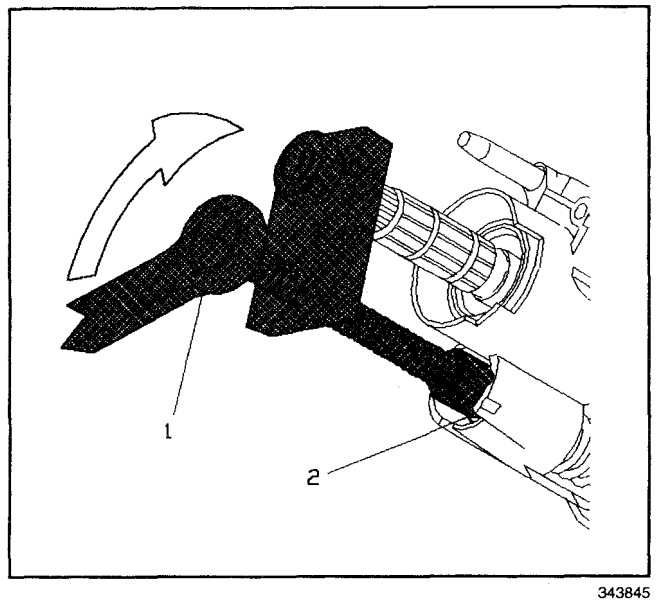

343839

5. Seat the counterbore of *J 39246* over the steering shaft assembly (1).
6. Thread and seat the standard hexagon nut (2) onto the steering shaft assembly (1).
7. Thread the hexagon nut (2) until it contacts the block of *J 39246*.




343842

8. Insert the square end (2) of *J 39246* into the spring retainer (1) and seat.




343845

9. Rotate the tool bolt clockwise with a wrench until it contacts the surface of the tool block.
10. Make a ¼ turn counter clockwise to the hexagon section on the end of the tool bolt.
11. Unscrew the tool bolt until the wheel tilt spring and the spring retainer (1) are free.
12. Remove *J 39246*.
13. Install the lock housing cover assembly. Refer to *Lock Housing Assembly - Assemble (Floor Shift)*.

## Turn Signal Cancel Cam, Upper Bearing Inner Race Disassemble (Column Shift)

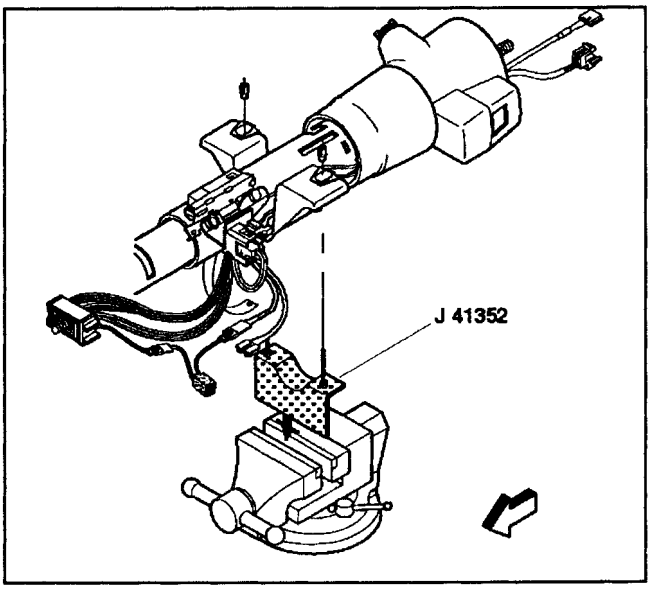
**Tools Required**

- *J 41352* Modular Column Holding Fixture
- *J 23653-SIR* Lock Plate Compressor
- *J 23653 - 91* Lock Plate Compressor Adapter

1. Set the steering column and *J 41352* into a vise.

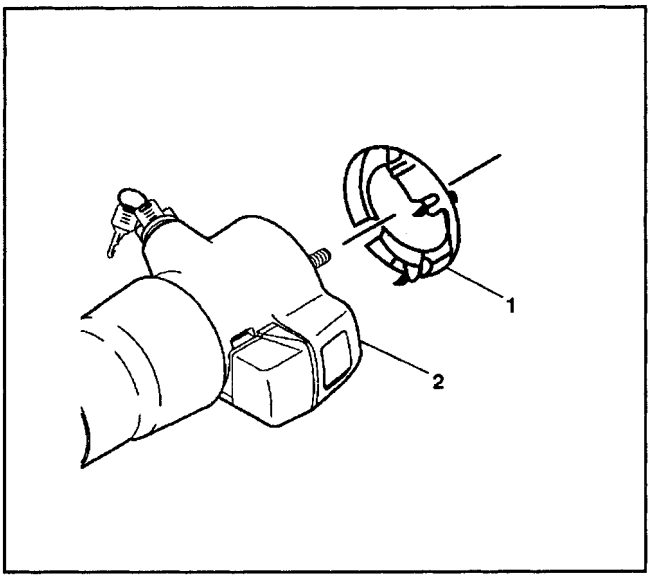
**Important:** The column must be in the center position.

2. Remove only those components necessary to do the repairs.
3. Check the steering column jacket assembly for accident damage. Refer to *Steering Column Accident Damage - Off Vehicle.*



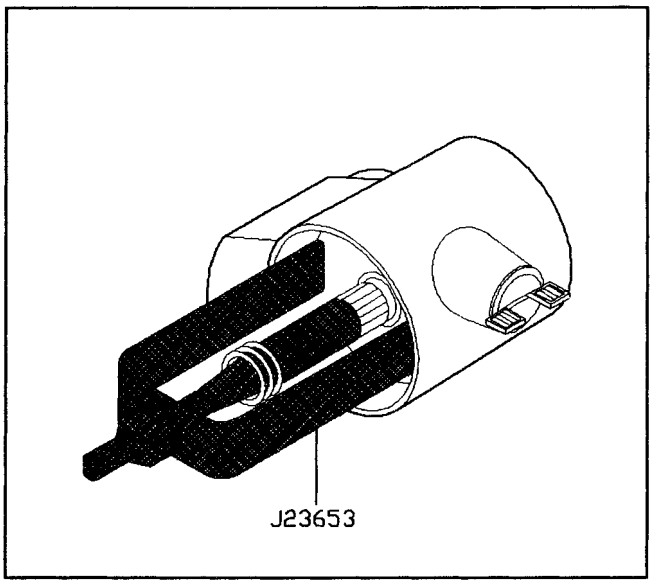

367752

4. Remove the lock bolt guard (1) from the steering column (2).

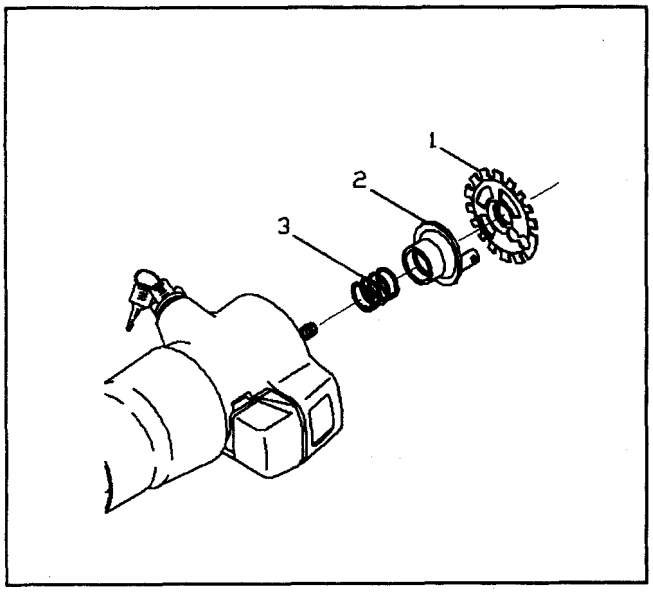



367718

5. Compress the shaft lock cam using *J 23653 - 91* and *J 23653-SIR.*
6. Remove the bearing retainer (1) from the steering shaft assembly.
7. Dispose of the bearing retainer (1).
8. Remove *J 23653 - 91* and *J 23653-SIR.*

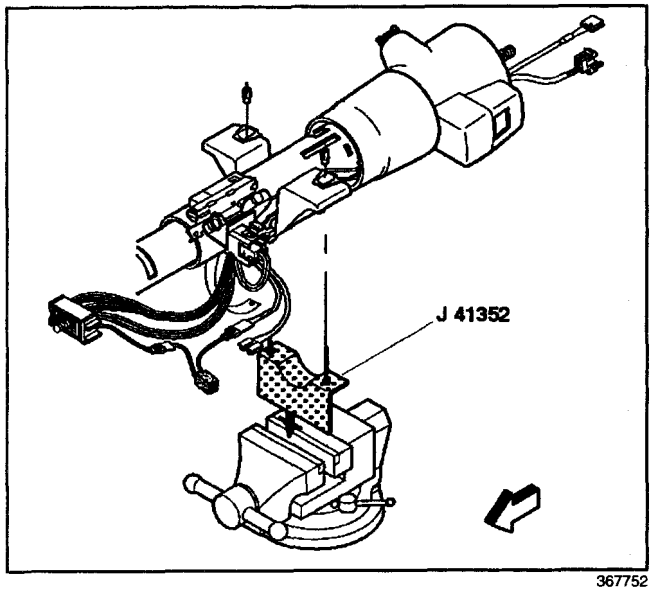



343728




344003

9. Remove the shaft lock cam (1) from the steering shaft assembly.
10. Remove the turn signal cancel cam assembly (2) from the steering shaft assembly.
11. Remove the upper bearing spring (3) from the steering shaft assembly.




367752

## Turn Signal Cancel Cam, Upper Bearing Inner Race Disassemble (Floor Shift)

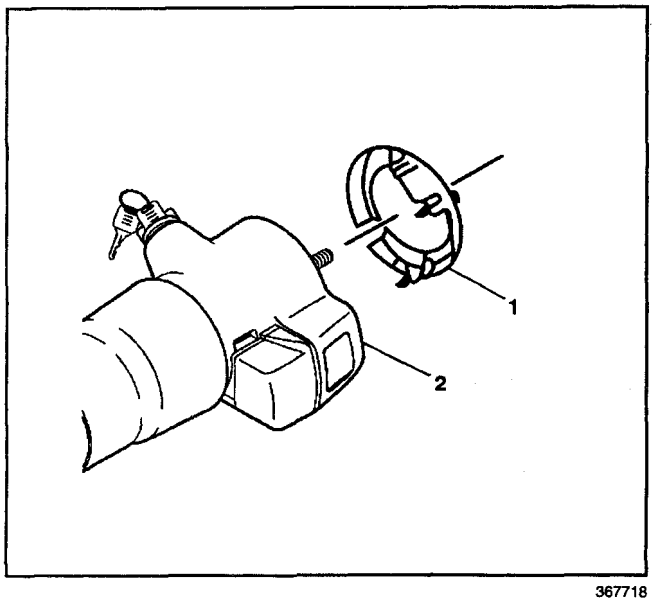
**Tools Required**

- *J 41352* Modular Column Holding Fixture
- *J 23653-SIR* Lock Plate Compressor
- *J 23653 - 91* Lock Plate Compressor Adapter

1. Set the steering column and *J 41352* into a vise.

**Important:** The column must be in the center position.

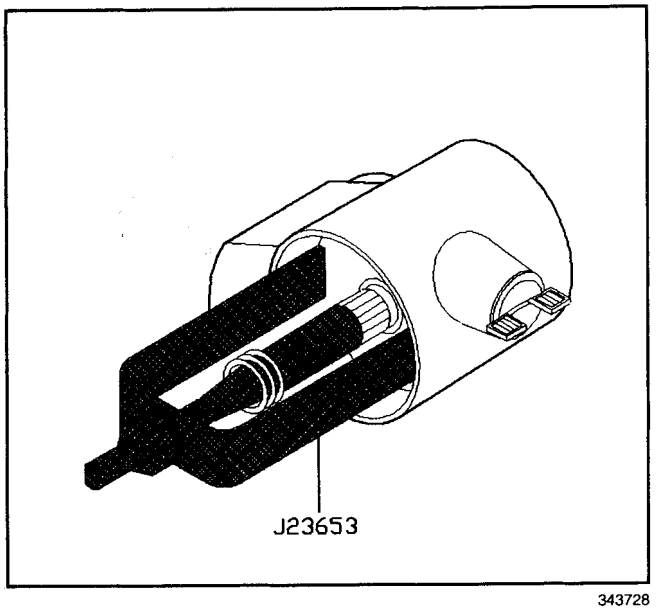
2. Remove only those components necessary to do the repairs.
3. Check the steering column jacket assembly for accident damage. Refer to *Steering Column Accident Damage - Off Vehicle.*




367718

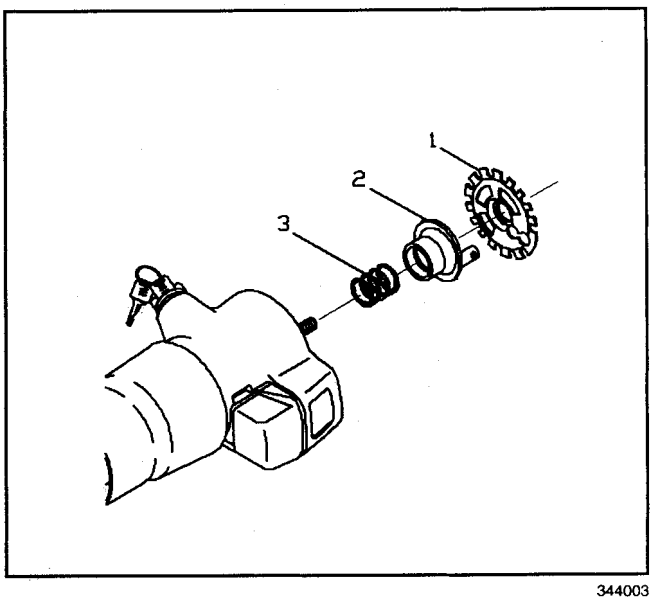
4. Remove the lock bolt guard (1) from the steering column (2).

5. Compress the shaft lock cam using *J 23653 - 91* and *J 23653-SIR*.
6. Remove the bearing retainer (1) from the steering shaft assembly.
7. Dispose of the bearing retainer (1).
8. Remove *J 23653 - 91* and *J 23653-SIR*.



343728

9. Remove the shaft lock cam (1) from the steering shaft assembly.
10. Remove the turn signal cancel cam assembly (2) from the steering shaft assembly.
11. Remove the upper bearing spring (3) from the steering shaft assembly.



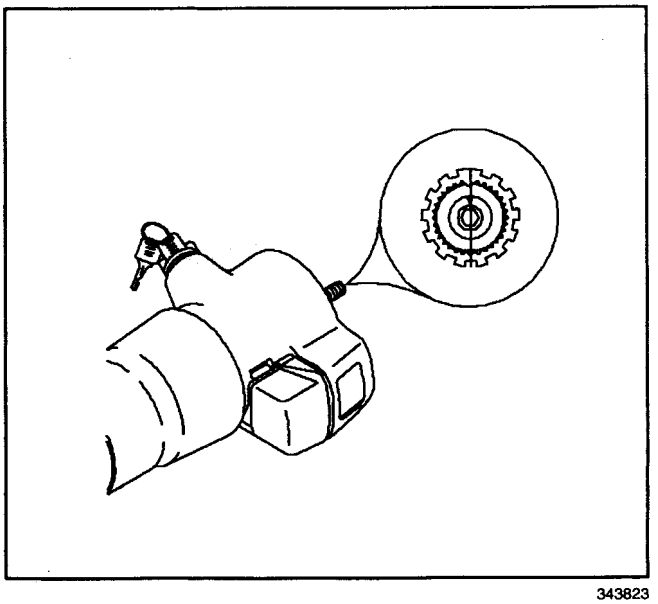
344003

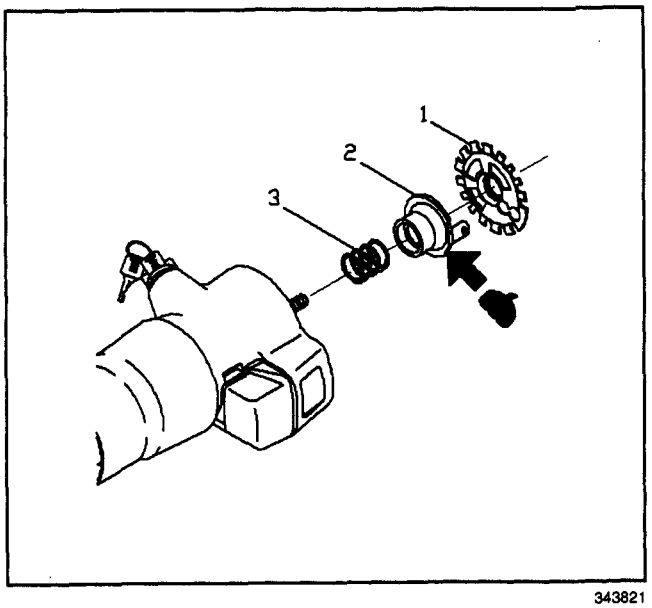
## Turn Signal Cancel Cam, Upper Bearing Inner Race Assemble - Off Vehicle (Column Shift)

**Tools Required**

- *J 41352* Modular Column Holding Fixture
- *J 23653-SIR* Lock Plate Compressor
- *J 23653 - 91* Lock Plate Compressor Adapter

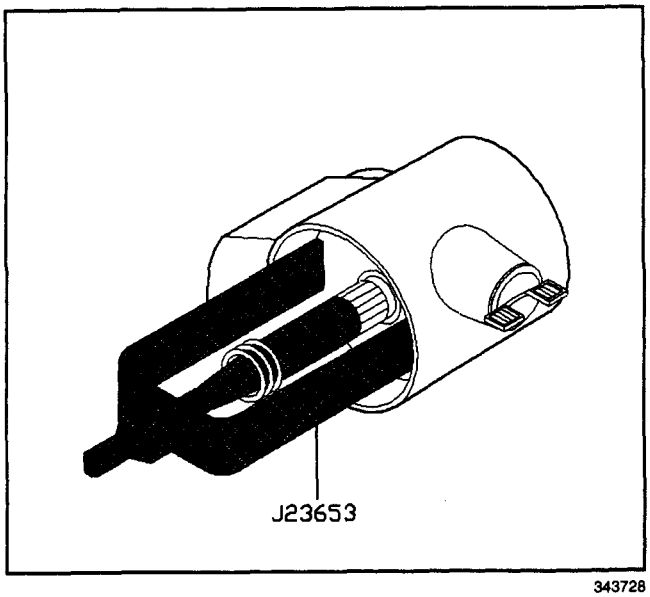
1. Align the block tooth on the steering shaft assembly to the 12 o'clock position.


343823



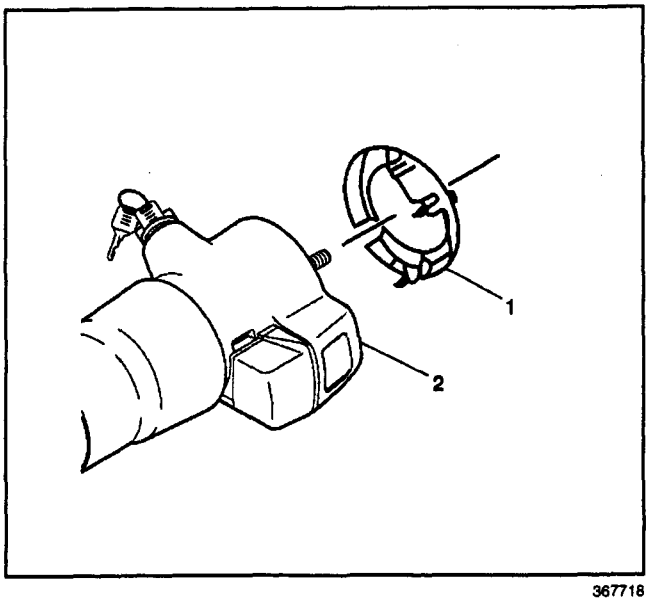

343821

2. Install the upper bearing spring (3) onto the steering shaft assembly.
3. Lubricate the turn signal cancel cam assembly (2) with lithium grease.
4. Install the turn signal cancel cam assembly (2) onto the steering shaft assembly.
5. Install the shaft lock cam (1) onto the steering shaft assembly.




343728

6. Compress the shaft lock cam using *J 23653 - 91* and *J 23653-SIR*.
7. Install the new bearing retainer (1) into the groove on the steering shaft assembly.
8. Remove *J 23653 - 91* and *J 23653-SIR*.




367718

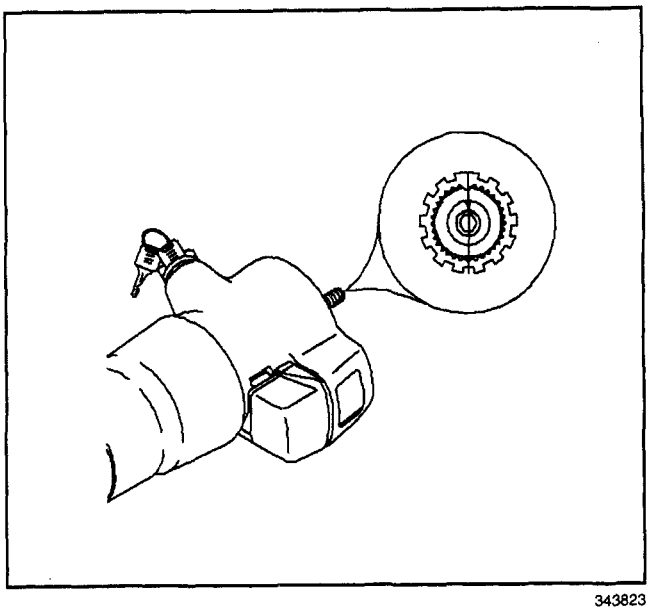
9. Install the lock bolt guard assembly (1) to the steering column (2).
10. Remove the steering column and *J 41352* from the vise.

## Turn Signal Cancel Cam, Upper Bearing Inner Race Assemble - Off Vehicle (Floor Shift)

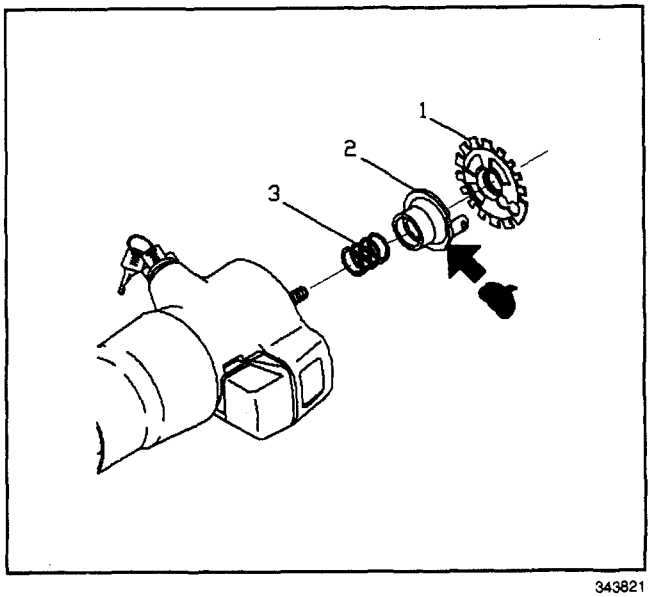
### Tools Required

- *J 41352* Modular Column Holding Fixture
- *J 23653-SIR* Lock Plate Compressor
- *J 23653 - 91* Lock Plate Compressor Adapter

1. Align the block tooth on the steering shaft assembly to the 12 o'clock position.

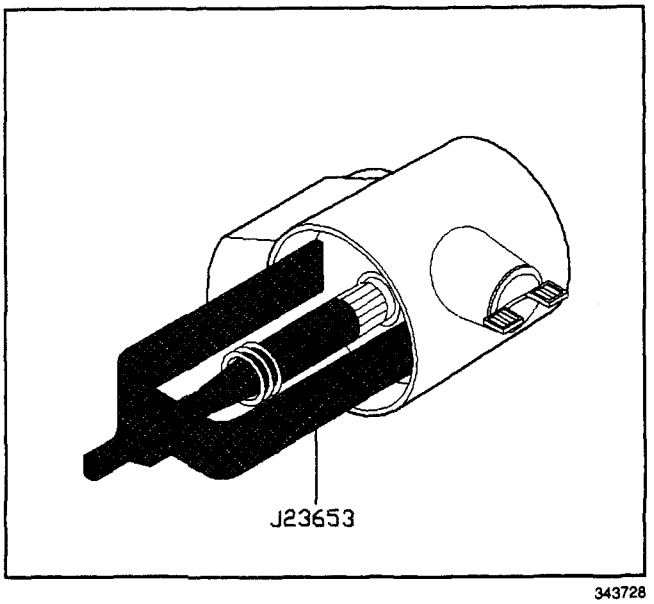

343823

2. Install the upper bearing spring (3) onto the steering shaft assembly.
3. Lubricate the turn signal cancel cam assembly (2) with lithium grease.
4. Install the turn signal cancel cam assembly (2) onto the steering shaft assembly.
5. Install the shaft lock cam (1) onto the steering shaft assembly.

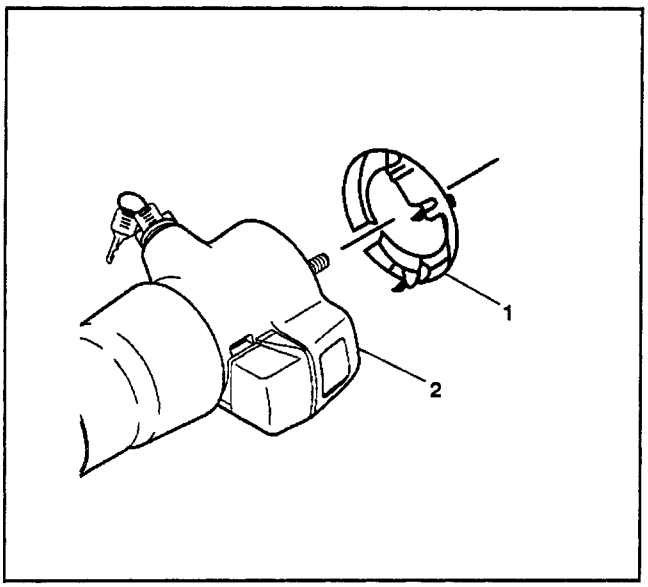


343821

6. Compress the shaft lock cam using *J 23653 - 91* and *J 23653-SIR*.
7. Install the new bearing retainer (1) into the groove on the steering shaft assembly.
8. Remove *J 23653 - 91* and *J 23653-SIR*.

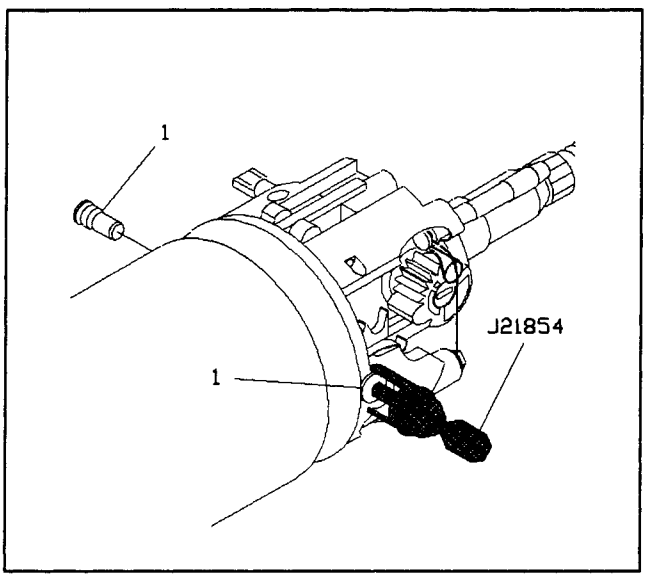


343728




367718

9. Install the lock bolt guard assembly (1) to the steering column (2).
10. Remove the steering column and *J 41352* from the vise.




343869

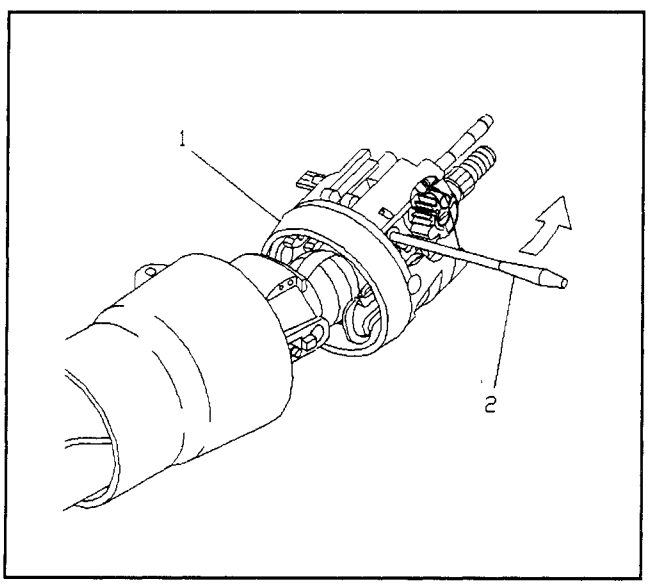
## Steering Column Housing - Disassemble (Column Shift)

### Disassembly Procedure

#### Tools Required

- *J 38639* Steering Column Housing Bearing Installer
- *J 8092* Driver Handle
- *J 22635* Lock Shoe and Release Lever Pin Remover and Installer
- *J 21854 - 01* Pivot Pin Remover

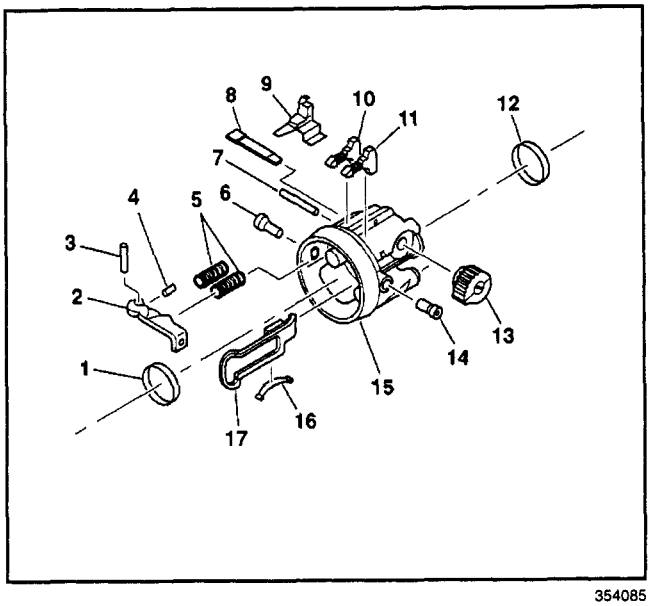
1. Remove the pivot and pulse switch assembly. Refer to *Pivot and Pulse Switch Assembly - Disassemble - Off Vehicle (Column Shift).*
2. Remove the tilt spring assembly only. Refer to *Tilt Spring - Disassemble (Column Shift).*
3. Remove only those components necessary to do the repairs.
4. Remove 2 pivot pins (1) using *J 21854 - 01.*




344138

5. Install the tilt lever (2).
6. Pull back on the tilt lever (2) and pull the steering column housing assembly (1) away from the steering column.
7. Remove the tilt lever (2).

8. Disassemble the steering column housing assembly, if needed:
   8.1. Remove the bearing assembly (12).
   8.2. Remove the wire protector shield (9).
   8.3. Remove the switch actuator rack (17) and the rack preload spring (16).
   8.4. Remove the drive shaft (8).
   8.5. Remove the switch actuator sector (13).
   8.6. Remove the release lever pin (3) using *J 22635*.
   8.7. Remove the shoe release lever (2).
   8.8. Remove the release lever spring (4).
   8.9. Remove the dowel pin (7).
   8.10. Remove the steering wheel lock shoes (10) and (11) using *J 22635* and the shoe springs (5).
   8.11. Remove the bearing assembly (1).



354085

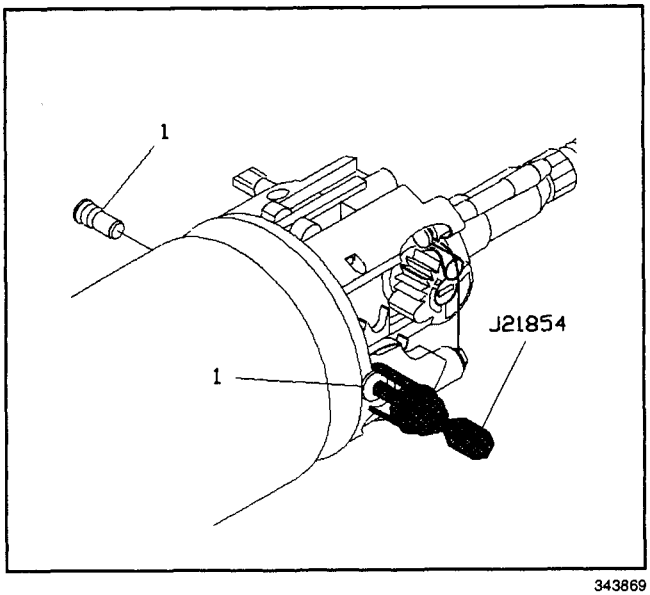
## Steering Column Housing - Disassemble (Floor Shift)

### Disassembly Procedure

**Tools Required**

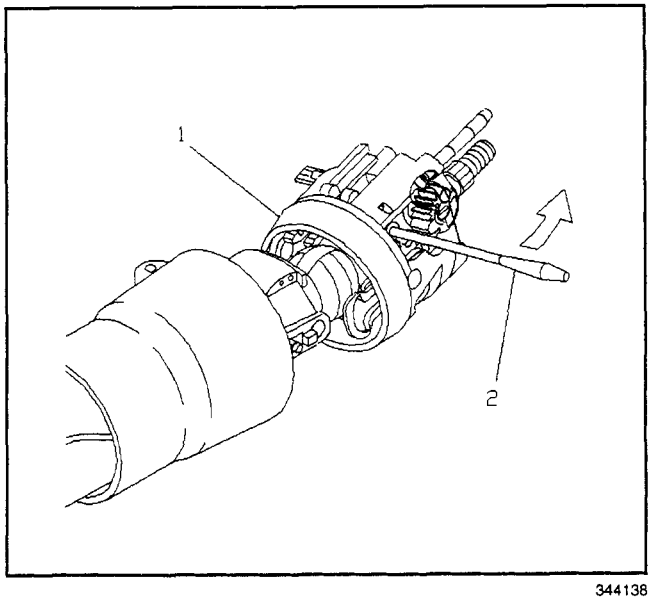
- *J 38639* Steering Column Housing Bearing Installer
- *J 8092* Driver Handle
- *J 22635* Lock Shoe and Release Lever Pin Remover and Installer
- *J 21854 - 01* Pivot Pin Remover

1. Remove the pivot and pulse switch assembly. Refer to *Pivot and Pulse Switch Assembly - Disassemble - Off Vehicle (Floor Shift)*.
2. Remove the tilt spring assembly only. Refer to *Tilt Spring - Disassemble (Floor Shift)*.
3. Remove only those components necessary to do the repairs.
4. Remove 2 pivot pins (1) using *J 21854 - 01*.

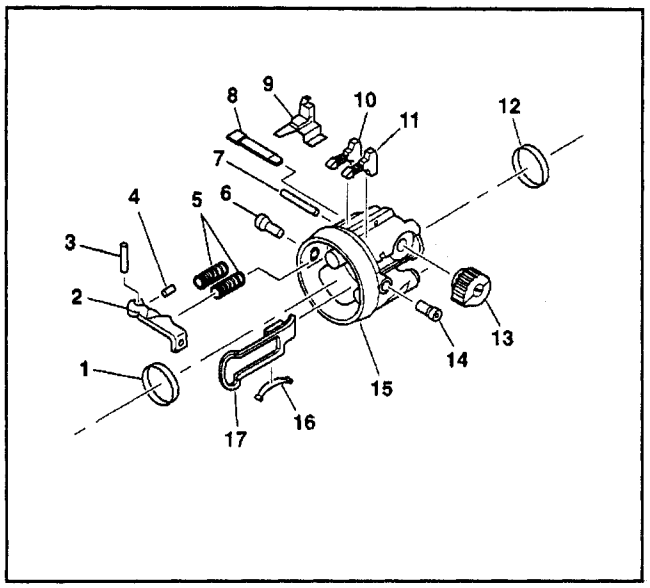


343869

5. Install the tilt lever (2).
6. Pull back on the tilt lever (2) and pull the steering column housing assembly (1) away from the steering column.
7. Remove the tilt lever (2).

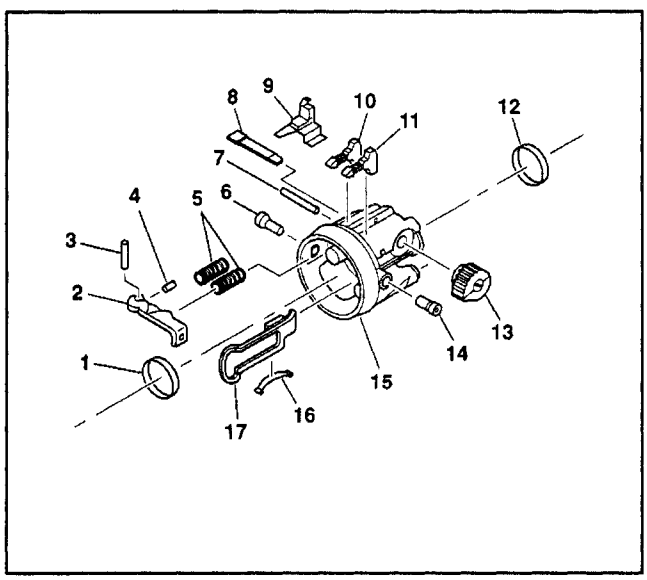


344138




354085

8. Disassemble the steering column housing assembly, if needed:
   8.1. Remove the bearing assembly (12).
   8.2. Remove the wire protector shield (9).
   8.3. Remove the switch actuator rack (17) and the rack preload spring (16).
   8.4. Remove the drive shaft (8).
   8.5. Remove the switch actuator sector (13).
   8.6. Remove the release lever pin (3) using *J 22635*.
   8.7. Remove the shoe release lever (2).
   8.8. Remove the release lever spring (4).
   8.9. Remove the dowel pin (7).
   8.10. Remove the steering wheel lock shoes (10) and (11) using *J 22635* and the shoe springs (5).
   8.11. Remove the bearing assembly (1).




354085

## Steering Column Housing - Assemble (Column Shift)

### Assembly Procedure

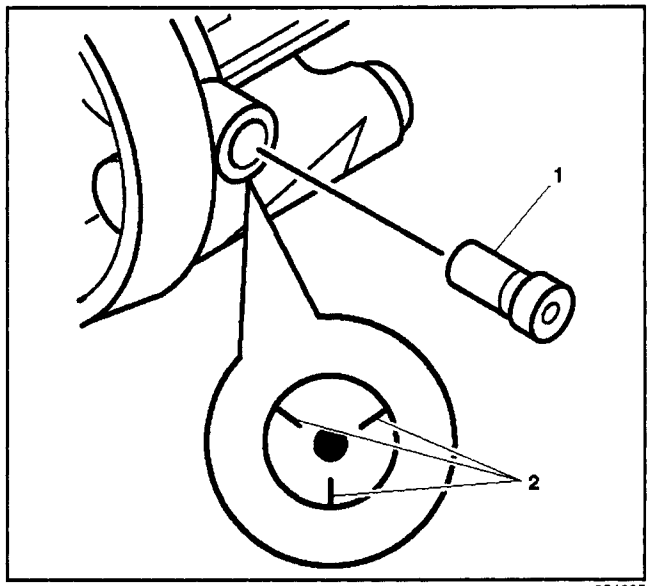
#### Tools Required

- *J 38639* Steering Column Housing Bearing Installer
- *J 8092* Driver Handle
- *J 22635* Lock Shoe and Release Lever Pin Remover and Installer
- *J 21854 - 01* Pivot Pin Remover

1. To assemble the steering column housing assembly, if needed:
2. Install the bearing assembly (1)
3. Install the shoe springs (5).
4. Install the steering wheel lock shoes (10) and (11).
5. Install the dowel pin (7).
6. Install the release lever spring (4).
7. Install the shoe release lever (2).
8. Install the lever pin (3) using *J 22635*.
9. Install the drive shaft (8).
10. Install the switch actuator sector (13).
11. Install the rack preload spring (16).
12. Install the switch actuator rack (17) to the switch actuator sector (13).
13. Install the bearing assembly (12) using *J 8092* and *J 38639*.
14. Install the wire protector shield (9).

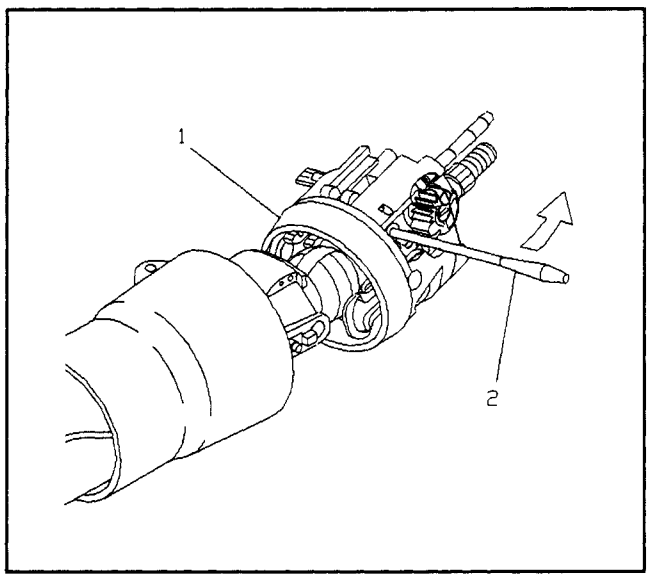
**Important:** If the steering column housing assembly has been staked 3 times it must be replaced.

