

Section 3

Suspension

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Suspension General Diagnosis

Diagnostic Information and Procedures

Vehicle Leads/Pulls

Condition	Correction
Camber incorrectly adjusted. Steering will pull to the side of the axle having the greatest positive camber.	Adjust the camber. Refer to <i>Front Camber Adjustment</i> in Front Wheel Alignment.
Low air pressure in the right or left tire. Steering will pull to the side having the lowest air pressure.	1. Inflate the tires to the correct pressure. 2. Inspect the tire for an air leak and repair as required.
Axle loose and shifted at the spring U-bolts.	1. Align and tighten the axle U-bolt nuts to specifications. 2. Inspect, replace damaged parts as required.
Rear axle loose at the spring. U-bolt shifted at one side causes the steering to pull.	1. Align the rear axle and replace defective components. 2. Tighten the U-bolts to specifications.

Suspension Bottoms

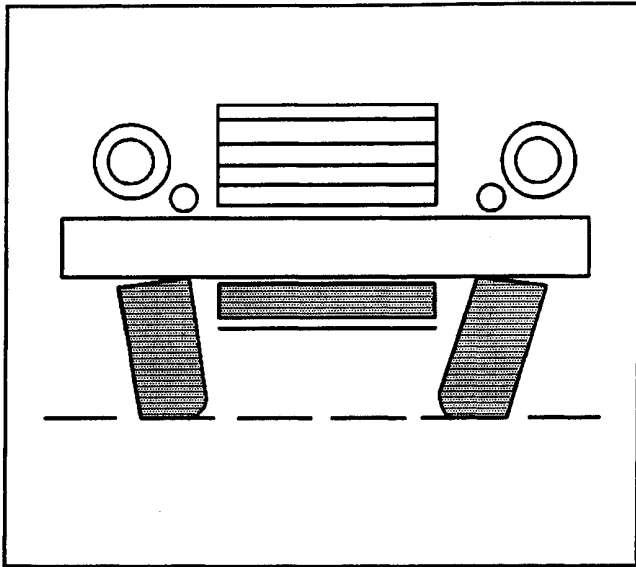
Problem	Action
The shock absorbers are inoperative.	Replace the shock absorbers.
The spring leaf is broken (Tapered Leaf).	Replace the spring assembly.
The spring leaf is broken (Multi Leaf).	Replace the leaf for the spring assembly.
Driver has severely operated or has overloaded the vehicle.	Verify the load capacity rating.

Abnormal or Excessive Tire Wear

Condition	Correction
The tire pressure is incorrect.	Properly inflate the tires to the recommended pressure. Refer to <i>Tire Inflation Description</i> in Tires and Wheels.
The tire and wheel usage is incorrect.	Install the correct tire and wheel combination. Refer to <i>Tire Matching</i> in Tires and Wheels.
The shock absorbers are defective.	Replace defective shock absorbers. Refer to <i>Shock Absorber Replacement</i> in Front Suspension.
The front end is out of alignment.	Align the front end. Refer to <i>Front Caster Adjustment</i> or <i>Front Camber Adjustment</i> or <i>Front Toe Adjustment</i> in Wheel Alignment.
The steering linkage, bushings, ball joints, and other suspension components are loose, worn, or damaged.	Inspect, repair, or replace suspension and steering components as needed.

Inspect all tires on the vehicle for signs of wear.
Refer to *Wheel Alignment Specifications* in Front Wheel Alignment.

Uneven Wear



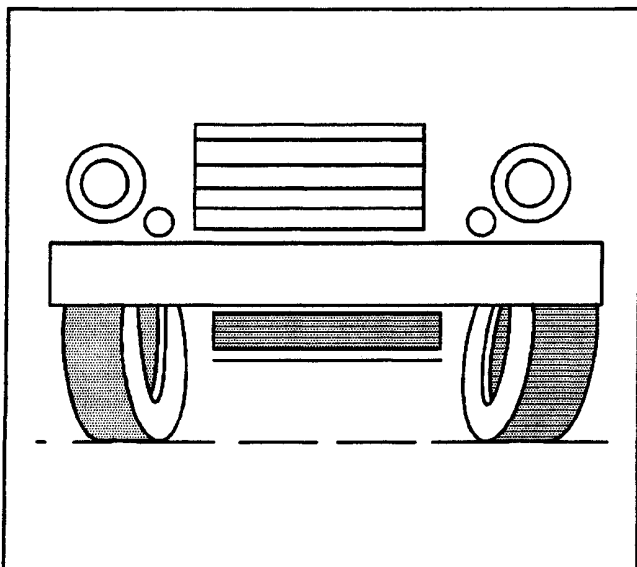
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The following conditions may cause spotty or uneven wear:

- Unequal caster or camber
- Bent suspension parts
- Out-of-balance wheels
- Out-of-round brake drums
- Brakes out of adjustment
- Other mechanical conditions

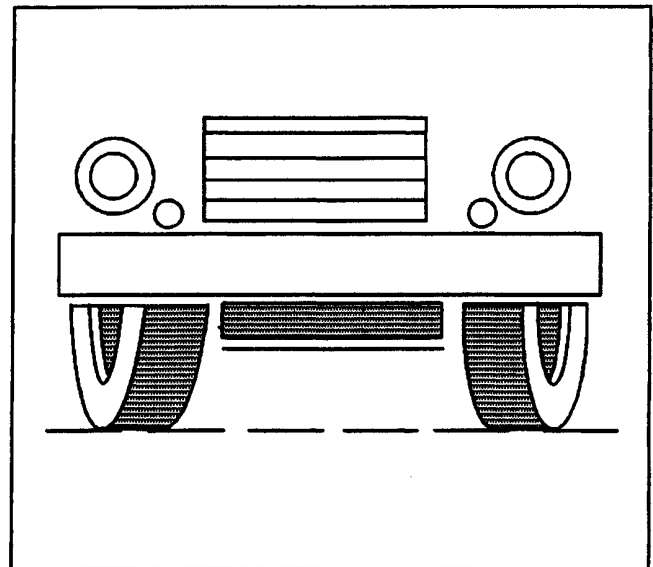
Locate the mechanical condition that causes uneven wear. Correct the condition.

Misalignment Wear



222202

Too much toe-in or toe-out on the front axle tires causes misalignment wear. The tires revolve with a side motion which scrapes off the tread rubber. The scraping action against the face of the tire causes a small feather edge of rubber to appear on one side of the tread. This feathering is an indication of misalignment.



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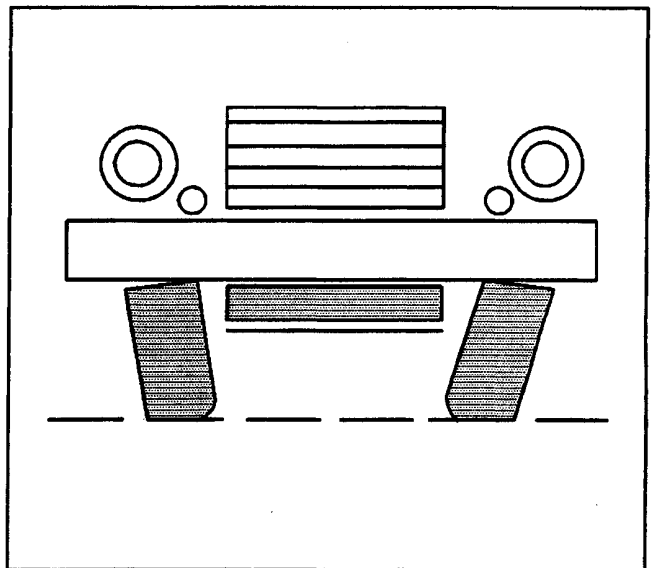
If the misalignment is severe, the rubber will be scraped off both tires. If the misalignment is slight, only one tire will be affected. In order to correct misalignment, adjust the toe-in or verify that the entire front end alignment settings are correct. Refer to *Front Toe Adjustment* in Front Wheel Alignment.

Side Wear

Side wear may be caused by the following conditions:

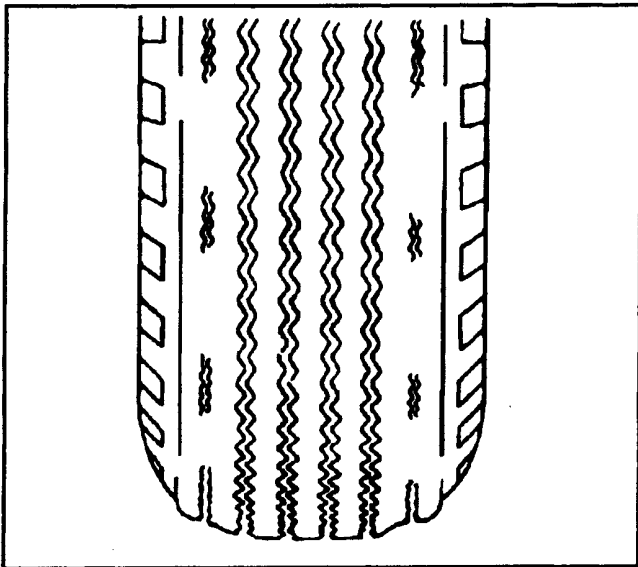
- Incorrect wheel camber
- Underinflation
- High cambered roads
- Excessive cornering speed

Incorrect wheel camber and underinflation are the most common causes of side wear.



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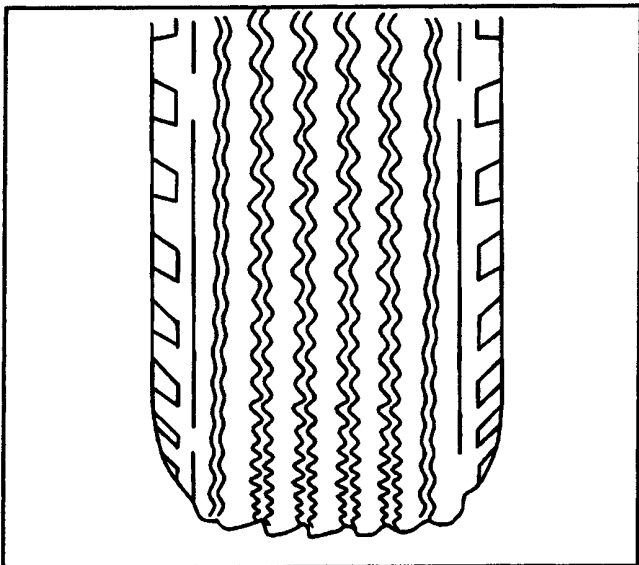
Camber wear occurs on one side of the tread.



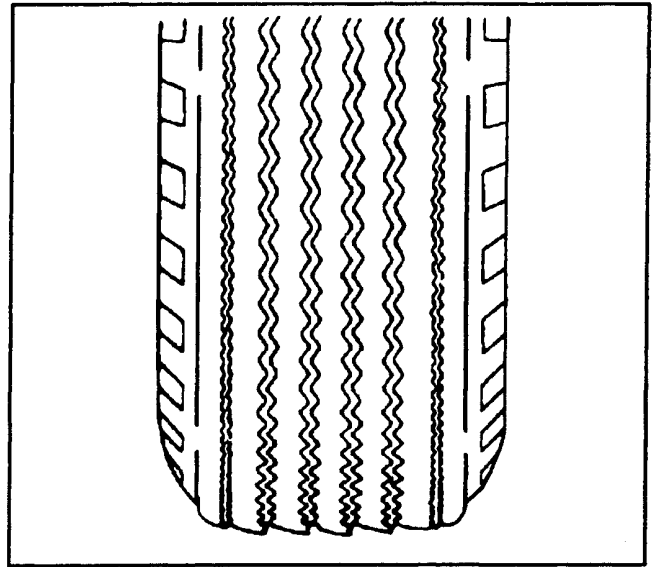
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Underinflation causes wear on both sides of the tread. Correct the camber first. Refer to *Front Camber Adjustment* in Front Wheel Alignment. Then rotate the tires.

Heel and Toe Wear



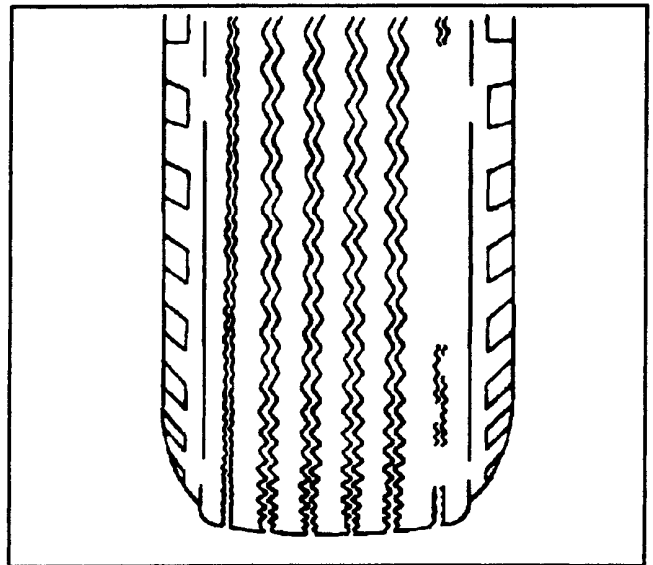
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222207

This saw toothed effect is caused by tire wear in the areas that first grip the road when the brakes are applied. In order to avoid this problem, rotate the tires regularly.

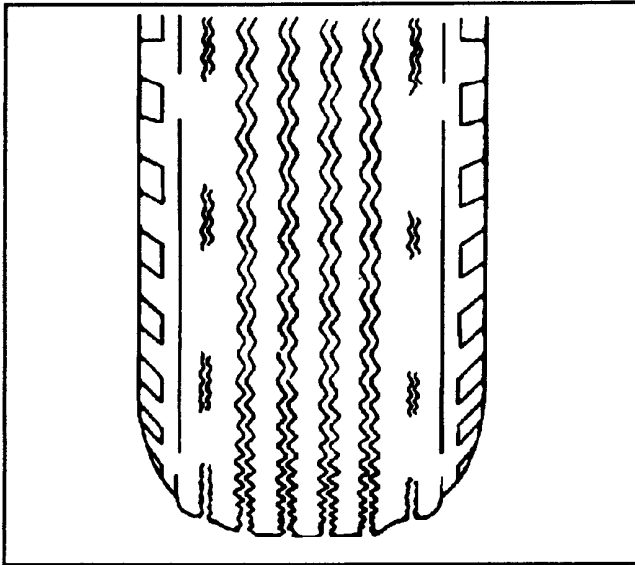
Cornering Wear



222242

During normal driving, weight is distributed evenly on all of the wheels. When a vehicle makes a fast turn, the weight is shifted to an abnormal overload on the outside tires and a very light load on the inside tires. This unequal loading may have two harmful results:

- The rear tire on the inside of the curve may be relieved of so much load that the tire is no longer geared to the road and slips. This grinds off the tread on the inside half of the tire. This type of tire wear resembles tire wear caused by negative camber.
- Weight transfer may overload the outside tires so much that these tires become laterally distorted. This excessive wear on the outside half of the tire resembles positive camber.



222209

Cornering wear differs from abnormal camber wear by the rounding off of the outside shoulder or edge of the tire, and by the roughening of the tread surface which shows abrasion. Cornering wear often produces a fin, or raised portion, along the inside edge of each row in the tread pattern.

In some cases this fin resembles a toe-in fin and in other cases the fin tapers into a row of tread blocks, giving the tire a step wear pattern. In order to offset normal cornering wear, rotate the tires on a regular basis.

Wander or Poor Steering Stability

Condition	Correction
Incorrectly adjusted front wheel bearings	Adjust the bearing or replace with new components as required. Refer to <i>Wheel Bearing Adjustment</i> in Front Suspension.
Worn coupling or steering shaft U-joints	Replace as needed.
Steering wheel loose on the shaft, a loose pitman arm, tie rods, steering arms, or steering linkage ball studs	Tighten fasteners to specifications. Refer to <i>Fastener Tightening Specifications</i> in Front Suspension.
Worn steering gear or bearings improperly adjusted	Adjust the preload.
Excessive pitman shaft to ball nut lash in the steering gear	Adjust the preload.
Toe-in being out of adjustment, worn intermediate rod or tie rod sockets	1. Replace the tie rod end if worn and adjust the Toe-in. Refer to <i>Front Toe Adjustment</i> in Wheel Alignment. 2. Inspect the steering arm and tie rod for a bent condition.
Steering system out of alignment	1. Completely align the front wheels. Refer to <i>Front Caster Adjustment</i> or <i>Front Camber Adjustment</i> or <i>Front Toe Adjustment</i> in Wheel Alignment. 2. Inspect the spring components for wear. Repair or replace as required.
Badly worn tires, edges rounded off	Adjust the front wheel alignment. Refer to <i>Front Caster Adjustment</i> or <i>Front Camber Adjustment</i> or <i>Front Toe Adjustment</i> in Wheel Alignment.
Lack of lubrication in the linkage and the king pins	1. Free up and lubricate any components that are frozen and will not take lubrication. 2. Inspect for wear and damage.

Noisy Front Suspension

Condition	Correction
The tie rod ends are worn.	Replace the tie rod ends. Refer to <i>Tie Rod Replacement</i> in Steering Linkage.
The suspension bolts are loose.	Refer to <i>Fastener Tightening Specifications</i> in Front Suspension.
The front suspension lacks the proper lubrication.	Refer to <i>Fastener Tightening Specifications</i> in Maintenance and Lubrication.
The shock absorbers are loose.	Tighten the bolts. Refer to <i>Shock Absorber Replacement</i> in Front Suspension.

Noisy Front Suspension (cont'd)

Condition	Correction
The shock absorber bushings are worn.	Replace the bushings.
The king pins and/or bearings are loose or worn.	Adjust and/or replace the king pin and the bearings.
The stabilizer shaft is loose.	Tighten the bolts. Refer to <i>Stabilizer Shaft Replacement</i> in Front Suspension.
The stabilizer shaft insulators are worn.	Replace the insulators.

Poor Directional Stability

Problem	Action
The steering linkage or the ball joints need lubrication.	Lubricate as needed.
The steering gear is adjusted too tightly.	Adjust the preload.
The front wheel alignment is incorrect.	Check the alignment and correct as necessary.
The steering gear to column is misaligned.	Align the column.

Tire Hop or Poor Handling

Condition	Correction
The wheel and tire out of balance	Refer to <i>Front Wheel Shimmy</i> in Suspension General Diagnosis.
A blister or bump on the tire	Replace the tire. Refer to <i>Tire Mounting and Dismounting</i> in Tires and Wheels.
Improper shock absorber action	Replace the shock absorber. Refer to <i>Shock Absorber Replacement</i> in Front Suspension.
Excessive wheel or tire runout	Refer to <i>Front Wheel Shimmy</i> in Suspension General Diagnosis.
Tire lead	Refer to <i>Front Wheel Shimmy</i> in Suspension General Diagnosis.

Excessive Road Shock

Condition	Action
The tire air pressure is too high.	Deflate the tire to the correct pressure. Refer to <i>Tire Inflation Description</i> in Tires and Wheels.
The wheel bearing are improperly adjusted.	Adjust the wheel bearings to specifications. Refer to <i>Wheel Bearing Adjustment</i> in Front Suspension.
The camber adjustment is incorrect (Negative camber contributes to road shock).	Adjust camber. Refer to <i>Wheel Bearing Adjustment</i> in Wheel Alignment.
The spring is broken or sagging.	Replace the spring. Refer to <i>Leaf Springs Replacement</i> in Front Suspension.
Inspect for defective shock absorbers.	Replace the shock absorbers. Refer to <i>Shock Absorber Replacement</i> in Front Suspension or refer to <i>Shock Absorber Replacement</i> in Rear Suspension.
The suspension components are loose.	Inspect, repair, adjust, the components as needed. Refer to <i>King Pin Bearing Preload</i> in Front Suspension.

Struts or Shock Absorbers Binding

Problem	Action
The shock has a scored rod.	Replace the shock absorber. Refer to <i>Shock Absorber Replacement</i> in Rear Suspension.
The shock has dents.	Replace the shock absorber. Refer to <i>Shock Absorber Replacement</i> in Rear Suspension.
The shock leaks at the seal cover.	Replace the shock absorber. Refer to <i>Shock Absorber Replacement</i> in Rear Suspension.

Struts or Shock Absorbers Bench Test

Notice: Do not clamp the vise jaws on the shock absorber reservoir tube or shaft. Doing so could damage component.

1. Place the shock absorber in a vertical position (top end up). Clamp the bottom mount in a vise.
2. Rotate the dust tube. Notice if any binding condition exists. Compare the action with a known good shock, if necessary. A binding condition indicates a scored rod. Replace shocks with scored pistons.
3. Fully extend the shocks and examine the shocks for leaks in the seal cover area. Shock fluid is a very thin hydraulic fluid and has a characteristic odor and dark brown tint. A slight trace of shock fluid around the seal cover area is not cause for shock replacement. The shock seal is made to permit a very slight seepage in order to lubricate the rod. Replace leaky units.
4. Inspect the shock for dents. A bent rod could cause the shock to bind.

5. Extend and compress each shock in order to determine that the shock has control (resistance) in both jounce and rebound.
6. Visually inspect the shock mounting for the following:
 - Broken mounts
 - Extreme bushing wear
 - A shifted bushing or wear
 - Deep cracks in the bushing material, shallow surface cracks are normal.

Struts or Shock Absorbers On-Vehicle Testing

1. Set the parking brake.
2. Block the front wheels.
3. Loosen the lower mounting of both shocks.
4. Raise and lower the bottom of each shock, noting the rate of jounce and rebound of the shock absorber. Shock absorbers are non-adjustable and non-repairable. Replace both shocks if you detect a definite rate differential.

Spring Noise

Condition	Correction
Loose U-bolts	Tighten to the specified torque. Refer to <i>Fastener Tightening Specifications</i> in Rear Suspension or refer to <i>Fastener Tightening Specifications</i> in Front Suspension.
Loose or worn eye bushings	Replace the eye bushings. Refer to <i>Spring Bushing Replacement</i> in Rear Suspension.
Lack of lubrication.	Lubricate as required.
Faulty shock absorber	Replace the shock absorber. Refer to <i>Shock Absorber Replacement</i> in Rear Suspension or refer to <i>Shock Absorber Replacement</i> in Front Suspension.

Spring Sags or Bottoms

Condition	Correction
The shock absorbers are inoperative.	Replace the shock absorbers. Refer to <i>Shock Absorber Replacement</i> in Rear Suspension or refer to <i>Shock Absorber Replacement</i> in Front Suspension.
The spring has a broken leaf.	Replace the leaf or spring assembly. Refer to <i>Spring Leaf Replacement</i> in Rear Suspension or refer to <i>Leaf Springs Replacement</i> in Front Suspension.
The vehicle was used under severe operation or the vehicle has been overloaded.	Check the load capacity rating. Refer to <i>Label - Vehicle Certification</i> in General Information.

Spring Breakage

Condition	Correction
The spring has loose U-bolts.	Tighten the U-bolts. Refer to <i>Fastener Tightening Specifications</i> in Rear Suspension or refer to <i>Fastener Tightening Specifications</i> in Front Suspension.
The spring shows normal fatigue.	Replace the spring. Refer to <i>Leaf Spring Replacement</i> in Rear Suspension.
The vehicle is overloaded.	Check the load capacity rating.

Front Wheel Shimmy

Condition	Correction
The seals are damaged and leaking, resulting in loss of lubricant, corrosion, and excessive wear.	Replace the damaged parts as necessary.
The tires, wheels, or brake drums are out of balance.	Balance the tires and wheels, preferably with a on-vehicle balancer. This method balances the entire wheel and drum assembly.
The wheel is bent or the tire is out of round. The wheel nuts are not tightened evenly.	Replace the wheel and remount or replace the tire.
The steering linkage components are loose.	Adjust, tighten to specifications. Repair the linkage as necessary.
The wheel is loose on the hub.	1. Inspect the wheel bolt holes for damage. Refer to <i>Rim/Hub Bolt Check</i> in Tires and Wheels. 2. Replace all of the wheel studs. 3. Replace the wheel if needed.
The king pin or king pin bearing are worn or loose.	1. Replace the worn parts as needed. 2. Adjust the king pin bearing.
The propeller shaft universal joint(s) are rough or defective. This condition may be confused with steering vibration.	Repair the propeller shaft.
The engine is missing or is in a out of balance condition. This condition may be confused with steering vibration.	1. Correct the engine miss, or repair the out of balance condition. 2. Repair the clutch, pressure plate, or harmonic balancer.
The shock absorbers are malfunctioning.	Replace the shock absorbers.
The wheel alignment is incorrect.	Align the front wheels.

Hard Steering

Condition	Correction
The front tire inflation pressure is low or uneven.	Inflate the tires to the recommended pressure.
The steering linkage, king pins, or ball joints need lubrication.	1. Lubricate, and free up the steering linkage. 2. Inspect for wear and damage.
The intermediate rod, the tie rod, or the idler socket is tight or frozen.	Lubricate or replace as necessary.
There is a misalignment of the steering gear to column.	Align the column.
The steering gear is adjusted too tightly.	Adjust the preload.

Hard Steering (cont'd)

Condition	Correction
The front wheel alignment is incorrect.	Verify the wheel alignment and correct as necessary.
A binding condition in the steering column.	1. Inspect the column mounting and the column bearings. 2. Adjust or replace as necessary.
The knuckle thrust bearings are worn.	1. Replace the bearings. 2. Inspect the axle for wear and damage.

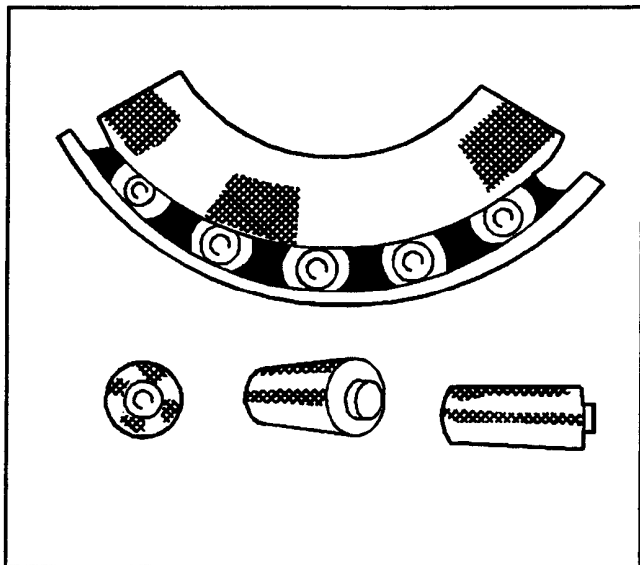
Wheel Bearings Diagnosis

Tapered Roller Bearing Diagnosis

Consider the following factors when diagnosing bearing condition:

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

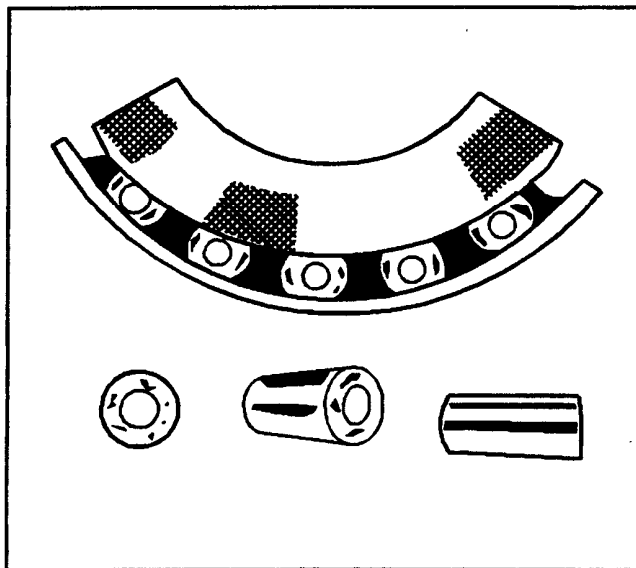
Abrasive Roller Wear



1453

A pattern on the roller ends may be caused by fine abrasives. Clean all of the parts and the housings. Check the seals and the bearings. Replace any leaky, rough, or noisy bearings.

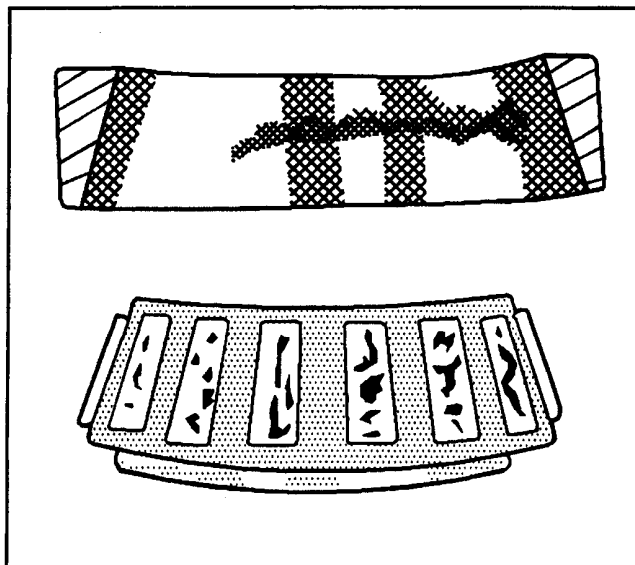
Galling



1454

Metal smears on the roller ends may be due to overheating, lubricant failure, or lubricant overload. Replace the bearing. Check the seals. Check for proper lubrication.

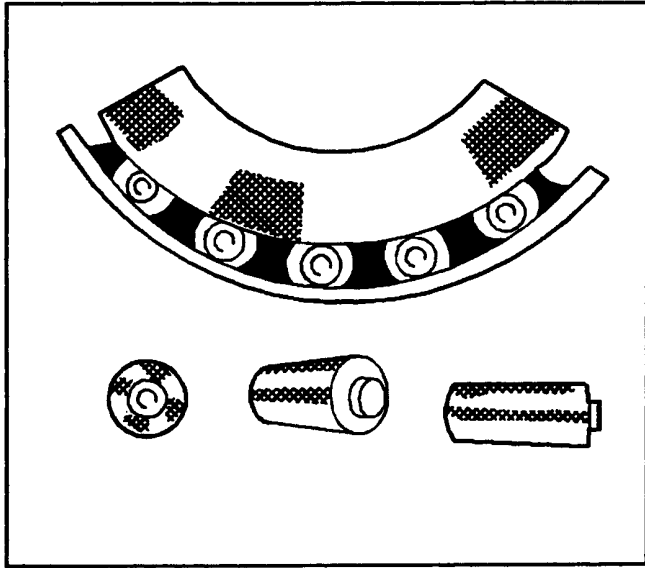
Etching



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

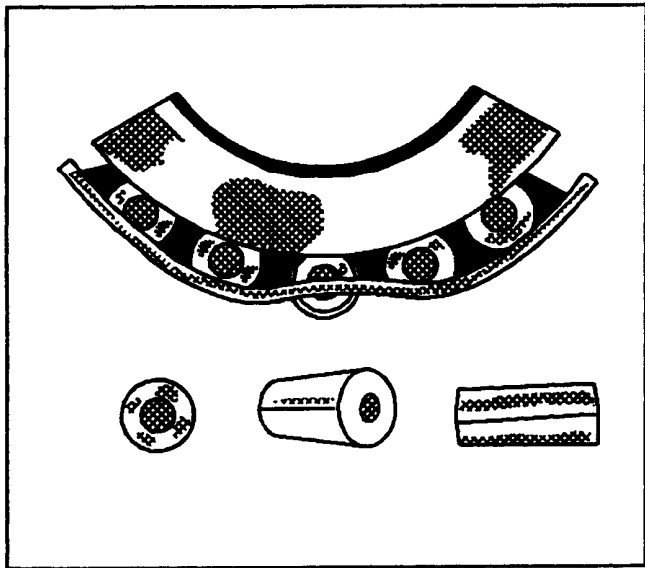
Abrasive Step Wear



1453

A pattern on the roller ends may be caused by fine abrasives. Clean all of the parts and housings. Check the seals and the bearings. Replace the bearing if the bearing is leaking, rough, or noisy.

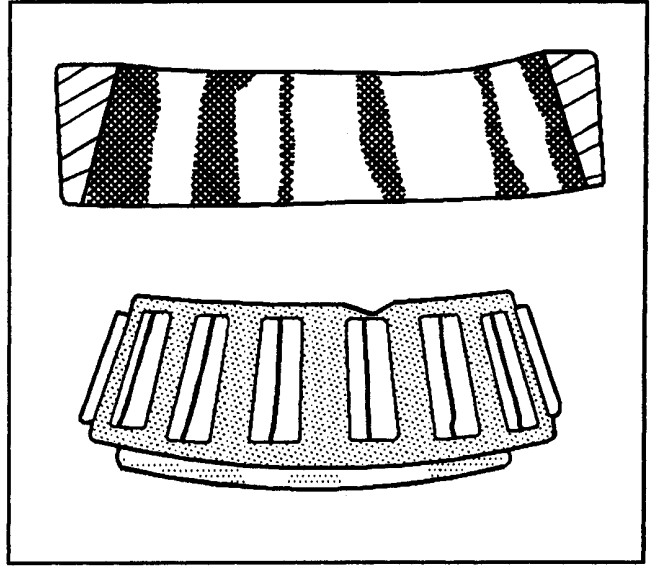
Bent Cage



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The cage may be damaged due to improper handling or improper tool usage. Replace the bearing.

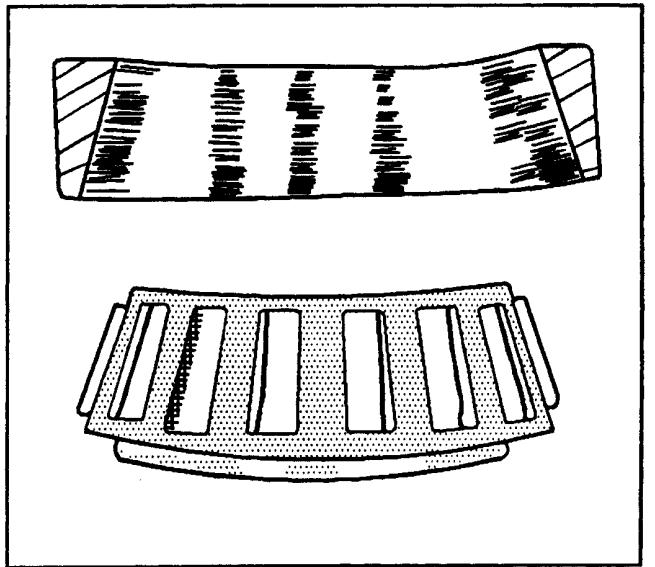
Bent Cage



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The cage may be damaged due to improper handling or improper tool usage. Replace the bearing.

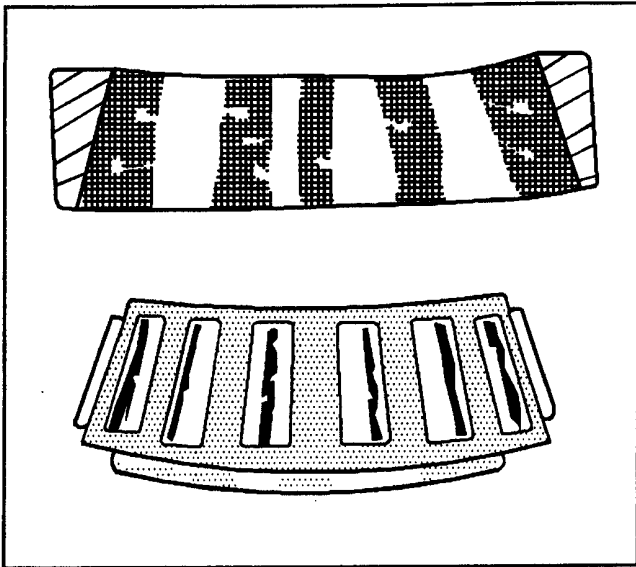
Cage Wear



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Wear around the outside diameter of the cage and the roller pockets may be caused by abrasive material. Wear may be caused from inefficient lubrication. Clean the related parts and the housings. Check the seals. Replace the bearings.

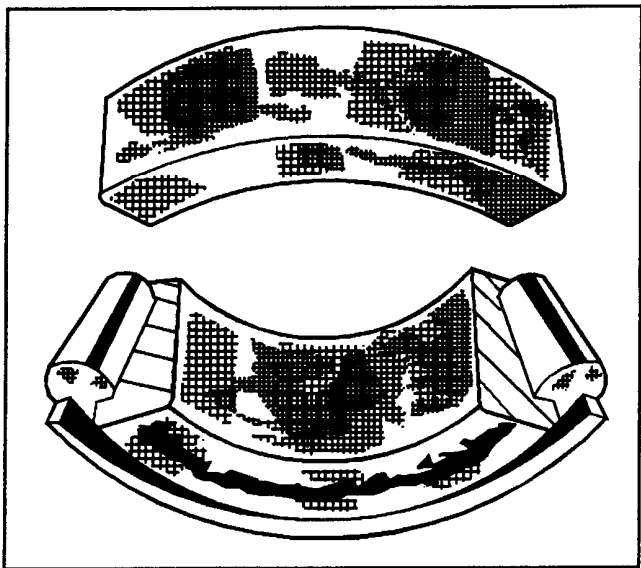
Indentations



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Surface depressions on the race and the rollers may be caused by hard particles of foreign matter. Clean all the parts and the housings. Check the seals. Replace rough or noisy bearings.

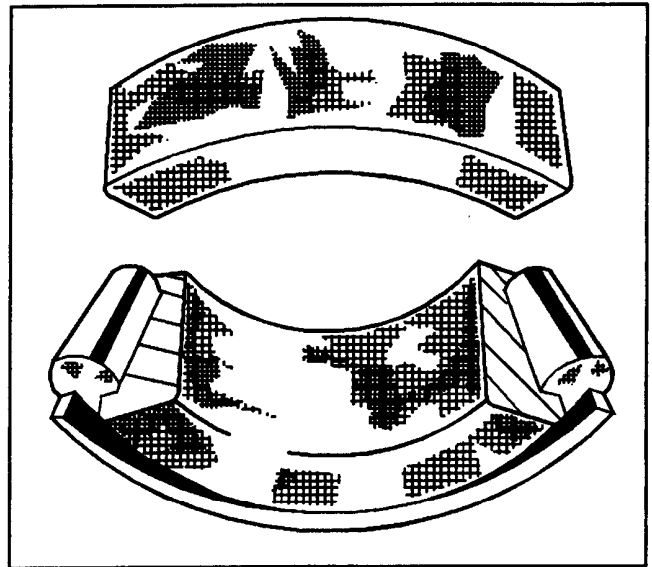
Fretting



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Corrosion may be caused by a small relative movement of parts with no lubrication. Replace the bearing. Clean the related parts. Check the seals. Check for proper lubrication.

Smears



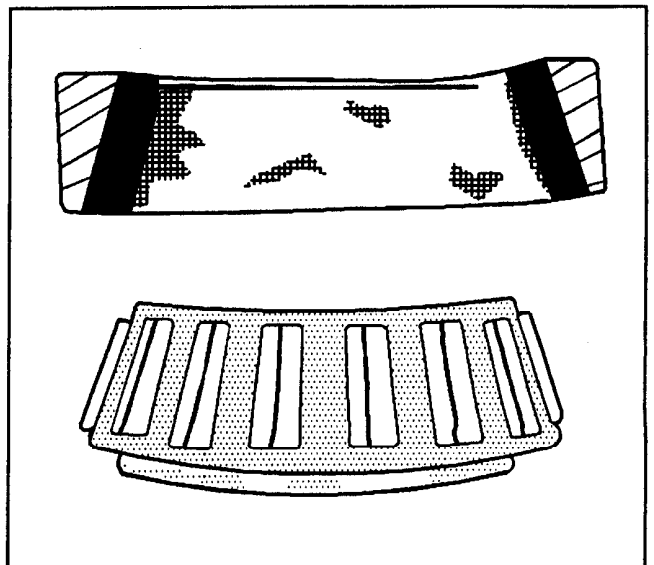
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Smearing of the metal may be due to slippage. Slippage can be caused by the following factors:

- Poor fits
- Inadequate lubrication
- Overheating
- Overloads
- Handling damage

Replace the bearings. Clean the related parts. Check for proper fit and lubrication.

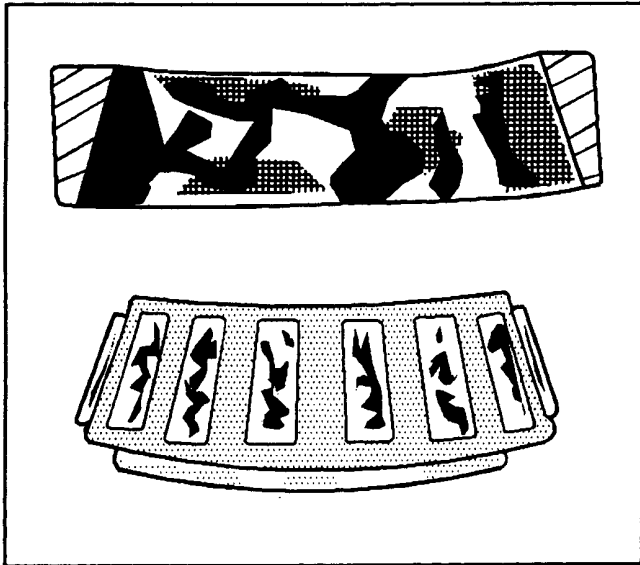
Stain Discoloration



1461

Discoloration, ranging from light brown to black, is caused by incorrect lubrication or moisture. Reuse the bearing if you can remove the stains with light polishing. Reuse the bearing if there is no evidence of overheating. Check the seals and the related parts for damage.

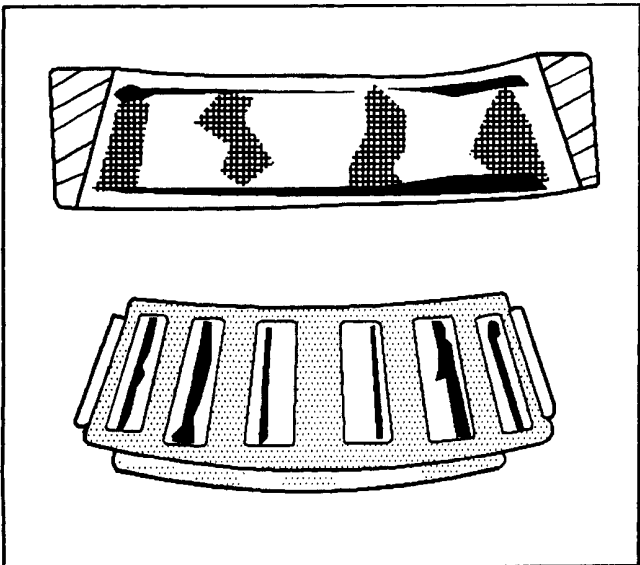
Heat Discoloration



1462

Heat discoloration ranges from faint yellow to dark blue. This discoloration results from overload or an incorrect lubricant. Excessive heat causes softening of the races or the rollers. In order to check for loss of temper on the races and the rollers, perform a file test. A file drawn over a tempered part will grab and cut the metal. A file drawn over a hard part will glide readily with no metal cutting. Replace the bearings if overheating damage is indicated. Check the seals and the other related parts.

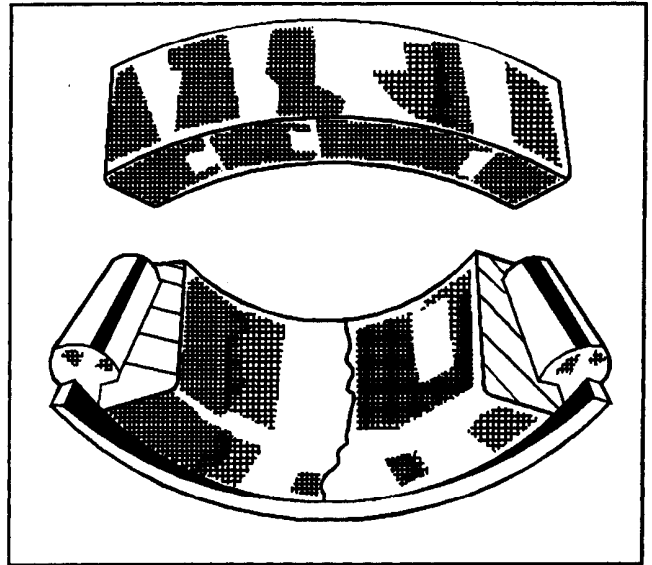
Misalignment



1463

The outer race is misaligned due to a foreign object. Clean the related parts. Replace the bearing. Ensure the races are properly sealed.

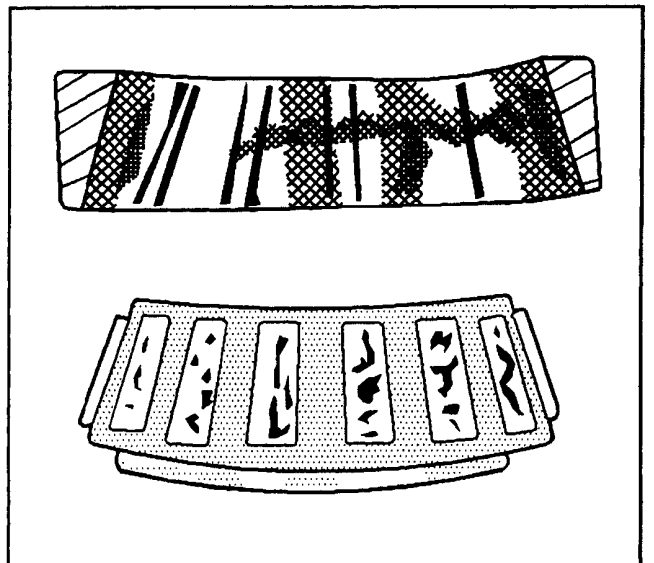
Cracked Inner Race



1464

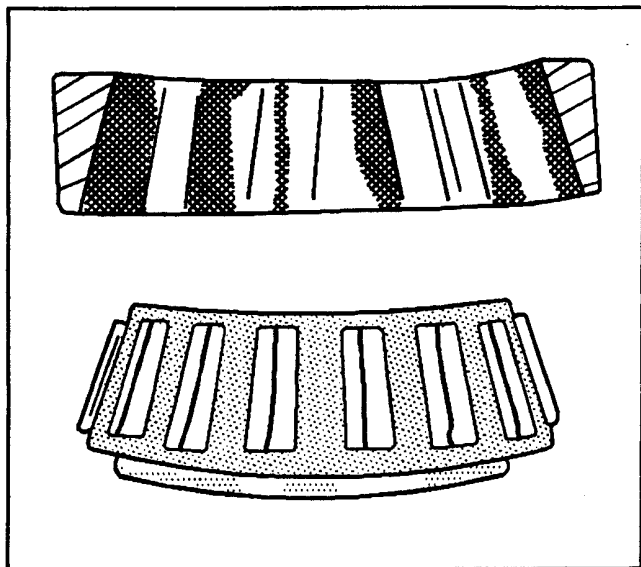
A cracked race may be due to improper fit, cocking, or poor bearing seats. Replace the bearing. Correct the bearing seats.

Fatigue Spalling



1465

Spalling is a flaked surface metal that results from fatigue. Replace the bearing. Clean all related parts.

Brinelling

1466

Surface indentations in the race way are caused by the rollers under impact loading or are caused from vibration while the bearing is not rotating. Replace a rough or noisy bearing.

Low or Uneven Trim Height

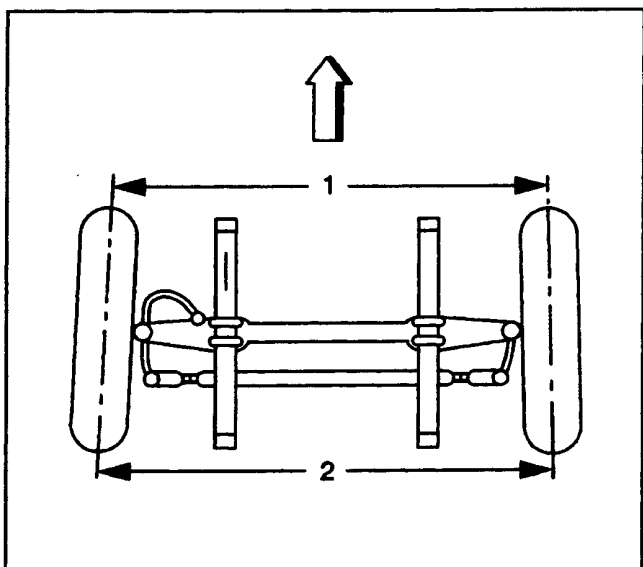
Problem	Action
The springs are broken or sagging.	Replace the springs. Refer to <i>Leaf Springs Replacement</i> in Front Suspension.
The vehicle is overloaded or improperly loaded.	Avoid overloading the vehicle. Refer to <i>Label - Vehicle Certification</i> in General Information.

Description and Operation

General Description

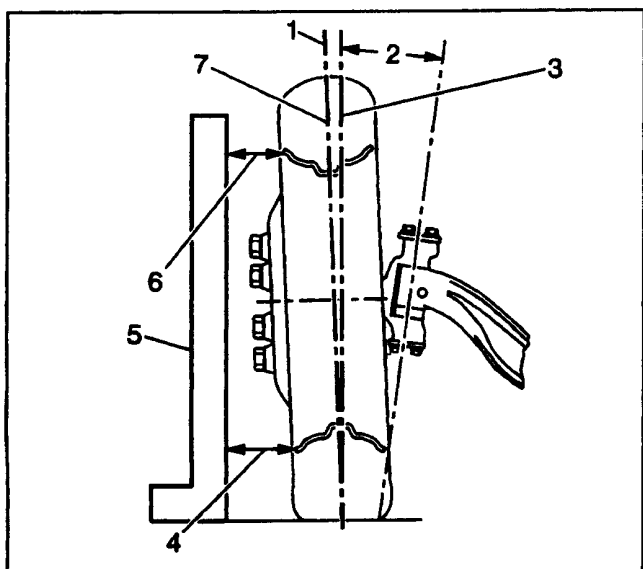
Alignment is the proper positioning or state of adjustment of parts in relation to each other. In order to ensure efficient steering and satisfactory tire life, proper alignment of the front wheels must be maintained. For details on tire wear patterns caused by alignment problems. Refer to *Wheel Alignment Specifications* in Suspension.

The most important factors of front wheel alignment are:



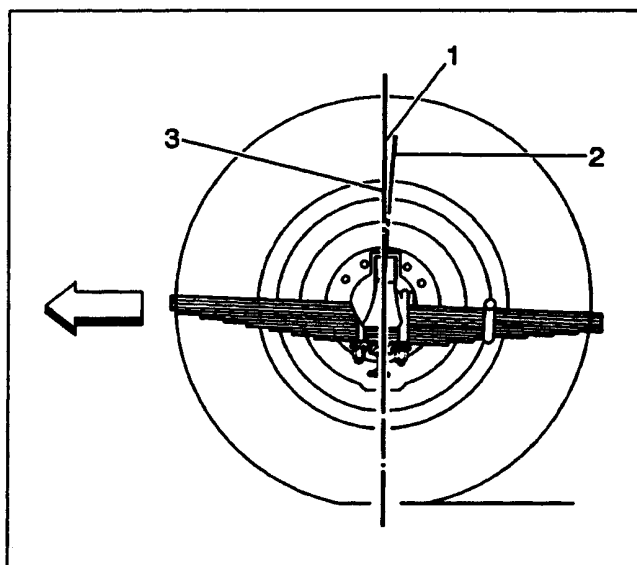
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- Wheel toe-in



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- Wheel camber



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- Axle caster.

Kingpin inclination and camber are designed into the axle end. Check the front wheel alignment at regular intervals and particularly after the front axle has been subjected to heavy impacts such as a collision or a hard curb impact. The wheel bearings must be properly adjusted before checking the alignment.

Loose wheel bearings will affect the instrument measurements when checking the wheel toe-in, wheel camber, and axle caster. When checking the alignment, follow the instructions carefully. Also follow the instructions covering each of these units:

- The brakes
- The springs
- The steering gear
- The hubs and bearings
- The tires and wheels

BLANK

Wheel Alignment

Specifications

Wheel Alignment Specifications

Application	Specification	
	Check	Set
Angular Toe-In per Wheel	0.028°–0.056°	0.028°–0.028°
Camber	0°–25°	—
Caster	Refer to <i>Front Caster Adjustment</i>	—
King Pin Inclination	6°	—
Linear Sum Toe-In	0.7940 mm–1.5875 mm (0.03125 in–0.0625 in)	0.7940 mm–0.7940 mm (0.03125 in–0.03125 in)

Fastener Tightening Specifications

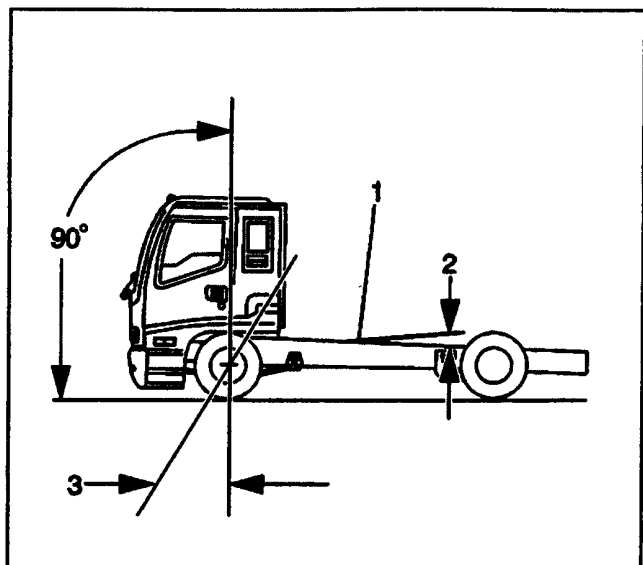
Application	Specification	
	Metric	English
Stop Screw Jam Nut	65 N.m	48 lb ft
Tie Rod End Clamp Nut	75 N.m	55 lb ft

Repair Instructions

Front Caster Adjustment

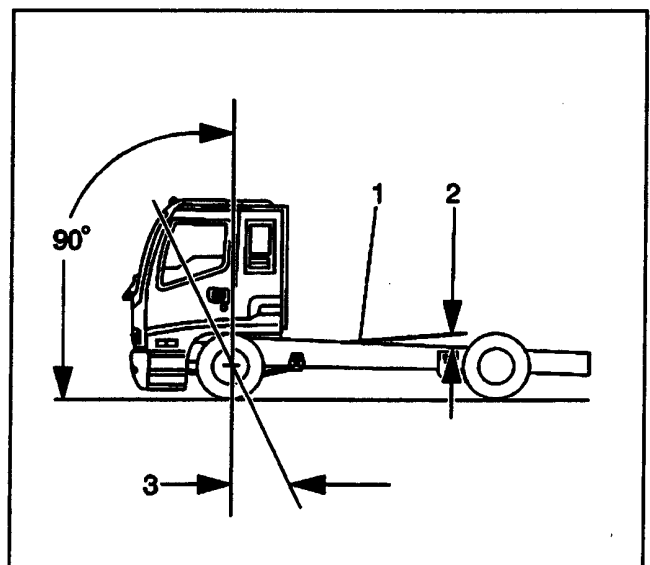
Caster dimensions are given for a vehicle carrying its design load equal to the capacity of the vehicle's suspension (GVWR). Perform alignment checks when the frame is level. If you make an alignment check when the frame is not level, determine the frame angle and add this angle to the caster angle, in order to obtain a true caster measurement. In order to determine the frame angle and the caster, complete the following steps:

1. Place the vehicle on a smooth level surface.
2. Measure the frame angle using a bubble protractor. The frame angle is the degree of tilt in the frame from the level position. Up in Rear, or negative frame angle, occurs when the frame is above level in the rear. Down in Rear, or positive frame angle, occurs when the frame is below level in the rear.
3. Determine the caster angle for the left wheel using alignment equipment.
4. Add or subtract the frame angle to or from the left wheel caster measurement in order to determine the corrected caster for the left wheel.
5. Determine the corrected caster with various frame and caster measurements according to the following rules:



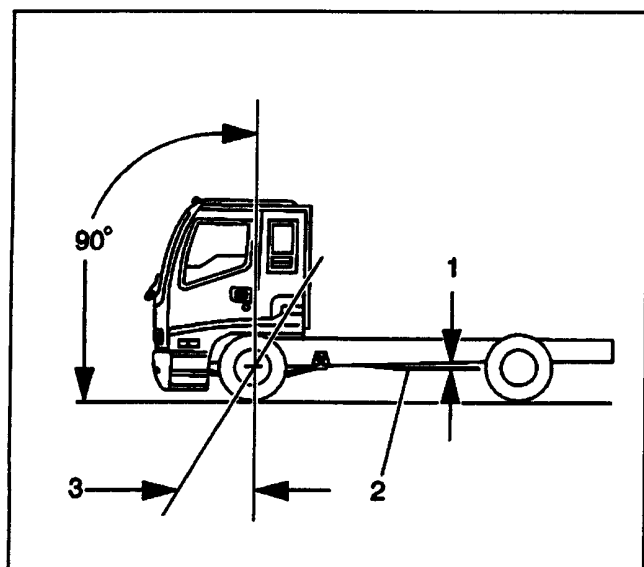
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6. Subtract the positive frame angle (2) from a positive caster measurement (3).



