

## Section 3

# Suspension

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# Suspension General Diagnosis

## Diagnostic Information and Procedures

### Vehicle Leads/Pulls (Pulls to One Side-No Braking)

Problem	Action
The tire inflation pressure is low.	Inflate the tires to the recommended pressure. Refer to <i>Tire Inflation Description</i> in Tires and Wheels.
The front or the rear brakes are dragging.	Adjust the brakes.
The front spring is broken or sagging.	Replace the spring. <ul style="list-style-type: none"> <li>• For independent suspension, refer to <i>Front Coil Springs Replacement (Independent)</i> in Front Suspension.</li> <li>• For I-Beam suspension, refer to <i>Leaf Springs Replacement (I-Beam)</i> in Front Suspension.</li> </ul>
The front wheel alignment setting (camber) is incorrect.	<ol style="list-style-type: none"> <li>1. Check the camber setting.</li> <li>2. Align the suspension as needed.</li> </ol> Refer to <i>Wheel Alignment Specifications</i> in Wheel Alignment.

### Vehicle Leads/Pulls (Leads to Either Side)

Problem	Action
Keep the wind and the road conditions in mind.	Test the vehicle, going in both directions, on a flat road.
The wheel alignment settings are incorrect.	Adjust to specifications. Refer to <i>Wheel Alignment Specifications</i> in Wheel Alignment.
The steering gear valve is unbalanced (if this is the cause, steering effort will be very light in the direction of lead and heavy in the opposite direction).	Replace the gear valve. Refer to <i>Valve Replacement</i> in Power Steering System.
The steering shaft is rubbing the inside diameter of the shaft tube.	<ol style="list-style-type: none"> <li>1. Align the steering column.</li> <li>2. Replace the steering column as needed.</li> </ol> Refer to <i>Steering Column Replacement</i> in Steering Wheel and Column.

### Abnormal or Excessive Tire Wear (Excessive or Uneven)

Problem	Action
The tires are underinflated or overinflated.	Inflate the tires to the recommended pressure. Refer to <i>Tire Inflation Description</i> in Tires and Wheels.
The toe-in setting is incorrect.	Adjust the toe-in setting. Refer to <i>Wheel Alignment Specifications</i> in Wheel Alignment.
The wheel and tire are out of balance.	Balance the wheels. Refer to <i>Balancing Tires and Wheels</i> in Vibration Diagnosis and Correction.
The vehicle operator has used hard driving techniques.	Instruct the operator about proper driving techniques.
The vehicle has been, or is overloaded.	Do not exceed the maximum recommended payload rating. Refer to <i>Label - Vehicle Certification</i> in General Information.

**Abnormal or Excessive Tire Wear (Cupped Tires)**

<b>Problem</b>	<b>Action</b>
The front shock absorbers are worn.	Replace the shock absorbers. <ul style="list-style-type: none"> <li>• For independent suspension, refer to <i>Shock Absorber Replacement (Independent)</i> in Front Suspension.</li> <li>• For I-Beam suspension, refer to <i>Shock Absorber Replacement (I-Beam)</i> in Front Suspension.</li> </ul>
The ball joints are worn.	Replace the ball joints. <ul style="list-style-type: none"> <li>• For the upper ball joint, refer to <i>Upper Ball Joint Replacement (Independent)</i> in Front Suspension.</li> <li>• For the lower ball joint, refer to <i>Lower Ball Joint Replacement (Independent)</i> in Front Suspension.</li> </ul>
The wheel bearings are incorrectly adjusted or worn.	<ol style="list-style-type: none"> <li>1. Adjust the wheel bearings.               <ul style="list-style-type: none"> <li>• For independent suspension, refer to <i>Wheel Bearing Adjustment (Independent)</i> in Front Suspension.</li> <li>• For I-Beam suspension, refer to <i>Wheel Bearing Adjustment (I-Beam)</i> in Front Suspension.</li> </ul> </li> <li>2. Replace the wheel bearings as needed.               <ul style="list-style-type: none"> <li>• For independent suspension, refer to <i>Wheel Hub, Bearing, and Seal Replacement (Independent)</i> in Front Suspension.</li> <li>• For I-Beam suspension, refer to <i>Wheel Hub, Bearing, and Seal Replacement (I-Beam)</i> in Front Suspension.</li> </ul> </li> </ol>
The wheel and tire is out of balance.	Balance the wheel and tire. Refer to <i>Balancing Tires and Wheels</i> in Vibration Diagnosis and Correction.
The tire and wheel has excessive runout.	Check and compensate for runout. Refer to <i>Tire and Wheel Vibration</i> in Vibration Diagnosis and Correction.

**Abnormal or Excessive Tire Wear (General)**

<b>Problem</b>	<b>Action</b>
The tires were not rotated.	Refer to <i>Tire Rotation</i> in Tires and Wheels.
The shock absorbers are damaged.	Replace the shock absorber. <ul style="list-style-type: none"> <li>• For independent suspension, refer to <i>Shock Absorber Replacement (Independent)</i> in Front Suspension.</li> <li>• For I-Beam suspension, refer to <i>Shock Absorber Replacement (I-Beam)</i> in Front Suspension.</li> </ul>
The tire inflation pressure is incorrect.	Refer to <i>Tire Inflation Description</i> in Tires and Wheels.
The wheel alignment settings are incorrect.	Align the wheels. Refer to <i>Wheel Alignment Specifications</i> in Wheel Alignment.
The vehicle is overloaded or improperly loaded.	Avoid overloading the vehicle. Refer to <i>Label - Vehicle Certification</i> in General Information.
The springs are broken or sagging.	Replace the springs. <ul style="list-style-type: none"> <li>• For independent suspension, refer to <i>Front Coil Springs Replacement (Independent)</i> in Front Suspension.</li> <li>• For I-Beam suspension, refer to <i>Leaf Springs Replacement (I-Beam)</i> in Front Suspension.</li> </ul>
The stabilizer bushings are loose or worn.	<ol style="list-style-type: none"> <li>1. Tighten the stabilizer bushing brackets. Refer to <i>Fastener Tightening Specifications</i> in Front Suspension.</li> <li>2. Replace the stabilizer bushings as needed.               <ul style="list-style-type: none"> <li>• For Independent suspension, refer to <i>Stabilizer Shaft Replacement (Independent)</i> in Front Suspension.</li> <li>• For I-Beam suspension, refer to <i>Stabilizer Shaft Replacement (I-Beam)</i> in Front Suspension.</li> </ul> </li> </ol>

**Abnormal or Excessive Tire Wear (Scuffed Tires)**

Problem	Action
The toe-in setting is incorrect.	Adjust the toe-in setting. Refer to <i>Wheel Alignment Specifications</i> in Wheel Alignment.
The operator uses excessive speed on turns.	Instruct the operator about proper driving techniques.
The tires are improperly inflated.	Inflate the tires to the recommended pressure. Refer to <i>Tire Inflation Description</i> in Tires and Wheels.
The suspension arm is bent or twisted.	Replace the suspension arm.

**Wheel Tramp**

Problem	Action
DEFINITION: The wheel and tire bounce onto and off of the road in direct relation to vehicle speed.	
The tire and wheel are out of balance.	Balance the wheels. Refer to <i>Balancing Tires and Wheels</i> in Vibration Diagnosis and Correction.
The tire and wheel are out of round.	Replace the tire. Refer to <i>Replacement Tires Description</i> in Tires and Wheels.
There are blisters or bumps on the tire.	Replace the tire. Refer to <i>Replacement Tires Description</i> in Tires and Wheels.
The shock absorber is working improperly.	Replace the shock absorber. <ul style="list-style-type: none"> <li>• For independent suspension, refer to <i>Shock Absorber Replacement (Independent)</i> in Front Suspension.</li> <li>• For I-Beam suspension, refer to <i>Shock Absorber Replacement (I-Beam)</i> in Front Suspension.</li> </ul>
The wheel or tire has excessive runout.	Refer to <i>Tire and Wheel Vibration</i> in Vibration Diagnosis and Correction.
The tire leads.	Use any of the following tables: <ul style="list-style-type: none"> <li>• Refer to <i>Vehicle Leads/Pulls (Leads to Either Side)</i>.</li> <li>• Refer to <i>Vehicle Leads/Pulls (Pulls to One Side-No Braking)</i>.</li> </ul>

**Noisy Front Suspension**

Problem	Action
The tie rod ends are worn.	Replace the tie rod ends. Refer to Tie Rod Replacement or Tie Rod Replacement (I-Beam) 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>Fluid and Lubricant Recommendations</i> in Maintenance and Lubrication.
The shock absorbers are loose.	Tighten the bolts. Refer to <i>Fastener Tightening Specifications</i> in Front Suspension.
The shock absorber bushings are worn.	Replace the bushings. <ul style="list-style-type: none"> <li>• For independent suspension, refer to <i>Shock Absorber Replacement (Independent)</i> in Front Suspension.</li> <li>• For I-Beam suspension, refer to <i>Shock Absorber Replacement (I-Beam)</i> in Front Suspension.</li> </ul>
The stabilizer shaft is loose.	Tighten the bolts. Refer to <i>Fastener Tightening Specifications</i> in Front Suspension.
The stabilizer shaft insulators are worn.	Replace the insulators. <ul style="list-style-type: none"> <li>• For independent suspension, refer to <i>Stabilizer Shaft Replacement (Independent)</i> in Front Suspension.</li> <li>• For I-Beam suspension, refer to <i>Stabilizer Shaft Replacement (I-Beam)</i> in Front Suspension.</li> </ul>

## Poor Directional Stability

Problem	Action
The steering linkage lacks lubrication.	Lubricate the linkage. Refer to <i>Fluid and Lubricant Recommendations</i> in Maintenance and Lubrication.
The tire pressure is low.	Inflate the tires to the recommended pressure. Refer to <i>Tire Inflation Description</i> in Tires and Wheels.
The wheel bearings are loose.	<ol style="list-style-type: none"> <li>Adjust the wheel bearings. <ul style="list-style-type: none"> <li>For independent suspension, refer to <i>Wheel Bearing Adjustment (Independent)</i> in Front Suspension.</li> <li>For I-Beam suspension, refer to <i>Wheel Bearing Adjustment (I-Beam)</i> in Front Suspension.</li> </ul> </li> <li>Replace the wheel bearings as needed. <ul style="list-style-type: none"> <li>For independent suspension, refer to <i>Wheel Hub, Bearing, and Seal Replacement (Independent)</i> in Front Suspension.</li> <li>For I-Beam suspension, refer to <i>Wheel Hub, Bearing, and Seal Replacement (I-Beam)</i> in Front Suspension.</li> </ul> </li> </ol>
The front wheel alignment setting (caster) is incorrect.	<ol style="list-style-type: none"> <li>Check the caster setting.</li> <li>Align the wheels to specification as needed.</li> </ol> Refer to <i>Wheel Alignment Specifications</i> in Wheel Alignment.
The springs are broken.	<p>Replace the springs.</p> <ul style="list-style-type: none"> <li>For independent suspension, refer to <i>Front Coil Springs Replacement (Independent)</i> in Front Suspension.</li> <li>For I-Beam suspension, refer to <i>Leaf Springs Replacement (I-Beam)</i> in Front Suspension.</li> </ul>
The shock absorber is malfunctioning.	<ol style="list-style-type: none"> <li>Inspect the shock absorber. Refer to <i>Struts or Shock Absorbers Bench Test (Non-Spiral Groove)</i>.</li> <li>Replace the shock absorber as needed. <ul style="list-style-type: none"> <li>For independent suspension, refer to <i>Shock Absorber Replacement (Independent)</i> in Front Suspension.</li> <li>For I-Beam suspension, refer to <i>Shock Absorber Replacement (I-Beam)</i> in Front Suspension.</li> </ul> </li> </ol>
The stabilizer shaft is broken or has a missing link.	<p>Replace the stabilizer shaft or the link.</p> <ul style="list-style-type: none"> <li>For independent suspension, refer to <i>Stabilizer Shaft Replacement (Independent)</i> in Front Suspension.</li> <li>For I-Beam suspension, refer to <i>Stabilizer Shaft Replacement (I-Beam)</i> in Front Suspension.</li> </ul>

## Noise Diagnosis - Front Suspension

Problem	Action
The steering linkage needs lubrication.	Lubricate at the recommended intervals. Refer to <i>Fluid and Lubricant Recommendations</i> in Maintenance and Lubrication.
The shock absorber is loose.	Tighten the bolts. Refer to <i>Fastener Tightening Specifications</i> in Front Suspension.
the shock absorber has worn bushings.	<p>Replace the shock absorber.</p> <ul style="list-style-type: none"> <li>For independent suspension, refer to <i>Shock Absorber Replacement (Independent)</i> in Front Suspension.</li> <li>For I-Beam suspension, refer to <i>Shock Absorber Replacement (I-Beam)</i> in Front Suspension.</li> </ul>
The control arm bushings are worn.	<p>Replace the bushings or the control arm.</p> <ul style="list-style-type: none"> <li>For the upper control arm, refer to <i>Upper Control Arm Replacement (Independent)</i> in Front Suspension.</li> <li>For the lower control arm, refer to <i>Lower Control Arm Replacement (Independent)</i> in Front Suspension.</li> </ul>

**Noise Diagnosis - Front Suspension (cont'd)**

Problem	Action
The wheel bearings are loose or worn.	<ol style="list-style-type: none"> <li>Adjust the wheel bearings.                             <ul style="list-style-type: none"> <li>For independent suspension, refer to <i>Wheel Bearing Adjustment (Independent)</i> in Front Suspension.</li> <li>For I-Beam suspension, refer to <i>Wheel Bearing Adjustment (I-Beam)</i> in Front Suspension.</li> </ul> </li> <li>Replace the wheel bearings as needed.                             <ul style="list-style-type: none"> <li>For independent suspension, refer to <i>Wheel Hub, Bearing, and Seal Replacement (Independent)</i> in Front Suspension.</li> <li>For I-Beam suspension, refer to <i>Wheel Hub, Bearing, and Seal Replacement (I-Beam)</i> in Front Suspension.</li> </ul> </li> </ol>
The stabilizer shaft is loose.	Tighten all of the stabilizer shaft attachments. Refer to <i>Fastener Tightening Specifications</i> in Front Suspension.
The wheel nuts are loose.	Tighten the wheel nuts. Refer to <i>Fastener Tightening Specifications</i> in Tires and Wheels.
The spring is improperly positioned.	Reposition the spring.
The suspension bolts are loose.	<ol style="list-style-type: none"> <li>Tighten the fasteners to specifications.</li> <li>Replace the fasteners as needed.</li> </ol> Refer to <i>Fastener Tightening Specifications</i> in Front Suspension.
The king pins and bushings are worn.	Replace the bushings and the king pins. Refer to <i>Steering Knuckle Replacement (I-Beam)</i> in Front Suspension.

**Struts or Shock Absorbers Binding (Rear)**

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

**Struts or Shock Absorbers Noisy (Rear)**

Problem	Action
The shock absorber has broken mounts.	Replace the shock absorber. Refer to <i>Shock Absorber Replacement</i> in Rear Suspension.
The shock absorber has extreme bushing wear.	Replace the shock absorber. Refer to <i>Shock Absorber Replacement</i> in Rear Suspension.

**Struts or Shock Absorbers Bench Test (Non-Spiral Groove)**

**Testing Procedure**

It is not necessary to purge air from non-spiral groove shock absorbers. These shock absorbers contain a gas filled cell within the shocks reservoir. These shocks differ from spiral groove shocks. Spiral groove shocks contain an air filled cell within the reservoir.

- Remove the shock absorber from the vehicle.
  - For independent suspension vehicles, refer to *Shock Absorber Replacement (Independent)* in Front Suspension.
  - For I-beam suspension vehicles, refer to *Shock Absorber Replacement (I-Beam)* in Front Suspension.

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

- Place the shock absorber in a vise.
  - Clamp the jaws on the top mounting stud of the shock.
  - Hold the shock vertically in the vise with the bottom end up.
- Pump the shock at various rates of speed. Observe the rebound force.
  - The rebound force normally is stronger than the compression force (approximately two to one).
  - The rebound force should be smooth and constant for each stroke rate.

- 4. Compare this shock with a good shock absorber.
- 5. If you observe any of the following conditions, replace the shock absorber:
  - A skip, or a lag, at reversal near mid-stroke
  - A seizing (except at the extreme ends of travel)
  - A noise, a grunt or a squeal, after completing one full stroke in both directions
  - A clicking noise at fast reversal

**Spring Noise (Rear)**

Checks	Action
The spring has loose U-bolts.	Tighten to the specified torque. Refer to <i>Fastener Tightening Specifications</i> in Rear Suspension.
The spring has loose or worn eye bushings.	Replace the eye bushings. Refer to <i>Spring Bushing Replacement</i> in Rear Suspension.
The spring lacks lubrication.	Lubricate as required. Refer to <i>Fluid and Lubricant Recommendations</i> in Maintenance and Lubrication.
The shock absorber is faulty.	Replace the shock absorber. Refer to <i>Shock Absorber Replacement</i> in Rear Suspension.

**Spring Sags or Bottoms (Rear)**

Checks	Action
The shock absorbers are inoperative.	Replace the shock absorbers. Refer to <i>Shock Absorber Replacement</i> in Rear Suspension.
The spring has a broken leaf.	Replace the spring assembly. Refer to <i>Leaf Spring Replacement</i> in Rear 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 (Rear)**

Problem	Action
The spring has loose U-bolts.	Tighten to the specified torque. Refer to <i>Fastener Tightening Specifications</i> in Rear 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. Refer to <i>Label - Vehicle Certification</i> in General Information.

**Front Wheel Shimmy**

Problem	Action
<b>DEFINITION:</b> Vehicle front wheel shimmy or shake while driving on a smooth road	
The tire and wheel are out of balance.	Balance the tires. Refer to <i>Balancing Tires and Wheels</i> in Vibration Diagnosis and Correction.
The tire and wheel are out of round.	Check runout. Refer to <i>Tire and Wheel Vibration</i> in Vibration Diagnosis and Correction.
The wheel bearings are worn or loose.	Adjust the wheel bearings. <ul style="list-style-type: none"> <li>• For independent suspension, refer to <i>Wheel Bearing Adjustment (Independent)</i> in Front Suspension.</li> <li>• For I-Beam suspension, refer to <i>Wheel Bearing Adjustment (I-Beam)</i> in Front Suspension.</li> </ul>
The king pin or king pin bearing is worn or loose.	<ol style="list-style-type: none"> <li>1. Replace the worn parts as needed.</li> <li>2. Adjust the king pin bearing.</li> </ol> Refer to <i>Steering Knuckle Replacement (I-Beam)</i> in Front Suspension.



Front Wheel Shimmy (cont'd)

Problem	Action
The ball joints are worn.	Replace the ball joints. <ul style="list-style-type: none"> <li>• For the upper ball joint, refer to <i>Upper Ball Joint Replacement (Independent)</i> in Front Suspension.</li> <li>• For the lower ball joint, refer to <i>Lower Ball Joint Replacement (Independent)</i> in Front Suspension.</li> </ul>
The shock absorber is malfunctioning.	<ol style="list-style-type: none"> <li>1. Inspect the shock absorber. Refer to <i>Struts or Shock Absorbers Bench Test (Non-Spiral Groove)</i>.</li> <li>2. Replace the shock absorber as needed.                             <ul style="list-style-type: none"> <li>• For independent suspension, refer to <i>Shock Absorber Replacement (Independent)</i> in Front Suspension.</li> <li>• For I-Beam suspension, refer to <i>Shock Absorber Replacement (I-Beam)</i> in Front Suspension.</li> </ul> </li> </ol>

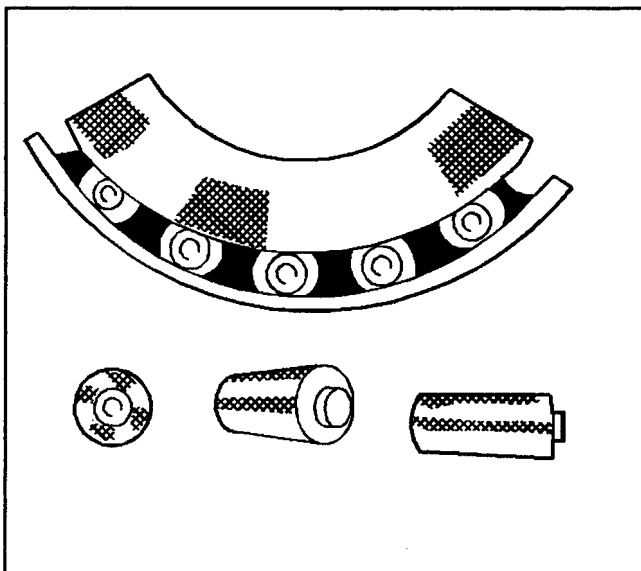
Wheel Bearings Diagnosis

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.

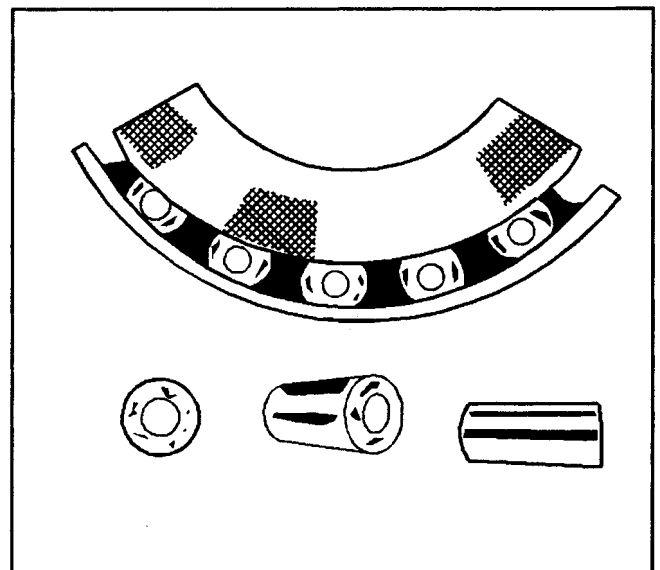
Abrasive Roller Wear



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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.

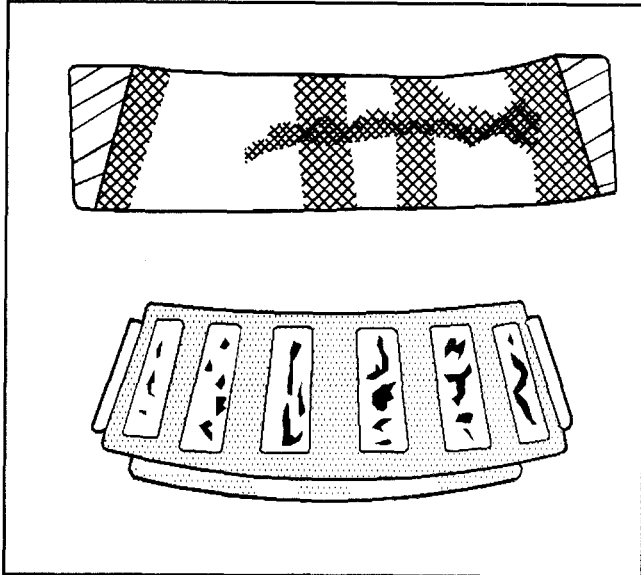
Galling



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.

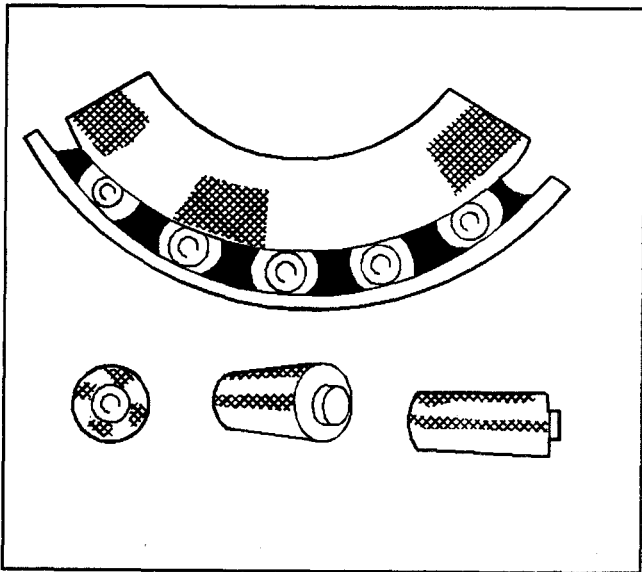
Etching



1455

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.

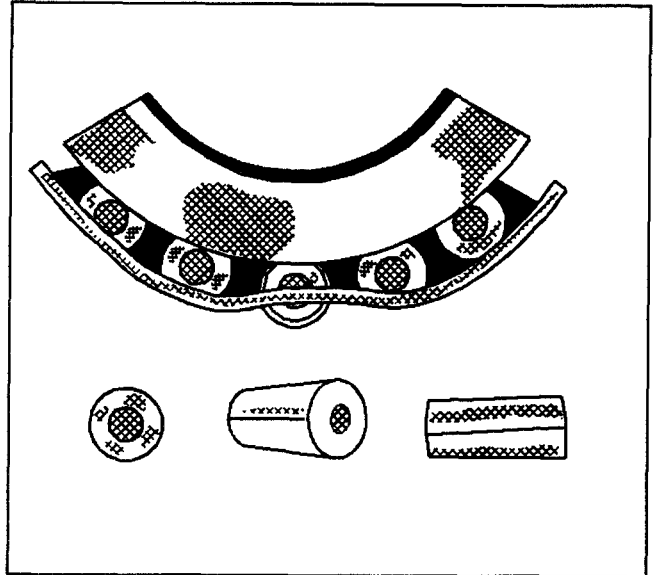
Abrasive Step Wear



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.

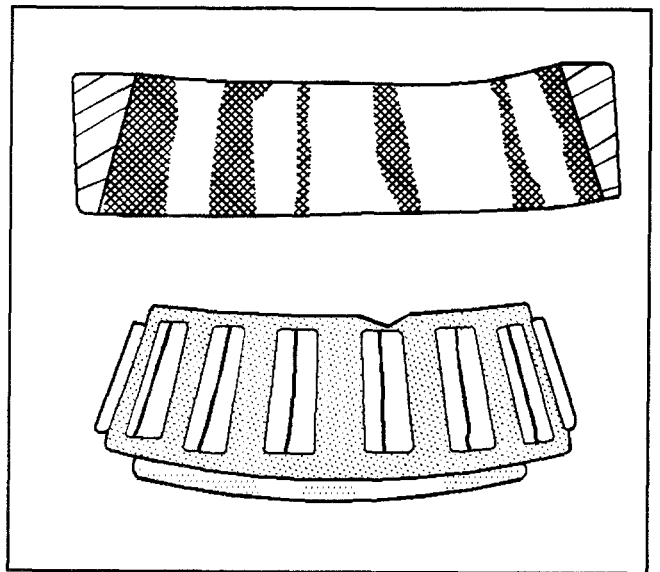
Bent Cage



1648

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

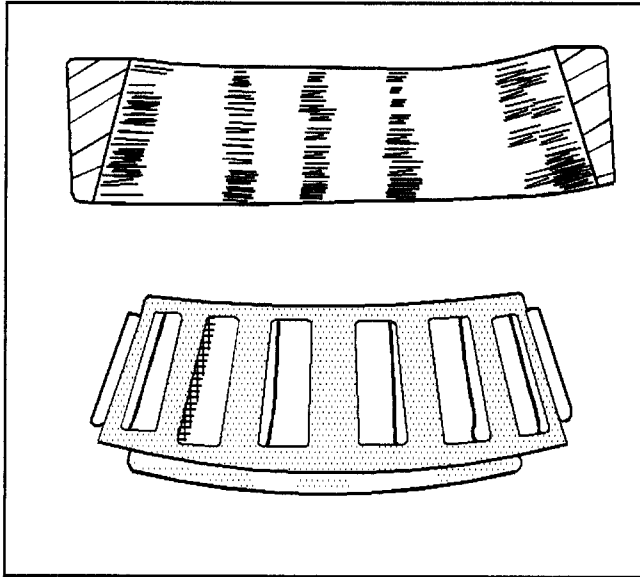
Bent Cage



1456

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

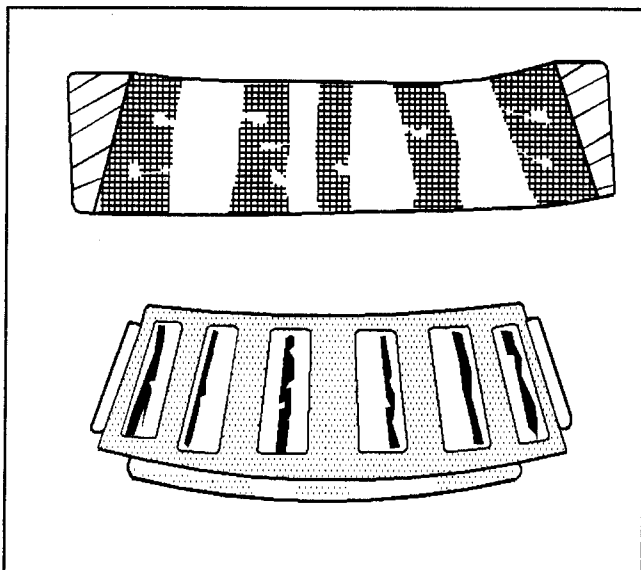
**Cage Wear**



1457

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.

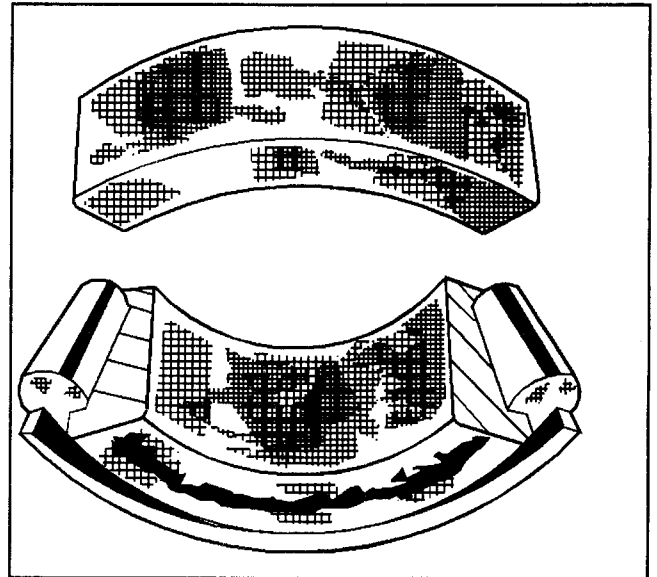
**Indentations**



1458

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.

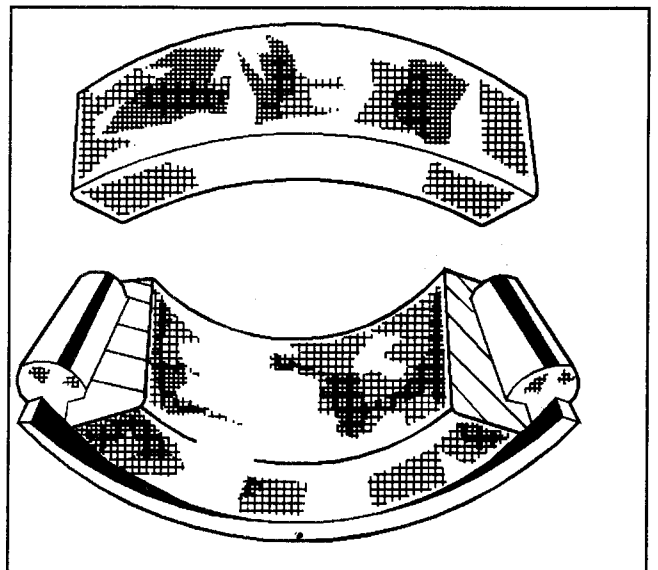
**Fretting**



1459

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**

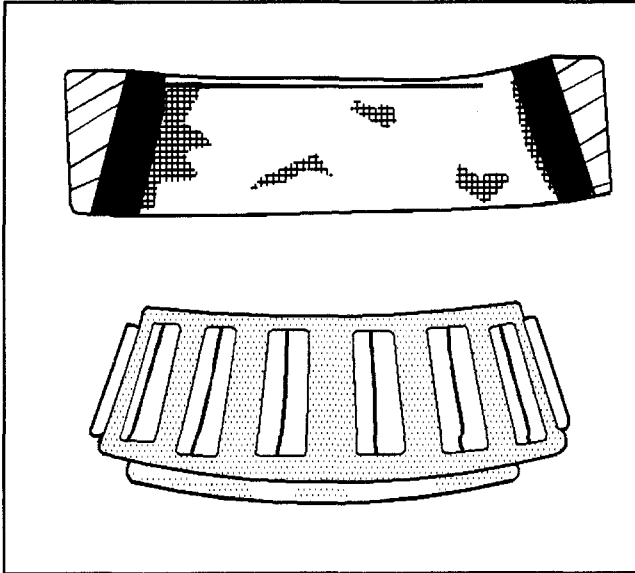


1460

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

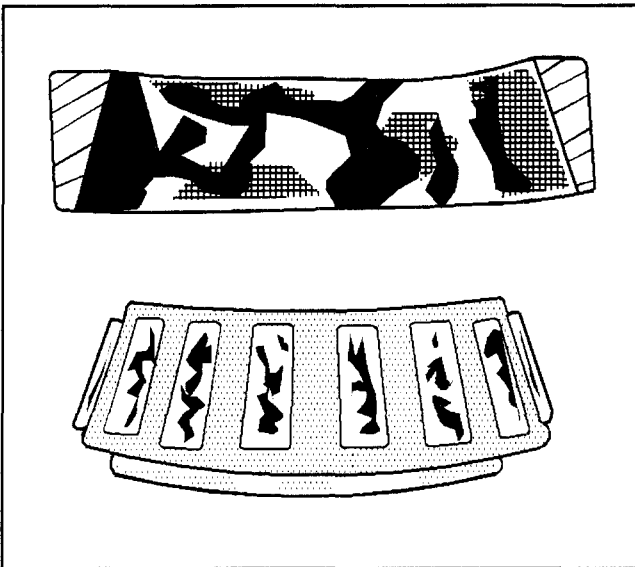
- Poor fits
- Inadequate lubrication
- Overheating
- Overloads
- Handling damage

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

**Stain Discoloration**

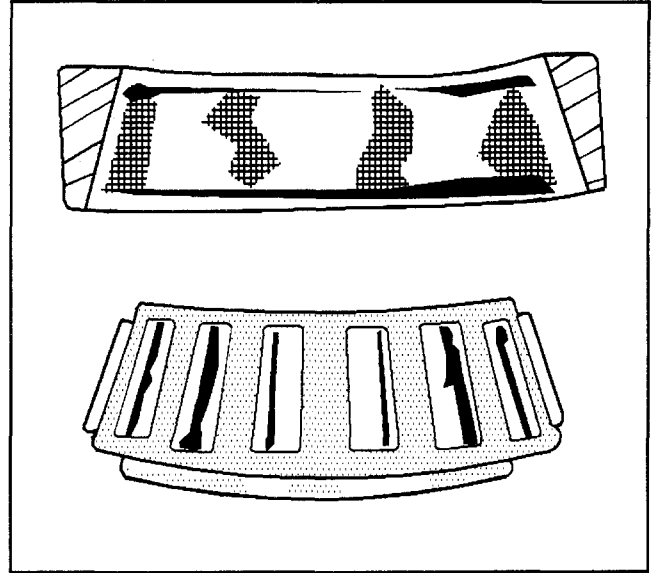
1461

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**

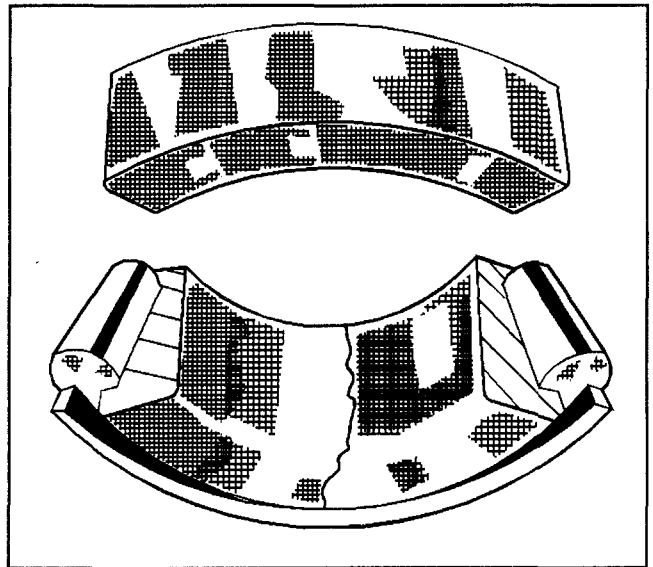
1462

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

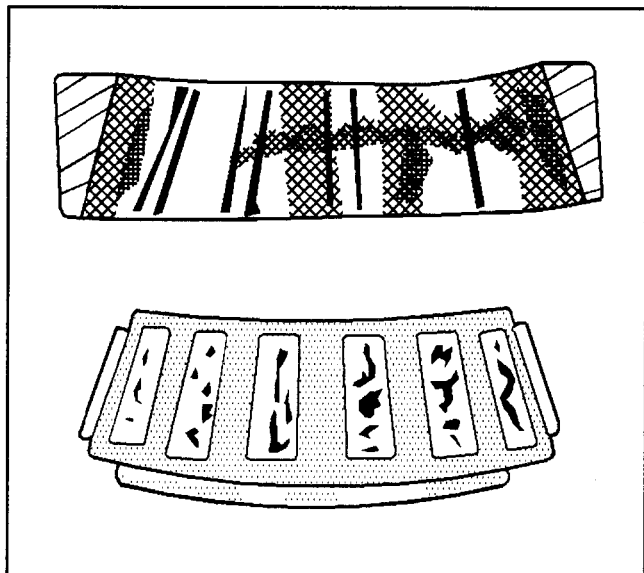
The outer race is misaligned due to a foreign object. Clean the related parts. Replace the bearing. Ensure the races are properly sealed.

**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.

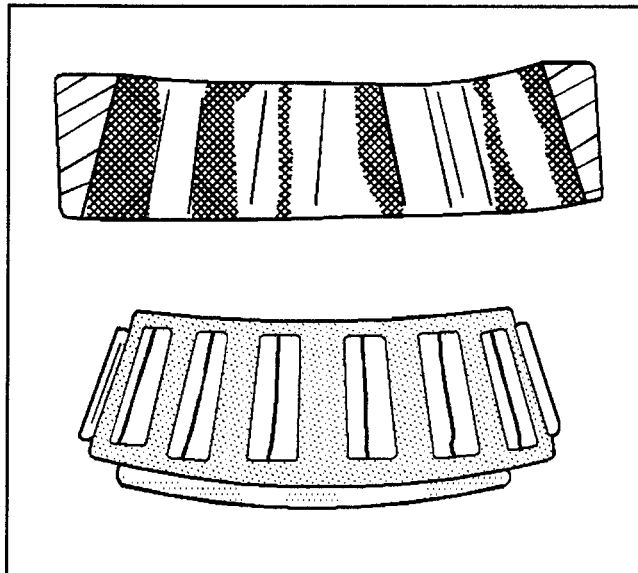
**Fatigue Spalling**



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. <ul style="list-style-type: none"> <li>• For independent suspension, refer to <i>Front Coil Springs Replacement (Independent)</i> in Front Suspension.</li> <li>• For I-Beam suspension, refer to <i>Leaf Springs Replacement (I-Beam)</i> in Front Suspension.</li> </ul>
The vehicle is overloaded or improperly loaded.	Avoid overloading the vehicle. Refer to <i>Label - Vehicle Certification</i> in General Information.

# Wheel Alignment

## Specifications

### Wheel Alignment Specifications

Operation	Service Checking	Service Setting	Side to Side Tolerance
Motorhome with Independent Front Suspension			
Caster	5.00° +/-1.00°	5.00° +/-0.50°	0.50°
Camber	0.25° +/-0.75°	0.25° +/-0.50°	0.50°
Toe	0.03in / 0.06° +/- 0.02in / +/-0.04°	0.03in / 0.06° +/- 0.01in / +/-0.02°	Toe-in equal
Commercial with Independent Front Suspension			
Caster	2.00° +/-1.00°	2.00° +/-0.50°	0.50°
Camber	0.25° +/- -0.75°	0.25° +/- 0.50°	0.50°
Toe	0.03in / 0.06° +/- 0.02in / +/-0.04°	0.03in / 0.06° +/- 0.01in / +/-0.02°	Toe-in equal
Motorhome or Commercial with I-Beam Front Suspension			
Caster	Not Adjustable	Not Adjustable	Not Adjustable
Camber	Not Adjustable	Not Adjustable	Not Adjustable
Toe	0.03in / 0.06° +/- 0.02in / +/-0.04°	0.03in / 0.06° +/- 0.01in / +/-0.02°	Toe-in equal
Important: The vehicle must be at the normal operating load during the alignment procedure.			

### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Steering Linkage Tie Rod Adjuster Retaining Nut	25	18
Upper Control Arm Bolt	190	140

## Diagnostic Information and Procedures

### Preliminary Alignment Inspection (Independent Front Suspension)

**Important:** Before making any adjustments affecting the caster, the camber, or the toe-in, inspect the front end thoroughly.

1. Inspect the tires for proper inflation pressure. Refer to *Tire Inflation Description* in Tires and Wheels.
2. Inspect the front wheel bearing for proper adjustment. Refer to *Wheel Bearing Adjustment (Independent)* or *Wheel Bearing Adjustment (I-Beam)* in Front Suspension.
3. Inspect the following parts:
  - The ball joints
  - The tie rod ends
  - The relay rods
 Correct excessive looseness before adjusting.
4. Inspect the tires and the wheels for runout. Refer to *Checking Tire and Wheel Runout* in Vibration Diagnosis.
5. Adjust the air cylinder pressure in order to level the vehicle with the vehicle normally loaded. Make the correction before adjusting the caster.
6. Inspect the steering gear for looseness at the frame.
7. Inspect the shock absorbers for leaks or any noticeable noise.
8. Inspect the control arms or stabilizer bar attachments for looseness.
9. Inspect the alignment equipment. Follow the manufacturer's instructions.
10. Inspect the level of the vehicle. The vehicle must be on a level surface fore and aft and transversely.

### Preliminary Alignment Inspection (I-Beam Front Suspension)

**Important:** Before making any adjustments affecting the caster, the camber, or the toe-in, inspect the front end thoroughly.

1. Inspect the front wheel bearing for proper adjustment. Refer to *Wheel Bearing Adjustment (Independent)* or *Wheel Bearing Adjustment (I-Beam)*.
2. Inspect the following parts:
  - The ball joints
  - The tie rod ends
  - The relay rods
 Correct excessive looseness before adjusting.
3. Inspect the tires and the wheels for runout. Refer to *Tire and Wheel Vibration Vibration Diagnosis and Correction*.
4. Inspect the steering gear for looseness at the frame.
5. Inspect the shock absorbers for leaks or any noticeable noise.
6. Inspect the I-Beam or the stabilizer bar attachments for looseness.
7. Inspect the alignment equipment. Follow the manufacturer's instructions.
8. Inspect the level of the vehicle. The vehicle must be on a level surface fore and aft and transversely.

### Preliminary Alignment Inspection (Front Wheel Alignment Rqmts.)

Satisfactory vehicle operation may occur over a wide range of front wheel alignment settings. Adjustments are necessary if the settings vary beyond certain tolerances. Refer to *Wheel Alignment Specifications*.

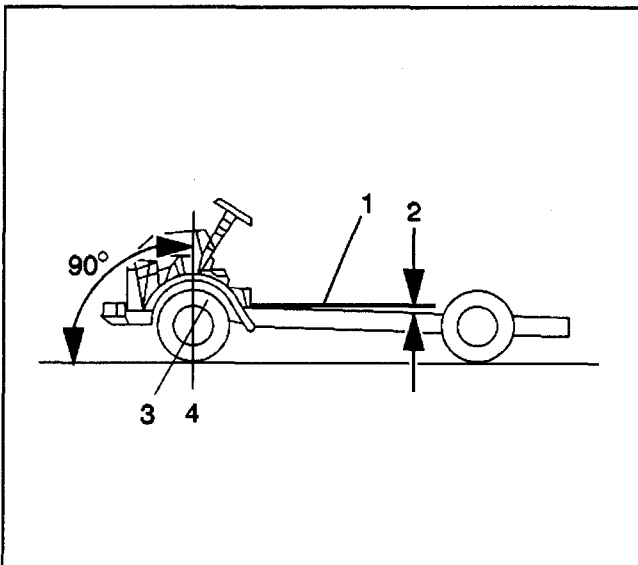
Check the front and the rear weight for proper distribution. Set the front wheel alignment to specifications while the vehicle is in the normally loaded condition. Vehicles which are consistently operated with heavy loads should have alignment adjustments made with the vehicle under a heavy load. This procedure should result in longer tire life.

## Repair Instructions

### Front Caster Adjustment

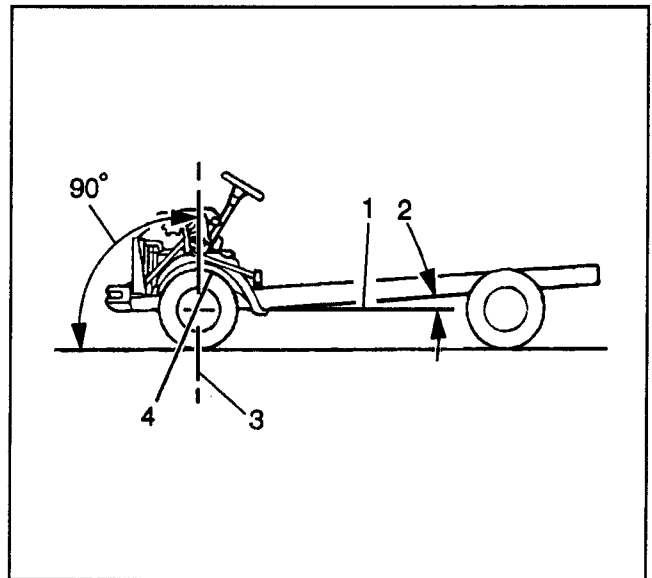
Caster dimensions are given for a vehicle carrying its design load equal to the capacity of the vehicle's suspension (GVWR). Perform alignment checks when the frame is level. If you make an alignment check when the frame is not level, determine the frame angle and add this angle to the caster angle,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

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 (found in step 2) to or from the left wheel caster measurement (found in step 3).
5. Subtract the positive frame angle (2) from a positive caster measurement (3).



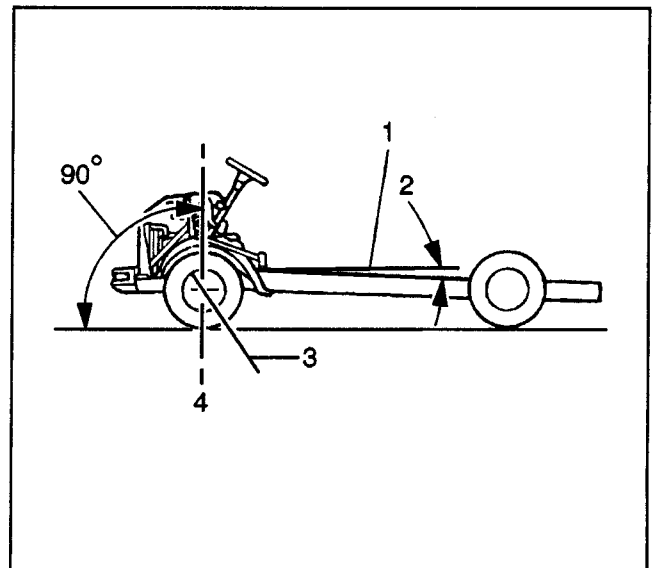


6. Add the negative frame angle (2) to a positive caster measurement (4).



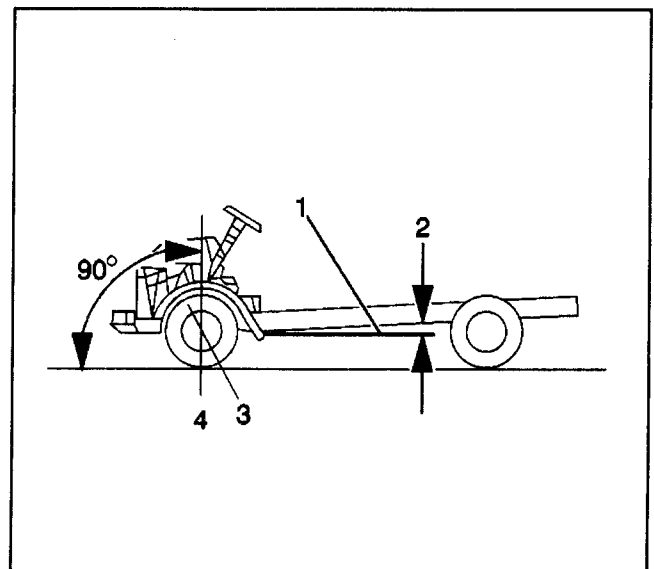
178910

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

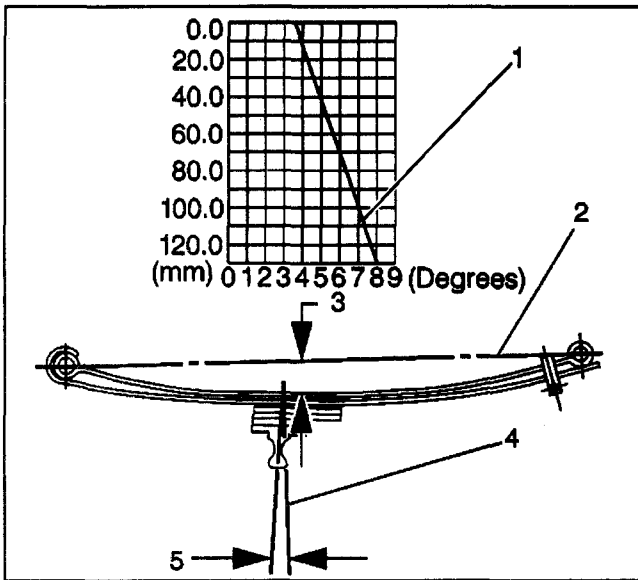


178908

8. Subtract the negative frame angle (2) from a negative caster measurement (3).
9. Repeat steps 1 through 8 for the right wheel.



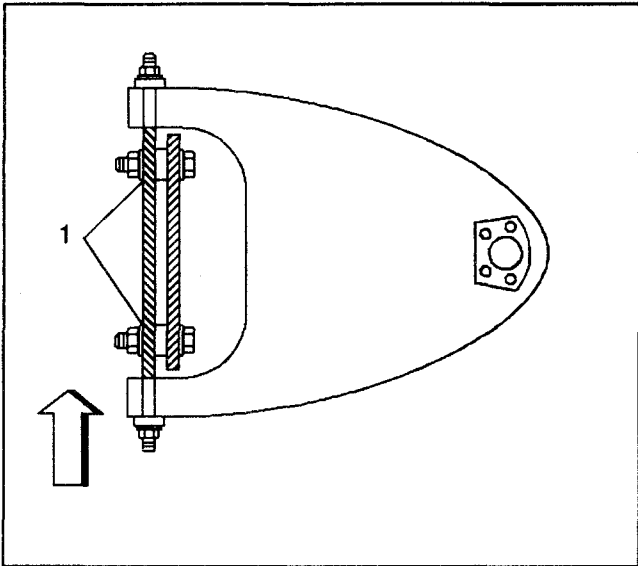
247493



247494

10. Determine the 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 (4) 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 (3).
- Determine the measured caster (5) angle using the graph (as shown).
- Compare the specified caster angle with the measured caster angle (5).
- If the measured caster angle (5) does not coincide with the specified caster angle (plus or minus one degree), determine the cause of the error and replace the faulty component.



83

**Front Camber Adjustment**

1. Determine the camber angle using the alignment equipment.
2. Add or subtract the shims from both the front (1) and the rear bolts (1) in order to effect a change.

### Front Toe Adjustment

1. Determine the toe settings using the alignment equipment.
2. Change the length of both of the tie rod sleeves in order to effect a toe change.
3. Increase or decrease by changing the length of the tie rod ends.
  - A threaded sleeve is provided for this purpose.
  - When the tie rod ends are mounted ahead of the steering knuckle, the tie rod ends must be decreased in length in order to increase the toe-in. Refer to *Tie Rod Replacement (Motorhome)* in Steering Linkage.
  - When the tie rod ends are mounted behind the steering knuckle, the tie rod ends must be lengthened in order to increase the toe-in. Refer to *Tie Rod Replacement (Commercial)* or *Tie Rod Replacement (Commercial (I-Beam Front Axle))* in Steering Linkage.

### Description and Operation

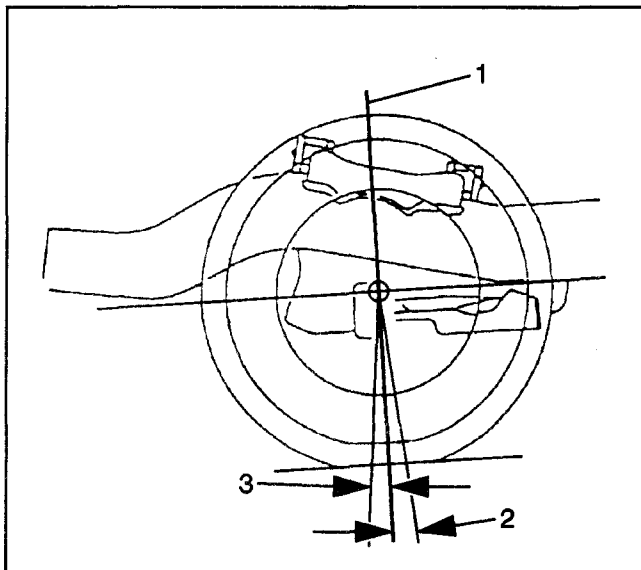
#### General Description

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

The proper front wheel alignment must be maintained in order to ensure directional stability and in order to prevent abnormal tire wear.

The most important factors of the front wheel alignment are the wheel toe-in, the wheel camber, and the axle caster.

#### Caster Description

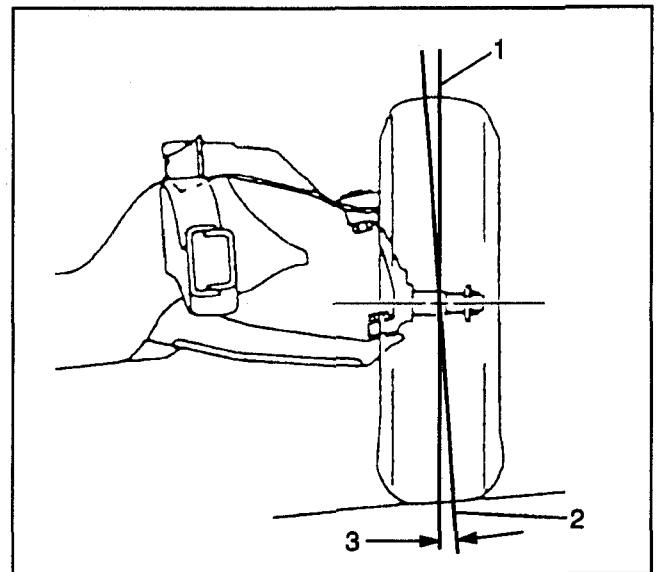


156649

The caster is the tilting of the steering axis either forward or backward from vertical when viewed from the side of the vehicle. A backward tilt is measured in positive degrees (1) and a forward tilt in negative degrees.

On the short and long arm type suspension, you cannot see a caster angle without a special instrument. However, if you look straight down from the top of the upper control arm to the ground, the ball joints do not line up (fore and aft) when a caster angle other than 0 degrees is present. With a positive angle, the lower ball joint center line would be slightly ahead (toward the front of the vehicle) of the upper ball joint center line.

#### Camber Description

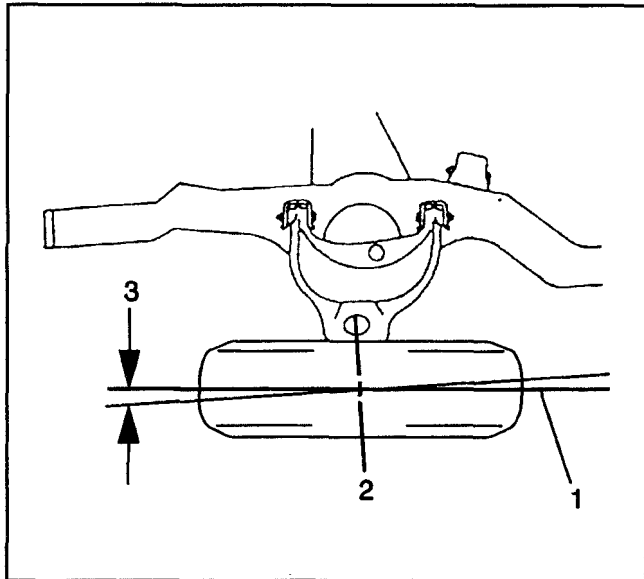


156644

The camber is the inward or outward tilting of the front wheels from the vertical (1). It is measured in degrees. When the wheels tilt outward at the top, the camber is positive. When the wheels tilt inward at the top, the camber is negative. The amount of tilt measured in the degrees from the vertical is called the camber angle.

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

### Toe Description



156652

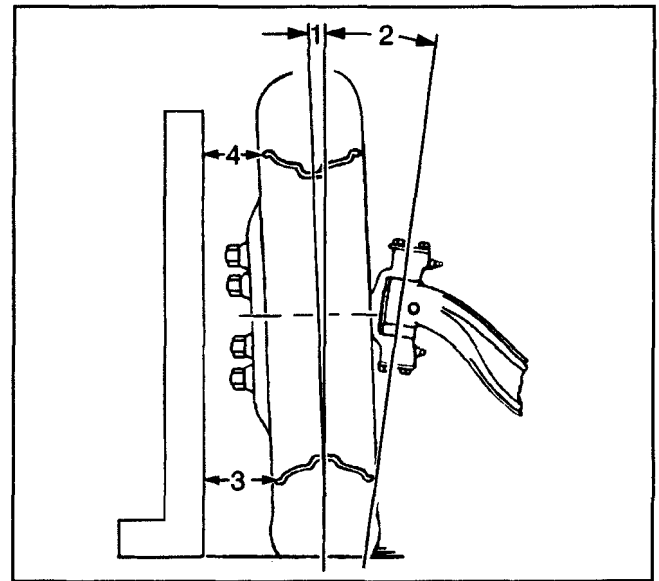
Toe-in is the adjustment of the front wheels that angles the tires toward each other. The actual amount of toe-in is normally a fraction of a degree. The toe-in is measured from the center (2) of the tire treads or from the inboard side of the tires. The purpose of the toe-in is to ensure parallel rolling of the front wheels and in order to offset any small deflections of the wheel support system which occurs when the vehicle is rolling forward. The incorrect toe-in results in excessive tire wear and unstable steering. The toe-in is the last alignment to be set in the front wheel alignment procedure.

### Frame Angle

The caster, the camber, and the toe-in are the dimensions determined for the vehicle at the design load with the frame level. The normal frame angle must be considered when using the alignment equipment. This is most important when making a caster angle check in order to obtain a true setting.

### I-Beam Front Axle Suspension Description

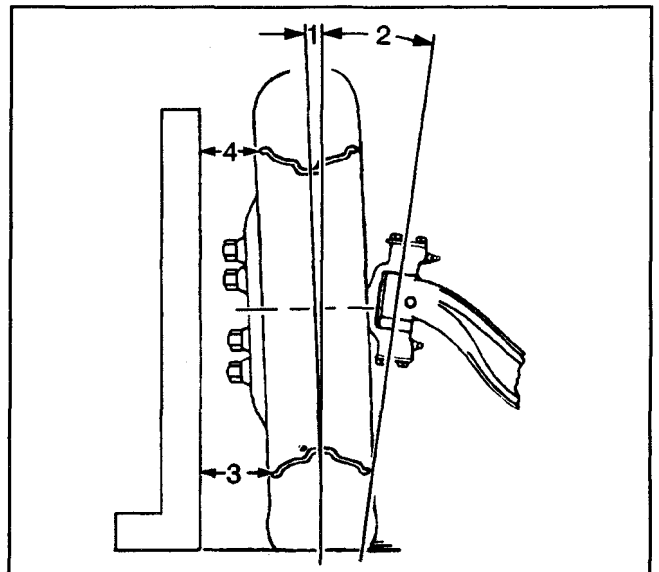
#### King Pin Inclination



178899

The king pin inclination (2) is the amount that the top of the king pin is inclined toward the center of the vehicle. The inclination is designed into the axle end. The king pins are inclined to assist the front wheel return to the center after a turn is made.

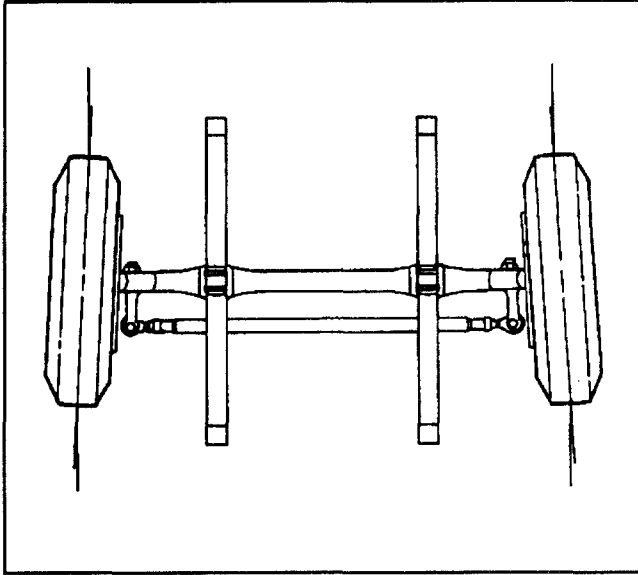
#### Camber



178899

The camber is the measurement in degrees (1) that the front wheels are tilted inward or outward at the top from the vertical position. The camber offsets the wheel deflection due to wear of the front axle parts and prevents a reverse or negative camber condition. If the camber is extreme or unequal between the wheels, improper steering and excessive tire wear will result.

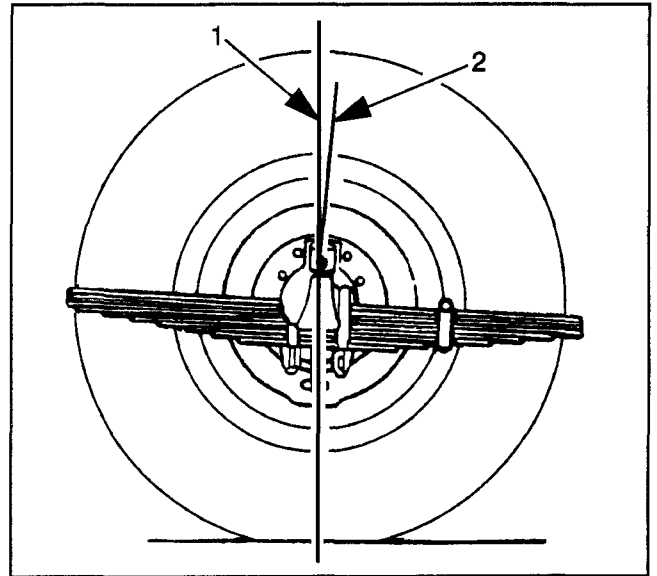
## Toe-In



36485

The toe-in is the adjustment of the front wheels that angles the tires toward each other. The actual amount of toe-in is normally a fraction of a degree. The toe-in is measured from the center of the tire treads or from the inboard side of the tires. The purpose of toe-in is in order to ensure parallel rolling of the front wheels and to offset any small deflections of the wheel support system which occurs when the vehicle is rolling forward. An incorrect toe-in results in excessive tire wear and unstable steering. The toe-in is the last alignment to be set in the front wheel alignment procedure.

## Front Axle Caster



178905

The caster is the inclination (tilt) of the king pin from vertical (1) to the frame either forward or rearward. An incorrect caster may result from sagging springs, bent or twisted axle, or uneven tightening of the spring U-bolt nuts. Tighten all of the U-bolts equally. Refer to *Fastener Tightening Specifications* in Front Suspension and Axle. Generally, if the axle is twisted, the caster will be unequal from the right to the left side.

## Frame Angle

The caster, the camber, and the toe-in dimensions are determined for the vehicle at the design load with the frame level. The normal frame angle must be considered when using the alignment equipment. This is most important when making a caster angle check in order to obtain a true setting.

# Front Suspension

## Specifications

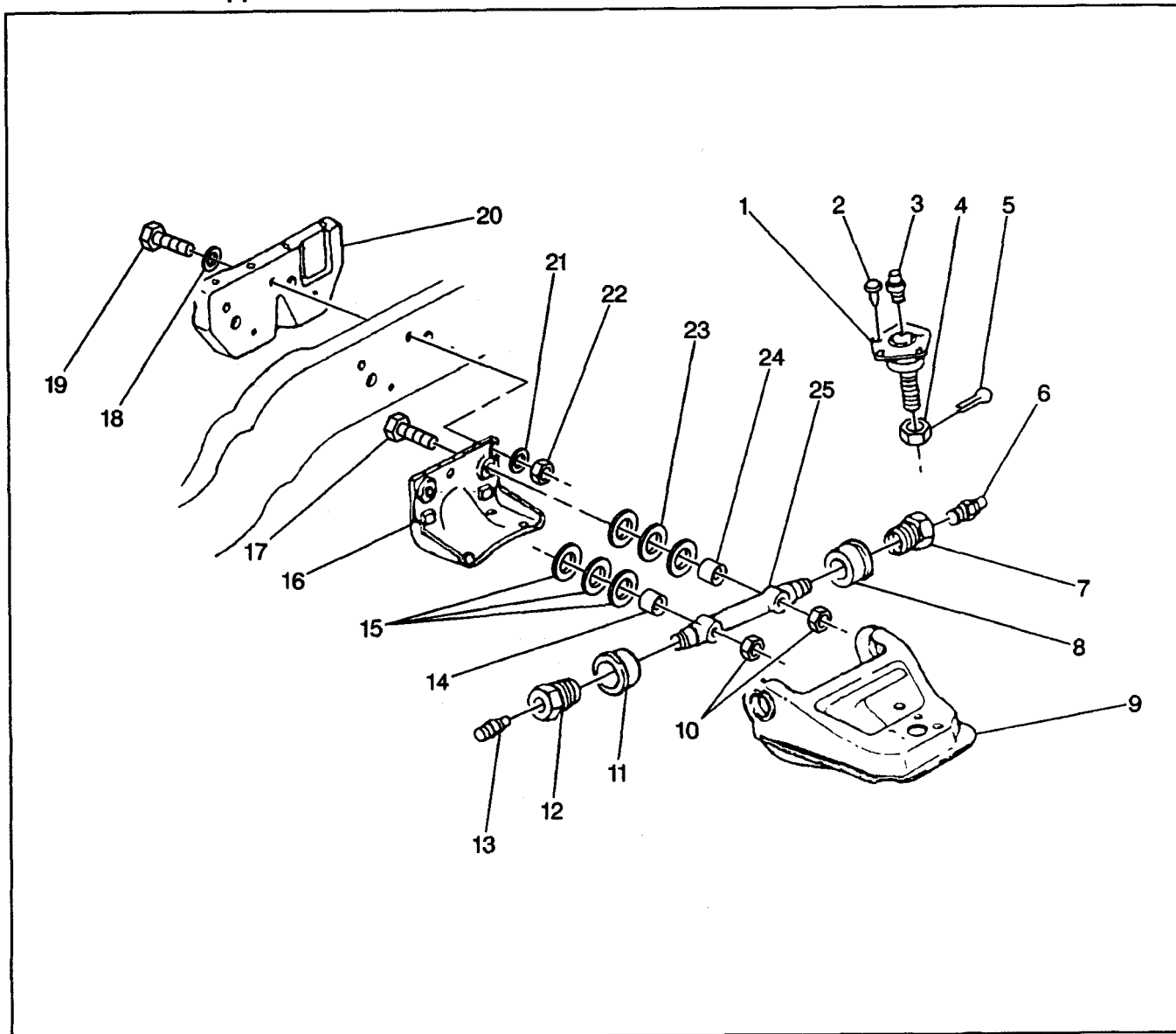
### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Ball Joint Nut—Maximum to Align Cotter Pin (Independent)	175 N·m	130 lb ft
Crossmember to Bottom Frame Rail (Commercial) (Independent)	125 N·m	92 lb ft
Crossmember to Bottom Frame Rail (Motorhome) (Independent)	250 N·m	184 lb ft
Crossmember to Frame Side Rails (Independent)	125 N·m	92 lb ft
Crossmember to Support Struts (Independent)	83 N·m	61 lb ft
Lock Pin to Steering Knuckle (I-Beam)	40 N·m	29 lb ft
Lower Control Arm Bushings (Independent)	379 N·m	280 lb ft
Lower Pivot Shaft U-Bolt Nuts (Independent)	115 N·m	85 lb ft
Shackle to Frame Nuts (I-Beam)	130 N·m	83 lb ft
Shock Absorber to Axle (I-Beam)	45 N·m	33 lb ft
Shock Absorber to Frame Nut	108 N·m	80 lb ft
Shock Absorber to Lower Control Arm (Independent)	80 N·m	59 lb ft
Splash Shield to Anchor Plate (I-Beam)	16 N·m	12 lb ft
Splash Shield to Steering Knuckle (Independent)	13 N·m	120 lb in
Spring to Axle U-Bolt Nuts (I-Beam)	109 N·m	80 lb ft
Spring to Hanger Nuts (I-Beam)	113 N·m	83 lb ft
Spring to Shackle Nuts (I-Beam)	113 N·m	83 lb ft
Stabilizer to Frame (I-Beam)	54 N·m	40 lb ft
Stabilizer to Frame (Independent)	33 N·m	24 lb ft
Stabilizer to Lower Control Arm (Independent)	33 N·m	24 lb ft
Stabilizer to Stabilizer Link (I-Beam)	63 N·m	47 lb ft
Steering Arm to Steering Knuckle Bolts (I-Beam)	16 N·m	12 lb ft
Steering Arm to Steering Knuckle Nuts (I-Beam)	312 N·m	230 lb ft
Steering Knuckle Cap Bolts (I-Beam)	7 N·m	60 lb in
Steering Knuckle to Lower Ball Joint Nut (Independent)	122 N·m	90 lb ft
Steering Knuckle to Upper Ball Joint Nut (Independent)	122 N·m	90 lb ft
Suspension Bumper (I-Beam)	34 N·m	25 lb ft
Suspension Bumper (Independent)	26 N·m	19 lb ft
Upper Ball Joint to Upper Control Arm	25 N·m	18 lb ft
Upper Control Arm and Frame Bracket Bolts (Commercial) (Independent)	87 N·m	64 lb ft
Upper Control Arm and Frame Bracket Bolts (Motorhome) (Independent)	135 N·m	100 lb ft
Upper Pivot Shaft Thru-Bolt Nuts	142 N·m	105 lb ft

Component Locator

Front Suspension Components

Upper Control Arm and Components (Independent Suspension)

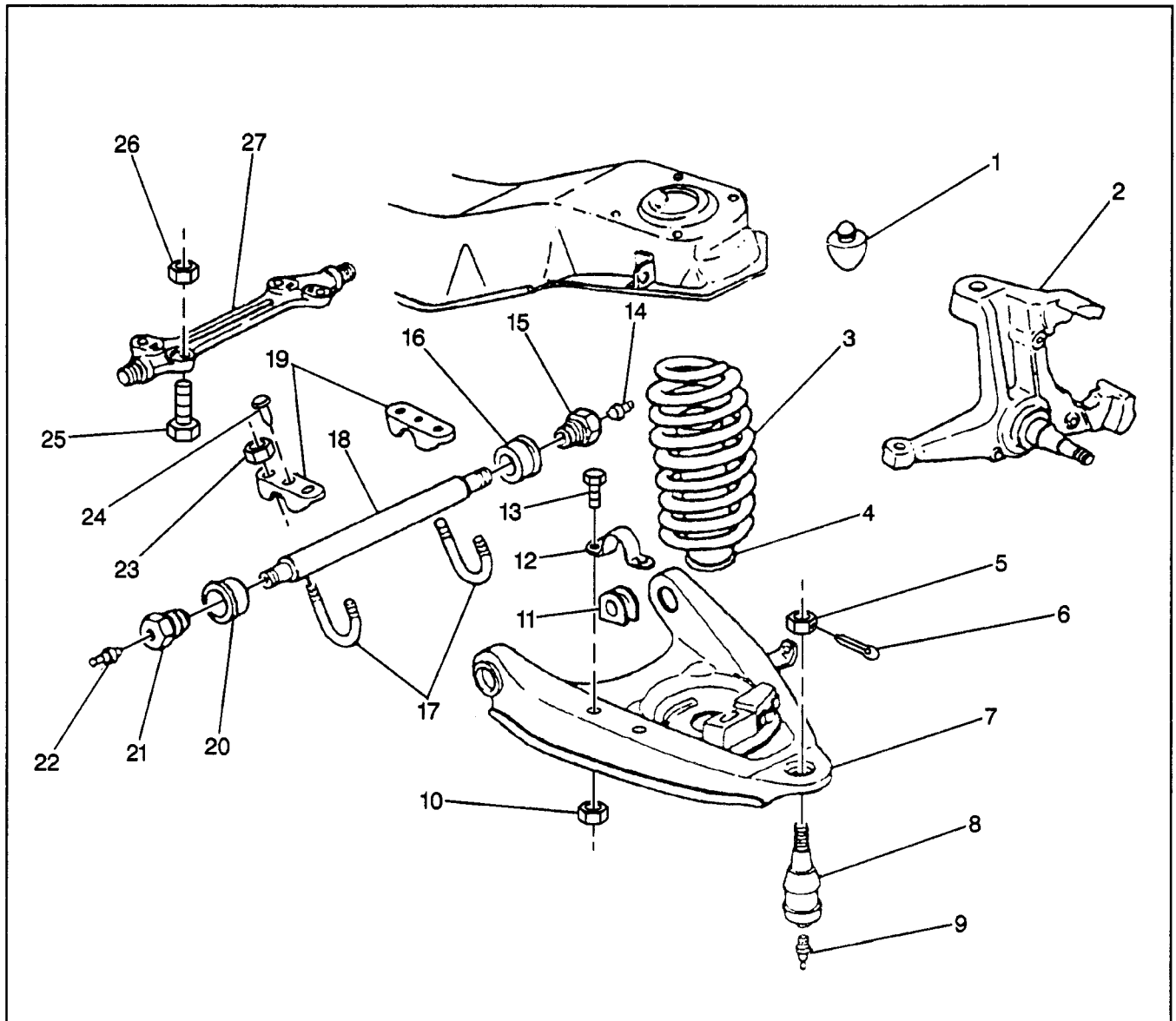


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Legend

- |   |   |
|---|---|
| (1) Upper Ball Joint                            | (14) Upper Control Arm Pivot Shaft Spacer |
| (2) Upper Ball Joint Rivet                      | (15) Shim Pack                            |
| (3) Upper Ball Joint Grease Fitting             | (16) Upper Control Arm Frame Bracket      |
| (4) Upper Ball Joint Nut                        | (17) Upper Control Arm Pivot Shaft Bolt   |
| (5) Cotter Pin                                  | (18) Reinforcement to Frame Washer        |
| (6) Upper Control Arm Front Seal Grease Fitting | (19) Reinforcement to Frame Bolt          |
| (7) Upper Control Arm Front Bushing             | (20) Reinforcement                        |
| (8) Upper Control Arm Front Seal                | (21) Frame Bracket Washer                 |
| (9) Upper Control Arm                           | (22) Frame bracket Nut                    |
| (10) Upper Control Arm Pivot Shaft Nuts         | (23) Shim Pack                            |
| (11) Upper Control Arm Rear Seal                | (24) Upper Control Arm Pivot Shaft Spacer |
| (12) Upper Control Arm Rear Bushing             | (25) Upper Control Arm Pivot Shaft        |
| (13) Upper Control Arm Rear Seal Grease Fitting |   |

Lower Control Arm and Components (Independent Suspension)



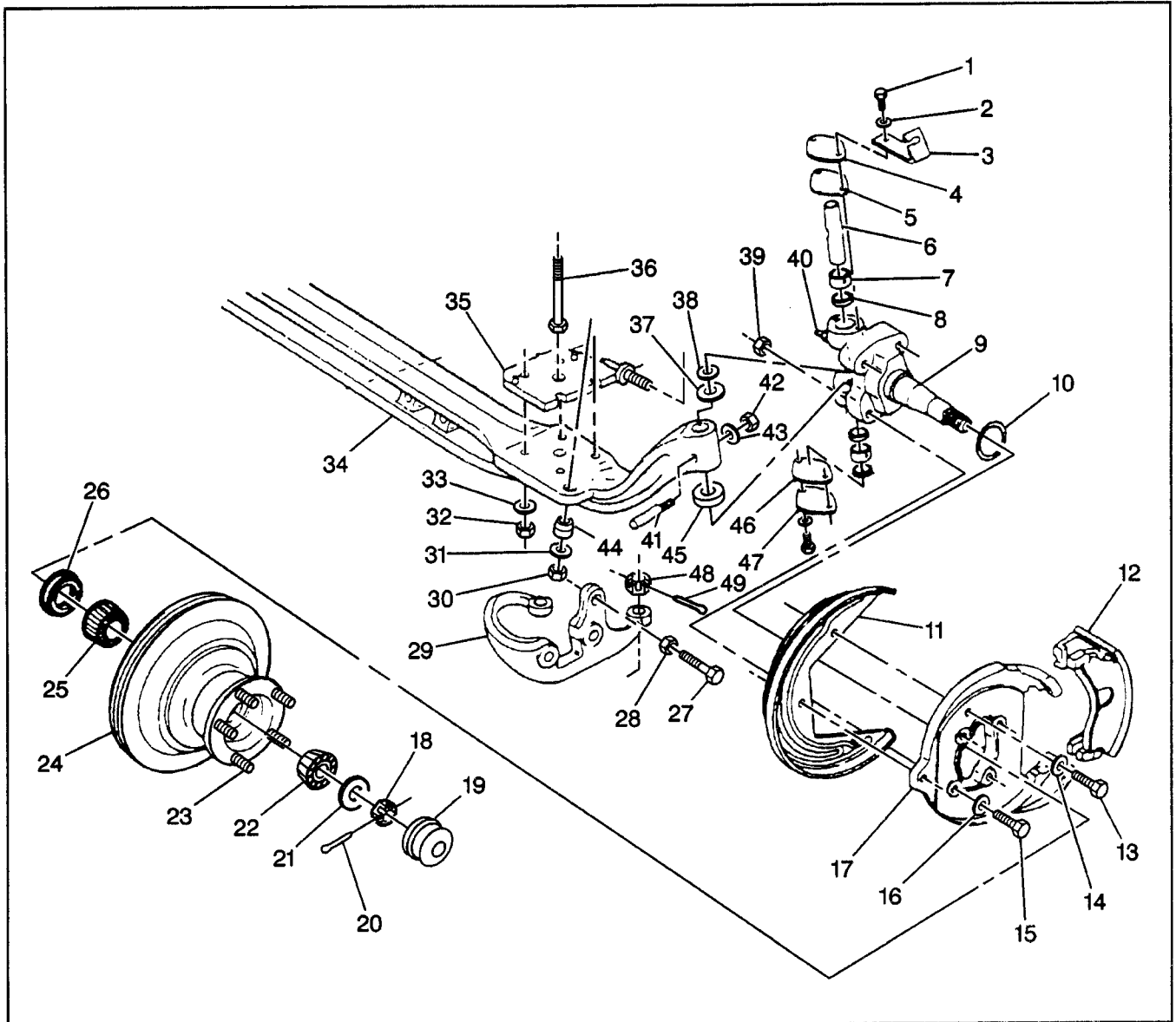
175323

Legend

- |   |  |
|---|--|
| (1) Bumper  | (14) Lower Control Arm Seal Grease Fitting |
| (2) Steering Knuckle                                  | (15) Lower Control Arm Rear Bushing        |
| (3) Coil Spring                                       | (16) Pivot Shaft Seal                      |
| (4) Air Cylinder                                      | (17) Pivot Shaft U-bolts                   |
| (5) Lower Ball Joint Nut                              | (18) Lower Control Arm Pivot Shaft         |
| (6) Cotter Pin  | (19) Pivot Shaft Brackets                  |
| (7) Lower Control Arm                                 | (20) Pivot Shaft Seal                      |
| (8) Lower Ball Joint                                  | (21) Lower Control Arm Front Bushing       |
| (9) Lower Ball Joint Grease Fitting                   | (22) Lower Control Arm Seal Grease Fitting |
| (10) Stabilizer Shaft to Lower Control Arm Clamp Nut  | (23) Pivot Shaft Bracket Nut               |
| (11) Stabilizer Shaft Bushing                         | (24) Pivot Shaft Bracket Rivet             |
| (12) Stabilizer Shaft to Lower Control Arm Clamp      | (25) Pivot Shaft Bolt                      |
| (13) Stabilizer Shaft to Lower Control Arm Clamp Bolt | (26) Pivot Shaft Nut                       |
|   | (27) Pivot Shaft                           |



Front Axle, Steering Knuckle, Hub, and Components (I-Beam Suspension)



