

SECTION 3A

FRONT WHEEL ALIGNMENT

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which components are being removed. This will reduce the possibility of the vehicle slipping from the hoist.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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3A-2 FRONT WHEEL ALIGNMENT

GENERAL DESCRIPTION

Front wheel alignment refers to the angular relationship between the front wheels, the front suspension attaching parts, and the ground.

Proper front wheel alignment must be maintained in order to ensure efficient steering, good directional stability, and prevent abnormal tire wear.

The most important factors of front wheel alignment are wheel toe-in, wheel camber, and axle caster (Figure 1).

DEFINITION OF TERMS

Caster (Figure 1)

Caster is the tilting of the steering axis either forward or backward from vertical when viewed from the side of the vehicle. A backward tilt is measured in positive degrees and a forward tilt in negative degrees.

On the short and long arm type suspension, you cannot see a caster angle without a special instrument. However, if you look straight down from the top of the upper control arm to the ground, the ball joints do not line up (fore and aft) when a caster angle other than 0 degrees is present. With a positive angle, the lower ball joint center line would be slightly ahead (toward the front of the vehicle) of the upper ball joint center line. Caster is designed into the front axle assembly on all vehicles, and is intended to be non-adjustable. However, if the caster is measured and found to be out of tolerance, the caster can be set to proper specifications.

Camber (Figure 1)

Camber is the inward or outward tilting of the front wheels from vertical. When the wheels tilt outward at

the top, the camber is positive. When the wheels tilt inward at the top, the camber is negative. The amount of tilt measured in degrees from vertical is called the camber angle. Camber is designed into the front axle assembly of all vehicles and is intended to be non-adjustable. However, if the camber is measured and found to be out of tolerance, the camber can be set to proper specifications.

If camber is extreme or unequal between the wheels, improper steering and excessive tire wear will result. Negative camber causes wear on the inboard side of the tire, while positive camber causes wear to the outboard side.

Toe-In

Linear sum toe-in results when the distance between the front wheels is less at the front of the axle than at the rear of the axle.

Angular toe-in is the angle of the front wheel centerlines, relative to the intersection of the forward projected vehicle center line.

The actual amount of toe-in is normally a fraction of a degree. Toe-in is measured from the center of the tire treads or from the inboard side of the tires. The purpose of toe-in is to ensure parallel rolling of the front wheels and to offset any small deflections of the wheel support system which occur when the vehicle is rolling forward. Incorrect toe-in can cause unstable steering and front tire wear. Toe-in is the last angle to be set in the front wheel alignment procedure.

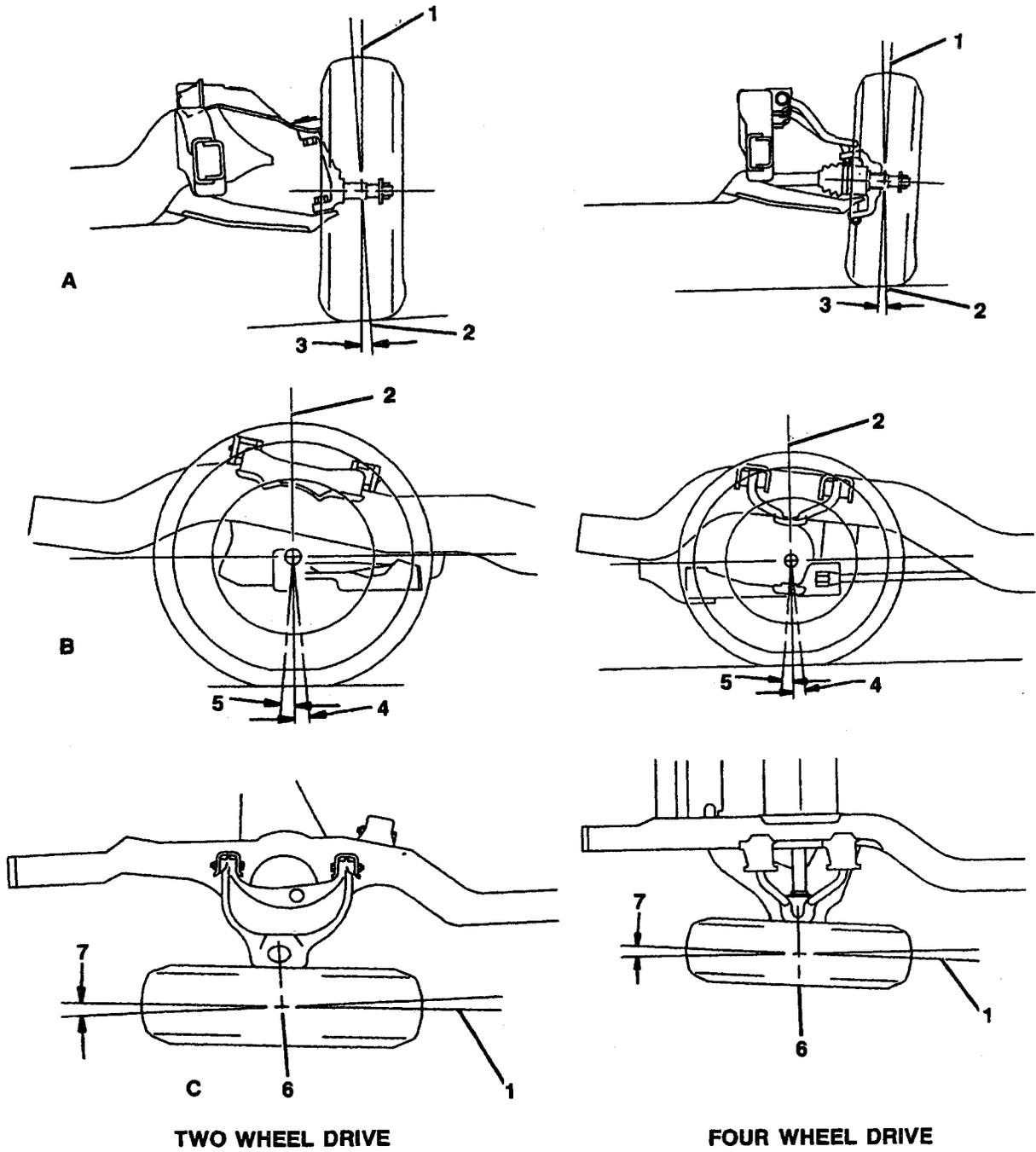
PRELIMINARY INSPECTIONS

Before making any adjustments affecting caster, camber, or toe-in, inspect front end as follows:



Inspect (Figure 2)

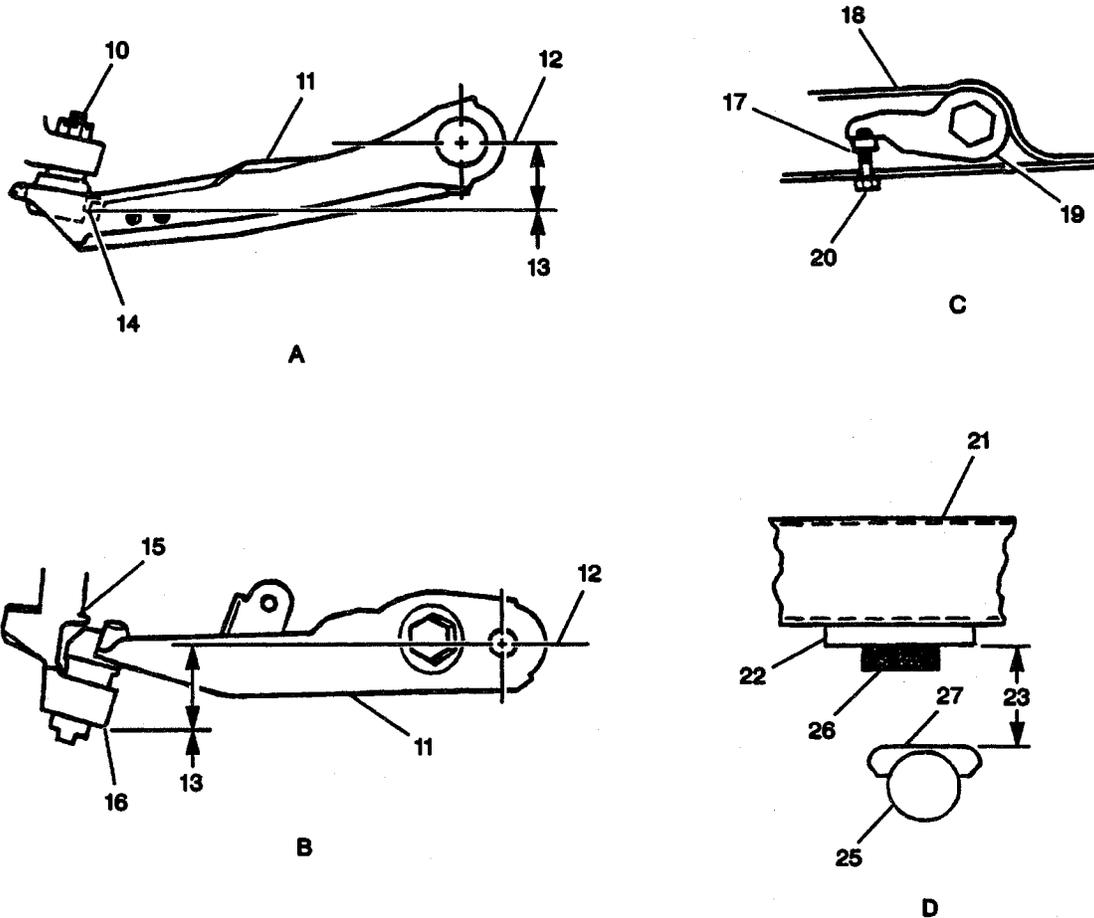
- Tires for proper inflation pressure. Refer to SECTION 3E.
- Front wheel bearing for proper adjustment. Refer to SECTION 3C.
- Ball joints, tie rod ends, and relay rods. If excessive looseness is noted, correct before adjusting. Refer to SECTION 3B3.
- Wheels and tires for runout. Refer to SECTION 3E.
- Dimension "Z" in (Figure 2). If not within specifications, the correction must be made before adjusting caster.
- Steering gear for looseness at the frame.
- Shock absorbers for leaks or any noticeable noise. Refer to SECTION 3C.
- Control arms or stabilizer shaft attachments for looseness. Refer to SECTION 3C.
- Alignment equipment. Follow the manufacturer's instructions.
- Level of the vehicle. The vehicle must be on a level surface fore and aft and side to side.
- Excess drag or poor return of steering wheel due to stiff or rusty suspension or linkage components.



- | | |
|---|--|
| <p>A. CAMBER
 B. CASTER
 C. TOE-IN
 1. CENTER LINE OF WHEEL
 2. VERTICAL REFERENCE LINE</p> | <p>3. CAMBER (POSITIVE)
 4. CASTER (NEGATIVE)
 5. CASTER (POSITIVE)
 6. AXIAL CENTER LINE OF WHEEL
 7. TOE-IN (POSITIVE)</p> |
|---|--|

Figure 1—Caster, Camber, and Toe-In Angles

3A-4 FRONT WHEEL ALIGNMENT



- | | |
|-----------------------------------|--|
| A. "C" MODEL | 15. STEERING KNUCKLE |
| B. "K" MODEL | 16. STEERING KNUCKLE LOWER CORNER |
| C. "K" MODEL TORSION BAR ADJUSTER | 17. NUT |
| D. "CK" MODEL REAR SUSPENSION | 18. TORSION BAR SUPPORT ASM. |
| 10. LOWER BALL JOINT | 19. TORSION BAR ADJUSTMENT ARM |
| 11. LOWER CONTROL ARM | 20. BOLT - ONE TURN EQUALS 6mm HEIGHT CHANGE |
| 12. PIVOT BOLT CENTER LINE | 21. FRAME |
| 13. "Z" HEIGHT | 22. BOTTOM SURFACE OF JOUNCE BRACKET |
| C 1,2,3 95.0 ± 6.0 mm | 23. "D" HEIGHT |
| K 1,2 (EXCEPT K10906 + L65 AND | 25. REAR AXLE |
| K20906 + C6P) 157.0 ± 6.00 mm | 26. JOUNCE BUMPER |
| K 10906 + L65 AND 20906 + C6P + 3 | 27. AXLE JOUNCE PAD |
| K 145.0 ± 6.0 mm | |
| K 3 145.0 ± 6.0 mm | |
| 14. LOWER BALL JOINT EXTRUSION | |

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Figure 2—Trim Heights

DIAGNOSIS OF FRONT WHEEL ALIGNMENT

PROBLEM	POSSIBLE CAUSE	CORRECTION
Noisy Front Suspension	<ol style="list-style-type: none"> 1. Worn tie rod ends. 2. Loose suspension bolts. 3. Lack of proper lubrication. 4. Loose shock absorbers or worn bushings. 5. Loose stabilizer shaft or worn insulators. 	<ol style="list-style-type: none"> 1. Replace the tie rod ends. 2. Refer to SECTION 3C. 3. Refer to SECTION 0B. 4. Tighten bolts and/or replace the bushings. 5. Tighten bolts and/or replace the insulators.
Wheel Bounce	<ol style="list-style-type: none"> 1. Wheel and tire out of balance. 2. Blister or bump on tire. 3. Improper shock absorber action. 4. Excessive wheel or tire runout. 5. Tire "Lead." 	<ol style="list-style-type: none"> 1. Refer to SECTION 3E. 2. Replace the tire. 3. Replace the shock absorber. 4. Refer to SECTION 3E. 5. Refer to SECTION 3E.
Low or Uneven Trlm Height	<ol style="list-style-type: none"> 1. Broken or sagging springs. 2. Overloaded or improperly loaded vehicle. 	<ol style="list-style-type: none"> 1. Replace the springs. Refer to SECTION 3C. 2. Avoid overloading the vehicle.
Excessive Tire Wear	<ol style="list-style-type: none"> 1. Failure to rotate the tires. 2. Damaged shock absorbers. 3. Improper tire pressure. 4. Incorrect wheel alignment. 5. Overloaded or improperly loaded vehicle. 6. Broken or sagging springs. 7. Loose or worn stabilizer bushings. 	<ol style="list-style-type: none"> 1. Refer to SECTION 3E. 2. Replace the shock absorber. 3. Refer to SECTION 3E. 4. Align the wheels. 5. Avoid overloading the vehicle. 6. Replace the springs. Refer to SECTION 3C. 7. Tighten the stabilizer bushing brackets or replace the stabilizer bushings.
Vehicle Leads To One Side Or The Other	<ol style="list-style-type: none"> 1. Keep in mind the road and wind conditions. 2. Front end misaligned. 3. Unbalanced steering gear valve. If this is the cause, steering effort will be very light in direction of lead and heavy in the opposite direction. 4. Steering shaft rubbing the inside diameter of the shaft tube. 	<ol style="list-style-type: none"> 1. Test the vehicle, going in both directions, on a flat road. 2. Adjust to specifications. 3. Replace the gear valve. 4. Align or replace the steering column.

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ON-VEHICLE SERVICE

MEASURING FRONT WHEEL ALIGNMENT

Satisfactory vehicle operation may occur over a wide range of front wheel alignment settings. If the settings vary beyond tolerances, adjustments are needed. Refer to "Specifications" in Figures 5 and 6.

As originally installed, the upper control arm cannot be adjusted for camber or caster. However, if the camber or caster is out of tolerance, the alignment can be reset to specifications by removing knockouts in the upper control arm frame brackets. Refer to SECTION 3C for upper control arm removal procedure.

Upon removal of control arm, remove the inserts outboard from the inside of the bracket with J 38794 knockout removal tool. Refer to "Frame Bracket Knockout Removal" in this section.



Important

- Set the front wheel alignment to specifications while the vehicle is in its normally loaded condition. Vehicles which are consistently operated with heavy loads should have toe-in adjusted with the vehicle under heavy load. This procedure should result in longer tire life.

3A-6 FRONT WHEEL ALIGNMENT



Measure

“Z” Height (Figure 2)

1. Lift the front bumper of the vehicle up about 38 mm (1.5 inches).
2. Gently remove your hands and let the vehicle settle on its own.
3. Repeat this operation twice more for a total of three times.
4. Measure the “Z” dimension.
5. Push the front bumper of the vehicle down about 38 mm (1.5 inches).
6. Gently remove your hands and let the vehicle rise on its own.
7. Repeat the operation twice more for a total of three times.
8. Measure the “Z” dimension.
9. Find the average of the high and low measurements. This is the true “Z” dimension.

“D” Height (Figure 2)

1. Lift the rear bumper of the vehicle up about 38 mm (1.5 inches).
2. Gently remove your hands and let the vehicle settle on its own.
3. Repeat this operation twice more for a total of three times.
4. Measure the “D” dimension.
5. Push the rear bumper of the vehicle down about 38 mm (1.5 inches).
6. Gently remove your hands and let the vehicle rise on its own.
7. Repeat the operation twice more for a total of three times.
8. Measure the “D” dimension.
9. Find the average of the high and low measurements. This is the true “D” dimension.



Measure

- Front alignment angles.
- Install alignment equipment according to the manufacturer’s instructions.
- Measure alignment angles and record the readings. If adjustments are required, make them in the following order: caster, camber, and toe-in.

Caster Adjustment



Important

- All caster specifications are given with the vehicle frame level (zero angle).
- To make caster or camber adjustments the frame bracket knockouts must be removed. Refer to “Frame Bracket Knockout Removal” in this section.

1. Position the vehicle on a smooth level surface.
2. If needed, correct the “Z” dimension to the correct specification.
3. Measure the frame angle, using a bubble protractor or inclinometer. The frame angle is the tilt (in degrees) of the frame from the level position.
4. Note the frame angle as being “up in the rear” or “down in the rear.”
5. Determine the caster angle from the alignment equipment.
6. Refer to Figure 5 or 6 to determine the actual (corrected) caster reading. The following rules must be used for correcting the caster.
 - A. A “down in rear” frame angle must be subtracted from a positive caster reading.
 - B. An “up in rear” frame angle must be added to a positive caster reading.
 - C. A “down in rear” frame angle must be added to a negative caster reading.
 - D. An “up in rear” frame angle must be subtracted from a negative caster reading.
7. If the caster angle is wrong, remove the frame bracket knockouts. Refer to “Frame Bracket Knockout Removal” in this section.
8. Reset the caster angle by turning the cam bolts. Refer to “Specifications” in Figure 5 or 6.

Camber Adjustment



Important

- To make caster or camber adjustments remove the frame bracket knockouts. Refer to “Frame Bracket Knockout Removal” in this section.
1. Determine the camber from the alignment equipment.
 2. If camber angle is wrong, remove the frame bracket knockouts. Refer to “Frame Bracket Knockout Removal” in this section.
 3. Reset the camber angle by turning the cam bolts. Refer to “Specifications” in Figure 5 or 6.

Toe-In Adjustment

1. Determine the toe-in from the alignment equipment.
2. Change the length of both tie rod sleeves to affect a toe-in change. Toe-in can be increased or decreased by changing the length of the tie rod ends. A threaded sleeve is provided for this purpose. When the tie rod ends are mounted ahead of the steering knuckle they must be decreased in length in order to increase toe-in. When the tie rod ends are mounted behind the steering knuckle they must be lengthened in order to increase toe-in. Refer to “Tie Rod Clamp and Adjuster Tube Positioning” in SECTION 3B3.

FRAME BRACKET KNOCKOUT REMOVAL

As originally installed, the upper control arm cannot be adjusted for caster or camber. However, if the caster or camber is measured and found to be out of tolerance, the caster and camber can be set to the proper specifications.

Two Wheel Drive

Tool Required:
J 38794 Knockout Removal Tool

Remove or Disconnect (Figure 3)

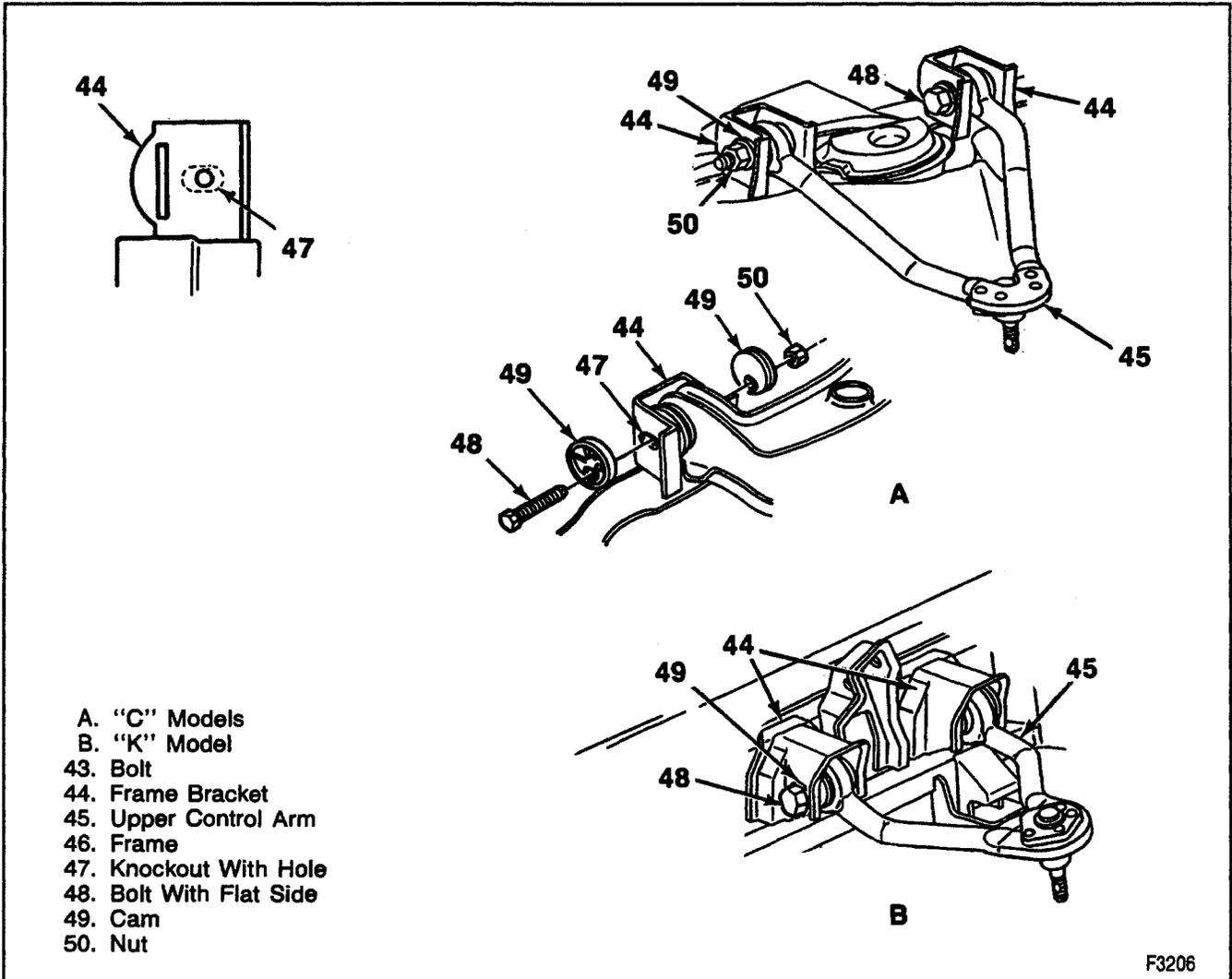
- Raise and support the vehicle.
- Support the lower control arms with jack or jack stands.

! Important

- The jack or stand must remain under the lower control arm during the removal and installation procedure in order to retain the lower control arm position.

1. Tire and wheel assembly.
2. Nuts (50), cams (49), and bolts (48) from the upper control arm bracket (44).
3. Lift upper control arm (45) up and to the side to gain access to the inner portion of the frame bracket.
4. Frame bracket knockout using tool J 38794 (Figure 4).

- Do not distort frame bracket when removing knockout.
- Apply extreme pressure lubricant to the threads of the T-bolt and insert the bolt through the knockout hole in the bracket support.
- Install bridge onto T-bolt (Figure 4). The forward bracket requires the bridge to be installed between the legs of the bracket due to access problems.
- Assemble the bridge, bearing (chamfered side out), washer, and nut in order.
- The T-bolt head and bridge must line up horizontally with the knockout; the bridge should span the knockout without interfering with the knockout procedure.



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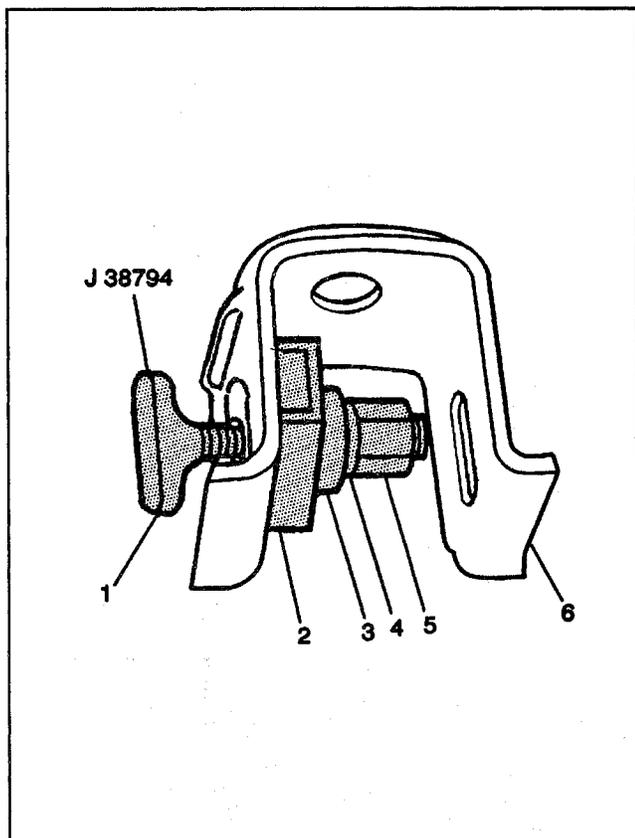
Figure 3—Knockout Removal Two and Four Wheel Drive

3A-8 FRONT WHEEL ALIGNMENT

- Tighten the T-bolt head against the knockout by turning the nut at the opposite end using a socket and torque wrench.
- An open end or adjustable wrench may be needed to prevent the T-bolt from losing horizontal alignment with the knockout.

NOTICE: Do not subject the tool to more than 100 N·m (75 lb ft) torque. Exceeding the recommended torque may damage the tool and/or the bracket.

- If the torque limit on the T-bolt is met and the knockout does not break free, use a die grinder of appropriate size. Using the stamped outline as a guide, remove the knockout. (Remove the wax coating in the knockout area to make the perforation lines more visible).
- If the outline is not visible, use the T-bolt head installed horizontally, as a template, and scribe the frame bracket.
- Repeat the procedure on the other upper control arm frame bracket.



Legend

- (1) T-Bolt
- (2) Bridge
- (3) Bearing
- (4) Washer
- (5) Nut
- (6) Frame Bracket

Figure 4 - Knockout Tool Installed Inside Bracket

Install or Connect (Figure 3)

NOTICE: Refer to "Notice" on page 3A-1.

1. Upper control arm (45) into frame brackets (44).
2. Bolts (48) and cams (49) through frame brackets (44), and control arm (45).
3. Cams (49) and nuts (50).
 - Install cams with radius toward frame brackets.
4. Partially tighten nut (50).
5. Front wheel assemblies.
6. Alignment machine heads.

Important

- Check "Front Wheel Alignment Specifications" in Figure 5 and 6 for special requirements and alignment adjustments. Check trim height "Z" and "D." Verify alignment specifications before proceeding.

Adjust

- Caster and camber to the correct specifications by rotating the bolt head installed through adjuster cam.

Tighten

- A. Front upper control arm nuts (50) to 190 N·m (140 lb ft).
 - B. Rear upper control arm nuts (50) to 190 N·m (140 lb ft).
- Set steering wheel on center, with wheels straight, and loosen adjuster sleeve nuts.

Adjust

- Toe-in. Refer to "Specifications" in Figures 5 and 6.

Tighten

- Tie rod adjuster sleeve nuts to 19 N·m (14 lb ft).
- Refer to SECTION 3B3 for proper position of clamps.
- Recheck alignment specifications.
- Lower the vehicle.

Four Wheel Drive

Tool Required:

J 38794 Knockout Removal Tool

Remove or Disconnect (Figure 3)

- Raise and support the vehicle.
 - Support the lower control arms with jack or jack stands.
1. Tire and wheel assembly.

Important

- The jack or stand must remain under the lower control arm torsion bar seat during the removal and installation procedure in order to retain the lower control arm position.
2. Nuts (50), cams (49), and bolts (48) from the upper control arm bracket (44).

FRONT WHEEL ALIGNMENT 3A-9

3. Lift upper control arm (45) up and to the side to gain access to the inner portion of the frame bracket.
4. Frame bracket knockout using tool J 38794 (Figure 4).

- Do not distort the frame bracket when removing the knockout.
- Apply extreme pressure lubricant to the threads of the T-bolt and insert the bolt through the knockout hole in the bracket support.
- Install bridge onto the T-bolt (Figure 4). The forward bracket requires the bridge to be installed between the legs of the bracket due to access problems.
- Assemble the bridge, bearing (chamfered side out), washer, and nut in order.
- The T-bolt head and bridge must line up horizontally with the knockout; the bridge should span the knockout without interfering with the knockout procedure.

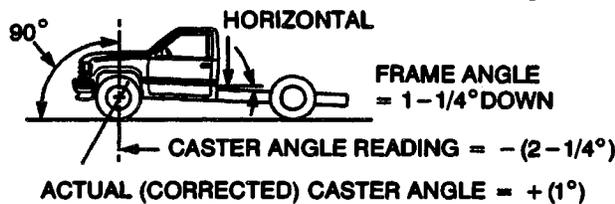
- Tighten the T-bolt head against the knockout by turning the nut at the opposite end using a socket and torque wrench.
- An open end or adjustable wrench may be needed to prevent the T-bolt from losing horizontal alignment with the knockout.

NOTICE: Do not subject the tool to more than 100 N.m (75 lb ft) torque. Exceeding the recommended torque may damage the tool and/or the bracket.

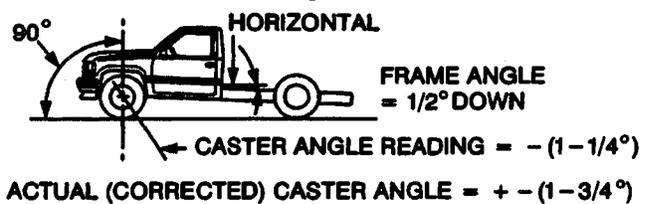
- If the torque limit on the T-bolt is met and the knockout does not break free, use a die grinder of appropriate size. Using the stamped outline as a guide, remove the knockout. (Remove the wax coating in the knockout area to make the perforation lines more visible).
- If the outline is not visible, use the T-bolt head installed horizontally, as a template, and scribe the frame bracket.
- Repeat the procedure on the other upper control arm frame bracket.

C - MODEL ALIGNMENT SPECIFICATIONS

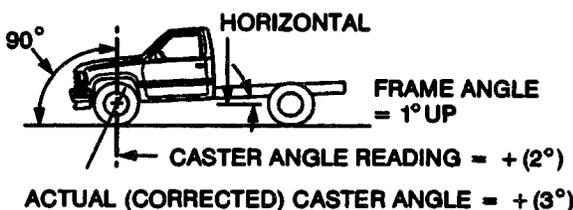
D. A "DOWN IN REAR" frame angle must be SUBTRACTED from a POSITIVE caster reading.



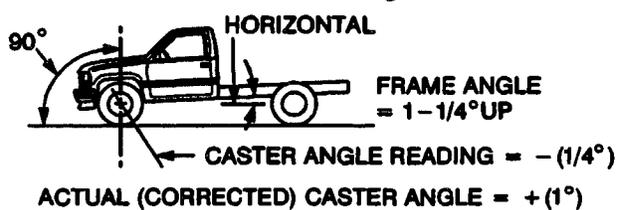
F. A "DOWN IN REAR" frame angle must be ADDED to a NEGATIVE caster reading.



E. An "UP IN REAR" frame angle must be ADDED to a POSITIVE caster reading.



G. An "UP IN REAR" frame angle must be SUBTRACTED from a NEGATIVE caster reading.



NOTE: VEHICLE MUST BE JOUNCED 3 TIMES BEFORE CHECKING ALIGNMENT TO ELIMINATE FALSE GEOMETRY READINGS.

	SERVICE SETTING
	C 100 200 300
CASTER (DEGREES)	3.75° ± 1.0° (B)
CAMBER (DEGREES)	.5° ± .5° (B)
(SUM TOE IN DEGREES)	.24° ± .2° (D)

IMPORTANT: CASTER ANGLE MUST BE CORRECTED TO LEVEL FRAME ANGLE.

	SERVICE SETTING
	I-BEAM FRONT SUSPENSION
CASTER (DEG)	+5 (E)
CAMBER (DEG)	+1.25 ± .5 (E)
SUM TOE-IN (IN)	.06 IN ± .06 IN
SUM TOE-IN (DEG)	.12° ± .12°
(E) Nominal: Reference only, no means of adjustment provided.	

- A. FRONT SUSPENSION (Z) DIMENSION IS HELD AS INDICATED IN "TRIM HEIGHTS" CHART.
- B. LEFT AND RIGHT SIDE TO BE EQUAL WITHIN .50°.
- C. LEFT AND RIGHT SIDE TO BE EQUAL WITHIN 1.0°.
- D. TOE - IN LEFT AND RIGHT SIDE TO BE EQUALLY PER WHEEL AND STEERING WHEEL MUST BE HELD IN STRAIGHT AHEAD POSITION WITHIN ± 5.0°.

Figure 5—Two Wheel Drive Alignment Specifications

3A-10 FRONT WHEEL ALIGNMENT

Install or Connect (Figure 3)

NOTICE: Refer to "Notice" on page 3A-1.

1. Upper control arm (45) into frame brackets (44).
2. Bolts (48) and cams (49) through frame brackets (44), and control arm (45).
3. Cams (49) and nuts (50).
 - Install cams with radius toward frame brackets.
4. Partially tighten nut (50).
5. Tire and wheel assembly.
6. Alignment machine heads.

Important

- Check "Front Wheel Alignment Specifications" in Figure 5 and 6 for special requirements and alignment adjustments. Check trim height "Z" and "D." Verify alignment specifications before proceeding.

Adjust

- Caster and camber to the correct specifications by rotating the bolt head installed through adjuster cam.

Tighten

- A. Front upper control arm nuts (50) to 190 N.m (140 lb ft).
 - B. Rear upper control arm nuts (50) to 190 N.m (140 lb ft).
- Set steering wheel on center, with wheels straight, and loosen adjuster sleeve nuts.

Adjust

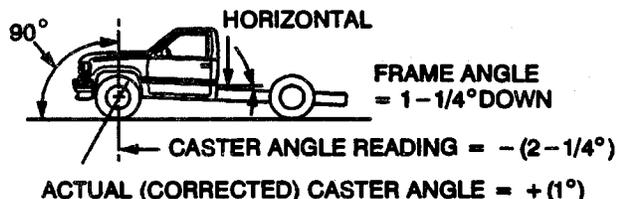
- Toe-in. Refer to "Specifications" in Figure 5 and 6.

Tighten

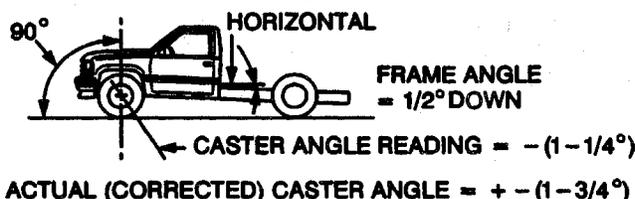
- Tie rod adjuster sleeve nuts to 19 N.m (14 lb ft).
- Refer to SECTION 3B3 for proper position of clamps.
- Recheck alignment specifications.
- Lower the vehicle.

K - MODEL ALIGNMENT SPECIFICATIONS

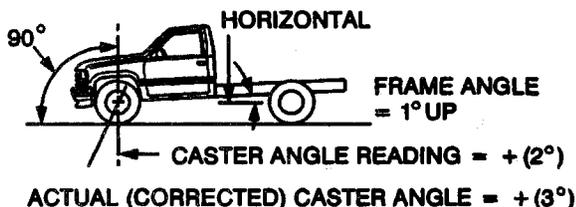
D. A "DOWN IN REAR" frame angle must be SUBTRACTED from a POSITIVE caster reading.



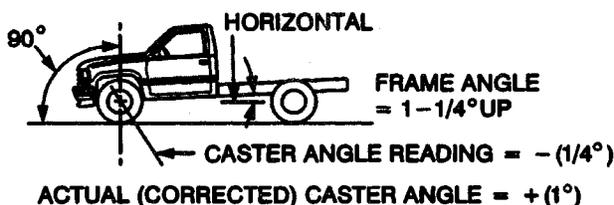
F. A "DOWN IN REAR" frame angle must be ADDED to a NEGATIVE caster reading.



E. An "UP IN REAR" frame angle must be ADDED to a POSITIVE caster reading.



G. An "UP IN REAR" frame angle must be SUBTRACTED from a NEGATIVE caster reading.



NOTE: VEHICLE MUST BE JOUNCED 3 TIMES BEFORE CHECKING ALIGNMENT TO ELIMINATE FALSE GEOMETRY READINGS.

IMPORTANT: CASTER ANGLE MUST BE CORRECTED TO LEVEL FRAME ANGLE.

- A. FRONT SUSPENSION (Z) DIMENSION IS HELD AS INDICATED IN "TRIM HEIGHTS" CHART.
- B. LEFT AND RIGHT SIDE TO BE EQUAL WITHIN .50°.
- C. LEFT AND RIGHT SIDE TO BE EQUAL WITHIN 1.0°.
- D. TOE - IN LEFT AND RIGHT SIDE TO BE EQUALLY PER WHEEL AND STEERING WHEEL MUST BE HELD IN STRAIGHT AHEAD POSITION WITHIN ± 5.0°.

	SERVICE SETTING	
	K100 K200 7200 LBS. GVW	K200 K300 8800 LBS. GVW
CASTER (DEGREES)	3.0° ± 1.0° (B)	3.0° ± 1.0° (B)
CAMBER DEGREES	.65° ± .5° (B)	.65° ± .5° (B)
(SUM TOE DEGREES)	.24° ± .2 (D)	.24° ± .2 (D)

Figure 6—Four Wheel Drive Alignment Specifications

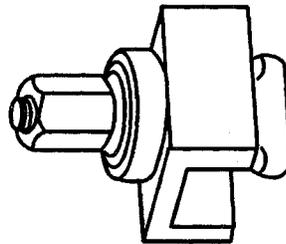
SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N.m	Lb ft	Lb in
Upper Control Arm Nuts	190	140	—
Tie Rod Adjuster Sleeve Nuts	19	14	—

SPECIAL TOOLS

1.



J 38794

1. KNOCKOUT REMOVAL TOOL

SECTION 3B

POWER STEERING GEAR AND PUMP

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which components are being removed. This will reduce the possibility of the vehicle slipping from the hoist.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

The hydraulic power steering system consists of a pump, fluid reservoir, steering gear, pressure hose, and a return hose.

POWER STEERING GEAR

The power steering gear has a recirculating ball system which acts as a rolling thread between the worm

shaft and the rack piston. The worm shaft is supported by a preloaded thrust bearing and two conical thrust races at the lower end, and a bearing assembly in the adjuster plug at the upper end. When the worm shaft is turned right, the rack piston moves up in the gear. Turning the worm shaft left moves the rack piston down in the gear. The rack piston teeth mesh with the sector, which is part of the pitman shaft. Turning the worm

3B-2 POWER STEERING GEAR AND PUMP

shaft turns the pitman shaft, which 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 loses hydraulic pressure, the vehicle can be controlled manually.

HYDRAULIC PUMP

The power steering pump is a vane-type design. The submerged pump (Figure 1) has a housing and internal parts that are inside the reservoir and operate submerged in oil.

There are two bore openings at the rear of the pump housing. The larger opening contains the cam ring, pressure plate, thrust plate, rotor and vane assembly, and end plate. The smaller opening contains the pressure hose union, flow control valve, and spring. The flow control orifice is part of the pressure hose union. The pressure relief valve inside the flow control valve limits the pump pressure.

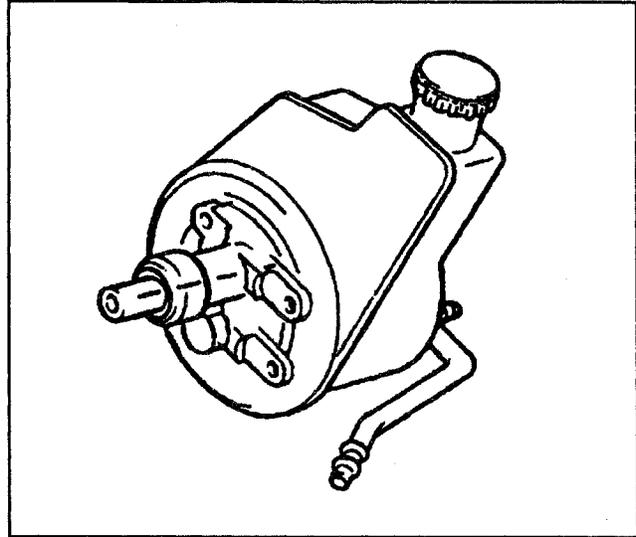


Figure 1—Power Steering Pump

DIAGNOSIS OF POWER STEERING SYSTEM

PROBLEM	POSSIBLE CAUSE	CORRECTION
Objectionable "Hiss"	1. Noisy relief valve in the hydraulic pump.	1. There is some normal noise in all the power steering systems. One of the most common is a "Hissing" sound most evident at an idle. "Hiss" is a high frequency noise. The noise is present in every valve and results from high velocity fluid passing through valve orifice edges. There is no relationship between this noise and the performance of the steering. "Hiss" may be expected when the steering wheel is at the end of travel or when slowly turning at a stand still. Do not replace the valve unless a "hiss" is extremely objectionable. A replacement valve will also exhibit slight noise and is not always a cure for the objection.
Rattle Or Chuckle Noise In The Steering Gear	1. Steering gear loose on the frame. 2. Steering linkage looseness. 3. Pressure hose touching other parts of the vehicle. 4. Loose pitman arm. 5. Improper over-center adjustment. A slight rattle may occur on turns because of the increased clearance off the "high point." This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle.	1. Check the gear mounting bolts. Tighten the bolts to specifications. 2. Check the steering linkage pivot points for wear. Replace if necessary. 3. Adjust the hose position. Do not bend the tubing by hand. 4. Tighten the pitman arm bolt. 5. Adjust to specifications. Refer to SECTION 3B1A.

DIAGNOSIS OF POWER STEERING SYSTEM (cont'd)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Excessive Wheel Kickback Or Loose Steering	<ol style="list-style-type: none"> 1. Air in the system. 2. Steering gear loose on the frame. 3. Steering linkage looseness. 4. Front wheel bearings incorrectly adjusted or worn. 5. Steering gear improperly adjusted. 6. Damaged or worn steering gear. 	<ol style="list-style-type: none"> 1. Add oil to the pump reservoir and bleed. Verify hose connectors for proper tightness. 2. Tighten attaching bolts to specifications. 3. Replace loose parts. Refer to SECTION 3B3. 4. Adjust the bearings or replace with new parts as necessary. Refer to SECTION 3C. 5. Adjust to specifications. Refer to SECTION 3B1A. 6. Disassemble and repair the steering gear as outlined in SECTION 3B1A.
Vehicle Leads To The One Side Or The Other	<ol style="list-style-type: none"> 1. Keep in mind the road and wind conditions. 2. Front wheels misaligned. 3. Unbalanced steering gear valve. If this is the cause, steering effort will be very light in direction of lead and heavy in opposite direction. 4. Steering shaft rubbing the ID of the shaft tube. 5. Worn or bad tires. 6. Low tire pressure. 	<ol style="list-style-type: none"> 1. Test the vehicle, going in both directions, on a flat road. 2. Adjust to specifications. Refer to SECTION 3A. 3. Replace the gear valve. 4. Align the column. 5. Replace tires. Refer to SECTION 3A. 6. Adjust tire pressure. Refer to SECTION 3E.
Momentary Increase In Effort When Turning The Wheel Quickly To The Right Or Left	<ol style="list-style-type: none"> 1. Low oil level in the pump. 2. Pump belt slipping. 3. High internal leakage (steering gear or pump). 4. Fluid flow actuator sticking closed. 	<ol style="list-style-type: none"> 1. Add power steering fluid as required. 2. Refer to SECTION 6B. 3. Refer to "Power Steering System Test" in this section. 4. Refer to "Diagnostic System Checks" in SECTION 3B5.

3B-4 POWER STEERING GEAR AND PUMP

DIAGNOSIS OF POWER STEERING SYSTEM (cont'd)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Poor Return Of The Steering	<ol style="list-style-type: none">1. Tires under-inflated.2. Lower coupling flange rubbing against the steering gear adjuster plug.3. Steering wheel rubbing against the directional signal housing.4. Tight or frozen steering shaft bearings.5. Binding of steering linkage, steering shock absorber or ball joints.6. Steering gear to column misalignment.7. Tie rod pivots not centralized.8. Lack of lubricant in the suspension ball joints and the steering linkage.9. Stuck or plugged valve spool.10. Rubber spacer binding in the shift tube.11. Improper front wheel alignment.12. Steering gear adjusted too tightly.13. Kink the in return hose.14. Steering intermediate shaft stone shield side-loaded against shaft assembly.	<ol style="list-style-type: none">1. Inflate to specified pressure. Refer to SECTION 3E.2. Loosen the pinch bolt and assemble properly.3. Adjust the steering jacket. Refer to SECTION 3F4 or 3F5.4. Replace the bearings. Refer to SECTION 3F4 or 3F5.5. Replace the affected parts. Refer to SECTION 3B3 or 3C.6. Align the steering column.7. Adjust tie rod ends as required to center pivots. Refer to SECTION 3B3.8. Lubricate. Refer to SECTION 0B.9. Remove and clean or replace the valve. Refer to SECTION 3B1A.10. Make certain the spacer is properly seated. Lubricate inside the diameter with silicone lubricant.11. Check and adjust to specifications. Refer to SECTION 3A.12. Adjust the over-center and thrust bearing preload to specifications. Refer to SECTION 3B1A.13. Replace the hose.14. Eliminate side-load.
Steering Wheel Surges Or Jerks When Turning With Engine Running Especially During Parking	<ol style="list-style-type: none">1. Low oil level in the pump.2. Loose pump belt.3. Sticky flow control valve.4. Insufficient pump pressure.5. Faulty gear relief valve.	<ol style="list-style-type: none">1. Add power steering fluid as required. Check for leaks.2. Refer to SECTION 6B.3. Replace or clean the control valve. Refer to "Diagnosis System Check" in SECTION 3B5.4. Refer to "Power Steering System Test" in this section.5. Replace the gear relief valve. Refer to SECTION 3B1A.

DIAGNOSIS OF POWER STEERING SYSTEM (cont'd)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Hard Steering Effort In Both Directions	<ol style="list-style-type: none"> 1. Low tire pressure. 2. Lack of lubricant in the suspension or ball joints (worn/contaminated joints). 3. Binding of the steering linkage, steering shock absorber, or ball joints. 4. Steering gear to the column misalignment. 5. Pump belt slipping. 6. Low fluid level in reservoir. 7. High internal leakage (steering gear or pump). 8. Sticky flow control valve. 9. Lower coupling flange rubbing against the steering gear adjuster plug. 10. Steering gear adjusted too tight. 11. Improper front wheel alignment. 12. Fluid flow actuator stuck. 	<ol style="list-style-type: none"> 1. Adjust the tire pressure. Refer to SECTION 3E. 2. Lubricate and relubricate at proper intervals or replace joints. Refer to SECTION 0B. 3. Replace all the affected parts. Refer to SECTION 3B3 or 3C. 4. Align the steering column. 5. Refer to SECTION 6B. 6. Fill to proper level. Inspect lines and joints for external leakage. 7. Refer to "Power Steering System Test" in this section. 8. Replace or clean the valve. Refer to "Diagnosis System Check" in SECTION 3B5. 9. Loosen the pinch bolt and align the assembly properly. 10. Adjust the over-center and thrust bearing preload to specifications. Refer to SECTION 3B1A. 11. Check and adjust to specifications. Refer to SECTION 3A. 12. Refer to "Diagnostic System Check" in Section 3B5.
Easy Steering Effort In Both Directions Above 45 MPH	<ol style="list-style-type: none"> 1. Stuck open fluid flow actuator 	<ol style="list-style-type: none"> 1. Refer to "Diagnostic System Check" in SECTION 3B5.
Foaming Milky Looking Power Steering Fluid, Low Level And Possible Low Pressure	<ol style="list-style-type: none"> 1. Air in the fluid and loss of fluid due to internal pump leakage causing overflow. 2. Hose or air leakage in the reservoir line. 	<ol style="list-style-type: none"> 1-2. Check for leaks and correct. Bleed system. Extremely cold temperatures will cause system aeration (should the oil level be low). If oil level is correct and pump still foams, remove the pump from the vehicle and separate 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.
Low Oil Pressure Due To Restriction In The Hose	<ol style="list-style-type: none"> 1. Check for kinks in the hose. 2. Foreign object stuck in the hose. 	<ol style="list-style-type: none"> 1. Remove the kinks or replace the hose. 2. Remove the foreign object or replace the hose.
Low Oil Pressure Due To The Steering Gear. Refer To "Power Steering System Test" In This Section	<ol style="list-style-type: none"> 1. Pressure loss in the cylinder due to worn piston ring or scored housing bore. 2. Leakage at the valve rings and valve body to the worm seal. 3. Leakage at the valve body or a loose fitting spool. 	<ol style="list-style-type: none"> 1. Disassemble the steering gear as outlined in SECTION 3B1A. Inspect the ring and housing bore. Replace the affected parts. 2. Disassemble the steering gear and replace seals. Refer to SECTION 3B1A. 3. Replace the valve. Refer to SECTION 3B1A.

3B-6 POWER STEERING GEAR AND PUMP

DIAGNOSIS OF POWER STEERING SYSTEM (cont'd)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Low Oil Pressure Due To The Steering Pump. Refer To "Power Steering System Test" In This Section	<ol style="list-style-type: none"> 1. Flow control valve stuck or inoperative. 2. Pressure plate not flat against the cam ring. 3. Extreme wear of cam ring. 4. Scored pressure plate, thrust plate, or rotor. 5. Vanes sticking in the rotor slots. 6. Vanes not installed properly. 7. Air in the oil. 8. Low oil level. 9. Pump belt slipping. 10. Damaged hoses or steering gear. 	<ol style="list-style-type: none"> 1. Replace or clean the valve. Refer to "Diagnostic System Check" in SECTION 3B5. 2. Replace the pressure plate. Refer to SECTION 3B1B. 3. Replace and flush the system. 4. Replace parts. If rotor, replace with rotating group. Flush the system. Refer to SECTION 3B1B. 5. Free up by removing burrs, varnish, or dirt. 6. Install properly. Radius edge to the outside. Refer to SECTION 3B1B. 7. Locate source of the leak and correct. Bleed the system. 8. Add power steering fluid as required. 9. Refer to SECTION 6B. 10. Replace as necessary.
Chirp Noise In The Steering Pump	<ol style="list-style-type: none"> 1. Pump belt slipping. 	<ol style="list-style-type: none"> 1. Refer to SECTION 6B.
Belt Squeal (Particularly Noticeable At Full Wheel Travel And Stand Still Parking)	<ol style="list-style-type: none"> 1. Pump belt slipping. 	<ol style="list-style-type: none"> 1. Refer to SECTION 6B.
Growl Noise In The Steering Pump	<ol style="list-style-type: none"> 1. Excessive back pressure in the hoses or steering gear caused by restriction. 	<ol style="list-style-type: none"> 1. Locate the restriction and correct.
Growl Noise In The Steering Pump (Particularly Noticeable At Stand Still Parking)	<ol style="list-style-type: none"> 1. Scored pressure plates, thrust plate, or rotor. 2. Extreme wear of the cam ring. 	<ol style="list-style-type: none"> 1. Replace parts and the flush system. Refer to SECTION 3B1B. 2. Replace parts. Refer to SECTION 3B1B.
Groan Noise In The Steering Pump	<ol style="list-style-type: none"> 1. Low oil level. 2. Air in the the oil. Poor pressure hose connection. 	<ol style="list-style-type: none"> 1. Add power steering fluid as required. Check for leaks. 2. Tighten the connector. Bleed the system.
Rattle Or Knock Noise In The Steering Pump	<ol style="list-style-type: none"> 1. Loose pump pulley nut. 2. Pump vanes sticking in the rotor slots. 3. Pressure hose touching other parts of the vehicle. 	<ol style="list-style-type: none"> 1. Tighten the nut to specifications. 2. Free up by removing burrs, varnish, or dirt. 3. Adjust the hose position.
Swish Noise In The Steering Pump	<ol style="list-style-type: none"> 1. Faulty flow control valve. 	<ol style="list-style-type: none"> 1. Replace the part. Refer to "Diagnostic System Check" in SECTION 3B5.
Whine Noise In The Steering Pump	<ol style="list-style-type: none"> 1. Pump shaft bearing scored. 	<ol style="list-style-type: none"> 1. Replace the housing and shaft. Flush the system. Refer to SECTION 3B1B.

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LOCATING OIL LEAKS

1. With the ignition "OFF," wipe the complete power steering system dry (gear, pump, hoses, and connections).
2. Check the fluid level in the pump reservoir. Refer to "Fluid Level" in this section.
3. Start the engine and turn the steering wheel from stop to stop several times. Do not hold the wheel against the stops as this may damage the pump.
4. Locate the exact area of the leak (Figure 2).
 - A. Return Tube Fitting—Tighten hose clamp if loose. If the fitting is deformed, replace it. Apply LOCTITE™ 75559 solvent and Loctite 290 adhesive (or equivalent) to the tube-housing connection.
 - B. Pressure Line Fitting—Tighten the fitting to 33 N.m (24 lb ft). If leakage persists, replace the seal.
 - C. Ball Seat Leak—Seat the ball in the housing with a blunt punch. Following the manufacturer's directions, apply LOCTITE™ 75559 solvent and LOCTITE™ 290 adhesive (or equivalent) to the area.
 - D. Drive Shaft Seal—Replace the drive shaft seal. Make sure that the drive shaft is clean and free of pitting in the seal area.
 - E. Housing Plug Seal—Seat the plug in the housing. Following manufacturer's directions, apply LOCTITE™ 75559 solvent and LOCTITE™ 290 adhesive (or equivalent) to the plug-housing area.

- F. Housing Seal—Replace the seal.
- G. Side Cover Leak—Tighten side cover bolts to 60 N.m (45 lb ft). Replace the side cover seal if the leakage persists.
- H. Adjuster Plug Seal—Replace the adjuster plug seals.
- I. Pressure Line Fitting—Tighten the line fitting nut to 33 N.m (24 lb ft). If leakage persists, replace the seal.
- J. Pitman Shaft Seals—Replace the seals.
- K. Top Cover Seal—Replace the seal.

POWER STEERING SYSTEM TEST

Tools Required:

J 5176-D Power Steering Gage

J 5421-02 Thermometer

The power steering system test is a method used to identify and isolate hydraulic circuit difficulties. Prior to performing this test, the following inspection and necessary corrections must be made (Figure 3).

 **Inspect**

- Pump reservoir for proper fluid level. Refer to "Fluid Level" in this section.
- Pump belt for proper tension. Refer to SECTION 6B.

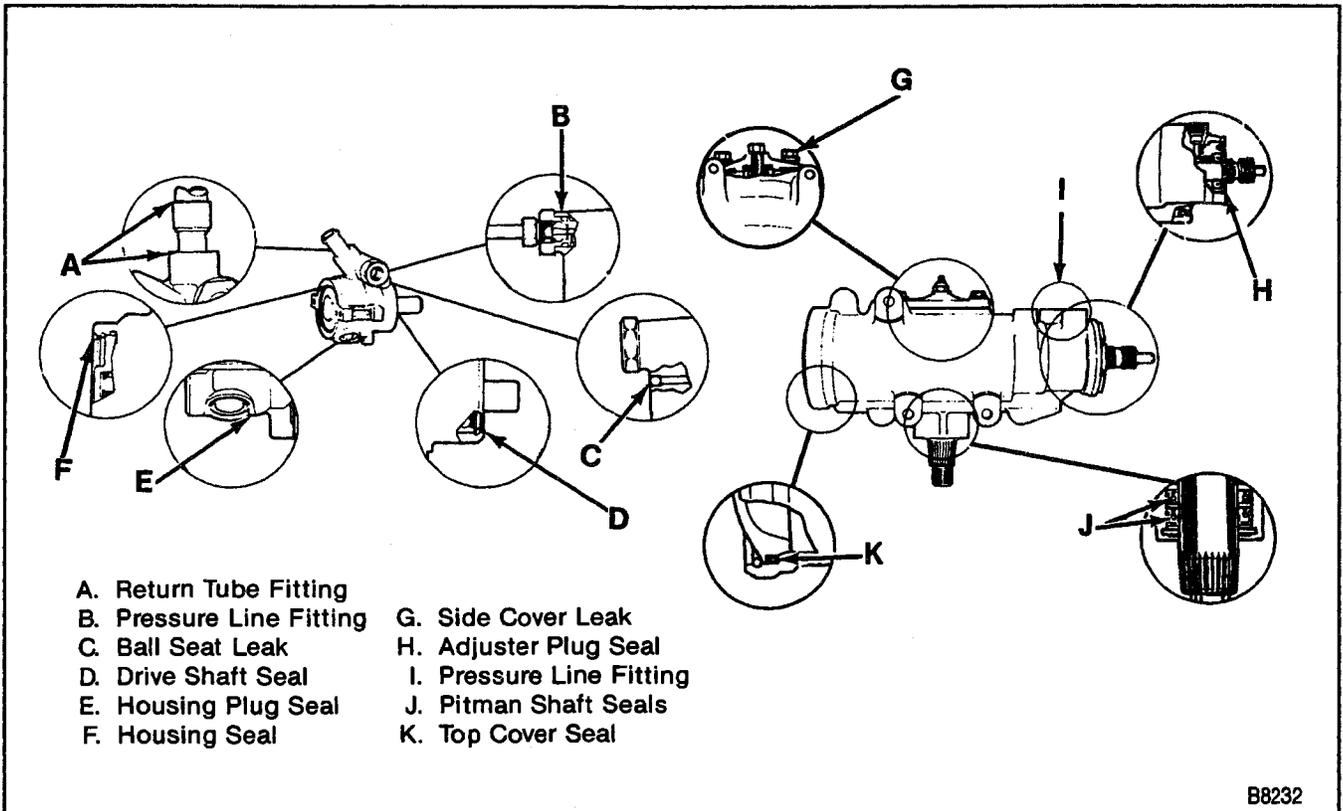


Figure 2—Fluid Leak Locations

3B-8 POWER STEERING GEAR AND PUMP

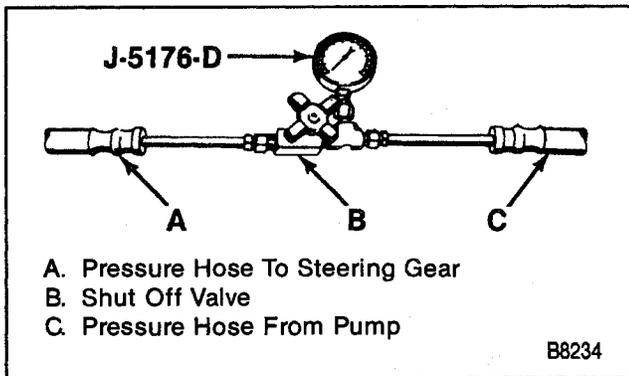


Figure 3—Checking Power Steering Pressure

- Pump drive pulley condition. Refer to SECTION 6B.

! Important

- All tests are made with the engine idling at normal operating temperature.
1. Place a container under the steering gear or pump to catch the fluid when disconnecting or connecting the hoses.
 2. With the ignition "OFF," disconnect the pressure hose at the steering gear or power steering pump and install J 5176-D to both hoses. The gage must be between the shutoff valve and pump. Open the shutoff valve.
 3. Remove the filler cap from the pump reservoir and check the fluid level. Fill the pump reservoir with power steering fluid to the full mark on the dipstick. Start the engine and, momentarily holding steering wheel against the stop, check the connections at J 5176-D for leaks.
 4. Bleed the system. Refer to "Bleed the Power Steering System" in this section.
 5. Insert thermometer J 5421-02 in the reservoir filler opening. Move the steering wheel from stop to stop several times until the thermometer indicates the power steering fluid in the reservoir has reached a temperature of 65° to 77° C (150° to 170° F).

! Important

- To prevent scrubbing flat spots on the tires, do not turn the steering wheel more than five times without rolling the vehicle to change the tire-to-floor contact area.

6. Start the engine and check the pump's fluid level. Add power steering fluid if required. When the engine is at normal operating temperature, the initial pressure reading on the gage (valve open) should be in the 550-860 kPa (80-125 psi) range. Should this pressure be in excess of 1380 kPa (200 psi), check the hoses for restrictions and the poppet valve for proper assembly.

NOTICE: Do not leave valve fully closed for more than 5 seconds, since this could damage the pump internally.

7. Fully close the gate valve three times. Record the highest pressures attained each time.
 - If the pressures recorded are within 9,308-9,998 kPa (1,350-1,450 psi), C 3500HD 10,101-10,446 kPa (1,465-1,515 psi) and the range of readings within 345 kPa (50 psi), the pump is functioning within its specifications.
 - If the pressures recorded are high, but do not repeat within 345 kPa (50 psi), the flow controlling valve is sticking. Remove the valve, clean it and remove any burrs using crocus cloth or a fine hone. If the system contains some dirt, flush it. If it is exceptionally dirty, both the pump and gear must be completely disassembled, cleaned, flushed, and reassembled before further usage.
 - If the pressures recorded are constant but between 690 kPa (100 psi) and 9,308 kPa (1,350 psi), replace the flow control valve and recheck. If the pressures are still low, replace the rotating group in the pump.
8. If the pump pressures are within specifications, leave the valve open and turn the steering wheel to both stops. Record the highest pressures and compare with the maximum pump pressure recorded. If this pressure cannot be reached in at least one side of the gear, the gear is leaking internally and must be disassembled and repaired.
9. Shut the engine "OFF," remove the testing gage, reconnect the pressure hose, check the fluid level, and/or make the needed repairs.
10. If the problem still exists, the steering and front suspension must be thoroughly examined. Refer to "Diagnosis Of Power Steering System" in this section.

ON-VEHICLE SERVICE

MAINTENANCE

Keep the power steering system clean. The power steering pump's fluid level should be checked at regular intervals and fluid added when required. Refer to SECTION 0B for type of fluid to be used and intervals for filling.

If the system contains some dirt, flush it. Refer to "Flushing The Power Steering System" in this section. If

it is exceptionally dirty, both the pump and the gear must be completely disassembled before further usage.

All tubes, hoses, and fittings should be inspected for leakage at regular intervals. Fittings must be tight. Make sure the clips, clamps, and supporting tubes and hoses are in place and properly secured.

Inspect the hoses with the wheels in the straight-ahead position. Then turn the wheels fully to the

left and right while observing the movement of the hoses. Correct any hose contact with other parts of the vehicle that could cause chafing or wear.

Power steering hoses and pipes must not be twisted, kinked, or tightly bent. The hoses should have sufficient natural curvature in the routing to absorb movement and hose shortening during vehicle operation.

Air in the system will cause spongy action and noisy operation. When a hose is disconnected or when fluid is lost for any reason, the system must be bled after refilling. Refer to "Bleeding The Power Steering System" in this section.

FLUID LEVEL

1. The fluid level may be checked hot or cold. To check the fluid level when hot do the following:
 - Run engine until the fluid reaches about 80° C (170° F), then shut the engine "OFF."
 - Remove the reservoir cap and check the fluid level on the dipstick.
 - The fluid level should be between HOT/FULL and COLD/FULL marks on the dipstick.
2. If the fluid level is being checked "COLD," do the following:
 - Remove the reservoir cap and check the fluid level on the dipstick.
 - The fluid level should be between the bottom of the COLD/FULL mark and the end of the dipstick.
3. If the fluid level is low, add power steering fluid to the proper level and install the reservoir cap. Refer to SECTION 0B.
4. When checking the fluid level after the steering system has been serviced, air must be bled from the system. Refer to "Bleeding The Power Steering System" in this section.

BLEEDING THE POWER STEERING SYSTEM

Refer to Figure 4 for the power steering bleeding procedure.

FLUSHING THE POWER STEERING SYSTEM

1. Raise the front end of the vehicle off the ground until the wheels are free to turn.
2. Remove the fluid return hose at the pump inlet connector and plug the connector port on the pump. Position the hose toward a large container to catch the draining fluid.
3. While an assistant is filling the reservoir with new power steering fluid, run the engine at idle. Turn the steering wheel from stop to stop. DO NOT contact wheel stops or hold the wheel in a corner or fluid will stop and the pump will be in pressure relief mode. A sudden overflow from the reservoir may develop if the wheel is held at a stop.

4. Install all the pipes and hoses. Fill the system with new power steering fluid and bleed the system as described in "Bleeding The Power Steering System" in this section. Operate the engine for about 15 minutes. Remove the pump return hose at the pump inlet and plug the connection on the pump. While refilling the reservoir, check the draining fluid for contamination. If foreign material is still evident, replace all hoses. Disassemble and clean or replace the power steering system components. Do not re-use any drained power steering fluid.

STEERING GEAR REPLACEMENT



Remove or Disconnect (Figure 5)

- Place a drain pan below the steering gear.
1. Hoses from the steering gear.
 - Cap or tape the ends of the hoses and gear fittings to prevent the entrance of dirt.
 2. Shield (27).
 3. Lower clamp bolt (16).
 - Draw alignment marks on the clamp (15) and the steering shaft (22) before removing the clamp.
 4. Clamp (15) from the steering shaft (22).
 5. Pitman arm. Refer to SECTION 3B3.
 6. Bolts (25) and washers (26).
 7. Steering gear (12).



Install or Connect (Figure 5)

NOTICE: Refer to "Notice" on page 3B-1.

1. Steering gear (12).
2. Washers (26) and bolts (25).
3. Pitman arm.



Tighten

- Bolts (25) to 135 N.m (100 lb ft).
 - Pitman arm to pitman shaft nut to 285 N.m (215 lb-ft).
4. Clamp (15) to the steering shaft.
 - Make sure the alignment marks line up.
 5. Clamp bolt (16).



Tighten

- Bolt (16) to 30 N.m (22 lb ft).
6. Shield
 7. Hoses (50 and 51).

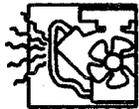


Tighten

- Hose connection to 28 N.m (20 lb ft).
8. Bleed the system. Refer to "Bleeding The Power Steering System" in this section.

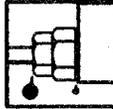
Bleeding Air from Power Steering Systems

Before bleeding: Inspect steering system. Check, and correct as needed:



Hoses must not touch any other part of vehicle.

• Steering system noise could be caused by hose touching frame, body, or engine.



All hose connections must be tight.

• Loose connections might not leak but could allow air into system.

When to bleed:
After any component replacement
After disconnecting fluid line
In case of steering system noise

Why bleed?
To prevent pump damage
To ensure proper system operation
To stop steering system noise

Power Steering Fluid
Use only clean, new power steering fluid. Fluid must be:

- Conventional Climate:*
GM #1052884 - 16 ounce
#1060017 - 32 ounce
- Cold Climate:*
GM #12345868 - 16 ounce
#12345867 - 32 ounce

How to bleed:

① **OFF** Switch ignition off.

② Raise front wheels off ground

③ Turn steering wheel full left.

④ Fill fluid reservoir to "FULL COLD" level. Leave cap off.

⑤ With assistant checking fluid level and condition, turn steering wheel lock-to-lock at least 20 times. Engine remains off.

- On systems with long return lines or fluid coolers, turn steering wheel lock-to-lock at least 40 times.
- Trapped air may cause fluid to overflow. Thoroughly clean any spilled fluid to allow for leak check.
- Keep fluid level at "FULL COLD."

⑥ While turning wheel, check fluid constantly.

- No bubbles are allowed.
- For any sign of bubbles, recheck connections. Repeat step 5.

⑦ **START** Start engine. With engine idling, maintain fluid level. Reinstall cap.

⑧ Return wheels to center. Lower front wheels to ground

⑨ Keep engine running for two minutes.

⑩ Turn steering wheel in both directions.

- Verify:**
- Smooth power assist
 - Noiseless operation
 - Proper fluid level
 - No system leaks
 - Proper fluid condition

• No bubbles, no foam, no discoloration

⑪ If all proper conditions apply, procedure is complete.

⑫ If any problem remains, see "Special Conditions."

Special Conditions:

Fluid



- Foam or bubbles in fluid
Fluid must be completely free of bubbles. In step 5, be alert to periodic bubbles that could indicate a loose connection or leaky O-ring seal in either the return hose or pressure hose.
- Discolored fluid
(milky, opaque, or light tan color)

Switch ignition off. Wait two minutes. Recheck hose connections. Repeat steps 7-10. If condition still exists, replace and check a possible cause:

- Return hose clamps
- Return hose O-rings
- Pressure hose O-rings
- Gear cylinder line O-rings

Fill system and repeat bleed procedure for each possible cause. Repeat steps 7-10 to verify whether noise had been eliminated.

Noise



- Pump whine or groan
With engine running, recheck hoses for possible contact with frame body or engine. If no contact is found, follow either method below to cool down fluid and repressurize system.

Method 1: Normal Cool Down

Switch engine off. Wait for system to cool. Install reservoir cap.

Method 2: partial Fluid Replacement

Switch engine off. Use a suction device to remove fluid from reservoir. Refill with cool, clean fluid. Install reservoir cap.

After either method of cooling, start engine and allow engine to come up to operating temperature. If noise persists, remove and replace power steering pump. Repeat bleed procedure following pump replacement.

Figure 4—Bleeding the Power Steering System

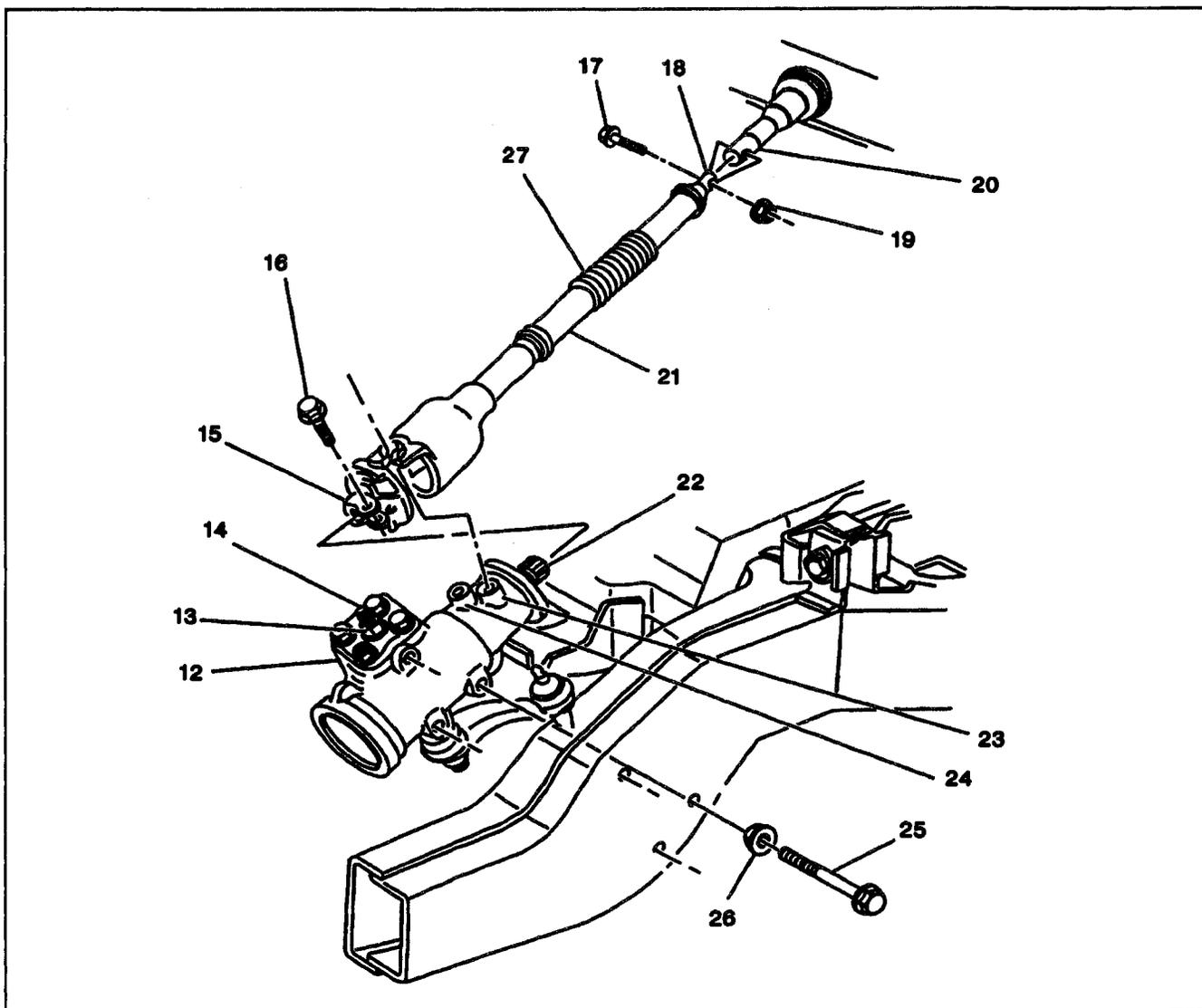


Figure 5—Steering Gear Assembly

PITMAN SHAFT SEAL REPLACEMENT

Tool Required:
 J 4245 Internal Snap Ring Pliers
 J 6219 Seal Installer

Two Wheel Drive

↔ Remove or Disconnect (Figure 6)

- Mark the position of the pitman arm to the pitman shaft.
- 1. Pitman arm from pitman shaft. Refer to SECTION 3B3.
- 2. Pitman shaft boot (1).
- 3. Dust seal (2).
- 4. Snap ring (3) using J 4245.
 - Loosely install pitman arm and nut on shaft. This is required to remove seal.

- Position a drain pan under the steering gear.
- Start the engine.
- Turn the steering wheel from stop to stop bouncing the wheel off the stops.
- Stop the engine.
- 5. Remove nut and pitman arm.
- 6. Washer (4) and seal (5).

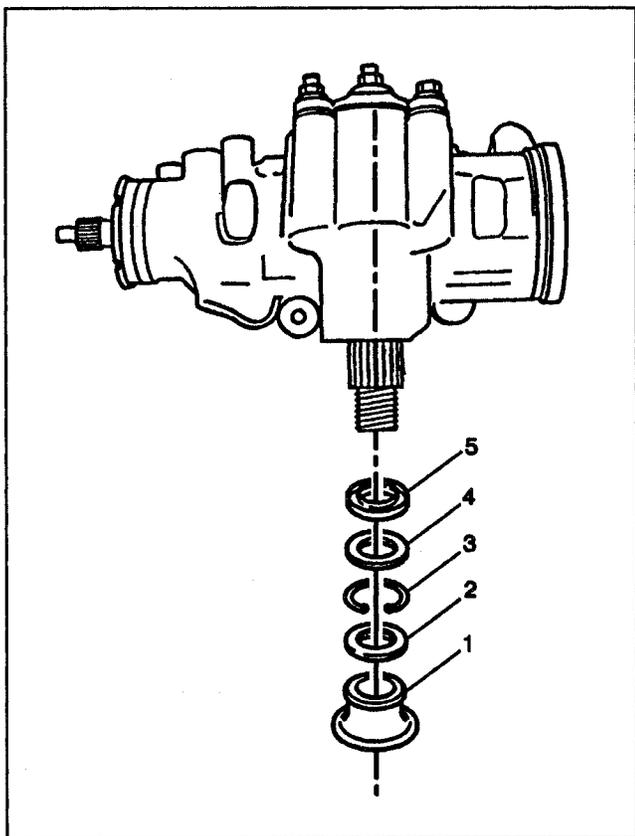
🔍 Inspect

- Pitman shaft seal surfaces for roughness or pitting. If pitted, replace the shaft.
- Housing for burrs. Remove the burrs before installing the new seals.

🧼 Clean

- Pitman shaft and seal areas using a crocus cloth.

3B-12 POWER STEERING GEAR AND PUMP



Legend

- (1) Pitman Shaft Boot
- (2) Dust Seal
- (3) Snap Ring
- (4) Washer
- (5) Oil Seal

Figure 6—Pitman Seal Assembly

Install or Connect (Figure 6)

NOTICE: Refer to "Notice" on page 3B-1.

- Lubricate the new seals with power steering fluid.
 - Apply a single layer of tape to the pitman arm shaft to avoid damaging the seals.
1. Seal (5).
 2. Washer (4) using J 6219 to seat the seal.
 - The seal should be in far enough to install the snap ring.
 3. Snap ring (3).
 4. Center the steering wheel.
 - Turn the wheel until it stops.
 - Turn the wheel in the opposite direction until it stops, while counting the number of turns.
 - Turn the wheel back 1/2 the number of turns in the previous step.
 5. Dust seal (2).
 6. Pitman shaft boot (1).
 7. Pitman arm.
 8. Bleed the system. Refer to "Bleeding The Power Steering System" in this section.

Four Wheel Drive

Remove or Disconnect (Figures 5 and 6)

1. Power steering gear. Refer to "Power Steering Gear Replacement" in this section.
2. Pitman arm. Refer to SECTION 3B3.
3. Pitman shaft seal. Refer to SECTION 3B1A.

Install or Connect (Figures 5 and 6)

NOTICE: Refer to "Notice" on page 3B-1.

1. Pitman shaft seal.
2. Pitman arm.
3. Power steering gear.

POWER STEERING PUMP REPLACEMENT

Tools Required:

- J 25034-B Power Steering Pump Pulley Remove
- J 25033-B Power Steering Pump Pulley Installer

Remove or Disconnect (Figures 7 through 10)

- Place a drain pan below the pump.
1. Hoses. Cap the hoses.
 2. Unload the tensioner assembly. Refer to SECTION 6B.
 3. Drive belt. Refer to SECTION 6B.
 4. Pulley.
 - Install J 25034-B. Be sure the pilot bolt bottoms in the pump shaft by turning the nut to the top of the pilot bolt (Figure 7).
 - Hold the pilot bolt.
 - Turn the nut counterclockwise.
 5. Front mounting bolts.
 6. Rear mounting nuts from studs.
 7. Electrical connector from EVO actuator.
 8. Pump.

Install or Connect (Figures 7 through 10)

NOTICE: Refer to "Notice" on page 3B-1.

1. Pump.
2. Front mounting bolts.

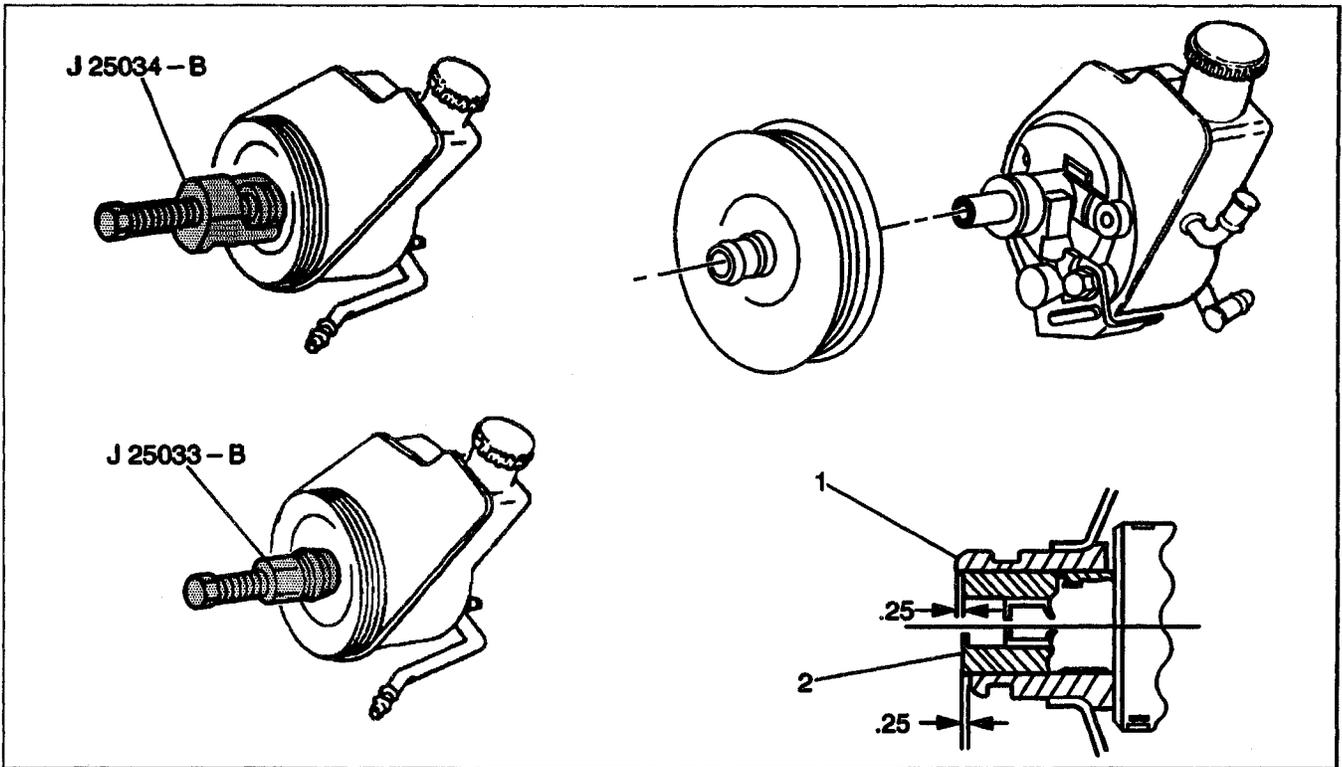
Tighten

- Bolts to 50 N-m (37 lb ft).

3. Rear mounting nuts to studs.

Tighten

- Nuts to 50 N-m (37 lb ft).



Legend

(1) Pulley Hub

(2) Pump Shaft

Figure 7—Replacing Steering Pump Pulley

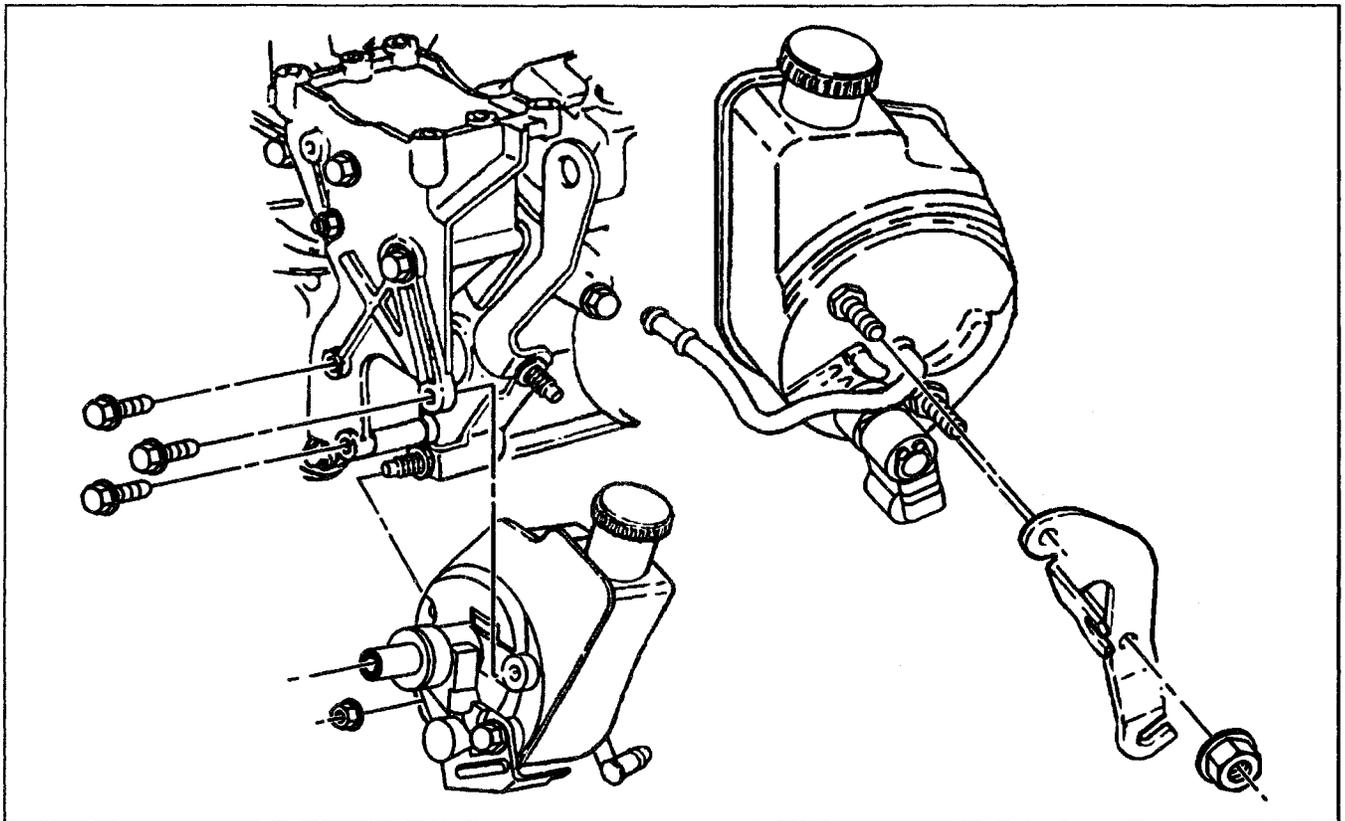


Figure 8—Power Steering Pump Mounting (4.3L, 5.0L, and 5.7L Engines)

3B-14 POWER STEERING GEAR AND PUMP

4. Pulley.

- Place pulley on the end of the pump shaft.
- Install J 25033-B. Be sure the pilot bolt bottoms in the shaft by turning the nut to the top of the pilot bolt (Figure 7).
- Hold the pilot bolt.
- Turn the nut clockwise.
- Install pulley flush ± 0.25 mm (0.010 in.) with the end of the power steering pump shaft (Figure 7).

NOTICE: Do not use arbor press or internal damage to the pump will result.

5. Drive belt.

6. Load the tensioner assembly.

7. Hoses.

8. Electrical connector to EVO actuator.

- Fill and bleed the system.



Inspect

- Hoses and wiring for clearance.

POWER STEERING HOSES

When a hose is reinstalled or replaced, the following points are essential:

- Route hoses in the same position they were in before removal (Figures 11 through 16).
- Route hoses smoothly; avoid sharp bends and kinking.

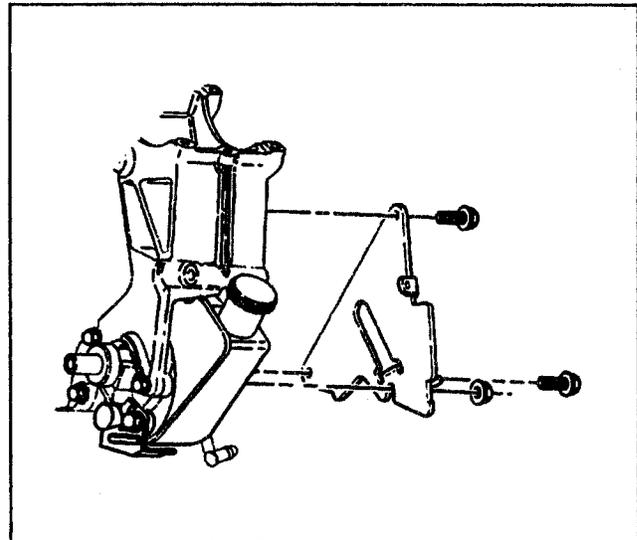


Figure 9—Power Steering Pump Mounting (7.4L Engines)

- After hoses are installed, check for leaks while the system is being bled. Refer to "Bleeding The Power Steering System" in this section.
- Tighten the hose connections to 28 N.m (20 lb ft).

NOTICE: Do not start the engine with any power steering hose disconnected, or damage to the components could occur.

