SERVICE MANUAL SECTION

CF 500, CF 600 Steering

Truck Model: CF 500

Truck Model: CF 600

Unit Code: 05CAV

Unit Code: 05PRN

Unit Code: 05710

S05017

05/03/2005

Table of Contents

Safety Information

NOTE: Read the following before starting the service procedure.

The information contained in this International Service Manual Section was current at the time of printing and is subject to change without notice or liability.

You must follow your company safety procedures when you service or repair equipment. Be sure to understand all of the procedures and instructions before you begin work on the unit.

International uses the following types of notations to give warning of possible safety problems and to give information that will prevent damage to the equipment being serviced or repaired.

WARNING: A warning indicates procedures that must be followed exactly. Personal injury or possible death can occur if the procedure is not followed.

CAUTION: A caution indicates procedures that must be followed exactly. If the procedure is not followed, damage to equipment or components can occur.

NOTE: A note indicates an operation, procedure or instruction that is important for correct service.

Some procedures require the use of special tools for safe and correct service. Failure to use these special tools when required can cause injury to service personnel or damage to vehicle components.

This service manual section is intended for use by professional technicians, NOT a "**do-it-yourselfer**." It is written to inform these technicians of conditions that may occur on some vehicles, or to provide information that could assist in the proper service of a vehicle. Properly trained technicians have the equipment, tools, safety instructions, and know-how to do a job properly and safely. If a condition is described, DO NOT assume that the service section applies to your vehicle. See your International Truck Dealer for information on whether this service section applies to your vehicle.

Steering System — General Information

Specifications

Table 1 General Specifications

Item	Specification
Lubricants	
Fleetrite CH990625C2	International TMS-6810
Power Steering Gear	
Turns lock-to-lock	4.16
Power Steering Purge Vacuum	
Vacuum	68-85 kPa (20-25 in/Hg)
Power Steering Pump	
Flow	16 liters/minute (4.2 gpm) Fluid @ 74°-80° C (165°-175° F) Engine at idle
Pressure	500.25 kPa (72.5 psi) Fluid @ 74°-80° C (165°-175° F) Engine at idle
Minimum capacity	6.1 liters/minute (1.6 gpm) Fluid @ 74°-80° C (165°-175° F) Engine at idle Pressure at 5,171 kPa (750 psi)
Relief pressure — 15,200 lb and 18,000 lb GVWR	12,406 kPa (1,798 psi)
Relief pressure — 20,500 lb GVWR	17,009 kPa (2,465 psi)

Table 2 Torque Specifications

Description	Nm	lbf-ft
Steering gear sector shaft adjusting screw	14	10
Steering gear sector shaft adjustment jam nut	58	43

Steering System Description and Operation

For information on the power steering fluid reservoir, power steering fluid lines, power steering fluid cooler, power steering pump, and/or steering gear, refer to Power Steering(Power Steering, page 11).

For information on the steering wheel and column assembly, refer to Steering Column(Steering Column, page 25).

For information on the front wheel knuckles and/or wheel hubs, refer to Front Suspension in S03014.

For information on the steering linkage, refer to Steering Linkage(Steering Linkage, page 19).

Steering System Diagnosis and Testing

Special Tools

Table 3

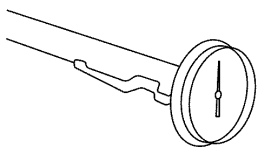
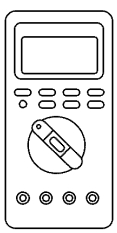
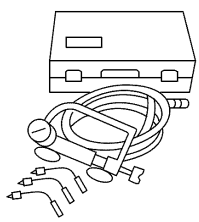
 ST1396-A	Dial Thermometer 0-220°F ZTSE4619
 ST1177-A	Hand Held Automotive Meter ZTSE4357
 ST1477-A	Power Steering Analyzer ZTSE2780
	Digital Tachometer or EZ-Tech III

Table 4 Material

Item	Specification
Fleetrite CH990625C2	International TMS-6810

Steering System Inspection and Verification

CAUTION: Do not hold the steering wheel at the stops for an extended amount of time. Damage to the power steering pump will result.

NOTE: Make the following preliminary check before repairing the steering system:

1. Verify the customer concern by operating the steering system.
2. Inspect Tires
   - Check the tire pressure; refer to the vehicle certification (VC) label.
   - Verify that all tires are sized to specification. Refer to Wheels and Tires in S17002.
   - Inspect the tires for damage or uneven wear.
3. Belt and Tensioner Check
   - Refer to the Engine Operation and Maintenance Manual for diagnosis and testing of the accessory drive system.
4. Fluid Level Check
   - Verify that the power steering fluid level is at the full (F) mark. Add as necessary.
5. Air Bleeding
   - Verify that there is no air in the power steering system. Run the engine until it reaches normal operating temperature. Turn the steering wheel to the left and right several times without hitting the stops. If any air bubbles are present, refer to Power Steering System Purging(Power Steering System Purging, page 9) in this section.
6. External Leak Check
   - With the ignition switch at OFF, wipe off the power steering pump, power steering pressure hose, power steering return hose, power steering fluid cooler and steering gear.
   - With the engine running, turn the steering wheel from stop to stop several times. Do not hold steering wheel at stops. Check for leaks. Repair as necessary if leaks are observed.

7. Visually inspect for obvious signs of mechanical damage; refer to the following chart.

Table 5 Visual Inspection Chart

Mechanical
• Loose tie rod ends
• Loose suspension components
• Loose steering column shaft universal joints
• Loose steering gear mounting bolts
• Binding or misaligned steering column
• Power steering pump
• Bent or pinched power steering lines

8. If an obvious cause for an observed or reported condition is found, correct the cause (if possible) before proceeding to the next step.
9. If the fault is not visually evident, determine the symptom. Go to the Symptom Chart below.

Drift/Pull

Pull is a tugging sensation, felt by the hands on the steering wheel, that must be overcome to keep the vehicle going straight.

Drift describes what a vehicle with this condition does with hands off the steering wheel.

- A vehicle-related drift/pull, on a flat road, will cause a consistent deviation from the straight-ahead path and require constant steering input in the opposite direction to counteract the effect.
- Drift/pull may be induced by conditions external to the vehicle (for example, wind or road camber).

Excessive Steering Wheel Play

Excessive steering wheel play is a condition in which there is too much steering wheel movement before the wheels move. A small amount of steering wheel free play is considered normal.

Feedback

Feedback is a roughness felt in the steering wheel when the vehicle is driven over rough pavement.

Hard Steering or Lack of Assist

Hard steering can remain constant through the full turn or occur near the end of a turn. It is important to know the difference between hard steering/lack of assist and binding.

Hard steering or lack of assist can result from either hydraulic or mechanical conditions. It is extremely important to know if this concern occurs during driving, during very heavy or static parking maneuvers.

Nibble

Sometimes confused with shimmy, nibble is a condition resulting from tire interaction with various road surfaces and observed by the driver as small rotational oscillations of the steering wheel.

Poor Returnability/Sticky Steering

Poor returnability and sticky steering is used to describe the poor return of the steering wheel to center after a turn or the steering correction is completed.

Shimmy

Shimmy, as observed by the driver, is large, consistent, rotational oscillations of the steering wheel resulting from large, side-to-side (lateral) tire/wheel movements.

Shimmy is usually experienced near 64 km/h (40 mph), and can begin or be amplified when the tire contacts pot holes or irregularities in the road surface.

Wander

Wander is the tendency of the vehicle to require frequent, random left and right steering wheel corrections to maintain a straight path down a level road.

Symptom Chart

Table 6 Symptom Chart

Condition	Possible Sources	Action
Hard steering or lack of assist	A. Seized lower steering column shaft U-joints. B. Damaged, fractured steering column bearing(s). C. Power steering pump. D. Suspension components. E. Steering gear internal leakage.	A. INSTALL a new lower steering column shaft U-joints. REFER to Steering Column. B. REPAIR the steering column. REFER to Steering Column. C. GO to Pump Flow and Pressure Test in this section. D. Refer to Suspension System in S03014 for suspension system diagnosis and testing. E. GO to Pump Flow and Pressure Test under Component Tests in this section.
Excessive steering pump noise	Power steering pump.	GO to Pump Flow and Pressure Test in this section.
Excessive steering wheel play	A. Loose, worn or damaged steering linkages or tie-rod end. B. Loose steering gear bolts. C. Damaged or worn steering gear. D. Loose, worn or damaged steering column bearing(s). E. Loose, worn or damaged lower steering column shaft U-joints.	A. GO to the Steering Linkage Component Test as necessary. B. TIGHTEN the bolts. REFER to Power Steering. C. REPAIR the steering gear. REFER to Power Steering. D. INSTALL new steering column bearing(s) if unserviceable. REFER to Steering Column.. E. INSTALL a new lower steering column shaft. REFER to Steering Column.

Table 6 Symptom Chart (cont.)

Condition	Possible Sources	Action
Wander	A. Unevenly loaded or overloaded vehicle. B. Loose or damaged steering gear mounting bolts. C. Loose lower steering column U-joint bolts. D. Loose, worn or damaged lower steering column shaft U-joints. E. Wheel alignment. F. Loose, worn or binding steering linkage(s) or tie-rod end(s). G. Improper steering gear preload/ meshload. H. Suspension components.	A. NOTIFY the customer of improper vehicle loading. B. INSTALL new or TIGHTEN the bolts. REFER to Power Steering. C. TIGHTEN the bolts. REFER to Steering Column. D. INSTALL a new lower steering column shaft. REFER to Steering Column. E. ADJUST as required. REFER to Suspension System in S03014. F. GO to the Steering Linkage Component Test. G. Refer to Steering Gear Meshload Adjustment in this section. H. Refer to Suspension System in S03014 for suspension system diagnosis and testing.
Drift/pull	A. Unevenly loaded or overloaded vehicle. B. Wheel alignment. C. Loose, worn or binding steering linkage(s) or tie-rod end(s). D. Suspension components. E. The steering gear valve effort out of balance. F. Check the brake system for proper operation. G. Improper frame/ underbody alignment.	A. NOTIFY the customer of improper vehicle loading. B. ADJUST as required. REFER to Suspension System in S03014. C. GO to the Steering Linkage Component Test. D. Refer to Suspension System in S03014 for suspension system diagnosis and testing. E. GO to Steering Gear Valve under Component Tests in this section. F. For additional information, REFER to Brake System in S04049. G. CORRECT as required. REFER to Full Frame and Body Mounting in S16030.

Table 6 Symptom Chart (cont.)

Condition	Possible Sources	Action
Feedback	A. Loose, worn or damaged steering linkage(s) or tie-rod end(s). B. Loose or damaged steering gear mounting bolts. C. Loose lower steering column shaft U-joint bolts. D. Loose suspension bushings or fasteners. E. Worn or damaged steering column bearing(s).	A. GO to the Steering Linkage Component Test. B. INSTALL new or TIGHTEN the bolts. REFER to Power Steering. C. TIGHTEN the bolts. REFER to Steering Column. D. INSTALL new as necessary. REFER to Front Suspension in S03014. E. INSTALL new steering column bearing(s) if unserviceable. REFER to Steering Column.
Sticky steering, poor returnability	A. Binding lower steering column shaft U-joints. B. Loose, worn or binding steering linkage(s) or tie-rod end(s). C. Check the steering gear for evidence of binding or damage. D. Suspension components. E. Wheel alignment. F. Binding steering column bearing(s). G. Power steering pump.	A. INSTALL a new lower steering column shaft. REFER to Steering Column. B. GO to the Steering Linkage Component Test. C. REPAIR the steering gear. REFER to Power Steering. D. Refer to Suspension System in S03014 for suspension system diagnosis and testing. E. ADJUST as required. REFER to Suspension System in S03014. F. INSTALL a new steering column bearing(s). REFER to Steering Column. G. GO to the Pump Flow and Pressure Test in this section.
Shimmy	A. Loose, worn or damaged steering linkage(s) or tie-rod end(s). B. Suspension system components.	A. GO to the Steering Linkage Component Test. B. REFER to Suspension System in S03014 for suspension system diagnosis and testing.

Component Tests — Steering Linkage

NOTE: Excessive **vertical** motion of the studs relative to the sockets may indicate excessive wear.

1. With the parking brake applied, perform the following:
   - Have an assistant rotate the steering wheel back and forth 360 degrees and watch for relative motion of the studs in the steering linkage ball sockets.
   - Watch for loose steering gear mounting.
2. Another method is to raise the front wheels off the ground, grasp the wheel at the front and rear and watch for excessive play or binding in the joints while trying to steer the wheels.
3. Replace or tighten any worn, damaged, or loose tie rods, tie-rod ends, linkages or components. Refer to Steering Linkage.