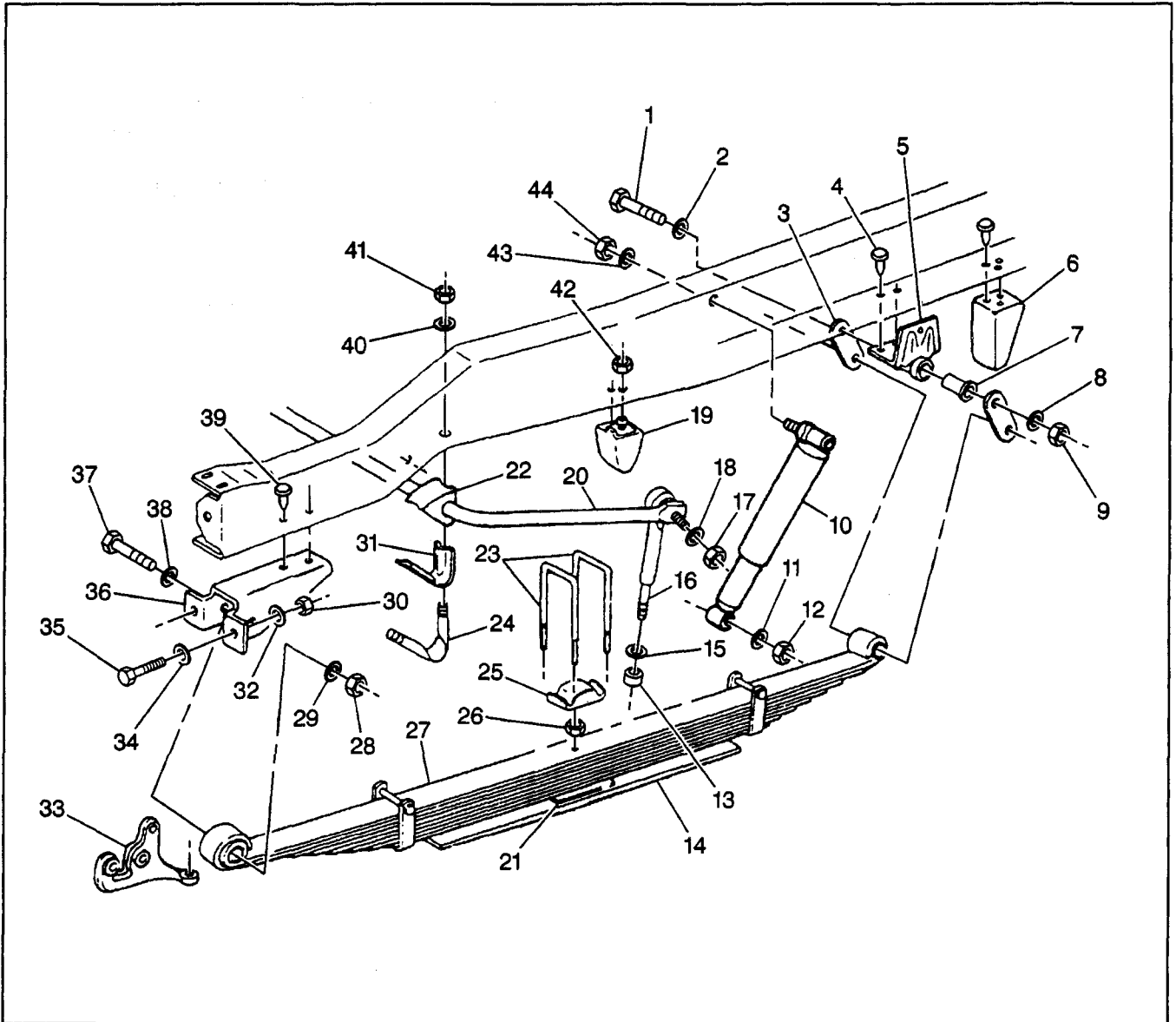
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Legend

- |  |   |
|--|---|
| (1) Brake Hose Bracket Bolt                  | (15) Anchor Plate to Steering Knuckle Nut |
| (2) Brake Hose Bracket Washer                | (16) Anchor Plate to Steering Knuckle Nut |
| (3) Brake Hose Bracket                       | (17) Anchor Plate                         |
| (4) Steering Knuckle Cap                     | (18) Hub/Rotor Nut                        |
| (5) Steering Knuckle Cap Gasket              | (19) Retainer Cap                         |
| (6) Steering Knuckle King Pin                | (20) Cotter Pin                           |
| (7) King Pin Bushing                         | (21) Hub/Rotor Washer                     |
| (8) King Pin Spacer                          | (22) Outer Wheel Bearing                  |
| (9) Steering Knuckle                         | (23) Wheel Hub Bolt                       |
| (10) Steering Knuckle Spindle Gasket         | (24) Wheel Hub/Rotor                      |
| (11) Splash Shield                           | (25) Inner Wheel Bearing                  |
| (12) Brake Caliper                           | (26) Bearing Seal                         |
| (13) Anchor Plate to Steering Knuckle Nut    | (27) Steering Arm Bolt                    |
| (14) Anchor Plate to Steering Knuckle Washer | (28) Steering Arm Bolt                    |

- 
- |   |  |
|---|--|
| (29) Steering Arm                             | (40) Grease Fitting                                |
| (30) Stabilizer Shaft Link to Axle Nut        | (41) Lock Pin                                      |
| (31) Stabilizer Shaft Link to Axle Retainer   | (42) Lock Pin Nut                                  |
| (32) Leaf Spring U-bolt Nut                   | (43) Lock Pin Washer                               |
| (33) Leaf Spring U-bolt Washer                | (44) Stabilizer Shaft Link Insulator               |
| (34) Front Axle                               | (45) Steering Knuckle to Front Axle Thrust Bearing |
| (35) Spring Spacer                            | (46) Steering Knuckle Cap Gasket                   |
| (36) Spring Spacer Bolt                       | (47) Steering Knuckle Cap                          |
| (37) Steering Knuckle to Front Axle Shim      | (48) Steering Arm Nut                              |
| (38) Steering Knuckle to Front Axle Dust Seal | (49) Cotter Pin                                    |
| (39) Anchor Plate to Steering Knuckle Nut     |  |
-

Leaf Spring and Components (I-Beam Suspension)



175321

Legend

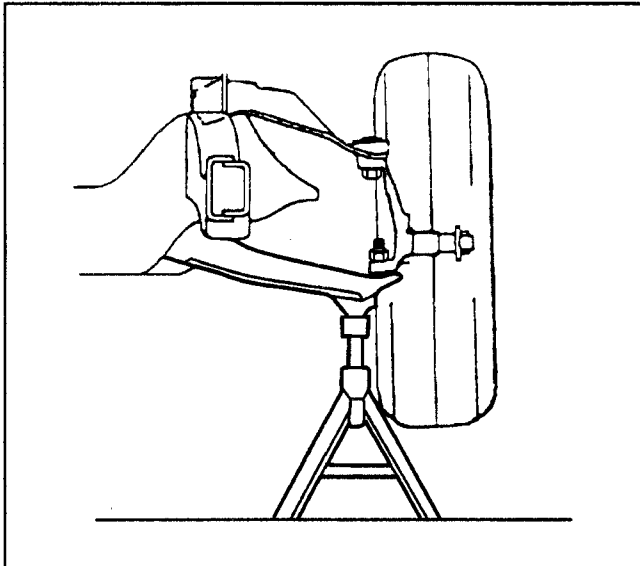
- |   |                                      |
|---|--------------------------------------|
| (1) Spring to Spring Hanger Bolt            | (17) Stabilizer Shaft Link Nut       |
| (2) Spring to Spring Hanger Washer          | (18) Stabilizer Shaft Link Washer    |
| (3) Spring Shackle                          | (19) Bumper                          |
| (4) Spring Hanger to Frame Rivet            | (20) Stabilizer Shaft                |
| (5) Spring Hanger                           | (21) Spacer                          |
| (6) Spring Stop                             | (22) Stabilizer Shaft Insulator      |
| (7) Spring Hanger Bushing                   | (23) Leaf Spring to Axle U-bolts     |
| (8) Spring to Spring Hanger Washer          | (24) Stabilizer Shaft to Frame Bolt  |
| (9) Spring to Spring Hanger Nut             | (25) Leaf Spring Spacer              |
| (10) Shock Absorber                         | (26) Spacer to Leaf Spring Nut       |
| (11) Shock Absorber to Spring Spacer Washer | (27) Front Spring                    |
| (12) Shock Absorber to Spring Spacer Nut    | (28) Spring to Spring Hanger Nut     |
| (13) Stabilizer Shaft Link Insulator        | (29) Spring to Spring Hanger Washer  |
| (14) Leaf Spring                            | (30) Spring Hanger Nut               |
| (15) Stabilizer Shaft Link Retainer         | (31) Stabilizer Shaft to Frame Clamp |
| (16) Stabilizer Shaft Link                  | (32) Spring Hanger Washer            |

- |                                     |                                       |
|-------------------------------------|---------------------------------------|
| (33) Steering Arm                   | (39) Spring Hanger to Frame Rivet     |
| (34) Spring Hanger Washer           | (40) Stabilizer Shaft to Frame Washer |
| (35) Spring Hanger Bolt             | (41) Stabilizer Shaft to Frame Nut    |
| (36) Spring Hanger                  | (42) Bumper to Frame Nut              |
| (37) Spring to Spring Hanger Bolt   | (43) Shock Absorber to Frame Washer   |
| (38) Spring to Spring Hanger Washer | (44) Shock Absorber to Frame Nut      |

## Diagnostic Information and Procedures

### Ball Joint Wear Check (Independent)

1. Rest the vehicle on a level surface.



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**Important:** If a seal is cut or torn, the ball joint **MUST** be replaced.

3. Wipe the ball joints clean. Check the seals for cuts or tears.
4. Adjust the front wheel bearings. Refer to *Wheel Bearing Adjustment (Independent)*.
5. Check the ball joints for vertical looseness.
  - With the vehicle on the jack stands, place a dial indicator against the spindle to show vertical movement.
  - Pry between the lower control arm and the outer race while reading the dial indicator. This will show vertical looseness in the ball joints.
  - If the dial indicator reading is more than 2 mm (0.08 in), replace the ball joint.

#### Important:

- The vehicle must be stable and should not rock on the floor stands.
  - The upper control arm boot seal must not contact the frame.
2. Raise the vehicle. Support the vehicle with suitable safety stands. Support the lower control arm with a floor stand or jack, as far outboard as possible, near the ball joint.

## Repair Instructions

### Front Suspension Crossmember Replacement (Independent)

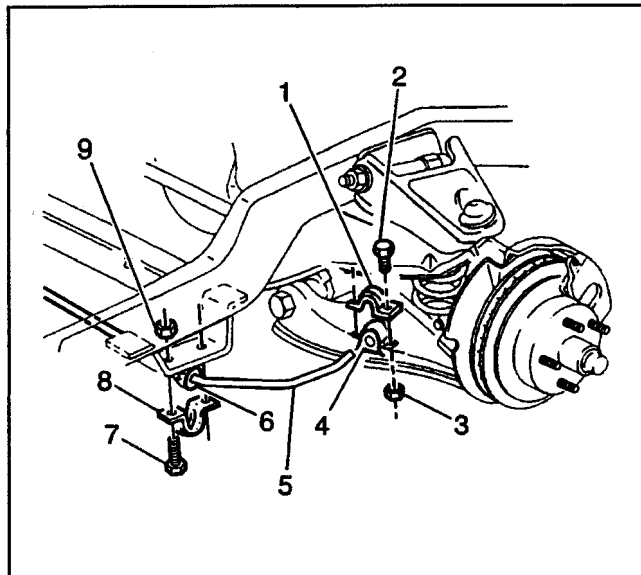
#### Removal Procedure

For control arms and components, refer to *Lower Control Arm and Components (Independent Suspension)* or *Upper Control Arm and Components (Independent Suspension)*.

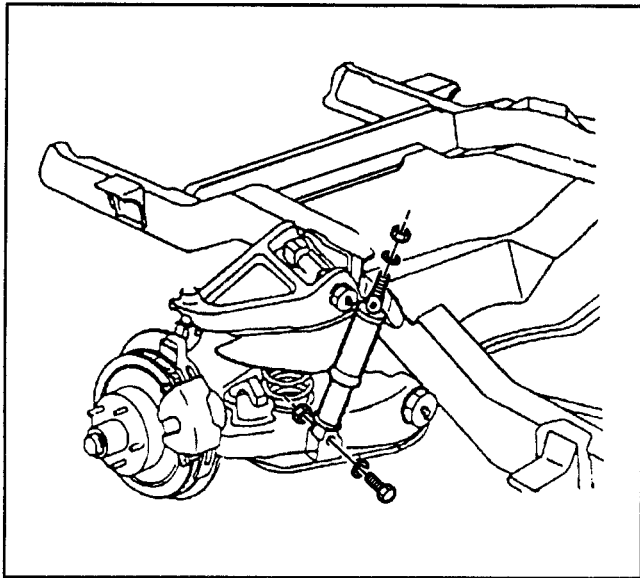
The front suspension and frame crossmember can be removed or installed as a unit if extensive service is required.

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

1. Disconnect the negative battery cable.
2. Raise the vehicle on a hoist. Support the vehicle with suitable safety stands placed at the frame side rails.
3. Lower the hoist.
4. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation in Tires and Wheels*.
5. Remove the front brake hose clip from both of the upper control arms.
6. Disconnect the brake hoses from the calipers.
  - 6.1. For commercial vehicles, refer to *Brake Hose Replacement - Front (Commercial FL7 and FL9)* or *Brake Hose Replacement - Front (Comm. FL5/6 JB7/8 Mtrhome JB8)* or *Brake Hose Replacement - Front (Commercial FK4/FK5 and JF9)* or *Brake Hose Replacement - Front (Commercial FK4/FK5 and JB8)* in Hydraulic Brakes.
  - 6.2. For motorhome vehicles, refer to *Brake Hose Replacement - Front (Motorhome JF9)* or *Brake Hose Replacement - Front (Motorhome JB7/JB8)* in Hydraulic Brakes.
7. Clean the area adjacent to the brake hose fittings.
8. Discard the special washers (2 on each hose), and cover the disconnected ends of each hose with suitable material.
9. Disconnect the tie rod ends from the steering knuckle. Refer to *Tie Rod Replacement (Commercial)* in Steering Linkage.
10. Remove the nuts (3), the bolts (2), and the brackets (1).
11. Remove the front stabilizer shaft from the lower control arms.



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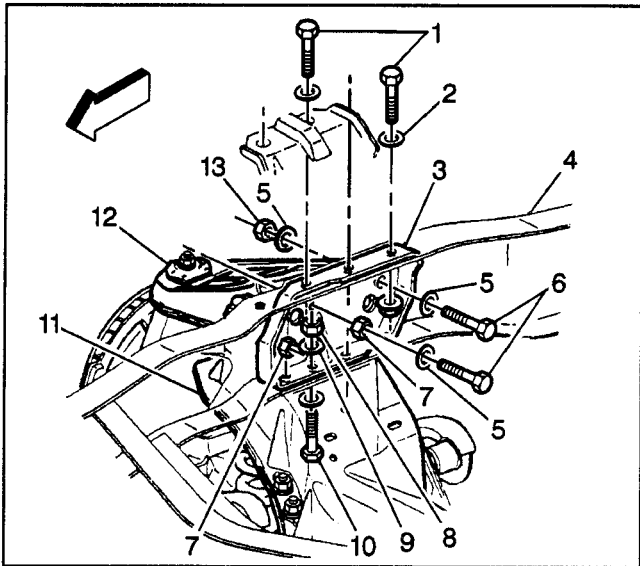


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12. Remove the nut, the washer, and the bolt.
13. Remove the shock absorbers from the lower control arms.

**Notice:** Failure to disconnect the brake line clips from the suspension unit will result in severe damage to the brake line when the unit is lowered from the vehicle.

14. Remove the brake line clip bolts from the front suspension crossmember.
15. Remove the suspension crossmember from the engine mounts. Refer to *Engine Mount Replacement (Front)* or *Engine Mount Replacement (Front)* or *Engine Mount Replacement (Front)* or *Engine Mount Replacement (Front)* in Engine Mechanical.



175300

16. Remove the suspension crossmember (11) from the frame rail (4).

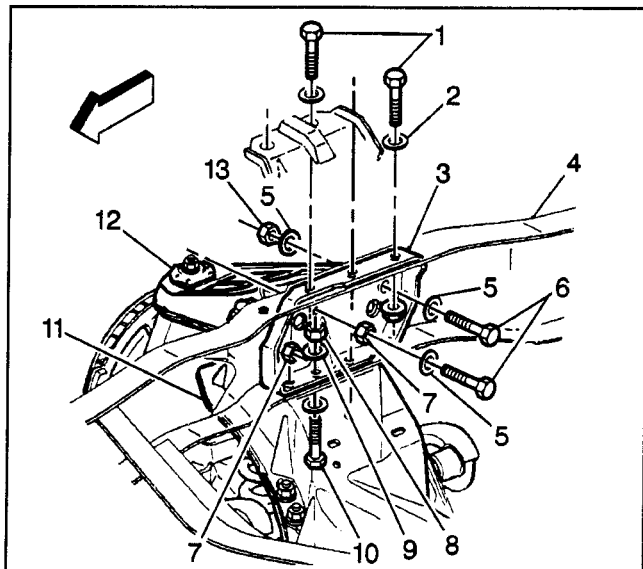
16.1. Raise the hoist in order to support the suspension crossmember.

16.2. Support the engine.

16.3. These must be done before the suspension unit is lowered from the vehicle.

17. Remove the upper control arm bracket to frame side rail nuts (13), the washers (5), and the bolts (6).

18. Remove the suspension and crossmember unit bolts (10), the washers (9), and the nuts (8). When removing the suspension and crossmember unit, lower the suspension and crossmember unit in order to bring the unit clear of the vehicle.



175300

**Installation Procedure**

For control arms and components, refer to *Lower Control Arm and Components (Independent Suspension)* or *Upper Control Arm and Components (Independent Suspension)*.

1. Install the suspension and crossmember unit. Raise the unit with the hoist and align the suspension crossmember and frame holes.
2. Install the suspension crossmember to frame rail bolts (10), the washers (9), and the nuts (8).

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

**Important:** The upper control arm to frame bracket bolts must be tightened first.

The crossmember must be in contact with the frame lower flange.

3. Install the upper control arm to frame bracket bolts (6), the washers (5), and the nuts (13).

**Tighten**

- For commercial models, tighten the bolts to 87 N·m (64 lb ft).
- For motorhome models, tighten the bolts to 135 N·m (100 lb ft).

4. Install the crossmember to frame bolts (1) through the reinforcement.

5. Install the washers (2) and the nuts as used.

**Tighten**

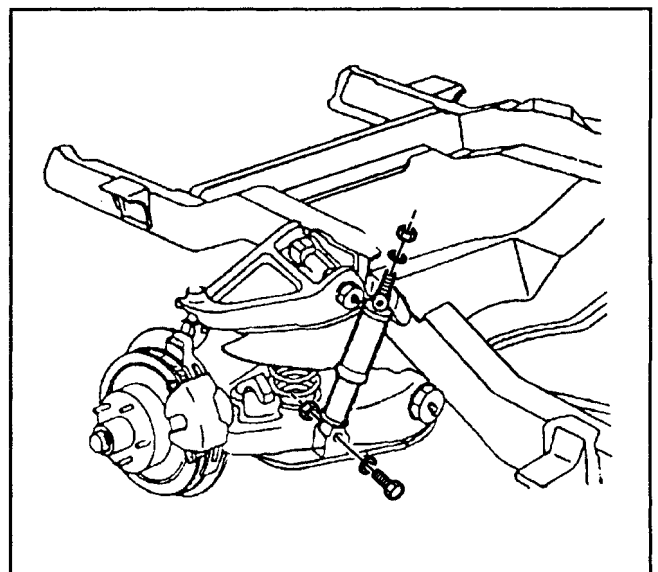
- For commercial models, tighten the bolts to 87 N·m (64 lb ft).
- For motorhome models, tighten the bolts to 135 N·m (100 lb ft).

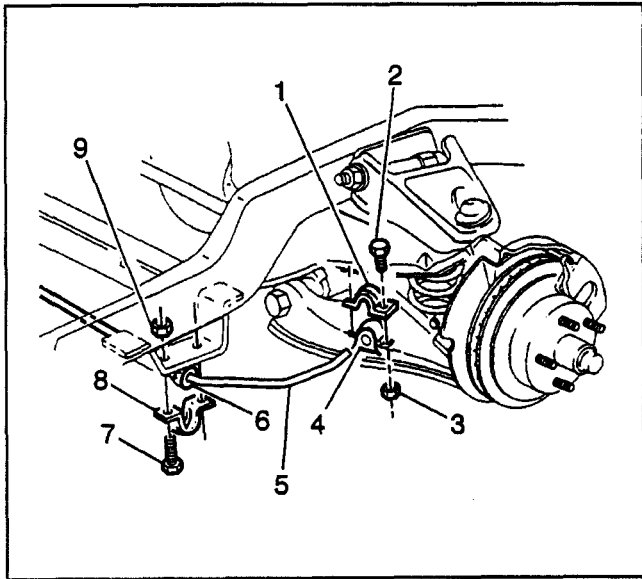
6. Install the engine mount support bracket to suspension crossmember bolts. Remove the engine support and lower the hoist. Refer to *Engine Mount Replacement (Front)* or *Engine Mount Replacement (Front)* or *Engine Mount Replacement (Front)* or *Engine Mount Replacement (Front)* in Engine Mechanical.

7. Install the brake line clip to the crossmember.
8. Install the shock absorber to the lower control arm.
9. Install the washers, the nuts, and the bolts.

**Tighten**

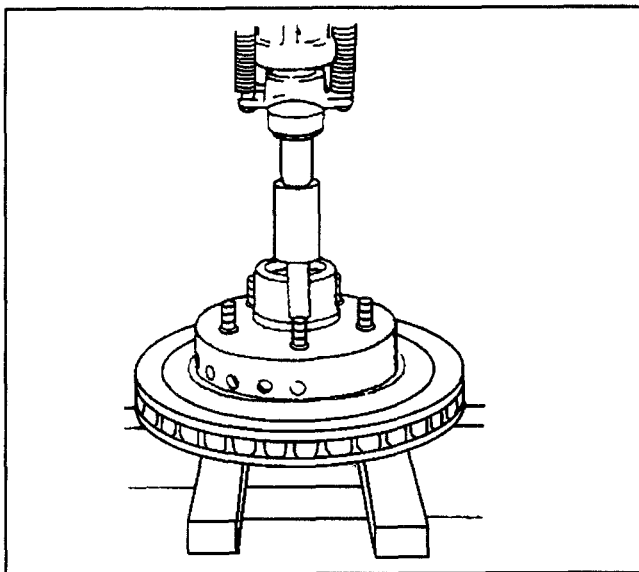
Tighten the nut to 102 N·m (75 lb ft).





175282

10. Install the stabilizer shaft (5) to the lower control arm.
  11. Install the bracket (1), the bolts (2), and the nuts (3).
- Tighten**  
Tighten the nut to 33 N·m (24 lb ft).
12. Connect the tie rod ends to the steering knuckle. Refer to *Tie Rod Replacement (Commercial)* in Steering Linkage.
  13. Connect the brake hose to the caliper.
    - 13.1. For commercial vehicles, refer to *Brake Hose Replacement - Front (Commercial FL7 and FL9)* or *Brake Hose Replacement - Front (Comm. FL5/6 JB7/8 Mtrhome JB8)* or *Brake Hose Replacement - Front (Commercial FK4/FK5 and JF9)* or *Brake Hose Replacement - Front (Commercial FK4/FK5 and JB8)* in Hydraulic Brakes.
    - 13.2. For motorhome vehicles, refer to *Brake Hose Replacement - Front (Motorhome JF9)* or *Brake Hose Replacement - Front (Motorhome JB7/JB8)* in Hydraulic Brakes.
  14. Install the brake hose clips to the upper control arms.
  15. Bleed the brake system. Refer to *Hydraulic Brake System Bleeding* in Hydraulic Brakes.
  16. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
  17. Lower the vehicle.
  18. Connect the negative battery cable.
  19. Check the front wheel alignment. Refer to *Wheel Alignment Specifications* in Wheel Alignment.



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## Wheel Hub Bolt Replacement (Independent)

### Removal Procedure

#### Tools Required

J 9746-02 Hub/Rotor Support

1. Raise the vehicle.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the hub/rotor from the vehicle. Refer to *Wheel Hub, Bearing, and Seal Replacement (Independent)*.

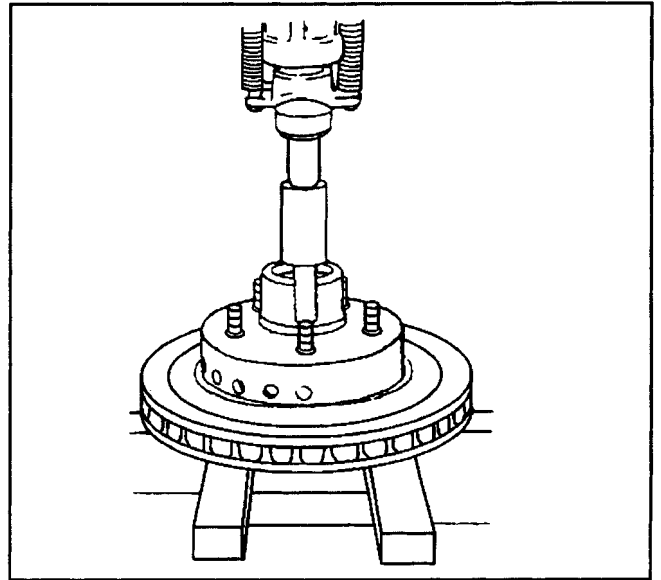
**Notice:** Place J 9746-02 between the press bars and the hub/rotor to protect the rotor surfaces.

4. Remove the wheel hub bolts using a press.
  - Support the hub/rotor using the J 9746-02 and the press bars.
  - Do not damage the wheel mounting surface on the hub/rotor flange.



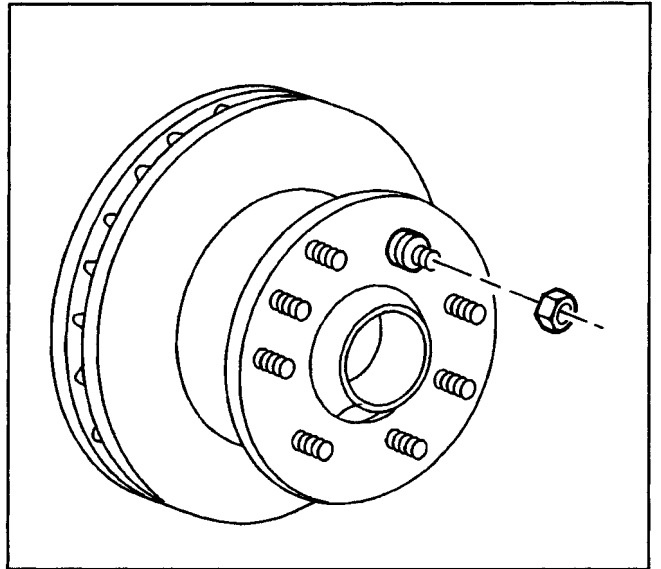
**Installation Procedure**

1. Install the wheel hub bolts into the hub/rotor (using a press).
  - Support the hub/rotor using the *J 9746-02* and the press bars.
  - Do not damage the wheel mounting surface on the hub/rotor flange.



1819

2. Install the wheel hub bolts into the hub/rotor (no press).
  - 2.1. Place four washers onto the bolt. Then, tighten a nut onto the bolt until the bolt fully seats into the hub/rotor.
  - 2.2. Remove the nut and the washers.
3. Install the hub/rotor on the vehicle. Refer to *Wheel Hub, Bearing, and Seal Replacement (Independent)*.
4. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in *Tires and Wheels*.
5. Lower the vehicle.



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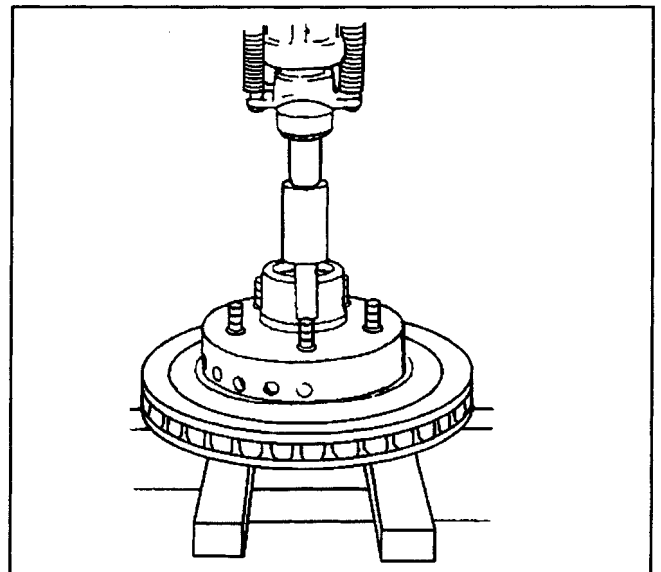
**Wheel Hub Bolt Replacement (I-beam)**

**Removal Procedure**

**Tools Required**

*J 9746-02* Hub/Rotor Support

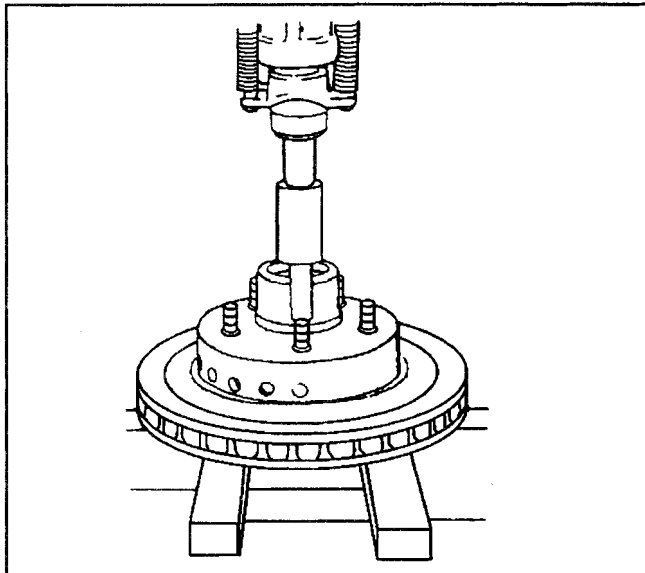
1. Raise the vehicle. Support the vehicle with suitable safety stands.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in *Tires and Wheels*.
3. Remove the hub/rotor assembly from the vehicle. Refer to *Wheel Hub, Bearing, and Seal Replacement (I-Beam)*.



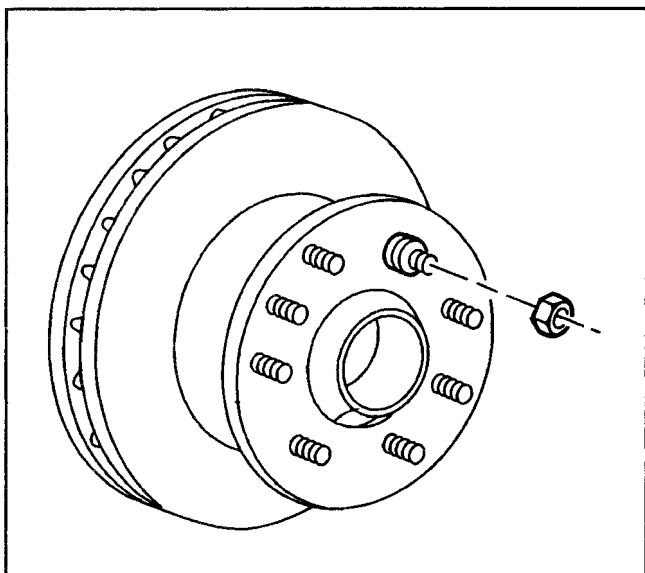
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**Notice:** Place J 9746-02 between the press bars and the hub/rotor to protect the rotor surfaces.

4. Remove the wheel hub bolts using a press.
  - Support the hub/rotor using the J 9746-02 and the press bars.
  - Do not damage the wheel mounting surface on the hub/rotor flange.



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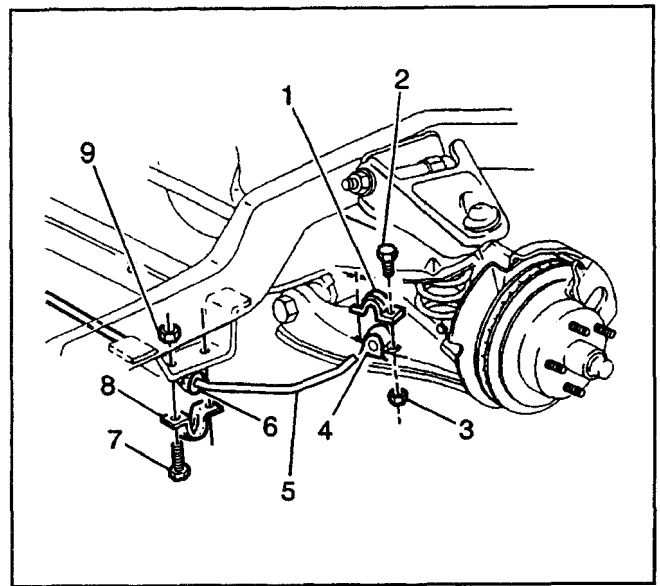
### Installation Procedure

1. Install the wheel hub bolts into the hub/rotor (using a press).
  - Support the hub/rotor using the J 9746-02 and the press bars.
  - Do not damage the wheel mounting surface on the hub/rotor flange.
2. Install the wheel hub bolts into the hub/rotor (no press).
  - 2.1. Place four washers onto the bolt. Then, tighten a nut onto the bolt until the bolt fully seats into the hub/rotor.
  - 2.2. Remove the nut and the washers.
3. Install the hub/rotor on the vehicle. Refer to *Wheel Hub, Bearing, and Seal Replacement (I-Beam)*.
4. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation in Tires and Wheels*.
5. Lower the vehicle.

## Stabilizer Shaft Replacement (Independent)

### Removal Procedure

1. Raise the vehicle. Support the vehicle with suitable safety stands.
2. Remove the tire and wheel assembly. refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the clamp to frame bolts (7), the nuts (9), and the washers.
4. Remove the clamp (8).
5. Remove the stabilizer shaft (5) from the frame.
6. Remove the clamp to control arm bolts (2), the nuts (3), and the washers.
7. Remove the clamp (1).
8. Remove the stabilizer shaft (5) from the lower control arm.
9. Remove the bushings (6).
  - Inspect the bushings for excessive wear, deterioration, or other damage.
  - Replace the bushings as necessary.



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### Installation Procedure

1. Install the bushings (6) to the stabilizer shaft (5).
  - The slit in the insulator should face forward.
  - Use rubber lubricant in order to ease installation.
2. Install the stabilizer shaft (5) to the vehicle.
3. Install the clamps (8) to the frame.
4. Install the bolts (7), the washers, and the nuts (9).
5. Install the clamps (1) to the control arm.

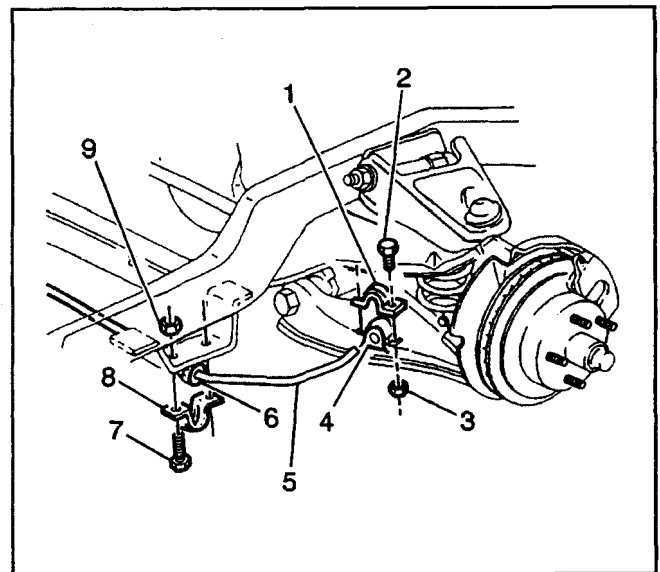
**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

6. Install the bolts (2), the washers, and the nuts (3).

#### Tighten

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

7. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
8. Lower the vehicle.



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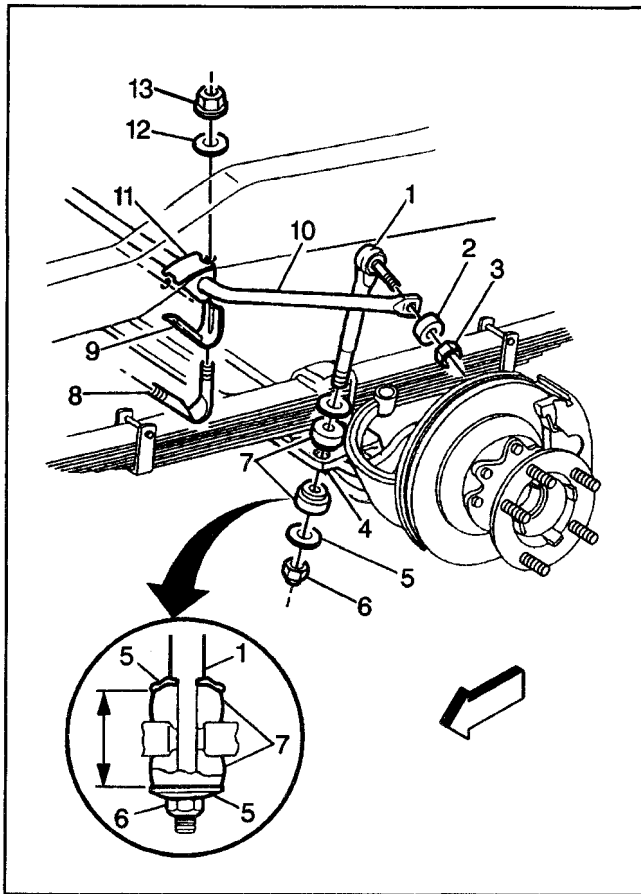
### Stabilizer Shaft Replacement (I-Beam)

#### Removal Procedure

#### Tools Required

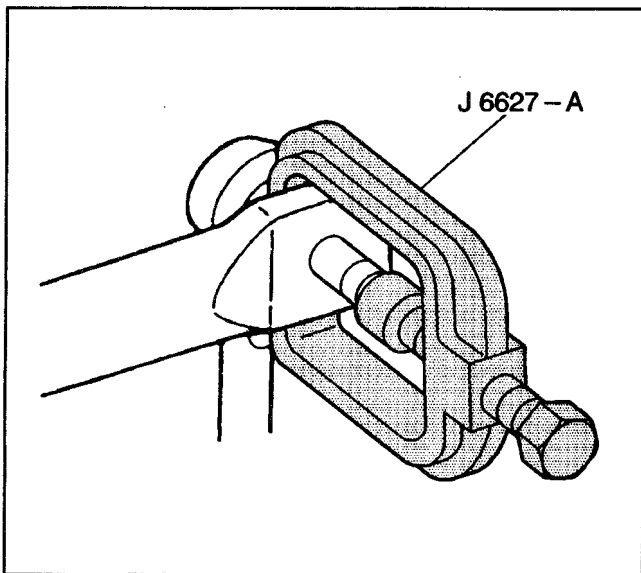
J 6627-A Tie Rod Remover

1. Raise the vehicle. Support the vehicle with suitable safety stands.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation in Tires and Wheels*.
3. Remove the nut (3) and the washer (2).



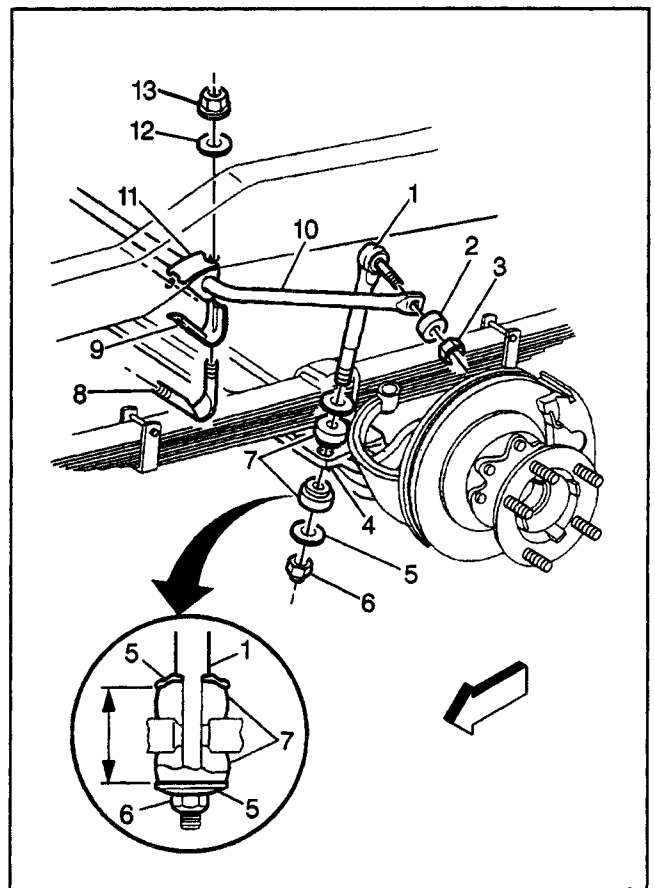
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4. Separate the stabilizer shaft (10) from the stabilizer link (1). Use the J 6627-A in order to separate the stabilizer link from the stabilizer end.