15. Stake the steering column housing assembly in 3 places (2) so you may install the pivot pins (1).



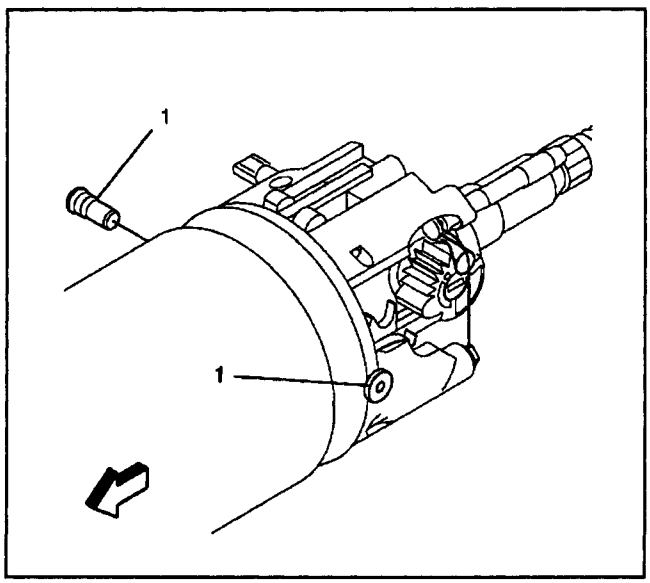
354605

16. Install the steering column housing assembly:
    - 16.1. Install the tilt lever (2).
    - 16.2. Position the steering column housing assembly (1) onto the steering column housing support.
    - 16.3. Align the switch actuator rack with the pin on the end of the ignition switch actuator assembly.
    - 16.4. Pull back on the tilt lever (2) to position the steering column housing assembly (1).
    - 16.5. Push the steering column housing assembly (1) into the steering column housing support.
    - 16.6. Release the tilt lever (2) to lock the steering wheel lock shoes and the dowel pin.
    - 16.7. Remove the tilt lever (2).

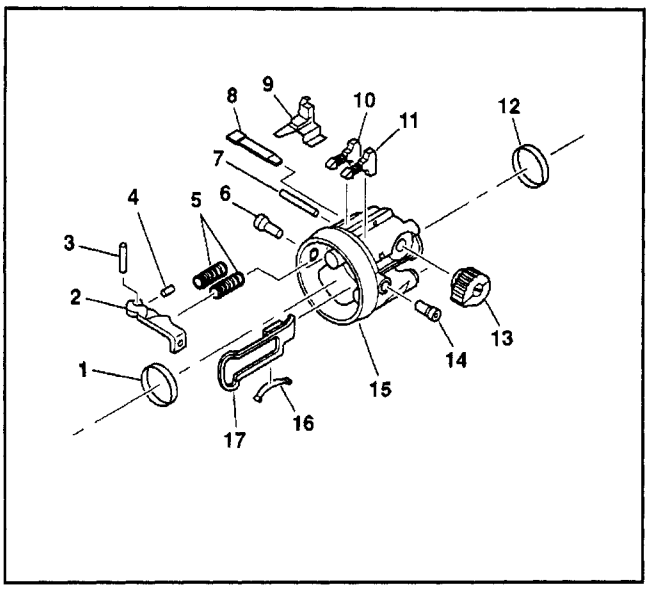


344138

17. Install 2 pivot pins (1).
18. Press the 2 pivot pins (1) until they are firmly seated.
19. Install the tilt spring assembly only. Refer to *Tilt Spring - Assemble (Column Shift)*.
20. Install the pivot and pulse switch assembly. Refer to *Pivot and Pulse Switch Assembly - Assemble - Off Vehicle (Column Shift)*.



352626




354085

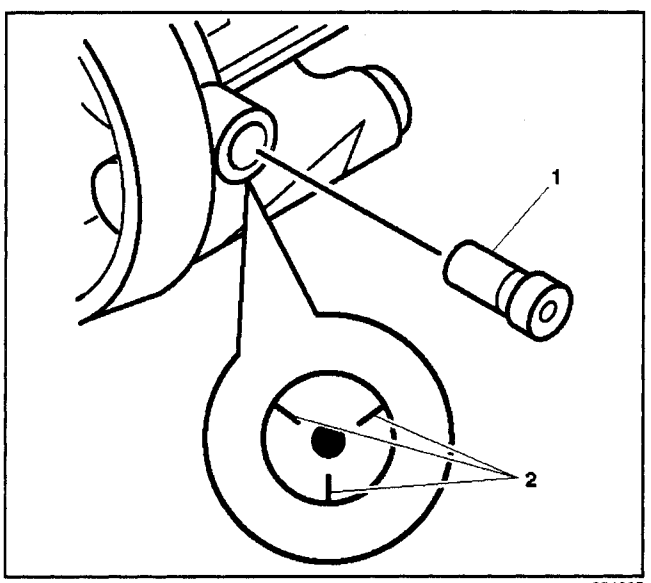
## Steering Column Housing - Assemble (Floor Shift)

### Assembly Procedure

#### Tools Required

- *J 38639* Steering Column Housing Bearing Installer
- *J 8092* Driver Handle
- *J 22635* Lock Shoe and Release Lever Pin Remover and Installer
- *J 21854 - 01* Pivot Pin Remover

1. To assemble the steering column housing assembly, if needed:
2. Install the bearing assembly (1)
3. Install the shoe springs (5).
4. Install the steering wheel lock shoes (10) and (11).
5. Install the dowel pin (7).
6. Install the release lever spring (4).
7. Install the shoe release lever (2).
8. Install the lever pin (3) using *J 22635.*
9. Install the drive shaft (8).
10. Install the switch actuator sector (13).
11. Install the rack preload spring (16).
12. Install the switch actuator rack (17) to the switch actuator sector (13).
13. Install the bearing assembly (12) using *J 8092* and *J 38639.*
14. Install the wire protector shield (9).

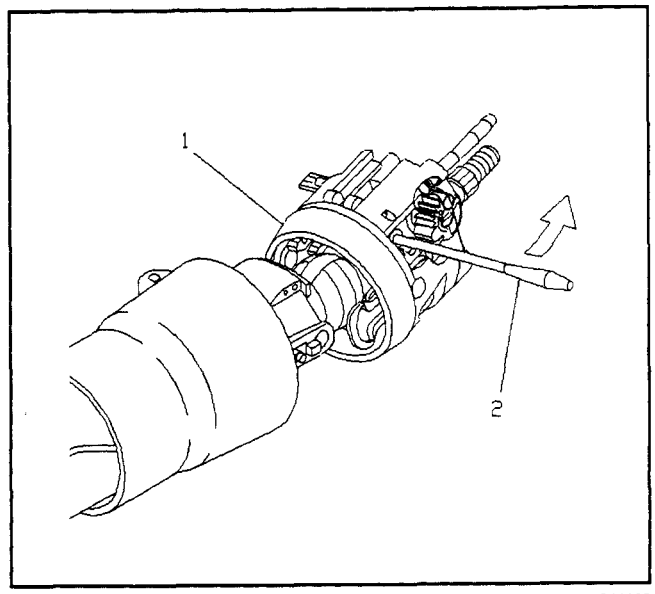



354605

**Important:** If the steering column housing assembly has been staked 3 times it must be replaced.

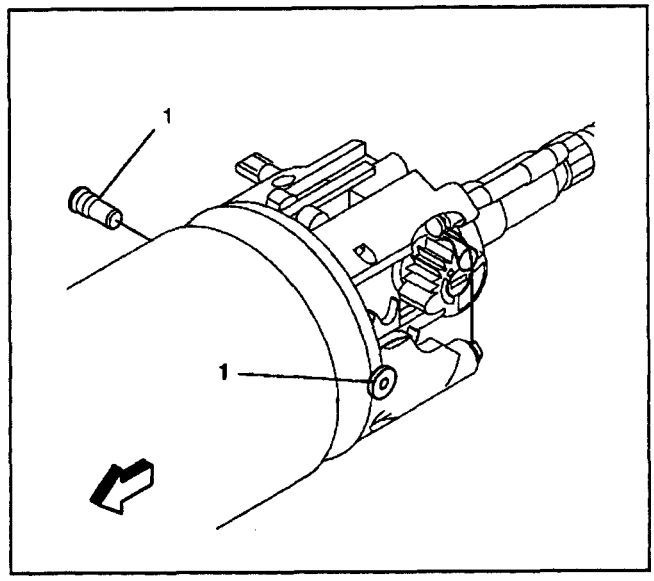
15. Stake the steering column housing assembly in 3 places (2) so you may install the pivot pins (1).

16. Install the steering column housing assembly:
    16.1. Install the tilt lever (2).
    16.2. Position the steering column housing assembly (1) onto the steering column housing support.
    16.3. Align the switch actuator rack with the pin on the end of the ignition switch actuator assembly.
    16.4. Pull back on the tilt lever (2) to position the steering column housing assembly (1).
    16.5. Push the steering column housing assembly (1) into the steering column housing support.
    16.6. Release the tilt lever (2) to lock the steering wheel lock shoes and the dowel pin.
    16.7. Remove the tilt lever (2).



344138

17. Install 2 pivot pins (1).
18. Press the 2 pivot pins (1) until they are firmly seated.
19. Install the tilt spring assembly only. Refer to *Tilt Spring - Assemble (Floor Shift)*.
20. Install the pivot and pulse switch assembly. Refer to *Pivot and Pulse Switch Assembly - Assemble - Off Vehicle (Floor Shift)*.

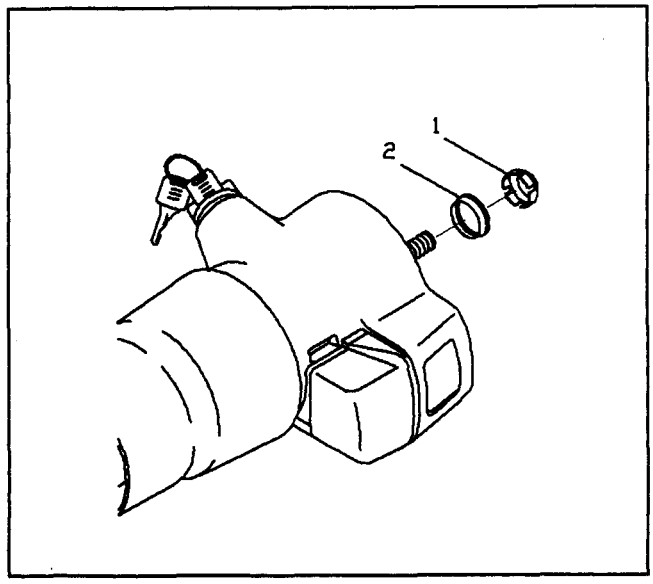


352626

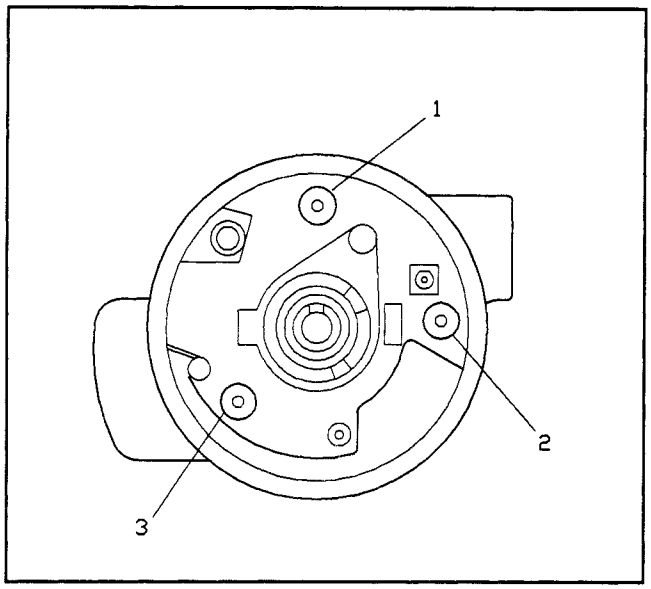
## Lock Housing Assembly - Disassemble (Column Shift)

### Disassembly Procedure

1. Remove the steering column lock cylinder set. Refer to *Steering Column Lock Cylinder Set - Disassemble (Column Shift)*.
2. Remove the upper bearing inner race seat (1) from the steering shaft assembly.
3. Remove the inner race (2) from the steering shaft assembly.

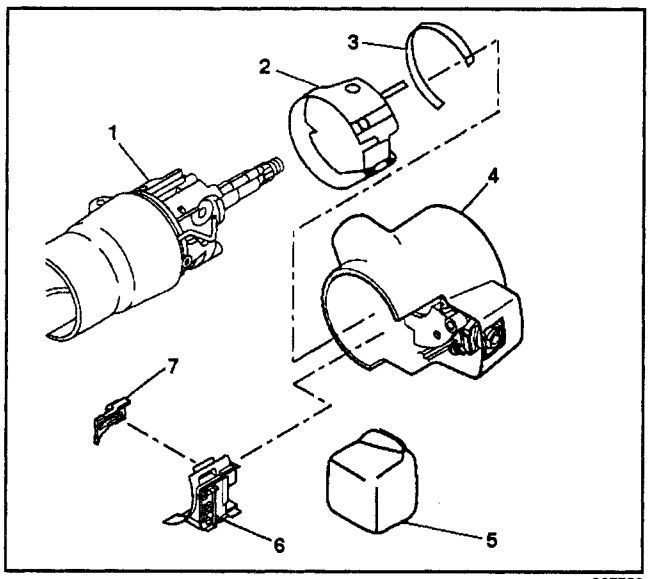


344004



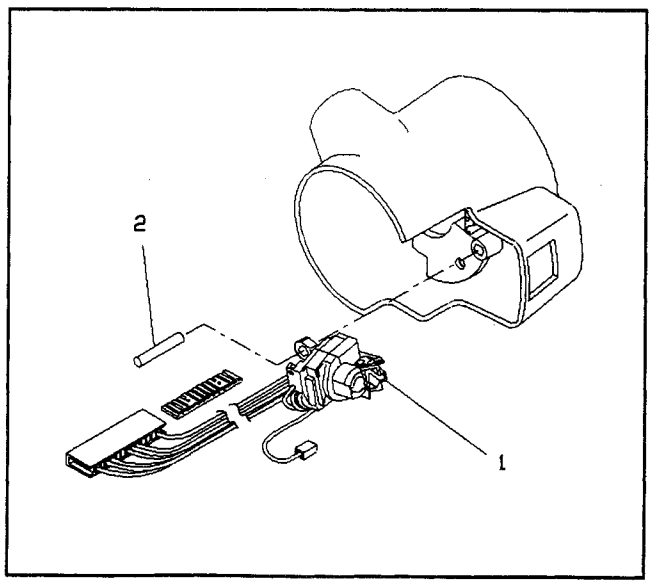

343832

4. Remove 3 pan head 6 lobe soc tap screws (1) from the lock housing cover assembly.




367758

5. Remove the lock housing cover assembly (4) from the steering column (1).
6. Remove the cover trim ring (3).
7. Remove the pin and cover liner assembly (2).
8. Remove the column housing cover end cap (5).
9. Remove the column housing cover end base plate (6).
10. Remove the dimmer switch rod actuator (7) from the lock housing cover assembly (4).



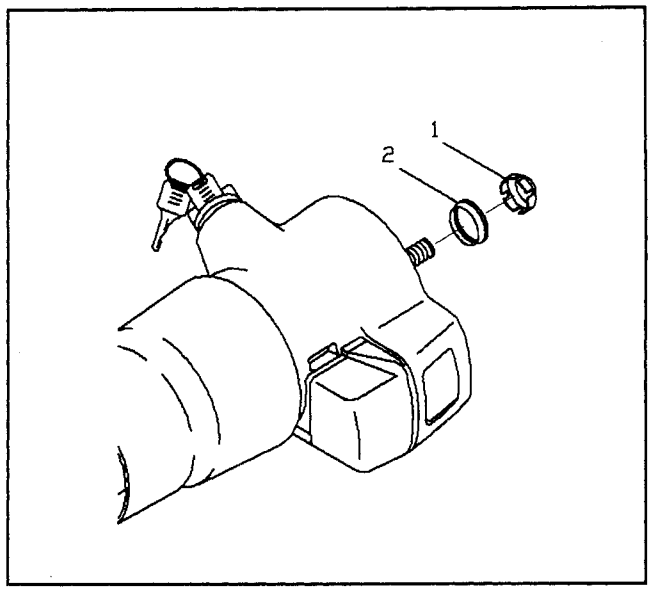

343835

11. Remove the switch actuator pivot pin (2) from the dimmer switch assembly (1).

## Lock Housing Assembly - Disassemble (Floor Shift)

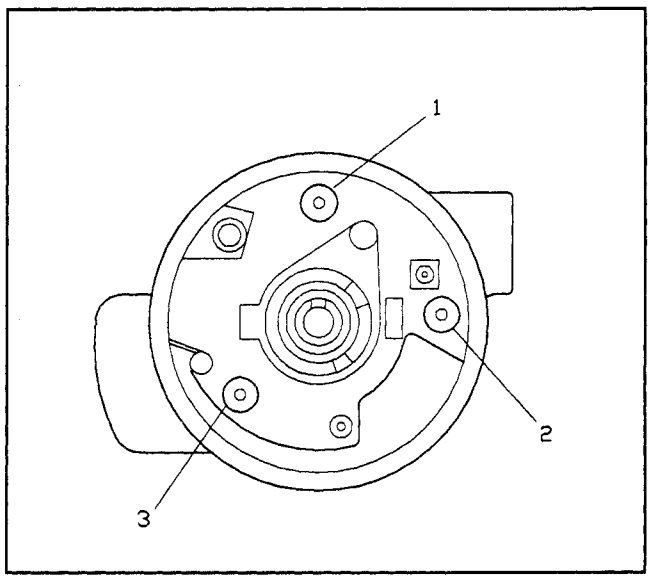
### Disassembly Procedure

1. Remove the steering column lock cylinder set. Refer to *Steering Column Lock Cylinder Set - Disassemble (Floor Shift)*.
2. Remove the upper bearing inner race seat (1) from the steering shaft assembly.
3. Remove the inner race (2) from the steering shaft assembly.



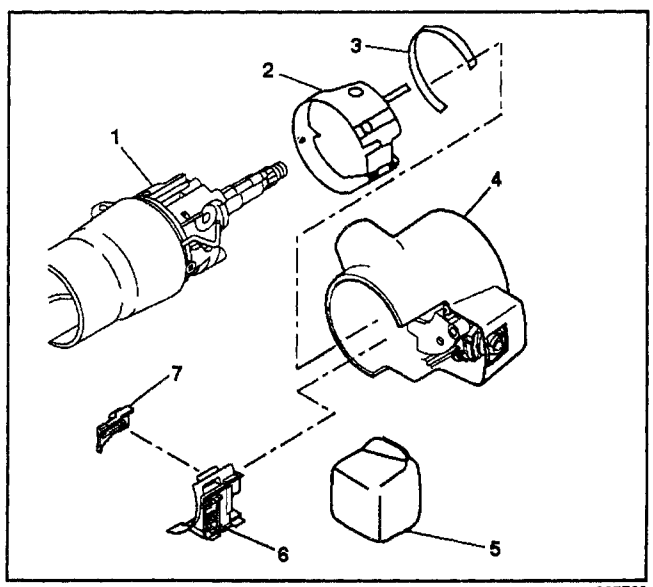
344004

4. Remove 3 pan head 6 lobe soc tap screws (1) from the lock housing cover assembly.

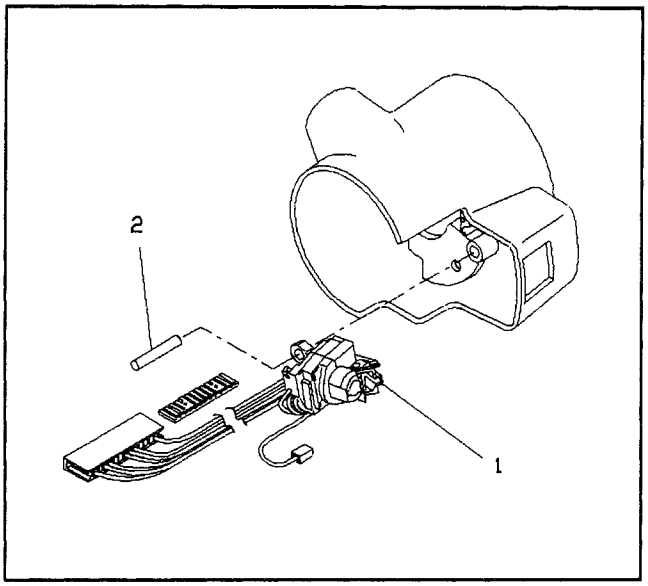


343832

5. Remove the lock housing cover assembly (4) from the steering column (1).
6. Remove the cover trim ring (3).
7. Remove the pin and cover liner assembly (2).
8. Remove the column housing cover end cap (5).
9. Remove the column housing cover end base plate (6).
10. Remove the dimmer switch rod actuator (7) from the lock housing cover assembly (4).

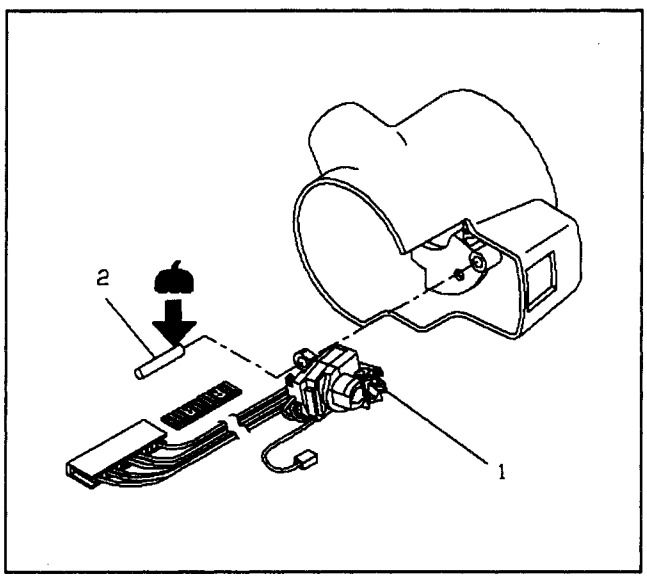


367758




343835

11. Remove the switch actuator pivot pin (2) from the dimmer switch assembly (1).

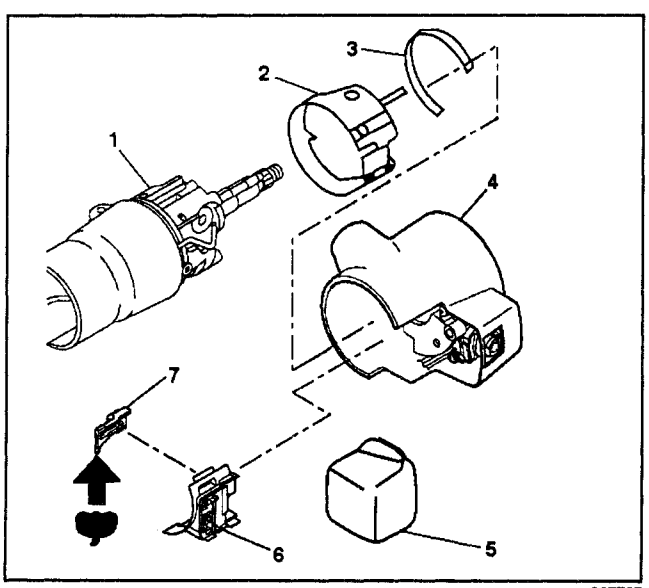



343861

## Lock Housing Assembly - Assemble (Column Shift)

### Assembly Procedure

1. Lubricate the switch actuator pivot pin (2) with lithium grease.
2. Install the switch actuator pivot pin (2) to the dimmer switch assembly (1).




367767

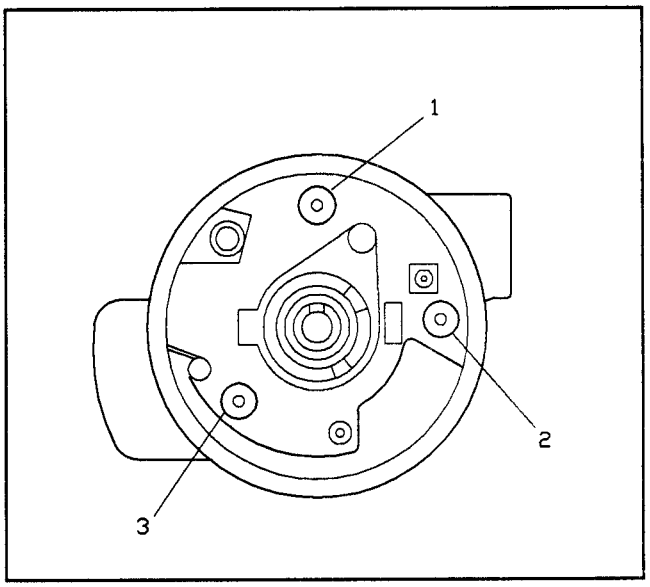
3. Install the pin and cover liner assembly (2) onto the steering column (1).
4. Install the cover trim ring (3) to the pin and cover liner assembly (2)
5. Align the lock housing cover assembly (4) onto the steering column (1).
6. Lubricate the dimmer switch rod actuator (7) with lithium grease.
7. Install the dimmer switch rod actuator (7) into the lock housing cover assembly (4).
8. Align the dimmer switch rod actuator (7) with the dimmer switch actuator rod.
9. Install the column housing cover end base plate (6).
10. Install the column housing cover end cap (5) to the lock housing cover assembly (4).

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

11. Install the lock housing cover assembly and secure using 3 pan head 6 lobe soc tap screws (1).

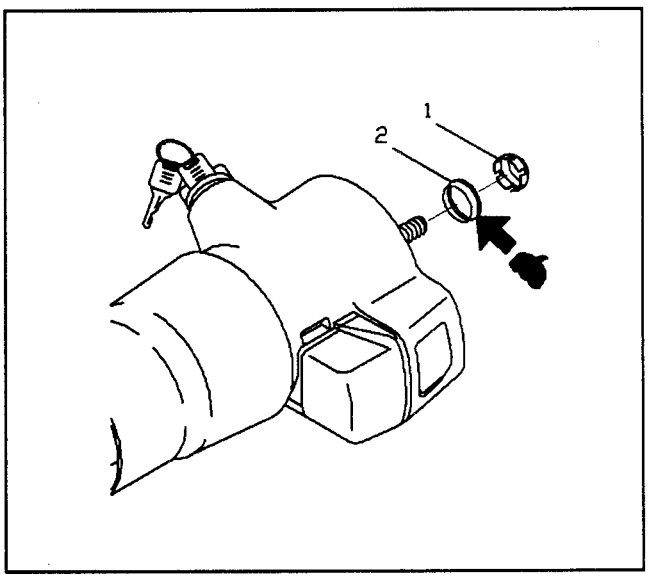
    **Tighten**

    Tighten the 3 pan head 6 lobe soc tap screws to 9 N·m (80 lb in).



343832

12. Lubricate the inner race (2) with lithium grease.
13. Install the inner race (2) to the steering shaft assembly.
14. Install the upper bearing inner race seat (1) to the steering shaft assembly.
15. Install the steering column lock cylinder set. Refer to *Steering Column Lock Cylinder Set - Assemble (Column Shift).*

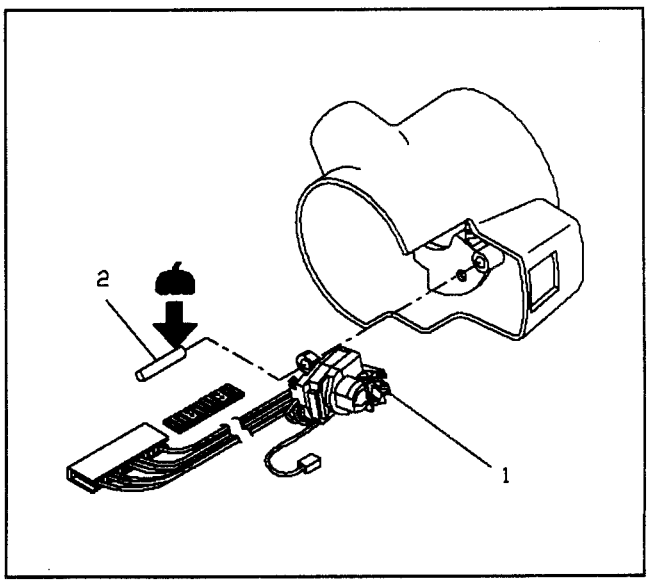


343818

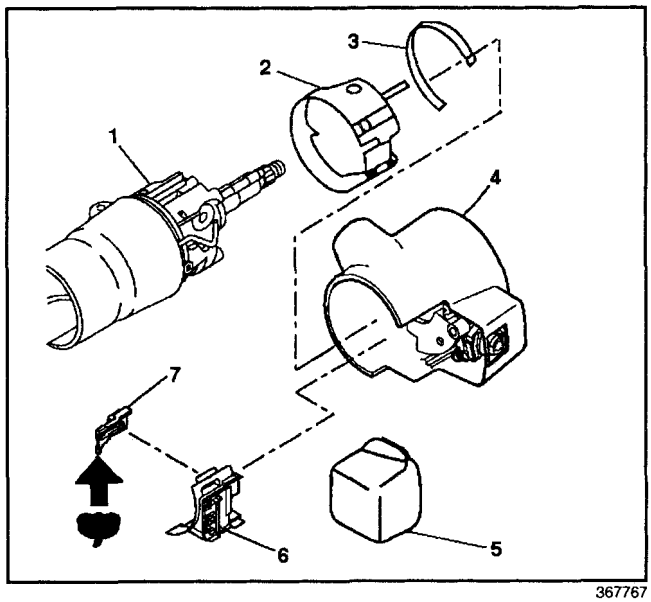
## Lock Housing Assembly - Assemble (Floor Shift)

### Assembly Procedure

1. Lubricate the switch actuator pivot pin (2) with lithium grease.
2. Install the switch actuator pivot pin (2) to the dimmer switch assembly (1).

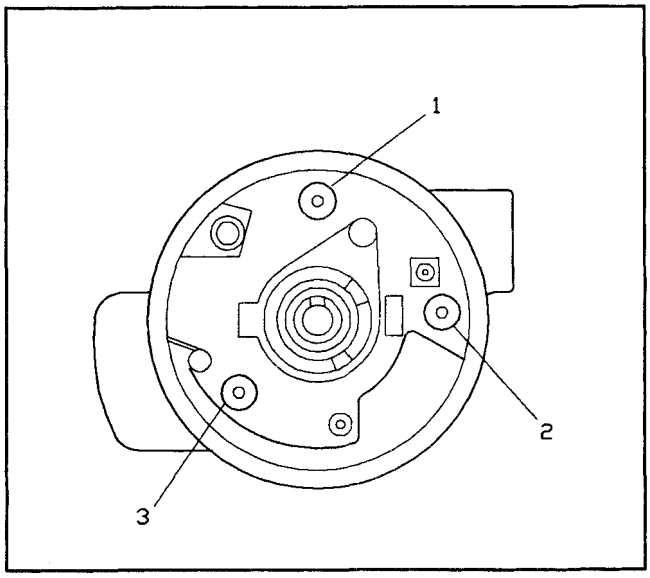


343861



367767

3. Install the pin and cover liner assembly (2) onto the steering column (1).
4. Install the cover trim ring (3) to the pin and cover liner assembly (2)
5. Align the lock housing cover assembly (1) onto the steering column (1).
6. Lubricate the dimmer switch rod actuator (7) with lithium grease.
7. Install the dimmer switch rod actuator (7) into the lock housing cover assembly (4).
8. Align the dimmer switch rod actuator (7) with the dimmer switch actuator rod.
9. Install the column housing cover end base plate (6).
10. Install the column housing cover end cap (5) to the lock housing cover assembly (4).



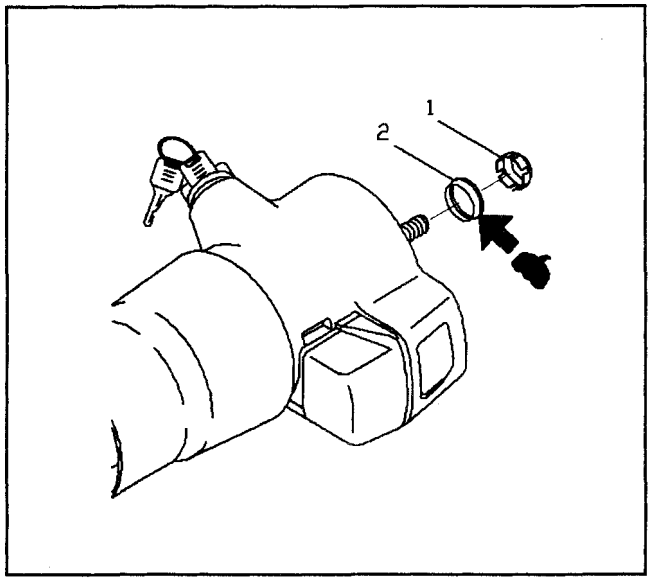
343832

***Notice:*** Refer to *Fastener Notice* Fastener Notice in Cautions and Notices.

11. Install the lock housing cover assembly and secure using 3 pan head 6 lobe soc tap screws (1).

    **Tighten**

    Tighten the 3 pan head 6 lobe soc tap screws to 9 N·m (80 lb in).



343818

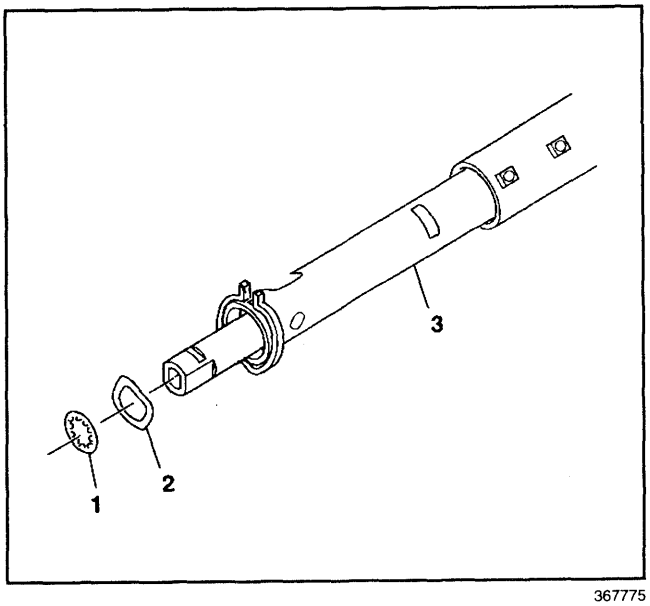
12. Lubricate the inner race (2) with lithium grease.
13. Install the inner race (2) to the steering shaft assembly.
14. Install the upper bearing inner race seat (1) to the steering shaft assembly.
15. Install the steering column lock cylinder set. Refer to *Steering Column Lock Cylinder Set - Assemble (Floor Shift).*

## Steering Shaft, Lower Bearing, Jacket-Disassemble (Column Shift)

### Disassembly Procedure

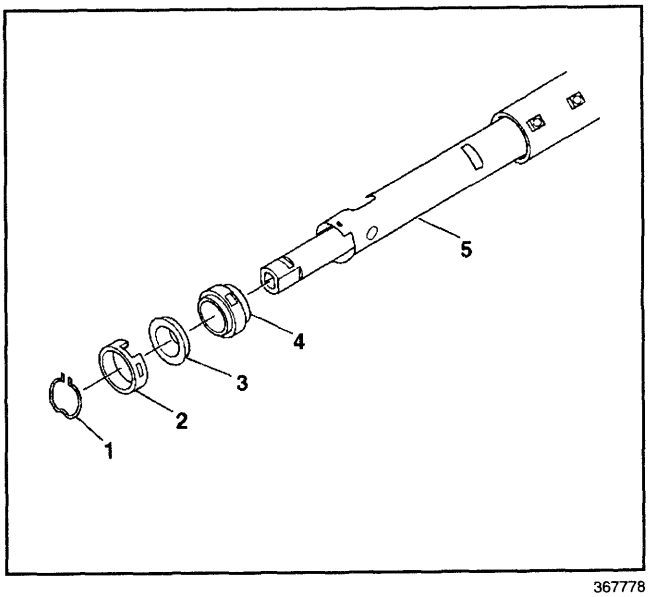
- *J 41688* Centering Sphere Installer Tool
- *J 23072* Shift Tube Remover

1. Remove the steering column housing assembly. Refer to *Steering Column Housing - Disassemble (Column Shift).*
2. Remove the lower spring retainer (1) from the steering column (3).
3. Dispose of the lower spring retainer ( 1).
4. Remove the bearing preload washer (2) from the steering column (3).



367775

5. Remove the lower bearing adapter clip (1) from the steering column (6).
6. Remove the bearing adapter retainer (2) from the steering column (6).
7. Remove the bearing assembly (3) from the steering column (6).
8. Remove the lower bearing adapter (4) from the steering column (6).

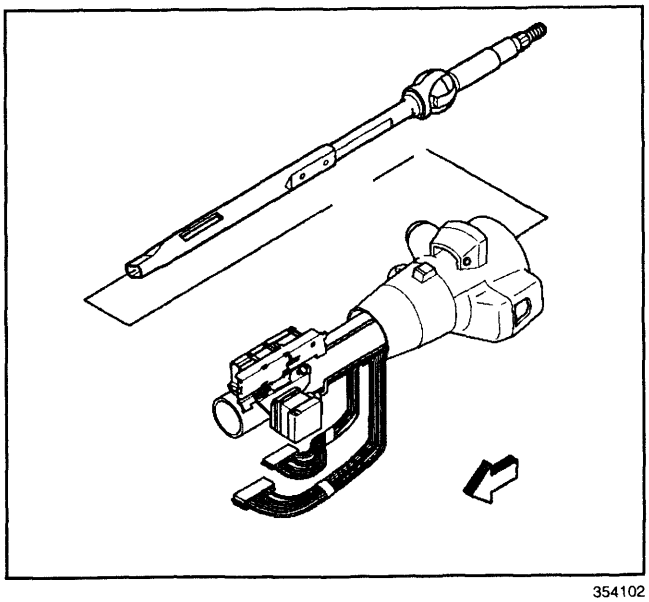


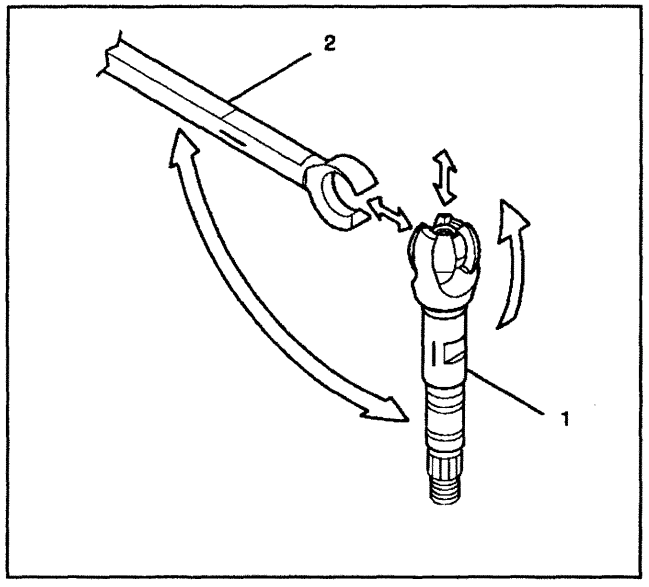
367778

9. Remove the steering shaft assembly.

**Important:** Mark the race and upper shaft assembly and the lower steering shaft assembly to ensure proper assembly. Failure to assemble properly will cause the steering wheel to be turned 180 degrees.

