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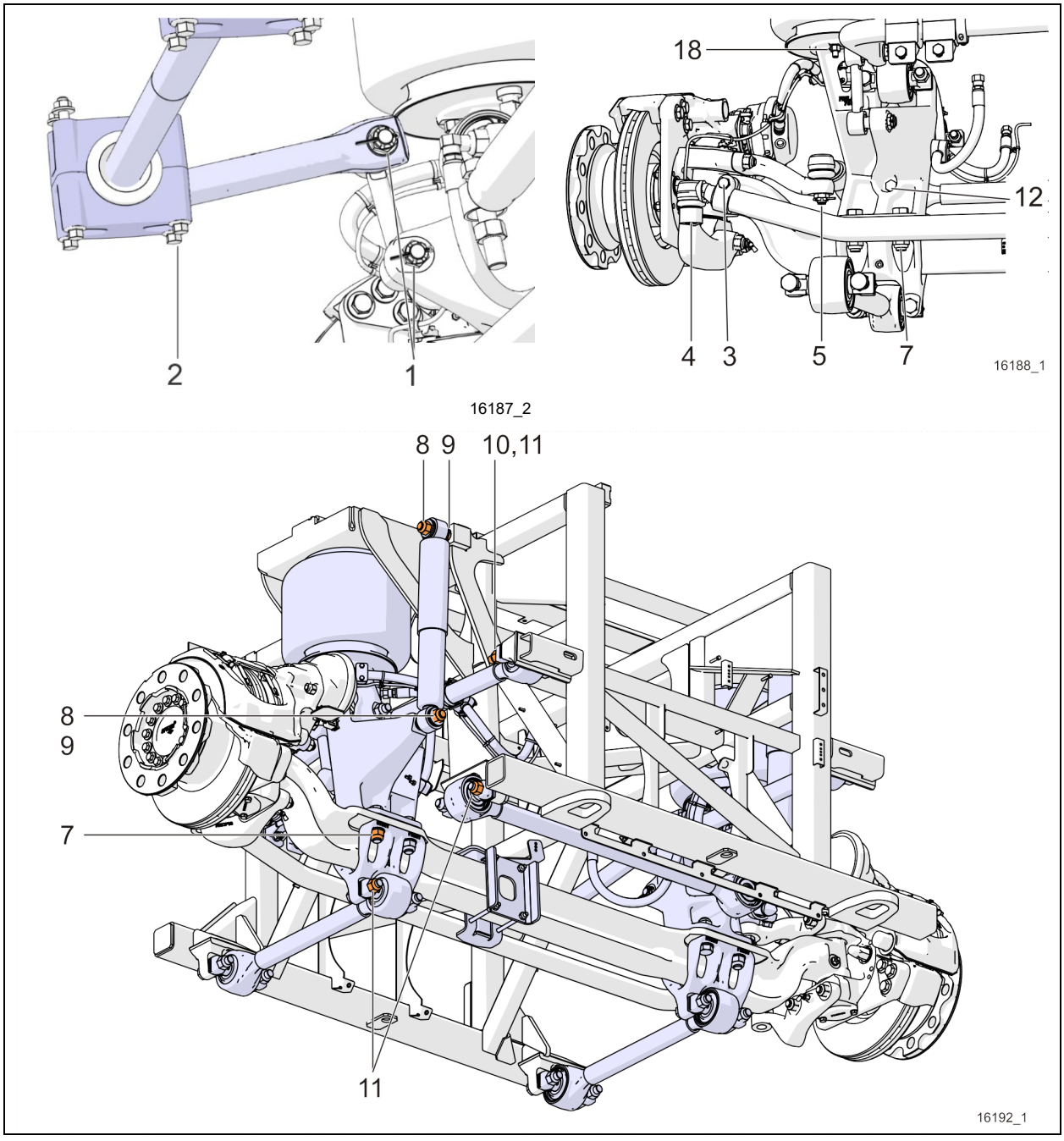
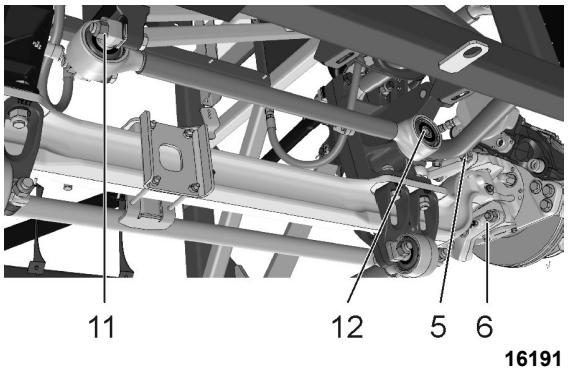
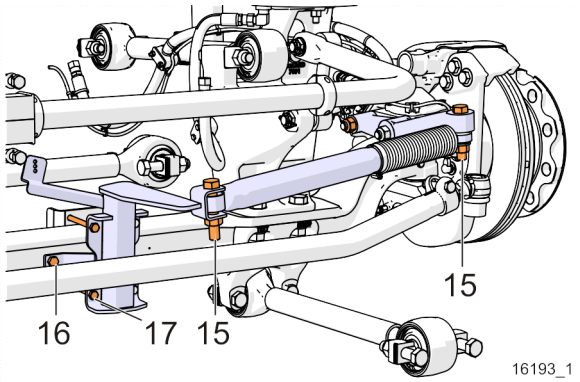
	DESCRIPTION	DATE
1	Updated for new IFS design	March 2025
2		
3		
4		
5		
6		

2 TORQUE TABLES

2.1 FRONT I-BEAM AXLE AND RELATED COMPONENTS

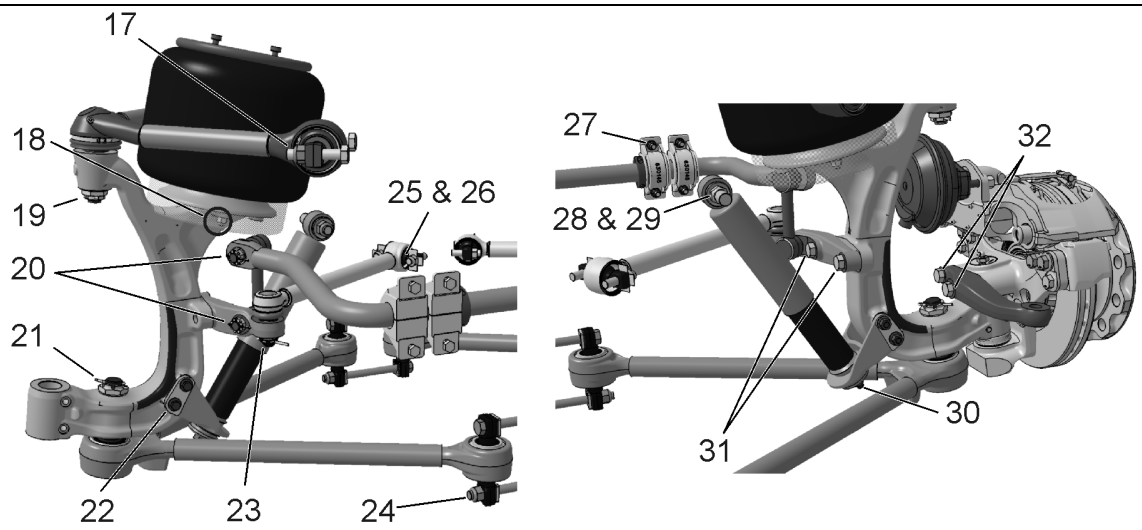






FRONT I-BEAM AXLE			
No	DESCRIPTION	QTY	TORQUE (dry)
1	Sway bar link, upper and lower nuts	4	165-200 lb-ft (224-271 Nm)
2	Sway bar bushing collars (front suspension)	8	80-100 lb-ft (108-136 Nm)
3	Tie rod end clamp nuts	2	118-133 lb-ft (160-180 Nm)
4	Tie rod end ball pin nuts	2	155-170 lb-ft (210-230 Nm)
6	Tie rod arm stud nuts	4	285-315 lb-ft (386-427 Nm)
7	I-beam axle mount nuts	8	230-280 lb-ft (312-380 Nm)
8	Shock absorber upper & lower mounting nuts	2	99-121 lb-ft (134-164 Nm)
9	Shock absorber pins, upper & lower	2	350-400 lb-ft (475-542 Nm)
10	Radius rod retaining studs	4	90-110 lb-ft (122-149 Nm)
11	Radius rod retaining nuts	18	225-255 lb-ft (305-346 Nm)
12	Transverse radius rod taper pin screw	1	206 lb-ft (279 Nm)
15	Steering damper nuts	2	100-120 lb-ft (136-163 Nm)
16	Steering damper bracket bolt	1	39-45 lb-ft (53-61 Nm)
17	Steering damper bracket nuts	4	30-36 lb-ft (41-49 Nm)
18	Air spring nut	4	25 lb-ft (34 Nm)
19	Steering damper arm nuts	2	285-315 lb-ft (386-427 Nm)

2.2 INDEPENDENT FRONT SUSPENSION – PREVIOUS DESIGN

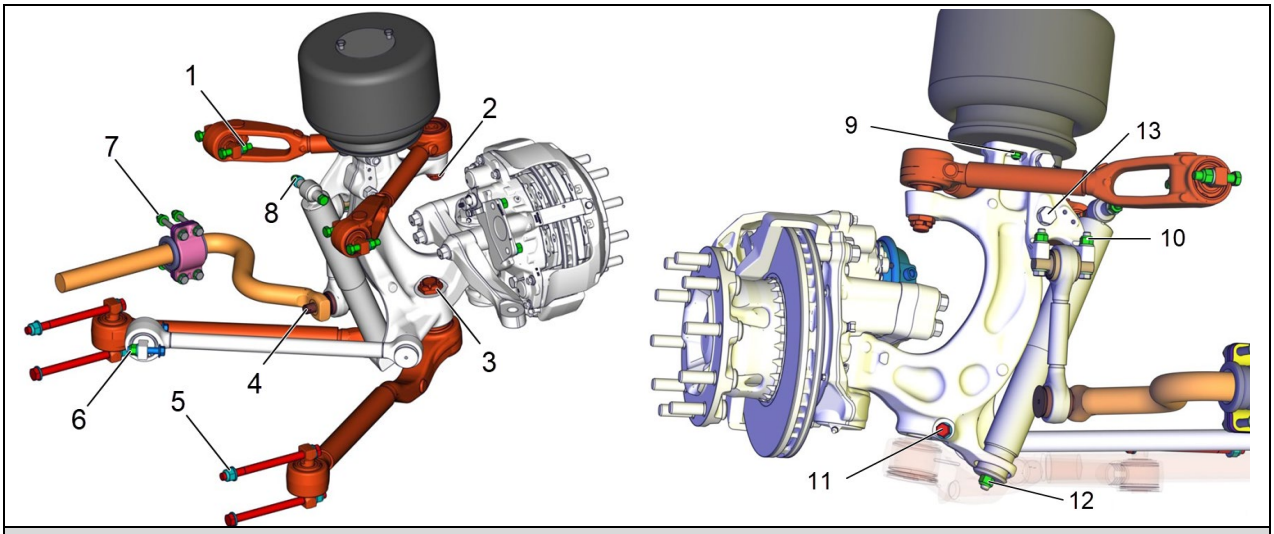


INDEPENDENT FRONT SUSPENSION			
No	DESCRIPTION	QTY	TORQUE (dry)
17	Upper a-arm ball joint	4	230-255 lb-ft (312-346 Nm)
18	Air spring lower stud nut (6 air springs)	2	31-38 lb-ft (42-52 Nm)
19	Upper a-arm central ball joint (castellated hex nut)*	1	210-250 lb-ft (285-339 Nm)
20	Sway bar link, upper and lower ball stud nuts (front suspension)*	2	165-200 lb-ft (224-271 Nm)
21	Lower a-arm central ball joint (castellated nut)*	1	490-540 lb-ft (664-732 Nm)
22	Shock absorber support	4	105-125 lb-ft (142-169 Nm)
23	Torque Rod ball stud nut*	1	150-200 lb-ft (203-271 Nm)
24	Lower a-arm ball joint	4	270-300 lb-ft (366-407 Nm)
25	Torque rod, nut	2	158-193 lb-ft (214-262 Nm)
26	Torque rod, stud	2	90-110 lb-ft (122-149 Nm)
27	Sway bar bushing collar (front suspension)	8	80-100 lb-ft (108-136 Nm)
28	Shock absorber mounting stud nut	1	99-121 lb-ft (134-164 Nm)
29	Shock absorber mounting stud	1	350-400 lb-ft (475-542 Nm)
30	Shock absorber lower mounting pin nut	1	60-75 lb-ft (81-102 Nm)
31	Torque rod lever bolt (M20-2.5)	2	520-575 lb-ft (705-780 Nm)
32	Steering arm bolt (M22-2.5)	2	642-708 lb-ft (870-960 Nm)

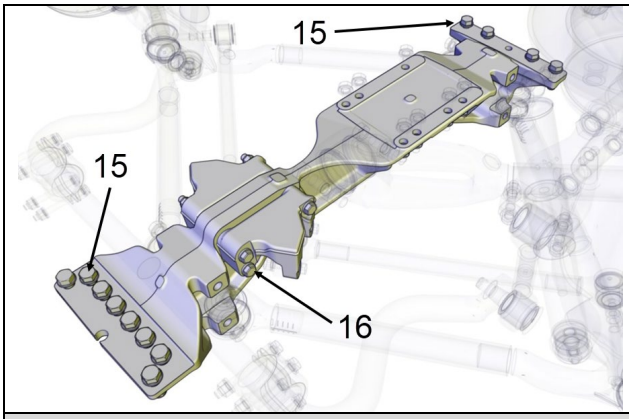
* Tighten nut to specified torque, then advance to next aligning cotter pin slot and install a new cotter pin.

NOTE
Apply corrosion-protective compound on exposed threads.

2.3 INDEPENDENT FRONT SUSPENSION – NEW DESIGN

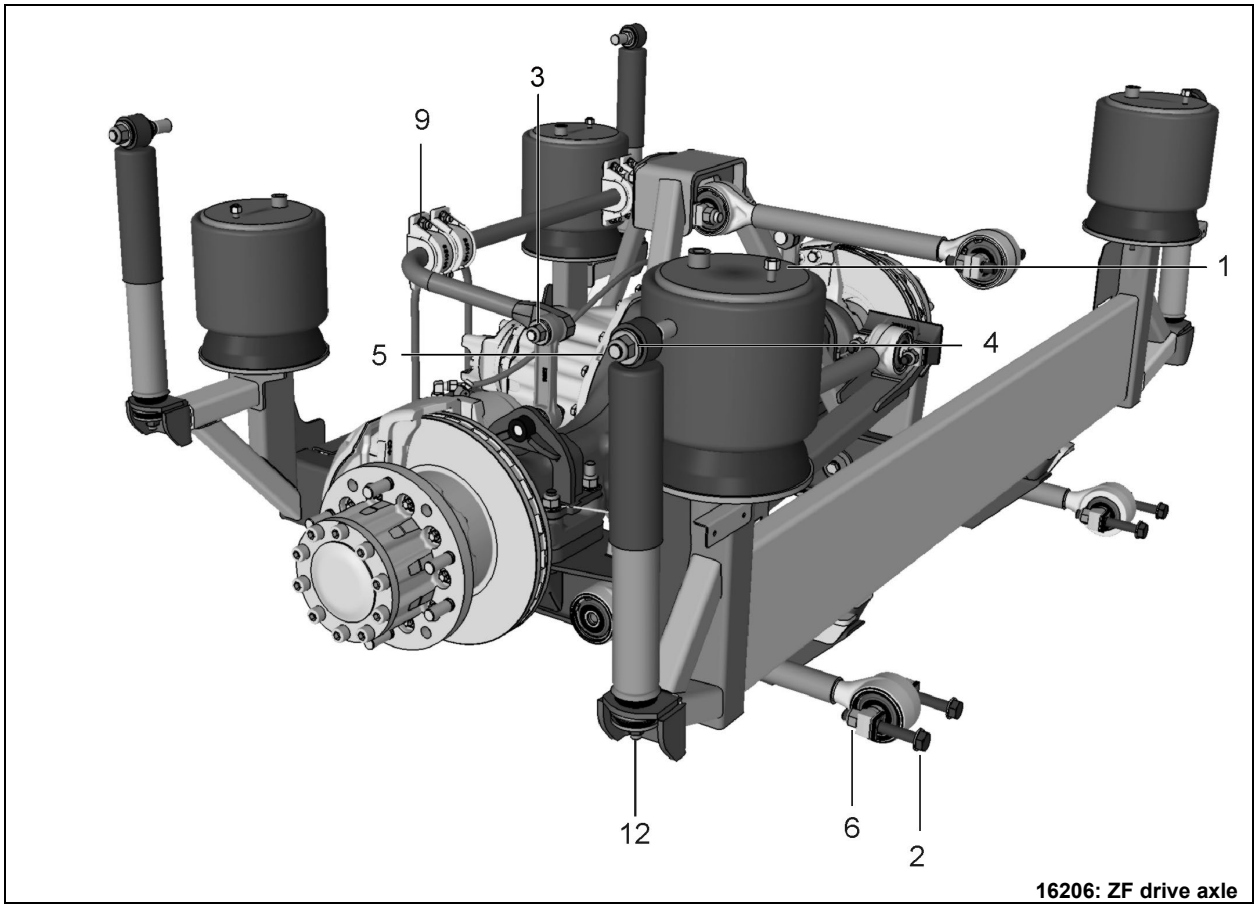


INDEPENDENT FRONT SUSPENSION– NEW DESIGN			
No	DESCRIPTION	QTY	TORQUE (dry)
1	Upper control arm bushing	4	198 lb-ft (268 Nm)
2	Upper control arm ball joint (castellated hex nut) *	1	210 lb-ft (285 Nm) wet
3	Lower control arm ball joint (castellated hex nut) *	1	490 lb-ft (664 Nm)
4	Sway bar link lower bushing (castellated hex nut) *	1	258 lb-ft (350 Nm)
5	Lower control arm bushing	4	387 lb-ft (525 Nm)
6	Reaction rod bushing	2	198 lb-ft (268 Nm)
7	Sway bar bushing collar nut	4	130 lb-ft (176 Nm)
8	Shock absorber mounting nut, upper	1	198 lb-ft (268 Nm)
9	Air spring lower stud nut	2	22 lb-ft (30 Nm)
10	Sway bar link upper bushing *	2	130 lb-ft (176 Nm)
11	Reaction rod bushing mounting bolt	1	198 lb-ft (268 Nm)
12	Shock absorber mounting nut, lower	1	74 lb-ft (100 Nm)
13	Link attachment bracket to upright	2	387 lb-ft (525 Nm)
Tighten castellated nuts to specified torque lower range value, then advance to next aligning cotter pin slot and install a new cotter pin.			