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5. Remove the nuts (13), the bolts (8), and the clamps (9).
6. Remove the stabilizer shaft (10) from the frame.
7. Remove the insulator (11) from the stabilizer shaft.
8. Remove the nut (6), the retainer (5), and the insulator (7).
9. Remove the stabilizer link (1) from the front axle (4). Pull the link from the axle. Another insulator and retainer will come off of the link.



175318

## Installation Procedure

1. Connect the stabilizer link (1) to the front axle (4). Slide a retainer (5) and an insulator (7) onto the link. Insert the link into the proper hole in the front axle.

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

2. Install the insulator (7), the retainer (5), and the nut (6).

### Tighten

Tighten the nut until the distance between each retainer is 52.8 mm (2.08 in).

3. Install the stabilizer shaft (10) to the frame.
4. Install the insulators (11) onto the stabilizer shaft.
5. Install the clamps (9), the bolts (8), and the nuts (13).

### Tighten

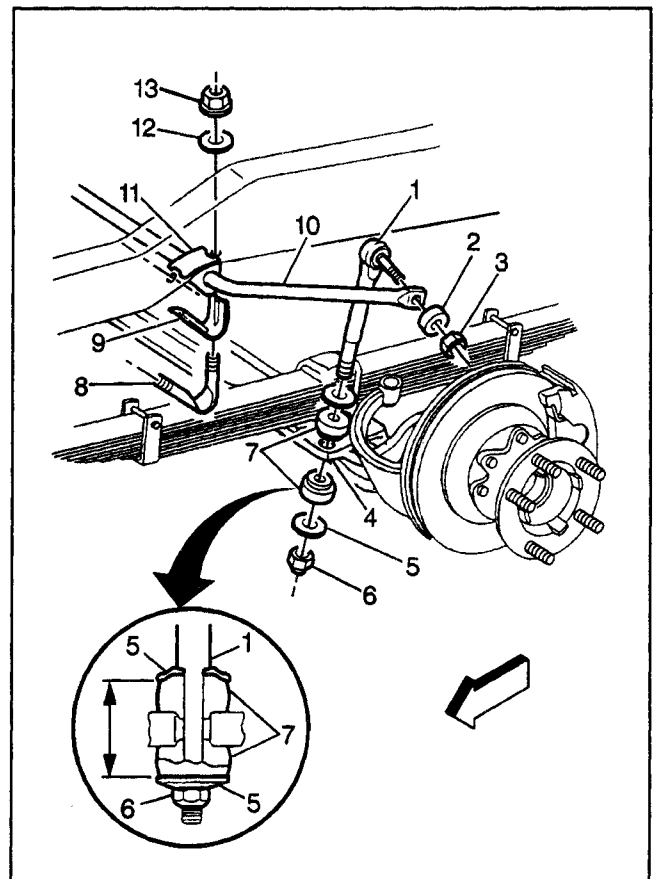
Tighten the nuts to 54 N·m (40 lb ft).

6. Connect the stabilizer shaft (10) to the stabilizer link (1).
7. Install the washer (2) and the nut (3).

### Tighten

Tighten the nuts to 63 N·m (47 lb ft).

8. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
9. Lower the vehicle.



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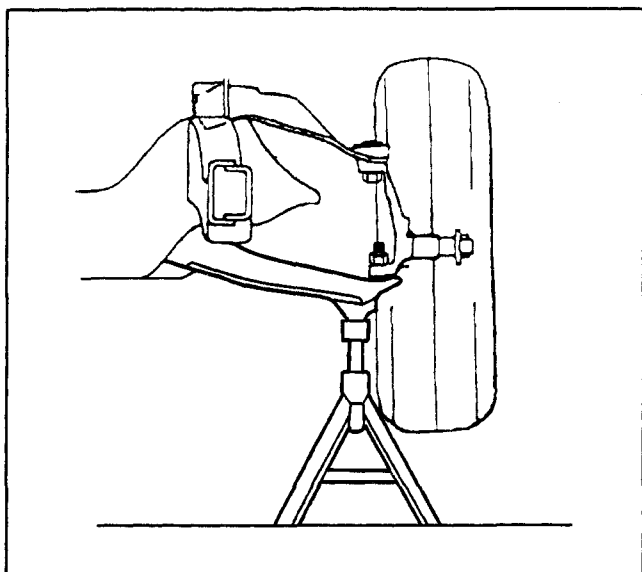
## I-Beam Suspension Replacement

### Removal Procedure

1. Raise the vehicle and support it with safety stands.
2. Remove the tire/wheel assembly. Refer to *Tire and Wheel Removal and Installation*.
3. Disconnect the connecting rod from the steering knuckle. Refer to *Connecting Rod Replacement, I-Beam Front Axle in Steering Linkage*.
4. Support the front axle.
5. Disconnect the stabilizer from the frame. Refer to *Stabilizer Shaft Replacement (I-Beam)*.
6. Disconnect the leaf spring from the frame. Refer to *Leaf Springs Replacement (I-Beam)*.
7. Remove the front suspension from under the vehicle.

### Installation Procedure

1. Position the front suspension unit directly under the vehicle in its correct mounting position.
2. Raise the front suspension unit into its mounting position.
3. Connect the leaf spring to the frame. Refer to *Leaf Springs Replacement (I-Beam)*.
4. Connect the stabilizer to the frame. Refer to *Stabilizer Shaft Replacement (I-Beam)*.
5. Install the connecting rod to the steering knuckle. Refer to *Connecting Rod Replacement, I-Beam Front Axle in Steering Linkage*.
6. Install the tire/wheel assembly. Refer to *Tire and Wheel Removal and Installation*.
7. Lower the vehicle.



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## Upper Ball Joint Replacement (Independent)

### Removal Procedure

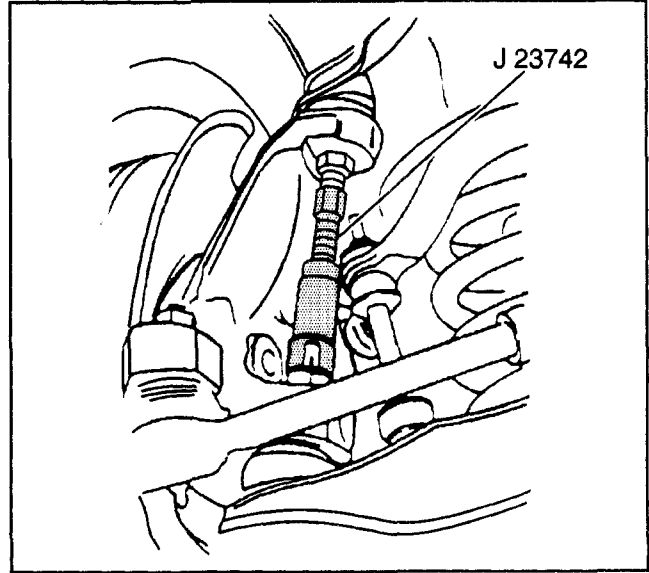
For the upper control arm and components, refer to *Upper Control Arm and Components (Independent Suspension)*.

### Tools Required

J 23742 Ball Joint Separator

1. Ensure that the ball joint is spring loaded in the socket. If there is any lateral movement, or if the ball joint can be twisted in the socket with your fingers, replace the ball joint.
2. Inspect the ball joint seals for cuts or tears. If any of these are found, replace the ball joint.
3. Raise the vehicle on a hoist. If a frame hoist is used, support the lower control arm with a floor jack.
4. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation in Tires and Wheels*.
5. Remove the cotter pin from the upper ball joint. Loosen the nut two turns, but do not remove.

6. Remove the caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.
7. Disconnect the upper ball joint from the steering knuckle. Use the J 23742 in order to separate the upper ball joint from the steering knuckle.
8. Remove the nut. Lift the upper control arm free of the steering knuckle.



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**Caution:** Floor jack must remain under the lower control arm during removal and installation to retain the lower control arm in position. Failure to do so could result in personal injury.

9. Remove the ball joint from the upper control arm.
  - 9.1. Drill 6.35 mm (1/4 in) deep holes in the rivet heads using a 3.175 mm (1/8 in) diameter drill bit.
  - 9.2. Drill off the rivet heads using a 12.7 mm (1/2 in) diameter drill bit.
  - 9.3. Punch out the rivets and remove the upper ball joint from the upper control arm.
10. Inspect the tapered holes in the steering knuckle that attach to the ball joints and the tie rod.
  - 10.1. Remove any dirt.
  - 10.2. If any tapered hole is out of round, deformed, or damaged in any way, replace the steering knuckle.

**Installation Procedure**

For the upper control arm and components, refer to *Upper Control Arm and Components (Independent Suspension)*.

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

1. Install the upper ball joint into the upper control arm.
  - 1.1. Position the ball joint into the upper control arm and install the 4 attaching bolts and nuts.
  - 1.2. Attach the brake hose bracket, if equipped.

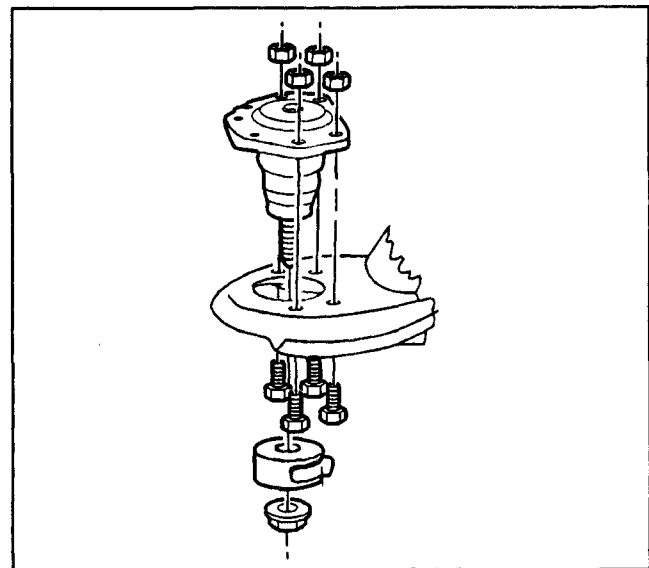
**Tighten**

Tighten the nut to 25 N·m (18 lb ft).

2. Connect the upper ball joint to the steering knuckle. The upper ball joint must be fully seated into the steering knuckle.
3. Install the upper ball joint nut.

**Tighten**

Tighten the nut to 122 N·m (90 lb ft).

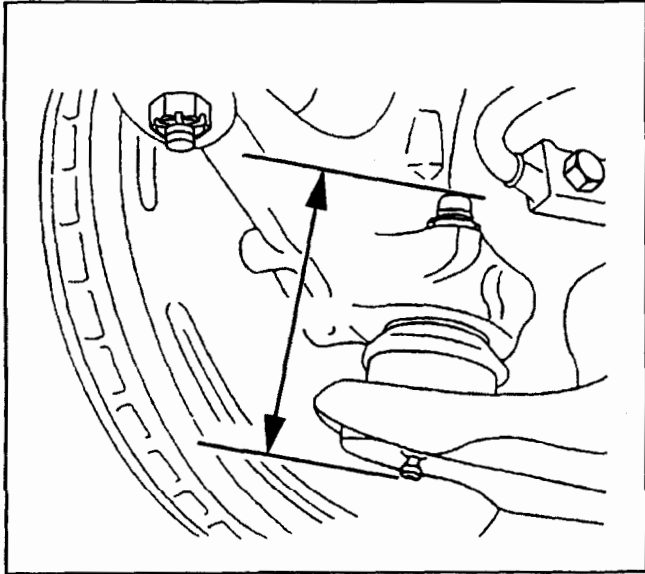


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**Important:** Maximum torque needed to align the cotter pin is 175 N·m (130 lb ft).

4. Install the cotter pin.
5. Install the upper ball joint grease fitting.
6. Grease the upper ball joint until visible. Use the recommended lubricant. Refer to *Fluid and Lubricant Recommendations* in Maintenance and Lubrication.
7. Install the caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.

8. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
9. Lower the vehicle.
10. Check the front wheel alignment. Refer to *Wheel Alignment Specifications* in Wheel Alignment.

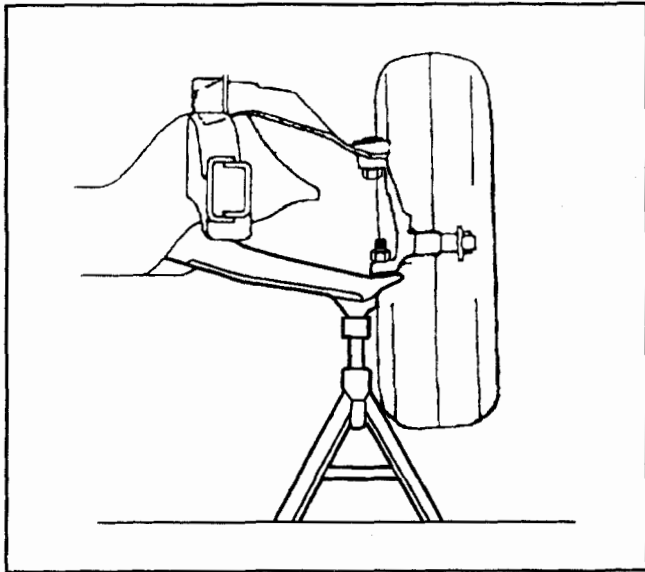


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### Lower Ball Joint Replacement (Independent)

#### Inspection Procedure

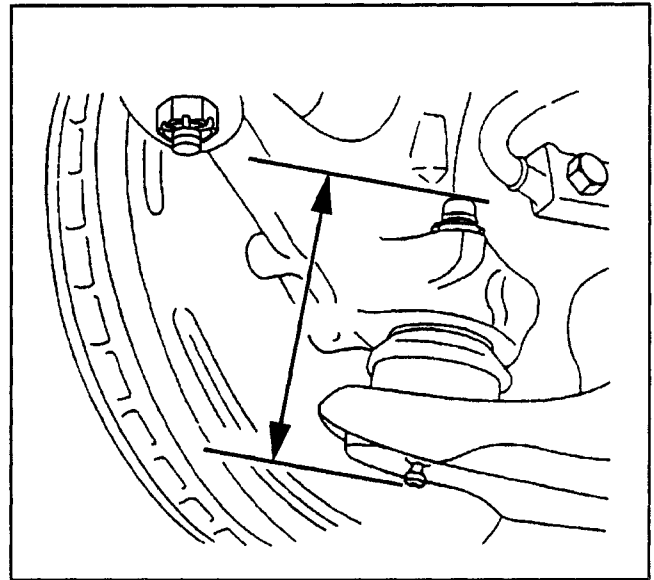
1. Raise the vehicle.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Support the weight of the control arms at the wheel hub and drum.
4. Measure the distance between the tip of the ball joint stud and the tip of the grease fitting below the ball joint.
5. Move the support to underneath the control arm, allowing the wheel hub and drum to hang free.



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6. Measure the distance again as in Step 4. If the difference in measurements exceed 2.38 mm (3/32 in), this indicates that the ball joint is worn. The ball joint **MUST** be replaced.
7. If the ball joint seals are cracked, cut, or torn, replace the ball joint.



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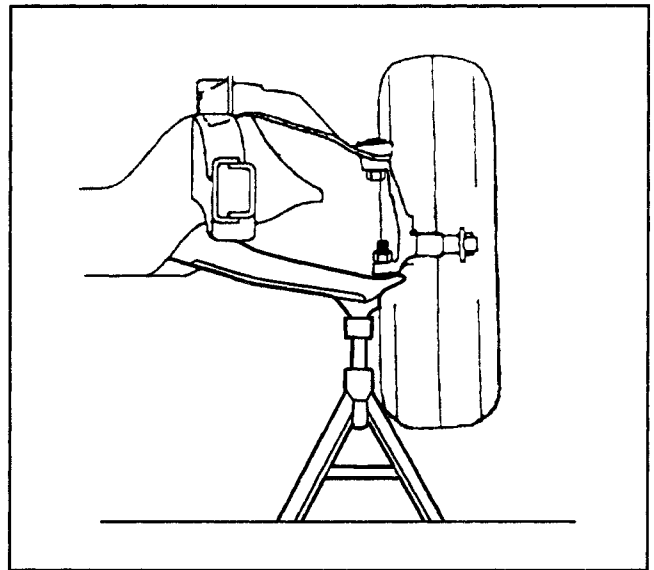
**Removal Procedure**

For lower control arm and components, refer to *Lower Control Arm and Components (Independent Suspension)*.

**Tools Required**

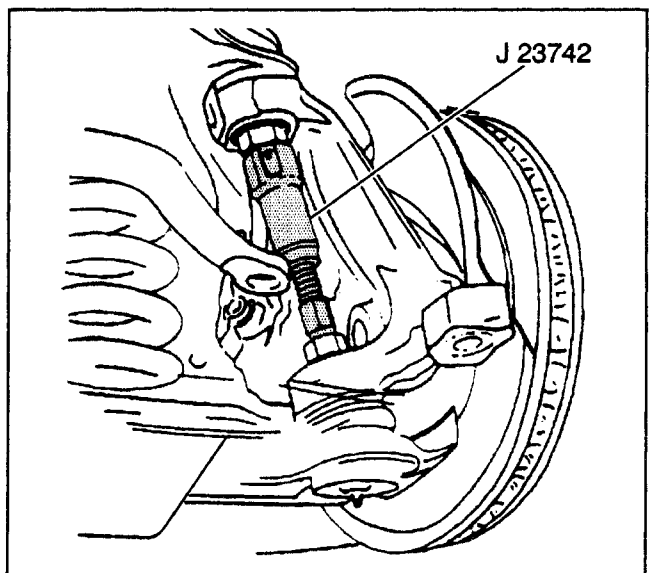
- J 23742 Ball Joint Separator
- J 9519-E Ball Joint Remover and Installer Set

1. Raise the vehicle on a hoist. If a frame hoist is used, support the lower control arm with a floor stand.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation in Tires and Wheels*.
3. Remove the cotter pin, the nut, and the grease fitting. Loosen the nut two turns, but do not remove.

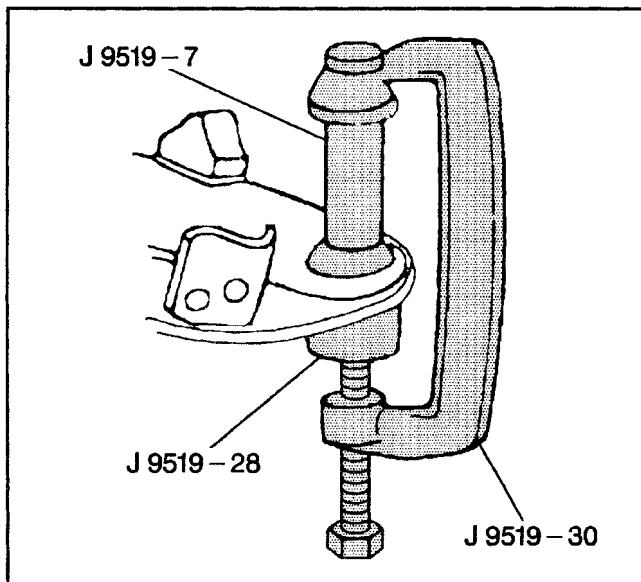


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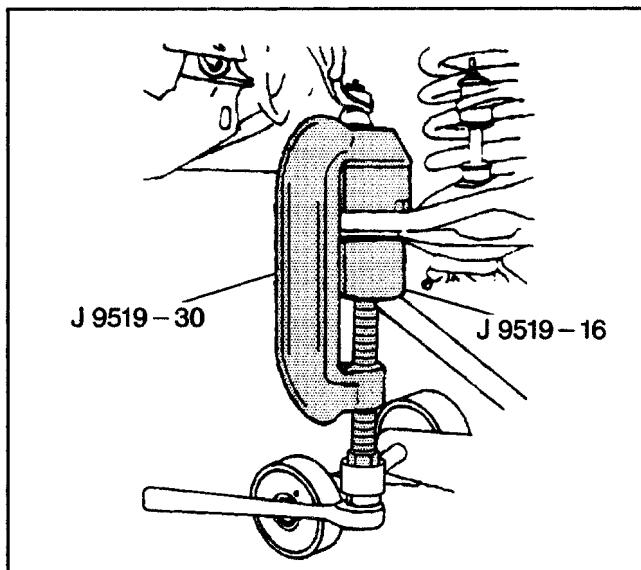
4. Loosen the ball joint in the steering knuckle.
  - 4.1. Use the J 23742 between the ball joint studs.
  - 4.2. You may need to remove the caliper and wire the caliper to the frame in order to gain clearance for the J 23742. Refer to *Brake Caliper Replacement (Front)* in *Disc Brakes*.
  - 4.3. Extend the J 23742 until the lower ball joint breaks free from the steering knuckle.
  - 4.4. Remove the nut and the J 23742.



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5. Take the hub/rotor and the knuckle assembly off of the lower ball joint.

**Caution:** Floor jack must remain under the lower control arm during removal and installation to retain the lower control arm in position. Failure to do so could result in personal injury.

6. Remove the ball joint from the lower control arm.
  - 6.1. Install the tools as shown.
  - 6.2. Turn the hex head screw until the ball joint comes free from the lower control arm.
  - 6.3. Remove the tools and the ball joint.

### Installation Procedure

For lower control arm and components, refer to *Lower Control Arm and Components (Independent Suspension)*.

1. Install the ball joint into the lower control arm.
  - 1.1. Start the ball joint into the control arm and install the tools as shown.
  - 1.2. Position the bleed vent in the rubber boot, facing inward.
  - 1.3. Turn the hex head screw until the ball joint is seated in the lower control arm.
2. Install the ball joint into the steering knuckle. Mate the steering knuckle to the lower ball joint.
3. Install the caliper, if removed. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.

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

4. Install the lower ball joint nut.

### Tighten

Tighten the nut to 122 N·m (90 lb ft).

**Important:** Maximum torque to align the cotter pin is 175 N·m (130 lb ft).

5. Install the cotter pin.
6. Install the grease fitting. Lubricate the ball joint with the recommended lubricant until visible. Refer to *Fluid and Lubricant Recommendations* in Maintenance and Lubrication.
7. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
8. Lower the vehicle.
9. Check the front wheel alignment. Refer to *Wheel Alignment Specifications* in Wheel Alignment.

## Steering Knuckle Replacement (Independent)

### Removal Procedure

For control arms and components, refer to *Upper Control Arm and Components (Independent Suspension)* or *Lower Control Arm and Components (Independent Suspension)*.

### Tools Required

J 23742 Ball Joint Separator

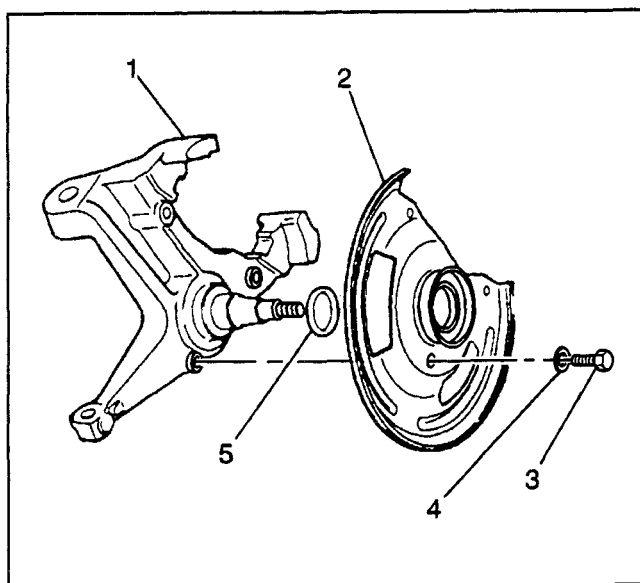
### Important:

- Raise and support the vehicle on a twin-post hoist in order to compress the front coil spring and provide accessibility to the wheel and the steering knuckle assembly.
- If a frame hoist is used, support the lower control arm with an adjustable jackstand in order to safely retain the spring in the curb height position.

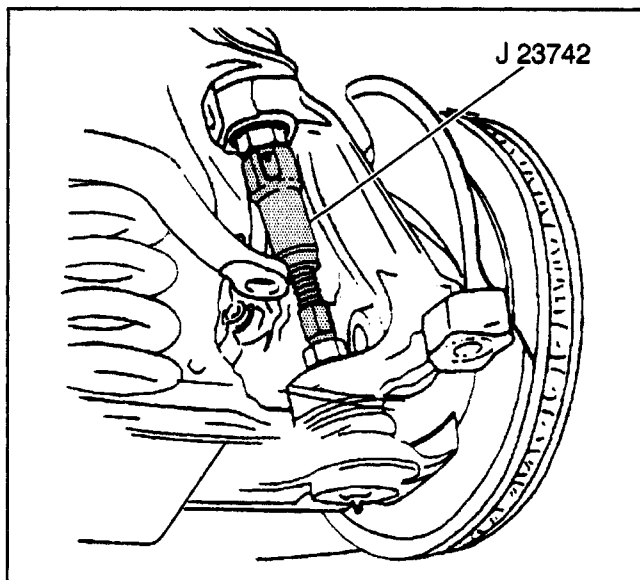
1. Raise the vehicle.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the brake caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.
4. Remove the hub/rotor. Refer to *Wheel Hub, Bearing, and Seal Replacement (I-Beam)*.
5. Remove the bolts (3) and the washers (4) of the splash shield.
6. Remove the gaskets (5).
7. Remove the splash shield (2).
8. Disconnect the steering knuckle from the tie rod end. Refer to *Tie Rod Replacement (Commercial)* in Steering Linkage.

**Caution:** Floor jack must remain under the lower control arm during removal and installation to retain the lower control arm in position. Failure to do so could result in personal injury.

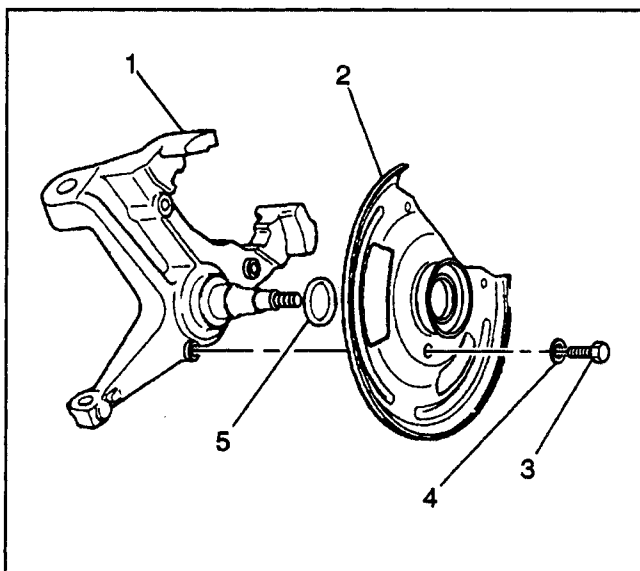
9. Disconnect the steering knuckle from the upper ball joint. Refer to *Upper Control Arm Replacement (Independent)*.



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10. Disconnect the steering knuckle from the lower ball joint.
  - 10.1. Use the *J 23742* in order to break the lower ball joint free from the steering knuckle.
  - 10.2. Lift the steering knuckle off of the lower ball joint.
11. Inspect the tapered holes in the steering knuckle that attach to the ball joints and the tie rod end.
  - Remove any dirt.
  - If any tapered hole is out of round, deformed, or damaged in any way, replace the steering knuckle.
12. Inspect the spindle for wear or damage. If the spindle is damaged or worn, replace the steering knuckle.

### Installation Procedure

For control arms and components, refer to *Upper Control Arm and Components (Independent Suspension)* or *Lower Control Arm and Components (Independent Suspension)*.

1. Connect the steering knuckle to the lower ball joint. Press the steering knuckle onto the lower ball joint until the knuckle is fully seated.
2. Connect the steering knuckle to the upper ball joint. Lower the upper control arm in order to seat the upper ball joint into the steering knuckle.

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

3. Install the lower and the upper control arm nuts.

#### Tighten

Tighten the nuts to 122 N·m (90 lb ft).

**Important:** Maximum torque on the nuts to align the cotter pin is 175 N·m (130 lb ft).

4. Install the cotter pins. If necessary, tighten the nuts an additional amount in order to align the cotter pin.
5. Remove the floor jack.
6. Connect the tie rod end to the steering knuckle. Refer to *Tie Rod Replacement (Commercial)* in Steering Linkage.
7. Install the splash shield (2).
8. Install the washers (4) and the bolts (3).

#### Tighten

Tighten the bolts to 13 N·m (120 lb in).

9. Install the hub/rotor assembly. Refer to *Wheel Hub, Bearing, and Seal Replacement (I-Beam)*.
10. Install the caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.
11. Adjust the wheel bearings. Refer to *Wheel Bearing Adjustment (Independent)*.

12. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
13. Lower the vehicle.
14. Check the front wheel alignment. Refer to *Wheel Alignment Specifications* in Wheel Alignment.

## Steering Knuckle Replacement (I-Beam)

### Removal Procedure

For front axle, steering knuckle, and hub components, refer to *Front Axle, Steering Knuckle, Hub, and Components (I-Beam Suspension)*.

1. Raise the vehicle. Support the vehicle with safety stands.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.
4. Remove the hub/rotor assembly. Refer to *Wheel Hub, Bearing, and Seal Replacement (I-Beam)*.
5. Remove the bolts, the washers, and the nuts.
6. Remove the anchor plate, the splash shield, and the steering arm.
  - Pull the anchor plate and the splash shield off of the knuckle.
  - The steering arm hangs from the tie rods.
7. Remove the bolts and the washers in order to separate the anchor plate from the splash shield. In order to separate the steering arm from the tie rod and the pitman arm, refer to *Tie Rod Replacement* in Steering Linkage.
8. Remove the bolts and the washers from the brake hose bracket.
9. Remove the brake hose bracket.
10. Remove the steering knuckle gaskets.
11. Remove the caps from the steering knuckle.
12. Remove the nut and washer from the lock pin.
13. Remove the lock pin.
14. Remove the king pin from the steering knuckle.
  - Drive out the king pin using a drift.
  - The spacers and the bushings will also come out.
15. Remove the steering knuckle from the axle.
16. Remove the dust seal, the shim, and the thrust bearing.

### Installation Procedure

For front axle, steering knuckle, and hub components, refer to *Front Axle, Steering Knuckle, Hub, and Components (I-Beam Suspension)*.

1. Install the steering knuckle bushings. Ream the new bushings to 29.982–30.022 mm (1.1804–1.1820 in) after installation.
2. Install the steering knuckle.

3. Install the thrust bearing, the shim, and the dust seal. Prelube the thrust bearing. Refer to *Fluid and Lubricant Recommendations* in Maintenance and Lubrication.
4. Install the king pin and the lock pin.
  - 4.1. Prelube the king pin.
  - 4.2. Insert the spacers in the proper order.

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

5. Install the washer and the nut.

#### **Tighten**

Tighten the nut to 40 N·m (29 lb ft).

6. Install the steering knuckle gaskets.
  7. Install the caps on the steering knuckle.
  8. Install the brake hose bracket.
  9. Install the brake hose bracket washers and the bolts.
- #### **Tighten**
- Tighten the bolts to 7 N·m (60 lb in).
10. Install the steering arm, the splash shield, and the anchor plate.
  11. Install the bolts and the washers that attach the splash shield to the anchor plate.
  12. Install the bolts, the washers, and the nuts that attach the anchor plate and the steering arm to the steering knuckle.

#### **Tighten**

- Tighten the bolts to 16 N·m (12 lb ft).
- Tighten the nuts to 312 N·m (230 lb ft).

13. Install the steering arm to the steering linkage. Refer to *Tie Rod Replacement (I-Beam)* in Steering Linkage.
14. Install the hub/rotor assembly. Refer to *Wheel Hub, Bearing, and Seal Replacement (I-Beam)*.
15. Adjust the wheel bearings. Refer to *Wheel Bearing Adjustment (I-Beam)*.
16. Install the caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.
17. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
18. Lower the vehicle.
19. Check the front wheel alignment. Refer to *Wheel Alignment Specifications* in Wheel Alignment.

## **Upper Control Arm Replacement (Independent)**

### **Removal Procedure**

For upper control arm and components, refer to *Upper Control Arm and Components (Independent Suspension)*.

### **Tools Required**

J 23742 Ball Joint Separator

1. Raise the vehicle. Support the vehicle with suitable safety stands. Place an adjustable jackstand under the lower control arm for support.

2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.
4. Remove the cotter pin.
5. Disconnect the upper control arm from the steering knuckle. Refer to *Wheel Hub, Bearing, and Seal Replacement (I-Beam)*.
6. Remove the nuts.
7. Remove the upper control arm from the frame bracket.

### **Installation Procedure**

For upper control arm and components, refer to *Upper Control Arm and Components (Independent Suspension)*.

1. Install the upper control arm to the frame bracket.

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

### **Important:**

- A normal shim pack will leave at least two threads of the bolt exposed beyond the nut.
  - If two threads cannot be obtained, check for a damaged control arm or related parts.
  - The difference between the front and the rear shim packs must not exceed 7.62 mm (0.30 in). The front shim pack must be at least 6.09 mm (0.24 in).
  - Always tighten the thinner shim pack nut first in order to improve the shaft to frame clamping force and torque retention.
2. Install the nuts.

#### **Tighten**

Tighten the nuts to 142 N·m (105 lb ft).

3. Connect the upper control arm to the steering knuckle. Insert the stud of the upper control arm ball joint into the steering knuckle.

**Important:** Maximum torque needed to align the cotter pin is 175 N·m (130 lb ft).

4. Install the nut and the cotter pin.

#### **Tighten**

- Tighten the nuts to 122 N·m (90 lb ft).
- Tighten the nut if needed to install the cotter pin.

5. Install the caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.
6. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
7. Lower the vehicle.
8. Check the front wheel alignment and reset as required. Refer to *Wheel Alignment Specifications* in Wheel Alignment.

## Lower Control Arm Replacement (Independent)

### Removal Procedure

For lower control arm and components, refer to *Lower Control Arm and Components (Independent Suspension)*.

### Tools Required

- J 23742 Ball Joint Separator
  - J 23028-01 Coil Spring Remover and Installer
1. Raise the vehicle. Support the vehicle with suitable safety stands.
  2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
  3. Remove the caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.
  4. Remove the coil spring. Refer to *Front Coil Springs Replacement (Independent)*. Use a jack in order to support the inboard end of the lower control arm when the control arm is separated from the frame.
  5. Remove the cotter pin. Then, loosen the nut one turn.
  6. Disconnect the lower control arm from the steering knuckle.
    - 6.1. Install the J 23742 with a large cup end over the upper ball joint nut.
    - 6.2. Extend the threaded end until the ball joint stud loosens from the steering knuckle.
    - 6.3. Remove the J 23742 and the nut.

### Installation Procedure

For the lower control arm and components, refer to *Lower Control Arm and Components (Independent Suspension)*.

1. Place the nut onto the stud. Do not tighten.
2. Install the coil spring. Refer to *Front Coil Springs Replacement (Independent)*. This step attaches the lower control arm to the frame.

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

3. Install the nut.

### Tighten

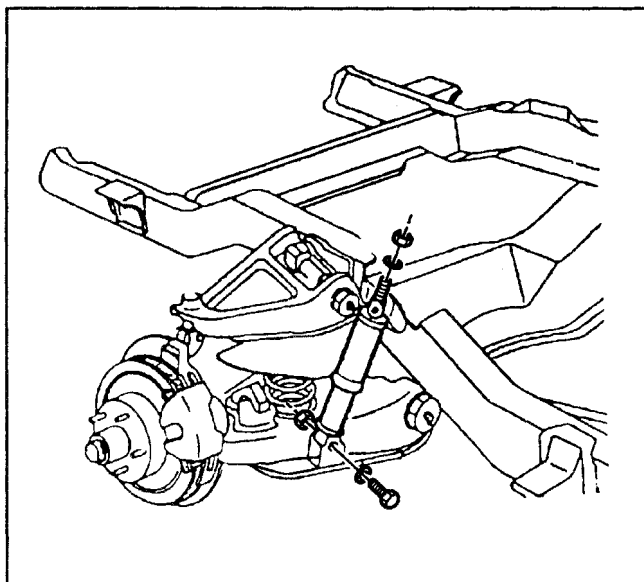
- Tighten the nut to 122 N·m (90 lb ft).
- Tighten the nut if needed to install the cotter pin.

**Important:** Maximum torque to align the cotter pin is 175 N·m (130 lb ft).

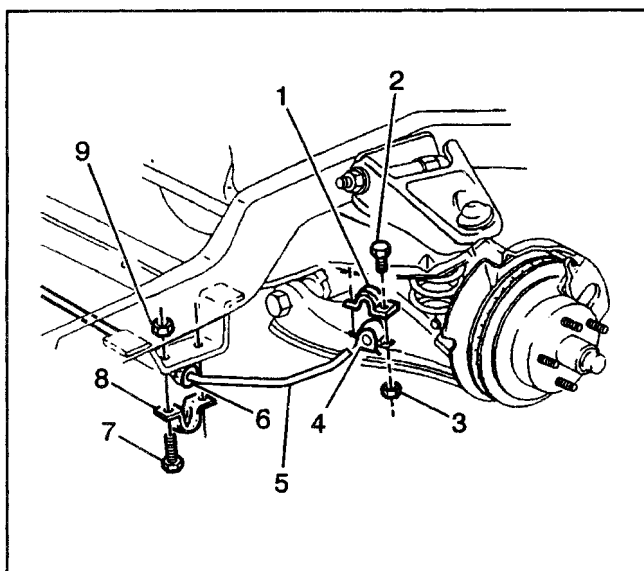
4. Install the cotter pin.
5. Install the caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.
6. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
7. Lower the vehicle.
8. Check the front wheel alignment. Refer to *Wheel Alignment Specifications* in Wheel Alignment.

### Air Spring Inspection

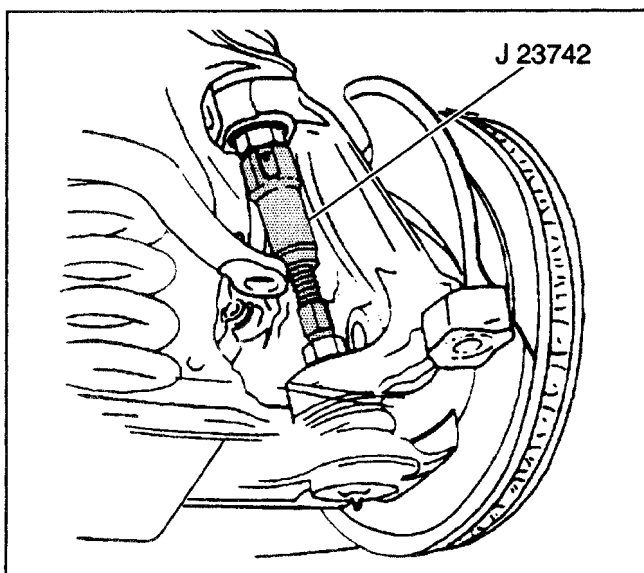
1. Inspect the air spring for leaks by replacing the valve core and inflating the air spring to 138 kPa (20 psi).
2. Submerge the air spring in water and check for bubbles. If bubbles are present, replace the air spring. Refer to *Air Spring Replacement (Independent Suspension Only)*.



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## Front Coil Springs Replacement (Independent)

### Removal Procedure

For lower control arm and components, refer to *Lower Control Arm and Components (Independent Suspension)*.

### Tools Required

- J 23742 Ball Joint Separator
- J 23028-01 Coil Spring Remover

1. Raise the vehicle. Support the vehicle with suitable safety stands, allowing the control arms to hang free.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation in Tires and Wheels*.
3. Disconnect the lower end of the shock absorber and move the shock aside.
4. Remove the nuts (3), the bolts (2), the bracket (1), and the stabilizer shaft (5) from the lower control arm.