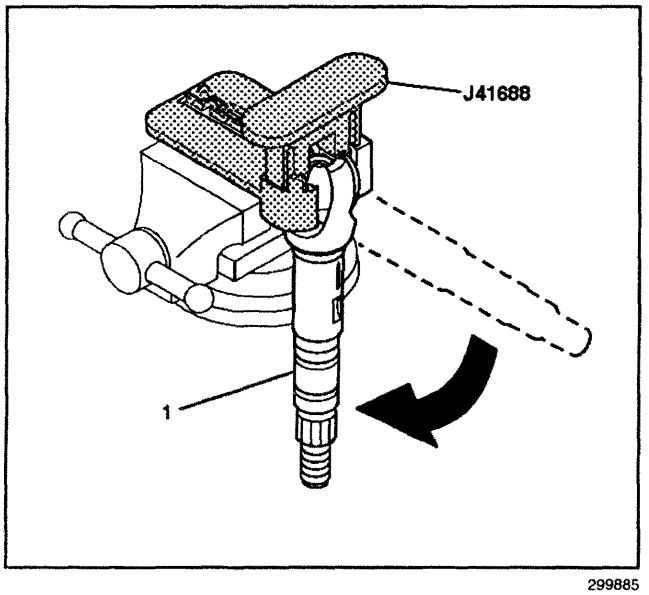
10. Mark the race and upper shaft assembly and the lower steering shaft assembly.
11. Check the steering column for accident damage. Refer to *Steering Column Accident Damage - Off Vehicle.*


354102



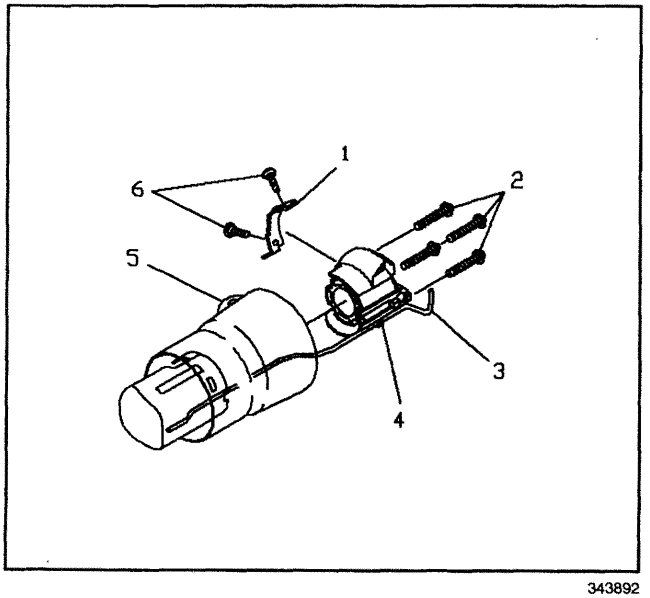

306318

12. Tilt the race and upper shaft assembly (1) 90 degrees to the lower steering shaft assembly (2) to disengage.




299885

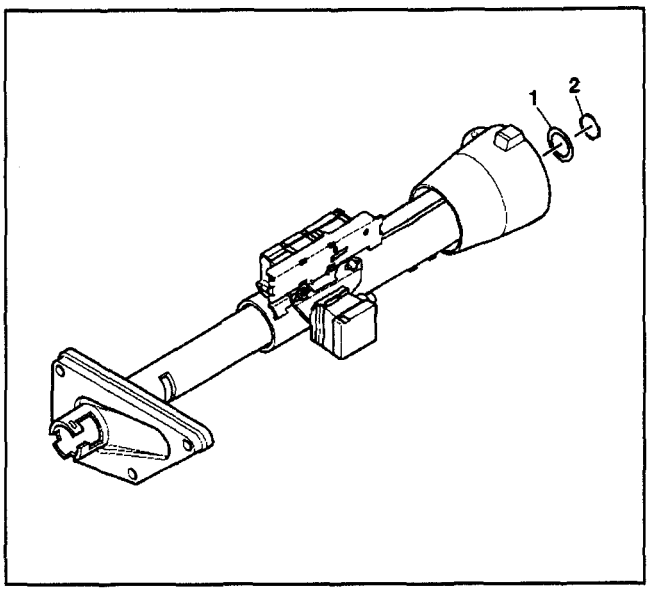
13. Insert the race and upper shaft assembly (1) into *J 41688.*
14. Rotate the race and upper shaft assembly (1) 90 degrees to disengage.




343892

15. Remove the 4 screw supports (2) from the steering column housing support.
16. Dispose of screws (2).
17. Remove 2 oval head cross recess screws (6) from the shift lever gate.
18. Remove the shift lever gate (1).
19. Remove the steering column housing support assembly (4) with the dimmer switch actuator rod (3) from the gearshift lever bowl assembly (5).
20. Remove the dimmer switch actuator rod (3) from the steering column housing support.

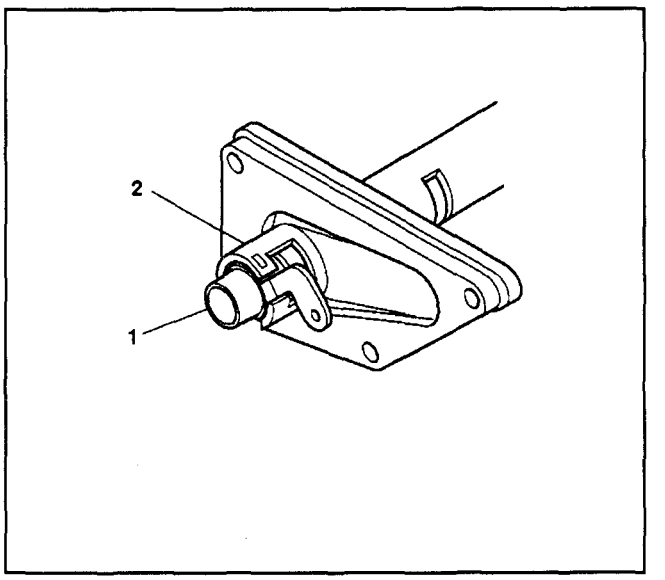
21. Remove the shift tube retaining ring (2).
22. Dispose of the shift tube retaining ring (2).
23. Remove the thrust washer (1)



354602

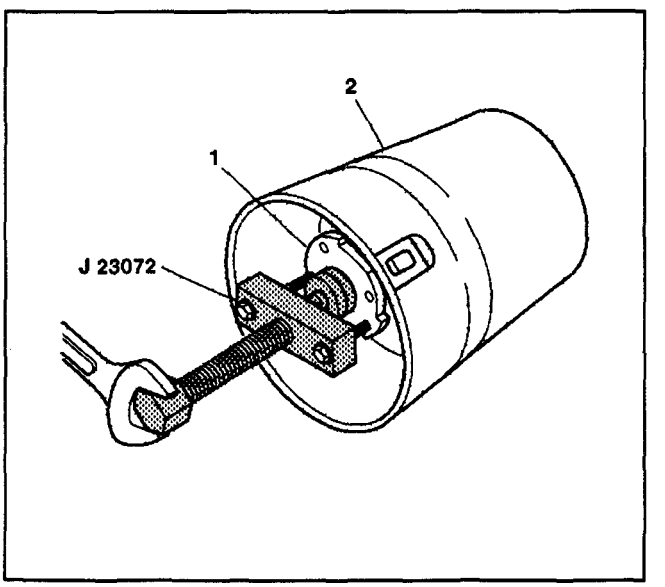
**Important:** The shift tube lever must be in position to clear the steering column jacket assembly for removal. Forcing the shift tube lever against the steering column jacket assembly may cause damage to the steering column jacket assembly.

24. Align the shift tube (1) to the gearshift lever bowl assembly (2).

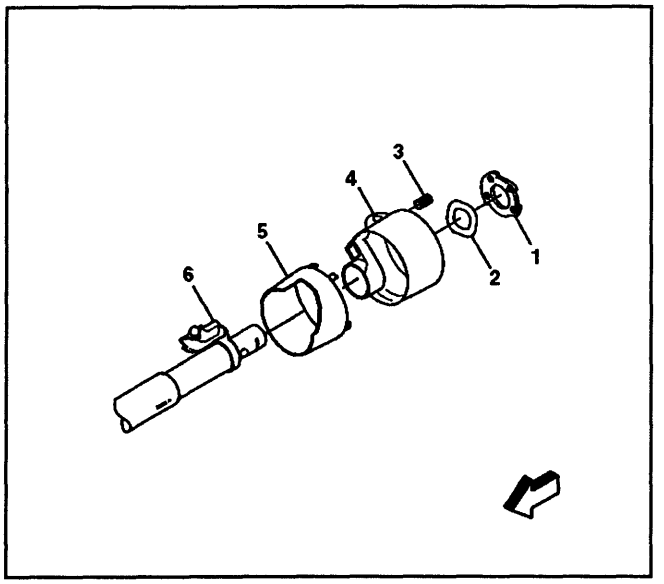


354091

25. Remove the shift tube (1) from the gearshift lever bowl assembly (2) using *J 23072*.

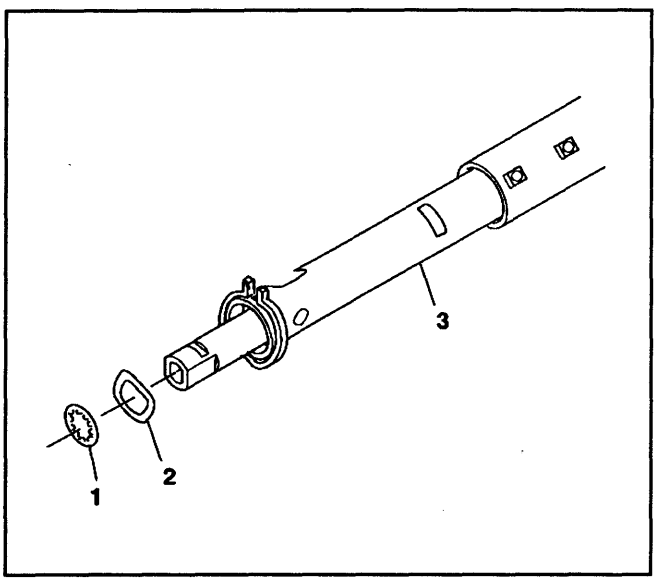


354590




354591

26. Remove the lock plate (1) from the gearshift lever bowl assembly (4).
27. Remove the wave washer (2).
28. Remove the gearshift lever bowl (4) assembly from the steering column jacket assembly (6).
29. Remove the gearshift bowl shroud (5) from the gearshift lever bowl assembly (4).
30. Remove the shift lever spring (3).




367775

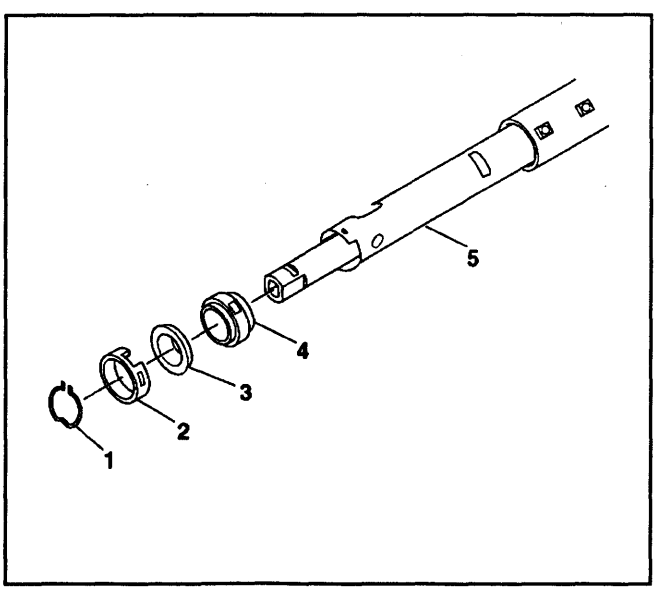
## Steering Shaft, Lower Bearing, Jacket-Disassemble (Floor Shift)

### Disassembly Procedure

#### Tools Required

*J 41688* Centering Sphere Installer Tool

1. Remove the steering column housing assembly. Refer to *Steering Column Housing - Disassemble (Floor Shift).*
2. Remove the lower spring retainer (1) from the steering column (3).
3. Dispose of the lower spring retainer (1).
4. Remove the bearing preload washer (2) from the steering column (3).



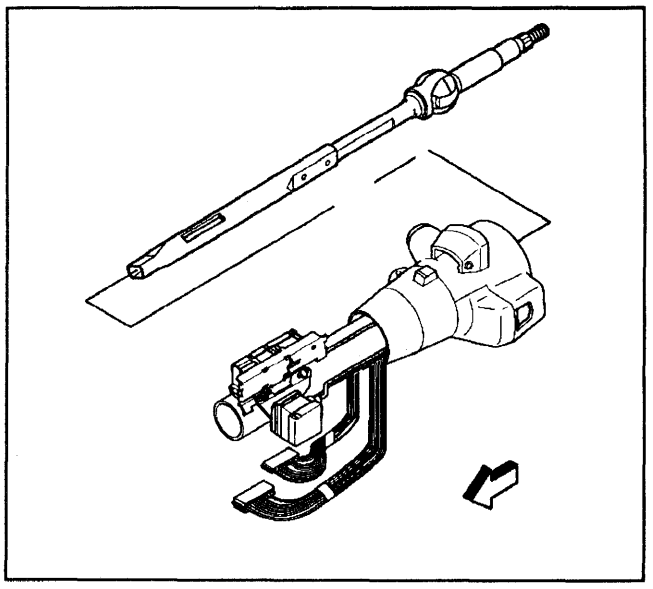

367778

5. Remove the lower bearing adapter clip (1) from the steering column jacket assembly (5).
6. Remove the bearing adapter retainer (2) from the steering column jacket assembly (5).
7. Remove the bearing assembly (3) from the steering column jacket assembly (5).
8. Remove the lower bearing adapter (4) from the steering column jacket assembly (5).

9. Remove the steering shaft assembly.

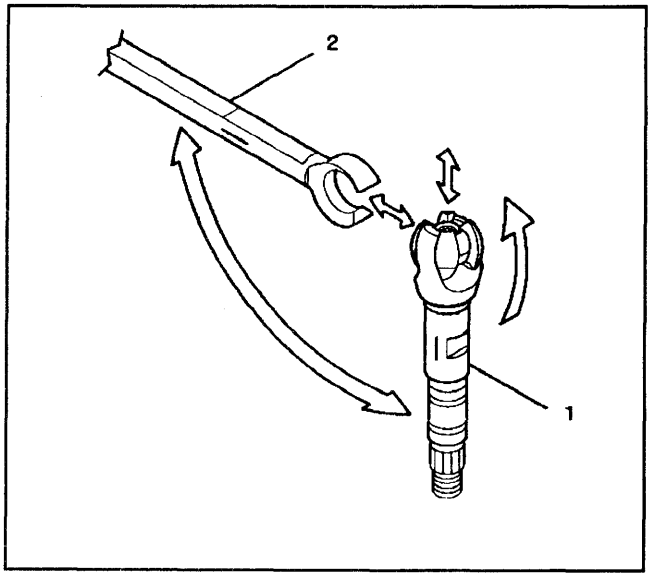
**Important:** Mark the race and upper shaft assembly and the lower steering shaft assembly to ensure proper assembly. Failure to assemble properly will cause the steering wheel to be turned 180 degrees.

10. Check the steering shaft assembly for accident damage. Refer to *Steering Column Accident Damage - Off Vehicle.*
11. Mark the race and upper shaft assembly and the lower steering shaft assembly.



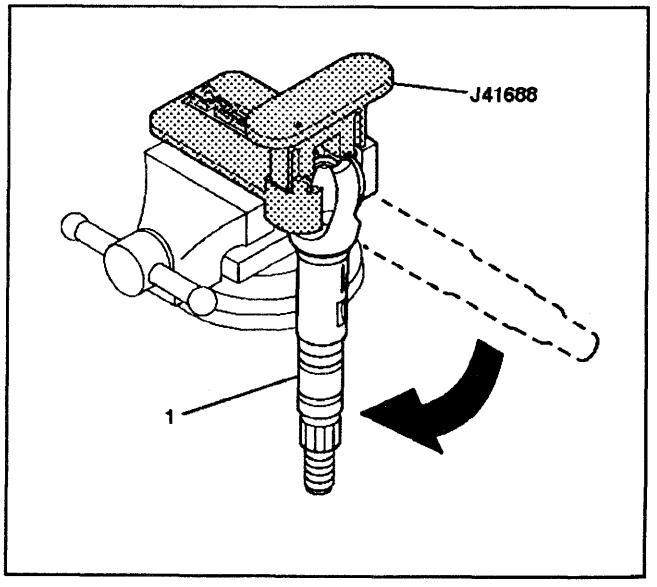
354102

12. Tilt the race and upper shaft assembly (1) 90 degrees to the lower steering shaft assembly (2) to disengage.

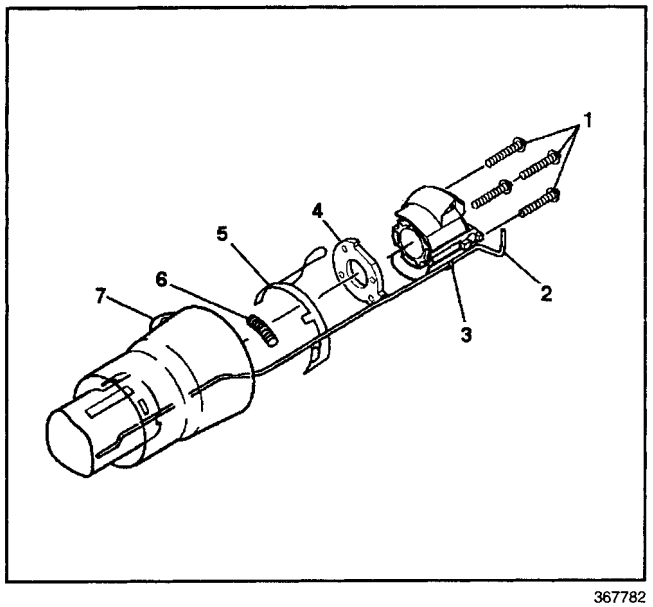



306318

13. Insert the race and upper shaft assembly (1) into *J 41688.*
14. Rotate the race and upper shaft assembly (1) 90 degrees to disengage.
15. Remove the centering sphere and the joint preload spring from *J 41688.*

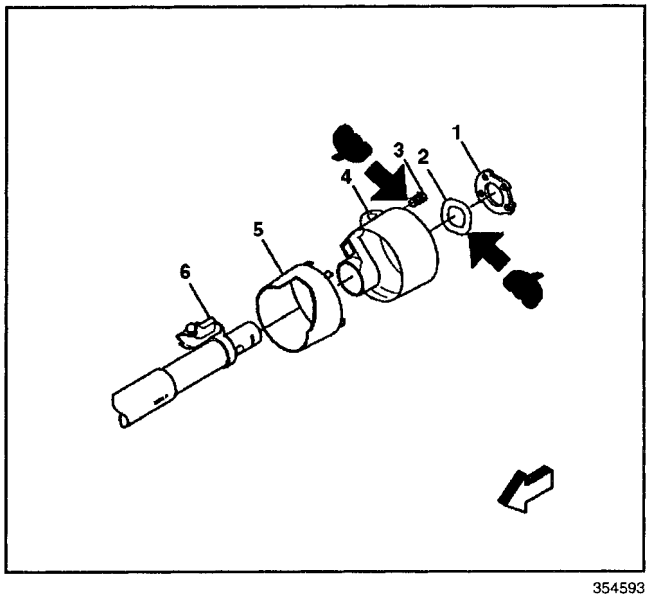



299885




367782

16. Remove the 4 support screws (1) from the steering column housing support assembly (3).
17. Dispose of screws (1).
18. Remove the steering column housing support assembly (3) with the dimmer switch actuator rod (2) from the steering column housing shroud (7).
19. Remove the lock plate (4) from the steering column housing shroud (7).
20. Remove the key release lever (5) from the steering column housing shroud (7).
21. Remove the key release lever spring (6) from the steering column housing shroud (7).
22. Remove the steering column housing shroud (7) from the steering column jacket assembly.
23. Remove the dimmer switch actuator rod (2) from the steering column housing support assembly (3).



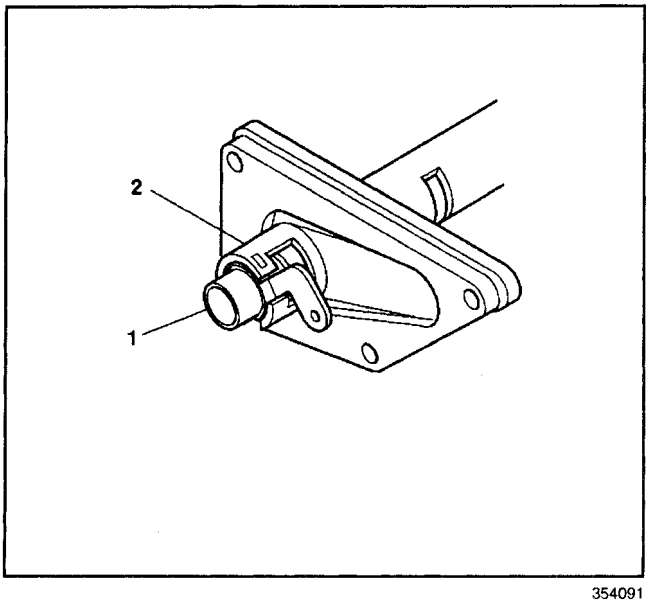

354593

## Steering Shaft, Lower Bearing, Jacket-Assemble (Column Shift)

### Assembly Procedure

- *J 41688* Centering Sphere Installer Tool
- *J 23073 - 01* Shift Tube Installer

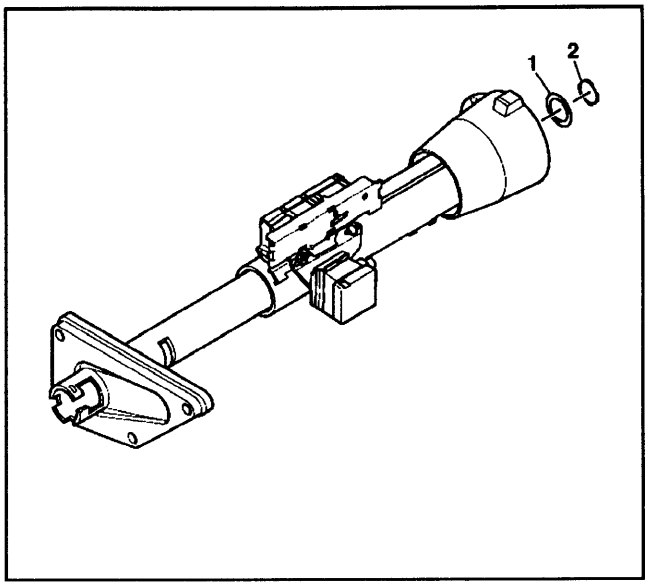
1. Install the gearshift bowl shroud (5) to the gearshift lever bowl assembly (4).
2. Lubricate the shift lever spring (3) with lithium grease.
3. Install the shift lever spring (3).
4. Lubricate the wave washer (2) with lithium grease.
5. Install the wave washer (2).
6. Install the lock plate (1) into the gearshift lever bowl assembly (4).
7. Install the gearshift lever bowl assembly (4) to the steering column jacket assembly (6)




354091

8. Insert the shift tube assembly (1) through the bottom of the steering column jacket assembly (2).
9. Line up the keyway from the shift tube assembly (1) with the keyway on the gearshift lever bowl assembly.
10. Apply just enough pressure to extend the shift tube assembly (1) past the lock plate.

11. Slide the thrust washer (1) onto the shift tube assembly.
12. Slide the shift tube retaining ring (2) onto the shift tube assembly.
13. Use the *J 23073 - 01* to seat the gearshift lever bowl assembly and the shift tube retaining ring (2).



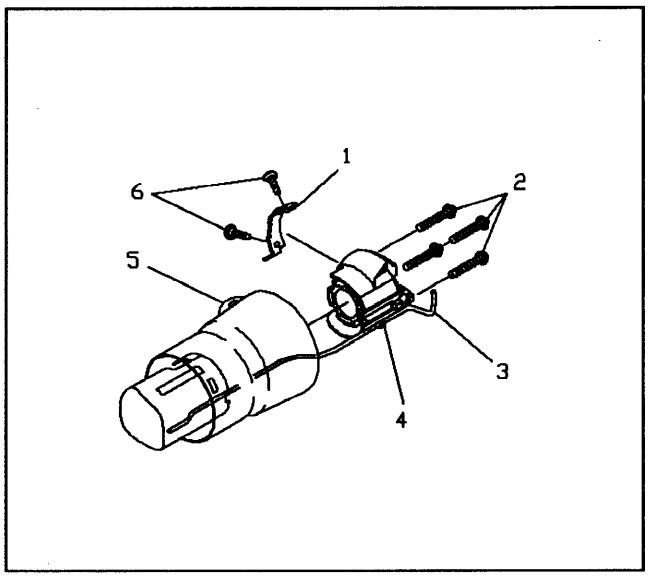
354602

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

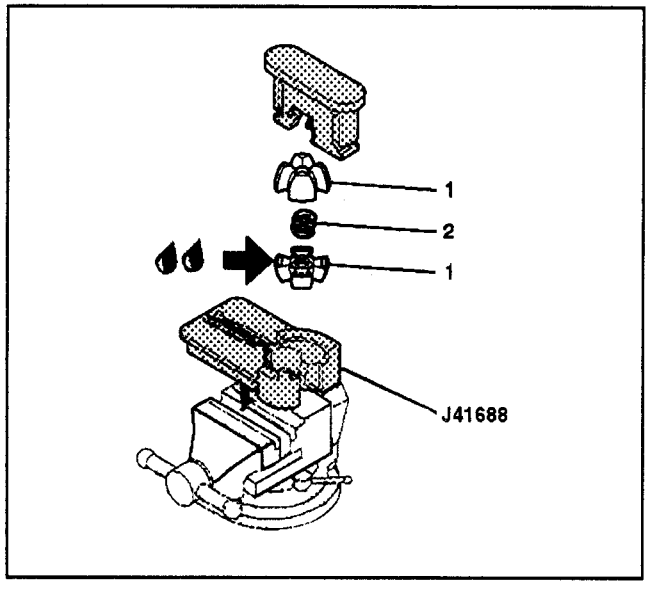
14. Install the shift lever gate (1) and secure using 2 oval head cross recess screws (6).
    **Tighten**
    Tighten the 2 oval head cross recess screws (6) to 3.5 N·m (31 lb in).
15. Install the dimmer switch actuator rod (3) into the steering column housing support (4).
16. Install the steering column housing support (4) into the gearshift lever bowl assembly (5).

**Important:** The support screws require a thread locking compound. New screw supports must be used when reassembling the steering column housing support (4).

17. Install 4 new support screws (2).
    **Tighten**
    Tighten the 4 new support screws (2) to 8.5 N·m (75 lb in).
18. The dimmer switch actuator rod (3) will rest in the slot on the dimmer switch assembly.

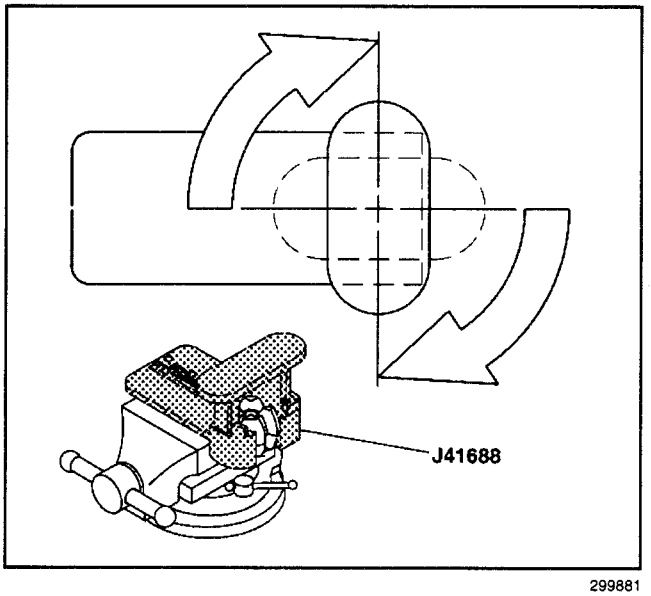


343892



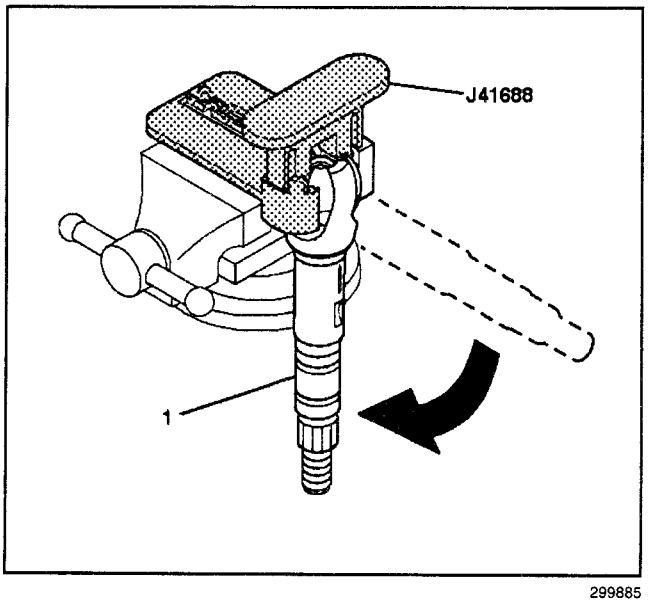

332949

19. Lubricate the inside of the centering sphere with lithium grease.
20. Install the centering sphere (1) and the joint preload spring (2) into the *J 41688*.




299881

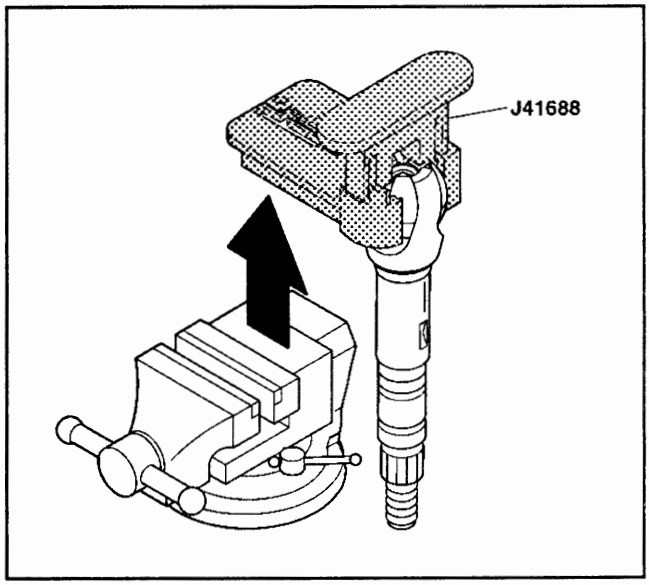
21. Compress the centering sphere and the joint preload spring in *J 41688*.
    Rotate the driver of *J 41688* 90 degrees in the clockwise direction until the arms lock in place.




299885

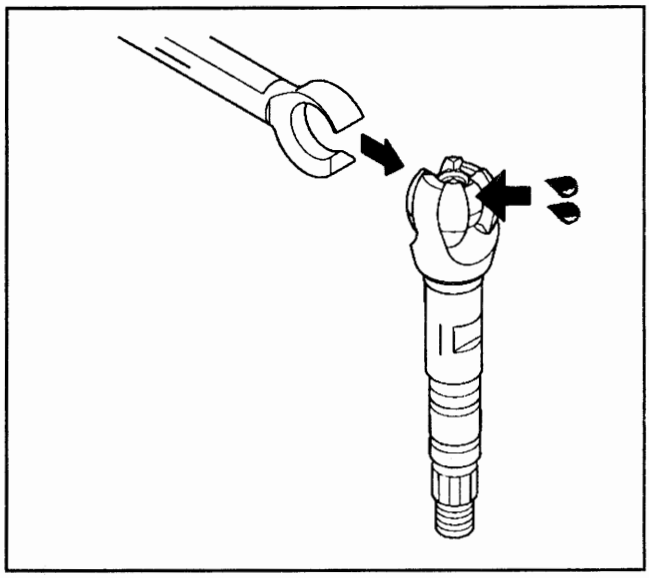
22. Install the race and upper shaft assembly (1) to *J 41688*.
    Rotate the race and upper shaft assembly (1) 90 degrees.

23. Remove the race and upper shaft assembly with *J 41688.*
24. Remove the race and upper shaft assembly with the centering sphere from the *J 41688.*



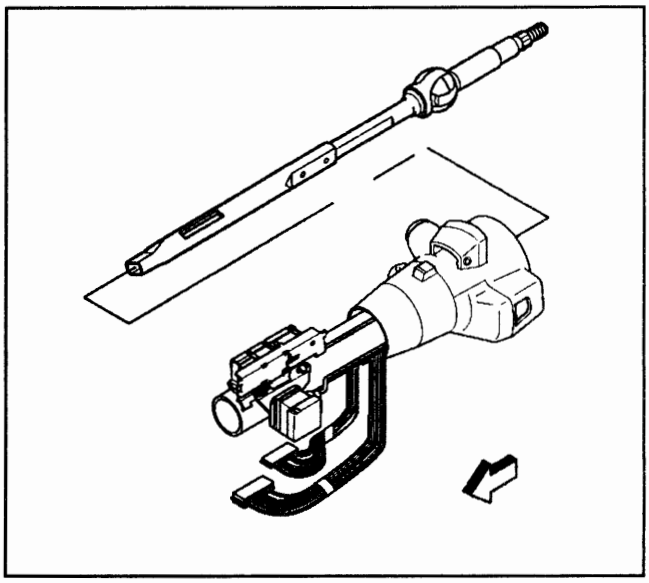

299887

25. Apply lithium grease to the race and upper shaft assembly (1).
26. Align the marks on the race and upper shaft assembly (1) with the marks on the lower steering shaft assembly (2).
27. Install the lower steering shaft assembly (2).

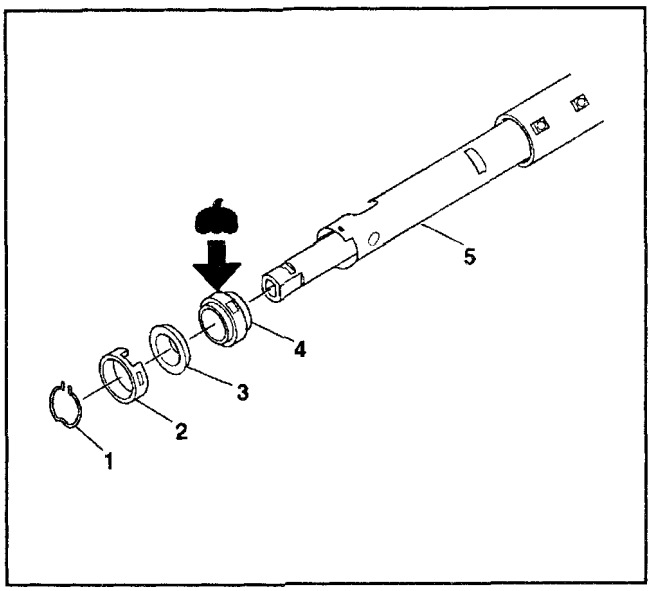


299888

28. Install the steering shaft assembly into the steering column jacket assembly.

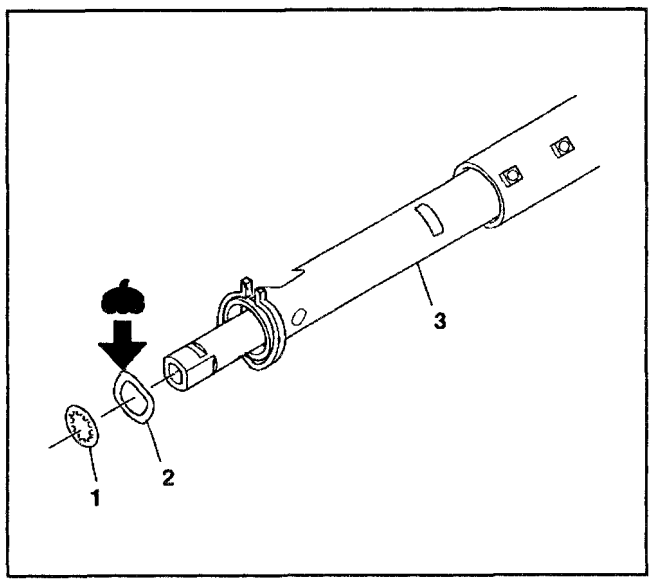


354102



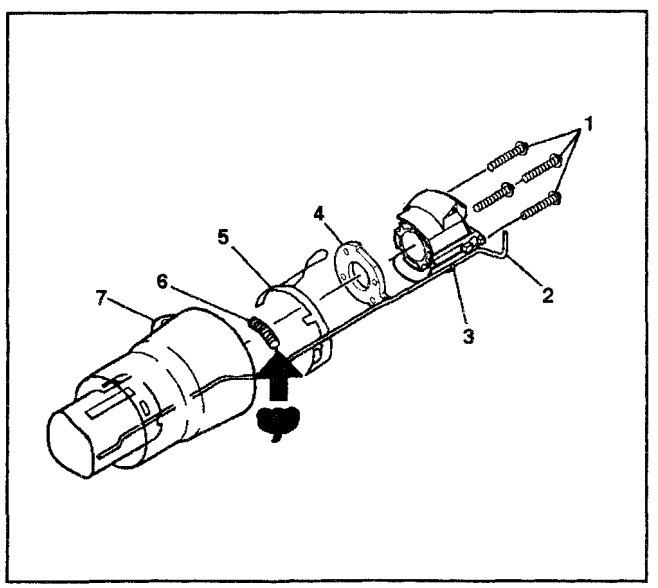

367805

29. Lubricate the inside of the lower bearing adapter (4).
30. Install the lower bearing adapter (4) to the steering column jacket assembly (5).
31. Install the bearing assembly (3) to the steering column jacket assembly (5).
32. Install the bearing adapter retainer (2) to the steering column jacket assembly (5).
33. Install the lower bearing adapter clip (1) to the steering column jacket assembly (5).




367809

34. Lubricate the bearing preload washer (2).
35. Install the bearing preload washer (2) to the steering column jacket assembly (3).
36. Install the new lower spring retainer (1) to the steering column jacket assembly (3).
37. Install the steering column housing assembly. Refer to *Steering Column Housing - Assemble (Column Shift).*




367787

## Steering Shaft, Lower Bearing, Jacket- Assemble (Floor Shift)

### Assembly Procedure

#### Tools Required

*J 41688* Centering Sphere Installer Tool

1. Install the steering column housing shroud (7) onto the steering column housing assembly.
2. Install the dimmer switch actuator rod (2) into the steering column housing support (3).
3. Lubricate the key release lever spring (6).
4. Install the key release lever spring (6) onto the steering column housing shroud (7).
5. Install the key release lever (5) onto the steering column housing shroud (7).
6. Install the lock plate (4) into the steering column housing shroud (7).

**Important:** The support screws require a thread locking compound. New screw supports must be used when reassembling the steering column housing support (4).

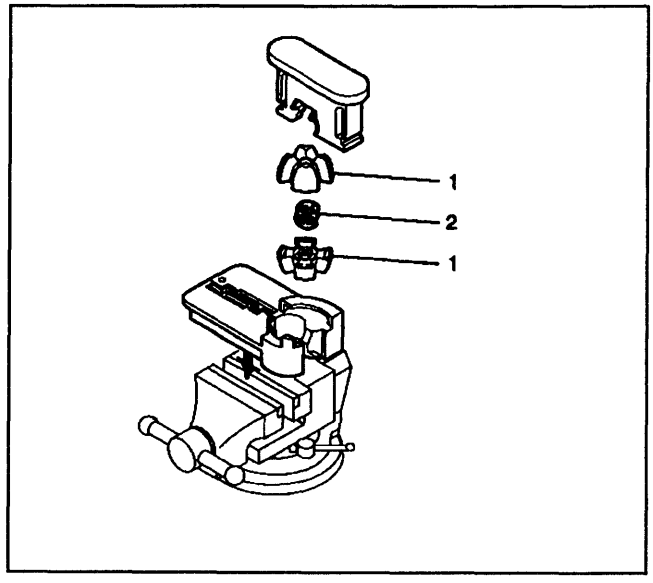
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices.

7. Install 4 new support screws (2).

   **Tighten**

   Tighten the 4 new support screws (2) to 8.5 N·m (75 lb in).

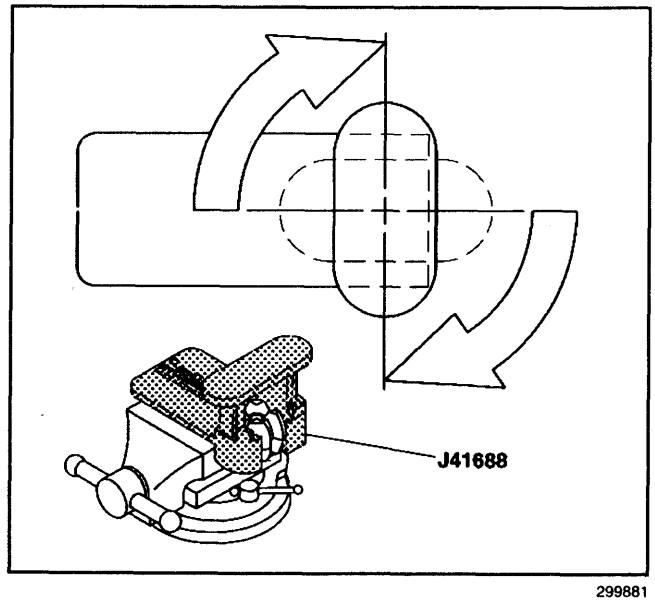
8. The dimmer switch actuator rod (2) will rest in the slot on the dimmer switch assembly.
9. Lubricate the inside of the centering sphere (1) with lithium grease.
10. Install the centering sphere (1) and the joint preload spring (2) into the *J 41688*.



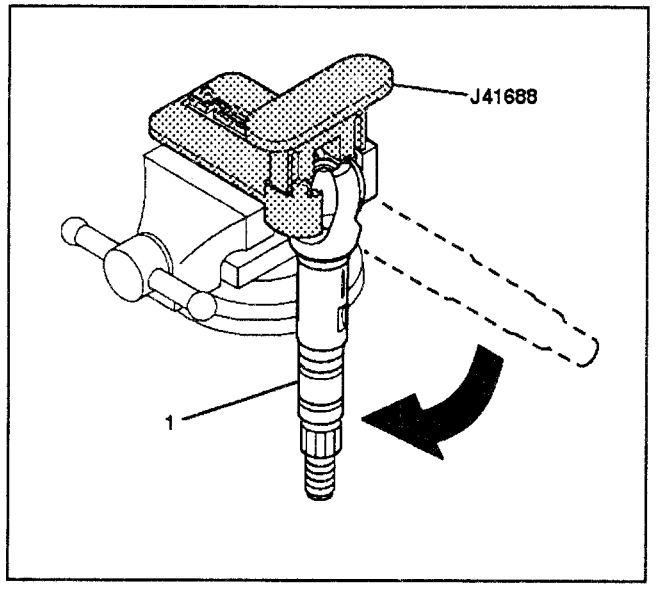

299879

11. Compress the centering sphere and the joint preload spring in *J 41688*.

    Rotate the driver of *J 41688* 90 degrees in the clockwise direction until the arms lock in place.

