SECTION 3B2

MANUAL STEERING GEAR

CAUTION: This vehicle is equipped with a Supplemental Inflatable Restraint (SIR). Refer to CAUTIONS in Section 9J under "ON-VEHICLE SERVICE" and the SIR component and wiring Locations View in Section 9J before performing service on or around SIR components or wiring. Failure to follow CAUTIONS could result in possible air bag deployment, personal injury or otherwise unneeded SIR 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 sequence and tightening specifications. Following these instructions can help you avoid damage to parts and systems.

CONTENTS

GENERAL DESCRIPTION

The rotary motion of the steering wheel is transferred through the steering upper shaft, lower shaft, steering gear and pitman arm. The pitman arm is attached to the center link and as the pitman arm rotates, the center link moves linearly, actuating the right and left tie rods and turning the wheels right or left through their knuckle arms. The steering system is designed for easy steering, high durability and excellent steering reaction, as well as reliable self-restoring action.

MANUAL STEERING GEAR

Figures 1 and 2

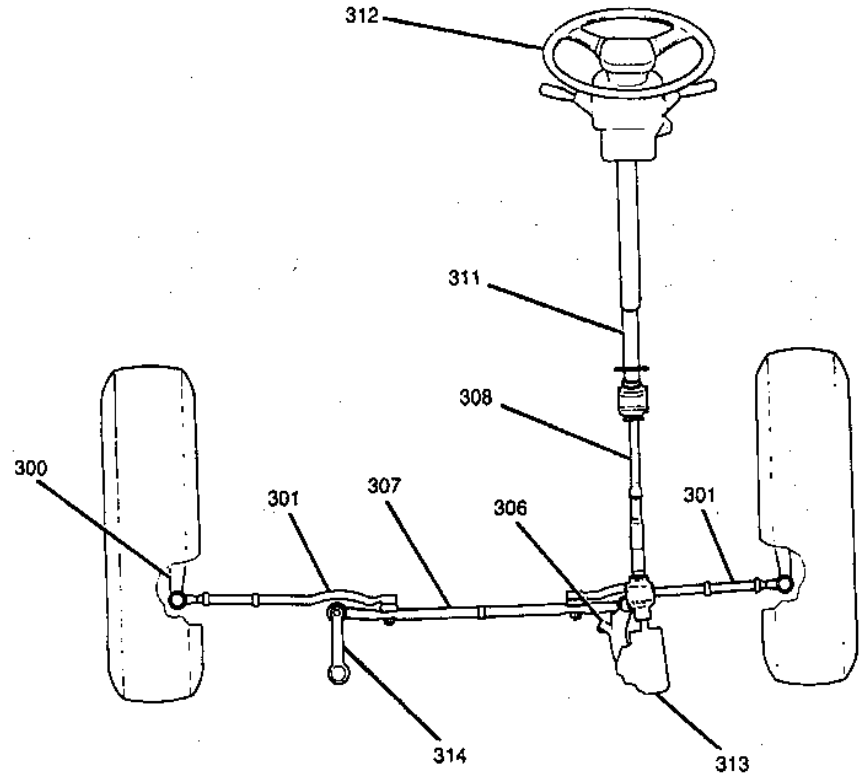
The pitman arm is rigidly connected to the outer end of the sector gear shaft. Between the ball nut and the worm shaft is a row of steel balls which serves two purposes: to provide rolling contact between the ball nut and worm shaft, and to keep the ball nut engaged with the worm shaft. With the nut prevented from turning, the rotation of the worm shaft causes the ball nut to move up or down the shaft.

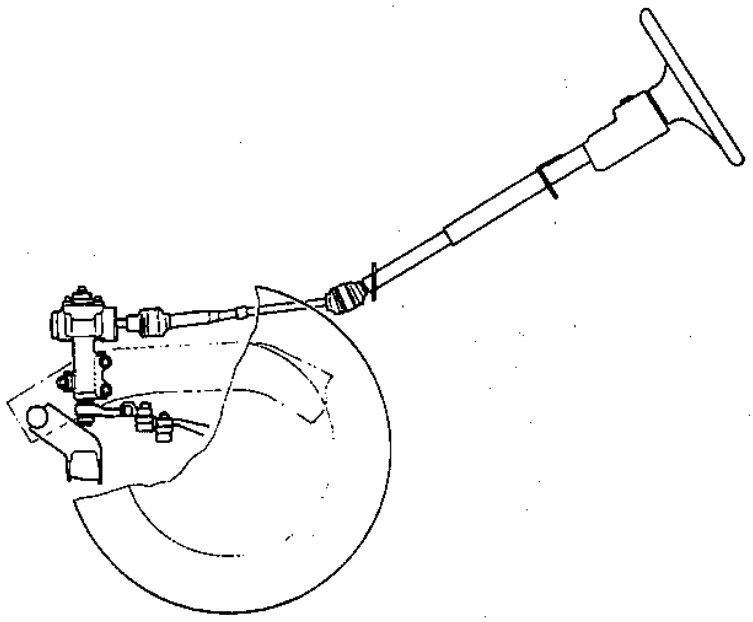
The worm shaft is an extension of the steering shaft. As the steering wheel is turned, the steel balls roll along in the groove and the ball nut moves forward or rearward. A steel ball that has reached the end of the groove in the ball nut enters the return guide. This guide sends the ball back to the other end of the same groove, recirculating the steel balls (Figure 2).

The manual steering gear is not serviceable. Should any part of it require repair, the steering gear must be replaced.

DIAGNOSIS

For manual steering gear diagnostic information, refer to SECTION 3.





300 KNUCKLE
301 TIE ROD
306 PITMAN ARM
307 CENTER LINK
308 LOWER STEERING SHAFT
311 STEERING COLUMN
312 STEERING WHEEL
313 STEERING GEAR
314 IDLER ARM