Component Tests — Pump Flow and Pressure Test

⚠ WARNING: Do not touch the flowmeter during the test procedure, or severe burns and serious injury may occur.

CAUTION: Make sure that the connection point will not interfere with any of the engine accessory drive components or drive belts.

1. Install the Power Steering Analyzer at the high pressure port of the power steering pump. Make sure the Power Steering Analyzer gate valve is fully open.
   - On some vehicles, the power steering pump high pressure port is inaccessible and the Power Steering Analyzer should then be installed either at the steering gear or at a point in the high pressure line between the power steering pump and the steering gear.
2. Place a Dial Thermometer in the power steering oil reservoir.
3. Check the power steering fluid level. If necessary, add power steering fluid.
4. Install a digital tachometer.

CAUTION: Do not hold the steering wheel against the stops for more than 3 to 5 seconds at a time. Damage to the power steering pump will occur.

5. Start the engine. Place the transmission in neutral. Set the parking brake. Raise the power steering fluid temperature to 74-80°C (165-175°F) by rotating the steering wheel fully to the left and right several times.
6. Set the engine speed to 1500 rpm. Record the flow rate and pressure readings.
   - If the flow rate is below the flow rate specification, the power steering pump may require replacement. Continue with the test procedure.
   - If the pressure reading is above the maximum pressure specification, then check power steering hoses for kinks and restrictions.
7. Partially close the gate valve to obtain 750 psi. Set the engine speed at idle. Record the flow rate.
   - If the flow is less than the specified flow rate, then replace the power steering pump.

CAUTION: Do not allow the gate valve to remain closed for more than 5 seconds.

8. Completely close and partially open the gate valve 3 times. Record the pressure relief valve actuation pressure reading.
   - If the pressure does not meet the relief pressure specification, then replace the power steering pump.
9. Set engine speed to 1500 rpm. Record the flow rate.
   - If the flow rate varies more than 3.785 liters/minute (1 gallon/minute) from the initial flow rate reading, then replace the power steering pump.

CAUTION: Do not hold the steering wheel against the stops for more than 3 to 5 seconds at a time. Damage to the power steering pump will occur.

10. Set the engine speed at idle. Turn (or have an assistant turn) the steering wheel to the left and right stops. Record flow rate and pressure readings at the stops.
    - The pressure reading at both stops should be nearly the same as the maximum pump relief pressure.
    - The flow rate should drop below 1.9 liters/minute (0.5 gallons/minute).
    - If the pressure does not reach the maximum pump relief pressure or the flow rate does not drop below the specified value, excessive internal leakage is occurring. Repair or replace the steering gear as necessary. Refer to Power Steering.
11. Turn (or have an assistant turn) the steering wheel slightly in both directions and release quickly while watching the pressure gauge.
    - The pressure reading should move from the normal back pressure reading and snap back as the steering wheel is released.
    - If the pressure returns slowly or sticks, the rotary valve in the steering gear is sticking or the steering column is binding. Check the steering column and linkages before servicing the steering gear.

Component Tests — Steering Gear Valve

1. With the vehicle in motion, place the transmission in NEUTRAL and turn the engine OFF.
    - If the vehicle does not pull with the engine OFF, repair or replace the steering gear. Refer to Power Steering.
2. If the vehicle pulls with the engine OFF, cross-switch the front wheels.
    - If the vehicle pulls to the opposite side, cross-switch the front and rear wheels on the same side.
3. If the vehicle pull direction does not change, check the front suspension components, wheel alignment and frame alignment. Refer to Suspension System in S03014 or an appropriate frame dimensions manual.

General Procedures

Power Steering System Flushing

Table 7 Material

Item	Specification
Fleetrite CH990625C2	International TMS-6810

WARNING: Do not mix oil types. Any mixture or any unapproved oil can lead to seal deterioration and leaks. A leak can ultimately cause loss of fluid, which can result in a loss of power steering assist. Failure to follow these instructions may result in personal injury.

1. Remove the power steering fluid reservoir cap.
2. Using a suitable suction device, remove the power steering fluid from the reservoir.
3. Disconnect the power steering fluid return hose from the reservoir.
    - Remove the clamp.
4. Plug the reservoir inlet port.
5. Attach an extension hose to the power steering return hose.

NOTE: Do not reuse the power steering fluid that has been flushed from the power steering system.

6. Place the open end of the extension hose into a suitable container.

CAUTION: Do not overfill the reservoir.

7. Fill the power steering fluid reservoir with clean fluid.

CAUTION: Do not allow the power steering pump to run completely dry of power steering fluid.

8. Start the engine while simultaneously turning the steering wheel to lock and then immediately turn the ignition to OFF.

CAUTION: Avoid turning the steering wheel without the engine running as this may cause air to be pulled into the steering gear.

CAUTION: Do not overfill the reservoir.

9. Fill the power steering fluid reservoir with the approved power steering fluid.
10. Repeat Steps 8 and 9, turning the steering wheel in the opposite direction each time, until the fluid exiting the power steering fluid return hose is clean and clear of foreign material.
11. Remove the extension hose from the power steering return hose.
12. Remove the plug from the power steering fluid reservoir inlet port.
13. Install the power steering return hose to the reservoir.
    - Install the clamp.

NOTE: It is necessary to correctly fill the power steering system to remove any trapped air and completely fill the power steering system components.

If, after correctly filling the power steering system, there is power steering noise accompanied by evidence of aerated fluid and there are no fluid leaks, it may be necessary to purge the power steering system. For additional information, refer to Power Steering System Purging in this section.

14. Fill the power steering system. For additional information, refer to Power Steering System Filling in this section.

Power Steering System Purging

Table 8 Material

Item	Specification
Fleetrite CH990625C2	International TMS-6810

CAUTION: If the air is not purged from the power steering system correctly, premature power steering pump failure could result. This condition can occur on pre-delivery vehicles with evidence of aerated fluid or on vehicles that have had steering component repairs.

NOTE: A whine heard from the power steering pump may be caused by air in the system. The power steering purge procedure must be carried out prior to any component repair for which power steering noise complaints are accompanied by evidence of aerated fluid.

1. Remove the reservoir cap. Check the fluid.
2. Tightly insert the stopper of a vacuum pump into the reservoir.
3. Start the vehicle.
4. Apply maximum vacuum, (68-85 kPa (20-25 in/Hg)), and maintain it for a minimum of 3 minutes with the engine speed set at idle.
5. Release the vacuum and remove the vacuum pump.

CAUTION: Do not overfill the reservoir.

6. Fill the reservoir.
7. Reinstall the vacuum pump. Apply and maintain maximum vacuum, (68-85 kPa (20-25 in/Hg)).

CAUTION: Do not hold the steering wheel against the stops for more than 3 to 5 seconds at a time. Damage to the power steering pump could occur.

8. Cycle the steering wheel fully to the left and right every 30 seconds for approximately 5 minutes.
9. Stop the engine, release the vacuum and remove the vacuum pump.
10. Install the reservoir cap.
11. Check for fluid leaks at all of the connections. If the power steering fluid shows signs of air, repeat this procedure.

Steering Gear Meshload Adjustment

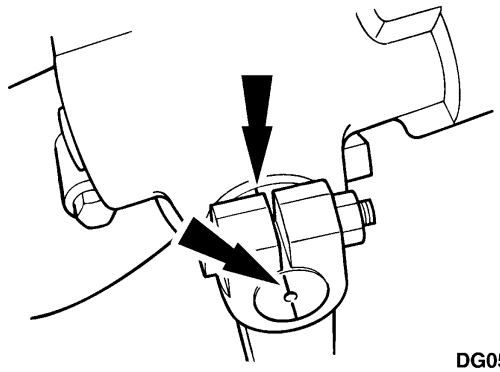
CAUTION: This adjustment must be carried out with the sector shaft on its center of travel.

CAUTION: The input shaft must not be rotated more than 1-1/2 revolutions when the steering sector shaft arm drag link is disconnected from the steering gear, to avoid possible misadjustment of the automatic poppet system.

NOTE: If the adjusting screw jam nut screw is accessible, this adjustment can be completed on the vehicle. Otherwise, the steering gear must be removed from the vehicle. For additional information, refer to Power Steering.

NOTE: If this adjustment is being carried out with the steering gear on the vehicle, disconnect the steering sector shaft arm drag link.

1. Put the sector shaft in the center of travel.
   - Rotate the input shaft until the timing marks across the end of the sector shaft are perpendicular to the input shaft and the valve worm is in line with the timing mark on the end of the housing trunnion.



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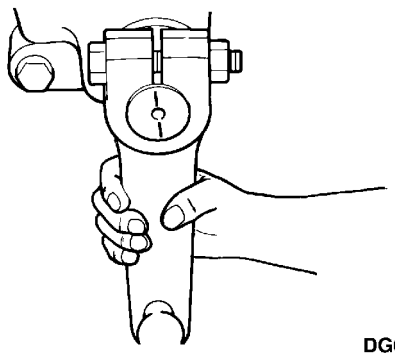
2. With the steering gear in the center position, grasp and gently try to move the steering sector shaft arm drag link back and forth in the direction of travel.
   - Fingertip force is adequate to detect the lash of a loose sector shaft. There must be no movement of the input shaft or the sector shaft.



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3. Loosen the jam nut on the sector shaft adjusting screw.
   - If no lash was detected, turn the adjusting screw counterclockwise until lash is detected at the output shaft.

CAUTION: Overadjustment of the shaft adjusting screw in the clockwise direction can result in a no-recovery, oversteering or darting condition of the vehicle.

4. Adjust the shaft adjusting screw.

a. Slowly turn the adjusting screw clockwise until no lash is felt at the steering sector shaft arm drag link. Use no more than the specified torque.

b. From the no-lash position, turn the screw clockwise an additional 1/8-3/16 turn. Hold the adjusting screw in place and tighten the jam nut to specification.

5. Turn the input shaft 1/4-turn each side of center and recheck the steering sector shaft arm drag link for lash. No lash should be felt. If lash exists, repeat Steps 1-4.

CAUTION: Maintain grease in the sector shaft bearing through the grease fitting in the housing using only a hand-operated grease gun. Add grease until it begins to extrude past the dirt and water seal. Do not use a power grease gun because it will supply grease too quickly. This can adversely affect the high-pressure seal and contaminate the hydraulic fluid.

6. If the adjustment was done with the steering gear on the vehicle, connect the steering sector shaft arm drag link. If the steering gear was removed from the vehicle, install the steering gear.

Power Steering

Power Steering Specifications

Table 9 Torque Specifications

Description	Nm	lbf-ft
Steering gear mounting nuts and bolts	350	258
Steering gear-to-steering column shaft coupler pinch bolt	48	35
Drag link-to-steering sector arm nut	115	85
Power steering fluid reservoir bolts	25	18
Power steering pump pressure line fitting	35	26
Power steering pump bolts	26	19

Power Steering Description and Operation

Pump Identification

CAUTION: Always use the ID code when ordering service parts.

The pump identification code is located on a tag attached to the power steering pump.

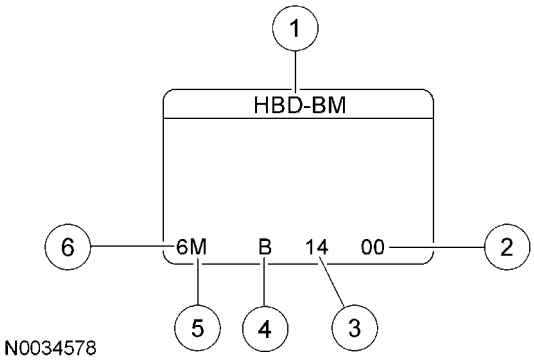


Figure 3

1. Model Code
2. For manufacturing purposes only
3. Day of the month
4. Shift
5. Month
6. Year

Steering Gear Identification

The steering gear specification number and date code are stamped on a machined surface opposite the input shaft of every TAS steering gear. An example date code would be 012-99; this means the gear was built on the 12th day of 1999.

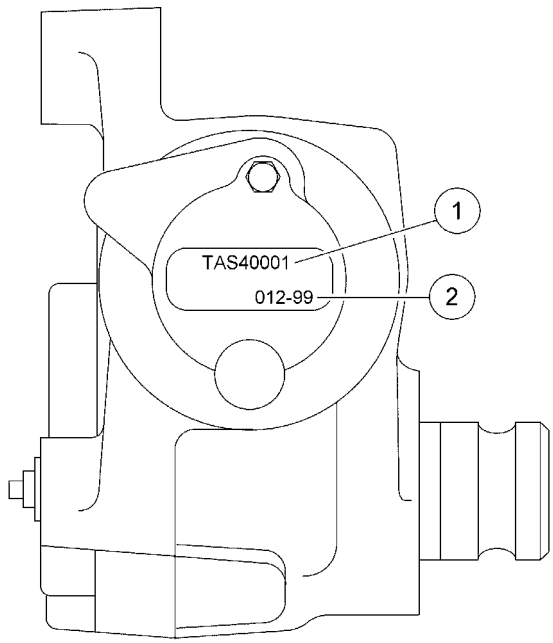


Figure 4

1. Specification number
2. Build date code

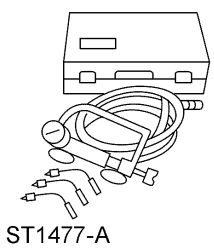
Power Steering Diagnosis and Testing

Refer to Steering System - General Information.