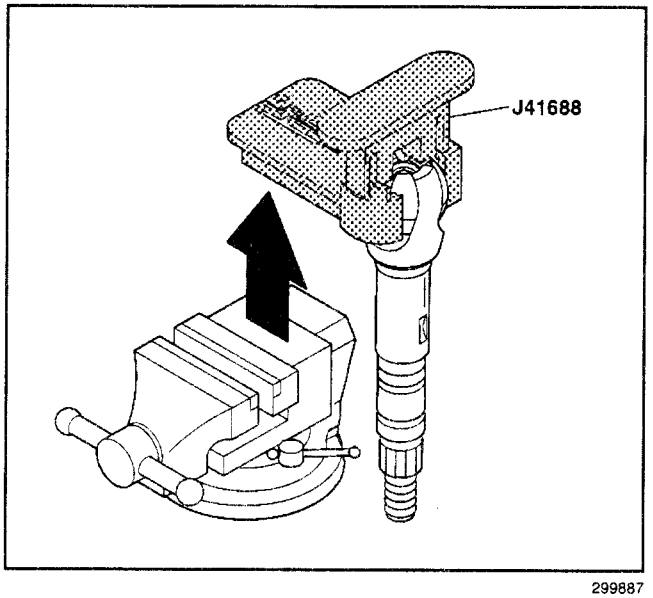



299881



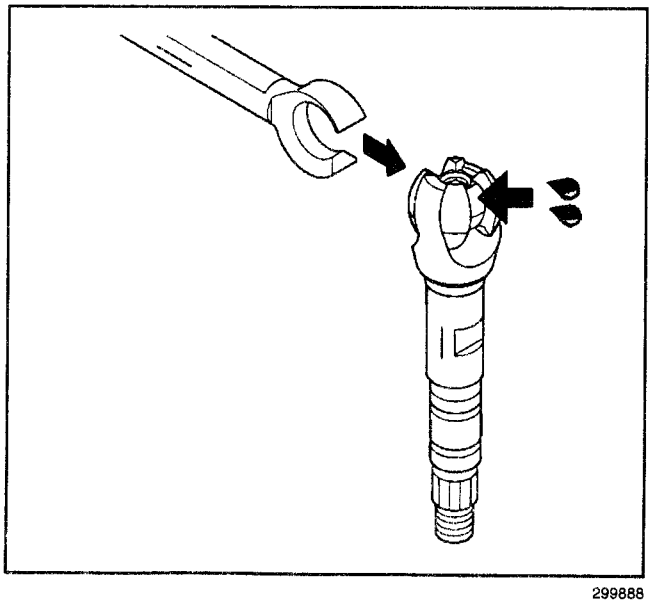

299885

12. Install the race and upper shaft assembly (1).
    Rotate the race and upper shaft assembly (1) 90 degrees.




299887

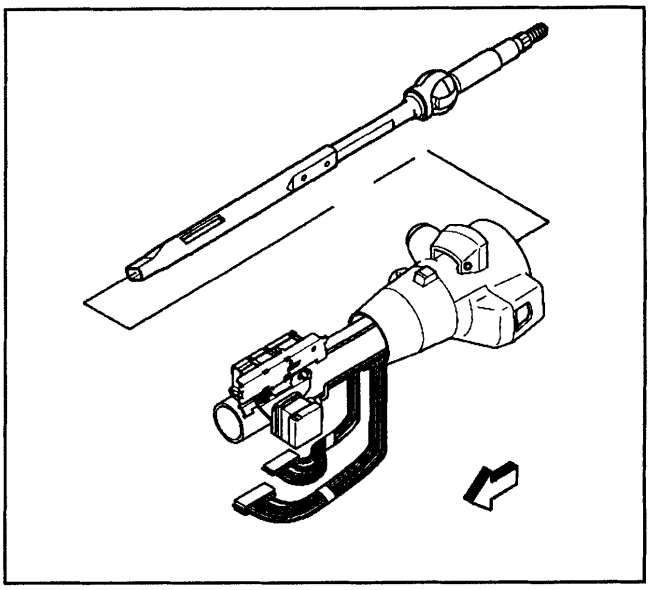
13. Remove the race and upper shaft assembly (1) with *J 41688*.
14. Remove the race and upper shaft assembly (1) and *J 41688* from the vise.
15. Rotate the race and upper shaft assembly (1) 90 degrees from *J 41688* to disengage.



299888

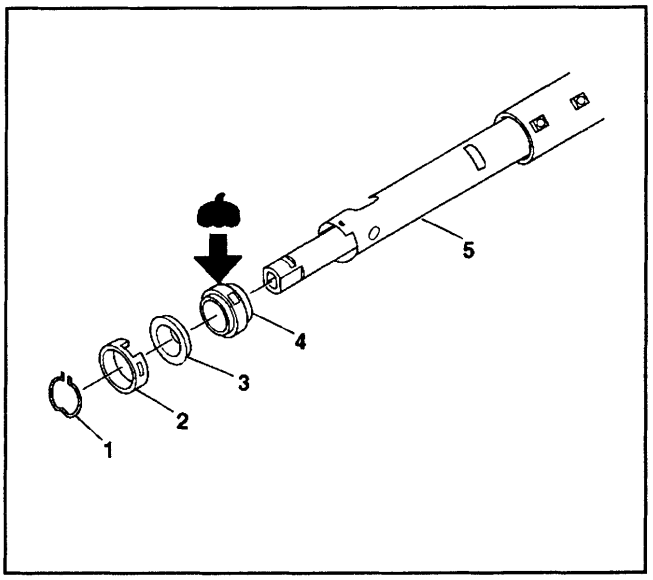
16. Apply lithium grease to the race and upper shaft assembly (1).
17. Align the marks on the race and upper shaft assembly (1) with the marks on the lower steering shaft assembly (2).
18. Install the lower steering shaft assembly (2) to the race and upper shaft assembly (1).

19. Install the steering shaft assembly into the steering column jacket assembly.
20. Install the steering column housing assembly. Refer to *Steering Column Housing - Assemble (Floor Shift)*.



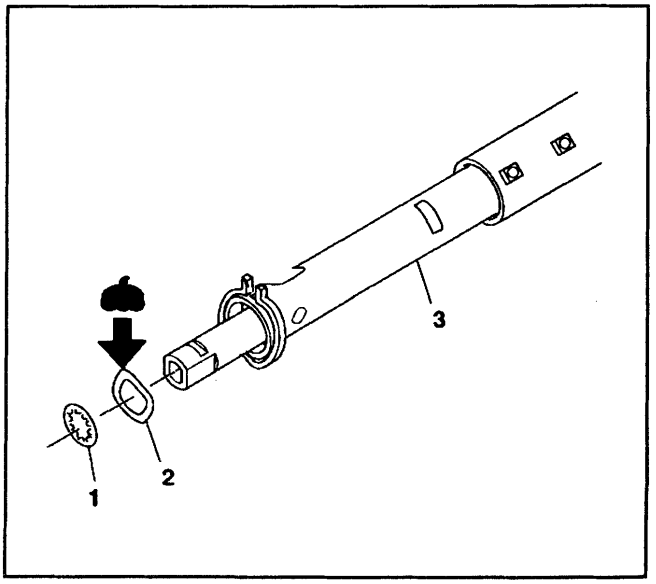
354102

21. Lubricate the inside of the lower bearing adapter (4).
22. Install the lower bearing adapter (4) to the steering column jacket assembly (5).
23. Install the bearing assembly (3) to the steering column jacket assembly (5).
24. Install the bearing adapter retainer (2) to the steering column jacket assembly (5).
25. Install the lower bearing adapter clip (1) to the steering column jacket assembly (5).




367805

26. Lubricate the bearing preload washer (2).
27. Install the bearing preload washer (2) to the steering column jacket assembly (5).
28. Install the new lower spring retainer (1) to the steering column jacket assembly (5).

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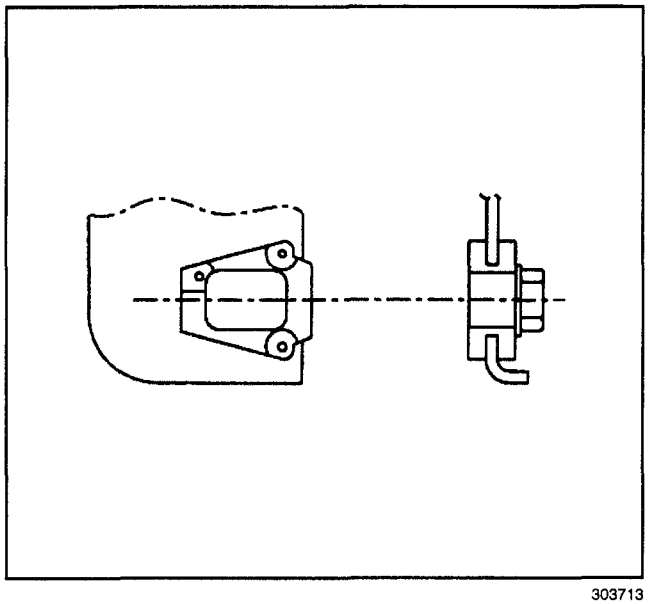

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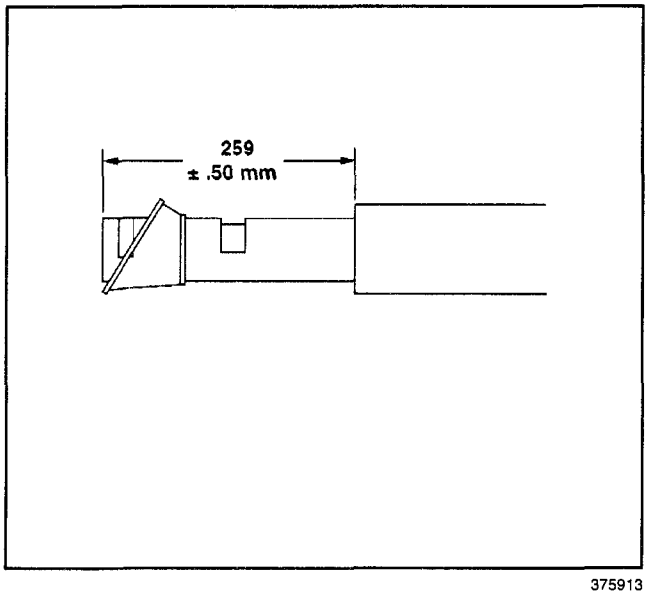


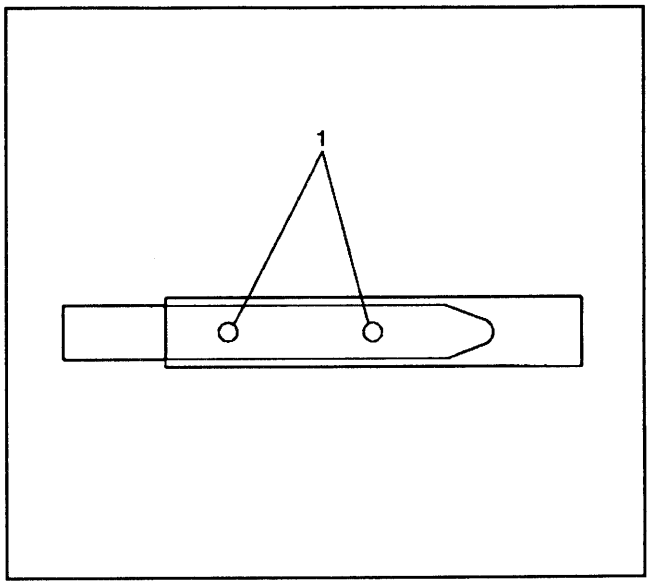

375913

## Steering Column Accident Damage - Off Vehicle

### Inspection Procedure

- Vehicles involved in accidents resulting in frame damage, major body or sheet metal damage, or where the steering column has been impacted, or where supplemental inflatable restraint systems deployed may also have a damaged or misaligned steering column.
- Check the capsules on the steering column bracket assembly. All capsules must be securely seated in the bracket slots and checked for any loose conditions when pushed or pulled by hand.
- Observe how the bracket is attached to the jacket assembly.
  - If the capsules are not securely seated and the bracket is bolted to the jacket assembly, replace only the bracket.
  - If the capsules are not securely seated and the bracket is welded to the jacket assembly, replace only the jacket assembly.
- Check for jacket assembly collapse by measuring the distance from the lower edge of the upper jacket to a defined point on the lower jacket. Replace the jacket assembly if the measured dimensions are not within specifications.

- Visually inspect the steering shaft for sheared injected plastic. If the steering shaft shows sheared plastic, replace the steering shaft.
- Any frame damage that could cause a bent steering shaft must have the steering shaft runout checked. Using a dial indicator (1) at the lower end of the steering shaft, rotate the steering wheel. The runout must not exceed 1.60 mm (0.0625 in).




303724

# Description and Operation

## Steering Wheel and Column Description

The steering wheel and column components include the following parts:

- A steering wheel
- A horn pad
- A steering column
- The brackets

The locking, energy-absorbing steering column includes 3 important features in addition to the steering function:

- The column is energy-absorbing. The column is designed to compress in a front-end collision in order to minimize the possibility of injury to the driver of the vehicle.
- The ignition switch and the lock are mounted conveniently on the column.
- With the column-mounted lock, the ignition, the steering, and the gearshifting operation can be locked in order to deter a theft of the vehicle.

The column may be disassembled and reassembled. In order to ensure the energy-absorbing action, use only the specified screws, bolts, and nuts. Tighten the fasteners to the specified torque.

The following actions may result in shearing or loosening the plastic fasteners that maintain column rigidity:

- A sharp blow on the end of the steering shaft or the shift lever
- Leaning on the column assembly
- Dropping the assembly

## Ignition Lock System Description

All column shift automatic transmission equipped vehicles contain both mechanical and electrical neutral safety start systems. These systems rely on a mechanical block as well as an electrical switch in order to prevent starting the engine in any gear other than Park or Neutral.

The mechanical block is a wedge-shaped lock bolt added to the ignition switch actuator rod.

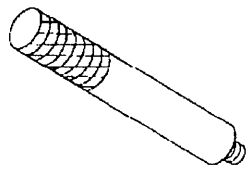
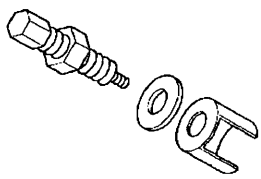
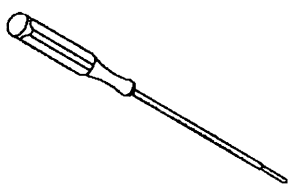
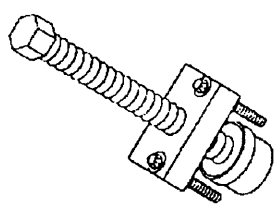
In either Park or Neutral, the wedge-shaped lock bolt passes through slots in the shift bowl, allowing the lock cylinder set to turn and start the engine.

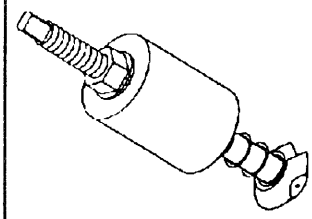
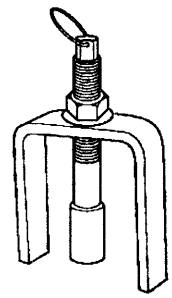
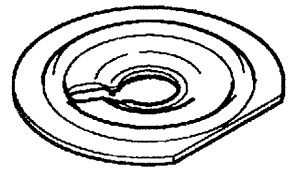
## Auto Trans Shift Lock Control Description

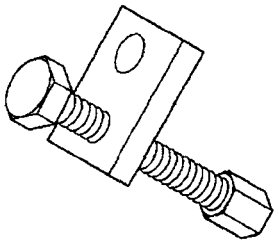
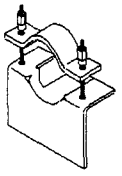
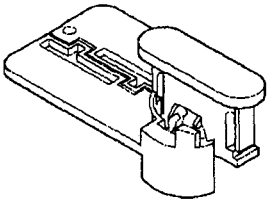
The brake transmission shift interlock (BTSI) system prevents the automatic transmission from being shifted out of PARK unless the brake pedal is depressed. When the brake pedal is depressed, the BTSI solenoid releases a lock pawl. This enables the movement of the shift linkage and the operation of the shift lever.

When service operations are required, overriding the BTSI is possible. In order to override the BTSI, turn the ignition switch to OFF (not LOCK), and remove the battery voltage from the solenoid.

## Special Tools and Equipment

| Illustration | Tool Number/ Description |
|---|---|
|  354978 | J 8092<br>Driver Handle |
|  802 | J 1859-A<br>Steering Wheel Puller |
|  247690 | J 21854 - 01<br>Pivot Pin Remover |
|  354985 | J 22635<br>Lock Shoe and Release Pin Remover and Installer |
|  354986 | J 23072<br>Shift Tube Remover |

| Illustration | Tool Number/ Description |
|---|---|
|  354992 | J 23073 - 01<br>Shift Tube Installer |
|  247694 | J23653-SIR<br>Lock Plate Compressor |
|  247693 | J 23653 - 91<br>Lock Plate Compressor Adapter |
|  354982 | J 38639<br>Steering Column Housing Bearing Installer |

| Illustration | Tool Number/ Description |
|---|---|
|  344001 | J 39246<br>Tilt Spring Compressor |
|  293263 | J 41352<br>Modular Column Holding Fixture |
|  247695 | J 41688<br>Centering Sphere |

# Section 2
# Steering

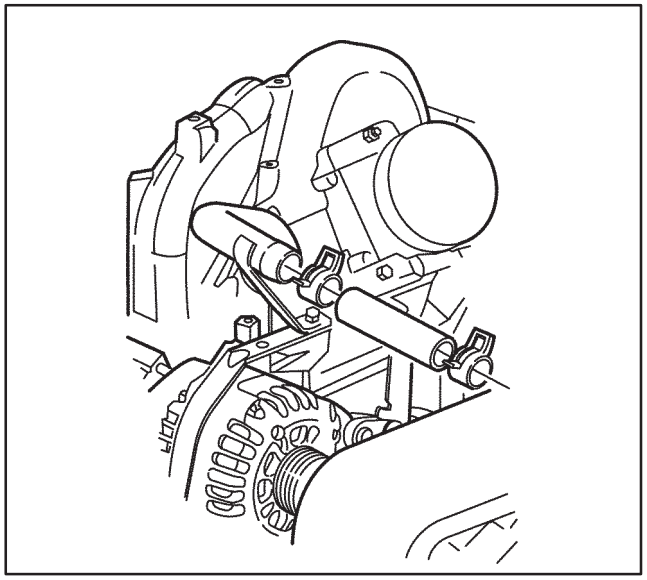
**BLANK**

# Power Steering System

## Specifications

### Fastener Tightening Specifications

| Application | Specification | |
|---|---|---|
| | Metric | English |
| Brake Booster to Steering Gear Hose Fitting at Brake Booster | 28 N·m | 21 lb ft |
| Brake Booster to Steering Gear Hose Steering Gear Reducer Bushing | 55 N·m | 41 lb ft |
| Brake Booster to Steering Gear Hose Steering Gear STC Female Elbow Fitting at Reducer Bushing | 55 N·m | 41 lb ft |
| PCM Bracket Bolt | 17 N·m | 13 lb ft |
| Pitman Arm to Pitman Shaft Nut | 520 N·m | 384 lb ft |
| Pitman Arm to Steering Arm Ball Stud Nut | 176 N·m | 130 lb ft |
| Power Steering Pressure and Return Tube Clamps to Frame Screw | 8 N·m | 71 lb in |
| Power Steering Pressure Hose to Steering Gear STC Female Fitting | 55 N·m | 41 lb ft |
| Power Steering Pump Bracket to Accessory Bracket Nut | 65 N·m | 48 lb ft |
| Power Steering Pump STC Female Fitting | 120 N·m | 89 lb ft |
| Power Steering Pump to Bracket Nut | 65 N·m | 48 lb ft |
| Power Steering Reservoir Bracket Nut | 65 N·m | 48 lb ft |
| Steering Gear Bolt to Frame Nut | 520 N·m | 384 lb ft |
| Steering Gear to Frame Bolt | 520 N·m | 384 lb ft |
| Steering Shaft Pinch Bolt | 65 N·m | 48 lb ft |



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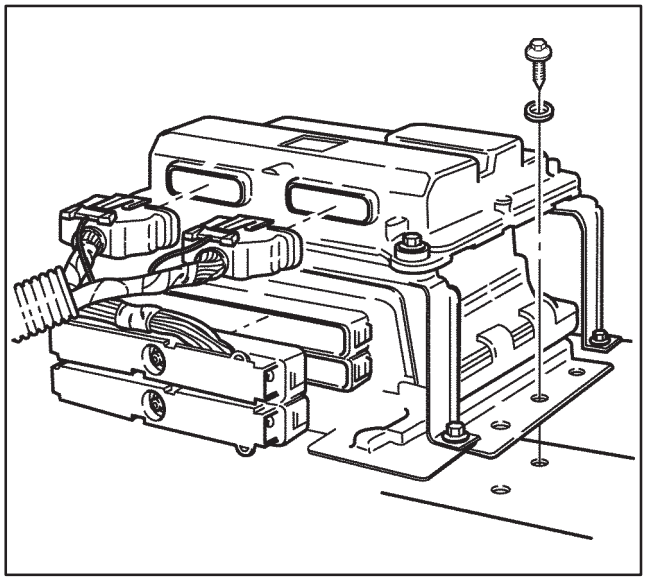


WRK22005

# Repair Instructions

## Power Steering Pump Replacement

### Tools Required

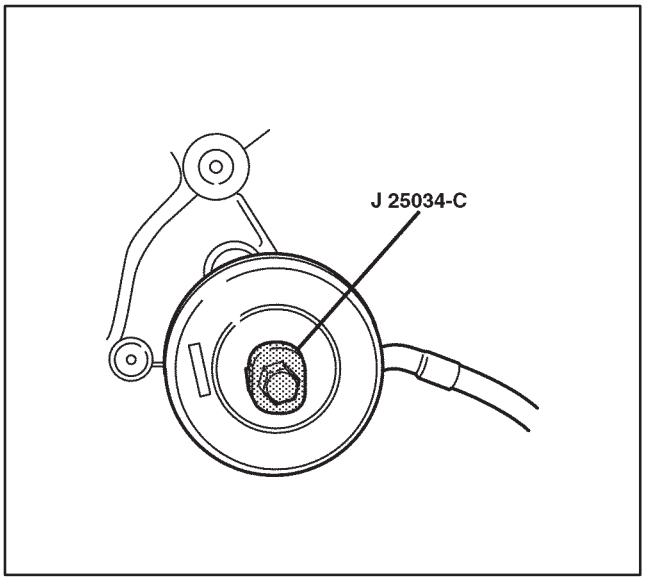
- *J 25033-C* Power Steering Pump Pulley Installer
- *J 25034-C* Power Steering Pump Pulley Remover
- *J 42971* Quick Disconnect Tool

### Removal Procedure

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices in the WCC Service Manual.***

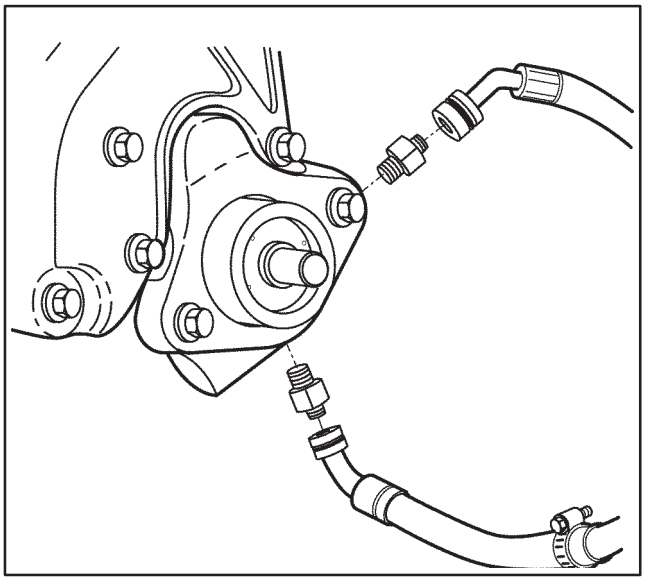
1. Disconnect the negative battery cable.
2. Drain the coolant from the radiator. Refer to *Draining and Filling Cooling System* in the WCC Service Manual.
3. Remove the air intake duct from the throttle body and MAF/IAT sensor. Refer to *Air Intake Duct Replacement (8.1L)* in this supplement.
4. Remove the engine oil fill tube from the oil pipe.
5. Disconnect the transmission control module (TCM) connectors.
6. Disconnect the powertrain control module (PCM) connectors.
7. Remove the PCM bracket retaining bolts and remove the bracket with the PCM and TCM attached.
8. Remove the upper radiator hose. Refer to *Radiator Hose Replacement – Inlet (8.1L)* in this supplement.
9. Remove the upper fan shroud. Refer to *Fan Shroud Replacement – Upper (8.1L)* in this supplement.
10. Remove the lower fan shroud. Refer to *Fan Shroud Replacement – Lower (8.1L)* in this supplement.
11. Remove the serpentine belt. Refer to *Drive Belt Replacement* in this supplement.
12. Remove the fan. Refer to *Fan Replacement* in this supplement.

13. Use *J 25034-C* to remove the power steering pump pulley.
    13.1. Turn the nut on the *J 25034-C* to the top of the pilot bolt to ensure that the pilot bolt bottoms in the pump shaft.
    13.2. Hold the *J 25034-C* pilot bolt and turn the nut counterclockwise to remove the pulley.
14. Place a drain pan below the power steering pump to catch draining fluids.

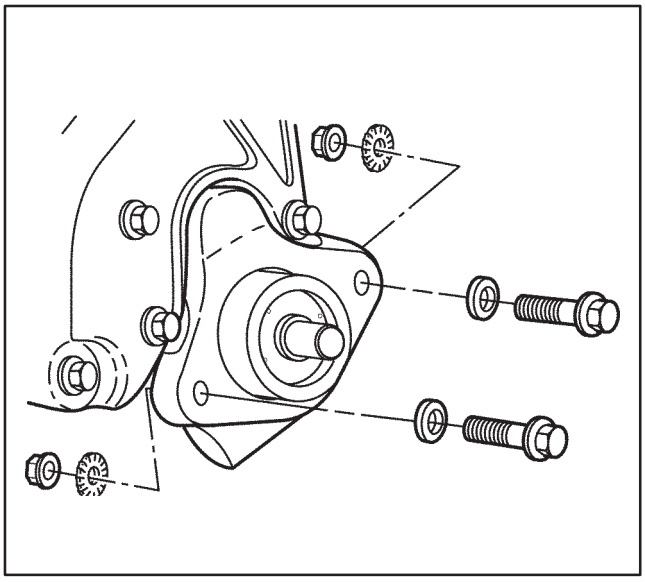


WRK22003

15. Disconnect the power steering pump hoses from the power steering pump using the *J 42971.*
16. If necessary, remove the STC female fittings from the power steering pump.
17. Raise the hoses to prevent drainage of the oil.
18. Cap the hoses and plug the holes in the power steering pump to prevent contamination.


WRK22001

19. Remove the nuts, lockwashers, washers, and bolts securing the power steering pump to the power steering pump bracket, and remove the power steering pump.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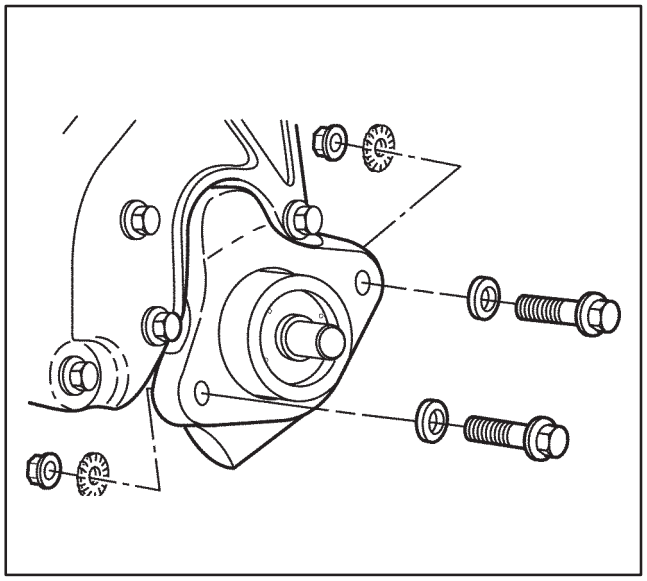


WRK22047

## Installation Procedure

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

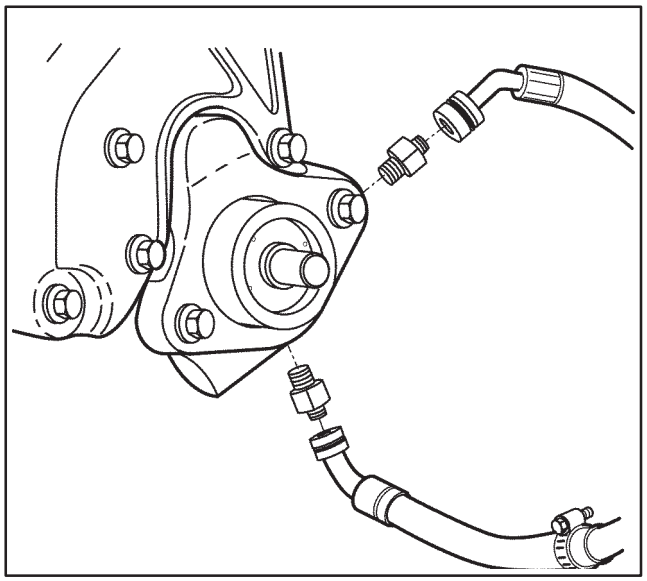
1. Install the power steering pump, bolts, washers, lockwashers, and nuts to the power steering pump bracket.

   **Tighten**

   Tighten the power steering pump nuts to 65 N·m (48 lb ft).
2. If removed, install the female STC fittings to the power steering pump.

   **Tighten**

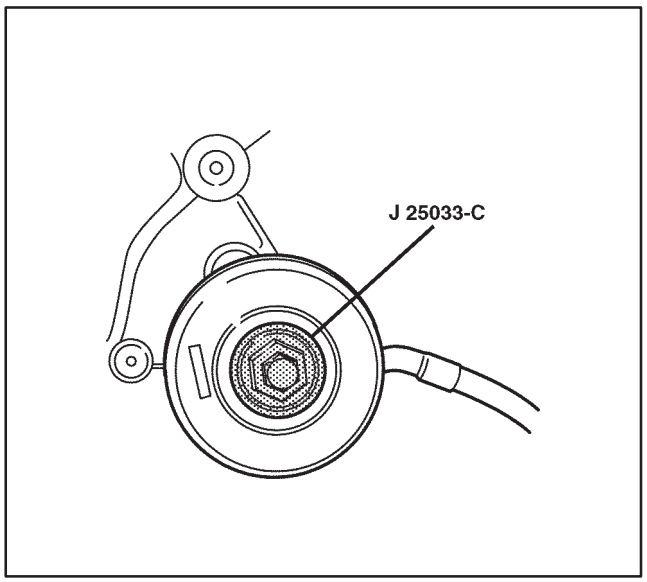
   Tighten the power steering pump STC female fittings to 120 N·m (89 lb ft).



WRK22001

***Notice:*** Make sure that hoses are not in contact with any sharp edges that could cause chafing.

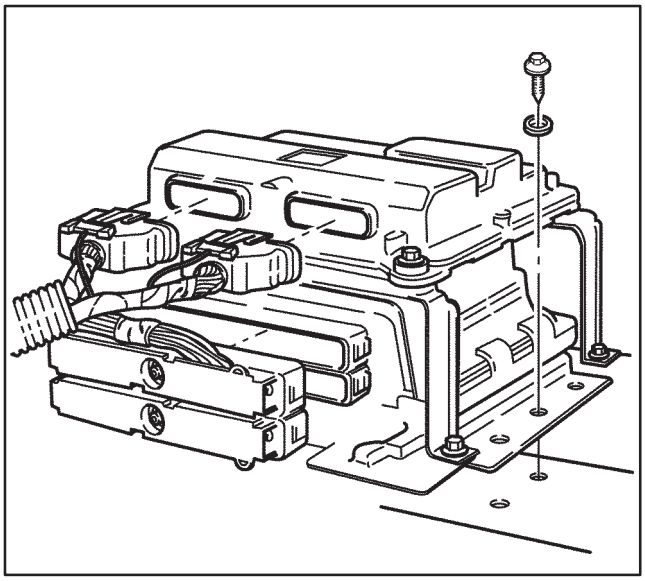
3. Connect the power steering pump hoses to the power steering pump. Refer to the connect procedure in *Quick Disconnect Connector Service (STC Type)* in this supplement.




WRK22002

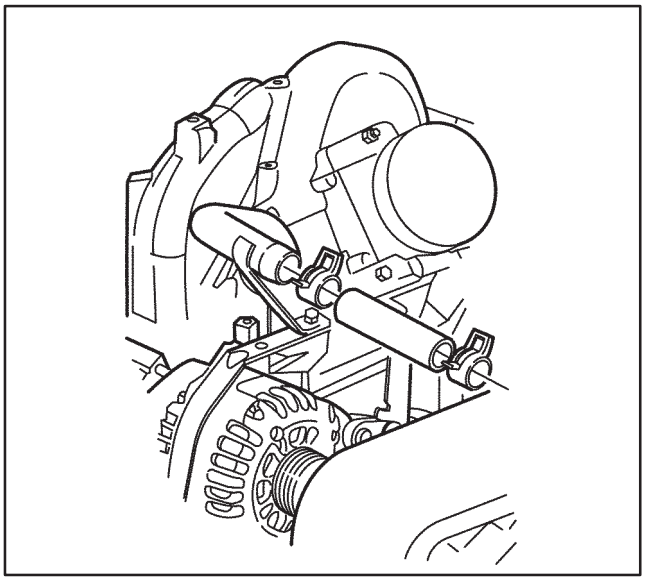
4. Use *J 25033-C* to install the power steering pump pulley to the power steering pump.
   4.1. Place the pulley on the end of the pump shaft.
   4.2. Install the *J 25033-C*.
   4.3. Turn the nut to the top of the pilot bolt to ensure that the pilot bolt bottoms in the shaft.
   4.4. Hold the pilot bolt and turn the nut clockwise until the pulley is flush with the end of the power steering pump shaft.
5. Install the fan. Refer to *Fan Replacement* in this supplement.
6. Install the serpentine belt. Refer to *Drive Belt Replacement* in this supplement.
7. Install the lower fan shroud. Refer to *Fan Shroud Replacement – Lower (8.1L)* in this supplement.
8. Install the upper fan shroud. Refer to *Fan Shroud Replacement – Upper (8.1L)* in this supplement.

9. Install the upper radiator hose Refer to *Radiator Hose Replacement – Inlet (8.1L)* in this supplement.
10. Install the PCM bracket with the PCM and TCM attached, and the retaining bolts.
    **Tighten**
    Tighten the PCM bracket retaining bolts to 17 N·m (13 lb ft).
11. Connect the powertrain control module (PCM) connectors.
12. Connect the transmission control module (TCM) connectors.



WRK22005

13. Install the engine oil fill tube to the oil pipe.
14. Install the air intake duct to the throttle body and MAF/IAT sensor. Refer to *Air Intake Duct Replacement (8.1L)* in this supplement.
15. Fill the cooling system. Refer to *Draining and Filling Cooling System* in the WCC Service Manual.
16. Connect the negative battery cable.
17. Fill and bleed the power steering system. Refer to *Bleeding Power Steering System* in the WCC Service Manual.



WRK62002

## Power Steering Pump Pulley Replacement

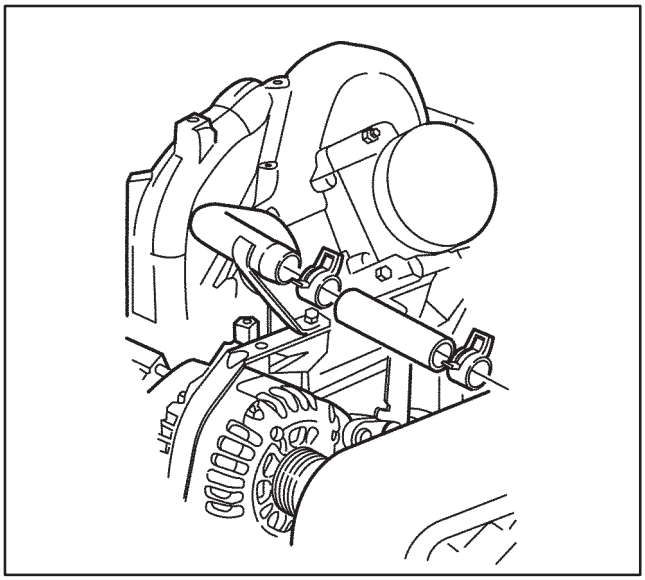
### Tools Required

- *J 25033-C* Power Steering Pump Pulley Installer
- *J 25034-C* Power Steering Pump Pulley Remover

### Removal Procedure

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices in the WCC Service Manual.***

1. Disconnect the negative battery cable.
2. Drain the coolant from the radiator. Refer to *Draining and Filling Cooling System* in the WCC Service Manual.
3. Remove the air intake duct from the throttle body and MAF/IAT sensor. Refer to *Air Intake Duct Replacement (8.1L)* in this supplement.
4. Remove the engine oil fill tube from the oil pipe.



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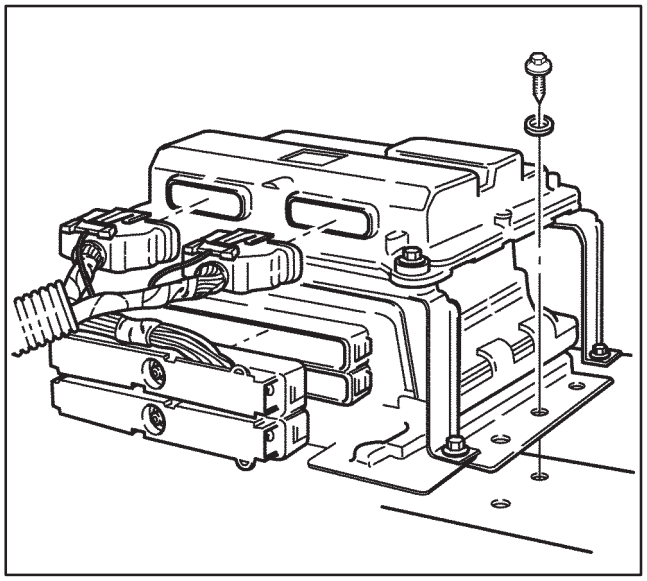
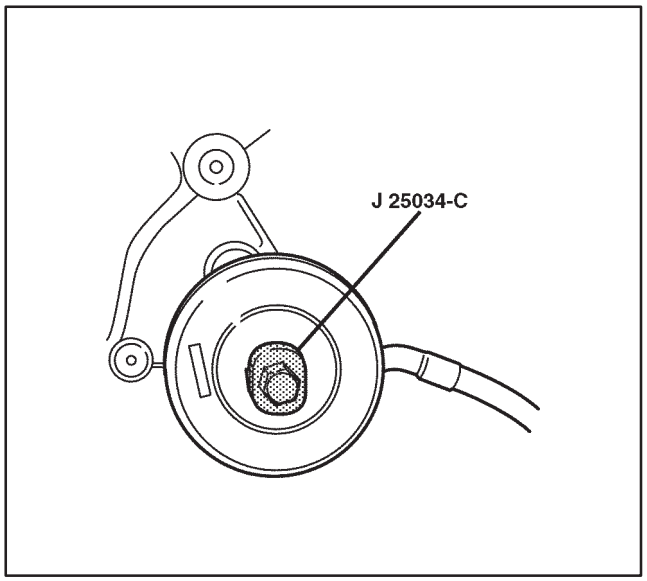


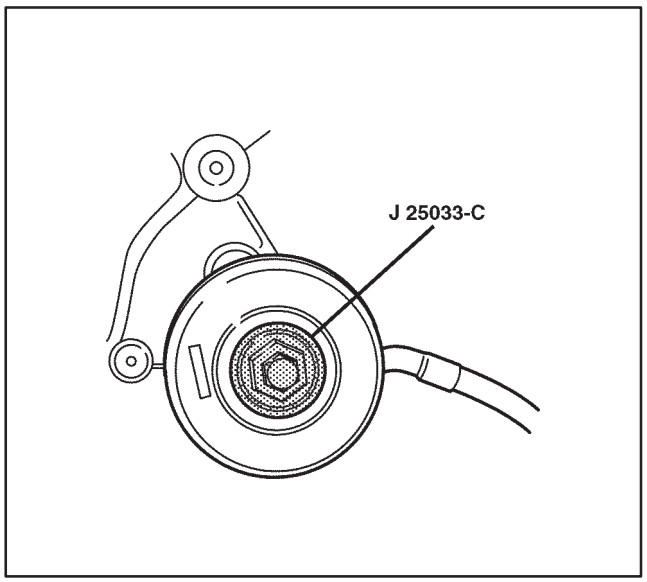
WRK22005

5. Disconnect the transmission control module (TCM) connectors.
6. Disconnect the powertrain control module (PCM) connectors.
7. Remove the PCM bracket retaining bolts and remove the bracket with the PCM and TCM attached.
8. Remove the upper radiator hose. Refer to *Radiator Hose Replacement – Inlet (8.1L)* in this supplement.
9. Remove the upper fan shroud. Refer to *Fan Shroud Replacement – Upper (8.1L)* in this supplement.
10. Remove the lower fan shroud. Refer to *Fan Shroud Replacement – Lower (8.1L)* in this supplement.
11. Remove serpentine belt. Refer to *Drive Belt Replacement* in this supplement.
12. Remove the fan. Refer to *Fan Replacement* in this supplement.