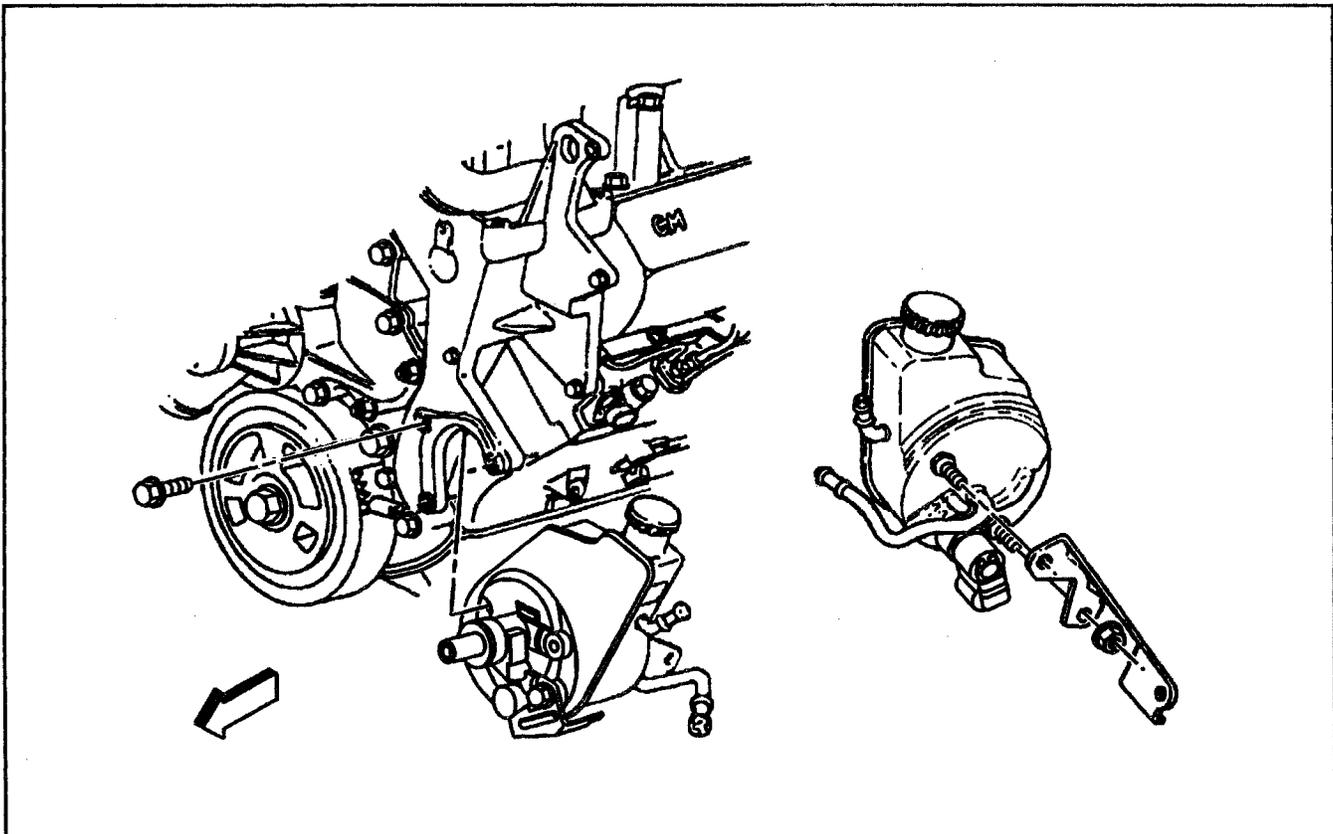
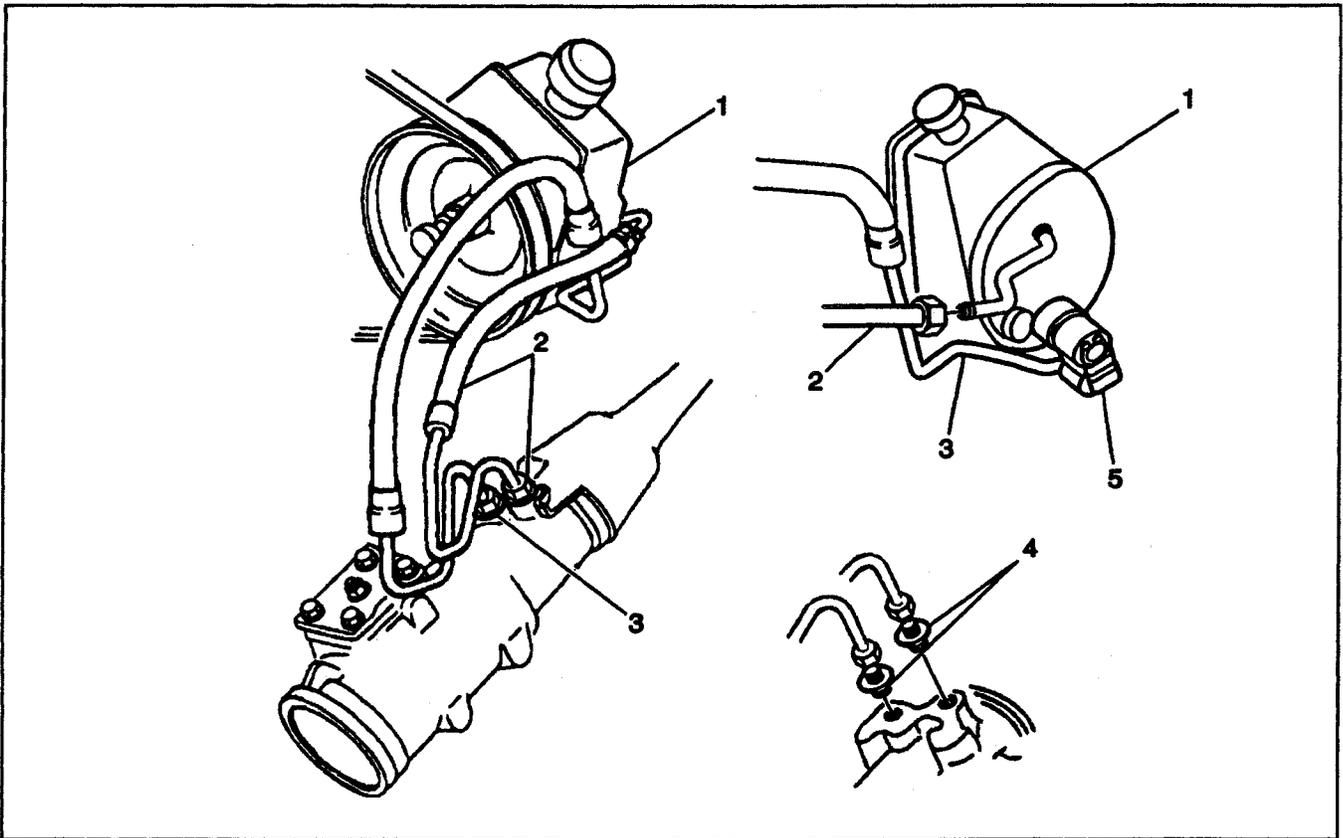


Figure 10—Power Steering Pump Mounting (6.5L Diesel Engines)

POWER STEERING GEAR AND PUMP 3B-15

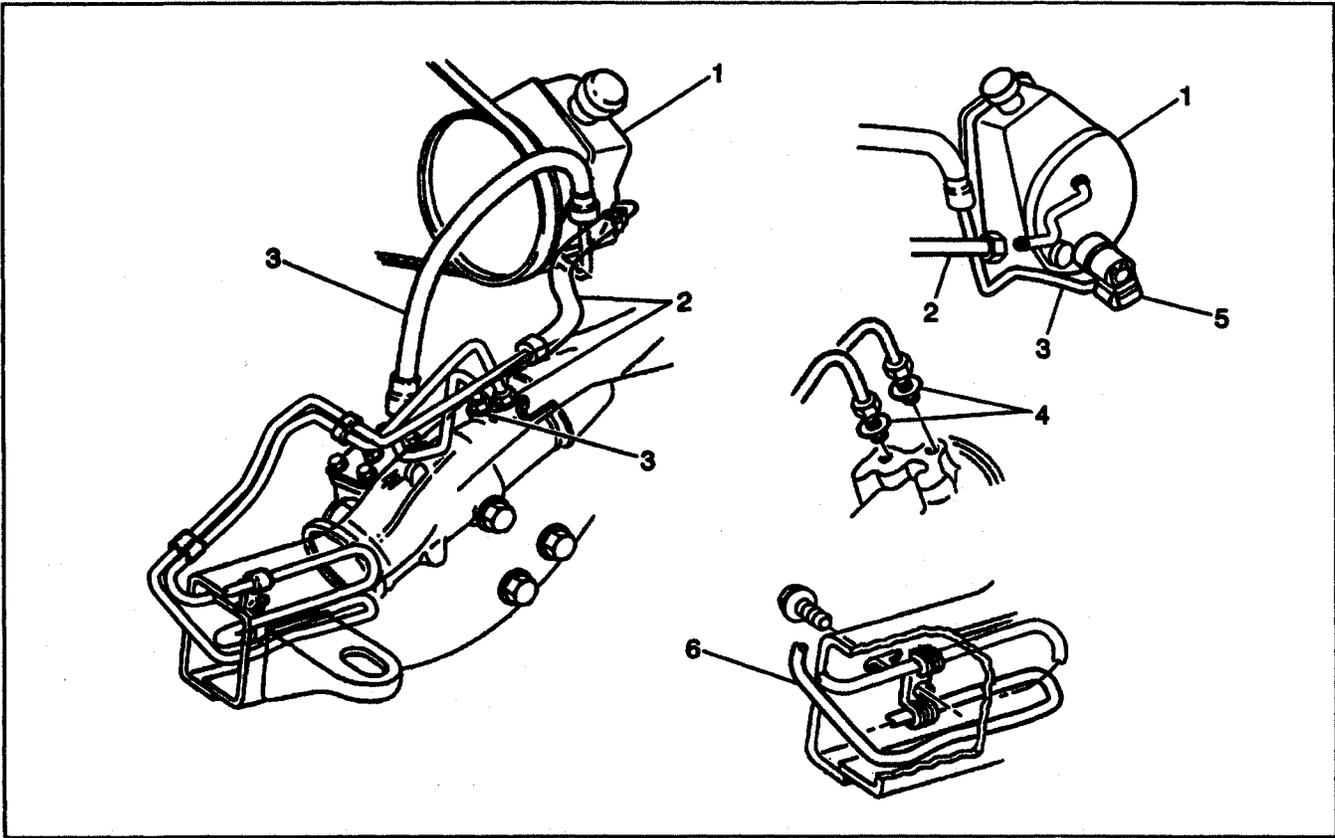


Legend

- (1) Pump
- (2) Return Hose
- (3) Feed Hose
- (4) Seals
- (5) Fluid Flow Actuator And Fitting Assembly

Figure 11—Hose Routing (C1 And 2 With 4.3L, 5.0L And 5.7L Engines—K1 With 5.7L Engine)

3B-16 POWER STEERING GEAR AND PUMP

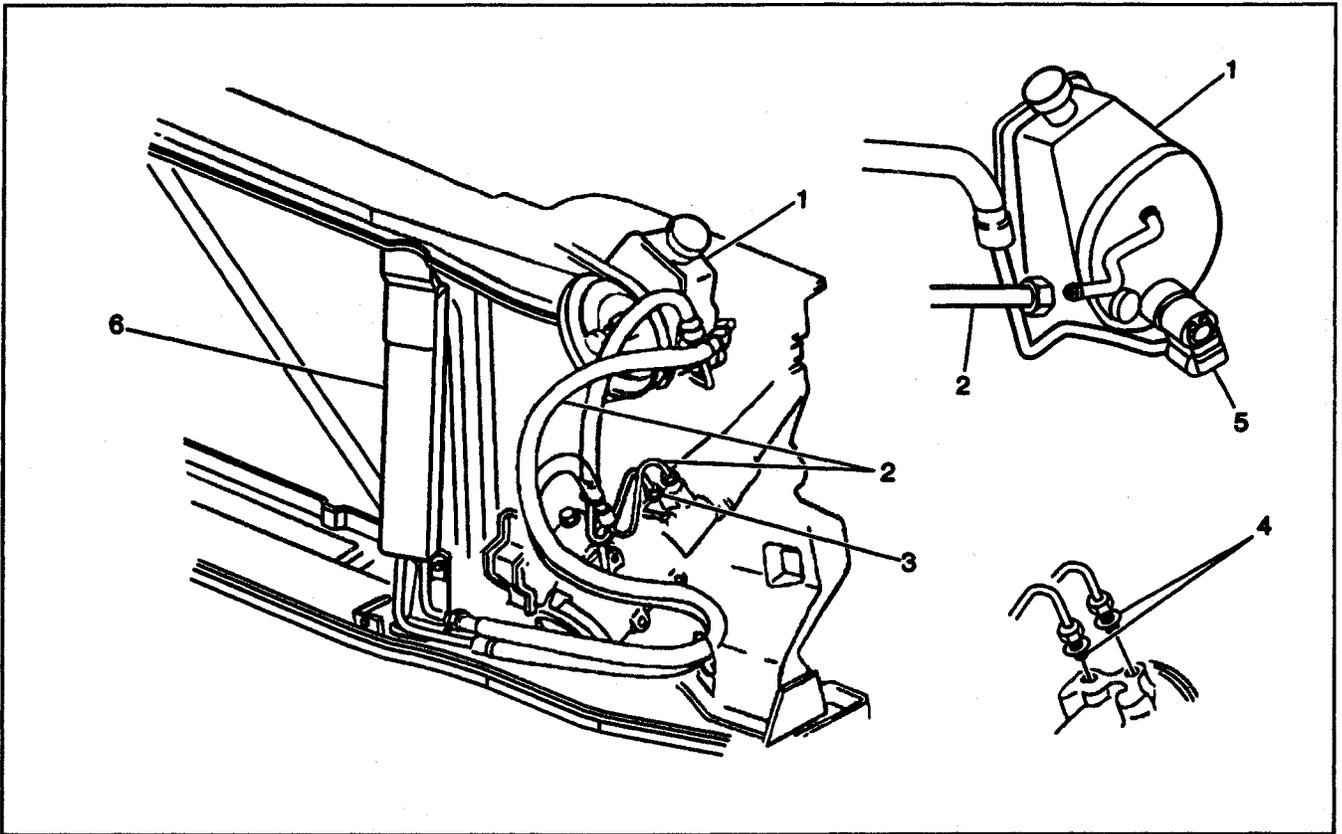


Legend

- | | |
|-----------------|--|
| (1) Pump | (4) Seals |
| (2) Return Hose | (5) Fluid Flow Actuator And Fitting Assembly |
| (3) Feed Hose | (6) Cooler |

Figure 12—Hose Routing (CK1, 2, And 3 With 4.3L, 5.0L, 5.7L, And 7.4L Engines)

POWER STEERING GEAR AND PUMP 3B-17



Legend

- | | |
|-----------------|--|
| (1) Pump | (4) Seals |
| (2) Return Hose | (5) Fluid Flow Actuator And Fitting Assembly |
| (3) Feed Hose | (6) Cooler |

Figure 13—Hose Routing (K1 And 2 With 4.3L Engine)

3B-18 POWER STEERING GEAR AND PUMP

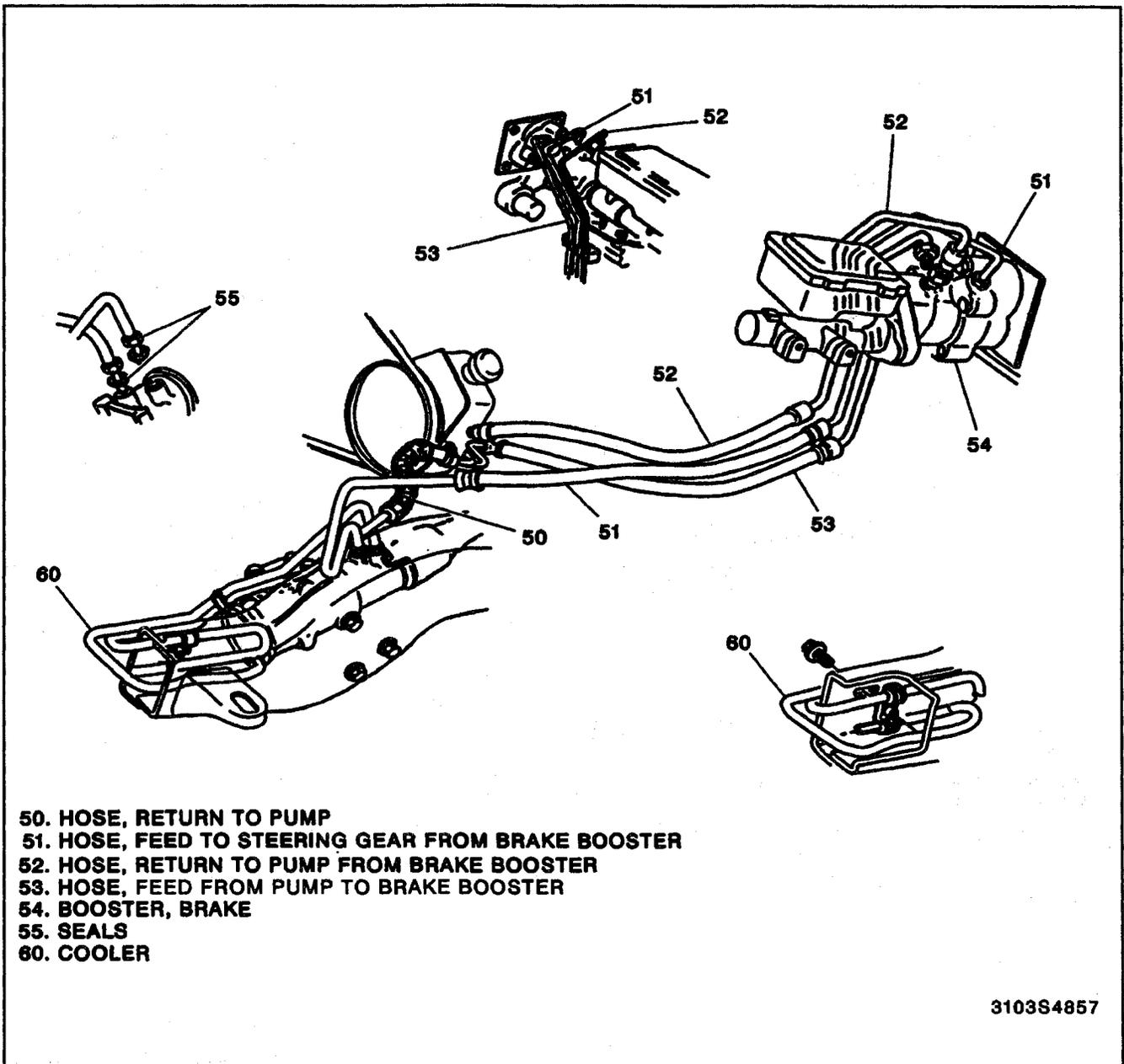


Figure 14—Hose Routing (CK2 and 3 with 5.7L, 7.4L Engines)

POWER STEERING GEAR AND PUMP 3B-19

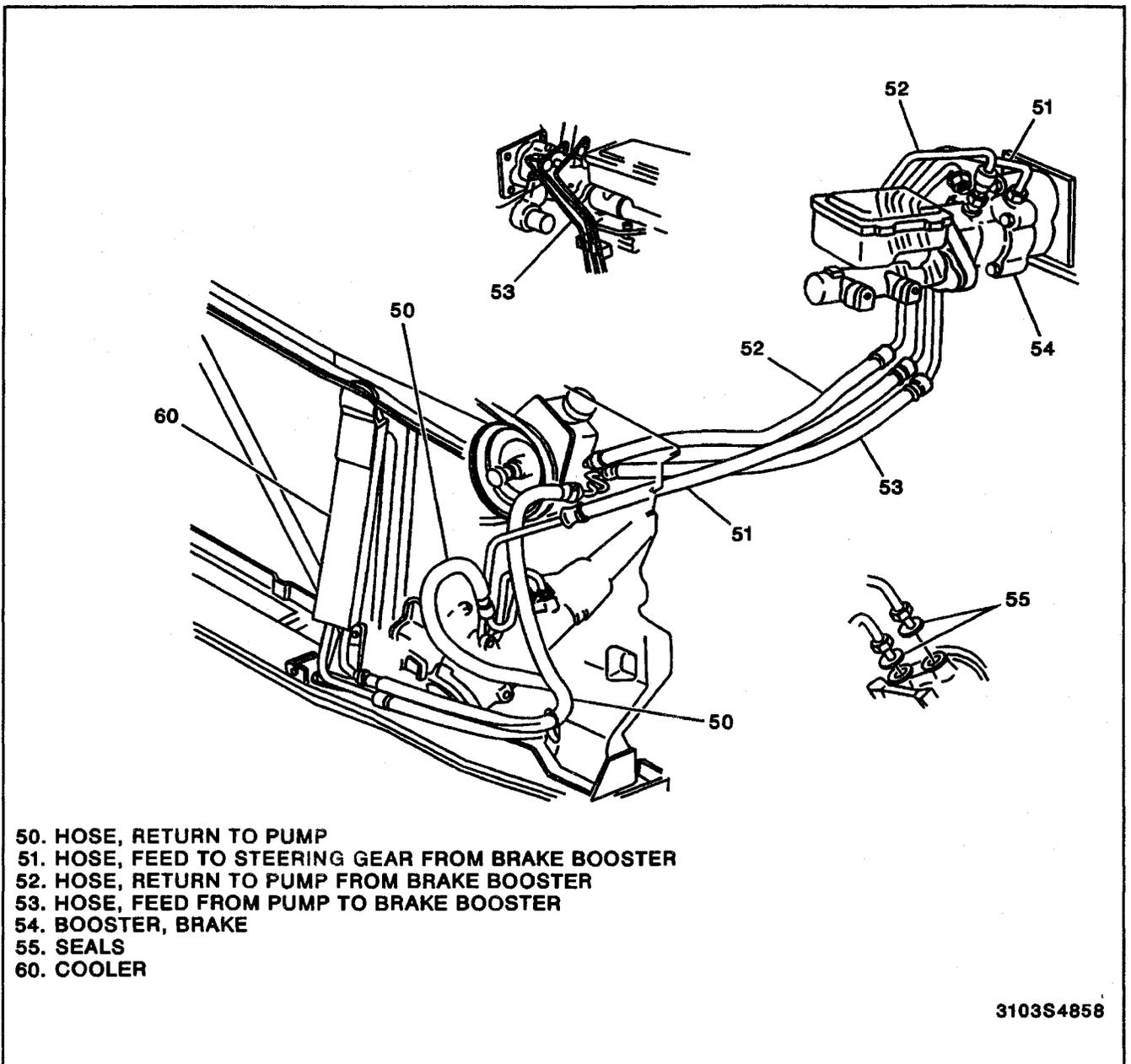


Figure 15—Hose Routing (CK1, 2 and 3 with 6.5L Diesel Engines)

3B-20 POWER STEERING GEAR AND PUMP

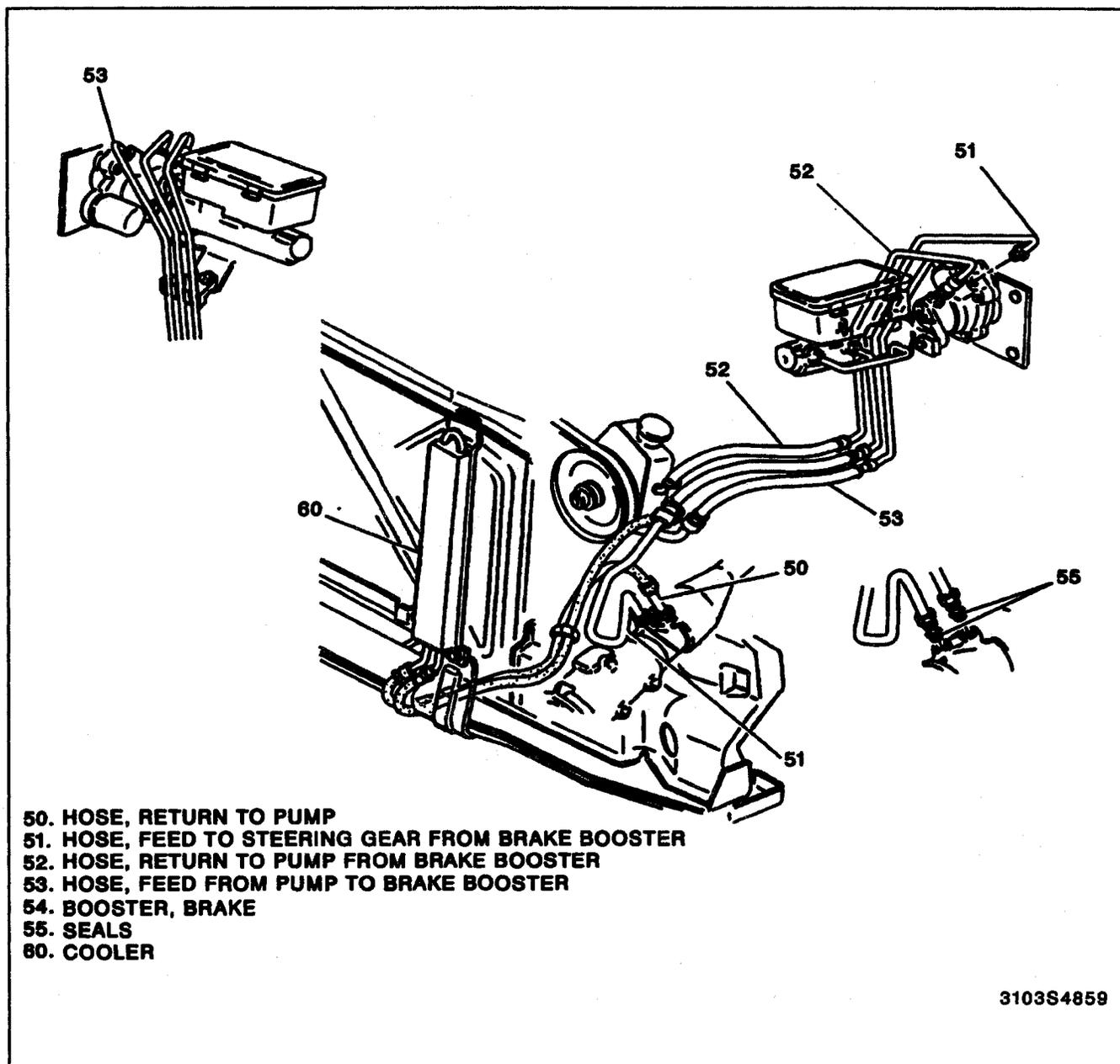


Figure 16—Hose Routing (C 3500HD I-Beam Front Axle)

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N.m	Lb ft	Lb in
Coupler Clamp Bolt	30	22	—
Gear To Frame Bolts	135	100	—
Pressure Hose Connection (At Gear)	33	24	—
Gear Side Cover Bolts	60	45	—
Front Pump Mounting Bolts	50	37	—
Pressure Hose Connection (At Pump)	28	20	—
Rear Pump Mounting Nut	50	37	—
Pitman Shaft Nut	285	215	—

POWER STEERING SYSTEM PRESSURES

Application	kPa	PSI
C 3500HD	10.1-10.45	1465-1515
All Other Applications	9.3-10.0	1350-1450

3B-22 POWER STEERING GEAR AND PUMP

SPECIAL TOOLS



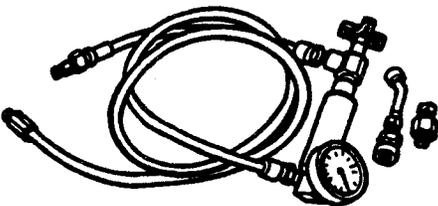
1. J 5176-20



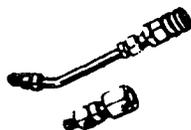
2. J 5176-20



3. J 5421-02



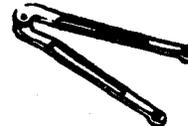
4. J 25323-A



5. J 29525



6. J 6219



7. J 7624



8. J 25034-B



9. J 25033-B

1. POWER STEERING PRESSURE TESTER
2. GAUGE ADAPTER 18MM POWER STEERING
3. THERMOMETER
4. POWER STEERING SYSTEM ANALYZER
5. POWER STEERING ANALYZER 18MM ADAPTER
6. PITMAN SHAFT SEAL INSTALLER
7. BEARING PRELOAD SPANNER WRENCH
8. POWER STEERING PUMP PULLEY REMOVER
9. POWER STEERING PUMP PULLEY INSTALLER

V0052

SECTION 3B1A

POWER STEERING GEAR UNIT REPAIR

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED,** do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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Power Steering Gear Assembly	3B1A-2	Rack Piston and Worm Shaft Replacement	3B1A-8
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Worm Thrust Bearing Preload Adjustment	3B1A-3	Check Valve Replacement	3B1A-11
Pitman Shaft Over-Center Preload Adjustment	3B1A-4	Specifications	3B1A-12
Steering Gear Service	3B1A-5	Fluid Capacities	3B1A-12
Pitman Shaft and Side Cover Replacement	3B1A-5	Fastener Tightening Specifications	3B1A-12
Housing End Plug Replacement	3B1A-6	Adjustment Tightening Specifications	3B1A-12
Adjuster Plug Assembly Replacement	3B1A-7	Special Tools	3B1A-12
Valve Replacement	3B1A-7		

3B1A-2 POWER STEERING GEAR UNIT REPAIR

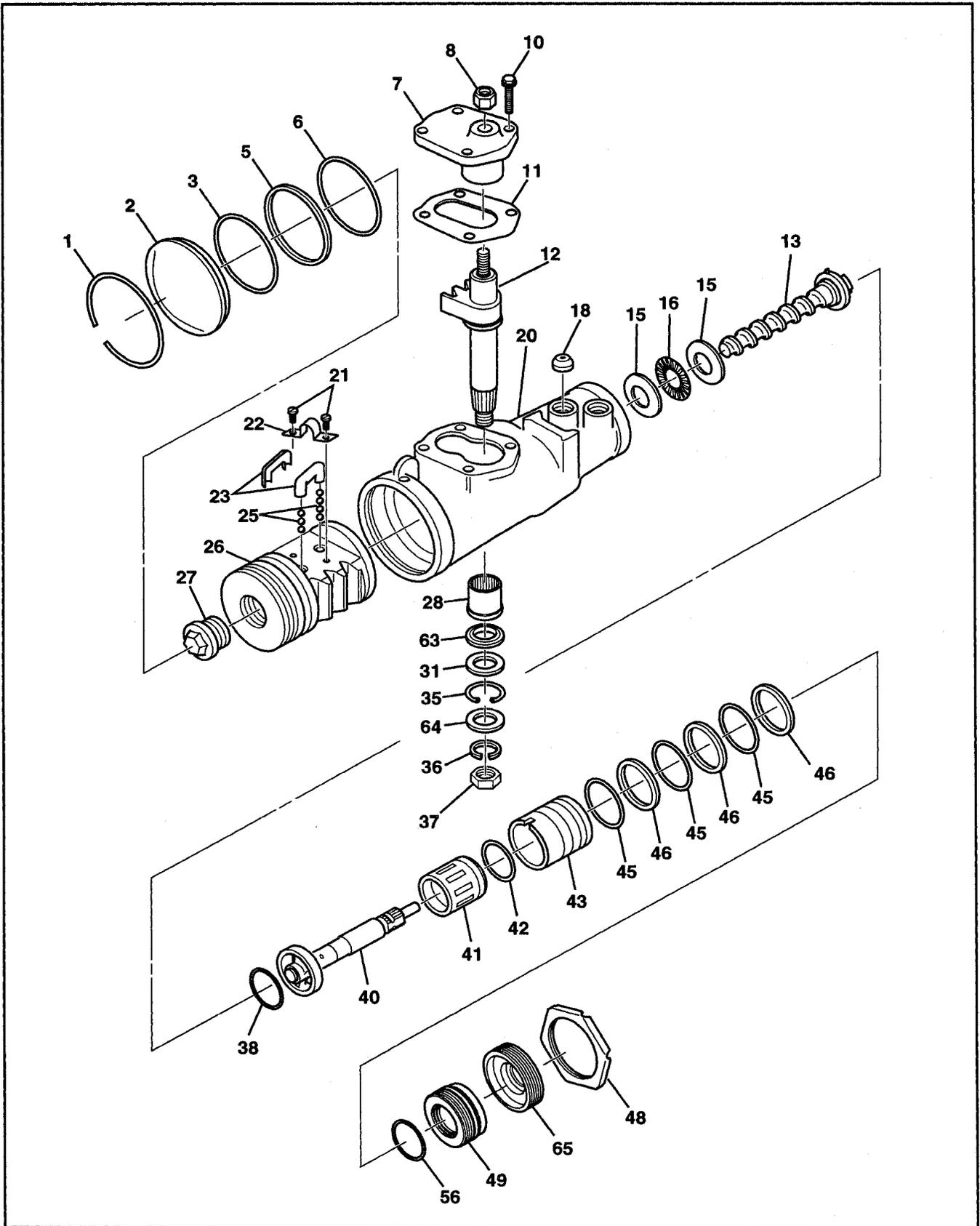


Figure 1 Power Steering Gear

Key No.	Part Name	Key No.	Part Name
1	RING, RETAINING	27	PLUG
2	PLUG	28	BEARING, NEEDLE
3	SEAL, O-RING	31	WASHER, BACKUP
5	RING, TEFLON	35	RING, RETAINING
6	SEAL, O-RING	36	WASHER, LOCK
7	COVER, SIDE	37	NUT
8	NUT, ADJUSTER LOCK	38	SEAL
10	BOLT	40	SHAFT, STUB
11	GASKET	41	SPOOL, VALVE
12	SHAFT, PITMAN	42	SEAL
13	SHAFT, WORM	43	BODY, VALVE
15	RACE, FLAT	45	SEAL, O-RING
16	BEARING, THRUST	46	RING
18	VALVE, CHECK	48	NUT, COUPLING SHIELD RET. AND LOCK
20	HOUSING	49	THRUST SUPPORT ASSEMBLY
21	SCREW	56	SEAL, O-RING
22	CLAMP	63	SEAL, PITMAN SHAFT
23	GUIDE, BALL	64	SEAL, DUST (CK, L ONLY)
25	BALLS	65	NUT, ADJUSTER
26	PISTON, RACK		

Figure 2 Power Steering Gear – Legend

STEERING GEAR ADJUSTMENTS

? Important

- Before any adjustments are made on the steering gear, refer to “Steering, Suspension, Tires and Wheels Diagnosis” (Section 3) for reviewing the possible steering system problems. Any steering gear adjustment is made only as a correction and not as a periodic adjustment.

For proper adjustment, remove the steering gear from the vehicle. Drain the power steering fluid from the gear. Mount the gear in a vise and make the following adjustments.

The steering gear requires two adjustments:

- The worm thrust bearing preload
- The pitman shaft over-center preload adjustment

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

? Important

- Adjust the worm thrust bearing preload first, then adjust the pitman shaft over-center preload.

WORM THRUST BEARING PRELOAD ADJUSTMENT

Figures 1 thru 6

Tool Required:

J 7624 Spanner Wrench

1. Remove steering gear from vehicle. Refer to “Power Steering Gear Replacement” in section 3B.
2. Rotate stub shaft (40) back and forth to drain power steering fluid.
3. Remove adjuster lock nut (48) from housing (20).

Notice: See “Notice” on page 3B1A-1 of this section.

4. Turn adjuster nut (65) in (clockwise) using J 7624 until adjuster nut (65) and thrust support asm (49) are firmly bottomed in housing (20).

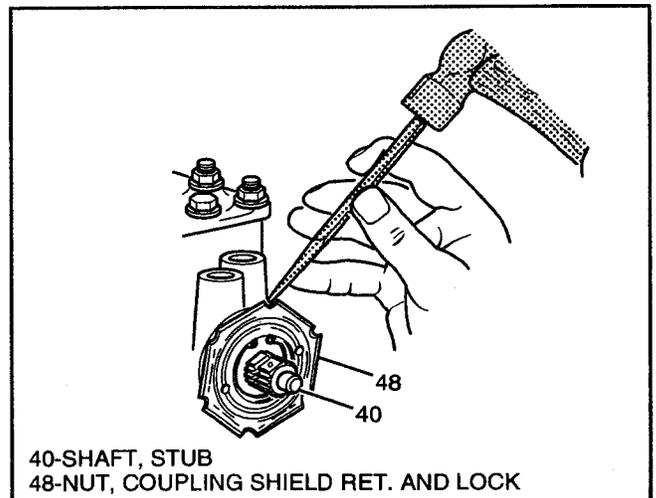


Figure 3 Loosening Coupling Shield Ret. and Lock Nut

3B1A-4 POWER STEERING GEAR UNIT REPAIR



Tighten

- Adjuster nut (65) to 28-31 N•m (20-23 lb. ft.).

5. Place an index mark on housing (20) even with one of the holes in the adjuster nut (65).
6. Measure back counterclockwise 13 mm (1/2 inch) and place a second mark on housing (20).

Notice: This will be different for some Chrysler models.

7. Turn adjuster nut (65) counterclockwise until hole in adjuster nut (65) is aligned with the second mark on the housing (20) (see Figure 6).
8. Install coupling shield ret. and lock nut (48).



Tighten

- Coupling shield ret. and lock lock nut (48) to 109 N•m (80 lb. ft.) using a drift in a notch.
- Hold adjuster nut (65) to maintain alignment of the marks.

9. Install steering gear. Refer to "Power Steering Gear Replacement" in section 3B.

PITMAN SHAFT OVER-CENTER PRELOAD ADJUSTMENT

Figures 7 thru 9

1. Remove steering gear from vehicle. Refer to "Power Steering Gear Replacement" in section 3B.
2. Rotate stub shaft back and forth to drain power steering fluid.
3. Loosen the adjuster lock nut (8).
4. Turn the pitman shaft adjuster screw counterclockwise until fully extended, then turn clockwise 1 full turn.
5. Rotate the stub shaft (40) from stop to stop, using a 12-point socket, and count the number of turns.

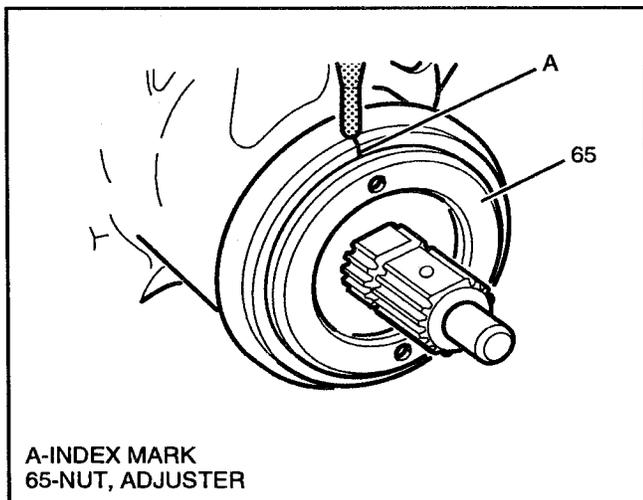


Figure 4 Marking Housing Even with Adjuster Nut

6. Starting at either stop, turn the stub shaft (40) back 1/2 the total number of turns. This is the "center" of the gear.

- When the gear is centered, the flat on the stub shaft (40) should face upward and be parallel with the side cover (7) and the master spline on the pitman shaft should be in line with the adjuster screw (see Figure 8).

7. Place a torque wrench on the stub shaft (40) with the handle in the vertical position. Rotate the stub shaft (40) 45 degrees each side of the center (see Figure 9).

- Stub shaft must rotate smoothly and must not stick or bind.
- Record the worm bearing preload measured on or near the center.
- Recorded bearing preload to be 0.7-1.7 N•m (6-15 lb. in.), with worm and ballnut installed. If the torque is outside this range, the gear assembly should be readjusted or repaired as required.

Notice: See "Notice" on page 3B1A-1 of this section.



Adjust

- Over-center torque by turning the pitman shaft adjuster screw clockwise until the correct preload torque is obtained.
- Add 0.7-1.1 N•m (6-10 lb. in.) torque to the previously measured worm bearing preload torque.



Tighten

- Adjuster lock nut (8) to 49 N•m (36 lb. ft.).
- Prevent adjuster screw from turning while tightening adjuster lock nut (8).

8. Install steering gear. Refer to "Power Steering Gear Replacement" in section 3B.

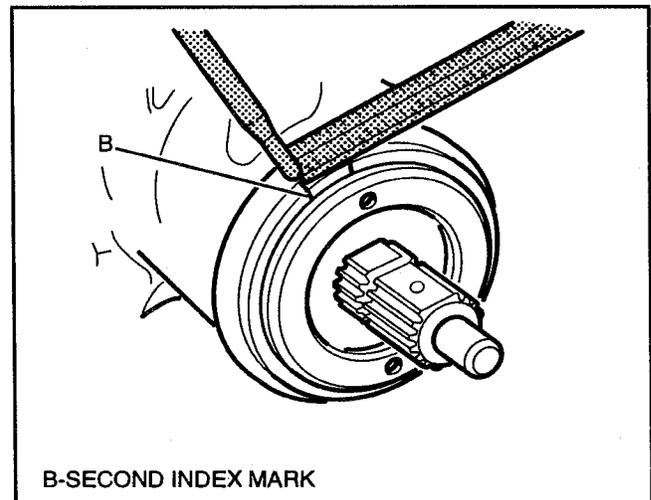


Figure 5 Remarking the Housing

STEERING GEAR SERVICE

PITMAN SHAFT AND SIDE COVER REPLACEMENT

Figures 1 and 2

Remove or Disconnect

- Steering gear from vehicle. Refer to "Power Steering Gear Replacement" in section 3B.
- Pitman arm from steering gear. Refer to "Steering Linkage" in section 3B3.
- Rotate stub shaft back and forth to drain power steering fluid.



Clean

- Exposed end of pitman shaft and housing.
- Use a wire brush to clean pitman shaft spline.



Disassemble

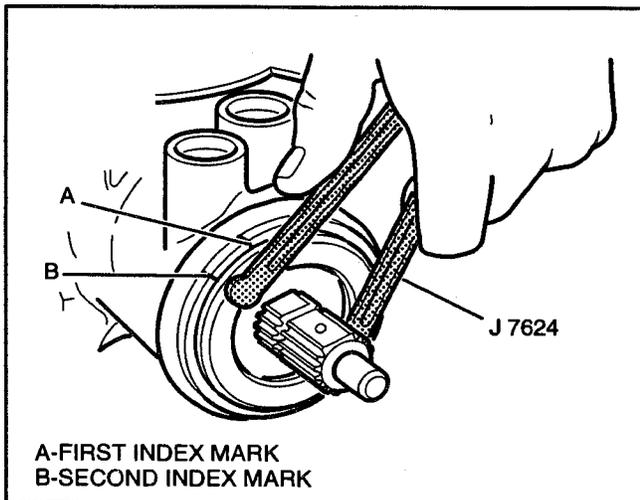
1. Adjuster lock nut (8).
2. Bolts (10).
 - Rotate stub shaft (40), using a 12-point socket, to center gear.
3. Side cover (7), gasket (11), and pitman shaft (12) as an assembly.
4. Pitman shaft (12) from the side cover (7).



Assemble

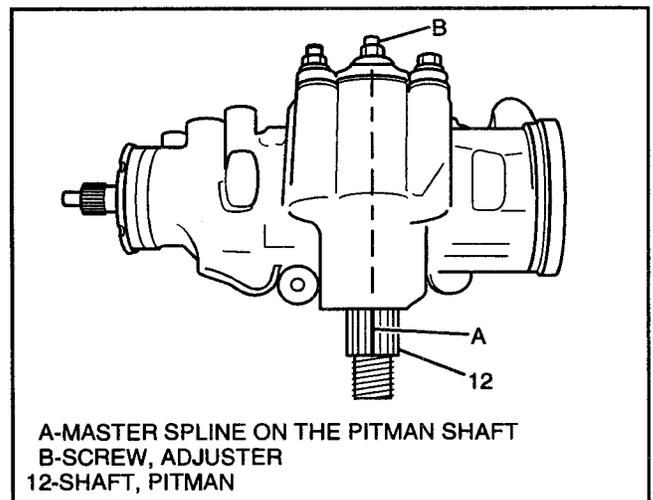
Notice: See "Notice" on page 3B1A-1 of this section.

1. Pitman shaft (12) to side cover (7) by screwing pitman shaft (12) in until it fully seats to side cover (7).
2. Adjuster lock nut (8).
 - Do not tighten adjuster lock nut (8) until after pitman shaft adjustment has been made.



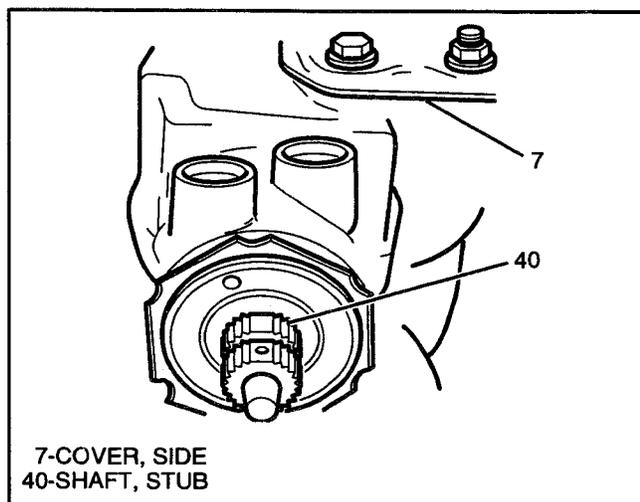
A-FIRST INDEX MARK
B-SECOND INDEX MARK

Figure 6 Aligning the Adjuster Nut to the Second Mark



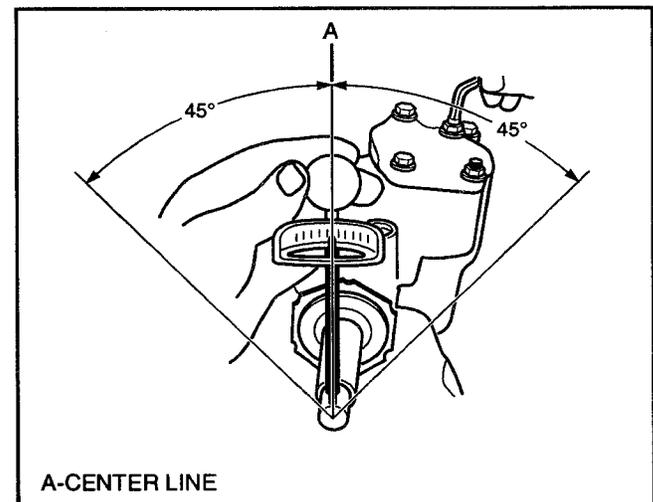
A-MASTER SPLINE ON THE PITMAN SHAFT
B-SCREW, ADJUSTER
12-SHAFT, PITMAN

Figure 8 Aligning Pitman Shaft Master Spline



7-COVER, SIDE
40-SHAFT, STUB

Figure 7 Aligning the Stub Shaft



A-CENTER LINE

Figure 9 Checking Over-Center Rotational Torque

3B1A-6 POWER STEERING GEAR UNIT REPAIR

3. Gasket (11) to side cover (7) and bend tabs around edges of side cover (7).
4. Pitman shaft assembly and side cover (7) to housing (20).
5. Bolts (10).

Tighten

- Bolts (10) to 60 N•m (44 lb. ft.).

Adjust

- Pitman shaft. Refer to "Pitman Shaft Over-Center Sector Adjustment" in this section.

Install or Connect

- Steering gear. Refer to "Power Steering Gear Replacement" in section 3B.

HOUSING END PLUG REPLACEMENT

Figure 10

Remove or Disconnect

- Steering gear from vehicle. Refer to "Power Steering Gear Replacement" in section 3B.

Disassemble

- Rotate stub shaft back and forth to drain fluid.

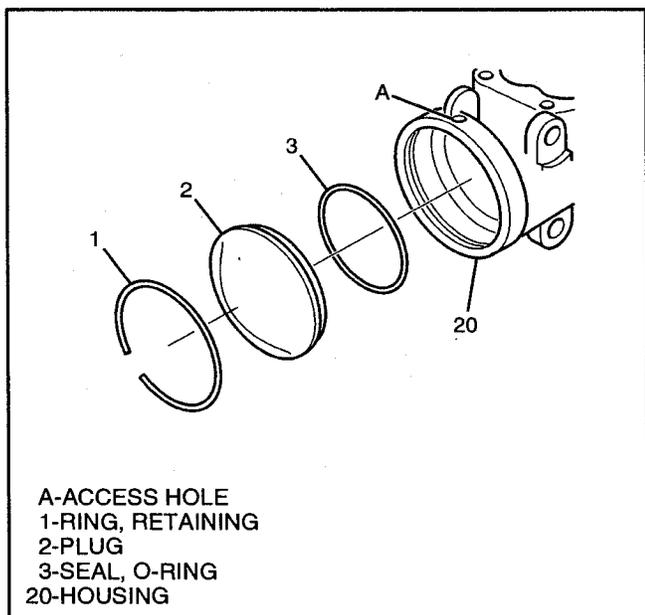


Figure 10 Housing End Plug

1. Retaining ring (1) by using a punch inserted into the housing access hole to unseat it.
2. Plug (2).
3. O-ring seal (3).

Assemble

- Lubricate O-ring seal with power steering fluid.
1. O-ring seal (3) into housing (20).
 2. Plug (2).
 3. Retaining Ring (1).
 - Install retaining ring (1) so that open end is approximately 25 mm (1 inch) from access hole in housing (20).

Install or Connect

- Steering gear. Refer to "Power Steering Gear Replacement" in section 3B.

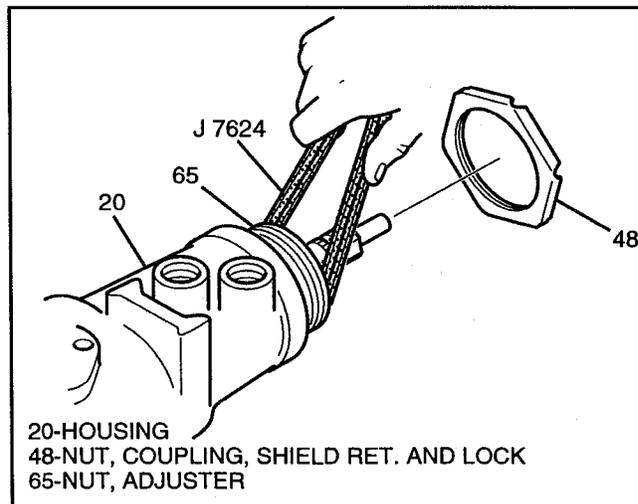


Figure 11 Removing Adjuster Nut

ADJUSTER PLUG ASSEMBLY REPLACEMENT

Figures 1, 2, 3, 11

Tools Required:

J 7624 Spanner Wrench



Remove or Disconnect

- Steering gear from vehicle. Refer to "Power Steering Gear Replacement" in section 3B.



Disassemble

- Coupling shield ret. and lock nut (48) from adjuster nut (65).
- Adjuster nut (65) from housing (20) using J 7624.
- Thrust support assembly (49) and O-ring seals (56).
- O-ring seal (56)



Assemble

- Lubricate O-ring seal (56).
- Install O-ring seal (56).
 - Thrust support assembly (49).
 - Adjuster nut (65) to housing (20) using J 7624.
 - Coupling shield ret. and lock nut (48) to adjuster nut (65).



Adjust

- Thrust bearing preload. Refer to "Worm Bearing Preload Adjustment" in this section.
- Install coupling shield ret. and lock nut (48), and using a drift in a notch, tighten securely.
 - Hold adjuster nut (65) to maintain alignment of the marks.



Adjust

- Pitman shaft over-center sector. Refer to "Pitman Shaft Over-Center Sector Adjustment" in this section.



Install or Connect

- Power steering gear. Refer to "Power Steering Gear

Replacement" in section 3B.

VALVE REPLACEMENT

Figures 1, 2, 12 thru 15



Remove or Disconnect

- Steering gear from vehicle. Refer to "Power Steering Gear Replacement" in section 3B.



Disassemble

- Adjuster nut (65). Refer to "Adjuster Nut Assembly Replacement" in this section.
- Stub shaft (40) and valve assembly.
- Stub shaft (40) from valve assembly, if necessary.
 - Tap stub shaft (40) lightly on a wood block to loosen shaft cap.
 - Pull cap and valve spool (41) out from valve body (43) 6 mm (1/4 inch) and disengage stub shaft pin from hole in valve spool (41).
- Valve assembly, if necessary.
 - Remove valve spool (41) by pulling and rotating from valve body (43).
 - Remove valve spool O-ring seal (42).
 - Remove valve body teflon rings (46) and O-ring seals (45).



Assemble

- Valve assembly, if necessary.
 - Install valve spool O-ring seal (42) to valve spool (41).
 - Lubricate valve spool (41) and O-ring seal (42) with power steering fluid.
 - Install valve spool (41) to valve body (43) by pushing and rotating until hole in valve spool (41) for stub shaft pin is accessible from opposite end of valve body (43).
- Stub shaft (40) to valve spool, if necessary and insert pin.
 - Notch in stub shaft cap must fully engage valve body pin and seat against valve body shoulder.
 - Install O-ring seals (45) and teflon rings (46) to valve body (43).
 - Lubricate O-ring seals (45) and teflon rings (46) with power steering fluid.
- Stub shaft (40) and valve assembly to worm shaft (13), fitting pin on worm shaft (13) to slot in the valve assembly.
- Adjuster plug. Refer to "Adjuster Plug Assembly

3B1A-8 POWER STEERING GEAR UNIT REPAIR

Replacement" in this section.



Adjust

- Thrust bearing preload and pitman shaft over-center sector. Refer to "Steering Gear Adjustments" in this section.



Install or Connect

- Steering gear. Refer to "Power Steering Gear Replacement" in section 3B.

RACK PISTON AND WORM SHAFT REPLACEMENT

Figures 1, 2, 16, 17, 18 and 19



Remove or Disconnect

- Steering gear from vehicle. Refer to "Power Steering Gear Replacement" in section 3B.



Disassemble

Tool Required:

J 21552 Rack Piston Arbor

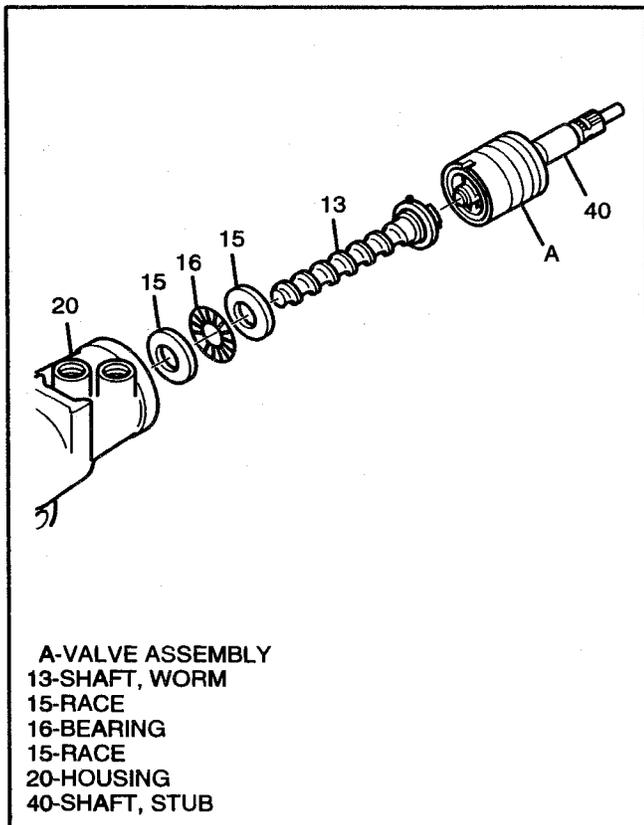


Figure 12 Bearing, Worm and Valve Assembly

1. Pitman shaft and side cover. Refer to "Pitman Shaft and Side Cover Replacement" in this section.
2. Housing end plug. Refer to "Housing End Plug Replacement" in this section.
 - Turn stub shaft counterclockwise until the rack piston (26) begins to come out of the housing (20).
3. Rack piston plug (27).
 - Insert J 21552 into bore of rack piston (26). Hold J 21552 tightly against worm shaft while turning the stub shaft counterclockwise.
 - The rack piston (26) will be forced onto J 21552 and hold the rack piston balls (25) in place.
4. Rack piston (26), rack piston balls (25), and J 21552 together from housing (20).
5. Valve. Refer to "Valve Replacement" in this section.
6. Worm shaft (13).
7. Thrust bearing (16) and races (15).

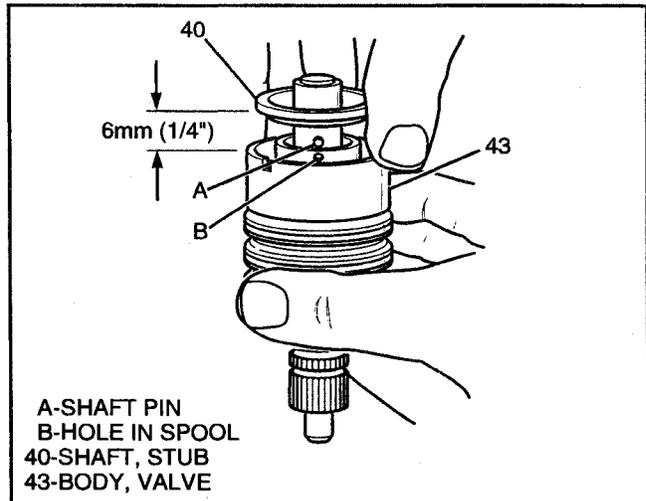


Figure 13 Remove and Install Stub Shaft

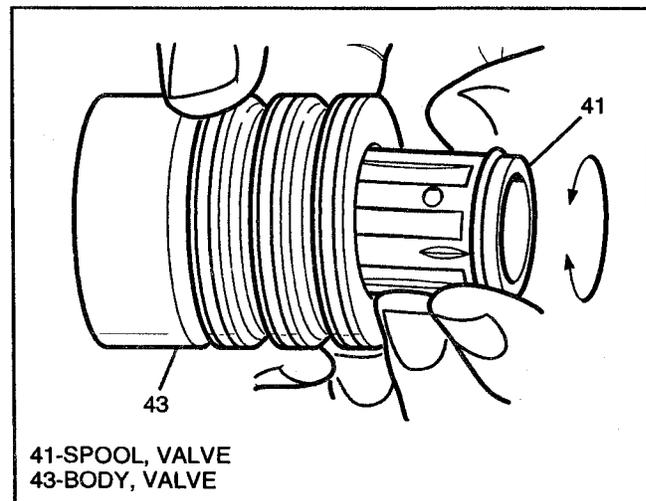


Figure 14 Remove and Install Spool

8. J 21552 from rack piston (26).
9. Rack piston balls (25).
10. Screws (21), clamp (22) and ball guide (23).
11. Teflon ring (5).
12. O-ring seal (6).



Clean

- All disassembled parts.



Inspect

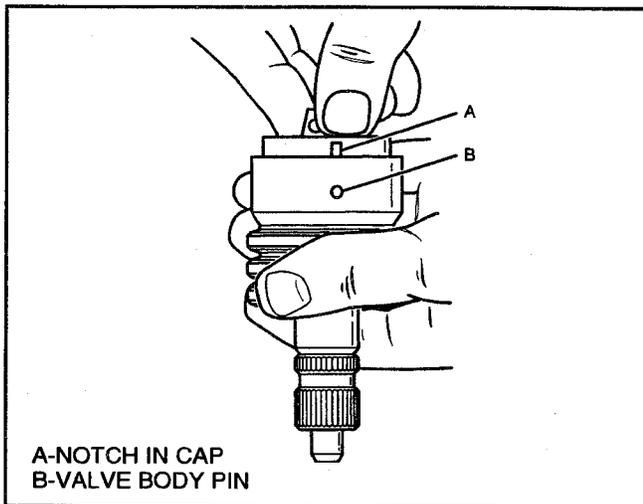
- All disassembled parts for wear. Replace if necessary.



Assemble

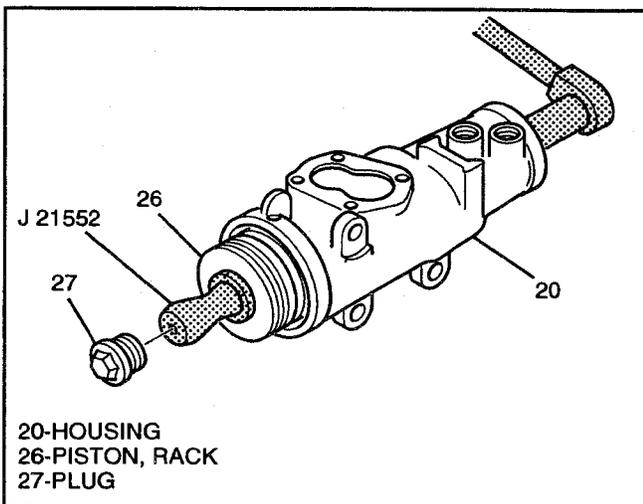
Tools Required:

- J 8947 Rack Piston Teflon Ring Compressor
- J 21332 Rack Piston Arbor



A-NOTCH IN CAP
B-VALVE BODY PIN

Figure 15 Engage Stub Shaft



20-HOUSING
26-PISTON, RACK
27-PLUG

Figure 16 Rack Piston

1. O-ring seal (6) and teflon ring (5) and lubricate with power steering fluid.
2. Worm shaft (13) to rack piston (26) outside of housing (20).
 - Fully seat worm shaft (13) to rack piston (26) and align worm shaft spiral groove with rack piston ball return guide hole (see Figure 20).



Important

- Make sure that all rack piston balls (25) are reinstalled in the rack piston. Improper rack piston ball installation may result in personal injury.

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

- Lubricate rack piston balls (25) with power steering fluid.
3. Rack piston balls (25) to rack piston (26) by inserting through ball return guide hole while turning worm shaft (13) counterclockwise.
 4. Remaining rack piston balls (25) to ball guide (23) using grease at each end to retain balls (25) (see Figure 21).
 5. Ball guide (23) to rack piston (26).

Notice: See "Notice" on page 3B1A-1 of this section.

6. Ball guide clamp (22) and screws (21).



Tighten

- Screws (21) to 58 N•m (43 lb. in.).
 - Insert J 21552 into bore of rack piston (26) while turning worm shaft (13) counterclockwise. The rack piston (26) will be forced onto J 21552 and will hold the rack piston balls (25) in place.
7. Races (15 and 17) and thrust bearing (16) to worm shaft (13) (see Figure 22).
 8. Worm shaft (13) to housing (20).
 9. Valve. Refer to "Valve Replacement" in this section.
 10. Rack piston (26) to worm shaft (13) from J 21552, using J 8947 to compress seals.
 - Hold J 21552 tightly against worm shaft and turn stub shaft clockwise until rack piston (26) is seated on worm shaft (13).



Important

- Make sure that all rack piston balls (25) are reinstalled in the rack piston. Improper rack piston ball installation may result in personal injury.

3B1A-10 POWER STEERING GEAR UNIT REPAIR

- Rack piston plug (27).



Tighten

- Rack piston plug (27) to 150 N•m (111 lb. ft.)

- Housing end plug. Refer to "Housing End Plug Replacement" in this section.
- Pitman shaft and side cover. Refer to "Pitman Shaft and Side Cover Replacement" in this section.



Adjust

- Steering gear. Refer to "Steering Gear Adjustments" in section 3B.



Install or Connect

- Steering gear. Refer to "Power Steering Gear Replacement" in this section.

PITMAN SHAFT SEALS AND BEARING REPLACEMENT

Figures 1 and 2

This procedure covers the seal and bearing replacement for steering gears. The steering gear uses one single lip seal and one double lip seal. Seals may be replaced without removing the power steering gear. Refer to "Pitman Shaft Seals and Bearing Replacement" under "On-Vehicle Service" in this section.

Tools Required:

- J 6278 Pitman Shaft Bearing Remover and Installer
- J 6219 Pitman Shaft Oil Seal Installer
- J 4245 Internal Snap Ring Pliers



Remove or Disconnect

- Pitman arm from steering gear. Refer to "Steering

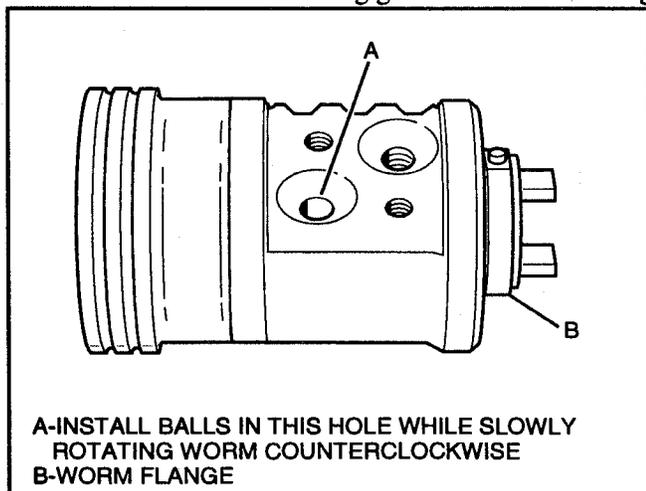


Figure 17 Installing the Balls in the Rack Piston

Linkage" in section 3B3.



Clean

- Exposed end of pitman shaft (12) and housing (20).
- Use a wire brush to clean pitman shaft splines.



Disassemble

- Retaining ring (35) using J 4245.

Notice: Use care not to score the housing bore when prying out seals and washers.

- Backup washer (33), and double lip seal (32) using a screwdriver to pry them from the housing (20).
- Backup washer (31) and single lip seal (30) using a screwdriver.



Inspect

- Housing (20) for burrs and remove if necessary.
- Needle bearing (28).
 - Insert J 6278 through the hole in the top of the housing (20) and drive out bearing (28).



Assemble

- Coat double lip seal (32) and washer (33) with grease.

- Needle bearing (28) to housing (20) using J 6278.
- Single lip seal (30) using J 6219.
- Backup washer (31).
- Double lip seal (32).
- Backup washer (33).
- Retaining ring (35) using J 4245.
- Pitman shaft and side cover. Refer to "Pitman Shaft

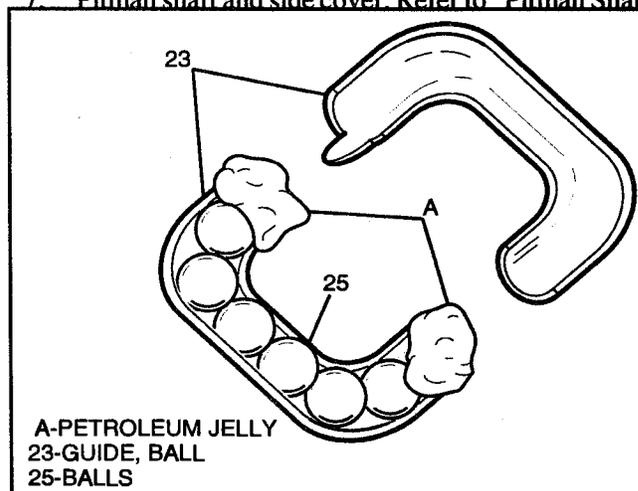


Figure 18 Placing Balls in the Ball Return Guide

and Side Cover Replacement” in this section.

↔ ↔ Install or Connect

- Pitman arm to steering gear. Refer to “Steering Linkage” in section 3B3.

CHECK VALVE REPLACEMENT

↔ ↔ Remove or Disconnect

- Steering gear from vehicle. Refer to “Power Steering Gear Replacement” in section 3B.

⊠ Disassemble

Notice: Use care not to damage threads of housing when removing check valve.

- Check valve (18) by prying from housing with a

small screwdriver.

⊠ Assemble

- Check valve (18) using a 3/8-inch diameter piece of tubing 100 mm (4 inches) long to drive into housing.

↔ ↔ Install or Connect

- Steering gear. Refer to “Power Steering Gear Replacement” in section 3B.

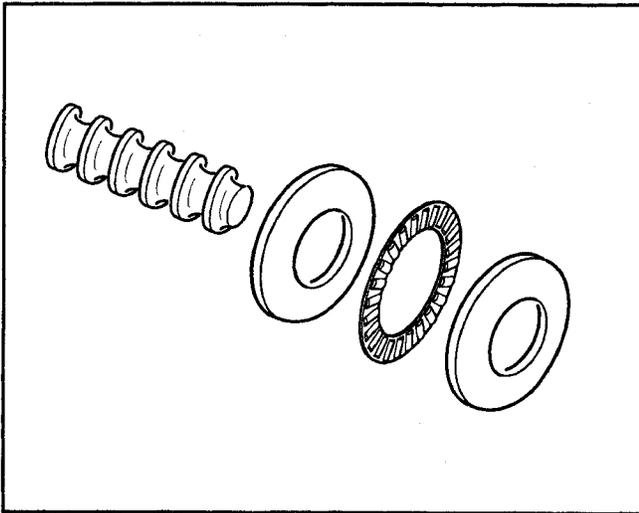


Figure 19 Worm Shaft and Bearing

SPECIFICATIONS

FLUID CAPACITIES

Power Steering Fluid Requirement GM Power Steering Fluid
Part No. 1050017 or Equivalent meeting GM Specification 9985010.

FASTENER TIGHTENING SPECIFICATIONS

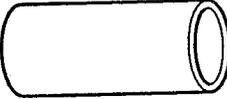
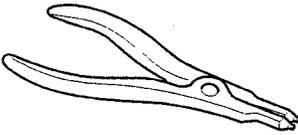
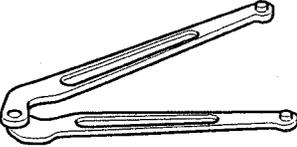
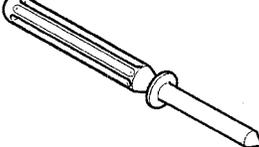
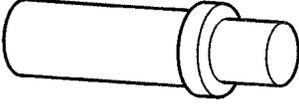
(8)	Steering Gear Adjuster Lock Nut	49 N•m	(36 lb. ft.)
(21)	Rack Piston Guide Clamp Screw	58 N•m	(43 lb. in.)
(27)	Rack Piston Plug	150 N•m	(111 lb. ft.)
(48)	Coupling Shield Ret. and Lock Nut	109 N•m	(80 lb. ft.)

ADJUSTMENT TIGHTENING SPECIFICATIONS

(40)	Pitman Shaft Over-Center Preload*	0.7-1.1 N•m	(6-10 lb. in.)
(65)	Steering Gear Adjuster Nut	30 N•m	(22 lb. ft.)

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

SPECIAL TOOLS

1. J 6219 	2. J 4245 	3. J 7624 
4. J 8947 	5. J 21552 	6. J 6278 

1. PITMAN SHAFT OIL SEAL INSTALLER
2. INTERNAL SNAP RING PLIERS
3. SPANNER WRENCH
4. RACK PISTON TEFLON RING COMPRESSOR
5. RACK PISTON ARBOR
6. PITMAN SHAFT BEARING REMOVER AND INSTALLER

SECTION 3B1B

POWER STEERING PUMP UNIT REPAIR

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use **ONLY** the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. **UNLESS OTHERWISE SPECIFIED,** do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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3B1B-2 POWER STEERING PUMP UNIT REPAIR

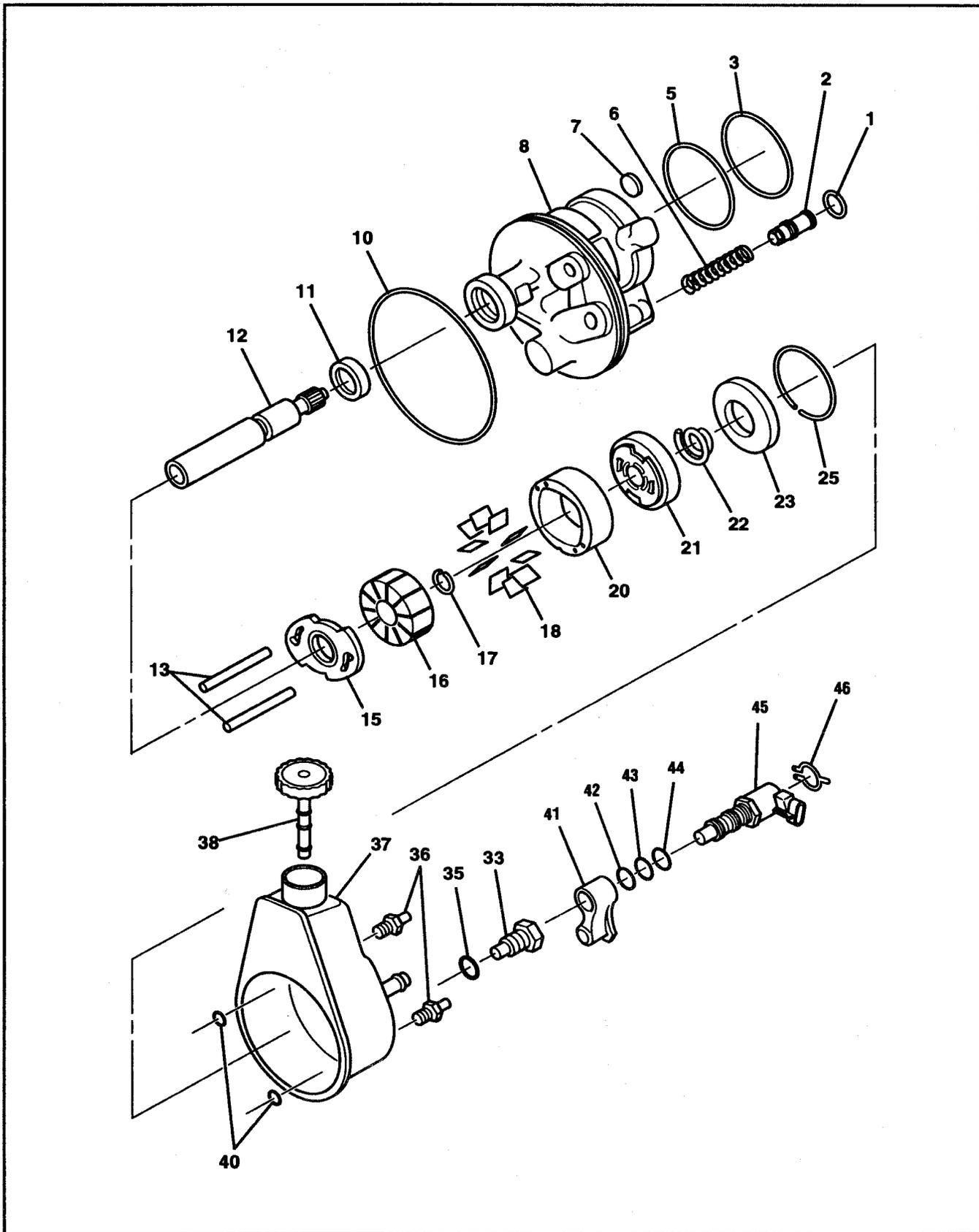


Figure 1 Power Steering Pump

Key No.	Part Name	Key No.	Part Name
1	SEAL, O-RING	21	PLATE, PRESSURE
2	VALVE ASM, CONTROL	22	SPRING, PRESSURE PLATE
3	SEAL, O-RING	23	PLATE, END
5	SEAL, O-RING	25	RING, END PLATE RETAINING
6	SPRING, FLOW CONTROL	33	FITTING ASM (CONNECTOR &)
7	MAGNET	35	SEAL, O-RING
8	HOUSING ASM, PUMP	36	BOLT, PUMP MOUNTING
10	SEAL, O-RING (HOUSING)	37	RESERVOIR ASM
11	SEAL, DRIVE SHAFT	38	ASM, RESERVOIR
12	SHAFT, DRIVE	40	SEAL, O-RING (HOUSING TO STUD)
13	PIN, DOWEL	41	FITTING, DISCHARGE
15	PLATE, THRUST	42	SEAL, O-RING
16	ROTOR, PUMP	43	SEAL, O-RING
17	RING, SHAFT RETAINING	44	SEAL, O-RING
18	VANE, PUMP	45	ACTUATOR & FITTING ASM, EVO
20	RING, PUMP	46	CLIP, RETAINING

Figure 2 Power Steering Pump - Legend

DRIVE SHAFT SEAL REPLACEMENT

Figures 1, 2 and 3



Remove or Disconnect

- Power steering pump from vehicle. Refer to "Power Steering Pump Replacement" in section 3B.



Disassemble

- Protect drive shaft (12) with shim stock.
- Seal (11) by cutting with a chisel.



Assemble

Tool Required:
J 7728 Shaft Oil Seal Installer

- Lubricate seal (11) with power steering fluid.
- Seal (11) using J 7728.



Install or Connect

- Power steering pump. Refer to "Power Steering Pump Replacement" in section 3B.

VARIABLE ASSIST STEERING ACTUATOR

Figures 1 and 2

This vehicle may be equipped with a Variable Assist Steering hydraulic control system. If the power steering pump has Variable Assist Steering, service as follows.



Remove or Disconnect

1. Negative (-) battery cable.
2. Electrical connector from Variable Assist Steering actuator (22).

3. Pump assembly from vehicle, if necessary for access.
4. Retaining clip (23) from Variable Assist Steering actuator (22).
5. Variable Assist Steering actuator (22) and discharge fitting (17).
 - Discharge fitting from Variable Assist Steering actuator.
 - O-Ring seals (18, 20 and 21) from Variable Assist Steering actuator (22).



Install or Connect

1. O-Ring seals (18, 20 and 21) on Variable Assist Steering actuator (22).
2. Discharge fitting (17) to Variable Assist Steering actuator (22).
3. Variable Assist Steering actuator and discharge fitting (17) to pump assembly.
4. Position discharge fitting (17).
5. Negative (-) battery cable.

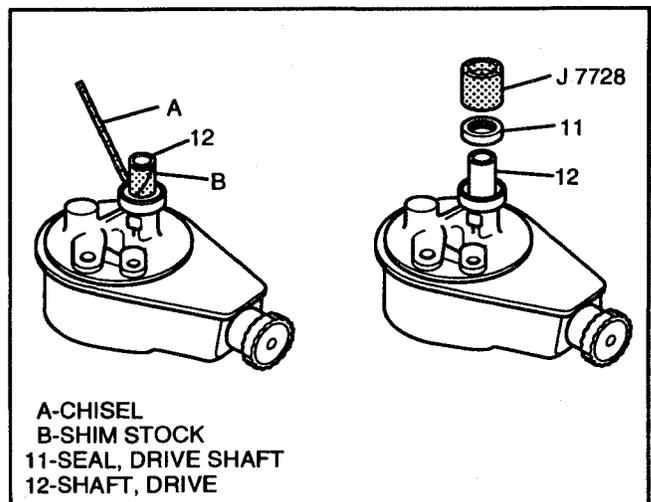


Figure 3 Drive Shaft Seal

3B1B-4 POWER STEERING PUMP UNIT REPAIR



Tighten

- Variable Assist Steering actuator (22) to 62 N•m (46 lb. ft.).
6. Electrical connector to Variable Assist Steering actuator (22).
 7. Retaining clip (23) to Variable Assist Steering actuator (22).
 - If a new Variable Assist Steering actuator (22) is being installed, position electrical connector before installing retaining clip (23).
 8. Pump assembly to vehicle, if removed.

PUMP RESERVOIR REPLACEMENT

Figure 1



Remove or Disconnect

- Power steering pump from vehicle. Refer to "Power Steering Pump Replacement" in section 3B.



Disassemble

- Drain power steering fluid from pump.
1. Bolts (36).
 2. Fitting (33) and O-ring seal (35).

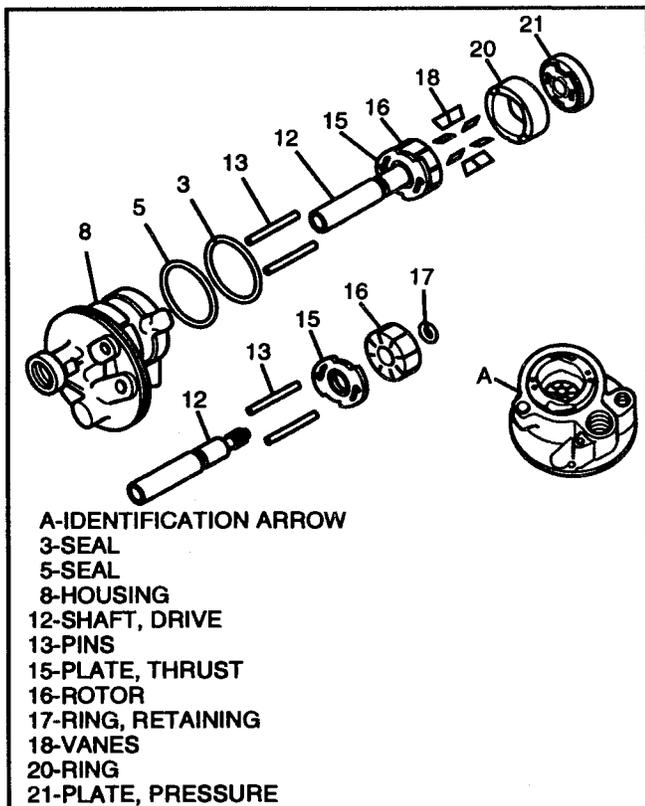


Figure 4 Rotating Group

3. Control valve assembly (2) and flow control spring (6) from housing (8) if replacement is required.
4. Reservoir (37) from housing (8).
5. O-ring seals (1, 10, and 40).
6. Magnet (7).



Clean

- Magnet (7).



Inspect

- Welch plug in housing (8). Do not remove. If plug is deformed or dislodged, replace housing (8).



Important

- Use new seals when assembling pump.



Assemble

- Lubricate O-ring seals (1, 10, 35 and 40) with power steering fluid.
1. Flow control spring (6) and control valve assembly (2) to housing (8). See Figure 1 for proper orientation.
 2. O-ring seals (1, 10, and 40) to housing (8).
 3. Magnet (7) to housing (8).
 4. Reservoir (37) to housing (8).
 5. O-ring seal (35) and fitting (33).

Notice: See "Notice" on page 3B1B-1 of this section.

6. Bolts (36).



Tighten

- Bolts (36) to 58 N•m (43 lb. ft.).
- Fitting (33) to 75 N•m (55 lb. ft.).



Install or Connect

- Power steering pump. Refer to "Power Steering Pump Replacement" in section 3B.

END PLATE AND ROTATING GROUP REPLACEMENT

Figures 1, 2 and 4



Remove or Disconnect

- Power steering pump from vehicle. Refer to "Power Steering Pump Replacement" in section 3B.



Disassemble

1. Pump reservoir. Refer to "Pump Reservoir Replacement" in this section.
2. Retaining ring (25).
3. End plate (23) and spring (22).

Notice: Examine exposed portion of pump drive shaft. If it is corroded, clean with crocus cloth before removing. This will prevent damage to the shaft bushing which might require replacement of the entire housing.

4. Pressure plate (21) by using a rubber mallet to tap lightly on the drive shaft (12).
5. Pump ring (20).
6. Pump vanes (18).
7. Shaft, rotor and thrust plate assembly.
8. Shaft retaining ring (17).
9. Pump rotor (16).
10. Thrust plate (15).
11. Drive shaft (12).
12. Dowel pins (13).
13. O-ring seals (3 and 5).



Important

- Use new seals and drive shaft retaining ring when assembling pump.



Assemble

- Lubricate O-ring seals (3 and 5) with power steering fluid.
1. O-ring seals (3 and 5) to housing (8).
 2. Dowel pins (13) to housing (8).
 3. Thrust plate (15) and pump rotor (16) to drive shaft (12) and secure with retaining ring (17).
 4. Shaft, rotor and thrust plate assembly to housing (8).
 5. Pump vanes (18) to pump rotor (16).
 6. Pump ring (20) to housing (8) with identification arrows on top edge of ring (20) facing outward.
 7. Pressure plate (21).
 8. Spring (22) and end plate (23).
 9. Retaining ring (25).
 10. Pump reservoir (37). Refer to "Pump Reservoir Replacement" in this section.



Install or Connect

- Power steering pump. Refer to "Power Steering Pump Replacement" in section 3B.

3B1B-6 POWER STEERING PUMP UNIT REPAIR

SPECIFICATIONS

FLUID CAPACITIES

Power Steering Fluid Requirement GM Power Steering Fluid
Part No. 1050017 or Equivalent meeting GM Specification 9985010.

FASTENER TIGHTENING SPECIFICATIONS

- | | | | |
|------|-----------------------------|--------|--------------|
| (33) | Pump Fitting Assembly | 75 N•m | (55 lb. ft.) |
| (36) | Steering Pump Bolt | 58 N•m | (43 lb. ft.) |

SPECIAL TOOLS

1. J 7728



1. SHAFT OIL SEAL INSTALLER

SECTION 3B3

STEERING LINKAGE

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which components are being removed. This will reduce the possibility of the vehicle slipping from the hoist.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

The steering linkage consists of a pitman arm, idler arm, relay rod and two adjustable tie rods. On some four wheel drive models, a steering shock absorber is attached to the relay rod.

When the steering wheel is turned, the gear rotates the pitman arm which forces the relay rod to one side. The tie rods, which are connected to the relay rod 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 steering shock absorber is attached to the frame and relay arm.

The C 3500HD steering linkage consists of a pitman arm, tie rod assembly, and adjustable drag link.

In the heavy duty series, when the wheel is turned, the gear rotates the pitman arm which forces the adjustable drag link to one side. The tie rod then moves sideways, actuating the steering knuckles and turning the wheels.

The overall condition of the steering linkage affects steering performance. If parts are bent, damaged, worn or poorly lubricated, improper and possibly dangerous steering action will result.

Whenever any steering linkage components are repaired or replaced, check the steering geometry and front end alignment. Refer to SECTION 3A.

DIAGNOSIS OF STEERING LINKAGE

For diagnosis of steering linkage. Refer to SECTION 3B.

ON-VEHICLE SERVICE

STEERING LINKAGE INSPECTION

Important

- Damaged or broken steering linkage components must be replaced. Never attempt to repair these parts by welding.

Tie Rods

There are two tie rod assemblies. Each assembly is made up of five pieces, consisting of a sleeve, two clamps, and two tie rod ends. The ends are threaded into the sleeve and secured with the clamps. Right and left hand threads are used for toe-in adjustments and steering gear centering. For lubrication of tie rod ends refer to SECTION 0B.

Tie rod ends should be replaced when excessive up-and-down motion is present, or when excessive end play or loss of motion at the ball stud exists.

Before any service is performed, 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. If the torque required to remove the nut from the bolt exceeds 9 N.m (80 Lb in) discard the nuts and bolts. Apply penetrating oil between the clamp and tube and rotate the clamps until they move freely. Install all parts, with the correct part number, in the proper position.

Idler Arm

Inspect (Figure 1)

1. Raise the vehicle. Support the vehicle with jack stands. Allow the front wheels to rotate freely and the steering mechanism freedom to turn. Position the wheels in a straight ahead position.
 - On four wheel drive (K Models), the front differential carrier shield must be removed to access idler arm and steering linkage. Refer to SECTION 4C.
2. Place a spring scale near the relay rod end of the idler arm. Exert a 110 N (25 Lb) force upward and then downward (the force is forward and rearward) while measuring the total distance the arm moves. The total allowable movement is 2 mm (0.080 inch). Replace the idler arm if it exceeds this test.

Important

- Jerking the right wheel and tire assembly back and forth, causing an up and down movement of the idler arm, is NOT an acceptable testing procedure. There is no control on the amount of force being applied to the idler arm.
- Diagnose carefully whenever shimmy complaints are suspected of being caused by loose idler arms. Before inspecting suspension or steering components, technicians should consider areas such as dynamic imbalance, runout, or force variation of wheel and tire assemblies, and road surface irregularities. Refer to SECTION 3E.

IDLER ARM REPLACEMENT

Tools Required:

- J 24319-01 Steering Linkage Puller
- J 29193 Steering Linkage Installer (12 mm)
- J 29194 Steering Linkage Installer (14 mm)

NOTICE: Do not attempt to free the ball stud by using a pickle fork or wedge type tool, because seal or bushing damage could result. Use the proper tool to separate all joints.

Remove or Disconnect (Figures 2 through 4)

- Raise the vehicle. Support the vehicle with jack stands.
- 1. Idler arm frame bolts and nuts.
- 2. Idler arm ball stud nut. Do not reuse the nut.
- 3. Idler arm from the relay rod. Use J 24319-01.

Inspect

- Ball stud threads for damage.
- Ball stud seal for cuts or other damage.

Clean

- Threads on the ball stud.

Install or Connect (Figures 2 through 4)

NOTICE: Refer to "Notice" on page 3B3-1.

- Position the idler arm mounting bracket on the frame.

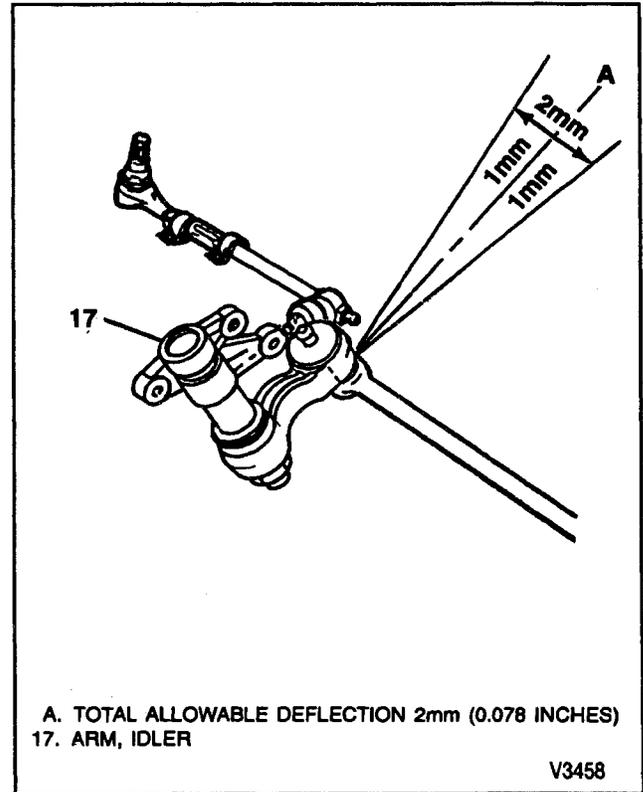
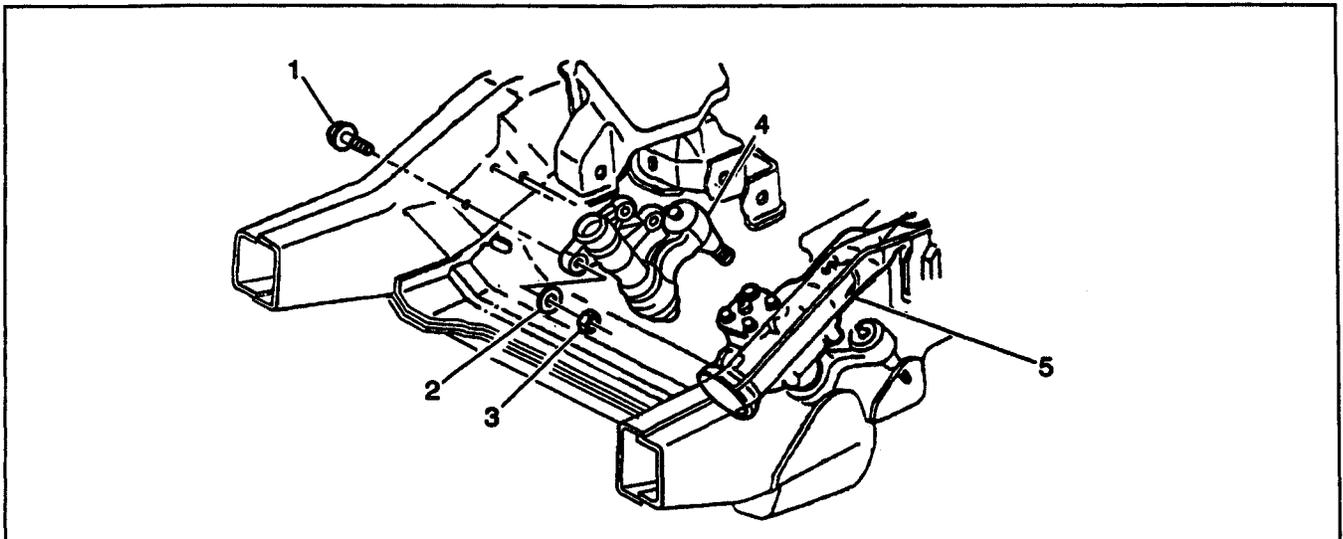


Figure 1—Idler Arm Movement Check



Legend

- | | |
|------------|-------------------|
| (1) Bolt | (4) Idler Arm |
| (2) Washer | (5) Steering Gear |
| (3) Nut | |

Figure 2 - Idler Arm Installation

3B3-4 STEERING LINKAGE

1. Frame bolts and nuts to the idler arm.

Tighten

1. Frame bolts to 99 nm (73 Lb ft).
2. Relay rod to the idler arm ball stud. Make sure the seal is on the stud. Tighten tool J 29193 or J 29194 to 54 N.m (40 Lb ft) to seat the tapers. Remove the tool.
3. New prevailing torque nut to the idler arm ball stud

Tighten

- Nut to 62 N.m (46 Lb ft).
- Lower the vehicle.

Adjust

- Toe-in if necessary. Refer to SECTION 3A.

RELAY ROD REPLACEMENT

Tool Required:

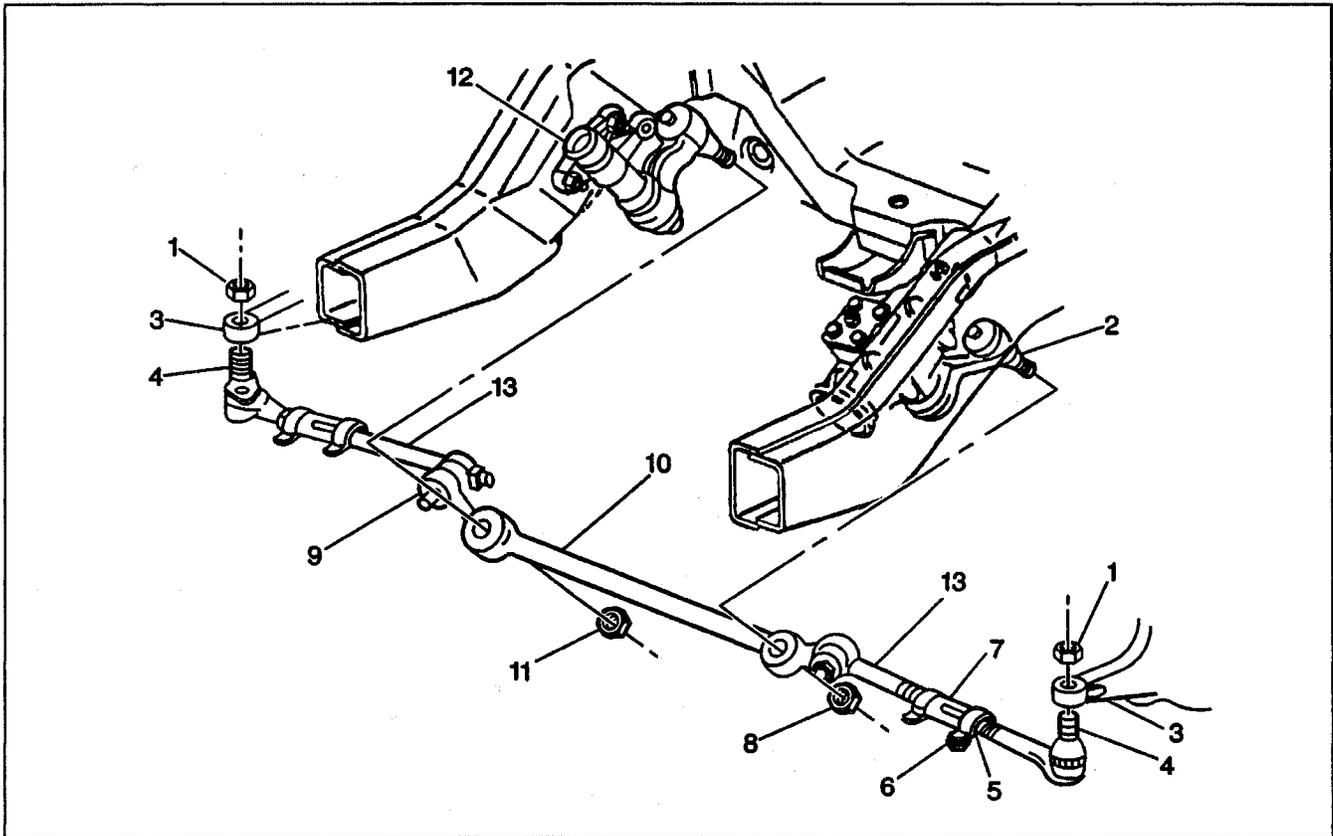
- J 24319-01 Steering Linkage Puller
- J 29193 Steering Linkage Installer (12 mm)
- J 29194 Steering Linkage Installer (14 mm)

Important

- Use the proper tool to separate all tie rod and ball joints.

Remove or Disconnect (Figures 2 through 6)

- Raise the vehicle. Support the vehicle with jack stands.
- 1. Steering shock absorber from the relay rod
- 2. Inner tie rod ball joint from the relay rod (if equipped). Refer to "Tie Rod Replacement" in this section.
- 3. Idler arm ball stud nut. Do not reuse.
- 4. Pitman arm nut. Do not reuse.



Legend

- | | |
|---------------------------|-----------------------|
| (1) Outer Tie Rod Nut | (8) Pitman Arm Nut |
| (2) Pitman Arm | (9) Inner Tie Rod Nut |
| (3) Steering Knuckle | (10) Relay Rod |
| (4) Tie Rod Ball Stud | (11) Idler Arm Nut |
| (5) Adjuster Sleeve Clamp | (12) Idler Arm |
| (6) Adjuster Sleeve Nut | (13) Inner Tie Rod |
| (7) Adjuster Sleeve | |

Figure 3 - Steering Linkage (Two Wheel Drive)

3B3-6 STEERING LINKAGE

- C. Tighten Steering Linkage Installer to 62 N.m (46 lb ft) to seat the tapers.
- D. Remove the tool.
3. New idler arm prevailing torque nut.
4. New pitman arm prevailing torque nut.

Tighten

- Nuts to 62 N.m (46 lb ft).
5. Tie rod inner ball joints to the relay rod. Refer to "Tie Rod Replacement" in this section.

DRAG LINK REPLACEMENT

I-Beam Front Axle (C 3500HD Models Only)

Tools Required:

- J 24319-01 Steering Linkage Puller
- J 29194 Steering Linkage Installer (14 mm)

Important

- Use the proper tool to separate all ball joints.

Remove or Disconnect (Figure 5)

- Raise the vehicle. Support the vehicle with jack stands.

1. Nuts from pitman arm ball stud and drag link ball stud.
2. Drag link from pitman arm using J 2419-01.
3. Drag link from tie rod assembly using J 2419-01.

Inspect

- Threads on the tie rod for damage.
- Ball stud threads for damage.
- Ball stud seals for excessive wear.

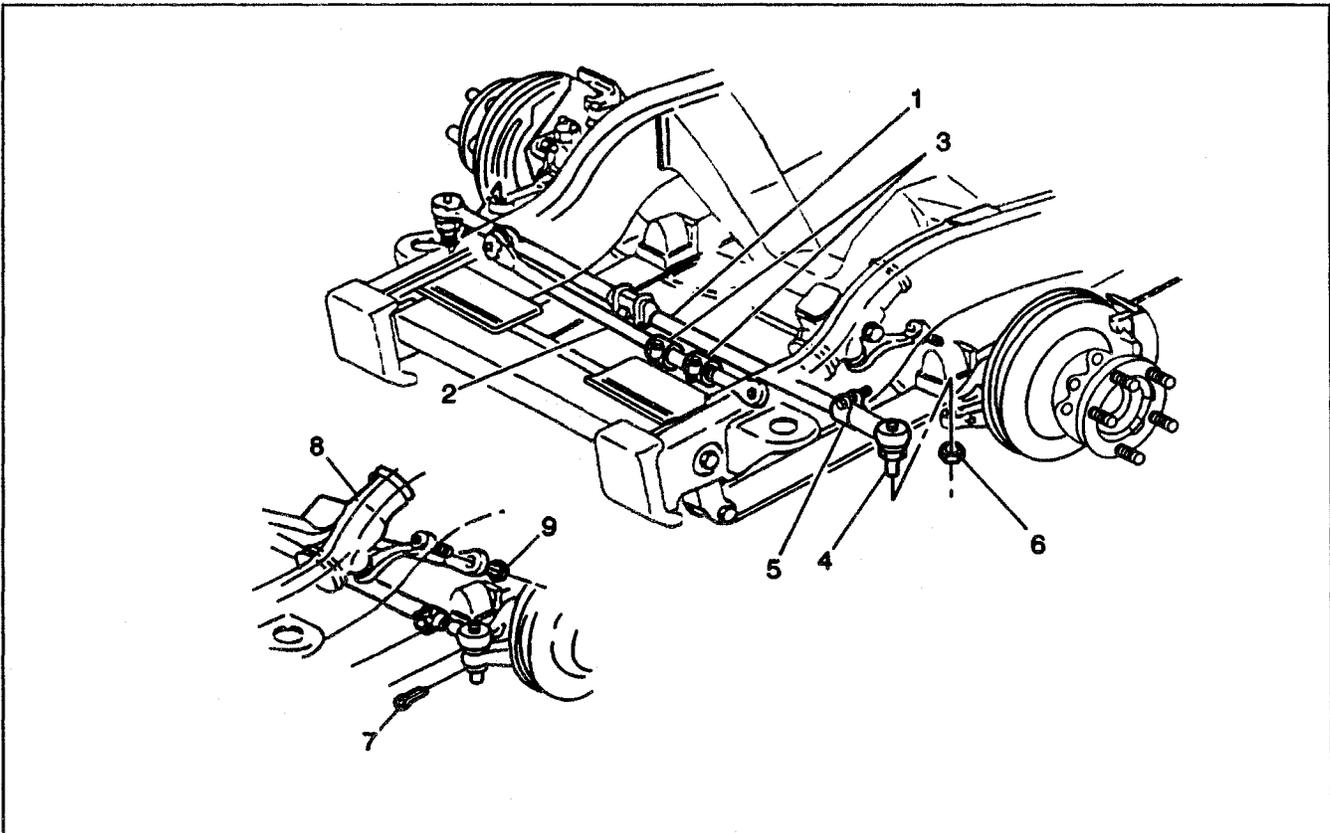
Clean

- Threads on the ball stud.

Install or Connect (Figure 5)

NOTICE: Refer to "Notice" on page 3B3-1.

1. Drag link ball stud to tie rod assembly.
 2. Drag link to pitman arm ball stud.
- A. Make sure the seal is on the studs.
 - B. Install J 29194.
 - C. Tighten to 62 N.m (48 lb ft) to seat the tapers.



Legend

- | | |
|------------------------|-------------------|
| (1) Tie Rod Assembly | (6) Nut |
| (2) Drag Link | (7) Cotter Pin |
| (3) Drag Link Adjuster | (8) Steering Gear |
| (4) Ball Stud | (9) Nut |
| (5) Adjuster Clamp | |

Figure 5—Steering Linkage - I-Beam Front Axle (C 3500HD Models)

- D. Remove the tool.
3. Nut to pitman arm ball stud.



- Nut to 54 N.m (40 lb ft).
4. Nut to drag link ball stud.



- Nut to 105 N.m (77 lb ft).
- Lower the vehicle.

PITMAN ARM REPLACEMENT

Two Wheel Drive

Tools Required:

- J 24319-01 Steering Linkage Puller
- J 29107 Pitman Arm Puller
- J 6632-01 Pitman Arm Remover
- J 29193 Steering Linkage Installer (12 mm).



- Use the proper tool to separate all ball joints.



- Raise the vehicle. Support the vehicle with jack stands.
1. Relay rod nut from the pitman arm ball stud. Do not reuse the nut.
 2. Relay rod from the pitman arm ball stud using J 24319-01.
 3. Pitman arm nut and washer.
 - Mark the pitman arm and the pitman shaft. This will permit proper alignment at assembly.

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

4. Pitman arm. Use J 6632-01 or J 29107.



- Ball stud threads for damage.
- Ball stud seals for excessive wear.



- Threads on the ball stud.



NOTICE: *Refer to "Notice" on page 3B3-1.*

1. Pitman arm on the pitman shaft. Line up the marks made at removal.
2. Pitman arm washer and nut.



- Pitman arm nut to 250 N.m (184 lb ft).

3. Relay rod to the pitman arm ball stud. Make sure the seal is on the stud.

- Tighten J 29193 Steering Linkage Installer to 62 N.m (46 lb ft) to seat the tapers. Then remove the tool.

4. New prevailing torque nut.



- Nut to 62 N.m (46 lb ft).
- Lower the vehicle.

Four Wheel Drive

Tools Required:

- J 24319-01 Steering Linkage Puller
- J 29107 Pitman Arm Puller
- J 6632-01 Pitman Arm Remover
- J 29193 Steering Linkage Installer (12 mm)



- Raise the vehicle. Support the vehicle with jack stands.
1. Relay rod nut from the pitman arm ball stud. Do not reuse the nut.
 2. Relay rod from the pitman arm ball stud using J 24319-01.
 3. Power steering gear. Refer to SECTION 3B.
 - Mark the pitman arm and the pitman shaft. This will permit proper alignment at assembly.

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

4. Pitman arm from pitman shaft of steering gear. Use J 6632-01 or J 29107.



- Ball stud threads for damage.
- Ball stud seals for excessive wear.



- Threads on the ball stud.



NOTICE: *Refer to "Notice" on page 3B3-1.*

1. Pitman arm on the pitman shaft. Line up the marks made at removal.
2. Pitman arm washer and nut.



- Pitman arm nut to 250 N.m (184 lb ft).
3. Steering gear to frame of vehicle. Refer to SECTION 3B.
 4. Relay rod to the pitman arm ball stud. Make sure the seal is on the stud.
 - Tighten J 29193 or J 29194 to 62 N.m (48 lb ft) to seat the tapers. Remove the tool.

3B3-8 STEERING LINKAGE

5. New prevailing torque nut.



Tighten

- Nut to 62 N.m (46 lb ft).
- Lower the vehicle.

I-Beam Front Axle (C 3500HD Models)

Tools Required:

- J 24319-01 Steering Linkage Puller
- J 29107 Pitman Arm Puller
- J 6632-01 Pitman Arm Remover
- J 29194 Steering Linkage Installer (14 mm)



Important

- Use the proper tool to separate all ball joints.



Remove or Disconnect (Figure 5)

- Raise the vehicle. Support the vehicle with jack stands.
1. Drag link from pitman arm ball stud.
 2. Pitman arm nut from steering gear shaft.
 - Mark the pitman arm and the pitman shaft. This will permit proper alignment at assembly.
 3. Pitman arm using J 6632-01 or J 29107.



Inspect

- Ball stud threads for damage.
- Ball stud seals for excessive wear.



Clean

- Threads on the ball stud.



Install or Connect (Figure 5)

NOTICE: Refer to "Notice" on page 3B3-1.

NOTICE: 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. Do not hammer, or damage to the steering gear may result.

1. Pitman arm on the pitman shaft. Line up the marks made at removal.
2. Pitman arm washer and nut.



Tighten

- Pitman arm nut to 250 N.m (184 lb ft).
3. Drag link to the pitman arm ball stud. Make sure the seal is on the stud.
 - Tighten J 29194 to 62 N.m (48 lb ft) to seat the tapers. Remove the tool.
 4. Pitman arm nut to the pitman arm ball stud.



Tighten

- Nut to 47 N.m (35 lb ft).
- Lower the vehicle.

TIE ROD REPLACEMENT

Tools Required:

J 6627-A Wheel Stud Remover and Tie Rod Remover

J 29193 Steering Linkage Installer (12 mm)

There are two tie rod assemblies. Each assembly consists of five pieces, an adjuster tube, two clamps, and two tie rod ends. The ends are threaded into the sleeve and secured with the clamps. Right and left hand threads are used for toe-in adjustments. The tie rod ends should be replaced when excessive up and down motion is present, or when excessive end play or loss of motion at the ball stud exists.

Before servicing, note the position of the tie rod adjuster tube and the direction the clamp bolts are installed. The tie rod adjuster tube components may be rusted. If the torque required to remove the nut from bolt the exceeds 9 N.m (80 lb in) discard the nuts and bolts. Apply penetrating oil between the clamp and tube and rotate the clamps until they move freely. Install all parts (with the correct part number) in the proper position.



Important

- Use J 6627-A to separate all tie rods and ball joints.



Remove or Disconnect (Figures 3 and 4)

- Raise the vehicle. Support the vehicle with jack stands.
1. Nut from the outer tie rod ball stud. Do not reuse the nut.
 2. Outer tie rod ball stud from the steering knuckle using J 6627-A.
 3. Nut from the inner tie rod ball stud Do not reuse the nut.
 4. Inner tie rod ball stud from the relay rod using J 6627-A.
 5. Tie rod ends from the adjuster tube.
 - A. Loosen the clamp nuts.
 - B. Spread the clamps.
 - C. Unscrew the tie rods.



Inspect

- Tie rod ends for damage.
- Tie rod end seals for excessive wear.
- Ball stud threads for damage.
- Adjuster tubes for bending or damaged threads.



Clean

- The tapered surfaces.
- Threads on the ball stud and in the ball stud nut.



Install or Connect (Figures 3 and 4)

NOTICE: Refer to "Notice" on page 3B3-1.

- If the rod end was removed, lubricate the tie rod threads with chassis lubricant.

1. Tie rod end to the adjuster tube. The number of threads on both the inner and outer rod ends must be equal within three threads.
2. Inner tie rod ball studs to the relay rod. The seal must be on the stud.
 - Stud to 54 N.m (40 lb ft) to seat the tapers, using J 29193.
3. New prevailing torque nut to the inner tie rod ball stud.

 **Tighten**

- Nut to 62 N.m (46 lb ft).
4. Outer tie rod ball studs to the steering knuckle.

 **Tighten**

- Stud to 54 N.m (40 lb ft) to seat the tapers, using J 29193.
5. New prevailing torque nut to the outer rod ball studs.

 **Tighten**

- Nut to 62 N.m (46 lb ft).

 **Adjust**

- Toe-in. Refer to SECTION 3A.

I-Beam Front Axle (C 3500HD Models)

The heavy duty suspension uses only one adjustable tie rod end, connected to the left steering knuckle spindle. A ball socket is found at the end of the tie rod assembly and attaches to the right steering knuckle spindle. The tie rod assembly rod attaches to the steering gear by means of a drag link and ball socket with an adjuster sleeve near to the pitman arm stud hole.

 **Remove or Disconnect (Figure 5)**

1. Cotter pin at ball stud.
2. Nut from ball stud.
3. Loosen nut and adjuster clamp.
4. Ball stud and tie rod end from tie rod assembly.

 **Inspect**

- Tie rod end for damage.
- Tie rod end seals for excessive wear.
- Threads on the relay rod and tie rod end for damage.
- Ball stud threads for damage.
- Adjuster tubes for bending or damaged threads.

 **Clean**

- The tapered surfaces.
- Threads on the ball stud and in the ball stud nut.

 **Install or Connect (Figure 5)**

NOTICE: Refer to "Notice" on page 3B3-1.

1. Ball stud and tie rod end to tie rod assembly.

2. Ball stud into steering knuckle.
3. Nut to ball stud and tie rod end.

 **Tighten**

- Nut to 88 N.m (65 lb ft)
4. Cotter pin, align cotter pin slot in nut with hole through tie rod stud. DO NOT back off nut to align slot.

 **Adjust**

- Toe-in. Refer to SECTION 3A.
5. Adjuster clamp nuts.

 **Tighten**

- Nut 104 N.m (77 lb ft).

TIE ROD CLAMP AND ADJUSTER TUBE POSITIONING

 **Adjust (Figure 6)**

1. Position adjuster tube clamp bolts (Figure 6). Before tightening the clamp bolts, be sure the following conditions have been met:
 - A. The clamps must be positioned between the locating dimples at either end of the adjuster tube.
 - B. The clamps must be positioned within the angular travel shown in Figure 6.
 - C. Both inner and outer tie rod ends must rotate for their full travel. The position of each tie rod end must be maintained as the clamps are tightened to ensure free movement of each joint.
 - D. The clamp ends may touch when nuts are tightened to specification, but the gap next to the adjuster tube must not be less than the minimum dimension shown in Figure 6.