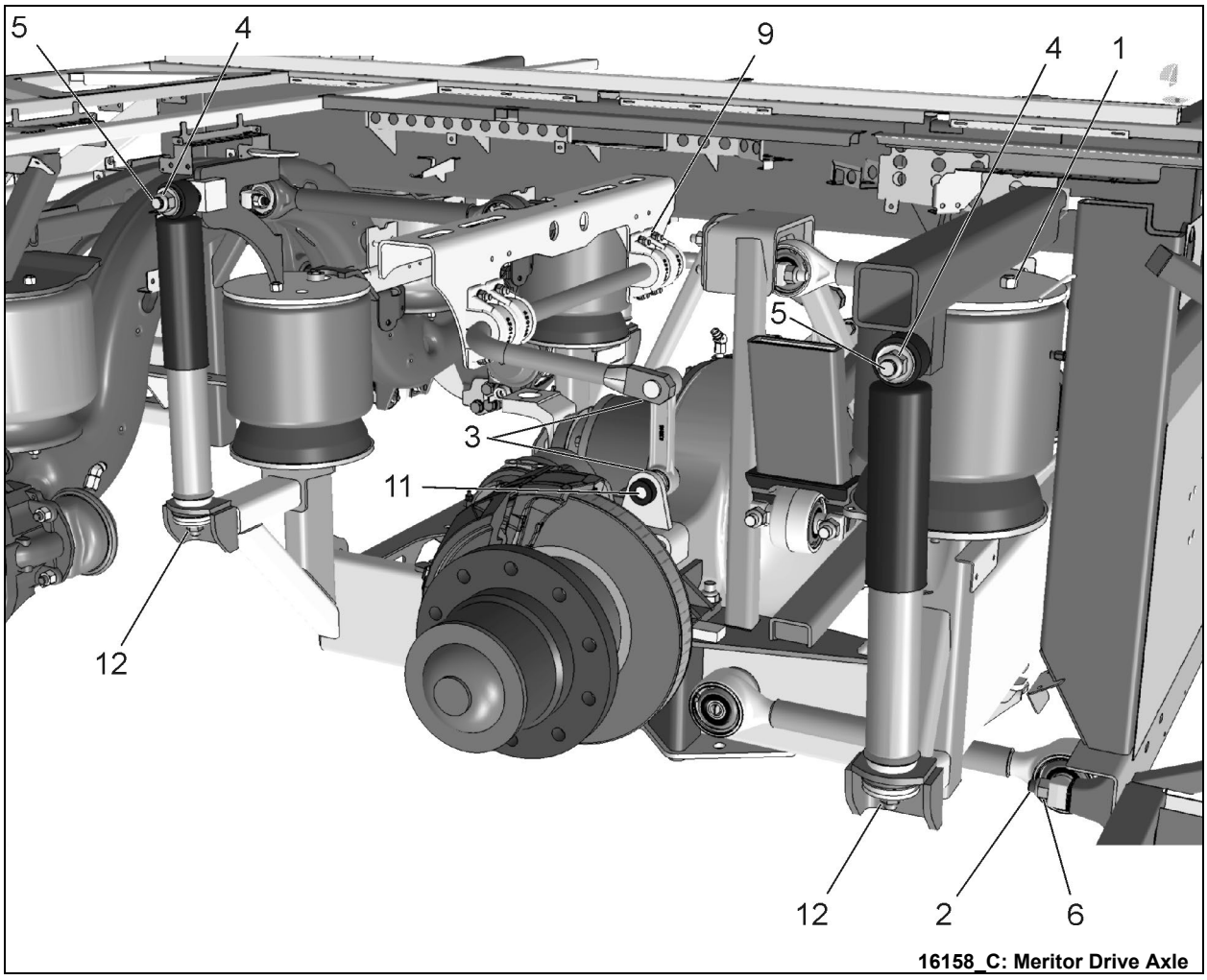


INDEPENDENT FRONT SUSPENSION– NEW DESIGN			
No	DESCRIPTION	QTY	TORQUE (dry)
15	Backbone attachment to structure	12	387 lb-ft (525 Nm)
16	Reaction rod bracket	3	198 lb-ft (268 Nm)
Tighten castellated nuts to specified torque lower range value, then advance to next aligning cotter pin slot and install a new cotter pin.			

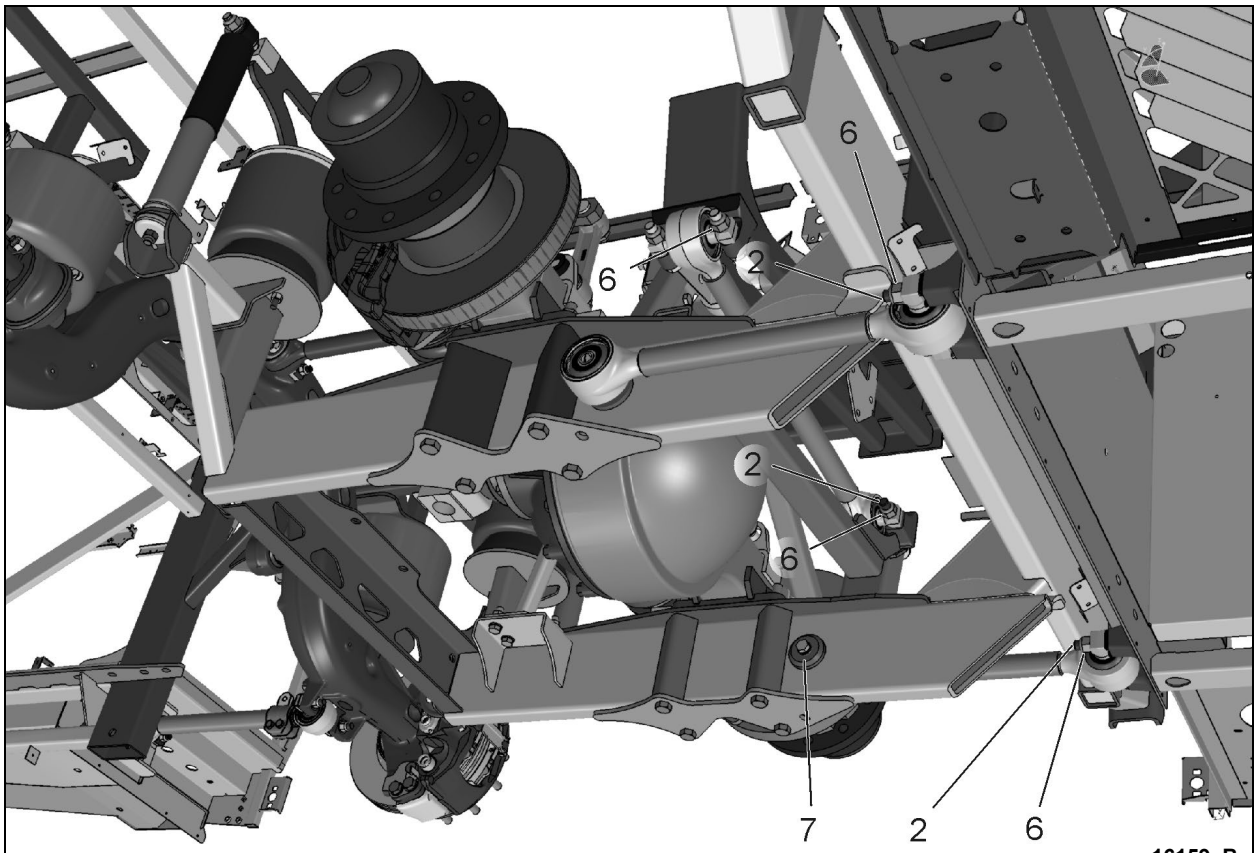
2.4 REAR SUSPENSION



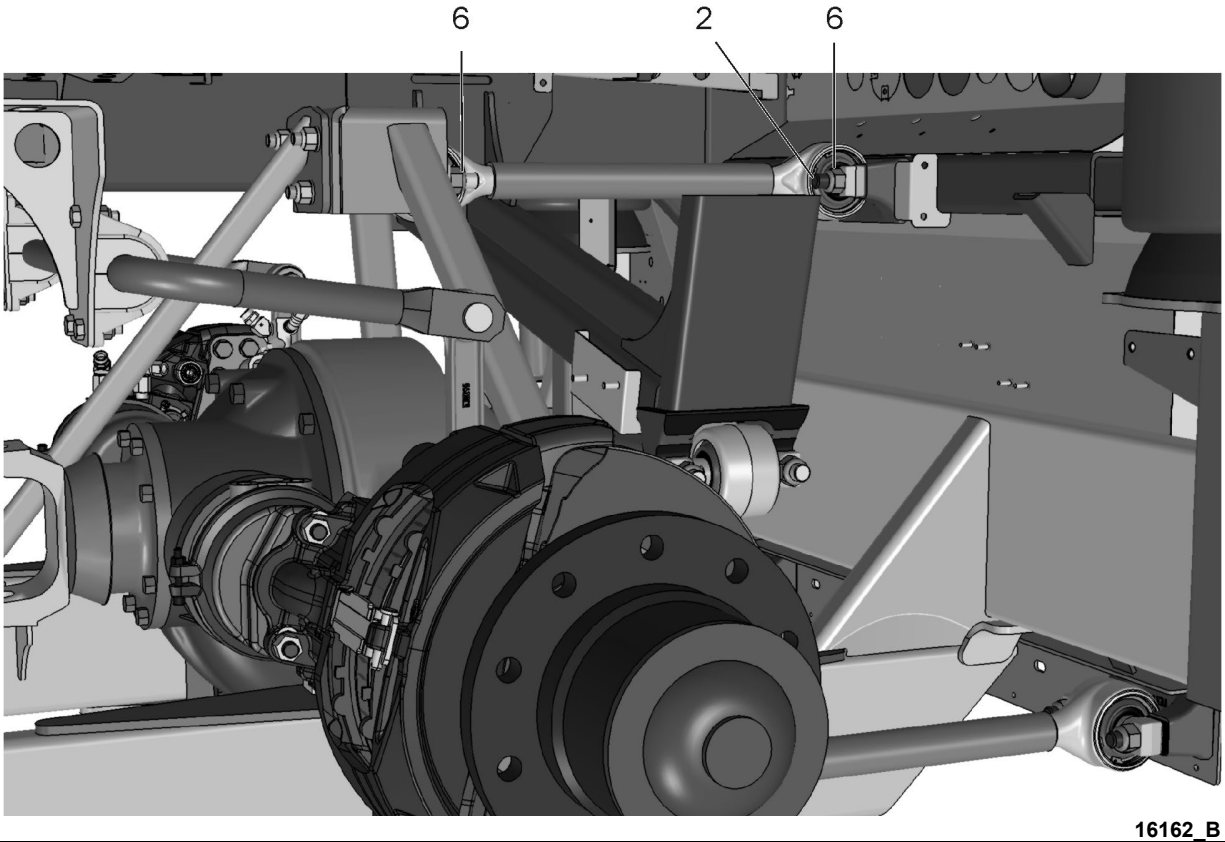
16206: ZF drive axle



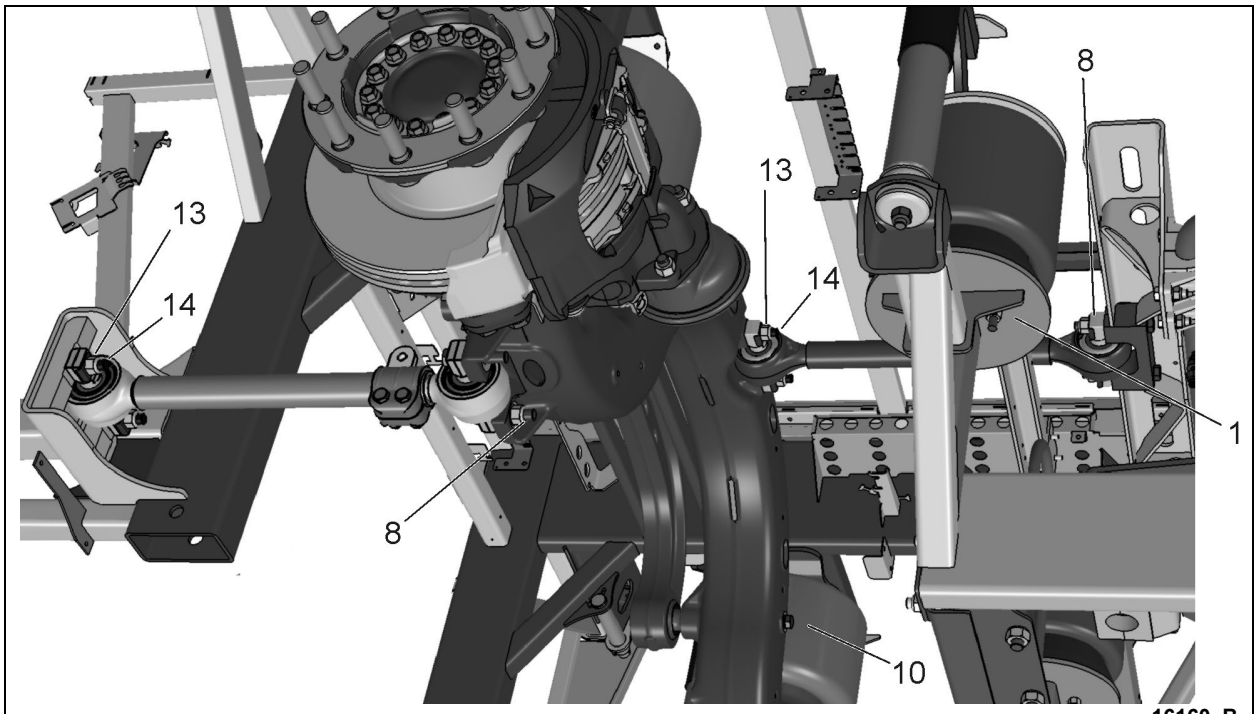
16158_C: Meritor Drive Axle



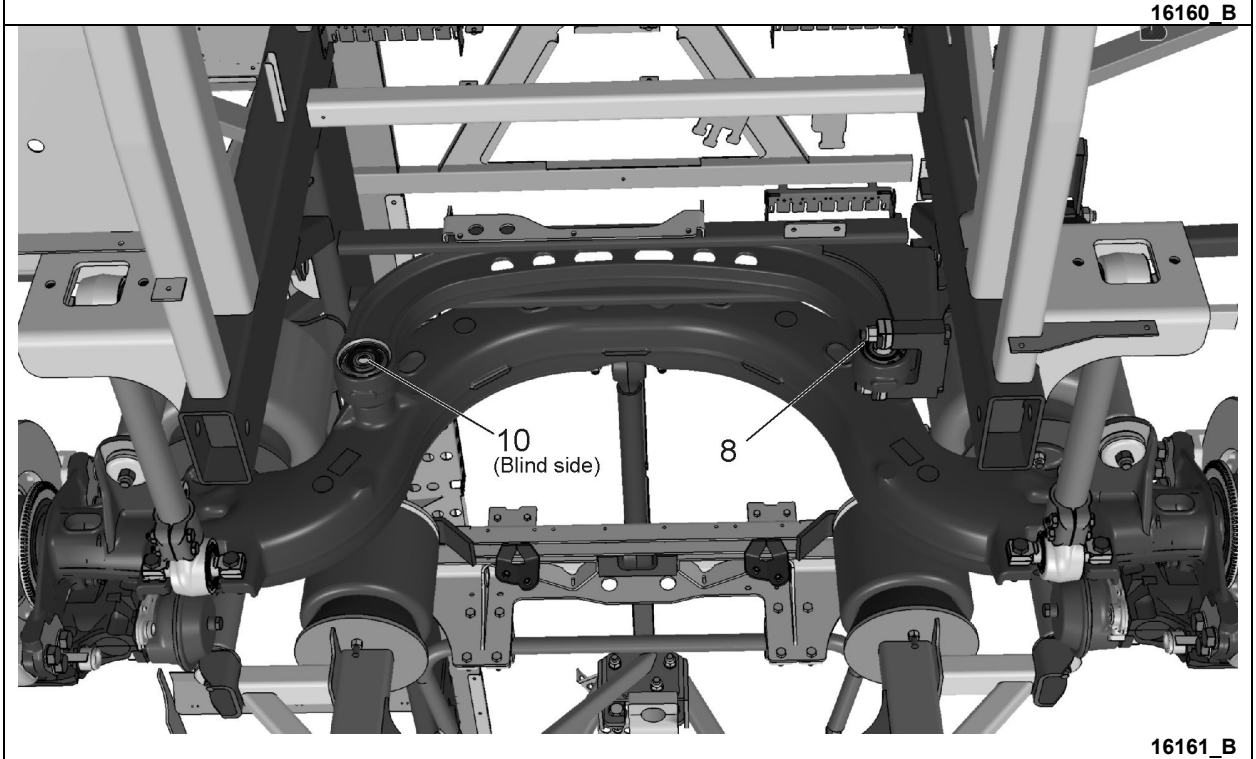
16159_B



16162_B



16160_B



16161_B

REAR SUSPENSION			
No	DESCRIPTION	QTY	TORQUE (dry)
1	Air Spring Upper & Lower Stud Nut	12	31-38 lb-ft (42-52 Nm)
2	Drive & Tag Axle Radius Rod stud	12	90-110 lb-ft (122-149 Nm)
3	Sway Bar Link Upper & Lower Nut	4	99-121 lb-ft (134-164 Nm)

4	Shock Absorber Pin Nut	6	99-121 lb-ft (134-164 Nm)
5	Shock Absorber Pin	6	350-400 lb-ft (475-542 Nm)
6	Drive axle Radius Rod Nut/bolt	6	225-255 lb-ft (305-346 Nm)
7	Drive Axle Longitudinal Radius Rod Retaining Bolt	2	185-227 lb-ft (251-308 Nm)
8	Tag Axle Radius Rod Nut	6	228-252 lb-ft (309-342 Nm)
9	Sway Bar Bushing Collar Bolt	8	80-100 lb-ft (108-136 Nm)
10	Tag Axle Transversal Radius Rod (Casting) Retaining Bolt	1	185-227 lb-ft (251-308 Nm)
11	Sway Bar Link Pin Stud	4	350-400 lb-ft (475-542 Nm)
12	Shock Absorber Lower Nut	6	60-75 lb-ft (81-102 Nm)
13	Tag Axle Radius Rod Nut	6	158-193 lb-ft (214-262 Nm)
14	Tag Axle Radius Rod Stud	6	90-110 lb-ft (122-149 Nm)

NOTE
Apply corrosion-protective compound on exposed threads.

3 DESCRIPTION

The vehicle is provided with an air suspension system. The system consists of air springs, height control valves, radius rods, sway bars, tripod and shock absorbers (Figure 1 to Figure 7). The system operation is fully automatic and maintains a constant vehicle height regardless of load, or load distribution.

The vehicle can also be equipped with systems such as:

- front kneeling + front high-buoy;
- front kneeling + full high-buoy;
- front kneeling + front high-buoy and low-buoy combination.
- front kneeling + full high-buoy and low-buoy combination;

for a description of each of these systems, refer to the appropriate heading in this section.

4 FRONT I-BEAM AXLE SUSPENSION

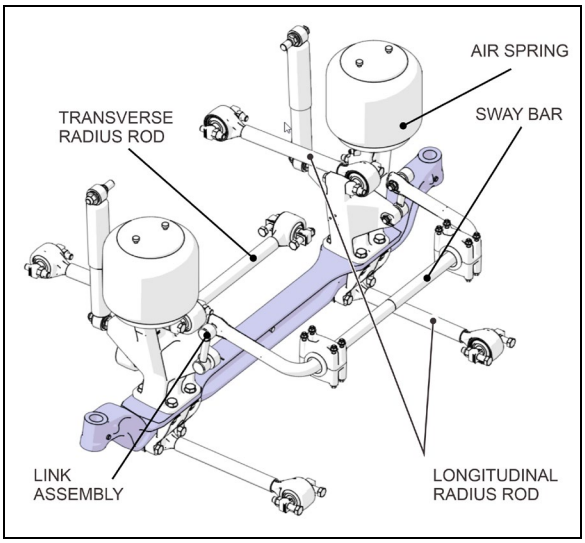


FIGURE 1: FRONT I-BEAM AXLE SUSPENSION

4.1 AIR SPRINGS

The air springs are made from a special compound rubber molded to the proper contour and dimensions. The entire vertical load of the vehicle is supported by these springs. Each of the three axles is provided with air springs that are attached to the subframe and to the axles.

4.1.1 Inspection

1. Check operation of bellows.
2. Visually inspect bellows for evidence of cracks, punctures, deterioration, or chafing. Replace the bellows if any damage is evident.
3. With the primary air system at normal operating pressure (122 - 140 psi (841 - 965 kPa)), coat all suspension air line connections and bellows mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is permissible. Repair or replace defective parts.

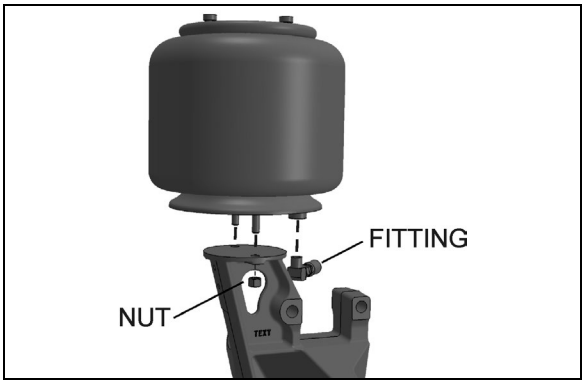


FIGURE 2: AIR SPRING 16052

NOTE

If air spring is removed from vehicle, bellows can be lightly inflated and submerged in water to detect any leakage. If any leakage is detected, replace bellows.

WARNING

To prevent personal injury, do not apply more than 10 psi (69 kPa) of air pressure to the uninstalled air spring.

4.1.2 Removal

NOTE

Front suspension air springs can be removed without removing the entire axle assembly.