WRK22003

13. Use *J 25034-C* to remove the power steering pump pulley from the power steering pump.
    13.1. Turn the nut on the *J 25034-C* to the top of the pilot bolt to ensure that the pilot bolt bottoms in the pump shaft.
    13.2. Hold the *J 25034-C* pilot bolt and turn the nut counterclockwise to remove the pulley.




WRK22002

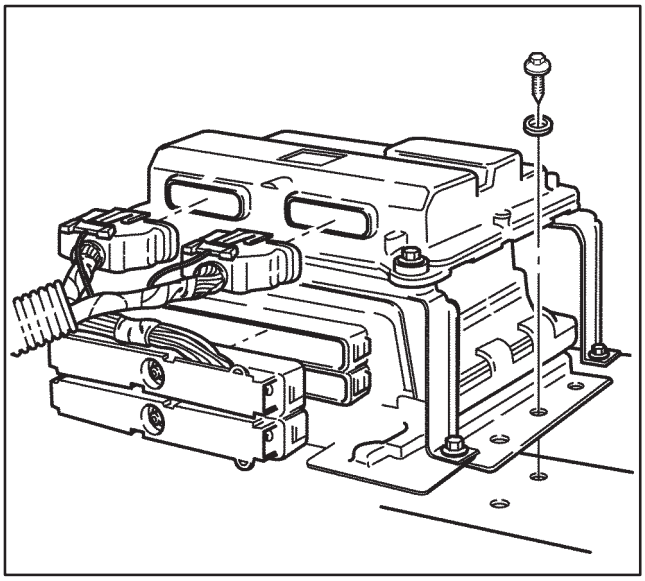
## Installation Procedure

1. Use *J 25033-C* to install the power steering pump pulley to the power steering pump.
    1.1. Place the pulley on the end of the pump shaft.
    1.2. Install the *J 25033-C*.
    1.3. Turn the nut to the top of the pilot bolt to ensure that the pilot bolt bottoms in the shaft.
    1.4. Hold the pilot bolt and turn the nut clockwise until the pulley is flush with the end of the power steering pump shaft.
2. Install the fan. Refer to *Fan Replacement* in this supplement.
3. Install the serpentine belt. Refer to *Drive Belt Replacement* in this supplement.
4. Install the lower fan shroud. Refer to *Fan Shroud Replacement – Lower (8.1L)* in this supplement.
5. Install the upper fan shroud. Refer to *Fan Shroud Replacement – Upper (8.1L*) in this supplement.

6. Install the upper radiator hose. Refer to *Radiator Hose Replacement – Inlet (8.1L)* in this supplement.

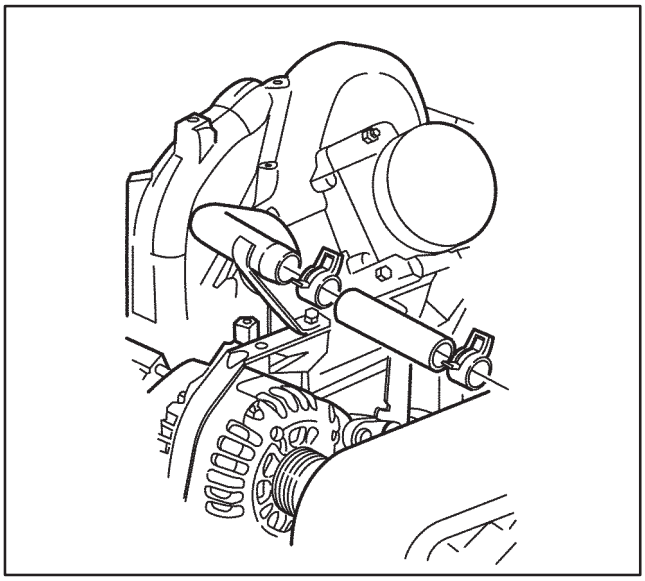
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

7. Install the PCM bracket with the PCM and TCM attached, and the retaining bolts.
   **Tighten**
   Tighten the PCM bracket retaining bolts to 17 N·m (13 lb ft).
8. Connect the powertrain control module (PCM) connectors.
9. Connect the transmission control module (TCM) connectors.



WRK22005

10. Install engine oil fill tube to the oil pipe.
11. Install the air intake duct to the throttle body and MAF/IAT sensor. Refer to *Air Intake Duct Replacement (8.1L)* in this supplement.
12. Fill the cooling system. Refer to *Draining and Filling Cooling System* in the WCC Service Manual.
13. Connect the negative battery cable.



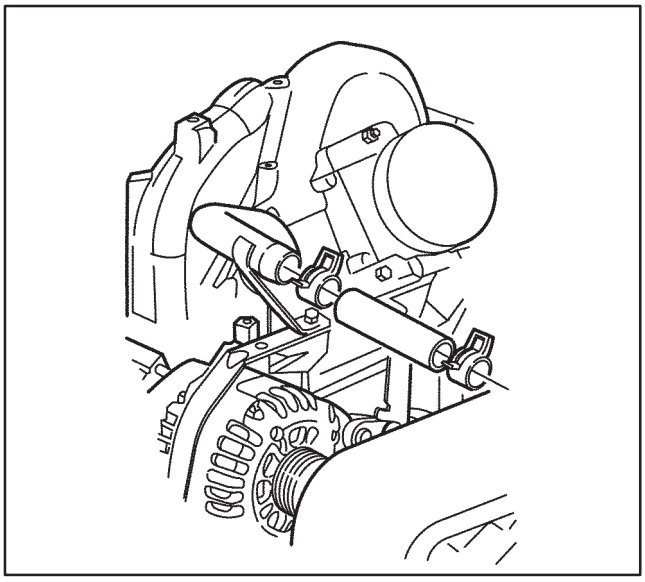
WRK62002

## Power Steering Pump Bracket Replacement

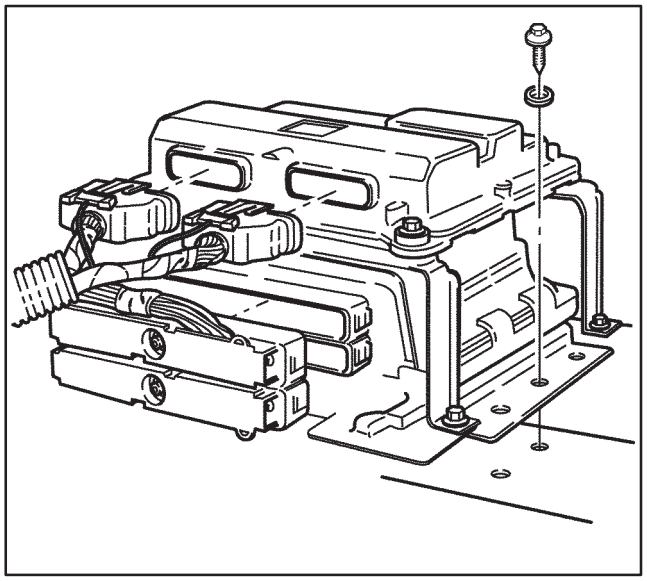
### Removal Procedure

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices in the WCC Service Manual.***

1. Disconnect the negative battery cable.
2. Drain the coolant from the radiator. Refer to *Draining and Filling Cooling System* in the WCC Service Manual.
3. Remove the air intake duct from the throttle body and MAF/IAT sensor. Refer to *Air Intake Duct Replacement (8.1L)* in this supplement.
4. Remove the engine oil fill tube from the oil pipe.

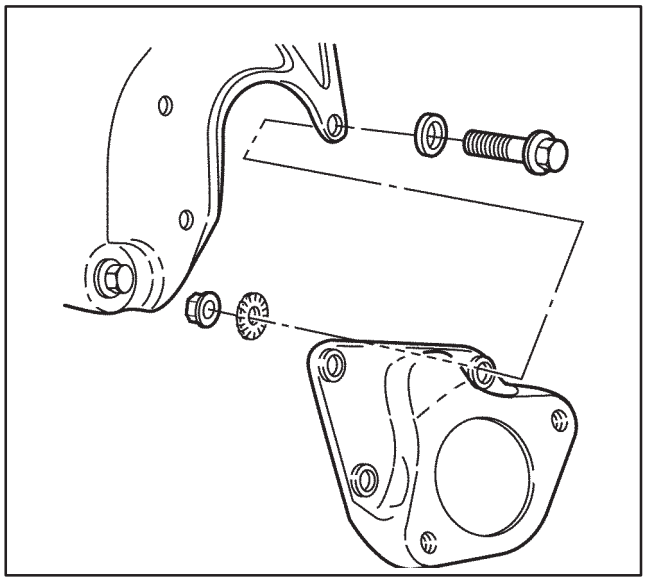


WRK62002



WRK22005

5. Disconnect the transmission control module (TCM) connectors.
6. Disconnect the powertrain control module (PCM) connectors.
7. Remove the PCM bracket retaining bolts and remove the bracket with the PCM and TCM attached.
8. Remove the upper radiator hose. Refer to *Radiator Hose Replacement – Inlet (8.1L)* in this supplement.
9. Remove the upper fan shroud. Refer to *Fan Shroud Replacement – Upper (8.1L)* in this supplement.
10. Remove the lower fan shroud. Refer to *Fan Shroud Replacement – Lower (8.1L)* in this supplement.
11. Remove the serpentine belt. Refer to *Drive Belt Replacement* in this supplement
12. Remove the fan. Refer to *Fan Replacement* in this supplement.
13. Remove the power steering pump pulley. Refer to *Power Steering Pump Pulley Replacement* in this supplement.
14. Remove the power steering pump. Refer to *Power Steering Pump Replacement* in this supplement.



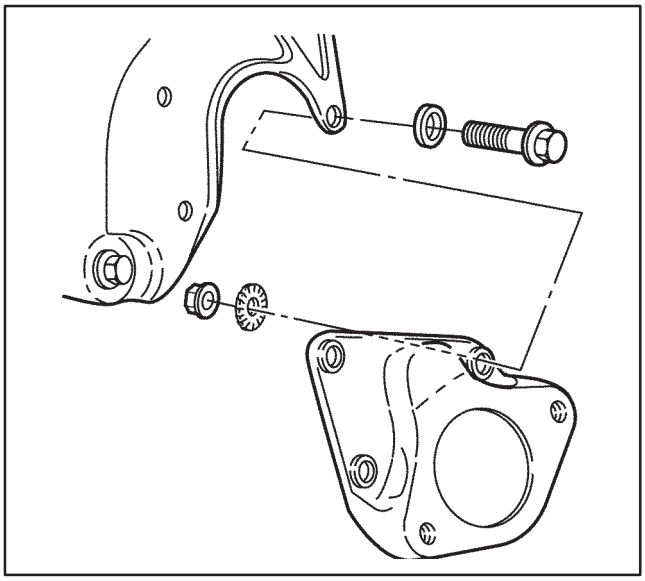
WRK22004

15. Remove the bolts, washers, lockwashers, and nuts from the left accessory bracket and the power steering pump bracket, and remove the power steering pump bracket.

## Installation Procedure

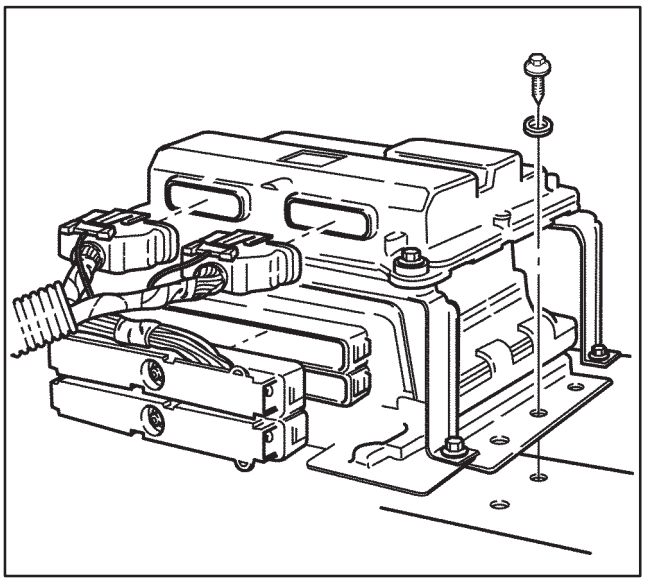
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

1. Install the power steering pump bracket, bolts, washers, lockwashers, and nuts to the left accessory bracket.
   **Tighten**
   Tighten the power steering pump bracket nuts to 65 N·m (48 lb ft).
2. Install the power steering pump. Refer to *Power Steering Pump Replacement* in this supplement.
3. Install the power steering pump pulley to the power steering pump. Refer to *Power Steering Pump Pulley Replacement* in this supplement.
4. Install the fan. Refer to *Fan Replacement* in this supplement.
5. Install the serpentine belt. Refer to *Drive Belt Replacement* in this supplement.
6. Install the lower fan shroud. Refer to *Fan Shroud Replacement – Lower (8.1L)* in this supplement.
7. Install the upper fan shroud. *Refer to Fan Shroud Replacement – Upper (8.1L)* in this supplement.
8. Install the upper radiator hose. Refer to *Radiator Hose Replacement – Inlet (8.1L)* in this supplement.

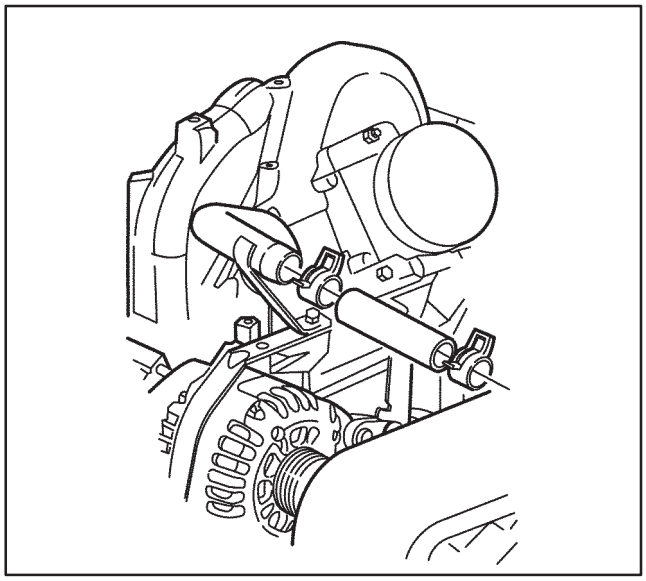


WRK22004

9. Install the PCM bracket with the PCM and TCM attached, and the retaining bolts.
   **Tighten**
   Tighten the PCM bracket retaining bolts to 17 N·m (13 lb ft).
10. Connect the powertrain control module (PCM) connectors.
11. Connect the transmission control module (TCM) connectors.

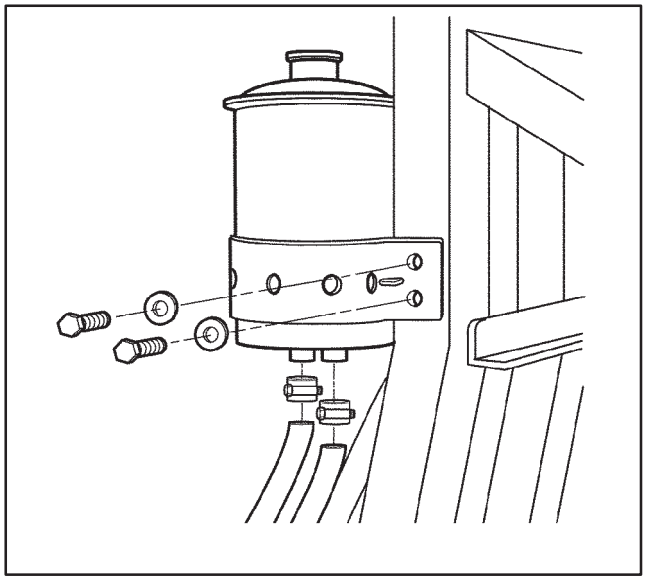


WRK22005



WRK62002

12. Install the engine oil fill tube to the oil pipe.
13. Install the air intake duct to the throttle body and MAF/IAT sensor. Refer to *Air Intake Duct Replacement (8.1L)* in this supplement.
14. Fill the cooling system. Refer to *Draining and Filling Cooling System* in the WCC Service Manual.
15. Connect the negative battery cable
16. Fill and bleed the power steering system. Refer to *Bleeding Power Steering System* in the WCC Service Manual.



WRK22007

## Power Steering Reservoir Assembly Replacement

### Removal Procedure

1. Place a drain pan below the power steering reservoir to catch draining fluids.
2. Remove the brake booster reservoir hose clamp and the hose at the power steering reservoir.
3. Raise the hose to prevent drainage of the oil.
4. Cap the hose and plug the hole in the reservoir to prevent contamination.
5. Remove the power steering pump return hose clamp and the hose at the power steering reservoir.
6. Raise the hose to prevent drainage of the oil.
7. Cap the hose and plug the hole in the reservoir to prevent contamination.
8. Remove the power steering reservoir bracket nuts, washers, and bolts, and the power steering reservoir assembly.

### Installation Procedure

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

1. Install the power steering reservoir assembly and the power steering reservoir bracket bolts, washers, and nuts.

   **Tighten**

   Tighten the power steering reservoir bracket nuts to 65 N·m (48 lb ft).

***Notice:*** Make sure that hoses are not in contact with any sharp edges that could cause chafing.

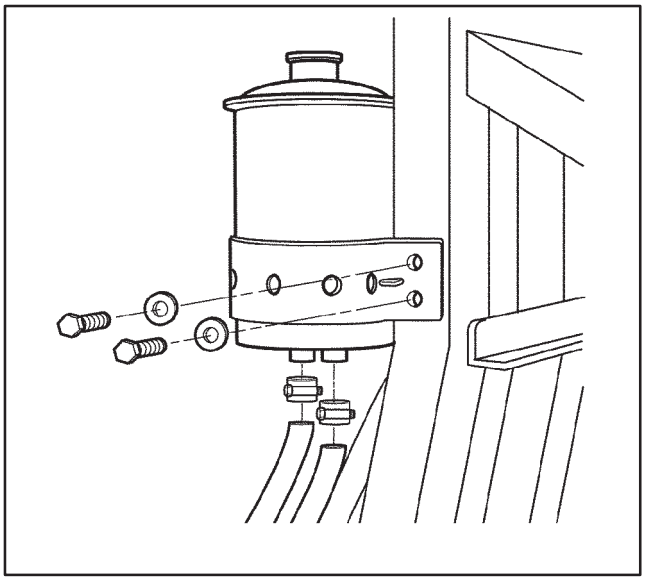
2. Install the power steering pump return hose and the hose clamp at the power steering reservoir.

   **Tighten**

   Tighten the power steering pump return hose clamp.
3. Install the brake booster reservoir hose and the hose clamp at the power steering reservoir.

   **Tighten**

   Tighten the brake booster reservoir hose clamp.
4. Fill and bleed the power steering system. Refer to *Bleeding Power Steering System* in the WCC Service Manual.



WRK22007

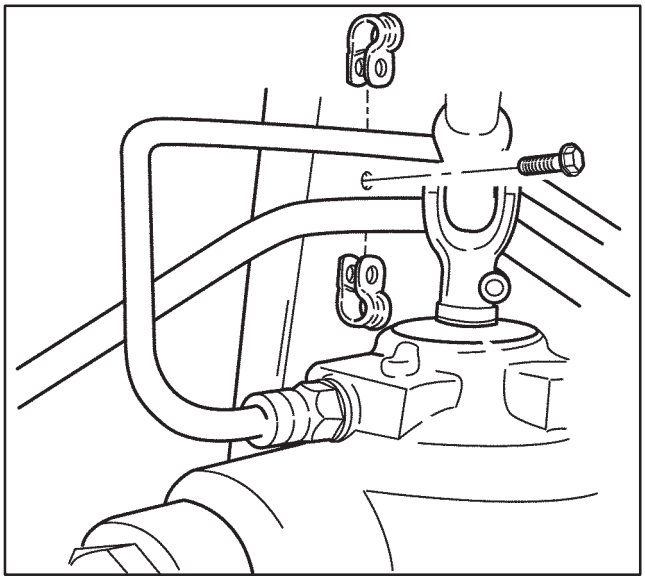
## Power Steering Hydraulic Hoses Replacement – Pressure

### Removal Procedure

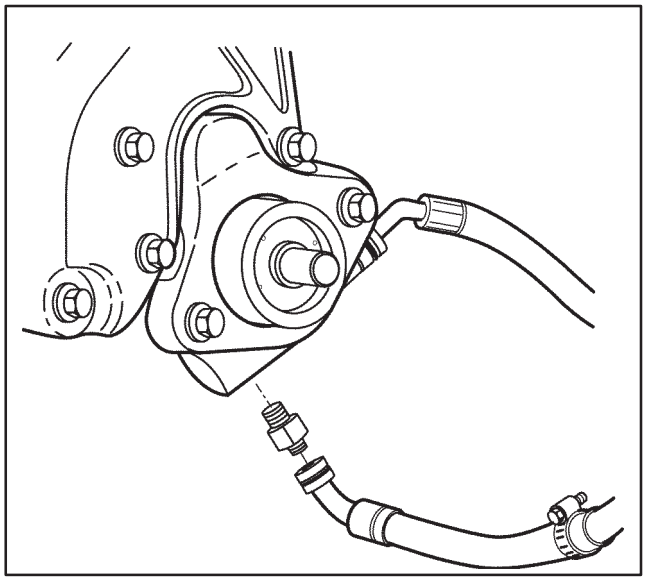
**Tools Required**

- *FF 90213-10* Quick Disconnect Tool
- *J 42971* Quick Disconnect Tool

1. Place drain pans below the power steering pump and the steering gear to catch draining fluids.
2. Remove the screw from the two tube clamps retaining the power steering pressure hose and the power steering pump return hose at the frame.
3. Remove the tube clamp from the power steering pressure hose.

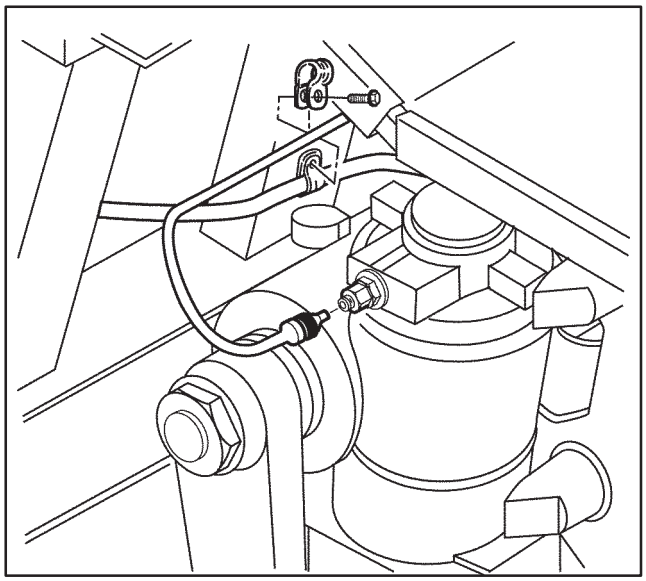


WRK22048



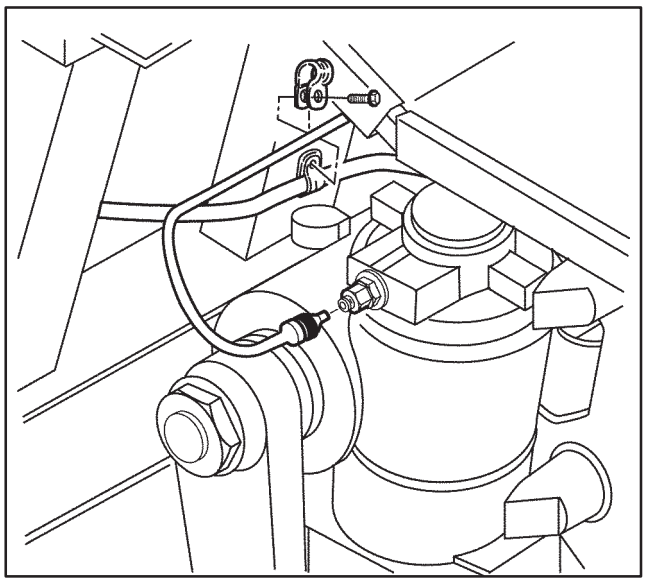
WRK22008

4. Disconnect the power steering pressure hose at the power steering pump using the *J 42971.*



WRK22009

5. If necessary, remove the STC female fitting from the power steering pump.
6. Drain the hose of the oil.
7. Cap the hose and plug the hole at the power steering pump to prevent contamination.
8. Disconnect the power steering pressure hose at the steering gear using the *FF 90213-10* and remove the hose.
9. If necessary, remove the STC female fitting from the steering gear.
10. Cap the hose and plug the hole at the steering gear to prevent contamination.



WRK22009

### Installation Procedure

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

1. If removed, install the STC female fitting to the steering gear.

   **Tighten**

   Tighten the power steering pressure hose steering gear STC female fitting to 55 N·m (41 lb ft).

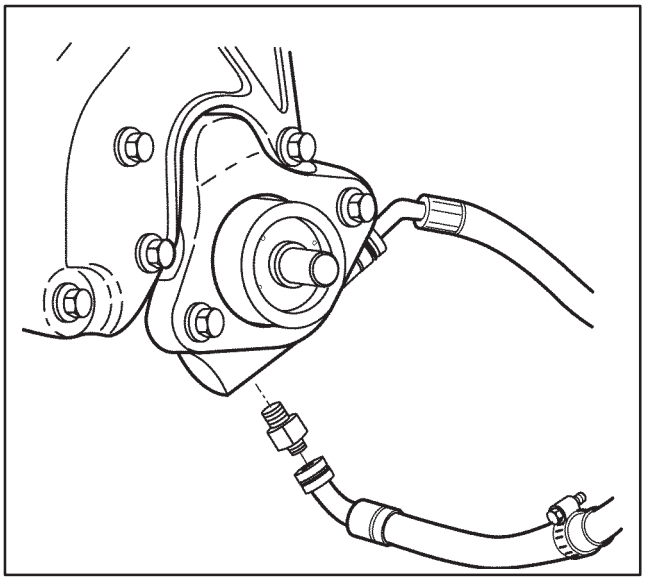
***Notice:*** Make sure that hoses are not in contact with any sharp edges that could cause chafing.

2. Route the power steering pressure hose and connect the hose at the steering gear. Refer to the connect procedure in *Quick Disconnect Connector Service (STC Type)* in this supplement.

3. If removed, install the STC female fitting to the power steering pump.

   **Tighten**

   Tighten the power steering pressure hose steering pump STC female fitting to 120 N·m (89 lb ft).
4. Connect the power steering pressure hose at the power steering pump. Refer to the connect procedure in *Quick Disconnect Connector Service (STC Type)* in this supplement.

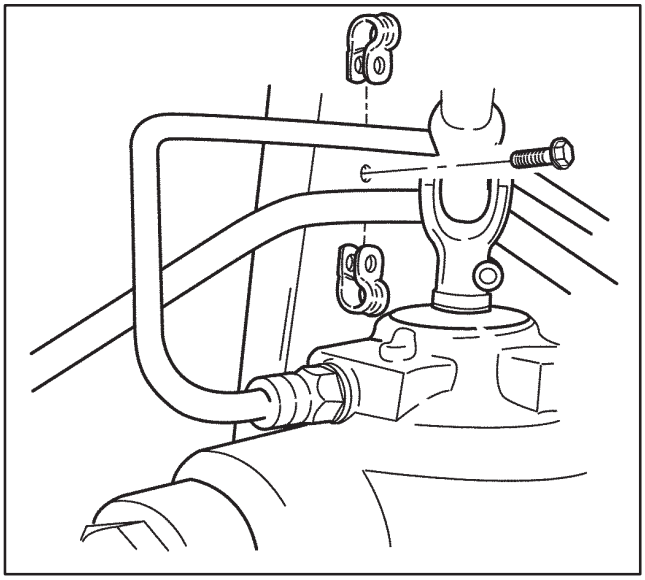


WRK22008

5. Install the tube clamp to the power steering pressure hose.
6. Install the screw to the two tube clamps retaining the power steering pressure hose and the power steering pump return hose at the frame.

   **Tighten**

   Tighten the power steering pressure hose and return tube clamps screw to 8 N·m (71 lb in).
7. Fill and bleed the power steering system. Refer to *Bleeding Power Steering System* in the WCC Service Manual.



WRK22048

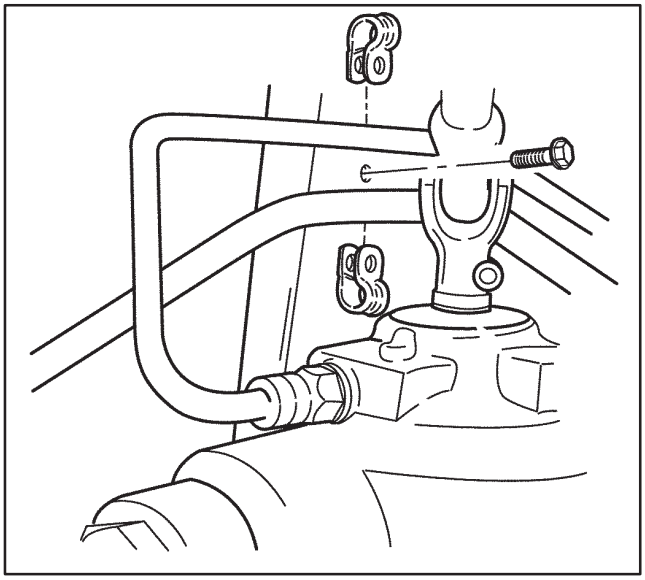
## Power Steering Hydraulic Hoses Replacement – Return

### Removal Procedure

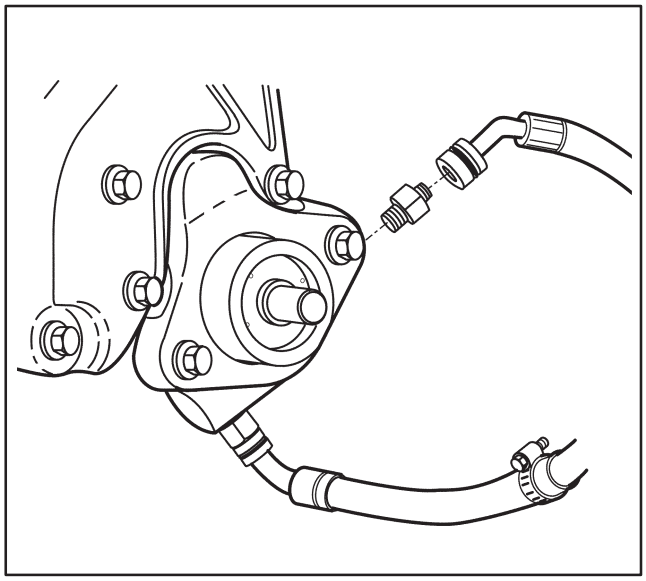
**Tools Required**

- *J 42971* Quick Disconnect Tool

1. Place drain pans below the power steering pump and the power steering reservoir to catch draining fluids.
2. Remove the screw from the two tube clamps retaining the power steering pressure hose and the power steering pump return hose at the frame.
3. Remove the tube clamp from the power steering pump return hose.

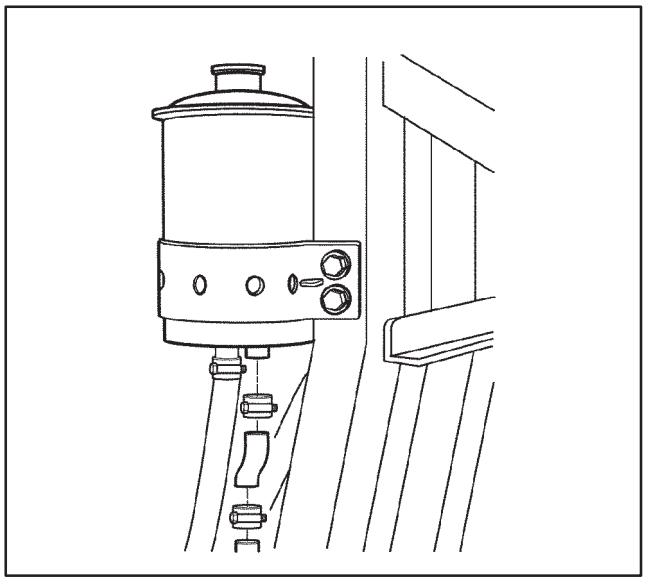


WRK22048



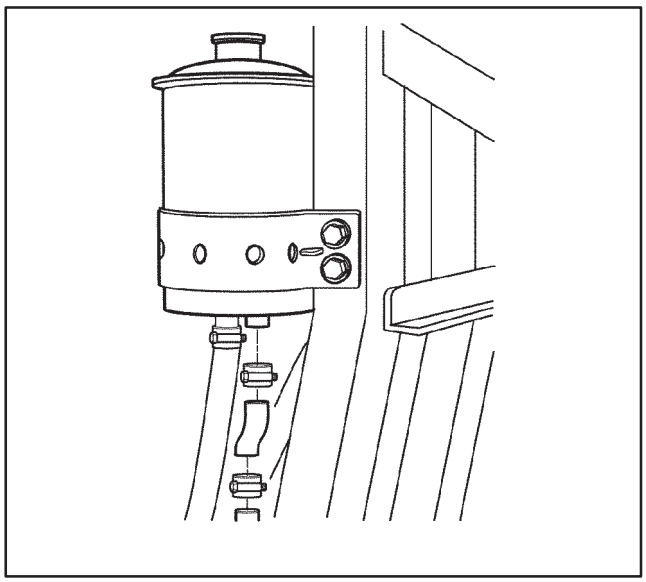
WRK22010

4. Disconnect the power steering return hose at the power steering pump using the *J 42971*.
5. If necessary, remove the STC female fitting from the power steering pump.
6. Drain the hose of the oil.
7. Cap the hose and plug the hole in the power steering pump to prevent contamination.



WRK22011

8. Disconnect the power steering pump return hose at the power steering reservoir, and remove the hose and the hose clamp.
9. Cap the hose and plug the hole in the power steering reservoir to prevent contamination.



WRK22011

## Installation Procedure

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

***Notice:*** Make sure that hoses are not in contact with any sharp edges that could cause chafing.

1. Route the power steering return hose and install the hose and the hose clamp at the power steering reservoir.

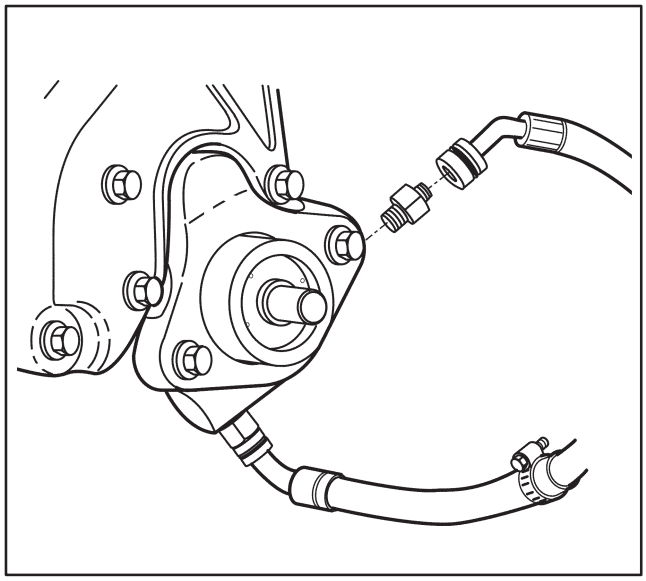
   **Tighten**

   Tighten the power steering pump return hose clamp.

2. If removed, install the STC female fitting to the power steering pump.

   **Tighten**

   Tighten the power steering pump return hose steering pump STC female fitting to 120 N · m (89 lb ft).
3. Connect the power steering pump return hose at the power steering pump. Refer to the connect procedure in *Quick Disconnect Connector Service (STC Type)* in this supplement.

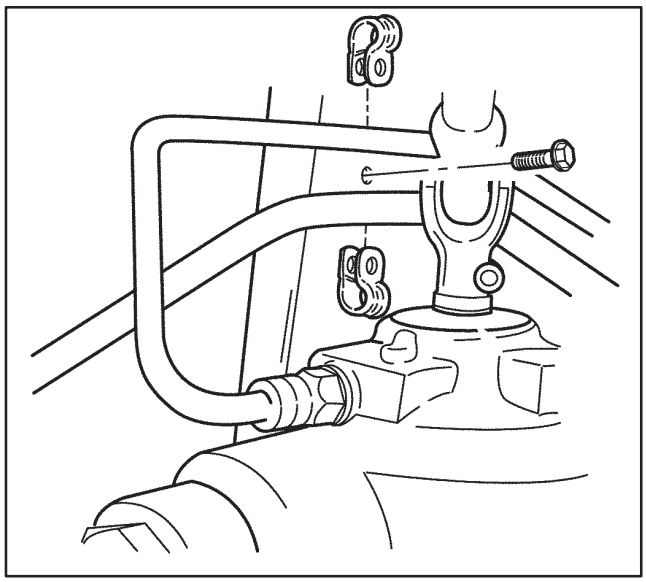


WRK22010

4. Install the tube clamp to the power steering pump return hose.
5. Install the screw to the two tube clamps retaining the power steering pressure hose and the power steering pump return hose at the frame.

   **Tighten**

   Tighten the power steering pressure and return tube clamps screw to 8 N · m (71 lb in).
6. Fill and bleed the power steering system. Refer to *Bleeding Power Steering System* in the WCC Service Manual.



WRK22048

## Power Steering Gear Assembly

### Removal Procedure

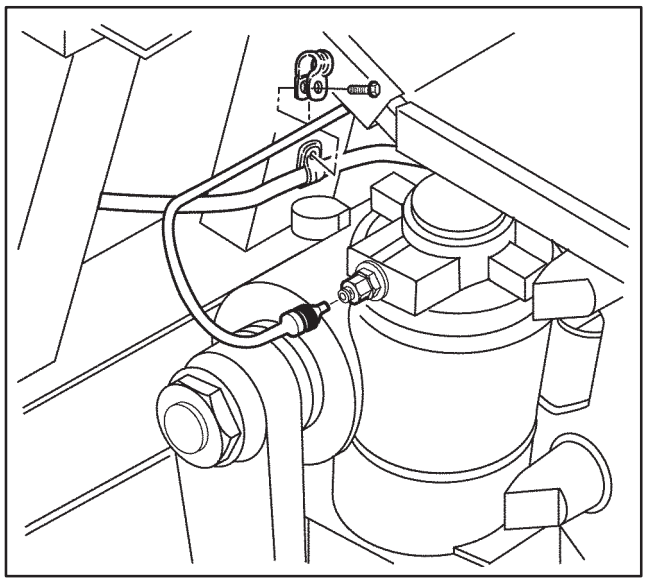
**Tools Required**

- *FF 90213-10* Quick Disconnect Tool
- *J 29107-A* Universal Pitman Arm Puller

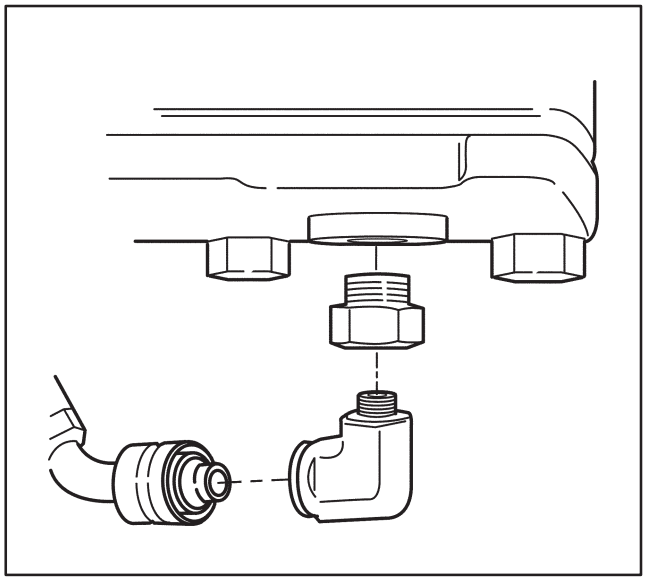
1. Position the front wheels and the steering wheel straight ahead.
2. Remove the radiator and radiator bracket. Refer to *Radiator Replacement (8.1L)* in this supplement.

***Notice:*** Avoid contaminating the power steering system. Cap open hoses and ports to prevent dirt and debris from entering system. Contaminated power steering fluid and dirt can cause early parts failure.

3. Place a drain pan under the steering gear to catch draining fluids.
4. Disconnect the pressure hose from the steering gear using the *FF 90213-10*.

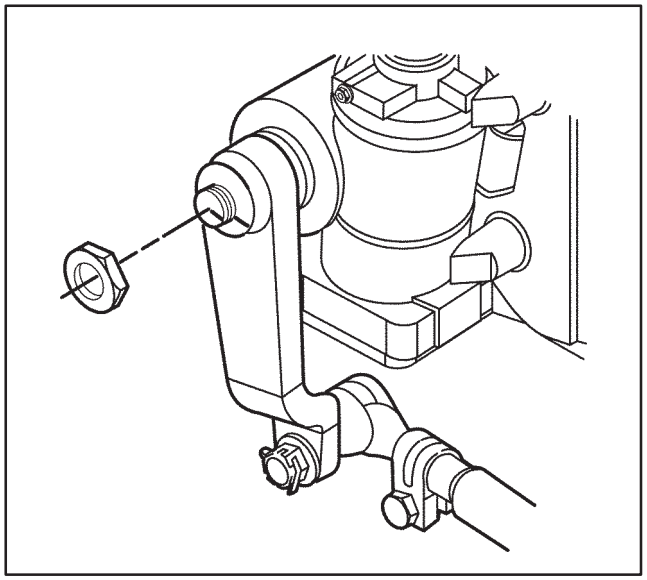


WRK22009



WRK22015

5. Disconnect the brake booster hose from the steering gear using the *FF 90213-10*.



WRK22056

6. Remove the pitman arm nut from the steering gear.

***Notice:*** Do not hammer on the pitman arm, pitman arm shaft, or puller. Damage to the pitman arm or steering gear may result.