I-Beam Front Axle (C 3500HD Models)

 **Adjust (Figure 7)**

1. Align the front right wheel by using the drag link adjuster tube assembly.
 - A. Position the drag link adjuster clamps on the adjuster tube so the edge of the clamp ears do not fall in the adjuster tube slot.
 - B. Adjuster clamp must be located between (and not on) stamped adjuster tube dimples.
 - C. Ears of the drag link adjuster clamps must be rotationally positioned as in (Figure 6).
 - D. Tighten the drag link to the recommended torque. Refer to "Specifications" at the end of this section.
 - E. The drag link assembly must be capable of rocking on the socket balls through a minimum of 8 degrees total after the clamp nuts are tightened.
 - F. If tools are used to rotate the adjuster tube, special attention must be given to prevent damage to the corrosion protection coating.

3B3-10 STEERING LINKAGE

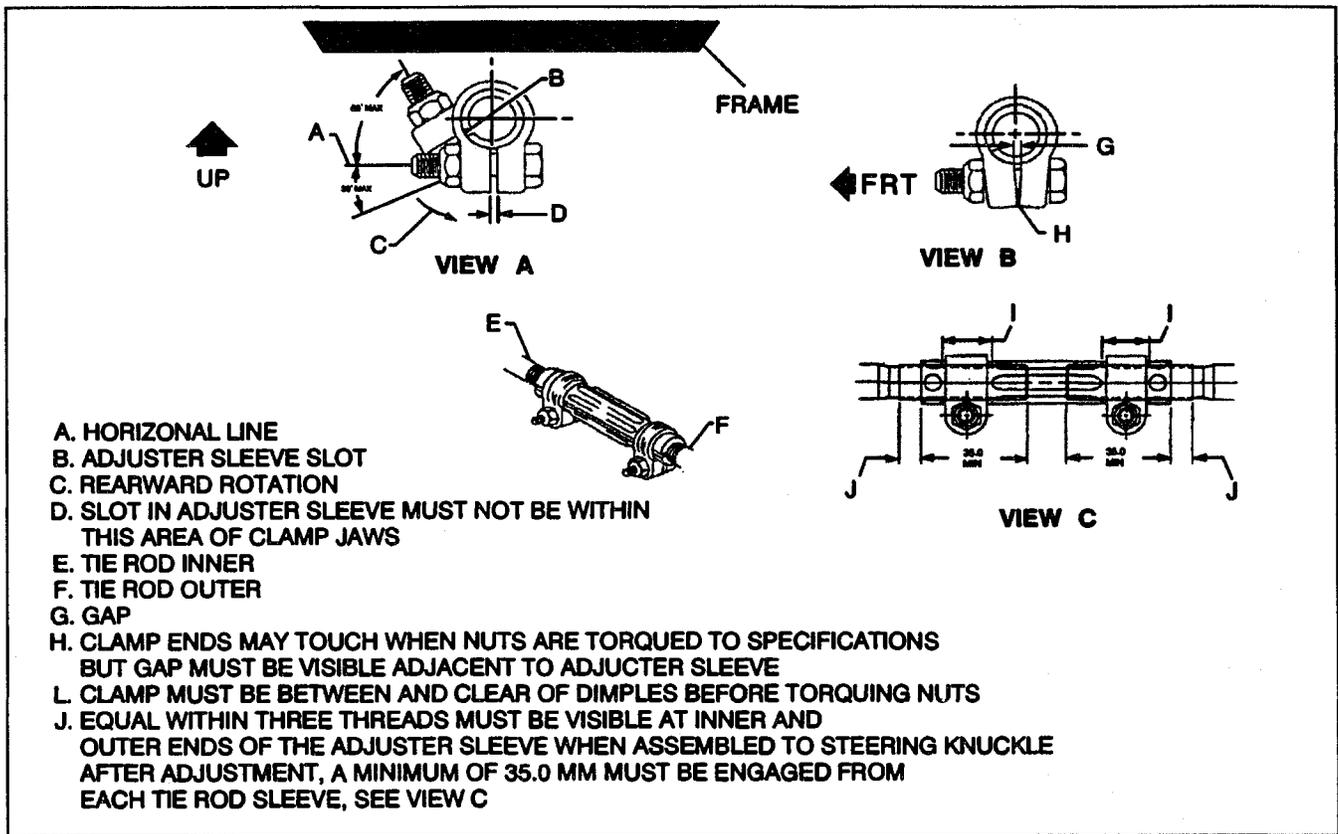


Figure 6—Tie Rod Clamp and Adjuster Tube Positioning

2. Align the left front wheel by using the tie rod adjuster tube assembly.

- A. Position the tie rod adjuster clamps on the adjuster tube so the edge of the clamp jaws do not fall in the adjuster tube slot.
- B. Adjuster clamps must be located between (and not on) the stamped adjuster tube dimples.
- C. Tie rod adjuster tube clamps must be positioned as specified in Figure 6.
- D. Tighten the tie rod adjuster tube clamp nut to the recommended torque. Refer to "Specifications" at the end of this section.
 - If tools are used to rotate the adjuster tube, special attention must be given to prevent damage to the corrosion protection coating.

Tighten

- Adjuster tube clamp bolt nuts to "Specifications" at the end of this section.

STEERING SHOCK ABSORBER INSPECTION

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

Inspect (Figure 8)

1. Shock absorber for fluid leakage. A slight film of fluid is allowable near the shaft seal. If there is excessive fluid leakage, be sure it is from the shock absorber and then replace the shock absorber.
2. Shock absorber bushing for excessive wear. Replace the shock absorber if necessary.
3. Test the shock absorber.
 - A. Disconnect the shock absorber from the frame or relay rod.
 - B. Extend and compress the shock absorber using as much travel as possible. Resistance should be smooth and constant for each stroking rate. Replace the shock absorber if any binding or unusual noises are present.
 - C. Install the end of the shock absorber and tighten to "Specifications" at the end of this section.

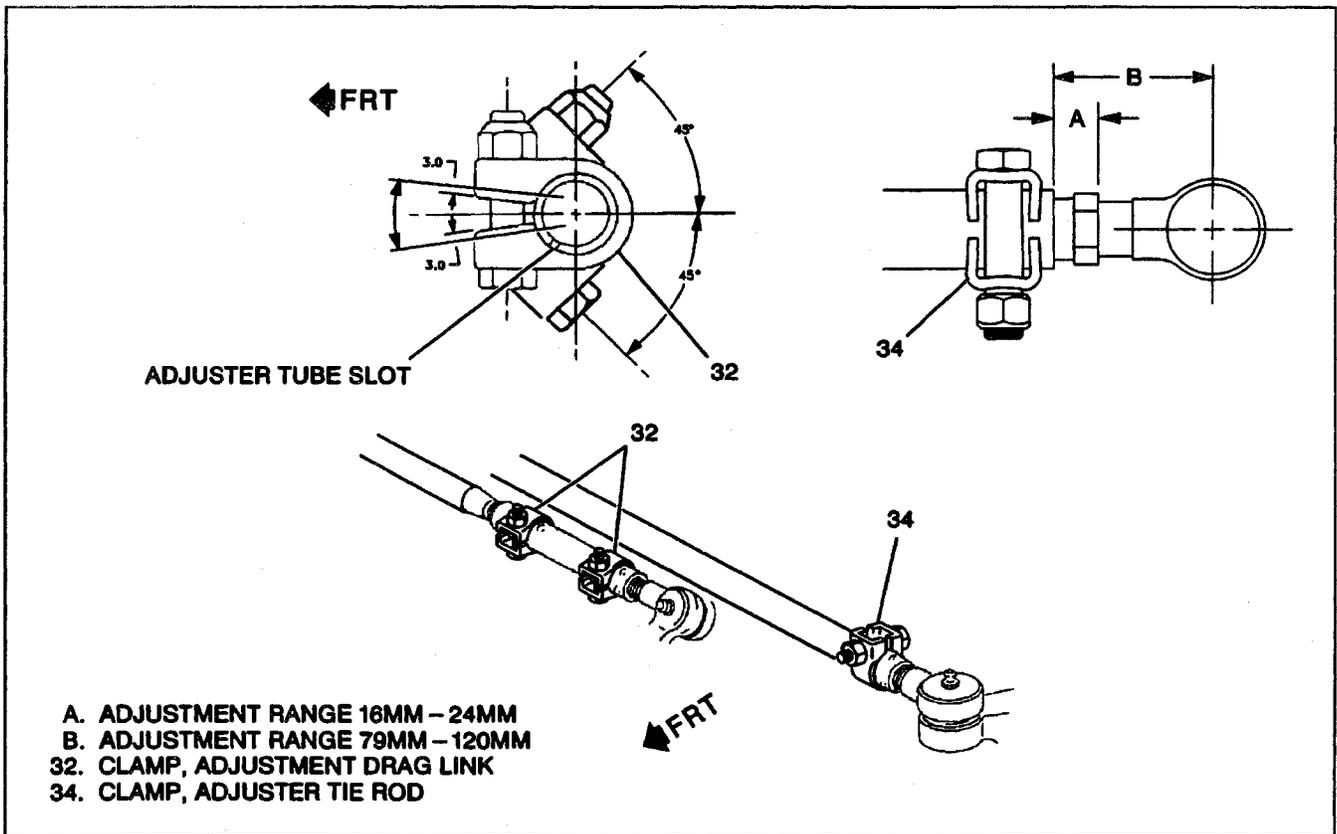


Figure 7—Tie Rod Clamp and Adjuster Tube Positioning - I-Beam Front Axle Models (C 3500HD Models)

STEERING SHOCK ABSORBER REPLACEMENT

Install or Connect (Figure 8)

Four Wheel Drive

Remove or Disconnect (Figure 8)

1. Relay rod cotter pin
2. Shock absorber lower ball stud nut.
3. Shock absorber lower ball stud from the relay rod.
4. Shock absorber mounting bolt nut.
5. Mounting bolt.
6. Shock absorber.

Inspect

- Shock absorber for leaks and damage.
- Mounting bolts and nuts for damage or corrosion.

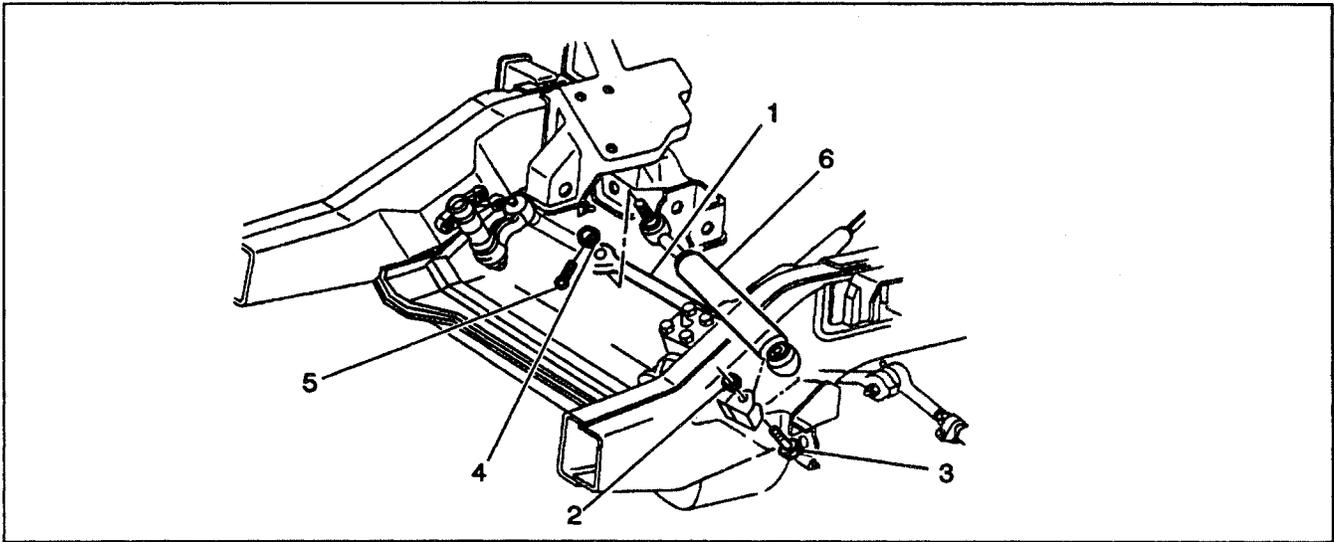
NOTICE: Refer to "Notice" on page 3B3-1.

1. Shock absorber.
2. Mounting bolt.
3. Nut.
4. Lower ball stud to the relay rod.
5. Nut.

Tighten

- Nut to 40 N.m (30 lb ft).
 - Nut to 63 N.m (46 lb ft). A maximum torque of 80 N.m (59 lb ft) is allowed in order to align the cotter pin slot. Do not back off the nut to insert the cotter pin.
6. Cotter pin.

3B3-12 STEERING LINKAGE



Legend

- | | |
|---------------|--------------------|
| (1) Relay Rod | (4) Nut |
| (2) Nut | (5) Cotter Pin |
| (3) Bolt | (6) Shock Absorber |

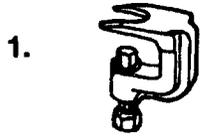
Figure 8—Steering Shock Absorber (K-Models)

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N-m	Lb ft	Lb in
C/K MODELS			
Adjuster Tube Clamp Nut	25	18	—
Idler Arm to Frame Nut	99	73	—
Idler Arm to Relay Rod Nut	62	46	—
Pitman Arm to Relay Rod Nut	62	46	—
Pitman Arm to Steering Gear Nut	250	184	—
Relay Rod to Tie Rod Nut	47	35	—
Steering Shock Absorber to Frame Bracket Nut	40	30	—
Steering Shock Absorber to Relay Rod Nut	62	46	—
Tie Rod to Steering Knuckle Nut	62	46	—
C 3500HD I-BEAM FRONT AXLE			
Drag Link Adjuster Tube Nuts	68	50	—
Drag Link to Tie Rod	105	77	—
Pitman Arm to Drag Link	47	35	—
Pitman Arm to Steering Gear	250	184	—
Tie Rod Adjuster Tube Nuts	104	77	—
Tie Rod to Steering Knuckle	88	65	—

SPECIAL TOOLS



J-6627-A

5.



J-29193

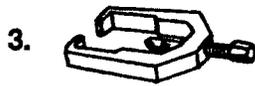


J-6632-01

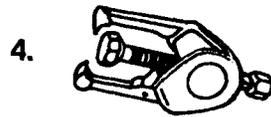
6.



J-29194



J-29107



J-24319-01

- 1. Tie Rod Puller
- 2. Pitman Arm Puller
- 3. Pitman Arm Puller
- 4. Universal Steering Linkage Puller
- 5. Steering Linkage Installer (12 mm) GM Torque Prevailing Nuts
- 6. Steering Linkage Installer (14 mm) GM Torque Prevailing Nuts

SECTION 3B5

**SPEED DEPENDENT STEERING
ELECTRONIC VARIABLE ORIFICE (EVO)**

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

NOTICE: Do not start the vehicle with any power steering gear inlet or outlet hoses disconnected. When disconnected, cap or plug all openings of components. Failure to do so could result in contamination or loss of power steering fluid and damage to the system.

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GENERAL DESCRIPTION

The Electronic Variable Orifice (EVO) system increases or decreases the amount of fluid leaving the power steering pump. This provides the driver with a comfortable balance of steering wheel feel and power assist.

At vehicle stand still or very low speeds, the system allows full hydraulic fluid flow for maximum power assist and reduced steering effort. As the vehicle gains speed, a variable orifice closes at the steering pump which reduces the pump fluid flow. This action provides a stiffer steering wheel response for improved road feel and greater directional stability at highway speeds.

A sensor mounted on the steering column, detects the rapid steering wheel movements associated with defensive driving maneuvers. A control module uses this sensor input and vehicle speed to adjust the amount of current to the fluid flow actuator.

The EVO System consists of the following components:

- The Power Steering Fluid Flow Actuator is located on the power steering pump discharge fitting.
- The Power Steering Control Module is mounted on the instrument panel carrier, to the right of the steering column.
- The Steering Wheel Position Sensor is located in the lower bearing of the steering column.
- The Vehicle Speed Sensor is located on the transmission (two wheel drive) or transfer case (four wheel drive).
- The Vehicle Speed Sensor Buffer is located on the bottom of the Powertrain Control Module (PCM) tray (diesel engines only).
- The Vehicle Control Module (VCM) is located in the engine compartment on the left inner wheel well panel (gas engines only).

HANDLING ELECTROSTATIC DISCHARGE (ESD) SENSITIVE PARTS

Many solid state electrical components can be damaged by Electrostatic Discharge (ESD). Some will display a label as shown in Figure 1, but many will not.

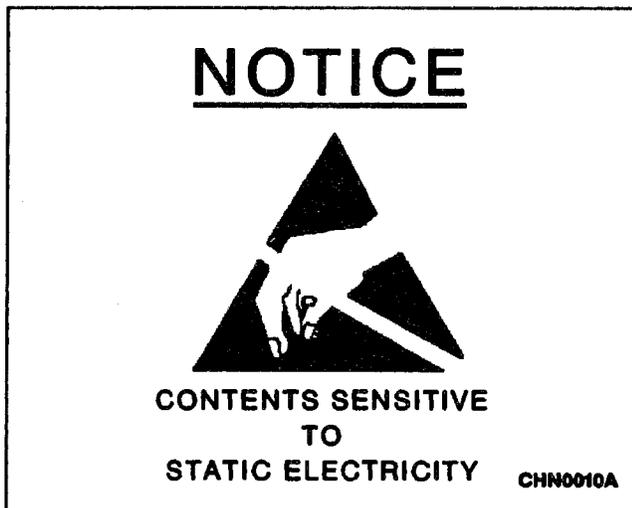


Figure 1 - Electrostatic Discharge Sensitive Parts Label

NOTICE: *In order to avoid possibly damaging any components, observe the following.*

1. Body movement produces an electrostatic charge. To discharge personal static electricity, touch a ground point (metal) on the vehicle. This should be done any time you:
 - Slide across the vehicle seat.
 - Sit down or get up.
 - Do any walking.
2. Do not touch exposed electric terminals on components or connectors with your finger or any tools. Remember, the connector you are checking might be tied into a circuit that could be damaged by electrostatic discharge.
3. When using a screwdriver or similar tool to disconnect a connector, never let the tool come in contact with or come between the exposed terminals.
4. Never jumper, ground, or use test equipment probes on any components or connectors unless specified in diagnosis. When using test equipment, always connect the ground lead first.
5. Do not remove the solid state component from its protective packaging until you are ready to install the part.
6. Always touch the solid state component package to a ground before opening. Solid state components can also be damaged if:
 - They are bumped or dropped.
 - They are laid on any metal work benches or components that operate electrically, such as a Radio, TV or Oscilloscope.

Not all parts that can be damaged by ESD have an ESD label. Some components that can be damaged by ESD are:

- Chime Module.
- Cruise Control Module.
- Powertrain Control Module (PCM).
- Vehicle Control Module (VCM).
- Automatic Day/Night Mirror.
- Radio/Radio Control.
- Anti-lock Brake System Electronic Brake (EBCM).
- Automatic Air Conditioning Control Assembly.
- Twilight Sentinel Amplifier.
- Electronic Spark Control Module.
- EPROM (programmable read only memory).

Solid state components also can be damaged if they are bumped or dropped, or if they are laid on a metal work bench or on an electrically operated item such as a Radio, a TV or an Oscilloscope.

SPEED DEPENDENT STEERING COMPONENTS AND OPERATION

Power Steering Hydraulic System

The Electronic Variable Orifice (EVO) power steering pump is a conventional power steering pump with a power steering fluid flow actuator mounted to the outlet port. When driving conditions require less hydraulic fluid, a flow control valve directs surplus pressurized fluid to the pump reservoir.

3B5-4 SPEED DEPENDENT STEERING

Power Steering Fluid Flow Actuator

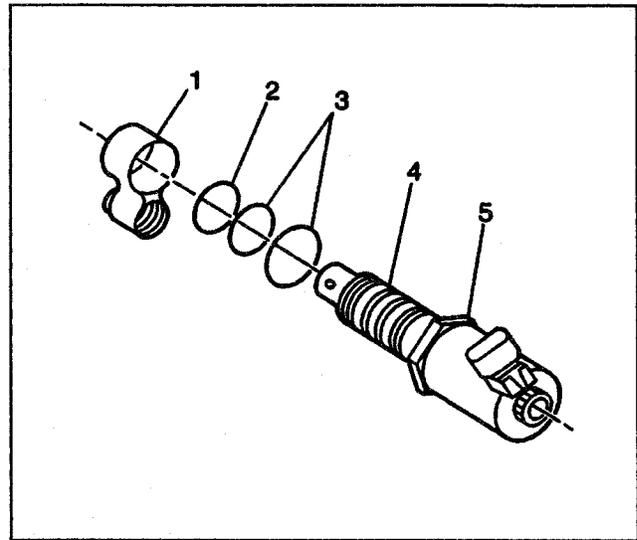
The power steering fluid flow actuator, mounted on the power steering pump (Figures 2 and 3), contains a solenoid operated valve. Discharged fluid passes through an orifice in the actuator. As the vehicle speed increases, the power steering control module increases electrical current to the fluid flow actuator. Higher current gradually moves the valve further and further into the orifice. This action restricts the passage of fluid flow through the orifice, reducing power assist in the steering gear. For diagnosis of the steering system, refer to SECTION 3B.

Because the Power Steering Control Module sends a variable signal, the power steering Fluid Flow Actuator provides variable levels of power assist. The EVO system therefore consistently adjusts power steering assist for changing vehicle speeds and driving conditions. For repair procedures, refer to "Power Steering Fluid Flow Actuator" in this section. For diagnosis, refer to "Diagnostic System Check" in this section.

Power Steering Control Module

The Power Steering Control Module (Figure 4), mounted behind the right side of the steering column to the I/P carrier, uses the Vehicle Speed Sensor and Steering Wheel Speed Sensor input to regulate electrical current to the Fluid Flow Actuator.

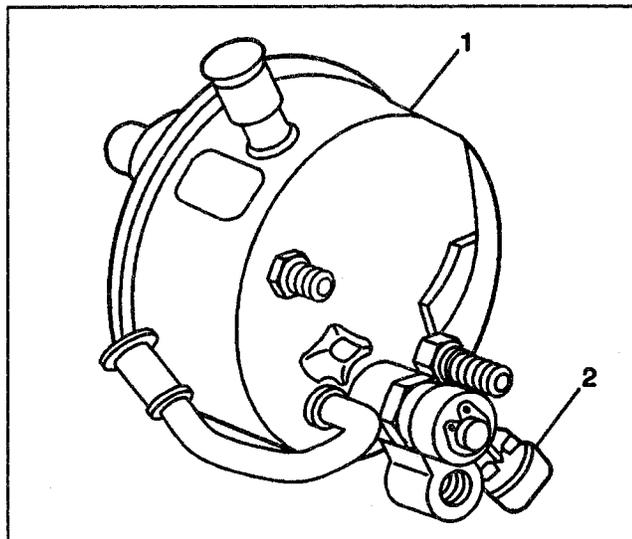
The Power Steering Control Module also detects faults with the Steering Wheel Speed Sensor, the Fluid Flow Actuator, and associated circuits. Upon detecting a fault, the Power Steering Control Module disables the EVO system and the vehicle operates with maximum power assist until the driver turns the ignition to the "OFF" position. When the vehicle is restarted, the Pow-



Legend

- (1) Discharge Fitting
- (2) O Ring (Large) Seal
- (3) O Ring (Small) Seal
- (4) Flow Control Valve
- (5) Power Steering Fluid Flow Actuator

Figure 3—Power Steering Fluid Flow Actuator



Legend

- (1) Power Steering Pump
- (2) Power Steering Fluid Flow Actuator,

Figure 2—Power Steering Fluid Flow Actuator Location

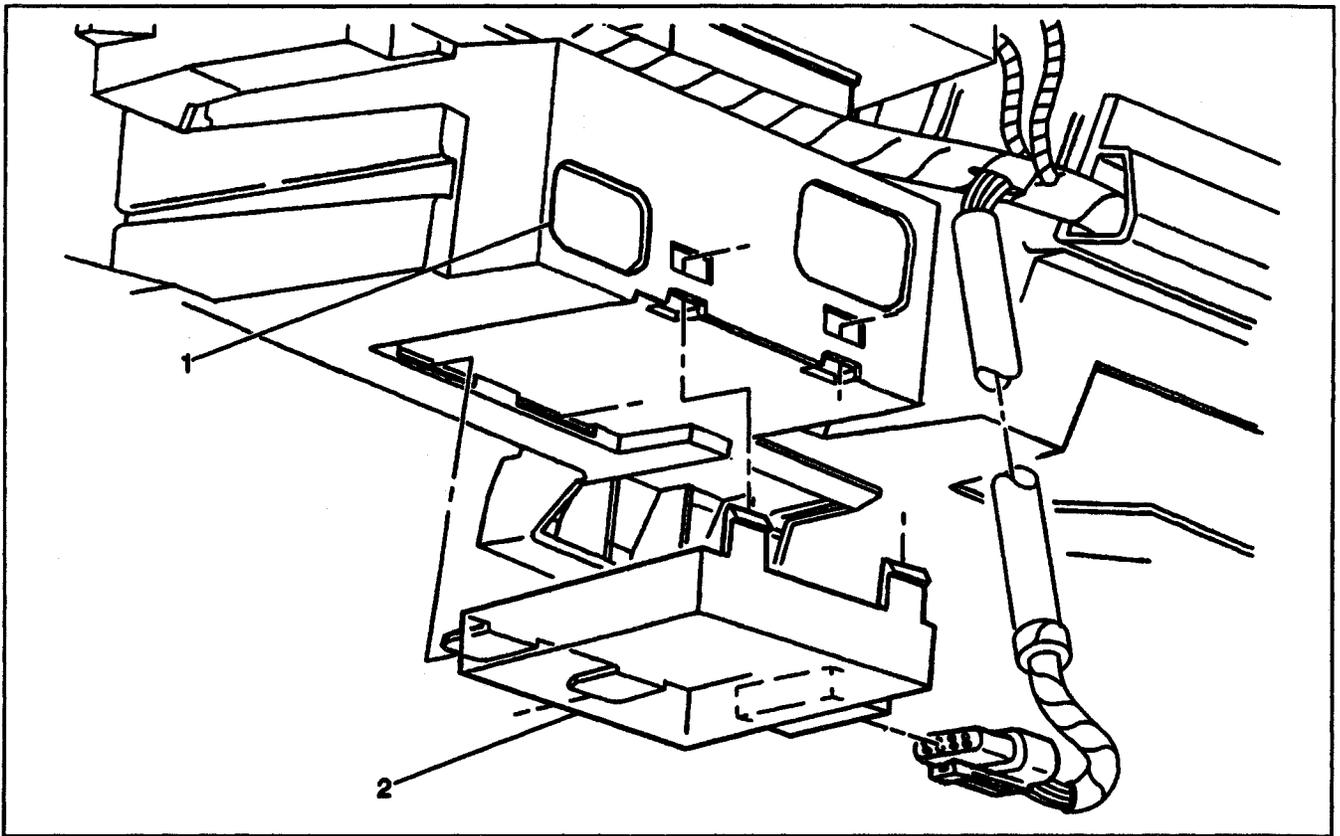
er Steering Control Module resets and enables EVO operation until it detects another fault. The Power Steering Control Module has fault code memory and can pinpoint specific faults. For repair procedure, refer to "Power Steering Control Module" in this section. For diagnosis, refer to "Diagnostic System Check" in this section.

Steering Wheel Position Sensor

This sensor is mounted in the lower bearing of the steering column. It detects abrupt or evasive steering maneuvers, and signals the Power Steering Control Module to reduce steering effort. The faster the driver turns the steering wheel, the quicker the signal is generated by the Steering Wheel Position Sensor. For repair procedures, refer to "Steering Wheel Position Sensor" in this section. For diagnosis, refer to "Diagnostic System Check" in this section.

Vehicle Speed Sensor

The Vehicle Speed Sensor (VSS) consists of a permanent magnet generator on the transmission housing or transfer case. The generator sends an electrical signal to the VSS buffer (Diesel Engines Only) or to the VCM (Gas Engines Only). The VSS buffer or VCM then calculates vehicle speed and notifies the Power Steering Control Module. For repair procedures, refer to SECTION 7A. For diagnosis, refer to "Diagnostic System Check" in this section.



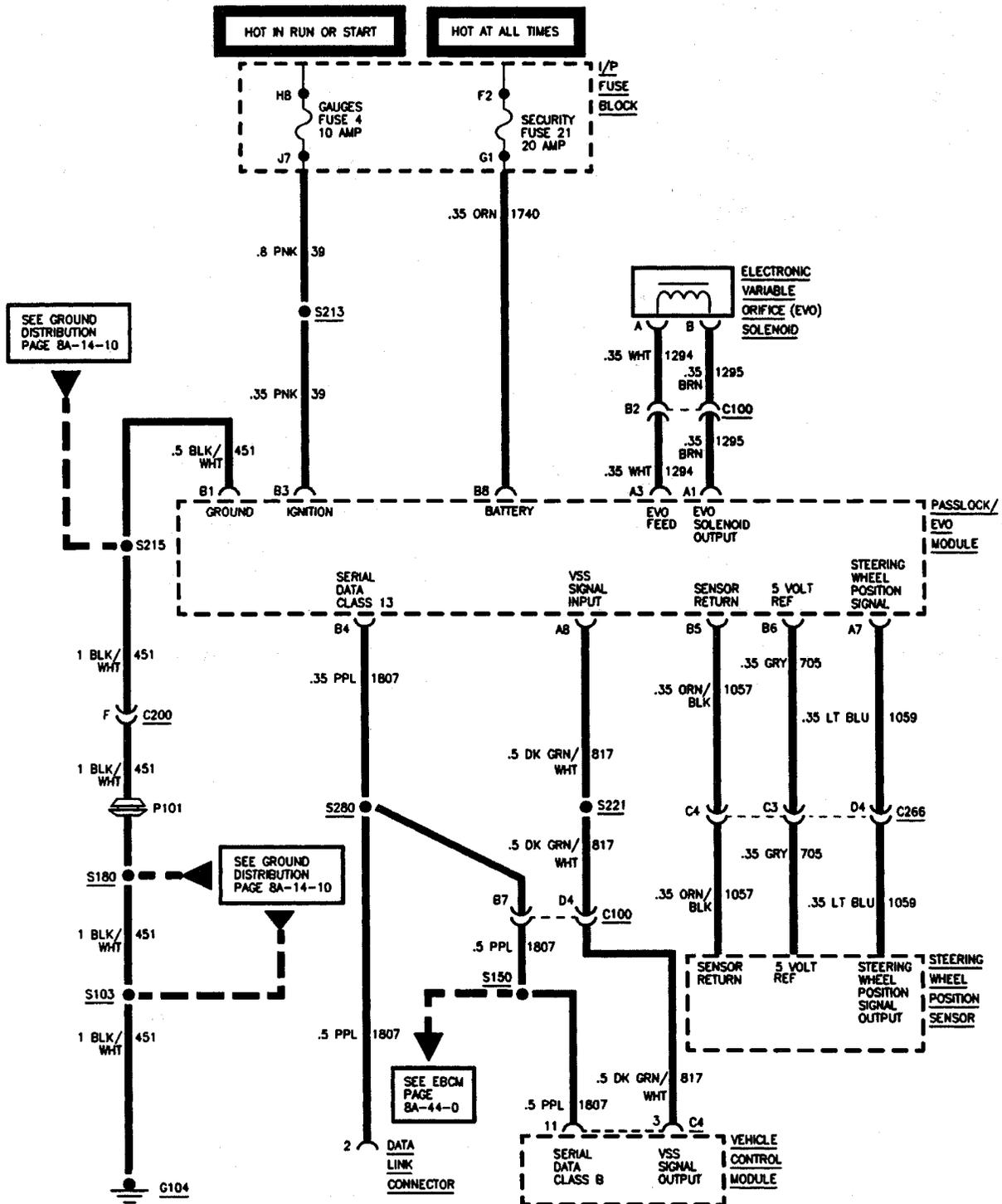
Legend

(1) Instrument Panel Carrier

(2) Power Steering Control Module

Figure 4—Power Steering Control Module

3B5-6 SPEED DEPENDENT STEERING



DIAGNOSIS SYSTEM CHECK

DIAGNOSTIC PROCESS

When servicing the Speed Dependent Steering Electronic Variable Orifice system (EVO), the following steps should be followed in order. Failure to follow these steps may result in the loss of important diagnostic data and may lead to difficult and time-consuming diagnostic procedures:

1. Perform a vehicle preliminary diagnostic inspection. This should include:
 - Inspection of the power steering fluid reservoir for proper power steering fluid level, signs of contamination and for proper power steering fluid type.
 - Inspection of the Power Steering Control Module (PSCM) and system for any wiring damage.
 - Inspection of Power Steering Fluid Flow Actuator, connector and wiring.
 - Inspection for poor powering steering pump performance.
 - Inspection of the power steering gear for leaks malfunction or poor performance.
 - Inspection of the vehicle speed system and wiring.
2. Perform the Diagnostic System Check found in this section. If any DTC's are displayed, note the last malfunction that occurred. Diagnose and repair this malfunction first.
3. If no DTC's or mechanical component malfunctions are present, or if the failure is intermittent and not reproducible, test drive the vehicle while using the automatic snapshot feature of the Scan Tool. Perform normal acceleration, stopping, and turning maneuvers. If this does not reproduce the malfunction, refer to intermittent diagnosis.
4. Once all system malfunctions have been corrected, clear the EVO DTC's and test drive the vehicle.

SELF DIAGNOSTICS

The Power Steering Control Module (PSCM) performs self-diagnostics of the EVO system and can detect and isolate system failures. When a malfunction is detected, the Power Steering Control Module (PSCM) sets a corresponding Diagnostic Trouble Code (DTC).

DISPLAYING DIAGNOSTIC TROUBLE CODES (DTC's)

DTC's must be read using a Scan Tool. There are no provisions for "Flash Code" DTC's.

CLEARING DIAGNOSTIC TROUBLE CODES (DTC's)

The DTC's in the memory can be erased using a Scan Tool.

Be sure to verify proper system operation and absence of DTC's when the clearing procedure is completed.

The Power Steering Control Module (PSCM) will not permit DTC clearing until all DTC's have been displayed. Also, DTC's cannot be cleared by unplugging the PSCM, disconnecting the battery cables, or turning the ignition OFF.

INTERMITTENT AND POOR CONNECTIONS

Most intermittent faults are caused by a faulty electrical connection or wiring, although a damaged Power Steering Control Module (PSCM) can occasionally be at fault. Refer to Intermittent and Poor Connections in Section 8A for a detailed explanation of how to locate and repair intermittent conditions.

SCAN TOOL DIAGNOSTICS

Refer to the Scan Tool Owner's Manual for information about the Scan Tool and the various modes.

CIRCUIT DESCRIPTION

The Power Steering Control Module (PSCM) supplies a 5.0 volt reference and a ground circuit to the Steering Wheel Position (SWP) Sensor. The SWP sensor returns a voltage signal to the (PSCM) indicating the steering wheel rate of steer. The SWP Sensor voltage returns a voltage greater than 0.2 volts and no more than 4.9 volts when the steering wheel has been turned one quarter revolution (90 degrees). The PSCM uses the sensor signal to control a pulse width modulation current (percentage DUTY CYCLE) to the power steering fluid flow actuator. The power steering fluid flow actuator in turn regulates the power steering pump output flow, thus increasing or decreasing power steering assist.

Diagnostic Trouble Code	Description
B0605	EEPROM Checksum Error
C0100	Vehicle Speed Information Circuit Malfunction
C0500	EVO Tracking Error
C0502	EVO Solenoid Circuit Low
C0503	EVO Solenoid Circuit High
C0507	Steering Wheel Position Sensor Signal Voltage Low
C0508	Steering Wheel Position Sensor Signal Voltage High

3B5-8 SPEED DEPENDENT STEERING

DIAGNOSTIC AIDS

A Tech 2 Scan Tool reads steering wheel position in volts. With the ignition switch in the "ON" position and as the steering wheel is rotated the, voltage should be between 0.2 - 4.9 volts. Voltage should increase at a steady rate up to 4.9 volts when the wheel is turned in either direction, one quarter revolution (90 degrees).

- above 0.2 volts.
- below 4.9 volts when the steering wheel is rotated one quarter revolution (90 degrees).

Using the Tech 2, scan the SWP Sensor.

- Turn the ignition "ON."
- Turn the steering wheel.

The Tech 2 display should show voltages from 0.2 -5.0 volts as the steering wheel is turned one quarter revolution (90 degrees). If the steering wheel voltage is not within specifications, verify that the steering wheel position sensor is not binding, grinding or damaged. For repair procedures refer to SECTION 3F4 or 3F5.

TEST DESCRIPTION

The numbers below refer to the step numbers in the on the Speed Dependent Electronic Variable Orifice (EVO) Diagnostic System Check Table.

- Step 1 ensures that the EVO System Check is performed.
- Step 2 verifies the class 2 communication between the PSCM and the Vehicle Control Module.
- Step 3 verifies if the EVO system is operating.
- Steps 4-9 verifies the power and ground to EVO module.
- Steps 10-12 verifies the EVO system sensor input and PSCM output.

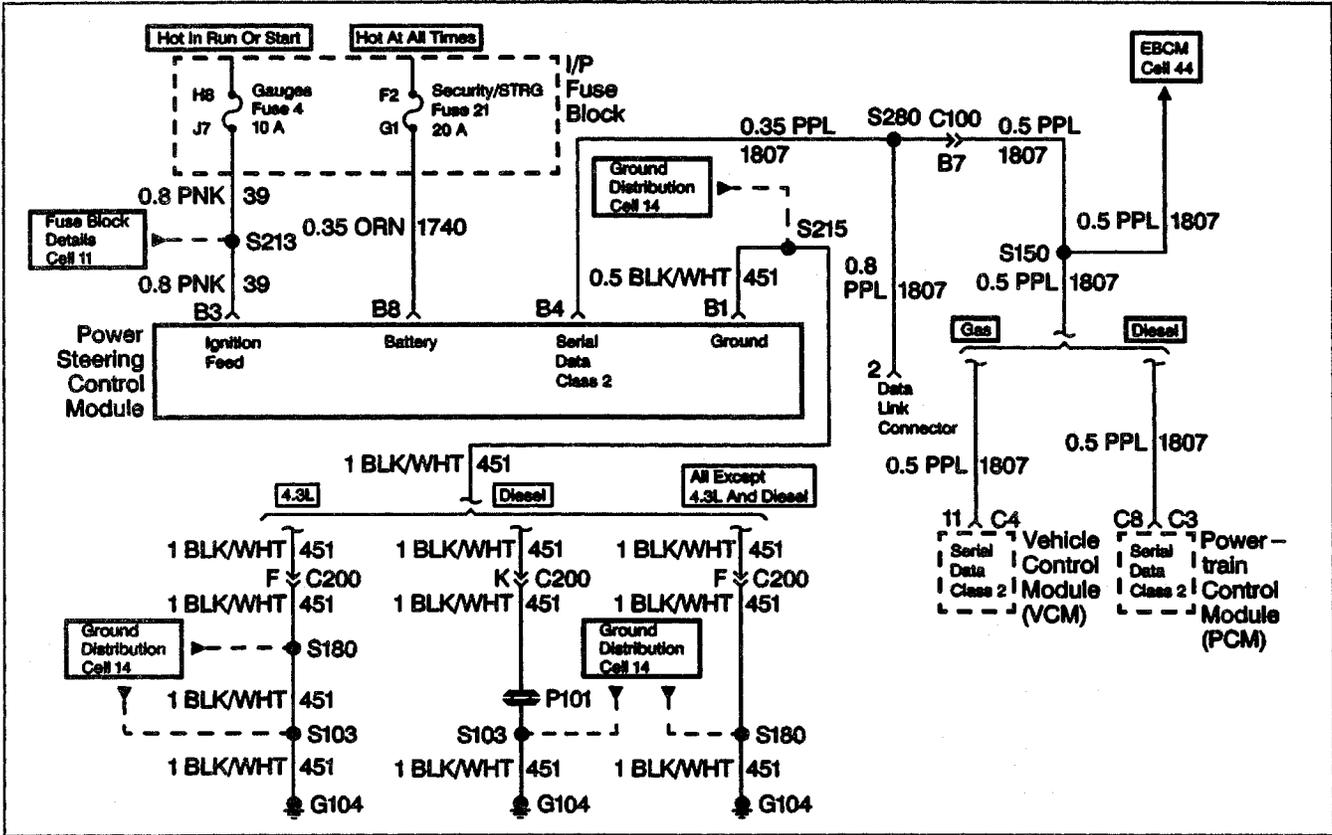
DIAGNOSTIC SYSTEM CHECK TABLE

Step	Action	Value(s)	Yes	No
1	1. Rotate the ignition switch to the ON position. 2. Connect the scan tool. 3. Check for any stored DTC's. Are there any DTC's?	—	Go to appropriate DTC Table	Go to Step 2
2	With the scan tool still connected monitor the steering wheel position sensor and power steering fluid flow actuator parameters on the scan tool. Are parameters present?	—	Go to Step 8	Go to Step 3
3	Inspect Fuse 21 (EVO). Was fuse open?	—	Go to Step 4	Go to Step 5
4	1. With the 16-way PSCM connector disconnected check for and repair short to ground between Fuse 21 and terminal B8 of the PSCM. 2. Inspect electrical terminals and connector for proper fit. Repair as necessary Was a repair made?	—	Go to Step 11	Go to Step 8
5	Inspect Fuse 4 (gauges). Was fuse open?	—	Go to Step 6	Go to Step 8
6	1. With the PSCM way connector disconnected check for and repair short to ground between Fuse 4 and terminal B3 of the PSCM. 2. Inspect electrical terminals and connector for proper fit. Repair as necessary. Was a repair made?	—	Go to Step 11	Go to Step 8

SPEED DEPENDENT STEERING 3B5-9

Step	Action	Value(s)	Yes	No
7	<ol style="list-style-type: none"> 1. With PSCM 16-way connector disconnected check for continuity or open wire from terminal B4 of the 16-way connector and ground. 2. Inspect electrical terminals and connector for proper fit. Repair as necessary. <p>Is continuity present?</p>	—	Go to Step 10	Go to Step 8
8	<p>Locate and repair open in CKT 451 between terminal B1 of the 16-way PSCM connector and ground.</p> <p>Was a repair made?</p>	—	Go to Step 11	Go to Step 10
9	<ol style="list-style-type: none"> 1. With the scan tool still connected, monitor the steering wheel position sensor and power steering fluid flow actuator parameters on the scan tool in the EVO selection. 2. Rotate the steering wheel a half turn to the left then slowly to the right. <p>Does the scan tool values change while rotating the steering wheel?</p>	—	Go to Step 10	Go to Step 11
10	<p>System normal. Refer to Troubleshooting Procedures in SECTION 8A-4.</p>	—	Go to Step 11	—
11	<ol style="list-style-type: none"> 1. Using scan tool clear DTC's. 2. Start the engine and drive the vehicle until normal operating temperature is reached. 3. Using the scan tool check to see if any DTC's are recorded. 4. Perform Diagnostic System Check. <p>Are there any DTC's stored?</p>	—	Go to Applicable DTC Table	System Normal

3B5-10 SPEED DEPENDENT STEERING



DTC B0605 - EEPROM CHECKSUM ERROR

CIRCUIT DESCRIPTION

The Power Steering Control Module (PSCM) calibrations are stored in the EEPROM (Electrically Erasable Programmable Read Only Memory). The PSCM performs internal tests on the EEPROM and will indicate if any calibration faults (checksum errors) are current.

DTC B0605 WILL SET WHEN

If no calibrations were programmed in the PSCM memory, or when an internal calibration failure (checksum error) is detected by the PSCM, a code will set.

ACTION TAKEN WHEN THE DTC SETS

The PSCM will not send any current to the power steering fluid flow actuator. This will result in the power steering fluid flow actuator valve to retract providing maximum fluid flow at all times

CONDITIONS FOR CLEARING THE DTC

After the ignition is cycled no internal calibration faults (checksum errors) are indicated by the PSCM, or when the PSCM is properly programmed.

DIAGNOSTIC AIDS

The EEPROM is not removable from the Power Steering Control Module (PSCM). If service is required, the module must be replaced. Refer to SECTION 8C.

TEST DESCRIPTION

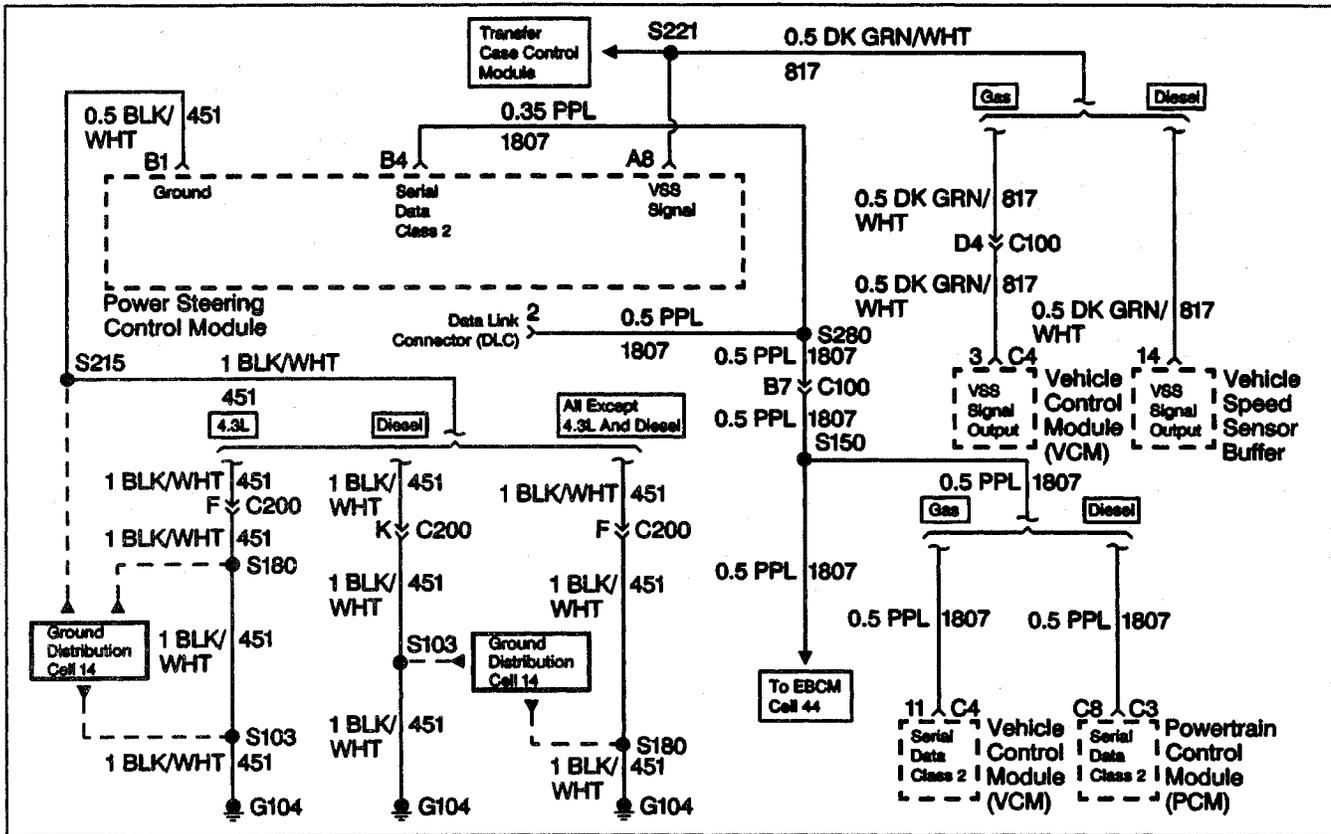
The numbers below refer to the step numbers on the EEPROM Checksum Error Diagnostic Table.

- Step 1 makes sure the "Diagnostic System Check" is completed.
- Step 2 checks if the PSCM was previously replaced.
- Step 3 indicates the PSCM Calibration must be complete.
- Step 4 checks for a valid EEPROM I/D number stored.
- Step 5 indicates PSCM replacement is required.

DTC B0605 - EEPROM CHECKSUM ERROR DIAGNOSTIC TABLE

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check in this section
2	Was a PSCM previously installed?	—	Go to Step 3	Go to Step 4
3	1. Cycle the ignition OFF then ON. 2. Clear DTC's. Does DTC B0605 reset?	—	Go to Step 5	Go to Diagnostic System Check in this section
4	Using a scan tool, check the PSCM EEPROM I/D number. Does it indicate 0000 (PSCM not programmed)?	—	Go to Step 3	Go to Step 5
5	1. Replace the PSCM. Refer to SECTION 8C. Is repair complete?	—	Go to Diagnostic System Check in this section	—

3B5-12 SPEED DEPENDENT STEERING



DTC C0100 - VEHICLE SPEED INFORMATION CIRCUIT MALFUNCTION

CIRCUIT DESCRIPTION

Vehicle speed information is provided to the Power Steering Control Module (PSCM) by the Vehicle Control Module (VCM) Gasoline Engines or by the Powertrain Control Module (PCM) Diesel Engines and the class 2 data line. Once vehicle speed has been detected, the PSCM compares the vehicle speed signal received from the VSS with the vehicle speed data received from the class 2 data line. The VSS is a permanent magnet sensor producing an AC signal with varying frequency. The VSS is mounted in the transmission or transfer case (4x4 models) and is driven off the output shaft. The VSS produces a pulsing AC voltage when vehicle speed is greater than 5 km/h (3mph). The AC voltage and the number of pulses increase with vehicle speed. The VCM supplies the vehicle speed signal to the Instrument Cluster and to the PSCM.

CONDITIONS FOR SETTING THE DTC

1. When there is a difference of more than 10 km/h (6 mph) between the class 2 vehicle speed message for 10 seconds and the vehicle speed sensor is less than 5 km/h (3 mph).
2. The above conditions have been met for 5 consecutive class 2 samples.

ACTION TAKEN WHEN THE DTC SETS

The PSCM will not send any current to the power steering fluid flow actuator. This will result in the power steering fluid flow actuator valve to retract providing maximum fluid flow and full power steering assist at all times.

CONDITIONS FOR CLEARING THE MIL/DTC

1. A history DTC will clear after 100 consecutive ignition cycles has occurred without a fault.
2. History and current DTC(s) can be cleared by using the Tech 2 scan tool.

DIAGNOSTIC AIDS

- If a DTC P0500 or any other vehicle speed related codes are set perform those table first.
- A scan tool will show vehicle speed when the drive wheels are turning faster than 5 km/h (3 mph). The vehicle speed display should not be used if the drive wheels are not turning.

- An "Intermittent" problem may be caused by a poor connection, break in the wire insulation exposing the internal wire, or a wire that is broken inside the insulation.
- The Power Steering Control Module (PSCM) and the Vehicle Control Module (VCM) should be thoroughly checked for terminals that have backed out, broken locks, improperly formed or damaged terminals, weak terminal retaining tension, or for proper routing.

TEST DESCRIPTION

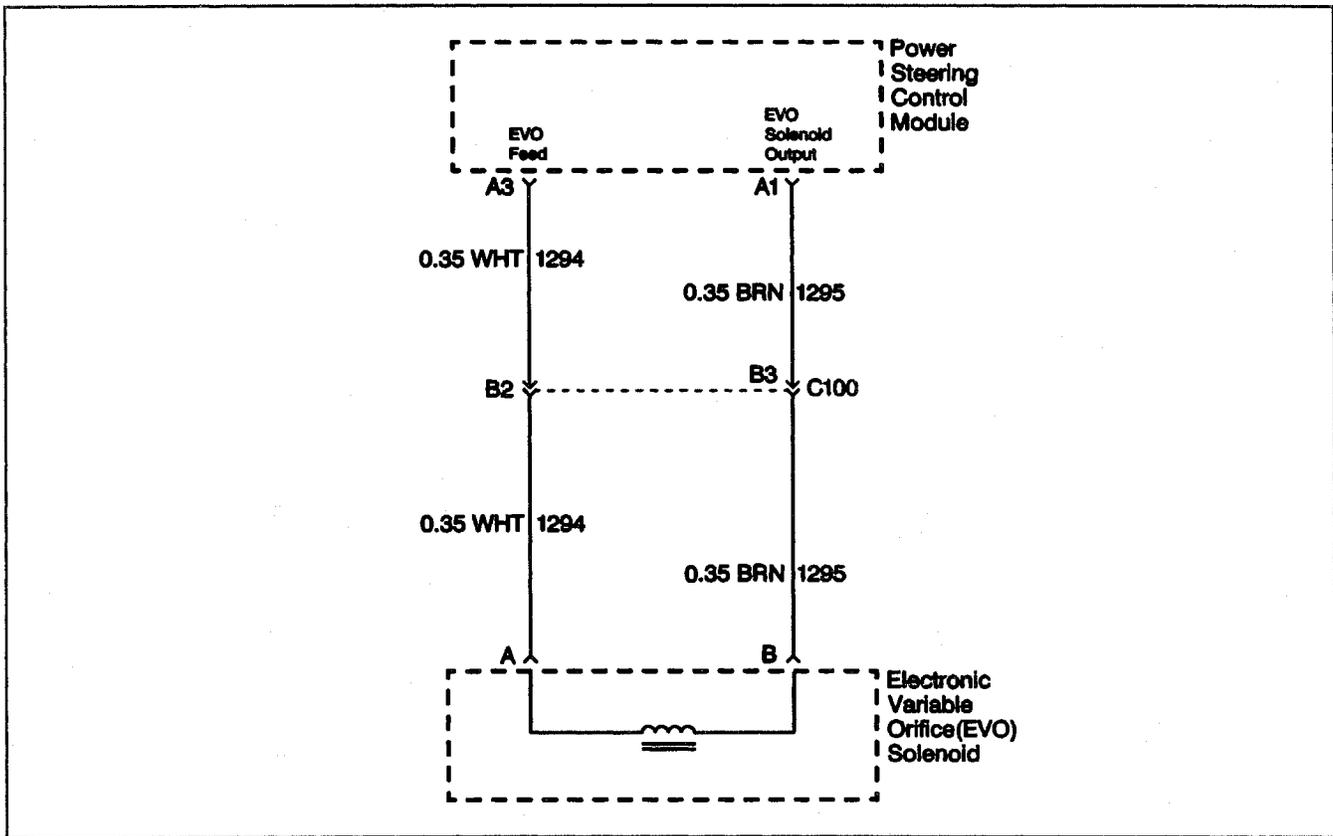
The step numbers below refer to the same step numbers in the Vehicle Speed Information Circuit Malfunction Diagnostic Table.

- Step 1 ensures that the "Diagnostic System Check" has been performed.
- Step 2 checks the vehicle speed signal to the VCM (Gasoline Engines) or the PCM (Diesel Engines).
- Step 3 makes sure other systems on the same circuit are receiving a VSS signal.

DTC C0100 - VEHICLE SPEED INFORMATION CIRCUIT MALFUNCTION DIAGNOSTIC TABLE

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check in this section
2	Connect a scan tool. Are any (PCM) or (VCM) Vehicle Speed Sensor (VSS) codes set?	—	Go to Step 4	Go to Step 3
3	Does the speedometer and cruise control operate correctly?	—	Go to Step 7	Go to Step 5
4	1. Refer to ENGINE CONTROLS for DTC diagnosis procedures. 2. Clear DTC's. Is action complete?	—	Go to Diagnostic System Check in this section	—
5	1. Refer to ENGINE CONTROLS Vehicle Speed Sensor diagnostic procedures. 2. Clear DTC's. Is action complete?	—	Go to Diagnostic System Check in this section	—
6	1. Locate and repair open in CKT 1807. Refer to SECTION 8A. 2. Reinstall removed connectors and components 3. Clear DTC's. Was there a repair made?	—	Go to Diagnostic System Check in this section	—
7	Check for an intermittent open in CKT 817 or terminal B4 at the 16-way PSCM connector. Was a problem found?	—	Go to Step 6	Go to Step 9
8	Replace the PSCM. Refer to SECTION 8C. Is action complete?	—	Go to Diagnostic System Check in this section	—
9	1. Turn the ignition switch to the OFF position. 2. Reinstall removed connectors and components. 3. Clear DTC's. 4. Drive vehicle over 13 km/h (20 mph) for a minimum of 20 seconds. Is DTC C0100 current?	—	Go to Diagnostic System Check in this section	—

3B5-14 SPEED DEPENDENT STEERING



DTC C0500 - EVO TRACKING ERROR

CIRCUIT DESCRIPTION

The PSCM supplies a 0-850 milliamperes pulse width modulation current (percent Duty Cycle) to the power steering fluid flow actuator. This current is used to extend or retract the actuator valve inside the solenoid. This in turn will regulate an orifice on the power steering pump causing the fluid flow output to modulate. This results in an increase or decreased in steering wheel efforts. With 0 milliamperes supplied to the power steering fluid flow actuator the valve will be fully retracted providing maximum fluid flow and power steering assist. With 850 milliamperes supplied to the power steering fluid flow actuator the valve will extend decreasing fluid flow and minimize power steering assist. The PSCM is constantly adjusting current flow to the power steering fluid flow actuator based on vehicle speed and steering wheel position, thus providing vehicle speed related power steering assist.

CONDITIONS FOR SETTING THE DTC

When there is a open or short to ground, or short to voltage in CRTs 1294 or 1254 while the PSCM is pulsing the current to the power steering fluid flow actuator.

1. When voltage is below 0 volts.
2. When voltage is at battery voltage.
 - The above conditions must be met for one second or longer.

ACTION TAKEN WHEN THE DTC SETS

The PSCM will not send any current to the power steering fluid flow actuator. This will result in the actuator valve to retract providing maximum fluid flow and full power steering assist at all times.

CONDITIONS FOR CLEARING THE MIL/DTC

1. A history DTC will clear after 100 consecutive ignition cycles has occurred without a fault.
2. History and current DTC(s) can be cleared by using the Tech 2 scan tool.

DIAGNOSTIC AIDS

- If DTC's 502 or 503 are present, perform these codes first.
- An "Intermittent" problem may be caused by a poor connection, break in the wire insulation exposing the internal wire, or a wire that is broken inside the insulation.
- The power Steering Control Module (PSCM) and the Vehicle Control Module (VCM) should be thoroughly checked for terminals that have backed out, broken locks, improperly formed or damaged terminals, weak terminal retaining tension, or for proper routing.

SPEED DEPENDENT STEERING 3B5-15

- The solenoid valve may be stuck providing uncalculated power steering assist, refer to mechanical diagnosis SECTION 3B.

TEST DESCRIPTION

The Step numbers below refer to the same step numbers in the EVO Tracking Errors Diagnostic Table

- Step 1 ensures that the "Diagnostic System Check" is performed.
- Step 2 checks for short to voltage CKTS 1294 or 1295 with the PSCM disconnected.

- Step 3 checks for commanded and actual duty cycle.
- Step 4 checks the power steering fluid flow actuator harness for a short to voltage with the actuator disconnected on CKTS 1294 and 1295.
- Step 6 checks the power steering fluid flow actuator harness for a short to ground or open with the actuator disconnected on CKTS 1294 and 1295.

- If voltage is indicated then there is a short to voltage on CKT 1294 or 1295.
- If voltage is 0 then there is a short to ground on CKT 1294 or 1295.

DTC C0500 - EVO TRACKING ERROR DIAGNOSTIC TABLE

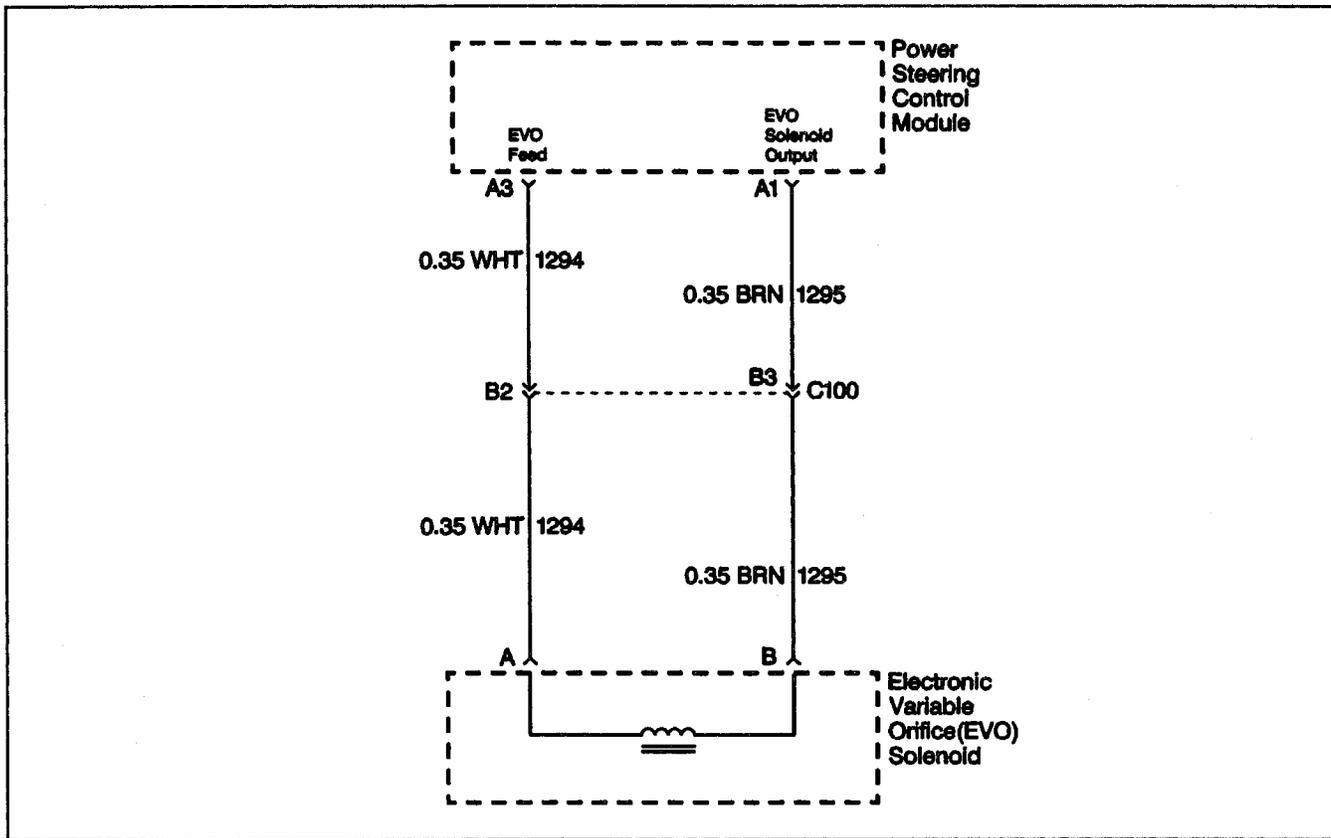
Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check in this section
2	1. Turn the ignition switch to the OFF position. 2. Connect scan tool. 3. Turn the ignition switch to the ON position. 4. Go to Chassis (EVO) and check for DTC C0502 or C0503. Are DTC(s) present?	—	Go to Appropriate DTC	Go to Step 3
3	1. Connect scan tool. 2. Set the parking brake or block wheels then start the vehicle. 3. Go to Chassis (EVO) and command the solenoid to 0, 25, 50, 75, and 100% ranges. 4. Monitor the commanded and actual state of the solenoid. Are the values equal?	—	Go to Diagnostic System Check in this section	Go to Step 4
4	1. Turn the ignition switch to the OFF position. 2. Disconnect the 16-way PSCM connector. 3. Disconnect the power steering fluid flow actuator connector. 4. Turn the ignition switch to the ON position. 5. Using J 39200 DMM measure the voltage from terminal A3 to ground and then from terminal A1 to ground. Is voltage present?	—	Go to Step 5	Go to Step 6
5	Locate and repair the short to voltage in CKT 1294 or 1295 between the PSCM and the power steering fluid flow actuator. Was a repair made?	—	Go to Diagnostic System Check in this section	Go to Step 6

3B5-16 SPEED DEPENDENT STEERING

Step	Action	Value(s)	Yes	No
6	1. Turn the ignition switch to the OFF position. 2. Disconnect the 16-way PSCM connector. 3. Disconnect the power steering fluid flow actuator connector. 4. Turn the ignition switch to the ON position. 5. Using J39200 DMM measure for continuity from terminal A3 to ground and then from terminal A1 to ground. Is continuity present?	—	Go to Step 7	Go to Step 8
7	Locate and repair the short to ground in CKT 1294 or 1295 between the PSCM and the power steering fluid flow actuator. Was a repair made?	—	Go to Diagnostic System Check in this section	Go to Step 8
8	Problem is intermittent. Refer to Intermittent Diagnosis in SECTION 8A-4.	—		

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3B5-18 SPEED DEPENDENT STEERING



DTC C0502 - POWER STEERING FLUID FLOW ACTUATOR OPEN OR SHORTED TO GROUND

CIRCUIT DESCRIPTION

The PSCM supplies a 0-850 milliamperes pulse width modulation current (percent Duty Cycle) to the power steering fluid flow actuator. This current is used to extend or retract the actuator valve inside the solenoid. This in turn will regulate an orifice on the power steering pump causing the fluid flow output to modulate. This results in an increase or decrease in steering wheel efforts. With 0 milliamperes supplied to the power steering fluid flow actuator, the valve will be fully retracted providing maximum fluid flow and power steering assist. With 850 milliamperes supplied to the power steering fluid flow actuator the valve will extend decreasing fluid flow and minimize power steering assist. The PSCM is constantly adjusting current flow to the power steering fluid flow actuator based on vehicle speed and steering wheel position, thus providing vehicle speed related power steering assist.

CONDITIONS FOR SETTING THE DTC

1. When there is a open or short to ground, in CKTS 1294 or 1295 when the ignition switch has been cycled to the "OFF" and then to the "ON" position.
2. When voltage is below 0 volts.
 - The above conditions must be met for one second or longer.

ACTION TAKEN WHEN THE DTC SETS

The PSCM will not send any current to the power steering fluid flow actuator. This will result in the power steering fluid flow actuator valve to retract providing maximum fluid flow and full power steering assist at all times.

CONDITIONS FOR CLEARING THE MIL/DTC

1. A history DTC will clear after 100 consecutive ignition cycles has occurred without a fault.
2. History and current DTC's can be cleared by using the Tech 2 scan tool.

DIAGNOSTIC AIDS

- An "Intermittent" problem may be caused by a poor connection, break in the wire insulation exposing the internal wire, or a wire that is broken inside the insulation.
- The PSCM and the Vehicle Control Module (VCM) or Powertrain Control Module (PCM) should be thoroughly checked for terminals that have backed out, broken locks, improperly formed or damaged terminals, weak terminal retaining tension, or for proper routing.

SPEED DEPENDENT STEERING 3B5-19

- The power steering fluid flow actuator valve may be stuck providing uncalculated power steering assist. For mechanical diagnosis, refer to SECTION 3B.

TEST DESCRIPTION

The step numbers below refer to the same step numbers in the power steering fluid flow actuator Open or Shorted to Ground Diagnostic Table.

- Step 1 ensures that the "Diagnostic System Check" is performed.
- Step 2 will determine if the power steering fluid flow actuator is open.
- Step 3 will determine if the power steering fluid flow actuator is shorted to ground.
- Step 4 Checks for a short or open to ground in CKT 1294 or 1295.

DTC C0502 - POWER STEERING FLUID FLOW ACTUATOR CIRCUIT OPEN OR SHORTED TO GROUND DIAGNOSTIC TABLE

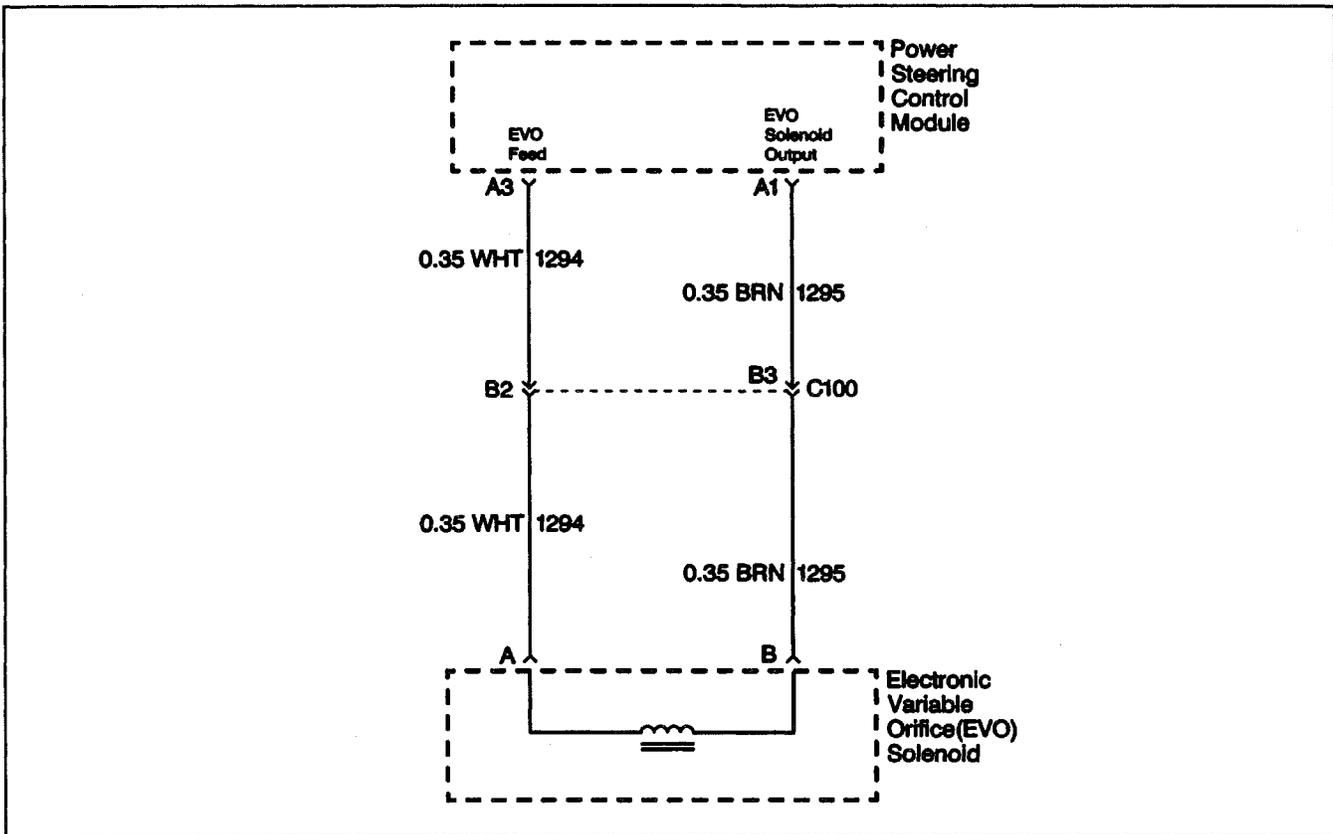
Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check in this section
2	<ol style="list-style-type: none"> 1. Turn the ignition switch to the OFF position. 2. Disconnect the power steering fluid flow actuator connector. 3. Using J39200 DMM measure the resistance at the power steering fluid flow actuator between terminal A and B. <p>Are the resistance's within specifications?</p>	Between 7-15 ohms	Go to Step 3	Go to Step 4
3	<ol style="list-style-type: none"> 1. Turn ignition switch to the OFF position. 2. Disconnect the power steering fluid flow actuator connector. 3. At the power steering fluid flow actuator, check for continuity between terminal A to ground and then terminal B to ground <p>Does the DMM display continuity?</p>	—	Go to Step 5	Go to Step 4
4	<ol style="list-style-type: none"> 1. Turn the ignition switch to OFF position 2. Disconnect the 16-way connector at the PSCM. 3. Disconnect the power steering fluid flow connector. 4. Using J39200 DMM check for continuity between the 16-way PSCM connector (harness side) from terminal A1 to ground and then terminal A3 to ground. <p>Is there continuity ?</p>	—	Go to Step 6	Go to Step 7
5	<p>Replace the power steering fluid flow actuator. Refer to On-Vehicle Service in this section.</p> <p>Is repair complete?</p>	—	Go to Step 9	—
6	<ol style="list-style-type: none"> 1. Locate and repair open or short to ground in CKTS 1294 and 1295 between the power steering fluid flow actuator and the PSCM. 2. Reinstall connectors and components removed. <p>Is action complete?</p>	—	Go to Diagnostic System Check in this section	—

3B5-20 SPEED DEPENDENT STEERING

Step	Action	Value(s)	Yes	No
7	Check the power steering fluid flow actuator connector and harness for an intermittent short to ground. Was a problem found?	—	Go to Step 8	Go to Step 9
8	Replace PCSM module. Refer to SECTION 8C. Is action complete?	—	Go to Step 9	—
9	1. Turn the ignition switch to the OFF position. 2. Reinstall removed connectors and components. 3. Clear DTC's. Is action complete?	—	Go to Diagnostic System Check in this section	—

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3B5-22 SPEED DEPENDENT STEERING



DTC C0503 - POWER STEERING FLUID FLOW ACTUATOR CIRCUIT SHORTED TO BATTERY

CIRCUIT DESCRIPTION

The PSCM supplies a 0-850 milliamperes pulse width modulation current (percent Duty Cycle) to the power steering fluid flow actuator. This current is used to extend or retract the actuator valve inside the solenoid. This in turn will regulate an orifice on the power steering pump causing the fluid flow out-put to modulate. This results in an increase or decreased in steering wheel efforts. With 0 milliamperes supplied to the power steering fluid flow actuator the valve will be fully retracted providing maximum fluid flow and power steering assist. With 850 milliamperes supplied to the power steering fluid flow actuator the valve will extend decreasing fluid flow and minimize power steering assist. The PSCM is constantly adjusting current flow to the power steering fluid flow actuator based on vehicle speed and steering wheel position, thus providing vehicle speed related power steering assist.

CONDITIONS FOR SETTING THE DTC

1. When there is an open or short to ground, in CKTS 1294 or 1295 when the ignition switch has been cycled to the "OFF" and then to the "ON" position.
2. When voltage is below 0 volts.
 - The above conditions must be met for one second or longer.

ACTION TAKEN WHEN THE DTC SETS

The PSCM will not send any current to the power steering fluid flow actuator. This will result in the power steering fluid flow actuator valve to retract providing maximum fluid flow and full power steering assist at all times.

CONDITIONS FOR CLEARING THE MIL/DTC

1. A history DTC will clear after 100 consecutive ignition cycles has occurred without a fault.
2. History and current DTC(s) can be cleared by using the Tech 2 scan tool.

DIAGNOSTIC AIDS

- An "Intermittent" problem may be caused by a poor connection, break in the wire insulation exposing the internal wire, or a wire that is broken inside the insulation.
- The Power Steering Control Module (PSCM) and the Vehicle Control Module (VCM) or Powertrain Control Module (PCM) should be thoroughly checked for terminals that have backed out, broken locks, improperly formed or damaged terminals, weak terminal retaining tension, or for proper routing.

SPEED DEPENDENT STEERING 3B5-23

- The solenoid valve may be stuck providing uncalculated power steering assist. For mechanical diagnosis, refer to SECTION 3B.

TEST DESCRIPTION

The step numbers below refer to the same step numbers in the power steering fluid flow actuator Circuit Shorted to Battery Diagnostic Table.

- Step 1 ensures that the "Diagnostic System Check" is performed.
- Step 2 checks for short to voltage CKT 1294 or 1295 with the PSCM disconnected.
- Step 3 checks the power steering fluid flow actuator harness for a short to voltage with the actuator disconnected.
 - If voltage is indicated, there is a short to voltage on CKT 1294 or 1295.

DTC C0503 - POWER STEERING FLUID FLOW ACTUATOR CIRCUIT SHORTED TO BATTERY DIAGNOSTIC TABLE

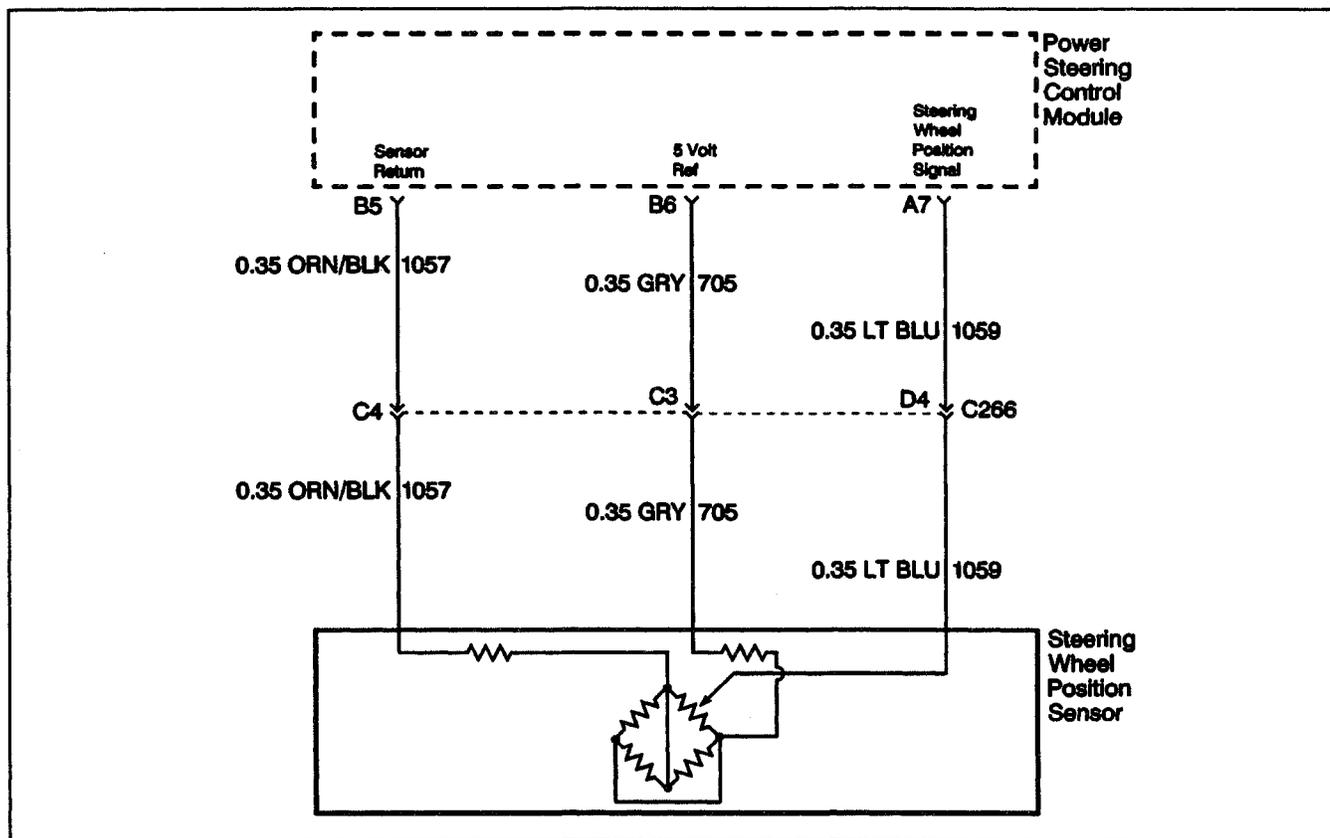
Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check in this section
2	1. Turn the ignition switch to the OFF position. 2. Disconnect the 16-way PSCM 3. Turn the ignition switch to the ON position. 4. Using J39200 DMM measure voltage between the PSCM connector (harness side) terminal A to ground and then terminal B to ground. Did the voltmeter display a voltage?	Over 1.0 volt	Go to Step 3	Go to Step 7
3	1. Turn the ignition switch to the OFF position. 2. Disconnect the power steering fluid flow actuator connector. 3. Disconnect the 16-way PSCM connector. 4. Turn the ignition switch to the "ON" position. 5. At the power steering fluid flow actuator connector (harness side), measure the voltage between terminal A to ground, and then terminal B to ground. Did the volt meter display a voltage?	Over 1.0 volt	Go to Step 5	Go to Step 4
4	1. Turn the ignition switch to the OFF position. 2. Disconnect the power steering fluid flow actuator connector. 3. Using J39200 DMM measure the resistance from terminal A to terminal B Does the DMM display correct resistance values?	Between 7-15 ohms	Go to Step 6	Go to Step 7
5	Locate and repair short to voltage in CKT 1294 or 1295. Is the action complete?	—	Go to Step 9	—
6	Replace the power steering fluid flow actuator. Refer to On-Vehicle Service in this section. Is action complete?	—	Go to Step 9	—

3B5-24 SPEED DEPENDENT STEERING

Step	Action	Value(s)	Yes	No
7	<ol style="list-style-type: none">1. Check the power steering fluid flow actuator connector and harness for intermittent short to voltage.2. Check for intermittent short to voltage on CKTS 1294 and 1295. <p>Was a problem found?</p>	—	Go to Step 5	Go to Step 8
8	<p>Replace the PSCM. Refer to SECTION 8C.</p> <p>Is action complete?</p>	—	Go to Diagnostic System Check in this section	—
9	<ol style="list-style-type: none">1. Turn the ignition switch to the OFF position.2. Reinstall removed connectors or components.3. Clear DTC's. <p>Is action complete?</p>	—	Go to Diagnostic Aids in this section	—

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3B5-26 SPEED DEPENDENT STEERING



DTC C0507-STEERING WHEEL POSITION (SWP) SENSOR—SIGNAL VOLTAGE LOW

CIRCUIT DESCRIPTION

The Power Steering Control Module (PSCM) supplies a 5.0 volt reference and a ground circuit to the Steering Wheel Position (SWP) Sensor. The SWP sensor returns a voltage signal to the PSCM indicating the steering wheel rate of steer. The SWP Sensor returns a voltage between 0.2 - 4.9 volts when the steering wheel has been turned one quarter revolution (90 degrees). The PSCM monitors the SWP sensor signal voltage to control a pulse width modulation current (percentage DUTY CYCLE) to them power steering fluid actuator.

CONDITIONS FOR SETTING THE DTC

1. The SWP Sensor signal circuit voltage is less than 0.2 volts.
2. The above condition must be met for 1 second.

ACTION TAKEN WHEN THE DTC SETS

The EVO module will not send any current to the power steering fluid actuator. This will result in the power steering fluid actuator valve to retract providing maximum fluid flow and full power steering assist at all times.

CONDITIONS FOR CLEARING THE MIL/DTC

1. A history DTC will clear after 100 concurrent ignition cycles has occurred without the fault reoccurring.
2. History and current DTC(s) can be cleared using the Tech 2 scan tool.

DIAGNOSTIC AIDS

The Tech 2 scan tool will read steering wheel position in volts. With the ignition switch in the "ON" position and as the steering wheel position sensor is rotated, the voltage reading should be between 0.2 - 4.9 volts. Voltage should increase at a steady rate up to 4.9 volts when the wheel is turned, one quarter revolution (90 degrees) in either direction.

- Above 0.2 volts.
- Below 4.9 volts when the steering wheel is rotated one quarter revolution (90 degrees).

Using the Tech 2, scan the SWP Sensor.

- Above 0.2 volts.
- Turn the steering wheel.
- The Tech 2 display should increase from above 0.2 volts and below 4.9 volts as the steering wheel is turned one quarter revolution (90 degrees).

TEST DESCRIPTION

The step numbers below refer to the same step numbers in the Steering Wheel Position (SWP) Sensor - Signal Voltage Low Diagnostic Table.

- Step 1 check prompts the technician to complete some basic checks and store the Freeze Frame Data. This also allows the technicians to stored failure records on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. This stored information in the scan tool can be referred to later.
- Step 2 verifies when the voltage is between 0.2 and 4.9 volts, the PSCM will use this voltage to

detect changes in the rate of steering and the system voltage should increase and decrease proportional to steering wheel rotation. If the voltage is not within specifications an appropriate DTC will set. In addition to DTC diagnosis, check for binding, grinding or damaged steering wheel position sensor. Refer to SECTION 3F4 or 3F5.

- Step 5 simulates a high voltage signal, which will identify an open in the signal circuit.
- Step 7 verifies if voltage is present from the DMM while probing the SWP sensor signal circuit, the SWP signal circuit is shorted to ground.
- Step 11 verifies before replacing the PSCM, check terminals for improper mating, broken locks and physical damage to the wiring harness.

DTC C0507 - STEERING WHEEL POSITION (SWP) SENSOR SIGNAL VOLTAGE LOW DIAGNOSTIC TABLE

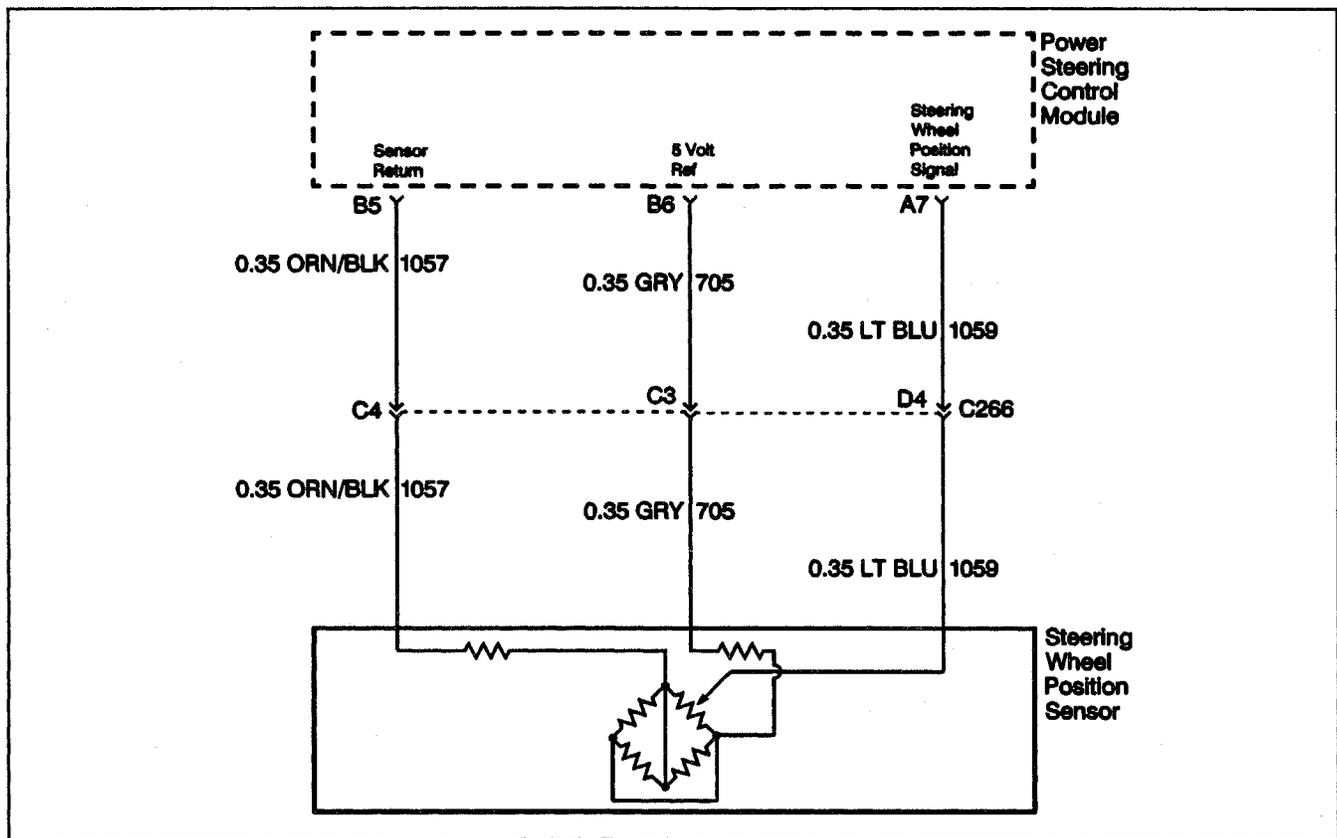
Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check in this section.
2	<ol style="list-style-type: none"> 1. Turn the ignition switch ON, engine OFF. 2. Connect scan tool. 3. Select the SWP display on the scan tool. 4. Check the scan tool while turning the steering wheel one quarter revolution (90 degrees). Slowly return the steering wheel to center position. 5. Repeat Step 4 above twice. <p>Does the SWP value increase and decrease steadily to the specified value when the steering wheel is rotated?</p>	Greater than 0.2 volts less than 4.9 volts	Go to Diagnostic System Check in this section	Go to Step 3
3	<ol style="list-style-type: none"> 1. Turn ignition switch to the ON position (engine off). 2. Review and record scan tool Freeze Frame data. 3. Operate the vehicle within the Freeze Frame conditions for setting the DTC as noted. <p>Is the SWP sensor voltage less than the specified value?</p>	0.2 volts	Go to Step 4	Go to Step 12
4	<ol style="list-style-type: none"> 1. Disconnect the SWP sensor electrical connector. 2. Jumper the 5.0 volt reference CKT 705 to the signal CKT 1059 at the SWP sensor electrical connector. 3. Monitor the scan tool values. <p>Is the SWP sensor voltage greater than the specified values?</p>	4 volts	Go to Step 10	Go to Step 5
5	<p>Using J39200 DMM connect positive lead of DMM to B+ and using negative lead, probe the signal CKT 1059 of SWP sensor harness connector.</p> <p>Is the SWP sensor voltage greater than specified value?</p>	4.0 V	Go to Step 6	Go to Step 8
6	<p>Check the 5.0 volt reference circuit for an open or short to ground in the SWP sensor signal CKT 705. Repair as necessary.</p> <p>Was a repair necessary?</p>	—	Go to Step 12	Go to Step 7

3B5-28 SPEED DEPENDENT STEERING

Step	Action	Value(s)	Yes	No
7	Check the 5.0 volt reference CKT 705 for a poor connection at the PSCM. Repair and replace terminal(s) as necessary. Was a repair necessary?	—	Go to Step 12	Go to Step 11
8	Check the SWP signal CKT 1059 for an open or short to ground. Repair as necessary. Was a repair necessary?	—	Go to Step 12	Go to Step 9
9	Check SWP sensor signal CKT 1059 for a poor connection at the PSCM. Repair as necessary Was a repair necessary?	—	Go to Step 12	Go to Step 11
10	Replace the SWP sensor. Is action complete?	—	Go to Step 12	—
11	Replace the PSCM. Is action complete?	—	Go to Step 12	—
12	1. Using the scan tool clear DTC's. 2. Start the vehicle and drive until normal operating temperature is reached. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle for the conditions for setting this DTC. Refer to Conditions for Setting the DTC's in this section. Does the scan tool indicate that this diagnostic ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool select Capture info, Review info. Are any DTC's displayed that have not been diagnosed?	—	Go to appropriate DTC table	System Normal

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3B5-30 SPEED DEPENDENT STEERING



DTC C0508-STEERING WHEEL POSITION (SWP) SENSOR—SIGNAL VOLTAGE HIGH

CIRCUIT DESCRIPTION

The PSCM supplies a 5.0 volt reference and a ground circuit to the Steering Wheel Position (SWP) Sensor. The SWP sensor returns a voltage signal to the PSCM indicating the steering wheel rate of steer. The SWP Sensor returns a voltage between 0.2 - 4.9 volts when the steering wheel has been turned one quarter revolution (90 degrees). The PSCM monitors the SWP sensor signal voltage to control a pulse width modulation current (percentage DUTY CYCLE) to the power steering fluid flow actuator.

CONDITIONS FOR SETTING THE DTC

The SWP Sensor signal circuit voltage is greater than 4.9 volts for one second or longer.

ACTION TAKEN WHEN THE DTC SETS

The PSCM will not send any current to the power steering fluid flow actuator. This will result in the power steering fluid flow actuator valve to retract providing maximum fluid flow and full power steering assist at all times.

CONDITIONS FOR CLEARING THE MIL/DTC

1. A history DTC will clear after 100 concurrent ignition cycles has occurred without the fault reoccurring.
2. The history and current DTC(s) can be cleared using the Tech 2 scan tool.

DIAGNOSTIC AIDS

The Tech 2 scan tool will read steering wheel position in volts. With the ignition switch in the "ON" position and as the steering wheel position sensor is rotated, the voltage reading should be between 0.2 - 4.9 volts. Voltage should increase at a steady rate up to 4.9 volts when the wheel is turned, one quarter revolution (90 degrees) in either direction.

- Above 0.2 volts.
- Below 4.9 volts when the steering wheel is rotated one quarter revolution (90 degrees).

Using the Tech 2, scan the SWP Sensor.

- Above 0.2 volts.
- Turn the steering wheel.
- The Tech 2 display should increase from above 0.2 volts and below 4.9 volts as the steering wheel is turned one quarter revolution (90 degrees).

TEST DESCRIPTION

The Step numbers below refer to the same step numbers in the Steering Wheel Position Sensor - Signal Voltage High Diagnostic Table

- Step 1 check prompts the technician to complete some basic checks and store the Freeze Frame Data. This also allows the technicians to stored failure records on the scan tool if applicable. This creates an electronic copy of the data taken when the fault occurred. This stored information in the scan tool can be referred to later.
- Step 2 verifies When the voltage is between 0.2 and 4.9 volts, the PSCM will use this voltage to detect changes in the rate of steering and the sys-

tem voltage should increase and decrease proportional to steering wheel rotation. If the voltage is not within specifications an appropriate DTC will set. In addition to DTC diagnosis, check for binding, grinding or damaged steering wheel position sensor. Refer to SECTION 3F4 or 3F5.

- Step 5 probes the ground circuit checks the circuit for high resistance which will cause a DTC C0508 to set.
- Step 6 verifies a shorted 5.0 volt reference circuit may also set additional DTC's.
- Step 11 verifies before replacing the PSCM, check terminals for improper mating, broken locks and physical damage to the wiring harness.

DTC C0508—STEERING WHEEL POSITION (SWP) SENSOR SIGNAL VOLTAGE HIGH DIAGNOSTIC TABLE

Step	Action	Value(s)	Yes	No
1	Was the Diagnostic System Check performed?	—	Go to Step 2	Go to Diagnostic System Check in this section
2	1. Turn the ignition switch ON, engine OFF. 2. Connect scan tool. 3. Select the SWP display on the scan tool. 4. Check the scan tool while turning the steering wheel one quarter revolution (90 degrees). Slowly return the steering wheel to center position. 5. Repeat Step 4 above twice. Does the SWP value increase and decrease steadily to the specified value when the steering wheel is rotated?	Greater than 0.2 volts less than 4.9 volts	Go to Diagnostic System Check in this section	Go to Step 3
3	1. Turn ignition switch to the RUN position (engine off). 2. Review and record the scan tool Freeze Frame data. 3. Operate the vehicle within the Freeze Frame conditions for setting the DTC as noted. Is the SWP sensor voltage greater than the specified value?	4.9 volts	Go to Step 4	Go to Step 12
4	1. Disconnect the SWP sensor electrical connector. 2. Monitor the values on the scan tool. Is the SWP sensor voltage less than the specified values?	0.2 volts	Go to Step 5	Go to Step 6
5	Using J39200 DMM connect positive lead of DMM to B+ and using negative lead, probe sensor signal CKT 1057 of SWP sensor harness connector. Is voltage greater than specified?	10 volts	Go to Step 7	Go to Step 9
6	Check for a short to voltage in the SWP sensor signal CKT 1059. Repair as necessary Was a repair necessary?	—	Go to Step 12	Go to Step 11

3B5-32 SPEED DEPENDENT STEERING

Step	Action	Value(s)	Yes	No
7	Check for a short to voltage in the SWP sensor signal CKT 1059. Repair as necessary. Was a repair necessary?	—	Go to Step 12	Go to Step 8
8	Check for poor electrical connections at the SWP sensor. Repair or replace terminals as necessary. Was a repair necessary?	—	Go to Step 12	Go to Step 10
9	Check for a SWP sensor open signal CKT 1059. Repair as necessary Was a repair necessary?	—	Go to Step 12	Go to Step 10
10	Replace the SWP sensor. Is action complete?	—	Go to Step 12	—
11	Replace the PSCM. Is action complete?	—	Go to Step 12	—
12	1. Using the scan tool clear DTC's. 2. Start the vehicle and drive until normal operating temperature is reached. 3. Select DTC, Specific, then enter the DTC number which was set. 4. Operate the vehicle for the conditions for setting this DTC. Refer to Conditions for Setting the DTC in this section. Does the scan tool indicate that this diagnostic ran and passed?	—	Go to Step 13	Go to Step 2
13	Using the scan tool select Capture info, Review info. Are any DTC's displayed that have not been diagnosed?	—	Go to Appropriate DTC table	System Normal

ON-VEHICLE SERVICE

POWER STEERING FLUID FLOW ACTUATOR, DISCHARGE FITTING, AND FLOW CONTROL VALVE

↔ Remove or Disconnect

1. Power steering pump from vehicle. Refer to SECTION 3B.
2. Power steering fluid flow actuator, discharge fitting, and flow control valve. Refer to SECTION 3B1B.

↔ Install or Connect

1. Flow control valve, discharge fitting, and fluid flow actuator to the pump.

Tighten

- Fluid flow actuator to 62 N.m (46 lb ft).
2. Power steering pump to vehicle. Refer to SECTION 3B.

POWER STEERING CONTROL MODULE

↔ Remove or Disconnect (Figure 4)

1. Negative battery cable. Refer to SECTION 6D1.
2. Knee bolster. Refer to SECTION 10A4.
3. I/P auxiliary storage compartment. Refer to SECTION 8C.
4. Ashtray. Refer to SECTION 8C.
5. Electrical connector.

- Pull down on control module to release.

↔ Install or Connect (Figure 4)

1. Electrical connector.
 - Slide in rear tabs and push up to engage control module.
2. Ashtray. Refer to SECTION 8C.
3. I/P auxiliary storage compartment. Refer to SECTION 8C.
4. Knee bolster. Refer to SECTION 10A4.
5. Negative battery cable. Refer to SECTION 6D1.

STEERING WHEEL POSITION SENSOR

↔ Remove or Disconnect

- Set front wheels in the straight-ahead position and the steering wheel in the "LOCKED" position.

1. Negative battery cable. Refer to SECTION 6D1.
2. Disable the (SIR). Refer to SECTION 9J.
3. Nut and bolt from upper to lower steering shaft connection. Slide lower shaft down.
4. Position sensor connector by using suitable tool to pull connector down around the right side of steering column for accessibility.
5. Position sensor and bearing assembly from steering column jacket by pulling straight out (Figure 5). Use care not to apply force to sensor and bearing in a sideways direction.
6. Position sensor from clips in bearing assembly.

↔ Install or Connect

NOTICE: Refer to "Notice" on page 3B5-1.

1. Position sensor into bearing assembly.
2. Bearing into steering column jacket. Align notches on bearing and column jacket and seat bearing fully into jacket. Use care not to apply force to sensor and bearing in a sideways direction.
3. Position sensor connector.
4. Bolt and nut to upper end of shaft.

Tighten

- Nut to 62 N.m (46 lb ft).
5. Negative battery cable.
 6. Enable the SIR system. Refer to SECTION 9J.

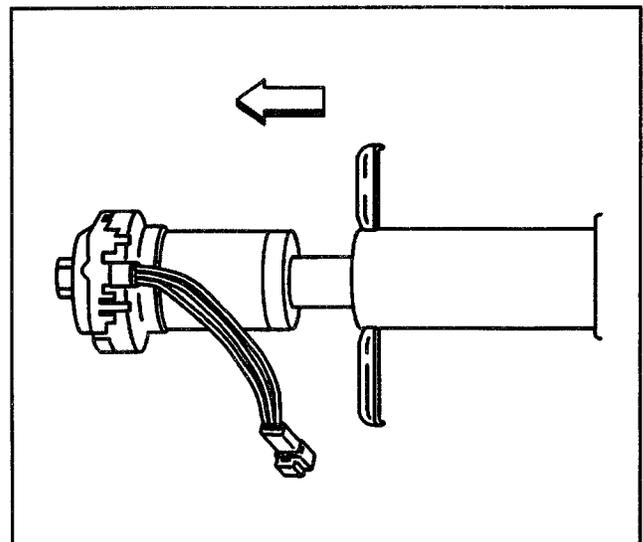


Figure 5—Position Sensor Removal

3B5-34 SPEED DEPENDENT STEERING

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N.m	Lb ft	Lb in
Power Steering Fluid Flow Actuator to the Power Steering Pump	62	46	—
Inlet Power Steering Pipe to the Power Steering Fluid Flow Actuator	28	21	—
Upper to Lower Steering Shaft Bolt	62	46	—

SPECIAL TOOLS



SECTION 3C

FRONT SUSPENSION AND AXLE

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which components are being removed. This will reduce the possibility of the vehicle slipping from the hoist.