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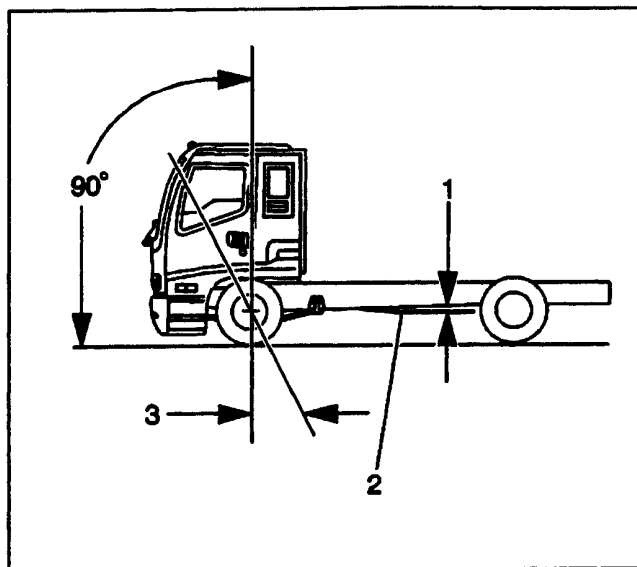
7. Add the negative frame angle (1) to a positive caster measurement (3).



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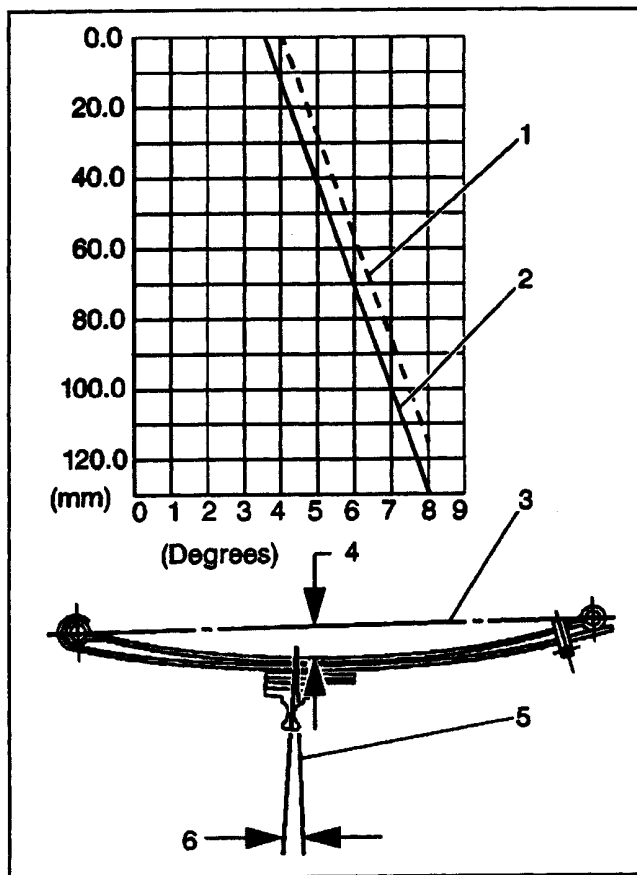
8. Add the positive frame angle (2) to a negative caster measurement (3).

9. Subtract the negative frame angle (1) from a negative caster measurement (3).
10. Repeat steps 1 through 9 for the right wheel.

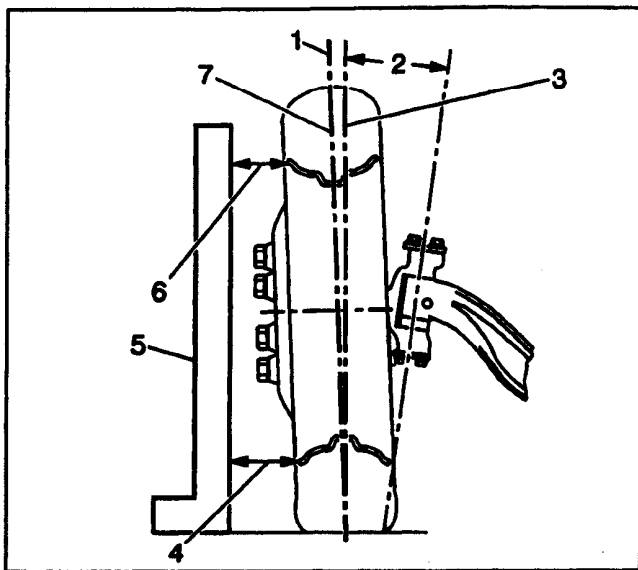


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11. Determine the specified caster by performing the following steps:
 - Hold a taut string (3) between the centers of the spring eyes.
 - Measure the distance from the taut string to the top surface of the upper spring leaf, on a line that is perpendicular to the bottom of the frame rail (5) and at the centerline of the spring. Note the distance in millimeters from the centerline of the spring eyes to the top of the spring at the spring centerline (4).
 - Determine the specified caster angle using the graph (as shown).
 - Compare the specified caster angle with the measured caster angle.
 - If the specified caster angle does not coincide with the measured caster angle (plus or minus one degree), determine the cause of the error and replace the faulty component.



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Front Camber Adjustment

Camber variations may be caused by one of the following conditions:

- Wear at the wheel bearings
- Wear at the steering knuckle bushings
- Bent steering knuckle
- Bent axle center

Refer to *Wheel Alignment Specifications* for camber specifications.

Important: Before checking the camber, inspect the king pin wear. Complete the following steps:

1. Raise the front of the vehicle.
2. Pull the bottom of the wheel outward and measure the camber.
3. Pull the top of the wheel outward and take a camber measurement (use a camber gauge, if available).
4. If a camber gauge is not available, place a square (5) against the tire and take the measurements.
5. If the measurements vary by more than 15 minutes ($1/4$ degree), adjust the wheel bearing. Refer to *Wheel Bearing Adjustment*.
6. Take the camber measurements again. If the measurements still vary by more than 15 minutes ($1/4$ degree), replace the steering knuckle bearing and/or the bushings and the king pins. Refer to *Steering Knuckle and King Pin Replacement* in Front Suspension.
7. Inspect the wheel runout. Refer to *Abnormal or Excessive Tire Wear*. Replace the wheel if the wheel runout is excessive.
8. Place the vehicle on a level surface, with the normal weight of the vehicle on the wheels. Take a final camber measurement.
9. Note the dimension of the top measurement and the dimension of the bottom measurement.
10. Ensure that the dimension of the bottom measurement exceeds the dimension of the top measurement. Verify that the camber dimensions of the right wheel do not vary by more than 2.4 mm (0.0938 in) from the camber dimensions of the left wheel. If the final camber measurement is incorrect, then either the steering knuckle or the axle center is bent. In order to determine which part is bent, inspect the king pin inclination. Add the camber plus the king pin inclination dimensions. This measurement is the included angle of the steering knuckle. Replace the steering knuckle if the included angle of the steering knuckle varies from specifications by more than 30 minutes ($1/2$ degrees), (the knuckle is bent). Straighten the axle center if the included angle of each knuckle end is within the specifications, but the final camber is incorrect (the axle center is bent).

Front Toe Adjustment

Measure toe-in at the following locations:

- From the center of the tire treads or from the inboard side of the tires
- At the front and the rear of the axle
- At the horizontal axis of the wheel

When setting the toe-in adjustment, neutralize the front suspension. Ensure that all component parts are in the same relative position when making the adjustment as they will be when in operation. In order to neutralize the suspension, roll the vehicle 3.5–4.5 meters (12–15 ft). When the vehicle is rolled forward, all normal tolerances in the suspension and the steering linkage are in the correct operating position. Neutralize the front suspension if the vehicle has been raised.

1. Loosen the tie rod end clamps.
2. Turn the tie rod using a pipe wrench until the wheels have the proper toe-in.

Set

Angular toe-in (set) should be 0.028–0.028 degrees per wheel or 7940 mm–0.7940 mm (0.03125 in–0.03125 in) linear sum toe-in.

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

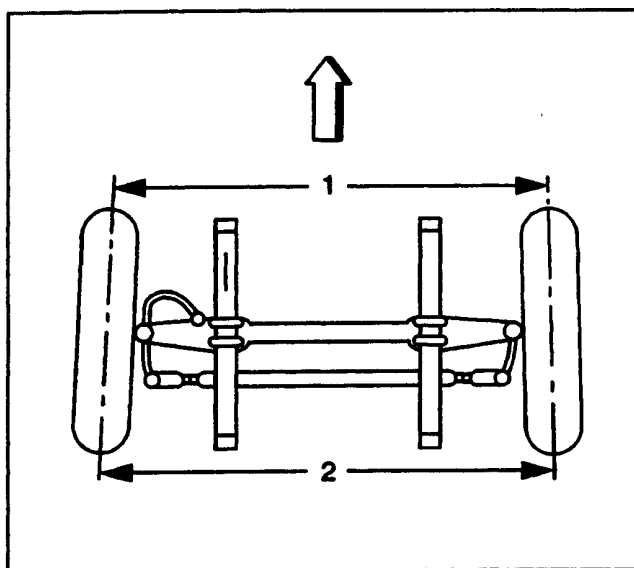
3. Tighten the tie rod end clamp nuts.

Tighten

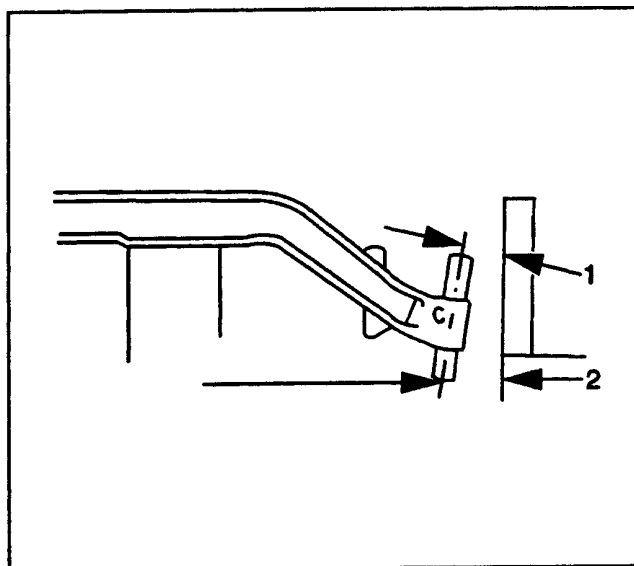
Tighten the tie rod end clamp nuts to 75 N.m (55 lb ft).

Checking and Correcting King Pin Inclination

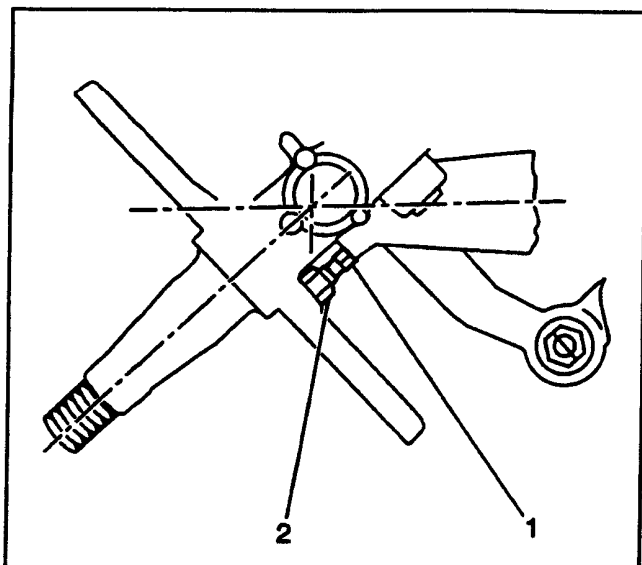
Kingpin inclination is the amount that the top of the kingpin is inclined toward the center of the vehicle. This is measured by subtracting the top (1) from the bottom (2) measurements. Use precision instruments to check the king pin inclination. If the axle is bent or twisted, refer to *Front Axle Replacement* in Front Suspension. Straightening the axle center in order to correct the king pin inclination will also change the camber. Recheck the camber after correcting the king pin inclination.



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Stop Screw Adjustment

The angle of the steering arms determines the turning angle or toe-out on turns.

Ensure that the stop screw adjustment provides 16 mm (0.6250 in) minimum clearance of the tire with all chassis components installed, regardless of the maximum turning angles. The stop screws are installed in the steering knuckles and stop against the axle center.

1. Loosen the jam nut (2) and the right stop screw (1) in order to prevent the stop screw from contacting its stop when the wheels are turned to the extreme right.
2. Hold the right wheel tightly against the right turn position, with the wheels turned to the extreme right.
3. Turn out the stop screw until the stop screw contacts firmly against the stop.
4. Turn the stop screw one more turn against the stop.
5. Verify the position of the tire. Adjust the tire as necessary in order to provide 16 mm (0.6250 in) clearance to all chassis components.

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

6. Tighten the jam nut on the stop screw.

Tighten

Tighten the jam nut to 65 N.m (48 lb ft).

7. Repeat the previous six steps for the left side stop screw adjustment.
8. Recheck the turning clearance and the stop screw setting when installing oversize tires.
9. Verify the position of the tire. Adjust the tire as necessary in order to provide 16 mm (0.6250 in) clearance to all of the chassis components.

Description and Operation

General Description

Alignment is the proper positioning, or the state of adjustment, of parts in relation to each other. Maintain proper alignment of the front wheels in order to ensure efficient steering and satisfactory tire life. For details on tire wear patterns caused by alignment problems, refer to *Abnormal or Excessive Tire Wear* in Suspension General diagnosis. The most important factors of wheel alignment are:

- Wheel toe-in
- Wheel camber
- Axle caster

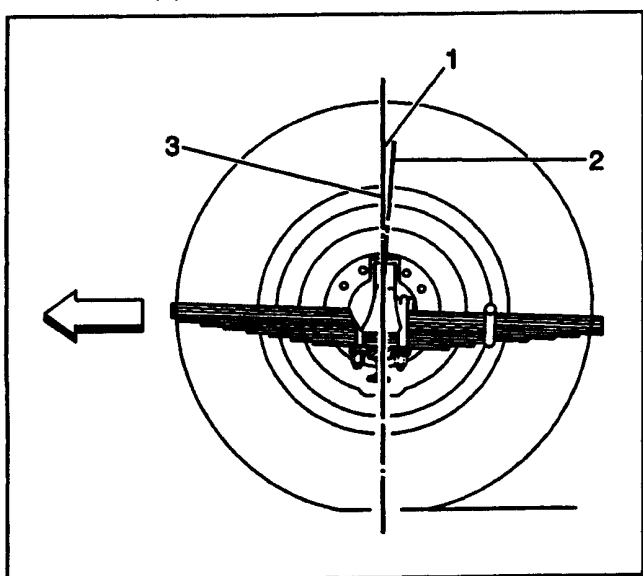
King pin inclination and camber are designed into the axle end. Inspect the front wheel alignment at regular intervals, particularly after the front axle has been subjected to heavy impacts, such as a collision or a hard curb impact. Adjust the wheel bearings before checking the alignment. Loose wheel bearings will affect the instrument measurements when checking wheel toe-in, wheel camber, and axle caster.

When inspecting the alignment, follow the instructions outlined in this section. Follow the instructions in other sections that cover any of the following units:

- The brakes
- The springs
- The steering gear
- The hubs and bearings
- The tires and wheels

Caster Description

Caster (1) is the inclination (tilt) of the king pin (2) or the steering axis either forward or backward from the vertical line (3).



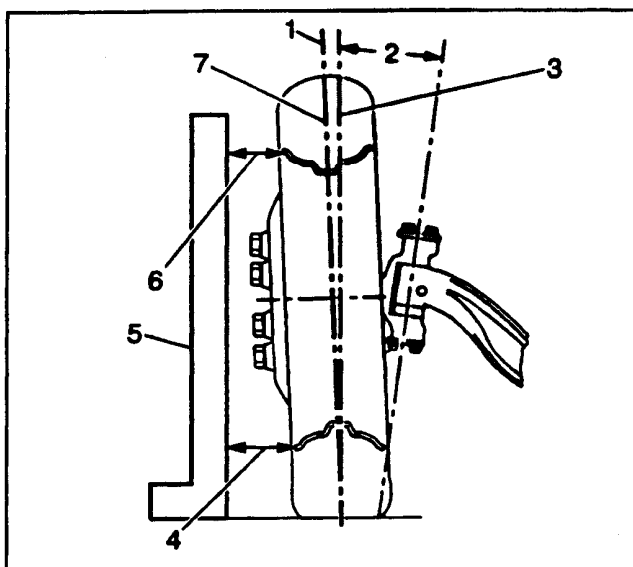
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Incorrect caster may result from one of the following conditions:

- Sagging springs
- A bent axle
- A twisted axle
- Uneven tightening of the spring U-bolt nuts

Tighten all of the U-bolt nuts equally. Refer to *Fastener Tightening Specifications*. The caster will be unequal for the right and left sides if the axle is twisted.

Camber Description

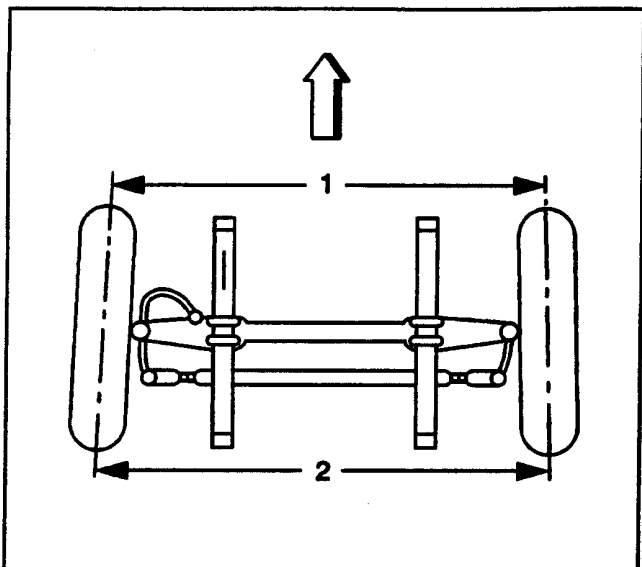


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Wheel camber is the measurement in degrees that the front wheels are tilted inward or outward at the top from the vertical position. Determine wheel camber by subtracting the top measurements (6) from the bottom measurements (4). Camber offsets wheel deflection caused by wear of the front axle parts, and prevents a reverse or negative camber condition. Extreme or unequal camber will cause improper steering and excessive tire wear.

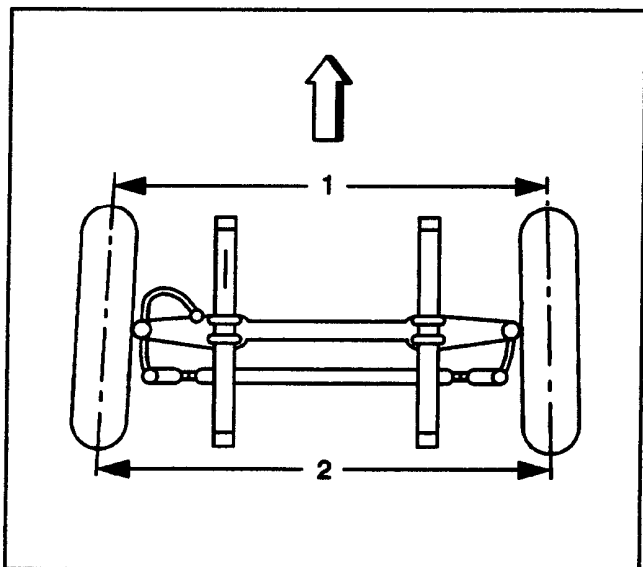
Toe Description

Toe-in is the angle of the tires and wheels toward each other. The amount of toe-in is normally a fraction of a degree. Measure the toe-in from the center of the tire treads or from the inboard side of the tires. Toe-in ensures parallel rolling of the front wheels and offsets any small deflections of the wheel support system, which occur when the vehicle is rolling forward. Incorrect toe-in results in excessive tire wear and unstable steering. Set the toe-in alignment last in the front wheel alignment procedure.

Linear Sum Toe-In

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Linear Sum Toe-In is the distance between the front wheels. The toe-in distance is less at the front of the axle (1) than at the rear of the axle (2).

Angular Toe-In

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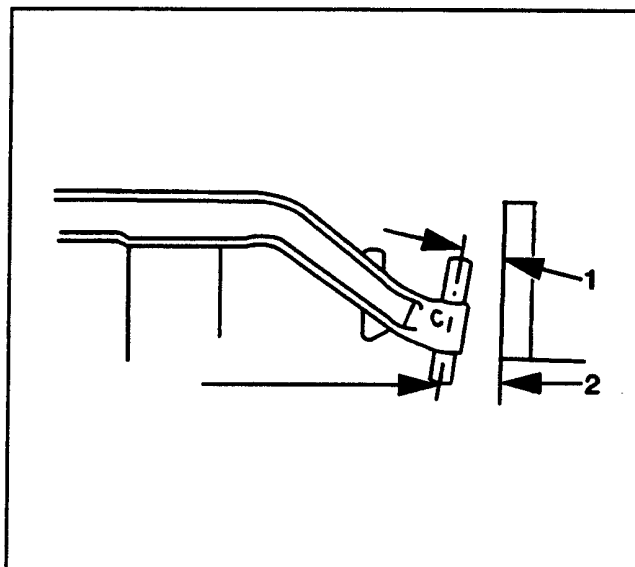
Angular Toe-In is the angle of the front wheel centerline, relative to the intersection of the forward projected vehicle centerline.

Frame Misalignment Description

Determine the following dimensions for the vehicle at the design load with the frame level:

- Caster
- Camber
- Toe-in

Consider the normal frame angle when using alignment equipment. Keep in mind the normal frame angle when checking the caster angle, in order to obtain a true setting.

Steering Axis Inclination Description

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King pin inclination is the amount that the top of the king pin is inclined toward the center of the vehicle. Measure king pin inclination by subtracting the top measurement (1) from the bottom measurement (2). The king pin inclination is designed into the axle end. King pins are inclined in order to assist the front wheel return to the center after a turn is made.

Front Suspension

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Bumper Bracket Nut	68 N.m	50 lb ft
Bump Stop Nut	40 N.m	30 lb ft
Eye Bolt	330 N.m	243 lb ft
Hub Cap Bolt	13 N.m	115 lb in
King Pin Cap Bolt	24 N.m	18 lb ft
King Pin Nut	550 N.m	406 lb ft
Shock Absorber Nut	84 N.m	62 lb ft
Stabilizer Nut	170 N.m	125 lb ft
U-Bolt Nut	400 N.m	295 lb ft

Diagnostic Information and Procedures

Wheel Bearing Test

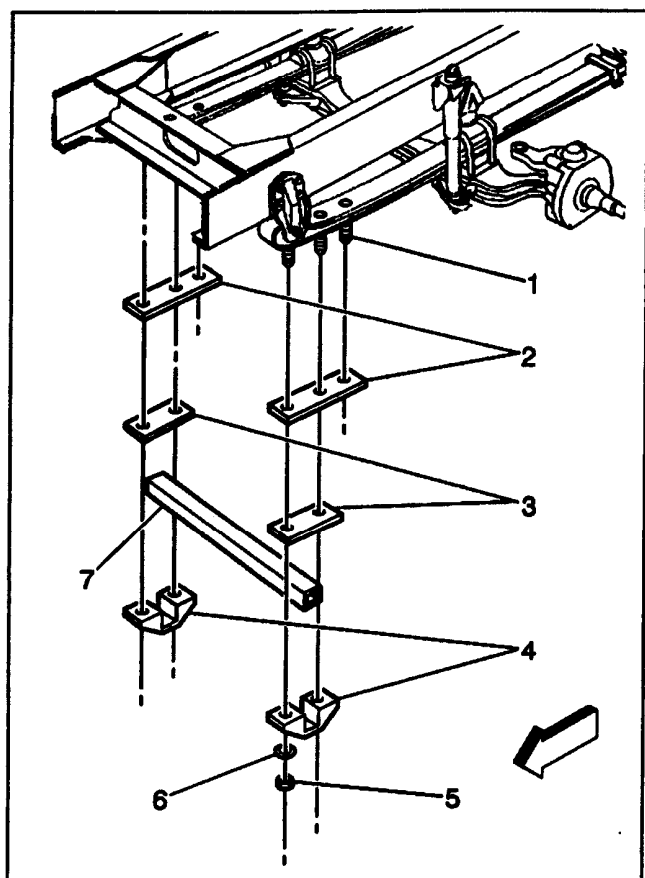
Before checking the wheel bearing adjustment, fully release the brakes. Raise the front axle until the wheels clear the floor.

Inspect the bearing play using either of the following procedures:

- Grasp the tire at the top and pull the tire back and forth.
- Use a pry bar under the tire.

If the bearings are properly adjusted, movement of the brake drum will be barely noticeable in relation to the backing plate, and the wheel will turn freely.

If movement is excessive, adjust the bearings. Refer to *Wheel Bearing Adjustment*.



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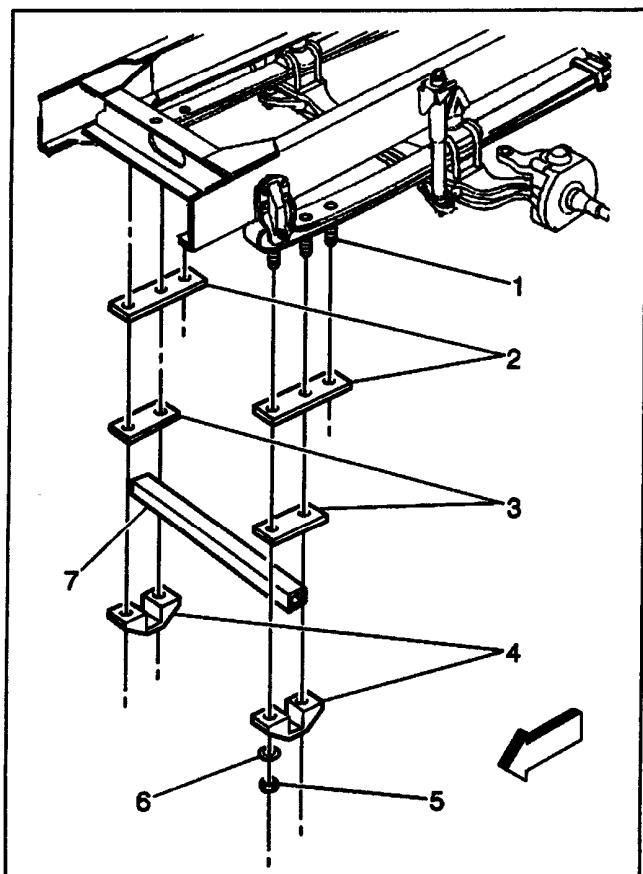
Repair Instructions

Stabilizer Shaft Replacement

Removal Procedure

Remove the following components from the springs:

1. The nuts (5)
2. The washers (6)
3. The shaft mounting brackets (4)
4. The stabilizer shaft (7)
5. The shims (2,3)



214490

Installation Procedure

1. Install the following components to the springs:

- 1.1. The shims (2,3)
- 1.2. The stabilizer shaft (7)
- 1.3. The shaft mounting brackets (4)
- 1.4. The washers (6)
- 1.5. The nuts (5)

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

2. Tighten the stabilizer nuts (5) alternately and evenly until the shaft mounting brackets (4) contact the lower shim (3).

Tighten

Tighten the stabilizer nuts to 170 N.m (125 lb ft).

Steering Knuckle and King Pin Replacement

Removal Procedure

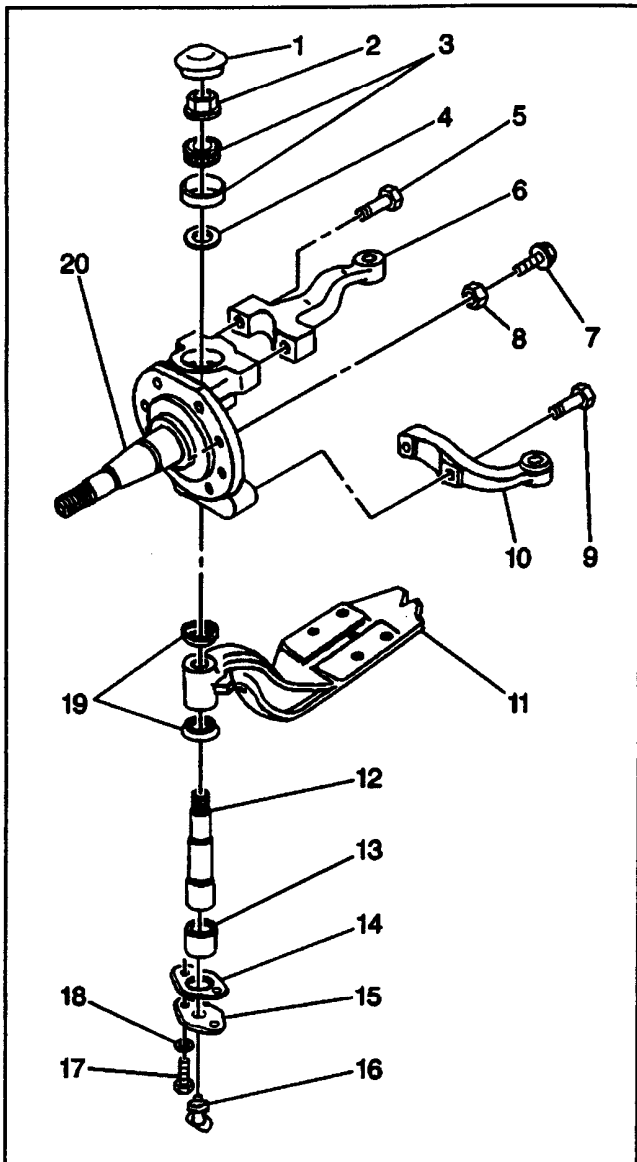
Tools Required

- J 35999 Tension Scale
- J 39758 King Pin Holding Tool

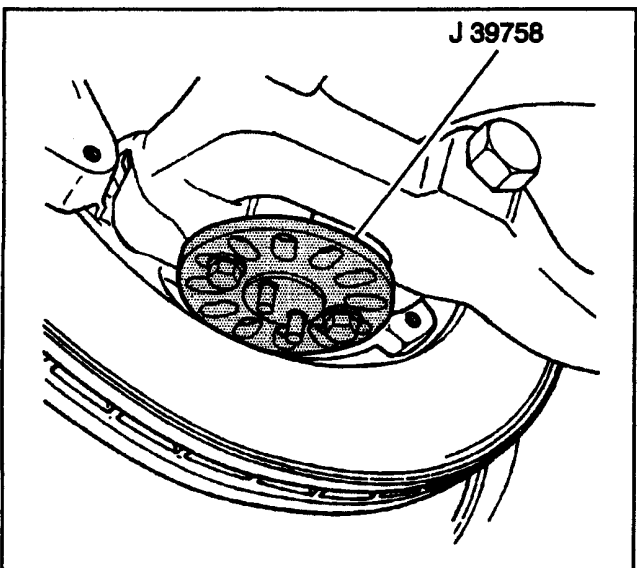
1. Set the parking brake.
2. Block the vehicle rear wheels.
3. Raise the front of the vehicle until the tires clear the floor.

Notice: Refer to *Crossmember Support Notice* in Cautions and Notices.

4. Support the frame using suitable safety stands.
5. Remove the wheels, the hubs, and the bearings.
6. Refer to the appropriate procedure:
 - *Wheel Hub, Bearing, and Seal Replacement (Drum Brakes)*
 - *Wheel Hub, Bearing, and Seal Replacement (Disc Brakes)*.
7. Remove the brake components as needed.
8. Refer to the appropriate procedure:
 - *Brake Caliper Replacement (Front, Bendix)*
 - *Brake Caliper Replacement (Front, Dayton-Walther)*
9. Remove the brake backing plates and the dust covers.



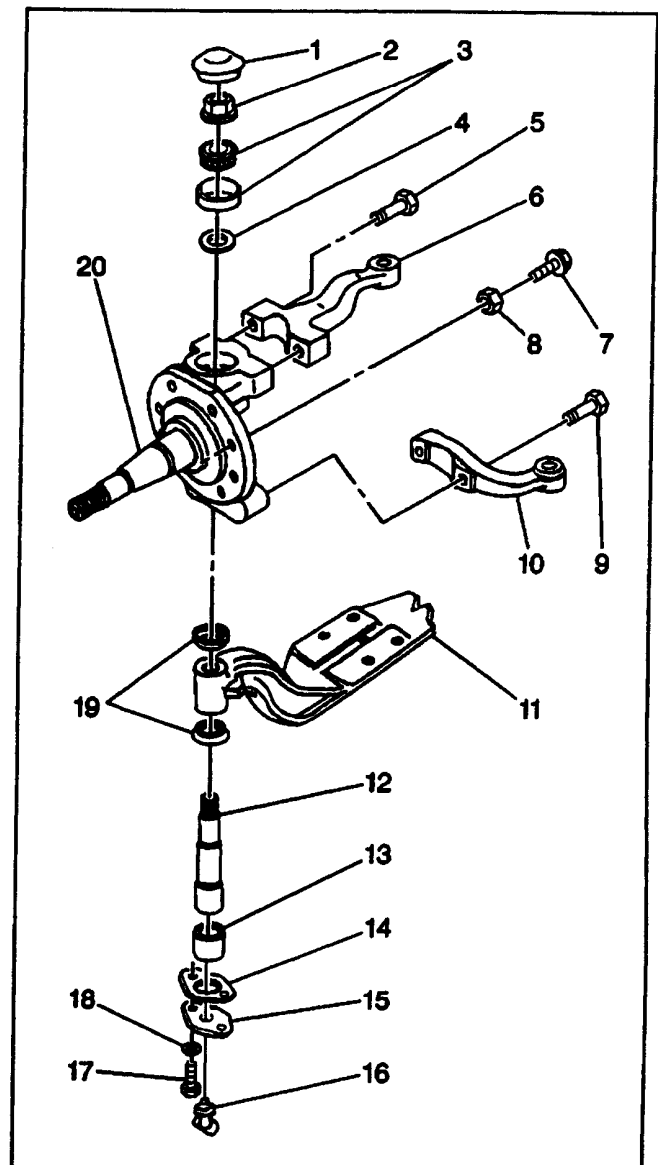
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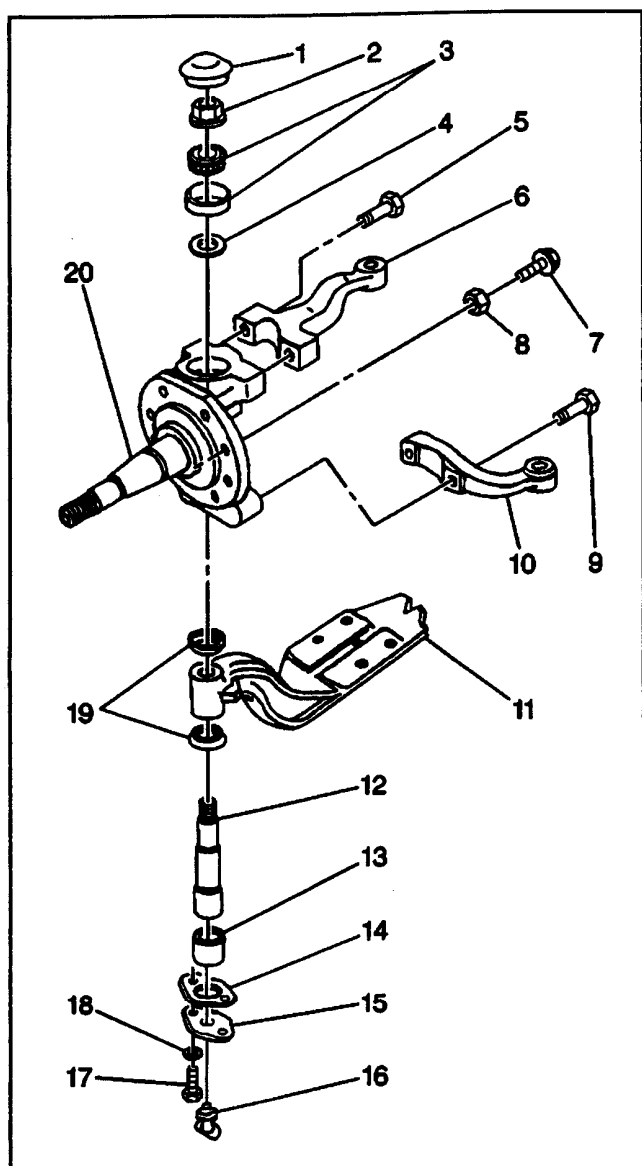
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10. Remove the tie rod arm bolts (9). Lower the tie rod arm (10) and the tie rod to the floor.
11. Remove the steering arm bolts (5). Support the steering arm (6) and the steering rod out of the way.
12. Remove the king pin upper cap (1).
13. Remove the following components:
 - The bolts (17)
 - The washers (18)
 - The king pin lower cap (15)
 - The gasket (14)
14. Remove the king pin nut (2).
15. Using the J 39758, insert the tool pins into the holes at the bottom of the king pin.
16. Align the tool's bolt holes.
17. Secure with two bolts into the steering knuckle in order to prevent the king pin from spinning.

18. Remove the king pin (12) by knocking out the pin with a soft-faced mallet.
19. Remove the steering knuckle (20).
20. Support the knuckle in a vise.
21. Remove the following components from the knuckle (20):
 - The seals (19)
 - The bearing (3)
 - The shim or spacer (4)
 - The bushing (13)
22. Remove the king pin bushing (13), if required. Refer to *King Pin Bushing and Bearing Cup Replacement*.



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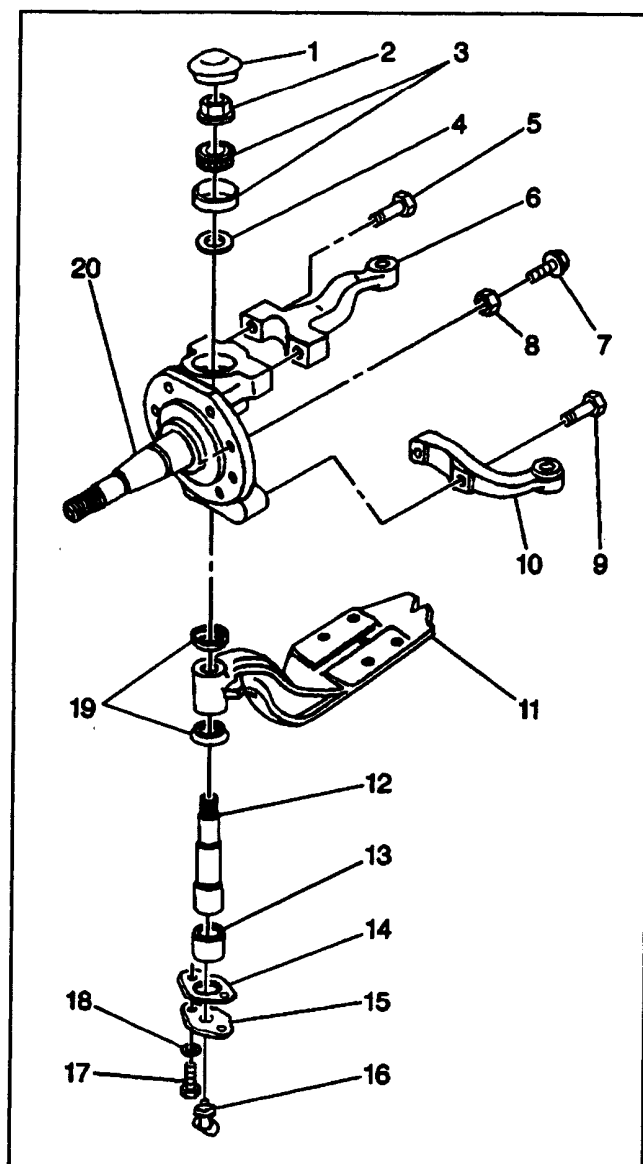
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Inspection Procedure

1. Clean the axle components using a cleaning solvent.
2. Soak the thrust bearing until all of the old lubricant is gone.
3. Inspect the axle components for the following conditions:
 - Wear
 - Pitting
 - Cracks
 - Damage
4. Use Magna-Flux™ inspection, if available, in order to inspect the steering knuckles (20) and the kingpins (12) for minute cracks, checks, or fractures.
5. Inspect the king pin bearings and the cups for rough rotation.
6. Inspect the bores in the axle king pin (12) for the following conditions:
 - Scratches
 - Burrs
 - Corrosion
7. Inspect the bores in the king pin bushing (13) for the following:
 - Scratches
 - Burrs
 - Corrosion
8. Smooth the bore using a crocus cloth or a fine grit sandpaper if needed. Clean the bore.

Installation Procedure

1. Install the king pin bushings (13), if removed.
2. Install the king pin bearing cup, if removed.
3. Install the steering knuckle (20).
4. Install the king pin (12) and install the dust seals (19).
5. Install a shim or spacer (4).
6. Install the king pin thrust bearing (3). Pack the bearing thoroughly with high temperature wheel bearing grease.
7. Install the king pin nut (2).



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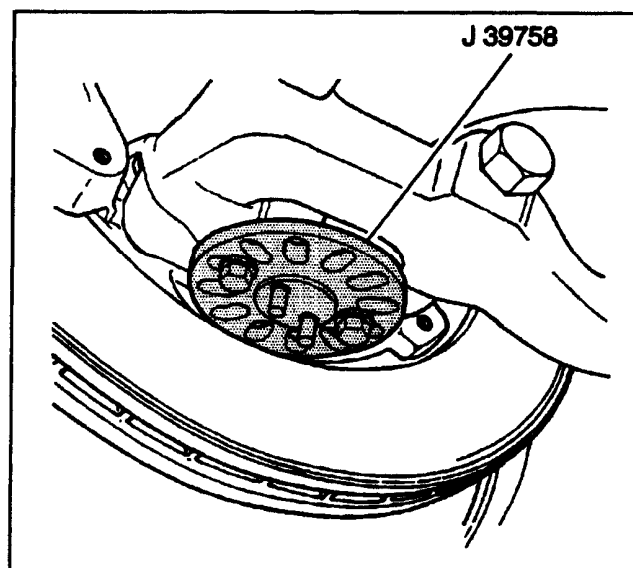
8. Using the *J 39758* insert the tool pins into the holes at the bottom of the king pin.
9. Align the tool's bolt holes.
Notice: Refer to *Fastener Notice* in Cautions and Notices.
10. Secure the tool with two bolts into the steering knuckle in order to keep the king pin from spinning.

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

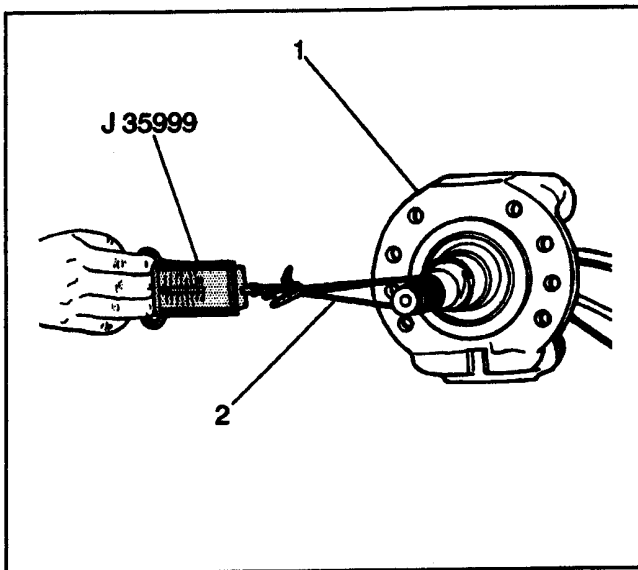
10. Secure the tool with two bolts into the steering knuckle in order to keep the king pin from spinning.

Tighten

Tighten the king pin nut (2) to 550 N·m (406 lb ft).

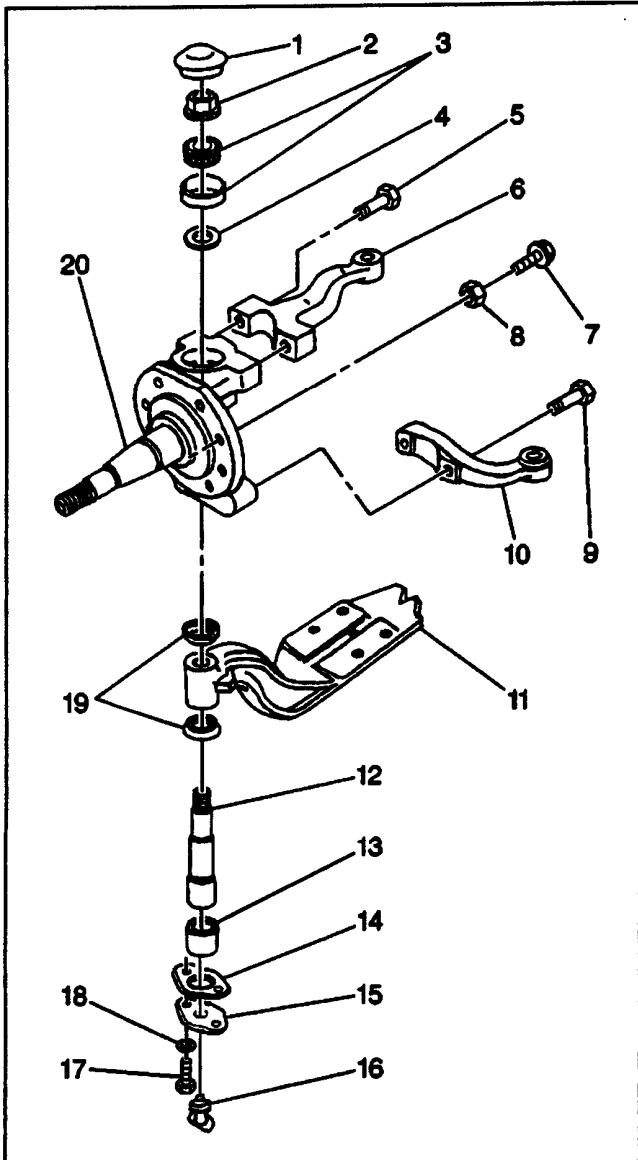


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11. Measure the king pin bearing preload. Refer to *King Pin Bearing Preload*.



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12. Install the following components:

- The bottom gasket (14)
- The dust cap (15)
- The washers (18)
- The bolts (17)

Tighten

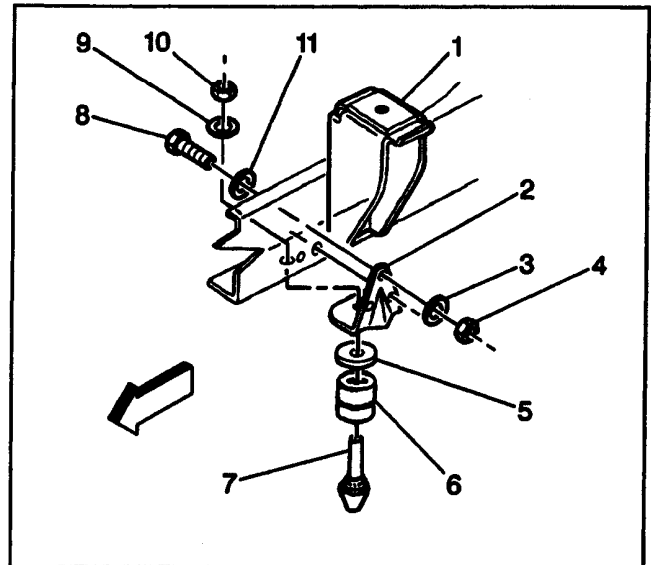
Tighten the dust cap bolt to 24 N.m (18 lb ft).

13. Install the king pin upper dust cap (1). Tap the dust cap into place using a soft-faced mallet. Grease the knuckle (20) through the lubrication fitting (16) on the bottom.
14. Install the tie rod arm (10).
15. Install the steering arm (6), if removed.
16. Install the brake backing plate and the dust cover.
17. Install the brake components as needed.
18. Refer to the appropriate procedure:
- *Brake Caliper Replacement (Front, Bendix)*
 - *Brake Caliper Replacement (Front, Dayton-Walther)*
19. Install the wheel bearings, the hubs, and the wheels.
20. Refer to the appropriate procedure:
- *Wheel Hub, Bearing, and Seal Replacement (Drum Brakes)*
 - *Wheel Hub, Bearing, and Seal Replacement (Disc Brakes)*
21. Remove the safety stands and lower the vehicle.
22. Check the axle alignment.
23. Check the stop screw (7,8) adjustment. Adjust as needed. Refer to *Stop Screw Adjustment* in *Wheel Alignment*.

Spring Bumper Replacement

Removal Procedure

1. Remove the nut (10) and the washer (9).
2. Remove the bumper stop (7) and the bumper (6).
3. Remove the spacer (5), if equipped.
4. Remove the following components:
 - The nuts (4)
 - The washers (3,11)
 - The bolts (8)
5. Remove the bumper bracket (2) from the frame (1).



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Installation Procedure

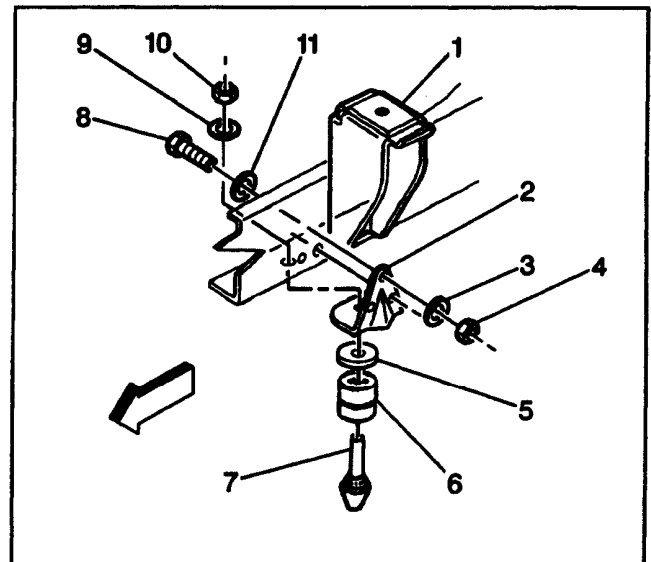
1. Install the bumper bracket (2) to the frame (1).
2. Install the following components:
 - The bolts (8)
 - The washers (3,11)
 - The nuts (4)
3. Install the bumper stop (7) through the bumper (6).
4. Install a spacer (5) on the bumper.
5. Install the bumper stop through the bracket (2) and the frame (1).

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

6. Install the washer (9) and the nut (10).

Tighten

- Tighten the spring bumper mounting nut (4) to 68 N.m (50 lb ft).
- Tighten the bumper stop nut (10) to 40 N.m (30 lb ft).



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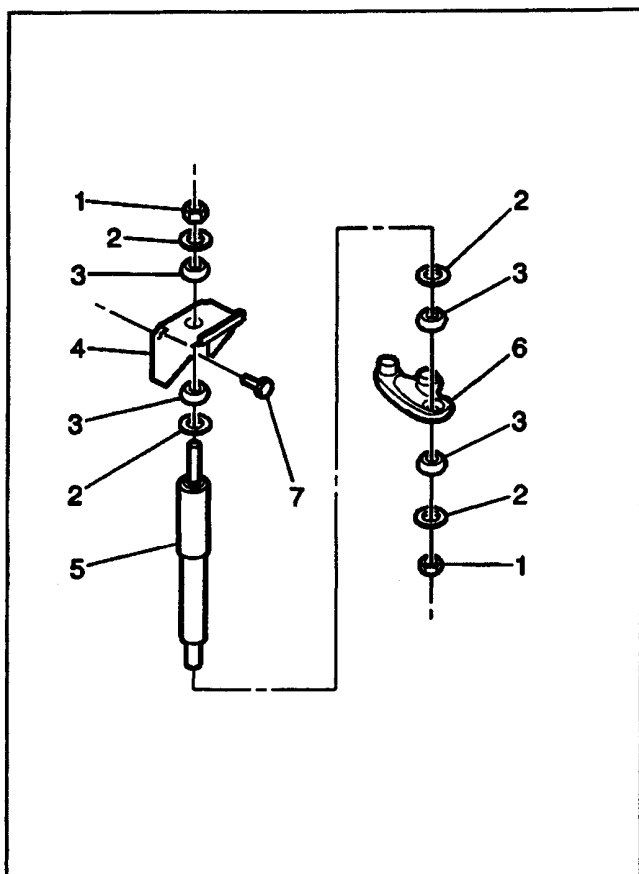
Leaf Springs Replacement

Removal Procedure

1. Set the parking brake.
2. Block the vehicle's rear wheels.
3. Raise the frame until the front tires clear the floor.
4. Support the axle using a jack. Raise the axle high enough in order to allow the spring to clear the brackets when you remove the spring.

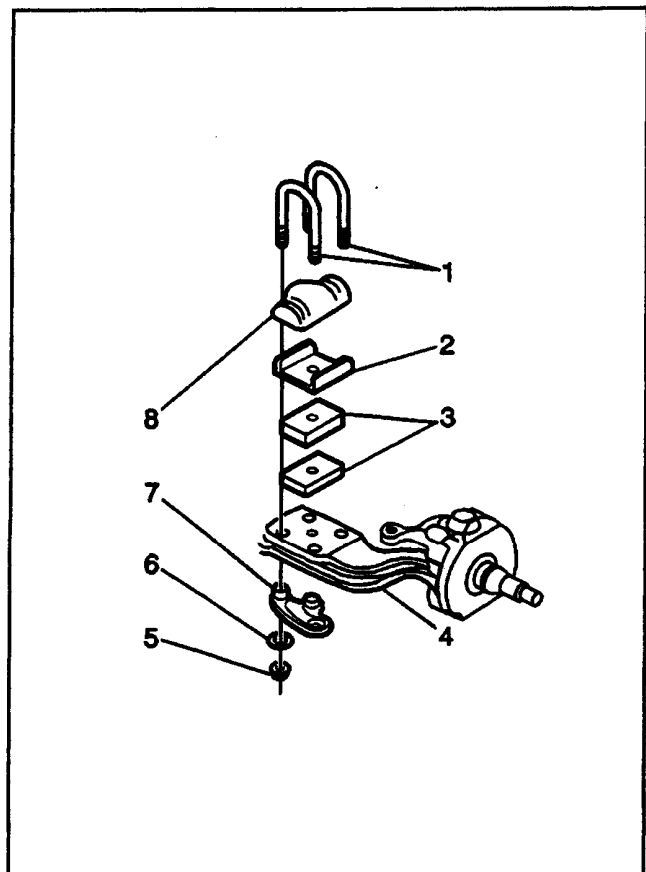
Notice: Do not use the front crossmember to support the vehicle or the crossmember may buckle.

5. Support the frame using suitable safety stands.



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6. Remove the following components from the lower mounting brackets (6). Push the shock absorbers into the fully retracted position:
 - The nuts (1)
 - The washers (2)
 - The insulators (3)
 - The shock absorbers (5)
7. Remove the insulator (3) and the washer (2) from the shock absorber lower stem.



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8. Remove the nuts from the front and rear eye bolts. Loosen the upper rear shackle bolt in order to allow the hanger to pivot.
9. Remove the nuts (5) the washers (6) and the U-bolts (1). Lower the axle (4) far enough in order to relieve the tension on the spring.
10. Remove the front eye bolt.
11. Remove the rear eye bolt.
12. Remove the following components from the vehicle:
 - The spring.
 - The spring spacers (2).
 - The U-bolt upper spacer (8).

Installation Procedure

Important: Assemble all of the components and remove all of the jacks and lifting devices before you tighten the suspension fasteners.

1. Install the spring (2).
2. Install the rear eye bolt and nut.
 - 2.1. Raise the axle in order to support the spring.
 - 2.2. Install the spring spacers (2) and the U-bolt spacer (8) on the spring.
 - 2.3. Align the spring center bolt to the axle.

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

3. Install the front eye bolt and nut.

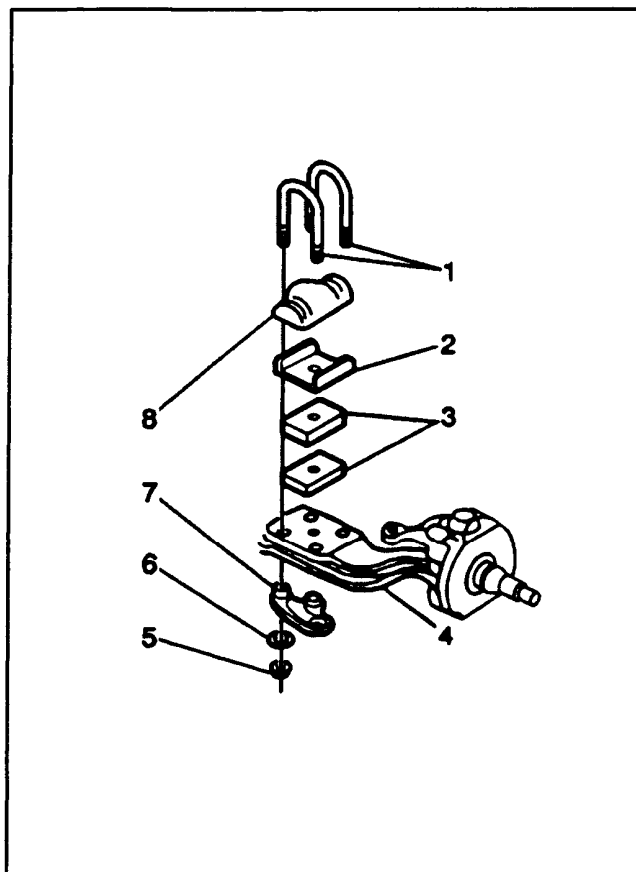
Tighten

Tighten the eye bolts to 330 N.m (243 lb ft).

4. Install the U-bolts (1), the washers (6) and the nuts (5).

Tighten

Tighten the U-bolt nuts to 400 N.m (295 lb ft).