General Procedures

Steering Gear Adjustment

Table 10 Special Tools

 ST1477-A	Power Steering Analyzer or equivalent ZTSE2780

Poppet Valve Manual Readjustment

NOTE: This resetting procedure will work in most cases with at least 1-3/4 hand wheel turns from side-to-side of center. If making a large reduction in wheel cut and this procedure does not work, the poppets may need to be internally reset. For additional information, refer to Steering Gear Poppet Component Replacement in this section.

NOTE: The steering gear is equipped with 2 hydraulic pressure-relieving poppet valves that are automatically set to trip, relieving pressure just before reaching the axle stops. This is achieved after initial installation into the vehicle at the first full right and left turns. The pressure-relieving poppet valves will automatically reset themselves within the poppet adjustment limits if the axle stops are reset for increased steering gear travel, based on acceptable equipment revisions from original factory installations.

1. To determine if the poppets require readjustment or if they are carried out correctly, install a Power Steering System Analyzer (PSSA) between the power steering pump and the steering gear. If poppet readjustment is necessary, you can leave the PSSA in the system to verify that the following procedure is completed correctly.
2. Poppets might need to be readjusted if the following conditions exist.
   - Changing to larger tires.
   - Reduced vehicle wheel cut.
   - Pitman arm mistimed, condition corrected.
   - Steering gear being installed on a different truck.
   - Steer axle stop bolt(s) were bent or broken.
   - Steer axle U-bolt(s) were bent or broken.

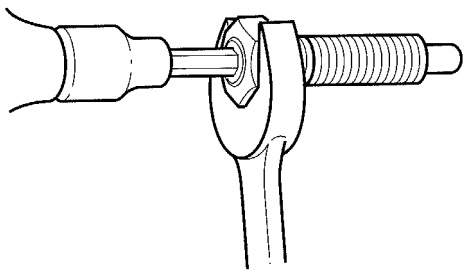
NOTE: An alternate method of manually resetting the poppet valves with the steering gear installed in the vehicle is done by using Ross special service tools, Poppet Adjuster Tool and Adjuster Lock Nut Tool.

3. Check the maximum turn angle of the front wheels. Refer to Suspension System in S03014 for the correct specifications.

NOTE: The steering gear will have either a fixed stop screw or an adjusting screw. If the adjusting screw is already part of the steering gear, back the nut off the adjusting screw until it is flush with the end of the adjusting screw.

NOTE: Only carry out the following step with the wheels in the straight-ahead position, with the steering gear in its center position and only when the timing marks on the end of the sector shaft and the housing trunnion are aligned.

4. Turn the poppet adjusting screw and sealing nut until the drive end of the screw is flush with the nut.



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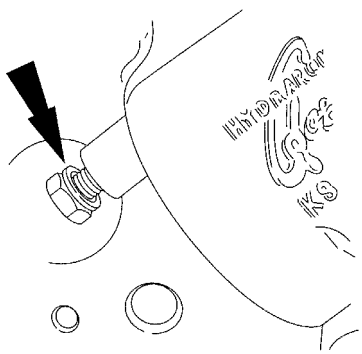
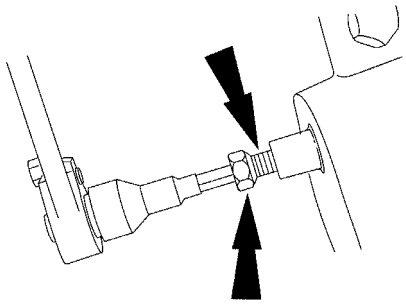
NOTE: If the unit has a poppet adjusting screw and sealing nut that need to be serviced, remove and discard them.

5. With the vehicle unloaded, the engine off and the wheels in the straight-ahead position, remove and discard the fixed stop screw, if equipped, and the washer from the lower end of the housing.



DG0394-A

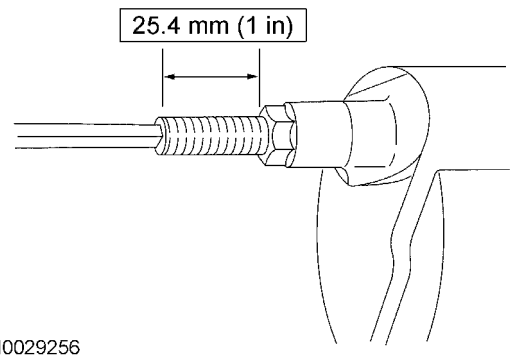
6. Install the adjusting screw and the sealing nut assembly (without moving the nut on the screw) into the housing until the nut is firmly against the housing. Tighten the sealing nut against the housing.



DG0395-A

CAUTION: Do not mix fluid types. Mixing transmission fluid, motor oil or other hydraulic fluids will cause seals to deteriorate faster.

7. Fill the power steering reservoir with the specified fluid.
8. Place a jack under the center of the front axle and raise the front end of the vehicle so the steering axle tires are off the ground.
9. Start the engine and let it run at idle speed.
10. Note which output shaft timing mark is nearest the housing piston bore.
11. Turn the steering wheel to make a right-hand turn, this makes the pitman arm turn in a counterclockwise direction toward the poppet adjusting screw. Turn in this direction until axle stop contact is made.
12. Pull hard on the steering wheel after the axle stop is contacted. Put 30 pounds of rim pull on a 508 mm (20 in) diameter steering wheel.
13. Turn the steering wheel in the opposite direction (end of timing mark away from the adjusting screw) until the other axle stop is contacted.
14. Pull hard on the steering wheel. Put 44 pounds of rim pull on a 457.2 mm (18 in) diameter steering wheel.
15. Release the steering wheel and shut off the engine. Do not steer again until Step 18 is completed.
16. Loosen the sealing nut and back out the adjusting screw until it is past the nut. Tighten the sealing nut against the housing.



N0029256

17. Start the engine and let it idle.

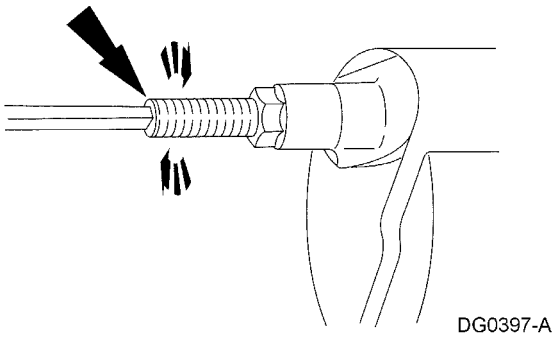
CAUTION: Do not hold the steering wheel at the stops for an extended amount of time. Damage to the power steering pump will result.

18. Turn the steering wheel in the original direction (end of timing mark toward adjusting screw) until axle stop contact is made.
19. Hold the steering wheel in this position (with 30 pounds rim pull) for 10 seconds, then release. Repeat this hold and release process as many times as necessary while completing Step 21.
20. With the steering wheel held at full LOCK position, loosen the jam nut and hold it in place with a wrench.

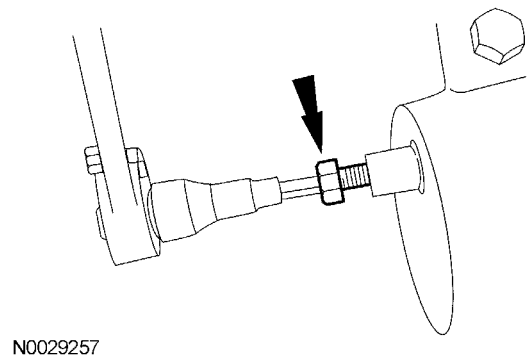
NOTE: Do not attempt to turn further.

NOTE: Pause the turning of the adjusting screw each time the driver releases the steering wheel. Continue turning only while the wheel is held at full turn.

21. Turn the adjusting screw in (clockwise) using finger pressure only until the Allen wrench comes to a stop. Do not use a ratchet.



22. Back off the adjusting screw 1-1/2 turns and tighten the sealing nut.
    - Tighten to 45 Nm (33 lb-ft).



23. Check the reservoir and fill as necessary.

WARNING: The length of the adjusting screw beyond the nut must be no more than 1-1/16 inch for correct thread engagement.

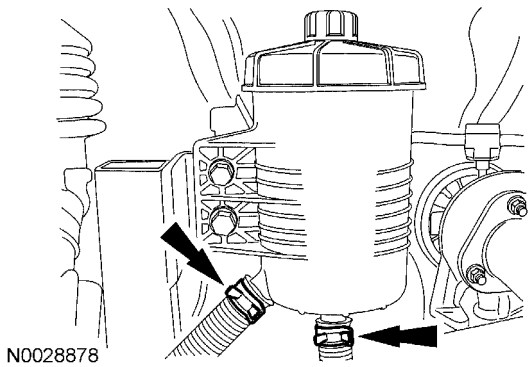
NOTE: The length of the adjusting screw beyond the sealing nut may be different for each vehicle.

24. Set the main gear using the procedures described above. Leave the adjusting screws on the rotary cylinders in place (as described above) after the poppets on the main gear have been reset.

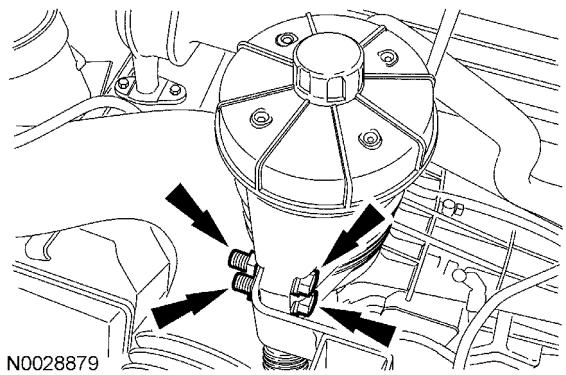
Removal and Installation

Power Steering Fluid Reservoir

1. Using a suction gun, remove the fluid from the reservoir.
2. Loosen the clamps and disconnect the hoses.
    - Drain the fluid into a suitable container.



3. Remove the nuts, bolts and the reservoir.
    - To install, tighten to 25 Nm (18 lb-ft).

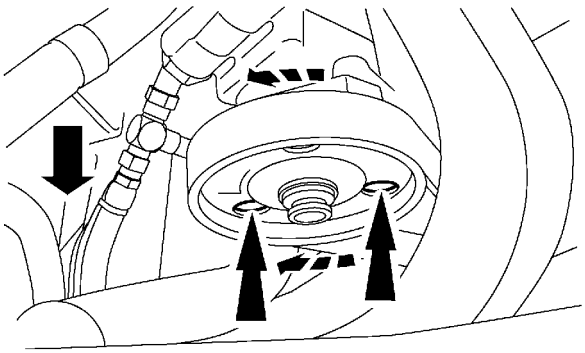


4. To install, reverse the removal procedure.
    - Fill, purge and leak check the system. For additional information, refer to Steering System.

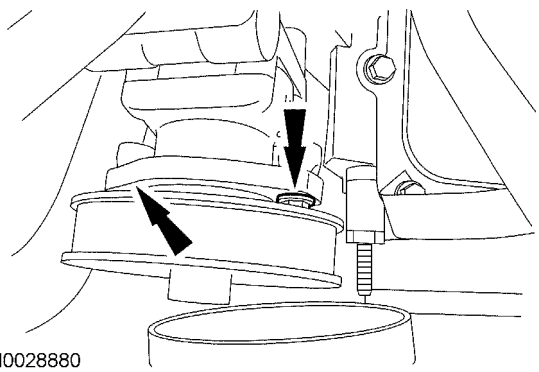
Power Steering Pump

1. Using a suction gun, remove the fluid from the reservoir.

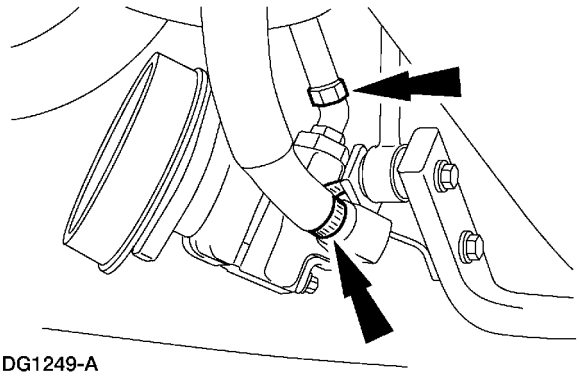
2. Remove the accessory drive belt. For additional information, refer to the Engine Operation and Maintenance Manual.
3. Align the 2 holes in the power steering pulley with the mounting bolts.