EJS0313B2

Figure 1—Manual Steering Gear and Linkage

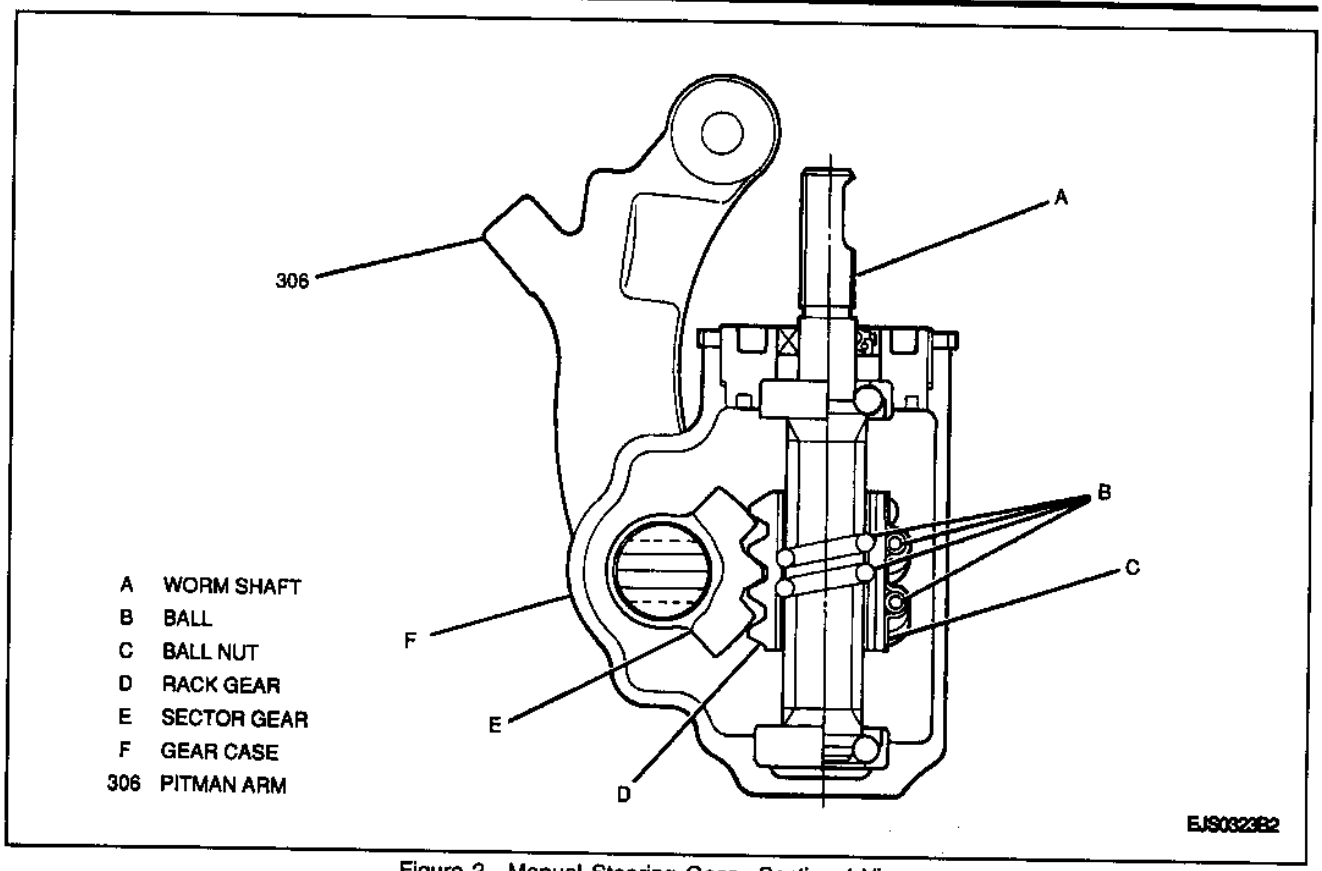


Figure 2—Manual Steering Gear—Sectional View

ON-VEHICLE SERVICE

MANUAL STEERING GEAR

Figures 3 through 6

Remove or Disconnect

Tool Required:
J 29107 Pitman Arm Puller

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Engine skid plate, if equipped (four bolts).
3. Mounting screws and splash shield from left inner wheel well.
4. Cotter pin and castle nut from center link ball joint.
5. Separate pitman arm from center link using a J 29107 (Figure 3).
6. Lower steering shaft from manual steering gear by removing pinch bolt (Figure 4).
7. Three manual steering gear mounting bolts and remove steering gear from vehicle.
8. Mount steering gear in a table vise and remove sector shaft nut and pitman arm from steering gear.

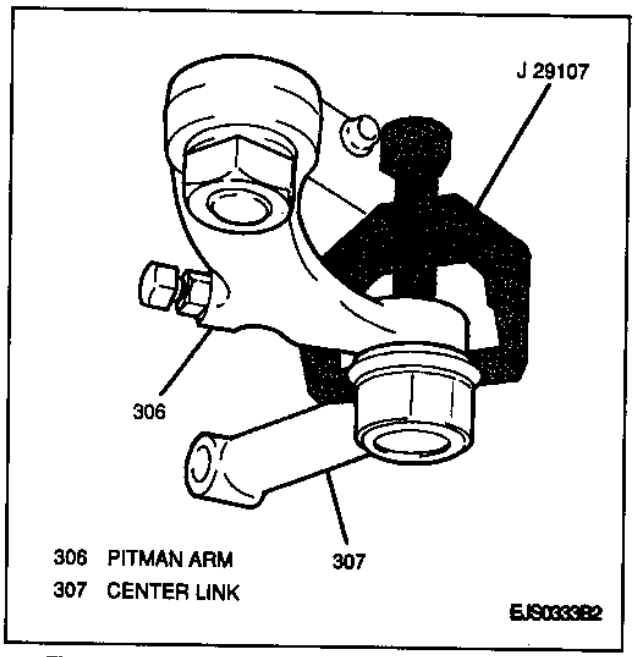
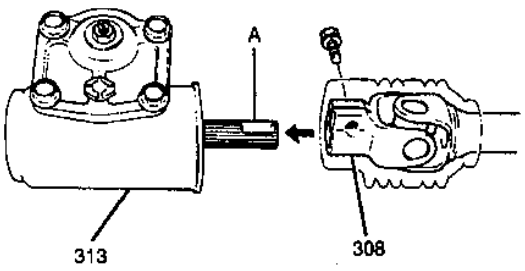


Figure 3—Separating Pitman Arm From Center Link

Install or Connect

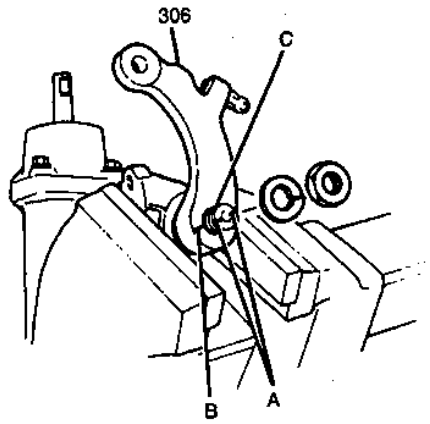
1. Pitman arm to manual steering gear; secure with sector shaft nut. Align matchmarks on sector shaft and pitman arm. Do not fully tighten sector nut at this time (Figure 5).



A FLAT AREA OF WORM SHAFT
308 LOWER STEERING SHAFT
313 STEERING GEAR

EJS034382

Figure 4—Lower Steering Shaft-to-Steering Gear Coupling



A SECTOR SHAFT MATCH MARKS
B PITMAN ARM MATCH MARK
C SECTOR SHAFT
306 PITMAN ARM

EJS035382

Figure 5—Installing Pitman Arm

2. Steering gear to vehicle; secure with two mounting bolts and one pilot bolt (Figure 6).

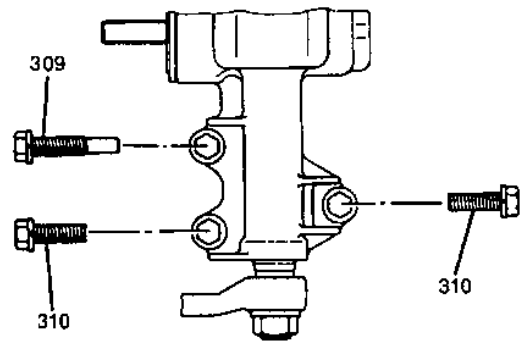
Tighten

- Manual steering gear mounting and pilot bolts to 100 N·m (72 lb. ft.).
- Pitman arm sector shaft nut fully at this time to 130 N·m (95 lb. ft.).

3. Lower steering shaft to steering gear, aligning shaft flats at the coupling. Secure with pinch bolt (Figure 4).
4. Pitman arm to center link; secure with castle nut.

Tighten

- Center link-to-pitman arm castle nut to 55 N·m (40 lb. ft.).