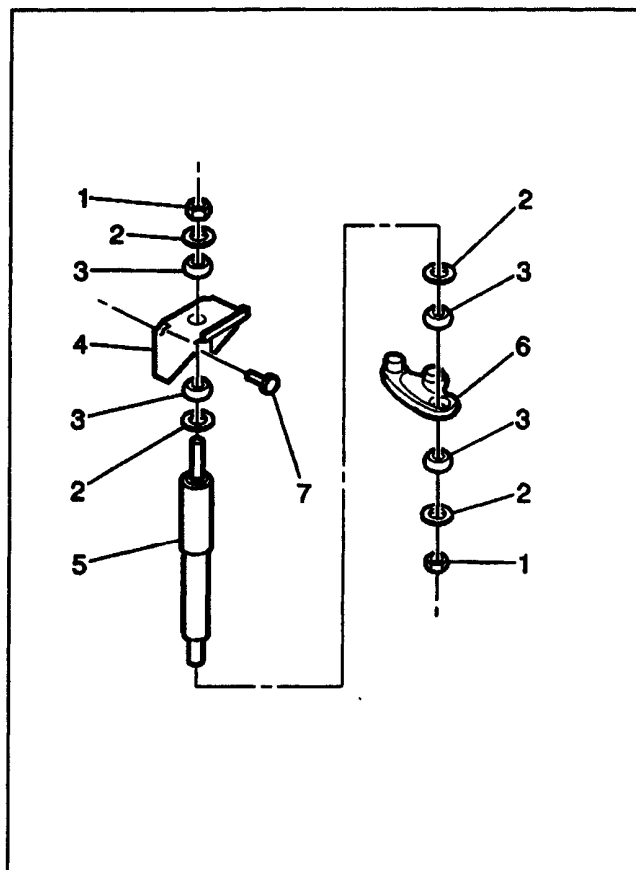
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5. Install the flat washer (2) and the insulator (3) onto the shock absorber lower stem.
6. Install the shock absorber (5) into the lower mounting bracket (6).
7. Install the following components:
 - The insulators (3)
 - The flat washers (2)
 - The nut (1)

Tighten

Tighten the lower shock absorber nut to 84 N.m (62 lb ft).

8. Remove the safety stands.
9. Lower the vehicle.



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Wheel Hub, Bearing, and Seal Replacement (Drum Brakes)

Removal Procedure

1. Set the parking brake.
 2. Block the vehicle rear wheels.
 3. Lift the vehicle frame until the front tire is off the ground.
- Notice:** Refer to *Crossmember Support Notice* in Cautions and Notices.
4. Support the frame using suitable safety stands.
 5. Remove the front tire and wheel assembly. Refer to *Wheel Removal (Front)* in Tires and Wheels.
 6. Remove the hub cap (3) and the gasket (4).
 7. Remove the following components:
 - The cotter pin (6)
 - The adjusting nut (5)
 - The washer (7)

Notice: Refer to *Do not let the bearing fall to the floor* in Cautions and Notices.

8. Pull the hub-and-drum assembly (10,11) part way off of the spindle of the steering knuckle (15). Remove the outer wheel bearing (8).

Notice: Refer to *Spindle Damage Notice* in Cautions and Notices.

9. Remove the hub-and-drum assembly (10,11) straight off the spindle (15).
10. Remove the seal (14).
11. Remove the inner wheel bearing (13).
12. Remove the bearing cups.

12.1. Insert a mild steel rod through the opposite end of the hub. Drive the rod against the inner edge of the cups.

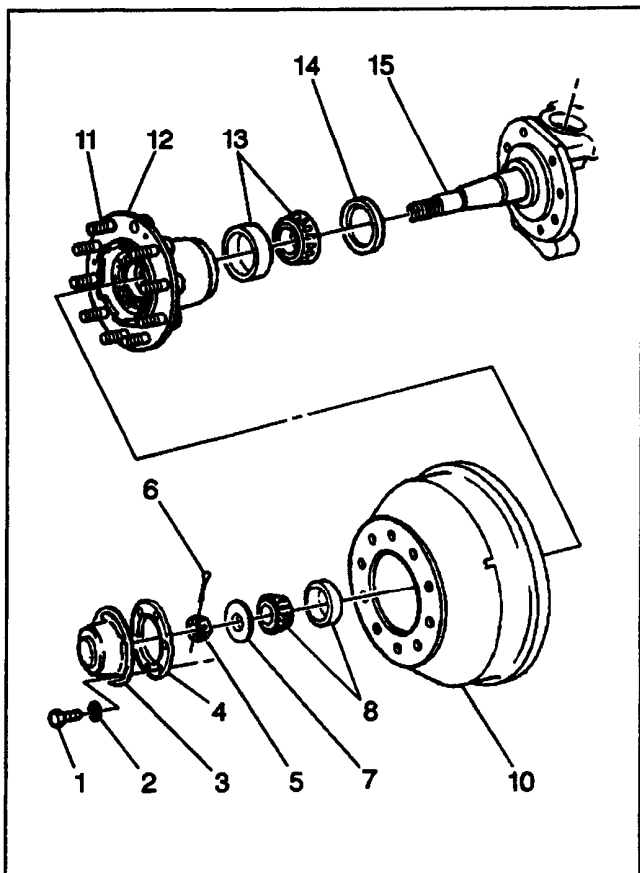
12.2. In order to avoid cocking the cups and damaging the inside of the hub, alternately drive the rod on opposite sides of the cups.

12.3. Remove the brake drum (10) by removing the hub-to-drum bolts.

13. Refer to *Brake Drum Replacement* in Air Drum.

Caution: If one stud is damaged, replace all the studs. A loose-running wheel may cause only one stud to break, but the other studs could have internal fatigue. Replacing only the broken stud and remounting the wheel may cause further damage and personal injury. If the stud holes in the wheels have become enlarged or distorted, replace the wheel.

14. Remove the wheel studs (11), if needed, using a press.



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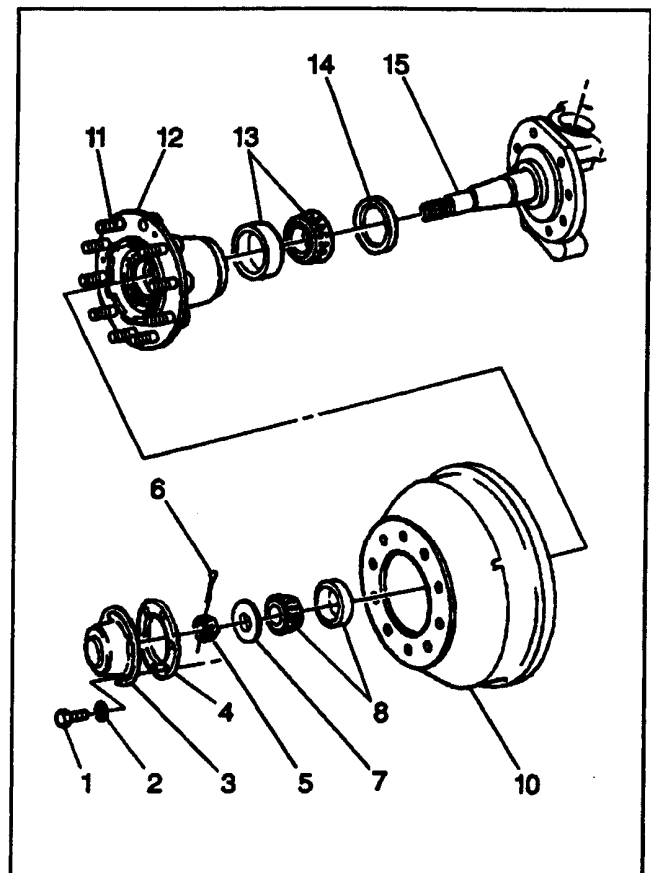
Inspection Procedure

Caution: When servicing wheel brake parts, do not create dust by grinding or sanding brake linings or by cleaning wheel bearing parts with compressed air. Many wheel brake parts contain fibers that can become air borne if dust is created during servicing. Breathing dust containing fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent fibers from becoming airborne.

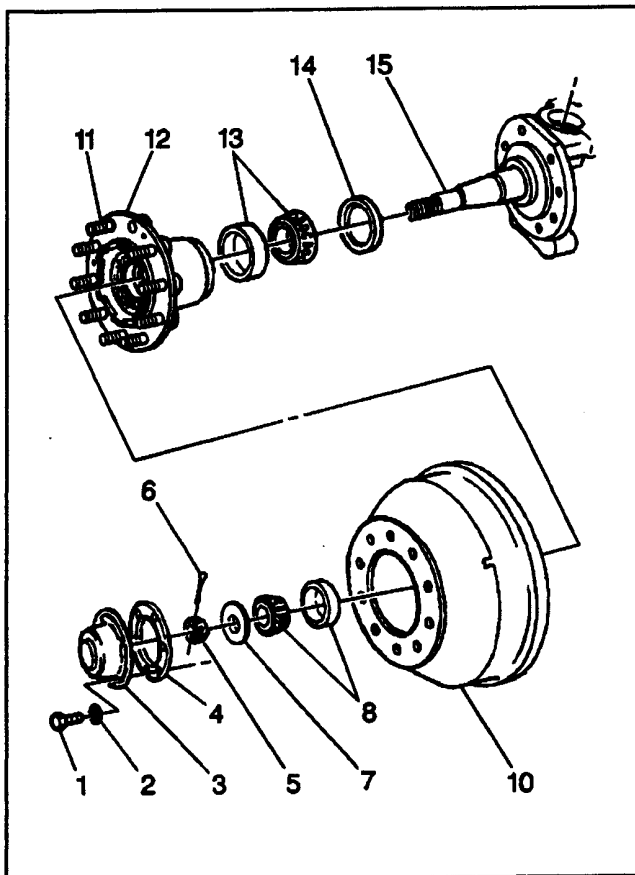
Notice: Refer to *Spin the Bearings with Lubricant* in Cautions and Notices.

Notice: Refer to *Do Not Use Oil-Based Solvent* in Cautions and Notices.

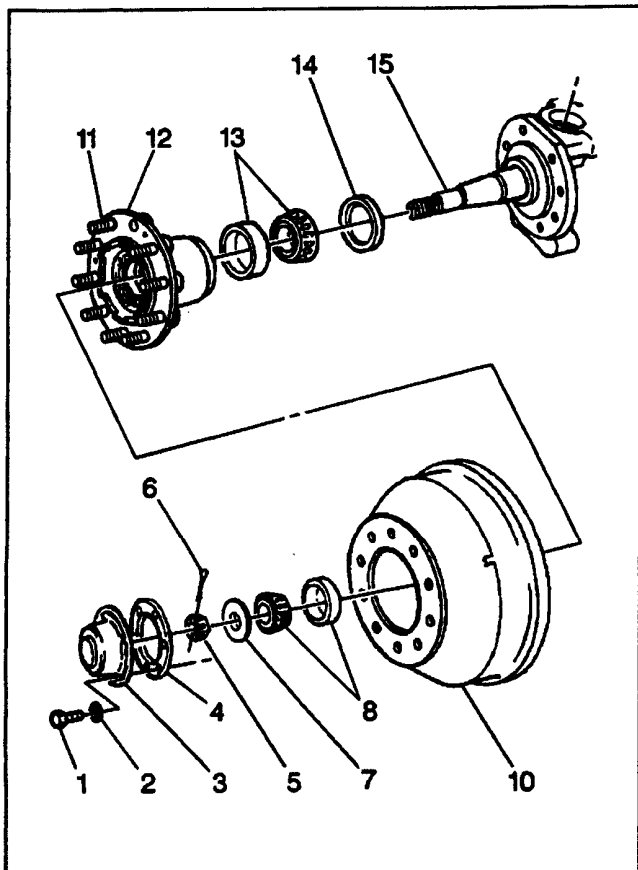
1. Clean the bearings (8, 13) in a suitable solvent. Use a stiff brush in order to remove all of the old lubricant.
2. Clean inside the hub (12) and the drum (10) assembly. Thoroughly clean all of the lubricant out of the inside of the hub. Wipe dry.
3. Remove all of the gasket particles from the hub (3) outer end. Clean all of the sealing compound out of the oil seal bore in the hub inner end.
- Important:** Keep the lubricant off of the drum (10) friction surface. Remove the lubricant with a suitable non-toxic, greaseless type of solvent. Wipe the surface clean with clean cloths.
4. Clean the steering knuckle spindle (15). Remove all lubricant with a cloth which has been soaked in solvent.
5. Clean the cap (3) in solvent. Blow dry. Remove all traces of the old gasket.
6. Clean the adjusting nut (5) and the washer (7) in solvent. Blow dry.
7. Clean the spindle shoulder and the hub bore. Remove all burrs and sharp edges with an emery cloth. Wipe clean with solvent.
8. Inspect the bearing cups for cracks and pits. Replace any cups that are cracked or pitted.
9. Inspect the cup fit in the hub. If the cups are loose or if the cups can be rotated in the bore, replace the hub.
10. Inspect the bearings (8, 13) for excessive wear, chipped edges, and other damage. Refer to *Wheel Bearings Diagnosis* in Suspension General Diagnosis.
11. Inspect the brake drum (10). Refer to *Air Drum Brake System Inspection* in Air Drum.
12. Inspect the wheel studs (11) for cracks or damaged threads.



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Installation Procedure

Important: If all of the studs were removed, verify that the shield is in place, if used.

1. Install the wheel studs (11), if needed, using a press. Fit the studs tightly.
2. Install the brake drum (10). Refer to *Brake Drum Replacement* in Air Drum.
3. Install the bearing cups to the hub. Position each cup in the hub and drive the cup into place using a suitable driver or a brass drift against the outer edge of the cup. If you use a drift, alternately drive against the opposite side in order to drive the cup squarely. Cups must seat against the shoulder in the hub.
4. Install the wheel bearings.

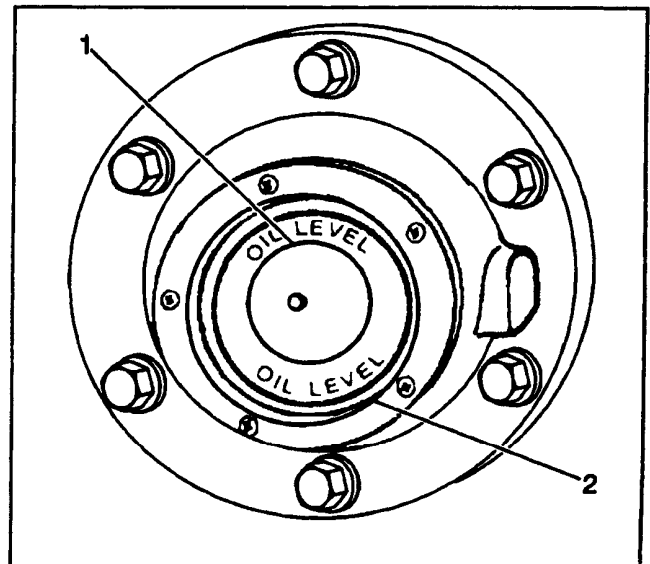
Oil or Grease Lubricated Wheel Bearing Installation

1. Whenever oil or grease is indicated in this procedure. Refer to *Fluid and Lubricant Recommendations* in Maintenance and Lubrication.

Important:

- Use a greasing machine, if available. If a greasing machine is not available, pack the bearings by hand. Thoroughly work the grease into the bearings, between the rollers, the core, and the cage.
 - Apply a thin coat of grease to the inside of the hub (12) and the spindle (15). DO NOT fill the hub with grease. A thin coat of grease 3 mm (1/8 in) thick will help to retard rusting. Allow some excess grease at the inside of the bearings and around the adjusting nut.
2. If the bearings are not oil lubricated, pack the bearings with high-temperature wheel bearing grease.
 3. Install the inner bearing (13) to the hub (12).
 4. Apply grease to the lips of the new seal.

5. Apply a thin layer of non-hardening sealing compound to the hub seal bore.
Important: Face the seal lip inside the hub (12). Provide enough clearance between the seal (14) and the bearing (13) so that the bearing can rotate freely without rubbing against the seal.
6. Install the new seal (14) to the hub (12). Press the seal into the hub (12) until the seal seats against the bearing cup.
7. Install the hub (12) and the drum assembly (10) to the spindle (15). DO NOT damage the seal or the flange ring.
8. Install the outer wheel bearing (8).
9. Install the washer (7).
10. Install the adjusting nut (5).
Important: DO NOT tighten the nut.
11. Install the front tire and wheel assembly. Refer to *Wheel Installation (Front)* in Tires and Wheels.
12. Adjust the front wheel bearings. Refer to *Wheel Bearing Adjustment*.
13. Install a new gasket (4). Install the hub cap (3).
Notice: Refer to *Fastener Notice* in Cautions and Notices.
14. Install the washers (2) and the bolts (1).
Tighten
Tighten the hub cap bolt (1) evenly to 13 N.m (115 lb in).
15. If oil lubrication is used, fill oil to the level on the window (2).
16. Install the window plug (1).
17. Adjust the brakes. Refer to *Brake Drum Replacement* in Air Drum.
18. Lower the vehicle.
19. Remove the blocks.



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Wheel Hub, Bearing, and Seal Replacement (Disc Brakes)

Removal Procedure

1. Set the parking brake.
2. Block the vehicle rear wheels.
3. Lift the vehicle frame until the front tire is off the ground.

Notice: Refer to *Crossmember Support Notice* in Cautions and Notices.

4. Support the frame using suitable safety stands.
5. Remove the front tire and wheel assembly. Refer to *Wheel Removal (Front)* in Tires and Wheels.
6. Remove the caliper assembly.
7. Refer to the appropriate procedure:
 - *Brake Caliper Replacement (Front, Bendix)*
 - *Brake Caliper Replacement (Front, Dayton-Walther)*
8. Remove the hub cap (3) and the gasket (4).
9. Remove the following components:
 - The cotter pin (6)
 - The adjusting nut (5)
 - The washer (7)

Notice: Refer to *Do not let the bearing fall to the floor* in Cautions and Notices.

10. Pull the hub and rotor assembly (10,12) part way off of the spindle of the steering knuckle (16). Remove the outer wheel bearing (8).

Notice: Refer to *Spindle Damage Notice* in Cautions and Notices.

11. Remove the hub and rotor assembly (10,12) straight off the spindle (16).
12. Remove the seal (15).
13. Remove the inner wheel bearing (14).
14. Remove the bearing cups.

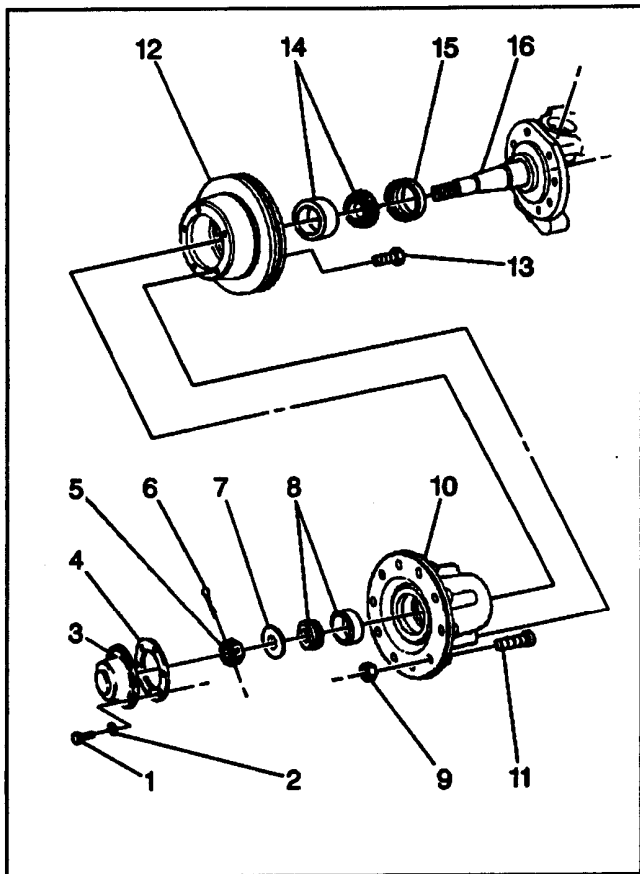
14.1. Insert a mild steel rod through the opposite end of the hub. Drive the rod against the inner edge of the cups.

14.2. In order to avoid cocking the cups and damaging the inside of the hub, alternately drive the rod on opposite sides of the cups.

15. Remove the brake rotor (12) by removing the hub-to-rotor bolts (13).

Caution: If one stud is damaged, replace all the studs. A loose-running wheel may cause only one stud to break, but the other studs could have internal fatigue. Replacing only the broken stud and remounting the wheel may cause further damage and personal injury. If the stud holes in the wheels have become enlarged or distorted, replace the wheel.

16. Remove the wheel studs (11), if needed, using a press.



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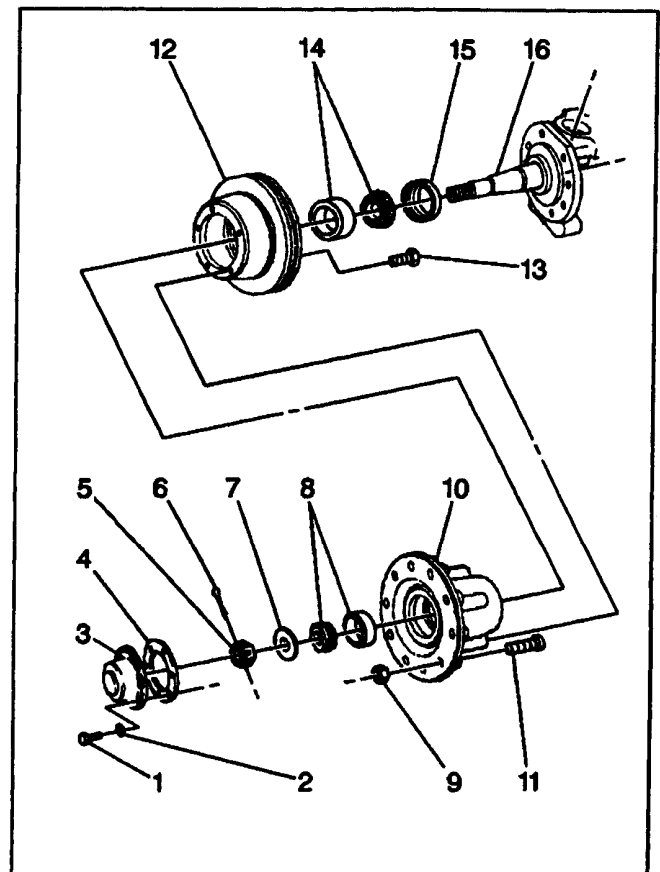
Inspection Procedure

Caution: When servicing wheel brake parts, do not create dust by grinding or sanding brake linings or by cleaning wheel bearing parts with compressed air. Many wheel brake parts contain fibers that can become air borne if dust is created during servicing. Breathing dust containing fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent fibers from becoming airborne.

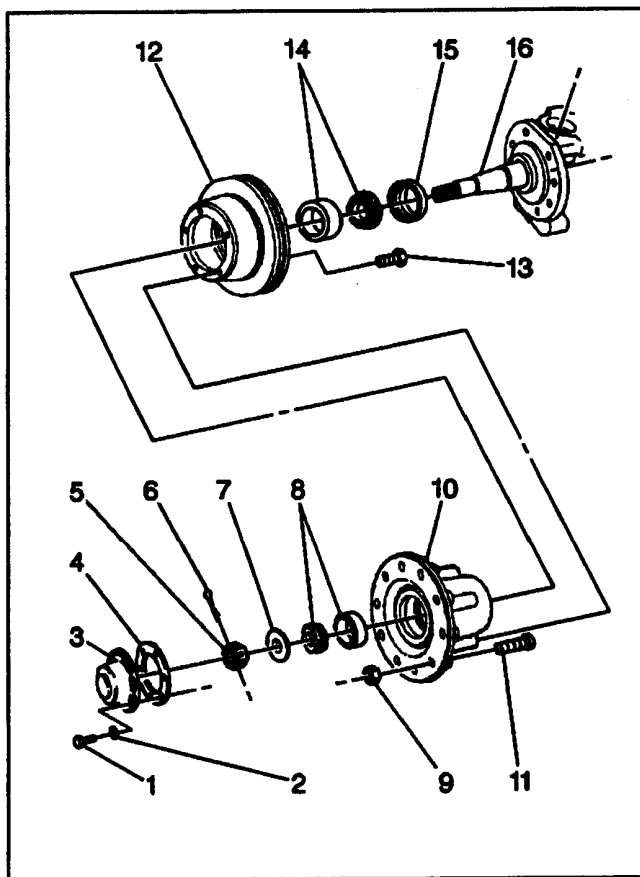
Notice: Refer to *Spin the Bearings with Lubricant* in Cautions and Notices.

Notice: Refer to *Do Not Use Oil-Based Solvent* in Cautions and Notices.

1. Clean the bearings (8, 14) in a suitable solvent. Use a stiff brush in order to remove all of the old lubricant.
2. Clean inside the hub (10) and the disc (12) assembly. Thoroughly clean all of the lubricant out of the inside of the hub. Wipe dry.
3. Remove all of the gasket particles from the hub (10) outer end. Clean all of the sealing compound out of the oil seal bore in the hub inner end.
- Important:** Keep the lubricant off of the disc (12) friction surface. Remove the lubricant with a suitable non-toxic, greaseless type of solvent. Wipe the surface clean with clean cloths.
4. Clean the steering knuckle spindle (16). Remove all lubricant with a cloth which has been soaked in solvent.
5. Clean the cap (3) in solvent. Blow dry. Remove all traces of the old gasket.
6. Clean the adjusting nut (5) and the washer (7) in solvent. Blow dry.
7. Clean the spindle shoulder (16) and the hub (10) bore. Remove all burrs and sharp edges with an emery cloth. Wipe clean with solvent.
8. Inspect the bearing cups for cracks and pits. Replace any cups that are cracked or pitted.
9. Inspect the cup fit in the hub. If the cups are loose or if the cups can be rotated in the bore, replace the hub.
10. Inspect the bearings (8, 14) for excessive wear, chipped edges, and other damage. Refer to *Wheel Bearings Diagnosis* in Suspension General Diagnosis.
11. Inspect the brake rotor (12). Refer to *Brake Rotor Thickness Variation Check* Brake Pad Inspection in Disc Brakes.
12. Inspect the wheel studs (11) for cracks or damaged threads.



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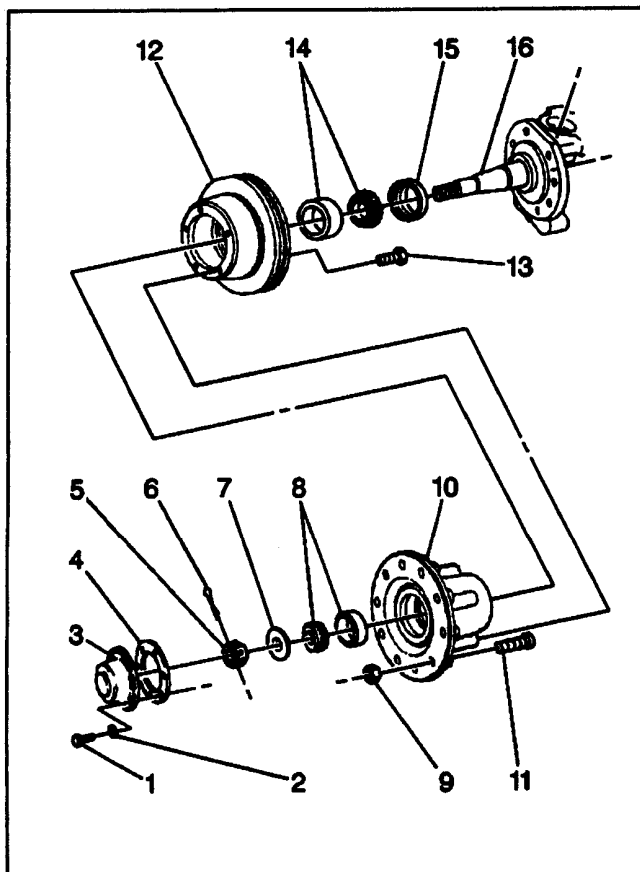


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Installation Procedure

Important: If all of the studs were removed, verify that the shield is in place, if used.

1. Install the wheel studs (11), if needed, using a press. Fit the studs tightly.
2. Install the brake rotor (12).
3. Install the bearing cups to the hub. Position each cup in the hub and drive the cup into place using a suitable driver or a brass drift against the outer edge of the cup. If you use a drift, alternately drive against the opposite side in order to drive the cup squarely. Cups must seat against the shoulder in the hub.
4. Install the wheel bearings.



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Oil or Grease Lubricated Wheel Bearing Installation

1. Whenever oil or grease is indicated in this procedure. Refer to *Fluid and Lubricant Recommendations* in Maintenance and Lubrication.

Important:

- Use a greasing machine, if available. If a greasing machine is not available, pack the bearings by hand. Thoroughly work the grease into the bearings, between the rollers, the core, and the cage.
 - Apply a thin coat of grease to the inside of the hub (10) and the spindle (16). DO NOT fill the hub with grease. A thin coat of grease 3 mm (1/8 in) thick will help to retard rusting. Allow some excess grease at the inside of the bearings and around the adjusting nut.
2. If the bearings are not oil lubricated, pack the bearings with high-temperature wheel bearing grease.
 3. Install the inner bearing (14) to the hub (10).
 4. Apply grease to the lips of the new seal.

5. Apply a thin layer of non-hardening sealing compound to the hub seal bore.

Important: Face the seal lip inside the hub (10). Provide enough clearance between the seal (15) and the bearing (14) so that the bearing can rotate freely without rubbing against the seal.

6. Install the new seal (15) to the hub (10). Press the seal into the hub (10) until the seal seats against the bearing cup.
7. Install the hub (10) and the disc assembly (12) to the spindle (16). DO NOT damage the seal or the flange ring.
8. Install the outer wheel bearing (8).
9. Install the washer (7).
10. Install the adjusting nut (5).

Important: DO NOT tighten the nut.

11. Install the caliper assembly.
12. Refer to the appropriate procedure:
 - *Brake Caliper Replacement (Front, Bendix)*
 - *Brake Caliper Replacement (Front, Dayton-Walther) in Disc Brakes.*
13. Install the front tire and wheel assembly. Refer to *Wheel Installation (Front)* in Tires and Wheels.
14. Adjust the front wheel bearings. Refer to *Wheel Bearing Adjustment* in this section.
15. Install a new gasket (4). Install the hub cap (3).

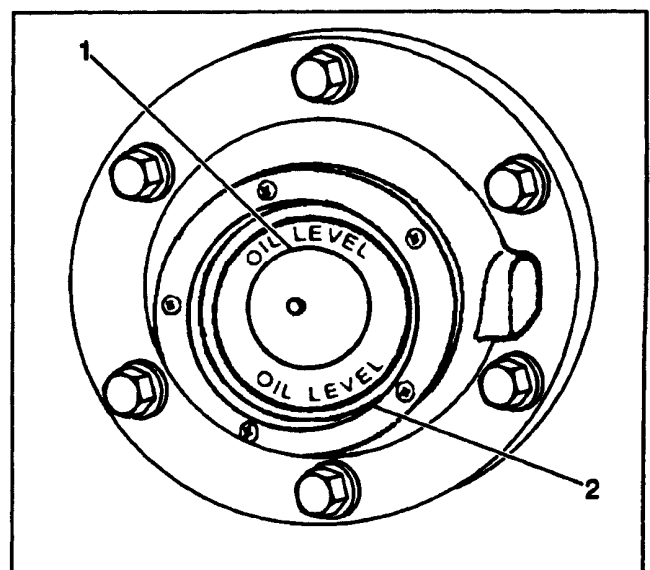
Notice: Refer to *Fastener Notice* in Cautions and Notices.

16. Install the washers (2) and the bolts (1).

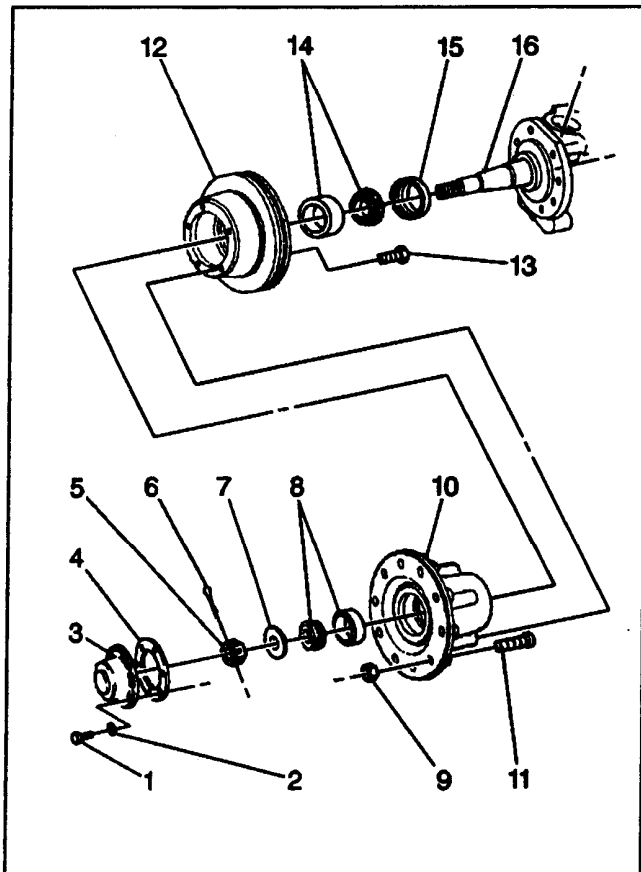
Tighten

Tighten the hub cap bolt (1) evenly to 13 N.m (115 lb in).

17. If oil lubrication is used, fill oil to the level on the window (2).
18. Install the window plug (1).
19. Lower the vehicle.
20. Remove the blocks.



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Hub Cap Replacement

Removal Procedure

1. Place a suitable container under the hub cap in order to catch the oil.
2. Remove the bolts (1) and the washers (2).
3. Remove the hub cap (3) and the gasket (4). Do not allow gasket material to fall into the hub (10).

Installation Procedure

1. Install a new gasket (4) and the hub cap (3) onto the hub (10). Align the gasket properly.

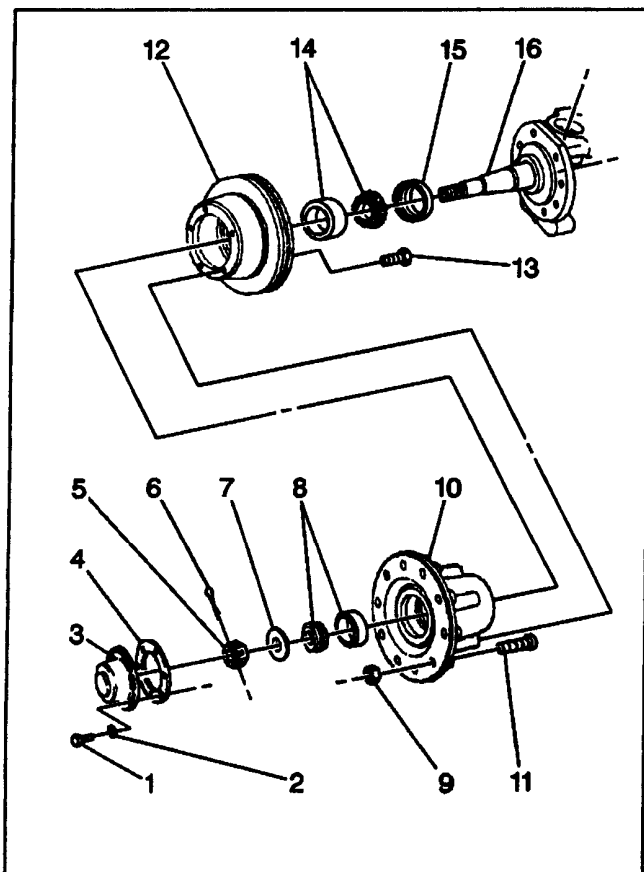
Notice: Refer to *Fastener Notice* in Cautions and Notices.

2. Install the bolts (1) and new washers (2).

Tighten

Tighten bolts evenly to 13 N.m (115 lb in).

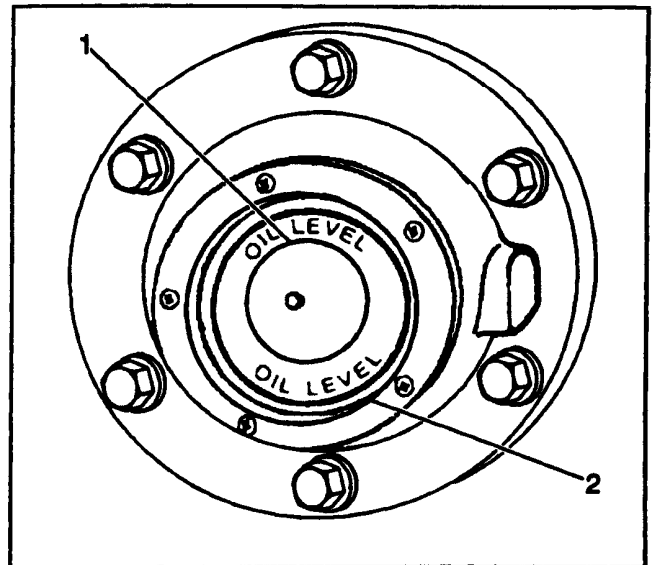
3. Install new lubricant. Refer to *Adding Lubricant to Hub Caps*.



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Adding Lubricant to Hub Caps

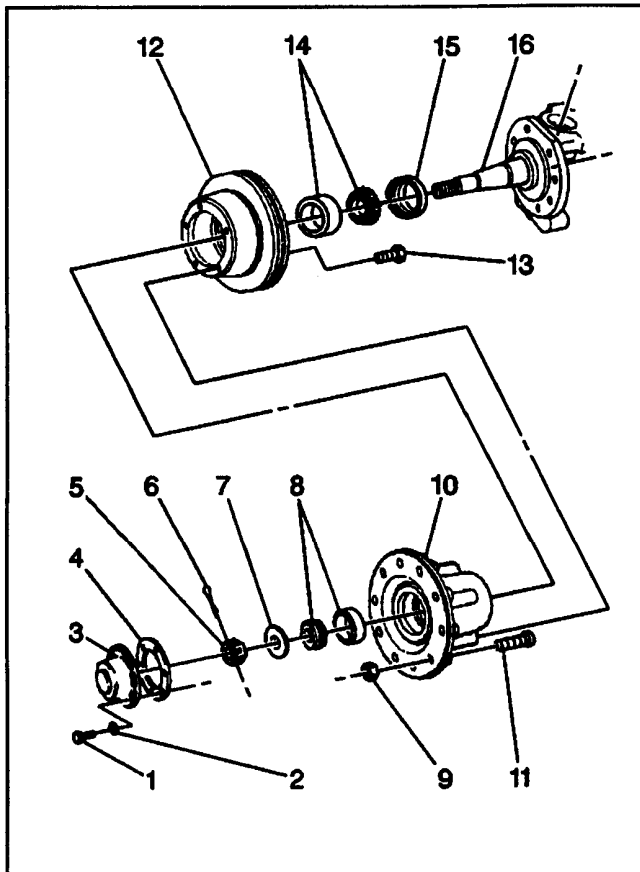
1. With the vehicle in a level position, the oil level should be at the oil level line.
2. If oil is required, remove the rubber window plug (1).
3. Add lubricant until the fluid is level with the oil level line. Refer to *Fluid and Lubricant Recommendations* in Maintenance and Lubrication.



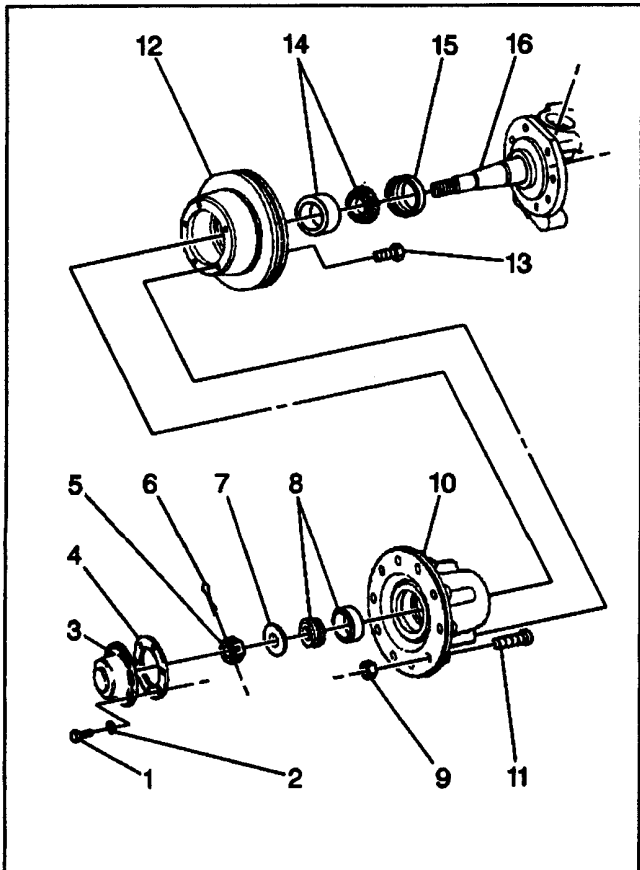
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Wheel Bearing Adjustment**Removal Procedure**

1. Set the parking brake.
2. Block the vehicle rear wheels.
3. Lift the vehicle frame until the front tire is off the ground.
Notice: Do not use the front crossmember to support the vehicle or the crossmember may buckle.
4. Support the frame using suitable safety stands.



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5. Remove the bolts (1) and the washers (2). (The illustration shows a wheel hub with disc brakes, but you will perform the bearing adjustment in the same manner for any kind of axle.)
6. Remove the hub cap (3) and the gasket (4). DO NOT allow the gasket material to fall into the hub, where applicable.
7. Remove the cotter pin (6).

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

8. Adjust the nut (5).

Tighten

Tighten the nut to 153 N.m (113 lb ft) while rotating the wheel 360 degrees in both directions. This rotation will correctly position the bearings.

Important: Always back off the nut 1/4–1/6 turn. This adjustment should result in bearing end play of 0.025–0.200 mm (0.001–0.008 in).

9. Back off the nut 1/4–1/6 turn until the slot in the nut lines up with hole in the spindle (16) of the steering knuckle.

Installation Procedure

1. Install a new cotter pin (6). Bend the cotter pin for proper clearance of the rotating components.
2. Install a new gasket (4) and align the gasket properly. Attach the hub cap (3).

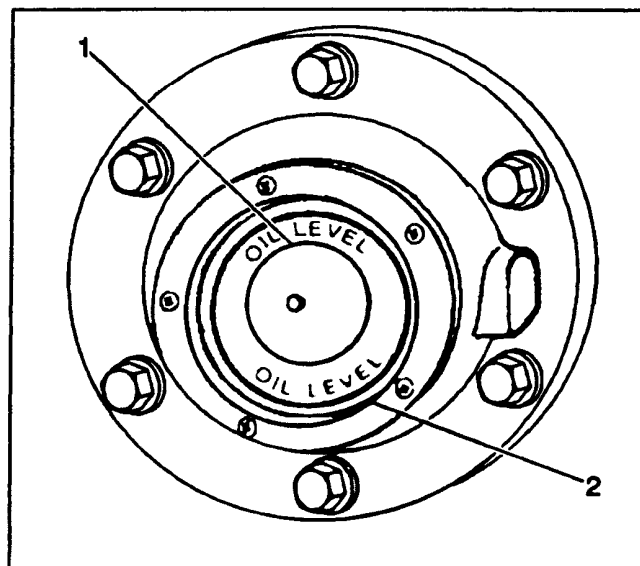
Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the hub cap bolts (1) with new washers (2).

Tighten

Tighten the hub cap bolts evenly to 13 N.m (115 lb in).

4. Add new lubricant to the oil lubricated bearings only. Refer to *Adding Lubricant to Hub Caps*.
5. Remove the safety stands.
6. Lower the vehicle.

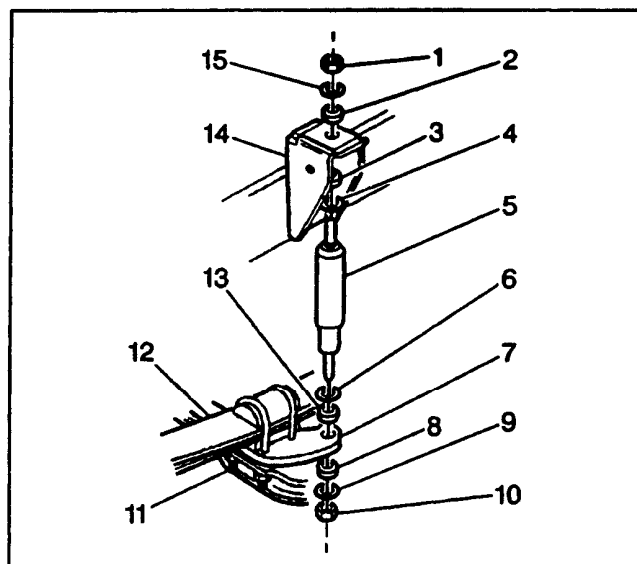


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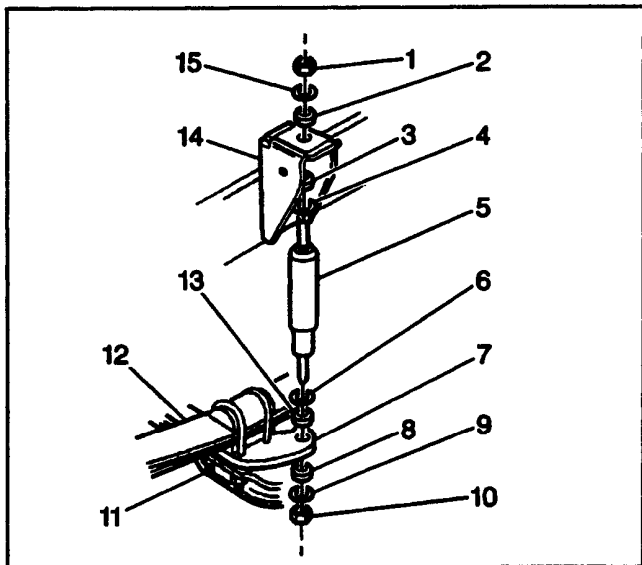
Shock Absorber Replacement

Removal Procedure

1. Set the parking brake.
2. Block the vehicle wheels.
3. Remove the following components from the shock absorber (5) at the lower bracket (7):
 - The nut (10)
 - The flat washer (9)
 - The insulator (8)
4. Remove the following components from the shock absorber at the upper bracket (14):
 - The nut (1)
 - The flat washer (15)
 - The insulator (2)
5. Remove the shock absorber (5) from the upper and the lower mounting brackets. Compress the shock absorber slightly in order to remove.
6. Remove the remaining flat washers (4,6) and the insulators (3,13).
7. Clean the shock absorber of the following conditions:
 - Dirt
 - Oil
 - Corrosion
8. Inspect the shock absorber for the following conditions:
 - Wear
 - Cracks
 - Damage
 - Signs of leaking
 - A bent damper rod
 - Worn or torn insulators



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9. Inspect the upper and the lower mounting brackets for the following conditions:
 - Cracks
 - Bends
 - Wear
 - Damage
10. Inspect the frame mounting hole for the following conditions:
 - Cracks
 - Wear
 - Burrs
11. Diagnose the shock absorbers.
12. Refer to the appropriate procedure:
 - *Struts or Shock Absorbers Bench Test*
 - *Struts or Shock Absorbers On-Vehicle Testing*

Installation Procedure

1. Install the flat washer (6) and the insulator (13) onto the shock absorber lower stem.
2. Install the shock absorber lower stem into the lower mounting bracket (7).
3. Install the flat washer (4) and the insulator (3) onto the shock absorber upper stem.
4. Install the shock absorber upper stem into the upper mounting bracket (14).

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

5. Install the following components onto the shock absorber lower stem:
 - The insulator (8)
 - The flat washer (9)
 - The nut (10)

Tighten

Tighten the lower shock absorber nuts (10) to 84 N.m (62 lb ft).

6. Install the following components onto the shock absorber upper stem:
 - The insulator (2)
 - The flat washer (15)
 - The nut (1)

Tighten

Tighten the upper shock absorber nuts (1) to 84 N.m (62 lb ft).

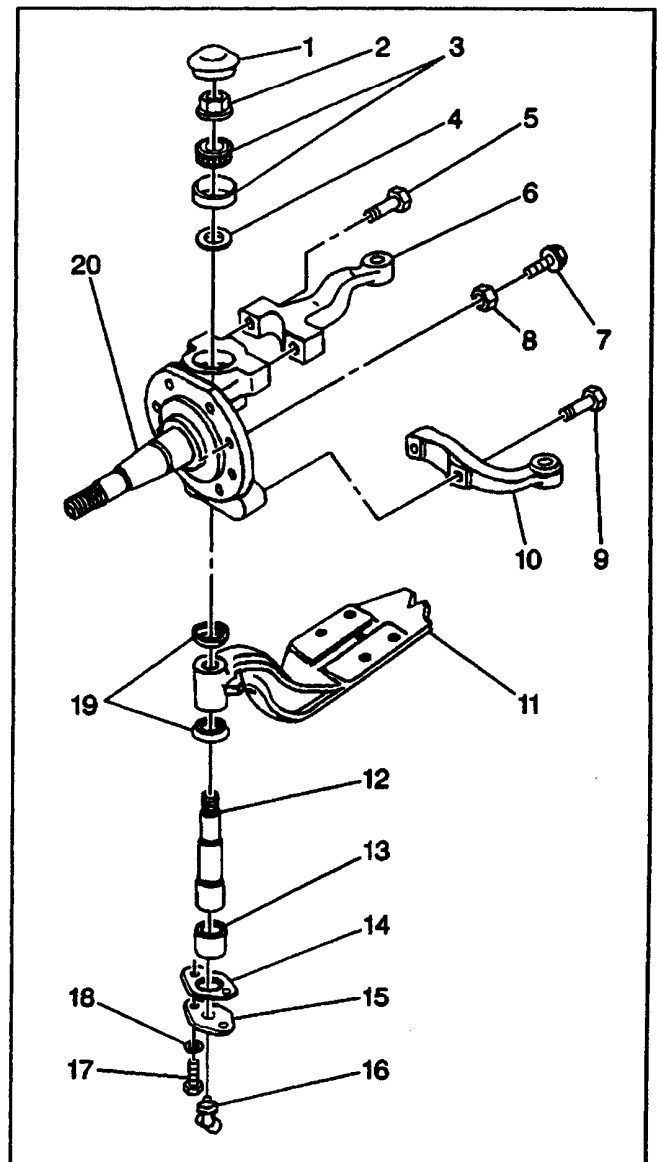
7. Lower the vehicle.
8. Remove the blocks.

King Pin Bushing and Bearing Cup Replacement

Removal Procedure

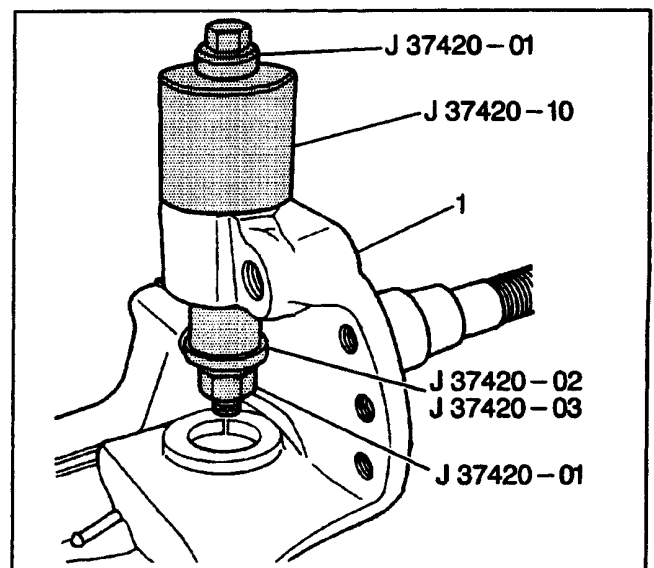
Tools Required

- J 37420 Steering Knuckle Service Set
 - J 39758 King Pin Holding Tool
1. Remove the steering knuckle (20) and the king pin (12). Refer to *Steering Knuckle and King Pin Replacement*
 2. Clamp the knuckle in a vise.

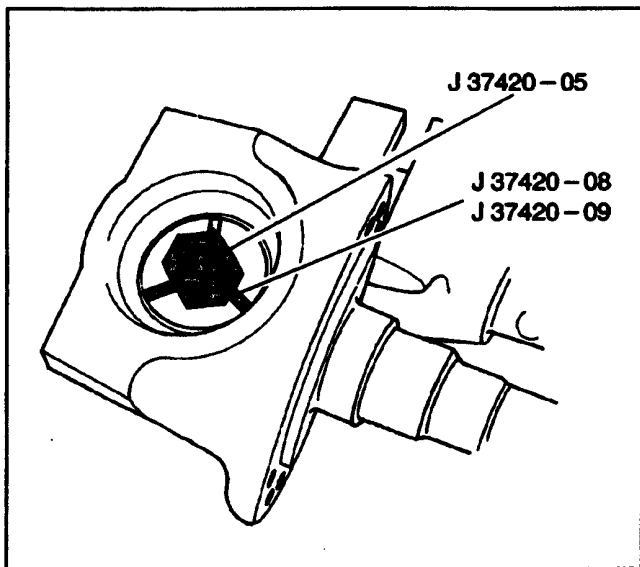


201703

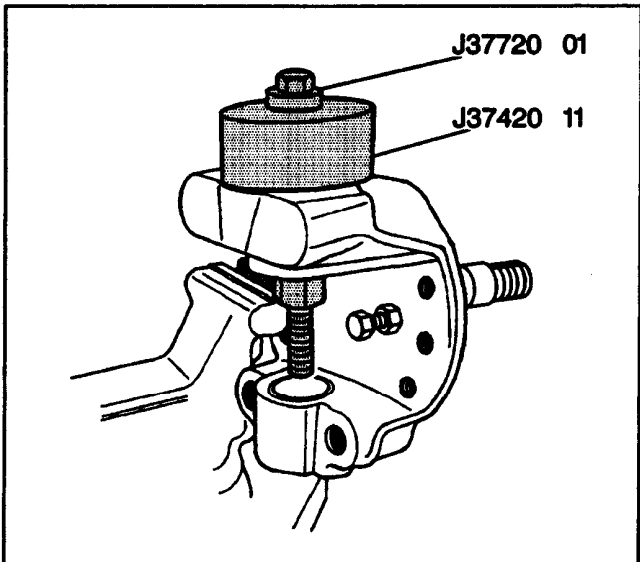
3. Remove the king pin bushing from the steering knuckle (1). Use components of the J 37420 shown in the illustration



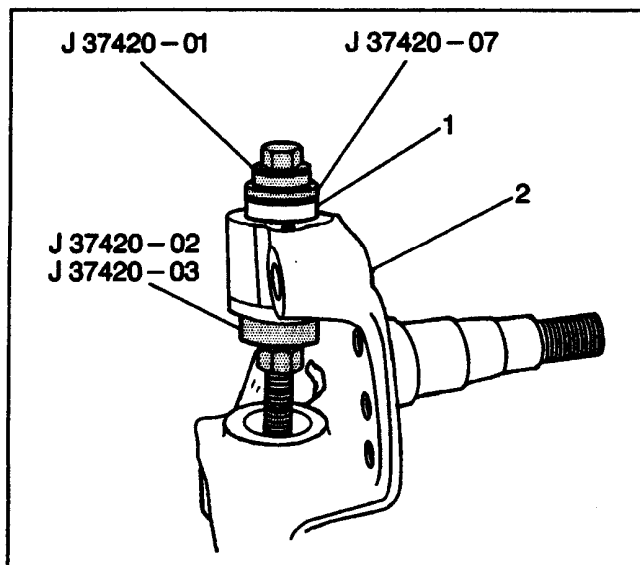
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Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. In order to remove the king pin bearing cup, assemble components of *J 37420*. First install *J 37420 -08* (or *J 37420 -09*), *J 37420 -05* and *J 37420 -04*, (not shown in the illustration).

Tighten

Tighten the nut to 27 N.m (20 lb ft).

5. Remove the king pin bearing cup using the *J 37420 -11* and the *J 37420 -01* screw (you will not use the nut in this task).