DG1244-B

4. Remove the 2 mounting bolts.
   - To install, tighten to 26 Nm (19 lb-ft).


N0028880

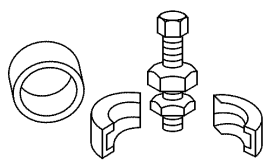
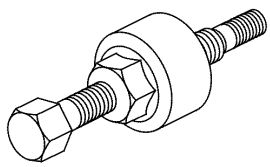
5. Disconnect the power steering pressure and return lines.
   - To install, tighten the pressure line to 35 Nm (26 lb-ft).


DG1249-A

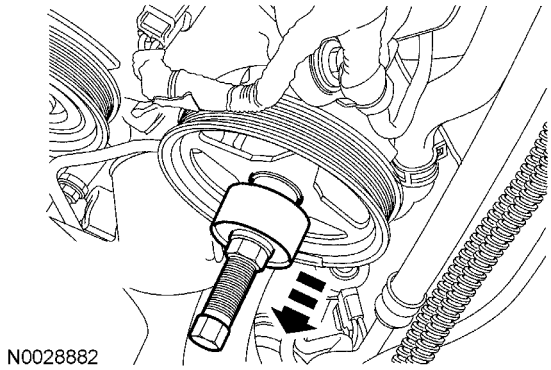
6. To install, reverse the removal procedure.
7. Fill, purge and leak check the power steering system. For additional information, refer to Steering System.

Power Steering Pump Pulley Removal

Table 11

 ST1290-A	Remover, Power Steering Pump Pulley ZTSE4716
 ST1586-A	Installer, Power Steering Pump Pulley ZTSE4717

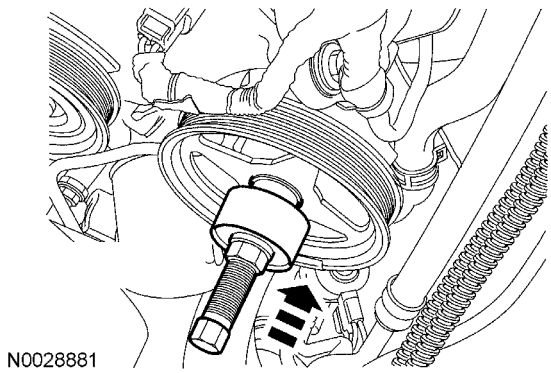
1. Remove the drive belt. For additional information, refer to the Engine Operation and Maintenance Manual.
2. Using the special tool, remove the power steering pump pulley.


N0028882

Power Steering Pump Pulley Installation

CAUTION: Replacement of the power steering pump pulley is necessary after being removed and installed 2 times.

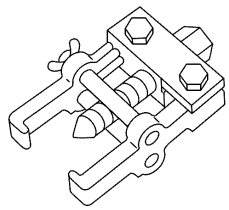
1. Using the special tool, install the power steering pump pulley.
   - Inspect the pulley for paint marks in the web area near the hub. If there are 2 paint marks, discard the pulley. If there is no paint or 1 paint mark, use a paint pencil to mark the web area of the pulley near the hub.


N0028881

2. Install the accessory drive belt. For additional information, refer to the Engine Operation and Maintenance Manual.

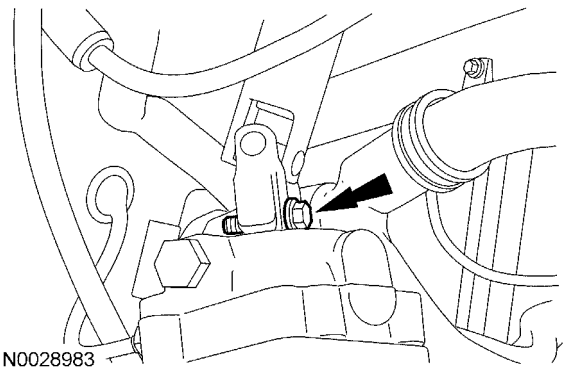
Steering Gear Removal and Installation

Table 12 Special Tool

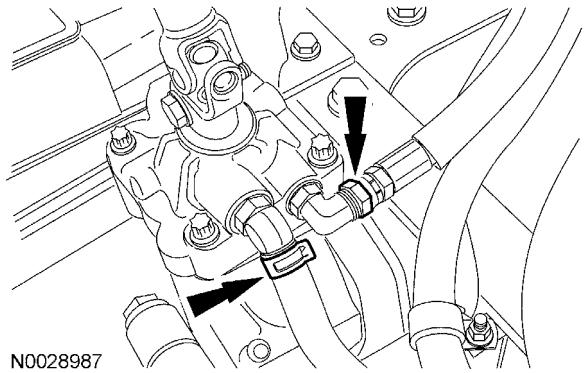
 ST1263-A	Remover, Steering Arm

CAUTION: While repairing the power steering system, care should be taken to prevent the entry of contaminants or premature failure of the power steering components can result.

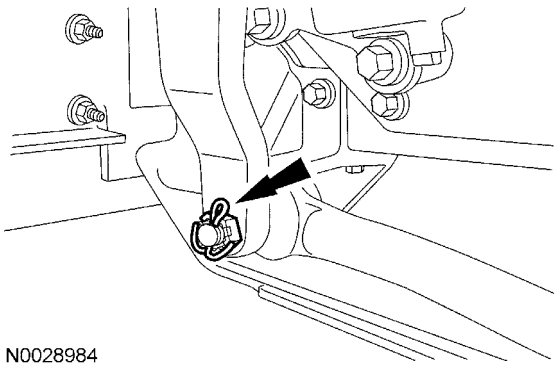
1. Remove the fluid from the reservoir using a suction gun.
2. Remove the bolt and disconnect the coupler from the steering gear.


N0028983

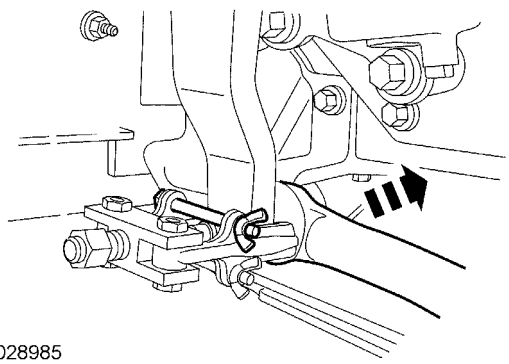
3. Disconnect the 2 power steering lines.
   - To install, tighten to 35 Nm (26 lb-ft).


N0028987

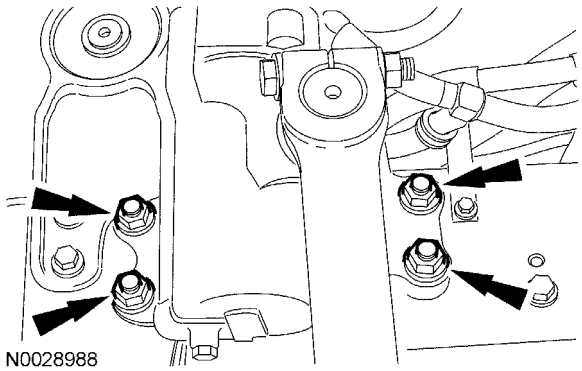
4. Remove and discard the cotter pin and nut.

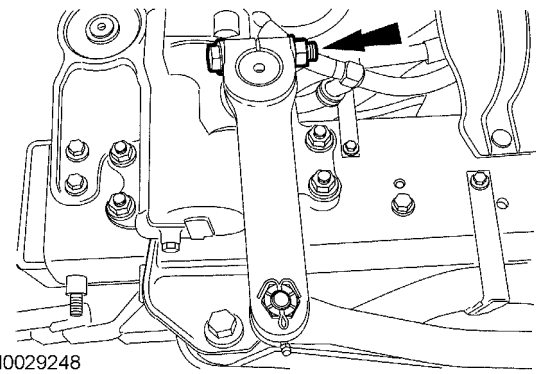

N0028984

5. Using the special tool, separate the steering link from the sector shaft arm.


N0028985

6. Remove the nuts, bolts and the steering gear.
   - If necessary, remove the sector shaft arm.
   - To install, tighten to 350 Nm (258 lb-ft).


N0028988


N0029248

7. To install, reverse the removal procedure.
   - To install, tighten to 350 Nm (258 lb-ft).
8. Fill, purge and leak check the power steering system. For additional information, refer to Steering System.

Steering Linkage

Specifications

Table 13 Torque Specifications

Description	Nm	lbf-ft
Adjusting sleeve clamp nuts	80	59
Spindle steering arm nuts	550	404
Steering gear sector shaft arm nut	350	259
Steering sector shaft arm drag link-to-steering gear sector shaft arm nut	115	85
Steering sector shaft arm drag link-to-spindle nut	175	129
Tie rod end nuts	115	85

Description and Operation

Steering Linkage

The steering linkage assemblies consist of the following:

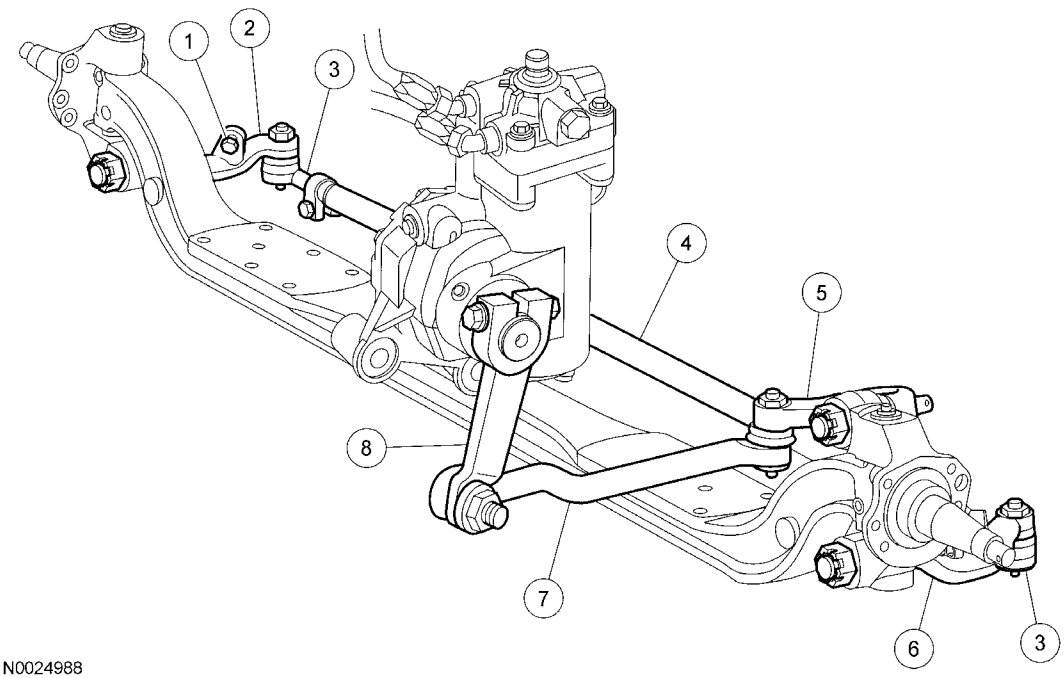


Figure 24

1. Steering stop
2. Spindle steering arm (RH)
3. Tie rod end
4. Adjusting sleeve
5. Drag link spindle steering arm
6. Spindle steering arm (LH)
7. Steering sector shaft arm drag link
8. Steering gear sector shaft arm

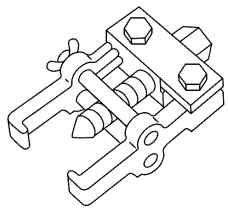
Diagnosis and Testing

Refer to Steering System — General Information.