1. Safely support vehicle at the recommended body jacking points. To gain access to a given air spring, the corresponding wheel can be removed as follows:

   a) Jack vehicle until the tire clears the ground, and place safety supports underneath body.

CAUTION

Only the recommended jacking points must be used as outlined in Section 18, “Body”.

   b) Support the axle with a suitable hydraulic floor jack at the recommended jacking points. Make sure that the measurement between the air spring mounting plates is greater than the normal clearance (normal ride height).

   c) Remove wheel.

2. Exhaust compressed air from accessory air tank by opening drain cock under reservoir.
3. Disconnect the height control valve link and pull down the control arm to ensure all air is exhausted from air springs.

NOTE

While performing this step, do not change the height control valve control arm adjustment.

4. Disconnect air line from air spring, remove elbow (if applicable), and cover both the line end and fitting to prevent the entry of foreign matter.
5. Unscrew the two air spring lower mounting nuts.
6. Rotate the air spring clockwise (Figure 3) to free the upper attachments from the mounting plate.
7. Remove the air springs.

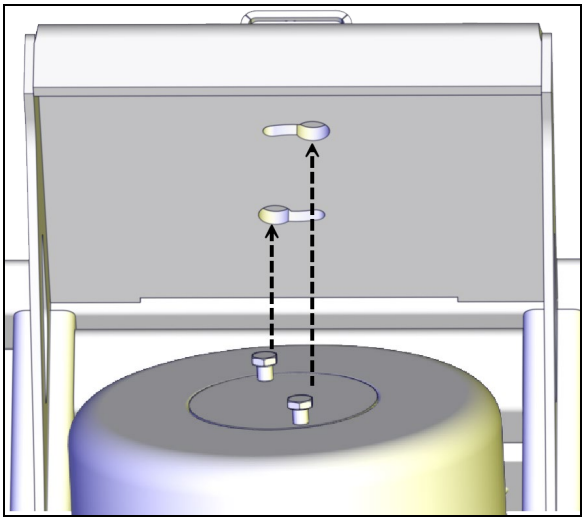


FIGURE 3: AIR SPRING UPPER MOUNTING PLATE

4.1.3 Installation

1. Compress air spring as necessary and position air spring between both the lower and upper mounting plates.
2. Align the upper attachments with holes in the mounting plate. Rotate air spring counterclockwise.
3. Thread the lower nuts a few turns.

NOTE

To facilitate air spring installation, compress it manually then put a piece of tape over the air line threaded fitting. This prevents air from

getting back into the air spring and keeps it compressed, thus enabling to place the air spring in between the mounting plates and greatly easing installation.

4. Tighten and torque the lower stud nuts according to Torque Table under heading Torque Specifications.
5. Install elbow (if applicable), then connect air line.
6. Connect the height control valve link.
7. Build up air pressure in system.

NOTE

To accelerate this operation, air reservoirs can be filled from an exterior air supply connected to the accessory tank fill valve or to the emergency fill valve.

7. Check operation of bellows and with the primary air system at normal operating pressure (122 - 140 psi (841 - 965 kPa)), coat the air line connections and air spring mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is permissible. Repair or replace defective parts.
8. Reinstall wheel.
9. Remove the hydraulic floor jack from under the axle, then lower vehicle to ground.

4.2 SHOCK ABSORBERS

Double-action, telescoping-type shock absorbers ensure a smooth ride and enhance vehicle stability on the road. All shock absorbers are eye-type mountings. The front and tag axles are each provided with two shock absorbers while the drive axle is provided with four of them.

Shock absorbers are non-adjustable and non-repairable. Maintenance requirements involve replacement of the rubber mounting bushings, and tightening of all shock absorber pins according to Torque Table under heading Torque Specifications when shock absorber replacement occurs. If a shock absorber becomes inoperative, complete unit must be replaced.

CAUTION

When a shock absorber is found defective, always replace with a new set on affected axle, except if there has been a recent replacement of one unit. The following method will help in determining if both shock absorbers on the same axle have to be replaced.

4.2.1 Inspection

Loosen lower mounting of both shocks, and then carefully attempt to raise and lower the bottom portion of each shock. Note the rate of effort for distance of travel. Replace both shocks if a definite differential rate is found.

The shock must be bench checked in an upright, vertical position. If checked in any other position, air will enter the cylinder tube and make the shock absorber appear defective.

Proceed as follows to check shock absorbers:

1. With the shock absorber in a vertical position (top end up), clamp the bottom mount in a vise.

CAUTION

Do not clamp the reservoir tube or the dust tube.

2. Rotate the dust tube. Notice any binding condition (may be compared with new unit).

Binding condition indicates a scored rod. Units with scored rods should be replaced.

3. Fully extend shocks and check for leaks in the seal cover area. Shock fluid is a very thin hydraulic fluid that has a characteristic odor and dark brown tint. A slight trace of shock fluid around the seal cover area is not a cause for replacement (Refer to the SACHS document "Guideline to Evaluate Warranty Claims" annexed at the end of this section before replacing a shock). The shock seal is designed to permit a very slight seepage to lubricate the rod. Units that leak should be replaced.
4. Visually check shock for dents that could cause the shock to bind. Also, check for a bent rod.
5. Extend and collapse shock several times to determine that it has control (resistance) in both rebound and compression.
6. Visually inspect the shock mountings and vehicle mounting for:
   a. Broken mounts;
   b. Extreme bushing wear;
   c. Shifted bushing or sleeve;
   d. Deep cracks in bushing material (shallow surface cracks are normal);
   e. Loose shock absorber pins;
   f. Presence of convex washers, and their position relative to the rubber bushing.

4.2.2 Removal

1. Remove nuts and washers from shock absorbers on upper and lower mounting pins, taking care to identify the inner and outer washers to ease reinstallation. Refer to Figure 4 for details.
2. Remove the shock absorber assembly from pins.
3. Remove the two inner bushings from the shock absorber and discard them.

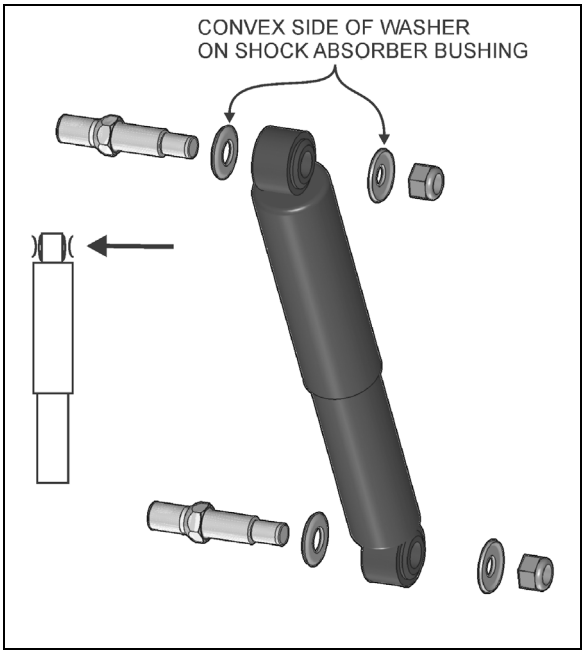


FIGURE 4: SHOCK ABSORBER 16008

4.2.3 Installation

1. Ensure that the shock absorber mounting pins are tight and that the threads are not stripped.
2. Install new rubber mounting bushings on shock absorbers (upper and lower).
3. Place the inner washers (with washer convex side facing the shock absorber rubber bushing) on each shock absorber pin.
4. Install the shock absorber eyes over the mounting pins, then the outer washers (with washer convex side facing the shock absorber rubber bushing) on each shock extremity.

NOTE
If shock absorber pins are removed, they must be reinstalled using "Loctite" (see "Parts Specifications" in this section).

5. Place the lower and upper mounting pin stud nuts and torque according to paragraph 13 Torque Specifications.

4.3 RADIUS RODS

Radius rods are used to secure the axles in the proper transversal and longitudinal positions. Five radius rods are provided on the front I-beam axle suspension (four longitudinal and one transversal). Refer to Figure 1 and Figure 5 for details. These rods transmit both braking and driving forces from the axles to the vehicle body.

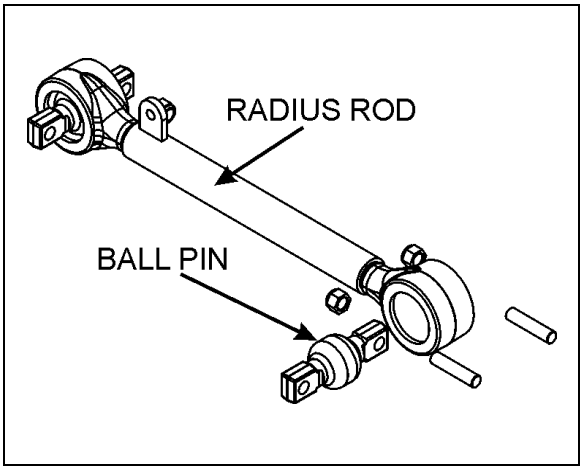


FIGURE 5: TYPICAL RADIUS ROD SETUP 16010

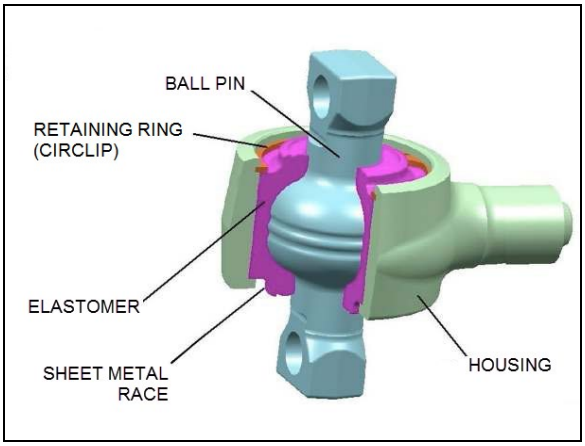


FIGURE 6: BALL PIN JOINT CONSTRUCTION 16186

4.3.1 Inspection

1. Clean all parts thoroughly.
2. Inspect radius rods for distortion and cracks. We recommend the “Magnaflux” process to detect cracks in the radius rod. Any damaged part should be replaced with a new one.

NOTE
New bushings should be used when rods are replaced.

3. The radius rod bushings should be checked periodically for signs of shearing, deterioration, or damage. Any defective part should be replaced.

Take off the load from the ball joint by lifting the vehicle. Apply a load on the joint in all six degrees of freedom (axial, radial, etc) with a suitable lever bar. After the load is taken off, the joint has to spring back into its starting position. Free play is not acceptable.

Separation of rubber from ball pin or sheet metal race is permissible up to a third of the circumference.

When the following characteristics are noted, the joint must be replaced:

- Free play between ball pin and housing;
- Radial cracking of the external sheet-metal race (Figure 6)
- Any crack or fracture of a metal part
- Permanent deformation of the sheet metal race
- Loosened bolt
- Broken bolt
- Loss of bolt
- Circlip (retaining ring) detached from groove
- Broken Circlip
- Loss of Circlip
- Incipient crack

If damage to the inner housing contour or the Circlip groove is found during replacement of the molecular bearing, the entire radius rod must be replaced.

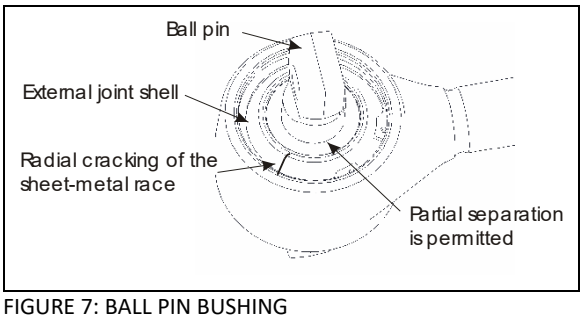


FIGURE 7: BALL PIN BUSHING

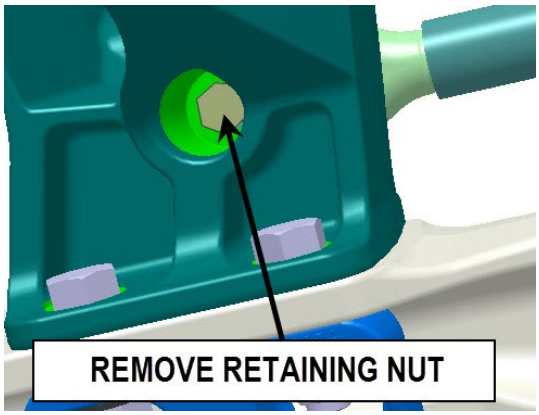
4.3.2 Radius Rod Removal

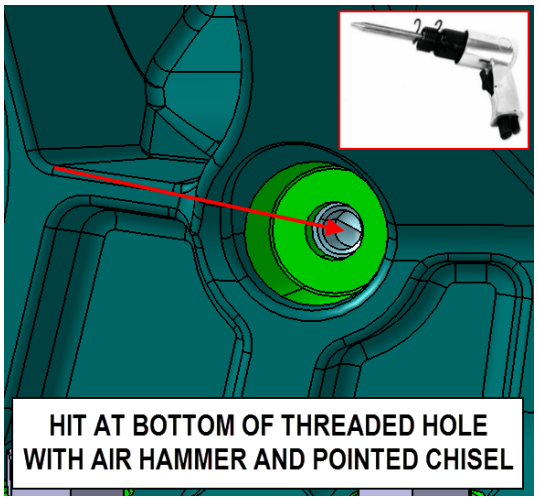
1. Unscrew the nuts (or bolts) at each extremity of the radius rod.

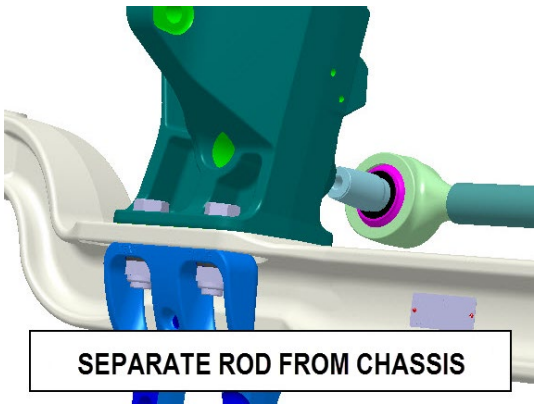
2. Remove the radius rod.

NOTE

One end of the transversal radius rod is fitted with a conical (taper) pin that will require the use of an air hammer and a pointed 13mm (1/2inch) diameter chisel to remove it from the chassis (after the retaining nut is removed from the rod end). ***Care must be taken not to damage the rod pin threads.***







CAUTION

Do not hit the cast parts of the chassis to disengage taper radius rods; this could lead to cracking and/or deformations of the cast parts.

4.3.3 Stripping Down

Strip down the defective joint by removing the Circlip, and ball pin/bushing assembly.

Clean out housing bore and Circlip groove.

4.3.4 Radius Rod Assembly

The assembly work may be done only by a recognized specialized workshop. Ensure that old and new parts do not get mixed up with each other. For this reason, all the old parts are to be scrapped immediately after a joint has been stripped down.

A complete repair set must be used for each joint repaired, i.e. use of only part of a repair set is not permissible.

Execute assembly of the new joint parts in the following sequence:

1. Complete lubrication of the contact surface between housing bore and ball pin elastomer through application of grease.

NOTE

Apply the supplied grease, only if you are using a repair kit.

2. Insert ball pin/bushing, assembly. Ensure that the bolt bores are in the correct position in relation to the axis of the tube.
3. Place joint in receiving fixture and mount annular assembly tool on the housing. Then

locate Circlip in the housing using axial load with the aid of the assembly matrix.

4. Opening of the Circlip is located at 45° to the housing shaft axis. Make sure that the Circlip is perfectly engaged in the housing.

4.3.5 Radius Rod Installation

1. Snug up the nuts (or bolts) and repeat at the other end.
2. Refer to heading *"Suspension Height Adjustment"* later in this section, and set the vehicle to normal ride height.
3. With the vehicle at normal ride height, tighten all radius rod anchor pin nuts or bolts as prescribed in Torque Table 1.

CAUTION

It is extremely important upon reconnection of the rods that the proper clearance height between the axle and body be maintained. Otherwise, the rubber bushings in radius rod ends will become preloaded, thus reducing their life span.

4.4 SWAY BAR

A sway bar is connected to the front axle to increase vehicle stability. It controls lateral motion.

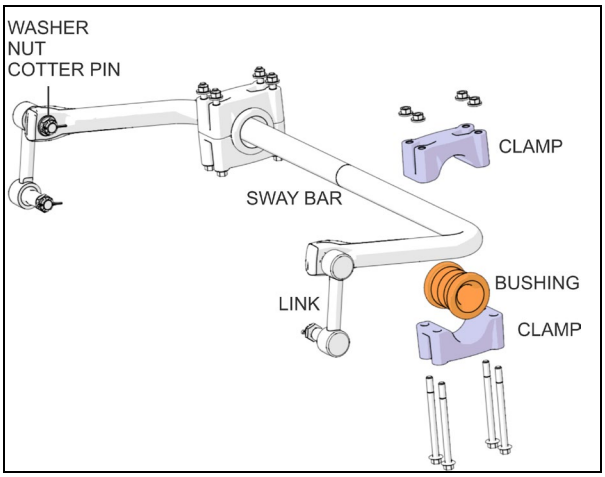


FIGURE 8: SWAY BAR 16028_3

4.4.1 Removal

1. Disconnect the two links from sway bar.
2. Safely support the sway bar. Unbolt the clamps from the subframe.
3. Remove the sway bar.
4. Remove and replace the split bushings if applicable.
5. Apply a thin layer of grease on the sway bar where the split bushings are to be positioned.
6. Make sure the split bushings are installed and oriented as shown in the pictures below.

Important: Respect the orientation of the flat on the split bushing in relation with the clamp halves (Figure 9).

The arrow on the split bushing must be aligned with the joint of the two clamp halves (Figure 10).

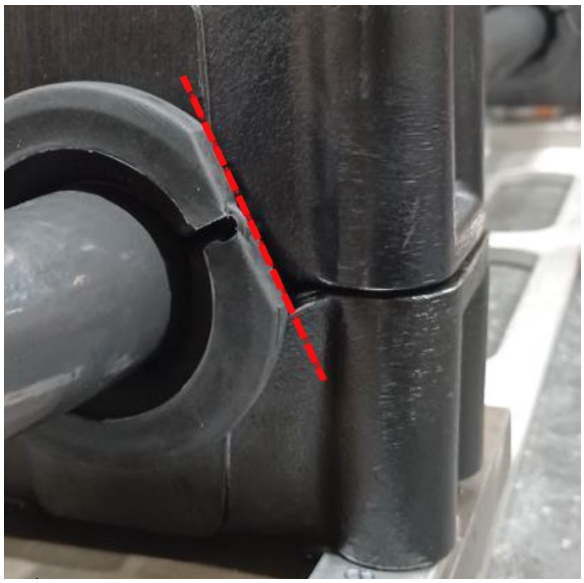


FIGURE 9: RESPECT THE ORIENTATION OF THE FLAT ON THE SPLIT BUSHING IN RELATION WITH THE CLAMP HALVES

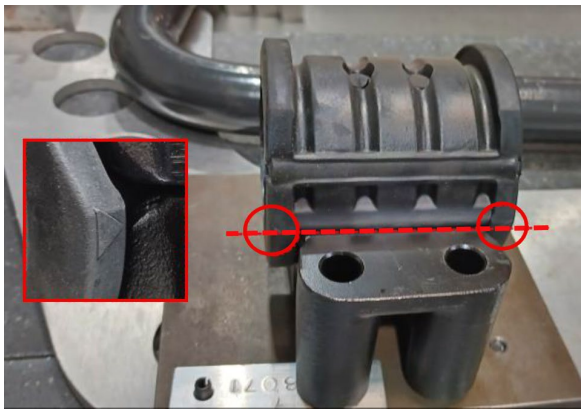


FIGURE 10: THE ARROW ON THE SPLIT BUSHING MUST BE ALIGNED WITH THE JOINT OF THE TWO CLAMP HALVES

NOTE
Sway bar bushings are slit to ease their removal.

4.4.2 Installation

1. Loosely install the sway bar.
2. Tighten the eight clamps nuts according to specifications.
3. Tighten sway bar link upper nuts and lower nuts according to specifications & install a cotter pin on each nut.

5 INDEPENDENT FRONT SUSPENSION (IFS) – PREVIOUS DESIGN

This section contains information and specifications unique to the independent front suspension (IFS).