309 PILOT BOLT
310 MOUNTING BOLTS

EJS036382

Figure 6—Steering Gear Mounting Bolts

5. Cotter pin to center link. Bend end of pin following installation.
6. Splash shield to left inner wheel well; secure with screws.
7. Engine skid plate, if equipped; secure with four bolts.

Tighten

- Engine skid plate bolts to 27 N·m (20 lb. ft.).

8. Lower vehicle.

TIE ROD (RIGHT OR LEFT)

Figures 1 and 7

Remove or Disconnect

Tool Required:
J 21687-02 Tie Rod End Remover

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Engine skid plate, if equipped (four bolts).
3. Cotter pin and castle nut securing tie rod to center link.
4. Tie rod from center link using a J 21687-02.
5. Loosen tie rod locknut at connector sleeve (Figure 7).
6. Tie rod from connector sleeve and tie rod end.
7. Locknut from tie rod.

Inspect

- Tie rod dust seal for perforation or excessive wear. Replace the seal if these conditions exist.

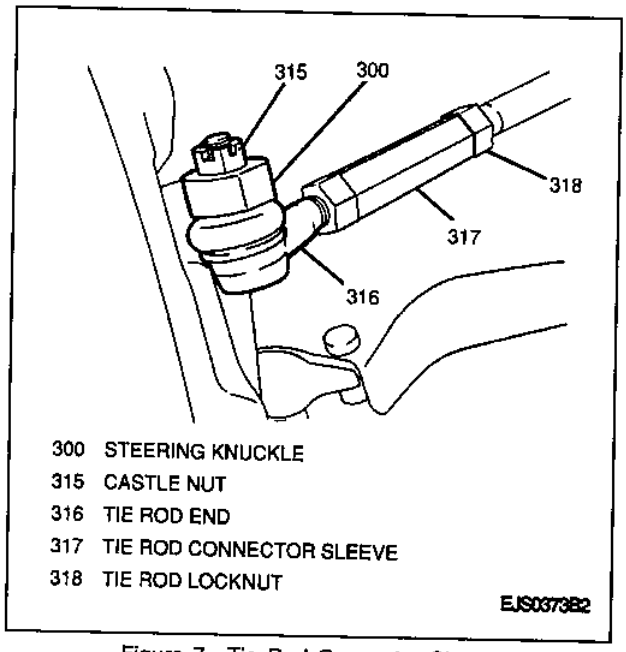


Figure 7—Tie Rod Connector Sleeve

Install or Connect

1. Locknut to tie rod.
2. Thread tie rod into connector sleeve and tie rod end.
3. Tie rod to center link; secure with castle nut.

Tighten

- Tie rod castle nut to 45 N.m (33 lb. ft.).
- Tie rod locknut to 65 N.m (48 lb. ft.).

4. Cotter pin to tie rod shaft. Bend end of pin following installation.

Inspect

- For proper toe adjustment. Refer to SECTION 3A.

5. Engine skid plate, if equipped; secure with four bolts.

Tighten

- Skid plate bolts to 27 N.m (20 lb. ft.).

6. Lower vehicle.

TIE ROD END (RIGHT OR LEFT)

Figures 8 through 11

Remove or Disconnect

Tool Required:
J 21687-02 Tie Rod End Remover

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Wheel from vehicle. Refer to SECTION 3E.
3. Cotter pin and castle nut from tie rod end.
4. Separate tie rod end from steering knuckle using a J 21687-02 (Figure 8).

Important

- For ease of adjustment after installation, mark the position of the tie rod end locknut on the tie rod thread.

5. Loosen tie rod end locknut (Figure 9).
6. Tie rod end from tie rod connector sleeve (Figure 9).

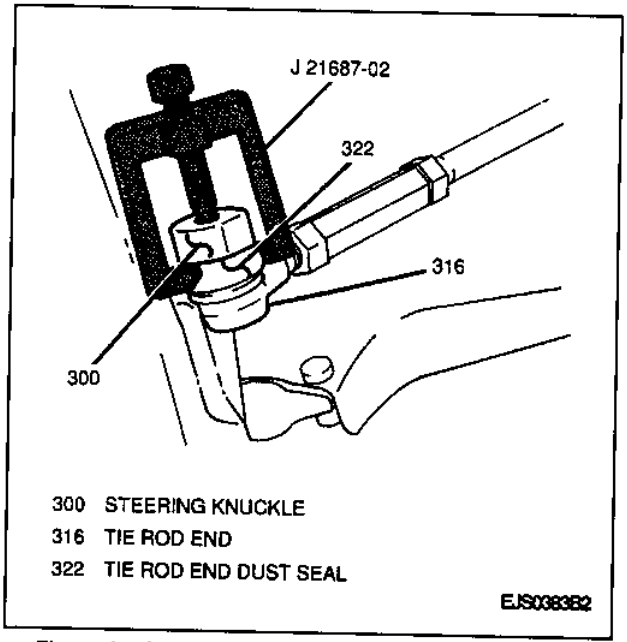


Figure 8—Separating Tie Rod From Steering Knuckle

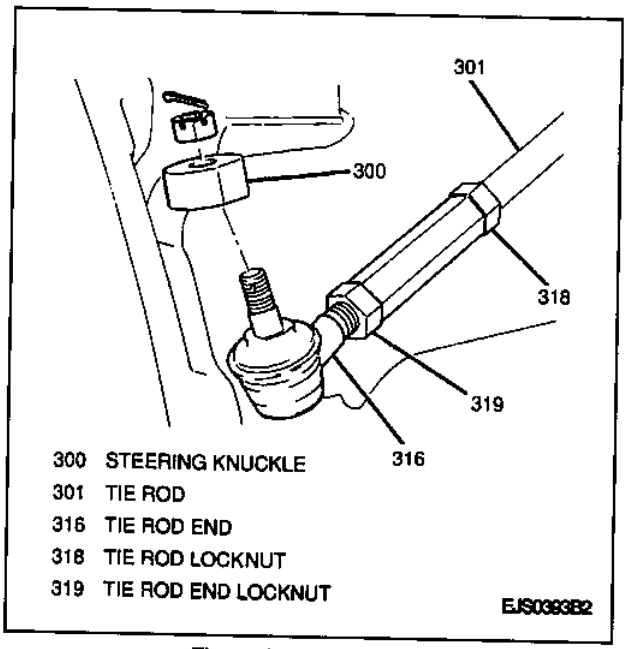


Figure 9—Tie Rod End

Inspect

- Tie rod end dust seal for perforation or excessive wear. Replace the seal if these conditions exist.

Install or Connect

1. Tie rod end and locknut to tie rod connector sleeve (Figure 10).
2. Align the marks (made during the removal procedure) denoting the position of the tie rod end locknut with the tie rod thread.
3. Tie rod end to steering knuckle; secure with castle nut.

Tighten

- Tie rod end castle nut to 45 N.m (33 lb. ft.).

4. Cotter pin to tie rod end. Bend end of pin following installation.

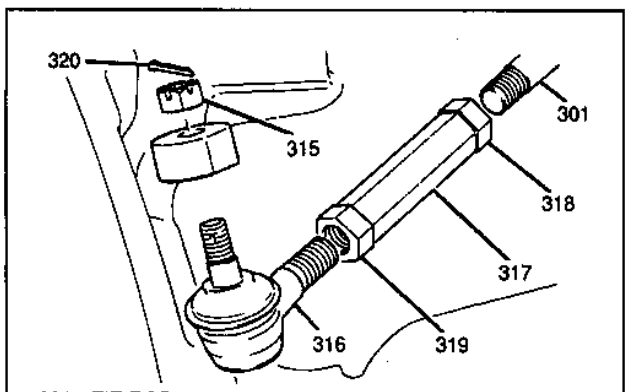
Inspect

- For proper toe adjustment. Refer to SECTION 3A.