5. Remove the nut from the lower ball joint.
6. Disconnect the lower ball joint from the steering knuckle.



**Caution:** Tool J 23028-01 should be secured to a suitable jack or personal injury could result.

**Important:** As a safety precaution, install a chain around the coil spring and through the lower control arm.

7. In order to install a chain with an air cylinder installed, use the following procedure:
8. Remove the valve core from the cylinder.
9. Expel the air by pushing on the cylinder with a pry bar.
10. Replace the valve cap in order to retain vacuum.
11. Push the air cylinder as far as possible toward the top of the spring.
12. Raise the jack in order to relieve the tension from the lower control arm pivot shaft.  
Remove the U-bolts or bolts and the nuts.
13. Lower the control arm by slowly releasing the jack until the spring can be removed.
14. Do not apply too much force on the ball joint. This can damage the ball joint.
15. Install the J 23028-01 on a suitable jack and then place under the lower control arm.
16. When compression is relieved from the spring, remove the spring and the safety chain. Proper maneuvering of the spring will allow for easy removal.
17. Remove the air cylinder, if equipped. Inspect the air cylinder for leaks using the following procedure:
  - 17.1. Replace the valve core.
  - 17.2. Inflate the air cylinder to 138 kPa (20 psi).
  - 17.3. Submerge the cylinder in water.
  - 17.4. Check for air bubbles.

### Installation Procedure

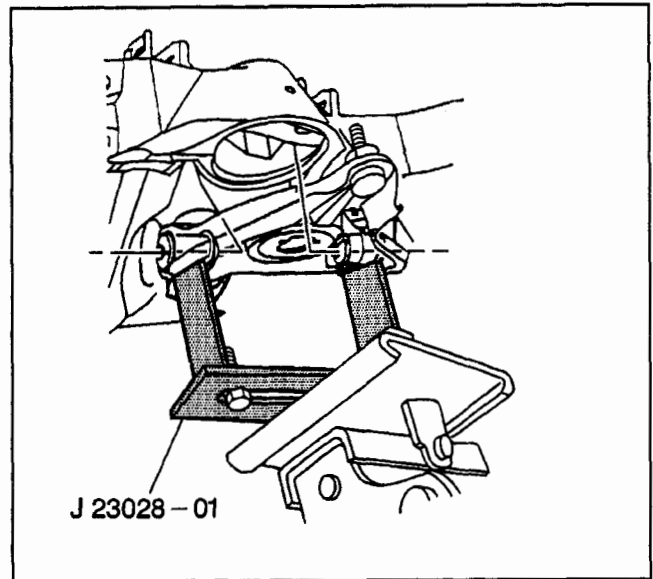
For lower control arm and components, refer to *Lower Control Arm and Components (Independent Suspension)*.

1. Install the air cylinder, if equipped. Install the air cylinder inside of the coil spring so that the Schrader valve protrudes through the hole in the lower control arm.

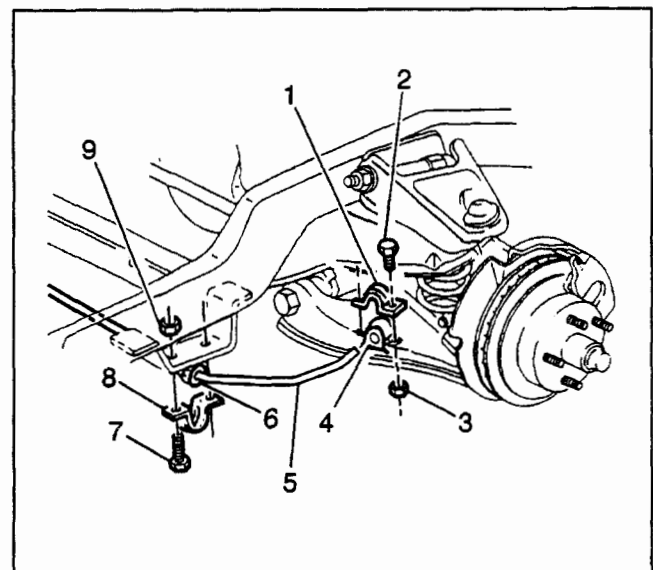
**Caution:** Tool J 23028-01 should be secured to a suitable jack or personal injury could result.

**Important:** Install a chain around the coil spring and through the lower control arm as an additional safety precaution.

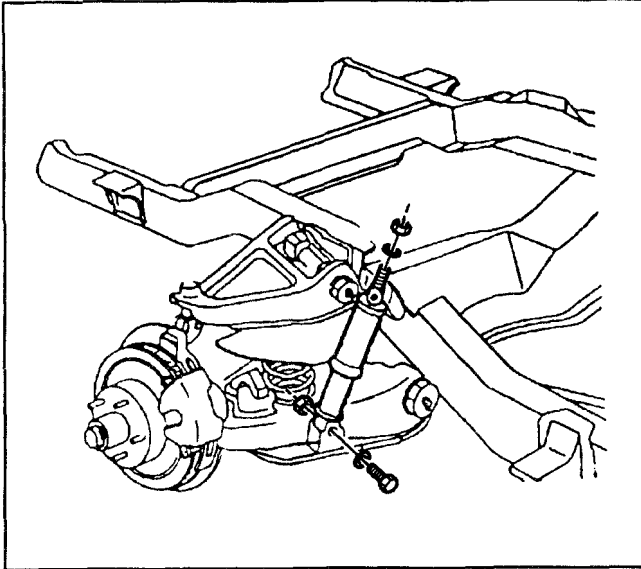
2. Place the coil spring into position on the lower control arm.
  - Place the end of the coil spring at the drain hole in the lower control arm.
  - Use the J 23028-01 bolted on a floor jack.
3. Slowly lift the lower control arm into position.
  - Line up the front indexing hole in the shaft with the crossmember attaching studs.
  - Do not damage the lower ball joint.



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

4. Install the U-bolts or bolts and the nuts.

**Tighten**

Tighten the nuts to 115 N·m (85 lb ft).

5. Lower the floor jack and remove the *J 23028-01*.
6. Install the stabilizer shaft (5), the bracket (1), the bolts (2), and the nuts (3) to the lower control arm.

**Tighten**

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

7. Install the shock absorber to the lower control arm.
8. Install the washer, the bolt, and the nut.

**Tighten**

Tighten the nuts to 80 N·m (59 lb ft).

9. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
10. Inflate the air cylinders, if equipped, to 414 kPa (60 psi).
  - Maintain the inflation pressure at 69 kPa (10 psi) in order to avoid chafing.
  - Under load, adjust the air cylinder air bags to the following pressures:
    - For a 4,300, 4,500, and 5,000 lb capacity front suspension, inflate the air bags to 276–414 kPa (40–60 psi).
    - For a 5,300 lb capacity front suspension, inflate the air bags to 414–552 kPa (60–80 psi).
    - For a 5,500 lb capacity front suspension, inflate the air bags to 552–689 kPa (80–100 psi).
11. Lower the vehicle.
12. Check the front wheel alignment. Refer to *Wheel Alignment Specifications* in Wheel Alignment.

### Air Spring Replacement (Independent Suspension Only)

#### Removal Procedure

1. Deflate the air spring.
2. Remove the coil spring. Refer to *Front Coil Springs Replacement (Independent)*.
3. Slide the air spring out of the coil spring.

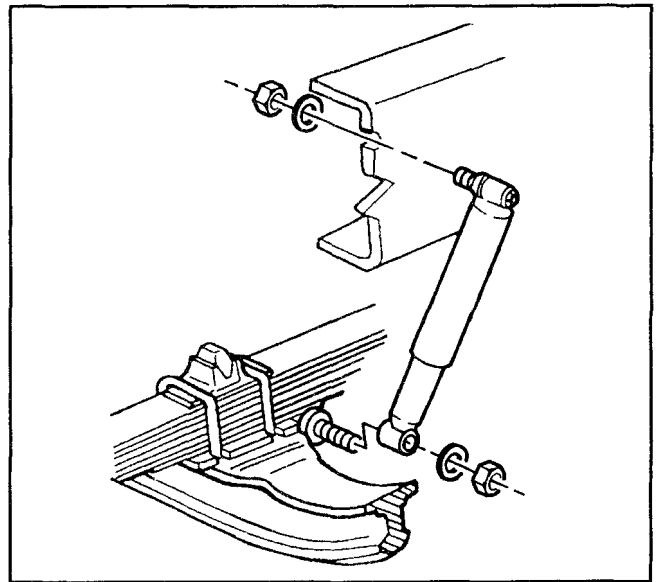
#### Installation Procedure

1. Slide the air spring into the coil spring.
2. Install the coil spring. Refer to *Front Coil Springs Replacement (Independent)*.
3. Inflate the air spring.

## Leaf Springs Replacement (I-Beam)

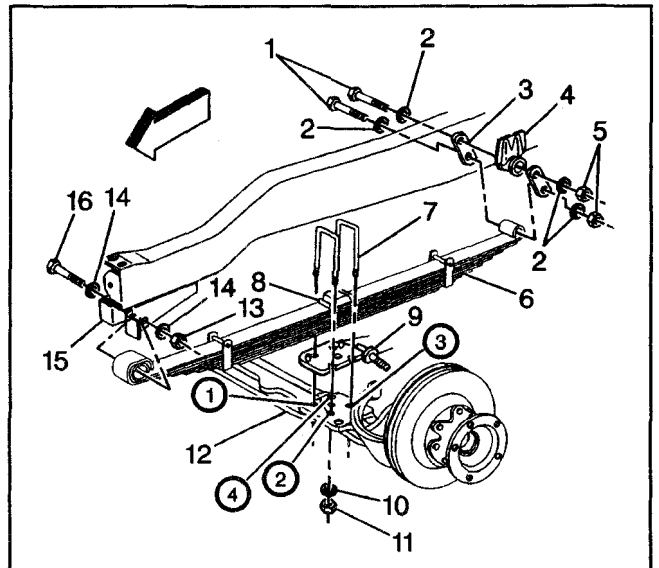
### Removal Procedure

1. Raise the vehicle. Support the vehicle with suitable safety stands. Support the axle separately in order to eliminate any load on the springs.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the nut and the washer.
4. Remove the shock absorber from the axle.



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5. Remove the spacer (8) and the spring spacer (9).
6. Remove the leaf spring (6) from the axle (12).
7. Remove the nut (5), the washers (2), and the bolt (1) in order to separate the spring from the rear shackle.
8. Remove the nut (13), the washers (14), and the bolts (16) in order to separate the spring from the front hanger (15). Pull the leaf spring backward and out.
9. Remove the leaf spring (6) from the frame.



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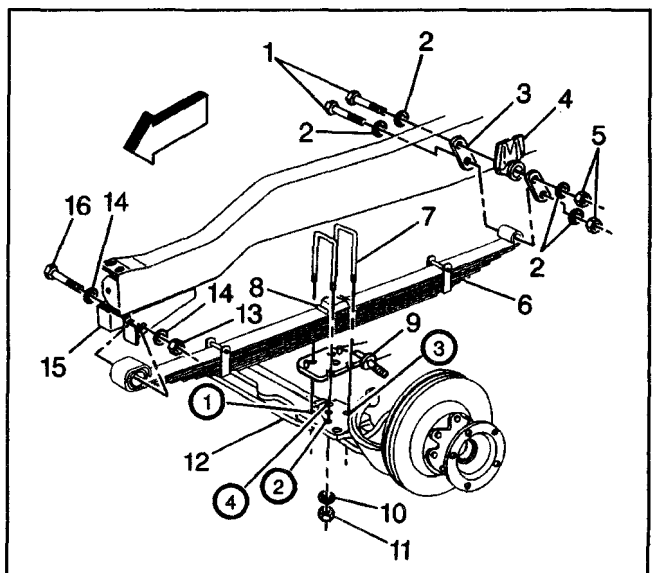
### Installation Procedure

1. Install the leaf spring (6) to the frame.
  - Line up the spring with the rear shackle (3) and the spring hanger (4).
  - The double wrap end is toward the front of the vehicle.
2. Install the washers (14), the bolt (16), and the nut (13) that attaches the spring to the front hanger (15).
3. Install the washers (2), the bolt (1), and the nut (5) that attaches the spring (6) to the rear shackle (3).

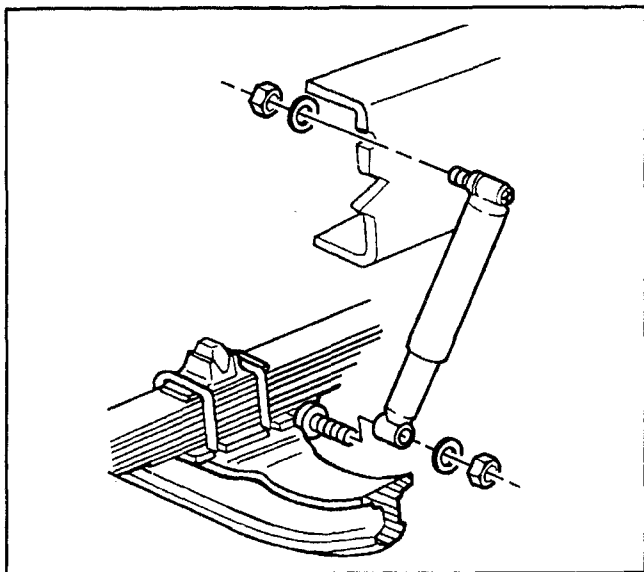
**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

#### Tighten

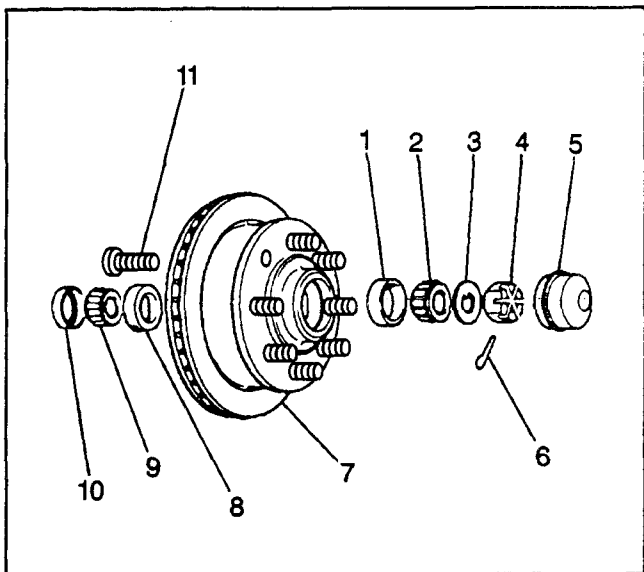
Tighten the nuts to 113 N·m (83 lb ft).



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4. Install the leaf spring (6) to the axle.
  - Position the spring spacer (9) onto the axle (12).
  - Either aligning pin can contact the edge of the leaf spring after the assembly is complete.
5. Install the spacer (8), the U-bolts (7), the washer (10), and the nuts (11).

**Tighten**

- Tighten the nuts to 25 N·m (18 lb ft) in a diagonal sequence (Example: 1-3-4-2).
- Tighten the nuts to 109 N·m (80 lb ft) in a diagonal sequence (Example: 1-3-4-2).

6. Install the shock absorber to the axle.
7. Install the washer and the nut.

**Tighten**

Tighten the nut to 45 N·m (33 lb ft).

8. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
9. Lower the vehicle.
10. Check the front wheel alignment and reset as required. Refer to *Wheel Alignment Specifications* in Wheel Alignment.

## Wheel Hub, Bearing, and Seal Replacement (Independent)

### Removal Procedure

#### Tools Required

- J 8092 Driver Handle
- J 6368 Outer Bearing Race Installer
- J 23448 Inner Bearing Race Installer
- J 9746-02 Hub/Rotor Support

1. Raise the vehicle. Support the vehicle with suitable safety stands.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.

**Notice:** Support the caliper with a piece of wire to prevent damage to the brake line.

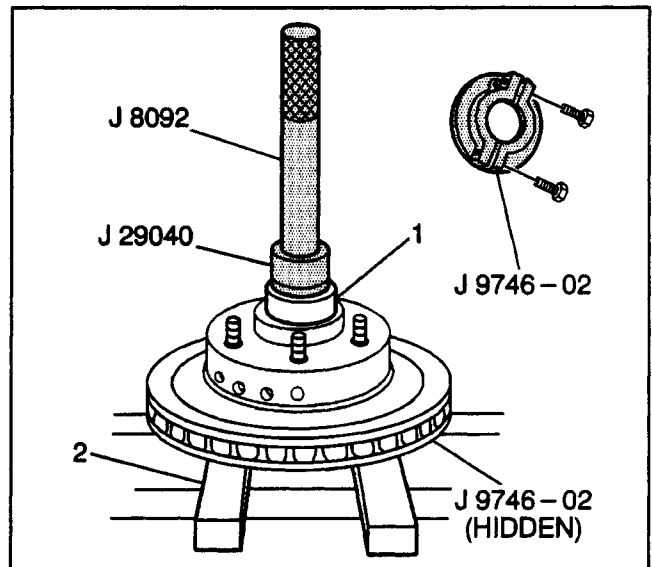
3. Remove the caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.
4. Remove the dust cap (5).
5. Remove the cotter pin (6), the nut (4), and the washer (3).

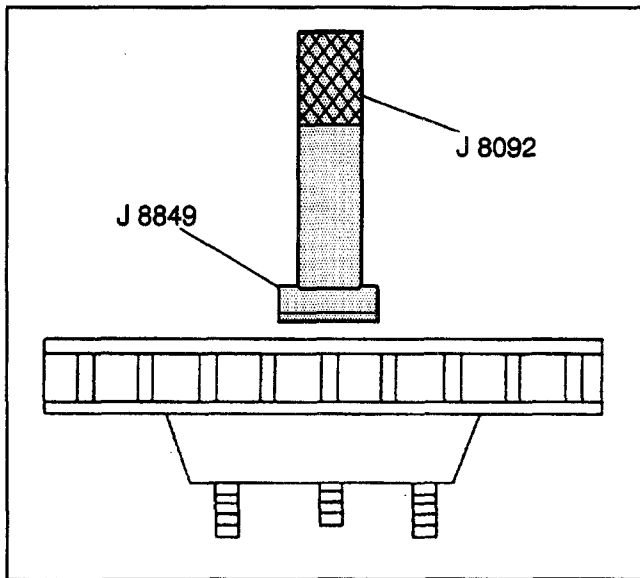
6. Remove the wheel hub/rotor (7).
    - Pull the hub/rotor free. Ensure that the outer wheel bearing (2) comes free of the hub/rotor.
    - Do not damage the steering knuckle spindle threads.
  7. Remove the seal (10). Pry out the seal.
  8. Remove the inner wheel bearing (9).
  9. Remove the races (1, 8). Drive out each race using a brass drift, inserted behind the race, in the notches in the hub.
  10. Clean grease from the hub/rotor and the steering knuckle spindle.
  11. Remove grease from inside of the hub, the wheel bearings, and the races.
- Notice:** Do not spin the wheel bearings with compressed air to dry them—the wheel bearings may be damaged.
12. Use clean solvent and a small brush with no loose bristles.
  13. Inspect the wheel bearings and the races for damage or wear. Refer to *Wheel Bearings Diagnosis* in Suspension General Diagnosis. If a bearing or the race is damaged or worn, replace the bearing and the race.
  14. Inspect the hub/rotor for the following conditions:
    - Damage
    - Out of round or scored
    - Pitting or cracks.

**Installation Procedure**

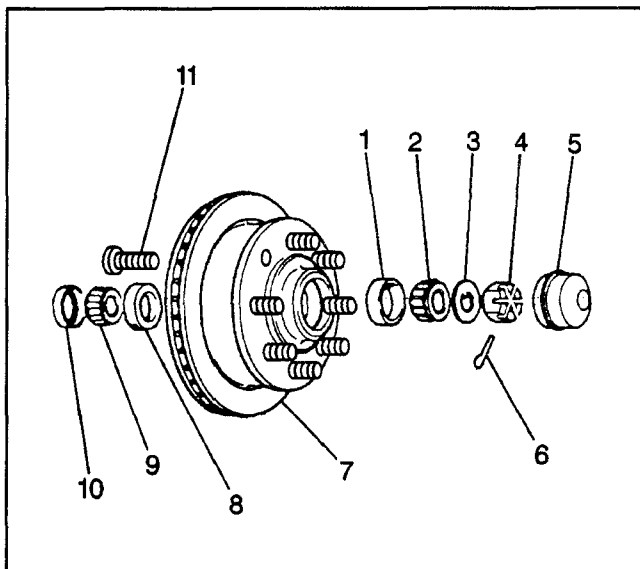
**Notice:** Start the races squarely inside the hub/rotor to avoid distortion and possible cracking.

1. Install the outer bearing race into the hub/rotor.
  - 1.1. Place the hub/rotor on the J 9746-02 and rest the assembly on the press bars.
  - 1.2. Use the J 8092 in order to drive the outer bearing outer race into position.





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2. Turn over the hub/rotor.
  - 2.1. Remove the *J 9746-02*.
  - 2.2. Drive in the inner bearing race using the *J 23448*.

**Important:**

- Use an approved high-temperature front wheel bearing grease in order to lubricate the bearings. Refer to *Fluid and Lubricant Recommendations* in Maintenance and Lubrication.
  - Do not mix different greases because mixing may change the properties of the greases, resulting in poor performance.
3. Apply a thin film of grease to the steering knuckle spindle at the outer wheel bearing seat and at the inner wheel bearing seat, the shoulder, and the seal seat.
  4. Apply a small quantity of grease inboard of each wheel bearing dust cap.

**Notice:** Failure to completely pack the wheel bearing (cones, rollers, and cage) with grease will result in premature wheel bearing damage and/or wear.

5. Fill each cone and roller assembly of the wheel bearing full of grease.
  - Use a cone-type grease machine that forces grease into the bearing.
  - If a cone-type grease machine is not available, pack the wheel bearing by hand.
  - When packing the wheel bearing by hand, work the grease into the bearings between the rollers, the cones, and the cage.
6. Install the inner wheel bearing (9) into the hub/rotor. Apply an additional quantity of grease outboard of this bearing.
7. Install a new seal (10).
  - 7.1. In order to ensure that the seal is flush with the hub/rotor flange, use a flat plate or block to install the seal.
  - 7.2. Lubricate the seal lip with a thin layer of grease.
8. Install the hub/rotor (7). Do not damage the steering knuckle spindle threads.
9. Install the outer wheel bearing (2). Slide the bearing over the spindle until the wheel bearing fully seats against the hub/rotor outer race.
10. Install the washer (3), the nut (4), and the cotter pin (6). Before the cotter pin is placed through the hole in the spindle, adjust the wheel bearings.
11. Adjust the wheel bearings. Refer to *Wheel Bearing Adjustment (Independent)*.
12. Install the new cotter pin (6).
  - 12.1. Make sure the bent pin ends do not interfere with the dust cap.
  - 12.2. Apply an additional quantity of grease outboard of the wheel bearing.
13. Install the dust cap (5) on the hub/rotor (7).
14. Install the caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.

15. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
16. Lower the vehicle.

## Wheel Hub, Bearing, and Seal Replacement (I-Beam)

### Removal Procedure

For front axle, hub, and components, refer to *Front Axle, Steering Knuckle, Hub, and Components (I-Beam Suspension)*.

### Tools Required

- J 8092 Driver Handle
- J 6368 Outer Bearing Race Installer
- J 9746-02 Hub/Rotor Support

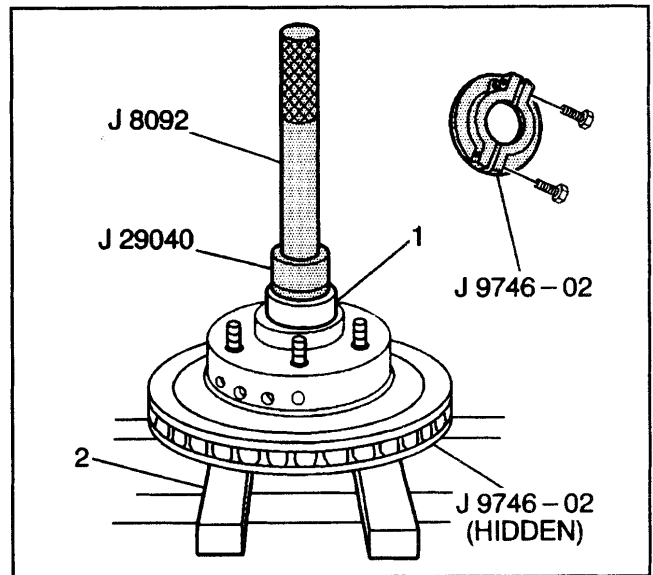
1. Raise the vehicle. Support the vehicle with suitable safety stands.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.

**Notice:** Support the caliper with a piece of wire to prevent damage to the brake line.

3. Remove the caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.
4. Remove the retainer cap.
5. Remove the cotter pin, the nut, and the washer.
6. Remove the wheel hub/rotor.
  - Pull the hub/rotor free from the spindle. Make sure the outer wheel bearing comes free.
  - Do not damage the steering knuckle spindle threads.
7. Remove the inner wheel bearing. Pry out the seal.
8. Remove the races. Drive out each race using a brass drift.
9. Remove the rubber gasket from the spindle.
10. Clean the grease off of the hub/rotor and the steering knuckle spindle. Clean the grease from the inside of the hub.

**Notice:** Do not spin the wheel bearings with compressed air to dry them—the wheel bearings may be damaged.

11. Clean the grease off of the wheel bearings and the races. Use clean solvent and a small brush with no loose bristles.
12. Inspect the wheel bearings and the races for damage or wear. Refer to *Wheel Bearings Diagnosis* in Suspension General Diagnosis. If a bearing or the race is damaged or worn, replace the bearing and the race.
13. Inspect the hub/rotor for the following conditions and repair or replace the hub/rotor if necessary:
  - Out of round
  - Scored
  - Pitting or cracks



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### Installation Procedure

For front axle, hub, and components, refer to *Front Axle, Steering Knuckle, Hub, and Components (I-Beam Suspension)*.

**Notice:** Start the races squarely inside the hub/rotor to avoid distortion and possible cracking.

1. Install the outer race into the hub/rotor.
  - 1.1. Place the hub/rotor on the *J 9746-02* and rest the assembly on the press bars.
  - 1.2. Use the *J 6368* in order to drive the outer bearing race into position.
2. Remove the *J 9746-02* and use a 7.6 cm (3 in) diameter bar in order to drive the inner bearing race into position. Using a bar larger than 7.6 cm (3 in) may damage the bearing seal seat.

### Important:

- Use an approved high-temperature front wheel bearing grease in order to lubricate the bearings. Refer to *Fluid and Lubricant Recommendations* in Maintenance and Lubrication.
  - Do not mix the greases because mixing may change the properties of the grease, resulting in poor performance.
3. Apply a thin film of grease to the steering knuckle spindle at the outer wheel bearing seat and at the inner wheel bearing seat, the shoulder, and the seal seat.
  4. Apply a small quantity of grease inboard of each wheel bearing retainer cap.

**Notice:** Failure to completely pack the wheel bearing (cones, rollers, and cage) with grease will result in premature wheel bearing damage and/or wear.

5. Fill each wheel bearing (cone and roller assembly) full of grease.
  - Use a cone-type grease machine that forces grease into the bearing.
  - If a cone-type grease machine is not available, pack the wheel bearing by hand.
  - When packing the wheel bearing by hand, work the grease into the bearings between the rollers, the cones, and the cage.
6. Install the inner wheel bearing into the hub/rotor. Apply an additional quantity of grease outboard of this bearing.
7. Install a new seal.
  - 7.1. In order to ensure that the seal is flush with the hub/rotor flange, use a flat plate or block to install the seal.
  - 7.2. Lubricate the seal lip with a thin layer of grease.
8. Install the rubber gasket on the spindle.
9. Install the hub/rotor. Do not damage the threads of the steering knuckle spindle.
10. Install the outer wheel bearing. Slide the bearing over the spindle until the wheel bearing fully seats against the hub/rotor outer race.



11. Install the washer, the nut, and the cotter pin. Do not place the cotter pin through the hole in the spindle until the wheel bearings are adjusted.
12. Adjust the wheel bearings. Refer to *Wheel Bearing Adjustment (I-Beam)*.
13. Install the retainer cap into place.
14. Install the caliper. Refer to *Brake Caliper Replacement (Front)* in Disc Brakes.
15. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
16. Lower the vehicle.
17. Check the front wheel alignment. Refer to *Wheel Alignment Specifications* in Wheel Alignment.

**Wheel Bearing Adjustment (Independent)**

**Notice:** Never preload the front wheel bearings. Damage can result by the steady load on the roller ends that comes from preloading.

**Important:**

- Adjust the front wheel bearings correctly in order to ensure the front suspension functions properly.
  - The bearings must be a slip fit on the spindle.
  - Lubricate the bearings in order to ensure that the roller bearings will roll and not skid.
  - The spindle nut must have a free-running fit on the spindle threads.
1. Raise the vehicle. Support the vehicle with suitable safety stands under the lower control arms.

2. Remove the dust cap (5) from the hub/rotor (7).

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

3. Remove the cotter pin (6).

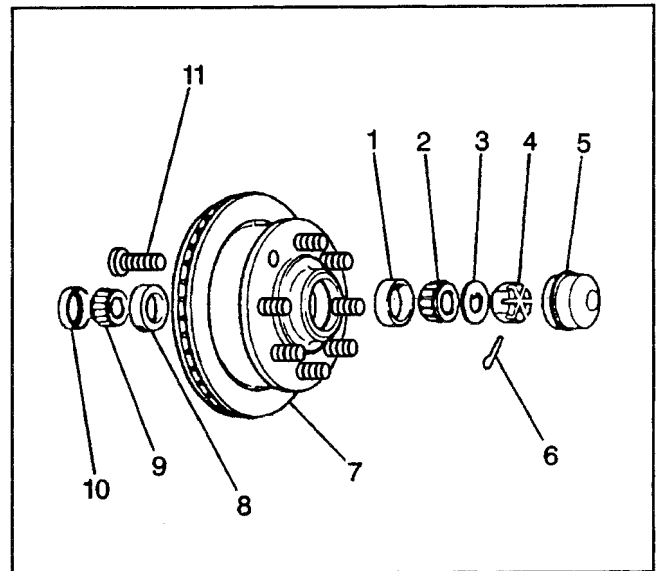
**Tighten**

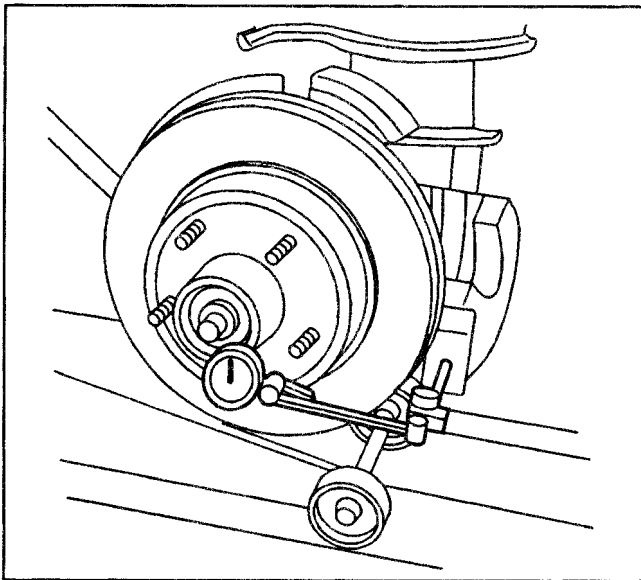
Tighten the nut to 16 N·m (12 lb ft), while turning the wheel and tire assembly forward by hand. This will seat the bearings.

4. Back the nut off to a just loose position.
5. Finger tighten the nut.

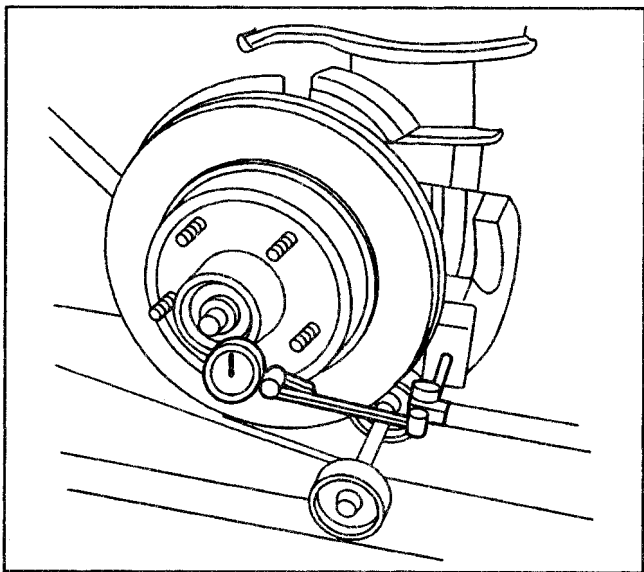
**Important:** Do not back the nut off more than 1/2 of a nut flat.

6. Back off the nut until the hole in the spindle lines up with a slot on the nut.
7. Install a new cotter pin. Make sure the cotter pin ends do not interfere with the dust cap.





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8. Measure the endplay in the hub/rotor assembly. This measurement should be between 0.03 mm (0.0012 in), and 0.13 mm (0.005 in) when properly adjusted.
9. Install the dust cap on the hub/rotor.
10. Install the tire and wheel assembly, if removed.
11. Lower the vehicle.

### Wheel Bearing Adjustment (I-Beam)

For the front axle, hub and components, refer to *Front Axle, Steering Knuckle, Hub, and Components (I-Beam Suspension)*.

**Notice:** Never preload the front wheel bearings. Damage can result by the steady load on the roller ends that comes from preloading.

#### Important:

- Adjust the front wheel bearings correctly in order to ensure the front suspension functions properly.
- The bearings must be a slip fit on the spindle.
- Lubricate the bearings in order to ensure that the roller bearings will roll and not skid.
- The spindle nut must have a free-running fit on the spindle threads.

1. Raise the vehicle. Support the vehicle with suitable safety stands under the lower control arms.
2. Remove the retainer cap.

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

3. Remove the cotter pin.

#### Tighten

Tighten the nut (4) to 16 N·m (12 lb ft), while turning the wheel and tire assembly, or the hub/rotor, forward by hand. This will seat the bearings.

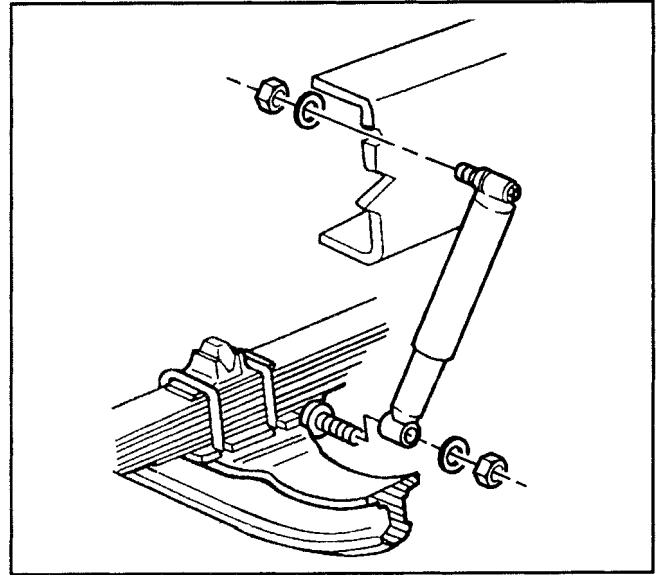
4. Back the nut off one flat.
  - If the hole in the spindle lines up with the slot in the nut, insert the cotter pin.
  - If these do not line up, back off the nut until these line up. Do not back off the nut more than one additional flat.

5. Measure the endplay in the hub/rotor. This measurement should be between 0.013–0.20 mm (0.0005–0.008 in) when properly adjusted.
6. Install the retainer cap.
7. Lower the vehicle.
8. Check the front wheel alignment. Refer to *Wheel Alignment Specifications* in Wheel Alignment.

## Shock Absorber Replacement (I-Beam)

### Removal Procedure

1. Raise the vehicle. Support the vehicle with suitable safety stands.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
3. Remove the nut and the washer.
4. Remove the shock absorber from the leaf spring spacer.
5. Remove the nut and the washer.
6. Remove the shock absorber from the frame.
7. Inspect the shock absorbers for damage and leakage.
8. Test the shock absorbers. Refer to *Struts or Shock Absorbers Bench Test (Non-Spiral Groove)* in Suspension General Diagnosis.



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### Installation Procedure

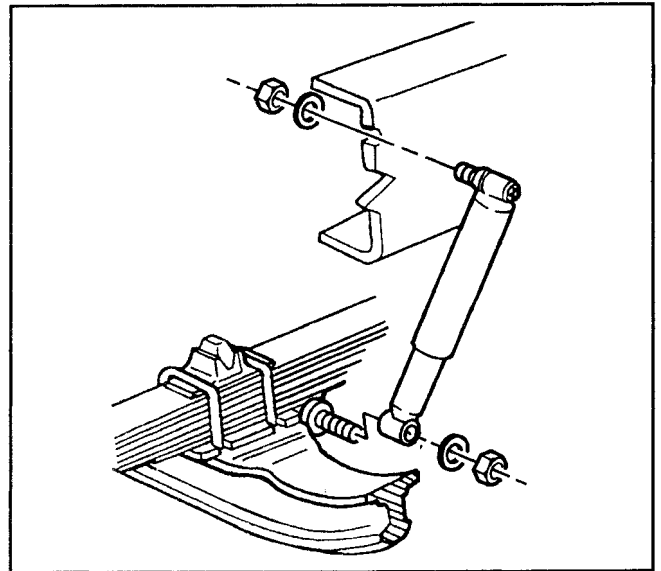
1. Install the shock absorber to the frame. Insert the upper stud into the hole in the frame.
2. Install the washer and the nut. Do not tighten.
3. Install the shock absorber to the leaf spring spacer. Position the lower shock mount onto the stud.

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

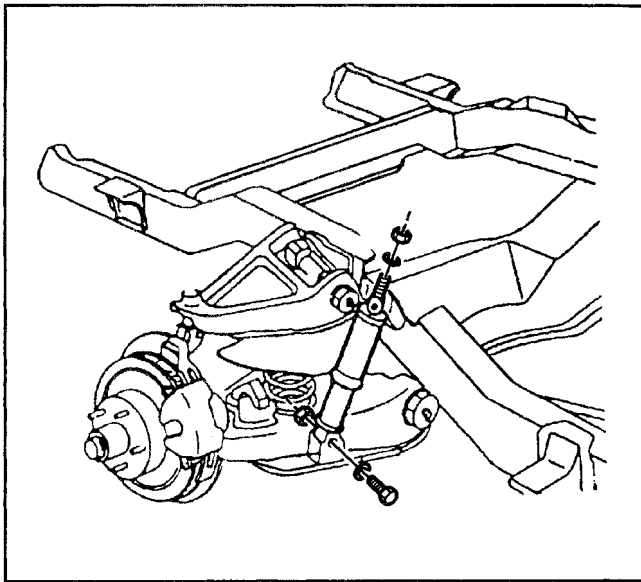
4. Install the washer and the nut.

#### Tighten

- Tighten the shock absorber upper nut to 108 N·m (80 lb ft).
  - Tighten the shock absorber lower nut to 45 N·m (33 lb ft).
5. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
  6. Lower the vehicle.



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## Shock Absorber Replacement (Independent)

### Removal Procedure

1. Raise the vehicle on a hoist.
2. Remove the nuts, the washers, and the bolts at the control arm.
3. Remove the shock absorber from the lower control arm.
4. Remove the nuts and washers at the frame.
5. Remove the shock absorber from the frame.
6. Inspect the shock absorbers for damage and leaks.
7. Test the shock absorbers. Refer to *Struts or Shock Absorbers Bench Test (Non-Spiral Groove)* in Suspension General Diagnosis.

### Installation Procedure

1. Install the shock absorber onto the vehicle.

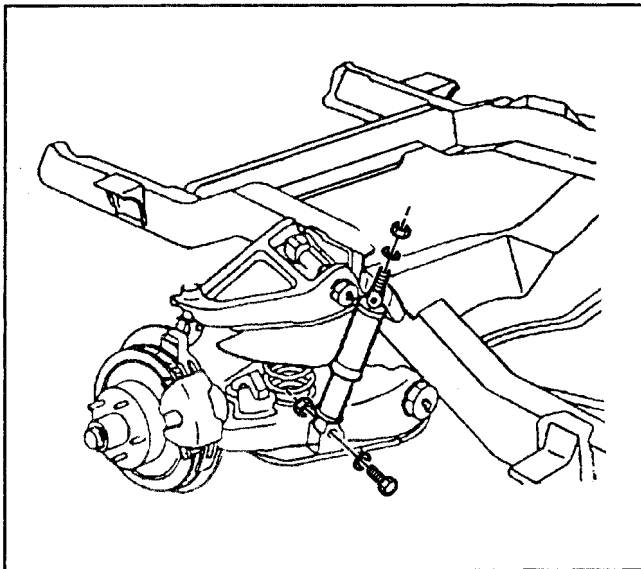
**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

2. Install the bolts, the washers, and the nuts.

#### Tighten

- Tighten the shock to frame nut to 108 N-m (80 lb ft).
- Tighten the shock to control arm nut to 102 N-m (75 lb ft).