NOTICE: *Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.*

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3C-2 FRONT SUSPENSION AND AXLE

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GENERAL DESCRIPTION

The front suspension (Figure 1) is designed to allow each wheel to compensate for changes in the road surface level without appreciably affecting the opposite wheel. Each wheel (except C 3500HD) is independently connected to the frame by a steering knuckle, ball joint assemblies, and upper and lower control arms. The front wheels are held in correct relationship to each other by two tie rods which are connected to steering arms on the knuckles and to a relay rod.

Two-wheel drive "C" Series models (except C 3500HD) have a front suspension consisting of coil springs that are mounted between the spring housings on the frame and the lower control arms. Shock absorbers are mounted inside the coil springs and attached to the lower control arms by bolts and nuts. The upper portion of each shock absorber extends through a frame bracket and is secured with two grommets, two grommet retainers, and a nut.

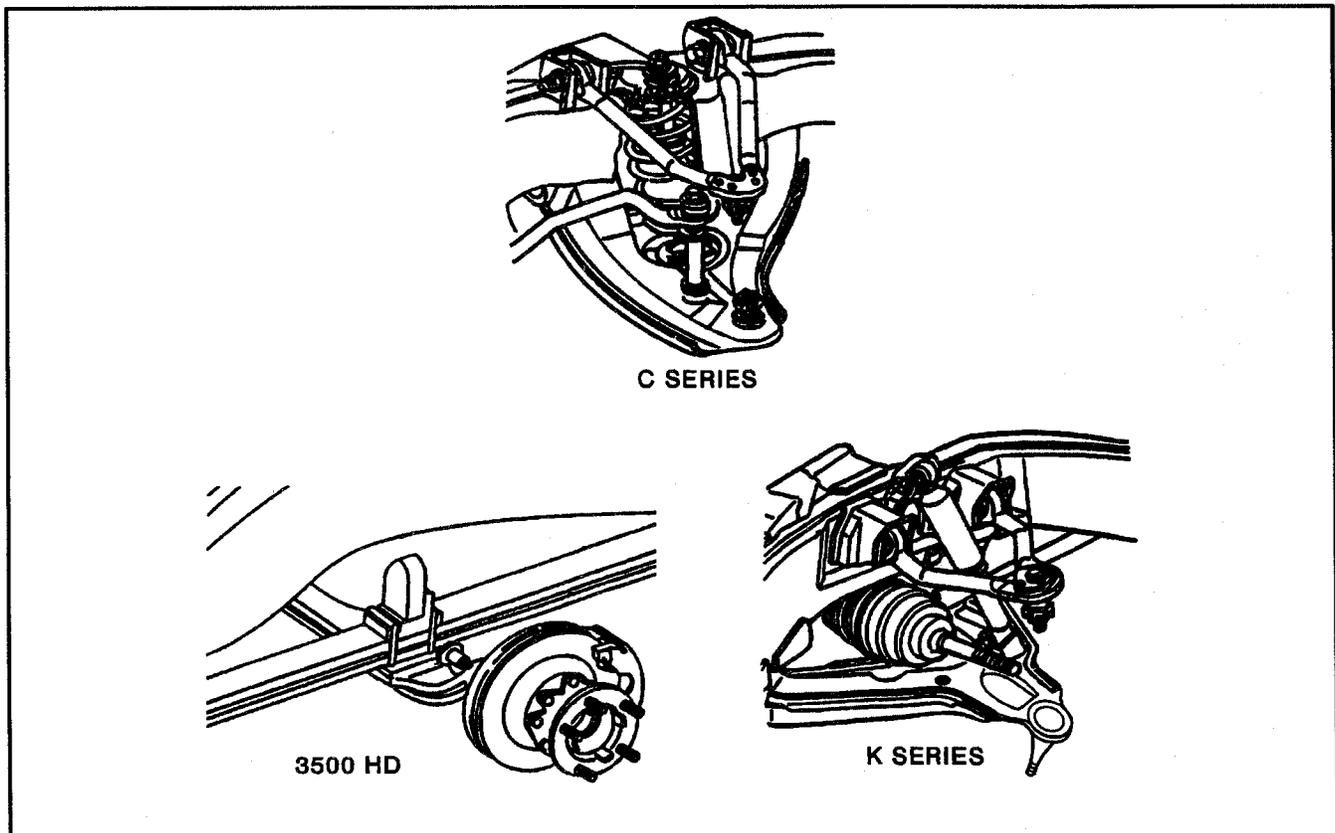


Figure 1—Front Suspension

FRONT SUSPENSION AND AXLE 3C-3

Side roll of the front suspension on some models is controlled by a spring steel stabilizer shaft. It is mounted in rubber bushings which are held to the frame side rails by brackets. The ends of the stabilizer are connected to the lower control arms by link bolts isolated by rubber grommets.

A ball joint assembly is riveted to the outer end of the upper control arm and is attached to the steering knuckle by a castellated nut and cotter pin.

The inner ends of the lower control arm have pressed-in bushings. Bolts, passing through the bushings, attach the arm to the frame. The lower ball joint assembly is a press fit in the lower control arm and attaches to the steering knuckle with a castellated nut and cotter pin.

Rubber grease seals are provided at ball socket assemblies to keep dirt and moisture from entering the joint and damaging bearing surfaces. Also, all ball joints have grease fittings for routine maintenance.

Four-wheel drive "K" Series models have a front suspension consisting of control arms, stabilizer shaft, shock absorber, and a right and left torsion bar. Torsion bars are used instead of conventional coil springs. The front end of the torsion bar is attached to the lower control arm. The rear of the torsion bar is mounted into an adjustable arm at the torsion bar crossmember. Vehicle trim height is controlled by this arm adjustment.

"K" Series models have sealed front wheel bearings that are pre-adjusted and require no lubrication maintenance. Darkened areas on the bearing assembly are caused by a heat treatment process and do not require bearing replacement.

A heavy-duty front suspension is standard on the C 3500HD model. This suspension is centered around a solid I-beam axle and includes taper leaf springs, shock absorbers and a stabilizer shaft.

DIAGNOSIS OF FRONT SUSPENSION

PROBLEM	POSSIBLE CAUSE	CORRECTION
Hard Steering	<ol style="list-style-type: none"> 1. Steering linkage needs lubrication. 2. Low or uneven front tire pressure. 3. Incorrect front wheel alignment. 4. Worn ball joints. 5. Worn or loose king pin and/or king pin bearing. 	<ol style="list-style-type: none"> 1. Lubricate the linkage. 2. Inflate tires to the recommended pressure. 3. Check and align the front suspension. 4. Check free play. 5. Replace worn parts and/or adjust the king pin bearing.
Poor Directional Stability	<ol style="list-style-type: none"> 1. Steering linkage needs lubrication. 2. Low or uneven tire pressure. 3. Loose wheel bearings. 4. Incorrect front wheel alignment (caster). 5. Broken springs. 6. Malfunctioning shock absorber. 7. Broken stabilizer shaft or a missing link. 	<ol style="list-style-type: none"> 1. Lubricate the linkage. 2. Inflate tires to the recommended pressure. 3. Adjust or replace the wheel bearings. 4. Check and align the front suspension. 5. Replace the springs. 6. Check and replace the shock absorber. 7. Replace the stabilizer shaft or link.
Front Wheel Shimmy (Smooth Road Shake)	<ol style="list-style-type: none"> 1. Tire and wheel are out of balance or out of round. 2. Worn or loose wheel bearings. 3. Worn ball joints. 4. Worn or loose king pin and/or king pin bearing. 5. Malfunctioning shock absorber. 	<ol style="list-style-type: none"> 1. Balance the tires, check runout. 2. Adjust the wheel bearings. 3. Replace the ball joints. 4. Replace worn parts and/or adjust the king pin bearing. 5. Check and replace the shock absorber.
Vehicle Pulls to One Side (No Braking Action)	<ol style="list-style-type: none"> 1. Low or uneven tire pressure. 2. Front or rear brakes dragging. 3. Broken or sagging front spring. 4. Incorrect front wheel alignment (camber). 	<ol style="list-style-type: none"> 1. Inflate the tires to the recommended pressure. 2. Adjust the brakes. 3. Replace the spring. 4. Check and align the front suspension. Refer to SECTION 3A.

3C-4 FRONT SUSPENSION AND AXLE

DIAGNOSIS OF FRONT SUSPENSION (cont'd)

PROBLEM	POSSIBLE CAUSE	CORRECTION
Noise In the Front End	<ol style="list-style-type: none"> 1. Steering linkage needs lubrication. 2. Loose shock absorber or worn bushings. 3. Worn control arm bushings. 4. Worn or loose wheel bearings. 5. Loose stabilizer shaft. 6. Loose wheel nuts. 7. Spring is improperly positioned. 8. Loose suspension bolts. 9. Worn king pins and bushings. 	<ol style="list-style-type: none"> 1. Lubricate at the recommended intervals. 2. Tighten the bolts or replace the shock absorber. 3. Replace the bushings or control arm. 4. Adjust or replace the wheel bearings. 5. Tighten all the stabilizer shaft attachments. 6. Tighten the wheel nuts. 7. Reposition the spring. 8. Tighten to specifications or replace. 9. Replace bushings and king pins.
Wheel Tramp	<ol style="list-style-type: none"> 1. Tire and the wheel are out of balance. 2. Tire and the wheel are out of round. 3. Blister or bump on the tire. 4. Improper shock absorber action. 	<ol style="list-style-type: none"> 1. Balance the wheels. 2. Replace the tire. 3. Replace the tire. 4. Replace the shock absorber.
Excessive or Uneven Tire Wear	<ol style="list-style-type: none"> 1. Underinflated or overinflated tires. 2. Improper toe-in. 3. Wheels are out of balance. 4. Hard driving. 5. Overloading the vehicle. 	<ol style="list-style-type: none"> 1. Inflate the tire to the recommended pressure. 2. Adjust toe-in setting. 3. Balance the wheels. 4. Follow proper driving techniques. 5. Do not exceed the maximum recommended payload rating.
Scuffed Tires	<ol style="list-style-type: none"> 1. Toe-in is incorrect. 2. Excessive speed on turns. 3. Tires are improperly inflated. 4. Suspension arm is bent or twisted. 	<ol style="list-style-type: none"> 1. Adjust toe-in setting. 2. Follow proper driving techniques. 3. Inflate the tires to the recommended pressure. 4. Replace the suspension arm.
Cupped Tires	<ol style="list-style-type: none"> 1. Front shock absorbers are worn. 2. Worn ball joints. 3. Wheel bearings are incorrectly adjusted or worn. 4. Wheel and tire is out of balance. 5. Excessive tire or wheel runout. 	<ol style="list-style-type: none"> 1. Replace the shock absorbers. 2. Replace the ball joints. 3. Adjust or replace the wheel bearings (also replace the races). 4. Balance the wheel and tire. 5. Check and compensate for runout.

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BALL JOINT WEAR CHECK

- Be sure the vehicle rests on a level surface.
- Raise the vehicle and support it with suitable safety stands. Support the lower control arm with a floor stand or jack as far outboard as possible under the stabilizer shaft bracket (Figure 2).



Important

- The vehicle must be stable and should not rock on the floor stands.
 - The upper control arm bumper must not contact the frame.
1. Wipe the ball joints clean and check the seals for cuts or tears.
 - If a seal is cut or torn, the ball joint MUST be replaced.
 2. Adjust the wheel bearings. Refer to "Wheel Bearing Adjustment" in this section.

3. Check the ball joints for vertical looseness.
 - With the vehicle on the jack stands, place a dial indicator against the spindle to show vertical movement (Figure 3).

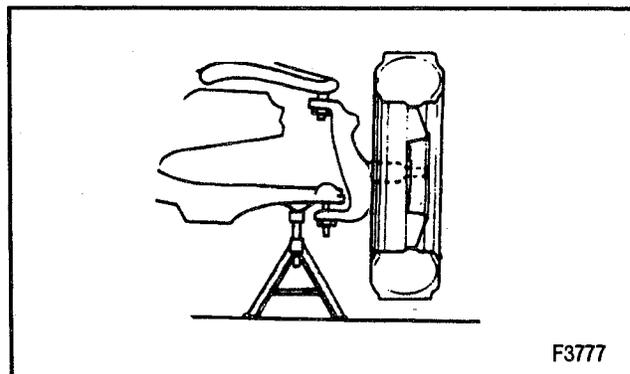


Figure 2—Supporting the Lower Control Arm

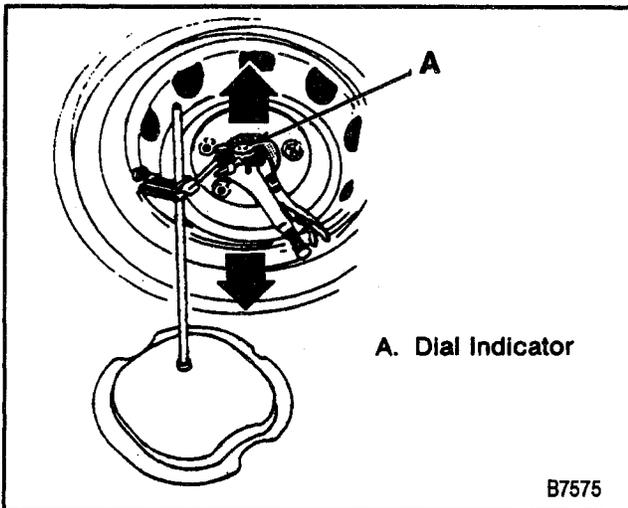


Figure 3—Dial Indicator Position

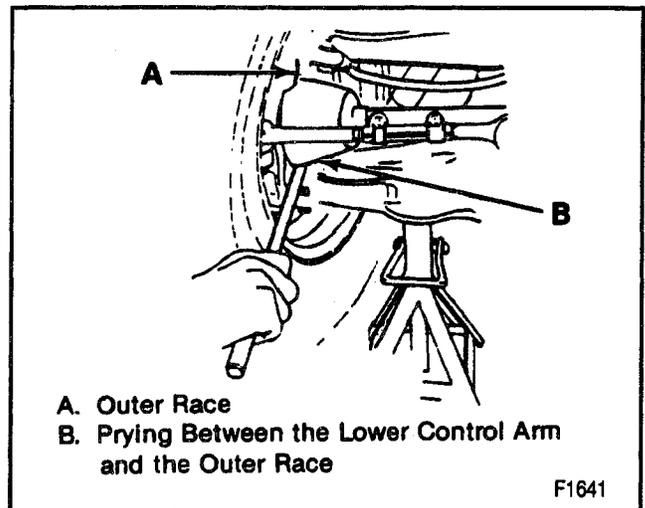


Figure 4—Checking Ball Joint Vertical Looseness

- Pry between the lower control arm and the outer race while reading the dial indicator. This will show vertical looseness in the ball joints (Figure 4).
- If the dial indicator reading is more than 2 mm (0.08 inch), replace the ball joint.

NOTICE: *Do not pry between the lower arm and the drive axle (halfshaft) boot or in such a manner that the ball joint seal is contacted. Damage to the drive axle (halfshaft) boot will result (4WD).*

DIAGNOSIS OF SHOCK ABSORBERS

PROBLEM	POSSIBLE CAUSE	CORRECTION
Noisy Shocks	Loose mounting.	Check all mounting torques (bolt and/or nut).
Excessive Road Shock	<ol style="list-style-type: none"> 1. Tire air pressure is too high. 2. Loose wheel bearings. 3. Camber adjustment is incorrect (negative camber contributes to road shock). 4. Weak or broken front spring. 5. Loose suspension components. 	<ol style="list-style-type: none"> 1. Deflate to correct pressure. 2. Adjust the bearings. 3. Adjust the camber. 4. Replace the spring. 5. Inspect, repair, and adjust as necessary.
Leaky Shocks	Seals are worn out.	Replace the shocks.
Weak Shocks	<ol style="list-style-type: none"> 1. Shocks are worn out. 2. Loss of shock fluid. 	<ol style="list-style-type: none"> 1. Replace the shocks. 2. Replace the shocks.
Vibration and Shimmy	<ol style="list-style-type: none"> 1. Seal damage resulting in loss of lubricant, corrosion, excessive wear. 2. Tires and wheels, or brake drums, are out of balance. 3. Bent wheel or tire is out of round. 4. Wheel stud nuts torqued unevenly. 5. Loose steering linkage. 6. Wheel is loose on the hub. 7. Driveline universal joints are rough or defective (may be confused with steering vibration). 8. Malfunctioning shock absorbers. 	<ol style="list-style-type: none"> 1. Replace the damaged parts as necessary. 2. Balance the tires and wheels, turn the brake drums. 3. Replace the wheel and remount, or replace the tire. 4. Re-tighten the wheel stud nuts. 5. Tighten or repair as necessary. 6. Inspect the wheel bolt for damage. Replace the wheel if needed. Replace all wheel studs. 7. Repair the driveline. 8. Replace the shock absorbers.

3C-6 FRONT SUSPENSION AND AXLE

SHOCK ABSORBER TEST

Bench Test—Non-Spiral Groove PIlacell Shock Absorbers

- Purging air from non-spiral groove shock absorbers is not necessary. These shock absorbers have a gas filled-cell in their reservoirs (as opposed to the air filled-cell in the spiral groove shock absorber reservoirs).
 - Remove the shock absorber from the vehicle. Refer to "Shock Absorber Replacement" in this section.
1. Place the shock absorber in a vise with the jaws clamped on the shock absorber top mounting stud.
 - The shock absorber should be held vertically in the vise—bottom end up.



Important

- Do not clamp the vise jaws on the shock absorber upper stem threads or reservoir.

2. Pump the shock absorber at various rates of speed and observe the rebound force.
 - Rebound force is normally stronger than compression force (approximately two to one).
 - Rebound force should be smooth and constant for each stroke rate.
3. Compare with a good shock absorber.
4. If one of the following is observed, replace the shock absorber.
 - A skip or lag at reversal near mid-stroke.
 - A seize (except at the extreme ends of travel).
 - A noise (grunt or squeal) after completing one full stroke in both directions.
 - A clicking noise at fast reversal.

DIAGNOSIS OF WHEEL BEARINGS

When diagnosing bearing condition, keep in mind the general condition of all parts during disassembly and

inspection. Use Figures 5 and 6 to classify the failure, and follow the recommended correction procedure.

ON-VEHICLE SERVICE: TWO-WHEEL DRIVE FRONT SUSPENSION

WHEEL BEARING ADJUSTMENT



Important

- The continuous smooth functioning of the front suspension cannot be maintained unless the front wheel bearings are correctly adjusted.
- The bearings must be a slip fit on the spindle and the wheel bearing must be lubricated to ensure that the roller bearings will roll and not skid.
- The spindle nut must have a free-running fit on the spindle threads.

NOTICE: *Never preload the front wheel bearings. Damage can result by the steady pressure on the roller ends which comes from preloading.*



Remove or Disconnect (Figure 7)

- Raise the vehicle and support it with suitable safety stands.
1. Wheel cover, if used.
 2. Cap (10) from the hub.
 3. Cotter pin (11).



Tighten

- Nut (12) to 16 N.m (12 lb ft) while turning the wheel forward by hand. This will seat the bearings.



Adjust

- Nut (12) to a "just loose" position by hand, then back the nut (12) off until the hole in the spindle aligns with a slot in the nut. **DO NOT BACK THE NUT (12) OFF MORE THAN 1/4 TURN.**



Install or Connect (Figures 7 and 8)

NOTICE: *Refer to "Notice" on page 3C-1.*

1. New cotter pin (11).
 - Be sure the cotter pin (11) ends do not interfere with the cap (10). Bend the ends of the cotter pin (11) against the nut (12) and cut off any extra pin length.



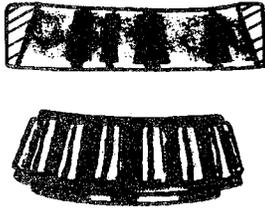
Measure

- The endplay in the hub/rotor assembly (17). Correct endplay should measure 0.03 to 0.20 mm (0.001 to 0.008 inch) (Figure 8).
2. Cap (10) to the hub/rotor (17).
 3. Wheel cover, if used.
 - Lower the vehicle.

TAPERED ROLLER BEARING DIAGNOSIS

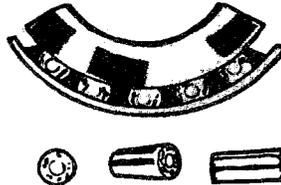
Consider the following factors when diagnosing bearing condition:

1. General condition of all parts during disassembly and inspection.
2. Classify the failure with the aid of the illustrations.
3. Determine the cause.
4. Make all repairs following recommended procedures.



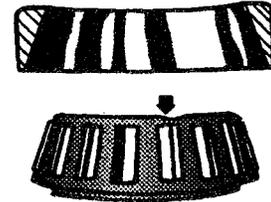
ABRASIVE ROLLER WEAR

Pattern on races and rollers caused by fine abrasives. Clean all parts and housings, check seals and bearings and replace if leaking, rough or noisy.



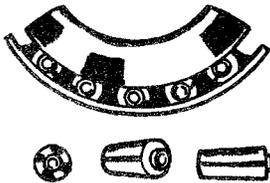
GALLING

Metal smears on roller ends due to overheat, lubricant failure or overload. Replace bearing, check seals and check for proper lubrication.



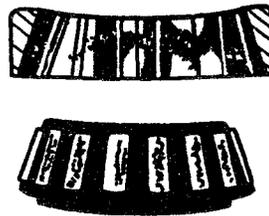
BENT CAGE

Cage damaged due to improper handling or tool usage. Replace bearing.



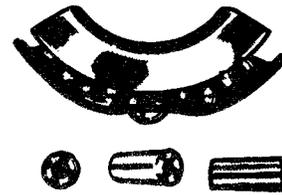
ABRASIVE STEP WEAR

Pattern on roller ends caused by fine abrasives. Clean all parts and housings, check seals and bearings and replace if leaking, rough or noisy.



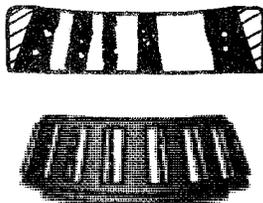
ETCHING

Bearing surfaces appear gray or grayish black in color with related etching away of material usually at roller spacing. Replace bearings, check seals, and check for proper lubrication.



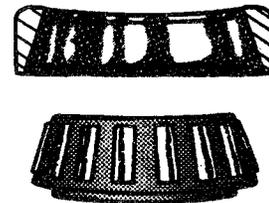
BENT CAGE

Cage damaged due to improper handling or tool usage. Replace bearing.



INDENTATIONS

Surface depressions on race and rollers caused by hard particles of foreign material. Clean all parts and housings. Check seals and replace bearings if rough or noisy.



MISALIGNMENT

Outer race misalignment due to foreign object. Clean related parts and replace bearing. Make sure races are properly sealed.

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Figure 5—Diagnosis of Wheel Bearings (Tapered Roller Bearings)

Diagnosis of Tapered Roller Bearings (con't)



FATIGUE SPALLING

Flaking of surface metal resulting from fatigue. Replace bearing, clean all related parts.



STAIN DISCOLORATION

Discoloration can range from light brown to black caused by incorrect lubricant or moisture. Re-use bearings if stains can be removed by light polishing or if no evidence of overheating is observed. Check seals and related parts for damage.



FRETTAGE

Corrosion set up by small relative movement of parts with no lubrication. Replace bearing. Clean related parts. Check seals and check for proper lubrication.



CAGE WEAR

Wear around outside diameter of cage and roller pockets caused by abrasive material and inefficient lubrication. Clean related parts and housings. Check seals and replace bearings.



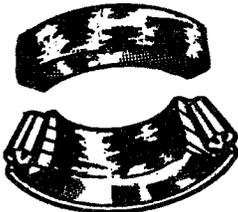
HEAT DISCOLORATION

Heat discoloration can range from faint yellow or dark blue resulting from overload or incorrect lubricant. Excessive heat can cause softening of races or rollers. To check for loss of temper on races or rollers a simple file test may be made. A file drawn over a tempered part will grab and cut metal, whereas, a file drawn over a hard part will glide readily with no metal cutting. Replace bearings if overheating damage is indicated. Check seals and other parts.



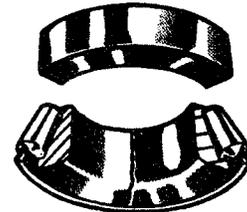
BRINELLING

Surface indentations in raceway caused by rollers either under impact loading or vibration while the bearing is not rotating. Replace bearing if rough or noisy.



SMEARS

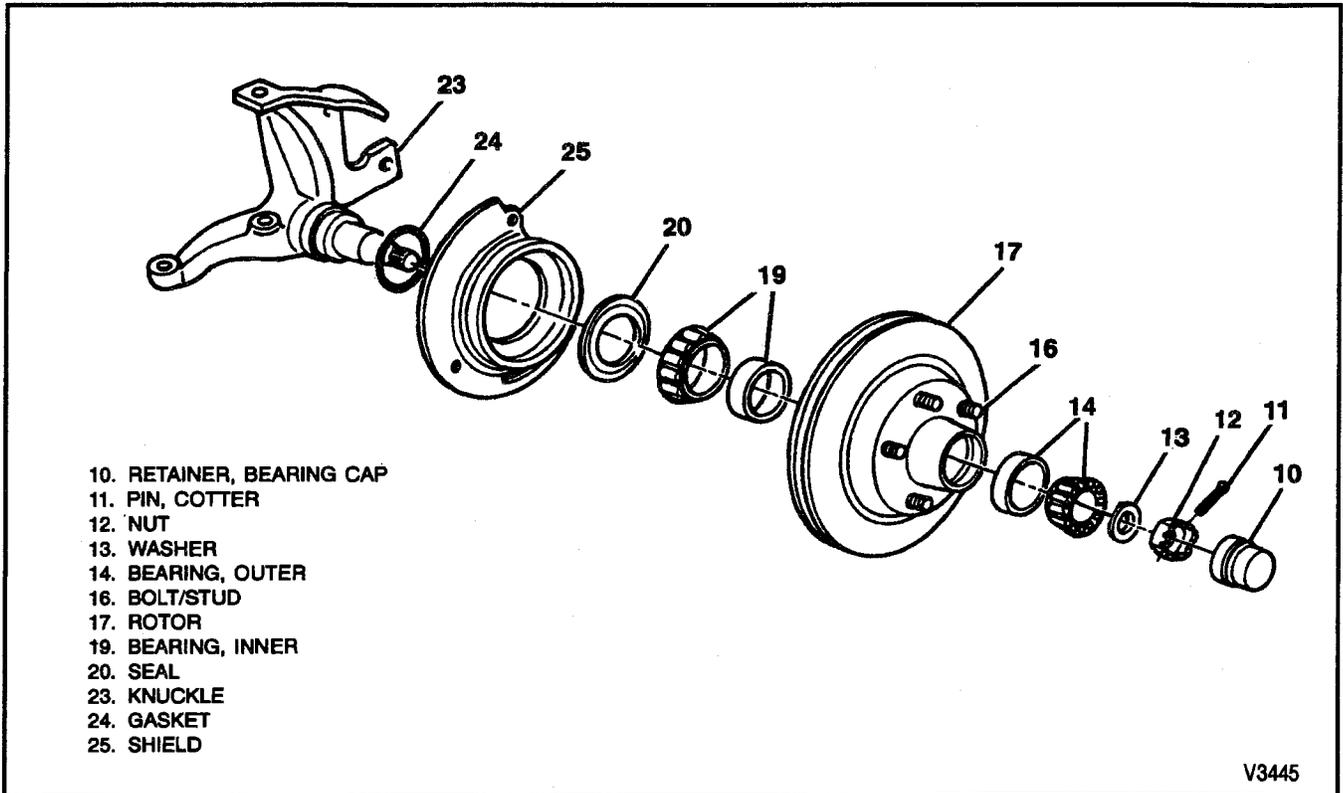
Smearing of metal due to slippage. Slippage can be caused by poor fits, lubrication, overheating, overloads or handling damage. Replace bearings, clean related parts and check for proper fit and lubrication.



CRACKED INNER RACE

Race cracked due to improper fit, cocking, or poor bearing seats. Replace bearing and correct bearing seats.

Figure 6—Diagnosis of Wheel Bearings (Tapered Roller Bearings) (Cont.)



- 10. RETAINER, BEARING CAP
- 11. PIN, COTTER
- 12. NUT
- 13. WASHER
- 14. BEARING, OUTER
- 16. BOLT/STUD
- 17. ROTOR
- 19. BEARING, INNER
- 20. SEAL
- 23. KNUCKLE
- 24. GASKET
- 25. SHIELD

V3445

Figure 7—Hub, Knuckle and Bearing Components

HUB, BEARING, AND SEAL REPLACEMENT

←→ Remove or Disconnect (Figure 7)

1. Brake caliper. Refer to SECTION 5B1.

! Important

- Support the caliper with a piece of wire to prevent damage to the brake line.
2. Cap (10) from the hub/rotor (17).
 3. Cotter pin (11), nut (12) and washer (13).
 4. Hub/rotor (17) from the spindle.
 - Be careful not to damage the outer bearing (14) and the spindle threads.
 5. Outer bearing (14).
 6. Seal (20).
 - Pry the seal (20) out and discard.
 7. Inner bearing (19).

☑ Clean

- All parts in a solvent and air dry. Do not spin the bearings with compressed air.

🔍 Inspect

- Hub/rotor (17). Refer to SECTION 5B1.
- Bearings (14 and 19) and races for a cracked cage, worn or pitted rollers, cracks, scores, or a brinelled condition. Refer to "Diagnosis Of

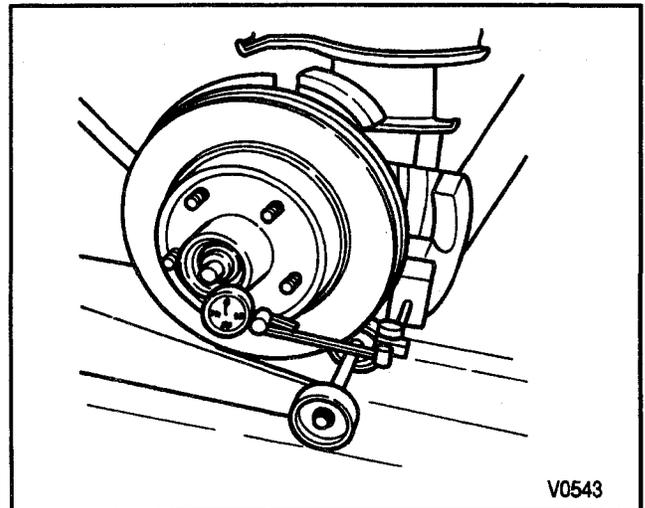
Wheel Bearings" in this section. Replace parts as necessary.

→← Install or Connect (Figure 7)

NOTICE: Refer to "Notice" on page 3C-1.

! Important

- Be sure all parts are clean and free of grease.
- Apply an approved high-temperature front wheel bearing grease to the spindle at the inner and outer



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Figure 8—Checking Wheel Bearing Endplay

3C-10 FRONT SUSPENSION AND AXLE

bearing seat, shoulder and seal seat. Also finger apply a small amount of grease inboard of each bearing cup in the hub/rotor (17). Pressure pack the bearings (14 and 19) with a greasing machine or hand pack them, making sure the grease is worked thoroughly into the rollers, cone and the cage.

1. Inner bearing (19) to the hub/rotor (17).
 - Apply an additional quantity of grease outboard of the inner bearing (19).
2. Seal (20).
 - Lubricate the seal (20) lip.
 - Use a seal installation tool or flat block to press the seal (20) down flush with the hub.
 - Seat the outer bearing (14) and cup (15).
3. Hub/rotor (17) to the spindle.
 - Be careful not to scuff the spindle threads.
4. Outer bearing (14) to the hub/rotor (17).
5. Washer (13).
6. Nut (12).

Tighten

- Nut (12) to 16 N.m (12 lb ft) while turning the wheel assembly forward by hand. Apply grease to the outboard side of the outer bearing (14).

Important

- Adjust the wheel bearings. Refer to "Wheel Bearing Adjustment" in this section.
7. Brake caliper. Refer to SECTION 5B1.

WHEEL HUB BOLT REPLACEMENT

Tools Required:
J 9746-02 Hub/Rotor Support

Remove or Disconnect (Figure 9)

- Raise the vehicle and support it with suitable safety stands.
1. Tire and wheel assembly. Refer to SECTION 3E.

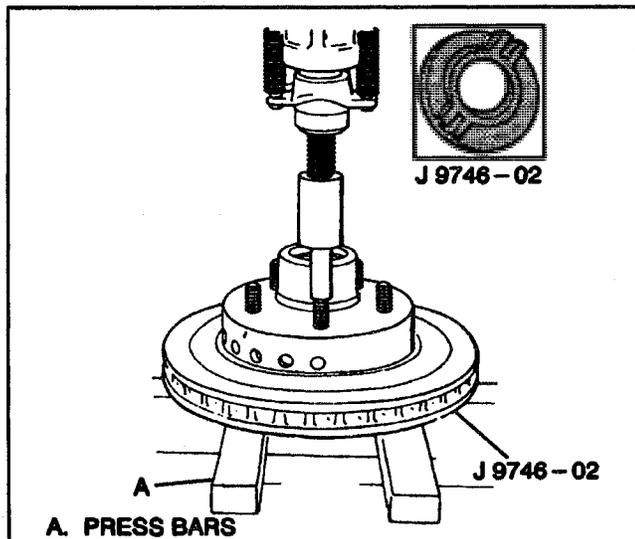


Figure 9—Removing the Wheel Hub Bolts

2. Brake caliper assembly. Refer to SECTION 5B1.
 - Support the caliper with a piece of wire to prevent damage to the brake line.
3. Hub/Rotor assembly. Refer to "Hub, Bearing, and Seal Replacement" in this section.
4. Wheel hub bolts with a press.
 - Support the hub/rotor using J 9746-02 and the press bars (Figure 9).
 - Do not damage the wheel mounting surface on the hub/rotor flange.

Install or Connect (Figure 10)

NOTICE: Refer to "Notice" on page 3C-1.

1. Wheel hub bolts into the hub/rotor.
 - Place four washers and a nut on the bolt, tighten until the bolt is fully seated in the hub/rotor.
2. Hub and rotor.
3. Brake caliper.
4. Tire and wheel assembly.
 - Lower the vehicle.

SHOCK ABSORBER REPLACEMENT

Remove or Disconnect (Figure 11)

NOTICE: The front shock absorbers of the C/K vehicle are multifunctional. In addition to contributing to a smooth ride they also provide the only stop to the front suspension when fully extended. Therefore, when servicing the shock absorber, service replacement shock absorbers must be equivalent to original shock absorbers in both extended length and strength. Use of shocks not complying to original equipment length or strength could result in suspension over-travel or shock breakage. Suspension over-travel may result in suspension component breakage.

- Raise the vehicle and support it with suitable safety stands.

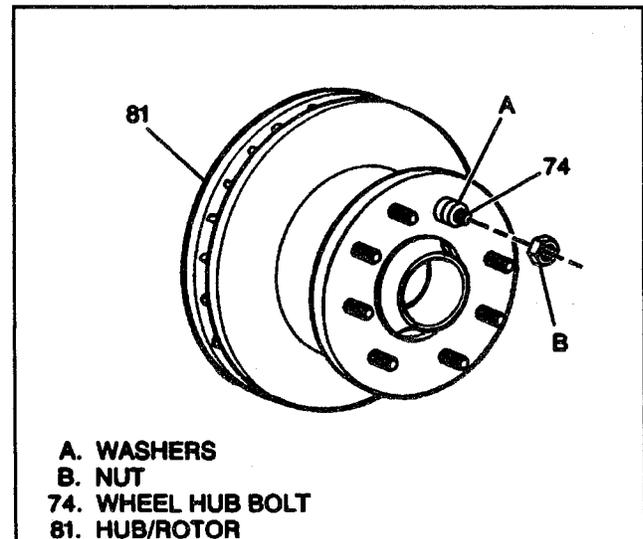


Figure 10—Installing the Wheel Hub Bolts

1. Nut (30).
 - Hold the shock absorber stem (33) with a wrench while backing the nut (30) off.
2. Retainer (31).
3. Grommet (32).
4. Bolts (38).
 - Pull the shock absorber (36) out from below.
 - Lower grommet (34) and retainer (35) are on the stem (33).

⇔ Install or Connect (Figure 11)

NOTICE: Refer to "Notice" on page 3C-1.

1. Retainer (35) and grommet (34) on the stem (33).
 - Fully extend the stem (33).
2. Shock absorber (36) up through the lower control arm (40) and spring (37).
 - Insert the stem (33) end through the hole in the upper control arm frame bracket (42).
3. Grommet (32) to the stem (33).
4. Retainer (31) to the stem (33).
5. Nut (30).

⌚ Tighten

- Nut (30) to 11 N.m (100 lb in) while holding the stem (33) with a wrench.
6. Bolts (38) through pivot (39) holes to the lower control arm holes.

⌚ Tighten

- Bolts (38) to 27 N.m (20 lb ft).
- Lower the vehicle.

STABILIZER SHAFT REPLACEMENT

⇔ Remove or Disconnect (Figure 12)

- Raise the vehicle and support it with suitable safety stands.
1. Nut (50) from the link bolt assembly (62).

! Important

- Be sure to remove parts from both the right and left side of the vehicle and keep them separated.
2. Link bolt (62).
 3. Spacer assembly (56).
 4. Bolts (63).
 5. Bracket (64).
 6. Stabilizer shaft (53).
 7. Rubber bushing (65).

🔍 Inspect

- All parts for wear and damage.

⇔ Install or Connect (Figure 12)

NOTICE: Refer to "Notice" on page 3C-1.

1. Rubber bushings (65) to the stabilizer shaft (53).
 - Be sure the bushings (65) are placed on the stabilizer shaft (53) with slits facing toward the front of the vehicle.

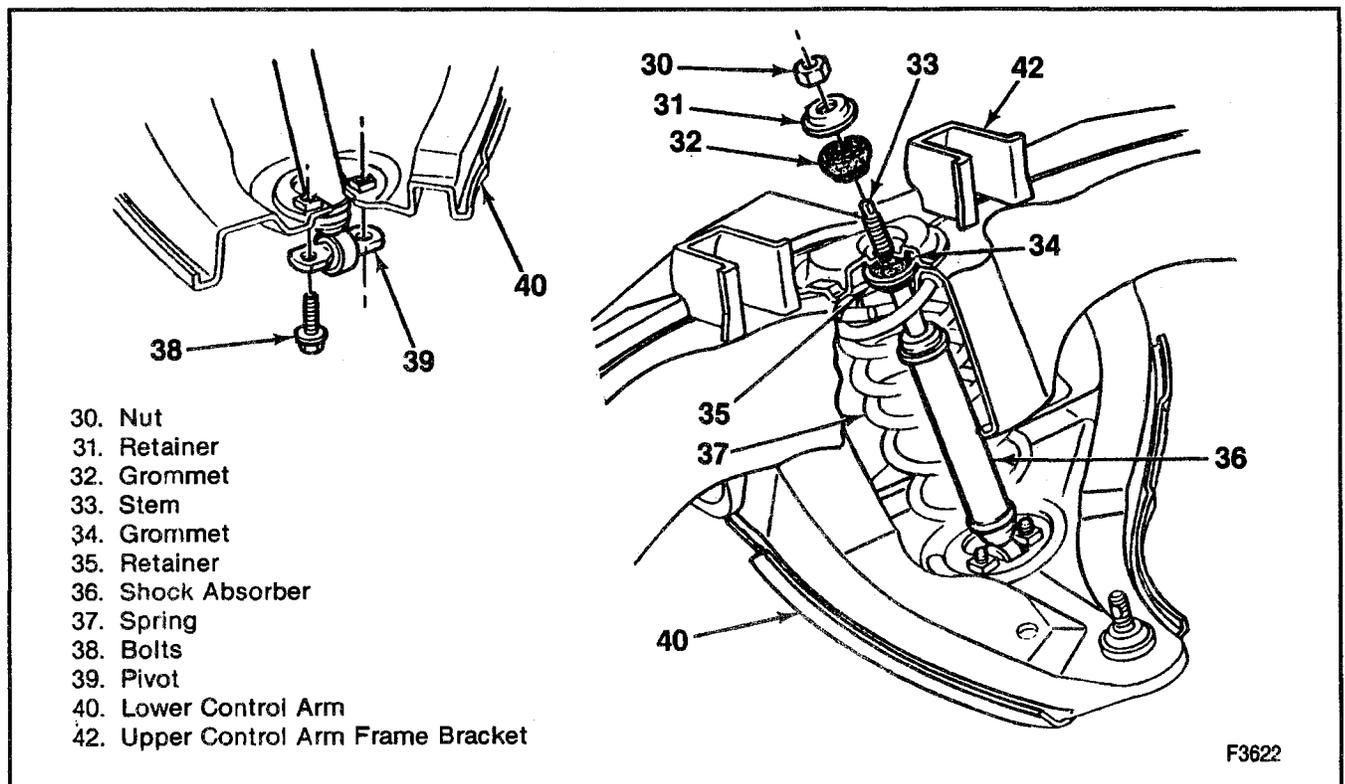


Figure 11—Attaching the Shock Absorber

3C-12 FRONT SUSPENSION AND AXLE

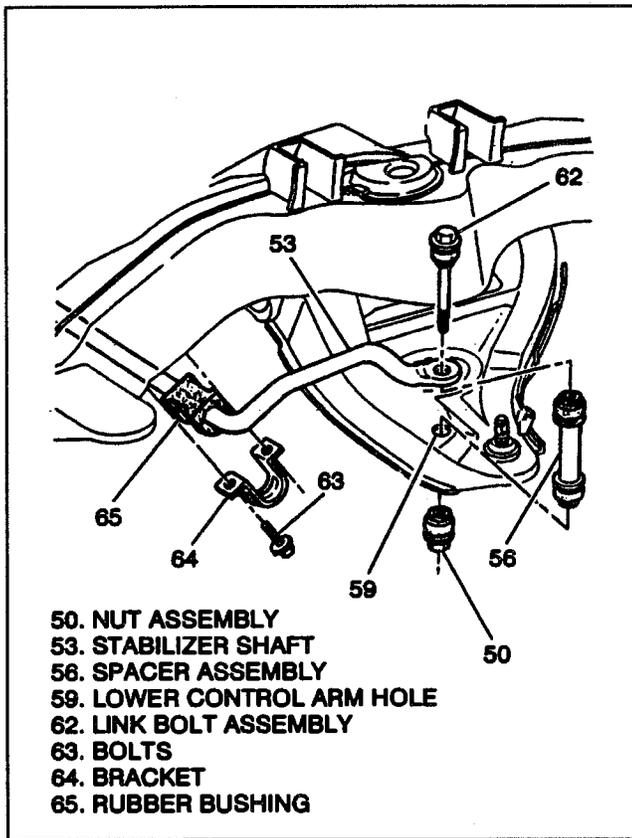


Figure 12—Stabilizer Shaft Components

2. Stabilizer shaft (53).
3. Brackets (64) over the bushings (65) and the stabilizer shaft (53).
4. Bolts (63) to the brackets (64) and the frame.



- Bolts (63) to 33 N.m (24 lb ft).
5. Spacer assembly (56).
 6. Link bolt assembly (62).
 7. Nuts (50).



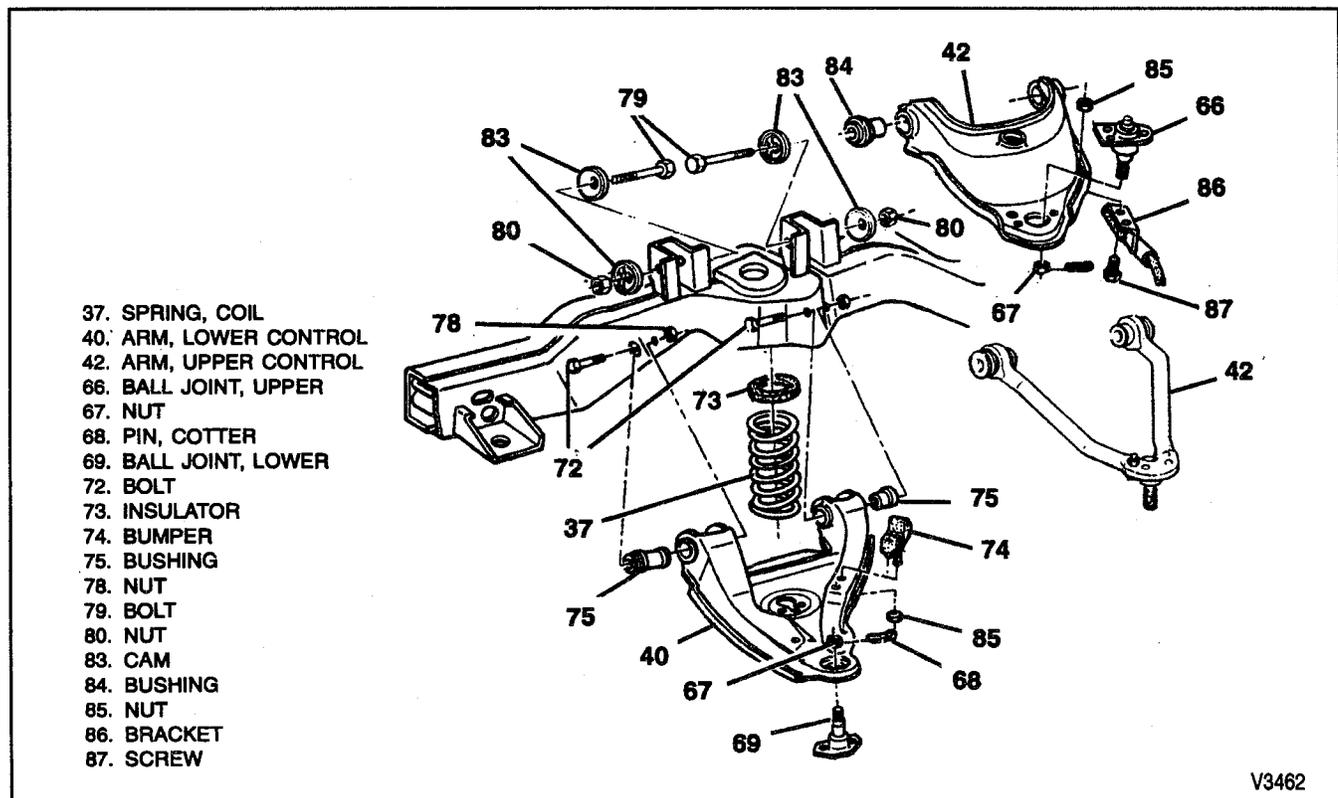
- Until the nut meets the end of the bolt threads for torque value.
- Nut (50) to 18 N.m (13 lb ft).
- Lower the vehicle.

LOWER BALL JOINT REPLACEMENT

Tools Required:
 J 9519-E Ball Joint Remover and Installer Set
 J 23742 Ball Joint Separator
 J 9519-40 Lower Ball Joint Remover Adapter
 J 9519-E Ball Joint Remover and Installer Set



- Raise the vehicle and support the frame with suitable safety stands.



V3462

Figure 13—Control Arms and Components

1. Tire and wheel assembly. Refer to SECTION 3E.
 - Place a floor jack under the control arm spring seat and raise it until it supports the control arm.

CAUTION: Floor jack must remain under the control arm spring seat during removal and installation to retain the spring and control arm in position or personal injury may result.

2. Brake caliper. Refer to SECTION 5B1.

! Important

- Support the caliper with a piece of wire to prevent damage to the brake line.

3. Cotter pin (68) and the nut (67).

- Use J 23742 to break the ball joint loose from the knuckle (Figure 14).

4. Lower control arm (40) from the knuckle.

- Guide the control arm out of the splash shield with a screwdriver while lifting the upper control arm with a pry bar.

! Important

- Block the knuckle assembly out of the way by placing a wooden block between the frame and upper control arm.

5. Lower ball joint (69) from the lower control arm.

- Use tools as shown in (Figure 15).

👁 Inspect

- The tapered hole in the steering knuckle and remove any dirt. If the hole is out of round, deformed or damaged, the knuckle must be replaced.

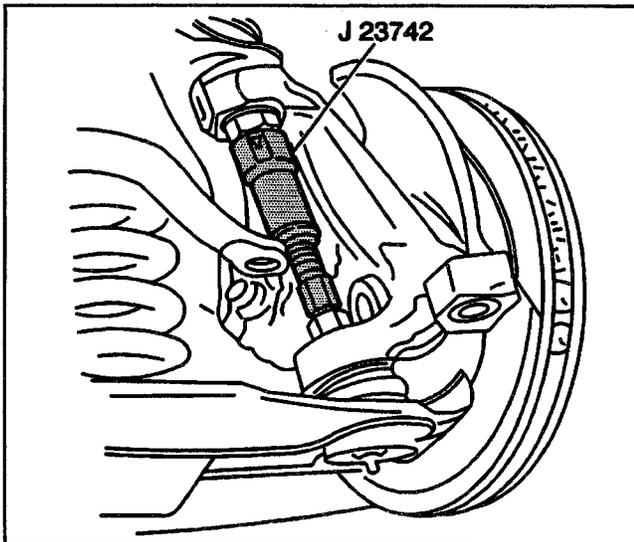


Figure 14—Disconnecting the Lower Ball Joint

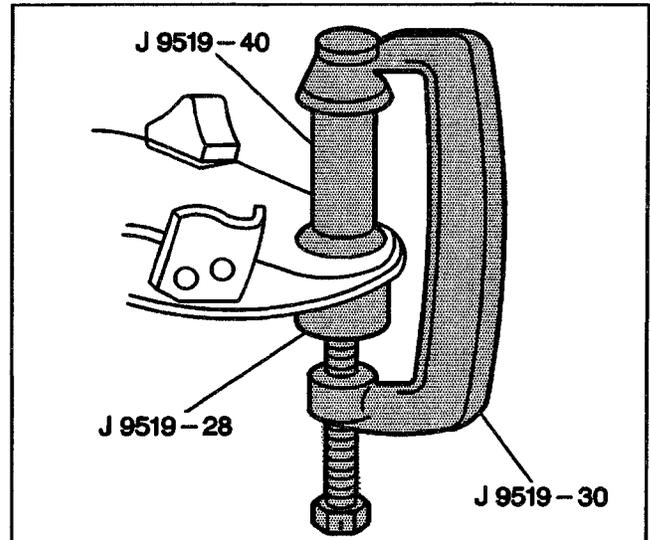


Figure 15—Removing the Lower Ball Joint

↔ Install or Connect (Figure 16)

NOTICE: Refer to "Notice" on page 3C-1.

1. New ball joint (69) into the lower control arm (40).
 - Press in the ball joint using tools as shown in (Figure 16). The ball joint will bottom on the control arm.
2. Ball joint stud into the steering knuckle.

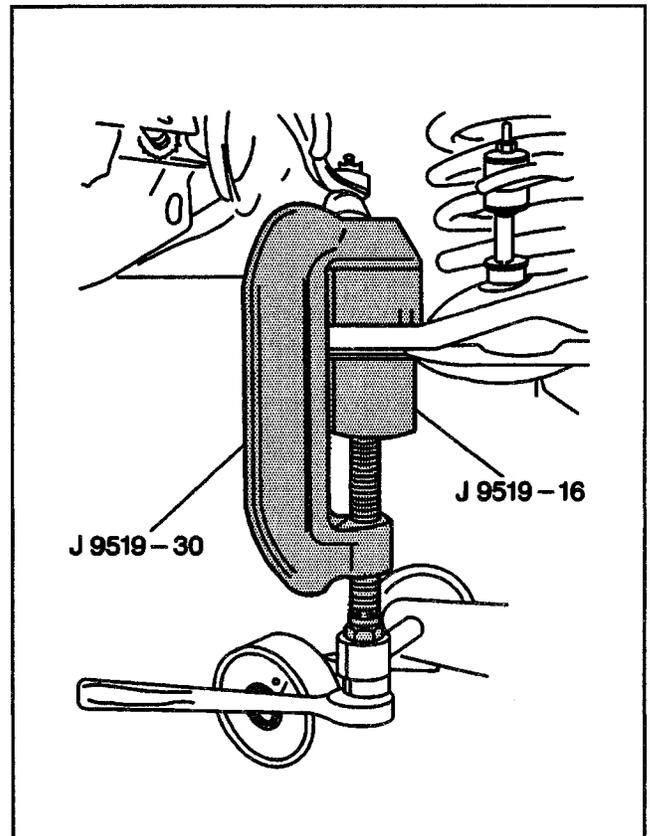


Figure 16—Installing the Lower Ball Joint

3C-14 FRONT SUSPENSION AND AXLE

3. Stud nut (67) onto the stud.



Tighten

- Nut (67) to 128 N.m (94 lb ft) and align the slot in the stud nut with the hole in the stud by tightening.

4. New cotter pin (68) to the stud.

5. Brake caliper.

6. Tire and wheel assembly.

- Lower the vehicle.



Important

- Check the front wheel alignment. Refer to SECTION 3A.

UPPER BALL JOINT REPLACEMENT

Tool Required:

J 23742 Ball Joint Separator

CAUTION: Floor jack or stand must remain under the control arm spring seat during removal and installation to retain the spring and control arm in position or personal injury may result.

- Raise the vehicle and support it with safety stands.
- Support the control arm with a jack.



Remove or Disconnect (Figure 13)

1. Tire and wheel assembly. Refer to SECTION 3E.
2. Brake caliper. Refer to SECTION 5B1.



Important

- Support the caliper with a piece of wire to prevent damage to the brake line.

3. Rivets from the upper ball joint (66).

A. Use a 3.175 mm (1/8 inch) drill to cut a 6.35 mm (1/4 inch) deep hole in the center of each rivet (Figure 17).

B. Drill the rivet heads away using a 12.75 mm (1/2 inch) drill (Figure 18).

C. Punch the rivets out using a small pin punch (Figure 19).

4. Cotter pin.

5. Stud nut (67) from the upper ball joint (66) (Figure 13).

A. Use J 23742 as shown in Figure 20.

B. Apply pressure on the tool until the stud breaks loose.

C. Remove J 23742.

D. Pull the stud away from the knuckle.



Important

- Support the knuckle assembly so that its weight will not damage the brake hose.

6. Upper ball joint (66).

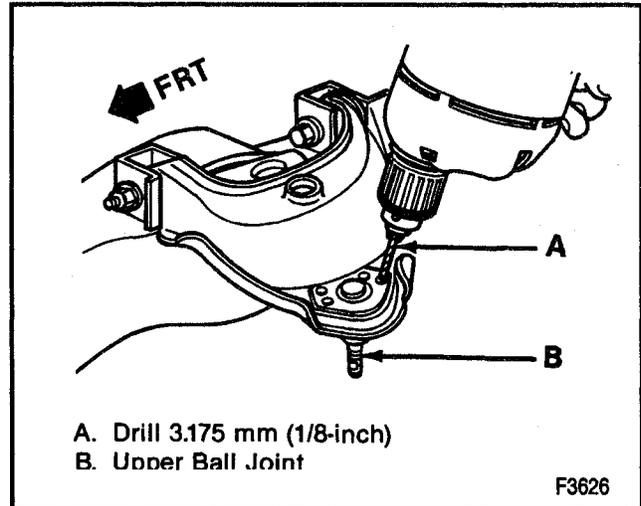


Figure 17—Drilling the Upper Ball Joint Rivets

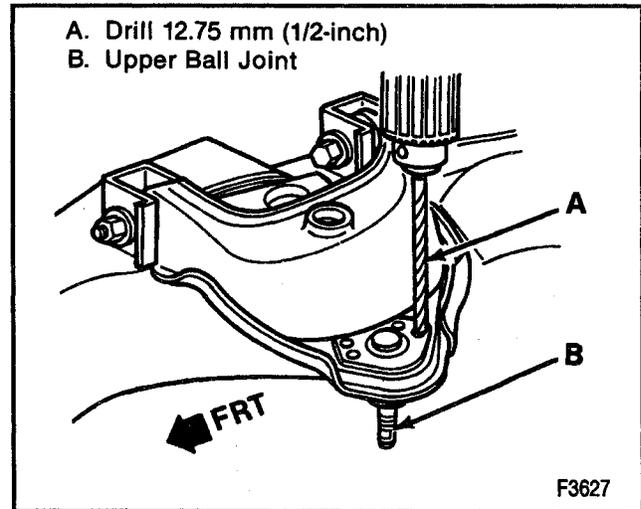


Figure 18—Drilling the Upper Ball Joint Rivet Heads

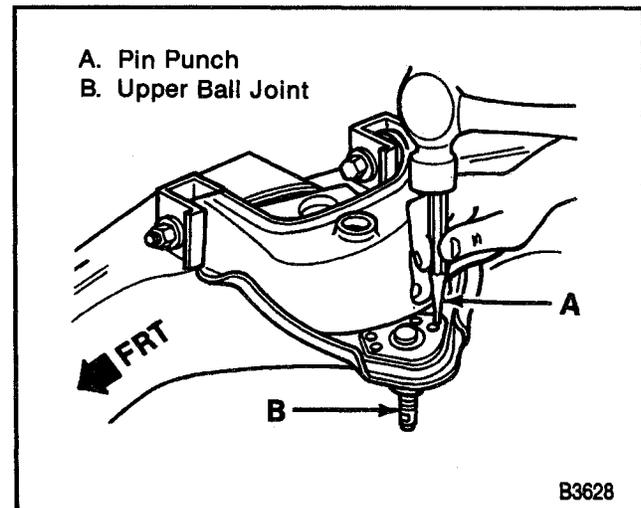


Figure 19—Removing the Upper Ball Joint Rivets

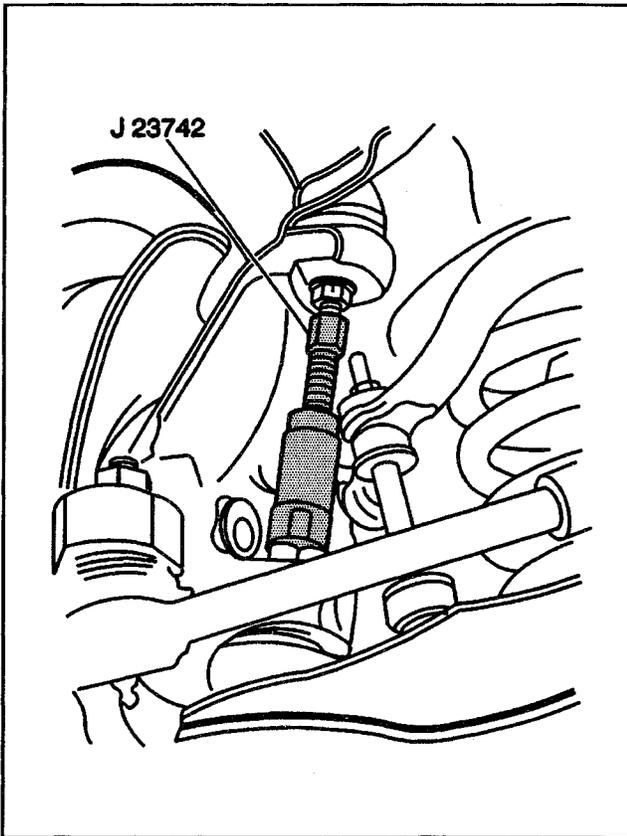


Figure 20—Disconnecting the Upper Ball Joint

↔ Install or Connect (Figure 13 and 21)

NOTICE: Refer to "Notice" on page 3C-1.

1. New upper ball joint (66) to the upper control arm (42) (Figure 21).
 - Position four attaching bolts and nuts (Figure 21).

 **Tighten**

- Nuts (A) to 24 N.m (18 lb ft).
- Take the support away from the knuckle assembly.

2. Upper ball joint (66) to the steering knuckle.
3. Stud nut (67).

 **Tighten**

- Nut (67) to 100 N.m (74 lb ft).
- Align the slot in the stud nut with the hole in the stud by tightening the stud nut.

4. New cotter pin.
5. Brake caliper.
6. Tire and wheel assembly.
7. Lower the vehicle.

 **Important**

- Check the running clearance at all suspension components.
- Check the front wheel alignment. Refer to SECTION 3A.

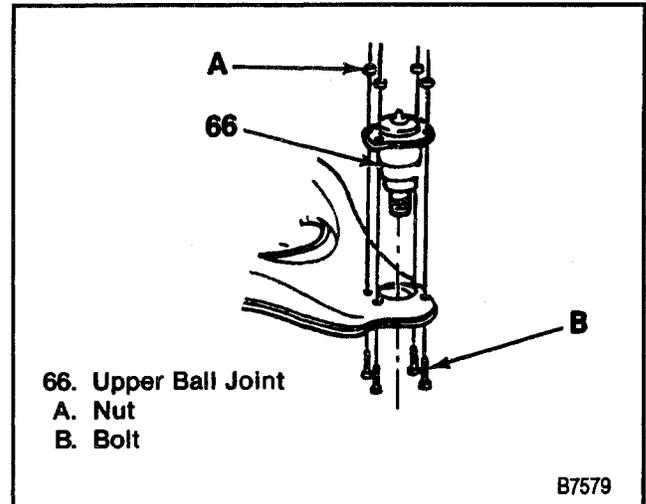


Figure 21—Installing the Upper Ball Joint

STEERING KNUCKLE REPLACEMENT

Tool Required:
J 23742 Ball Joint Separator

↔ Remove or Disconnect (Figure 7, 14, 20 22, and 23)

- Raise the front of the vehicle and place floor stands under the front lift points. Do not place the floor stands under the lower control arms because spring tension is needed to assist in breaking loose the ball joint studs.

1. Tire and wheel assembly. Refer to SECTION 3E.
2. Tie rod from the steering knuckle. Refer to SECTION 3B3.
3. Brake caliper. Refer to SECTION 5B1.

 **Important**

- Support the caliper with a piece of wire to prevent damage to the brake line.
4. Hub/rotor assembly (17). Refer to "Hub, Bearing, and Seal Replacement" in this section.
 5. Three bolts attaching the splash shield to the steering knuckle (Figure 22).
 6. Steering knuckle seal (20) if the steering knuckle (23) is to be replaced (Figure 23).
 - Be careful not to damage the knuckle seal (20).
 7. Upper and lower ball joint studs from the steering knuckle (23) using J 23742 (Figures 14 and 20). Refer to "Ball Joint Replacement" in this section.

CAUTION: Floor jack must remain under control arm spring seat during removal and installation to retain the spring and control arm in position or personal injury may result.

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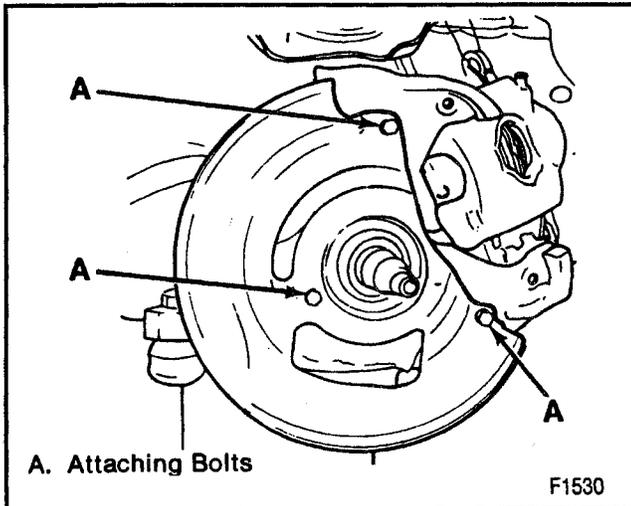


Figure 22—Splash Shield Attachment

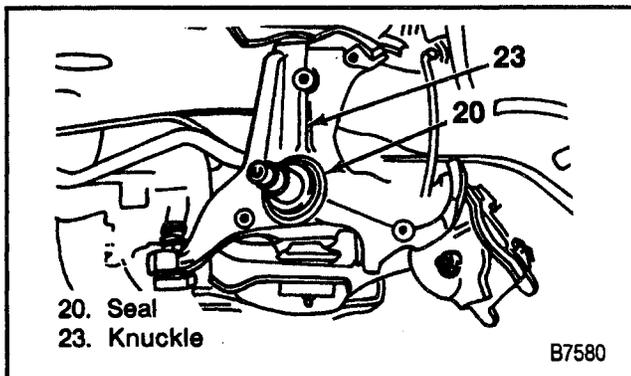


Figure 23—Locating the Seal on the Knuckle

Position a floor jack under the lower control arm near the spring seat. Raise the jack until it just supports the lower control arm.

- Raise the upper control arm and disengage the ball joint stud from the knuckle (23).

8. Steering knuckle (23) from the lower ball joint stud.



Clean

- The steering knuckle.



Inspect

- Steering knuckle tapered hole. If out-of-round, deformed or damaged, the knuckle must be replaced.



Install or Connect (Figures 7, 22, and 23)

NOTICE: Refer to "Notice" on page 3C-1.

1. Upper and lower ball joints into the steering knuckle (23) (Figure 7).
2. Steering knuckle seal (20) (Figure 23).
3. Splash shield (25) to the steering knuckle (23).

4. Bolts (A) to the splash shield (Figure 22).



Tighten

- Bolts (A) to 26 N·m (19 lb ft).
5. Tie rod end into the knuckle (23).
 6. Hub/rotor assembly (17).
 - Adjust the wheel bearing. Refer to "Wheel Bearing Adjustment" in this section.
 7. Tire and wheel assembly.
 8. Floor stands.
 - Lower the vehicle.
 - Check front wheel alignment. Refer to SECTION 3A.

COIL SPRING REPLACEMENT

Tool Required:

J 23028-01 Coil Spring Remover and Installer



Remove or Disconnect (Figure 13, 24, and 25)

- Raise the vehicle on a hoist so that the control arms hang free.
 1. Tire and wheel assembly. Refer to SECTION 3E.
 2. Shock absorber. Refer to "Shock Absorber Replacement" in this section.
 - Cradle the lower control arm using J 23028-01 secured to the end of a suitable jack (Figure 24).
 3. Stabilizer shaft from the lower control arm. Refer to "Stabilizer Shaft Replacement" in this section.
 - Raise the jack to remove tension on the lower control arm pivot bolts (72) (Figure 13).
 - Secure the spring with a chain through the spring and the control arm.
 4. Pivot bolts (72) and nuts (78).
 - Take the rear pivot bolt (72) out first.
 - Lower the control arm (40) by lowering the jack.
 - When compression is removed from the coil spring, take the chain away.

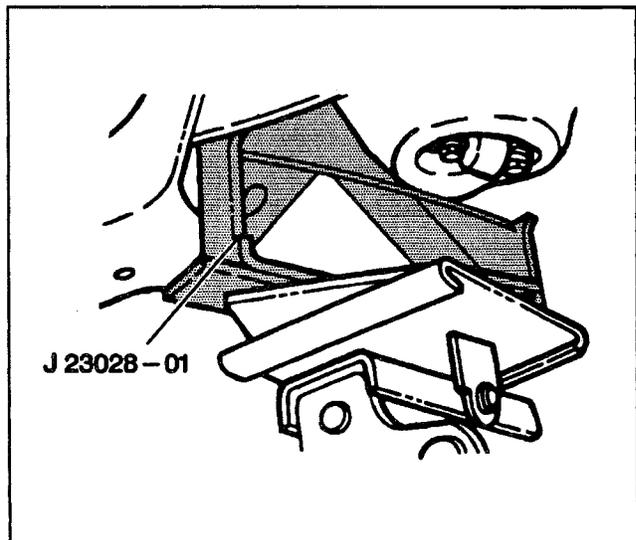


Figure 24—Cradling the Lower Control Arm

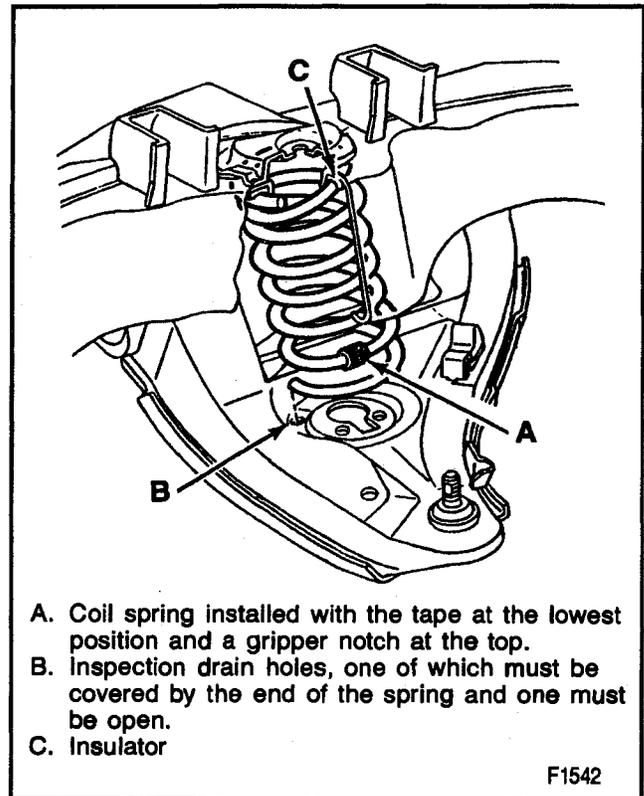
! Important

- Do not force the lower control arm and ball joint in order to remove the coil spring.
5. Coil spring (37) and the insulator (73) (Figure 13).
- Position the coil spring properly for easy removal.

↔ Install or Connect (Figures 13, 24, 25 and 26)

NOTICE: Refer to "Notice" on page 3C-1.

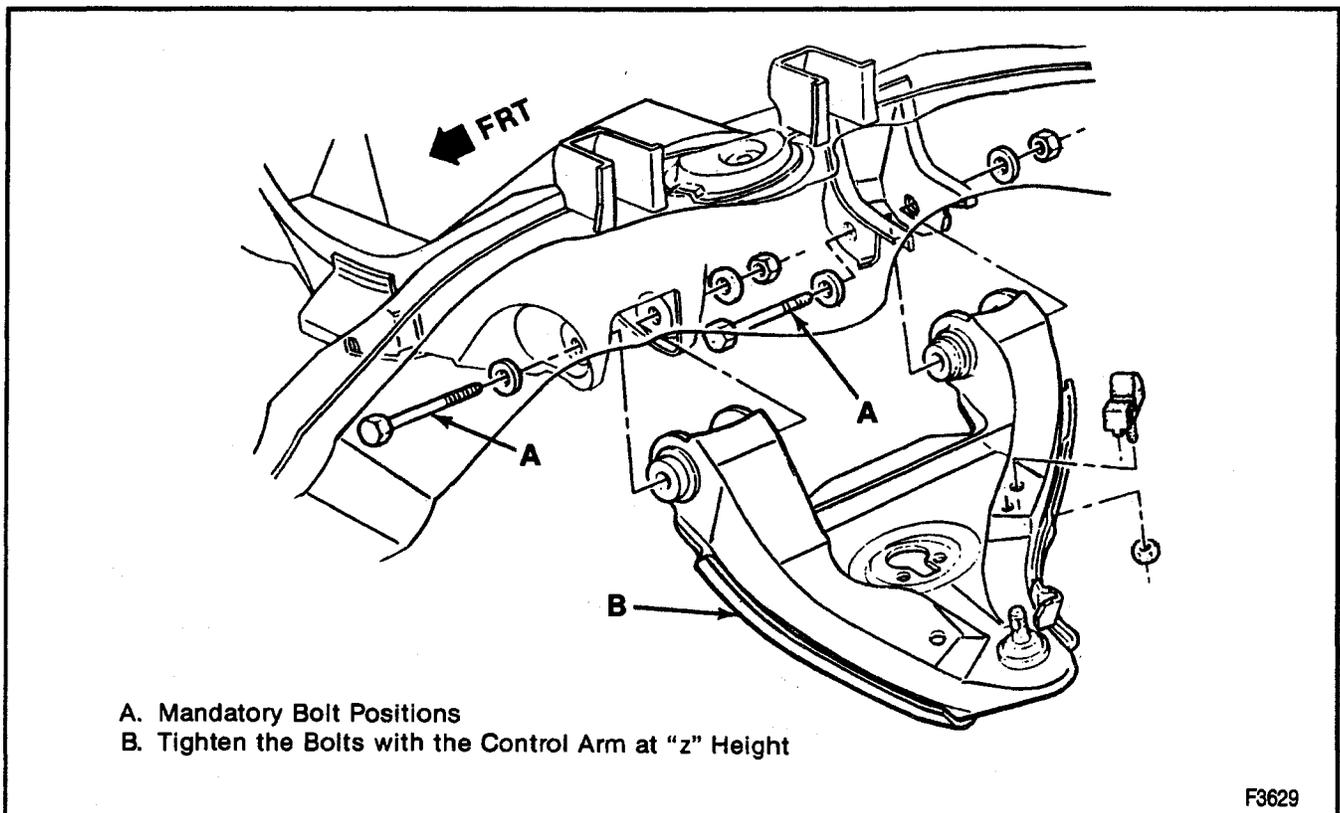
1. Coil spring (37) and the insulator (73) on the lower control arm (40) (Figure 13).
 - Refer to Figure 25 for correct coil spring positioning.
 - Secure the spring with a chain through the spring and the control arm.
 - Be sure the spring insulator is on top.
 - Use J 23028-01 to support the control arm (Figure 24).
2. The lower control arm (40) in place on the frame.
 - Guide the control arm into place with a pry bar.
3. Pivot bolts (72) and new nuts (78).
 - Insert and tighten the front bolt (72) first.
 - Remove the chain and the jack.



- A. Coil spring installed with the tape at the lowest position and a gripper notch at the top.
- B. Inspection drain holes, one of which must be covered by the end of the spring and one must be open.
- C. Insulator

F1542

Figure 25—Positioning the Coil Spring



- A. Mandatory Bolt Positions
- B. Tighten the Bolts with the Control Arm at "z" Height

F3629

Figure 26—Installing the Lower Control Arm

3C-18 FRONT SUSPENSION AND AXLE



Important

- Refer to mandatory bolt direction of installation in (Figure 26).



Tighten

- Nuts (78) to 137 N·m (101 lb ft).
 - Front nut (78) must be tightened before the rear nut.
 - The nuts (78) must be tightened with the control arm at "Z" Height. Refer to SECTION 3A.
4. Stabilizer shaft.
 5. Shock absorber.
 6. Tire and wheel assembly.
 - Lower the vehicle.

UPPER CONTROL ARM AND BUSHING REPLACEMENT



Remove or Disconnect (Figures 13)

- Raise the front of the vehicle and support the lower control arm with floor stands. Since the weight of the vehicle is used to relieve the spring tension on the upper control arm, the floor stands must be positioned between the spring seats and the ball joints of the lower control arms for maximum leverage.

CAUTION: The floor jack must remain under the control arm spring seat during removal and installation to retain the spring and control arm in position or personal injury may result.

1. Tire and wheel assembly. Refer to SECTION 3E.
2. Air cleaner extension, if required.
3. Brake hose bracket (86) (Figure 13).
 - Nuts (85) and screws (87).
 - Tie the hose out of the way.
4. Upper ball joint from the steering knuckle. Refer to "Upper Ball Joint Replacement" in this section.
5. Upper control arm attaching bolts (79) and nuts (80).
6. Upper control arm (42).
7. Bushings (84).



Inspect

- All parts for wear and damage.



Install or Connect (Figures 13 and 27)

NOTICE: Refer to "Notice" on page 3C-1.

1. Bushings (84).
2. Upper control arm (42) to the frame.
3. Bolts (79) and new nuts (80).

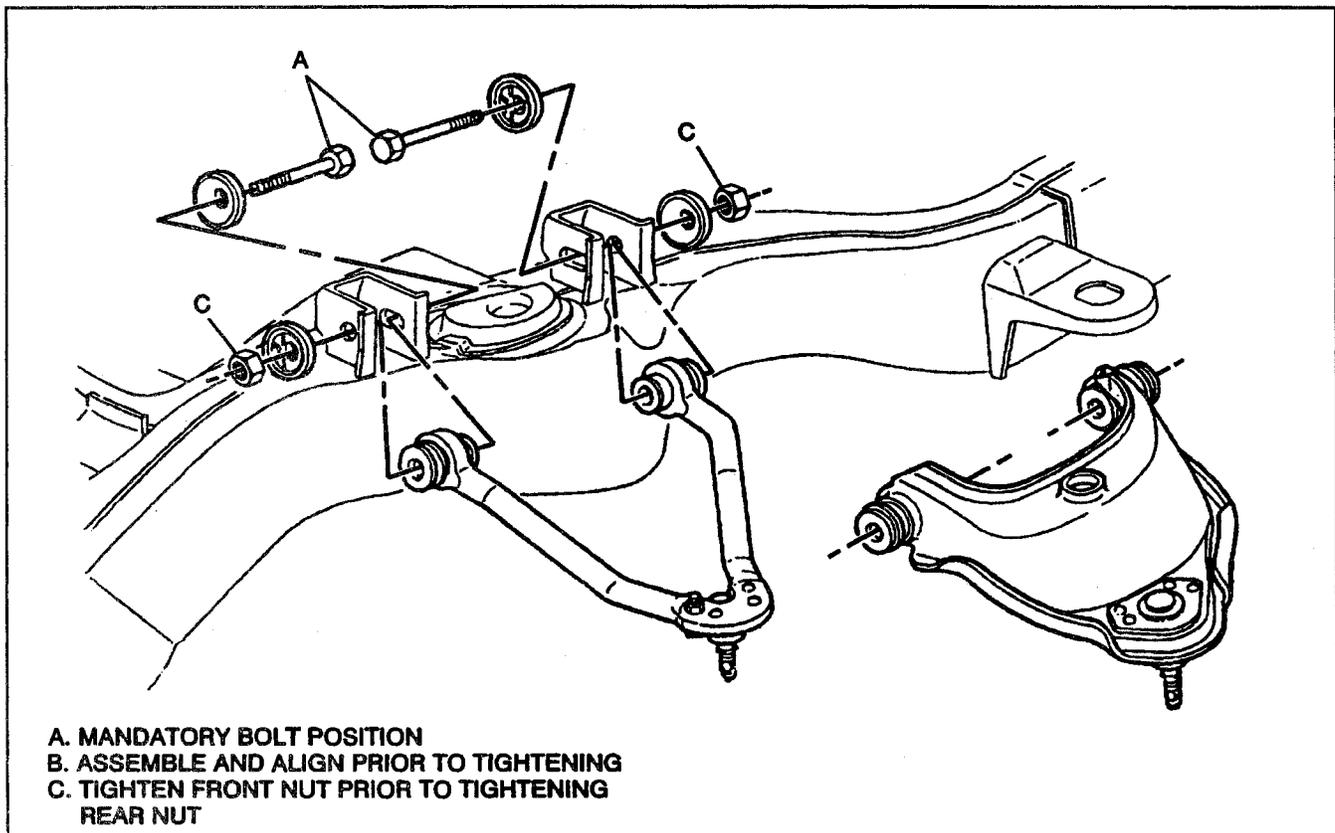


Figure 27—Installing the Upper Control Arm



Important

- Refer to mandatory bolt direction (Figure 27).
- Tighten front nut prior to tightening rear nut.



Tighten

- Nuts (80) to 190 N.m (140 lb ft).
 - The nuts (80) must be tightened with the control arm at "Z" Height. Refer to SECTION 3A.
4. Upper ball joint to the steering knuckle.
 5. Brake hose bracket (86) to control arm (Figure 13).
 - Screws (87) and the nuts (85).



Tighten

- Nuts to 18 N.m (13 lb ft).
6. Brake hose to bracket.
 7. Air cleaner extension, if removed.
 8. Tire and wheel assembly.
 - Check front wheel alignment. Refer to SECTION 3A.

LOWER CONTROL ARM AND BUSHING REPLACEMENT

Tool Required:

J 23742 Ball Joint Separator



Remove or Disconnect (Figures 13 and 26)

1. Cotter pin (68) and the nut (85).
 - Separate the ball joint using J 23742.

ON-VEHICLE SERVICE: FOUR-WHEEL DRIVE FRONT SUSPENSION

SHOCK ABSORBER REPLACEMENT



Remove or Disconnect (Figure 28)

NOTICE: *Original equipment shock absorbers serve additionally as suspension drop cutoffs. Replacement shock absorbers must have a built in suspension cutoff feature and must not be longer than original shocks when they are fully extended or serious vehicle or component damage could result.*

- Raise the vehicle on a hoist.
1. Nut (92), washer (97), and the bolt (94).
 - Collapse the shock absorber (91).
 2. Nut (90), washer(97), and the bolt (96).
 3. Shock absorber (91).

2. Control arm (42) from the knuckle.
3. Coil spring. Refer to "Coil Spring Replacement" in this section.
4. Nuts (78) from bolts (72).
5. Bolts (72) from lower control arm.
6. Lower control arm (42).
7. Bushings (75).



Install or Connect (Figures 13 and 26)

NOTICE: *Refer to "Notice" on page 3C-1.*

1. Bushings (75).
2. Control arm (42) to frame.
3. Bolts (72).
4. Nuts (78).
5. Coil spring.
6. Control arm (42) to steering knuckle.
7. Nut (67).



Tighten

- Nuts (78) to 137 N.m (101 lb ft).
 - Nut (67) to 128 N.m (94 lb ft) and align the slot in the stud nut with the hole in the stud by tightening.
8. New cotter pin (68).



Install or Connect (Figure 28)

NOTICE: *Refer to "Notice" on page 3C-1.*

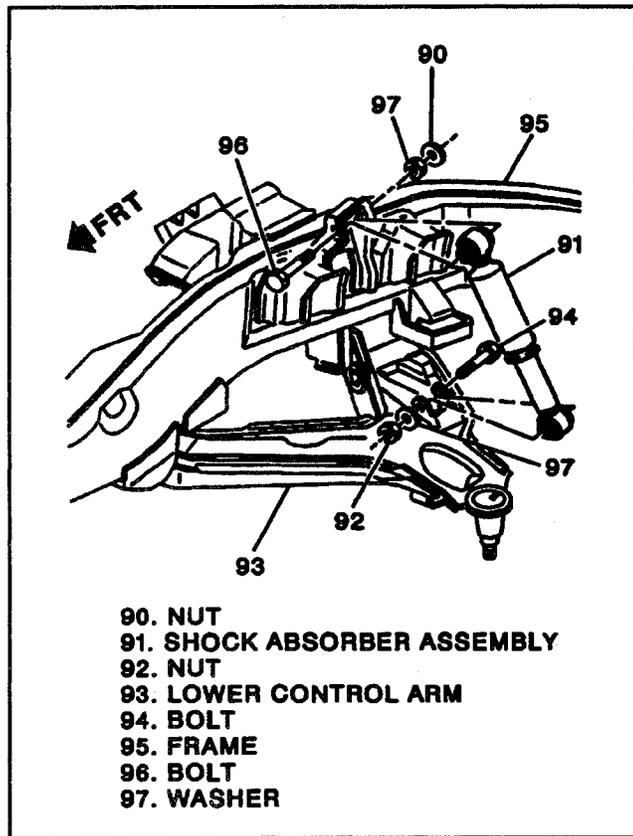
1. Shock absorber (91) to the bracket.
2. Bolts (94 and 96).
 - Fit the bolts (94 and 96) in the direction shown in Figure 28.
3. New nuts (90 and 92) and washers (97) to the bolts (94 and 96).



Tighten

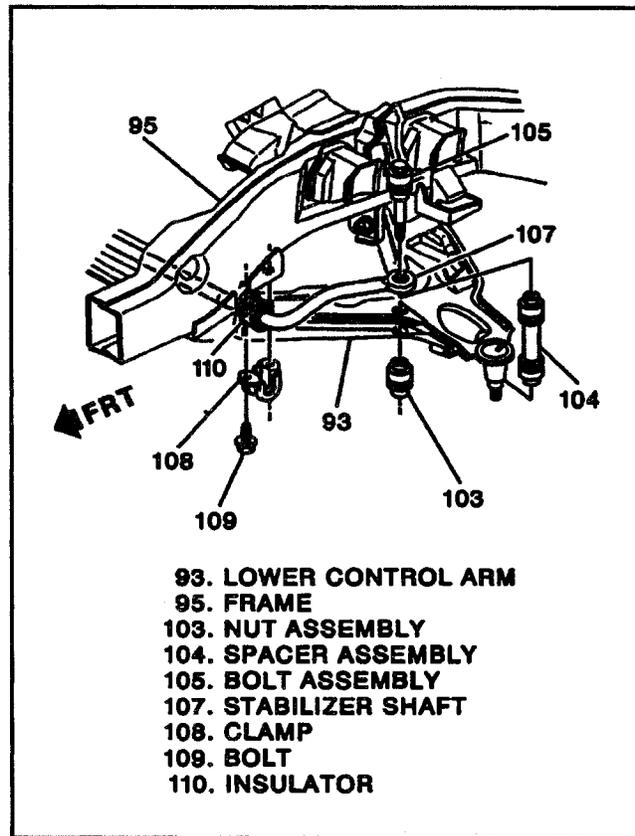
- Upper nut (90) to 90 N.m (66 lb ft).
- Lower nut (92) 90 N.m (66 lb ft).

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- 90. NUT
- 91. SHOCK ABSORBER ASSEMBLY
- 92. NUT
- 93. LOWER CONTROL ARM
- 94. BOLT
- 95. FRAME
- 96. BOLT
- 97. WASHER

Figure 28—Shock Absorber Attachment



- 93. LOWER CONTROL ARM
- 95. FRAME
- 103. NUT ASSEMBLY
- 104. SPACER ASSEMBLY
- 105. BOLT ASSEMBLY
- 107. STABILIZER SHAFT
- 108. CLAMP
- 109. BOLT
- 110. INSULATOR

Figure 29—Stabilizer Shaft Components

STABILIZER SHAFT REPLACEMENT

↔ Remove or Disconnect (Figure 29)

- Raise the vehicle and support it with suitable safety stands.

! Important

- Be sure to remove parts from the right and left front of the vehicle and keep them separated.

1. Nuts (103).
2. Bolts (105).
3. Spacers (104).
4. Bolts (109).
5. Clamp (108).
6. Stabilizer shaft (107).
7. Insulators (110).

🔍 Inspect

- All parts for wear and damage.

→↔ Install or Connect (Figure 29)

- Unload the torsion bar. Refer to "Torsion Bar(s) and Support Assembly Replacement" in this section.

1. Insulators (110) to the stabilizer shaft (107).
 - Be sure the slit in the insulator (110) faces forward.
2. Stabilizer shaft (107) to the frame and lower control arm (93).
3. Clamp (108) to the insulator (110).
4. Bolts (109) to the frame (95).

🔧 Tighten

- Bolts (109) to 33 N.m (24 lb ft).

5. Spacers (104).
6. Link bolts (105).
7. Nuts (103).

🔧 Tighten

- Nuts (103) to 18 N.m (13 lb ft).

- Lower the vehicle.

! Important

- Adjust the trim height of the vehicle. Refer to SECTION 3A.

NOTICE: Refer to "Notice" on page 3C-1.

ROTOR REPLACEMENT

K1 and K2 Models

←→ Remove or Disconnect (Figure 30)

- Raise the vehicle and support it with suitable safety stands.
- 1. Tire and wheel assembly. Refer to SECTION 3E.
- 2. Brake caliper. Refer to SECTION 5B1.
- 3. Rotor (113).

🔍 Inspect

- All parts. Replace as necessary.

→→ Install or Connect (Figure 30)

NOTICE: Refer to "Notice" on page 3C-1.

1. Rotor (113) to the hub and bearing assembly.
2. Brake caliper.
3. Tire and wheel assembly.
 - Lower the vehicle.
 - Depress the brake pedal.

K3 Models

←→ Remove or Disconnect (Figure 30 through 34)

- Raise the vehicle and support it with suitable safety stands.

1. Tire and wheel assembly. Refer to SECTION 3E.
2. Brake caliper. Refer to SECTION 5B1.
3. Nut (120) (Figure 30).
4. Hub/rotor retaining bolts (21). (Figure 31).
5. Using wheel puller, remove rotor assembly (20) (Figure 32).

🔍 Inspect

- All parts. Replace as necessary.

→→ Install or Connect (Figure 31 through 34)

NOTICE: Refer to "Notice" on page 3C-1.

1. Hub/rotor (20) to the hub and bearing assembly.
2. Rotor and hub assembly to axle.

🔩 Tighten

- Bolts (21) 180 N.m (133 lb ft).
 - Nut (120) 225 N.m (165 lb ft).
3. Brake caliper.
 4. Tire and wheel assembly.
 - Lower the vehicle.
 - Depress the brake pedal.

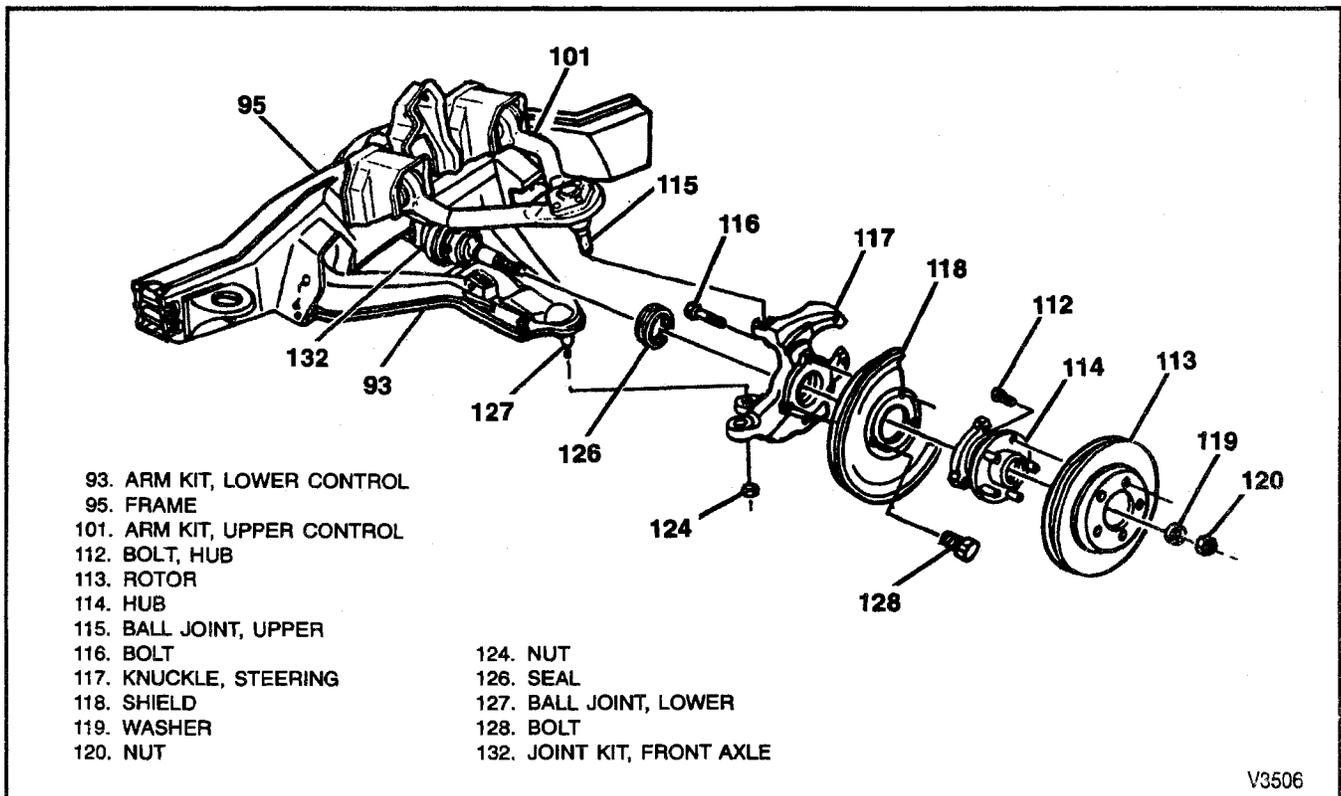


Figure 30—Hub, Knuckle, and Control Arm Components

3C-22 FRONT SUSPENSION AND AXLE

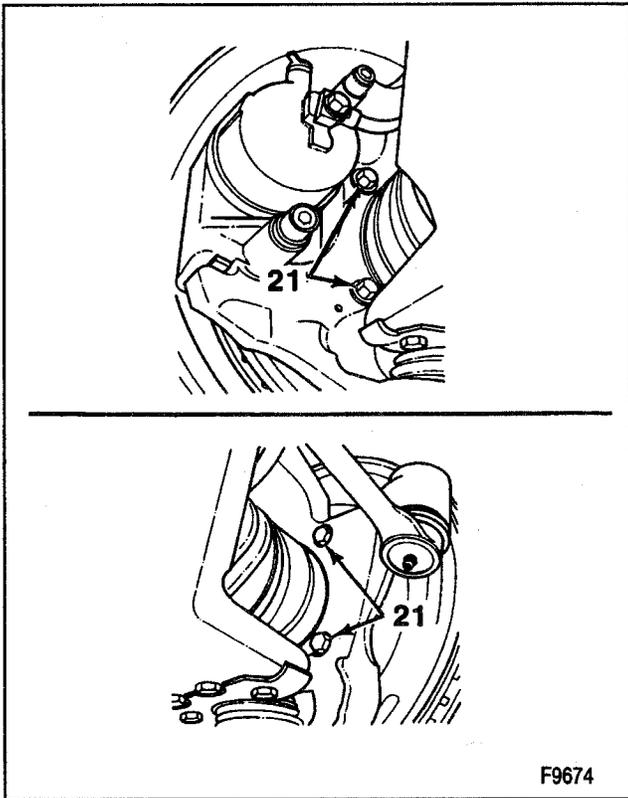


Figure 31—Removing Rotor Retaining Bolts (K-3)

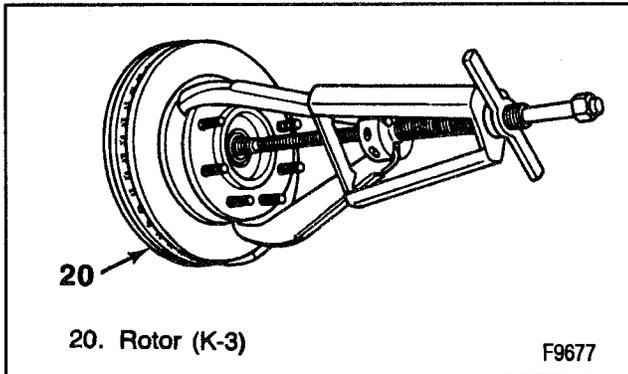


Figure 32—Removing Rotor from the Spindle (K-3)

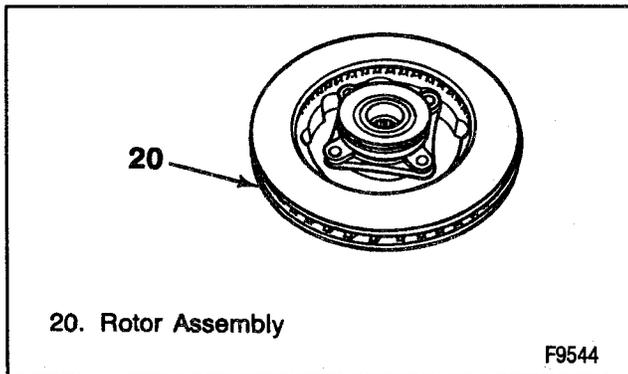


Figure 33—Rotor Assembly (K-3)

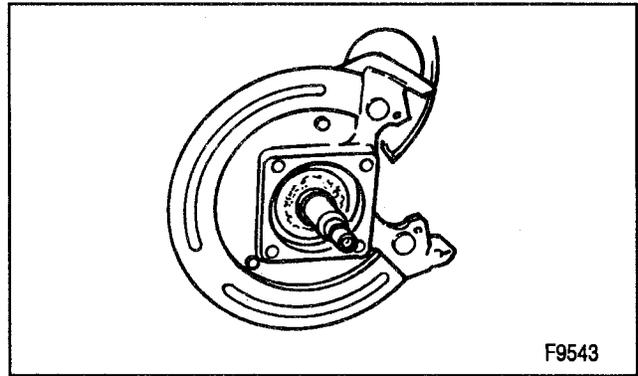


Figure 34—Front Axle Assembly (K-3)

WHEEL HUB BOLT REPLACEMENT

Tool Required:
J 6627-A Wheel Stud Remover

↔ Remove or Disconnect (Figure 35)

- Raise the vehicle and support it with suitable safety stands.
1. Tire and wheel assembly. Refer to SECTION 3E.
 2. Brake caliper. Refer to SECTION 5B1.

! Important

- Support the caliper with a piece of wire to prevent damage to the brake line.
3. Rotor. Refer to "Rotor Replacement" in this section.
 4. Stud (112) using J 6627-A (Figure 36).
- Do not hammer on a wheel stud.

↔ Install or Connect (Figure 36)

NOTICE: Refer to "Notice" on page 3C-1.

1. Stud (112) to the hub and bearing assembly.

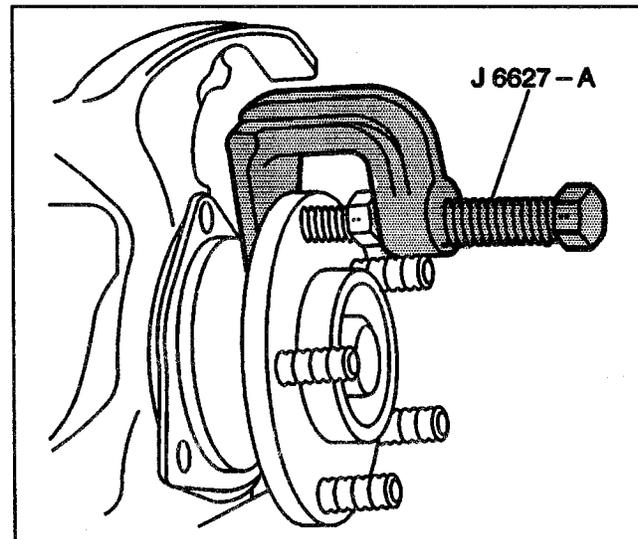


Figure 35—Removing the Wheel Hub Bolts

2. Washers (A) and nut (B) to the stud (Figure 36).

 **Tighten**

- Nut (B). Draw the stud in.
- Remove the nut and washers.

3. Rotor.
4. Brake caliper.
5. Tire and wheel assembly.
 - Lower the vehicle.

HUB AND BEARING, KNUCKLE, AND SEAL ASSEMBLY REPLACEMENT

Tool Required:
 J 36607 Ball Joint Separator
 J 36605 Steering Knuckle Seal Installer

 **Remove or Disconnect (Figure 30)**

- Raise the vehicle and support with suitable safety stands.
1. Tire and wheel assembly. Refer to SECTION 3E.
 - Wrap shop towels around both the inner and outer C/V joint boots to avoid damage to the boots during removal and installation.
 2. Brake caliper. Refer to SECTION 5B1.

 **Important**

- Support the caliper with a piece of wire to prevent damage to the brake line.
3. Brake rotor. Refer to "Rotor Replacement" in this section.
 4. Drive axle (halfshaft) nut (120).
 5. Washer (119).
 6. Tie rod nut (124).
 7. Tie rod end from the knuckle (117). Refer to SECTION 3B3.
 8. Hub and bearing assembly (114), using a puller.

 **Important**

- Lay the hub and bearing assembly on the hub bolt (outboard) side. This will prevent damage or contamination of the bearing seal.
9. Drive axle (halfshaft). Refer to SECTION 4C.

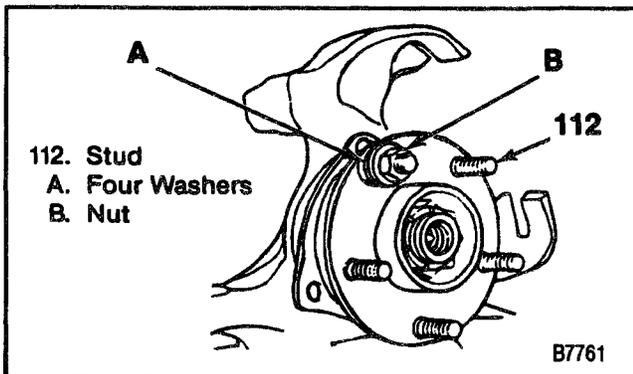


Figure 36—Installing the Wheel Hub Bolts

10. Splash shield bolts (128).
11. Splash shield (118).
 - Support the lower control arm with a jack stand.
12. Upper ball joint nut.
13. Upper ball joint (115) from the knuckle (117). Using J 36607. Refer to "Ball Joint Replacement" in this section.
14. Lower ball joint nut.
15. Lower ball joint (127) from the knuckle (117). Using J 36607. Refer to "Ball Joint Replacement" in this section.
16. Knuckle (117).
17. Seal from the knuckle.