Tighten

- Tie rod end locknut to 65 N.m (48 lb. ft.) (Figure 11).

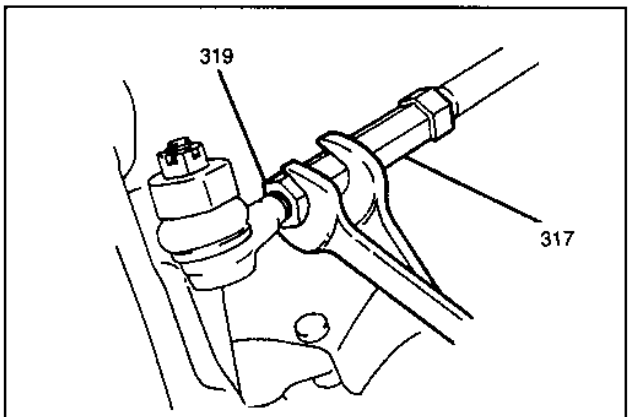
5. Wheel to vehicle. Refer to SECTION 3E.
6. Lower vehicle.



301 TIE ROD
315 CASTLE NUT
316 TIE ROD END
317 TIE ROD CONNECTOR SLEEVE
318 TIE ROD LOCKNUT
319 TIE ROD END LOCKNUT
320 COTTER PIN

EJS040382

Figure 10—Installing Tie Rod End



317 TIE ROD CONNECTOR SLEEVE
319 TIE ROD END LOCKNUT

EJS041382

Figure 11—Tightening Tie Rod End

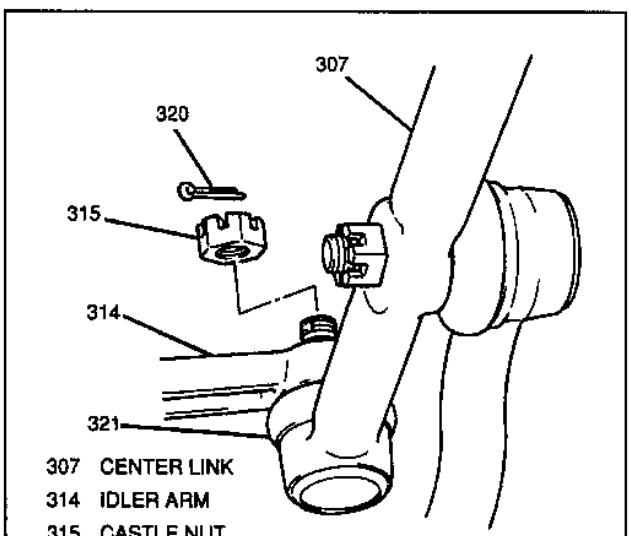
IDLER ARM

Figures 12 through 15

Remove or Disconnect

Tool Required:
J 21687-02 Tie Rod End Remover

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Cotter pin and idler arm castle nut from center link (Figure 12).
3. Idler arm from center link, using a J 21687-02 (Figure 13).
4. Idler arm nut, two lower washers, idler arm and upper washer from mounting bracket shaft.



307 CENTER LINK
314 IDLER ARM
315 CASTLE NUT
320 COTTER PIN
321 IDLER ARM DUST SEAL

EJS042382

Figure 12—Idler Arm Castle Nut

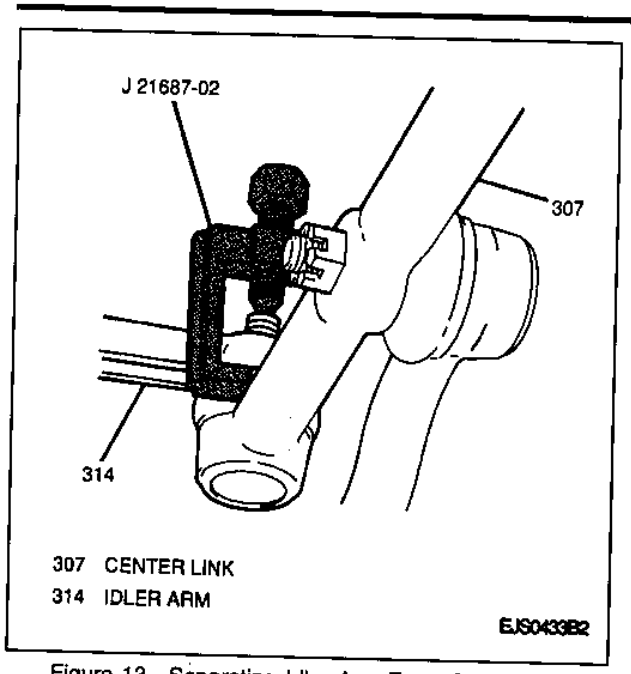


Figure 13—Separating Idler Arm From Center Link

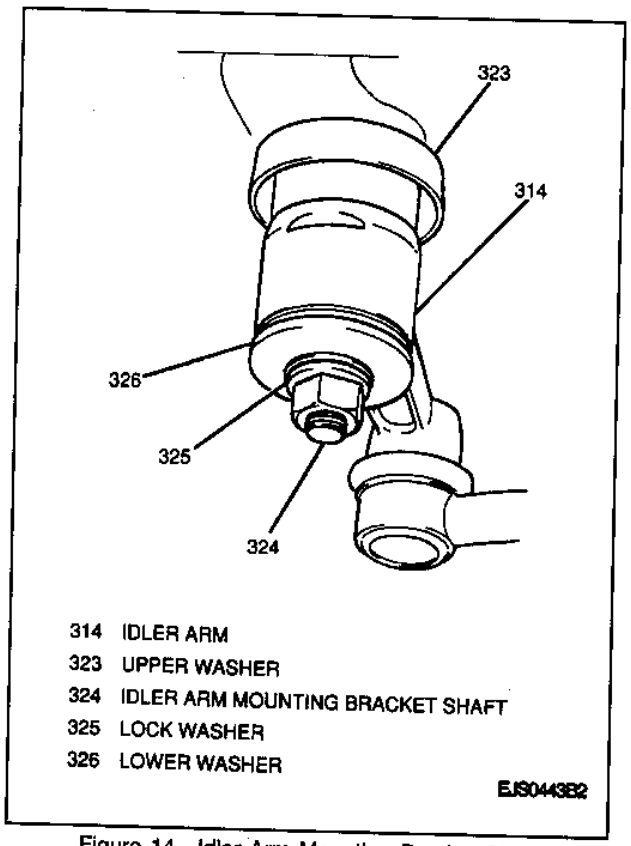


Figure 14—Idler Arm Mounting Bracket Shaft

Inspect

- Idler arm dust seal for perforation or excessive wear. Replace the seal if these conditions exist.