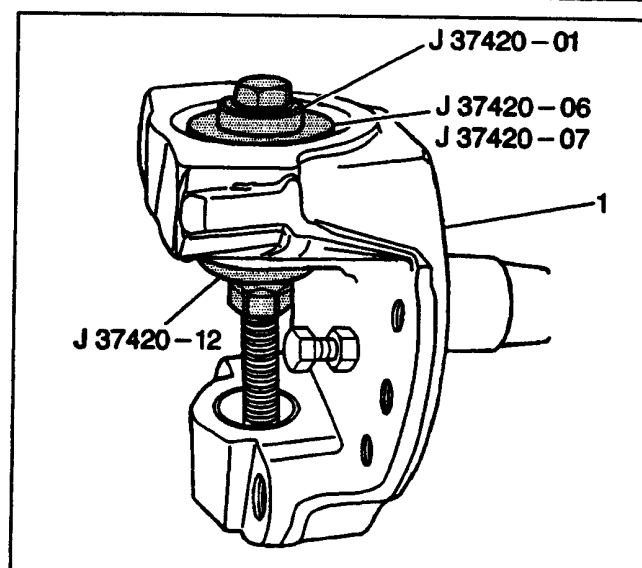
Installation Procedure

Tools Required

- *J 37420* Steering Knuckle Service Set
- *J 35999* Tension Scale

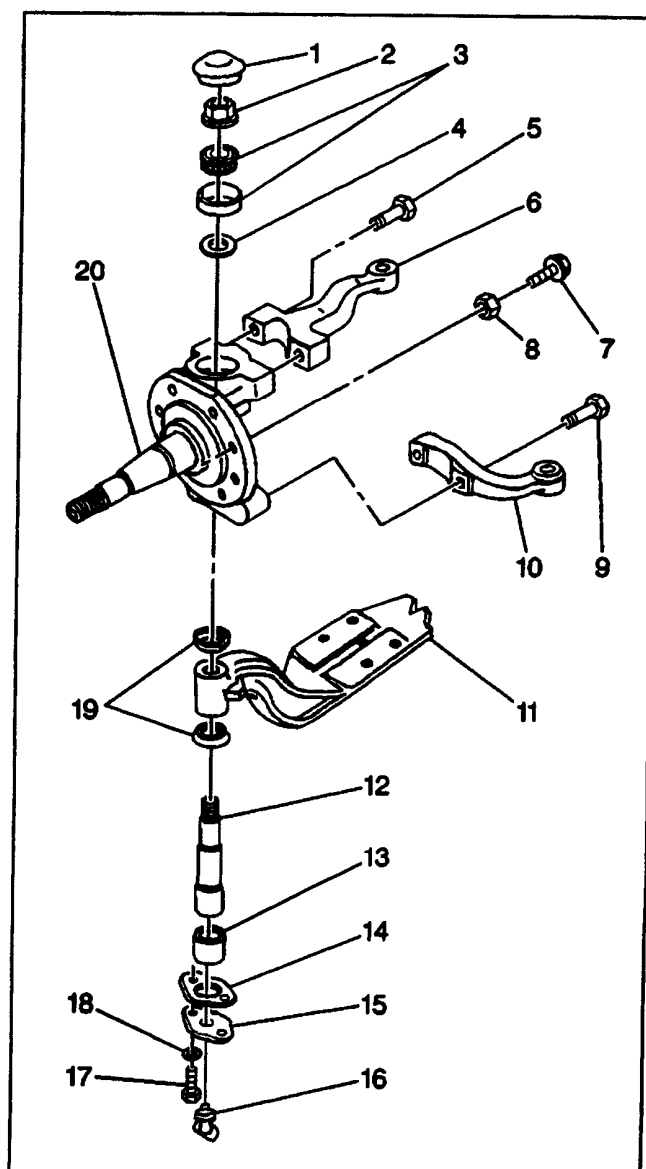
1. Install the king pin bushing (1) onto the steering knuckle (2). Use components of the *J 37420*.

2. Install the king pin bearing cup onto the steering knuckle (1). Use components of the J 37420 as shown in the illustration.

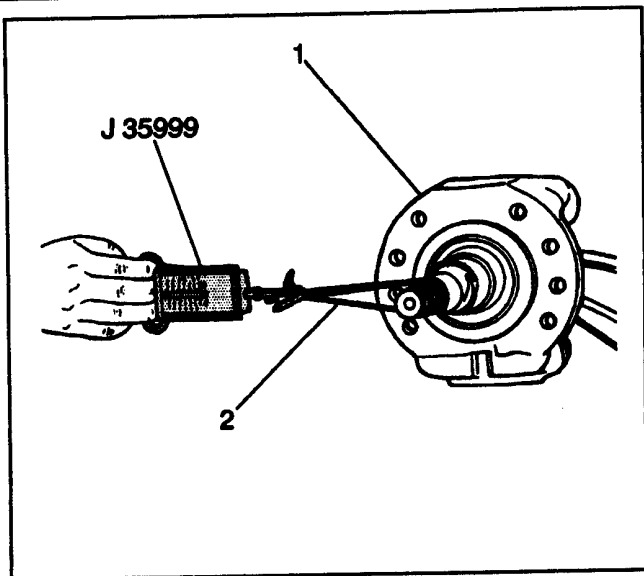


201716

3. Install the knuckle (20) and the king pin (12).



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201718

4. Measure the king pin bearing preload, using the J 35999. Refer to *King Pin Bearing Preload*

King Pin Upper Bearing Repack

Removal Procedure

Tools Required

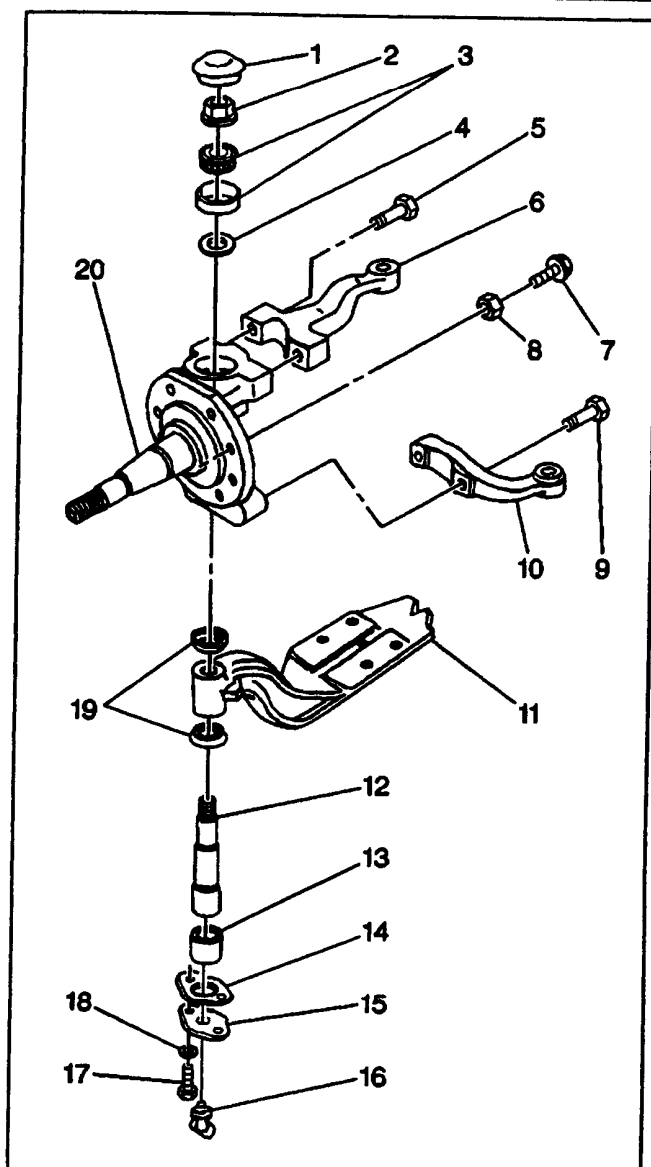
J 39758 King Pin Holding Tool

1. Set the parking brake.
2. Block the vehicle rear wheels.
3. Raise the vehicle frame until the front tires clear the floor.

Notice: Refer to *Crossmember Support Notice* in Cautions and Notices.

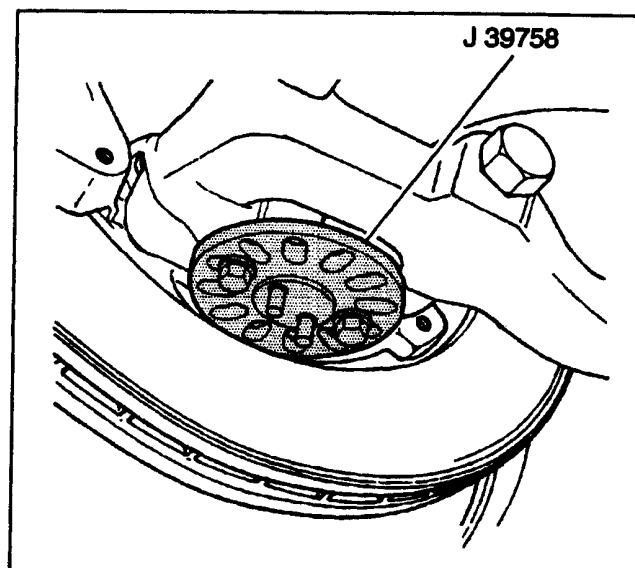
4. Support the frame using suitable safety stands.
5. Remove the wheels, the hubs, and the bearings. Refer to *Wheel Hub, Bearing, and Seal Replacement (Drum Brakes)* or *Wheel Hub, Bearing, and Seal Replacement (Disc Brakes)* in this section.
6. Remove the brake components as needed. Refer to *Brake Caliper Replacement (Front, Bendix)* or to *Brake Caliper Replacement (Front, Dayton-Walther)* in Disc Brakes.
7. Remove the brake backing plates and the dust covers.

8. Remove the upper king pin dust cap (1).

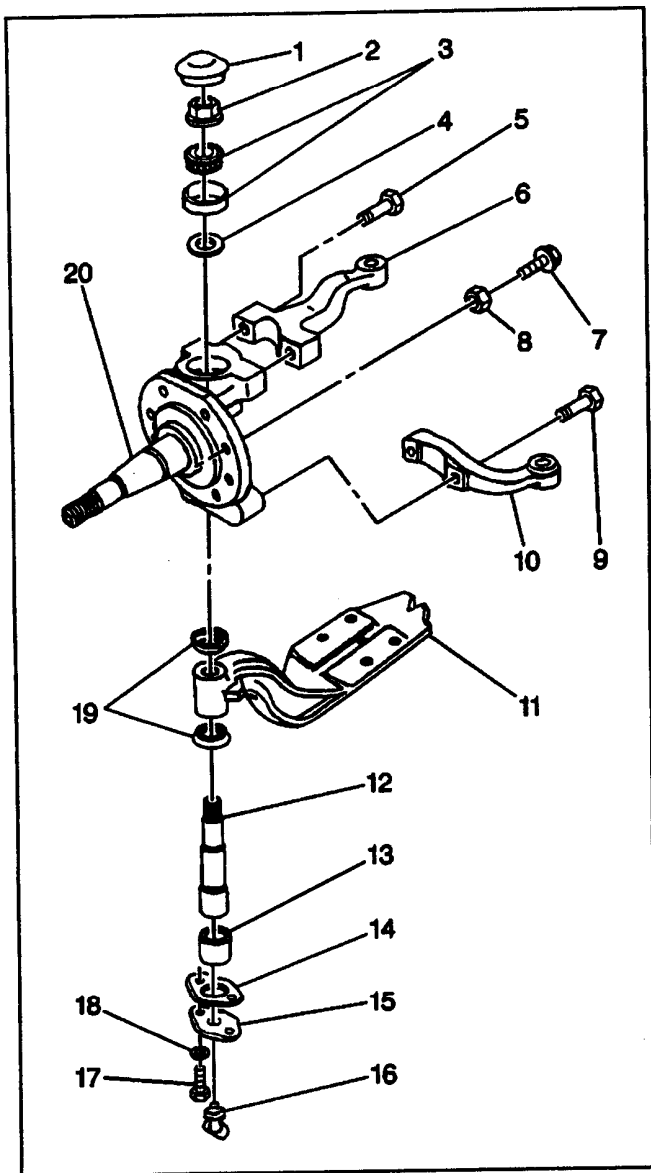


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9. In order to remove the king pin nut, use the J 39758.
10. Insert the tool pins into the holes at the bottom of the king pin.
11. Align the tool's bolt holes and secure the tool with two bolts into the steering knuckle. This will keep the king pin from spinning.



201706



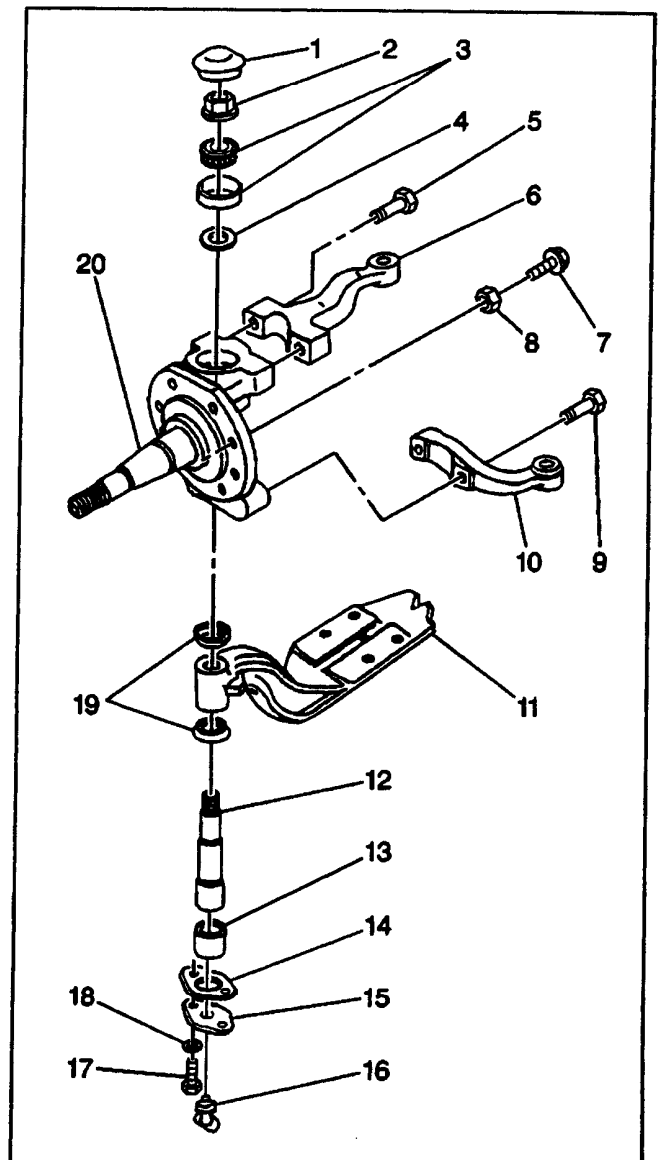
201703

12. Remove the king pin nut (2).
13. Remove the king pin bearing-and-cup assembly (3).
14. Clean the following components using cleaning solvent:
 - The king pin nut
 - The bearing. Soak the bearing until all of the old lubricant is gone.
 - The cavity

Installation Procedure

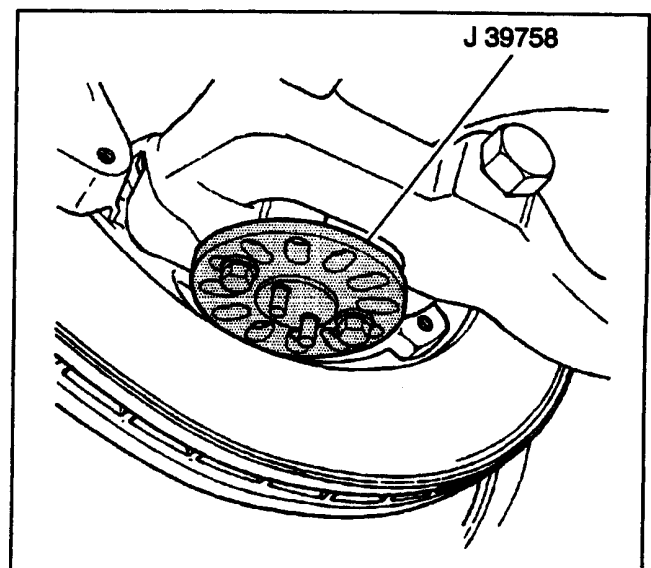
Tools Required

- J 35999 Tension Scale
 - J 39758 King Pin Holding Tool
1. Pack the cavity and the king pin thrust bearing (3) using high-temperature wheel bearing grease.
 2. Install the king pin bearing (3).

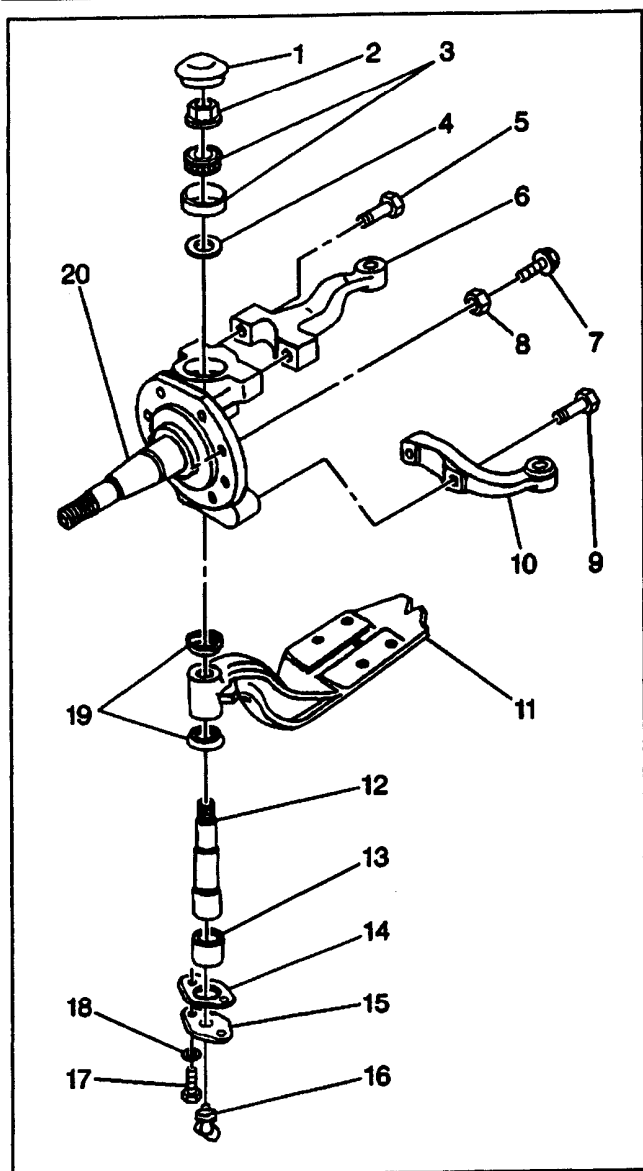


201703

3. In order to install the king pin nut, use the J 39758.
4. Insert the tool pins into the holes at the bottom of the king pin.
5. Align the tool's bolt holes and secure the tool with two bolts into the steering knuckle. This will keep the king pin from spinning.



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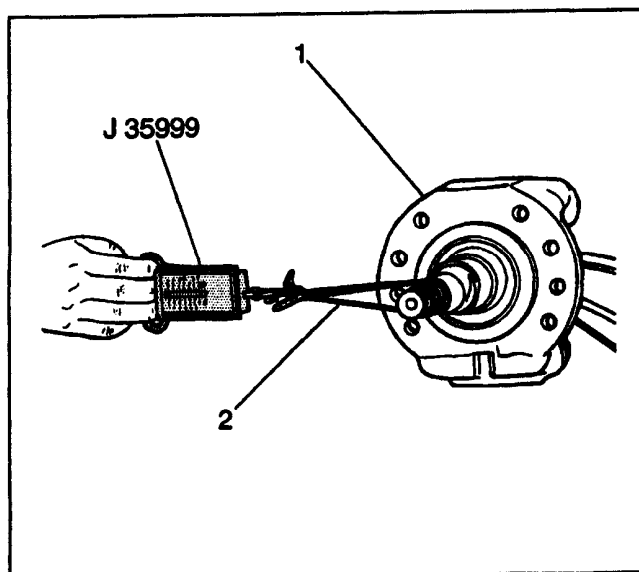
201703

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

6. Install the king pin nut (2).

Tighten

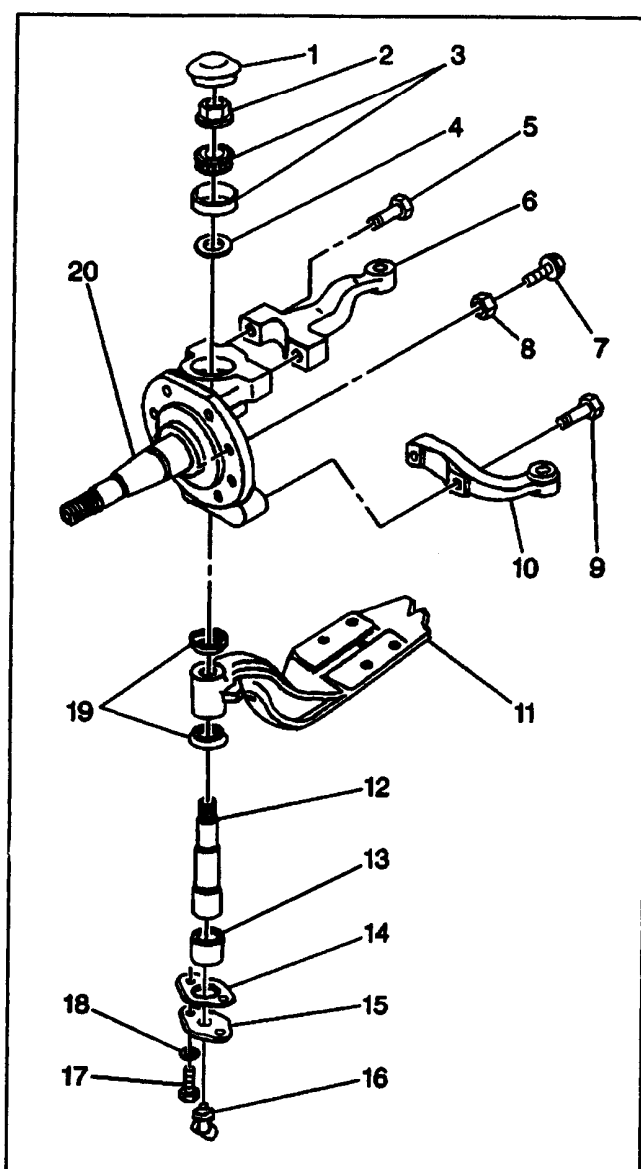
Tighten the king pin nut to 550 N.m (406 lb ft).



201718

7. Use the *J 35999* in order to measure the king pin bearing preload. Refer to *King Pin Bearing Preload*.

8. Install the dust cap (15) and install the snap ring.
 9. Install the following parts:
 - The bottom gasket
 - The cap
 - The washers and the bolts
 10. Install the lower king pin cap bolt (17).
- Tighten**
- Tighten the lower king pin cap bolt to 24 N·m (18 lb ft).
11. Lower the vehicle.
 12. Remove the blocks.



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King Pin Bearing Preload

Adjustment Procedure

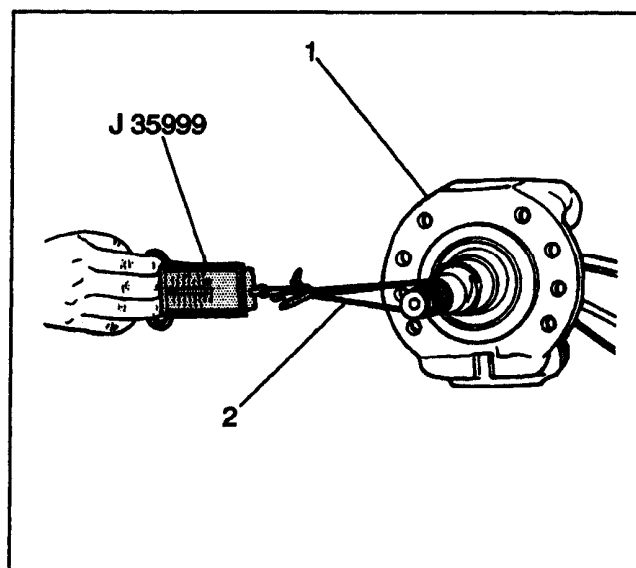
Tools Required

- J 35999 Tension Scale
- J 39758 King Pin Holding Tool

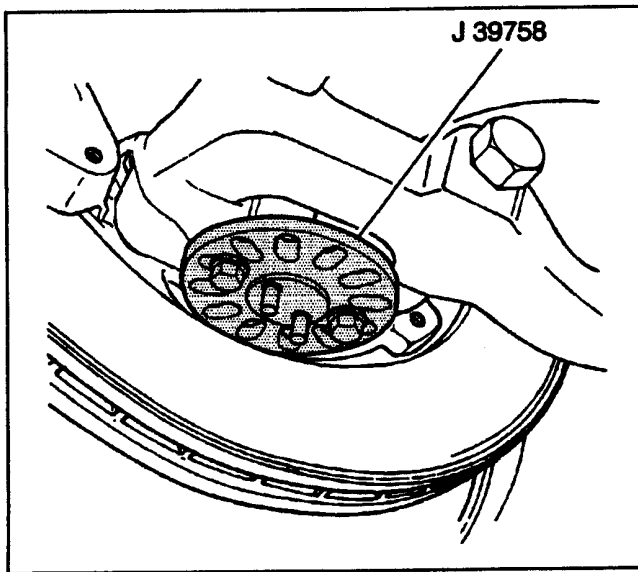
1. Check the king pin bearing or steering knuckle preload torque. Use the J 35999 and a piece of string.
2. Place the string (2) on the steering knuckle (1) at the point where the threads meet the spindle.
3. Pull the knuckle from lock position to lock position. Note the scale reading, ignoring the force needed to start the rotation.

Reading

The correct reading on the J 35999 should be 10–50 N·m (8–37 lb ft). If the reading is outside of these limits, change the shim thickness.

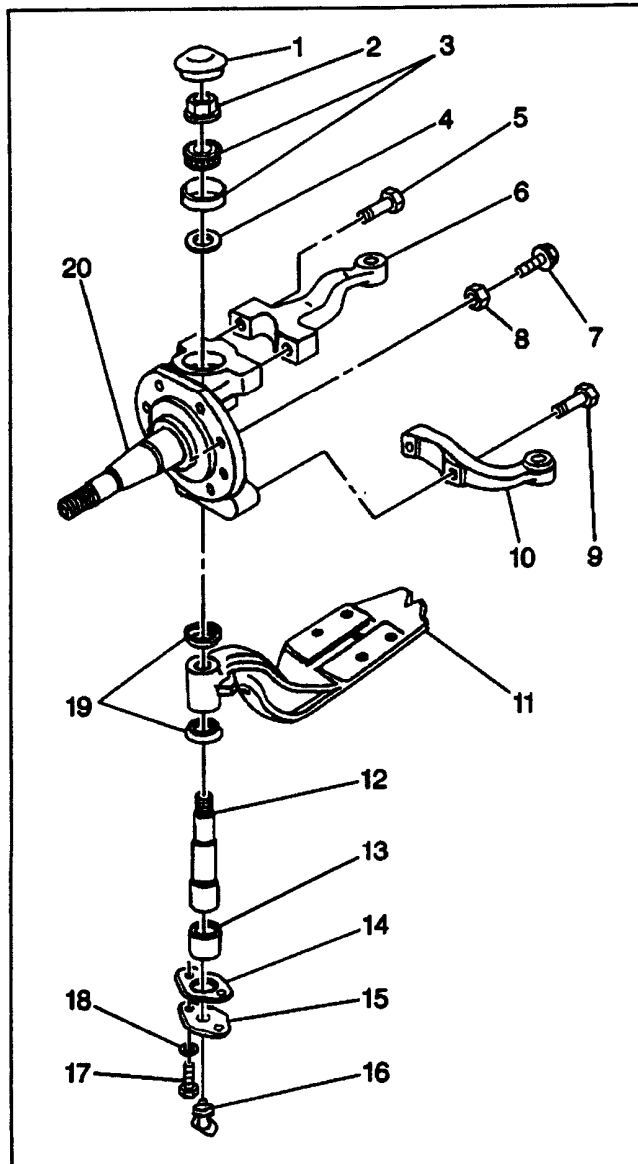


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4. In order to change the shim, you must first remove the king pin nut. Use the *J 39758* and refer to *Steering Knuckle and King Pin Replacement*.



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5. Change the thickness of the shim (4).
- In order to increase the torque, reduce the shim thickness.
 - In order to decrease the torque, increase the shim thickness.

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

6. Check the king pin nut (2) for correct torque specification.

Tighten

Tighten the king pin nut (2) to 550 N·m (406 lb ft).

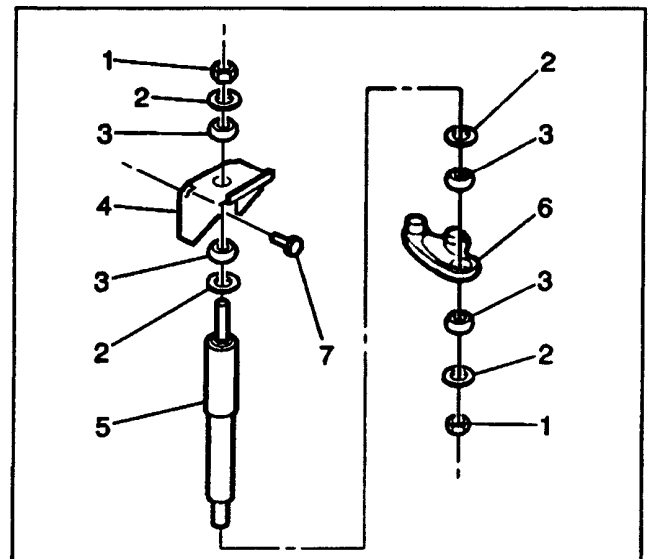
Front Axle Replacement

Removal Procedure

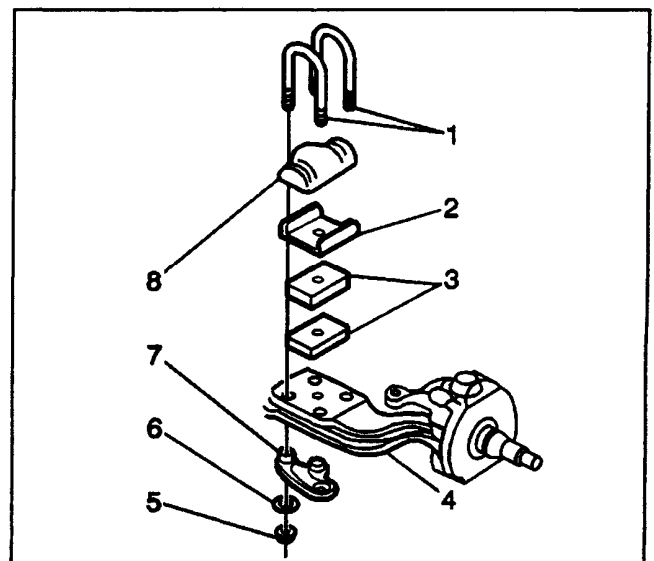
1. Set the parking brakes
2. Block the vehicle rear wheels.
3. Raise the vehicle frame until the front tires clear the floor.

Notice: Refer to *Crossmember Support Notice* in Cautions and Notices.

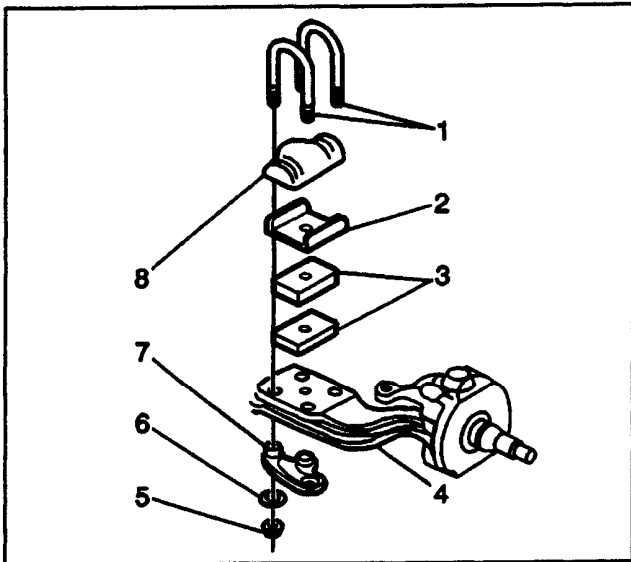
4. Support the frame using suitable safety stands.
5. Remove the wheels, the hubs, and the bearings as needed
6. Refer to the appropriate procedure:
 - *Wheel Hub, Bearing, and Seal Replacement (Drum Brakes)*
 - *Wheel Hub, Bearing, and Seal Replacement (Disc Brakes)*
7. Remove the relay rod from the steering arm. Refer to *Relay Rod Replacement* in Steering Linkage.
8. Remove the tie rod arm. Refer to *Tie Rod Arm Replacement* in Steering Linkage.
9. Remove the brake lines and the hoses as needed from each front brake assembly.
10. Remove the following components from the lower brackets (6). Push the shock absorbers into the fully retracted position:
 - The nuts (1)
 - The washers (2)
 - The insulators (3)
 - The shock absorbers (5)
11. Remove the lower insulator (13) and the washers (6) from the shock absorber lower stem.
12. Remove the nuts (7), the washers (6) and the U-bolts (1).
13. Lower the axle partially and remove the U-bolt spacers.
14. Remove the following components:
 - The spring spacers (2).
 - The spacers (3).
 - The shock absorber brackets (5).
15. Remove the axle tie rod from under the vehicle.
16. Clean the axle components using a cleaning solvent.



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17. Inspect the axle for wear and damage. Use Magna-Flux™ inspection equipment if available. Inspect the axle for the following conditions:
 - Minute cracks
 - Checks
 - Fractures
18. Using alignment instruments, inspect the axle center for twist. If the axle center has been twisted or bent more than 5 degrees (13 mm or 1/2 in) from the original shape, replace the axle.
19. Inspect the axle king pin bore for the following conditions:
 - Scratches
 - Burrs
 - Corrosion
20. Smooth the bore using a crocus cloth or a fine grit sandpaper if needed. Clean the bore.

Installation Procedure

1. With the vehicle on a floor jack, install the axle tie rod.
2. Raise the axle and align the spring center bolt to the axle.
3. Install the following components:
 - The spring spacers (2)
 - The spacers (3)

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

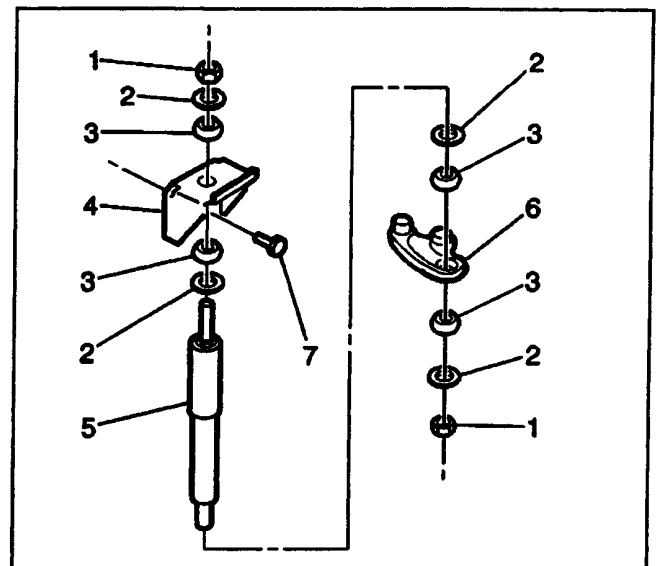
Important: Assemble all of the components and remove all of the jacks and lifting devices before you finally tighten the suspension fasteners.

4. Install the following components:
 - The U-bolts (1)
 - The U-bolt spacers.
 - The shock brackets (6).
 - The washers (6).
 - The nuts (7).

Tighten

Tighten the U-bolt nuts to 400 N·m (295 lb ft).

5. Install the flat washer (2) and the insulator (3) onto the shock absorber lower stem (5).
 6. Install the shock absorber (5) into the lower bracket (6).
 7. Install the following components:
 - The lower insulator (3)
 - The flat washer (2)
 - The nut (1)
- Tighten**
- Tighten the lower shock absorber nut (10) to 84 N·m (62 lb ft)
8. Install the wheels, the hubs, and the bearings as needed.
 9. Refer to the appropriate procedure:
 - *Wheel Hub, Bearing, and Seal Replacement (Drum Brakes)*
 - *Wheel Hub, Bearing, and Seal Replacement (Disc Brakes)*
 10. Install the relay rod to the steering arm.
 11. Install the tie rod arm and the steering arm as needed.
 12. Remove the safety stands.
 13. Lower the vehicle.



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Description and Operation

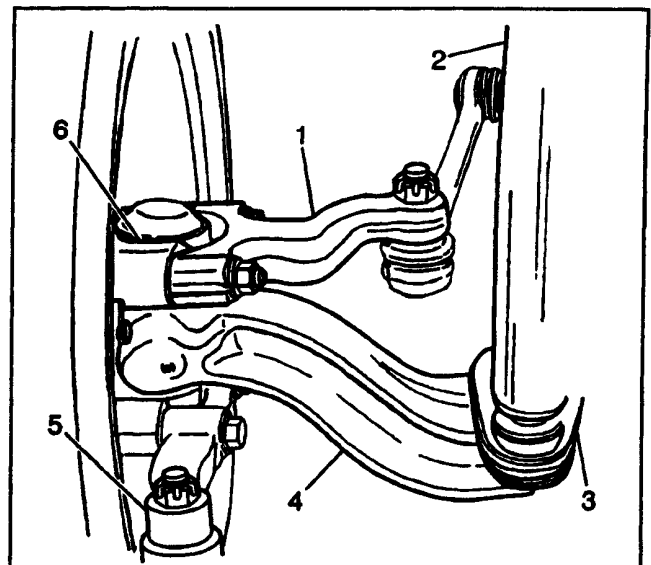
General Description

Front Axle

The front axle (4) is a one-piece, steel-forged I-beam section. The outer ends of the axle center are machined in order to accommodate the steering king pins and the knuckles (6). King pin inclination is built into the knuckle end. The front axle is available in the following four weights:

- 3 675 kg (8,100 lbs)
- 5 000 kg (11,000 lbs)
- 5 450 kg (12,000 lbs)
- 6 610 kg (14,600 lbs)

The steering arm (1) and the tie rod arms (5) attach to the knuckle (6) with bolts.



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The stepped king pin is located in the following locations:

- In a steel-backed bronze bushing at the lower end
- In a high-angle tapered roller bearing at the upper end

The lower bushings are greased through fittings in the lower covers; excess grease is purged through skirt-type seals. The upper bearing is packed with grease during assembly.

The upper bearing is pre-loaded against a thrust washer by placing a shim or a spacer between the inner race and the axle beam king pin boss, then by tightening the pivot pin prevailing torque locknut to a specified torque.

The upper bearing cover is press fit into the knuckle. The lower cover is a gasket and a flat plate retained with bolts.

Front Suspension

The springs are tapered leaf type with an eye-and-compression shackle. All springs and shackles are rubber bushed.

The spring assembly rests on the shock mounting bracket, and both are attached to the front axle with U-bolts. A rubber bumper is attached to the frame. This bumper hangs suspended above the spring center.

The stabilizer assembly consists of the following components:

- A shaft
- Two shaft mounting brackets
- Shims

The springs have six studs that mount the stabilizer shaft to the springs. The studs are a part of the springs.

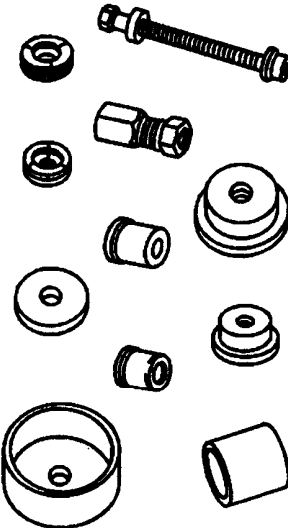
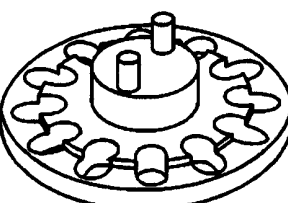
Twin-tube shock absorbers provide damping. The shock absorbers are mounted vertically behind the front axle. The top and bottom attachments are pin type with rubber insulators. The shock absorber upper mounting is a stamping that is attached to the frame. The lower attachment is a forging between the axle spring seat and the spring.

Front Hubs and Bearings

The front wheel bearings consist of two tapered roller bearings. These bearings are closed at the outer end by a cap and a gasket. The bearings are closed at the inner end by a seal. Lubricate these bearings using either grease or oil.

Brake drum and rotor mounting bolts, studs, and nuts vary in form and type, depending on the vehicle series and equipment.

Special Tools and Equipment

Illustration	Tool Number/ Description
 206815	J 37420 Steering Knuckle Service Set
 157140	J 35999 Tension Scale
 206824	J 39758 King Pin Holding Tool

Rear Suspension

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
Bumper Nut	40 N.m	30 lb ft
Rear Spring Hanger Rebound Bolt, Taperleaf Spring	415 N.m	305 lb ft
Shock Absorber (Lower) Nut	61 N.m	45 lb ft
Spring Center Bolt Nut	81 N.m	60 lb ft
Spring Eye Bolt (Front) Nut	415 N.m	305 lb ft
Spring Hanger Nut	70 N.m	52 lb ft
Stabilizer Bracket Nut	70 N.m	52 lb ft
Stabilizer Clamp Nut	220 N.m	162 lb ft
Stabilizer Link Nut	240 N.m	177 lb ft
Stabilizer Shaft Nut	240 N.m	177 lb ft
20 mm (0.787 in) U-Bolt Anchor Plate Nut Final Torque	388 N.m	287 lb ft
22 mm (0.866 in) U-Bolt Anchor Plate Nut Final Torque	437 N.m	344 lb ft

Diagnostic Information and Procedures

Spring Maintenance

Lubrication

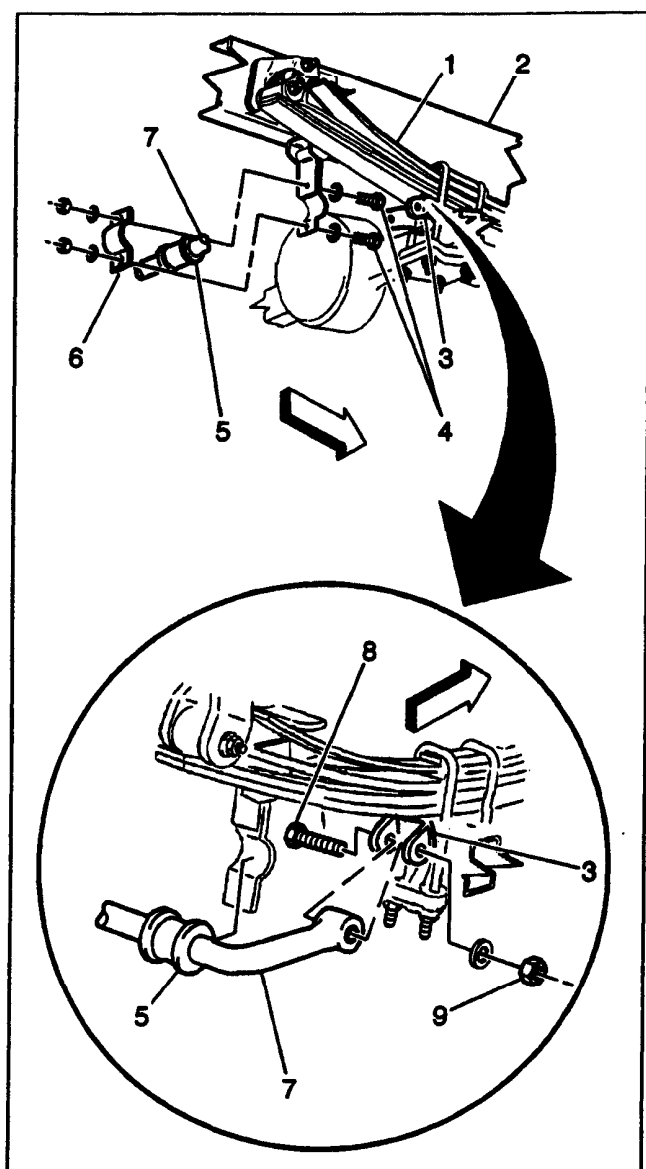
Spring leaves are lubricated at the time of manufacturing and require no further lubrication unless the spring is disassembled. Radius leaf bushings that are rubber mounted do not require lubrication.

Tightening

Keep the U-bolts tight at all times in order to hold the axle in place at the spring. If the U-bolts are not tight, the axle may shift, causing misalignment and spring leaf malfunction at the spring center bolt. Refer to Fasteners in General Information for tightening intervals.

Center Bolt

The spring center bolt holds the spring together while in shipment and during installation. The center bolt is also a locating point when assembling the spring to the axle. After assembly, the U-bolts hold the spring and the axle in alignment.



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Repair Instructions

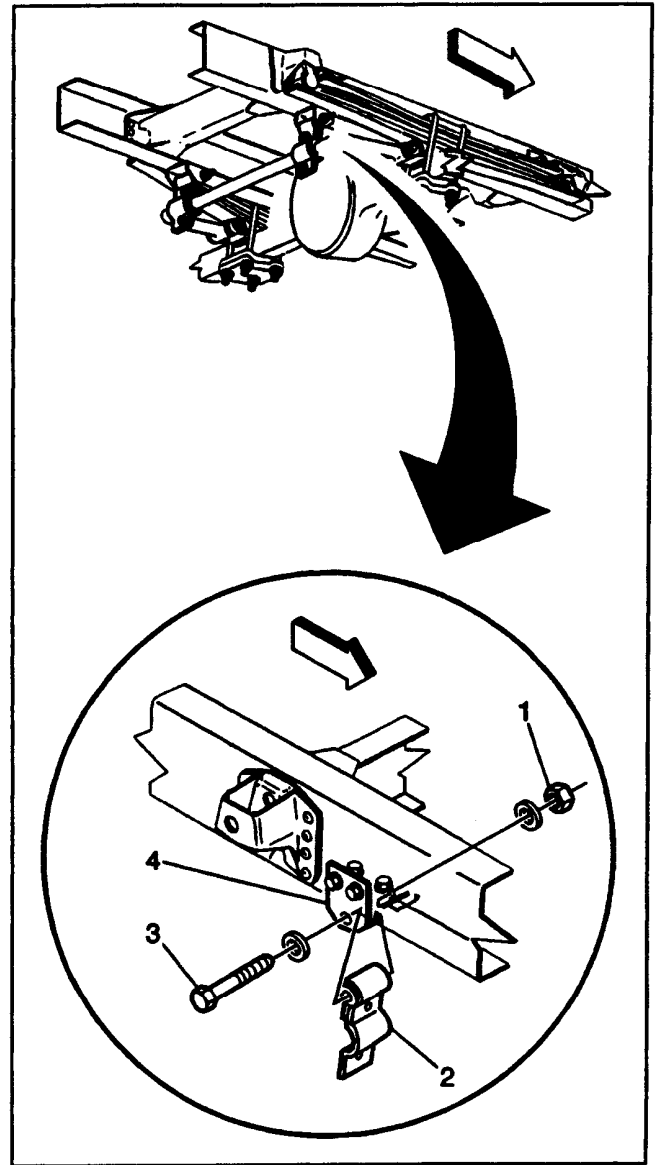
Stabilizer Shaft Replacement

Removal Procedure

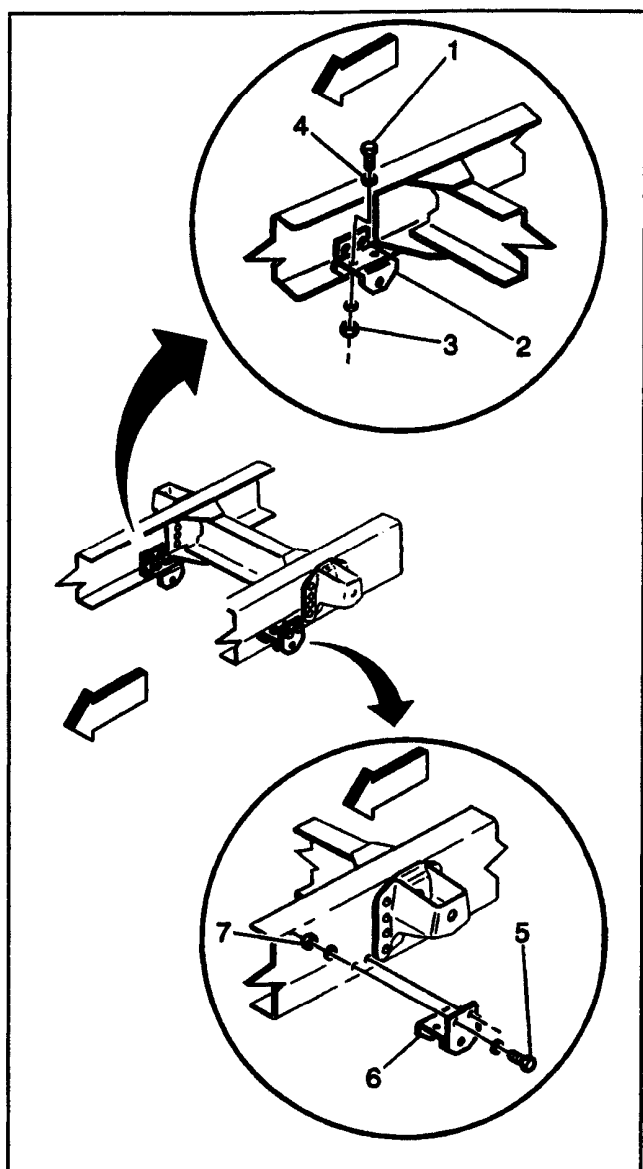
1. Set the parking brake.
2. Block the front wheels.
3. Remove the following stabilizer clamp components from the stabilizer links:
 - The bolt nuts
 - The washers
 - The bolts (4)
 - The clamps (6)
4. Remove the following stabilizer shaft (7) components from the stabilizer bracket/spring seats (3):
 - The bolt nut (9)
 - The washers
 - The bolts (8)
5. Remove the stabilizer shaft (7) from the stabilizer bracket spring/seats (3).
6. Inspect the stabilizer insulators (5) for wear and damage. Replace the stabilizer insulators if wear or damage is evident.
7. Remove the stabilizer insulator from the stabilizer shaft.

Important: If the stabilizer brackets require replacement, perform the next two steps.

8. Remove the following components from the stabilizer bracket (4) and the stabilizer link (2):
- The stabilizer link nuts (1)
 - The washers
 - The bolts (3)



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9. Remove the following components from the side member:

- The stabilizer bracket nuts (3,7)
- The washers (4)
- The bolts (1,5)
- The stabilizer bracket (2,6)

Installation Procedure

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

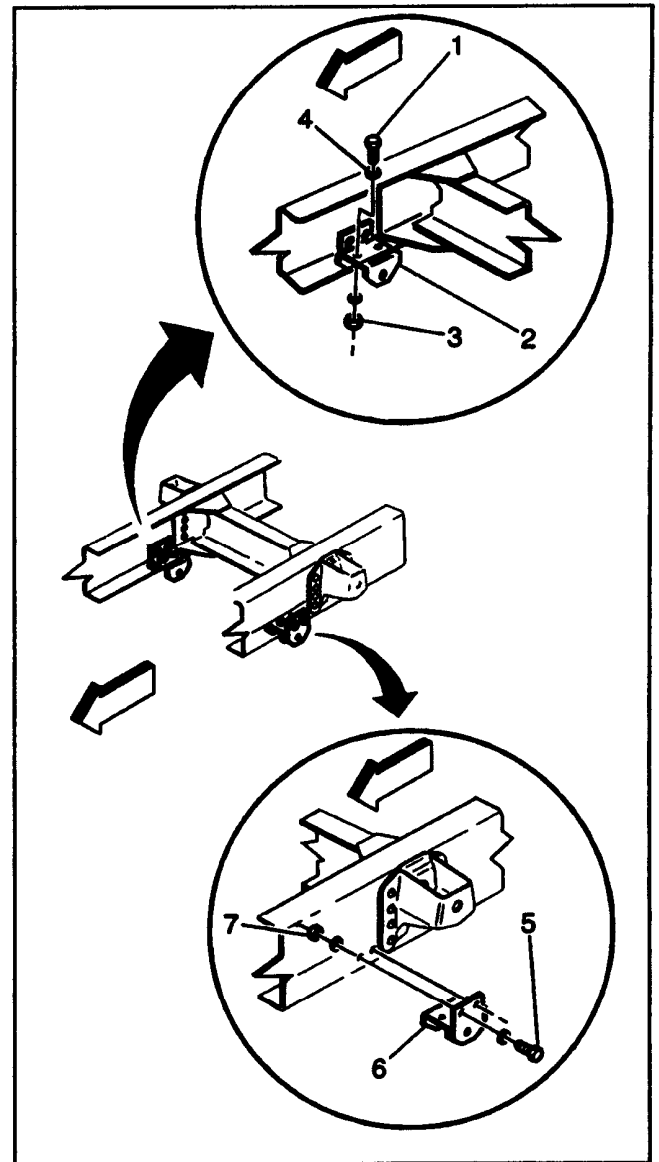
Important: If the stabilizer brackets require replacement, perform the first two steps.

1. Install the following components to the side member:

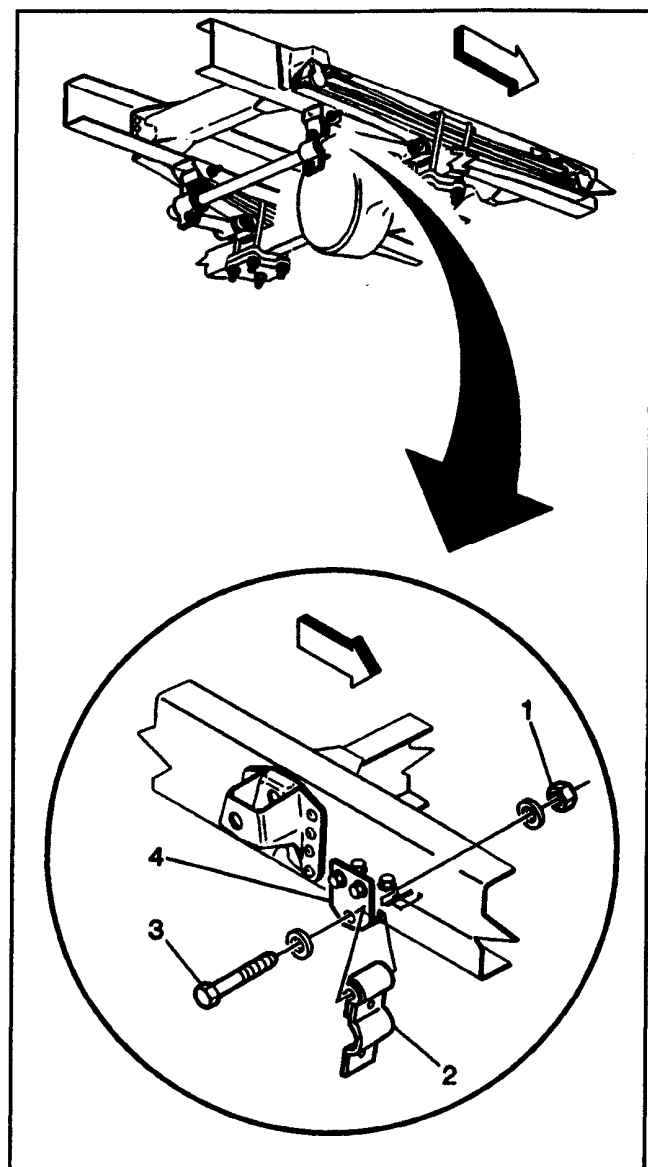
- The stabilizer bracket (2,6)
- The bolts (1,5)
- The washers (4)
- The stabilizer bracket nuts (3,7)

Tighten

Tighten the stabilizer bracket nut to 70 N·m (52 lb ft).



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2. Install the following components:

- The stabilizer link (2) to the stabilizer bracket (4)
- The stabilizer link bolts (3)
- The washers
- The nuts (1)

Tighten

Tighten the stabilizer link nut to 240 N.m (177 lb ft).

3. Install the stabilizer insulator on the stabilizer shaft.

4. Install the stabilizer shaft (7) to the stabilizer bracket/spring seats (3).
5. Install the following components on the stabilizer shaft and the stabilizer bracket/spring seats:

- The stabilizer shaft bolts (8)
- The washers
- The nuts (9)

Tighten

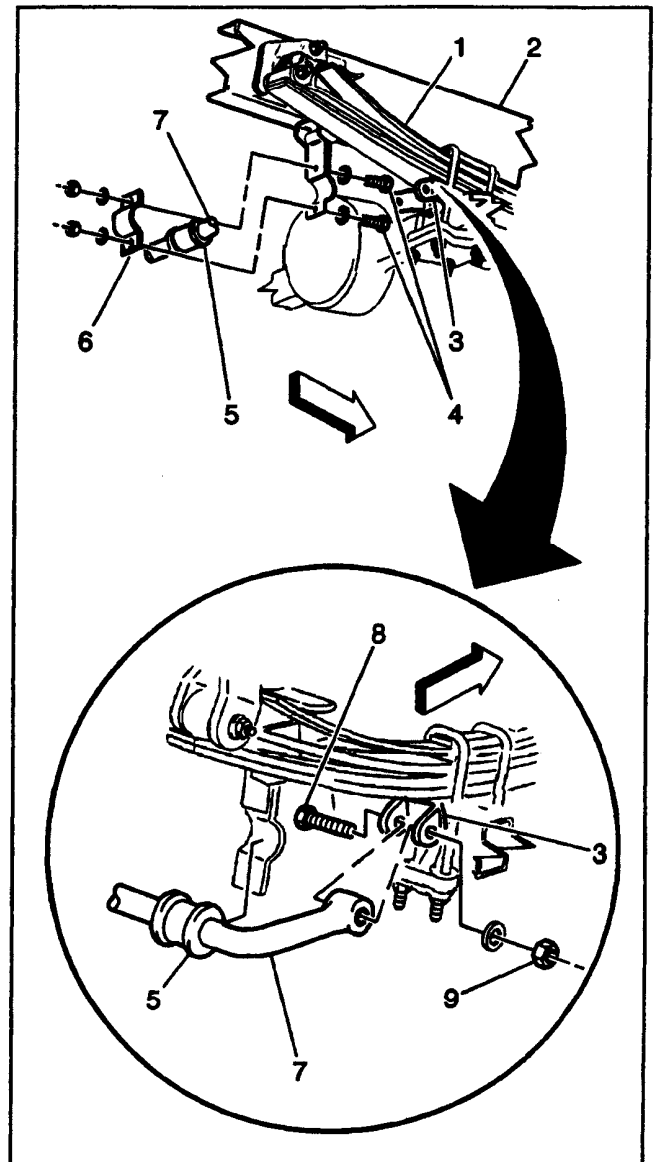
Tighten the stabilizer shaft nut to 240 N.m (177 lb ft).