3. Lower the vehicle.

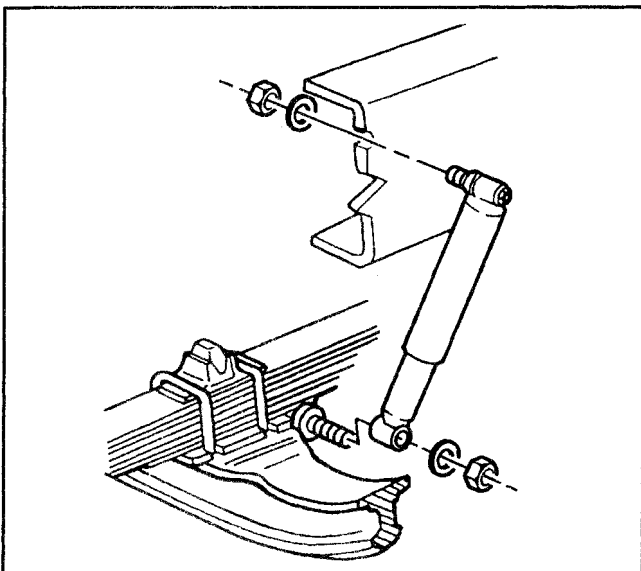


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## Front Axle Replacement (I-Beam)

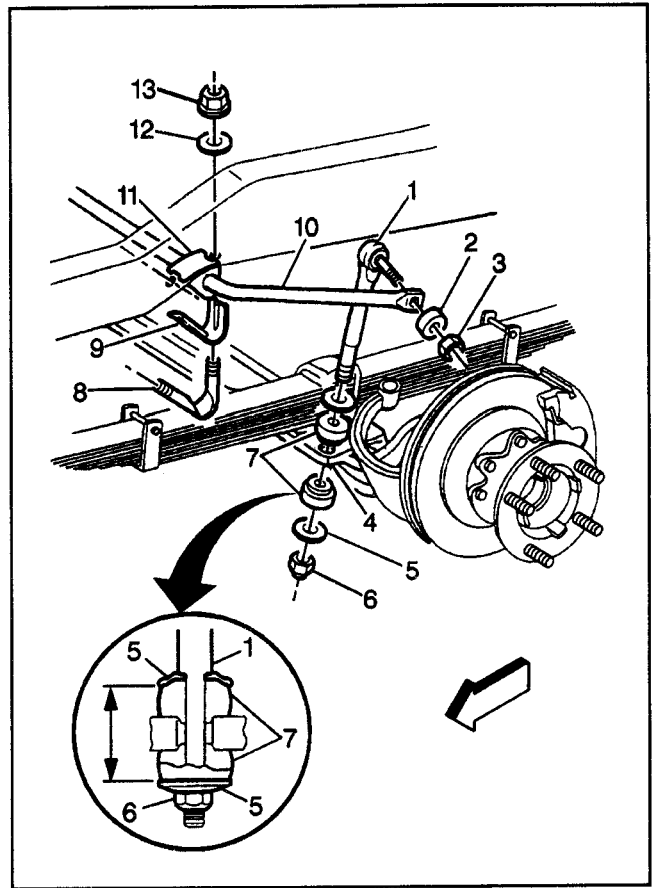
### Removal Procedure

1. Raise the vehicle. Support the vehicle with suitable safety stands on the frame.
2. Remove the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation in Tires and Wheels*.
3. Support the axle with a floor jack in order to eliminate any load on the springs.
4. Remove the steering arm, the knuckle, and the spindle. Refer to *Steering Knuckle Replacement (I-Beam)*.
5. Remove the nut and the washer.
6. Remove the shock absorber from the axle.



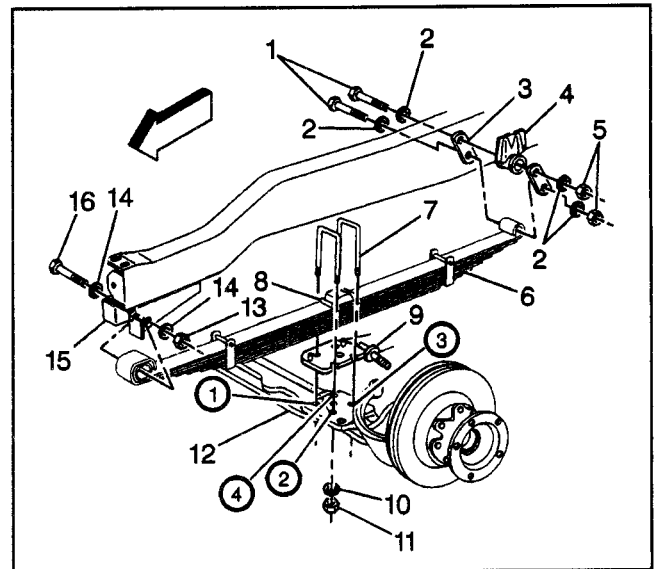
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7. Remove the nut (3) and the washer (2).
8. Remove the stabilizer link (1) from the axle (4). Pull the link free from the axle. Do not lose the other insulator or the retainer.
9. Remove the nut (6), the retainer (5), and the insulator (7).

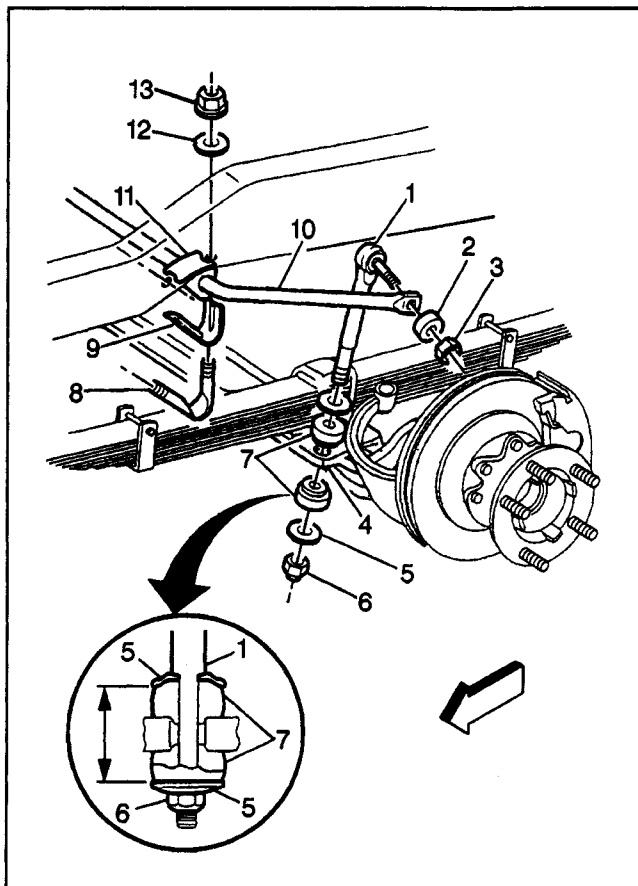


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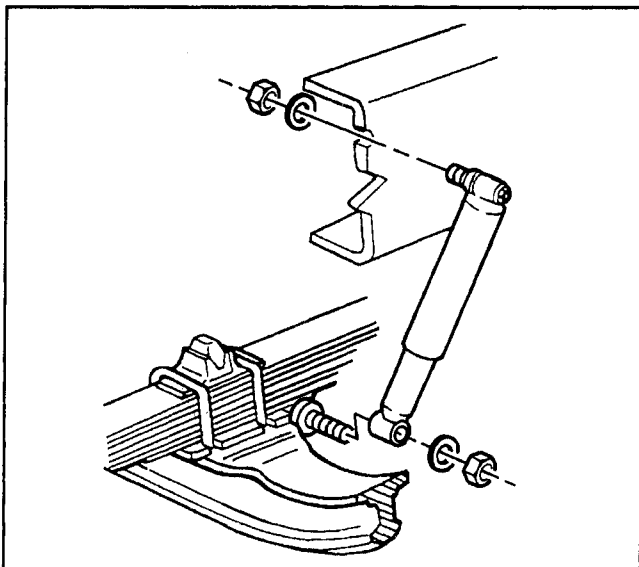
10. Remove the nuts (11), the washers (10), and the U-bolts (7).
11. Remove the spacer (8) and the spring spacer (9).
12. Remove the leaf spring from the axle. Refer to *Leaf Springs Replacement (I-Beam)*.
13. Remove the steering damper from the axle. Refer to *Steering Linkage*.
14. Lower the floor jack and pull the axle clear of the vehicle.



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### Installation Procedure

1. Line up the axle under the leaf springs.
2. Raise the axle into position using a floor jack.
3. Install the steering damper to the axle. Refer to *Steering Linkage*.
4. Install the axle to the leaf springs. Refer to *Leaf Springs Replacement (I-Beam)*.
5. Install the stabilizer link (1) into the axle (4).
6. Install the link (1) into the hole on the spring spacer and the axle.

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

7. Install the insulator (7), the retainer (5), and the nut (6).

#### Tighten

Tighten the nut until the distance between each retainer is 52.8 mm (2.08 in).

8. Install the shock absorber onto the axle.
9. Install the washer and the nut.

#### Tighten

Tighten the nut to 45 N·m (33 lb ft).

10. Install the steering arm, the knuckle, and the spindle. Refer to *Steering Knuckle Replacement (I-Beam)*.
11. Adjust the wheel bearings. Refer to *Wheel Bearing Adjustment (I-Beam)*.
12. Install the tire and wheel assembly. Refer to *Tire and Wheel Removal and Installation* in Tires and Wheels.
13. Lower the vehicle.
14. Check the front wheel alignment and reset as required. Refer to *Wheel Alignment Specifications* in Wheel Alignment.

## Description and Operation

### General Description

For I-beam suspension components, refer to *Leaf Spring and Components (I-Beam Suspension)* or *Front Axle, Steering Knuckle, Hub, and Components (I-Beam Suspension)*.

For Independent suspension control arms and components, refer to *Upper Control Arm and Components (Independent Suspension)* or *Lower Control Arm and Components (Independent Suspension)*.

An independent front suspension is standard on P model vehicles. In order to reduce vibration and shock load, this suspension features unequal length control arms (lower control arm carries the load), coil springs, and shock absorbers.

A stabilizer shaft controls sway or roll.

Some vehicles have air cylinders inside the coil springs. These cylinders minimize harsh impact on large road bumps.

A special heavy-duty front suspension is also available on P model vehicles. This suspension centers around a solid I-beam axle and includes leaf springs, shock absorbers, and a stabilizer shaft.

### Special Tools and Equipment

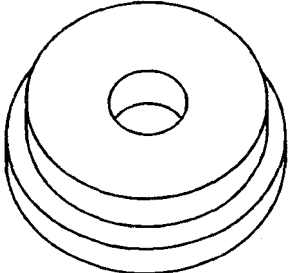
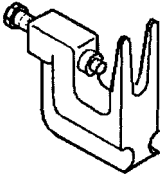
Illustration	Tool Number/Description
 <p>175330</p>	<p>J 6368 Outer Bearing Race Installer</p>
 <p>130</p>	<p>J 6627-A Wheel Stud and Tie Rod Remover</p>

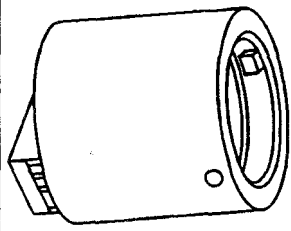
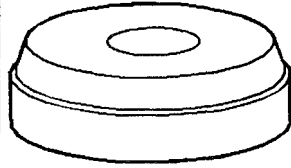
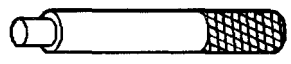
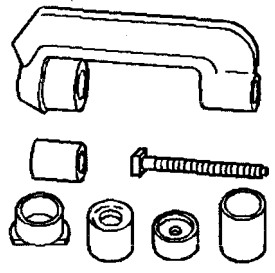
Illustration	Tool Number/Description
 <p>175342</p>	<p>J 6893-D Wheel Bearing Nut Wrench</p>
 <p>5320</p>	<p>J 7817 Front Pinion Bearing Installer</p>
 <p>2015</p>	<p>J 8092 Driver Handle</p>
 <p>3286</p>	<p>J 9519-E Ball Joint Remover/Installer Set</p>

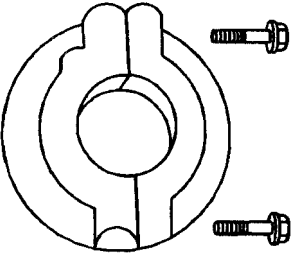
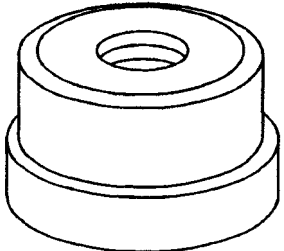
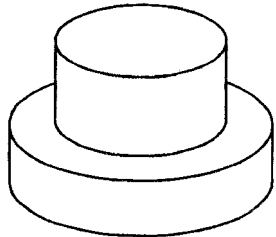
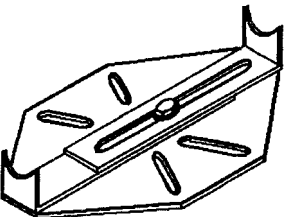
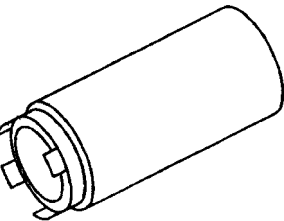
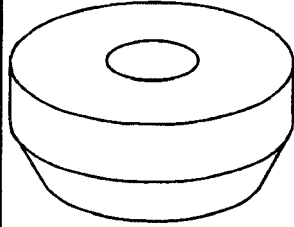
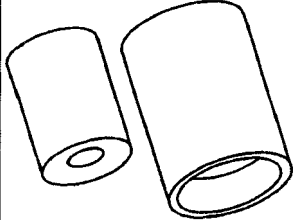
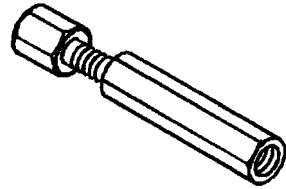
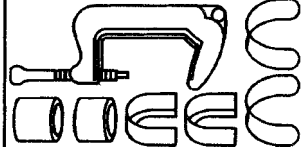
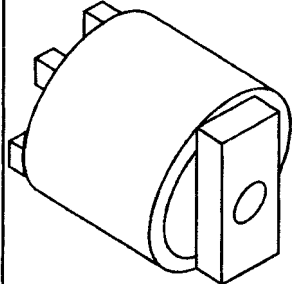
Illustration	Tool Number/Description
 <p data-bbox="373 520 420 541">36479</p>	<p data-bbox="490 338 691 401">J 9746-02 Hub/Rotor Support</p>
 <p data-bbox="365 873 420 894">175326</p>	<p data-bbox="503 695 678 758">J 21465-17 Bearing Installer</p>
 <p data-bbox="365 1224 420 1245">175328</p>	<p data-bbox="467 1035 715 1119">J 22301 Ball Joint Bearing Seal Installer</p>
 <p data-bbox="377 1577 420 1598">2024</p>	<p data-bbox="475 1398 699 1461">J 23028-01 Coil Spring Remover</p>
 <p data-bbox="362 1934 420 1955">175341</p>	<p data-bbox="471 1755 702 1818">J 23447 Ball Stud Nut Wrench</p>

Illustration	Tool Number/Description
 <p data-bbox="1067 520 1122 541">175334</p>	<p data-bbox="1146 338 1447 401">J 23448 Inner Bearing Race Installer</p>
 <p data-bbox="1067 873 1122 894">175332</p>	<p data-bbox="1146 695 1447 758">J 23454-D Ball Joint Remover/Installer</p>
 <p data-bbox="1078 1224 1122 1245">2027</p>	<p data-bbox="1185 1052 1400 1115">J 23742 Ball Joint Separator</p>
 <p data-bbox="1063 1577 1122 1598">175338</p>	<p data-bbox="1161 1398 1423 1461">J 24435-A Needle Bearing Installer</p>
 <p data-bbox="1063 1934 1122 1955">175344</p>	<p data-bbox="1141 1755 1439 1818">J 26878-A Wheel Bearing Nut Wrench</p>



# Rear Suspension

## Specifications

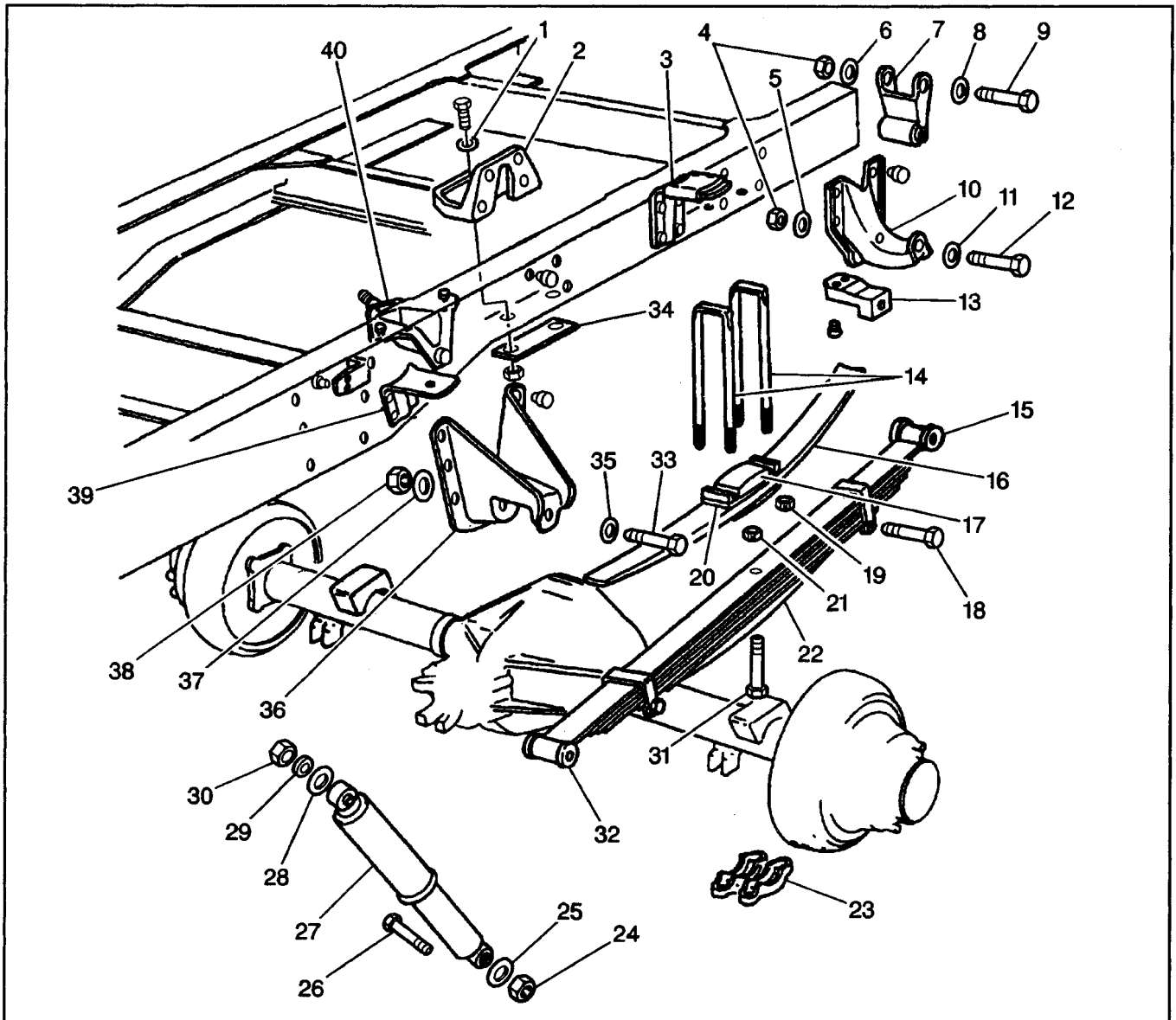
### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Anchor Plate to U-Bolt Nut	205 N·m	151 lb ft
Shackle to Hanger Nut	135 N·m	100 lb ft
Shock Absorber to Axle Bolt	155 N·m	115 lb ft
Shock Absorber to Frame Nut	29 N·m	22 lb ft
Spring to Axle (With RPO JB8)	200 N·m	151 lb ft
Spring to Axle (With RPO JF9)	260 N·m	192 lb ft
Spring to Hanger Bolt	180 N·m	133 lb ft
Spring to Hanger Nut	135 N·m	100 lb ft
Spring to Shackle Nut	135 N·m	100 lb ft
Stabilizer Shaft to Anchor Bolt	41 N·m	30 lb ft
Stabilizer Shaft to Frame Bolt	41 N·m	30 lb ft

Component Locator

Rear Suspension Components (Commercial Models)

Rear Suspension (Commercial Models)



173317

Legend

- |                          |                                |
|--------------------------|--------------------------------|
| (1) Spring Clip          | (11) Washer                    |
| (2) Front Hanger Support | (12) Bolt                      |
| (3) Bracket              | (13) Rear Reinforcement Hanger |
| (4) Nut                  | (14) Bolt                      |
| (5) Washer               | (15) Leaf Spring Bushing       |
| (6) Washer               | (16) Auxilliary Spring         |
| (7) Rear Shackle         | (17) Spacer                    |
| (8) Washer               | (18) Bolt                      |
| (9) Bolt                 | (19) Nut                       |
| (10) Rear Hanger         | (20) Anchor                    |

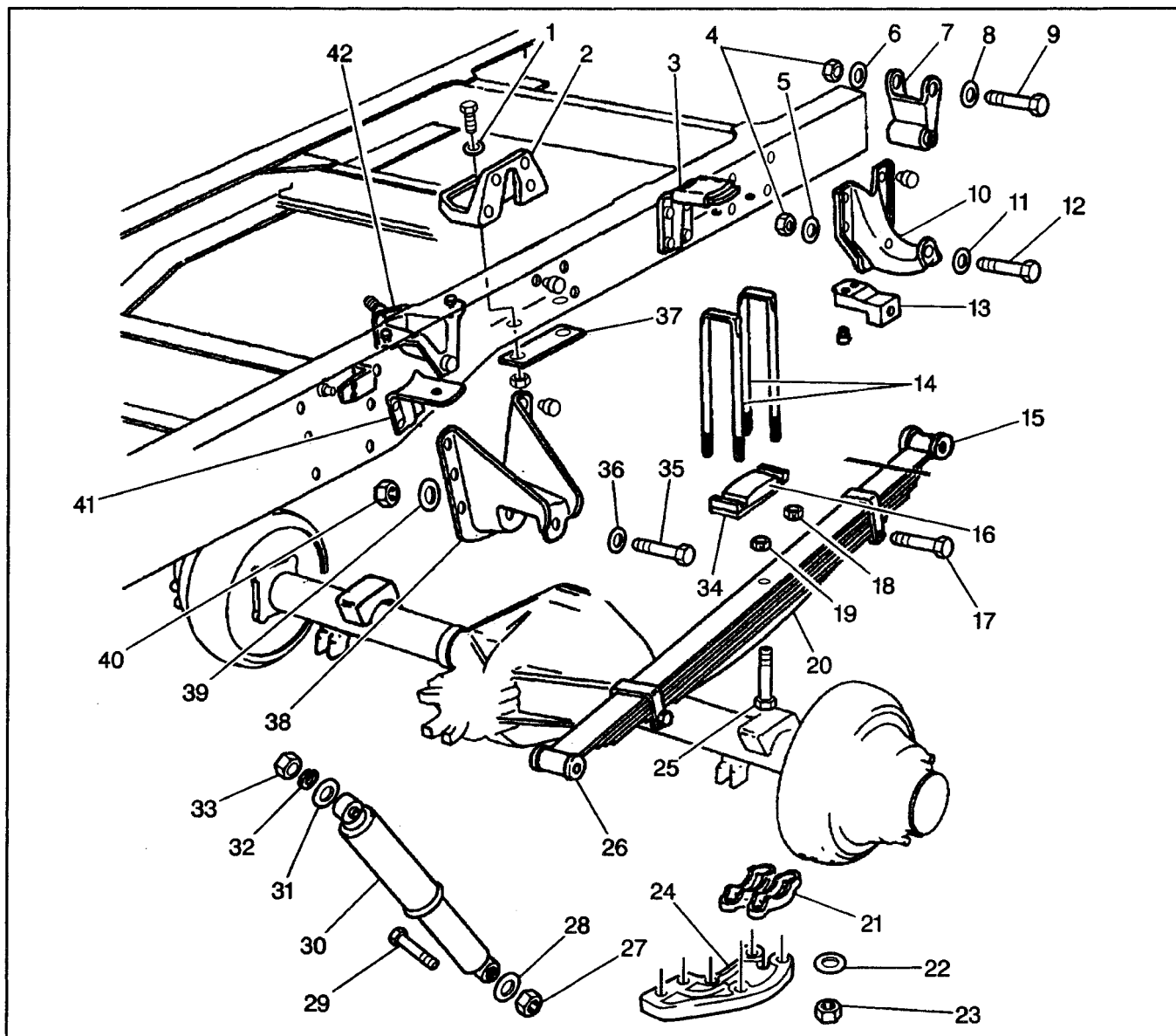
**Suspension****Rear Suspension 3-67**

- 
- (21) Nut
  - (22) Leaf Spring
  - (23) Anchor Plate
  - (24) Nut
  - (25) Spring Washer
  - (26) Bolt
  - (27) Rear Shock Absorber
  - (28) Spring Washer
  - (29) Washer
  - (30) Nut

- (31) Bolt
  - (32) Leaf Spring Bushing
  - (33) Bolt
  - (34) Anchor
  - (35) Washer
  - (36) Front Hanger
  - (37) Washer
  - (38) Nut
  - (39) Bracket
  - (40) Bracket
-

Rear Suspension Components (Motorhome Models)

Rear Suspension (Motorhome Models)



173319

Legend

- |                          |                                |
|--------------------------|--------------------------------|
| (1) Spring Clip          | (13) Rear Reinforcement Hanger |
| (2) Front Hanger Support | (14) Bolt                      |
| (3) Bracket              | (15) Leaf Spring Bushing       |
| (4) Nut                  | (16) Spacer                    |
| (5) Washer               | (17) Bolt                      |
| (6) Washer               | (18) Nut                       |
| (7) Rear Shackle         | (19) Nut                       |
| (8) Washer               | (20) Leaf Spring               |
| (9) Bolt                 | (21) Anchor Plate              |
| (10) Rear Hanger         | (22) Washer                    |
| (11) Washer              | (23) Nut                       |
| (12) Bolt                |                                |

(24) Stabilizer Shaft Adapter	(34) Anchor
(25) Bolt	(35) Bolt
(26) Leaf Spring Bushing	(36) Washer
(27) Nut	(37) Anchor
(28) Spring Washer	(38) Front Hanger
(29) Bolt	(39) Washer
(30) Rear Shock Absorber	(40) Nut
(31) Washer	(41) Bracket
(32) Spring Washer	(42) Bracket
(33) Nut	

---

## **Diagnostic Information and Procedures**

### **Spring Maintenance**

#### **Lubrication**

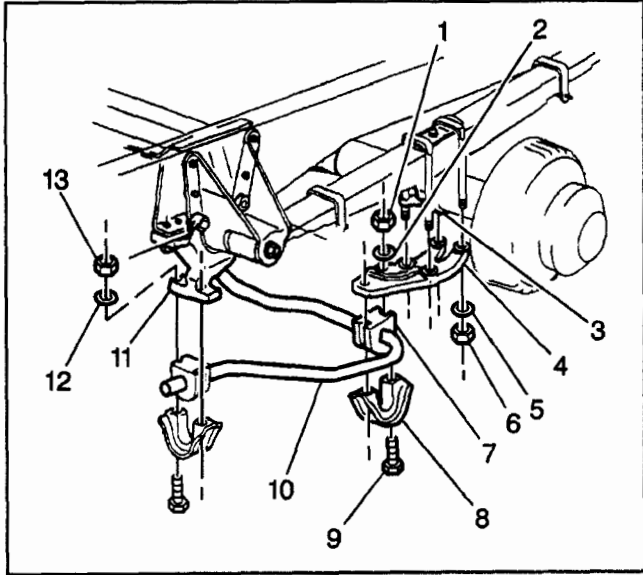
Spring leaves are lubricated at the time of manufacturing and require no further lubrication unless the spring is disassembled. Radius leaf bushings that are rubber mounted do not require lubrication.

#### **Tightening**

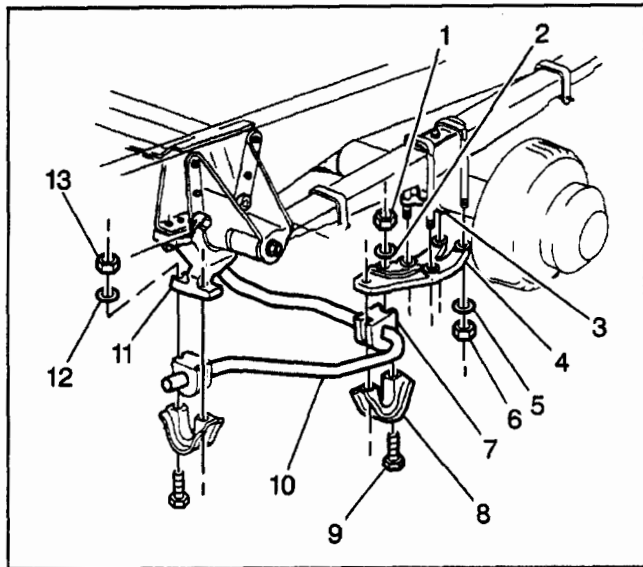
Keep the U-bolts tight at all times in order to hold the axle in place at the spring. If the U-bolts are not tight, the axle may shift, causing misalignment and spring leaf malfunction at the spring center bolt.

#### **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. Raise the vehicle on a hoist.
2. Remove the stabilizer shaft from the following parts:
  - The anchor plate mounting nuts (1)
  - The washers (2)
  - The anchor plate mounting bolts (9)
  - The anchor plate brackets (8)
3. Remove the stabilizer shaft (10) from the anchor plates (3).
4. Remove the stabilizer shaft (10) from the following parts:
  - The frame mounting nuts (13)
  - The washers (12)
  - The frame mounting bolts (9)
  - The brackets (8)
5. Remove the stabilizer shaft (10) from the frame.
6. Remove the insulators from the stabilizer shaft.

#### Installation Procedure

1. Install the insulators to the stabilizer shaft (10).
2. Install the stabilizer shaft (10) to the anchor plates (3).
3. Install the brackets (8).

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

4. Install the stabilizer shaft to the anchor plate mounting bolts (9).

#### Tighten

Tighten the stabilizer shaft to the anchor plate mounting bolts to 41 N·m (39 lb ft).

5. Install the washers (5).
6. Install the stabilizer shaft to the anchor plate mounting nuts (1).

**Important:** Route the parking brake cable over the stabilizer shaft.

7. Install the stabilizer shaft to the frame.
8. Install the brackets (8).
9. Install the stabilizer shaft to the frame mounting bolts (9).
10. Install the washers (2).
11. Install the stabilizer shaft to the frame mounting nuts (1).

#### Tighten

Tighten the stabilizer shaft to the frame mounting bolts to 41 N·m (30 lb ft).

12. Lower the vehicle.

## Shock Absorber Replacement

### Removal Procedure

For the rear suspension components, refer to *Rear Suspension Components (Motorhome Models)* or *Rear Suspension Components (Commercial Models)*.

1. Raise the vehicle on a hoist.
2. Remove the shock absorber to the frame mounting nut.
3. Remove the spring washer.
4. Remove the washer.
5. Remove the shock absorber from the frame.
6. Remove the shock absorber from the following parts:
  - The axle mounting nut
  - The spring washer
  - The axle mounting bolt
7. Remove the shock absorber from the axle.

### Installation Procedure

For the rear suspension components, refer to *Rear Suspension Components (Motorhome Models)* or *Rear Suspension Components (Commercial Models)*.

1. Install the shock absorber to the frame.
2. Install the spring washer.

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

3. Install the shock absorber to the frame mounting nut.

#### Tighten

Tighten the shock absorber to frame mounting nut to 29 N·m (22 lb ft).

4. Install the shock absorber to the axle.  
Line up the shock absorber with the axle bracket.
5. Install the shock absorber to the following parts:
  - The axle mounting bolt
  - The spring washer
  - The axle mounting nut

#### Tighten

Tighten the shock absorber to the axle mounting bolt to 155 N·m (114 lb ft).

6. Lower the vehicle to the ground.

## Spring Bushing Replacement

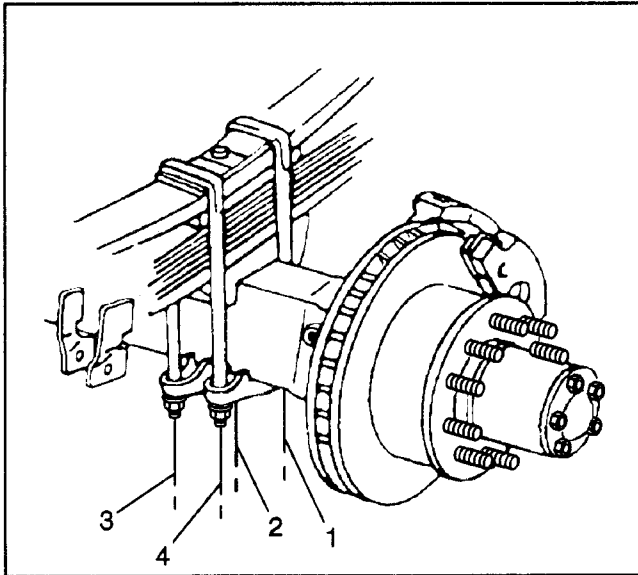
### Removal Procedure

For rear suspension components, refer to *Rear Suspension Components (Motorhome Models)* or *Rear Suspension Components (Commercial Models)*.

1. Remove the leaf spring from the vehicle. Refer to *Leaf Spring Replacement*.
2. Remove the bushing from the leaf spring.  
Place the leaf spring in a press.  
Press out the bushing.

### Installation Procedure

1. Install the bushing into the leaf spring.  
Use a press in order to properly position the bushings.
2. Install the leaf spring to the vehicle. Refer to *Leaf Spring Replacement*.



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## Leaf Spring Replacement

### Removal Procedure

For rear suspension components, refer to *Rear Suspension Components (Motorhome Models)* or *Rear Suspension Components (Commercial Models)*.

1. Raise the vehicle on a hoist and support the rear axle independently in order to relieve the tension on the leaf springs.
2. Remove the stabilizer shaft from the vehicle, if equipped. Refer to *Stabilizer Shaft Replacement*.
3. Remove the leaf spring from the rear hanger.  
Loosen but do not remove the spring to shackle nut and the bolt.
4. Remove the following components that secure the shackle to the rear hanger:
  - The nut
  - The bolt
  - The washers
5. Remove the following components that secure the leaf spring to the front hanger:
  - The nut
  - The bolt
  - The washers
6. Remove the leaf spring from the front hanger.
7. Remove the following components that secure the shackle to the leaf spring:
  - The nut
  - The bolt
8. Remove the shackle from the leaf spring.
9. Remove the following components:
  - The U-bolt nuts (1,2,3,4)
  - The washers
  - The rear stabilizer anchor, if equipped
  - The anchor plate
  - The top anchor
  - The spacer
  - The auxiliary spring, if equipped
  - The U-bolts
10. Remove the leaf spring from the vehicle.



**Installation Procedure**

For rear suspension components, refer to *Rear Suspension Components (Motorhome Models)* or *Rear Suspension Components (Commercial Models)*.

1. Install the leaf spring to the rear axle.  
Install the taperleaf spring with the tapered end forward.

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

2. Install the following parts:
  - The spacer
  - The top anchor
  - The auxiliary spring, if equipped
  - The anchor plate
  - The U-bolts
  - The washers
  - The nuts

**Tighten**

- Tighten the nuts initially, in the sequence given (1,2,3,4), to 25 N·m (18 lb ft).
- Perform the final torque, in the sequence given, to 260 N·m (192 lb ft).

3. Install the shackle to the leaf spring.
4. Install the following parts:
  - The bolt  
Ensure that the bolt is positioned correctly.
  - The washer
  - The nuts  
Do not tighten.

5. Install the leaf spring to the front hanger.

6. Install the following parts:
  - The bolt
  - The washer
  - The nuts  
Do not tighten.

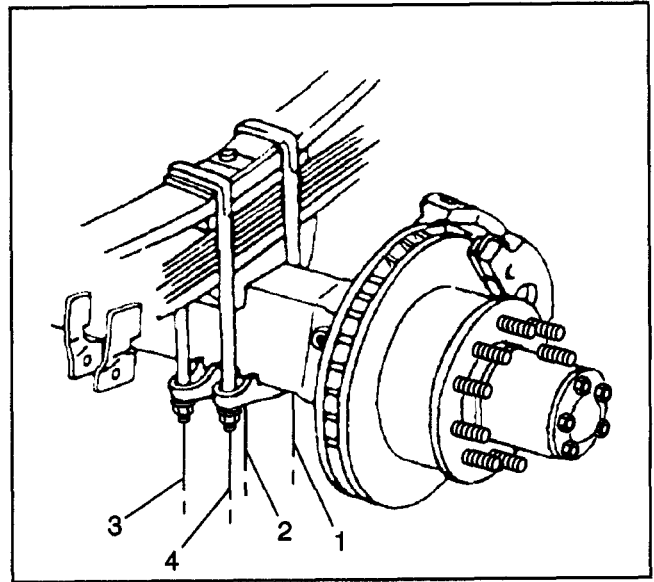
7. Install the leaf spring to the rear hanger.

8. Install the following parts:
  - The bolt
  - The washer
  - The nuts

**Tighten**

Tighten the shackle and the hanger nuts to 135 N·m (100 lb ft).

9. Install the stabilizer shaft to the vehicle, if equipped.
10. Lower the support on the rear axle.
11. Lower the vehicle.



173358

## Description and Operation

### General Description

For the rear suspension components, refer to *Rear Suspension components (Motorhome Models)* or *Rear Suspension Components (Commercial Models)*.

Both vehicles use a leaf spring and solid rear axle suspension system.

The rear axle assembly is attached to the multi-leaf springs by the U-bolts. The front ends of the springs are attached to the frame at the front hangers through rubber bushings. The rear ends of the springs are attached to the frame with shackles that allow the springs to change position while the vehicle is in motion.

The ride control is provided by two identical, direct, double-acting, shock absorbers that are angle-mounted between the frame and the brackets, and are attached to the axle tubes.

# Tires and Wheels

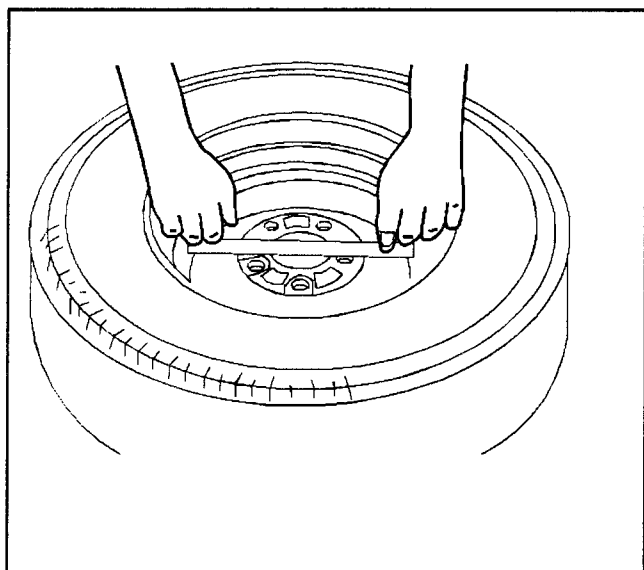
## Specifications

### Fastener Tightening Specifications

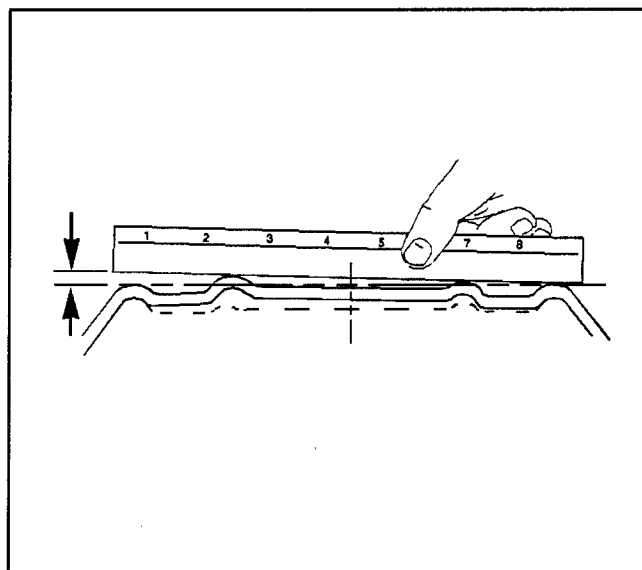
Application	Specification	
	Metric	English
Wheel Stud Nut (Single Front and Dual Rear Wheels) (8 Studs) (w/RPO J88)	190 N·m	140 lb ft
Wheel Stud Nut (Single Front and Dual Rear Wheels) (10 Studs) (w/RPO JF9)	1. 190 N·m (Initial) 2. 240 N·m (Final)	1. 140 lb ft (Initial) 2. 175 lb ft (Final)
Wheel Stud Nut (Single Front and Rear Wheels) (8 Studs) (All)	160 N·m	120 lb ft

## Diagnostic Information and Procedures

### Wheel Mounting Surface Check



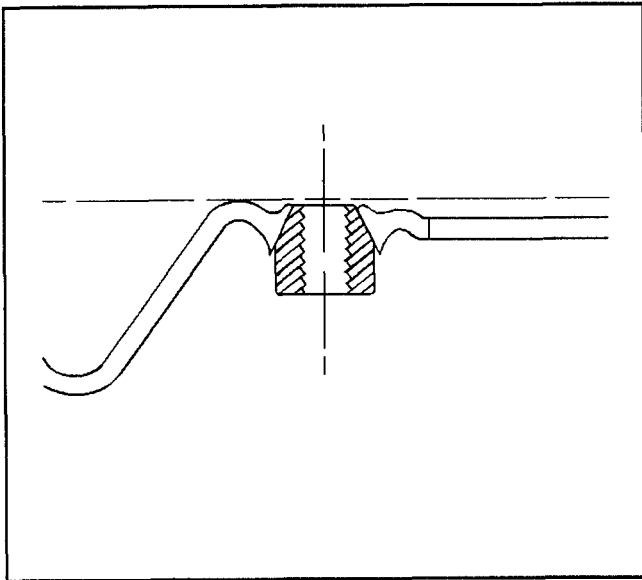
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1. Use a straight edge 203–229 mm (8–9 in) long. Place the straight edge on the wheel inboard mounting surface. Try to rock the straight edge up and down within the mounting surface.