 **Install or Connect (Figure 30)**

NOTICE: Refer to "Notice" on page 3C-1.

1. Seal (126) into the knuckle (117) using J 36605.
2. Knuckle (117) to the upper and lower ball joints (115 and 127).
3. Nuts (129).

 **Tighten**

- Lower stud nut (129) to 128 N.m (94 lb ft).
 - Upper stud nut (129) to 100 N.m (74 lb ft).
 - Tighten the nuts to align the cotter pin. Do not tighten more than 1/6 turn.
4. New cotter pins.
 - Bend the pin ends against the nut.
 5. Splash shield (118).
 - Be sure the splash shield is aligned properly.
 6. Splash shield bolts (128).

 **Tighten**

- Bolts (128) to 26 N.m (19 lb ft).
 - Prelube steering knuckle seal.
7. Drive axle (halfshaft). Refer to SECTION 4C.
 8. Hub and bearing assembly (114).
 - Align the threaded holes.
 9. Bolts (116).

 **Tighten**

- Bolts (116) to 180 N.m (133 lb ft).
10. Tie rod end (125) to the knuckle (117).
 11. Tie rod nut (124).

 **Tighten**

- Nut (124) to 48 N.m (35 lb ft).
12. Washer (119).
 13. Nut (120).

 **Tighten**

- Nut (120) to 225 N.m (165 lb ft).
14. Brake rotor.
 15. Brake caliper.
 16. Tire and wheel assembly.
 - Remove the jack stand.
 - Lower the vehicle.
 - Check vehicle trim height, and adjust if necessary. Refer to SECTION 3A.

3C-24 FRONT SUSPENSION AND AXLE

UPPER BALL JOINT REPLACEMENT

Tool Required:
J 36607 Ball Joint Separator

↔ Remove or Disconnect (Figures 17 through 20, 30 and 37)

- Raise the vehicle and support it with suitable safety stands.
1. Tire and wheel assembly. Refer to SECTION 3E.
 2. Rivets from the ball joint (115).
 - A. Brake hose and bracket, upper control arm only.
 - B. Use a 3.17 mm (1/8 inch) drill to cut a 6.35 mm (1/4 inch) deep hole in the center of each rivet (Figure 16).
 - C. Drill the rivet heads away using a 12.7 mm (1/2 inch) drill (Figure 18).
 - D. Using a pin punch remove the rivets (Figure 19).
 3. Cotter pin.
 4. Stud nut from upper ball joint.
 5. Ball joint (115) from the knuckle (117) using J 36607 (Figure 30).
 - Support the knuckle.
 6. Ball joint (115) (Figure 30).

↔ Install or Connect (Figures 17, 18, 19, 30 and 37)

NOTICE: Refer to "Notice" on page 3C-1.

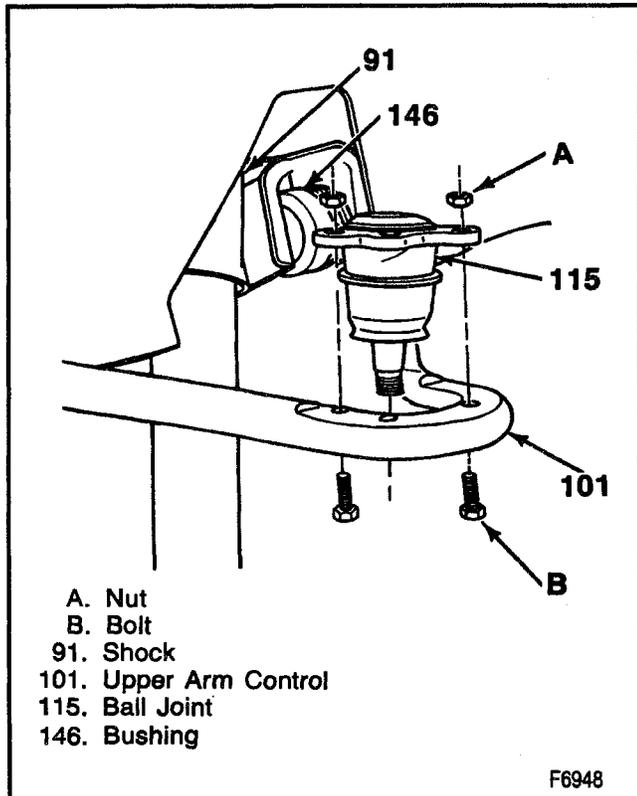


Figure 37—Installing the Upper Ball Joint

1. Ball joint (115) to the control arm (101) (Figure 30).
2. Bolts (B) and nuts (A) to the ball joint (Figure 37).

⌚ Tighten

- Nuts (A) to 23 N.m (17 lb ft) for K1-K2, and to 70 N.m (52 lb ft) for K3.
3. Ball joint (115) to the knuckle (117) (Figure 30).
 4. Nut.

⌚ Tighten

- Nut to 100 N.m (74 lb ft).
 - Nut must be tightened with the control arm at "Z" Height. Refer to SECTION 3A.
 - Tighten the nut to align the cotter pin. Do not tighten more than 1/6 turn.
5. New pin.
 - Bend the pin ends against the nut.
 6. Tire and wheel assembly.
 - Lower the vehicle.
 - Check front wheel alignment. Refer to SECTION 3A.

LOWER BALL JOINT REPLACEMENT

Tools Required
J 24319-01 Steering Linkage Puller
J 29193 Steering Linkage Installer
J 39549 Ball Joint/Tie Rod End Separator
J 9519-E Ball Joint Remover and Installer Set
J 41435 Ball Joint Remover and Installer Kit
Consisting of:
J 41435-1 Remover
J 41435-2 Installer
J 41435-3 Remover/Installer

↔ Remove or Disconnect (Figures 30, 38 through 40)

- Raise the vehicle and support the frame with suitable safety stands.
1. Tire and wheel assembly. Refer to SECTION 3E.
 - Place a floor jack under the control arm and raise it until it supports the control arm.

CAUTION: Floor jack must remain under the control arm during removal and installation to retain the torsion bar and control arm in position or personal injury may result.

2. Drive axle (halfshaft). Refer to SECTION 4C.
3. Brake caliper. Refer to SECTION 5B1.

! Important

- Support the caliper with a piece of wire to prevent damage to the brake line.
4. Cotter pin and the nut from lower control arm ball joint.
 - Use J 39549 to break the ball joint loose from the knuckle.
 5. Lower control arm from the knuckle.

FRONT SUSPENSION AND AXLE 3C-25

6. Knuckle from vehicle.
7. Ball joint from lower control arm.
 - Use tools as shown in (Figure 38).

Inspect

- The tapered hole in the steering knuckle and remove any dirt. If the hole is out of round, deformed or damaged, the knuckle must be replaced.

Install or Connect (Figures 30, 39 and 40)

NOTICE: Refer to "Notice" on page 3C-1.

Clean

- Lower control arm ball joint mounting surfaces and new ball joint prior to installation using Loctite Cleaning Solvent 755 or equivalent. Do not apply solvent to ball joint seal.

1. New ball joint into the lower control arm.

- Apply a 6 mm (1/4 inch) bead of Loctite 680 evenly to the serrations on the ball joint prior to installation.
- Position ball joint in control arm with grease fitting toward rear of vehicle.
- Press in the ball joint using tools in (Figure 39). The ball joint will bottom on the control arm.
- When installing ball joint with J 41435, ensure notch in tool is aligned with grease fitting.

2. Ball joint into the steering knuckle.
3. Stud nut onto the stud.

Tighten

- Nut to 128 N.m (94 lb ft) and align the slot in the stud nut with the hole in the stud by tightening.

4. New cotter pin to the stud.
5. Drive axle (halfshaft).

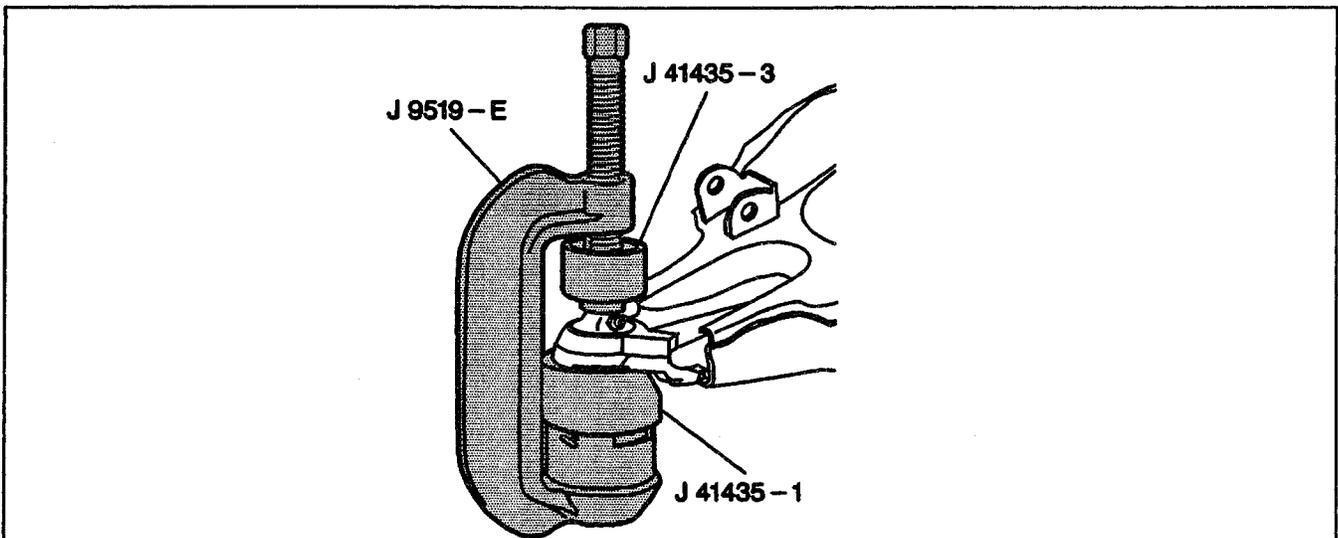


Figure 38—Removing the Lower Ball Joint

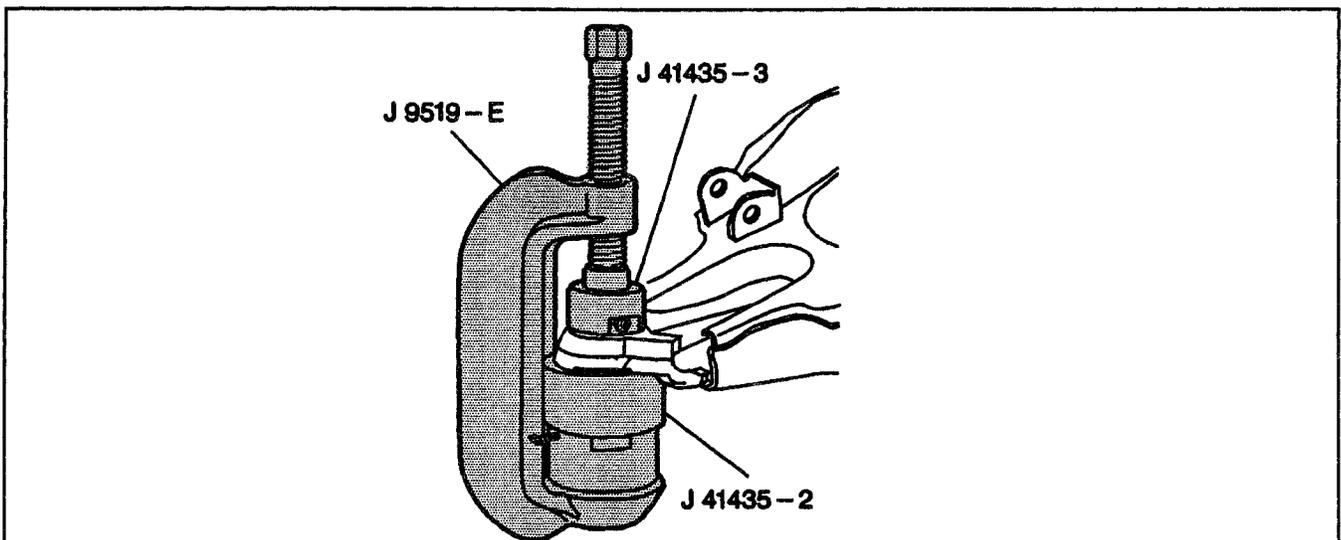


Figure 39—Installing the Lower Ball Joint

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6. Brake caliper.
7. Tire and wheel assembly.
 - Lower the vehicle.

Important

- Check the front wheel alignment. Refer to SECTION 3A.

UPPER CONTROL ARM AND BUSHING REPLACEMENT

Remove or Disconnect (Figure 30 and 41)

- Raise the vehicle and support it with suitable safety stands.
1. Tire and wheel assembly. Refer to SECTION 3E.
 2. Air cleaner extension, if needed.
 3. Brake hose.
 - Nut and the screw.
 - Bracket and the hose.
 - Tie the hose out of the way.
 4. Cotter pin.
 5. Nut.
 6. Upper control arm (101) from the knuckle (117).
 7. Nuts.
 8. Bolts.
 9. Upper control arm (101).
 10. Bushings.

Install or Connect (Figure 30 and 41)

NOTICE: Refer to "Notice" on page 3C-1.

1. Bushings.
2. Upper control arm (101) to the frame (95).
3. Bolts and the washers.
 - Be sure the bolt heads are opposed inside the bracket.
4. New nuts.

Tighten

- Tighten the front nut prior to tightening the rear nut.
 - Nuts to 190 N.m (140 lb ft).
 - The nuts must be tightened with the control arm at "Z" Height. Refer to SECTION 3A.
5. Upper ball joint (115) stud to the knuckle (117).
 6. Nut to the upper ball joint (115) stud.

Tighten

- Nut (129) to 100 N.m (94 lb ft).
 - Tighten the nut to align the cotter pin. Do not tighten more than 1/6 turn.
7. New cotter pin.
 - Bend the cotter pin ends against the nut flats.
 - Remove the support from the knuckle.
 8. Brake hose.
 - Bracket and the hose.
 - Screw and the nut.
 9. Air cleaner extension, if needed.
 10. Tire and wheel assembly.
 - Lower the vehicle.

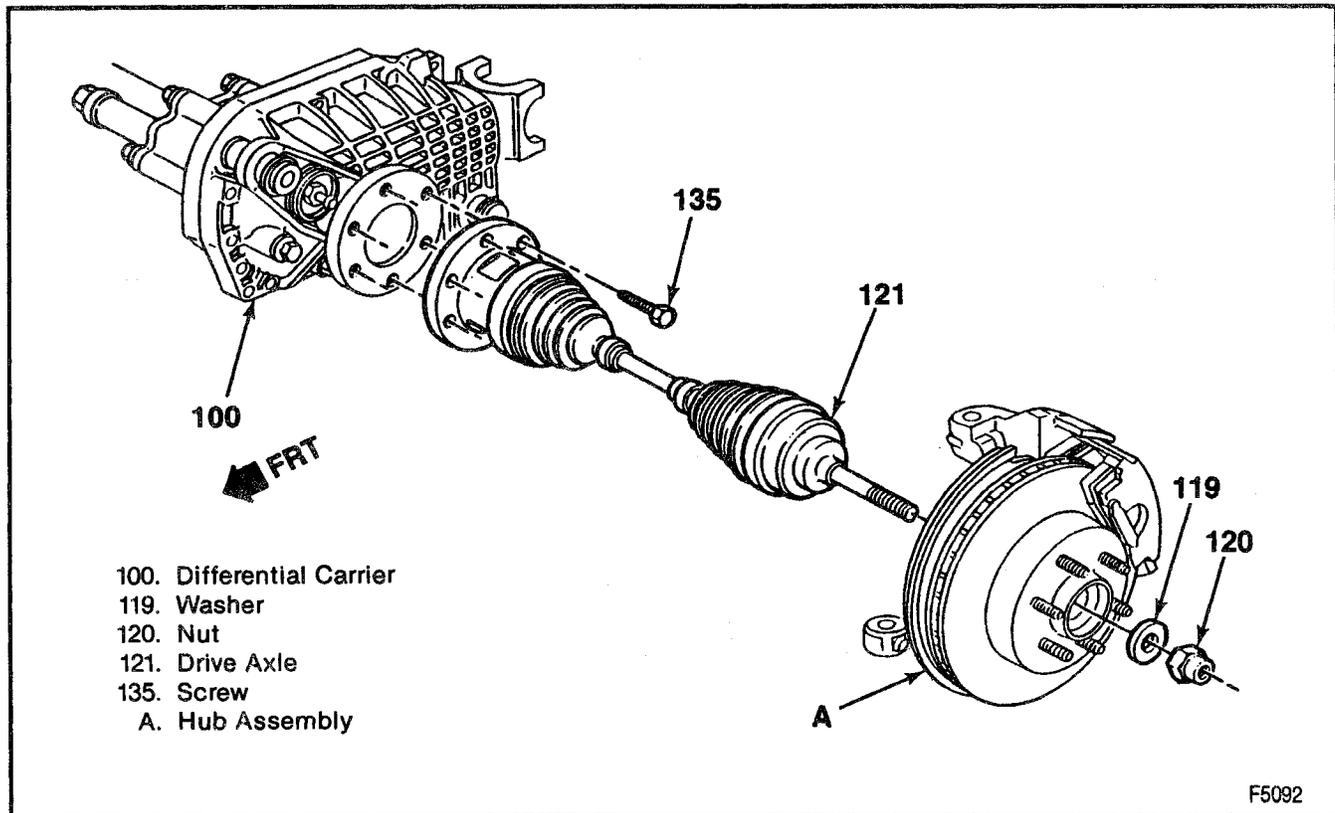
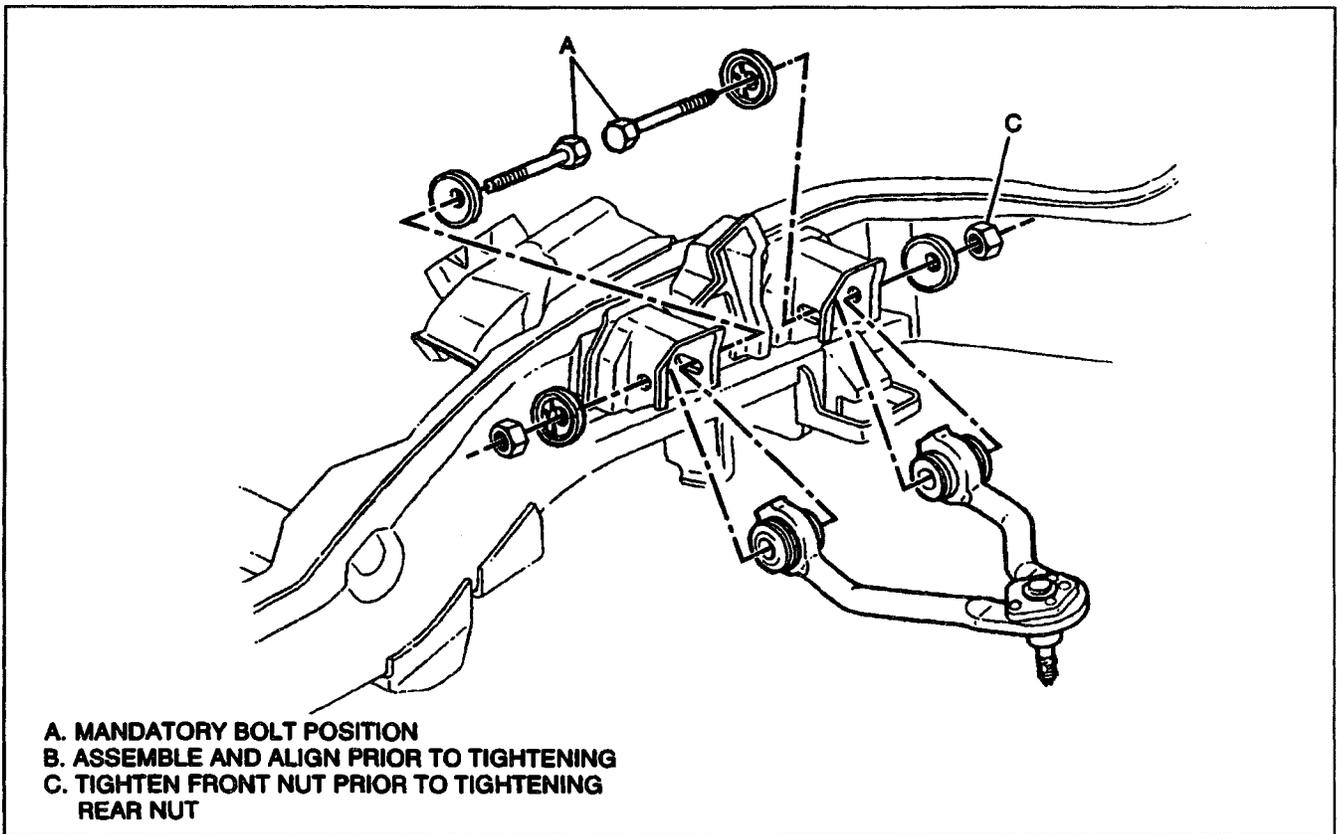


Figure 40—Drive Axle (Halfshaft)



**A. MANDATORY BOLT POSITION
 B. ASSEMBLE AND ALIGN PRIOR TO TIGHTENING
 C. TIGHTEN FRONT NUT PRIOR TO TIGHTENING
 REAR NUT**

Figure 41—Installing The Upper Control Arm

LOWER CONTROL ARM AND BUSHING REPLACEMENT

Tools Required:

- J 24319-01 Steering Linkage Puller
- J 36202 Torsion Bar Unloading Tool
- J 36607 Ball Joint Separator
- J 36618 Series 30 Lower Control Arm Bushing Service Set
- J 9519-23 Ball Joint C-Clamp

←→ Remove or Disconnect (Figures 30 and 40 through 44)

- Raise the vehicle and support it with suitable safety stands.
- 1. Tire and wheel assembly. Refer to SECTION 3E.
 - Unload the torsion bar, using J 36202. Mark the adjuster bolt for installation. Refer to "Torsion Bar(s) and Support Assembly Replacement" in this section.
 - Slide the bar forward to remove the adjuster arm.
- 2. Adjuster arm (186).
- 3. Outer axle shaft nut (120) and washer (119) from the hub assembly (114).
- 4. Brake caliper. Refer to SECTION 5B1.
- 5. Brake rotor. Refer to "Rotor Replacement" in this section.
- 6. Lower shock bolt from control arm and compress shock. Refer to "Shock Absorber Replacement" in this section.

- 7. Inner tie rod end from the relay rod, using J 24319-01.
 - Support the lower control arm with a jack.
- 8. Stabilizer link from control arm. Refer to "Stabilizer Shaft Replacement" in this section.
- 9. Drive axle (121) from hub refer to SECTION 4C.
- 10. Cotter pin and nut from the upper ball joint (115).
- 11. Upper ball joint (115) from knuckle (117) using J 36607.
- 12. Nuts (170 and 165) and washer (162).
- 13. Bolts (166 and 160).
- 14. Lower control arm (93) and knuckle (117) as a unit.
- 15. Front bushing (167)
 - Unbend crimps, using a punch.
 - Remove the bushing, using J 36618-2, J 9519-23, J 36618-4, and J 36618-1.
- 16. Rear bushing (163) (no crimp).
 - Remove using J 36618-5, J 36618-3, J 36618-2, and J 9519-23.
 - Replace lower control arm on K1 and K2 vehicles if the bushings are worn or damaged.

→→ Install or Connect (Figures 30 and 40 through 44)

NOTICE: Refer to "Notice" on page 3C-1.

- 1. Front bushing, using J 36618 and J 9519-23.
 - K3 vehicle only.
 - After installing the bushing, crimp it in place.

3C-28 FRONT SUSPENSION AND AXLE

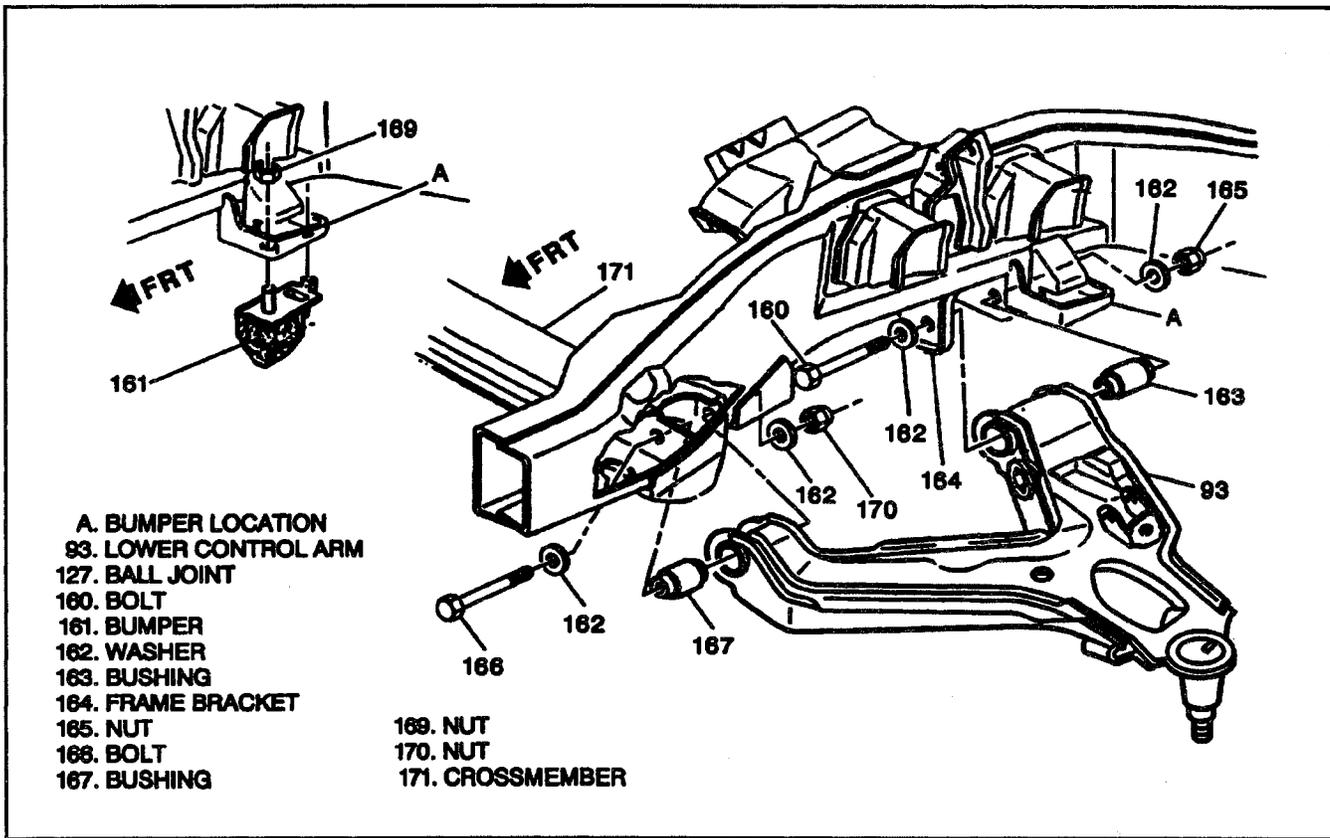


Figure 42—Lower Control Arm Components

2. Rear bushing, using J 36618 and J 9519-23.
3. Lower control arm (93) and knuckle assembly (117) to the crossmember (171) and the frame bracket (164).
 - Install the front leg of the lower control arm into the crossmember (171) before installing the rear leg into the frame bracket (164).
4. Bolts (166, 160) in the direction shown in (Figure 41).
5. New nuts (170 and 165).

Tighten

- Tighten front nut prior to tightening rear nut.
 - Nuts (170 and 165) to 165 N.m (121 lb ft).
 - The nuts must be tightened with the control arm at the specified "Z" height. Refer to SECTION 3A.
 - Pre-lube the steering knuckle seal.
 - Start the drive axle through the hub.
6. Ball joint (115) to the knuckle (117).
 7. Ball joint nut (131).

Tighten

- Nut to 128 N.m (94 lb ft).
8. Cotter Pin.
 - Flatten the cotter pin against the sides of the nut.
 9. Adjuster arm (186).
 - Slide the bar rearward to install the sides of the nut.

- Load the torsion bar, using J 36202.
 - Install the adjuster bolt and screw it down to the installation mark.
10. Outer axle shaft washer (119) and nut (120) to the hub assembly (114).

Tighten

- Nut (120) to 225 N.m (165 lb ft).
11. Lower shock bolt. Refer to "Shock Absorber Replacement" in this section.
 12. Stabilizer link. Refer to "Stabilizer Shaft Replacement" in this section.
 13. Tire and wheel assembly.

TORSION BAR(S) AND SUPPORT ASSEMBLY REPLACEMENT

Tool Required:

J 36202 Torsion Bar Unloading Tool

Remove or Disconnect (Figures 43 through 45)

- Raise the vehicle and support it with suitable safety stands.
1. Adjustment assemblies on both torsion bars.
 - A. Mark the adjustment bolt (184) setting.
 - B. Increase the tension on the adjustment arm (186) using J 36202.
 - C. Remove the adjustment bolt (184) and retaining plate (185).
 - D. Move the tool aside.

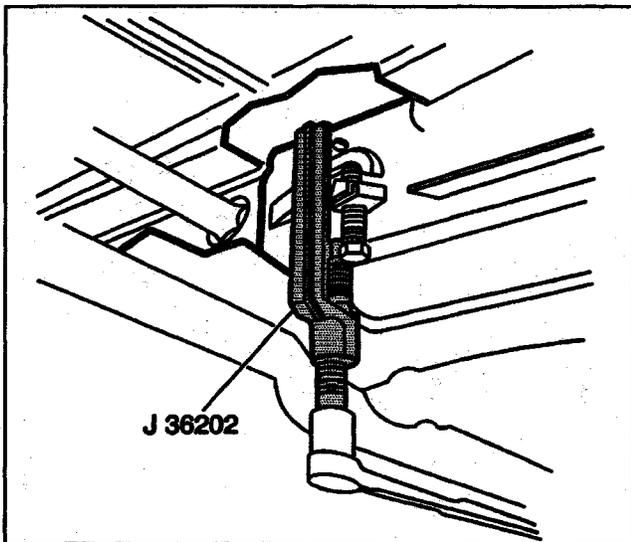


Figure 43—Removing or Installing the Torsion Bar Adjusting Bolt

- E. Slide the torsion bars forward.
 - F. Remove the adjustment arms (186).
2. Nuts (177, 179, and 189) and bolts (178, 180, and 181) from the torsion bar support crossmember (175).
 - Slide the support crossmember (175) rearward.
 3. Torsion bars (182).
 - Note the location and the front ends of the torsion bars. There are different bars for the left and right sides.
 4. Support crossmember (175).
 5. Retainer (188), spacer (176), and insulator (187) from the support crossmember.

↔ Install or Connect (Figures 44 and 45)

NOTICE: Refer to "Notice" on page 3C-1.

1. Insulator (187), spacer (176), and retainer (188) on the support crossmember (175).
2. Support crossmember assembly (175) on the frame, rearward of the mounting holes.
3. Torsion bars (182).
 - Make sure the bars (182) are on their respective sides.
 - Slide the support crossmember (175) forward until the torsion bars (182) are supported.
4. Adjustment arms (186) on the torsion bars (182).
5. Bolts (178, 180, and 181) and nuts (177, 179, and 189) into the torsion bar support crossmember (175).

Ⓜ Tighten

- Center nut (189) to 24 N·m (18 ft lb).
 - Edge nuts (177 and 179) to 62 N·m (46 ft lb).
6. Adjustment retainer plate (185) and bolt (184) on both torsion bars.
 - Increase the tension on the torsion bar, using J 36202.

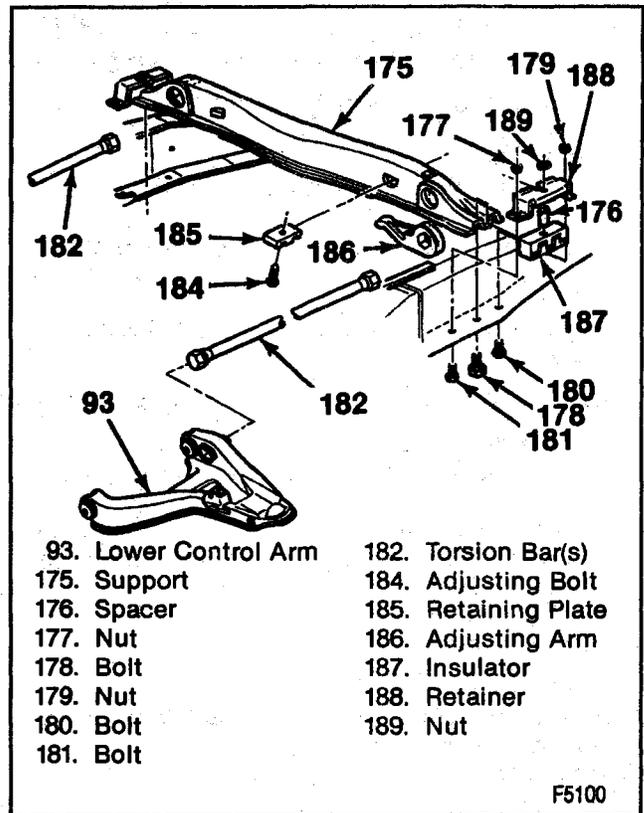


Figure 44—Torsion Bars and Support

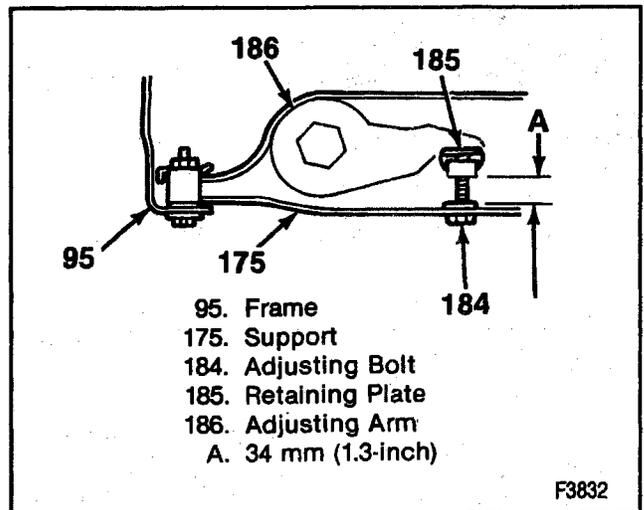


Figure 45—Torsion Bar Adjuster Height

- Install the retaining plate and the adjustment bolt.
 - Set the adjustment bolt to the marked setting.
 - Release the tension on the torsion bar until the load is taken up by the adjustment bolt.
 - Remove J 36202.
7. Lower the vehicle.
 - Check the "Z" height. Refer to SECTION 3A.

3C-30 FRONT SUSPENSION AND AXLE

TORSION BAR(S) AND SUPPORT ASSEMBLY REPLACEMENT (FOUR DOOR UTILITY)

Tool Required:
J 36202 Torsion Bar Unloading Tool

↔ Remove or Disconnect (Figures 46 and 47)

- Raise the vehicle and support it with suitable safety stands.
1. Adjustment assemblies on both torsion bars.
 - A. Mark the adjustment bolt setting.
 - B. Increase the tension on the adjustment arm using J 36202.
 - C. Remove the adjustment bolt and retaining plate.
 - D. Decrease the tension on the adjustment arm using J 36202.
 - E. Move the tool aside.
 - F. Slide the torsion bars forward.
 - G. Remove the adjustment arms.
 2. Nuts and bolts from the torsion bar support cross-member link assembly.
 3. Torsion bars.
 - Note the location and the front ends of the torsion bars. There are different bars for the left and right sides.
 4. Support crossmember.
 5. Link assembly from the support crossmember.

↔ Install or Connect (Figures 46 and 47)

NOTICE: Refer to "Notice" on page 3C-1.

1. Link assembly on the support crossmember.
2. Support crossmember assembly to the frame, rearward of the mounting holes.
3. Torsion bars.
 - Make sure the bars are on their respective sides.
 - Slide the support crossmember forward until the torsion bars are supported.
4. Adjustment arms on the torsion bars.
5. Bolts and nuts into the torsion bar support cross-member link assembly.

Tighten

- Link assembly nuts to 125 N.m (92 lb ft).

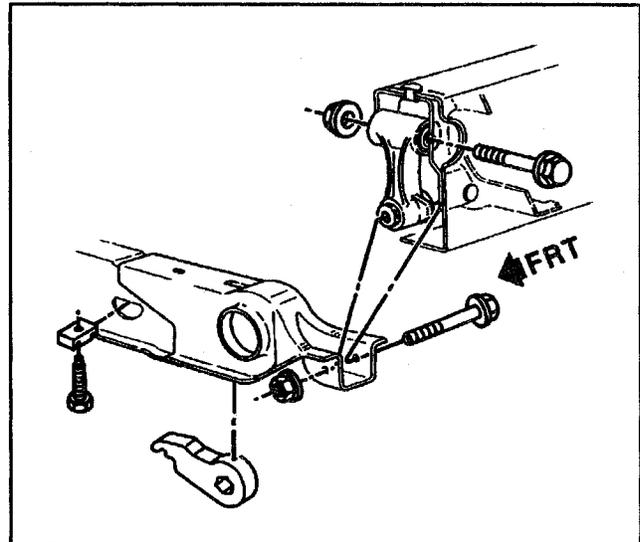


Figure 46—Torsion Bar Support Assembly

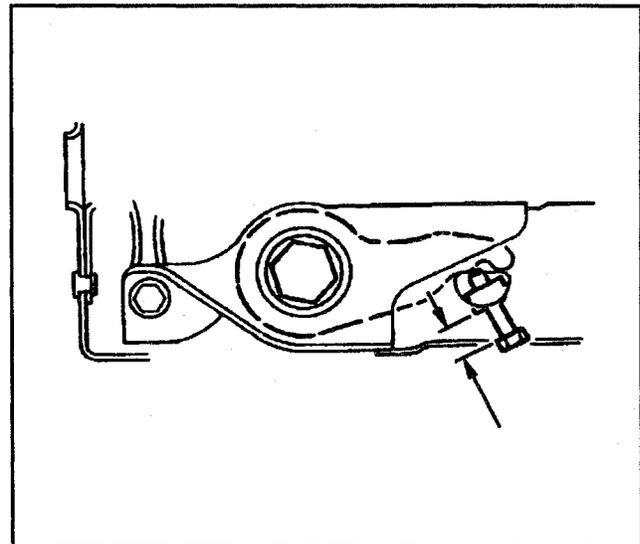


Figure 47—Torsion Bar Adjuster Height

6. Adjustment retainer plate and bolt on both torsion bars.
 - Increase the tension on the torsion bar, using J 36202.
 - Install the retaining plate and the adjustment bolt.
 - Set the adjustment bolt to the marked setting 34 mm (1.3 inch).
 - Release the tension on the torsion bar until the load is taken up by the adjustment bolt.
 - Remove J 36202.
7. Lower the vehicle.
 - Check the "Z" height. Refer to SECTION 3A.

ON-VEHICLE SERVICE: I-BEAM FRONT SUSPENSION (C 3500HD)

SHOCK ABSORBER

Remove or Disconnect (Figure 48 through 50)

- Raise the vehicle and support it with suitable safety stands.
- 1. Tire and wheel assembly. Refer to SECTION 3E.
- 2. Nut (195) and washer (196).
- 3. Shock absorber (197) from the leaf spring spacer (242).
- 4. Nut (195), washer (196) and bolt (253).
- 5. Shock absorber from the frame.

Inspect

- Shock absorbers for damage and leakage.
- Test the shock absorbers. Refer to "Shock Absorber Bench Test" in this section.

Install or Connect (Figures 48 through 50)

NOTICE: Refer to "Notice" on page 3C-1.

1. Shock absorber (197) to the frame (Figure 50).
 - Insert bolt (253) through the upper shock bracket and shock absorber.
2. Washer (196) and nut (195).
 - Do not tighten.
3. Shock absorber to the leaf spring spacer (242) (Figure 50).
 - Position the lower shock mount onto the stud.
4. Washer (196) and nut (195).

Tighten

- Shock absorber upper nut to 185 N.m (136 lb ft).
- Shock absorber lower nut to 50 N.m (37 lb ft).
- 5. Tire and wheel assembly.
 - Lower the vehicle.

STABILIZER SHAFT

Tool Required:
J 6627-A Tie Rod Remover

Remove or Disconnect (Figures 48, 49, and 51)

- Raise the vehicle and support it with suitable safety stands.
- 1. Tire and wheel assembly. Refer to SECTION 3E.
- 2. Nut (199) and washer (198).
- 3. Stabilizer shaft (248) from the stabilizer link (200).
 - Use J 6627-A to separate the stabilizer link from the stabilizer end.
- 4. Nuts (199), washers (198), clamp bolts (251), and clamps (250).
- 5. Stabilizer shaft (248) from the axle.
- 6. Insulator (249) from the stabilizer shaft (248).

7. Nut (220), retainer (201) insulator (202).
8. Stabilizer link (200) from the frame bracket.
 - Pull the link from the bracket. Another insulator (202) and retainer (201) will come off the link.

Install or Connect (Figures 48, 49, and 51)

NOTICE: Refer to "Notice" on page 3C-1.

1. Stabilizer link (200) to the frame bracket.
 - Slide a retainer (201) and an insulator (202) on to the link and insert the link into the proper hole in the frame bracket.
2. Insulator (202), retainer (201) and nut (220).

Tighten

- Nut (220) until the distance between each retainer is 38 mm (1.5 inches).
- 3. Stabilizer shaft to the front axle (241).
- 4. Insulators (249) onto the stabilizer shaft.
- 5. Clamps (250), clamp bolts (251), washers (198) and nuts (199).

Tighten

- Nuts (199) to 29 N.m (21 lb ft).
- 6. Stabilizer shaft to the stabilizer link.
- 7. Washer (198) and nut (199).

Tighten

- Nuts (199) to 68 N.m (50 lb ft).
- 8. Tire and wheel assembly.
 - Lower the vehicle.

WHEEL HUB/ROTOR ASSEMBLY

Tool Required:
J 9746-02 Hub/Rotor Support

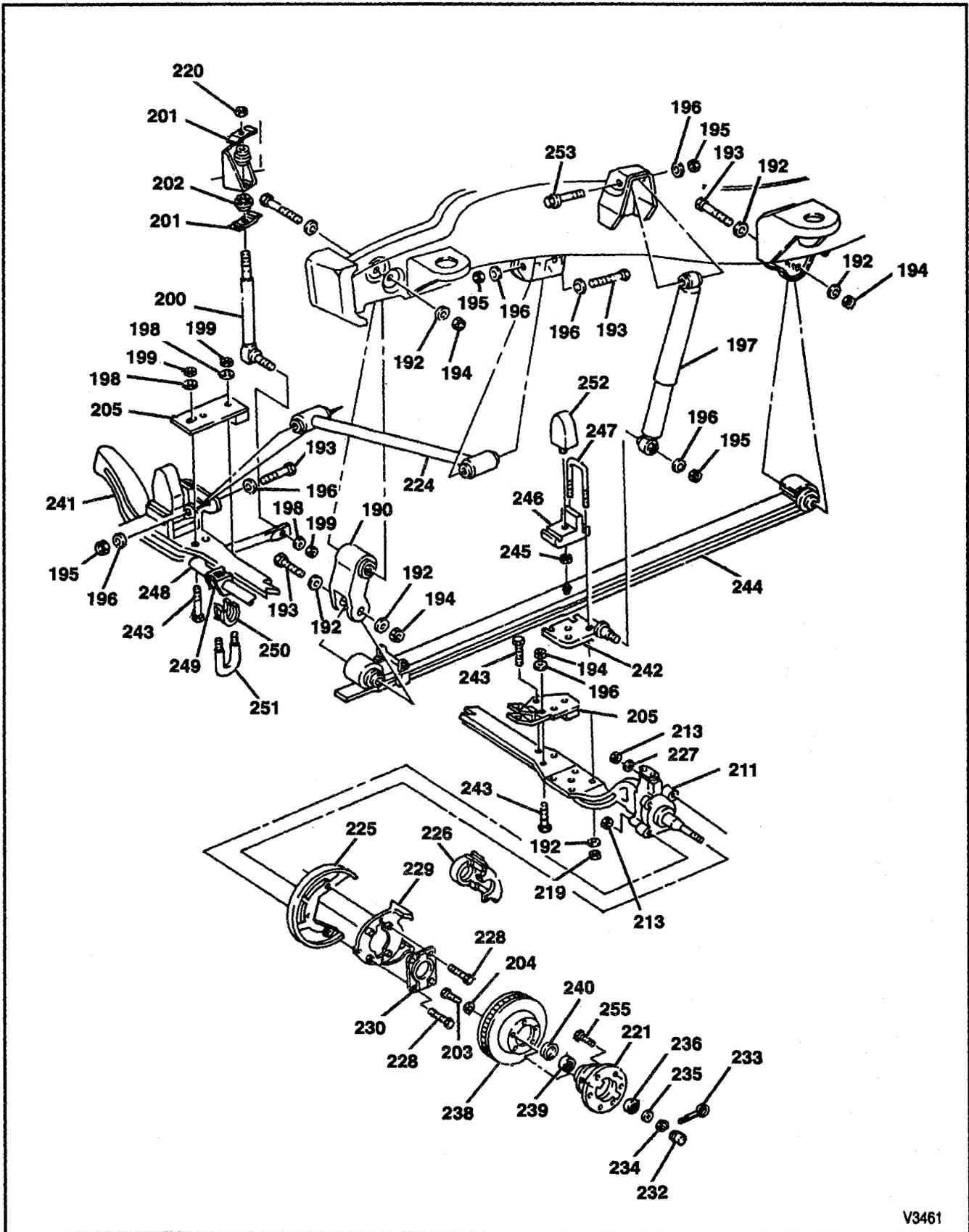
Remove or Disconnect (Figures 48 and 49)

- Raise the vehicle and support it with suitable safety stands.
- 1. Tire and wheel assembly. Refer to SECTION 3E.

NOTICE: Support the caliper with a piece of wire to prevent damage to the brake line.

2. Brake caliper. Refer to SECTION 5B1.
3. Retainer/cap (232).
4. Cotter pin (233), nut (234) and washer (235).
5. Wheel hub/rotor (238).
 - Pull the hub/rotor free from the spindle, making sure the outer wheel bearing (236) comes free.
 - Do not damage the steering knuckle spindle threads.

3C-32 FRONT SUSPENSION AND AXLE



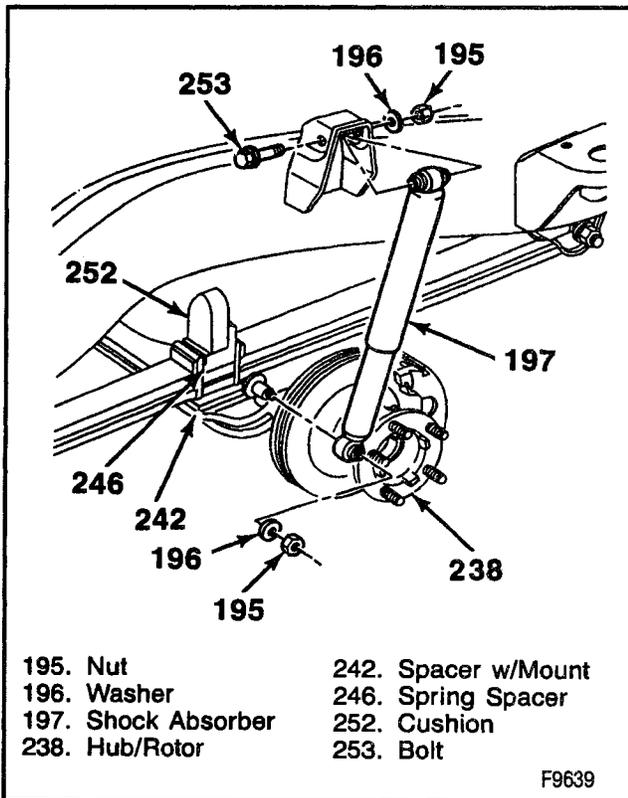
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Figure 48—C 3500HD Model I-Beam Front Axle Suspension Components

- | | |
|---|--|
| <ul style="list-style-type: none"> 190. HANGER, SPRING 192. WASHER 193. BOLT 194. NUT 195. NUT 196. WASHER 197. ABSORBER, ASSEMBLY 198. WASHER 199. NUT 200. LINK, STABILIZER 201. RETAINER 202. INSULATOR 203. BOLT 204. WASHER 205. BRACKET, FRONT STABILIZER 211. KNUCKLE, STEERING 213. NUT 219. NUT 220. NUT 221. HUB 223. PIN, COTTER 224. ROD, AXLE TIE 225. SHIELD, SPLASH 226. CALIPER, BRAKE 227. WASHER | <ul style="list-style-type: none"> 228. BOLT 229. PLATE, ANCHOR 230. SHIELD, BEARING SEAL 232. CAP, RETAINER 233. PIN, COTTER 234. NUT 235. WASHER 236. BEARING, OUTER 237. BOLT, HUB 238. ROTOR, HUB 239. BEARING, INNER 240. SEAL, BEARING 241. AXLE, FRONT 242. SPACER, SPRING 243. BOLT 244. SPRING, FRONT 245. NUT 246. SPACER 247. U-BOLT 248. SHAFT, STABILIZER 249. INSULATOR 250. CLAMP 251. BOLT 252. CUSHION 253. BOLT |
|---|--|

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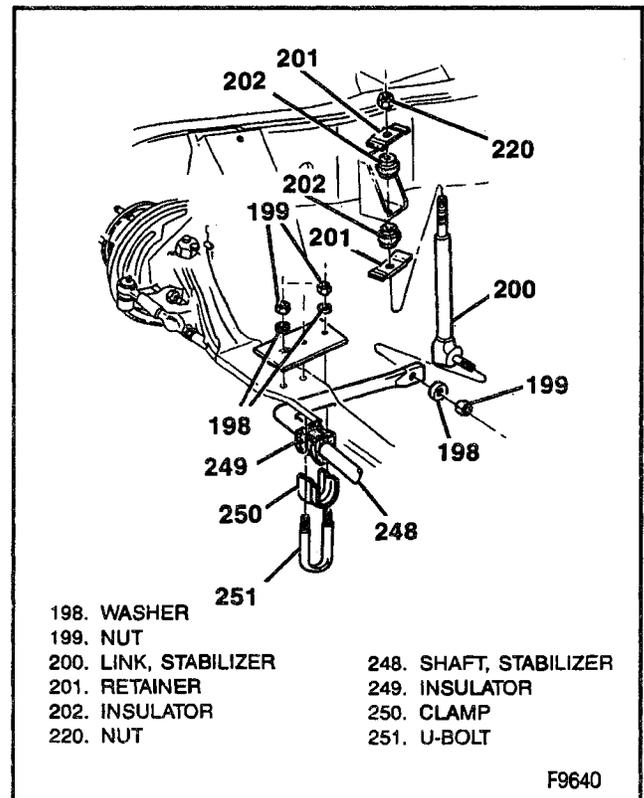
Figure 49—C 3500HD Model I-Beam Front Axle Suspension Components



- | | |
|--|--|
| <ul style="list-style-type: none"> 195. Nut 196. Washer 197. Shock Absorber 238. Hub/Rotor | <ul style="list-style-type: none"> 242. Spacer w/Mount 246. Spring Spacer 252. Cushion 253. Bolt |
|--|--|

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Figure 50—Shock Absorber Attachment Points



- | | |
|---|---|
| <ul style="list-style-type: none"> 198. WASHER 199. NUT 200. LINK, STABILIZER 201. RETAINER 202. INSULATOR 220. NUT | <ul style="list-style-type: none"> 248. SHAFT, STABILIZER 249. INSULATOR 250. CLAMP 251. U-BOLT |
|---|---|

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Figure 51—Stabilizer Shaft Components

3C-34 FRONT SUSPENSION AND AXLE

6. Inner wheel bearing (239).
 - Pry out the seal (240).
7. Races.
 - Drive out each race using a brass drift.



Clean

- A. Grease from the hub/rotor (238) and steering knuckle spindle.
 - Grease from inside the hub.
- B. Grease from the wheel bearings (236 and 239) and races.
 - Use clean solvent and a small brush with no loose bristles.

NOTICE: *Do not spin the wheel bearings with compressed air to dry them—the wheel bearings may be damaged.*



Inspect

1. Wheel bearings (236 and 239) and their races for damage or wear.
 - Refer to "Diagnosis of Wheel Bearings" in this section.
 - If either a bearing or its race is damaged or worn, replace both.
2. Hub/rotor (238) for damage or wear.
 - Check for out-of-round or scored conditions.
 - Check for pitting or cracks.
 - Repair or replace as necessary.



Install or Connect (Figures 48 and 49)

NOTICE: *Refer to "Notice" on page 3C-1.*

NOTICE: *Start the races squarely inside the hub/rotor to avoid distortion and possible cracking.*

1. Races into the hub/rotor.
 - A. Place the hub/rotor on J 9746-02 and rest this assembly on press bars.
 - B. Use a 7.6 cm (3 inch) diameter bar or equivalent to press the outer bearing race into position.
 - C. Remove J 9746-02 and use a 7.6 cm (3 inch) diameter bar (or equivalent tool) to press the inner bearing race into position. If the bar is larger than 7.6 cm (3 inches), it may damage the bearing seal seat.



Important

- Use an approved high-temperature front wheel bearing grease to lubricate the bearings. Refer to SECTION 0B.
 - Do not mix different greases as mixing may change the grease properties resulting in poor performance.
2. Apply a thin film of grease to the steering knuckle spindle at the outer wheel bearing seat and at the inner wheel bearing seat, shoulder, and seal seat.

3. Put a small quantity of grease inboard of each wheel bearing retainer/cap (232).
4. Fill each wheel bearing (cone and roller assembly) full of grease.
 - Use a cone-type grease machine that forces grease into the bearing.
 - If a cone-type grease machine is not available, pack the wheel bearing by hand.
 - When packing the wheel bearing by hand, work the grease into the bearings between the rollers, cones, and the cage.

NOTICE: *Failure to completely pack the wheel bearing (cones, rollers, and cage) with grease will result in premature wheel bearing damage and/or wear.*

5. Inner wheel bearing (239) into the hub/rotor (238).
 - Put an additional quantity of grease outboard of this bearing.
6. New seal (240).
 - Use a seal installer or block to install the seal to ensure it is flush with the hub/rotor flange.
 - Lubricate the seal lip with a thin layer of grease.
7. Hub/rotor (238).
 - Do not damage the steering knuckle spindle threads.
8. Outer wheel bearing (236).
 - Slide it over the spindle until the wheel bearing (236) fully seats against the hub/rotor outer race.
9. Washer (235), nut (234) and cotter pin (233).
 - Do not place the cotter pin through the hole in the spindle until the wheel bearings are adjusted.



Tighten

- Nut (234) to 16 N.m (12 lb ft) while turning the hub/rotor assembly in either direction.
 - Put an additional amount of grease outboard of the wheel bearing (236).
 - Adjust the wheel bearings. Refer to "Wheel Bearing Adjustment" in this section.
10. Cotter pin (233).
 11. Retainer/cap (232) in place.
 12. Brake caliper.
 13. Tire and wheel assembly.
 - Lower the vehicle.

WHEEL BEARING ADJUSTMENT



Important

- The continuous smooth functioning of the front suspension cannot be maintained unless the front wheel bearings are correctly adjusted.
- The bearings must be a slip fit on the spindle and the wheel bearing must be lubricated to ensure that the roller bearings will roll and not skid.
- The spindle nut must have a free-running fit on the spindle threads.

NOTICE: *Never preload the front wheel bearings. Damage can result by the steady thrust on the roller ends which comes from preloading.*

Adjust

- Raise the vehicle and support it with suitable safety stands under the lower control arms.

1. Remove the retainer/cap (232).
2. Remove the cotter pin (233).

Tighten

- Nut (234) to 16 N.m (12 lb ft) while rotating the wheel and tire assembly (or the hub/rotor). This will seat the bearings.

1. Back off the nut (234) one flat. * If the hole in the spindle lines up with the slot in the nut, insert the cotter pin (233). * If they do not line up, back off the nut until they do, but not more than one additional flat.

Measure

- * Endplay in the hub/rotor should measure between 0.013-0.20 mm (0.0005-0.008 inches) when properly adjusted.

2. Install the retainer/cap (232). * Lower the vehicle.

WHEEL HUB BOLT REPLACEMENT

Tool Required:
J 9746-02 Hub/Rotor Support

Remove or Disconnect (Figure 52)

1. Hub/rotor assembly from the vehicle.
 - Refer to "Wheel Hub/Rotor Assembly" in this section.

NOTICE: *Place J 9746-02 between the press bars and the hub/rotor to protect the rotor surfaces.*

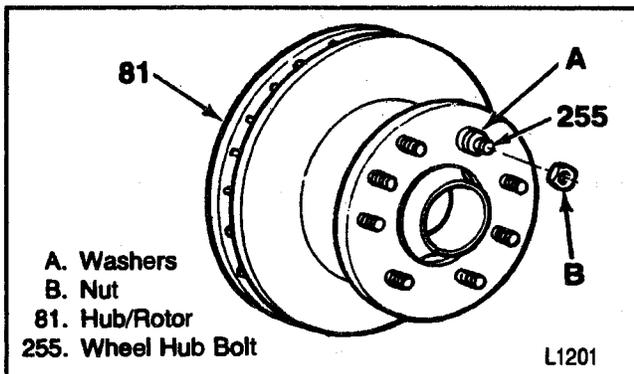


Figure 52—Installing the Hub Bolts

2. Wheel hub bolts (255) with a press (Figure 52).
 - Support the hub/rotor (81) using J 9746-02 and the press bars.
 - Do not damage the wheel mounting surface on the hub/rotor flange.

Install or Connect (Figure 52)

NOTICE: *Refer to "Notice" on page 3C-1.*

1. Wheel hub bolts (255) into the hub/rotor (81).
 - Place four washers onto the bolt, then fasten a nut onto the bolt until the nut bottoms on the washers (Figure 52).
 - Tighten the nut until the bolt fully seats into the hub/rotor (255).
 - Remove the nut and washers.
2. Hub/rotor to the vehicle.
3. Tire and wheel assembly.
 - Lower the vehicle.

STEERING ARM, KNUCKLE, AND SPINDLE

Remove or Disconnect (Figures 48 and 49)

- Raise the vehicle and support it with suitable safety stands.
1. Tire and wheel assembly. Refer to SECTION 3E.
 2. Brake caliper. Refer to SECTION 5B1.
 3. Hub/rotor assembly (238).
 - Refer to "Wheel Hub/Rotor Assembly" in this section.
 4. Bolts (228), washers (227), and nuts (213).
 5. Anchor plate (229), splash shield (225), and the steering arm (224).
 - Pull the anchor plate and splash shield off the knuckle. Steering arm hangs by the rods.
 - Bolts (228) and washers (227) to separate the anchor plate from the splash shield.
 - Refer to SECTION 3B3 to separate the steering arm from the tie rod and pitman arm.
 6. Bolts (203) and washers (204).
 7. Stabilizer bracket (205).
 8. Gaskets.
 9. Caps from the steering knuckle (211).
 10. Nut and washer.
 11. Lock pin.
 12. King pin from the steering knuckle (211).
 - Drive the king pin out using a drift.
 - Spacers and bushings will also come out.
 13. Steering knuckle (211) from the axle (241).
 14. Dust seal, shim and thrust bearing.

Install or Connect (Figures 48 and 49)

1. Bushings.
 - Ream new bushings to 29.982-30.022 mm (1.1804-1.1820 in) after installing.
2. Steering knuckle (211).
3. Thrust bearing shim and dust seal.
 - Pre-lube the thrust bearing. Refer to SECTION 0B.

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4. King pin and the lock pin.

- Pre-lube the king pin.
- Insert the spacers in the correct order.

5. Washer and nut.



Tighten

- Nut to 40 N.m (29 lb ft).

6. Gaskets.

7. Caps to the steering knuckle (211).
8. Stabilizer bracket (205).



Tighten

- Bolts (119) to 7 N.m (60 lb in).

9. Steering arm (224), splash shield (225) and anchor plate (229).

10. Bolts and washers to attach splash shield to anchor plate.
11. Bolts (228), washers (227) and nuts (213) to attach anchor plate and steering arm to the steering knuckle.



Tighten

- Bolts (228) to 16 N.m (12 lb ft).
- Nuts (213) to 312 N.m (230 lb ft).

12. Steering arm (224) to the steering linkage.
13. Hub/rotor assembly (238).



Adjust

- Adjust the wheel bearings. Refer to "Wheel Bearing Adjustment" in this section.

14. Brake caliper. Refer to SECTION 5B1.

15. Tire and wheel assembly.

- Lower the vehicle.
- Check the front wheel alignment and reset as required.
- Refer to SECTION 3A.

FRONT AXLE

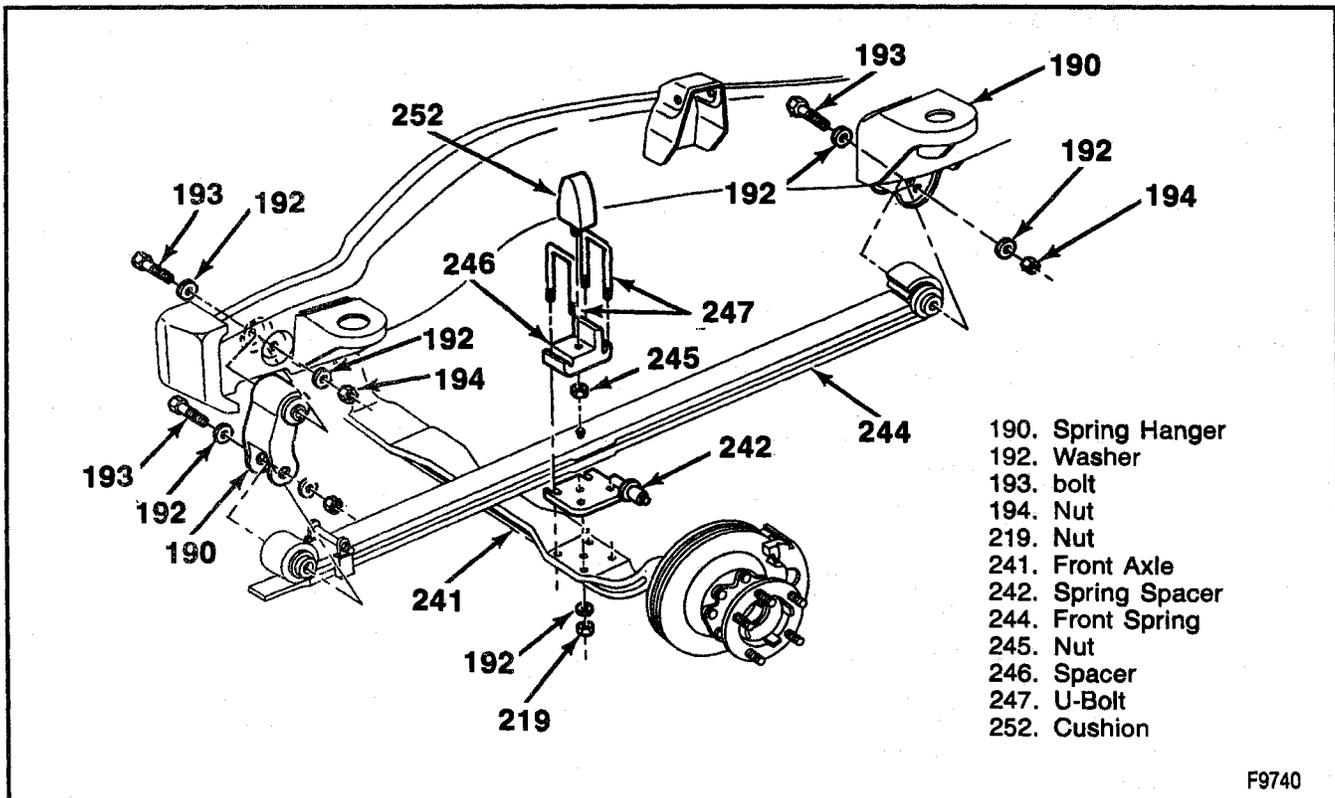
Tool Required:

J 6627-A Tie Rod Remover



Remove or Disconnect (Figures 48 through 51 and 53)

- Raise the vehicle and support it with suitable safety stands on the frame.
1. Tire and wheel assembly. Refer to SECTION 3E.
 - Support the axle with a floor jack to eliminate any load on the springs.
 2. Steering arm, knuckle, and spindle.
 - Refer to "Spindle Arm, Knuckle, and Spindle" in this section.
 3. Nut (195) and washer (196).
 4. Shock absorber (197) from the axle (241) (Figure 51). Refer to "Shock Absorber Replacement" in this section.
 5. Nut (199) and washer (198).



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Figure 53—Axle and Leaf Spring Attachment Points

6. Stabilizer link (200) from the stabilizer shaft (248) (Figure 51).
 - Use J 6627-A to separate the stabilizer shaft from the stabilizer link.
7. Nut (220), retainer (201) and insulator (202).
8. Stabilizer link (200) from the axle (241) (Figure 48).
 - Pull the link free from the axle, making sure not to lose the other insulator and retainer.
9. Nuts (219), washers (192), and U-bolts (247).
10. Spacer (246) and spring spacer (242).
11. Leaf spring (244) from the axle (Figure 53). Refer to "Leaf Spring" in this section.
12. Steering damper from the axle. Refer to SECTION 3B3.
13. Lower the floor jack and pull the axle clear of the vehicle.

Install or Connect (Figures 48 through 51, and 53)

- Line up the axle under the leaf springs.
 - Raise it into position using a floor jack.
1. Steering damper to the axle.
 2. Axle (241) to the leaf springs (244).
 3. Stabilizer link (200) to the axle (Figure 51).
 4. Link into the hole on the spring spacer (242) and axle.
 5. Insulator (202), retainer (201), and nut (220).

Tighten

- Nut (220) until the distance between each retainer (117) is 38.0 mm (1.5 inches) (Figure 54).
6. Stabilizer link to the stabilizer shaft (Figure 51).
 7. Washer (198) and nut (199).

Tighten

- Nut (199) to 68 N.m (50 lb ft).
8. Shock absorber to the axle .
 9. Washer (196) and nut (195).

Tighten

- Nut (195) to 185 N.m (136 lb ft).

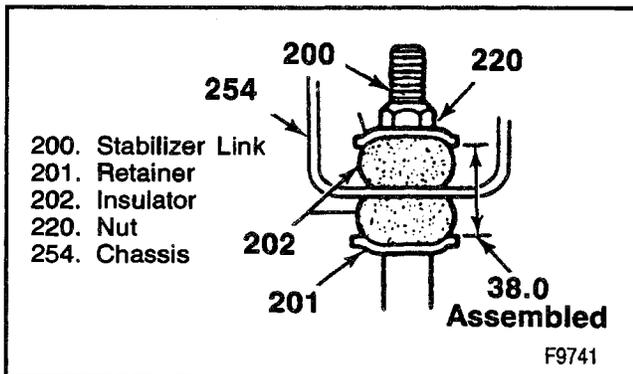


Figure 54—Stabilizer Link Hardware Tightened Dimension

10. Steering arm, knuckle, and spindle.

Adjust

- Adjust the wheel bearings. Refer to "Wheel Bearing Adjustment" in this section.
11. Tire and wheel assembly.
 - Lower the vehicle.
 - Check the front wheel alignment and reset as required.
 - Refer to SECTION 3A.

LEAF SPRINGS

Tool Required:
J 6627-A Tie Rod Remover

Remove or Disconnect (Figures 48 through 51 and 53)

- Raise the vehicle and support it with suitable safety stands. Support the axle separately to eliminate any load on the springs.
1. Tire and wheel assembly.
 2. Nut (195) and washer (196).
 3. Shock absorber (197) from the axle (241) (Figures 50 and 53).
 4. Nut (199) and washer (198).
 5. Stabilizer link (200) from the stabilizer shaft (248) (Figure 51).
 - Use J 6627-A to separate the stabilizer shaft from the stabilizer link.
 6. Nut (220), retainer (201) and insulator (202).
 7. Stabilizer link (200) from the axle.
 - Pull the link free from the axle, making sure not to lose the other insulator and retainer.
 8. Nuts (219), washers (192) and U-bolts (247).
 9. Spacer (246) and spring spacer (242).
 10. Leaf spring (244) from the axle.
 11. Nut (194), washer (192), bolt (193), and washer (192) to separate the spring from the rear shackle (190).
 12. Nut (194), washer (192), bolt (193), and washer (192) to separate the spring from the front hanger (190).
 - Pull the leaf spring back and out.
 13. Leaf spring (244) from the frame.

Install or Connect (Figures 47 through 50, and 52)

1. Leaf spring (244) to the frame.
 - Line up the spring with the spring hanger (190) and the spring hanger (190). Double wrap end is toward the front of the vehicle.
2. Washer (192), bolt (193), washer (192) and nut (194) to attach the spring to the front spring hanger (190).
3. Washer (192), bolt (193), washer (192), and nut (194) to attach the spring to the spring hanger (190).

Tighten

- Nut (194) to 185 N.m (136 lb ft).

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4. Leaf spring (244) to the axle.
 - Position the spring spacer (242) onto the axle. Either aligning pin can contact the edge of the leaf spring after the assembly is complete.
5. Spacer (246), U-bolts (247), washers (192), and nuts (219).

Tighten

- Nuts (219) to 25 N.m (18 lb ft) in a diagonal sequence (e.g., 1-3-4-2).
 - Nuts (219) in a diagonal sequence (e.g. 1-3-4-2) to 125 N.m (92 lb ft).
6. Stabilizer link (200) to the axle.
 - Insert the link into the proper hole in the axle after the retainer (201) and insulator (202) are attached.
 7. Insulator (202), retainer (201), and nut (220).

Tighten

- Nut (220) until the distance between each retainer (201) is 38.0 mm (1.5 inches) (Figure 52).

8. Stabilizer link (200) to the stabilizer shaft (248) (Figure 47).
9. Washer (198) and nut (199).

Tighten

- Nut (199) to 68 N.m (50 lb ft).
10. Shock absorber (197) to the axle.
 11. Washer (196) and nut (195).

Tighten

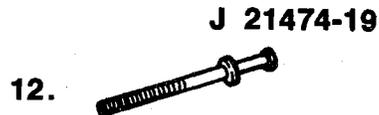
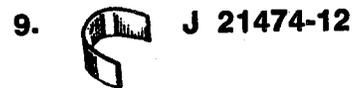
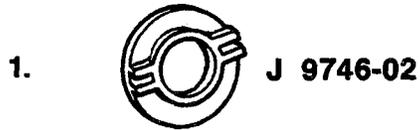
- Nut (195) to 50 N.m (37 lb ft).
12. Tire and wheel assembly.
 - Lower the vehicle.
 - Check the front end alignment and reset as required. Refer to SECTION 3A.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

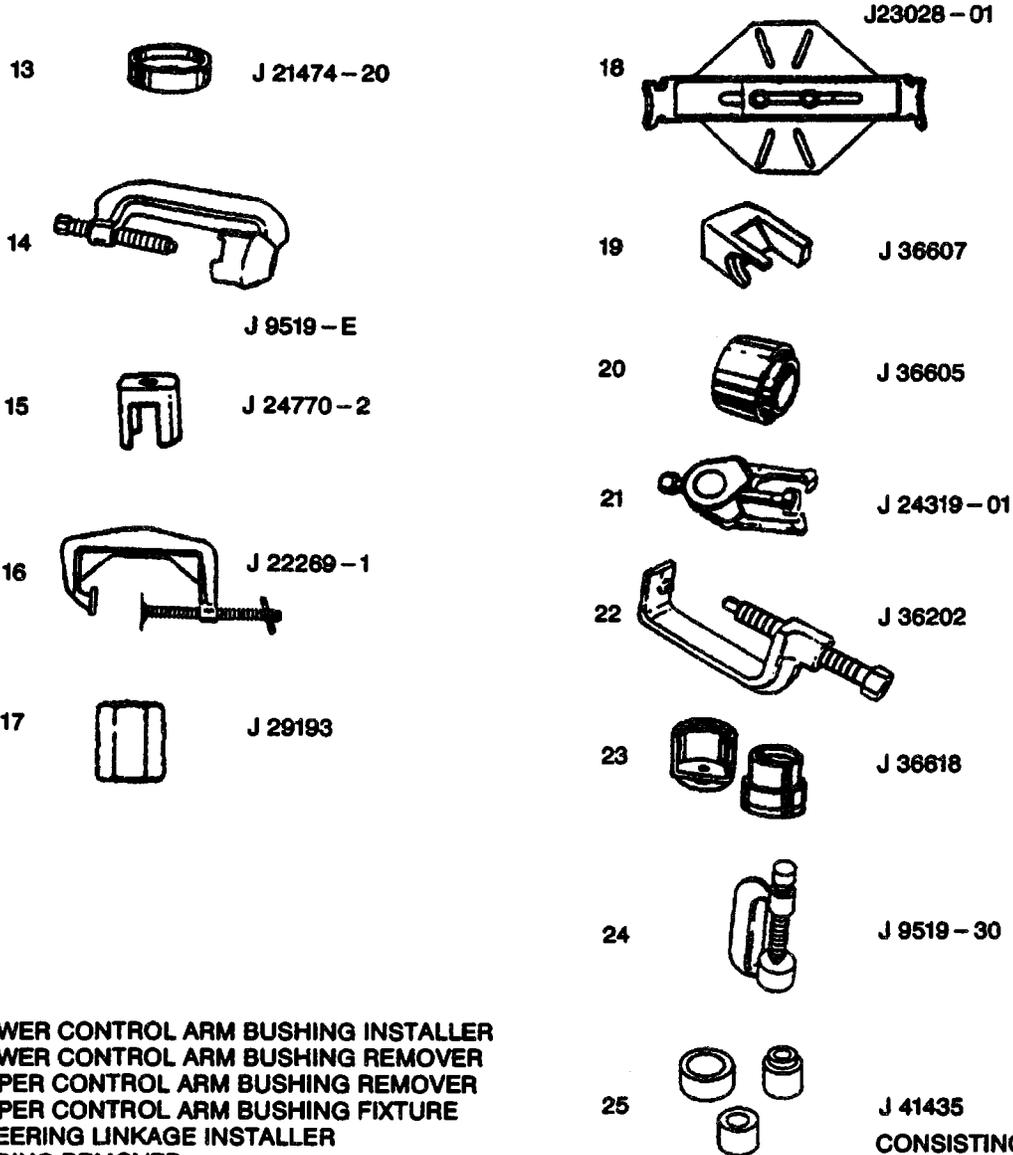
Application	N.m	Lb ft	Lb in
Brake Hose Bracket Nuts—C Models	18	13	—
Lower Ball Joint to Steering Knuckle Nut—C Models	128	94	—
Upper Ball Joint Nuts—C Models	24	18	—
Upper Ball Joint to Steering Knuckle Nut—C Models	100	74	—
Lower Control Arm Bumper—C Models	32	23	—
Lower Control Arm to Frame Nuts and Bolts—C Models	165	121	—
Upper Control Arm to Frame Nuts and Bolts—C Models	190	140	—
Shock Absorber to Control Arm Bolts—C Models	27	20	—
Shock Absorber Upper Nut—C Models	11	—	100
Stabilizer Bar Bracket to Frame Nuts and Bolts—C Models	33	24	—
Stabilizer Link Nuts—C Models	18	13	—
Splash Shield to Steering Knuckle Bolts—C Models	26	19	—
Outer Tie Rod Nut—C Models	62	46	—
Lower Ball Joint to Steering Knuckle Nut—K Models	128	94	—
Upper Ball Joint to Steering Knuckle Nut—K Models	100	74	—
Lower Control Arm to Frame Nuts and Bolts—K Models	165	121	—
Upper Control Arm to Frame Nuts and Bolts—K Models	190	140	—
Shock Absorber Nuts—K Models	90	66	—
Stabilizer Bar Bracket to Frame Nuts and Bolts—K Models	33	24	—
Stabilizer Link Nuts—K Models	18	13	—
Splash Shield to Steering Knuckle Bolts—K Models	26	19	—
Torsion Bar Support Link Nuts (Four Door Utility K Models)	125	92	—
Torsion Bar Support Center Nuts—K Models	24	18	—
Torsion Bar Support Outside Nuts—K Models	62	46	—
Outer Tie Rod Nut—K Models	62	46	—
Hub and Bearing Assembly to Steering Knuckle Bolts—K Models	180	133	—
Axle Shaft Nut—K Models	225	165	—
Splash Shield to Anchor Plate Bolts—C3500 HD	16	22	—
Lower Shock Absorber Nut—C3500 HD	185	136	—
Upper Shock Absorber Bolt and Nut—C3500 HD	50	37	—
Shackle to Frame Nut and Bolt—C3500HD	95	70	—
Spring to Axle U-Bolts—C3500 HD	125	92	—
Spring Eye Bolts and Nuts—C3500 HD	95	70	—
Suspension Bumper—C3500 HD	34	25	—
Stabilizer Clamp Bolts—C3500 HD	29	21	—
Stabilizer to Link Nuts—C3500 HD	68	50	—
Caps to Steering Knuckle—C3500 HD	17	—	150
Lock Pin to Steering Knuckle Nut—C3500 HD	40	29	—
Steering Arm to Knuckle Nut—C3500HD	285	210	—
Stabilizer Bracket Bolts—C3500HD	7	—	60
Steering Knuckle Nuts—C3500HD	312	230	—

SPECIAL TOOLS



- 1. Bearing Remover
- 2. Front Outer Race Remover
- 3. Driver Handle
- 4. Wheel Stud and Tie Rod Remover
- 5. Ball Joint Separator
- 6. Ball Joint Remover and Installer Set
- 7. Receiver Tool
- 8. Lower Control Arm Bushing Remover
- 9. Lower Control Arm Bushing Installer Spacer
- 10. Lower Control Arm Bushing Installer
- 11. Special Nut
- 12. Special Bolt

SPECIAL TOOLS



- 13. LOWER CONTROL ARM BUSHING INSTALLER
- 14. LOWER CONTROL ARM BUSHING REMOVER
- 15. UPPER CONTROL ARM BUSHING REMOVER
- 16. UPPER CONTROL ARM BUSHING FIXTURE
- 17. STEERING LINKAGE INSTALLER
- 18. SPRING REMOVER
- 19. BALL JOINT SEPARATOR
- 20. STEERING KNUCKLE SEAL INSTALLER
- 21. STEERING LINKAGE PULLER
- 22. TORSION BAR UNLOADING TOOL
- 23. LOWER CONTROL ARM BUSHING SERVICE SET
- 24. BALL JOINT REMOVER AND INSTALLER
- 25. LOWER BALL JOINT REMOVER AND INSTALLER KIT (K CHASSIS)

CONSISTING OF:
 J 41435-1 REMOVER
 J 41435-2 INSTALLER
 J 41435-3 REMOVER/
 INSTALLER

3C-42 FRONT SUSPENSION AND AXLE

BLANK

SECTION 3D

REAR SUSPENSION

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which components are being removed. This will reduce the possibility of the vehicle slipping from the hoist.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

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GENERAL DESCRIPTION

All C/K series vehicles use a leaf spring and solid rear axle suspension system. The rear axle assembly is attached to multi-leaf springs by U-bolts. The front ends of the springs are attached to the frame at the front hangers through rubber bushings. The rear ends of the springs are attached to the frame with shackles that

allow the springs to change their length while the vehicle is in motion.

Ride control is provided by two identical direct double-acting shock absorbers angle-mounted between the frame and brackets attached to the axle tubes.

ON-VEHICLE SERVICE

SHOCK ABSORBER REPLACEMENT

NOTICE: *Original equipment shock absorbers serve additionally as suspension drop cutoffs. Replacement shock absorbers must have a built in suspension cutoff feature and must not be longer than original shocks when they are fully extended or serious vehicle or component damage could result.*

Remove or Disconnect (Figure 1)

- Raise the vehicle on a hoist.
1. Upper shock nut (1) and bolt (2) from the frame bracket.
 2. Lower shock nut (3), washer (4), and bolt (5) from the axle bracket.
 3. Shock absorber (6) from the vehicle.

Install or Connect (Figure 1)

NOTICE: *Refer to "Notice" on page 3D-1.*

1. Shock absorber (6) to the vehicle.
2. Lower shock bolt (5), washer (4), and nut (3).
3. Upper shock bolt or bolt (2) and nut (1).

Tighten

- Lower nut to torque listed in "Specifications" at the end of this section.
- Upper nut or bolt to torque listed in "Specifications" at the end of this section.

STABILIZER SHAFT REPLACEMENT

Remove or Disconnect (Figure 2)

- Raise the vehicle on a hoist.
1. Lower nuts (32), washers (36) and bolts (33) from stabilizer links (28).
 2. Bolt/screws (37) from clamp (29).
 3. Clamps (29) and insulators (31).
 4. Stabilizer shaft (27).

Install or Connect (Figure 2)

NOTICE: *Refer to "Notice" on page 3D-1.*

1. Stabilizer shaft (27) to rear axle.
2. Insulators (31) and clamps (29).
3. Bolt (37) to clamp.
4. Lower bolts (33) through washers (36), stabilizer link (28), and washers (36).

5. Nuts (32).

Tighten

- Bolts (37) to 34 N.m (25 lb ft).
- Nuts (32) to 45 N.m (33 lb ft).

STABILIZER SHAFT LINK BRACKET REPLACEMENT (ALL MODELS EXCEPT C/K 3 SERIES)

Remove or Disconnect (Figure 2)

- Raise the vehicle on a hoist.
1. Upper nuts, washers and bolts from stabilizer links.
 2. Bolts from clamps insulators.
 3. Nuts and bolts from stabilizer bracket to frame.

Install or Connect (Figure 2)

NOTICE: *Refer to "Notice" on page 3D-1.*

1. Nuts and bolts to stabilizer bracket and frame.

Tighten

- Nuts to 45 N.m (33 lb ft).
2. Bolts to insulators and clamps.

Tighten

- Bolts to 34 N.m (25 lb ft).
3. Upper nuts, washers and bolts to stabilizer links.

Tighten

- Nuts to 45 N.m (33 lb ft).

C/K 3 Models

Remove or Disconnect (Figure 2)

- Raise the vehicle on a hoist.
1. Nuts (42) and insulators (41).
 2. Bolts (38) from spacer (39) and stabilizer shaft (27).
 3. Nuts (35) from U-bolts.
 4. U-Bolts (40), clamps (29) and insulators (31).
 5. Stabilizer shaft (27).

Install or Connect (Figure 2)

NOTICE: *Refer to "Notice" on page 3D-1.*

1. Stabilizer shaft (27) to rear axle.
2. Insulators (31), clamps (29) and U-bolts (40).
3. Nuts (35) to U-bolt (40).

Tighten

- Nuts (35) to 30 N.m (22 lb ft).

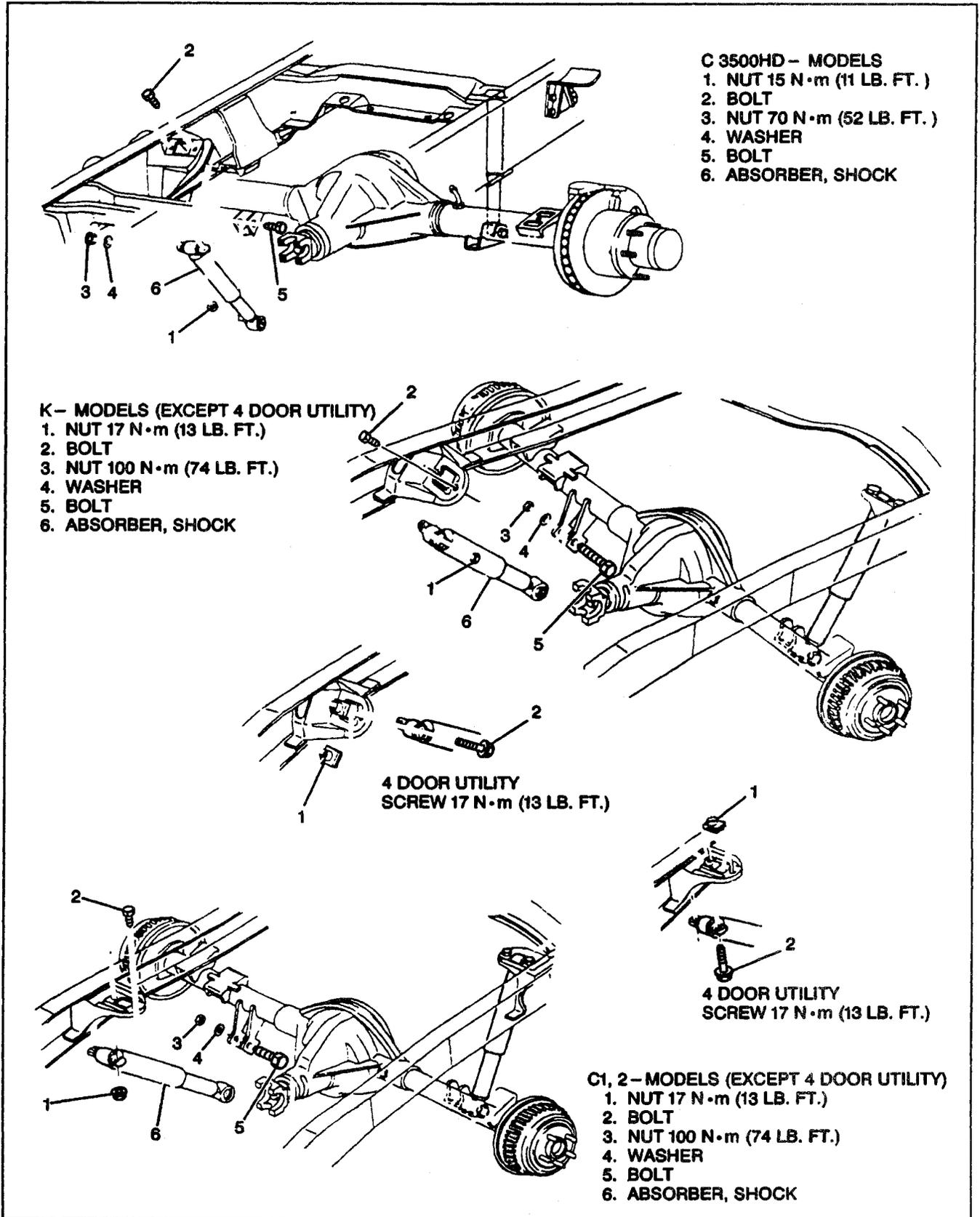
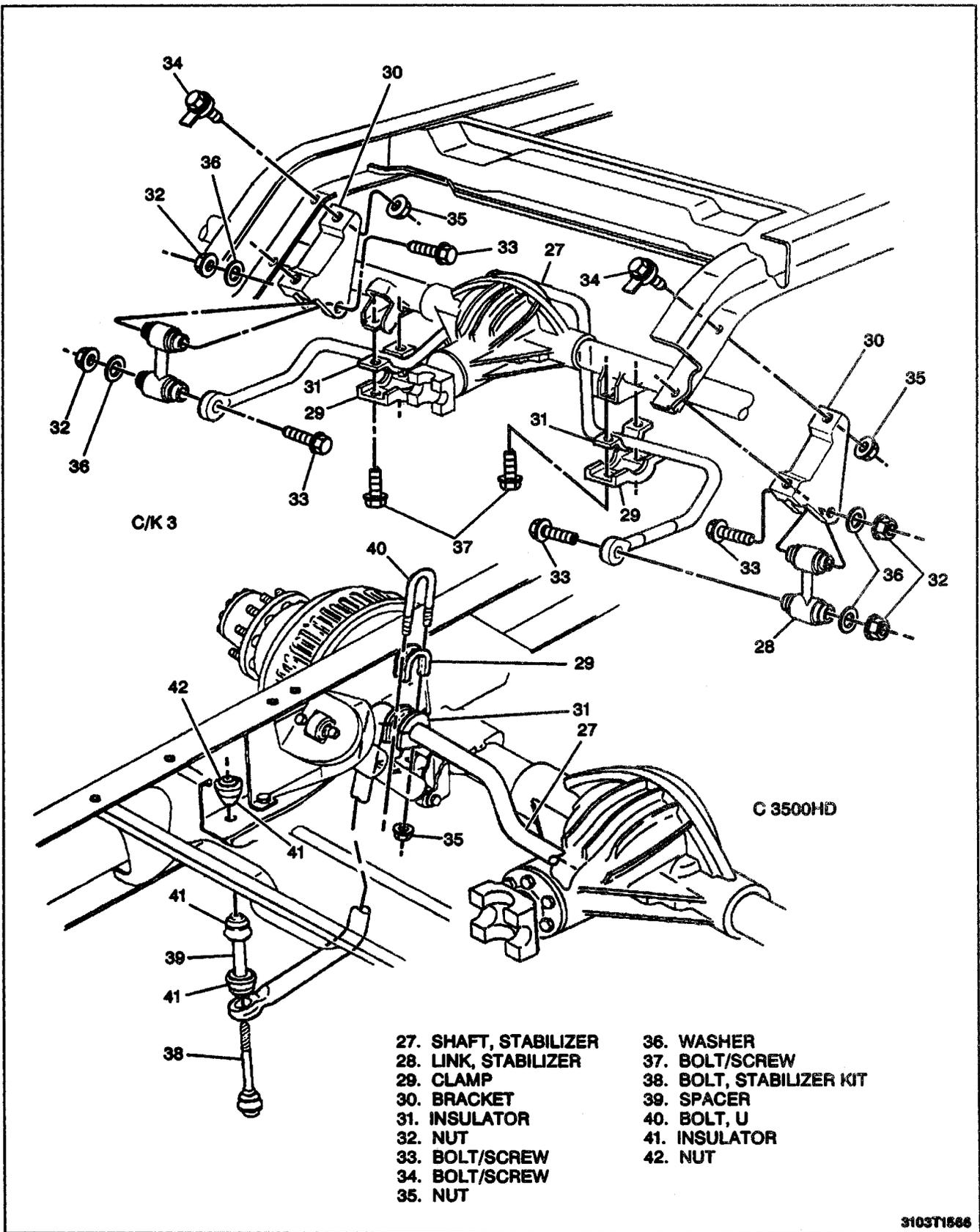


Figure 1—Shock Absorber Components

3D-4 REAR SUSPENSION



3103T1566

Figure 2—Stabilizer Shaft Components

4. Bolts (38) through insulators (41), stabilizer shaft (27) and spacers (39).
5. Nuts (42).

 **Tighten**

- Nuts (42) to 23 N-m (17 lb ft).

LEAF SPRING REPLACEMENT

 **Remove or Disconnect (Figures 3 and 4)**

- Raise the vehicle on a hoist and support the rear axle independently to relieve the tension on the leaf springs.
1. U-bolt nuts (7) and washers (8).
 2. Anchor plate (9).
 3. U-bolts (10) and spacer (11).
 - Loosen the shackle to spring nut (12).
 4. Shackle (18) to rear bracket nut (15), washers (16) and bolt (17).
 5. Spring to front bracket (23), nut (20), washers (21), and bolt (22).
 6. Spring assembly (24) from the vehicle.

 **Install or Connect (Figures 3 and 4)**

NOTICE: Refer to "Notice" on page 3D-1.

1. Spring assembly (24) to the vehicle.
2. Spring to front bracket bolt (22), washers (21), and nut (20).
 - Do not tighten.
3. Shackle (18) to rear bracket bolt (17), nut (15), and washers (16).
 - Do not tighten.
4. Spacer (11) and new U-bolts (10) to the top of the spring.

 **Important**

- Do not re-use old U-bolts.
5. Anchor plate (9).
 6. Washers (8) and nuts (7).

 **Tighten (Figures 4 and 5)**

- Nuts (7) in sequence (Figure 5).
- Nuts to the torque listed in "Specifications" at the end of this section.

 **Adjust (Figure 6)**

- The spring height between the top surface of the axle jounce pad and the bottom surface of the frame jounce bracket (Figure 6).

 **Tighten**

- Leaf spring to bracket nuts to torque listed in "Specifications" at the end of this section.
- Leaf spring to shackle nut to torque listed in "Specifications" at the end of this section.
- Shackle to bracket nuts to torque listed in "Specifications" at the end of this section.

SHACKLE REPLACEMENT

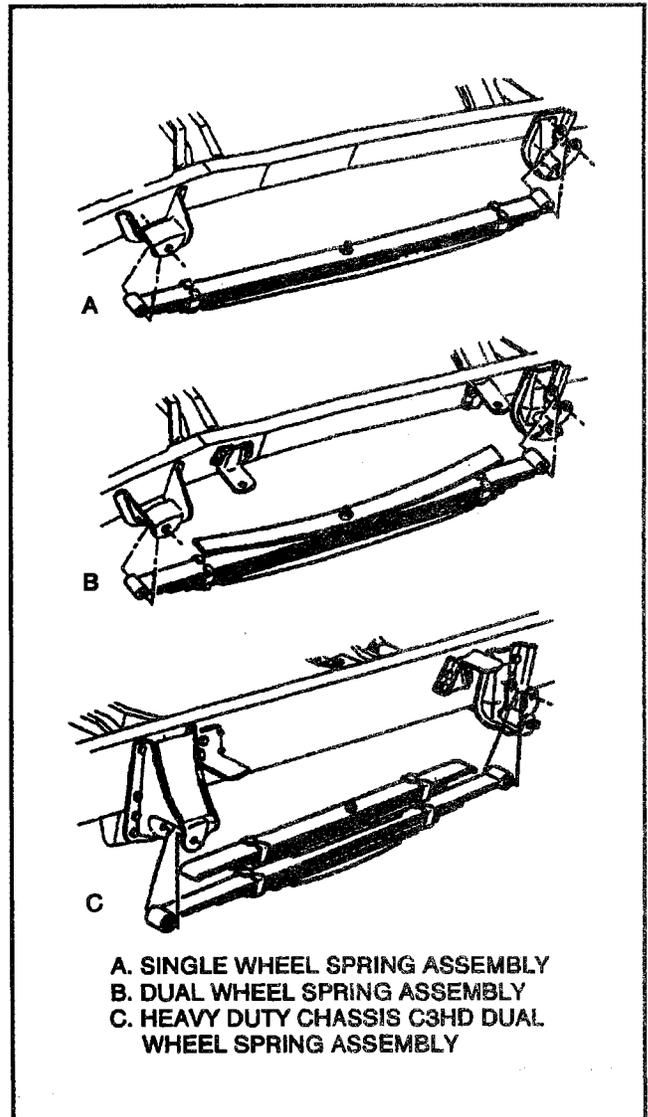
 **Remove or Disconnect (Figures 2 and 3)**

- Raise the vehicle on a hoist and support the rear axle independently to relieve the tension on the leaf springs.
 - Loosen the shackle to spring nut (12).
1. Shackle (18) to rear bracket bolt (17), nut (15), and washers (16).
 2. Shackle to spring nut (12), washers (13), and bolt (14).
 3. Shackle (18) from the vehicle.

 **Install or Connect (Figures 2 and 3)**

NOTICE: Refer to "Notice" on page 3D-1.

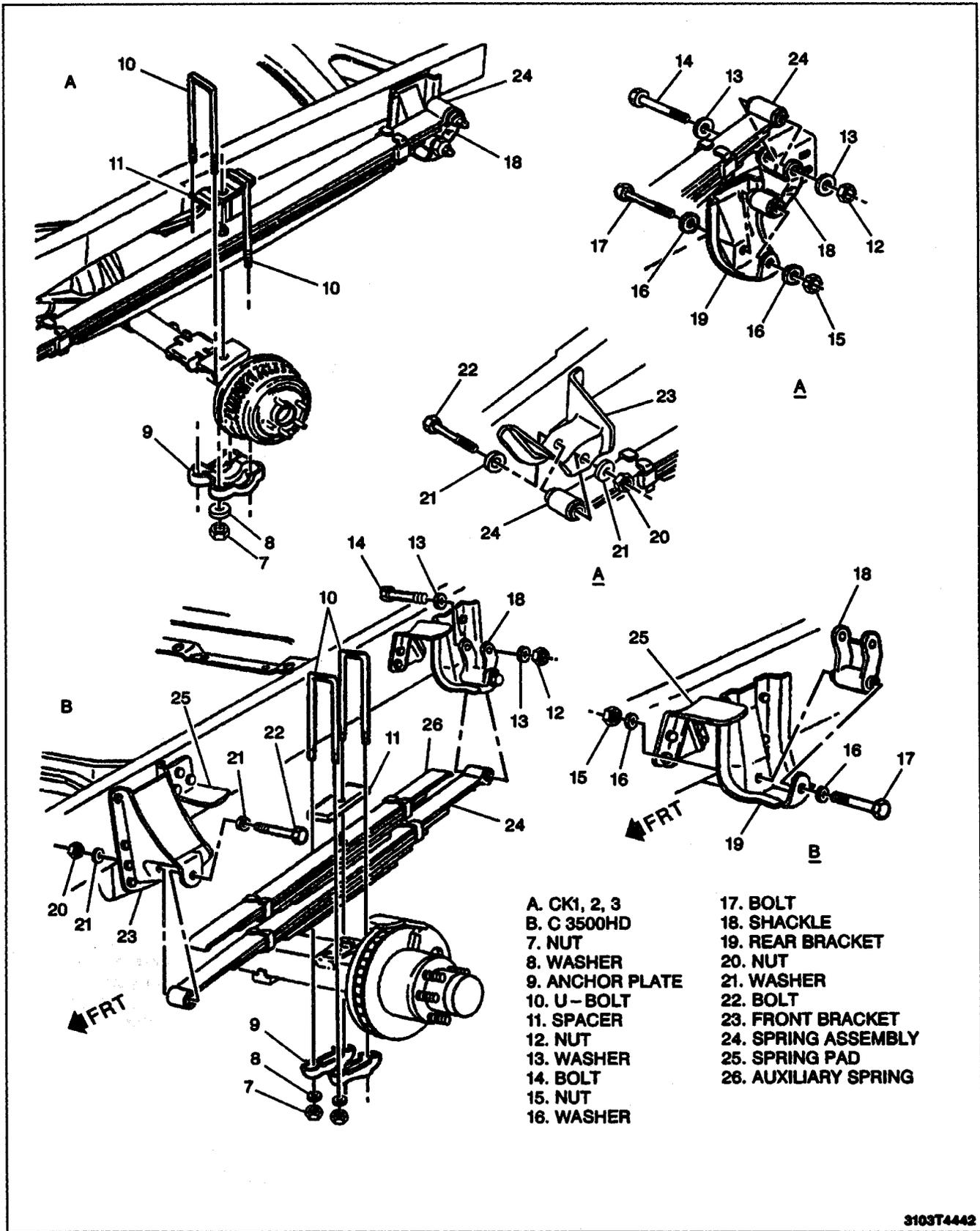
1. Shackle (18) to the vehicle.
2. Shackle to spring bolt (14), washers (13), and nut (12).
 - Do not tighten.



A. SINGLE WHEEL SPRING ASSEMBLY
 B. DUAL WHEEL SPRING ASSEMBLY
 C. HEAVY DUTY CHASSIS C3HD DUAL WHEEL SPRING ASSEMBLY

Figure 3—Single and Dual Wheel Leaf Springs

3D-6 REAR SUSPENSION



3103T4442

Figure 4—Axle Attaching Components

3. Shackle to rear bracket bolt (17), nut (15), and washers (16).
 - Do not tighten.



Adjust (Figure 6)

- The spring height between the top surface of the axle jounce pad and the bottom surface of the frame jounce bracket (Figure 6).



Tighten

- Leaf spring to bracket nuts to torque listed in "Specifications" at the end of this section.
- Leaf spring to shackle nut to torque listed in "Specifications" at the end of this section.
- Shackle to bracket nuts to torque listed in "Specifications" at the end of this section.

BUSHING REPLACEMENT



Remove or Disconnect

1. Spring assembly. Refer to "Leaf Spring Replacement" in this section.
2. Bushing from the leaf spring.
 - Place the leaf spring in a press and press the bushing out.
 - Clean the spring bushing bore of bits of old bushing, and burrs or corrosion.