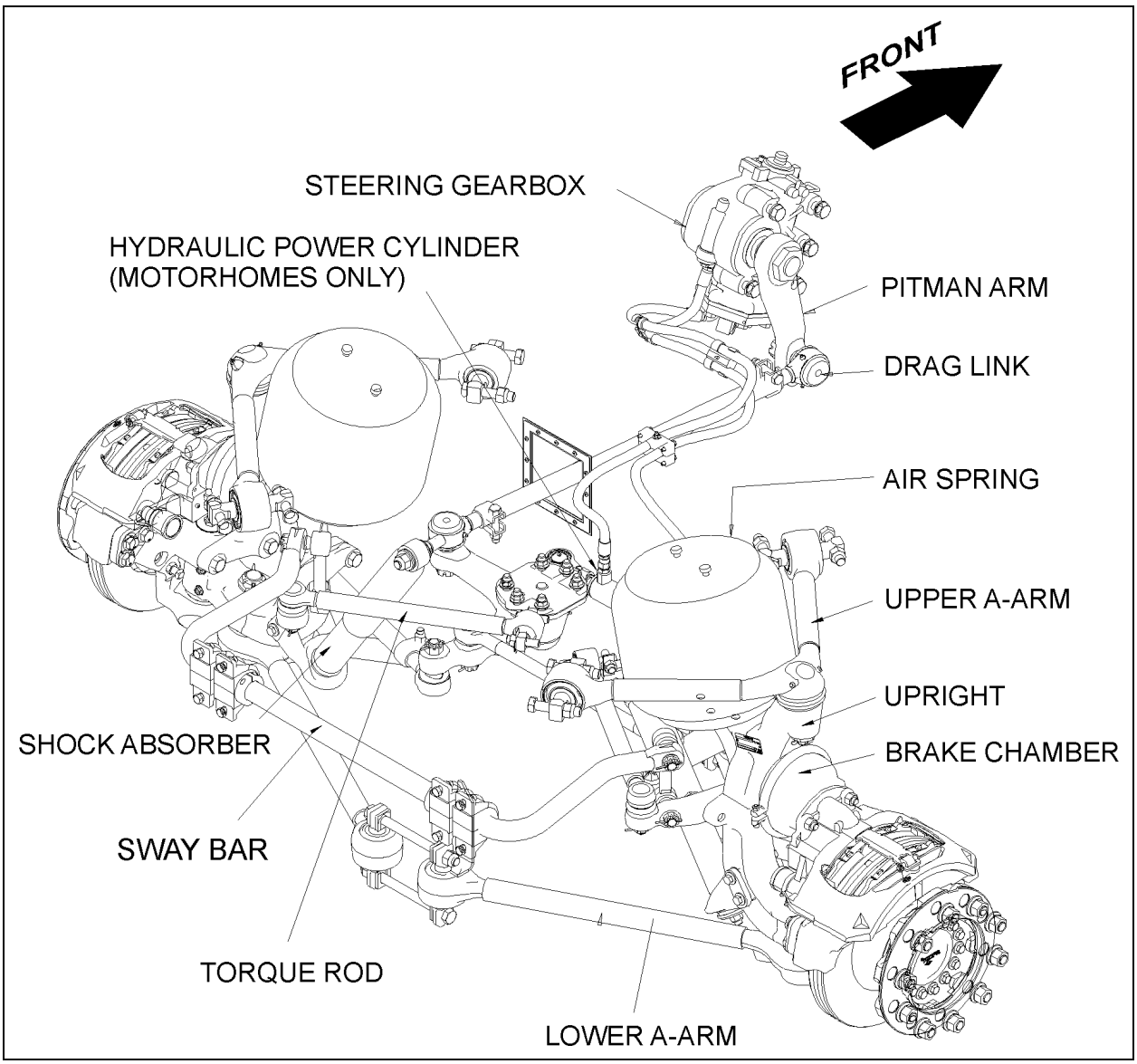


FIGURE 11: INDEPENDENT FRONT SUSPENSION 16124

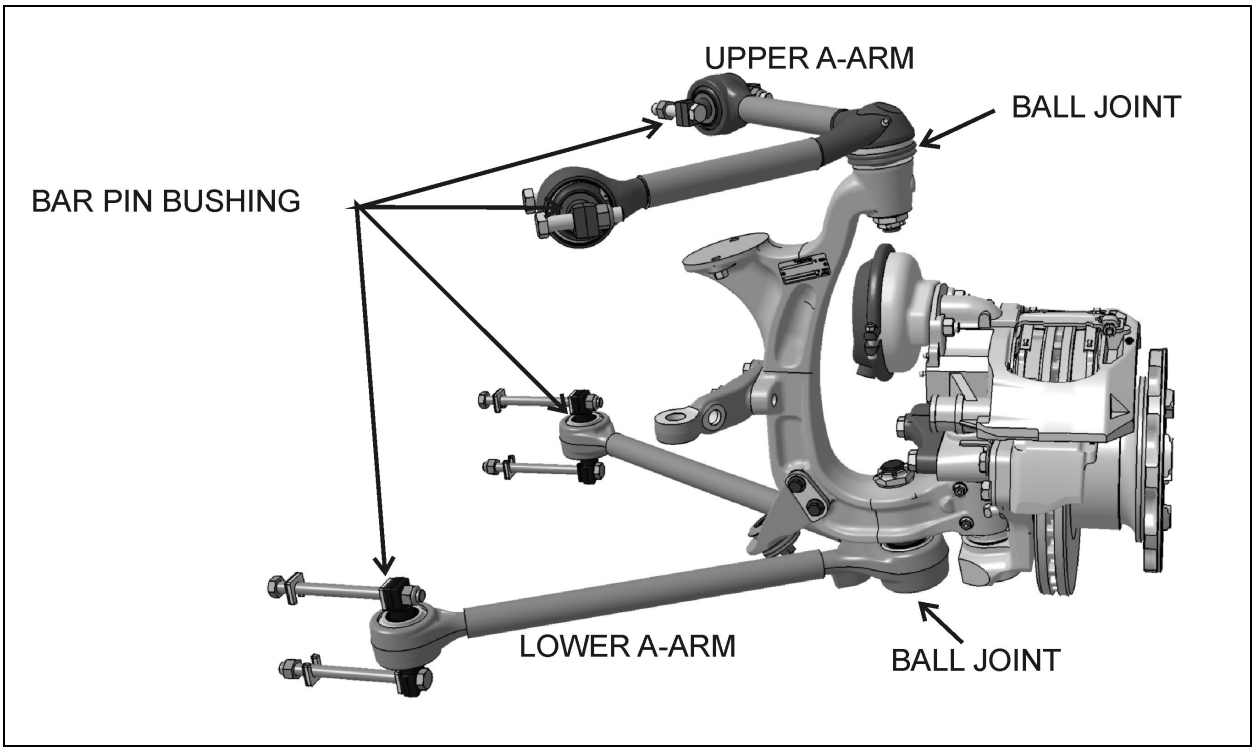


FIGURE 12: A-ARM JOINT IDENTIFICATION

5.1 LOWER AND UPPER A-ARM BALL PIN BUSHING REPAIR

The assembly work may be done only by a recognized specialized workshop. Ensure that old and new parts do not get mixed up with each other. For this reason, all the old parts are to be scrapped immediately after a joint has been stripped down. A complete repair set must be used for each joint repaired, i.e. use of only part of a repair set is not permissible.

5.1.1 Inspection

Take off the load from the joint by lifting the front of the vehicle. Apply a load on the joint in all six degrees of freedom (axial, radial, etc) with a suitable lever bar. After the load is taken off, the joint has to spring back into its starting position. Free play is not acceptable.

Separation of rubber from ball pin or external joint shell is in accordance with "normal wear characteristics".

When the following characteristics are noted, the joint is to be changed:

-Free play;

-Radial cracking of the external sheet-metal race.

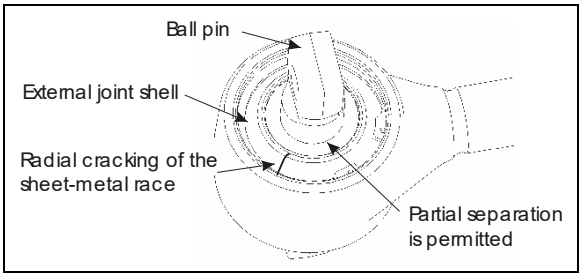
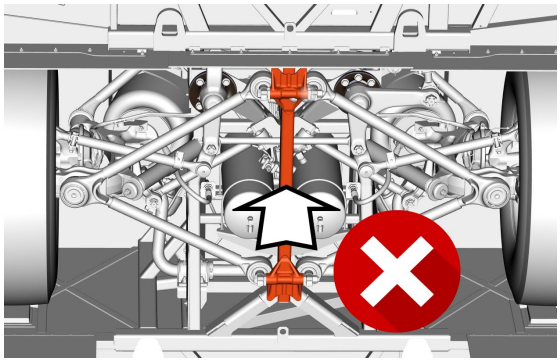


FIGURE 13: BALL PIN BUSHING

CAUTION

NEVER USE THE CENTRAL BEAM AS LIFTING POINT ON THE INDEPENDENT SUSPENSION



5.1.2 Stripping Down

Strip down the defective joint through removal of retaining ring, annular spacer and ball pin bushing assembly and thereafter clean out housing bore and locking circlips groove.

5.1.3 Assembly

Execute assembly of the new joint parts in the following sequence:

1. Complete lubrication of the contact surface between housing bore and ball pin bushing through application of the grease.

NOTE
Apply grease, only in the case of repair kit (Prevost # 611114)).

2. Insert ball pin bushing assembly. In case of the two-bolt type, ensure that the bolt bores are in the correct position in relation to the axis of the tube.
3. Place joint in receiving fixture and mount annular assembly tool on the housing. Position annular spacer and retaining ring in the housing using axial load of the assembly matrix. If the ends of the annular spacer are not in contact with each other, the opening must be located 180° from the opening of the retaining ring. Pay attention during assembly to ensure that the retaining ring eyelets are located on both sides of the housing shaft axis (retaining ring eyelet lug points to tube), and that retaining ring is properly engaged in the groove of the housing.
4. When repairing defective ball pin assemblies, the necked down-bolt must regularly be replaced with a new one.

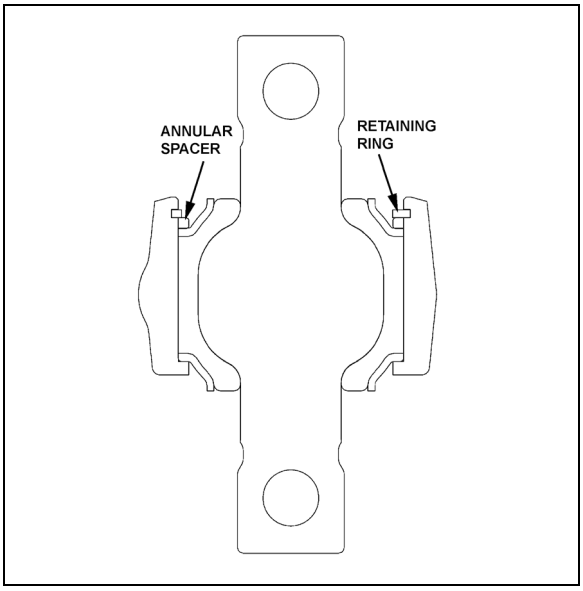


FIGURE 14: LOWER A-ARM BALL PIN BUSHING 16047

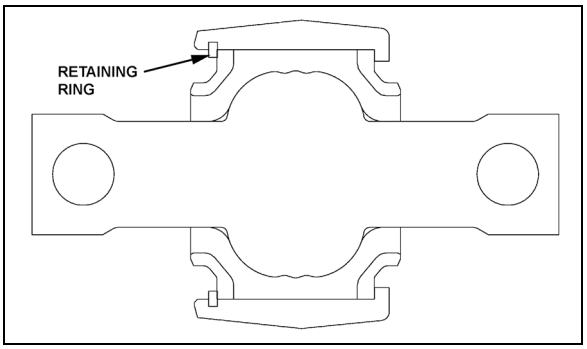


FIGURE 15: UPPER A-ARM BALL PIN BUSHING

5.2 LOWER A-ARM BALL JOINT REPAIR

Take off the load from the ball joint by lifting the front of the vehicle. Apply a load on the joint in all six degrees of freedom (axial, radial, etc) with a suitable lever bar. After the load is taken off, the joint has to spring back into its starting position. Free play is not acceptable.

Separation of rubber from ball pin or external joint bushing shell is in accordance with "normal wear characteristics".

When the following characteristics are noted, the joint is to be changed:

- Free play;

- Radial cracking of the external bushing shell.

5.2.1 Stripping Down

Strip down the defective joint through removal of retaining ring, annular spacer and ball pin/bushing, assembly and thereafter clean out housing bore and locking circlips groove

5.2.2 Assembly

Assemble the new component parts of the joint in the following sequence:

1. Complete moistening of the contact surface between housing bore and ball pin through application of the grease.
2. Place joint in receiving fixture and mount annular assembly tool on the housing. Position annular spacer and retaining ring in the housing using axial load of the assembly matrix. If the ends of the annular spacer are not in contact with each other, the opening must be located 180° from the opening of the retaining ring. Pay attention during assembly to ensure that the retaining ring eyelets are located on both sides of the housing shaft axis (retaining ring eyelet lug points to tube), and that retaining ring is properly engaged in the groove of the housing.

3. Properly apply grease by mechanical means to the complete bracket-outer core and entire ball-inner cone. Insert bracket outer cone in fixture with distance ring and then use press tool to apply pressure to press mount with ball-inner cone.

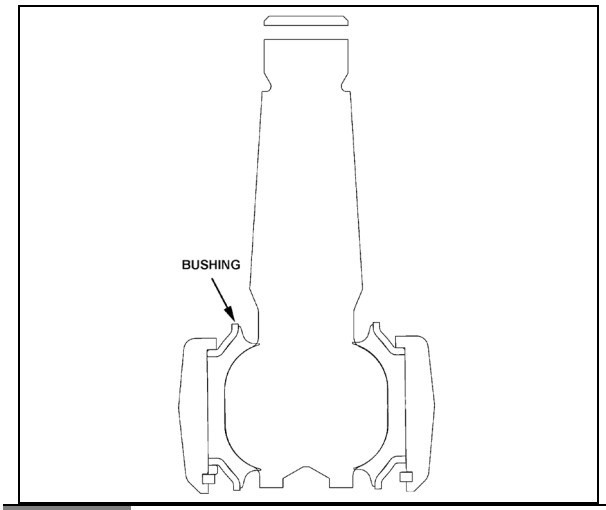


FIGURE 16: LOWER A-ARM BALL JOINT

5.3 UPPER A-ARM BALL JOINT

5.3.1 Visual Inspection

Check the condition of the sealing boot, in particular:

Check if the retainer ring, which secures the sealing boot at the conical section of the ball stud, is still present.

Check if grease is present on the external surface of the sealing boots. Escaped fluid and accumulations of grease on the sealing boot may be the result of the sealing boot's rupturing. In this case, the ball joint must be systematically replaced.

5.3.2 Play Measurement

1. Raise the vehicle and support through axle jacking points.

2. Using a caliper, measure dimension “A” on Figure 17.

3. With a lever tool, exert sufficient force under the upper A-arm as to separate the upper A-arm from the upright in order to have the ball joint to its maximum extent. Measure dimension A again. If the difference between the two dimensions is greater than 0.060" (1.5mm), then the ball joint should be replaced.

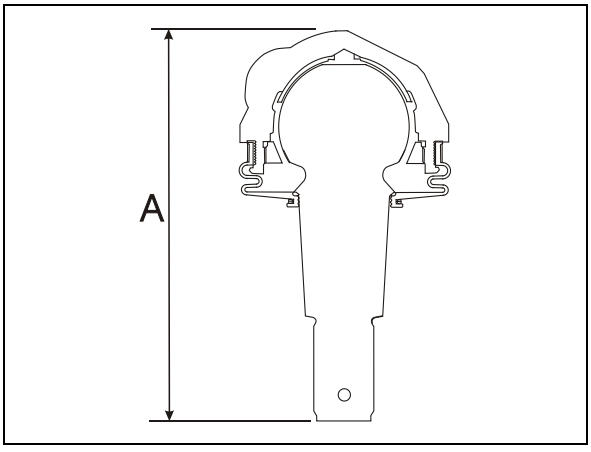


FIGURE 17: UPPER A-ARM BALL JOINT 16116

5.4 FRONT AIR SPRINGS

Two *"rolling lobe"* type air springs are used with the independent front suspension, one at each wheel. These air springs are special and use the complete piston as an extra reservoir to lower the spring stiffness. Front air springs are attached to the subframe and to uprights.

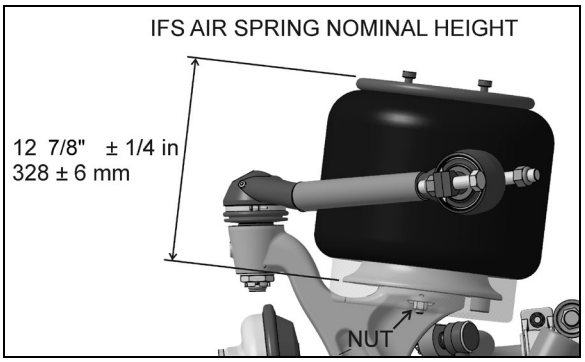


FIGURE 18: AIR SPRINGS 16052

5.4.1 Inspection

1. Check operation of air springs.
2. Visually inspect bellows for evidence of cracks, punctures, deterioration, or chafing. Replace the air spring if damage is evident.
3. With the primary air system at normal operating pressure (122 - 140 psi (841 - 965 kPa)), coat all suspension air line connections and bellows mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is permissible. Repair or replace defective parts.

NOTE

If air spring is removed from vehicle, bellows can be lightly inflated and submerged in water to detect any leakage. If leakage is detected, replace air spring.

WARNING

To prevent personal injury, do not apply more than 10 psi (69 kPa) air pressure to the dismounted air spring.

5.4.2 Removal

NOTE

Front air springs can be removed without removing the entire suspension assembly.

1. Jack up the vehicle using the axles jacking points.
2. Safely support the front of the vehicle at the recommended body jacking points.
3. To gain access to a given air spring, the corresponding wheel can be removed.

CAUTION

Only the recommended jacking points must be used as outlined in Section 18, "Body" in the maintenance manual.

CAUTION

Always adequately support the IFS assembly when lifting up the vehicle to avoid maximum extension of shock absorber.

4. Exhaust compressed air from accessory air tank by opening drain cock under reservoir.
5. Disconnect the height control valve link and pull down the control arm to ensure all air is exhausted from air springs.
6. Lower the IFS slightly while maintaining the vehicle body at the same level.

NOTE

While performing this step, do not change the height control valve control arm adjustment.

7. Disconnect air line from air spring, remove elbow (if applicable), and cover both the line end and fitting to prevent the entry of foreign matter.
8. Unscrew the two air spring lower nuts (2 nuts). Rotate the air spring to disengage the upper mounting and remove the air spring.

5.4.3 Installation

NOTE

To facilitate air spring installation, compress it manually then put a piece of tape over the air line threaded fitting. This prevents air from getting back into the bag and keeps it compressed, thus enabling to place the bag in between the mounting plates and greatly easing installation.

1. Compress air spring as necessary, then aligning studs with their holes, position air spring between both the lower and upper supports. Thread the lower nuts a few turns.
2. Tighten and torque the lower stud nuts as prescribed in Torque Table 2.
3. Install elbow (if applicable), then connect air line.
4. Connect the height control valve link.
5. Build up air pressure in system.

NOTE
To accelerate this operation, air reservoirs can be filled from an exterior air supply connected to the accessory tank fill valve or to the emergency fill valve.

6. Check operation of air springs and with the primary air system at normal operating pressure(122 - 140 psi (841 - 965 kPa)), coat the air line connections and air spring mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is permissible. Repair or replace defective parts.

5.5 SHOCK ABSORBERS

The two front shock absorbers are double-acting and telescopic type. Shock absorbers ensure a smooth ride and enhance vehicle stability on the road. Front shock absorbers have eye-type mountings on the upper side and bayonet type on lower side. Shock absorbers are non-adjustable and non-repairable.