Removal and Installation

Tie Rod End — Outer

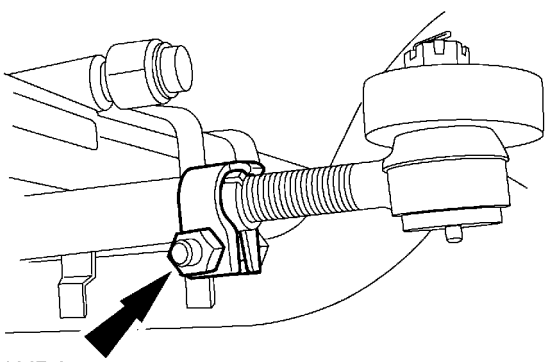
Table 14 Special Tool

 ST1263-A	Remover, Steering Arm

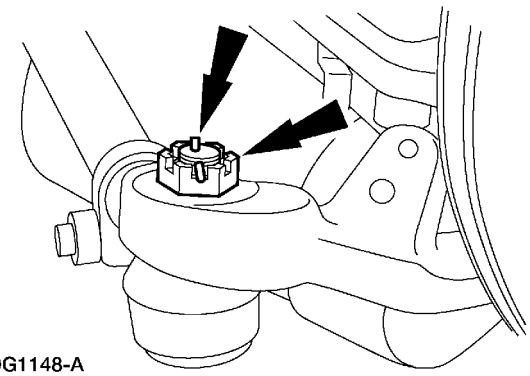
NOTE: Install a new front wheel spindle tie rod if the ball stud is loose in the socket or the front wheel spindle tie rod is bent. Install a new front suspension steering ball stud dust seal if any nicks, cuts or tears are present. Do not attempt to straighten a bent front wheel spindle tie rod.

NOTE: RH front wheel spindle tie rod shown, LH front wheel spindle tie rod similar.

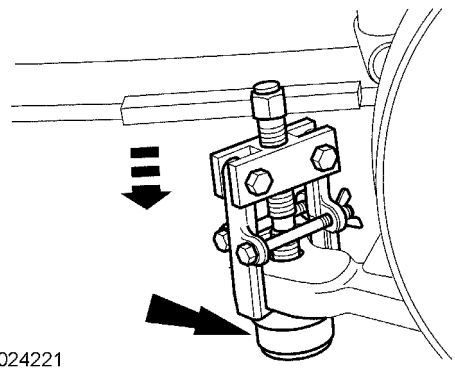
1. Remove the wheel and tire assembly. For additional information, refer to Wheels and Tires in S17002.
2. Loosen the adjusting sleeve clamp nut.
   - Tighten to 80 Nm (59 lb-ft).


DG1147-A

3. Remove the cotter pin and castellated tie-rod end nut. Discard the cotter pin.
   - To install, tighten to 115 Nm (85 lb-ft).
   - Install a new cotter pin.


DG1148-A

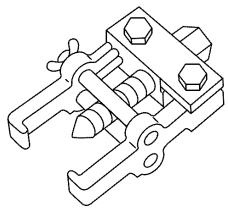
4. Using the special tool, disconnect the front wheel spindle tie rod.


N0024221

5. Remove the front wheel spindle tie rod.
   - Note the number of turns required to remove the front wheel spindle tie rod.
6. To install, reverse the removal procedure.
7. Check the toe-in and clear vision settings. For additional information, refer to Suspension System in S03014.

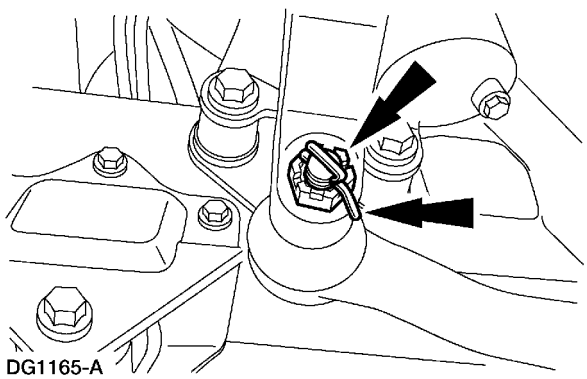
Sector Shaft Arm Drag Link

Table 15 Special Tool

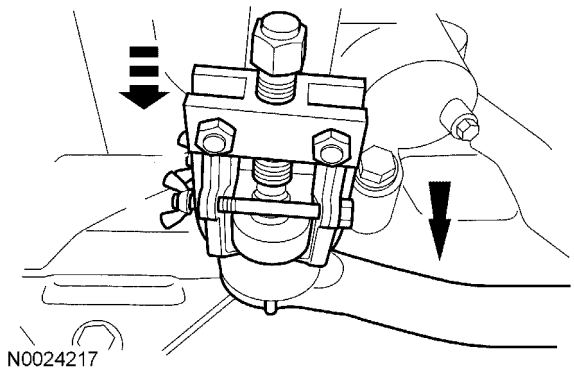
 ST1263-A	Remover, Steering Arm

NOTE: Install a new steering sector shaft arm drag link if the ball stud is loose in the socket or if the steering sector shaft arm drag link is bent. Install a new front suspension steering ball stud dust seal if any nicks, cuts or tears are present. Do not attempt to straighten a steering sector shaft arm drag link.

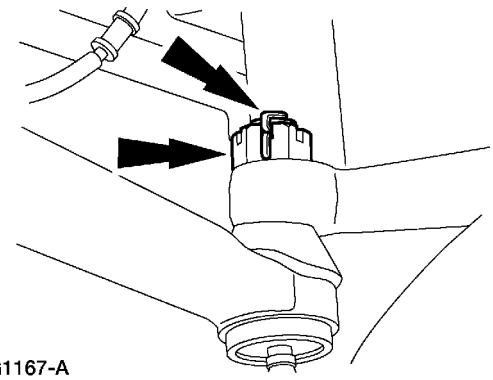
1. Remove the cotter pin and castellated steering sector shaft arm drag link-to-sector gear shaft arm nut. Discard the cotter pin.
   - Tighten to 115 Nm (85 lb-ft).
   - Install a new cotter pin.


DG1165-A

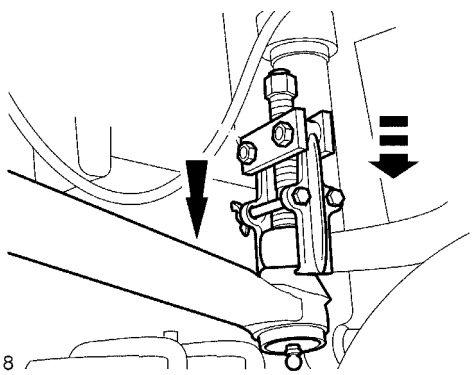
2. Using the special tool, disconnect the steering sector shaft arm drag link from the steering gear sector shaft arm.


N0024217

3. Remove the cotter pin and castellated steering sector shaft arm drag link-to-spindle nut. Discard the cotter pin.
   - Tighten to 175 Nm (129 lb-ft).
   - Install a new cotter pin.


DG1167-A

4. Using the special tool, disconnect and remove the steering sector shaft arm drag link.


N0024218

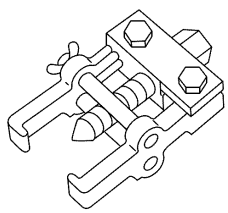
NOTE: When installing a new steering sector shaft arm drag link, equalize the thread engagement of the short and long tie-rod ends in the adjusting sleeve. This will provide an approximate toe-in setting.

NOTE: The steering linkage must be installed with the steering gear on center (± 45 degrees of the power steering gear input shaft and control). The ball studs must be seated in the tapered hole to prevent rotation while tightening the nuts.

5. To install, reverse the removal procedure.
6. Check the toe-in and clear vision settings. For additional information, refer to Suspension System in S03014.

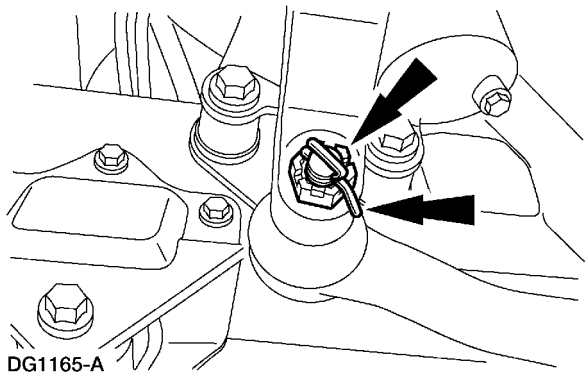
Sector Shaft Arm

Table 16 Special Tool

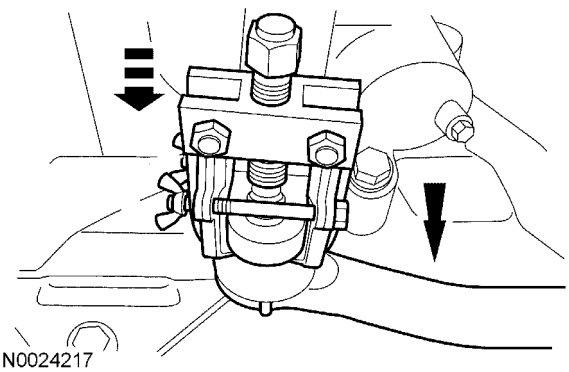
 ST1263-A	Remover, Steering Arm

NOTE: Install a new steering gear sector shaft arm if it is bent. If the steering gear sector shaft arm is bent, check remainder of the steering linkage system for signs of damage. Replace any damaged steering linkage parts as required. Do not attempt to straighten the steering gear sector shaft arm or any other steering linkage components.

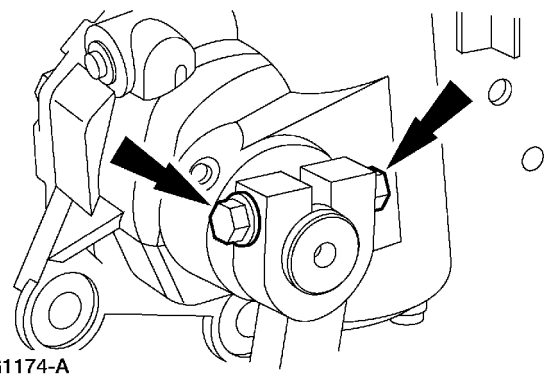
1. Remove the cotter pin and castellated steering sector shaft arm drag link-to-sector gear shaft arm nut. Discard the cotter pin.
   - Tighten to 115 Nm (85 lb-ft).
   - Install a new cotter pin.


DG1165-A

2. Using the special tool, disconnect the steering sector shaft arm drag link. Position the steering sector shaft arm drag link aside.

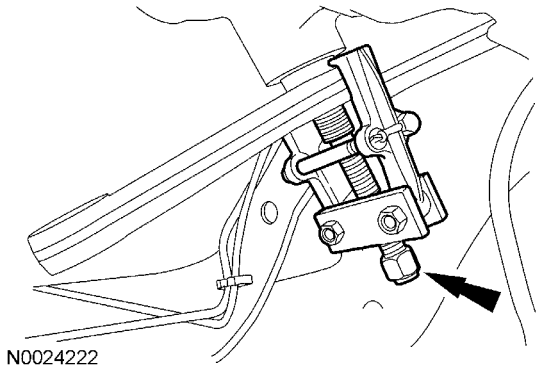

N0024217

3. Remove and discard the steering gear sector shaft arm nut and bolt.
   - To install, tighten to 350 Nm (259 lb-ft).


DG1174-A

CAUTION: Do not use heat or pound on the steering gear sector shaft arm or sector shaft as damage can result. These components must be installed new rather than repaired if they are damaged.

4. Using the special tool, remove the steering gear sector shaft arm.

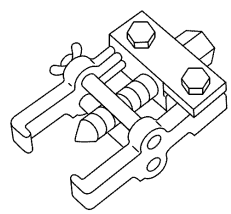

N0024222

NOTE: The wheels should be in a straight-ahead position.

5. To install, reverse the removal procedure.
6. Check the toe-in and clear vision settings. For additional information, refer to Suspension System in S03014.

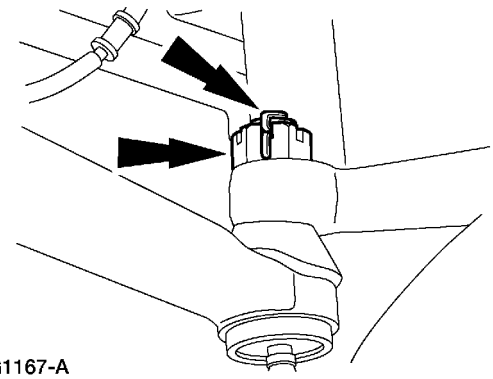
Spindle Steering Arm

Table 17 Special Tool

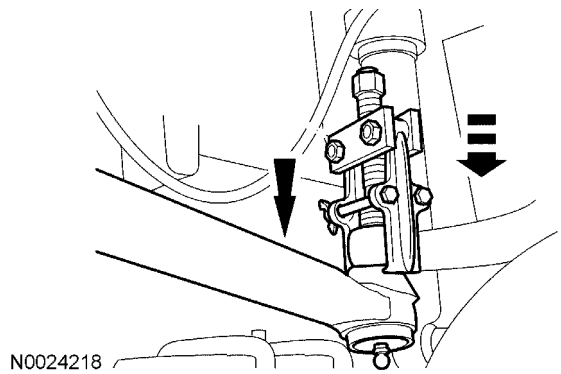
 ST1263-A	Remover, Steering Arm

NOTE: Drag link spindle steering arm shown, LH and RH spindle steering arms similar.