Install or Connect

NOTICE: Refer to "Notice" on page 3D-1.

1. Bushing to the leaf spring.
 - Place the leaf spring in a press and press the bushing in.
2. Spring assembly. Refer to "Leaf Spring Replacement" in this section.

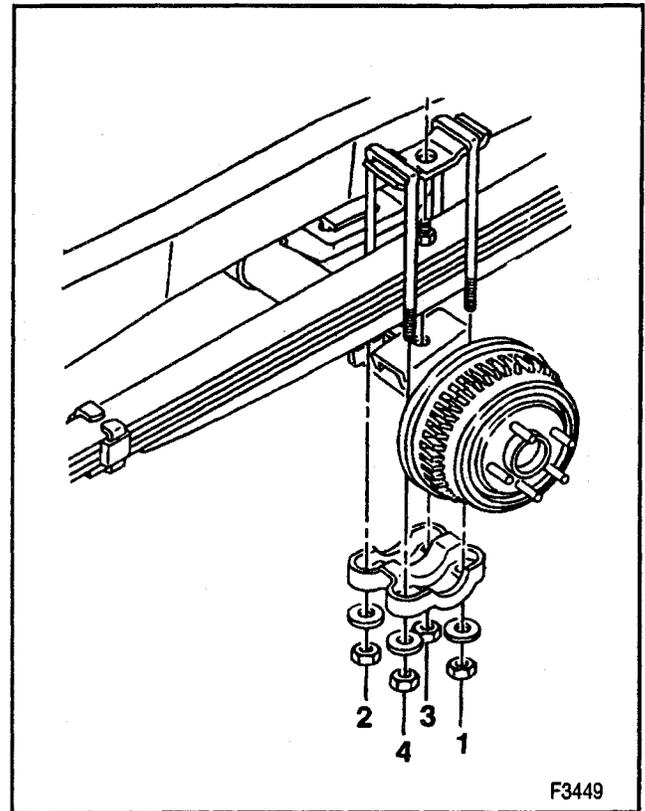


Figure 5—U-Bolt Tightening Sequence

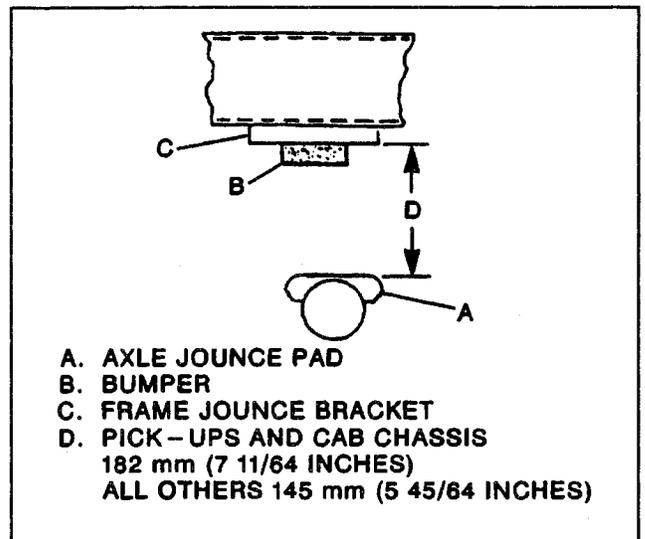


Figure 6—Rear Axle Trim Height

3D-8 REAR SUSPENSION

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N.m	Lb ft	Lb in
Leaf Spring to Bracket Nuts	95	70	—
Leaf Spring to Bracket Nuts (C 3500HD)	415	306	—
Leaf Spring to Shackle Nuts	95	70	—
Leaf Spring to Shackle Nuts (C 3500HD)	213	157	—
Shackle to Bracket Nuts	95	70	—
Shackle to Bracket Nuts (C 3500HD)	213	157	—
Shock Absorber Lower Nuts	100	74	—
Shock Absorber Lower Nuts (C 3500HD)	70	52	—
Shock Absorber Upper Nuts	17	13	—
Shock Absorber Upper Nuts (C 3500HD)	15	11	—
Stabilizer Clamp U-Bolt Nuts	30	22	—
Stabilizer Kit Nut	23	17	—
Stabilizer Link Bracket to Frame Nut	45	33	—
Stabilizer Link Nut	45	33	—
U-Bolt Nuts (C/K1,2)	110	81	—
U-Bolt Nuts (C/K 3 without Dual Rear Wheels or 7.4L Engine)	110	81	—
U-Bolt Nuts (C/K 3 with Dual Rear Wheels or 7.4L Engine without Dual Rear Wheels)	148	109	—
U-Bolts (C 3500HD)	253	187	—

SECTION 3E

TIRES AND WHEELS

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which components are being removed. This will reduce the possibility of the vehicle slipping from the hoist.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these Instructions can help you avoid damage to parts and systems.

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3E-2 TIRES AND WHEELS

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GENERAL DESCRIPTION

The factory installed tires are designed to operate satisfactorily with loads up to and including the full rated load capacity when inflated to the recommended inflation pressures.

Correct tire pressures, wheel alignment, and driving techniques have an important influence on tire life. Heavy cornering, excessive rapid acceleration, and heavy braking will increase tire wear.

REPLACEMENT TIRES

A Tire Performance Criteria (TPC) specification number is molded in the sidewall near the tire size of all original equipment tires. This specification number ensures that the tire meets GM performance standards for traction, endurance, dimension, noise, handling, rolling resistance, and others. Usually, a specific TPC number is assigned to each tire size.

Replacement tires should be the same size, load range, and construction as the original tires. Replace the original tires with tires of the same TPC specification number. Use of any other size or type tire may seriously affect ride, handling, speedometer/odometer calibration, vehicle ground clearance, and tire clearance to body chassis.

Note: C 3500HD models do not use TPC tires. Refer to the tire manufacturer for assistance.

CAUTION: Do not mix different types of tires such as radial, bias, and bias-belted tires. Vehicle handling may be seriously affected and may result in loss of control and possible personal injury.



Inspect

- Tires should be inspected and replaced when the following conditions are found:
 - They are worn to a point where 1.6 mm (1/16 inch) or less tread remains, or the cord or fabric is showing. To help detect this, tires may have built-in tread wear indicators that appear between the tread grooves when the tread is 1.6 mm (1/16 inch) or less. When the indicators appear in two or more adjacent grooves at three spots around the tire, replace the tire.
 - The tread or sidewall is cracked, cut or snagged deep enough to expose the cord or fabric.
 - The tire has a bump, bulge, or split. Slight sidewall indentations are normal and should not affect ride.
 - The tire has a puncture, cut, or other damage that cannot be correctly repaired because of the size or location of the damage.



Important

- It is recommended that new tires be installed in pairs on the same axle. If it is necessary to replace only one tire, pair it with the tire having the most tread.

ALL SEASONS TIRES

Some vehicles are equipped with all season radial tires as standard equipment. These tires qualify as snow tires. They have a 37% higher average rating for

snow traction than the non all season radial tires previously used. These tires are identified by an "M+S" molded in the tire sidewall following the size. The suffix "MS" is also molded in the sidewall after the TPC specification number.

P-METRIC TIRES

Most P-metric and LT-metric tires do not have exact corresponding alpha-numeric tire sizes. For example, a P205/75R15 is not equal in size and load carrying capacity to an FR78-15. For this reason, replacement tires should be of the same TPC specification number (same size, load range, construction) as those originally on the vehicle. If P-metric or LT-metric tires must be replaced with other sizes, a tire dealer should be consulted. Tire companies can best recommend the closest match. Refer to Figure 1.

TIRE CHAIN USAGE

When chains are to be used, most current vehicles require SAE Class "S" or SAE Class "U" tire chains (Figure 2). These may also be designated as 1100 Series, Type "PL," 1200 Series, Type "P," or 1800 Series Lug Reinforced tire chains. These chains are specially designed to limit the "fly off" effect that occurs when the wheel rotates.

Manufacturers of tire chains have a specific chain size for each tire size to ensure proper fit when installed. Therefore, be sure to purchase the correct chains for the tires on which they are to be used. Rubber adjusters should not be used to take up slack or clearance in chains that are loose due to incorrect size.

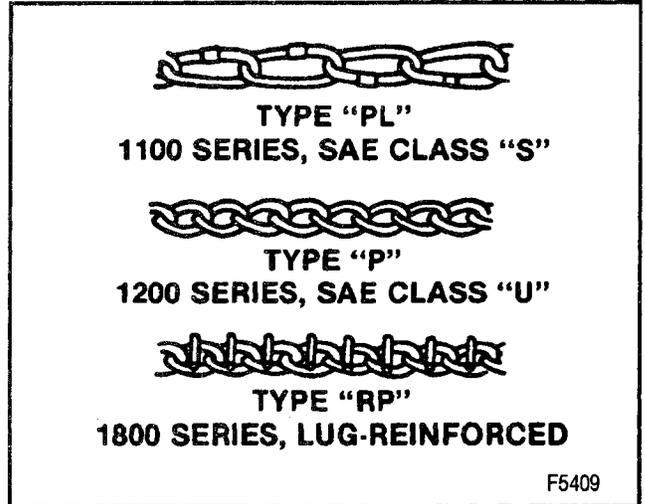


Figure 2—Tire Chain Types

Always follow the chain manufacturer's installation instruction.

Use of chains may adversely affect handling. When using chains:

- A. Ensure that the vehicle is designed for chain clearance.
- B. Adjust speed to road conditions.
- C. Avoid sharp turns.
- D. Avoid locked-wheel braking in general, to help prevent chain damage to the vehicle.
- E. Install the chains on the drive tires as tightly as possible, then tighten them again after driving 0.4 to 0.8 kilometer (1/4 to 1/2 mile). The use of chains on the non-drive tires is not recommended; the chains may contact and possibly damage the vehicle. If chains are used on the non-drive tires, make sure there is enough clearance.
- F. Do not exceed 70 km/h (45 mph) or the chain manufacturer's speed limit, if lower.
- G. Drive in a restrained manner and avoid large bumps, potholes, severe turns, and other maneuvers that could cause the tires to bounce up and down.
- H. Follow any other instructions of the chain manufacturer that do not agree with the above.

TIRE PLACARD

The tire information label is permanently located on the rear face of the drivers door, and should be referred to for tire information. The label lists the maximum vehicle load, tire size (including spare), and cold inflation pressure (including spare). For further information, refer to SECTION 0A.

WHEELS

Wheels must be replaced if they are bent, dented, have excessive lateral or radial runout, leak air through the welds, have elongated bolt holes, or wheel nuts will not stay tight. Wheels with runout greater than specified may cause objectionable vibrations.

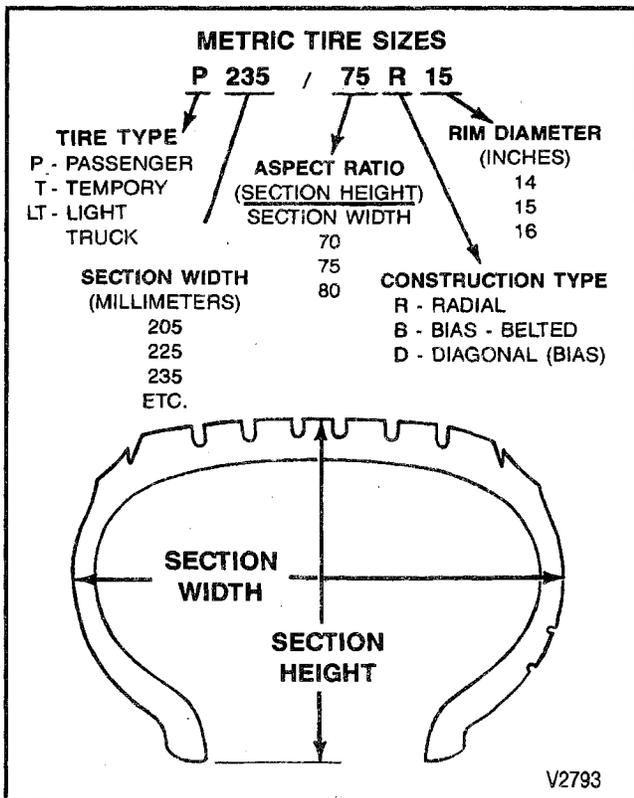


Figure 1—Tire Size Explanation

3E-4 TIRES AND WHEELS

Checking Wheel Mounting Surface

Inspect (Figures 3 and 4)

- A. Use a straight edge 203 to 229mm (8 to 9 inches) long (Figure 3). Place it on the inboard mounting surface of the wheel and try to rock it up and down.
- B. Repeat the above procedure on at least three or four different positions on the inboard mounting surface.
- C. The outer ring of the mounting surface is normally raised above everything inside it. If the wheel mounting surface has been bent on a tire changer, it will be raised above the outer ring (Figure 3).
- D. Check mounting wheel/nut holes for damage that can be caused from over torquing the lug nuts. Look for collapsed wheel/nut bosses or cracked bosses (Figure 4).
- E. If the wheel is bent or the wheel/nut boss area is cracked, replace the wheel.

Important

- Replacement wheels must be equivalent to the original equipment wheels in load capacity, diameter, rim width, offset, and mounting configuration. A wheel of incorrect size or type may affect wheel and hub bearing life, brake cooling, speedometer/odometer calibration, vehicle ground clearance, and tire clearance to the body and chassis.

Steel wheels can be identified by a two or three-letter code stamped into the front side rim near the valve stem. Aluminum wheels have the code, part number, and manufacturer's ID cast into the backside.

NOTICE: *The use of aftermarket reverse-type wheels, designed to extend the wheel away from the body, will increase the scrub radius. An increased scrub radius may greatly increase steering effort and reduce hub bearing life.*

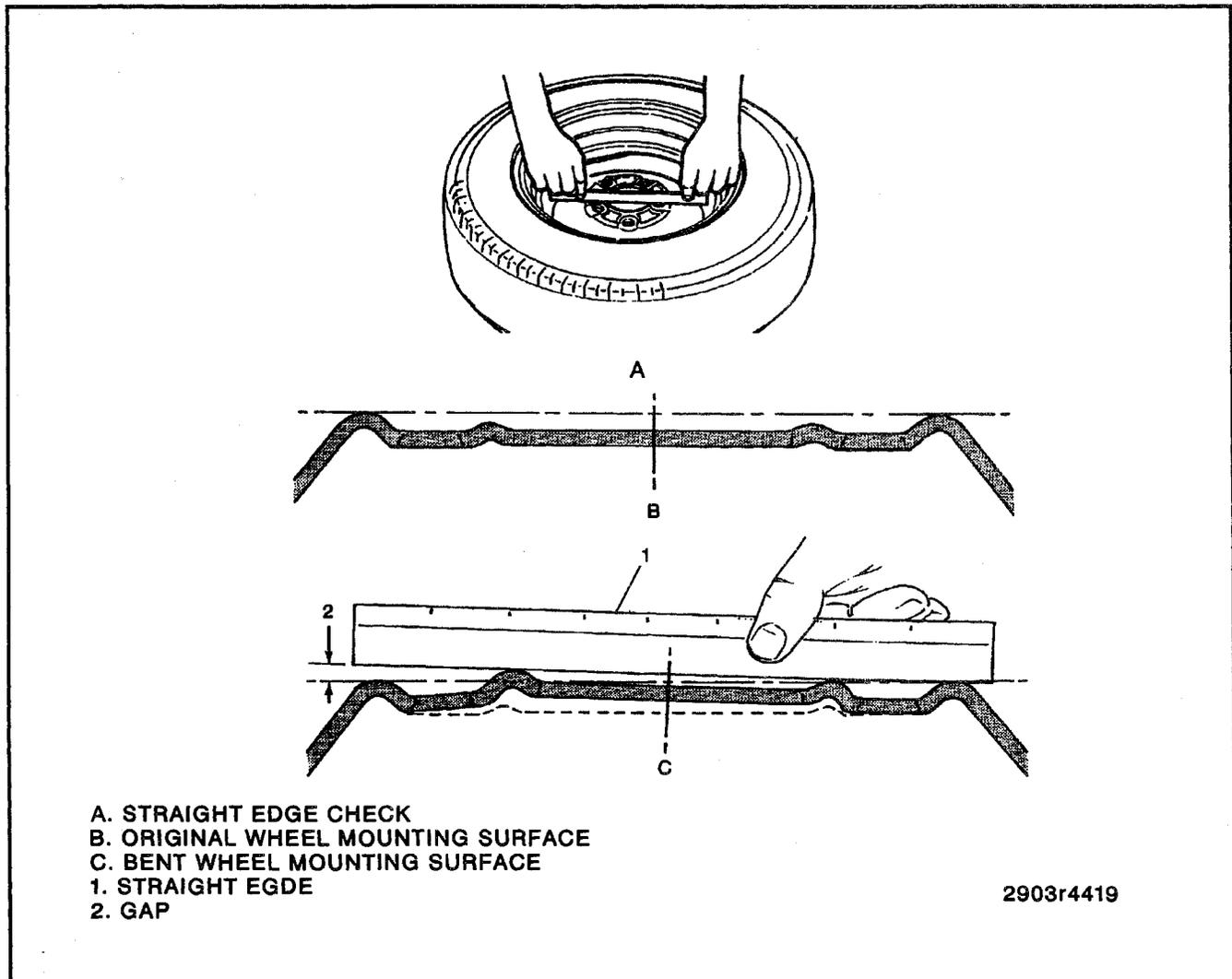


Figure 3—Checking Wheel Mounting Surface

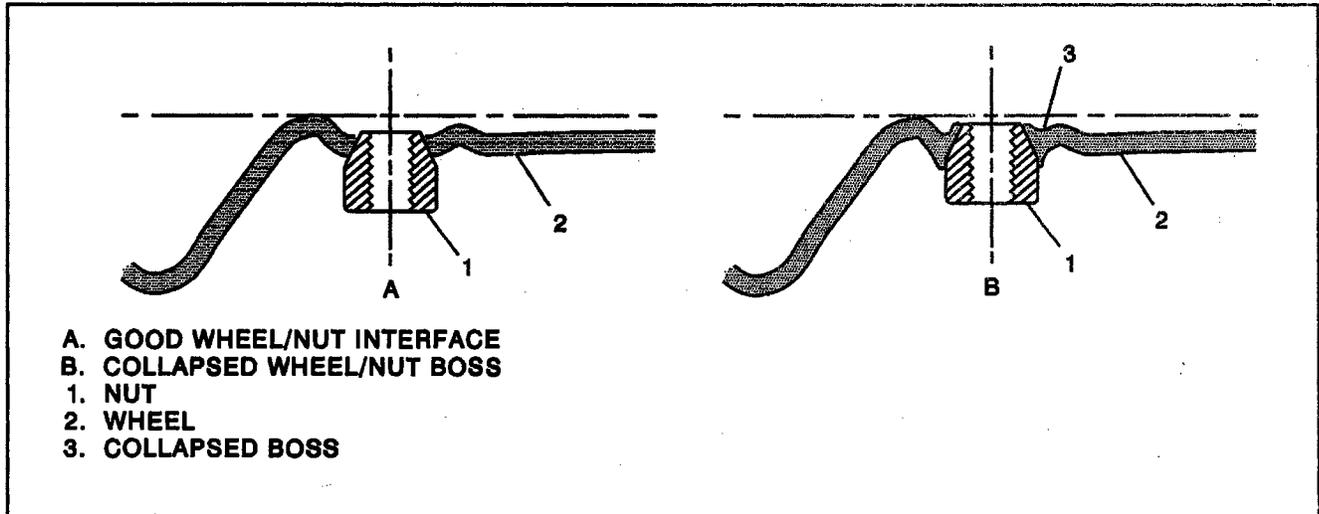


Figure 4—Checking Wheel/Nut Boss

DIAGNOSIS OF TIRES AND WHEELS

The following information (including the Radial Tire Lead/Pull Chart) will help to identify certain tire-related durability and drivability problems.

PROBLEM	POSSIBLE CAUSE	CORRECTION
Excessive Heel And Toe Wear	1. Hard cornering. 2. Incorrect alignment (excessive toe).	1. Correct as required. 2. Set to correct specifications.
Excessive Tire Edge(s) Wear	1. Underinflated tires. 2. Vehicle overloaded. 3. Hard cornering. 4. Incorrect toe setting.	1. Inflate to recommended pressure. 2. Refer to certification label. 3. Correct as required. 4. Set to correct specifications.
Excessive Tire Wear (Center Of Tread)	1. Overinflated tires. 2. Overloaded vehicle. 3. Rapid acceleration/excessive braking.	1. Deflate to recommended pressure. 2. Refer to certification label. 3. Correct as required.
Uneven Tire Wear	1. Improper tire pressure. 2. Incorrect tire and wheel usage. 3. Front end out of alignment. 4. Loose, worn, or damaged steering linkage, joints, suspension components, bushings and/or ball joints.	1. Inflate to recommended pressure. 2. Install correct tire-wheel combination. 3. Align the front end. 4. Inspect, repair or replace as required.
Radial Tire Waddle (Side To Side Movement At Speeds Between 5 and 15 MPH)	1. Excessive lateral runout (wheel). 2. Excessive lateral runout (tire).	1. Replace wheel. 2. Replace tire.
Vibration	1. Out of balance wheel/tire. 2. Tire runout. 3. Wheel runout. 4. Uneven tire wear.	1. Balance wheel/tire. 2. Replace tire. 3. Replace wheel. 4. Replace tire.

3E-6 TIRES AND WHEELS

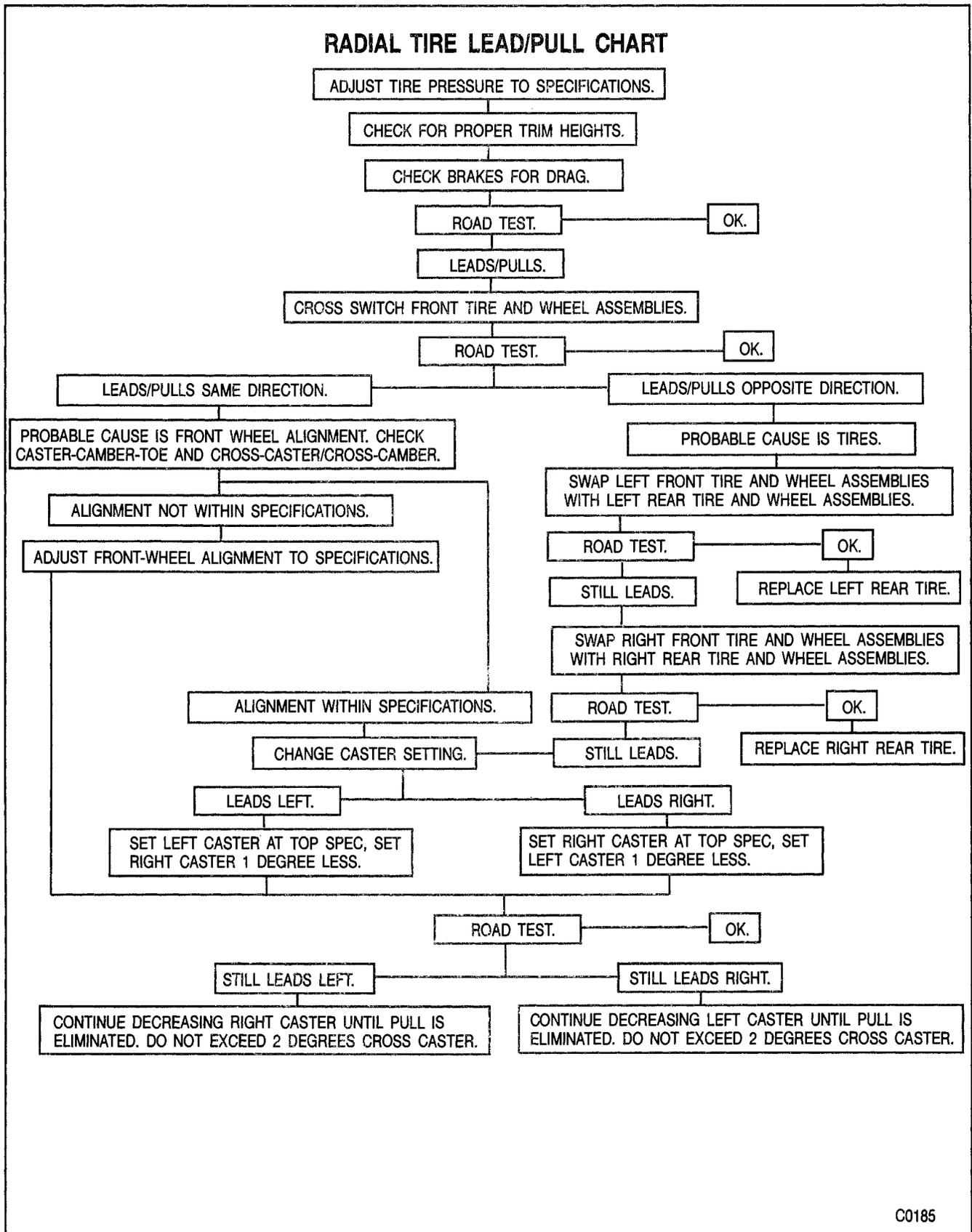


Figure 5—Radial Tire Lead/Pull Chart

ON-VEHICLE SERVICE

WHEEL REPAIR

Wheel repairs that use heating, welding, or peening are not approved. An inner tube is not an acceptable repair for leaky wheels or tires. If a wheel is found to be leaking, the wheel should be repaired or replaced with one of original equipment quality.

METRIC WHEEL NUTS AND BOLTS

Metric wheel nuts and bolts are identified as follows: The wheel nut has the word "Metric" stamped on the face. The letter "M" is stamped into the end of the wheel bolt. The thread size of metric wheel nuts and bolts are indicated by the following example:

- "M14 x 1.5"
- M=Metric
- 14=Diameter in millimeters
- 1.5=Millimeters per thread (gap between)

TIRE INFLATION AND LOAD LIMITS

The factory installed wheels and tires are designed to handle loads up to and including their gross axle weight when inflated to the recommended inflation pressures.

Correct tire pressures, wheel alignment, and driving techniques have an important influence on tire life. Under-inflated tires can cause handling problems, poor fuel economy, shortened tire life, and tire overloading. Heavy cornering, excessive rapid acceleration, and heavy braking will increase tire wear.

Tire pressure, with tires cold (after vehicle has set for three hours or more, or driven less than one mile) should be checked monthly or before any extended trip and set to the specifications on the tire label.

Valve caps or extensions should be installed on the valves to keep out dust and water.

The metric term for tire inflation pressure is the kilopascal (kPa). Tire pressure may be printed in both kPa and psi. One psi equals 6.9 kPa (Figure 6).

INFLATION PRESSURE CONVERSION CHART (KILOPASCALS TO PSI)			
kPa	psi	kPa	psi
140	20	215	31
145	21	220	32
155	22	230	33
160	23	235	34
165	24	240	35
170	25	250	36
180	26	275	40
185	27	310	45
190	28	345	50
200	29	380	55
205	30	415	60

Conversion: 6.9 kPa=1 psi

T2567

Figure 6—Inflation Pressure Conversion

Higher Than Recommended Pressure Can Cause:

- Hard ride.
- Tire bruising or carcass damage.
- Rapid tread wear at center of the tire.

Lower Than Recommended Pressure Can Cause:

- Tire squeal on turns.
- Hard steering.
- Rapid and uneven wear on the edge of the tread.
- Tire rim bruises and rupture.
- Tire cord breakage.
- High tire temperatures.
- Reduced handling.
- High fuel consumption.
- Soft ride.

Unequal Pressure On Same Axle Can Cause:

- Uneven braking.
- Steering lead.
- Reduced handling.

WHEEL REMOVAL

Penetrating oil has been found to be effective in removing tight wheels. However, if it is used it should be applied sparingly to the hub surface only.

CAUTION: If penetrating oil gets on the vertical surfaces between the wheel and the rotor or drum it could cause the wheel to work loose as the vehicle is driven, resulting in loss of control and an injury accident. Never use heat to loosen a tight wheel. It can shorten the life of the wheel, studs, or hub and bearing assemblies. Wheel nuts must be tightened in sequence and to the specified torque to avoid bending the wheel or rotor.

Sometimes wheels can be difficult to remove from the vehicle due to foreign material or a tight fit between the wheel center hole and the hub or rotor. Excessive force such as hammering the wheel or tire can cause damage and is not recommended. Slight tapping of the tire side wall with a rubber mallet is acceptable.

The wheel can be removed without damage as follows:

1. Tighten all the lug nuts on the affected wheel.
 - Do not torque.
2. Loosen each nut two turns.
3. Rock the vehicle from side to side to loosen the wheel. Or rock the vehicle from forward to reverse allowing the vehicle to move several feet in each direction. Apply quick, hard jabs on the brake pedal to loosen the wheel. If that did not free up the wheel, then rock the vehicle again from side to side as hard as possible using one or more person's body weight to loosen the wheel. If the wheel is still tight, repeat the procedure.

3E-8 TIRES AND WHEELS

WHEEL AND TIRE INSTALLATION

Single Wheels (Front or Rear)

Tool Required:

- Torque Wrench or
- J 39544 GM Wheel Nut Torque Adapters (For use with pneumatic impact)

↔ Remove or Disconnect

1. Raise vehicle and support with safety stands.
2. Hub cap, if required.
3. Wheel nuts.
 - Mark the location of tire and wheel assembly to hub assembly.
4. Tire and wheel assembly.

CAUTION: Before installing a wheel, remove any corrosion on the wheel mounting surface and brake drum or disc mounting surface by scraping and wire brushing. Installing wheels with poor metal-to-metal contact at the mounting surfaces can cause wheel nuts to loosen. This can lead to a wheel coming off while the vehicle is moving, possibly causing loss of control and personal injury.

🧼 Clean

- Wheel nuts, bolts, and the wheel and rotor mounting surfaces.

NOTICE: A torque wrench or J 39544 must be used to ensure that wheel nuts are tightened to specification. Never use lubricants or penetrating fluids on wheel stud, nuts, or mounting surfaces, as this can raise the actual torque on the nut with out a corresponding torque reading on the torque wrench. Wheel nuts, studs, and mounting surfaces must be clean and dry. Failure to follow these instructions could result in wheel, nut, and/or stud damage.

→← Install or Connect

1. Tire and wheel assembly.
 - Align locating mark of tire and wheel to hub assembly.
2. Wheel nuts.

🔧 Tighten

- Wheel nuts to "Specifications" at the end of this section.
 - Tighten evenly and alternately to avoid excessive runout (Figure 7).
3. Hub cap, if required.
 4. Lower the vehicle.

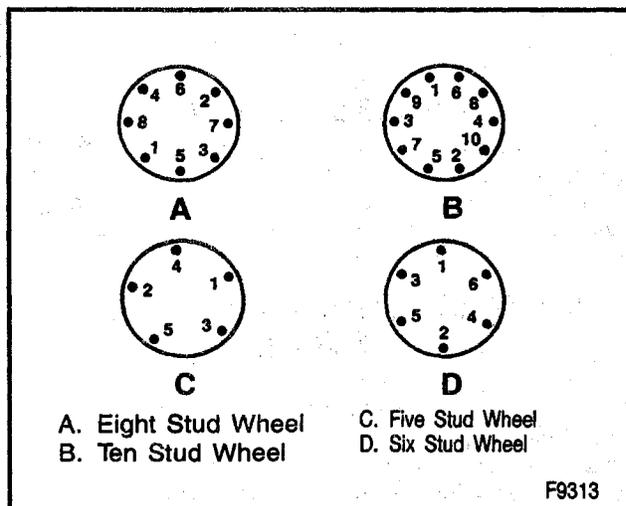


Figure 7—Wheel Nut Tightening Sequence

Dual Rear Wheels

↔ Remove or Disconnect

1. Raise vehicle and support with suitable safety stands.
2. Hub cap, if required.
3. Wheel nuts.
 - Mark location of tire and wheel assembly to hub assembly.
4. Clamp ring and outer and inner wheel.

→← Install or Connect

1. Inner and outer wheel and clamp ring.
 - Make sure the pins on the clamp ring face outward.
2. Wheel nuts.

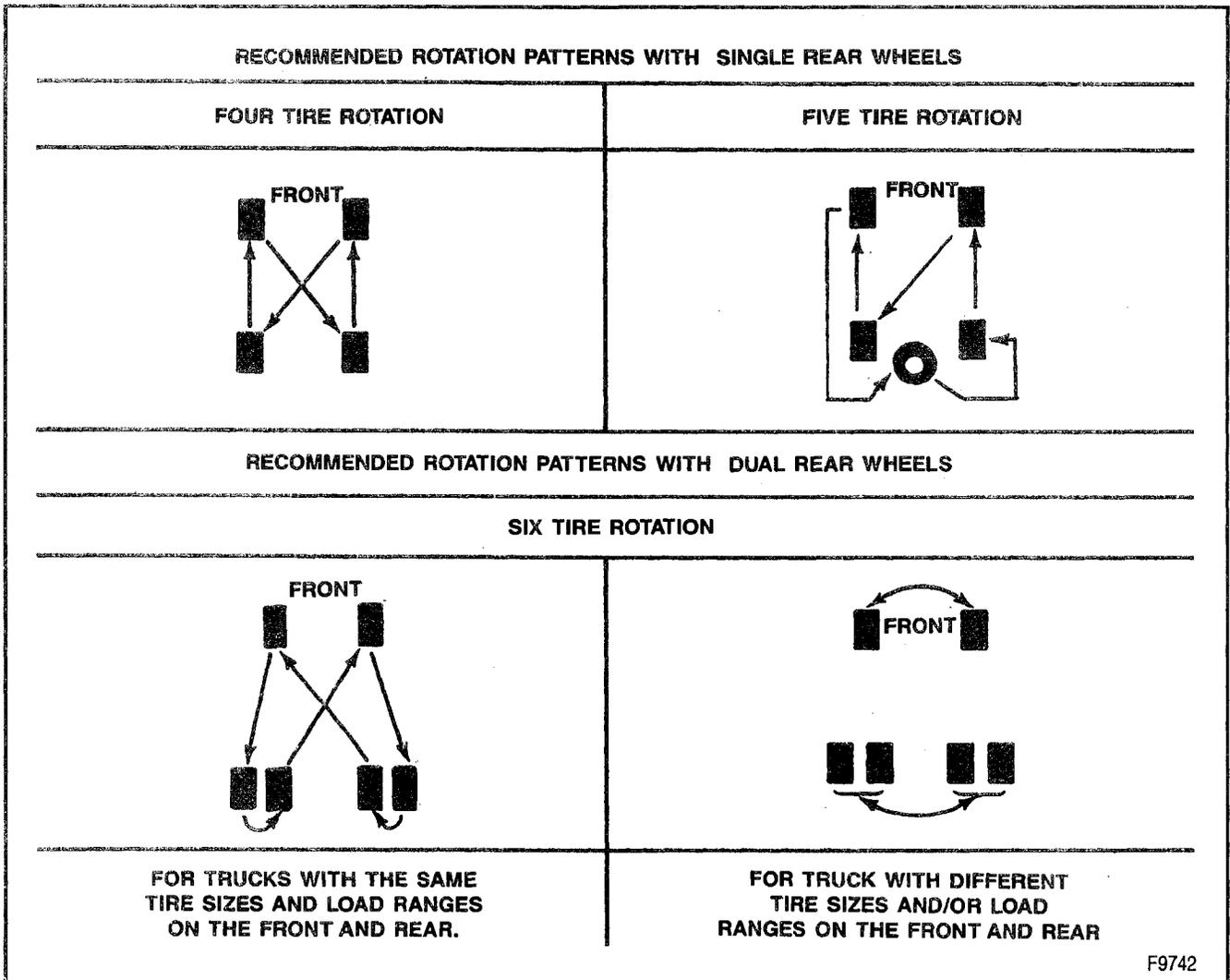
🔧 Tighten

- Nuts to "Specifications" listed at the end of this section.
 - Tighten evenly and alternately to avoid excessive runout (Figure 7).
3. Hub cap, if required.
 4. Lower the vehicle.

TIRE ROTATION

To equalize wear, rotate tires at intervals specified in SECTION 0B. In addition to scheduled rotation, the tire and wheel assembly should be rotated whenever uneven tire wear is noticed (Figure 8).

Due to their design, radial tires tend to wear faster in the shoulder area, particularly in front positions. Radial tires in non-drive locations may develop an irregular wear pattern that can generate tire noise. This makes regular rotation especially necessary.



F9742

Figure 8—Tire Rotation Pattern

TIRE MOUNTING AND DISMOUNTING

Use a tire changing machine to mount or dismount tires. Follow the manufacturer's instructions. Do not use hand tools or tire irons to change a tire as they may damage the tire bead, or wheel rim flanges.

Rim bead seats should be cleaned with a wire brush or coarse steel wool to remove old rubber and light rust or corrosion. Before mounting or dismounting a tire, the bead area should be cleaned and well lubricated.

CAUTION: Do not stand over the tire when inflating. The bead may break when it snaps over the safety hump, and cause serious personal injury. Do not exceed 275 kPa (40 psi) pressure when inflating. If 275 kPa (40 psi) pressure will not seat beads, deflate, re-lubricate, and re-inflate. Overinflation may cause the bead to break and result in personal injury.

NOTICE: It is important to note that damage to either the tire mounting surface or the wheel mounting holes can result from the use of improper wheel attachment or tire mounting techniques. It takes 70 seconds for all the air to completely exhaust from a large tire. Failure to follow proper procedures could cause the tire changer to put enough force on the tire to bend the wheel at the mounting surface. Such damage may result in vibration and/or shimmy and under severe use lead to cracking.

Install the valve core and inflate to proper air pressure. Check the locking rings of the tire to make sure they show around the rim flanges on both sides of the wheel.

3E-10 TIRES AND WHEELS

TIRE REPAIR

There are many different materials and techniques on the market to repair tires. Not all work on some types of tires. Tire manufacturer's have published detailed instructions on how and when to repair tires. The instructions can be obtained from the tire manufacturer.

CHECKING WHEEL AND TIRE RUNOUT

Some vehicles are sensitive to tire and wheel assembly runout. Tires that are satisfactory on one vehicle might be unsatisfactory on another. When analyzing vibration problems, it is important to keep this in mind. In addition, different wheel positions on a vehicle may have different sensitivity levels. You should check for wheel runout or total wheel and tire runout in the following cases:

- A. If the tire and wheel vibration occurs below 40 miles per hour.
- B. If all wheels are balanced and a vibration occurs.
- C. If there appears to be a bulge in a tire or an out-of-round condition as a tire rotates on a balancer.
- D. If any wheel damage is noticed.
- E. If there is a poor wheel fit on the hub and the vehicle exhibits vibration.

MEASURING WHEEL AND TIRE RUNOUT

Wheel runout should be measured with an accurate dial indicator. Measurements may be taken with the wheel installed on the vehicle, or off the vehicle using an accurate mounting surface such as a wheel balancer. Measurements may also be taken with or without the tire mounted on the wheel.

Radial runout and lateral runout should be measured on both the inboard and outboard rim flanges. With the dial indicator firmly in position, slowly rotate the wheel one revolution and record the total indicator reading. If any measurement exceeds specifications, and there is a vibration that wheel balancing will not correct, the wheel should be replaced. Disregard any indicator readings due to welds, paint runs, scratches, etc.

Radial Runout

Radial runout is the egg-shaped difference from a perfect circle. Measure tire radial runout from the center tire tread rib although other tread ribs can be measured as well. The total runout is the reading from the gage, and the high spot is the location of the maximum runout. On a rim, if either flange is beyond specifications, replace the rim (Figure 9).

- Aluminum Wheels—0.76 mm (0.030 inch)
- Steel Wheels—1.01 mm (0.040 inch)

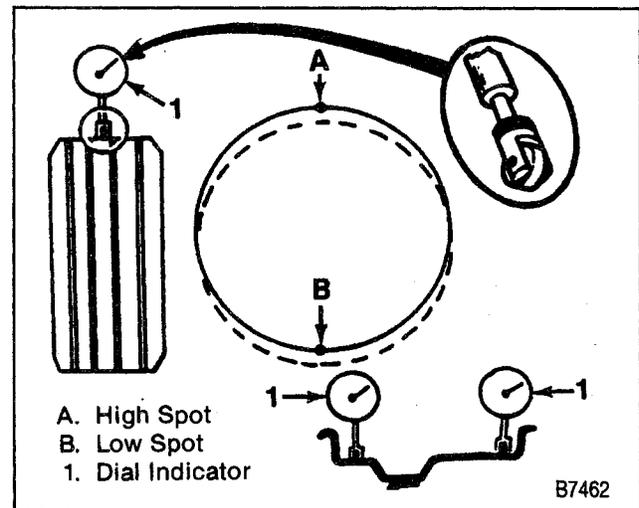


Figure 9—Measuring Radial Runout

Lateral Runout

Lateral runout is a sideways variation causing a twist or wobble and is measured on a side surface. On the tire and wheel assembly, measure the sidewall of the tire as close to the tread shoulder design edge as possible. The total runout is the reading from the gage, and the high spot is the location of the maximum runout. On a rim, if either flange is beyond guidelines, replace the rim (Figure 10).

- Aluminum Wheels—0.76 mm (0.030 inch)
- Steel Wheels—1.14 mm (0.045 inch)

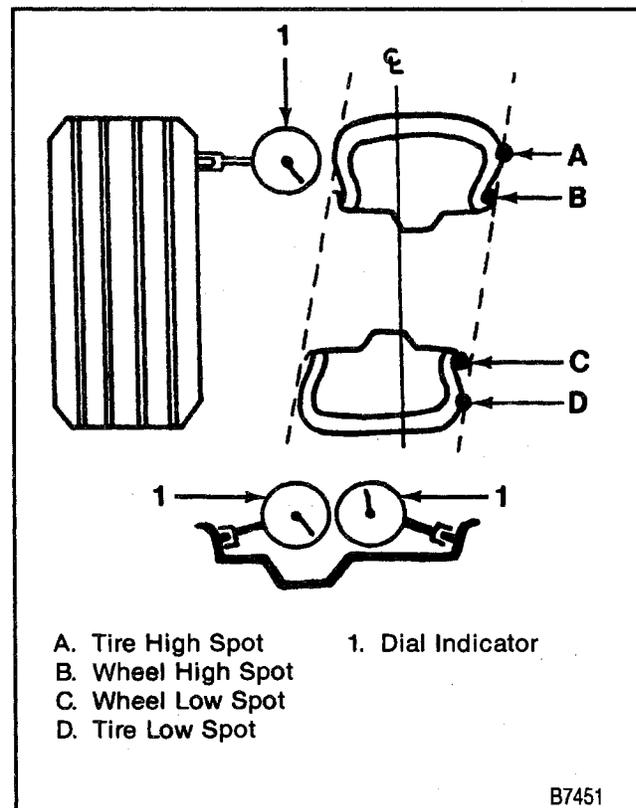


Figure 10—Measuring Lateral Runout

Measurement Procedures

1. Inflate the tires to specifications.
2. Warm up the tires prior to taking measurements to eliminate flat spotting.
 - Newly installed tires usually do not require warming up.
3. Raise vehicle and support with safety stands.
 - If measurements will be taken off the vehicle, mount each tire and wheel assembly on a dynamic balance machine.
4. Mark the tire and wheel assemblies for exact replacement.
 - A. Mark a wheel hub bolt and its exact position on the wheel.
 - B. Mark each tire and wheel assembly for replacement on the exact hub/rotor assembly.
5. Take either a radial or lateral runout measurement.
 - A. Place the dial indicator in position.
 - B. Rotate the tire and wheel assembly (or just the wheel) to find its low spot. Adjust the dial indicator to read zero.
 - C. Rotate again to verify the low spot location—the dial indicator must return to zero.
 - D. Disregard any instantaneous dial jumps due to welds, paint runs, scratches, etc. on the wheel.
 - E. Rotate the tire and wheel assembly (or just the wheel) and note the amount of variance (runout) from zero. Locate and mark the high spot.
6. If there is a large difference in runout measurements from “ON” vehicle to “OFF” vehicle, the runout problem is likely due to excessive runout of the bolt circle or hub.
7. If measured runouts are not within the guidelines located in “Wheel Runout Specifications” at the end of this section, proceed to “Vectoring” in this section to correct the problem.

Vectoring

Vectoring is a technique used to reduce radial or lateral runout and even dynamic balance on tire and wheel assemblies. Vectoring can be accomplished by the positioning of the tire on the wheel and the positioning of the tire and wheel assembly on the hub/rotor.

! Important

- Always rebalance the tire and wheel assembly after vectoring.

Tire to Wheel Vectoring

1. Determine which runout needs to be minimized.
 - Determine visually.
2. If radial runout is the problem, take a measurement on the center tread rib.
 - If the trend is uneven, wrap tape tightly around the tire, record the runout magnitude, and mark the high spot location (Figure 11).
3. If lateral runout is the problem, take a measurement on the sidewall just below the edge of the tread shoulder.
 - Record the runout magnitude, and mark the high spot location.
4. Mark the tire sidewall at the valve location.
 - This is the 12 o'clock position.
 - The location of the high spot is always with respect to the clock location on the wheel.

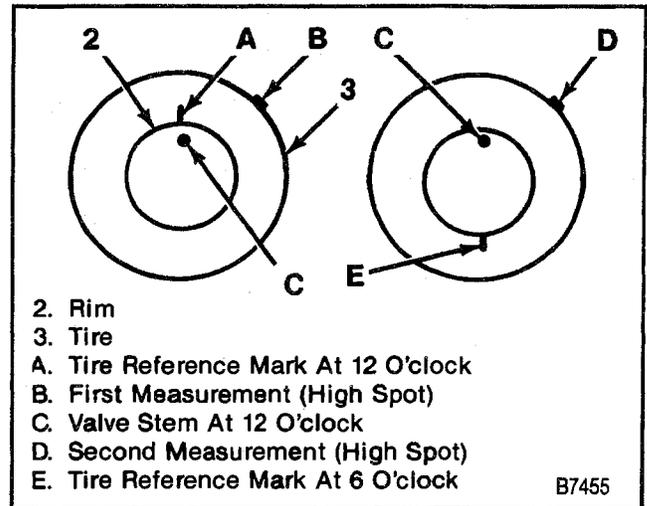


Figure 11—Checking Tire to Wheel Vectoring

5. Break the tire and wheel assembly down on a tire mounting machine and rotate the tire 6 hours (180 degrees) on the rim (Figure 12).
 - Reinflate the tire and measure the runout in question.
 - Record the magnitude and the location of the high spot (Valve stem is 12 o'clock.).
6. If the clock location of the high spot remained at or near the clock location of the original high spot, the rim is the major contributor to the runout problem.
 - Confirm by removing the tire from the wheel and check the wheel rim runout.
 - If the wheel rim runout exceeds guidelines, replace the wheel.
7. If the clock position of the high spot is 6 hours from the original high spot, the tire is the major contributor to the runout problem (Figure 12).
 - Replace the tire.
8. After correcting the tire to the wheel vectoring, rebalance the wheel and tire assembly.

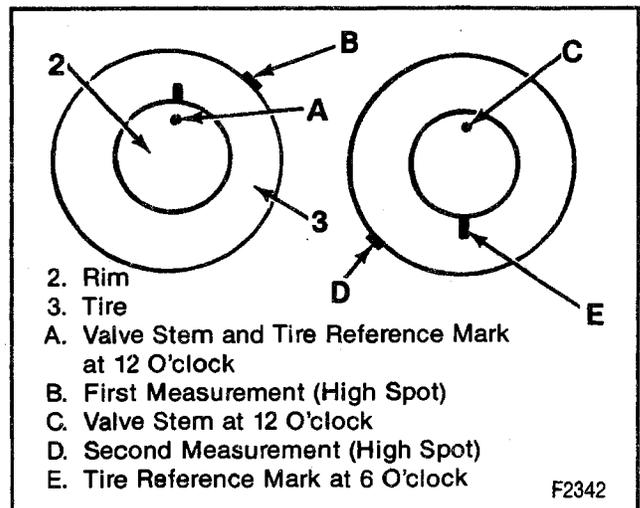


Figure 12—Tire to Wheel Vectoring (Excessive Tire Runout)

3E-12 TIRES AND WHEELS

Tire and Wheel Assembly to Hub/Rotor Vectoring

1. Mark the wheel hub bolt nearest the valve stem for reference (Figure 13).
2. Rotate the tire assembly two wheel hub bolts and recheck the runout (Figure 13).
 - Several positions may have to be tried to locate the optimum location.
 - This can be effective for both radial and lateral runouts.
3. If there is some looseness in the wheel hub bolt holes, radial runout can be reduced by loosening the hub bolt nuts slightly, moving the wheel position on the bolts and then retightening the nuts.
4. Balance the tire and wheel to hub/rotor assembly.
 - Compensates for any imbalance in the brake rotor, drum, or wheel cover.

BALANCING TIRE AND WHEEL

There are two types of tire and wheel balancing, static and dynamic. Static balance is the equal distribution of weight to the inboard and outboard rim flanges (splitting) at one location on the wheel. Assemblies that are statically unbalanced cause a bouncing action called wheel tramp (Figure 14). This condition will eventually cause uneven tire wear.

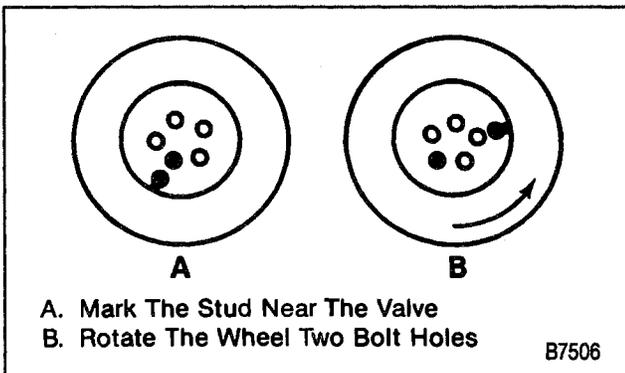


Figure 13—Tire and Wheel Assembly to Hub/Rotor Vectoring

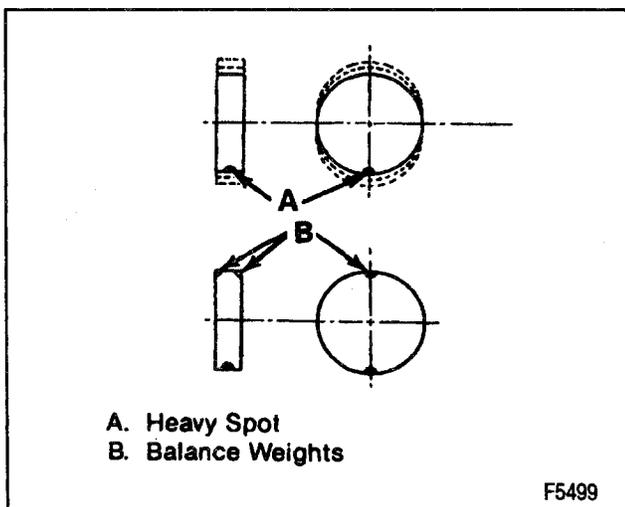


Figure 14—Static Unbalance

Dynamic balance is the distribution of weight on each side of the centerline so that when the assembly spins there is no tendency for the assembly to move from side to side (Figure 15). Assemblies that are dynamically unbalanced may cause wheel shimmy.

General Balance Precautions

Deposits of foreign material must be cleaned from the inside of the wheel. Stones should be removed from the tread in order to avoid operator injury during spin balancing and to obtain a good balance. The tire should be inspected for any damage, then balanced according to the equipment manufacturer's recommendations.

Off-Vehicle Balancing

When balancing tire and wheel assemblies off the vehicle, use a balancer that pilots the wheel by the center hole (not the wheel bolt) if possible. Always follow the equipment manufacturer's instructions.

Some electronic off-vehicle balancers are more accurate than the on-vehicle spin balancers, but do not correct for rotor unbalance. If the vibration is not corrected by the off-vehicle balance, an on-vehicle balance may also be needed.

On-Vehicle Balancing

When needed, on-vehicle balancing will help correct vibrations due to brake drum, rotor, and wheel cover imbalance.

When balancing on-vehicle remove the balance weights from the off-vehicle dynamic balance. If more than 28 grams (one ounce) of additional weight is required, it should be split between the inner and outer rim flange.

CAUTION: On vehicles equipped with limited slip rear axles, do not attempt to balance a tire on a drive wheel with the other drive wheel on the ground. The vehicle may drive through this wheel and cause the vehicle to move unexpectedly, resulting in personal injury and property damage.

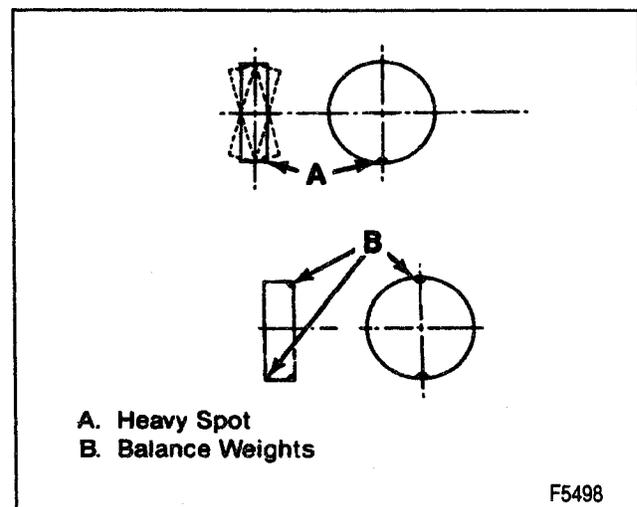


Figure 15—Dynamic Unbalance

CAUTION: Do not spin the drive wheels faster than 35 mph (55 km/h) as indicated by the speedometer. This limit is necessary because the speedometer indicates only one-half of the actual wheel speed when one drive wheel is spinning and the other drive wheel is stopped. Personal injury and damage may result from high speed spinning.

NOTICE: *The driven tire and wheel assemblies should be spun using the engine. Limit speed as stated in the preceding Caution.*

To distinguish between standard rear axle and a limited slip rear axle, check for Limited Slip Differential (G80) on the Service Parts Identification label.

Wheel Balance Weights

If more than 28 grams (1 ounce) are needed when static balancing, the balance weights should be split as equally as possible between the inboard and outboard flanges.

Balancing of factory aluminum wheels requires the use of special polyester-coated clip-on type balance weights. These weights are designed to fit over the thicker rim flange of the aluminum wheel. They also provide a much better appearance and will not discolor, corrode, or damage the wheel.

 **Important**

- When installing the polyester-coated weights, care must be used so the polyester coating does not crack. Use a teflon coated hammer.

Adhesive Wheel Balance Weight Installation

1. Wipe the wheel balance weight attachment area with a mixture of half isopropyl alcohol and half water. A clean cloth or paper towel must be used for this operation.
2. Dry the attachment area with hot air. Surface of the wheel should be warm to the touch.
3. The adhesive backing on the wheel balance weights must be warmed to room temperature.
4. Remove the tape from back of the weights. Do not touch the adhesive surface.
5. Apply the wheel balance weight and press on it with hand pressure.
6. Secure the wheel balance weight with a 70 to 110 N (16 to 25 lb) force applied with a roller.

CORRECTING NON-UNIFORM TIRES

There are two ways to correct tires that cause a vibration even though they are properly balanced. One method uses an automatic machine that loads the tire and buffs small amounts of rubber from high spots on the outer two tread rows. Correction by this method is usually permanent and, if done properly, does not significantly affect the appearance or tire tread life. Tire trueing with a blade-type machine is not recommended as this reduces the tread life substantially and often does not permanently correct the problem.

Another method is to vector the tire and wheel assembly. Refer to "Vectoring" in this section.

ALUMINUM WHEELS

Aluminum wheels should be cleaned and waxed regularly. Do not use abrasive cleaners, as they could damage the protective coating.

Hub Cap

 **Remove or Disconnect**

1. Tire and wheel assembly. Refer to "Wheel and Tire Installation" in this section.
2. Place a block of wood approximately 50 mm (2 inches) in diameter with a squared off end against the back surface of the cap. A sharp hammer blow on the block of wood will remove the cap.

 **Install or Connect**

NOTICE: *Failure to hit the cap squarely without the load distributed evenly could result in permanent damage to the cap.*

1. Place cap into position at wheel opening and place a block of wood at least 75 mm (3 inches) in diameter against cap face. Install the cap by striking the block of wood with a hammer.
2. Tire and wheel assembly. Refer to "Wheel and Tire Installation" in this section.

Porosity Repair

1. Remove the tire and wheel assembly. Refer to "Wheel and Tire Installation" in this section.
2. Locate leaking areas by inflating tire to 345 kPa (50 psi) and dipping the tire and wheel assembly into a water bath.
3. Mark leak areas and remove the tire from the wheel.
4. Scuff the inside surface at leak area with 80 grit sandpaper and clean the area with general purpose cleaner such as 3M® P/N 08984 or equivalent.
 - Apply 3 mm (1/8 inch) thick layer of adhesive/sealant GM P/N 1052366 or equivalent to the leak area and allow 12 hours of drying time.
5. Mount the tire on the wheel, pressurize to 345 kPa (50 psi) and check for leaks.

CAUTION: To avoid serious personal injury, do not stand over the tire when inflating. The bead may break when the bead snaps over the safety hump. Do not exceed 275 kPa (40 psi) pressure when inflating any tire if beads are not seated. If 275 kPa (40 psi) pressure will not seat the beads, deflate, relubricate the beads and reinflate. Overinflation may cause the bead to break and cause serious personal injury.

6. Adjust tire pressure to meet specifications.
7. Balance the tire and wheel assembly.
8. Install the tire and wheel assembly. Refer to "Wheel and Tire Installation" in this section.

3E-14 TIRES AND WHEELS

Refinishing

A protective clear coating is applied to the surface of original equipment cast aluminum wheels. A surface degradation condition can begin to develop if frequent, repeated automatic car wash cleaning abrades or wears off the factory applied protective clear coating. This can happen at some automatic car wash facilities using aggressive silicon carbide tipped tire brushes to clean white walls and tires. Once the protective clear coating is damaged, exposure to caustic cleaners and/or road salt further causes surface degradation. The following procedure details how to strip, clean, and recoat aluminum wheels that are affected by these conditions.

- A. Mark the wheel and tire for position on the vehicle and remove. Refer to "Wheel and Tire Installation" in this section.
- B. Mark the position of the wheel weights and remove. Note: It is not necessary to remove the tire from the wheel to perform this procedure. However, if the tire is removed, its position to the wheel must be marked using the valve stem as an index. When remounting, the tire should be returned to its original position on the wheel.
- C. Wash the wheel inside and out with a water base all purpose cleaner. Remove grease and oil with a solvent cleaner.

Accent Color Preparation

- Sand over painted areas that will not require recoloring with 400 grit (wet or dry) to promote adhesion of the clear coat.

Surface Damage, Clear Coat Damage

- Mount the wheel on a brake lathe and spin slowly. Sand the wheel with a backing block or pad while holding the abrasive flat to the surface of the wheel and moving slowly back and forth from center to outer edge to remove imperfections.

1. Sand with 80 grit.
2. Sand with 150 grit.
3. Sand with 240 grit.

- Never use abrasives coarser than 80 grit.

Slight Clear Coat Damage on Unpainted Wheels

1. Remove the original clear coating.
 - A. Apply a chemical stripper to the wheel surface and allow the chemical to penetrate the coating.
 - B. Remove the stripper following the manufacturer's recommendations.
 - C. Rinse the wheel surface thoroughly with clean water.

CAUTION: Use of eye goggles is necessary to prevent personal injury.

2. Remove surface oxidation.
 - Sand the wheel with 240 grit (wet or dry) while rotating the wheel on a slow spinning brake lathe or by mounting it on the vehicle and spinning the wheel by hand. This should restore the machined appearance and promote adhesion.

CAUTION: Do not use vehicle power to rotate wheel while sanding to avoid serious personal injury.

3. Recoat the wheels.
 - A. Clean the surface of any contaminants by washing with soap and water.
 - B. Spray the wheel with Amchem #33 or equivalent and let soak 1 to 3 minutes.
 - C. Rinse with water and blow dry.
 - D. Mask the tire off.
 - E. Finish with Ditzler Delclear acrylic urethane and Ditzler Ultra urethane additive or equivalent. Three coats:
 - 1st coat - Light mist coat, let flash.
 - 2nd coat - Light, let flash.
 - 3rd coat - Heavy, double wet coat.
 - F. Let dry for 24 hours or if necessary, flash for 30 minutes, force dry at 140° F (60° C) for 30 minutes, and allow to cool for 30 minutes before mounting.
 - G. Rebalance the tire and wheel assembly by replacing the original balance weights with polyester coated weights.
 - H. Mount the weights in the marked positions and remove the masking from the tire.

SPARE TIRE MOUNTING

Spare tire mounting for Suburban and Two Door Utility models is at the left rear wheel well. The Two Door Utility uses a bracket for retention while the Suburban uses a mount that is part of the body (Figure 16). Spare tire mounting for Pickup and Four Door Utility models is behind the rear axle and forward of the rear bumper using a winch/cable hoist system for stowage (Figures 17 and 18).

SPARE TIRE CARRIER REPLACEMENT

Suburban Models

Remove or Disconnect (Figure 16)

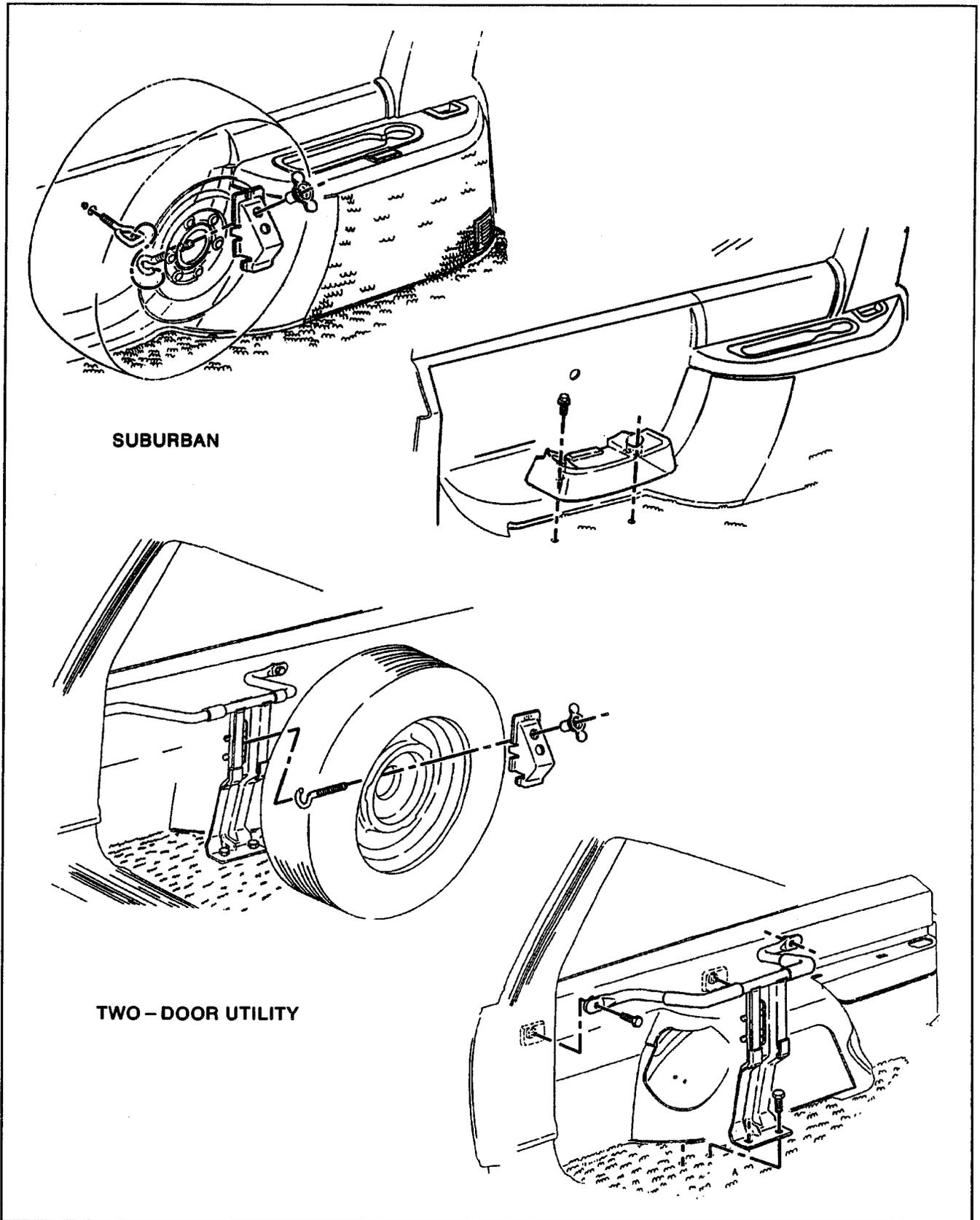
1. Spare tire.
 - Nut.
 - Adapter.
 - Spare tire.
2. Bolts from support.
3. Support from vehicle.

Install or Connect (Figure 16)

1. Support.
2. Bolts.

Tighten

- Bolts to 5 N.m (44 lb in)
3. Spare tire.
 - Spare tire.
 - Adapter.
 - Nut.



SUBURBAN

TWO - DOOR UTILITY

Figure 16—Spare Tire Carrier Replacement (Suburban and Two Door Utility)

3E-16 TIRES AND WHEELS

Two Door Utility Models

↔ Remove or Disconnect (Figure 16)

1. Spare tire.
 - Nut from bolt.
 - Adapter from bolt.
2. Bolts from carrier.
3. Carrier.

↔ Install or Connect (Figure 16)

1. Carrier.
2. Bolts.

⌚ Tighten

- Bolts to 40 N.m (32 lb ft)
3. Spare tire.
 - Spare tire.
 - Adapter.
 - Nut.

SPARE TIRE HOIST AND SHAFT REPLACEMENT

All Pickup Models

↔ Remove or Disconnect (Figure 17)

1. Spare tire.
 - Attach ratchet to wheel with "DOWN" mark facing you.

- Put end of wheel wrench through rear bumper access hole until wrench connects into hoist shaft.
- Turn ratchet counter clockwise to lower tire.
- Turn ratchet until the spare tire can be pulled out from under vehicle.
- When the tire has been lowered, tilt the retainer at the end of the cable and pull through wheel opening.

2. Pin and retainer from shaft.
3. Bolts and nuts.
4. Hoist from crossmember.

↔ Install or Connect (Figure 17)

1. Hoist to crossmember.
2. Bolts and nuts.

⌚ Tighten

- Nuts to 25 N.m (18 lb ft)
3. Pin and retainer to shaft.
 4. Spare tire.
 - Put tire on ground at rear of vehicle with valve stem pointed down.
 - Pull wheel retainer through wheel opening.
 - Attach ratchet to wheel with "UP" mark facing you.
 - Put end of wheel wrench through rear bumper access hole until wrench connects into hoist shaft.
 - Turn ratchet clockwise to raise tire.
 - Stop turning wrench when two clicks are heard.

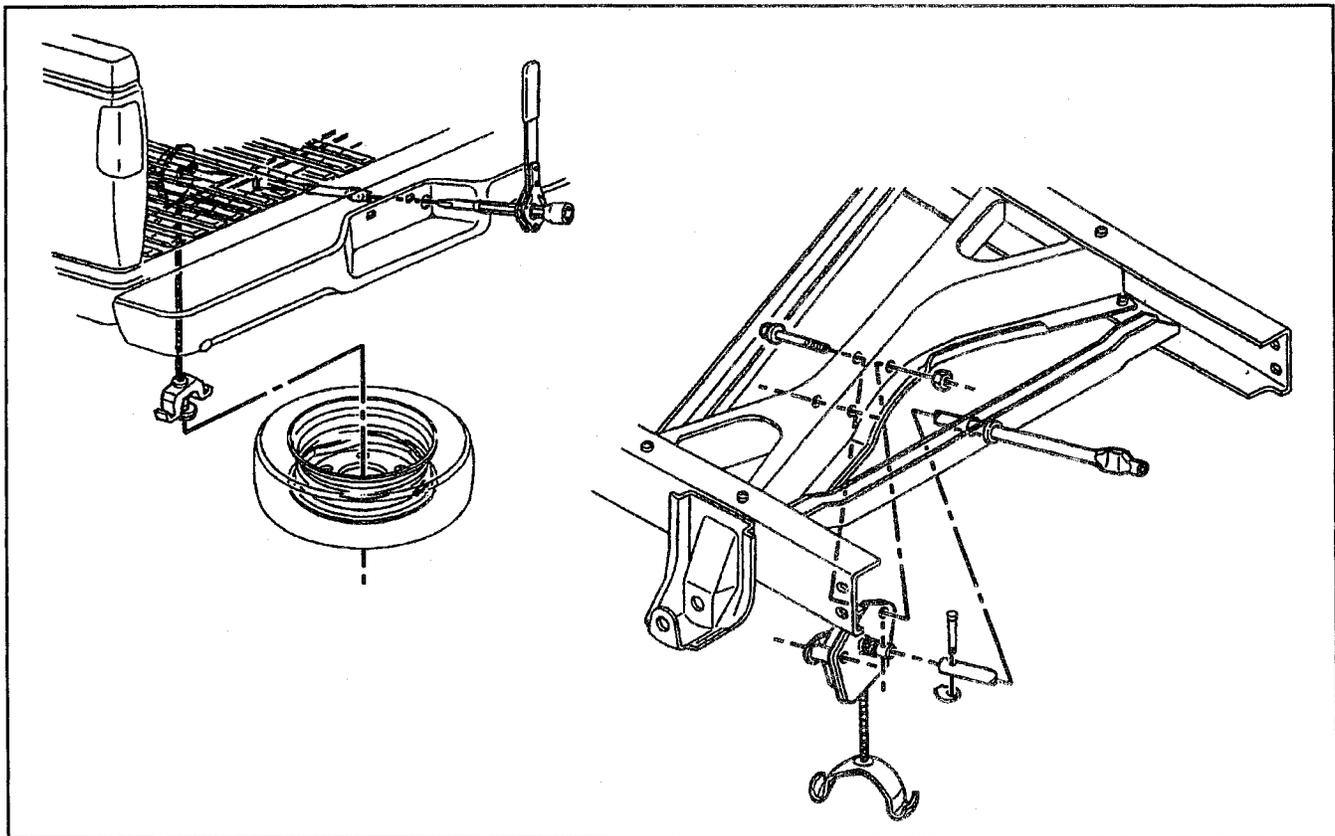


Figure 17—Spare Tire Hoist Replacement (Pick-Up)

Four Door Utility Models

Remove or Disconnect (Figure 18)

1. Spare tire.
 - Attach ratchet to wheel with "DOWN" mark facing you.
 - Put end of wheel wrench through rear bumper access hole until wrench connects into hoist shaft.
 - Turn ratchet counter clockwise to lower tire.
 - Turn ratchet until the spare tire can be pulled out from under vehicle.
 - When the tire has been lowered, tilt the retainer at the end of the cable and pull through wheel opening.
2. Pin and retainer attaching shaft to hoist assembly.
3. Shaft from hoist assembly.
4. Two bolts attaching hoist assembly to wheel carrier.
5. Hoist assembly from wheel carrier.

Install or Connect (Figure 18)

1. Hoist assembly to wheel carrier.
2. Bolts and nuts attaching hoist assembly to wheel carrier.

Tighten

- Nuts to 47 N.m (35 lb ft).
3. Shaft to hoist assembly
 4. Pin and retainer attaching shaft to hoist assembly.
 5. Spare tire.
 - Put tire on ground at rear of vehicle with valve stem pointed down.
 - Pull wheel retainer through wheel opening.
 - Attach ratchet to wheel with "UP" mark facing you.
 - Put end of wheel wrench through rear bumper access hole until wrench connects into hoist shaft.
 - Turn ratchet clockwise to raise tire.
 - Stop turning wrench when two clicks are heard.

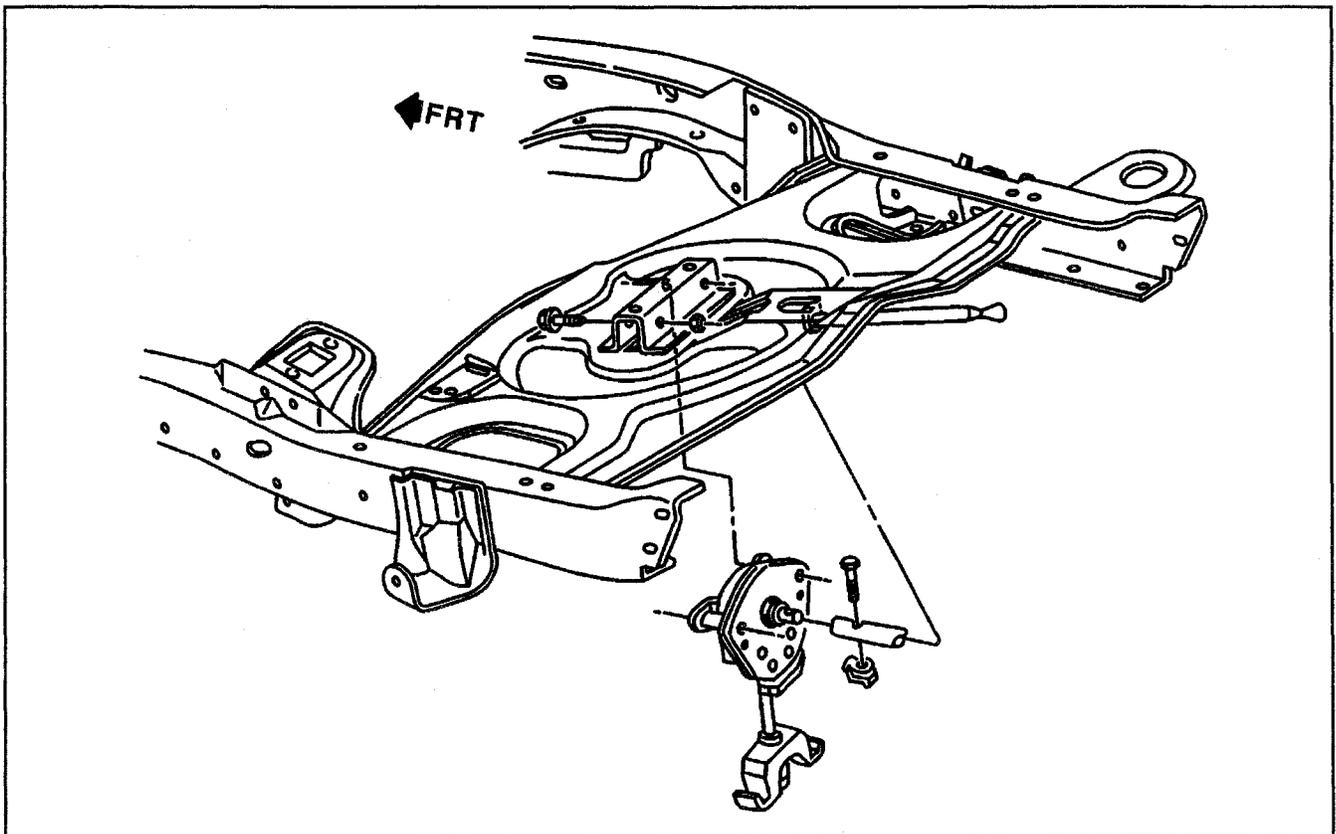


Figure 18—Spare Tire Hoist and Shaft Replacement (Four Door Utility)

3E-18 TIRES AND WHEELS

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N.m	Lb ft	Lb in
Support Bolts (Suburban Models)	5	—	44
Support Bolts (Two Door Utility Models)	44	32	—
Hoist to Crossmember Nuts (All Pickup Models)	25	18	—
Hoist to Wheel Carrier Nuts (Four Door Utility Models)	47	35	—

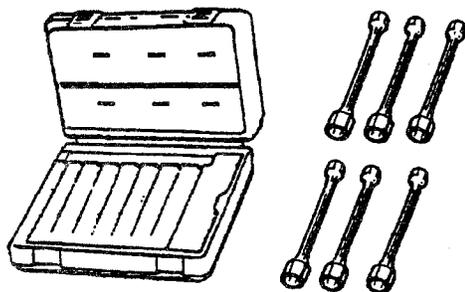
WHEEL STUD NUT TORQUE

SERIES	NUMBER OF STUDS	NUT TORQUE
C1	5	190 N.m (140 Lb ft)
CK1,2	6	190 N.m (140 Lb ft)
CK2,3 (Single)	8	190 N.m (140 Lb ft)
CK3 Dual)	8	190 N.m (140 Lb ft)
C 3500HD (Dual)	10	240 N.m (177 Lb ft)

WHEEL RUNOUT

	STEEL WHEELS	ALUMINUM WHEELS
Radial Runout	1.01 mm (0.04 inches)	0.76 mm (0.03 inches)
Lateral Runout	1.14 mm (0.045 inches)	0.76 mm (0.03 inches)

SPECIAL TOOLS



J 39544 - GM
WHEEL NUT TORQUE
ADAPTERS (Use with
pneumatic impact wrench not
exceeding 250 Ft. Lbs.)
includes: J 39544 - 12, J 39544 - 13
J 39544 - 14, J 39544 - 13, and
J 39544 - CSE

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SECTION 3F

**STEERING WHEEL AND COLUMN
ON-VEHICLE SERVICE**

CAUTION: This vehicle has a Supplemental Inflatable Restraint (SIR) System. Refer to the SIR Component and Wiring Location view in order to determine whether you are performing service on or near the SIR components or the SIR wiring. When you are performing service on or near the SIR components or the SIR wiring, refer to the SIR On-Vehicle Service information. Failure to follow the CAUTIONS could cause air bag deployment, personal injury, or unnecessary SIR system repairs.

CAUTION: To help avoid personal injury when a vehicle is on a hoist, provide additional support for the vehicle at the opposite end from which components are being removed. This will reduce the possibility of the vehicle slipping from the hoist.

NOTICE: *Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require a replacement after removal. General Motors will also call out the fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.*

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3F-2 STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE

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GENERAL DESCRIPTION

The steering wheel and column components include a steering wheel, horn pad or inflator module, steering column, and brackets.

The locking, energy-absorbing, steering column includes three important features in addition to the steering function.

1. The column is energy-absorbing, designed to compress in a front-end collision to minimize the possibility of injury to the driver of the vehicle.
2. The ignition switch and lock are mounted conveniently on the column.
3. With the column mounted lock, the ignition, steering, and gearshifting operation can be locked to inhibit theft of the vehicle.

The column may be disassembled and reassembled. To ensure the energy absorbing action, it is important that the specified screws, bolts, and nuts be used only as designated and they are tightened to the specified torque.

NOTICE: *When the column is removed from the vehicle, actions such as a sharp blow on the end of the steering shaft or shift lever, leaning on the column assembly, or dropping the assembly could shear or loosen the plastic fasteners that maintain column rigidity.*

BRAKE TRANSMISSION SHIFT INTERLOCK (BTSI)

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 paw, enabling the shift linkage to move and the shift lever to operate.

When service operations are required, the BTSI system can be overridden. This is done by turning the ignition switch to OFF (not locked) and removing battery voltage from the solenoid.

SUPPLEMENTAL INFLATABLE RESTRAINT (SIR)

The supplemental inflatable restraint (SIR) system supplements the normal restraint of the driver's seat belt by deploying an air bag from the center of the steering wheel during an accident. The air bag deploys when the vehicle is involved in a front end collision of sufficient force. Refer to SECTION 9J.

DIAGNOSIS

IGNITION LOCK SYSTEM

Refer to "Diagnosis of the Steering Column" in this section.

REPAIRS and INSPECTIONS REQUIRED AFTER an ACCIDENT

Refer to SECTION 9J.

DIAGNOSIS OF THE STEERING COLUMN

Lock System Will Not Unlock

STEP	CAUSE/ACTION	YES	NO
1	Damaged Shaft Assembly?	Go to Step 2.	Go to Step 3.
2	Repair or replace shaft as needed.	Go to Unit Repair.	
3	Damaged shear bolts?	Go to Step 4.	Go to Step 5.
4	Replace shear bolts.	Go to Unit Repair.	
5	Damaged housing assembly?	Go to Step 6.	Go to Step 7.
6	Replace housing assembly.	Go to Unit Repair.	
7	Damaged BTSI system?	Go to Step 8.	Go to Step 9.
8	Repair or replace as needed.	Go to Unit Repair.	
9	Damaged ignition switch assembly?	Go to Step 10.	Go to Step 11.
10	Replace ignition switch assembly.	Go to Unit Repair.	
11	Park lock cable misadjusted?	Go to Step 12.	Go to Step 13.
12	Adjust park lock cable.	Go to Unit Repair.	
13	Shift lever not in "PARK".	Go to Step 14.	Go to Step 15.
14	Place gear shifter in "PARK" position.	Go to Unit Repair.	
15	Incorrect, bent or twisted key?	Go to Step 16.	
16	Replace key.	Go to Unit Repair.	

Lock System Will Not Lock

STEP	CAUSE/ACTION	YES	NO
1	Damaged shear bolts?	Go to Step 2.	Go to Step 3.
2	Replace shear bolts.	Go to Unit Repair.	
3	Damaged housing assembly?	Go to Step 4.	Go to Step 5.
4	Replace housing assembly.	Go to Unit Repair.	
5	Improper shift linkage adjustment?	Go to Step 6	Go to Step 7
6	Adjust shift linkage adjustment.	Go to Unit Repair.	
7	Damaged BTSI system?	Go to Step 8.	Go to Step 9.
8	Repair or replace as needed.	Go to Unit Repair.	
9	Damaged shaft assembly?	Go to Step 10.	Go to Step 11.
10	Replace as needed.	Go to Unit Repair.	
11	Damaged ignition switch assembly?	Go to Step 12.	Go to Step 13.
12	Replace ignition switch assembly.	Go to Unit Repair.	
13	Incorrect, bent or twisted key?	Go to Step 14.	Go to Step 15.
14	Replace key.	Go to Unit Repair.	

3F-4 STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE

STEP	CAUSE/ACTION	YES	NO
15	Park lock cable misadjusted?	Go to Step 16.	Go to Step 17.
16	Adjust park lock cable.	Go to Unit Repair.	
17	Shift lever not in "PARK"?	Go to Step 18.	
18	Place gear shifter in "PARK" position.	Go to Unit Repair.	

Lock System-High Effort

STEP	CAUSE/ACTION	YES	NO
1	Damaged BTSI system?	Go to Step 2.	Go to Step 3.
2	Repair or replace as needed.	Go to Unit Repair.	
3	Damaged lock cylinder housing assembly?	Go to Step 4.	Go to Step 5.
4	Replace lock cylinder housing.	Go to Unit Repair.	
5	Damaged shaft assembly?	Go to Step 6.	Go to Step 7.
6	Replace shaft assembly.	Go to Unit Repair.	
7	Damaged ignition switch assembly?	Go to Step 8.	Go to Step 9.
8	Replace ignition switch assembly.	Go to Unit Repair.	
9	Improper shaft linkage adjustment?	Go to Step 10.	Go to Step 11.
10	Adjust shift linkage adjustment.	Go to Unit Repair.	
11	Broken or weak rack preload spring?	Go to Step 12.	Go to Step 13.
12	Replace rack preload spring.	Go to Unit Repair.	
13	Park lock cable misadjusted?	Go to Step 14.	Go to Step 15.
14	Adjust park lock cable.	Go to Unit Repair.	
15	Incorrect, bent or twisted key?	Go to Step 16.	Go to Step 17.
16	Replace key.	Exit.	
17	Bent or broken rack?	Go to Step 18.	
18	Replace rack.	Go to Unit Repair.	

Lock Cylinder High Effort Between the "OFF" and "OFF-LOCK" Positions

STEP	CAUSE/ACTION	YES	NO
1	Distorted rack?	Go to Step 2.	
2	Repair or replace as required.	Go to Unit Repair.	

STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE 3F-5

Lock Cylinder-Sticks in "START" Position

STEP	CAUSE/ACTION	YES	NO
1	Damaged BTSI system?	Go to Step 2.	Go to Step 3.
2	Repair or replace as required.	Go to Unit Repair.	
3	Damaged housing assembly?	Go to Step 4.	Go to Step 5.
4	Replace housing assembly.	Go to Unit Repair.	
5	Damaged shaft assembly?	Go to Step 6.	Go to Step 7.
6	Replace shaft assembly.	Exit.	
7	Park lock cable misadjusted?	Go to Step 8.	
8	Adjust park lock cable.	Go to Unit Repair.	

Key Cannot Be Removed in the "OFF-LOCK" Position

STEP	CAUSE/ACTION	YES	NO
1	Damaged shaft system?	Go to Step 2.	Go to Step 3.
2	Replace shaft assembly.	Go to Unit Repair.	
3	Damaged housing assembly?	Go to Step 4.	Go to Step 5.
4	Replace housing assembly.	Go to Unit Repair.	
5	Damaged BTSI system?	Go to Step 6.	Go to Step 7.
6	Repair or Replace as required.	Go to Unit Repair.	
7	Incorrect, bent or twisted key?	Go to Step 8.	Go to Step 9.
8	Replace key.	Exit.	
9	Park lock cable misadjusted?	Go to Step 10.	
10	Adjust park lock cable.	Go to Unit Repair.	

Steering Vibrates, (Shudders), During Low Speed or Static Steering

STEP	CAUSE/ACTION	YES	NO
1	Air in system?	Go to Step 2.	Go to Step 3.
2	Bleed air from power steering system.	Exit.	
3	Loose power steering belt?	Go to Step 4.	
4	Tighten power steering belt.	Exit.	

3F-6 STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE

Noise in the Column

STEP	CAUSE/ACTION	YES	NO
1	Worn or broken lower or upper steering column jacket bushing assembly.	Go to Step 2.	Go to Step 3.
2	Replace bushing.	Go to Unit Repair.	
3	Column not correctly aligned?	Go to Step 4.	Go to Step 5.
4	Align column correctly.	Go to Unit Repair.	
5	Horn contact ring not lubricated?	Go to Step 6.	Go to Step 7.
6	Lubricate horn contact ring.	Go to Unit Repair.	
7	Lack of grease on bearing or bearing surface?	Go to Step 8.	Go to Step 9.
8	Lubricate bearings and surfaces.	Go to Unit Repair.	
9	Retaining ring not sealed?	Go to Step 10.	Go to Step 11.
10	Seat retaining ring.	Go to Unit Repair.	
11	Sheared intermediate shaft plastic joint?	Go to Step 12.	Go to Step 13.
12	Replace intermediate shaft.	Go to Unit Repair.	
13	Loose column components?	Go to Step 14.	Go to Step 15.
14	Replace loose components.	Exit.	
15	Unlubricated spherical joints?	Go to Step 16.	Go to Step 17.
16	Lubricate spherical joints.	Exit.	
17	Loose steering coupling?	Go to Step 18.	Go to Step 19.
18	Tighten steering coupling.	Go to Unit Repair.	
19	Joints from column to gear loose?	Go to Step 20.	Go to Step 21.
20	Tighten all connectors.	Go to Unit Repair.	
21	Loose intermediate shaft pinch bolt?	Go to Step 22.	
22	Tighten pinch bolt to specified torque.	Go to Unit Repair.	

High Steering Shaft Effort

STEP	CAUSE/ACTION	YES	NO
1	Column assembly is misaligned?	Go to Step 2.	Go to Step 3.
2	Align column correctly.	Go to Unit Repair.	
3	Worn or broken lower or upper steering column jacket bushing assembly?	Go to Step 4.	
4	Replace bushing assembly.	Go to Unit Repair.	

STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE 3F-7

Lash in Mounted Column

STEP	CAUSE/ACTION	YES	NO
1	Column mounting bracket bolts loose?	Go to Step 2.	Go to Step 3.
2	Tighten connection.	Go to Unit Repair.	
3	Broken weld nut on jacket?	Go to Step 4.	Go to Step 5.
4	Replace jacket assembly.	Go to Unit Repair.	
5	Column bracket capsule sheared?	Go to Step 4.	Go to Step 6.
6	Loose tilt head pivot pins?	Go to Step 4.	Go to Step 7.
7	Loose shoe lock pin in support?	Go to Step 4.	Go to Step 8.
8	Loose support screws?	Go to Step 9.	Go to Step 10.
9	Tighten support screws.	Go to Unit Repair.	
10	Loose column upper and lower bracket to jacket bolts?	Go to Step 11.	Go to Step 12.
11	Tighten bolts to specified torque.	Go to Unit Repair.	
12	Loose lower bracket to adapter and bearing assembly, mounting bolts?	Go to Step 13.	Go to Step 14.
13	Tighten mounting screws to specified torque.	Go to Unit Repair.	
14	Loose I.P. to jacket mounting bolts?	Go to Step 15.	
15	Tighten mounting bolts to specified torque.	Go to Unit Repair.	

Steering Wheel Loose

STEP	CAUSE/ACTION	YES	NO
1	Excessive clearance between holes in support or housing and pivot pin diameter?	Go to Step 2.	Go to Step 3.
2	Inspect A. Is support out of round? B. Is housing damaged? C. Is the pivot pin seated correctly?	Go to Unit Repair.	Go to Step 3.
3	Broken or missing joint preload spring?	Go to Step 4.	Go to Step 5.
4	Replace joint preload spring.	Go to Unit Repair.	Go to Step 5.
5	Upper bearing not seated in housing?	Go to Step 6.	Go to Step 7.
6	Seat bearing in housing.	Go to Unit Repair.	
7	Missing upper bearing inner race seal?	Go to Step 8.	Go to Step 9.
8	Replace inner race seal.	Go to Unit Repair.	
9	Loose support screws?	Go to Step 10.	
10	Tighten screws to specified torque.	Go to Unit Repair.	

3F-8 STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE

Steering Wheel Loose in every other Tilt Position

STEP	CAUSE/ACTION	YES	NO
1	Loose fit between shoe and shoe pivot/dowel pin?	Go to Step 2.	Go to Step 3.
2	Replace pivot/dowel pin.	Go to Unit Repair.	
3	Shoe not in free slot (both shoes engaged on pin at the same time)?	Go to Step 4.	
4	Check for proper shoes and replace if necessary.	Go to Unit Repair.	

Steering Wheel not Locking in any Tilt Position

STEP	CAUSE/ACTION	YES	NO
1	Shoe seized on pivot pin?	Go to Step 2.	Go to Step 3.
2	Replace the shoes and pivot pin.	Go to Unit Repair.	
3	Burrs or dirt in shoe grooves?	Go to Step 4.	Go to Step 5.
4	Remove burrs and dirt from grooves.	Exit.	
5	Weak or broken shoe lock spring?	Go to Step 6.	
6	Replace shoe lock spring.	Go to Unit Repair.	

Steering Wheel Fails to Return to Top Tilt Position

STEP	CAUSE/ACTION	YES	NO
1	Binding pivot pins?	Go to Step 2.	Go to Step 3.
2	Lubricate end of pivot pin.	Go to Unit Repair.	
3	Broken or weak wheel tilt spring?	Go to Step 4.	Go to Step 5.
4	Replace tilt spring.	Go to Unit Repair.	
5	Binding wire harness.	Go to Step 6.	
6	Loosen screws, reposition wires.	Exit.	

Noise when Tilting Column

STEP	CAUSE/ACTION	YES	NO
1	Worn upper tilt bumpers?	Go to Step 2.	Go to Step 3.
2	Replace support assembly.	Go to Unit Repair.	
3	Unlubricated tilt spheres?	Go to Step 4.	
4	Lubricate tilt spheres.	Go to Unit Repair.	

STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE 3F-9

Pivot and Switch Assembly Inoperative: No "LOW," "HIGH" and/or "WASH"

STEP	CAUSE/ACTION	YES	NO
1	Loose body to switch connector?	Go to Step 2.	Go to Step 3.
2	Tighten connection, check operation.	Exit.	
3	Internally damaged or worn switch?	Go to Step 4.	
4	Replace switch.	Go to Unit Repair.	

Ignition Switch: Electrical System will not Function

STEP	CAUSE/ACTION	YES	NO
1	Damaged ignition switch?	Go to Step 2.	Go to Step 3.
2	Replace ignition switch assembly.	Go to Unit Repair.	
3	Loose connection at the ignition switch or column connectors?	Go to Step 4.	
4	Connect securely, check operation.	Go to Unit Repair.	

Ignition Switch will not Turn

STEP	CAUSE/ACTION	YES	NO
1	Damaged ignition switch?	Go to Step 2.	
2	Replace ignition switch assembly.	Go to Unit Repair.	

Turn Signal Switch will not Cancel

STEP	CAUSE/ACTION	YES	NO
1	Broken, missing, or out of position detent, return or canceling spring?	Go to Step 2.	Go to Step 3.
2	Replace turn signal switch.	Go to Unit Repair.	
3	Loose switch mounting screws?	Go to Step 4.	Go to Step 5.
4	Tighten screws to specified torque.	Go to Unit Repair.	
5	Broken switch?	Go to Step 6.	Go to Step 7.
6	Replace turn signal switch.	Go to Unit Repair.	
7	Uneven or canceling cam to canceling spring interference?	Go to Step 8.	
8	Inspect canceling cam & switch (replace damaged parts).	Go to Unit Repair.	

3F-10 STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE

Turn Signal Difficult to Operate

STEP	CAUSE/ACTION	YES	NO
1	Broken switch?	Go to Step 2.	Go to Step 3.
2	Replace turn signal switch.	Go to Unit Repair.	
3	Switch mounted loosely?	Go to Step 4.	Go to Step 5.
4	Install switch correctly.	Go to Unit Repair.	
5	Foreign material?	Go to Step 6.	
6	Remove foreign material.	Exit.	

Turn Signal will not Indicate Lane Change

STEP	CAUSE/ACTION	YES	NO
1	Broken switch?	Go to Step 2.	Go to Step 3.
2	Replace turn signal switch.	Go to Unit Repair.	
3	Broken lane change pressure pad or spring hanger?	Go to Step 4.	Go to Step 5.
4	Replace turn signal switch.	Go to Unit Repair.	
5	Jammed base wires?	Go to Step 6.	
6	Reposition wire harness.	Go to Unit Repair.	

Turn Signal will not Stay in Turn Position

STEP	CAUSE/ACTION	YES	NO
1	Broken switch?	Go to Step 2.	Go to Step 3.
2	Replace turn signal switch.	Go to Unit Repair.	
3	Foreign material or loose parts impeding movement of the switch?	Go to Step 4.	Go to Step 5.
4	Remove foreign material.	Exit.	
5	Broken or missing detent?	Go to Step 6.	
6	Replace turn signal switch.	Go to Unit Repair.	

Hazard Switch cannot be Turned Off

STEP	CAUSE/ACTION	YES	NO
1	Damaged turn signal switch?	Go to Step 2.	Go to Step 3.
2	Replace turn signal switch.	Go to Unit Repair.	
3	Foreign material?	Go to Step 4.	
4	Remove foreign material.	Exit.	

Hazard Switch will not Stay On or Difficult to Turn Off

STEP	CAUSE/ACTION	YES	NO
1	Loose turn signal switch?	Go to Step 2.	Go to Step 3.
2	Tighten turn signal switch to correct torque.	Go to Unit Repair.	
3	Interference with other components?	Go to Step 4.	Go to Step 5.
4	Reposition components.	Exit.	
5	Foreign material?	Go to Step 6.	Go to Step 7.
6	Remove foreign material.	Exit.	
7	Damaged or broken turn signal switch?	Go to Step 8.	
8	Replace turn signal switch.	Go to Unit Repair.	

STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE 3F-11

No Turn Signal Lights

STEP	CAUSE/ACTION	YES	NO
1	Damaged turn signal lights?	Go to Step 2.	Go to Step 3.
2	Replace bulbs.	Exit.	
3	Electrical failure in wiring harness?	Go to Step 4.	Go to Step 5.
4	Replace turn signal switch if damage is on column side of connection.	Go to Unit Repair.	
5	Inoperative turn signal flasher?	Go to Step 6.	Go to Step 7.
6	Replace turn signal flasher.	Go to Unit Repair.	
7	Loose turn signal switch connector?	Go to Step 8.	Go to Step 9.
8	Tighten all wiring connectors.	Go to Unit Repair.	
9	Blown fuse?	Go to Step 10.	
10	Replace fuse.	Exit.	

Turn Indicator Light On, But Not Flashing

STEP	CAUSE/ACTION	YES	NO
1	Inoperative turn signal flasher?	Go to Step 2.	Go to Step 3.
2	Replace turn signal flashers.	Exit.	
3	Inoperative turn signal switch?	Go to Step 4.	Go to Step 5.
4	Replace turn signal switch.	Go to Unit Repair.	
5	High resistance connection?	Go to Step 6.	
6	Inspect and repair connections.	Go to Unit Repair.	

Front or Rear Turn Signal Lights Not Flashing

STEP	CAUSE/ACTION	YES	NO
1	Burned-out or damaged turn signal bulb?	Go to Step 2.	Go to Step 3.
2	Replace bulbs.	Exit.	
3	High resistance connection to ground at bulb socket?	Go to Step 4.	Go to Step 5.
4	Check for shorts to ground.	Exit.	
5	Loose turn signal switch connection?	Go to Step 6.	
6	Reconnect turn signal switch.	Go to Unit Repair.	

3F-12 STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE

Turn Indicator Panel Lights

STEP	CAUSE/ACTION	YES	NO
1	Burned-out or damaged bulbs?	Go to Step 2.	Go to Step 3.
2	Replace bulbs.	Exit.	
3	Opens or grounds in wiring harness?	Go to Step 4.	
4	Inspect for broken wires or damaged terminals and repair if necessary.	Exit.	

Hazard Signal Lights Will Not Flash - Turn Signal Normal Operation

STEP	CAUSE/ACTION	YES	NO
1	Blown fuse?	Go to Step 2.	Go to Step 3.
2	Replace fuse.	Exit.	
3	Inoperative hazard warning flasher?	Go to Step 4.	Go to Step 5.
4	Replace multifunction switch.	Go to Unit Repair.	
5	Loose turn signal switch connection?	Go to Step 6.	
6	Check wire harness connection.	Go to Unit Repair.	

Turn Signal Lights Flash Very Slow

STEP	CAUSE/ACTION	YES	NO
1	Loose turn signal connection?	Go to Step 2.	
2	Check wire harness connection.	Exit.	

ON-VEHICLE SERVICE

SERVICE PRECAUTIONS - SUPPLEMENTAL INFLATABLE RESTRAINT

CAUTION: When performing service on or around SIR components or wiring, follow the procedures listed in SECTION 9J to temporarily disable the SIR system. Failure to follow procedures could result in possible air bag deployment, personal injury or otherwise unneeded SIR repairs.

Disabling the SIR System

For procedure to disable the SIR system, refer to SECTION 9J.

Live (Undeployed) Inflator Module Handling

Special care is necessary when handling and storing a live (undeployed) inflator module. The rapid gas generation produced during deployment of the air bag could cause the inflator module, or another object placed in

front of the inflator module, to be thrown through the air in the unlikely event of an accidental deployment.

CAUTION: When carrying a live inflator module, make sure the bag opening cover is pointed away from you. In case of accidental deployment, the bag will then deploy with a minimal chance of injury. Never carry the inflator module by the wires or connectors on the underside of the module. When placing a live inflator module on a bench or other surface, always face the bag and trim cover up, away from the surface. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Never rest a steering column assembly on the steering wheel with the inflator module face down and the column vertical. Otherwise, personal injury may result.

Deployed Inflator Module Handling

After an inflator module has been deployed, the surface of the air bag may contain a powdery residue. This powder consists primarily of cornstarch (used to lubricate the bag as it inflates) and by-products of the chemical reaction. Sodium hydroxide dust (similar to lye soap) is produced as a by-product of the deployment reaction. The sodium hydroxide then quickly reacts with atmospheric moisture and is converted to sodium carbonate and sodium bicarbonate (baking soda). Therefore, it is unlikely that sodium hydroxide will be present after deployment. However as a precaution, wear gloves and safety glasses to prevent any possible irritation of the skin or eyes.

Inflator Module Shipping Procedure

Refer to SECTION 9J.

Inflator Module Scrapping Procedure

CAUTION: Failure to follow proper Supplemental Inflatable Restraint (SIR) inflator module disposal procedures can result in air bag deployment which may cause personal injury. Undeployed inflator modules must not be disposed of through normal refuse channels. The undeployed inflator module contains substances that can cause severe illness or personal injury if the sealed container is damaged during disposal. Disposal in any manner inconsistent with proper procedures may be a violation of federal, state and/or local laws.

Refer to SECTION 9J.