CAUTION
When a shock absorber is found defective, always replace with a new set on affected axle, except if there has been a recent replacement of one unit. The following method will help in determining if both shock absorbers on the same axle have to be replaced. (Refer to the SACHS document “Guideline To Evaluate Warranty Claims” annexed at the end of this section before replacing a shock).

5.5.1 Shock Absorber Removal

1. Remove the nut, washer and rubber joint from shock absorber mounting stud. Discard the rubber joints.

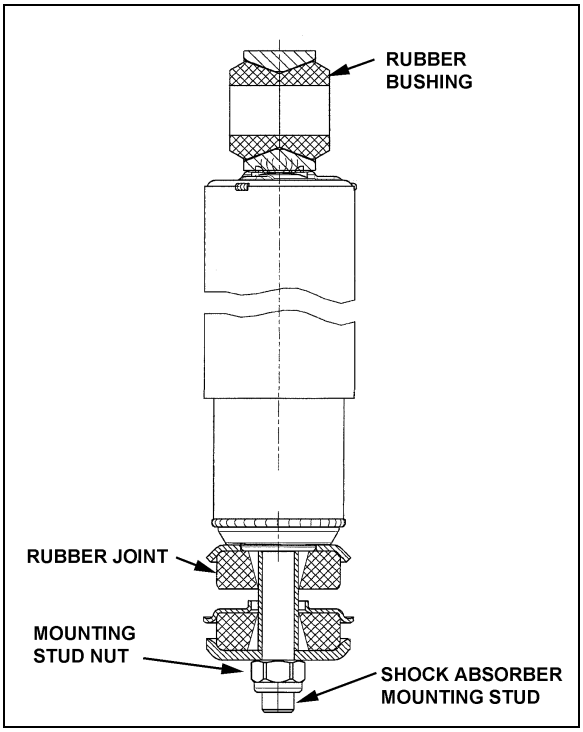


FIGURE 19: SHOCK ABSORBER 16112

2. Remove the nut and washer from shock absorber mounting pin (upper side), taking care to identify the inner and outer washers to ease reinstallation.
3. Remove the shock absorber from the vehicle.
4. Remove inner: washers, rubber joint and bushings from the shock absorber. Discard bushings and rubber joint.

5.5.2 Shock Absorber Installation

1. Check that the shock absorber mounting pin is tightened as prescribed in Torque Table 2. Ensure that the pin is clean and not stripped (upper end).
2. Install new rubber (mounting) bushing on shock absorber (upper end).
3. Place the inner washer on shock absorber stud.

4. On the lower mounting, take care to install the rubber joints with the wide end of the tapered hole as shown in Figure 20.

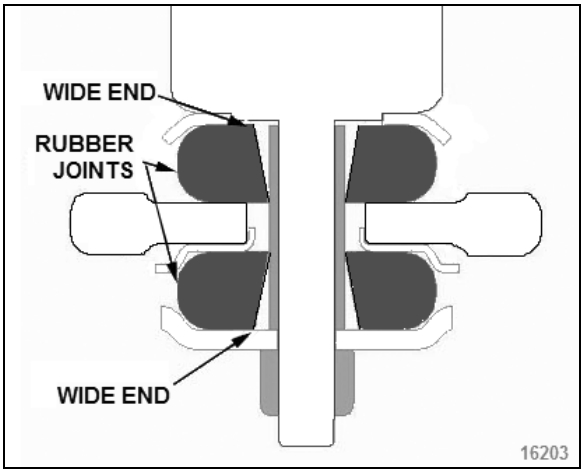


FIGURE 20: LOWER SHOCK MOUNTING BUSHINGS

5. Install the shock absorber as shown in Figure 19 with the mounting stud protruding through the hole in the mounting bracket and the shock absorber eyes over the mounting pins. Install the outer washer.
6. Place a rubber joint and washer on the shock absorber mounting stud. Place the lower shock absorber mounting stud nut and torque as prescribed in Torque Table 2.
7. Place the upper mounting pin stud nut and torque as prescribed in Torque Table 2.

5.6 SWAY BAR

A sway bar is provided on front and rear suspension to increase vehicle stability. It controls lateral motion (swaying movement) of vehicle.

5.6.1 Removal

1. Disconnect the two links from sway bar.
2. Safely support the sway bar. Unbolt bushing collars from subframe.
3. Remove sway bar.

NOTE
Sway bar bushings are slit to ease their removal.

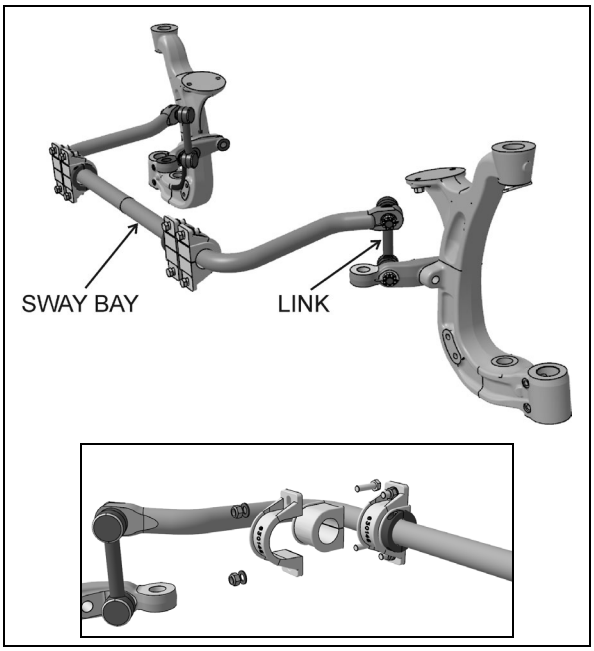


FIGURE 21: SWAY BAR (INDEPENDENT FRONT SUSPENSION)

5.6.2 Installation

1. Loosely install the sway bar.
2. Torque bushing collar nuts as prescribed in Torque Table.
3. Torque sway bar link nuts as prescribed in Torque Table.

6 INDEPENDENT FRONT SUSPENSION (IFS) - NEW DESIGN

This section contains information and specifications unique to the new independent front suspension (IFS) design.

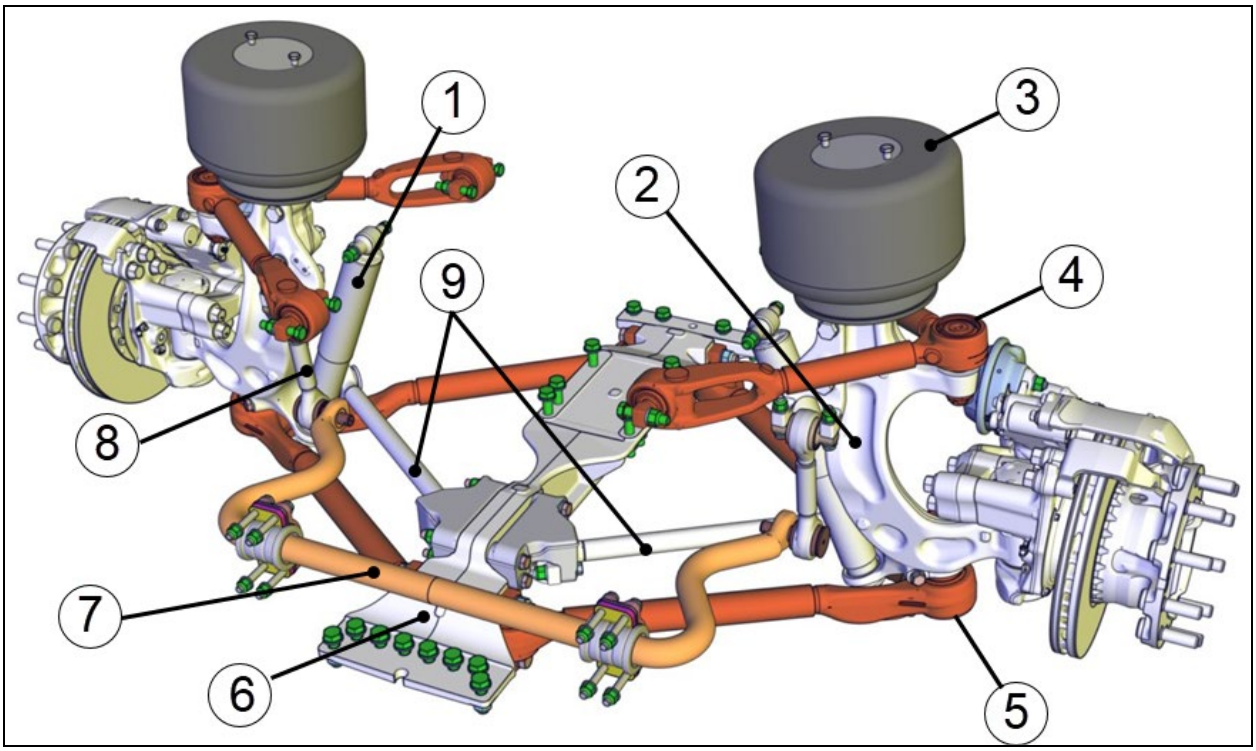


FIGURE 22: INDEPENDENT FRONT SUSPENSION

1. Shock absorber
2. Upright
3. Air spring
4. Upper control arm
5. Lower control arm
6. Backbone
7. Sway bar
8. Sway bar link
9. Reaction rod

6.1 LOWER AND UPPER CONTROL ARM BUSHING & BALL JOINT REPAIR

The assembly work may be done only by a recognized specialized workshop. Ensure that old and new parts do not get mixed up with each other. For this reason, all the old parts are to be scrapped immediately after a joint has been stripped down. A complete repair set must be used for each joint repaired, i.e. use of only one part of a repair set is not permissible.

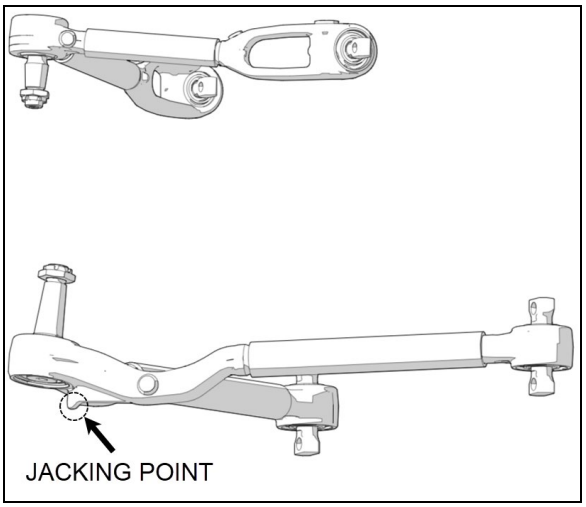
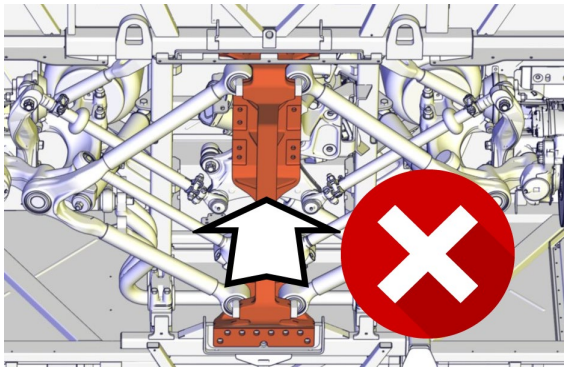


FIGURE 23: UPPER & LOWER CONTROL ARMS

CAUTION

NEVER USE THE BACKBONE AS LIFTING POINT



6.1.1 Inspection

Take off the load from the joint by lifting the front of the vehicle. Apply a load on the joint in all six degrees of freedom (axial, radial, etc) with a suitable lever bar. After the load is taken off, the joint has to spring back into its starting position. Free play is not acceptable.

Separation of rubber from ball pin or external joint shell is in accordance with "normal wear characteristics".

When the following characteristics are noted, the joint is to be changed:

-Free play;

-Radial cracking of the external sheet-metal race.

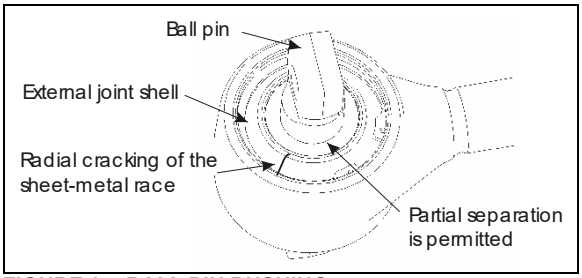


FIGURE 24: BALL PIN BUSHING

6.1.2 Bushing & Ball Joint Stripping Down

Strip down the defective joint through removal of retaining ring, annular spacer (when applicable) and ball pin bushing assembly and thereafter clean out housing bore and locking circlips groove.

6.1.3 Assembly

Execute assembly of the new joint parts in the following sequence:

1. Complete lubrication of the contact surface between housing bore and ball pin bushing through application of the grease.

2. Insert ball pin bushing assembly. In case of the two-bolt type, ensure that the bolt bores are in the correct position in relation to the axis of the tube.

3. Place joint in receiving fixture and mount annular assembly tool on the housing. Position annular spacer and retaining ring in the housing using axial load of the assembly matrix. If the ends of the annular spacer are not in contact with each other, the opening must be located 180° from the opening of the retaining ring. Position retaining ring in the housing using axial load of the assembly matrix. Pay attention during assembly to

ensure that the retaining ring eyelets are located on both sides of the housing shaft axis (retaining ring eyelet lug points to tube), and that retaining ring is properly engaged in the groove of the housing.

4. When repairing defective ball pin assemblies, the necked down-bolt must regularly be replaced with a new one.

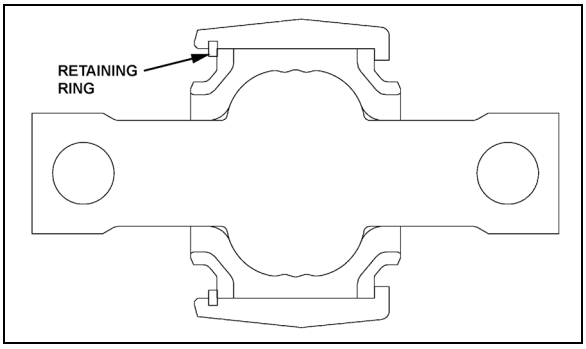


FIGURE 25: BUSHING

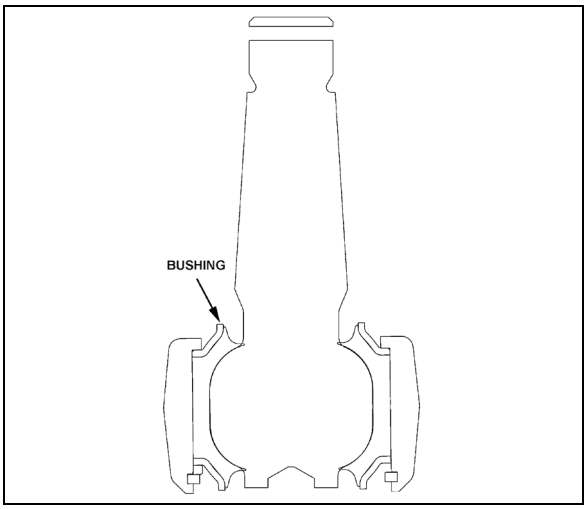


FIGURE 26: BUSHING

6.2 FRONT AIR SPRINGS

Two *"rolling lobe"* type air springs are used with the independent front suspension, one at each wheel. Front air springs are attached between the subframe and the uprights.

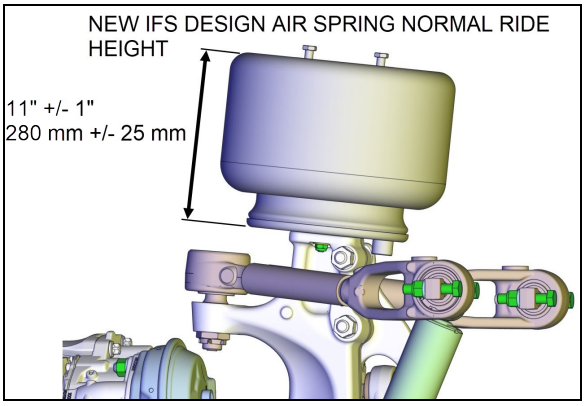


FIGURE 27: AIR SPRINGS

6.2.1 Inspection

1. Check operation of air springs.
2. Visually inspect bellows for evidence of cracks, punctures, deterioration, or chafing. Replace the air spring if material damage is evident.
3. With the primary air system at normal operating pressure (122 - 140 psi (841 - 965 kPa)), coat all suspension air line connections and bellows mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is permissible. Repair or replace defective parts.

NOTE
If air spring is removed from vehicle, bellows can be lightly inflated and submerged in water to detect any leakage. If leakage is detected, replace air spring.

WARNING
To prevent personal injury, do not apply more than 10 psi (69 kPa) air pressure to the dismounted air spring.

6.2.2 Removal

NOTE
Front air springs can be removed without removing the entire suspension assembly.

1. Safely support the front of the vehicle at the recommended body jacking points.
2. In addition, support the IFS at the lower control arms jacking points.

3. To gain access to a given air spring, the corresponding wheel can be removed.

CAUTION

Only the recommended jacking points must be used.

CAUTION

Always adequately support the IFS assembly when lifting up the vehicle to avoid maximum extension of shock absorber.

4. Exhaust compressed air from accessory air tank by opening drain cock under reservoir.
5. Disconnect the height control valve link and pull down the control arm to ensure all air is exhausted from air springs.
6. Lower the IFS slightly while maintaining the vehicle body at the same level.

NOTE

While performing this step, do not change the height control valve control arm adjustment.

7. Disconnect air line from air spring, remove elbow (if applicable), and cover both the line end and fitting to prevent the entry of foreign matter.
8. Unscrew the two air spring lower nuts (2 nuts). Rotate the air spring to disengage the upper mounting and remove the air spring.

6.2.3 Installation

NOTE

To facilitate air spring installation, compress it manually then put a piece of tape over the air line threaded fitting. This prevents air from getting back into the bag and keeps it compressed, thus enabling to place the bag in between the mounting plates and greatly easing installation.

1. Compress air spring as necessary, then aligning studs with their holes, position air spring between both the lower and upper supports. Thread the lower nuts a few turns.

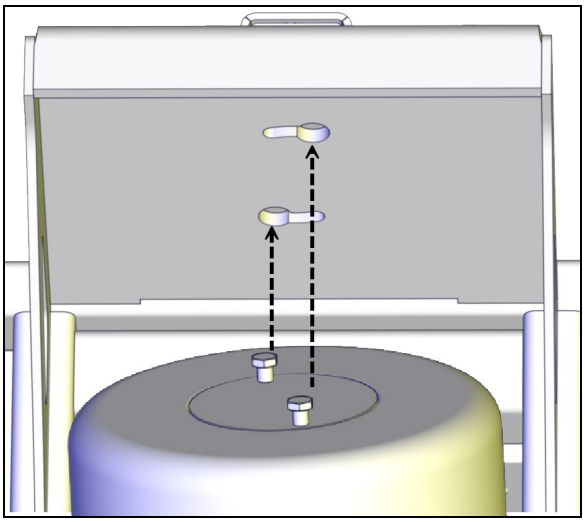


FIGURE 28

2. Tighten and torque the lower stud nuts to recommended torque.
3. Install elbow (if applicable), then connect air line.
4. Connect the height control valve link.
5. Build up air pressure in system.

NOTE

To accelerate this operation, air reservoirs can be filled from an exterior air supply connected to the accessory tank fill valve or to the emergency fill valve.

6. Check operation of air springs and with the primary air system at normal operating pressure (122 - 140 psi (841 - 965 kPa)), coat the air line connections and air spring mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is permissible. Repair or replace defective parts.

6.3 SHOCK ABSORBERS

The two front shock absorbers are double-acting and telescopic type. Shock absorbers ensure a smooth ride and enhance vehicle stability on the road. Front shock absorbers have eye-type mountings on the upper side and bayonet type on lower side. Shock absorbers are non-adjustable and non-repairable.

6.3.1 Shock Absorber Removal

1. Support the IFS at the lower control arms jacking point (Figure 23).
2. Remove the nut from shock absorber mounting stud (bottom).
3. Remove the nut and washer from shock absorber bolt at the top.
4. Remove the shock absorber and bushings from the vehicle.