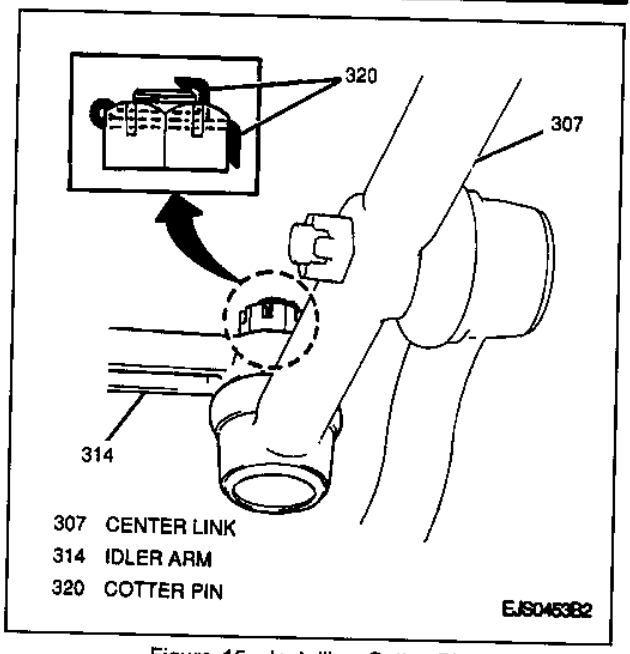


Figure 15—Installing Cotter Pin

Install or Connect

1. Upper washer, idler arm and two lower washers to mounting bracket shaft; secure with nut (Figure 14).

Tighten

- Idler arm nut to 75 N.m (55 lb. ft.).

2. Idler arm to center link; secure with castle nut.

Tighten

- Idler arm castle nut to 45 N.m (33 lb. ft.).

3. Cotter pin to center link. Bend end of pin after installation (Figure 15).
4. Lower vehicle.

PITMAN ARM

Figure 3

Remove or Disconnect

Tool Required:
J 29107 Pitman Arm Puller

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Engine skid plate, if equipped (four bolts).
3. Mounting screws and splash shield from left inner wheel well.
4. Cotter pin and castle nut from center link.

5. Separate pitman arm from center link using a J 29107 (Figure 3).
6. Sector shaft nut and washer from steering gear sector shaft; remove pitman arm from steering gear.

Install or Connect

1. Pitman arm to steering gear sector shaft, aligning matchmarks on pitman arm and shaft; secure with sector shaft nut.

Tighten

- Sector shaft nut to 130 N.m (95 lb. ft.).

2. Pitman arm to center link; secure with castle nut.

Tighten

- Center link-to-pitman arm castle nut to 55 N.m (40 lb. ft.).

3. Cotter pin to center link. Bend end of pin following installation.
4. Splash shield to left inner wheel well; secure with screws.
5. Engine skid plate, if equipped; secure with four bolts.

Tighten

- Engine skid plate bolts to 27 N.m (20 lb. ft.).

6. Lower vehicle.

STEERING WHEEL INSPECTION

Figure 16

- Inspect steering wheel for play and rattle with the wheels in a straight-ahead position and with the vehicle on level ground (Figure 16). Steering wheel play (A) should be 10 to 30 mm (0.40 to 1.20-inch).
- If play is not within specification, inspect for the following. If any part is found to be defective, replace it.
  - Tie rod ball end for wear.
  - Lower ball joint for wear.
  - Steering shaft joint for wear.
  - Idler arm bushing for damage or wear.
  - Loosely installed parts.
  - Steering gear sector shaft for wear.

MANUAL STEERING GEAR INSPECTION

Oil Level

Figure 17

Inspect

- Inspect the manual steering gear oil level through the steering gear fill/breather plug, located on the top of the gear box. Gear oil should be visible 35 mm (1.38-inch) below the top of the gear box (Figure 17). If the oil is not visible, fill to the specified level with manual steering gear lube GM P/N 1052182, or equivalent.

Adjusting Worm Shaft Preload Torque

Figures 18 and 19

The steering gear has one adjusting nut which sets preload for the sector shaft.

Adjust

Tool Required:
J 4871-A Pinion Socket

1. Worm shaft preload torque:

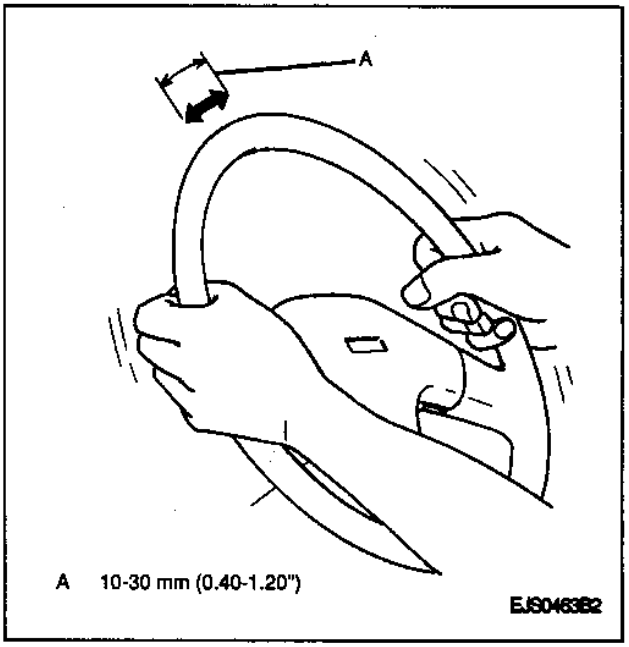


Figure 16—Inspecting Steering Wheel Play (Typical)