WIRING REPAIRS

For wiring repairs and electrical diagnosis, refer to the Driveability, Emissions and Electrical Diagnosis Manual.

NOTICE: Do not repair or splice the wire harness on the column side of the connector. If wiring within the column requires repair, replace the component with a new replacement part. Failure to follow these instructions could cause a short circuit and malfunction of the steering column controls.

IGNITION SWITCH

Refer to "Ignition and Key Alarm Switch" in SECTIONS 3F4 or 3F5.

INFLATOR MODULE REPLACEMENT

CAUTION: When performing service on or around SIR components or wiring, follow the procedures listed below to temporarily disable the SIR system. Failure to follow procedures could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

Remove or Disconnect (Figure 1)

1. Disable the SIR system. Refer to SECTION 9J.
2. Negative battery cable. Refer to SECTION 6D1.

3. Turn steering wheel 90 degrees to access rear shroud holes to inflator module.
4. Insert screw driver and push leaf spring to release pin.
5. Turn steering wheel 180 degrees to access remaining rear shroud holes.
6. Insert screw driver and push leaf spring to release pin.
7. Inflator module (tilt rearward from the top to access SIR wiring).
8. SIR lead wire from clip on inflator module.
9. SIR lead wire from clip on steering wheel.
10. Connector Position Assurance (CPA) and retainer from the inflator module.

CAUTION: When carrying a live inflator module, make sure the bag opening is pointed away from you. In case of accidental deployment, the bag will then deploy with a minimal chance of personal injury. Never carry the inflator module by the wires or connectors on the underside of the module. When placing a live inflator module on a bench or other surface, always face the bag and trim cover up, away from the surface. This is necessary so that a free space is provided to allow the air bag to expand in the unlikely event of accidental deployment. Never rest a steering column assembly on the steering wheel with the inflator module face down and the column vertical. Otherwise, personal injury may result.

Install or Connect (Figure 1)

NOTICE: Refer to "Notice" on page 3F-1.

1. SIR Connector Position Assurance (CPA) and retainer to the inflator module.
2. SIR lead wire to clip on steering wheel.
3. SIR lead wire to clip on inflator module.
4. Inflator module by pressing it firmly into steering wheel enough to engage and latch all four notched pins in the leaf spring. Do not pinch the wires.
5. Negative battery cable.
6. Enable the SIR system. Refer to SECTION 9J.

HORN CONTACT REPLACEMENT (Plunger Switch)

Remove or Disconnect (Figure 2)

1. Negative battery cable. Refer to SECTION 6D1.
2. Disable the SIR system. Refer to SECTION 9J.
3. Inflator module. Refer to "Inflator Module Replacement" in this section.
4. Horn contact from steering column.

Install or Connect (Figure 2)

NOTICE: Refer to "Notice" on page 3F-1.

3F-14 STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE

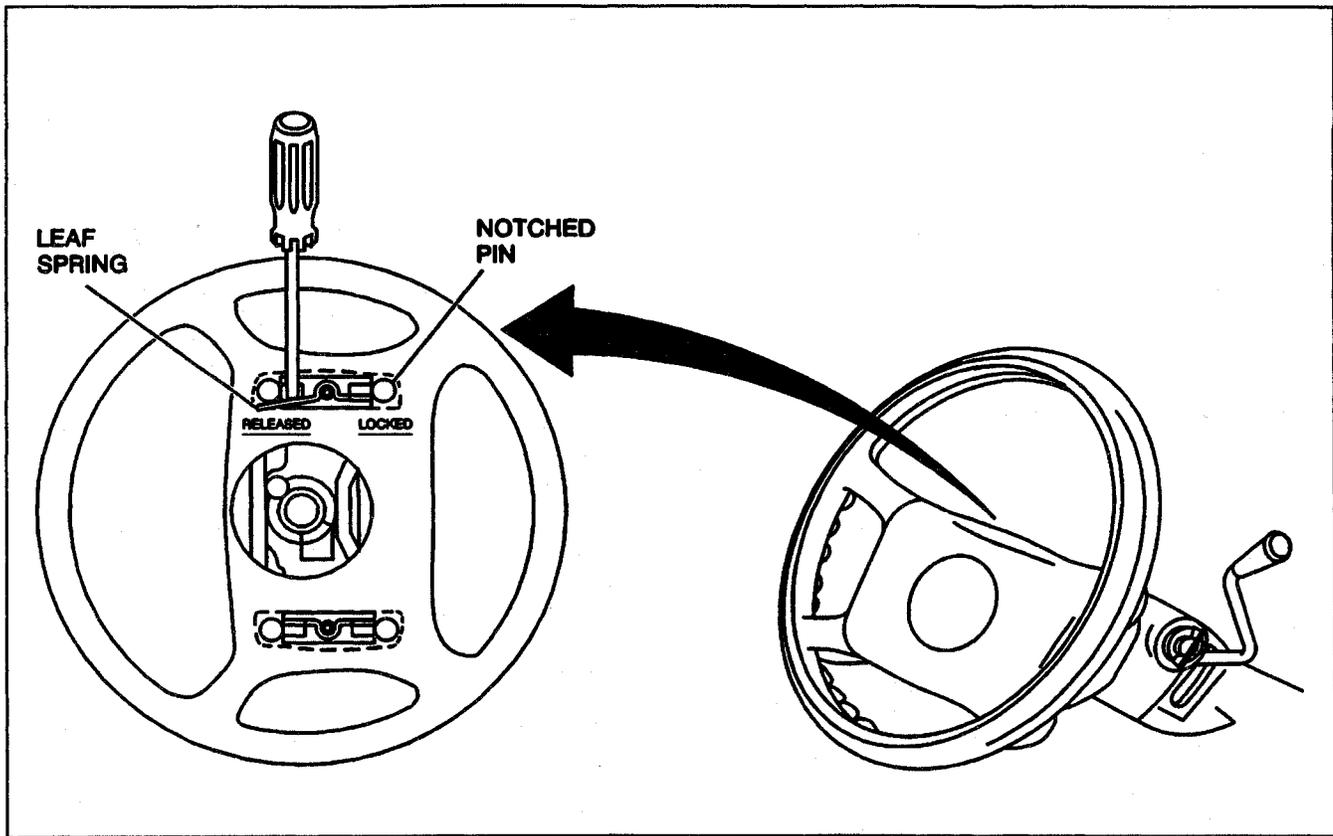


Figure 1—Inflator Module Components

1. Horn contact into steering column.
2. Inflator module to the steering wheel.
3. Negative battery cable.
4. Enable the SIR system.

HORN PAD ASSEMBLY REPLACEMENT

↔ Remove or Disconnect (Figure 3)

1. Negative battery cable. Refer to SECTION 6D1.
2. Pull four corners of horn pad from steering wheel.
3. Ground wire.
4. Horn wire assembly.

↔ Install or Connect (Figure 3)

1. Horn wire assembly.
2. Ground wire.
3. Push horn pad assembly on steering wheel.
4. Negative battery cable.

STEERING WHEEL REPLACEMENT

Tool Required:
J 1859-A Steering Wheel Puller

↔ Remove or Disconnect (Figures 4 and 5)

1. Negative battery cable. Refer to SECTION 6D1.
2. Disable the SIR system (if equipped). Refer to SECTION 9J.
3. Inflator module. Refer to "Inflator Module Replacement" in this section.

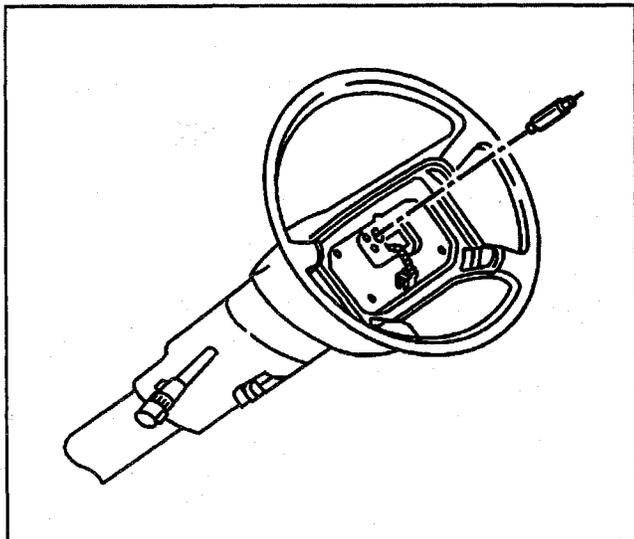


Figure 2—Horn Contact Replacement

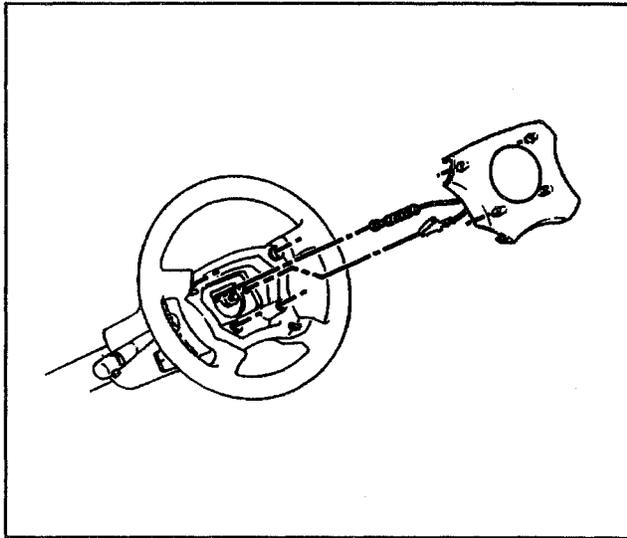


Figure 3—Horn Pad Assembly Replacement

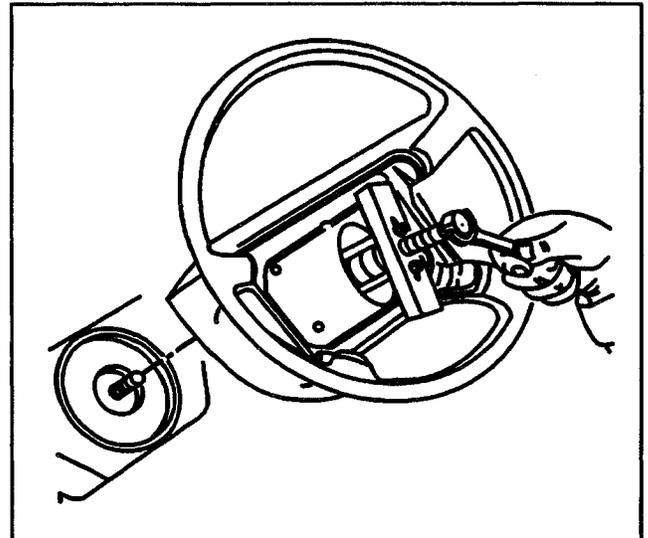


Figure 5—Steering Wheel Removal

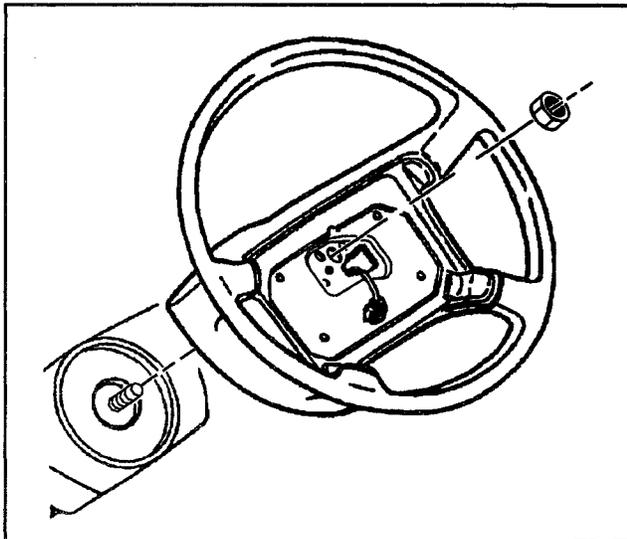


Figure 4—Steering Wheel Assembly

4. Horn contact (if equipped with SIR). Refer to "Horn Contact Replacement" in this section.
5. Horn pad assembly (if not equipped with SIR). Refer to "Horn Pad Assembly Replacement" in this section.
6. Steering wheel nut.
 - Notice the alignment mark and its relationship to the steering wheel and steering shaft.
7. Steering wheel using J 1859-A (Figure 5).

NOTICE: Do not hammer on the puller or damage could result to the steering column.

 Install or Connect (Figures 4 and 5)

NOTICE: Refer to "Notice" on page 3F-1.

1. Steering wheel onto the steering shaft.
 - Align the marks on steering shaft and steering wheel.

2. Steering wheel nut.

 Tighten

- Nut to 40 N.m (29 lb ft).
3. Horn pad assembly (if not equipped with SIR).
 4. Horn contact (if equipped with SIR).
 5. Inflator module assembly.
 6. Negative battery cable.
 7. Enable the SIR system (if equipped with SIR). Refer to SECTION 9J.

TILT WHEEL LEVER REPLACEMENT

 Remove or Disconnect

1. Pull lever out.

 Install or Connect

1. Align and push lever in to secure.

MULTIFUNCTION TURN SIGNAL/HAZARD SWITCH REPLACEMENT

 Remove or Disconnect (Figures 6 and 7)

1. Make sure the lever is in the center or "Off" position.
2. Negative battery cable. Refer to SECTION 6D1.
3. Disable the SIR system. Refer to SECTION 9J.
4. Inflator module. Refer to "Inflator Module Replacement-SIR" in this section.
5. Tilt wheel lever. Refer to "Tilt Wheel Lever Replacement" in this section.
6. Horn contact (if equipped with SIR). Refer to "Horn Contact Replacement" in this section.
7. Horn pad assembly (if not equipped with SIR).

3F-16 STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE

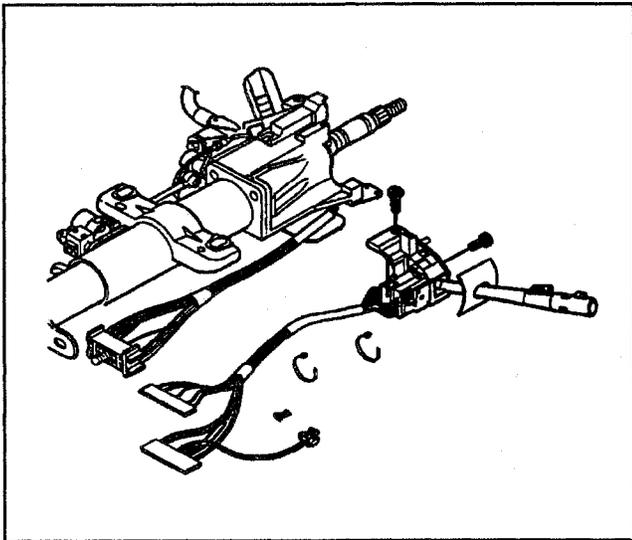


Figure 6—Multifunction Lever

Refer to "Horn Pad Assembly Replacement" in this section.

8. Steering wheel nut.
9. Steering wheel using J 1859-A. Refer to "Steering Wheel Replacement" in this section.
10. Knee bolster. Refer to SECTION 10A4.
11. Loosen steering column bracket nuts.
12. Two TORX® head screws from lower column cover.

13. Lower column cover.
 - Tilt cover down and slide back to disengage locking tabs.
14. Two TORX.RTM® head screws from upper column cover.
15. Steering column lock set. Refer to SECTIONS 3F4 or 3F5.
16. Upper column cover.
17. Two wire harness straps from steering column wire harness.
18. Retainer (CPA) and connector from BTSI.
19. Steering column bulkhead connector from vehicle wire harness.
20. Gray and black connectors of switch from column bulkhead connector.
21. Two TORX® head screws on switch.
22. Multifunction turn signal/hazard switch.



Install or Connect (Figures 6 and 7)

NOTICE: Refer to "Notice" on page 3F-1.

1. Multifunction turn signal/hazard switch.
 - Use small blade screwdriver to compress electrical contact and move multifunction switch into position.
 - Electrical contact must rest on cancelling cam assembly.

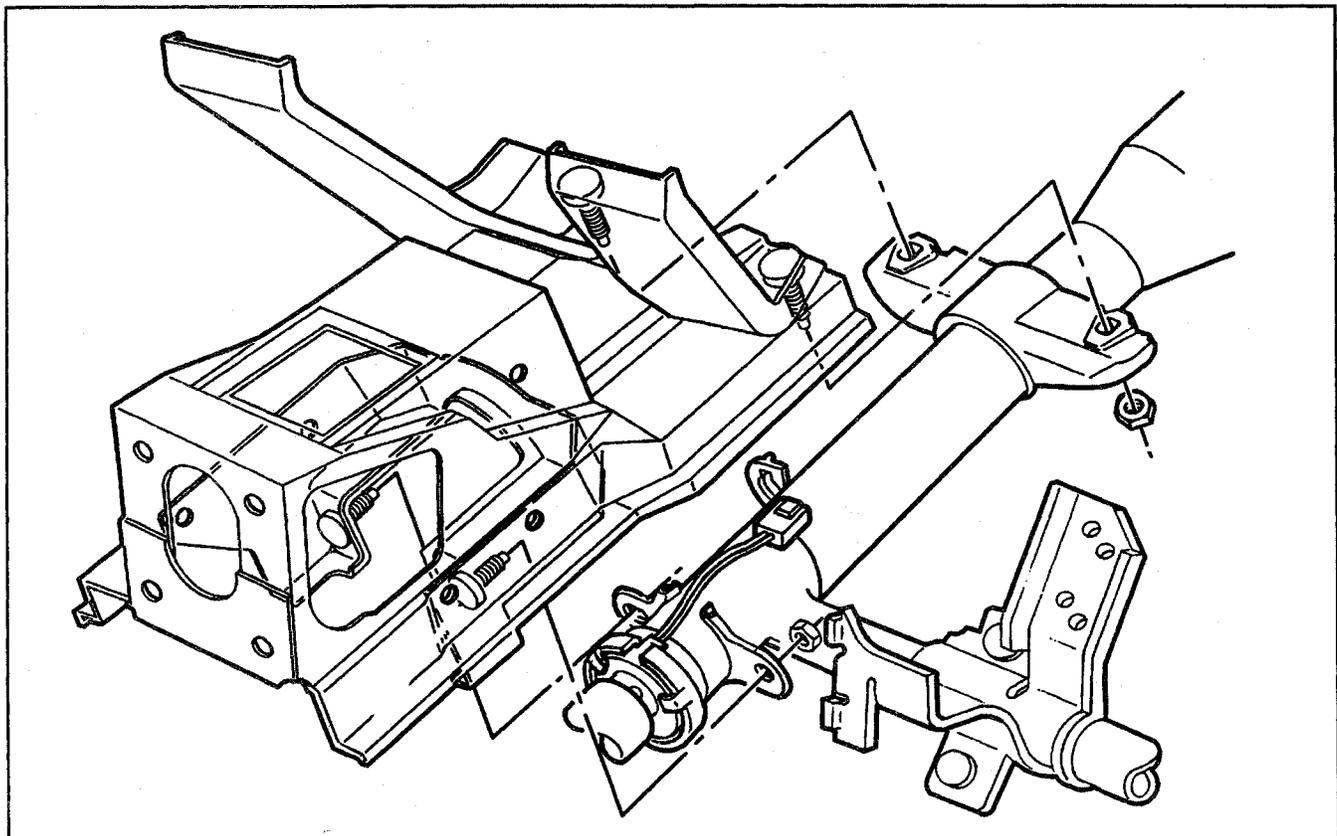


Figure 7—Steering Column To Bracket Assembly

- Two TORX® head screws on switch.

Tighten

- Screws to 6 N.m (53 lb in).
- Gray and black connectors of switch to column bulkhead connector.
 - Steering column bulkhead connector to vehicle wire harness.
 - Connector and retainer (CPA) to BTSI.
 - Two wire straps on steering column wire harness.
 - Upper column cover.
 - Steering column bracket nuts.

Tighten

- Nuts to 30 N.m (22 lb ft).
- Knee bolster.
 - Steering column cylinder lock set.
 - Two TORX® head screws to upper column cover.

Tighten

- Screws to 1.4 N.m (12 lb in).
- Lower column cover.
 - Two TORX® head screws to lower column cover.

Tighten

- Screws to 6 N.m (53 lb in).
- Make sure the lever is in the center or "OFF" position.
 - Steering wheel onto the steering shaft.
 - Steering wheel nut.

Tighten

- Nut to 40 N.m (29 lb ft).
- Horn pad assembly (if not equipped with SIR).
 - Horn contact (if equipped with SIR).
 - Inflator module.
 - Tilt wheel lever.
 - Negative battery cable.
 - Enable the SIR system (if equipped). Refer to SECTION 9J.

SHIFT LEVER REPLACEMENT

Remove or Disconnect

- Roll seal back until TORX® head screw is exposed.
- TORX® head screw.
- Shift lever.

Install or Connect

NOTICE: Refer to "Notice" on page 3F-1.

- Shift lever.
- TORX® head screw.
 - Screw to 22 N.m (29 lb ft).
- Roll seal over TORX® head screw.

SHIFT LEVER SEAL REPLACEMENT

Remove or Disconnect

- TORX® head screws from lower column cover. Do not remove cover, let the lower column cover pivot on upper column cover.
- Roll seal back until TORX® head screw is exposed.
- TORX® head screw from shift lever.
- Shift lever.
- Shift lever seal.

Install or Connect

- Shift lever seal.
- Shift lever.
- TORX® head screw to shift lever.
 - Screw to 22 N.m (16 lb ft).
- Roll seal up lever until TORX® head screw is covered.
- TORX® head screws to lower column cover.
 - Screws to 6 N.m (53 lb in).

INTERMEDIATE SHAFT REPLACEMENT

Remove or Disconnect (Figure 8)

- Set the front wheels in the straight-ahead position and the steering wheel in the "LOCKED" position.
- Shield from steering gear.
 - Mark the upper to lower intermediate shaft and the lower shaft coupler to the steering gear inputshaft relationship to be sure of proper installation.
 - Nut and bolt from upper to lower shaft connection.
 - Bolt from lower shaft coupler.
 - Intermediate shaft assembly by sliding shaft up (towards dash) to get lower shaft coupler to clear steering gear inputshaft.
 - Slide intermediate shaft down out of the upper shaft.

Install or Connect (Figure 8)

NOTICE: Refer to "Notice" on page 3F-1.

- Upper end of intermediate shaft into upper shaft.
- Lower end of intermediate shaft coupler onto steering gear wormshaft. Align marks made at removal only if putting the same shaft back in.
- Bolt to lower shaft coupler.
- Bolt and nut to upper end of shaft.

Tighten

- Upper nut to 62 N.m (46 lb ft).
 - Coupler pinch bolt to 30 N.m (22 lb ft).
- Shield on to steering gear.

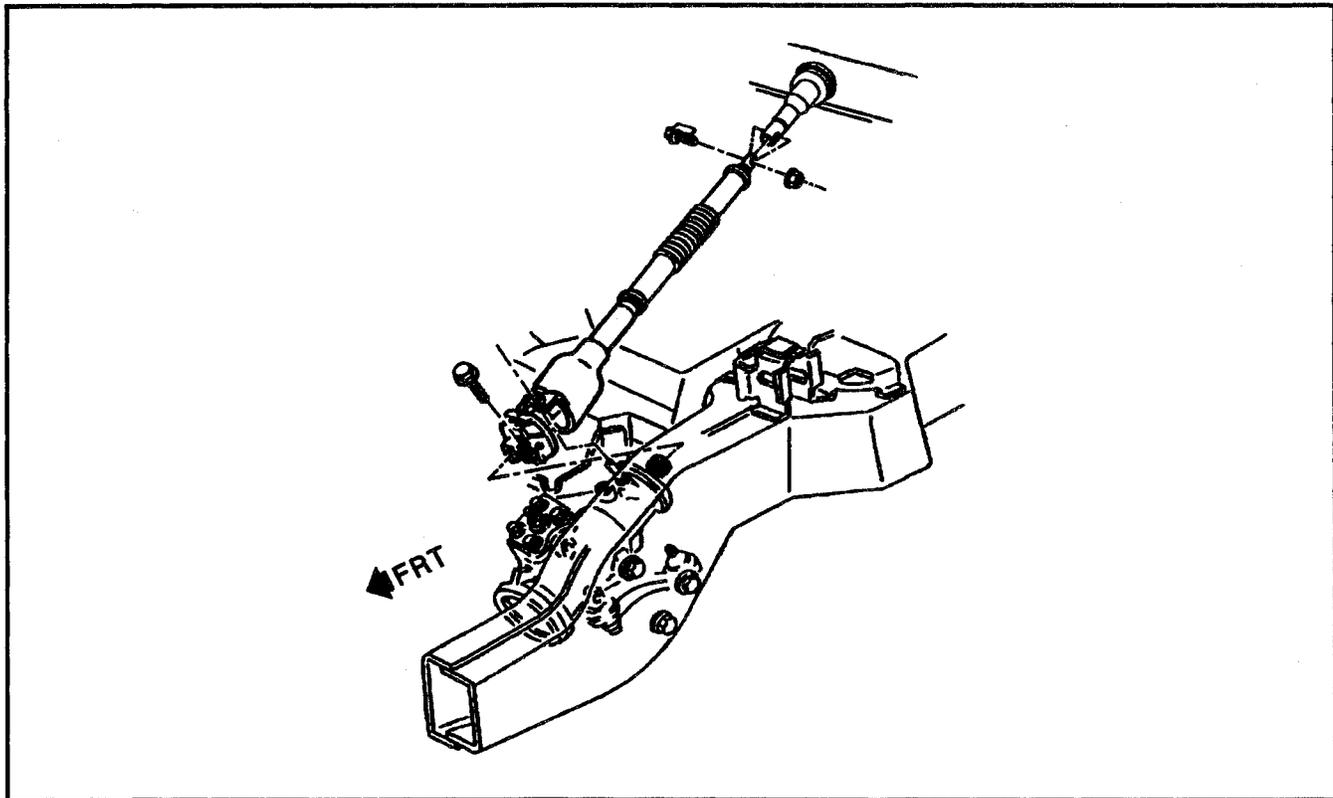


Figure 8—Intermediate Shaft Installation

STEERING COLUMN REPLACEMENT

↔ Remove or Disconnect (Figures 7 through 9)

NOTICE: *When the column is removed from the vehicle, a sharp blow on the end of the steering shaft or shift lever, leaning on the column assembly, or dropping of the assembly could shear or loosen the plastic fasteners that maintain column rigidity.*

- Set front wheels in the straight-ahead position and the steering wheel in the "LOCKED" position.
- 1. Negative battery cable. Refer to SECTION 6D1.
- 2. Disable the (SIR). Refer to SECTION 9J.
- 3. Screws and steering column trim panels. Refer to SECTION 10A4.
- 4. Transmission control cable from the column.
- 5. Steering wheel. Refer to "Steering Wheel Replacement" in this section.
- 6. Harness at the connectors.
- 7. Nut and bolt from upper to lower shaft connection.
- 8. Nuts from upper and lower support brackets.
- 9. Lower the steering column.

- 10. Steering column assembly.
 - Rotate the column so the shift lever clears the dash panel opening.

↔ Install or Connect (Figures 7 through 9)

NOTICE: *Refer to "Notice" on page 3F-1.*

1. Lower the end of the steering column through the dash panel opening.
2. Harness to connectors on the steering column.
3. Raise the steering column into place.
 - Rotate column up over two upper studs and loosely assemble two nuts.
4. Lower column nuts.
5. Upper column nuts.

 **Tighten**

- Nuts to 30 N.m (22 lb ft).
- 6. Bolt and nut to upper end of shaft.

 **Tighten**

- Nut to 62 N.m (46 lb ft).
- 7. Transmission control cable.

STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE 3F-19

8. Steering column trim panel and screws.
9. Steering wheel.
10. Negative battery cable.
11. Enable the SIR system. Refer to SECTION 9J.

STEERING COLUMN SEAL REPLACEMENT (ALL EXCEPT C 3500HD)

Remove or Disconnect (Figures 7 and 9)

- Set the front wheels in the straight-ahead position and the steering wheel in the "LOCKED" position.
 - Mark the upper to lower intermediate shaft to be sure of proper installation.
1. Shield from steering gear.
 2. Nut and bolt from upper to lower shaft connection.
 3. Pull lower shaft out of upper shaft.
 4. Seal by grasping and compressing it while pulling away from dash panel.

Install or Connect (Figures 7 and 9)

NOTICE: Refer to "Notice" on page 3F-1.

1. Slide seal up steering column.
2. Align locating tab on seal with notch at the bottom of dash panel opening.
3. Slightly compress seal while forcing it inward until retaining collar snaps open inside cab.

4. Pull lower shaft up into upper shaft.
 - Verify retaining collar has opened inside cab 360 degrees.
5. Nut and bolt to upper end of shaft.

Tighten

- Nut and bolt to 62 N.m (46 lb ft).
6. Shield to intermediate shaft.

STEERING COLUMN SEAL REPLACEMENT (C 3500HD)

Remove or Disconnect (Figures 7 and 9)

1. Steering column. Refer to "Steering Column Replacement" in this section.
2. Push locking ring tabs inward one at a time until seal separates from the dash panel. Note position of locating tab directly at bottom of the locking ring and dash panel opening (Figure 9).

Install or Connect (Figures 7 and 9)

NOTICE: Refer to "Notice" on page 3F-1.

1. Align locating tab groove on seal directly at bottom of dash panel opening so sheet metal fits into the tabs groove. Force the seal upward and inward until seal snaps into place.
2. Steering column.

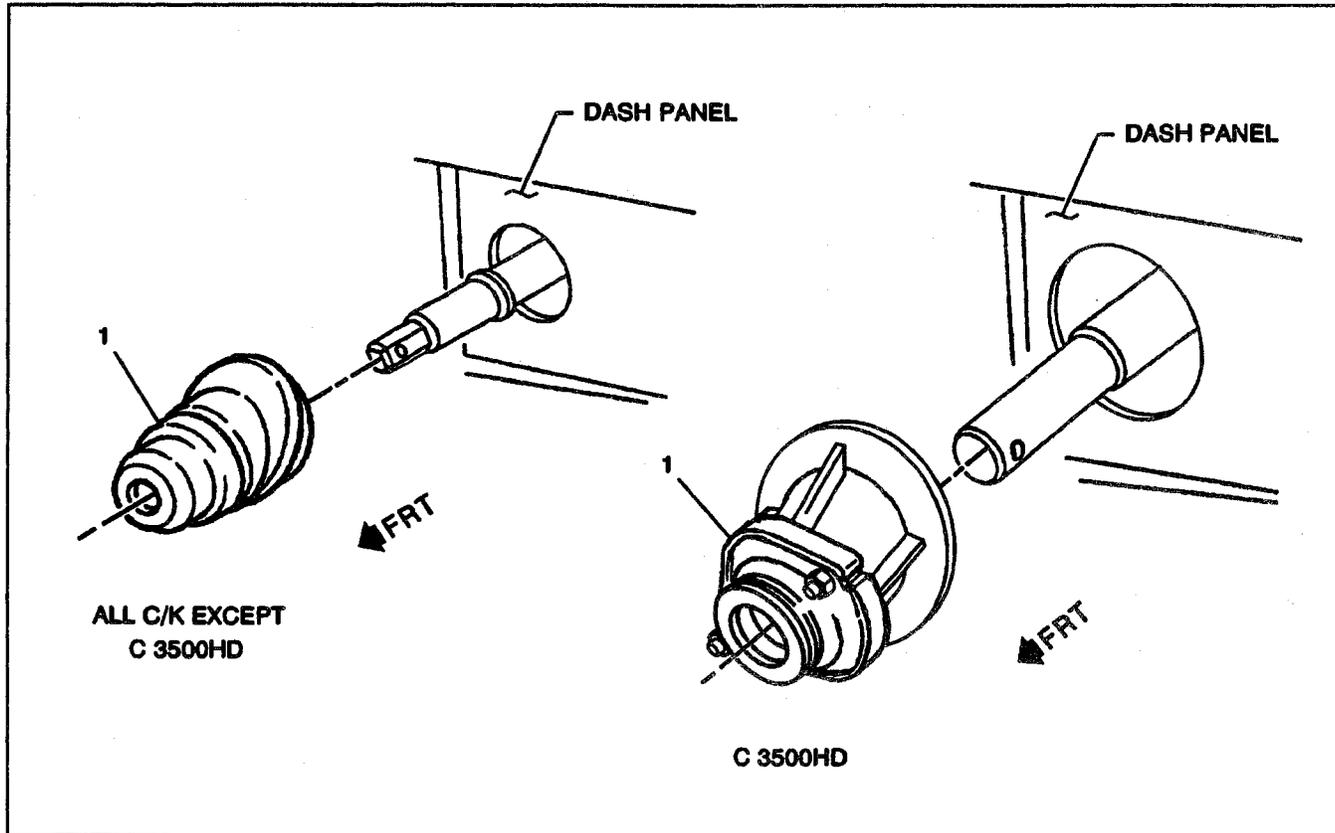


Figure 9—Steering Column Seal

3F-20 STEERING WHEEL AND COLUMN ON-VEHICLE SERVICE

CHECKING STEERING COLUMN FOR ACCIDENT DAMAGE

Refer to SECTIONS 3F4 or 3F5.

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

Application	N.m	Lb Ft	Lb In
Intermediate Shaft Coupling Pinch Bolt	30	22	—
Intermediate Shaft Upper Pinch Nut	62	46	—
Steering Column Bracket Nuts	30	22	—
Steering Wheel Nut	40	29	—
Support Bracket Bolts	30	22	—
Upper Column Cover Screws	1.4	—	12
Lower Column Cover Screws	6	—	53
Multifunction Turn Signal/Hazard Switch Screws	6	—	53
Shift Lever Screw	22	16	—

SPECIAL TOOLS



J 1859-A

1. STEERING WHEEL PULLER

V3305

SECTION 3F4

**SUPPLEMENTAL INFLATABLE RESTRAINT
(SIR) STANDARD STEERING COLUMN
UNIT REPAIR**

CAUTION: The procedures in this section must be followed in the order listed to temporarily disable the Supplemental Inflatable Restraint (SIR) System and prevent false diagnostic codes from setting. Failure to follow procedures could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the negative battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "off" or "lock" position.

NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

NOTICE: Once steering column is removed from vehicle, the column is extremely susceptible to damage. Dropping steering column assembly on its end could collapse steering shaft or loosen plastic injections which maintain column rigidity. Leaning on steering column assembly could cause jacket to bend or deform. Any of the above damage could impair steering column's collapsible design. If it is necessary to remove steering wheel, use only the specified steering wheel puller and holding fixture. Never place column directly into a vise. Under no conditions should the end of shaft be hammered on as hammering could loosen plastic injections which maintain steering column rigidity.

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G/S Lever Asm Support Brkt			

- 1- NUT, HEXAGON LOCKING (M14x1.5)
- 2- COIL ASM, INFLATABLE RESTRAINT
STEERING WHEEL MODULE
- 3- WASHER, WAVE
- 4- RING, RETAINING
- 5- SHIELD ASM, SHAFT LOCK
- 6- CAM ASM, T/SIG CANCEL
- 7- SPRING, UPPER BEARING
- 8- WASHER, THRUST
- 9- SCREW, TORX HEAD
- 10- SHROUD, UPPER
- 11- BOLT ASM, LOCK
- 12- SPRING, LOCK BOLT
- 13- SCREW, PAN HD TAPPING
- 14- SCREW, TORX HEAD
- 15- MODULE ASM, LOCK
- 16- SEAL, SHIFT LEVER
- 17- LOCK CYL SET, STRG COLUMN
- 18- SCREW, TAPPING
- 19- SWITCH ASM, IGN & KEY ALARM
- 22- STRAP, WIRE HARNESS
- 23- CONNECTOR, AXIAL POSN ASSUR
- 24- SWITCH ASM, T/S & MULTIFUNC
- 26- HOUSING ASM, STRG COLUMN
- 27- PROTECTOR, SHROUD
- 28- SHROUD, LOWER
- 29- STUD, SHROUD MOUNTING
- 30- RING, RETAINING
- 31- RING, RETAINING
- 32- SHAFT ASM, STEERING
- 33- SCREW, SHIFT LEVER
- 34- LEVER ASM, AUTO TRANS CONTROL
- 40- SHIFT ASM, LINEAR
- 41- CLEVIS, SHIFT LEVER
- 43- SCREW, FLAT HD 6-LOBED SOC TAP
- 44- CAM ASM, CABLE SHIFT
- 45- ACTUATOR ASM, BALL &
- 46- BOLT, HEX FLANGE HEAD
- 47- SCREW, OVAL HD 6-LOBED SOC TAP
- 48- CABLE ASM, PARK LOCK
- 49- BRACKET, G/S LEVER ASM SUPPORT
- 58- JACKET ASM, STRG COL
- 60- BEARING ASM, ADAPTER &
- 61- ACTUATOR, ELECTRICAL (BTSI)
- 62- SENSOR ASM, EVO
- 63- BUSHING, CAM
- 64-SHAFT ASM, YOKE & INTER STRG
- 65- BOLT, ROUND HD LOCKING
- 66-BOLT, PINCH
- 67-NUT, HEX HD
- 68-SHAFT ASM, CPLG & STRG

Figure 2 - Standard Steering Column - Legend

DISABLING THE SIR SYSTEM

SERVICE PRECAUTIONS

CAUTION: When performing service on or around SIR components or SIR wiring, follow the procedures listed below to temporarily disable the SIR system. Failure to follow procedures could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

The DERM can maintain sufficient voltage to cause a deployment for up to 2 minutes after the ignition switch is turned "OFF" or the battery is disconnected. Many of the service procedures require disconnection of the "AIR BAG" fuse and the inflator module circuits from the deployment loops to avoid an accidental deployment.

Remove or Disconnect

- Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
 - Turn the ignition switch to "LOCK" and remove key.
1. "AIR BAG" fuse from I/P fuse block.
 2. Steering column filler panel. Refer to section 10A4.
 3. Connector position assurance (CPA) retainer and yellow 2-way SIR connector at base of steering column.

Important

- With the "AIR BAG" fuse removed and ignition switch "ON", the "AIR BAG" warning lamp will be "ON". This is normal operation and does not indicate an SIR system malfunction.

ENABLING THE SIR SYSTEM

Install or Connect

- Turn the ignition switch to "LOCK" and remove key.
1. Yellow 2-way SIR connector and CPA retainer at base of steering column.
 2. "AIR BAG" fuse to I/P fuse block.
 3. Steering column filler panel. Refer to section 10A4.
 - Turn ignition switch to "RUN" and verify that the "AIR BAG" warning lamp flashes 7 times and then turns "OFF". If it does not operate as described, perform the "SIR Diagnostic System Check" in section 9J-A of the Service Manual Supplement.

UNIT REPAIR

LOWER SHROUD STRG COLUMN LOCK CYL SET UPPER SHROUD SHIFT LEVER SEAL (c/s only)

Figure 1, 3, through 5

Tools Required:

J 41352 Modular Column Holding Fixture

Remove or Disconnect

1. Negative (-) battery cable.
2. Disable the SIR system; refer to DISABLING THE SIR SYSTEM in this Section.
3. Cplg & Strg shaft assembly (62) or Yoke & Inter Strg shaft assembly (64) (Depending on Model) from shaft assembly.
 - Remove bolt

NOTICE: Once steering column is removed from vehicle, the column is extremely susceptible to damage. See NOTICE on page 3F5-1 in this section.

4. Lower or remove steering column from vehicle; refer to section 3F.
 - Secure steering column to modular col. holding fixture J 41352.
 - Place holding fixture into vise. (See Fig.3)

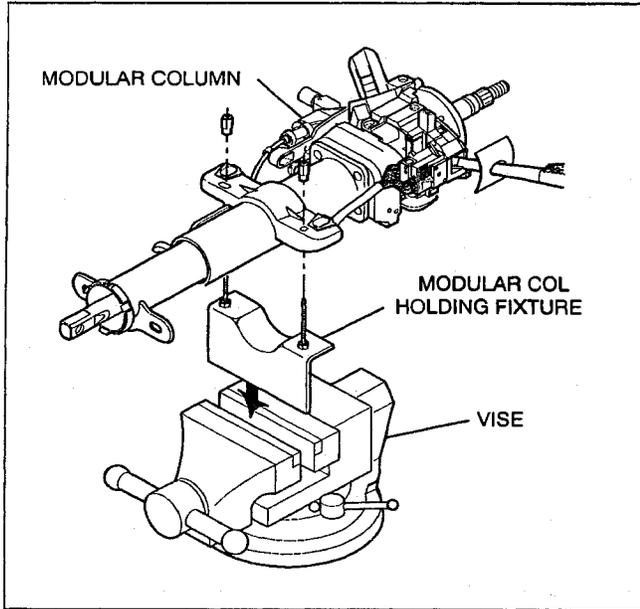


Figure 3 - Modular Column Holding Fixture

Inspect

- Steering shaft assembly for accident damage. (See Figure 27).
5. Two pan head tapping screws (13) from lower shroud (28).
 6. Lower shroud (28).
 - Tilt shroud (28) down and slide back to disengage locking tabs.
 7. Two torx head screws (14) from upper shroud (10).

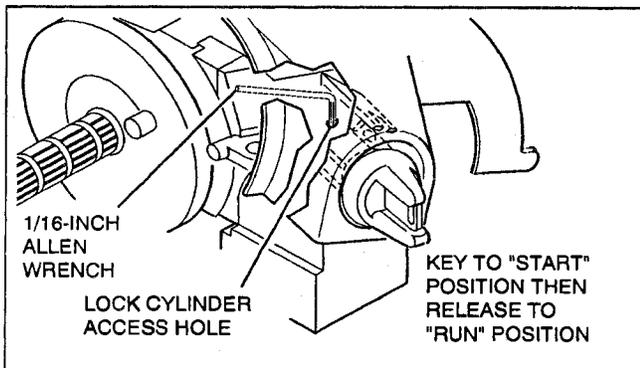


Figure 4 - Removing Lock Cylinder and Upper Shroud

8. Lift upper shroud (10) to gain access to lock cylinder hole.
 - A. Hold key in "START" position.
 - B. Using 1/16-inch allen wrench push on lock cylinder retaining pin.
 - C. Release key to "RUN" position and pull steering column lock cylinder set (17) from lock module assembly (15).
 - D. Remove upper shroud (10).
9. Shift lever; refer to section 3F.
10. Shift lever seal (16).
11. Shroud protector (27) from lower shroud (28).

Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Shift lever seal (16).
2. Shift lever; refer to section 3F.
3. Shroud protector (27) to lower shroud (28).
4. Move shift lever seal (16) and multifunction lever seal to ease in installation of upper and lower shrouds.

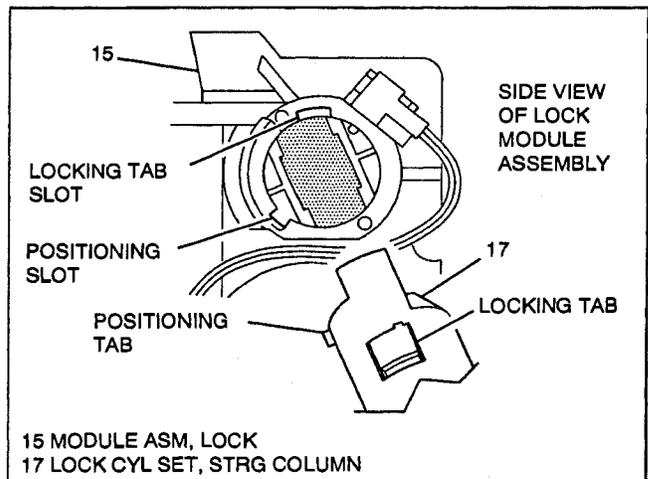


Figure 5 - Sector and Lock Cylinder Alignment Position

3F4-6 STD STRG COL UNIT REPAIR (SIR)

5. Upper shroud (10) and steering column lock cylinder set (17).
 - A. Key installed in lock cylinder (17) and in "RUN" position.
 - B. Ensure sector in lock module assembly (15) is in "RUN" position. (See Figure 5)
 - C. Lock cylinder (17) to upper shroud (10).
 - D. Line up locking tab and positioning tab with slots in lock module assembly (15) and push cylinder (17) into position.
6. Two torx head screws (14) to upper shroud (10).

Tighten

- Tighten screws (14) to 1.4 N·m (12 lb.in.).

7. Lower shroud (28).
 - Ensure that slots on lower shroud (28) engage with tabs on upper shroud (10).
 - Tilt lower shroud up and snap shrouds together.
8. Two pan head tapping screws (13) to lower shroud (28).

Tighten

- Tighten screws (13) to 6.0 N·m (53 lb.in.).

9. Shift lever seal (16) and multifunction lever seal into position.
10. Raise or install steering column to vehicle; refer to section 3F.
11. Cplg & Strg shaft assembly (68) or Yoke & Inter Strg shaft assembl (64) to shaft assembly (32).

Tighten

- Tighten bolt to 47 N·m (35 lb.ft.).

Tighten

- Tighten Hex Hd Nut (67) to 62 N·m (46 lb.ft.).

12. If all service operations are completed, enable the SIR system; refer to "ENABLING THE SIR SYSTEM" in this section.
13. Negative (-) battery cable.

COIL ASM, INFL RST STRG WHL MDL

Figures 1 through 7

Tools Required:

J 41352 Modular Column Holding Fixture

Remove or Disconnect

1. Negative (-) battery cable.
2. Do steps 1 through 7, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.
3. Air bag module and steering wheel; refer to service procedures in section 3F.

NOTICE: Coil assembly (2) will become uncentered if:

- 1) Steering column is separated from steering gear and allowed to rotate.
- 2) Centering spring is pushed down, letting hub rotate while coil (2) is removed from steering column. (If this occurs, refer to Figure 7 to center coil)

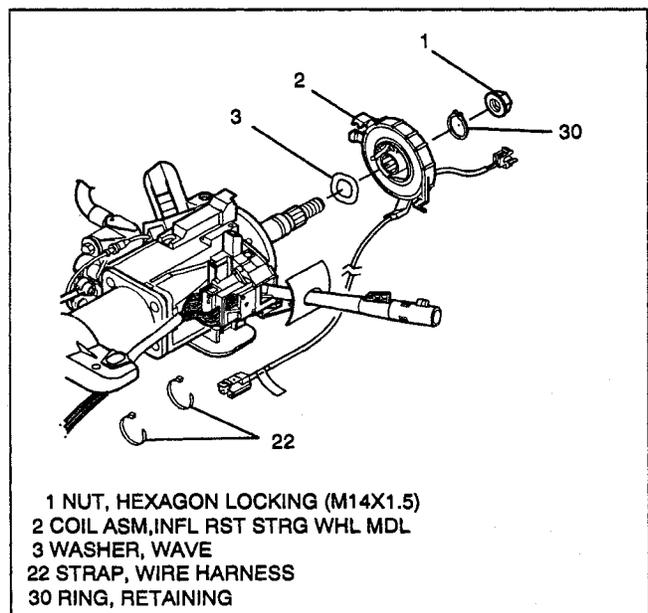


Figure 6 - Removing Coil Assembly

4. Retaining ring (30).
5. Coil assembly (2). (See Figure 6)

6. Wave washer (3).
7. Two wire harness straps (22) from steering column wire harness.

→+ Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Center steering shaft assembly (32) and coil assembly(2).
 - A. Wheels straight ahead.
 - Block tooth and centering mark on steering shaft assembly (32) at 12 o'clock position.
 - B. Ignition switch to "LOCK" position.
 - C. Ensure coil asm (2) is centered; refer to figure(6).
2. Wave washer (3).

NOTICE: New coil assembly (2) will be pre-centered. Install new coil asm, remove and dispose of centering tab.

3. Coil assembly (2).
 - A. Ensure shaft (32) and coil asm (2) are centered.
 - B. Align coil asm (2) with horn tower and slide onto shaft (32).
4. Retaining ring (30) must seat securely in groove on shaft (32).
5. Route lower coil wire along steering column jacket assembly (58).
6. Two wire harness straps (22) to steering column wire harness.
7. Do steps 4 through 10, "Install or Connect", LOWER SHROUD, UPPER SHROUD, in this Section.
8. Steering wheel and air bag module; refer to service procedures in section 3F.
9. If all service operations are completed, enable the SIR system; refer to ENABLING THE SIR SYSTEM in this section.
10. Negative (-) battery cable.

T/S & MULTIFUNCTION SWITCH ASM

Figures 1 through 8

Tools Required:

J 41352 Modular Column Holding Fixture

←+ Remove or Disconnect

1. Do steps 1 through 7, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.

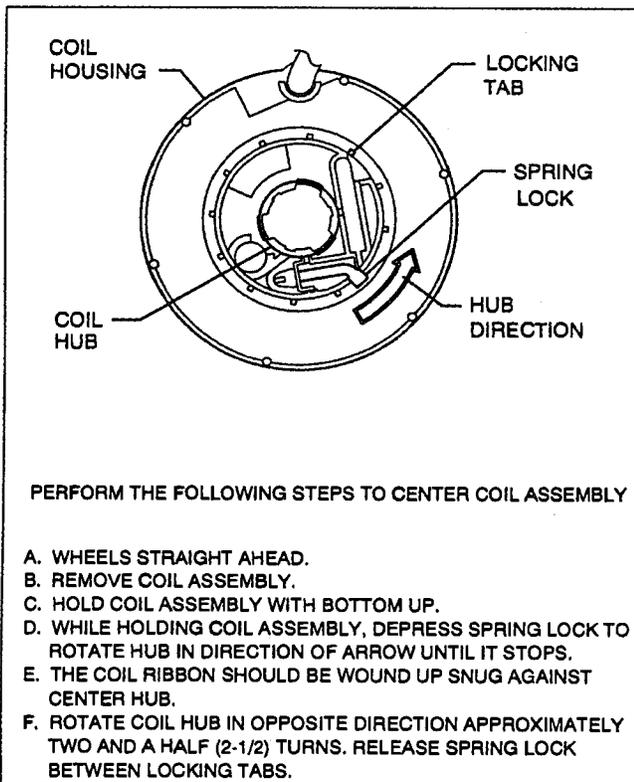


Figure 7 - Centering Coil Assembly

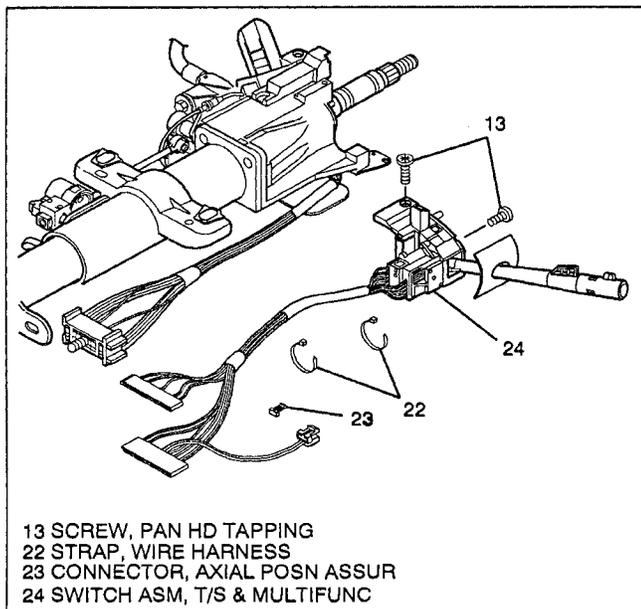


Figure 8 - Removing T/S & multifunction Switch

2. Two wire harness straps (22) from steering column wire harness.
3. Steering column bulkhead connector from vehicle wire harness.
4. Axial position assurance connector (23) from electrical (BTSI) actuator (61). (Column shift only)
 - Electrical connector from (BTSI) actuator (61).
5. Grey and black connectors of turn signal & multifunction switch (24) from column bulkhead connector.
6. Two pan head tapping screws (13).
7. Turn signal & multifunction switch assembly (24) from column.

→← Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Turn signal & multifunction switch assembly (24) to column.
 - With small blade screwdriver compress electrical contact and move multifunction switch (24) into position.
 - Electrical contact must rest on cancelling cam assembly (6).

2. Two pan head tapping screws (13).

⌚ Tighten

- Tighten screws (13) to 6.0 N·m (53 lb.in.).
3. Grey and black connectors of multifunction switch (24) to column bulkhead connector.
 4. Electrical connector to electrical (BTSI) actuator (61). (Column shift only)
 - Axial position assurance connector (23).
 5. Steering column bulkhead connector to vehicle wire harness.
 6. Two wire harness straps (22) to steering column wire harness.
 7. Do steps 4 through 10, "Install or Connect", LOWER SHROUD, UPPER SHROUD, in this section.

IGN & KEY ALARM SWITCH ASM

Figures 1 through 10

Tools Required:
 J 41352 Modular Column Holding Fixture

↔ Remove or Disconnect

1. Do steps 1 through 7, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.
2. Do steps 2 through 6, "Remove or Disconnect", T/S & MULTIFUNCTION SWITCH ASM, in this section.

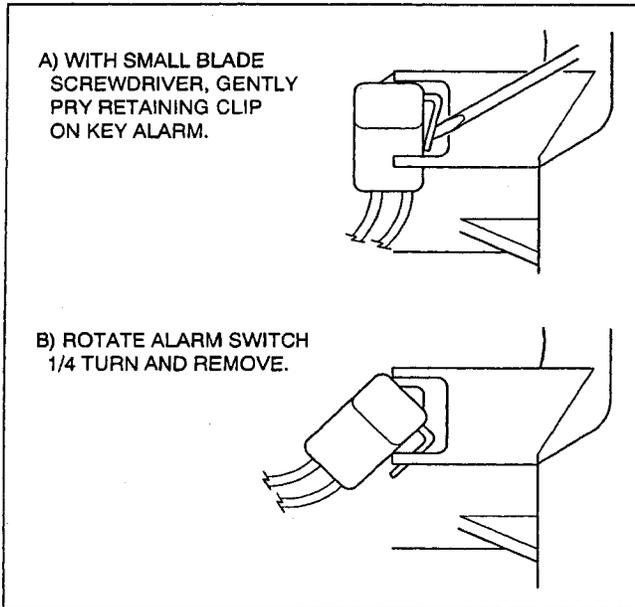


Figure 9 - Removing Alarm Switch

3. Alarm switch from lock module assembly (15).
 - Gently pry retaining clip on alarm switch with small blade screwdriver.
 - Rotate alarm switch 1/4 turn and remove.

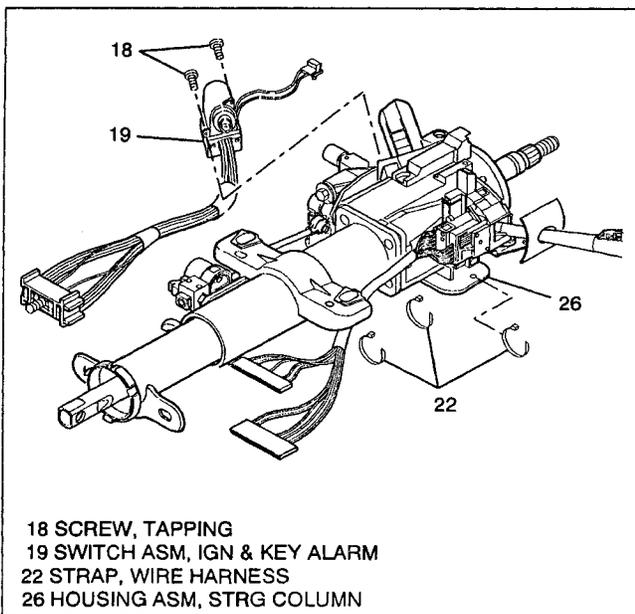


Figure 10 - Removing Ignition & Key Alarm Switch

4. Two tapping screws (18).
5. Ignition & key alarm switch assembly (19).
 - Wire harness from slot in steering column housing assembly (26).

↔ Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Ignition & key alarm switch assembly (19).
 - Route wire harness through slot in steering column housing assembly (26). Secure wire harness with a wire harness strap (22) through hole located in the bottom of housing assembly (26).
2. Two tapping screws (18).

⌚ Tighten

- Tighten screws (18) to 1.4 N·m (12 lb.in.).
3. Alarm switch to lock module assembly (15).
 - A. Switch with retaining clip parallel to lock cylinder (17).
 - B. Rotate switch 1/4 turn until locked into place.
 4. Do steps 3 through 8, "Install or Connect", T/S & MULTIFUNCTION SWITCH ASM, in this section.

STRG COLUMN LOCK CYL SET (Replacement - Lost Key)

Figure 3, 7 and 11-14, 19 through 21

Tools Required:

- J 23653-SIR Lock Plate Compressor
- J 41352 Modular Column Holding Fixture
- J 41396 Park Lock Cable Pliers

↔ Remove or Disconnect

1. Do steps 1 through 7, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section if you "DO NOT" have the "Key" to match the cylinder. The upper shroud (10) will remain with the lock module assembly (15).

3F4-10 STD STRG COL UNIT REPAIR (SIR)

NOTICE: If you "DO" have the "Key" that matches the lock cylinder, then do steps 1 through 8, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.

2. Air bag module and steering wheel; refer to service procedures in section 3F.

NOTICE: Coil assembly (2) will become uncentered if:

- 1) Steering column is separated from steering gear and allowed to rotate.
 - 2) Centering spring is pushed down, letting hub rotate while coil (2) is removed from steering column. (If this occurs, refer to Figure 7 to center coil).
3. Retaining ring (30).
 4. Coil assembly (2).
 5. Wave washer (3).
 6. Shaft lock retaining ring (4) using J 23653-SIR to push down shaft lock shield assembly (5).
 - Dispose of ring (4).
 7. Shaft lock shield assembly (5).
 8. Turn signal cancel cam assembly (6).
 9. Park lock cable assembly (48) from lock module assembly (15).
 - Lock cylinder should be in "OFF-LOCK" position and gear shift in "PARK" position.
 - Insert small blade screwdriver into slot in module assembly (15). Push against locking tab on end of cable assembly (48) and remove.
 10. Key alarm switch from module assembly (15). (See Figure 9)
 - Gently pry retaining clip on alarm switch with small blade screwdriver.
 - Rotate alarm switch 1/4 turn and remove.
 11. Two tapping screws (18).
 12. Ignition & key alarm switch assembly (19).
 - Let switch (19) hang freely.
- NOTICE:** Lock bolt assembly (11) is under slight spring tension from lock bolt spring (12). Hold lock bolt (11) in place while removing lock module assembly (15).
13. Three pan head tapping screws (13).
 14. Lock module assembly (15) with upper shroud (10).

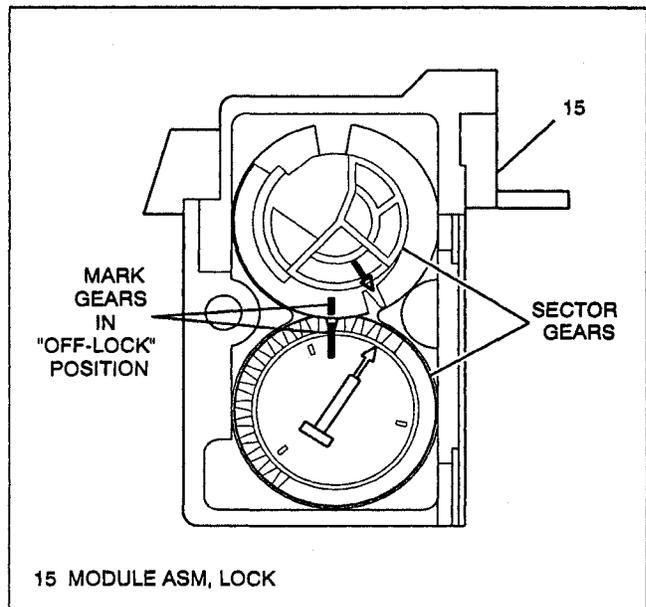


Figure 11 - Sector Gear Timing Position (OFF-LOCK)

15. Backing plate from lock module assembly (15).

Important

- Mark two sector gears at "OFF-LOCK" position to ensure proper reassembly. Failure to assemble sector gears properly will cause lock cylinder (17) and ignition switch (19) to improperly timed. (See Figure 11 for proper timing)
- 16.. Remove both sector gears (See Figure 11).

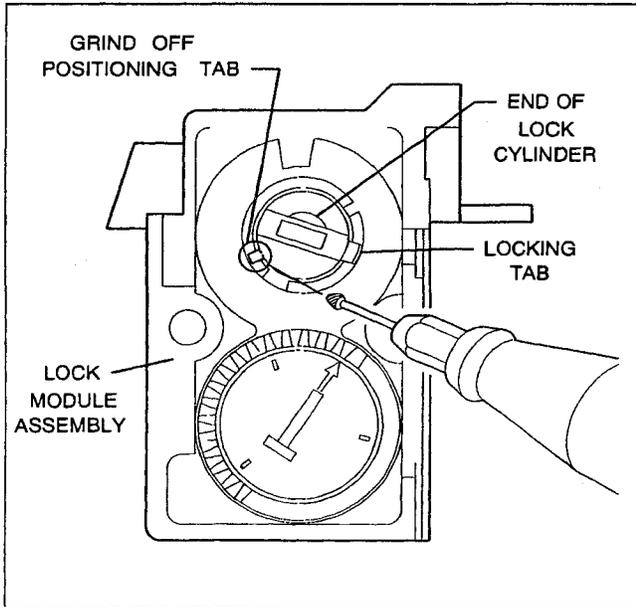


Figure 12 - Grinding Off Lock Cylinder Positioning Tab

17. Remove positioning tab on end of lock cylinder (17) using an 1/8-inch burring tool. (See Figure 12)
 - Remove all burrs in and around lock module assembly (15) and lock cylinder (17).
18. From inside module assembly (15) push on locking tab and pull lock cylinder (17) from lock module assembly (15) and upper shroud (10).

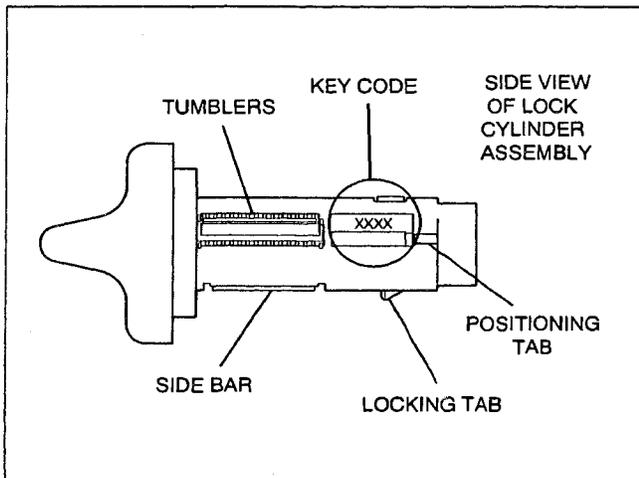


Figure 13- Location of Key Code

19. Record "Key Code " from old lock cylinder. (See Figure 13)
 - Build up "New" lock cylinder.
 - Cut "New " key.
 - Discard "Old" lock cylinder.

 Clean

- All debris and metal shavings from inside module assembly (15).
- Remove all burrs.

 Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Align marks made on sector gears and install sector gears and backing plate to lock module assembly (15). (See Figure 11 for proper timing of gears)
2. Steering column lock cylinder set (17) to lock module assembly (15).
 - A. Ensure sector in lock module assembly (15) is in "OFF-LOCK" position. (See Figure 11)
 - B. Key installed in lock cylinder (17) and in "OFF-LOCK" position.
 - C. Line up locking tab positioning with slots in lock module assembly (15) and push cylinder (17) into position.
 - D. Rotate lock cylinder to "ACC" position and check alignment of "ARROWS" on sector gears. Arrows should be pointing towards each other.
 - E. Rotate lock cylinder to "LOCK" position.
3. Lock module assembly (15).
 - Push lock bolt (11) into steering column housing assembly (26) until flush.
 - Align lock module assembly (15) with housing assembly (26) and install.
4. Three pan head tapping screws (13).

 Tighten

- Tighten screws (13) to 6.0 N·m (53 lb.in.)

5. Ignition & key alarm switch assembly (19).

3F4-12 STD STRG COL UNIT REPAIR (SIR)

6. Two tapping screws (18) for ignition and key alarm switch (19)

Tighten

- Tighten screws (18) to 1.4 N·m (12 lb.in.).
7. Key alarm switch to module assembly (15).
 - A. Key alarm switch with retaining clip parallel to lock cylinder (17).
 - B. Rotate key alarm switch 1/4 turn until locked into place.
 8. Turn signal cancel cam assembly (6).
 - Lubricate lower brass surface with grease, synthetic (service kit).
 9. Shaft lock shield assembly (5).
 - Align inner block tooth of lock plate to block tooth of race & upper shaft assembly (34).
 10. New shaft lock retaining ring (4) using J 23653-SIR to push down shaft lock shield assembly (5).
 - Ring (4) must be firmly seated in groove on shaft.
 11. Center steering shaft assembly (32).
 - A. Wheels straight ahead.
 - Block tooth and centering mark on shaft assembly (32) at 12 o'clock position.
 - B. Ignition switch to "LOCK" position.
 - C. Ensure coil (2) is centered; refer to figure (7).

12. Wave washer (3).

NOTICE: New coil assembly (2) will be pre-centered. Install new coil, remove and dispose of centering tab.

13. Coil assembly (2).
 - A. Ensure shaft (32) and coil asm (2) are centered.
 - B. Align coil asm (2) with horn tower and slide onto shaft (32).
14. Retaining ring (30) must seat securely in groove on shaft (32).
15. Route lower coil wire along steering column jacket assembly (58).
16. Two wire harness straps (22) to steering column wire harness.

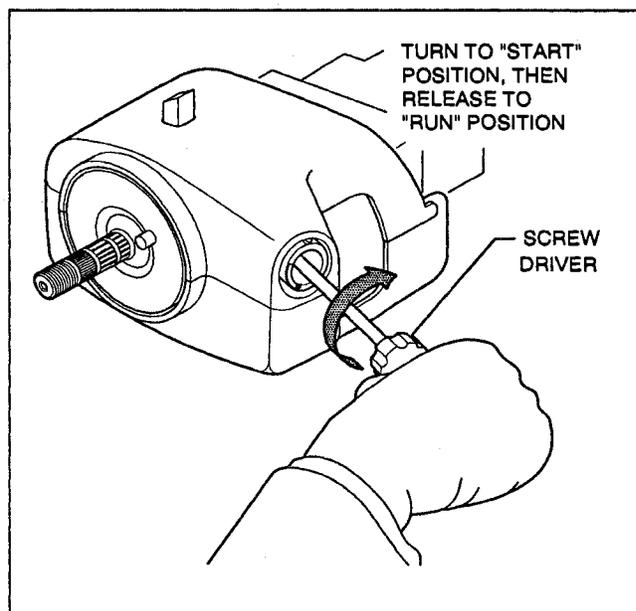


Figure 14 - Sector Alignment Procedure

17. Park lock cable assembly (48) to module assembly (15).
 - Lock cylinder should be in "OFF - LOCK" position and gear shift in "PARK" position.
 - Locking tab on end of cable (48) to slot in module assembly (15)



Adjust

- Park lock cable assembly (48). (See Figure 17)
 - A. Gear shift lever installed and in "PARK" position.
 - B. Ignition in "OFF LOCK" position and remove key.
 - C. Unlock adjuster ring on cable assembly (48) with tool J 41396. (See Figure 18)
 - D. Pull on cable until park lock latch contacts gear shift lever.
 - Release the cable.
 - E. Lock adjuster ring securely in place on cable assembly (48) with tool J 41396. (See Figure 19)

Inspect

- Park lock cable assembly (48). (See Figure 17)
 - A. With lock cylinder in "OFF-LOCK" position, gear shift lever should not be able to shift out of "PARK" position.
 - B. Insert key and turn to "RUN" position.
 - C. Shifter in "NEUTRAL" position.
 - D. With gear shift in "NEUTRAL" position lock cylinder should not be able to go into "OFF-LOCK" position.
 - E. Shifter in "PARK" position.
 - F. Lock cylinder in "OFF-LOCK" position and remove key.

18. Remove steering column lock cylinder (17) from lock module assembly (15).
19. Upper shroud (10).
20. Two torx head screws (14) to upper shroud (10).

Tighten

- Tighten screws (14) to 1.4 N·m (12 lb.in.).

21. Lower shroud (28).
 - Ensure that slots on lower shroud (28) engage with tabs on upper shroud (10).
 - Tilt lower shroud up and snap shrouds together.
22. Two pan head tapping screws (13) to lower shroud (28).

Tighten

- Tighten screws (13) to 6.0 N·m (53 lb.in.).

23. Shift lever seal (16) and multifunction lever seal into position.
24. Steering column lock cylinder set (17) to lock module assembly (15).
 - A. Ensure sector in lock module assembly (15) is in "RUN" position. (See Figure 11)
 - B. Key installed in lock cylinder (17) and in "RUN" position.
 - C. Line up locking tab and positioning tab with slots in lock module assembly (15) and push cylinder (17) into position.

25. Raise or install steering column to vehicle; refer to section 3F.

26. Steering wheel.
27. If all service operations are completed, enable the SIR system; refer to "ENABLING THE SIR SYSTEM" in this section.
28. Negative (-) battery cable.

ELECTRICAL (BTSI) ACTUATOR (c/s only)

Figures 1,15,16 and 17

Remove or Disconnect

1. Negative (-) battery cable.
2. Disable the SIR system; refer to **DISABLING THE SIR SYSTEM**, in this section.

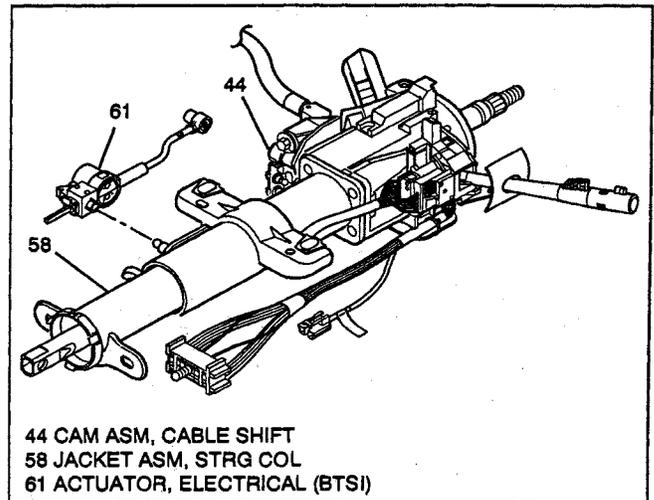


Figure 15 - Removing Electrical (BTSI) Actuator

3. Electrical (BTSI) actuator (61) from column.
 - A. Column in "NEUTRAL" position.
 - B. Pry (BTSI) actuator (61) from mounting pin on steering column jacket assembly (58) and outer shift cable ball stud on cable shift cam assembly (44).
 - C. Axial position assurance connector (23) from electrical connector.
 - Electrical connector from (BTSI) actuator (61).

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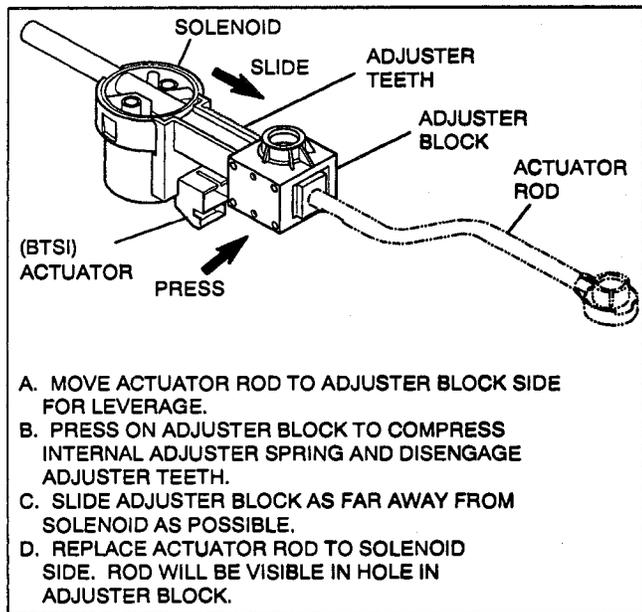


Figure 16 - Adjusting Electrical (BTSI) Actuator

Adjust

- Electrical (BTSI) Actuator (61).
(See Figures 16, 17)
- A. Move actuator rod to adjuster block side for leverage.
 - B. Press on adjuster block to compress internal adjuster spring and disengage the adjuster teeth.
 - C. Slide the adjuster block as far away from the solenoid as possible.
 - D. Replace actuator rod to solenoid side.

Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Electrical (BTSI) actuator (61) to column.
 - A. Column in "Neutral" position.
 - B. (BTSI) actuator (61) to mounting pin on steering column jacket assembly (58) and outer shift cable ball stud on cable shift cam assembly (44).
 - C. Electrical connector to (BTSI) actuator (61).
 - Axial position assurance connector (23) to electrical connector.

2. If all service operations are completed, enable the SIR system; refer to ENABLING THE SIR SYSTEM, in this section.
3. Negative (-) battery cable.

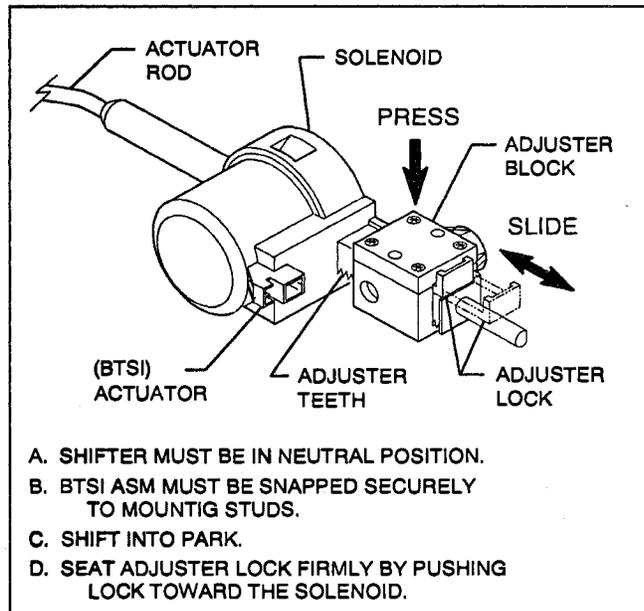


Figure 17 - (BTSI) Adjuster Lock

Inspect

- Function check Electrical (BTSI) actuator (61) for proper operation.
- Actuator (61) must lock gearshift lever when ever steering column is in "PARK" position and when trying to shift from "PARK" position without pressing brake pedal. (Solenoid is energized)
- Actuator (61) must release gearshift lever when pressure is applied to brake pedal. (Solenoid is de-energized)
- Readjust if needed.

LINEAR SHIFT ASM (REMOVAL)

(c/s only)

Figures 1,3,15 through 21

Tools Required:

J 41352 Modular Column Holding Fixture

J 41396 Park Lock Cable Pliers

NOTICE: Linear shift assembly (40) may be removed as an assembly or certain components may be disassembled as necessary to do repairs. Remove or disassemble only those components necessary to do repairs.

Remove or Disconnect

1. Do all steps, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.
2. Park lock cable assembly (48) from lock module assembly (15).
 - Lock cylinder should be in "OFF-LOCK" position and gear shift in "PARK" position.
 - Insert small blade screwdriver into slot in module assembly (15). Push against locking tab on end of cable assembly (48) and remove.
3. Pry actuator arm of electrical (BTISI) actuator (61) from outer shift cable ball stud on cable shift cam assembly (44) and mounting pin on jacket (58).
4. Transaxle cable from inner shift cable ball stud on cable shift cam assembly (44).

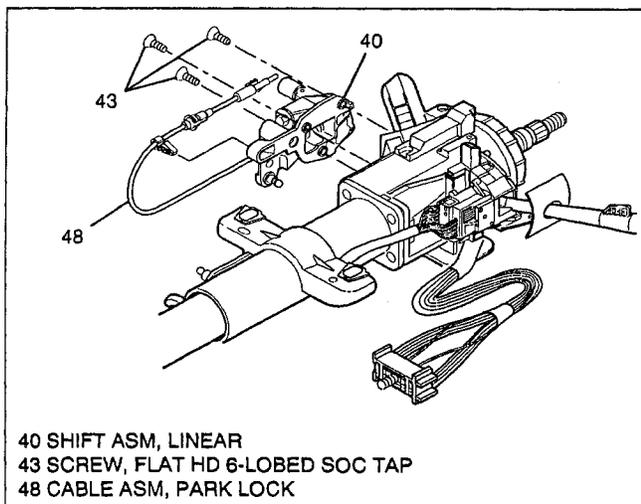


Figure 18 - Removing Linear Shift Assembly

5. Three flat head 6 -lobed socket tap screws (43).
 - Shift column to "NEUTRAL" position to gain access to lower socket tap screw (43).
6. Linear shift assembly (40) from column.

Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do may result in component damage or malfunction of steering column.

1. Linear shift assembly (40) to column.
2. Three flat head 6-lobed socket tap screws (43).
 - Linear shift assembly (40) must be out of "PARK" position to install lower socket tap screw (43).

Tighten

- Tighten screws (43) to 10 N·m (89 lb.in.).
3. Transaxle cable to inner shift cable ball stud on cable shift cam assembly (44).
 4. Park lock cable assembly (48) to lock module assembly (15).
 - Lock cylinder should be in "OFF-LOCK" position and gear shift in "PARK" position.
 - Locking tab on end of cable (48) to slot in module assembly (15).
 5. Actuator arm of electrical (BTISI) actuator (61) to outer shift cable ball stud on cable shift cam assembly (44).
 6. Do **Adjust and Inspect**, "Install or Connect", ELECTRICAL (BTISI) ACTUATOR, in this section.

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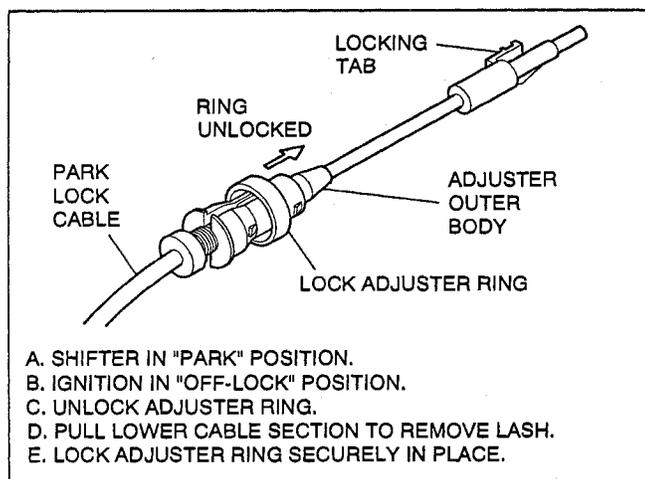


Figure 19 - Adjusting Park Lock Cable

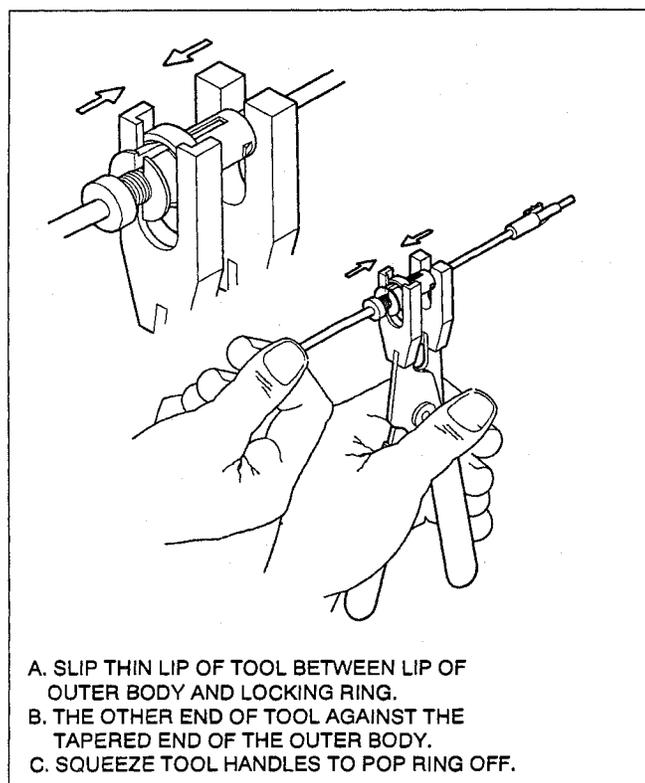


Figure 20 - Unlocking Adjuster Ring on Park Lock Cable

Adjust

- Park lock cable assembly (48). (See Figure 9)
 - A. Gear shift lever installed and in "PARK" position.
 - B. Ignition in "OFF LOCK" position and remove key.

- C. Unlock adjuster ring on cable assembly (48) with tool J 41396. (See Figure 20).
- D. Pull on cable until park lock latch contacts gear shift lever.
 - Release the cable.
- E. Lock adjuster ring securely in place on cable assembly (48) with tool J 41396. (See Figure 21)

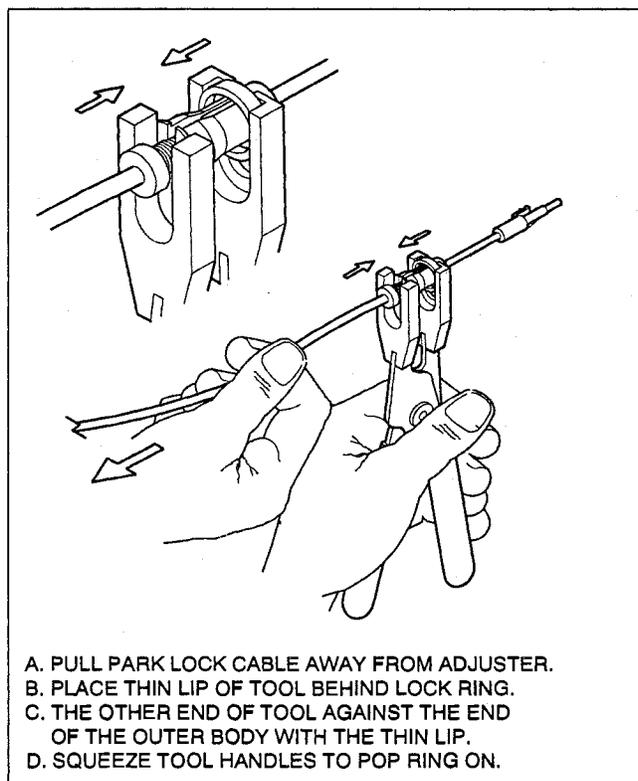


Figure 21 - Park Lock Cable Locking Adjuster Ring

Inspect

- Park lock cable assembly (48). (See Figure 19)
 - A. With lock cylinder in "OFF-LOCK" position, gear shift lever should not be able to shift out of "PARK" position.
 - B. Insert key and turn to "RUN" position.
 - C. Shifter in "NEUTRAL" position.
 - D. With gear shift in "NEUTRAL" position, lock cylinder should not be able to go into "OFF-LOCK" position.
 - E. Shifter in "PARK" position.
 - F. Lock cylinder in "OFF-LOCK" position and remove key.
- 7. Do all steps "Install or Connect", LOWER SHROUD, UPPER SHROUD, in this section.

**LINEAR SHIFT ASM (DISASSEMBLY)
 BALL & ACTUATOR ASM
 SHIFT LEVER CLEVIS
 PARK LOCK CABLE ASM
 G/S LEVER ASM SUPPORT BRKT**

(c/s only)

Figures 1,3,15 through 22

Tools Required:

- J 41352 Modular Column Holding Fixture
- J 41396 Park Lock Cable Pliers

Disassemble

1. Do all steps "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.

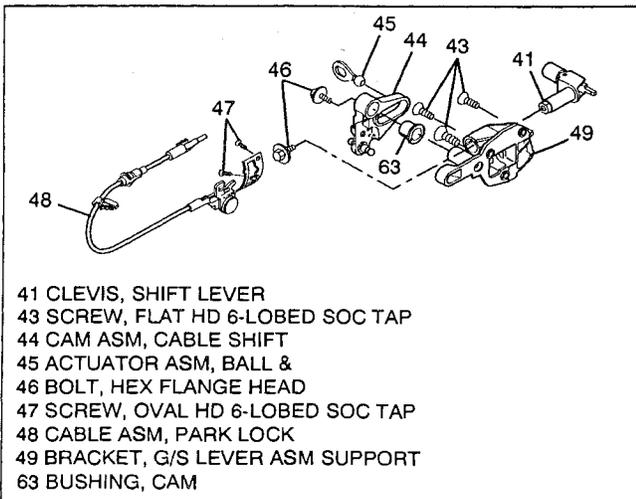


Figure 22 - Disassembling Linear Shift Assembly

2. Hexagon flanged head bolt (46).
3. Ball & actuator assembly (45).
4. Pop off locking ring on park lock cable assembly (48). (See Figure 19,20)
 - Move park lock latch to gain access to lower oval head 6-lobed socket tap screw (47).
5. Two oval head 6-lobed socket tap screws (47) from shift gate.
6. Shift lever clevis (41).
 - A. Lift up on shift gate and rotate shift lever clevis (41).
 - B. Clevis (41) from gearshift lever assembly support bracket (49).
7. Park lock cable assembly (48) from support bracket (49). Insert retaining clip.

8. Pry actuator arm of electrical (BTSI) actuator (61) from outer shift cable ball stud on cable shift cam assembly (44).
9. Pry transaxle shift cable from inner ball stud on cable shift cam assembly (44).
10. Hexagon flange head bolt (46).
11. Cable shift cam assembly (44).
12. Cam bushing (63) from cable shift cam assembly (44).
13. Three flat head 6-lobed socket tap screws (43).
14. Gearshift lever assembly support bracket (49).

Assemble

1. Lubricate all moving parts of assembly with synthetic grease.
2. Gearshift lever assembly support bracket (49).
3. Three flat head 6-lobed socket tap screws (43).

Tighten

- Tighten screws (43) to 10 N·m (89 lb.in.).

4. Insert cam bushing (63) into cable shift cam assembly (44).
5. Cable shift cam assembly (44).
6. Hexagon flange head bolt (46).

Tighten

- Tighten bolt (46) to 18.0 N·m (14 lb.ft.).

7. Transaxle shift cable to inner ball stud on cable shift cam assembly (44).
8. Actuator arm of electrical (BTSI) actuator (61) to outer shift cable ball stud on cable shift cam assembly (44).
9. Park lock cable assembly (48) to support bracket (49). Remove retaining clip.
10. Shift lever clevis (41) and shift gate to support bracket (49).
 - A. Position shift gate to end of clevis (41) lever.
 - B. Rotate clevis (41) and shift gate into position.
 - C. Push against shift lever spring tension to align shift gate holes with support bracket (49) holes.

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- Two oval head 6-lobed socket tap screws (47).

Tighten

- Tighten screws (47) to 6.5 N·m (58 lb.in.).

- Ball & actuator assembly (45).
- Hexagon flanged head bolt (46).

Tighten

- Tighten bolt (46) to 18.0 N·m (14 lb.ft.).

- Park lock cable assembly (48) to lock module assembly (15).
 - Lock cylinder should be in "OFF-LOCK" position and gear shift in "PARK" position.
 - Locking tab on end of cable (48) to slot in module assembly (15).
- Do **Adjust** and **Inspect**, "Install or Connect", LINEAR SHIFT ASM (REMOVAL), in this section.
- Do all steps, "Install or Connect", LOWER SHROUD, UPPER SHROUD, in this section.

UPPER COLUMN HOUSING COMPONENTS SHAFT LOCK SHIELD ASM TURN SIGNAL CANCEL CAM ASM UPPER BEARING SPRING THRUST WASHER

Figures 1, 3, 5, 9, 21 and 22

Tools Required:

J 23653-SIR Lock Plate Compressor

Remove or Disconnect

- Do steps 1 through 6, "Remove or Disconnect", COIL ASSEMBLY, in this section.
 - Let coil assembly (2) hang freely.

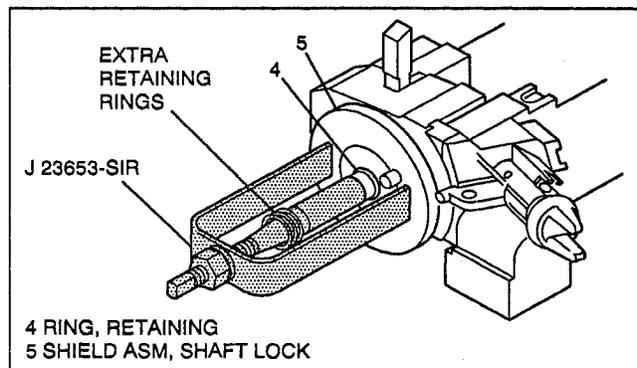


Figure 23 - Removing Shaft Lock Retaining Ring

- Shaft lock retaining ring (4) using J 23653-SIR to push down shaft lock shield assembly (5).
 - Dispose of ring (4).

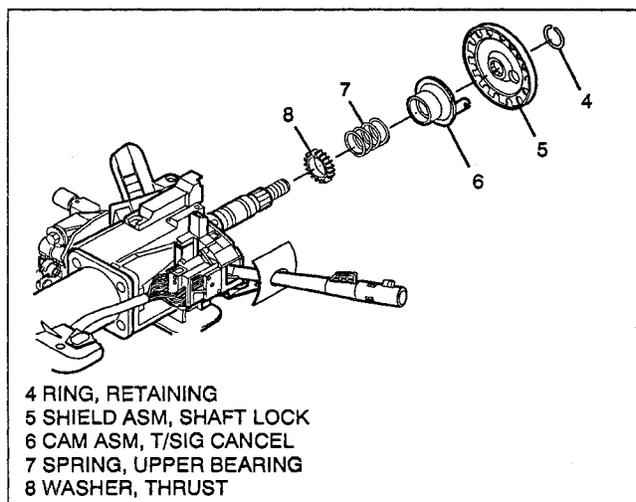


Figure 24 - Removing Upper Shaft Components

- Shaft lock shield assembly (5).
- Turn signal cancel cam assembly (6).
- Upper bearing spring (7).
- Thrust washer (8).

Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F4-1 in this section. Failure to do may result in component damage or malfunction of steering column.

- Thrust washer (8).
- Upper bearing spring (7).

3. Turn signal cancel cam assembly (6).
 - Lubricate lower brass surface with grease, synthetic (service kit).
4. Shaft lock shield assembly (5).
 - Align inner block tooth of lock plate to block tooth of steering shaft assembly (32).
5. New shaft lock retaining ring (4) using J 23653-SIR to push down shaft lock shield assembly (5).
 - Ring (4) must be firmly seated in groove on shaft.
6. Do steps 1 through 4 and 7 through 10, "Install or Connect", COIL ASSEMBLY, in this section.
6. Three pan head tapping screws (13).
7. Lock module assembly (15).
8. Lock bolt assembly (11) with lock bolt spring (12).
 - Spring (12) from lock bolt (11).
9. Steering column lock cylinder set (17).
 - Turn lock cylinder (17) to "RUN" position.
 - Insert small blade screwdriver into hole on top of module assembly (15). Push against locking button and remove lock cylinder (17).

LOCK MODULE ASM

Figures 1, 4, 5, 7 through 21 and 25

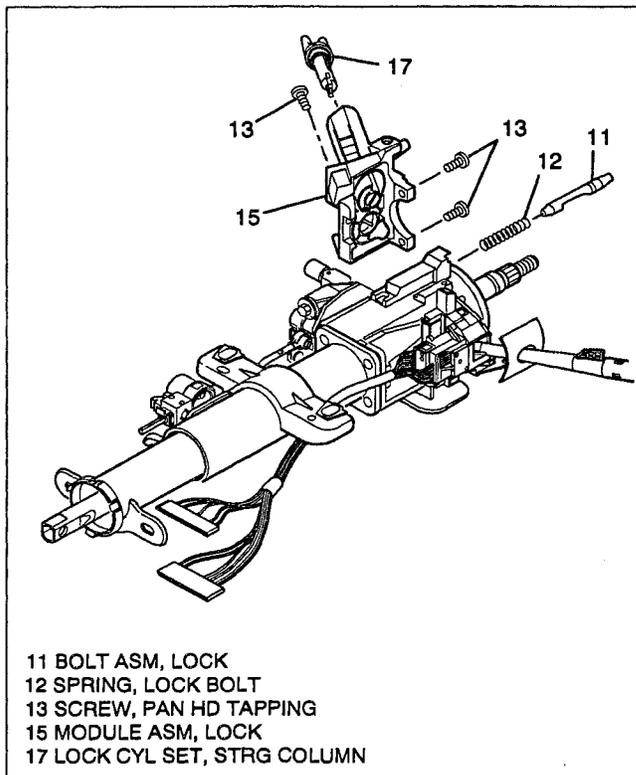
Tools Required:

- J 23653-SIR Lock Plate Compressor
- J 41396 Park Lock Cable Pliers

↔ Remove or Disconnect

1. Do steps 1 through 4, "Remove or Disconnect", UPPER COLUMN HOUSING COMPONENTS, in this section.
2. Park lock cable assembly (48) from lock module assembly (15).
 - Lock cylinder should be in "OFF-LOCK" position and gear shift in "PARK" position.
 - Insert small blade screwdriver into slot in module assembly (15). Push against locking tab on end of cable assembly (48) and remove.
3. Key alarm switch from module assembly (15). (See Figure 9)
 - Gently pry retaining clip on alarm switch with small blade screwdriver.
 - Rotate alarm switch 1/4 turn and remove.
4. Two tapping screws (18).
5. Ignition & key alarm switch assembly (19).
 - Let switch (19) hang freely.

NOTICE: Lock bolt assembly (11) is under slight spring tension from lock bolt spring (12). Hold lock bolt (11) in place while removing lock module assembly (15).



11 BOLT ASM, LOCK
 12 SPRING, LOCK BOLT
 13 SCREW, PAN HD TAPPING
 15 MODULE ASM, LOCK
 17 LOCK CYL SET, STRG COLUMN

Figure 25 - Removing Lock Module Assembly

→← Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F4-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Steering column lock cylinder set (17).
 - Key installed in lock cylinder (17).
 - Ensure sector is in "RUN" position. (See Figure 5, 14).
 - Line up locking tab with slot in lock module assembly (15) and push into position.
 - Turn lock cylinder (17) to "LOCK" position.

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2. Lock bolt assembly (11) with lock bolt spring (12).
 - Ensure cutout in lock bolt (11) is in the 6 o'clock position. (See Figure 25)
3. Lock module assembly (15).
 - Push lock bolt (11) into steering column housing assembly (26) until flush.
 - Align lock module assembly (15) with housing assembly (26) and install.
4. Three pan head tapping screws (13).

Tighten

- Tighten screws (13) to 6.0 N·m (53 lb.in.)
5. Ignition & key alarm switch assembly (19).
 6. Two tapping screws (18).

Tighten

- Tighten screws (18) to 1.4 N·m (12 lb.in.).
7. Alarm switch to module assembly (15).
 - A. Switch with retaining clip parallel to lock cylinder (17).
 - B. Rotate switch 1/4 turn until locked into place.

8. Park lock cable assembly (48) to module assembly (15). (See Figure 18)
 - Lock cylinder should be in "OFF-LOCK" position and gear shift in "PARK" position.
 - Locking tab on end of cable (48) to slot in module assembly (15).

Adjust

- Park lock cable assembly (48). (See Figure 18,19)
 - A. Gear shift lever installed and in "PARK" position.
 - B. Ignition in "OFF LOCK" position and remove key.
 - C. Unlock adjuster ring on cable assembly (48) with tool J 41396. (See Figure 20)
 - D. Pull on cable until park lock latch contacts gear shift lever.
 - Release the cable.

- E. Lock adjuster ring securely in place on cable assembly (48) with tool J 41396. (See Figure 21)

Inspect

- Park lock cable assembly (48). (See Figure 19)
 - A. With lock cylinder in "OFF-LOCK" position, gear shift lever should not be able to shift out of "PARK" position.
 - B. Insert key and turn to "RUN" position.
 - C. Shifter in "NEUTRAL" position.
 - D. With gear shift in "NEUTRAL" position, lock cylinder should not be able to go into "OFF-LOCK" position.
 - E. Shifter in "PARK" position.
 - F. Lock cylinder in "OFF-LOCK" position and remove key.
9. Do steps 3 through 6, "Install or Connect", UPPER COLUMN HOUSING COMPONENTS, in this section.

STRG COL HOUSING ASM

Figures 1, 4 through 25

Tools Required:

- J 23653-SIR Lock Plate Compressor
- J 41396 Park Lock Cable Pliers

Remove or Disconnect

1. Do all steps, "Remove or Disconnect", COIL ASSEMBLY, in this section.
2. Do steps 7 and 8, "Remove or Disconnect", T/S & MULTIFUNCTION SWITCH ASM, in this section.
3. Do steps 2 through 6, "Remove or Disconnect", LINEAR SHIFT ASM (REMOVAL), in this section.
4. Do steps 2 through 6, "Remove or Disconnect", UPPER COLUMN HOUSING COMPONENTS, in this section.
5. Do steps 2 through 9, "Remove or Disconnect", LOCK MODULE ASM, in this section.
6. Four torx head screws (9).
7. Steering column housing assembly (26).

↔ Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F4-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Steering column housing assembly (26).
2. Four torx head screws (9).

⌚ Tighten

- Tighten screws (9) to 9.0 N·m (80 lb.in.)

3. Do steps 1 through 8, "Install or Connect", LOCK MODULE ASM, in this section.
4. Do steps 1 through 5, "Install or Connect", UPPER COLUMN HOUSING COMPONENTS, in this section.
5. Do steps 1 through 5, "Install or Connect", LINEAR SHIFT ASM (REMOVAL), and Adjust and Inspect, in this section.
6. Do all steps, "Install or Connect", COIL ASSEMBLY, in this section.

**STEERING SHAFT ASM
ADAPTER & BEARING ASM
STRG COL JACKET ASM**

Figures 1, 3, 4, 5, 19, through 24, 26 and 27

Tools Required:

- J 23653-SIR Lock Plate Compressor
- J 41352 Modular Column Holding Fixture

↔ Remove or Disconnect

1. Negative (-) battery cable.
2. Disable the SIR System; refer to DISABLING THE SIR SYSTEM, in this section.
3. Do steps 1 through 7, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.
4. Do all steps "Remove or Disconnect", UPPER COLUMN HOUSING COMPONENTS, in this section.
5. Cplg & Strg shaft assembly (68) or Yoke & Inter Strg shaft assembly (64) (Depending on Model) from shaft assembly (32).
 - Remove bolt

6. Adapter & bearing assembly (60), steering shaft assembly (32), and evo sensor asm (62) from bottom of jacket assembly (58).
7. Evo sensor asm (62) and Adapter & bearing assembly (60) from shaft assembly (32).
 - Retaining ring (31) from shaft assembly (32).

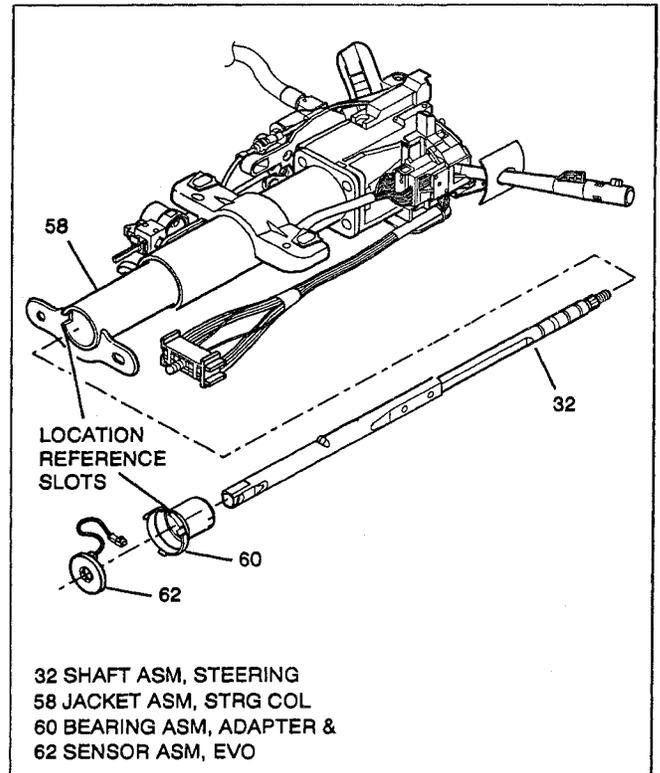


Figure 26 - Removing Steering Shaft Assembly

↔ Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F4-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Retaining ring (31) to steering shaft assembly (32).
2. Shaft assembly (32) through bottom of jacket assembly (58).