2. Repeat this procedure on at least 3 or 4 different positions on the inboard mounting surface.
  - The outer ring of the mounting surface normally is raised above everything inside the mounting surface.
  - The mounting surface is raised above the outer ring if the wheel mounting surface is bent on a tire changer.



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3. Inspect the mounting wheel/nut holes for damage caused from over-torquing the wheel nuts. Inspect for collapsed wheel/nut bosses. Inspect for cracked wheel bosses.

**Notice:** The use of aftermarket reverse-type wheels, designed to extend the wheel away from the body, will increase the scrub radius. An increased scrub radius may greatly increase steering effort and reduce hub bearing life.

**Important:**

- Replacement wheels must be equivalent to the original equipment wheels in the following ways:
    - Load capacity
    - Wheel diameter
    - Rim width
    - Wheel offset
    - Mounting configuration
  - A wheel of incorrect size or type may affect the following conditions:
    - Wheel and hub-bearing life
    - Brake cooling
    - Speedometer/odometer calibration
    - Vehicle ground clearance
    - Tire clearance to the body and the chassis
4. Replace the wheel if the wheel is bent. Replace the wheel if the wheel/nut boss area is cracked.

Identify steel wheels with a 2 or 3 letter code stamped into the rim near the valve stem.

## Repair Instructions

### Tire and Wheel Removal and Installation

**Caution:** If penetrating oil gets on the vertical surfaces between the wheel and the rotor or drum it could cause the wheel to work loose as the vehicle is driven, resulting in loss of control and an injury accident.

**Notice:** Never use heat to loosen a tight wheel. It can shorten the life of the wheel, studs, or hub and bearing assemblies. Wheel nuts must be tightened in sequence and to the specified torque to avoid bending the wheel or rotor.

Penetrating oil is not effective in removing tight wheels. However, if used, apply the penetrating oil sparingly to the hub surface only.

Excessive force, such as hammering the wheel or the tire, may cause damage. Lightly tap the tire's sidewall with a rubber mallet.

Sometimes wheels can be difficult to remove from the vehicle due to foreign material or a tight fit between the wheel center hole and the hub or rotor. Use the following procedure to safely remove the wheel:

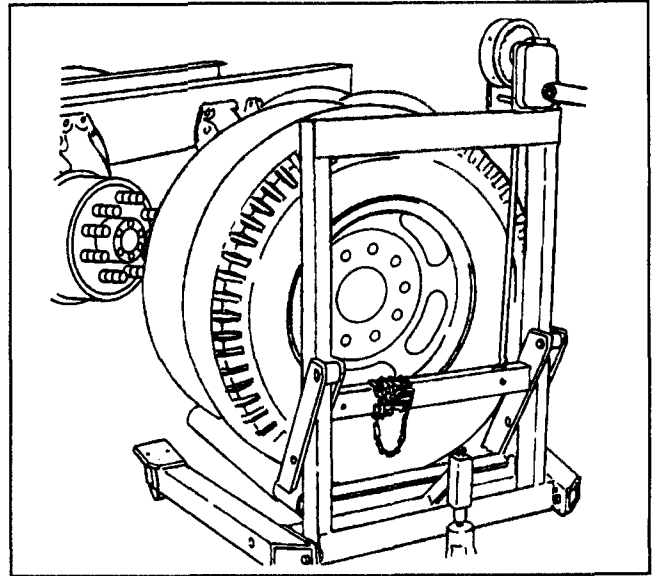
1. Tighten all of the wheel nuts on the affected wheel.
2. Loosen each wheel nut two turns.
3. Lower the vehicle onto the floor.
4. Rock the vehicle from side to side as hard as possible using one or more person's body weight to loosen the wheel.
5. Rock the vehicle from Drive gear to Reverse gear allowing the vehicle to move several feet in each direction. Apply quick, hard jabs on the brake pedal in order to loosen the wheel.

### Removal Procedure

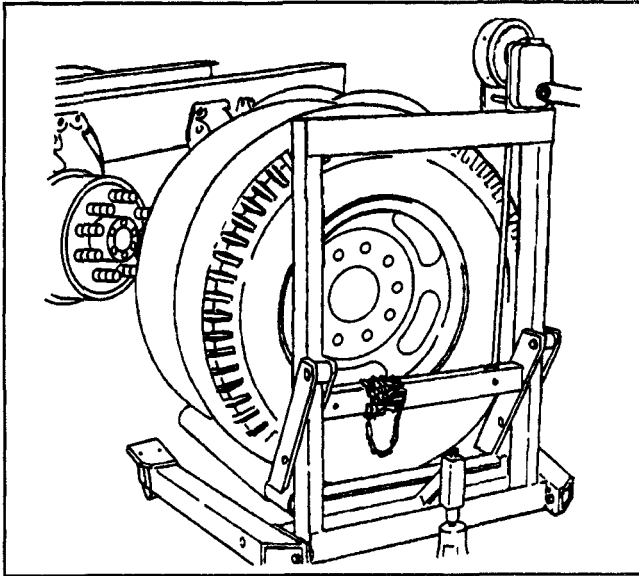
**Caution:** To avoid eye injury, use approved safety lenses, goggles, or face shield to prevent eye injury when deflating tires.

**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. Break the wheel nuts loose.
2. Raise the vehicle until the tire clears the floor. Support the vehicle. Refer to *Lifting and Jacking the Vehicle* in General Information.
3. Remove the wheel nuts.
4. Remove the wheel from the hub.



203150



203150

5. Clean the following components:
  - Clean the wheel nuts.
  - Clean the studs.
  - Clean the wheel.
  - Clean the rotor/drum mounting surfaces.

### Installation Procedure

**Caution:** Before installing the wheels, remove any buildup of corrosion on the wheel mounting surface and brake drum or disc mounting surface by scraping and wire brushing. Installing wheels with poor metal-to-metal contact at the mounting surfaces can cause wheel nuts to loosen. This can cause a wheel to come off when the vehicle is moving, causing loss of control and possibly personal injury.

**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 so that a hub pad is 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.

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

**Notice:** A torque wrench or J 39544 must be used to ensure that wheel nuts are tightened to specification. Never use lubricants or penetrating fluids on wheel stud, nuts, or mounting surfaces, as this can raise the actual torque on the nut without a corresponding torque reading on the torque wrench. Wheel nuts, studs, and mounting surfaces must be clean and dry. Failure to follow these instructions could result in wheel, nut, and/or stud damage.

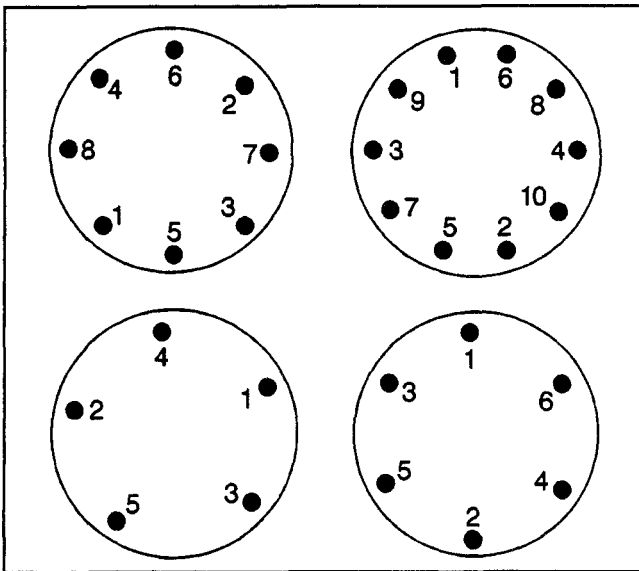
**Notice:** Refer to *Fastener Notice* in Cautions and Notices.

6. Install the wheel nuts.

### Tighten

Tighten the wheel nuts to specifications. Refer to *Fastener Tightening Specifications*.

Tighten the wheel nuts evenly and alternately in order to avoid excessive runout.



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## Tire Mounting and Dismounting

### Tire and Wheel Dismounting Procedure

**Notice:** Use a tire changing machine in order to dismount tires. Do not use hand tools or tire irons alone in order to remove the tire from the wheel. Damage to the tire beads or the wheel rim could result.

**Notice:** It is important to note that damage to either the tire mounting surface or the wheel mounting holes can result from the use of improper wheel attachment or tire mounting techniques. It takes 70 seconds for all the air to completely exhaust from a large tire. Failure to follow proper procedures could cause the tire changer to put enough force on the tire to bend the wheel at the mounting surface. Such damage may result in vibration and/or shimmy and under severe usage lead to cracking.

Follow the tire changing machine manufacturer's instructions in order to properly separate the tire from the wheel.

### Bias Ply Tire Mounting Procedure

1. Clean the tire bead area.
2. Clean the rim bead seats with a wire brush or coarse steel wool in order to remove lubricants, old rubber, and light rust.
3. Apply an approved tire lubricant to the tire bead area.
4. Attach the tire to the wheel.
  - Use a tire changing machine.
  - Follow the equipment manufacturer's instructions.

**Caution:** *To avoid serious personal injury, do not stand over tire when inflating. The bead may break when the bead snaps over the safety hump. Do not exceed 275 kPa (40 psi) pressure when inflating any tire if beads are not seated. If 275 kPa (40 psi) pressure will not seat the beads, deflate, relubricate the beads and reinflate. Overinflation may cause the bead to break and cause serious personal injury.*

5. Install a valve core. Inflate the tire to the specified pressure on the certification label.
  - The locating rings on each side of the tire must show above the rim flanges.
  - Position the rings in direct relation to the wheel, not off-center as compared to the rim.
6. Check the bead seating. Mount and inflate the tires in accordance with the safety precautions included with the tire mounting equipment.

### Radial Ply Tire Mounting Procedure

**Notice:** Failure to follow radial tire inflation procedures can cause bead deformation in both tube and tubeless tires due to incorrect bead seating.

### Tubeless Tire Mounting Procedure

**Notice:** The use of tubes in tubeless tires is not a recommended repair due to the fact that speed ratings are greatly reduced.

**Important:** Only use rims approved for radial tire usage by the rim manufacturer.

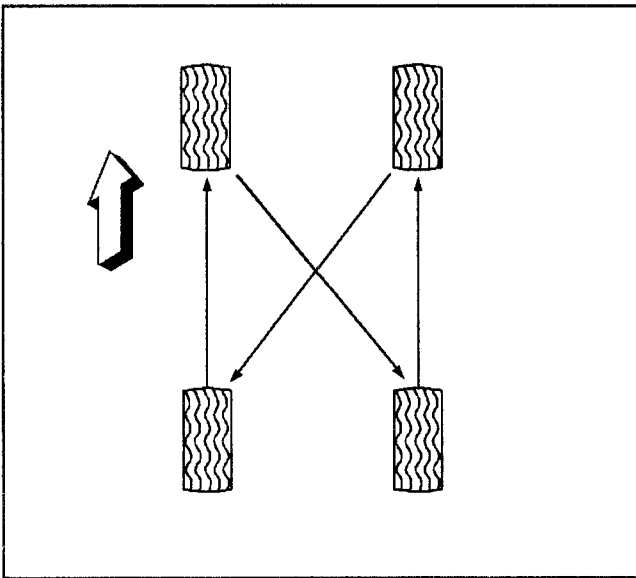
1. Clean the rim. Remove all rust and foreign material.

**Notice:** Do not use silicone base lubricants—this could cause the tire to slip on the wheel.

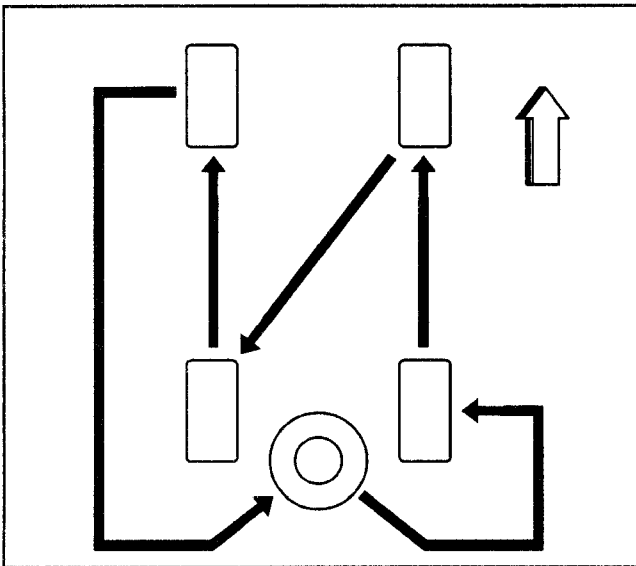
2. Lubricate the tire beads and the rim bead seats with an approved rubber lubricant.
3. Inflate the tire to the recommended pressure.
  - Because of the construction of radial truck tires, particularly in the lower sidewall and bead area, difficulty may occur in getting the tire to take air.
  - An inflation aid may be necessary in order to help seat the bead of radial tubeless tires. The following are two types of inflation aids commercially available:
    - Metal rings that use compressed air to seat the beads.
    - Rubber rings that seal between the tire bead and the rim bead seat, allowing the bead to move out and seat.
    - Lubrication is necessary with both aids.

### Important:

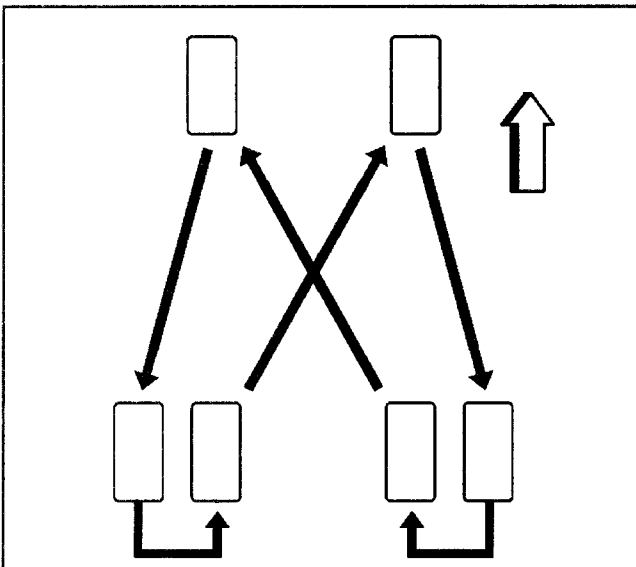
- In order to prevent bead deformation, follow this procedure to insure proper bead seating.
  - Mount and inflate radial and bias tires in accordance with safety precautions noted in RMA Radial and Bias Truck Tire Service Manuals.
4. Check the spacing between the rim flange and one of the three rings of the lower sidewall rim line, while the tire is laying flat, in order to verify bead seating.
    - Measure each 90 degrees around the circumference of the rim flange.
    - If the spacing is uneven around the bead from side to side, repeat Steps 1 through 3, then recheck.



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**Tire Rotation**

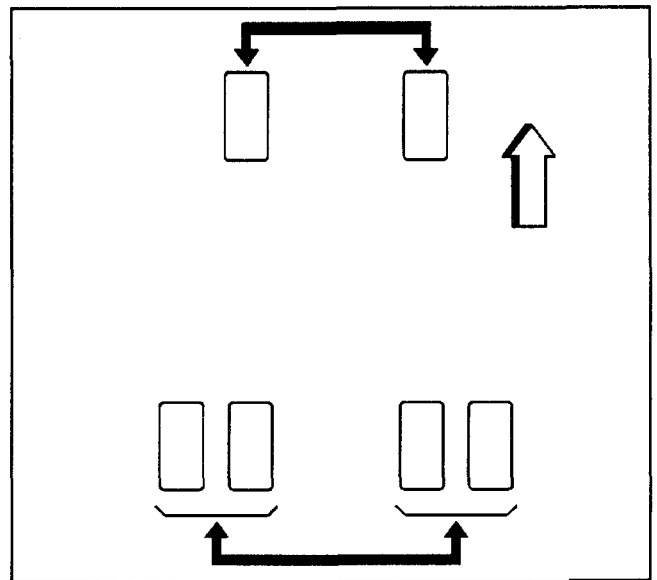
In order to equalize wear, rotate the tires at the specified intervals. Refer to *Maintenance Schedule* in Maintenance and Lubrication. In addition to scheduled rotation, rotate the tire and wheel assembly whenever you notice uneven tire wear.

Radial tires tend to wear faster in the shoulder area, particularly in front positions, due to design. Radial tires in non-drive locations may develop an irregular wear pattern that can generate tire noise. This especially makes regular tire rotation necessary.

- For vehicles with single rear wheels (four tires), rotate the tires as shown.
- For vehicles with single rear wheels (five tires), rotate the tires as shown.
- For vehicles with dual rear wheels (same tire sizes and load ranges), rotate the tires as shown.



- For vehicles with dual rear wheels (different tire sizes and load ranges), rotate the tires as shown.



156824

## Description and Operation

### General Description

This section details special service procedures that are not covered in the vehicle's Owner's Manual. For jacking instructions, basic tire changing and rotation instructions, and a detailed explanation of all other owner oriented information, refer to the vehicle's Owner's Manual.

### Tire Inflation Description

**Important:** The use of wheels or tires with higher load capacity ratings than originally equipped on the vehicle will not increase the gross axle weight rating (GAWR) or the gross vehicle weight rating (GVWR) of the vehicle.

The factory installed tires and wheels are designed to handle loads up to and including the rated load capacity, shown on the vehicle certification label, when the tires are inflated to the recommended inflation pressures.

Correct tire pressures and driving techniques affect tire life. Underinflated tires can cause the following conditions:

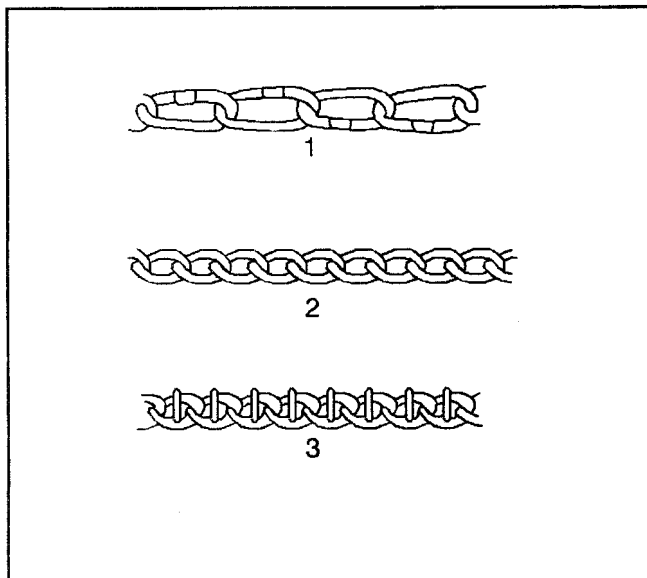
- Handling problems
- Poor fuel economy
- Shortened tire life
- Tire overloading

The following actions can also increase tire wear:

- Heavy cornering
- Excessively rapid acceleration
- Unnecessary braking

## Tire Chain Usage Description

When you use tire chains, most current vehicles require the following chain types:



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### Legend

- (1) SAE Class S or 1100 Series, Type P tire chains
- (2) SAE Class U or 1200 Series, Type P tire chains
- (3) 1800 Series Lug Reinforced tire chains

These chains are specially designed to limit the fly-off effect that occurs when the wheel rotates.

Manufacturers of tire chains have a specific chain size for each tire size. These ensure a proper fit when the chains are installed. Purchase the correct chains for the tires on which the chains will be used. Do not use rubber adjusters to take up slack in chains that are loose due to incorrect size. Always follow the chain manufacturer's installation instructions.

Use of chains may adversely affect handling. When using chains, remember the following information:

- Ensure that the vehicle is designed for chain clearance.
- Adjust the speed to road conditions.
- Avoid sharp turns.
- Avoid locked-wheel braking in order to help prevent chain damage to the vehicle.
- Install the chains as tightly as possible on the drive tires. Tighten the chains again after driving 0.4–0.8 km (¼–½ mi). Do not use chains on the non-drive tires. These chains may contact and damage the vehicle. If you use chains on the non-drive tires, ensure that there is enough clearance.
- Do not exceed 70 km/h (45 mph). Do not exceed the chain manufacturer's speed limit, if lower.

- Drive in a restrained manner. Avoid large bumps, potholes, severe turns, and other maneuvers that cause the tires to bounce up and down.
- Follow any other instructions from the chain manufacturer that do not disagree with the above.

## Replacement Tires Description

**Caution:** Do not mix different types of tires on the same vehicle such as radial, bias, and bias-belted tires except in emergencies because vehicle handling may be seriously affected and may result in loss of control and possible serious injury.

**Important:** Install new tires in pairs on the same axle. If you need to replace only one tire, this should be paired with the tire that has the most tread.

A Tire Performance Criteria (TPC) specification number is molded in the sidewall near the tire size of all original equipment tires. This number ensures that the tire meets performance standards for traction, endurance, dimension, noise, handling, rolling resistance, and others. A specific TPC number usually is assigned to each tire size.

Replacement tires should be the same size, load range, and construction as the original tires. Replace the original tires with tires that have the same TPC specification number. Use of any other tire size or type may seriously affect the following items:

- Vehicle ride
- Vehicle handling
- Speedometer/odometer calibration
- Vehicle ground clearance
- Tire clearance to the body and chassis

Replace tires when you find the following conditions:

- The tires are worn to a point where 1.6 mm (1/16 in) or less tread remains, or, the cord or fabric shows. The tires may have built-in tread wear indicators that appear between the tread grooves when the tread is 1.6 mm (1/16 in) or less. When the indicators appear in two or more adjacent grooves at three spots around the tire, replace the tire.
- The tread or sidewall is cracked, cut, or snagged deep enough to expose the cord or the fabric.
- The tire has a bump, bulge, or a split. Slight sidewall indentations are normal and this should not affect ride.
- The tire has a puncture, a cut, or other damage that cannot be repaired correctly because of the size or location of the damage.

## All Seasons Tires Description

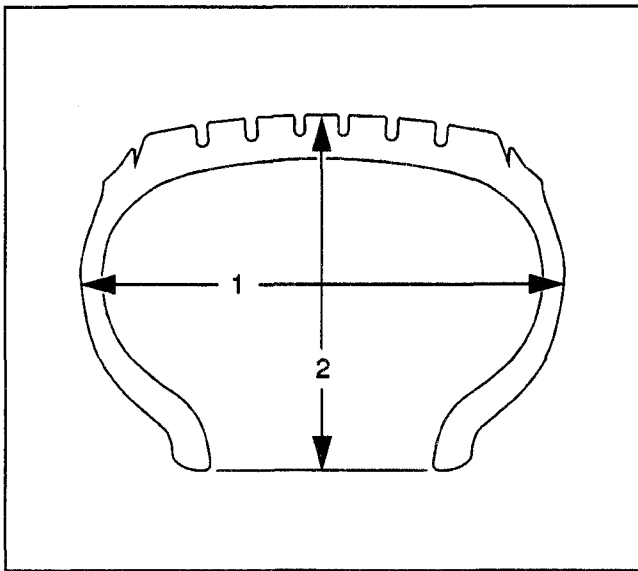
Some vehicles are equipped with all-season radial tires as standard equipment.

These tires have a 37 percent higher average rating for snow traction than non all-season radial tires previously used. For this reason, these qualify as snow tires. You can identify these tires by an M+S molded in the tire sidewall after the size.

### P-Metric Sized Tires Description

Most P-metric tires do not have exactly corresponding alpha/numeric tire sizes. A P205/75R15 is not equal in size and load carrying capacity to an FR78-15. Because of this, replacement tires should be of the same TPC specification number (size, load range, and construction) as those originally on the vehicle. If you must replace P-metric tires with other sizes, consult a tire dealer. Tire companies can best recommend the closest match.

Identify radial-ply by the letter R or Radial on the sidewall. Encoded on the side wall are the tire type, the tire size, and the aspect ratio (eg. P205/75R15).



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The following are the code designations:

- P is passenger car (LT is light trucks)
- 205 is the section width (1) of the tire
- R is the radial type design construction
- 75 is the aspect ratio (2) (height to width ratio)
- 15 is the rim diameter in inches

An all-season tire has either M+S, M&S, or M-S imprinted on the sidewall.

### Tire Placard Description

The tire information label is on the rear face of the driver's door. Refer to this label for tire information. The label lists the following items:

- Maximum vehicle load
- Tire size
- Cold inflation pressure

### Wheels Description

Replace any wheel when the following conditions apply:

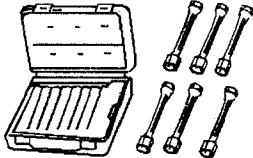
- A bent wheel
- A dented wheel
- Wheels with excessive lateral or radial runout
- The welds leak air
- Elongated bolt holes
- The wheel nuts will not stay tight

Wheels with runout greater than specified may cause objectionable vibrations.

### Wheel Repair Description

Do not use heating, welding, or peening to repair wheels. These methods are not approved. Do not use inner tubes to repair leaky wheels or tires. If leaks are found in a steel wheel, replace the wheel with a wheel of original equipment quality.

### Special Tools and Equipment

Illustration	Tool No. and Description
	<p>J 39544-GM                      Wheel Nut Torque Adapters                      (Use with pneumatic impact wrench that does not exceed 250 lb ft). Includes:                      J 39544-12, J 39544-13,                      J 39544-14, J 39544-CSE</p>

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## Section 3

# Suspension

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# Wheel Alignment Specifications

## Wheel Alignment Specifications

Operation	Service Checking	Service Setting	Side to Side Tolerance
Motorhome with Independent Front Suspension			
Caster	5.00° ± 1.00°	5.00° ± 0.50°	0.50°
Camber	0.25° ± 0.75°	0.25° ± 0.50°	0.50°
Toe	0.03 in. / 0.06° ± 0.02 in. / ± 0.04°	0.03 in. / 0.06° ± 0.01 in. / ± 0.02°	Toe-in equal
Commercial with Independent Front Suspension			
Caster	2.00° ± 1.00°	2.00° ± 0.50°	0.50°
Camber	0.25° ± 0.75°	0.25° ± 0.50°	0.50°
Toe	0.03 in. / 0.06° ± 0.02 in. / ± 0.04°	0.03 in. / 0.06° ± 0.01 in. / ± 0.02°	Toe-in equal
Motorhome or Commercial with I-Beam Front Suspension			
Caster	Not Adjustable	Not Adjustable	Not Adjustable
Camber	Not Adjustable	Not Adjustable	Not Adjustable
Toe	0.03 in. / 0.06° ± 0.02 in. / ± 0.04°	0.03 in. / 0.06° ± 0.01 in. / ± 0.02°	Toe-in equal
Important: The vehicle must be at the normal operating load during the alignment procedure.			

## Fastener Tightening Specifications

Application	Specification	
	Metric	English
Steering Linkage Tie Rod Adjuster Retaining Nut (P22)	68 N·m	50 lb ft
Steering Linkage Tie Rod Adjuster Retaining Nut (P32 MY2001)	25 N·m	18 lb ft
Upper Control Arm Bolt	190 N·m	140 lb ft

# Front Suspension

## Specifications

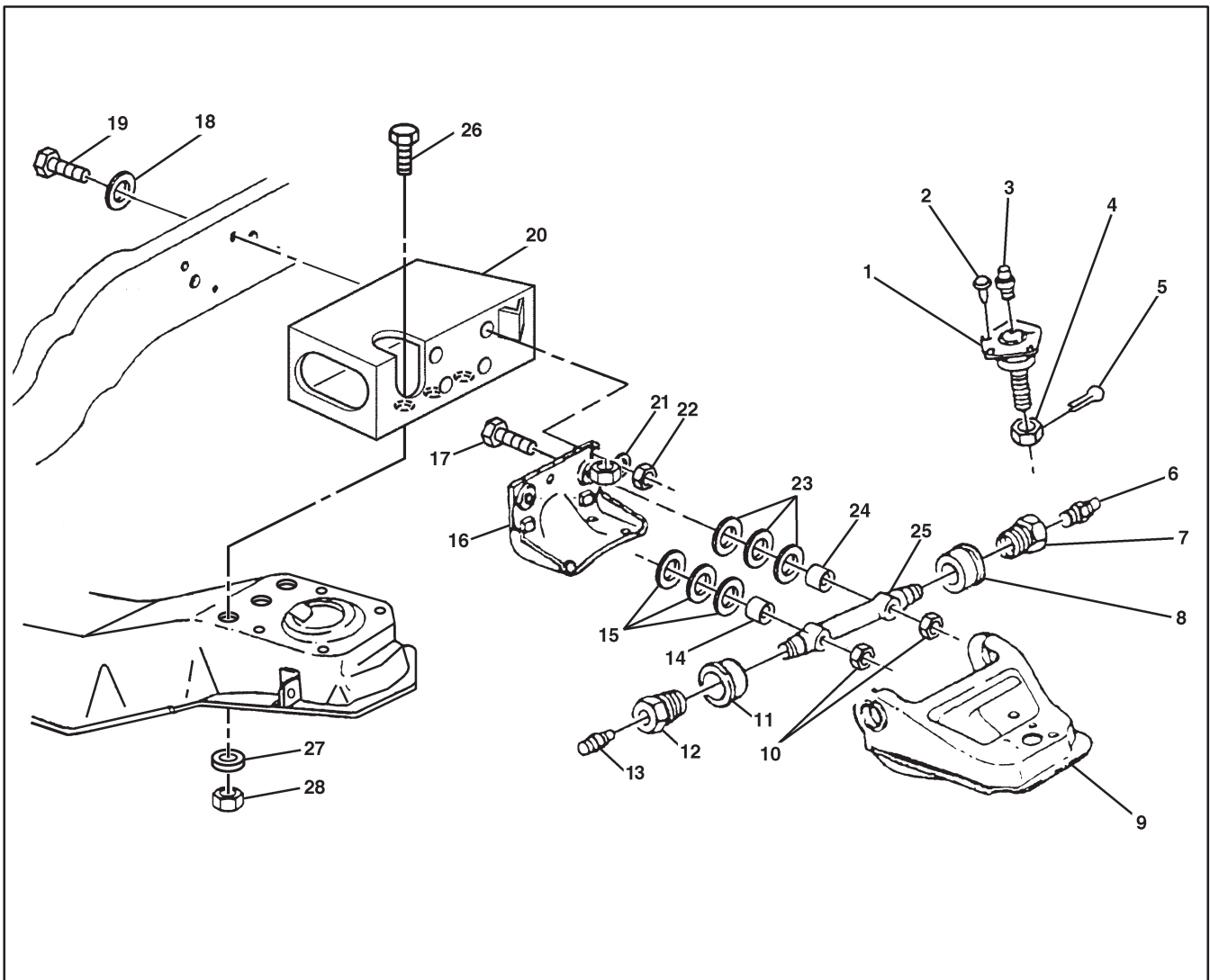
### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Auxiliary Spring to Frame Nut (P22)	41 N · m	30 lb ft
Front Shock Absorber to Control Arm Nut (P32)	102 N · m	75 lb ft
Front Shock Absorber to Frame Nut (P32)	108 N · m	80 lb ft
Hanger Through-Bolt Nut, Front and Rear (P22)	373 N · m	275 lb ft
Hanger to Frame Nut, Front and Rear (P22)	203 N · m	150 lb ft
Hub Cap Mounting Bolt	13 N · m	115 lb in
Hub to Brake Rotor Mounting Nut	120 N · m	88 lb ft
Shackle Bolt Nut (P22)	373 N · m	275 lb ft
Shock Absorber Through-Bolt Nut, Upper and Lower (P22)	110 N · m	81 lb ft
Shock Bracket to Frame Nut, Upper (P22)	250 N · m	184 lb ft
Spindle Nut Initial Torque While Rotating Hub 360° in Both Directions Back Off 1/4 to 1/6 Turn to Align Cotter Pin Hole	153 N · m	113 lb ft
Splash Shield Mounting Bolt	13 N · m	115 lb in
Spring and Clamp Block to Axle U-Bolt Nut (P22)	250 N · m	184 lb ft
Stabilizer Shaft Clamp Nut (P22)	373 N · m	275 lb ft
Upper and Lower Control Arm Nut Initial Torque Maximum to Align Cotter Pin Hole	122 N · m 175 N · m	90 lb ft 130 lb ft

Component Locator

Front Suspension Components

Upper Control Arm and Components (Independent Suspension) (P32)



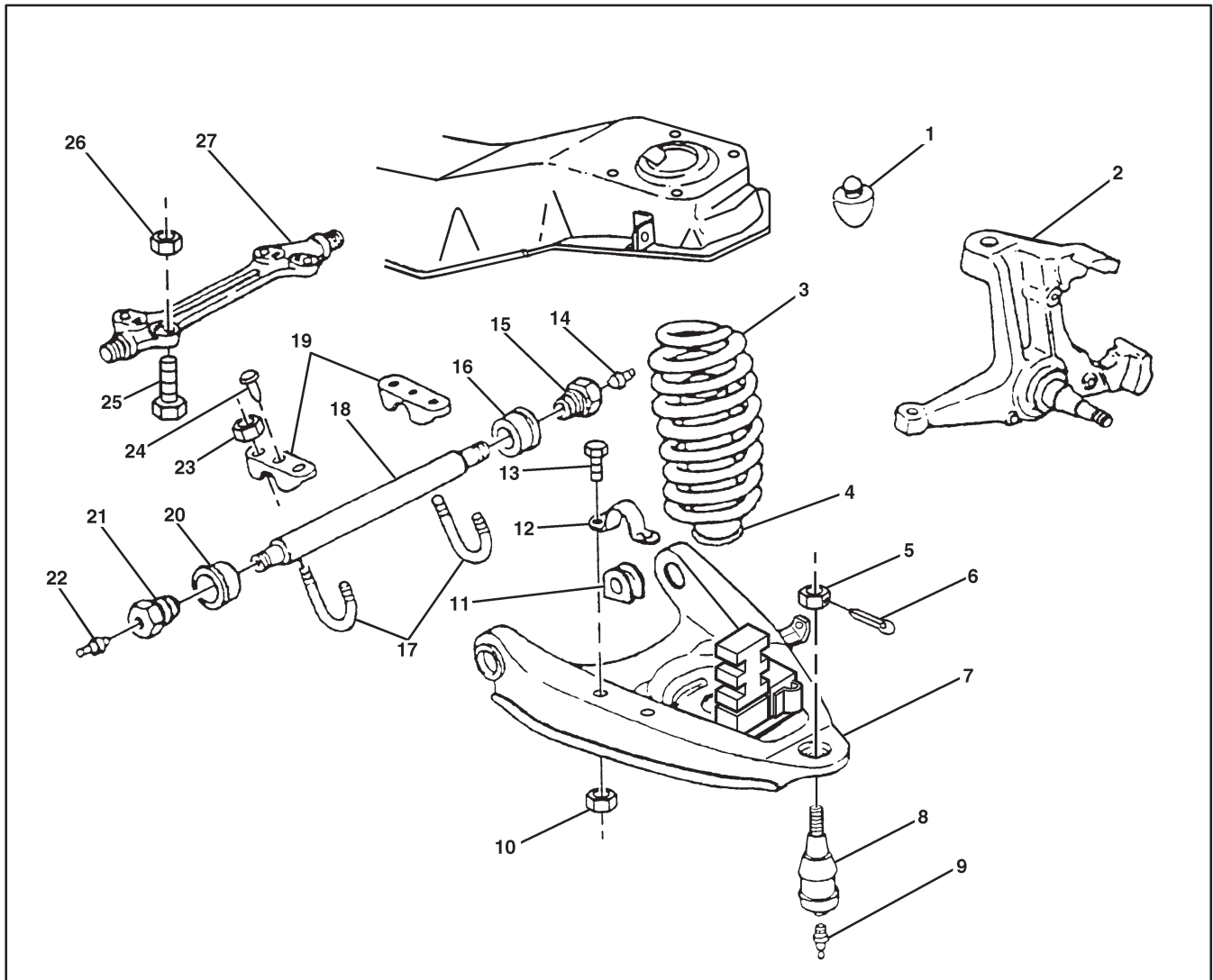
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Legend

- |   |   |
|---|---|
| (1) Upper Ball Joint                            | (15) Shim Pack                            |
| (2) Upper Ball Joint Rivet                      | (16) Upper Control Arm Frame Bracket      |
| (3) Upper Ball Joint Grease Fitting             | (17) Upper Control Arm Pivot Shaft Bolt   |
| (4) Upper Ball Joint Nut                        | (18) Reinforcement to Frame Washer        |
| (5) Cotter Pin                                  | (19) Reinforcement to Frame Bolt          |
| (6) Upper Control Arm Front Seal Grease Fitting | (20) Reinforcement                        |
| (7) Upper Control Arm Front Bushing             | (21) Frame Bracket Washer                 |
| (8) Upper Control Arm Front Seal                | (22) Frame Bracket Nut                    |
| (9) Upper Control Arm                           | (23) Shim Pack                            |
| (10) Upper Control Arm Pivot Shaft Nuts         | (24) Upper Control Arm Pivot Shaft Spacer |
| (11) Upper Control Arm Rear Seal                | (25) Upper Control Arm Pivot Shaft        |
| (12) Upper Control Arm Rear Bushing             | (26) Reinforcement to Crossmember Bolt    |
| (13) Upper Control Arm Rear Seal Grease Fitting | (27) Reinforcement to Crossmember Washer  |
| (14) Upper Control Arm Pivot Shaft Spacer       | (28) Reinforcement to Crossmember Nut     |



Lower Control Arm and Components (Independent Suspension) (P32)



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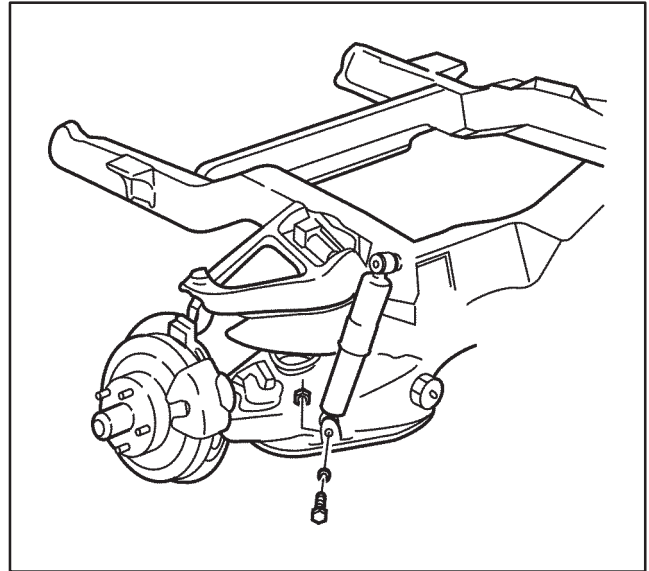
Legend

- |  |  |
|--|--|
| (1) Bumper   | (14) Lower Control Arm Seal Grease Fitting |
| (2) Steering Knuckle                                     | (15) Lower Control Arm Rear Bushing        |
| (3) Coil Spring  | (16) Pivot Shaft Seal                      |
| (4) Air Cylinder   | (17) Pivot Shaft U-Bolts                   |
| (5) Lower Ball Joint Nut                                 | (18) Lower Control Arm Pivot Shaft         |
| (6) Cotter Pin   | (19) Pivot Shaft Brackets                  |
| (7) Lower Control Arm                                    | (20) Pivot Shaft Seal                      |
| (8) Lower Ball Joint                                     | (21) Lower Control Arm Front Bushing       |
| (9) Lower Ball Joint Grease Fitting                      | (22) Lower Control Arm Seal Grease Fitting |
| (10) Stabilizer Shaft to Lower Control Arm<br>Clamp Nut  | (23) Pivot Shaft Bracket Nut               |
| (11) Stabilizer Shaft Bushing                            | (24) Pivot Shaft Bracket Rivet             |
| (12) Stabilizer Shaft to Lower Control Arm Clamp         | (25) Pivot Shaft Bolt                      |
| (13) Stabilizer Shaft to Lower Control Arm<br>Clamp Bolt | (26) Pivot Shaft Nut                       |
|  | (27) Pivot Shaft                           |

## Repair Instructions

### Front Suspension Crossmember Replacement (Independent) (P32)

P32 chassis configuration is shown here. Refer to *Front Suspension Crossmember Replacement (Independent)* in the WCC Service Manual for removal and installation procedures.