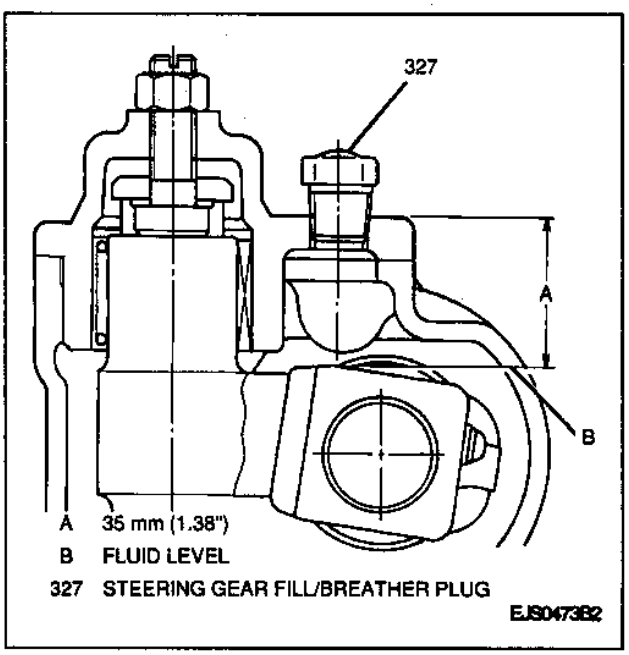


Figure 17—Steering Gear Oil Level

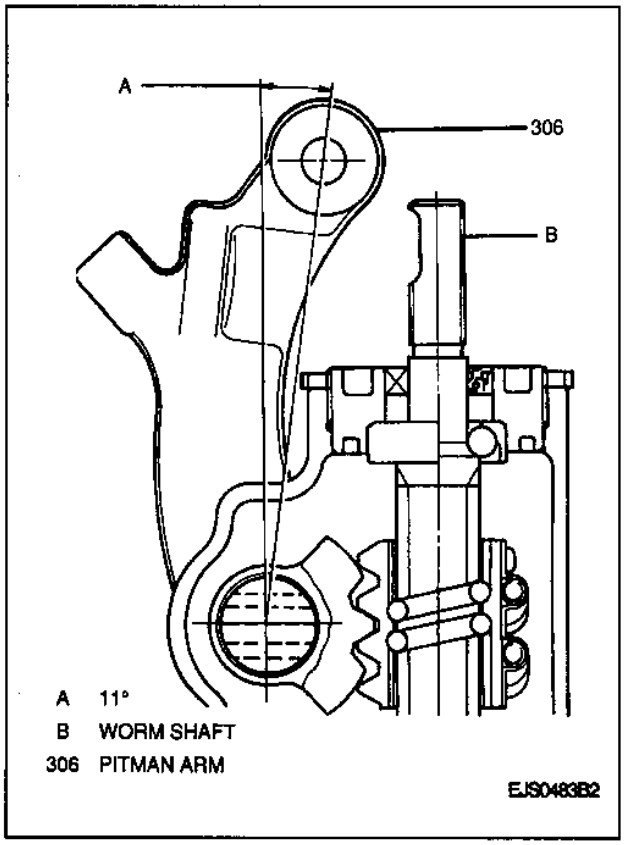


Figure 18—Pitman Arm Position

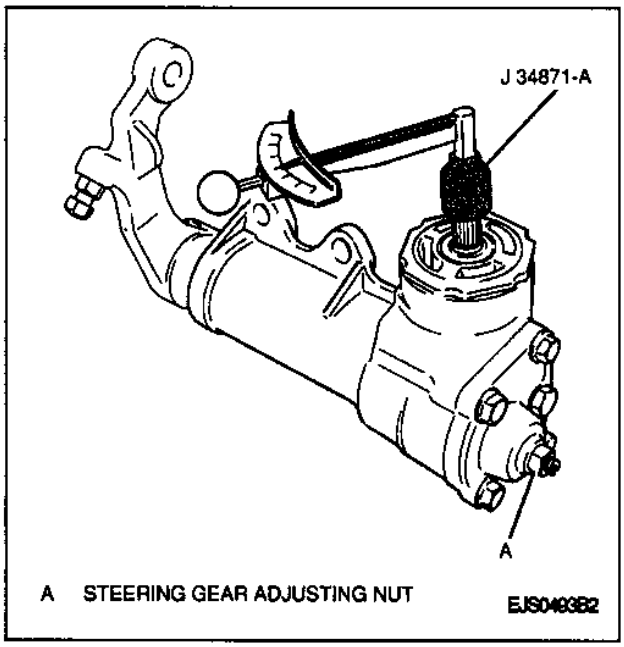


Figure 19—Adjusting Worm Preload Torque

A. Check worm shaft to ensure that it is free of thrust play.
B. Position pitman arm 11 degrees inward from parallel with the worm shaft (Figure 18). (With pitman arm in this position, the vehicle's front wheels are straight.)

Tighten

- Worm shaft (including steering gear sector shaft) to 1 N·m (9 lb. in.) using a torque wrench and a J 34871-A (Figure 19).
- If the measured worm shaft preload torque does not conform to specification, tighten or loosen the steering gear adjusting nut (depending upon whether the worm shaft preload torque measured high or low), and then recheck worm shaft preload torque.

Important

- If the specified preload torque is not attained even after readjustment, replace the manual steering gear box with a new one.

ADJUSTING STEERING ANGLE

Figure 20

Measure

- Steering angle. Refer to SECTION 3A. If the angle is out of specification, adjust by changing the length of the pitman arm stopper bolts (Figure 20).

Adjust

- Steering angle to 32.5 degrees (inside angle), and 30.5 degrees (outside angle).

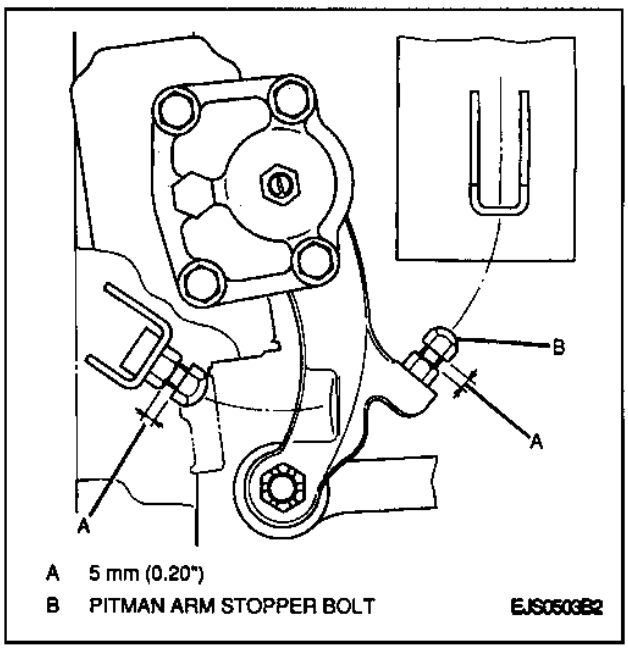


Figure 20—Adjusting Steering Angle

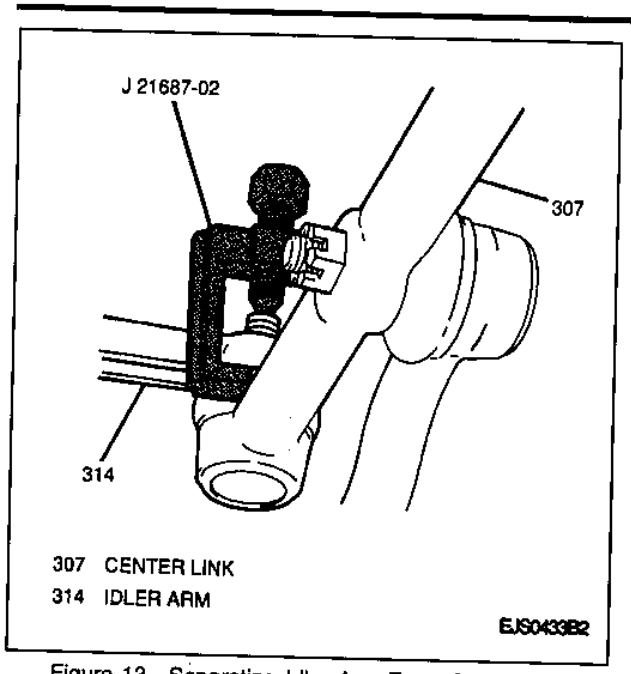


Figure 13—Separating Idler Arm From Center Link

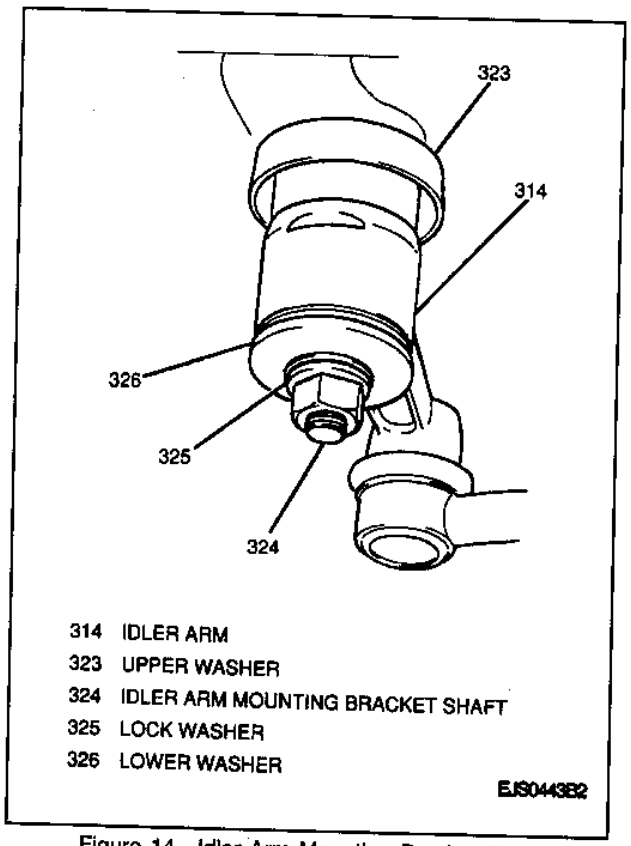


Figure 14—Idler Arm Mounting Bracket Shaft

Inspect

- Idler arm dust seal for perforation or excessive wear. Replace the seal if these conditions exist.