6. Install the following components on the stabilizer links:

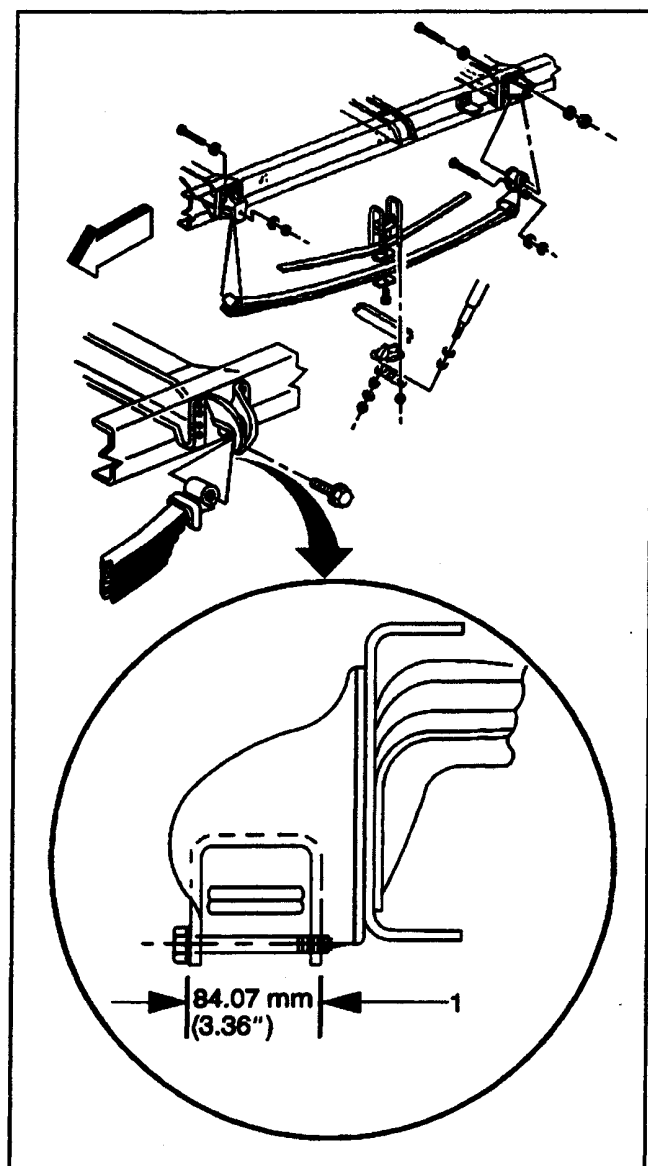
- The stabilizer clamps (6)
- The bolts (4)
- The washers
- The nuts

Tighten

Tighten the stabilizer clamp nut to 220 N.m (162 lb ft).



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202137

Shock Absorber Replacement

Removal Procedure

Important: If a shock absorber is faulty, replace the complete unit. Refer to *Struts or Shock Absorbers Bench Test* and *Struts or Shock Absorbers On-Vehicle Testing*.

1. Set the parking brake.
2. Block the front and rear wheels.
3. Remove the upper nut and bolt.
4. Remove the shock absorber from the crossmember.
5. Remove the nut and the washer.
6. Remove the shock absorber from the lower mounting bracket.

Installation Procedure

1. Install the shock absorber to the lower mounting bracket.

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

2. Install the washer and the nut.

Tighten

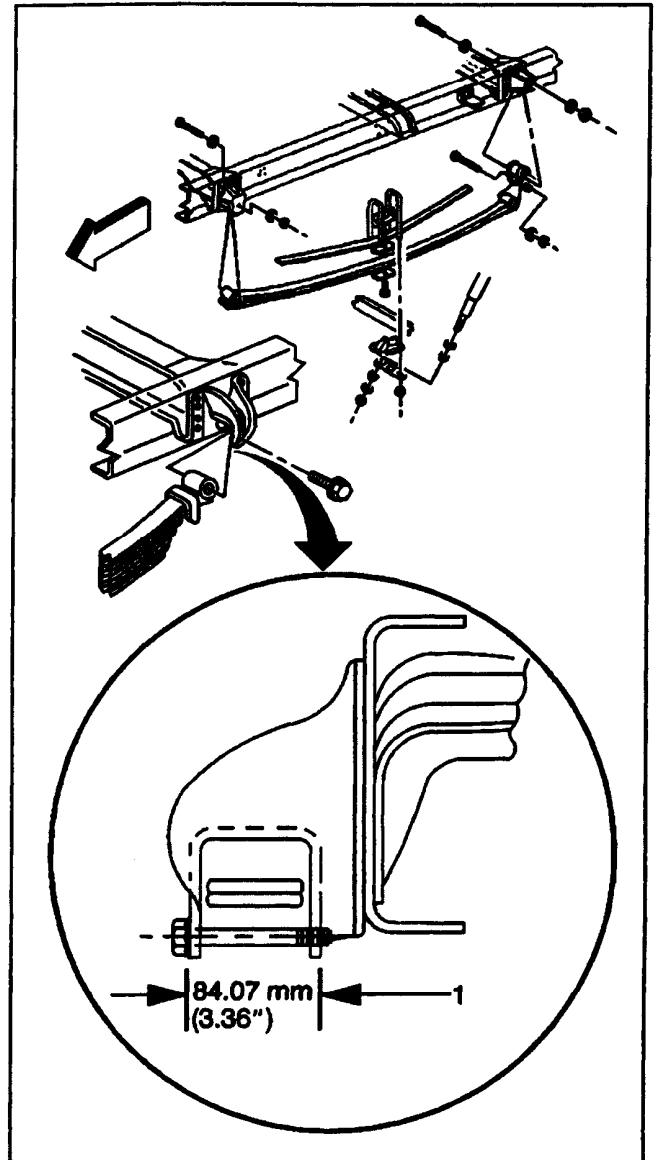
Tighten the lower shock absorber nut to 61 N·m (45 lb ft).

3. Install the shock absorber to the crossmember.

4. Install the upper bolt and nut.

Tighten

Tighten the upper shock absorber nut to 160 N·m (120 lb ft).



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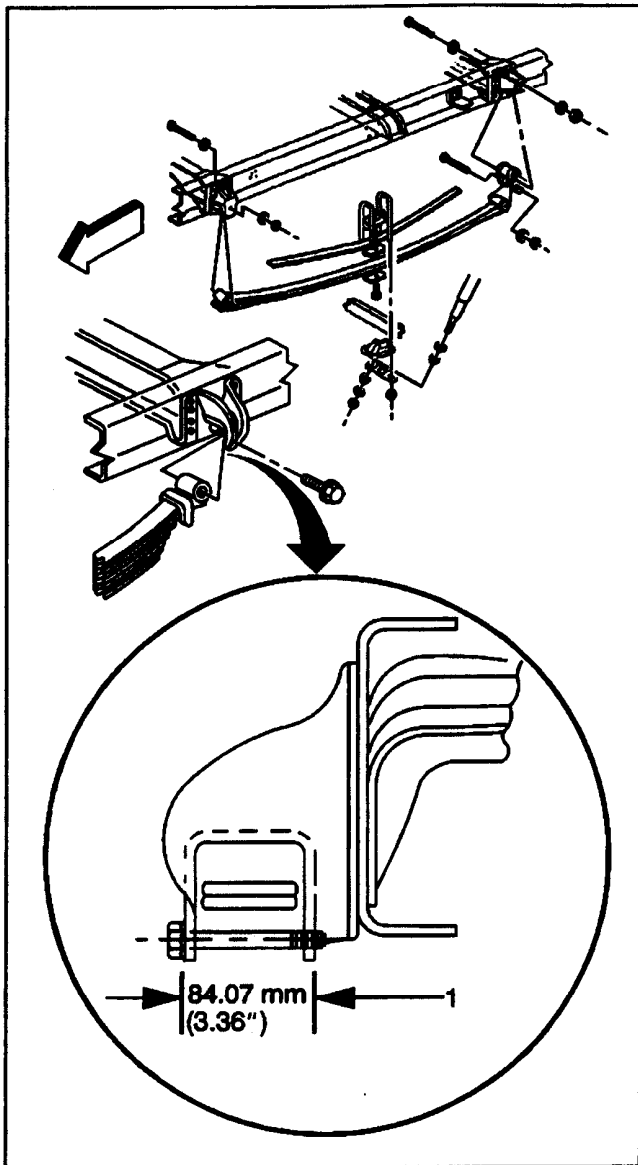
Spring Bushing Replacement

Removal Procedure

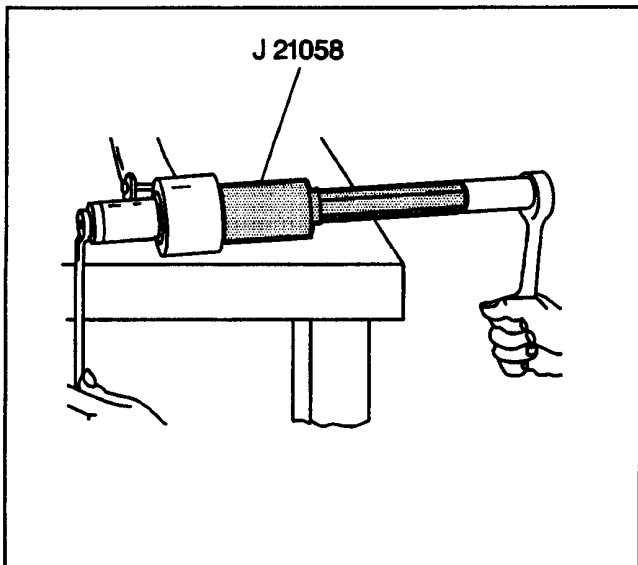
Tools Required

J 21058 Bushing Remover and Installer

1. Set the parking brake.
2. Block the front wheels.
3. Raise the vehicle frame using a suitable lifting device in order to remove the weight of the vehicle from the spring assembly.
4. Place jack stands under the rear axle in order to support the frame rearward of the of the rear axle.
5. Remove the rear wheel assembly, if necessary. Refer to *Wheel Removal (Front)* in Tires and Wheels.



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6. For taperleaf springs, remove the following components:
 - The rear spring hanger rebound nut
 - The washer
 - The bolt
7. For multileaf springs, remove the rear spring hanger bolt.
8. Remove the following components:
 - The lower shock absorber nut
 - The washer
 - The insulator
 - The shock
 - The washer (if equipped)
9. Remove the U-bolt nuts and the washers.
10. Remove the following components:
 - The U-bolt anchor plate
 - The seat
 - The shock absorber bracket (if equipped).
11. Remove the U-bolts.
12. Lower the axle slightly in order to gain access to the spring front eye bolt.
13. Remove the following components:
 - The front eye bolt nut
 - The washer
 - The eye bolt
14. Raise the frame in order to provide clearance between the spring assembly and hanger bracket.
15. Remove the bushing using the *J 21058*.

Installation Procedure

Tools Required

J 21058 Bushing Remover and Installer

1. Install the eye bushing using the *J 21058*.
2. Lower the frame slightly in order to install the spring front eye bolt.

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

3. Install the following components:

- The spring front eye bolt

Tighten

Tighten the spring front eye bolt to 415 N·m (305 lb ft).

- The washer
- The nut

4. Lower the frame until the hanger touches the surface of the rear spring eye.

5. For taperleaf springs, install the following components:

- The rear spring hanger rebound bolt
- The washer
- The nut

Tighten

Tighten the rear hanger rebound bolt to 415 N·m (305 lb ft).

6. Install the U-bolt spacer over the center bolt.
7. Install the U-bolts into the spacer grooves.
8. Install the U-bolt anchor plate and the seat.
9. Install the shock absorber bracket (if equipped).

Important: In order to properly tighten the U-bolts, tighten the bolts in the specified sequence.

10. Install the U-bolt nuts and washers according to the next two steps.

11. For 20 mm (0.78 in) U-bolts:

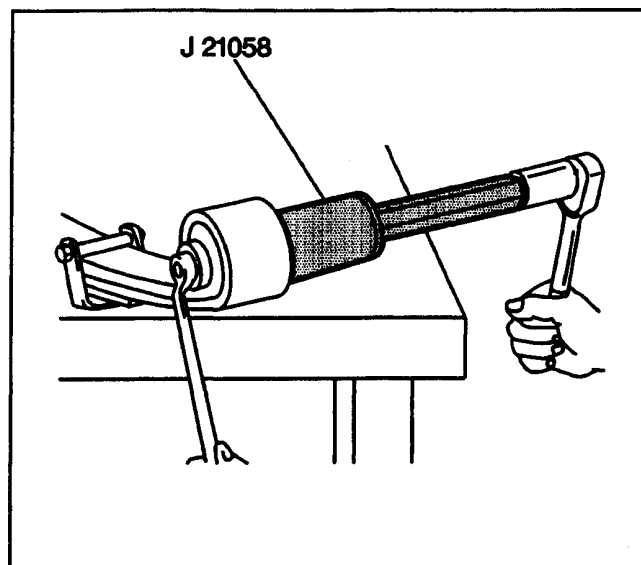
Tighten

- 11.1. Tighten U-bolt nuts to 100 N·m (74 lb ft) in sequence.
- 11.2. Tighten U-bolt nuts to 250 N·m (184 lb ft) in sequence.
- 11.3. Tighten U-bolt nuts to 375–400 N·m (276–295 lb ft) in sequence.

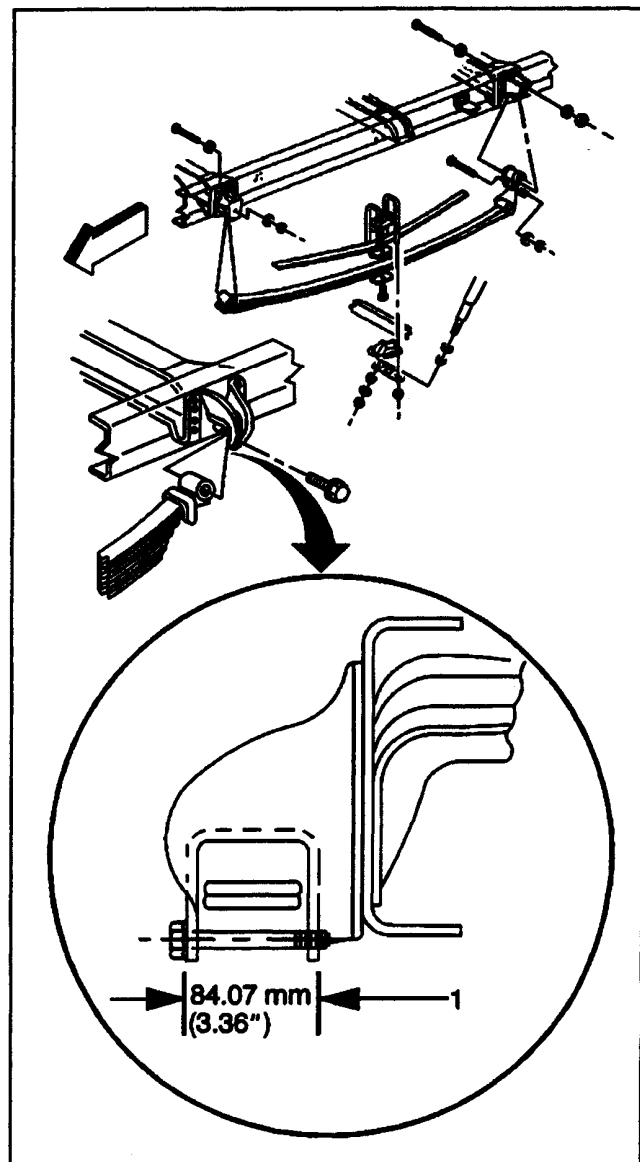
12. For 22 mm (0.875 in) U-bolts:

Tighten

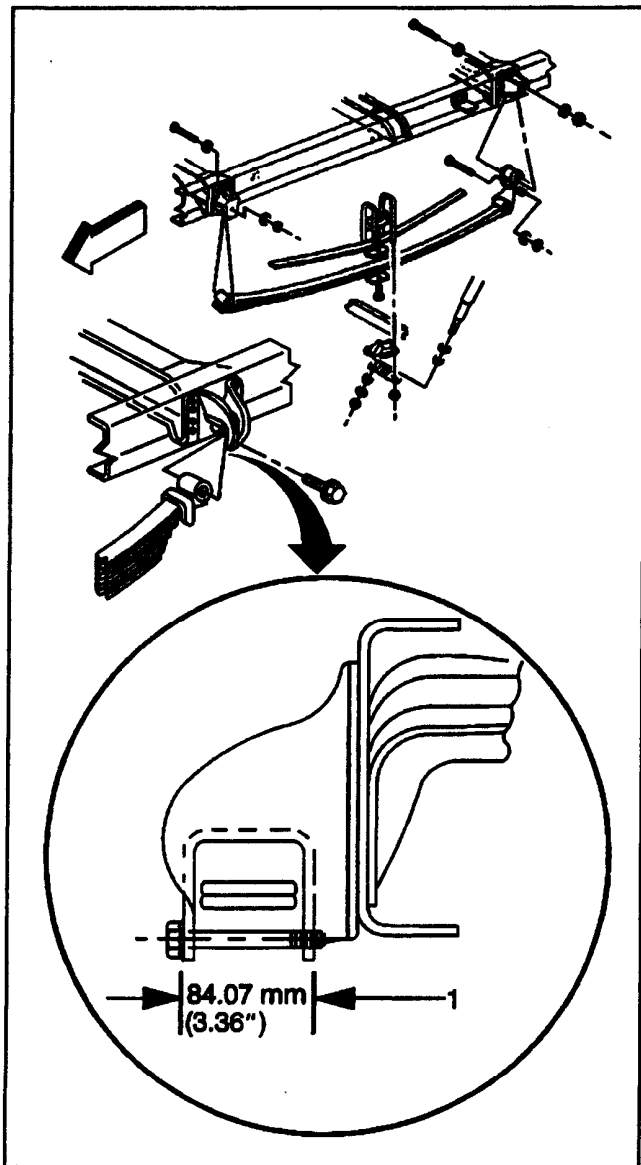
- 12.1. Tighten U-bolt nuts to 150 N·m (111 lb ft) in sequence.
- 12.2. Tighten U-bolt nuts to 275 N·m (203 lb ft) in sequence.
- 12.3. Tighten U-bolt nuts to 425–450 N·m (313–332 lb ft) in sequence.



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13. For multileaf springs, install the rear spring hanger bolt.

Tighten

Tighten the rear spring hanger bolt. Ensure that a minimum of 84.07 mm (3.36 in) is between the ears of the rear spring hanger.

14. Raise the vehicle.
15. Remove the jack stands.
16. Lower the vehicle.
17. Remove the blocks from the front wheels.

Leaf Spring Replacement

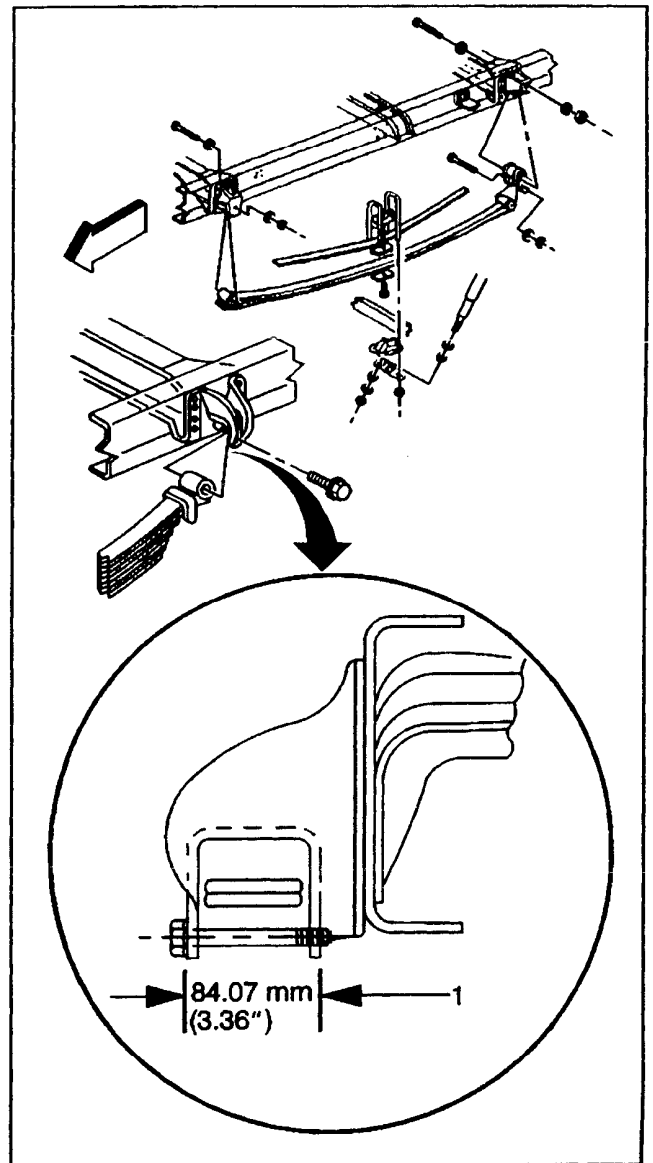
Removal Procedure

1. Set the parking brake.
2. Block the front wheels.
3. Raise and support the vehicle using a suitable lifting device in order to remove the weight from the spring assembly.
4. Place the jack stands under the rear axle in order to support the axle weight.
5. Remove the rear wheel assembly, if necessary. Refer to *Wheel Removal (Dual/Rear)* in Tires and Wheels.
6. Remove the following rear spring hanger components:
 - The rebound nut
 - The washer
 - The bolt
7. Remove the following components:
 - The shock absorber nut
 - The washer
 - The insulator
 - The shock
 - The washer (if equipped)
8. Remove the U-bolt nuts and the washers.
9. Remove the following components:
 - The U-bolt anchor plate
 - The seat
 - The shock absorber bracket (if equipped)
10. Remove the U-bolts.
11. Lower the axle slightly.
12. Remove the following components:
 - The eye bolt nut
 - The washer
 - The eye bolt

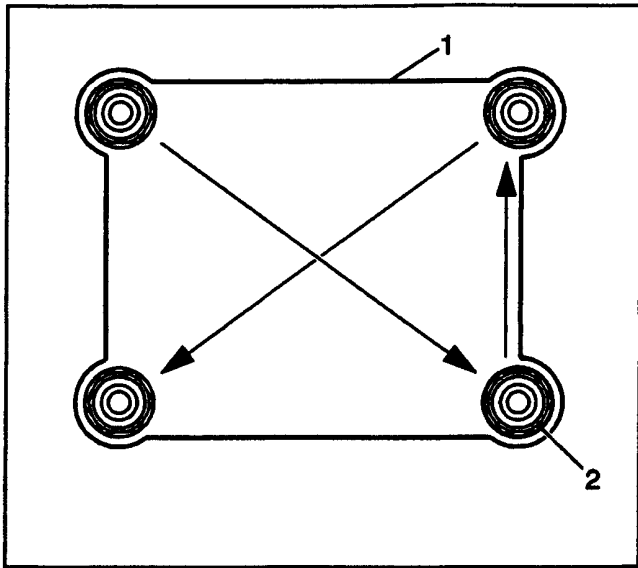
13. Raise and support the frame using a suitable lifting device in order to provide clearance between the spring assembly and the hanger bracket.
14. Remove the spring assembly using a suitable hoist.
15. Remove the following components:
 - The auxiliary spring
 - The bolt
 - The spacers
 - The U-bolt spacers (if equipped)

Installation Procedure

1. Install the following components:
 - The auxiliary spring
 - The U-bolt spacers
 - The spacers
 - The bolt (if removed)
2. Install the spring assembly onto the axle pad or the axle stabilizer/spring seat (if equipped), using a suitable hoist.
3. Install the U-bolt spacer over the center bolt.
4. Install the U-bolts into the spacer grooves.



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5. Install the U-bolt anchor plate (1) and the seat.
6. Install the shock absorber bracket or the stabilizer shaft/spring seat, if equipped.

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

Important: In order to properly tighten the U-bolt nuts, torque them progressively as described in the next two steps.

7. For a 20 mm (0.787 in) U-bolt, install the U-bolt nuts (2) and the washers.

Tighten

- 7.1. Tighten the U-bolt nut to 100 N.m (74 lb ft) in sequence.
- 7.2. Tighten the U-bolt nut to 250 N.m (184 lb ft) in sequence.
- 7.3. Tighten the U-bolt nut to 375–400 N.m (276–295 lb ft) in sequence.

8. For a 22 mm (0.866 in) U-bolt, install the U-bolt nuts (2) and the washers.

Tighten

- 8.1. Tighten the U-bolt nut to 150 N.m (111 lb ft) in sequence.
- 8.2. Tighten the U-bolt nut to 275 N.m (203 lb ft) in sequence.
- 8.3. Tighten the U-bolt nut to 425–450 N.m (313–332 lb ft) in sequence.

9. Install the following components:
 - The spring front eye nut
 - The washer
 - The spring front eye bolt

Tighten

Tighten the spring front eye bolt to 415 N·m (305 lb ft).
10. Install the following components:
 - The shock absorber washer
 - The shock
 - The insulator
 - The washer
 - The nut

Tighten

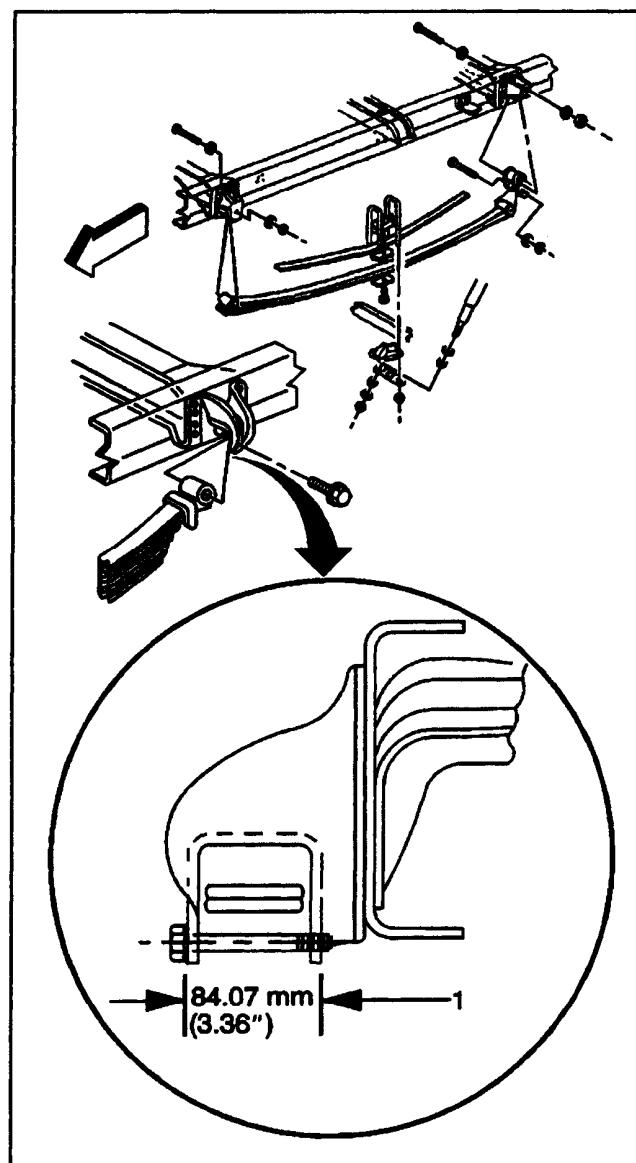
Tighten the lower shock absorber nut to 61 N·m (45 lb ft).
11. Lower the frame until the hangers touch the surface of the spring eye.
12. For tapered leaf springs, install the following components:
 - The washer
 - The nut
 - The rear spring hanger rebound bolt

Tighten

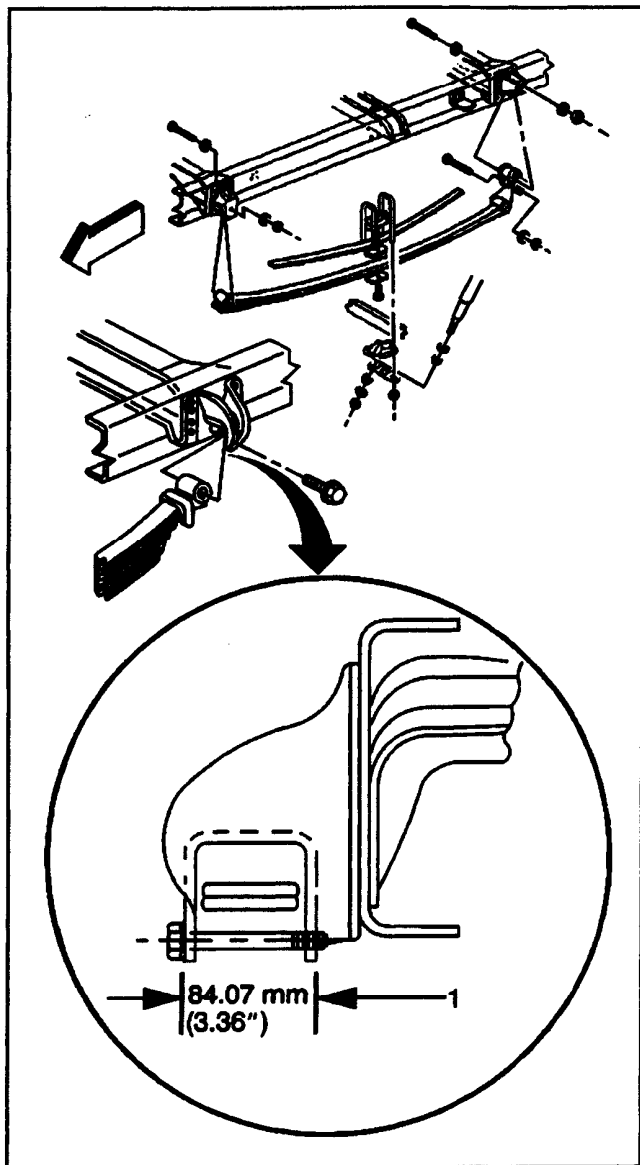
Tighten the rear spring hanger rebound bolt to 415 N·m (305 lb ft).
13. For multileaf springs, install the rear spring hanger bolt.

Tighten

Tighten the rear spring hanger bolt. Ensure that a minimum of 84.07 mm (3.36 in) is between the ears of the rear spring hanger.
14. Raise the vehicle.
15. Remove the jack stands.
16. Lower the vehicle.
17. Remove the blocks from the front wheels.



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Spring Leaf Replacement

Removal Procedure

Important: A leaf spring replacement is only possible on the multileaf spring. The leaf replacement is usually necessary on only the first or second, main leaf. If any of the secondary leaves need replacement, replace the complete spring assembly.

1. Remove the spring assembly. Refer to *Leaf Spring Replacement* in Rear Suspension.

Notice: Do not use a machinist's scribe or a screwdriver to match/mark spring leaves. Marking the spring leaves with any sharp tool can cause metal stress and could contribute to early fatigue and malfunction.

2. Mark the spring assembly alignment on one side using a grease pencil or chalk.
3. Secure the spring assembly in a vise or an arbor press.
4. Remove the rebound clip bolts and the nuts.
5. Remove the rebound clips.

Caution: *Relieve the spring tension slowly. Spring leaves are under great pressure and could fly apart causing serious injury.*

6. Remove the center bolt and the nut.
File the peened portion of the center bolt.
7. Remove the center bolt.

Open the vise or arbor press slowly in order to let the spring assembly expand.

8. Clean the spring leaves using a brush, if necessary.

Do not disturb the alignment marks.

9. Inspect the spring leaves for cracks or signs of fatigue. Replace only the first or second main leaf.

Replace the entire spring assembly if additional springs are broken.

10. Inspect the rebound clips for cracks or breaks.
11. Inspect the center bolt hole for distortion or wear.

Installation Procedure

1. Install the spring.
 - 1.1. Apply a thin film of graphite grease to each leaf.
 - 1.2. Stack the leaves in the correct order.
 - 1.3. Align the center bolt holes in the spring leaves using a long drift.
 - 1.4. Align the match marks.
 - 1.5. Mount the assembled spring in a vise or an arbor press.

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

2. Install a new center bolt and nut.

Tighten

Tighten the spring center bolt nut to 81 N.m (60 lb ft).

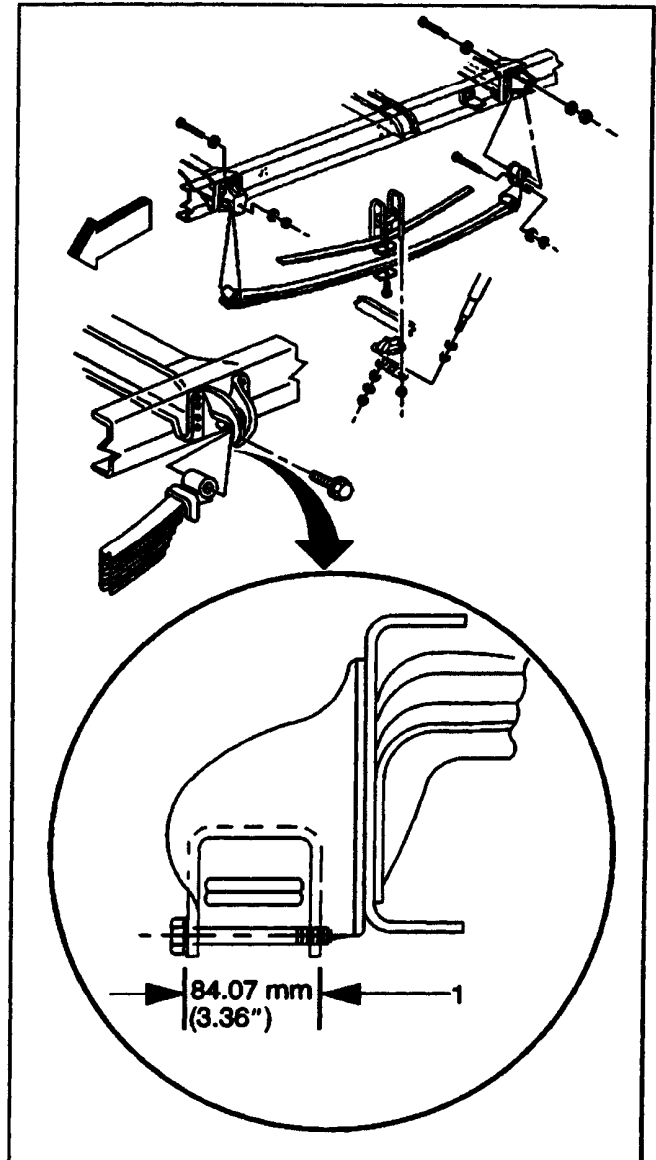
3. Peen the end of the center bolt.
4. Remove the spring assembly from the vise or the arbor press.

Important: Ensure that the rebound clips are tight enough in order to hold the spring leaves in alignment, but not tight enough to restrict the free movement of the leaves.

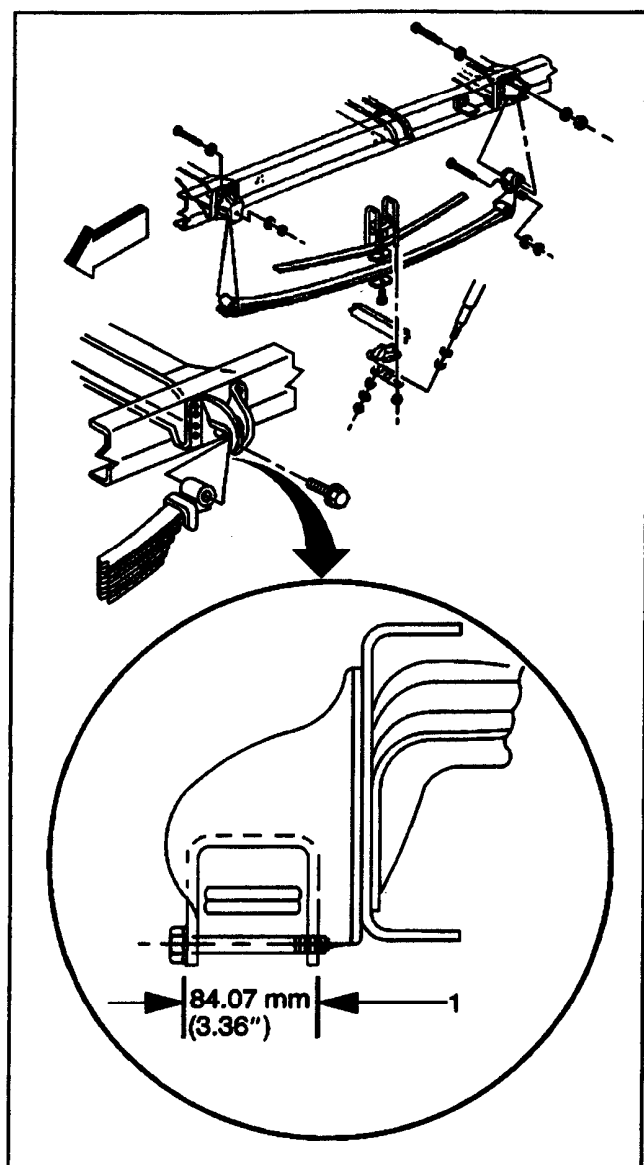
5. Install the rebound clips using new bolts and nuts.

Align the leaves using a soft faced hammer (if needed).

6. Peen the end of the bolts.
7. Install the spring assembly. Refer to *Leaf Spring Replacement* in Rear Suspension.



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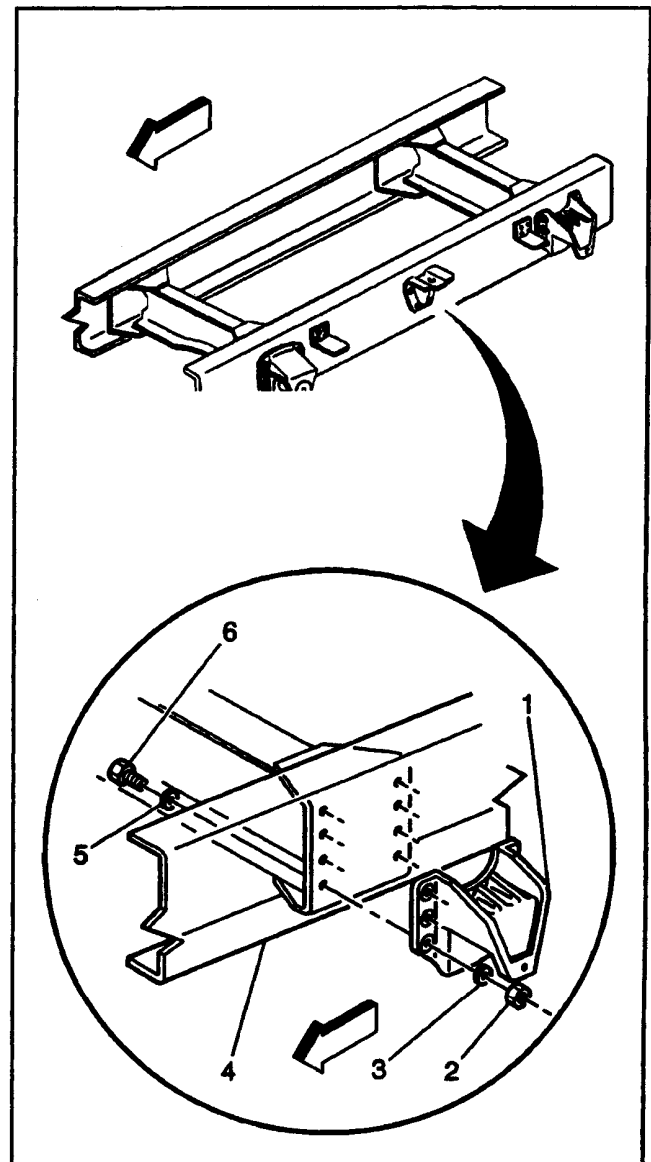
Spring Hanger Replacement

Removal Procedure

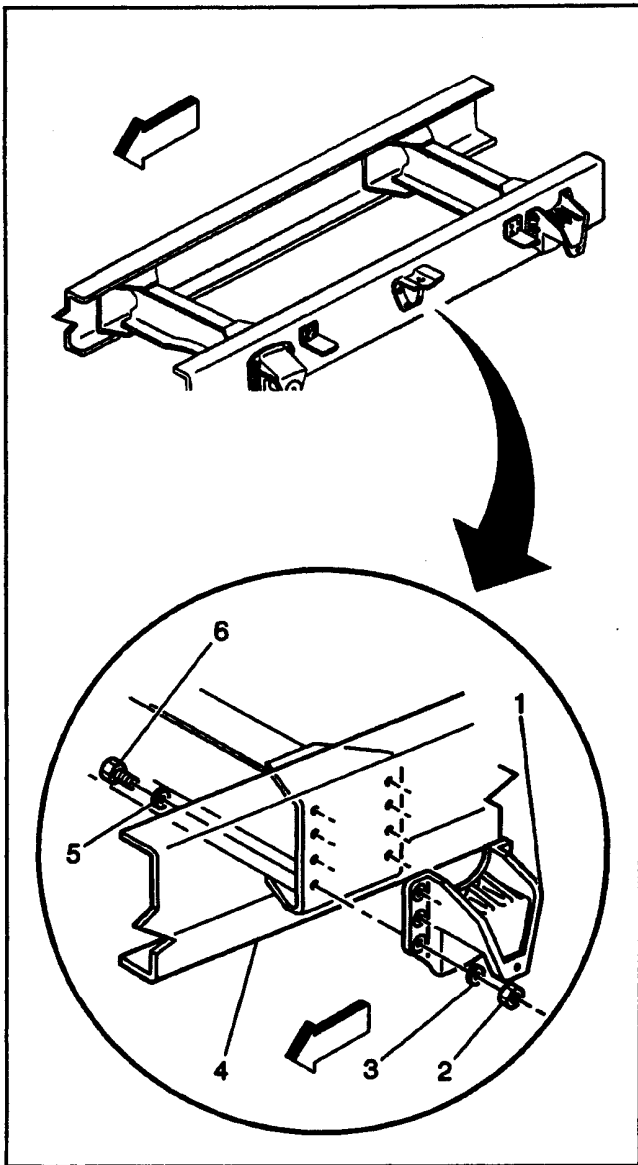
1. Set the parking brake.
2. Block the front wheels.
3. Raise the frame until the tension is released from the spring and the hanger bolt.
4. Remove the following components from the spring and the hanger:
 - The spring to hanger nut
 - The washers
 - The bolt
5. Remove the spring hanger rivets, if equipped.

6. Remove the following components from the side member (4):

- The spring hanger nuts (2)
- The washers (3,5)
- The bolts (6)
- The spring hanger (1)



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Installation Procedure

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

1. Install the spring hanger (1) to the side member (4) using the following components:

- The bolts (6)
- The washers (3,5)
- The nuts (2)

Tighten

Tighten the spring hanger nuts to 70 N.m (52 lb ft).

2. Raise the spring in order to align the spring eye and the spring hanger holes.

3. For tapered leaf springs, install the following rear spring hanger components:

- The rebound bolt
- The washer
- The nut

Tighten

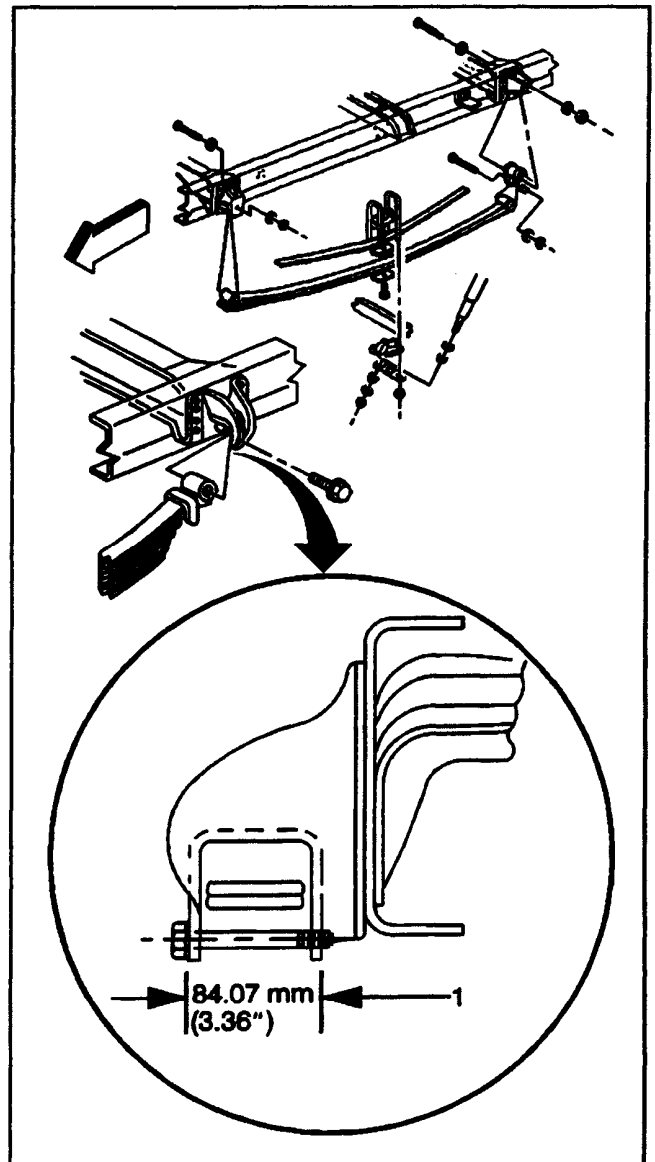
Tighten the rear spring hanger rebound bolt to 415 N·m (305 lb ft).

4. For multileaf springs, install the rear spring hanger bolt.

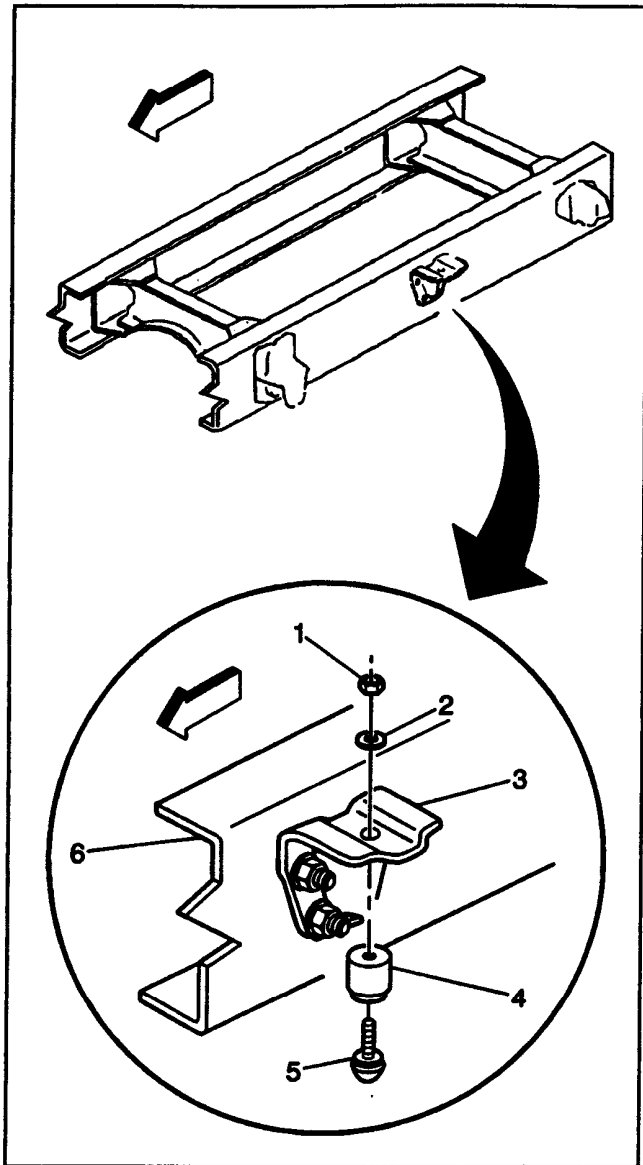
Tighten

Tighten the rear spring hanger bolt. Ensure that a minimum of 84.07 mm (3.36 in) is between the ears of the rear spring hanger.

5. Lower the vehicle.
6. Remove the blocks from the wheels.



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Spring Bumper Replacement

Removal Procedure

Remove the following components from the bumper bracket (3):

- The nut (1)
- The washer (2)
- The bumper bolt (5)
- The bumper (4)

Installation Procedure

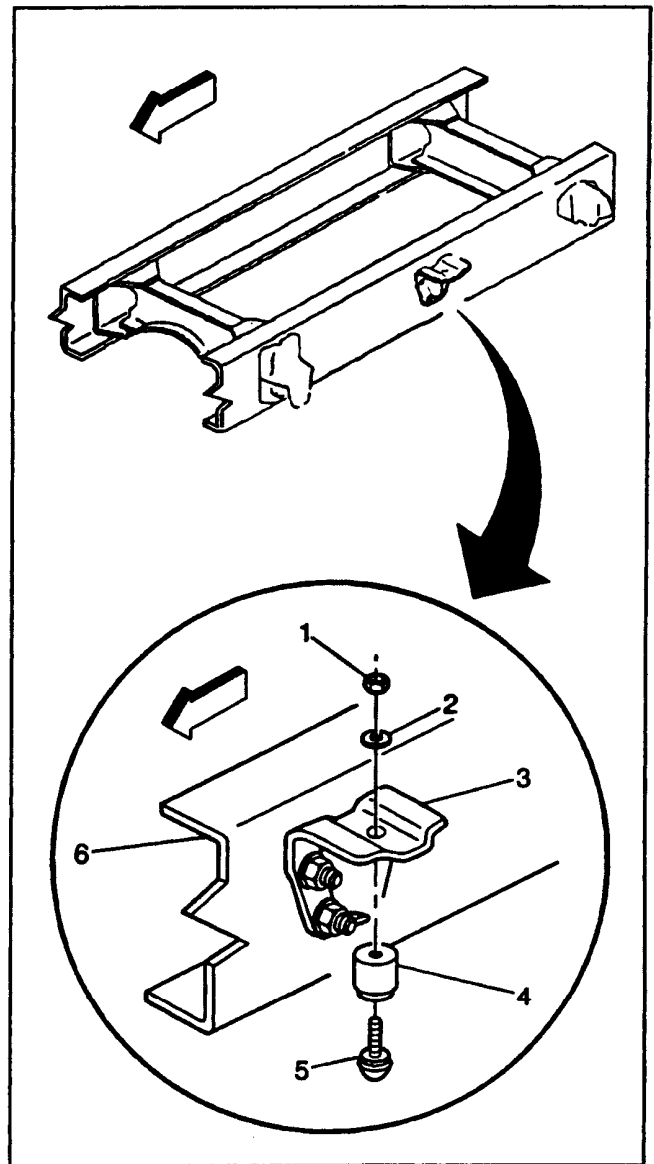
Notice: Refer to *Fastener Notice* in Cautions and Notices.

Install the following components to the bumper bracket (3):

- The bumper (4)
- The bumper bolt (5)
- The washer (2)
- The nut (1)

Tighten

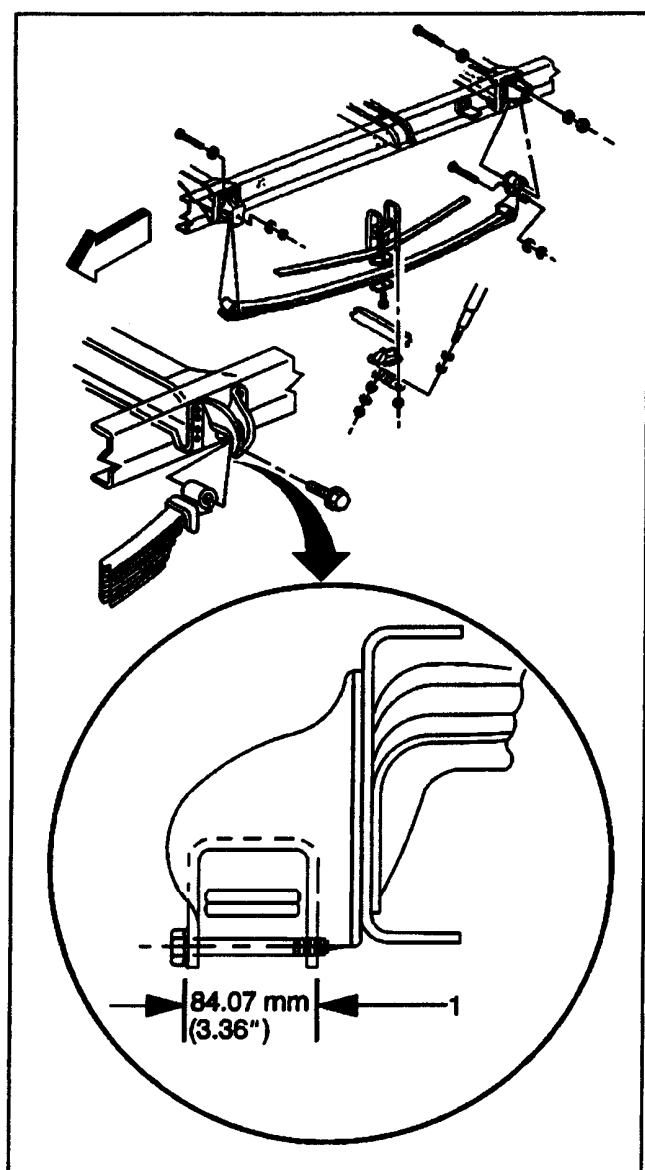
Tighten the bumper nut to 40 N.m (30 lb ft).



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Description and Operation

General Description



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Tapered leaf springs have three leaves of parabolic taper form. Tapered leaf springs use a front eye and rear compression shackle.

Multileaf springs use a front eye and rear slider. All springs are a two stage-design. All spring and shackle eyes are rubber bushed and non-lubricated.

Spring eyes are fully reamed in order to accept the rubber bushings. The auxiliary spring is a single leaf parabolic taper form and the frame brackets are shaped cams to produce a variable rate.

A polyurethane spring aid and rubber bump stop are attached to the frame. The spring aid and the rubber bump stop hang suspended above the spring center.

Dampening is provided by twin-tube shock absorbers mounted vertically behind the axle. Top and bottom attachments are pin type with rubber insulators. The upper end is attached to a frame crossmember while the lower end is attached to a bracket that mounts below the axle housing.

Shocks are required with the tapered leaf springs and optional with the multileaf springs.

The stabilizer shaft assembly consists of the following components:

- A shaft attached to the frame by two links
- The shaft ends attached to the axle by castings mounted between the spring assembly and the axle housing

Special Tools and Equipment

Illustration	Tool Number/ Description
	J 21058 Bushing Remover and Installer Set
3287	

Tires and Wheels

Specifications

Fastener Tightening Specifications

Application	Specification	
	Metric	English
8-Hole Wheel Nut Final Torque	520–580 N.m	383–427 lb ft
10-Hole Wheel Nut Final Torque	610–678 N.m	450–500 lb ft
Valve Stem Nut	6 N.m	53 lb in

Diagnostic Information and Procedures

Wheel Mounting Surface Check

1. Clean grease and road dirt from the wheel.
2. Clean the rubber from the bead seat using a wire brush or steel wool.

Notice: Do not heat wheels in an attempt to soften them for straightening or repair damage from striking curbs, etc. Do not weld wheels. The alloy used in these wheels is heat-treated and uncontrolled heating from welding affects the properties of the material.

3. Inspect the gutter areas for bulges. Remove any bulges that you find.

Bulges will cause the following conditions:

- Uneven seating of the side ring
- Uneven seating of the lock ring
- Chipping of the gutter

4. Inspect the mounting area for bulges. Smooth any bulges that you find.
5. Inspect the fixed flange area for nicks and gouges that may cause rim fracture.

Wheel Mounting Surface Check

Problem	Possible Cause	Correction
Tire Slippage on Rim	Improper storage or operating conditions	Correct as required.
	Poor maintenance	Follow the proper maintenance procedures.
	Rust, corrosion or faulty bead seating	Correct as required.
	Loss of pressure	Follow the proper maintenance procedures.
Tire Mounting Difficulties	Mismatched tire and rim size	Correct as required
	Over inflation of the tires	Follow the proper maintenance procedures.
	Corrosion and dirt	Correct as required.

Hub Bolt and Nut

Problem	Possible Cause	Correction
Broken Wheel Studs	Loose wheel nuts	Replace the studs and follow the recommended torque procedure.
	Overloading	Replace the stud.
Stripped Threads	Excessive clamp load	Replace the studs and follow the recommended torque procedure.
Rusted Streaks from Stud Holes	Loose wheel nuts	Inspect the complete assembly. Replace the studs and follow the recommended torque procedure.
Damaged Wheel Nuts	Loose wheel assembly	Replace the wheel nuts and follow the recommended torque procedure.
Frozen Wheel Nuts	Corrosion or galling	Replace the wheel nuts. Replace the wheel studs.