7. Use the *J 29107-A* to remove the pitman arm from the steering gear assembly.
8. Remove the intermediate steering shaft pinch bolt from the steering shaft.
9. Remove the three steering gear bolts from the frame.
10. Remove the steering gear nut and bolt from the frame.
11. Remove the steering gear from the frame and steering shaft.

### Installation Procedure

1. Install the steering gear to the frame and steering shaft.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

2. Install the steering gear bolt and nut to the frame.

   **Tighten**

   Tighten the steering gear nut to 520 N·m (384 lb ft).
3. Install the three steering gear bolts to the frame.

   **Tighten**

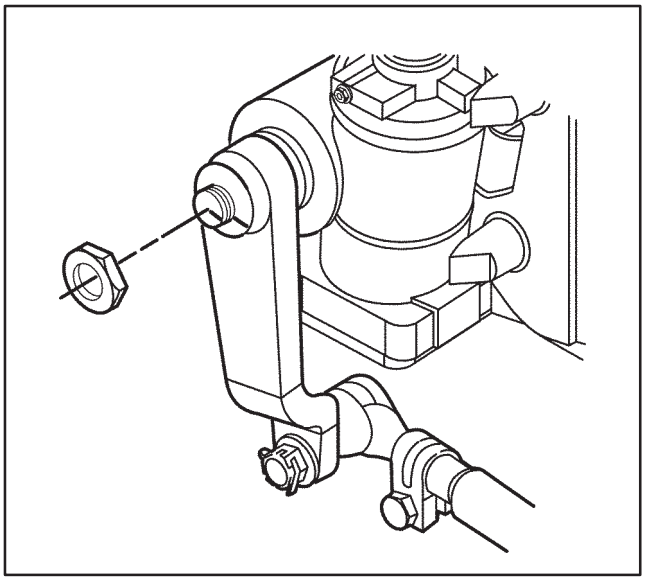
   Tighten the steering gear bolts to 520 N·m (384 lb ft).
4. Install the intermediate steering shaft pinch bolt to the steering shaft.

   **Tighten**

   Tighten the intermediate steering shaft pinch bolt to 65 N·m (48 lb ft).
5. Align the match marks and install the pitman arm to the steering gear assembly.
6. Install the pitman arm nut to the steering gear.

   **Tighten**

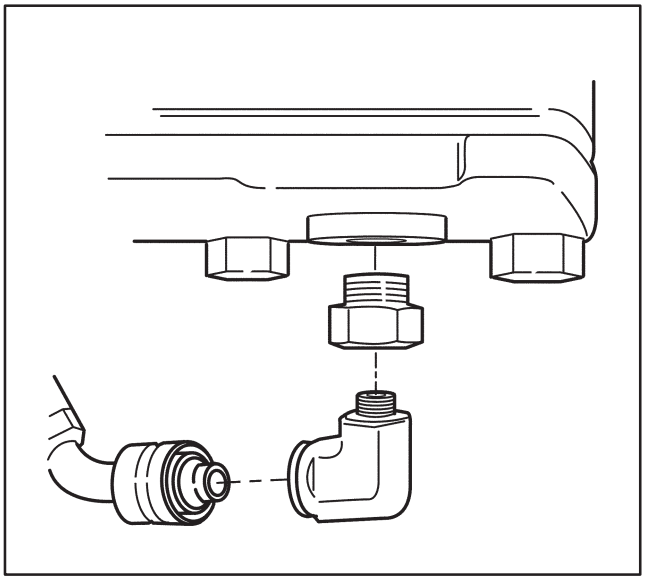
   Tighten the pitman arm nut to 520 N·m (384 lb ft).
7. Pinch the pitman arm nut.



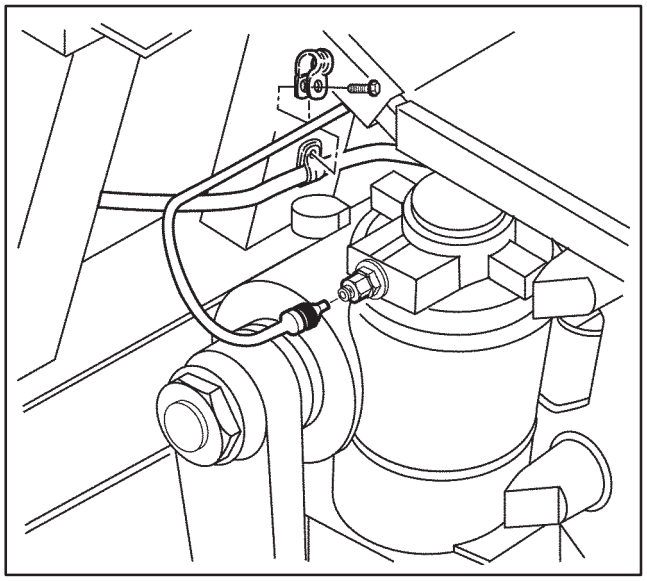
WRK22056

***Notice:*** Make sure that hoses are not in contact with any sharp edges that could cause chafing.

8. Connect the brake booster hose to the steering gear. Refer to the connect procedure in *Quick Disconnect Connector Service (STC Type)* in this supplement.

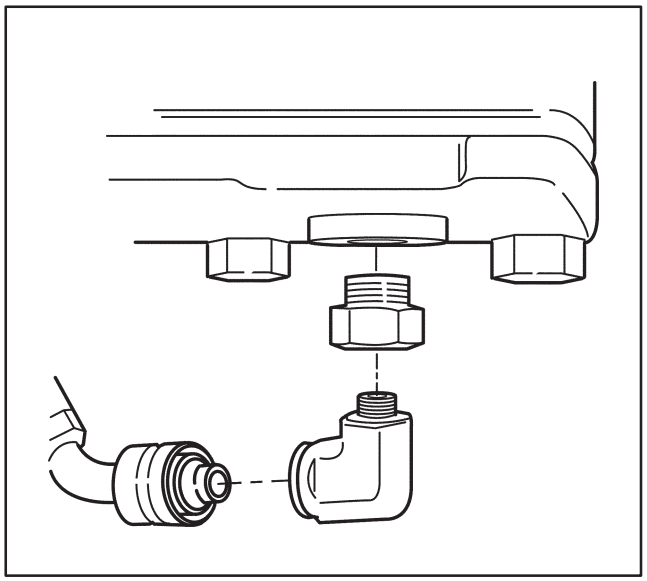


WRK22015



WRK22009

9. Connect the pressure hose to the steering gear. Refer to the connect procedure in *Quick Disconnect Connector Service (STC Type)* in this supplement.
10. Install the radiator bracket and radiator. Refer to *Radiator Replacement (8.1L)* in this supplement.
11. Fill and bleed the power steering system. Refer to *Bleeding Power Steering System* in the WCC Service Manual.



WRK22015

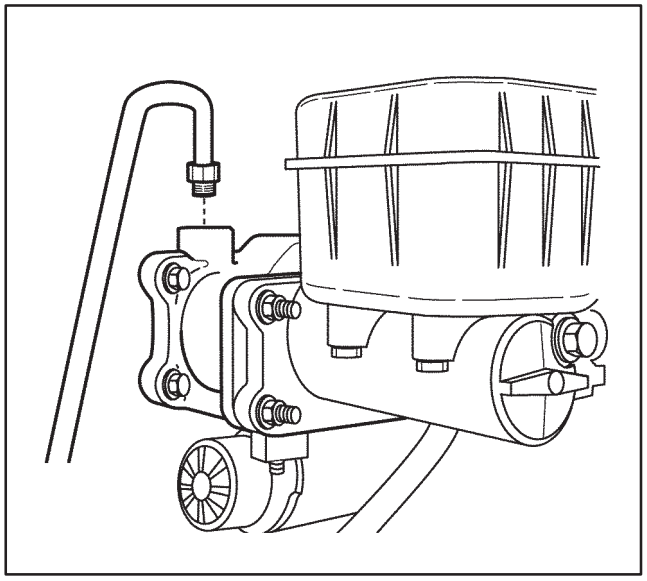
## Brake Booster to Steering Gear Hose Replacement

### Removal Procedure

#### Tools Required

- *FF 90213-10* Quick Disconnect Tool

1. Place drain pans below the brake booster and the steering gear to catch draining fluids.
2. Disconnect the brake booster hose at the steering gear elbow using the *FF 90213-10.*
3. If necessary, remove the STC female elbow fitting and reducer bushing from the steering gear.
4. Cap the hose and plug the hole at the steering gear to prevent contamination.



WRK22014

5. Disconnect the brake booster hose at the brake booster, and remove the hose.
6. Cap the hose and plug the hole at the brake booster to prevent contamination.

### Installation Procedure

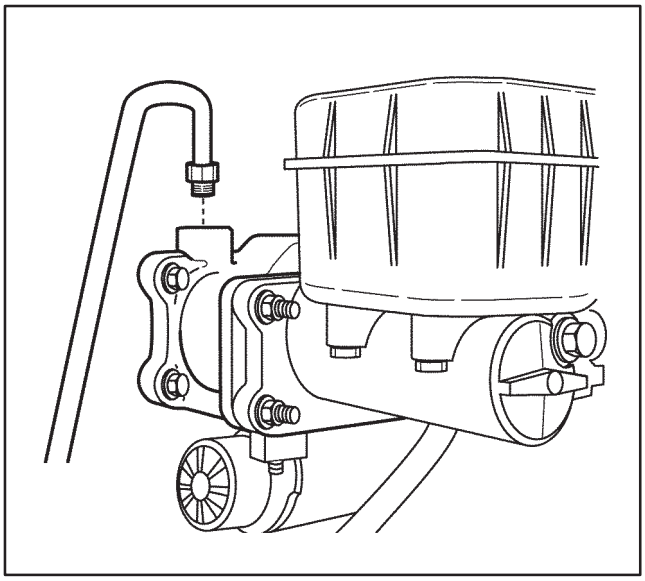
***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

***Notice:*** Make sure that hoses are not in contact with any sharp edges that could cause chafing.

1. Route the brake booster hose and connect the hose at the brake booster.

   **Tighten**

   Tighten the brake booster hose fitting at the brake booster to 28 N·m (21 lb ft).

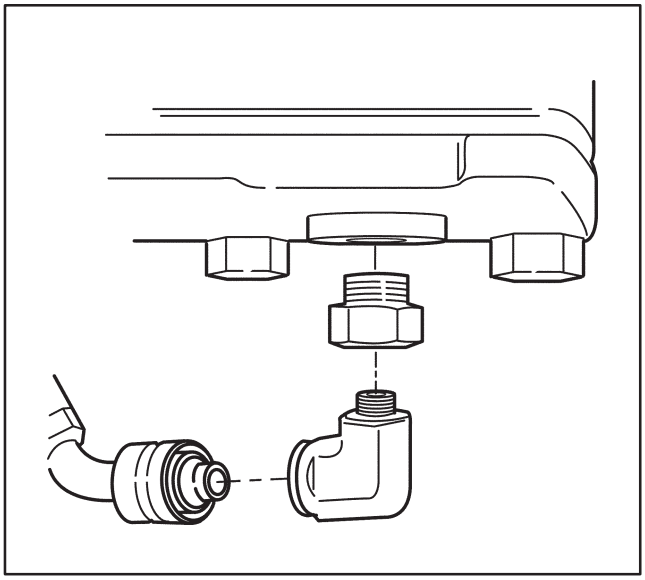


WRK22014

2. If removed, install the reducer bushing and elbow to the steering gear.

   **Tighten**

   - Tighten the steering gear reducer bushing to 55 N·m (41 lb ft).
   - Tighten the steering gear STC female elbow fitting to 55 N·m (41 lb ft).
3. Connect the brake booster hose at the steering gear STC female elbow fitting. Refer to the connect procedure in *Quick Disconnect Connector Service (STC Type)* in this supplement.
4. Fill and bleed the power steering system. Refer to *Bleeding Power Steering System* in the WCC Service Manual.



WRK22015

## Pitman Arm Replacement

### Removal Procedure

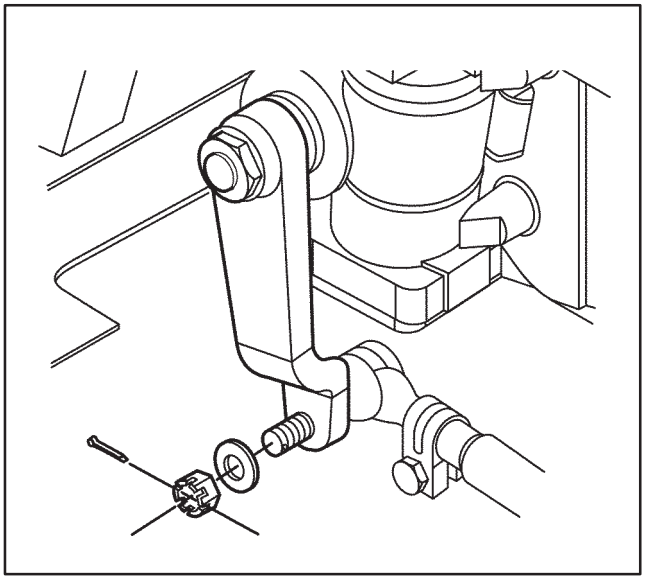
**Tools Required**

- *J 24319-B* Universal Steering Linkage Puller
- *J 29107-A* Universal Pitman Arm Puller

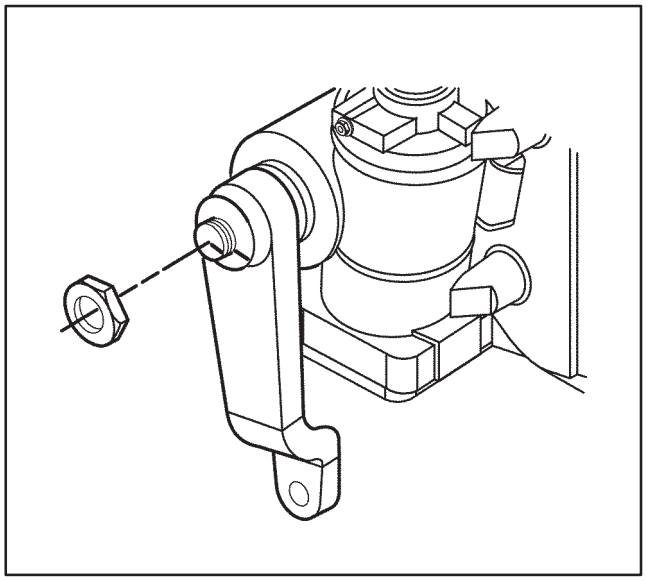
1. Remove the cotter key and castle nut from the steering arm ball stud at the pitman arm.

***Notice:*** Do not attempt to disconnect a steering linkage joint by driving a wedge between the joint and the attached part. Seal damage may result which will cause premature failure of the joint.

2. Using the *J 24319-B,* remove the steering arm ball stud from the pitman arm.



WRK22016

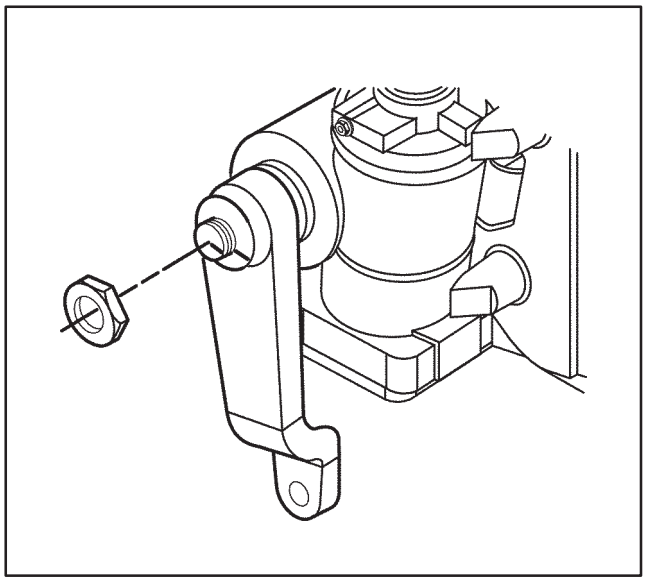


WRK22017

3. Remove the pitman arm nut from the steering gear.

***Notice:*** Do not hammer on the pitman arm, pitman shaft or puller. Damage to the pitman arm or steering gear may result.

4. Using the *J 29107-A,* remove the pitman arm.
5. Inspect the ball stud threads for damage.
6. Inspect the ball stud seals for excessive wear.
7. Clean the following components:
   - The threads on the ball studs.
   - The threads in the ball stud nut.



WRK22017

## Installation Procedure

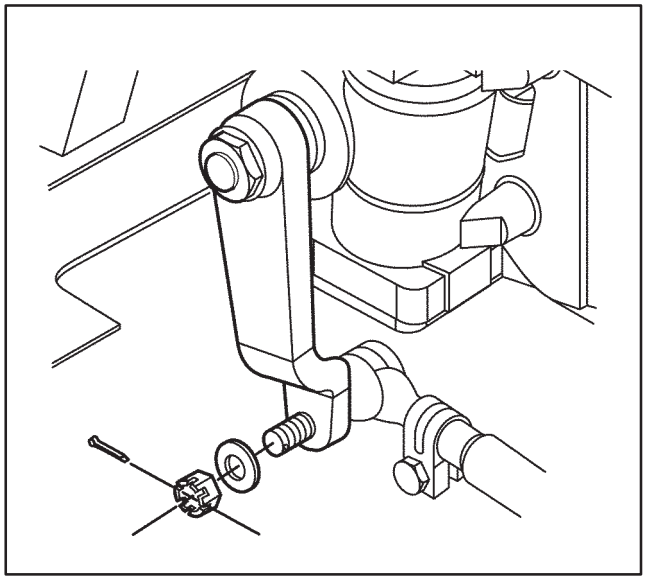
1. Align the match marks and install the pitman arm to the steering gear.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

2. Install the pitman arm nut to the steering gear.

   **Tighten**

   Tighten the pitman arm nut to 520 N·m (384 lb ft).
3. Pinch the pitman arm nut.



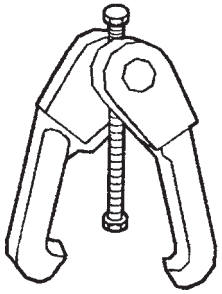
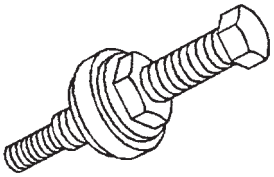
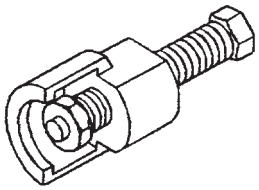
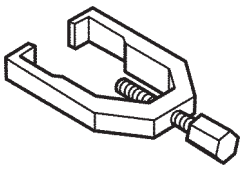
WRK22016

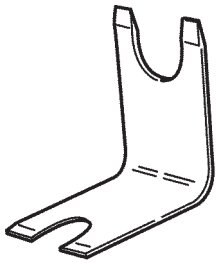
4. Install the steering arm ball stud to the pitman arm.
5. Install the castle nut to the steering arm ball stud at the pitman arm.

   **Tighten**

   Tighten the steering arm ball stud nut to 176 N·m (130 lb ft).
6. Install the cotter pin.

## Special Tools and Equipment

| Illustration | Tool Number/ Description |
|---|---|
| NO ART AVAILABLE<br>WRK00000 | FF 90213-10<br>Quick Disconnect Tool |
|  <br>WRK22041 | J 24319-B<br>Universal Steering Linkage Puller |
|  <br>WRK22043 | J 25033-C<br>Power Steering Pump Pulley Installer |
|  <br>WRK22042 | J 25034-C<br>Power Steering Pump Pulley Remover |
|  <br>WRK22044 | J 29107-A<br>Universal Pitman Arm Puller |

| Illustration | Tool Number/ Description |
|---|---|
|  <br>WRK71130 | J 42971<br>Quick Disconnect Tool |

**BLANK**

# Steering Wheel and Column – Tilt

## Specifications

### Fastener Tightening Specifications

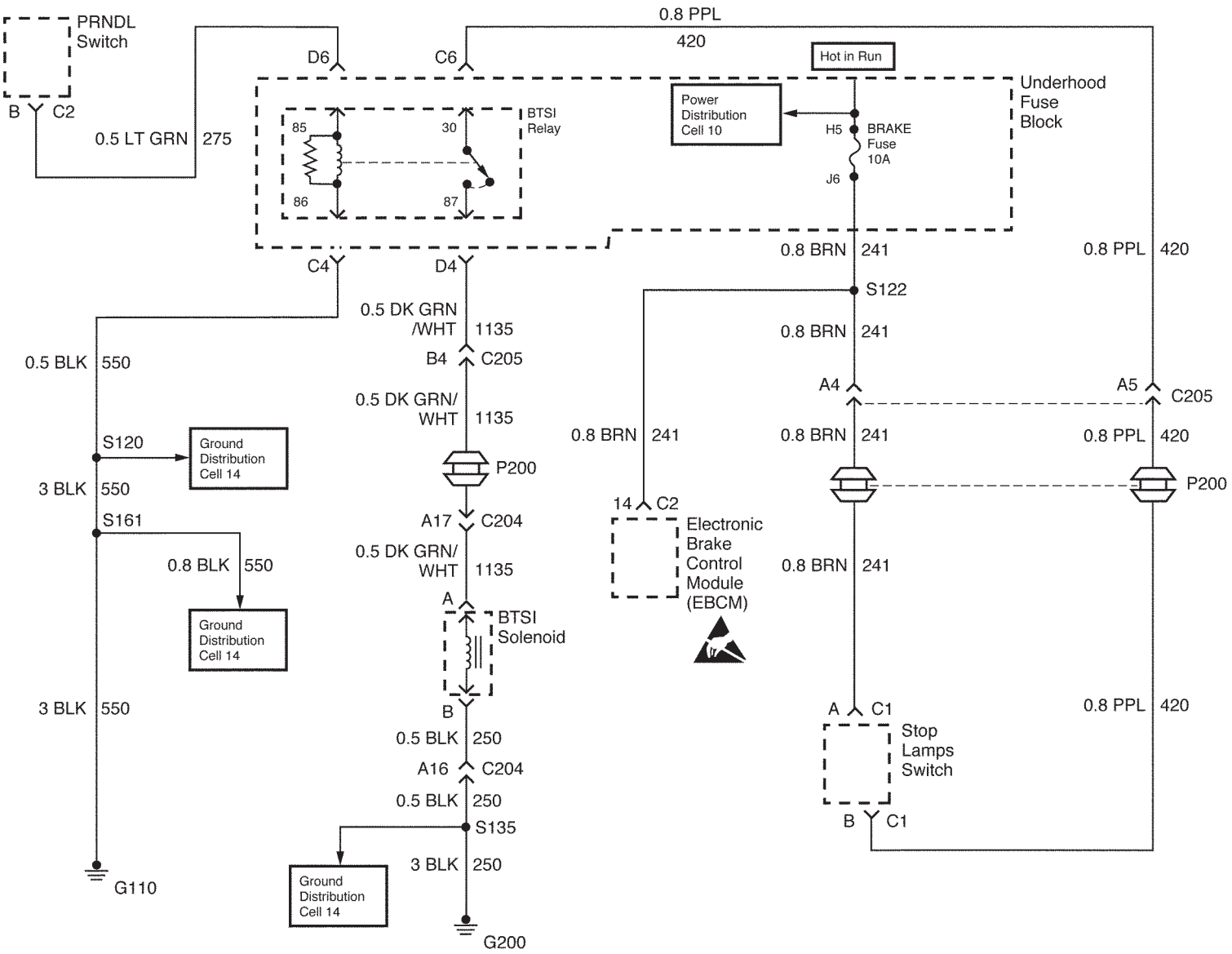
| Application | Specification | |
|---|---|---|
| | Metric | English |
| Intermediate Steering Shaft Lower Cardan Joint Pinch Bolt | 65 N·m | 48 lb ft |
| Intermediate Steering Shaft Upper Cardan Joint Pinch Bolt | 45 N·m | 33 lb ft |
| Linear Shift Assembly Screws | 10 N·m | 89 lb in |
| Lock Module Screws | 3.5 N·m | 31 lb in |
| Lower Steering Column Cover Screw | 6 N·m | 53 lb in |
| Steering Column Floor Plate Nut | 27 N·m | 20 lb ft |
| Steering Column Support Screw | 17 N·m | 13 lb ft |
| Steering Wheel Nut | 41 N·m | 30 lb ft |
| Upper Steering Column Brace Bolt | 30 N·m | 22 lb ft |
| Upper Steering Column Cover Screw | 1.4 N·m | 12 lb in |

## Schematic and Routing Diagrams

### Steering Wheel and Column – Tilt Schematic Icons

| Icon | Icon Definition |
|---|---|
|  | Refer to *ESD Notice* in Cautions and Notices in the WCC Service Manual. |

## Automatic Transmission Shift Lock Control Schematics (P22 Motorhome) (Cell 138: BTSI Relay and Related Circuits)

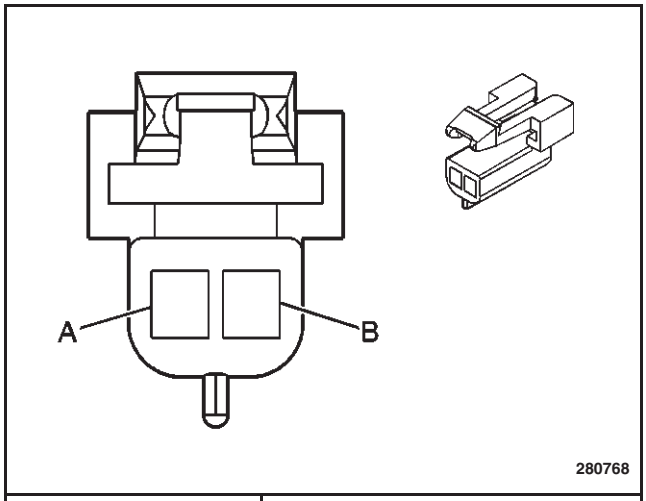



WRK22057

# Component Locator

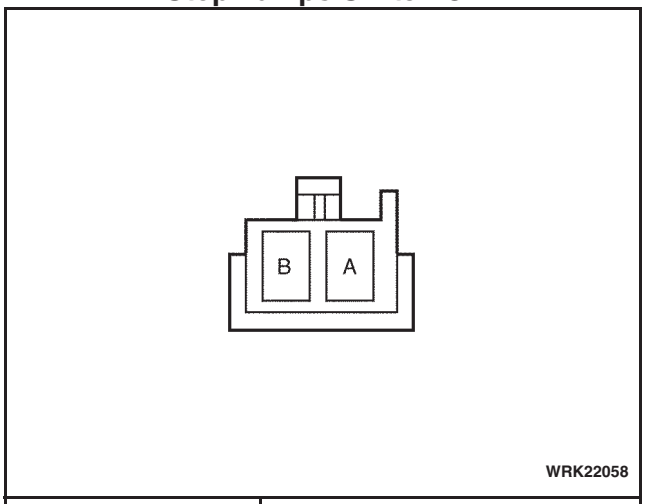
## Tilt Wheel/Column Connector End Views

### Brake Transmission Shift Interlock (BTSI) Solenoid




| Connector Part Information | • 12052832<br>• 2 Way F Metri-Pack 150 Series (BLK) | | |
|---|---|---|---|
| **Pin** | **Wire Color** | **Circuit No.** | **Function** |
| A | DK GRN/ WHT | 1135 | Brake Transmission Shift Interlock Solenoid Feed |
| B | BLK | 250 | Ground |

### Stop Lamps Switch C1



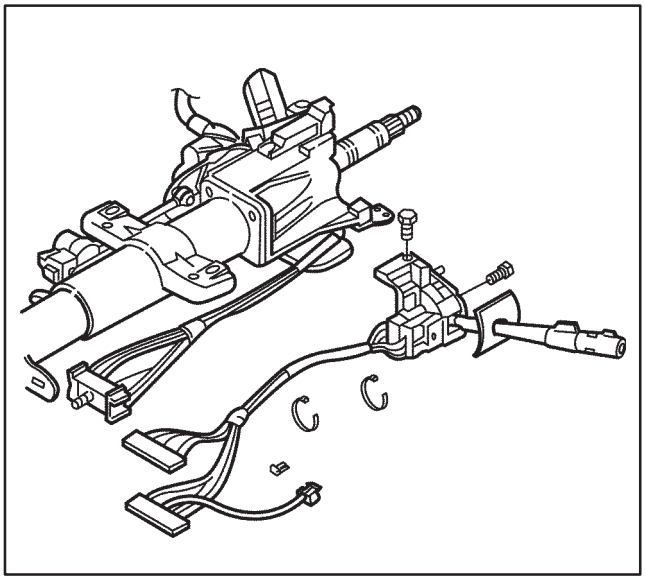

| Connector Part Information | • 12015197<br>• 2 Way F Metri-Pack 280 Series (BLU) | | |
|---|---|---|---|
| **Pin** | **Wire Color** | **Circuit No.** | **Function** |
| A | BRN | 241 | Ignition Positive Feed |
| B | PPL | 420 | BTSI Relay Feed |

# Repair Instructions

## Multifunction Turn Signal Lever Replacement – On Vehicle

### Removal Procedure

1. Remove the tilt lever. Refer to *Tilt Lever Replacement – On Vehicle* in this supplement.
2. Remove the lower steering column cover. Refer to *Steering Column Cover Replacement – Lower* in this supplement.
3. Remove the lock cylinder. Refer to *Steering Column Lock Cylinder Replacement* in this supplement.
4. Remove the upper steering column cover. Refer to *Steering Column Cover Replacement – Upper* in this supplement.
5. Remove the multifunction lever bolts and lever from the steering column.
6. Disconnect the multifunction lever electrical connector.



WRK22018

### Installation Procedure

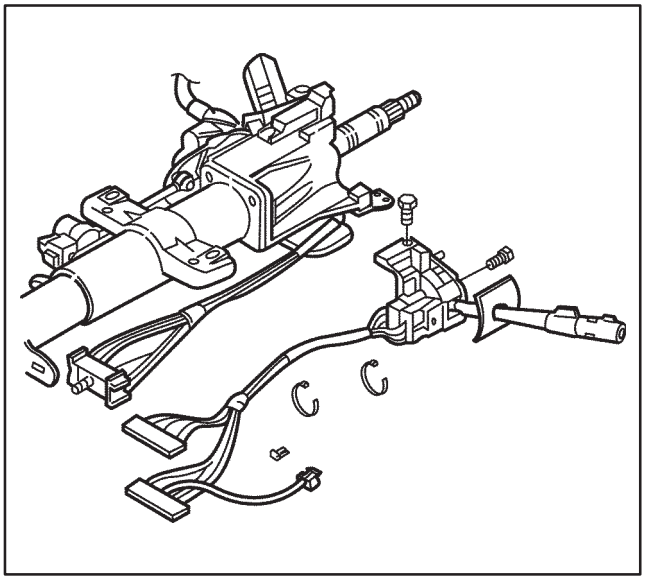
1. Connect the multifunction lever electrical connector.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

2. Install the multifunction lever and bolts to the steering column.

   **Tighten**

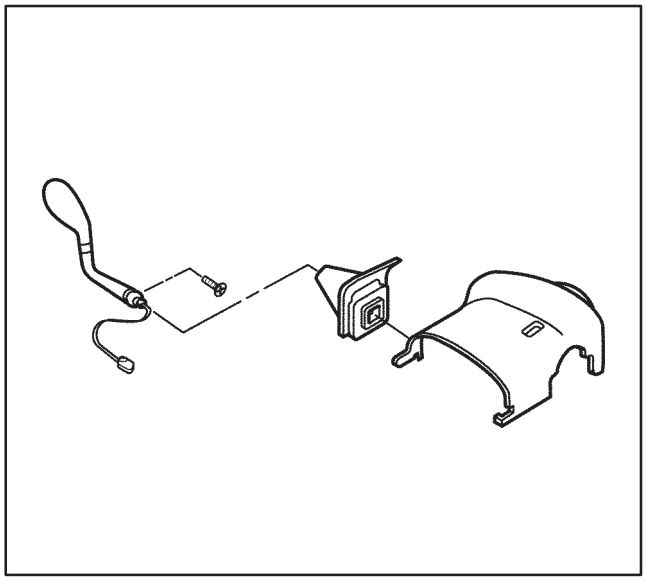
   Tighten the multifunction lever bolts.
3. Install the upper steering column cover. Refer to *Steering Column Cover Replacement – Upper* in this supplement.
4. Install the lock cylinder. Refer to *Steering Column Lock Cylinder Replacement* in this supplement.
5. Install the lower steering column cover. Refer to *Steering Column Cover Replacement – Lower* in this supplement.
6. Install the tilt lever. Refer to *Tilt Lever Replacement – On Vehicle* in this supplement.



WRK22018

## Hazard Warning Switch Replacement – On Vehicle

The hazard warning switch is part of the multifunction lever. Refer to *Multifunction Turn Signal Lever Replacement – On Vehicle* in this supplement.

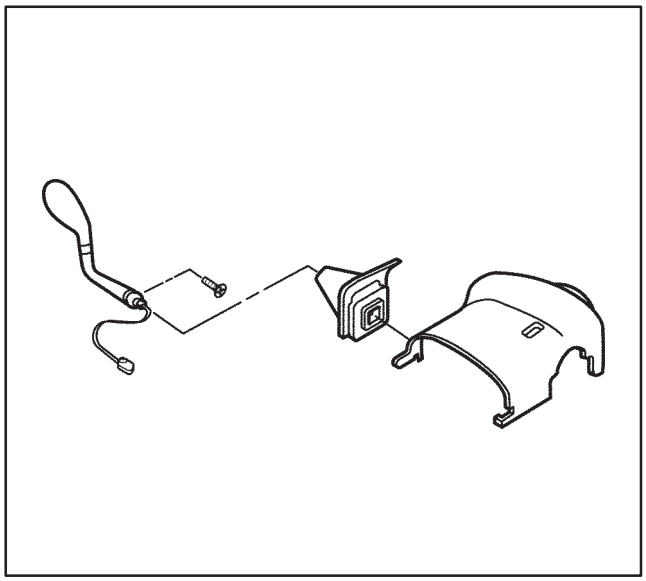


WRK22019

## Shift Lever Replacement – On Vehicle

### Removal Procedure

1. Remove the lower steering column cover. Refer to *Steering Column Cover Replacement – Lower* in this supplement.
2. Remove the tilt lever. Refer to *Tilt Lever Replacement – On Vehicle* in this supplement.
3. Disconnect the park lock cable system.
4. Remove the bolt from the shift lever and the lever from the shift column.



WRK22019

### Installation Procedure

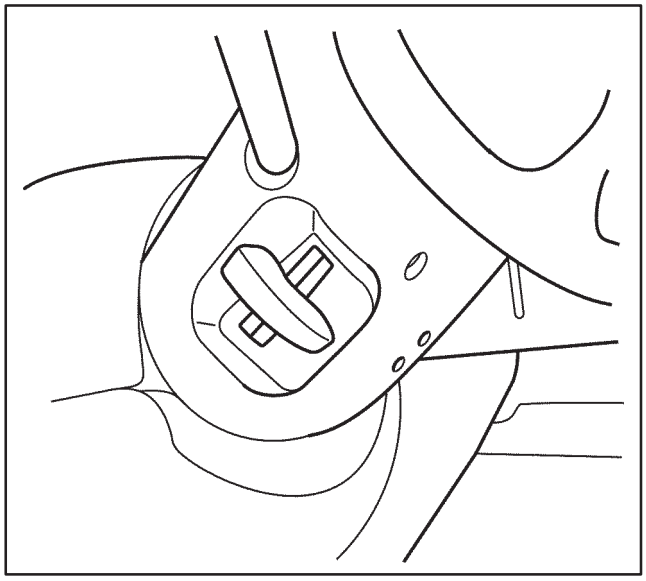
1. Connect the park lock cable system.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

2. Install the shift lever and bolt to the steering column.

   **Tighten**

   Tighten the shift lever bolt.
3. Install the lower steering column cover. Refer to *Steering Column Cover Replacement – Lower* in this supplement.
4. Install the tilt lever. Refer to *Tilt Lever Replacement* in this supplement.



WRK22020

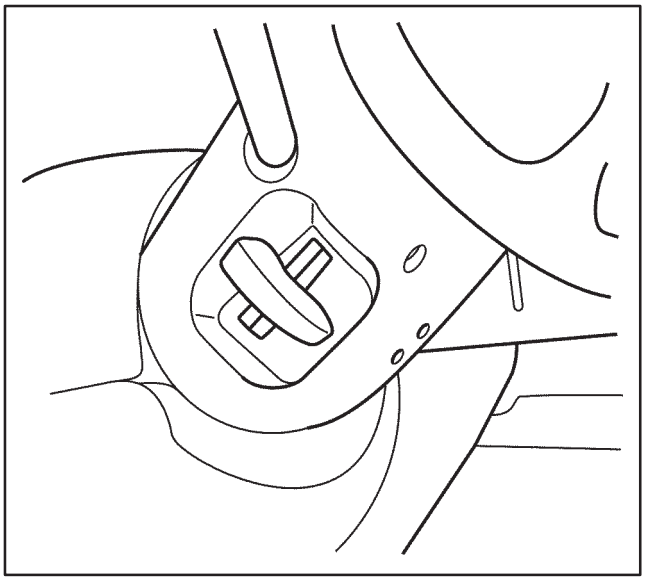
## Tilt Lever Replacement – On Vehicle

### Removal Procedure

Pull the tilt lever straight out from the steering column tilt latch.

### Installation Procedure

Push the till lever into the steering column tilt latch.



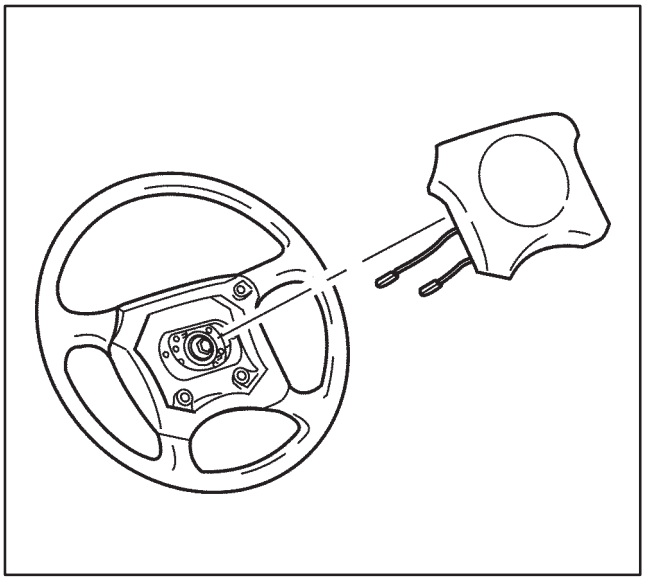
WRK22020

## Horn Switch Replacement

### Removal Procedure

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices in the WCC Service Manual.***

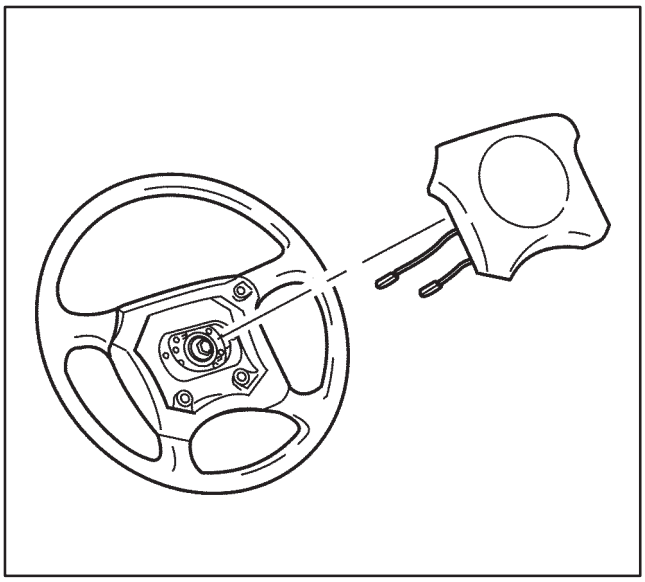
1. Disconnect the negative battery cable.
2. Remove the horn pad assembly.
3. Remove the horn wires from the steering wheel.



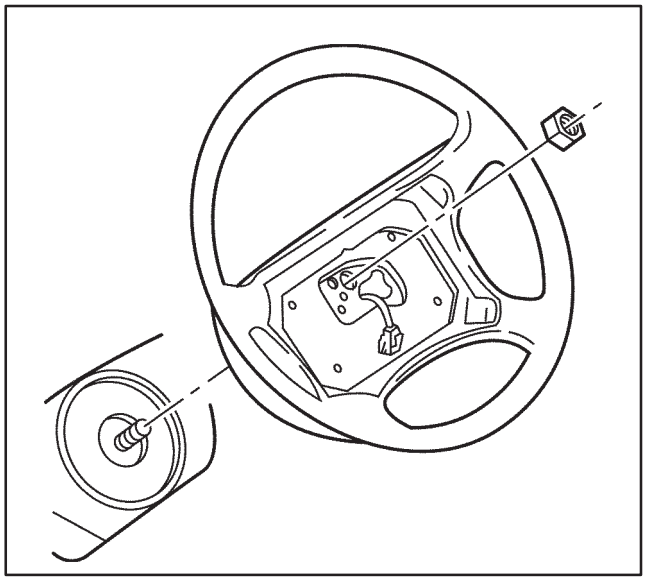
WRK22021

### Installation Procedure

1. Install the horn wires to the steering wheel.
2. Install the horn pad assembly.
3. Connect the negative battery cable.