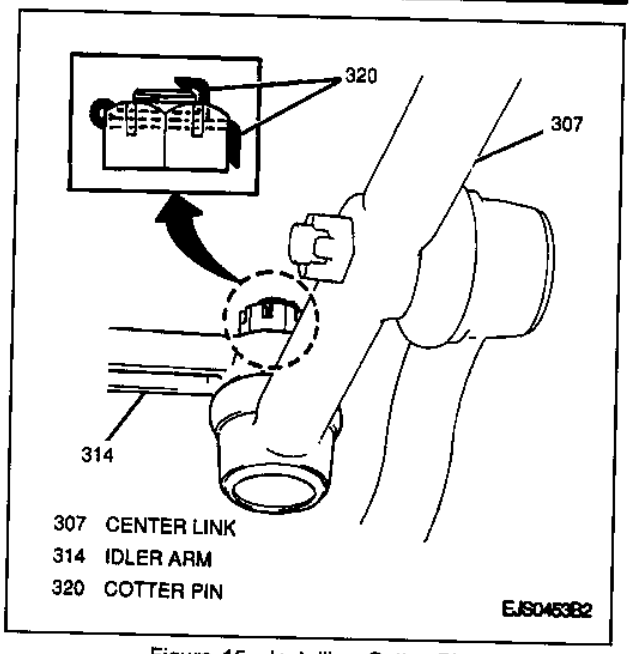


Figure 15—Installing Cotter Pin

Install or Connect

1. Upper washer, idler arm and two lower washers to mounting bracket shaft; secure with nut (Figure 14).

Tighten

- Idler arm nut to 75 N.m (55 lb. ft.).

2. Idler arm to center link; secure with castle nut.

Tighten

- Idler arm castle nut to 45 N.m (33 lb. ft.).

3. Cotter pin to center link. Bend end of pin after installation (Figure 15).
4. Lower vehicle.

PITMAN ARM

Figure 3

Remove or Disconnect

Tool Required:
J 29107 Pitman Arm Puller

1. Raise and suitably support vehicle. Refer to SECTION 0A.
2. Engine skid plate, if equipped (four bolts).
3. Mounting screws and splash shield from left inner wheel well.
4. Cotter pin and castle nut from center link.

5. Separate pitman arm from center link using a J 29107 (Figure 3).
6. Sector shaft nut and washer from steering gear sector shaft; remove pitman arm from steering gear.

Install or Connect

1. Pitman arm to steering gear sector shaft, aligning matchmarks on pitman arm and shaft; secure with sector shaft nut.

Tighten

- Sector shaft nut to 130 N.m (95 lb. ft.).

2. Pitman arm to center link; secure with castle nut.

Tighten

- Center link-to-pitman arm castle nut to 55 N.m (40 lb. ft.).

3. Cotter pin to center link. Bend end of pin following installation.
4. Splash shield to left inner wheel well; secure with screws.
5. Engine skid plate, if equipped; secure with four bolts.

Tighten

- Engine skid plate bolts to 27 N.m (20 lb. ft.).

6. Lower vehicle.

STEERING WHEEL INSPECTION

Figure 16

- Inspect steering wheel for play and rattle with the wheels in a straight-ahead position and with the vehicle on level ground (Figure 16). Steering wheel play (A) should be 10 to 30 mm (0.40 to 1.20-inch).
- If play is not within specification, inspect for the following. If any part is found to be defective, replace it.
  - Tie rod ball end for wear.
  - Lower ball joint for wear.
  - Steering shaft joint for wear.
  - Idler arm bushing for damage or wear.
  - Loosely installed parts.
  - Steering gear sector shaft for wear.

MANUAL STEERING GEAR INSPECTION

Oil Level

Figure 17

Inspect

- Inspect the manual steering gear oil level through the steering gear fill/breather plug, located on the top of the gear box. Gear oil should be visible 35 mm (1.38-inch) below the top of the gear box (Figure 17). If the oil is not visible, fill to the specified level with manual steering gear lube GM P/N 1052182, or equivalent.

Adjusting Worm Shaft Preload Torque

Figures 18 and 19

The steering gear has one adjusting nut which sets preload for the sector shaft.

Adjust

Tool Required:
J 4871-A Pinion Socket

1. Worm shaft preload torque:

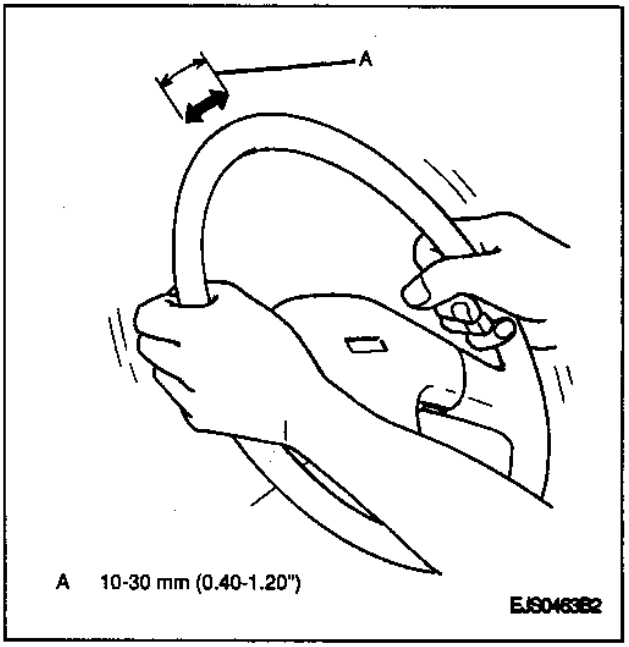


Figure 16—Inspecting Steering Wheel Play (Typical)