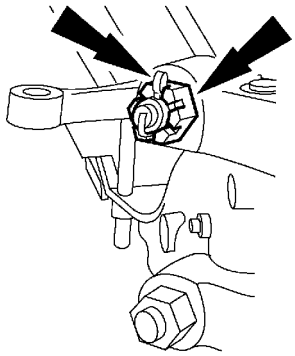
1. Remove the cotter pin and castellated steering sector shaft arm drag link-to-spindle nut. Discard the cotter pin.
   - Tighten to 175 Nm (129 lb-ft).
   - Install a new cotter pin.


DG1167-A

2. Using the special tool, disconnect the steering sector shaft arm drag link.

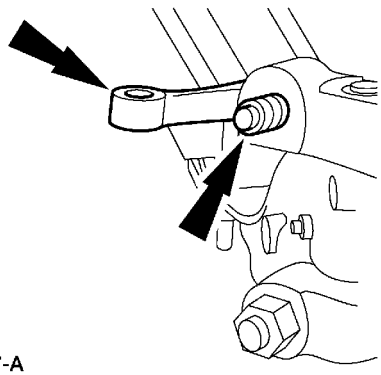

N0024218

3. Remove the cotter pin and castellated spindle steering arm nut.
   - To install, tighten to 550 Nm (404 lb-ft).
   - Install a new cotter pin.



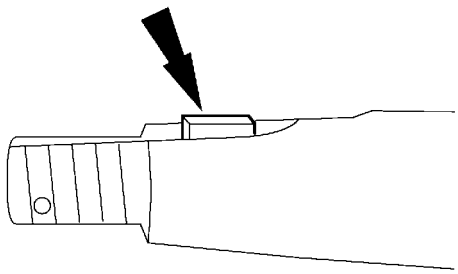
DG1256-A

4. Remove the spindle steering arm.



DG1257-A

5. Remove the key.



DG1258-A

NOTE: The spindle hole is slotted to align the spindle steering arm with the front wheel spindle. Be sure that the key is flush with the face of the spindle steering arm.

6. To install, reverse the removal procedure.
7. Check the toe-in and clear vision settings. For additional information, refer to Suspension System in S03014.

Steering Column

Specifications

Table 18 Torque Specifications

Description	Nm	lbf-ft
Steering column bracket bolts	16	12
Steering column bracket nuts	16	12
Steering shaft pinch nut	16	12
Steering wheel nut	45	33

Description and Operation

Steering Column

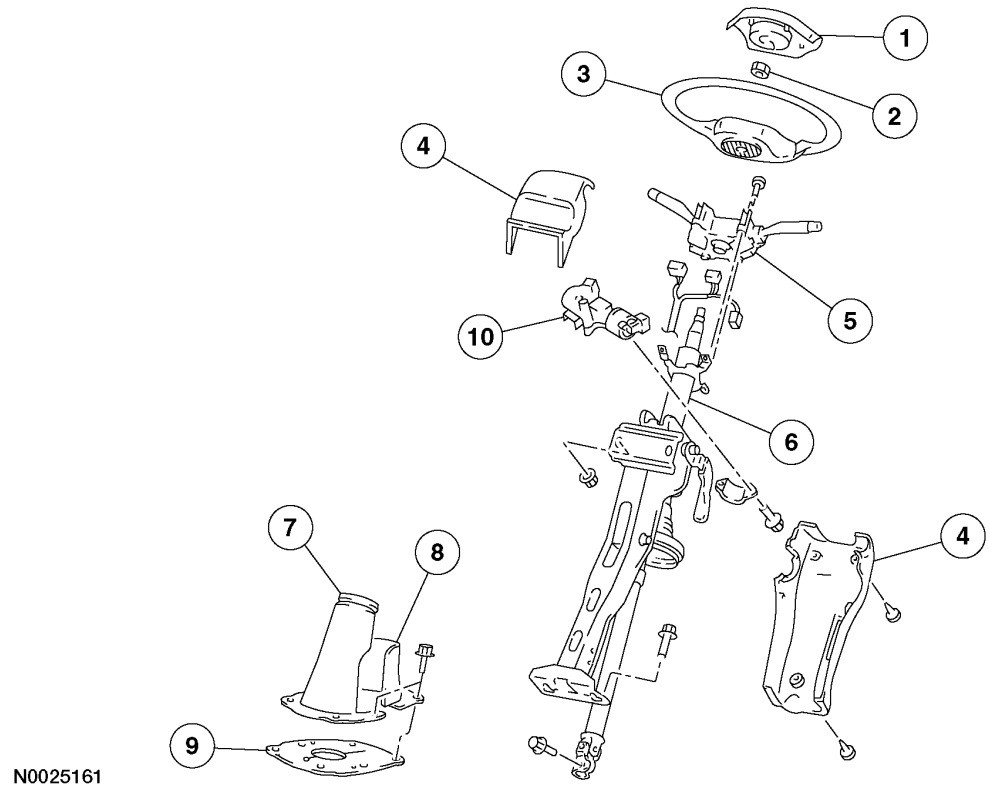


Figure 41

1. HORN PAD
2. STEERING WHEEL NUT
3. STEERING WHEEL
4. STEERING COLUMN COVER
5. MULTIFUNCTION SWITCH
6. STEERING COLUMN ASSEMBLY
7. STEERING SHAFT COVER (FRONT HALF)
8. STEERING SHAFT COVER (REAR HALF)
9. DUST SHIELD
10. IGNITION SWITCH ASSEMBLY

NOTE: All fasteners are important because they can affect the performance of vital parts and systems. Incorrect installation of the fasteners can result in major repair expenses. Install new fasteners of the same part number if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute a design. Torque values must be used as specified during assembly to make sure these parts function correctly.

The body of the steering column is made of magnesium die castings. The steering column is attached to a support that is an integral part of the instrument panel. The lower attachments of the steering column are through a bracket that bends during collapse. The upper attachments are through plastic shear modules that separate from the main casting during collapse.

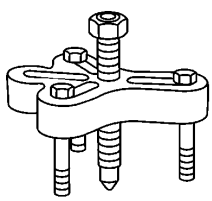
Diagnosis and Testing

Refer to Steering System — General Information.

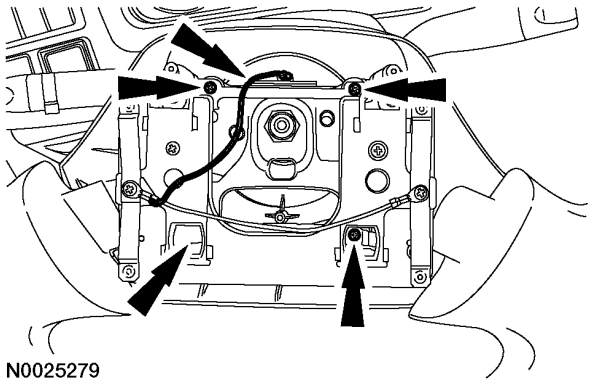
Removal and Installation

Steering Wheel

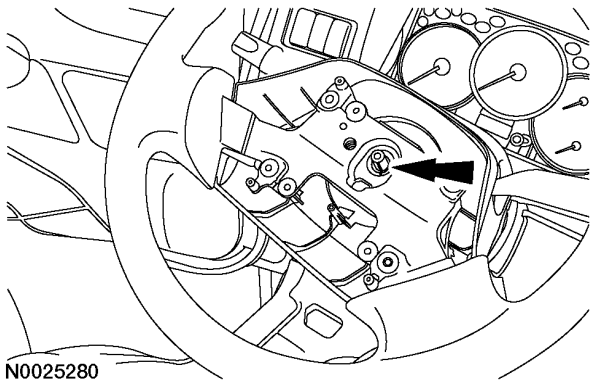
Table 19 Special Tool

 ST2729-A	Remover, Steering Wheel ZTSE4229 or equivalent

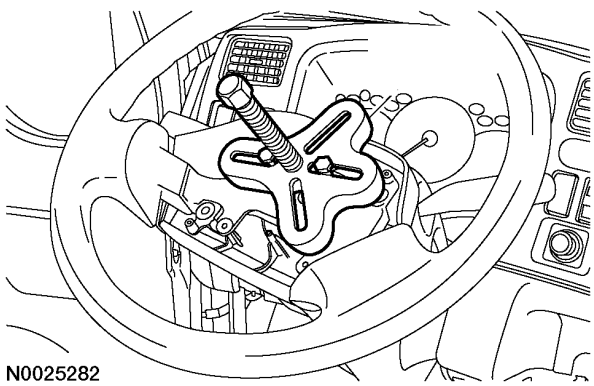
1. Make sure the wheels are in the straight-ahead position.
2. Disconnect the battery ground cable. For additional information, refer to Battery, Mounting and Cables in S08307.
3. Remove the steering wheel horn pad from the steering wheel.
4. Disconnect the horn ground wire and remove the 4 screws, then remove the horn switch assembly.


N0025279

5. Remove the steering wheel retaining nut.
   - To install, tighten to 45 Nm (33 lb-ft).
6. Index-mark the steering wheel to the steering shaft.


N0025280

7. Using the special tool, remove the steering wheel.


N0025282

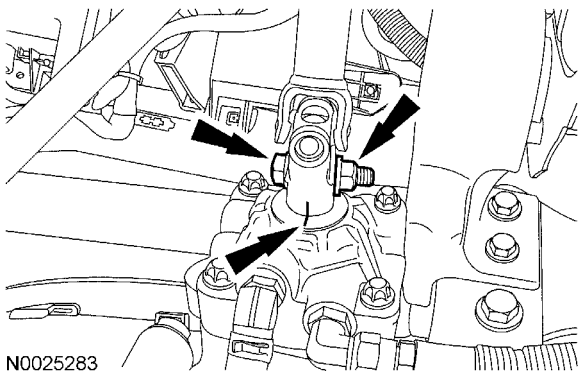
8. To install, reverse the removal procedure.

• Lubricate the steering wheel hub and the multifunction switch bushing with multi-purpose grease.

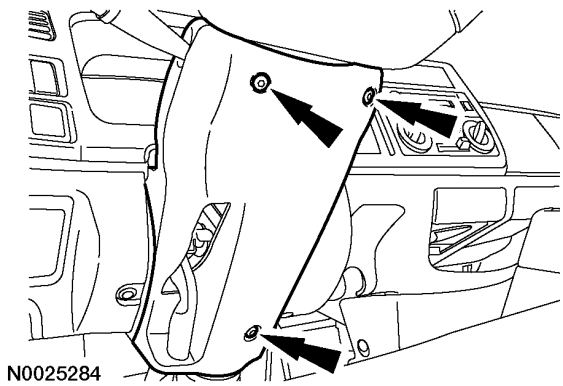
Steering Column Removal

1. Remove the steering wheel. For additional information, refer to Steering Wheel in this section.
2. Tilt the cab forward.
3. Index-mark the steering shaft to the steering gear, then remove the steering shaft pinch nut and bolt.

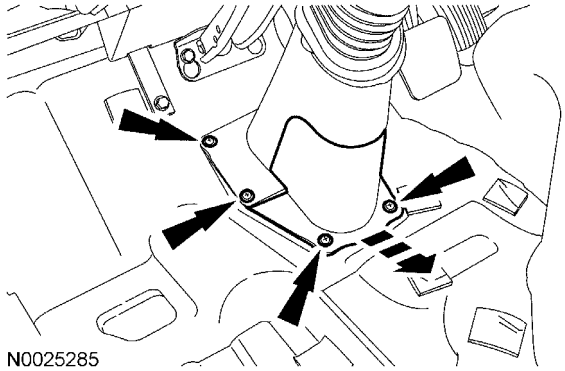
   • Disconnect the steering shaft from the steering gear.


N0025283

4. Lower the cab.
5. Remove the 3 steering column cover screws, then remove the 2 steering column covers.


N0025284

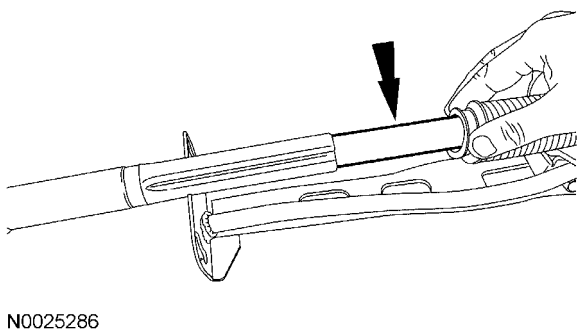
6. Remove the 6 steering shaft cover screws, then remove the steering shaft cover rear half.