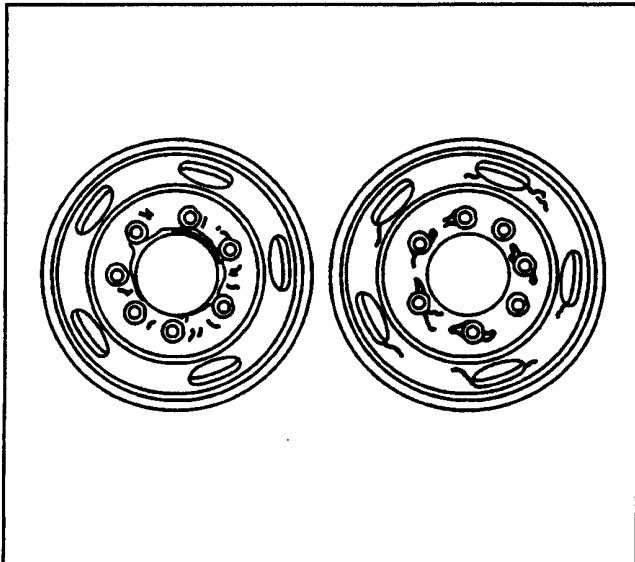
Hub Bolt and Nut

Problem	Possible Cause	Correction
Cracked or Broken Wheel Discs, Cracks Developed in the Wheel Disc around Hand Holes, Rims, or Studs	Metal fatigue resulting from overheating	Replace the wheel. Inspect the position of the wheel on the vehicle for proper working load specifications.
Damaged Stud Holes, Stud Holes become Worn, Elongated or Deformed, Metal Builds Up around Stud Hole Edges, Cracks Develop from Stud Hole to Stud Hole	Loose wheel mounting	Replace the wheel and perform the following inspections: • Inspect the installation for correct wheel studs and wheel nuts. • Replace cracked or broken wheel studs. • Replace a hub with worn, damaged or cracked wheel pilot pads. • Clean the mounting surfaces and retorque the wheel nuts periodically. • Rust streaks fanning out from the stud holes indicate that the wheel nuts are loose or were loose.

Rim/Hub Bolt Check

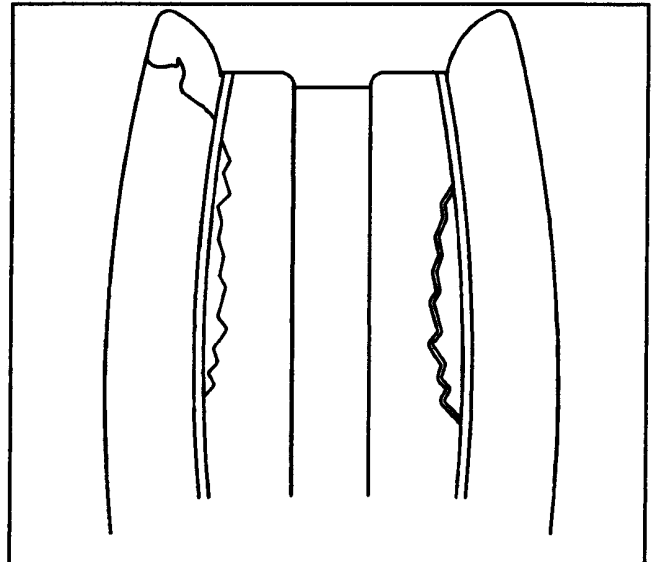
Inspect the wheel for worn wheel stud holes. Worn stud holes may appear as a shiny worn surface on the wheel face. If the stud holes are oval and if metal is built up around the holes, replace the wheels.

Inspect the wheel for cracks radiating from the hand, the stud, the bolt, or the center holes. Cracks are a result of overloading. Replace damaged wheels and inspect the wheel studs. The hub assembly may have a worn mounting face. Inspect the wheel ball seats for wear. Replace all damaged parts.



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Inspect the wheel for damaged or cracked rims.



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Carefully inspect the rims before mounting the tires. Replace all cracked rims. Cracked rims are dangerous to use.

Inspect for damaged bead seats. Excessive corrosion and improper bead seating can cause erosion and chipping of the bead seats.

Wheel Stud Check Procedure

Caution: If one stud is damaged, replace all the studs. A loose-running wheel may cause only one stud to break, but the other studs could have internal fatigue. Replacing only the broken stud and remounting the wheel may cause further damage and personal injury. If the stud holes in the wheels have become enlarged or distorted, replace the wheel.

Notice: Excessive mounting torque can cause stripped or broken studs, out of round rims, or cracks in the stud hole area.

Stripped threads on the studs may be caused by the following conditions:

- Over-torquing the wheel nuts
- Stud damage which occurred during wheel installation

Replace any studs which show damaged threads.

Broken studs may be caused by the following conditions:

- Operating with loose wheel nuts
- Over-torqued wheel nuts
- Improperly seated wheels

Wheel Nut Check Procedure

Notice: Excessive mounting torque can cause stripped or broken studs, out of round rims, or cracks in the stud hole area.

A loose mounting condition can cause damaged wheel nuts. Replace all damaged wheel nuts and wheel studs.

Repair Instructions

Aluminum Wheel Refinishing

Aluminum resists corrosion. Therefore aluminum wheels do not need painting for most operating conditions. Wash the aluminum wheels when you wash the vehicle. Do NOT use highly alkaline cleaning agents.

Certain environments created by some operations may lead to aluminum wheel corrosion. Some of these operations include the following conditions:

- Livestock hauling
- Snow removal using salt or chloride compounds
- Using highly alkaline cleaning agents

If these operating conditions exist, clean the wheels often with a stream of high-pressure water and mild detergent. Whenever you remove the tires, thoroughly clean the wheels.

Various protective coatings give good results. When using a protective coating, refer to the following suggested procedures:

1. Use a general purpose pad (such as 3M Scotch-Brite® No. 7447), or use a buffing wheel and a medium abrasive rubbing compound (such as 3M No. 05979 Clean-N-Glaze™). Aggressively rub the machined surfaces in order to remove some of the corrosion and to restore most of the luster.
2. Wipe the surface with aluminum cleaner-polish (such as Mag Wheel Cleaner Polish™ Stock No. PGC) in order to obtain maximum luster.
3. Clean the wheel with silicone remover (such as 3M No. 08984 General Purpose Adhesive Cleaner and Wax Remover™, or Prep-Sol®). Wash the wheel with clean water and dry with compressed air.

4. Wipe the wheel again with aluminum cleaner-polish. Apply a metal preparation (such as C.I.L. Metal Prep. No. 33 for aluminum) following manufacturer's instructions.
5. Apply a zinc chromate primer in four light applications, rotating the wheel 90 degrees between applications.
6. Spray the wheel with two light coats of wheel protectant (such as Coricone 1700 Clear Metal Protectant™ Stock Code DDC).

Clearcoat Damage to Aluminum Wheels

Aluminum resists corrosion. Therefore aluminum wheels do not need painting for most operating conditions. Wash the aluminum wheels when you wash the vehicle. Do NOT use highly alkaline cleaning agents.

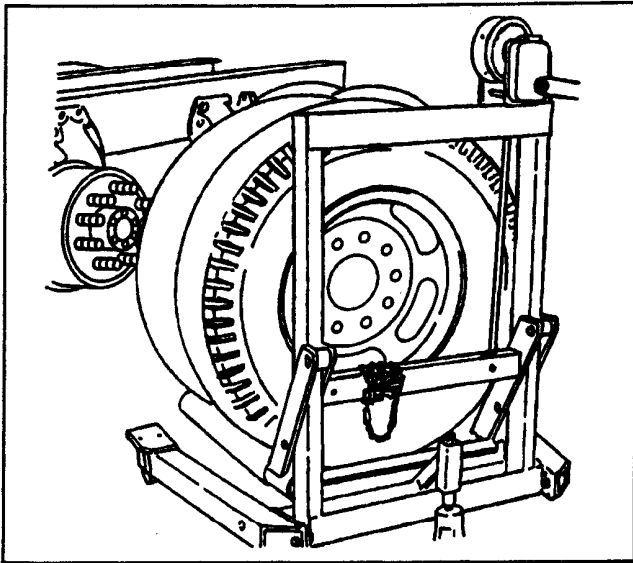
Certain environments created by some operations may lead to aluminum wheel corrosion. Some of these operations include the following conditions:

- Livestock hauling
- Snow removal using salt or chloride compounds
- Using highly alkaline cleaning agents

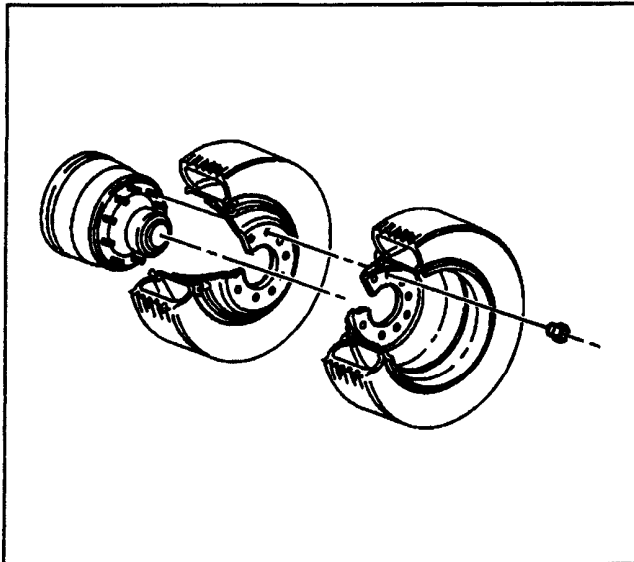
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2. Wipe the surface with aluminum cleaner-polish (such as Mag Wheel Cleaner Polish™ Stock No. PGC) in order to obtain maximum luster.
3. Clean the wheel with silicone remover (such as 3M No. 08984 General Purpose Adhesive Cleaner and Wax Remover™, or Prep-Sol®). Wash the wheel with clean water and dry with compressed air.
4. Wipe the wheel again with aluminum cleaner-polish. Apply a metal preparation (such as C.I.L. Metal Prep. No. 33 for aluminum) following manufacturer's instructions.
5. Apply a zinc chromate primer in four light applications, rotating the wheel 90 degrees between applications.
6. Spray the wheel with two light coats of wheel protectant (such as Coricone 1700 Clear Metal Protectant™ Stock Code DDC).



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Wheel Removal (Front)

Caution: To avoid eye injury, use approved safety lenses, goggles, or face shield to prevent eye injury when deflating tires.

Important: When removing and demounting any tire and wheel assembly, deflate the tire by removing the valve core. Perform this procedure before removing the tire assembly from the vehicle.

1. Raise the vehicle until the tire clears the floor. Support the vehicle. Refer to *Notice* in General Information.
2. Remove the wheel nuts.
3. Remove the wheel from the hub.

Wheel Removal (Dual/Rear)

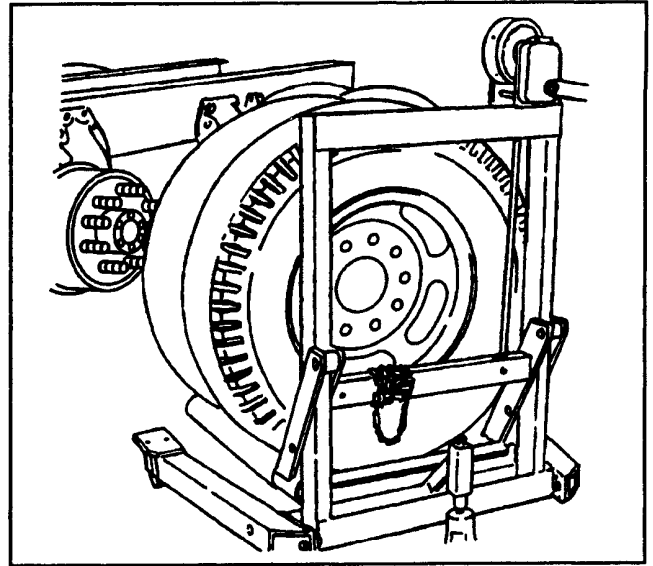
Caution: To avoid eye injury, use approved safety lenses, goggles, or face shield to prevent eye injury when deflating tires.

Notice: Wheel hub flanges, wheel studs, and stud nuts should be free of rust, lubricants, dirt, and finish color paint on all contact surfaces to ensure proper torque retention.

Important: When removing and demounting any tire and wheel assembly, deflate the tire by removing the valve core. Perform this procedure before removing the tire assembly from the vehicle.

1. Break the wheel nuts loose.
2. Raise the vehicle until the tire clears the floor. Support the vehicle. Refer to *Notice* in General Information.
3. Remove the wheel nuts.
4. Remove the wheel from the hub. Refer to *Wheels Description*.
5. If applicable, remove the stud nuts from the inner wheel.

6. If applicable, remove the inner wheel from the hub.



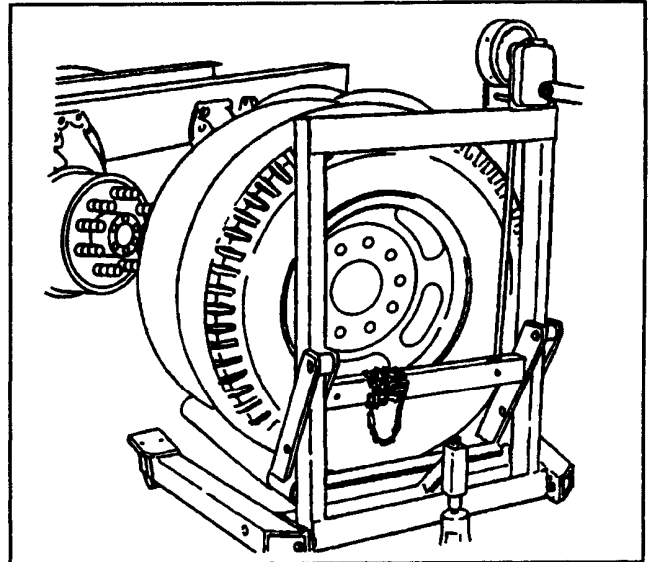
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Wheel Installation (Front)

Installation Procedure

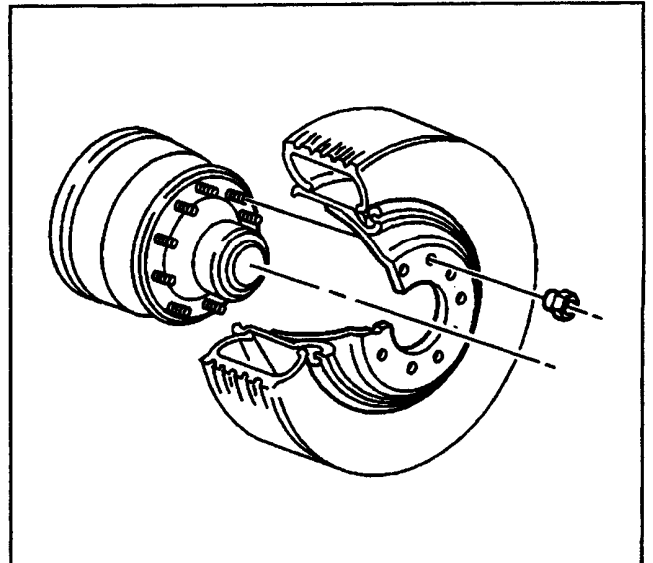
Notice: Wheel hub flanges, wheel studs, and stud nuts should be free of rust, lubricants, dirt, and finish color paint on all contact surfaces to ensure proper torque retention.

1. Apply a thin coat of grease to the hub pads in order to prevent corrosion.
2. Turn the hub in order to position the hub pad at a 12 o'clock position.

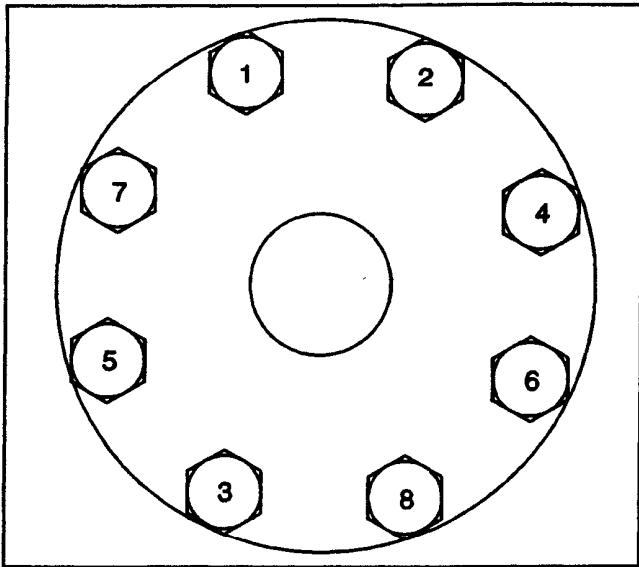


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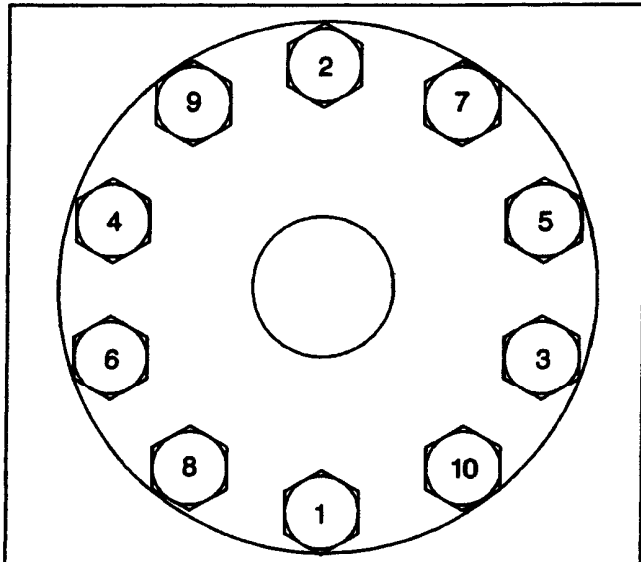
3. Install the wheel on the hub.



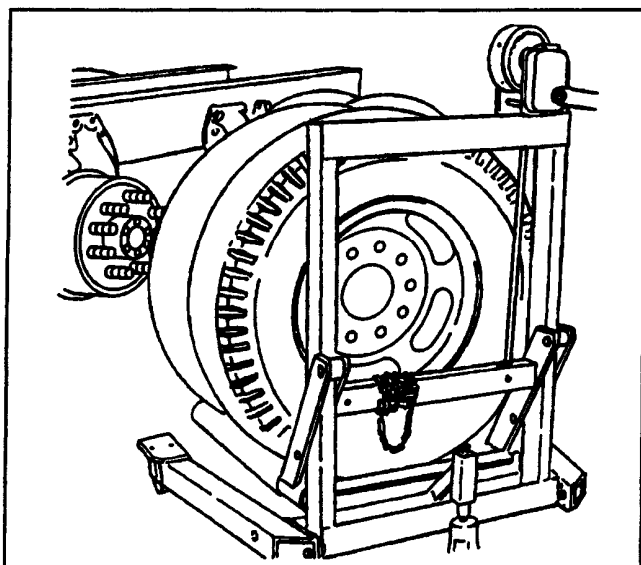
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Notice: Refer to *Fastener Notice* in Cautions and Notices.

Important: Tighten the wheel nuts progressively using the first specification; then retighten the nuts using the second specification.

4. For 8-hole wheels, install the wheel nuts.

Tighten

- Tighten the wheel nuts to 100 N.m (74 lb ft) in the sequence shown.
- Tighten the wheel nuts to 520–580 N.m (383–427 lb ft) in the sequence shown.

5. For 10-hole wheels, install the wheel nuts.

Tighten

- Tighten the wheel nuts to 225 N.m (166 lb ft) in the sequence shown.
- Tighten the wheel nuts to 610–678 N.m (450–500 lb ft) in the sequence shown.

Wheel Installation (Dual/Rear)

Installation Procedure

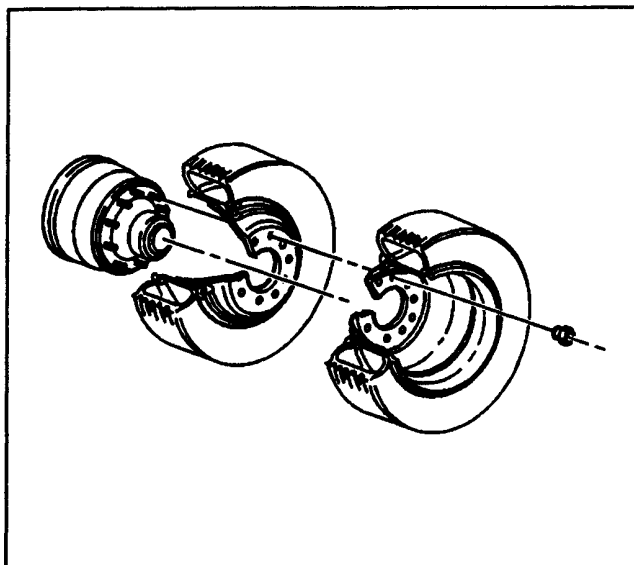
Notice: Wheel hub flanges, wheel studs, and stud nuts should be free of rust, lubricants, dirt, and finish color paint on all contact surfaces to ensure proper torque retention.

1. Apply a thin coat of grease to the hub pads in order to prevent corrosion.
2. Turn the hub in order to position the hub pad at a 12 o'clock position.

3. Install the wheel on the hub.

Important: Perform steps 4 and 5 for dual wheel applications only. For single wheel applications, proceed to step 6.

4. Install the inner wheel on the hub.
5. Install the outer wheel on the hub with the valve stems of both wheels positioned as close to 180 degrees as possible.



290802

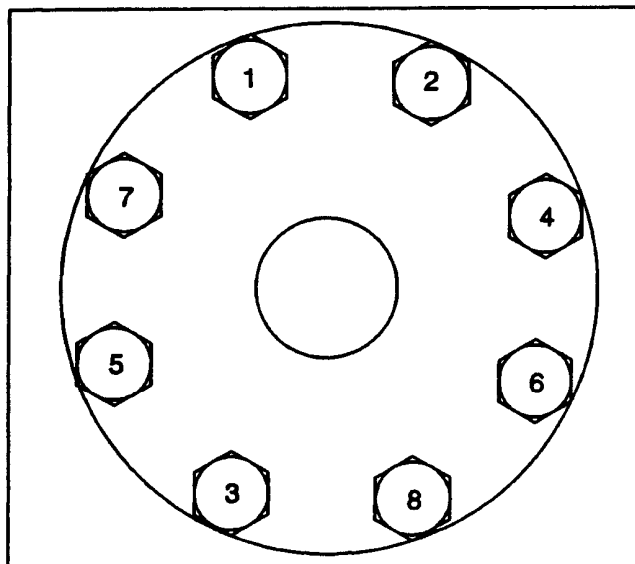
Notice: Refer to *Fastener Notice* in Cautions and Notices.

Important: Tighten the wheel nuts progressively using the first specification; then retighten the nuts using the second specification.

6. For 8-hole wheels, install the wheel nuts.

Tighten

- Tighten the wheel nuts to 100 N.m (74 lb ft) in the sequence shown.
- Tighten the wheel nuts to 520–580 N.m (383–427 lb ft) in the sequence shown.

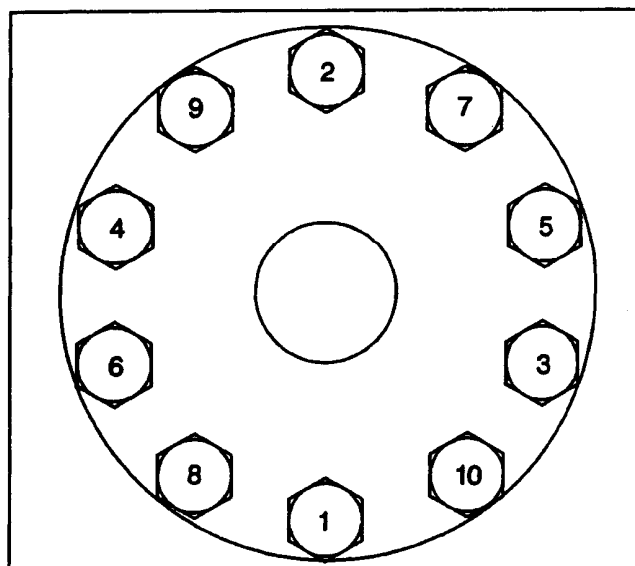


203172

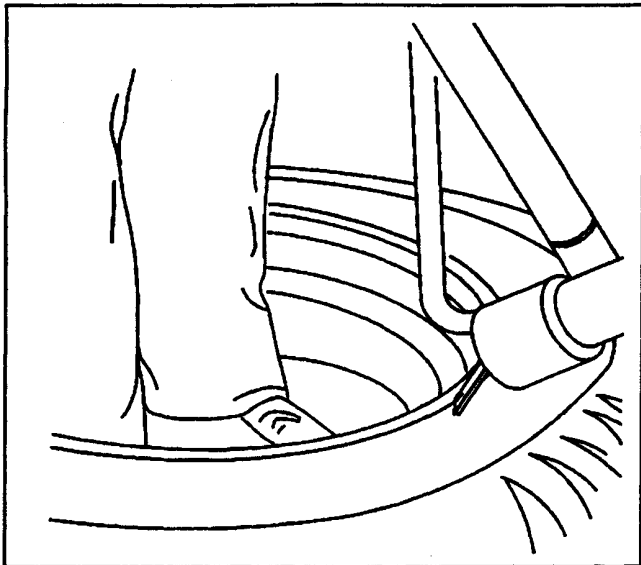
7. For 10-hole wheels, install the wheel nuts.

Tighten

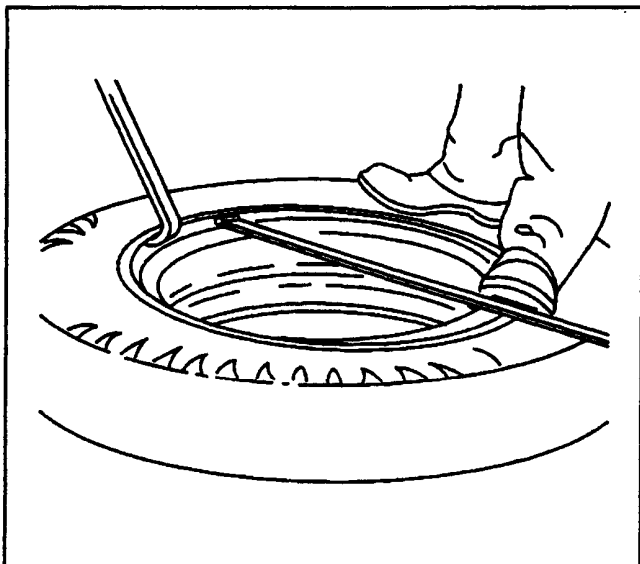
- Tighten the wheel nuts to 225 N.m (166 lb ft) in the sequence shown.
- Tighten the wheel nuts to 610–678 N.m (450–500 lb ft) in the sequence shown.



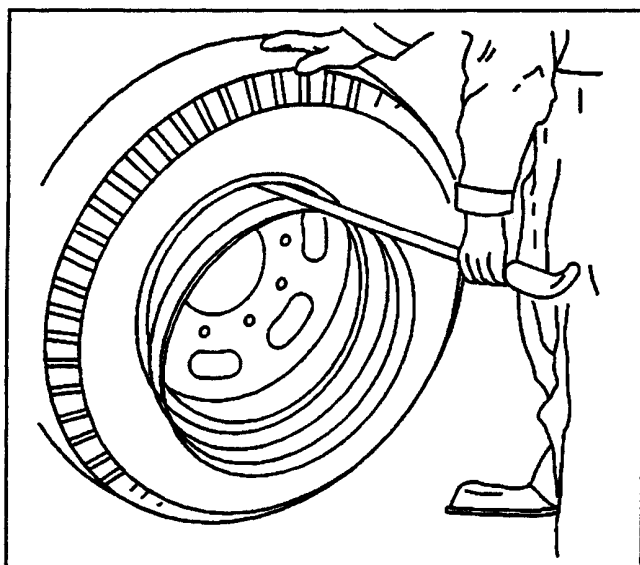
203173



214470



214473



214475

Tire Mounting and Dismounting

Removal Procedure

Caution: To avoid eye injury, use approved safety lenses, goggles, or face shield to prevent eye injury when deflating tires.

1. Completely deflate the tire prior to demounting. If either the rim or the rings are damaged, or if the ring appears to be unseated, deflate the tire prior to removing the assembly from the vehicle. Reduce the pressure by pushing in the valve stem, or remove the entire core. Keep your eyes away from the valve.
2. Loosen both beads from the rim by driving the flat end of the tire tool between the tire bead and the rim flange. Straighten the tool to a vertical position and hammer downward in order to pry the tire from the rim. Repeat this step at approximately 200 mm (8 in) intervals around the flanges until you free the beads from the rim.
3. Place the wide side of the rim down.
4. Lubricate the tire bead and the rim.
5. Insert the curved end of both tools and step on the tire opposite the valve in order to direct the first bead into the rim well. Hold one tool in position with your foot, and pull the second tool toward the center of the rim. Progressively work the first bead off of the rim.
6. Stand the wheel on the tire tread with the valve near the top.
7. Lubricate the second bead and the rim.
8. Insert the straight end of the tool between the tire bead and the back rim flange. Hook the tool over the second flange. Lean the tire assembly toward the tool and provide a rocking or a bouncing action in order to pry the rim out of the tire.

Caution: To avoid eye injury, use approved safety lenses, goggles, or face shield when using buffing and cleaning equipment.

9. Clean the rim of dirt, corrosion and light rust. If you mount the tires on dirty or corroded rims, or if you do not properly center the tires on their rims, then the tire bead may bind on the rim and refuse to seat. Replace any rims that are corroded and weakened:
 - Remove surface rust and other foreign material from the rim.
 - Verify that rim flanges and the bead ledge areas are smooth and clean, especially around the hump and the radius.
 - Remove the following foreign materials using a wire brush:
 - Dried tire mounting lubricant
 - Surface rust
 - Heavy paint
 - Paint steel wheels that show bare metal using a good grade of aluminum paint or equivalent, in order to prevent rust.
10. Inspect the rim for the following conditions:
 - Cracks
 - Bends
 - Corrosion which results in heavy pitting
 - Rust
 - Distortion
11. Replace damaged rims.

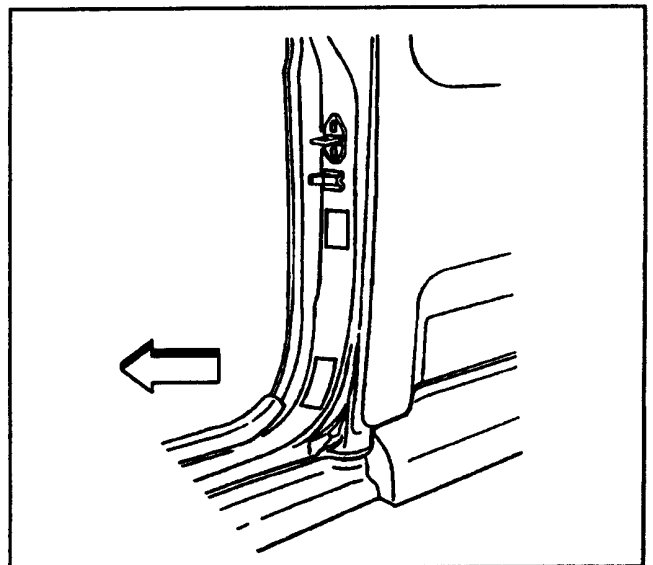
Installation Procedure

Caution: Only use mounting equipment tools specifically designed for tire mounting. Do not use improvised tools. Failure to observe this precaution could cause serious injury to you or other personnel in the area.

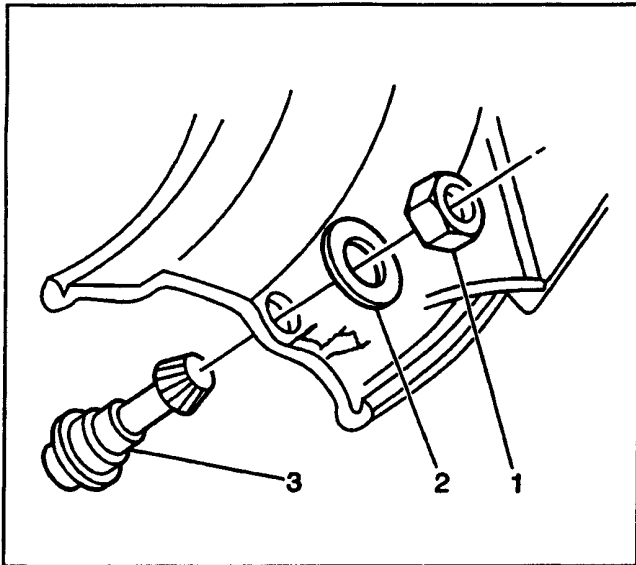
Notice: Use an approved tire mounting compound such as Ru-Glyde®, Frey Lube II® or equivalent. Do not use silicone-base compounds or corrosive-type compounds. Silicone-base compounds can cause the tire to slip on the rim. Corrosive-type compounds can cause tire and/or rim deterioration.

Important: Use only proper size rims. Do NOT exceed the recommended air pressures as specified on the vehicle certification label.

1. Select tires and rims which are the correct size.



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203179

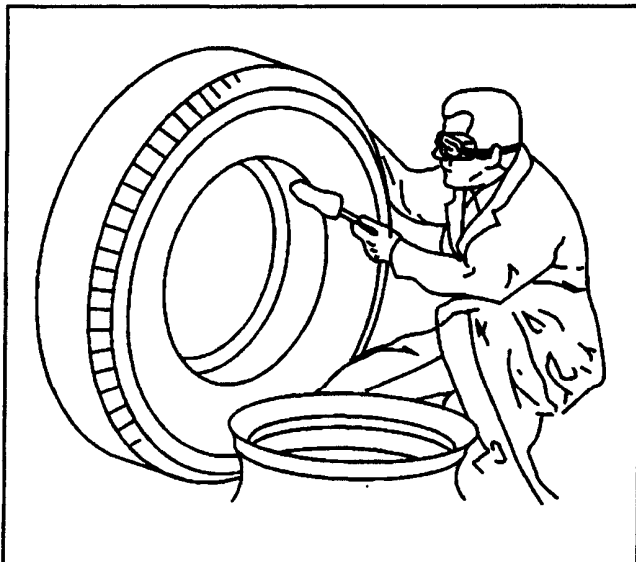
2. Place the valve stem with the rubber washer through the valve hole from the tire side of the rim.

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

3. Screw on the valve nut from the opposite side. Center the rubber bushing, the metal collar, and the nut snugly in the valve hole.

Tighten

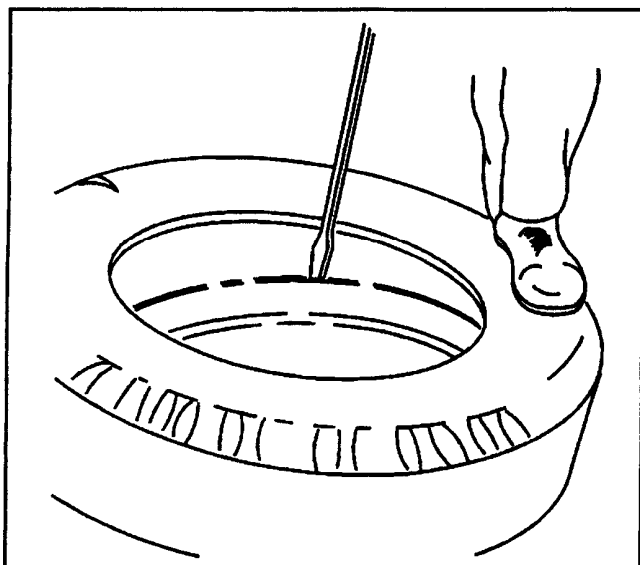
Tighten the valve stem nut to 6 N·m (53 lb in).



203180

4. Use an approved tire mounting compound such as RU-Glyde®, Frey Lube II® or equivalent in order to lubricate the following areas:

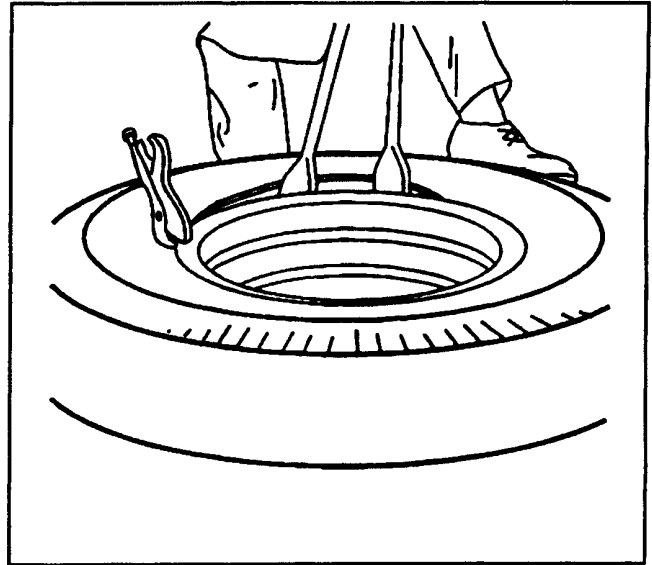
- The tire beads
- The rim flanges
- The bead ledge areas



214479

5. Place the rim on the floor with the wide end side down.
6. Push the first bead over the flange and into the rim well.
7. Using the straight end of a tool (with the stop resting on the flange of the rim), take small bites in order to work the remaining section of the bead onto the rim.

8. Stand on the tire in order to start the second bead over the rim flange into the well.
9. Use the spoon end of a tire iron, with the stop toward the rim. Work progressively around the bead using small bites until the bead slips over the flange onto the rim base.



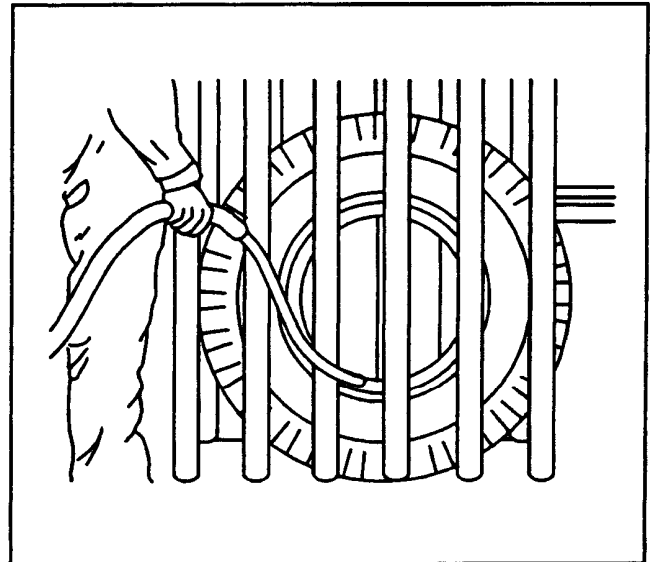
214482

Caution: Be careful not to drop tire and wheel assemblies on your hands and feet. Lift properly, using your legs as well as your body. Tires and wheels are heavy and can cause injury if not handled correctly.

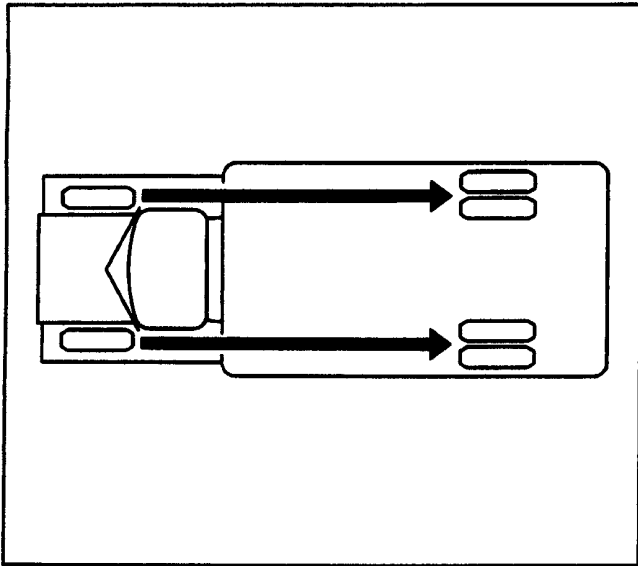
Caution: Allowing pressure to continue to build up within a tire in an attempt to seat the bead is a dangerous practice that can result in a broken tire bead and possible serious injury to the technician.

Important:

- Use dry air for tire inflation. Use moisture traps on the air lines leading from the air compressor.
 - Do NOT overload the tires. Verify that the load and the vehicle weights do not exceed the rated load of the tires used on the vehicle. The rims are designed in order to sustain the maximum rated load of the maximum tire size that is recommended for that rim. Refer to the *Vehicle Certification Label Description* in General Information for recommended rated load and tire size.
 - Do not exceed the maximum inflation pressures. Inflation pressures are determined by the size and the ply rating of the tire. Refer to the manufacturer's specification for proper inflation. Equally inflate both tires of a dual assembly in order to equally distribute the weight.
10. Inflate the tire in a safety cage using an extension hose equipped with an air gage and a chuck. Confirm that you have seated the bead properly by referencing any circumferential design element on the tire and on the top of the rim flange. These design elements should be equally spaced around the tire.



203182



203209

Tire Rotation

The movement of the tires from the front of the vehicle to various rear wheel positions depends on the type of unit being operated. Use tires with good non-skid tread design on the drive wheels.

Notice: Never rotate a drive-type tread tire to the front axle. When rotating tires, only rotate tires that have the same tire tread type. When a drive-type tread tire is placed on the front axle, improper vehicle handling and tire damage may result. Following these instructions can help you avoid damage to parts and the steering system.

Rotate the tires from the front wheel to the rear wheels when the tread depth is 3.2 mm (0.13 in). If the front wheel tire wear is uneven, then rotate the tires and check the vehicle for mechanical irregularities.

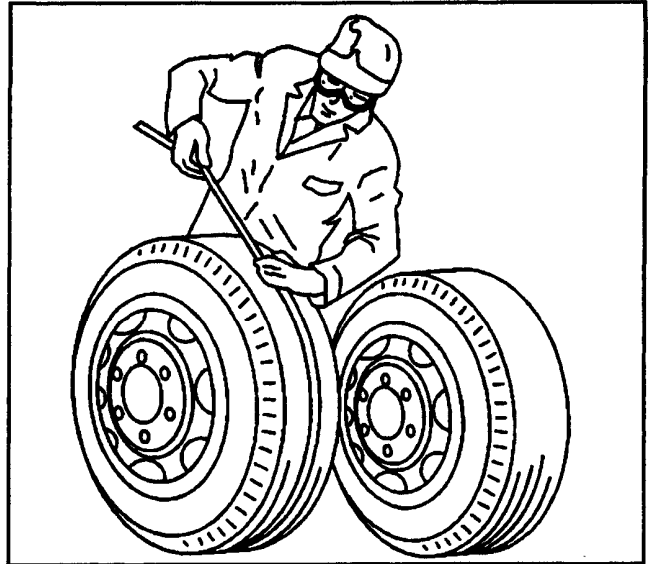
Tire Matching

1. Mismatched tires on tandem drive units will cause the following conditions:
 - Tire wear
 - Scuffing
 - Possible damage to the drive units
2. Match the tires to within 3 mm (0.125 in) of the same rolling radius and 19 mm (0.75 in) of the same rolling circumference.

Notice: The four largest tires should never be installed on one driving axle or the four smallest tires on the other driving axle. Such tire mounting will cause an inter-axle bind and unusually high axle lubricant temperatures that result in premature lubricant breakdown and possible costly axle damage.

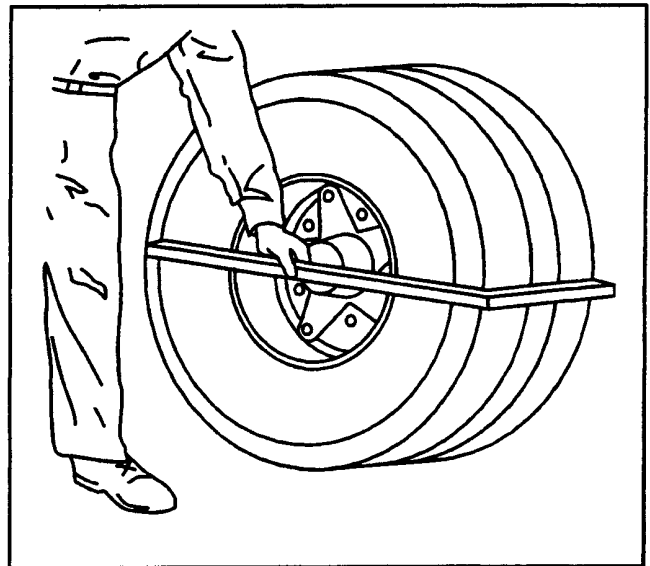
3. Ensure that the total tire circumference of one driving axle matches the total tire circumference of the other driving axle as nearly as possible. This will result in higher tire mileage. This will also maintain satisfactory temperatures of tandem axle lubricants which lengthen the drive unit service.

4. Park the vehicle on a level floor, carrying an evenly rated capacity load. Verify that all of the tires are the same size. Measure new tires in order to be sure that the tires will be correctly matched.
5. Inflate all tires to the same recommended pressure:
 - Measure the rolling circumference of each tire using a steel tape after you have inflated the tires and placed the tires on their rims, but before you have installed the tires on a vehicle. This is the most accurate method. This procedure allows for any irregularities in wear.

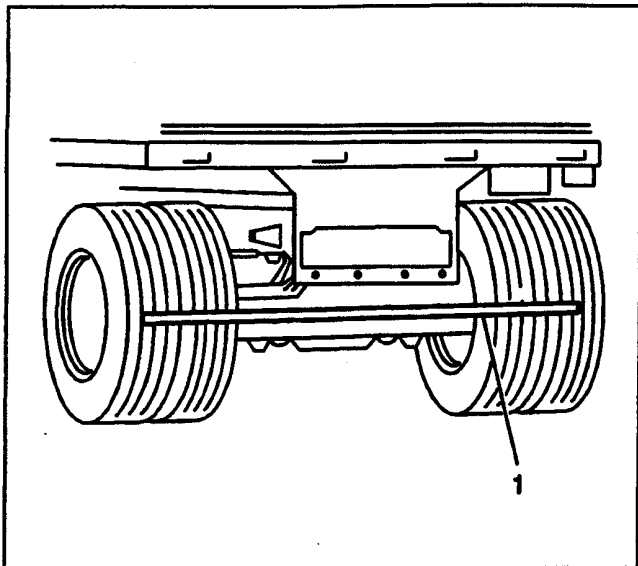


203195

- In order to check the tires already installed on the vehicle use a large square.

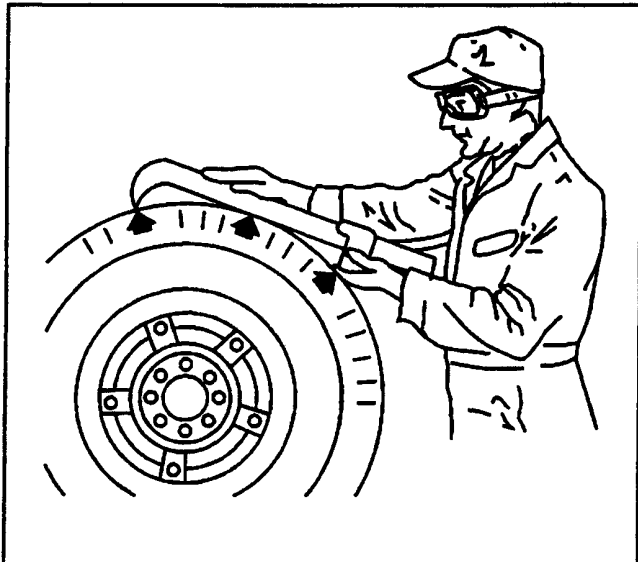


203202



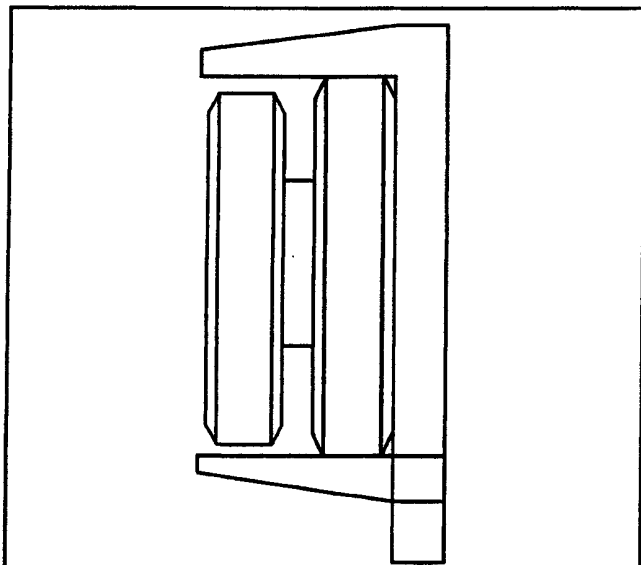
203199

- Check the tires using a string gage (1).



203204

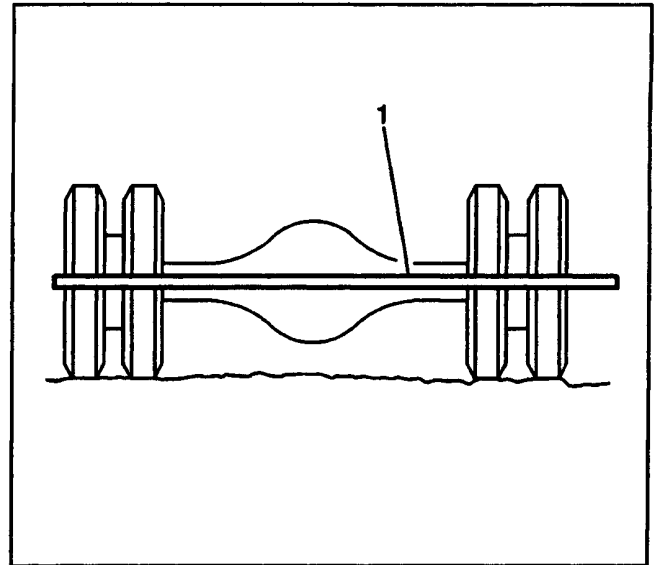
- Check the tires using a large caliper.



203205

- Check the tires using a matching stick.

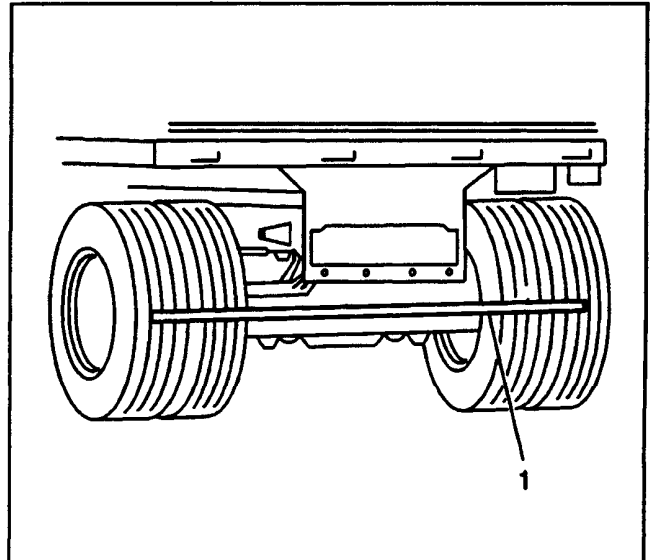
- Check using a wooden straightedge (1) long enough to lie across the treads of all four tires. Mark the size on each tire with chalk and arrange the tires in order of size, largest to smallest.



203207

Installation Procedure

1. Install the two largest tires on one side of one axle.
2. Install the two smallest tires on the opposite side of the same axle.
3. Install four other tires on each of the other axles as described in steps 1 and 2.
4. Inspect the rear axle lubricant temperature readings.
 - Run the vehicle for accurate readings.
 - Vary the tire air pressure, within the tire manufacturer's recommended range, in order to ensure that the lubricant temperature of both axles is within 17°C (30°F) of each other and not in excess of 104°C (220°F). This will result in uniform tire loading and will assure good tire life.



203199

Tire Measuring

Overall Diameter (5): Overall diameter is the diameter of the tire measured from the opposite outer tread surfaces, without carrying a load.

Free Radius (3): The free radius is one-half of the overall diameter.

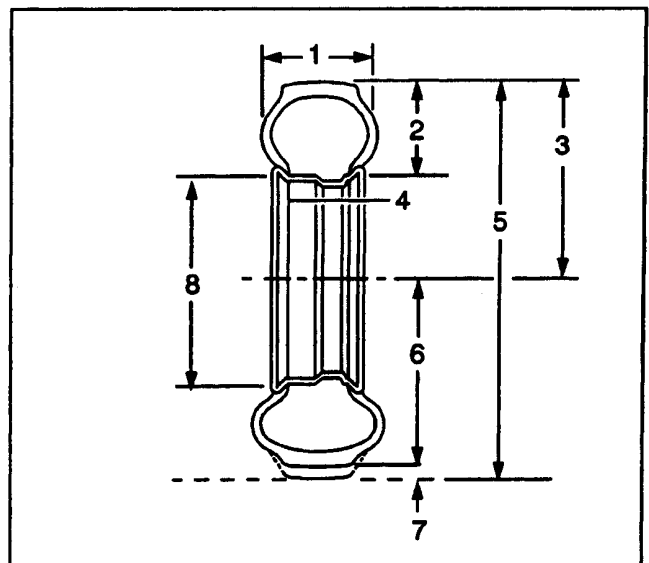
Section Height (2): Section height is the distance from the rim seat (4) to the outer tread surface of the tire without carrying a load.

Section Width (1): Section width is the distance between the outside of the sidewalls of the inflated tire.

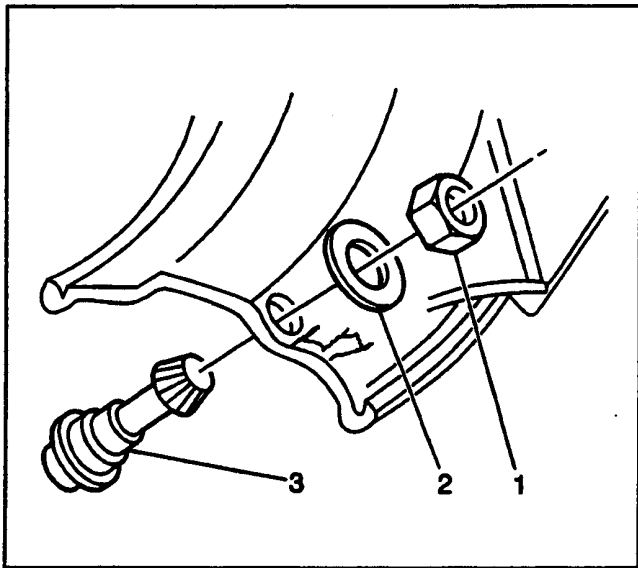
Loaded Radius (6): Loaded radius is the distance from the wheel axle centerline to the supporting surface under a tire, properly inflated for its load.

Deflection (7): The deflection of a tire is the free radius (3) minus the loaded radius (6).

Revolutions Per Mile: Revolutions per mile is the measured number of revolutions for a tire traveling one mile. This measurement can vary with load inflation.



203275



203179

Loads Per Axle and Inflation Pressures: The carrying capacity of each tire size is determined by various inflation pressures for a single application (two tires) axle load and for a dual application (four tires) axle load.

Wear Bars: Truck tires contain wear bars in the grooves of the tire tread that show when only 1.6 mm (0.0625 in) or less of tread is remaining. When the wear bars show, replace the tires. The tires on the front axles must have at least 3.2 mm (0.13 in) of tread depth.

Load Range/Ply Rating: Load range is a letter that corresponds to the numerical ply rating. Refer to Load Range/Ply Rating Description.

Valve Core and Cap Replacement

The valve core (3) is a spring-loaded check valve in the valve stem. The valve core allows inflation or deflation of the tube or the tire. This check valve is intended to hold air during operation. The valve cap keeps dirt and foreign material away from the valve core. Use valve caps at all times.

Description and Operation

Tires Description

Caution: Do not mix bias-ply and radial tires on the vehicle except in emergencies, because vehicle handling could be affected and may result in the loss of control.

Radial tires are constructed of the following material:

- Casing plies which run perpendicular to the tread direction
- Several layers of steel or fabric tread-reinforcing plies just under the tread area

This construction permits flexing of the tire sidewall with the following advantages:

- A minimum of tread distortion
- Better traction
- A softer ride

Tubeless radial tires are recommended for this vehicle.

When inspecting the tires, check the valve stem cores for leakage. Also check around the tires for embedded steel, rock, or glass. If these objects remain in the tread, these objects may eventually cause a failure. In some cases a puncture will occur, and removal of the foreign object will cause the tire or the tube to lose pressure.

Overloading causes many kinds of cord body breaks. Overloading is due to abnormal flexing or overworking of the cord body of the tire. Overload flex breaks occur in the sidewall or in the shoulder of a tire. These breaks run with the circumference of the tire. Sometimes the breaks are only 51–76 mm (2–3 in) long. Other times these breaks will extend partly around the tire. These breaks may cause a blowout or a pinched tube that allows the tire to go flat.

Normal flexing of a tire can go on for long periods of time without causing any great damage to the cords. If the tire is overworked or overflexed abnormal heat is generated, and the cords may become weak and will break.