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## Steering Knuckle Replacement (Independent) (P32)

### Removal Procedure

For control arms and components, refer to *Upper Control Arm and Components (Independent Suspension)* in the WCC Service Manual.

### Tools Required

J 23742 Ball Joint Separator

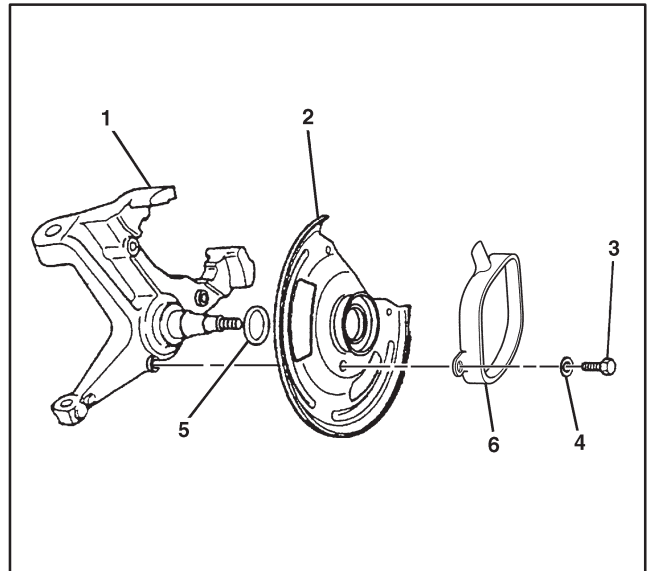
**Important:** Raise and support the vehicle on a twin-post hoist in order to compress the front coil springs and provide accessibility to the wheel and steering knuckle assembly.

**Important:** If a frame hoist is used, support the lower control arm with an adjustable jackstand in order to safely retain the coil spring in the curb height position.

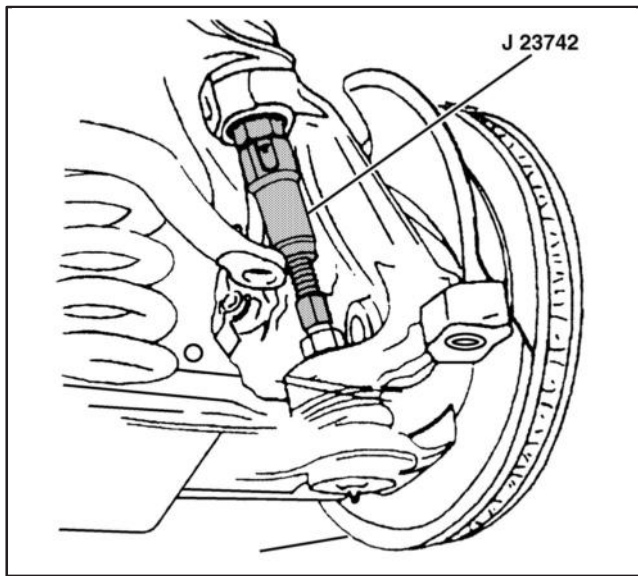
1. Raise and suitably support the vehicle.
2. Remove the wheel and tire assembly. Refer to *Tire and Wheel Removal and Installation* in the WCC Service Manual.

**Notice:** Support the brake caliper with a piece of wire to prevent damage to the brake line.

3. Remove the brake caliper. Refer to *Brake Caliper Replacement (Front)* in the WCC Service Manual.
4. Remove the hub/rotor. Refer to *Wheel Hub, Bearing, and Seal Replacement* in the WCC Service Manual.
5. Remove the bolts (3) and washers (4), of the two splash shields.
6. Remove the grease seal (5) from the spindle.
7. Remove the two splash shields (2) and (6).
8. Disconnect the tie rod end from the steering knuckle. Refer to *Tie Rod Replacement (Commercial)* in the WCC Service Manual.



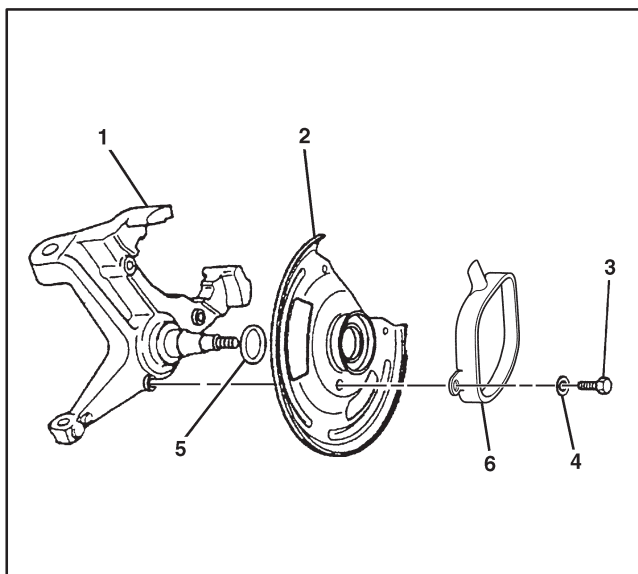
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**Caution:** Floor jack must remain under the lower control arm during removal and installation to retain the lower control arm in position. Failure to do so could result in personal injury.

9. Disconnect the steering knuckle from the upper control arm ball joint. Refer to *Upper Control Arm Replacement (Independent)* in the WCC Service Manual.
10. Disconnect the steering knuckle from the lower ball joint.
  - 10.1. Use the *J 23742* to break the lower ball joint free from the steering knuckle.
  - 10.2. Lift the steering knuckle off of the lower ball joint.
11. Inspect the tapered holes in the steering knuckle that attach to the ball joints and the tie rod end.
  - Remove any dirt.
  - If any tapered hole is out of round, deformed, or damaged in any way, replace the steering knuckle.
12. Inspect the spindle for wear or damage. If the spindle is worn or damaged, replace the steering knuckle.



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### Installation Procedure

For control arms and components, refer to *Upper Control Arm and Components (Independent Suspension)* in the WCC Service Manual.

1. Connect the steering knuckle to the lower ball joint. Press the steering knuckle onto the ball joint until it is fully seated.
2. Connect the steering knuckle to the upper ball joint. Lower the upper control arm in order to seat the upper ball joint into the steering knuckle.

**Notice:** Refer to Fastener Notice under Cautions and Notices in the WCC Service Manual.

3. Install the upper and lower control arm nuts.

### Tighten

Control arm nuts to 122 N·m (90 lb ft).

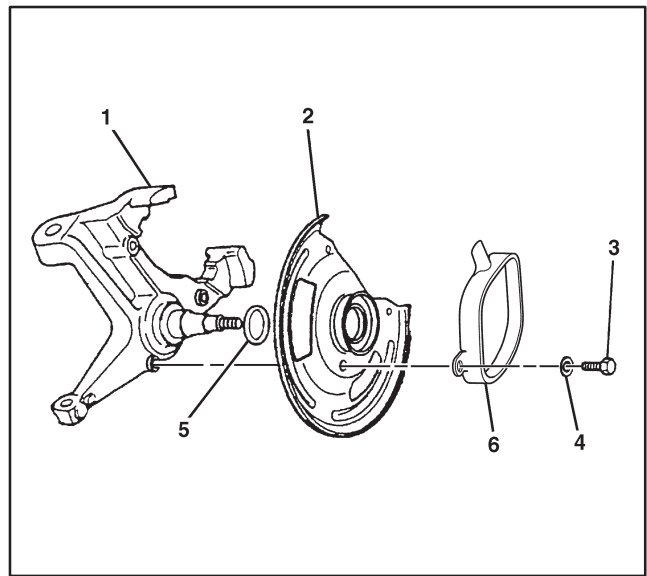
**Important:** Maximum torque on the nuts to align the cotter pin is 175 N·m (130 lb ft).

4. Install the cotter pins. If necessary, tighten the nuts an additional amount in order to align the cotter pins.
5. Remove the floor jack.
6. Connect the tie rod end to the steering knuckle. Refer to *Tie Rod Replacement (Commercial)* in the WCC Service Manual.
7. Install the splash shields (2) and (6).
8. Install the splash shield mounting bolts (3) and washers (4).

### Tighten

Tighten mounting bolts to 13 N·m (115 lb in)

9. Install the grease seal (5) to the spindle.
10. Install the hub/rotor. Refer to *Wheel Hub, Bearing, and Seal Replacement* in the WCC Service Manual.
11. Install the brake caliper. Refer to *Brake Caliper Replacement (Front)* in the WCC Service Manual.
12. Install the wheel and tire assembly. Refer to *Tire and Wheel Removal and Installation* in the WCC Service Manual.
13. Lower the vehicle.
14. Check the wheel alignment. Refer to *Wheel Alignment Specifications* in the WCC Service Manual.



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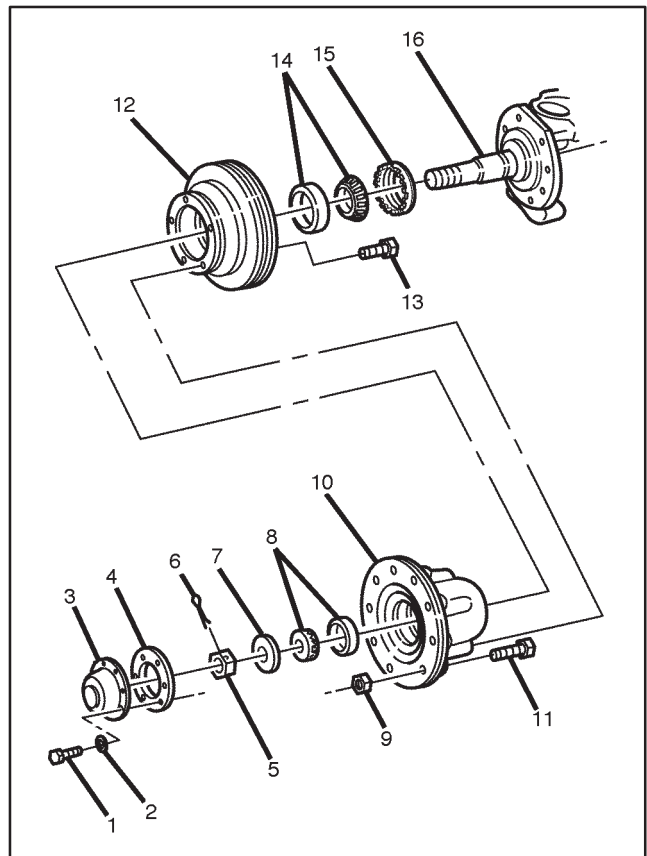
## Wheel, Hub, Bearing, and Seal Replacement (I-Beam) (P32)

### Removal Procedure

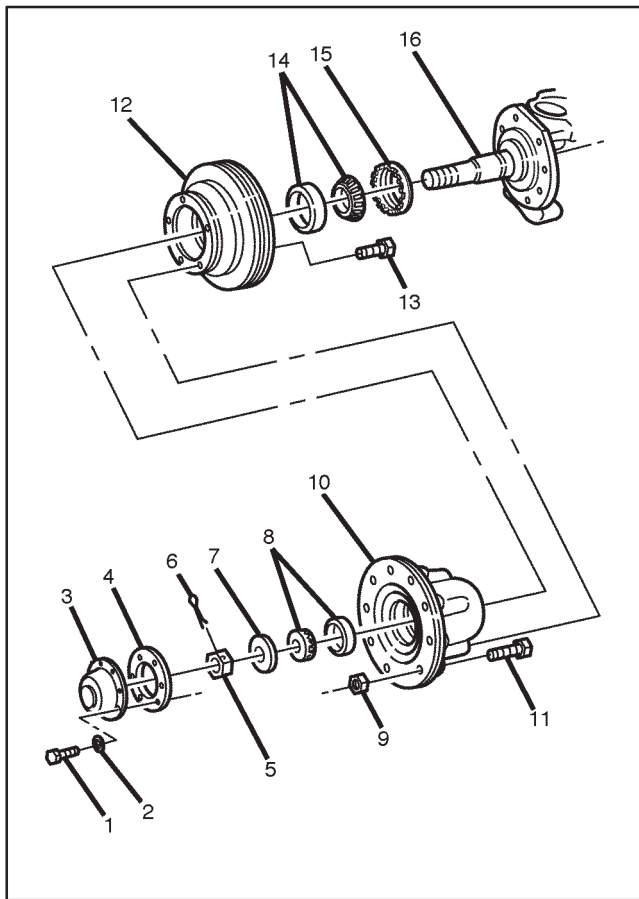
For front axle, hub, and components, refer to *Front Axle, Steering Knuckle, Hub and Components* in the WCC Service Manual.

### Tools Required

- J 8092 Driver Handle
  - J 6368 Outer Bearing Race Installer
  - J 9746-02 Hub/Rotor Support
1. Raise and suitably support the front end of the vehicle.
  2. Remove the wheel and tire assembly. Refer to *Tire and Wheel Removal and Installation* in the WCC Service Manual.



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**Notice:** Support the brake caliper with a piece of wire to prevent damage to the brake line.

3. Remove the brake caliper. Refer to *Brake Caliper Replacement (Front)* in the WCC Service Manual.
4. Remove the drain plug from the hub cap (3) and allow the oil to drain into a suitable container, then replace the drain plug.
5. Remove the bolts (1), washers (2), hub cap (3), and gasket (4) from the hub.
6. Remove the cotter pin (6), nut (5) and washer (7) from the spindle.
7. Remove the hub/rotor.
  - 7.1 Pull the hub/rotor (10, 12) free from the spindle (16). Make sure the outer bearing (8) comes free.
  - 7.2. Be careful not to damage the steering knuckle spindle threads.
  - 7.3. Pull the hub/rotor (10, 12) part way off, then remove the outer bearing (8).
8. Remove the oil seal (15) and inner bearing (14). Gently pry out the oil seal (15).
9. Remove the bearing races using a brass drift.
10. Remove the brake rotor mounting bolts (11), nuts (9), and rotor (12) from the hub (10).
11. Clean any gasket material from the hub cap (3) and hub (10).
12. Clean the oil from the hub (10) and rotor (12).

**Notice:** Do not spin the wheel bearings with compressed air to dry them – the wheel bearings might be damaged.

13. Clean the wheel bearings (8 and 14) in a suitable solvent. Use a stiff brush with no loose bristles.
14. Inspect the wheel bearings and races for damage or wear. Refer to *Wheel Bearings Diagnosis* in the WCC Service Manual. If either the bearing or the race is worn, replace the bearing and the race.
15. Inspect the hub (10) and the rotor (12) for the following conditions and replace the hub (10) or rotor (12) as necessary.
  - Out of round
  - Scored
  - Pitting or cracks

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

16. Inspect the wheel studs (11) to see if they are stripped, cracked, broken, or otherwise damaged. Replace wheel studs as required.

## Installation Procedure

For front axle, hub, and components, refer to *Front Axle, Steering Knuckle, Hub and Components* in the WCC Service Manual.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

1. Install the brake rotor mounting bolts (11), nuts (9), and rotor (12) to the hub (10).

### Tighten

Tighten hub to rotor nuts to 120 N·m (88 lb ft).

**Notice:** Start the races squarely inside the hub/rotor to avoid distortion and possible cracking.

2. Install the outer bearing race into the bearing hub (10).
  - 2.1. Place the hub/rotor on the J 9746-02 and rest the assembly on the press bars.
  - 2.2. Use the J 6368 in order to drive the outer bearing into position.
  - 2.3. Remove the J 9746-02.

**Notice:** Using a bar larger than 7.6 cm (3 in) may damage the bearing seal seat.

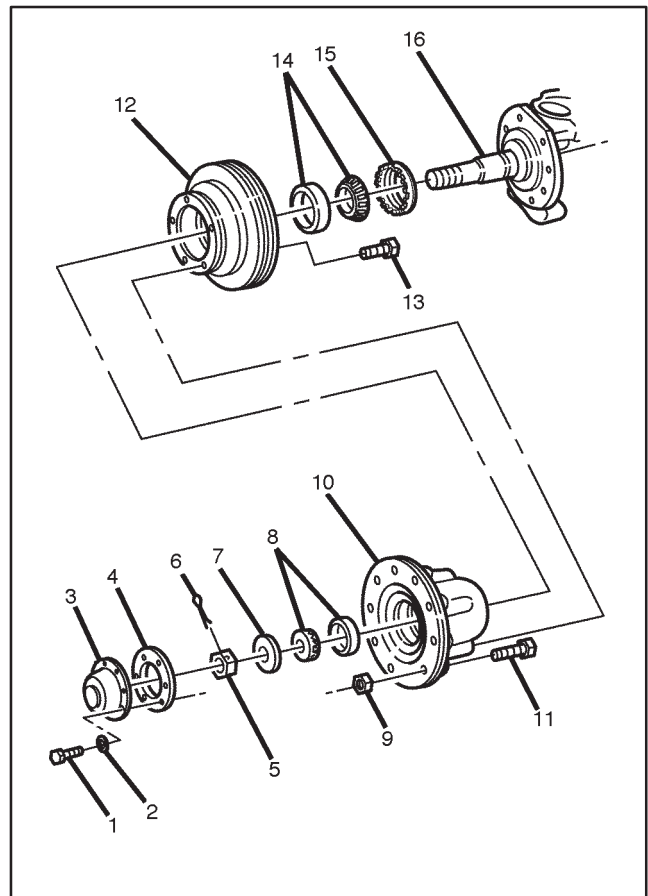
3. Use a 7.6 cm (3 in) diameter bar to drive the inner bearing race into position.
4. Install the inner bearing (14).

**Important:** Face the seal lip towards the inside of the wheel. Provide enough clearance between the seal and the bearing so that the bearing can turn freely without rubbing against the seal.

5. Install a new oil seal (15).
  - 5.1. In order to ensure that the seal is flush with the hub/rotor flange, use a flat plate or block to install the seal.
  - 5.2. Press the seal into the hub until it seats against the bearing race.
  - 5.3. Lubricate the lip of the oil seal (15) with a light coat of grease.

**Notice:** Be careful not to damage the steering knuckle spindle threads or the oil seal (15).

6. Install the hub/rotor (10, 12) by sliding the hub/rotor (10, 12) onto the spindle (16) until it seats.
7. Install the outer wheel bearing (8). Slide the bearing cone onto the spindle (16) until it seats against the outer bearing race.
8. Install the washer (7) and the castle nut (5). Do not fully tighten the nut (5) or install the new cotter pin (6).
9. Install the brake caliper. Refer to *Brake Caliper Replacement (Front)* in the WCC Service Manual.
10. Install the wheel and tire assembly. Refer to *Tire and Wheel Removal and Installation* in the WCC Service Manual.



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## Wheel Bearing Adjustment (I-Beam) (P32)

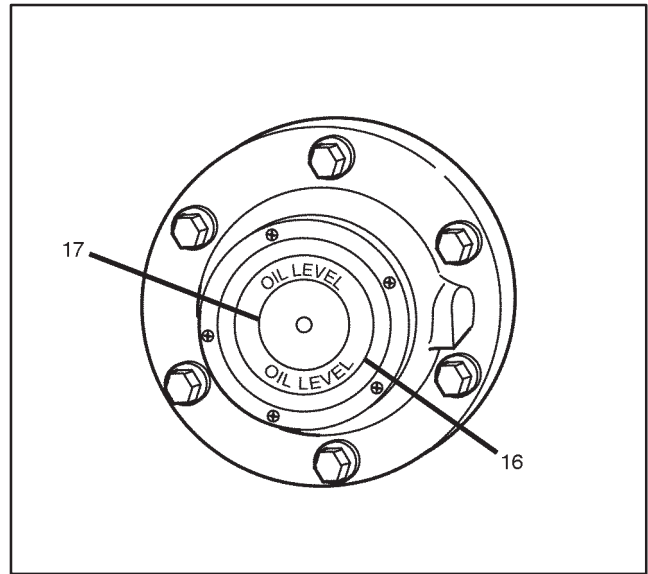
For front axle, hub, and components, refer to *Front Axle, Steering Knuckle, Hub and Components* in the WCC Service Manual.

**Notice:** Never preload the front wheel bearings. Damage can result by the steady load on the roller ends that comes from preloading.

**Important:**

- Adjust the bearings correctly in order to ensure that the front suspension functions properly.
- The bearings must be a slip fit on the spindle.
- Lubricate the bearings in order to ensure that the roller bearings will roll and not skid.
- The spindle nut must have a free-running fit on the spindle threads.

1. Set the parking brake.
2. Block the rear wheels.



WRK32010

3. Raise and suitably support the front end of the vehicle so that the front wheels are off of the ground.
4. Remove the drain plug from the hub cap (3) and allow the oil to drain into a suitable container, then replace the drain plug.
5. Remove the bolts (1), washers (2), hub cap (3), and gasket (4) from the hub.
6. Remove the cotter pin (6).
7. Adjust the spindle nut (5).

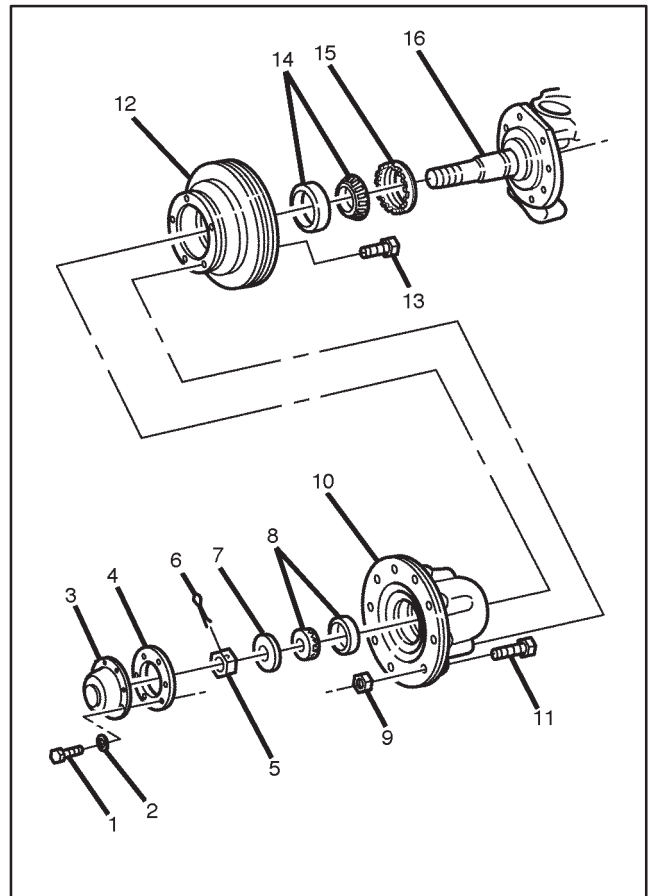
**Tighten**

Tighten the spindle nut (5) to 153 N·m (113 lb ft) while rotating the wheel 360° in both directions. This rotation will properly position the bearings.

8. Back off the nut (5) 1/4 to 1/6 turn until the slot in the nut aligns with the cotter pin hole in the spindle (15).
9. Install a new cotter pin (6), then bend the ends for proper clearance from rotating components.
10. Install the bolts (1), washers (2), hub cap (3), and a new gasket (4) to the hub.

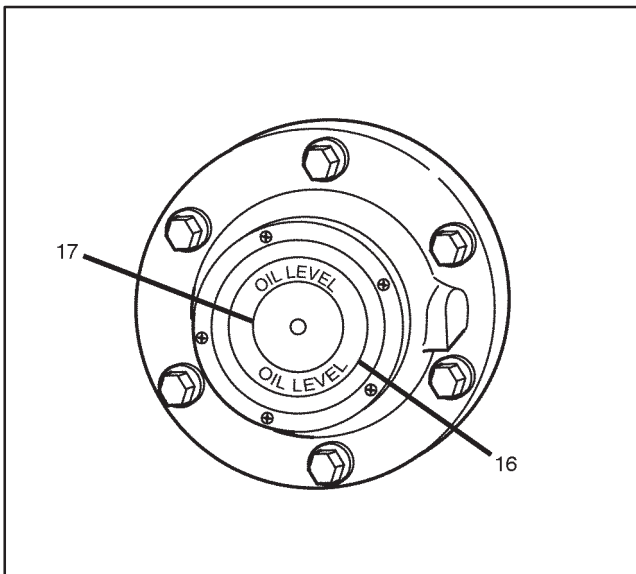
**Tighten**

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



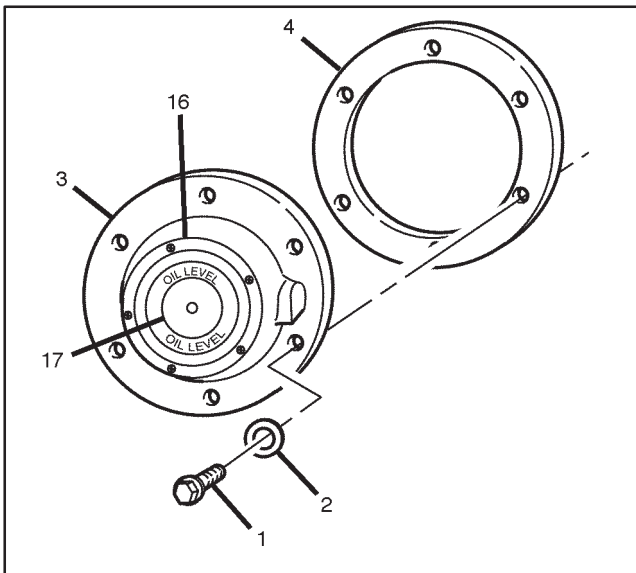
WRK32006





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11. Fill oil to the level on the window (16).
  - 11.1. Remove the window plug (17).
  - 11.2. Fill the oil to the proper level. Refer to *Adding Lubricant to the Hub Caps* in this supplement.
  - 11.3. Install the window plug (17).
12. Lower the vehicle.
13. Check the wheel alignment. Refer to *Wheel Alignment Specifications* in this supplement.

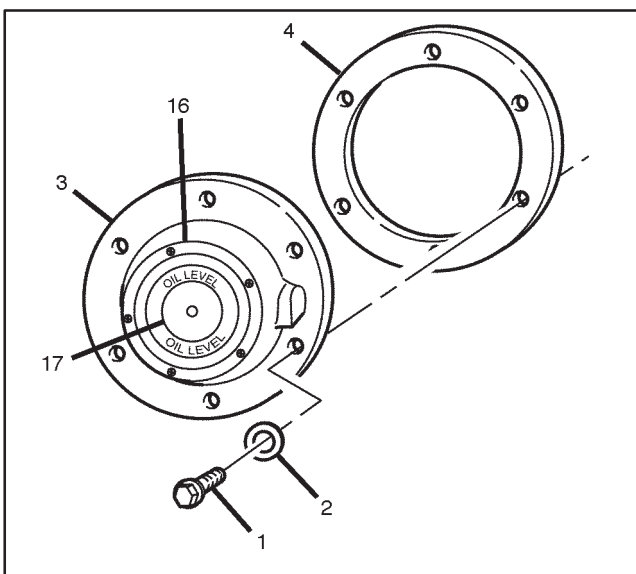


WRK32007

### Hub Cap Replacement (I-Beam) (P32)

#### Removal Procedure

1. Remove the drain plug from the hub cap (3) and allow the oil to drain into a suitable container, then replace the drain plug.
2. Remove the bolts (1), washers (2), hub cap (3), and gasket (4) from the hub.
3. Clean any gasket material from the hub cap (3) and hub (10).



WRK32007

#### Installation Procedure

**Notice:** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

1. Install the bolts (1), washers (2), hub cap (3), and a new gasket (4) to the hub.

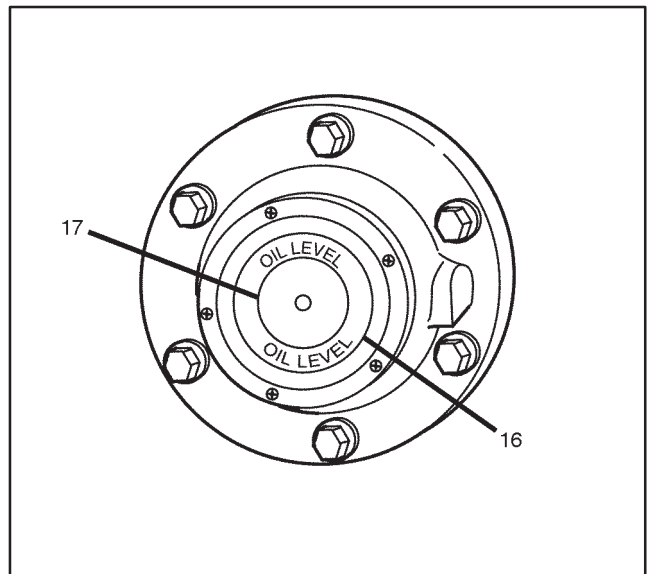
#### Tighten

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

2. Fill oil to the level on the window (16).
  - 2.1. Remove the window plug (17).
  - 2.2. Fill the oil to the proper level. Refer to *Adding Lubricant to the Hub Caps* in this supplement.
  - 2.3. Install the window plug (17).

**Adding Lubricant to the 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, do the following:
  - 2.1. Remove the window plug (17).
  - 2.2. Add lubricant until the fluid is level with the oil level line. Refer to *Fluid and Lubricant Recommendations* in this supplement.
  - 2.3. Install the window plug (17).

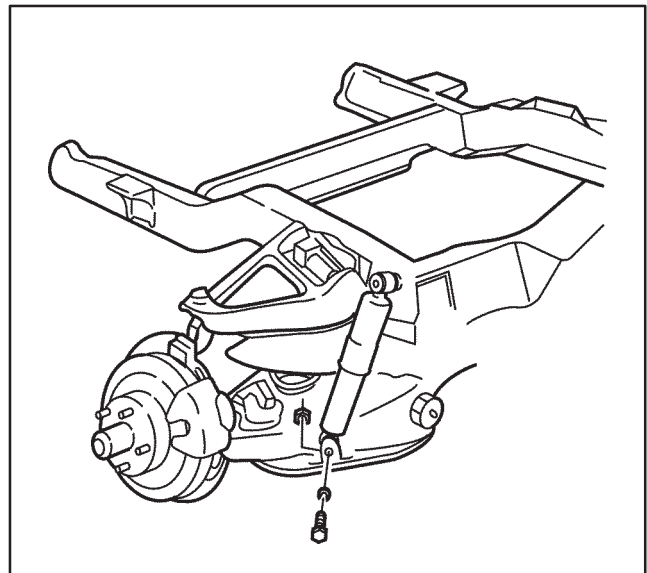


WRK32010

**Shock Absorber Replacement (Independent) (P32)**

**Removal Procedure**

1. Raise the vehicle on a hoist.
2. Remove the nut, washer, and bolt from the lower control arm.
3. Remove the shock absorber from the lower control arm.
4. Remove the nut and washer at the frame bracket.
5. Remove the shock absorber from the frame.
6. Inspect the shock absorber for leaks.
7. Test the shock absorber. Refer to *Struts or Shock Absorbers Bench Test (Non-Spiral Groove)* in the WCC Service Manual.



WRK32003

**Installation Procedure**

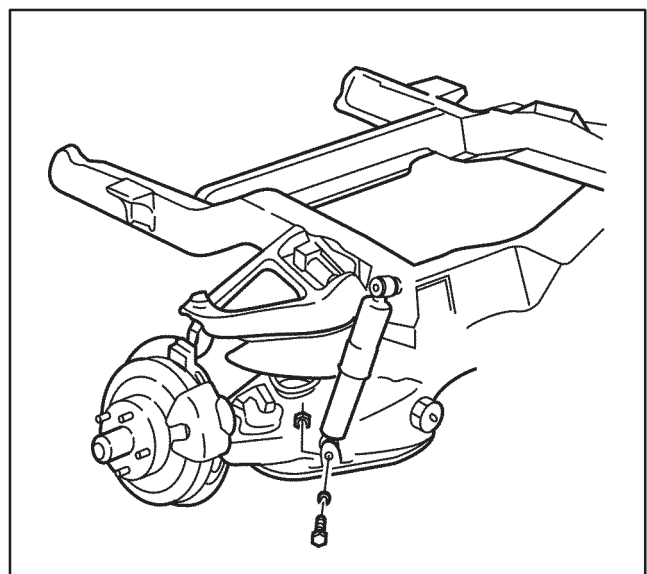
1. Install the shock absorber to the vehicle.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

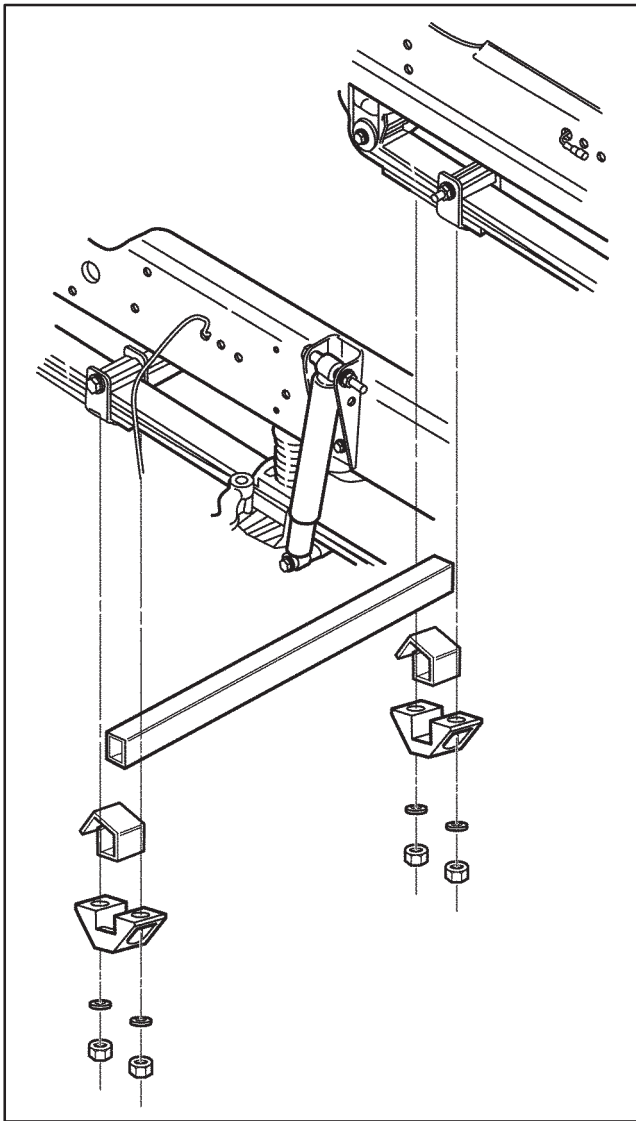
2. Install the nut and washer at the frame bracket.
3. Install the nut, washer, and bolt at the lower control arm.

**Tighten**

- Tighten the shock to frame nut to 108 N·m (80 lb ft).
  - Tighten the shock to control arm nut to 102 N·m (75 lb ft).
4. Lower the vehicle.



WRK32003



WRK32008

## Stabilizer Shaft Replacement (Front) (P22)

### Removal Procedure

1. Raise the vehicle on a hoist
2. Remove the nuts and washers from the stabilizer shaft clamp and the right front leaf spring.
3. Remove the nuts and washers from the stabilizer shaft clamp and the left front leaf spring, and remove the stabilizer shaft from the vehicle.
4. Remove the clamps from the stabilizer shaft.
5. Remove the insulators from the stabilizer shaft.

### Installation Procedure

1. Install the insulators to the stabilizer shaft.
2. Install the clamps to the stabilizer shaft.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

3. Install the washers and nuts to the stabilizer shaft clamp and the left front leaf spring.
4. Install the washers and nuts to the stabilizer shaft clamp and the right front leaf spring.

### Tighten

Tighten the stabilizer shaft clamp nuts to 373 N · m (275 lb ft).

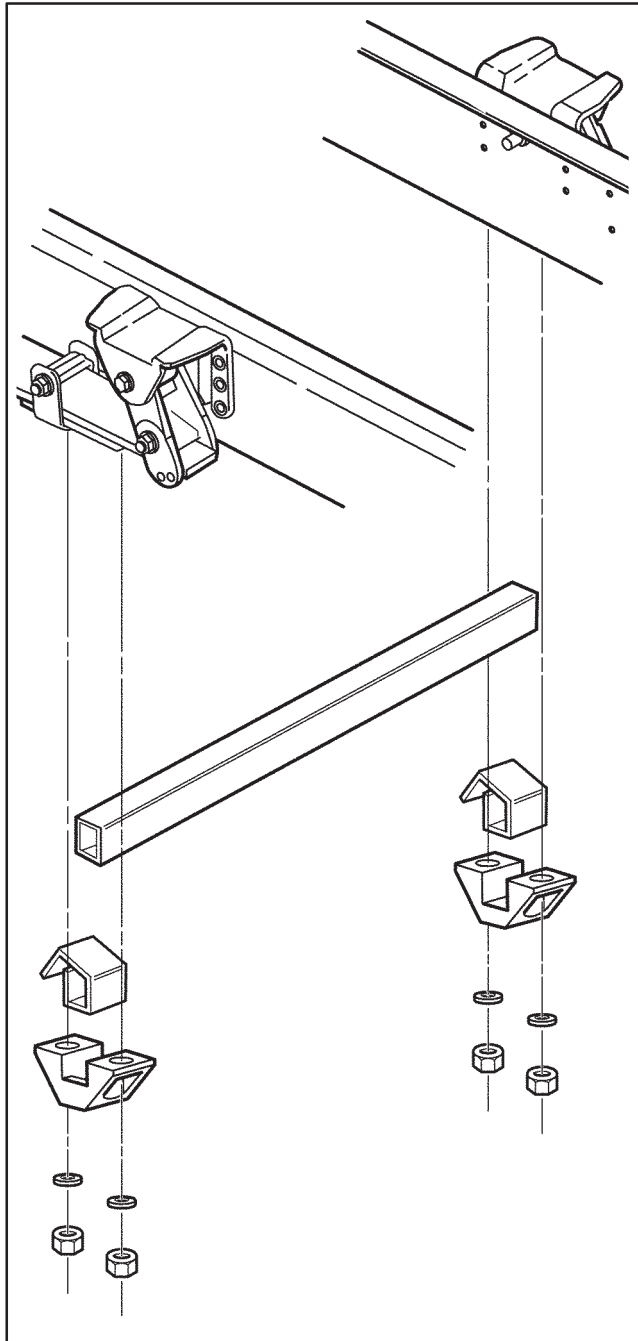
5. Lower the vehicle.

# Rear Suspension

## Specifications

### Fastener Tightening Specifications

Application	Specification	
	Metric	English
Stabilizer Shaft Clamp Nut (P22)	102 N · m	75 lb ft



WRK32009

## Repair Instructions

### Stabilizer Shaft Replacement (Rear) (P22)

#### Removal Procedure

1. Raise the vehicle on a hoist
2. Remove the nuts and washers from the stabilizer shaft clamp and the right rear leaf spring.
3. Remove the nuts and washers from the stabilizer shaft clamp and the left rear leaf spring, and remove the stabilizer shaft from the vehicle.
4. Remove the clamps from the stabilizer shaft.
5. Remove the insulators from the stabilizer shaft.

#### Installation Procedure

1. Install the insulators to the stabilizer shaft.
2. Install the clamps to the stabilizer shaft.

**Notice:** Refer to *Fastener Notice* in Cautions and Notices in the WCC Service Manual.

3. Install the washers and nuts to the stabilizer shaft clamp and the left rear leaf spring.
4. Install the washers and nuts to the stabilizer shaft clamp and the right rear leaf spring.

#### Tighten

Tighten the stabilizer shaft clamp nuts to 102 N · m (75 lb ft).

5. Lower the vehicle.