N0025285

7. Disconnect the following 4 electrical connectors:
   - Ignition switch
   - Key-in-ignition switch
   - Turn signal/head lamp switch
   - Windshield wiper switch
8. Remove the 2 steering column bracket lower bolts.
9. Remove the 2 steering column bracket upper nuts.
10. Remove the steering column.

Steering Column Installation

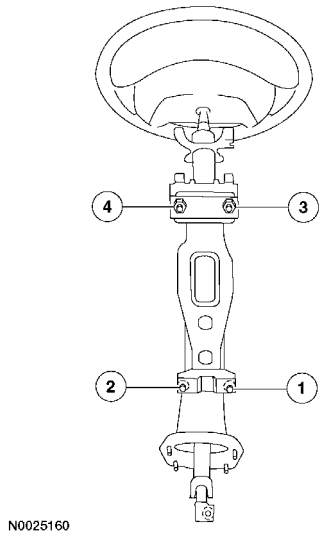
1. Lubricate the steering shaft sliding joint with multi-purpose grease.


N0025286

2. Position the steering column, connecting the steering shaft to the steering gear.
3. Install the 2 bracket bolts and the 2 bracket nuts.

• Do not tighten the fasteners at this time.

4. Tighten the 2 bolts and the 2 nuts to 16 Nm (12 lb-ft) in the sequence shown.



5. Tilt the cab forward and install the steering shaft pinch bolt and nut.

   • Tighten to 16 Nm (12 lb-ft).

6. Lower the cab and connect the 4 electrical connectors.
7. Position the steering shaft cover rear half and install the 6 screws.
8. Position the 2 steering column covers and install the 3 screws.
9. Install the steering wheel. For additional information, refer to Steering Wheel in this section.

Steering Column Switches

Specifications

Table 20 Torque Specifications

Description	Nm	lbf-ft
Ignition switch mounting bolts*	—	—
*Tighten the bolts until the bolt heads break off.		

Description and Operation

Steering Column Switches

The steering column switches system consists of the following components:

- Multifunction switch
- Ignition switch assembly

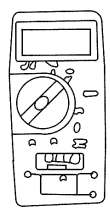
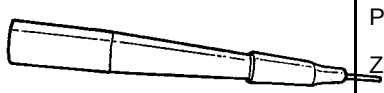
The multifunction switch is mounted to the steering column and controls the turn signal, headlamp dimmer/flash-to-pass and windshield wiper/washer.

The ignition switch assembly is mounted below the steering column and is activated by using the ignition key and rotating the ignition switch lock cylinder on the steering column. The ignition switch assembly contains the following items:

- Ignition lock cylinder
- Ignition switch
- Key-in-ignition switch

Diagnosis and Testing

Table 21 Special Tool

 ST1137-A	Automotive Meter ZTSE4357
	Probe Kit ZTSE4435B

Principles of Operation

Steering Column Switches

The steering column switches include the ignition switch and the multifunction switch (high beam/low beam, flash-to-pass, turn signal and windshield wiper). The ignition switch is controlled by the ignition lock cylinder with a key. When the ignition lock cylinder is turned using the key, a mechanical connection positions the ignition switch to the selected position and allows the ignition switch to send voltage to specific components. The multifunction switch controls the various components electrically. The headlamp switch sends constant voltage to the headlamps when placed in the ON position, while the flash-to-pass is a momentary switch used to send voltage to the headlamp high beams only. The headlamp high beam/low beam switch sends voltage to the low or high beam headlamps while the headlamps are on. The turn signal switch portion of the multifunction switch operates the left and right turn signals. The windshield wiper switch function uses a ground signal to activate the various wiper modes and the wiper/washer.

Inspection and Verification

1. Verify the customer concern by operating the multifunction switch or ignition switch.
2. Visually inspect for obvious signs of mechanical and electrical damage. Refer to the following chart:

Table 22 Visual Inspection Chart

Mechanical	Electrical
• Multifunction switch • Ignition switch • Ignition key • Ignition switch lock cylinder • Steering column shrouds	• In-line fuse 1 • Power Distribution Center (PDC) fuse(s): — 7 (25A) — 12 (20A) — 13 (20A) — 37 (10A) — 42 (10A) — 46 (5A) • Circuitry open/shorted • Disconnected, loose fitting or incorrectly installed electrical connectors and pins

NOTE: For multifunction switch concerns, refer to one of the following sections:

- For exterior lighting, refer to Exterior Lighting in S08307.
- For wipers and washers, refer to Wipers and Washers in S16030.

3. If an obvious cause for an observed or reported concern is found, correct the cause (if possible) before proceeding to the next step.
4. If the concern remains after the inspection, refer to the Symptom Chart.

Table 23 Symptom Chart

Condition	Possible Sources	Action
The ignition switch is inoperative	• In-line fuse 1. • Power Distribution Center (PDC) fuse(s): — 12 (20A) — 13 (20A) • Circuitry open. • Ignition switch.	Go to Pinpoint Test A.
No power in ACC	• In-line fuse 1. • Power Distribution Center (PDC) fuse(s): — 12 (20A) — 42 (10A) • Circuitry open. • Ignition switch.	Go to Pinpoint Test B.
No power in ON	• In-line fuse 1. • Power Distribution Center (PDC) fuse(s): — 12 (20A) — 13 (20A) — 37 (10A) — 42 (10A) — 46 (5A) • Circuitry open. • Ignition switch.	Go to Pinpoint Test C.
No power in START	• In-line fuse 1. • Power Distribution Center (PDC) fuse(s): — 12 (20A) — 13 (20A) — 46 (5A) • Circuitry open. • Ignition switch.	Go to Pinpoint Test D.

Table 23 Symptom Chart (cont.)

Condition	Possible Sources	Action
The ignition key is hard to turn	• Key. • Ignition lock cylinder. • Ignition switch.	Go to Pinpoint Test E.
The multifunction switch/hazard switch does not operate correctly	• Multifunction switch.	• CARRY OUT the Multifunction Switch Continuity Test. Refer to Wiring Diagrams Cell for component testing. • For a concern with exterior lighting, refer to Exterior Lighting in S08307. • For a concern with wipers and washers, refer to Wipers and Washers in S16030.

Pinpoint Tests

Pinpoint Test A: The Ignition Switch is Inoperative

Normal Operation

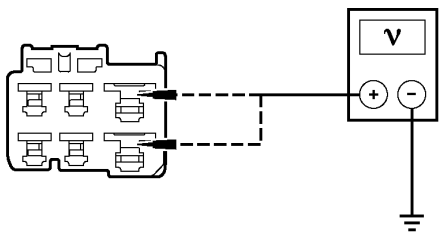
The Power Distribution Center (PDC) receives fused battery power from the in-line fuse 1. The PDC then provides the ignition switch with fused battery power through fuse 12 (20A) circuit 1050 (LG/VT) and fuse 13 (20A) circuit 1522 (LG). The ignition switch has 3 possible states:

- OFF — No power on any circuit to the PDC
- ON/START — Power on circuit 298 (VT/OG) to fuse 37 (10A) of the PDC , power on circuit 297 (BK/LG) to fuse 46 (5A) of the PDC, power on circuit 296 (WH/VT) to fuse 42 (10A) of the PDC and power on circuit 32 (RD/LB) to pin 85 of the starter relay.
- ON/ACC — Power on circuit 298 (VT/OG) to fuse 37 (10A) of the PDC, power on circuit 297 (BK/LG) to fuse 46 (5A) of the PDC and power on circuit 296 (WH/VT) to fuse 42 (10A) of the PDC.

Possible Causes

- In-line fuse 1
- An open in one or both of the following PDC fuse(s):
  - — 12 (20A)
  - — 13 (20A)
- An open in circuit 1050 (LG/VT) or 1522 (LG)
- Ignition switch

Table 24 PINPOINT TEST A: THE IGNITION SWITCH IS INOPERATIVE

Test Step	Result / Action to Take
A1 CHECK THE VOLTAGE TO THE IGNITION SWITCH **CAUTION: Use the Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.** • **Disconnect:** Ignition Switch C250 • Measure the voltage between ignition switch C250-6, circuit 1522 (LG) and ground; and between ignition switch C250-3, circuit 1050 (LG/VT) and ground.  N0028411 **Are the voltages greater than 10 volts?**	**Yes** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation. **No** INSPECT in-line fuse 1 and PDC fuses 12 (20A) and 13 (20A) for an open. If OK, REPAIR circuit 1050 (LG/VT) or 1522 (LG) for an open. TEST the system for normal operation.

Pinpoint Test B: No Power in ACC

Normal Operation

The Power Distribution Center (PDC) receives fused battery power from the in-line fuse 1. The PDC then provides the ignition switch with fused battery power for ACC through fuse 12 (20A) circuit 1050 (LG/VT). When placed in the ACC position, the ignition switch provides voltage to circuit 296 (WH/VT) which is distributed to the power window relay, the reverse lamp relay and PDC fuse 42 (10A). The audio unit receives voltage through PDC fuse 42 (10A).

Possible Causes

- An open in one or both of the following PDC fuse(s):
  - — 12 (20A)
  - — 42 (10A)
- An open in circuit 296 (WH/VT)
- Ignition switch

Table 25 PINPOINT TEST B: NO POWER IN ACC

Test Step	Result / Action to Take
B1 CHECK RADIO OPERATION • Key in ON position. • Verify the radio operates. **Does the radio operate?**	**Yes** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation. **No** Go to Pinpoint Test C.

Pinpoint Test C: No Power in On

Normal Operation

The Power Distribution Center (PDC) receives fused battery power from the in-line fuse 1. The PDC then provides the ignition switch with fused battery power through fuse 12 (20A) circuit 1050 (LG/VT) and fuse 13 (20A) circuit 1522 (LG). When placed in the ON position, the ignition switch provides voltage to circuits 296 (WH/VT), 297 (BK/LG) and 298 (VT/OG).

Possible Causes

- An open in one or both of the following PDC fuse(s):
  - — 12 (20A)
  - — 13 (20A)
  - — 37 (10A)
  - — 42 (10A)
  - — 46 (5A)
- An open in one or more of the following circuits:
  - — 1050 (LG/VT)
  - — 1522 (LG)
  - — 296 (WH/VT)
  - — 297 (BK/LG)
  - — 298 (VT/OG)
- Ignition switch

Table 26 PINPOINT TEST C: NO POWER IN ON

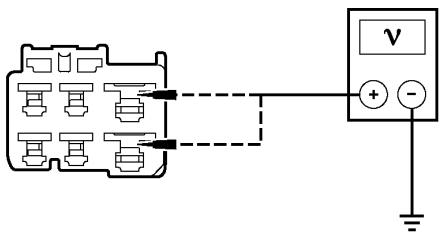
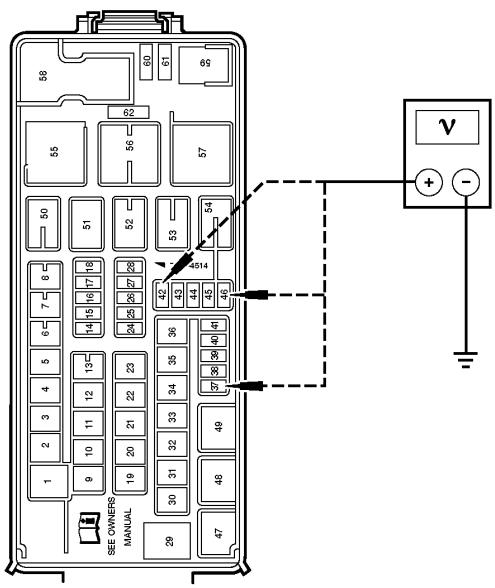
Test Step	Result / Action to Take
C1 CHECK THE VOLTAGE SUPPLY TO THE IGNITION SWITCH **CAUTION: Use the Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.** • Key in OFF position. • **Disconnect:** Ignition Switch C250 • Measure the voltage between ignition switch C250-6, circuit 1522 (LG) and ground; and between ignition switch C250-3, circuit 1050 (LG/VT) and ground.  N0028411 **Are the voltages greater than 10 volts?**	**Yes** Go to C2. **No** INSPECT in-line fuse 1 and PDC fuses 12 (20A) and 13 (20A) for an open. If OK, REPAIR circuit 1050 (LG/VT) or 1522 (LG) for an open. TEST the system for normal operation.

Table 26 PINPOINT TEST C: NO POWER IN ON (cont.)