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3. Evo sensor asm (62) and Adapter & bearing assembly (60) to steering column jacket assembly (58). (See Figure 26).
 - Position tab on adapter & bearing assembly (60) with slot in steering column jacket assembly (58) and push together.
4. Cplg & Strg shaft assembly (68) or Yoke & Inter Strg shaft assembl (64) to shaft assembly (32).

Tighten

- Tighten bolt to 47 N·m (35 lb.ft.).

Tighten

- Tighten Hex Hd Nut (67) to 62 N·m (46 lb.ft.).
5. Do steps 1 through 5, "Install or Connect", UPPER COLUMN HOUSING COMPONENTS, in this section.
 6. Do steps 1 through 7, "Install or Connect", COIL ASSEMBLY, in this section.
 7. Steering column assembly to vehicle, refer to section 3F.
 8. If all service operations are completed, enable the SIR system; refer to ENABLING THE SIR SYSTEM in this section.
 9. Negative (-) battery cable.

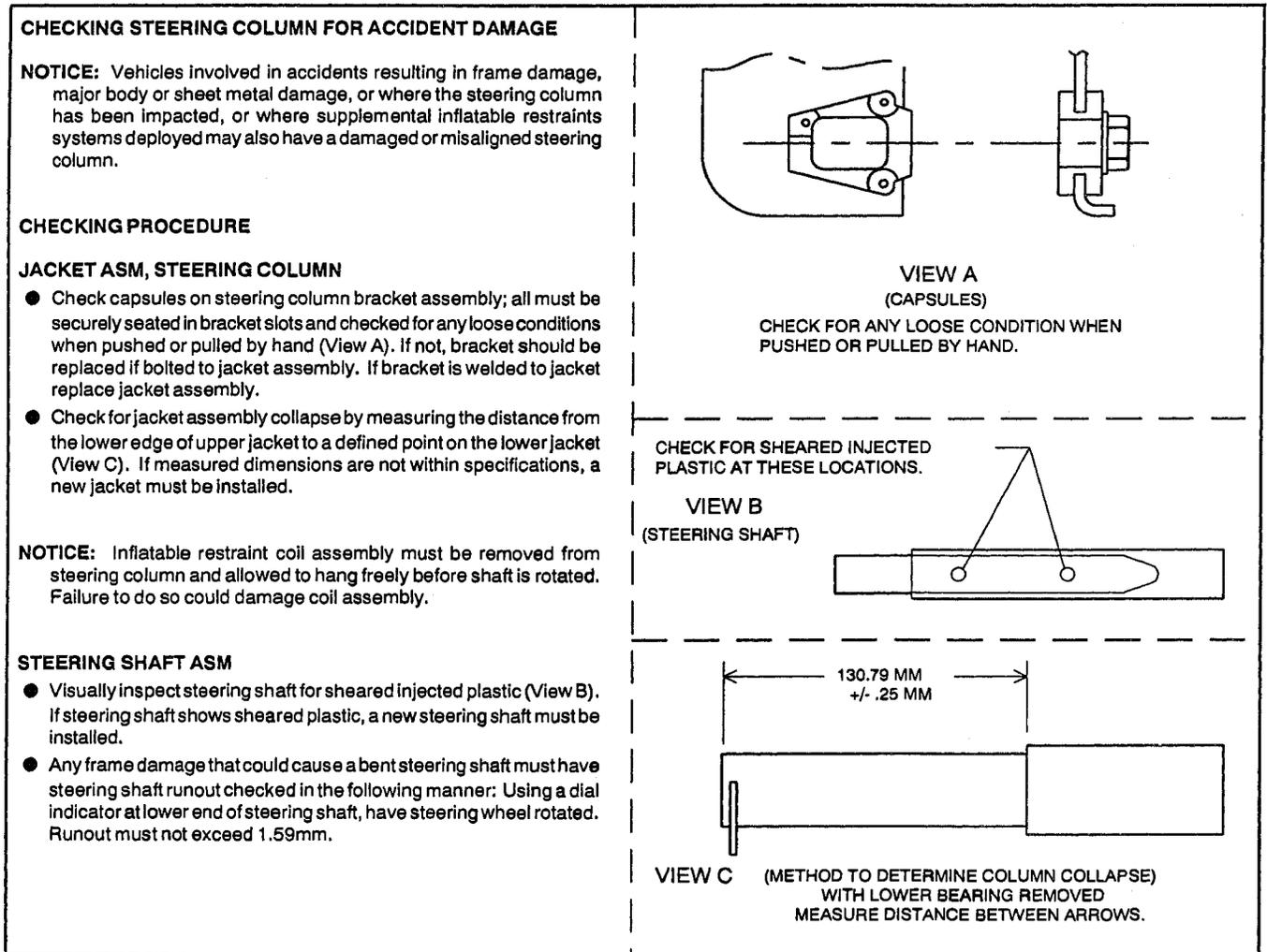


Figure 27 - Checking for Accident Damage

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

(1) Steering Wheel-to-Shaft Nut	41.0 N·m (30 lb.ft.)
(9) Housing Assembly-to-Jacket Screws	9.0 N·m (80 lb.in.)
(13) Lock Cylinder Module Screws	6.0 N·m (53 lb.in.)
(13) Turn Signal & Multifunction Switch Screws	6.0 N·m (53 lb.in.)
(13) Lower Shroud Screws	6.0 N·m (53 lb.in.)
(14) Upper Shroud Screws	1.4 N·m (12 lb.in.)
(18) Ignition & Key Alarm Switch Screws	1.4 N·m (12 lb.in.)
(31) Shift Lever Screw	20.0 N·m (15 lb.ft.)
(43) G/S Lever Support Bracket Screws	10.0 N·m (89 lb.in.)
(46) Shift Lever Clevis and Cable shift Cam Screws	18.0 N·m (14 lb.ft.)
(47) Shift Lever Gate Screws	6.5 N·m (58 lb.in.)
(65) Round Hd Locking Bolt	47.0 N·m (35 lb.ft.)
(66) Pinch Bolt	47.0 N·m (35 lb.ft.)
(67) Hex Hd Nut	62.0 N·m (46 lb.ft.)

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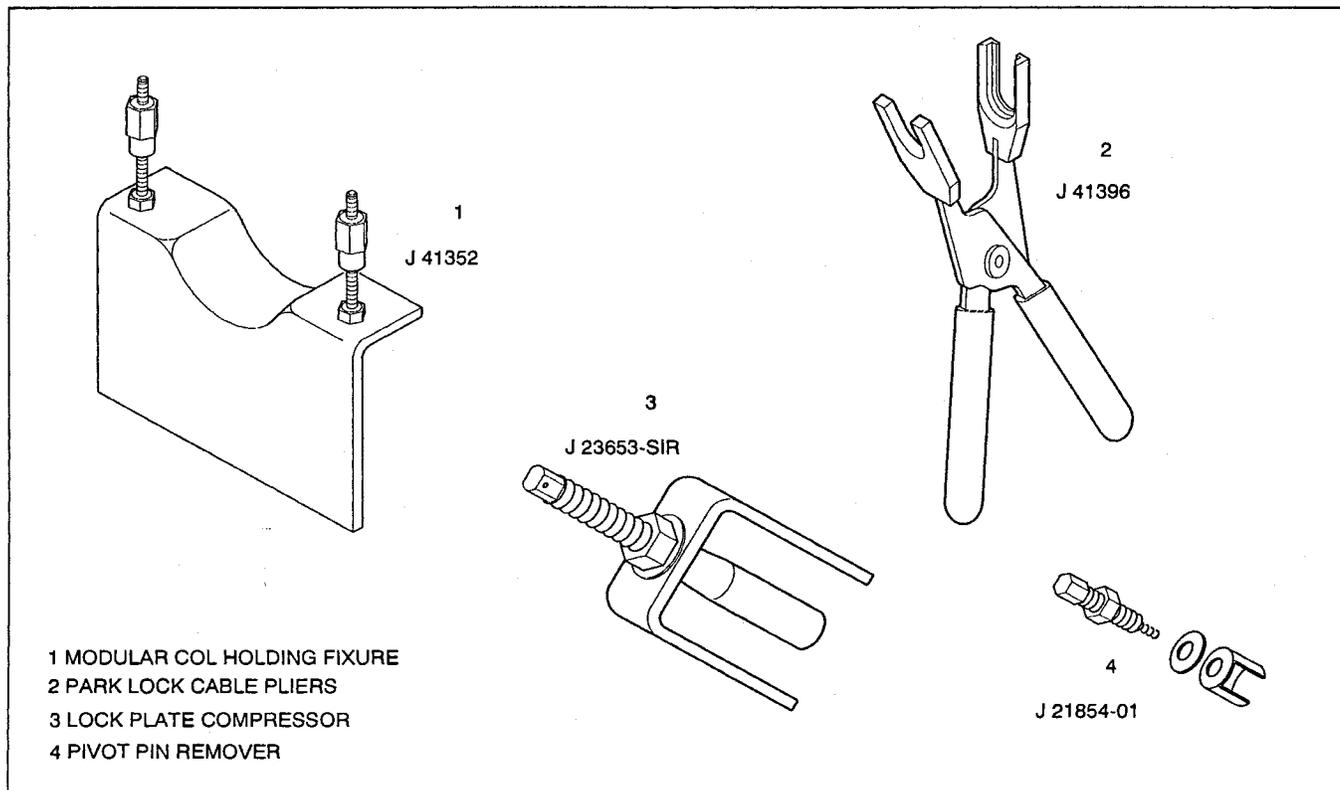


Figure 28 - Special Tools

SECTION 3F5

SUPPLEMENTAL INFLATABLE RESTRAINT (SIR) TILT STEERING COLUMN UNIT REPAIR

CAUTION: The procedures in this section must be followed in the order listed to temporarily disable the Supplemental Inflatable Restraint (SIR) System and prevent false diagnostic codes from setting. Failure to follow procedures could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

CAUTION: Before removing or installing any electrical unit or when a tool or equipment could easily come in contact with "live" exposed electrical terminals, disconnect the negative battery cable to help prevent personal injury and/or damage to the vehicle or components. Unless instructed otherwise, the ignition switch must be in the "off" or "lock" position.

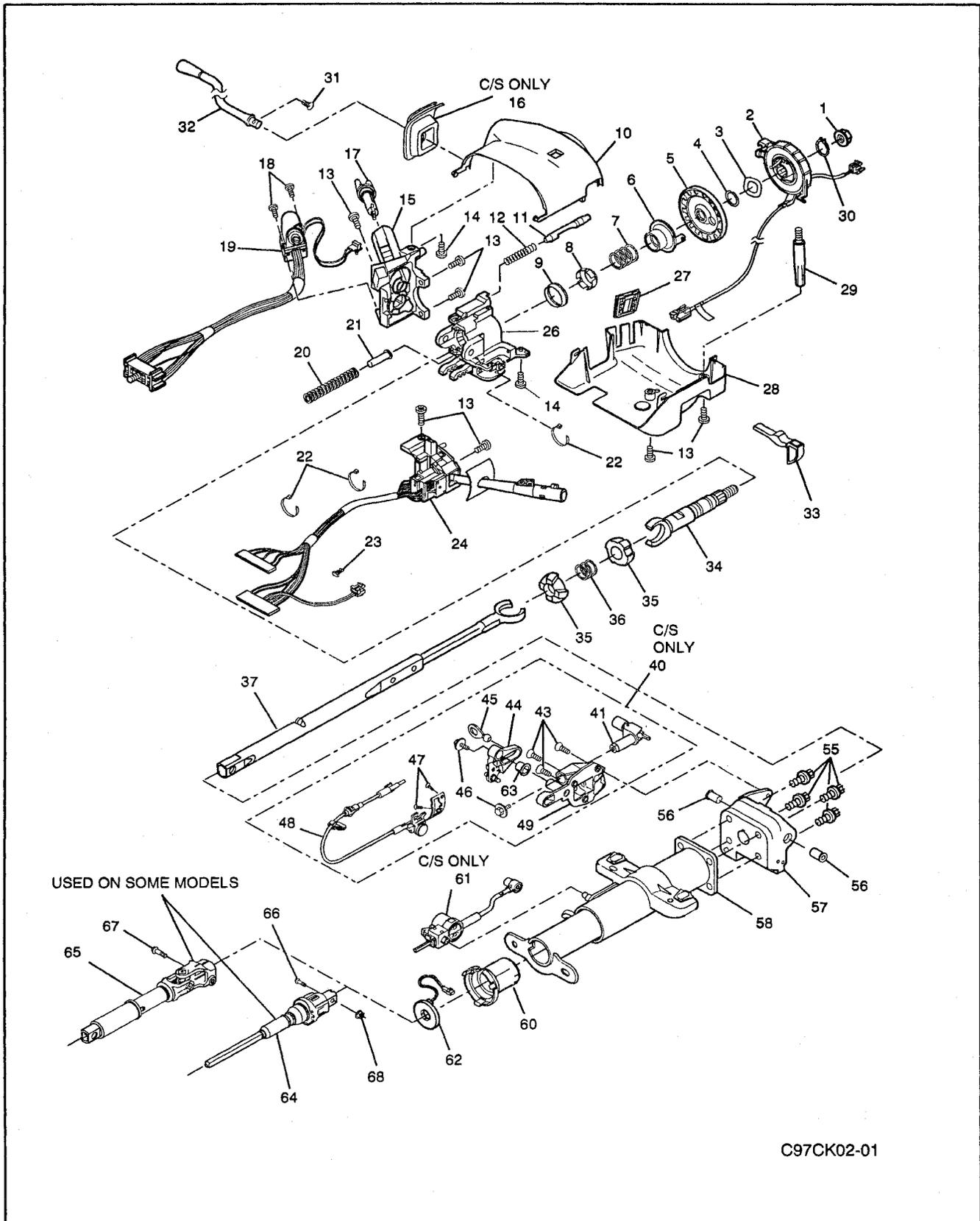
NOTICE: Always use the correct fastener in the proper location. When you replace a fastener, use ONLY the exact part number for that application. General Motors will call out those fasteners that require thread lockers or thread sealant. UNLESS OTHERWISE SPECIFIED, do not use supplemental coatings (paints, greases, or other corrosion inhibitors) on threaded fasteners or fastener joint interfaces. Generally, such coatings adversely affect the fastener torque and the joint clamping force, and may damage the fastener. When you install fasteners, use the correct tightening sequence and specifications. Following these instructions can help you avoid damage to parts and systems.

NOTICE: Once steering column is removed from vehicle, the column is extremely susceptible to damage. Dropping steering column assembly on its end could collapse steering shaft or loosen plastic injections which maintain column rigidity. Leaning on steering column assembly could cause jacket to bend or deform. Any of the above damage could impair steering column's collapsible design. If it is necessary to remove steering wheel, use only the specified steering wheel puller and holding fixture. Never place column directly into a vise. Under no conditions should the end of shaft be hammered on as hammering could loosen plastic injections which maintain steering column rigidity.

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3F5-2 TILT STRG COL UNIT REPAIR (SIR)



C97CK02-01

Figure 1 - Tilt Steering Column

- | | |
|--|---------------------------------|
| 1-NUT, HEXAGON LOCKING (M14x1.5) | 63-BUSHING, CAM |
| 2- COIL ASM, INFLATABLE RESTRAINT
STEERING WHEEL MODULE | 64-SHAFT ASM, CPLG & STRG |
| 3-WASHER, WAVE | 65-SHAFT ASM, YOKE & INTER STRG |
| 4-RING, RETAINING | 66-BOLT, ROUND HD LOCKING |
| 5-SHIELD ASM, SHAFT LOCK | 67-BOLT, PINCH |
| 6-CAM ASM, T/SIG CANCEL | 68-NUT, HEX HD |
| 7-SPRING, UPPER BEARING | |
| 8-SEAT, UPPER BEARING INNER RACE | |
| 9-RACE, INNER | |
| 10-SHROUD, UPPER | |
| 11-BOLT ASM, LOCK | |
| 12-SPRING, LOCK BOLT | |
| 13-SCREW, PAN HD TAPPING | |
| 14-SCREW, TORX HEAD | |
| 15-ASM, LOCK MODULE | |
| 16-SEAL, SHIFT LEVER | |
| 17-LOCK CYL SET, STRG COLUMN | |
| 18-SCREW, TAPPING | |
| 19-SWITCH ASM, IGN & KEY ALARM | |
| 20-SPRING, TILT | |
| 21-GUIDE, SPRING | |
| 22-STRAP, WIRE HARNESS | |
| 23-CONNECTOR, AXIAL POSN ASSUR | |
| 24-SWITCH ASM, T/S & MULTIFUNCTION | |
| 26-TILT HEAD ASM, STRG COL | |
| 27-PROTECTOR, SHROUD | |
| 28-SHROUD, LOWER | |
| 29-STUD, SHROUD MOUNTING | |
| 30-RING, RETAINING | |
| 31- SCREW, SHIFT LEVER | |
| 32-LEVER ASM, A/TRNS CONTROL | |
| 33- LEVER ASM, TILT | |
| 34-SHAFT ASM, RACE & UPPER | |
| 35-SPHERE, CENTERING | |
| 36-SPRING, JOINT PRELOAD | |
| 37-SHAFT ASM, LOWER STRG | |
| 40-SHIFT ASM, LINEAR | |
| 41-CLEVIS, SHIFT LEVER | |
| 43-SCREW, FLAT HD 6-LOBED SOC TAP | |
| 44-CAM ASM, CABLE SHIFT | |
| 45-ACTUATOR ASM, BALL & | |
| 46-BOLT, HEX FLANGE HEAD | |
| 47-SCREW, OVAL HD 6-LOBED SOC TAP | |
| 48-CABLE ASM, PARK LOCK | |
| 49-BRACKET, G/S LEVER ASM SUPPORT | |
| 55-SCREW, TORX HEAD | |
| 56-PIN, PIVOT | |
| 57-SUPPORT ASM, STRG COL | |
| 58-JACKET ASM, STRG COL | |
| 60-BEARING ASM, ADAPTER & | |
| 61-ACTUATOR, ELECTRICAL (BTSI) | |
| 62-SENSOR ASM, EVO | |

Figure 2 - Tilt Steering Column - Legend

3F5-4 TILT STRG COL UNIT REPAIR (SIR)

DISABLING THE SIR SYSTEM

SERVICE PRECAUTIONS

CAUTION: When performing service on or around SIR components or SIR wiring, follow the procedures listed below to temporarily disable the SIR system. Failure to follow procedures could result in possible air bag deployment, personal injury, or otherwise unneeded SIR system repairs.

The DERM can maintain sufficient voltage to cause a deployment for up to 2 minutes after the ignition switch is turned "OFF" or the battery is disconnected. Many of the service procedures require disconnection of the "AIR BAG" fuse and the inflator module circuits from the deployment loops to avoid an accidental deployment.

Remove or Disconnect

- Turn the steering wheel so that the vehicle's wheels are pointing straight ahead.
 - Turn the ignition switch to "LOCK" and remove key.
1. "AIR BAG" fuse from I/P fuse block.
 2. Steering column filler panel. Refer to section 10A4.
 3. Connector position assurance (CPA) retainer and yellow 2-way SIR connector at base of steering column.

Important

- With the "AIR BAG" fuse removed and ignition switch "ON", the "AIR BAG" warning lamp will be "ON". This is normal operation and does not indicate an SIR system malfunction.

ENABLING THE SIR SYSTEM

Install or Connect

- Turn the ignition switch to "LOCK" and remove key.

1. Yellow 2-way SIR connector and CPA retainer at base of steering column.
2. "AIR BAG" fuse to I/P fuse block.
3. Steering column filler panel. Refer to section 10A4.
 - Turn ignition switch to "RUN" and verify that the "AIR BAG" warning lamp flashes 7 times and then turns "OFF". If it does not operate as described, perform the "SIR Diagnostic System Check" in section 9J-A of the Service Manual Supplement.

UNIT REPAIR

LOWER SHROUD STRG COLUMN LOCK CYL SET UPPER SHROUD SHIFT LEVER SEAL (c/s only) *Figure 1, 3 through 5, 14, and 29*

Tools Required:

J 41352 Modular Column Holding Fixture

Remove or Disconnect

1. Negative (-) battery cable.
2. Disable the SIR system; refer to DISABLING THE SIR SYSTEM in this Section.
3. Cplg & Strg shaft assembly (64) or Yoke & Inter Strg shaft assembly (65) (Depending on Model) from shaft assembly (37).
 - Remove bolt

NOTICE: Once steering column is removed from vehicle, the column is extremely susceptible to damage. See NOTICE on page 3F5-1 in this section.

4. Lower or remove steering column from vehicle; refer to section 3F.
 - Secure steering column to modular col. holding fixture J 41352.
 - Place holding fixture into vise. (See Fig.3)

Inspect

- Steering shaft assembly for accident damage. (See Figure 31).

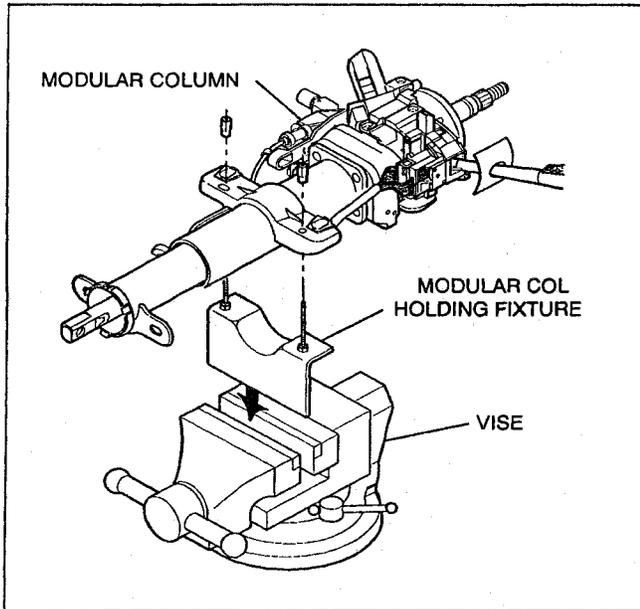


Figure 3 - Modular Column Holding Fixture

5. Tilt lever; refer to section 3F.
6. Two pan head tapping screws (13) from lower shroud (28).
7. Lower shroud (28).
 - Tilt shroud (28) down and slide back to disengage locking tabs.
8. Two torx head screws (14) from upper shroud (10).

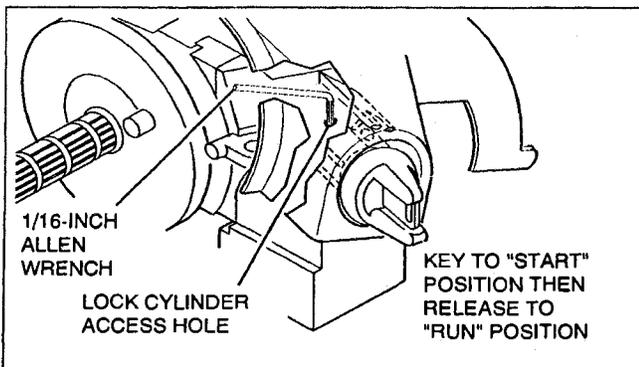


Figure 4 - Removing Lock Cylinder and Upper Shroud

9. Lift upper shroud (10) to gain access to lock cylinder hole.
 - A. Hold key in "START" position.
 - B. Using 1/16-inch allen wrench push on lock cylinder retaining pin.

- C. Release key to "RUN" position and pull steering column lock cylinder set (17) from lock module assembly (15).
- D. Remove upper shroud (10).

10. Shift lever; refer to section 3F.
11. Shift lever seal (16).
12. Shroud protector (27) from lower shroud (28).

↔ Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Shift lever seal (16).
2. Shift lever; refer to section 3F.
3. Shroud protector (27) to lower shroud (28).
4. Move shift lever seal (16) and multifunction lever seal to ease in installation of upper and lower shrouds.

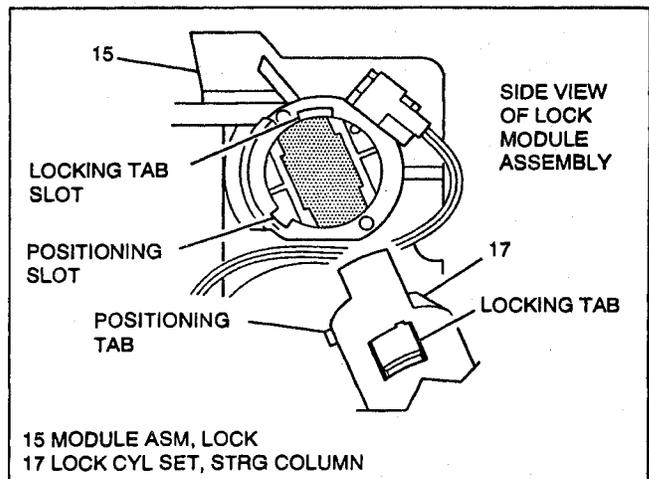


Figure 5 - Sector and Lock Cylinder Alignment Position

5. Upper shroud (10) and steering column lock cylinder set (17).
 - A. Key installed in lock cylinder (17) and in "RUN" position.
 - B. Ensure sector in lock module assembly (15) is in "RUN" position. (See Figure 4)
 - C. Lock cylinder (17) to upper shroud (10).
 - D. Line up locking tab and positioning tab with slots in lock module assembly (15) and push cylinder (17) into position.

3F5-6 TILT STRG COL UNIT REPAIR (SIR)

- Two torx head screws (14) to upper shroud (10).

Tighten

- Tighten screws (14) to 1.4 N·m (12 lb.in.).

- Lower shroud (28).
 - Ensure that slots on lower shroud (28) engage with tabs on upper shroud (10).
 - Tilt lower shroud up and snap shrouds together.
- Two pan head tapping screws (13) to lower shroud (28).

Tighten

- Tighten screws (13) to 6.0 N·m (53 lb.in.).

- Shift lever seal (16) and multifunction lever seal into position.
- Tilt lever; refer to section 3F.
- Raise or install steering column to vehicle; refer to section 3F.
- Cplg & Strg shaft assembly (64) or Yoke & Inter Strg shaft assembly (65) to shaft assembly (37).

Tighten

- Tighten bolt to 47 N·m (35 lb.ft.).

Tighten

- Tighten Hex Hd Nut (68) to 62 N·m (46 lb.ft.).

- If all service operations are completed, enable the SIR system; refer to "ENABLING THE SIR SYSTEM" in this section.
- Negative (-) battery cable.

COIL ASM, INFL RST STRG WHL MDL

Figures 1 through 7

Tools Required:

J 41352 Modular Column Holding Fixture

Remove or Disconnect

- Do steps 1 through 8, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.
- Air bag module and steering wheel; refer to service procedures in section 3F.

NOTICE: Coil assembly (2) will become uncentered if:

- Steering column is separated from steering gear and allowed to rotate.
- Centering spring is pushed down, letting hub rotate while coil asm (2) is removed from steering column. (If this occurs, refer to Figure 7 to center coil)

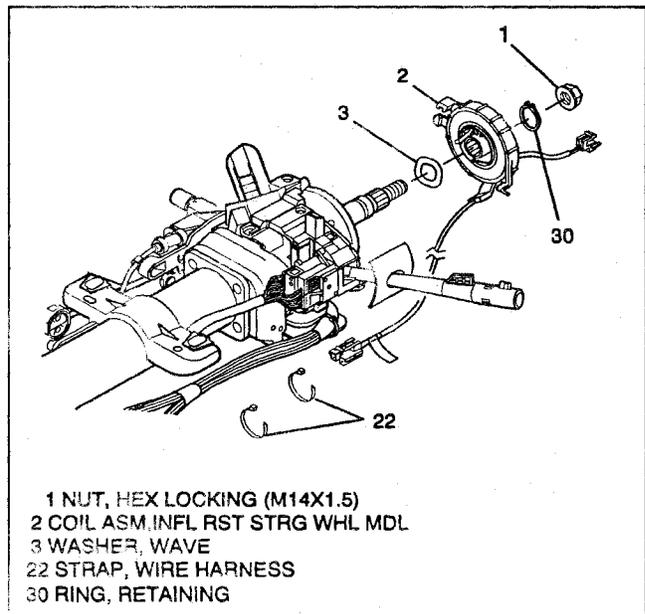


Figure 6 - Removing Coil Assembly

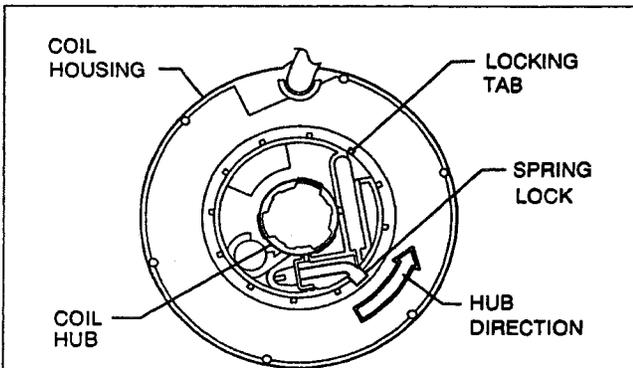
- Retaining ring (30).
- Coil assembly (2).
- Wave washer (3).
- Two wire harness straps (22) from steering column wire harness.

Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Center race & upper shaft assembly (34) and coil assembly (2).
 - A. Wheels straight ahead.
 - Block tooth and centering mark on shaft assembly (34) at 12 o'clock position.
 - B. Ignition switch to "LOCK" position.
 - C. Ensure coil asm (2) is centered; refer to figure (6).
2. Wave washer (3).

NOTICE: New coil assembly (2) will be pre-centered. Install new coil, remove and dispose of centering tab.



PERFORM THE FOLLOWING STEPS TO CENTER COIL ASSEMBLY

- A. WHEELS STRAIGHT AHEAD.
- B. REMOVE COIL ASSEMBLY.
- C. HOLD COIL ASSEMBLY WITH BOTTOM UP.
- D. WHILE HOLDING COIL ASSEMBLY, DEPRESS SPRING LOCK TO ROTATE HUB IN DIRECTION OF ARROW UNTIL IT STOPS.
- E. THE COIL RIBBON SHOULD BE WOUND UP SNUG AGAINST CENTER HUB.
- F. ROTATE COIL HUB IN OPPOSITE DIRECTION APPROXIMATELY TWO AND A HALF (2-1/2) TURNS. RELEASE SPRING LOCK BETWEEN LOCKING TABS.

Figure 7 - Centering Coil Assembly

3. Coil assembly (2).
 - A. Ensure shaft (34) and coil asm (2) are centered.
 3. Align coil asm (2) with horn tower and slide onto shaft (34).

4. Retaining ring (30).
 - Ring (30) must seat securely in groove on shaft (34).
5. Route lower coil wire along steering column jacket assembly (58).
6. Two wire harness straps (22) to steering column wire harness.
7. Do steps 4 through 11, "Install or Connect", LOWER SHROUD, UPPER SHROUD, in this Section.
8. Steering wheel and air bag module; refer to service procedures in section 3F.
9. If all service operations are completed, enable the SIR system; refer to ENABLING THE SIR SYSTEM in this section.
10. Negative (-) battery cable.

T/S & MULTIFUNCTION SWITCH ASM

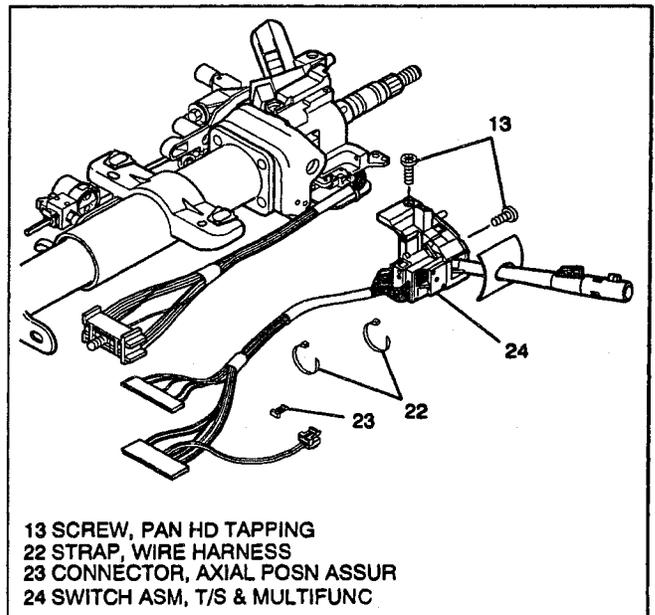
Figures 1 through 8

Tools Required:

J 41352 Modular Column Holding Fixture

Remove or Disconnect

1. Do steps 1 through 8, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.



- 13 SCREW, PAN HD TAPPING
- 22 STRAP, WIRE HARNESS
- 23 CONNECTOR, AXIAL POSN ASSUR
- 24 SWITCH ASM, T/S & MULTIFUNC

Figure 8 - Removing T/S & multifunction Switch

3F5-8 TILT STRG COL UNIT REPAIR (SIR)

- Two wire harness straps (22) from steering column wire harness.
- Steering column bulkhead connector from vehicle wire harness.
- Axial position assurance connector (23) from electrical (BTSI) actuator (61). (Column shift only)
 - Electrical connector from (BTSI) actuator (61).
- Grey and black connectors of turn signal & multifunction switch (24) from column bulkhead connector.
- Two pan head tapping screws (13).
- Turn signal & multifunction switch assembly (24) from column.

Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do may result in component damage or malfunction of steering column.

- Turn signal & multifunction switch assembly (24) to column.
 - With small blade screwdriver compress electrical contact and move multifunction switch (24) into position.
 - Electrical contact must rest on cancelling cam assembly (6).
- Two pan head tapping screws (13).

Tighten

- Tighten screws (13) to 6.0 N·m (53 lb.in.).
- Grey and black connectors of multifunction switch (24) to column bulkhead connector.
 - Electrical connector to electrical (BTSI) actuator (61). (Column shift only)
 - Axial position assurance connector (23).
 - Steering column bulkhead connector to vehicle wire harness.
 - Two wire harness straps (22) to steering column wire harness.
 - Do steps 4 through 11, "Install or Connect", LOWER SHROUD, UPPER SHROUD, in this section.

IGN & KEY ALARM SWITCH ASM

Figures 1 through 10

Tools Required:

J 41352 Modular Column Holding Fixture

Remove or Disconnect

- Do steps 1 through 8, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.
- Do steps 2 through 6, "Remove or Disconnect", T/S & MULTIFUNCTION SWITCH ASM, in this section.

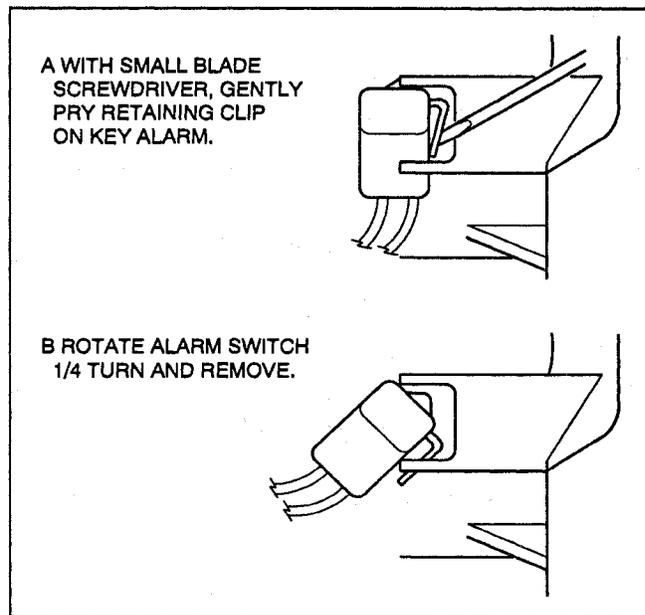


Figure 9 - Removing Alarm Switch

- Key alarm switch from lock module assembly (15).
 - Gently pry retaining clip on alarm switch with small blade screwdriver.
 - Rotate alarm switch 1/4 turn and remove.

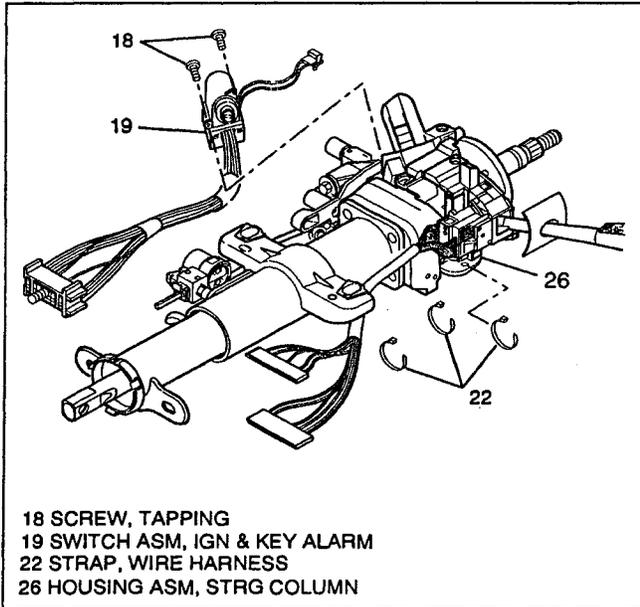


Figure 10 -Remove Ignition & Key Alarm Switch

4. Two tapping screws (18).
5. Ignition & key alarm switch assembly (19).
 - Wire harness from slot in steering column tilt head assembly (26).

→→ Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Ignition & key alarm switch assembly (19).
 - Route wire harness through slot in steering column tilt head assembly (26). Secure wire harness with a wire harness strap (22) through hole located in the bottom of housing assembly (26).
2. Two tapping screws (18).

Ⓐ Tighten

- Tighten screws (18) to 1.4 N·m (12 lb.in.).
3. Key alarm switch to lock module assembly (15).
 - A. Switch with retaining clip parallel to lock cylinder (17).
 - B. Rotate switch 1/4 turn until locked into place.
 4. Do steps 3 through 8, "Install or Connect", T/S & MULTIFUNCTION SWITCH ASM, in this section.

**STRG COLUMN LOCK CYL SET
 (Replacement-Lost Key)**

Figure 3-5, 6, 7, 9 through 21, 28, 30

Tools Required:

- J 23653-SIR Lock Plate Compressor
- J 41352 Modular Column Holding Fixture
- J 41396 Park Lock Cable Pliers

↔ Remove or Disconnect

1. Do steps 1 through 7, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section if you "DO NOT" have the "Key" to match the lock cylinder. The upper shroud (10) will remain with the lock module assembly (15).

NOTICE: If you "DO" have the "Key" that matches the lock cylinder, then do steps 1 through 9, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.

2. Air bag module and steering wheel; refer to service procedures in section 3F.

NOTICE: Coil assembly (2) will become uncentered if:

- 1) Steering column is separated from steering gear and allowed to rotate.
- 2) Centering spring is pushed down, letting hub rotate while coil (2) is removed from steering column. (If this occurs, refer to Figure 7 to center coil)

3. Retaining ring (30).
4. Coil assembly (2).
5. Wave washer (3).
6. Shaft lock retaining ring (4) using J 23653-SIR to push down shaft lock shield assembly (5).
 - Dispose of ring (4).
7. Shaft lock shield assembly (5).
8. Turn signal cancel cam assembly (6).
9. Park lock cable assembly (48) from lock module assembly (15).
 - Insert small blade screwdriver into slot in lock module assembly (15). Push against locking tab on end of cable assembly (48) and remove.

3F5-10 TILT STRG COL UNIT REPAIR (SIR)

10. Key alarm switch from lock module assembly (15).
(See Figure 9)
 - Gently pry retaining clip on alarm switch with small blade screwdriver.
 - Rotate alarm switch 1/4 turn and remove.
11. Two tapping screws (18).
12. Ignition & key alarm switch assembly (19).
 - Let switch (19) hang freely.

NOTICE: Lock bolt assembly (11) is under slight spring tension from lock bolt spring (12). Hold lock bolt (11) in place while removing lock module assembly (15).

13. Three pan head tapping screws (13).
14. Lock module assembly (15) with upper shroud (10).

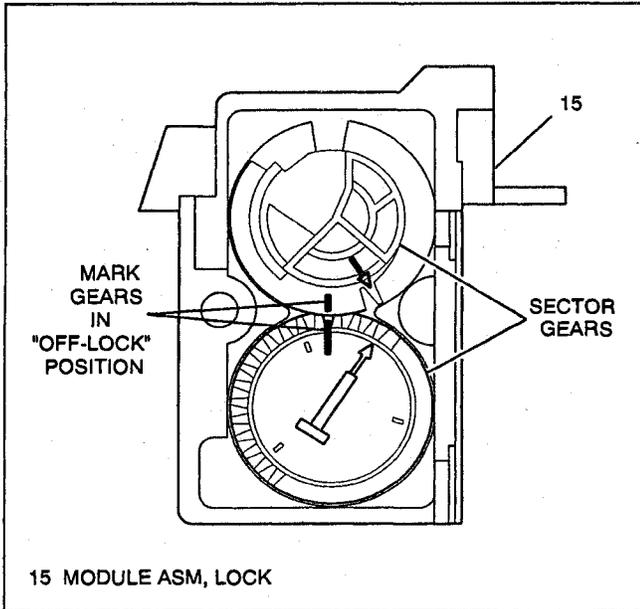


Figure 11 - Sector Gear Timing Position (OFF-LOCK)

15. Backing plate from lock module assembly (15).

? Important

- Mark two sector gears at "OFF-LOCK" position to ensure proper reassembly. Failure to assemble sector gears properly will cause lock cylinder (17) and ignition switch (19) to be improperly timed. (See Figure 11 for proper timing)

16. Remove both sector gear.

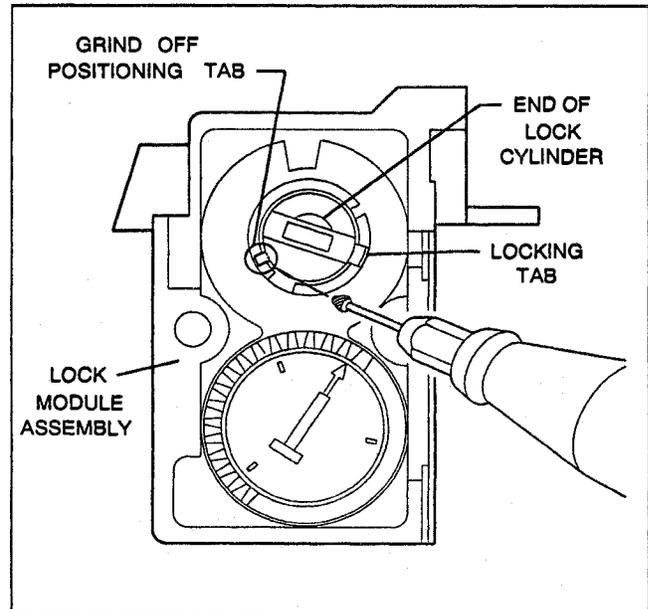


Figure 12 - Grinding Off Lock Cylinder Positioning Tab

17. Remove positioning tab on end of lock cylinder (17) using an 1/8-inch burring tool. (See Figure 12)
 - Remove all burrs in and around lock module assembly (15) and lock cylinder (17).
18. From inside lock module assembly (15) push on locking tab and pull lock cylinder (17) from lock module assembly (15) and upper shroud (10).

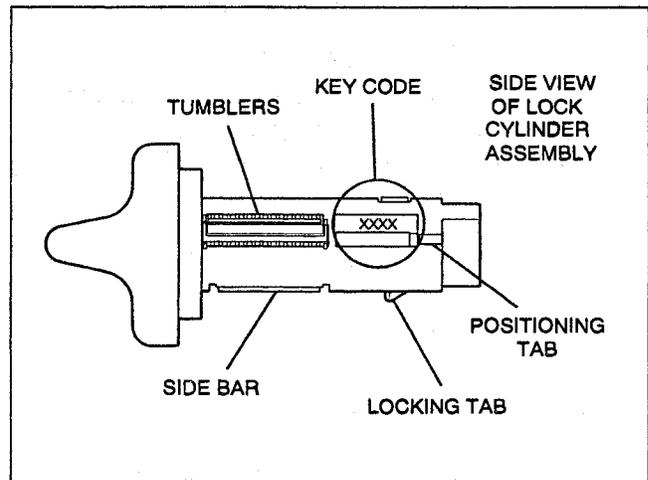


Figure 13 - Location of Key Code

19. Record "Key Code" from old lock cylinder. (See Figure 13)
 - Build up "New" lock cylinder.
 - Cut "New" key.
 - Discard "Old" lock cylinder.

 Clean

- All debris and metal shavings from inside lock module assembly (15).
- Remove all burrs.

 Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Align marks made on sector gears and install sector gears and backing plate to lock module assembly (15). (See Figure 11 for proper timing of gears)
 2. Steering column lock cylinder set (17) to lock module assembly (15).
 - A. Ensure sector in lock module assembly (15) is in "OFF-LOCK" position. (See Figure 11)
 - B. Key installed in lock cylinder (17) and in "OFF-LOCK" position.
 - C. Line up locking tab and positioning tab with slots in lock module assembly (15) and push cylinder (17) into position.
 - D. Rotate lock cylinder to "ACC" position and check alignment of "ARROWS" on sector gears. Arrows should be pointing towards each other.
 - E. Rotate lock cylinder to "LOCK" position.
 3. Lock module assembly (15).
 - Push lock bolt (11) into steering column tilt head assembly (26) until flush.
 - Align lock module assembly (15) with tilt head assembly (26) and install.
 4. Three pan head tapping screws (13).
-
-  Tighten
- Tighten screws (13) to 6.0 N·m (53 lb.in.)
5. Ignition & key alarm switch assembly (19).
 6. Two tapping screws (18) for ignition & key alarm switch (19).
-
-  Tighten
- Tighten screws (18) to 1.4 N·m (12 lb.in.).
-
7. Key alarm switch to lock module assembly (15).
 - A. Switch with retaining clip parallel to lock cylinder (17).
 - B. Rotate switch 1/4 turn until locked into place.
 8. Turn signal cancel cam assembly (6).
 - Lubricate lower brass surface with grease, synthetic (service kit).
 9. Shaft lock shield assembly (5).
 - Align inner block tooth of lock plate to block tooth of race & upper shaft assembly (34).
 10. New shaft lock retaining ring (4) using J 23653-SIR to push down shaft lock shield assembly (5).
 - Ring (4) must be firmly seated in groove on shaft.
 11. Center race & upper shaft assembly (34).
 - A. Wheels straight ahead.
 - Block tooth and centering mark on shaft assembly (34) at 12 o'clock position. (See Figure 30)
 - B. Ignition switch to "LOCK" position.
 - C. Ensure coil (2) is centered; refer to figure (7).
 12. Wave washer (3).
- NOTICE:** New coil assembly (2) will be pre-centered. Install new coil asm, remove and dispose of centering tab.
13. Coil assembly (2).
 - A. Ensure shaft (34) and coil asm (2) are centered.
 - If steering shaft assembly (34) needs to be centered (See Figure 28).
 - If coil asm needs to be centered (See Figure 7).
 - B. Align coil asm (2) with horn tower and slide onto shaft (34).
 14. Retaining ring (30) must seat securely in groove on shaft (32).
 15. Route lower coil wire along steering column jacket assembly (58).
 16. Two wire harness straps (22) to steering column wire harness.

3F5-12 TILT STRG COL UNIT REPAIR (SIR)

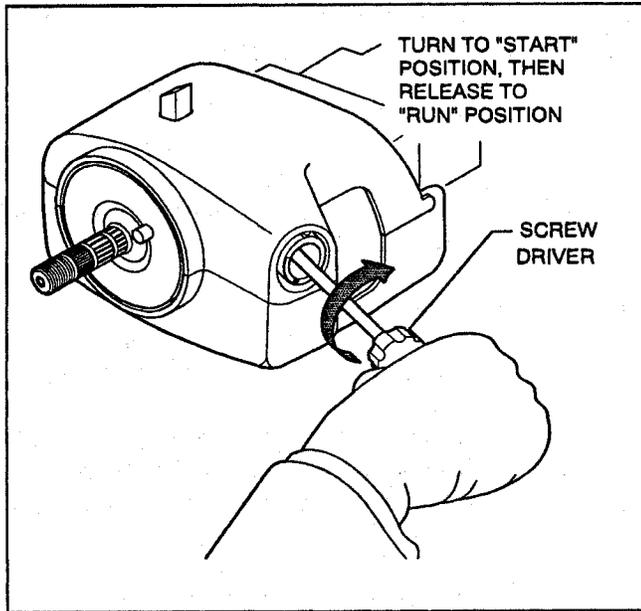


Figure 14 - Sector Alignment Procedure

17. Park lock cable assembly (48) to lock module assembly (15).

- Lock cylinder should be in "OFF-LOCK" position and gear shift in "PARK" position.
- Locking tab on end of cable (48) to slot in lock module assembly (15).

Adjust

- Park lock cable assembly (48). (See Figure 19)
 - A. Gear shift lever installed and in "PARK" position.
 - B. Ignition in "OFF-LOCK" position and remove key.
 - C. Unlock adjuster ring on cable assembly (48) with tool J 41396. (See Figure 20)
 - D. Pull on cable until park lock latch contacts gear shift lever.
 - Release the cable.
 - E. Lock adjuster ring securely in place on cable assembly (48) with tool J 41396. (See Figure 21)

Inspect

- Park lock cable assembly (48). (See Figure 19)
 - A. With lock cylinder in "OFF-LOCK" position, gear shift lever should not be able to shift out of "PARK" position.
 - B. Insert key and turn to "RUN" position.
 - C. Shifter in "NEUTRAL" position.
 - D. With gear shift in "NEUTRAL" position, lock cylinder should not be able to go into "OFF-LOCK" position.
 - E. Shifter in "PARK" position.
 - F. Lock cylinder in "OFF-LOCK" position and remove key.

18. Remove steering column lock cylinder (17) from lock module assembly (15).
19. Upper shroud (10).
20. Two torx head screws (14) to upper shroud (10).

Tighten

- Tighten screws (14) to 1.4 N·m (12 lb.in.).
21. Lower shroud (28).
- Ensure that slots on lower shroud (28) engage with tabs on upper shroud (10).
 - Tilt lower shroud up and snap shrouds together.
22. Two pan head tapping screws (13) to lower shroud (28).

Tighten

- Tighten screws (13) to 6.0 N·m (53 lb.in.).
23. Shift lever seal (16) and multifunctional lever seal into position.
24. Steering column lock cylinder set (17) to lock module assembly (15).
 - A. Ensure sector in lock module assembly (15) is in "RUN" position. (See Figure 11)
 - B. Key installed in lock cylinder (17) and in "RUN" position.
 - C. Line up locking tab and positioning tab with slots in lock module assembly (15) and push cylinder (17) into position.

25. Tilt lever; refer to section 3F.
26. Wheels straight ahead and column at 12 o'clock position.
27. Raise or install steering column to vehicle; refer to section 3F.
28. Steering wheel.
29. If all service operations are completed, enable the SIR system; refer to "ENABLING THE SIR SYSTEM" in this section.
30. Negative (-) battery cable.

ELECTRICAL (BTSI) ACTUATOR (c/s only)

Figures 1,15 through 17

Remove or Disconnect

1. Negative (-) battery cable.
2. Disable the SIR system; refer to **DISABLING THE SIR SYSTEM**, in this section.
3. Tilt column to "CENTER" position.

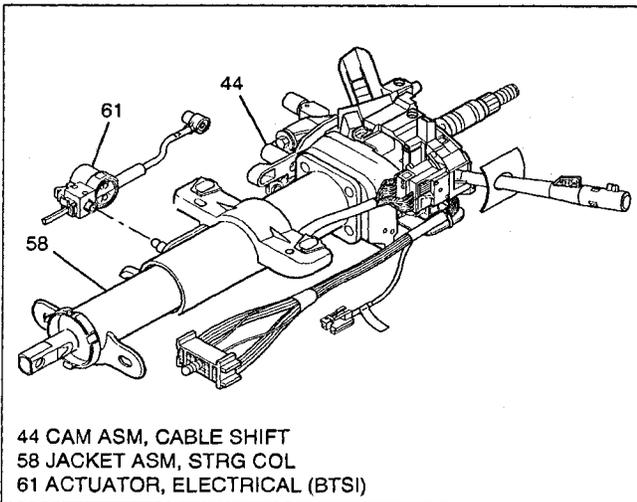


Figure 15 - Removing Electrical (BTSI) Actuator

4. Electrical (BTSI) actuator (61) from column.
 - A. Column in "NEUTRAL" position.
 - B. Pry (BTSI) actuator (61) from mounting pin on steering column jacket assembly (58) and outer shift cable ball stud on cable shift cam assembly (44).

- C. Axial position assurance connector (23) from electrical connector.
 - Electrical connector from (BTSI) actuator (61).

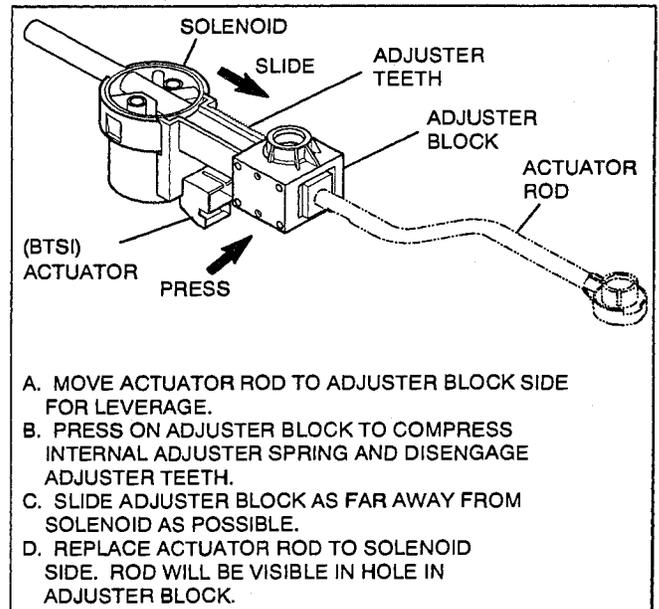


Figure 16 - Adjusting Electrical (BTSI) Actuator

Adjust

- Electrical (BTSI) Actuator (61) (See Figures 16,17)
 - A. Move actuator rod to adjuster block side for leverage.
 - B. Press on adjuster block to compress internal adjuster spring and disengage the adjuster teeth.
 - C. Slide the adjuster block as far from the solenoid as possible.
 - D. Replace actuator rod to solenoid side.

3F5-14 TILT STRG COL UNIT REPAIR (SIR)

Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Electrical (BTSI) actuator (61) to column.
 - A. Column in "Neutral" position.
 - B. (BTSI) actuator (61) to mounting pin on steering column jacket assembly (58) and outer shift cable ball stud on cable shift cam assembly (44).
 - C. Electrical connector to (BTSI) actuator (61).
 - Axial position assurance connector (23) to electrical connector.
2. If all service operation are completed, enable the SIR system; refer to ENABLING THE SIR SYSTEM, in this section.
3. Negative (-) battery cable.

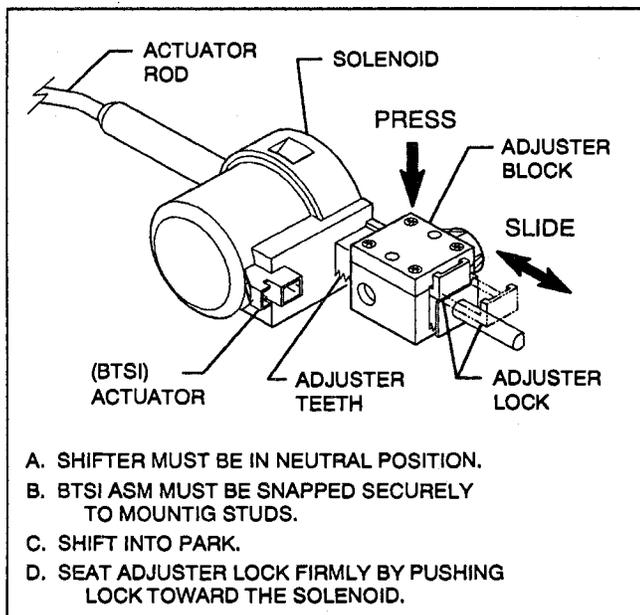


Figure 17 - (BTSI) Adjuster Lock

Inspect

- Function check Electrical (BTSI) actuator (61) for proper operation.
- Actuator (61) must lock gearshift lever when ever steering column is in "PARK" position and when trying to shift from "PARK" position without pressing brake pedal. (Solenoid is energized)

- Actuator (61) must release gearshift lever when pressure is applied to brake pedal. (Solenoid is de-energized)
- Readjust if needed.

LINEAR SHIFT ASM (REMOVAL) (c/s only)

Figures 1, 3, 15 through 21

Tools Required:

- J 41352 Modular Column Holding Fixture
- J 41396 Park Lock Cable Pliers

NOTICE: Linear shift assembly (40) may be removed as an assembly or certain components may be disassembled as necessary to do repairs. Remove or disassemble only those components necessary to do repairs.

Remove or Disconnect

1. Do all steps, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.
2. Park lock cable assembly (48) from lock module assembly (15).
 - Lock cylinder should be in "OFF-LOCK" position and gear shift in "PARK" position.
 - Insert small blade screwdriver into slot in lock module assembly (15). Push against locking tab on end of cable assembly (48) and remove.
3. Pry actuator arm of electrical (BTSI) actuator (61) from outer shift cable ball stud on cable shift cam assembly (44) and mounting pin on jacket (58).
4. Transaxle cable from inner shift cable ball stud on cable shift cam assembly (44).

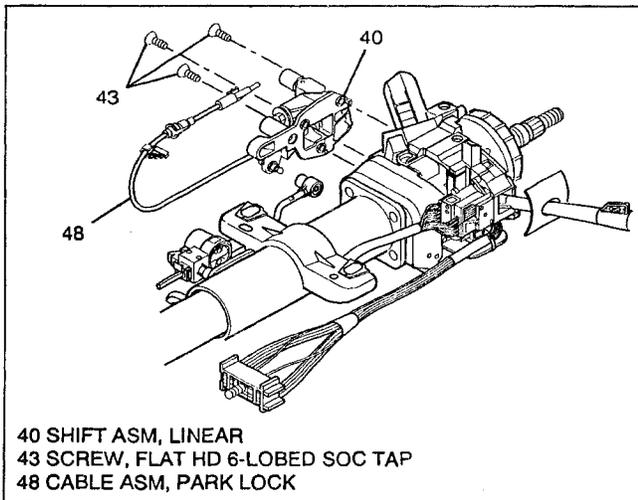


Figure 18 - Removing Linear Shift Assembly

5. Three flat head 6-lobed socket tap screws (43).
 - Shift column to "NEUTRAL" position to gain access to lower socket tap screw (43).
6. Linear shift assembly (40) from column.

→+ Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Linear shift assembly (40) to column.
2. Three flat head 6-lobed socket tap screws (43).
 - Linear shift assembly (40) must be out of "PARK" position to install lower socket tap screw (43).

Ⓐ Tighten

- Tighten screws (43) to 10 N·m (89 lb.in.).
3. Transaxle cable to inner shift cable ball stud on cable shift cam assembly (44).
 4. Park lock cable assembly (48) to lock module assembly (15).
 - Lock cylinder should be in "OFF-LOCK" position and gear shift in "PARK" position.
 - Locking tab on end of cable (48) to slot in lock module assembly (15).

5. Actuator arm of electrical (BTSI) actuator (61) to outer shift cable ball stud on cable shift cam assembly (44).
6. Do **Adjust and Inspect**, "Install or Connect", ELECTRICAL (BTSI) ACTUATOR, in this section.

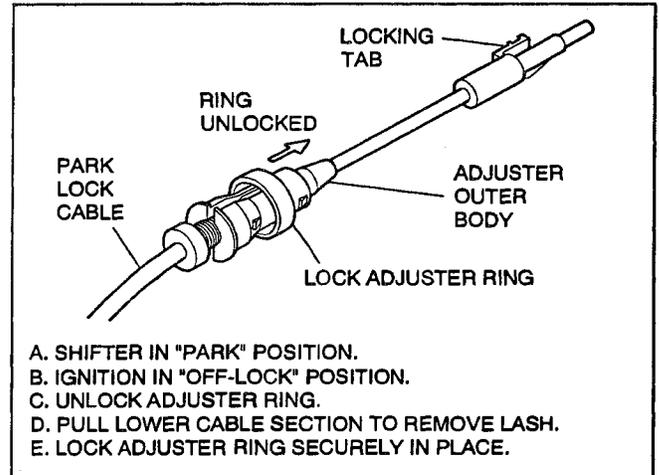


Figure 19 - Adjusting Park Lock Cable

3F5-16 TILT STRG COL UNIT REPAIR (SIR)

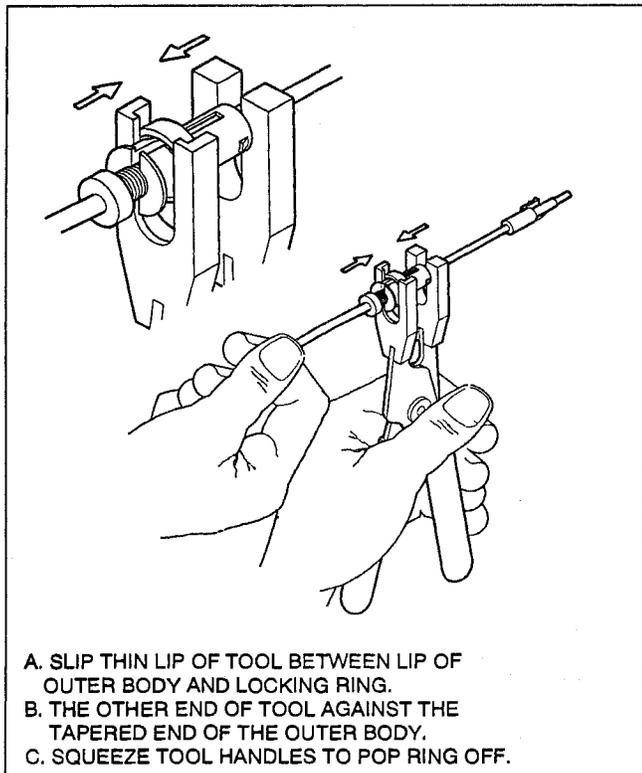


Figure 20 - Unlocking Adjuster Ring on Park Lock Cable

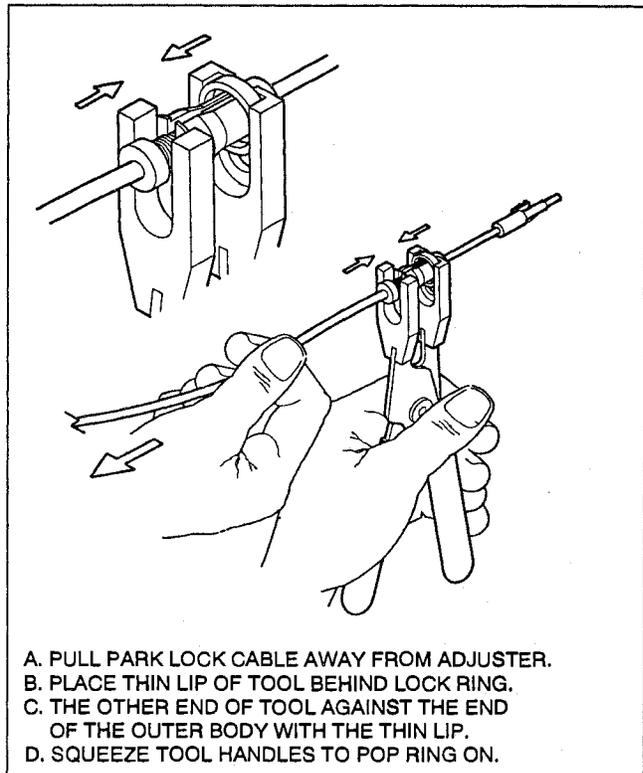


Figure 21 - Park Lock Cable Locking Adjuster Ring

Adjust

- Park lock cable assembly (48). (See Figure 19)
 - A. Gear shift lever installed and in "PARK" position.
 - B. Ignition in "OFF LOCK" position and remove key.
 - C. Unlock adjuster ring on cable assembly (48) with tool J 41396. (See Figure 20)
 - D. Pull on cable until park lock latch contacts gear shift lever.
 - Release the cable.
 - E. Lock adjuster ring securely in place on cable assembly (48) with tool J 41396. (See Figure 21)

Inspect

- Park lock cable assembly (48). (See Figure 19)
 - A. With lock cylinder in "OFF-LOCK" position, gear shift lever should not be able to shift out of "PARK" position.
 - B. Insert key and turn to "RUN" position.
 - C. Shifter in "NEUTRAL" position.
 - D. With gear shift in "NEUTRAL" position, lock cylinder should not be able to go into "OFF-LOCK" position.
 - E. Shifter in "PARK" position.
 - F. Lock cylinder in "OFF-LOCK" position and remove key.
- 7. Do all steps "Install or Connect", LOWER SHROUD, UPPER SHROUD, in this section.

**LINEAR SHIFT ASM (DISASSEMBLY)
 BALL & ACTUATOR ASM
 SHIFT LEVER CLEVIS
 PARK LOCK CABLE ASM
 G/S LEVER ASM SUPPORT BRKT**

(c/s only)

Figures 1,3,15 through 22

Tools Required:

- J 41352 Modular Column Holding Fixture
- J 41396 Park Lock Cable Pliers

7. Park lock cable assembly (48) from support bracket (49). Remove retaining clip.
8. Pry actuator arm of electrical (BTSI) actuator (61) from outer shift cable ball stud on cable shift cam assembly (44).
9. Pry transaxle shift cable from inner ball stud on cable shift cam assembly (44).
10. Hexagon flange head bolt (46).
11. Cable shift cam assembly (44).
12. Cam bushing (63) from cable shift cam assembly (44).
13. Three flat head 6-lobed socket tap screws (43).
14. Gearshift lever assembly support bracket (49).

Disassemble

1. Do all steps "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.

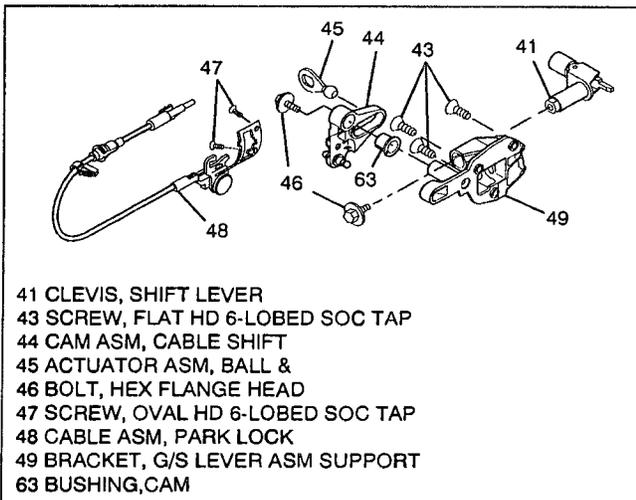


Figure 22 - Disassembling Linear Shift Assembly

2. Hexagon flanged head bolt (46).
3. Ball & actuator assembly (45).
4. Pry off locking ring on park lock cable assembly (48). (See Figures 19,20)
 - Move park lock latch to gain access to lower oval head 6-lobed socket tap screw (47).
5. Two oval head 6-lobed socket tap screws (47) from shift gate.
6. Shift lever clevis (41).
 - A. Lift up on shift gate and rotate shift lever clevis (41).
 - B. Clevis (41) from gearshift lever assembly support bracket (49).

Assemble

1. Lubricate all moving parts of assembly with synthetic grease.
2. Gearshift lever assembly support bracket (49).
3. Three flat head 6-lobed socket tap screws (43).

Tighten

- Tighten screws (43) to 10 N·m (89 lb.in.).

4. Insert cam bushing (63) into cable shift cam assembly (44).
5. Cable shift cam assembly (44).
6. Hexagon flange head bolt (46).

Tighten

- Tighten bolt (46) to 18.0 N·m (14 lb.ft.).

7. Transaxle shift cable to inner ball stud on cable shift cam assembly (44).
8. Actuator arm of electrical (BTSI) actuator (61) to outer shift cable ball stud on cable shift cam assembly (44).
9. Park lock cable assembly (48) to support bracket (49). Insert retaining clip.
10. Shift lever clevis (41) and shift gate to support bracket (49).
 - A. Position shift gate to end of clevis (41) lever.
 - B. Rotate clevis (41) and shift gate into position.
 - C. Push against shift lever spring tension to align shift gate holes with support bracket (49) holes.

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- Two oval head 6-lobed socket tap screws (47).

Tighten

- Tighten screws (47) to 6.5 N·m (58 lb.in.).

- Ball & actuator assembly (45).
- Hexagon flanged head bolt (46).

Tighten

- Tighten bolt (46) to 18.0 N·m (14 lb.ft.).

- Park lock cable assembly (48) to lock module assembly (15).
 - Lock cylinder should be in "OFF-LOCK" position and gear shift in "PARK" position.
 - Locking tab on end of cable (48) to slot in lock module assembly (15).
- Do **Adjust** and **Inspect**, "Install or Connect", LINEAR SHIFT ASM (REMOVAL), in this section.
- Do all steps, "Install or Connect", LOWER SHROUD, UPPER SHROUD, in this section.

TILT SPRING

Figures 1 and 23

Remove or Disconnect

- Disable the SIR System; refer to **DISABLING THE SIR SYSTEM**, in this section.
- Two pan head tapping screws (13) from lower shroud (28).
- Lower shroud (28).
 - Tilt shroud (28) down and slide back to disengage locking tabs.
- Tilt column to "UP" position.

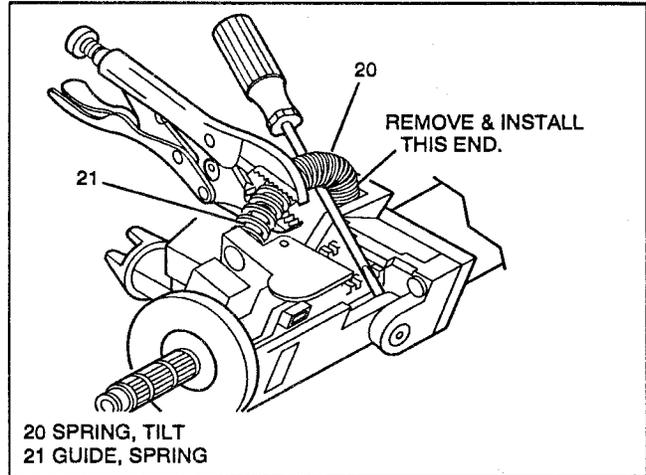


Figure 23 - Removing Tilt Spring

CAUTION: The tilt spring (20) and spring guide (21) are under pressure and could become a projectile. During removal and installation secure spring with locking pliers. Exercise caution when removing or installing spring and guide, as bodily injury may result.

- Tilt spring (20).
 - Pry spring (20) up until a bulge occurs and most spring tension is removed.
 - Secure spring (20) with locking pliers and continue prying until spring disengages from post on steering column support assembly (57) and steering column tilt head assembly (26).
- Spring guide (21) from tilt spring (20).

Install or Connect

NOTICE: Refer to **NOTICE** about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

- Spring guide (21) to tilt spring (20).
- Tilt spring (20) with guide (21).
 - Spring (20) to post on steering column support assembly (57).
 - Secure spring (20) with locking pliers.
 - With end of spring (20) on post pull on center of spring (20) while pushing guide end to post on steering column tilt head assembly (26).
 - With both ends installed to post, push spring (20) into position.

3. Lower shroud (28).
 - Ensure that slots on lower shroud (28) engage with tabs on upper shroud (10).
 - Tilt lower shroud up and snap shrouds together.
4. Two pan head tapping screws (13) to lower shroud (28).

Tighten

- Tighten screws (13) to 6 N·m (53 lb.in.).
5. If all service operations are completed, enable the SIR system; refer to ENABLING THE SIR SYSTEM, in this section.

**UPPER TILT HEAD COMPONENTS
SHAFT LOCK SHIELD ASM
TURN SIGNAL CANCEL CAM ASM
UPPER BEARING SPRING
UPPER BEARING INNER RACE SEAT
INNER RACE**

Figures 1, 6, 7, 24, and 25

Tools Required:
J 23653-SIR Lock Plate Compressor

Remove or Disconnect

1. Do steps 1 through 4, "Remove or Disconnect", COIL ASSEMBLY, in this section.
 - Let coil assembly (2) hang freely.

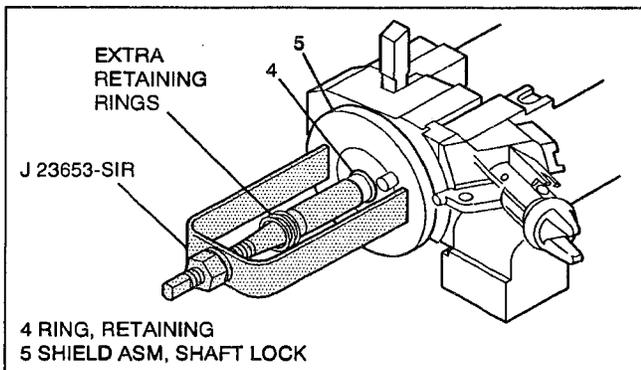


Figure 24 - Removing Shaft Lock Retaining Ring

2. Shaft lock retaining ring (4) using J 23653-SIR to push down shaft lock shield assembly (5).
 - Dispose of ring (4).
3. Shaft lock shield assembly (5).
4. Turn signal cancel cam assembly (6).
5. Upper bearing spring (7).
6. Upper bearing inner race seat (8).
7. Inner race (9).

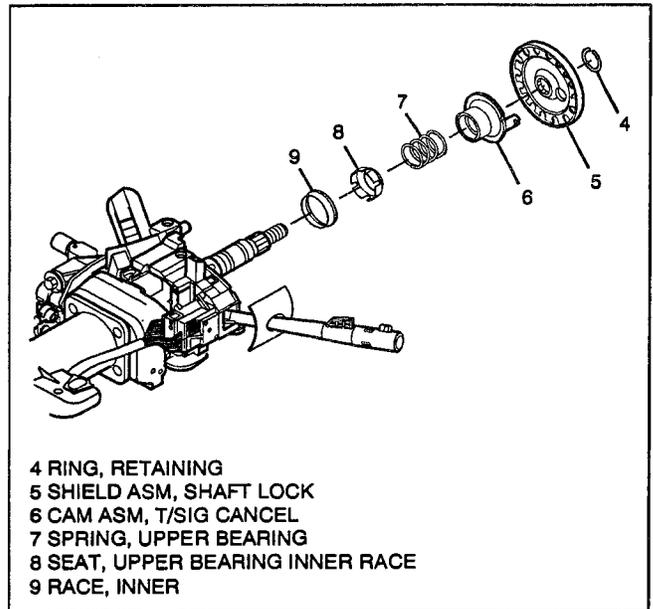


Figure 25 - Removing Upper Shaft Components

Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Inner race (9).
2. Upper bearing inner race seat (8).
3. Upper bearing spring (7).
4. Turn signal cancel cam assembly (6).
5. Shaft lock shield assembly (5).
 - Align inner block tooth of lock plate to block tooth of race & upper shaft assembly (34).
 - Lubricate with grease, synthetic (service kit).

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6. New shaft lock retaining ring (4) using J 23653-SIR to push down shaft lock shield assembly (5).
 - Ring (4) must be firmly seated in groove on shaft.
7. Do steps 1 through 3 and 6 through 9, "Install or Connect", COIL ASSEMBLY, in this section.
9. Steering column lock cylinder set (17).
 - Turn lock cylinder (17) to "RUN" position.
 - Insert small blade screwdriver into hole on top of module assembly (15). Push against locking button and remove lock cylinder (17).

LOCK MODULE ASM

Figures 1,6,7, 9,10,19,20,21 and 24 through 26

Tools Required:

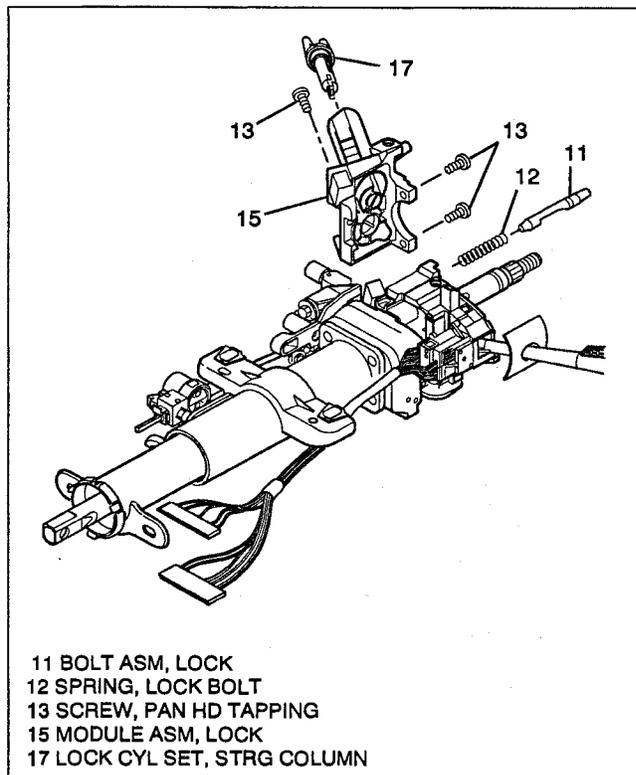
- J 23653-SIR Lock Plate Compressor
- J 41396 Park Lock Cable Pliers

↔ Remove or Disconnect

1. Do steps 1 through 4, "Remove or Disconnect", UPPER TILT HEAD COMPONENTS, in this section.
2. Park lock cable assembly (48) from lock module assembly (15).
 - Lock cylinder should be in "OFF-LOCK" position and gear shift in "PARK" position.
 - Insert small blade screwdriver into slot in lock module assembly (15). Push against locking tab on end of cable assembly (48) and remove.
3. Key alarm switch from lock module assembly (15). (See Figure 9)
 - Gently pry retaining clip on alarm switch with small blade screwdriver.
 - Rotate alarm switch 1/4 turn and remove.
4. Two tapping screws (18).
5. Ignition & key alarm switch assembly (19).
 - Let switch (19) hang freely.

NOTICE: Lock bolt assembly (11) is under slight spring tension from lock bolt spring (12). Hold lock bolt (11) in place while removing lock module assembly (15).

6. Three pan head tapping screws (13).
7. Lock module assembly (15).
8. Lock bolt assembly (11) with lock bolt spring (12).
 - Spring (12) from lock bolt (11).



- 11 BOLT ASM, LOCK
- 12 SPRING, LOCK BOLT
- 13 SCREW, PAN HD TAPPING
- 15 MODULE ASM, LOCK
- 17 LOCK CYL SET, STRG COLUMN

Figure 26 - Removing Lock Module Assembly

→← Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do may result in component damage or malfunction of steering column.

1. Steering column lock cylinder set (17).
 - Key installed in lock cylinder (17).
 - Ensure sector is in "RUN" position. (See Figure 5,14).
 - Line up locking tab with slot in lock module assembly (15) and push into position.
 - Turn lock cylinder (17) to "LOCK" position.
2. Lock bolt assembly (11) with lock bolt spring (12).
 - Ensure cutout in lock bolt (11) is in the 6 o'clock position. (See Figure 26)

3. Lock module assembly (15). (See Figure 26)
 - Push lock bolt (11) into steering column housing assembly (26) until flush.
 - Align lock module assembly (15) with tilt head assembly (26) and install.
4. Three pan head tapping screws (13).

 **Tighten**

- Tighten screws (13) to 6.0 N·m (53 lb.in.)
5. Ignition & key alarm switch assembly (19).
 6. Two tapping screws (18).

 **Tighten**

- Tighten screws (18) to 1.4 N·m (12 lb.in.).
7. Alarm switch to lock module assembly (15).
 - A. Switch with retaining clip parallel to lock cylinder (17).
 - B. Rotate switch 1/4 turn until locked into place.

8. Park lock cable assembly (48) to lock module assembly (15). (See Figure 18)
 - Lock cylinder should be in "OFF-LOCK" position and gear shift in "PARK" position.
 - Locking tab on end of cable (48) to slot in lock module assembly (15).

 **Adjust**

- Park lock cable assembly (48). (See Figure 18,19)
 - A. Gear shift lever installed and in "PARK" position.
 - B. Ignition in "OFF LOCK" position and remove key.
 - C. Unlock adjuster ring on cable assembly (48) with tool J 41396. (See Figure 20)
 - D. Pull on cable until park lock latch contacts gear shift lever.
 - Release the cable.
 - E. Lock adjuster ring securely in place on cable assembly (48) with tool J 41396. (See Figure 21)

 **Inspect**

- Park lock cable assembly (48). (See Figure 19)
 - A. With lock cylinder in "OFF-LOCK" position, gear shift lever should not be able to shift out of "PARK" position.
 - B. Insert key and turn to "RUN" position.
 - C. Shifter in "NEUTRAL" position.
 - D. With gear shift in "NEUTRAL" position, lock cylinder should not be able to go into "OFF-LOCK" position.
 - E. Shifter in "PARK" position.
 - F. Lock cylinder in "OFF-LOCK" position and remove key.
9. Do steps 4 through 7, "Install or Connect", UPPER TILT HEAD COMPONENTS, in this section.

STRG COL TILT HEAD ASM

Figures 1 through 27

Tools Required:

- J 23653-SIR Lock Plate Compressor
- J 21854-01 Pivot Pin Remover

 **Remove or Disconnect**

1. Do all steps, "Remove or Disconnect", COIL ASSEMBLY, in this section.
2. Do steps 7 and 8, "Remove or Disconnect", T/S & MULTIFUNCTION SWITCH ASM, in this section.
3. Do steps 2 through 6, "Remove or Disconnect", LINEAR SHIFT ASM (REMOVAL), in this section. (Column shift only)
4. Do steps 2 through 7, "Remove or Disconnect", UPPER TILT HEAD COMPONENTS, in this section.
5. Do steps 6 through 8, "Remove or Disconnect", LOCK MODULE ASM, in this section.
6. Do steps 4 and 5, "Remove or Disconnect", TILT SPRING, in this section.

3F5-22 TILT STRG COL UNIT REPAIR (SIR)

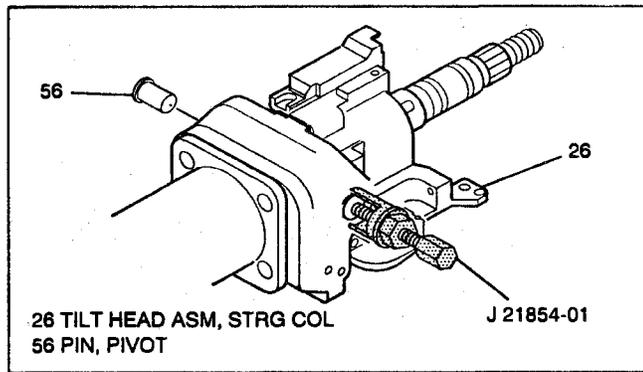


Figure 27 - Removing Pivot Pin

7. Two pivot pins (56) using J 21854-01.
8. Steering column tilt head assembly (26).
 - Pull tilt arm to disengage steering wheel lock shoes from dowel pins in steering column support assembly (57).

↔ Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do so may result in component damage or malfunction of steering column.

1. Steering column tilt head assembly (26).
 - Using tilt lever position lock shoes to dowel pins.
 - Rotate head assembly (26) until holes for pivot pins (56) line up.
2. Two pivot pins (56).
 - A. Lubricate with lithium grease.
 - B. Press pins until firmly seated two places.
 - C. Stake pins (56) three locations two places.
3. Do step 2, "Install or Connect", TILT SPRING, in this section.
4. Do steps 2 through 4, "Install or Connect", LOCK MODULE ASM, in this section.
5. Do steps 1 through 6, "Install or Connect", UPPER TILT HEAD COMPONENTS, in this section.
6. Do steps 1 through 6, "Install or Connect", LINEAR SHIFT ASM (REMOVAL), in this section. (Column shift only) and adjust and inspect in this section.
7. Do all steps, "Install or Connect", COIL ASSEMBLY.

LOWER STEERING SHAFT ASM SPHERE JOINT SPRING STRG COL SUPPORT ASM ADAPTER & BEARING ASM STRG COL JACKET ASM

Figures 1, 3, 6 through 8, 15 through 23, 27 through 31

Tools Required:

- J 21854-01 Pivot Pin Remover
- J 41352 Modular Column Holding Fixture

↔ Remove or Disconnect

NOTICE: Once steering column is removed from vehicle, the column is extremely susceptible to damage. See NOTICE on page 3F5-1 in this section.

1. Steering column guide assemblies (53) and (54) from steering column jacket assembly (58).
2. Do steps 1 through 8, "Remove or Disconnect", LOWER SHROUD, UPPER SHROUD, in this section.
3. Two pan head tapping screws (13).
4. Turn signal & multifunction switch assembly (24).
5. Linear shift assembly (40).
 - Do steps 2 through 6 "Remove or Disconnect", LINEAR SHIFT ASM (REMOVAL), in this section. (Column shift only)
6. Refer to CAUTION and do steps 5 and 6, "Remove or Disconnect", TILT SPRING, in this section.
7. Cplg & Strg shaft assembly (64) or Yoke & Inter Strg shaft assembly (65) (Depending on Model) from shaft assembly (37).
 - Remove bolt
8. Evo sensor asm (62), adapter & bearing assembly (60) from jacket assembly (58).

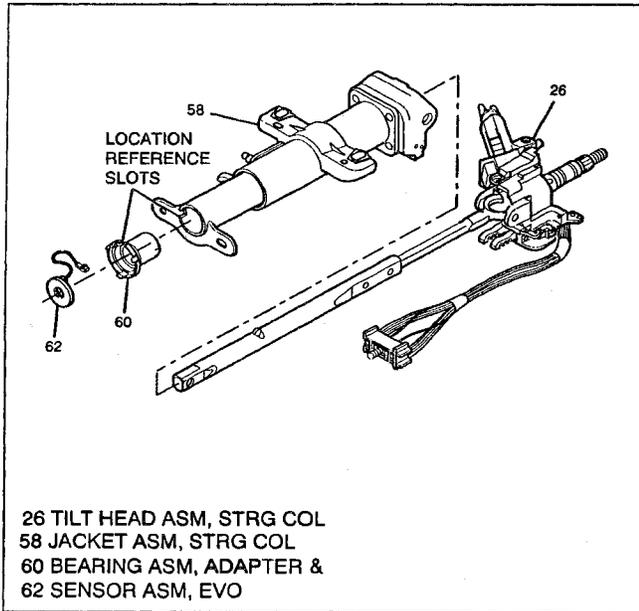


Figure 28 - Removing Tilt Head Assembly with Steering Shaft

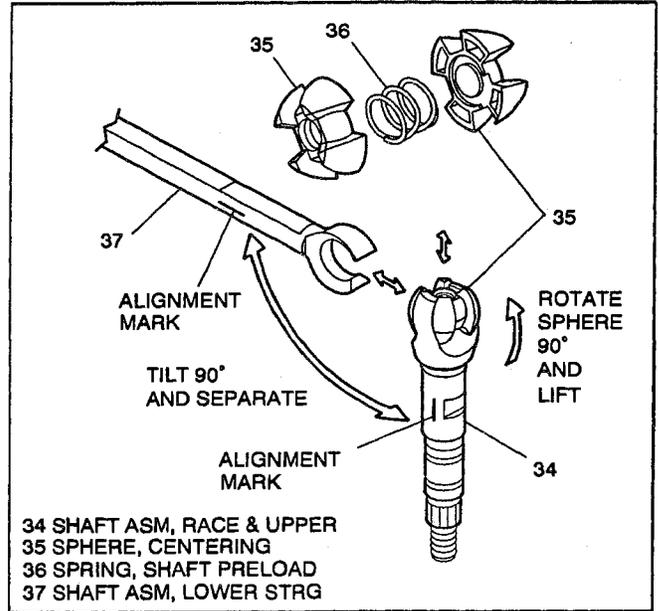


Figure 29 - Disassembling Steering Shaft Assembly

8. Two pivot pins (56) using J 21854-01.
9. Steering column tilt head assembly (26) with steering shaft assembly.
 - Install and pull tilt arm to disengage steering wheel lock shoes from dowel pins in steering column support assembly (57).

! Important

- Mark race & upper shaft assembly (34) and lower steering shaft assembly (37) to ensure proper assembly. Failure to assemble properly will cause steering wheel to be turned 180 degrees. (See Figures 28 and 29).

⊕ Disassemble

- Lower steering shaft assembly (37) from race & upper shaft assembly (34) and steering column tilt head assembly (26).
- A. Race & upper shaft assembly (34) from lower steering shaft assembly (37).
 - Tilt 90 degrees to each other and disengage.
- B. Centering sphere (35) from upper shaft assembly (34).
 - Rotate sphere 90 degrees and slip out.
- C. Shaft preload spring (36) from centering sphere (35).

3F5-24 TILT STRG COL UNIT REPAIR (SIR)

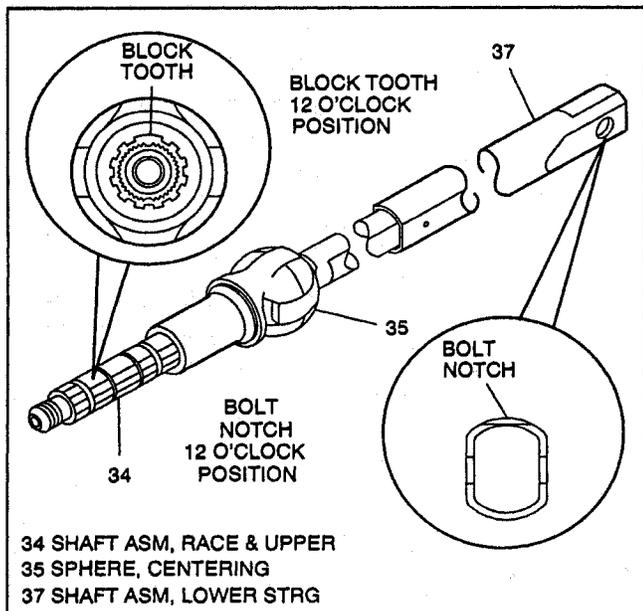


Figure 30 - Correct Upper to Lower Shaft Orientation

Assemble

- Lower steering shaft assembly (37) to race & upper shaft assembly (34) and steering column tilt head assembly (26).
 - A. Shaft preload spring (36) to centering sphere (35).
 - B. Centering sphere (35).
 - Lubricate with lithium grease. Slip into upper shaft assembly (34) and rotate sphere 90 degrees.
 - C. Lower steering shaft assembly (37) to race & upper shaft assembly (34).
 - Line up marks and tilt assemblies 90 degrees to each other.

10. Four torx head screws (55).
11. Steering column support assembly (57).

Install or Connect

NOTICE: Refer to NOTICE about fasteners on page 3F5-1 in this section. Failure to do may result in component damage or malfunction of steering column.

1. Steering column support assembly (57).

2. Four torx head screws (55).

Tighten

- Tighten screws (55) to 9 N·m (80 lb.in.).

3. Do steps 1 through 4, 6, and 7, "Install or Connect", STRG COL TILT HEAD ASM, in this section.
4. Evo sensor asm (62), Adapter & bearing assembly (60) to steering column jacket assembly (58).
 - Position tab on adapter & bearing assembly (60) with slot in steering column jacket assembly (58) and push together. (See Figure 27).
5. Cplg & Strg shaft assembly (64) or Yoke & Inter Strg shaft assembly (65) (Depending on Model) to shaft assembly (37).

Tighten

- Tighten bolt to 47 N·m (35 lb.ft.)

Tighten

- Tighten Hex Hd Nut (68) to 62 N·m (46 lb.ft.)

6. Turn signal & multifunction switch assembly (24) to column.
 - With small blade screwdriver compress electrical contact and move multifunction switch (24) into position.
 - Electrical contact must rest on cancelling cam assembly (6).
7. Two pan head tapping screws (13).

Tighten

- Tighten screws (13) to 6 N·m (53 lb.in.).

8. Do steps 4 through 13, "Install or Connect", LOWER SHROUD, UPPER SHROUD, in this section.

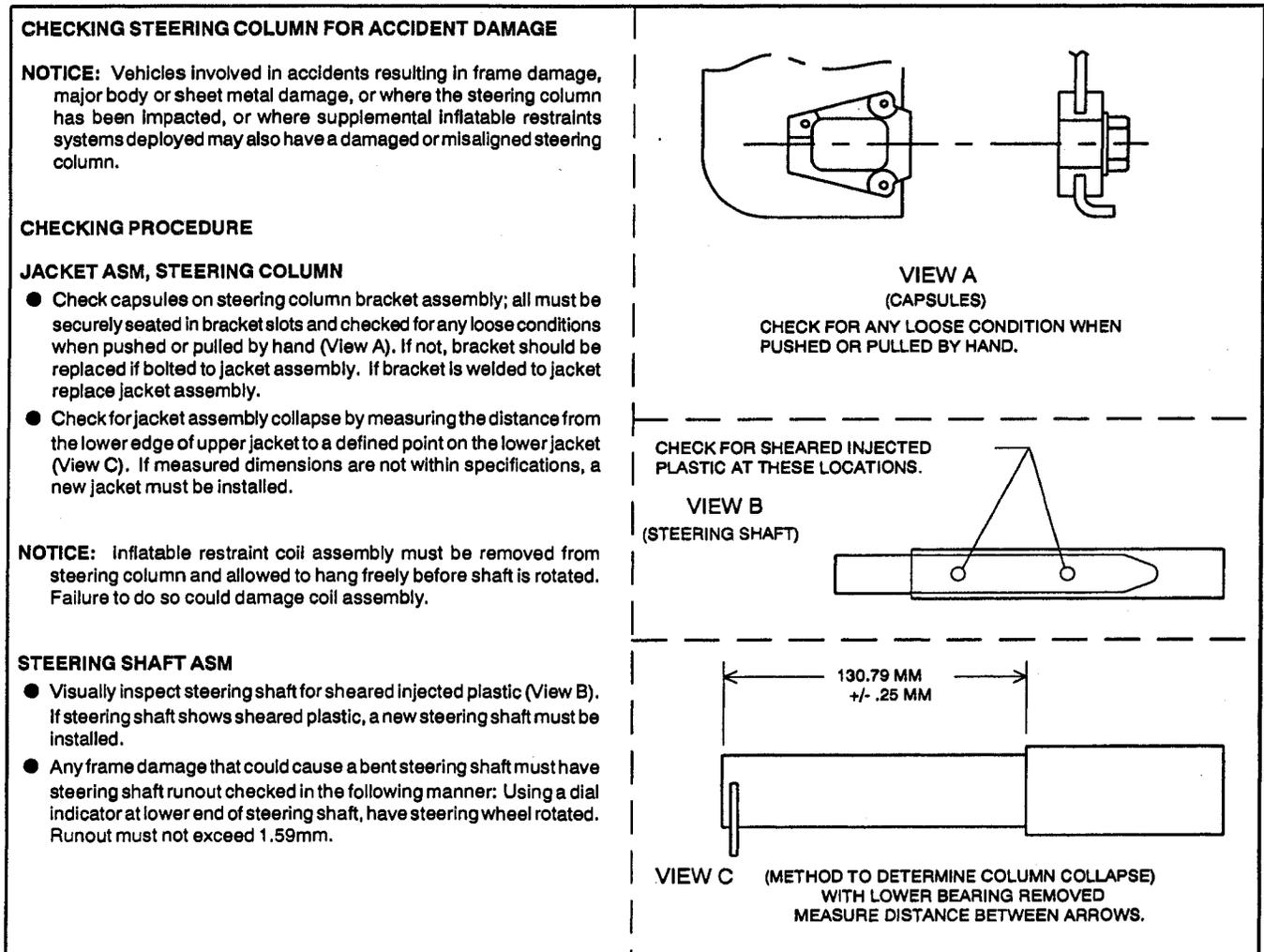


Figure 31 - Checking for Accident Damage

SPECIFICATIONS

FASTENER TIGHTENING SPECIFICATIONS

(1) Steering Wheel-to-Shaft Nut	41.0 N·m (30 lb.ft.)
(13) Lock module assembly Screws	6.0 N·m (53 lb.in.)
(13) Turn Signal & Multifunction Switch Screws	6.0 N·m (53 lb.in.)
(13) Lower Shroud Screws	6.0 N·m (53 lb.in.)
(14) Upper Shroud Screws	1.4 N·m (12 lb.in.)
(18) Ignition & Key Alarm Switch Screws	1.4 N·m (12 lb.in.)
(31) Shift Lever Screw	20.0 N·m (15 lb.ft.)
(43) G/S Lever Support Bracket Screws	10.0 N·m (89 lb.in.)
(46) Shift Lever Clevis and Cable shift Cam Screws	18.0 N·m (14 lb.ft.)
(47) Shift Lever Gate Screws	6.5 N·m (58 lb.in.)
(55) Steering Column Support Screws	9.0 N·m (80 lb.in.)
(66) Round Hd Locking Bolt	47.0 N·m (35 lb.ft.)
(67) Pinch Bolt	47.0 N·m (35 lb.ft.)
(68) Hex Hd Nut	62.0 N·m (46 lb.ft.)

3F5-26 TILT STRG COL UNIT REPAIR (SIR)

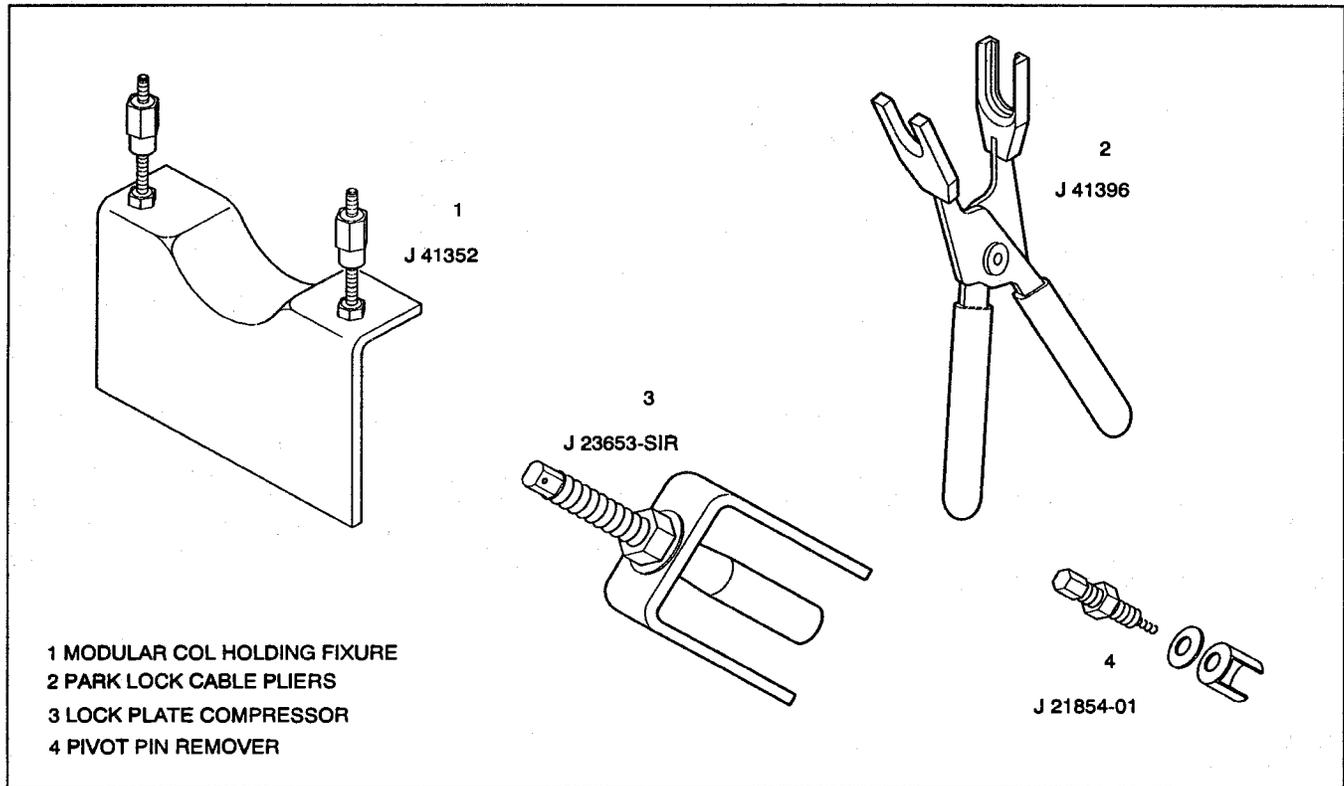


Figure 32 - Special Tools