The following conditions may cause flex breaks:

- Underinflation
- Sprung axles
- Mismatched dual tires
- Poor load distribution

You may avoid this condition by using proper size and type of tires and rims which are large enough to carry the load. Do not attempt to increase the rated carrying capacity of a tire by inflating the tire beyond the maximum recommended pressure. For information on bias-ply tire inflation, refer to the manufacturer's information.

Tire Repair Description

Caution: Do not mix bias-ply and radial tires on the vehicle except in emergencies, because vehicle handling could be affected and may result in the loss of control.

Inspect the valve stem cores for leakage. Refer to *Valve Core and Cap Replacement*. Inspect around the tires for embedded steel, rock, or glass. In some cases the tube of an inflated tire may already be punctured, and pressure will be lost only when the object is removed.

Overloading is the cause of many kinds of cord body breaks. Such breaks are due to abnormal flexing or overworking of the cord body of the tire. Overload flex breaks occur in the sidewall or the shoulder of a tire. These breaks run with the circumference of the tire. Sometimes the breaks are only 51–76 mm (2–3 in) long. Other times the breaks will extend partly around the tire, resulting either in a blowout or a pinched tube that allows the tire to go flat.

Normal flexing of a tire can go on for long periods of time without causing any great damage to the cords. If the tire is overworked or overflexed from overload, then abnormal heat is generated, and the cords become weak and the cords break.

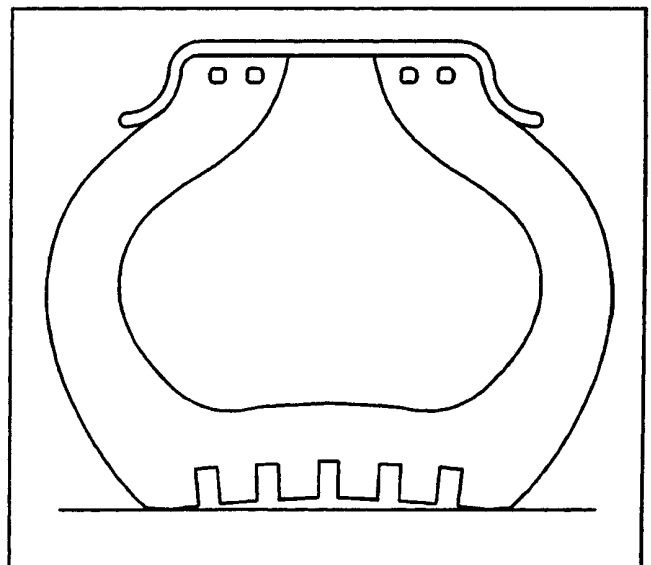
Underinflation will cause the same result. In addition, sprung axles, mismatched duals, and poor load distribution tend to cause flex breaks. This can be avoided if vehicles are equipped with the tires and the rims of the proper size and type, large enough to carry the load. Inflating the tire beyond the maximum recommended pressure will not increase the rated carrying capacity of a tire. Refer to the manufacturer's specifications for load and pressure recommendations.

Tire Inflation Description

The following tire qualities are designed in order to obtain maximum length of service under normal operating conditions:

- The fabric
- The rubber
- The bead
- The contour
- The size of tires used on these vehicles

The tires are made in order to operate efficiently only on a specified amount of air. Unless the driver of the vehicle maintains the correct air pressure, the tires will not function as intended.

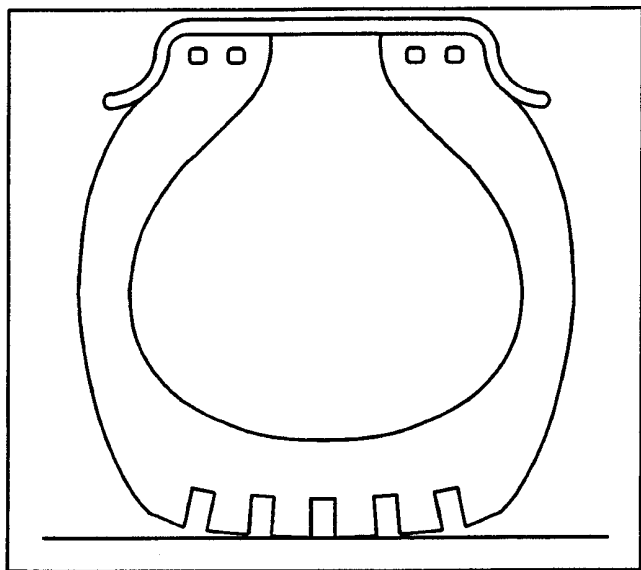


203217

An underinflated tire may cause the vehicle to operate in the following manners:

- Runs sluggishly
- Heats up quickly because of the greater flexing
- Bruises more often

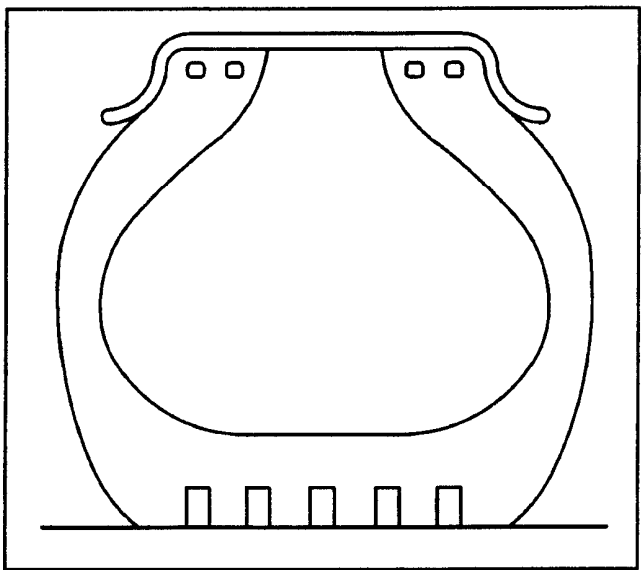
In dual tire mounting, loss of pressure in one tire could cause the rim to slip on the wheel.



203219

Overinflation may weaken the tire, causing a blow-out. Improperly inflated tires will affect the following conditions:

- Steering
- Riding comfort
- Safe driving



203215

Inflate the tires as indicated by the manufacturer's recommendation:

- For greater riding comfort
- For longer tire life
- To reduce vehicle chassis wear

Ensure that the combined front and rear tire load do not exceed the maximum recommended load.

Inflate the tires to the recommended pressure when the tires are cool. If the tires are always carrying less than the recommended maximum load, reduce the air pressure to correspond with the actual load carried.

Never bleed the tires in order to relieve pressure buildup. Tire temperature and air pressure will increase when the tire is in service. Tire design allows for this buildup in pressure. Tire temperature and air pressure will stay within limits that are not harmful to the tire when used with the recommended load and air pressure.

The following conditions may be responsible for high pressure buildup:

- Overload
- Underinflation
- Speed
- A combination of these

Use the size and type of tire that has the capacity to carry the load at a recommended cold starting pressure.

Pressure Loss

At periodic intervals, use an accurate gage in order to check each tire for pressure loss. If you notice a pressure loss in any of the tires, complete the following steps:

1. Make an inspection.
2. Determine the cause of the pressure loss.
3. Correct the problem.

Balanced Inflation

All tires on the same axle should always carry the same air pressure. Although a difference in air pressure of the rear and the front tires may be allowed, within certain limitations, you should not tolerate a difference in pressures between the right and the left tires on the same axle.

A 34 kPa (5 psi) underinflated tire can lower the efficiency of most brakes. Balanced tire inflation contributes to the following conditions:

- Easier steering
- Riding comfort
- Driving safety
- Minimum fuel use
- Maximum tire mileage

Tire Overheat

As a tire becomes heated, the air in the tire expands and the air pressure rises. This is a normal condition, unless the pressure buildup is excessive. Increased tire pressure over 138 kPa (20 psi) is excessive. Increased tire pressure indicates the following conditions:

- Underinflation
- Overload
- Too much speed
- Too small a tire
- More often, a combination of these factors

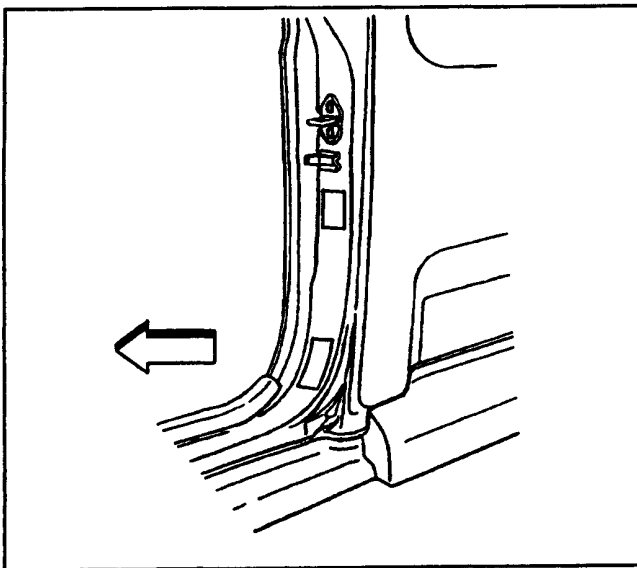
Investigate pressure buildups of over 138 kPa (20 psi) in order to determine the cause of the buildups. Take proper corrective action. Normal pressure buildups, not over 138 kPa (20 psi), reduce flexing.

Heat balance is defined as the temperature at which the rate of heating equals the rate of cooling. Normal pressure buildup reaches this heat balance at a lower temperature than by frequently bleeding the air in order to maintain the inflation pressure. Never bleed the tires. When the pressure builds up excessively, reduce the speed or the load.

Load Range/Ply Rating Description

Load Range	Ply Rating
A	2
B	4
C	6
D	8
E	10
F	12
G	14
H	16
J	18
L	20
M	22
N	24

Vehicle Certification Label Description

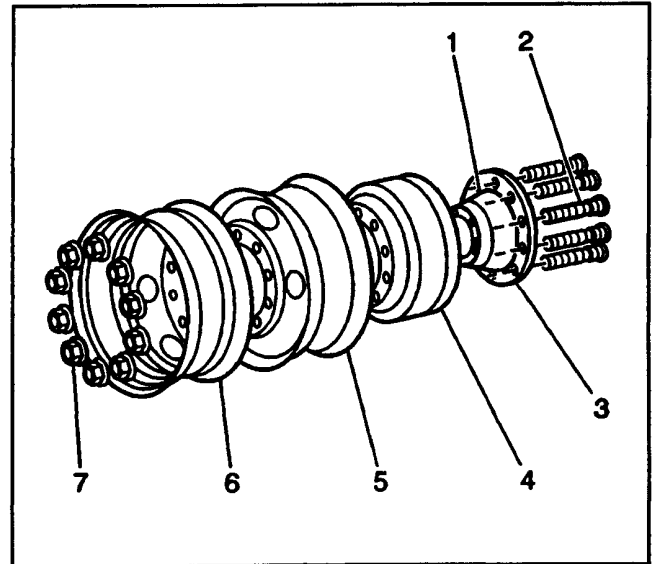


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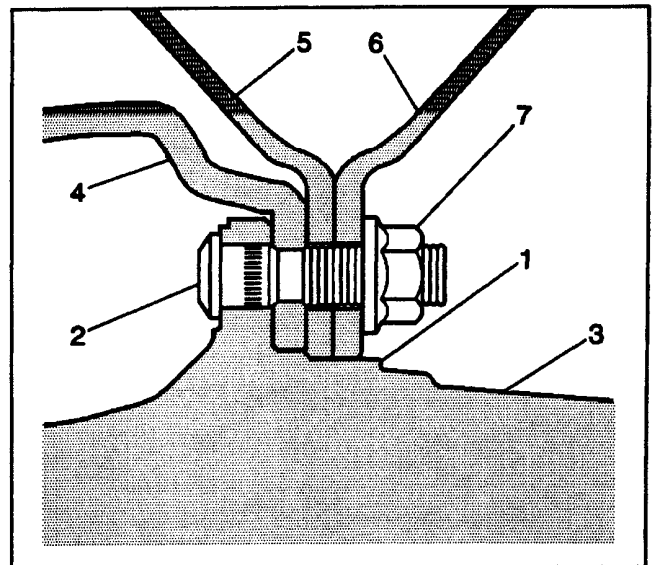
The vehicle certification label shows the originally equipped tire size and the recommended inflation pressures. The label is located on the driver side door sill.

Wheels Description

The wheels are all of a hub-piloted design. "Hub-piloted" refers to the way that the rim trues (centers) itself on the hub by the use of hub pads. A hub pad (1) is the cast and machined ears of the hub (3) that comes into contact with the rim (5,6) during installation. The wheel is attached to the hub by two-piece flange nuts (7).



203156



203157

The wheels are made of aluminum or steel. The steel type wheel utilizes a two-piece steel construction, making the wheel and the rim an integral unit. The aluminum wheel is a one-piece cast aluminum component.

BLANK

Air Suspension

Specifications

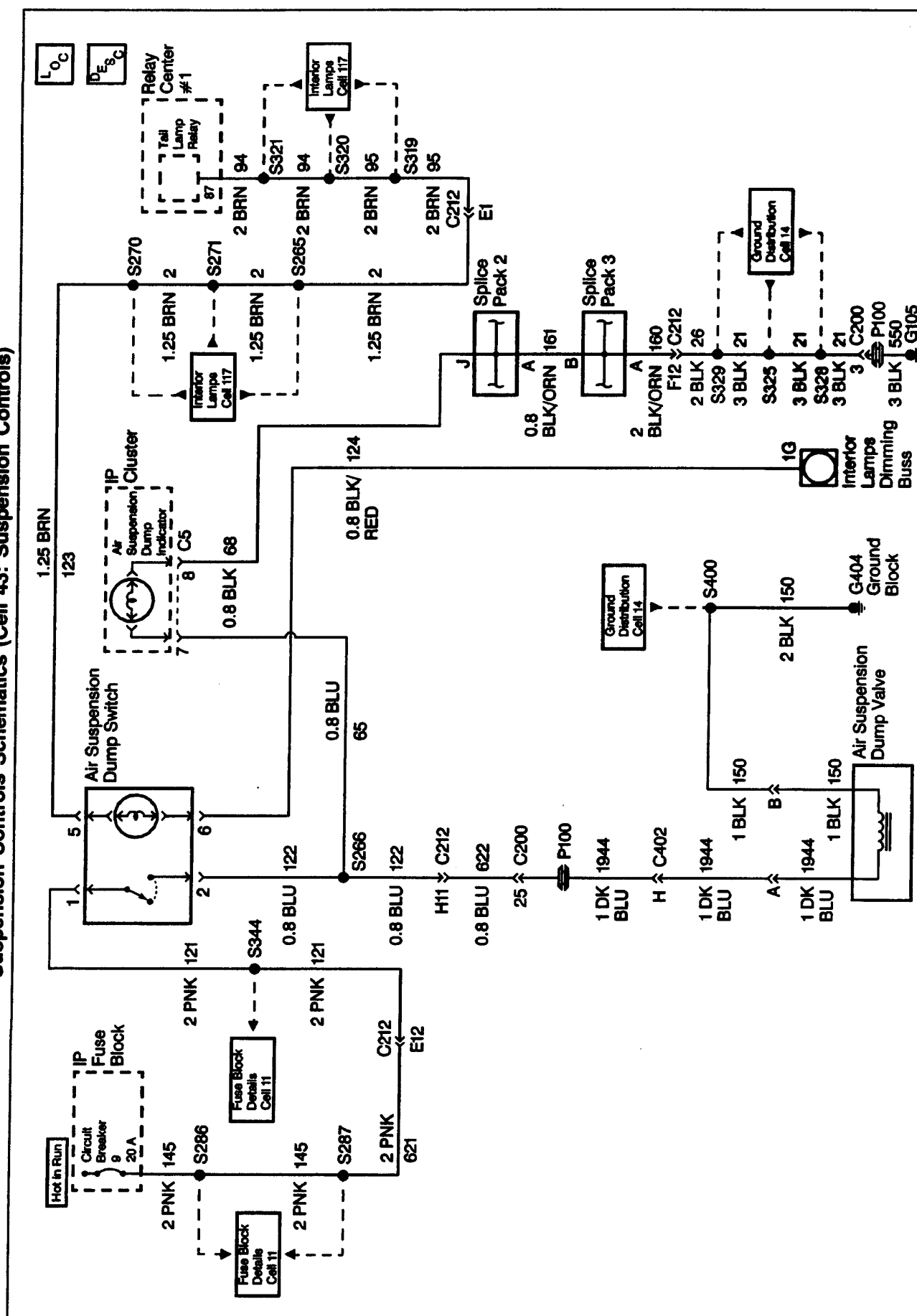
Fastener Tightening Specifications

Application	Specification	
	Metric	English
Air Spring Frame Hanger to Frame Locknut	300–360 N.m	221–266 lb ft
Air Spring to Air Spring Frame Hanger Locknut	27–41 N.m	20–30 lb ft
Air Suspension Relief Valve Bolt	15–20 N.m	11–15 lb ft
Cross Channel to Main Support Beam Locknut	330 N.m	243 lb ft
Leveling Valve Arm on Leveling Valve Locknut	21–25 N.m	15–18 lb ft
Leveling Valve Mounting Locknut-Models Without RPO-GPG	82–108 N.m	60–80 lb ft
Leveling Valve Mounting Locknut-Models With RPO-GPG	68–95 N.m	50–70 lb ft
Rebound Bolt Locknut	68–95 N.m	50–70 lb ft
Shock Absorber to Mounting Bracket Locknut	68–95 N.m	50–70 lb ft
Transverse Rod Bar Pin Nut-Models Without RPO-GPG	285–310 N.m	210–229 lb ft
Transverse Rod Taper Pin Locknut-Models With RPO-GPG	474–542 N.m	350–400 lb ft
Torque Bar Rod Pin Locknut	203–278 N.m	150–205 lb ft
Torque Rod Locknut	203–278 N.m	150–205 lb ft
Torque Rod Locknut at Axle End of Torque Rod	203–278 N.m	150–205 lb ft
10 mm (0.375") Hex Head Self-Tapping Screw	34 N.m	25 lb ft

Schematic and Routing Diagrams

Suspension Controls Schematic References

Reference on Schematic	Section Number - Subsection Name
Fuse Block Details Cell 11	8—Wiring Systems
Ground Distribution Cell 14	8—Cruise Control
Interior Lamps Cell 117	8—Lighting Systems



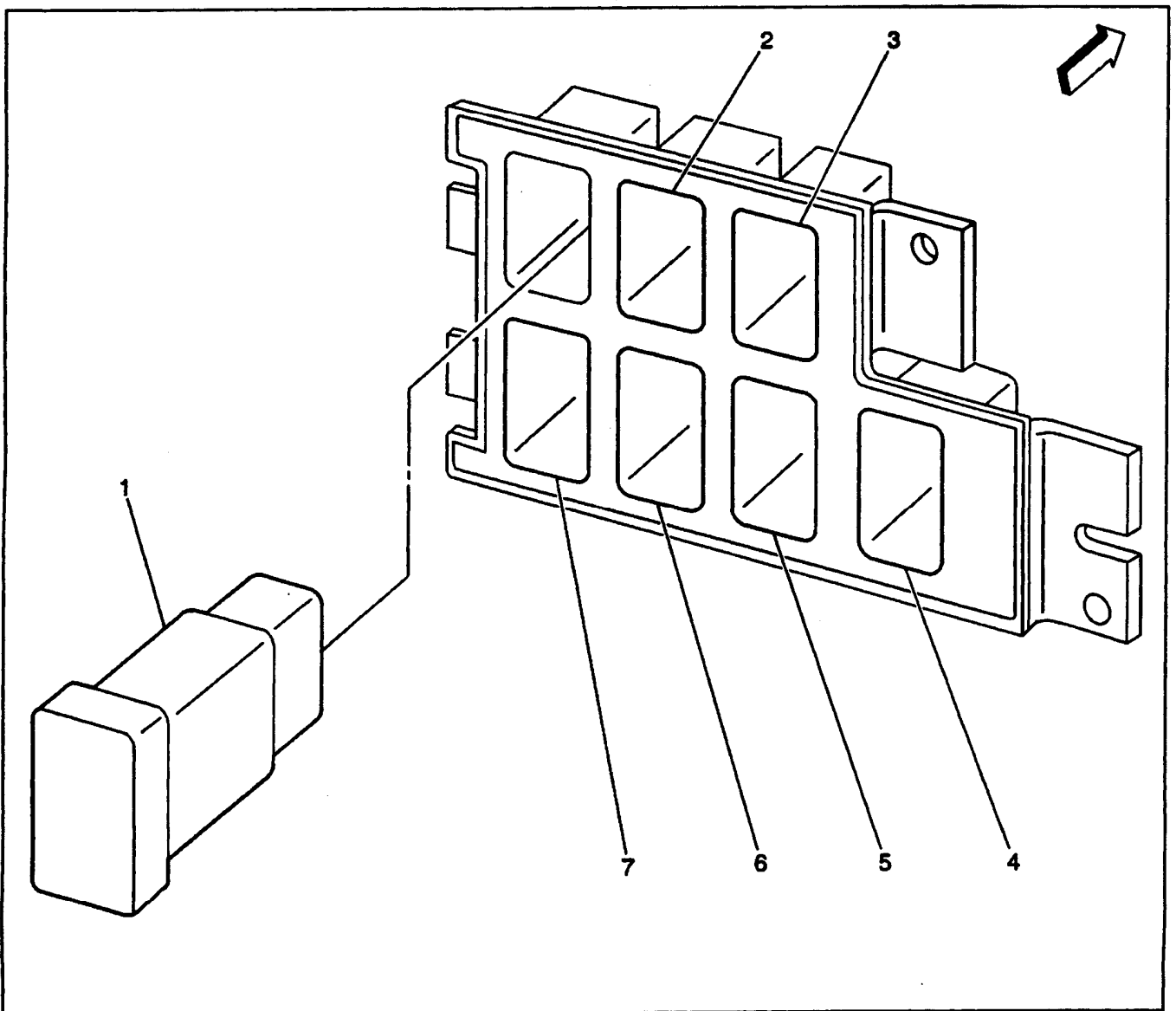
Component Locator

Suspension Controls Components

Name	Location	Locator View	Connector End View
Air Suspension Dump Switch	Center of the I/P	<i>Suspension Controls Component Views</i>	<i>Suspension Controls Connector End Views</i>
Air Suspension Dump Valve	Inboard RH frame rail, rear of the shock absorber crossmember	—	<i>Suspension Controls Connector End Views</i>

Suspension Controls Component Views

Instrument Panel Switches, Center Forward View



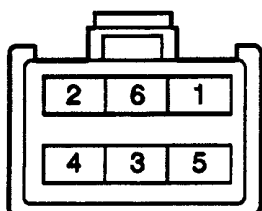
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Legend

- | | |
|--|--------------------------------|
| (1) Exhaust Brake Switch | (5) Air Suspension Dump Switch |
| (2) Fast Idle Switch | (6) Differential Lock Switch |
| (3) Heated Mirror Switch | (7) Clearance Lamps Switch |
| (4) Two Speed Rear Axle Shift Switch
(Automatic Transmission) | |

Suspension Controls Connector End Views

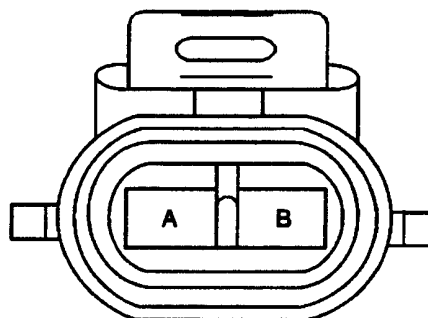
Air Suspension Dump Switch



231646

Connector Part Information		• 6 Way • Female	
Pin	Wire Color	Circuit No.	Function
1	PNK	121	Fuse Output-Ignition
2	BLU	122	Air Suspension Dump Valve Solenoid Feed
3-4	—	—	Not Used
5	BRN	123	Illumination
6	BLK/RED	124	Interior lamp Dimming Buss

Air Suspension Dump Valve Solenoid



35437

Connector Part Information		• 12052641 • 2 Way F Metri-Pack 150 Series (BLK)	
Pin	Wire Color	Circuit No.	Function
A	DK BLU	1944	Suspension Dump Valve Solenoid Feed
B	BLK	150	Ground

Diagnostic Information and Procedures

Rear Air Springs Do Not Deflate

Step	Action	Value(s)	Yes	No
1	• Turn the ignition switch to RUN. • Disconnect the air suspension dump switch. Does the Air Suspension Dump Solenoid Valve disengage?	—	Go to Step 2	Go to Step 3
2	Replace the air suspension dump solenoid valve switch. Is the Air Suspension Valve engaged at all times?	—	Go to Step 3	System OK
3	1. Disconnect the air suspension dump solenoid valve harness connector. 2. Connect a test lamp between terminals A and B of the Air Suspension Dump Valve connector. Does the test lamp light?	—	Go to Step 4	Go to Step 5
4	Locate and repair short to voltage in BLU (122, 65, 622, or 1944) circuit between the Air Suspension Dump Switch, the I/P Cluster, and the Air Suspension Dump Valve. Is the Air Suspension Dump Valve engaged at all times?	—	—	System OK
5	Replace the air suspension dump valve. Is the Air Suspension Dump Valve engaged at all times?	—	—	System OK

Air Suspension Dump Indicator Inoperative

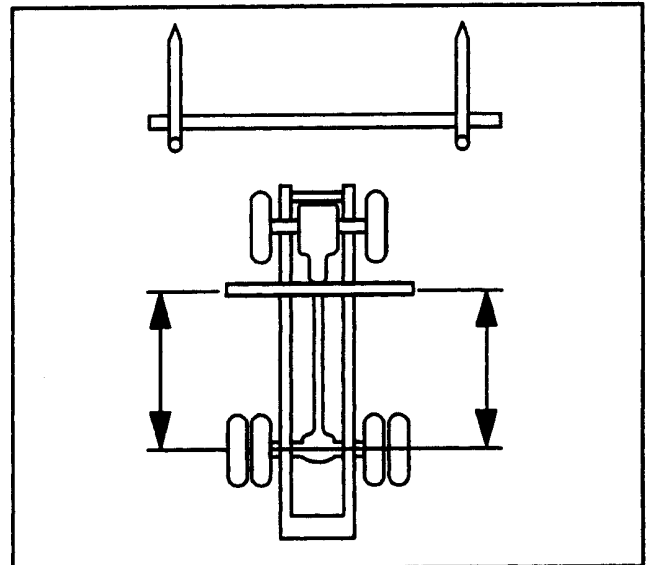
Step	Action	Value(s)	Yes	No
1	Activate the air suspension dump valve solenoid. Does the air suspension dump solenoid valve energize?	—	Go to Step 2	Refer to Air Suspension Dump Valve Does Not Engage
2	1. Connect a test lamp from BLU (65) wire at 13 Way I/P Harness connector (terminal E7) to ground. 2. Place the Ignition Switch in RUN. 3. Turn the air suspension dump switch ON. Does the test lamp light?	—	Go to Step 4	Go to Step 3
3	Locate and repair open in BLU (65) circuit between the I/P Harness connector and S266. Does the Air Suspension Dump Indicator Lamp function?	—	System OK	Go to Step 4
4	Connect a test lamp from BLU (65) wire (terminal E7) to BLK (68) wire (terminal E8) at 13 Way I/P Harness connector. Does the test lamp light?	—	Go to Step 5	Go to Step 6
5	Replace the Instrument Cluster. Does the Air Suspension Dump Indicator Lamp function?	—	System OK	—
6	Locate and repair open in BLK (68) circuit between the I/P Cluster and ground. Does the Air Suspension Dump Indicator Lamp function?	—	System OK	—

Repair Instructions

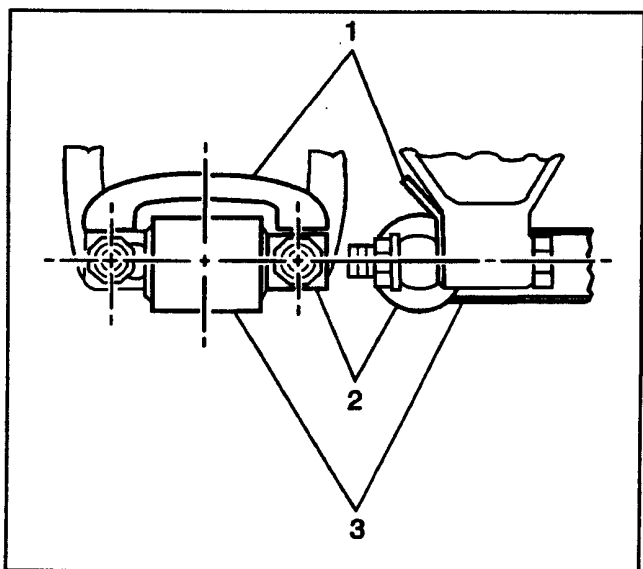
Suspension Alignment

Perform the following procedure after all of the repairs are completed and all of the suspension fasteners have been tightened to the specified torque values.

1. Place the vehicle on a level floor area. Free and center all of the suspension joints by slowly moving the vehicle back and forth several times without using the brakes.
2. Block the front wheels. Ensure that the vehicle breaks are released.
3. Securely clamp a nine foot piece of straight bar stock or angle iron across the frame using C-clamps.
Select a location as far forward of the drive axle as possible.
4. Use a square in order to align a straight edge to the frame.



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5. Use a trammel bar or its equivalent in order to measure from a straight edge to the center line of the drive axle on both sides of the vehicle.

- 5.1. If both sides measure within 4.8 mm (0.1875 in) of being equal, alignment of the rear axle is acceptable.

- 5.2. If both side measurements differ by more than 4.8 mm (0.1875 in), complete the following steps:

- 5.2.1. Loosen the rebound bolt locknut

- 5.2.2. Adjust the rear drive axle by loosening the torque rod bar pin locknuts on the spring hanger and add drop-in shims.

6. Mount the torque rod bar pin (2) adjacent to the forward face of the spring hanger legs. Do not use more than four shims (1) or 6.0 mm (0.25 in) total thickness.

7. Install the torque rod bar pin locknuts. Do not torque the locknuts to specification.

8. Follow the alignment of the drive axle and move the vehicle back and forth several times prior to removing the straight edge from the frame.

9. Reinspect the alignment in order to confirm the adjustments.

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

10. Tighten the torque bar rod pin locknuts.

Tighten

Tighten the torque bar rod pin locknuts to 203–278 N.m (150–205 lb ft).

11. Tighten the rebound bolt locknuts.

Tighten

Tighten the rebound bolt locknuts to 68–95 N.m (50–70 lb ft).

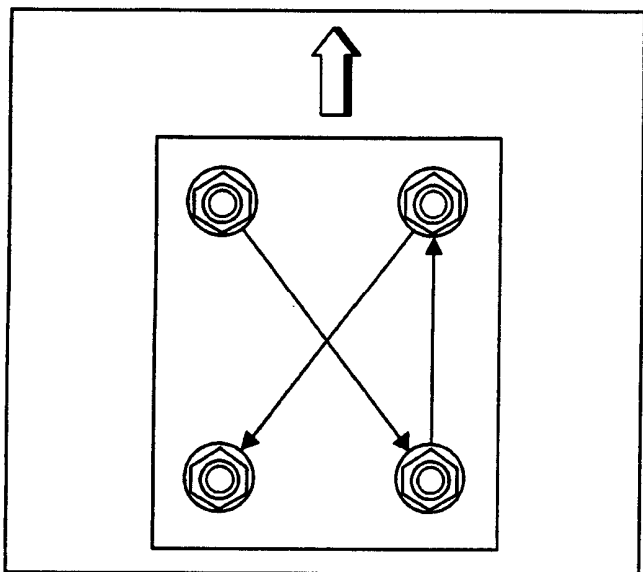
Preventive Maintenance

Use the following procedure when servicing a vehicle with a Hendrickson Suspension model HAS air suspension:

Notice: Check for proper seating of components to eliminate gaps or misalignment.

Notice: If the tightening torques recommended are not achieved and maintained, metal surfaces can work and wear the spring seats, axle bottom caps and possibly other components related in the total assembly.

1. Torque the U-bolt nuts at preparation for delivery.
2. Retorque the U-bolt locknuts at 3 000 km (2,000 miles).
3. Inspect and retorque the U-bolt locknuts at regular intervals. Do not exceed 10 400 km (6,500 miles) between inspection intervals.



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4. Use the following procedure in order to replace the U-bolts or other components:

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

- 4.1. Evenly torque the U-bolt locknuts.

Tighten

Tighten the locknuts in 37 N.m (50 lb ft) increments in order to achieve uniform bolt tension and correct (level) attitude of the main support beam, the spring seat, and the axle bottom cap at the final torque.

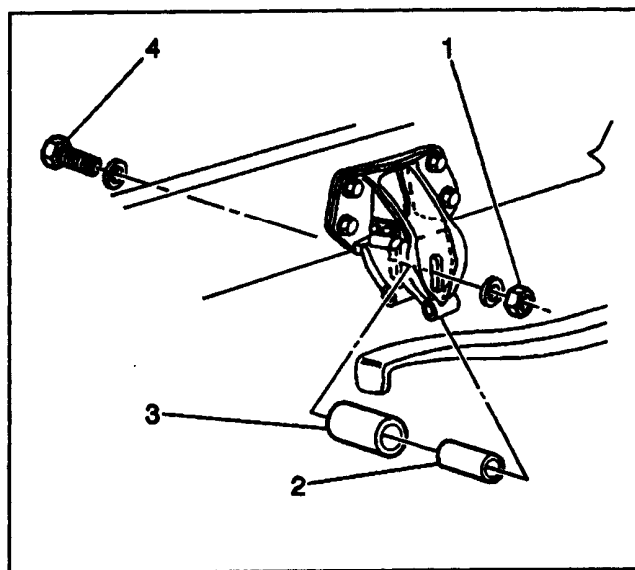
Notice: Check for proper seating of components to eliminate gaps or misalignment.

- 4.2. Drive the vehicle in order to seat the components.
- 4.3. After the road test, retorque the U-bolt locknuts to the specified torque.
- 4.4. Retorque the U-bolt locknuts at 3 000 km (2,000 miles) following service.
- 4.5. Inspect and retorque the U-bolt locknuts at regular intervals. Do not exceed 10 400 km (6,500 miles) between inspection intervals.

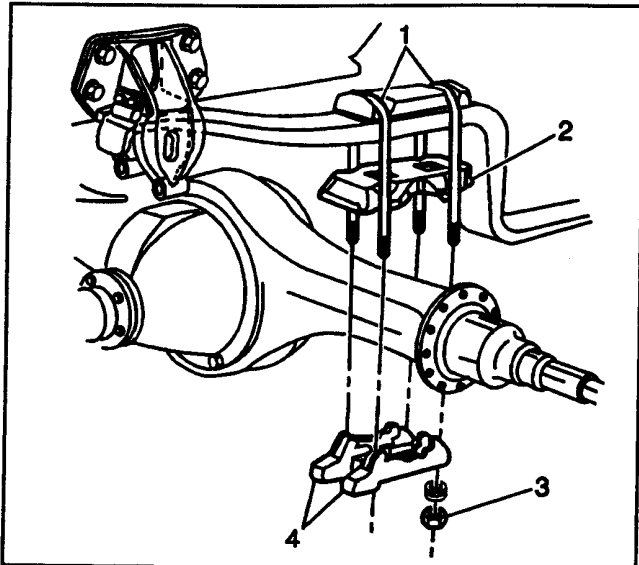
Main Support Beam

Removal Procedure

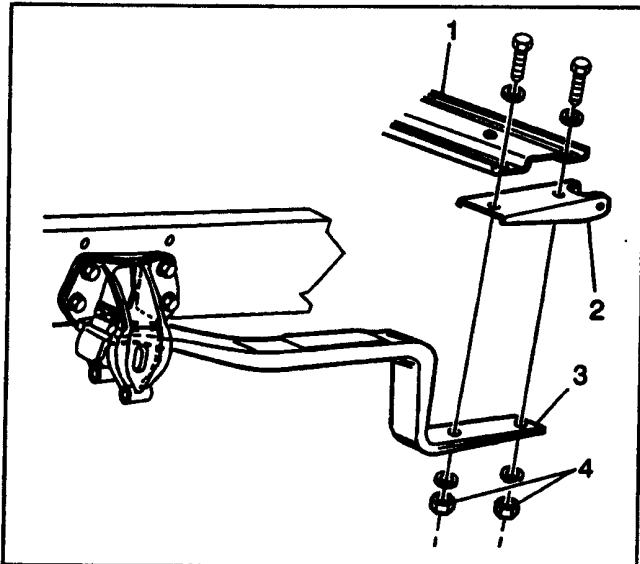
1. Block the wheels of the axle.
2. Support the axle using jack stands.
3. Drain the air pressure from the air springs.
4. Remove the height control valve link from the valve.
5. Remove the following components from the spring hanger:
 - The rebound bolt (4)
 - The locknut (1)
 - The washers
 - The spacer tube (2)
 - The rebound roller (3)
6. Raise the rear of the frame far enough in order to remove the load from the main support beam.



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7. Remove the U-bolt locknuts (3) and the washers.
8. Remove the following components:
 - The U-bolts (1)
 - The bottom pads (4)
 - The top pad (2)

9. Remove the locknuts (4) and the washers that connect the cross channel (1) to both of the main support beams (3).
10. Lift the cross channel off of the main support beam using jacks.
11. Remove the main support beam assembly.

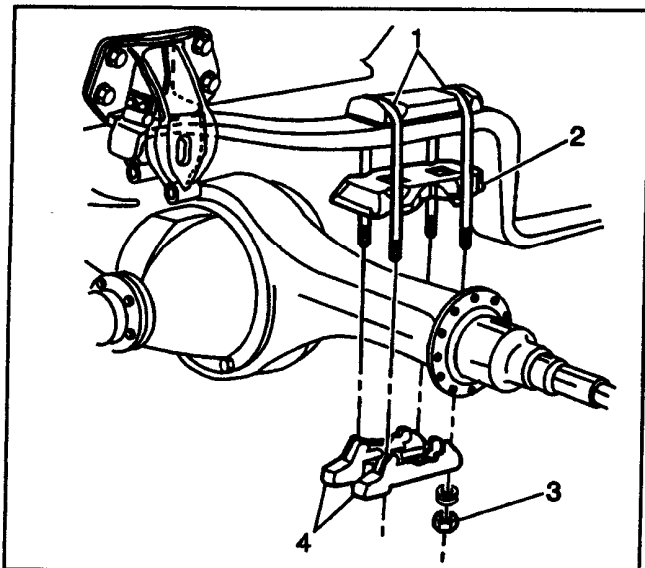
Installation Procedure

Important: The Delrin liner must be positioned on the top side of the main support beam.

1. Position the main support beam on the axle seat with the main support beam center dowel pin. Pilot the main support beam into the hole of the axle seat or the spacer plate.

Important: Do not tighten the U-bolts at this time. Position the torque rod mounting bolts of the spring seats toward the front of the vehicle.

2. Install the following components:
 - The top pad (2)
 - The U-bolts (1)
 - The bottom cap (4)
 - The washers
 - The locknuts (3)



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3. Lower the air spring and the cross channel mounting bolts into the main support beams (3).

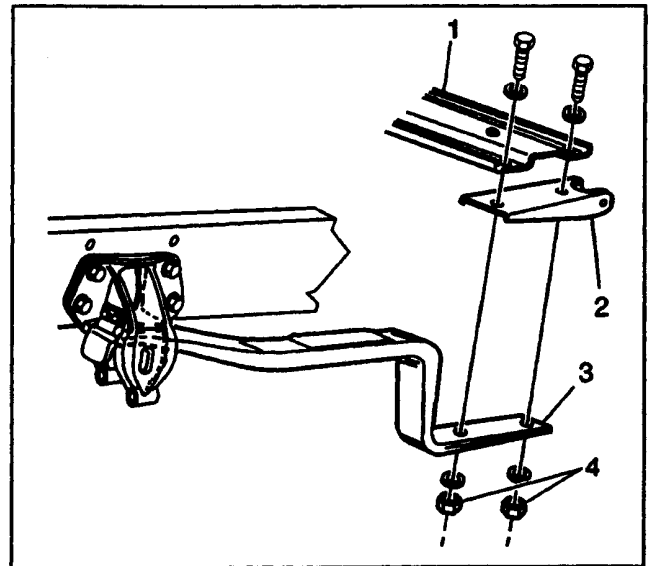
Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the washers and the locknuts (4) that connect the cross channel (1) to the main support beam (3).

Tighten

Tighten the locknuts in 37 N.m (50 lb ft) increments to 330 N.m (243 lb ft).

5. Lower the frame in order to ensure that the spring hangers engage the main support beam.
6. Refill air into the system.
7. Center the tip of the main support beam between the spring hanger legs.



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Important: Do not exceed the specified torque on the U-bolt locknuts.

8. Tighten the U-bolt nuts.

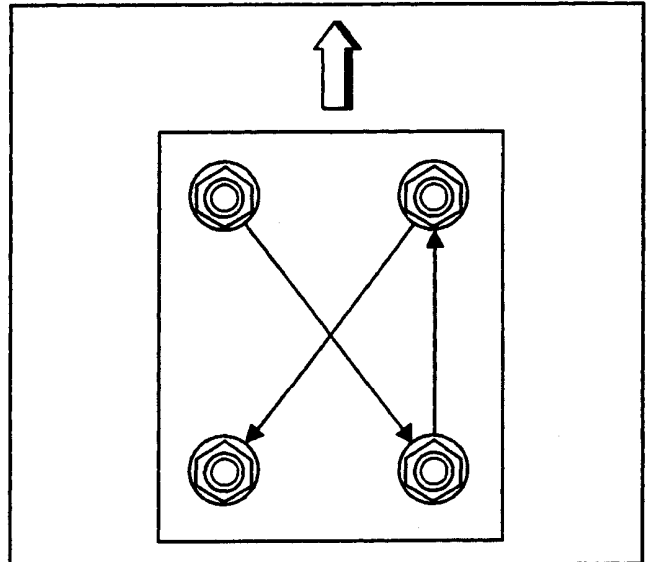
Tighten

Tighten the U-bolt nuts in 37 N.m (50 lb ft) increments to 353–434 N.m (260–320 lb ft).

9. Hit the top of the U-bolts using a hammer. Retighten the U-bolt nuts.

Tighten

Retighten the U-bolt nuts in 37 N.m (50 lb ft) increments to 353–434 N.m (260–320 lb ft).



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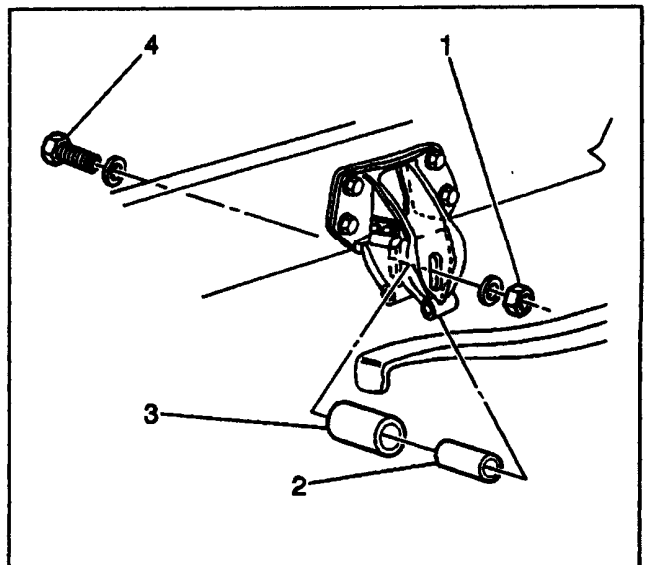
10. Install the following components in the hangers:

- The rebound bolt (4)
- The spacer tube (2)
- The rebound roller (3)
- The washers
- The locknuts (1)

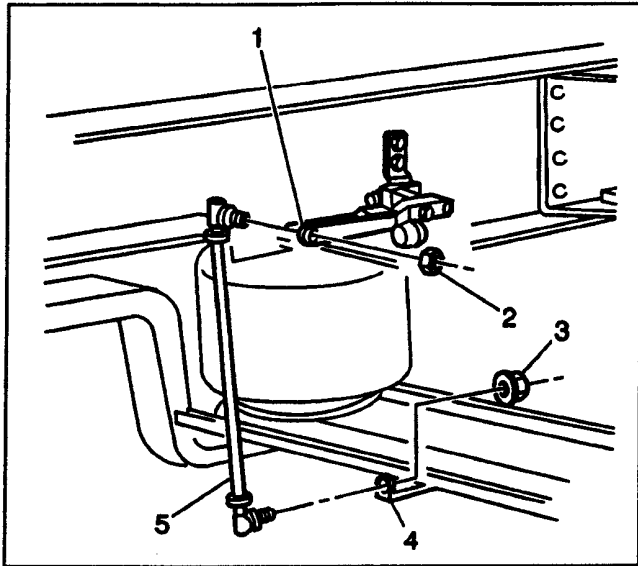
Tighten

Tighten the rebound bolt locknut to 68–95 N.m (50–70 lb ft).

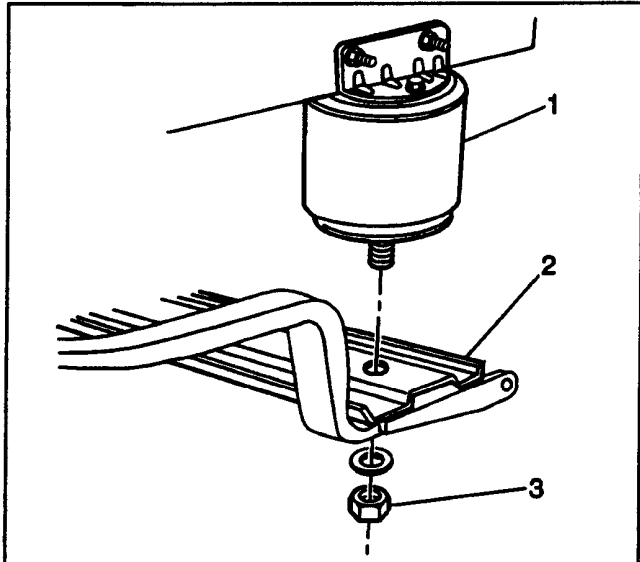
11. Unblock the wheels.
12. Inspect the alignment after installing the new main support beams.



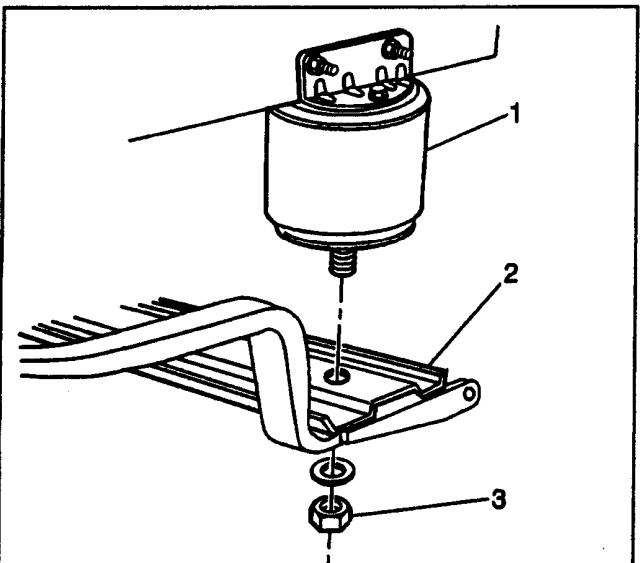
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Cross Channel Replacement

Removal Procedure

1. Block the wheels of the axle.
2. Remove the locknuts (2,3) and the washer that connects the height control valve link (5) to the valve (1).
3. Remove the height control valve link (5) from the control valve (1).
4. Drain the air pressure from the air springs.
5. Raise the frame of the vehicle in order to remove the load from the suspension.
6. Support the frame using jack stands.

7. Remove the locknut (3) and the washer that connect the air spring (1) to the cross channel (2) and to both of the main support beams.
8. Raise the cross channel using jacks, if required.

Installation Procedure

1. Connect the cross channel (2) to both of the air springs (1).
2. Lower the frame.
3. Pilot the bolt holes onto the main support beam.

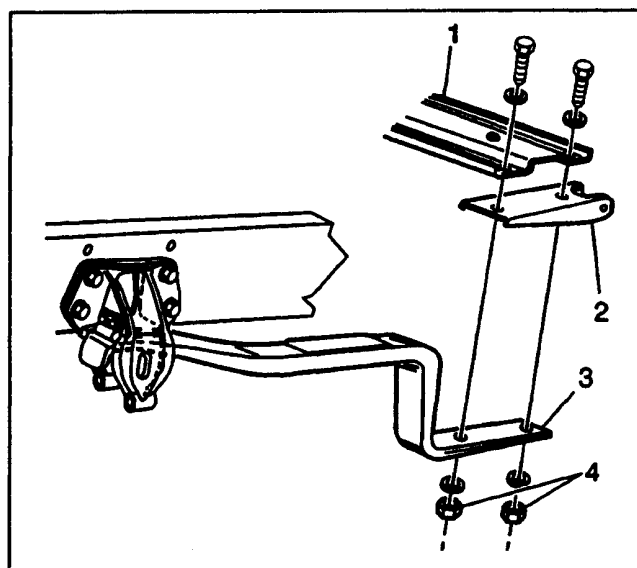
Notice: Refer to *Fastener Notice* in Cautions and Notices.

4. Install the washers and the locknuts (4) that connect the cross channel (1) to the main support beam (3).

Tighten

Tighten the locknuts in 37 N.m (50 lb ft) increments to 330 N.m (243 lb ft).

5. Refill the system with air.
6. Unblock the wheels.

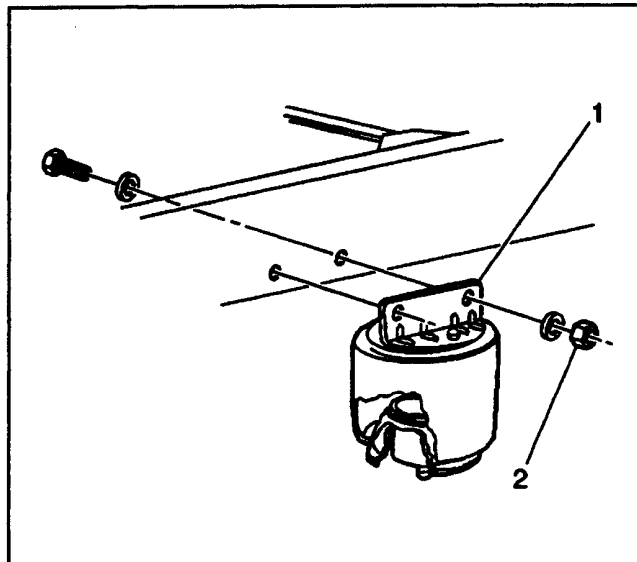


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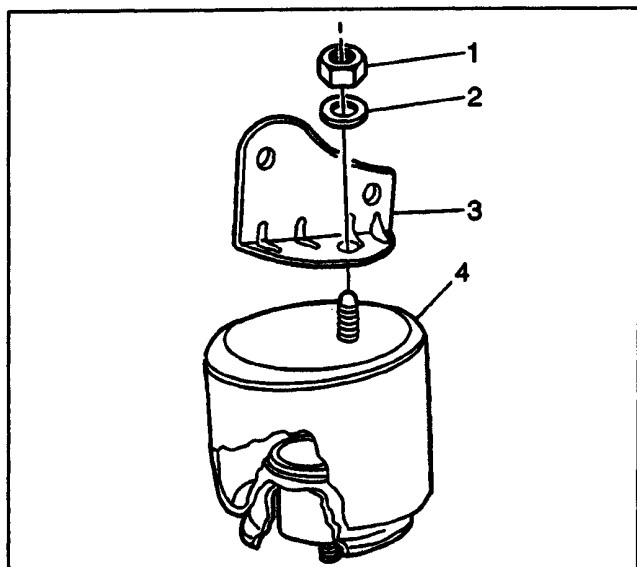
Air Spring Frame Hanger Replacement

Removal Procedure

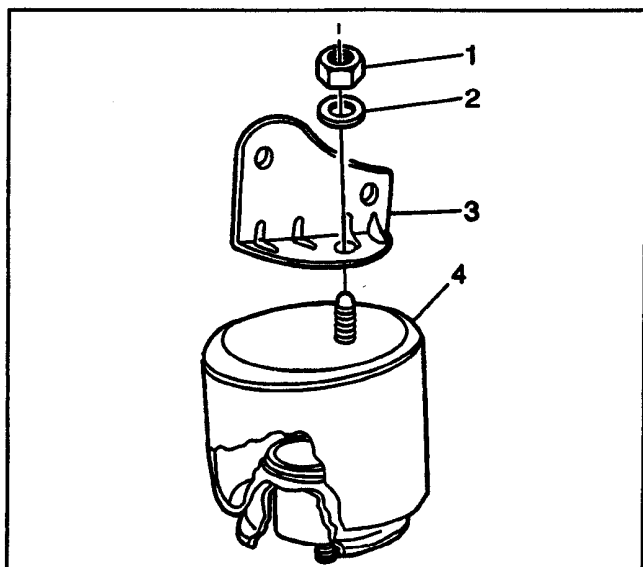
1. Block the front wheels.
2. Drain the air pressure from the air springs.
3. Raise the frame of the vehicle in order to remove the load from the suspension.
4. Remove the air lines that connect to the air spring.
5. Remove the brass air fittings from the air spring.
6. Remove the locknuts (2) and the washers that connect the air spring (1) bracket to the frame side rail.
7. Remove the locknut (1) and the washer (2) that connect the air spring (4) to the air spring frame hanger (3).
8. Remove the air spring frame hanger (3).



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Installation Procedure

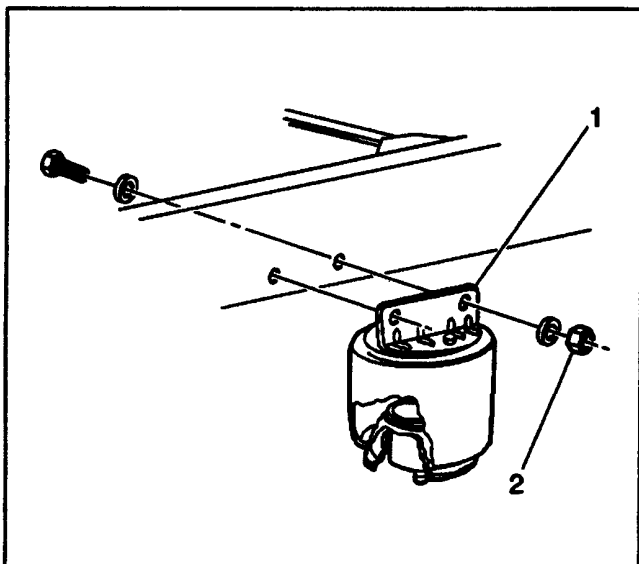
1. Connect the air spring frame hanger (3) to the top of the air spring (4).

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

2. Install the following components that connect the air spring frame hanger (1) to the frame:
 - The bolts
 - The washers
 - The locknuts (2)

Tighten

Tighten the locknuts in 37 N·m (50 lb ft) increments to 300–360 N·m (221–266 lb ft).



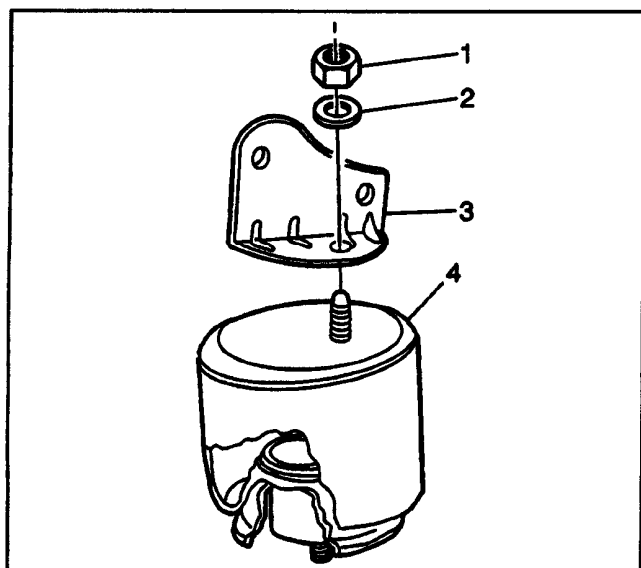
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3. Install the washer (2) and the locknut (1) that connect the air spring (4) to the air spring frame hanger (3).

Tighten

Tighten the air spring to air spring frame hanger locknut to 27–41 N·m (20–30 lb ft).

4. Install the brass air fitting to the air spring using a Teflon® thread seal.
5. Unblock the wheels.
6. Refill the system with air.