WRK22021



WRK22022

## Steering Wheel Replacement

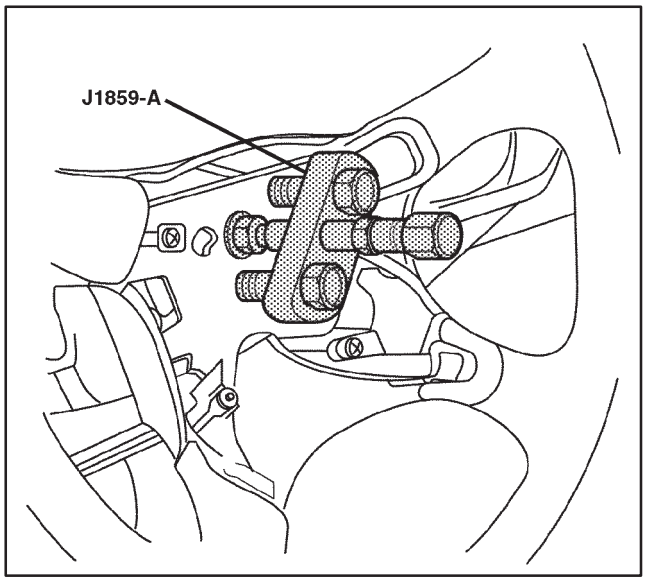
### Removal Procedure

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices in the WCC Service Manual.***

**Tools Required**

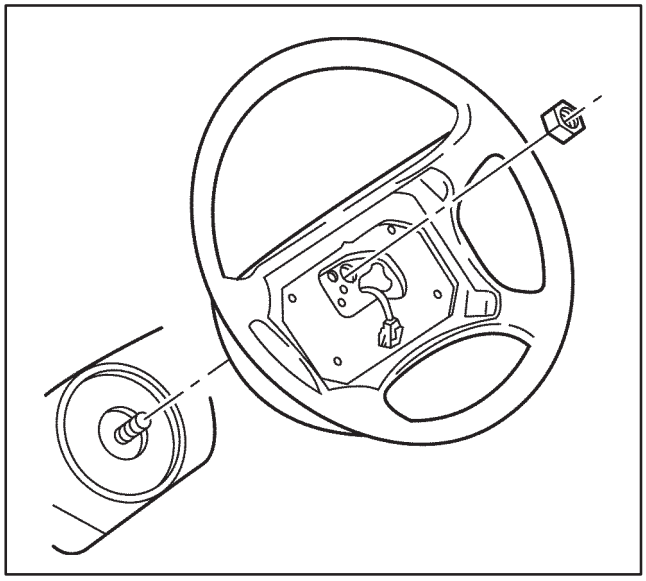
*J 1859-A* Steering Wheel Puller

1. Disconnect the negative battery cable.
2. Set the wheels in the straight-ahead position and lock the steering wheel.
3. Remove the horn pad. Refer to *Horn Switch Replacement* in this supplement.
4. Remove the steering wheel nut.
5. Match mark the steering wheel and the steering shaft.




WRK22023

6. Using *J 1859-A,* remove the steering wheel.



WRK22022

### Installation Procedure

1. Align the match marks and install the steering wheel onto the steering shaft.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

2. Install the steering wheel nut.

   **Tighten**

   Tighten the steering wheel nut to 41 N·m (30 lb ft).
3. Install the horn pad. Refer to *Horn Switch Replacement* in this supplement.
4. Connect the negative battery cable.

## Turn Signal Lever Replacement – On Vehicle

The turn signal lever is part of the multifunction lever. Refer to *Multifunction Turn Signal Lever Replacement – On Vehicle* in this supplement.

## Turn Signal Cancel Cam and Upper Bearing Inner Race Replacement – On Vehicle

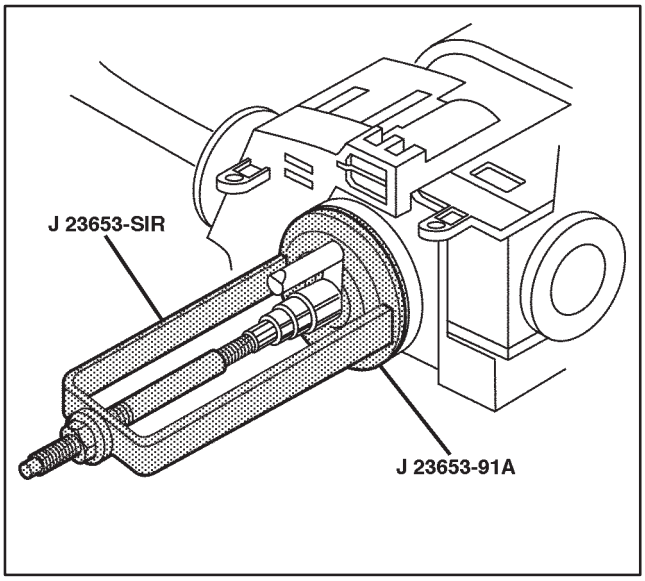
### Tools Required

- *J 23653-SIR* Lock Plate Compressor
- *J 23653-91A* Lock Plate Compressor Adapter

### Removal Procedure

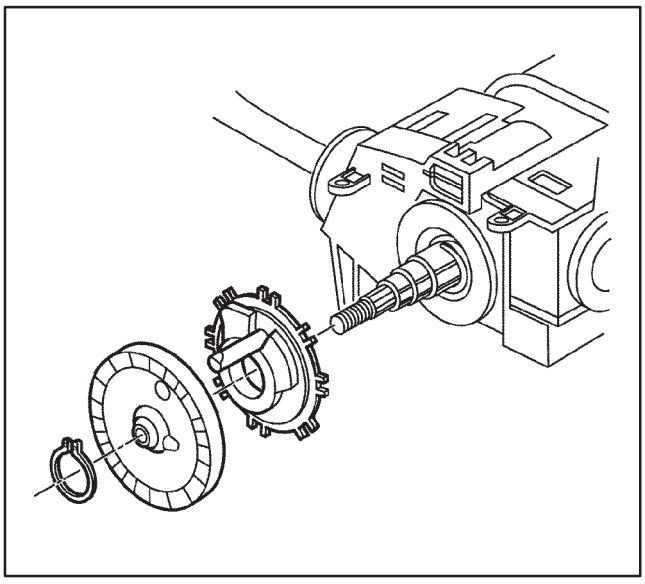
***Caution: Refer to Battery Disconnect Caution in Cautions and Notices in the WCC Service Manual.***

1. Disconnect the negative battery cable.
2. Remove the horn pad. Refer to *Horn Switch Replacement* in this supplement.
3. Remove the steering wheel. Refer to *Steering Wheel Replacement* in this supplement.
4. Remove the tilt lever. Refer to *Tilt Lever Replacement – On Vehicle* in this supplement.
5. Remove the lower steering column cover. Refer to *Steering Column Cover Replacement – Lower* in this supplement.
6. Remove the lock cylinder. Refer to *Steering Column Lock Cylinder Replacement* in this supplement.
7. Remove the upper steering column cover. Refer to *Steering Column Cover Replacement – Upper* in this supplement.
8. Install the *J 23653-91A* and the *J 23653-SIR* to the shaft lock shield and the steering shaft.

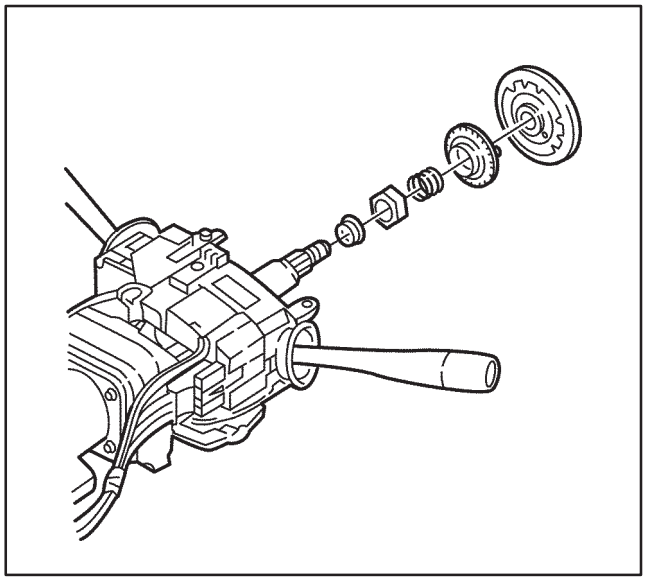



WRK22034

9. Remove the shaft lock shield retaining ring.
10. Remove the *J 23653-SIR* and the *J 23653-91A*.
11. Remove the shaft lock shield.
12. Remove the turn signal cancel cam.

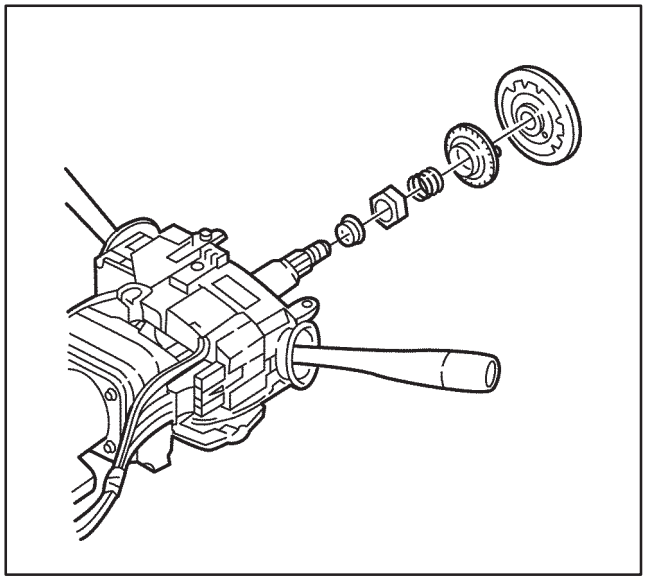


WRK22025



WRK22035

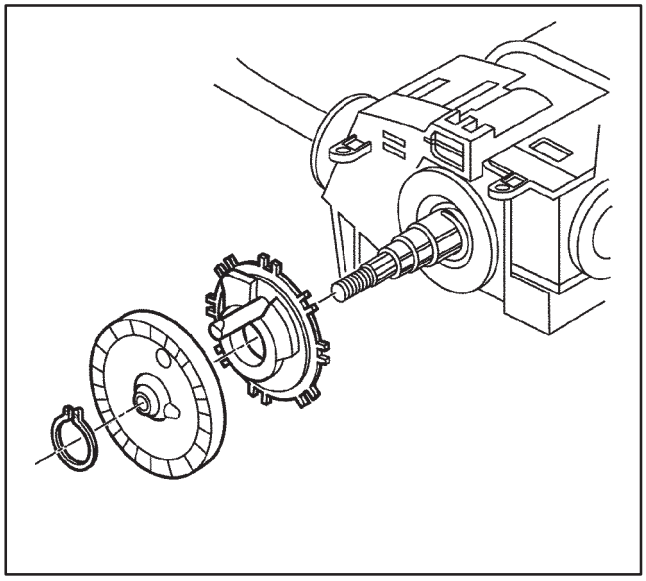
13. Remove the upper bearing spring, the upper bearing inner race seat, and the upper bearing inner race.



WRK22035

### Installation Procedure

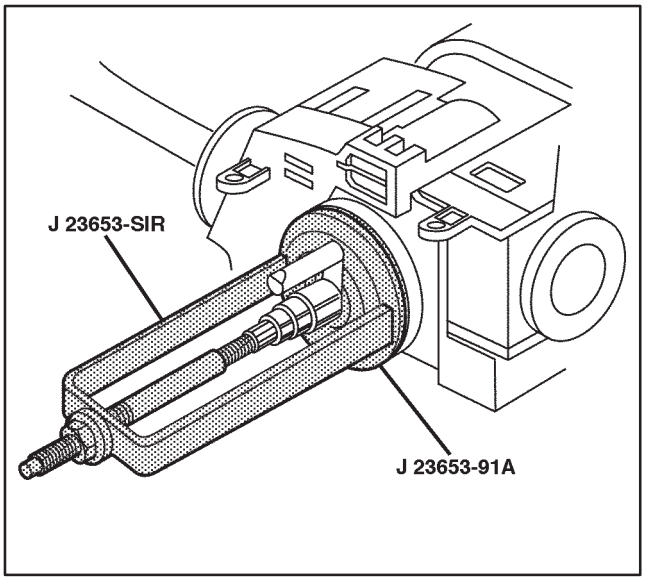
1. Install the upper bearing inner race, the upper bearing inner race seat, and the upper bearing spring.



WRK22025

2. Install the turn signal cancel cam.
3. Install the shaft lock shield.

4. Install the *J 23653-91A* and the *J 23653-SIR* to the shaft lock shield and the steering shaft.
5. Install the shaft lock shield retaining ring.
6. Remove the *J 23653-SIR* and the *J 23653-91A*.
7. Install the upper steering column cover. Refer to *Steering Column Cover Replacement – Upper* in this supplement.
8. Install the lock cylinder. Refer to *Steering Column Lock Cylinder Replacement* in this supplement.
9. Install the lower steering column cover. Refer to *Steering Column Cover Replacement – Lower* in this supplement.
10. Install the tilt lever. Refer to *Tilt Lever Replacement – On Vehicle* in this supplement.
11. Install the steering wheel. Refer to *Steering Wheel Replacement* in this supplement.
12. Install the horn pad. Refer to *Horn Switch Replacement* in this supplement.
13. Connect the negative battery cable.

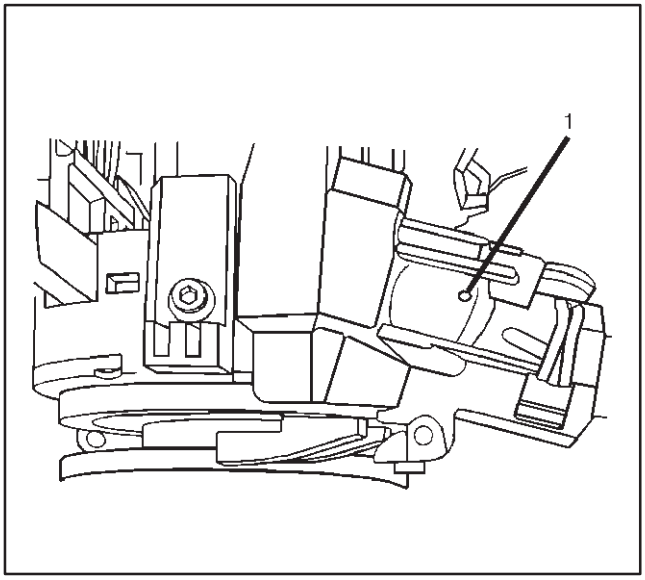



WRK22034

## Steering Column Lock Cylinder Replacement

### Removal Procedure

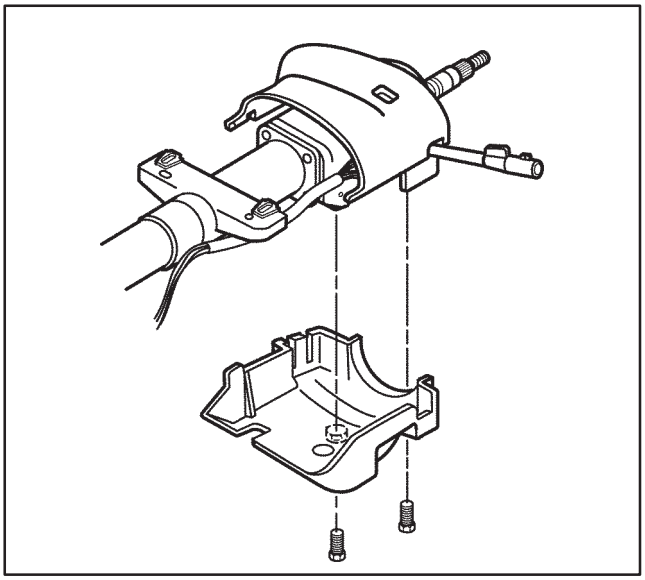
1. Remove the tilt lever. Refer to *Tilt Lever Replacement – On Vehicle* in this supplement.
2. Remove the lower steering column cover. Refer to *Steering Column Cover Replacement – Lower* in this supplement.
3. Remove the two screws from the upper steering column cover to access the top of the steering column. Refer to *Steering Column Cover Replacement – Upper* in this supplement.
4. Place the ignition cylinder in the run position.
5. Install an awl into the access hole (1) at the top of the steering column.
6. Turn the ignition cylinder to the start position and remove the ignition cylinder.




WRK22027

### Installation Procedure

1. Install the ignition cylinder by pushing into the cylinder case, position ignition to the run position.
2. Install the upper steering column cover screws. Refer to *Steering Column Cover Replacement – Upper* in this supplement.
3. Install the lower steering column cover. Refer to *Steering Column Cover Replacement – Lower* in this supplement.
4. Install the tilt lever. Refer to *Tilt Lever Replacement – On Vehicle* in this supplement.

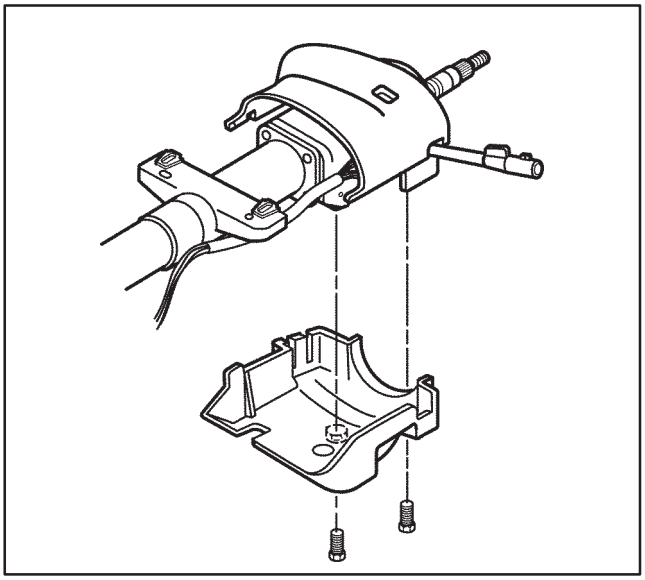


WRK22028

## Steering Column Cover Replacement – Lower

### Removal Procedure

1. Remove the tilt lever. Refer to *Tilt Lever Replacement – On Vehicle* in this supplement.
2. Remove the two screws from the lower steering cover.



WRK22028

### Installation Procedure

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

1. Install the lower cover and the two screws to the steering column.

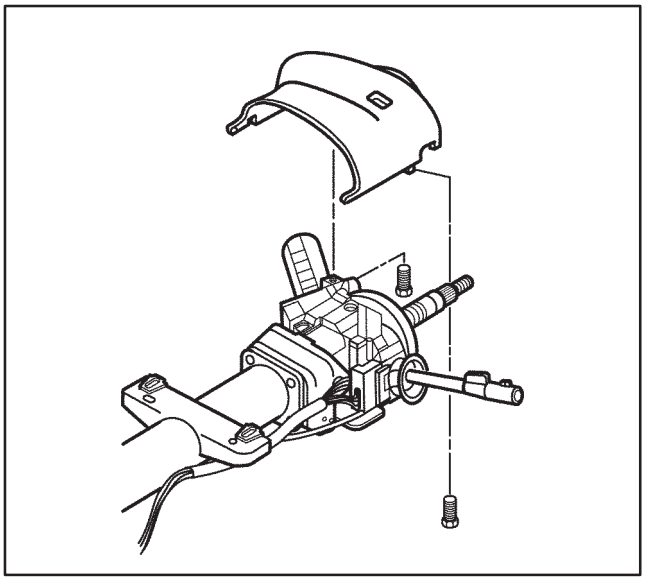
   **Tighten**

   Tighten the lower steering column cover screws to 6 N · m (53 lb in).
2. Install the tilt lever. Refer to *Tilt Lever Replacement* in this supplement.

## Steering Column Cover Replacement – Upper

### Removal Procedure

1. Remove the tilt lever. Refer to *Tilt Lever Replacement – On Vehicle* in this supplement.
2. Remove the lower steering column cover. Refer to *Steering Column Cover Replacement – Lower* in this supplement.
3. Remove the two screws from the upper cover to access the top of the steering column.
4. Remove the steering lock cylinder. Refer to *Steering Column Lock Cylinder Replacement* in this supplement.
5. Remove the upper cover.



WRK22029

### Installation Procedure

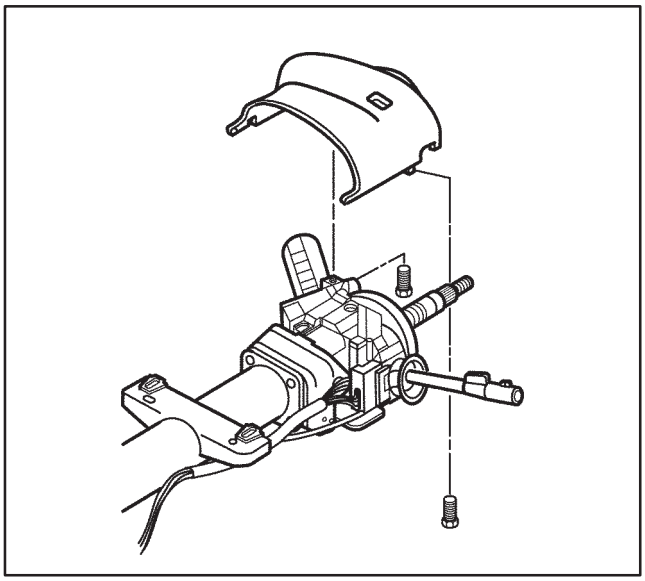
1. Install the upper cover.
2. Install the steering lock cylinder. Refer to *Steering Column Lock Cylinder Replacement* in this supplement.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

3. Install the two screws to the upper cover.

   **Tighten**

   Tighten the upper steering column cover screws to 1.4 N·m (12 lb in).
4. Install the lower cover. Refer to *Steering Cover Replacement – Lower* in this supplement.
5. Install the tilt lever. Refer to *Tilt Lever Replacement* in this supplement.



WRK22029

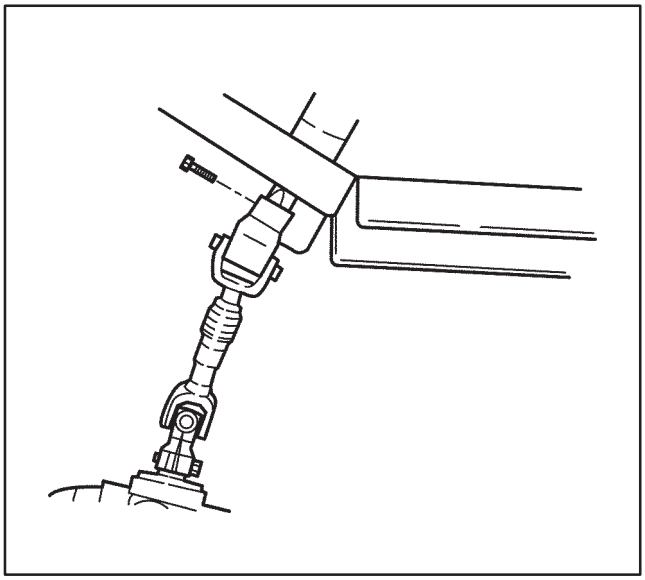
## Steering Column Replacement

### Removal Procedure

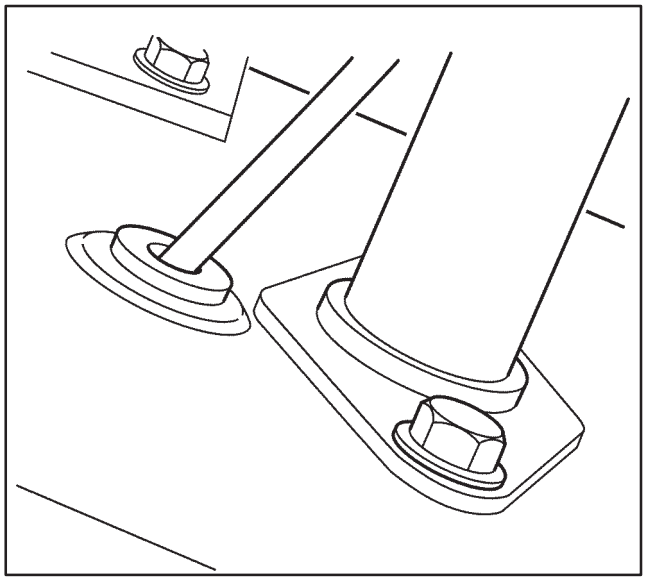
1. Set the front wheels in the straight-ahead position.
2. Set the steering wheel in the locked position.

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices in the WCC Service Manual.***

3. Disconnect the negative battery cable.
4. Remove the horn pad. Refer to *Horn Switch Replacement* in this supplement.
5. Remove the steering wheel. Refer to *Steering Wheel Replacement* in this supplement.
6. Disconnect the shift cable. Refer to *Shift Cable Replacement* in this supplement.
7. Disconnect the steering column harness at the connectors.
8. Match mark intermediate steering shaft and the steering shaft to ensure proper installation.
9. Remove the upper cardan joint pinch bolt from the intermediate steering gear coupling shaft.



WRK22031

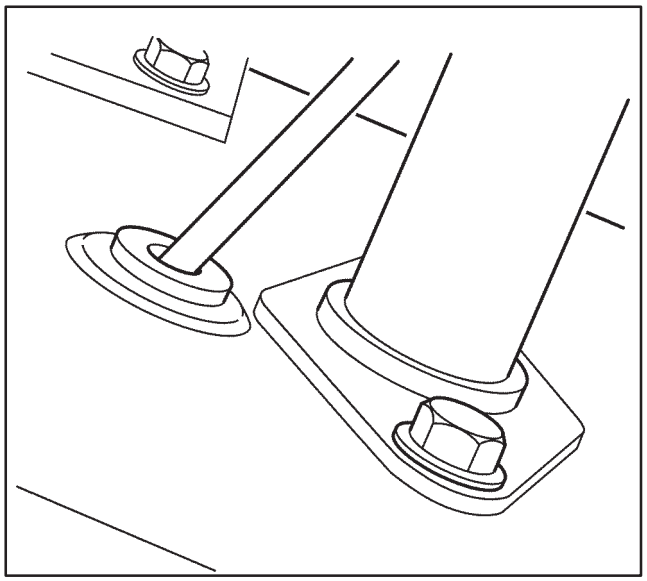


WRK22030

10. Remove the steering column floor plate nuts and bolts.
11. Remove the upper steering column brace bolts from inner bracket.

***Notice:*** Once the steering column is removed from the vehicle, the column is extremely susceptible to damage. Dropping the column assembly on its end could collapse the steering shaft or loosen the plastic injections that maintain column rigidity. Leaning on the column assembly could cause the jacket to bend or deform. Any of the above damage could impair the columns collapsible design. If it is necessary to remove the steering wheel, refer to *Steering Wheel Replacement* in this supplement. Under no condition should the end of the shaft be hammered on, as hammering could loosen the plastic injections, which maintain column rigidity.

12. Remove the steering column from the vehicle.



WRK22030

## Installation Procedure

1. Install the steering column to the vehicle, making sure to align the match marks on the intermediate steering shaft and the steering shaft.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

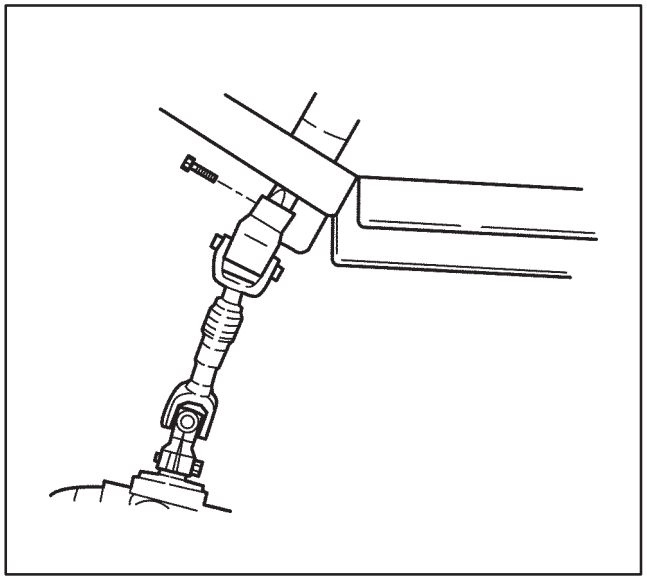
2. Install the upper steering column brace bolts to the inner bracket.

   **Tighten**

   Tighten the bolts to 30 N·m (22 lb ft).
3. Install the steering column floor plate nuts and bolts.

   **Tighten**

   Tighten the floor plate nuts to 27 N·m (20 lb ft).



WRK22031

4. Install the upper cardan joint pinch bolt to the intermediate steering shaft. Ensure that the pinch bolt passes through the shaft undercut.

   **Tighten**

   Tighten the pinch bolt to 45 N·m (33 lb ft).
5. Connect the steering column harness.
6. Connect the shift cable. Refer to *Shift Cable Replacement* in this supplement.
7. Install the steering wheel. Refer to *Steering Wheel Replacement* in this supplement.
8. Install the horn pad. Refer to *Horn Replacement* in this supplement.
9. Connect the negative battery cable.

## Steering Column Support Replacement

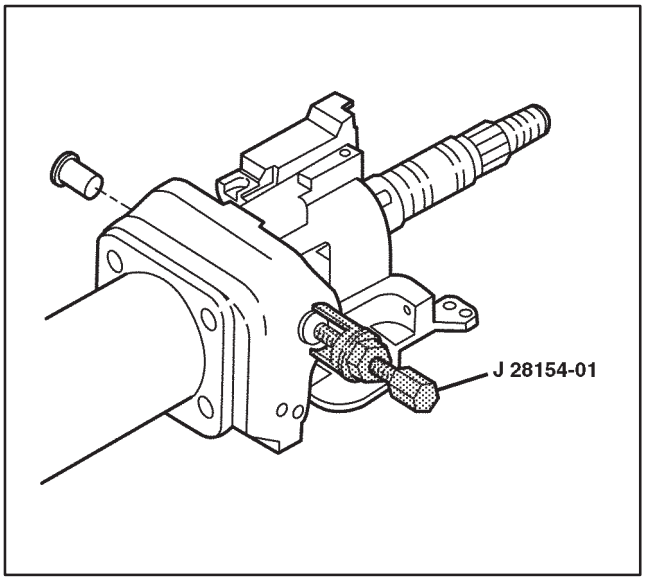
### Tools Required

- *J 21854-01* Pivot Pin Remover

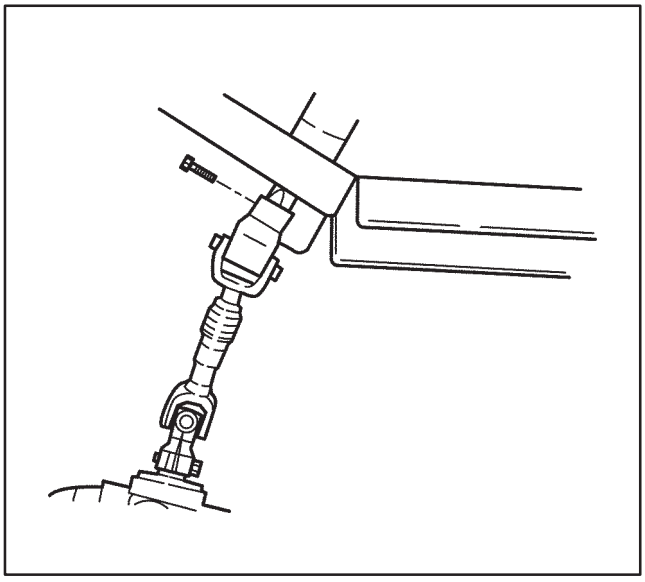
### Removal Procedure

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices in the WCC Service Manual.***

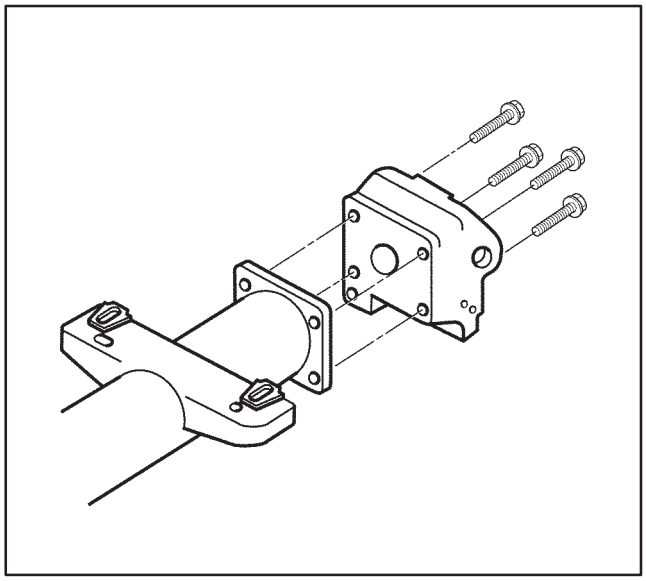
1. Disconnect the negative battery cable.
2. Remove the horn pad. Refer to *Horn Switch Replacement* in this supplement.
3. Disconnect the steering column electrical connections.
4. Remove the steering wheel. Refer to *Steering Wheel Replacement* in this supplement.
5. Remove the tilt lever. Refer to *Tilt Lever Replacement – On Vehicle* in this supplement.
6. Remove the lower steering column cover. Refer to *Steering Column Cover Replacement – Lower* in this supplement.
7. Remove the lock cylinder. Refer to *Steering Column Lock Cylinder Replacement* in this supplement.
8. Remove the upper steering column cover. Refer to *Steering Column Cover Replacement – Upper* in this supplement.
9. Remove the turn signal cancel cam and upper bearing inner race. Refer to *Turn Signal Cancel Cam* and *Upper Bearing Inner Race Replacement – On Vehicle* in this supplement.
10. Remove the multifunction turn signal lever assembly. Refer to *Multifunction Turn Signal Lever Replacement – On Vehicle* in this supplement.
11. Remove the lock module retaining screws.
12. Remove the lock module assembly.
13. Disconnect the park lock cable.
14. Remove the linear shift assembly retaining screws and the assembly.
15. Remove the tilt spring.
16. Using the *J 21854-01,* remove the pivot pins.
17. Remove the tilt head assembly.
18. Mark the position of the lower steering shaft in relation to the intermediate shaft.
19. Remove the pinch bolt.
20. Remove the lower steering shaft assembly from the steering column jacket assembly.




WRK22050

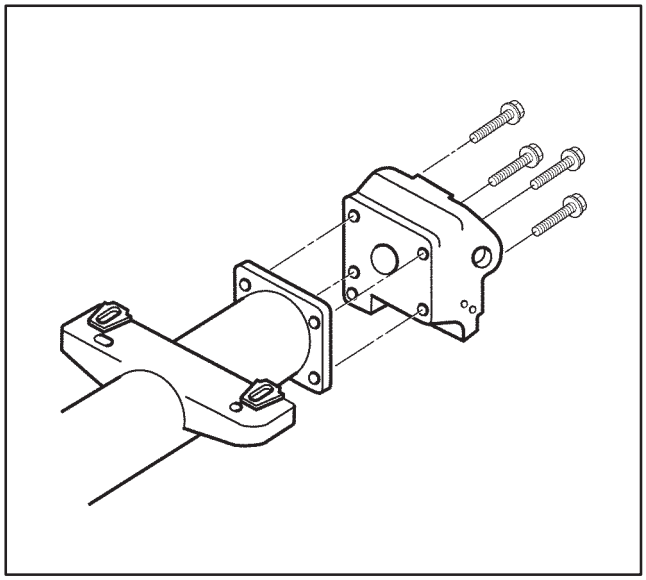


WRK22031



WRK22033

21. Remove the steering column support assembly retaining screws and the assembly.



WRK22033

## Installation Procedure

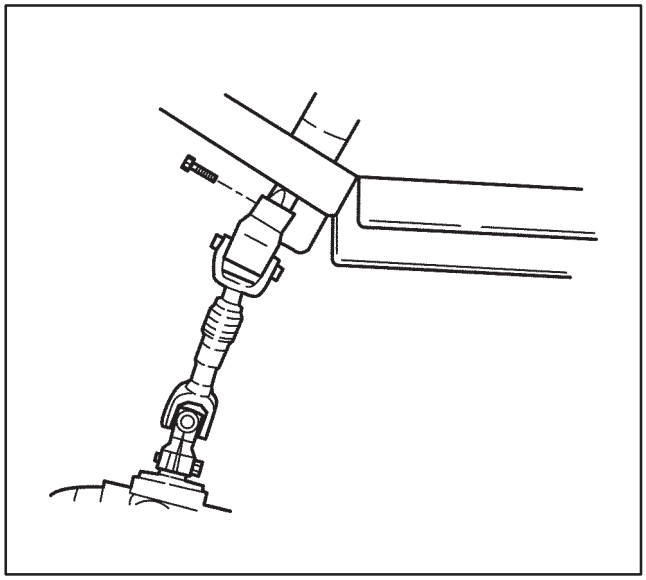
**Important:** Replace the steering column support assembly and the pivot pins if the steering column support assembly and the pivot pins have been staked three times.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

1. Install the steering column support assembly and the retaining screws.

   **Tighten**

   Tighten the steering column support screws to 17 N·m (13 lb ft).
2. Install the lower steering shaft assembly to the steering column jacket assembly, aligning the match marks on the intermediate shaft and the steering shaft.



WRK22031

3. Install the pinch bolt. Ensure that the pinch bolt passes through the shaft undercut.

   **Tighten**

   Tighten the upper pinch bolt to 45 N·m (33 lb ft).

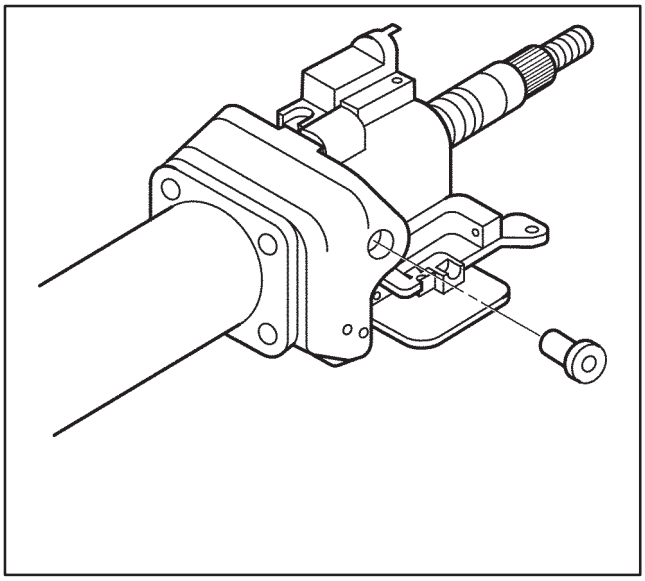
4. Install the tilt head assembly.
5. Install the tilt head pivot pins.
6. Stake the pivot pins.
7. Install the tilt spring.
8. Install the linear shift assembly and the retaining screws.

   **Tighten**

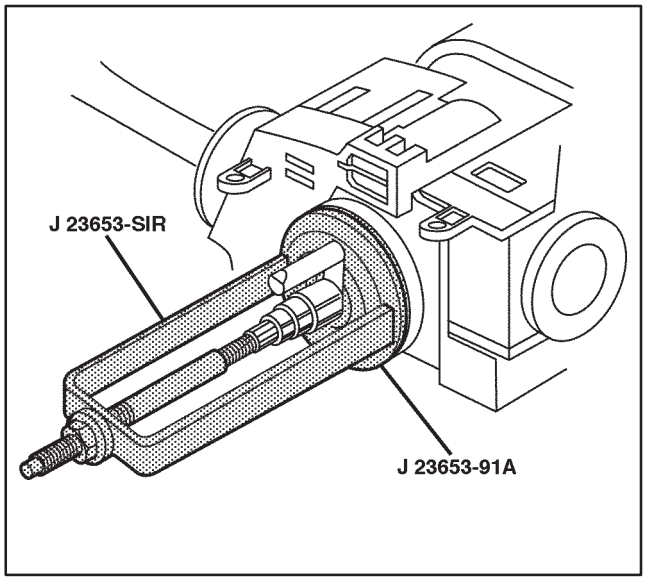
   Tighten the screws to 10 N·m (89 lb in).
9. Connect the park lock cable.
10. Install the lock module assembly.
11. Install the lock module retaining screws.

    **Tighten**

    Tighten the lock module screws to 3.5 N·m (31 lb in).
12. Install the multifunction turn signal lever assembly. Refer to *Multifunction Turn Signal Lever Replacement* in this supplement.
13. Install the upper bearing inner race and the turn signal cancel cam. Refer to *Turn Signal Cancel Cam and Upper Bearing Inner Race Replacement – On Vehicle* in this supplement.
14. Install the upper steering column cover. Refer to *Steering Column Cover Replacement – Upper* in this supplement.
15. Install the lock cylinder. Refer to *Steering Column Lock Cylinder Replacement* in this supplement.
16. Install the lower steering column cover. Refer to *Steering Column Cover Replacement – Lower* in this supplement.
17. Install the tilt lever. Refer to *Tilt Lever Replacement – On Vehicle* in this supplement.
18. Install the steering wheel. Refer to *Steering Wheel Replacement* in this supplement.
19. Connect the steering column electrical connections.
20. Install the horn pad. Refer to *Horn Switch Replacement* in this supplement.
21. Connect the negative battery cable.