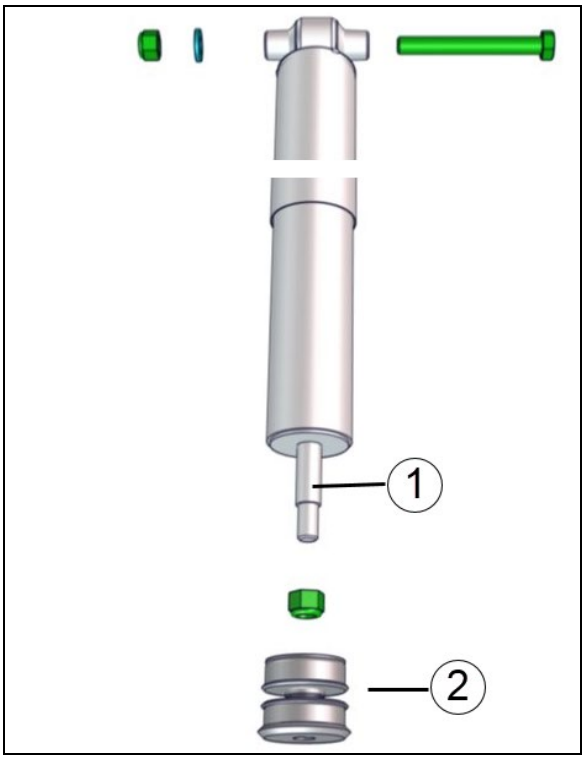


FIGURE 29: SHOCK ABSORBER, (1) SHOCK ABSORBER MOUNTING STUD, (2) LOWER BUSHINGS

6.3.2 Shock Absorber Installation

1. Installation is like removal but in reverse order. Take care to respect the bushings arrangement shown in FIGURE 30.
2. Tighten fasteners to prescribed torque.

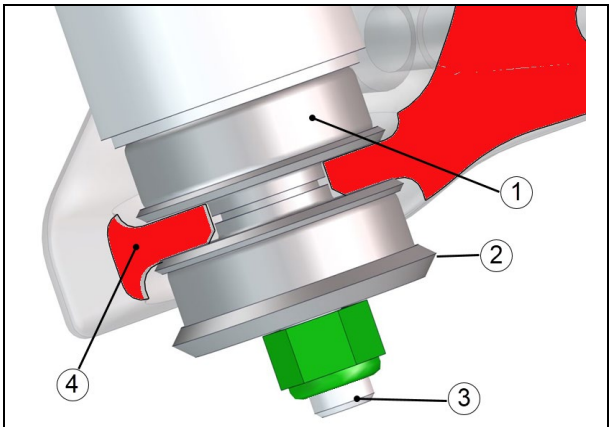


FIGURE 30: LOWER SHOCK MOUNTING BUSHINGS

1	Bushing
2	Bushing with thick base plate
3	Mounting stud
4	Upright section cut

6.4 SWAY BAR

A sway bar is provided on IFS to increase vehicle stability. It controls lateral motion (swaying movement) of vehicle.

Sway bar diameter:

X3-45 VIP Commercial Use: 45 mm

VIP Private coaches: 50 mm

Coaches: 40 mm

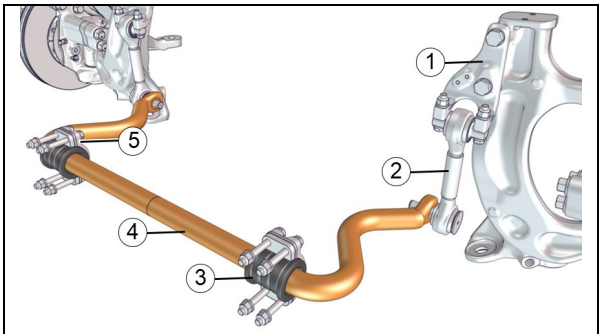


FIGURE 31

1	Upright
2	Link
3	Slit bushing
4	Sway bar
5	Collar

6.4.1 Removal

1. Disconnect the two links from sway bar.
2. Safely support the sway bar. Unbolt bushing collars from subframe.
3. Remove sway bar.
4. Remove and replace the split bushings if applicable. Apply a thin layer of grease on the sway bar where the split bushings are to be positioned.

NOTE
Sway bar bushings are slit to ease their removal.

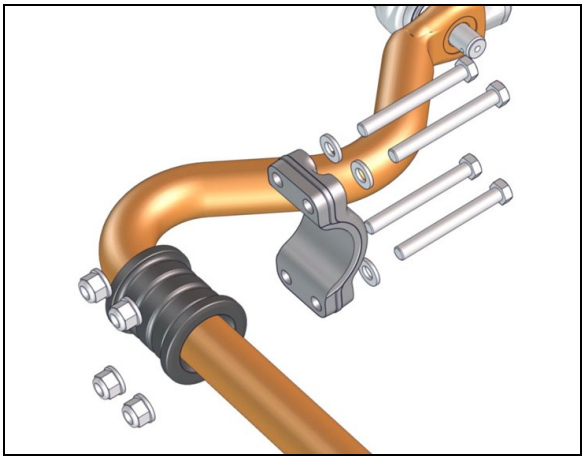


FIGURE 32: SWAY BAR

6.4.2 Installation

1. Loosely install the sway bar.
2. Tighten the bushing collar nuts to prescribed torque.
3. Torque sway bar link castellated nuts to prescribed torque.
4. Install a new split pin.

7 REAR SUSPENSION

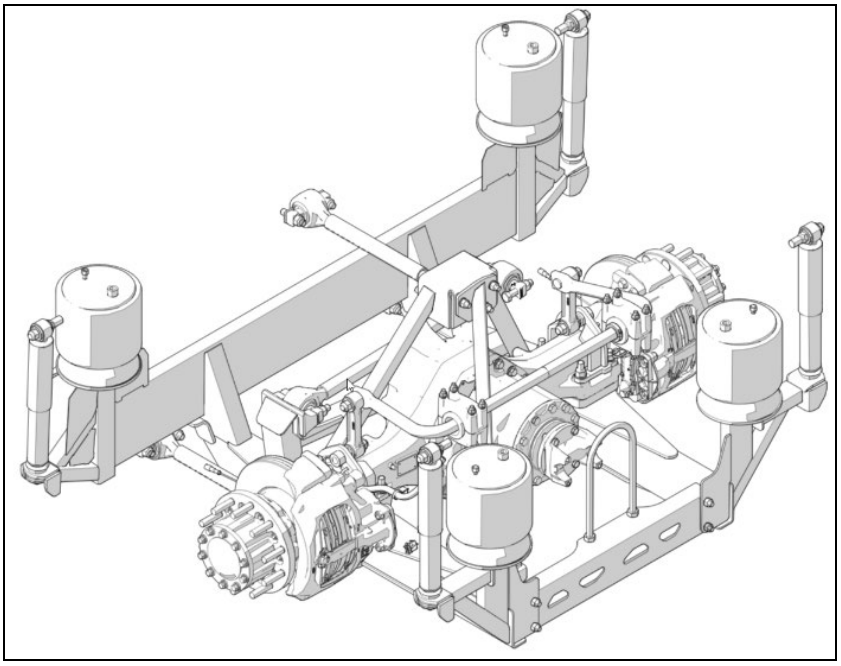


FIGURE 33: DRIVE AXLE, DETAILS OF REAR SUSPENSION16106

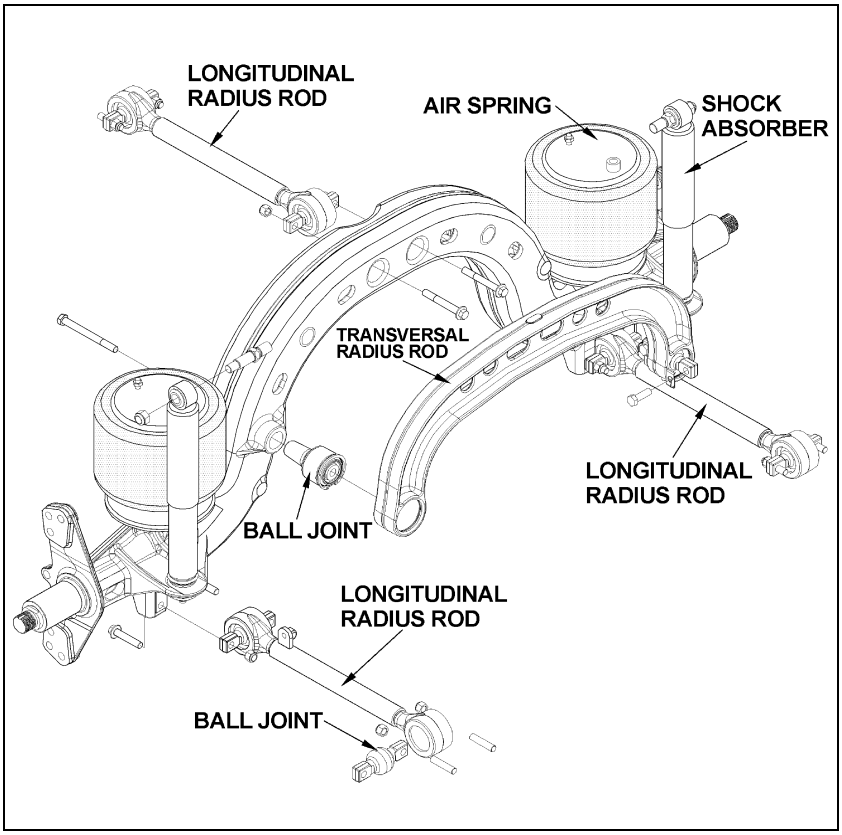


FIGURE 34: TAG AXLE SUSPENSION

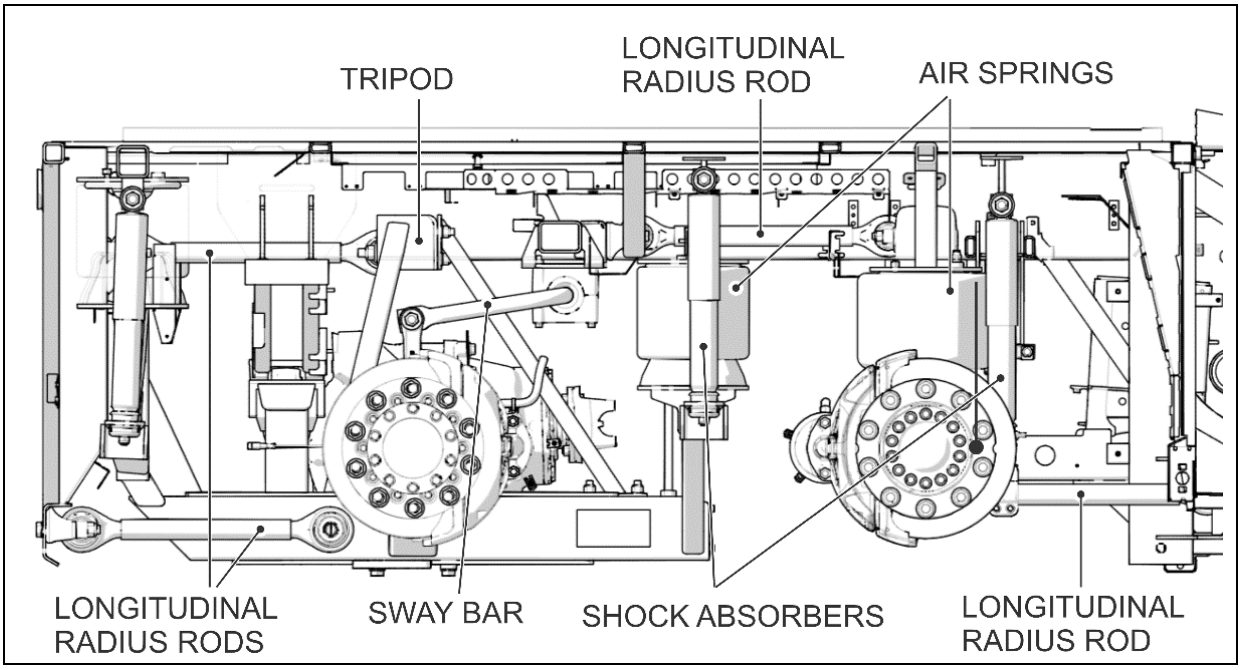


FIGURE 35: REAR SUSPENSION COMPONENTS 16184_3

7.1 AIR SPRINGS

The air springs are made from a special compound rubber molded to the proper contour and dimensions. The entire vertical load of the vehicle is supported by these springs. Each of the two axles is provided with air springs that are attached to the subframe and to the axles.

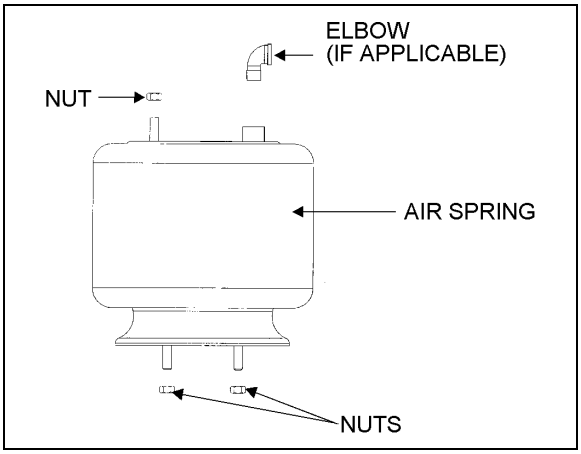


FIGURE 36: AIR SPRING 16052

7.1.1 Inspection

1. Check operation of bellows.
2. Visually inspect bellows for evidence of cracks, punctures, deterioration, or chafing. Replace the bellows if any damage is evident.
3. With the primary air system at normal operating pressure (122 - 140 psi (841 - 965 kPa)), coat all suspension air line connections and bellows mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is permissible. Repair or replace defective parts.

NOTE

If air spring is removed from vehicle, bellows can be lightly inflated and submerged in water to detect any leakage. If any leakage is detected, replace bellows.

WARNING

To prevent personal injury, do not apply more than 10 psi (69 kPa) of air pressure to the uninstalled air spring.

7.1.2 Removal

NOTE

Suspension air springs (drive and tag axles) can be removed without removing the entire axle assembly.

1. Safely support vehicle at the recommended body jacking points. To gain access to a given air spring, the corresponding wheel can be removed as follows.

   a) Jack vehicle until the tire clears the ground, and place safety supports underneath body.

CAUTION

Only the recommended jacking points must be used as outlined in Section 18, “Body”.

   b) Support the axle with a suitable hydraulic floor jack at the recommended jacking point.

   c) Remove wheel.

2. Exhaust compressed air from accessory air tank by opening drain cock under reservoir.
3. Disconnect the height control valve link and pull down the control arm to ensure all air is exhausted from air springs.

NOTE

While performing this step, do not change the height control valve control arm adjustment.

4. Disconnect air line from air spring, remove elbow (if applicable), and cover both the line end and fitting to prevent the entry of foreign matter.
5. Remove the air spring upper nut, and then the two lower nuts. Remove air spring.

7.1.3 Installation

1. Compress air spring as necessary, then aligning studs with their holes, position air spring between both the lower and upper

supports. Thread the lower nuts and the small upper nut a few turns.

NOTE
To facilitate air spring installation, compress it manually then put a piece of tape over the air line threaded fitting. This prevents air from getting back into the bag and keeps it compressed, thus enabling to place the bag in between the mounting plates and greatly easing installation.

2. Tighten and torque the lower stud nuts, and then the upper one as prescribed in Torque Table 3.
3. Thread the remaining upper nut (large nut) and tighten as prescribed in Torque Table 3.
4. Install elbow (if applicable), then connect air line.
5. Connect the height control valve link.
6. Build up air pressure in system.

NOTE
To accelerate this operation, air reservoirs can be filled from an exterior air supply connected to the accessory tank fill valve or to the emergency fill valve.

7. Check operation of bellows, and with the primary air system at normal operating pressure (122 - 140 psi (841 - 965 kPa)), coat the air line connections and air spring mounting areas with a water and soap solution. Bubbles will indicate an air leak, and none is permissible. Repair or replace defective parts.
8. Reinstall wheel.
9. Remove the hydraulic floor jack from under the axle, then lower vehicle to ground.

7.2 SHOCK ABSORBERS

Double-action, telescoping-type shock absorbers ensure a smooth ride and enhance vehicle stability on the road. The tag axle is provided with two shock absorbers while the drive axle is provided with four of them (Figure 37).

Shock absorbers are non-adjustable and non-repairable. Maintenance requirements involve replacement of the rubber mounting bushings, and tightening of all shock absorber mounting pins at the proper torque (refer to Torque Table 3) when shock absorber replacement occurs. If a shock absorber becomes inoperative, complete unit must be replaced.

⚠ **CAUTION**
When a shock absorber is found defective, always replace with a new set on affected axle, except if there has been a recent replacement of one unit. The following method will help in determining if both shock absorbers on the same axle have to be replaced.

7.2.1 Inspection

Loosen lower mounting of both shocks, and then carefully attempt to raise and lower the bottom portion of each shock. Note the rate of effort for distance of travel. Replace both shocks if a definite differential rate is found.

The shock must be bench checked in an upright, vertical position. If checked in any other position, air will enter the cylinder tube and make the shock absorber appear defective.

Proceed as follows to check shock absorbers:

1. With the shock absorber in a vertical position (top end up), clamp the bottom mount in a vise.

⚠ **CAUTION**
Do not clamp the reservoir tube or the dust tube.

2. Rotate the dust tube. Notice any binding condition (may be compared with new unit).

Binding condition indicates a scored rod. Units with scored rods should be replaced.

3. Fully extend shocks and check for leaks in the seal cover area. Shock fluid is a very thin hydraulic fluid that has a characteristic odor and dark brown tint. A slight trace of shock fluid around the seal cover area is not a cause for replacement. The shock seal is designed to permit a very slight seepage to lubricate the rod. Units that leak should be replaced.
4. Visually check shock for dents that could cause the shock to bind. Also, check for a bent rod.
5. Extend and collapse shock several times to determine that it has control (resistance) in both rebound and compression.
6. Visually inspect the shock mountings and vehicle mounting for:
   a) Broken mounts;
   b) Extreme bushing wear;
   c) Shifted bushing or sleeve;
   d) Deep cracks in bushing material (shallow surface cracks are normal);
   e) Loose shock absorber pins;
   f) Presence of convex washers, and their position relative to the rubber bushing.

7.2.2 Removal

1. Remove nuts and washers from shock absorbers on upper mounting pin and lower mounting bracket, taking care to identify the inner and outer washers to ease reinstallation. Refer to Figure 37 for details.
2. Remove the shock absorber assembly from pins.
4. Remove the two rubber joints from the shock absorber and discard them.

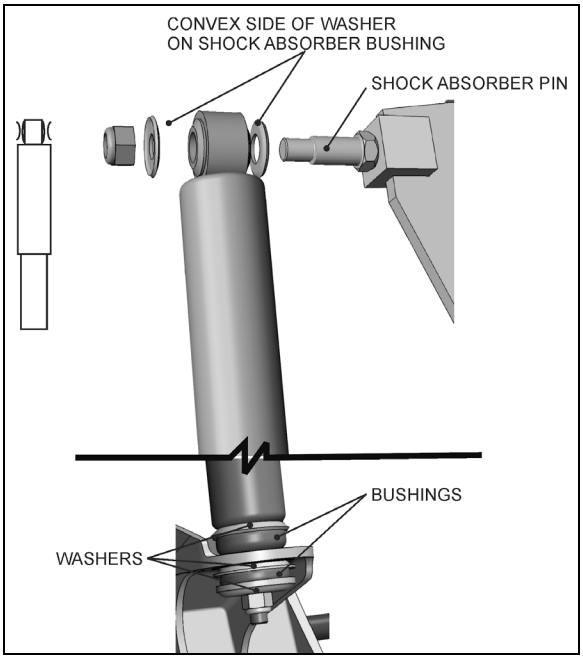


FIGURE 37: TYPICAL SHOCK ABSORBER SETUP 16009

7.2.3 Installation

1. Ensure that the shock absorber mounting pin is tight and that the threads are not stripped.
2. Install new upper rubber mounting bushings on shock absorber.
3. On the lower mounting, take care to install the rubber joints with the wide end of the tapered hole as shown in Figure 38.