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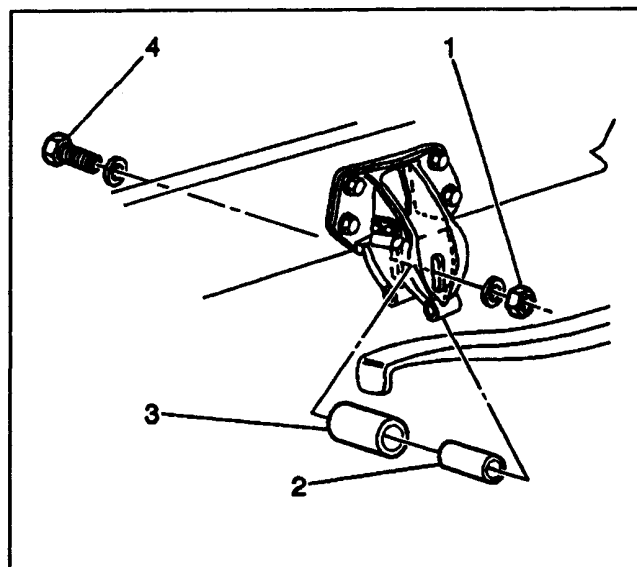
Spring Hanger Bracket Insulator Replacement

Removal Procedure

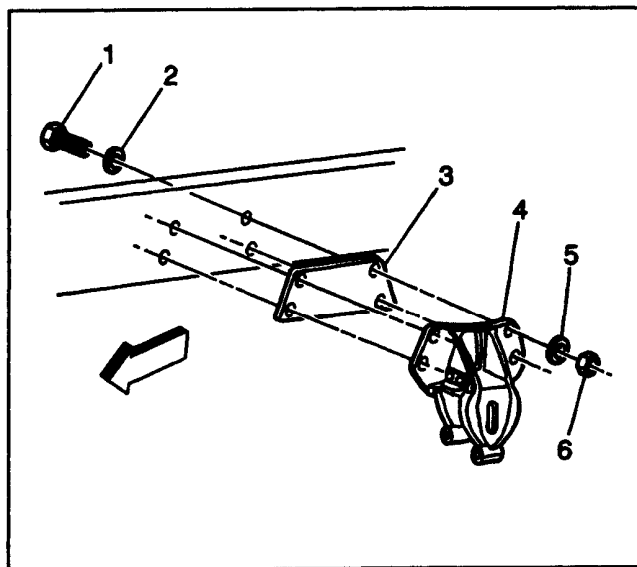
1. Block the wheels of all of the axles.
2. Support the frame using frame stands.
3. Support the axles using jack stands.
4. Drain the air pressure from the air springs.
5. Remove the following components:
 - The rebound bolt (4)
 - The locknut (1)
 - The washers
 - The spacer tube (2)
 - The rebound roller (3)

Important: The torque rods may remain in place.

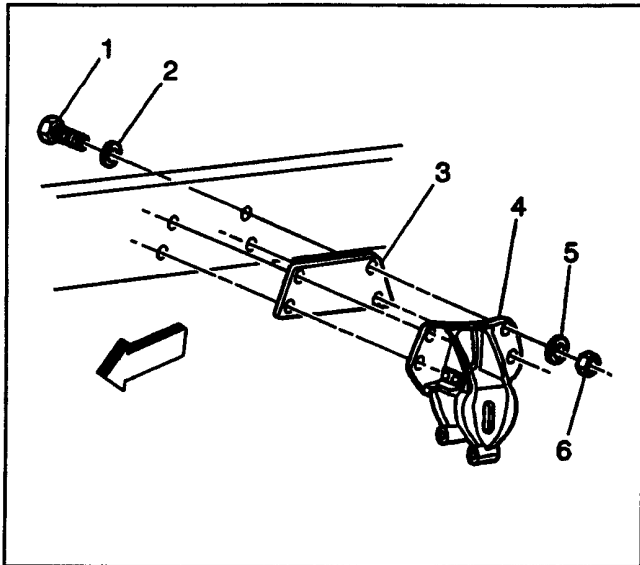
6. Apply an upward force on the cross tube or lower air spring brackets using a jack or a pry bar. The tips of the main support beams will drop away from the cam surface of the spring hanger brackets.
7. Remove the following components:
 - The insulator fasteners (1,2,5,6)
 - The reinforcement plates
 - The insulator pads (3)



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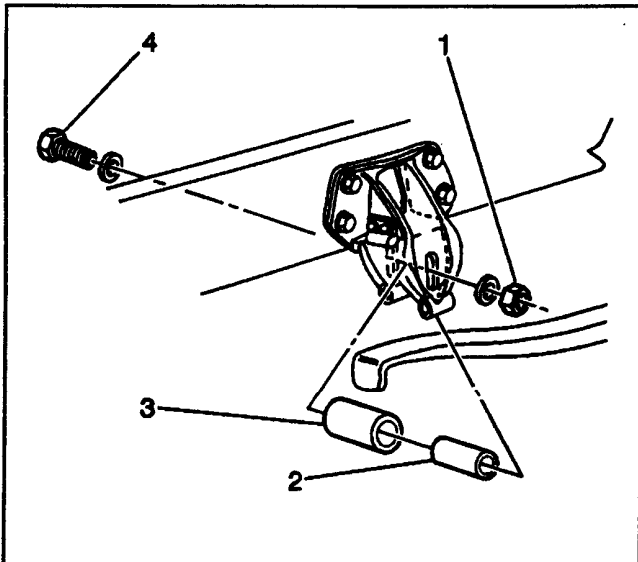
Installation Procedure

1. Place a new insulator pad on the spring hanger (4).

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

2. Place the retainer plate over the insulator pad.
Tighten

Tighten the 10 mm (0.375 in) hex head self-tapping screws to 34 N·m (25 lb ft).



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3. Release the jack or pry bar on the cross tube or on the lower air spring brackets. Allow the main support beams to come up to the new insulator pads.

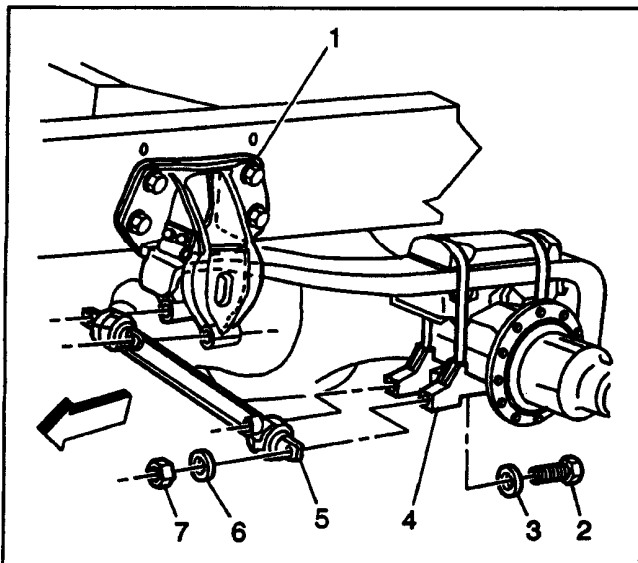
4. Install the following components:

- The rebound rollers (3)
- The spacers (2)
- The rebound bolts (4)
- The washers
- The locknuts (1)

Tighten

Tighten the rebound bolt locknuts to 68–95 N·m (50–70 lb ft).

5. Unblock the wheels.



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Torque Rod Replacement**Removal Procedure**

1. Block the wheels of the drive axles.
2. Remove the torque rod bar pin locknuts (7) and the washers (6) at the axle end of the torque rod (5).
3. Loosen the rebound bolt locknut in the spring hanger (1).

Important: Note the number of shims. Reinstall the shims in the same manner in order to avoid affecting the alignment.

4. Remove the following components at the spring hanger ends of the torque rod:

- The torque rod bar pin locknuts (7)
- The bolts
- The washers (6)
- The alignment shims

Installation Procedure

1. Position the new or rebushed torque rod into the spring seat (4).
2. Install the washers (6) and the torque rod locknuts (7). Tighten the locknuts by hand.
3. Position the torque rod on the forward face of the spring hanger legs.

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

4. Install the following components:

- The bolts
- The washers
- The alignment shims
- The locknuts

Tighten

- Tighten the torque rod locknuts to 203–278 N.m (150–205 lb ft).
- Tighten the rebound bolt locknuts to 68–95 N.m (50–70 lb ft).
- Tighten the torque rod locknuts, at the axle end of the torque rod, to 203–278 N.m (150–205 lb ft).

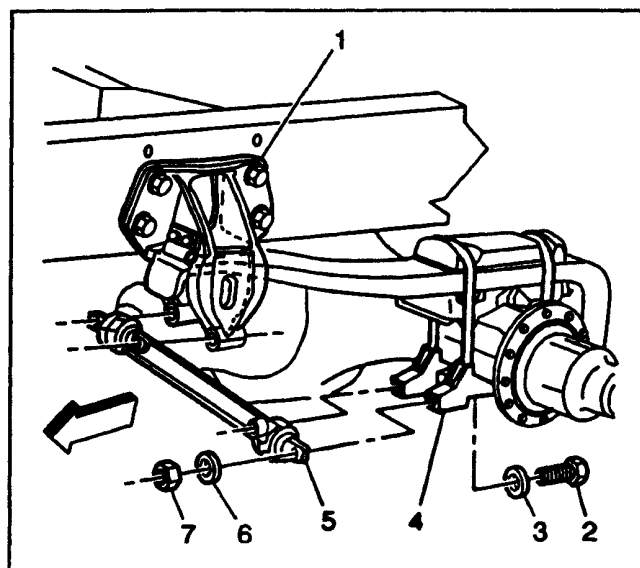
5. Unblock the wheels.

Torque Rod Bushing Replacement**Removal Procedure**

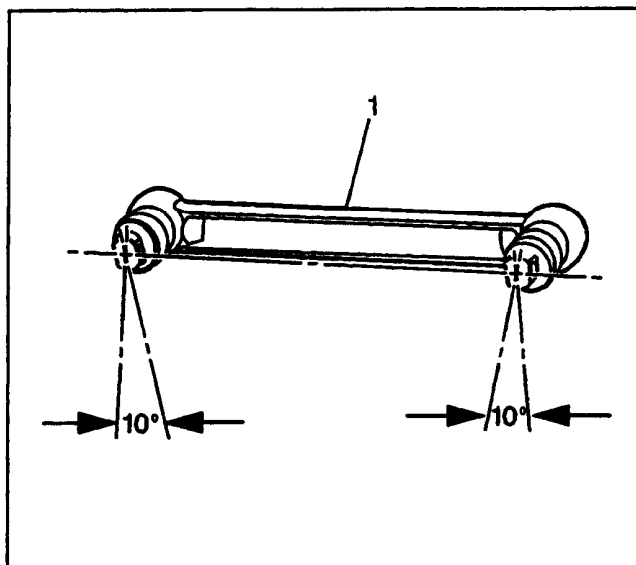
1. Use a press with a minimum capacity of 10 tons.
2. Support the torque rod (1) on a piece of 6 mm (0.25 in) wall steel tubing that is 127 mm (5 in) long with an inside diameter of 50.8 mm (2 in).

Notice: Do not use heat or a cutting torch to remove the bushings from the torque rod. The use of heat will adversely affect the strength of the torque rod.

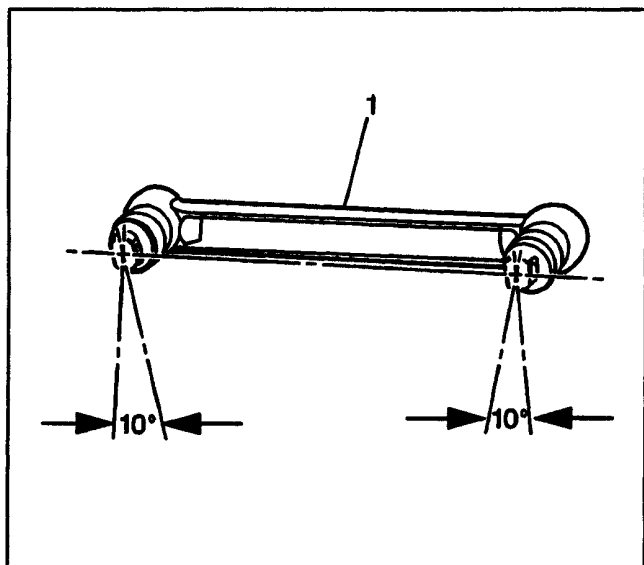
3. Remove the bushing from the torque rod by pushing directly on the bar pin of the bushing.
4. Inspect the inside diameter of the ends of the torque rods.
5. Remove any nicks and small scratches from the bore of the torque rod. Use an emery cloth.



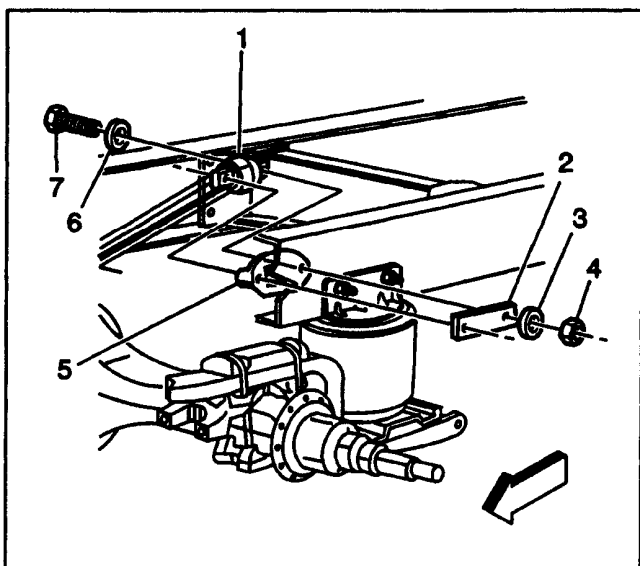
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Installation Procedure

Important: Do not use a petroleum or a soap base lubricant.

1. Lubricate the inside diameter of the torque rod (1) and the new bushing using a vegetable base oil, such as cooking oil.

Notice: If the tightening torques recommended are not achieved and maintained, metal surfaces can work and wear the spring seats, axle bottom caps and possibly other components related in the total assembly.

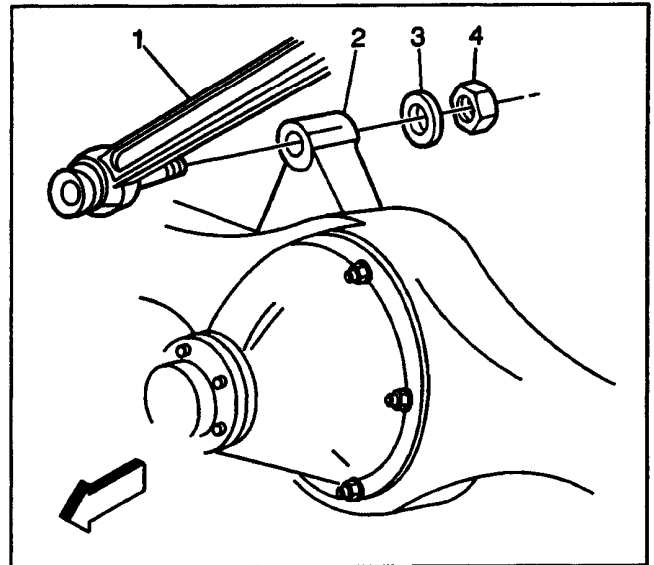
2. Support the torque rod on a piece of steel tubing during assembly. Center the bore of the torque rod in the tubing.
3. Place the bushing in the bore of the torque rod in order to position the mounting flats of the bar pin 10 degrees counterclockwise to the shank of the rod.
4. Press the bushing into the torque rod in order to extend the bushing 4.8 mm (0.1875 in) on the opposite side of the torque rod.
5. Turn the torque rod over and press on the bar pin in order to center the bushing into the bore of the torque rod.

Transverse Rod Replacement (with RPO-GPG)

Removal Procedure

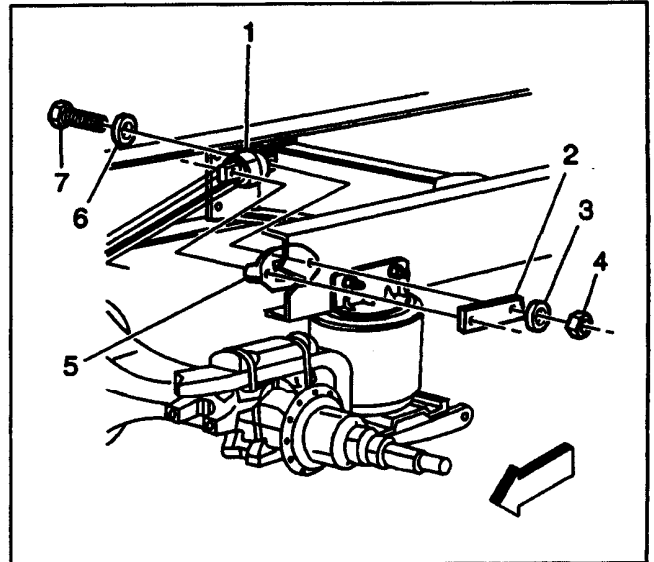
1. Remove the locknuts (4) and the washers (3) that connect the transverse rod (1) to the frame.

2. Remove the locknuts (4) and the washers (3) that fasten the transverse rod (1) to the axle housing (2).
3. Remove the transverse rod (1).



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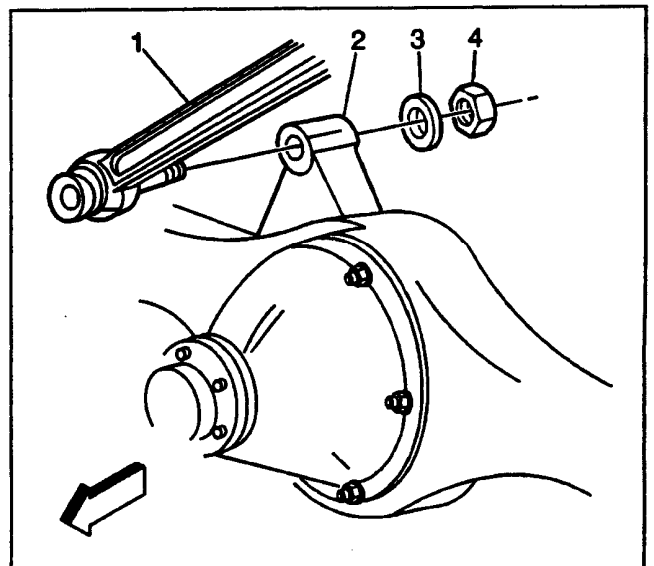
4. Remove the transverse rod bracket from the frame.
5. Inspect the transverse rod bushings. If the transverse rod bushings are worn or damaged, remove the bushing from the transverse rod (1).



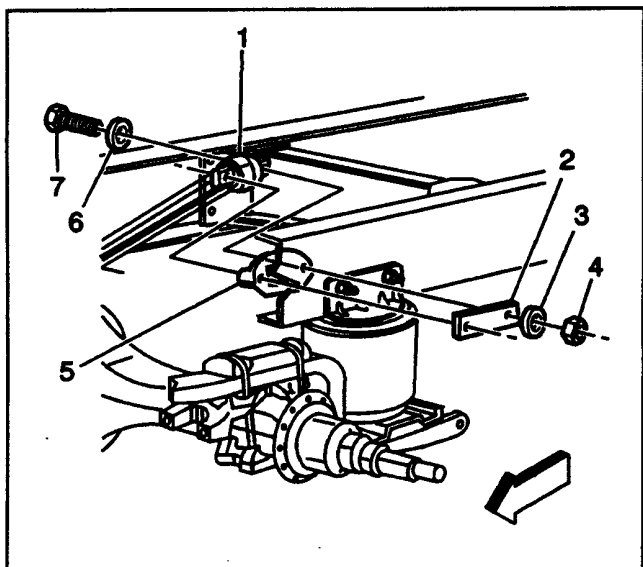
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Installation Procedure

1. Install the bushings in the transverse rod.
2. Position the transverse rod (1) in the bracket on the axle housing (3).



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

3. Install the following components:

- The transverse rod bolt (7)
- The washers (6)
- The locknuts (4) that fasten the rod to the bracket

Tighten

Tighten the locknut to 474–542 N.m (350–400 lb ft) for models with RPO-GPG.

4. Install the following components:

- The reinforcement bolts
- The washers
- The locknuts that fasten the torque rod and the bracket to the frame

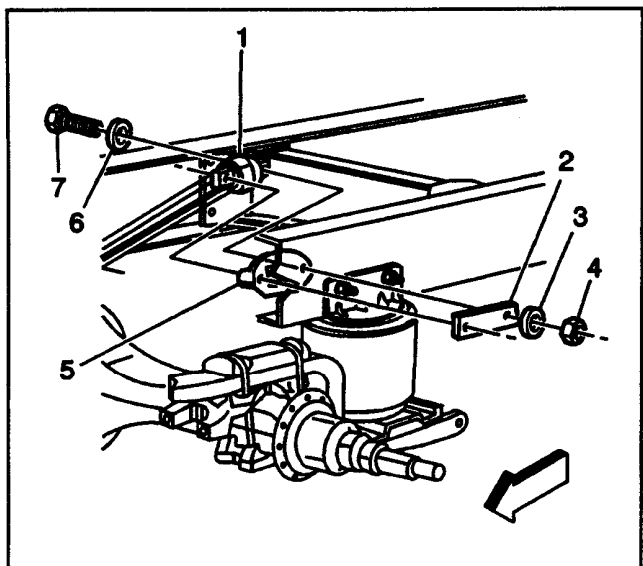
Tighten

Tighten the rod bar pin nuts to 285–310 N.m (210–229 lb ft).

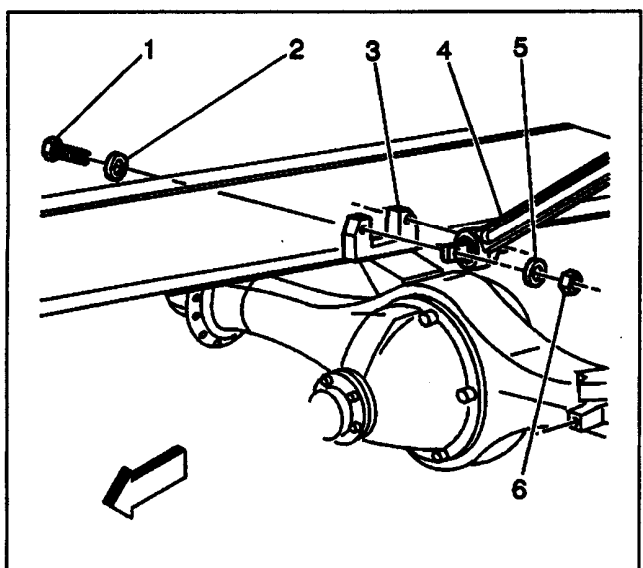
Transverse Rod Replacement (without RPO-GPG)

Removal Procedure

1. Remove the locknuts (4) and the washers (3) that connect the transverse rod (1) to the frame.



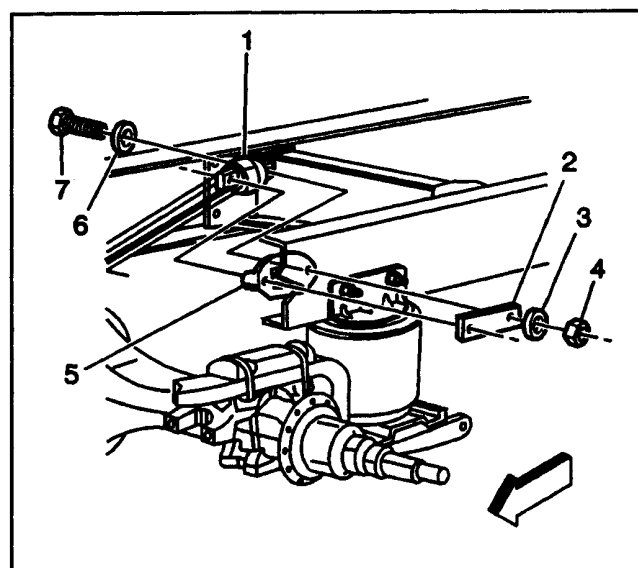
200688



200691

2. Remove the locknuts (6) and the washers (2,5) that fasten the transverse rod (4) to the axle housing (3).
3. Remove the transverse rod (4).

4. Remove the transverse rod bracket from the frame.
5. Inspect the transverse rod bushings. If the transverse rod bushings are worn or damaged, remove the bushing from the transverse rod (5).



200688

Installation Procedure

1. Install the bushings in the transverse rod.
2. Position the transverse rod (1) in the bracket on the axle housing (2).

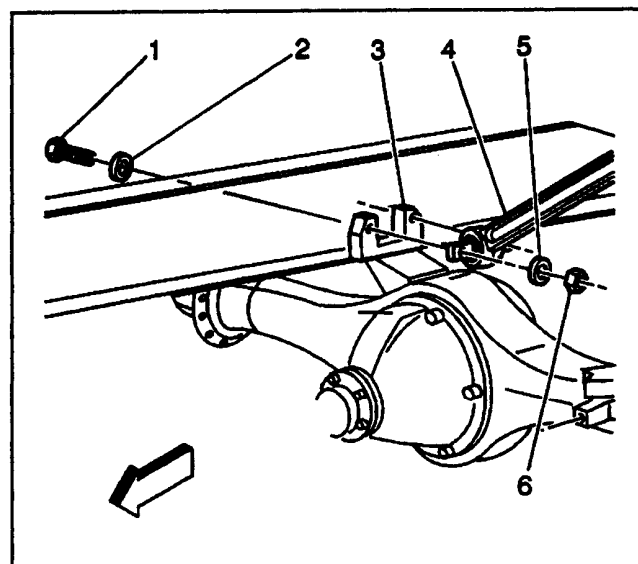
Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the following components:

- Transverse rod bolts (1)
- The washers (2)
- The locknuts (6) that fasten the rod to the bracket

Tighten

Tighten the locknut on the transverse rod taper pin to 285–310 N.m (210–229 lb ft) for models without RPO-GPG.



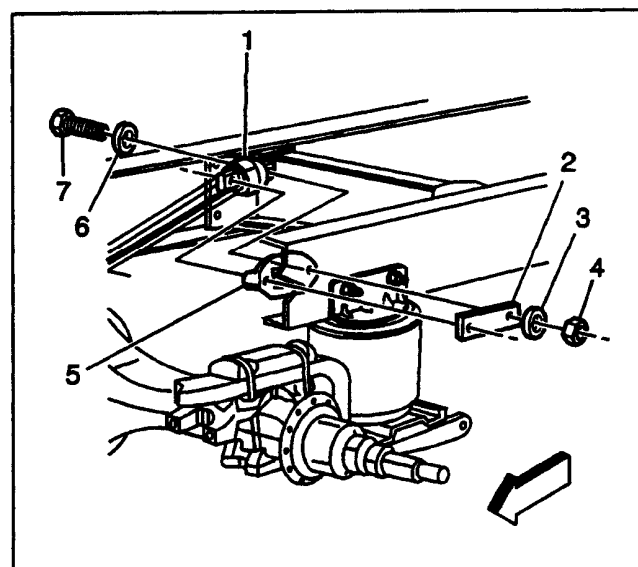
200691

4. Install the following components:

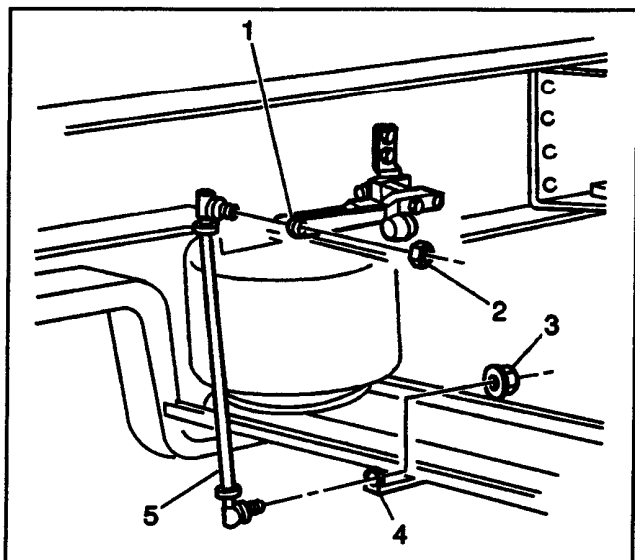
- The reinforcement bolts
- The washers
- The locknuts

Tighten

Tighten the pin nuts on the transverse rod bar to 285–310 N.m (210–229 lb ft).



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Height Leveling Valve Replacement (with RPO-GPG)

Removal Procedure

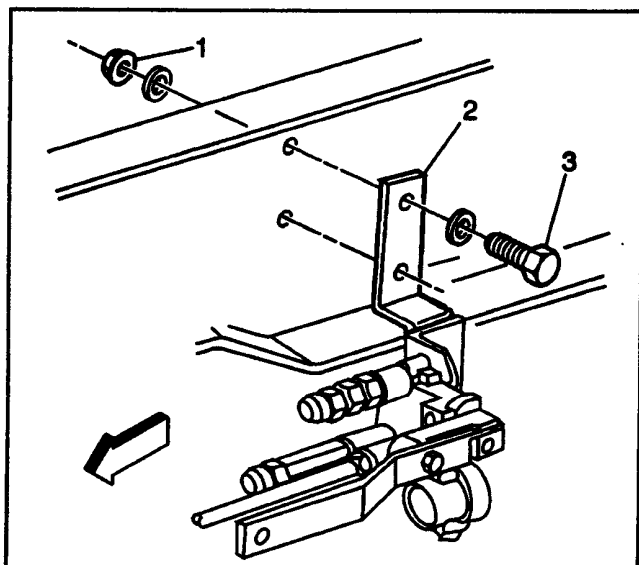
1. Drain all of the air from the air supply system.
2. Mark both of the air lines to the leveling valve.
3. Remove the valve locknut (2) that fastens the control valve link (5) to the control valve (1).

4. Remove the following components:

- The leveling valve locknuts (1)
- The washers
- The bolts (3)

5. Remove the height leveling valve (2).

6. Remove the brass air fittings from the height leveling valve.



200696

Installation Procedure

1. Install the brass air fitting on the leveling valve.
2. Connect the leveling valve in position on the frame.

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

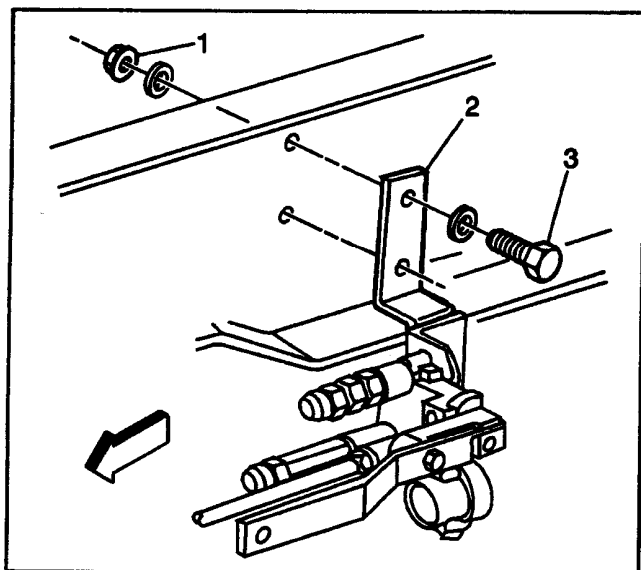
3. Install the following components:

- The leveling valve locknuts (1)
- The washers
- The bolts (3)

Tighten

Tighten the leveling valve mounting locknuts to 68–95 N.m (50–70 lb ft) for models with RPO-GPG.

4. Connect the leveling valve air lines to the correct ports on the leveling valve.



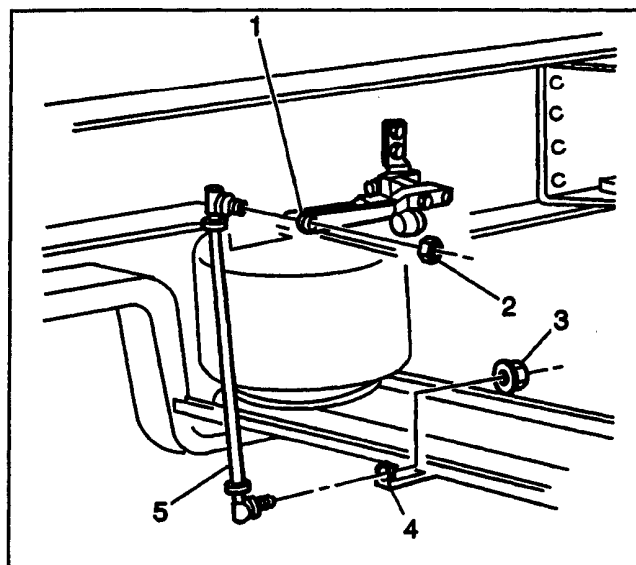
200696

5. Connect the control valve link (5) to the control valve (1).
6. Install the locknut that connects the control valve link to the control valve.

Tighten

Tighten the locknut on the control valve link to 21–25 N.m (15–18 lb ft).

7. Apply air pressure and inspect the valve for leaks.

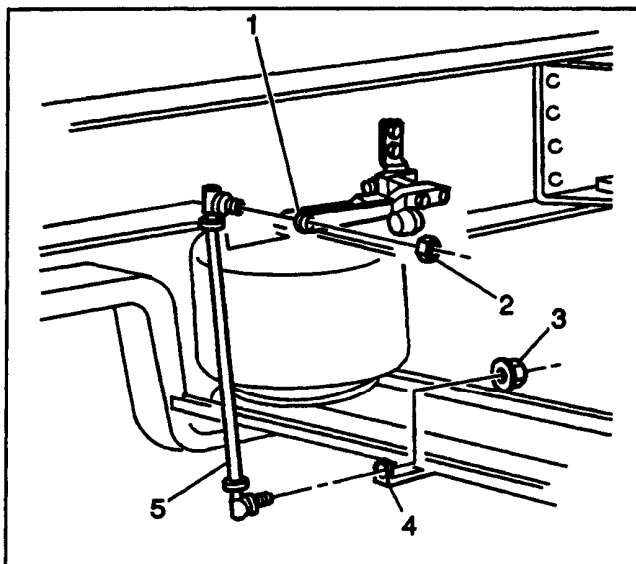


200667

Height Leveling Valve Replacement (without RPO-GPG)

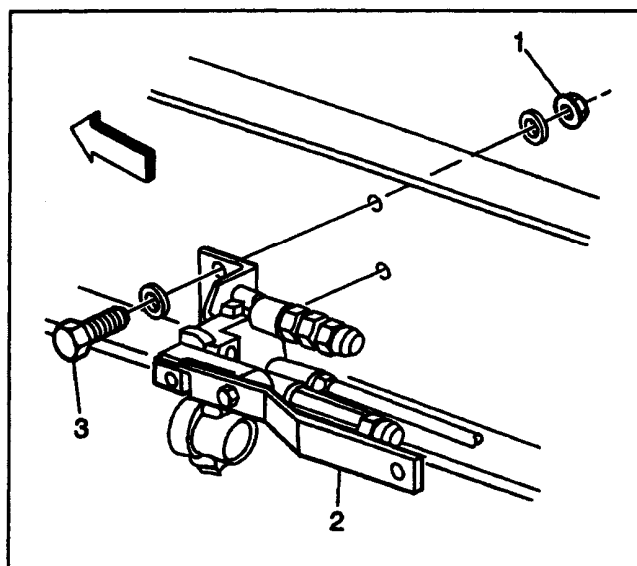
Removal Procedure

1. Drain all of the air from the air supply system.
2. Mark both of the air lines to the leveling valve.
3. Remove the valve locknut (2) that fastens the control valve link (5) to the control valve (1).

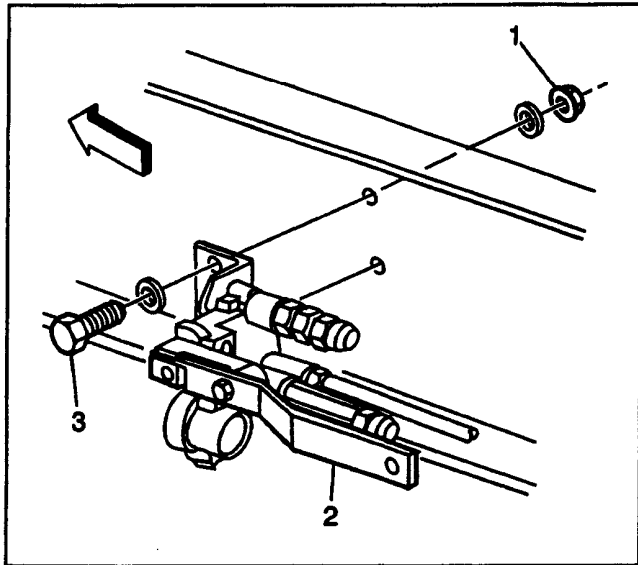


200667

4. Remove the following components:
 - The leveling valve locknuts (1)
 - The washers
 - The bolts (3)
5. Remove the height leveling valve (2).
6. Remove the brass air fittings from the height leveling valve.



200699



200699

Installation Procedure

1. Install the brass air fitting on the leveling valve.
2. Connect the leveling valve in position on the frame.

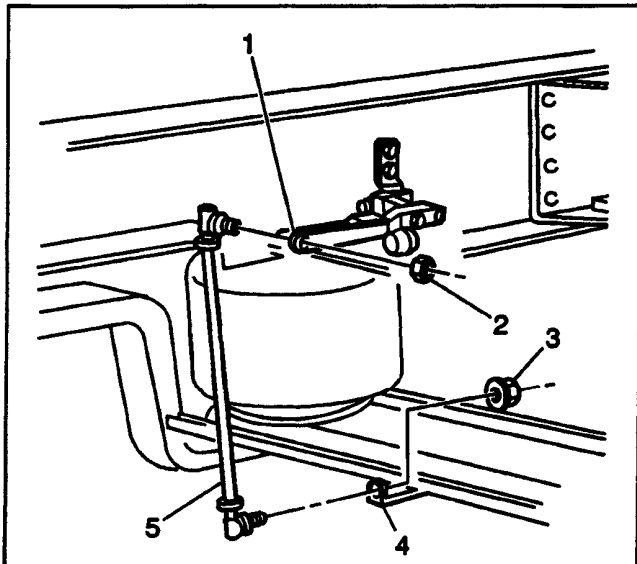
Notice: Refer to *Fastener Notice* in Cautions and Notices.

3. Install the following components:
 - The leveling valve locknuts (1)
 - The washers
 - The bolts (3)

Tighten

Tighten the leveling valve mounting locknuts to 82–108 N.m (60–80 lb ft) for models without RPO-GPG.

4. Connect the leveling valve air lines to the correct ports on the leveling valve.



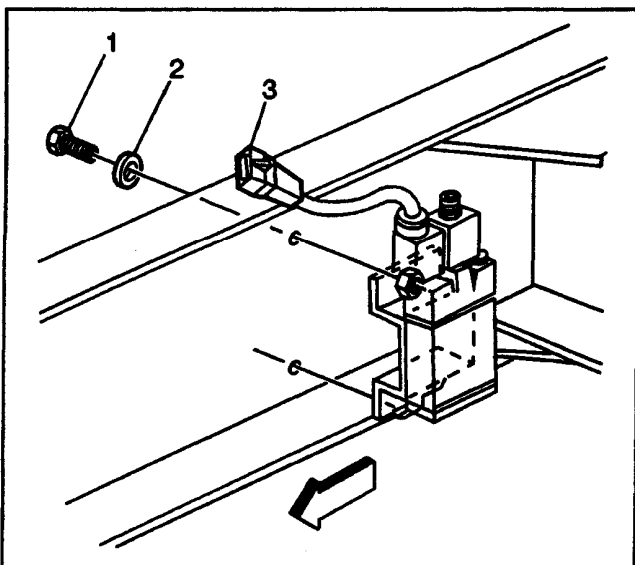
200687

5. Connect the control valve link (5) on the control valve (1).
6. Install the locknut that connects the control valve link to the control valve.

Tighten

Tighten the locknut to 21–25 N.m (15–18 lb ft).

7. Apply air pressure. Inspect the valve for leaks.



200700

Air Suspension Relief Valve Replacement**Removal Procedure**

1. Drain all of the air from the air supply system.
2. Mark the lines to the air suspension relief valve.
3. Disconnect the electrical connector (3) at the air suspension relief valve.
4. Remove the following components:
 - The air suspension relief valve mounting bolts (1)
 - The washers (2)
 - The air suspension relief valve

Installation Procedure

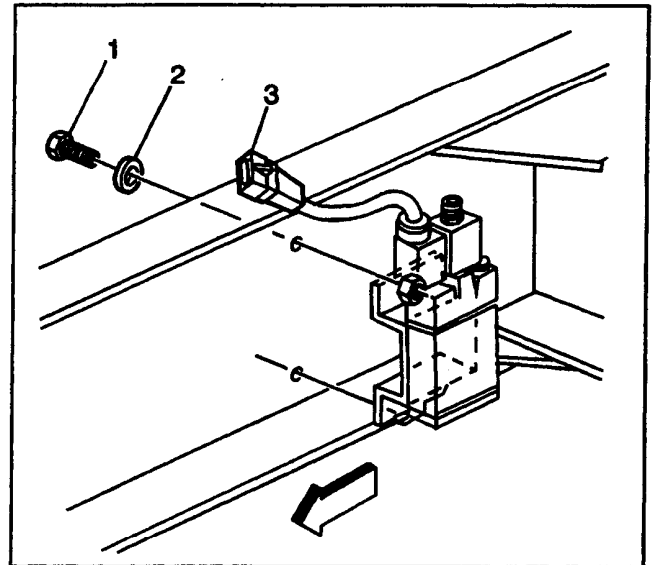
Notice: Refer to *Fastener Notice* in Cautions and Notices.

1. Install the following components:
 - The air suspension relief valve
 - The washers (2)
 - The air suspension relief valve mounting bolts (1)

Tighten

Tighten the bolts to 15–20 N.m (11–15 lb ft).

2. Connect the electrical connector (3) to the air suspension relief valve.
3. Connect the air lines of the air suspension relief valve to the correct ports on the air suspension relief valve.
4. Operate the vehicle in order to charge the air supply system and to ensure that the valve does not leak.

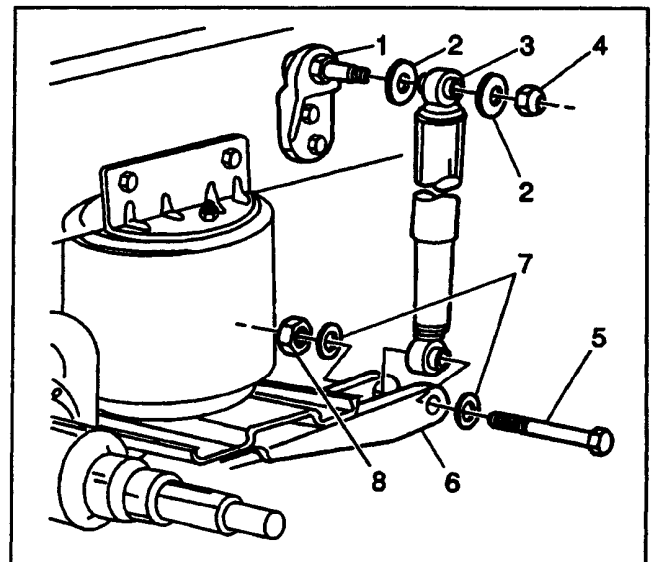


200700

Shock Absorber Replacement

Removal Procedure

1. Remove the locknut (4) and the washers (2) that connect the shock absorber (3) to the shock absorber outboard frame hanger bracket (1).
2. Remove the following components that connect the shock absorber (3) to the lower shock absorber bracket (6):
 - The locknut (8)
 - The washers (7)
 - The bolt (5)
3. Remove the shock absorber (3).



200680

Installation Procedure

1. Install the shock absorber (3).
- Notice:** Refer to *Fastener Notice* in Cautions and Notices.
2. Install the washers (2) and the locknut (4) that connect the shock absorber (3) to the upper shock absorber mounting bracket.

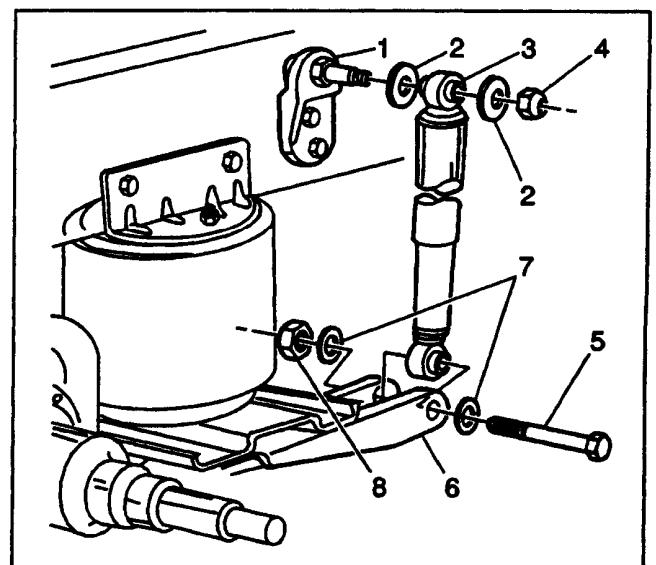
Tighten

Tighten the locknut to 68–95 N.m (50–70 lb ft).

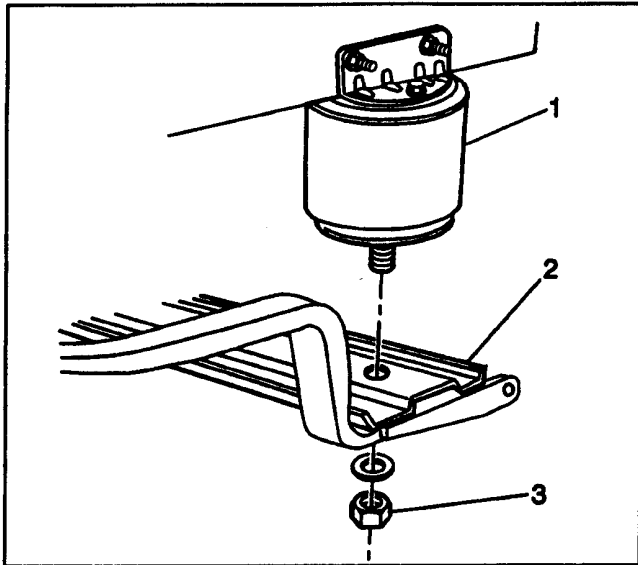
3. Install the following components that connect the shock absorber (3) to the lower shock absorber bracket (6):
 - The bolt (5)
 - The washers (7)
 - The locknut (8)

Tighten

Tighten the locknut to 68–95 N.m (50–70 lb ft).



200680



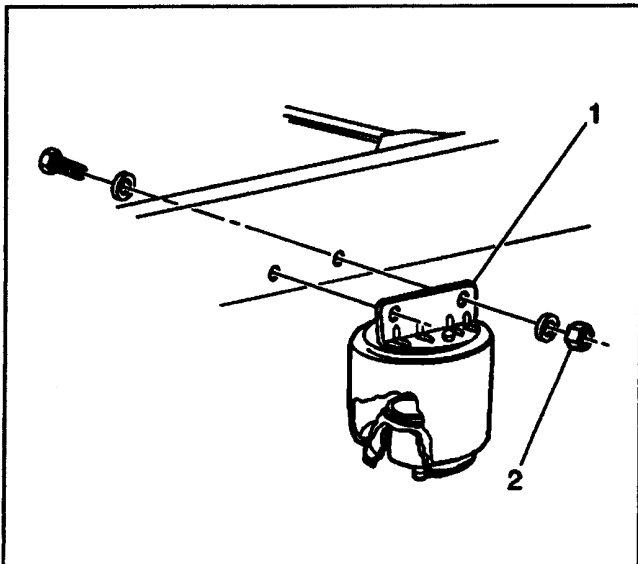
200663

Air Spring Replacement

Removal Procedure

1. Block the wheels of the axle.
2. Drain the air pressure from the air springs.
3. Raise the frame of the vehicle in order to remove the load from the suspension.
4. Support the frame using jack stands.
5. Remove the locknuts (3) and the washers that connect the air spring (1) to the cross channel (2).
6. Remove the air line that connects to the air spring (1).
7. Remove the brass air fittings from the air spring (1).

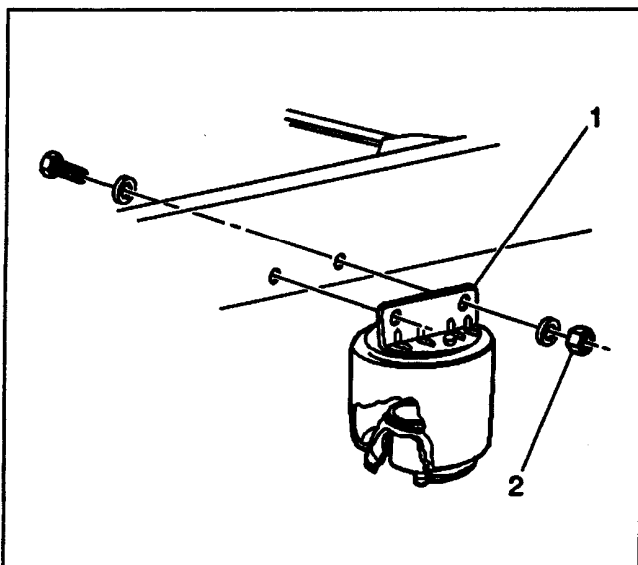
8. Remove the locknuts (2) and the washers that connect the air spring (1) to the upper frame hanger.
9. Remove the air spring (1).



200665

Installation Procedure

1. Connect the air spring (1) to the air spring frame hanger.



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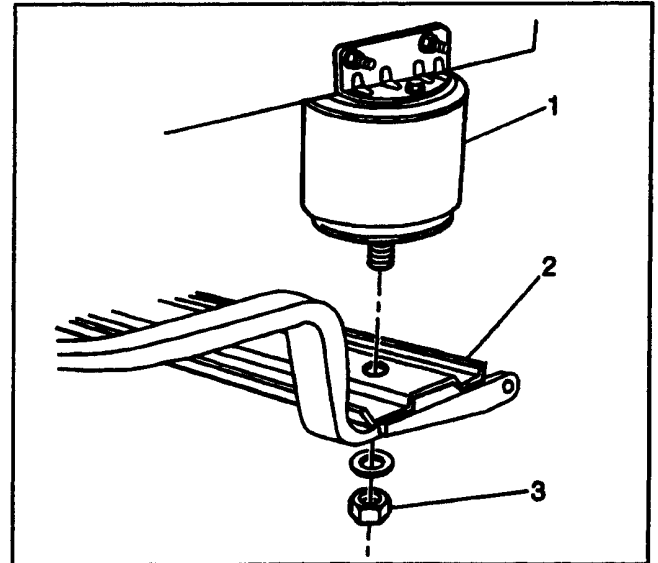
2. Connect the air spring (1) to the cross channel (2).

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

3. Install the washers and the locknuts (3) that connect the air spring to the cross channel.

Tighten

Tighten the locknuts to 27–41 N.m (20–30 lb ft).



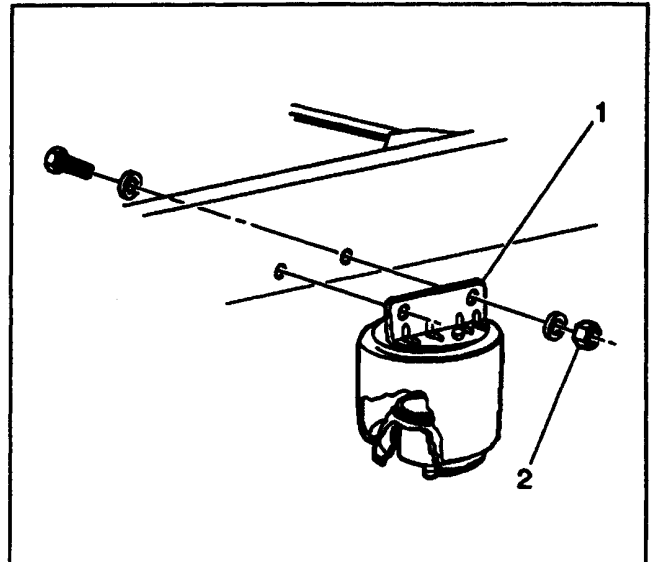
200863

4. Install the washers and the locknuts (2) that connect the air spring (1) to the air spring frame hanger.

Tighten

Tighten the locknuts to 27–41 N.m (20–30 lb ft).

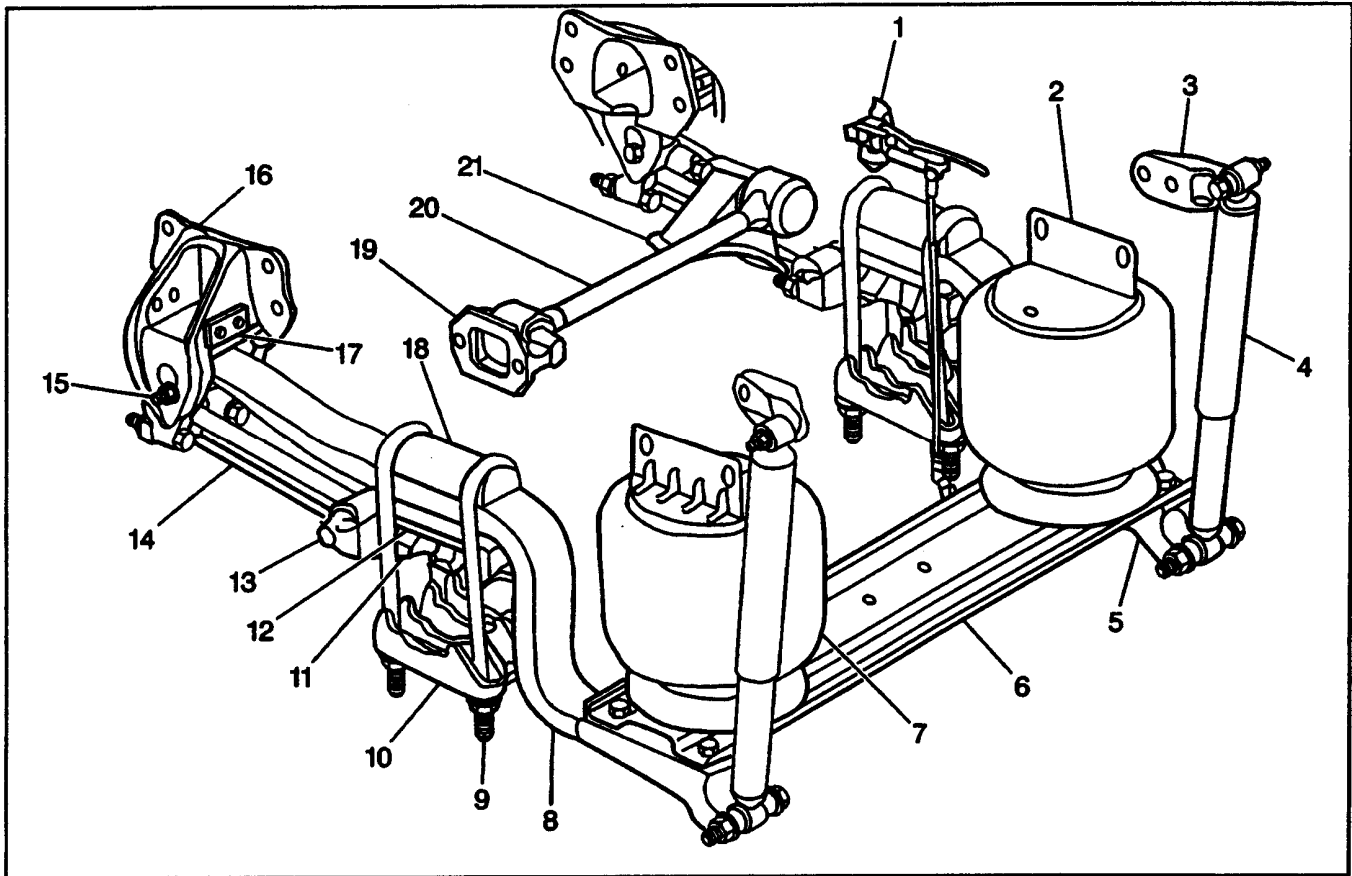
5. Install the brass air fitting to the air spring using a Teflon® thread seal.
6. Connect the air lines to the air springs.
7. Lower the frame of the vehicle.
8. Unblock the wheels.
9. Refill air into the system.



200865

Description and Operation

Rear Air Suspension



200633

The Hendrickson HAS Series single axle air suspension is made up of two air springs (7). The air springs are supported on main support beams (8), which are fastened to the axle and to the frame. A torque rod (14) from the frame bracket to the spring seat (11) or bottom axle cap (10) provides stability. Additional stability is provided by a transverse torque rod (20) from the frame to the axle housing. The shock absorbers (4) help to control jounce and rebound during vehicle operation.

Air Control System

The suspension air control system uses air drawn from the vehicle air system in order to pressurize the air spring assemblies through the height leveling valve.

The correct vehicle ride height is maintained through use of a frame-mounted height leveling valve.

The pressure protection valve is located on the front service reservoir. The pressure protection valve protects the air supply to the brakes if a failure occurs in the air suspension system. If a loss of air occurs forward (upstream) of the protection valve, air pressure within the air spring system will be partially maintained until repairs can be made. If a loss of air occurs rearward (downstream) of the protection valve, the air in the brake system will be protected but the air pressure in the air springs will be lost.

Height Leveling Valve

The height leveling valve is located on the frame. The height leveling valve attaches to the cross channel by a fixed link. The valve senses changes in the ride height due to varying loads. The valve either will add air or exhaust air from the air springs until the correct ride height is reached.

Air Suspension Relief Valve

The air suspension relief valve permits deflation of the rear suspension air springs. The air suspension relief valve is manually operated by the control valve switch located on the dash panel. The supply port on the relief valve closes when the control valve switch is actuated. This allows the air from the air springs to exhaust and the springs to deflate. The exhaust port closes and the supply air is directed to the air springs when the control valve switch is deactivated. The air springs are then allowed to inflate to normal ride height.

Suspension Controls Circuit Description

Circuit Operation

Voltage is applied to the Air Suspension Dump Switch when the Ignition Switch is in RUN. When the switch is manually closed, voltage is then applied to the Air Suspension Dump Valve. Since this valve is permanently grounded at G404, the valve will energize until the switch is manually opened.