Test Step	Result / Action to Take
C2 CHECK THE IGNITION SWITCH Carry out the Ignition Switch Continuity Check. **Does the ignition switch test OK?**	**Yes** Go to C3. **No** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation.
C3 CHECK THE VOLTAGE SUPPLY TO THE Power Distribution Center (PDC) • Key in ON position. • Measure the voltage between the Power Distribution Center (PDC) and ground as follows: Power Distribution Center (PDC) Fuse 37 (10A) — Circuit 298 (VT/OG) Power Distribution Center (PDC) Fuse 42 (10A) — Circuit 296 (WH/VT) Power Distribution Center (PDC) Fuse 46 (5A) — Circuit 297 (BK/LG)  N0028412 **Are the voltages greater than 10 volts?**	**Yes** VERIFY the concern. REFER to the Symptom Chart. **No** INSPECT PDC fuses 37 (10A), 42 (10A) and 46 (5A) for an open. If OK, REPAIR the circuits 298 (VT/OG), 296 (WH/VT) or 297 (BK/LG) for an open. TEST the system for normal operation.

Pinpoint Test D: No Power in Start

Normal Operation

The Power Distribution Center (PDC) receives fused battery power from the in-line fuse 1. The PDC then provides the ignition switch with fused battery power through fuse 12 (20A) circuit 1050 (LG/VT) and fuse 13 (20A) circuit 1522 (LG). When placed in the START position, the ignition switch provides voltage to circuits 32 (RD/LB) and 297 (BK/LG).

Possible Causes

- An open in one of the following PDC fuse(s):
  - 12 (20A)
  - 13 (20A)
  - 46 (5A)
- An open in one or more of the following circuits:
  - 1050 (LG/VT)
  - 1522 (LG)
  - 32 (RD/LB)
  - 297 (BK/LG)

Table 27 PINPOINT TEST D: NO POWER IN START

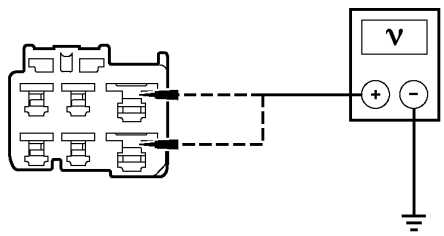
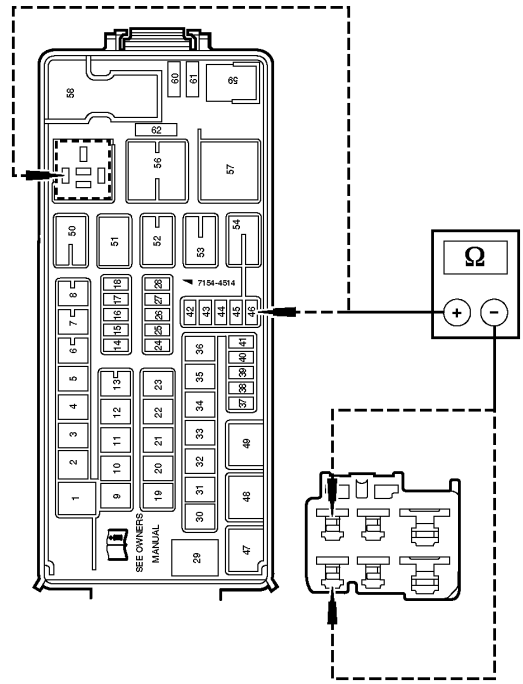
Test Step	Result / Action to Take
D1 CHECK THE VOLTAGE SUPPLY TO THE IGNITION SWITCH **CAUTION: Use the Probe Kit for all test connections to prevent damage to the wiring terminals. Do not use standard multimeter probes.** • **Disconnect:** Ignition Switch C250 • Measure the voltage between ignition switch C250-6, circuit 1522 (LG) and ground; and between ignition switch C250-3, circuit 1050 (LG/VT) and ground.  N0028411 **Are the voltages greater than 10 volts?**	**Yes** Go to D2. **No** INSPECT in-line fuse 1 and PDC fuses 12 (20A) and 13 (20A) for an open. If OK, REPAIR circuit 1050 (LG/VT) or 1522 (LG) for an open. TEST the system for normal operation.

Table 27 PINPOINT TEST D: NO POWER IN START (cont.)

Test Step	Result / Action to Take
D2 CHECK CIRCUITS 32 (RD/LB) AND 297 (BK/LG) FOR AN OPEN • Measure the resistance between ignition switch C250-4, circuit 32 (RD/LB) and starter relay socket pin 85; and between ignition switch C250-1, circuit 297 (BK/LG) and central junction box fuse 46 (5A).  N0028410 **Are the resistances less than 5 ohms?**	**Yes** Go to D3. **No** INSPECT PDC fuse 46 (5A) for an open. If OK, REPAIR the circuits 32 (RD/LB) or 297 (BK/LG) for an open. TEST the system for normal operation.
D3 CHECK THE IGNITION SWITCH Carry out the Ignition Switch Continuity Check. **Does the ignition switch test OK?**	**Yes** Refer to the Engine Operation and Maintenance Manual. **No** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation.

Pinpoint Test E: The Ignition Key is Hard to Turn

Normal Operation

The ignition lock cylinder is the mechanical link to the ignition switch.

Possible Causes

- Ignition switch
- Ignition key

- Ignition lock cylinder

Table 28 PINPOINT TEST E: THE IGNITION KEY IS HARD TO TURN

Test Step	Result / Action to Take
E1 CHECK THE STEERING WHEEL POSITION **NOTE:** The ignition lock cylinder should return from the START position back to the ON position without assistance. • Check to see if the steering wheel is turned and locked full left or full right. • **Is the steering wheel locked full left or full right?**	**Yes** APPLY turning effort to the steering wheel in the direction of lock while turning the key to the ON position. TEST the system for normal operation. **No** Go to E2.
E2 CHECK THE IGNITION LOCK CYLINDER KEY • Check the ignition lock cylinder key for burrs, damaged key or incorrect key cut. • **Is the key OK?**	**Yes** Go to E3. **No** INSTALL a new ignition key. TEST the system for normal operation.
E3 CHECK THE IGNITION LOCK CYLINDER • Remove the ignition lock cylinder. Refer to Handles, Locks, Latches, and Entry Systems in S16030. • Check the ignition lock cylinder by rotating the ignition lock cylinder through all of the switch positions. • **Does the ignition lock cylinder stick or bind in any of the positions?**	**Yes** INSTALL a new ignition lock cylinder. REFER to Handles, Locks, Latches, and Entry Systems in S16030. **No** Go to E4.
E4 CHECK THE IGNITION LOCK CYLINDER HOUSING • Check for binding or sticking ignition switch actuating rod, burrs around the rack and pinion actuator in the ignition lock cylinder housing, or insufficient lube. • **Is the ignition switch actuating rod, rack and pinion actuator and lubrication OK?**	**Yes** INSTALL a new ignition switch. REFER to Ignition Switch in this section. TEST the system for normal operation. **No** REPAIR or LUBRICATE as necessary. TEST the system for normal operation.

Component Test

Ignition Switch Continuity Check

Refer to Wiring Diagrams for component testing.

Multifunction Switch

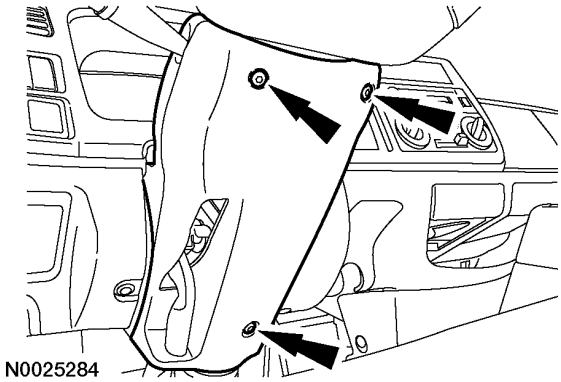
Refer to Wiring Diagrams for component testing.

Removal and Installation

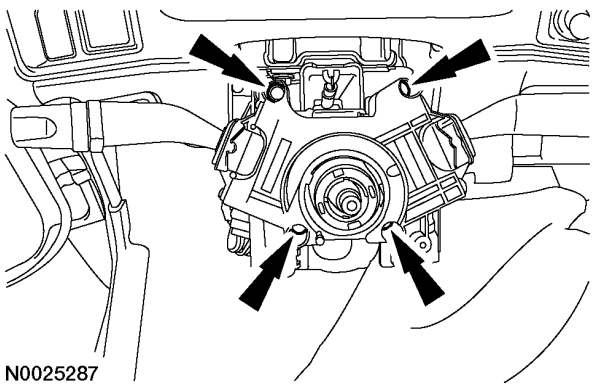
Steering Column Multifunction Switch

1. Disconnect the battery ground cable. For additional information, refer to Battery, Mounting and Cables in S08307.

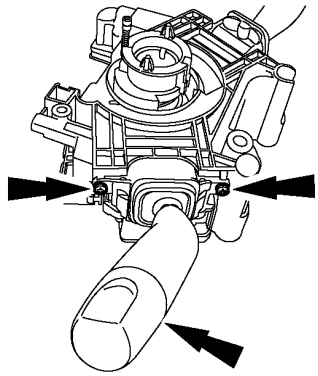
2. Remove the steering wheel. For additional information, refer to Steering Column.
3. Remove the 3 steering column cover screws, then remove the 2 steering column covers.


N0025284

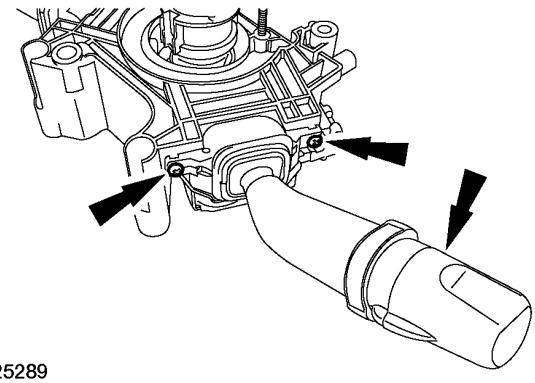
4. Disconnect the turn signal/headlamp switch and the windshield wiper switch electrical connectors.
5. Remove the 4 screws, then remove the multifunction switch assembly.


N0025287

6. Remove the 2 screws, then remove the windshield wiper switch.


N0025288

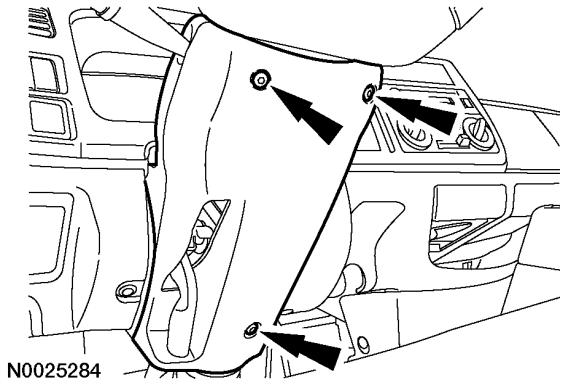
7. Remove the 2 screws, then remove the turn signal/headlamp switch.


N0025289

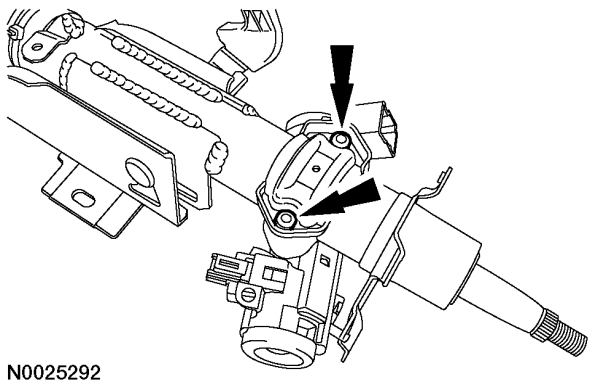
8. To install, reverse the removal procedure.

Ignition Switch Removal

1. Disconnect the battery ground cable. For additional information, refer to Battery, Mounting and Cables in S08307.
2. Remove the 3 steering column cover screws, then remove the 2 steering column covers.


N0025284

3. Disconnect the ignition switch and the key-in-ignition switch electrical connectors.
4. Using a hammer and a chisel, make a groove in the heads of the ignition switch assembly mounting bolts.


N0025292

5. Remove the 2 bolts and the ignition switch assembly.

Ignition Switch Installation

1. Position the ignition switch assembly onto the steering column by aligning the key cylinder with the groove in the steering shaft. Verify ignition switch operation by inserting the key into the ignition switch. Do not turn the ignition key.

NOTE: The mounting bracket bolts are designed so that when the correct torque specification is achieved, the bolt heads will break off. Use hand tools when tightening the bolts, the use of a torque wrench is not necessary.

2. Position the mounting bracket and install 2 new mounting bolts.
   - Tighten the bolts until the bolt heads break off.
3. Connect the ignition switch and the key-in-ignition switch electrical connectors.
4. Position the 2 steering column covers, then install the 3 steering column cover screws.
5. Connect the battery ground cable. For additional information, refer to Battery, Mounting and Cables in S08307.