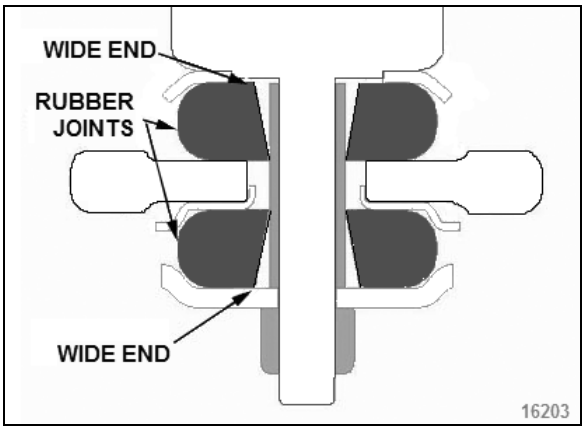


FIGURE 38: LOWER SHOCK MOUNTING BUSHINGS

4. At the upper mounting pin, place the inner washer with washer convex side facing the shock absorber rubber bushing.
5. Install the shock absorber eyes over the mounting pin, then the outer washers (with

washer convex side facing the shock absorber rubber joints.

NOTE
If shock absorber pins are removed, they must be reinstalled using "Loctite" (see "Parts Specifications" in this section).

5. Place the lower and upper mounting pin stud nuts and torque as prescribed in Torque Table 3.

7.3 RADIUS RODS

Radius rods are used to secure the axles in the proper transversal and longitudinal positions. Four radius rods are provided on the drive axle suspension (three longitudinal and one transversal) and four on the tag axle. These rods transmit both braking and driving forces from the axles to the vehicle body.

Refer to section 2.3 for more information regarding radius rods.

8 SUSPENSION AIR SYSTEM

The suspension air system has its own air reservoir (accessory tank) which is in the reclining bumper compartment. Pressurized air from the main tank (wet tank) flows through a pressure protection valve (PR-4), to the accessory air tank and through an air filter which is in front service compartment.

The pressure protection valve (PR-4) is mounted to the supply port of the tank. This valve controls the pressure at which compressed air is delivered to the accessory air tank. The valve remains closed until a preset pressure is reached (approximately 70 psi (485 kPa)). It then opens and passes air out the delivery port.

The main use for this valve is to protect the main air system by ensuring at all times a sufficient air pressure in the main system (i.e. air delivered to the accessories will be shut off in case of a decrease in pressure). Maintenance and repair information on the pressure protection valve is supplied in the applicable booklet, annexed to Section 12, *"Brakes and Air System"* under reference number SD-03-2010.

WARNING
Depressurize parts prior to removal.

8.1 INSPECTION

The following inspection should be performed at established service inspection periods. Performing these procedures will allow substandard performance to be discovered before the condition becomes bad enough to cause operator complaints or failure during operation.

1. Visually inspect the suspension air lines for evidence of chafing on metal parts or other damage.
2. Visually inspect the air springs for cracks, abrasion or other damage.
3. Replace any parts found to be damaged.

8.2 AIR LINE TEST

With the main air system at normal operating pressure, coat all suspension air line connections and air spring mountings with a solution of soap and water. Air leakage will produce soap bubbles. Any leak found must be corrected as no air leakage is permissible.

9 SUSPENSION HEIGHT ADJUSTMENT

The flow of pressurized air from the accessory air tank to the air springs is controlled by three height control valves. These valves are mounted to the subframe and connected to the axles through an arm and link connection. This connection allows the valves to apportion air pressure in the springs to the vehicle load, maintaining normal ride height.

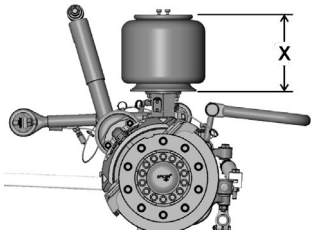
To adjust suspension height, refer to Maintenance Information MI16-14 SUSPENSION HEIGHT ADJUSTMENT USING HEIGHT CONTROL VALVES included after Section 16 in this Maintenance Manual.

9.1 NORMAL RIDE HEIGHT

The normal ride height is obtained by measuring and adjusting air spring height of front and rear suspension.

FRONT SUSPENSION (I-BEAM AXLE)

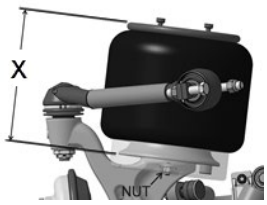
2 air springs



X = 11 ¾ ± ¼ inch (297 ± 6 mm)

INDEPENDENT FRONT SUSPENSION (IFS) – PREVIOUS DESIGN

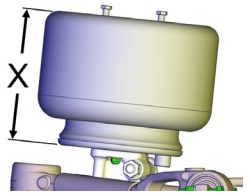
2 air springs



X = 12 7/8 ± 1/4 inch (327 ± 6 mm)

INDEPENDENT FRONT SUSPENSION (IFS) – NEW DESIGN

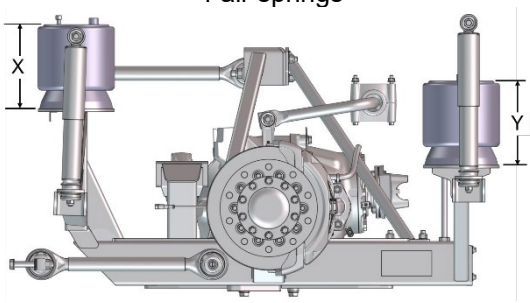
2 air springs



X = 11 ± 1 inch (280 ± 25 mm)

REAR SUSPENSION

4 air springs



FRONT AIR SPRINGS

X = 11 ½ ± 1/16 inch (292 ± 1.5 mm)

REAR AIR SPRINGS

Y = 11 ½ ± 1/4 inch (292 ± 6 mm)

9.2 HEIGHT CONTROL VALVES

The height control valves automatically add air to, or release air from air springs to maintain constant suspension height regardless of load, or load distribution. Each valve adjusts independently according to the following conditions:

Loading position

As the load increases and lowers the vehicle body, the control arm commands the height control valve to add air to air springs.

Neutral position

When vehicle body reaches the normal ride height, the height control valve control arm reaches the "neutral" position and keeps both the supply and exhaust ports closed to ensure normal ride height is maintained. This condition remains static until the vehicle load is altered.

Unloading position

As the load decreases and raises the vehicle body, the control arm commands the height control valve to release air from air springs.

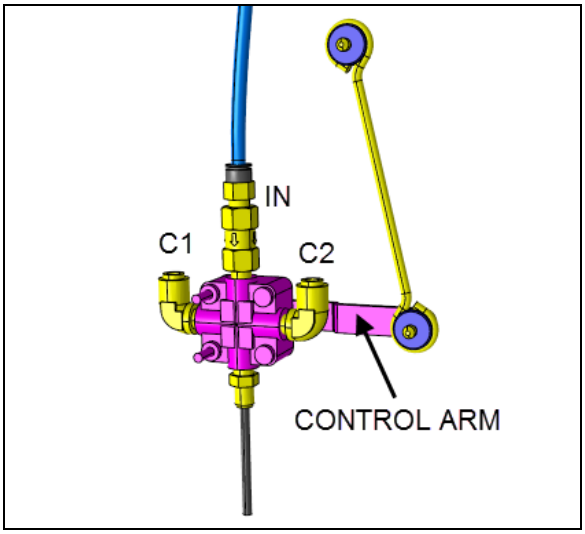


FIGURE 39: HEIGHT CONTROL VALVE 16093

9.2.1 Maintenance

The height control valve requires no periodic maintenance. Height control valve linkage operates on rubber bushings and no lubrication should be attempted at this point. Inspect the valve for loose joints, air leaks and worn bushings.

9.2.2 Removal and installation

Before disconnecting any height control valve air lines, securely support the vehicle by its jacking points on the body, and place safety support underneath body. Refer to *"VEHICLE JACKING POINTS"* in Section 18, *"Body"*.

1. Exhaust air from air system by opening the drain cock on accessory air reservoir. Remove height control valves.
2. Disconnect overtravel lever from link and pull down lever to exhaust remaining air from air springs.
3. Disconnect air supply and delivery lines from the height control valve. Cover ends of the lines with tape to prevent entry of foreign matter.
4. Remove the nuts retaining the height control valve to the mounting bracket, then remove valve assembly.

   Note: The height control valve bolts equipped with a nylon insert should be replaced after the third (3rd) tightening.

Reverse removal procedure to replace height control valve. After installation, check for leakage using a soap and water solution.

9.2.3 Air leakage test

NOTE
The following procedure applies when valve assembly has been removed from vehicle.

1. Clean the exterior of valve assembly.
2. Connect air pressure line to air inlet port, then allow air pressure build-up (70- 100 psi (480 - 690 kPa)).
3. Dip the valve assembly in a container full of water, and watch for air bubbles when the control arm is in the center position. No air should escape from any point of the valve assembly.
4. If bubbles appear from the air spring port, this is an indication that the air inlet valve assembly is defective and must be replaced.
5. Remove air pressure line from air inlet fitting and connect it to the air spring port. If bubbles appear at the air inlet check valve port, this is an indication that the check valve unit is defective and must be replaced.
6. If bubbles appear at the exhaust port, this is an indication that the exhaust valve assembly is defective and must be replaced.
7. If bubbles appear around edge of valve cover plate, the cover plate gasket must be replaced.
8. If no leaks are found, remove valve assembly from water, then with air pressure still connected to the air spring port, actuate control arm to remove any excess water which may have entered exhaust valve chamber. Remove air line, connect it to the air inlet port, and repeat operation to remove water from the air inlet valve chamber.

10 "LEVEL-LOW" LEVELING SYSTEM – VIP SERIES OPTION ONLY

The purpose of the *Level-Low* leveling system is to adjust suspension in three separate points (front, rear right and rear left) in order to level vehicle body. This system can be put into service when the ignition key is turned to the *"ON"* position, and must be used only when the parking brake is applied. The *Level-Low* warning light on the dashboard indicates that the selector switch is not in the *"OFF"* position. Level low system controls are located on L.H. side control panel.

10.1 PRINCIPLES OF OPERATION

Down

The (front/rear right/rear left) control solenoid valve supplies air to the (front/rear right/rear left) five-way three-position air control valve, which bypasses the (front/rear right/rear left) height control valve, and opens a passage to allow the air control and exhaust valve to release air from (front/rear right/rear left) air springs.

Up

The (front/rear right/rear left) control solenoid valve supplies air to the (front/rear right/rear left) five-way three-position air control valve, which bypasses the (front/rear right/rear left) height control valve, and opens a passage to allow the air control and exhaust valve to supply air to (front/rear right/rear left) air springs.

Drive

When the ignition key is turned to the *"ON"* position with selector knob in the *"DRIVE"* position, the drive control solenoid valve supplies air to all five-way three-position air control valves, each one opening a passage to allow height control valves to accomplish their function.

When the ignition key is turned to the *"OFF"* position and selector knob to the *"DRIVE"* position, the air is entrapped between air springs and five-way three-position air control valves to ensure the adjusted level will be kept.

WARNING

Never move vehicle with selector knob in any other position than the “DRIVE” position.

10.2 MAINTENANCE

Since the kneeling action is issued from both the air system and electrical system, refer to Section: 12, *“Brake and Air System”* and Section 06, *“Electrical System*”.

For diagnosis and understanding of the system, refer to wiring diagrams, and to the appropriate air system schematic diagram annexed to Section 12, *“Brake and Air System”*.

11 FRONT KNEELING SYSTEM (COACHES ONLY)

The kneeling system is used to lower front of vehicle. This allows passengers to board the vehicle with greater ease. The kneeling action is achieved by exhausting air from the front air springs (bellows). This system bypasses the height control valve to provide a fast up and down movement of the front suspension. Only seven seconds are required to lower vehicle from normal level to the lowered position, and approximately the same time to raise the vehicle back to normal level. The quick response is achieved by the kneeling air tank installed beside the secondary air reservoir (for exact position, refer to Section 12, *"Brake and Air System").*

This tank provides sufficient air supply to the kneeling system for some successive operations. The system is provided with two safety features; first, a speed switch will enable the kneeling system to work only below 5 mph (8 km/h). Secondly, the parking brake is automatically applied, and a limit switch will keep it applied as long as the vehicle has not returned to a certain height where the driver will be able to manually remove the parking brake.

The purpose of the front axle hi-buoy function in this system is to raise the front end of the vehicle to allow an extra ground clearance for particular situations. In driving condition, the height control valve is in operation and only the hi-buoy can be operated.

11.1 PRINCIPLE OF OPERATION

Refer to the air system schematic diagram annexed at the end of Section 12, *"Brake and Air System".*

DOWN (FRONT KNEELING):

Both the air spring control and air spring exhaust solenoid valves are energized, so the air control valves release air from front air springs. The height control valve is bypassed to ensure no air is forwarded to air springs while lowering the front suspension.

UP (FRONT HIGH-BUOY):

Only the air spring control solenoid valve is energized, so the air coming from the kneeling air tank is routed through air control valves, and up to front air springs.

The height control valve is bypassed until the kneeling proximity switch signals the kneeling module to cut off the air spring control solenoid valve, about 1" (25 mm) below normal ride height. The final height adjustment is achieved by the height control valve.

11.2 MAINTENANCE

Since the kneeling action is issued from both the air system and electrical system, refer to Section: 12, *"Brake and Air System"* and Section 06, *"Electrical System".*

For diagnosis and understanding of the system, refer to wiring diagrams, and to the appropriate air system schematic diagram annexed to Section 12, *"Brake and Air System".*

11.3 AIR SPRING CONTROL SOLENOID VALVES

11.3.1 Removal and installation

1. On the rear side of steering compartment, locate both the air spring control and air spring exhaust solenoid valves.
2. Identify hoses and wires to ease reinstallation. Disconnect solenoid wires and the three flexible black hoses from solenoid valves.
3. Unscrew and remove the control solenoid valve and exhaust solenoid valve assembly. Place on a clean working place.

Reverse removal procedure to reinstall.

CAUTION

Always adjust on "fill cycle". If it is necessary to lower vehicle height, release sufficient air to be well below height, and adjust to height or fill cycle.

12 HIGH-BUOY SYSTEM (COACHES ONLY)

The purpose of the full high-buoy system is to raise the entire vehicle body about 4” (100 mm) in order to increase ground clearance to board a ferryboat, to jump a curb, etc. This system can be put into service during normal vehicle operation.

12.1 PRINCIPLES OF OPERATION

The rear high-buoy system is added over the front kneeling (with front high-buoy). The front end uses the same valves as the front kneeling (with front high-buoy). A solenoid valve is added to send air to the double shuttle valves for the rear end. It uses the same dash switch as the kneeling.

UP:

The air coming from the control valve flows through double shuttle valves, to supply air springs. The double shuttle valves prevent height control valves from releasing air from air springs.

DOWN:

The control valve, on the dashboard, cuts off air supply, so the double shuttle valves allow height control valves to accomplish their function. Height control valves release air from air springs until suspension returns to its normal position.

12.2 MAINTENANCE

Refer to the air system schematic diagram “OPT. FRONT KNEELING WITH REAR HIGH-BUOY COMBINATION.

12.3 HIGH-BUOY – PRESSURE REGULATOR

The H series vehicles pressure regulator is located on ceiling of the spare wheel and tire compartment and is accessible through the reclining bumper. On X series vehicles, the regulating valve is located in the front service compartment. This valve should be adjusted to 90 psi (621 kPa).

12.3.1 Adjustment

1. Before turning on system air pressure, release jam nut (2, Figure 40) then turn regulator adjustment handle counter-clockwise until the load is removed from the regulating spring.
2. Turn on system pressure.
3. Turn regulator adjustment handle clockwise until the desired outlet pressure is reached.
4. To avoid minor readjustment after making a change in pressure setting, always approach the desired pressure from a lower pressure. When reducing from a higher to a lower setting, first reduce the pressure at a lower pressure, and then increase it to the desired level of pressure.
5. Tighten jam nut (2,Figure 40) to lock pressure setting.

12.3.2 Disassembly

1. Shut off inlet pressure and reduce pressure in inlet and outlet lines to zero. Turn regulator adjustment handle (1, Figure 40) counterclockwise until all load is removed from regulating spring. Regulator can be disassembled without removal from air line.
2. Disassemble regulator in accordance with the item numbers on the exploded view.

Torque Table	
Item	Value
3 (Screw)	**25-35 lb-in (2.8-3.9 Nm)**
17 (Bottom plug)	**20-25 lb-in (2.3-2.8 Nm)**

12.3.3 Cleaning

1. Clean parts with warm water and soap. Dry parts and blow out internal passages in body using clean, dry compressed air.
2. Inspect parts. Replace those found to be damaged.

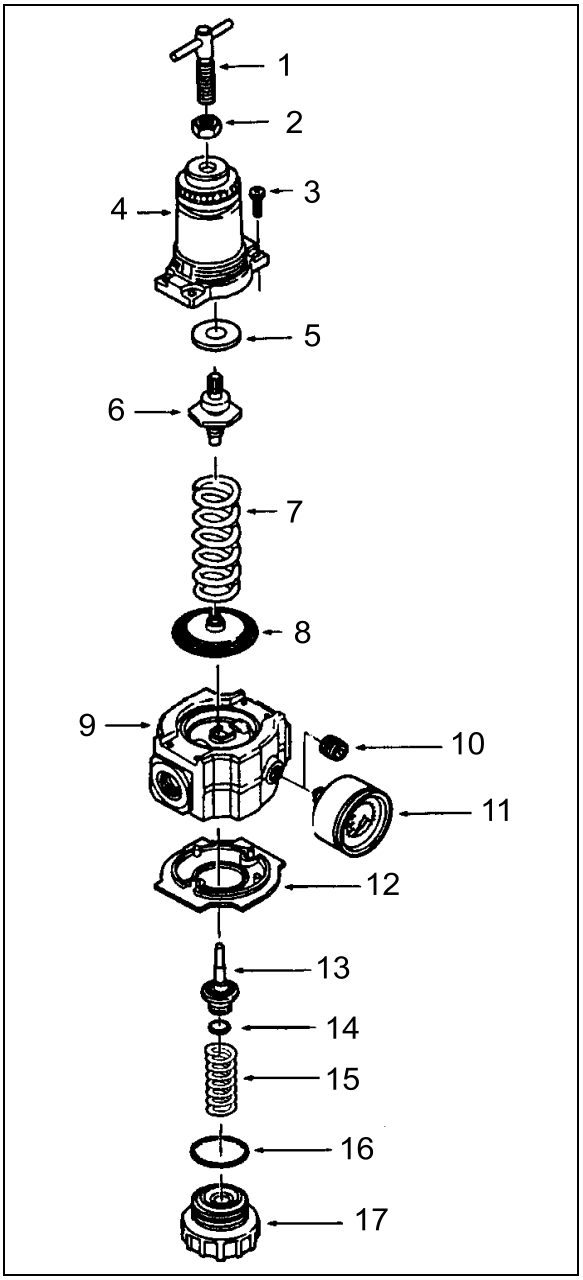


FIGURE 40: AIR PRESSURE REGULATOR 16035

12.3.4 Reassembly

1. Lubricate O-ring (14 and 16, Figure 40), valve stem (13), tip of adjusting screw (1), and the outer circumference and both sides of the thrust washer (8) with a light coat of good quality O-ring grease.
2. Assemble the regulator as shown in the exploded view.

13 LOW-BUOY SYSTEM (COACHES ONLY)

The purpose of the low-buoy system is to lower the whole suspension by about 4" (100 mm) in order to reduce the overall height for low clearances. This system can be put into service during normal vehicle operation.

13.1 PRINCIPLES OF OPERATION

The rear low-buoy is added over the front kneeling system. The control valve on the left console panel sends an electric signal from its pressure switch to control the front suspension as if kneeling. It also removes air from a relay valve that exhausts air supply to all leveling valves and the quick release in the rear section. Air from the rear suspension can then be depleted through the check valve-quick release assembly.

DOWN:

The control valve, on the L.H. control panel, cuts off air supply, so air is released from air springs. A relay valve prevents height control valves from supplying air springs.

UP:

The control valve, on the L.H. control panel, supplies air to close the passage between both the delivery and supply ports. A relay valve opens and provides air springs until the suspension reaches the normal ride height.

13.2 MAINTENANCE

Refer to the air system schematic diagram "OPT. FRONT KNEELING WITH REAR LOW-BUOY COMBINATION".