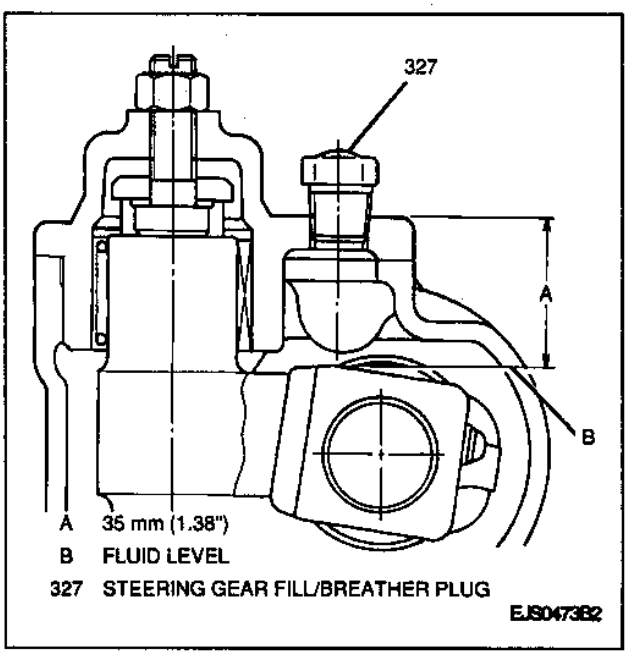


Figure 17—Steering Gear Oil Level

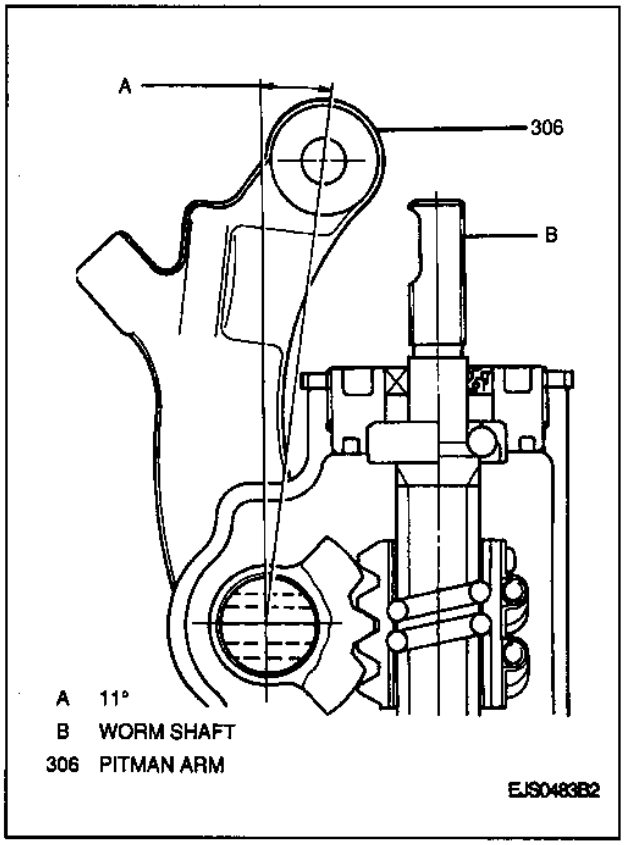


Figure 18—Pitman Arm Position

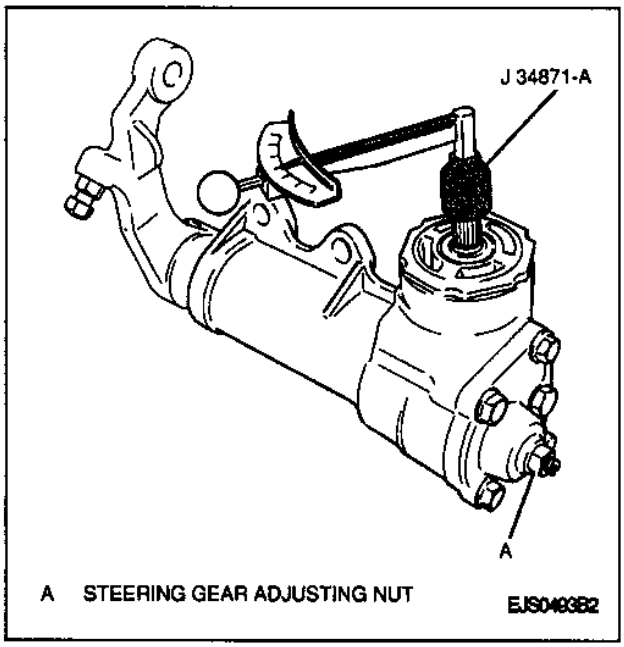


Figure 19—Adjusting Worm Preload Torque

A. Check worm shaft to ensure that it is free of thrust play.
B. Position pitman arm 11 degrees inward from parallel with the worm shaft (Figure 18). (With pitman arm in this position, the vehicle's front wheels are straight.)

Tighten

- Worm shaft (including steering gear sector shaft) to 1 N·m (9 lb. in.) using a torque wrench and a J 34871-A (Figure 19).
- If the measured worm shaft preload torque does not conform to specification, tighten or loosen the steering gear adjusting nut (depending upon whether the worm shaft preload torque measured high or low), and then recheck worm shaft preload torque.

Important

- If the specified preload torque is not attained even after readjustment, replace the manual steering gear box with a new one.

ADJUSTING STEERING ANGLE

Figure 20

Measure

- Steering angle. Refer to SECTION 3A. If the angle is out of specification, adjust by changing the length of the pitman arm stopper bolts (Figure 20).

Adjust

- Steering angle to 32.5 degrees (inside angle), and 30.5 degrees (outside angle).

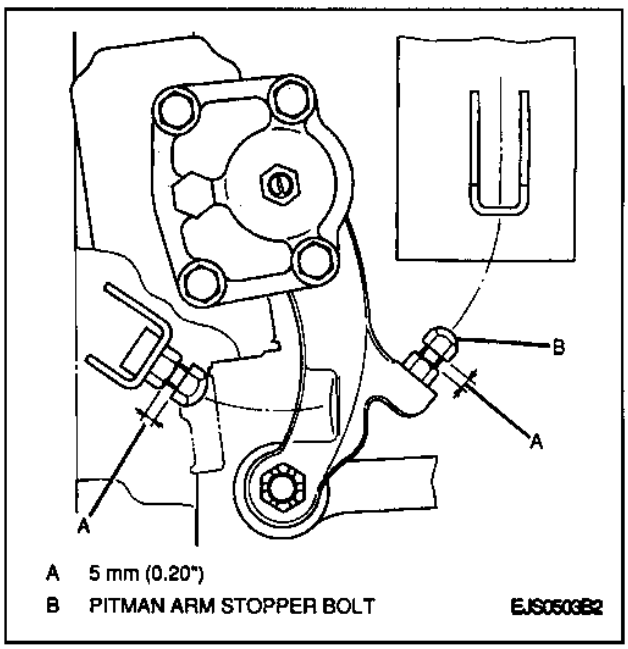


Figure 20—Adjusting Steering Angle

SPECIFICATIONS

FASTENER TORQUES

Manual Steering Gear Mounting Pilot Bolts	100 N.m (72 lb. ft.)
Pitman Arm Sector Shaft Nut	130 N.m (95 lb. ft.)
Center Link-To-Pitman Arm Castle Nut	55 N.m (40 lb. ft.)
Engine Skid Plate Bolts	27 N.m (20 lb. ft.)
Tie Rod Castle Nut	45 N.m (33 lb. ft.)
Tie Rod Locknut	65 N.m (48 lb. ft.)
Tie Rod End Castle Nut	45 N.m (33 lb. ft.)
Tie Rod End Locknut	65 N.m (48 lb. ft.)
Idler Arm Nut	75 N.m (55 lb. ft.)
Idler Arm Castle Nut	45 N.m (33 lb. ft.)
Worm Shaft Preload	1 N.m (9 lb. in.)

STEERING GEAR SPECIFICATIONS

Steering Gear Preload

Steering Gear Sector Shaft Preload	1 N.m (9 lb. in.)

Steering Gear Angle

Inside Angle	32.5 degrees
Outside Angle	30.5 degrees

SPECIAL TOOLS