WRK22032




WRK22034

## Steering Shaft and Sphere Assembly Replacement

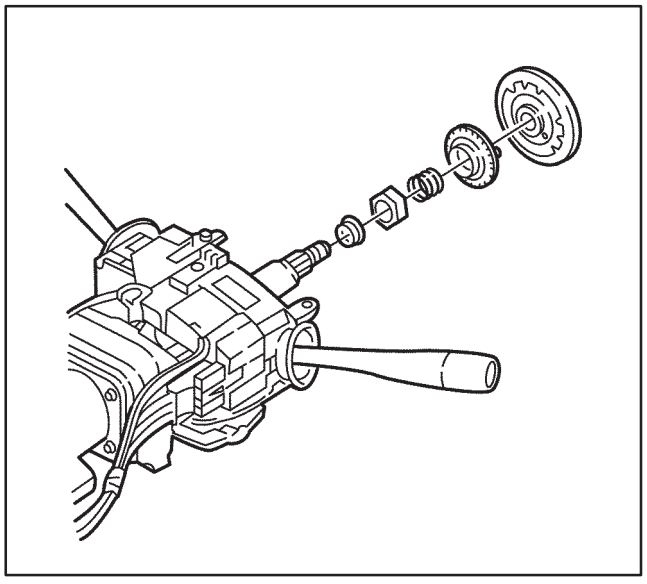
### Removal Procedure

#### Tools Required

- *J 21854-01* Pivot Pin Remover
- *J 23653-SIR* Lock Plate Compressor
- *J 23653-91A* Lock Plate Compressor Adapter
- *J 41352* Modular Column Holding Fixture

***Caution: Refer to Battery Disconnect Caution in Cautions and Notices in the WCC Service Manual.***

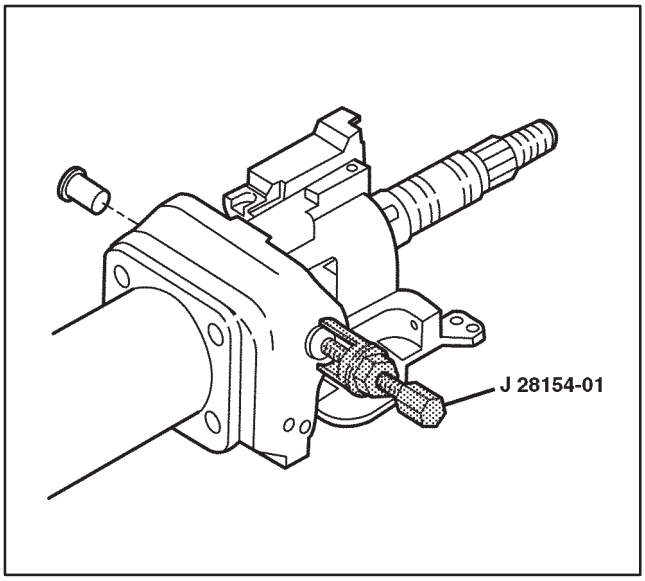
1. Disconnect the negative battery cable.
2. Remove the horn pad. Refer to *Horn Switch Replacement* in this supplement.
3. Remove the steering wheel. Refer to *Steering Wheel Replacement* in this supplement.
4. Remove the steering column from the vehicle. Refer to *Steering Column Replacement* in this supplement.
5. Remove the transmission shift lock control assembly. Use a screwdriver to pry the electrical BTSI actuator from the steering column jacket assembly.
6. Install the *J 41352* to the column.
7. Install the steering column assembly to the vise.
8. Remove the tilt lever. Refer to *Tilt Lever Replacement – On Vehicle* in this supplement.
9. Remove the lower steering column cover. Refer to *Steering Column Cover Replacement – Lower* in this supplement.
10. Remove the lock cylinder. Refer to *Steering Column Lock Cylinder Replacement* in this supplement.
11. Remove the upper steering column cover. Refer to *Steering Column Cover Replacement – Upper* in this supplement.
12. Install the *J 23653-91A* and the *J 23653-SIR* to the shaft lock shield.



WRK22035

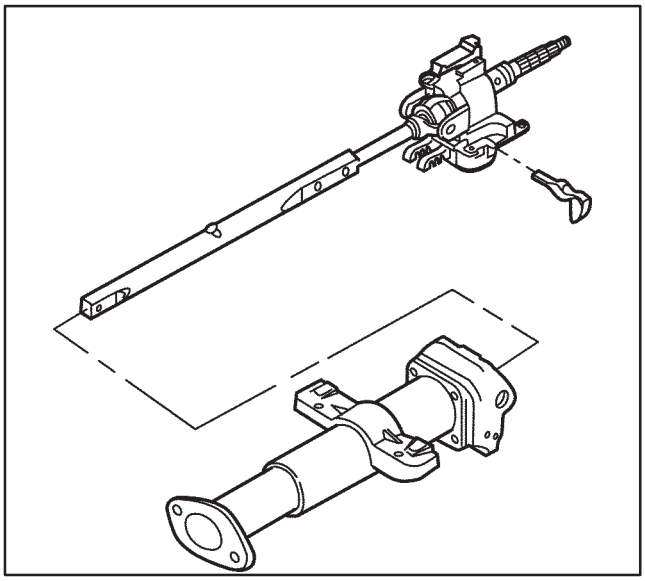
13. Remove the shaft lock shield retaining ring.
14. Remove the *J 23653-SIR* and the *J 23653-91A*.
15. Remove the shaft lock shield.
16. Remove the turn signal cancel cam.
17. Remove the multifunction turn signal lever assembly. Refer to *Multifunction Turn Signal Lever Replacement* in this supplement.
18. Remove the lock module retaining screws.
19. Remove the lock module assembly.
20. Disconnect the park lock cable.
21. Remove the linear shift assembly retaining screws and remove the assembly.
22. Remove the tilt spring.
23. Remove the adapter and bearing assembly from the steering column jacket assembly.

24. Using the *J 21854-01* remove the pivot pins.



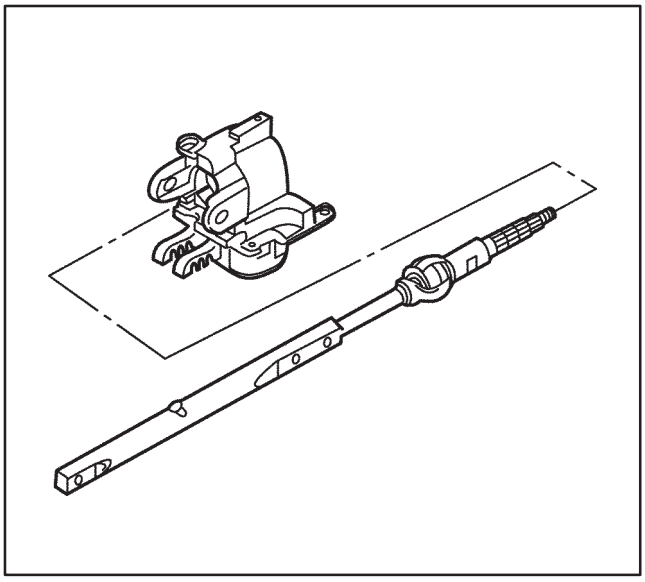

WRK22050

25. Using the tilt lever, remove the tilt head assembly from the steering column jacket with the lower steering shaft assembly still attached.

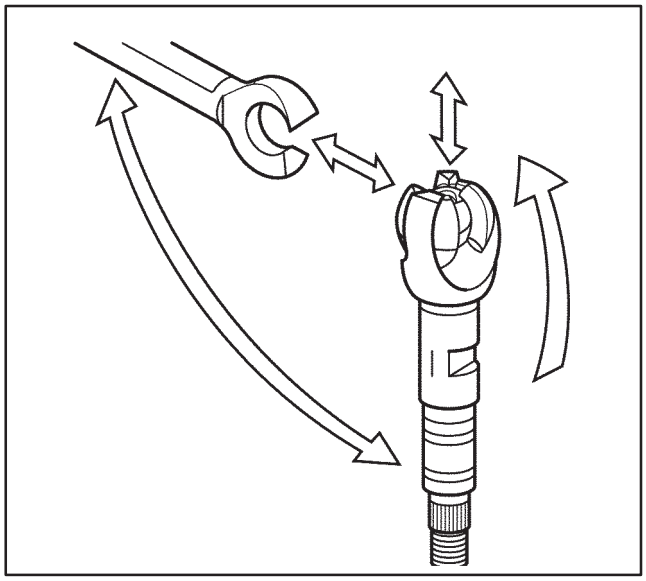


WRK22051

26. Remove the tilt head assembly from the steering shaft assembly.



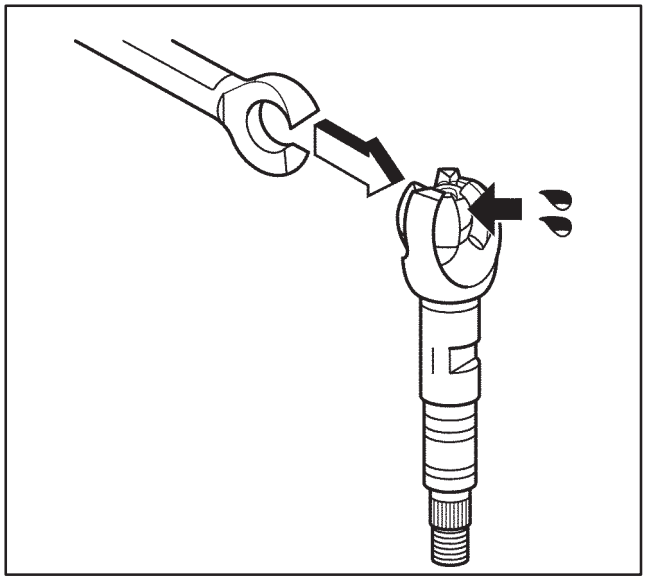
WRK22052



WRK22053

**Important:** Mark the race and upper shaft assembly and the lower shaft assembly before disassembly. Failure to assemble the race and upper shaft assembly correctly will cause the steering wheel to be turned 180 degrees.

27. Remove the race and upper shaft assembly from the lower steering shaft.
28. Remove the shaft preload spring and the centering sphere from the race and upper shaft assembly.
29. If necessary, discard the old centering sphere and the old shaft preload spring.

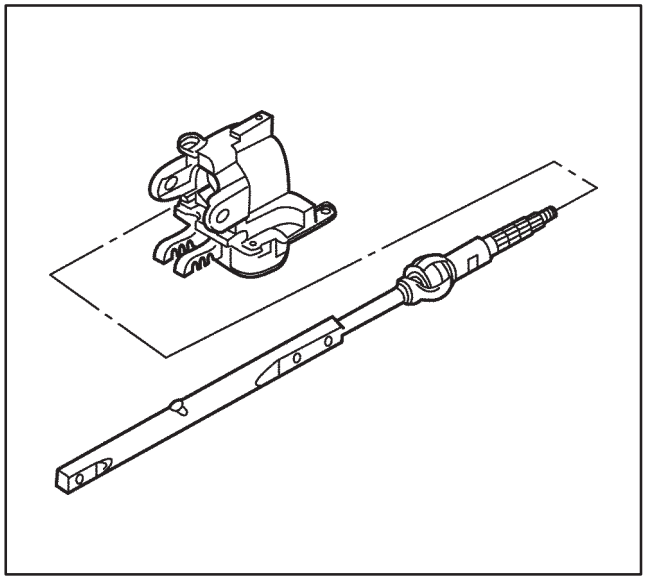


WRK22036

## Installation Procedure

**Important:** Replace the steering column support assembly and the pivot pins if the steering column support assembly and the pivot pins have been staked three times.

1. Lubricate the centering sphere with lithium grease.
2. Install the centering sphere and the joint preload spring into the race and upper shaft assembly.
3. Apply lithium grease to the race and upper shaft assembly.
4. Install the lower shaft assembly to the race and upper shaft assembly using the marks from the removal procedure.



WRK22052

5. Install the tilt head assembly to the steering shaft assembly.

6. Install the tilt head assembly with the steering shaft assembly to the steering column jacket.
7. Install the tilt head pivot pins.
8. Install the adapter and bearing assembly to the steering jacket assembly.
9. Install the tilt spring.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

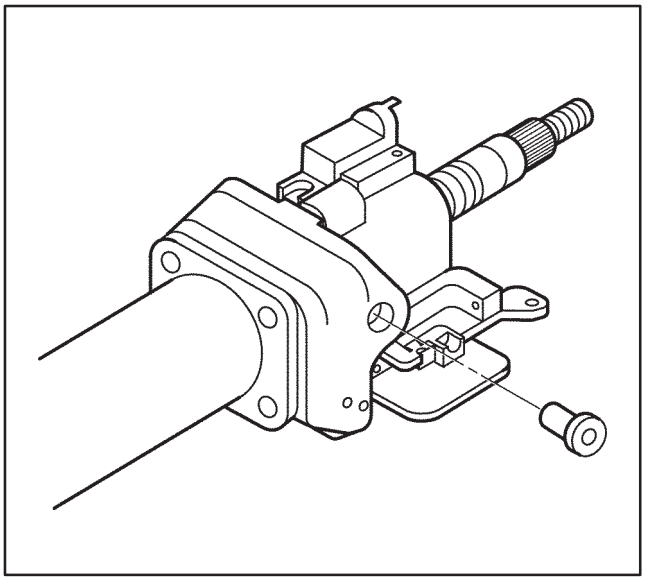
10. Install the linear shift assembly and install the retaining screws.

    **Tighten**

    Tighten the linear shift assembly screws to 10 N·m (89 lb in).
11. Install the lock module assembly.
12. Connect the park lock cable.
13. Install the lock module retaining screws.

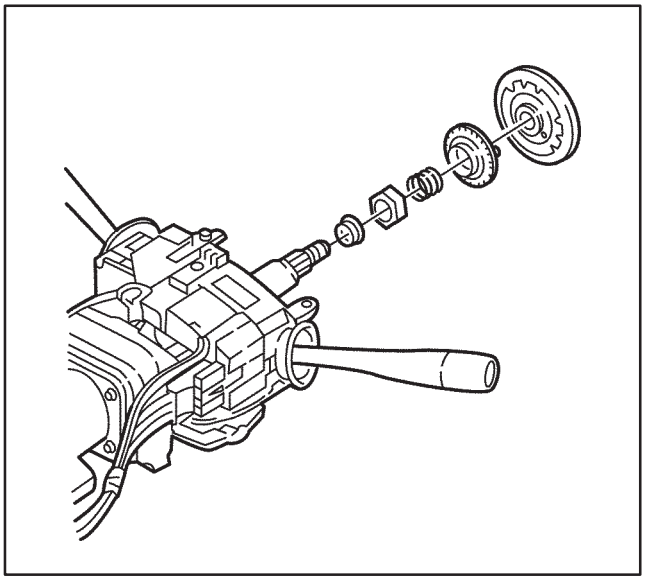
    **Tighten**

    Tighten the lock module screws to 3.5 N·m (31 lb in).
14. Install the multifunction turn signal lever. Refer to *Multifunction Turn Signal Lever Replacement* in this supplement.

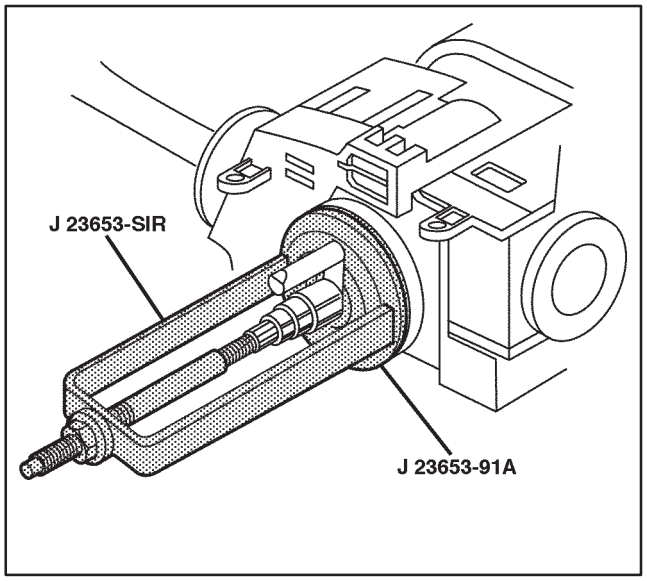


WRK22032

15. Install the turn signal cancel cam.
16. Install the shaft lock shield.

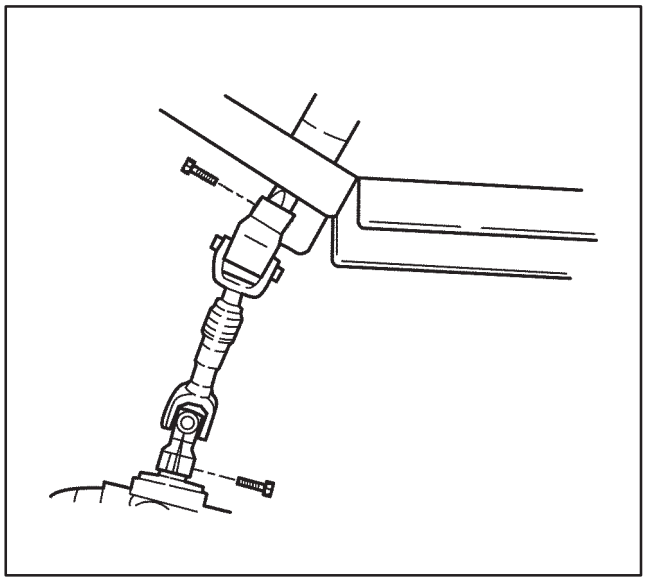


WRK22035




WRK22034

17. Install the *J 23653-91A* and the *J 23653-SIR* to the shaft lock shield.
18. Install the shaft lock shield retaining ring.
19. Remove the *J 23653-91A* and the *J 23653-SIR.*
20. Install the upper steering column cover. Refer to *Steering Column Cover Replacement – Upper* in this supplement.
21. Install the lock cylinder. Refer to *Steering Column Lock Cylinder Replacement* in this supplement.
22. Install the lower steering column cover. Refer to *Steering Column Cover Replacement – Lower* in this supplement.
23. Install the tilt lever. Refer to *Tilt Lever Replacement – On Vehicle* in this supplement.
24. Remove the steering column assembly from the vise.
25. Remove the *J 41352* from the column.
26. Install the transmission shift lock control assembly.
27. Install the steering column to the vehicle. Refer to *Steering Column Replacement* in this supplement.
28. Install the steering wheel. Refer to *Steering Wheel Replacement* in this supplement.
29. Install the horn pad. Refer to *Horn Switch Replacement* in this supplement.
30. Connect the negative battery cable.



WRK22054

## Intermediate Steering Shaft Replacement

### Removal Procedure

1. Set the front wheels in the straight-ahead position.
2. Set the steering wheel in the locked position.
3. Mark the relationship of the following components in order to ensure proper installation.
   - The intermediate steering shaft to the steering shaft.
   - The intermediate steering shaft to the steering gear input shaft.
4. Remove the upper cardan joint pinch bolt from the intermediate steering shaft.
5. Remove the lower cardan joint pinch bolt from the intermediate steering shaft.
6. Remove the intermediate steering shaft from the steering shaft and the steering gear input shaft.

### Installation Procedure

1. Align the marks made on the steering gear input shaft and the steering shaft with the match marks made on the intermediate steering shaft.
2. Install the intermediate steering shaft to the steering shaft and the steering gear input shaft.

***Notice:*** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

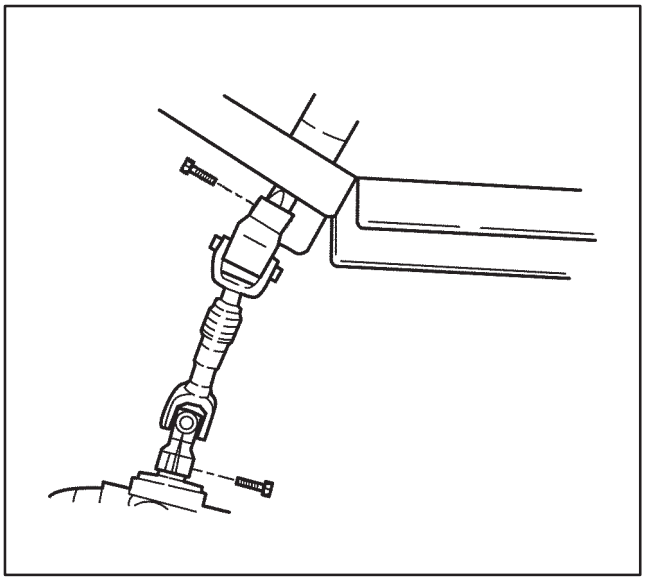
3. Install the upper cardan joint pinch bolt to the intermediate steering shaft. Ensure that the pinch bolt passes through the shaft undercut.

   **Tighten**

   Tighten the upper pinch bolt to 45 N · m (33 lb ft).
4. Install the lower cardan joint pinch bolt to the intermediate steering shaft. Ensure that the pinch bolt passes through the shaft undercut.

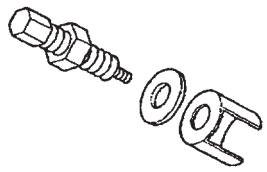
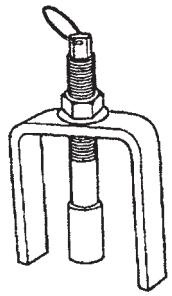
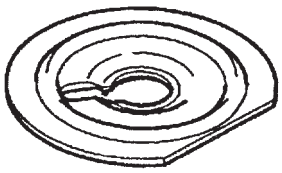
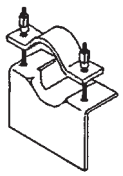
   **Tighten**

   Tighten the lower pinch bolt to 65 N · m (48 lb ft).



WRK22054

## Special Tools and Equipment

| Illustration | Tool Number/ Description |
|---|---|
|  WRK22045 | J 1859-A<br>Steering Wheel Puller |
|  WRK22049 | J 21854-01<br>Pivot Pin Remover |
|  WRK22040 | J 23653-SIR<br>Lock Plate Compressor |
|  WRK22039 | J 23653-91A<br>Lock Plate Compressor Adapter |
|  WRK22055 | J 41352<br>Modular Column Holding Fixture |

# Section 2
# Steering
## Sub-Section 2.3 – Steering Wheel and Column

**BLANK**

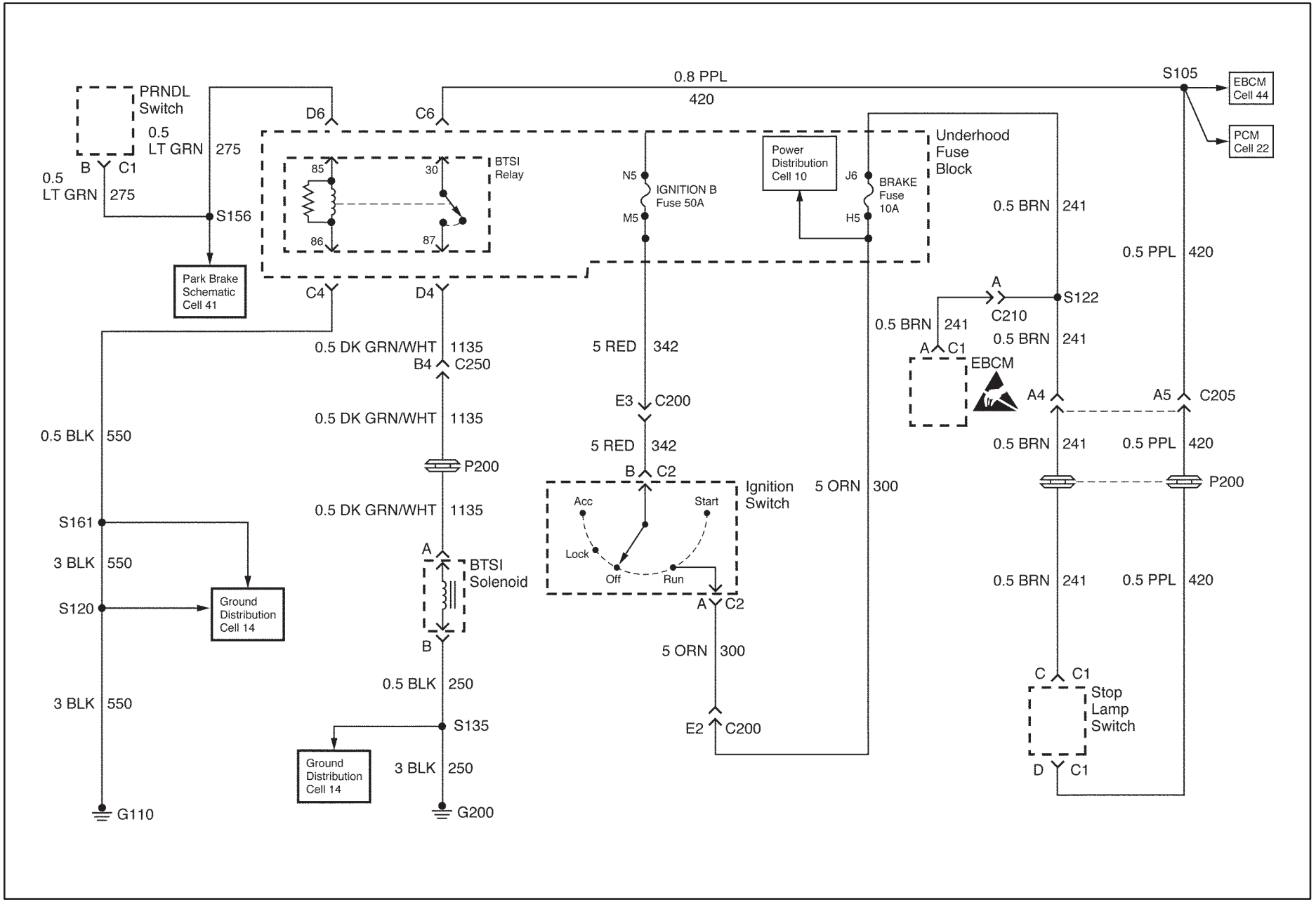
# Steering Wheel and Column

## Schematic and Routing Diagrams

### Steering Wheel and Column Schematic Icons

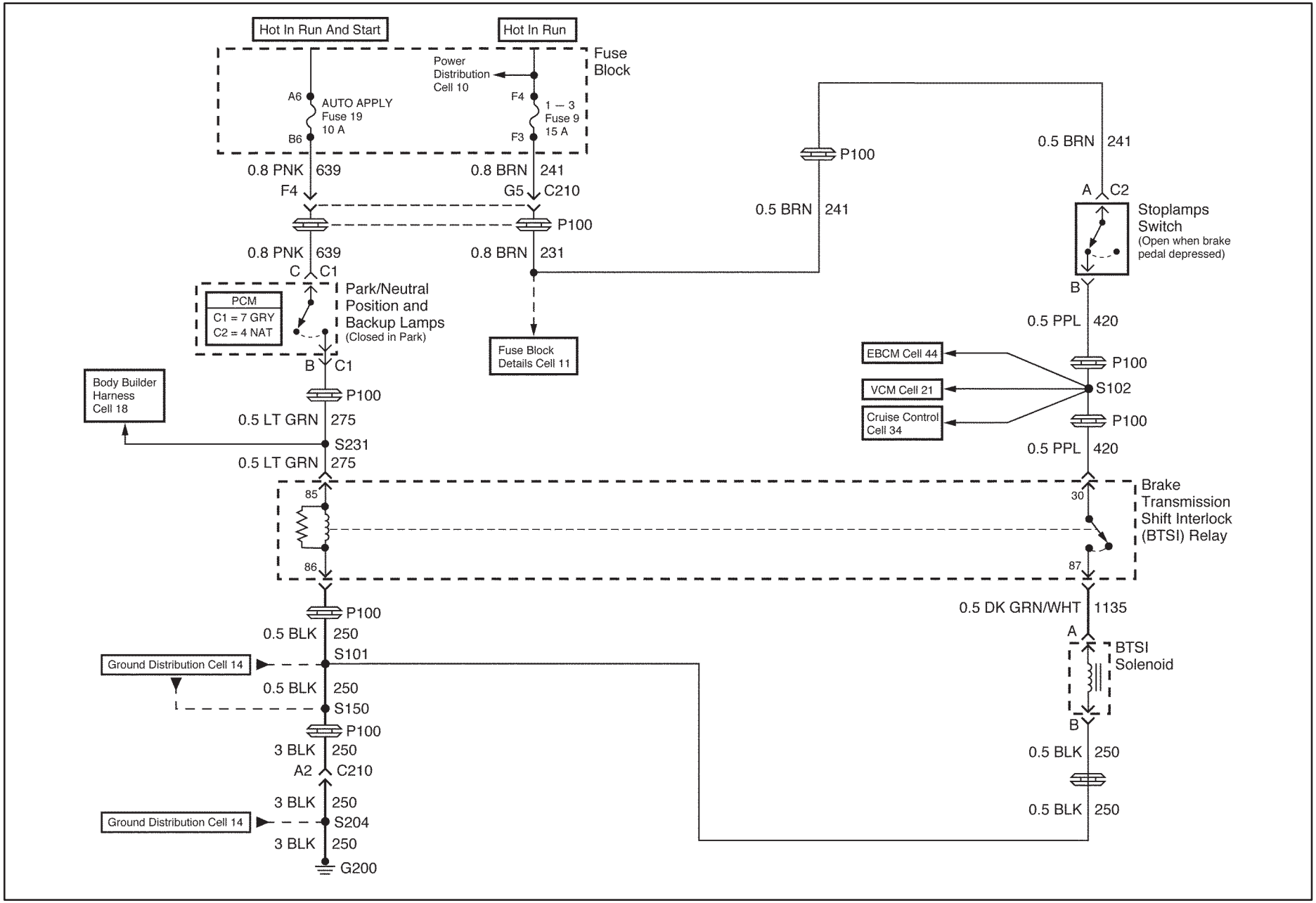
| Icon | Icon Definition |
|---|---|
|  | Refer to *ESD Notice* in Cautions and Notices in the WCC Service Manual. |

# Automatic Transmission Shift Lock Control Schematics (P32 Motorhome) (Cell 138: BTSI Relay and Related Circuits) (L18)



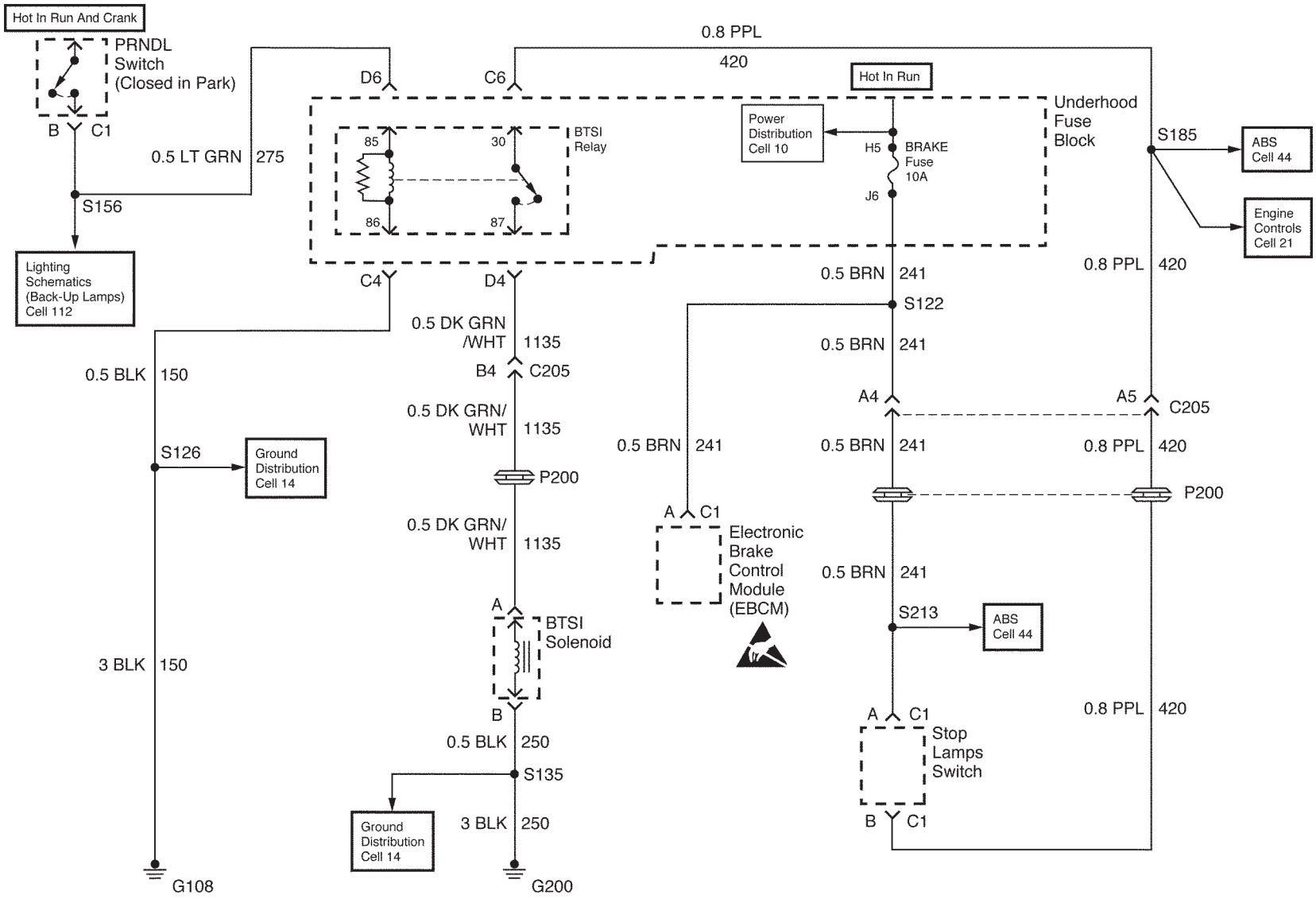

77523001

# Automatic Transmission Shift Lock Control Schematics (P32 Motorhome) (Cell 138: BTSI Relay and Related Circuits) (L31)



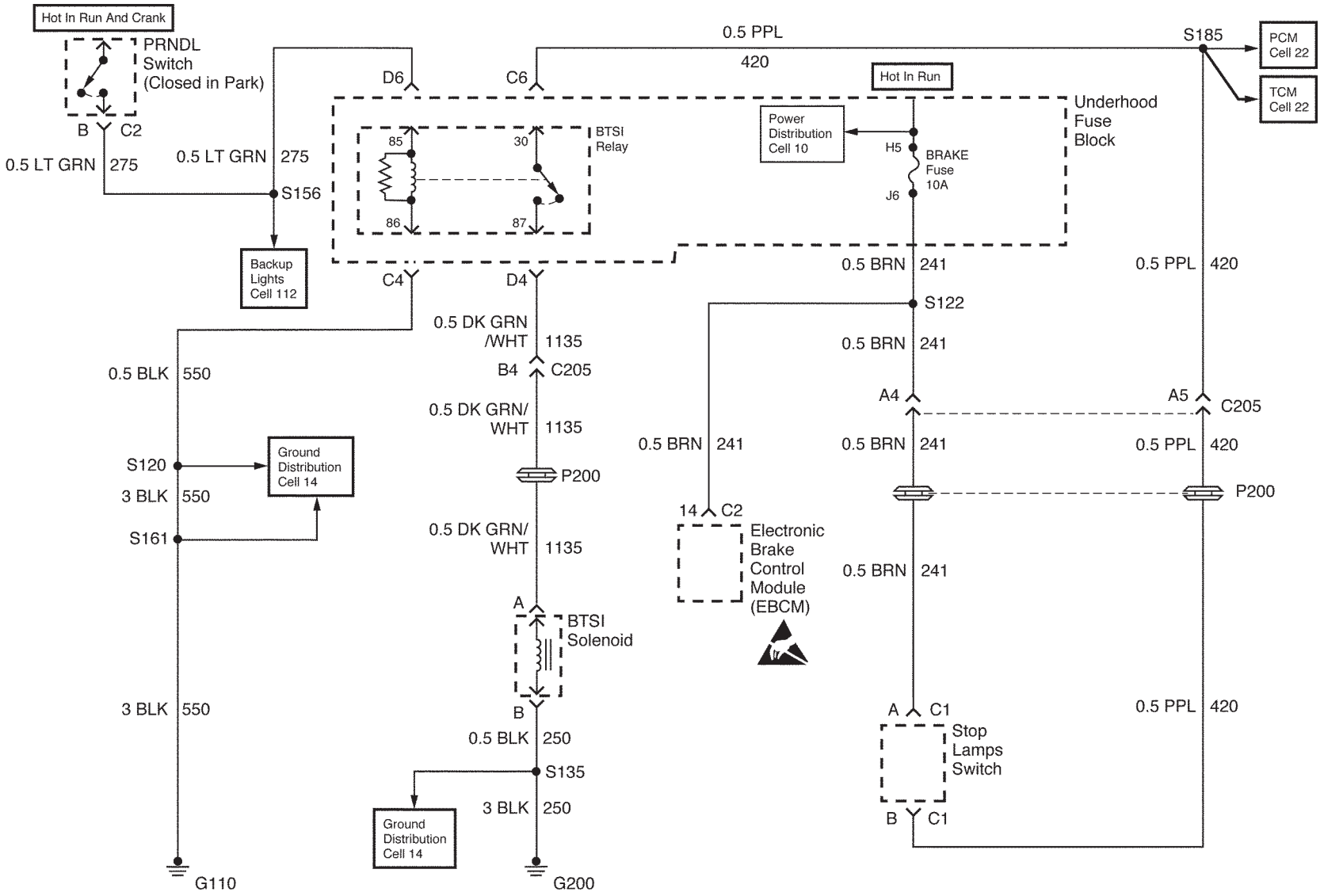

77523002

# Automatic Transmission Shift Lock Control Schematics (P42 Commercial) (Cell 138: BTSI Relay and Related Circuits) (L4B)




77523003

# Automatic Transmission Shift Lock Control Schematics (P52 Commercial) (Cell 138: BTSI Relay and Related Circuits) (L18)

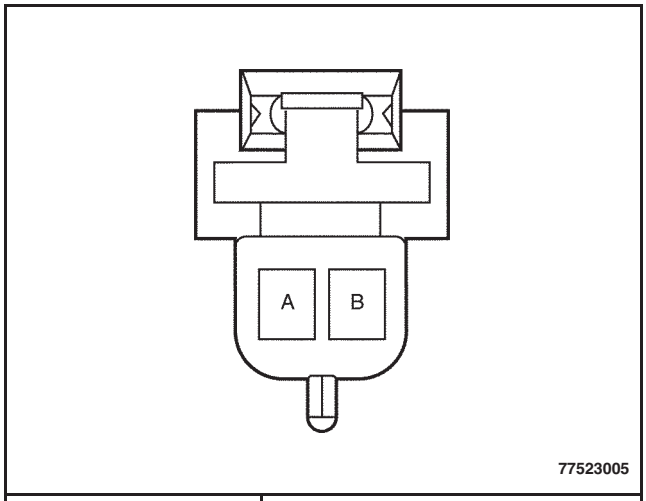



77523004

# Visual Identification

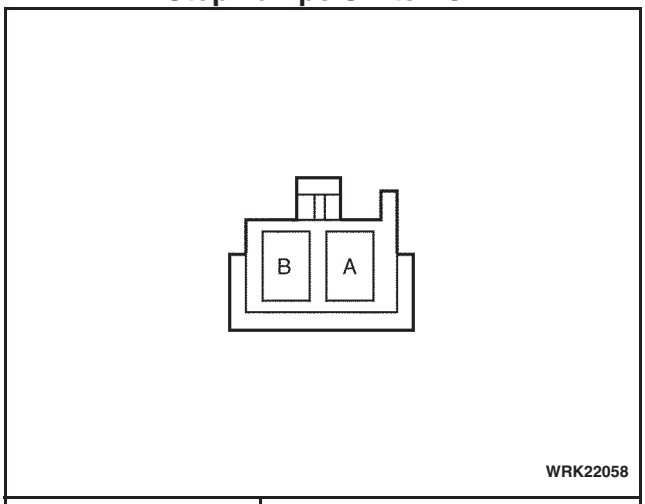
## Wheel/Column Connector End Views

### Brake Transmission Shift Interlock (BTSI) Solenoid



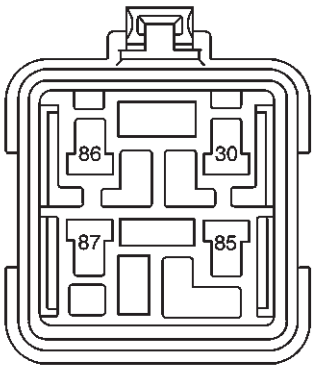

| Connector Part Information | • 12052832<br>• 2 Way F Metri-Pack 150 Series (BLK) | | |
|---|---|---|---|
| **Pin** | **Wire Color** | **Circuit No.** | **Function** |
| A | DK GRN/ WHT | 1135 | Brake Transmission Shift Interlock Solenoid Feed |
| B | BLK | 250 | Ground |

### Stop Lamps Switch C1




| Connector Part Information | • 12015197<br>• 2 Way F Metri-Pack 280 Series (BLU) | | |
|---|---|---|---|
| **Pin** | **Wire Color** | **Circuit No.** | **Function** |
| A | BRN | 241 | Ignition Positive Feed |
| B | PPL | 420 | BTSI Relay Feed |

## Brake Transmission Shift Interlock (BTSI) Relay (P32 Motorhome) (L31)




39670

| Connector Part Information | | • 12129716<br>• 4 Way F Metri-Pack 280 Series, Flexlock (GRY) | |
|---|---|---|---|
| **Pin** | **Wire Color** | **Circuit No.** | **Function** |
| 30 | PPL | 420 | Brake Pedal Switch Output – Torque Converter Clutch |
| 85 | YEL | 1737 | Transmission Mounted Neutral Safety Switch Output – Park/ Neutral |
| 86 | BLK | 250 | Ground |
| 87 | DK GRN/ WHT | 1135 | Brake Transmission Shift Interlock Solenoid Feed |