14 TROUBLESHOOTING

Condition	Cause	Correction
Air springs deflate over time	1. Defective check valve assembly. 2. Defective exhaust valve assembly. 3. Leak in air line and/or air springs. 4. Defective valve cover, rubber O-rings or gasket.	1. Replace check valve assembly. 2. Replace exhaust valve assembly. 3. Replace air line or air springs. 4. Replace valve cover, O-rings or gasket.
Air springs raise to full height and fail to exhaust air pressure	1. A clogged exhaust screen in height control valve assembly. 2. A combination clogged exhaust screen and defective air inlet valve assembly.	1. Remove and clean screen. 2. Clean exhaust screen and replace air inlet valve assembly.
Erratic valve action	1. Dirt or foreign matter in the air valve lever chamber. 2. Defectives valves.	1. Remove valve cover and blow out dirt. Install cover using new gasket. 2. Overhaul height control valve assembly
Vehicle body fails to level to satisfactory ride height	1. Improper height control valve control arm adjustment	1. Adjust lever as directed.

MAINTENANCE INFORMATION

MI16-14

DATE :	JUNE 2016	SECTION : 16 - Suspension
SUBJECT :	**SUSPENSION HEIGHT ADJUSTMENT USING HEIGHT CONTROL VALVES**	

APPLICATION

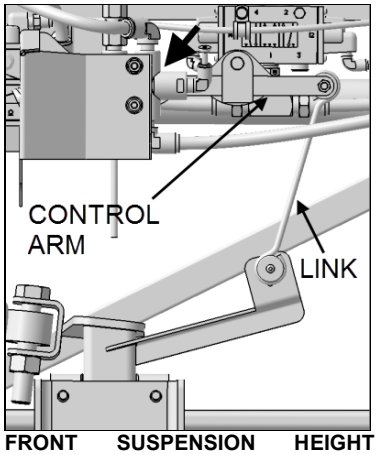
Model	
All models Model Year : From 2014	

DESCRIPTION

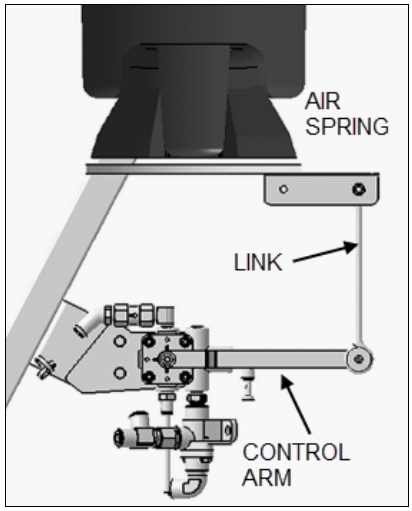
Use this procedure when a suspension height check or adjustment must be performed.

HEIGHT CONTROL VALVES

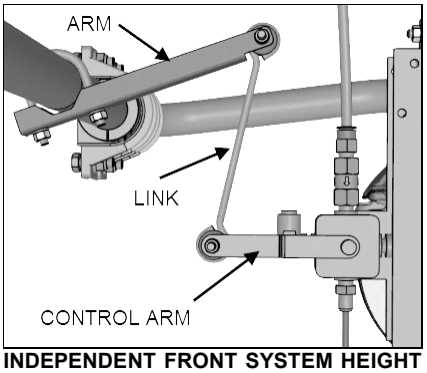
Three height control valves automatically control air volume in the suspension air springs at three separate locations to maintain a constant vehicle height regardless of load or load distribution.



FRONT SUSPENSION HEIGHT CONTROL VALVE (I-BEAM AXLE)



REAR SUSPENSION HEIGHT CONTROL VALVE – UNDER FORE UNDERFRAME AIR SPRINGS



INDEPENDENT FRONT SYSTEM HEIGHT CONTROL VALVE

The **two rear suspension height control valves** are mounted to the chassis and connected to the fore air springs of the rear underframe through a control arm and link.

One front suspension valve is mounted to the chassis and connected to the front axle through a control arm and link.

On IFS, one height control valve is located on the center of the front sway bar.

If an adjustment is required, change the position of the control arm. The control arm should be moved up to supply air and raise vehicle height and should be moved down to release some air from air springs and lower vehicle height. Make sure that air pressure is greater than 90 psi.

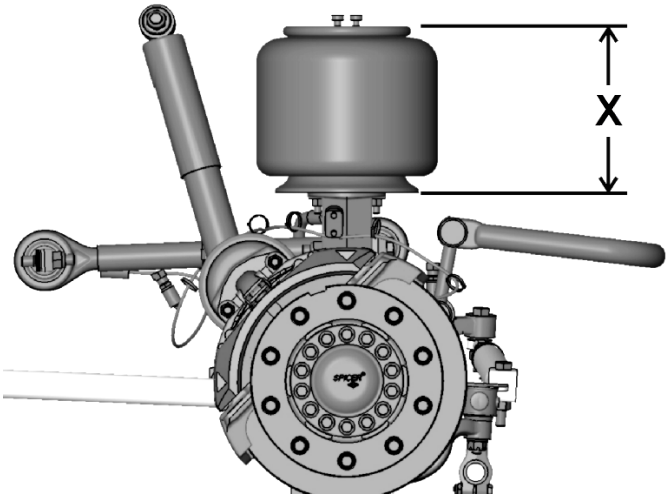
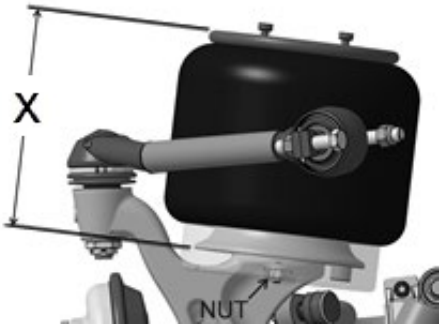
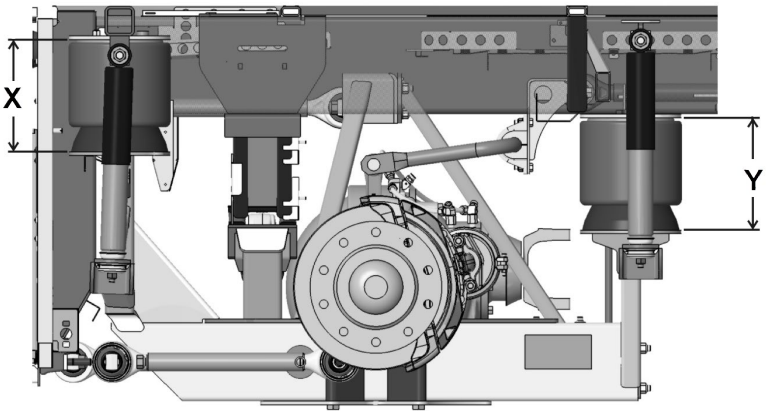
The appropriate vehicle body height is checked by measuring the clearance of all the air springs installed on the front and rear suspension. The tag axle, by its nature, doesn't need to be adjusted.

If an adjustment is required, begin with the rear suspension.

NORMAL RIDE HEIGHT

The normal ride height is obtained by measuring and adjusting **air spring** height of front and rear suspension.

TABLE 1 – PRESCRIBED AIR SPRING HEIGHTS

FRONT SUSPENSION (I-BEAM AXLE) 2 air springs		
INDEPENDENT FRONT SUSPENSION (IFS) 2 air springs	X = 12 7/8 ± 1/4 inch (327 ± 6 mm)	
REAR SUSPENSION 4 air springs	FORE AIR SPRINGS X = 11 ½ ± 1/16 inch (292 ± 1.5 mm) AFT AIR SPRINGS Y = 11 ½ ± 1/4 inch (292 ± 6 mm)	

PROCEDURE

DANGER

Park vehicle safely, apply parking brake, stop engine. Prior to working on the vehicle, set the ignition switch to the OFF position and trip the main circuit breakers equipped with a trip button. On Commuter type vehicles, set the battery master switch (master cut-out) to the OFF position.

REAR SUSPENSION AIR SPRINGS ADJUSTMENT

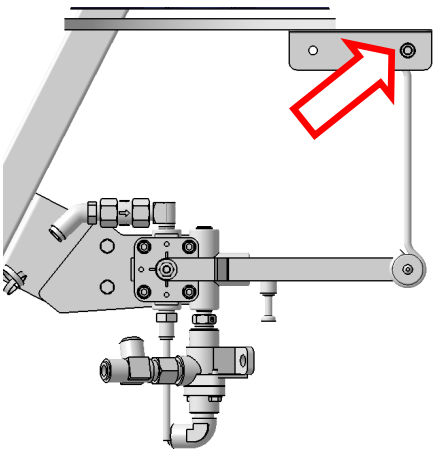
Measurement

1. Make sure that the air system pressure is at least **90 psi**.
2. Measure the drive axle air springs clearance **(all four air springs)**. To do so, measure the clearance between the round metal plate found above the air spring and the other round metal plate found under the air spring.
3. The clearance should be in accordance with the value of Table 1.

Air spring height adjustment

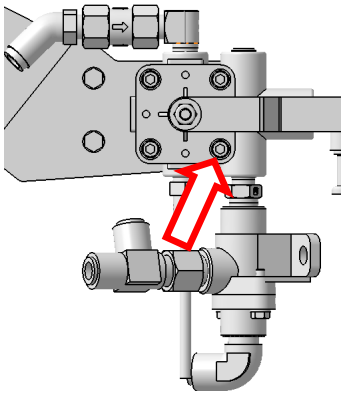
While proceeding with one side of the vehicle at a time, adjust the air springs clearance with the height control valve

4. It is necessary to adjust clearance on *"fill cycle"*.
   a) Disconnect the link. This link is equipped with a rubber bushing that allows easy disconnection.
   b) Lower the control arm to release some air from air springs.
   c) Raise the control arm to fill the air springs (the valve is now in “fill cycle”) and connect the link back in place.



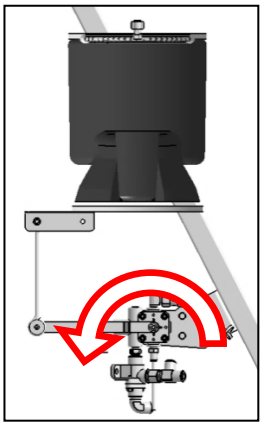
5. Loosen the lower mounting bolt shown.

   Take note that the bolt is equipped with a nylon insert. The bolt should be replaced after three (3) tightenings.

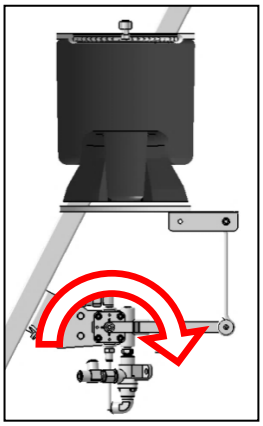


6. Rotate the valve body to increase or decrease the clearance as shown (the mounting bracket has a slotted hole).
7. Allow 15 minutes to the air system to settle before measuring the resulting clearance. Repeat previous step if necessary.
8. Tighten the lower mounting bolt once adjustment is done.
9. Repeat this procedure with the rear suspension height control valve located on the other side of the vehicle.

INCREASING CLEARANCE

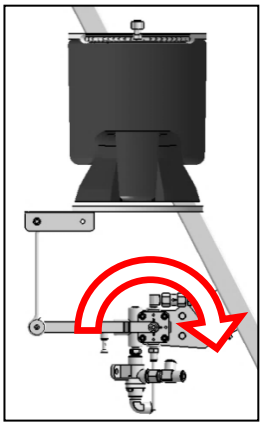


STREET SIDE

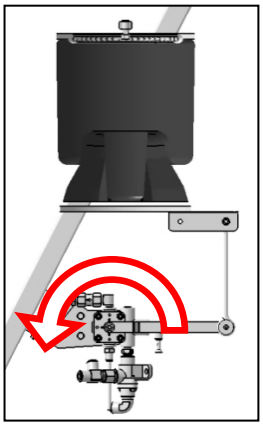


CURB SIDE

DECREASING CLEARANCE



STREET SIDE



CURB SIDE

FRONT SUSPENSION AIR SPRINGS ADJUSTMENT (I-BEAM AXLE)

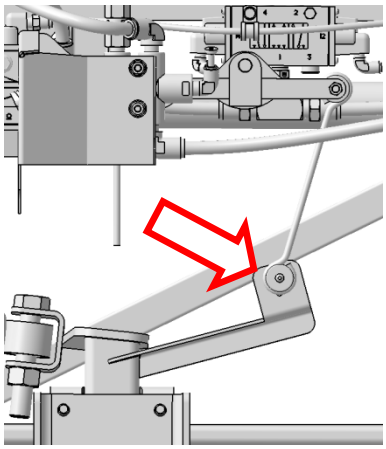
Measurement

1. Make sure that the air system pressure is at least **90 psi**.
2. Measure the front axle air springs clearance **(two air springs)**. To do so, measure the clearance between the support above the air spring and the lower end of the air spring *(if needed, use a small metal ruler to reach the lower end of the air spring)*.
3. The clearance should be in accordance with the value of Table 1.

Air springs height adjustment

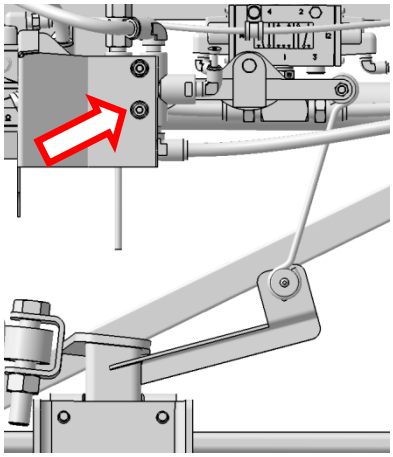
Adjust the air springs clearance with the height control valve

4. It is necessary to adjust clearance on *"fill cycle"*.
   a) Disconnect the link. It is equipped with a rubber bushing that allows easy disconnection.
   b) Lower the control arm to release some air from air springs.
   c) Raise the control arm to fill the air springs (the valve is now in “fill cycle”) and connect the link back in place.



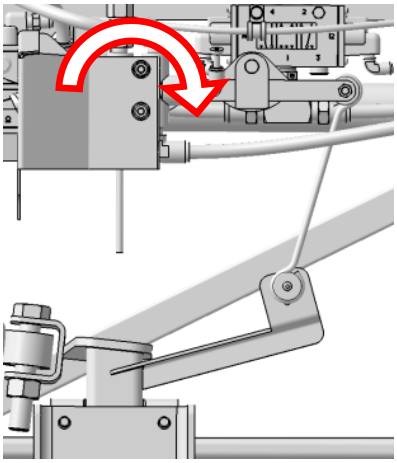
5. Loosen the lower mounting bolt shown.

Take note that the bolt is equipped with a nylon insert. This bolt should be replaced after three (3) tightenings.

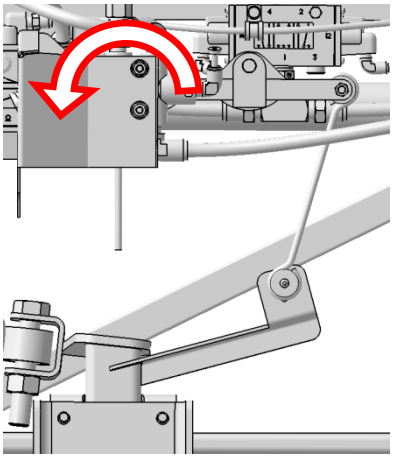


6. Rotate the valve body to increase or decrease the clearance as shown (the mounting bracket has a slotted hole).
7. Allow 15 minutes to the air system to settle before measuring the resulting clearance. Repeat previous step if necessary.

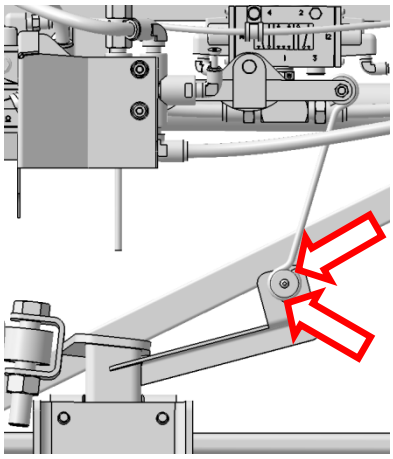
INCREASING CLEARANCE



DECREASING CLEARANCE



8. If rotation of the control valve is not enough to obtain the required adjustment, you can use one of the two (2) other holes.
9. Tighten the lower mounting bolt once adjustment is done.

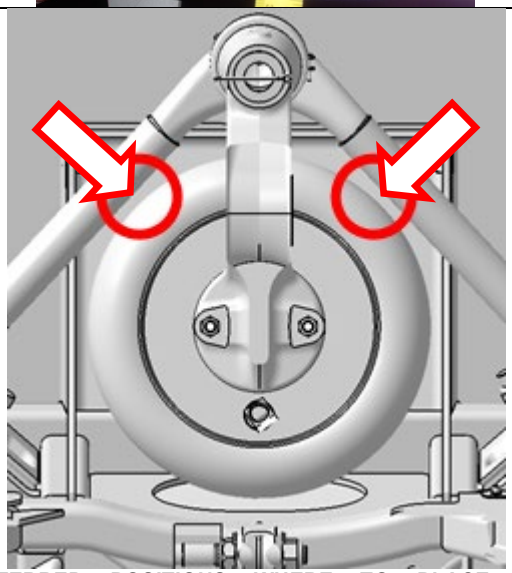


INDEPENDENT FRONT SUSPENSION ADJUSTMENT

Measurement

1. Make sure that the air system pressure is at least **90 psi**.
2. Measure that the air springs clearance **(two air springs)**. To do so, measure the clearance between the support found above the air spring and the lower end of the air spring *(if needed, use a metal ruler to reach the lower end of the air spring)*.
3. The clearance should be in accordance with the value of Table 1.

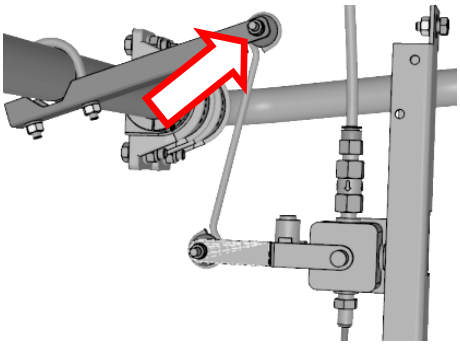
4. Take the measurement where indicated on the image preferably.



PREFERRED POSITIONS WHERE TO PLACE THE MEASURING TAPE

Air springs height adjustment

Adjust the air springs clearance with the height control valve



5. It is necessary to adjust clearance on *"fill cycle"*.
    a) Disconnect the link. It is equipped with a rubber bushing that allows easy disconnection.
    b) Lower the control arm to release some air from air springs.
    c) Raise the control arm to fill the air springs (the valve is now in “fill cycle”) and connect the link back in place.

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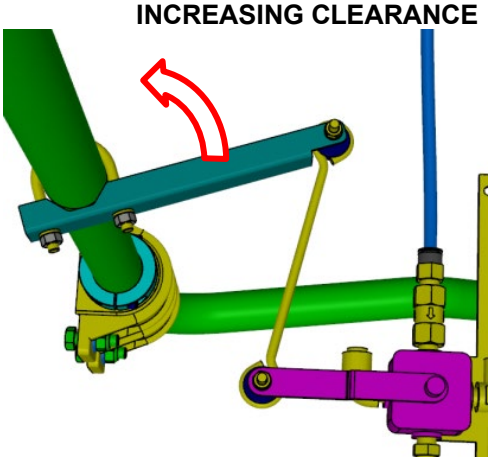
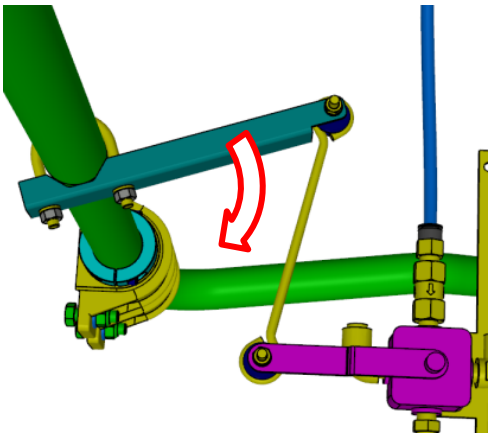
6. Using a hammer, tap gently on the arm secured to the sway bar. Even if the fasteners are properly tightened, it will rotate around the sway bar. Rotate the arm secured to the sway bar to increase or decrease the clearance as shown.
7. Allow 15 minutes to the air system to settle then measure the new clearance. Repeat previous step if necessary.

INCREASING CLEARANCE



DECREASING CLEARANCE



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